TEXAS INSTRUMENTS
Data sheet acquired from Harris Semiconductor
SCHS034C – Revised October 2003

# CD4029B Types

## CMOS Presettable Up/Down Counter

Binary or BCD-Decade

High-Voltage Types (20-Volt Rating)

■ CD4029B consists of a four-stage binary or BCD-decade up/down counter with provisions for look-ahead carry in both counting modes. The inputs consist of a single CLOCK, $\overline{\text{CARRY-IN}}$ ($\overline{\text{CLOCK ENABLE}}$), BINARY/DECADE, UP/DOWN, PRESET ENABLE, and four individual JAM signals. Q1, Q2, Q3, Q4 and a $\overline{\text{CARRY OUT}}$ signal are provided as outputs.

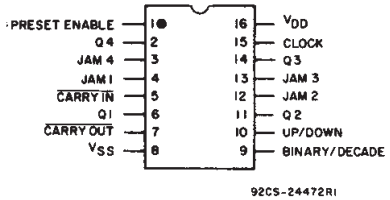
A high PRESET ENABLE signal allows information on the JAM INPUTS to preset the counter to any state asynchronously with the clock. A low on each JAM line, when the PRESET-ENABLE signal is high, resets the counter to its zero count. The counter is advanced one count at the positive transition of the clock when the $\overline{\text{CARRY-IN}}$ and PRESET ENABLE signals are low. Advancement is inhibited when the $\overline{\text{CARRY-IN}}$ or PRESET ENABLE signals are high. The $\overline{\text{CARRY-OUT}}$ signal is normally high and goes low when the counter reaches its maximum count in the UP mode or the minimum count in the DOWN mode provided the $\overline{\text{CARRY-IN}}$ signal is low. The $\overline{\text{CARRY-IN}}$ signal in the low state can thus be considered a $\overline{\text{CLOCK ENABLE}}$. The $\overline{\text{CARRY-IN}}$ terminal must be connected to $V_{SS}$ when not in use.

Binary counting is accomplished when the BINARY/DECADE input is high; the counter counts in the decade mode when the BINARY/DECADE input is low. The counter counts up when the UP/DOWN input is high, and down when the UP/DOWN input is low. Multiple packages can be connected in either a parallel-clocking or a ripple-clocking arrangement as shown in Fig. 17.

Parallel clocking provides synchronous control and hence faster response from all counting outputs. Ripple-clocking allows for longer clock input rise and fall times.

The CD4029B-series types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 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).

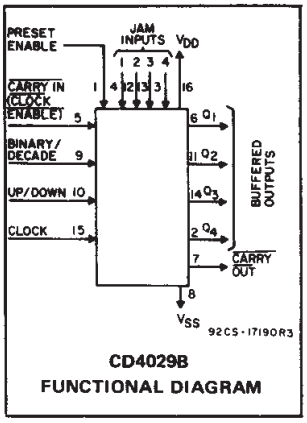
**CD4029B Terminal Diagram**




92CS-24472R1

*Features:*

- **Medium-speed operation . . . 8 MHz (typ.) @ $C_L$ = 50 pF and $V_{DD}-V_{SS}$ = 10 V**
- **Multi-package parallel clocking for synchronous high speed output response or ripple clocking for slow clock input rise and fall times**
- **"Preset Enable" and individual "Jam" inputs provided**
- **Binary or decade up/down counting**
- **BCD outputs in decade mode**
- **100% tested for quiescent current at 20 V**
- **5-V, 10-V, and 15-V parametric ratings**
- **Standardized, symmetrical output characteristics**
- **Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C**
- **Noise margin (over 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**
- **Meets all requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"**




**CD4029B FUNCTIONAL DIAGRAM**

*Applications:*

- **Programmable binary and decade counting/frequency synthesizers-BCD output**
- **Analog to digital and digital to analog conversion**
- **Up/Down binary counting**
- **Magnitude and sign generation**
- **Up/Down decade counting**
- **Difference counting**

**RECOMMENDED OPERATING CONDITIONS at $T_A$ = 25°C, Except as Noted. For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:**

| CHARACTERISTIC | $V_{DD}$ (V) | LIMITS Min. | LIMITS Max. | UNITS |
|---|---|---|---|---|
| Supply-Voltage Range (For $T_A$ = Full Package-Temperature Range) | – | 3 | 18 | V |
| Setup Time $t_{SU}$: Carry-In | 5 | 200 | – | ns |
| | 10 | 70 | – | |
| | 15 | 60 | – | |
| U/D or B/D | 5 | 340 | – | |
| | 10 | 140 | – | |
| | 15 | 100 | – | |
| Clock Pulse Width, $t_W$ | 5 | 180 | – | |
| | 10 | 90 | – | |
| | 15 | 60 | – | |
| Preset Enable Pulse Width, $t_W$ | 5 | 130 | – | |
| | 10 | 70 | – | |
| | 15 | 50 | – | |
| Clock Input Frequency, $f_{CL}$ | 5 | – | 2 | MHz |
| | 10 | – | 4 | |
| | 15 | – | 5.5 | |
| Clock Rise and Fall Time, $t_rCL$, $t_fCL$ | 5 | – | 15 | μs |
| | 10 | – | | |
| | 15 | – | | |

**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 $V_{DD}$ +0.5V
DC INPUT CURRENT, ANY ONE INPUT ..... ±10mA
POWER DISSIPATION PER PACKAGE ($P_D$):
For $T_A$ = -55°C to +100°C ..... 500mW
For $T_A$ = +100°C to +125°C ..... Derate Linearity at 12mW/°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°C to +125°C
STORAGE TEMPERATURE RANGE ($T_{stg}$) ..... -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

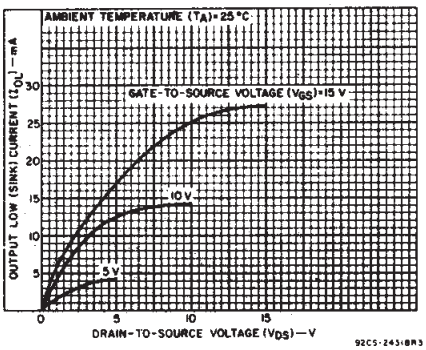



*Fig. 1 – Typical output low (sink) current characteristics.*

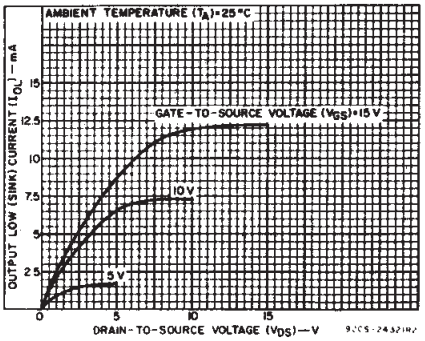



*Fig. 2 – Minimum output low (sink) current characteristics.*

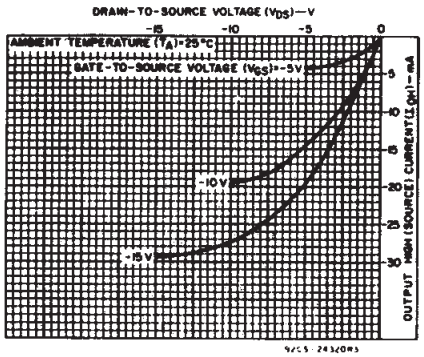



*Fig. 3 – Typical output high (source) current characteristics.*

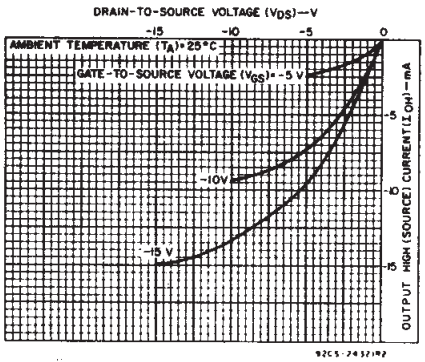



*Fig. 4 – Minimum output high (source) current characteristics.*

**STATIC ELECTRICAL CHARACTERISTICS**

| CHARACTERISTIC | CONDITIONS | | | LIMITS AT INDICATED TEMPERATURES (°C) | | | | | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | +25 | | | |
| | $V_O$ (V) | $V_{IN}$ (V) | $V_{DD}$ (V) | -55 | -40 | +85 | +125 | Min. | Typ. | Max. | |
| Quiescent Device Current, $I_{DD}$ Max. | – | 0,5 | 5 | 5 | 5 | 150 | 150 | – | 0.04 | 5 | µA |
| | – | 0,10 | 10 | 10 | 10 | 300 | 300 | – | 0.04 | 10 | |
| | – | 0,15 | 15 | 20 | 20 | 600 | 600 | – | 0.04 | 20 | |
| | – | 0,20 | 20 | 100 | 100 | 3000 | 3000 | – | 0.08 | 100 | |
| 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 | – | |
| | 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. | – | 0,5 | 5 | 0.05 | | | | – | 0 | 0.05 | V |
| | – | 0,10 | 10 | 0.05 | | | | – | 0 | 0.05 | |
| | – | 0,15 | 15 | 0.05 | | | | – | 0 | 0.05 | |
| Output Voltage: High-Level, $V_{OH}$ Min. | – | 0,5 | 5 | 4.95 | | | | 4.95 | 5 | – | |
| | – | 0,10 | 10 | 9.95 | | | | 9.95 | 10 | – | |
| | – | 0,15 | 15 | 14.95 | | | | 14.95 | 15 | – | |
| Input Low Voltage $V_{IL}$ Max. | 0.5,4.5 | – | 5 | 1.5 | | | | – | – | 1.5 | V |
| | 1,9 | – | 10 | 3 | | | | – | – | 3 | |
| | 1.5,13.5 | – | 15 | 4 | | | | – | – | 4 | |
| Input High Voltage, $V_{IH}$ Min. | 0.5,4.5 | – | 5 | 3.5 | | | | 3.5 | – | – | |
| | 1,9 | – | 10 | 7 | | | | 7 | – | – | |
| | 1.5,13.5 | – | 15 | 11 | | | | 11 | – | – | |
| Input Current $I_{IN}$ Max. | – | 0,18 | 18 | ±0.1 | ±0.1 | ±1 | ±1 | – | $\pm 10^{-5}$ | ±0.1 | µA |

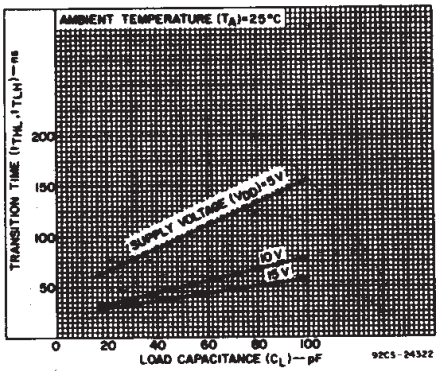



*Fig. 5 – Typical transition time as a function of load capacitance.*

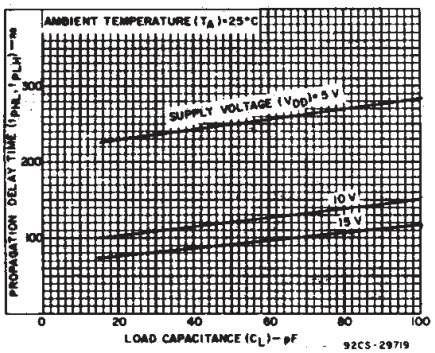



*Fig. 6 – Typical propagation delay times as a function of load capacitance (Q output).*

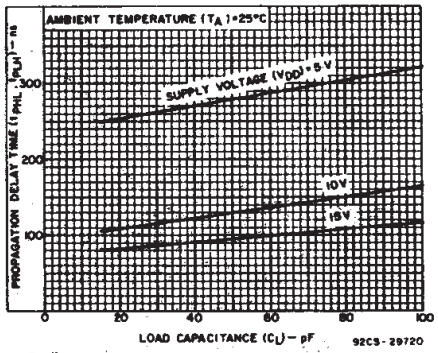



*Fig. 7 – Typical propagation delay time as a function of load capacitance (carry output).*

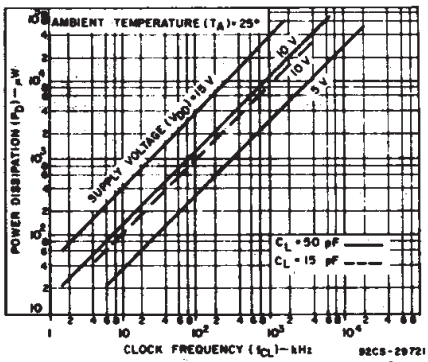



*Fig. 8 – Typical power dissipation as a function of frequency.*

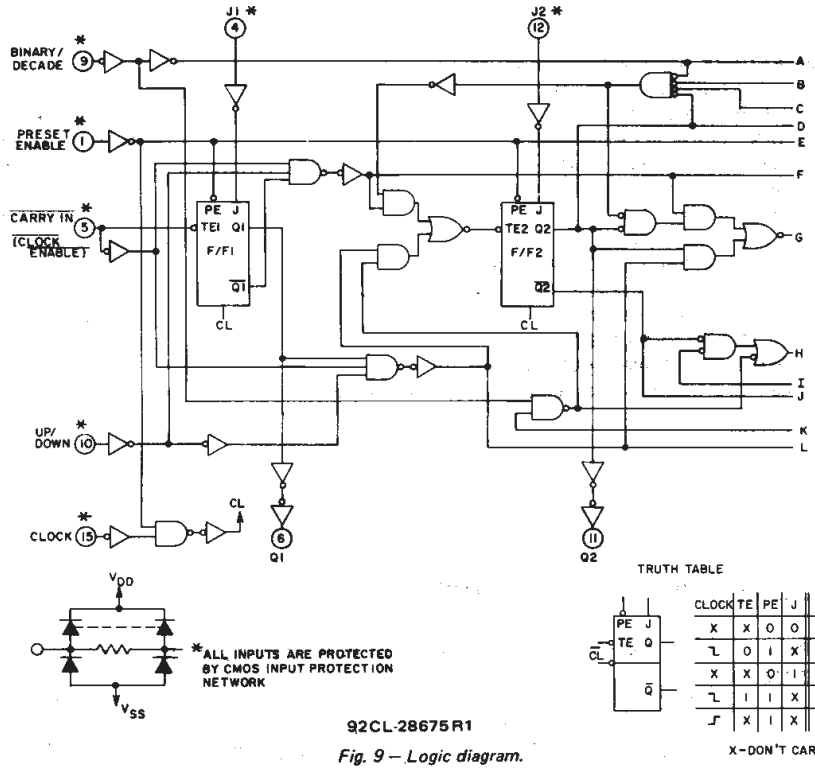



*Fig. 9 – Logic diagram.*

TRUTH TABLE

| CLOCK | TE | PE | J | Q | $\overline{Q}$ |
|---|---|---|---|---|---|
| X | X | 0 | 0 | 0 | 1 |
| ↓ | 0 | 1 | X | $\overline{Q}$ | Q |
| X | X | 0 | 1 | 1 | 0 |
| ↓ | 1 | 1 | X | Q | $\overline{Q}$ NC |
| ↑ | X | 1 | X | Q | $\overline{Q}$ NC |

X-DON'T CARE

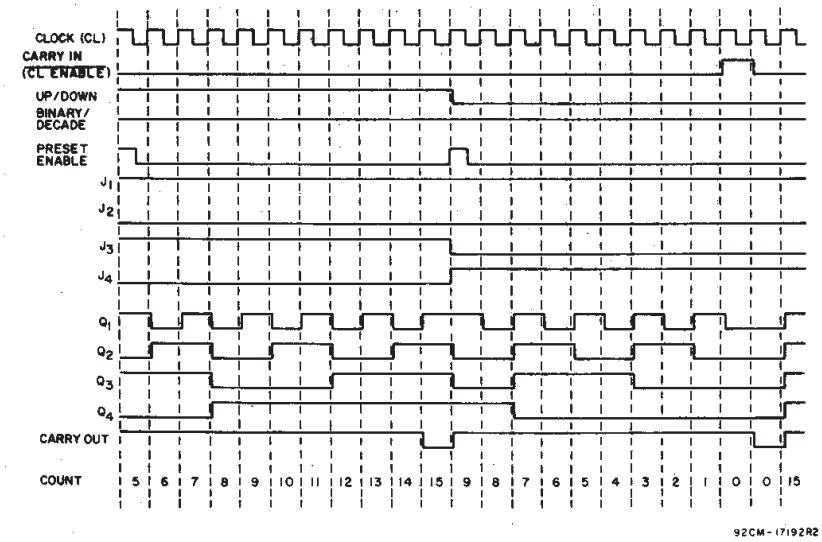
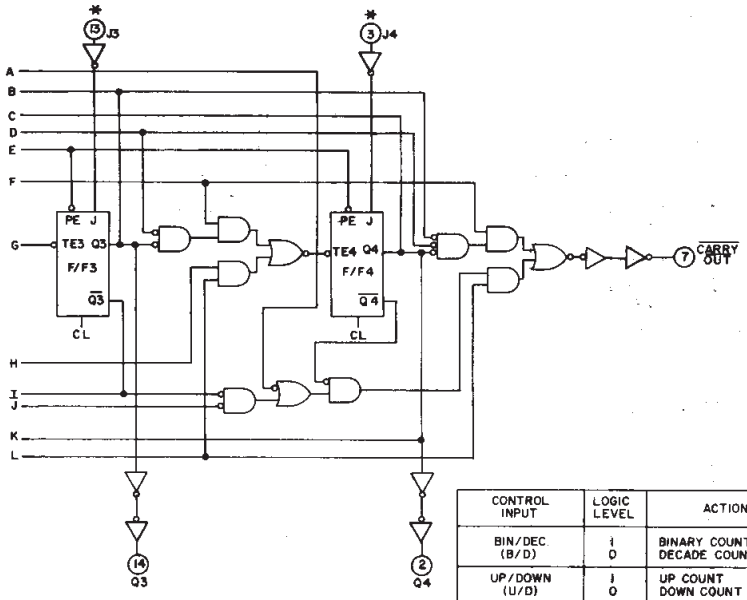



*Fig. 10 – Timing diagram-binary mode.*




| CONTROL INPUT | LOGIC LEVEL | ACTION |
|---|---|---|
| BIN/DEC (B/D) | 1 | BINARY COUNT |
| | 0 | DECADE COUNT |
| UP/DOWN (U/D) | 1 | UP COUNT |
| | 0 | DOWN COUNT |
| PRESET ENABLE (PE) | 1 | JAM IN |
| | 0 | NO JAM |
| $\overline{\text{CARRY IN (CI)}}$ $\overline{\text{(CLOCK ENABLE)}}$ | 1 | NO COUNTER ADVANCE AT POS. CLOCK TRANSITION |
| | 0 | ADVANCE COUNTER AT POS. CLOCK TRANSITION |

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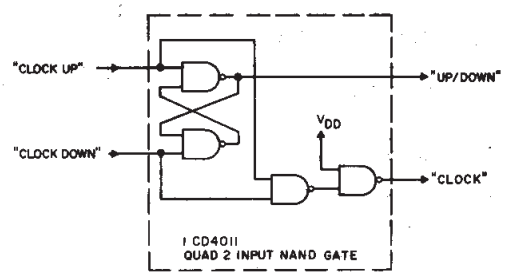
*Fig. 9 – Logic diagram (cont'd).*



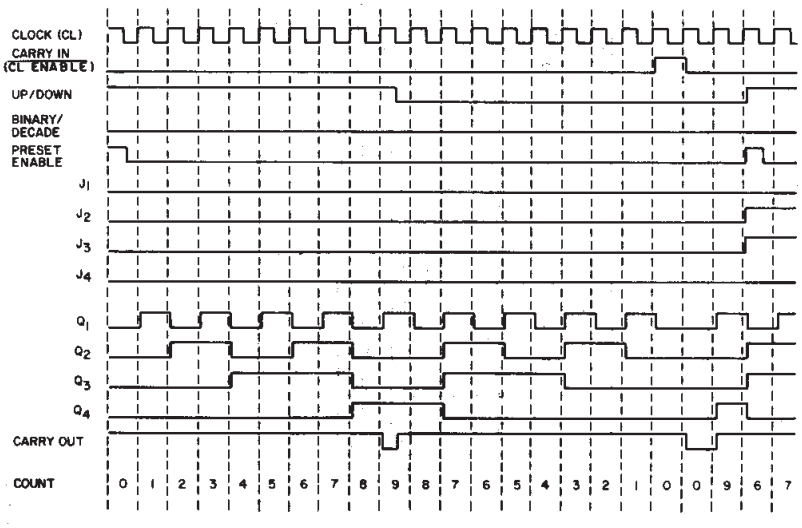

92CS-17195R2

*Fig. 11 – Conversion of clock up, clock down input signals to clock and up/down input signals.*

The CD4029B CLOCK and UP/DOWN inputs are used directly in most applications. In applications where CLOCK UP and CLOCK DOWN inputs are provided, conversion to the CD4029B CLOCK and UP/DOWN inputs can easily be realized by use of the circuit in Fig. 11.

CD4029B changes count on positive transitions of CLOCK UP or CLOCK DOWN inputs. For the gate configuration shown below, when counting up the CLOCK DOWN input must be maintained high and conversely when counting down the CLOCK UP input must be maintained high.






92CM-17193R3

*Fig. 12 – Timing diagram-decade mode.*

**DYNAMIC ELECTRICAL CHARACTERISTICS at $T_A$ = 25°C, Input $t_r$, $t_f$ = 20 ns, $C_L$ = 50 pF, $R_L$ = 200 kΩ**

| CHARACTERISTIC | TEST CONDITIONS $V_{DD}$ (V) | LIMITS Min. | Typ. | Max. | UNITS |
|---|---|---|---|---|---|
| **Clocked Operation** | | | | | |
| Propagation Delay Time: $t_{PHL}$, $t_{PLH}$ Q Output | 5 | – | 250 | 500 | ns |
| | 10 | – | 120 | 240 | |
| | 15 | – | 90 | 180 | |
| Carry Output | 5 | – | 280 | 560 | |
| | 10 | – | 130 | 260 | |
| | 15 | – | 95 | 190 | |
| Transition Time: $t_{THL}$, $t_{TLH}$ Q Outputs, Carry Output | 5 | – | 100 | 200 | |
| | 10 | – | 50 | 100 | |
| | 15 | – | 40 | 80 | |
| Minimum Clock Pulse Width, $t_W$ | 5 | – | 90 | 180 | |
| | 10 | – | 45 | 90 | |
| | 15 | – | 30 | 60 | |
| Clock Rise & Fall Time, $t_rCL$, $t_fCL$** | 5 | – | – | 15 | μs |
| | 10 | – | – | 15 | |
| | 15 | – | – | 15 | |
| Minimum Setup Times, $t_S$* B/D or U/D | 5 | – | 170 | 340 | ns |
| | 10 | – | 70 | 140 | |
| | 15 | – | 50 | 100 | |
| Maximum Clock Input Frequency, $f_{CL}$ | 5 | 2 | 4 | – | MHz |
| | 10 | 4 | 8 | – | |
| | 15 | 5.5 | 11 | – | |
| Input Capacitance, $C_{IN}$ | Any Input | – | 5 | 7.5 | pF |
| **Preset Enable** | | | | | |
| Propagation Delay Time: $t_{PHL}$, $t_{PLH}$ Q Outputs | 5 | – | 235 | 470 | ns |
| | 10 | – | 100 | 200 | |
| | 15 | – | 80 | 160 | |
| Carry Output | 5 | – | 320 | 640 | |
| | 10 | – | 145 | 290 | |
| | 15 | – | 105 | 210 | |
| Minimum Preset Enable Pulse Width, $t_W$ | 5 | – | 65 | 130 | |
| | 10 | – | 35 | 70 | |
| | 15 | – | 25 | 50 | |
| Minimum Preset Enable Removal Time, $t_{rem}$* | 5 | – | 100 | 200 | |
| | 10 | – | 55 | 110 | |
| | 15 | – | 40 | 80 | |
| **Carry Input** | | | | | |
| Propagation Delay Time: $t_{PHL}$, $t_{PLH}$ Carry Output | 5 | – | 170 | 340 | ns |
| | 10 | – | 70 | 140 | |
| | 15 | – | 50 | 100 | |
| Min. HOLD Time $t_H$*** Carry In | 5 | – | 25 | 50 | ns |
| | 10 | – | 15 | 30 | |
| | 15 | – | 12 | 25 | |
| Min Set-Up Time $t_s$*** Carry In | 5 | – | 100 | 200 | ns |
| | 10 | – | 35 | 70 | |
| | 15 | – | 30 | 60 | |

* From Up/Down, Binary/Decode, Carry In, or Preset Enable Control Inputs to Clock Edge.

** If more than one unit is cascaded in the parallel clocked application, $t_rCL$ should be made less than or equal to the sum of the fixed propagation delay at 15 pF and the transition time of the carry output driving stage for the estimated capacitive load. This measurement was made with a decoupling capacitor (>1 μF) between $V_{DD}$ and $V_{SS}$.

*** From Carry In to Clock Edge

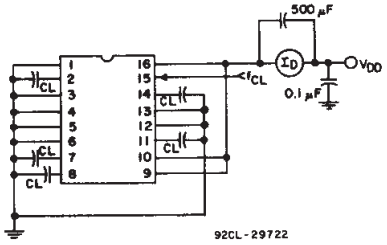



*Fig. 13 – Power dissipation test circuit.*

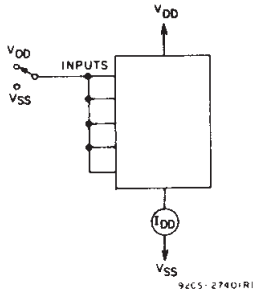



*Fig. 14 – Quiescent-device current test circuit.*

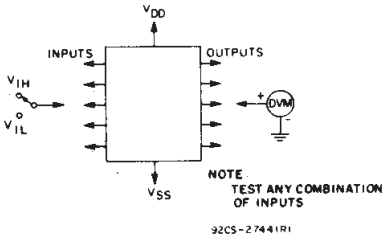



*Fig. 15 – Input voltage test circuit.*

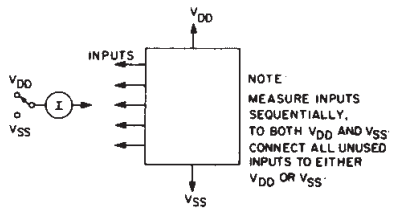
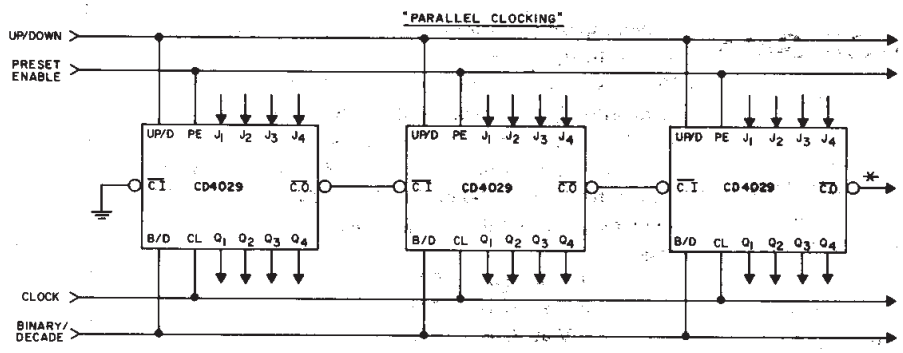
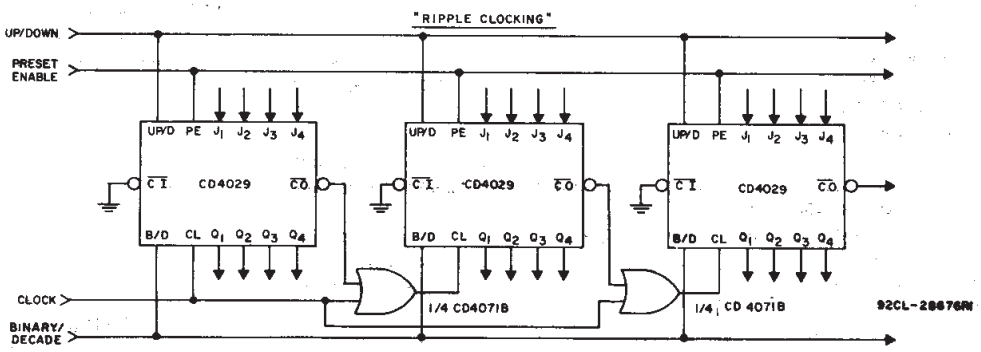



*Fig. 16 – Input current test circuit.*

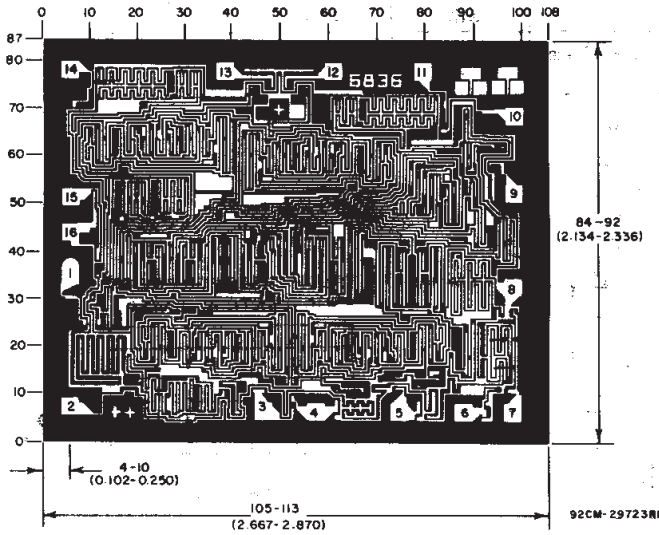



* $\overline{\text{CARRY OUT}}$ lines at the 2nd, 3rd, etc., stages may have a negative-going glitch pulse resulting from differential delays of different CD4029B IC's. These negative-going glitches do not affect proper CD4029B operation. However, if the $\overline{\text{CARRY OUT}}$ signals are used to trigger other edge-sensitive logic devices, such as FF's or counters, the $\overline{\text{CARRY OUT}}$ signals should be gated with the clock signal using a 2-input OR gate such as CD4071B.




Ripple Clocking Mode:
The Up/Down control can be changed at any count. The only restriction on changing the Up/Down control is that the clock input to the first counting stage must be high. For cascading counters operating in a fixed up-count or down-count mode, the OR gates are not required between stages, and $\overline{\text{CO}}$ is connected directly to the CL input of the next stage with $\overline{\text{CI}}$ grounded.

*Fig. 17 – Cascading counter packages.*



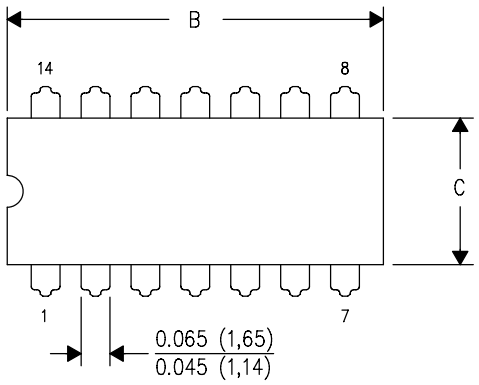

*Chip dimensions and pad layout for CD4029B*

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

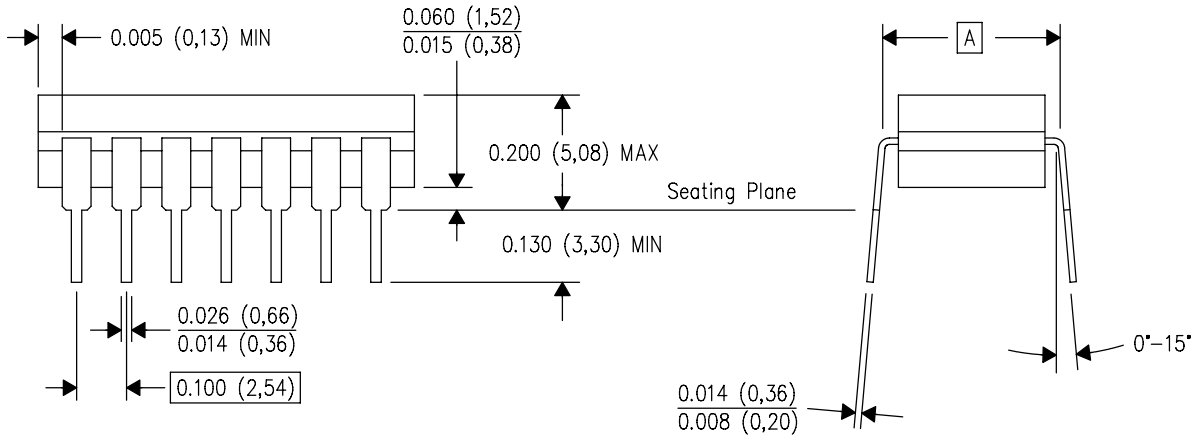
J (R–GDIP–T**)

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) |



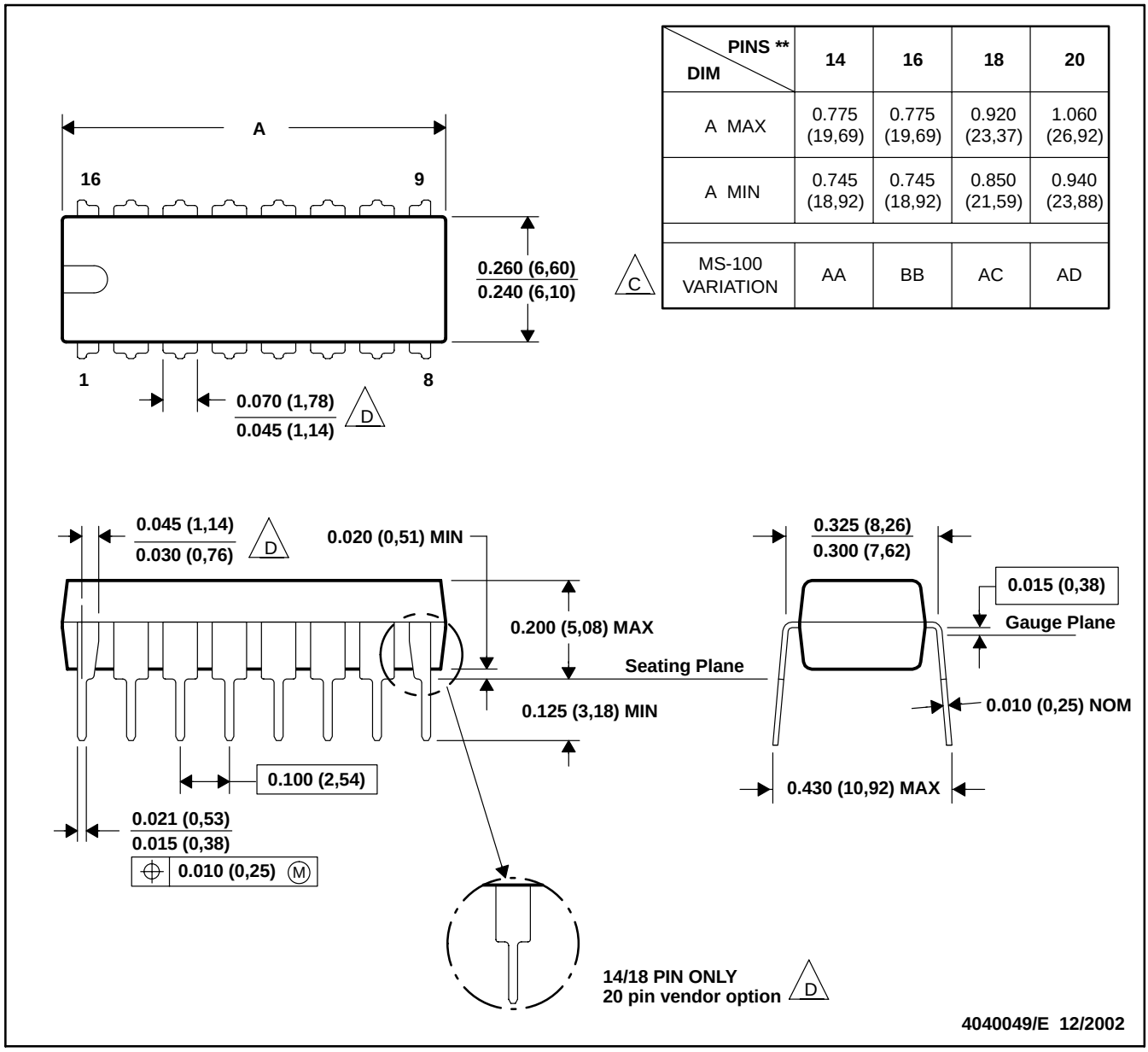

4040083/F 03/03

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**)

## PLASTIC DUAL-IN-LINE PACKAGE

**16 PINS SHOWN**




| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| 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-100 VARIATION | AA | BB | AC | AD |

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 lrngth (Dim A).

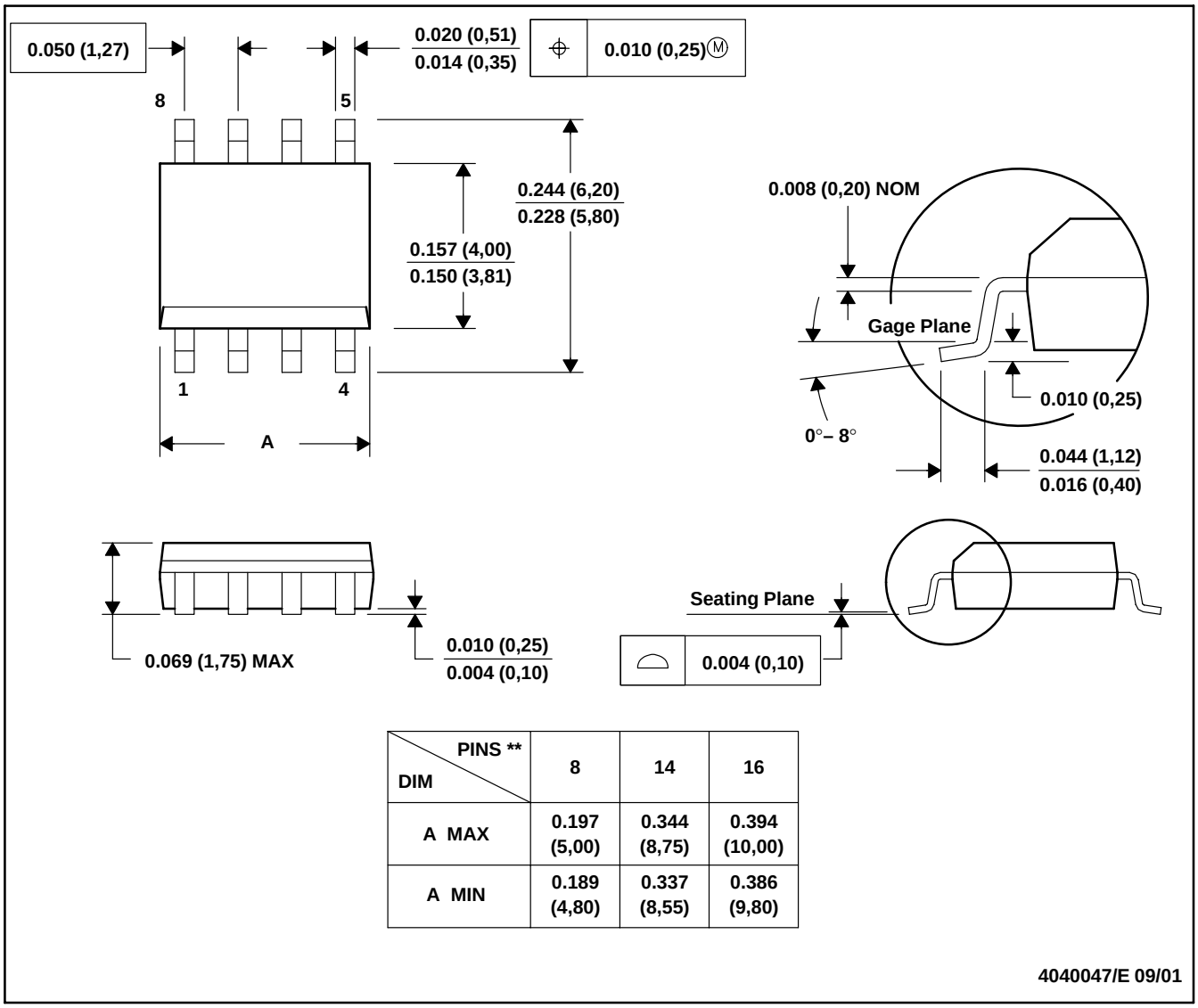
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

MSOI002B – JANUARY 1995 – REVISED SEPTEMBER 2001

## D (R-PDSO-G**)

## PLASTIC SMALL-OUTLINE PACKAGE

**8 PINS SHOWN**




| DIM \ PINS ** | 8 | 14 | 16 |
|---|---|---|---|
| A MAX | 0.197 (5,00) | 0.344 (8,75) | 0.394 (10,00) |
| A MIN | 0.189 (4,80) | 0.337 (8,55) | 0.386 (9,80) |

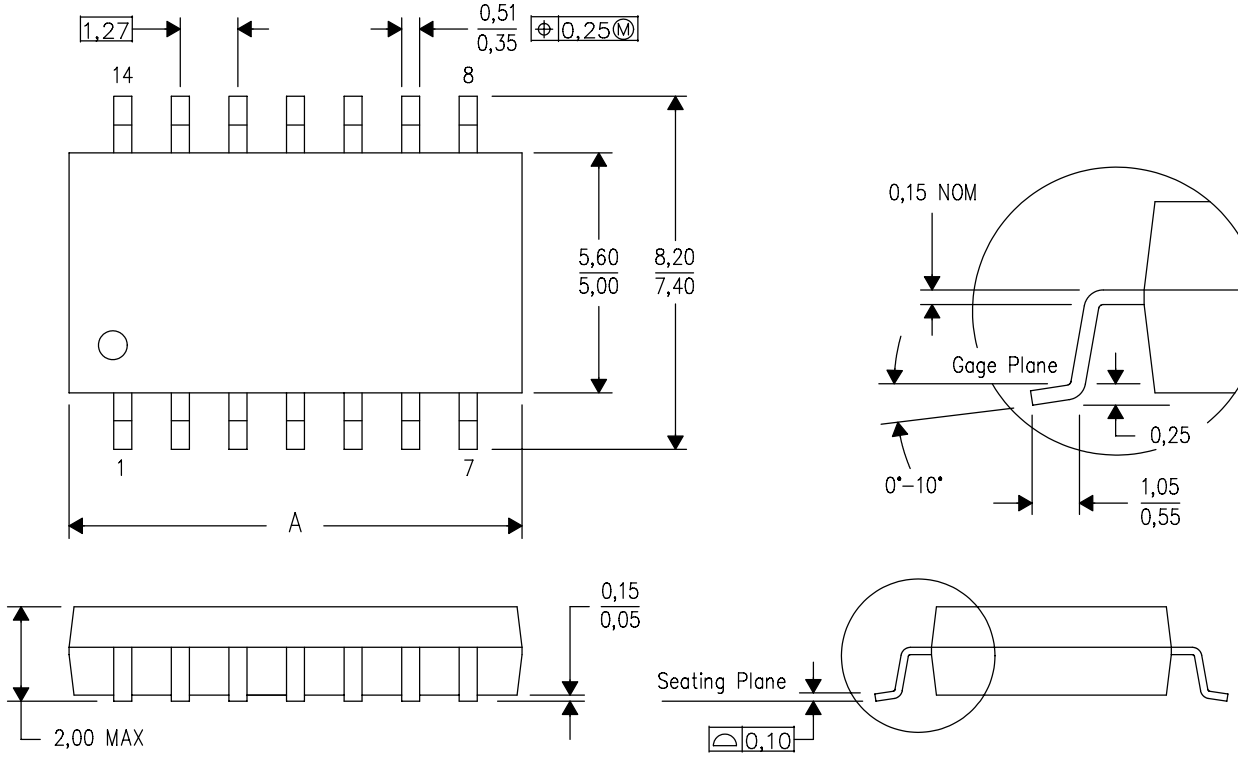
**4040047/E 09/01**

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

## MECHANICAL DATA

**NS (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**14-PINS SHOWN**



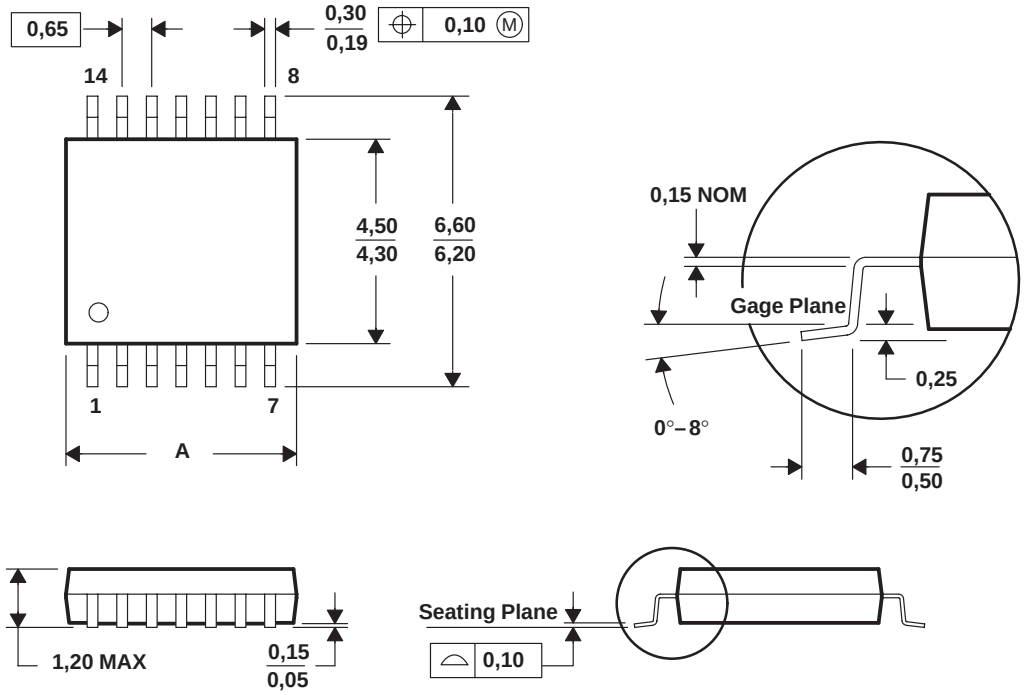

| DIM \ PINS ** | 14 | 16 | 20 | 24 |
|---|---|---|---|---|
| A MAX | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN | 9,90 | 9,90 | 12,30 | 14,70 |

4040062/C 03/03

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**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**14 PINS SHOWN**




| DIM \ PINS ** | 8 | 14 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|
| A MAX | 3,10 | 5,10 | 5,10 | 6,60 | 7,90 | 9,80 |
| A MIN | 2,90 | 4,90 | 4,90 | 6,40 | 7,70 | 9,60 |

**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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