

# CD4094B Types

## CMOS

## 8-Stage Shift-and-Store Bus Register

### High-Voltage Types (20-Volt Rating)

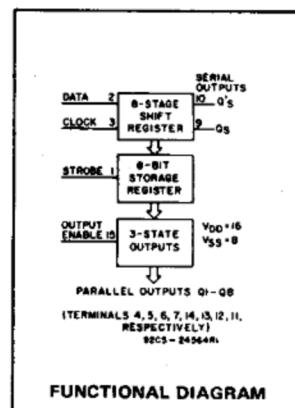
■ CD4094B is an 8-stage serial shift register having a storage latch associated with each stage for strobing data from the serial input to parallel buffered 3-state outputs. The parallel outputs may be connected directly to common bus lines. Data is shifted on positive clock transitions. The data in each shift register stage is transferred to the storage register when the STROBE input is high. Data in the storage register appears at the outputs whenever the OUTPUT-ENABLE signal is high.

Two serial outputs are available for cascading a number of CD4094B devices. Data is available at the Q<sub>S</sub> serial output terminal on positive clock edges to allow for high-speed operation in cascaded systems in which the clock rise time is fast. The same serial information, available at the Q'<sub>S</sub> terminal on the next negative clock edge, provides a means for cascading CD4094B devices when the clock rise time is slow.

The CD4094B 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 (NSR suffix), and 16-lead thin shrink small-outline packages (PW and PWR suffixes).

### Features:

- 3-state parallel outputs for connection to common bus
- Separate serial outputs synchronous to both positive and negative clock edges for cascading
- Medium speed operation – 5 MHz at 10 V (typ.)
- Standardized, symmetrical output characteristics
- 100% tested for quiescent current at 20 V
- Maximum input current of 1  $\mu$ A at 18 V over full package-temperature range; 100 nA at 18 V and 25°C
- Noise margin (full package temperature range):  
 $1\text{ V at }V_{DD} = 5\text{ V}$        $2\text{ V at }V_{DD} = 10\text{ V}$   
 $2.5\text{ V at }V_{DD} = 15\text{ V}$
- 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"



FUNCTIONAL DIAGRAM

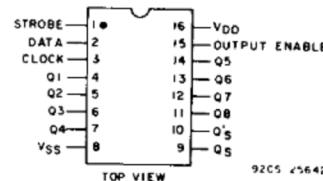


Fig. 1 – Terminal assignment.

### Applications:

- Serial-to-parallel data conversion
- Remote control holding register
- Dual-rank shift, hold, and bus applications

### MAXIMUM RATINGS, Absolute-Maximum Values:

#### DC SUPPLY-VOLTAGE RANGE, (V<sub>DD</sub>)

Voltages referenced to V<sub>SS</sub> Terminal) ..... -0.5V to +20V

INPUT VOLTAGE RANGE, ALL INPUTS ..... -0.5V to V<sub>DD</sub> +0.5V

DC INPUT CURRENT, ANY ONE INPUT ..... ±10mA

#### POWER DISSIPATION PER PACKAGE (P<sub>D</sub>):

For T<sub>A</sub> = -55°C to +100°C ..... 500mW

For T<sub>A</sub> = +100°C to +125°C ..... Derate Linearity at 12mW/°C to 200mW

#### DEVICE DISSIPATION PER OUTPUT TRANSISTOR

FOR T<sub>A</sub> = FULL PACKAGE-TEMPERATURE RANGE (All Package Types) ..... 100mW

OPERATING-TEMPERATURE RANGE (T<sub>A</sub>) ..... -55°C to +125°C

STORAGE TEMPERATURE RANGE (T<sub>stg</sub>) ..... -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

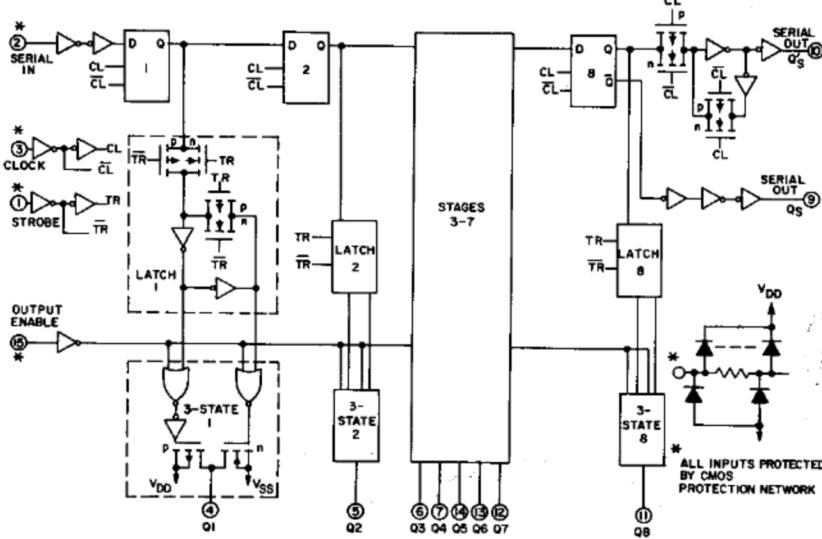


Fig. 2 – CD4094B Logic diagram.

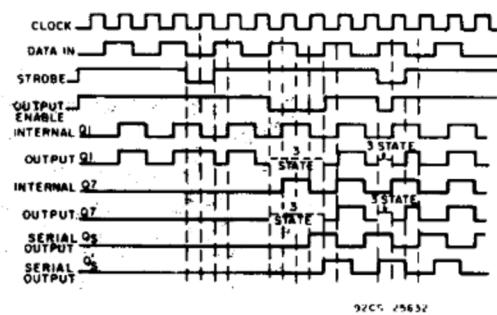


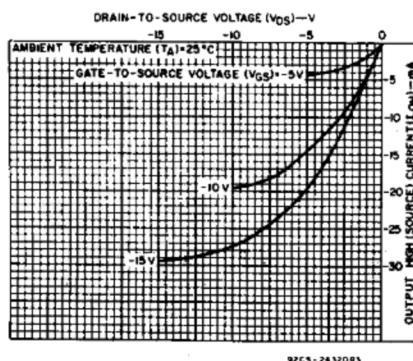
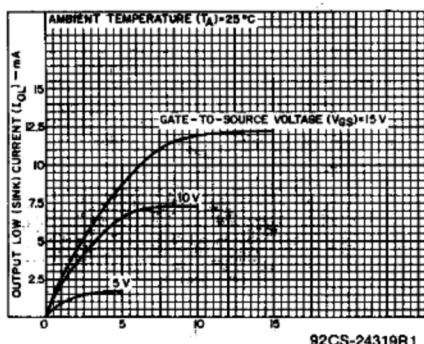
Fig. 3 – Timing diagram.

## CD4094B Types

**RECOMMENDED OPERATING CONDITIONS at  $T_A = 25^\circ C$ , Except as Noted.**  
 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 (For $T_A$ =Full Package-Temperature Range)		3	18	V
Data Setup Time, $t_S$	5	125	—	ns
	10	55	—	
	15	35	—	
Clock Pulse Width, $t_W$	5	200	—	ns
	10	100	—	
	15	83	—	
Clock Input Frequency, $f_{CL}$	5		1.25	MHz
	10	dc	2.5	
	15		3	
Clock Input Rise or Fall time, $t_{rCL}, t_{fCL}^*$	5	—	15	$\mu s$
	10	—	5	
	15	—	5	
Strobe Pulse Width, $t_W$	5	200	—	ns
	10	80	—	
	15	70	—	

\*If more than one unit is cascaded  $t_{fCL}$  (for  $Q_8$  only) should be made less than or equal to the sum of the fixed propagation delay at 50 pF and the transition time of the output driving stage for the estimated capacitive load.



CL <sup>a</sup>	Output Enable	Strobe	Data	Parallel Outputs		Serial Outputs	
				Q1	QN	QS*	Q8
/	0	X	X	OC	OC	Q7	NC
/	0	X	X	OC	OC	NC	Q7
/	1	0	X	NC	NC	Q7	NC
/	1	1	0	0	Qn-1	Q7	NC
/	1	1	1	1	Qn-1	Q7	NC
/	1	1	NC	NC	NC	NC	Q7

<sup>a</sup> ▲ = Level Change  
 X = Don't Care  
 NC = No Change  
 OC = Open Circuit

\* At the positive clock edge information in the 7th shift register stage is transferred to the 8th register stage and the  $Q_8$  output.

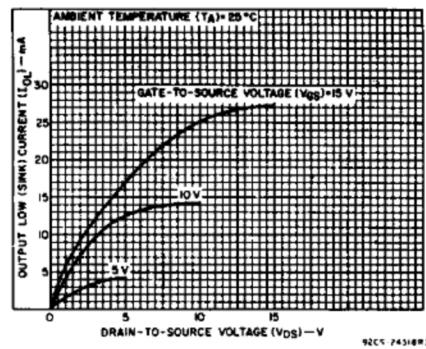


Fig. 4 – Typical output low (sink) current characteristics.

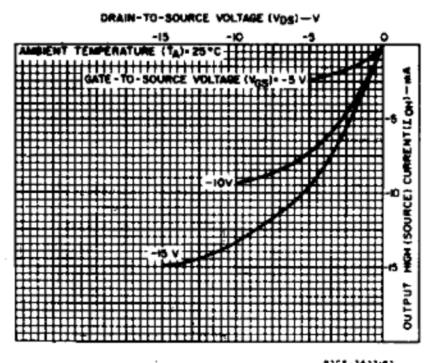


Fig. 7 – Minimum output high (source) current characteristics.

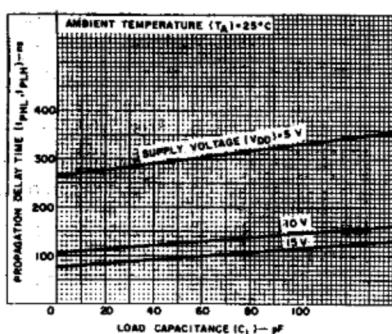


Fig. 8 – Clock-to-serial output  $Q_S$  propagation delay vs  $C_L$ .

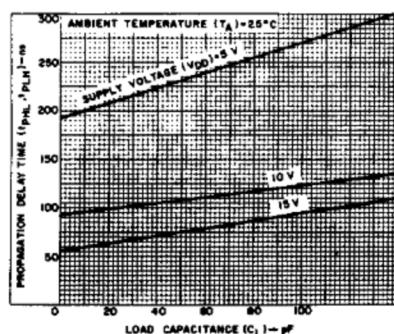


Fig. 9 – Clock-to-serial output  $Q'_S$  propagation delay vs  $C_L$ .

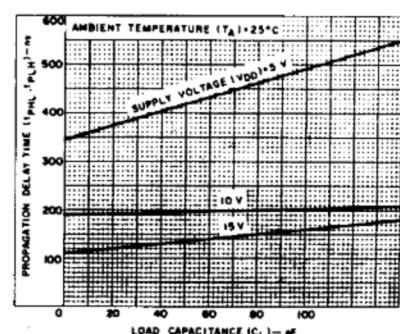


Fig. 10 – Clock-to-parallel output propagation delay vs  $C_L$ .

## CD4094B Types

### STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)							UNITS
	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	-55	-40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current, I <sub>DD</sub> 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 <sub>OL</sub> 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 <sub>OH</sub> Min.	4,6	0,5	5	-0,64	-0,61	-0,42	-0,36	-0,51	-1	—	mA
	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 <sub>OL</sub> 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 <sub>OH</sub> Min.	—	0,5	5	4,95	—	4,95	5	—	—	—	V
	—	0,10	10	9,95	—	9,95	10	—	—	—	
	—	0,15	15	14,95	—	14,95	15	—	—	—	
Input Low Voltage, V <sub>IL</sub> 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 <sub>IH</sub> 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 <sub>IN</sub> Max.	—	0,18	18	±0,1	±0,1	±1	±1	—	±10 <sup>-5</sup>	±0,1	μA
3-State Output Leakage Current I <sub>OUT</sub> Max.	0,18	0,18	18	±0,4	±0,4	±12	±12	—	±10 <sup>-4</sup>	±0,4	μA

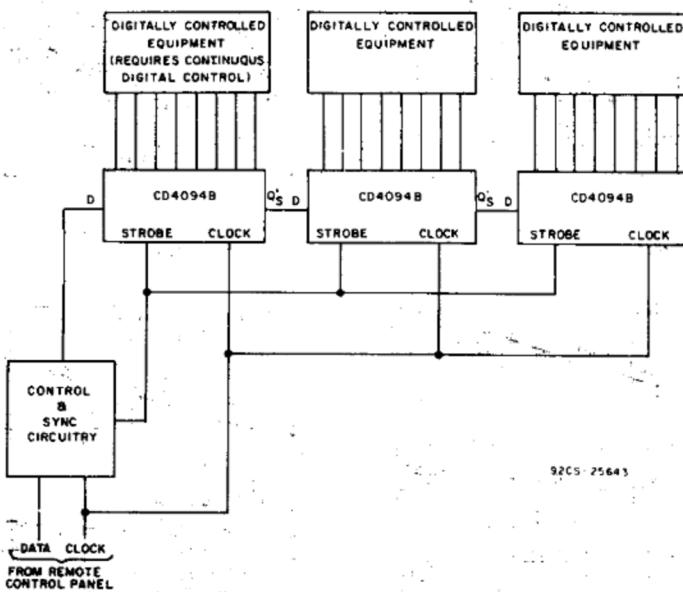


Fig. 14 – Remote control holding register.

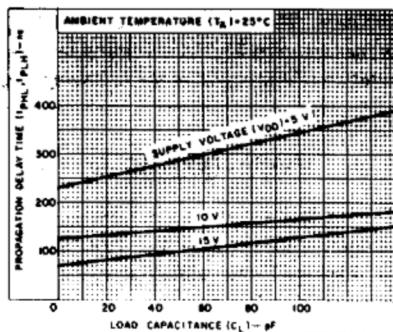


Fig. 11 – Strobe-to-parallel output propagation delay vs  $C_L$ .

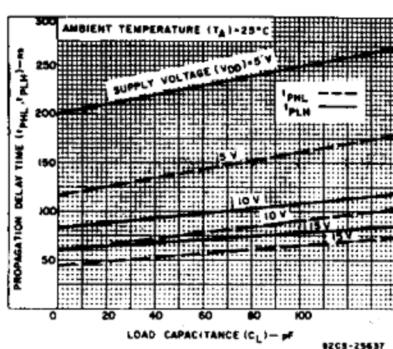


Fig. 12 – Output enable-to-parallel output propagation delay vs  $C_L$ .

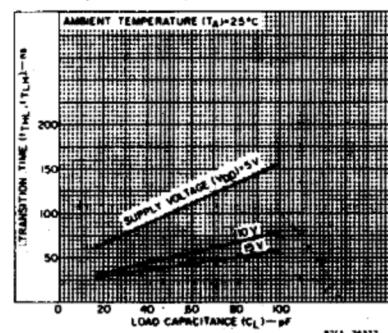


Fig. 13 – Typical transition time vs. load capacitance.

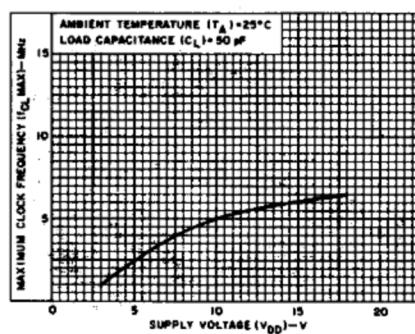


Fig. 15 – Typical maximum-clock-frequency vs. supply voltage.

## CD4094B Types

### DYNAMIC ELECTRICAL CHARACTERISTICS

At  $T_A=25^\circ C$ ; Input  $t_r, t_f = 20 \text{ ns}$ ,  $C_L = 50 \text{ pF}$ ,  $R_L = 200 \text{ k}\Omega$

CHARACTERISTIC	V <sub>DD</sub> (V)	LIMITS			UNITS
		MIN.	TYP.	MAX.	
Propagation Delay Time, t <sub>PHL</sub> , t <sub>PZH</sub>	5	—	300	600	ns
Clock to Serial Output Q <sub>S</sub>	10	—	125	250	ns
	15	—	95	190	ns
Clock to Serial Output Q' <sub>S</sub>	5	—	230	460	ns
	10	—	110	220	ns
	15	—	75	150	ns
Clock to Parallel Output	5	—	420	840	ns
	10	—	195	390	ns
	15	—	135	270	ns
Strobe to Parallel Output	5	—	290	580	ns
	10	—	145	290	ns
	15	—	100	200	ns
Output Enable to Parallel Output: t <sub>PHZ</sub> , t <sub>PZH</sub>	5	—	140	280	ns
	10	—	60	120	ns
	15	—	45	90	ns
t <sub>PZL</sub> , t <sub>PZL</sub>	5	—	100	200	ns
	10	—	50	100	ns
	15	—	40	80	ns
Minimum Strobe Pulse Width, t <sub>W</sub>	5	—	100	200	ns
	10	—	40	80	ns
	15	—	35	70	ns
Minimum Clock Pulse Width, t <sub>W</sub>	5	—	100	200	ns
	10	—	50	100	ns
	15	—	40	83	ns
Minimum Data Setup Time, t <sub>S</sub>	5	—	60	125	ns
	10	—	30	55	ns
	15	—	20	35	ns
Transition Time; t <sub>THL</sub> , t <sub>T LH</sub>	5	—	100	200	ns
	10	—	50	100	ns
	15	—	40	80	ns
Maximum Clock Input Rise or Fall Time, t <sub>rCL</sub> , t <sub>fCL</sub>	5	15	—	—	μs
	10	5	—	—	μs
	15	5	—	—	μs
Maximum Clock Input Frequency, f <sub>CL</sub>	5	1.25	2.5	—	MHz
	10	2.5	5	—	MHz
	15	3	6	—	MHz
Input Capacitance C <sub>IN</sub> (Any Input)	—	—	5	7.5	pF

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

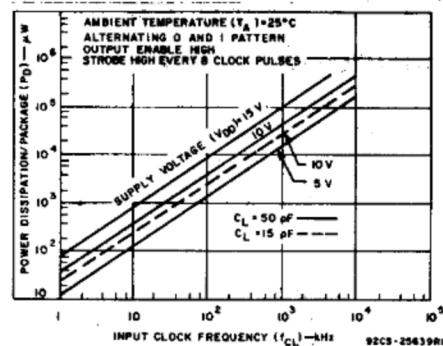


Fig. 16 – Dynamic power dissipation vs input clock frequency.

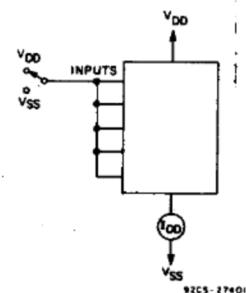


Fig. 17 – Quiescent device current test circuit.

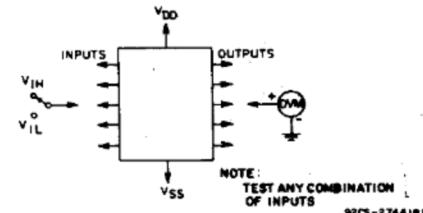


Fig. 18 – Input voltage test circuit.

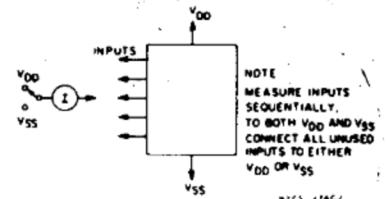
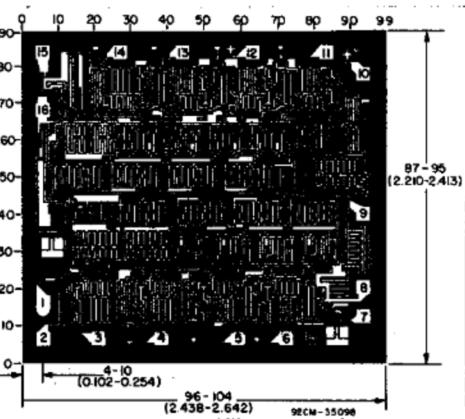


Fig. 19 – Input current test circuit.



Dimensions and Pad Layout for CD4094B Chip.

## PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package Drawing	Pins Qty	Eco Plan	Lead finish/ Ball material	MSL Peak Temp ( <sup>(3)</sup> )	Op Temp (°C)	Device Marking ( <sup>(4/5)</sup> )	Samples
7702501EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	<b>Samples</b>
CD4094BE	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	<b>Samples</b>
CD4094BEE4	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	<b>Samples</b>
CD4094BF	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	<b>Samples</b>
CD4094BF3A	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	<b>Samples</b>
CD4094BNSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	<b>Samples</b>
CD4094BPW	ACTIVE	TSSOP	PW	16	90	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	<b>Samples</b>
CD4094BPWR	ACTIVE	TSSOP	PW	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	<b>Samples</b>

<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> **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet IEC60709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~-" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF CD4094B, CD4094B-MIL :**

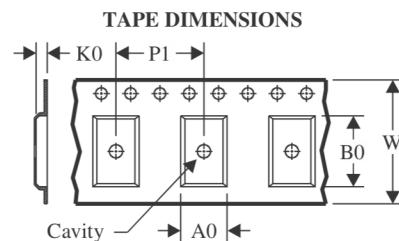
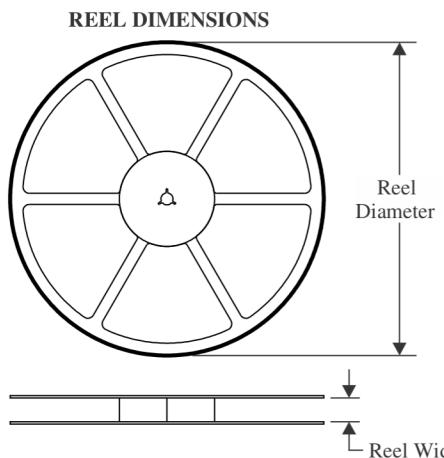
- Catalog : [CD4094B](#)

- Military : [CD4094B-MIL](#)

NOTE: Qualified Version Definitions:

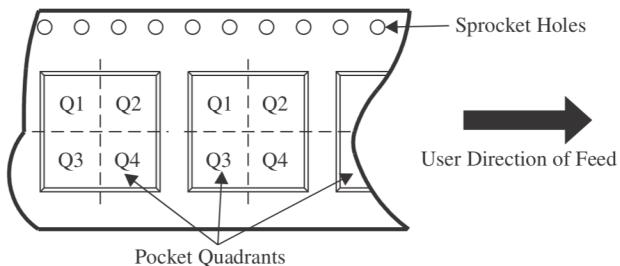
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TAPE AND REEL INFORMATION



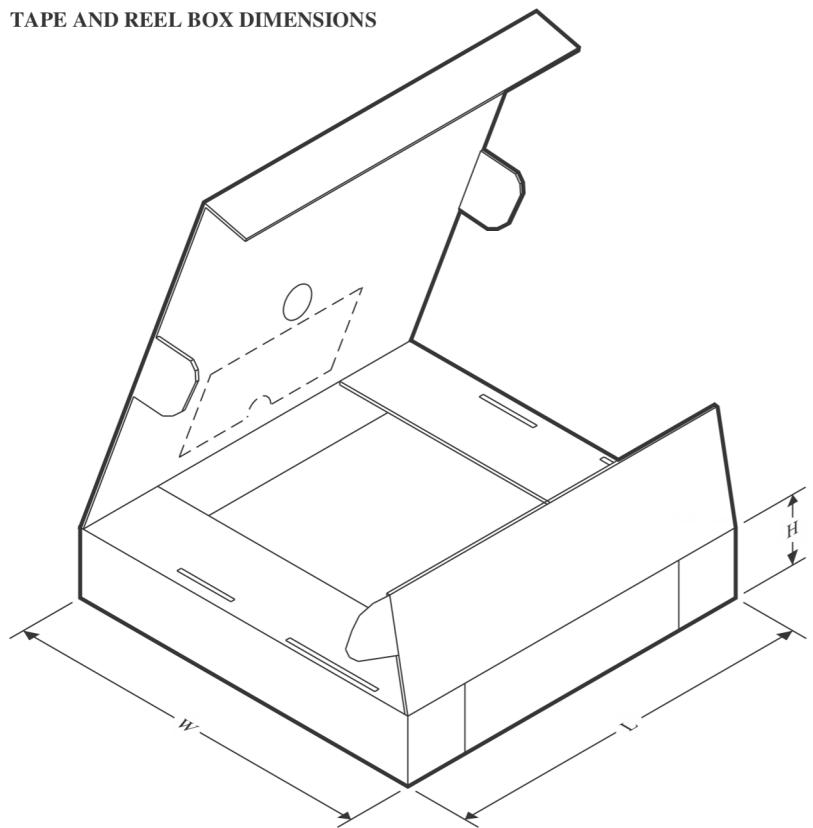
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



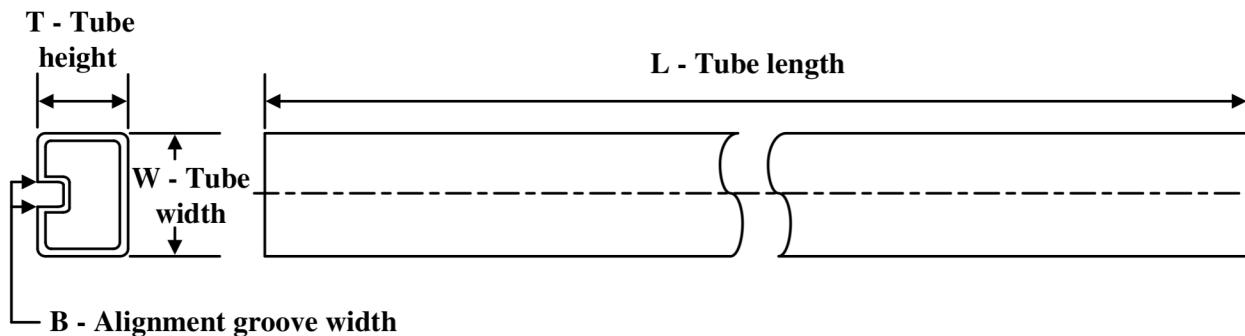
\*All dimensions are nominal

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
CD4094BNSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
CD4094BPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

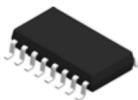
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD4094BNSR	SO	NS	16	2000	367.0	367.0	38.0
CD4094BPWR	TSSOP	PW	16	2000	356.0	356.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T ( $\mu$ m)	B (mm)
CD4094BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4094BE	N	PDIP	16	25	506	13.97	11230	4.32
CD4094BEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4094BEE4	N	PDIP	16	25	506	13.97	11230	4.32
CD4094BPW	PW	TSSOP	16	90	530	10.2	3600	3.5

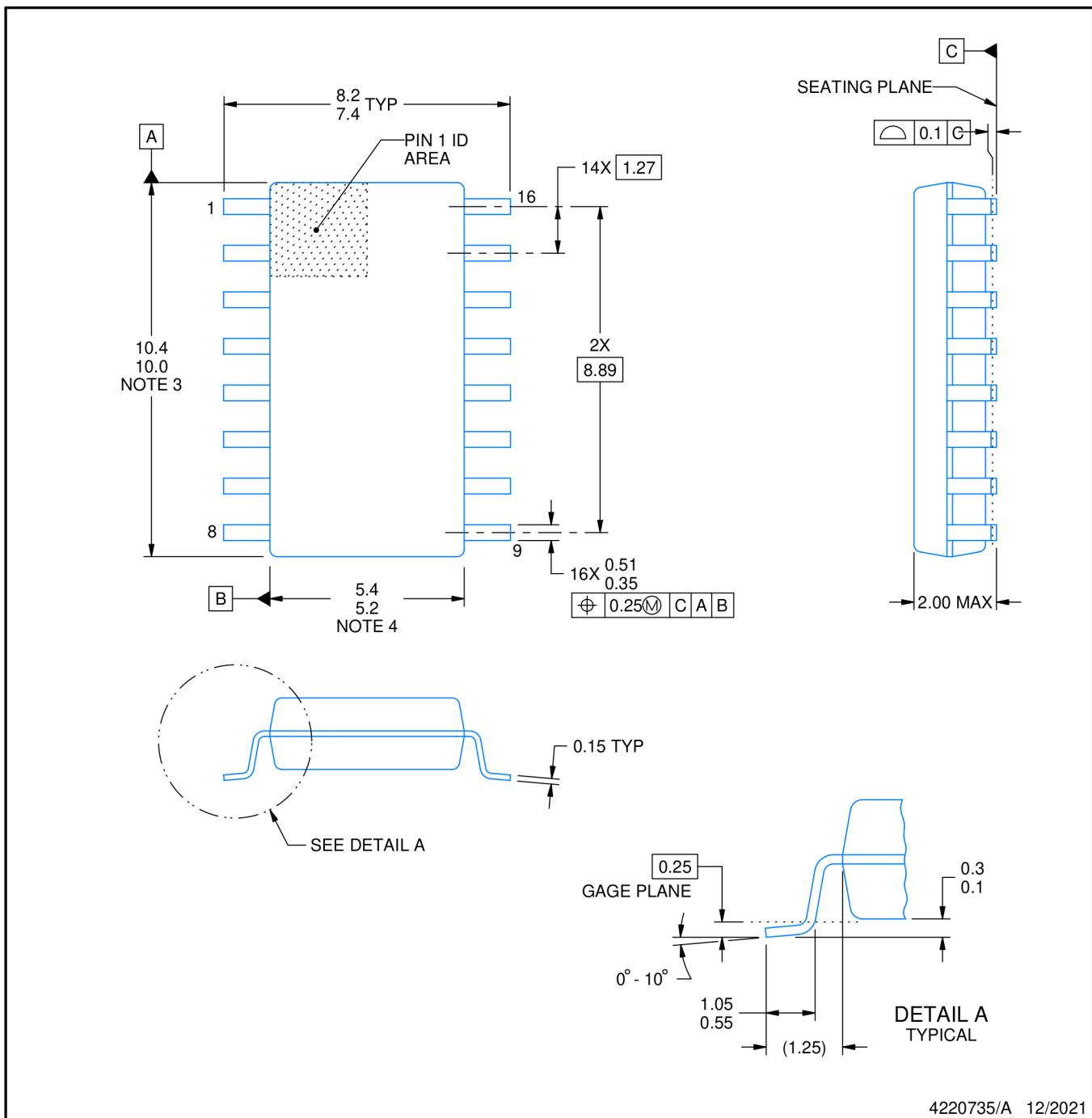
NS0016A



# PACKAGE OUTLINE

SOP - 2.00 mm max height

SOP



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## NOTES:

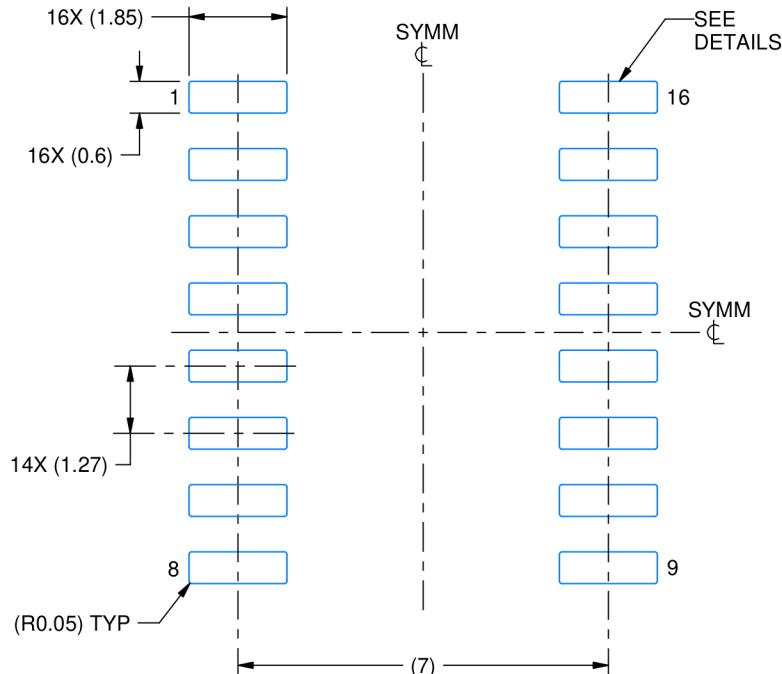
- All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.

# EXAMPLE BOARD LAYOUT

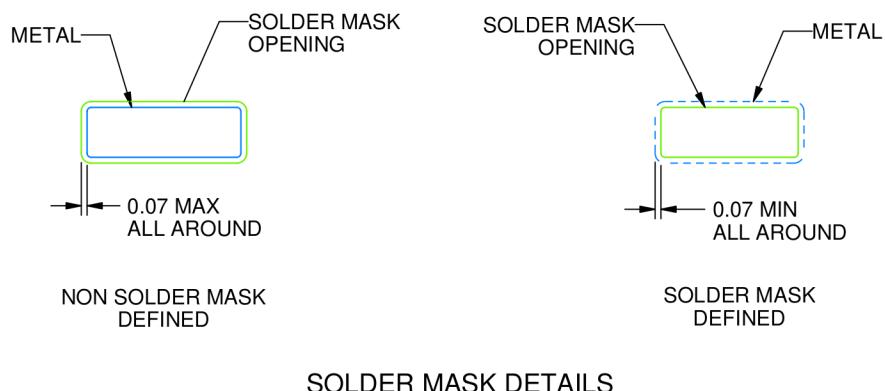
NS0016A

SOP - 2.00 mm max height

SOP



LAND PATTERN EXAMPLE  
SCALE:7X



SOLDER MASK DETAILS

4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

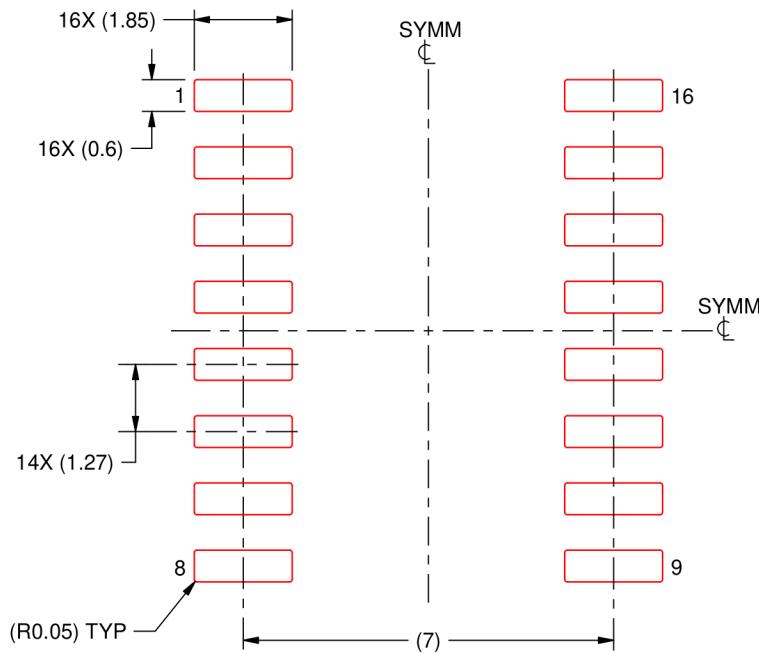
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

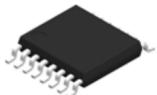
4220735/A 12/2021

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

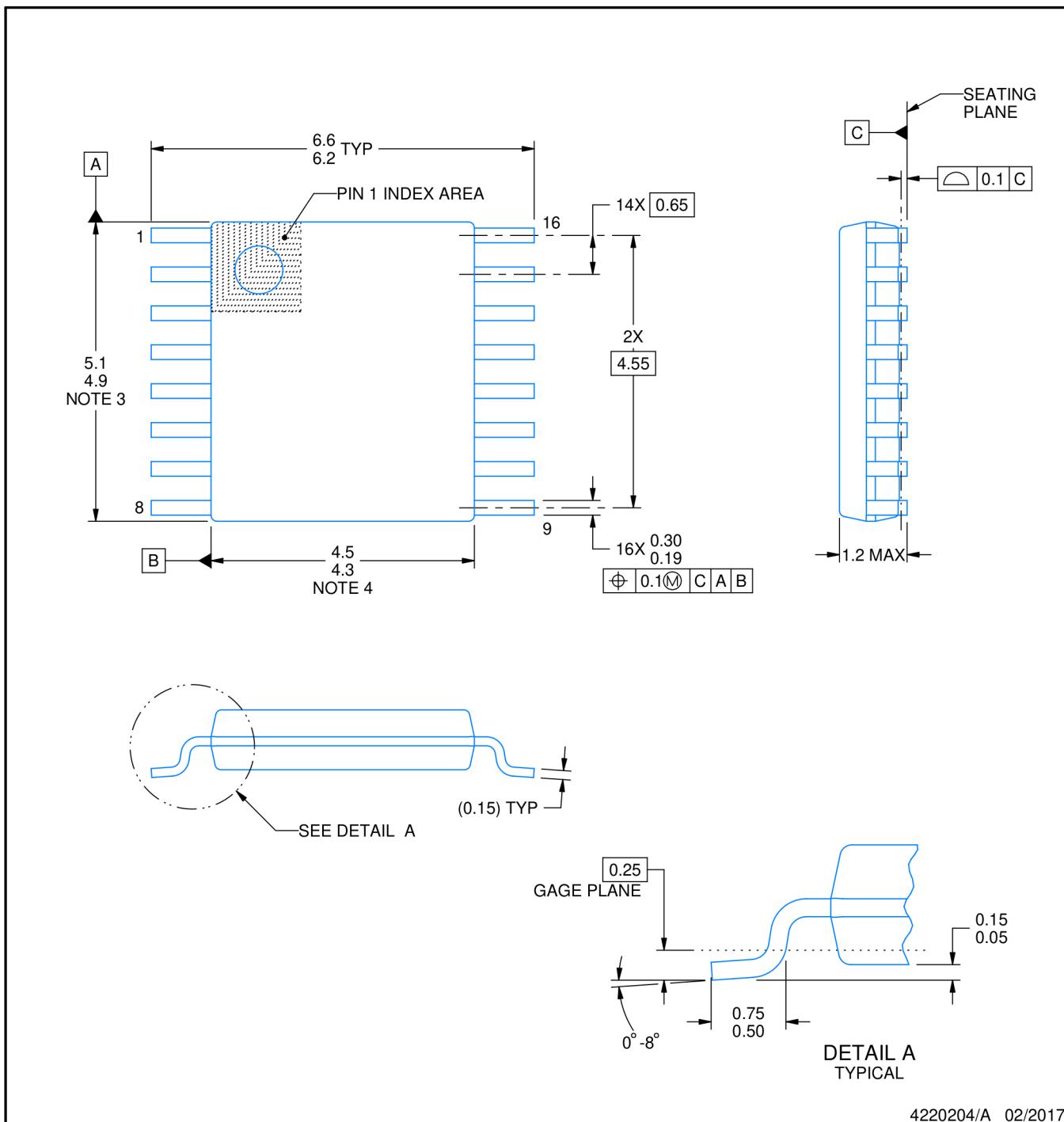
# PACKAGE OUTLINE

PW0016A



TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



## NOTES:

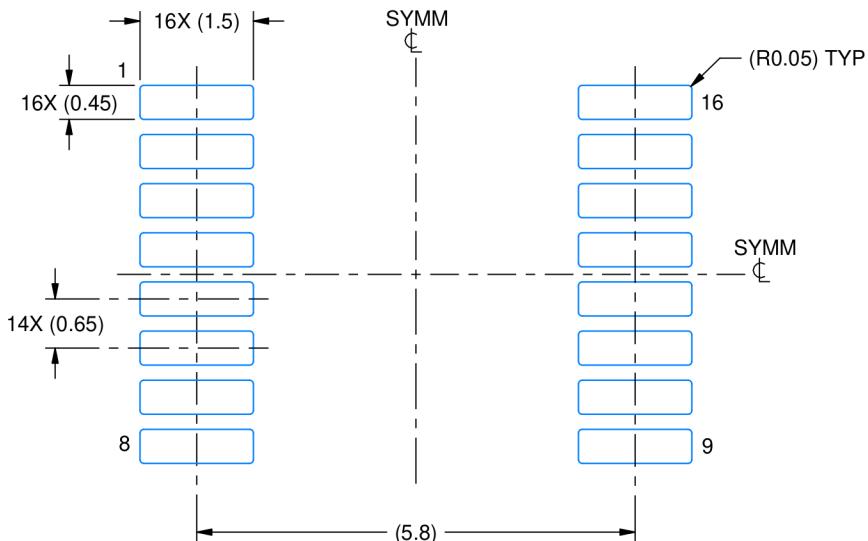
- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
- This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
- Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

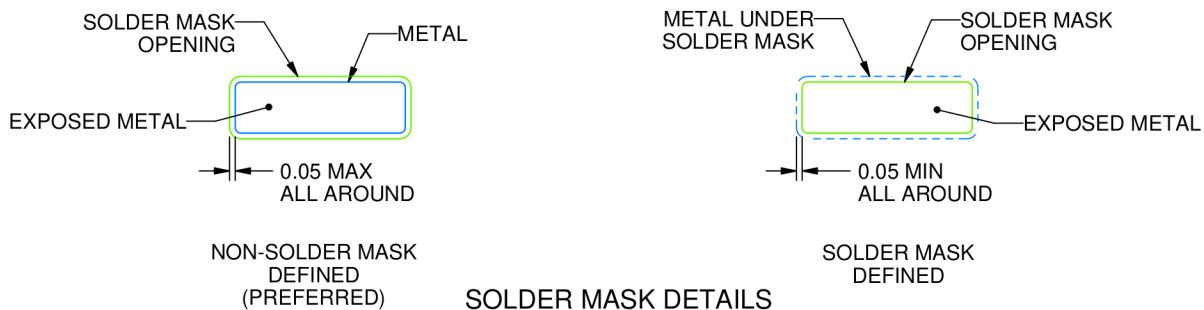
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220204/A 02/2017

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

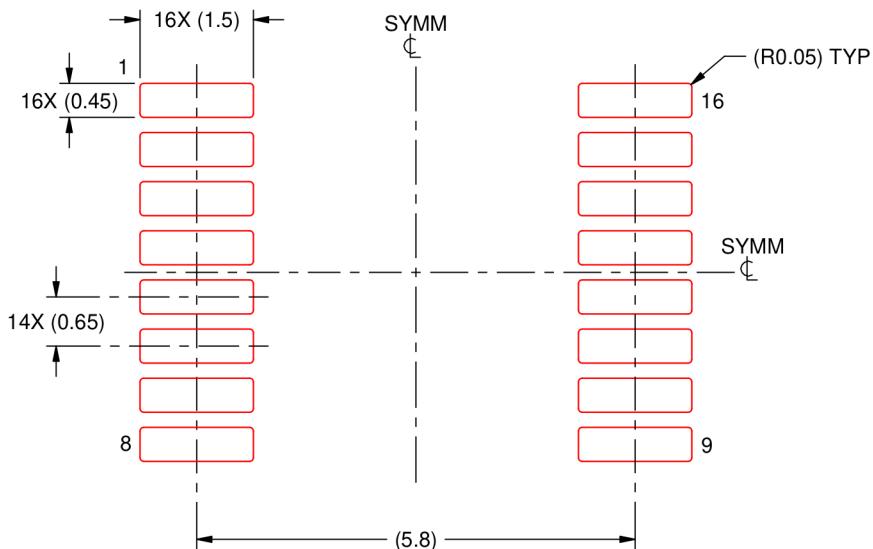
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/A 02/2017

NOTES: (continued)

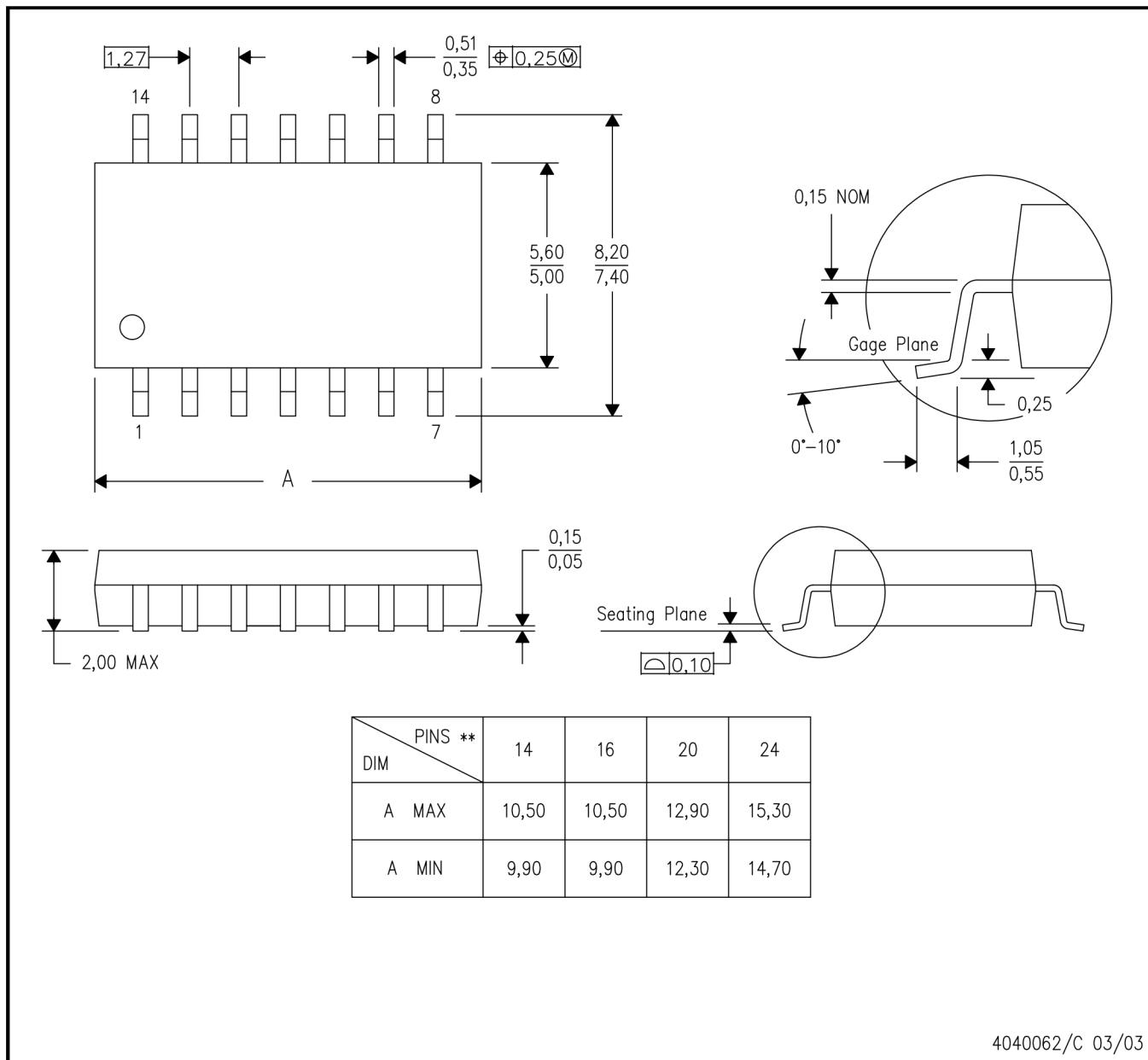
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

## MECHANICAL DATA

**NS (R-PDSO-G\*\*)**

**14-PINS SHOWN**

**PLASTIC SMALL-OUTLINE PACKAGE**

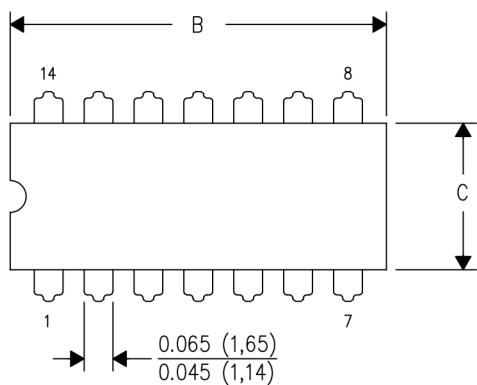


- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

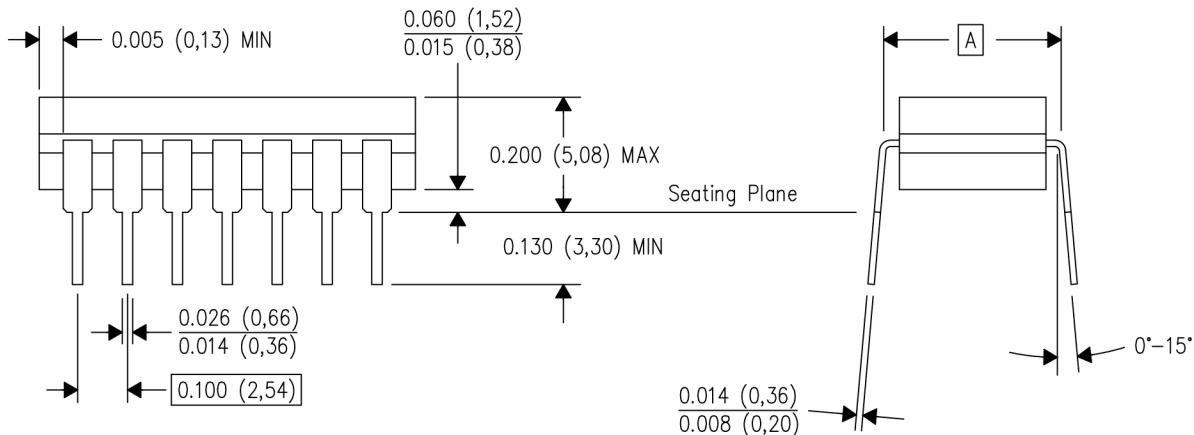
J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS **\nDIM	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)



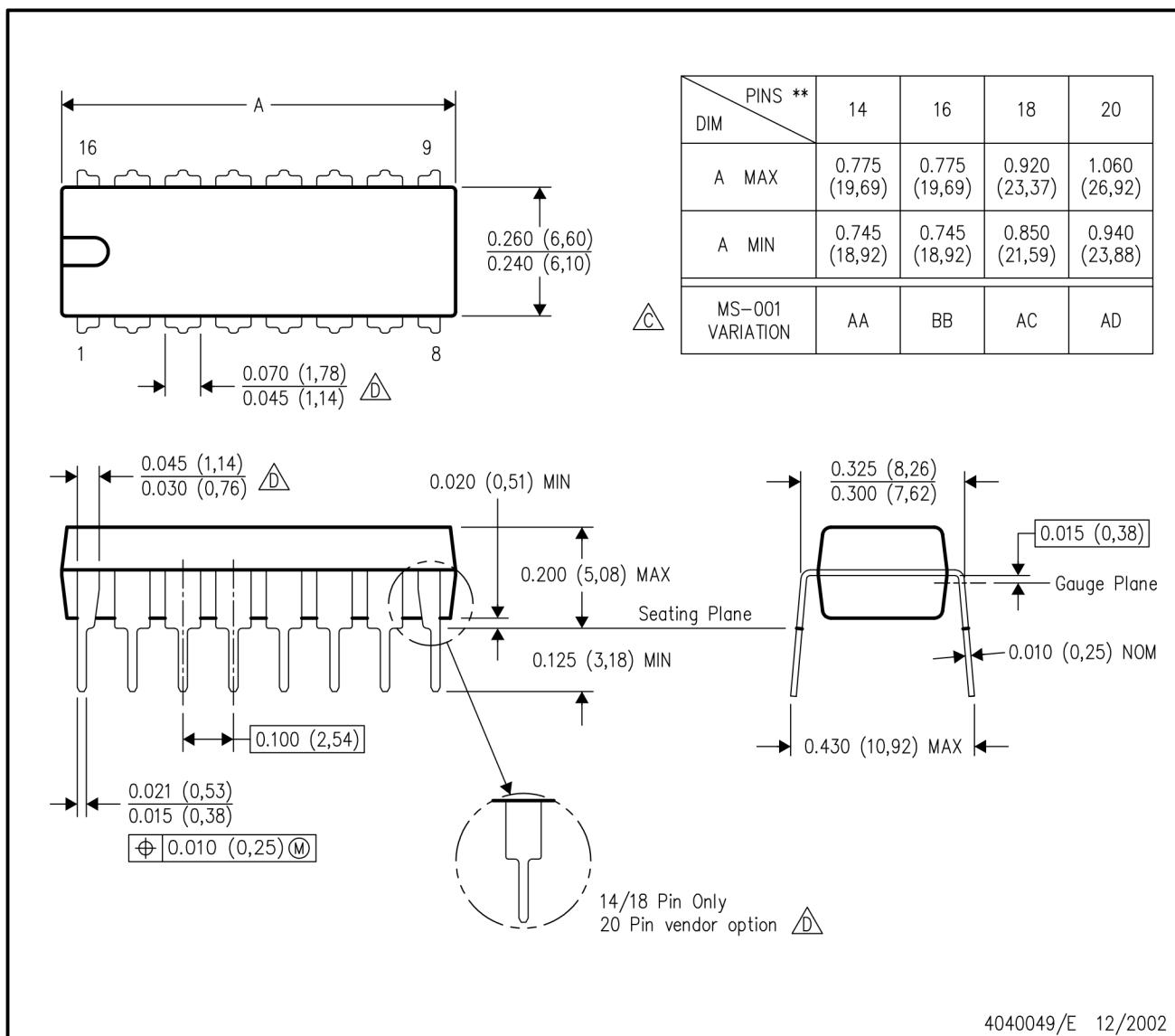
4040083/F 03/03

- 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.

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

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.

$\triangle$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).

$\triangle$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

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