TEXAS INSTRUMENTS

CMOS Programmable Timer
## High Voltage Types (20V Rating)

Features

- **Low Symmetrical Output Resistance, Typically 100Ω at V_{DD} = 15V**
- **Built-In Low-Power RC Oscillator**
- **Oscillator Frequency Range . . . . DC to 100kHz**
- **External Clock (Applied to Pin 3) can be Used Instead of Oscillator**
- **Operates as 2^N Frequency Divider or as a Single-Transition Timer**
- **Q/$\overline{Q}$ Select Provides Output Logic Level Flexibility**
- **AUTO or MASTER RESET Disables Oscillator During Reset to Reduce Power Dissipation**
- **Operates With Very Slow Clock Rise and Fall Times**
- **Capable of Driving Six Low Power TTL Loads, Three Low-Power Schottky Loads, or Six HTL Loads Over the Rated Temperature Range**
- **Symmetrical Output Characteristics**
- **100% Tested for Quiescent Current at 20V**
- **5V, 10V, and 15V Parametric Ratings**
- **Meets All Requirements of JEDEC Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"**

Description

CD4541B programmable timer consists of a 16-stage binary counter, an oscillator that is controlled by external R-C components (2 resistors and a capacitor), an automatic power-on reset circuit, and output control logic. The counter increments on positive-edge clock transitions and can also be reset via the MASTER RESET input.
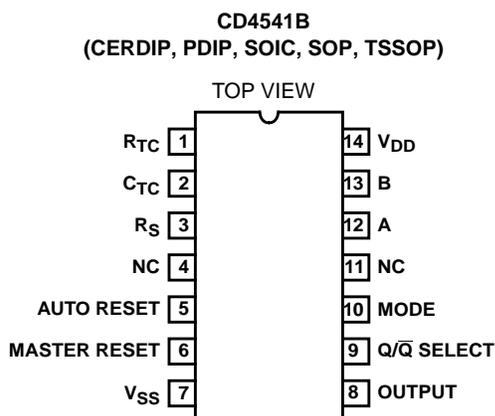
The output from this timer is the Q or $\overline{Q}$ output from the 8th, 10th, 13th, or 16th counter stage. The desired stage is chosen using time-select inputs A and B (see Frequency Select Table).

The output is available in either of two modes selectable via the MODE input, pin 10 (see Truth Table). When this MODE input is a logic "1", the output will be a continuous square wave having a frequency equal to the oscillator frequency divided by 2^N. With the MODE input set to logic "0" and after a MASTER RESET is initiated, the output (assuming Q output has been selected) changes from a low to a high state after 2^{N-1} counts and remains in that state until another MASTER RESET pulse is applied or the MODE input is set to a logic "1".

Timing is initialized by setting the AUTO RESET input (pin 5) to logic "0" and turning power on. If pin 5 is set to logic "1", the AUTO RESET circuit is disabled and counting will not start until after a positive MASTER RESET pulse is applied and returns to a low level. The AUTO RESET consumes an appreciable amount of power and should not be used if low-power operation is desired. For reliable automatic power-on reset, V_{DD} should be greater than 5V.

The RC oscillator, shown in Figure 2, oscillates with a frequency determined by the RC network and is calculated using:

$$f = \frac{1}{2.3\ R_{TC}C_{TC}}$$

Where f is between 1kHz and 100kHz and $R_S \geq 10k\Omega$ and $\approx 2R_{TC}$

Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD4541BF3A	-55 to 125	14 Ld CERDIP
CD4541BE	-55 to 125	14 Ld PDIP
CD4541BM	-55 to 125	14 Ld SOIC
CD4541BMT	-55 to 125	14 Ld SOIC
CD4541BM96	-55 to 125	14 Ld SOIC
CD4541BNSR	-55 to 125	14 Ld SOP
CD4541BPW	-55 to 125	14 Ld TSSOP
CD4541BPWR	-55 to 125	14 Ld TSSOP

NOTE: When ordering, use the entire part number. The suffixes 96 and R denote tape and reel. The suffix T denotes a small-quantity reel of 250.

Pinout

CD4541B
(CERDIP, PDIP, SOIC, SOP, TSSOP)

TOP VIEW

R_{TC}	1	14 V_{DD}
C_{TC}	2	13 B
R_S	3	12 A
NC	4	11 NC
AUTO RESET	5	10 MODE
MASTER RESET	6	9 Q/$\overline{Q}$ SELECT
V_{SS}	7	8 OUTPUT

Functional Diagram

A 12
B 13
R_{TC} 1
C_{TC} 2
R_S 3
AR 5
MR 6
MODE 10
Q/$\overline{Q}$ SELECT 9

8 Q

V_{DD} = PIN 14
V_{SS} = PIN 7

12 13
†A †B

1 OF 3 MUX

2^{16} OR 2^8

2^{10} 2^{13}

$\overline{R}$

Q 8

9
†Q/$\overline{Q}$ SELECT

10
†MODE

†R_S 3
†C_{TC} 2
†R_{TC} 1

OSC

8-STAGE COUNTER

N P

N P

8-STAGE COUNTER

R

$\overline{R}$

R

V_{DD}

V_{SS}

AUTO RESET† 5

PWR ON RESET

MANUAL RESET† 6

V_{DD} = 14
V_{SS} = 7   NC = 4, 11

† All inputs are protected by CMOS Protection Network.

FIGURE 1.

FREQUENCY SELECTION TABLE

A	B	NO. OF STAGES N	COUNT 2^N
0	0	13	8192
0	1	10	1024
1	0	8	256
1	1	16	65536

TRUTH TABLE

PIN	STATE	
	0	1
5	Auto Reset On	Auto Reset Disable
6	Master Reset Off	Master Reset On
9	Output Initially Low After Reset (Q)	Output Initially High After Reset ($\overline{Q}$)
10	Single Transition Mode	Recycle Mode

R_S

C_{TC} 2

R_{TC} 1

3
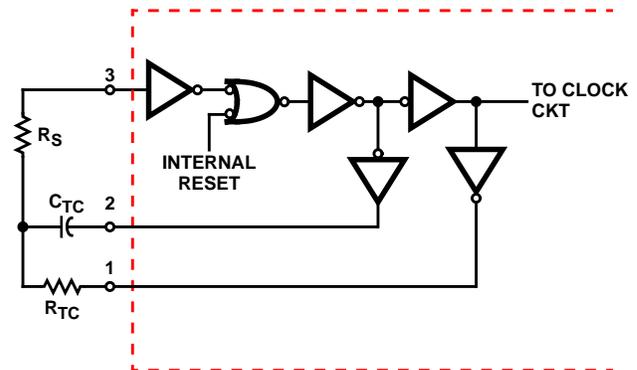
INTERNAL RESET

TO CLOCK CKT

FIGURE 2. RC OSCILLATOR CIRCUIT

CD4541B

Absolute Maximum Ratings

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
Device Dissipation Per Output Transistor
  For T_A = Full Package Temperature Range
  (All Package Types) 100mW

Operating Conditions

Temperature Range T_A . . . . -55°C to 125°C
Supply Voltage Range
  For T_A = Full Package Temperature Range . . . . . 3V (Min), 18V (Typ)

Thermal Information

Package Thermal Impedance, θ_{JA} (see Note 1)
  PDIP package . . . . 80°C/W
  SOIC package . . . . 86°C/W
  SOP package . . . . 76°C/W
  TSSOP package . . . . 113°C/W
Maximum Junction Temperature (Plastic Package) . . . . 150°C
Maximum Storage Temperature Range (T_{STG}) . . . -65°C to 150°C
Maximum Lead Temperature (Soldering 10s)
  At Distance 1/16in ± 1/32in (1.59mm ±0.79mm)
  from case for 10s Maximum . . . . 265°C
  (SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

 1. The package thermal impedance is calculated in accordance with JESD 51-7.

Electrical Specifications

PARAMETER	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (^{o}C)							
								25			
	V_O (V)	V_{IN} (V)	V_{DD} (V)	-55	-40	85	125	MIN	TYP	MAX	UNITS
Quiescent Device Current, (Note 2) I_{DD} (Max)	-	0, 5	5	5	5	150	150	-	0.04	5	µA
	-	0, 10	10	10	10	300	300	-	0.04	10	µA
	-	0, 15	15	20	20	600	600	-	0.04	20	µA
	-	0, 20	20	100	100	3000	3000	-	0.08	100	µA
Output Low (Sink) Current I_{OL} (Min)	0.4	0, 5	5	1.9	1.85	1.26	1.08	1.55	3.1	-	mA
	0.5	0, 10	10	5	4.8	3.3	2.8	4	8	-	mA
	1.5	0, 15	15	12.6	12	8.4	7.2	10	20	-	mA
Output High (Source) Current, I_{OH} (Min)	4.6	0, 5	5	-1.9	-1.85	-1.26	-1.08	-1.55	-3.1	-	mA
	2.5	0, 5	5	-6.2	-6	-4.1	-3	-5	-10	-	mA
	9.5	0, 10	10	-5	-4.8	-3.3	-2.8	-4	-8	-	mA
	13.5	0, 15	15	-12.6	-12	-8.4	-7.2	-10	-20	-	mA
Output Voltage: Low-Level, V_{OL} (Max)	-	0, 5	5	-	0.05			-	0	0.05	V
	-	0, 10	10	-	0.05			-	0	0.05	V
	-	0, 15	15	-	0.05			-	0	0.05	V
Output Voltage: High-Level, V_{OH} (Min)	-	0, 5	5	-	4.95			4.95	5	-	V
	-	0, 10	10	-	9.95			9.95	10	-	V
	-	0, 15	15	-	14.95			14.95	15	-	V
Input Low Voltage, V_{IL} (Max)	0.5, 4.5	-	5	-	1.5			-	-	1.5	V
	1, 9	-	10	-	3			-	-	3	V
	1.5, 13.5	-	15	-	4			-	-	4	V

Electrical Specifications (Continued)

PARAMETER	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (^{o}C)							UNITS
	V_O (V)	V_{IN} (V)	V_{DD} (V)	-55	-40	85	125	25			
								MIN	TYP	MAX	
Input High Voltage, V_{IH} (Min)	0.5, 4.5	-	5	-		3.5		3.5	-	-	V
	1, 9	-	10	-		7		7	-	-	V
	1.5, 13.5	-	15	-		11		11	-	-	V
Input Current, I_{IN} (Max)	-	0, 18	18	±0.1	±0.1	±1	±1	-	±10^{-5}	±0.1	µA

NOTE:

2. With AUTO RESET enabled, additional current drain at 25°C is:

    7µA (Typ), 200µA (Max) at 5V;
    30µA (Typ), 350µA (Max) at 10V;
    80µA (Typ), 500µA (Max) at 15V

Dynamic Electrical Specifications T_A = 25°C, Input t_r, t_f = 20ns, C_L = 50pF, R_L = 200kΩ

PARAMETER	SYMBOL	V_{DD} (V)	MIN	TYP	MAX	UNITS
Propagation Delay Times Clock to Q	(2^8) t_{PHL}, t_{PLH}	5	-	3.5	10.5	µs
		10	-	1.25	3.8	µs
		15	-	0.9	2.9	µs
	(2^{16}) t_{PHL}, t_{PLH}	5	-	6.0	18	µs
		10	-	3.5	10	µs
		15	-	2.5	7.5	µs
Transition Time	t_{THL}	5	-	100	200	ns
		10	-	50	100	ns
		15	-	40	80	ns
	t_{THL}	5	-	180	360	ns
		10	-	90	180	ns
		15	-	65	130	ns
MASTER RESET, CLOCK Pulse Width		5	900	300	-	ns
		10	300	100	-	ns
		15	225	85	-	ns
Maximum Clock Pulse Input Frequency	f_{CL}	5	-	1.5	-	MHz
		10	-	4	-	MHz
		15	-	6	-	MHz
Maximum Clock Pulse Input Rise or Fall time	t_r, t_f	5, 10, 15	Unlimited			µs

Digital Timer Application

A positive pulse on MASTER RESET resets the counters and latch. The output goes high and remains high until the number of pulses, selected by A and B, are counted. This circuit is retriggerable and is as accurate as the input frequency. If additional accuracy is desired, an external clock can be used on pin 3. A setup time equal to the width of the one-shot output is required immediately following initial power up, during which time the output will be high.
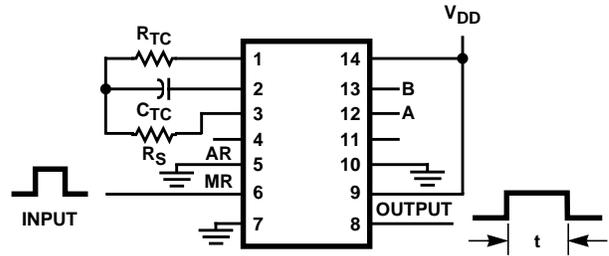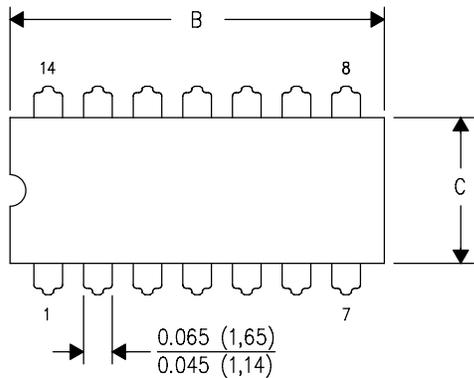

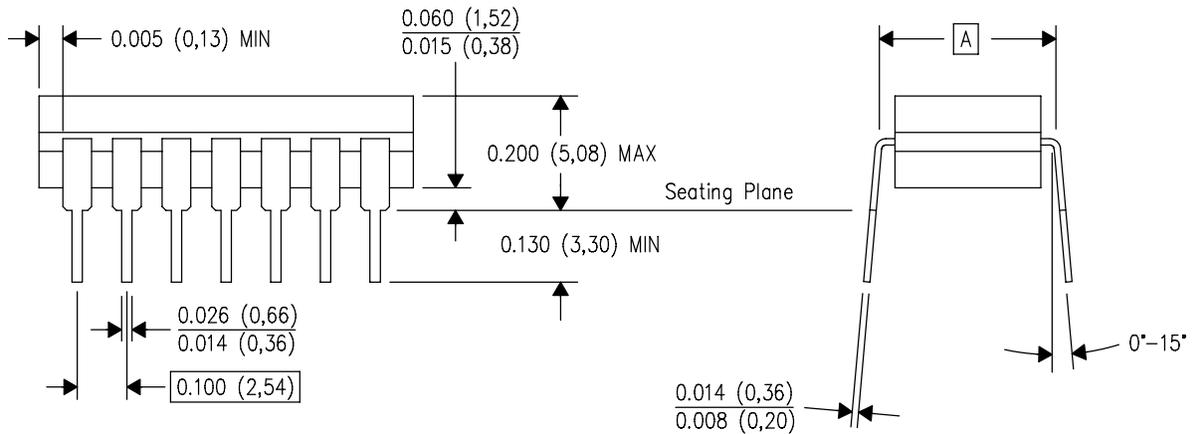**FIGURE 3. DIGITAL TIMER APPLICATION CIRCUIT**

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)

B

14   8

C

1   7

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

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)
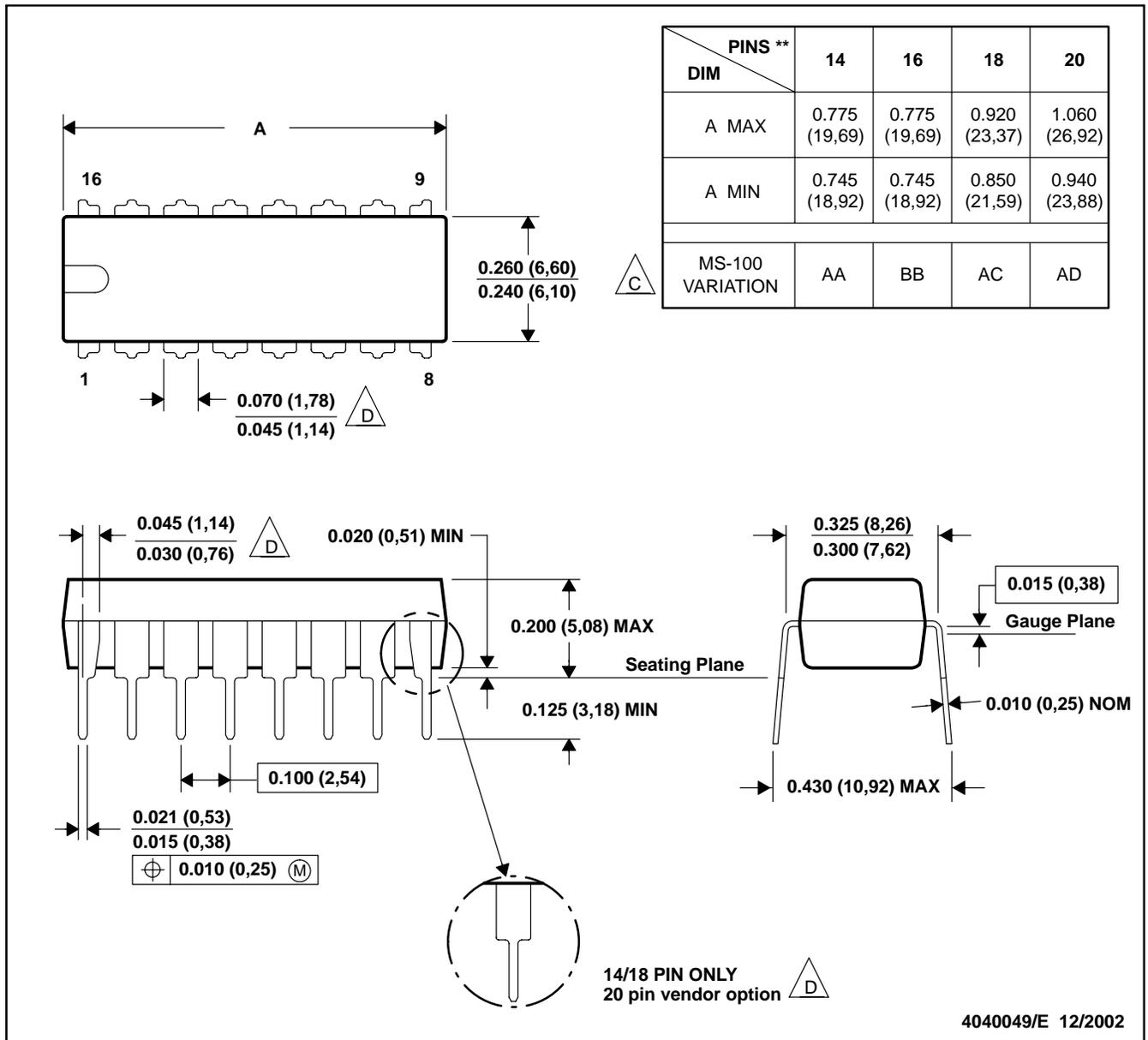
4040083/F 03/03

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.

MECHANICAL

N (R-PDIP-T**)   **PLASTIC DUAL-IN-LINE PACKAGE**

16 PINS SHOWN

PINS ** DIM	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 /C\	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) /D\

0.045 (1,14) / 0.030 (0,76) /D\

0.020 (0,51) MIN

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

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

⊕ 0.010 (0,25) Ⓜ

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

0.015 (0,38)

Gauge Plane

0.010 (0,25) NOM

0.430 (10,92) MAX

14/18 PIN ONLY
20 pin vendor option /D\

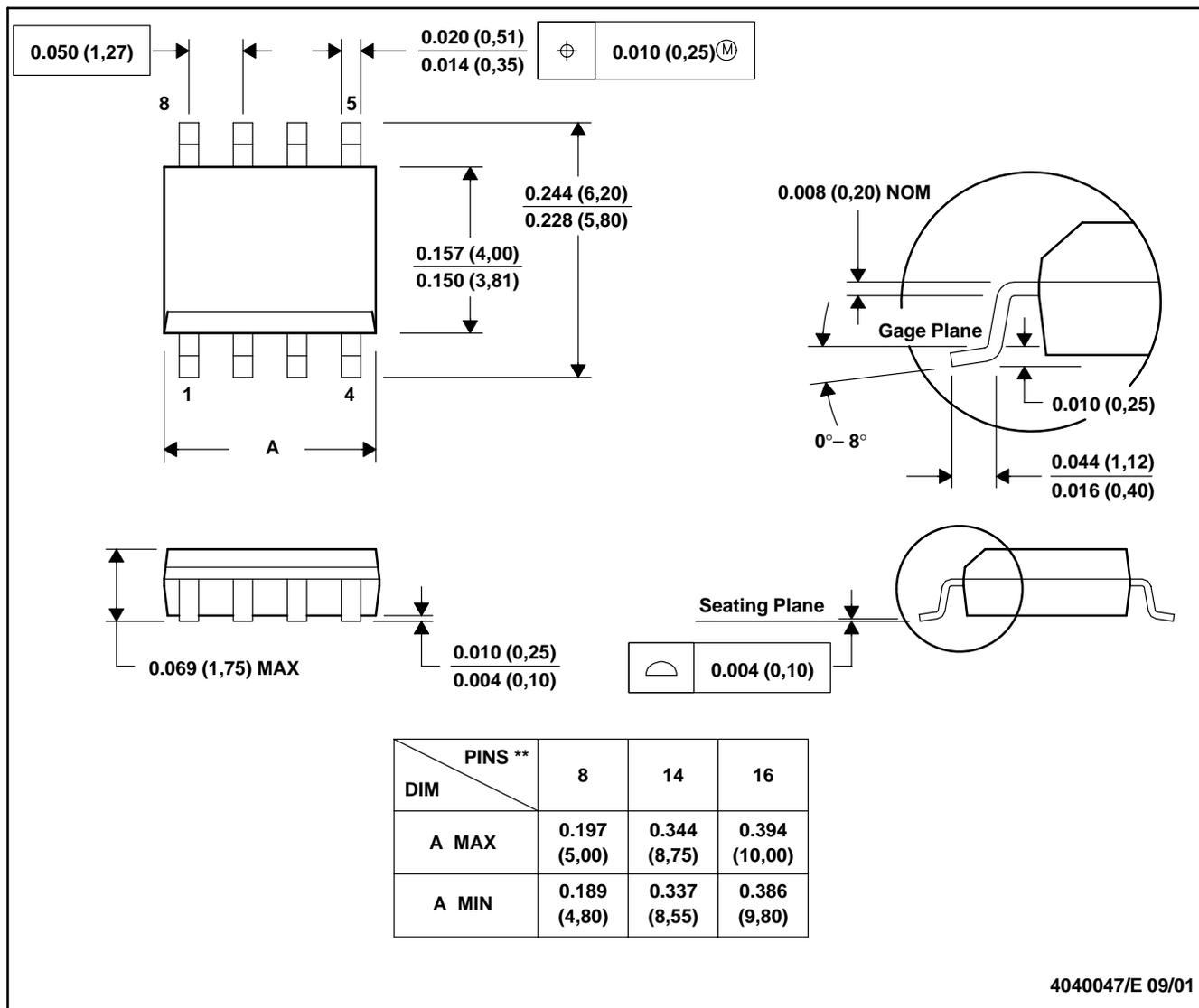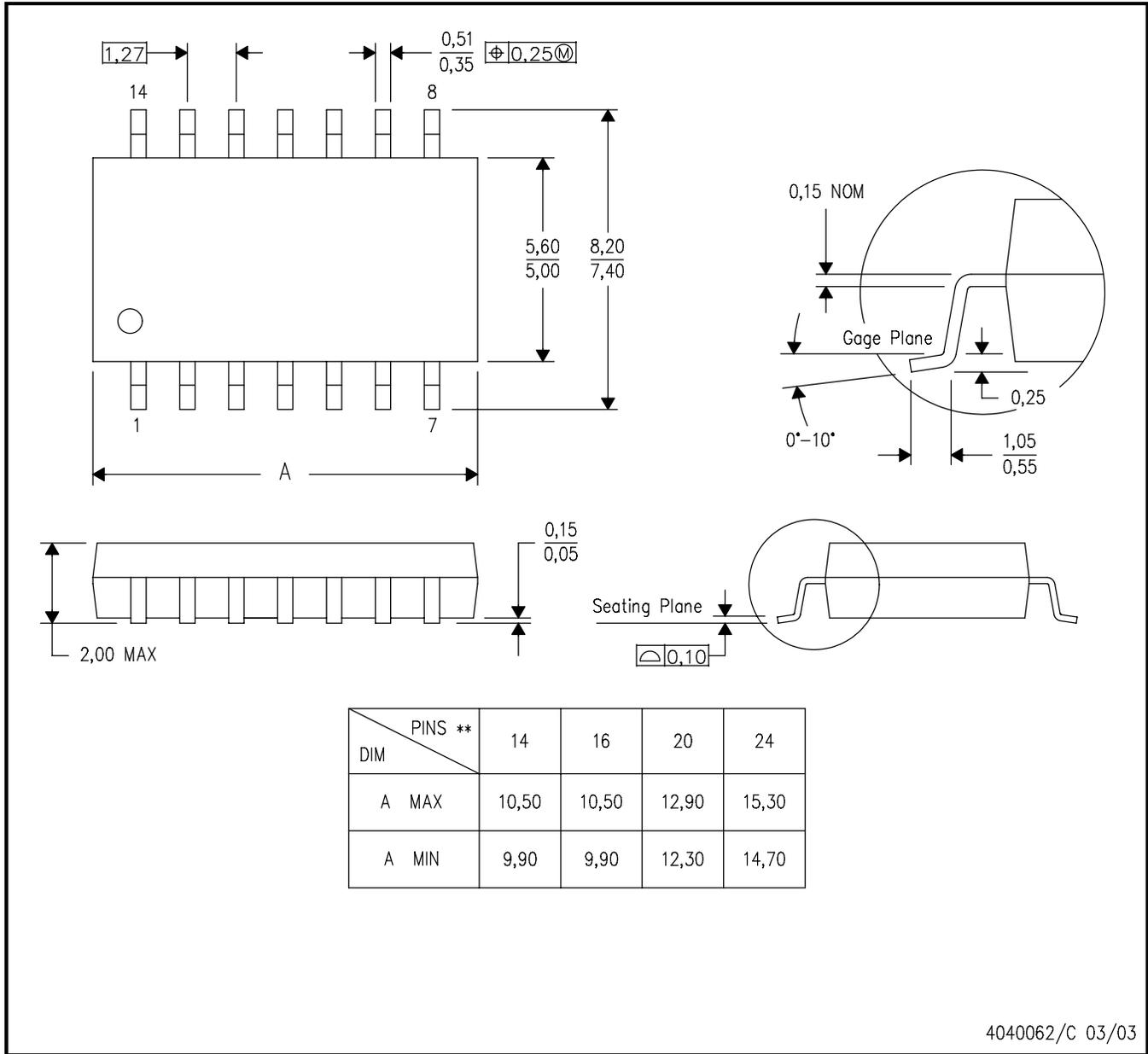**4040049/E 12/2002**

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 lrngth (Dim A).
     /D\ The 20 pin end lead shoulder width is a vendor option, either half or full width.

TEXAS INSTRUMENTS

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1

MECHANICAL DATA

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

8 PINS SHOWN

0.050 (1,27)

0.020 (0,51) / 0.014 (0,35)

⊕ 0.010 (0,25) Ⓜ

8   5

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

0.157 (4,00) / 0.150 (3,81)

1   4

A

0.008 (0,20) NOM

Gage Plane

0°– 8°

0.010 (0,25)

0.044 (1,12) / 0.016 (0,40)

0.069 (1,75) MAX

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

Seating Plane

◠ 0.004 (0,10)

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

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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