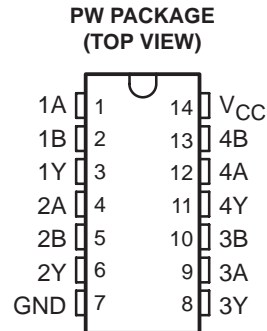


SN74LV86A-EP QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

SCLS567A – JANUARY 2004 – REVISED MAY 2004

- **Controlled Baseline**
 - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –40°C to 105°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **2-V to 5.5-V V_{CC} Operation**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$**
- **Supports Mixed-Mode Voltage Operation on All Ports**

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.



description/ordering information

The SN74LV86A is a quadruple 2-input exclusive-OR gate designed for 2-V to 5.5-V V_{CC} operation.

This device contains four independent 2-input exclusive-OR gates. It 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
–40°C to 105°C	TSSOP – PW	Tape and reel	SN74LV86ATPWREP	LV86AEP

‡ 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.



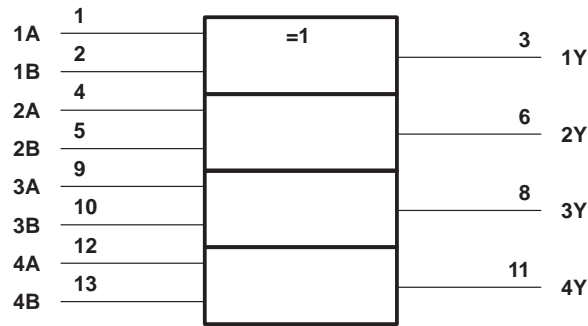
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SN74LV86A-EP
QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

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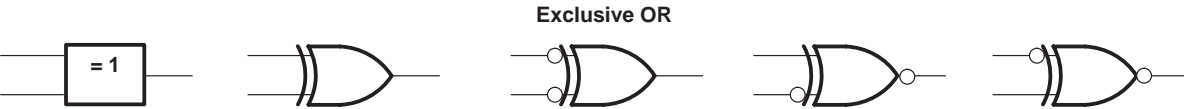
logic symbol†



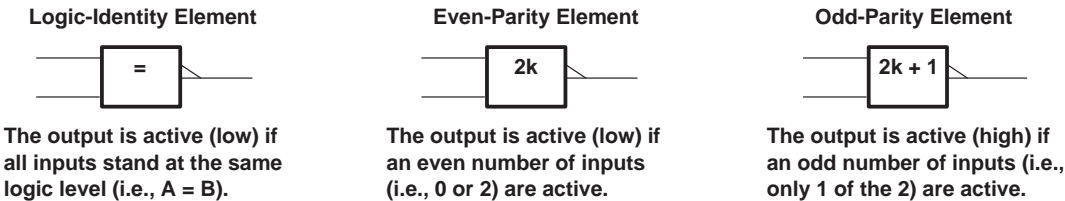
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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 'LV86A gate in positive logic; negation can be shown at any two ports.



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

Table with 2 columns: Parameter and Rating. Parameters include Supply voltage range, Input voltage range, Voltage range applied to any output in the high-impedance or power-off state, Output voltage range, Input clamp current, Output clamp current, Continuous output current, Continuous current through VCC or GND, Package thermal impedance, and Storage temperature range.

‡ 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.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- 2. This value is limited to 5.5 V maximum.
- 3. The package thermal impedance is calculated in accordance with JESD 51-7.

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QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

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recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V _{CC}	Supply voltage		2	5.5	V
V _{IH}	High-level input voltage	V _{CC} = 2 V	1.5		V
		V _{CC} = 2.3 V to 2.7 V	V _{CC} × 0.7		
		V _{CC} = 3 V to 3.6 V	V _{CC} × 0.7		
		V _{CC} = 4.5 V to 5.5 V	V _{CC} × 0.7		
V _{IL}	Low-level input voltage	V _{CC} = 2 V	0.5		V
		V _{CC} = 2.3 V to 2.7 V	V _{CC} × 0.3		
		V _{CC} = 3 V to 3.6 V	V _{CC} × 0.3		
		V _{CC} = 4.5 V to 5.5 V	V _{CC} × 0.3		
V _I	Input voltage		0	5.5	V
V _O	Output voltage		0	V _{CC}	V
I _{OH}	High-level output current	V _{CC} = 2 V	−50		μA
		V _{CC} = 2.3 V to 2.7 V	−2		mA
		V _{CC} = 3 V to 3.6 V	−6		
		V _{CC} = 4.5 V to 5.5 V	−12		
I _{OL}	Low-level output current	V _{CC} = 2 V	50		μA
		V _{CC} = 2.3 V to 2.7 V	2		mA
		V _{CC} = 3 V to 3.6 V	6		
		V _{CC} = 4.5 V to 5.5 V	12		
Δt/Δv	Input transition rise or fall rate	V _{CC} = 2.3 V to 2.7 V	0	200	ns/V
		V _{CC} = 3 V to 3.6 V	0	100	
		V _{CC} = 4.5 V to 5.5 V	0	20	
T _A	Operating free-air temperature		−40	105	°C

NOTE 4: 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}	MIN	TYP	MAX	UNIT
V_{OH}	$I_{OH} = -50\text{ }\mu\text{A}$	2 V to 5.5 V	$V_{CC}-0.1$			V
	$I_{OH} = -2\text{ mA}$	2.3 V	2			
	$I_{OH} = -6\text{ mA}$	3 V	2.48			
	$I_{OH} = -12\text{ mA}$	4.5 V	3.8			
V_{OL}	$I_{OL} = 50\text{ }\mu\text{A}$	2 V to 5.5 V			0.1	V
	$I_{OL} = 2\text{ mA}$	2.3 V			0.4	
	$I_{OL} = 6\text{ mA}$	3 V			0.44	
	$I_{OL} = 12\text{ mA}$	4.5 V			0.55	
I_I	$V_I = 5.5\text{ V or GND}$	0 to 5.5 V			± 1	μA
I_{CC}	$V_I = V_{CC}\text{ or GND, } I_O = 0$	5.5 V			20	μA
I_{off}	$V_I\text{ or }V_O = 0\text{ to }5.5\text{ V}$	0			5	μA
C_i	$V_I = V_{CC}\text{ or GND}$	3.3 V		1.4		pF

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QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

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switching characteristics over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{pd}	A or B	Y	$C_L = 50\text{ pF}$	10.5	22.6		1	26.5	ns

switching characteristics over recommended operating free-air temperature range, $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{pd}	A or B	Y	$C_L = 50\text{ pF}$	7.4	14.5		1	16.5	ns

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)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
				MIN	TYP	MAX			
t_{pd}	A or B	Y	$C_L = 50\text{ pF}$	5.3	8.8		1	10	ns

noise characteristics, $V_{CC} = 3.3\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 5)

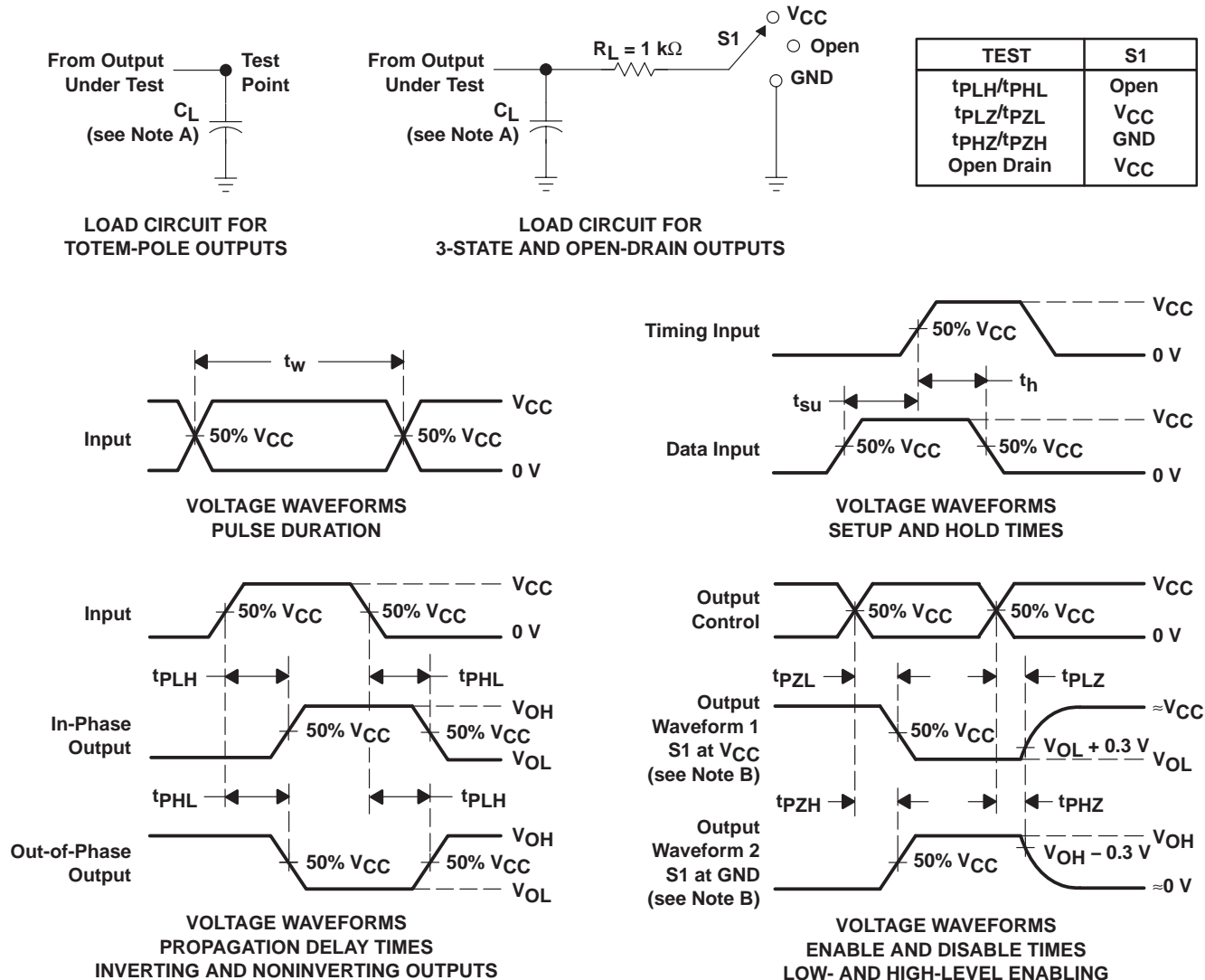
PARAMETER		MIN	TYP	MAX	UNIT
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		0.2	0.8	V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		–0.1	–0.8	V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		3.1		V
$V_{IH(D)}$	High-level dynamic input voltage	2.31			V
$V_{IL(D)}$	Low-level dynamic input voltage			0.99	V

NOTE 5: Characteristics are for surface-mount packages only.

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

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	$C_L = 50\text{ pF}$, $f = 10\text{ MHz}$	3.3 V	8.4	pF
			5 V	8.8	

PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A. C_L includes probe and jig 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: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 3\text{ ns}$, $t_f \leq 3\text{ ns}$.
 - D. The outputs are measured one at a time, with one input transition per measurement.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PHL} and t_{PLH} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74LV86ATPWREP	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 105	LV86AEP
SN74LV86ATPWREP.A	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 105	LV86AEP
V62/04694-01XE	Active	Production	TSSOP (PW) 14	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 105	LV86AEP

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts 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.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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OTHER QUALIFIED VERSIONS OF SN74LV86A-EP :

- Catalog : [SN74LV86A](#)

- Automotive : [SN74LV86A-Q1](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

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
SN74LV86ATPWREP	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)
SN74LV86ATPWREP	TSSOP	PW	14	2000	353.0	353.0	32.0

EXAMPLE BOARD LAYOUT

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 10X



SOLDER MASK DETAILS

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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

PW0014A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

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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.

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