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## 74VHC74 Dual D-Type Flip-Flop with Preset and Clear

### Features

- High Speed:  $f_{MAX} = 170\text{MHz}$  (typ.) at  $T_A = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min.)
- Power down protection is provided on all inputs
- Low power dissipation:  $I_{CC} = 2\mu\text{A}$  (max.) at  $T_A = 25^\circ\text{C}$
- Pin and function compatible with 74HC74

### General Description

The VHC74 is an advanced high speed CMOS Dual D-Type Flip-Flop fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The signal level applied to the D input is transferred to the Q output during the positive going transition of the CK pulse.  $\overline{\text{CLR}}$  and  $\overline{\text{PR}}$  are independent of the CK and are accomplished by setting the appropriate input LOW.

An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

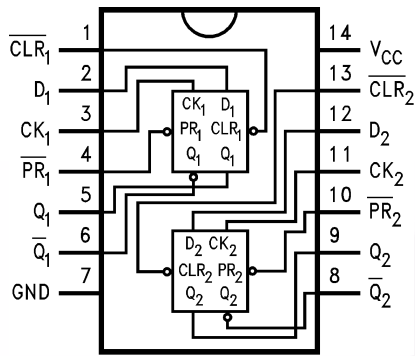
### Ordering Information

| Order Number | Package Number | Package Description  |
|--------------|----------------|--|
| 74VHC74M     | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74VHC74SJ    | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| 74VHC74MTC   | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |
| 74VHC74N     | N14A           | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

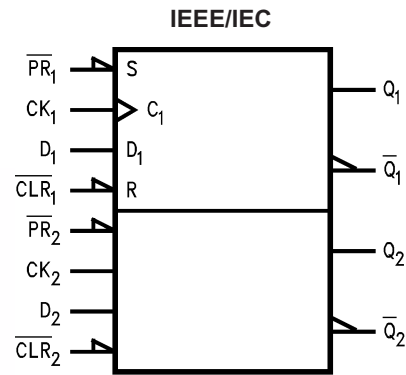
Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.

 All packages are lead free per JEDEC: J-STD-020B standard.

### Connection Diagram



### Logic Symbol



### Pin Description

| Pin Names   | Description          |
|---|----------------------|
| D <sub>1</sub> , D <sub>2</sub>   | Data Inputs          |
| CK <sub>1</sub> , CK <sub>2</sub>   | Clock Pulse Inputs   |
| $\overline{\text{CLR}}_1$ , $\overline{\text{CLR}}_2$                               | Direct Clear Inputs  |
| $\overline{\text{PR}}_1$ , $\overline{\text{PR}}_2$                                 | Direct Preset Inputs |
| Q <sub>1</sub> , $\overline{\text{Q}}_1$ , Q <sub>2</sub> , $\overline{\text{Q}}_2$ | Output               |

### Truth Table

| Inputs                  |                        |   |                    | Outputs          |                         | Function  |
|-------------------------|------------------------|---|--------------------|------------------|-------------------------|-----------|
| $\overline{\text{CLR}}$ | $\overline{\text{PR}}$ | D | CK                 | Q                | $\overline{\text{Q}}$   |           |
| L                       | H                      | X | X                  | L                | H                       | Clear     |
| H                       | L                      | X | X                  | H                | L                       | Preset    |
| L                       | L                      | X | X                  | H <sup>(1)</sup> | H <sup>(1)</sup>        |           |
| H                       | H                      | L | $\nearrow$         | L                | H                       |           |
| H                       | H                      | H | $\nearrow$         | H                | L                       |           |
| H                       | H                      | X | $\curvearrowright$ | Q <sub>n</sub>   | $\overline{\text{Q}}_n$ | No Change |

#### Note:

1. This configuration is nonstable; that is, it will not persist when preset and clear inputs return to their inactive (HIGH) state.

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol    | Parameter                                | Rating                   |
|-----------|--|--------------------------|
| $V_{CC}$  | Supply Voltage                           | -0.5V to +7.0V           |
| $V_{IN}$  | DC Input Voltage                         | -0.5V to +7.0V           |
| $V_{OUT}$ | DC Output Voltage                        | -0.5V to $V_{CC} + 0.5V$ |
| $I_{IK}$  | Input Diode Current                      | -20mA                    |
| $I_{OK}$  | Output Diode Current                     | $\pm 20mA$               |
| $I_{OUT}$ | DC Output Current                        | $\pm 25mA$               |
| $I_{CC}$  | DC $V_{CC}/GND$ Current                  | $\pm 50mA$               |
| $T_{STG}$ | Storage Temperature                      | -65°C to +150°C          |
| $T_L$     | Lead Temperature (Soldering, 10 seconds) | 260°C                    |

## Recommended Operating Conditions<sup>(2)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol     | Parameter   | Rating                            |
|------------|---|-----------------------------------|
| $V_{CC}$   | Supply Voltage  | 2.0V to +5.5V                     |
| $V_{IN}$   | Input Voltage   | 0V to +5.5V                       |
| $V_{OUT}$  | Output Voltage  | 0V to $V_{CC}$                    |
| $T_{OPR}$  | Operating Temperature   | -40°C to +85°C                    |
| $t_r, t_f$ | Input Rise and Fall Time,<br>$V_{CC} = 3.3V \pm 0.3V$<br>$V_{CC} = 5.0V \pm 0.5V$ | 0ns/V ~ 100ns/V<br>0ns/V ~ 20ns/V |

### Note:

- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

| Symbol          | Parameter                 | V <sub>CC</sub> (V) | Conditions  | T <sub>A</sub> = 25°C   |      |                        | T <sub>A</sub> = -40°C to +85°C |                       | Units |   |      |      |
|-----------------|---------------------------|---------------------|---|-------------------------|------|------------------------|---------------------------------|-----------------------|-------|---|------|------|
|                 |                           |                     |   | Min.                    | Typ. | Max.                   | Min.                            | Max.                  |       |   |      |      |
| V <sub>IH</sub> | HIGH Level Input Voltage  | 2.0                 |   | 1.50                    |      |                        | 1.50                            |                       | V     |   |      |      |
|                 |                           | 3.0–5.5             |   | 0.7 × V <sub>CC</sub>   |      |                        | 0.7 × V <sub>CC</sub>           |                       |       |   |      |      |
| V <sub>IL</sub> | LOW Level Input Voltage   | 2.0                 |   |                         |      | 0.50                   |                                 | 0.50                  | V     |   |      |      |
|                 |                           | 3.0–5.5             |   |                         |      | 0.3 × V <sub>CC</sub>  |                                 | 0.3 × V <sub>CC</sub> |       |   |      |      |
| V <sub>OH</sub> | HIGH Level Output Voltage | 2.0                 | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OH</sub> = -50μA | 1.9  | 2.0                    |                                 | 1.9                   |       | V |      |      |
|                 |                           | 3.0                 |   |                         | 2.9  | 3.0                    |                                 | 2.9                   |       |   |      |      |
|                 |                           | 4.5                 |   |                         | 4.4  | 4.5                    |                                 | 4.4                   |       |   |      |      |
|                 |                           | 3.0                 |   |                         |      | I <sub>OH</sub> = -4mA | 2.58                            |                       |       |   | 2.48 |      |
|                 |                           | 4.5                 |   |                         |      | I <sub>OH</sub> = -8mA | 3.94                            |                       |       |   | 3.80 |      |
| V <sub>OL</sub> | LOW Level Output Voltage  | 2.0                 | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 50μA  |      | 0.0                    | 0.1                             |                       | 0.1   | V |      |      |
|                 |                           | 3.0                 |   |                         |      | 0.0                    | 0.1                             |                       | 0.1   |   |      |      |
|                 |                           | 4.5                 |   |                         |      | 0.0                    | 0.1                             |                       | 0.1   |   |      |      |
|                 |                           | 3.0                 |   |                         |      | I <sub>OL</sub> = 4mA  |                                 |                       | 0.36  |   |      | 0.44 |
|                 |                           | 4.5                 |   |                         |      | I <sub>OL</sub> = 8mA  |                                 |                       | 0.36  |   |      | 0.44 |
| I <sub>IN</sub> | Input Leakage Current     | 0–5.5               | V <sub>IN</sub> = 5.5V or GND                           |                         |      | ±0.1                   |                                 | ±1.0                  | μA    |   |      |      |
| I <sub>CC</sub> | Quiescent Supply Current  | 5.5                 | V <sub>IN</sub> = V <sub>CC</sub> or GND                |                         |      | 2.0                    |                                 | 20.0                  | μA    |   |      |      |

## AC Electrical Characteristics

| Symbol                              | Parameter   | V <sub>CC</sub> (V) | Conditions             | T <sub>A</sub> = 25°C |      |      | T <sub>A</sub> = -40°C to +85°C |      | Units |
|-------------------------------------|---|---------------------|------------------------|-----------------------|------|------|---------------------------------|------|-------|
|                                     |   |                     |                        | Min.                  | Typ. | Max. | Min.                            | Max. |       |
| f <sub>MAX</sub>                    | Maximum Clock Frequency   | 3.3 ± 0.3           | C <sub>L</sub> = 15pF  | 80                    | 125  |      | 70                              |      | MHz   |
|                                     |   |                     | C <sub>L</sub> = 50pF  | 50                    | 75   |      | 45                              |      |       |
|                                     |   | 5.0 ± 0.5           | C <sub>L</sub> = 15pF  | 130                   | 170  |      | 110                             |      |       |
|                                     |   |                     | C <sub>L</sub> = 50pF  | 90                    | 115  |      | 75                              |      |       |
| t <sub>PLH</sub> , t <sub>PHL</sub> | Propagation Delay Time (CK-Q, $\bar{Q}$ )                         | 3.3 ± 0.3           | C <sub>L</sub> = 15pF  |                       | 6.7  | 11.9 | 1.0                             | 14.0 | ns    |
|                                     |   |                     | C <sub>L</sub> = 50pF  |                       | 9.2  | 15.4 | 1.0                             | 17.5 |       |
|                                     |   | 5.0 ± 0.5           | C <sub>L</sub> = 15pF  |                       | 4.6  | 7.3  | 1.0                             | 8.5  |       |
|                                     |   |                     | C <sub>L</sub> = 50pF  |                       | 6.1  | 9.3  | 1.0                             | 10.5 |       |
| t <sub>PLH</sub> , t <sub>PHL</sub> | Propagation Delay Time ( $\bar{CLR}$ , $\bar{PR}$ -Q, $\bar{Q}$ ) | 3.3 ± 0.3           | C <sub>L</sub> = 15pF  |                       | 7.6  | 12.3 | 1.0                             | 14.5 | ns    |
|                                     |   |                     | C <sub>L</sub> = 50pF  |                       | 10.1 | 15.8 | 1.0                             | 18.0 |       |
|                                     |   | 5.0 ± 0.5           | C <sub>L</sub> = 15pF  |                       | 4.8  | 7.7  | 1.0                             | 9.0  |       |
|                                     |   |                     | C <sub>L</sub> = 50pF  |                       | 6.3  | 9.7  | 1.0                             | 11.0 |       |
| C <sub>IN</sub>                     | Input Capacitance   |                     | V <sub>CC</sub> = Open |                       | 4    | 10   |                                 | 10   | pF    |
| C <sub>PD</sub>                     | Power Dissipation Capacitance                                     |                     | ( <sup>3</sup> )       |                       | 25   |      |                                 |      | pF    |

## Note:

3. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained from the equation:

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 2 \text{ (per F/F).}$$

## AC Operating Requirements

| Symbol                                | Parameter  | V <sub>CC</sub> (V) <sup>(4)</sup> | T <sub>A</sub> = 25°C |                    | T <sub>A</sub> = -40°C to +85°C |      | Units |
|---------------------------------------|--|------------------------------------|-----------------------|--------------------|---------------------------------|------|-------|
|                                       |  |                                    | Typ.                  | Guaranteed Minimum | Min.                            | Max. |       |
| t <sub>W(L)</sub> , t <sub>W(H)</sub> | Minimum Pulse Width (CK)                           | 3.3                                |                       | 6.0                | 7.0                             | ns   |       |
|                                       |  | 5.0                                |                       | 5.0                | 5.0                             |      |       |
| t <sub>W(L)</sub>                     | Minimum Pulse Width ( $\bar{CLR}$ , $\bar{PR}$ )   | 3.3                                |                       | 6.0                | 7.0                             | ns   |       |
|                                       |  | 5.0                                |                       | 5.0                | 5.0                             |      |       |
| t <sub>S</sub>                        | Minimum Setup Time                                 | 3.3                                |                       | 6.0                | 7.0                             | ns   |       |
|                                       |  | 5.0                                |                       | 5.0                | 5.0                             |      |       |
| t <sub>H</sub>                        | Minimum Hold Time                                  | 3.3                                |                       | 0.5                | 0.5                             | ns   |       |
|                                       |  | 5.0                                |                       | 0.5                | 0.5                             |      |       |
| t <sub>REC</sub>                      | Minimum Recovery Time ( $\bar{CLR}$ , $\bar{PR}$ ) | 3.3                                |                       | 5.0                | 5.0                             | ns   |       |
|                                       |  | 5.0                                |                       | 3.0                | 3.0                             |      |       |

## Note:

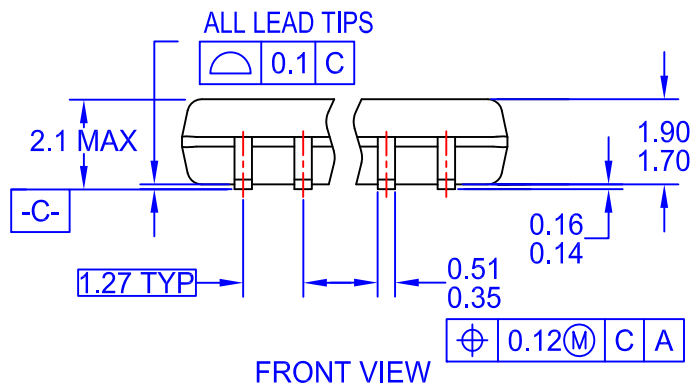
4. V<sub>CC</sub> is 3.3 ± 0.3V or 5.0 ± 0.5V



**NOTES:**

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