

# DATA SHEET

## **74HC1G86; 74HCT1G86** 2-input EXCLUSIVE-OR gate

Product specification  
File under Integrated Circuits, IC06

1998 Aug 05

## 2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86

## FEATURES

- Wide operating voltage range: 2.0 to 6.0 V
- Symmetrical output impedance
- High noise immunity
- Low power dissipation
- Balanced propagation delays
- Very small 5 pins package
- Output capability: standard.

## DESCRIPTION

The 74HC1G/HCT1G86 is a high-speed Si-gate CMOS device.

The 74HC1G/HCT1G86 provides the 2-input EXCLUSIVE-OR function.

The standard output currents are  $\frac{1}{2}$  compared to the 74HC/HCT86.

## FUNCTION TABLE

See note 1.

| INPUTS |     | OUTPUT |
|--------|-----|--------|
| inA    | inB | outY   |
| L      | L   | L      |
| L      | H   | H      |
| H      | L   | H      |
| H      | H   | L      |

## Note

1. H = HIGH voltage level;  
L = LOW voltage level.

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $t_r = t_f = 6.0\text{ ns}$ .

| SYMBOL            | PARAMETER                          | CONDITIONS                                    | TYP. |       | UNIT |
|-------------------|------------------------------------|---|------|-------|------|
|                   |                                    |   | HC1G | HCT1G |      |
| $t_{PHL}/t_{PLH}$ | propagation delay inA, inB to outY | $C_L = 15\text{ pF}$<br>$V_{CC} = 5\text{ V}$ | 9    | 10    | ns   |
| $C_I$             | input capacitance                  |   | 1.5  | 1.5   | pF   |
| $C_{PD}$          | power dissipation capacitance      | notes 1 and 2                                 | 23   | 23    | pF   |

## Notes

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

$C_L$  = output load capacitance in pF;

$V_{CC}$  = supply voltage in V;

$\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

2. For HC1G the condition is  $V_I = \text{GND to } V_{CC}$ ;  
For HCT1G the condition is  $V_I = \text{GND to } V_{CC} - 1.5\text{ V}$ .

## PINNING

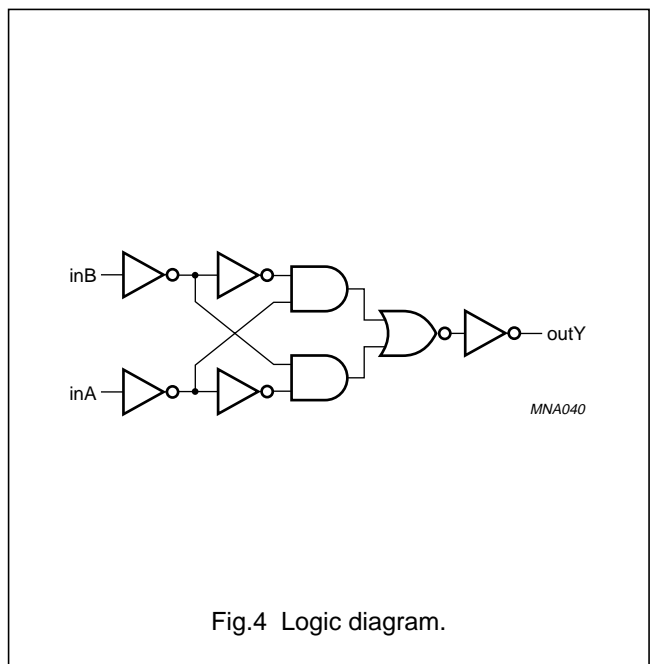
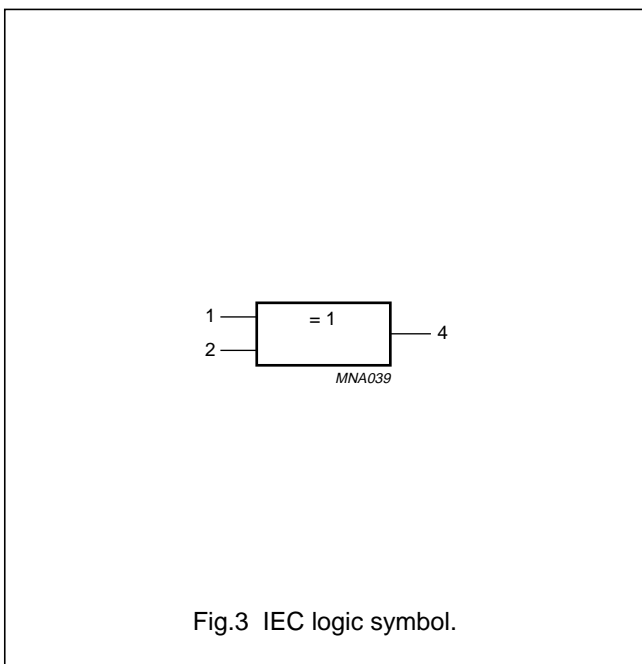
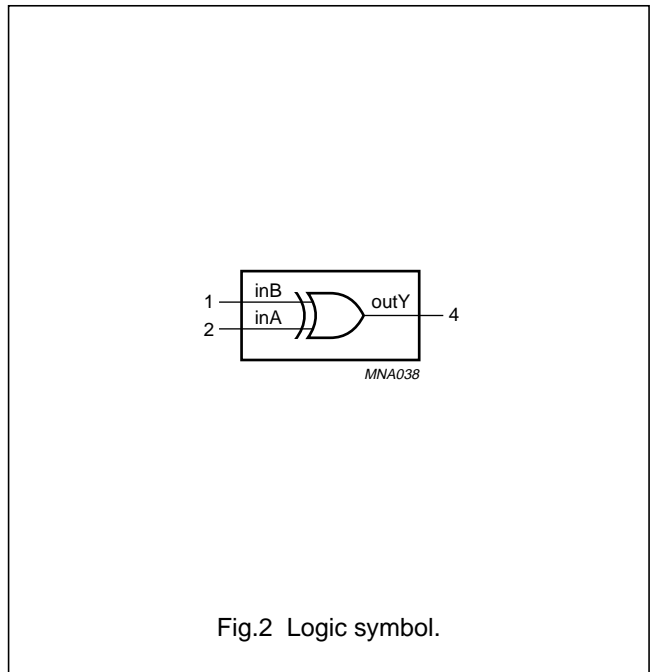
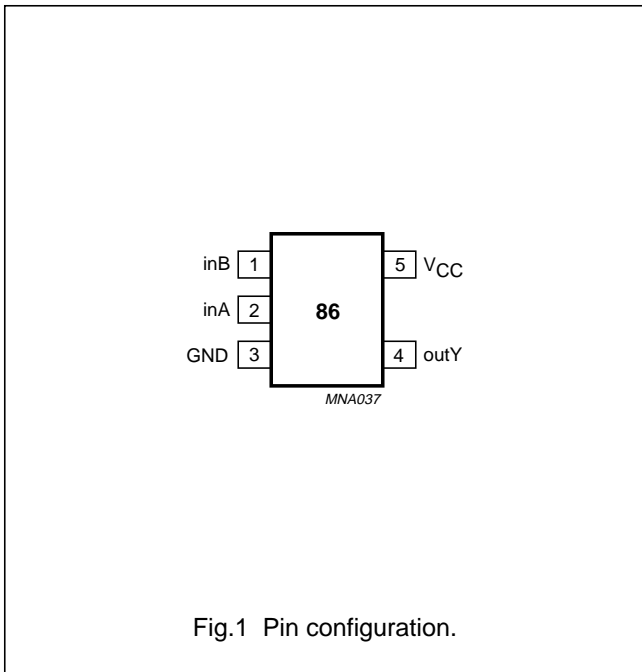
| PIN     | SYMBOL   | DESCRIPTION       |
|---------|----------|-------------------|
| 1 and 2 | inB, inA | data inputs       |
| 3       | GND      | ground (0 V)      |
| 4       | outY     | data output       |
| 5       | $V_{CC}$ | DC supply voltage |

2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86

ORDERING AND PACKAGE INFORMATION

| OUTSIDE NORTH AMERICA | PACKAGES          |      |         |          |        |         |
|-----------------------|-------------------|------|---------|----------|--------|---------|
|                       | TEMPERATURE RANGE | PINS | PACKAGE | MATERIAL | CODE   | MARKING |
| 74HC1G86GW            | -40 to +125 °C    | 5    | SC-88A  | plastic  | SOT353 | HH      |
| 74HCT1G86GW           |                   | 5    | SC-88A  | plastic  | SOT353 | TH      |



## 2-input EXCLUSIVE-OR gate

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## RECOMMENDED OPERATING CONDITIONS

| SYMBOL     | PARAMETER   | 74HC1G |      |          | 74HCT1G |      |          | UNIT | CONDITIONS                               |
|------------|---|--------|------|----------|---------|------|----------|------|--|
|            |   | MIN.   | TYP. | MAX.     | MIN.    | TYP. | MAX.     |      |  |
| $V_{CC}$   | DC supply voltage   | 2.0    | 5.0  | 6.0      | 4.5     | 5.0  | 5.5      | V    |  |
| $V_I$      | input voltage   | 0      | –    | $V_{CC}$ | 0       | –    | $V_{CC}$ | V    |  |
| $V_O$      | output voltage  | 0      | –    | $V_{CC}$ | 0       | –    | $V_{CC}$ | V    |  |
| $T_{amb}$  | operating ambient temperature range                         | –40    | +25  | +125     | –40     | +25  | +125     | °C   | see DC and AC characteristics per device |
| $t_r, t_f$ | input rise and fall times except for Schmitt-trigger inputs | –      | –    | 1000     | –       | –    | –        | ns   | $V_{CC} = 2.0\text{ V}$                  |
|            |   | –      | –    | 500      | –       | –    | 500      | ns   | $V_{CC} = 4.5\text{ V}$                  |
|            |   | –      | –    | 400      | –       | –    | –        | ns   | $V_{CC} = 6.0\text{ V}$                  |

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134); voltages are referenced to GND (ground = 0 V).

| SYMBOL       | PARAMETER  | CONDITIONS   | MIN. | MAX. | UNIT |
|--------------|--|--|------|------|------|
| $V_{CC}$     | DC supply voltage  |  | –0.5 | +7.0 | V    |
| $\pm I_{IK}$ | DC input diode current                                     | $V_I < -0.5$ or $V_I > V_{CC} + 0.5\text{ V}$ ; note 1                                 | –    | 20   | mA   |
| $\pm I_{OK}$ | DC output diode current                                    | $V_O < -0.5$ or $V_O > V_{CC} + 0.5\text{ V}$ ; note 1                                 | –    | 20   | mA   |
| $\pm I_O$    | DC output source or sink current standard outputs          | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$ ; note 1                                 | –    | 12.5 | mA   |
| $\pm I_{CC}$ | DC $V_{CC}$ or GND current for types with standard outputs | note 1   | –    | 25   | mA   |
| $T_{stg}$    | storage temperature range                                  |  | –65  | +150 | °C   |
| $P_D$        | power dissipation per package<br>5 pins plastic SC-88A     | for temperature range: –40 to +125 °C<br>above +55 °C derate linearly with<br>2.5 mW/K | –    | 200  | mW   |

## Note

1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## 2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86

## DC CHARACTERISTICS FOR THE 74HC1G

Over recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL          | PARAMETER                                   | T <sub>amb</sub> (°C) |                     |      |             |      | UNIT | TEST CONDITIONS     |   |
|-----------------|---|-----------------------|---------------------|------|-------------|------|------|---------------------|---|
|                 |   | -40 to +85            |                     |      | -40 to +125 |      |      | V <sub>CC</sub> (V) | OTHER   |
|                 |   | MIN.                  | TYP. <sup>(1)</sup> | MAX. | MIN.        | MAX. |      |                     |   |
| V <sub>IH</sub> | HIGH-level input voltage                    | 1.5                   | 1.2                 | –    | 1.5         | –    | V    | 2.0                 |   |
|                 |   | 3.15                  | 2.4                 | –    | 3.15        | –    | V    | 4.5                 |   |
|                 |   | 4.2                   | 3.2                 | –    | 4.2         | –    | V    | 6.0                 |   |
| V <sub>IL</sub> | LOW-level input voltage                     | –                     | 0.8                 | 0.5  | –           | 0.5  | V    | 2.0                 |   |
|                 |   | –                     | 2.1                 | 1.35 | –           | 1.35 | V    | 4.5                 |   |
|                 |   | –                     | 2.8                 | 1.8  | –           | 1.8  | V    | 6.0                 |   |
| V <sub>OH</sub> | HIGH-level output voltage; all outputs      | 1.9                   | 2.0                 | –    | 1.9         | –    | V    | 2.0                 | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>–I <sub>O</sub> = 20 μA  |
|                 |   | 4.4                   | 4.5                 | –    | 4.4         | –    | V    | 4.5                 |   |
|                 |   | 5.9                   | 6.0                 | –    | 5.9         | –    | V    | 6.0                 |   |
| V <sub>OH</sub> | HIGH-level output voltage; standard outputs | 4.13                  | 4.32                | –    | 3.7         | –    | V    | 4.5                 | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>–I <sub>O</sub> = 2.0 mA |
|                 |   | 5.63                  | 5.81                | –    | 5.2         | –    | V    | 6.0                 | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>–I <sub>O</sub> = 2.6 mA |
| V <sub>OL</sub> | LOW-level output voltage; all outputs       | –                     | 0                   | 0.1  | –           | 0.1  | V    | 2.0                 | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>I <sub>O</sub> = 20 μA   |
|                 |   | –                     | 0                   | 0.1  | –           | 0.1  | V    | 4.5                 |   |
|                 |   | –                     | 0                   | 0.1  | –           | 0.1  | V    | 6.0                 |   |
| V <sub>OL</sub> | LOW-level output voltage; standard outputs  | –                     | 0.15                | 0.33 | –           | 0.4  | V    | 4.5                 | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>I <sub>O</sub> = 2.0 mA  |
|                 |   | –                     | 0.16                | 0.33 | –           | 0.4  | V    | 6.0                 | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>I <sub>O</sub> = 2.6 mA  |
| I <sub>I</sub>  | input leakage current                       | –                     | –                   | 1.0  | –           | 1.0  | μA   | 6.0                 | V <sub>I</sub> = V <sub>CC</sub> or GND   |
| I <sub>CC</sub> | quiescent supply current                    | –                     | –                   | 10   | –           | 20   | μA   | 6.0                 | V <sub>I</sub> = V <sub>CC</sub> or GND;<br>I <sub>O</sub> = 0                    |

## Note

1. All typical values are measured at T<sub>amb</sub> = 25 °C.

## 2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86**DC CHARACTERISTICS FOR THE 74HCT1G**

Over recommended operating conditions; voltages are referenced to GND (ground = 0 V).

| SYMBOL          | PARAMETER                                   | $T_{amb}$ (°C) |                     |      |             |      | UNIT    | TEST CONDITIONS |   |
|-----------------|---|----------------|---------------------|------|-------------|------|---------|-----------------|---|
|                 |   | -40 to +85     |                     |      | -40 to +125 |      |         | $V_{CC}$ (V)    | OTHER   |
|                 |   | MIN.           | TYP. <sup>(1)</sup> | MAX. | MIN.        | MAX. |         |                 |   |
| $V_{IH}$        | HIGH-level input voltage                    | 2.0            | 1.6                 | –    | 2.0         | –    | V       | 4.5 to 5.5      |   |
| $V_{IL}$        | LOW-level input voltage                     | –              | 1.2                 | 0.8  | –           | 0.8  | V       | 4.5 to 5.5      |   |
| $V_{OH}$        | HIGH-level output voltage; all outputs      | 4.4            | 4.5                 | –    | 4.4         | –    | V       | 4.5             | $V_I = V_{IH}$ or $V_{IL}$ ;<br>$-I_O = 20 \mu A$       |
| $V_{OH}$        | HIGH-level output voltage; standard outputs | 4.13           | 4.32                | –    | 3.7         | –    | V       | 4.5             | $V_I = V_{IH}$ or $V_{IL}$ ;<br>$-I_O = 2.0 \text{ mA}$ |
| $V_{OL}$        | LOW-level output voltage; all outputs       | –              | 0                   | 0.1  | –           | 0.1  | V       | 4.5             | $V_I = V_{IH}$ or $V_{IL}$ ;<br>$I_O = 20 \mu A$        |
| $V_{OL}$        | LOW-level output voltage; standard outputs  | –              | 0.15                | 0.33 | –           | 0.4  | V       | 4.5             | $V_I = V_{IH}$ or $V_{IL}$ ;<br>$I_O = 2.0 \text{ mA}$  |
| $I_I$           | input leakage current                       | –              | –                   | 1.0  | –           | 1.0  | $\mu A$ | 5.5             | $V_I = V_{CC}$ or GND                                   |
| $I_{CC}$        | quiescent supply current                    | –              | –                   | 10.0 | –           | 20.0 | $\mu A$ | 5.5             | $V_I = V_{CC}$ or GND;<br>$I_O = 0$                     |
| $\Delta I_{CC}$ | additional supply current per input         | –              | –                   | 500  | –           | 850  | $\mu A$ | 4.5 to 5.5      | $V_I = V_{CC} - 2.1 \text{ V}$ ;<br>$I_O = 0$           |

**Note**1. All typical values are measured at  $T_{amb} = 25 \text{ }^\circ\text{C}$ .

## 2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86**AC CHARACTERISTICS FOR 74HC1G86**GND = 0 V;  $t_r = t_f = 6.0$  ns;  $C_L = 50$  pF.

| SYMBOL            | PARAMETER                             | $T_{amb}$ (°C) |                     |      |             |      | UNIT | TEST CONDITIONS |                  |
|-------------------|---------------------------------------|----------------|---------------------|------|-------------|------|------|-----------------|------------------|
|                   |                                       | -40 to +85     |                     |      | -40 to +125 |      |      | $V_{CC}$ (V)    | WAVEFORMS        |
|                   |                                       | MIN.           | TYP. <sup>(1)</sup> | MAX. | MIN.        | MAX. |      |                 |                  |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>inA, inB to outY | -              | 22                  | 115  | -           | 135  | ns   | 2.0             | see Figs 5 and 6 |
|                   |                                       | -              | 11                  | 23   | -           | 27   | ns   | 4.5             |                  |
|                   |                                       | -              | 9                   | 20   | -           | 23   | ns   | 6.0             |                  |

**Note**1. All typical values are measured at  $T_{amb} = 25$  °C.**AC CHARACTERISTICS FOR 74HCT1G86**GND = 0 V;  $t_r = t_f = 6.0$  ns;  $C_L = 50$  pF.

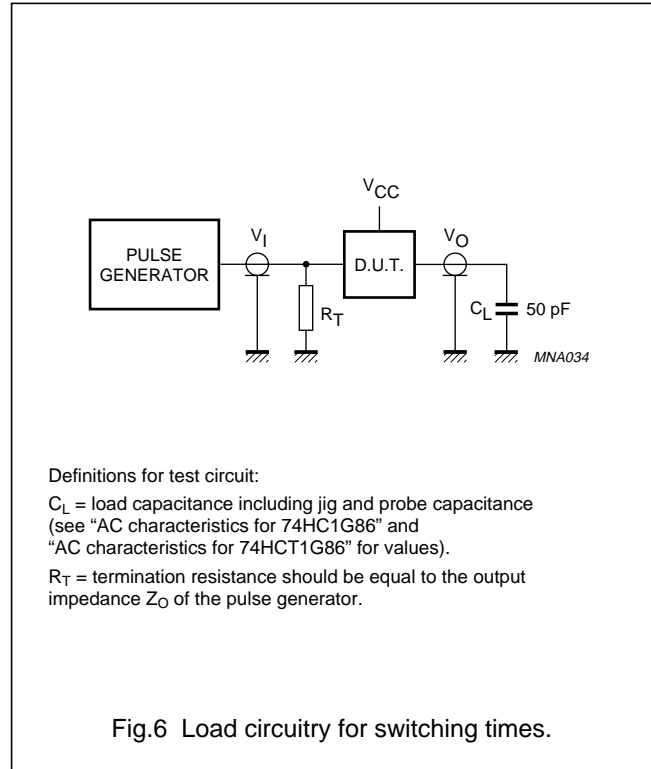
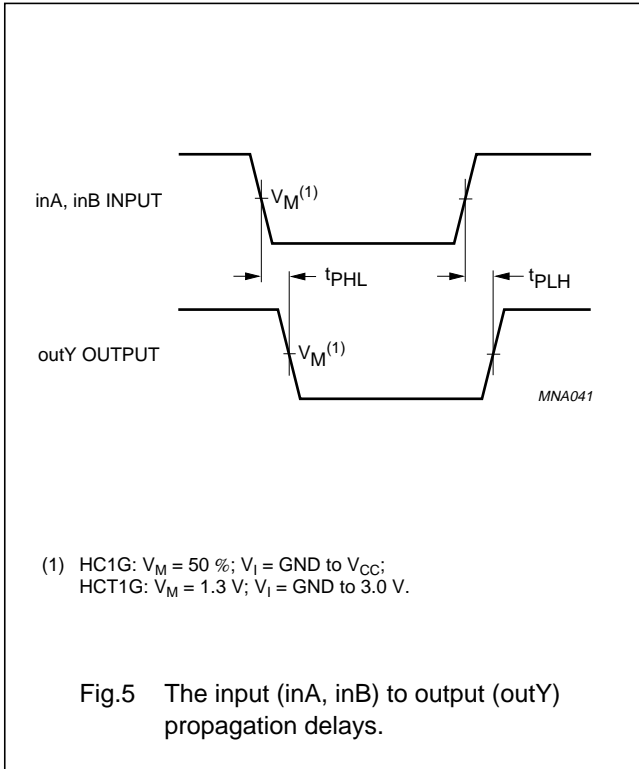
| SYMBOL            | PARAMETER                             | $T_{amb}$ (°C) |                     |      |             |      | UNIT | TEST CONDITIONS |                  |
|-------------------|---------------------------------------|----------------|---------------------|------|-------------|------|------|-----------------|------------------|
|                   |                                       | -40 to +85     |                     |      | -40 to +125 |      |      | $V_{CC}$ (V)    | WAVEFORMS        |
|                   |                                       | MIN.           | TYP. <sup>(1)</sup> | MAX. | MIN.        | MAX. |      |                 |                  |
| $t_{PHL}/t_{PLH}$ | propagation delay<br>inA, inB to outY | -              | 13                  | 23   | -           | 27   | ns   | 4.5             | see Figs 5 and 6 |

**Note**1. All typical values are measured at  $T_{amb} = 25$  °C.

2-input EXCLUSIVE-OR gate

74HC1G86;  
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AC WAVEFORMS





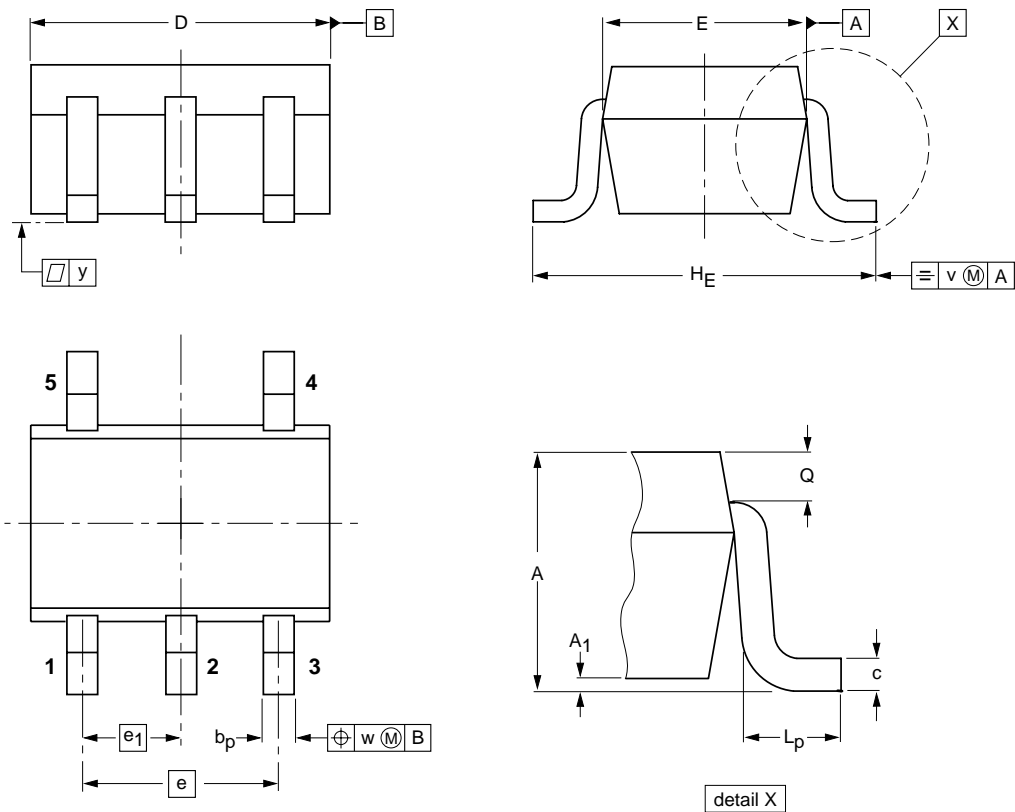
2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86

PACKAGE OUTLINE

Plastic surface mounted package; 5 leads

SOT353



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max | b <sub>p</sub> | c            | D          | E <sup>(2)</sup> | e   | e <sub>1</sub> | H <sub>E</sub> | L <sub>p</sub> | Q            | v   | w   | y   |
|------|------------|-----------------------|----------------|--------------|------------|------------------|-----|----------------|----------------|----------------|--------------|-----|-----|-----|
| mm   | 1.1<br>0.8 | 0.1                   | 0.30<br>0.20   | 0.25<br>0.10 | 2.2<br>1.8 | 1.35<br>1.15     | 1.3 | 0.65           | 2.2<br>2.0     | 0.45<br>0.15   | 0.25<br>0.15 | 0.2 | 0.2 | 0.1 |

| OUTLINE<br>VERSION | REFERENCES |       |        |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|--------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ   |  |                        |            |
| SOT353             |            |       | SC-88A |  |                        | 97-02-28   |

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## 2-input EXCLUSIVE-OR gate

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74HC1G86;  
74HCT1G86

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### SOLDERING

#### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (order code 9398 652 90011).

#### Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

#### Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

#### Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

## 2-input EXCLUSIVE-OR gate

74HC1G86;  
74HCT1G86**DEFINITIONS**

|   |   |
|---|---|
| <b>Data sheet status</b>  |   |
| Objective specification   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification   | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification   | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>  |   |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |   |
| <b>Application information</b>  |   |
| Where application information is given, it is advisory and does not form part of the specification.   |   |

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