

# CD40147B Types

## 10-Line to 4-Line BCD Priority Encoder

### High-Voltage Types (20-Volt Rating)

The CD40147B CMOS encoder features priority encoding of the inputs to ensure that only the highest-order data line is encoded. Ten data input lines (0-9) are encoded to four-line (8, 4, 2, 1) BCD. The highest priority line is line 9. All four output lines are logic 1 ( $V_{SS}$ ) when all input lines are logic 0. All inputs and outputs are buffered, and each output can drive one TTL low-power Schottky load. The CD40147B is functionally similar to the TTL5474147 if pin 5 is tied low.

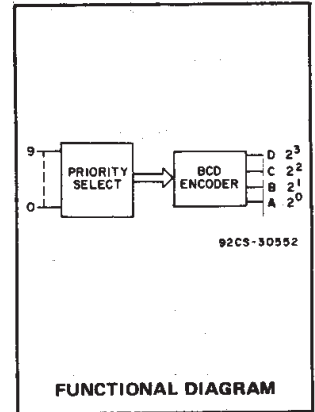
The CD40147B types are supplied in 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, MT, and NSR suffixes), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

### Features:

- Encodes 10-line to 4-line BCD
- Active low inputs and outputs
- Standardized, symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- 5-V, 10-V, and 15-V parametric ratings
- Meets all requirements of JEDEC Tentative Standard No. 13A, "Standard Specifications for Description of 'B' Series CMOS Devices"
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (full package-temperature range) =
  - 1 V at  $V_{DD} = 5$  V
  - 2 V at  $V_{DD} = 10$  V
  - 2.5 V at  $V_{DD} = 15$  V

### Applications:

- Keyboard encoding
- 10-line to BCD encoding
- Range selection



### RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following range:

| CHARACTERISTIC                                                    | LIMITS |      | UNITS |
|-------------------------------------------------------------------|--------|------|-------|
|                                                                   | Min.   | Max. |       |
| Supply Voltage Range (For $T_A$ = Full Package Temperature Range) | 3      | 18   | V     |

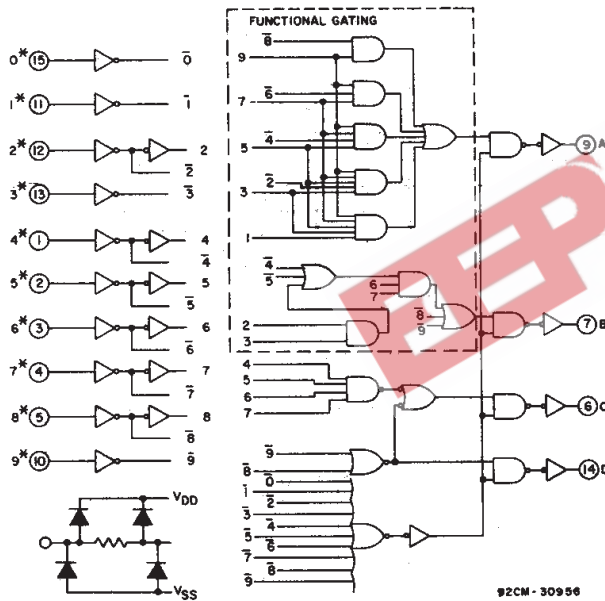
### TRUTH TABLE (Negative Logic)

| INPUTS |   |   |   |   |   |   |   |   |   | OUTPUTS |   |   |   |
|--------|---|---|---|---|---|---|---|---|---|---------|---|---|---|
| 0      | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | D       | C | B | A |
| 0      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1       | 1 | 1 | 1 |
| 1      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0       | 0 | 0 | 0 |
| X      | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0       | 0 | 0 | 1 |
| X      | X | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0       | 0 | 1 | 0 |
| X      | X | X | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0       | 0 | 1 | 1 |
| X      | X | X | X | 1 | 0 | 0 | 0 | 0 | 0 | 0       | 1 | 0 | 0 |
| X      | X | X | X | X | 1 | 0 | 0 | 0 | 0 | 0       | 1 | 0 | 1 |
| X      | X | X | X | X | X | 1 | 0 | 0 | 0 | 0       | 1 | 1 | 0 |
| X      | X | X | X | X | X | X | 1 | 0 | 0 | 0       | 1 | 1 | 1 |
| X      | X | X | X | X | X | X | X | 1 | 0 | 1       | 0 | 0 | 0 |
| X      | X | X | X | X | X | X | X | X | 1 | 1       | 0 | 0 | 1 |

0 = High Level

1 = Low Level

X = Don't Care



\* INPUTS PROTECTED BY COS/MOS PROTECTION NETWORK

Fig. 1 - CD40147B logic diagram.

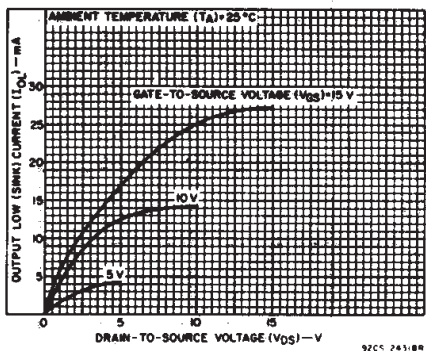


Fig. 2 - Typical output low (sink) current characteristics.

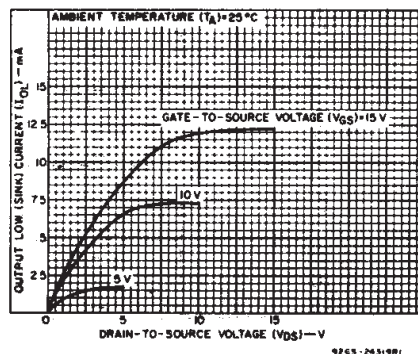


Fig. 3 - Minimum output low (sink) current characteristics.

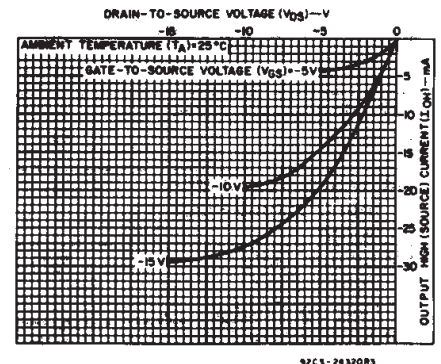


Fig. 4 - Typical output high (source) current characteristics.

# CD40147B Types

## MAXIMUM RATINGS, Absolute-Maximum Values:

### DC SUPPLY-VOLTAGE RANGE, (V<sub>DD</sub>)

Voltages referenced to V<sub>SS</sub> Terminal ..... -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5V to V<sub>DD</sub> +0.5V

DC INPUT CURRENT, ANY ONE INPUT ..... ±10mA

### POWER DISSIPATION PER PACKAGE (P<sub>D</sub>):

For T<sub>A</sub> = -55°C to +100°C ..... 500mW

For T<sub>A</sub> = +100°C to +125°C ..... Derate Linearly at 12mW/°C to 200mW

### DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR T<sub>A</sub> = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) ..... 100mW

OPERATING-TEMPERATURE RANGE (T<sub>A</sub>) ..... -55°C to +125°C

STORAGE TEMPERATURE RANGE (T<sub>stg</sub>) ..... -65°C to +150°C

### LEAD TEMPERATURE (DURING SOLDERING):

At distance 1/16 ± 1/32 inch (1.59 ± 0.79mm) from case for 10s max ..... +265°C

## STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC                                   | CONDITIONS            |                        |                        | LIMITS AT INDICATED TEMPERATURES (°C) |      |      |      |      |                   |      | UNITS |
|--------------------------------------------------|-----------------------|------------------------|------------------------|---------------------------------------|------|------|------|------|-------------------|------|-------|
|                                                  | V <sub>O</sub><br>(V) | V <sub>IN</sub><br>(V) | V <sub>DD</sub><br>(V) | -55                                   | -40  | +85  | +125 | +25  |                   |      |       |
|                                                  |                       |                        |                        |                                       |      |      |      | Min. | Typ.              | Max. |       |
| Quiescent Device Current, I <sub>DD</sub> Max.   | —                     | 0.5                    | 5                      | 5                                     | 5    | 150  | 150  | —    | 0.04              | 5    | μA    |
| Output Low (Sink) Current I <sub>OL</sub> Min.   | 0.4                   | 0.5                    | 5                      | 0.64                                  | 0.61 | 0.42 | 0.36 | 0.51 | 1                 | —    |       |
| Output (Source) Current, I <sub>OH</sub> Min.    | 0.5                   | 0.10                   | 10                     | 1.6                                   | 1.5  | 1.1  | 0.9  | 1.3  | 2.6               | —    |       |
| Output Voltage: Low-Level, V <sub>OL</sub> Max.  | —                     | 0.15                   | 15                     | 4.2                                   | 4    | 2.8  | 2.4  | 3.4  | 6.8               | —    |       |
| Output Voltage: High-Level, V <sub>OH</sub> Min. | —                     | 0.15                   | 15                     | —                                     | —    | —    | —    | —    | —                 | —    | V     |
| Input Low Voltage, V <sub>IL</sub> Max.          | 0.5, 4.5              | —                      | 5                      | —                                     | —    | —    | —    | —    | —                 | 1.5  |       |
| Input High Voltage, V <sub>IH</sub> Min.         | 1.9                   | —                      | 10                     | —                                     | —    | —    | —    | —    | —                 | 3    |       |
| Input Current I <sub>IN</sub> Max.               | —                     | 0.18                   | 18                     | ±0.1                                  | ±0.1 | ±1   | ±1   | —    | ±10 <sup>-5</sup> | ±0.1 |       |

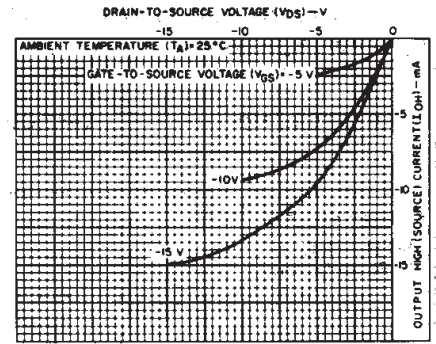


Fig. 5 - Minimum output high (source) current characteristics.

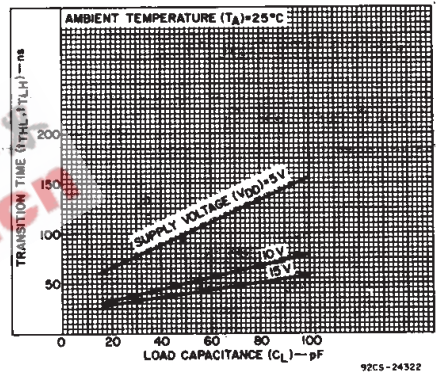


Fig. 6 - Typical transition time as a function of load capacitance.

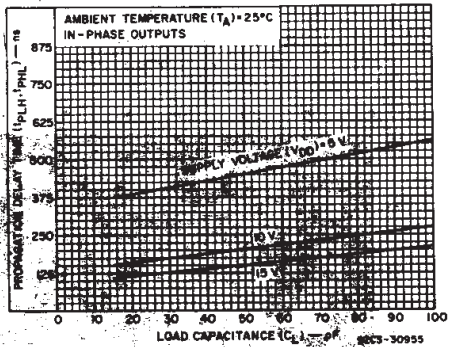


Fig. 7 - Propagation delay time as a function of load capacitance.

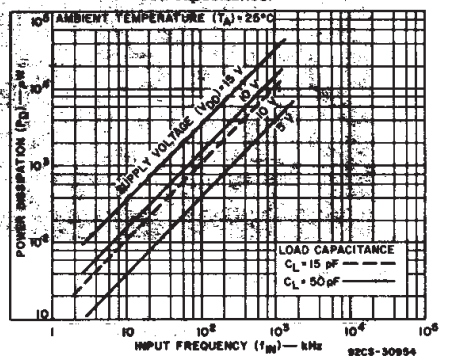


Fig. 8 - Typical dynamic power dissipation as a function of input frequency.

3  
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## CD40147B Types

DYNAMIC ELECTRICAL CHARACTERISTICS at  $T_A = 25^\circ\text{C}$ , Input  $t_r, t_f = 20\text{ ns}$ ,  
 $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$

| CHARACTERISTIC                                                | TEST CONDITIONS         | LIMITS ALL TYPES    |      | UNITS |      |
|---------------------------------------------------------------|-------------------------|---------------------|------|-------|------|
|                                                               |                         | V <sub>DD</sub> (V) | Typ. |       | Max. |
| Propagation Delay Time, $t_{PLH}, t_{PHL}$<br>In-Phase Output | Any input to any output | 5                   | 450  | 900   | ns   |
|                                                               |                         | 10                  | 200  | 400   |      |
|                                                               |                         | 15                  | 150  | 300   |      |
| Out-of-Phase Output                                           |                         | 5                   | 425  | 850   | ns   |
|                                                               |                         | 10                  | 175  | 350   |      |
|                                                               |                         | 15                  | 125  | 250   |      |
| Transition Time, $t_{THL}, t_{TLH}$                           | 5                       | 100                 | 200  | ns    |      |
|                                                               | 10                      | 50                  | 100  |       |      |
|                                                               | 15                      | 40                  | 80   |       |      |
| Input Capacitance, $C_1$                                      | Any Input               | 5                   | 7.5  | pF    |      |

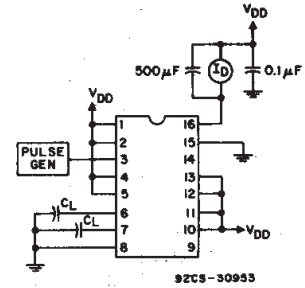


Fig. 9 – Dynamic power dissipation test circuit.

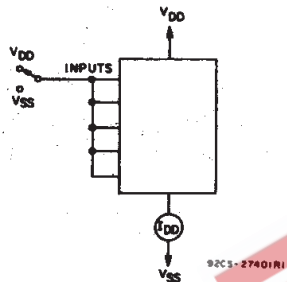


Fig. 10 – Quiescent device current test circuit.

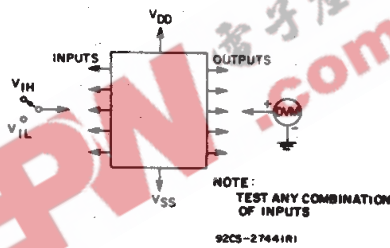


Fig. 11 – Input voltage test circuit.

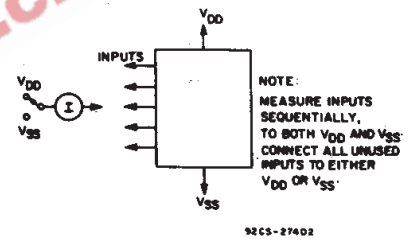
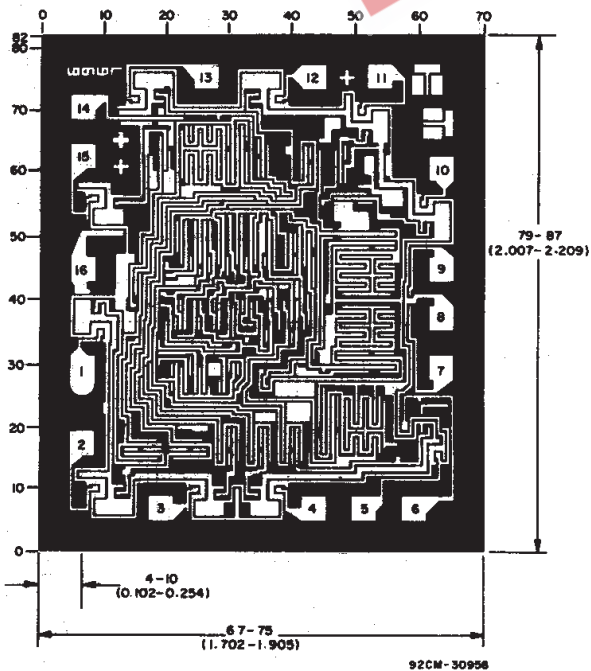
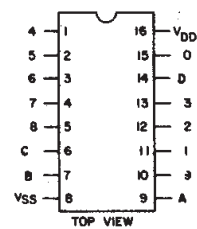


Fig. 12 – Input current test circuit.



Dimensions and pad layout for CD40147BH



CD40147B  
TERMINAL  
ASSIGNMENT

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD40147BE        | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC               |
| CD40147BEE4      | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC               |
| CD40147BM        | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BM96      | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BM96E4    | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BME4      | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BMT       | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BMTE4     | ACTIVE                | SOIC         | D               | 16   | 250         | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BNSR      | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BNSRE4    | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BPW       | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BPWE4     | ACTIVE                | TSSOP        | PW              | 16   | 90          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BPWR      | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| CD40147BPWRE4    | ACTIVE                | TSSOP        | PW              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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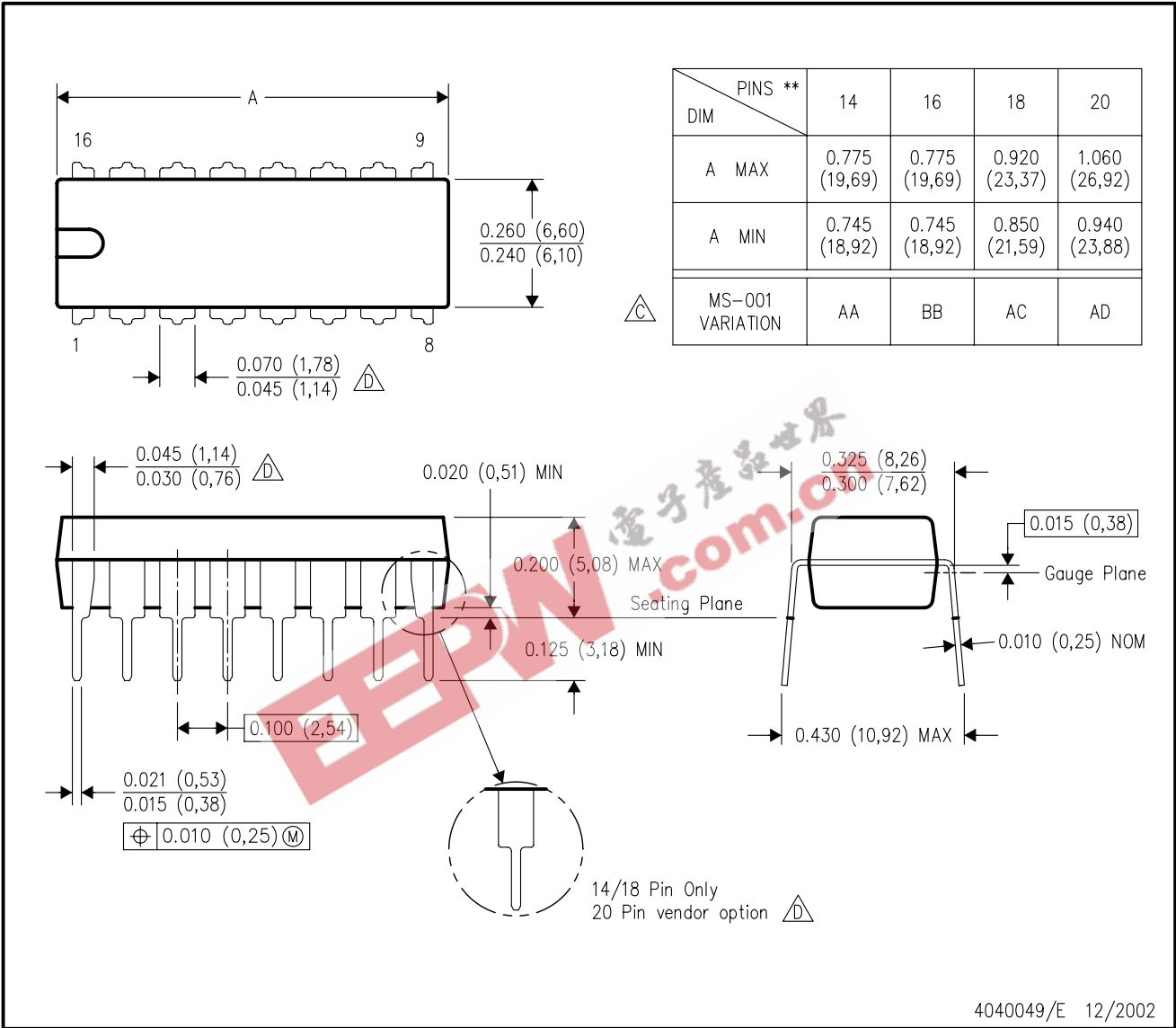
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# MECHANICAL DATA

## N (R-PDIP-T\*\*)

## PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

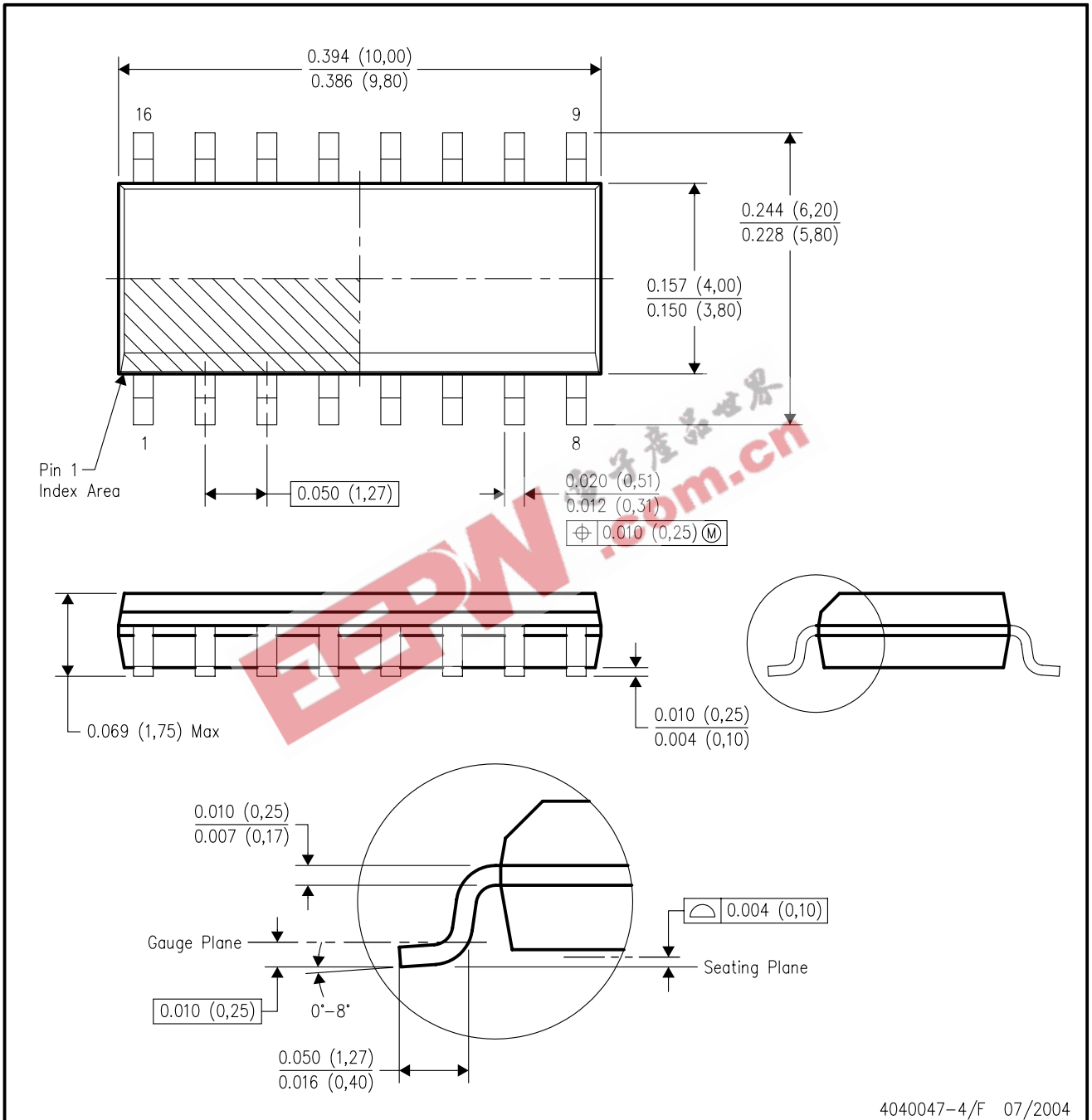


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

# MECHANICAL DATA

## D (R-PDSO-G16)

## PLASTIC SMALL-OUTLINE PACKAGE



4040047-4/F 07/2004

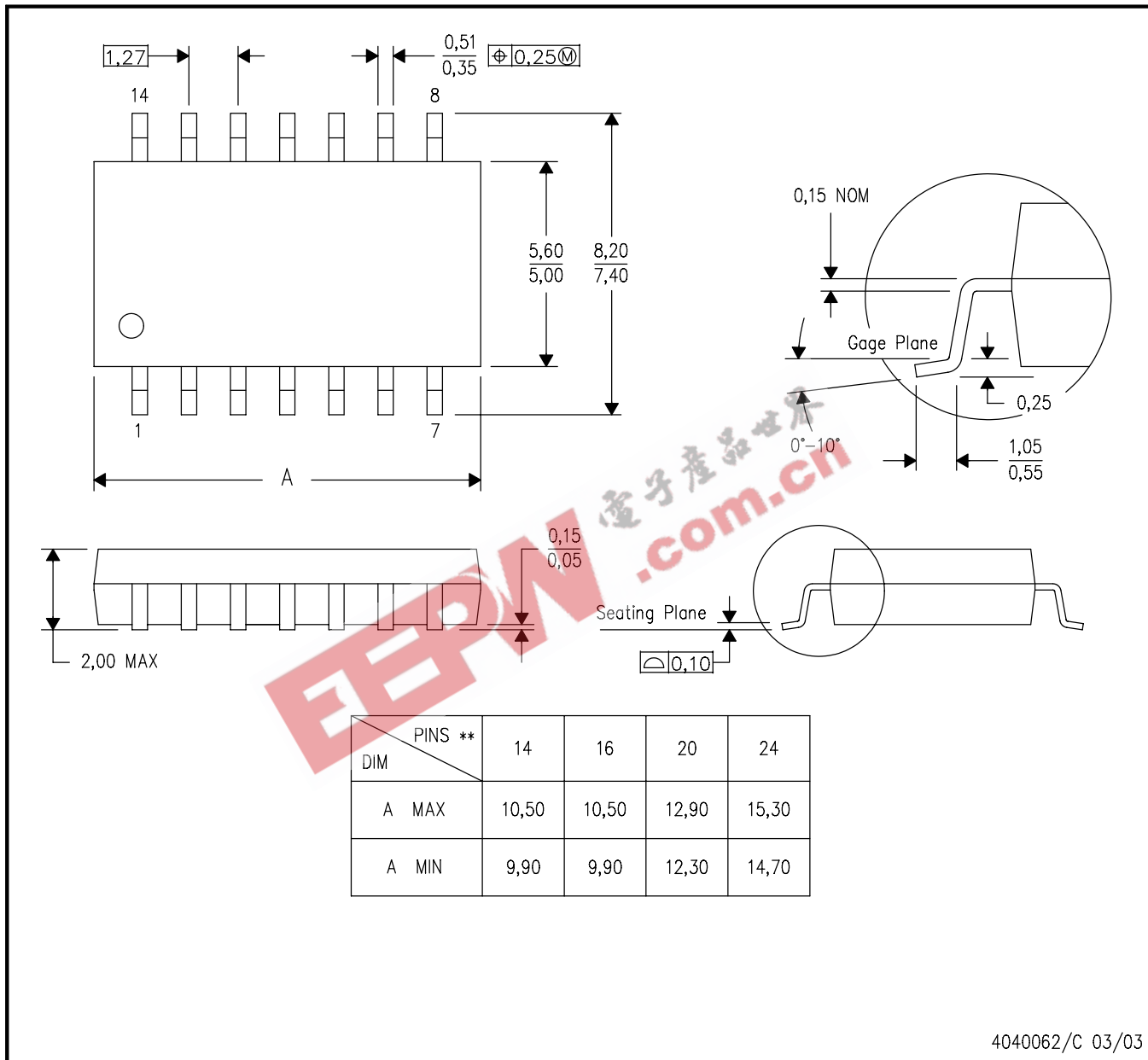
- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-012 variation AC.

## 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.



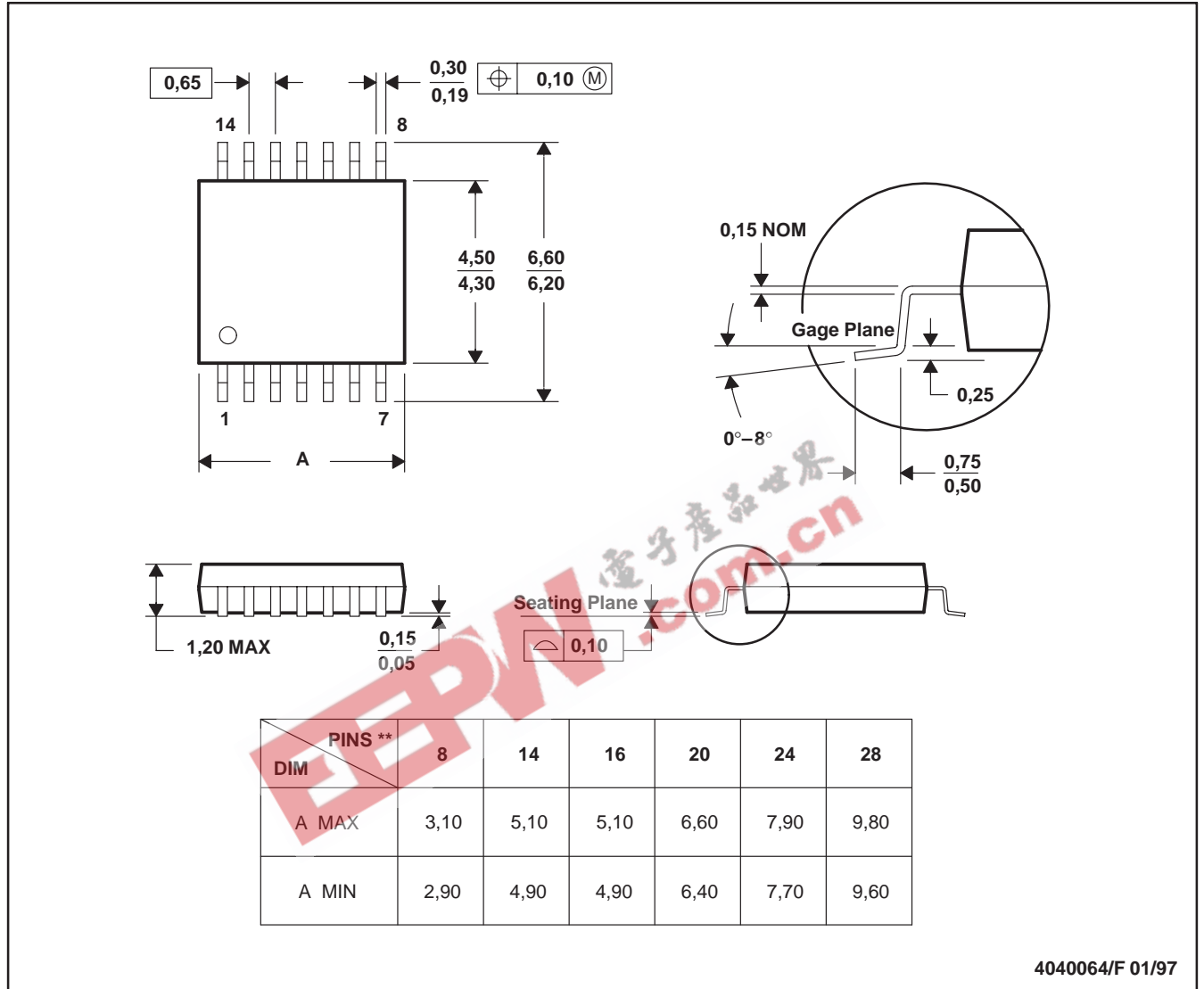
# MECHANICAL DATA

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

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