

# SN54HC05, SN74HC05 HEX INVERTERS WITH OPEN-DRAIN OUTPUTS

SCLS080B – MARCH 1984 – REVISED MAY 1997

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

## description

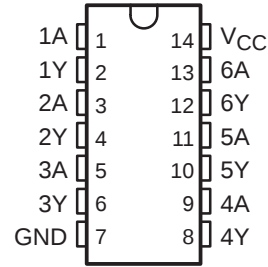
These devices contain six independent inverters. They perform the Boolean function  $Y = \bar{A}$  in positive logic. The open-drain outputs require pullup resistors to perform correctly. They may be connected to other open-drain outputs to implement active-low wired-OR or active-high wired-AND functions.

The SN54HC05 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC05 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

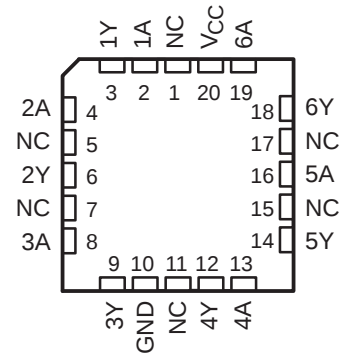
FUNCTION TABLE  
(each inverter)

| INPUT<br>A | OUTPUT<br>Y |
|------------|-------------|
| H          | L           |
| L          | H           |

SN54HC05 . . . J OR W PACKAGE  
SN74HC05 . . . D OR N PACKAGE  
(TOP VIEW)

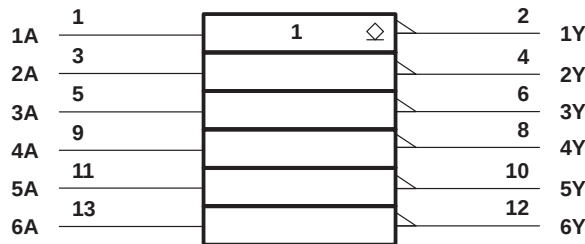


SN54HC05 . . . FK PACKAGE  
(TOP VIEW)



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, N, and W packages.

## logic diagram (positive logic)



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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**

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# SN54HC05, SN74HC05

## HEX INVERTERS

### WITH OPEN-DRAIN OUTPUTS

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#### absolute maximum ratings over operating free-air temperature<sup>†</sup>

|                                                                             |                |
|-----------------------------------------------------------------------------|----------------|
| Supply voltage range, $V_{CC}$                                              | –0.5 V to 7 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) | ±20 mA         |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )                  | ±25 mA         |
| Continuous current through $V_{CC}$ or GND                                  | ±50 mA         |
| Package thermal impedance, $\theta_{JA}$ (see Note 2): D package            | 127°C/W        |
| N package                                                                   | 78°C/W         |
| Storage temperature range, $T_{stg}$                                        | –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.

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, except for through-hole packages, which use a trace length of zero.

#### recommended operating conditions

|          |                                       |                  | SN54HC05 |     |          | SN74HC05 |     |          | UNIT |
|----------|---------------------------------------|------------------|----------|-----|----------|----------|-----|----------|------|
|          |                                       |                  | MIN      | NOM | MAX      | MIN      | NOM | MAX      |      |
| $V_{CC}$ | Supply voltage                        |                  | 2        | 5   | 6        | 2        | 5   | 6        | V    |
| $V_{IH}$ | High-level input voltage              | $V_{CC} = 2$ V   | 1.5      |     |          | 1.5      |     |          | V    |
|          |                                       | $V_{CC} = 4.5$ V | 3.15     |     |          | 3.15     |     |          |      |
|          |                                       | $V_{CC} = 6$ V   | 4.2      |     |          | 4.2      |     |          |      |
| $V_{IL}$ | Low-level input voltage               | $V_{CC} = 2$ V   | 0        |     | 0.5      | 0        |     | 0.5      | V    |
|          |                                       | $V_{CC} = 4.5$ V | 0        |     | 1.35     | 0        |     | 1.35     |      |
|          |                                       | $V_{CC} = 6$ V   | 0        |     | 1.8      | 0        |     | 1.8      |      |
| $V_I$    | Input voltage                         |                  | 0        |     | $V_{CC}$ | 0        |     | $V_{CC}$ | V    |
| $V_O$    | Output voltage                        |                  | 0        |     | $V_{CC}$ | 0        |     | $V_{CC}$ | V    |
| $t_t$    | Input transition (rise and fall) time | $V_{CC} = 2$ V   | 0        |     | 1000     | 0        |     | 1000     | ns   |
|          |                                       | $V_{CC} = 4.5$ V | 0        |     | 500      | 0        |     | 500      |      |
|          |                                       | $V_{CC} = 6$ V   | 0        |     | 400      | 0        |     | 400      |      |
| $T_A$    | Operating free-air temperature        |                  | –55      |     | 125      | –40      |     | 85       | °C   |

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

| PARAMETER | TEST CONDITIONS                |                   | $V_{CC}$   | $T_A = 25^\circ\text{C}$ |      |     | SN54HC05 |     | SN74HC05 |     | UNIT |
|-----------|--------------------------------|-------------------|------------|--------------------------|------|-----|----------|-----|----------|-----|------|
|           |                                |                   |            | MIN                      | TYP  | MAX | MIN      | MAX | MIN      | MAX |      |
| $I_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$     | $V_O = V_{CC}$    | 6 V        | 0.01                     | 0.5  |     | 10       |     | 5        |     | μA   |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$     | $I_{OL} = 20$ μA  | 2 V        | 0.002                    | 0.1  |     | 0.1      |     | 0.1      |     | V    |
|           |                                |                   | 4.5 V      | 0.001                    | 0.1  |     | 0.1      |     | 0.1      |     |      |
|           |                                |                   | 6 V        | 0.001                    | 0.1  |     | 0.1      |     | 0.1      |     |      |
|           |                                | $I_{OL} = 4$ mA   | 4.5 V      | 0.17                     | 0.26 |     | 0.4      |     | 0.33     |     |      |
|           |                                | $I_{OL} = 5.2$ mA | 6 V        | 0.15                     | 0.26 |     | 0.4      |     | 0.33     |     |      |
| $I_I$     | $V_I = V_{CC}$ or 0            |                   | 6 V        | ±0.1                     | ±100 |     | ±1000    |     | ±1000    |     | nA   |
| $I_{CC}$  | $V_I = V_{CC}$ or 0, $I_O = 0$ |                   | 6 V        |                          | 2    |     | 40       |     | 20       |     | μA   |
| $C_i$     |                                |                   | 2 V to 6 V | 3                        | 10   |     | 10       |     | 10       |     | pF   |



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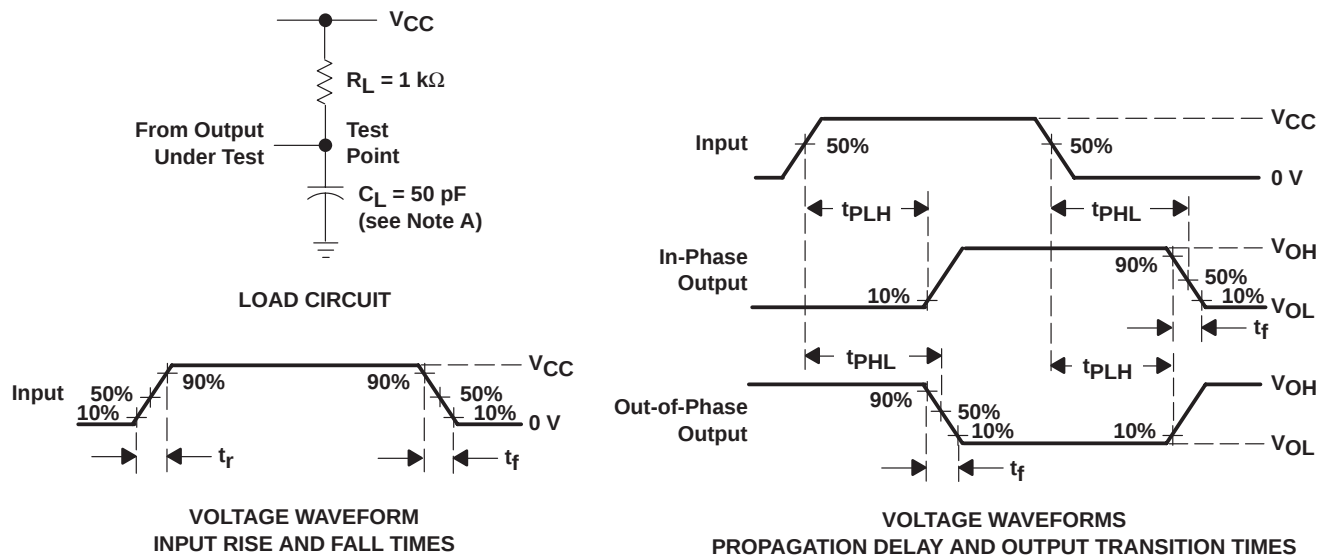
switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ | $T_A = 25^\circ\text{C}$ |     |     | SN54HC05 |     | SN74HC05 |     | UNIT |
|-----------|--------------|-------------|----------|--------------------------|-----|-----|----------|-----|----------|-----|------|
|           |              |             |          | MIN                      | TYP | MAX | MIN      | MAX | MIN      | MAX |      |
| $t_{PLH}$ | A            | Y           | 2 V      |                          | 60  | 115 |          | 175 |          | 145 | ns   |
|           |              |             | 4.5 V    |                          | 13  | 23  |          | 35  |          | 29  |      |
|           |              |             | 6 V      |                          | 10  | 20  |          | 30  |          | 25  |      |
| $t_{PHL}$ | A            | Y           | 2 V      |                          | 45  | 85  |          | 130 |          | 105 | ns   |
|           |              |             | 4.5 V    |                          | 9   | 17  |          | 26  |          | 21  |      |
|           |              |             | 6 V      |                          | 8   | 14  |          | 22  |          | 18  |      |
| $t_f$     |              | Y           | 2 V      |                          | 38  | 75  |          | 110 |          | 95  | ns   |
|           |              |             | 4.5 V    |                          | 8   | 15  |          | 22  |          | 19  |      |
|           |              |             | 6 V      |                          | 6   | 13  |          | 19  |          | 16  |      |

operating characteristics,  $T_A = 25^\circ\text{C}$

| PARAMETER |                                            | TEST CONDITIONS | TYP | UNIT |
|-----------|--------------------------------------------|-----------------|-----|------|
| $C_{pd}$  | Power dissipation capacitance per inverter | No load         | 20  | pF   |

### PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 6\text{ ns}$ ,  $t_f = 6\text{ ns}$ .
  - C. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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