

CD74AC04, CD74ACT04, CD74AC05, CD74ACT05

September 1998

Hex Inverters

Features

- CD74AC04, CD74ACT04 Active Outputs
- CD74AC05, CD74ACT05 Open-Drain Outputs
- Buffered Inputs
- Typical Propagation Delay
 - 3.5ns at $V_{CC} = 5V$, $T_A = 25^\circ C$, $C_L = 50pF$
- Exceeds 2kV ESD Protection MIL-STD-883, Method 3015
- SCR-Latchup-Resistant CMOS Process and Circuit Design
- Speed of Bipolar FAST™/AS/S with Significantly Reduced Power Consumption
- Balanced Propagation Delays
- AC Types Feature 1.5V to 5.5V Operation and Balanced Noise Immunity at 30% of the Supply
- $\pm 24mA$ Output Drive Current
 - Fanout to 15 FAST™ ICs
 - Drives 50Ω Transmission Lines

Description

The CD74AC04, CD74ACT04, CD74AC05 and CD74ACT05 are hex inverters that utilize the Harris Advanced CMOS Logic technology.

Ordering Information

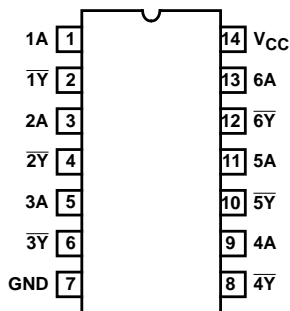
| PART NUMBER | TEMP. RANGE (°C) | PACKAGE | PKG. NO. |
|-------------|------------------|------------|----------|
| CD74AC04E | -55 to 125 | 14 Ld PDIP | E14.3 |
| CD74ACT04E | -55 to 125 | 14 Ld PDIP | E14.3 |
| CD74AC05E | -55 to 125 | 14 Ld PDIP | E14.3 |
| CD74ACT05E | -55 to 125 | 14 Ld PDIP | E14.3 |
| CD74AC04M | -55 to 125 | 14 Ld SOIC | M14.15 |
| CD74ACT04M | -55 to 125 | 14 Ld SOIC | M14.15 |
| CD74AC05M | -55 to 125 | 14 Ld SOIC | M14.15 |
| CD74ACT05M | -55 to 125 | 14 Ld SOIC | M14.15 |

NOTES:

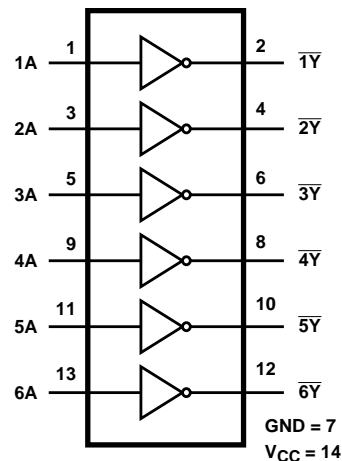
1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Wafer and die for this part number is available which meets all electrical specifications. Please contact your local sales office or Harris customer service for ordering information.

Pinout

CD74AC04, CD74ACT04, CD74AC05, CD74ACT05
(PDIP, SOIC)
TOP VIEW



Functional Diagram



TRUTH TABLE

| CD74AC/ACT04 | | CD74AC/ACT05 | |
|--------------|--------|--------------|--------|
| INPUT | OUTPUT | INPUT | OUTPUT |
| L | H | L | Z |
| H | L | H | L |

Z = High Impedance

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

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File Number **1945.1**

CD74AC04, CD74ACT04, CD74AC05, CD74ACT05

Absolute Maximum Ratings

| | |
|---|-------------|
| DC Supply Voltage, V_{CC} | -0.5V to 6V |
| DC Input Diode Current, I_{IK} | |
| For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ | $\pm 20mA$ |
| DC Output Diode Current, I_{OK} | |
| For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ | $\pm 50mA$ |
| DC Output Source or Sink Current per Output Pin, I_O | |
| For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ | $\pm 50mA$ |
| DC V_{CC} or Ground Current, I_{CC} or I_{GND} (Note 3) | $\pm 100mA$ |

Thermal Information

| | |
|--|------------------------------------|
| Thermal Resistance (Typical, Note 5) | θ_{JA} ($^{\circ}C/W$) |
| PDIP Package | 90 |
| SOIC Package | 175 |
| Maximum Junction Temperature (Plastic Package) | 150 $^{\circ}C$ |
| Maximum Storage Temperature Range | -65 $^{\circ}C$ to 150 $^{\circ}C$ |
| Maximum Lead Temperature (Soldering 10s) | 300 $^{\circ}C$ |

Operating Conditions

| | |
|---|------------------------------------|
| Temperature Range, T_A | -55 $^{\circ}C$ to 125 $^{\circ}C$ |
| Supply Voltage Range, V_{CC} (Note 4) | |
| AC Types | 1.5V to 5.5V |
| ACT Types | 4.5V to 5.5V |
| DC Input or Output Voltage, V_I , V_O | 0V to V_{CC} |
| Input Rise and Fall Slew Rate, dt/dv | |
| AC Types, 1.5V to 3V | 50ns (Max) |
| AC Types, 3.6V to 5.5V | 20ns (Max) |
| ACT Types, 4.5V to 5.5V | 10ns (Max) |

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

3. For up to 4 outputs per device, add $\pm 25mA$ for each additional output.
4. Unless otherwise specified, all voltages are referenced to ground.
5. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

DC Electrical Specifications

| PARAMETER | SYMBOL | TEST CONDITIONS | | V_{CC} (V) | 25 $^{\circ}C$ | | -40 $^{\circ}C$ TO 85 $^{\circ}C$ | | -55 $^{\circ}C$ TO 125 $^{\circ}C$ | | UNITS | |
|--------------------------------|----------|----------------------|-----------------|-----------------|----------------|------|-----------------------------------|------|------------------------------------|------|-------|---|
| | | V_I (V) | I_O (mA) | | MIN | MAX | MIN | MAX | MIN | MAX | | |
| AC TYPES | | | | | | | | | | | | |
| High Level Input Voltage | V_{IH} | - | - | 1.5 | 1.2 | - | 1.2 | - | 1.2 | - | V | |
| | | | | 3 | 2.1 | - | 2.1 | - | 2.1 | - | V | |
| | | | | 5.5 | 3.85 | - | 3.85 | - | 3.85 | - | V | |
| Low Level Input Voltage | V_{IL} | - | - | 1.5 | - | 0.3 | - | 0.3 | - | 0.3 | V | |
| | | | | 3 | - | 0.9 | - | 0.9 | - | 0.9 | V | |
| | | | | 5.5 | - | 1.65 | - | 1.65 | - | 1.65 | V | |
| High Level Output Voltage (04) | V_{OH} | V_{IH} or V_{IL} | -0.05 | -0.05 | 1.5 | 1.4 | - | 1.4 | - | 1.4 | - | V |
| | | | -0.05 | -0.05 | 3 | 2.9 | - | 2.9 | - | 2.9 | - | V |
| | | | -0.05 | -0.05 | 4.5 | 4.4 | - | 4.4 | - | 4.4 | - | V |
| | | | -4 | -4 | 3 | 2.58 | - | 2.48 | - | 2.4 | - | V |
| | | | -24 | -24 | 4.5 | 3.94 | - | 3.8 | - | 3.7 | - | V |
| | | | -75 (Note 6, 7) | -75 (Note 6, 7) | 5.5 | - | - | 3.85 | - | - | - | V |
| | | | -50 (Note 6, 7) | -50 (Note 6, 7) | 5.5 | - | - | - | - | 3.85 | - | V |

CD74AC04, CD74ACT04, CD74AC05, CD74ACT05

DC Electrical Specifications (Continued)

| PARAMETER | SYMBOL | TEST CONDITIONS | | V _{CC} (V) | 25°C | | -40°C TO 85°C | | -55°C TO 125°C | | UNITS | |
|---|------------------|------------------------------------|---------------------|---------------------|------|------|---------------|------|----------------|------|-------|---|
| | | V _I (V) | I _O (mA) | | MIN | MAX | MIN | MAX | MIN | MAX | | |
| Low Level Output Voltage | V _{OL} | V _{IH} or V _{IL} | 0.05 | 0.05 | 1.5 | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | | 0.05 | 0.05 | 3 | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | | 0.05 | 0.05 | 4.5 | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | | 12 | 12 | 3 | - | 0.36 | - | 0.44 | - | 0.5 | V |
| | | | 24 | 24 | 4.5 | - | 0.36 | - | 0.44 | - | 0.5 | V |
| | | | 75 (Note 6, 7) | 75 (Note 6, 7) | 5.5 | - | - | - | 1.65 | - | - | V |
| | | | 50 (Note 6, 7) | 50 (Note 6, 7) | 5.5 | - | - | - | - | - | 1.65 | V |
| Input Leakage Current | I _I | V _{CC} or GND | - | 5.5 | - | ±0.1 | - | ±1 | - | ±1 | μA | |
| Quiescent Supply Current, SSI | I _{CC} | V _{CC} or GND | 0 | 5.5 | - | 4 | - | 40 | - | 80 | μA | |
| ACT TYPES | | | | | | | | | | | | |
| High Level Input Voltage | V _{IH} | - | - | 4.5 to 5.5 | 2 | - | 2 | - | 2 | - | V | |
| Low Level Input Voltage | V _{IL} | - | - | 4.5 to 5.5 | - | 0.8 | - | 0.8 | - | 0.8 | V | |
| High Level Output Voltage (04) | V _{OH} | V _{IH} or V _{IL} | -0.05 | -0.05 | 4.5 | 4.4 | - | 4.4 | - | 4.4 | - | V |
| | | | -24 | -24 | 4.5 | 3.94 | - | 3.8 | - | 3.7 | - | V |
| | | | -75 | -75 | 5.5 | - | - | 3.85 | - | - | - | V |
| | | | -50 | -50 | 5.5 | - | - | - | - | 3.85 | - | V |
| Low Level Output Voltage | V _{OL} | V _{IH} or V _{IL} | 0.05 | 0.05 | 4.5 | - | 0.1 | - | 0.1 | - | 0.1 | V |
| | | | 24 | 24 | 4.5 | - | 0.36 | - | 0.44 | - | 0.5 | V |
| | | | 75 (Note 6, 7) | 75 (Note 6, 7) | 5.5 | - | - | - | 1.65 | - | - | V |
| | | | 50 (Note 6, 7) | 50 (Note 6, 7) | 5.5 | - | - | - | - | - | 1.65 | V |
| Input Leakage Current | I _I | V _{CC} or GND | - | 5.5 | - | ±0.1 | - | ±1 | - | ±1 | μA | |
| Quiescent Supply Current, SSI | I _{CC} | V _{CC} or GND | 0 | 5.5 | - | 4 | - | 40 | - | 80 | μA | |
| Additional Supply Current per Input Pin TTL Inputs High 1 Unit Load | ΔI _{CC} | V _{CC} -2.1 | - | 4.5 to 5.5 | - | 2.4 | - | 2.8 | - | 3 | mA | |

NOTES:

- Test one output at a time for a 1-second maximum duration. Measurement is made by forcing current and measuring voltage to minimize power dissipation.
- Test verifies a minimum 50Ω transmission-line-drive capability at 85°C, 75Ω at 125°C.

ACT Input Load Table

| INPUT | UNIT LOAD |
|-------|-----------|
| nA | 0.18 |

NOTE: Unit load is ΔI_{CC} limit specified in DC Electrical Specifications Table, e.g., 2.4mA max at 25°C.

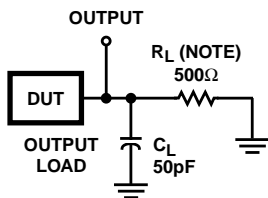
CD74AC04, CD74ACT04, CD74AC05, CD74ACT05

Switching Specifications Input $t_r, t_f = 3\text{ns}$, $C_L = 50\text{pF}$ (Worst Case)

| PARAMETER | SYMBOL | V_{CC} (V) | -40°C TO 85°C | | | -55°C TO 125°C | | | UNITS |
|--|-----------------------|-----------------|---------------|-----|------|----------------|-----|------|-------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| AC TYPES | | | | | | | | | |
| Propagation Delay, Input to Output (CD74AC/ACT04) | t_{PLH}, t_{PHL} | 1.5 | - | - | 74 | - | - | 81 | ns |
| | | 3.3 (Note 9) | 2.3 | - | 8.3 | 2.3 | - | 9.1 | ns |
| | | 5 (Note 10) | 1.7 | - | 5.9 | 1.6 | - | 6.5 | ns |
| Propagation Delay, High Z to Output Low (CD74AC/ACT05) | t_{PZL} | 1.5 | - | - | 74 | - | - | 81 | ns |
| | | 3.3 | 2.3 | - | 8.3 | 2.3 | - | 9.1 | ns |
| | | 5 | 1.7 | - | 5.9 | 1.6 | - | 6.5 | ns |
| Propagation Delay, Output Low to High Z (CD74AC/ACT05) | t_{PLZ} | 1.5 | - | - | 94 | - | - | 103 | ns |
| | | 3.3 | 3 | - | 10.4 | 2.9 | - | 11.5 | ns |
| | | 5 | 2.2 | - | 7.5 | 2.1 | - | 8.2 | ns |
| Input Capacitance | C_I | - | - | - | 10 | - | - | 10 | pF |
| Power Dissipation Capacitance | C_{PD} (Note 11) | - | - | 105 | - | - | 105 | - | pF |
| ACT TYPES | | | | | | | | | |
| Propagation Delay, Input to Output (CD74AC/ACT04) | t_{PLH}, t_{PHL} | 5 (Note 10) | 2.4 | - | 8.5 | 2.3 | - | 9.3 | ns |
| Propagation Delay, Output Low to High Z | t_{PLZ} | 5 | 2.8 | - | 9.8 | 2.7 | - | 10.8 | ns |
| Propagation Delay, High Z to Output Low (CD74AC/ACT05) | t_{PZL} | 5 | 2.4 | - | 8.5 | 2.3 | - | 9.3 | ns |
| Input Capacitance | C_I | - | - | - | 10 | - | - | 10 | pF |
| Power Dissipation Capacitance | C_{PD} (Note 11) | - | - | 105 | - | - | 105 | - | pF |

NOTES:

8. Limits tested at 100%.
9. 3.3V Min at 3.6V, Max at 3V.
10. 5V Min at 5.5V, Max at 4.5V.
11. C_{PD} is used to determine the dynamic power consumption per gate.
 AC: $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$
 ACT: $P_D = V_{CC}^2 f_i (C_{PD} + C_L) + V_{CC} \Delta I_{CC}$ where f_i = input frequency, C_L = output load capacitance, V_{CC} = supply voltage.



NOTE: For AC Series Only: When $V_{CC} = 1.5\text{V}$, $R_L = 1\text{k}\Omega$.

| | CD74AC | CD74ACT |
|---------------------------------|--------------|--------------|
| Input Level | V_{CC} | 3V |
| Input Switching Voltage, V_S | $0.5 V_{CC}$ | 1.5V |
| Output Switching Voltage, V_S | $0.5 V_{CC}$ | $0.5 V_{CC}$ |

FIGURE 1. PROPAGATION DELAY TIMES

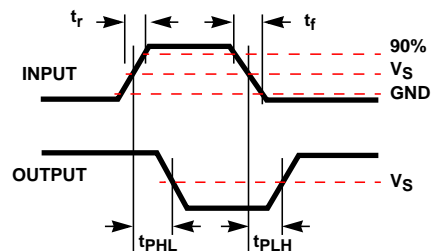


FIGURE 2. WAVEFORMS

CD74AC04, CD74ACT04, CD74AC05, CD74ACT05

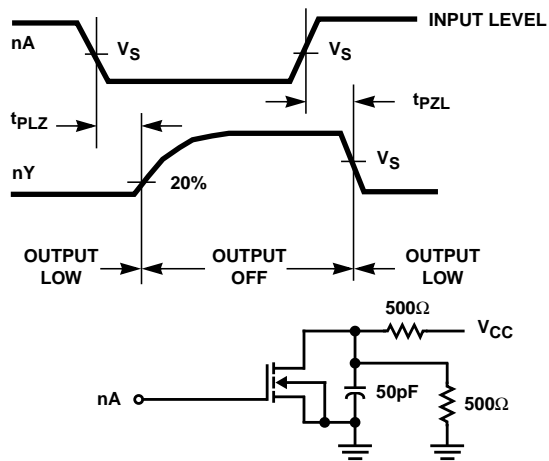


FIGURE 3. PROPAGATION DELAY TIMES AND TEST CIRCUIT

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