TEXAS INSTRUMENTS

Data sheet acquired from Harris Semiconductor
SCHS020C – Revised October 2003

CD4009UB, CD4010B Types

CMOS Hex Buffers/Converters

High-Voltage Types (20-Volt Rating)

Inverting Type: CD4009UB
Non-Inverting Type: CD4010B

■ CD4009UB and CD4010B Hex Buffer/Converters may be used as CMOS to TTL or DTL logic-level converters or CMOS high-sink-current drivers.

The CD4049UB and CD4050B are preferred hex buffer replacements for the CD4009UB and CD4010B, respectively, in all applications except multiplexers. For applications not requiring high sink current or voltage conversion, the CD4069UB Hex Inverter is recommended.

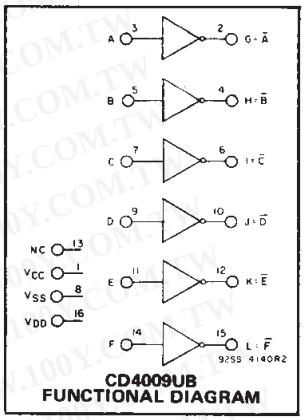
The CD4009UB and CD4010B types are supplied in 16-lead hermetic dual-in-line ceramic packages (F3A suffix), 16-lead dual-in-line plastic packages (E suffix), 16-lead small-outline packages (M, M96, MT, and NSR suffixes), and 16-lead thin shink small-outline packages (PW and PWR suffixes).

Features:

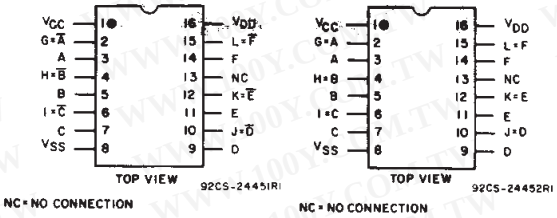
- 100% tested for quiescent current at 20 V
- Maximum input current of 1 μA at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- 5-V, 10-V, and 15-V parametric ratings

Applications:

- CMOS to DTL/TTL hex converter
- CMOS current "sink" or "source" driver
- CMOS high-to-low logic-level converter
- Multiplexer — 1 to 6 or 6 to 1

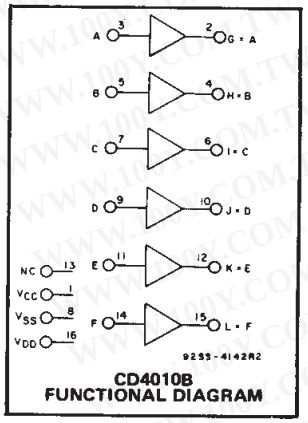


CD4009UB
FUNCTIONAL DIAGRAM



CD4009UB CD4010B

TERMINAL ASSIGNMENTS



CD4010B
FUNCTIONAL DIAGRAM

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

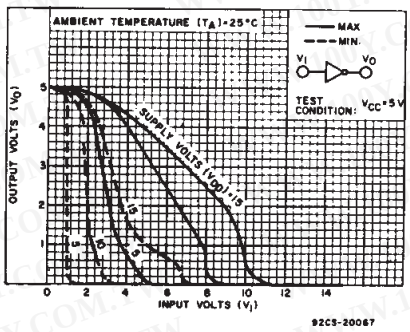


Fig. 3 — Minimum and maximum voltage transfer characteristics—CD4009UB.

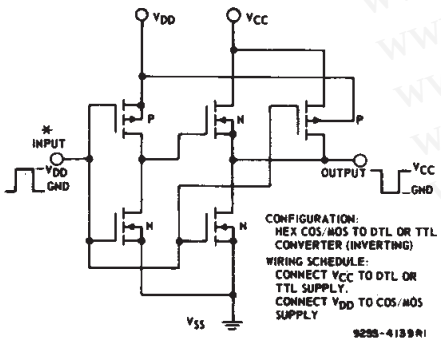


Fig. 1 — Schematic diagram of CD4009UB— 1 of 6 identical stages.

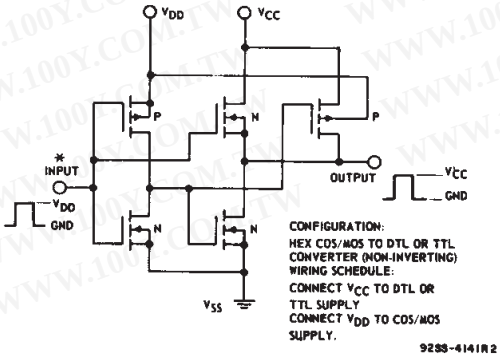
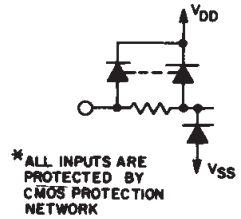


Fig. 2 — Schematic diagram of CD4010B— 1 of 6 identical stages.



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), V_{DD}	3	18	V
V_{CC}*	3	V_{DD}	
Input Voltage Range (V_I)	V_{CC}*	V_{DD}	V

*The CD4009UB and CD4010B have high-to-low level voltage conversion capability but not low-to-high level, therefore it is recommended that $V_{DD} \geq V_I \geq V_{CC}$.

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.	+25 Typ.	+25 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	
Output Low (Sink) Current I_{OL} Min.	0.4	0,5	4.5	3.2	3.1	2.1	1.8	2.6	3.4	–	mA
	0.4	0,5	5	3.75	3.6	2.4	2.1	3	4	–	
	0.5	0,10	10	10	9.6	6.4	5.6	8	10	–	
	1.5	0,15	15	30	40	19	16	24	36	–	
Output High (Source) Current I_{OH} Min.	4.6	0,5	5	−0.25	−0.23	−0.18	−0.15	−0.2	−0.4	–	
	2.5	0,5	5	−1	−0.9	−0.65	−0.58	−0.8	−1.6	–	
	9.5	0,10	10	−0.55	−0.5	−0.38	−0.33	−0.45	−0.9	–	
	13.5	0,15	15	−1.65	−1.6	−1.25	−1.1	−1.5	−3	–	
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. CD4009UB	4.5	–	5	1				–	–	1	V
	9	–	10	2				–	–	2	
	13.5	–	15	2.5				–	–	2.5	
Input Low Voltage: V_{IL} Max. CD4010B	0.5	–	5	1.5				–	–	1.5	
	1	–	10	3				–	–	3	
	1.5	–	15	4				–	–	4	
Input High Voltage: V_{IH} Min. CD4009UB	0.5	–	5	4				4	–	–	
	1	–	10	8				8	–	–	
	1.5	–	15	12.5				12.5	–	–	
Input High Voltage: V_{IH} Min. CD4010B	4.5	–	5	3.5				3.5	–	–	
	9	–	10	7				7	–	–	
	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

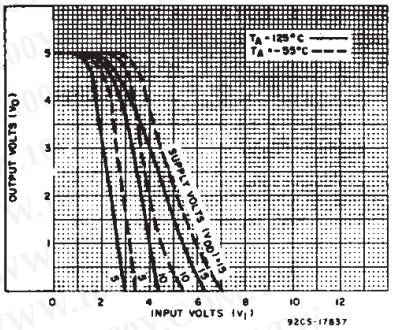


Fig. 4 – Typical voltage transfer characteristics as function of temp.–CD4009UB.

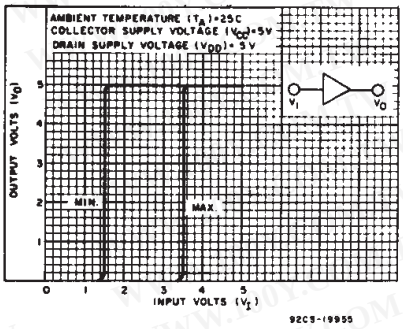


Fig. 5 – Minimum and maximum voltage transfer characteristics (V_{DD}=5)–CD4010B.

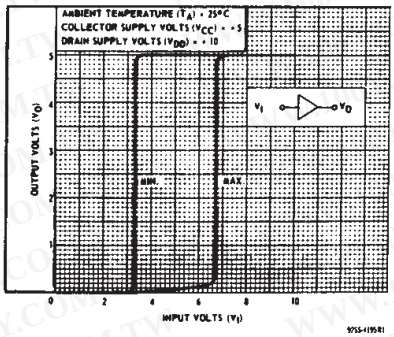


Fig. 6 – Minimum and maximum voltage transfer characteristics (V_{DD}=10)–CD4010B.

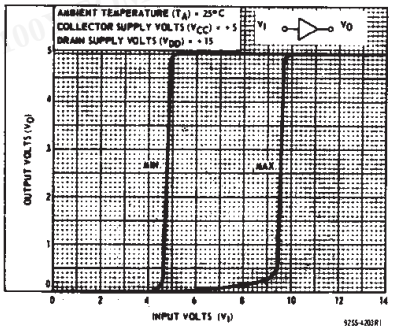


Fig. 7 – Minimum and maximum voltage transfer characteristics (V_{DD}=15)–CD4010B.

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

CHARACTERISTIC	CONDITIONS V_{DD} (V)	V_I (V)	V_{CC} (V)	LIMITS ALL PKGS TYP.	MAX.	UNIT
Propagation Delay Time: Low-to-High, t_{PLH}	5	5	5	70	140	ns
	10	10	10	40	80	
CD4009UB	10	10	5	35	70	
	15	15	15	30	60	
	15	15	5	30	60	
	5	5	5	100	200	ns
	10	10	10	50	100	
CD4010B	10	10	5	50	100	
	15	15	15	35	70	
	15	15	5	35	70	
High-to-Low, t_{PHL}	5	5	5	30	60	ns
	10	10	10	20	40	
CD4009UB	10	10	5	15	30	
	15	15	15	15	30	
	15	15	5	10	20	
	5	5	5	65	130	ns
	10	10	10	35	70	
CD4010B	10	10	5	30	70	
	15	15	15	25	50	
	15	15	5	20	40	
Transition Time: Low-to-High, t_{TLH}	5	5	5	150	350	ns
	10	10	10	75	150	
	15	15	15	55	110	
High-to-Low, t_{THL}	5	5	5	35	70	ns
	10	10	10	20	40	
	15	15	15	15	30	
Input Capacitance, C_{IN} CD4009UB	–	–	–	15	22.5	pF
CD4010B	–	–	–	5	7.5	

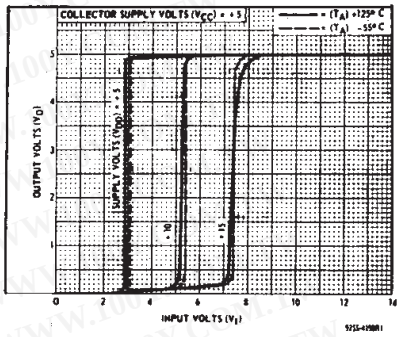


Fig. 8 – Typical voltage transfer characteristics as a function of temperature—CD4010B.

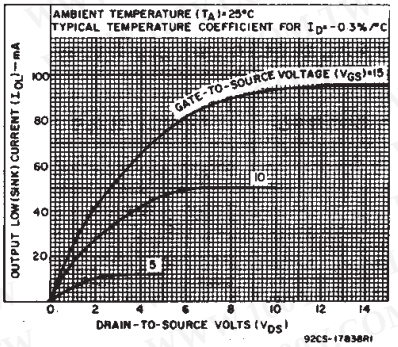


Fig. 9 – Typical output low (sink) current characteristics.

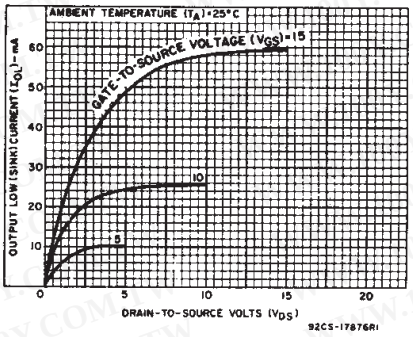


Fig. 10 – Minimum output low (sink) current characteristics.

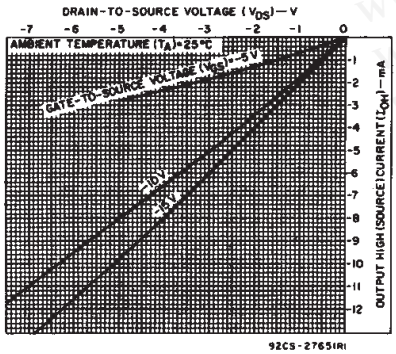


Fig. 11 – Typical output high (source) current characteristics.

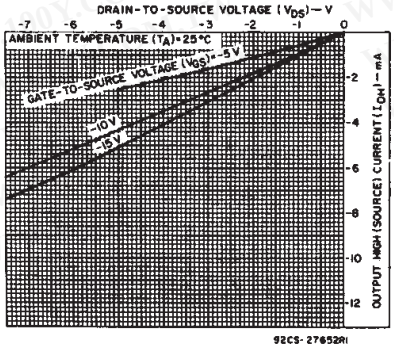


Fig. 12 – Minimum output high (source) current characteristics.

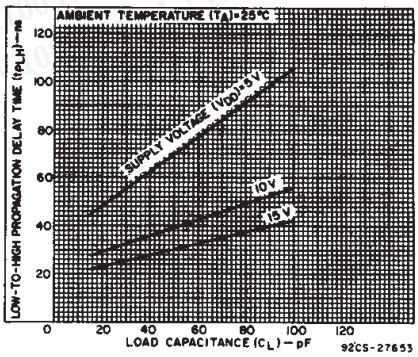


Fig. 13 – Typical low-to-high propagation delay time vs. load capacitance (CD4009UB).

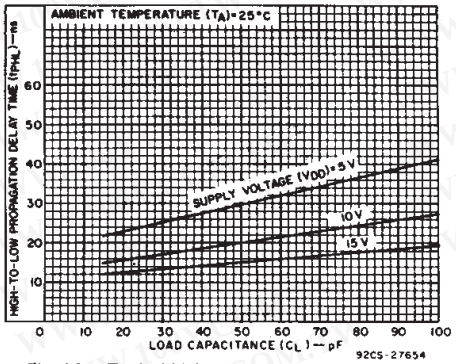


Fig. 14 — Typical high-to-low propagation delay time vs. load capacitance (CD4009UB).

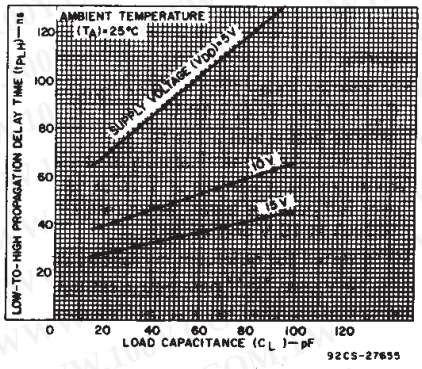


Fig. 15 — Typical low-to-high propagation delay time vs. load capacitance (CD4010B).

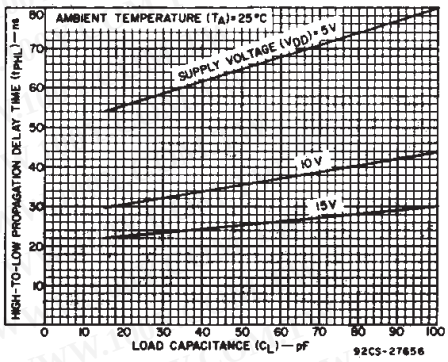


Fig. 16 — Typical high-to-low propagation delay time vs. load capacitance (CD4010B).

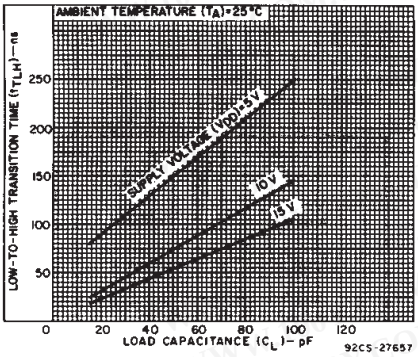


Fig. 17 — Typical low-to-high transition time vs. load capacitance.

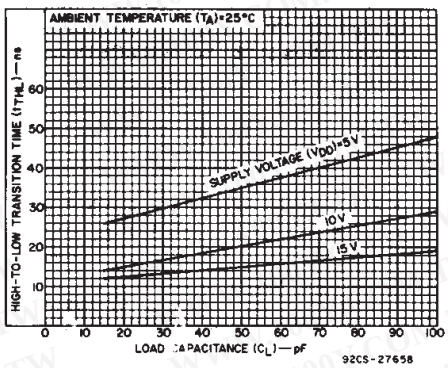


Fig. 18 — Typical high-to-low transition time vs. load capacitance.

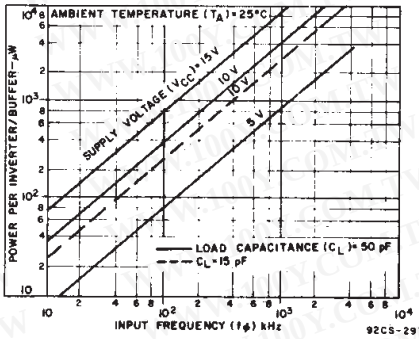


Fig. 19 — Typical dissipation characteristics.

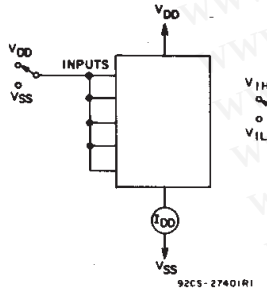


Fig. 20 — Quiescent device current test circuit.

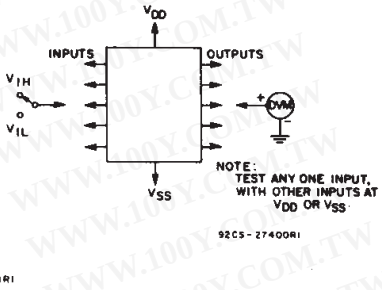


Fig. 21 — Noise immunity test circuit.

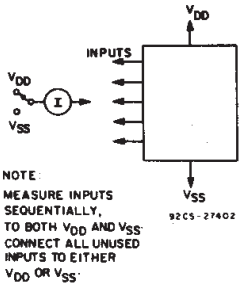
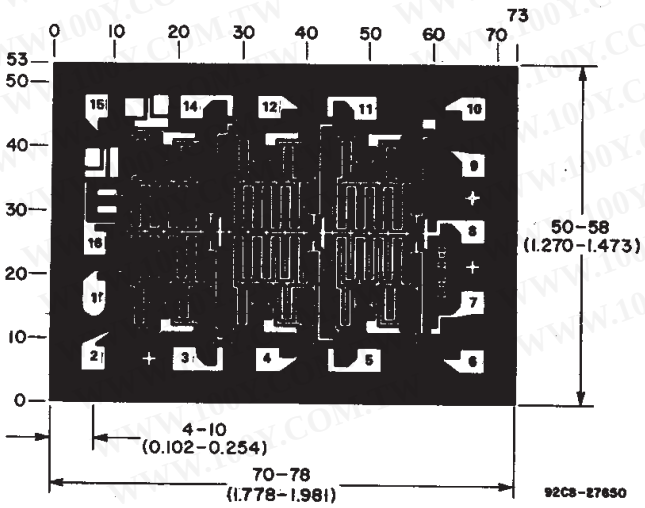


Fig. 22 — Input current test circuit.

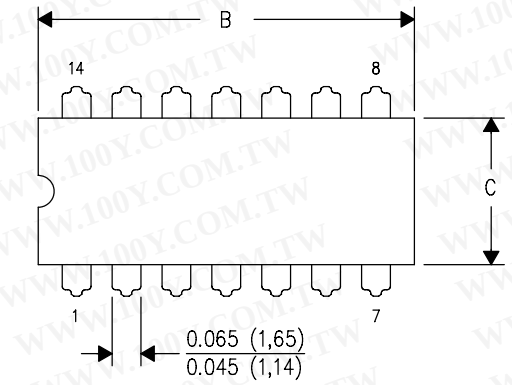


Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid Graduations Are In Mils (10^{-3} Inch)

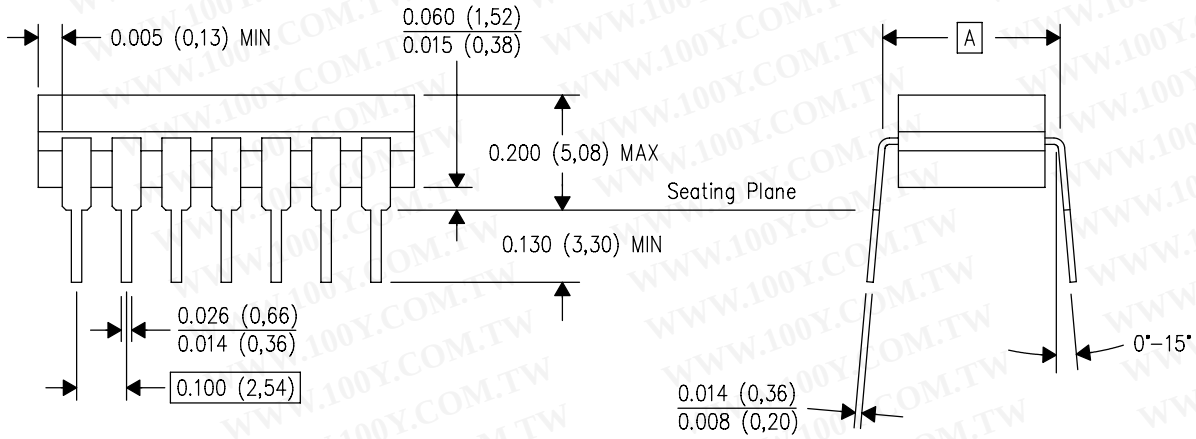
Photograph of chip for CD4009UB. Dimensions and pad layout for CD4010B are identical.

J (R–GDIP–T**) CERAMIC DUAL IN–LINE PACKAGE

14 LEADS SHOWN



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)



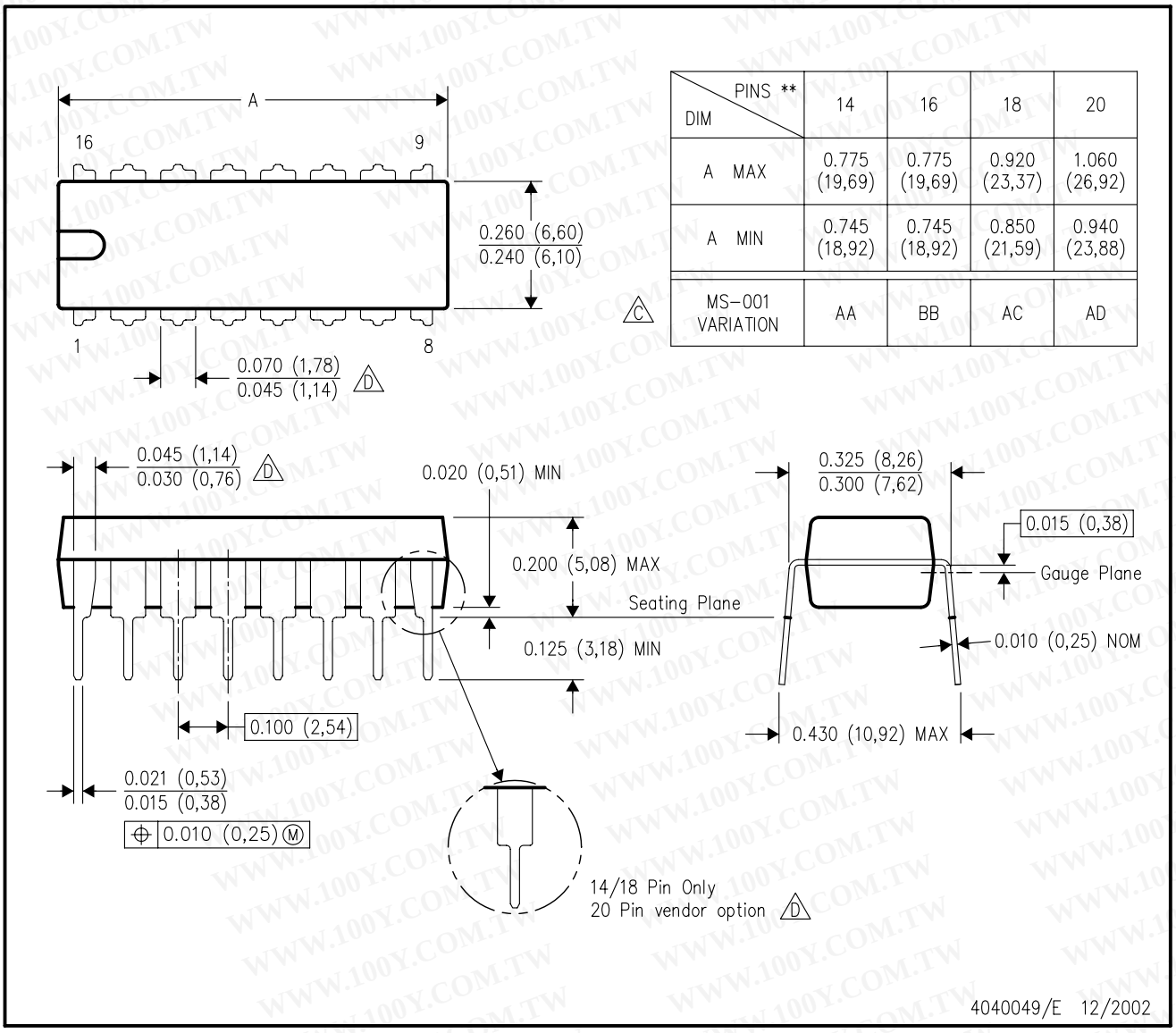
4040083/F 03/03

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

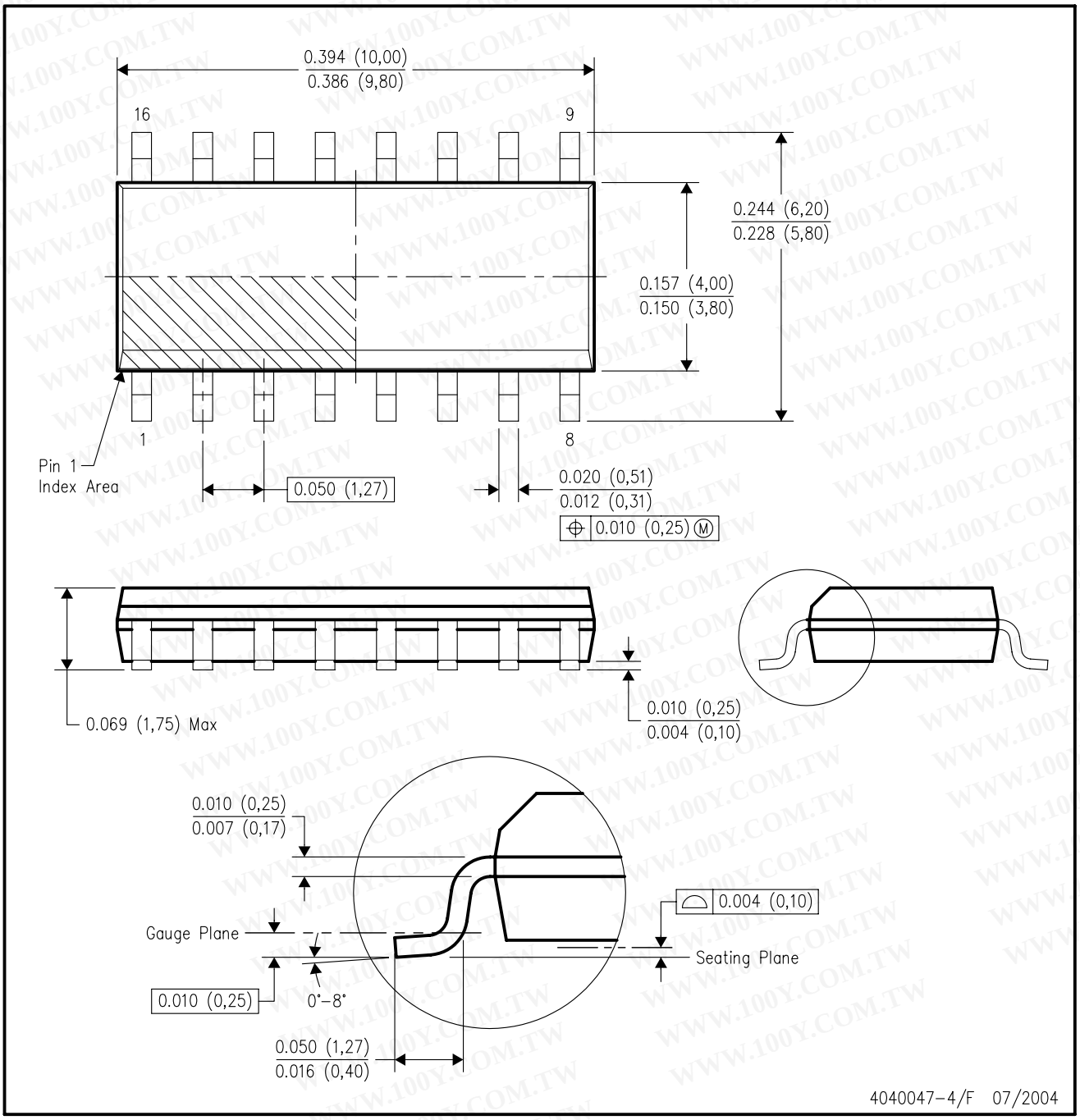


DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION	AA	BB	AC	AD

4040049/E 12/2002

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.

D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE

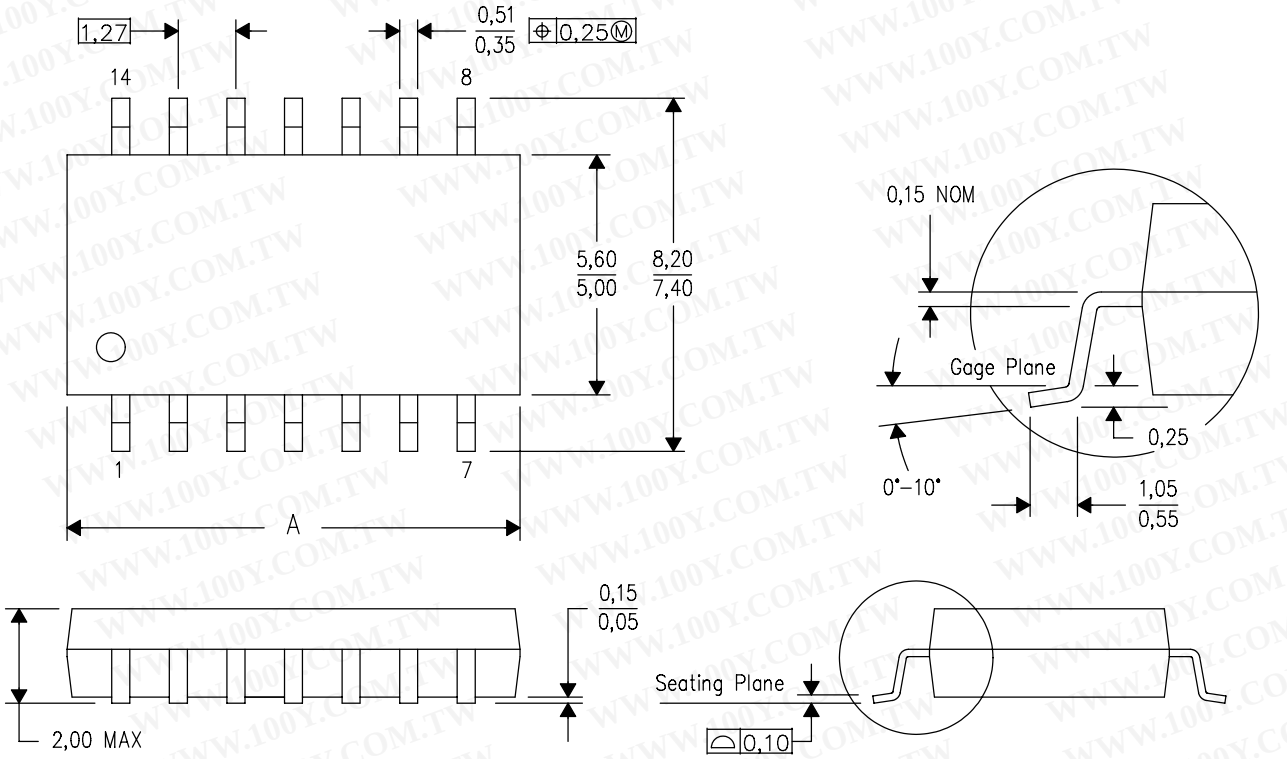


NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AC.

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

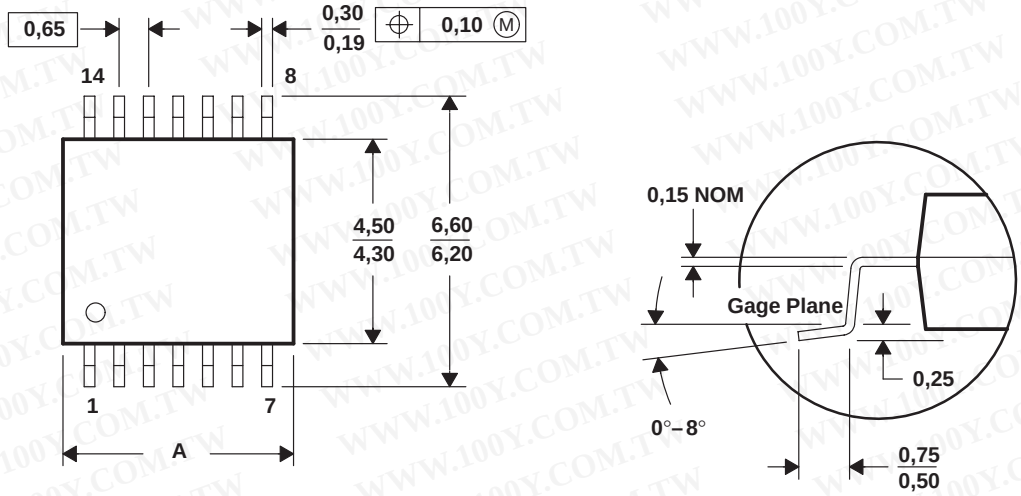
4040062/C 03/03

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

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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