

# CD74HC139, CD74HCT139

## High Speed CMOS Logic Dual 2-to-4 Line Decoder/Demultiplexer

September 1997

### Features

- Multifunction Capability
  - Binary to 1 of 4 Decoders or 1 to 4 Line Demultiplexer
- Active Low Mutually Exclusive Outputs
- 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  $V_{OL}$ ,  $V_{OH}$
- Memory Decoding, Data Routing, Code Conversion

### Description

The Harris CD74HC139, CD74HCT139 contain two independent binary to one of four decoders each with a single active low enable input ( $\overline{1E}$  or  $\overline{2E}$ ). Data on the select inputs (1A0 and 1A1 or 2A0 and 2A1) cause one of the four normally high outputs to go low.

If the enable input is high all four outputs remain high. For demultiplexer operation the enable input is the data input. The enable input also functions as a chip select when these devices are cascaded. This device is functionally the same as the CD4556B and is pin compatible with it.

The outputs of these devices can drive 10 low power Schottky TTL equivalent loads. The 74HCT logic family is functionally as well as pin equivalent to the 74LS logic family.

### Ordering Information

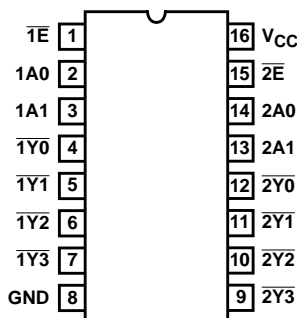
| PART NUMBER | TEMP. RANGE (°C) | PACKAGE    | PKG. NO. |
|-------------|------------------|------------|----------|
| CD74HC139E  | -55 to 125       | 16 Ld PDIP | E16.3    |
| CD74HCT139E | -55 to 125       | 16 Ld PDIP | E16.3    |
| CD74HC139M  | -55 to 125       | 16 Ld SOIC | M16.15   |

#### NOTES:

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

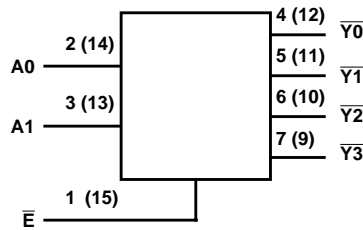
### Pinout

CD74HC139, CD74HCT139  
(PDIP, SOIC)  
TOP VIEW



**CD74HC139, CD74HCT139**

**Functional Diagram**

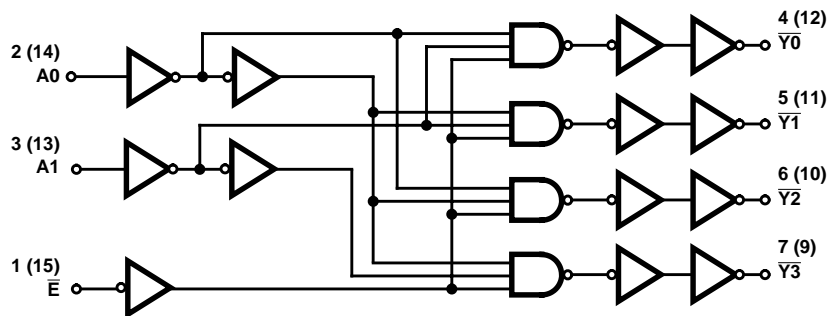


**TRUTH TABLE**

| INPUTS ENABLE SELECT |    |    | OUTPUTS     |             |             |             |
|----------------------|----|----|-------------|-------------|-------------|-------------|
| $\bar{E}$            | A1 | A0 | $\bar{Y}_3$ | $\bar{Y}_2$ | $\bar{Y}_1$ | $\bar{Y}_0$ |
| 0                    | 0  | 0  | 1           | 1           | 1           | 0           |
| 0                    | 0  | 1  | 1           | 1           | 0           | 1           |
| 0                    | 1  | 0  | 1           | 0           | 1           | 1           |
| 0                    | 1  | 1  | 0           | 1           | 1           | 1           |
| 1                    | X  | X  | 1           | 1           | 1           | 1           |

NOTE: X = Don't Care, Logic 1 = High, Logic 0 = Low

**Logic Diagram**



**CD74HC139, CD74HCT139****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 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, $I_{CC}$ or $I_{GND}$ ..... | $\pm 50mA$  |

**Thermal Information**

|  |                                  |
|--|----------------------------------|
| Thermal Resistance (Typical, Note 3)           | $\theta_{JA}$ (°C/W)             |
| PDIP Package .....                             | 90                               |
| SOIC Package .....                             | 115                              |
| Maximum Junction Temperature .....             | 150°C                            |
| Maximum Storage Temperature Range .....        | -65°C to 150°C                   |
| Maximum Lead Temperature (Soldering 10s) ..... | 300°C<br>(SOIC - Lead Tips Only) |

**Operating Conditions**

|   |                |
|---|----------------|
| Temperature Range ( $T_A$ ) .....               | -55°C to 125°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                        |                |
| 2V .....  | 1000ns (Max)   |
| 4.5V .....                                      | 500ns (Max)    |
| 6V .....  | 400ns (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      |            | $V_{CC}$<br>(V) | 25°C |     |           | -40°C TO 85°C |         | -55°C TO 125°C |         | UNITS   |
|---|----------|----------------------|------------|-----------------|------|-----|-----------|---------------|---------|----------------|---------|---------|
|   |          | $V_I$ (V)            | $I_O$ (mA) |                 | MIN  | TYP | MAX       | MIN           | MAX     | MIN            | MAX     |         |
| <b>HC TYPES</b>                         |          |                      |            |                 |      |     |           |               |         |                |         |         |
| High Level Input Voltage                | $V_{IH}$ | -                    | -          | 2               | 1.5  | -   | -         | 1.5           | -       | 1.5            | -       | V       |
|   |          |                      |            | 4.5             | 3.15 | -   | -         | 3.15          | -       | 3.15           | -       | V       |
|   |          |                      |            | 6               | 4.2  | -   | -         | 4.2           | -       | 4.2            | -       | V       |
| Low Level Input Voltage                 | $V_{IL}$ | -                    | -          | 2               | -    | -   | 0.5       | -             | 0.5     | -              | 0.5     | V       |
|   |          |                      |            | 4.5             | -    | -   | 1.35      | -             | 1.35    | -              | 1.35    | V       |
|   |          |                      |            | 6               | -    | -   | 1.8       | -             | 1.8     | -              | 1.8     | V       |
| High Level Output Voltage<br>CMOS Loads | $V_{OH}$ | $V_{IH}$ or $V_{IL}$ | -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<br>TTL Loads  | $V_{OH}$ | $V_{IH}$ or $V_{IL}$ | -          | -               | -    | -   | -         | -             | -       | -              | -       | V       |
|   |          |                      | -4         | 4.5             | 3.98 | -   | -         | 3.84          | -       | 3.7            | -       | V       |
|   |          |                      | -5.2       | 6               | 5.48 | -   | -         | 5.34          | -       | 5.2            | -       | V       |
| Low Level Output Voltage<br>CMOS Loads  | $V_{OL}$ | $V_{IH}$ or $V_{IL}$ | 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       |
| Low Level Output Voltage<br>TTL Loads   | $V_{OL}$ | $V_{IH}$ or $V_{IL}$ | -          | -               | -    | -   | -         | -             | -       | -              | -       | V       |
|   |          |                      | 4          | 4.5             | -    | -   | 0.26      | -             | 0.33    | -              | 0.4     | V       |
|   |          |                      | 5.2        | 6               | -    | -   | 0.26      | -             | 0.33    | -              | 0.4     | V       |
| Input Leakage Current                   | $I_I$    | $V_{CC}$ or GND      | -          | 6               | -    | -   | $\pm 0.1$ | -             | $\pm 1$ | -              | $\pm 1$ | $\mu A$ |
| Quiescent Device Current                | $I_{CC}$ | $V_{CC}$ or GND      | 0          | 6               | -    | -   | 8         | -             | 80      | -              | 160     | $\mu A$ |

## CD74HC139, CD74HCT139

## 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  | TYP | MAX  | MIN           | MAX  | MIN            | MAX |       |
| <b>HCT TYPES</b>  |                  |                                    |                     |                     |      |     |      |               |      |                |     |       |
| High Level Input Voltage  | V <sub>IH</sub>  | -                                  | -                   | 4.5 to 5.5          | 2    | -   | -    | 2             | -    | 2              | -   | V     |
| Low Level Input Voltage   | V <sub>IL</sub>  | -                                  | -                   | 4.5 to 5.5          | -    | -   | 0.8  | -             | 0.8  | -              | 0.8 | V     |
| High Level Output Voltage<br>CMOS Loads                                 | V <sub>OH</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | -0.02               | 4.5                 | 4.4  | -   | -    | 4.4           | -    | 4.4            | -   | V     |
| High Level Output Voltage<br>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 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> and GND            | 0                   | 5.5                 | -    | -   | ±0.1 | -             | ±1   | -              | ±1  | μA    |
| Quiescent Device Current  | I <sub>CC</sub>  | V <sub>CC</sub> or GND             | 0                   | 5.5                 | -    | -   | 8    | -             | 80   | -              | 160 | μA    |
| Additional Quiescent Device Current Per Input Pin: 1 Unit Load (Note 4) | ΔI <sub>CC</sub> | V <sub>CC</sub> -2.1               | -                   | 4.5 to 5.5          | -    | 100 | 360  | -             | 450  | -              | 490 | μA    |

NOTE:

4. 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 |
|-------|------------|
| All   | 0.7        |

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

Switching Specifications Input t<sub>r</sub>, t<sub>f</sub> = 6ns

| PARAMETER                              | SYMBOL                              | TEST CONDITIONS       | V <sub>CC</sub> (V) | 25°C |     |     | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|--|-------------------------------------|-----------------------|---------------------|------|-----|-----|---------------|-----|----------------|-----|-------|
|  |                                     |                       |                     | MIN  | TYP | MAX | MIN           | MAX | MIN            | MAX |       |
| <b>HC TYPES</b>                        |                                     |                       |                     |      |     |     |               |     |                |     |       |
| Propagation Delay<br>A0, A1 to Outputs | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 145 | -             | 180 | -              | 220 | ns    |
|  |                                     |                       | 4.5                 | -    | -   | 29  | -             | 36  | -              | 44  | ns    |
|  |                                     |                       | 6                   | -    | -   | 25  | -             | 31  | -              | 38  | ns    |
| $\bar{E}$ to Outputs                   | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 50pF | 2                   | -    | -   | 135 | -             | 170 | -              | 205 | ns    |
|  |                                     |                       | 4.5                 | -    | -   | 27  | -             | 34  | -              | 41  | ns    |
|  |                                     |                       | 6                   | -    | -   | 23  | -             | 29  | -              | 35  | ns    |
| Select to Output                       | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 15pF | 5                   | -    | 12  | -   | -             | -   | -              | ns  |       |
| Enable to Output                       | t <sub>PLH</sub> , t <sub>PHL</sub> | C <sub>L</sub> = 15pF | 5                   | -    | 11  | -   | -             | -   | -              | ns  |       |

## CD74HC139, CD74HCT139

Switching Specifications Input  $t_r, t_f = 6\text{ns}$  (Continued)

| PARAMETER                                   | SYMBOL             | TEST CONDITIONS     | $V_{CC}$<br>(V) | 25°C |     |     | -40°C TO<br>85°C |     | -55°C TO<br>125°C |     | UNITS |
|---|--------------------|---------------------|-----------------|------|-----|-----|------------------|-----|-------------------|-----|-------|
|   |                    |                     |                 | MIN  | TYP | MAX | MIN              | MAX | MIN               | MAX |       |
| Output Transition Time (Figure 1)           | $t_{TLH}, t_{THL}$ | $C_L = 50\text{pF}$ | 2               | -    | -   | 75  | -                | 95  | -                 | 110 | ns    |
|   |                    |                     | 4.5             | -    | -   | 15  | -                | 19  | -                 | 22  | ns    |
|   |                    |                     | 6               | -    | -   | 13  | -                | 16  | -                 | 19  | ns    |
| Power Dissipation Capacitance, (Notes 5, 6) | $C_{PD}$           | -                   | 5               | -    | 55  | -   | -                | -   | -                 | -   | pF    |
| Input Capacitance                           | $C_{IN}$           | -                   | -               | -    | -   | 10  | -                | 10  | -                 | 10  | pF    |
| <b>HCT TYPES</b>                            |                    |                     |                 |      |     |     |                  |     |                   |     |       |
| Propagation Delay                           |                    |                     |                 |      |     |     |                  |     |                   |     |       |
| A0, A1 to Outputs                           | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 34  | -                | 43  | -                 | 51  | ns    |
| $\bar{E}$ to Outputs                        | $t_{PLH}, t_{PHL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 34  | -                | 43  | -                 | 51  | ns    |
| Select to Output                            | $t_{PLH}, t_{PHL}$ | $C_L = 15\text{pF}$ | 5               | -    | 14  | -   | -                | -   | -                 | -   | ns    |
| Enable to Output                            | $t_{PLH}, t_{PHL}$ | $C_L = 15\text{pF}$ | 5               | -    | 14  | -   | -                | -   | -                 | -   | ns    |
| Output Transition Time (Figure 2)           | $t_{TLH}, t_{THL}$ | $C_L = 50\text{pF}$ | 4.5             | -    | -   | 15  | -                | 19  | -                 | 22  | ns    |
| Power Dissipation Capacitance, (Notes 5, 6) | $C_{PD}$           | -                   | 5               | -    | 59  | -   | -                | -   | -                 | -   | pF    |
| Input Capacitance                           | $C_{IN}$           | -                   | -               | -    | -   | 10  | -                | 10  | -                 | 10  | pF    |

## NOTES:

- $C_{PD}$  is used to determine the dynamic power consumption, per decoder/demux.
- $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$  where:  $f_i$  = Input Frequency,  $C_L$  = Output Load Capacitance,  $V_{CC}$  = Supply Voltage.

## Test Circuits and Waveforms

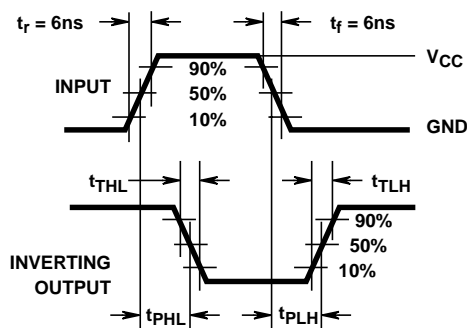


FIGURE 1. HC AND HCU TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

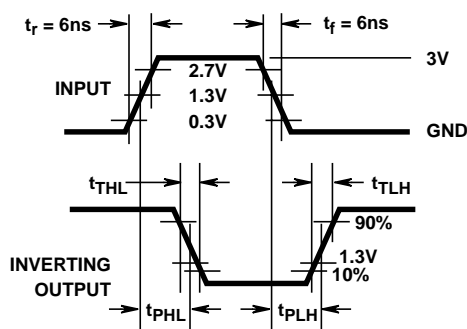


FIGURE 2. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC