

# SN5486, SN54LS86A, SN54S86 SN7486, SN74LS86A, SN74S86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

SDLS124 - DECEMBER 1972 - REVISED MARCH 1988

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Standard Plastic and Ceramic 300-mil DIPs

- Dependable Texas Instruments Quality and Reliability

TYPE	TYPICAL AVERAGE PROPAGATION DELAY TIME	TYPICAL TOTAL POWER DISSIPATION
'86	14 ns	150 mW
'LS86A	10 ns	30.5 mW
'S86	7 ns	250 mW

## description

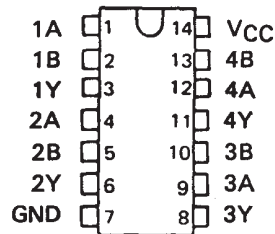
These devices contain four independent 2-input Exclusive-OR gates. They perform the Boolean functions  $Y = A \oplus B = \bar{A}B + A\bar{B}$  in positive logic.

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

The SN5486, 54LS86A, and the SN54S86 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7486, SN74LS86A, and the SN74S86 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

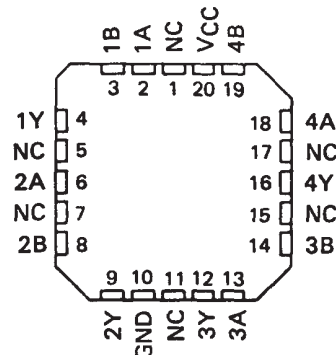
SN5486, SN54LS86A, SN54S86 . . . J OR W PACKAGE  
SN7486 . . . N PACKAGE  
SN74LS86A, SN74S86 . . . D OR N PACKAGE

(TOP VIEW)



SN54LS86A, SN54S86 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

## 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 '86 or 'LS86A gate in positive logic; negation may be shown at any two ports.

**LOGIC IDENTITY ELEMENT**



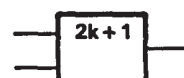
The output is active (low) if all inputs stand at the same logic level (i.e.,  $A=B$ ).

**EVEN-PARITY**



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.

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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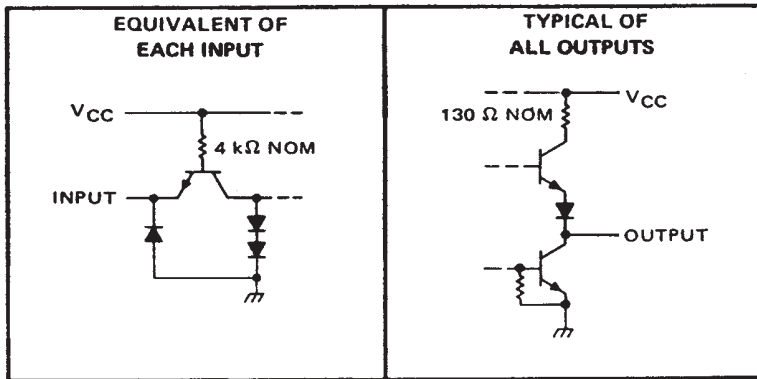
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# SN5486, SN54LS86A, SN54S86 SN7486, SN74LS86A, SN74S86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

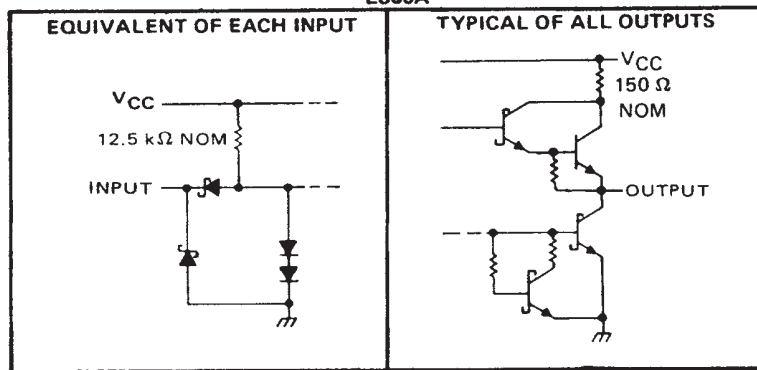
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## schematics of inputs and outputs

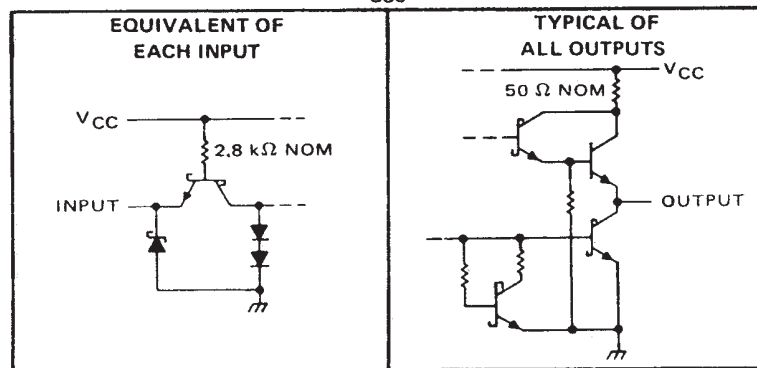
'86



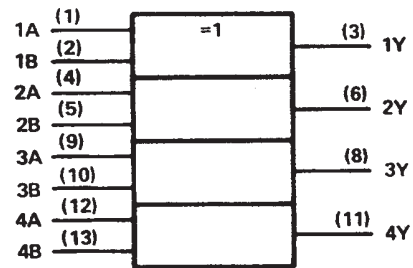
'LS86A



'S86



## logic symbol†



†This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

## FUNCTION TABLE

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

H = high level, L = low level

SN5486, SN54LS86A, SN54S86  
SN7486, SN74LS86A, SN74S86  
**QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES**  
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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC}$ (see Note 1)	7	V
Input voltage	5.5	V
Operating free-air temperature range: SN5486	–55	°C to 125
SN7486	0	°C to 70
Storage temperature range	–65	°C to 150

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

	SN5486			SN7486			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
High-level output current, $I_{OH}$			–800			–800	$\mu$ A
Low-level output current, $I_{OL}$			16			16	mA
Operating free-air temperature, $T_A$	–55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	SN5486			SN7486			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IH}$ High-level input voltage		2			2			V
$V_{IL}$ Low-level input voltage				0.8			0.8	V
$V_{IK}$ Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -8 \text{ mA}$			–1.5			–1.5	V
$V_{OH}$ High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -800 \mu\text{A}$	2.4	3.4		2.4	3.4		V
$V_{OL}$ Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$		0.2	0.4		0.2	0.4	V
$I_I$ Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1			1	mA
$I_{IH}$ High-level input current	$V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$			40			40	$\mu$ A
$I_{IL}$ Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			–1.6			–1.6	mA
$I_{OS}$ Short-circuit output current§	$V_{CC} = \text{MAX}$	–20		–55	–18		–55	mA
$I_{CC}$ Supply current	$V_{CC} = \text{MAX}, \text{ See Note 2}$		30	43		30	50	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time.

NOTE 2:  $I_{CC}$  is measured with the inputs grounded and the outputs open.

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

PARAMETER¶	FROM (INPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{PLH}$	A or B	Other input low	$C_L = 15 \text{ pF}, R_L = 400 \Omega,$		15	23	ns
$t_{PHL}$					11	17	
$t_{PLH}$	A or B	Other input high	See Note 3		18	30	ns
$t_{PHL}$					13	22	

¶  $t_{PLH}$  = propagation delay time, low-to-high-level output

$t_{PHL}$  = propagation delay time, high-to-low-level output

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



# SN5486, SN54LS86A, SN54S86 SN7486, SN74LS86A, SN74S86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage	7 V
Operating free-air temperature range: SN54LS86A	-55°C to 125°C
SN74LS86A	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

	SN54LS86A			SN74LS86A			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
High-level output current, $I_{OH}$			-400			-400	$\mu$ A
Low-level output current, $I_{OL}$			4			8	mA
Operating free-air temperature, $T_A$	-55		125	0		70	°C

## electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	SN54LS86A			SN74LS86A			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IH}$ High-level input voltage		2			2			V
$V_{IL}$ Low-level input voltage				0.7			0.8	V
$V_{IK}$ Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5			-1.5	V
$V_{OH}$ High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu\text{A}$	2.5	3.4		2.7	3.4		V
$V_{OL}$ Low-level output voltage	$V_{CC} = \text{MIN}, I_{OL} = 4 \text{ mA}$		0.25	0.4		0.25	0.4	V
	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 8 \text{ mA}$					0.35	0.5	
$I_I$ Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$			0.2			0.2	mA
$I_{IH}$ High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			40			40	$\mu$ A
$I_{IL}$ Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-0.8			-0.8	mA
$I_{OS}$ Short-circuit output current§	$V_{CC} = \text{MAX}$	-20		-100	-20		-100	mA
$I_{CC}$ Supply current	$V_{CC} = \text{MAX}, \text{ See Note 2}$		6.1	10		6.1	10	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time.

NOTE 2:  $I_{CC}$  is measured with the inputs grounded and the outputs open.

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

PARAMETER¶	FROM (INPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{PLH}$	A or B	Other input low	$C_L = 15 \text{ pF}, R_L = 2 \text{ k}\Omega,$ See Note 3		12	23	ns
					10	17	
$t_{PHL}$	A or B	Other input high	See Note 3		20	30	ns
					13	22	

¶  $t_{PLH}$  = propagation delay time, low-to-high-level output

$t_{PHL}$  = propagation delay time, high-to-low-level output

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



SN5486, SN54LS86A, SN54S86  
SN7486, SN74LS86A, SN74S86  
**QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES**  
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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)**

Supply voltage, $V_{CC}$ (see Note 1)	7 V	
Input voltage	5.5 V	
Operating free-air temperature range: SN54S86	–55°C to 125°C	
SN74S86	0°C to 70°C	
Storage temperature range	–65°C to 150°C	

NOTE 1: Voltage values are with respect to network ground terminal.

**recommended operating conditions**

	SN54S86			SN74S86			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
High-level output current, $I_{OH}$			–1			–1	mA
Low-level output current, $I_{OL}$			20			20	mA
Operating free-air temperature, $T_A$	–55		125	0		70	°C

**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

PARAMETER	TEST CONDITIONS†	SN54S86			SN74S86			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
$V_{IH}$ High-level input voltage		2			2			V
$V_{IL}$ Low-level input voltage				0.8			0.8	V
$V_{IK}$ Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			–1.2			–1.2	V
$V_{OH}$ High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -1 \text{ mA}$	2.5	3.4		2.7	3.4		V
$V_{OL}$ Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 20 \text{ mA}$			0.5			0.5	V
$I_I$ Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1			1	mA
$I_{IH}$ High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			50			50	µA
$I_{IL}$ Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.5 \text{ V}$			–2			–2	mA
$I_{OS}$ Short-circuit output current §	$V_{CC} = \text{MAX}$	–40		–100	–40		–100	mA
$I_{CC}$ Supply current	$V_{CC} = \text{MAX}, \text{ See Note 2}$		50	75		50	75	mA

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

NOTE 2:  $I_{CC}$  is measured with the inputs grounded and the outputs open.

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

PARAMETER¶	FROM (INPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
		Other input low	Other input high				
$t_{PLH}$	A or B	Other input low	$C_L = 15 \text{ pF}, R_L = 280 \Omega, \text{ See Note 3}$		7	10.5	ns
$t_{PHL}$				6.5	10		
$t_{PLH}$	A or B	Other input high			7	10.5	ns
$t_{PHL}$				6.5	10		

¶  $t_{PLH}$  = propagation delay time, low-to-high-level output

¶  $t_{PHL}$  = propagation delay time, high-to-low-level output

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

