

# TL081, TL081A, TL081B, TL082, TL082A, TL082B TL082Y, TL084, TL084A, TL084B, TL084Y JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

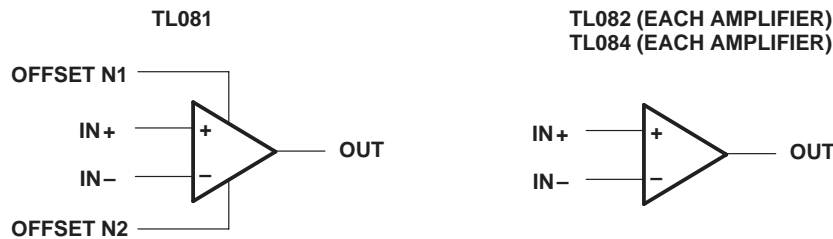
- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion . . . 0.003% Typ
- High Input Impedance . . . JFET-Input Stage
- Latch-Up-Free Operation
- High Slew Rate . . . 13 V/ $\mu$ s Typ
- Common-Mode Input Voltage Range Includes  $V_{CC+}$

## description

The TL08x JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET 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. Offset adjustment and external compensation options are available within the TL08x family.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from –40°C to 85°C. The Q-suffix devices are characterized for operation from –40°C to 125°C. The M-suffix devices are characterized for operation over the full military temperature range of –55°C to 125°C.

## symbols



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

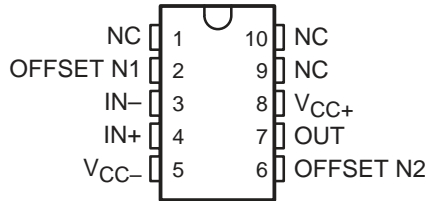
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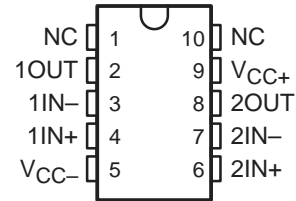
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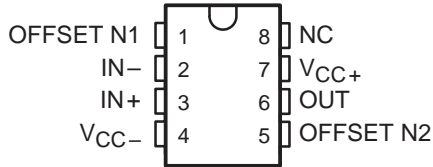
**TL081M  
U PACKAGE  
(TOP VIEW)**



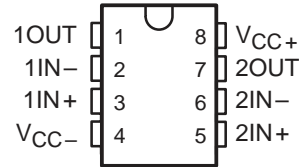
**TL082M  
U PACKAGE  
(TOP VIEW)**



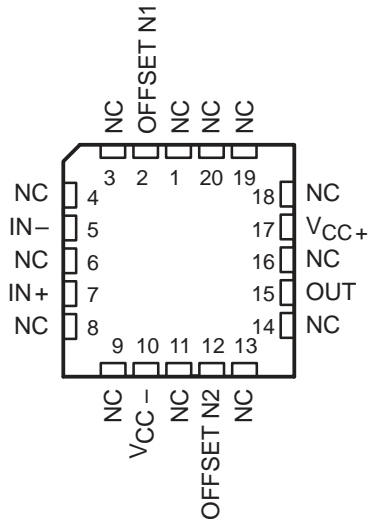
**TL081, TL081A, TL081B  
D, JG, P, OR PW PACKAGE  
(TOP VIEW)**



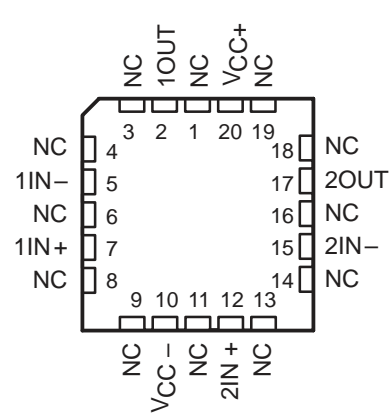
**TL082, TL082A, TL082B  
D, JG, P, OR PW PACKAGE  
(TOP VIEW)**



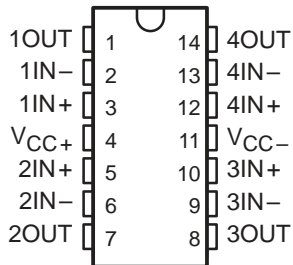
**TL081M . . . FK PACKAGE  
(TOP VIEW)**



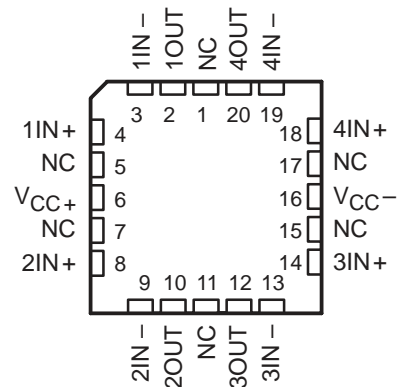
**TL082M . . . FK PACKAGE  
(TOP VIEW)**



**TL084, TL084A, TL084B  
D, J, N, PW, OR W PACKAGE  
(TOP VIEW)**



**TL084M . . . FK PACKAGE  
(TOP VIEW)**



NC – No internal connection

AVAILABLE OPTIONS

| T <sub>A</sub>       | V <sub>IOMax</sub><br>AT 25°C | PACKAGED DEVICES                |                                 |                                  |                       |                        |                       |                                 |                                 |                     |                     | CHIP<br>FORM<br>(Y) |        |
|----------------------|-------------------------------|---------------------------------|---------------------------------|----------------------------------|-----------------------|------------------------|-----------------------|---------------------------------|---------------------------------|---------------------|---------------------|---------------------|--------|
|                      |                               | SMALL<br>OUTLINE<br>(D008)      | SMALL<br>OUTLINE<br>(D014)      | CHIP<br>CARRIER<br>(FK)          | CERAMIC<br>DIP<br>(J) | CERAMIC<br>DIP<br>(JG) | PLASTIC<br>DIP<br>(N) | PLASTIC<br>DIP<br>(P)           | TSSOP<br>(PW)                   | FLAT<br>PACK<br>(U) | FLAT<br>PACK<br>(W) |                     |        |
| 0°C<br>to<br>70°C    | 15 mV<br>6 mV<br>3 mV         | TL081CD<br>TL081ACD<br>TL081BCD | —                               | —                                | —                     | —                      | —                     | —                               | TL081CP<br>TL081ACP<br>TL081BCP | TL081CPW            | —                   | —                   | —      |
|                      | 15 mV<br>6 mV<br>3 mV         | TL082CD<br>TL082ACD<br>TL082BCD | —                               | —                                | —                     | —                      | —                     | —                               | TL082CP<br>TL082ACP<br>TL082BCP | TL082CPW            | —                   | —                   | TL082Y |
|                      | 15 mV<br>6 mV<br>3 mV         | —                               | TL084CD<br>TL084ACD<br>TL084BCD | —                                | —                     | —                      | —                     | TL084CN<br>TL084ACN<br>TL084BCN | —                               | TL084CPW            | —                   | —                   | TL084Y |
| -40°C<br>to<br>85°C  | 6 mV<br>6 mV<br>6 mV          | TL081ID<br>TL082ID<br>TL084ID   | —                               | —                                | —                     | —                      | —                     | —                               | TL081IP<br>TL082IP              | —                   | —                   | —                   | —      |
| -40°C<br>to<br>125°C | 9 mV                          | —                               | TL084QD                         | —                                | —                     | —                      | —                     | —                               | —                               | —                   | —                   | —                   | —      |
| -55°C<br>to<br>125°C | 6 mV<br>6 mV<br>9 mV          | —                               | —                               | TL081MFK<br>TL082MFK<br>TL084MFK | —                     | TL081MJG<br>TL082MJG   | —                     | —                               | —                               | —                   | TL081MU<br>TL082MU  | —                   | —      |
|                      |                               |                                 |                                 |                                  | TL084MJ               |                        |                       |                                 |                                 |                     |                     | TL084MW             |        |

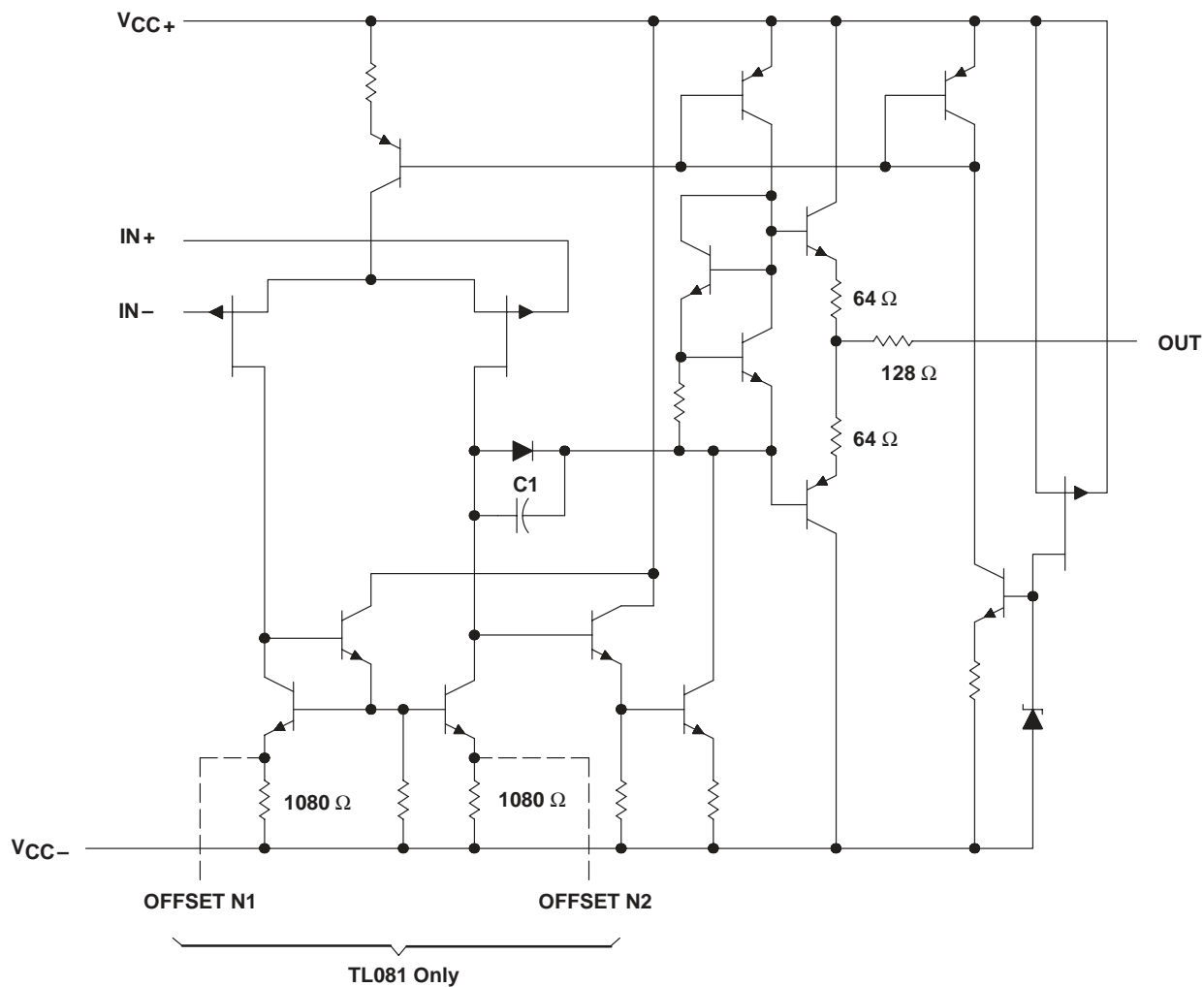
The D package is available taped and reeled. Add R suffix to the device type (e.g., TL081CDR).

TL081, TL081A, TL081B, TL082, TL082A, TL082B  
 TL082Y, TL084, TL084A, TL084B, TL084Y  
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**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

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**schematic (each amplifier)**



Component values shown are nominal.



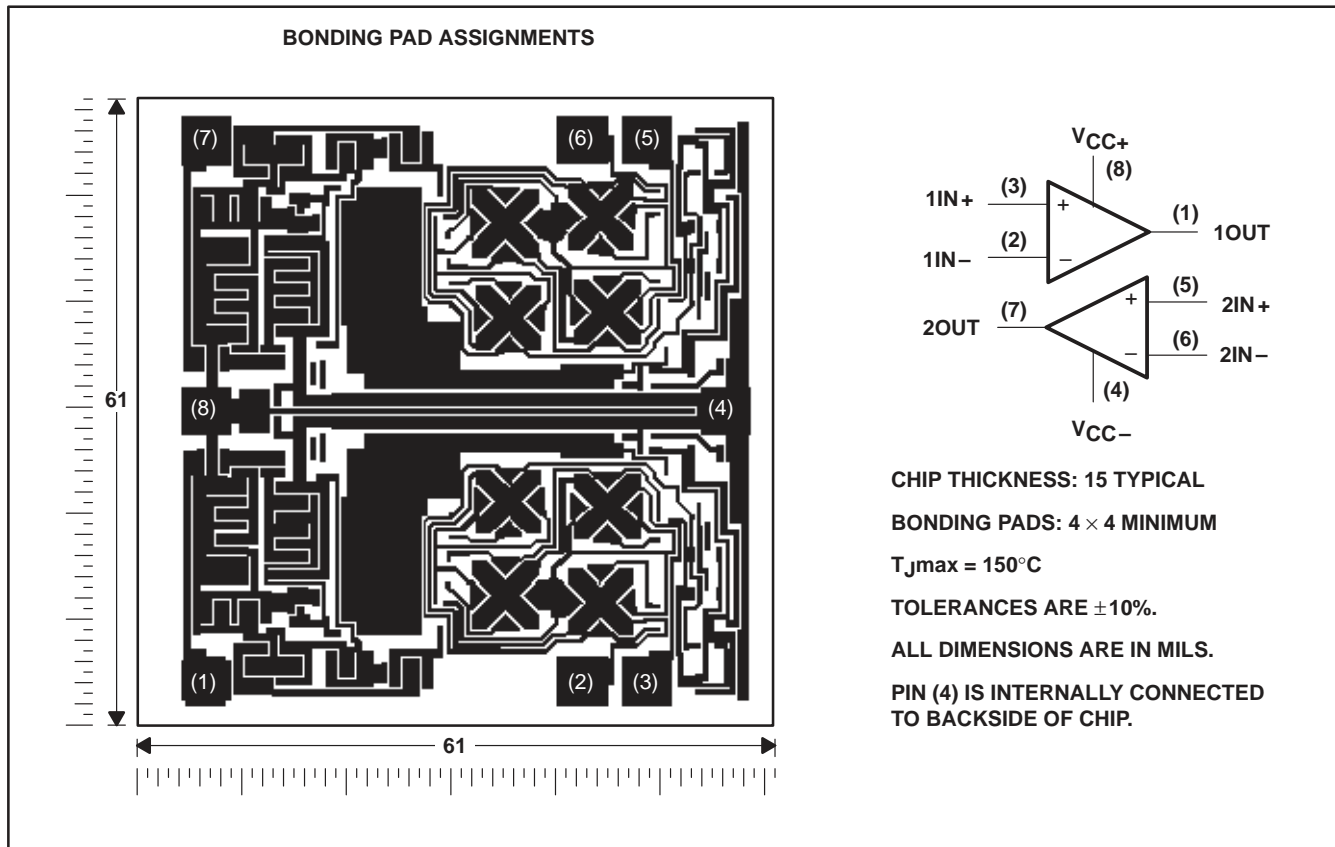
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TL081, TL081A, TL081B, TL082, TL082A, TL082B  
 TL082Y, TL084, TL084A, TL084B, TL084Y  
**JFET-INPUT OPERATIONAL AMPLIFIERS**

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**TL082Y chip information**

These chips, when properly assembled, display characteristics similar to the TL082. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.

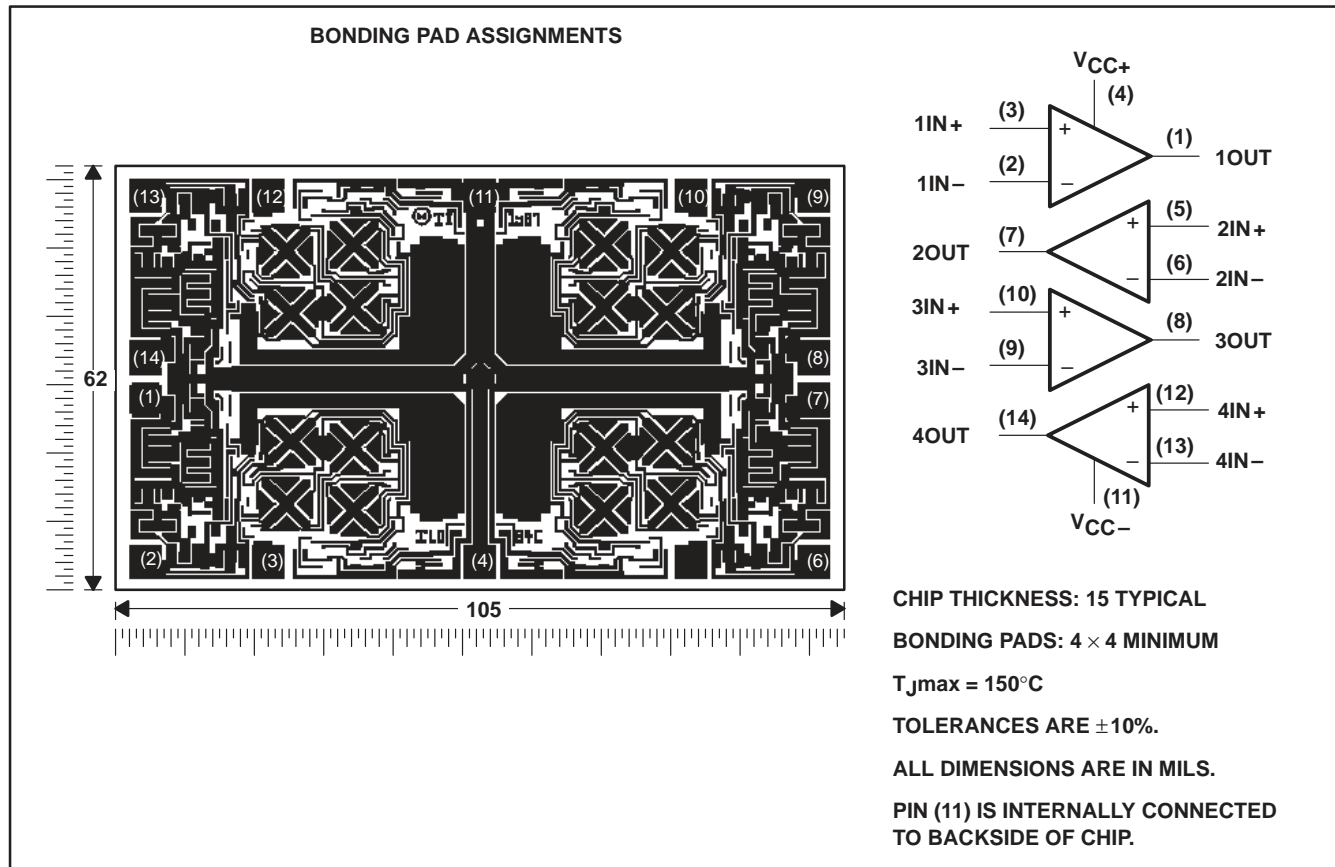


**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

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**TL084Y chip information**

These chips, when properly assembled, display characteristics similar to the TL084. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



# TL081, TL081A, TL081B, TL082, TL082A, TL082B TL082Y, TL084, TL084A, TL084B, TL084Y JFET-INPUT OPERATIONAL AMPLIFIERS

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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

|  | TL08_C<br>TL08_AC<br>TL08_BC | TL08_I     | TL084Q     | TL08_M     | UNIT               |
|--|------------------------------|------------|------------|------------|--------------------|
| Supply voltage, $V_{CC+}$ (see Note 1)                       | 18                           | 18         | 18         | 18         | V                  |
| Supply voltage $V_{CC-}$ (see Note 1)                        | -18                          | -18        | -18        | -18        | V                  |
| Differential input voltage, $V_{ID}$ (see Note 2)            | $\pm 30$                     | $\pm 30$   | $\pm 30$   | $\pm 30$   | V                  |
| Input voltage, $V_I$ (see Notes 1 and 3)                     | $\pm 15$                     | $\pm 15$   | $\pm 15$   | $\pm 15$   | V                  |
| Duration of output short circuit (see Note 4)                | unlimited                    | unlimited  | unlimited  | unlimited  |                    |
| Continuous total power dissipation                           | See Dissipation Rating Table |            |            |            |                    |
| Operating free-air temperature range, $T_A$                  | 0 to 70                      | -40 to 85  | -40 to 125 | -55 to 125 | $^{\circ}\text{C}$ |
| Storage temperature range, $T_{stg}$                         | -65 to 150                   | -65 to 150 | -65 to 150 | -65 to 150 | $^{\circ}\text{C}$ |
| Case temperature for 60 seconds, $T_C$                       | FK package                   |            |            | 260        | $^{\circ}\text{C}$ |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds | J or JG package              |            |            | 300        | $^{\circ}\text{C}$ |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | D, N, P, or PW package       | 260        | 260        | 260        | $^{\circ}\text{C}$ |

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
  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.

**DISSIPATION RATING TABLE**

| PACKAGE     | $T_A \leq 25^{\circ}\text{C}$<br>POWER RATING | DERATING<br>FACTOR          | DERATE<br>ABOVE $T_A$ | $T_A = 70^{\circ}\text{C}$<br>POWER RATING | $T_A = 85^{\circ}\text{C}$<br>POWER RATING | $T_A = 125^{\circ}\text{C}$<br>POWER RATING |
|-------------|---|-----------------------------|-----------------------|--|--|---|
| D (8 pin)   | 680 mW  | 5.8 mW/ $^{\circ}\text{C}$  | 32 $^{\circ}\text{C}$ | 460 mW                                     | 373 mW                                     | N/A   |
| D (14 pin)  | 680 mW  | 7.6 mW/ $^{\circ}\text{C}$  | 60 $^{\circ}\text{C}$ | 604 mW                                     | 490 mW                                     | 186 mW                                      |
| FK          | 680 mW  | 11.0 mW/ $^{\circ}\text{C}$ | 88 $^{\circ}\text{C}$ | 680 mW                                     | 680 mW                                     | 273 mW                                      |
| J           | 680 mW  | 11.0 mW/ $^{\circ}\text{C}$ | 88 $^{\circ}\text{C}$ | 680 mW                                     | 680 mW                                     | 273 mW                                      |
| JG          | 680 mW  | 8.4 mW/ $^{\circ}\text{C}$  | 69 $^{\circ}\text{C}$ | 672 mW                                     | 546 mW                                     | 210 mW                                      |
| N           | 680 mW  | 9.2 mW/ $^{\circ}\text{C}$  | 76 $^{\circ}\text{C}$ | 680 mW                                     | 597 mW                                     | N/A   |
| P           | 680 mW  | 8.0 mW/ $^{\circ}\text{C}$  | 65 $^{\circ}\text{C}$ | 640 mW                                     | 520 mW                                     | N/A   |
| PW (8 pin)  | 525 mW  | 4.2 mW/ $^{\circ}\text{C}$  | 25 $^{\circ}\text{C}$ | 336 mW                                     | N/A  | N/A   |
| PW (14 pin) | 700 mW  | 5.6 mW/ $^{\circ}\text{C}$  | 25 $^{\circ}\text{C}$ | 448 mW                                     | N/A  | N/A   |
| U           | 675 mW  | 5.4 mW/ $^{\circ}\text{C}$  | 25 $^{\circ}\text{C}$ | 432 mW                                     | 351 mW                                     | 135 mW                                      |
| W           | 680 mW  | 8.0 mW/ $^{\circ}\text{C}$  | 65 $^{\circ}\text{C}$ | 640 mW                                     | 520 mW                                     | 200 mW                                      |

electrical characteristics,  $V_{CC\pm} = \pm 15\text{ V}$  (unless otherwise noted)

| PARAMETER   | TEST CONDITIONS   | $T_A$ †    | TL081C<br>TL082C<br>TL084C |            |     | TL081AC<br>TL082AC<br>TL084AC |            |     | TL081BC<br>TL082BC<br>TL084BC |            |     | TL081I<br>TL082I<br>TL084I |            |                              | UNIT |
|---|---|------------|----------------------------|------------|-----|-------------------------------|------------|-----|-------------------------------|------------|-----|----------------------------|------------|------------------------------|------|
|   |   |            | MIN                        | TYP        | MAX | MIN                           | TYP        | MAX | MIN                           | TYP        | MAX | MIN                        | TYP        | MAX                          |      |
| $V_{IO}$ Input offset voltage   | $V_O = 0$ $R_S = 50\ \Omega$  | 25°C       | 3                          | 15         |     | 3                             | 6          |     | 2                             | 3          |     | 3                          | 6          | mV                           |      |
|   |   | Full range |                            | 20         |     |                               | 7.5        |     |                               | 5          |     |                            | 9          |                              |      |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage                  | $V_O = 0$ $R_S = 50\ \Omega$  | Full range |                            | 18         |     |                               | 18         |     |                               | 18         |     |                            | 18         | $\mu\text{V}/^\circ\text{C}$ |      |
| $I_{IO}$ Input offset current‡  | $V_O = 0$   | 25°C       | 5                          | 200        |     | 5                             | 100        |     | 5                             | 100        |     | 5                          | 100        | pA                           |      |
|   |   | Full range |                            | 2          |     |                               | 2          |     |                               | 2          |     |                            | 10         | nA                           |      |
| $I_{IB}$ Input bias current‡  | $V_O = 0$   | 25°C       | 30                         | 400        |     | 30                            | 200        |     | 30                            | 200        |     | 30                         | 200        | pA                           |      |
|   |   | Full range |                            | 10         |     |                               | 7          |     |                               | 7          |     |                            | 20         | nA                           |      |
| $V_{ICR}$ Common-mode input voltage range                                       |   | 25°C       | $\pm 11$                   | -12 to 15  |     | $\pm 11$                      | -12 to 15  |     | $\pm 11$                      | -12 to 15  |     | $\pm 11$                   | -12 to 15  | V                            |      |
| $V_{OM}$ Maximum peak output voltage swing                                      | $R_L = 10\ \text{k}\Omega$  | 25°C       | $\pm 12$                   | $\pm 13.5$ |     | $\pm 12$                      | $\pm 13.5$ |     | $\pm 12$                      | $\pm 13.5$ |     | $\pm 12$                   | $\pm 13.5$ | V                            |      |
|   | $R_L \geq 10\ \text{k}\Omega$   | Full range | $\pm 12$                   |            |     | $\pm 12$                      |            |     | $\pm 12$                      |            |     | $\pm 12$                   |            |                              |      |
|   | $R_L \geq 2\ \text{k}\Omega$  |            | $\pm 10$                   | $\pm 12$   |     | $\pm 10$                      | $\pm 12$   |     | $\pm 10$                      | $\pm 12$   |     | $\pm 10$                   | $\pm 12$   |                              |      |
| $A_{VD}$ Large-signal differential voltage amplification                        | $V_O = \pm 10\ \text{V}$ , $R_L \geq 2\ \text{k}\Omega$                           | 25°C       | 25                         | 200        |     | 50                            | 200        |     | 50                            | 200        |     | 50                         | 200        | V/mV                         |      |
|   | $V_O = \pm 10\ \text{V}$ , $R_L \geq 2\ \text{k}\Omega$                           | Full range | 15                         |            |     | 25                            |            |     | 25                            |            |     | 25                         |            |                              |      |
| $B_1$ Unity-gain bandwidth  |   | 25°C       |                            | 3          |     |                               | 3          |     |                               | 3          |     |                            | 3          | MHz                          |      |
| $r_i$ Input resistance  |   | 25°C       |                            | $10^{12}$  |     |                               | $10^{12}$  |     |                               | $10^{12}$  |     |                            | $10^{12}$  | $\Omega$                     |      |
| CMRR Common-mode rejection ratio  | $V_{IC} = V_{ICRmin}$ , $V_O = 0$ , $R_S = 50\ \Omega$                            | 25°C       | 70                         | 86         |     | 75                            | 86         |     | 75                            | 86         |     | 75                         | 86         | dB                           |      |
| $k_{SVR}$ Supply voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC} = \pm 15\ \text{V}$ to $\pm 9\ \text{V}$ , $V_O = 0$ , $R_S = 50\ \Omega$ | 25°C       | 70                         | 86         |     | 80                            | 86         |     | 80                            | 86         |     | 80                         | 86         | dB                           |      |
| $I_{CC}$ Supply current (per amplifier)   | $V_O = 0$ , No load   | 25°C       |                            | 1.4        | 2.8 |                               | 1.4        | 2.8 |                               | 1.4        | 2.8 |                            | 1.4        | 2.8                          | mA   |
| $V_{O1}/V_{O2}$ Crosstalk attenuation   | $A_{VD} = 100$  | 25°C       |                            | 120        |     |                               | 120        |     |                               | 120        |     |                            | 120        | dB                           |      |

† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified. Full range for  $T_A$  is 0°C to 70°C for TL08\_C, TL08\_AC, TL08\_BC and -40°C to 85°C for TL08\_I.

‡ Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive as shown in Figure 17. Pulse techniques must be used that maintain the junction temperature as close to the ambient temperature as possible.



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TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

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**electrical characteristics,  $V_{CC} \pm = \pm 15$  V (unless otherwise noted)**

| PARAMETER  | TEST CONDITION <sup>†</sup>   | $T_A$      | TL081M, TL082M |                |          | TL084Q, TL084M |                |      | UNIT             |
|--|---|------------|----------------|----------------|----------|----------------|----------------|------|------------------|
|  |   |            | MIN            | TYP            | MAX      | MIN            | TYP            | MAX  |                  |
| $V_{IO}$ Input offset voltage  | $V_O = 0, R_S = 50 \Omega$  | 25°C       | 3              | 6              |          | 3              | 9              | mV   |                  |
|  |   | Full range |                |                | 9        |                | 15             |      |                  |
| $\alpha_{VIO}$ Temperature coefficient of input offset voltage               | $V_O = 0, R_S = 50 \Omega$  | Full range | 18             |                |          | 18             |                |      | $\mu V/^\circ C$ |
| $I_{IO}$ Input offset current <sup>‡</sup>                                   | $V_O = 0$   | 25°C       | 5              | 100            |          | 5              | 100            | pA   |                  |
|  |   | 125°C      | 20             |                |          | 20             |                |      | nA               |
| $I_{IB}$ Input bias current <sup>‡</sup>                                     | $V_O = 0$   | 25°C       | 30             | 200            |          | 30             | 200            | pA   |                  |
|  |   | 125°C      | 50             |                |          | 50             |                |      | nA               |
| $V_{ICR}$ Common-mode input voltage range                                    |   | 25°C       | $\pm 11$       | $\pm 12$ to 15 |          | $\pm 11$       | $\pm 12$ to 15 | V    |                  |
| $V_{OM}$ Maximum peak output voltage swing                                   | $R_L = 10 \text{ k}\Omega$  | 25°C       | $\pm 12$       | $\pm 13.5$     |          | $\pm 12$       | $\pm 13.5$     | V    |                  |
|  | $R_L \geq 10 \text{ k}\Omega$   | Full range | $\pm 12$       |                | $\pm 12$ |                |                |      |                  |
|  | $R_L \geq 2 \text{ k}\Omega$  |            | $\pm 10$       | $\pm 12$       | $\pm 10$ | $\pm 12$       |                |      |                  |
| $A_{VD}$ Large-signal differential voltage amplification                     | $V_O = \pm 10 \text{ V}, R_L \geq 2 \text{ k}\Omega$                      | 25°C       | 25             | 200            |          | 25             | 200            | V/mV |                  |
|  | $V_O = \pm 10 \text{ V}, R_L \geq 2 \text{ k}\Omega$                      | Full range | 15             |                | 15       |                |                |      |                  |
| $B_1$ Unity-gain bandwidth   |   | 25°C       | 3              |                |          | 3              |                |      | MHz              |
| $r_i$ Input resistance   |   | 25°C       | $10^{12}$      |                |          | $10^{12}$      |                |      | $\Omega$         |
| CMRR Common-mode rejection ratio   | $V_{IC} = V_{ICRmin}, V_O = 0, R_S = 50 \Omega$                           | 25°C       | 80             | 86             |          | 80             | 86             | dB   |                  |
| $k_{SVR}$ Supply voltage rejection ratio ( $\Delta V_{CC} / \Delta V_{IO}$ ) | $V_{CC} = \pm 15 \text{ V to } \pm 9 \text{ V}, V_O = 0, R_S = 50 \Omega$ | 25°C       | 80             | 86             |          | 80             | 86             | dB   |                  |
| $I_{CC}$ Supply current (per amplifier)                                      | $V_O = 0, \text{ No load}$  | 25°C       | 1.4            | 2.8            |          | 1.4            | 2.8            | mA   |                  |
| $V_{O1}/V_{O2}$ Crosstalk attenuation  | $A_{VD} = 100$  | 25°C       | 120            |                |          | 120            |                |      | dB               |

<sup>†</sup> All characteristics are measured under open-loop conditions with zero common-mode input voltage unless otherwise specified.

<sup>‡</sup> Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive as shown in Figure 17. Pulse techniques must be used that maintain the junction temperatures as close to the ambient temperature as is possible.

**operating characteristics,  $V_{CC} \pm = \pm 15$  V,  $T_A = 25^\circ C$  (unless otherwise noted)**

| PARAMETER                            | TEST CONDITIONS  | MIN                                    | TYP | MAX | UNIT            |                 |
|--------------------------------------|--|--|-----|-----|-----------------|-----------------|
| SR Slew rate at unity gain           | $V_I = 10 \text{ V}, R_L = 2 \text{ k}\Omega, C_L = 100 \text{ pF}, \text{ See Figure 1}$  | 8*                                     | 13  |     | V/ $\mu s$      |                 |
|                                      | $V_I = 10 \text{ V}, R_L = 2 \text{ k}\Omega, C_L = 100 \text{ pF}, T_A = -55^\circ C \text{ to } 125^\circ C, \text{ See Figure 1}$ | 5*                                     |     |     |                 |                 |
| $t_r$ Rise time                      | $V_I = 20 \text{ mV}, R_L = 2 \text{ k}\Omega, C_L = 100 \text{ pF}, \text{ See Figure 1}$   | 0.05                                   |     |     | $\mu s$         |                 |
| Overshoot factor                     |  | 20%                                    |     |     |                 |                 |
| $V_n$ Equivalent input noise voltage | $R_S = 20 \Omega$  | $f = 1 \text{ kHz}$                    |     |     | 18              | nV/ $\sqrt{Hz}$ |
|                                      |  | $f = 10 \text{ Hz to } 10 \text{ kHz}$ |     |     | 4               | $\mu V$         |
| $I_n$ Equivalent input noise current | $R_S = 20 \Omega, f = 1 \text{ kHz}$   | 0.01                                   |     |     | pA/ $\sqrt{Hz}$ |                 |
| THD Total harmonic distortion        | $V_{I rms} = 6 \text{ V}, f = 1 \text{ kHz}, A_{VD} = 1, R_S \leq 1 \text{ k}\Omega, R_L \geq 2 \text{ k}\Omega,$                    | 0.003%                                 |     |     |                 |                 |

\*On products compliant to MIL-PRF-38535, this parameter is not production tested.



**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

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**electrical characteristics,  $V_{CC\pm} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

| PARAMETER  | TEST CONDITIONS†   | TL082Y, TL084Y |                 |     | UNIT                         |
|--|--|----------------|-----------------|-----|------------------------------|
|  |  | MIN            | TYP             | MAX |                              |
| $V_{IO}$ Input offset voltage  | $V_O = 0$ , $R_S = 50\ \Omega$   |                | 3               | 15  | mV                           |
| $\alpha V_{IO}$ Temperature coefficient of input offset voltage            | $V_O = 0$ , $R_S = 50\ \Omega$   |                | 18              |     | $\mu\text{V}/^\circ\text{C}$ |
| $I_{IO}$ Input offset current‡   | $V_O = 0$ ,  |                | 5               | 200 | pA                           |
| $I_{IB}$ Input bias current‡   | $V_O = 0$ ,  |                | 30              | 400 | pA                           |
| $V_{ICR}$ Common-mode input voltage range                                  |  | $\pm 11$       | -12<br>to<br>15 |     | V                            |
| $V_{OM}$ Maximum peak output voltage swing                                 | $R_L = 10\ \text{k}\Omega$ ,   | $\pm 12$       | $\pm 13.5$      |     | V                            |
| $A_{VD}$ Large-signal differential voltage amplification                   | $V_O = \pm 10\ \text{V}$ , $R_L \geq 2\ \text{k}\Omega$                              | 25             | 200             |     | V/mV                         |
| $B_1$ Unity-gain bandwidth   |  |                | 3               |     | MHz                          |
| $r_i$ Input resistance   |  |                | $10^{12}$       |     | $\Omega$                     |
| CMRR Common-mode rejection ratio   | $V_{IC} = V_{ICRmin}$ , $V_O = 0$ ,<br>$R_S = 50\ \Omega$                            | 70<br>70       | 86<br>86        |     | dB                           |
| kSVR Supply voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ ) | $V_{CC} = \pm 15\ \text{V}$ to $\pm 9\ \text{V}$ ,<br>$V_O = 0$ , $R_S = 50\ \Omega$ | 70<br>70       | 86<br>86        |     | dB                           |
| $I_{CC}$ Supply current (per amplifier)                                    | $V_O = 0$ , No load  |                | 1.4             | 2.8 | mA                           |
| $V_{O1}/V_{O2}$ Crosstalk attenuation                                      | $A_{VD} = 100$   |                | 120             |     | dB                           |

† All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified.

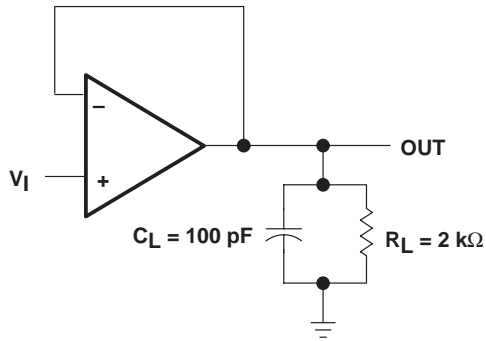
‡ Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive as shown in Figure 17. Pulse techniques must be used that maintain the junction temperature as close to the ambient temperature as possible.

**operating characteristics,  $V_{CC\pm} = \pm 15\ \text{V}$ ,  $T_A = 25^\circ\text{C}$**

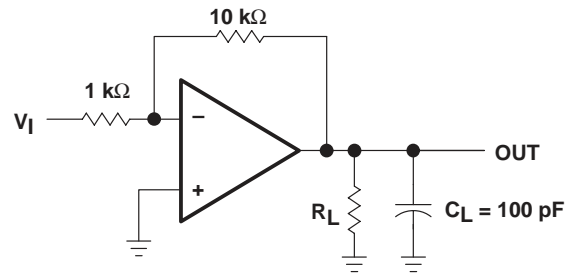
| PARAMETER                            | TEST CONDITIONS                          |                             |   | MIN | TYP    | MAX | UNIT                   |
|--------------------------------------|--|-----------------------------|---|-----|--------|-----|------------------------|
| SR Slew rate at unity gain           | $V_I = 10\ \text{V}$ ,                   | $R_L = 2\ \text{k}\Omega$ , | $C_L = 100\ \text{pF}$ , See Figure 1                         | 8   | 13     |     | V/ $\mu\text{s}$       |
| $t_r$ Rise time                      | $V_I = 20\ \text{mV}$ ,                  | $R_L = 2\ \text{k}\Omega$ , | $C_L = 100\ \text{pF}$ , See Figure 1                         |     | 0.05   |     | $\mu\text{s}$          |
| Overshoot factor                     |  |                             |   |     | 20%    |     |                        |
| $V_n$ Equivalent input noise voltage | $R_S = 20\ \Omega$                       | f = 1 kHz                   |   |     | 18     |     | nV/ $\sqrt{\text{Hz}}$ |
|                                      |  | f = 10 Hz to 10 kHz         |   |     | 4      |     | $\mu\text{V}$          |
| $I_n$ Equivalent input noise current | $R_S = 20\ \Omega$ ,                     | f = 1 kHz                   |   |     | 0.01   |     | pA/ $\sqrt{\text{Hz}}$ |
| THD Total harmonic distortion        | $V_{I rms} = 6\ \text{V}$ ,<br>f = 1 kHz | $A_{VD} = 1$ ,              | $R_S \leq 1\ \text{k}\Omega$ , $R_L \geq 2\ \text{k}\Omega$ , |     | 0.003% |     |                        |



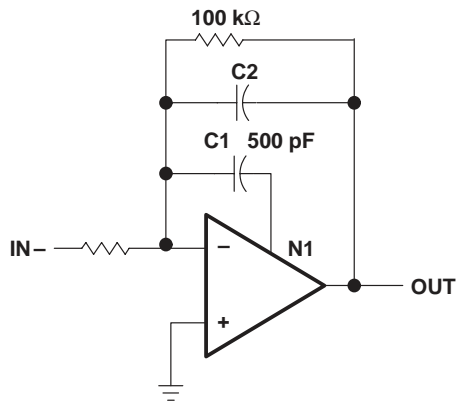
**PARAMETER MEASUREMENT INFORMATION**



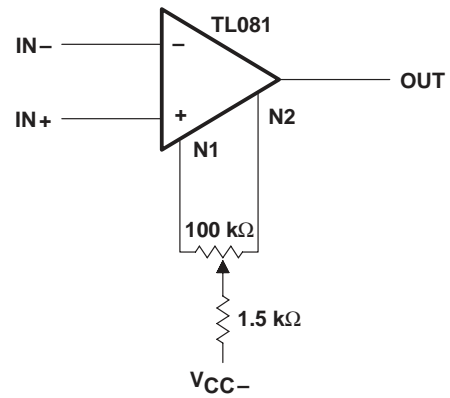
**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**

**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

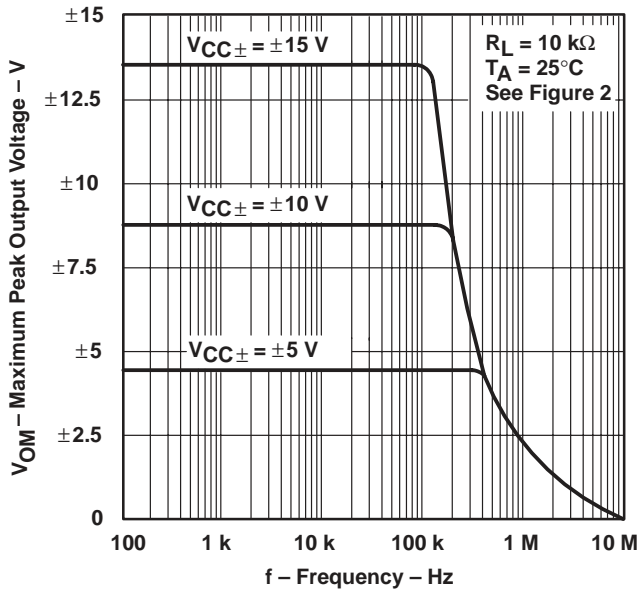
SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

**TYPICAL CHARACTERISTICS**

**Table of Graphs**

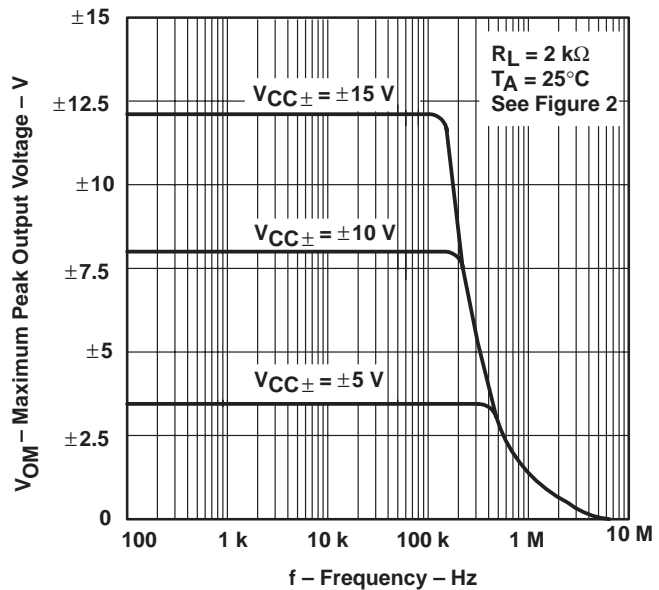
|                 |   | FIGURE                  |
|-----------------|---|-------------------------|
| V <sub>OM</sub> | Maximum peak output voltage                     | vs Frequency            |
|                 |   | vs Free-air temperature |
|                 |   | vs Load resistance      |
|                 |   | vs Supply voltage       |
| A <sub>VD</sub> | Large-signal differential voltage amplification | 5, 6, 7                 |
|                 | Differential voltage amplification              | 8, 9, 10                |
| P <sub>D</sub>  | Total power dissipation                         | 11                      |
| I <sub>CC</sub> | Supply current                                  | 12                      |
| I <sub>IB</sub> | Input bias current                              | 13                      |
|                 | Large-signal pulse response                     | 14                      |
| V <sub>O</sub>  | Output voltage                                  | 15                      |
| CMRR            | Common-mode rejection ratio                     | 16                      |
| V <sub>n</sub>  | Equivalent input noise voltage                  | 17                      |
| THD             | Total harmonic distortion                       | 18                      |

**MAXIMUM PEAK OUTPUT VOLTAGE  
vs  
FREQUENCY**



**Figure 5**

**MAXIMUM PEAK OUTPUT VOLTAGE  
vs  
FREQUENCY**



**Figure 6**

TYPICAL CHARACTERISTICS†

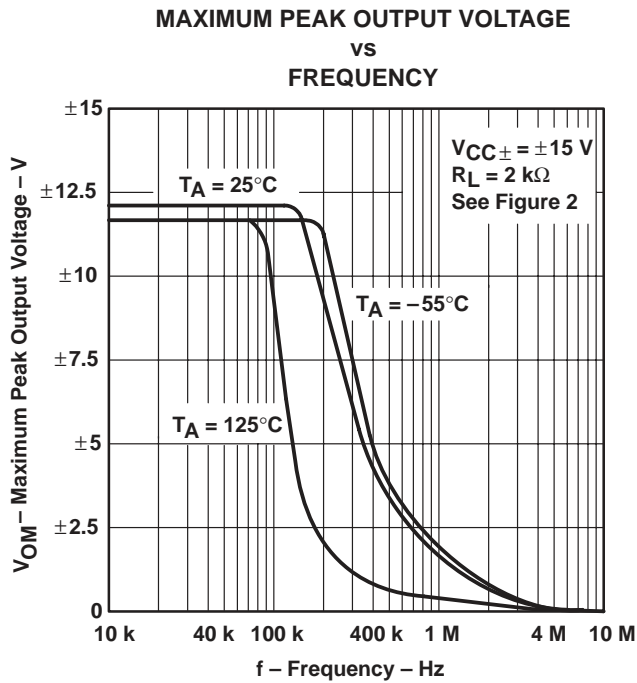


Figure 7

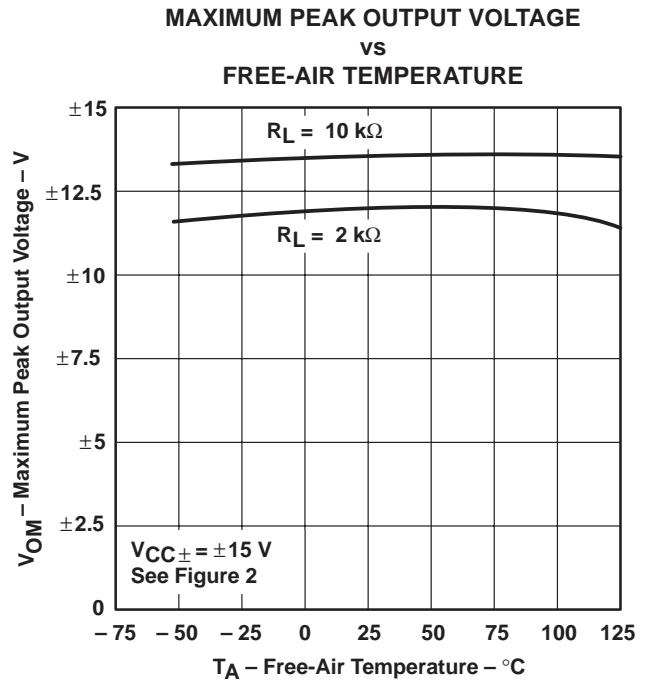


Figure 8

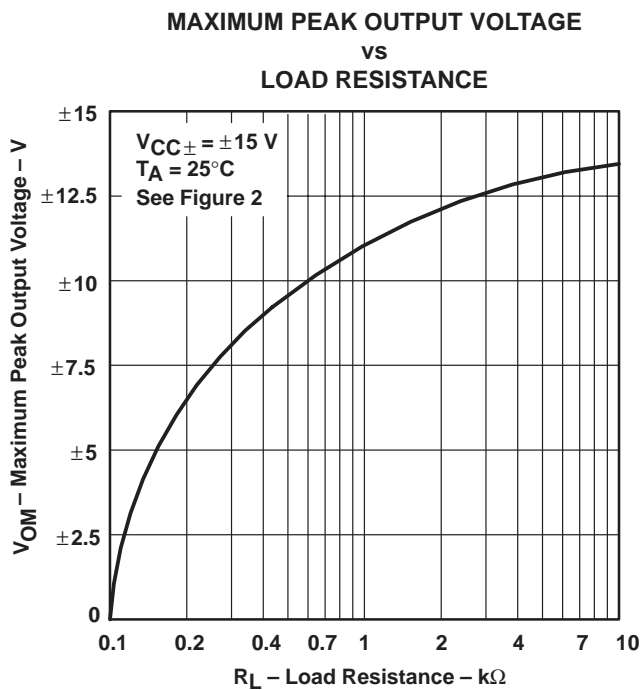


Figure 9

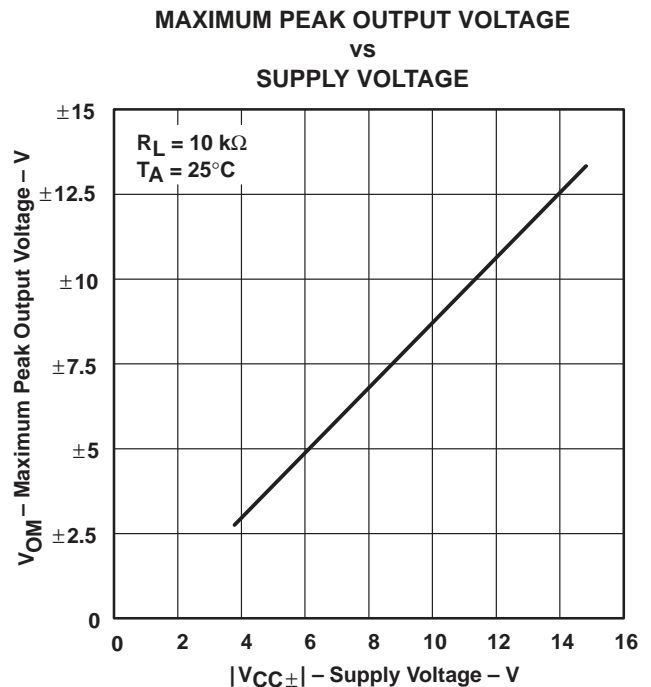


Figure 10

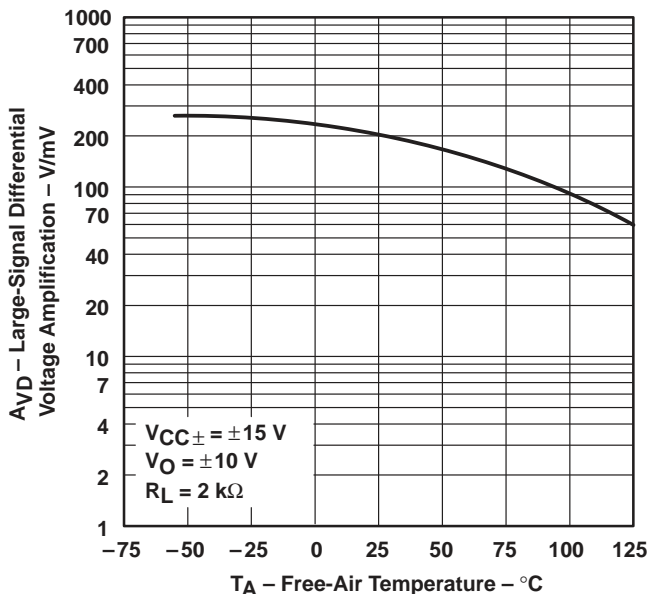
† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

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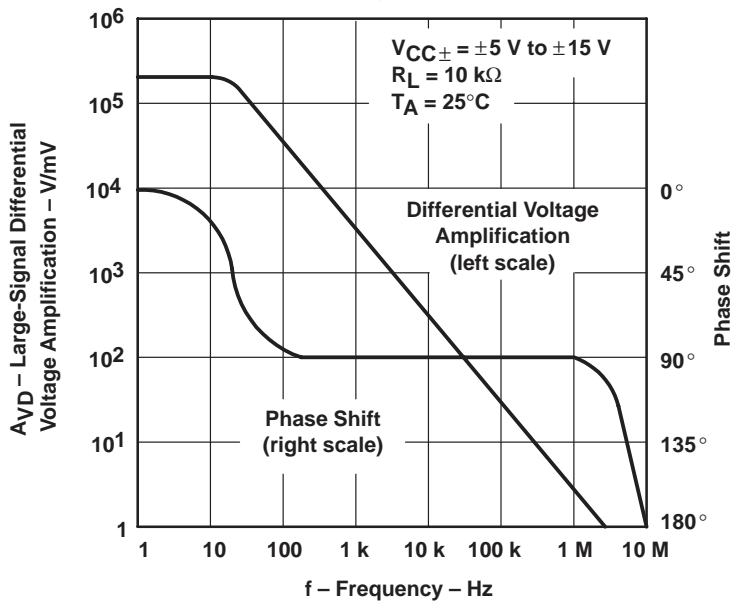
**TYPICAL CHARACTERISTICS†**

**LARGE-SIGNAL  
DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREE-AIR TEMPERATURE**



**Figure 11**

**LARGE-SIGNAL  
DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREQUENCY**



**Figure 12**

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS†

DIFFERENTIAL VOLTAGE AMPLIFICATION  
 vs  
 FREQUENCY WITH FEED-FORWARD COMPENSATION

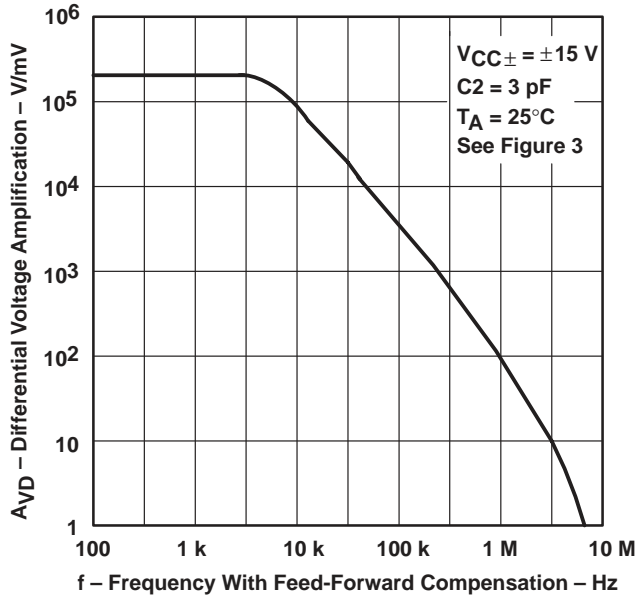


Figure 13

TOTAL POWER DISSIPATION  
 vs  
 FREE-AIR TEMPERATURE

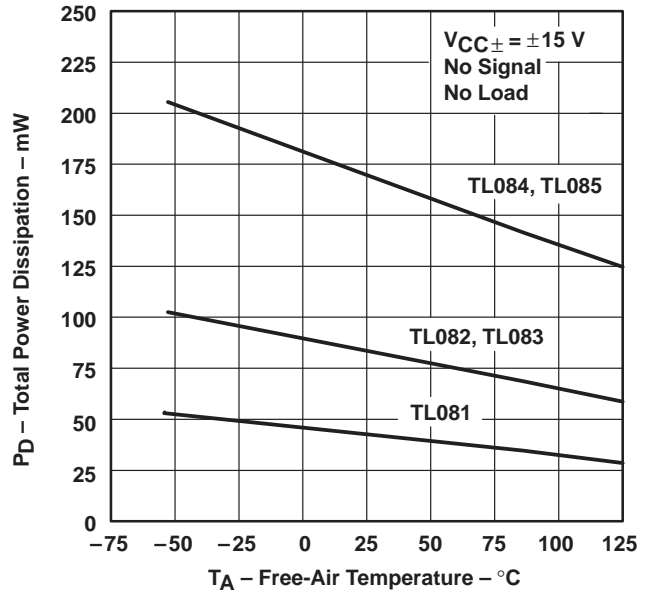


Figure 14

SUPPLY CURRENT PER AMPLIFIER  
 vs  
 FREE-AIR TEMPERATURE

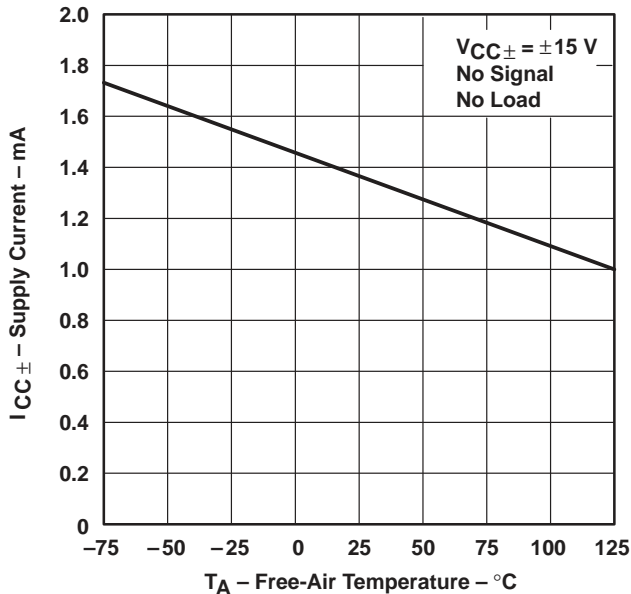


Figure 15

SUPPLY CURRENT  
 vs  
 SUPPLY VOLTAGE

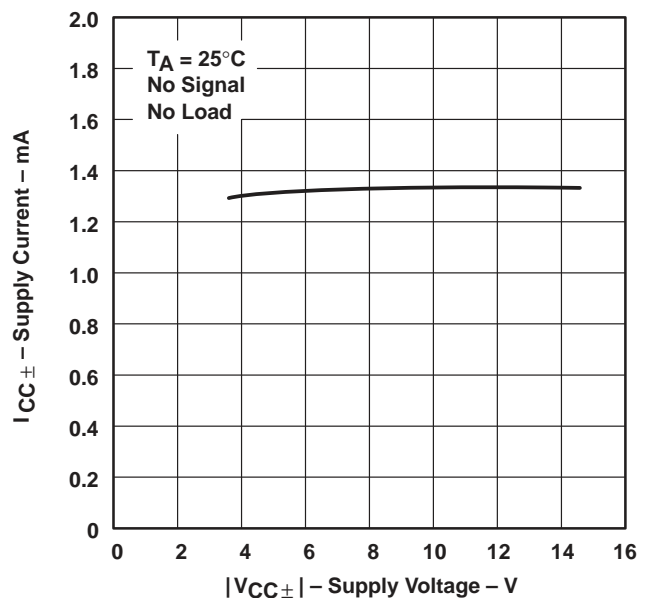
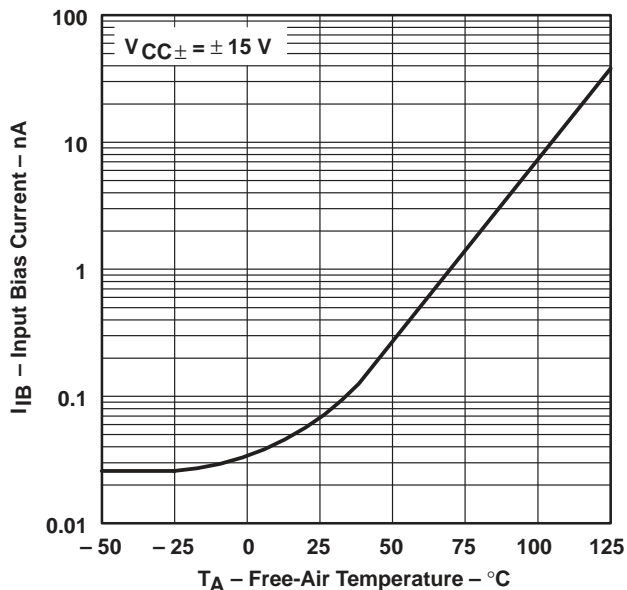


Figure 16

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

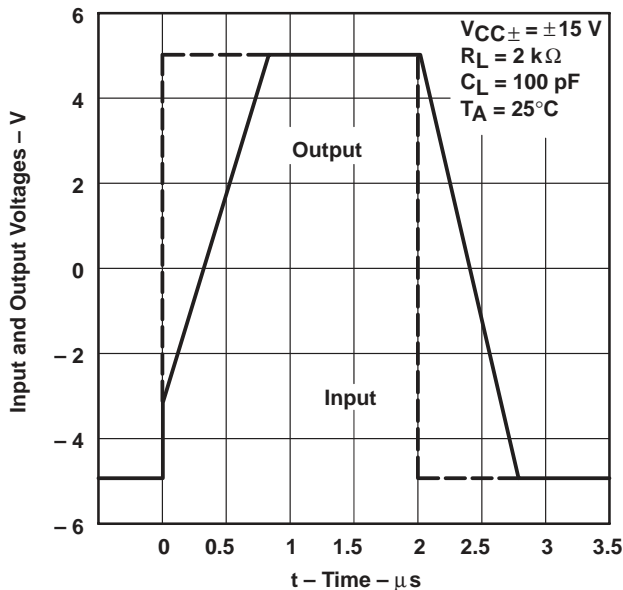
**TYPICAL CHARACTERISTICS†**

**INPUT BIAS CURRENT  
 vs  
 FREE-AIR TEMPERATURE**



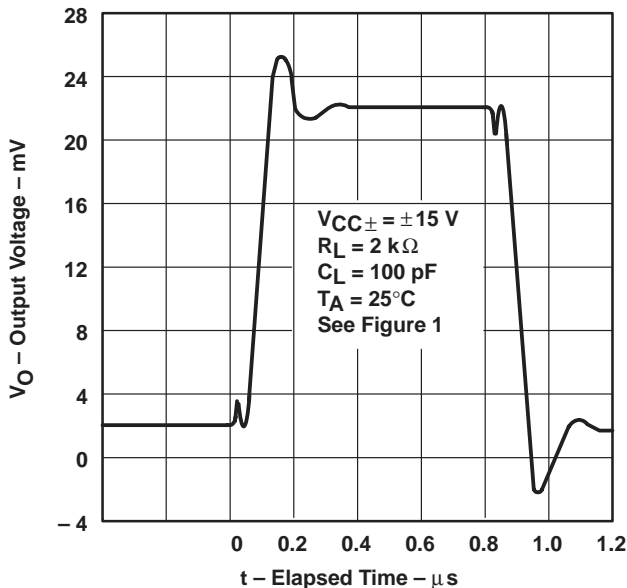
**Figure 17**

**VOLTAGE-FOLLOWER  
 LARGE-SIGNAL PULSE RESPONSE**



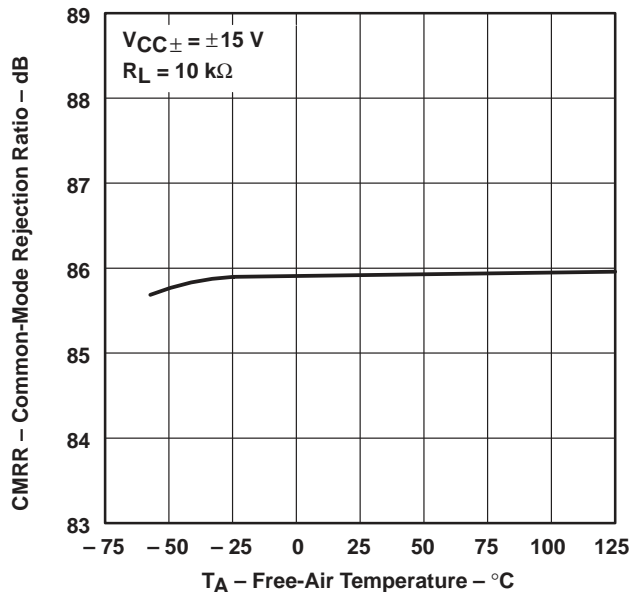
**Figure 18**

**OUTPUT VOLTAGE  
 vs  
 ELAPSED TIME**



**Figure 19**

**COMMON-MODE REJECTION RATIO  
 vs  
 FREE-AIR TEMPERATURE**



**Figure 20**

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.



TYPICAL CHARACTERISTICS†

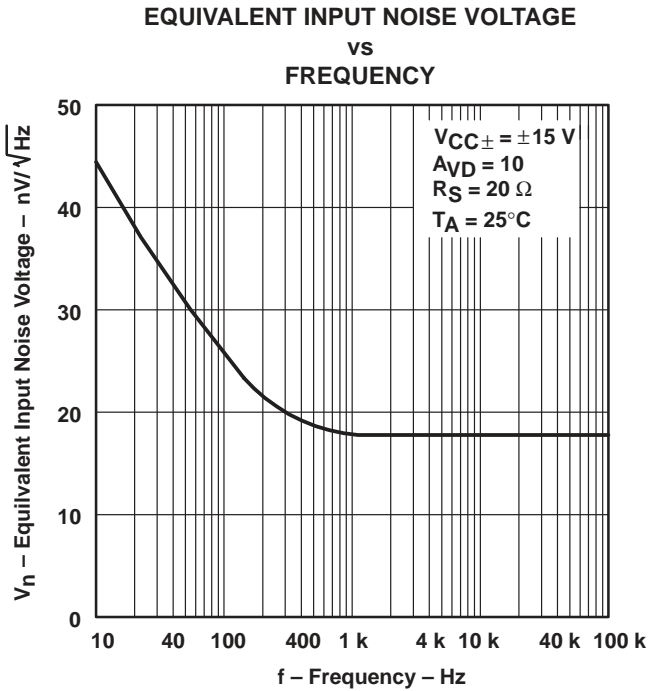


Figure 21

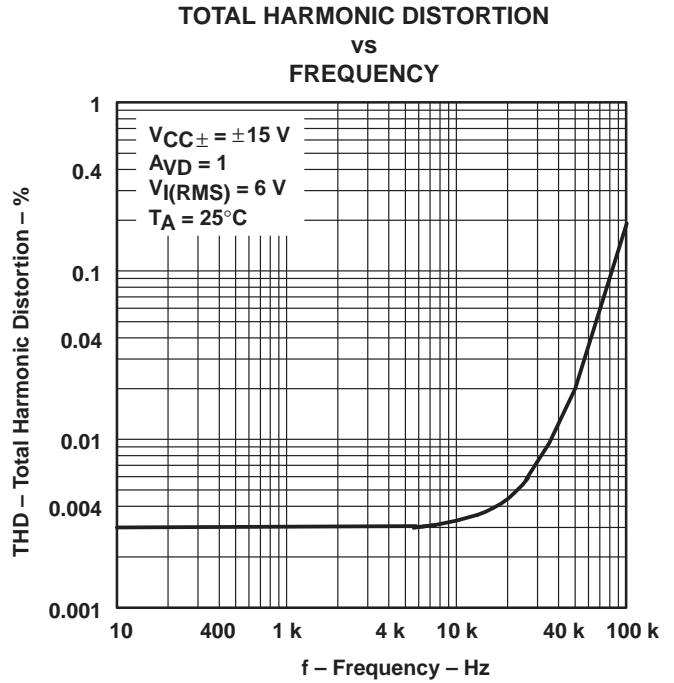


Figure 22

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

APPLICATION INFORMATION

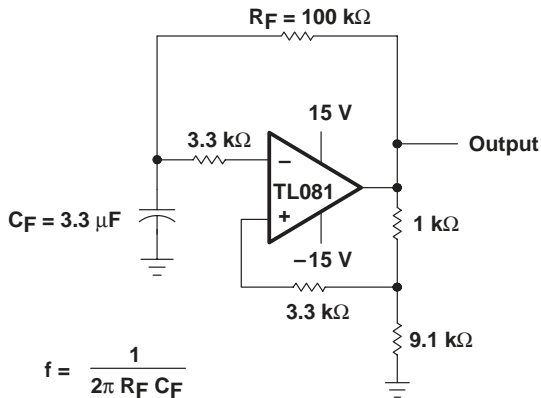


Figure 23

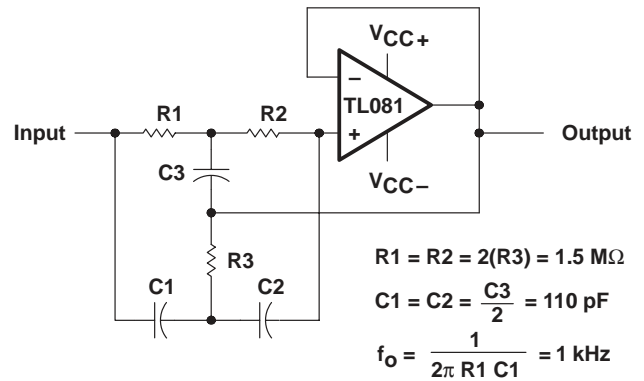
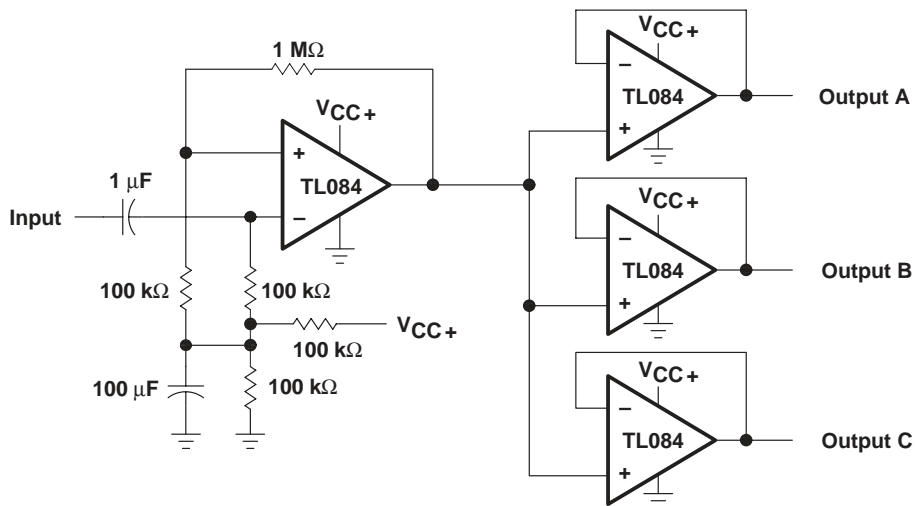
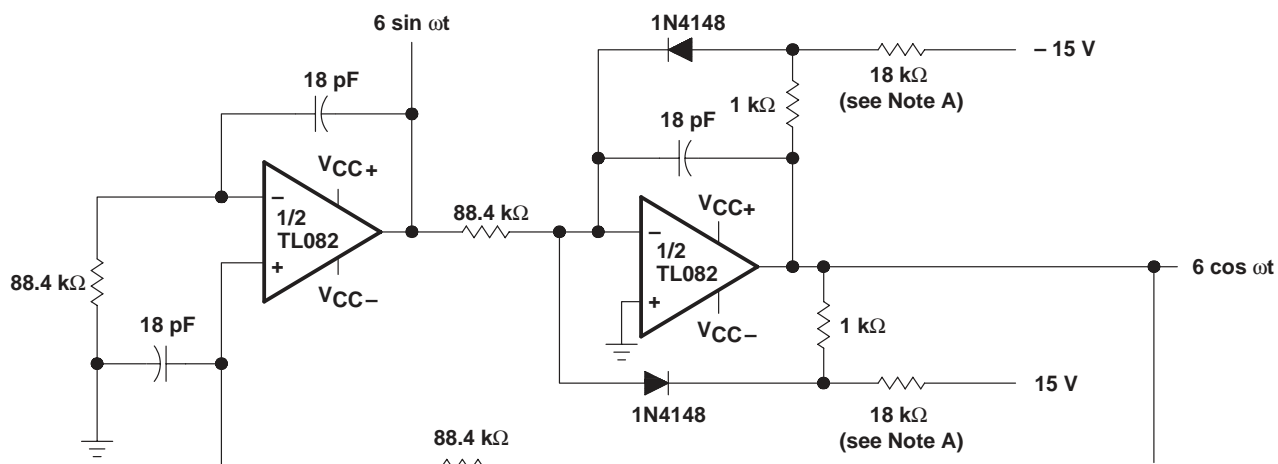


Figure 24

**APPLICATION INFORMATION**



**Figure 25. Audio-Distribution Amplifier**



NOTE A: These resistor values may be adjusted for a symmetrical output.

**Figure 26. 100-KHz Quadrature Oscillator**

APPLICATION INFORMATION

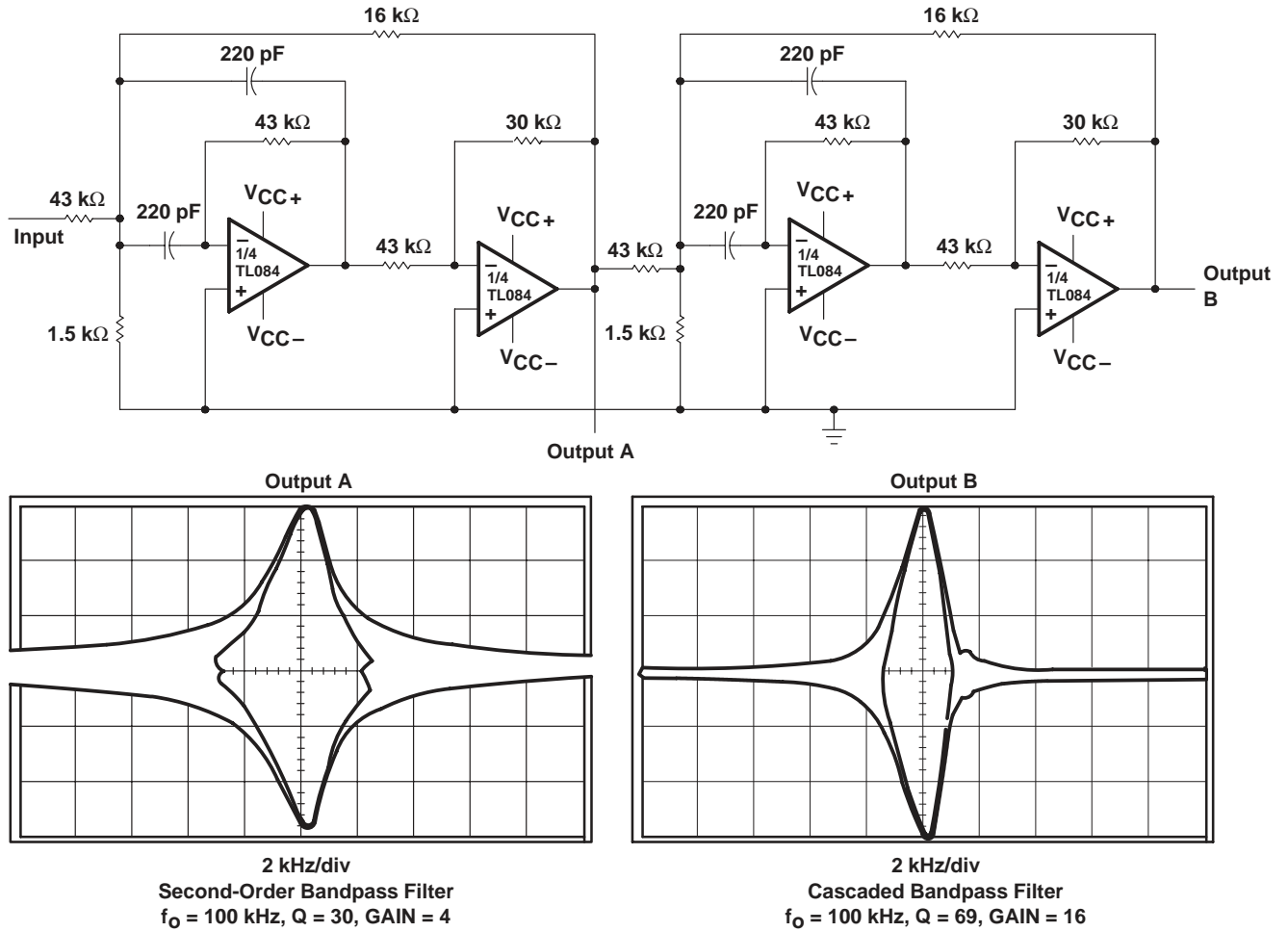


Figure 27. Positive-Feedback Bandpass Filter

**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

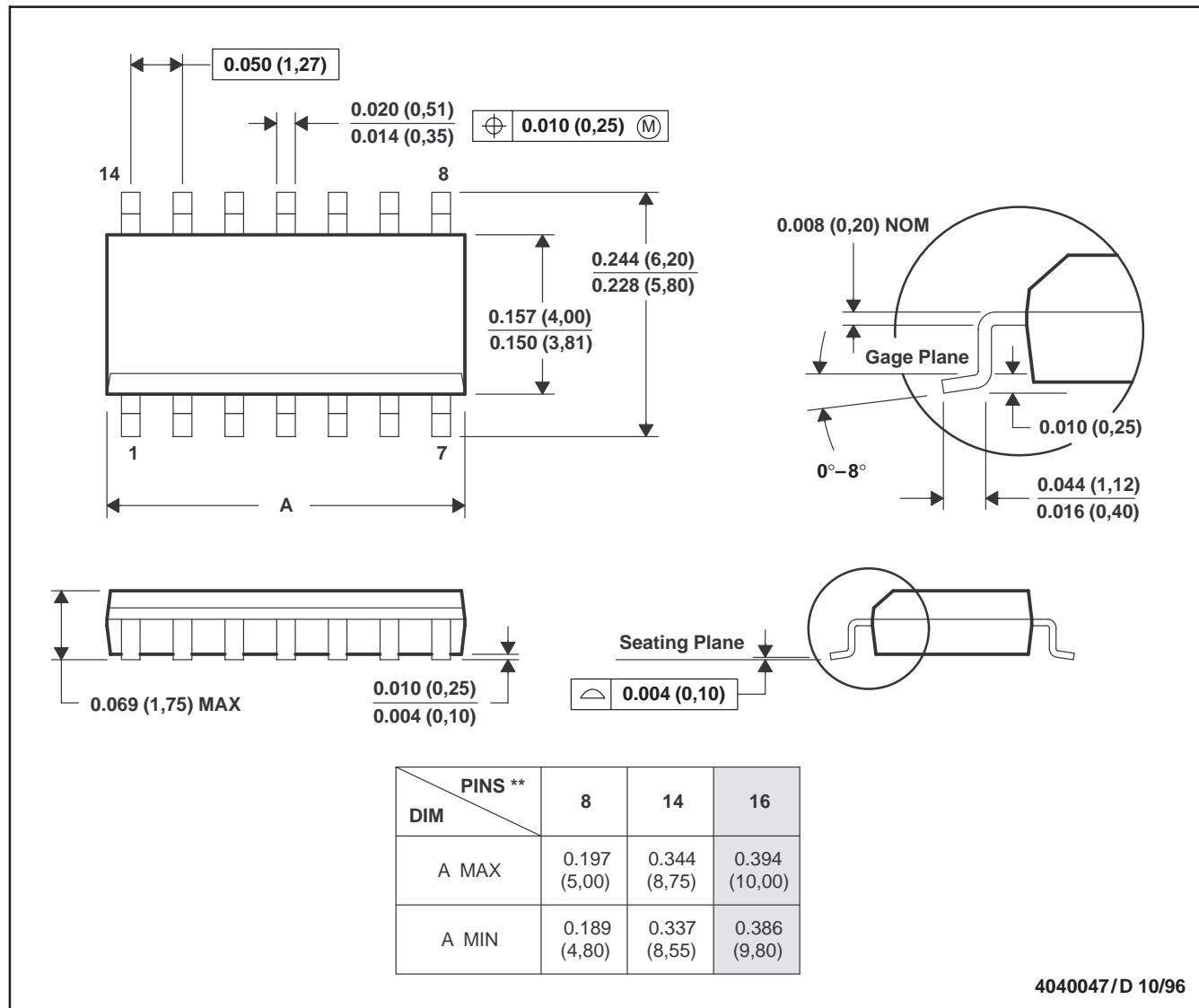
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**MECHANICAL DATA**

**D (R-PDSO-G\*\*)**

**PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).  
 D. Falls within JEDEC MS-012

TL081, TL081A, TL081B, TL082, TL082A, TL082B  
 TL082Y, TL084, TL084A, TL084B, TL084Y  
 JFET-INPUT OPERATIONAL AMPLIFIERS

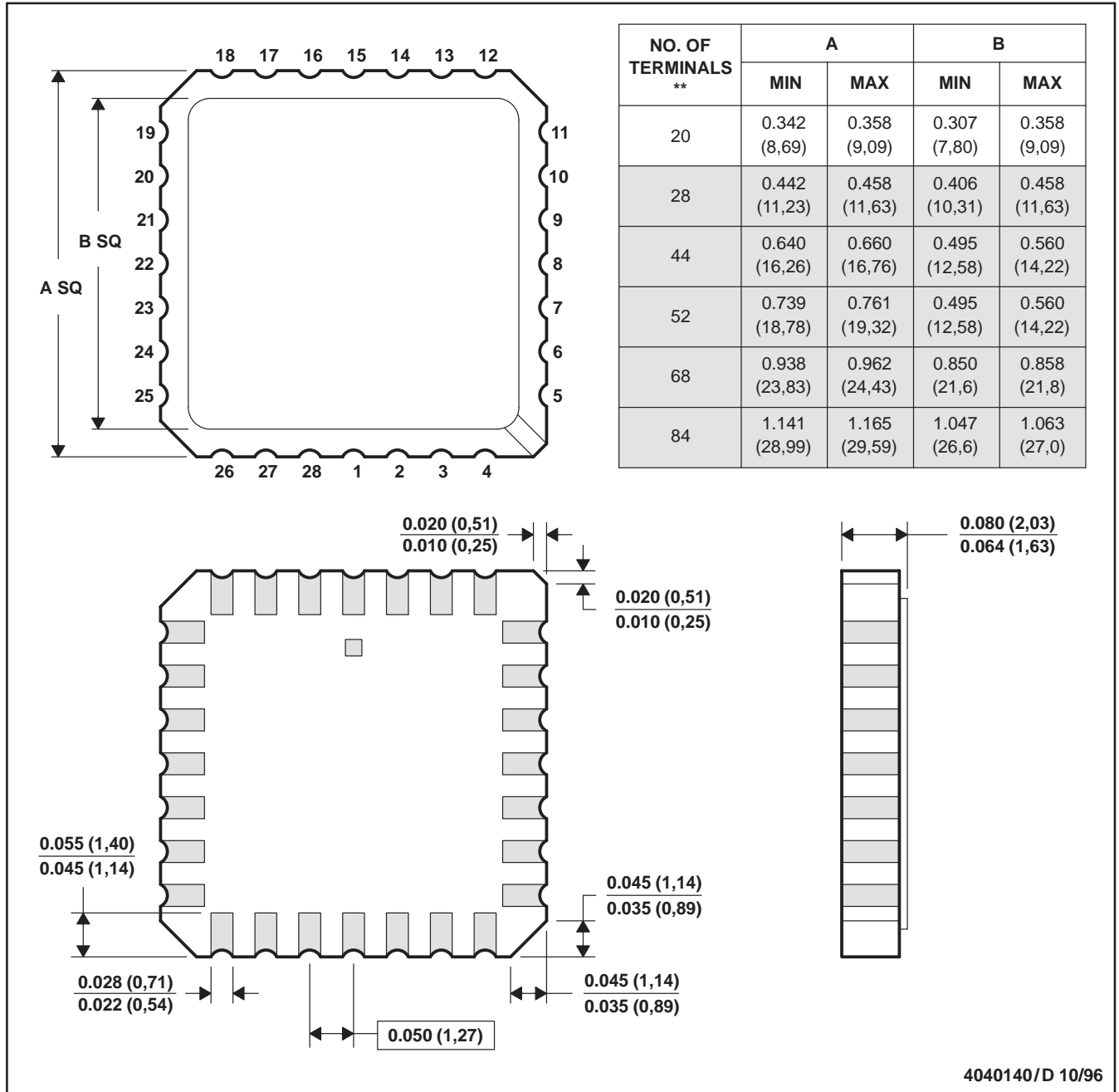
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MECHANICAL DATA

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a metal lid.  
 D. The terminals are gold plated.  
 E. Falls within JEDEC MS-004

**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

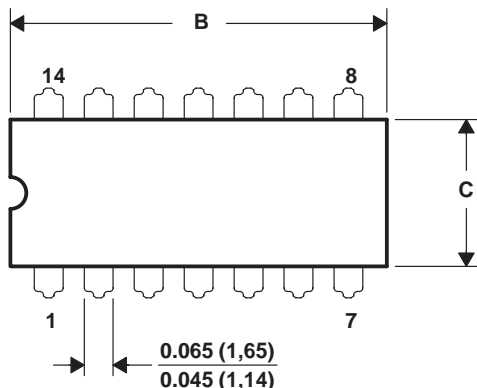
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**MECHANICAL DATA**

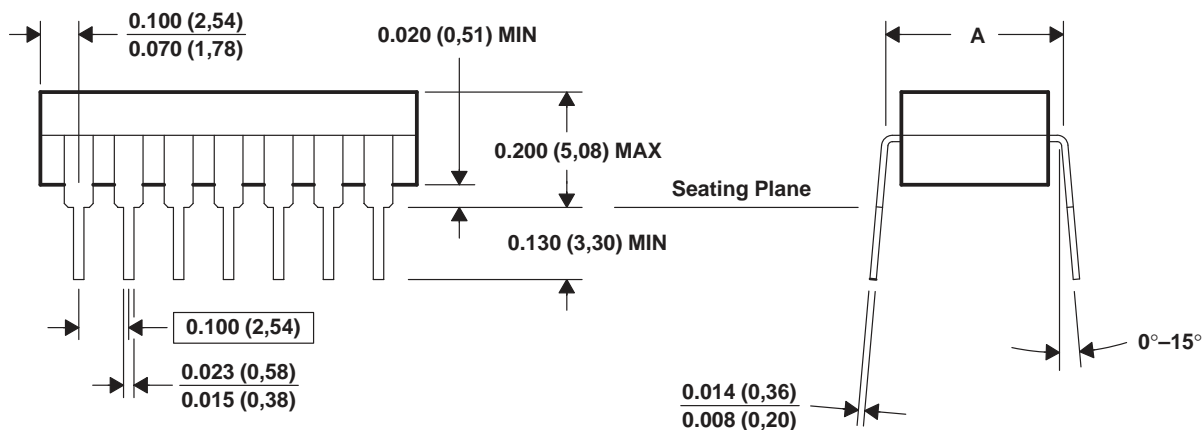
**J (R-GDIP-T\*\*)**

**CERAMIC DUAL-IN-LINE PACKAGE**

14 PIN SHOWN



| DIM \ PINS ** | 14               | 16               | 18               | 20               |
|---------------|------------------|------------------|------------------|------------------|
|               | A MAX            | 0.310<br>(7,87)  | 0.310<br>(7,87)  | 0.310<br>(7,87)  |
| A MIN         | 0.290<br>(7,37)  | 0.290<br>(7,37)  | 0.290<br>(7,37)  | 0.290<br>(7,37)  |
| B MAX         | 0.785<br>(19,94) | 0.785<br>(19,94) | 0.910<br>(23,10) | 0.975<br>(24,77) |
| B MIN         | 0.755<br>(19,18) | 0.755<br>(19,18) | —                | 0.930<br>(23,62) |
| C MAX         | 0.300<br>(7,62)  | 0.300<br>(7,62)  | 0.300<br>(7,62)  | 0.300<br>(7,62)  |
| C MIN         | 0.245<br>(6,22)  | 0.245<br>(6,22)  | 0.245<br>(6,22)  | 0.245<br>(6,22)  |



4040083/D 08/98

- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.  
 E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18, GDIP1-T20, and GDIP1-T22.



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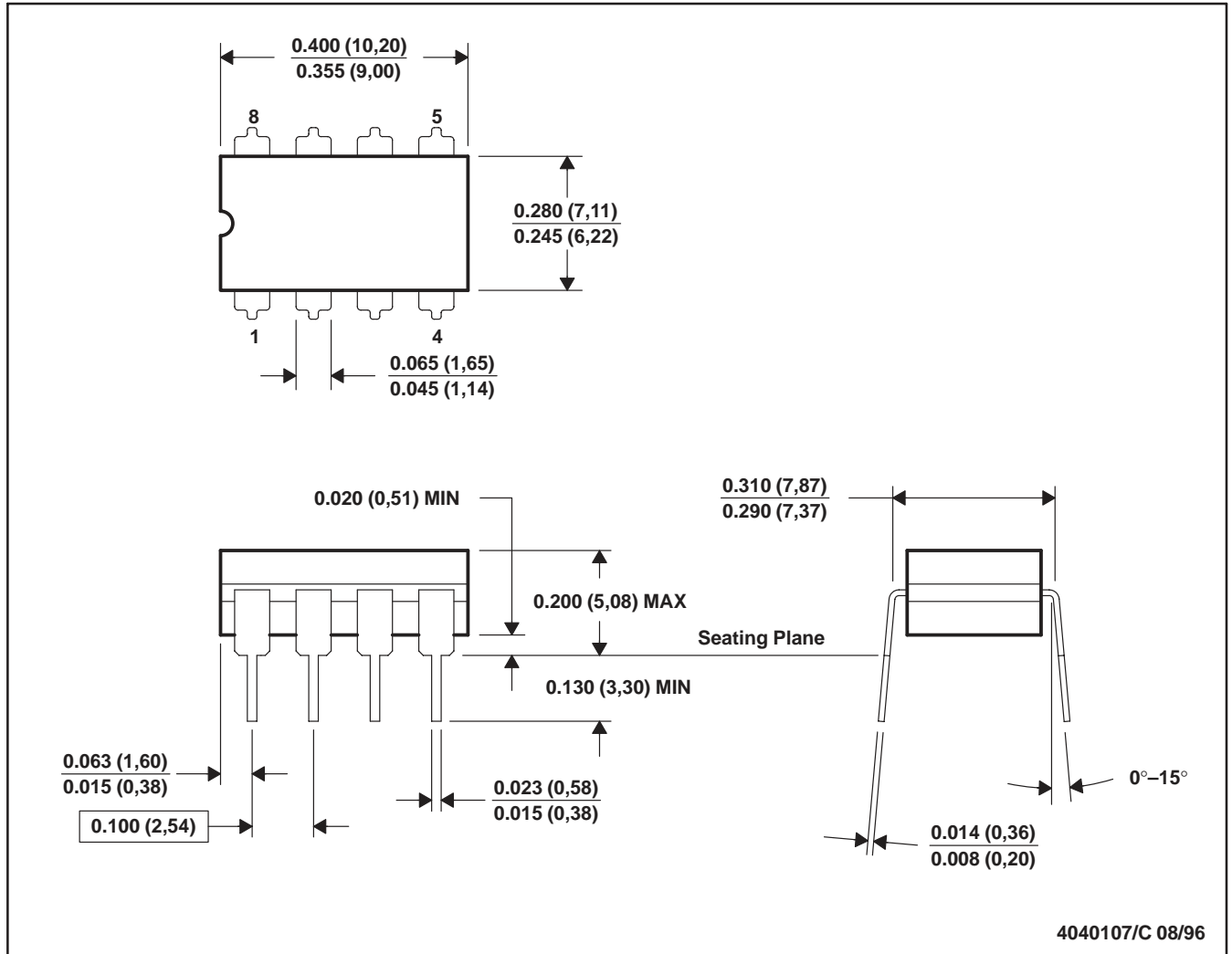
TL081, TL081A, TL081B, TL082, TL082A, TL082B  
 TL082Y, TL084, TL084A, TL084B, TL084Y  
 JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

MECHANICAL DATA

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.  
 E. Falls within MIL-STD-1835 GDIP1-T8

**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

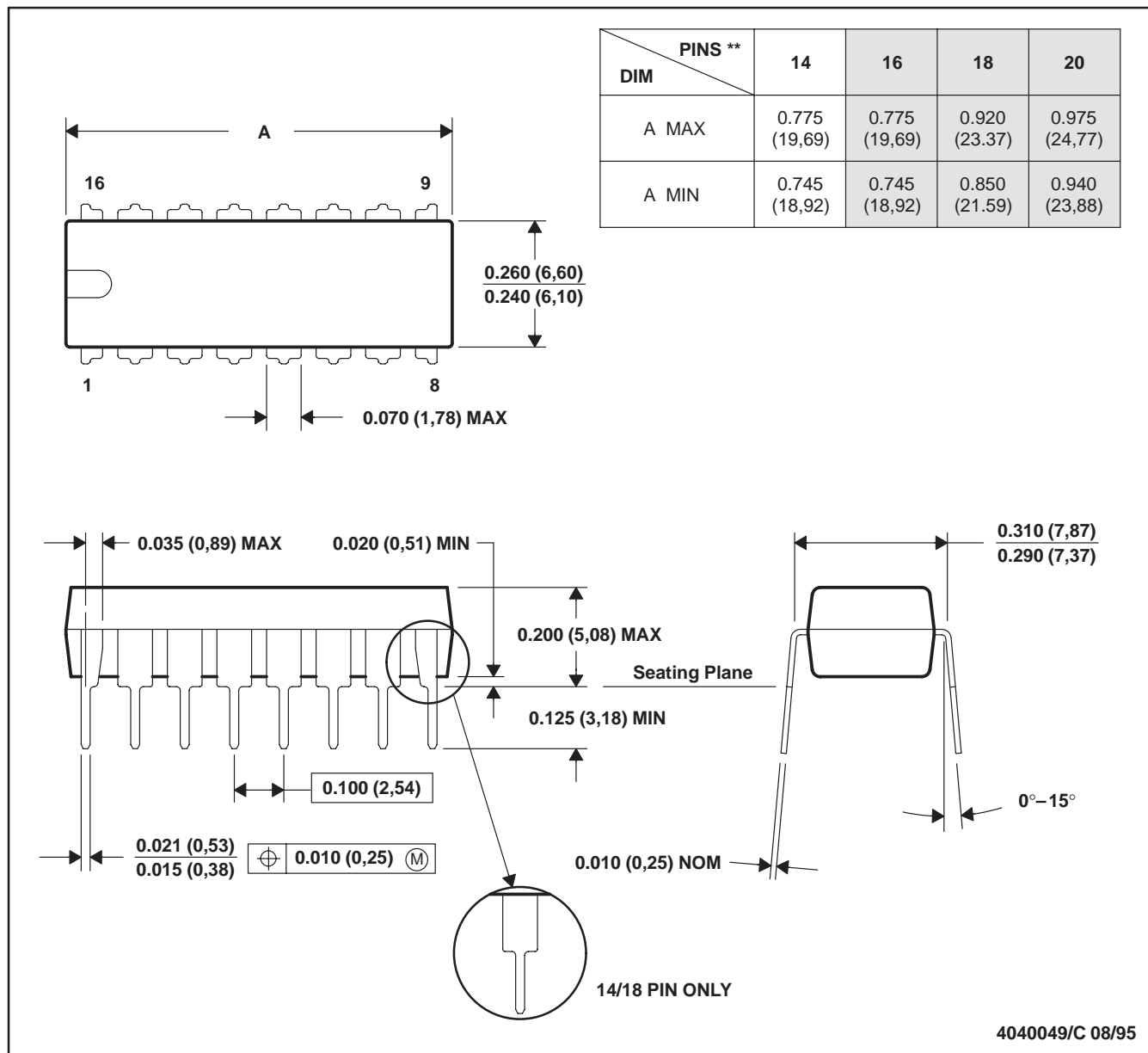
SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

**MECHANICAL DATA**

**N (R-PDIP-T\*\*)**

**PLASTIC DUAL-IN-LINE PACKAGE**

16 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001 (20 pin package is shorter than MS-001.)



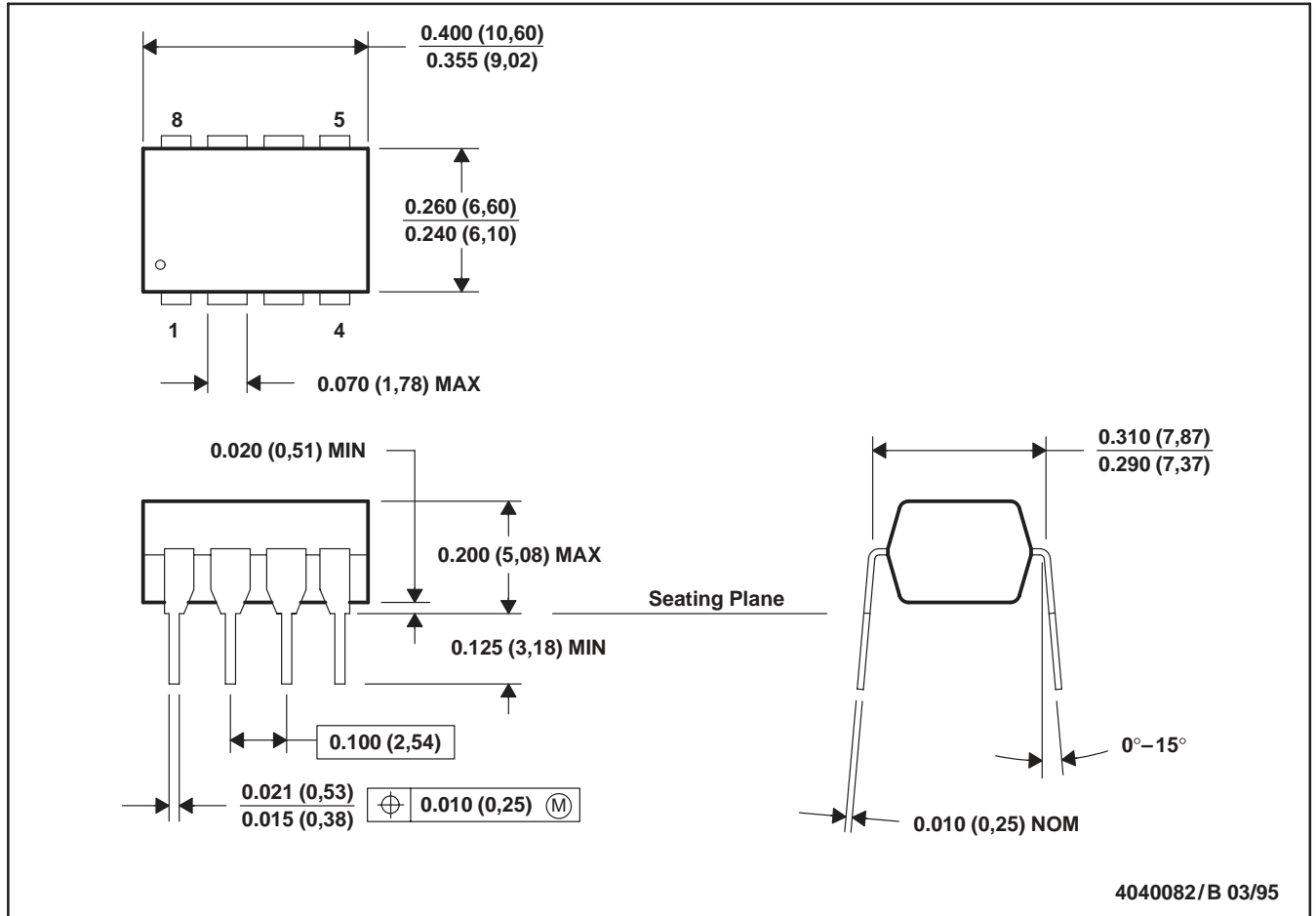
TL081, TL081A, TL081B, TL082, TL082A, TL082B  
 TL082Y, TL084, TL084A, TL084B, TL084Y  
 JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

MECHANICAL DATA

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Falls within JEDEC MS-001

**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

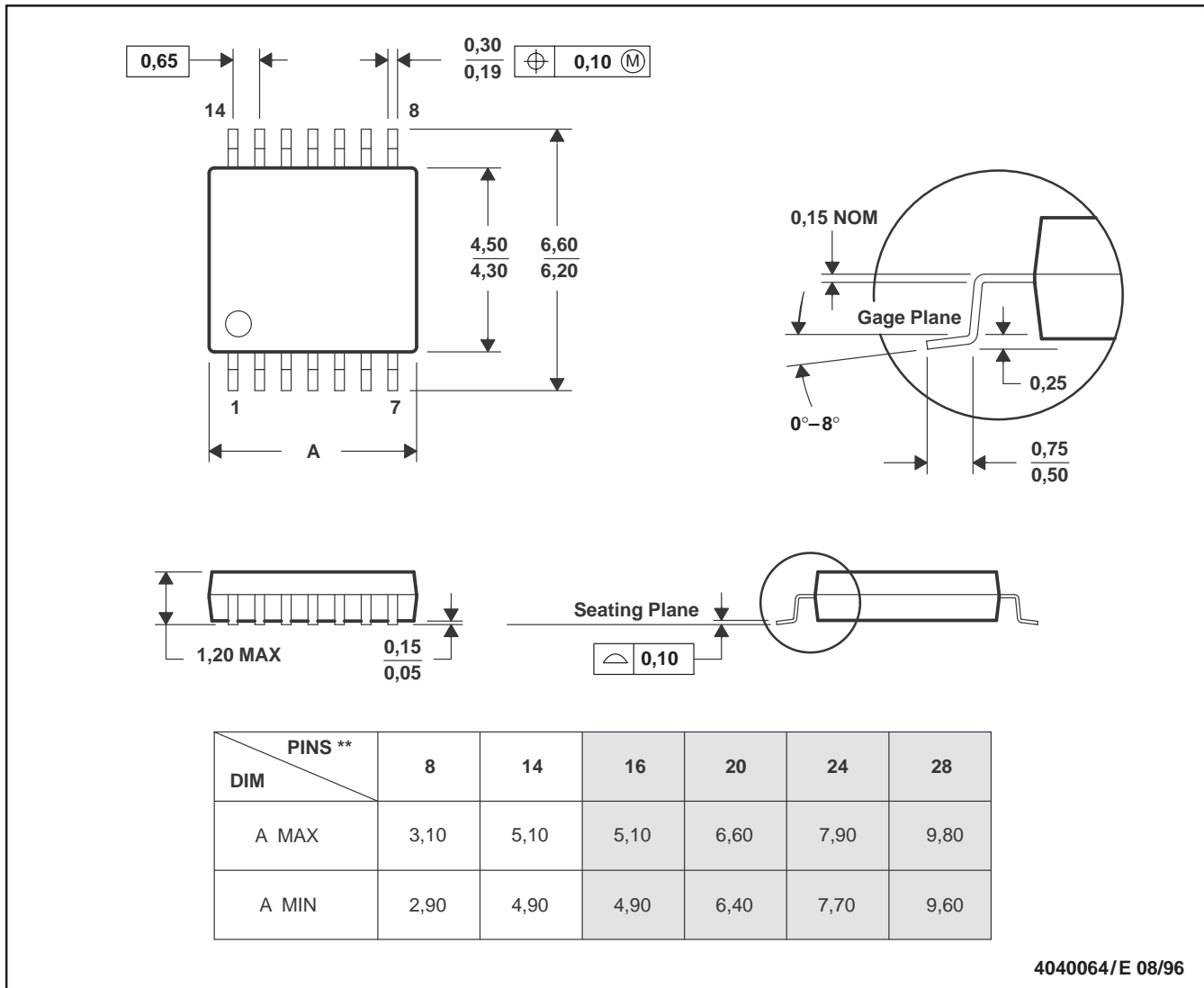
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**MECHANICAL DATA**

**PW (R-PDSO-G\*\*)**

**PLASTIC SMALL-OUTLINE PACKAGE**

14 PIN SHOWN



4040064/E 08/96

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153



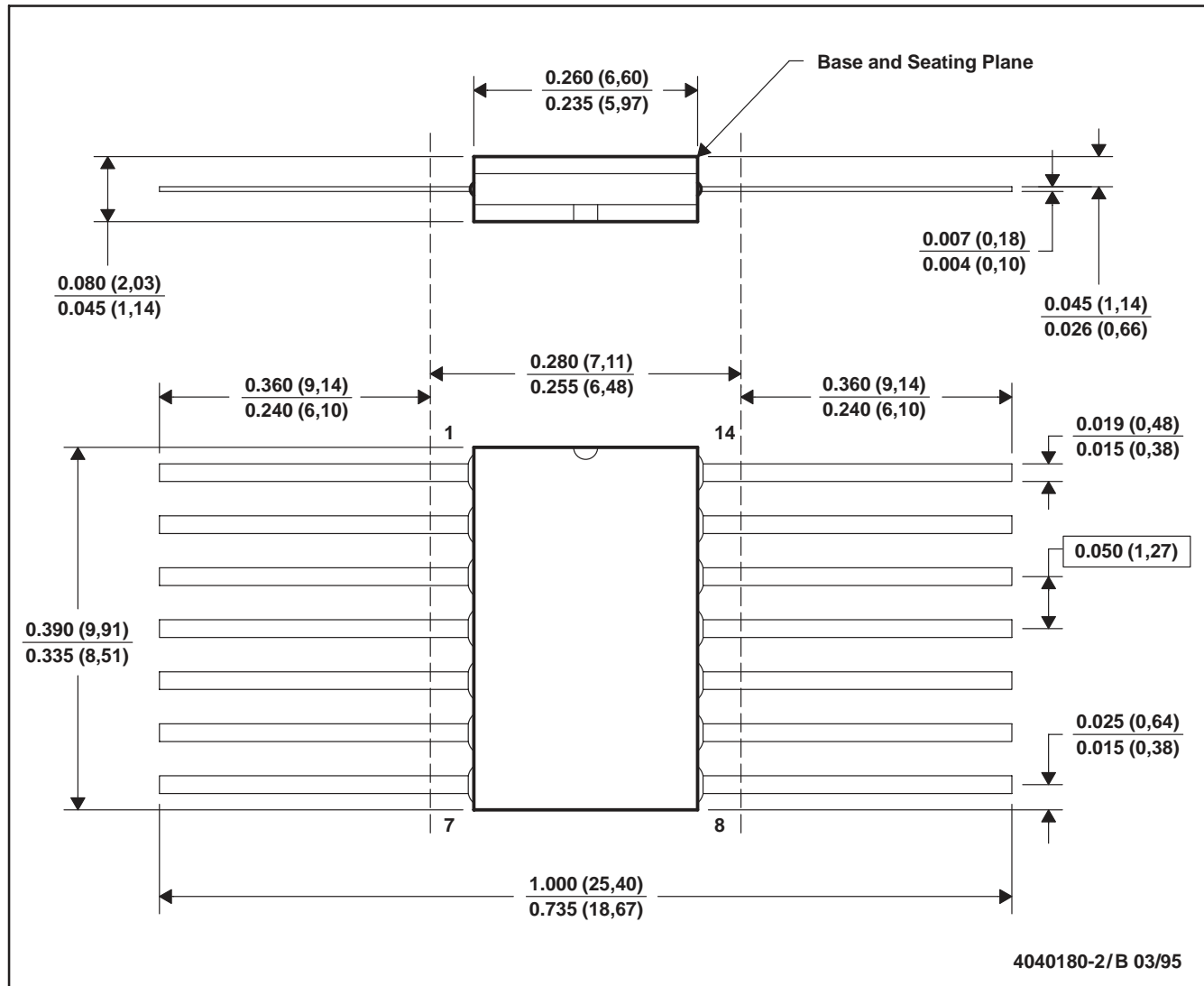
**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL082Y, TL084, TL084A, TL084B, TL084Y  
JFET-INPUT OPERATIONAL AMPLIFIERS**

SLOS081E – FEBRUARY 1977 – REVISED FEBRUARY 1999

**MECHANICAL DATA**

**W (R-GDFP-F14)**

**CERAMIC DUAL FLATPACK**



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification only.  
 E. Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

## IMPORTANT NOTICE

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## TL081, JFET-Input General-Purpose Operational Amplifier

DEVICE STATUS: **ACTIVE**

| PARAMETER NAME              | TL081 |
|-----------------------------|-------|
| Vs (max) (V)                | 36    |
| Vs (min) (V)                | 7     |
| IQ per channel (max) (mA)   | 2.8   |
| IQ per channel (typ) (mA)   | 1.4   |
| GBW (typ) (MHz)             | 3     |
| Slew Rate (typ) (V/us)      | 13    |
| VIO (Full Range) (max) (mV) | 20    |
| VIO (25 deg C) (max) (mV)   | 15    |
| IIB (max) (pA)              | 400   |
| CMRR (min) (dB)             | 70    |
| Vn at 1kHz (typ) (nV/rtHz)  | 18    |
| Number of Channels          | 1     |
| Spec'd at Vs (V)            | +/-15 |
| Open Loop Gain (min) (dB)   | 88    |
| Offset Drift (typ) (uV/C)   | 18    |

### FEATURES

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- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion...0.003% Typ
- High Input Impedance...JFET-Input Stage
- Latch-Up-Free Operation
- High Slew Rate...13 V/us Typ
- Common-Mode Input Voltage Range Includes  $V_{CC+}$

### DESCRIPTION

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The TL08x JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET 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. Offset adjustment and external compensation options are available within the TL08x family.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from -40°C to 85°C. The Q-suffix devices are characterized for operation from -40°C to 125°C. The M-suffix devices are characterized for operation over the full military temperature range of -55°C to 125°C.

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- [Stability Analysis Of Voltage-Feedback Op Amps, Including Compensation Technique](#) (SLOA020 - Updated: 07/14/1999)

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- [Universal Operational Amplifier Evaluation Module Selection Guide](#) (SLOU060A, 16 KB - Updated: 09/28/2000)
- [Universal Operational Amplifier Single, Dual, Quad \(MSOP/TSSOP\)](#) (SLOU055, 1196 KB - Updated: 10/22/1999)
- [Universal Operational Amplifier Single, Dual, Quad \(PDIP\)](#) (SLOU062, 1211 KB - Updated: 10/22/1999)

#### SAMPLES

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| ORDERABLE DEVICE | PACKAGE  | PINS | TEMP (°C) | STATUS | DSCC NUMBER | SAMPLES                         |
|------------------|----------|------|-----------|--------|-------------|---------------------------------|
| TL081CP          | <u>P</u> | 8    | 0 TO 70   | ACTIVE |             | <a href="#">Request Samples</a> |

#### PRICING/ AVAILABILITY

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| ORDERABLE DEVICE | PACKAGE   | PINS | TEMP (°C) | STATUS   | BUDGETARY PRICE US\$/UNIT QTY= 1000+ | PACK QTY | DSCC NUMBER | PRICING/AVAILABILITY                 |
|------------------|-----------|------|-----------|----------|--------------------------------------|----------|-------------|--------------------------------------|
| TL081CD          | <u>D</u>  | 8    | 0 TO 70   | ACTIVE   | 0.35                                 | 75       |             | <a href="#">Check stock or order</a> |
| TL081CDR         | <u>D</u>  | 8    | 0 TO 70   | ACTIVE   | 0.38                                 | 2500     |             | <a href="#">Check stock or order</a> |
| TL081CP          | <u>P</u>  | 8    | 0 TO 70   | ACTIVE   | 0.35                                 | 50       |             | <a href="#">Check stock or order</a> |
| TL081CPS         | <u>PS</u> | 8    | 0 TO 70   | OBSOLETE |                                      |          |             |                                      |
| TL081CPWLE       | <u>PW</u> | 8    | 0 TO 70   | OBSOLETE |                                      |          |             |                                      |
| TL081ID          | <u>D</u>  | 8    | -40 TO 85 | ACTIVE   | 0.59                                 | 75       |             | <a href="#">Check stock or order</a> |

|           |           |    |               |        |      |      |  |                                      |
|-----------|-----------|----|---------------|--------|------|------|--|--------------------------------------|
| TL0811DR  | <u>D</u>  | 8  | -40 TO<br>85  | ACTIVE | 0.59 | 2500 |  | <a href="#">Check stock or order</a> |
| TL0811P   | <u>P</u>  | 8  | -40 TO<br>85  | ACTIVE | 0.59 | 50   |  | <a href="#">Check stock or order</a> |
| TL081MFKB | <u>FK</u> | 20 | -55 TO<br>125 | ACTIVE | 9.67 | 165  |  | <a href="#">Check stock or order</a> |
| TL081MJG  | <u>JG</u> | 8  | -55 TO<br>125 | ACTIVE | 2.86 | 1    |  | <a href="#">Check stock or order</a> |
| TL081MJGB | <u>JG</u> | 8  | -55 TO<br>125 | ACTIVE | 3.36 | 1    |  | <a href="#">Check stock or order</a> |

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| Tool Part Number              | Tool Title   | Tool Type                |
|-------------------------------|--|--------------------------|
| <a href="#">UNIV-OPAMP-1B</a> | Universal EVM for Single/Dual OpAmps without Shutdown in MSOP/SOIC/SOT-23 packages     | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-2B</a> | Universal EVM for Single/Dual OpAmps with Shutdown in MSOP/SOIC/SOT-23 packages        | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-3B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in MSOP/TSSOP packages | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-4B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in SOIC packages       | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-5B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in PDIP packages       | Evaluation Modules (EVM) |

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## TL082, Dual JFET-Input General-Purpose Operational Amplifier

DEVICE STATUS: **ACTIVE**

| PARAMETER NAME              | TL082 |
|-----------------------------|-------|
| Vs (max) (V)                | 36    |
| Vs (min) (V)                | 7     |
| IQ per channel (max) (mA)   | 2.8   |
| IQ per channel (typ) (mA)   | 1.4   |
| GBW (typ) (MHz)             | 3     |
| Slew Rate (typ) (V/us)      | 13    |
| VIO (Full Range) (max) (mV) | 20    |
| VIO (25 deg C) (max) (mV)   | 15    |
| IIB (max) (pA)              | 400   |
| CMRR (min) (dB)             | 70    |
| Vn at 1kHz (typ) (nV/rtHz)  | 18    |
| Number of Channels          | 2     |
| Spec'd at Vs (V)            | +/-15 |
| Open Loop Gain (min) (dB)   | 88    |
| Offset Drift (typ) (uV/C)   | 18    |

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- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion...0.003% Typ
- High Input Impedance...JFET-Input Stage
- Latch-Up-Free Operation
- High Slew Rate...13 V/us Typ
- Common-Mode Input Voltage Range Includes  $V_{CC+}$

### DESCRIPTION

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The TL08x JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates

well-matched, high-voltage JFET 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. Offset adjustment and external compensation options are available within the TL08x family.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from -40°C to 85°C. The Q-suffix devices are characterized for operation from -40°C to 125°C. The M-suffix devices are characterized for operation over the full military temperature range of -55°C to 125°C.

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- [Analog Applications Journal, September 1999 edition](#) (SLYT005 - Updated: 07/15/1999)
- [Analysis Of The Sallen-Key Architecture](#) (SLOA024A - Updated: 07/27/1999)
- [Stability Analysis Of Voltage-Feedback Op Amps, Including Compensation Technique](#) (SLOA020 - Updated: 07/14/1999)

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- [Universal Operational Amplifier EVM](#) (SLVU006A, 387 KB - Updated: 03/22/1999)
- [Universal Operational Amplifier Evaluation Module Selection Guide](#) (SLOU060A, 16 KB - Updated: 09/28/2000)
- [Universal Operational Amplifier Single, Dual, Quad \(MSOP/TSSOP\)](#) (SLOU055, 1196 KB - Updated: 10/22/1999)
- [Universal Operational Amplifier Single, Dual, Quad \(PDIP\)](#) (SLOU062, 1211 KB - Updated: 10/22/1999)

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| ORDERABLE DEVICE | PACKAGE   | PINS | TEMP (°C) | STATUS   | DSCC NUMBER | SAMPLES                         |
|------------------|-----------|------|-----------|----------|-------------|---------------------------------|
| TL082CD          | <u>D</u>  | 8    | 0 TO 70   | ACTIVE   |             | <a href="#">Request Samples</a> |
| TL082CP          | <u>P</u>  | 8    | 0 TO 70   | ACTIVE   |             | <a href="#">Request Samples</a> |
| TL082CPWLE       | <u>PW</u> | 8    | 0 TO 70   | OBSOLETE |             |                                 |
| TL082ID          | <u>D</u>  | 8    | -40 TO 85 | ACTIVE   |             | <a href="#">Request Samples</a> |
| TL082IP          | <u>P</u>  | 8    | -40 TO 85 | ACTIVE   |             | <a href="#">Request Samples</a> |

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| ORDERABLE DEVICE | PACKAGE   | PINS | TEMP (°C) | STATUS   | BUDGETARY PRICE US\$/UNIT QTY= 1000+ | PACK QTY | DSCC NUMBER | PRICING/AVAILABILITY                 |
|------------------|-----------|------|-----------|----------|--------------------------------------|----------|-------------|--------------------------------------|
| TL082CD          | <u>D</u>  | 8    | 0 TO 70   | ACTIVE   | 0.38                                 | 75       |             | <a href="#">Check stock or order</a> |
| TL082CDR         | <u>D</u>  | 8    | 0 TO 70   | ACTIVE   | 0.42                                 | 2500     |             | <a href="#">Check stock or order</a> |
| TL082CJG         | <u>JG</u> | 8    | 0 TO 70   | OBSOLETE |                                      |          |             |                                      |

|            |           |    |               |          |       |      |                 |                                      |
|------------|-----------|----|---------------|----------|-------|------|-----------------|--------------------------------------|
| TL082CP    | <u>P</u>  | 8  | 0 TO<br>70    | ACTIVE   | 0.38  | 50   |                 | <a href="#">Check stock or order</a> |
| TL082CPS   | <u>PS</u> | 8  | 0 TO<br>70    | OBSOLETE |       |      |                 |                                      |
| TL082CPSR  | <u>PS</u> | 8  | 0 TO<br>70    | ACTIVE   | 0.47  | 2000 |                 | <a href="#">Check stock or order</a> |
| TL082CPWLE | <u>PW</u> | 8  | 0 TO<br>70    | OBSOLETE |       |      |                 |                                      |
| TL082CPWR  | <u>PW</u> | 8  | 0 TO<br>70    | ACTIVE   | 0.38  | 2000 |                 | <a href="#">Check stock or order</a> |
| TL082ID    | <u>D</u>  | 8  | -40 TO<br>85  | ACTIVE   | 0.59  | 75   |                 | <a href="#">Check stock or order</a> |
| TL082IDR   | <u>D</u>  | 8  | -40 TO<br>85  | ACTIVE   | 0.62  | 2500 |                 | <a href="#">Check stock or order</a> |
| TL082IJG   | <u>JG</u> | 8  | -40 TO<br>85  | OBSOLETE |       |      |                 |                                      |
| TL082IP    | <u>P</u>  | 8  | -40 TO<br>85  | ACTIVE   | 0.59  | 50   |                 | <a href="#">Check stock or order</a> |
| TL082MFK   | <u>FK</u> | 20 | -55 TO<br>125 | OBSOLETE |       |      |                 |                                      |
| TL082MFKB  | <u>FK</u> | 20 | -55 TO<br>125 | ACTIVE   | 10.65 | 165  | 5962-9851501Q2A | <a href="#">Check stock or order</a> |
| TL082MJG   | <u>JG</u> | 8  | -55 TO<br>125 | ACTIVE   | 2.86  | 1    |                 | <a href="#">Check stock or order</a> |
| TL082MJGB  | <u>JG</u> | 8  | -55 TO<br>125 | ACTIVE   | 3.72  | 1    | 5962-9851501QPA | <a href="#">Check stock or order</a> |

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| Tool Part Number              | Tool Title   | Tool Type                |
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| <a href="#">UNIV-OPAMP-2B</a> | Universal EVM for Single/Dual OpAmps with Shutdown in MSOP/SOIC/SOT-23 packages        | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-3B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in MSOP/TSSOP packages | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-4B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in SOIC packages       | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-5B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in PDIP packages       | Evaluation Modules (EVM) |

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## TL084, Quad JFET-Input General-Purpose Operational Amplifier

DEVICE STATUS: **ACTIVE**

| PARAMETER NAME              | TL084 |
|-----------------------------|-------|
| Vs (max) (V)                | 36    |
| Vs (min) (V)                | 7     |
| IQ per channel (max) (mA)   | 2.8   |
| IQ per channel (typ) (mA)   | 1.4   |
| GBW (typ) (MHz)             | 3     |
| Slew Rate (typ) (V/us)      | 13    |
| VIO (Full Range) (max) (mV) | 20    |
| VIO (25 deg C) (max) (mV)   | 15    |
| IIB (max) (pA)              | 400   |
| CMRR (min) (dB)             | 70    |
| Vn at 1kHz (typ) (nV/rtHz)  | 18    |
| Number of Channels          | 4     |
| Spec'd at Vs (V)            | +/-15 |
| Open Loop Gain (min) (dB)   | 88    |
| Offset Drift (typ) (uV/C)   | 18    |

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- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion...0.003% Typ
- High Input Impedance...JFET-Input Stage
- Latch-Up-Free Operation
- High Slew Rate...13 V/us Typ
- Common-Mode Input Voltage Range Includes  $V_{CC+}$

### DESCRIPTION

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The TL08x JFET-input operational amplifier family is designed to offer a wider selection than any previously developed operational amplifier family. Each of these JFET-input operational amplifiers incorporates

well-matched, high-voltage JFET 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. Offset adjustment and external compensation options are available within the TL08x family.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from -40°C to 85°C. The Q-suffix devices are characterized for operation from -40°C to 125°C. The M-suffix devices are characterized for operation over the full military temperature range of -55°C to 125°C.

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- [Universal Operational Amplifier Evaluation Module Selection Guide](#) (SLOU060A, 16 KB - Updated: 09/28/2000)
- [Universal Operational Amplifier Single, Dual, Quad \(MSOP/TSSOP\)](#) (SLOU055, 1196 KB - Updated: 10/22/1999)
- [Universal Operational Amplifier Single, Dual, Quad \(PDIP\)](#) (SLOU062, 1211 KB - Updated: 10/22/1999)

#### SAMPLES

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| ORDERABLE DEVICE | PACKAGE  | PINS | TEMP (°C) | STATUS | DSCC NUMBER | SAMPLES                         |
|------------------|----------|------|-----------|--------|-------------|---------------------------------|
| TL084CD          | <u>D</u> | 14   | 0 TO 70   | ACTIVE |             | <a href="#">Request Samples</a> |
| TL084CN          | <u>N</u> | 14   | 0 TO 70   | ACTIVE |             | <a href="#">Request Samples</a> |
| TL084ID          | <u>D</u> | 14   | -40 TO 85 | ACTIVE |             | <a href="#">Request Samples</a> |
| TL084IN          | <u>N</u> | 14   | -40 TO 85 | ACTIVE |             | <a href="#">Request Samples</a> |

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| ORDERABLE DEVICE | PACKAGE  | PINS | TEMP (°C) | STATUS   | BUDGETARY PRICE<br>US\$/UNIT<br>QTY= 1000+ | PACK QTY | DSCC NUMBER | PRICING/AVAILABILITY                 |
|------------------|----------|------|-----------|----------|--|----------|-------------|--------------------------------------|
| TL084CD          | <u>D</u> | 14   | 0 TO 70   | ACTIVE   | 0.50                                       | 50       |             | <a href="#">Check stock or order</a> |
| TL084CDR         | <u>D</u> | 14   | 0 TO 70   | ACTIVE   | 0.53                                       | 2500     |             | <a href="#">Check stock or order</a> |
| TL084CJ          | <u>J</u> | 14   | 0 TO 70   | OBSOLETE |  |          |             |                                      |
| TL084CN          | <u>N</u> | 14   | 0 TO 70   | ACTIVE   | 0.50                                       | 25       |             | <a href="#">Check stock or order</a> |

|            |           |    |               |          |       |      |  |                             |
|------------|-----------|----|---------------|----------|-------|------|--|-----------------------------|
| TL084CNSLE | <u>NS</u> | 14 | 0 TO<br>70    | OBSOLETE |       |      |  |                             |
| TL084CNSR  | <u>NS</u> | 14 | 0 TO<br>70    | ACTIVE   | 0.59  | 2000 |  | <u>Check stock or order</u> |
| TL084CPWLE | <u>PW</u> | 14 | 0 TO<br>70    | OBSOLETE |       |      |  |                             |
| TL084CPWR  | <u>PW</u> | 14 | 0 TO<br>70    | ACTIVE   | 0.50  | 2000 |  | <u>Check stock or order</u> |
| TL084ID    | <u>D</u>  | 14 | -40 TO<br>85  | ACTIVE   | 0.67  | 50   |  | <u>Check stock or order</u> |
| TL084IDR   | <u>D</u>  | 14 | -40 TO<br>85  | ACTIVE   | 0.70  | 2500 |  | <u>Check stock or order</u> |
| TL084IJ    | <u>J</u>  | 14 | -40 TO<br>85  | OBSOLETE |       |      |  |                             |
| TL084IN    | <u>N</u>  | 14 | -40 TO<br>85  | ACTIVE   | 0.67  | 25   |  | <u>Check stock or order</u> |
| TL084MFKB  | <u>FK</u> | 20 | -55 TO<br>125 | ACTIVE   | 12.36 | 1    |  | <u>Check stock or order</u> |
| TL084MJ    | <u>J</u>  | 14 | -55 TO<br>125 | ACTIVE   | 4.00  | 1    |  | <u>Check stock or order</u> |
| TL084MJB   | <u>J</u>  | 14 | -55 TO<br>125 | ACTIVE   | 4.49  | 1    |  | <u>Check stock or order</u> |
| TL084QD    | <u>D</u>  | 14 | -40 TO<br>125 | ACTIVE   | 0.70  | 50   |  | <u>Check stock or order</u> |
| TL084QDR   | <u>D</u>  | 14 | -40 TO<br>125 | ACTIVE   | 0.74  | 2500 |  | <u>Check stock or order</u> |

## DEVELOPMENT TOOLS

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| Tool Part Number              | Tool Title   | Tool Type                |
|-------------------------------|--|--------------------------|
| <a href="#">UNIV-OPAMP-1B</a> | Universal EVM for Single/Dual OpAmps without Shutdown in MSOP/SOIC/SOT-23 packages     | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-2B</a> | Universal EVM for Single/Dual OpAmps with Shutdown in MSOP/SOIC/SOT-23 packages        | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-3B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in MSOP/TSSOP packages | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-4B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in SOIC packages       | Evaluation Modules (EVM) |
| <a href="#">UNIV-OPAMP-5B</a> | Universal EVM for Single/Dual/Quad OpAmps with/without Shutdown in PDIP packages       | Evaluation Modules (EVM) |

Table Data Updated on: 11/26/2000

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