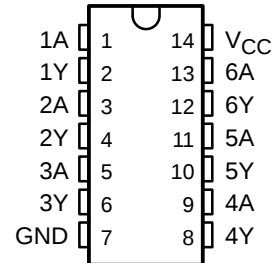


# CD54AC05, CD74AC05 HEX INVERTERS WITH OPEN-DRAIN OUTPUTS

SCHS306C – JANUARY 2001 –REVISED JUNE 2002

- AC Types Feature 1.5-V to 5.5-V Operation and Balanced Noise Immunity at 30% of the Supply Voltage
- Speed of Bipolar F, AS, and S, With Significantly Reduced Power Consumption
- Balanced Propagation Delays
- $\pm 24$ -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

CD54AC05 . . . F PACKAGE  
CD74AC05 . . . E OR M PACKAGE  
(TOP VIEW)



## description

The 'AC05 devices contain six independent inverters. These devices perform the Boolean function  $Y = \bar{A}$ . The open-drain outputs require pullup resistors to perform correctly, and can be connected to other open-drain outputs to implement active-low wired-OR or active-high wired-AND functions.

## ORDERING INFORMATION

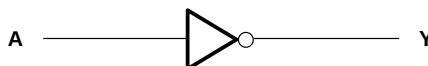
| $T_A$          | PACKAGE <sup>†</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------------------|---------------|-----------------------|------------------|
| –55°C to 125°C | PDIP – E             | Tube          | CD74AC05E             | CD74AC05E        |
|                | SOIC – M             | Tube          | CD74AC05M             | AC05M            |
|                |                      | Tape and reel | CD74AC05M96           |                  |
|                | CDIP – F             | Tube          | CD54AC05F3A           | CD54AC05F3A      |

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE (each inverter)

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

## logic diagram, each inverter (positive logic)



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**TEXAS  
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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

# CD54AC05, CD74AC05

## HEX INVERTERS

### WITH OPEN-DRAIN OUTPUTS

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

|                                                                             |                |
|-----------------------------------------------------------------------------|----------------|
| 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, $\theta_{JA}$ (see Note 2): E package            | 80°C/W         |
| M package                                                                   | 86°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 51-7.

#### recommended operating conditions (see Note 3)

|                     |                                    |                                          | $T_A = 25^\circ\text{C}$ |          | –40°C TO 85°C |          | –55°C TO 125°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           | $V_{CC} = 1.5\text{ V}$                  | 1.2                      |          | 1.2           |          | 1.2            |          | V    |
|                     |                                    | $V_{CC} = 3\text{ V}$                    | 2.1                      |          | 2.1           |          | 2.1            |          |      |
|                     |                                    | $V_{CC} = 5.5\text{ V}$                  | 3.85                     |          | 3.85          |          | 3.85           |          |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 1.5\text{ V}$                  |                          | 0.3      |               | 0.3      |                | 0.3      | V    |
|                     |                                    | $V_{CC} = 3\text{ V}$                    |                          | 0.9      |               | 0.9      |                | 0.9      |      |
|                     |                                    | $V_{CC} = 5.5\text{ V}$                  |                          | 1.65     |               | 1.65     |                | 1.65     |      |
| $V_I$               | Input voltage                      |                                          | 0                        | $V_{CC}$ | 0             | $V_{CC}$ | 0              | $V_{CC}$ | V    |
| $V_O$               | Output voltage                     |                                          | 0                        | 5.5      | 0             | 5.5      | 0              | 5.5      | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ |                          | –24      |               | –24      |                | –24      | mA   |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ |                          | 24       |               | 24       |                | 24       | mA   |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 1.5\text{ V to } 3\text{ V}$   |                          | 50       |               | 50       |                | 50       | ns/V |
|                     |                                    | $V_{CC} = 3.6\text{ V to } 5.5\text{ V}$ |                          | 20       |               | 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.

**CD54AC05, CD74AC05**  
**HEX INVERTERS**  
**WITH OPEN-DRAIN OUTPUTS**  
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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER       | TEST CONDITIONS                                             |                                      | V <sub>CC</sub> | T <sub>A</sub> = 25°C |      | –40°C TO 85°C |     | –55°C TO 125°C |     | UNIT |
|-----------------|-------------------------------------------------------------|--------------------------------------|-----------------|-----------------------|------|---------------|-----|----------------|-----|------|
|                 |                                                             |                                      |                 | MIN                   | MAX  | MIN           | MAX | MIN            | MAX |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>         | I <sub>OL</sub> = 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 <sub>OL</sub> = 12 mA              | 3 V             | 0.36                  | 0.44 | 0.5           |     |                |     |      |
|                 |                                                             | I <sub>OL</sub> = 24 mA              | 4.5 V           | 0.36                  | 0.44 | 0.5           |     |                |     |      |
|                 |                                                             | I <sub>OL</sub> = 50 mA <sup>†</sup> | 5.5 V           |                       |      | 1.65          |     |                |     |      |
|                 |                                                             | I <sub>OL</sub> = 75 mA <sup>†</sup> | 5.5 V           |                       | 1.65 |               |     |                |     |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                     |                                      | 5.5 V           | ±0.1                  | ±1   | ±1            | μA  |                |     |      |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 |                                      | 5.5 V           | 4                     | 40   | 80            | μA  |                |     |      |
| C <sub>i</sub>  |                                                             |                                      |                 | 10                    | 10   | 10            | pF  |                |     |      |

<sup>†</sup> 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.

switching characteristics over recommended operating free-air temperature range,  
 V<sub>CC</sub> = 1.5 V, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | –40°C TO<br>85°C |     | –55°C TO<br>125°C |     | UNIT |
|-----------|-----------------|----------------|------------------|-----|-------------------|-----|------|
|           |                 |                | MIN              | MAX | MIN               | MAX |      |
| tPLZ      | A               | Y              | 94               |     | 103               |     | ns   |
| tpZL      |                 |                | 74               |     | 81                |     |      |

switching characteristics over recommended operating free-air temperature range,  
 V<sub>CC</sub> = 3.3 V ± 0.3 V, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | –40°C TO 85°C |      | –55°C TO 125°C |      | UNIT |
|------------------|--------------|-------------|---------------|------|----------------|------|------|
|                  |              |             | MIN           | MAX  | MIN            | MAX  |      |
| t <sub>PLZ</sub> | A            | Y           | 3             | 10.4 | 2.9            | 11.5 | ns   |
| t <sub>PZL</sub> |              |             | 2.3           | 8.3  | 2.3            | 9.1  |      |

switching characteristics over recommended operating free-air temperature range,  
 V<sub>CC</sub> = 5 V ± 0.5 V, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | –40°C TO 85°C |     | –55°C TO 125°C |     | UNIT |
|------------------|--------------|-------------|---------------|-----|----------------|-----|------|
|                  |              |             | MIN           | MAX | MIN            | MAX |      |
| t <sub>PLZ</sub> | A            | Y           | 2.2           | 7.5 | 2.1            | 8.2 | ns   |
| t <sub>PZL</sub> |              |             | 1.7           | 5.9 | 1.6            | 6.5 |      |

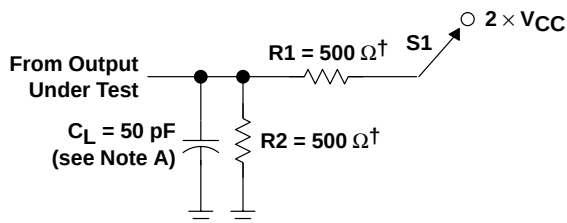
operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

| PARAMETER       |                               |  | TYP | UNIT |
|-----------------|-------------------------------|--|-----|------|
| C <sub>pd</sub> | Power dissipation capacitance |  | 105 | pF   |

# CD54AC05, CD74AC05 HEX INVERTERS WITH OPEN-DRAIN OUTPUTS

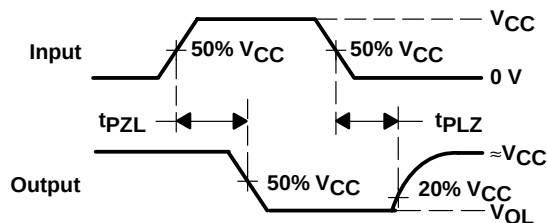
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## PARAMETER MEASUREMENT INFORMATION



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

LOAD CIRCUIT



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 3\text{ ns}$ ,  $t_f \leq 3\text{ ns}$ .  
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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