

September 1998

# CD74AC175, CD74ACT175

## Quad D Flip-Flop with Reset

### Features

- Buffered Inputs
- Typical Propagation Delay
  - 6.4ns 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 50 $\Omega$  Transmission Lines

### Description

The CD74AC175 and CD74ACT175 are quad D flip-flops with reset that utilize the Harris Advanced CMOS Logic technology. Information at the D input is transferred to the Q and Q outputs on the positive-going edge of the clock pulse. All four flip-flops are controlled by a common clock (CP) and a common reset ( $\overline{MR}$ ). Resetting is accomplished by a LOW logic level independent of the clock.

### Ordering Information

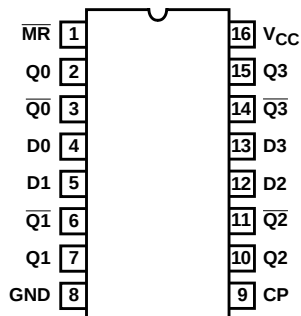
| PART NUMBER | TEMP. RANGE ( $^{\circ}C$ ) | PACKAGE    | PKG. NO. |
|-------------|-----------------------------|------------|----------|
| CD74AC175E  | -55 to 125                  | 16 Ld PDIP | E16.3    |
| CD74ACT175E | -55 to 125                  | 16 Ld PDIP | E16.3    |
| CD74AC175M  | -55 to 125                  | 16 Ld SOIC | M16.15   |
| CD74ACT175M | -55 to 125                  | 16 Ld SOIC | M16.15   |

#### NOTES:

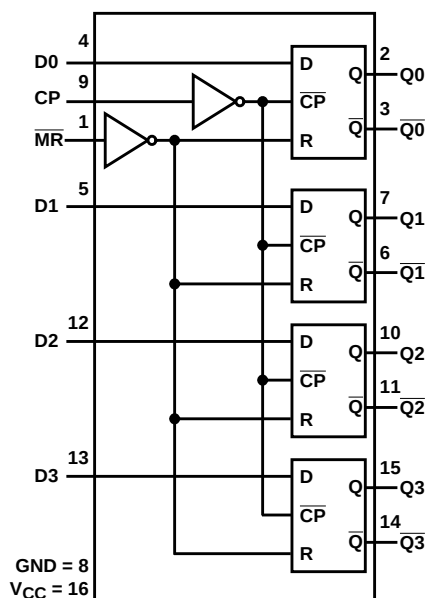
- When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
- Wafer and die for this part number is available which meets all electrical specifications. Please contact your local sales office or Harris customer service for ordering information.

### Pinout

CD74AC175, CD74ACT175  
(PDIP, SOIC)  
TOP VIEW



## Functional Diagram



TRUTH TABLE (EACH FLIP-FLOP)

| INPUTS        |             |            | OUTPUTS |        |
|---------------|-------------|------------|---------|--------|
| RESET<br>(MR) | CLOCK<br>CP | DATA<br>Dn | Qn      | Qn-bar |
| L             | X           | X          | L       | H      |
| H             | ↑           | H          | H       | L      |
| H             | ↑           | L          | L       | H      |
| H             | L           | X          | Q0      | Q0-bar |

H = High Level (Steady State)

L = Low Level (Steady State)

X = Irrelevant

↑ = Transition from Low to High level

Q0, Q0-bar = Level before the Indicated Steady-State Input conditions were established.

# CD74AC175, CD74ACT175

## 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)  $\theta_{JA}$  ( $^{\circ}C/W$ )  
     PDIP Package ..... 90  
     SOIC Package ..... 160  
 Maximum Junction Temperature (Plastic Package) .....  $150^{\circ}C$   
 Maximum Storage Temperature Range .....  $-65^{\circ}C$  to  $150^{\circ}C$   
 Maximum Lead Temperature (Soldering 10s) .....  $300^{\circ}C$   
     (SOIC - Lead Tips Only)

## 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:

15. For up to 4 outputs per device, add  $\pm 25mA$  for each additional output.
16. Unless otherwise specified, all voltages are referenced to ground.
17.  $\theta_{JA}$  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><br>(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  |       |
| AC TYPES                  |                 |                                    |                     |                        |      |      |               |      |                |      |       |
| High Level Input Voltage  | V <sub>IH</sub> | -                                  | -                   | 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 <sub>IL</sub> | -                                  | -                   | 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 | V <sub>OH</sub> | V <sub>IH</sub> or V <sub>IL</sub> | -0.05               | 1.5                    | 1.4  | -    | 1.4           | -    | 1.4            | -    | V     |
|                           |                 |                                    | -0.05               | 3                      | 2.9  | -    | 2.9           | -    | 2.9            | -    | V     |
|                           |                 |                                    | -0.05               | 4.5                    | 4.4  | -    | 4.4           | -    | 4.4            | -    | V     |
|                           |                 |                                    | -4                  | 3                      | 2.58 | -    | 2.48          | -    | 2.4            | -    | V     |
|                           |                 |                                    | -24                 | 4.5                    | 3.94 | -    | 3.8           | -    | 3.7            | -    | V     |
|                           |                 |                                    | -75<br>(Note 6, 7)  | 5.5                    | -    | -    | 3.85          | -    | -              | -    | V     |
|                           |                 |                                    | -50<br>(Note 6, 7)  | 5.5                    | -    | -    | -             | -    | 3.85           | -    | V     |

# CD74AC175, CD74ACT175

## 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                                            | V <sub>OL</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | 0.05                | 1.5                 | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
|                                                                     |                  |                                    | 0.05                | 3                   | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
|                                                                     |                  |                                    | 0.05                | 4.5                 | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
|                                                                     |                  |                                    | 12                  | 3                   | -    | 0.36 | -             | 0.44 | -              | 0.5  | V     |
|                                                                     |                  |                                    | 24                  | 4.5                 | -    | 0.36 | -             | 0.44 | -              | 0.5  | V     |
|                                                                     |                  |                                    | 75<br>(Note 6, 7)   | 5.5                 | -    | -    | -             | 1.65 | -              | -    | V     |
|                                                                     |                  |                                    | 50<br>(Note 6, 7)   | 5.5                 | -    | -    | -             | -    | -              | 1.65 | V     |
| Input Leakage Current                                               | I <sub>I</sub>   | V <sub>CC</sub> or GND             | -                   | 5.5                 | -    | ±0.1 | -             | ±1   | -              | ±1   | μA    |
| Quiescent Supply Current MSI                                        | I <sub>CC</sub>  | V <sub>CC</sub> or GND             | 0                   | 5.5                 | -    | 8    | -             | 80   | -              | 160  | μA    |
| <b>ACT 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                                           | V <sub>OH</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | -0.05               | 4.5                 | 4.4  | -    | 4.4           | -    | 4.4            | -    | V     |
|                                                                     |                  |                                    | -24                 | 4.5                 | 3.94 | -    | 3.8           | -    | 3.7            | -    | V     |
|                                                                     |                  |                                    | -75<br>(Note 6, 7)  | 5.5                 | -    | -    | 3.85          | -    | -              | -    | V     |
|                                                                     |                  |                                    | -50<br>(Note 6, 7)  | 5.5                 | -    | -    | -             | -    | 3.85           | -    | V     |
| Low Level Output Voltage                                            | V <sub>OL</sub>  | V <sub>IH</sub> or V <sub>IL</sub> | 0.05                | 4.5                 | -    | 0.1  | -             | 0.1  | -              | 0.1  | V     |
|                                                                     |                  |                                    | 24                  | 4.5                 | -    | 0.36 | -             | 0.44 | -              | 0.5  | V     |
|                                                                     |                  |                                    | 75<br>(Note 6, 7)   | 5.5                 | -    | -    | -             | 1.65 | -              | -    | V     |
|                                                                     |                  |                                    | 50<br>(Note 6, 7)   | 5.5                 | -    | -    | -             | -    | -              | 1.65 | V     |
| Input Leakage Current                                               | I <sub>I</sub>   | V <sub>CC</sub> or GND             | -                   | 5.5                 | -    | ±0.1 | -             | ±1   | -              | ±1   | μA    |
| Quiescent Supply Current MSI                                        | I <sub>CC</sub>  | V <sub>CC</sub> or GND             | 0                   | 5.5                 | -    | 8    | -             | 80   | -              | 160  | μA    |
| Additional Supply Current per Input Pin TTL Inputs High 1 Unit Load | ΔI <sub>CC</sub> | V <sub>CC</sub> -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 |
|-------|-----------|
| Dn    | 0.58      |
| MR    | 0.67      |
| CP    | 0.92      |

NOTE: Unit load is ΔI<sub>CC</sub> limit specified in DC Electrical Specifications Table, e.g., 2.4mA max at 25°C.

# CD74AC175, CD74ACT175

## Prerequisite For Switching Function

| PARAMETER                                  | SYMBOL           | V <sub>CC</sub> (V) | -40°C TO 85°C |     | -55°C TO 125°C |     | UNITS |
|--------------------------------------------|------------------|---------------------|---------------|-----|----------------|-----|-------|
|                                            |                  |                     | MIN           | MAX | MIN            | MAX |       |
| AC TYPES                                   |                  |                     |               |     |                |     |       |
| Data to CP Set-Up Time                     | t <sub>SU</sub>  | 1.5                 | 2             | -   | 2              | -   | ns    |
|                                            |                  | 3.3<br>(Note 8)     | 2             | -   | 2              | -   | ns    |
|                                            |                  | 5<br>(Note 9)       | 2             | -   | 2              | -   | ns    |
| Hold Time                                  | t <sub>H</sub>   | 1.5                 | 2             | -   | 2              | -   | ns    |
|                                            |                  | 3.3                 | 2             | -   | 2              | -   | ns    |
|                                            |                  | 5                   | 2             | -   | 2              | -   | ns    |
| Removal Time, $\overline{\text{MR}}$ to CP | t <sub>REM</sub> | 1.5                 | 1             | -   | 1              | -   | ns    |
|                                            |                  | 3.3                 | 1             | -   | 1              | -   | ns    |
|                                            |                  | 5                   | 1             | -   | 1              | -   | ns    |
| $\overline{\text{MR}}$ Pulse Width         | t <sub>W</sub>   | 1.5                 | 44            | -   | 50             | -   | ns    |
|                                            |                  | 3.3                 | 4.9           | -   | 5.6            | -   | ns    |
|                                            |                  | 5                   | 3.5           | -   | 4              | -   | ns    |
| CP Pulse Width                             | t <sub>W</sub>   | 1.5                 | 55            | -   | 63             | -   | ns    |
|                                            |                  | 3.3                 | 6.1           | -   | 7              | -   | ns    |
|                                            |                  | 5                   | 4.4           | -   | 5              | -   | ns    |
| CP Frequency                               | f <sub>MAX</sub> | 1.5                 | 9             | -   | 8              | -   | MHz   |
|                                            |                  | 3.3                 | 81            | -   | 71             | -   | MHz   |
|                                            |                  | 5                   | 114           | -   | 100            | -   | MHz   |
| ACT TYPES                                  |                  |                     |               |     |                |     |       |
| Data to CP Set-Up Time                     | t <sub>SU</sub>  | 5<br>(Note 9)       | 2             | -   | 2              | -   | ns    |
| Hold Time                                  | t <sub>H</sub>   | 5                   | 2             | -   | 2              | -   | ns    |
| Removal Time, $\overline{\text{MR}}$ to CP | t <sub>REM</sub> | 5                   | 1             | -   | 1              | -   | ns    |
| $\overline{\text{MR}}$ Pulse Width         | t <sub>W</sub>   | 5                   | 3.5           | -   | 4              | -   | ns    |
| Clock Pulse Width                          | t <sub>W</sub>   | 5                   | 4.4           | -   | 5              | -   | ns    |
| CP Frequency                               | f <sub>MAX</sub> | 5                   | 114           | -   | 114            | -   | MHz   |

NOTES:

20. 3.3V Min is at 3V.

21. 5V Min is at 4.5V.

## Switching Specifications Input t<sub>r</sub>, t<sub>f</sub> = 3ns, C<sub>L</sub> = 50pF (Worst Case)

| PARAMETER                                  | SYMBOL                              | V <sub>CC</sub> (V) | -40°C TO 85°C |     |      | -55°C TO 125°C |     |      | UNITS |
|--------------------------------------------|-------------------------------------|---------------------|---------------|-----|------|----------------|-----|------|-------|
|                                            |                                     |                     | MIN           | TYP | MAX  | MIN            | TYP | MAX  |       |
| AC TYPES                                   |                                     |                     |               |     |      |                |     |      |       |
| Propagation Delay, CP to Q, $\overline{Q}$ | t <sub>PLH</sub> , t <sub>PHL</sub> | 1.5                 | -             | -   | 139  | -              | -   | 153  | ns    |
|                                            |                                     | 3.3<br>(Note 11)    | 4.4           | -   | 15.5 | 4.3            | -   | 17.1 | ns    |
|                                            |                                     | 5<br>(Note 12)      | 3.2           | -   | 11.1 | 3.1            | -   | 12.2 | ns    |

# CD74AC175, CD74ACT175

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

| PARAMETER                                               | SYMBOL                | $V_{CC}$ (V)   | -40°C TO 85°C |     |      | -55°C TO 125°C |     |      | UNITS |
|---------------------------------------------------------|-----------------------|----------------|---------------|-----|------|----------------|-----|------|-------|
|                                                         |                       |                | MIN           | TYP | MAX  | MIN            | TYP | MAX  |       |
| Propagation Delay, $\overline{MR}$ to Q, $\overline{Q}$ | $t_{PLH}$ , $t_{PHL}$ | 1.5            | -             | -   | 139  | -              | -   | 153  | ns    |
|                                                         |                       | 3.3            | 4.4           | -   | 15.5 | 4.3            | -   | 17.1 | ns    |
|                                                         |                       | 5              | 3.2           | -   | 11.1 | 3.1            | -   | 12.2 | ns    |
| Input Capacitance                                       | $C_I$                 | -              | -             | -   | 10   | -              | -   | 10   | pF    |
| Power Dissipation Capacitance                           | $C_{PD}$<br>(Note 13) | -              | -             | 55  | -    | -              | 55  | -    | pF    |
| <b>ACT TYPES</b>                                        |                       |                |               |     |      |                |     |      |       |
| Propagation Delay, CP to Qn                             | $t_{PLH}$ , $t_{PHL}$ | 5<br>(Note 12) | 3             | -   | 10.5 | 2.9            | -   | 11.5 | ns    |
| Propagation Delay, $\overline{MR}$ to Qn                | $t_{PLH}$ , $t_{PHL}$ | 5              | 3.3           | -   | 11.8 | 3.3            | -   | 13   | ns    |
| Input Capacitance                                       | $C_I$                 | -              | -             | -   | 10   | -              | -   | 10   | pF    |
| Power Dissipation Capacitance                           | $C_{PD}$<br>(Note 13) | -              | -             | 55  | -    | -              | 55  | -    | pF    |

### NOTES:

22. Limits tested 100%.

23. 3.3V Min is at 3.6V, Max is at 3V.

24. 5V Min is at 5.5V, Max is at 4.5V.

25.  $C_{PD}$  is used to determine the dynamic power consumption per flip-flop.

$P_D = C_{PD} V_{CC}^2 f_i + \Sigma (C_L + V_{CC}^2 f_o) + V_{CC} \Delta I_{CC}$  where  $f_i$  = input frequency,  $f_o$  = output frequency,  $C_L$  = output load capacitance,  $V_{CC}$  = supply voltage.

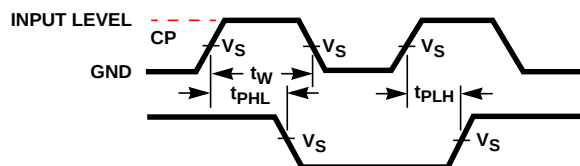


FIGURE 5. PROPAGATION DELAYS

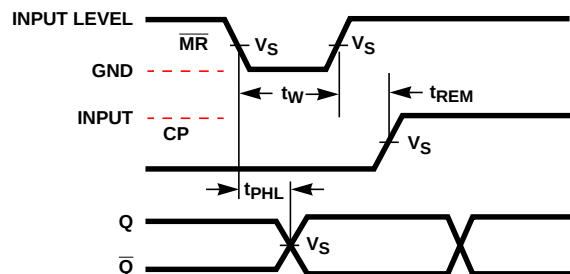


FIGURE 6. RESET OR SET PREREQUISITE AND PROPAGATION DELAYS

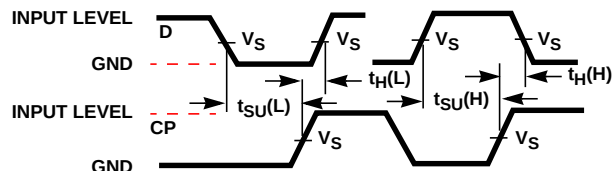
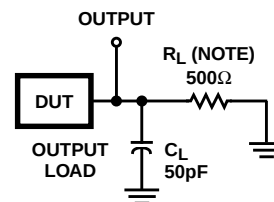


FIGURE 7.



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 8. PROPAGATION DELAY TIMES

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