

CMOS Hex Schmitt Triggers

High-Voltage Types (20-Volt Rating)

■ CD40106B consists of six Schmitt-trigger circuits. Each circuit functions as an inverter with Schmitt-trigger action on the input. The trigger switches at different points for positive- and negative-going signals. The difference between the positive-going voltage (V_P) and the negative-going voltage (V_N) is defined as hysteresis voltage (V_H) (see Fig.6). The CD40106B types are supplied in 14-lead hermetic dual-in-line ceramic packages (F3A suffix), 14-lead dual-in-line plastic packages (E suffix), 14-lead small-outline packages (M, MT, M96, and NSR suffixes), and 14-lead thin shrink small-outline packages (PW and PWR suffixes).

- Features:**
- Schmitt-trigger action with no external components
 - Hysteresis voltage (typ.) 0.9 V at $V_{DD} = 5\text{ V}$, 2.3 V at $V_{DD} = 10\text{ V}$, and 3.5 V at $V_{DD} = 15\text{ V}$
 - Noise immunity greater than 50%
 - No limit on input rise and fall times
 - Standardized, symmetrical output characteristics
 - 100% tested for quiescent current at 20 V
 - Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
 - Low V_{DD} to V_{SS} current during slow input ramp
 - 5-V, 10-V, and 15-V parametric ratings
 - Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

- Applications:**
- Wave and pulse shapers
 - High-noise-environment systems
 - Monostable multivibrators
 - Astable multivibrators

MAXIMUM RATINGS, Absolute-Maximum Values:
DC SUPPLY-VOLTAGE RANGE, (V_{DD})
Voltages referenced to V_{SS} Terminal) -0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS -0.5V to $V_{DD} + 0.5\text{V}$
DC INPUT CURRENT, ANY ONE INPUT $\pm 10\text{ mA}$
POWER DISSIPATION PER PACKAGE (P_D):
For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ 500mW
For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ Derate Linearity at 12mW/°C to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR
FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$ 100mW
OPERATING-TEMPERATURE RANGE (T_A) -55°C to $+125^\circ\text{C}$
STORAGE TEMPERATURE RANGE (T_{stg}) -65°C to $+150^\circ\text{C}$
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 \pm 1/32 Inch (1.59 \pm 0.79mm) from case for 10s max $+265^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

| CHARACTERISTIC | LIMITS | | UNITS |
|--|--------|------|-------|
| | MIN. | MAX. | |
| Supply-Voltage Range (For T_A Full Package-Temperature Range) | 3 | 18 | V |

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 | | UNITS | |
|-------------------------|-----------------|---------|------|-------|------|
| | | VDD (V) | TYP. | | MAX. |
| Propagation Delay Time: | | 5 | 140 | 280 | ns |
| tPHL | | 10 | 70 | 140 | |
| tPLH | | 15 | 60 | 120 | |
| Transition Time: | | 5 | 100 | 200 | ns |
| tTHL | | 10 | 50 | 100 | |
| tTLH | | 15 | 40 | 80 | |
| Input Capacitance, CIN | Any Input | | 5 | 7.5 | pF |

CD40106B Types

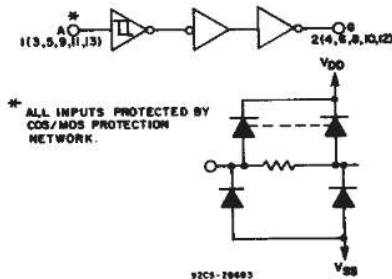
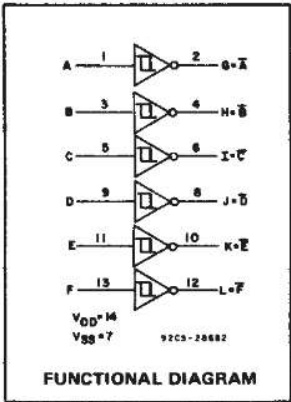


Fig.1 – Logic diagram
(1 of 6 Schmitt triggers).

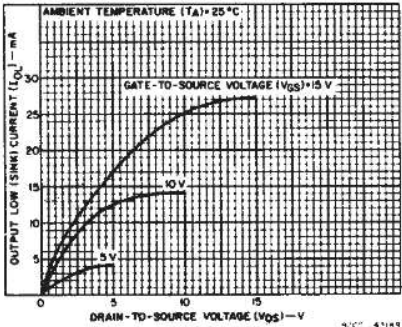


Fig.2 – Typical output low (sink)
current characteristics.

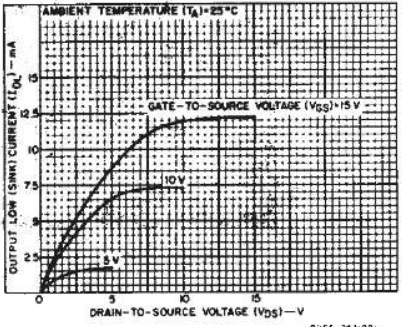
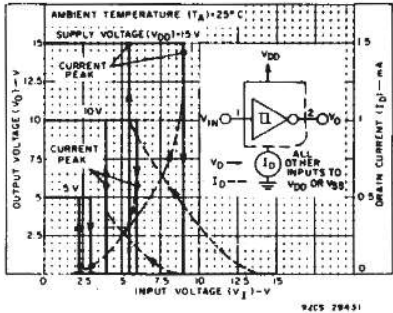
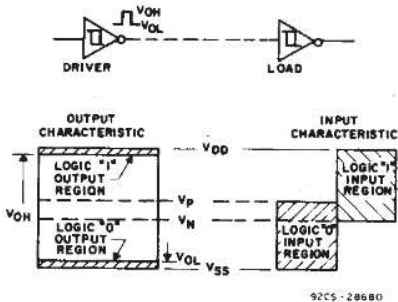
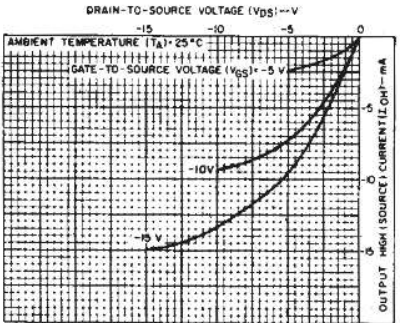
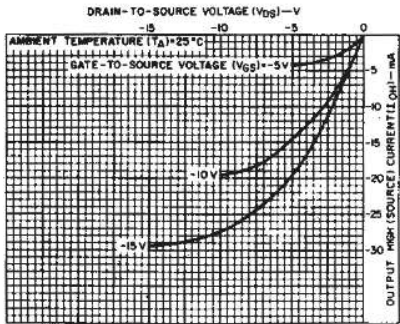
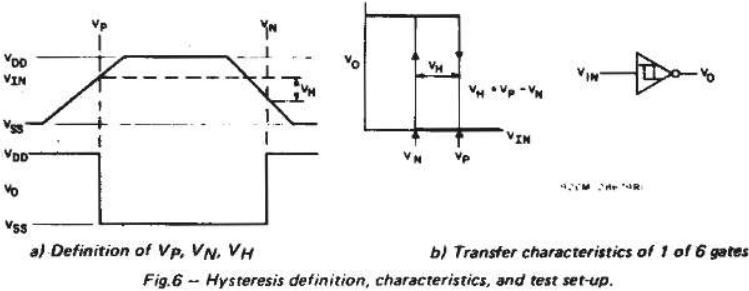


Fig.3 – Minimum output low (sink)
current characteristics.

CD40106B Types

STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC | CONDITIONS | | | LIMITS AT INDICATED TEMPERATURES (°C) | | | | | | | UNITS |
|--|-----------------------|------------------------|------------------------|---------------------------------------|-------|-------|-------|-------|-------------------|------|-------|
| | V _O (V) | V _{IN} (V) | V _{DD} (V) | -55 | -40 | +85 | +125 | +25 | | | |
| | | | | | | | | Min. | Typ. | Max. | |
| Quiescent Device Current, I _{DD} Max. | — | 0,5 | 5 | 1 | 1 | 30 | 30 | — | 0.02 | 1 | μA |
| | — | 0,10 | 10 | 2 | 2 | 60 | 60 | — | 0.02 | 2 | |
| | — | 0,15 | 15 | 4 | 4 | 120 | 120 | — | 0.02 | 4 | |
| | — | 0,20 | 20 | 20 | 20 | 600 | 600 | — | 0.04 | 20 | |
| Positive Trigger Threshold Voltage V _p Min. | — | — | 5 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.9 | — | V |
| | — | — | 10 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 5.9 | — | |
| | — | — | 15 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 8.8 | — | |
| V _p Max. | — | — | 5 | 3.6 | 3.6 | 3.6 | 3.6 | — | 2.9 | 3.6 | V |
| | — | — | 10 | 7.1 | 7.1 | 7.1 | 7.1 | — | 5.9 | 7.1 | |
| | — | — | 15 | 10.8 | 10.8 | 10.8 | 10.8 | — | 8.8 | 10.8 | |
| Negative Trigger Threshold Voltage V _N Min. | — | — | 5 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.9 | — | V |
| | — | — | 10 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 3.9 | — | |
| | — | — | 15 | 4 | 4 | 4 | 4 | 4 | 5.8 | — | |
| V _N Max. | — | — | 5 | 2.8 | 2.8 | 2.8 | 2.8 | — | 1.9 | 2.8 | V |
| | — | — | 10 | 5.2 | 5.2 | 5.2 | 5.2 | — | 3.9 | 5.2 | |
| | — | — | 15 | 7.4 | 7.4 | 7.4 | 7.4 | — | 5.8 | 7.4 | |
| Hysteresis Voltage V _H Min. | — | — | 5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.9 | — | V |
| | — | — | 10 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 2.3 | — | |
| | — | — | 15 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 3.5 | — | |
| V _H Max. | — | — | 5 | 1.6 | 1.6 | 1.6 | 1.6 | — | 0.9 | 1.6 | V |
| | — | — | 10 | 3.4 | 3.4 | 3.4 | 3.4 | — | 2.3 | 3.4 | |
| | — | — | 15 | 5 | 5 | 5 | 5 | — | 3.5 | 5 | |
| Output Low (Sink) Current, I _{OL} Min. | 0.4 | 0,5 | 5 | 0.64 | 0.61 | 0.42 | 0.36 | 0.51 | 1 | — | mA |
| | 0.5 | 0,10 | 10 | 1.6 | 1.5 | 1.1 | 0.9 | 1.3 | 2.6 | — | |
| | 1.5 | 0,15 | 15 | 4.2 | 4 | 2.8 | 2.4 | 3.4 | 6.8 | — | |
| Output High (Source) Current, I _{OH} Min. | 4.6 | 0,5 | 5 | -0.64 | -0.61 | -0.42 | -0.36 | -0.51 | -1 | — | mA |
| | 2.5 | 0,5 | 5 | -2 | -1.8 | -1.3 | -1.15 | -1.6 | -3.2 | — | |
| | 9.5 | 0,10 | 10 | -1.6 | -1.5 | -1.1 | -0.9 | -1.3 | -2.6 | — | |
| | 13.5 | 0,15 | 15 | -4.2 | -4 | -2.8 | -2.4 | -3.4 | -6.8 | — | |
| Output Voltage Low-Level, V _{OL} Max. | — | 5 | 5 | 0.05 | | | | — | 0 | 0.05 | V |
| | — | 10 | 10 | 0.05 | | | | — | 0 | 0.05 | |
| | — | 15 | 15 | 0.05 | | | | — | 0 | 0.05 | |
| Output Voltage High Level, V _{OH} Min. | — | 0 | 5 | 4.95 | | | | 4.95 | 5 | — | V |
| | — | 0 | 10 | 9.95 | | | | 9.95 | 10 | — | |
| | — | 0 | 15 | 14.95 | | | | 14.95 | 15 | — | |
| Input Current, I _{IN} Max. | — | 0,18 | 18 | ±0.1 | ±0.1 | ±1 | ±1 | — | ±10 ⁻⁵ | ±0.1 | μA |



CD40106B Types

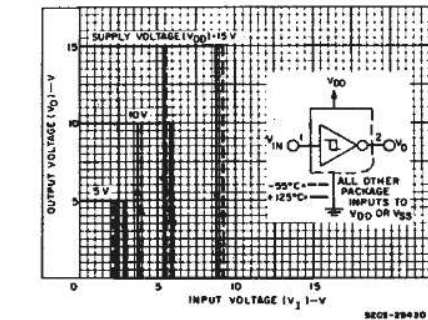


Fig.9 – Typical voltage transfer characteristics as a function of temperature.

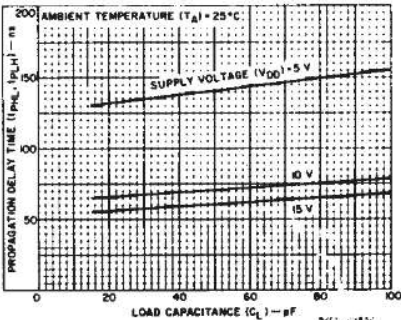


Fig.10 – Typical propagation delay time as a function of load capacitance.

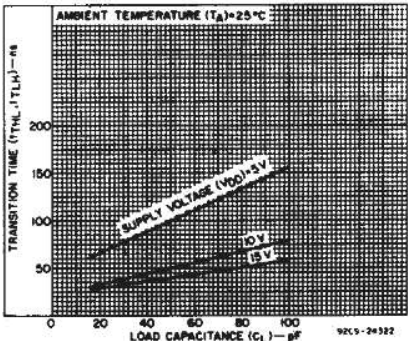


Fig.11 – Typical transition time as a function of load capacitance.

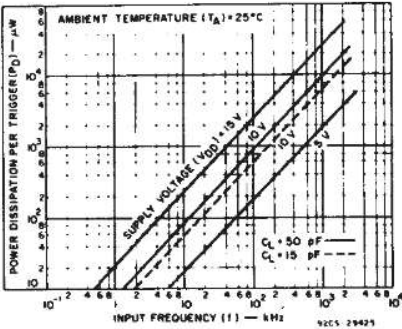


Fig.12 – Typical power dissipation per trigger as a function of input frequency.

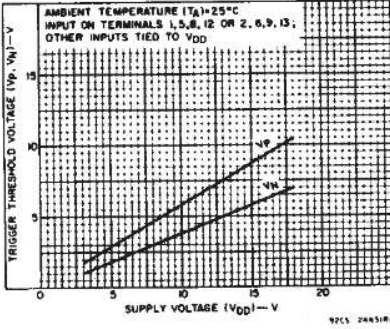


Fig.13 – Typical trigger threshold voltage as a function of supply voltage.

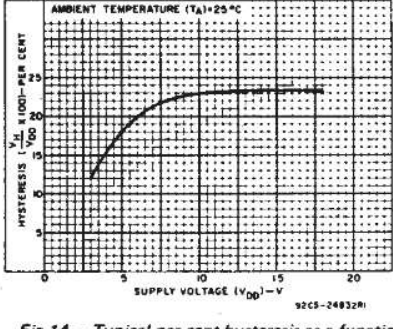


Fig.14 – Typical per cent hysteresis as a function of supply voltage.

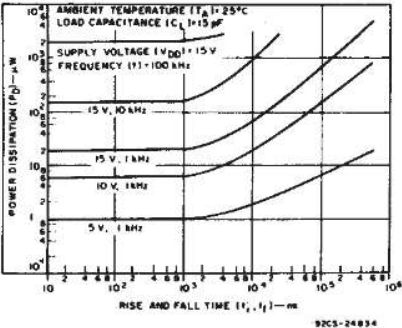


Fig.15 – Typical power dissipation as a function of rise and fall times.

APPLICATIONS

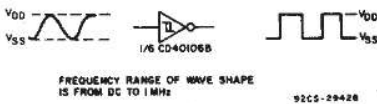


Fig.16 – Wave shaper.

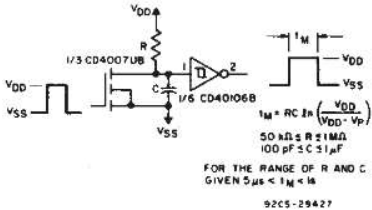


Fig.17 – Monostable multivibrator.

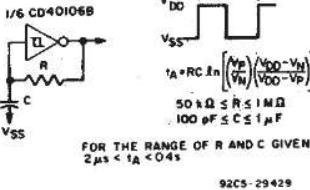


Fig.18 – Astable multivibrator.

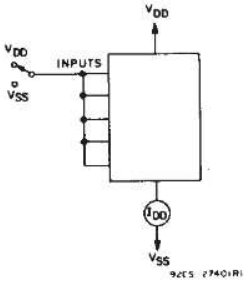


Fig.19 – Quiescent device current test circuit.

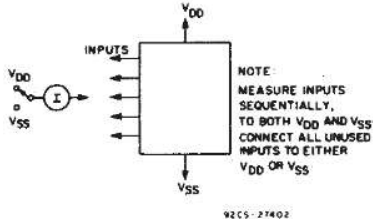


Fig.20 – Input current test circuit.

CD40106B Types

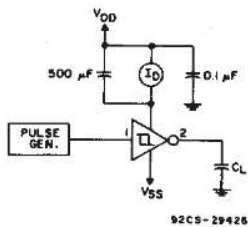
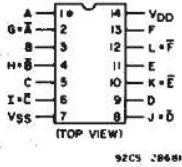
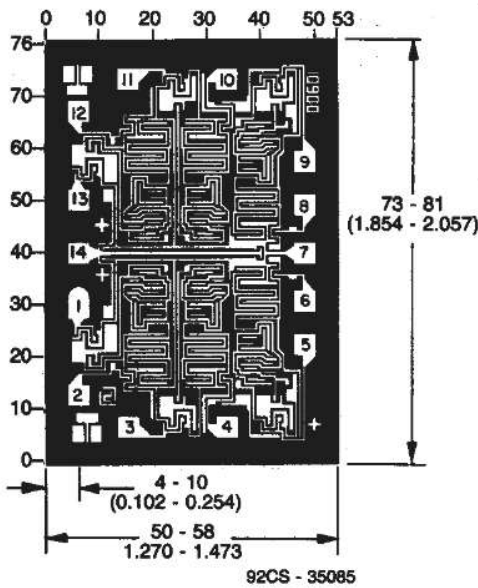


Fig.21 – Dynamic power dissipation test circuit.



TERMINAL ASSIGNMENT



Dimensions and Pad Layout for CD40106BH

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| CD40106BE | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| CD40106BF | ACTIVE | CDIP | J | 14 | 1 | None | Call TI | Level-NC-NC-NC |
| CD40106BF3A | ACTIVE | CDIP | J | 14 | 1 | None | Call TI | Level-NC-NC-NC |
| CD40106BM | ACTIVE | SOIC | D | 14 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| CD40106BM96 | ACTIVE | SOIC | D | 14 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| CD40106BMT | ACTIVE | SOIC | D | 14 | 250 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| CD40106BNSR | ACTIVE | SO | NS | 14 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| CD40106BPW | ACTIVE | TSSOP | PW | 14 | 90 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-UNLIM |
| CD40106BPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-1-250C-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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

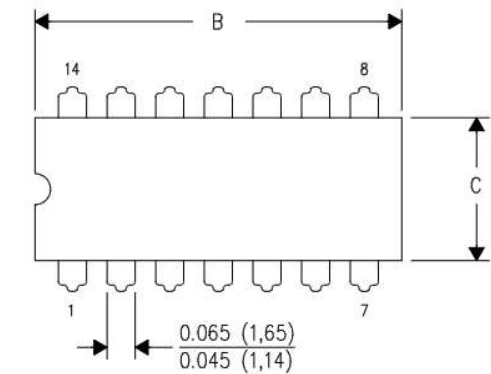
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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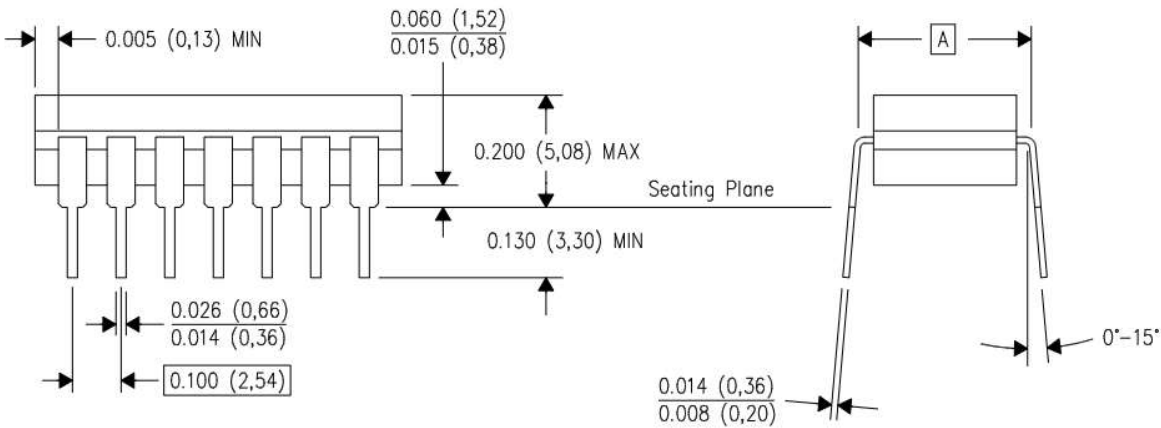
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J (R-GDIP-T**)
14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---------------|------------------|------------------|------------------|------------------|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



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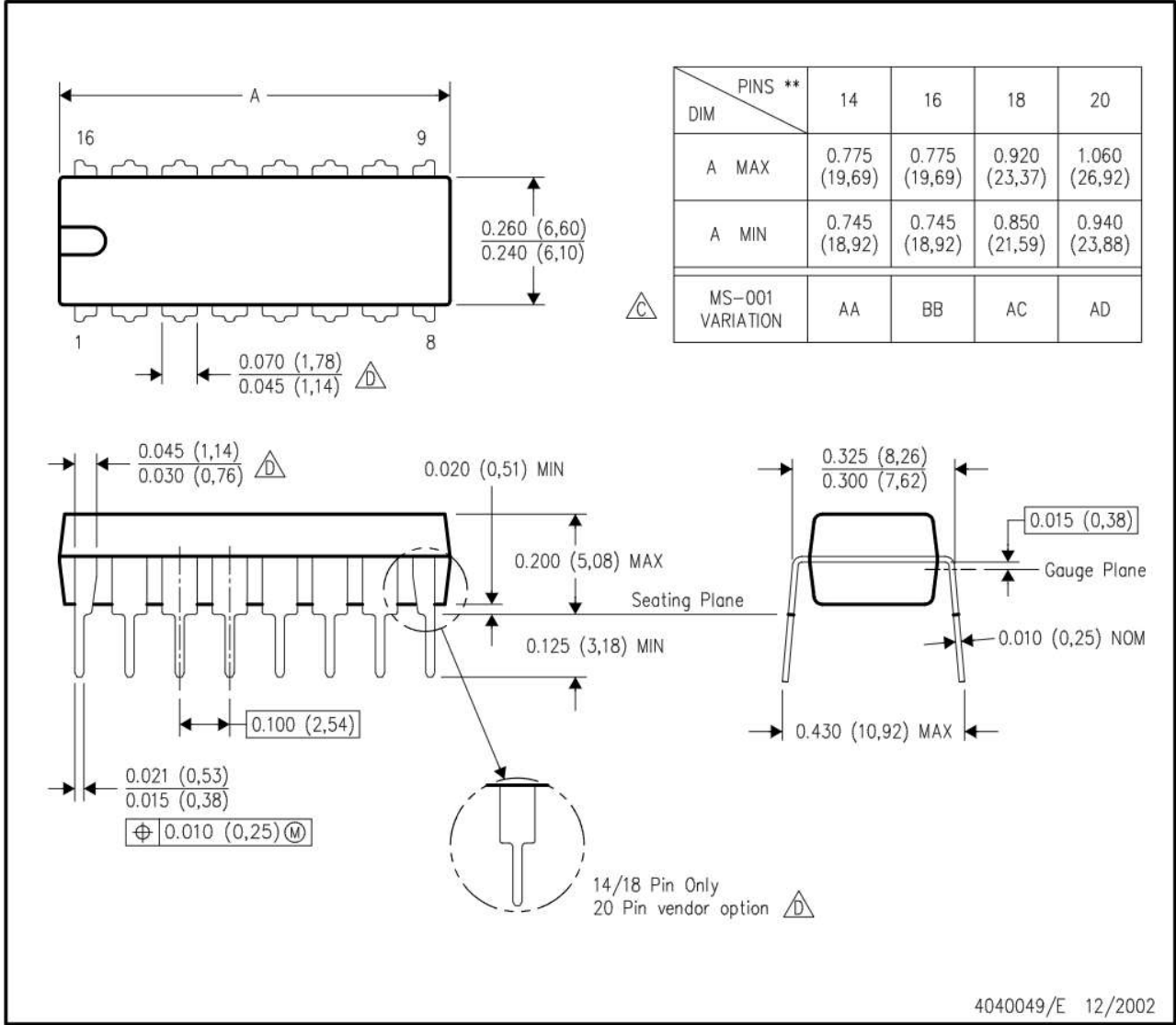
- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

MECHANICAL DATA

N (R-PDIP-T**)

16 PINS SHOWN

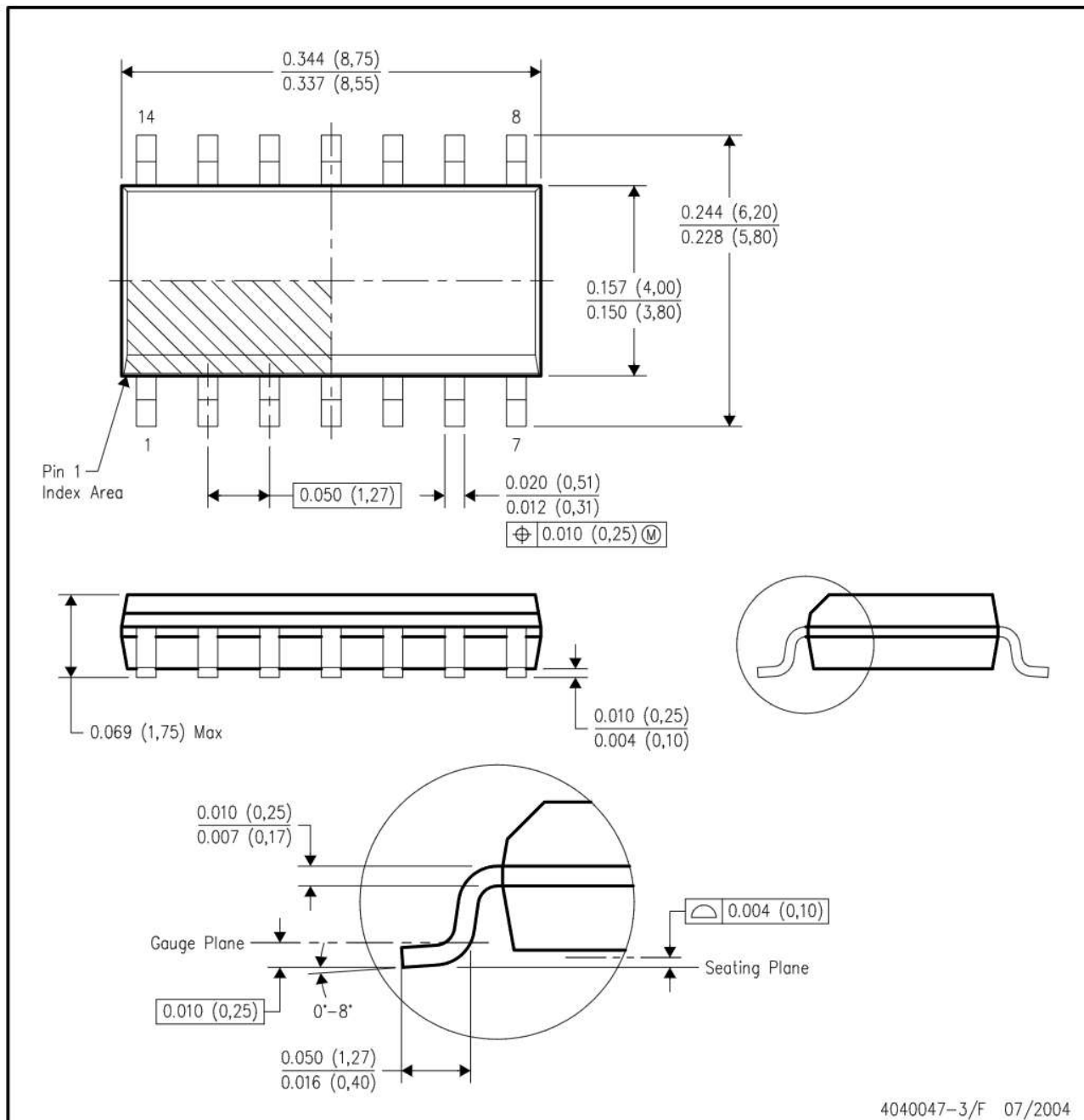
PLASTIC DUAL-IN-LINE PACKAGE



MECHANICAL DATA

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



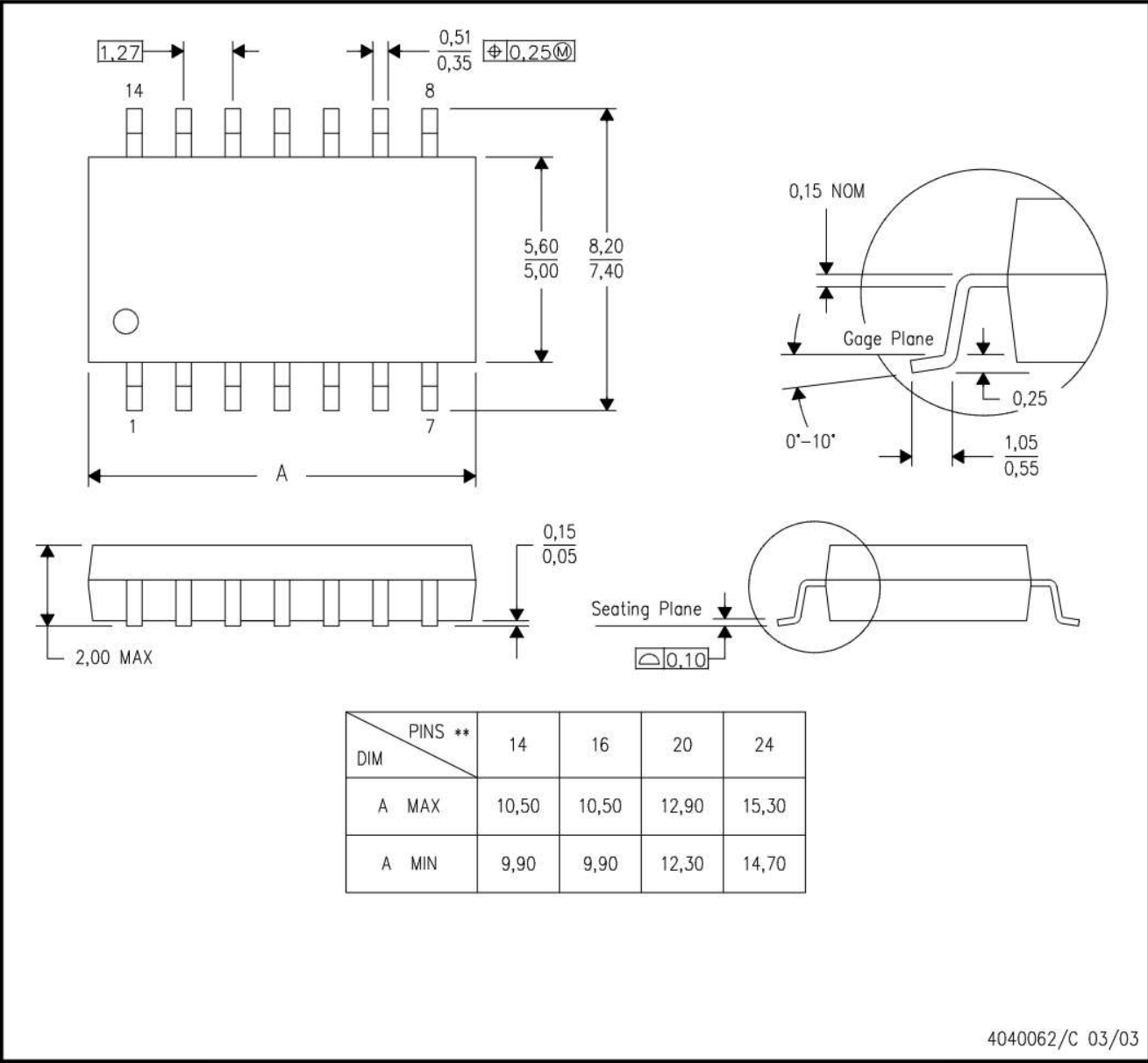
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MECHANICAL DATA

NS (R-PDSO-G**)

14-PINS SHOWN

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.

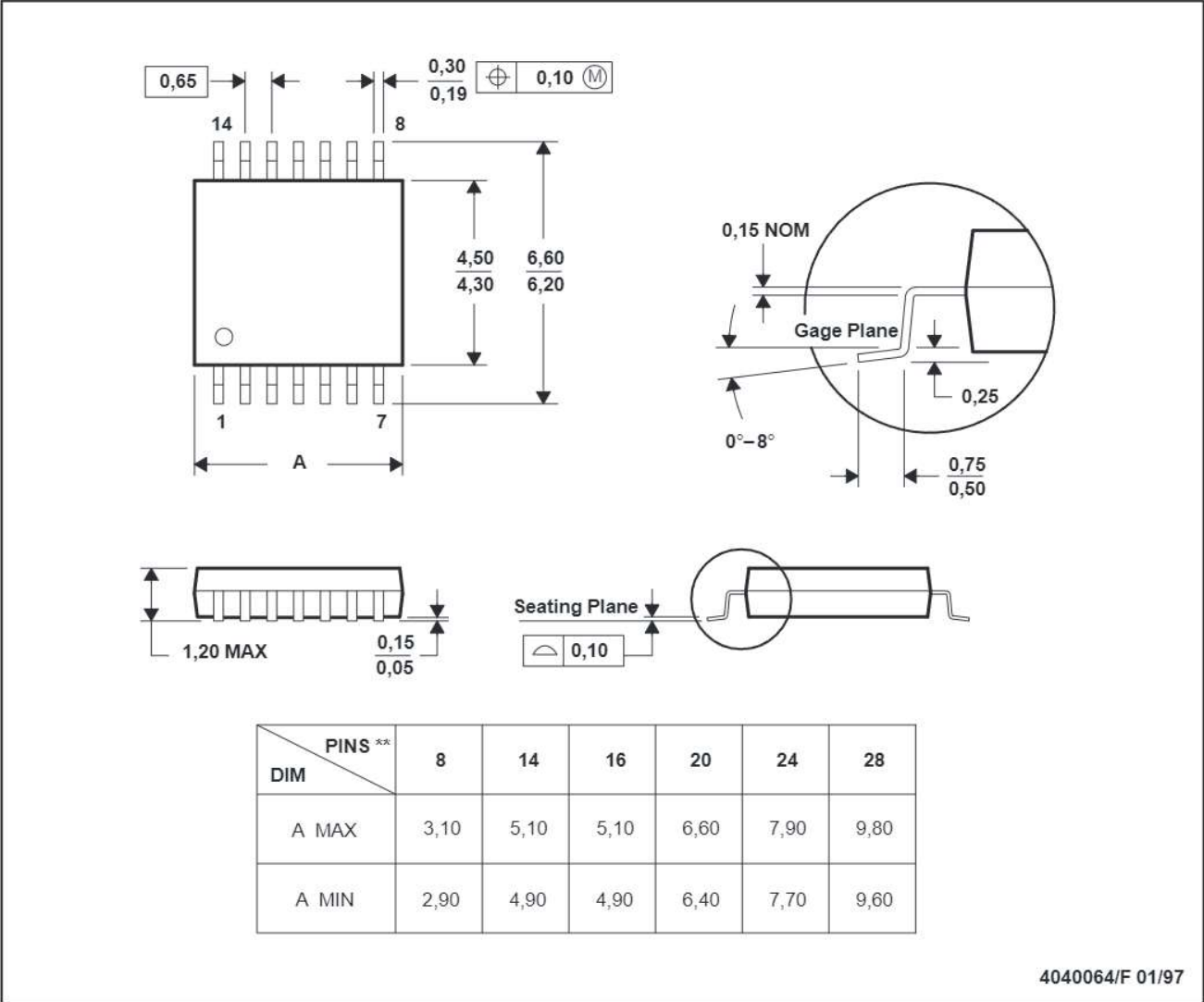
MECHANICAL DATA

MTSS001C – JANUARY 1995 – REVISED FEBRUARY 1999

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- 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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