

SN74LS19A, SN74LS24A SCHMITT-TRIGGER POSITIVE-NAND GATES AND INVERTERS WITH TOTEM-POLE OUTPUTS

JANUARY 1981 — REVISED MARCH 1988

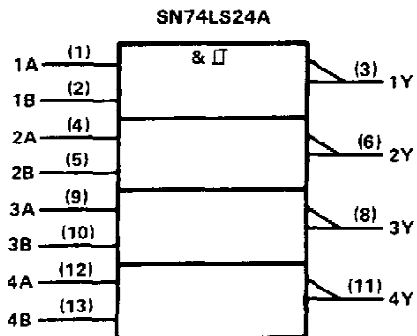
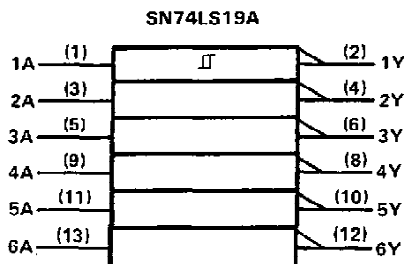
- Functionally and Mechanically Identical to 'LS13, 'LS14, and 'LS132, Respectively
- Improved Line-Receiving Characteristics
- P-N-P Inputs Reduce System Loading
- Excellent Noise Immunity with Typical Hysteresis of 0.8 V

description

Each circuit functions as a NAND gate or inverter, but because of the Schmitt action, it has different input threshold levels for positive-going (V_{T+}) and for negative-going (V_{T-}) signals. The hysteresis or backlash, which is the difference between the two threshold levels ($V_{T+} - V_{T-}$), is typically 800 millivolts.

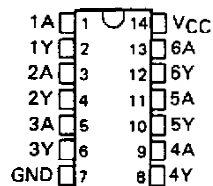
These circuits are temperature-compensated and can be triggered from the slowest of input ramps and still give clean, jitter-free output signals.

logic symbols †

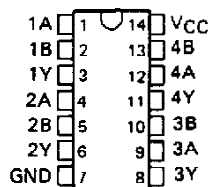


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

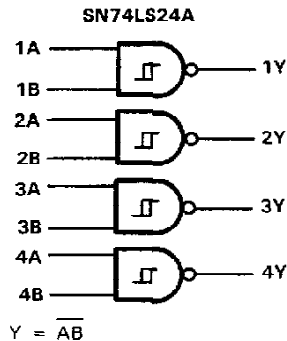
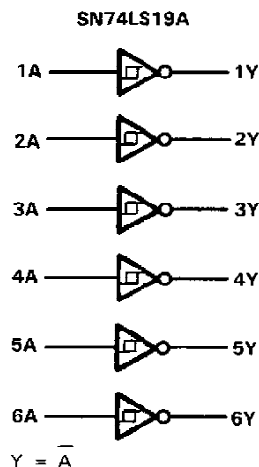
SN74LS19A . . . D, J, OR N PACKAGE
(TOP VIEW)



SN74LS24A . . . D, J, OR N PACKAGE
(TOP VIEW)



logic diagrams (positive logic)



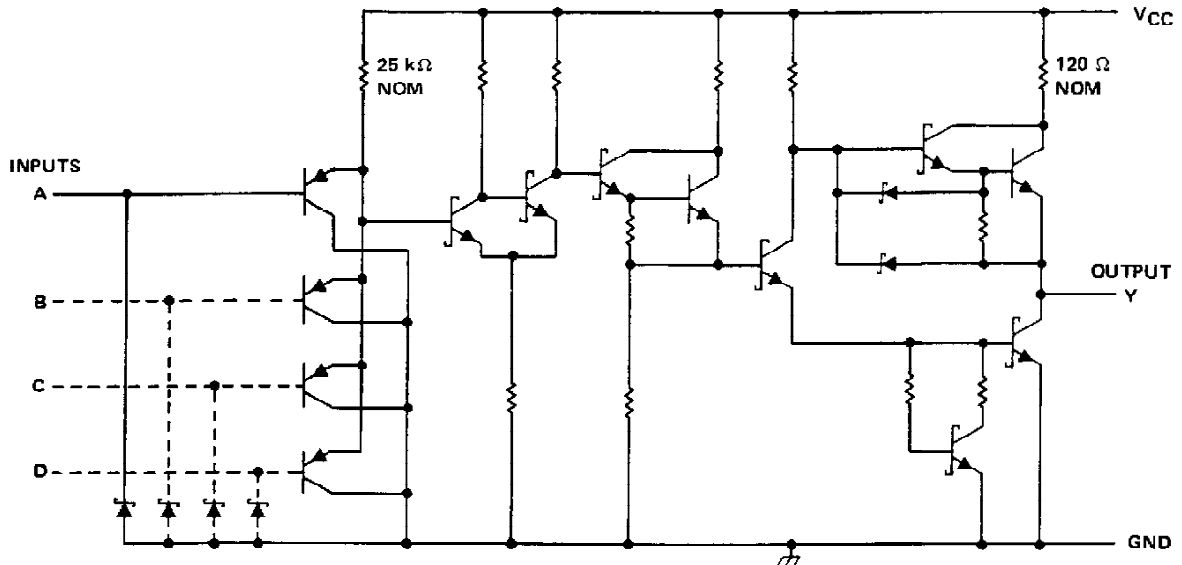
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TEXAS
INSTRUMENTS

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SN74LS19A, SN74LS24A
SCHMITT-TRIGGER POSITIVE-NAND GATES
AND INVERTERS WITH TOTEM-POLE OUTPUTS

schematic (each gate)



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

| | |
|--|----------------|
| Supply voltage, V _{CC} (see Note 1) | 7 V |
| Input voltage | 7 V |
| Operating free-air temperature range | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

recommended operating conditions

| | MIN | NOM | MAX | UNIT |
|--|------|-----|------|------|
| Supply voltage, V _{CC} | 4.75 | 5 | 5.25 | V |
| High-level output current, I _{OH} | | | -400 | μA |
| Low-level output current, I _{OL} | | | 8 | mA |
| Operating free-air temperature, T _A | 0 | | 70 | °C |

SN74LS19A, SN74LS24A
SCHMITT-TRIGGER POSITIVE-NAND GATES
AND INVERTERS WITH TOTEM-POLE OUTPUTS

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MIN | TYP‡ | MAX | UNIT |
|-------------------------------------|---|------------------------|------|------|---------------|
| V_{T+} | $V_{CC} = 5\text{ V}$ | 1.65 | 1.9 | 2.15 | V |
| V_{T-} | $V_{CC} = 5\text{ V}$ | 0.75 | 1.0 | 1.25 | V |
| Hysteresis ($V_{T+} - V_{T-}$) | $V_{CC} = 5\text{ V}$ | 0.4 | 0.9 | | V |
| V_{IK} | $V_{CC} = \text{MIN.}$ $I_I = -18\text{ mA}$ | | -1.5 | | V |
| V_{OH} | $V_{CC} = \text{MIN.}$ $V_I = V_{T-\text{min}}$ $I_{OH} = -0.4\text{ mA}$ | 2.7 | 3.4 | | V |
| V_{OL} | $V_{CC} = \text{MIN.}$ $V_I = V_{T+\text{max}}$ | $I_{OL} = 4\text{ mA}$ | 0.25 | 0.4 | V |
| | | $I_{OL} = 8\text{ mA}$ | 0.35 | 0.5 | |
| I_{T+} | $V_{CC} = 5\text{ V.}$ $V_I = V_{T+}$ | | -2 | -20 | μA |
| I_{T-} | $V_{CC} = 5\text{ V.}$ $V_I = V_{T-}$ | | -5 | -30 | μA |
| I_I | $V_{CC} = \text{MAX.}$ $V_I = 7\text{ V}$ | | 0.1 | | mA |
| I_{IH} | $V_{CC} = \text{MAX.}$ $V_I = 2.7\text{ V}$ | | | 20 | μA |
| I_{IL} | $V_{CC} = \text{MAX.}$ $V_I = 0.4\text{ V}$ | | | -50 | μA |
| I_{OS}^{\S} | $V_{CC} = \text{MAX.}$ $V_I = V_O = 0\text{ V}$ | | -20 | -100 | mA |
| I_{CCH} | $V_{CC} = \text{MAX.}$ $V_I = 0\text{ V}$ | 'LS19A | 9.9 | 18 | mA |
| | | 'LS24A | 6.6 | 12 | |
| I_{CCL} | $V_{CC} = \text{MAX.}$ $V_I = 4.5\text{ V}$ | 'LS19A | 17 | 30 | mA |
| | | 'LS24A | 11 | 20 | |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5\text{ V.}$ $T_A = 25^\circ\text{C.}$

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

switching characteristics, $V_{CC} = 5\text{ V,}$ $T_A = 25^\circ\text{C}$ (see Figure 1)

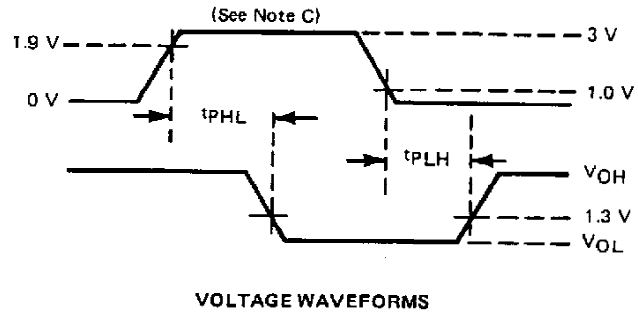
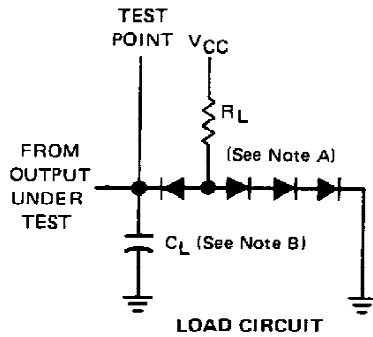
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | SN74LS19A | | | SN74LS24A | | | UNIT |
|-----------|-----------------|----------------|--|-----------|-----|-----|-----------|-----|-----|------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH} | Any | Y | $R_L = 2\text{ k}\Omega,$ $C_L = 15\text{ pF}$ | | 13 | 20 | | 13 | 20 | ns |
| t_{PHL} | Any | Y | | | 18 | 30 | | 25 | 40 | ns |

t_{PLH} = Propagation delay time, low-to-high-level output

t_{PHL} = Propagation delay time, high-to-low-level output

SN74LS19A, SN74LS24A
SCHMITT-TRIGGER POSITIVE-NAND GATES
AND INVERTERS WITH TOTEM-POLE OUTPUTS

PARAMETER MEASUREMENT INFORMATION



- NOTES: A. All diodes are IN3064 or equivalent.
 B. C_L includes probe and circuit capacitance.
 C. The generator characteristics are: PRR = 1 MHz, t_r = 15 ns, t_p = 6 ns, Z_o = 50 Ω.

FIGURE 1

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74LS19AD | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADE4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19AN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS19ANE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS19ANSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ANSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ANSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS24AD | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI |
| SN74LS24AN | OBSOLETE | PDIP | N | 14 | | 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), 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.

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PACKAGING INFORMATION

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| SN74LS19ADG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADR | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADRE4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ADRG4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19AN | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS19ANE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS19ANSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ANSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS19ANSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS24AD | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI |
| SN74LS24AN | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI |

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TAPE AND REEL INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LS19ADR | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LS19ANSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LS19ADR | SOIC | D | 14 | 2500 | 346.0 | 346.0 | 33.0 |
| SN74LS19ANSR | SO | NS | 14 | 2000 | 346.0 | 346.0 | 33.0 |

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

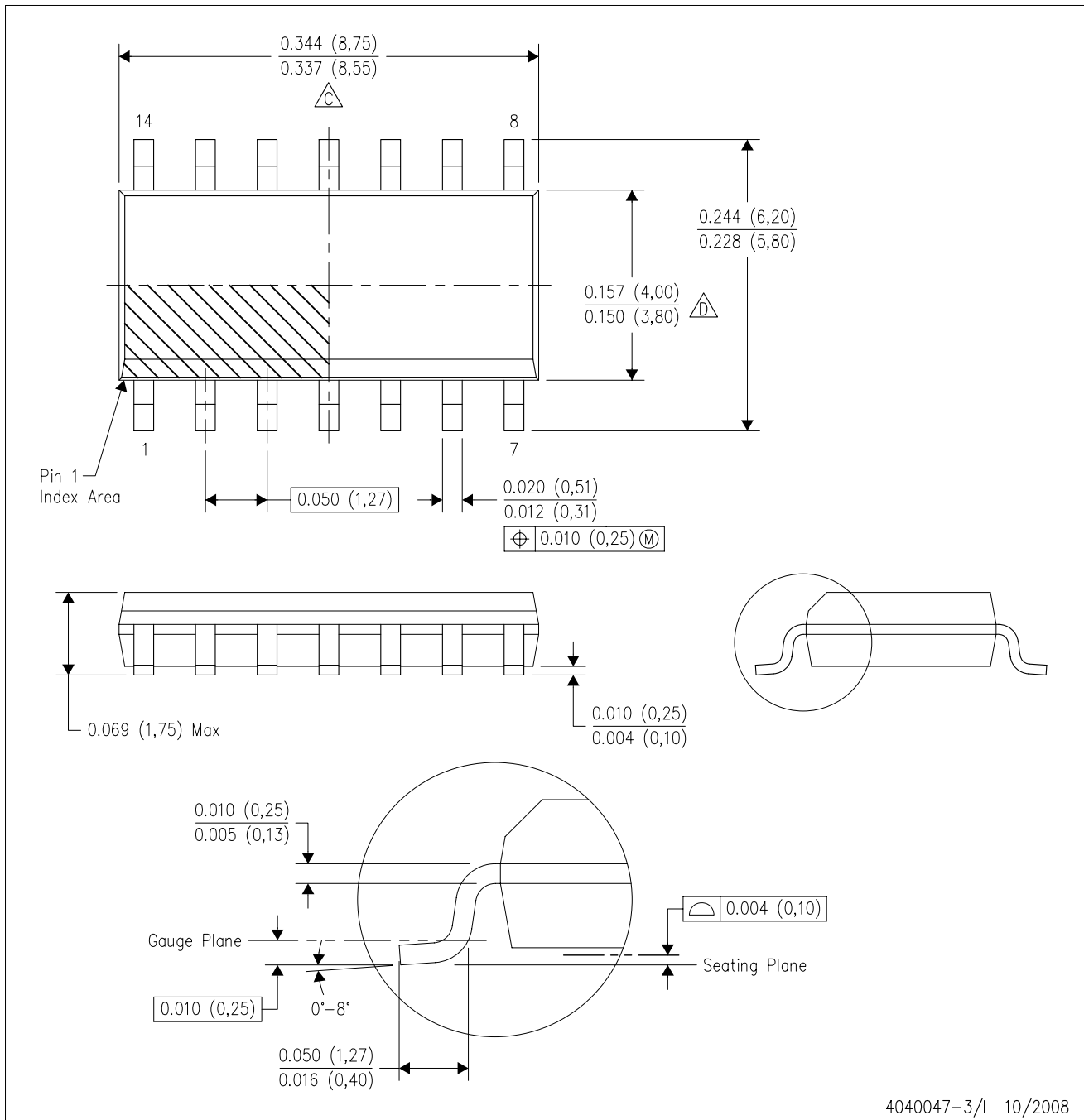
14-PINS SHOWN



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

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



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

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

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