

# SN5406, SN5416, SN7406, SN7416 HEX INVERTER BUFFERS/DRIVERS WITH OPEN-COLLECTOR HIGH-VOLTAGE OUTPUTS

SDLS031A – DECEMBER 1983 – REVISED DECEMBER 2001

- Convert TTL Voltage Levels to MOS Levels
- High Sink-Current Capability
- Input Clamping Diodes Simplify System Design
- Open-Collector Drivers for Indicator Lamps and Relays
- Inputs Fully Compatible With Most TTL Circuits

## description

These TTL hex inverter buffers/drivers feature high-voltage open-collector outputs for interfacing with high-level circuits (such as MOS) or for driving high-current loads (such as lamps or relays), and also are characterized for use as inverter buffers for driving TTL inputs. The SN5406 and SN7406 have minimum breakdown voltages of 30 V. The SN5416 and SN7416 have minimum breakdown voltages of 15 V. The maximum sink current is 30 mA for the SN5406 and SN5416, and 40 mA for the SN7406 and SN7416.

SN5406, SN5416 . . . J OR W PACKAGE  
SN7406 . . . D, N, OR NS PACKAGE  
SN7416 . . . D OR N PACKAGE  
(TOP VIEW)



SN5406 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC – D	Tube	SN7406D	7406
		Tape and reel	SN7406DR	
		Tube	SN7416D	7416
		Tape and reel	SN7416DR	
	PDIP – N	Tube	SN7406N	SN7406N
				SN7416N
	SOP – NS	Tape and reel	SN7406NSR	SN7406
–55°C to 125°C	CDIP – J	Tube	SNJ5406J	SNJ5406J
		Tube	SNJ5416J	SNJ5416J
	CDIP – W	Tube	SNJ5406W	SNJ5406W
		Tube	SNJ5416W	SNJ5416W
	LCCC – FK	Tube	SNJ5406FK	SNJ5406FK

† 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).



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 **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.

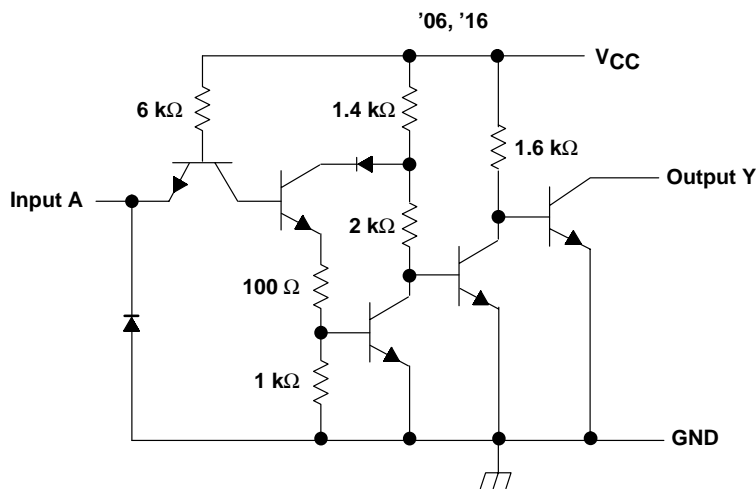
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## logic diagram (positive logic)



## schematic (each buffer/driver)



Resistor values shown are nominal.

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage, $V_I$ (see Note 1)	5.5 V
Output voltage, $V_O$ (see Notes 1 and 2): SN5406, SN7406	30 V
SN5416, SN7416	15 V
Package thermal impedance, $\theta_{JA}$ (see Note 3): D package	86°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. 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. Voltage values are with respect to network ground terminal.
  2. This is the maximum voltage which should be applied to any output when it is in the off state.
  3. The package thermal impedance is calculated in accordance with JESD 51-7.



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## recommended operating conditions

		SN5406 SN5416			SN7406 SN7416			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage			0.8			0.8	V
V <sub>OH</sub>	High-level output voltage				'06			V
					'16			
I <sub>OL</sub>	Low-level output current				30			mA
T <sub>A</sub>	Operating free-air temperature	-55			125			°C

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

PARAMETER	TEST CONDITIONS†	SN5406 SN5416			SN7406 SN7416			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -12 mA			-1.5			-1.5	V
I <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IL</sub> = 0.8 V, V <sub>OH</sub> = §			0.25			0.25	mA
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V	I <sub>OL</sub> = 16 mA			0.4			V
		I <sub>OL</sub> = ¶			0.7			
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V			1			1	mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2.4 V			40			40	µA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.4 V			-1.6			-1.6	mA
I <sub>CCH</sub>	V <sub>CC</sub> = MAX			30			48	mA
I <sub>CCL</sub>	V <sub>CC</sub> = MAX			32			51	mA

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

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

§ V<sub>OH</sub> = 30 V for '06 and 15 V for '16.

¶ I<sub>OL</sub> = 30 mA for SN54' and 40 mA for SN74'.

## switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	A	Y	R <sub>L</sub> = 110 Ω, C <sub>L</sub> = 15 pF		10	15	ns
t <sub>PHL</sub>					15	23	



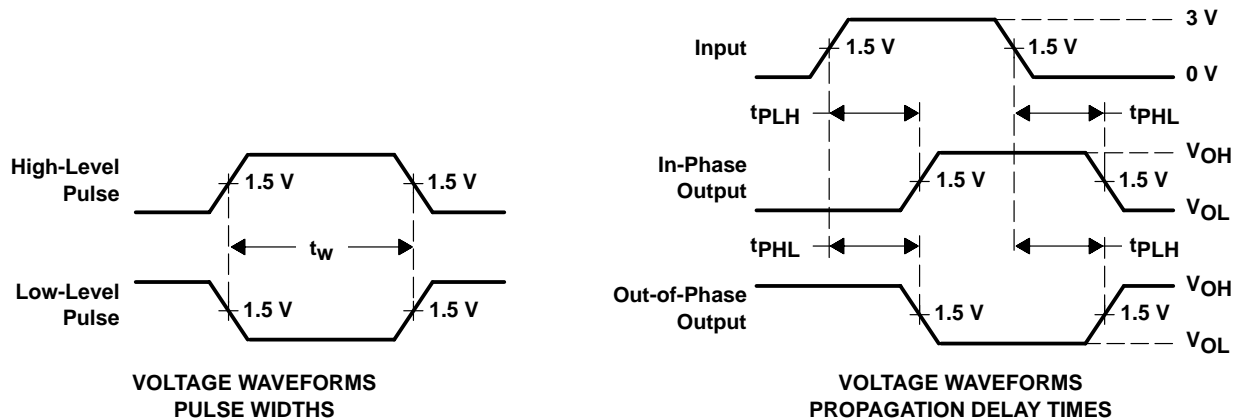
**SN5406, SN5416, SN7406, SN7416**  
**HEX INVERTER BUFFERS/DRIVERS**  
**WITH OPEN-COLLECTOR HIGH-VOLTAGE OUTPUTS**

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**PARAMETER MEASUREMENT INFORMATION**



**LOAD CIRCUIT**



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. In the examples above, the phase relationships between inputs and outputs have been chosen arbitrarily.  
 C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 7$  ns,  $t_f \leq 7$  ns.  
 D. The outputs are measured one at a time with one input transition per measurement.

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

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**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
JM38510/00801BCA	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
JM38510/00801BDA	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type
SN5406J	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
SN5416J	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
SN7406D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406J	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
SN7406N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN7406N3	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN7406NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN7406NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7406NSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN7416N3	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN7416NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN7416NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN7416NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
						no Sb/Br)		
SN7416NSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ5406FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ5406J	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ5406W	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type
SNJ5416J	ACTIVE	CDIP	J	14	1	TBD	A42 SNPB	N / A for Pkg Type
SNJ5416W	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN7406DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN7406DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN7406NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN7416DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN7416NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1



**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN7406DR	SOIC	D	14	2500	333.2	345.9	28.6
SN7406DR	SOIC	D	14	2500	346.0	346.0	33.0
SN7406NSR	SO	NS	14	2000	346.0	346.0	33.0
SN7416DR	SOIC	D	14	2500	346.0	346.0	33.0
SN7416NSR	SO	NS	14	2000	346.0	346.0	33.0

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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN

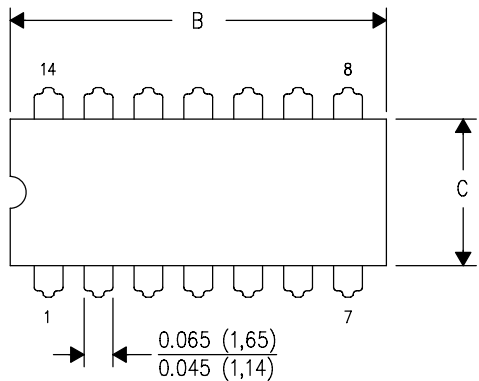


- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

# J (R-GDIP-T\*\*)

14 LEADS SHOWN

# CERAMIC DUAL IN-LINE PACKAGE



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)



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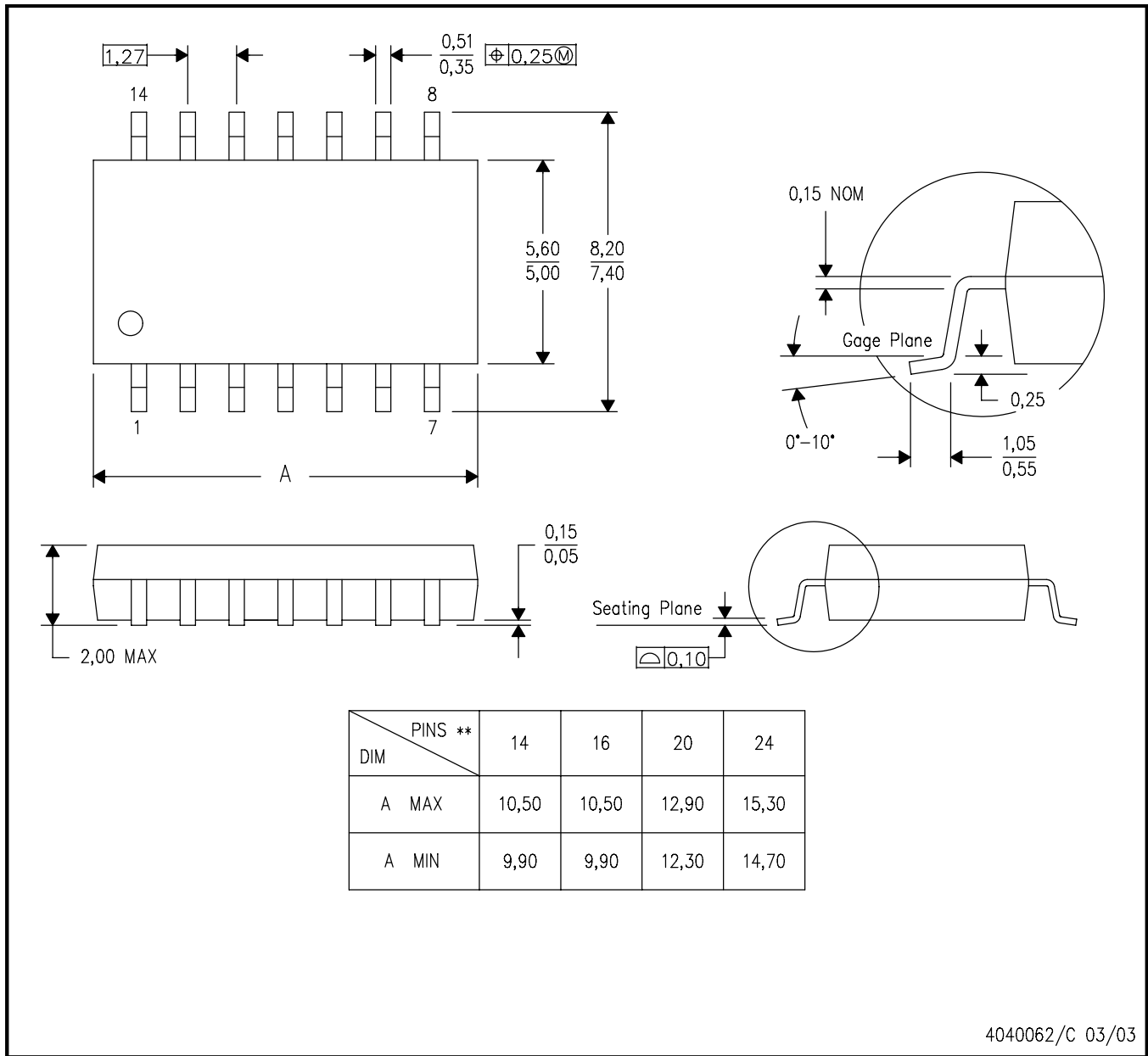
- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

# MECHANICAL 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.

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



- 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 AB.

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

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.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.