

# SN5404, SN54LS04, SN54S04, SN7404, SN74LS04, SN74S04 HEX INVERTERS

SDLS029C – DECEMBER 1983 – REVISED JANUARY 2004

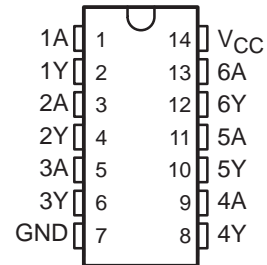
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## description/ordering information

These devices contain six independent inverters.

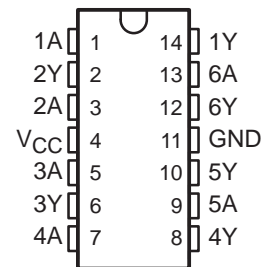
SN5404 . . . J PACKAGE  
SN54LS04, SN54S04 . . . J OR W PACKAGE  
SN7404, SN74S04 . . . D, N, OR NS PACKAGE  
SN74LS04 . . . D, DB, N, OR NS PACKAGE

(TOP VIEW)



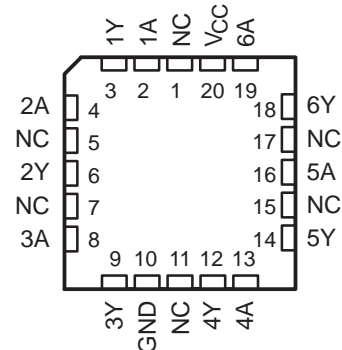
SN5404 . . . W PACKAGE

(TOP VIEW)



SN54LS04, SN54S04 . . . FK PACKAGE

(TOP VIEW)



NC – No internal connection



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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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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

**SN5404, SN54LS04, SN54S04,  
SN7404, SN74LS04, SN74S04  
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**ORDERING INFORMATION**

<b>T<sub>A</sub></b>	<b>PACKAGE†</b>		<b>ORDERABLE PART NUMBER</b>	<b>TOP-SIDE MARKING</b>
0°C to 70°C	PDIP – N	Tube	SN7404N	SN7404N
		Tube	SN74LS04N	SN74LS04N
		Tube	SN74S04N	SN74S04N
	SOIC – D	Tube	SN7404D	7404
		Tape and reel	SN7404DR	
		Tube	SN74LS04D	LS04
		Tape and reel	SN74LS04DR	
		Tube	SN74S04D	S04
		Tape and reel	SN74S04DR	
	SOP – NS	Tape and reel	SN7404NSR	SN7404
		Tape and reel	SN74LS04NSR	74LS04
		Tape and reel	SN74S04NSR	74S04
	SSOP – DB	Tape and reel	SN74LS04DBR	LS04
	–55°C to 125°C	CDIP – J	Tube	SN5404J
Tube			SNJ5404J	SNJ5404J
Tube			SN54LS04J	SN54LS04J
Tube			SN54S04J	SN54S04J
Tube			SNJ54LS04J	SNJ54LS04J
Tube			SNJ54S04J	SNJ54S04J
CFP – W		Tube	SNJ5404W	SNJ5404W
		Tube	SNJ54LS04W	SNJ54LS04W
		Tube	SNJ54S04W	SNJ54S04W
LCCC – FK		Tube	SNJ54LS04FK	SNJ54LS04FK
		Tube	SNJ54S04FK	SNJ54S04FK

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

**FUNCTION TABLE  
(each inverter)**

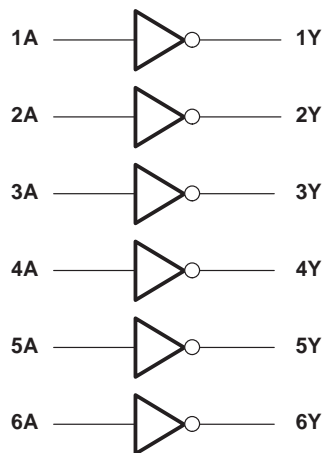
<b>INPUT A</b>	<b>OUTPUT Y</b>
H	L
L	H



**SN5404, SN54LS04, SN54S04,  
SN7404, SN74LS04, SN74S04  
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logic diagram (positive logic)

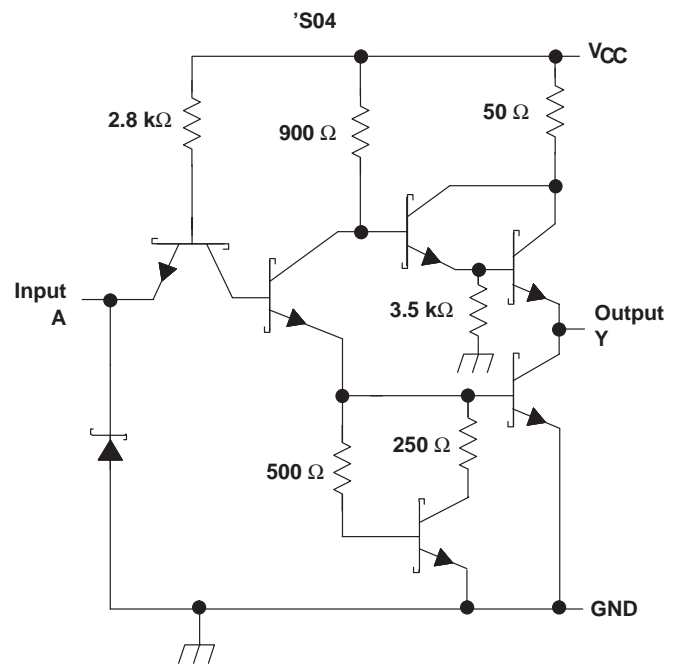
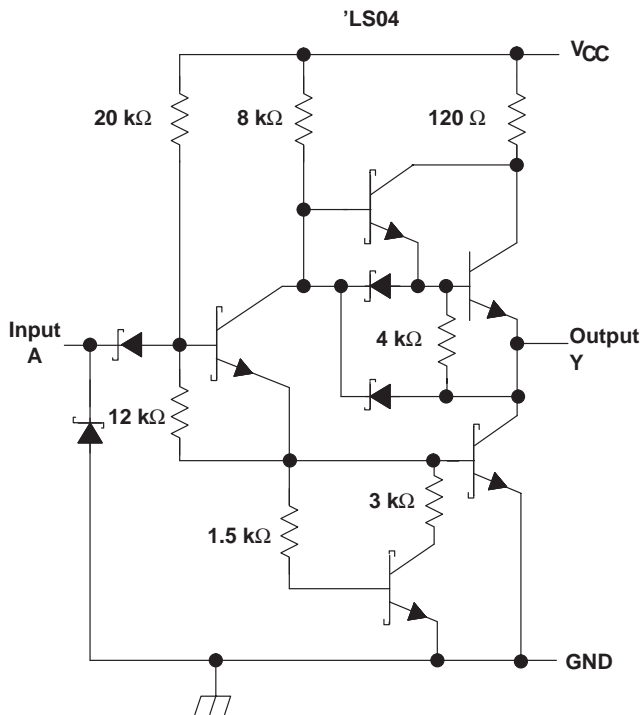
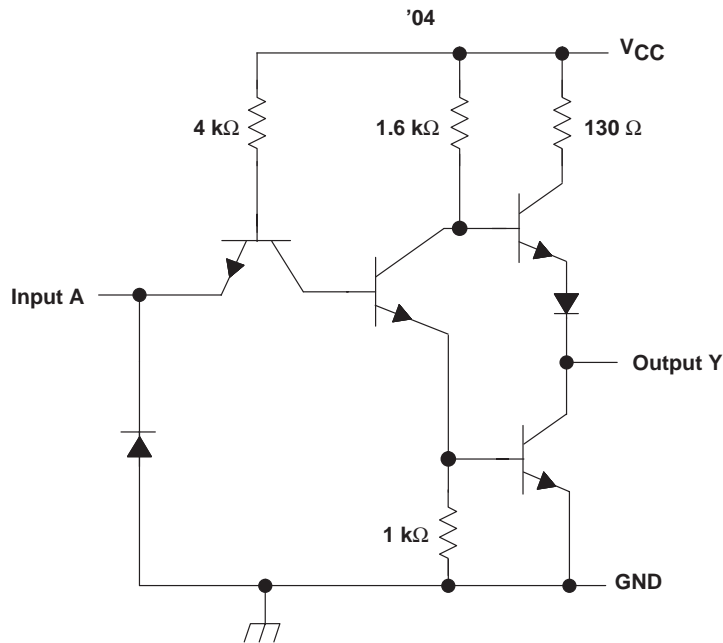


$$Y = \bar{A}$$

# SN5404, SN54LS04, SN54S04, SN7404, SN74LS04, SN74S04 HEX INVERTERS

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## schematics (each gate)



Resistor values shown are nominal.

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage, $V_I$ : '04, 'S04	5.5 V
'LS04	7 V
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package	86°C/W
DB package	96°C/W
N package	80°C/W
NS package	76°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. This 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. Voltage values are with respect to network ground terminal.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions (see Note 3)

		SN5404			SN7404			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage				0.8			V
$I_{OH}$	High-level output current				-0.4			mA
$I_{OL}$	Low-level output current				16			mA
$T_A$	Operating free-air temperature	-55			125			°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.

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

PARAMETER	TEST CONDITIONS‡	SN5404			SN7404			UNIT
		MIN	TYP§	MAX	MIN	TYP§	MAX	
$V_{IK}$	$V_{CC} = \text{MIN}$ , $I_I = -12 \text{ mA}$	-1.5			-1.5			V
$V_{OH}$	$V_{CC} = \text{MIN}$ , $V_{IL} = 0.8 \text{ V}$ , $I_{OH} = -0.4 \text{ mA}$	2.4	3.4		2.4	3.4	V	
$V_{OL}$	$V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 16 \text{ mA}$	0.2			0.4			V
$I_I$	$V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$	1			1			mA
$I_{IH}$	$V_{CC} = \text{MAX}$ , $V_I = 2.4 \text{ V}$	40			40			µA
$I_{IL}$	$V_{CC} = \text{MAX}$ , $V_I = 0.4 \text{ V}$	-1.6			-1.6			mA
$I_{OS}¶$	$V_{CC} = \text{MAX}$	-20		-55	-18		-55	mA
$I_{CCH}$	$V_{CC} = \text{MAX}$ , $V_I = 0 \text{ V}$	6			12			mA
$I_{CCL}$	$V_{CC} = \text{MAX}$ , $V_I = 4.5 \text{ V}$	18			33			mA

‡ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

§ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

¶ Not more than one output should be shorted at a time.



# SN5404, SN54LS04, SN54S04, SN7404, SN74LS04, SN74S04 HEX INVERTERS

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## switching characteristics, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$ (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN5404 SN7404			UNIT
				MIN	TYP	MAX	
$t_{PLH}$	A	Y	$R_L = 400\ \Omega$ , $C_L = 15\text{ pF}$	12		22	ns
$t_{PHL}$				8		15	

## recommended operating conditions (see Note 3)

		SN54LS04			SN74LS04			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage	0.7			0.8			V
$I_{OH}$	High-level output current	-0.4			-0.4			mA
$I_{OL}$	Low-level output current	4			8			mA
$T_A$	Operating free-air temperature	-55			125			$^\circ\text{C}$

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.

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

PARAMETER	TEST CONDITIONS†	SN54LS04			SN74LS04			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$	$V_{CC} = \text{MIN}$ , $I_I = -18\text{ mA}$	-1.5			-1.5			V
$V_{OH}$	$V_{CC} = \text{MIN}$ , $V_{IL} = \text{MAX}$ , $I_{OH} = -0.4\text{ mA}$	2.5	3.4		2.7	3.4		V
$V_{OL}$	$V_{CC} = \text{MIN}$ , $V_{IH} = 2\text{ V}$	$I_{OL} = 4\text{ mA}$		0.4		0.4		V
		$I_{OL} = 8\text{ mA}$				0.25		
$I_I$	$V_{CC} = \text{MAX}$ , $V_I = 7\text{ V}$	0.1			0.1			mA
$I_{IH}$	$V_{CC} = \text{MAX}$ , $V_I = 2.7\text{ V}$	20			20			$\mu\text{A}$
$I_{IL}$	$V_{CC} = \text{MAX}$ , $V_I = 0.4\text{ V}$	-0.4			-0.4			mA
$I_{OS}§$	$V_{CC} = \text{MAX}$	-20		-100	-20		-100	mA
$I_{CCH}$	$V_{CC} = \text{MAX}$ , $V_I = 0\text{ V}$	1.2		2.4	1.2		2.4	mA
$I_{CCL}$	$V_{CC} = \text{MAX}$ , $V_I = 4.5\text{ V}$	3.6		6.6	3.6		6.6	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

## switching characteristics, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$ (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54LS04 SN74LS04			UNIT
				MIN	TYP	MAX	
$t_{PLH}$	A	Y	$R_L = 2\text{ k}\Omega$ , $C_L = 15\text{ pF}$	9		15	ns
$t_{PHL}$				10		15	



**SN5404, SN54LS04, SN54S04,  
SN7404, SN74LS04, SN74S04  
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**recommended operating conditions (see Note 3)**

		SN54S04			SN74S04			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage			0.8			0.8	V
$I_{OH}$	High-level output current			-1			-1	mA
$I_{OL}$	Low-level output current			20			20	mA
$T_A$	Operating free-air temperature	-55		125	0		70	°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.

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

PARAMETER	TEST CONDITIONS†	SN54S04			SN74S04			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IK}$	$V_{CC} = \text{MIN}$ , $I_I = -18 \text{ mA}$			-1.2			-1.2	V
$V_{OH}$	$V_{CC} = \text{MIN}$ , $V_{IL} = 0.8 \text{ V}$ , $I_{OH} = -1 \text{ mA}$	2.5	3.4		2.7	3.4		V
$V_{OL}$	$V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ , $I_{OL} = 20 \text{ mA}$			0.5			0.5	V
$I_I$	$V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$			1			1	mA
$I_{IH}$	$V_{CC} = \text{MAX}$ , $V_I = 2.7 \text{ V}$			50			50	µA
$I_{IL}$	$V_{CC} = \text{MAX}$ , $V_I = 0.5 \text{ V}$			-2			-2	mA
$I_{OS}§$	$V_{CC} = \text{MAX}$	-40		-100	-40		-100	mA
$I_{CCH}$	$V_{CC} = \text{MAX}$ , $V_I = 0 \text{ V}$		15	24		15	24	mA
$I_{CCL}$	$V_{CC} = \text{MAX}$ , $V_I = 4.5 \text{ V}$		30	54		30	54	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

**switching characteristics,  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$  (see Figure 1)**

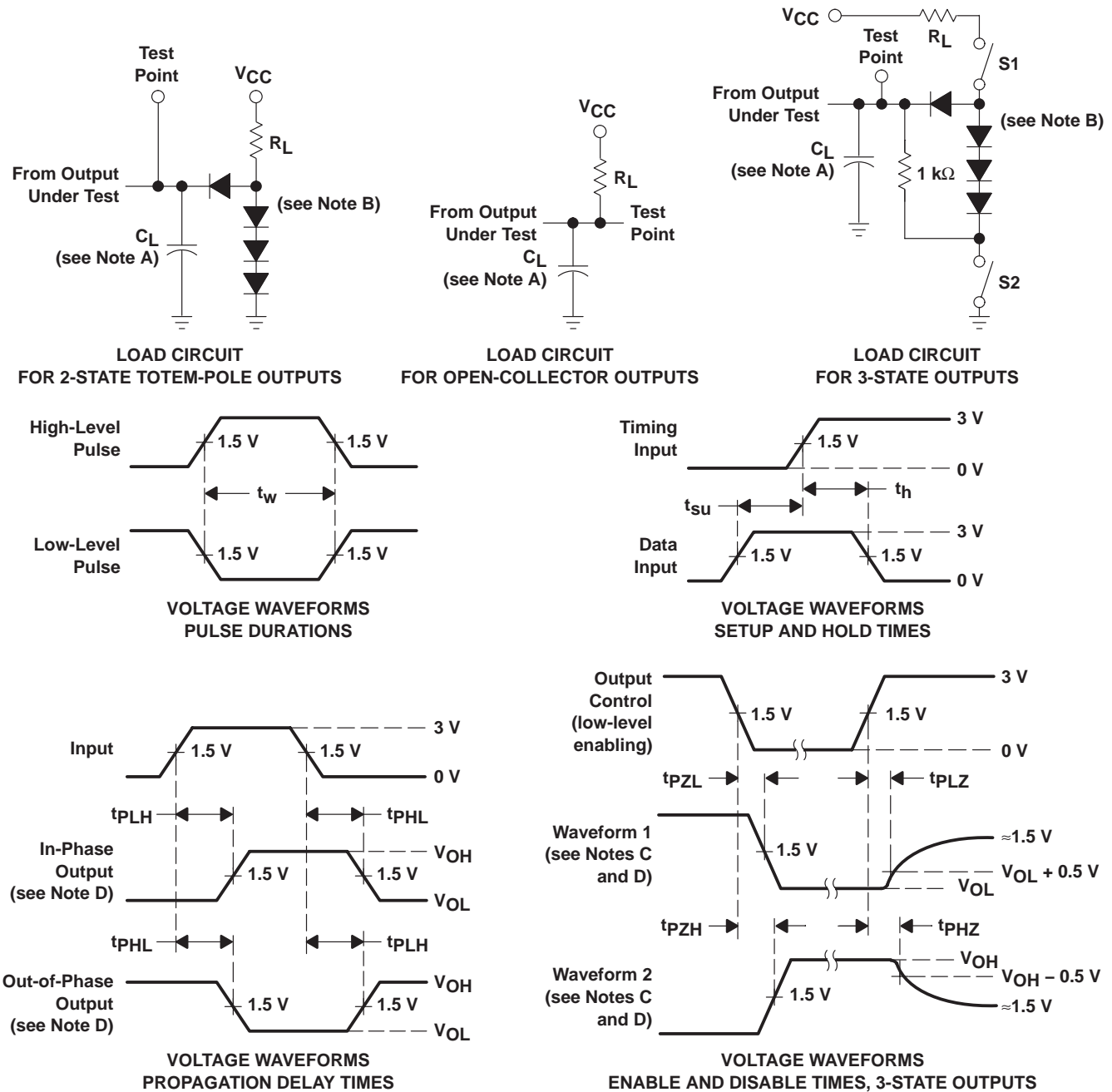
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN54S04 SN74S04			UNIT
				MIN	TYP	MAX	
$t_{PLH}$	A	Y	$R_L = 280 \Omega$ , $C_L = 15 \text{ pF}$	3		4.5	ns
$t_{PHL}$				3		5	
$t_{PLH}$	A	Y	$R_L = 280 \Omega$ , $C_L = 50 \text{ pF}$	4.5		5	ns
$t_{PHL}$				5			



**SN5404, SN54LS04, SN54S04,  
SN7404, SN74LS04, SN74S04  
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**PARAMETER MEASUREMENT INFORMATION  
SERIES 54/74 AND 54S/74S DEVICES**

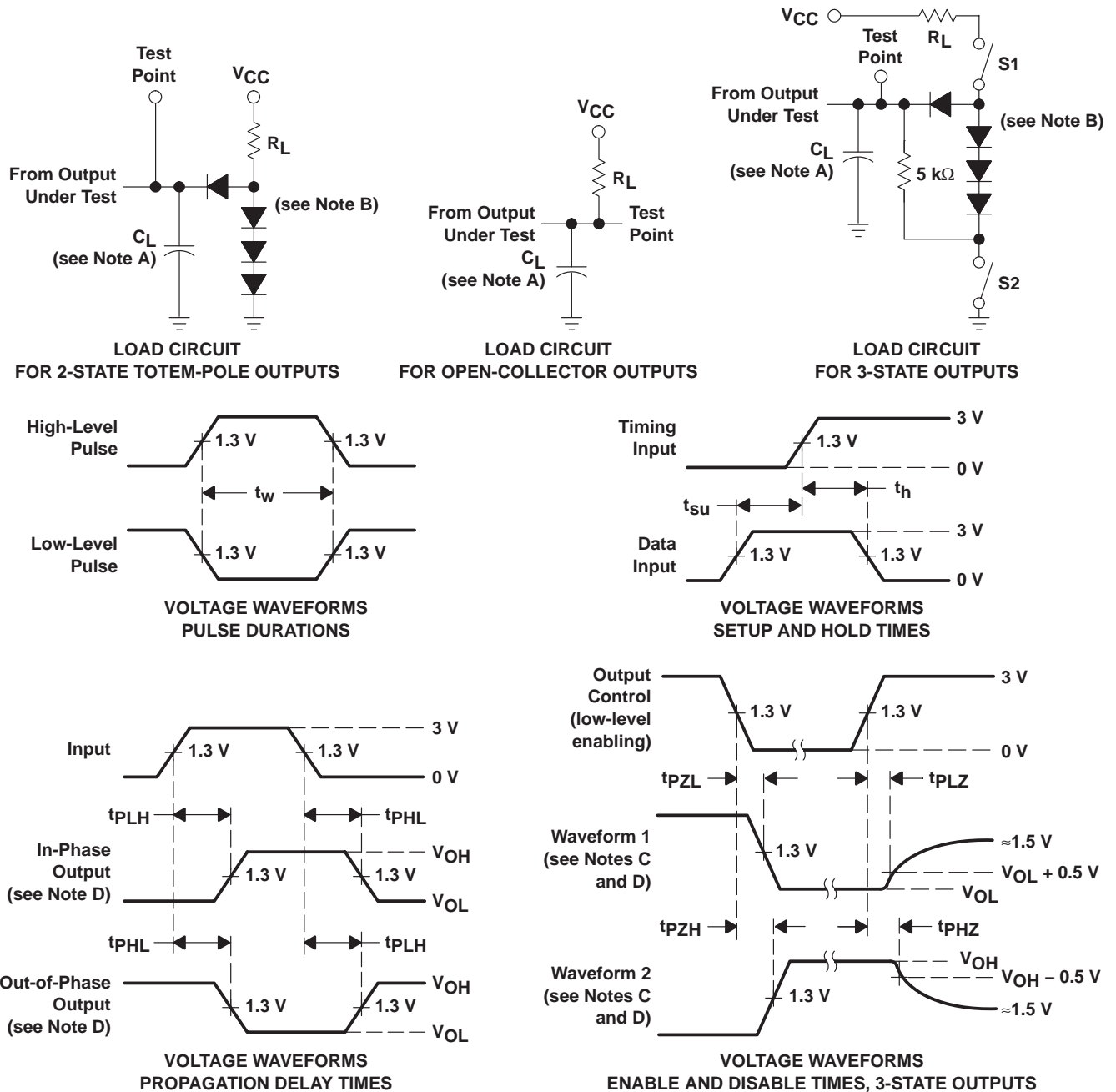


- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All diodes are 1N3064 or equivalent.  
 C. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
 D. S1 and S2 are closed for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_{PHZ}$ , and  $t_{PLZ}$ ; S1 is open and S2 is closed for  $t_{PZH}$ ; S1 is closed and S2 is open for  $t_{PZL}$ .  
 E. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O \approx 50 \Omega$ ;  $t_r$  and  $t_f \leq 7$  ns for Series 54/74 devices and  $t_r$  and  $t_f \leq 2.5$  ns for Series 54S/74S devices.  
 F. The outputs are measured one at a time, with one input transition per measurement.

**Figure 1. Load Circuits and Voltage Waveforms**



PARAMETER MEASUREMENT INFORMATION  
SERIES 54LS/74LS DEVICES



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All diodes are 1N3064 or equivalent.  
 C. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
 D. S1 and S2 are closed for  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_{PHZ}$ , and  $t_{PLZ}$ ; S1 is open and S2 is closed for  $t_{PZH}$ ; S1 is closed and S2 is open for  $t_{PZL}$ .  
 E. Phase relationships between inputs and outputs have been chosen arbitrarily for these examples.  
 F. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  1 MHz,  $Z_O \approx 50 \Omega$ ,  $t_r \leq 1.5$  ns,  $t_f \leq 2.6$  ns.  
 G. The outputs are measured one at a time, with one input transition per measurement.

Figure 2. Load Circuits and Voltage Waveforms

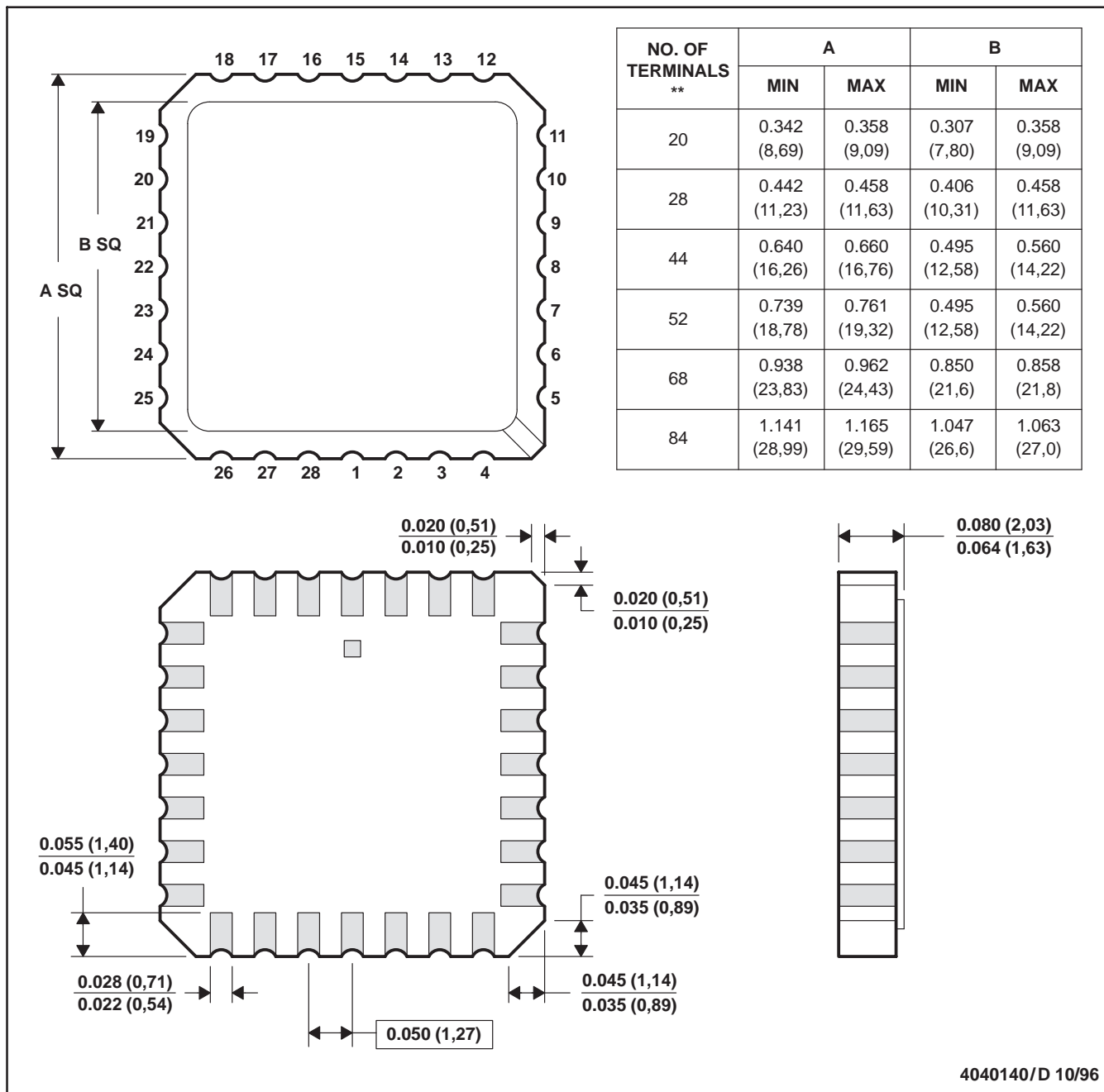




FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN

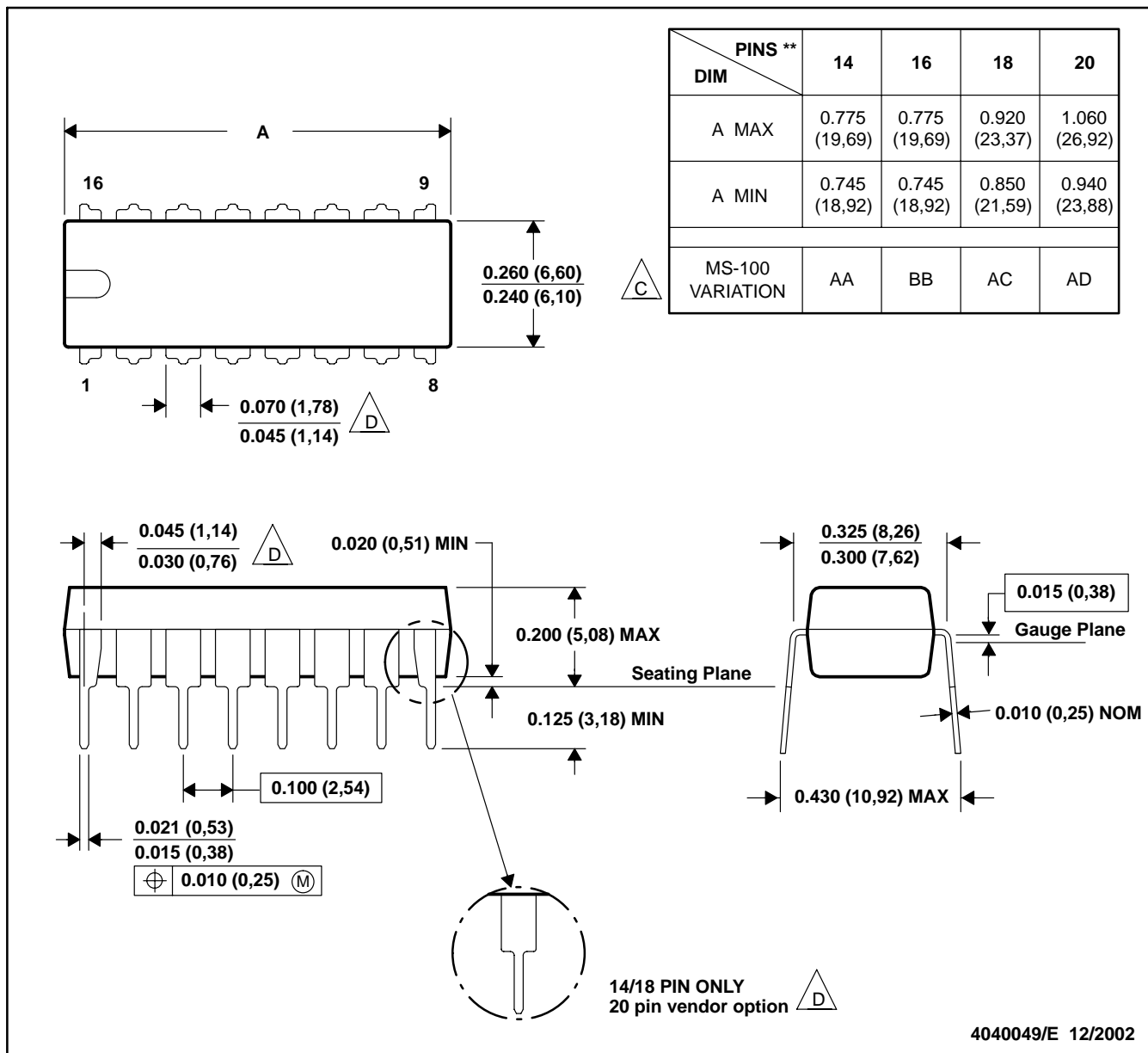


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN

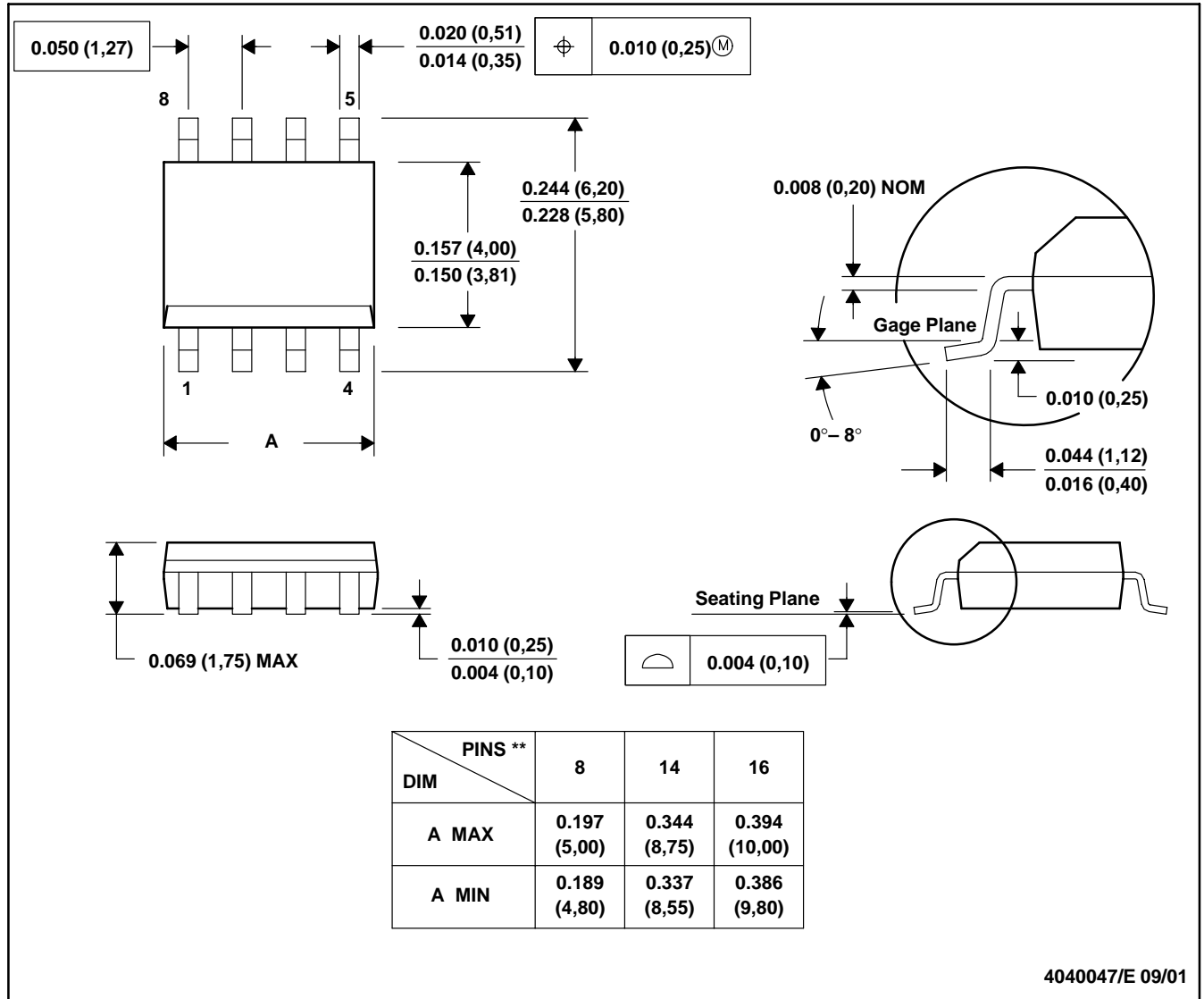


- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 D The 20 pin end lead shoulder width is a vendor option, either half or full width.

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



- 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.

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