

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

SLOS081G – FEBRUARY 1977 – REVISED SEPTEMBER 2004

- 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/ordering information

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.

## ORDERING INFORMATION

| $T_J$       | $V_{IOmax}$<br>AT 25°C | PACKAGE†   | ORDERABLE<br>PART NUMBER | TOP-SIDE<br>MARKING |         |
|-------------|------------------------|------------|--------------------------|---------------------|---------|
| 0°C to 70°C | 15 mV                  | PDIP (P)   | Tube of 50               | TL081CP             | TL081CP |
|             |                        |            | Tube of 50               | TL082CP             | TL082CP |
|             |                        | PDIP (N)   | Tube of 25               | TL084CN             | TL084CN |
|             |                        | SOIC (D)   | Tube of 75               | TL081CD             | TL081C  |
|             |                        |            | Reel of 2500             | TL081CDR            |         |
|             |                        |            | Tube of 75               | TL082CD             | TL082C  |
|             |                        |            | Reel of 2500             | TL082CDR            |         |
|             |                        |            | Tube of 50               | TL084CD             | TL084C  |
|             |                        |            | Reel of 2500             | TL084CDR            |         |
|             |                        | SOP (PS)   | Reel of 2000             | TL081CPSR           | T081    |
|             |                        |            | Reel of 2000             | TL082CPSR           | T082    |
|             |                        | SOP (NS)   | Reel of 2000             | TL084CNSR           | TL084   |
|             |                        | TSSOP (PW) | Tube of 150              | TL082CPW            | T082    |
|             |                        |            | Reel of 2000             | TL082CPWR           |         |
|             |                        |            | Tube of 90               | TL084CPW            | T084    |
|             |                        |            | Reel of 2000             | TL084CPWR           |         |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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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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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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

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**description/ordering information (continued)**

**ORDERING INFORMATION**

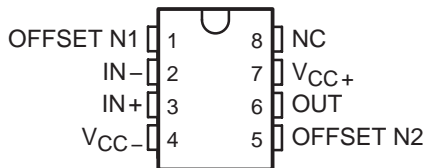
| T <sub>J</sub> | V <sub>IO</sub> max<br>AT 25°C | PACKAGE†     | ORDERABLE<br>PART NUMBER | TOP-SIDE<br>MARKING |          |
|----------------|--------------------------------|--------------|--------------------------|---------------------|----------|
| 0°C to 70°C    | 6 mV                           | PDIP (P)     | Tube of 50               | TL081ACP            | TL081ACP |
|                |                                |              | Tube of 50               | TL082ACP            | TL082ACP |
|                |                                | PDIP (N)     | Tube of 25               | TL084ACN            | TL084ACN |
|                |                                | SOIC (D)     | Tube of 75               | TL081ACD            | 081AC    |
|                |                                |              | Reel of 2500             | TL081ACDR           |          |
|                |                                |              | Tube of 75               | TL082ACD            | 082AC    |
|                |                                |              | Reel of 2500             | TL082ACDR           |          |
|                |                                | SOIC (D)     | Tube of 50               | TL084ACD            | TL084AC  |
|                | Reel of 2500                   |              | TL084ACDR                |                     |          |
|                | SOP (PS)                       | Reel of 2000 | TL082ACPSR               | T082A               |          |
|                | SOP (NS)                       | Reel of 2000 | TL084ACNSR               | TL084A              |          |
|                | 3 mV                           | PDIP (P)     | Tube of 50               | TL081BCP            | TL081BCP |
|                |                                |              | Tube of 50               | TL082BCP            | TL082BCP |
|                |                                | PDIP (N)     | Tube of 25               | TL084BCN            | TL084BCN |
| SOIC (D)       |                                | Tube of 75   | TL081BCD                 | 081BC               |          |
|                |                                | Reel of 2500 | TL081BCDR                |                     |          |
|                |                                | Tube of 75   | TL082BCD                 | 082BC               |          |
|                |                                | Reel of 2500 | TL082BCDR                |                     |          |
| SOIC (D)       |                                | Tube of 50   | TL084BCD                 | TL084BC             |          |
|                | Reel of 2500                   | TL084BCDR    |                          |                     |          |
| -40°C to 85°C  | 6 mV                           | PDIP (P)     | Tube of 50               | TL081IP             | TL081IP  |
|                |                                |              | Tube of 50               | TL082IP             | TL082IP  |
|                |                                | PDIP (N)     | Tube of 25               | TL084IN             | TL081IN  |
|                |                                | SOIC (D)     | Tube of 75               | TL081ID             | TL081I   |
|                |                                |              | Reel of 2500             | TL081IDR            |          |
|                |                                |              | Tube of 75               | TL082ID             | TL082I   |
|                |                                |              | Reel of 2500             | TL082IDR            |          |
|                |                                | SOIC (D)     | Tube of 50               | TL084ID             | TL084I   |
|                | Reel of 2500                   |              | TL084IDR                 |                     |          |
|                | TSSOP (PW)                     | Reel of 2000 | TL082IPWR                | Z082                |          |
| -40°C to 125°C | 9 mV                           | SOIC (D)     | Tube of 50               | TL084QD             | TL084QD  |
|                |                                |              | Reel of 2500             | TL084QDR            |          |
| -55°C to 125°C | 9 mV                           | CDIP (J)     | Tube of 25               | TL084MJ             | TL084MJ  |
|                |                                | LCCC (FK)    | Reel of 55               | TL084FK             | TL084FK  |
|                | 6 mV                           | CDIP (JG)    | Tube of 50               | TL082MJG            | TL082MJG |
|                |                                | LCCC (FK)    | Tube of 55               | TL082MFK            | TL082MFK |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

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

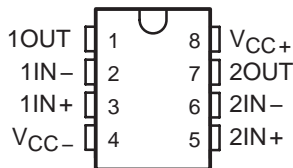
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**TL081, TL081A, TL081B**  
D, P, OR PS PACKAGE  
(TOP VIEW)

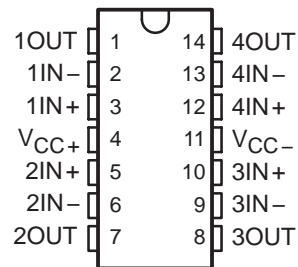


NC – No internal connection

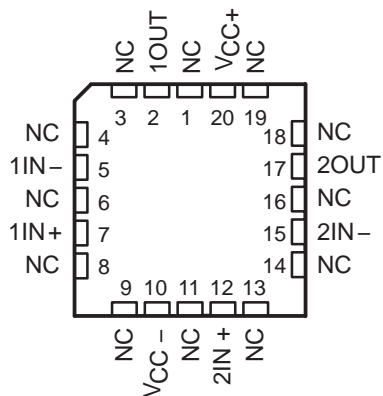
**TL082, TL082A, TL082B**  
D, JG, P, PS, OR PW PACKAGE  
(TOP VIEW)



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

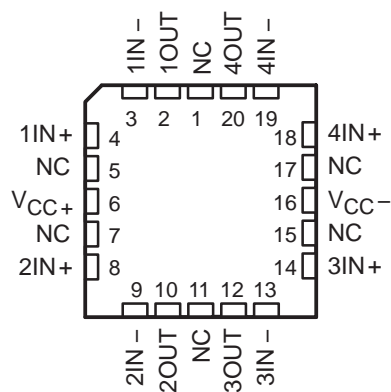


**TL082M . . . FK PACKAGE**  
(TOP VIEW)



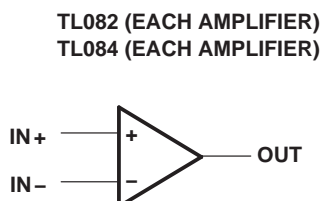
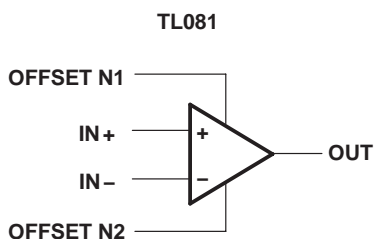
NC – No internal connection

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



NC – No internal connection

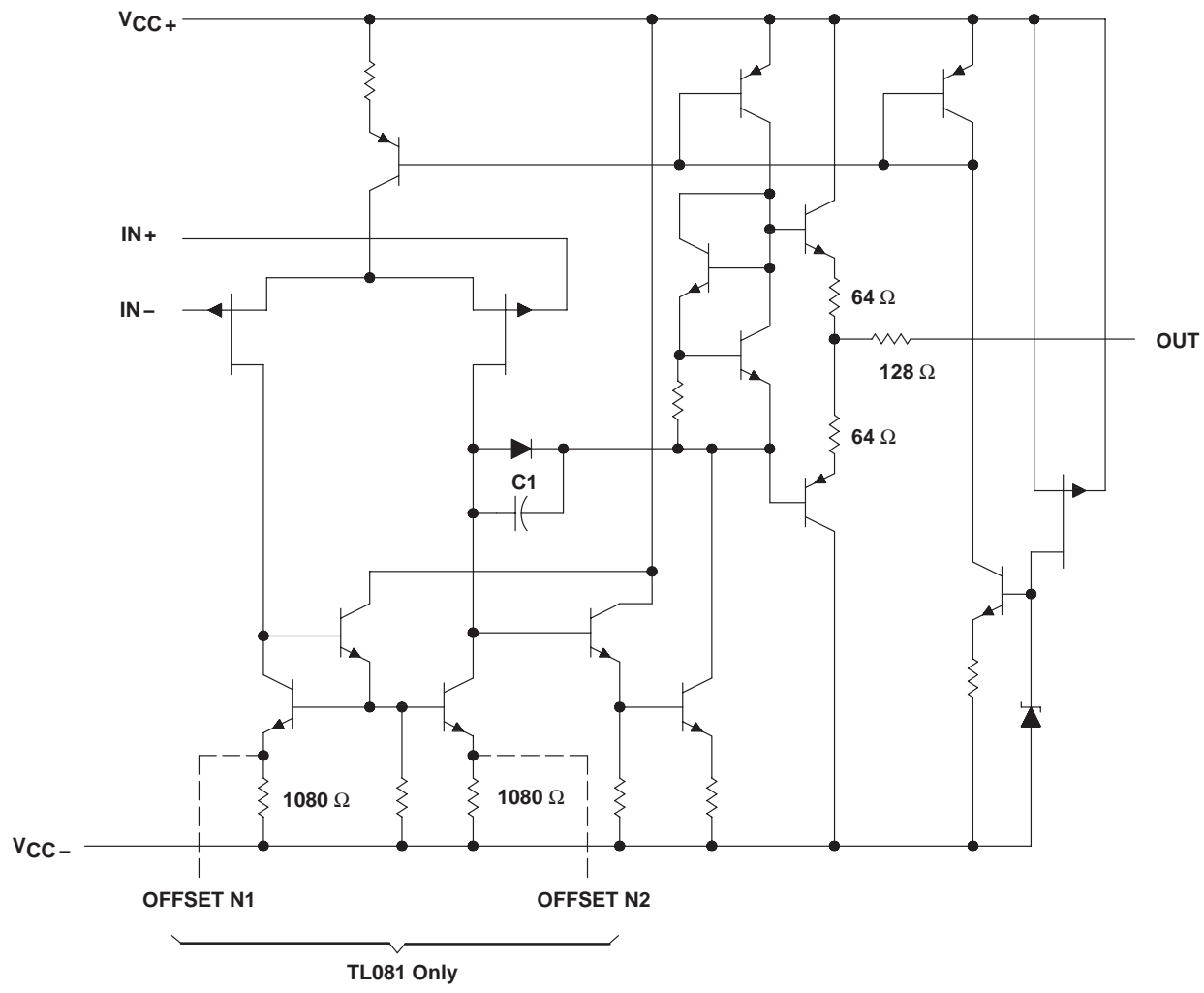
## symbols



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

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**schematic (each amplifier)**



Component values shown are nominal.

# TL081, TL081A, TL081B, TL082, TL082A, TL082B TL084, TL084A, TL084B 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 | $^{\circ}\text{C}$          |
| Package thermal impedance, $\theta_{JA}$<br>(see Notes 5 and 6) | D package (8-pin)            | 97         | 97         |            | $^{\circ}\text{C}/\text{W}$ |
|   | D package (14-pin)           | 86         | 86         |            |                             |
|   | N package (14-pin)           | 76         | 76         |            |                             |
|   | NS package (14-pin)          | 80         |            |            |                             |
|   | P package (8-pin)            | 85         | 85         |            |                             |
|   | PS package (8-pin)           | 95         | 95         |            |                             |
|   | PW package (8-pin)           | 149        |            |            |                             |
|   | PW package (14-pin)          | 113        | 113        |            |                             |
| Operating virtual junction temperature                          | 150                          | 150        | 150        | 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        | $^{\circ}\text{C}$          |
| Storage temperature range, $T_{stg}$                            | -65 to 150                   | -65 to 150 | -65 to 150 | -65 to 150 | $^{\circ}\text{C}$          |

† 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:
- All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
  - Differential voltages are at  $IN+$  with respect to  $IN-$ .
  - The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
  - 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.
  - Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150 $^{\circ}\text{C}$  can affect reliability.
  - The package thermal impedance is calculated in accordance with JESD 51-7.

**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 (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                                      |



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

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

| PARAMETER                        | TEST CONDITIONS  | TA†        | 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 <sub>IO</sub>                  | Input offset voltage<br>V <sub>O</sub> = 0<br>R <sub>S</sub> = 50 Ω                              | 25°C       | 3                          | 15        | 6                | 3                             | 6                | 2         | 3                             | 3         | 6                | 3                          | 6   | mV               |           |
|                                  |  | Full range |                            | 20        | 7.5              |                               | 5                |           |                               | 5         |                  |                            | 9   |                  |           |
| α <sub>VIO</sub>                 | Temperature coefficient of input offset voltage<br>V <sub>O</sub> = 0<br>R <sub>S</sub> = 50 Ω   | Full range | 18                         |           |                  | 18                            |                  |           | 18                            |           |                  | 18                         |     | μV/°C            |           |
|                                  |  | 25°C       | 5                          | 200       | 100              | 5                             | 100              | 5         | 100                           | 5         | 100              | 5                          | 100 |                  |           |
| I <sub>IO</sub>                  | Input offset current ‡<br>V <sub>O</sub> = 0   | Full range |                            | 2         | 2                |                               | 2                |           | 2                             |           | 2                |                            | 10  | pA               |           |
|                                  |  | 25°C       | 30                         | 400       | 200              | 30                            | 200              | 30        | 200                           | 30        | 200              | 30                         | 200 |                  |           |
| I <sub>IB</sub>                  | Input bias current ‡<br>V <sub>O</sub> = 0   | Full range |                            | 10        | 7                |                               | 7                |           | 7                             |           | 7                |                            | 20  | nA               |           |
|                                  |  | 25°C       | ±11                        | -12 to 15 | ±11              | -12 to 15                     | ±11              | -12 to 15 | ±11                           | -12 to 15 | ±11              | -12 to 15                  | ±11 |                  | -12 to 15 |
| V <sub>ICR</sub>                 | Common-mode input voltage range  | 25°C       | ±12                        | ±13.5     | ±12              | ±13.5                         | ±12              | ±13.5     | ±12                           | ±13.5     | ±12              | ±13.5                      | ±12 | V                |           |
|                                  |  | Full range | ±12                        |           | ±12              |                               | ±10              | ±12       | ±10                           | ±12       | ±10              | ±12                        | ±10 |                  | ±12       |
| V <sub>OM</sub>                  | Maximum peak output voltage swing  | 25°C       | ±10                        | ±12       | ±10              | ±12                           | ±10              | ±12       | ±10                           | ±12       | ±10              | ±12                        | ±10 | V                |           |
|                                  |  | Full range | ±10                        |           | ±10              |                               | ±10              | ±12       | ±10                           | ±12       | ±10              | ±12                        | ±10 |                  | ±12       |
| A <sub>V/D</sub>                 | Large-signal differential voltage amplification<br>V <sub>O</sub> = ±10 V, R <sub>L</sub> ≥ 2 kΩ | 25°C       | 25                         | 200       | 50               | 200                           | 50               | 200       | 50                            | 200       | 50               | 200                        | 50  | V/mV             |           |
|                                  |  | Full range | 15                         |           | 25               |                               | 25               |           | 25                            |           | 25               |                            | 25  |                  |           |
| B <sub>1</sub>                   | Unity-gain bandwidth   | 25°C       | 3                          |           | 3                |                               | 3                |           | 3                             |           | 3                |                            | MHz |                  |           |
|                                  |  | 25°C       | 10 <sup>12</sup>           |           | 10 <sup>12</sup> |                               | 10 <sup>12</sup> |           | 10 <sup>12</sup>              |           | 10 <sup>12</sup> |                            |     | 10 <sup>12</sup> |           |
| r <sub>i</sub>                   | Input resistance   | 25°C       | 70                         | 86        | 75               | 86                            | 75               | 86        | 75                            | 86        | 75               | 86                         | Ω   |                  |           |
|                                  |  | 25°C       | 70                         | 86        | 75               | 86                            | 75               | 86        | 75                            | 86        | 75               | 86                         |     |                  |           |
| CMRR                             | Common-mode rejection ratio  | 25°C       | 70                         | 86        | 75               | 86                            | 75               | 86        | 75                            | 86        | 75               | 86                         | dB  |                  |           |
|                                  |  | 25°C       | 70                         | 86        | 75               | 86                            | 75               | 86        | 75                            | 86        | 75               | 86                         |     |                  |           |
| kSVR                             | Supply-voltage rejection ratio (ΔV <sub>CC±</sub> /ΔV <sub>IO</sub> )                            | 25°C       | 70                         | 86        | 75               | 86                            | 75               | 86        | 75                            | 86        | 75               | 86                         | dB  |                  |           |
|                                  |  | 25°C       | 70                         | 86        | 75               | 86                            | 75               | 86        | 75                            | 86        | 75               | 86                         |     |                  |           |
| I <sub>CC</sub>                  | Supply current (per amplifier)   | 25°C       | 1.4                        | 2.8       | 1.4              | 2.8                           | 1.4              | 2.8       | 1.4                           | 2.8       | 1.4              | 2.8                        | mA  |                  |           |
|                                  |  | 25°C       | 1.4                        | 2.8       | 1.4              | 2.8                           | 1.4              | 2.8       | 1.4                           | 2.8       | 1.4              | 2.8                        |     |                  |           |
| V <sub>O1</sub> /V <sub>O2</sub> | Crosstalk attenuation  | 25°C       | 120                        |           | 120              |                               | 120              |           | 120                           |           | 120              |                            | dB  |                  |           |
|                                  |  | 25°C       | 120                        |           | 120              |                               | 120              |           | 120                           |           | 120              |                            |     |                  |           |

† All characteristics are measured under open-loop conditions with zero common-mode voltage, unless otherwise specified. Full range for T<sub>A</sub> 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 an 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.



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

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

| PARAMETER   | TEST CONDITIONS†   | $T_A$      | 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             |            |      | $\mu\text{V}/^\circ\text{C}$ |
| $I_{IO}$ Input offset current‡  | $V_O = 0$  | 25°C       | 5              | 100        |          | 5              | 100        | pA   |                              |
|   |  | 125°C      | 20             |            |          | 20             |            |      | nA                           |
| $I_{IB}$ Input bias current‡  | $V_O = 0$  | 25°C       | 30             | 200        |          | 30             | 200        | pA   |                              |
|   |  | 125°C      | 50             |            |          | 50             |            |      | nA                           |
| $V_{ICR}$ Common-mode input voltage range                                     |  | 25°C       | $\pm 11$       | -12 to 15  |          | $\pm 11$       | -12 to 15  | V    |                              |
| $V_{OM}$ Maximum peak output voltage swing                                    | $R_L = 10\ \text{k}\Omega$   | 25°C       | $\pm 12$       | $\pm 13.5$ |          | $\pm 12$       | $\pm 13.5$ | 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 ( $\Delta V_{CC\pm}/\Delta V_{IO}$ ) | $V_{CC} = \pm 15\ \text{V to } \pm 9\ \text{V}, V_O = 0, R_S = 50\ \Omega$ | 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                           |

† All characteristics are measured under open-loop conditions, with zero common-mode input 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 temperatures as close to the ambient temperature as possible.

**operating characteristics,  $V_{CC\pm} = \pm 15\ \text{V}, T_A = 25^\circ\text{C}$  (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/ $\mu\text{s}$             |   |
|                                      | $V_I = 10\ \text{V}, R_L = 2\ \text{k}\Omega, C_L = 100\ \text{pF}, T_A = -55^\circ\text{C to } 125^\circ\text{C}, \text{ See Figure 1}$ | 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  |       |     | $\mu\text{s}$                |   |
| Overshoot factor                     |  | 20  |       |     | %                            |   |
| $V_n$ Equivalent input noise voltage | $R_S = 20\ \Omega$   | f = 1 kHz   |       |     | $\text{nV}/\sqrt{\text{Hz}}$ |   |
|                                      |  | f = 10 Hz to 10 kHz   |       |     | $\mu\text{V}$                |   |
| $I_n$ Equivalent input noise current | $R_S = 20\ \Omega, f = 1\ \text{kHz}$  | 0.01  |       |     | $\text{pA}/\sqrt{\text{Hz}}$ |   |
| THD Total harmonic distortion        | $V_{rms} = 6\ \text{V}, f = 1\ \text{kHz}$   | $A_{VD} = 1, R_S \leq 1\ \text{k}\Omega, R_L \geq 2\ \text{k}\Omega,$ | 0.003 |     |                              | % |

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



**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL084, TL084A, TL084B  
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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    |     | $\text{V}/\mu\text{s}$       |
| $t_r$ 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 | $R_S = 20\ \Omega$   | $f = 1\text{ kHz}$                   | 18    |     | $\text{nV}/\sqrt{\text{Hz}}$ |
|                                      |  | $f = 10\text{ Hz to } 10\text{ kHz}$ | 4     |     | $\mu\text{V}$                |
| $I_n$ Equivalent input noise current | $R_S = 20\ \Omega$ , $f = 1\text{ kHz}$  |                                      | 0.01  |     | $\text{pA}/\sqrt{\text{Hz}}$ |
| THD Total harmonic distortion        | $V_{I\text{rms}} = 6\text{ V}$ , $f = 1\text{ kHz}$ , $A_{VD} = 1$ , $R_S \leq 1\text{ k}\Omega$ , $R_L \geq 2\text{ k}\Omega$ , |                                      | 0.003 |     | %                            |

**PARAMETER MEASUREMENT INFORMATION**

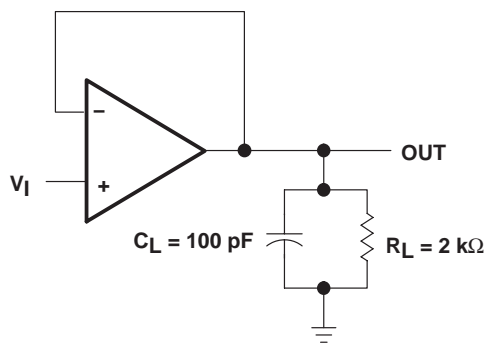


Figure 1

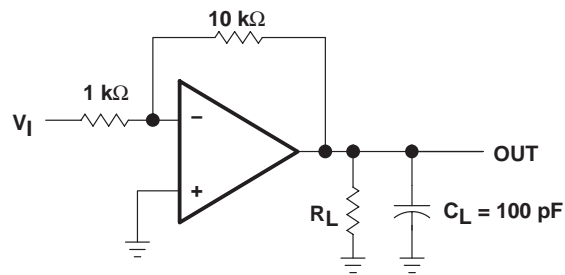


Figure 2

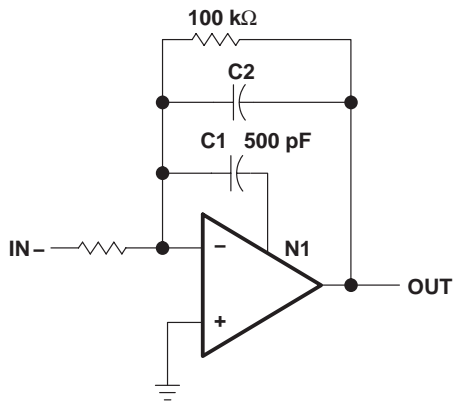


Figure 3

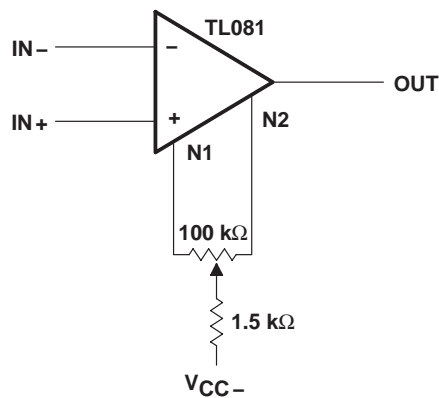


Figure 4

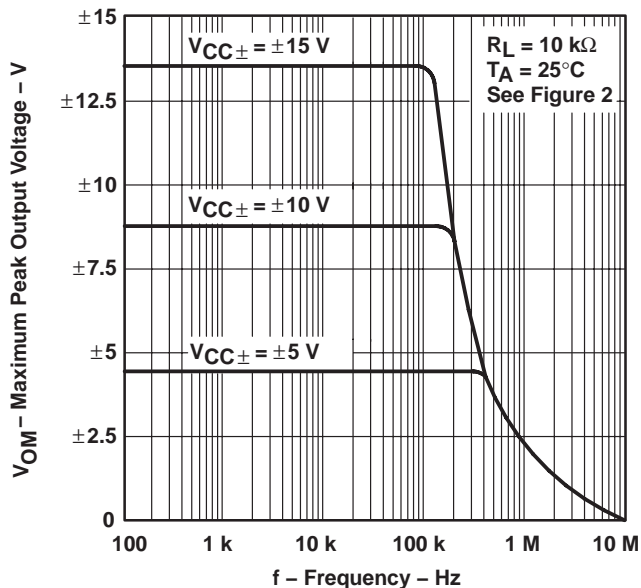


**TYPICAL CHARACTERISTICS**

**Table of Graphs**

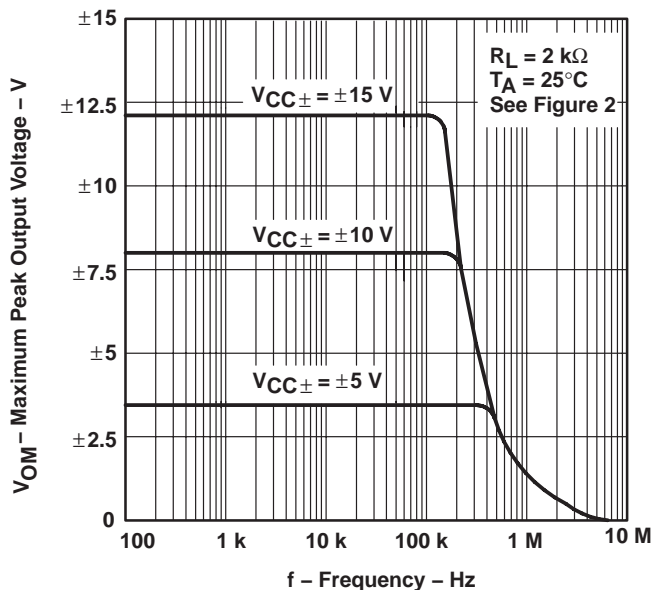
|                 |   | FIGURE                                      |
|-----------------|---|---|
| V <sub>OM</sub> | Maximum peak output voltage                     | vs Frequency                                |
|                 |   | vs Free-air temperature                     |
|                 |   | vs Load resistance                          |
|                 |   | vs Supply voltage                           |
| AVD             | Large-signal differential voltage amplification | vs Free-air temperature                     |
|                 |   | vs Frequency                                |
|                 | Differential voltage amplification              | vs Frequency with feed-forward compensation |
| PD              | Total power dissipation                         | vs Free-air temperature                     |
| I <sub>CC</sub> | Supply current                                  | vs Free-air temperature                     |
|                 |   | vs Supply voltage                           |
| I <sub>IB</sub> | Input bias current                              | vs Free-air temperature                     |
|                 | Large-signal pulse response                     | vs Time                                     |
| V <sub>O</sub>  | Output voltage                                  | vs Elapsed time                             |
| CMRR            | Common-mode rejection ratio                     | vs Free-air temperature                     |
| V <sub>n</sub>  | Equivalent input noise voltage                  | vs Frequency                                |
| THD             | Total harmonic distortion                       | vs Frequency                                |

**MAXIMUM PEAK OUTPUT VOLTAGE  
 vs  
 FREQUENCY**



**Figure 5**

**MAXIMUM PEAK OUTPUT VOLTAGE  
 vs  
 FREQUENCY**

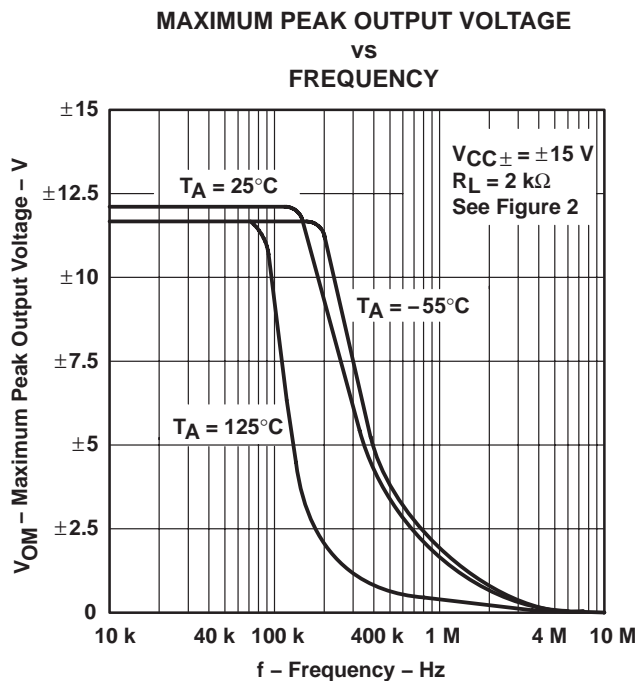


**Figure 6**

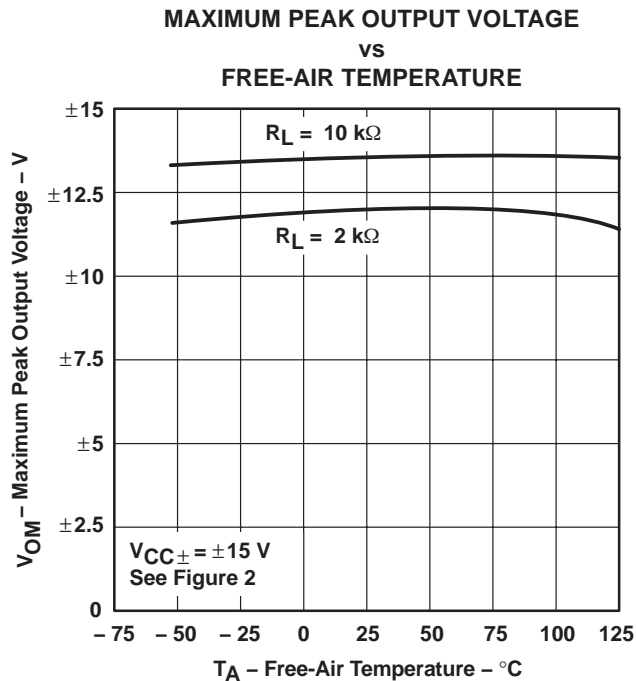
**TL081, TL081A, TL081B, TL082, TL082A, TL082B  
TL084, TL084A, TL084B  
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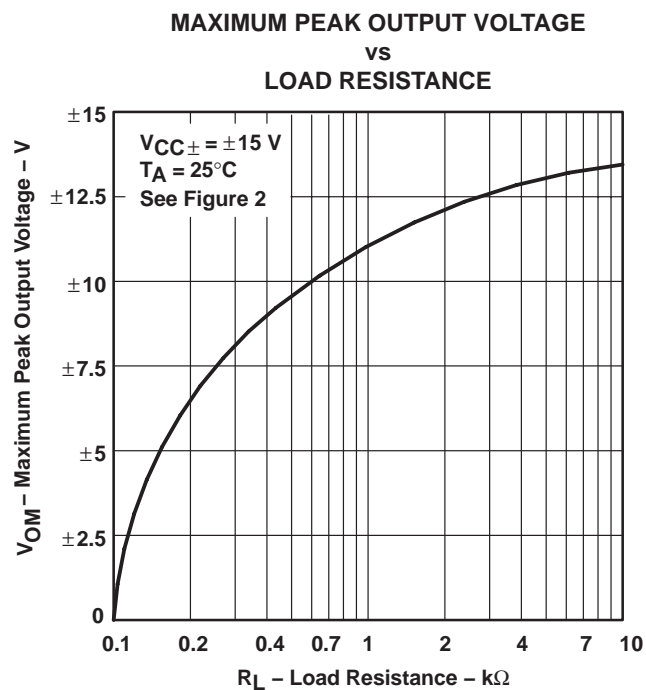
**TYPICAL CHARACTERISTICS†**



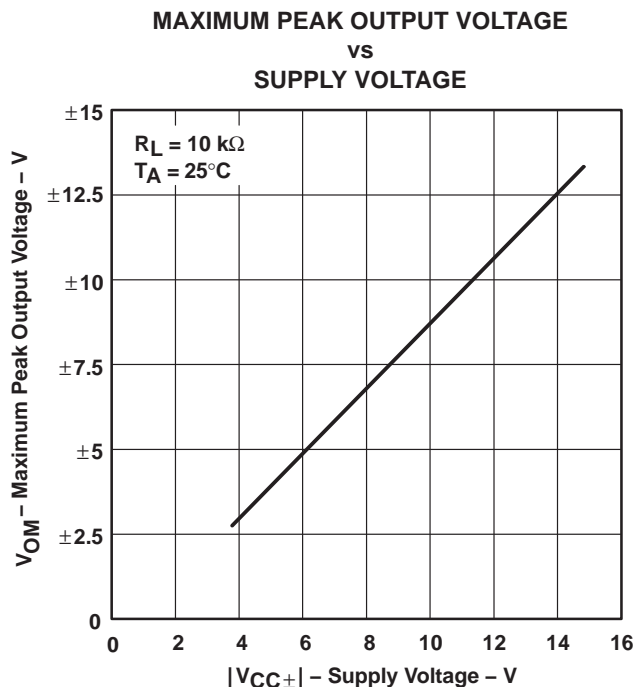
**Figure 7**



**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.



**TYPICAL CHARACTERISTICS†**

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



Figure 11

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

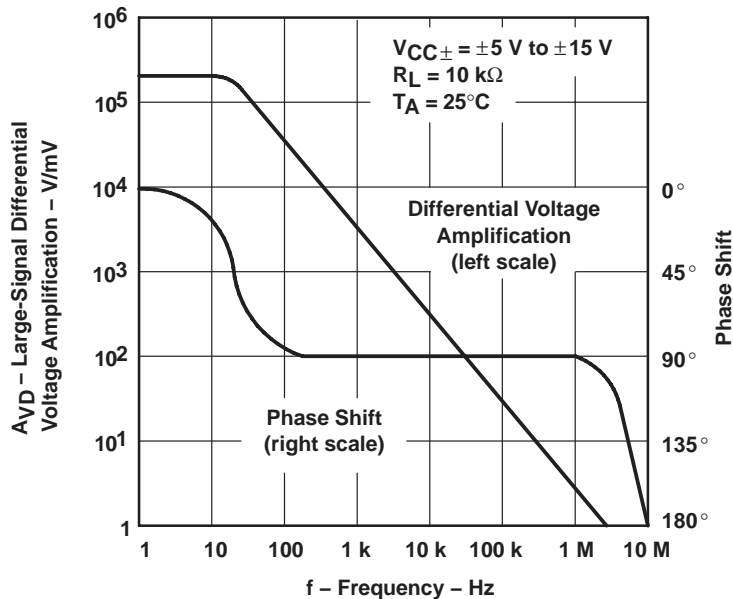


Figure 12

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

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

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**TYPICAL CHARACTERISTICS†**

**DIFFERENTIAL VOLTAGE AMPLIFICATION  
vs  
FREQUENCY WITH FEED-FORWARD COMPENSATION**



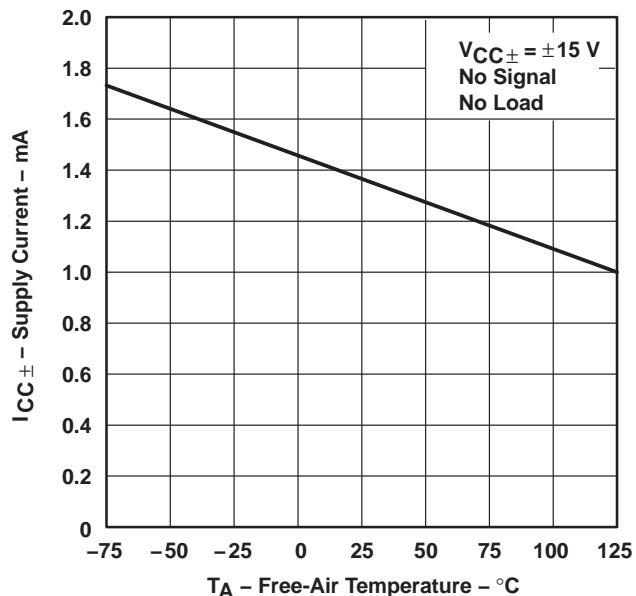
**Figure 13**

**TOTAL POWER DISSIPATION  
vs  
FREE-AIR TEMPERATURE**



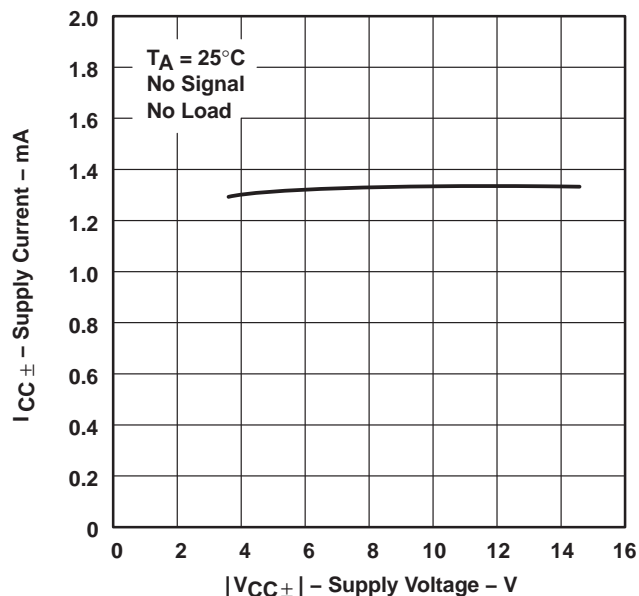
**Figure 14**

**SUPPLY CURRENT PER AMPLIFIER  
vs  
FREE-AIR TEMPERATURE**



**Figure 15**

**SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE**

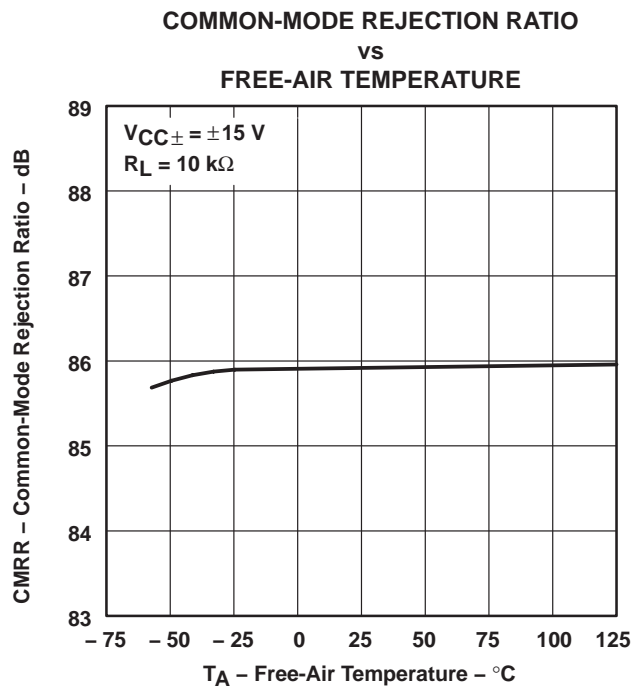
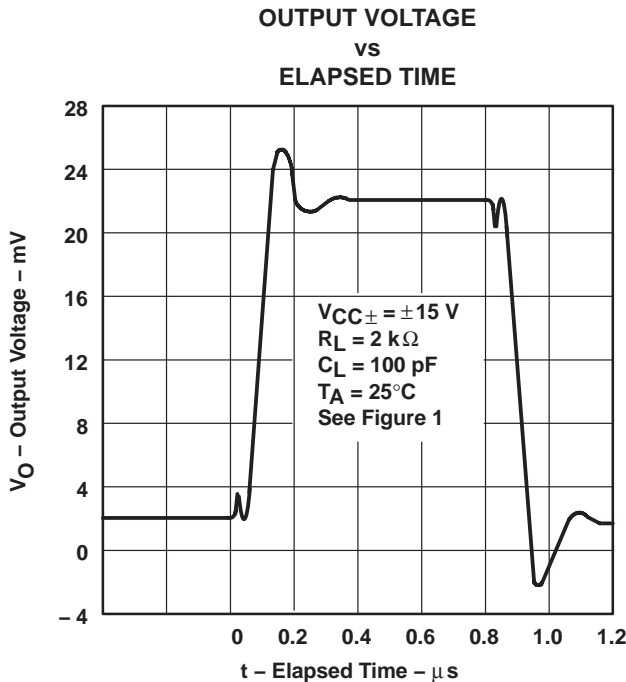
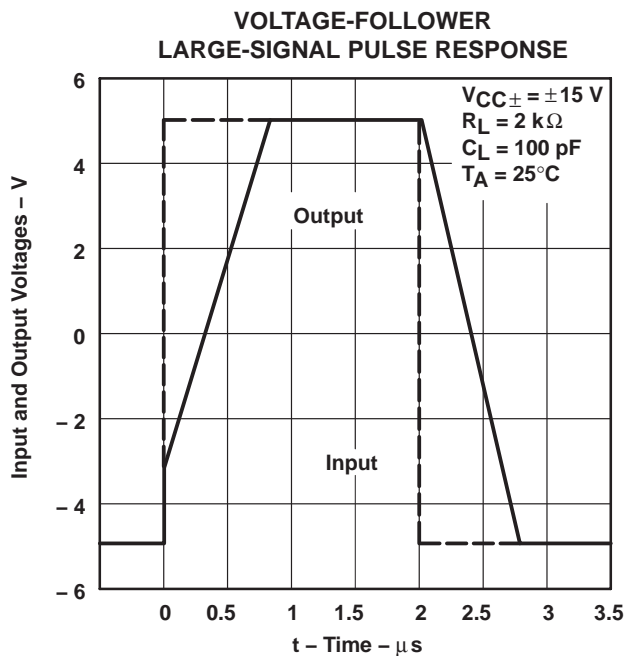


**Figure 16**

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



**TYPICAL CHARACTERISTICS†**



† 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  
TL084, TL084A, TL084B  
JFET-INPUT OPERATIONAL AMPLIFIERS**

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**TYPICAL CHARACTERISTICS†**

**EQUIVALENT INPUT NOISE VOLTAGE  
VS  
FREQUENCY**



**Figure 21**

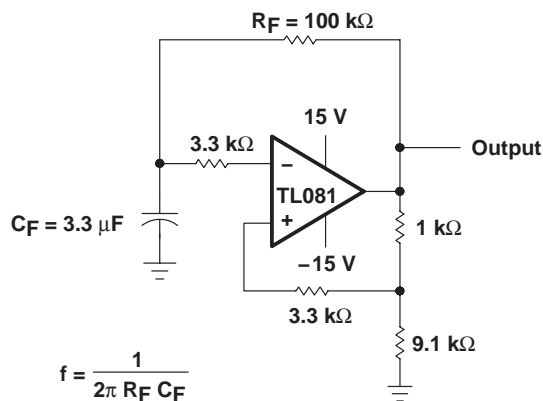
**TOTAL HARMONIC DISTORTION  
VS  
FREQUENCY**



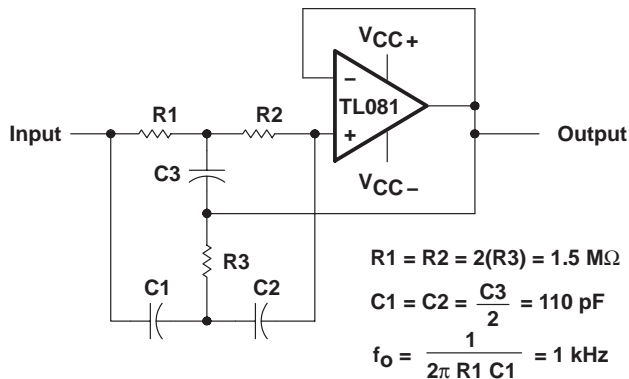
**Figure 22**

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

**APPLICATION INFORMATION**

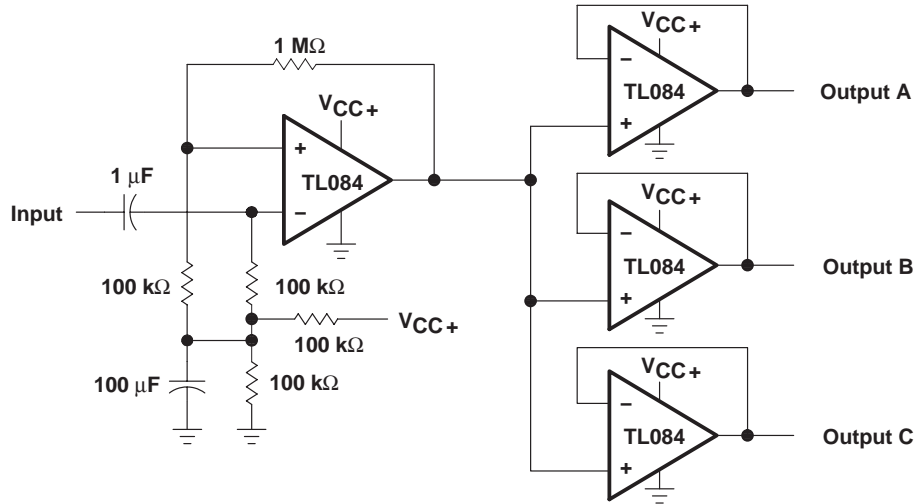


**Figure 23**



**Figure 24**

**APPLICATION INFORMATION**



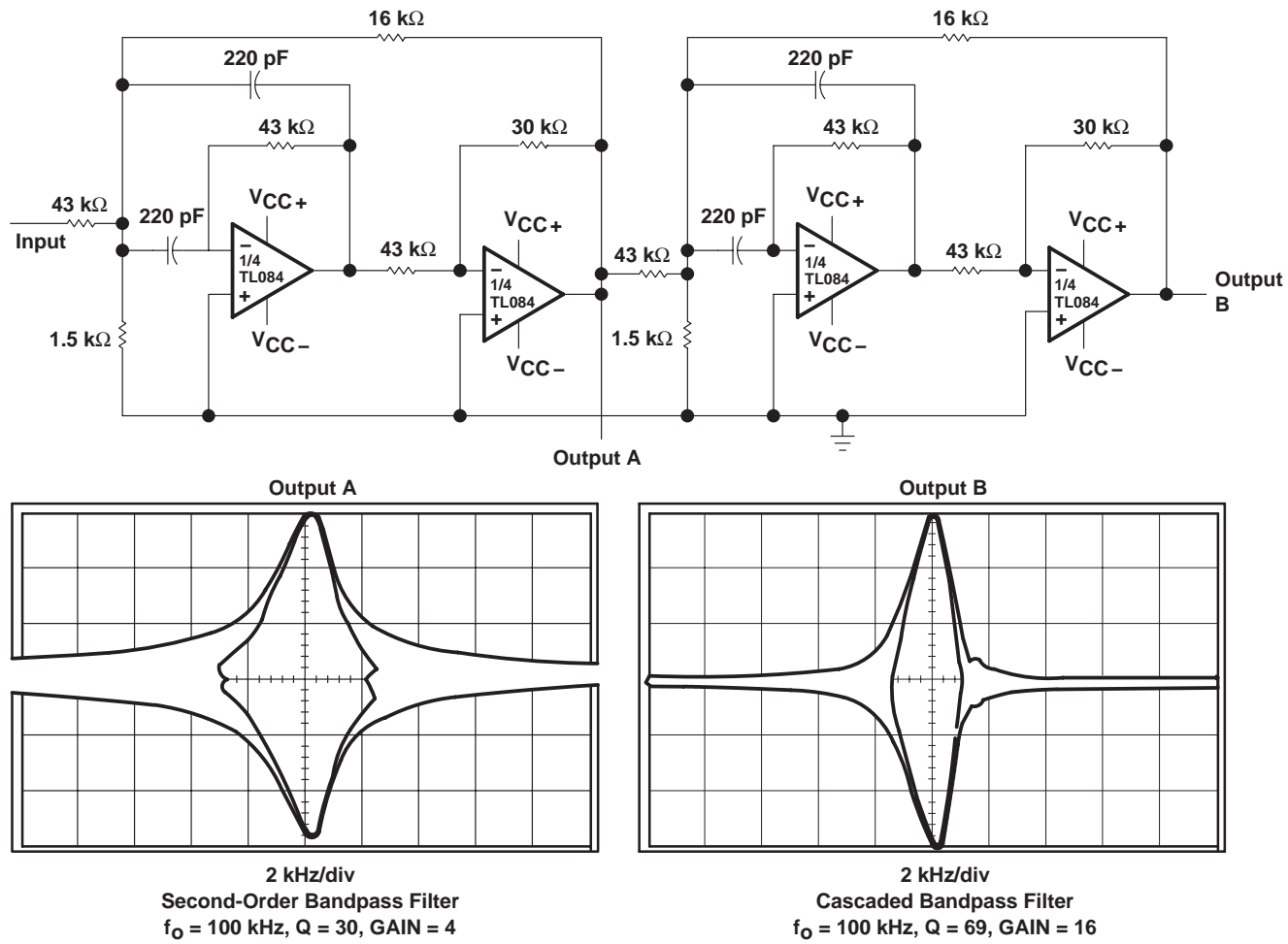
**Figure 25. Audio-Distribution Amplifier**



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**



**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-9851501Q2A  | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| 5962-9851501QPA  | ACTIVE                | CDIP         | JG              | 8    | 1           | TBD                     | A42              | N / A for Pkg Type           |
| 5962-9851503Q2A  | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| 5962-9851503QCA  | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| TL081ACD         | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081ACDE4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081ACDG4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081ACDR        | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081ACDRE4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081ACDRG4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081ACJG        | OBSOLETE              | CDIP         | JG              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL081ACP         | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081ACPE4       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081BCD         | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081BCDE4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081BCDG4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081BCDR        | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081BCDRE4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081BCDRG4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081BCP         | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081BCPE4       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081CD          | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CDE4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CDG4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CDR         | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CDRE4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CDRG4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TL081CP          | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081CPE4        | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081CPSR        | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CPSRE4      | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CPSRG4      | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081CPWLE       | OBSOLETE              | TSSOP        | PW              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL081ID          | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081IDE4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081IDG4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081IDR         | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081IDRE4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081IDRG4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL081IP          | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081IPE4        | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL081MFKB        | OBSOLETE              | LCCC         | FK              | 20   |             | TBD                     | Call TI          | Call TI                      |
| TL081MJG         | OBSOLETE              | CDIP         | JG              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL081MJGB        | OBSOLETE              | CDIP         | JG              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL082ACD         | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACDE4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACDG4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACDR        | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACDRE4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACDRG4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACP         | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082ACPE4       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082ACPSR       | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACPSRE4     | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082ACPSRG4     | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
|                  |                       |              |                 |      |             | no Sb/Br)               |                  |                              |
| TL082BCD         | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082BCDE4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082BCDG4       | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082BCDR        | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082BCDRE4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082BCDRG4      | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082BCP         | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082BCPE4       | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082CD          | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CDE4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CDG4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CDR         | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CDRE4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CDRG4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CJG         | OBSOLETE              | CDIP         | JG              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL082CP          | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082CPE4        | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082CPSR        | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPSRG4      | ACTIVE                | SO           | PS              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPW         | ACTIVE                | TSSOP        | PW              | 8    | 150         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPWE4       | ACTIVE                | TSSOP        | PW              | 8    | 150         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPWG4       | ACTIVE                | TSSOP        | PW              | 8    | 150         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPWLE       | OBSOLETE              | TSSOP        | PW              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL082CPWR        | ACTIVE                | TSSOP        | PW              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPWRE4      | ACTIVE                | TSSOP        | PW              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082CPWRG4      | ACTIVE                | TSSOP        | PW              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TL082ID          | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IDE4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IDG4        | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IDR         | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IDRE4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IDRG4       | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IJG         | OBSOLETE              | CDIP         | JG              | 8    |             | TBD                     | Call TI          | Call TI                      |
| TL082IP          | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082IPE4        | ACTIVE                | PDIP         | P               | 8    | 50          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL082IPWR        | ACTIVE                | TSSOP        | PW              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IPWRE4      | ACTIVE                | TSSOP        | PW              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082IPWRG4      | ACTIVE                | TSSOP        | PW              | 8    | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL082MFK         | OBSOLETE              | LCCC         | FK              | 20   |             | TBD                     | Call TI          | Call TI                      |
| TL082MFKB        | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| TL082MJG         | ACTIVE                | CDIP         | JG              | 8    | 1           | TBD                     | A42              | N / A for Pkg Type           |
| TL082MJGB        | ACTIVE                | CDIP         | JG              | 8    | 1           | TBD                     | A42              | N / A for Pkg Type           |
| TL084ACD         | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACDE4       | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACDG4       | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACDR        | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACDRE4      | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACDRG4      | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACN         | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084ACNE4       | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084ACNSR       | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACNSRE4     | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ACNSRG4     | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084BCD         | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TL084BCDE4       | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084BCDG4       | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084BCDR        | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084BCDRE4      | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084BCDRG4      | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084BCN         | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084BCNE4       | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084CD          | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CDE4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CDG4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CDR         | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CDRE4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CDRG4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CJ          | OBSOLETE              | CDIP         | J               | 14   |             | TBD                     | Call TI          | Call TI                      |
| TL084CN          | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084CNE4        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084CNSLE       | OBSOLETE              | SO           | NS              | 14   |             | TBD                     | Call TI          | Call TI                      |
| TL084CNSR        | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CNSRG4      | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CPW         | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CPWE4       | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CPWG4       | ACTIVE                | TSSOP        | PW              | 14   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CPWLE       | OBSOLETE              | TSSOP        | PW              | 14   |             | TBD                     | Call TI          | Call TI                      |
| TL084CPWR        | ACTIVE                | TSSOP        | PW              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CPWRE4      | ACTIVE                | TSSOP        | PW              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084CPWRG4      | ACTIVE                | TSSOP        | PW              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084ID          | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TL084IDE4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084IDG4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084IDR         | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084IDRE4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084IDRG4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084IJ          | OBSOLETE              | CDIP         | J               | 14   |             | TBD                     | Call TI          | Call TI                      |
| TL084IN          | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084INE4        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| TL084MFK         | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| TL084MFKB        | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | POST-PLATE       | N / A for Pkg Type           |
| TL084MJ          | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| TL084MJB         | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | A42              | N / A for Pkg Type           |
| TL084QD          | ACTIVE                | SOIC         | D               | 14   | 50          | TBD                     | CU NIPDAU        | Level-1-220C-UNLIM           |
| TL084QDG4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| TL084QDR         | ACTIVE                | SOIC         | D               | 14   | 2500        | TBD                     | CU NIPDAU        | Level-1-220C-UNLIM           |
| TL084QDRG4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF TL082, TL082M, TL084, TL084M :**

- Automotive: [TL082-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

**TAPE AND REEL INFORMATION**

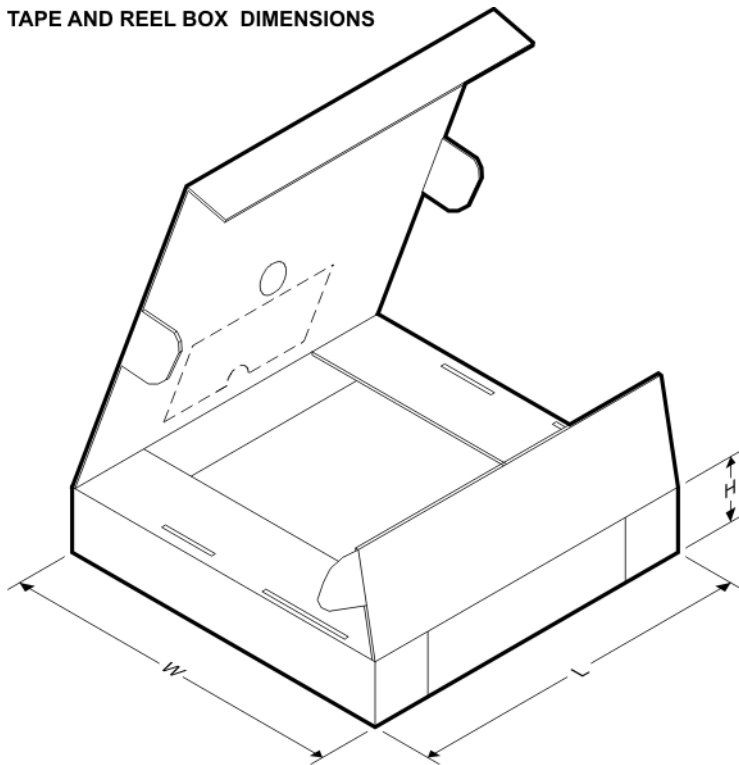
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL081ACDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL081BCDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL081CDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL081CPSR  | SO           | PS              | 8    | 2000 | 330.0              | 16.4               | 8.2     | 6.6     | 2.5     | 12.0    | 16.0   | Q1            |
| TL081IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082ACDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082ACDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082ACPSR | SO           | PS              | 8    | 2000 | 330.0              | 16.4               | 8.2     | 6.6     | 2.5     | 12.0    | 16.0   | Q1            |
| TL082BCDR  | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082CDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082CDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082CPSR  | SO           | PS              | 8    | 2000 | 330.0              | 16.4               | 8.2     | 6.6     | 2.5     | 12.0    | 16.0   | Q1            |
| TL082CPWR  | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TL082IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082IDR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| TL082IPWR  | TSSOP        | PW              | 8    | 2000 | 330.0              | 12.4               | 7.0     | 3.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TL084ACDR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TL084ACDR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |



| Device     | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL084ACNSR | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| TL084BCDR  | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TL084CDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| TL084CNSR  | SO           | NS              | 14   | 2000 | 330.0              | 16.4               | 8.2     | 10.5    | 2.5     | 12.0    | 16.0   | Q1            |
| TL084CPWR  | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| TL084IDR   | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


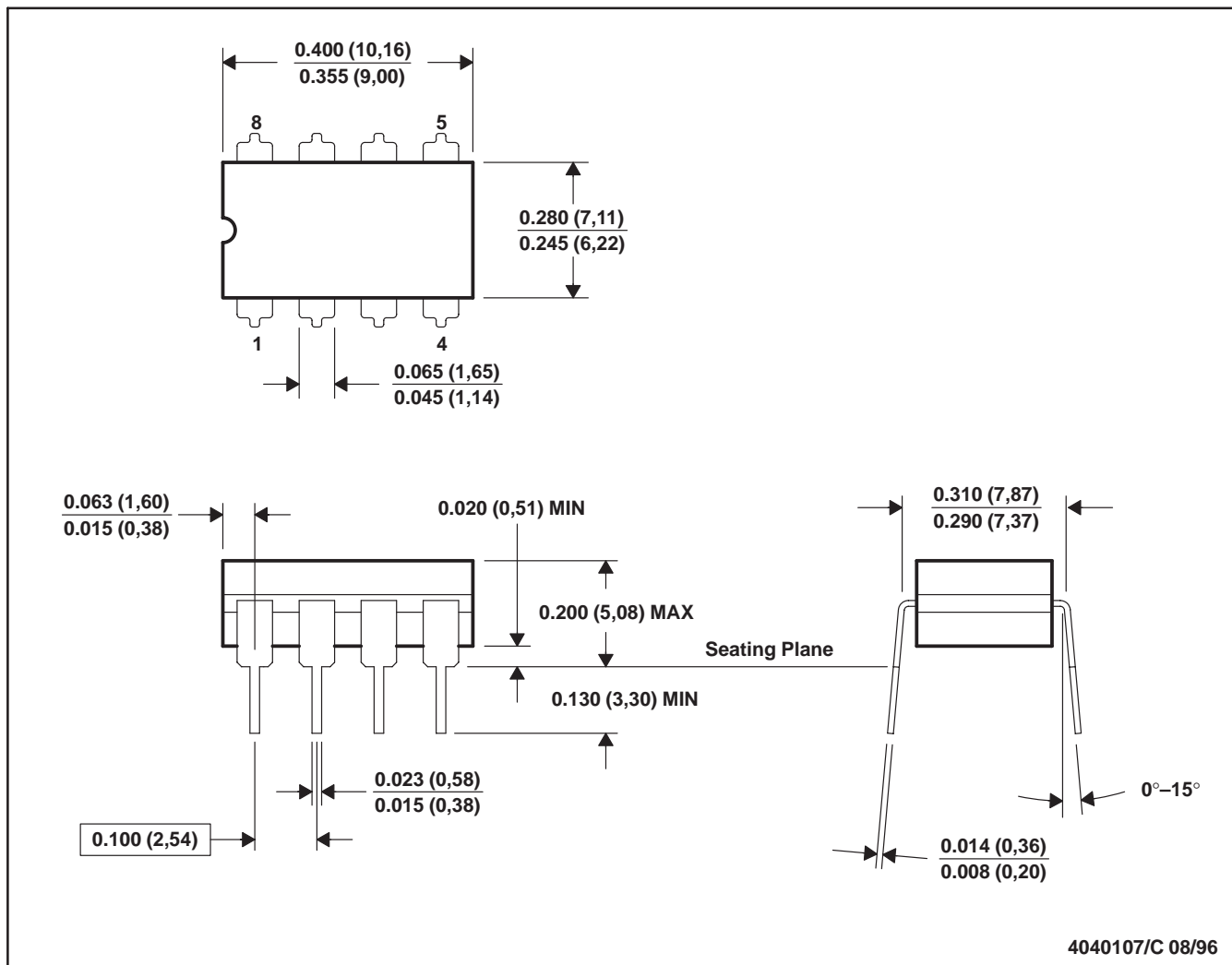
\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL081ACDR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL081BCDR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL081CDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL081CPSR  | SO           | PS              | 8    | 2000 | 346.0       | 346.0      | 33.0        |
| TL081IDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL082ACDR  | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |
| TL082ACDR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL082ACPSR | SO           | PS              | 8    | 2000 | 346.0       | 346.0      | 33.0        |
| TL082BCDR  | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL082CDR   | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |
| TL082CDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL082CPSR  | SO           | PS              | 8    | 2000 | 346.0       | 346.0      | 33.0        |
| TL082CPWR  | TSSOP        | PW              | 8    | 2000 | 346.0       | 346.0      | 29.0        |
| TL082IDR   | SOIC         | D               | 8    | 2500 | 340.5       | 338.1      | 20.6        |
| TL082IDR   | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |
| TL082IPWR  | TSSOP        | PW              | 8    | 2000 | 346.0       | 346.0      | 29.0        |
| TL084ACDR  | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| TL084ACDR  | SOIC         | D               | 14   | 2500 | 346.0       | 346.0      | 33.0        |
| TL084ACNSR | SO           | NS              | 14   | 2000 | 346.0       | 346.0      | 33.0        |
| TL084BCDR  | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| TL084CDR   | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |
| TL084CNSR  | SO           | NS              | 14   | 2000 | 346.0       | 346.0      | 33.0        |
| TL084CPWR  | TSSOP        | PW              | 14   | 2000 | 346.0       | 346.0      | 29.0        |
| TL084IDR   | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



- 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.  
 E. Falls within MIL STD 1835 GDIP1-T8

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

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14                     | 16                     | 18                     | 20                     |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A             | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX         | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN         | —                      | —                      | —                      | —                      |
| C MAX         | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN         | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |



4040083/F 03/03

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

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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



4040140/D 10/96

- 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

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



4040082/E 04/2010

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

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

PLASTIC DUAL-IN-LINE PACKAGE

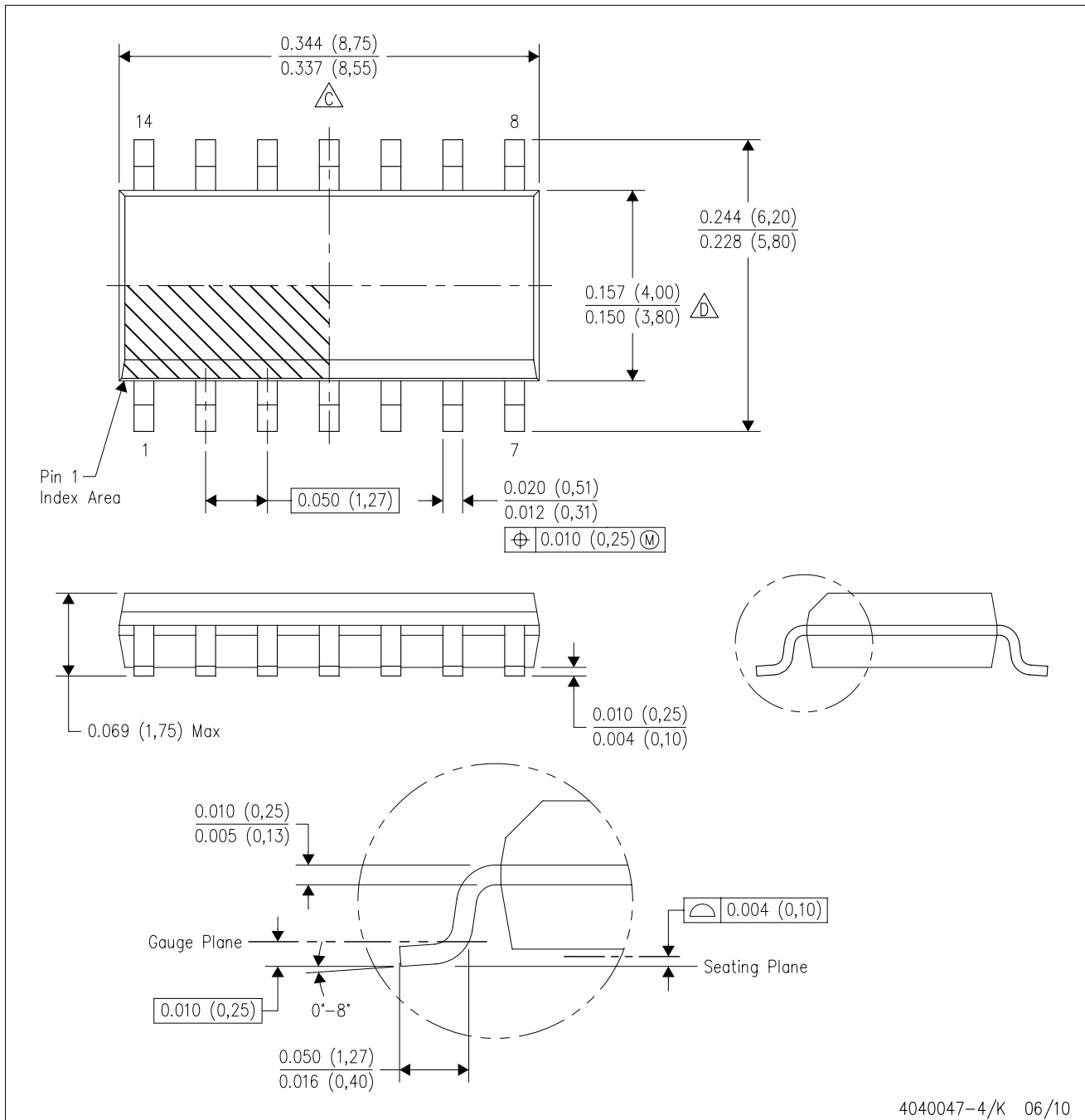
16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE

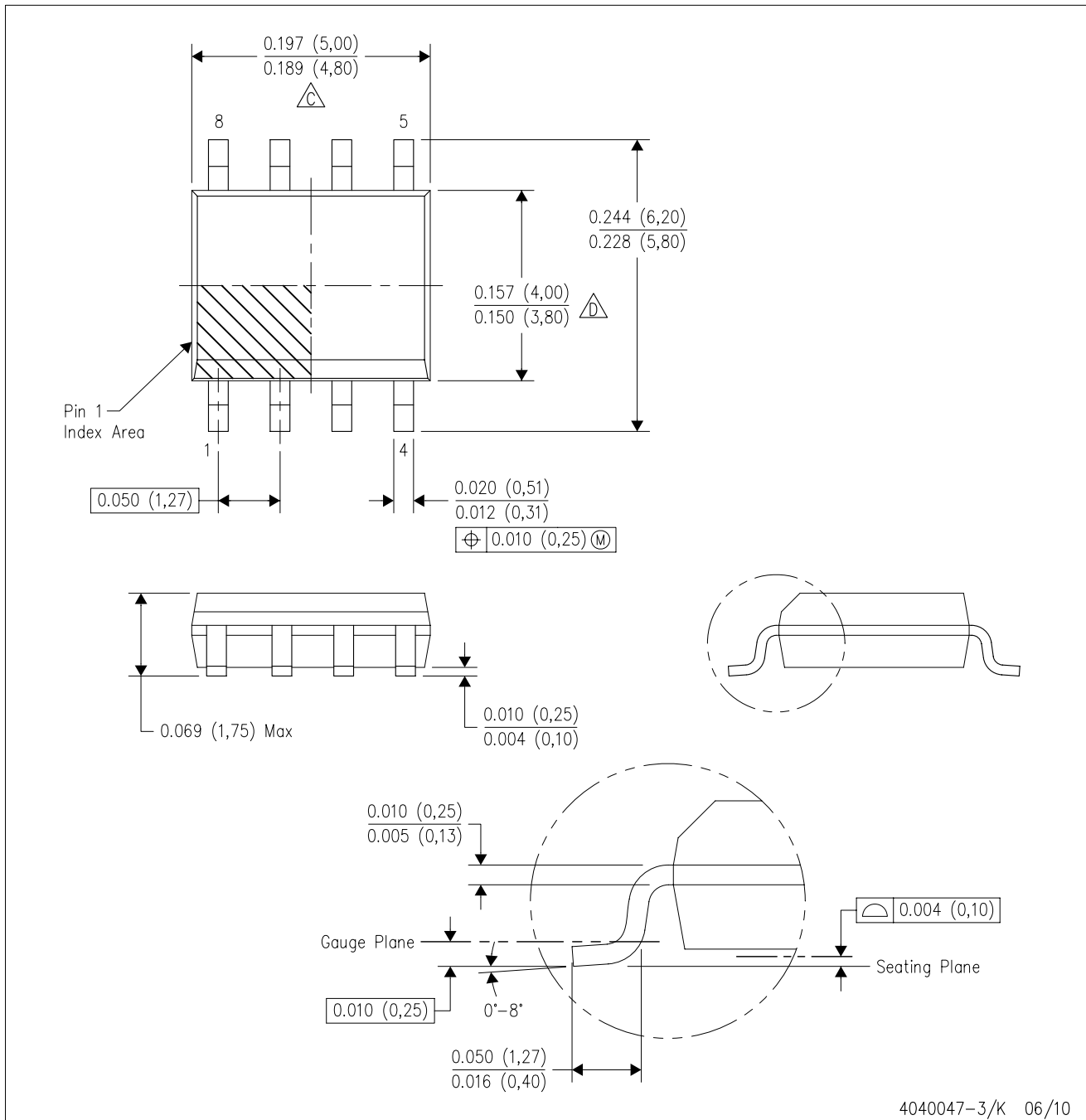


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AB.



D (R-PDSO-G8)

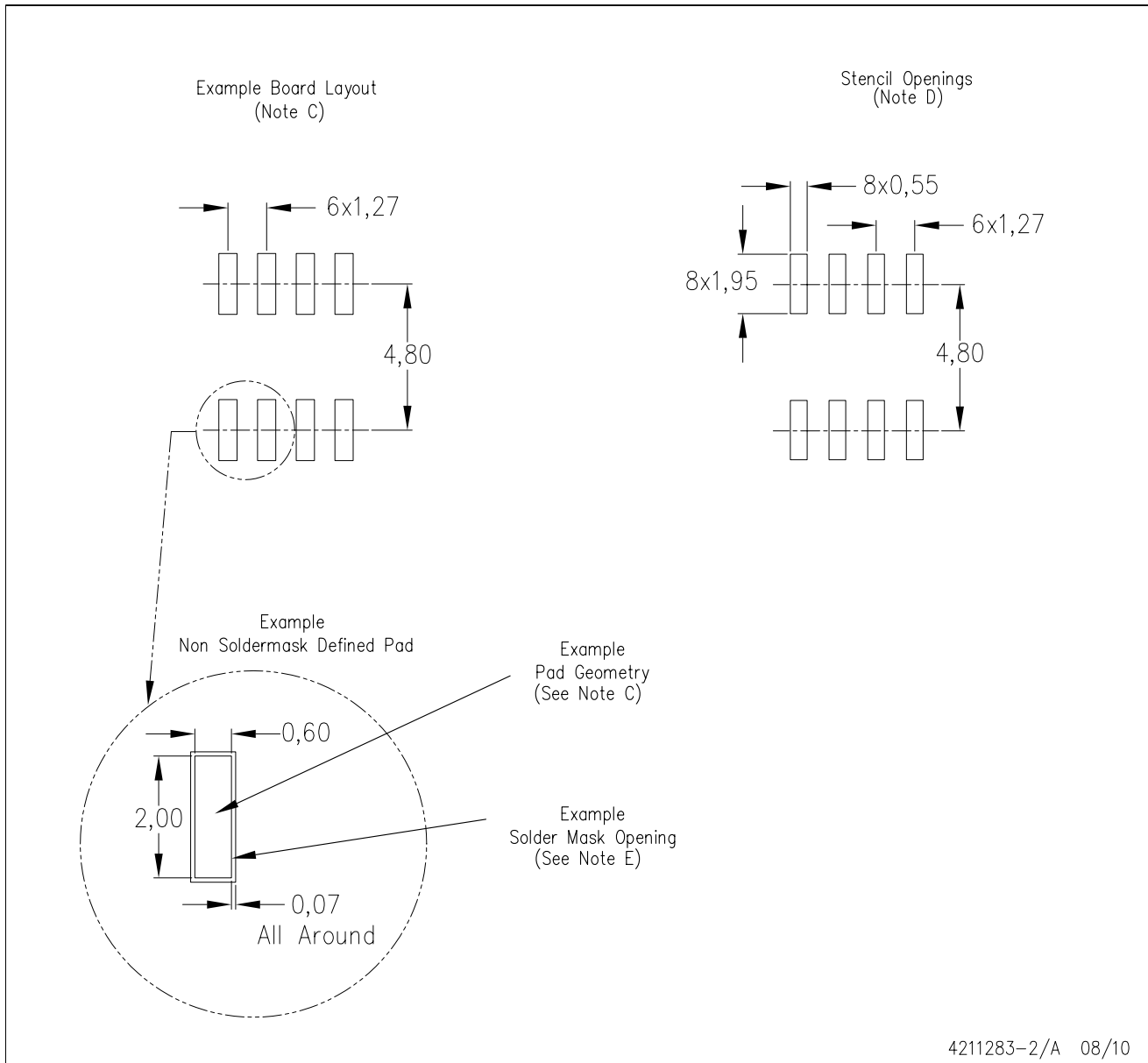
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- 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.

# MECHANICAL DATA

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

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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.

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

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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

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| DSP                         | <a href="http://dsp.ti.com">dsp.ti.com</a>                         | Computers and Peripherals  | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Clocks and Timers           | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>           | Consumer Electronics       | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Interface                   | <a href="http://interface.ti.com">interface.ti.com</a>             | Energy                     | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Logic                       | <a href="http://logic.ti.com">logic.ti.com</a>                     | Industrial                 | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
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