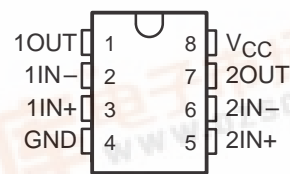


- **Low-Voltage and Single-Supply Operation**
 $V_{CC} = 2\text{ V to }7\text{ V}$
- **Common-Mode Voltage Range That Includes Ground**

D, P, OR PW PACKAGE
 (TOP VIEW)



description

The TL393 is a dual differential comparator built using a new Texas Instruments-developed bipolar process. The TL393 is intended as an enhanced alternative to the industry-standard LM393 in circuits with supply-voltage limits of 7 V.

The new bipolar process allows the TL393 to perform with lower supply-current requirements than the LM393 (0.7 mA typical) while still providing a faster response time than the older device.

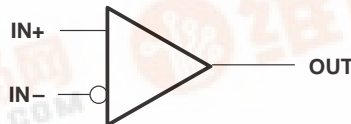
Package availability for this device includes the TSSOP (thin-shrink small-outline package). With a maximum thickness of 1.1 mm and a package area that is 25% smaller than the standard surface-mount package, the TSSOP is ideal for high-density circuits, particularly in hand-held and portable equipment.

AVAILABLE OPTIONS

| T _A | SUPPLY CURRENT (TYP) | RESPONSE TIME (TYP) | PACKAGED DEVICES | | | CHIP FORM (Y) |
|----------------|----------------------|---------------------|-------------------|-----------------|-------------------------|---------------|
| | | | SMALL OUTLINE (D) | PLASTIC DIP (P) | TSSOP (PW) [†] | |
| -40°C to 105°C | 0.7 mA | 0.65 μs | TL393ID | TL393IP | TL393IPWLE | TL393Y |

[†] The PW packages are only available left-ended taped and reeled (e.g., TL393IPWLE).

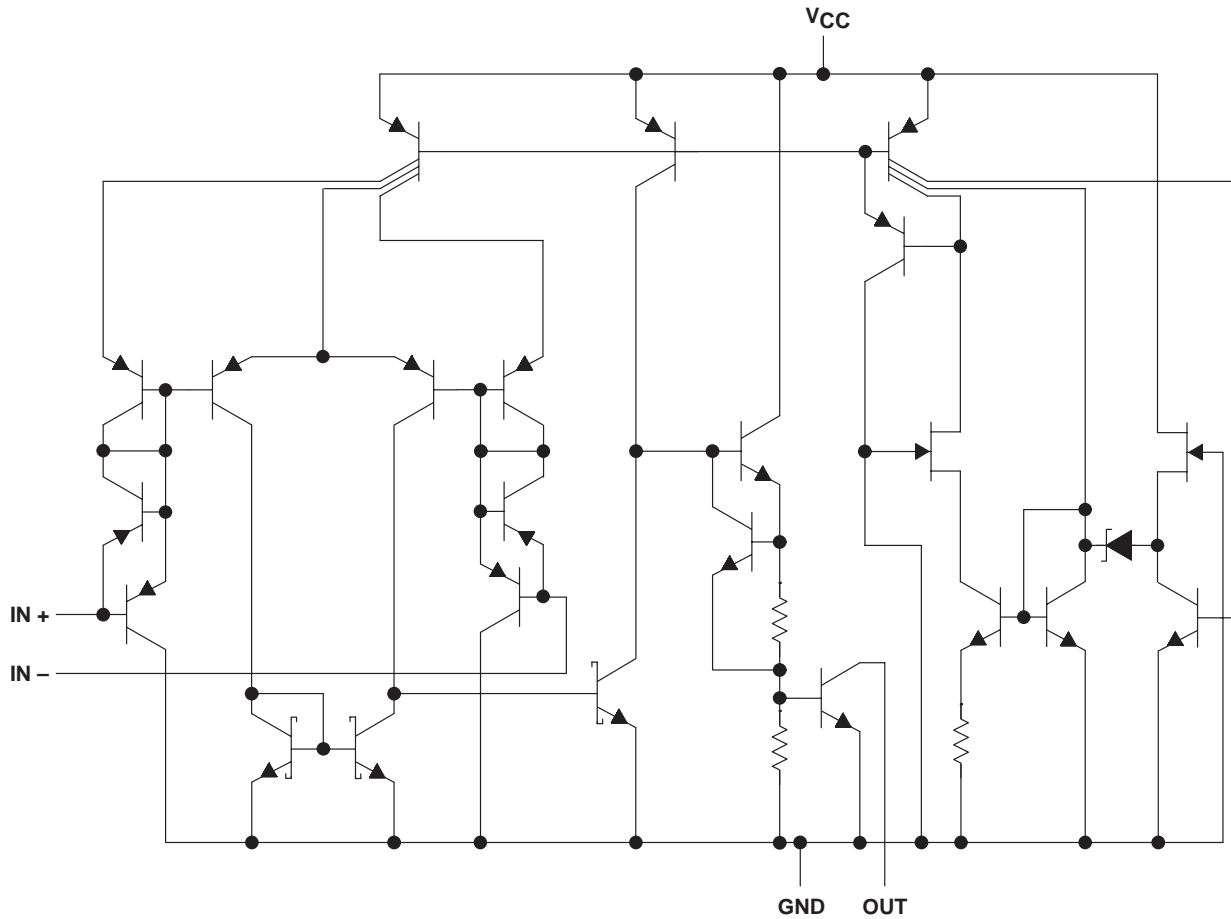
symbol (each comparator)



TL393, TL393Y DUAL DIFFERENTIAL COMPARATORS

SLCS120A – AUGUST 1993 – REVISED DECEMBER 1993

equivalent schematic (each comparator)



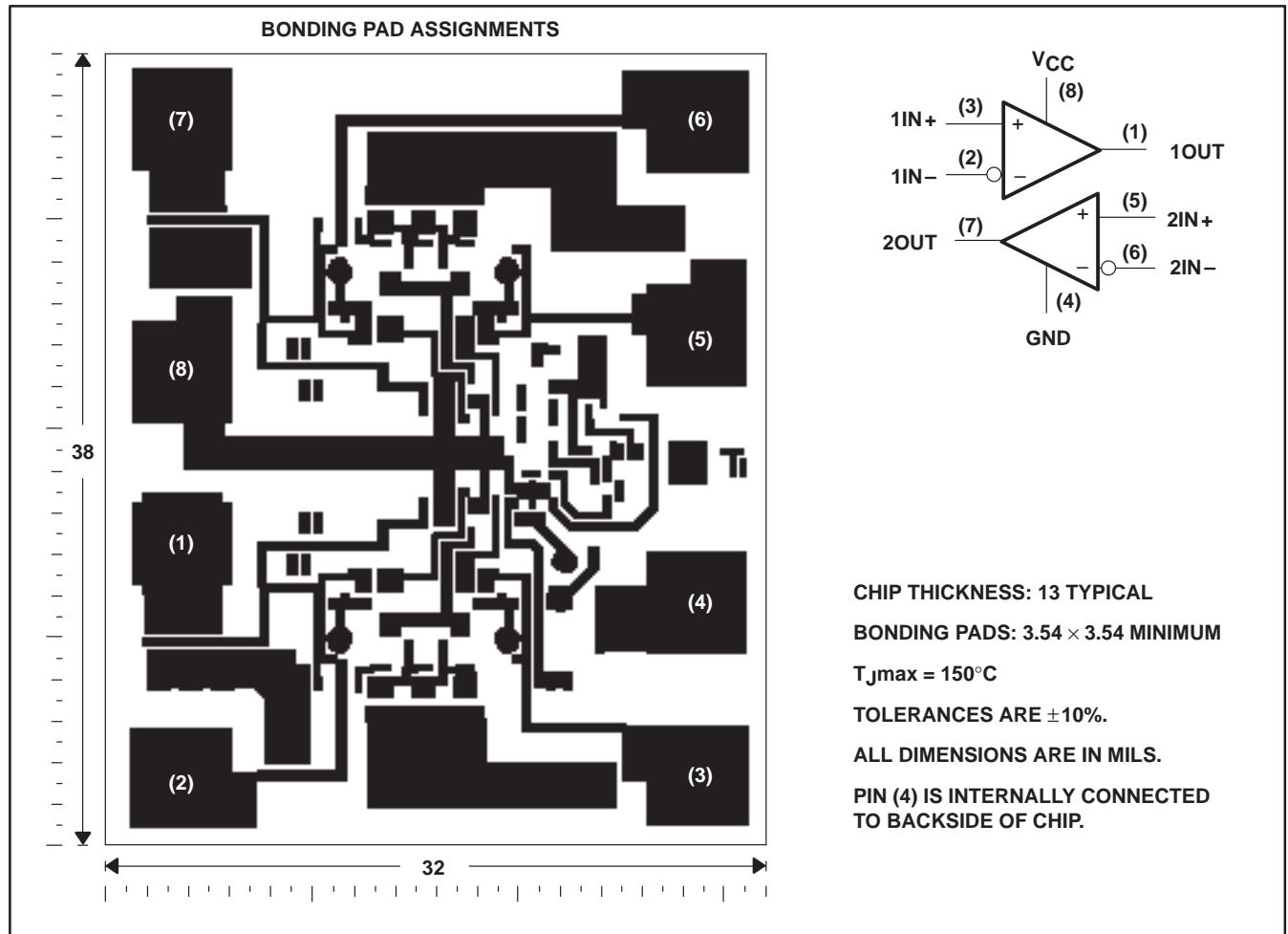
| COMPONENT COUNT | |
|-----------------|----|
| Transistors | 48 |
| Resistors | 5 |
| Diodes | 7 |
| Epi-FETs | 2 |

TL393, TL393Y DUAL DIFFERENTIAL COMPARATORS

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TL393Y chip information

This chip, when properly assembled, displays characteristics similar to the TL393. Thermal compression or ultrasonic bonding may be used on the doped-aluminum bonding pads. Chips may be mounted with conductive epoxy or a gold-silicon preform.



TL393, TL393Y DUAL DIFFERENTIAL COMPARATORS

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

| | |
|--------------------------------------------------------------|------------------------------|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Differential input voltage, V_{ID} (see Note 2) | 7 V |
| Input voltage, V_I (any input) | 7 V |
| Output voltage, V_O | 7 V |
| Output current, I_O (each output) | 20 mA |
| Duration of short-circuit current to GND (see Note 3) | unlimited |
| Continuous total dissipation | See Dissipation Rating Table |
| Operating free-air temperature range, T_A | -40°C to 105°C |
| Storage temperature range | -65°C to 150°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°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 network GND.
 2. Differential voltages are at $IN+$ with respect to $IN-$.
 3. Short circuits from the outputs to V_{CC} can cause excessive heating and eventual destruction of the chip.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$ | DERATING FACTOR | $T_A = 70^\circ\text{C}$ | $T_A = 85^\circ\text{C}$ |
|---------|-----------------------------|--------------------------------|--------------------------|--------------------------|
| | POWER RATING | ABOVE $T_A = 25^\circ\text{C}$ | POWER RATING | POWER RATING |
| D | 725 mW | 5.8 mW/°C | 464 mW | 377 mW |
| P | 1000 mW | 8.0 mW/°C | 640 mW | 520 mW |
| PW | 525 mW | 4.2 mW/°C | 336 mW | 273 mW |

recommended operating conditions

| | MIN | MAX | UNIT |
|---------------------------------------|-----|-----|------|
| Supply voltage, V_{CC} | 2 | 7 | V |
| Operating free-air temperature, T_A | -40 | 105 | °C |

TL393, TL393Y DUAL DIFFERENTIAL COMPARATORS

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electrical characteristics, $V_{CC} = 5\text{ V}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_A † | TL393 | | | UNIT |
|-------------------------------------------|--------------------------------------------------|------------|---------------------|---------------------|------|---------------|
| | | | MIN | TYP | MAX | |
| V_{IO} Input offset voltage | $V_O = 1.4\text{ V}$, $V_{IC} = V_{ICRmin}$ | 25°C | | 1.5 | 5 | mV |
| | | Full range | | | 9 | |
| V_{ICR} Common-mode input voltage range | | 25°C | 0 to $V_{CC} - 1.5$ | 0 to $V_{CC} - 1.2$ | | V |
| | | Full range | 0 to $V_{CC} - 2$ | | | |
| V_{OL} Low-level output voltage | $V_{ID} = -1\text{ V}$, $I_{OL} = 1\text{ mA}$ | 25°C | | 70 | 300 | mV |
| | $V_{ID} = -1\text{ V}$, $I_{OL} = 4\text{ mA}$ | Full range | | 200 | 700 | |
| 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 | | -40 | -250 | nA |
| | | Full range | | | -400 | |
| I_{OH} High-level output current | $V_{ID} = 1\text{ V}$, $V_{OH} = 3\text{ V}$ | 25°C | | 0.1 | | nA |
| | $V_{ID} = 1\text{ V}$, $V_{OH} = 5\text{ V}$ | Full range | | | 100 | |
| I_{OL} low-level output current | $V_{ID} = -1\text{ V}$, $V_{OL} = 1.5\text{ V}$ | 25°C | 6 | | | mA |
| I_{CCH} High-level supply current | $V_O = V_{OH}$ | 25°C | | 140 | 200 | μA |
| | | Full range | | | 300 | |
| I_{CCL} Low-level supply current | $V_O = V_{OL}$ | 25°C | | 0.8 | 1 | mA |
| | | Full range | | | 1.2 | |

† Full range is -40°C to 105°C .

switching characteristics, $V_{CC} = 5\text{ V}$, $C_L = 15\text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | TL393 | | | UNIT |
|---------------|--------------------------------------------------------------------------------------|-------|------|-----|---------------|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, R_L connected to 5 V through 5.1 k Ω | | 0.65 | | μs |
| | TTL-level input step, R_L connected to 5 V through 5.1 k Ω | | 0.2 | | |

TL393, TL393Y DUAL DIFFERENTIAL COMPARATORS

SLCS120A – AUGUST 1993 – REVISED DECEMBER 1993

electrical characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | TL393Y | | | UNIT |
|-------------------------------------------|--------------------------------------------------|---------------------|---------------------|------|---------------|
| | | MIN | TYP | MAX | |
| V_{IO} Input offset voltage | $V_O = 1.4\text{ V}$, | | 1.5 | 5 | mV |
| V_{ICR} Common-mode input voltage range | | 0 to $V_{CC} - 1.5$ | 0 to $V_{CC} - 1.2$ | | V |
| V_{OL} Low-level output voltage | $V_{ID} = -1\text{ V}$, $I_{OL} = 1\text{ mA}$ | | 70 | 300 | mV |
| I_{IO} Input offset current | $V_O = 1.4\text{ V}$ | | 5 | 50 | nA |
| I_{IB} Input bias current | $V_O = 1.4\text{ V}$ | | -40 | -250 | nA |
| I_{OH} High-level output current | $V_{ID} = 1\text{ V}$, $V_{OH} = 3\text{ V}$ | | 0.1 | | nA |
| I_{OL} low-level output current | $V_{ID} = -1\text{ V}$, $V_{OL} = 1.5\text{ V}$ | 6 | | | mA |
| I_{CCH} High-level supply current | $V_O = V_{OH}$ | | 140 | 200 | μA |
| I_{CCL} Low-level supply current | $V_O = V_{OL}$ | | 0.8 | 1 | mA |

switching characteristics, $V_{CC} = 5\text{ V}$, $C_L = 15\text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | TL393Y | | | UNIT |
|---------------|--------------------------------------------------------------------------------------|--------|------|-----|---------------|
| | | MIN | TYP | MAX | |
| Response time | 100-mV input step with 5-mV overdrive, R_L connected to 5 V through 5.1 k Ω | | 0.65 | | μs |
| | TTL-level input step, R_L connected to 5 V through 5.1 k Ω | | 0.2 | | |

TYPICAL CHARACTERISTICS

LOW- TO HIGH-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

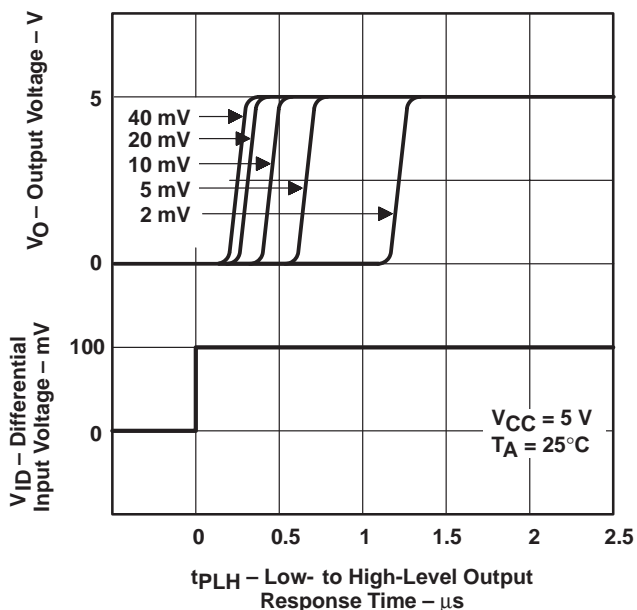


Figure 1

HIGH- TO LOW-LEVEL OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES

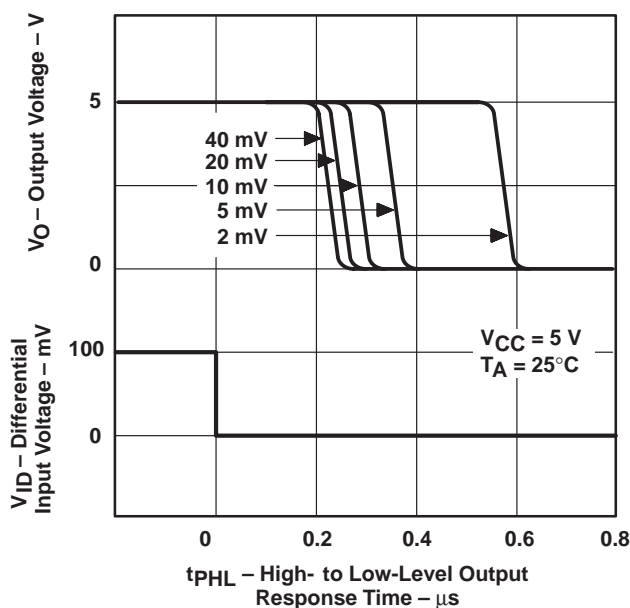


Figure 2

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| TL393ID | OBSOLETE | SOIC | D | 8 | | TBD | Call TI | Call TI |
| TL393IDR | OBSOLETE | SOIC | D | 8 | | TBD | Call TI | Call TI |
| TL393IP | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI |
| TL393IPWLE | OBSOLETE | TSSOP | PW | 8 | | TBD | Call TI | Call TI |

⁽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.

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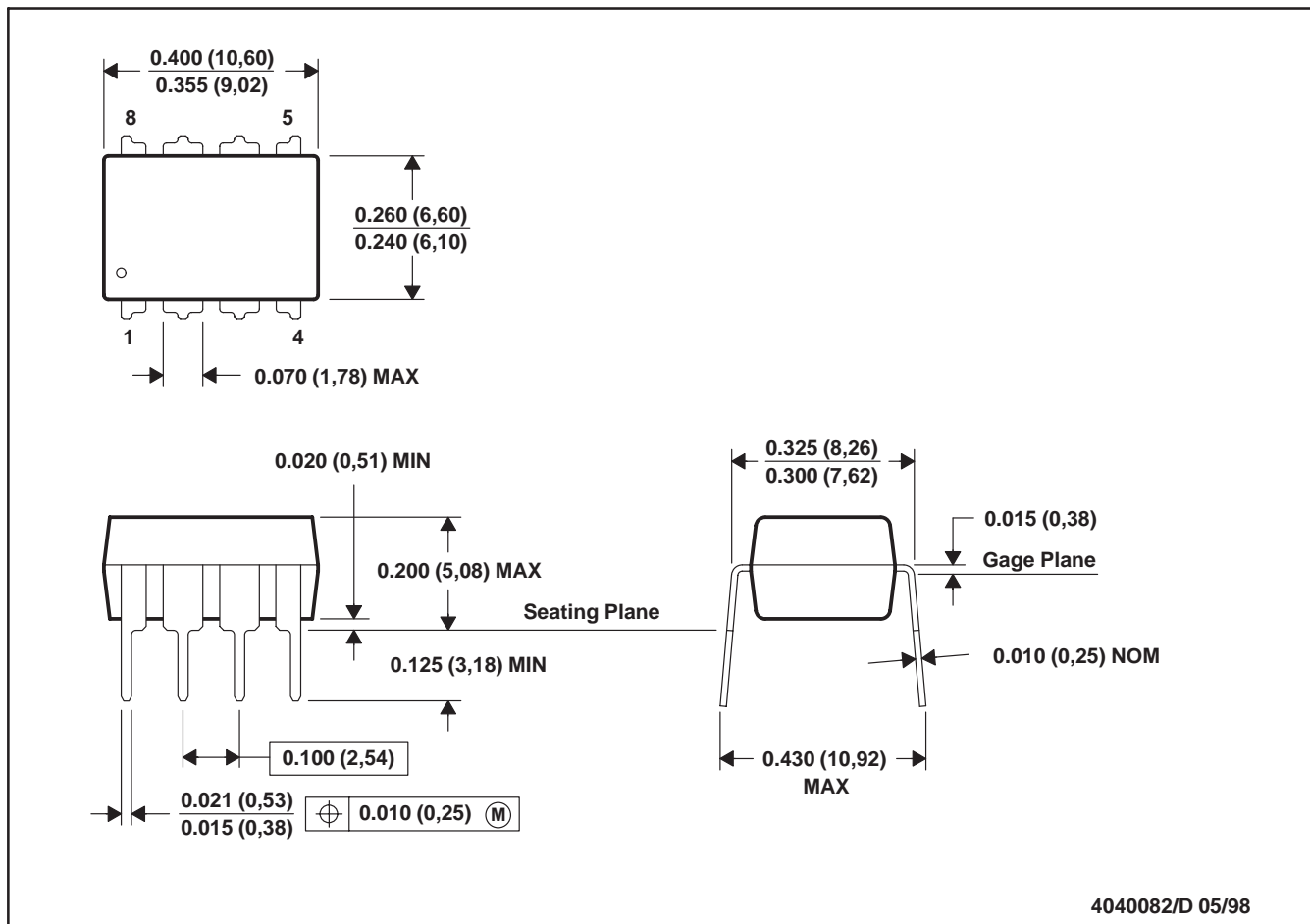
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MPDI001A – JANUARY 1995 – REVISED JUNE 1999

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE

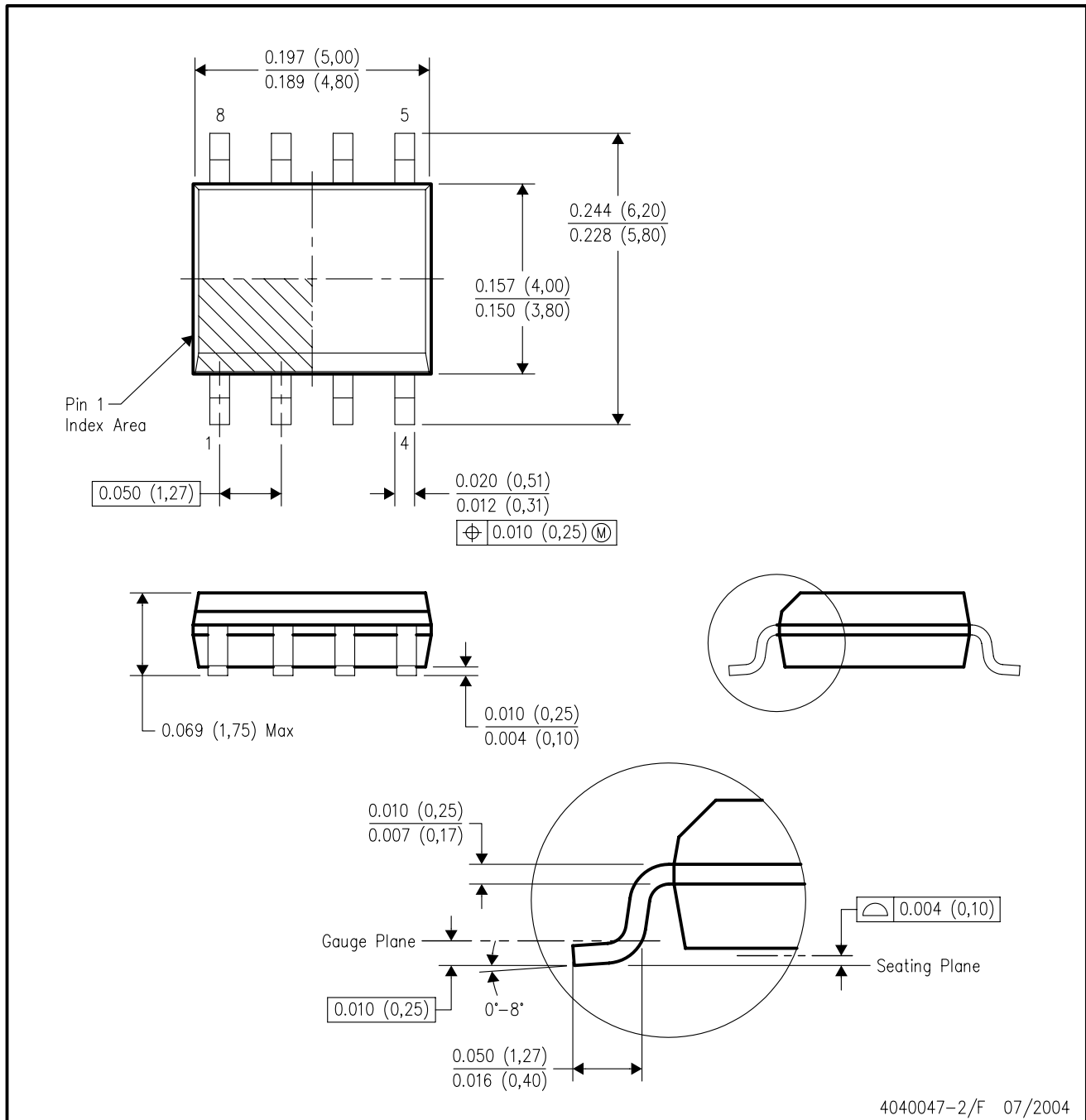


- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

MECHANICAL DATA

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.

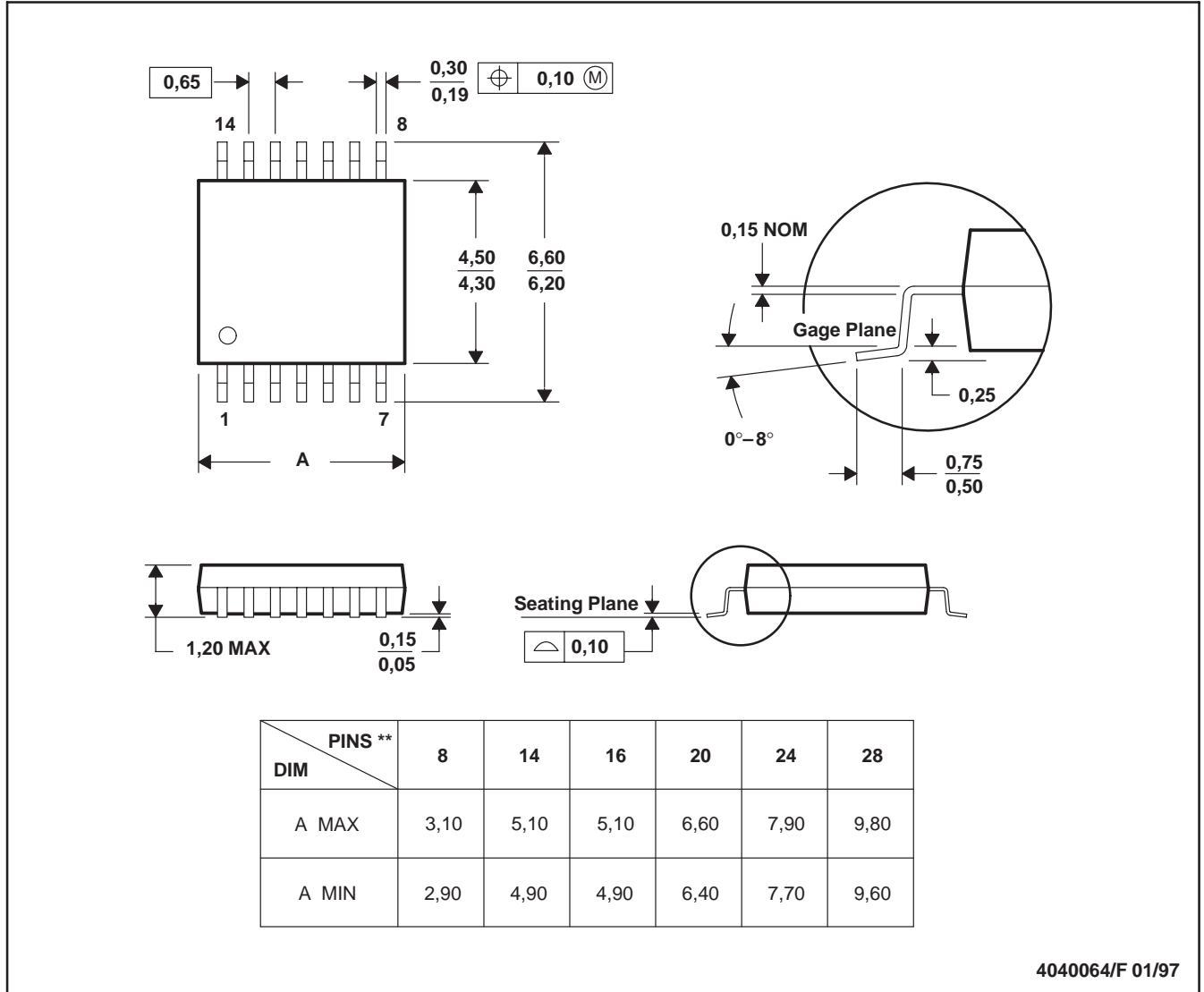
MECHANICAL DATA

MTSS001C – JANUARY 1995 – REVISED FEBRUARY 1999

PW (R-PDSO-G)**

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



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

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