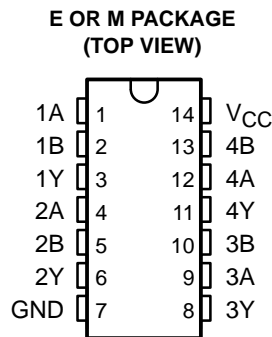


CD74AC86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

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



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 |
|----------------|----------|---------------|-----------------------|------------------|
| | PDIP – E | Tube | | |
| –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 Y |
|--------|---|-------------|
| A | B | |
| L | L | L |
| L | H | H |
| H | L | H |
| H | H | L |



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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**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

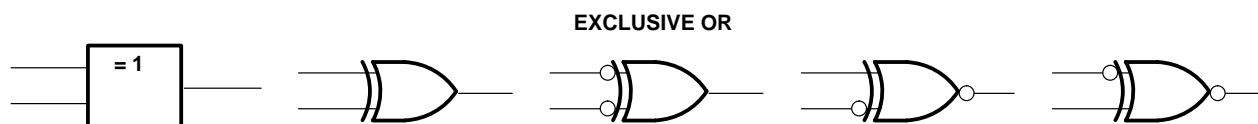
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CD74AC86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

SCHS324 – JANUARY 2003

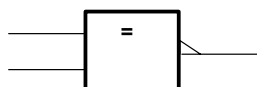
exclusive-OR logic

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



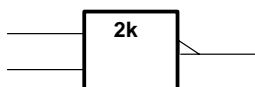
These are five equivalent exclusive-OR symbols valid for an CD74AC86 gate in positive logic; negation may be shown at any two ports.

LOGIC-IDENTITY ELEMENT



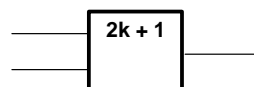
The output is active (low) if all inputs stand at the same logic level (i.e., $A = B$).

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)†

| | |
|---|----------------|
| 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.

CD74AC86 QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

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recommended operating conditions (see Note 3)

| | | T _A = 25°C | | –55°C to 125°C | | –40°C to 85°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 V | | 1.2 | | 1.2 | | V |
| | | V _{CC} = 3 V | | 2.1 | | 2.1 | | |
| | | V _{CC} = 5.5 V | | 3.85 | | 3.85 | | |
| V _{IL} | Low-level input voltage | V _{CC} = 1.5 V | | 0.3 | | 0.3 | | V |
| | | V _{CC} = 3 V | | 0.9 | | 0.9 | | |
| | | V _{CC} = 5.5 V | | 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 V to 5.5 V | | –24 | | –24 | | mA |
| I _{OL} | Low-level output current | V _{CC} = 4.5 V to 5.5 V | | 24 | | 24 | | mA |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 1.5 V to 3 V | | 50 | | 50 | | ns/V |
| | | V _{CC} = 3.6 V to 5.5 V | | 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°C | | –55°C to 125°C | | –40°C to 85°C | | UNIT |
|-----------------|---|---------------------------------------|-----------------------|------|----------------|------|---------------|-----|------|
| | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | V _I = V _{IH} or V _{IL} | I _{OH} = –50 μA | 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 mA | 3 V | 2.58 | 2.4 | 2.48 | | | |
| | | I _{OH} = –24 mA | 4.5 V | 3.94 | 3.7 | 3.8 | | | |
| | | I _{OH} = –50 mA [†] | 5.5 V | | 3.85 | | | | |
| V _{OL} | V _I = V _{IH} or V _{IL} | I _{OL} = 50 μA | 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 mA | 3 V | 0.36 | 0.5 | 0.44 | | | |
| | | I _{OL} = 24 mA | 4.5 V | 0.36 | 0.5 | 0.44 | | | |
| | | I _{OL} = 50 mA [†] | 5.5 V | | 1.65 | | | | |
| I _I | V _I = V _{CC} or GND | 5.5 V | ±0.1 | ±1 | ±1 | μA | | | |
| I _{CC} | V _I = V _{CC} or 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.



CD74AC86

QUADRUPLE 2-INPUT EXCLUSIVE-OR GATE

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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)

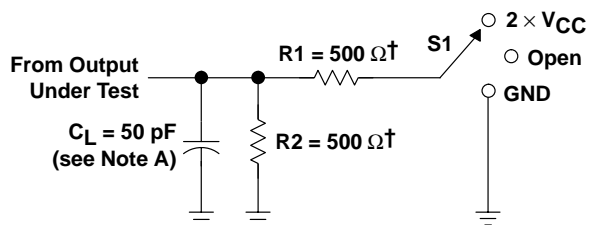
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | -55°C to 125°C | | -40°C TO 85°C | | UNIT |
|------------------|-----------------|----------------|-------------------|------|------------------|-----|------|
| | | | MIN | MAX | MIN | MAX | |
| t _{PLH} | A or B | Y | 2.7 | 10.8 | 2.8 | 9.8 | ns |
| t _{PHL}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



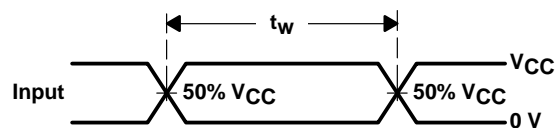
PARAMETER MEASUREMENT INFORMATION



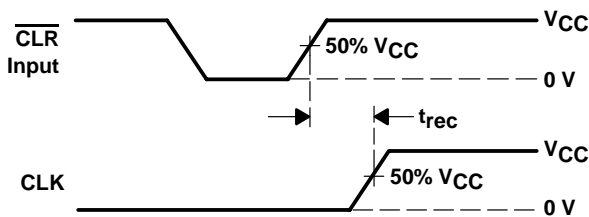
† When $V_{CC} = 1.5\text{ V}$, $R1 = R2 = 1\text{ k}\Omega$

LOAD CIRCUIT

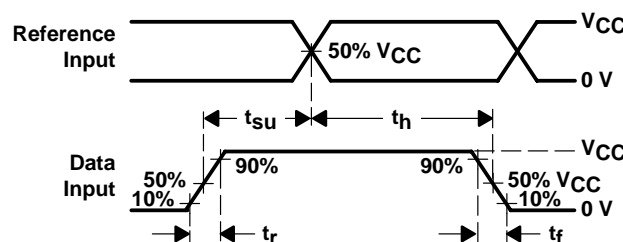
| TEST | S1 |
|-------------------|-------------------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ}/t_{PZH} | GND |



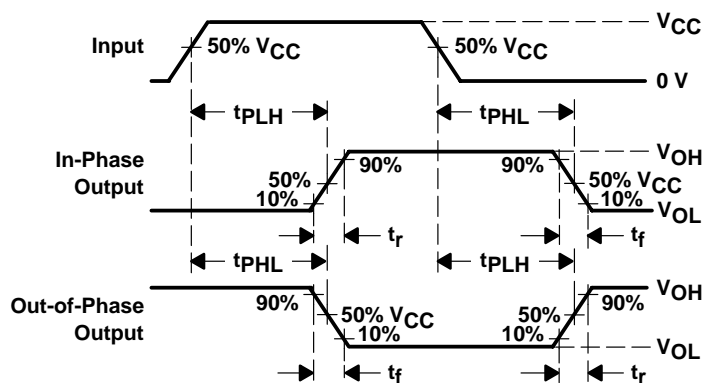
VOLTAGE WAVEFORMS
PULSE DURATION



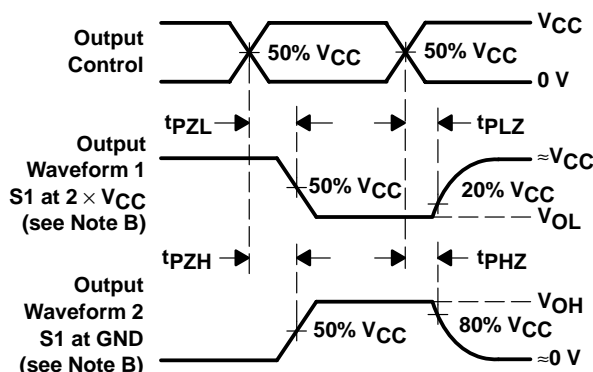
VOLTAGE WAVEFORMS
RECOVERY TIME



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES



VOLTAGE WAVEFORMS
OUTPUT ENABLE AND DISABLE TIMES

- 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 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) |
|-----------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| CD74AC86E | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -55 to 125 | CD74AC86E |
| CD74AC86E.A | Active | Production | PDIP (N) 14 | 25 TUBE | Yes | NIPDAU | N/A for Pkg Type | -55 to 125 | CD74AC86E |
| CD74AC86M | Obsolete | Production | SOIC (D) 14 | - | - | Call TI | Call TI | -55 to 125 | AC86M |
| CD74AC86M96 | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -55 to 125 | AC86M |
| CD74AC86M96.A | Active | Production | SOIC (D) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-1-260C-UNLIM | -55 to 125 | AC86M |

(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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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 |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| 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 | 353.0 | 353.0 | 32.0 |

TUBE


*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| CD74AC86E | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| CD74AC86E | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| CD74AC86E.A | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |
| CD74AC86E.A | N | PDIP | 14 | 25 | 506 | 13.97 | 11230 | 4.32 |



D0014A

PACKAGE OUTLINE

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

EXAMPLE BOARD LAYOUT

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE
SCALE:8X



SOLDER MASK DETAILS

4220718/A 09/2016

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

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4220718/A 09/2016

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.

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

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