CD74AC14 Hex Schmitt-Trigger Inverter

1 Features

- 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage
- Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption
- Greater Noise Immunity Than Standard Inverters
- Operates With Much Slower Than Standard Input Rise and Fall Slew Rates
- Balanced Propagation Delays
- ±24-mA Output Drive Current − Fanout to 15 F Devices
- SCR Latchup-Resistant CMOS Process and Circuit Design

2 Description

The CD74AC14 contains six independent inverters.

Package Information

PART NUMBER	PACKAGE1	BODY SIZE (NOM)
CD74AC14	D (SOIC, 14)	9.9 mm x 3.9 mm
	N (PDIP, 14)	20.32 mm x 12.7 mm

1. For all available packages, see the orderable addendum at the end of the data sheet.

Simplified Schematic

Table of Contents

3 Revision History

Changes from Revision B (March 2004) to Revision C (May 2023)	Page
• Added *Package Information* table, *Pin Functions* table, and *Thermal Information* table	1

4 Pin Configuration and Functions

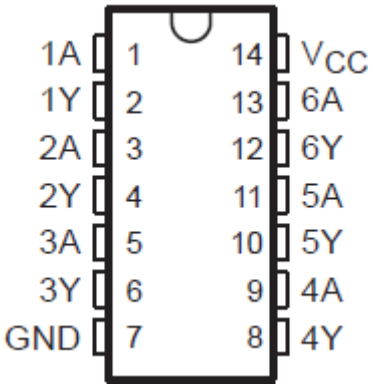


Figure 4-1. E or M Package Top View

Table 4-1. Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
1A	1	Input	Channel 1, Input A
1Y	2	Output	Channel 1, Output Y
2A	3	Input	Channel 2, Input A
2Y	4	Output	Channel 2, Output Y
3A	5	Input	Channel 3, Input A
3Y	6	Output	Channel 3, Output Y
GND	7	—	Ground
4Y	8	Output	Channel 4, Output Y
4A	9	Input	Channel 4, Input A
5Y	10	Output	Channel 5, Output Y
5A	11	Input	Channel 5, Input A
6Y	12	Output	Channel 6, Output Y
6A	13	Input	Channel 6, Input A
V_{CC}	14	—	Positive Supply

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

			MIN	MAX	UNIT
V_{CC}	Supply voltage range		−0.5	6	V
I_{IK}	Input clamp current	(V_I < 0 or V_I > V_{CC}) 1		±20	mA
I_{OK}	Output clamp current	(V_O < 0 or V_O > V_{CC}) 1		±50	mA
	Continuous output current	(V_O = 0 to V_{CC})		±50	mA
	Continuous current through V_{CC}or GND			±100	mA
T_{stg}	Storage temperature range		−65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

5.2 Recommended Operating Conditions

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

			T_A = 25°C		− 55°C to 125°C		− 40°C to 85°C		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		1.5	5.5	1.5	5.5	1.5	5.5	V
V_I	Input voltage		0	V_{CC}	0	V_{CC}	0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	V_{CC} = 4.5 V to 5.5 V		− 24		− 24		− 24	mA
I_{OL}	Low-level output current	V_{CC} = 4.5 V to 5.5 V		24		24		24	mA

5.3 Thermal Information

THERMAL METRIC(1)		CD74AC14		UNIT
		E	M	
		14 PINS	14 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	80	86	°C/W

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report (SPRA953).

5.4 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS		V_{CC}	TA = 25°C		− 55°C to 125°C		− 40°C to 85°C		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
V_{T+} Positive-going threshold			5 V	2.6	3.4	2.6	3.4	2.6	3.4	V
V_{T-} Negative-going threshold			5 V	1.6	2.4	1.6	2.4	1.6	2.4	V
ΔVT Hysteresis (V_{T+} − V_{T-})			5 V	0.5		0.5		0.5		V
V_{OH}	$V_I = V_{T+}$	I_{OH} = −50 µA	1.5 V	1.4		1.4		1.4		V
			3 V	2.9		2.9		2.9		
			4.5 V	4.4		4.4		4.4		
		I_{OH} = −4 mA	3 V	2.58		2.4		2.48		
		I_{OH} = −24 mA	4.5 V	3.94		3.7		3.8		
		I_{OH} = −50 mA[1]	5.5 V			3.85				
		I_{OH} = −75 mA[1]	5.5 V					3.85		
V_{OL}	$V_I = V_{T-}$	I_{OL}= 50 µA	1.5 V		0.1		0.1		0.1	V
			3 V		0.1		0.1		0.1	
			4.5 V		0.1		0.1		0.1	
		I_{OL} = 12 mA	3 V		0.36		0.5		0.44	
		I_{OL} = 24 mA	4.5 V		0.36		0.5		0.44	
		I_{OL} = 50 mA[1]	5.5 V				1.65			
		I_{OL} = 75 mA[1]	5.5 V							
I_I	$V_I = V_{CC}$ or GND		5.5 V		± 0.1		± 0.1		± 0.1	µA
I_{CC}	$V_I = V_{CC}$ or GND	I_O = 0	5.5 V		4		80		40	µA
C_i					10		10		10	pF

1. Test one output at a time, not exceeding 1-second duration. Measurement is made by forcing indicated current and measuring voltage to minimize power dissipation. Test verifies a minimum 50-Ω transmission-line drive capability at 85°C and 75-Ω transmission-line drive capability at 125°C.

5.5 Switching Characteristics

over operating free-air temperature range V_{CC} = 5 V ± 0.5 V, C_L = 50 pF (unless otherwise noted)

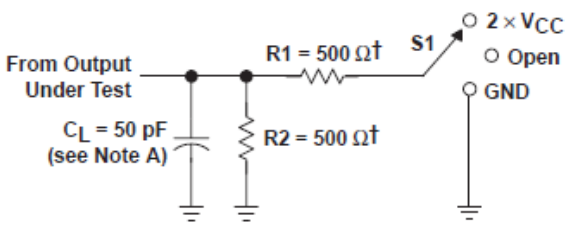
PARAMETER	FROM (INPUT)	TO (OUTPUT)	− 55°C TO 125°C		− 40°C TO 85°C		UNIT
			MIN	MAX	MIN	MAX	
t_{PLH}	A	Y	2.6	10.5	2.7	9.5	ns
t_{PHL}			2.6	10.5	2.7	9.5	

5.6 Operating Characteristics

V_{CC} = 5 V, T_A = 25°C

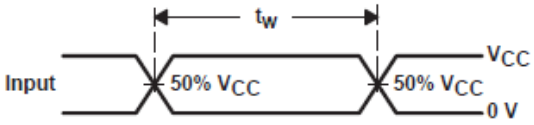
PARAMETER		TYP	UNIT
C_{pd}	Power dissipation capacitance	45	pF

6 Parameter Measurement Information

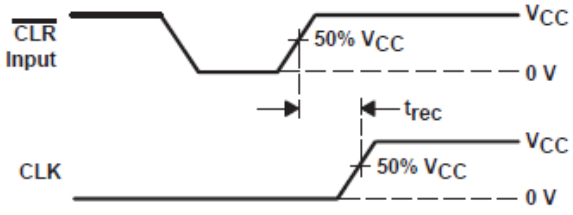


LOAD CIRCUIT

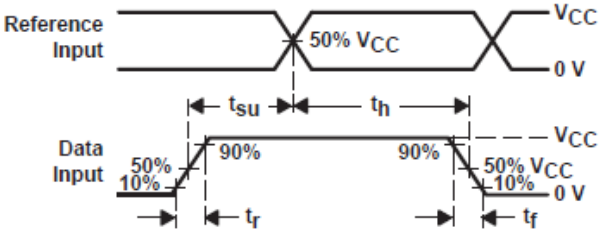
TEST	S1
t_{PLH}/t_{PHL} t_{PLZ}/t_{PZL} t_{PHZ}/t_{PZH}	Open 2 × VCC GND



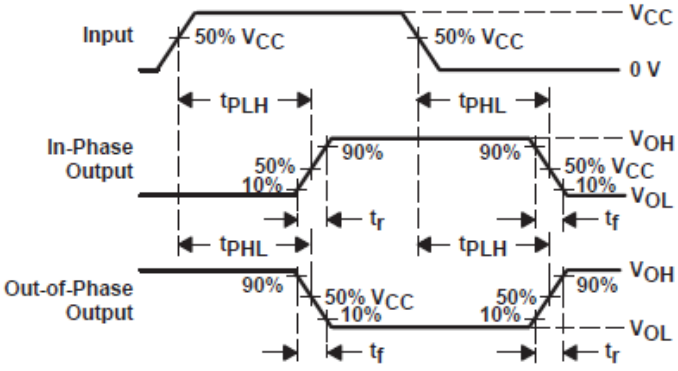
VOLTAGE WAVEFORMS
PULSE DURATION



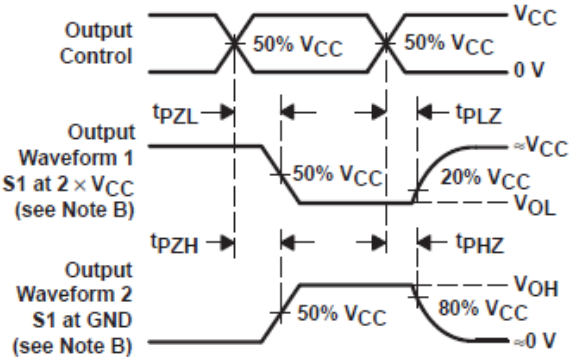
VOLTAGE WAVEFORMS
RECOVERY TIME



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
OUTPUT ENABLE AND DISABLE TIMES

NOTES: A. C_L includes probe and test-fixture capacitance.
B. 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.
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 3 ns, t_f = 3 ns. Phase relationships between waveforms are arbitrary.
D. For clock inputs, f_{max} is measured with the input duty cycle at 50%.
E. The outputs are measured one at a time, with one input transition per measurement.
F. t_{PLH} and t_{PHL} are the same as t_{pd}.
G. t_{PZL} and t_{PZH} are the same as t_{en}.
H. t_{PLZ} and t_{PHZ} are the same as t_{dis}.

Figure 6-1.

7 Detailed Description

7.1 Overview

The CD74AC14 device performs the Boolean function $Y = \overline{A}$. Each circuit functions as an independent inverter, but because of the Schmitt action, the inverters have different input threshold levels for positive-going (V_T+) and negative-going (V_T-) signals.

7.2 Functional Block Diagram

Figure 7-1. Logic Diagram, Each Inverter (Positive Logic)

7.3 Device Functional Modes

Table 7-1. Function Table (Each Inverter)

INPUT	OUTPUT
A	Y
H	L
L	H

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD74AC14E	ACTIVE	PDIP	N	14	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD74AC14E	Samples
CD74AC14EE4	ACTIVE	PDIP	N	14	25	RoHS & Green	NIPDAU	N / A for Pkg Type	-55 to 125	CD74AC14E	Samples
CD74AC14M96	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC14M	Samples
CD74AC14M96E4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC14M	Samples
CD74AC14M96G4	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC14M	Samples

(1) 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.

(2) **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 JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

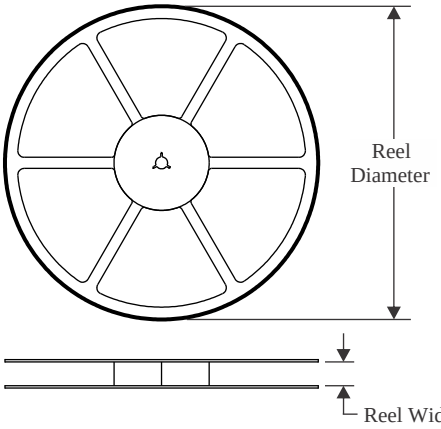
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

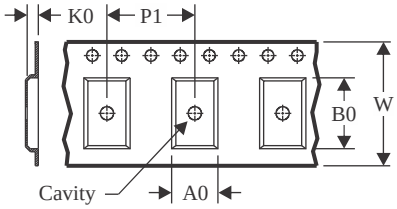
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

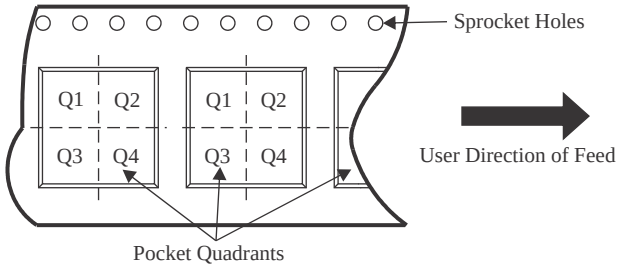


TAPE DIMENSIONS



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

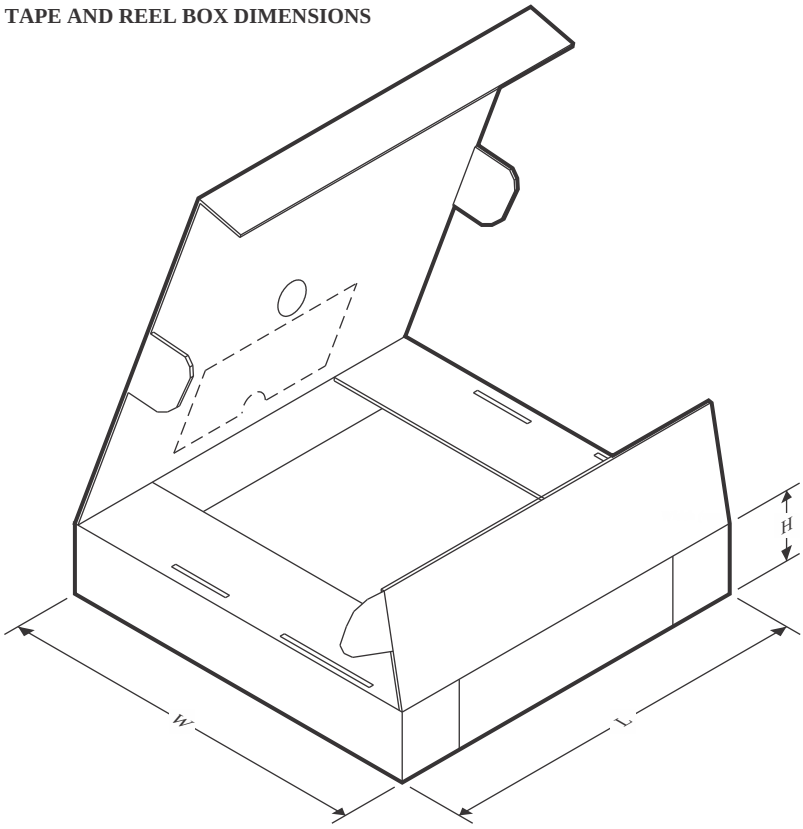
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
CD74AC14M96	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

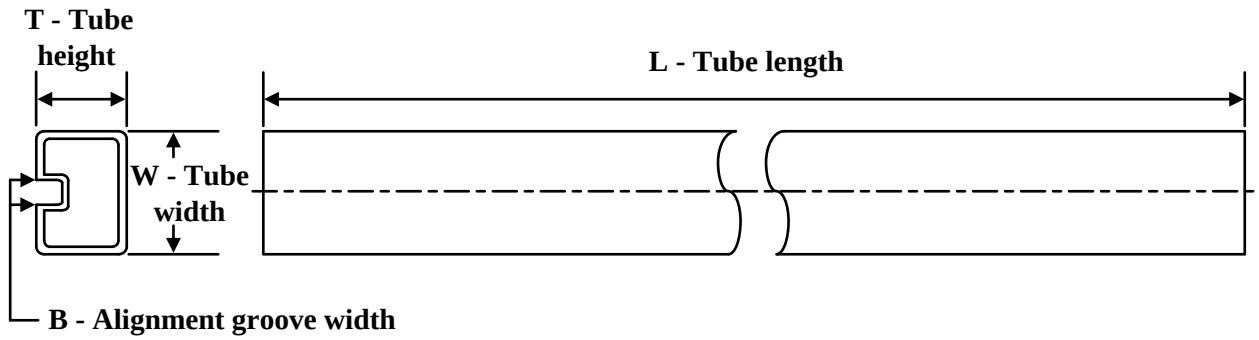
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74AC14M96	SOIC	D	14	2500	356.0	356.0	35.0

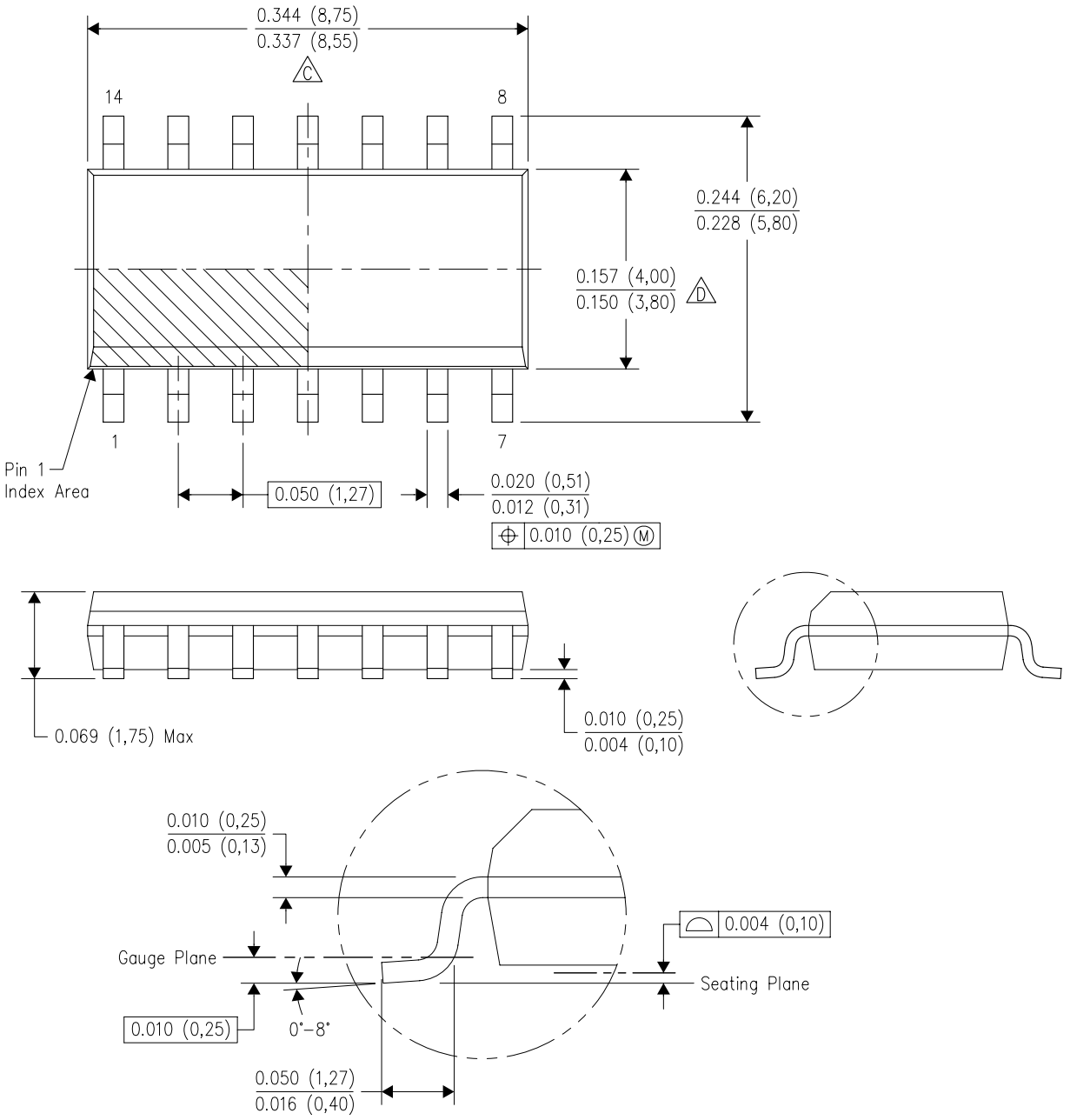
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
CD74AC14E	N	PDIP	14	25	506	13.97	11230	4.32
CD74AC14E	N	PDIP	14	25	506	13.97	11230	4.32
CD74AC14EE4	N	PDIP	14	25	506	13.97	11230	4.32
CD74AC14EE4	N	PDIP	14	25	506	13.97	11230	4.32

D (R–PDSO–G14) PLASTIC SMALL OUTLINE



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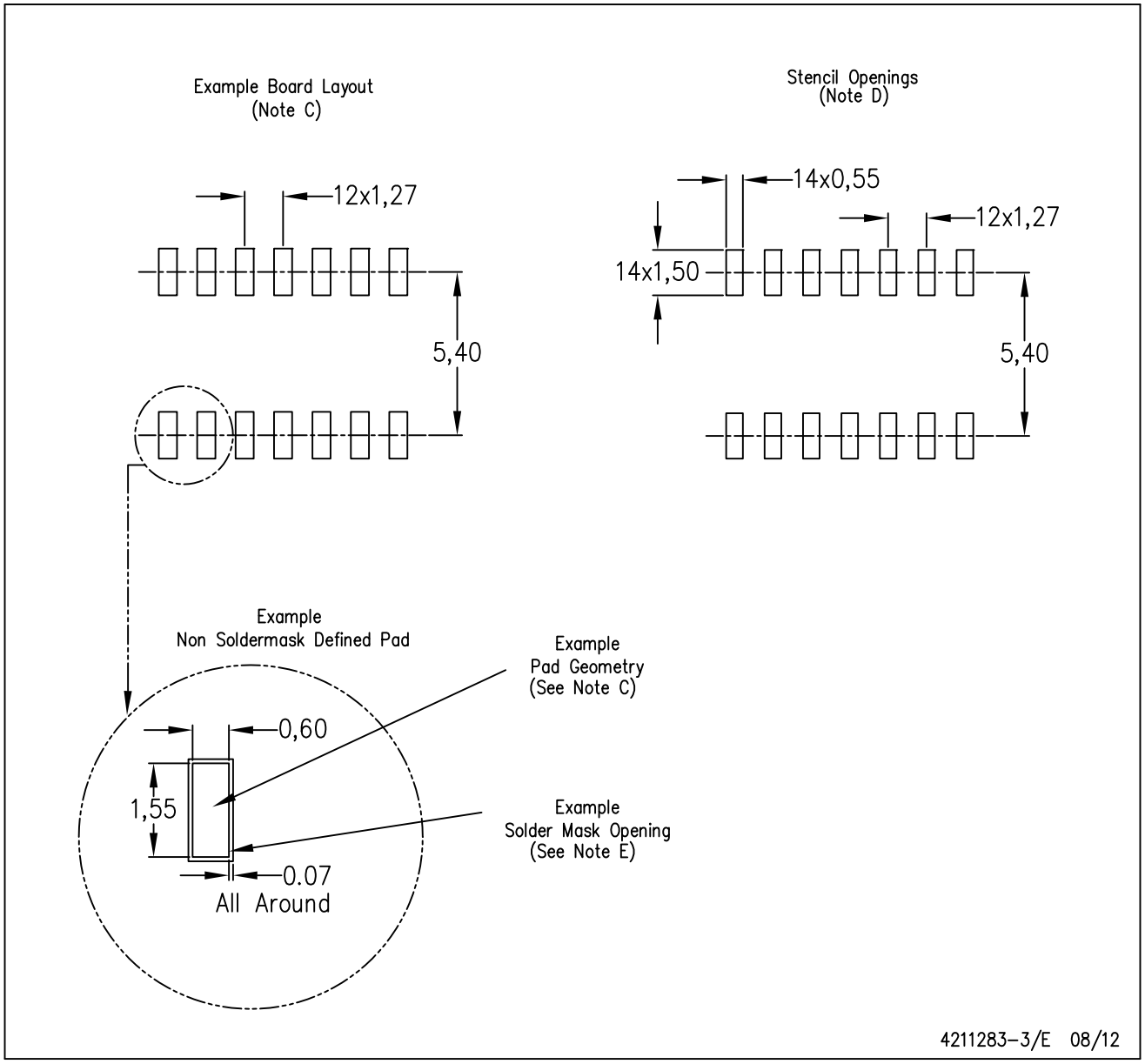
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AB.

D (R–PDSO–G14) PLASTIC SMALL OUTLINE

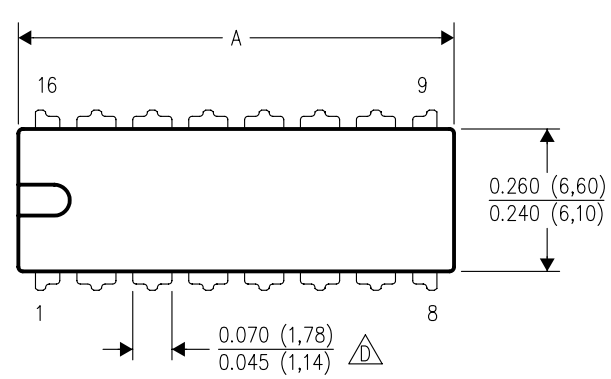


NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC–7525 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

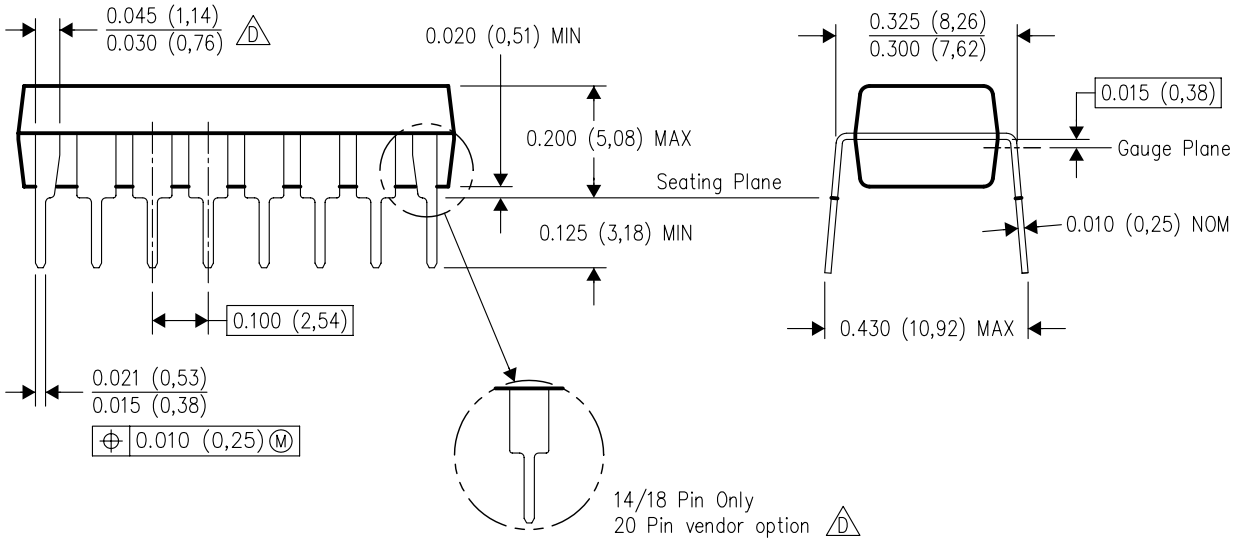
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



DIM \ PINS **	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–001 VARIATION (C)	AA	BB	AC	AD



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

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