

# CD74HC14, CD74HCT14

## High Speed CMOS Logic Hex Inverting Schmitt Trigger

### Features

- Unlimited Input Rise and Fall Times
- Exceptionally High Noise Immunity
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
  - Bus Driver Outputs . . . . . 15 LSTTL Loads
- Wide Operating Temperature Range . . . -55°C to 125°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
  - 2V to 6V Operation
  - High Noise Immunity:  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$

at  $V_{CC} = 5V$ 

- HCT Types
  - 4.5V to 5.5V Operation
  - Direct LSTTL Input Logic Compatibility,  $V_{IL} = 0.8V$  (Max),  $V_{IH} = 2V$  (Min)
  - CMOS Input Compatibility,  $I_I \leq 1\mu A$  at  $V_{OL}$ ,  $V_{OH}$

### Description

The Harris CD74HC14, CD74HCT14 each contain 6 inverting Schmitt Triggers in one package.

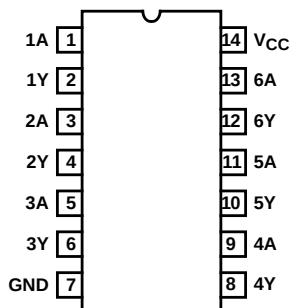
### Ordering Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE      | PKG. NO. |
|-------------|------------------|--------------|----------|
| CD54HCT14F  | -55 to 125       | 14 Ld CERDIP | F14.3    |

### Pinout

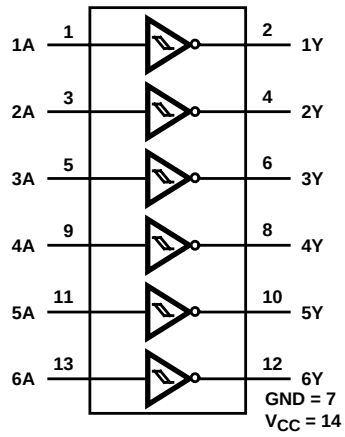
CD54HC14, CD54HCT14, CD74HC14, CD74HCT14  
(PDIP, CERDIP, SOIC)

TOP VIEW



## CD74HC14, CD74HCT14

### Functional Diagram



TRUTH TABLE

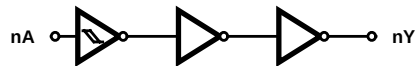
| INPUT (A) | OUTPUT (Y) |
|-----------|------------|
| L         | H          |
| H         | L          |

NOTE:

H= High Level

L= Low Level

### Logic Diagram



# **CD74HC14, CD74HCT14**

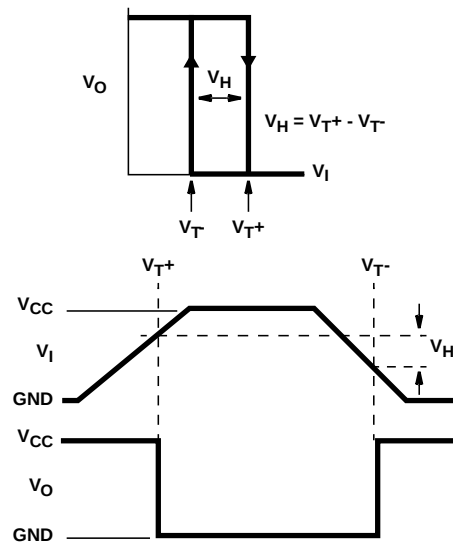


**FIGURE 3. HYSTERESIS DEFINITION, CHARACTERISTIC, AND TEST SETUP**

## CD74HC14, CD74HCT14

### Absolute Maximum Ratings

|                                                        |             |
|--------------------------------------------------------|-------------|
| DC Supply Voltage, $V_{CC}$                            | -0.5V to 7V |
| 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 $V_O > V_{CC} + 0.5V$             | $\pm 20mA$  |
| DC Drain Current, per Output, $I_O$                    |             |
| For $-0.5V < V_O < V_{CC} + 0.5V$                      | $\pm 25mA$  |
| DC Output Source or Sink Current per Output Pin, $I_O$ |             |
| For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$             | $\pm 25mA$  |
| DC $V_{CC}$ or Ground Current, $I_{CC}$                | $\pm 50mA$  |

### Thermal Information

|                                                              |                                                  |                                               |
|--------------------------------------------------------------|--------------------------------------------------|-----------------------------------------------|
| Thermal Resistance (Typical, Note 3)                         | $\theta_{JA}$ ( $^{\circ}\text{C}/\text{W}$ )    | $\theta_{JC}$ ( $^{\circ}\text{C}/\text{W}$ ) |
| PDIP Package . . . . .                                       | 90                                               | -                                             |
| CERDIP Package . . . . .                                     | 130                                              | 55                                            |
| SOIC Package . . . . .                                       | 120                                              | -                                             |
| Maximum Junction Temperature (Hermetic Package or Die) . . . | 175 $^{\circ}\text{C}$                           |                                               |
| Maximum Junction Temperature (Plastic Package) . . . . .     | 150 $^{\circ}\text{C}$                           |                                               |
| Maximum Storage Temperature Range . . . . .                  | -65 $^{\circ}\text{C}$ to 150 $^{\circ}\text{C}$ |                                               |
| Maximum Lead Temperature (Soldering 10s) . . . . .           | 300 $^{\circ}\text{C}$                           |                                               |
| (SOIC - Lead Tips Only)                                      |                                                  |                                               |

### Operating Conditions

|                                           |                                    |
|-------------------------------------------|------------------------------------|
| Temperature Range, $T_A$                  | -55 $^{\circ}C$ to 125 $^{\circ}C$ |
| Supply Voltage Range, $V_{CC}$            |                                    |
| HC Types                                  | .2V to 6V                          |
| HCT Types                                 | .4.5V to 5.5V                      |
| DC Input or Output Voltage, $V_I$ , $V_O$ | 0V to $V_{CC}$                     |
| Input Rise and Fall Time, $t_r$ , $t_f$   |                                    |
| 2V                                        | 100ms (Max)                        |
| 4.5V                                      | 100ms (Max)                        |
| 6V                                        | 100ms (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.

#### NOTE:

- $\theta_{JA}$  is measured with the component mounted on an evaluation PC board in free air.

### DC Electrical Specifications

| PARAMETER                            | SYMBOL          | TEST CONDITIONS                    |                     | V <sub>CC</sub> (V) | 25°C |      | -40°C TO 85°C |      | -55°C TO 125°C |      | UNITS |
|--------------------------------------|-----------------|------------------------------------|---------------------|---------------------|------|------|---------------|------|----------------|------|-------|
|                                      |                 | V <sub>I</sub> (V)                 | I <sub>O</sub> (mA) |                     | MIN  | MAX  | MIN           | MAX  | MIN            | MAX  |       |
| HC TYPES                             |                 |                                    |                     |                     |      |      |               |      |                |      |       |
| Input Switch Points                  | V <sub>T+</sub> | -                                  | -                   | 2                   | 0.7  | 1.5  | 0.7           | 1.5  | 0.7            | 1.5  | V     |
|                                      |                 |                                    |                     | 4.5                 | 1.7  | 3.15 | 1.7           | 3.15 | 1.7            | 3.15 | V     |
|                                      |                 |                                    |                     | 6                   | 2.1  | 4.2  | 2.1           | 4.2  | 2.1            | 4.2  | V     |
|                                      | V <sub>T-</sub> | -                                  | -                   | 2                   | 0.3  | 1.0  | 0.3           | 1.0  | 0.3            | 1.0  | V     |
|                                      |                 |                                    |                     | 4.5                 | 0.9  | 2.2  | 0.9           | 2.2  | 0.9            | 2.2  | V     |
|                                      |                 |                                    |                     | 6                   | 1.2  | 3.0  | 1.2           | 3.0  | 1.2            | 3.0  | V     |
|                                      | V <sub>H</sub>  | -                                  | -                   | 2                   | 0.2  | 1.0  | 0.2           | 1.0  | 0.2            | 1.0  | V     |
|                                      |                 |                                    |                     | 4.5                 | 0.4  | 1.4  | 0.4           | 1.4  | 0.4            | 1.4  | V     |
|                                      |                 |                                    |                     | 6                   | 0.6  | 1.6  | 0.6           | 1.6  | 0.6            | 1.6  | V     |
| High Level Output Voltage CMOS Loads | V <sub>OH</sub> | V <sub>T-</sub> or V <sub>T+</sub> | -0.02               | 2                   | 1.9  | -    | 1.9           | -    | 1.9            | -    | V     |
|                                      |                 |                                    | -0.02               | 4.5                 | 4.4  | -    | 4.4           | -    | 4.4            | -    | V     |
|                                      |                 |                                    | -0.02               | 6                   | 5.9  | -    | 5.9           | -    | 5.9            | -    | V     |
| High Level Output Voltage TTL Loads  |                 |                                    | -                   | -                   | -    | -    | -             | -    | -              | -    | V     |
|                                      |                 |                                    | -4                  | 4.5                 | 3.98 | -    | 3.84          | -    | 3.7            | -    | V     |
|                                      |                 |                                    | -5.2                | 6                   | 5.48 | -    | 5.34          | -    | 5.2            | -    | V     |

# CD74HC14, CD74HCT14

## DC Electrical Specifications (Continued)

| PARAMETER                                                            | SYMBOL                       | TEST CONDITIONS                       |                     | V <sub>CC</sub> (V) | 25°C |      | -40°C TO 85°C |      | -55°C TO 125°C |     | UNITS |
|----------------------------------------------------------------------|------------------------------|---------------------------------------|---------------------|---------------------|------|------|---------------|------|----------------|-----|-------|
|                                                                      |                              | V <sub>I</sub> (V)                    | I <sub>O</sub> (mA) |                     | MIN  | MAX  | MIN           | MAX  | MIN            | MAX |       |
| Low Level Output Voltage<br>CMOS Loads                               | V <sub>OL</sub>              | V <sub>IH</sub> or<br>V <sub>IL</sub> | 0.02                | 2                   | -    | 0.1  | -             | 0.1  | -              | 0.1 | V     |
|                                                                      |                              |                                       | 0.02                | 4.5                 | -    | 0.1  | -             | 0.1  | -              | 0.1 | V     |
|                                                                      |                              |                                       | 0.02                | 6                   | -    | 0.1  | -             | 0.1  | -              | 0.1 | V     |
| -                                                                    |                              |                                       | -                   | -                   | -    | -    | -             | -    | -              | V   |       |
| Low Level Output Voltage<br>TTL Loads                                |                              |                                       | 4                   | 4.5                 | -    | 0.26 | -             | 0.33 | -              | 0.4 | V     |
|                                                                      |                              |                                       | 5.2                 | 6                   | -    | 0.26 | -             | 0.33 | -              | 0.4 | V     |
| Input Leakage Current                                                | I <sub>I</sub>               | V <sub>CC</sub> or<br>GND             | -                   | 6                   | -    | ±0.1 | -             | ±1   | -              | ±1  | μA    |
| Quiescent Device<br>Current                                          | I <sub>CC</sub>              | V <sub>CC</sub> or<br>GND             | 0                   | 6                   | -    | 2    | -             | 20   | -              | 40  | μA    |
| HCT TYPES                                                            |                              |                                       |                     |                     |      |      |               |      |                |     |       |
| Input Switch Points                                                  | V <sub>T+</sub>              | -                                     | -                   | 4.5                 | 1.2  | 1.9  | 1.2           | 1.9  | 1.2            | 1.9 | V     |
|                                                                      |                              |                                       |                     | 5.5                 | 1.4  | 2.1  | 1.4           | 2.1  | 1.4            | 2.1 | V     |
|                                                                      | V <sub>T-</sub>              |                                       |                     | 4.5                 | 0.5  | 1.2  | 0.5           | 1.2  | 0.5            | 1.2 | V     |
|                                                                      |                              |                                       |                     | 5.5                 | 0.6  | 1.4  | 0.6           | 1.4  | 0.6            | 1.4 | V     |
|                                                                      | V <sub>H</sub>               |                                       |                     | 4.5                 | 0.4  | 1.4  | 0.4           | 1.4  | 0.4            | 1.4 | V     |
|                                                                      |                              |                                       |                     | 5.5                 | 0.4  | 1.5  | 0.4           | 1.5  | 0.4            | 1.5 | V     |
| High Level Output<br>Voltage CMOS Loads                              | V <sub>OH</sub>              | V <sub>IH</sub> or<br>V <sub>IL</sub> | -0.02               | 4.5                 | 4.4  | -    | 4.4           | -    | 4.4            | -   | V     |
| High Level Output<br>Voltage TTL Loads                               |                              |                                       | -4                  | 4.5                 | 3.98 | -    | 3.84          | -    | 3.7            | -   | V     |
| Low Level Output Voltage<br>CMOS Loads                               | V <sub>OL</sub>              | V <sub>IH</sub> or<br>V <sub>IL</sub> | 0.02                | 4.5                 | -    | 0.1  | -             | 0.1  | -              | 0.1 | V     |
| Low Level Output Voltage<br>TTL Loads                                |                              |                                       | 4                   | 4.5                 | -    | 0.26 | -             | 0.33 | -              | 0.4 | V     |
| Input Leakage Current                                                | I <sub>I</sub>               | V <sub>CC</sub><br>and<br>GND         | -                   | 5.5                 | -    | ±0.1 | -             | ±1   | -              | ±1  | μA    |
| Quiescent Device<br>Current                                          | I <sub>CC</sub>              | V <sub>CC</sub> or<br>GND             | 0                   | 5.5                 | -    | 2    | -             | 20   | -              | 40  | μA    |
| Additional Quiescent<br>Device Current Per Input<br>Pin: 1 Unit Load | ΔI <sub>CC</sub><br>(Note 4) | V <sub>CC</sub><br>- 2.1              | -                   | 4.5 to<br>5.5       | -    | 360  | -             | 450  | -              | 490 | μA    |

NOTE:

- For dual-supply systems theoretical worst case (V<sub>I</sub> = 2.4V, V<sub>CC</sub> = 5.5V) specification is 1.8mA.

## HCT Input Loading Table

| INPUT | UNIT LOADS |
|-------|------------|
| nA    | 0.6        |

NOTE: Unit Load is ΔI<sub>CC</sub> limit specified in DC Electrical Specifications table, e.g., 360μA max at 25°C.

## Switching Specifications Input $t_r, t_f = 6\text{ns}$

| PARAMETER                                     | SYMBOL                              | TEST<br>CONDITIONS    | V <sub>CC</sub><br>(V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|-----------------------------------------------|-------------------------------------|-----------------------|------------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|                                               |                                     |                       |                        | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| HC TYPES                                      |                                     |                       |                        |      |     |     |               |     |                |     |       |
| Propagation Delay,<br>A to Y                  | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                      | -    | -   | 135 | -             | 170 | -              | 205 | ns    |
|                                               |                                     | C <sub>L</sub> = 50pF | 4.5                    | -    | -   | 27  | -             | 34  | -              | 41  | ns    |
|                                               |                                     | C <sub>L</sub> = 15pF | 5                      | -    | 11  | -   | -             | -   | -              | -   | ns    |
|                                               |                                     | C <sub>L</sub> = 50pF | 6                      | -    | -   | 23  | -             | 29  | -              | 35  | ns    |
| Output Transition Times                       | t <sub>TLH</sub> , t <sub>THL</sub> | C <sub>L</sub> = 50pF | 2                      | -    | -   | 75  | -             | 95  | 18             | 110 | ns    |
|                                               |                                     |                       | 4.5                    | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
|                                               |                                     |                       | 6                      | -    | -   | 13  | -             | 16  | -              | 19  | ns    |
| Input Capacitance                             | C <sub>I</sub>                      | -                     | -                      | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| Power Dissipation Capacitance<br>(Notes 5, 6) | C <sub>PD</sub>                     | -                     | 5                      | -    | 20  | -   | -             | -   | -              | -   | pF    |
| HCT TYPES                                     |                                     |                       |                        |      |     |     |               |     |                |     |       |
| Propagation Delay,<br>A to Y                  | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 4.5                    | -    | -   | 38  | -             | 48  | -              | 57  | ns    |
|                                               |                                     | C <sub>L</sub> = 15pF | 5                      | -    | 16  | -   | -             | -   | -              | -   | ns    |
| Output Transition Times                       | t <sub>TLH</sub> , t <sub>THL</sub> | C <sub>L</sub> = 50pF | 4.5                    | -    | -   | 15  | -             | 19  | -              | 22  | ns    |
| Input Capacitance                             | C <sub>I</sub>                      | -                     | -                      | -    | -   | 10  | -             | 10  | -              | 10  | pF    |
| Power Dissipation Capacitance<br>(Notes 5, 6) | C <sub>PD</sub>                     | -                     | 5                      | -    | 20  | -   | -             | -   | -              | -   | pF    |

NOTES:

- $C_{PD}$  is used to determine the dynamic power consumption, per inverter.
- $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$  where  $f_i$  = input frequency,  $C_L$  = output load capacitance,  $V_{CC}$  = supply voltage.

## Test Circuits and Waveforms

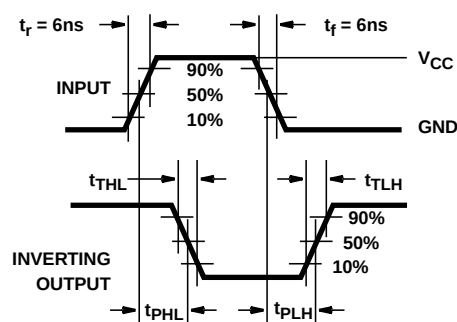


FIGURE 4. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

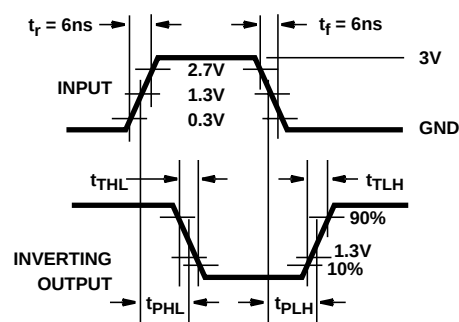


FIGURE 5. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

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