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DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH CLEAR AND PRESET

SCAS521F – AUGUST 1995 – REVISED OCTOBER 2003

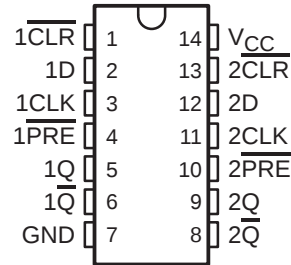
- 2-V to 6-V V_{CC} Operation
- Inputs Accept Voltages to 6 V
- Max t_{pd} of 10 ns at 5 V

description/ordering information

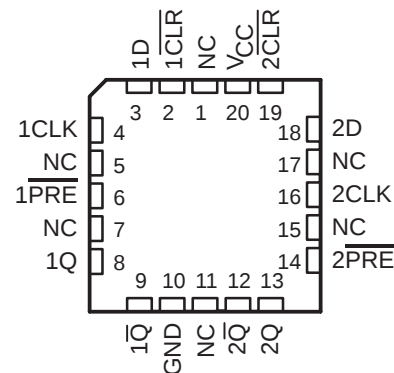
The 'AC74 devices are dual positive-edge-triggered D-type flip-flops.

A low level at the preset ($\overline{PRE}$) or clear ($\overline{CLR}$) input sets or resets the outputs, regardless of the levels of the other inputs. When $\overline{PRE}$ and $\overline{CLR}$ are inactive (high), data at the data (D) input meeting the setup-time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold-time interval, data at D can be changed without affecting the levels at the outputs.

SN54AC74 ... J OR W PACKAGE
SN74AC74 ... D, DB, N, NS, OR PW PACKAGE
(TOP VIEW)



SN54AC74 ... FK PACKAGE
(TOP VIEW)



NC – No internal connection

ORDERING INFORMATION

T _A	PACKAGE [†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – N	Tube	SN74AC74N	SN74AC74N
	SOIC – D	Tube	SN74AC74D	AC74
		Tape and reel	SN74AC74DR	
	SOP – NS	Tape and reel	SN74AC74NSR	AC74
	SSOP – DB	Tape and reel	SN74AC74DBR	AC74
	TSSOP – PW	Tube	SN74AC74PW	AC74
Tape and reel		SN74AC74PWR		
-55°C to 125°C	CDIP – J	Tube	SNJ54AC74J	SNJ54AC74J
	CFP – W	Tube	SNJ54AC74W	SNJ54AC74W
	LCCC – FK	Tube	SNJ54AC74FK	SNJ54AC74FK

[†] Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS
INSTRUMENTS

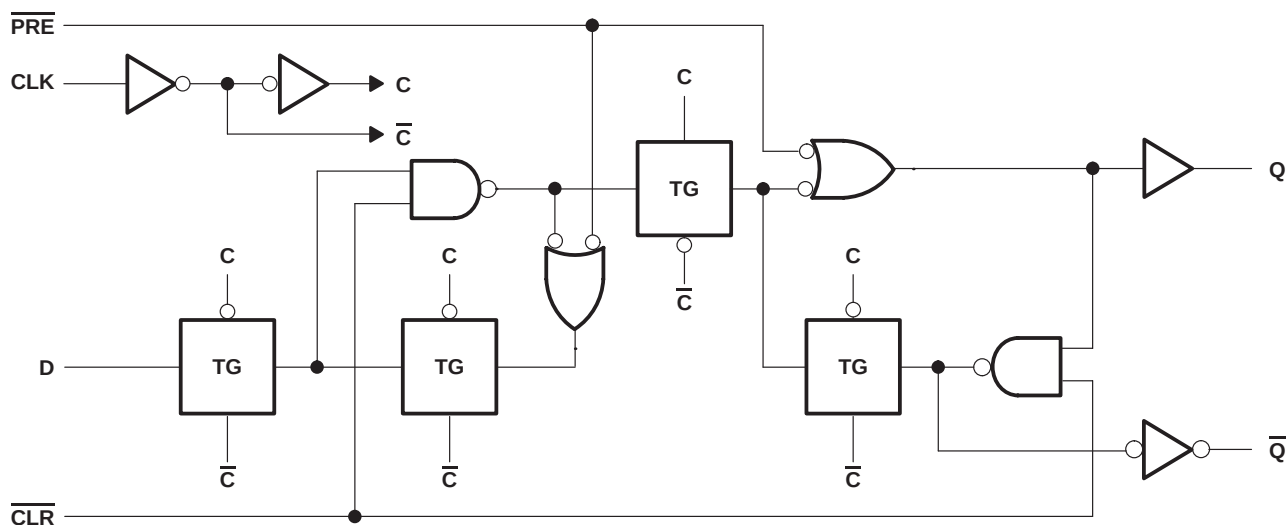
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INPUTS				OUTPUTS	
$\overline{\text{PRE}}$	$\overline{\text{CLR}}$	CLK	D	Q	$\overline{\text{Q}}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	$\text{H}^{\dagger}$	$\text{H}^{\dagger}$
H	H	$\uparrow$	H	H	L
H	H	$\uparrow$	L	L	H
H	H	L	X	Q_0	$\overline{\text{Q}}_0$

logic diagram, each flip-flop (positive logic)



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	–0.5 V to 7 V
Input voltage range, V_I (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$)	±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±50 mA
Continuous current through V_{CC} or GND	±200 mA
Package thermal impedance, θ_{JA} (see Note 2): D package	86°C/W
DB package	96°C/W
N package	80°C/W
NS package	76°C/W
PW package	113°C/W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 3)

			SN54AC74		SN74AC74		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2	6	2	6	V
V_{IH}	High-level input voltage	$V_{CC} = 3$ V	2.1		2.1		V
		$V_{CC} = 4.5$ V	3.15		3.15		
		$V_{CC} = 5.5$ V	3.85		3.85		
V_{IL}	Low-level input voltage	$V_{CC} = 3$ V		0.9		0.9	V
		$V_{CC} = 4.5$ V		1.35		1.35	
		$V_{CC} = 5.5$ V		1.65		1.65	
V_I	Input voltage		0	V_{CC}	0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 3$ V		–12		–12	mA
		$V_{CC} = 4.5$ V		–24		–24	
		$V_{CC} = 5.5$ V		–24		–24	
I_{OL}	Low-level output current	$V_{CC} = 3$ V		12		12	mA
		$V_{CC} = 4.5$ V		24		24	
		$V_{CC} = 5.5$ V		24		24	
$\Delta t/\Delta v$	Input transition rise or fall rate			8		8	ns/V
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54AC74		SN74AC74		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = -50 µA		3 V	2.9	4.49		2.9		2.9		V
			4.5 V	4.4	5.49		4.4		4.4		
			5.5 V	5.4	5.49		5.4		5.4		
	I _{OH} = -12 mA		3 V	2.56			2.4		2.46		
			4.5 V	3.86			3.7		3.76		
			5.5 V	4.86			4.7		4.76		
	I _{OH} = -50 mA [†]		5.5 V				3.85				
			5.5 V						3.85		
V _{OL}	I _{OL} = 50 µA		3 V		0.002	0.1		0.1		0.1	V
			4.5 V		0.001	0.1		0.1		0.1	
			5.5 V		0.001	0.1		0.1		0.1	
	I _{OL} = 12 mA		3 V			0.36		0.5		0.44	
			4.5 V			0.36		0.5		0.44	
			5.5 V			0.36		0.5		0.44	
	I _{OL} = 50 mA [†]		5.5 V				1.65				
			5.5 V						1.65		
I _I	Data pins	V _I = V _{CC} or GND	5.5 V			±0.1		±1		±1	µA
	Control pins					±0.1		±1		±1	
I _{CC}		V _I = V _{CC} or GND, I _O = 0	5.5 V			2		40		20	µA
C _i		V _I = V _{CC} or GND	5 V		3						pF

[†] Not more than one output should be tested at a time, and the duration of the test should not exceed 2 ms.

timing requirements over recommended operating free-air temperature range,
V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

			T _A = 25°C		SN54AC74		SN74AC74		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f _{clock}	Clock frequency			100		70		95	MHz
t _w	Pulse duration	PRE or CLR low	5.5		8		7		ns
		CLK	5.5		8		7		
t _{su}	Setup time, data before CLK↑	Data	4		5		4.5		ns
		PRE or CLR inactive	0		0.5		0		
t _h	Hold time, data after CLK↑		0.5		0.5		0.5		ns



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**timing requirements over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)**

			$T_A = 25^{\circ}\text{C}$		SN54AC74		SN74AC74		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		140		95		125		MHz
t_W	Pulse duration	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low	4.5		5.5		5		ns
		CLK	4.5		5.5		5		
t_{su}	Setup time, data before $\text{CLK}\uparrow$	Data	3		4		3		ns
		$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ inactive	0		0.5		0		
t_h	Hold time, data after $\text{CLK}\uparrow$		0.5		0.5		0.5		ns

**switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			SN54AC74		SN74AC74		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			100	125		70		95		MHz
t_{PLH}	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	3.5	8	12	1	13	2.5	13	ns
t_{PHL}			4	10.5	12	1	14	3.5	13.5	
t_{PLH}	CLK	Q or $\overline{Q}$	4.5	8	13.5	1	17.5	4	16	ns
t_{PHL}			3.5	8	14	1	13.5	3.5	14.5	

**switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			SN54AC74		SN74AC74		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			140	160		95		125		MHz
t_{PLH}	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	2.5	6	9	1	9.5	2	10	ns
t_{PHL}			3	8	9.5	1	10.5	2.5	10.5	
t_{PLH}	CLK	Q or $\overline{Q}$	3.5	6	10	1	12	3	10.5	ns
t_{PHL}			2.5	6	10	1	10	2.5	10.5	

operating characteristics, $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance	$C_L = 50\text{ pF}$	$f = 1\text{ MHz}$	45	pF



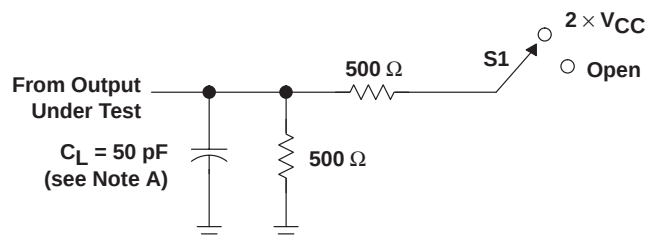
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WITH CLEAR AND PRESET

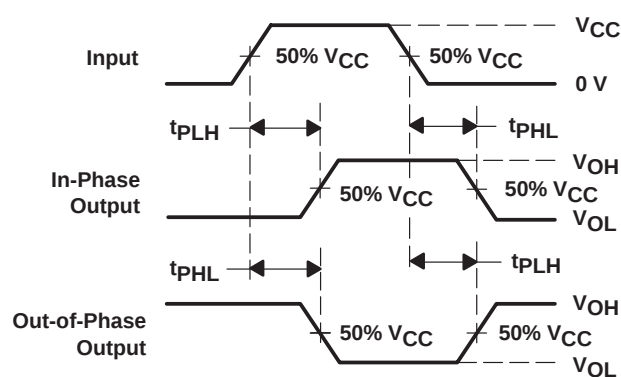
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PARAMETER MEASUREMENT INFORMATION

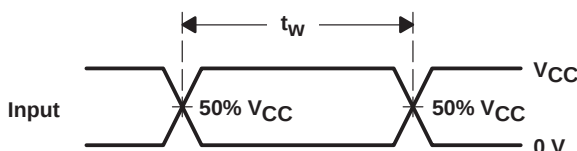


LOAD CIRCUIT

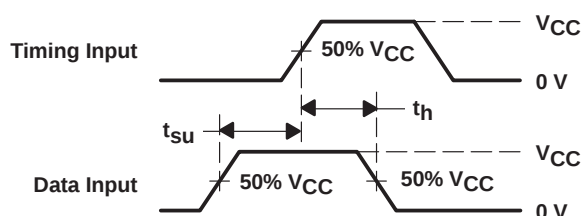
TEST	S1
t_{PLH}/t_{PHL}	Open



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

NOTES: A. C_L includes probe and jig capacitance.

B. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r \leq 2.5 \text{ ns}$, $t_f \leq 2.5 \text{ ns}$.

C. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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)

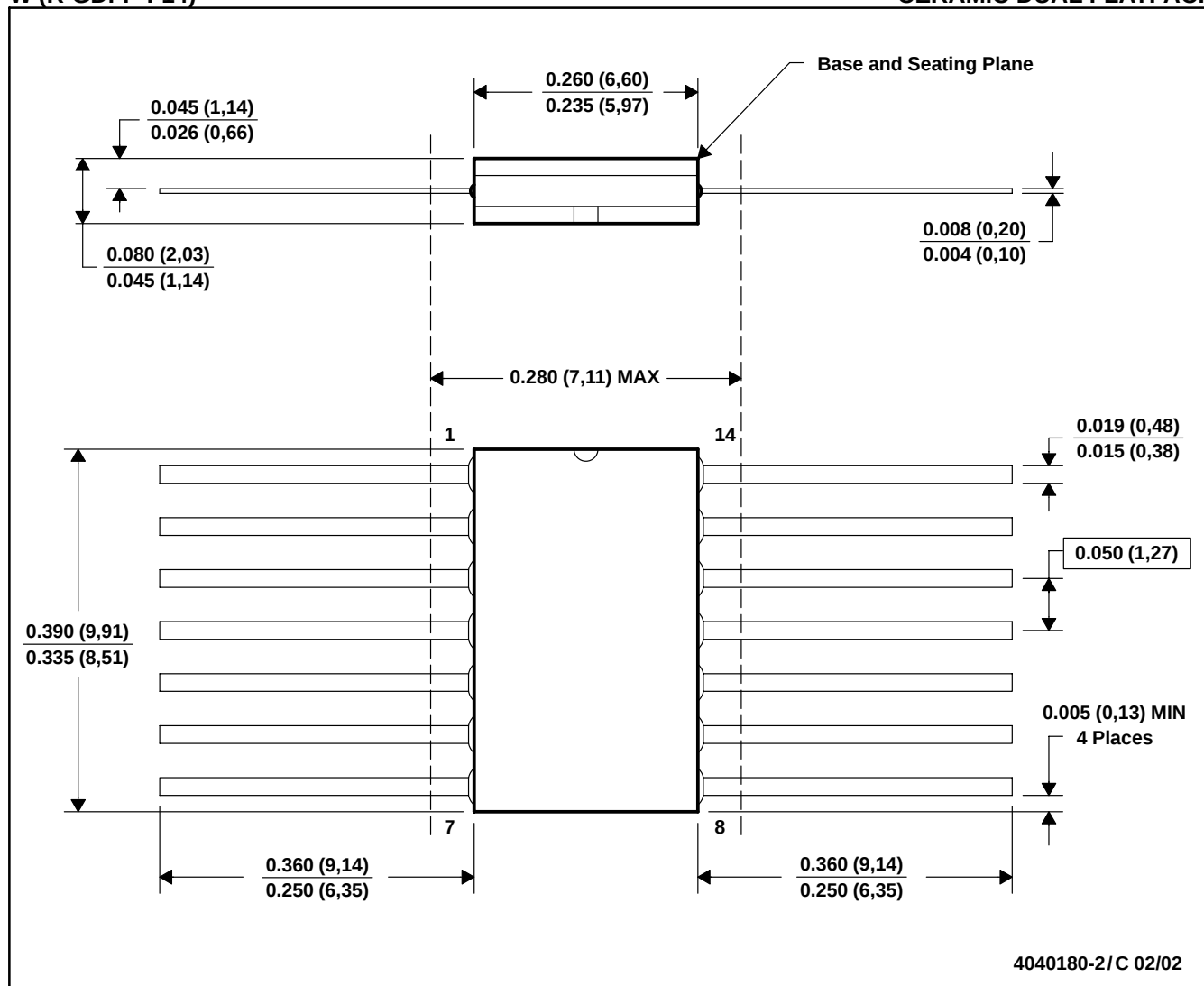


4040083/F 03/03

- 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.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. This package can be hermetically sealed with a ceramic lid using glass frit.
 D. Index point is provided on cap for terminal identification only.
 E. Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN

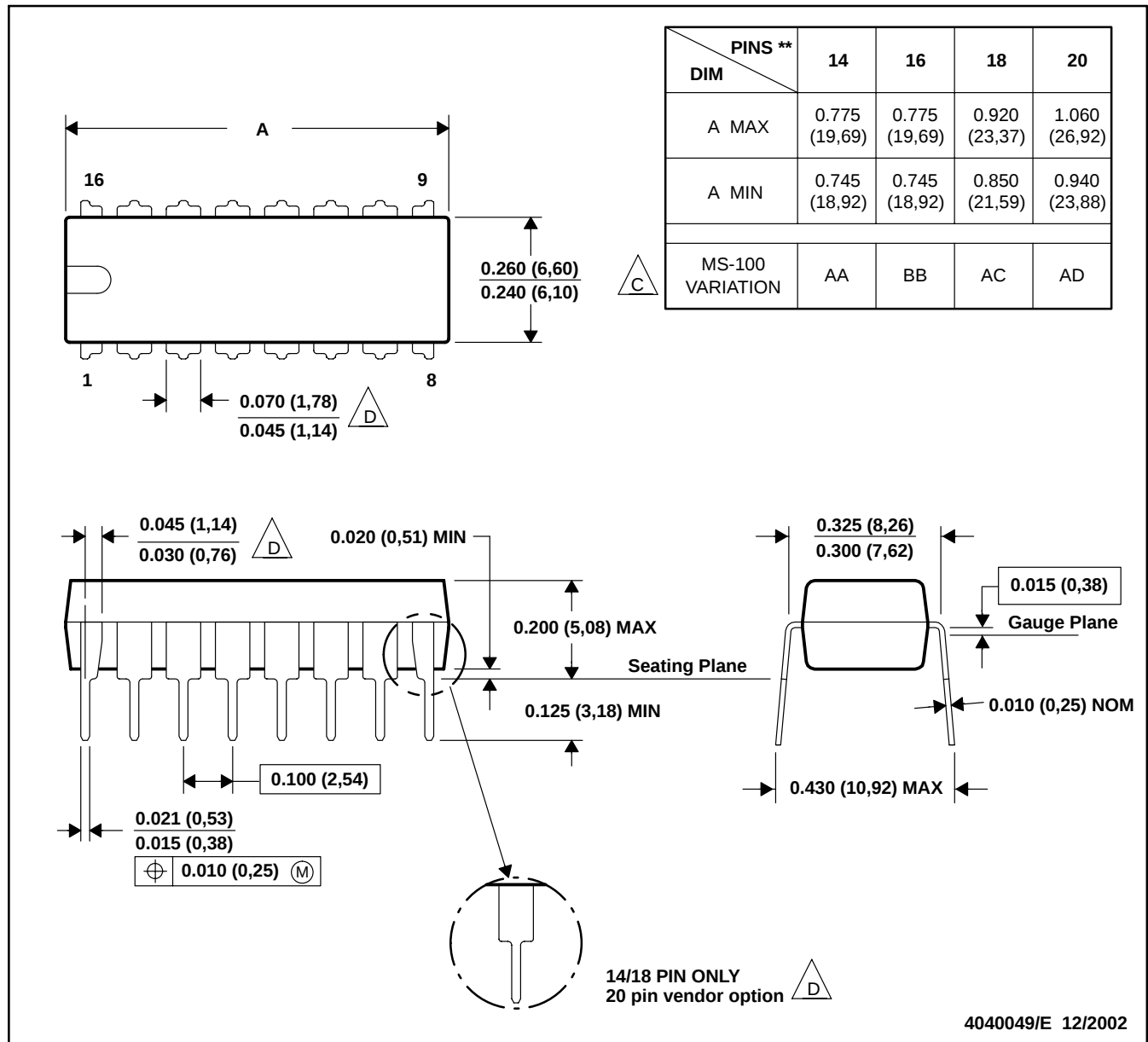


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

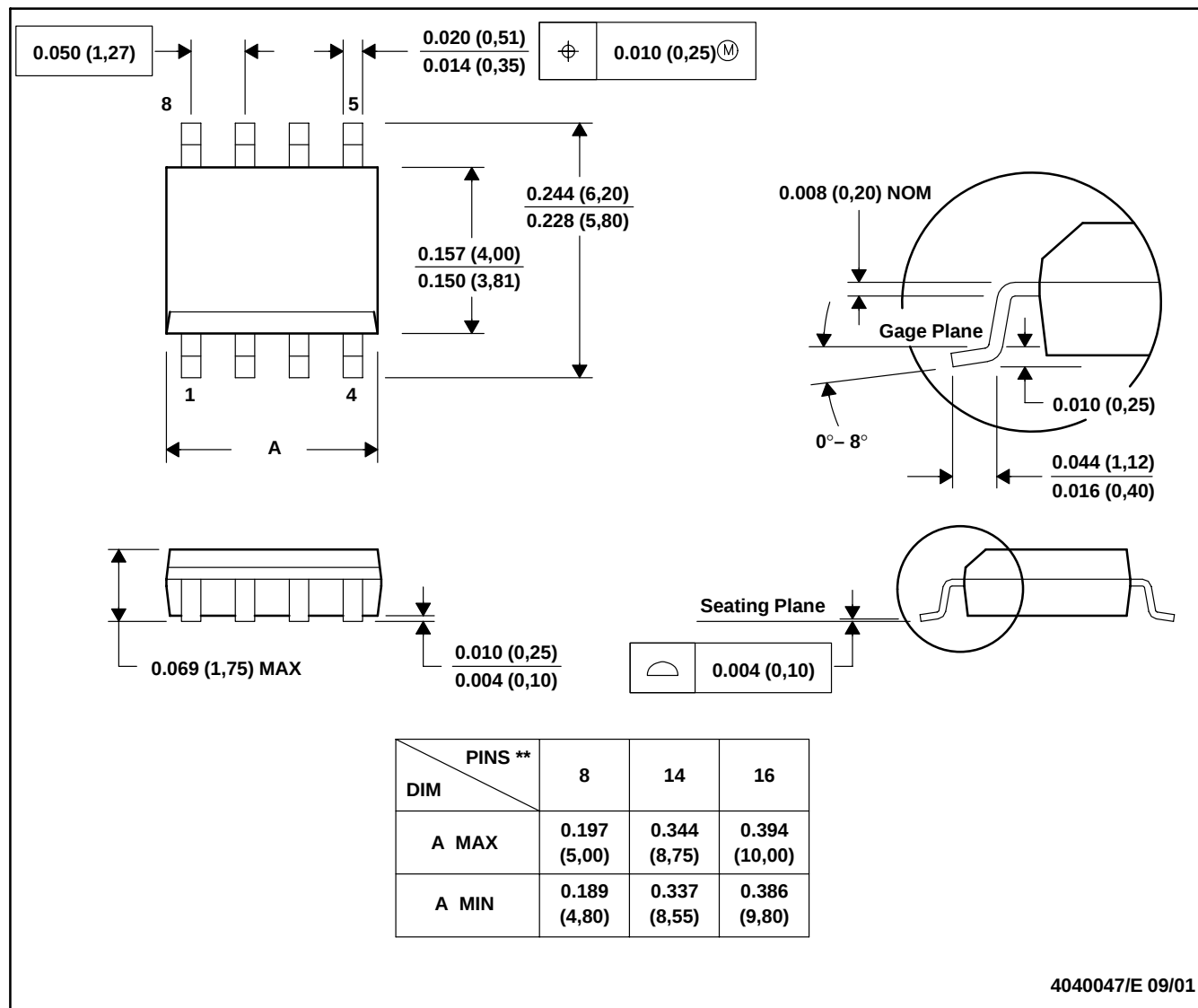


NOTES: A. All linear dimensions are in inches (millimeters).

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-G)****PLASTIC SMALL-OUTLINE PACKAGE****8 PINS SHOWN**

- 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.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 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.
 D. Falls within JEDEC MO-150

PW (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.
 D. Falls within JEDEC MO-153

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