

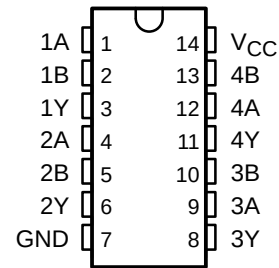
CD74AC86

QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

SCHS324 – JANUARY 2003

- AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply
- Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption
- Balanced Propagation Delays
- ± 24 -mA Output Drive Current
 - Fanout to 15 F Devices
- SCR-Latchup-Resistant CMOS Process and Circuit Design
- Exceeds 2-kV ESD Protection Per MIL-STD-883, Method 3015

E OR M PACKAGE
(TOP VIEW)



description/ordering information

The CD74AC86 is a quadruple 2-input exclusive-OR gate. This device performs the Boolean function $Y = A \oplus B$ or $Y = \overline{A}B + A\overline{B}$ in positive logic.

A common application is as a true/complement element. If one of the inputs is low, the other input is reproduced in true form at the output. If one of the inputs is high, the signal on the other input is reproduced inverted at the output.

ORDERING INFORMATION

T _A	PACKAGE [†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–55°C to 125°C	PDIP – E	Tube	CD74AC86E	CD74AC86E
	SOIC – M	Tube	CD74AC86M	AC86M
		Tape and reel	CD74AC86M96	

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

FUNCTION TABLE
(each gate)

INPUTS		OUTPUT
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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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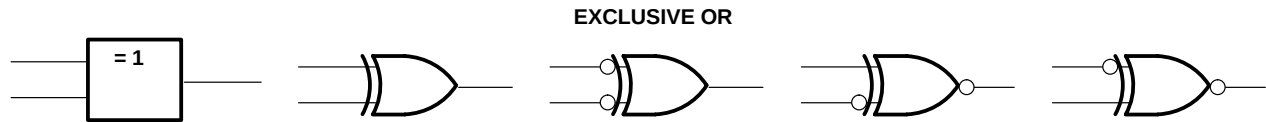
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CD74AC86
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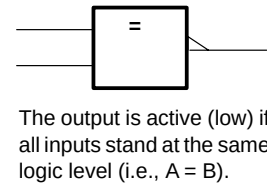
exclusive-OR logic

An exclusive-OR gate has many applications, some of which can be represented better by alternative logic symbols.

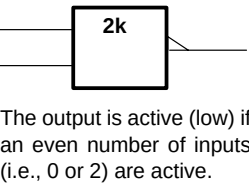


These are five equivalent exclusive-OR symbols valid for an CD74AC86 gate in positive logic; negation may be shown at any two ports.

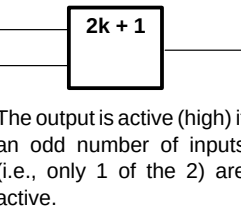
LOGIC-IDENTITY ELEMENT



EVEN-PARITY ELEMENT



ODD-PARITY ELEMENT



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

Supply voltage range, V_{CC}	–0.5 V to 6 V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1)	±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1)	±50 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±50 mA
Continuous current through V_{CC} or GND	±100 mA
Package thermal impedance, θ_{JA} (see Note 2): E package	80°C/W
M package	86°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.

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recommended operating conditions (see Note 3)

			$T_A = 25^\circ\text{C}$		$-55^\circ\text{C to } 125^\circ\text{C}$		$-40^\circ\text{C to } 85^\circ\text{C}$		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_{IH}	High-level input voltage	$V_{CC} = 1.5\text{ V}$	1.2		1.2		1.2		V
		$V_{CC} = 3\text{ V}$	2.1		2.1		2.1		
		$V_{CC} = 5.5\text{ V}$	3.85		3.85		3.85		
V_{IL}	Low-level input voltage	$V_{CC} = 1.5\text{ V}$		0.3		0.3		0.3	V
		$V_{CC} = 3\text{ V}$		0.9		0.9		0.9	
		$V_{CC} = 5.5\text{ V}$		1.65		1.65		1.65	
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	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$		-24		-24		-24	mA
I_{OL}	Low-level output current	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$		24		24		24	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 1.5\text{ V to } 3\text{ V}$		50		50		50	ns/V
		$V_{CC} = 3.6\text{ V to } 5.5\text{ V}$		20		20		20	

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		V_{CC}	$T_A = 25^\circ\text{C}$		$-55^\circ\text{C to } 125^\circ\text{C}$		$-40^\circ\text{C to } 85^\circ\text{C}$		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
V_{OH}	$V_I = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -50\text{ }\mu\text{A}$	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		
		$I_{OH} = -4\text{ mA}$	3 V	2.58		2.4		2.48		
		$I_{OH} = -24\text{ mA}$	4.5 V	3.94		3.7		3.8		
		$I_{OH} = -50\text{ mA}^\dagger$	5.5 V			3.85				
		$I_{OH} = -75\text{ mA}^\dagger$	5.5 V					3.85		
V_{OL}	$V_I = V_{IH} \text{ or } V_{IL}$	$I_{OL} = 50\text{ }\mu\text{A}$	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	
		$I_{OL} = 12\text{ mA}$	3 V		0.36		0.5		0.44	
		$I_{OL} = 24\text{ mA}$	4.5 V		0.36		0.5		0.44	
		$I_{OL} = 50\text{ mA}^\dagger$	5.5 V				1.65			
		$I_{OL} = 75\text{ mA}^\dagger$	5.5 V						1.65	
I_I	$V_I = V_{CC} \text{ or } \text{GND}$		5.5 V		± 0.1		± 1		± 1	μA
I_{CC}	$V_I = V_{CC} \text{ or } \text{GND}, I_O = 0$		5.5 V		4		80		40	μA
C_i					10		10		10	pF

[†] 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.



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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 1.5\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C TO 85°C		UNIT
			MIN	MAX	MIN	MAX	
t _{PLH}	A or B	Y	135		123		ns
t _{PHL}			135		123		

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3\text{ V} \pm 0.3\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C TO 85°C		UNIT
			MIN	MAX	MIN	MAX	
t_{PLH}	A or B	Y	3.8	15.1	3.9	13.7	ns
t_{PHL}			3.8	15.1	3.9	13.7	

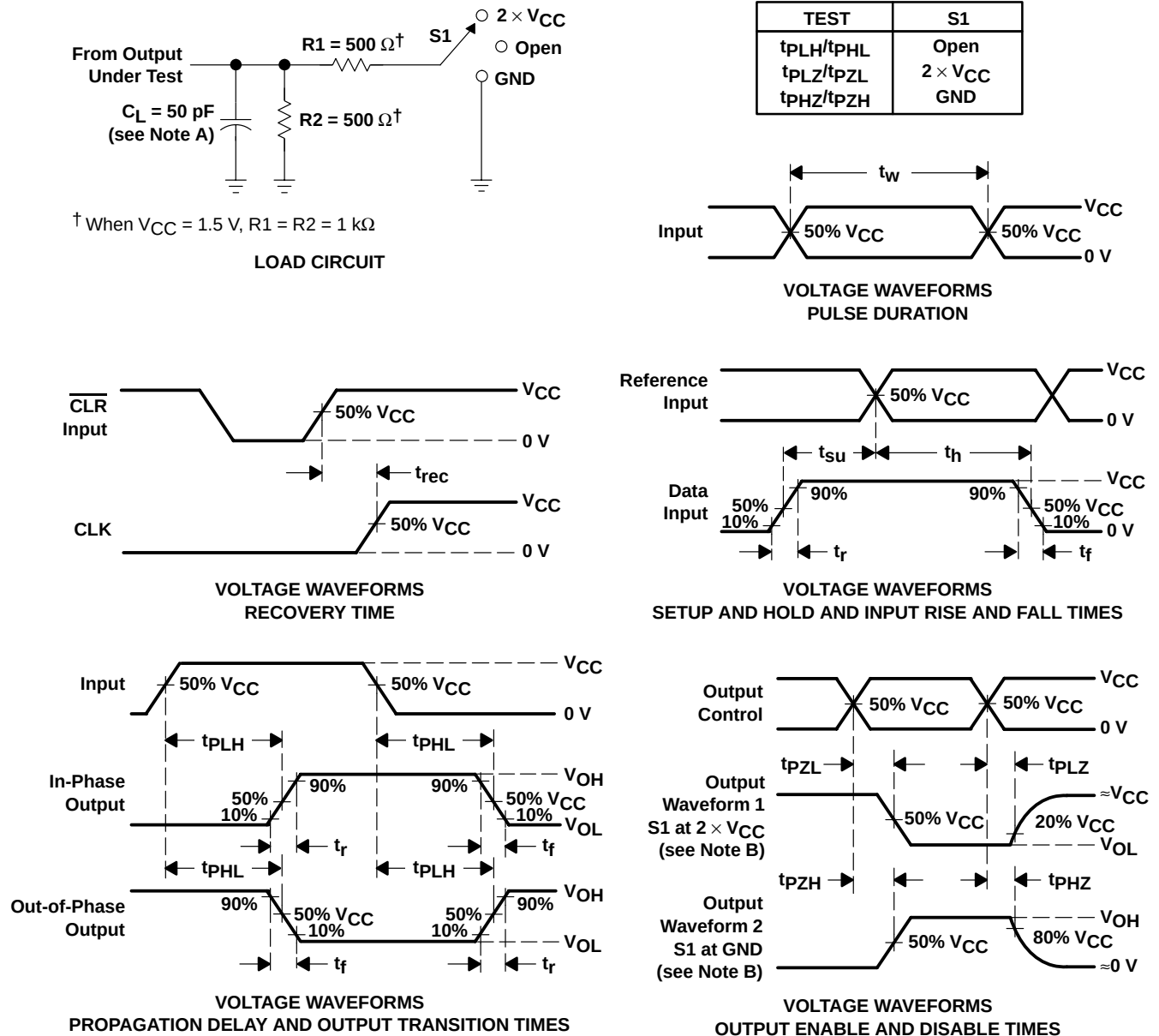
switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$, $C_L = 50\text{ pF}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	–55°C to 125°C		–40°C TO 85°C		UNIT
			MIN	MAX	MIN	MAX	
t_{PLH}	A or B	Y	2.7	10.8	2.8	9.8	ns
t_{PHL}			2.7	10.8	2.8	9.8	

operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER		TYP	UNIT
C_{pd}	Power dissipation capacitance	57	pF

PARAMETER MEASUREMENT INFORMATION



- 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: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r = 3\text{ ns}$, $t_f = 3\text{ ns}$. 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} .
- I. All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD74AC86E	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-55 to 125	CD74AC86E	Samples
CD74AC86M	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC86M	Samples
CD74AC86M96	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC86M	Samples
CD74AC86M96E4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC86M	Samples
CD74AC86MG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-55 to 125	AC86M	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.

OBSELETE: TI has discontinued the production of the device.

(2) 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)

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

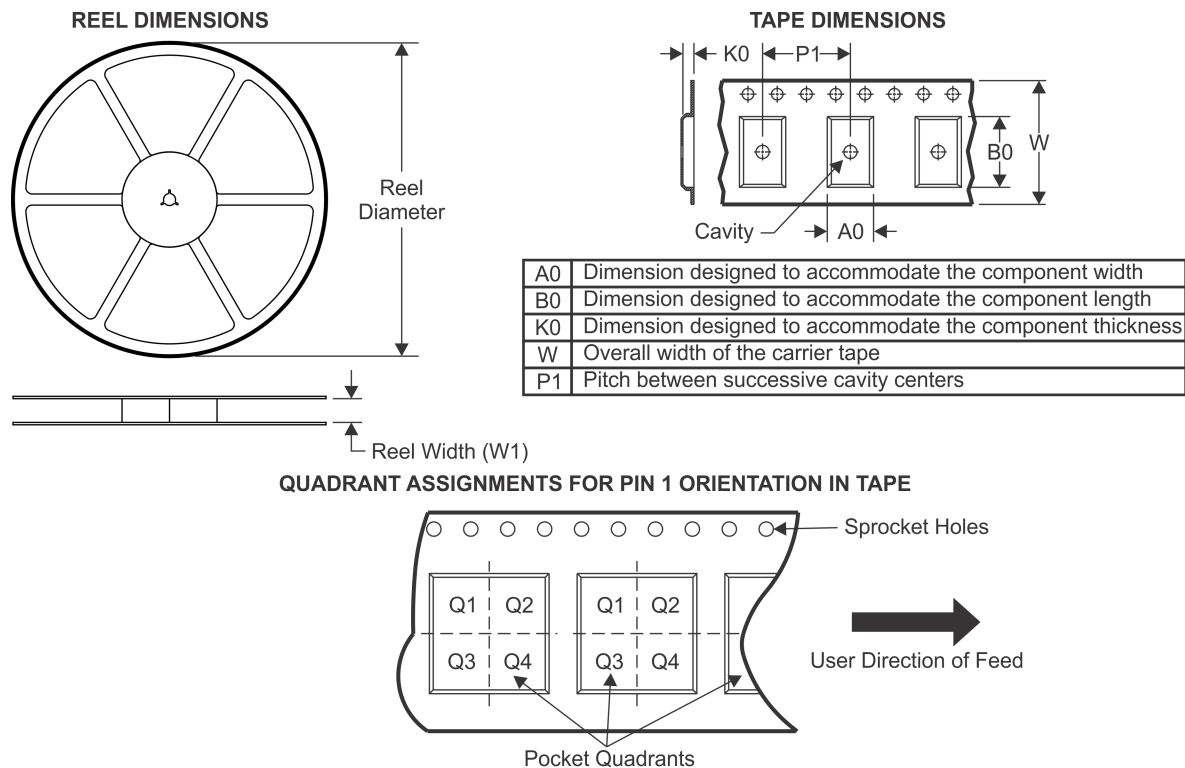
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

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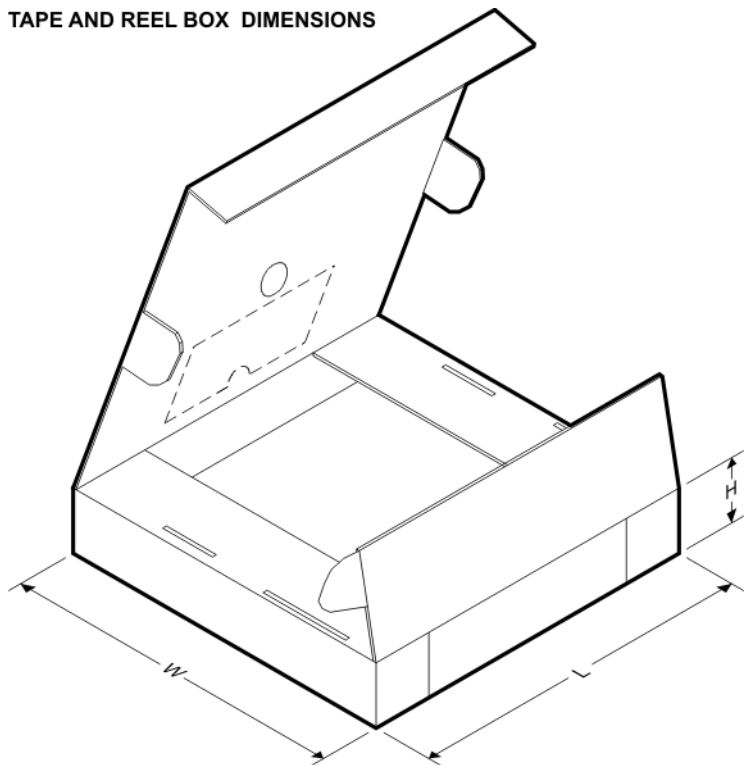
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TAPE AND REEL INFORMATION


*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
CD74AC86M96	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



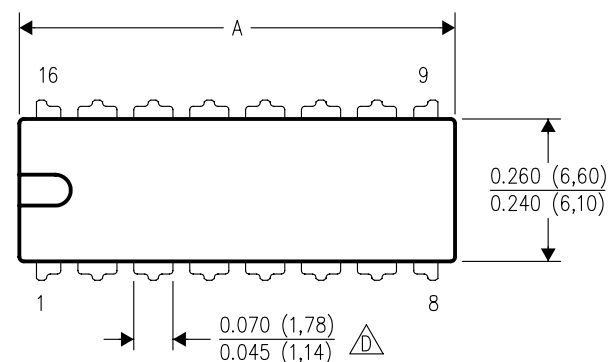
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74AC86M96	SOIC	D	14	2500	367.0	367.0	38.0

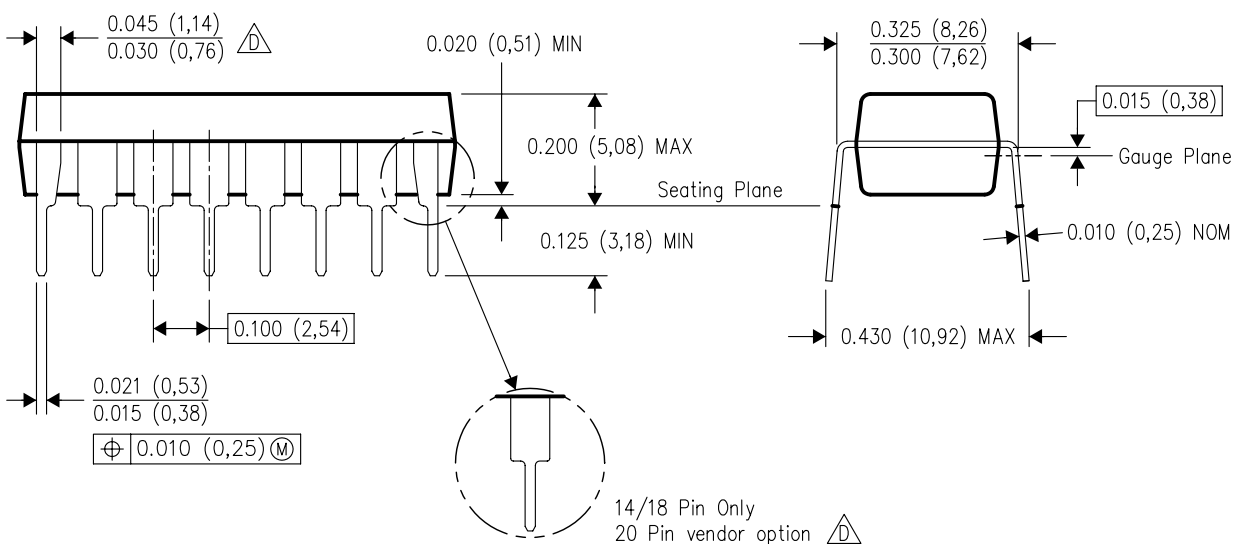
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS ** DIM	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	AA	BB	AC	AD



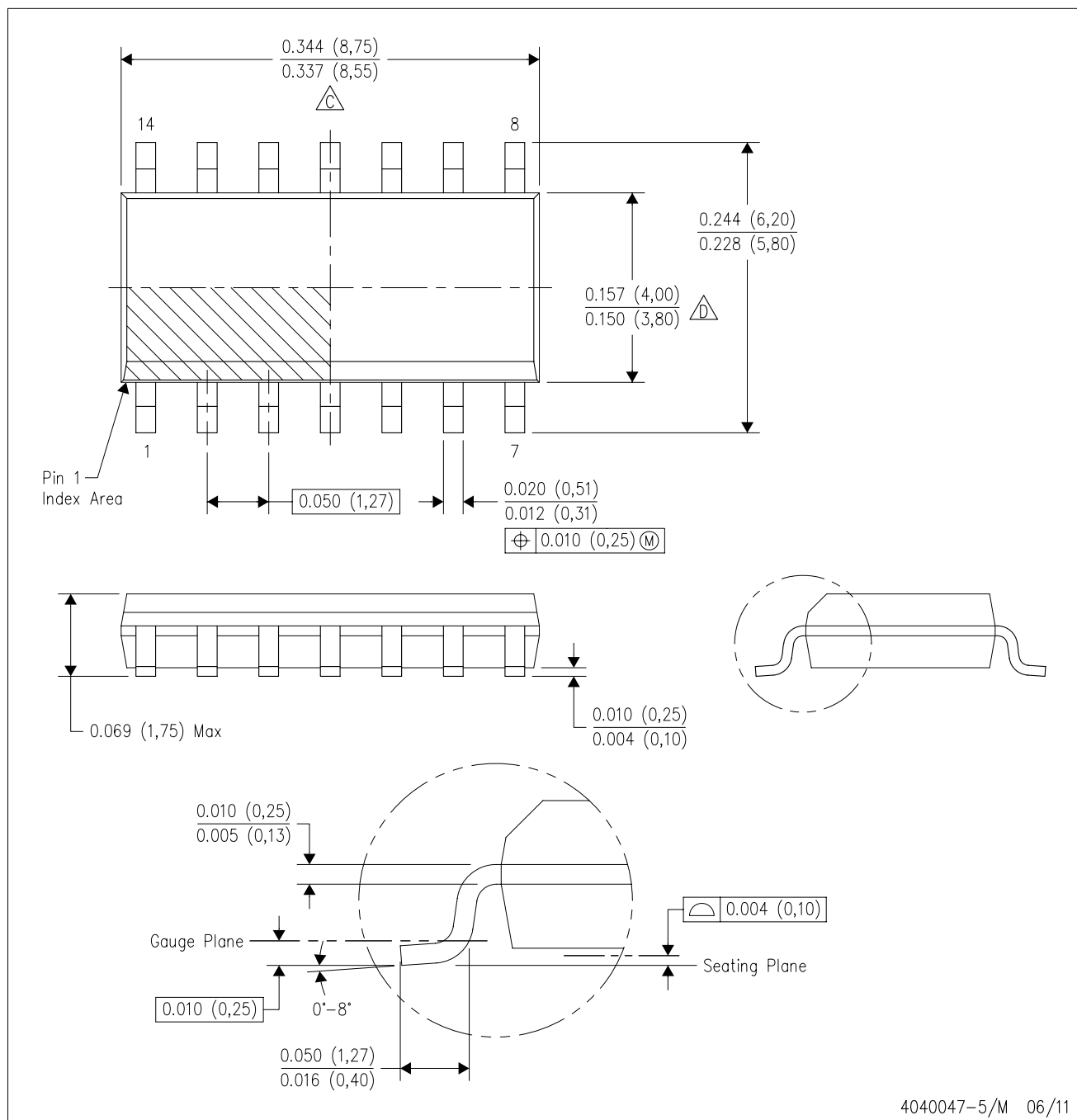
4040049/E 12/2002

NOTES:

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

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



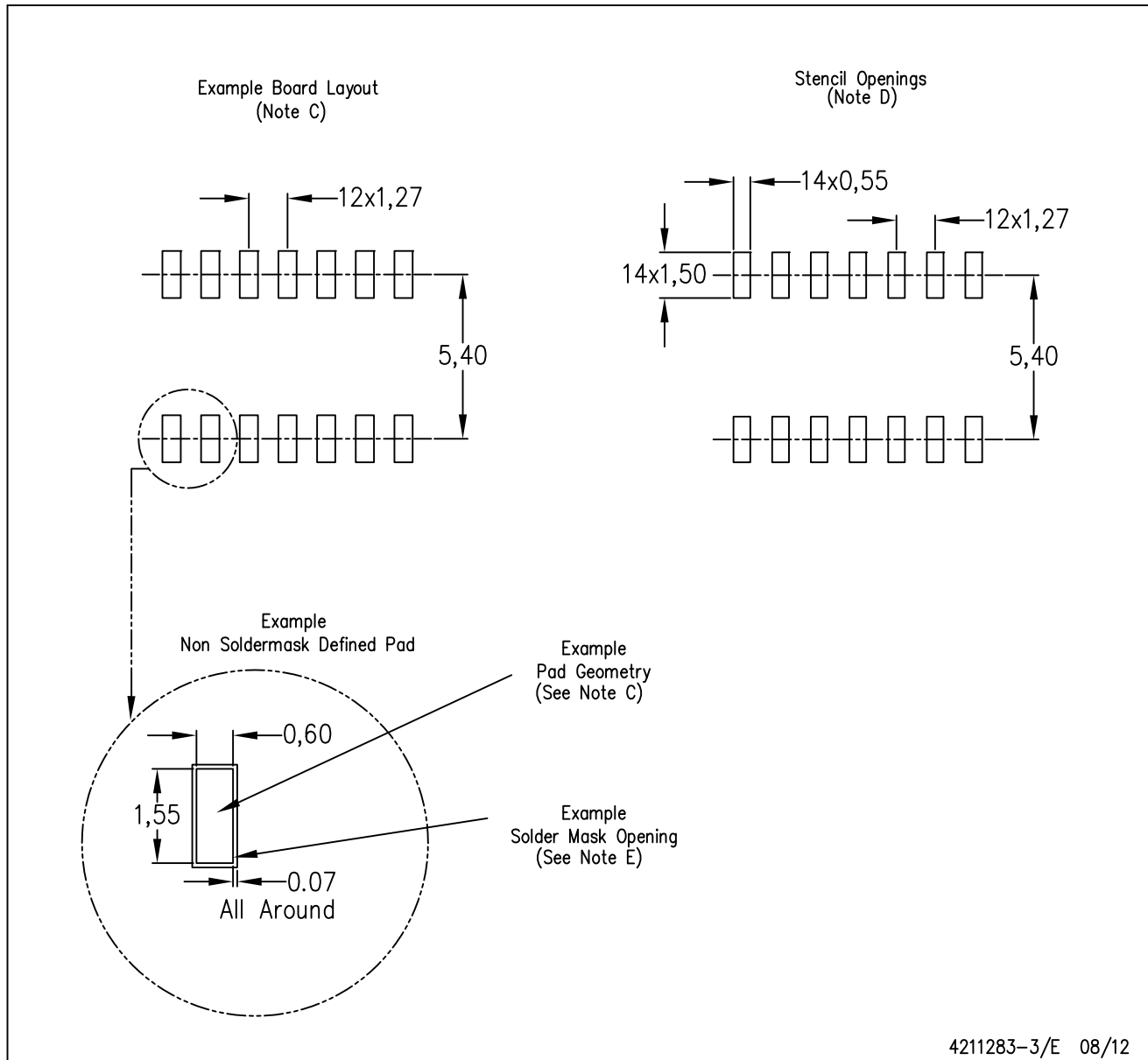
4040047-5/M 06/11

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:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - 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.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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