- **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/μs 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**

| $T_J$ | $V_{IO}$max AT 25°C | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE 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.



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.

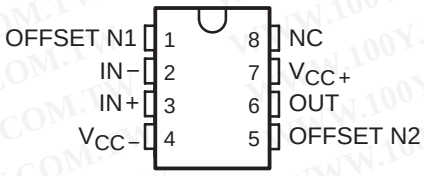
## description/ordering information (continued)

### ORDERING INFORMATION

| $T_J$ | $V_{IO}$max AT 25°C | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE 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 | |
| | | | 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 | |
| | | | 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 | |
| | | | 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 |

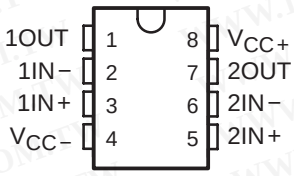
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

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

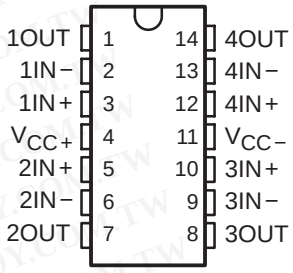



NC − No internal connection

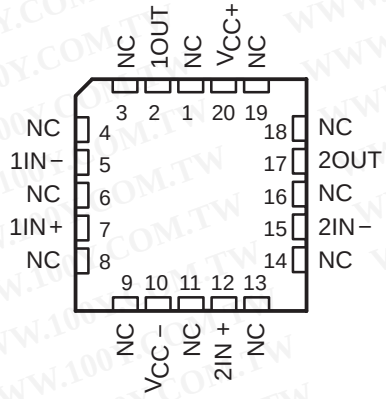
**TL082, TL082A, TL082B**
**D, JG, P, PS, OR PW PACKAGE**
**(TOP VIEW)**




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

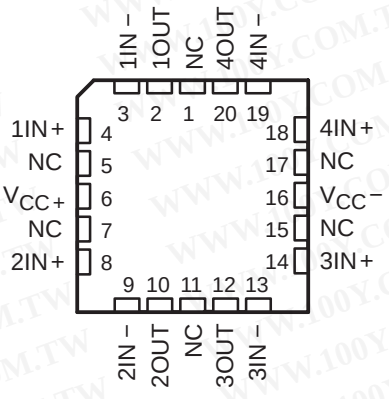



**TL082M . . . FK PACKAGE**
**(TOP VIEW)**




NC − No internal connection

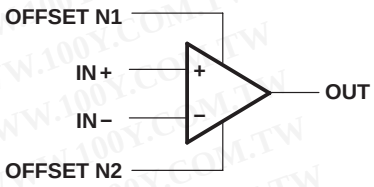
**TL084M . . . FK PACKAGE**
**(TOP VIEW)**



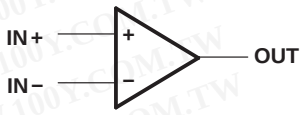

NC − No internal connection

## symbols

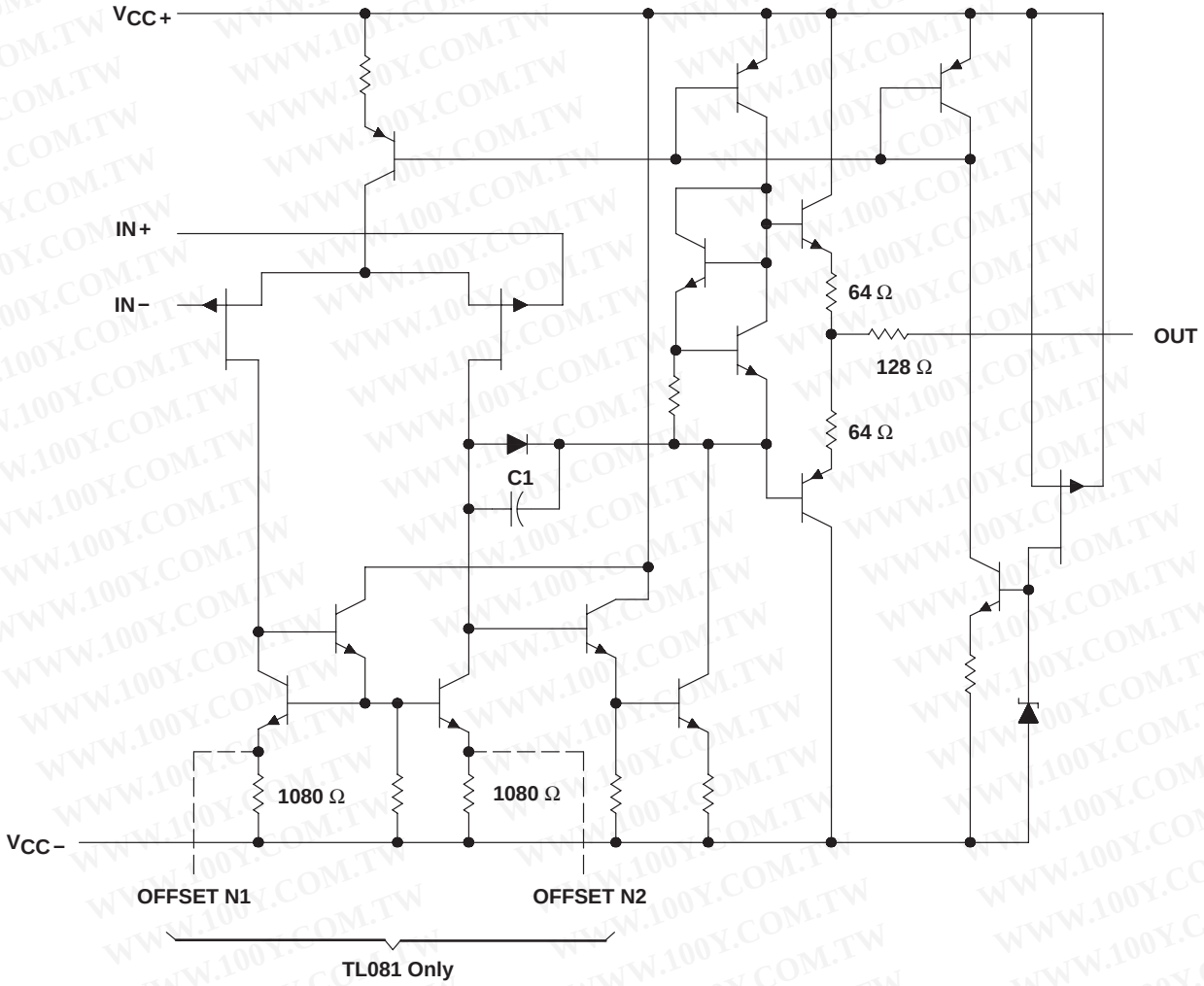
**TL081**




**TL082 (EACH AMPLIFIER)**
**TL084 (EACH AMPLIFIER)**



## schematic (each amplifier)




Component values shown are nominal.

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

| | | TL08_C TL08_AC 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) | | ±30 | ±30 | ±30 | ±30 | V |
| Input voltage, $V_I$ (see Notes 1 and 3) | | ±15 | ±15 | ±15 | ±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 | °C |
| Package thermal impedance, $\theta_{JA}$ (see Notes 5 and 6) | D package (8-pin) | 97 | 97 | | | °C/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 | °C |
| Case temperature for 60 seconds, $T_C$ | FK package | | | | 260 | °C |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds | J or JG package | | | | 300 | °C |
| Storage temperature range, $T_{stg}$ | | − 65 to 150 | − 65 to 150 | − 65 to 150 | − 65 to 150 | °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.
5. Maximum power dissipation is a function of $T_J(max)$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum $T_J$ of 150°C can affect reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR | DERATE ABOVE $T_A$ | $T_A = 70°C$ POWER RATING | $T_A = 85°C$ POWER RATING | $T_A = 125°C$ POWER RATING |
|---|---|---|---|---|---|---|
| D (14 pin) | 680 mW | 7.6 mW/°C | 60°C | 604 mW | 490 mW | 186 mW |
| FK | 680 mW | 11.0 mW/°C | 88°C | 680 mW | 680 mW | 273 mW |
| J | 680 mW | 11.0 mW/° C | 88°C | 680 mW | 680 mW | 273 mW |
| JG | 680 mW | 8.4 mW/°C | 69°C | 672 mW | 546 mW | 210 mW |

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

| PARAMETER | | TEST CONDITIONS | | $T_A$† | TL081C, TL082C, TL084C | | | TL081AC, TL082AC, TL084AC | | | TLO81BC, TL082BC, TL084BC | | | TL081I, TL082I, 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 Ω | 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 Ω | Full range | | 18 | | | 18 | | | 18 | | | 18 | | µV/°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 | ±11 | −12 to 15 | | ±11 | −12 to 15 | | ±11 | −12 to 15 | | ±11 | −12 to 15 | | V |
| $V_{OM}$ | Maximum peak output voltage swing | $R_L$ = 10 kΩ | | 25°C | ±12 | ±13.5 | | ±12 | ±13.5 | | ±12 | ±13.5 | | ±12 | ±13.5 | | V |
| | | $R_L$ ≥ 10 kΩ | | Full range | ±12 | | | ±12 | | | ±12 | | | ±12 | | | |
| | | $R_L$ ≥ 2 kΩ | | | ±10 | ±12 | | ±10 | ±12 | | ±10 | ±12 | | ±10 | ±12 | | |
| $A_{VD}$ | Large-signal differential voltage amplification | $V_O$ = ±10 V, | $R_L$ ≥ 2 kΩ | 25°C | 25 | 200 | | 50 | 200 | | 50 | 200 | | 50 | 200 | | V/mV |
| | | $V_O$ = ±10 V, | $R_L$ ≥ 2 kΩ | Full range | 15 | | | 25 | | | 25 | | | 25 | | | |
| $B_1$ | Unity-gain bandwidth | | | 25°C | | 3 | | | 3 | | | 3 | | | 3 | | MHz |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | | $10^{12}$ | | | $10^{12}$ | | | $10^{12}$ | | Ω |
| CMRR | Common-mode rejection ratio | $V_{IC}$ = $V_{ICR}$min, $V_O$ = 0, | $R_S$ = 50 Ω | 25°C | 70 | 86 | | 75 | 86 | | 75 | 86 | | 75 | 86 | | dB |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | $V_{CC}$ = ±15 V to ± 9 V, $V_O$ = 0, | $R_S$ = 50 Ω | 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 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.

## electrical characteristics, $V_{CC\pm}$ = ±15 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 Ω | 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 Ω | Full range | | 18 | | | 18 | | μV/°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 | ±11 | −12 to 15 | | ±11 | −12 to 15 | | V |
| $V_{OM}$ | Maximum peak output voltage swing | $R_L$ = 10 kΩ | | 25°C | ±12 | ±13.5 | | ±12 | ±13.5 | | V |
| | | $R_L$ ≥ 10 kΩ | | Full range | ±12 | | | ±12 | | | |
| | | $R_L$ ≥ 2 kΩ | | | ±10 | ±12 | | ±10 | ±12 | | |
| $A_{VD}$ | Large-signal differential voltage amplification | $V_O$ = ±10 V, | $R_L$ ≥ 2 kΩ | 25°C | 25 | 200 | | 25 | 200 | | V/mV |
| | | $V_O$ = ±10 V, | $R_L$ ≥ 2 kΩ | Full range | 15 | | | 15 | | | |
| $B_1$ | Unity-gain bandwidth | | | 25°C | | 3 | | | 3 | | MHz |
| $r_i$ | Input resistance | | | 25°C | | $10^{12}$ | | | $10^{12}$ | | Ω |
| CMRR | Common-mode rejection ratio | $V_{IC}$ = $V_{ICR}$min, $V_O$ = 0, | $R_S$ = 50 Ω | 25°C | 80 | 86 | | 80 | 86 | | dB |
| $k_{SVR}$ | Supply-voltage rejection ratio ($\Delta V_{CC\pm}/\Delta V_{IO}$) | $V_{CC}$ = ±15 V to ±9 V, $V_O$ = 0, | $R_S$ = 50 Ω | 25°C | 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 | 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, $V_{CC\pm}$ = ±15 V, $T_A$ = 25°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| SR | Slew rate at unity gain | $V_I$ = 10 V, | $R_L$ = 2 kΩ, | $C_L$ = 100 pF, | See Figure 1 | 8* | 13 | | V/μs |
| | | $V_I$ = 10 V, $T_A$ = − 55°C to 125°C, | $R_L$ = 2 kΩ, See Figure 1 | $C_L$ = 100 pF, | | 5* | | | |
| $t_r$ | Rise time | $V_I$ = 20 mV, | $R_L$ = 2 kΩ, | $C_L$ = 100 pF, | See Figure 1 | | 0.05 | | μs |
| | Overshoot factor | | | | | | 20 | | % |
| $V_n$ | Equivalent input noise voltage | $R_S$ = 20 Ω | f = 1 kHz | | | | 18 | | nV/√Hz |
| | | | f = 10 Hz to 10 kHz | | | | 4 | | μV |
| $I_n$ | Equivalent input noise current | $R_S$ = 20 Ω, | f = 1 kHz | | | | 0.01 | | pA/√Hz |
| THD | Total harmonic distortion | $V_I$rms = 6 V, f = 1 kHz | $A_{VD}$ = 1, | $R_S$ ≤ 1 kΩ, | $R_L$ ≥ 2 kΩ, | | 0.003 | | % |

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

## operating characteristics, $V_{CC\pm}$ = ±15 V, $T_A$ = 25°C

| PARAMETER | | TEST CONDITIONS | | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| SR | Slew rate at unity gain | $V_I$ = 10 V, | $R_L$ = 2 kΩ, | $C_L$ = 100 pF, | See Figure 1 | 8 | 13 | | V/μs |
| $t_r$ | Rise time | $V_I$ = 20 mV, | $R_L$ = 2 kΩ, | $C_L$ = 100 pF, | See Figure 1 | | 0.05 | | μs |
| | Overshoot factor | | | | | | 20 | | % |
| $V_n$ | Equivalent input noise voltage | $R_S$ = 20 Ω | f = 1 kHz | | | | 18 | | nV/√Hz |
| | | | f = 10 Hz to 10 kHz | | | | 4 | | μV |
| $I_n$ | Equivalent input noise current | $R_S$ = 20 Ω, | f = 1 kHz | | | | 0.01 | | pA/√Hz |
| THD | Total harmonic distortion | $V_I$rms = 6 V, f = 1 kHz | $A_{VD}$ = 1, | $R_S$ ≤ 1 kΩ, | $R_L$ ≥ 2 kΩ, | | 0.003 | | % |

## PARAMETER MEASUREMENT INFORMATION

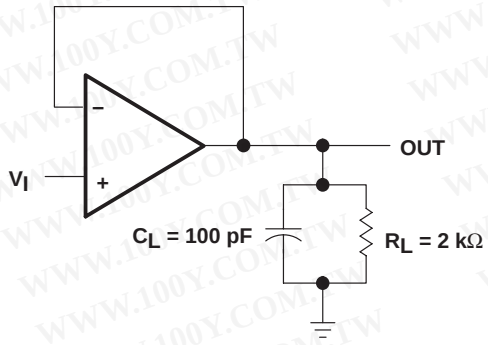



Figure 1

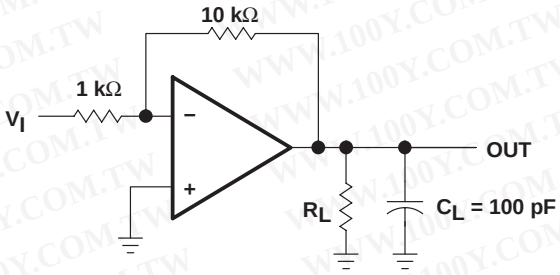



Figure 2

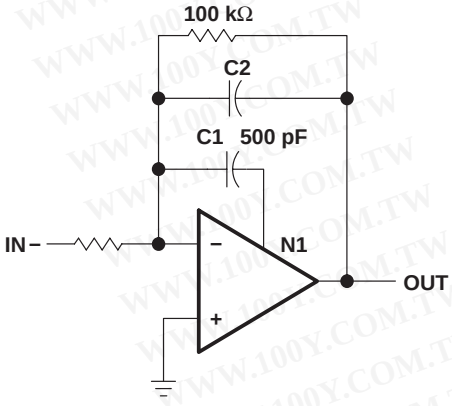



Figure 3

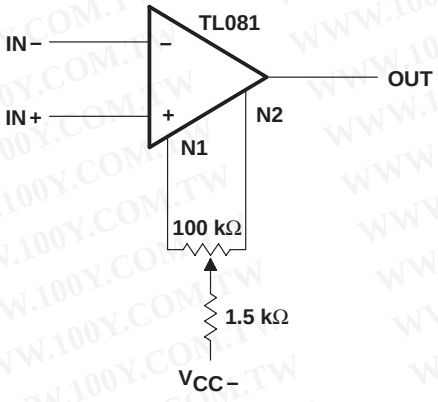



Figure 4



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## TYPICAL CHARACTERISTICS

### Table of Graphs

| | | | FIGURE |
|---|---|---|---|
| $V_{OM}$ | Maximum peak output voltage | vs Frequency<br>vs Free-air temperature<br>vs Load resistance<br>vs Supply voltage | 5, 6, 7<br>8<br>9<br>10 |
| $A_{VD}$ | Large-signal differential voltage amplification | vs Free-air temperature<br>vs Frequency | 11<br>12 |
| | Differential voltage amplification | vs Frequency with feed-forward compensation | 13 |
| $P_D$ | Total power dissipation | vs Free-air temperature | 14 |
| $I_{CC}$ | Supply current | vs Free-air temperature<br>vs Supply voltage | 15<br>16 |
| $I_{IB}$ | Input bias current | vs Free-air temperature | 17 |
| | Large-signal pulse response | vs Time | 18 |
| $V_O$ | Output voltage | vs Elapsed time | 19 |
| CMRR | Common-mode rejection ratio | vs Free-air temperature | 20 |
| $V_n$ | Equivalent input noise voltage | vs Frequency | 21 |
| THD | Total harmonic distortion | vs Frequency | 22 |

**MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY**

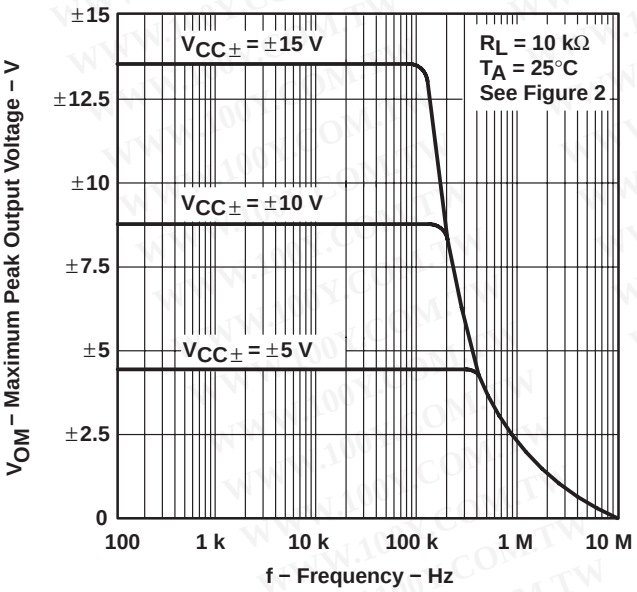


Figure 5

**MAXIMUM PEAK OUTPUT VOLTAGE vs FREQUENCY**

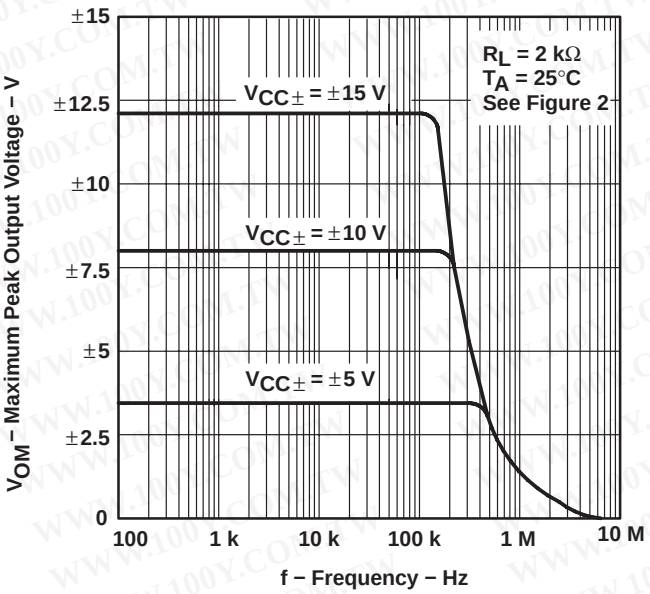


Figure 6

## TYPICAL CHARACTERISTICS†

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREQUENCY

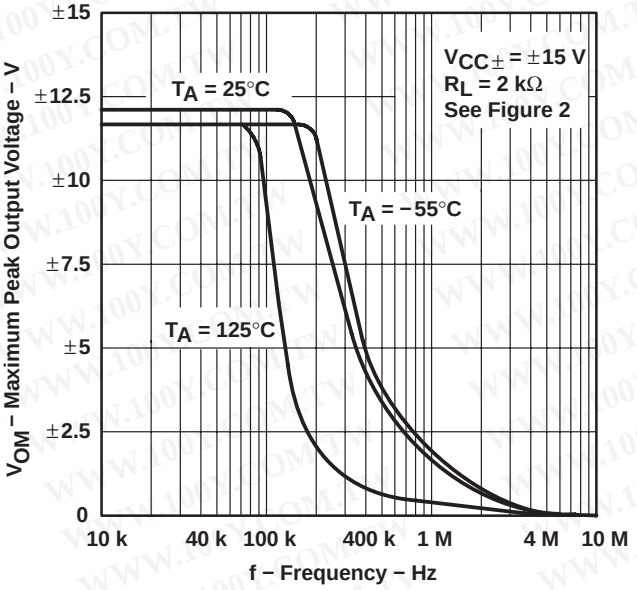


Figure 7

MAXIMUM PEAK OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

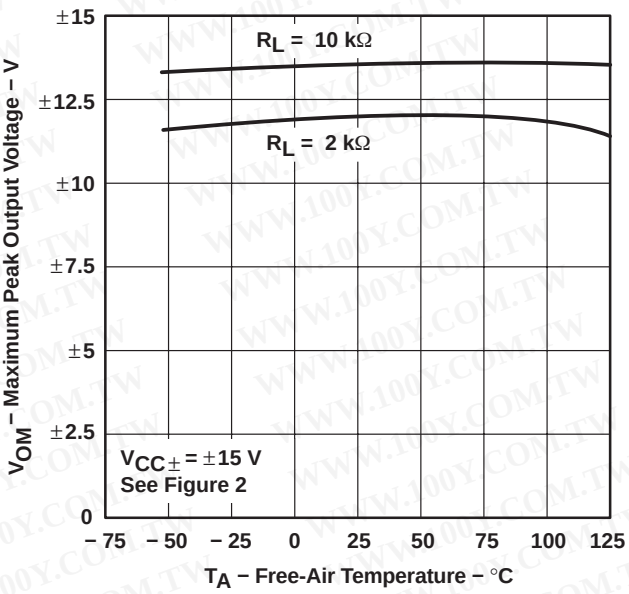


Figure 8

MAXIMUM PEAK OUTPUT VOLTAGE
vs
LOAD RESISTANCE

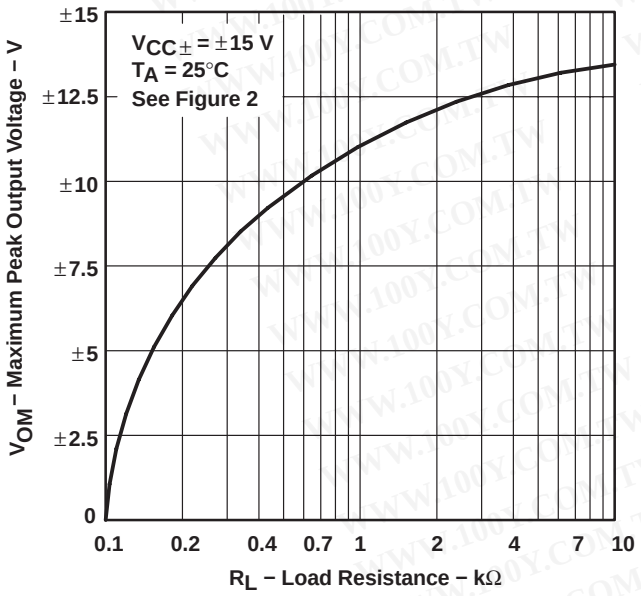


Figure 9

MAXIMUM PEAK OUTPUT VOLTAGE
vs
SUPPLY VOLTAGE

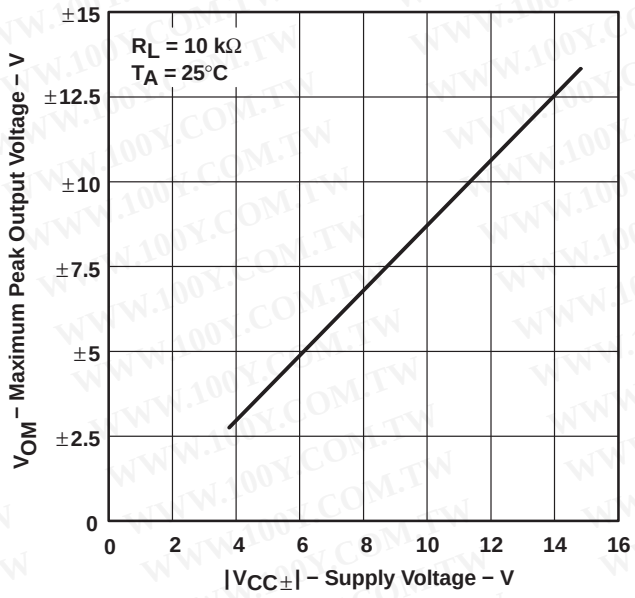


Figure 10

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



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## TYPICAL CHARACTERISTICS†

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

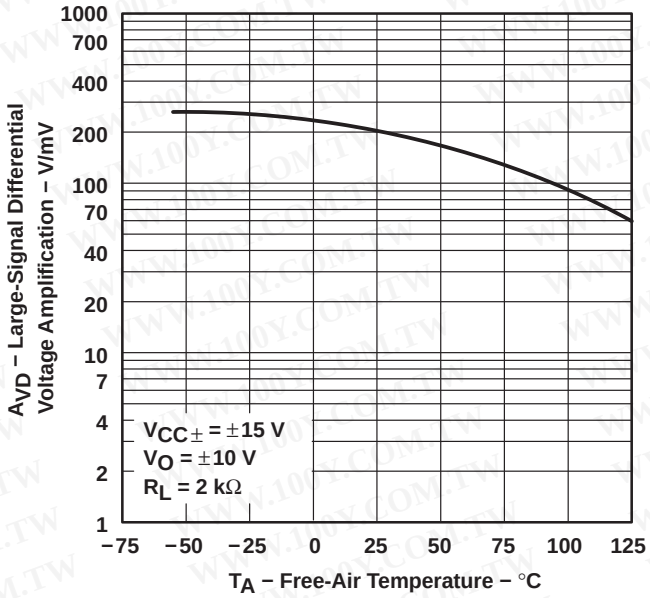


**Figure 11**

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

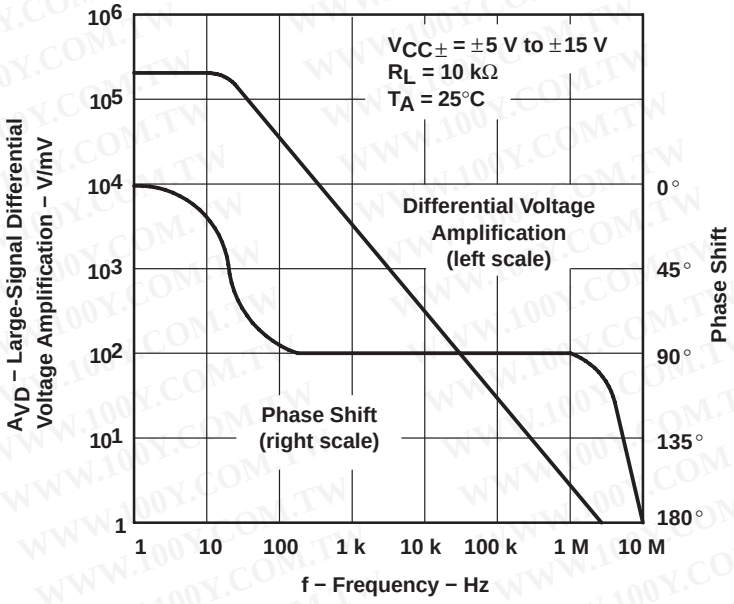


**Figure 12**

† 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

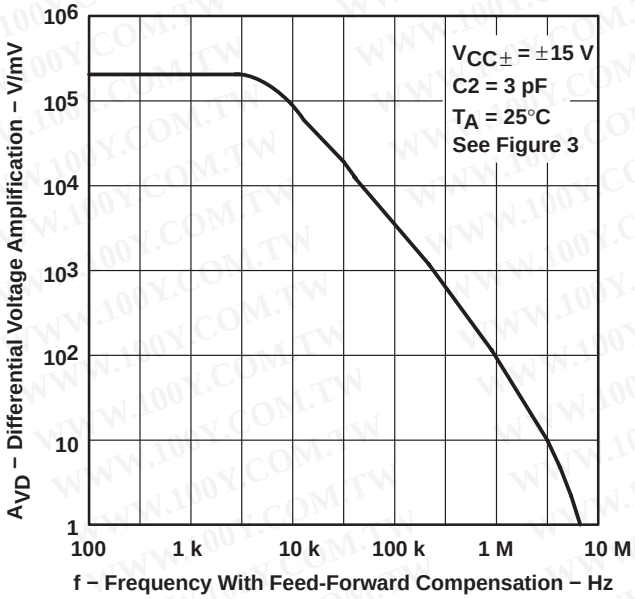


Figure 13

### TOTAL POWER DISSIPATION vs FREE-AIR TEMPERATURE

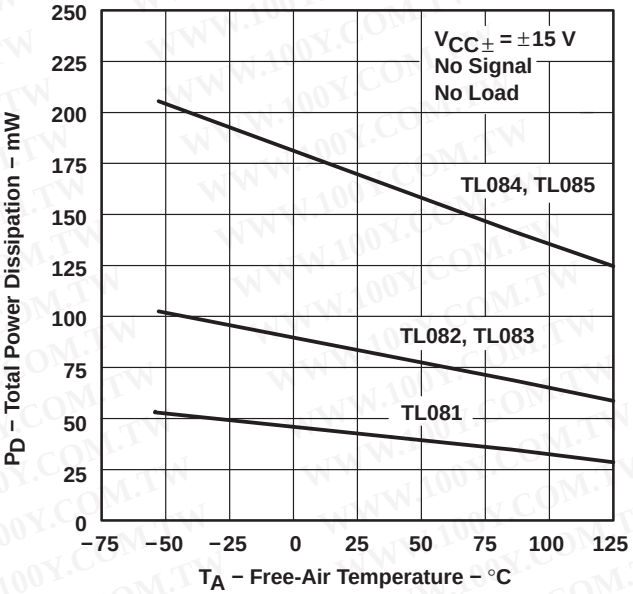


Figure 14

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

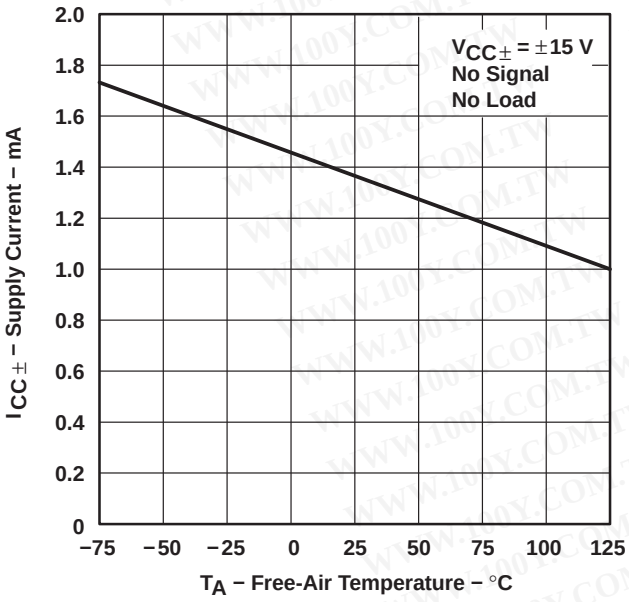


Figure 15

### SUPPLY CURRENT vs SUPPLY VOLTAGE

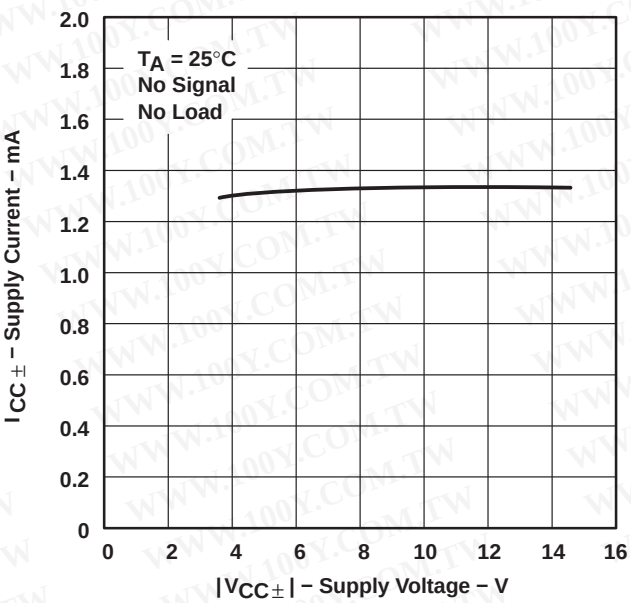


Figure 16

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



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## TYPICAL CHARACTERISTICS†

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

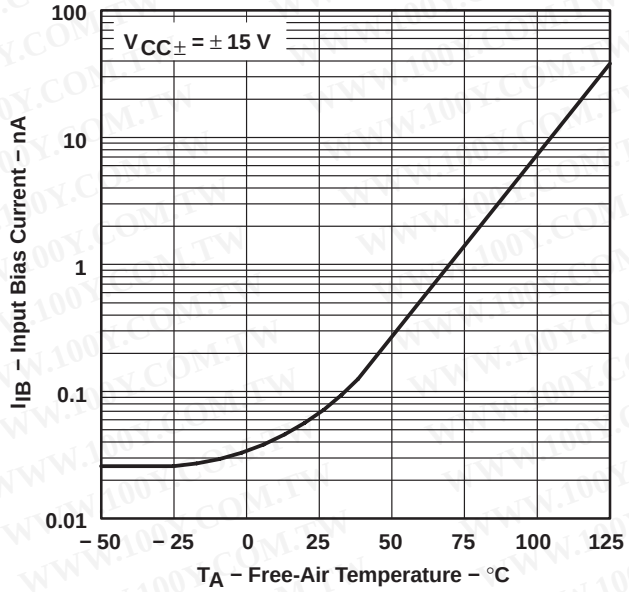


Figure 17

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

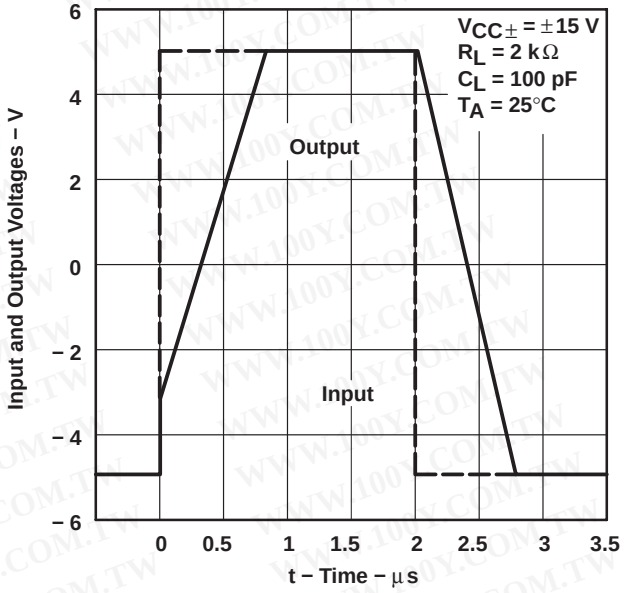


Figure 18

**OUTPUT VOLTAGE vs ELAPSED TIME**

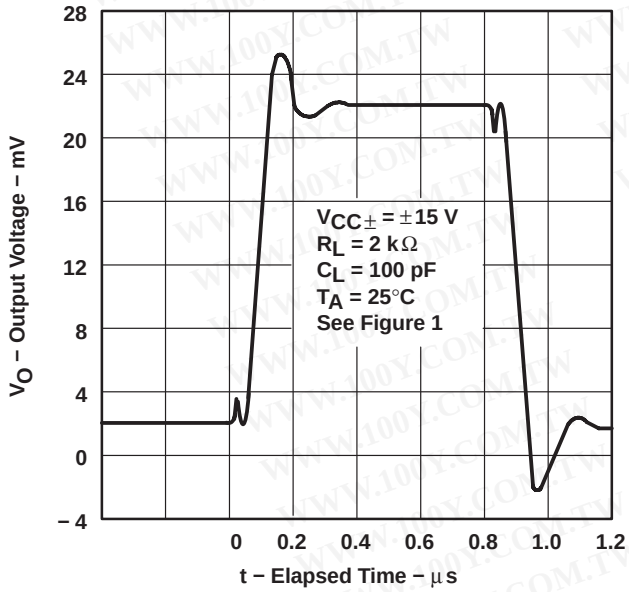


Figure 19

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

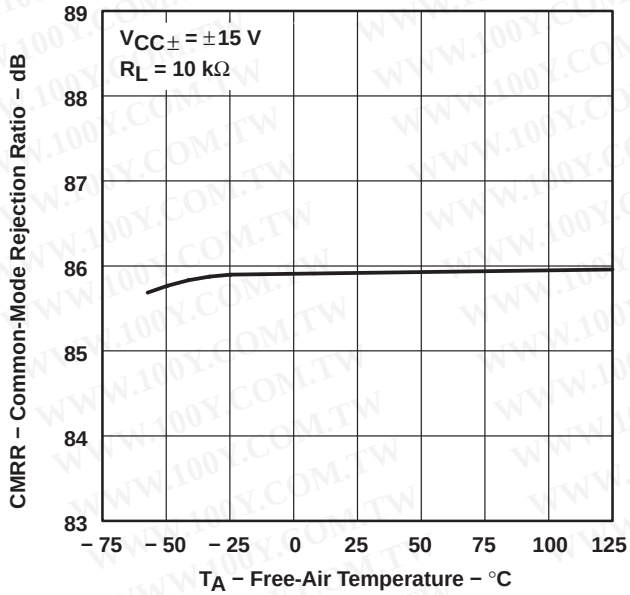


Figure 20

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

## TYPICAL CHARACTERISTICS†

### EQUIVALENT INPUT NOISE VOLTAGE vs FREQUENCY

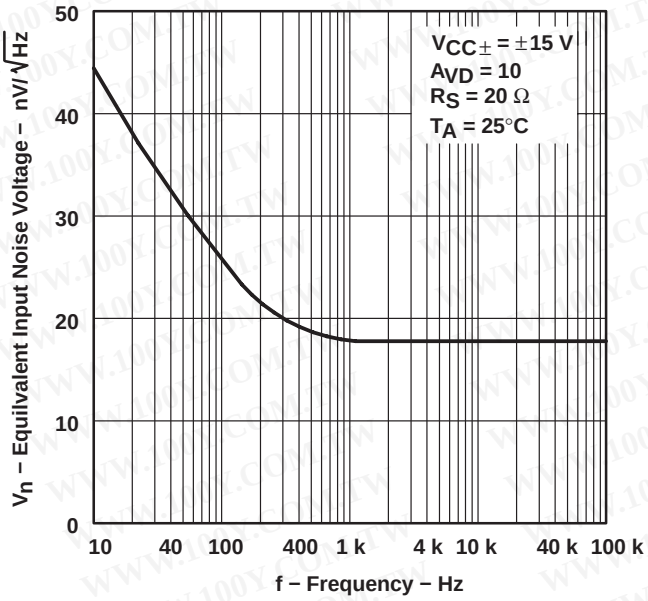


Figure 21

### TOTAL HARMONIC DISTORTION vs FREQUENCY

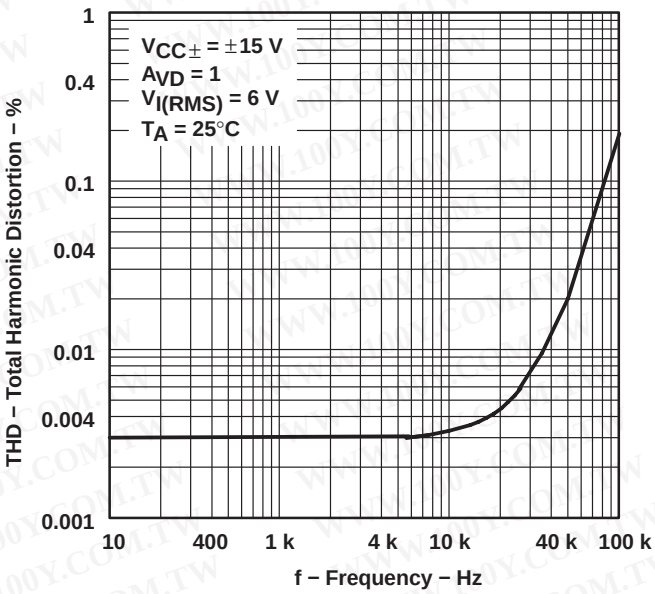


Figure 22

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

## APPLICATION INFORMATION

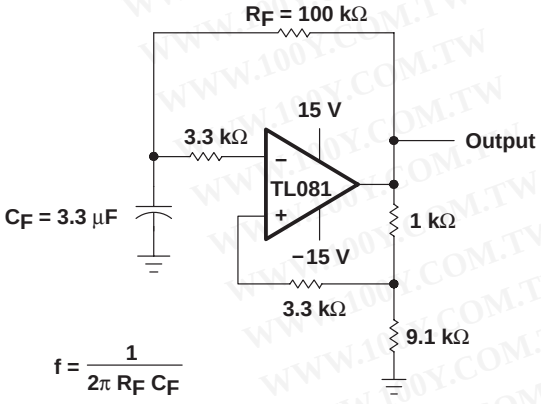


Figure 23

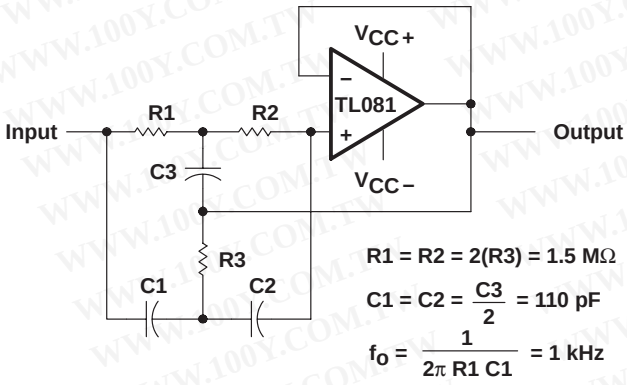


Figure 24



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## APPLICATION INFORMATION

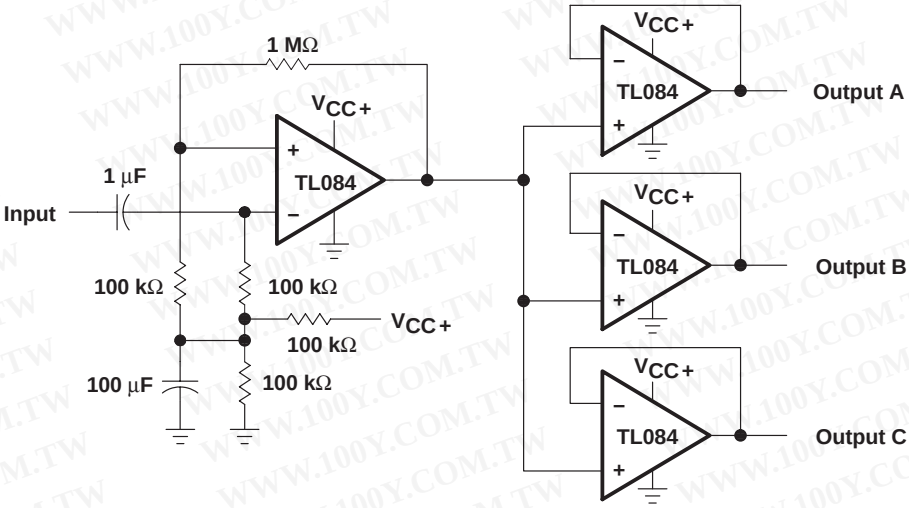
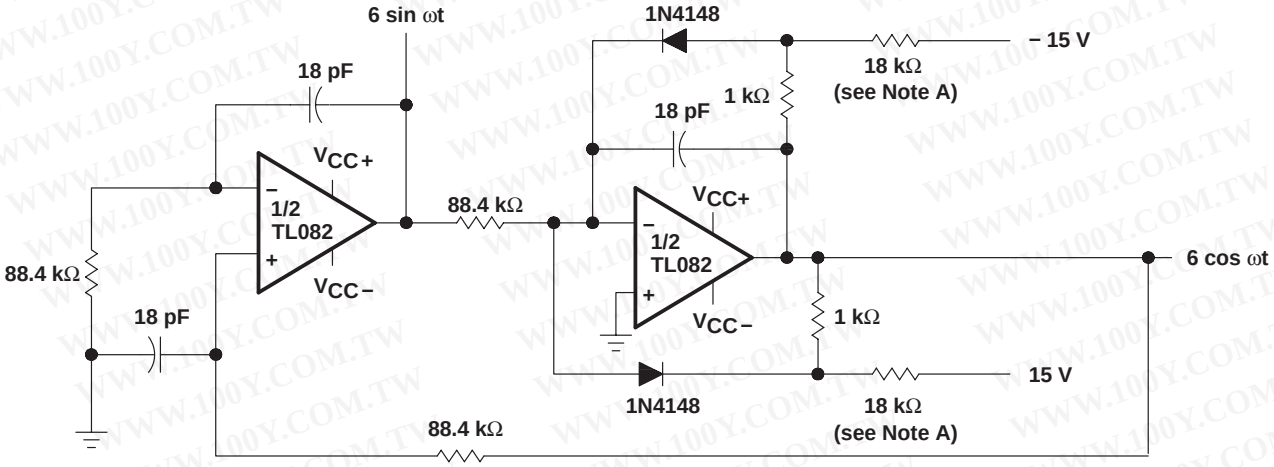


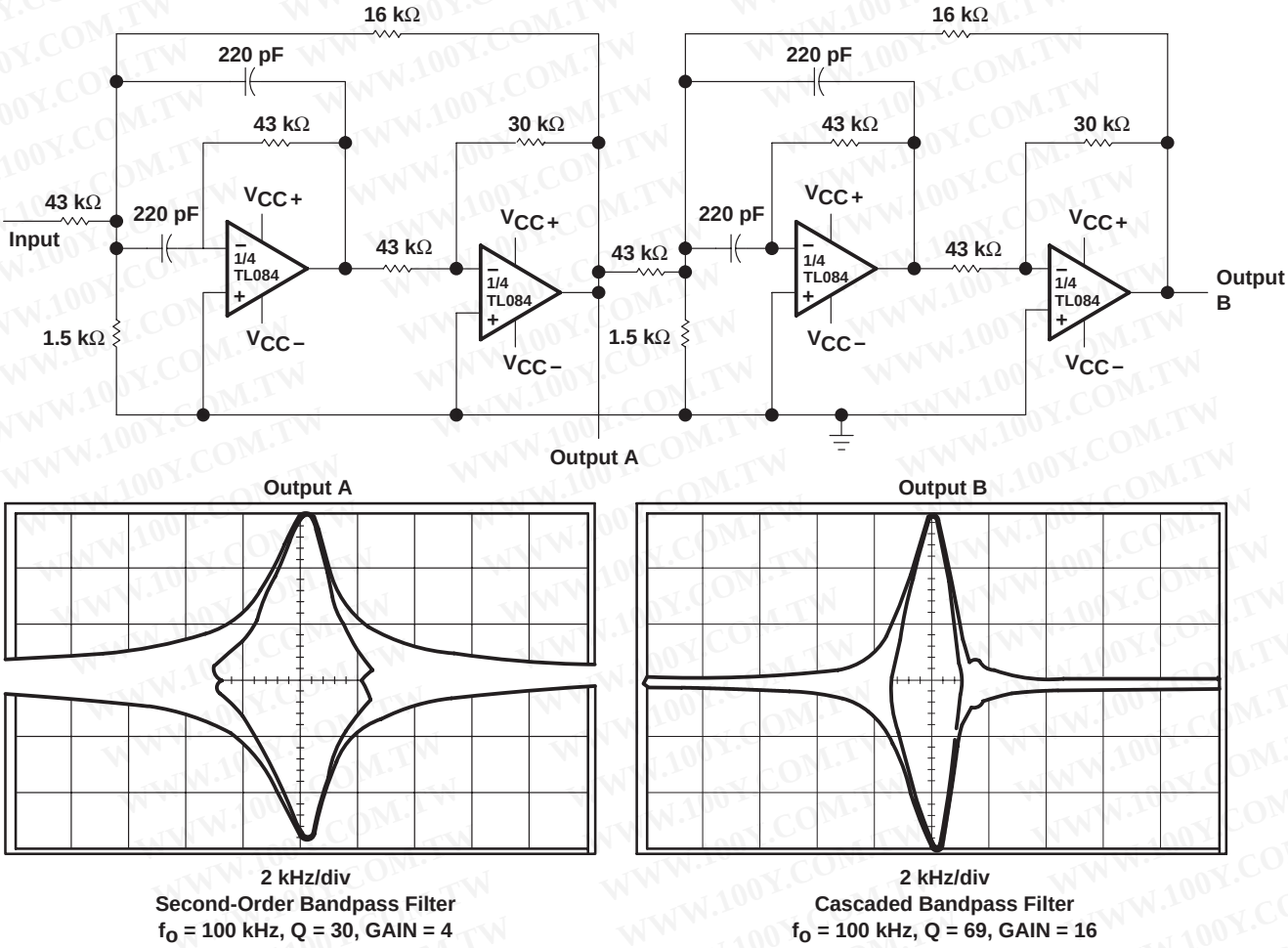

**Figure 25. Audio-Distribution Amplifier**




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

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

## APPLICATION INFORMATION







2 kHz/div
Second-Order Bandpass Filter
$f_O$ = 100 kHz, Q = 30, GAIN = 4

2 kHz/div
Cascaded Bandpass Filter
$f_O$ = 100 kHz, Q = 69, GAIN = 16

**Figure 27. Positive-Feedback Bandpass Filter**



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## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| 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 (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| 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 & | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 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 (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| 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 [1] | Package Type | Package Drawing | Pins | Package Qty | Eco Plan [2] | Lead/Ball Finish | MSL Peak Temp [3] |
|---|---|---|---|---|---|---|---|---|
| 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 [1] | Package Type | Package Drawing | Pins | Package Qty | Eco Plan [2] | Lead/Ball Finish | MSL Peak Temp [3] |
|---|---|---|---|---|---|---|---|---|
| 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 |

[1] 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.

[2] 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)

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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 :**

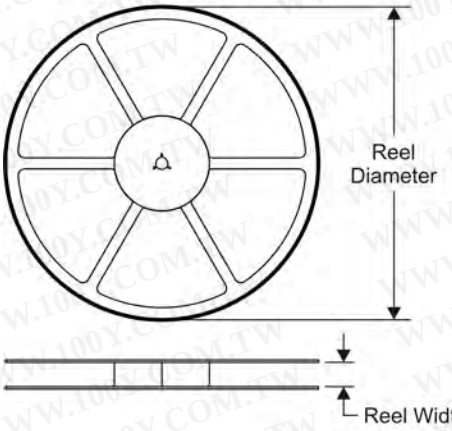
- Automotive: TL082-Q1

NOTE: Qualified Version Definitions:

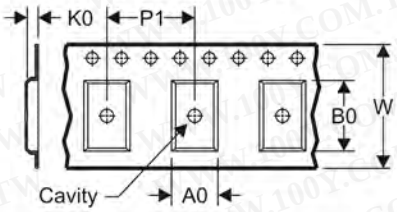
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

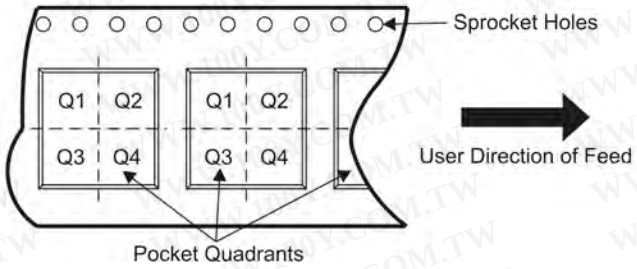



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

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

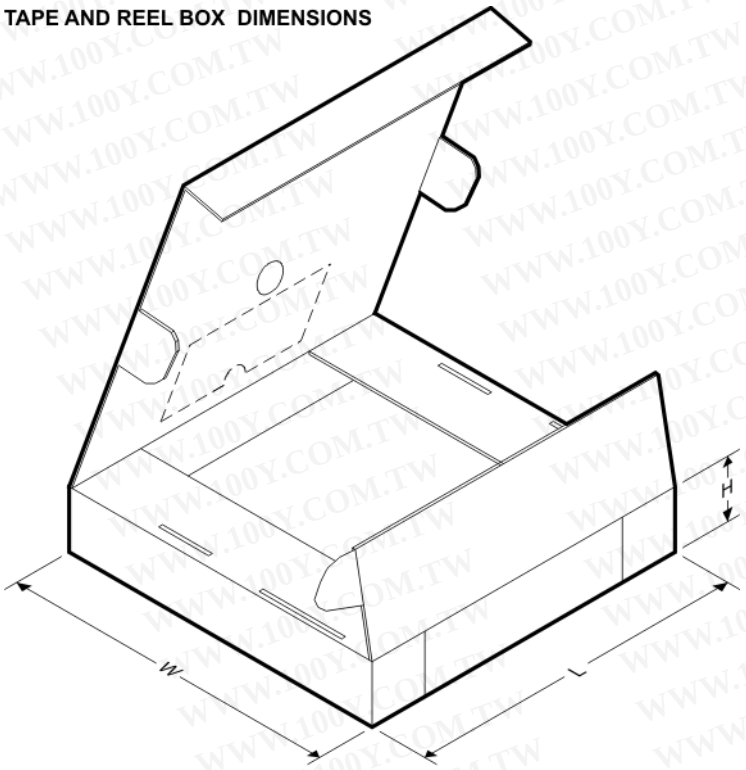



*All dimensions are nominal

| 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 |
| TL084QDR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |

**TAPE AND REEL BOX DIMENSIONS**



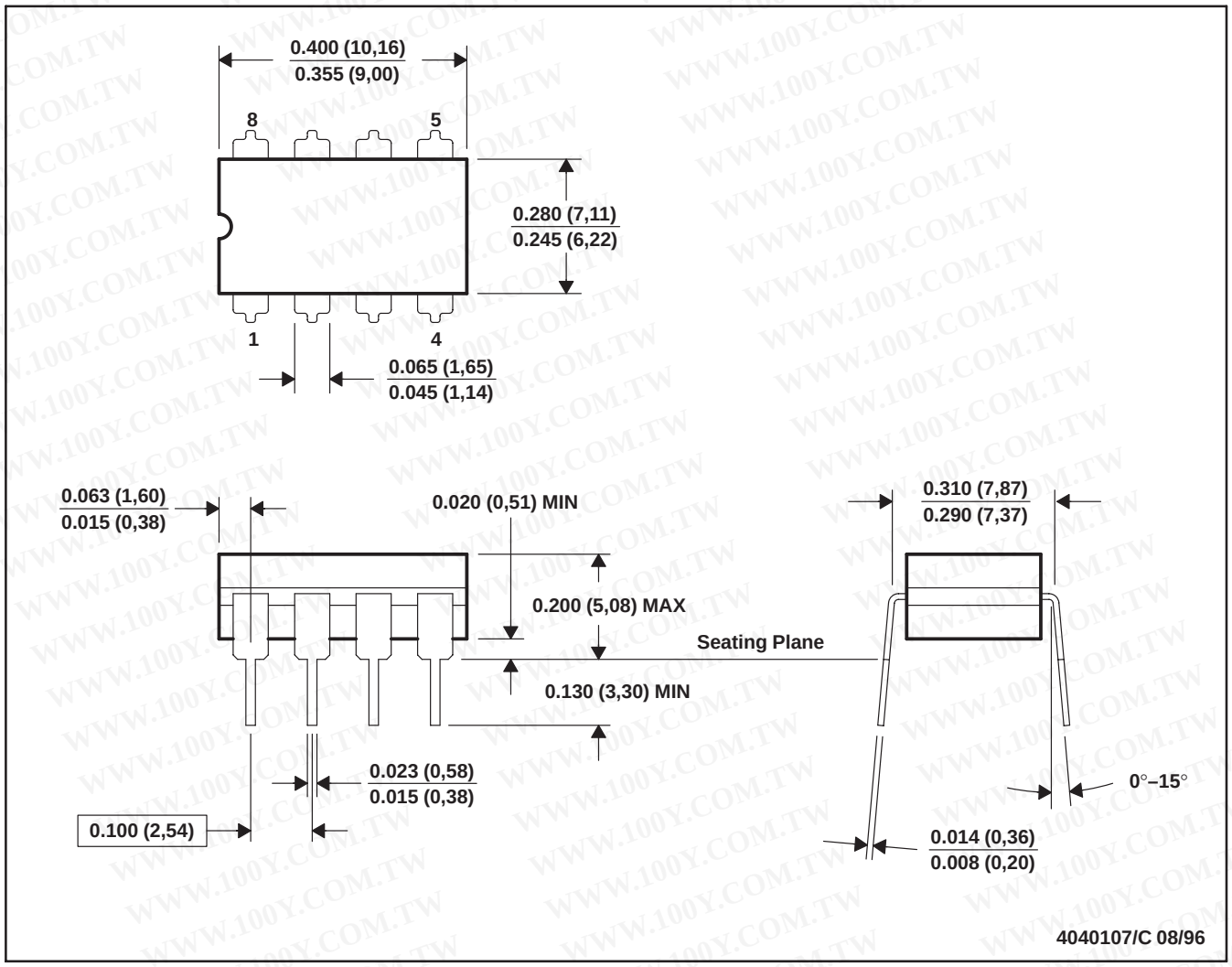

*All dimensions are nominal

| 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 | 340.5 | 338.1 | 20.6 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TL082CDR | SOIC | D | 8 | 2500 | 346.0 | 346.0 | 29.0 |
| 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 | 346.0 | 346.0 | 29.0 |
| TL082IDR | SOIC | D | 8 | 2500 | 340.5 | 338.1 | 20.6 |
| 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 |
| TL084QDR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

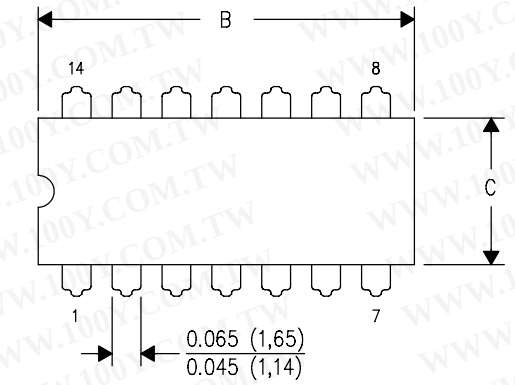
**JG (R-GDIP-T8)** **CERAMIC DUAL-IN-LINE**



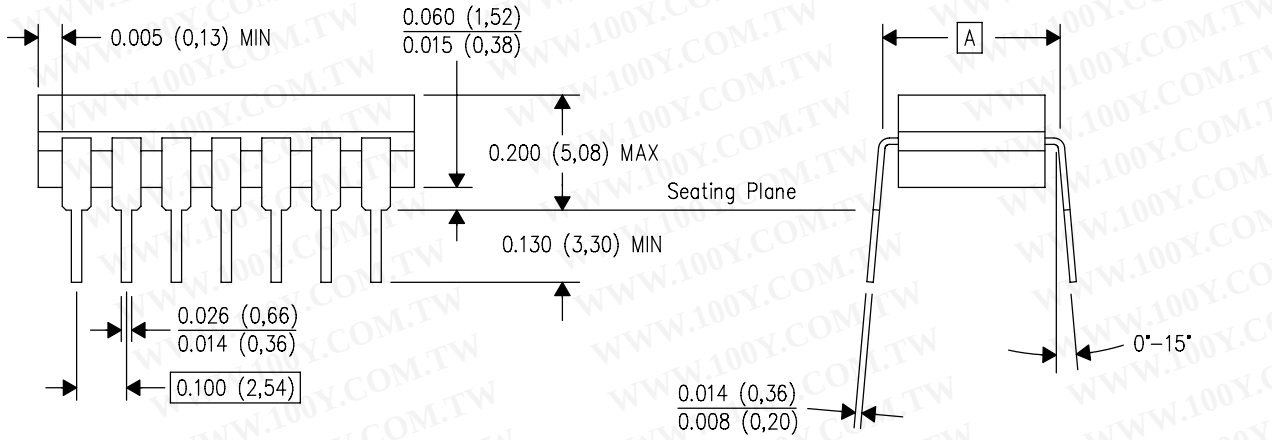

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP1-T8

# J (R–GDIP–T**) CERAMIC DUAL IN–LINE PACKAGE

14 LEADS SHOWN




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

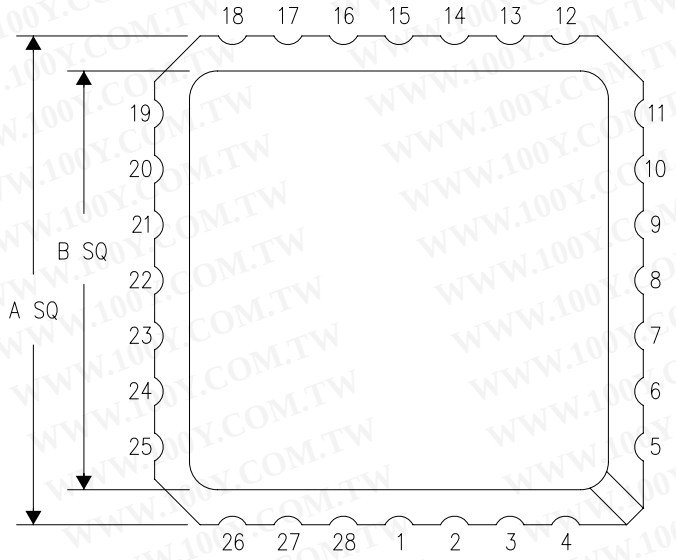



4040083/F 03/03

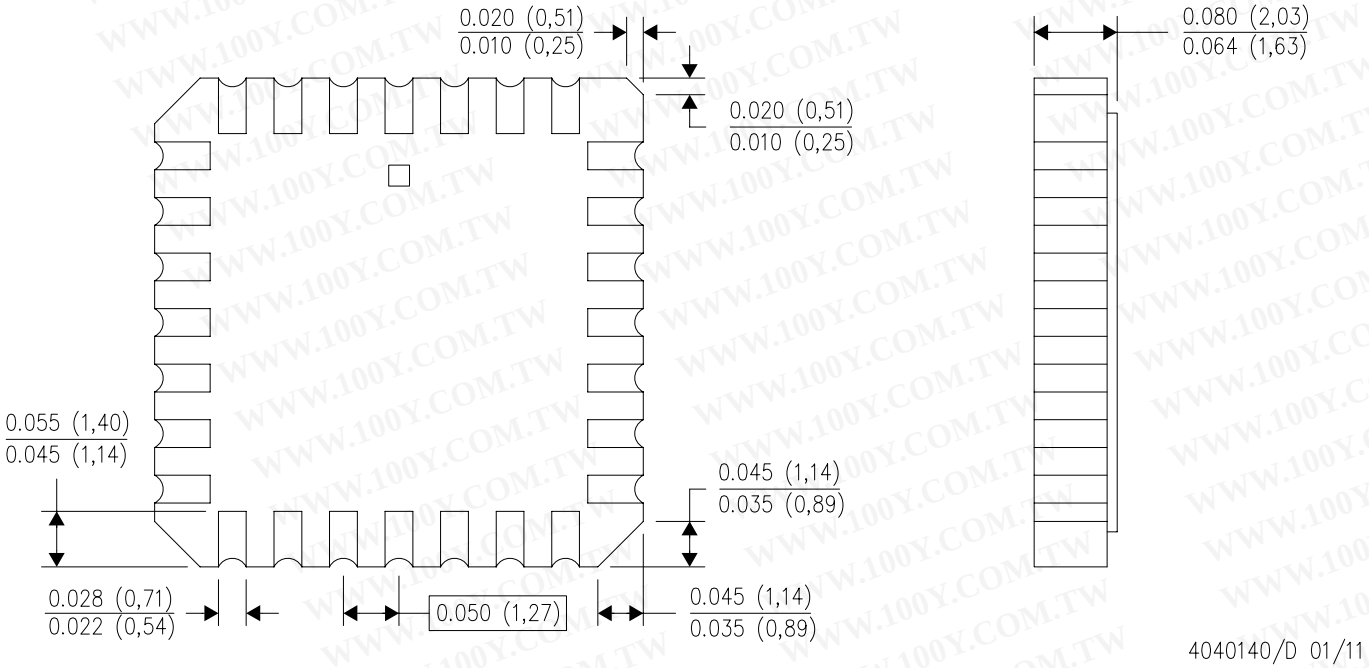
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls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

FK (S–CQCC–N**) LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



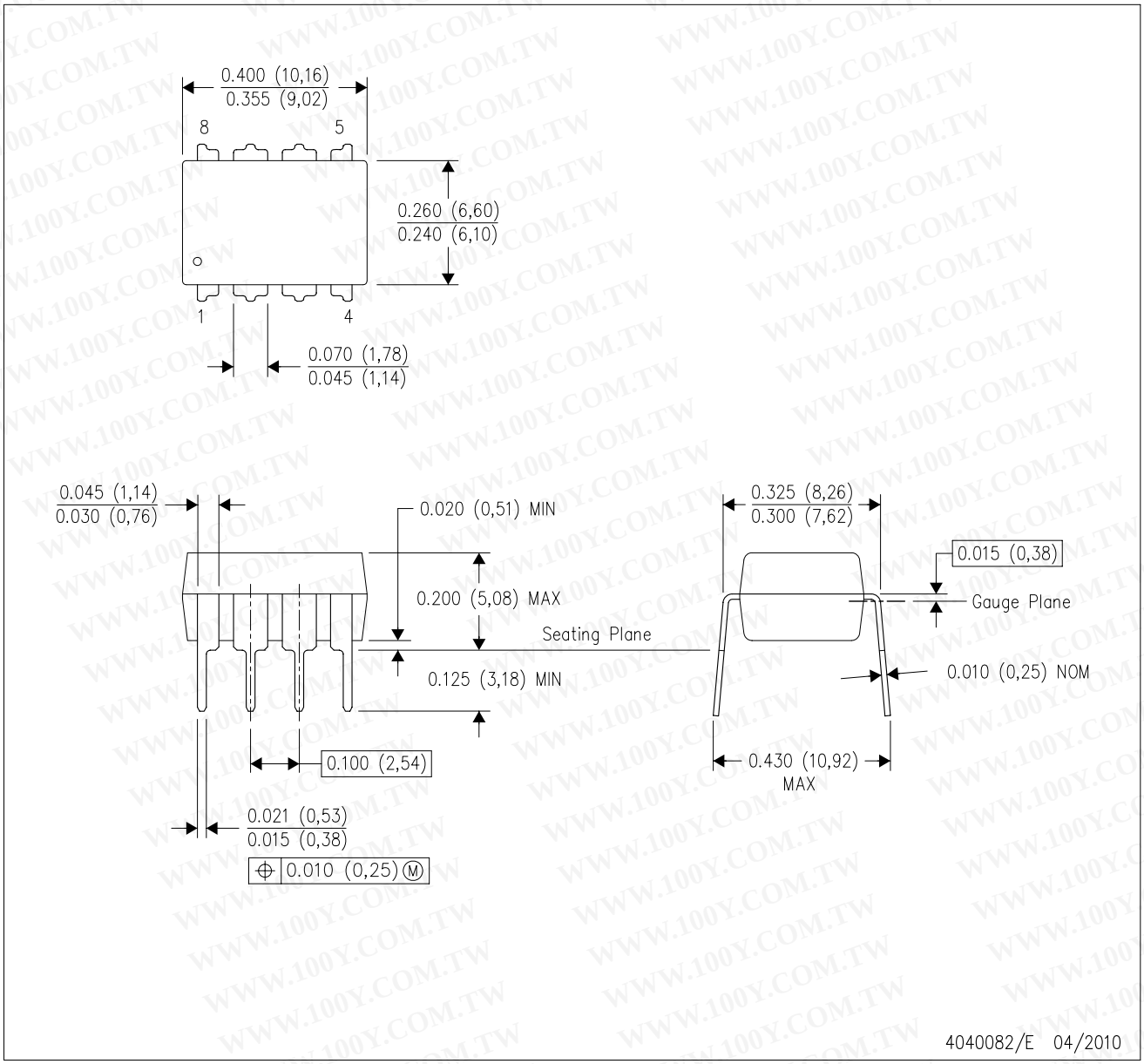

| NO. OF TERMINALS ** | A | | B | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| 20 | 0.342 (8,69) | 0.358 (9,09) | 0.307 (7,80) | 0.358 (9,09) |
| 28 | 0.442 (11,23) | 0.458 (11,63) | 0.406 (10,31) | 0.458 (11,63) |
| 44 | 0.640 (16,26) | 0.660 (16,76) | 0.495 (12,58) | 0.560 (14,22) |
| 52 | 0.740 (18,78) | 0.761 (19,32) | 0.495 (12,58) | 0.560 (14,22) |
| 68 | 0.938 (23,83) | 0.962 (24,43) | 0.850 (21,6) | 0.858 (21,8) |
| 84 | 1.141 (28,99) | 1.165 (29,59) | 1.047 (26,6) | 1.063 (27,0) |




4040140/D 01/11

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. Falls within JEDEC MS–004

P (R–PDIP–T8) PLASTIC DUAL–IN–LINE PACKAGE

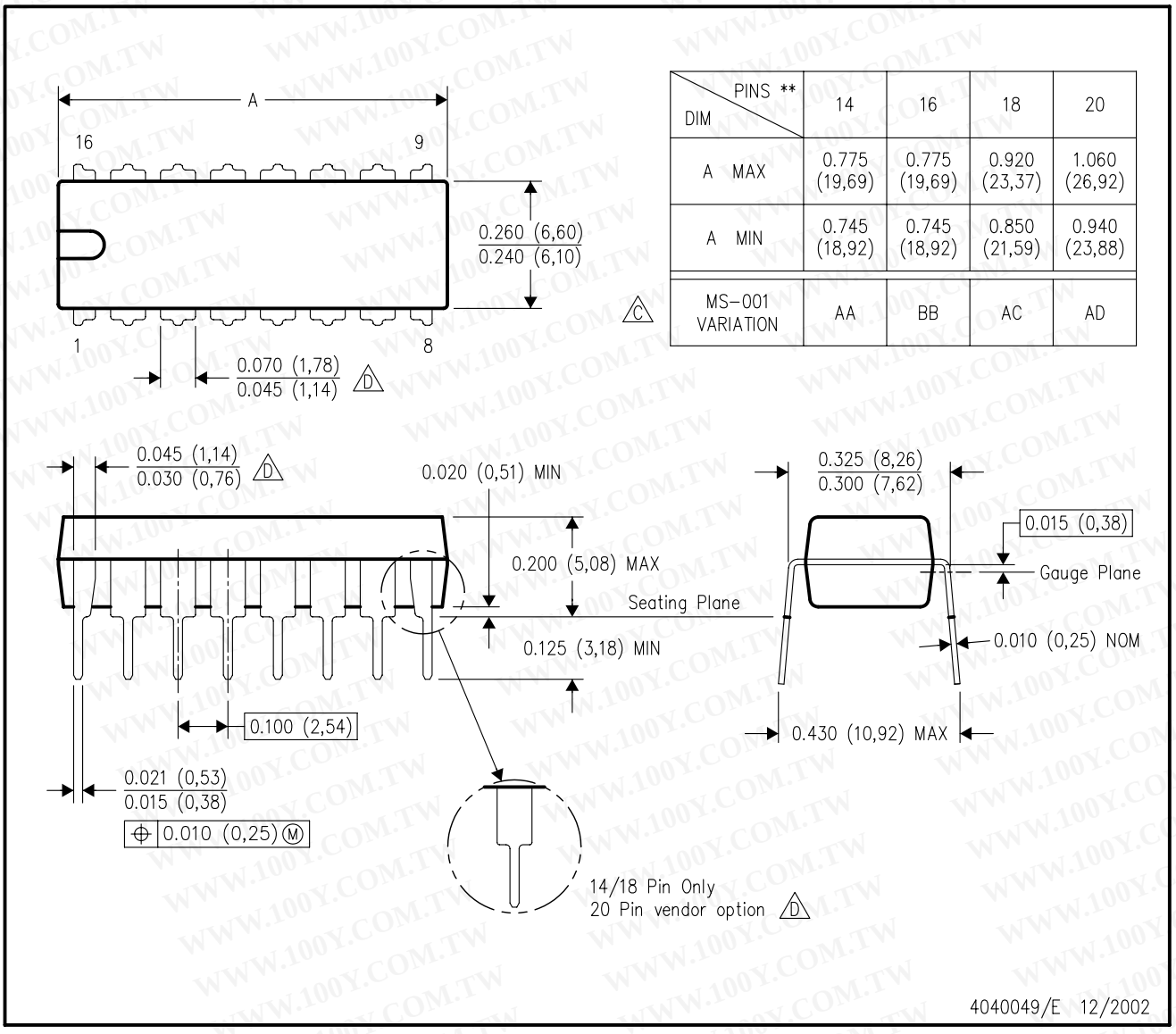



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN

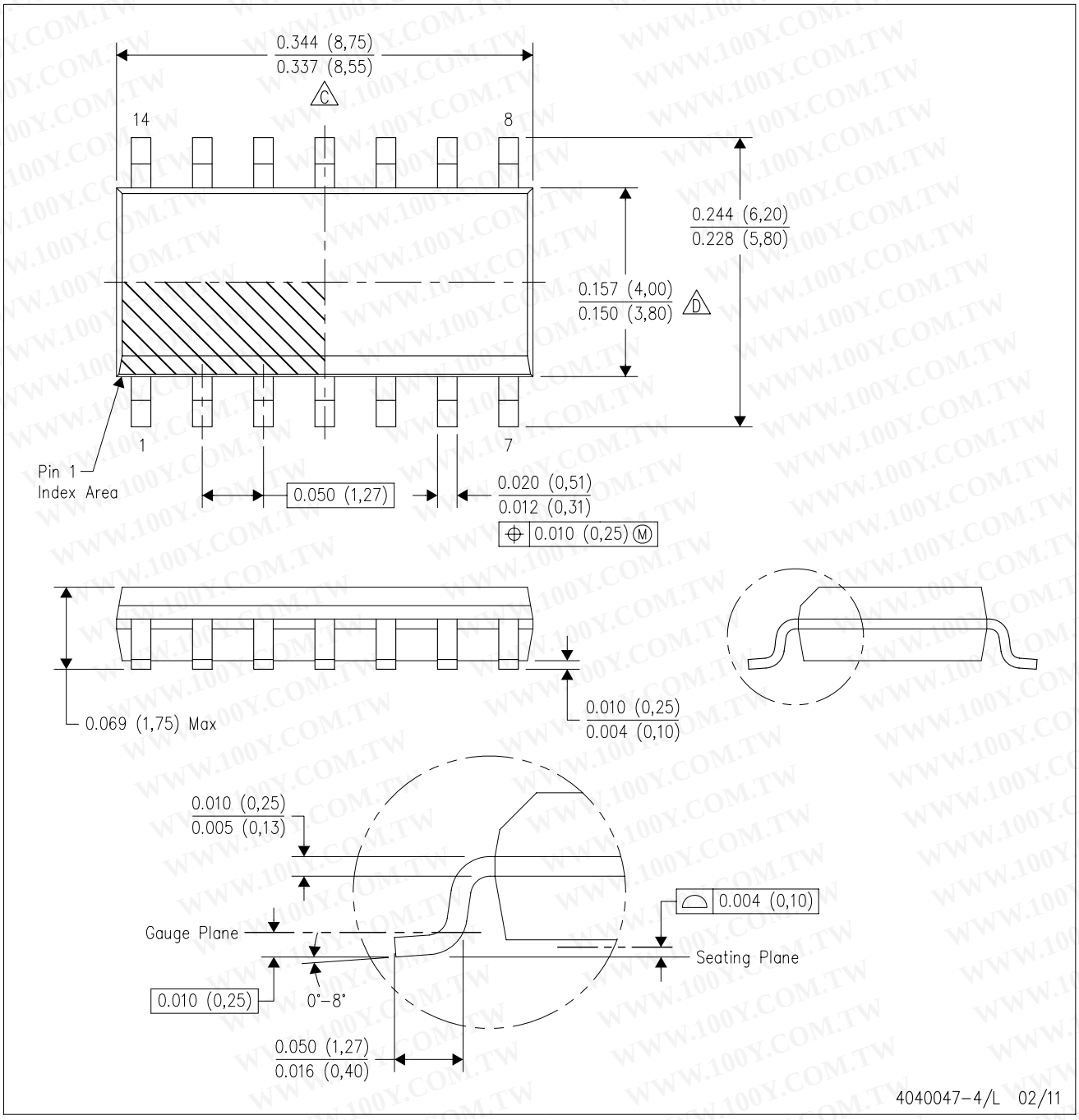



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION | AA | BB | AC | AD |

4040049/E 12/2002

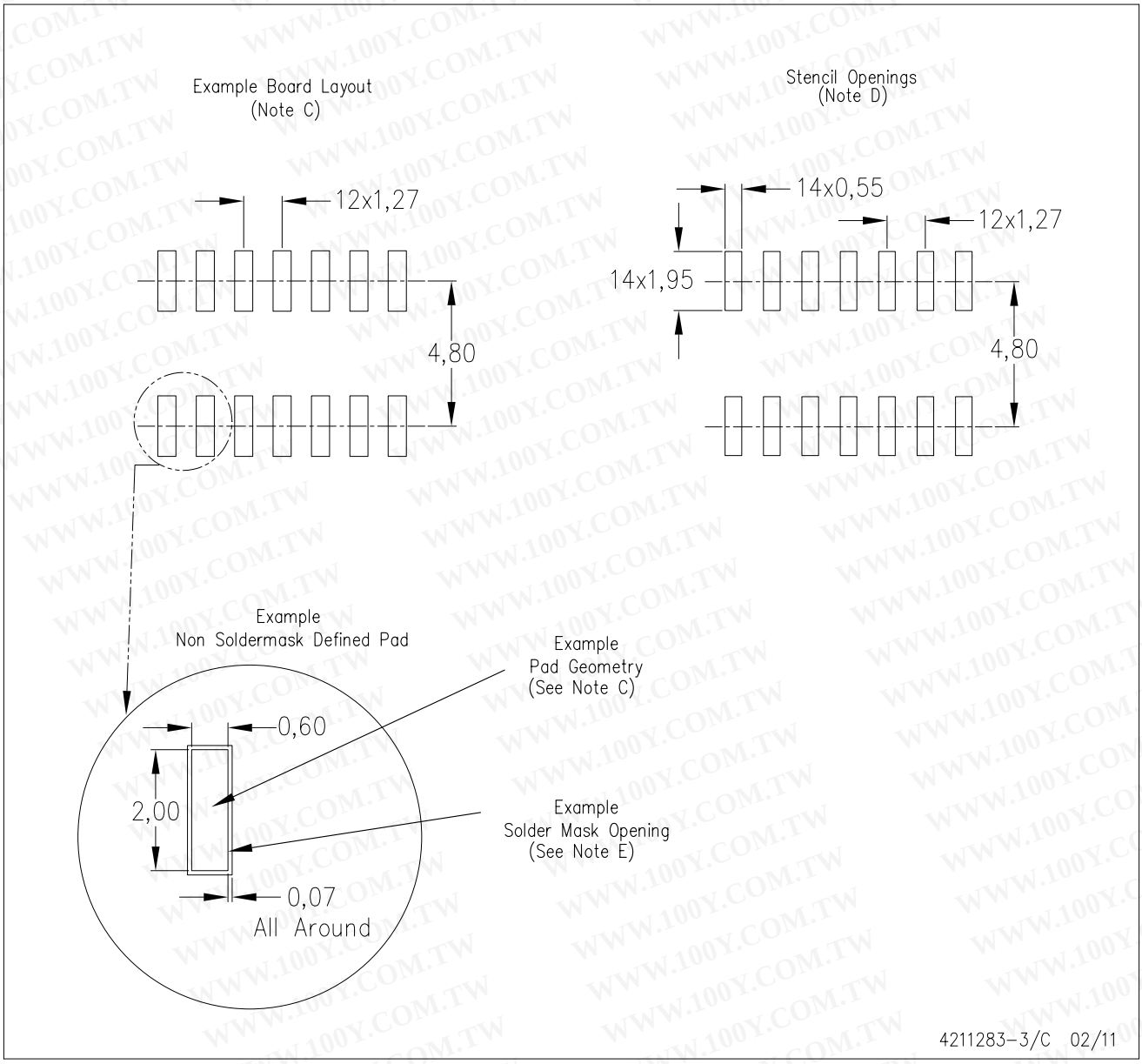
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R–PDSO–G14) PLASTIC SMALL OUTLINE



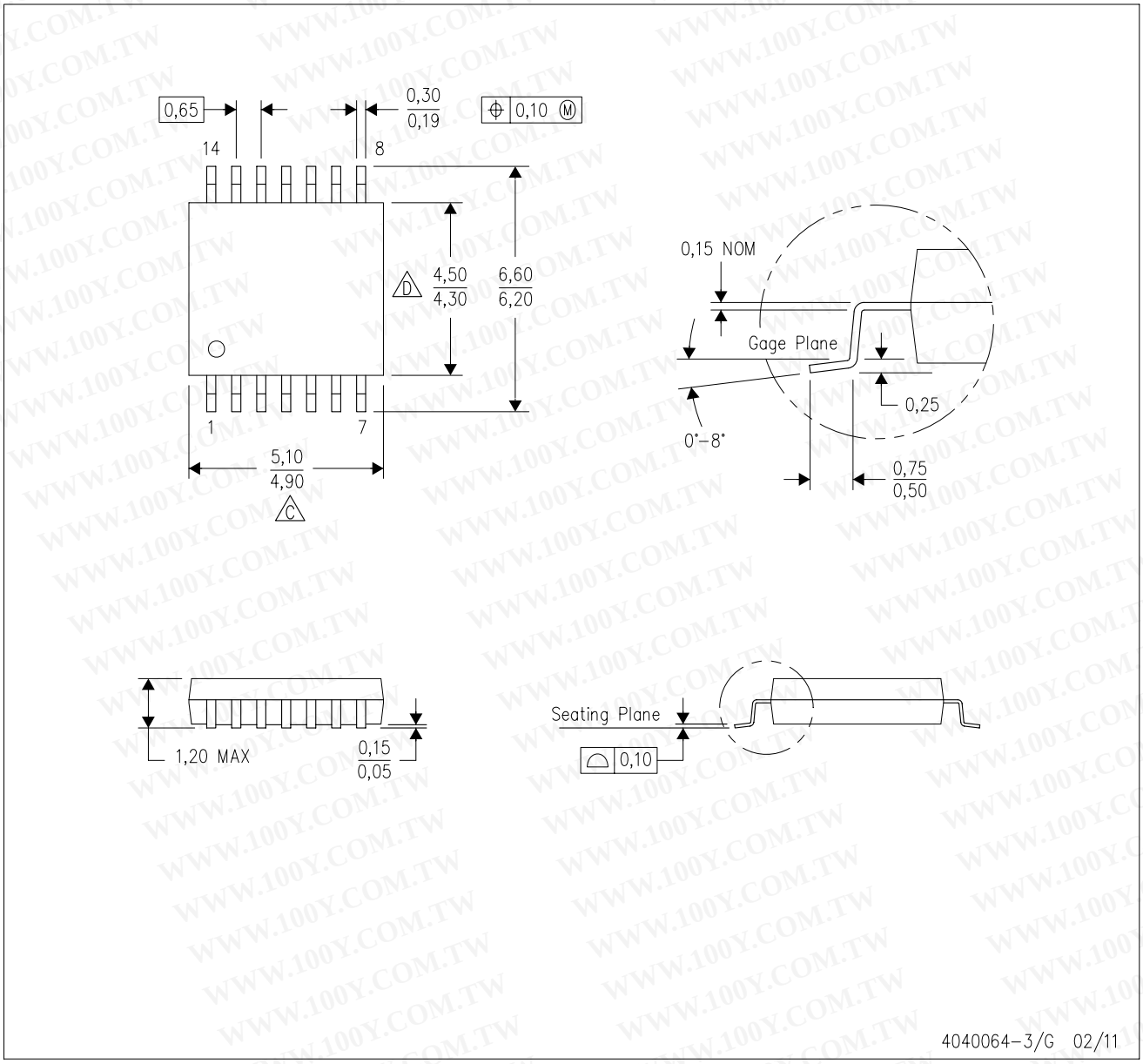

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AB.

D (R–PDSO–G14) PLASTIC SMALL OUTLINE



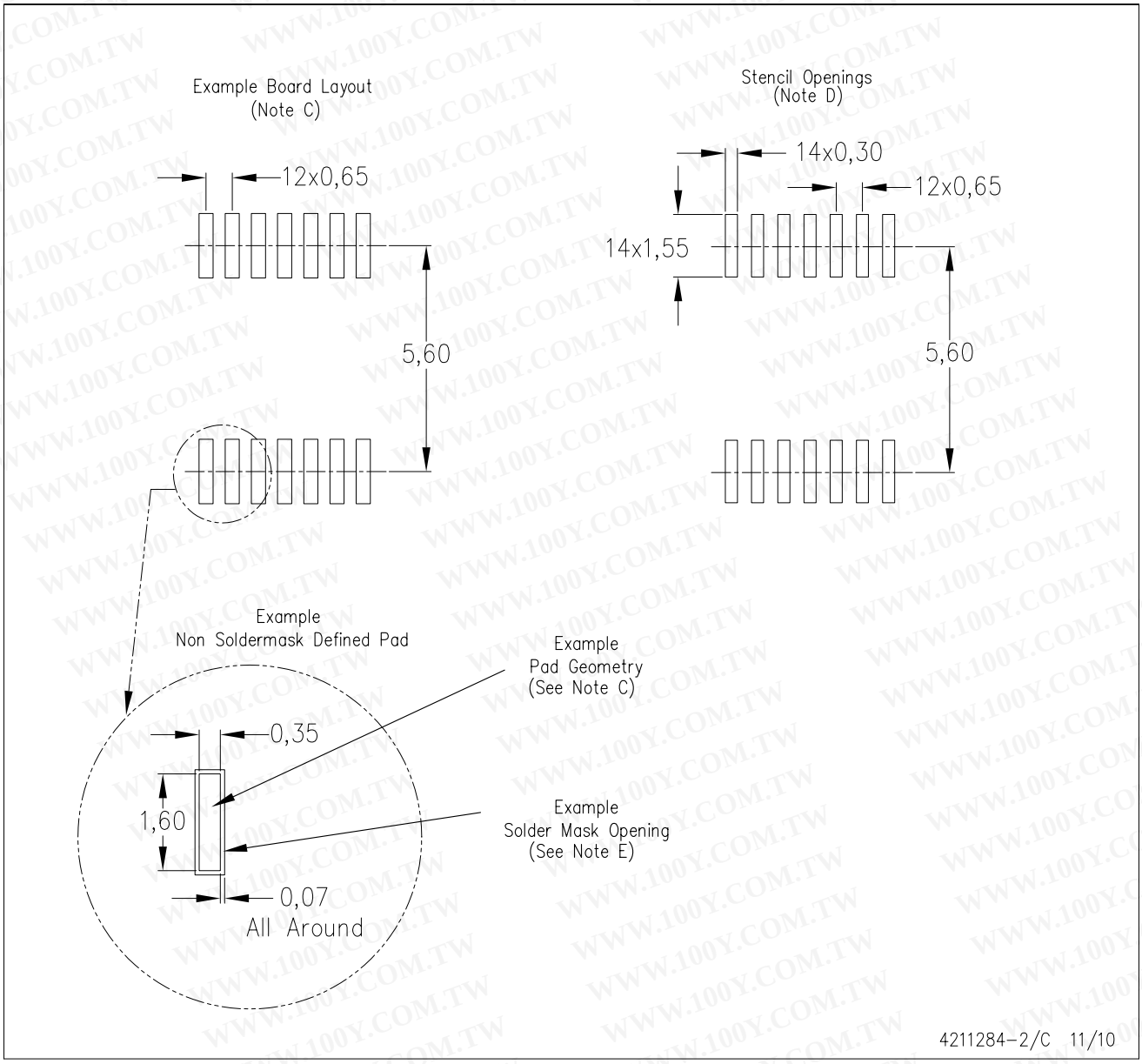

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact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

PW (R–PDSO–G14) PLASTIC SMALL OUTLINE



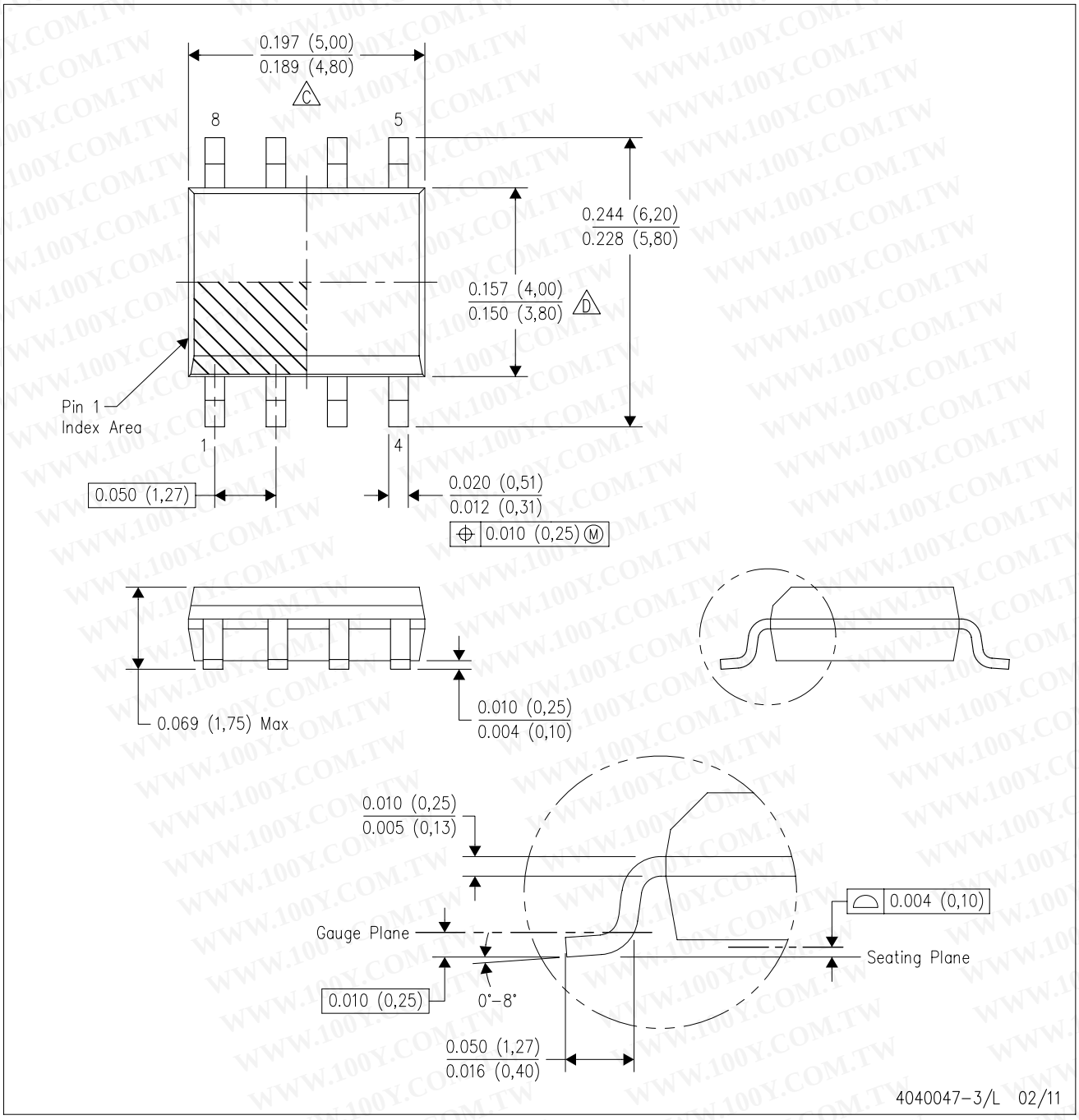

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

PW (R-PDSO-G14) PLASTIC SMALL OUTLINE



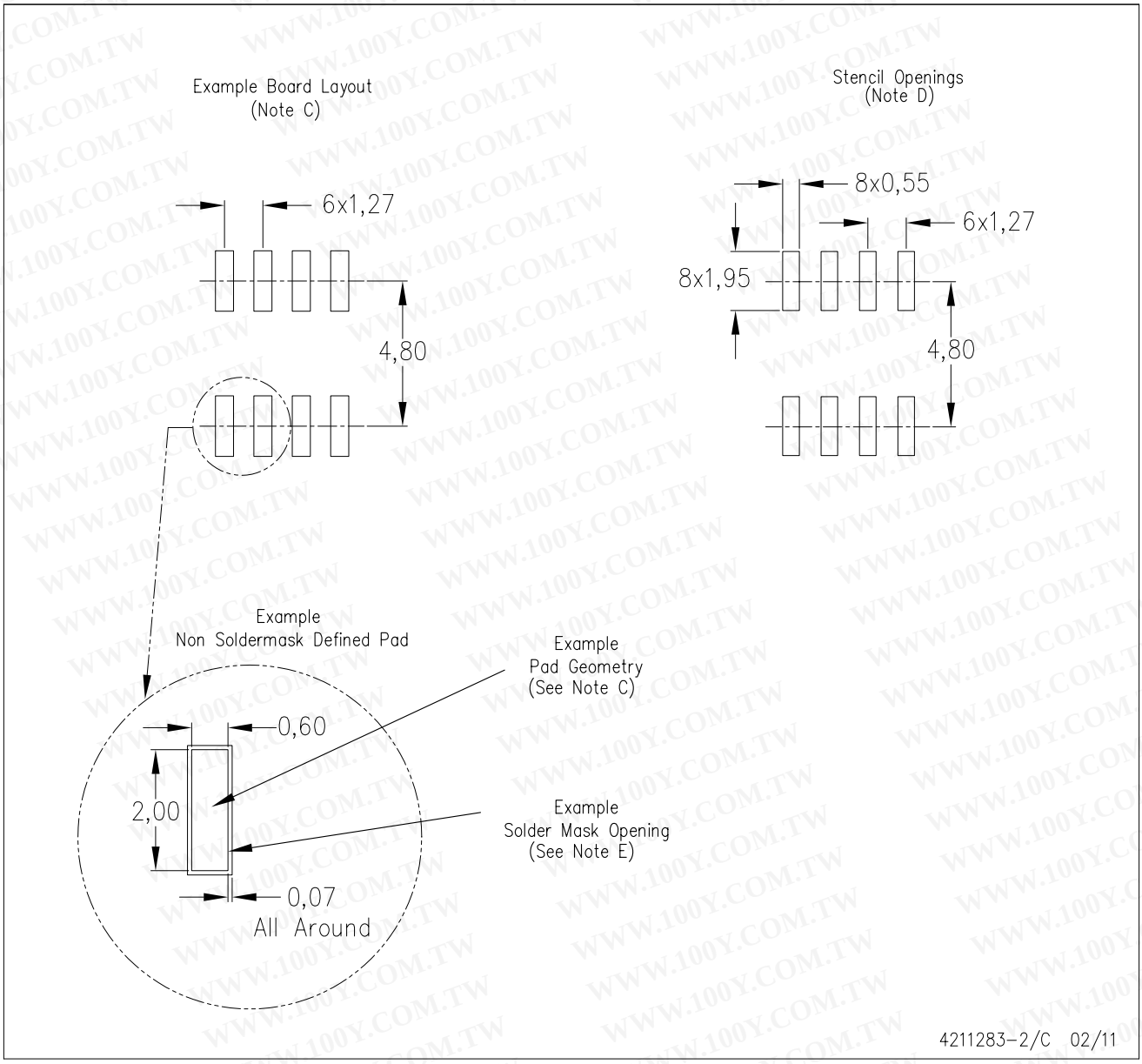

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC-7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact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

D (R–PDSO–G8) PLASTIC SMALL OUTLINE




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 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

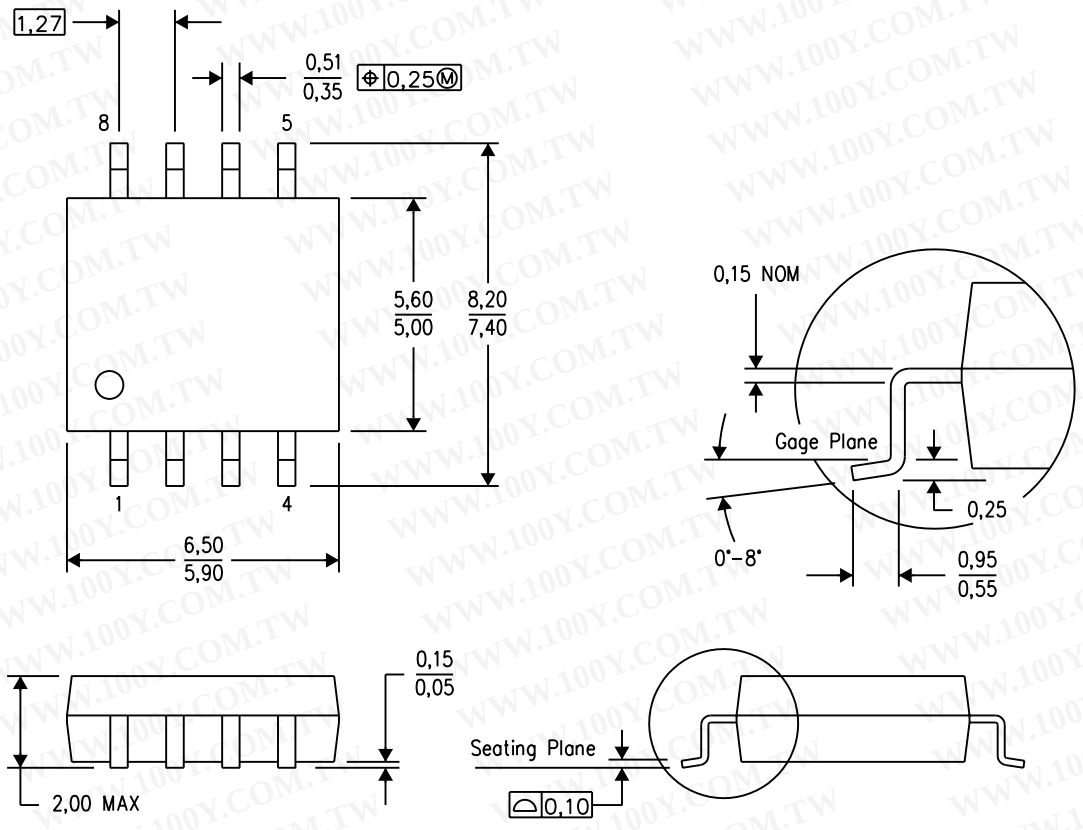
D (R–PDSO–G8) PLASTIC SMALL OUTLINE




NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. 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.
E. 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**



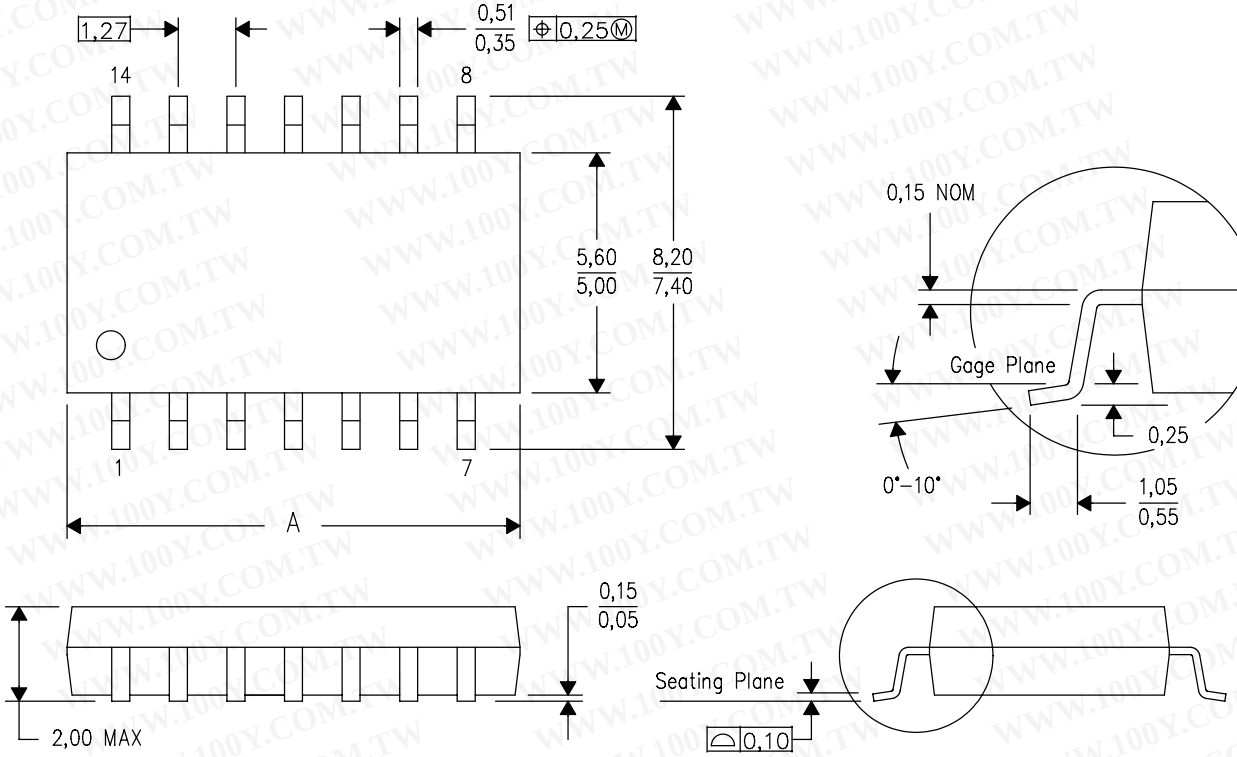

4040063/C 03/03

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**

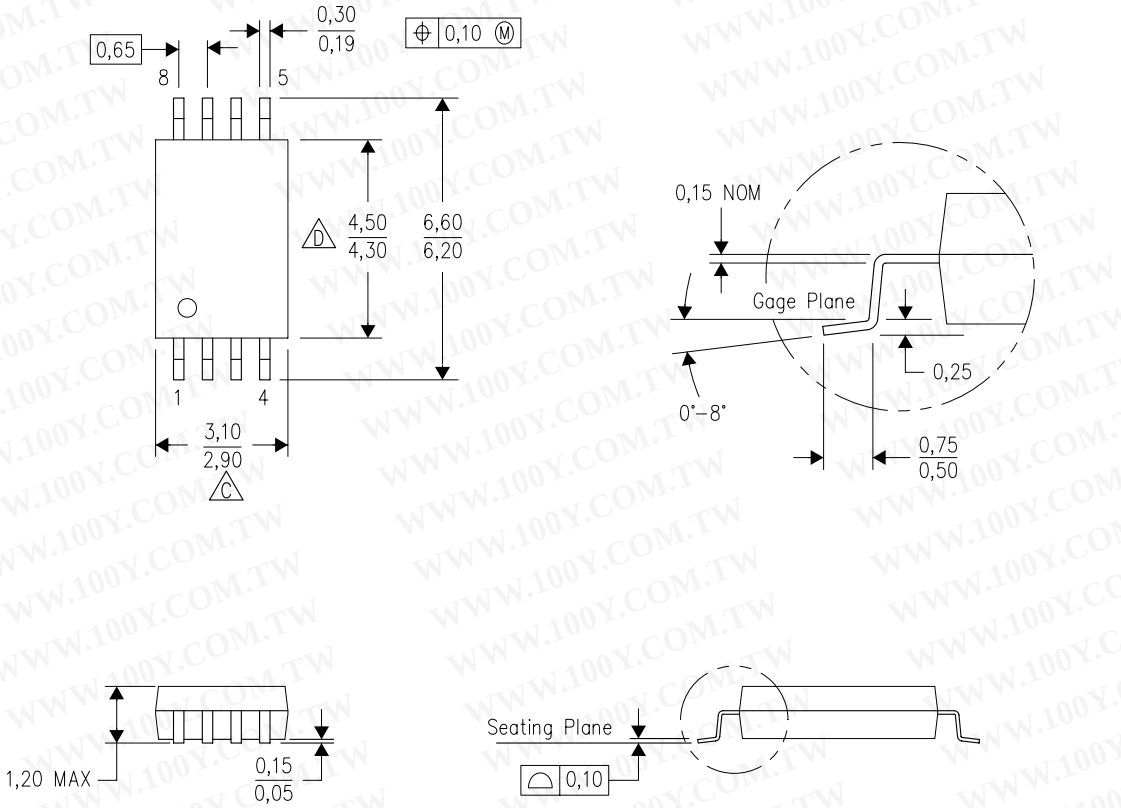



| DIM \ PINS ** | 14 | 16 | 20 | 24 |
|---|---|---|---|---|
| A MAX | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN | 9,90 | 9,90 | 12,30 | 14,70 |

4040062/C 03/03

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–G8) PLASTIC SMALL OUTLINE




4040064–2/G 02/11

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
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 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

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