

# SN54ALS86, SN54AS86A, SN74ALS86, SN74AS86A QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

SDAS006B – APRIL 1982 – REVISED DECEMBER 1994

- Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

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

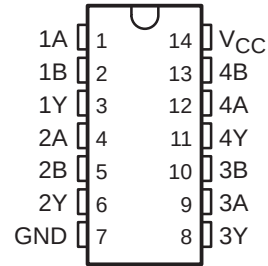
A common application is as a true/complement element. If one of the inputs is low, the other input is reproduced in true form at the output. If one of the inputs is high, the signal on the other input is reproduced inverted at the output.

The SN54ALS86 and SN54AS86A are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS86 and SN74AS86A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

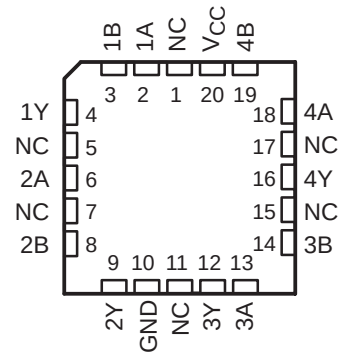
FUNCTION TABLE  
(each gate)

| INPUTS |   | OUTPUT |
|--------|---|--------|
| A      | B | Y      |
| L      | L | L      |
| L      | H | H      |
| H      | L | H      |
| H      | H | L      |

SN54ALS86, SN54AS86A . . . J PACKAGE  
SN74ALS86, SN74AS86A . . . D OR N PACKAGE  
(TOP VIEW)

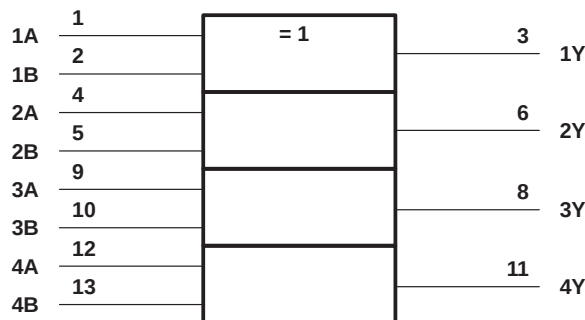


SN54ALS86, SN54AS86A . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## logic symbol†



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

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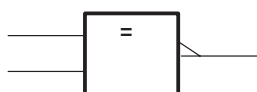
## exclusive-OR logic

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



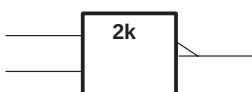
These are five equivalent exclusive-OR symbols valid for an 'ALS86 or 'AS86A gate in positive logic. Negation may be shown at any two ports.

### LOGIC-IDENTITY ELEMENT



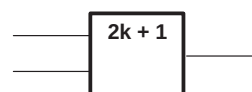
The output is active (low) if all inputs are at the same logic level (i.e.,  $A = B$ ).

### 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.

# SN54ALS86, SN54AS86A, SN74ALS86, SN74AS86A QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

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

|                                                         |                |
|---------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                | 7 V            |
| Input voltage, $V_I$                                    | 7 V            |
| Operating free-air temperature range, $T_A$ : SN54ALS86 | –55°C to 125°C |
| SN74ALS86                                               | 0°C to 70°C    |
| Storage temperature range                               | –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.

## recommended operating conditions

|          |                                | SN54ALS86 |     |      | SN74ALS86 |     |      | UNIT |
|----------|--------------------------------|-----------|-----|------|-----------|-----|------|------|
|          |                                | MIN       | NOM | MAX  | MIN       | NOM | MAX  |      |
| $V_{CC}$ | Supply voltage                 | 4.5       | 5   | 5.5  | 4.5       | 5   | 5.5  | V    |
| $V_{IH}$ | High-level input voltage       | 2         |     |      | 2         |     |      | V    |
| $V_{IL}$ | Low-level input voltage        |           |     | 0.7  |           |     | 0.8  | V    |
| $I_{OH}$ | High-level output current      |           |     | –0.4 |           |     | –0.4 | mA   |
| $I_{OL}$ | Low-level output current       |           |     | 4    |           |     | 8    | mA   |
| $T_A$    | Operating free-air temperature | –55       |     | 125  | 0         |     | 70   | °C   |

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

| PARAMETER    | TEST CONDITIONS                                                         |                        | SN54ALS86    |                  |      | SN74ALS86    |                  |      | UNIT |
|--------------|-------------------------------------------------------------------------|------------------------|--------------|------------------|------|--------------|------------------|------|------|
|              |                                                                         |                        | MIN          | TYP <sup>‡</sup> | MAX  | MIN          | TYP <sup>‡</sup> | MAX  |      |
| $V_{IK}$     | $V_{CC} = 4.5\text{ V}$ ,<br>$I_I = -18\text{ mA}$                      |                        |              |                  | –1.5 |              |                  | –1.5 | V    |
| $V_{OH}$     | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ ,<br>$I_{OH} = -0.4\text{ mA}$ |                        | $V_{CC} - 2$ |                  |      | $V_{CC} - 2$ |                  |      | V    |
| $V_{OL}$     | $V_{CC} = 4.5\text{ V}$                                                 | $I_{OL} = 4\text{ mA}$ | 0.25         |                  | 0.4  | 0.25         |                  | 0.4  | V    |
|              |                                                                         | $I_{OL} = 8\text{ mA}$ |              |                  |      | 0.35         |                  | 0.5  |      |
| $I_I$        | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 7\text{ V}$                         |                        |              |                  | 0.1  |              |                  | 0.1  | mA   |
| $I_{IH}$     | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 2.7\text{ V}$                       |                        |              |                  | 20   |              |                  | 20   | μA   |
| $I_{IL}$     | $V_{CC} = 5.5\text{ V}$ ,<br>$V_I = 0.4\text{ V}$                       |                        |              |                  | –0.1 |              |                  | –0.1 | mA   |
| $I_{O}^{\S}$ | $V_{CC} = 5.5\text{ V}$ ,<br>$V_O = 2.25\text{ V}$                      |                        | –20          |                  | –112 | –30          |                  | –112 | mA   |
| $I_{CC}$     | $V_{CC} = 5.5\text{ V}$ ,<br>All inputs at 4.5 V                        |                        | 3.9          |                  | 5.9  | 3.9          |                  | 5.9  | mA   |

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

<sup>\S</sup> The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

## switching characteristics (see Figure 1)

| PARAMETER        | FROM<br>(INPUT)              | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX†¶ |     |           |     | UNIT |
|------------------|------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----------|-----|------|
|                  |                              |                | SN54ALS86                                                                                                                |     | SN74ALS86 |     |      |
|                  |                              |                | MIN                                                                                                                      | MAX | MIN       | MAX |      |
| t <sub>PLH</sub> | A or B<br>(other input low)  | Y              | 3                                                                                                                        | 22  | 3         | 17  | ns   |
| t <sub>PHL</sub> |                              |                | 2                                                                                                                        | 14  | 2         | 12  |      |
| t <sub>PLH</sub> | A or B<br>(other input high) | Y              | 3                                                                                                                        | 22  | 3         | 17  | ns   |
| t <sub>PHL</sub> |                              |                | 2                                                                                                                        | 12  | 2         | 10  |      |

<sup>\parallel</sup> For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



# SN54ALS86, SN54AS86A, SN74ALS86, SN74AS86A

## QUADRUPLE 2-INPUT EXCLUSIVE-OR GATES

SDAS006B – APRIL 1982 – REVISED DECEMBER 1994

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

|                                                         |                |
|---------------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                                | 7 V            |
| Input voltage, $V_I$                                    | 7 V            |
| Operating free-air temperature range, $T_A$ : SN54AS86A | –55°C to 125°C |
| SN74AS86A                                               | 0°C to 70°C    |
| Storage temperature range                               | –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.

### recommended operating conditions

|          |                                | SN54AS86A |     |     | SN74AS86A |     |     | UNIT |
|----------|--------------------------------|-----------|-----|-----|-----------|-----|-----|------|
|          |                                | MIN       | NOM | MAX | MIN       | NOM | MAX |      |
| $V_{CC}$ | Supply voltage                 | 4.5       | 5   | 5.5 | 4.5       | 5   | 5.5 | V    |
| $V_{IH}$ | High-level input voltage       | 2         |     |     | 2         |     |     | V    |
| $V_{IL}$ | Low-level input voltage        |           |     | 0.8 |           |     | 0.8 | V    |
| $I_{OH}$ | High-level output current      |           |     | –2  |           |     | –2  | mA   |
| $I_{OL}$ | Low-level output current       |           |     | 20  |           |     | 20  | mA   |
| $T_A$    | Operating free-air temperature | –55       |     | 125 | 0         |     | 70  | °C   |

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

| PARAMETER  | TEST CONDITIONS                                      | SN54AS86A    |                  |      | SN74AS86A    |                  |      | UNIT |
|------------|------------------------------------------------------|--------------|------------------|------|--------------|------------------|------|------|
|            |                                                      | MIN          | TYP <sup>‡</sup> | MAX  | MIN          | TYP <sup>‡</sup> | MAX  |      |
| $V_{IK}$   | $V_{CC} = 4.5$ V, $I_I = -18$ mA                     |              |                  | –1.2 |              |                  | –1.2 | V    |
| $V_{OH}$   | $V_{CC} = 4.5$ V to 5.5 V, $I_{OH} = -2$ mA          | $V_{CC} - 2$ |                  |      | $V_{CC} - 2$ |                  |      | V    |
| $V_{OL}$   | $V_{CC} = 4.5$ V, $I_{OL} = 20$ mA                   | 0.35         |                  | 0.5  | 0.35         |                  | 0.5  | V    |
| $I_I$      | $V_{CC} = 5.5$ V, $V_I = 7$ V                        |              |                  | 0.1  |              |                  | 0.1  | mA   |
| $I_{IH}$   | $V_{CC} = 5.5$ V, $V_I = 2.7$ V                      |              |                  | 20   |              |                  | 20   | μA   |
| $I_{IL}$   | $V_{CC} = 5.5$ V, $V_I = 0.4$ V                      |              |                  | –0.5 |              |                  | –0.5 | mA   |
| $I_{OS}^§$ | $V_{CC} = 5.5$ V, $V_O = 2.25$ V                     | –30          |                  | –112 | –30          |                  | –112 | mA   |
| $I_{CCH}$  | $V_{CC} = 5.5$ V, $V_{I(A)} = 4.5$ V, $V_{I(B)} = 0$ |              | 11               | 18   |              | 11               | 18   | mA   |
| $I_{CCL}$  | $V_{CC} = 5.5$ V, $V_I = 4.5$ V                      |              | 20               | 38   |              | 20               | 38   | mA   |

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

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

### switching characteristics (see Figure 1)

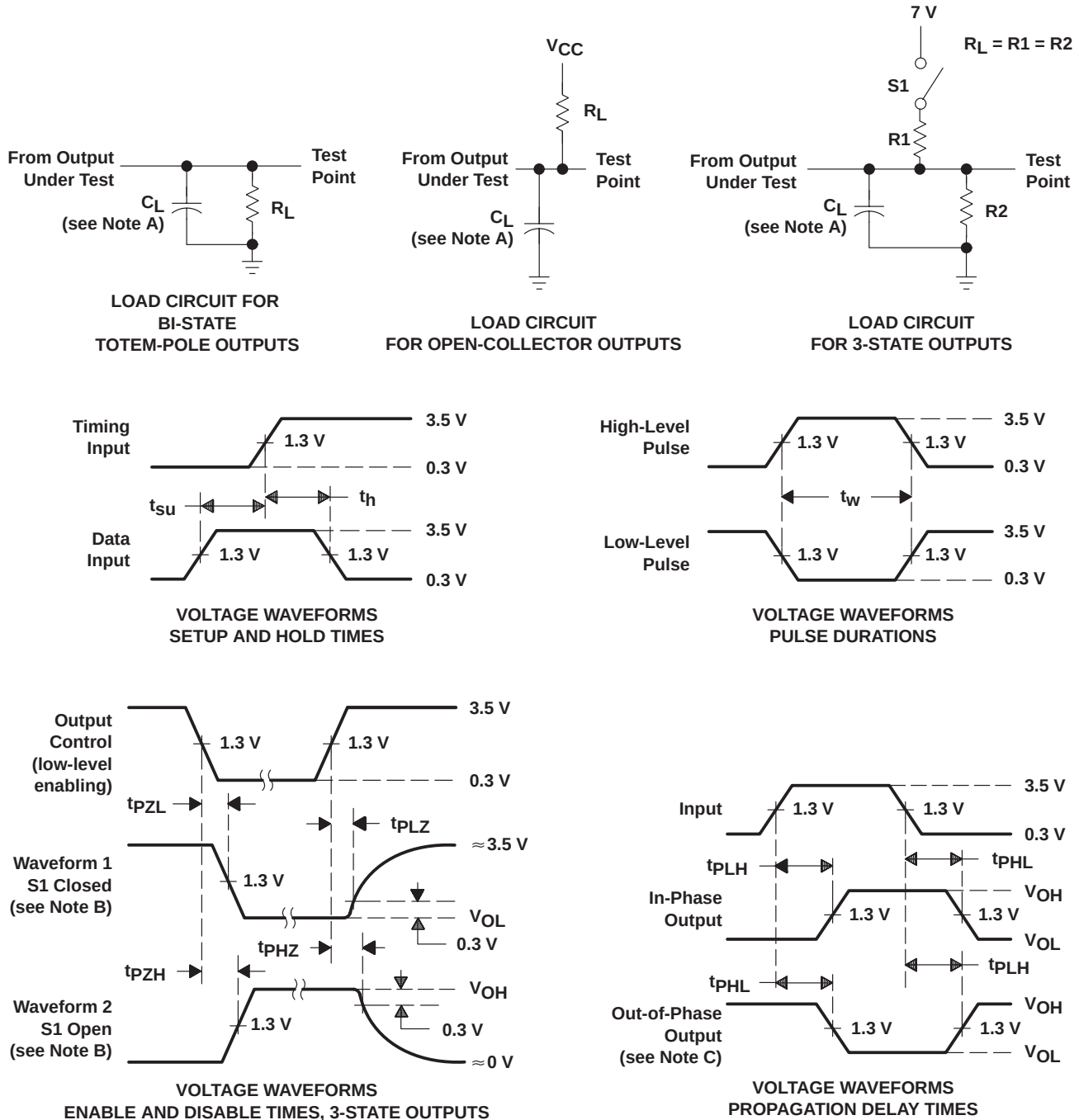
| PARAMETER        | FROM<br>(INPUT)              | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX†¶ |     |           |     | UNIT |
|------------------|------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----------|-----|------|
|                  |                              |                | SN54AS86A                                                                                                                |     | SN74AS86A |     |      |
|                  |                              |                | MIN                                                                                                                      | MAX | MIN       | MAX |      |
| t <sub>PLH</sub> | A or B<br>(other input low)  | Y              | 2                                                                                                                        | 8.5 | 2         | 7.5 | ns   |
| t <sub>PHL</sub> |                              |                | 2                                                                                                                        | 8   | 2         | 6.5 |      |
| t <sub>PLH</sub> | A or B<br>(other input high) | Y              | 1                                                                                                                        | 8   | 1         | 6.5 | ns   |
| t <sub>PHL</sub> |                              |                | 1                                                                                                                        | 9   | 1         | 7   |      |

<sup>||</sup> For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



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PARAMETER MEASUREMENT INFORMATION  
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

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