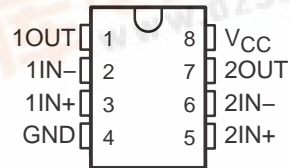


LM193, LM293, LM293A LM393, LM393A, LM2903, LM2903V DUAL DIFFERENTIAL COMPARATORS

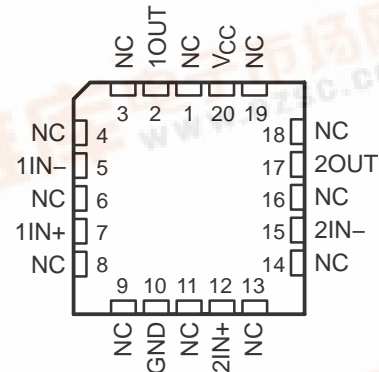
SLCS005S – JUNE 1976 – REVISED OCTOBER 2004

- **Single Supply or Dual Supplies**
- **Wide Range of Supply Voltage**
 - Max Rating . . . 2 V to 36 V
 - Tested to 30 V . . . Non-V Devices
 - Tested to 32 V . . . V-Suffix Devices
- **Low Supply-Current Drain Independent of Supply Voltage . . . 0.4 mA Typ Per Comparator**
- **Low Input Bias Current . . . 25 nA Typ**
- **Low Input Offset Current . . . 3 nA Typ (LM193)**
- **Low Input Offset Voltage . . . 2 mV Typ**
- **Common-Mode Input Voltage Range Includes Ground**
- **Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . ± 36 V**
- **Low Output Saturation Voltage**
- **Output Compatible With TTL, MOS, and CMOS**

LM193 . . . D OR JG PACKAGE
LM293 . . . D, DGK, OR P PACKAGE
LM293A . . . D OR DGK PACKAGE
LM393, LM393A . . . D, DGK, P, PS, OR PW PACKAGE
LM2903 . . . D, DGK, P, PS, OR PW PACKAGE
(TOP VIEW)



LM193 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description/ordering information

These devices consist of two independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies also is possible as long as the difference between the two supplies is 2 V to 36 V, and V_{CC} is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

The LM193 is characterized for operation from -55°C to 125°C . The LM293 and LM293A are characterized for operation from -25°C to 85°C . The LM393 and LM393A are characterized for operation from 0°C to 70°C . The LM2903 is characterized for operation from -40°C to 125°C .

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.

LM193, LM293, LM293A
LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS

SLCS005S – JUNE 1976 – REVISED OCTOBER 2004

description/ordering information (continued)

ORDERING INFORMATION

| TA | V _{IOMax} AT 25°C | MAX V _{CC} | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|------------------|-------------------------------|---------------------|--------------|--------------|--------------------------|---------------------|
| 0°C to 70°C | 5 mV | 30 V | PDIP (P) | Tube of 50 | LM393P | LM393P |
| | | | SOIC (D) | Tube of 75 | LM393D | LM393 |
| | | | | Reel of 2500 | LM393DR | |
| | | | SOP (PS) | Reel of 2000 | LM393PSR | L393 |
| | | | TSSOP (PW) | Tube of 150 | LM393PW | L393 |
| | Reel of 2000 | LM393PWR | | | | |
| | MSOP/VSSOP (DGK) | Reel of 2500 | LM393DGKR | M9 ‡ | | |
| | 2 mV | 30 V | PDIP (P) | Tube of 50 | LM393AP | LM393AP |
| | | | SOIC (D) | Tube of 75 | LM393AD | LM393A |
| | | | | Reel of 2500 | LM393ADR | |
| SOP (PS) | | | Reel of 2000 | LM393APSR | L393A | |
| TSSOP (PW) | | | Reel of 2000 | LM393APWR | L393A | |
| MSOP/VSSOP (DGK) | Reel of 2500 | LM393ADGKR | M8 ‡ | | | |
| -25°C to 85°C | 5 mV | 30 V | PDIP (P) | Tube of 50 | LM293P | LM293P |
| | | | SOIC (D) | Tube of 75 | LM293D | LM293 |
| | | | | Reel of 2500 | LM293DR | |
| | MSOP/VSSOP (DGK) | Reel of 2500 | LM293DGKR | MC ‡ | | |
| | 2 mV | 30 V | SOIC (D) | Tube of 75 | LM293AD | LM293A |
| Reel of 2500 | | | LM293ADR | | | |
| MSOP/VSSOP (DGK) | Reel of 2500 | LM293ADGKR | MD ‡ | | | |
| -40°C to 125°C | 7 mV | 30 V | PDIP (P) | Tube of 50 | LM2903P | LM2903P |
| | | | SOIC (D) | Tube of 75 | LM2903D | LM2903 |
| | | | | Reel of 2500 | LM2903DR | |
| | | | SOP (PS) | Reel of 2000 | LM2903PSR | L2903 |
| | | | TSSOP (PW) | Reel of 2000 | LM2903PWR | L2903 |
| | MSOP/VSSOP (DGK) | Reel of 2500 | LM2903DGKR | MA ‡ | | |
| | 7 mV | 32 V | SOIC (D) | Reel of 2500 | LM2903VQDR | L2903V |
| | | | TSSOP (PW) | Reel of 2000 | LM2903VQPWR | L2903V |
| | 2 mV | 32 V | SOIC (D) | Reel of 2500 | LM2903AVQDR | L2903AV |
| TSSOP (PW) | | | Reel of 2000 | LM2903AVQPWR | L2903AV | |
| -55°C to 125°C | 5 mV | 30 V | CDIP (JG) | Tube of 50 | LM193JG | LM193JG |
| | | | LCCC (FK) | Tube of 55 | LM193FK | LM193FK |
| | | | SOIC (D) | Reel of 2500 | LM193DR | LM193 |

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

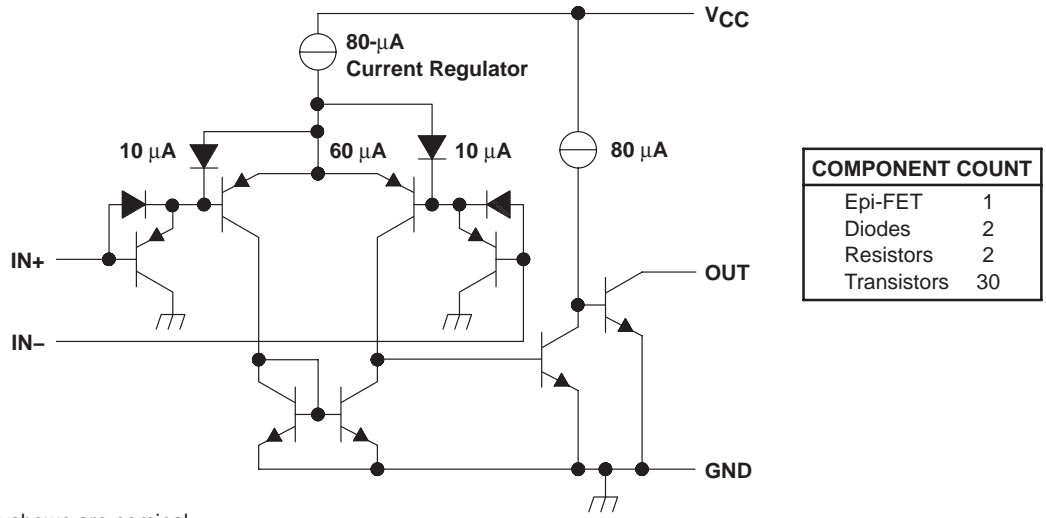
‡ The actual top-side marking has one additional character that designates the assembly/test site.

LM193, LM293, LM293A
LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS
 SLCS005S – JUNE 1976 – REVISED OCTOBER 2004

symbol (each comparator)



schematic (each comparator)



| COMPONENT COUNT | |
|-----------------|----|
| Epi-FET | 1 |
| Diodes | 2 |
| Resistors | 2 |
| Transistors | 30 |

Current values shown are nominal.

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

| | |
|--|----------------|
| Supply voltage, V_{CC} (see Note 1) | 36 V |
| Differential input voltage, V_{ID} (see Note 2) | ± 36 V |
| Input voltage range, V_I (either input) | -0.3 V to 36 V |
| Output voltage, V_O | 36 V |
| Output current, I_O | 20 mA |
| Duration of output short-circuit to ground (see Note 3) | Unlimited |
| Package thermal impedance, θ_{JA} (see Notes 4 and 5): | |
| D package | 97°C/W |
| DGK package | 172°C/W |
| P package | 85°C/W |
| PS package | 95°C/W |
| PW package | 149°C/W |
| Package thermal impedance, θ_{JC} (see Notes 6 and 7): | |
| FK package | 5.61°C/W |
| JG package | 14.5°C/W |
| Operating virtual junction temperature, T_J | 150°C |
| Case temperature for 60 seconds: FK package | 260°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package | 300°C |
| Storage temperature range, T_{stg} | -65°C 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:
- All voltage values, except differential voltages, are with respect to GND.
 - Differential voltages are at $IN+$, with respect to $IN-$.
 - Short circuits from outputs to V_{CC} can cause excessive heating and eventual destruction.
 - Maximum power dissipation is a function of $T_J(max)$, θ_{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.
 - The package thermal impedance is calculated in accordance with JESD 51-7.
 - Maximum power dissipation is a function of $T_J(max)$, θ_{JC} , and T_C . The maximum allowable power dissipation at any allowable case temperature is $P_D = (T_J(max) - T_C)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 - The package thermal impedance is calculated in accordance with MIL-STD-883.

LM193, LM293, LM293A
LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS

SLCS005S – JUNE 1976 – REVISED OCTOBER 2004

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_A † | LM193 | | | LM293 LM393 | | | UNIT |
|--|--|------------------------|------------|---------------------|------|---------------------|------|------|---------------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| V_{IO} Input offset voltage | $V_{CC} = 5\text{ V to }30\text{ V}$, $V_O = 1.4\text{ V}$, $V_{IC} = V_{IC(min)}$ | 25°C | | 2 | 5 | | 2 | 5 | mV |
| | | Full range | | | 9 | | 9 | | |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | 25°C | | 3 | 25 | | 5 | 50 | nA |
| | | Full range | | | 100 | | 250 | | |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | 25°C | | -25 | -100 | | -25 | -250 | nA |
| | | Full range | | | -300 | | -400 | | |
| V_{ICR} Common-mode input voltage range ‡ | | 25°C | | 0 to $V_{CC} - 1.5$ | | 0 to $V_{CC} - 1.5$ | | V | |
| | | Full range | | 0 to $V_{CC} - 2$ | | 0 to $V_{CC} - 2$ | | | |
| A_{VD} Large-signal differential-voltage amplification | $V_{CC} = 15\text{ V}$, $V_O = 1.4\text{ V to }11.4\text{ V}$, $R_L \geq 15\text{ k}\Omega\text{ to }V_{CC}$ | 25°C | | 50 | 200 | | 50 | 200 | V/mV |
| I_{OH} High-level output current | $V_{OH} = 5\text{ V}$, $V_{ID} = 1\text{ V}$ | 25°C | | 0.1 | | | 0.1 | 50 | nA |
| | $V_{OH} = 30\text{ V}$, $V_{ID} = 1\text{ V}$ | Full range | | | | | 1 | 1 | μA |
| V_{OL} Low-level output voltage | $I_{OL} = 4\text{ mA}$, $V_{ID} = -1\text{ V}$ | 25°C | | 150 | 400 | | 150 | 400 | mV |
| | | Full range | | 700 | | | 700 | | |
| I_{OL} Low-level output current | $V_{OL} = 1.5\text{ V}$, $V_{ID} = -1\text{ V}$ | 25°C | | 6 | | | 6 | | mA |
| I_{CC} Supply current | $R_L = \infty$ | $V_{CC} = 5\text{ V}$ | 25°C | 0.8 | | | 0.8 | | mA |
| | | $V_{CC} = 30\text{ V}$ | Full range | | | | 2.5 | | |

† Full range (MIN or MAX) for LM193 is -55°C to 125°C, for LM293 is 25°C to 85°C, and for LM393 is 0°C to 70°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

‡ The voltage at either input or common-mode should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is $V_{CC+} - 1.5\text{ V}$, but either or both inputs can go to 30 V without damage.

LM193, LM293, LM293A
LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS
 SLCS005S – JUNE 1976 – REVISED OCTOBER 2004

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_A † | LM293A LM393A | | | UNIT |
|--|--|------------------------|---------------------|-----|------|---------------|
| | | | MIN | TYP | MAX | |
| V_{IO} Input offset voltage | $V_{CC} = 5\text{ V to }30\text{ V}$, $V_O = 1.4\text{ V}$, $V_{IC} = V_{IC}(\text{min})$ | 25°C | | 1 | 2 | mV |
| | | Full range | | | 4 | |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | 25°C | | 5 | 50 | nA |
| | | Full range | | | 150 | |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | 25°C | | -25 | -250 | nA |
| | | Full range | | | -400 | |
| V_{ICR} Common-mode input voltage range§ | | 25°C | 0 to $V_{CC} - 1.5$ | | | V |
| | | Full range | 0 to $V_{CC} - 2$ | | | |
| A_{VD} Large-signal differential-voltage amplification | $V_{CC} = 15\text{ V}$, $V_O = 1.4\text{ V to }11.4\text{ V}$, $R_L \geq 15\text{ k}\Omega$ to V_{CC} | 25°C | 50 | 200 | | V/mV |
| I_{OH} High-level output current | $V_{OH} = 5\text{ V}$, $V_{ID} = 1\text{ V}$ | 25°C | | 0.1 | 50 | nA |
| | $V_{OH} = 30\text{ V}$, $V_{ID} = 1\text{ V}$ | Full range | | | 1 | μA |
| V_{OL} Low-level output voltage | $I_{OL} = 4\text{ mA}$, $V_{ID} = -1\text{ V}$ | 25°C | | 150 | 400 | mV |
| | | Full range | | | 700 | |
| I_{OL} Low-level output current | $V_{OL} = 1.5\text{ V}$, $V_{ID} = -1\text{ V}$ | 25°C | 6 | | | mA |
| I_{CC} Supply current | $R_L = \infty$ | $V_{CC} = 5\text{ V}$ | 25°C | 0.8 | 1 | mA |
| | | $V_{CC} = 30\text{ V}$ | Full range | | 2.5 | |

† Full range (MIN or MAX) for LM293A is 25°C to 85°C, and for LM393A is 0°C to 70°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

§ The voltage at either input or common-mode should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is $V_{CC+} - 1.5\text{ V}$, but either or both inputs can go to 30 V without damage.

**LM193, LM293, LM293A
LM393, LM393A, LM2903, LM2903V
DUAL DIFFERENTIAL COMPARATORS**

SLCS005S – JUNE 1976 – REVISED OCTOBER 2004

electrical characteristics at specified free-air temperature, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_A † | LM2903 | | | LM2903A | | | UNIT | |
|--|--|-----------------------|------------|---------------------|------|---------|---------------------|------|---------------|----|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | | |
| V_{IO} Input offset voltage | $V_{CC} = 5\text{ V to MAX}^\ddagger$, $V_O = 1.4\text{ V}$, $V_{IC} = V_{IC(min)}$ | 25°C | | 2 | 7 | | 1 | 2 | mV | |
| | | Full range | | | 15 | | | 4 | | |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | 25°C | | 5 | 50 | | 5 | 50 | nA | |
| | | Full range | | | 200 | | | 200 | | |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | 25°C | | -25 | -250 | | -25 | -250 | nA | |
| | | Full range | | | -500 | | | -500 | | |
| V_{ICR} Common-mode input voltage range§ | | 25°C | | 0 to $V_{CC} - 1.5$ | | | 0 to $V_{CC} - 1.5$ | | V | |
| | | Full range | | 0 to $V_{CC} - 2$ | | | 0 to $V_{CC} - 2$ | | | |
| A_{VD} Large-signal differential-voltage amplification | $V_{CC} = 15\text{ V}$, $V_O = 1.4\text{ V to }11.4\text{ V}$, $R_L \geq 15\text{ k}\Omega\text{ to }V_{CC}$ | 25°C | | 25 | 100 | | 25 | 100 | V/mV | |
| I_{OH} High-level output current | $V_{OH} = 5\text{ V}$, $V_{ID} = 1\text{ V}$ | 25°C | | 0.1 | 50 | | 0.1 | 50 | nA | |
| | $V_{OH} = V_{CC}\text{ MAX}$, $V_{ID} = 1\text{ V}$ | Full range | | | 1 | | | 1 | μA | |
| V_{OL} Low-level output voltage | $I_{OL} = 4\text{ mA}$, $V_{ID} = -1\text{ V}$ | 25°C | | 150 | 400 | | 150 | 400 | mV | |
| | | Full range | | | 700 | | | 700 | | |
| I_{OL} Low-level output current | $V_{OL} = 1.5\text{ V}$, $V_{ID} = -1\text{ V}$ | 25°C | | 6 | | | 6 | | mA | |
| I_{CC} Supply current | $R_L = \infty$ | $V_{CC} = 5\text{ V}$ | 25°C | | 0.8 | 1 | | 0.8 | 1 | mA |
| | | $V_{CC} = \text{MAX}$ | Full range | | | 2.5 | | | 2.5 | |

† Full range (MIN or MAX) for LM2903 is -40°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

‡ $V_{CC}\text{ MAX} = 30\text{ V}$ for non-V devices and 32 V for V-suffix devices.

§ The voltage at either input or common-mode should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is $V_{CC+} - 1.5\text{ V}$, but either or both inputs can go to 30 V (32 V for V-suffix devices) without damage.

switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | LM193 LM293, LM293A LM393, LM393A LM2903 | UNIT | |
|---------------|---|---|------|---------------|
| | | TYP | | |
| Response time | R_L connected to 5 V through 5.1 k Ω , $C_L = 15\text{ pF}$ †, See Note 8 | 100-mV input step with 5-mV overdrive | 1.3 | μs |
| | | TTL-level input step | 0.3 | |

† C_L includes probe and jig capacitance.

NOTE 8: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| 5962-9452601Q2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | Level-NC-NC-NC |
| 5962-9452601QPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | Level-NC-NC-NC |
| JM38510/11202BPA | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | Level-NC-NC-NC |
| LM193DR | ACTIVE | SOIC | D | 8 | 2500 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| LM193FKB | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | Level-NC-NC-NC |
| LM193JG | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | Level-NC-NC-NC |
| LM193JGB | ACTIVE | CDIP | JG | 8 | 1 | TBD | A42 SNPB | Level-NC-NC-NC |
| LM2903AVQDR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-250C-1 YEAR/ Level-1-235C-UNLIM |
| LM2903AVQPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-250C-UNLIM |
| LM2903D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903P | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM2903PE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM2903PSR | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903PSRG4 | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903PWG4 | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903PWLE | OBSOLETE | TSSOP | PW | 8 | | TBD | Call TI | Call TI |
| LM2903PWR | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903PWRE4 | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903PWRG4 | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM2903QD | NRND | SOIC | D | 8 | 75 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| LM2903QDR | NRND | SOIC | D | 8 | 2500 | TBD | CU NIPDAU | Level-1-220C-UNLIM |
| LM2903QP | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| LM2903VQDR | ACTIVE | SOIC | D | 8 | 2500 | Pb-Free | CU NIPDAU | Level-2-250C-1 YEAR/ |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| | | | | | | (RoHS) | | Level-1-235C-UNLIM |
| LM2903VQPWR | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | CU NIPDAU | Level-1-250C-UNLIM |
| LM293AD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293ADE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293ADG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293ADGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293ADR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293ADRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293ADRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293DE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293DRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM293P | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM293PE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM393AD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393ADE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393ADG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393ADGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393ADR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393ADRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393ADRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393AP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM393APE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free | CU NIPDAU | Level-NC-NC-NC |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| | | | | | | (RoHS) | | |
| LM393APSR | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393APSRE4 | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393APWLE | OBSOLETE | TSSOP | PW | 8 | | TBD | Call TI | Call TI |
| LM393APWR | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393APWRE4 | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393DE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393DRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393P | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM393PE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| LM393PSLE | OBSOLETE | SO | PS | 8 | | TBD | Call TI | Call TI |
| LM393PSR | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393PSRG4 | ACTIVE | SO | PS | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393PW | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393PWE4 | ACTIVE | TSSOP | PW | 8 | 150 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393PWLE | OBSOLETE | TSSOP | PW | 8 | | TBD | Call TI | Call TI |
| LM393PWR | ACTIVE | TSSOP | PW | 8 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM393PWRE4 | ACTIVE | TSSOP | PW | 8 | 2000 | TBD | Call TI | Call TI |
| LM393PWRG4 | ACTIVE | TSSOP | PW | 8 | 2000 | 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) 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.

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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

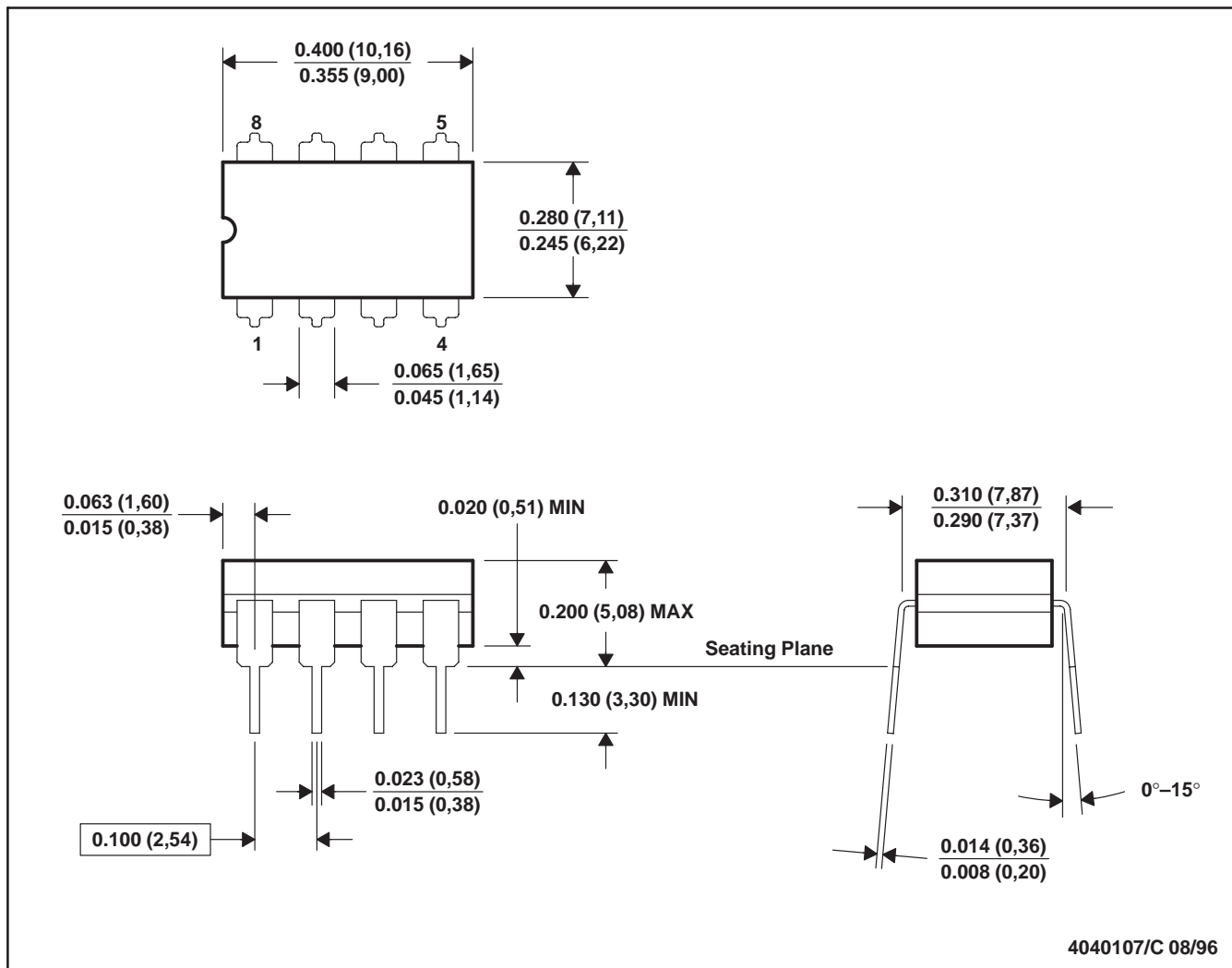
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

MECHANICAL DATA

MCER001A – JANUARY 1995 – REVISED JANUARY 1997

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



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

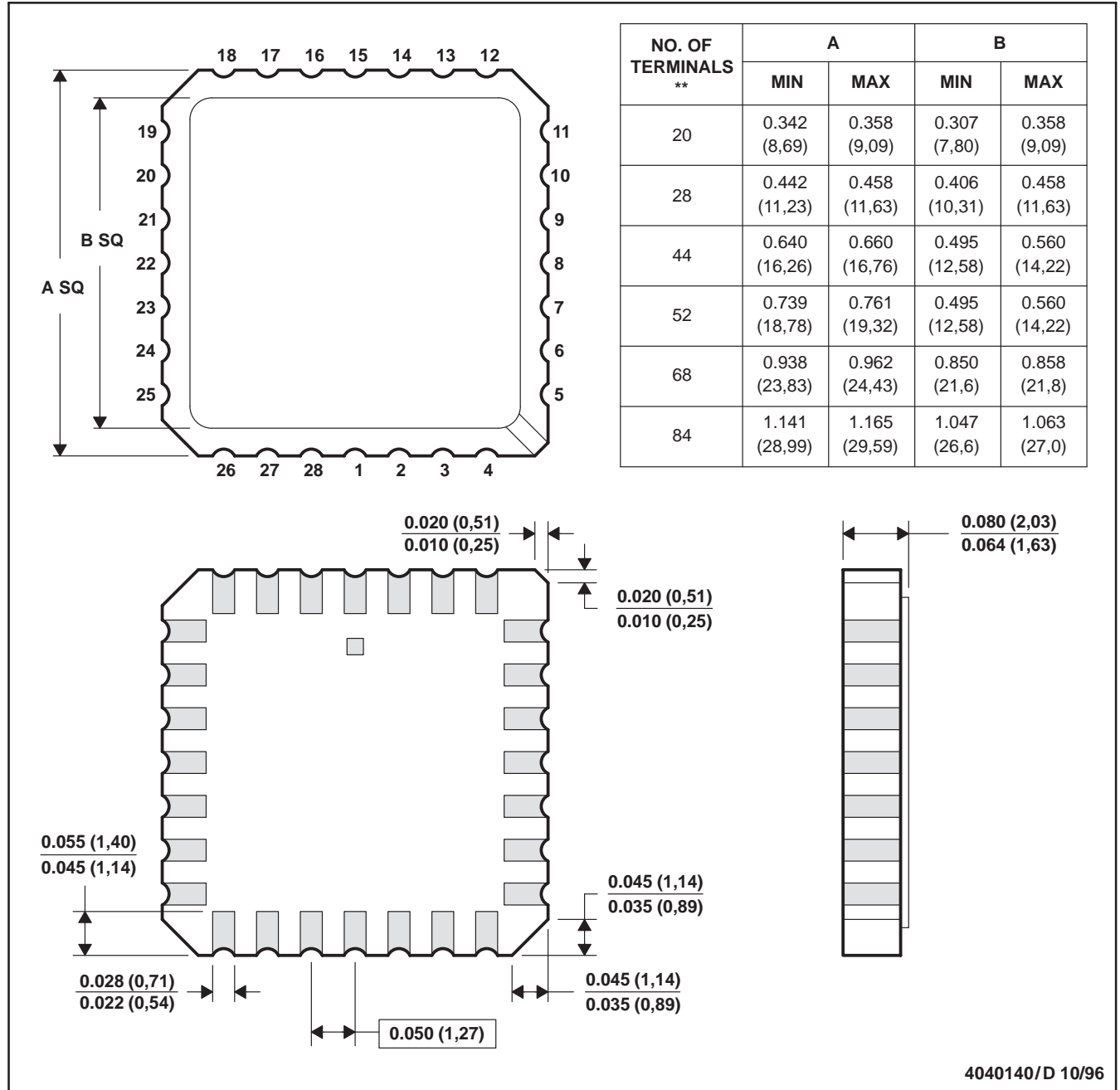
MECHANICAL DATA

MLCC006B – OCTOBER 1996

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



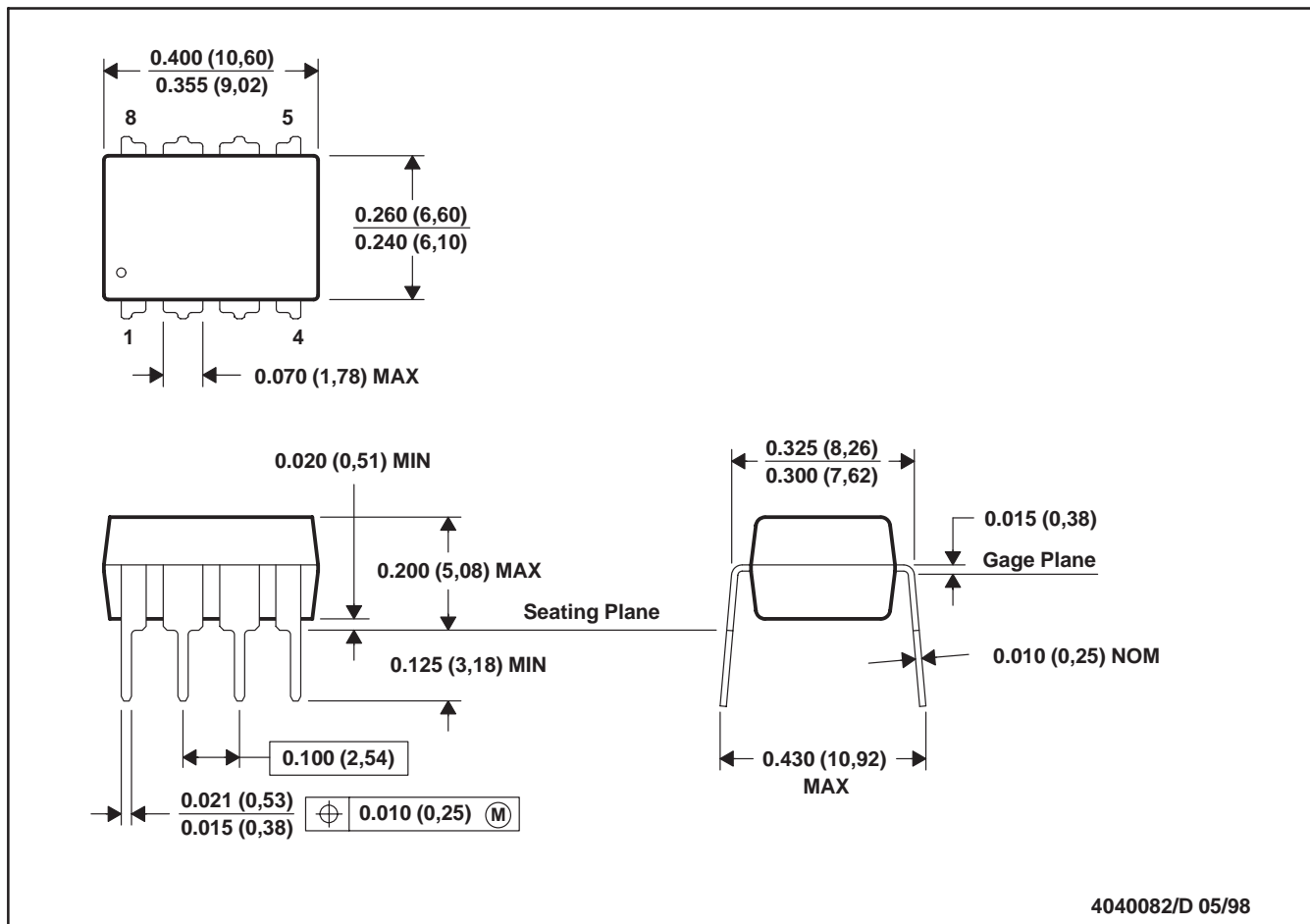
- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a metal lid.
 - The terminals are gold plated.
 - Falls within JEDEC MS-004

MECHANICAL DATA

MPDI001A – JANUARY 1995 – REVISED JUNE 1999

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



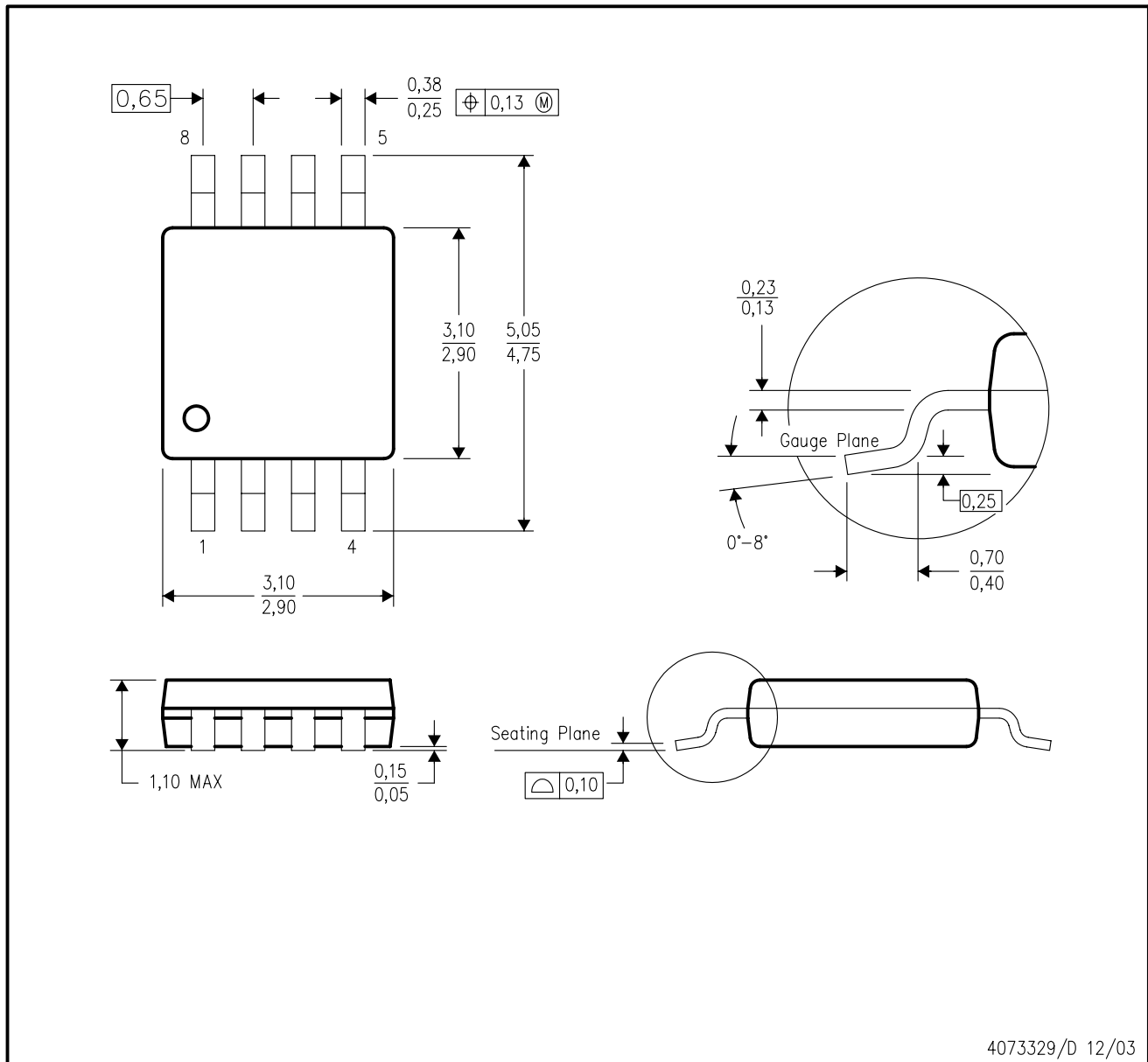
4040082/D 05/98

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

MECHANICAL DATA

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

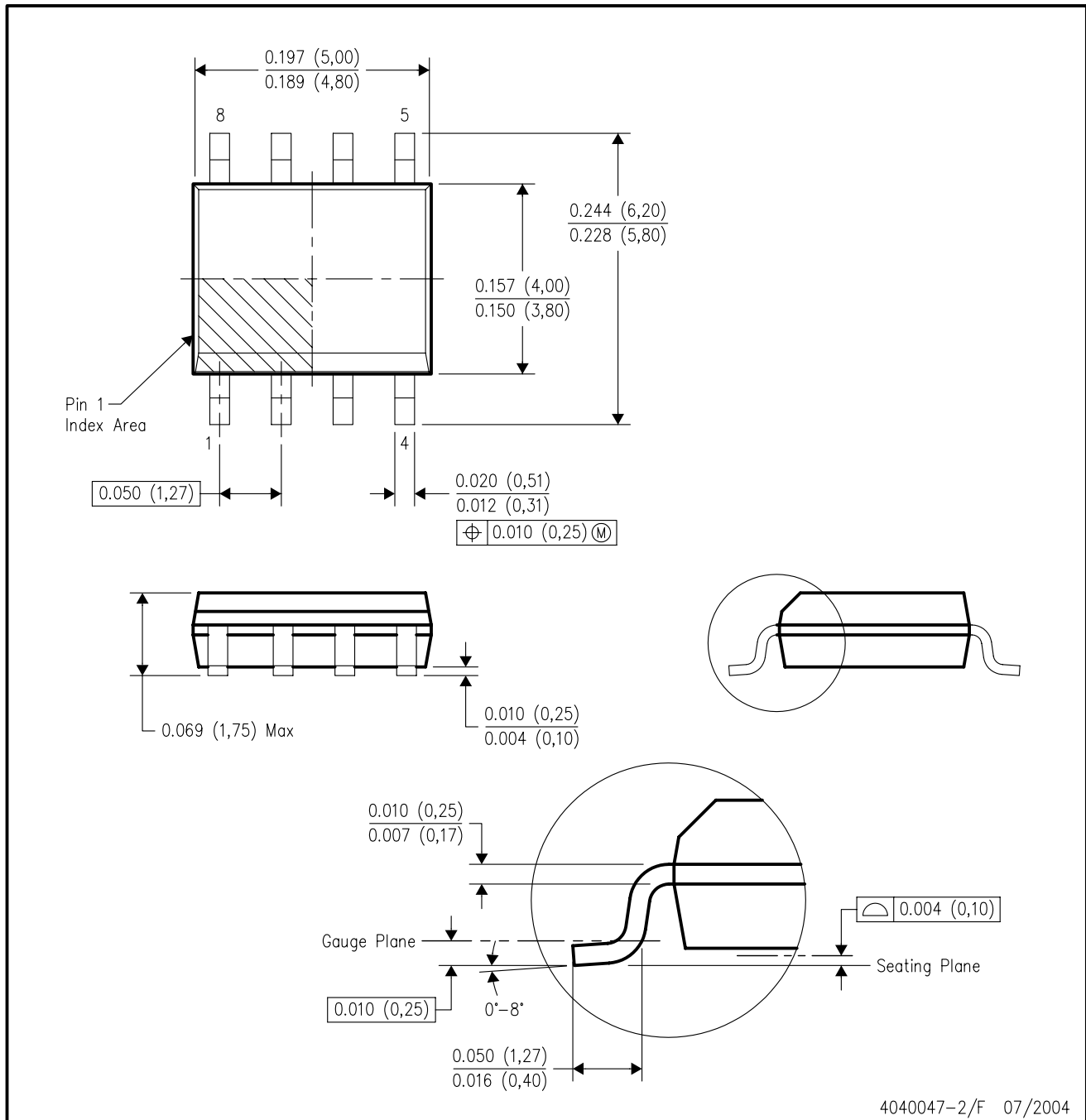


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion.
 - D. Falls within JEDEC MO-187 variation AA.

MECHANICAL DATA

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

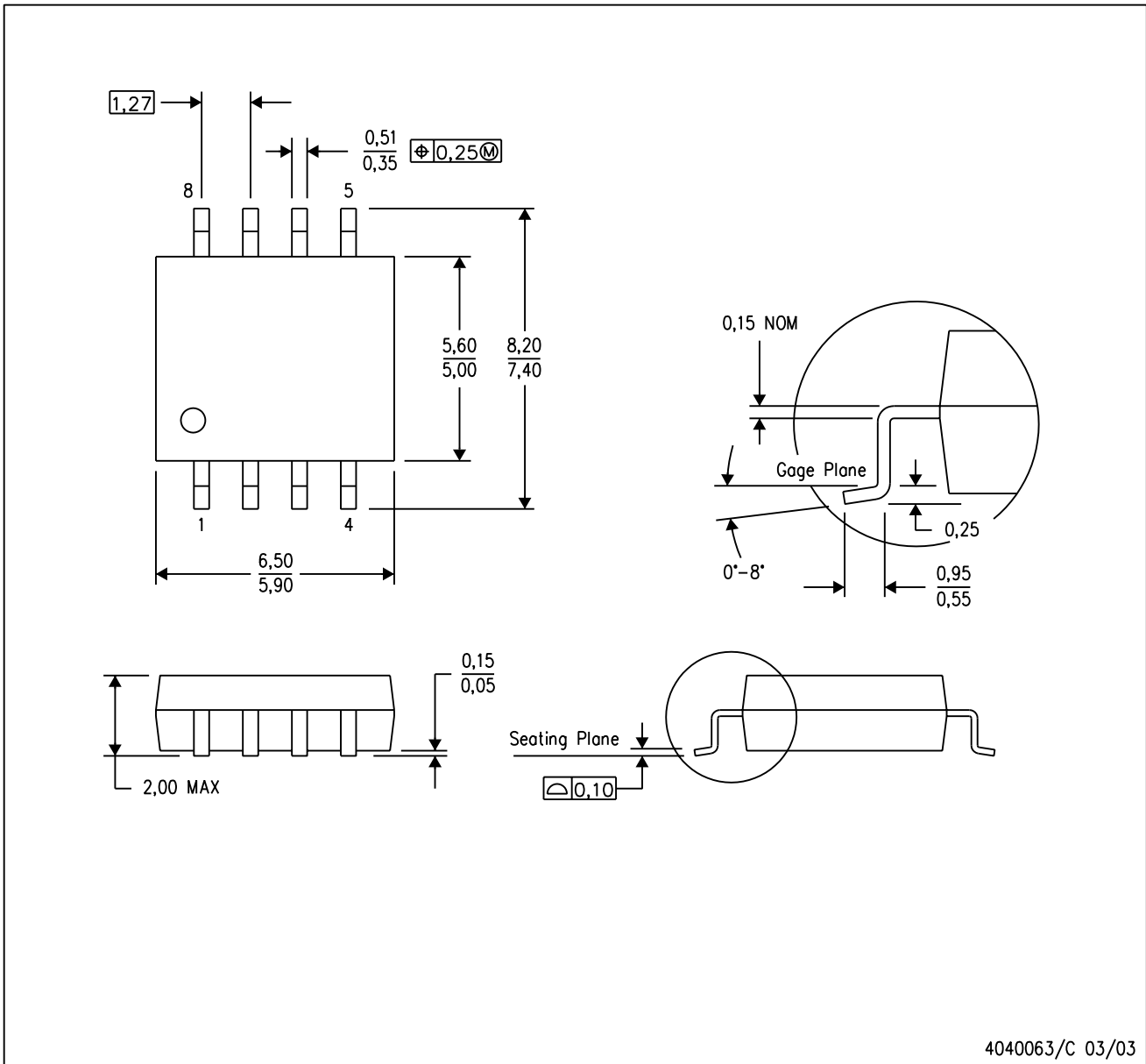


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-012 variation AA.

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.

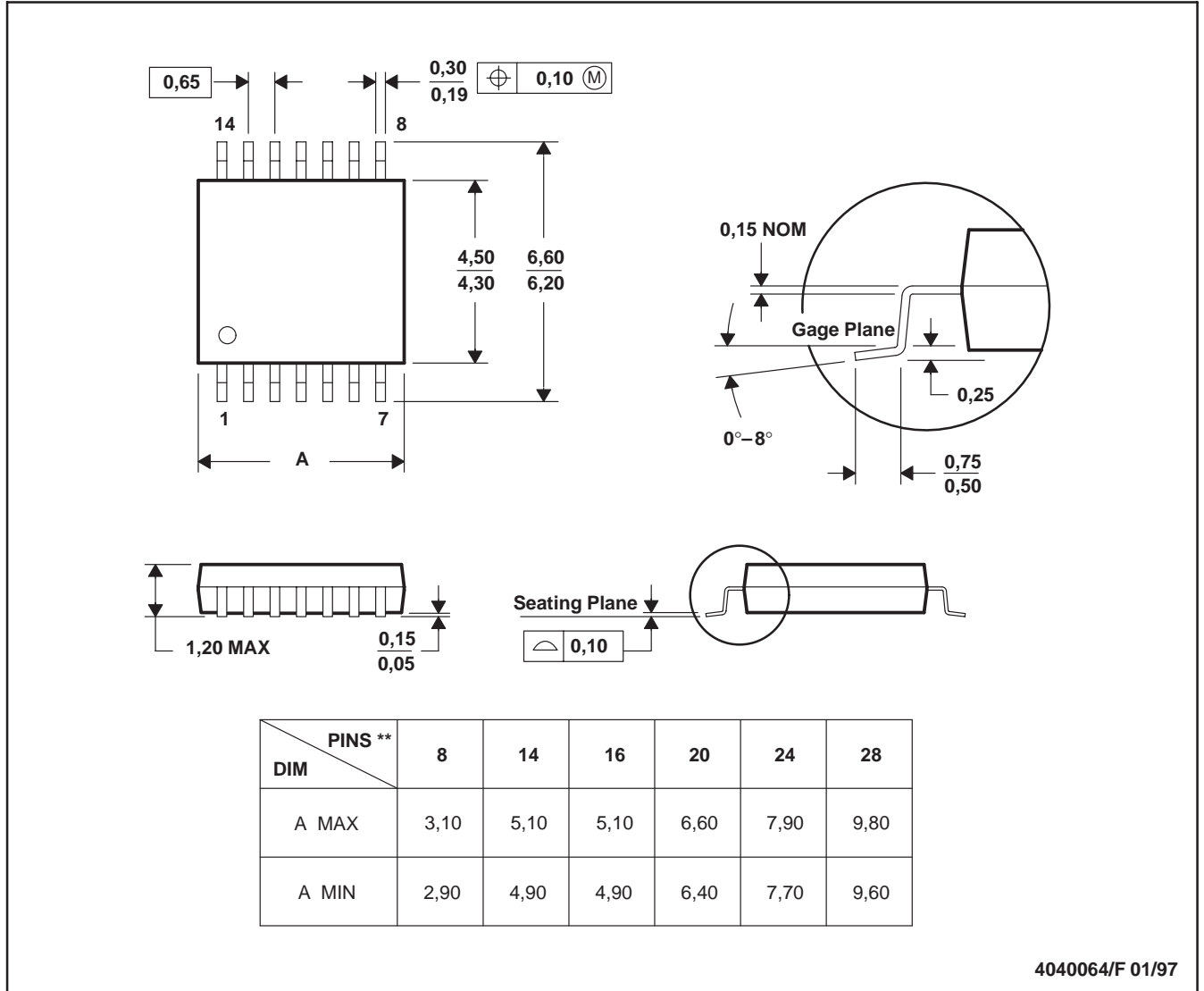
MECHANICAL DATA

MTSS001C – JANUARY 1995 – REVISED FEBRUARY 1999

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

| Products | | Applications | |
|------------------|--|---------------------|--|
| Amplifiers | amplifier.ti.com | Audio | www.ti.com/audio |
| Data Converters | dataconverter.ti.com | Automotive | www.ti.com/automotive |
| DSP | dsp.ti.com | Broadband | www.ti.com/broadband |
| Interface | interface.ti.com | Digital Control | www.ti.com/digitalcontrol |
| Logic | logic.ti.com | Military | www.ti.com/military |
| Power Mgmt | power.ti.com | Optical Networking | www.ti.com/opticalnetwork |
| Microcontrollers | microcontroller.ti.com | Security | www.ti.com/security |
| | | Telephony | www.ti.com/telephony |
| | | Video & Imaging | www.ti.com/video |
| | | Wireless | www.ti.com/wireless |

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265