

# DATA SHEET

For a complete data sheet, please also download:

- The IC06 74HC/HCT/HCU/HCMOS Logic Family Specifications
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Information
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Outlines

## **74HC4049**

Hex inverting high-to-low level shifter

Product specification  
File under Integrated Circuits, IC06

December 1990

## Hex inverting high-to-low level shifter

74HC4049

## FEATURES

- Output capability: standard
- I<sub>CC</sub> category: SSI

## GENERAL DESCRIPTION

The 74HC4049 is a high-speed Si-gate CMOS device and is pin compatible with the "4049" of the "4000B" series. It is specified in compliance with JEDEC standard no. 7A.

The 74HC4049 provides six inverting buffers with a modified input protection structure, which has no diode connected to V<sub>CC</sub>. Input voltages of up to 15 V may therefore be used.

This feature enables the inverting buffers to be used as logic level translators, which will convert high level logic to low level logic, while operating from a low voltage power supply. For example 15 V logic ("4000B series") can be converted down to 2 V logic.

The actual input switch level remains related to the V<sub>CC</sub> and is the same as mentioned in the family characteristics. At the same time each part can be used as a simple inverter without level translation.

## APPLICATIONS

- Converting 15 V logic ("4000B" series) down to 2 V logic.

## QUICK REFERENCE DATA

GND = 0 V; T<sub>amb</sub> = 25 °C; t<sub>r</sub> = t<sub>f</sub> = 6 ns

| SYMBOL                             | PARAMETER                                | CONDITIONS                                    | TYPICAL | UNIT |
|------------------------------------|--|---|---------|------|
|                                    |  |   | HC      |      |
| t <sub>PHL</sub> /t <sub>PLH</sub> | propagation delay nA to n $\bar{Y}$      | C <sub>L</sub> = 15 pF; V <sub>CC</sub> = 5 V | 8       | ns   |
| C <sub>I</sub>                     | input capacitance                        |   | 3.5     | pF   |
| C <sub>PD</sub>                    | power dissipation capacitance per buffer | note 1  | 14      | pF   |

## Note

1. C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in  $\mu$ 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<sub>i</sub> = input frequency in MHz

f<sub>o</sub> = output frequency in MHz

C<sub>L</sub> = output load capacitance in pF

V<sub>CC</sub> = supply voltage in V

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

## ORDERING INFORMATION

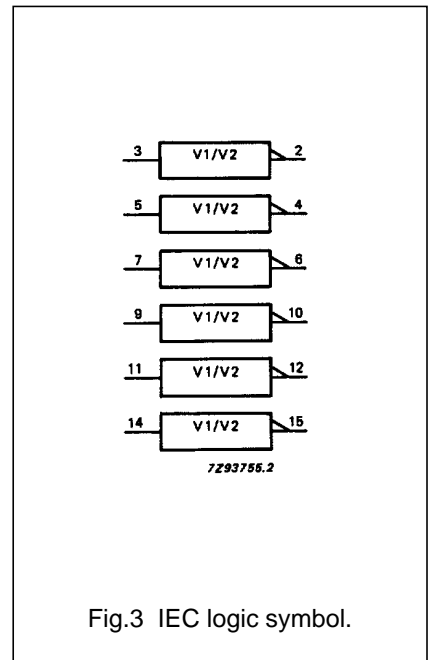
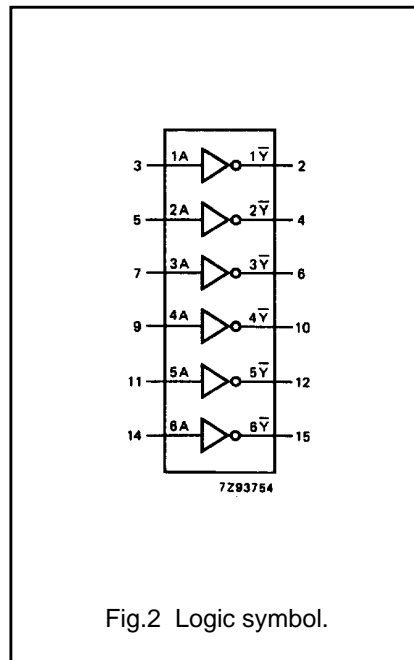
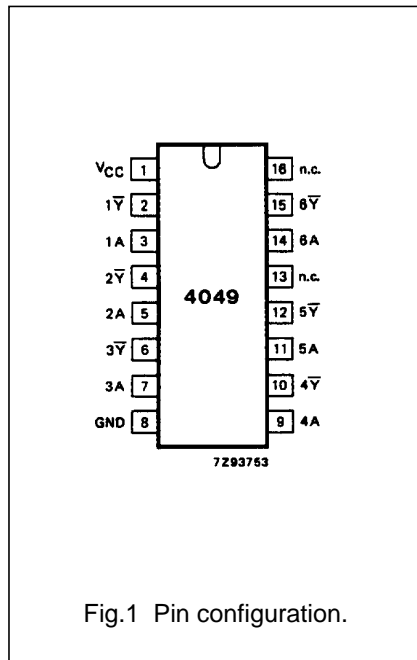
See "74HC/HCT/HCU/HCMOS Logic Package Information".

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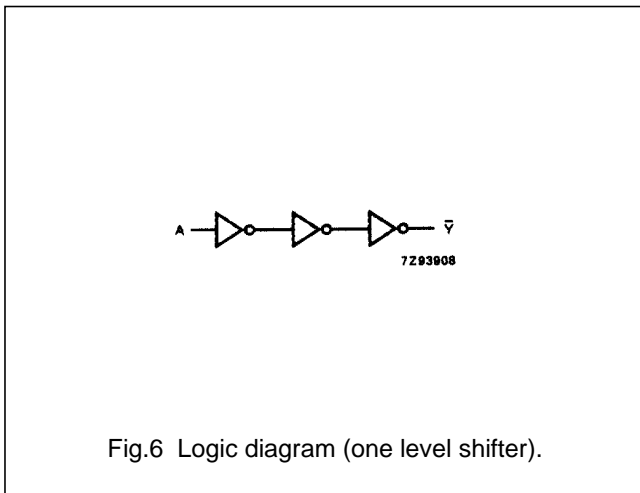
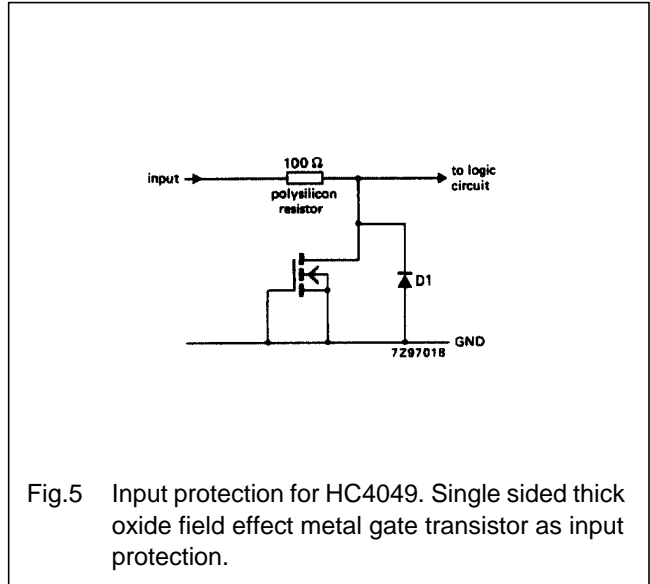
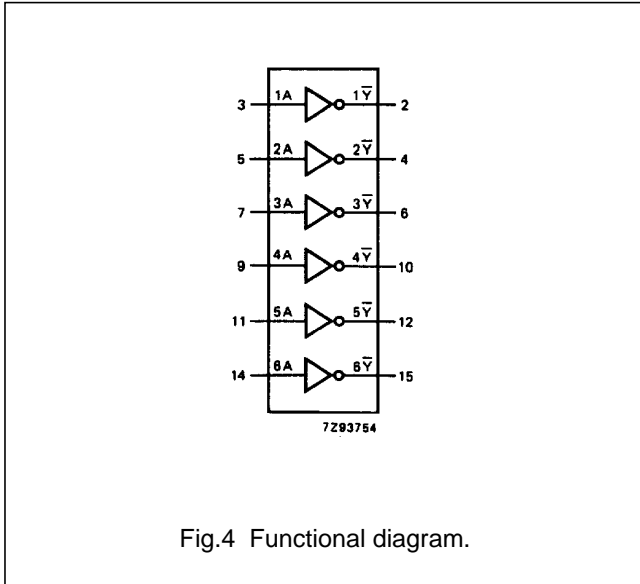
## PIN DESCRIPTION

| PIN NO.             | SYMBOL                     | NAME AND FUNCTION       |
|---------------------|----------------------------|-------------------------|
| 1                   | V <sub>CC</sub>            | positive supply voltage |
| 2, 4, 6, 10, 12, 15 | 1 $\bar{Y}$ to 6 $\bar{Y}$ | data outputs            |
| 3, 5, 7, 9, 11, 14  | 1A to 6A                   | data inputs             |
| 8                   | GND                        | ground (0 V)            |
| 13, 16              | n.c.                       | not connected           |



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**FUNCTION TABLE**

| INPUT | OUTPUT |
|-------|--------|
| nA    | nY-bar |
| L     | H      |
| H     | L      |

**Notes**

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

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**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages are referenced to GND (ground = 0 V)

| SYMBOL                          | PARAMETER   | MIN. | MAX. | UNIT | CONDITIONS                                    |
|---------------------------------|---|------|------|------|---|
| $V_{CC}$                        | DC supply voltage   | -0.5 | +7   | V    |   |
| $V_{IK}$                        | DC input voltage range  | -0.5 | +16  | V    |   |
| $-I_{IK}$                       | DC input diode current  |      | 20   | mA   | for $V_I < -0.5$ V                            |
| $\pm I_{OK}$                    | DC output diode current   |      | 20   | mA   | for $V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V  |
| $\pm I_O$                       | DC output source or sink current<br>- standard outputs              |      | 25   | mA   | for $-0.5$ V $< V_O < V_{CC} + 0.5$ V         |
| $\pm I_{CC}$ ;<br>$\pm I_{GND}$ | DC $V_{CC}$ or GND current for types<br>with:<br>- standard outputs |      | 50   | mA   |   |
| $T_{stg}$                       | storage temperature range   | -65  | +150 | °C   |   |
| $P_{tot}$                       | power dissipation per package                                       |      |      |      | for temperature range: -40 to +125 °C<br>74HC |
|                                 | plastic DIL   |      | 750  | mW   | above +70 °C: derate linearly with 12 mW/K    |
|                                 | plastic mini-pack (SO)  |      | 400  | mW   | above +70 °C: derate linearly with 8 mW/K     |

**RECOMMENDED OPERATING CONDITIONS**

| SYMBOL     | PARAMETER                           | 74HC |      |                                   | UNIT | CONDITIONS   |
|------------|-------------------------------------|------|------|-----------------------------------|------|--|
|            |                                     | min. | typ. | max.                              |      |  |
| $V_{CC}$   | DC supply voltage                   | 2.0  | 5.0  | 6.0                               | V    |  |
| $V_I$      | DC input voltage range              | GND  | -    | 15                                | V    |  |
| $T_{amb}$  | operating ambient temperature range | -40  |      | +85                               | °C   | see DC and AC<br>characteristics   |
| $T_{amb}$  | operating ambient temperature range | -40  |      | +125                              | °C   |  |
| $t_r, t_f$ | input rise and fall times           |      | 6.0  | 1000<br>500<br>400<br>650<br>1000 | ns   | $V_{CC} = 2.0$ V; $V_{IN} = 2.0$ V<br>$V_{CC} = 4.5$ V; $V_{IN} = 4.5$ V<br>$V_{CC} = 6.0$ V; $V_{IN} = 6.0$ V<br>$V_{CC} = 6.0$ V; $V_{IN} = 10.0$ V<br>$V_{CC} = 6.0$ V; $V_{IN} = 15.0$ V |

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**DC CHARACTERISTICS FOR 74HC**

Voltages are referenced to GND (ground = 0 V)

| SYMBOL           | PARAMETER                                  | T <sub>amb</sub> (°C) |                   |                    |                    |                    |                    |                    | UNIT | TEST CONDITIONS        |  |   |
|------------------|--|-----------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------|------------------------|--|---|
|                  |  | 74HC                  |                   |                    |                    |                    |                    |                    |      | V <sub>CC</sub><br>(V) | V <sub>I</sub>                           | OTHER   |
|                  |  | +25                   |                   |                    | -40 to +85         |                    | -40 to +125        |                    |      |                        |  |   |
|                  |  | min.                  | typ.              | max.               | min.               | max.               | min.               | max.               |      |                        |  |   |
| V <sub>IH</sub>  | HIGH level input voltage                   | 1.5<br>3.15<br>4.2    | 1.3<br>2.4<br>3.1 |                    | 1.5<br>3.15<br>4.2 |                    | 1.5<br>3.15<br>4.2 |                    | V    | 2.0<br>4.5<br>6.0      |  |   |
| V <sub>IL</sub>  | LOW level input voltage                    |                       | 0.7<br>1.8<br>2.3 | 0.5<br>1.35<br>1.8 |                    | 0.5<br>1.35<br>1.8 |                    | 0.5<br>1.35<br>1.8 | V    | 2.0<br>4.5<br>6.0      |  |   |
| V <sub>OH</sub>  | HIGH level output voltage all outputs      | 1.9<br>4.4<br>5.9     | 2.0<br>4.5<br>6.0 |                    | 1.9<br>4.4<br>5.9  |                    | 1.9<br>4.4<br>5.9  |                    | V    | 2.0<br>4.5<br>6.0      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | -I <sub>O</sub> = 20 μA<br>-I <sub>O</sub> = 20 μA<br>-I <sub>O</sub> = 20 μA |
| V <sub>OH</sub>  | HIGH level output voltage standard outputs | 3.98<br>5.48          |                   |                    | 3.84<br>5.34       |                    | 3.7<br>5.2         |                    | V    | 4.5<br>6.0             | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | -I <sub>O</sub> = 4.0 mA<br>-I <sub>O</sub> = 5.2 mA                          |
| V <sub>OL</sub>  | LOW level output voltage all outputs       |                       |                   | 0.1<br>0.1<br>0.1  |                    | 0.1<br>0.1<br>0.1  |                    | 0.1<br>0.1<br>0.1  | V    | 2.0<br>4.5<br>6.0      | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | I <sub>O</sub> = 20 μA<br>I <sub>O</sub> = 20 μA<br>I <sub>O</sub> = 20 μA    |
| V <sub>OL</sub>  | LOW level output voltage standard outputs  |                       |                   | 0.26<br>0.26       |                    | 0.33<br>0.33       |                    | 0.4<br>0.4         | V    | 4.5<br>6.0             | V <sub>IH</sub><br>or<br>V <sub>IL</sub> | I <sub>O</sub> = 4.0 mA<br>I <sub>O</sub> = 5.2 mA                            |
| ± I <sub>I</sub> | input leakage current                      |                       |                   | 0.1                |                    | 1.0                |                    | 1.0                | μA   | 6.0                    | V <sub>CC</sub><br>or<br>GND             |   |
|                  |  |                       |                   | 0.5                |                    | 5.0                |                    | 5.0                | μA   | 2.0<br>to<br>6.0       | 15 V                                     |   |
| I <sub>CC</sub>  | quiescent supply current                   |                       |                   | 2.0                |                    | 20.0               |                    | 40.0               | μA   | 6.0                    | 15 V<br>or<br>GND                        |   |

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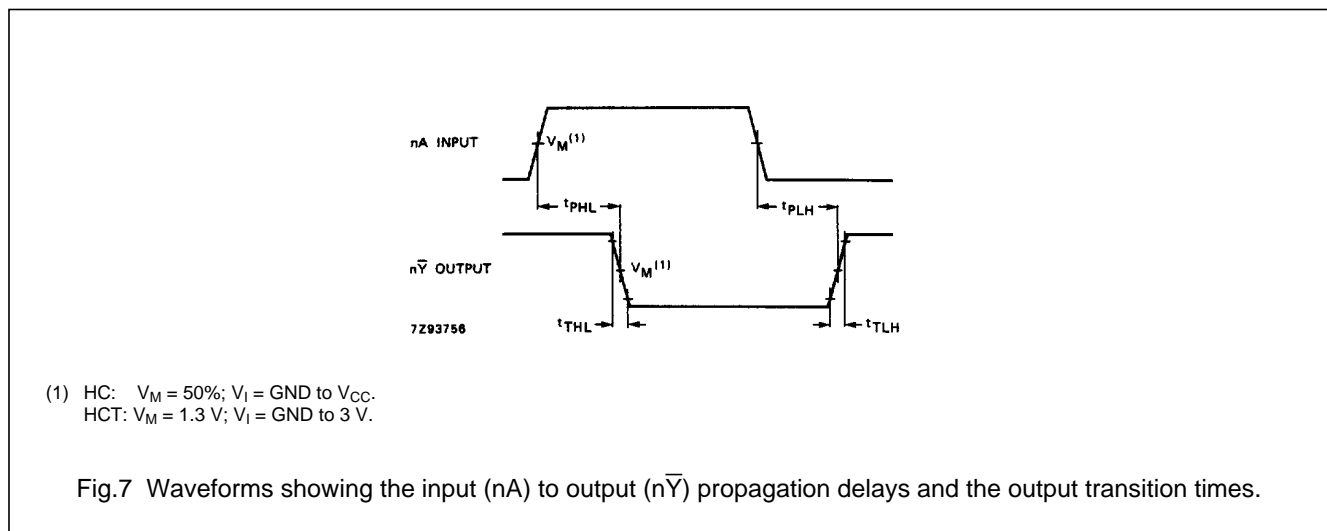
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## AC CHARACTERISTICS FOR 74HC

GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

| SYMBOL              | PARAMETER                              | $T_{amb}$ (°C) |               |                |            |                 |             | UNIT            | TEST CONDITIONS |                   |       |
|---------------------|--|----------------|---------------|----------------|------------|-----------------|-------------|-----------------|-----------------|-------------------|-------|
|                     |  | 74HC           |               |                |            |                 |             |                 | $V_{CC}$ (V)    | WAVEFORMS         |       |
|                     |  | +25            |               |                | -40 to +85 |                 | -40 to +125 |                 |                 |                   |       |
|                     |  | min.           | typ.          | max.           | min.       | max.            | min.        |                 |                 |                   | max.  |
| $t_{PHL} / t_{PLH}$ | propagation delay<br>nA to n $\bar{Y}$ |                | 28<br>10<br>8 | 85<br>17<br>14 |            | 105<br>21<br>18 |             | 130<br>26<br>22 | ns              | 2.0<br>4.5<br>6.0 | Fig.7 |
| $t_{THL} / t_{TLH}$ | output transition<br>time              |                | 19<br>7<br>6  | 75<br>15<br>13 |            | 95<br>19<br>16  |             | 110<br>22<br>19 | ns              | 2.0<br>4.5<br>6.0 | Fig.7 |

## AC WAVEFORMS



## PACKAGE OUTLINES

See "74HC/HCT/HCU/HCMOS Logic Package Outlines".