CD4014B, CD4021B Types

CMOS 8-Stage Static Shift Registers
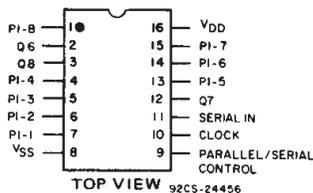
High-Voltage Types (20-Volt Rating)
CD4014B:
Synchronous Parallel or
Serial Input/Serial Output

CD4021B:
Asynchronous Parallel Input or
Synchronous Serial Input/Serial Output

■ CD4014B and CD4021B series types are 8-stage parallel- or serial-input/serial output registers having common CLOCK and PARALLEL/SERIAL CONTROL inputs, a single SERIAL data input, and individual parallel "JAM" inputs to each register stage. Each register stage is a D-type, master-slave flip-flop. In addition to an output from stage 8, "Q" outputs are also available from stages 6 and 7. Parallel as well as serial entry is made into the register synchronously with the positive clock line transition in the CD4014B. In the CD4021B serial entry is synchronous with the clock but parallel entry is asynchronous. In both types, entry is controlled by the PARALLEL/SERIAL CONTROL input. When the PARALLEL/SERIAL CONTROL input is low, data is serially shifted into the 8-stage register synchronously with the positive transition of the clock line. When the PARALLEL/SERIAL CONTROL input is high, data is jammed into the 8-stage register via the parallel input lines and synchronous with the positive transition of the clock line. In the CD4021B, the CLOCK input of the internal stage is "forced" when asynchronous parallel entry is made. Register expansion using multiple packages is permitted.

The CD4014B and CD4021b 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).

Features:

■ Medium-speed operation . . . 12 MHz (typ.) clock rate at $V_{DD}-V_{SS}$ = 10 V
■ Fully static operation
■ 8 master-slave flip-flops plus output buffering and control gating
■ 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
■ 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
■ Standardized, symmetrical output characteristics
■ 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"

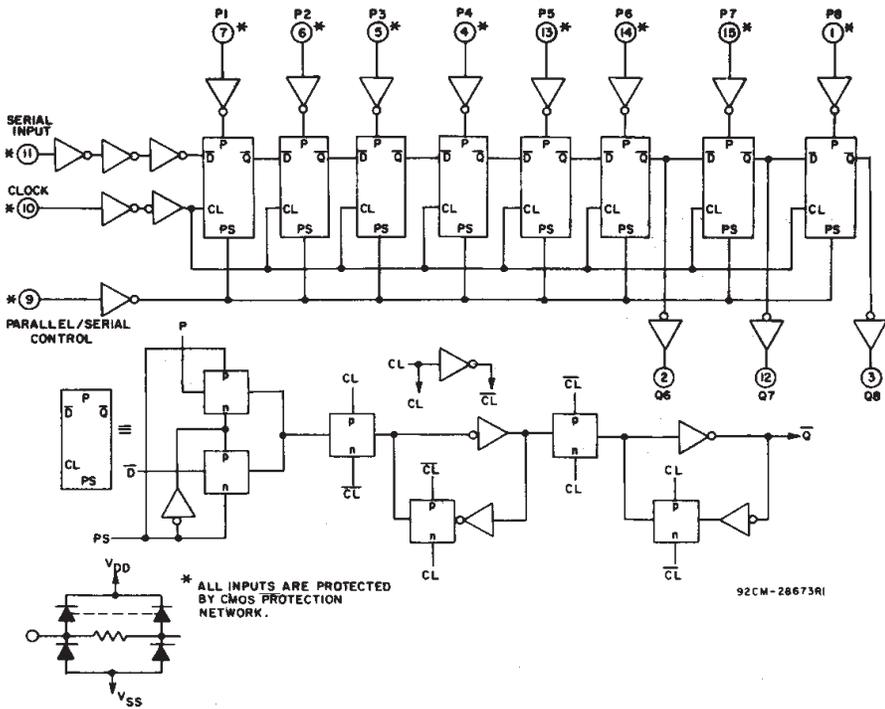**CD4014B, CD4021B FUNCTIONAL DIAGRAM**
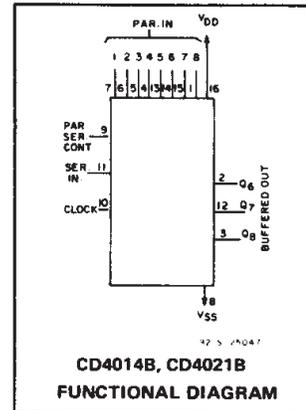
Applications:

■ Parallel input/serial output data queueing
■ Parallel to serial data conversion
■ General-purpose register

**TERMINAL DIAGRAM
CD4014B, CD4021B**

RECOMMENDED OPERATING CONDITIONS AT T_A = 25°C, Unless Otherwise Specified
For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges.

CHARACTERISTIC	V_{DD} (V)	LIMITS		UNITS
		Min.	Max.	
Supply-Voltage Range (T_A = Full Package-Temperature Range)	–	3	18	V
Clock Pulse Width, t_W	5	180	–	ns
	10	80	–	
	15	50	–	
Clock Frequency, f_{CL}	5	–	3	MHz
	10	–	6	
	15	–	8.5	
Clock Rise and Fall Time, t_rCL, t_fCL	5	–	15	μs
	10	–	15	
	15	–	15	
Set-up Time, t_s:				
Serial Input (ref. to CL)	5	120	–	ns
	10	80	–	
	15	60	–	
Parallel Inputs CD4014B (ref. to CL)	5	80	–	ns
	10	50	–	
	15	40	–	
Parallel Inputs CD4021B (ref. to P/S)	5	50	–	ns
	10	30	–	
	15	20	–	
Parallel/Serial Control CD4014B (ref. to CL)	5	180	–	ns
	10	80	–	
	15	60	–	
Parallel/Serial Pulse Width, t_W (CD4021B)	5	160	–	ns
	10	80	–	
	15	50	–	
Parallel/Serial Removal Time, t_{REM} (CD4021B)	5	280	–	ns
	10	140	–	
	15	100	–	

Fig. 1 — Logic diagram for CD4014B.

TRUTH TABLE — CD4014B

CL	SER IN	PAR SER CONTROL	PI-1	PI-n	Q1 (INTERNAL)	Qn
⟋	X	1	0	0	0	0
⟋	X	1	1	0	1	0
⟋	X	1	0	1	0	1
⟋	X	1	1	1	1	1
⟋	0	0	X	X	0	Q_{n-1}
⟋	1	0	X	X	1	Q_{n-1}
⟍	X	X	X	X	Q_1	Q_n NC

X = DON'T CARE CASE

NC = NO CHANGE

Fig. 2 — Logic diagram for CD4021B.
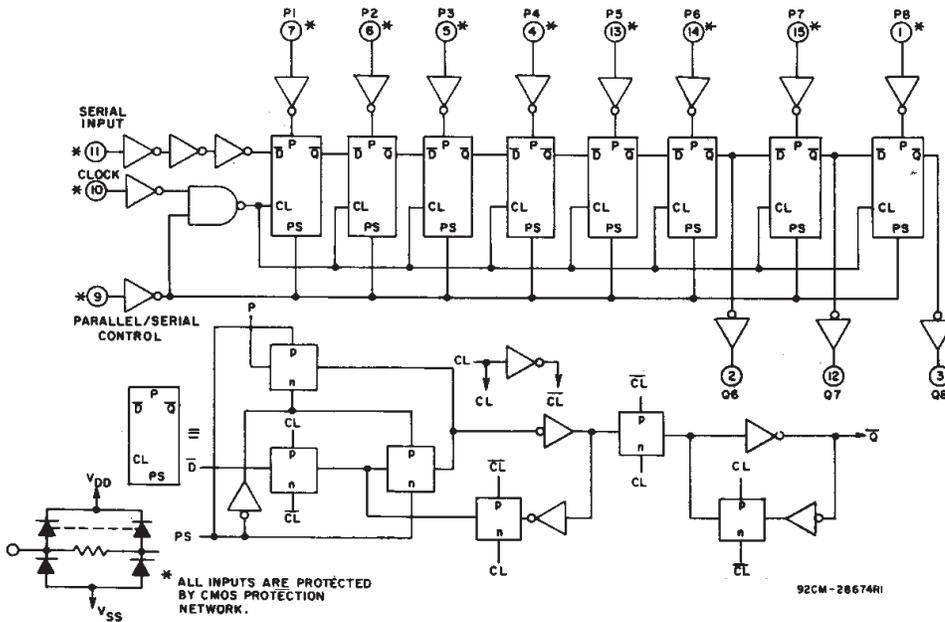
TRUTH TABLE — CD4021B

CL	Serial Input	Parallel/Serial Control	PI-1	PI-n	Q1 (Internal)	Qn
X	X	1	0	0	0	0
X	X	1	0	1	0	1
X	X	1	1	0	1	0
X	X	1	1	1	1	1
⟋	0	0	X	X	0	Q_{n-1}
⟋	1	0	X	X	1	Q_{n-1}
⟍	X	0	X	X	Q_1	Q_n NC

X = DON'T CARE CASE

CD4014B, CD4021B Types

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 Linearly 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
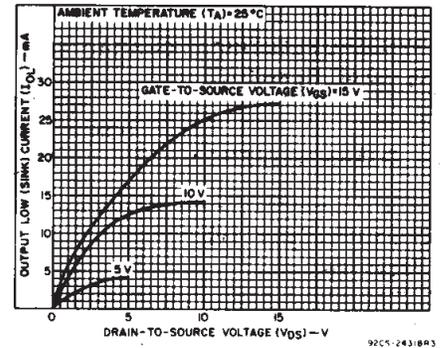

Fig. 3 — Typical output low (sink) current characteristics.
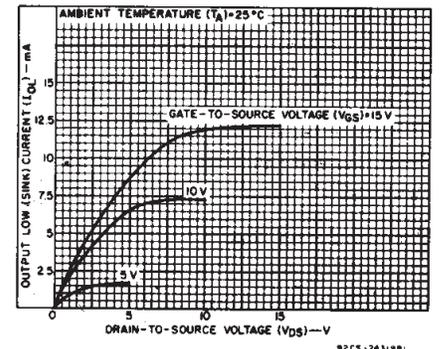

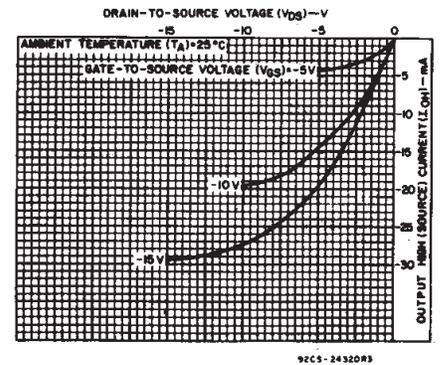Fig. 4 — Minimum output low (sink) current characteristics.

Fig. 5 — Typical output high (source) current characteristics.
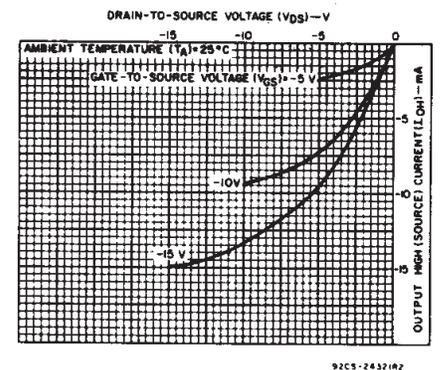
Fig. 6 — Minimum output high (source) current characteristics.

STATIC ELECTRICAL CHARACTERISTICS

CHARAC-TERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)				+25			UNITS
	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	—	—	V
	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	—	±10^{-5}	±0.1	µA

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			UNITS
		Min.	Typ.	Max.	
Propagation Delay Time, t_{PLH}, t_{PHL}	5	–	160	320	ns
	10	–	80	160	
	15	–	60	120	
Transition Time, t_{THL}, t_{TLH}	5	–	100	200	ns
	10	–	50	100	
	15	–	40	80	
Maximum Clock Input Frequency, f_{CL}	5	3	6	–	MHz
	10	6	12	–	
	15	8.5	17	–	
Minimum Clock Pulse Width, t_W	5	–	90	180	ns
	10	–	40	80	
	15	–	25	50	
Clock Rise and Fall Time, t_rCL, t_fCL*	5	–	–	15	μs
	10	–	–	15	
	15	–	–	15	
Minimum Set-up Time, t_s: Serial Input (ref. to CL)	5	–	60	120	ns
	10	–	40	80	
	15	–	30	60	
Parallel Inputs CD4014B (ref. to CL)	5	–	40	80	ns
	10	–	25	50	
	15	–	20	40	
Parallel Inputs CD4021B (ref. to P/S)	5	–	25	50	ns
	10	–	15	30	
	15	–	10	20	
Parallel/Serial Control CD4014B (ref. to CL)	5	–	90	180	ns
	10	–	40	80	
	15	–	30	60	
Minimum Hold Time, t_H: Serial In, Parallel In, Parallel/Serial Control	5	–	–	0	ns
	10	–	–	0	
	15	–	–	0	
Minimum P/S Pulse Width, t_{WH} (CD4021B)	5	–	80	160	ns
	10	–	40	80	
	15	–	25	50	
Minimum P/S Removal Time, t_{REM} CD4021B (ref. to CL)	5	–	140	280	ns
	10	–	70	140	
	15	–	50	100	
Average Input Capacitance, C_I	Any Input	–	5	7.5	pF

*If more than one unit is cascaded t_rCL should be made less than or equal to the sum of the transition time and the fixed propagation delay of the output of the driving stage for the estimated capacitive load.
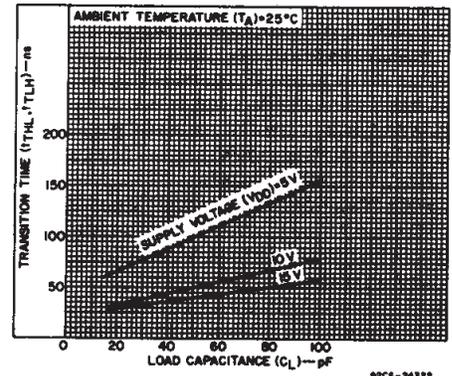

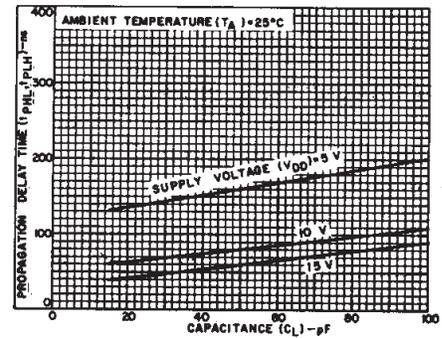Fig. 7 – Typical transition time as a function of load capacitance.

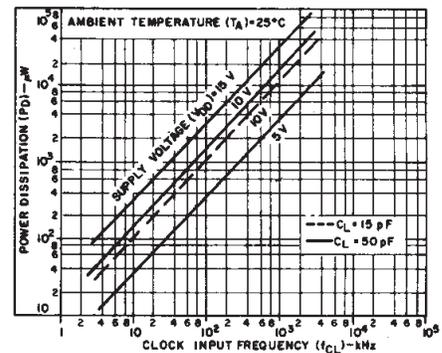Fig. 8 – Typical propagation delay time as a function of load capacitance.

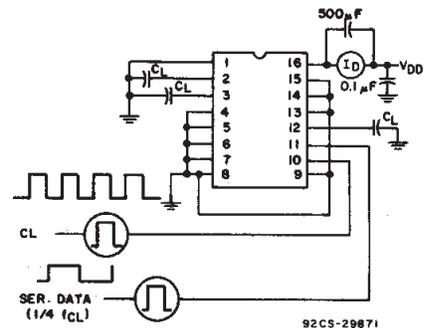Fig. 9 – Typical dynamic power dissipation as a function of clock input frequency.

Fig. 10 – Dynamic power dissipation test circuit.
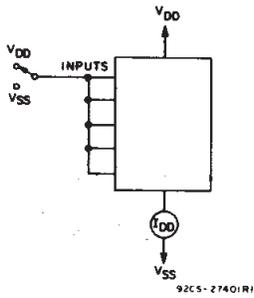
Fig. 11 — Quiescent device current test circuit.
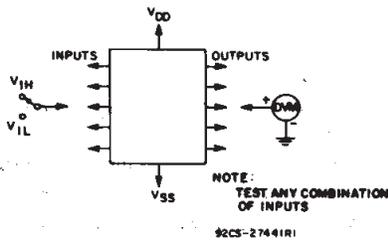
Fig. 12 — Input voltage test circuit.

Fig. 13 — Input current test circuit.

80-88
(2.032-2.235)

4-10
(0.102-0.254)

91-99
(2.312-2.514)

Dimensions and pad layout for CD4014BH (CD4021BH is identical)

92CM-29870

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

3

COMMERCIAL CMOS HIGH VOLTAGE ICs

PACKAGING INFORMATION

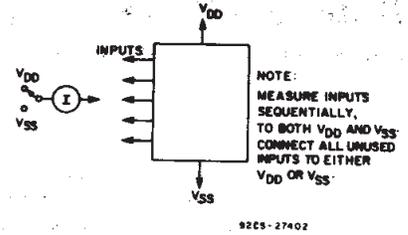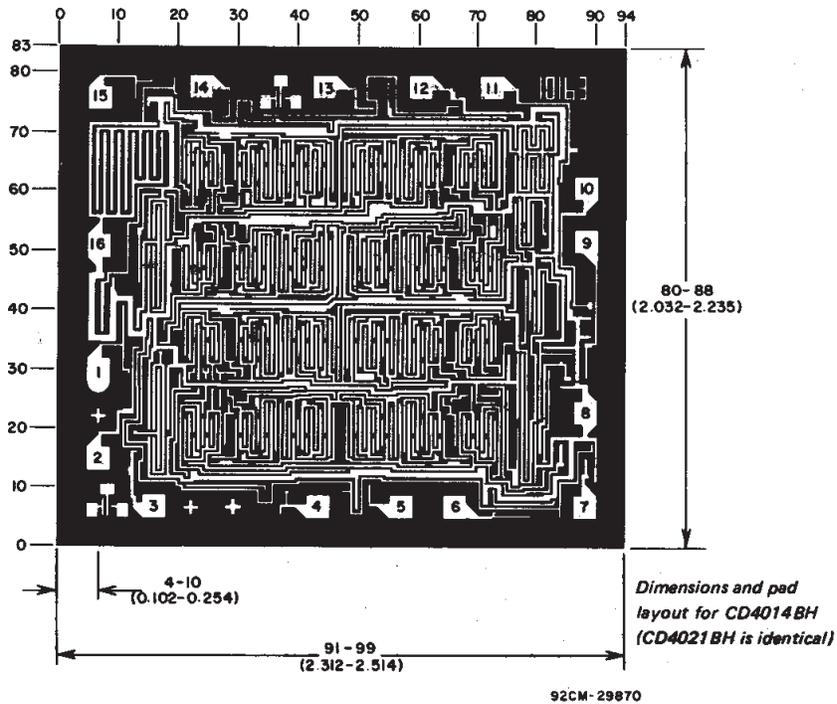| Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
CD4014BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4014BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4014BF3A	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD4014BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BMTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4014BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BE	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4021BEE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
CD4021BF	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD4021BF3A	ACTIVE	CDIP	J	16	1	TBD	A42 SNPB	N / A for Pkg Type
CD4021BM	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BM96	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BM96E4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BME4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BMT	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BMTE4	ACTIVE	SOIC	D	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BNSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
CD4021BNSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BPWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CD4021BPWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
JM38510/05754BEA	ACTIVE	CDIP	J	16	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.
OBSOLETE: 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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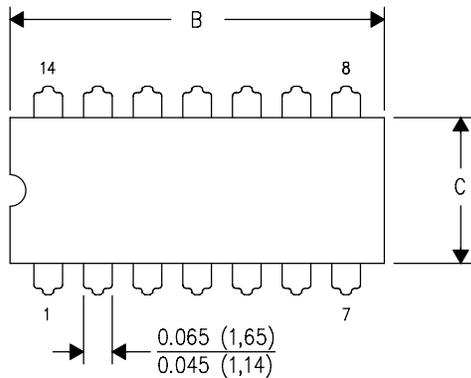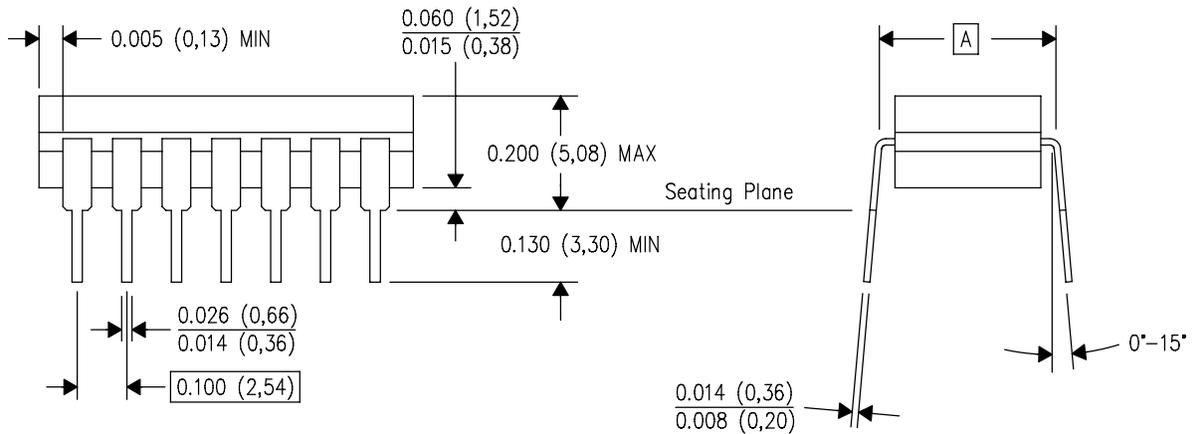
DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

B

14   8

1   7

0.065 (1,65)
0.045 (1,14)

C

0.005 (0,13) MIN

0.060 (1,52)
0.015 (0,38)

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

0.026 (0,66)
0.014 (0,36)

0.100 (2,54)

A

0°-15°

0.014 (0,36)
0.008 (0,20)

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

A

16   9

0.260 (6,60)
0.240 (6,10)

1   8

0.070 (1,78)
0.045 (1,14)

0.045 (1,14)
0.030 (0,76)

0.020 (0,51) MIN

0.325 (8,26)
0.300 (7,62)

0.015 (0,38)

Gauge Plane

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.010 (0,25) NOM

0.100 (2,54)

0.430 (10,92) MAX

0.021 (0,53)
0.015 (0,38)

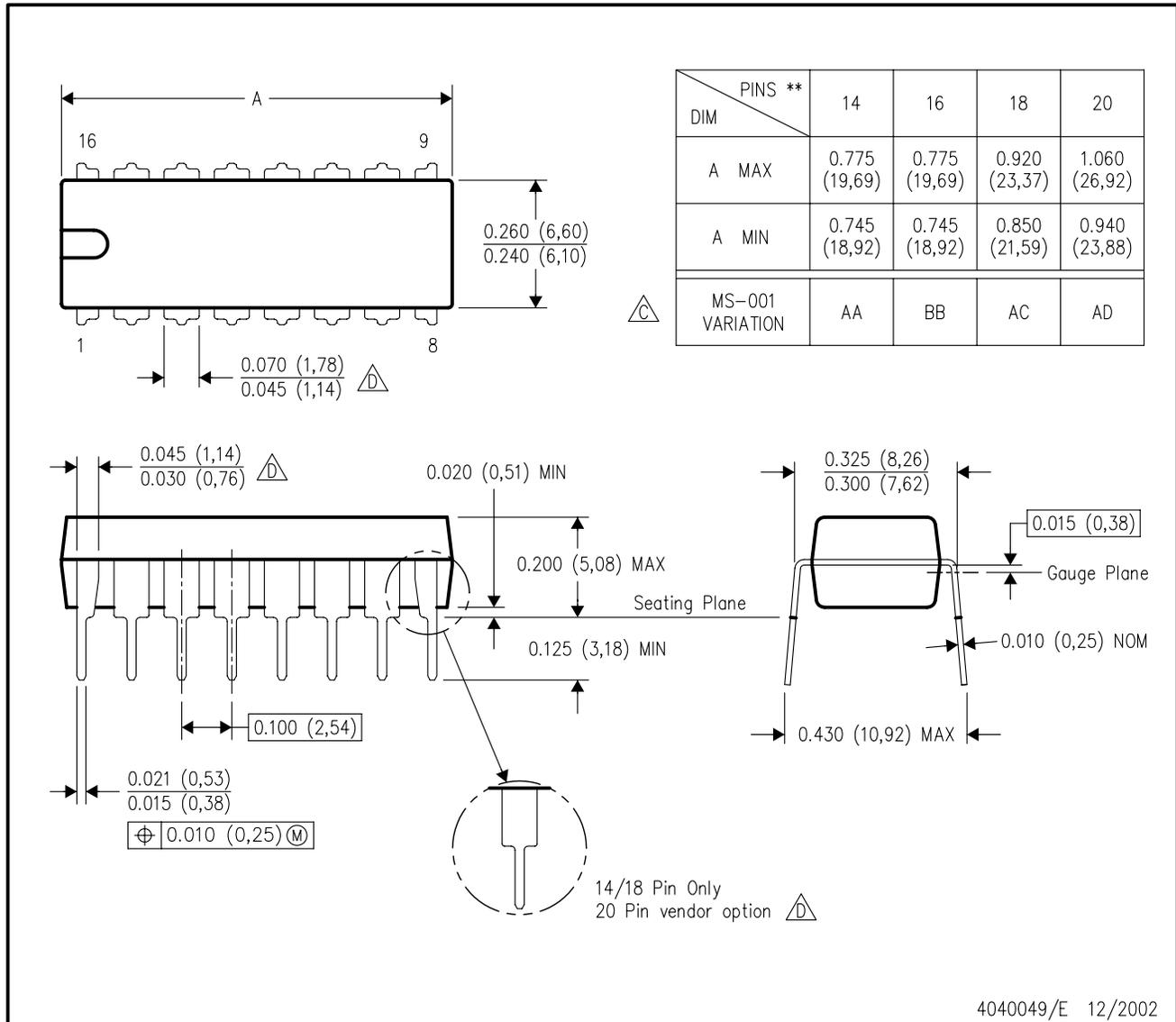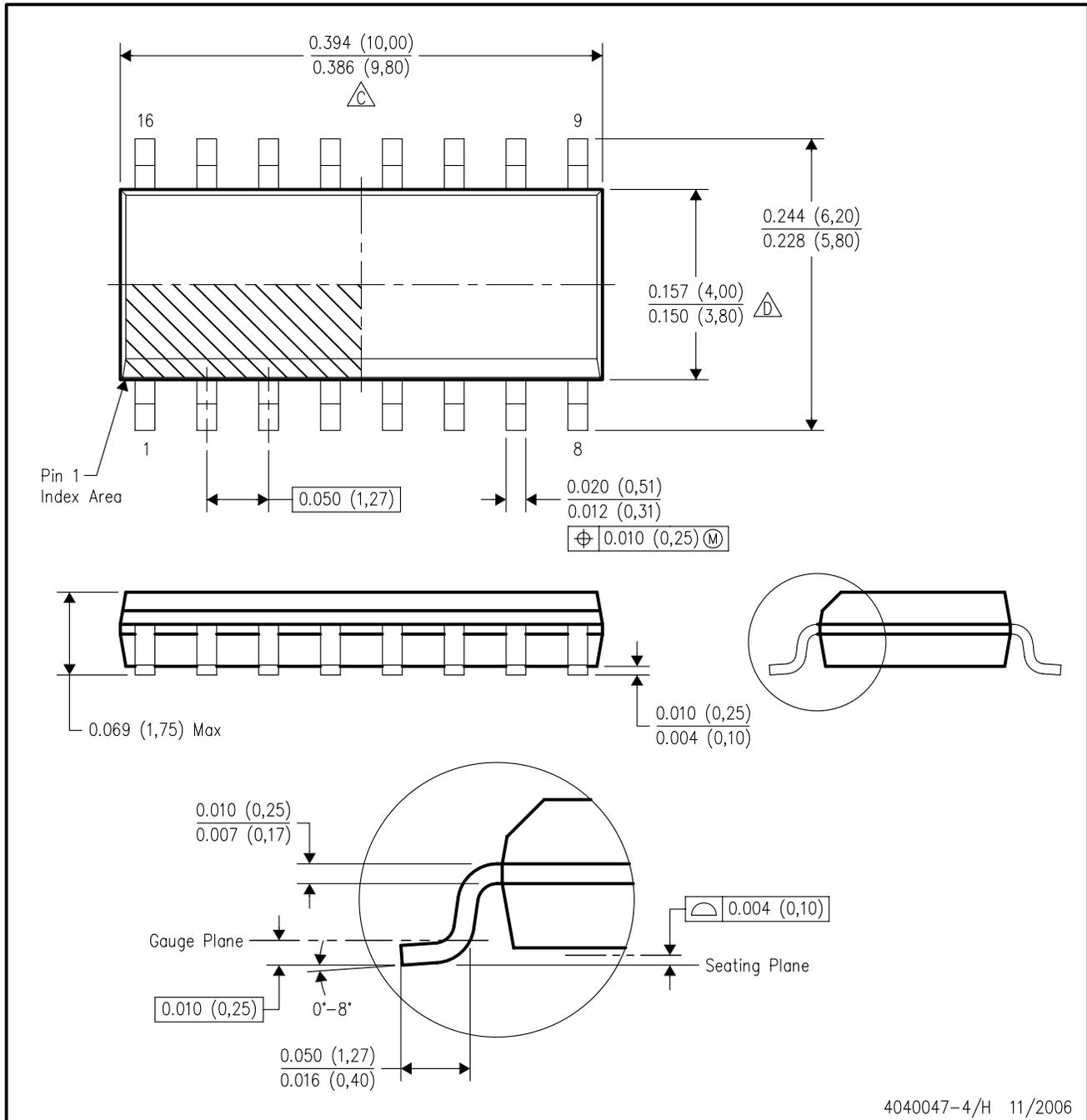⊕ 0.010 (0,25) Ⓜ

14/18 Pin Only
20 Pin vendor option

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.

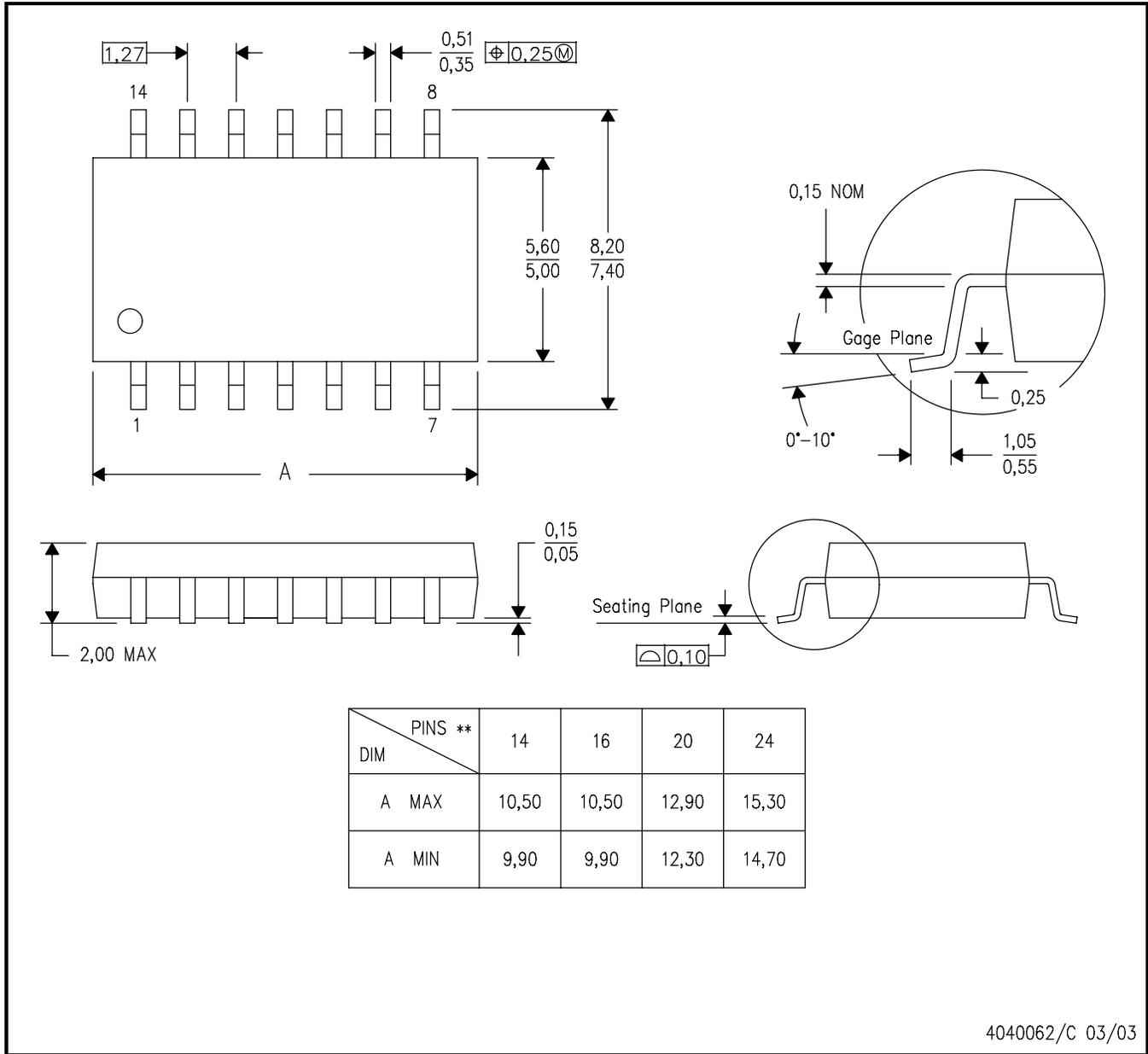D (R−PDSO−G16)   PLASTIC SMALL−OUTLINE PACKAGE

0.394 (10,00)
0.386 (9,80) /C\

0.244 (6,20)
0.228 (5,80)

0.157 (4,00)
0.150 (3,80) /D\

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

Pin 1
Index Area

0.069 (1,75) Max

0.010 (0,25)
0.004 (0,10)

0.010 (0,25)
0.007 (0,17)

0.004 (0,10)

Gauge Plane

Seating Plane

0.010 (0,25)   0°−8°

0.050 (1,27)
0.016 (0,40)

4040047−4/H 11/2006

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 AC.

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MECHANICAL DATA

1,27

0,51
0,35

⊕ 0,25 Ⓜ

14   8

5,60   8,20
5,00   7,40

1   7

A

0,15 NOM

Gage Plane

0°–10°

0,25

1,05
0,55

0,15
0,05

2,00 MAX

Seating Plane

◁ 0,10

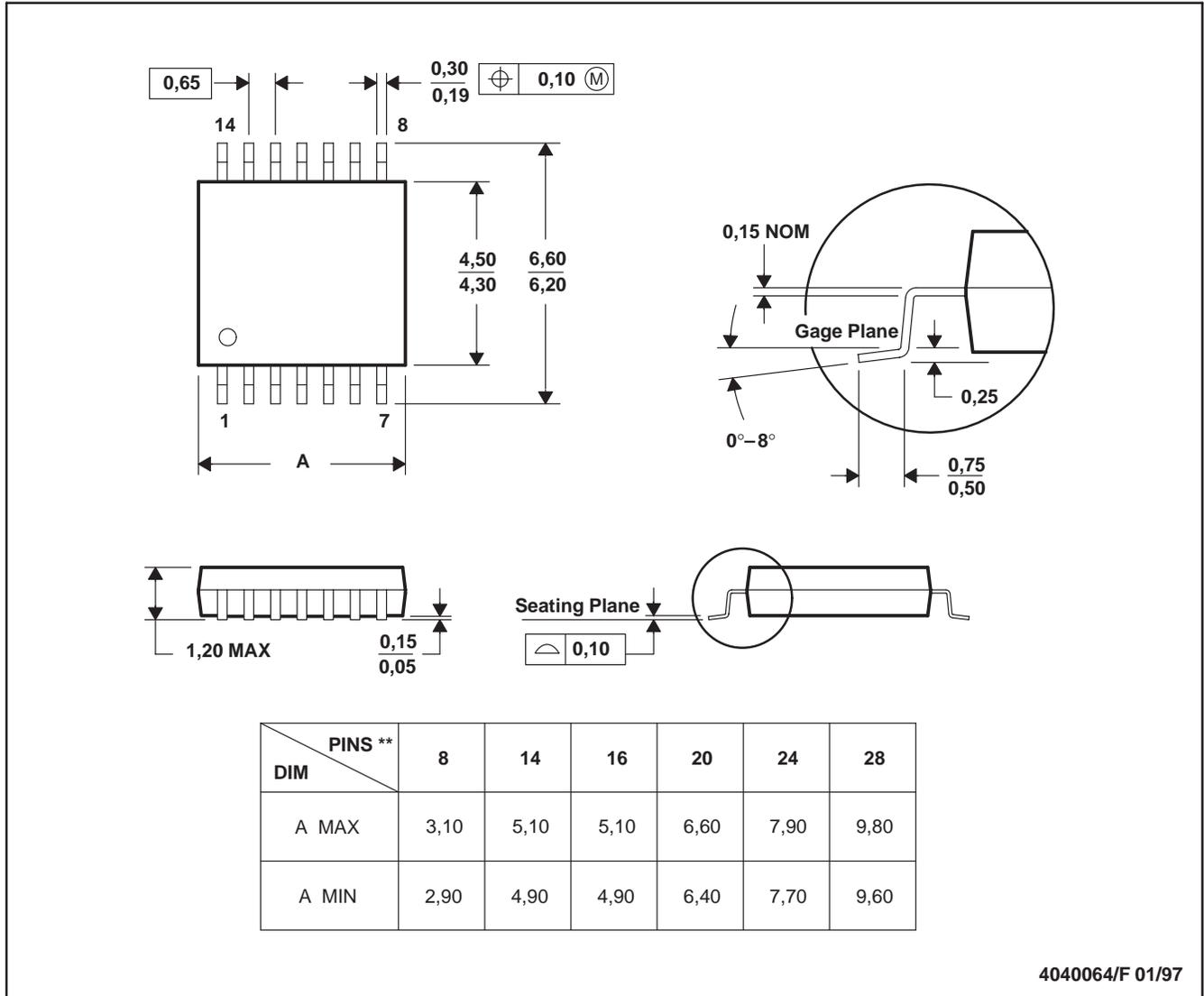| DIM / PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

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

PINS ** DIM	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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