

SN54LS348, SN74LS348 (TIM9908) 8-LINE TO 3-LINE PRIORITY ENCODERS WITH 3-STATE OUTPUTS

SDLS161 - OCTOBER 1976 - REVISED MARCH 1988

- 3-State Outputs Drive Bus Lines Directly
- Encodes 8 Data Lines to 3-Line Binary (Octal)
- Applications Include:
N-Bit Encoding
Code Converters and Generators
- Typical Data Delay . . . 15 ns
- Typical Power Dissipation . . . 60 mW

description

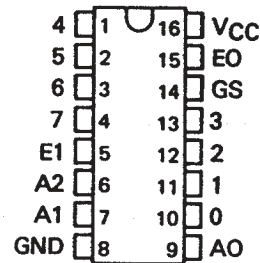
These TTL encoders feature priority decoding of the inputs to ensure that only the highest-order data line is encoded. The 'LS348 circuits encode eight data lines to three-line (4-2-1) binary (octal). Cascading circuitry (enable input E1 and enable output EO) has been provided to allow octal expansion. Outputs A0, A1, and A2 are implemented in three-state logic for easy expansion up to 64 lines without the need for external circuitry. See Typical Application Data.

FUNCTION TABLE

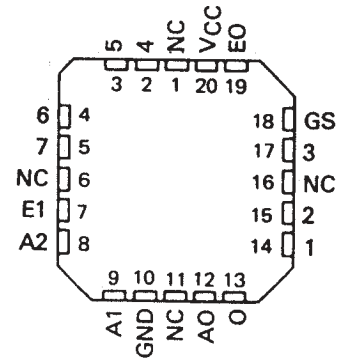
| E1 | INPUTS | | | | | | | | OUTPUTS | | | | |
|----|--------|---|---|---|---|---|---|---|---------|----|----|----|----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | A2 | A1 | A0 | GS | EO |
| H | X | X | X | X | X | X | X | X | Z | Z | Z | H | H |
| L | H | H | H | H | H | H | H | H | Z | Z | Z | H | L |
| L | X | X | X | X | X | X | X | L | L | L | L | L | H |
| L | X | X | X | X | X | L | H | H | L | L | H | L | H |
| L | X | X | X | X | L | H | H | H | L | H | H | L | H |
| L | X | X | X | L | H | H | H | H | H | L | L | L | H |
| L | X | X | L | H | H | H | H | H | H | L | H | L | H |
| L | L | H | H | H | H | H | H | H | H | H | H | L | H |

H = high logic level, L = low logic level, X = irrelevant
Z = high-impedance state

SN54LS348 . . . J OR W PACKAGE
SN74LS348 . . . D OR N PACKAGE
(TOP VIEW)

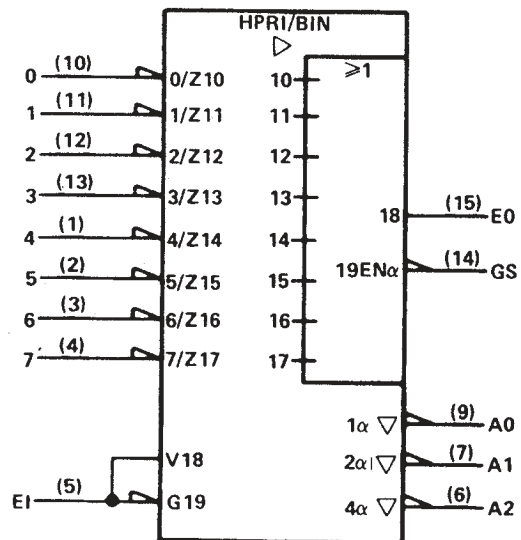


SN54LS348 . . . FK PACKAGE
(TOP VIEW)



NC - No internal connection

logic symbol†



†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

Pin numbers shown are for D, J, N, and W packages.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

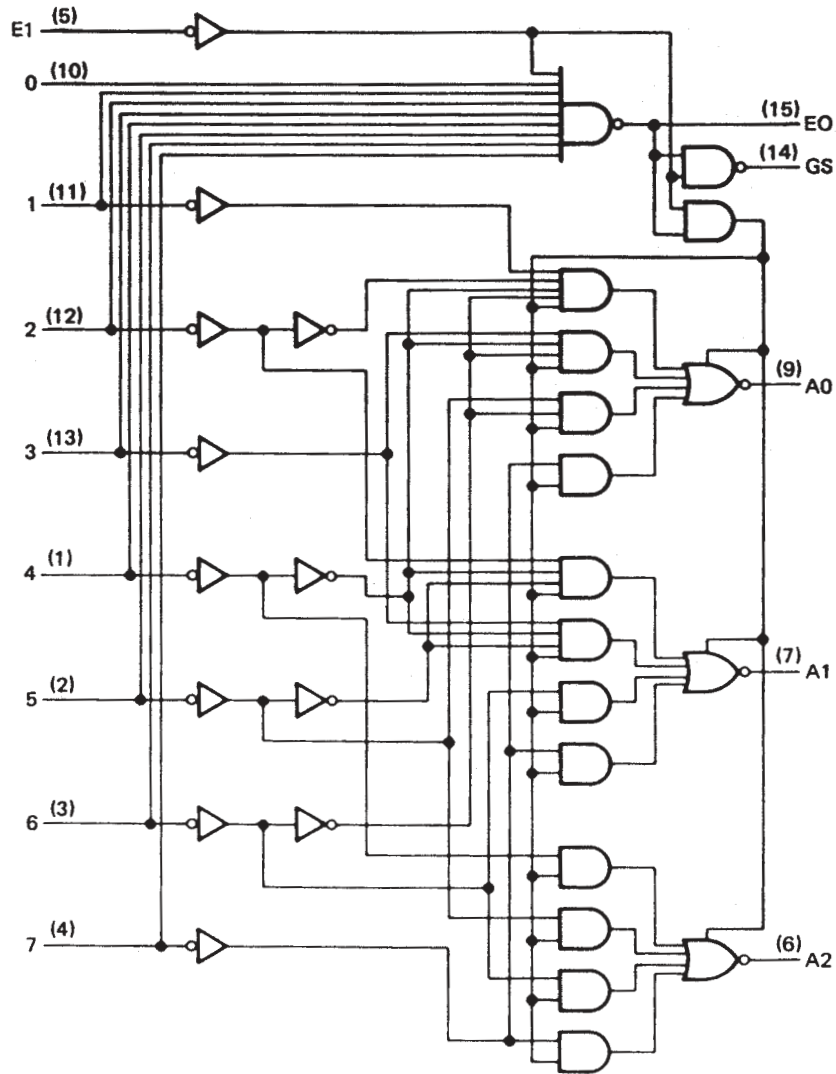
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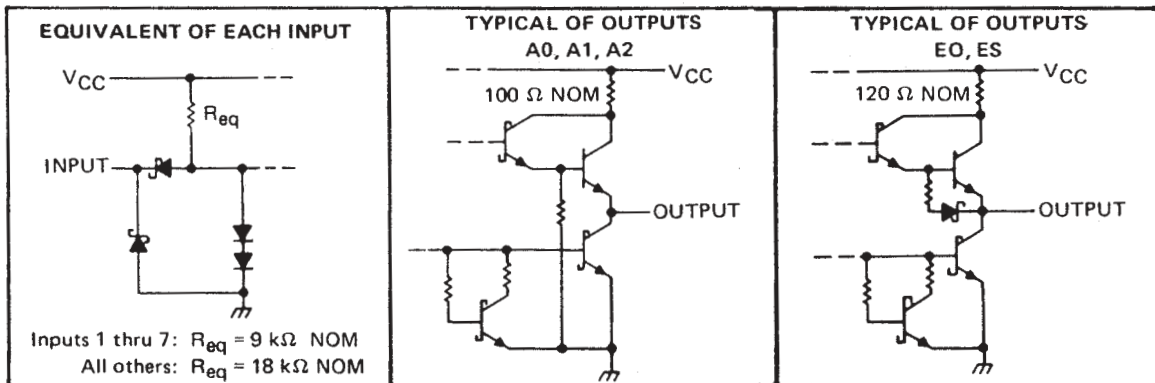
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logic diagram (positive logic)



Pin numbers shown are for D, J, N, and W packages.

schematic of inputs and outputs



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SDLS161 – OCTOBER 1976 – REVISED MARCH 1988

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: SN54LS348 | -55°C to 125°C |
| SN74LS348 | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

| | SN54LS348 | | | SN74LS348 | | | UNIT |
|---------------------------------------|------------|-----|-----|-----------|-----|------|---------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output current, I_{OH} | A0, A1, A2 | | | -1 | | | mA |
| | EO, GS | | | -400 | | | μ A |
| Low-level output current, I_{OL} | A0, A1, A2 | | | 12 | | | mA |
| | EO, GS | | | 4 | | | mA |
| Operating free-air temperature, T_A | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | | TEST CONDITIONS† | SN54LS348 | | SN74LS348 | | UNIT | | |
|-----------|---|---|---|-------------|-----------|------|---------|------|-----|
| | | | MIN | TYP‡ | MAX | MIN | | TYP‡ | MAX |
| V_{IH} | High-level input voltage | | 2 | | 2 | | V | | |
| V_{IL} | Low-level input voltage | | | 0.7 | | 0.8 | V | | |
| V_{IK} | Input clamp voltage | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | | -1.5 | | -1.5 | V | | |
| V_{OH} | High-level output voltage | A0, A1, A2 | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, I_{OH} = -1 \text{ mA}$ | 2.4 | 3.1 | | V | | |
| | | EO, GS | $V_{IL} = V_{IL\text{max}}, I_{OH} = -2.6 \text{ mA}$ | | | 2.4 | | 3.1 | |
| V_{OL} | Low-level output voltage | A0, A1, A2 | $V_{CC} = \text{MIN}, I_{OL} = 12 \text{ mA}$ | 0.25 | 0.4 | 0.25 | 0.4 | V | |
| | | | $V_{IH} = 2 \text{ V}, I_{OL} = 24 \text{ mA}$ | | | 0.35 | 0.5 | | |
| | | EO, GS | $V_{IL} = V_{IL\text{max}}, I_{OL} = 4 \text{ mA}$ | 0.25 | 0.4 | 0.25 | 0.4 | | |
| | | | $I_{OL} = 8 \text{ mA}$ | | | 0.35 | 0.5 | | |
| I_{OZ} | Off-State (high-impedance state) output current | A0, A1, A2 | $V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}, V_O = 2.7 \text{ V}$ | 20 | | 20 | μ A | | |
| I_I | Input current at maximum input voltage | Inputs 1 thru 7 | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$ | 0.2 | | 0.2 | mA | | |
| | | All other inputs | | 0.1 | | 0.1 | | | |
| I_{IH} | High-level input current | Inputs 1 thru 7 | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | 40 | | 40 | μ A | | |
| | | All other inputs | | 20 | | 20 | | | |
| I_{IL} | Low-level input current | Inputs 1 thru 7 | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | -0.8 | | -0.8 | mA | | |
| | | All other inputs | | -0.4 | | -0.4 | | | |
| I_{OS} | Short-circuit output current§ | Outputs A0, A1, A2 | $V_{CC} = \text{MAX}$ | -30 | -130 | -30 | -130 | mA | |
| | | Outputs EO, GS | | -20 | -100 | -20 | -100 | | |
| I_{CC} | Supply current | | $V_{CC} = \text{MAX},$ See Note 2 | Condition 1 | 13 | 25 | 13 | 25 | mA |
| | | | | Condition 2 | 12 | 23 | 12 | 23 | |

† 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.

NOTE 2: I_{CC} (condition 1) is measured with inputs 7 and E1 grounded, other inputs and outputs open. I_{CC} (condition 2) is measured with all inputs and outputs open.



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SDLS161 – OCTOBER 1976 – REVISED MARCH 1988

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

| PARAMETER† | FROM (INPUT) | TO (OUTPUT) | WAVEFORM | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------------|--------------|---------------|---------------------|--|---|-----|-----|------|
| t _{PLH} | 1 thru 7 | A0, A1, or A2 | In-phase output | C _L = 45 pF, R _L = 667 Ω, See Note 3 | | 11 | 17 | ns |
| t _{PHL} | | | | | | 20 | 30 | |
| t _{PLH} | 1 thru 7 | A0, A1, or A2 | Out-of-phase output | | | 23 | 35 | ns |
| t _{PHL} | | | | | | 23 | 35 | |
| t _{PZH} | EI | A0, A1, or A2 | | | | 25 | 39 | ns |
| t _{PZL} | | | | | | 24 | 41 | |
| t _{PLH} | 0 thru 7 | EO | Out-of-phase output | C _L = 15 pF R _L = 2 kΩ, See Note 3 | | 11 | 18 | ns |
| t _{PHL} | | | | | | 26 | 40 | |
| t _{PLH} | 0 thru 7 | GS | In-phase output | | | 38 | 55 | ns |
| t _{PHL} | | | | | | 9 | 21 | |
| t _{PLH} | EI | GS | In-phase output | | | 11 | 17 | ns |
| t _{PHL} | | | | | | 14 | 36 | |
| t _{PLH} | EI | EO | In-phase output | | | 17 | 26 | ns |
| t _{PHL} | | | | | | 25 | 40 | |
| t _{PHZ} | EI | A0, A1, or A2 | | | C _L = 5 pF R _L = 667 Ω | | 18 | 27 |
| t _{PLZ} | | | | | | 23 | 35 | |

- † t_{PLH} = propagation delay time, low-to-high-level output
- t_{PHL} = propagation delay time, high-to-low-level output
- t_{PZH} = output enable time to high level
- t_{PZL} = output enable time to low level
- t_{PHZ} = output disable time from high level
- t_{PLZ} = output disable time from low level

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TYPICAL APPLICATION DATA

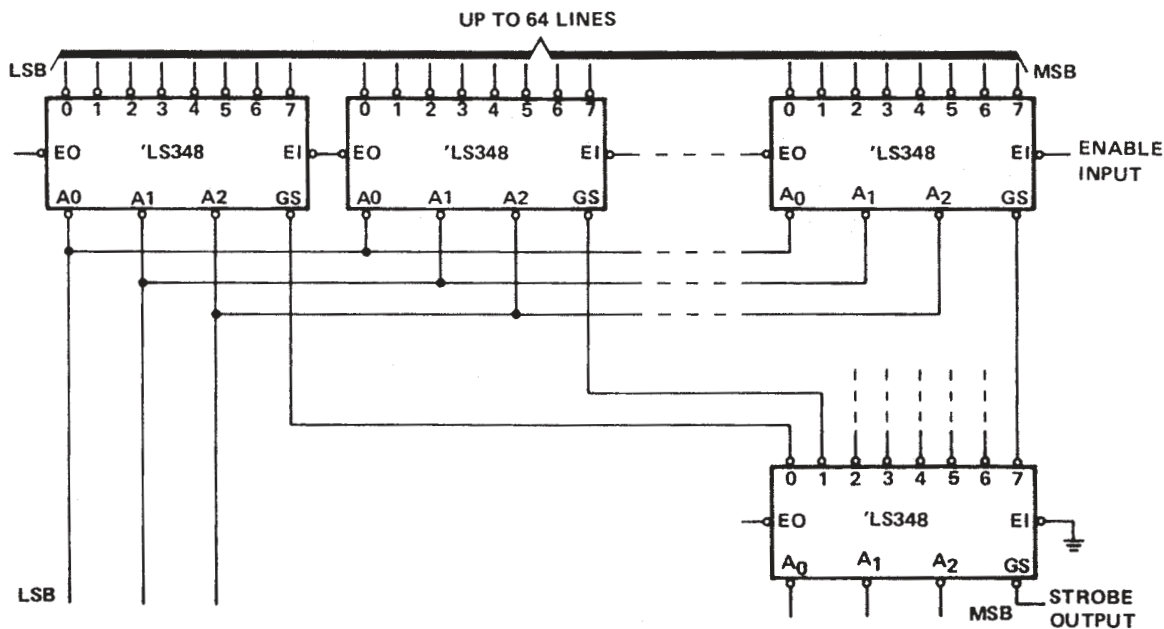


FIGURE 1—PRIORITY ENCODER WITH UP TO 64 INPUTS.



PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LS348D | ACTIVE | SOIC | D | 16 | 40 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | 0 to 70 | LS348 | Samples |
| SN74LS348N | ACTIVE | PDIP | N | 16 | 25 | RoHS & Green | NIPDAU | N / A for Pkg Type | 0 to 70 | SN74LS348N | Samples |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

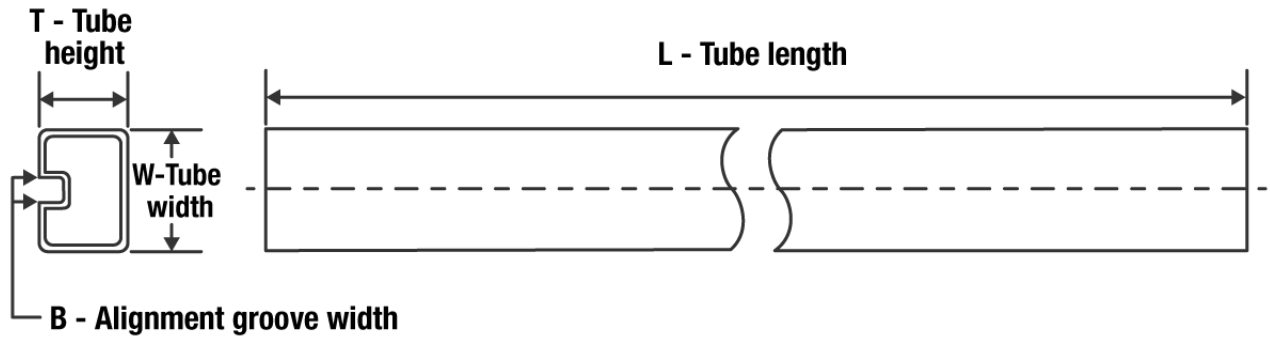
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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TUBE


*All dimensions are nominal



| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN74LS348D | D | SOIC | 16 | 40 | 507 | 8 | 3940 | 4.32 |
| SN74LS348N | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |
| SN74LS348N | N | PDIP | 16 | 25 | 506 | 13.97 | 11230 | 4.32 |

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

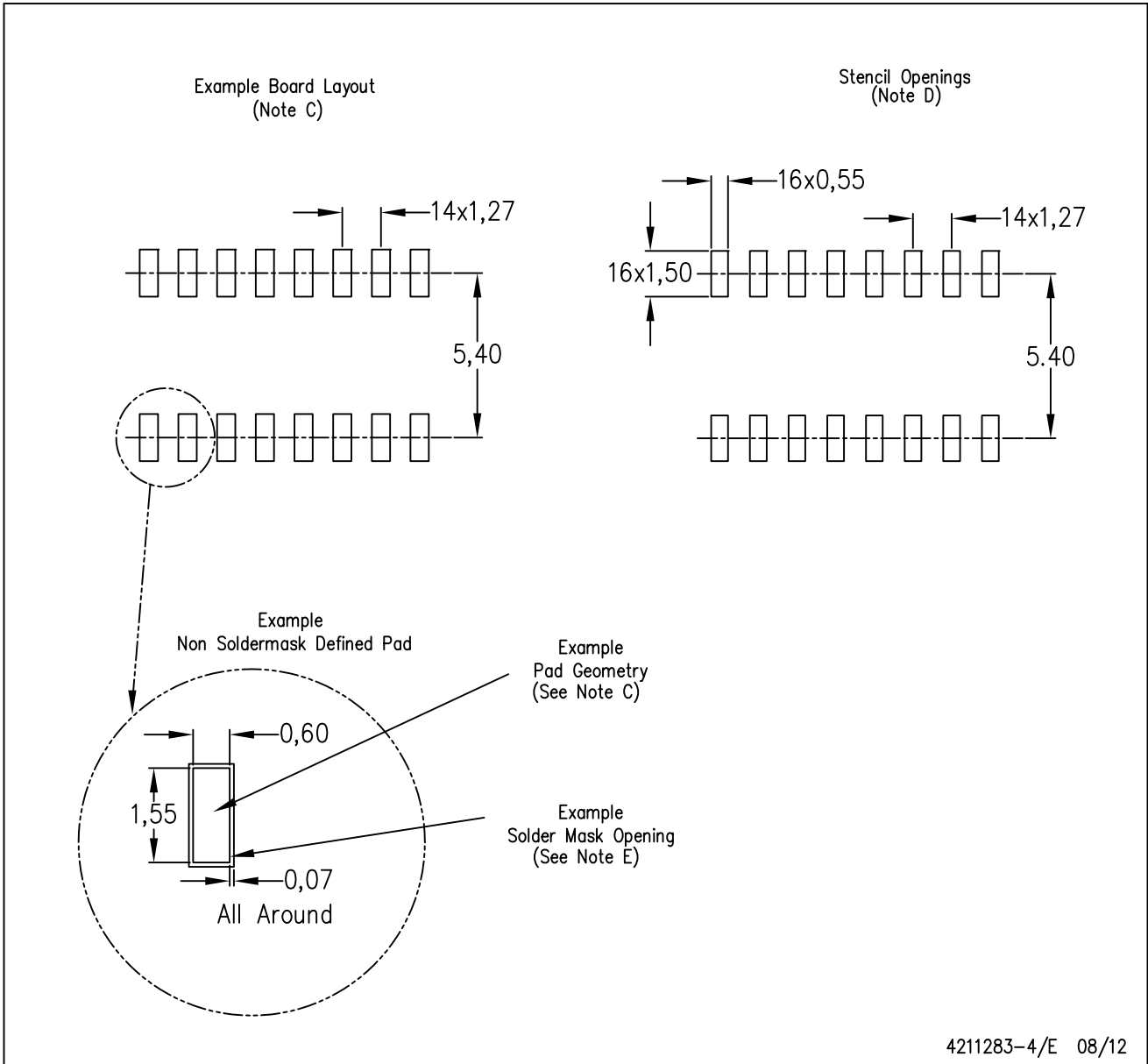


4040047-6/M 06/11

- 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 AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE

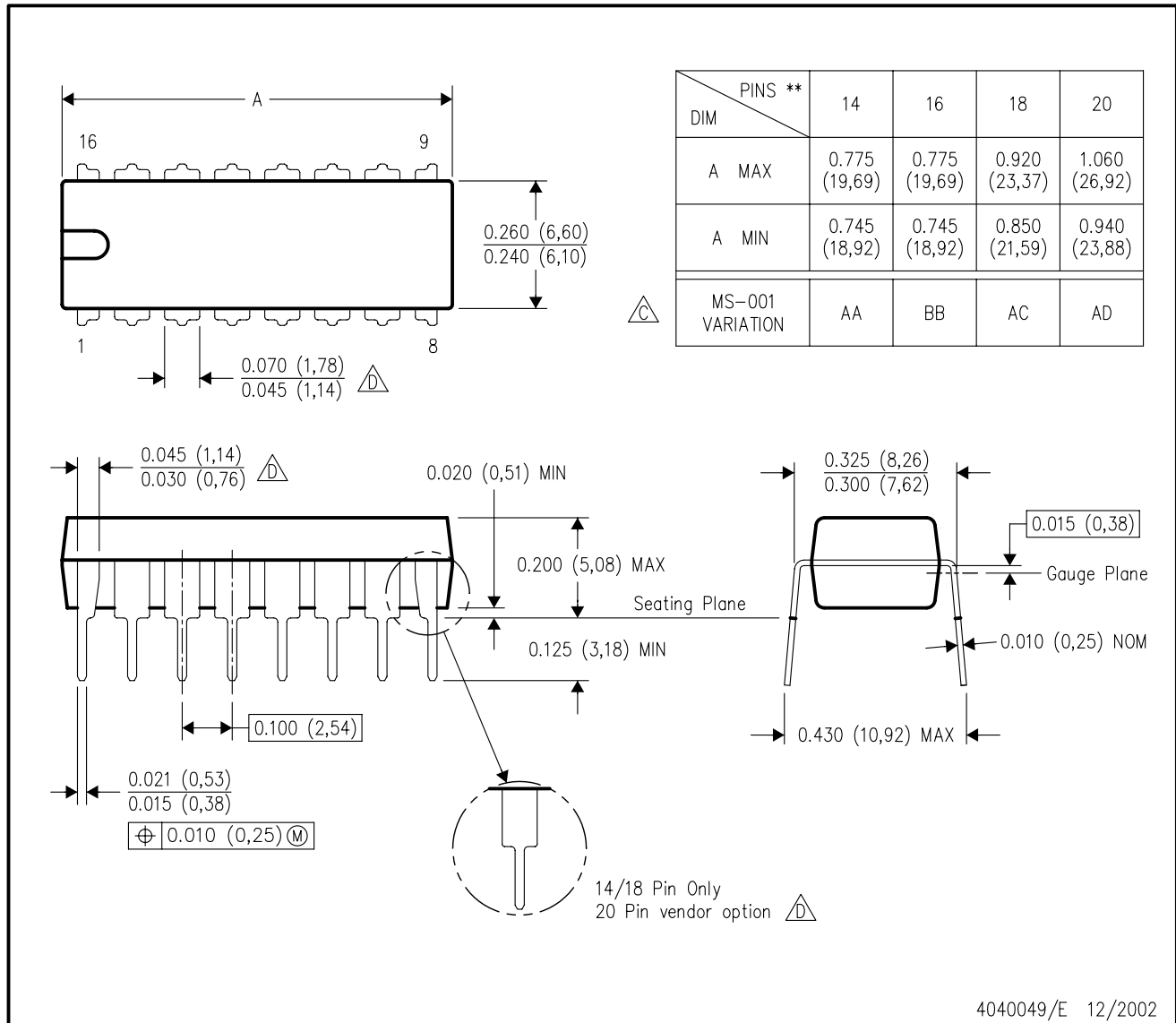


- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should 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.

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.
 - (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.

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