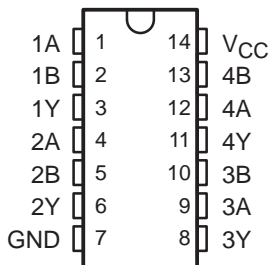


# SN54ACT86, SN74ACT86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

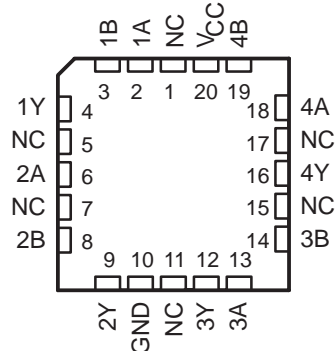
SCAS534C – AUGUST 1995 – REVISED OCTOBER 2003

- 4.5-V to 5.5-V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 10 ns at 5 V
- Inputs Are TTL-Voltage Compatible

SN54ACT86 . . . J OR W PACKAGE  
SN74ACT86 . . . D, DB, N, NS, OR PW PACKAGE  
(TOP VIEW)



SN54ACT86 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## description/ordering information

The 'ACT86 devices are quadruple 2-input exclusive-OR gates. The devices perform the Boolean functions  $Y = A \oplus B$  or  $Y = \overline{AB} + A\overline{B}$  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
-40°C to 85°C	PDIP – N	Tube	SN74ACT86N	SN74ACT86N
	SOIC – D	Tube	SN74ACT86D	ACT86
		Tape and reel	SN74ACT86DR	
	SOP – NS	Tape and reel	SN74ACT86NSR	ACT86
	SSOP – DB	Tape and reel	SN74ACT86DBR	AD86
	TSSOP – PW	Tube	SN74ACT86PW	AD86
Tape and reel		SN74ACT86PWR		
-55°C to 125°C	CDIP – J	Tube	SNJ54ACT86J	SNJ54ACT86J
	CFP – W	Tube	SNJ54ACT86W	SNJ54ACT86W
	LCCC – FK	Tube	SNJ54ACT86FK	SNJ54ACT86FK

† 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).



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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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.

# SN54ACT86, SN74ACT86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

SCAS534C – AUGUST 1995 – REVISED OCTOBER 2003

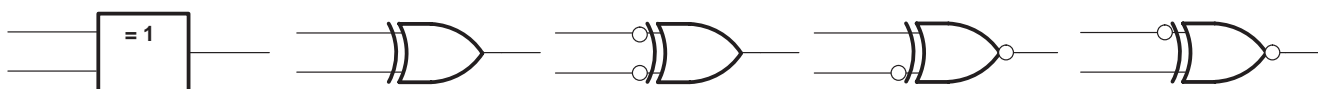
FUNCTION TABLE  
(each gate)

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

## exclusive-OR logic

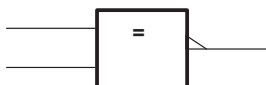
An exclusive-OR gate has many applications, some of which can be represented better by alternative logic symbols.

EXCLUSIVE-OR



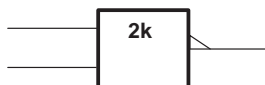
These five equivalent exclusive-OR symbols are valid for an 'ACT86 gate in positive logic; negation may be shown at any two ports.

LOGIC-IDENTITY ELEMENT



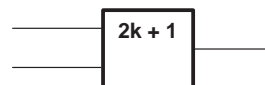
The output is active (low) if all inputs stand at the same logic level (i.e.,  $A = B$ ).

EVEN-PARITY ELEMENT



The output is active (low) if an even number of inputs (i.e., 0 or 2) are active.

ODD-PARITY ELEMENT



The output is active (high) if an odd number of inputs (i.e., only 1 of the 2) are active.

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

Supply voltage range, $V_{CC}$ .....	-0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 200$ mA
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
PW package .....	113°C/W
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

<sup>†</sup> 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.

# SN54ACT86, SN74ACT86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

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## recommended operating conditions (see Note 3)

		SN54ACT86		SN74ACT86		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	4.5	5.5	4.5	5.5	V
$V_{IH}$	High-level input voltage	2		2		V
$V_{IL}$	Low-level input voltage		0.8		0.8	V
$V_I$	Input voltage	0	$V_{CC}$	0	$V_{CC}$	V
$V_O$	Output voltage	0	$V_{CC}$	0	$V_{CC}$	V
$I_{OH}$	High-level output current		-24		-24	mA
$I_{OL}$	Low-level output current		24		24	mA
$\Delta t/\Delta v$	Input transition rise or fall rate		8		8	ns/V
$T_A$	Operating free-air temperature	-55	125	-40	85	°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	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54ACT86		SN74ACT86		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$V_{OH}$	$I_{OH} = -50 \mu\text{A}$	4.5 V	4.4	4.49		4.4		4.4	V	
		5.5 V	5.4	5.49		5.4		5.4		
	$I_{OH} = -24 \text{ mA}$	4.5 V	3.86			3.7		3.76		
		5.5 V	4.86			4.7		4.76		
	$I_{OH} = -50 \text{ mA}^\dagger$	5.5 V				3.85				
$I_{OH} = -75 \text{ mA}^\dagger$	5.5 V						3.85			
$V_{OL}$	$I_{OL} = 50 \mu\text{A}$	4.5 V		0.001	0.1		0.1		V	
		5.5 V		0.001	0.1		0.1			
	$I_{OL} = 24 \text{ mA}$	4.5 V			0.36		0.5			0.44
		5.5 V			0.36		0.5			
	$I_{OL} = 50 \text{ mA}^\dagger$	5.5 V					1.65			
$I_{OL} = 75 \text{ mA}^\dagger$	5.5 V						1.65			
$I_I$	$V_I = V_{CC}$ or GND	5.5 V			$\pm 0.1$		$\pm 1$		$\pm 1$	$\mu\text{A}$
$I_{CC}$	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5 V			4		80		40	$\mu\text{A}$
$\Delta I_{CC}^\ddagger$	One input at 3.4 V, Other inputs at GND or $V_{CC}$	5.5 V			0.6		1.6		1.5	mA
$C_i$	$V_I = V_{CC}$ or GND	5 V			2.6					pF

$^\dagger$  Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

$^\ddagger$  This is the increase in supply current for each input that is at one of the specified TTL voltage levels, rather than 0 V or  $V_{CC}$ .

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			SN54ACT86		SN74ACT86		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A or B	Y	1.5	8.5	9.5	1	10	1	10	ns
$t_{PHL}$			1.5	7	9.5	1	10.5	1	10.5	



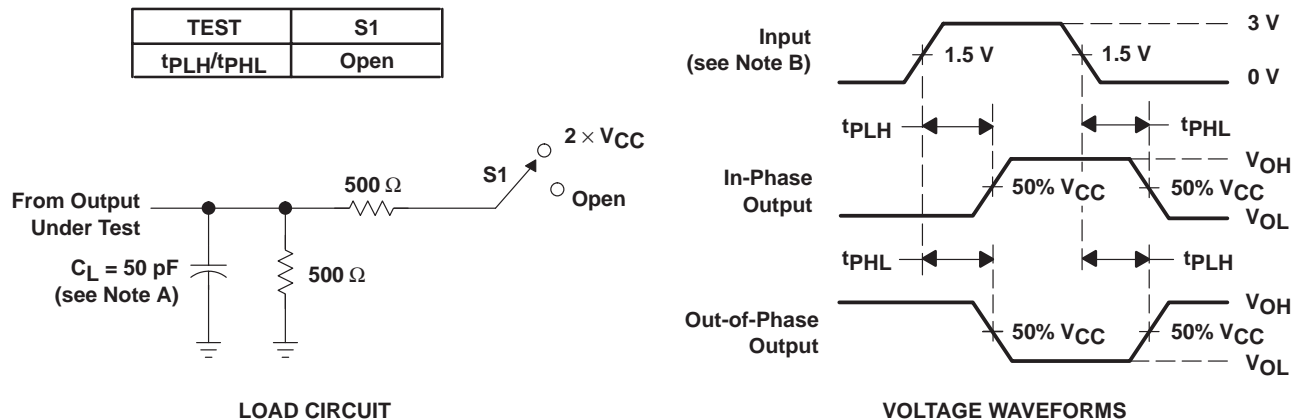
# SN54ACT86, SN74ACT86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

SCAS534C – AUGUST 1995 – REVISED OCTOBER 2003

operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	$C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$	25	pF

## PARAMETER MEASUREMENT INFORMATION



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2.5\text{ ns}$ ,  $t_f \leq 2.5\text{ ns}$ .  
 C. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

**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>
5962-9068701Q2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-9068701QCA	ACTIVE	CDIP	J	14	1	TBD	A42	N / A for Pkg Type
5962-9068701QDA	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type
SN74ACT86D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DBLE	OBSOLETE	SSOP	DB	14		TBD	Call TI	Call TI
SN74ACT86DBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DBRG4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ACT86NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ACT86NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86NSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86NSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86PWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86PWLE	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI
SN74ACT86PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86PWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ACT86PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54ACT86FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54ACT86J	ACTIVE	CDIP	J	14	1	TBD	A42	N / A for Pkg Type
SNJ54ACT86W	ACTIVE	CFP	W	14	1	TBD	A42	N / A for Pkg Type

(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) 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.

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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
SN74ACT86DBR	SSOP	DB	14	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74ACT86DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74ACT86NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74ACT86PWR	TSSOP	PW	14	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)
SN74ACT86DBR	SSOP	DB	14	2000	346.0	346.0	33.0
SN74ACT86DR	SOIC	D	14	2500	346.0	346.0	33.0
SN74ACT86NSR	SO	NS	14	2000	346.0	346.0	33.0
SN74ACT86PWR	TSSOP	PW	14	2000	346.0	346.0	29.0

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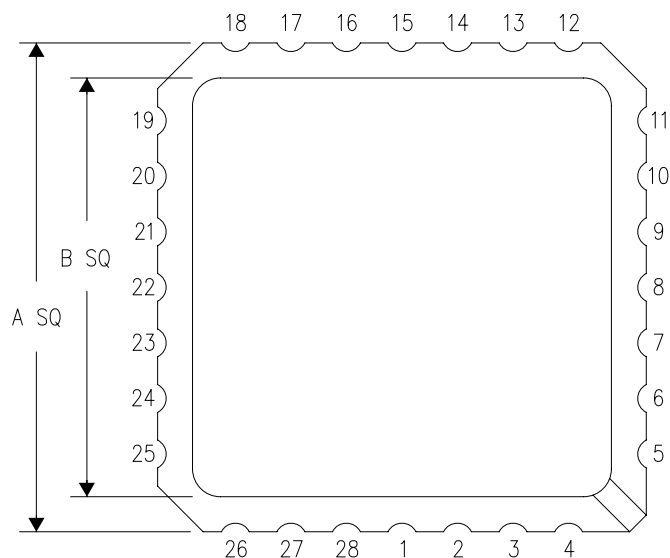
- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
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



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

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - 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.
  - 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)

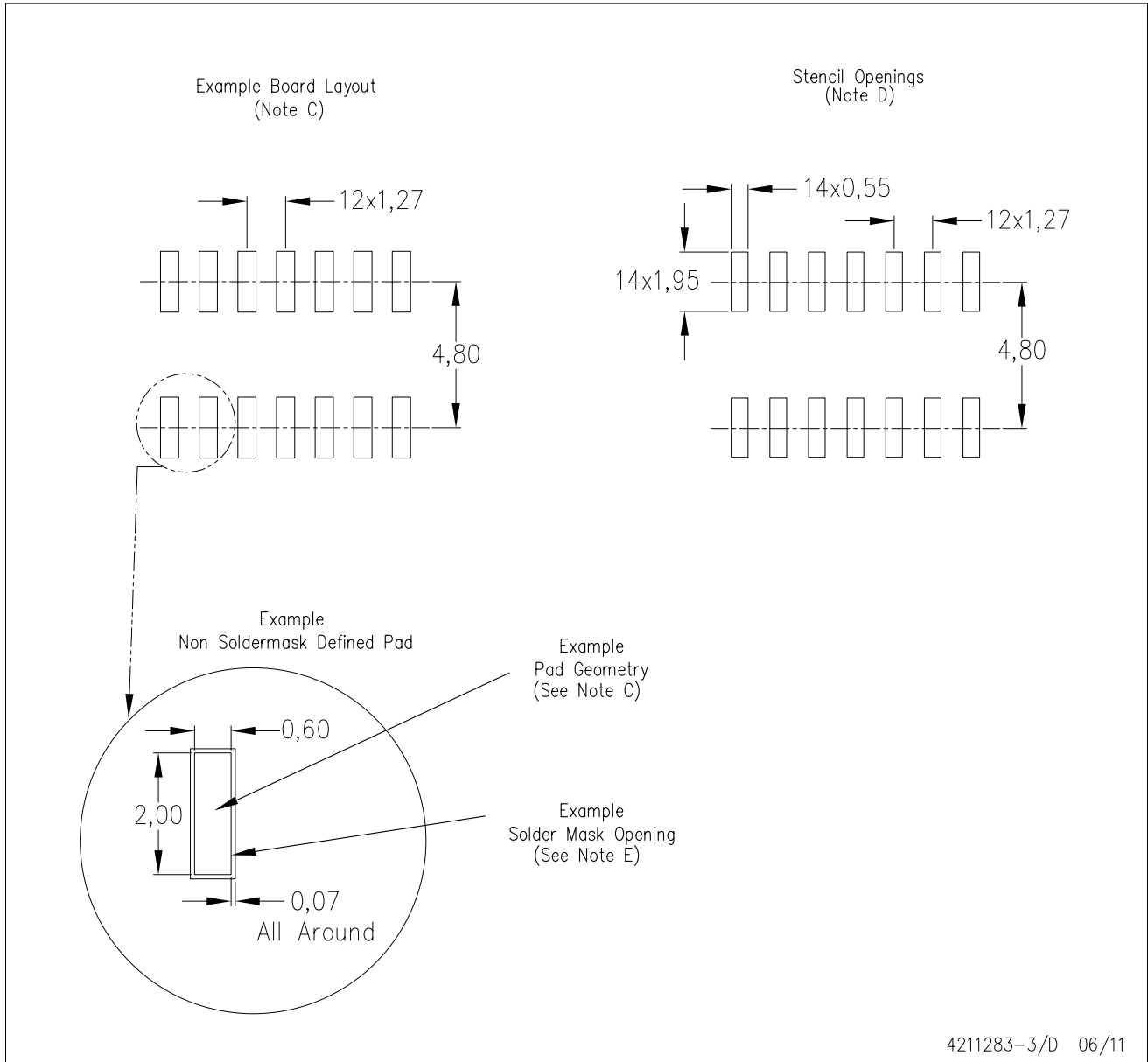
PLASTIC SMALL OUTLINE



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

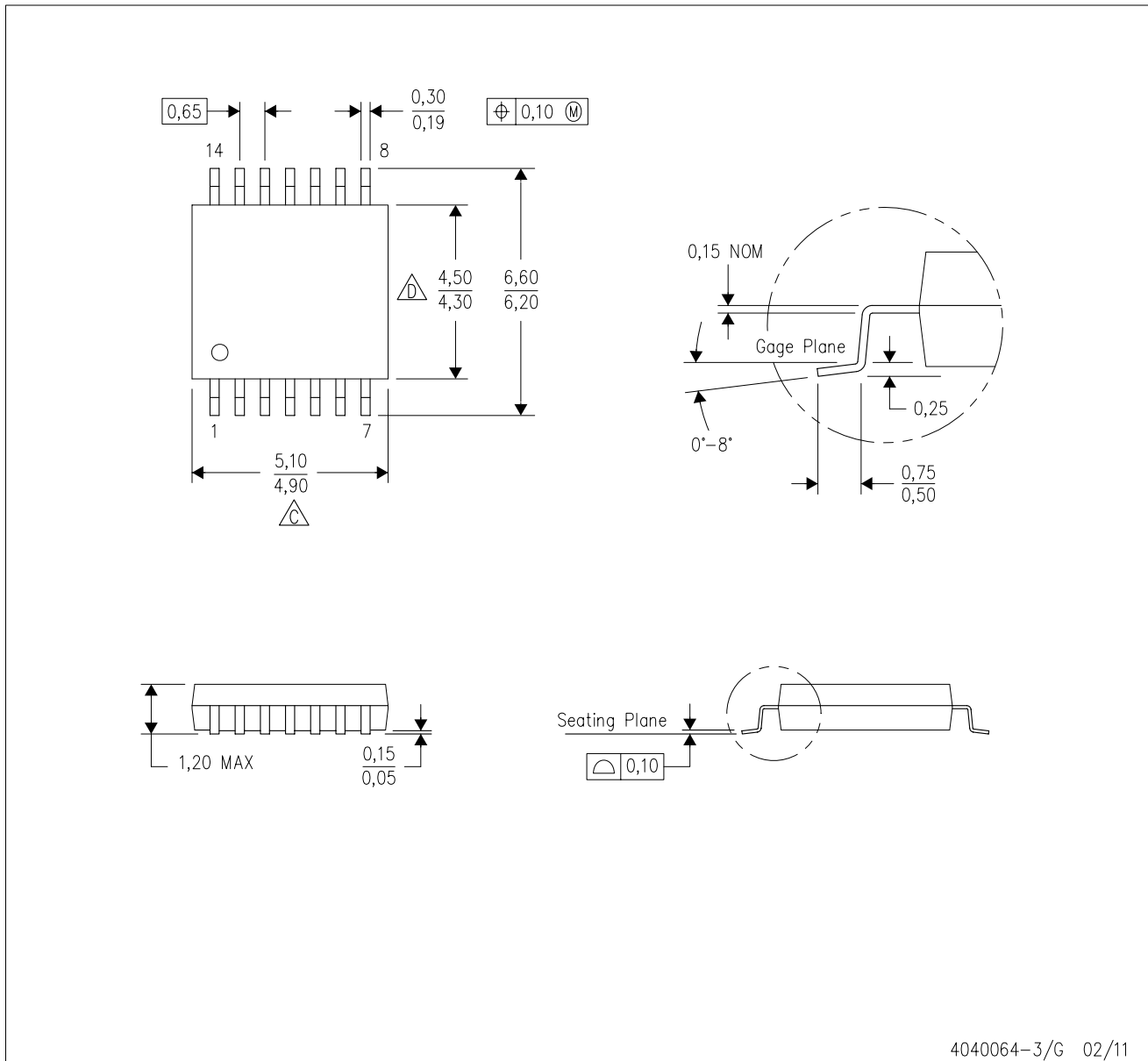


- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact 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.



# MECHANICAL DATA

PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE

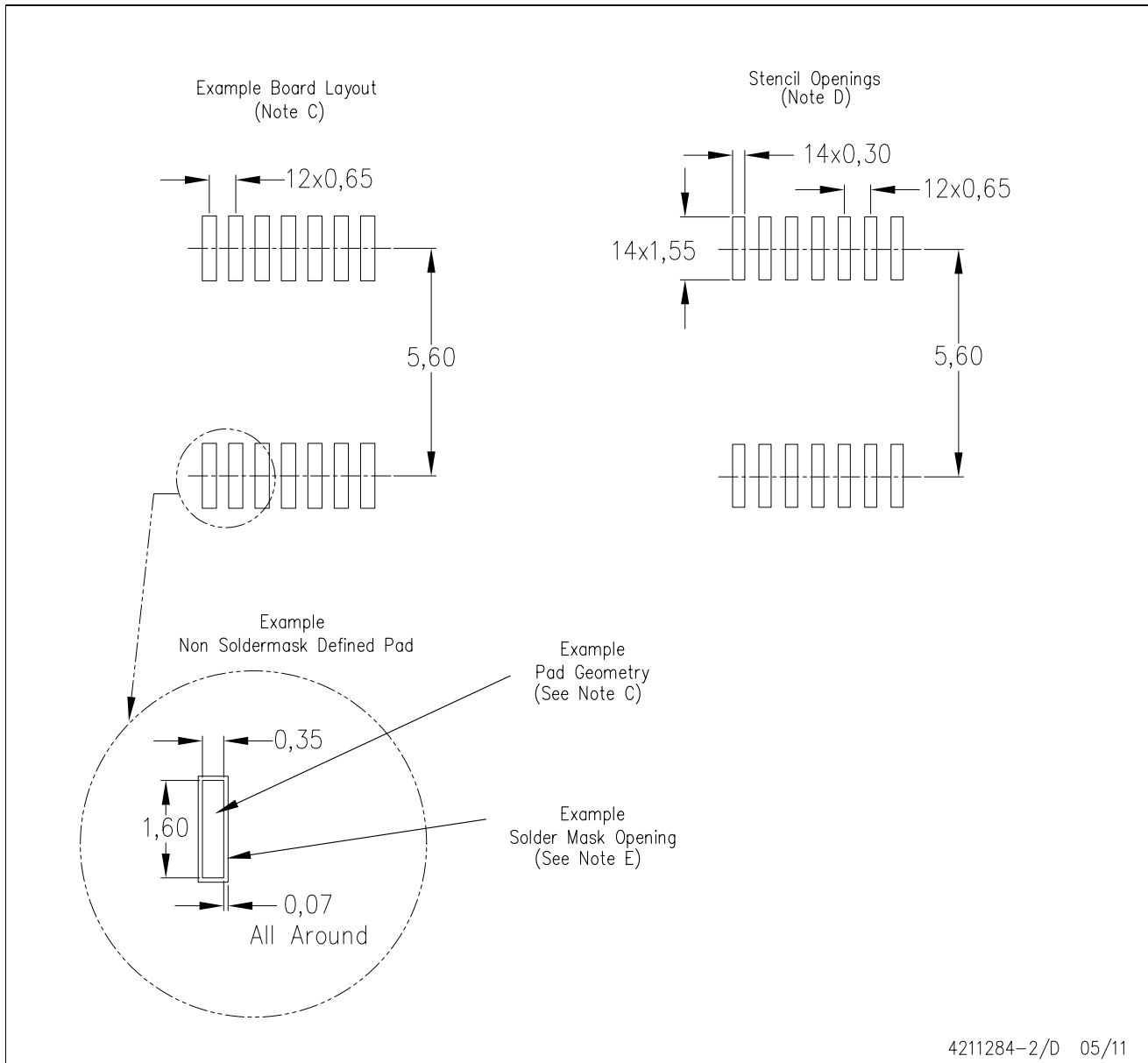


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- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  -  C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  -  D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (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.

# 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.

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

PLASTIC SMALL-OUTLINE

28 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. Falls within JEDEC MO-150

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