

CMOS Hex Inverter

High-Voltage Types (20-Volt Rating)

■ CD4069UB types consist of six CMOS inverter circuits. These devices are intended for all general-purpose inverter applications where the medium-power TTL-drive and logic-level-conversion capabilities of circuits such as the CD4009 and CD4049 Hex Inverter/Buffers are not required.

The CD4069UB-Series 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).

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 |

MAXIMUM RATINGS, Absolute-Maximum Values:

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

DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A = 25^\circ C$; Input $t_r, t_f = 20$ ns,

$C_L = 50$ pF, $R_L = 200$ K Ω

| CHARACTERISTIC | | CONDITIONS | LIMITS | | UNITS |
|--|--|----------------------|--------|------|-------|
| | | V _{DD} V | Typ. | Max. | |
| | | | | | |
| Propagation Delay Time; t _{PLH} , t _{PHL} | | 5 | 55 | 110 | ns |
| | | 10 | 30 | 60 | |
| | | 15 | 25 | 50 | |
| Transition Time; t _{THL} , t _{TLH} | | 5 | 100 | 200 | ns |
| | | 10 | 50 | 100 | |
| | | 15 | 40 | 80 | |
| Input Capacitance; C _{IN} | | Any Input | 10 | 15 | pF |

Features:

- Standardized symmetrical output characteristics
- Medium Speed Operation— $t_{PHL}, t_{PLH} = 30$ ns (typ.) at 10 V
- 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 $25^\circ C$
- Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications:

- Logic inversion
- Pulse shaping
- Oscillators
- High-input-impedance amplifiers

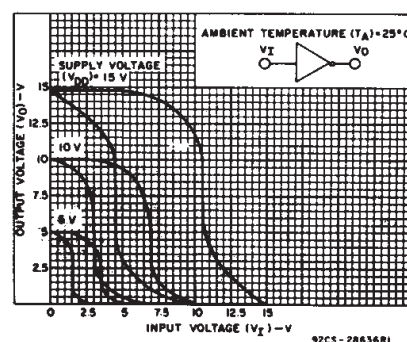
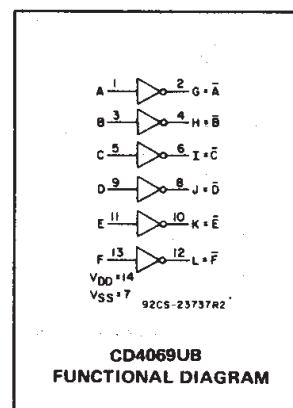


Fig. 1 — Minimum and maximum voltage transfer characteristics.

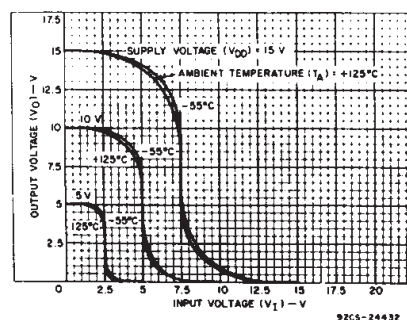


Fig. 2 — Typical voltage transfer characteristics as a function of temperature.

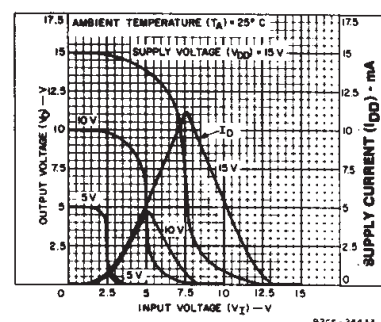


Fig. 3 — Typical current and voltage transfer characteristics.

CD4069UB Types

STATIC ELECTRICAL CHARACTERISTICS

| CHARACTER- ISTIC | CONDITIONS | | | LIMITS AT INDICATED TEMPERATURES (°C) | | | | | | | UNITS |
|---|-----------------------|------------------------|------------------------|---------------------------------------|-------|-------|-------|-------|-------------------|------|-------|
| | V _O (V) | V _{IN} (V) | V _{DD} (V) | +25 | | | | | | | |
| | | | | -55 | -40 | +85 | +125 | Min. | Typ. | Max. | |
| Quiescent Device Current, I _{DD} Max. | — | 0,5 | 5 | 0.25 | 0.25 | 7.5 | 7.5 | — | 0.01 | 0.25 | μA |
| | — | 0,10 | 10 | 0.5 | 0.5 | 15 | 15 | — | 0.01 | 0.5 | |
| | — | 0,15 | 15 | 1 | 1 | 30 | 30 | — | 0.01 | 1 | |
| | — | 0,20 | 20 | 5 | 5 | 150 | 150 | — | 0.02 | 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 Low Voltage, V _{IL} Max. | 4.5 | — | 5 | 1 | | | | — | — | 1 | V |
| | 9 | — | 10 | 2 | | | | — | — | 2 | |
| | 13.5 | — | 15 | 2.5 | | | | — | — | 2.5 | |
| Input High Voltage, V _{IH} Min. | 0.5 | — | 5 | 4 | | | | 4 | — | — | V |
| | 1 | — | 10 | 8 | | | | 8 | — | — | |
| | 1.5 | — | 15 | 12.5 | | | | 12.5 | — | — | |
| Input Current I _{IN} Max. | | 0,18 | 18 | ±0.1 | ±0.1 | ±1 | ±1 | — | ±10 ⁻⁵ | ±0.1 | μA |

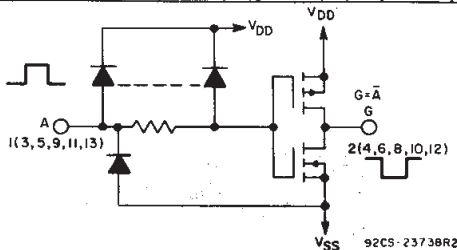


Fig. 6 – Schematic diagram of one of six identical inverters.

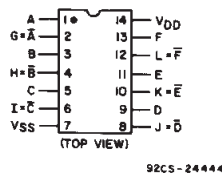


Fig. 7 – CD4069UB terminal assignment.

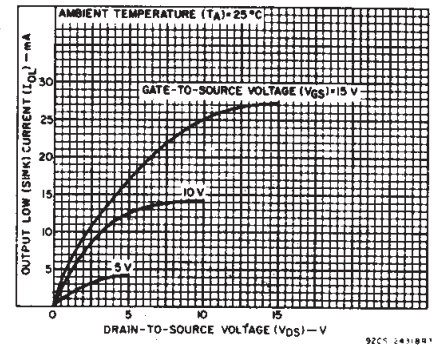


Fig. 4 – Typical output low (sink) current characteristics.

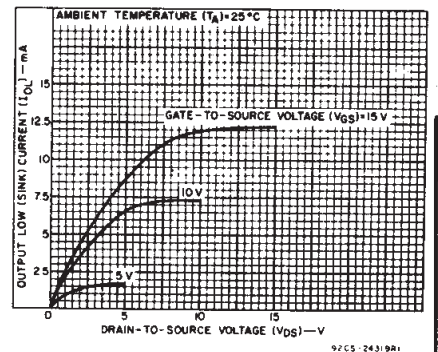


Fig. 5 – Minimum output low (sink) current characteristics.

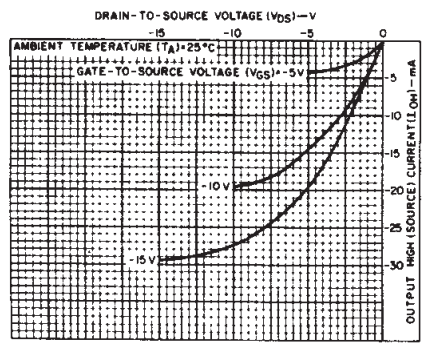


Fig. 8 – Typical output high (source) current characteristics.

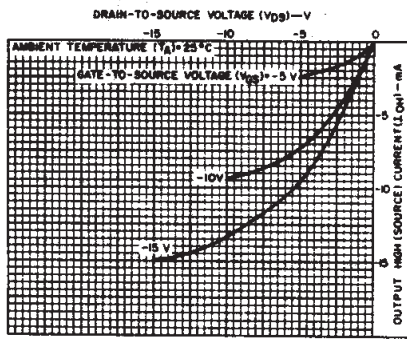


Fig. 9 – Minimum output high (source) current characteristics.

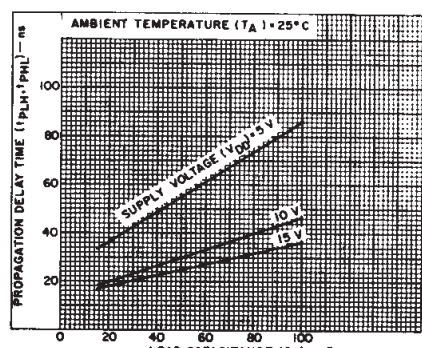


Fig. 10 – Typical propagation delay time vs. load capacitance.

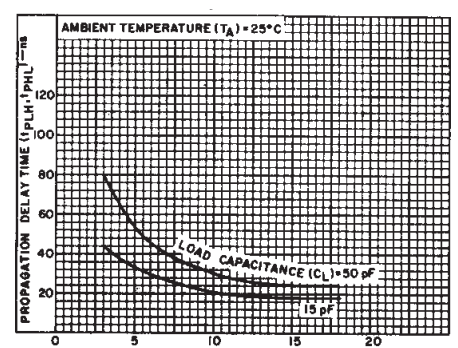


Fig. 11 – Typical propagation delay time vs. supply voltage.

CD4069UB Types

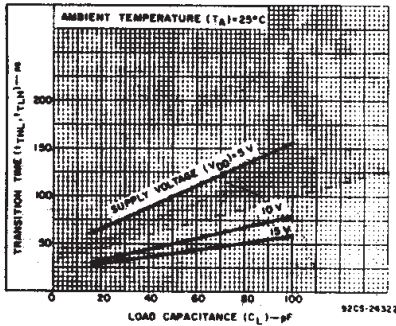


Fig. 12 - Typical transition time vs. load capacitance.

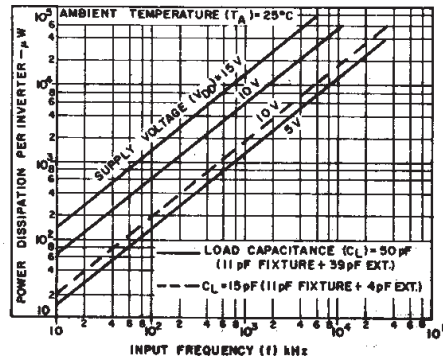


Fig. 13 - Typical dynamic power dissipation vs. frequency.

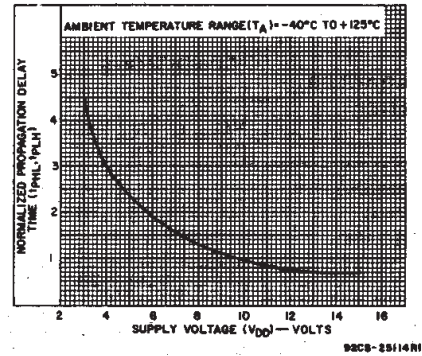


Fig. 14 - Variation of normalized propagation delay time (t_{PHL} and t_{PLH}) with supply voltage.

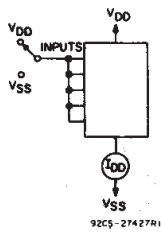


Fig. 15 - Quiescent device current test circuit.

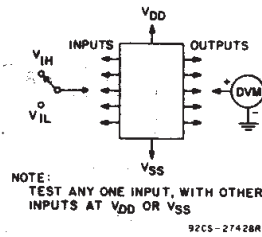


Fig. 16 - Noise immunity test circuit.

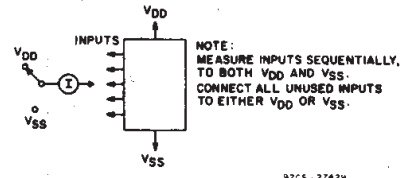


Fig. 17 - Input leakage current test circuit.

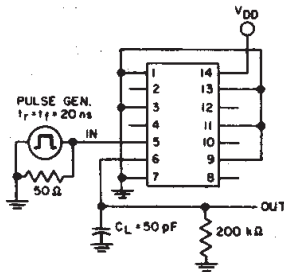


Fig. 18 - Dynamic electrical characteristics test circuit and waveforms.

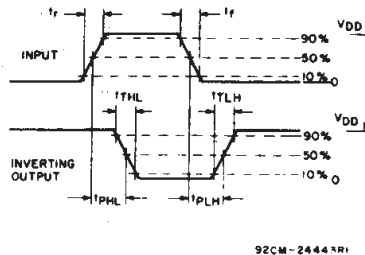


Fig. 19 - Typical crystal oscillator circuit.

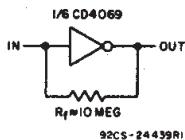


Fig. 20 - High-input impedance amplifier.

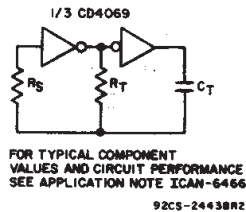


Fig. 21 - Typical RC oscillator circuit.

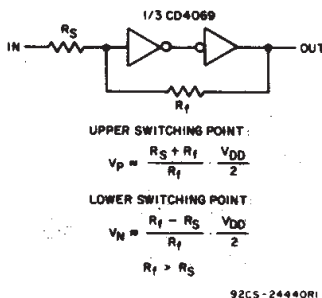


Fig. 22 - Input pulse shaping circuit (Schmitt trigger).

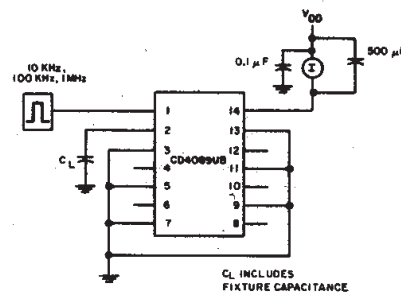
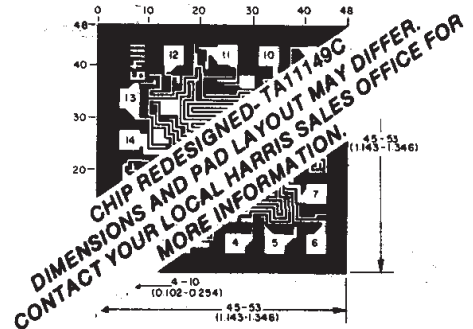


Fig. 23 - Dynamic power dissipation test circuit.



Dimensions and pad layout for CD4069UBH.

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

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PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| CD4069UBE | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD4069UBEE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| CD4069UBF | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| CD4069UBF3A | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |
| CD4069UBM | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBM96 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBM96E4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBM96G4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBME4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBMG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBMT | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBMTE4 | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBMTG4 | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBNSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBNSRE4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBNSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBPWE4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBPWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| CD4069UBPWG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| JM38510/17401BCA | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 SNPB | N / A for Pkg Type |

⁽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.

OBSELETE: 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.

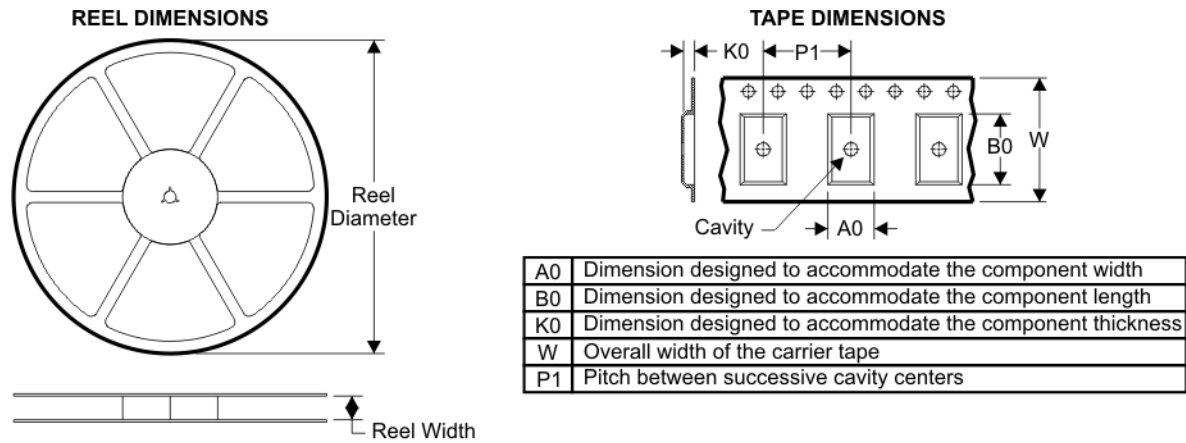
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

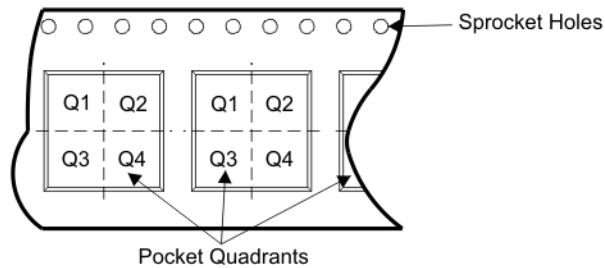
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TAPE AND REEL BOX INFORMATION



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



| Device | Package | Pins | Site | Reel Diameter (mm) | Reel Width (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|---------|------|---------|--------------------|-----------------|---------|---------|---------|---------|--------|---------------|
| CD4069UBM96 | D | 14 | SITE 41 | 330 | 16 | 6.5 | 9.0 | 2.1 | 8 | 16 | Q1 |
| CD4069UBNSR | NS | 14 | SITE 41 | 330 | 16 | 8.2 | 10.5 | 2.5 | 12 | 16 | Q1 |
| CD4069UBPWR | PW | 14 | SITE 41 | 330 | 12 | 7.0 | 5.6 | 1.6 | 8 | 12 | Q1 |

TAPE AND REEL BOX DIMENSIONS



| Device | Package | Pins | Site | Length (mm) | Width (mm) | Height (mm) |
|-------------|---------|------|---------|-------------|------------|-------------|
| CD4069UBM96 | D | 14 | SITE 41 | 346.0 | 346.0 | 33.0 |
| CD4069UBNSR | NS | 14 | SITE 41 | 346.0 | 346.0 | 33.0 |
| CD4069UBPWR | PW | 14 | SITE 41 | 346.0 | 346.0 | 29.0 |

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| PINS ** DIM | 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) |



4040083/F 03/03

- 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.

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



| PINS ** | 14 | 16 | 18 | 20 |
|---------------------|------------------|------------------|------------------|------------------|
| DIM | | | | |
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS-001 VARIATION | AA | BB | AC | AD |



4040049/E 12/2002

- NOTES:
- All linear dimensions are in inches (millimeters).
 - 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.

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



NOTES:

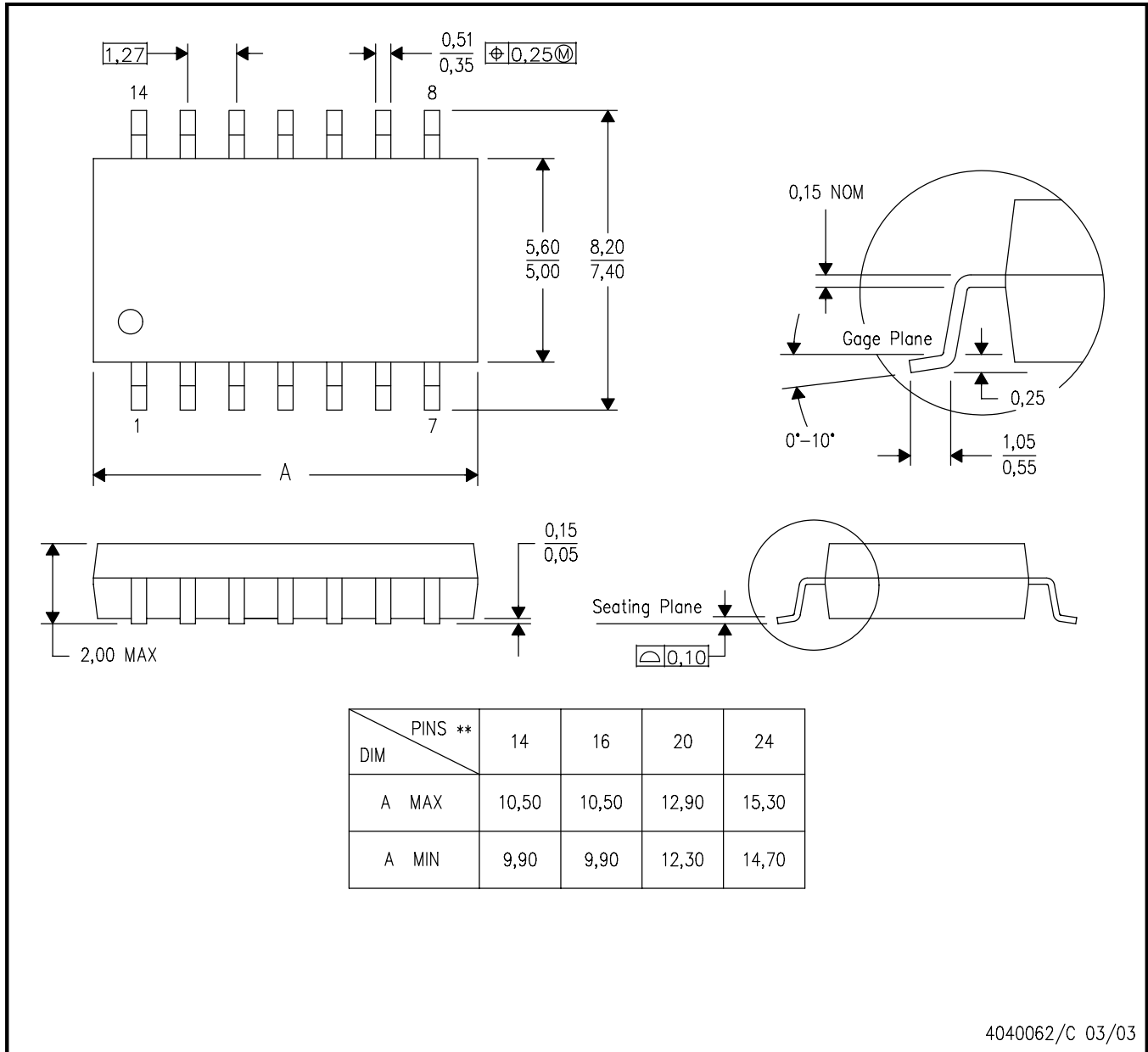
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
- D. Body width does not include interlead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

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

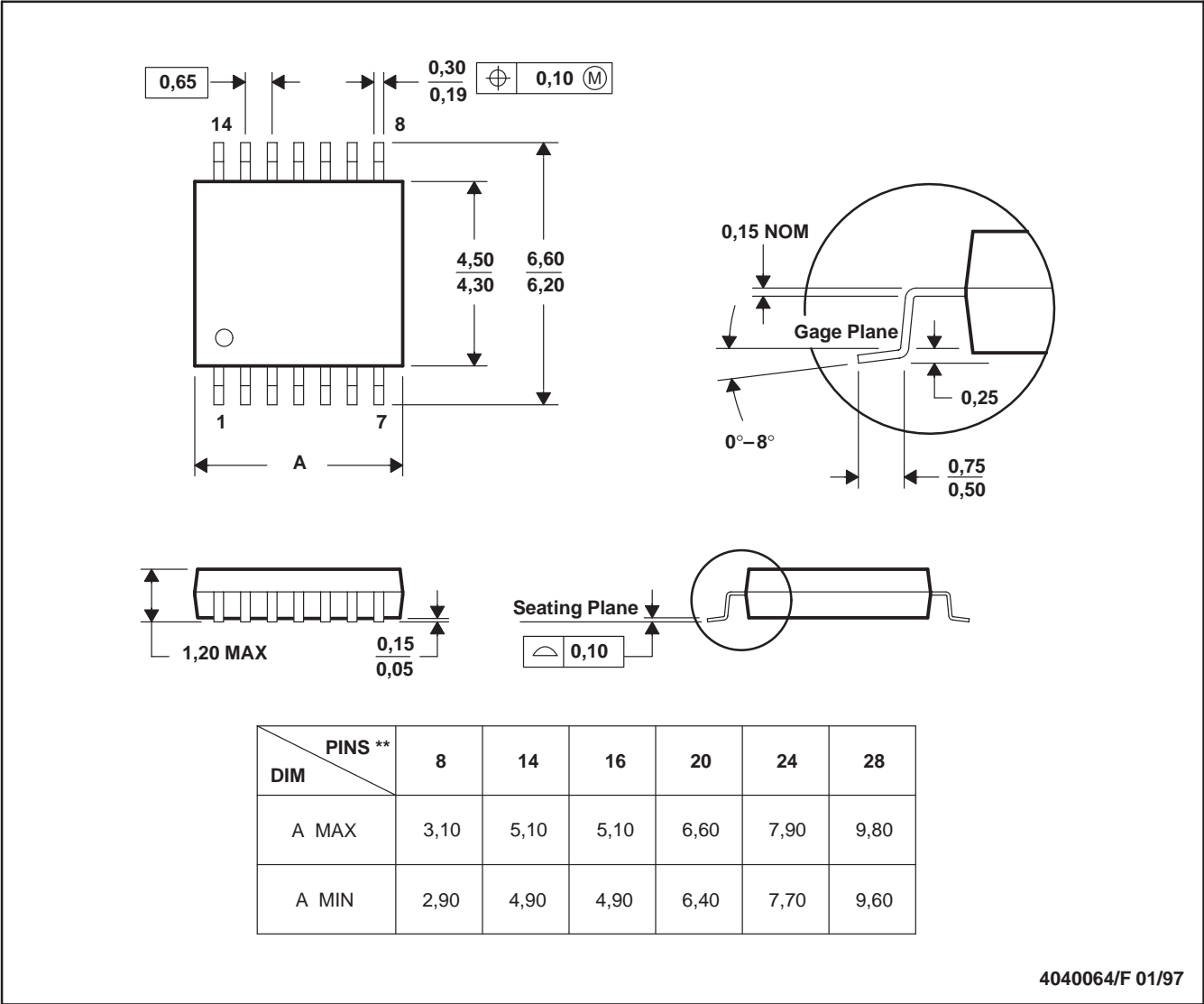
14-PINS SHOWN



- 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.

PW (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.
D. Falls within JEDEC MO-153