

## 54174/DM54174/DM74174, 54175/DM54175/DM74175 Hex/Quad D Flip-Flops with Clear

### General Description

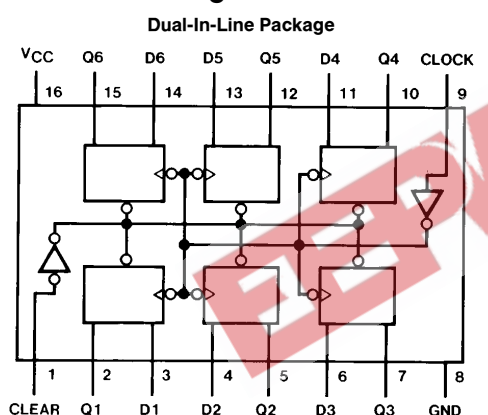
These positive-edge triggered flip-flops utilize TTL circuitry to implement D-type flip-flop logic. All have a direct clear input, and the quad (175) version features complementary outputs from each flip-flop.

Information at the D inputs meeting the setup and hold time requirements is transferred to the Q outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When the clock input is at either the high or low level, the D input signal has no effect at the output.

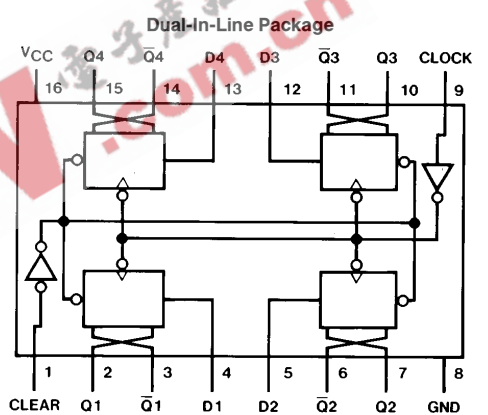
### Features

- 174 contains six flip-flops with single-rail outputs
- 175 contains four flip-flops with double-rail outputs
- Buffered clock and direct clear inputs
- Individual data input to each flip-flop
- Applications include:
  - Buffer/storage registers
  - Shift registers
  - Pattern generators
- Typical clock frequency 40 MHz
- Typical power dissipation per flip-flop 38 mW
- Alternate Military/Aerospace device (54174, 54175) is available. Contact a National Semiconductor Sales Office/Distributor for specifications.

### Connection Diagrams



TL/F/6557-1  
Order Number 54174DMQB, 54174FMB, DM54174J,  
DM54174W or DM74174N  
See NS Package Number J16A, N16E or W16A



TL/F/6557-2  
Order Number 54175DMQB, 54175FMB, DM54175J,  
DM54175W or DM74175N  
See NS Package Number J16A, N16E or W16A

### Function Table (Each Flip-Flop)

| Inputs |       |   | Outputs        |                |
|--------|-------|---|----------------|----------------|
| Clear  | Clock | D | Q              | Q <sup>†</sup> |
| L      | X     | X | L              | H              |
| H      | ↑     | H | H              | L              |
| H      | ↑     | L | L              | H              |
| H      | L     | X | Q <sub>0</sub> | Q <sub>0</sub> |

H = High Level (steady state)

L = Low Level (steady state)

X = Don't Care

↑ = Transition from low to high level

Q<sub>0</sub> = The level of Q before the indicated steady-state input conditions were established.

† = 175 only

## Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 5.5V            |
| Operating Free Air Temperature Range |                 |
| DM54 and 54                          | −55°C to +125°C |
| DM74                                 | 0°C to +70°C    |
| Storage Temperature Range            | −65°C to +150°C |

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

## Recommended Operating Conditions

| Symbol           | Parameter                      |            | DM54174 |     |      | DM74174 |     |      | Units |
|------------------|--------------------------------|------------|---------|-----|------|---------|-----|------|-------|
|                  |                                |            | Min     | Nom | Max  | Min     | Nom | Max  |       |
| V <sub>CC</sub>  | Supply Voltage                 |            | 4.5     | 5   | 5.5  | 4.75    | 5   | 5.25 | V     |
| V <sub>IH</sub>  | High Level Input Voltage       |            | 2       |     |      | 2       |     |      | V     |
| V <sub>IL</sub>  | Low Level Input Voltage        |            |         |     | 0.8  |         |     | 0.8  | V     |
| I <sub>OH</sub>  | High Level Output Current      |            |         |     | −0.8 |         |     | −0.8 | mA    |
| I <sub>OL</sub>  | Low Level Output Current       |            |         |     | 16   |         |     | 16   | mA    |
| f <sub>CLK</sub> | Clock Frequency (Note 4)       |            | 0       |     | 30   | 0       |     | 30   | MHz   |
| t <sub>w</sub>   | Pulse Width (Note 4)           | Clock Low  | 25      |     |      | 25      |     |      | ns    |
|                  |                                | Clock High | 10      |     |      | 10      |     |      |       |
|                  |                                | Clear      | 20      |     |      | 20      |     |      |       |
| t <sub>SU</sub>  | Data Setup Time (Note 4)       |            | 20      |     |      | 20      |     |      | ns    |
| t <sub>H</sub>   | Data Hold Time (Note 4)        |            | 0       |     |      | 0       |     |      | ns    |
| t <sub>REL</sub> | Clear Release Time (Note 4)    |            | 30      |     |      | 30      |     |      | ns    |
| T <sub>A</sub>   | Free Air Operating Temperature |            | −55     |     | 125  | 0       |     | 70   | °C    |

## '174 Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

| Symbol          | Parameter                         | Conditions                                                                                   | Min  | Typ (Note 1) | Max  | Units |
|-----------------|-----------------------------------|----------------------------------------------------------------------------------------------|------|--------------|------|-------|
| V <sub>I</sub>  | Input Clamp Voltage               | V <sub>CC</sub> = Min, I <sub>I</sub> = −12 mA                                               |      |              | −1.5 | V     |
| V <sub>OH</sub> | High Level Output Voltage         | V <sub>CC</sub> = Min, I <sub>OH</sub> = Max<br>V <sub>IL</sub> = Max, V <sub>IH</sub> = Min | 2.4  |              |      | V     |
| V <sub>OL</sub> | Low Level Output Voltage          | V <sub>CC</sub> = Min, I <sub>OL</sub> = Max<br>V <sub>IH</sub> = Min, V <sub>IL</sub> = Max |      |              | 0.4  | V     |
| I <sub>I</sub>  | Input Current @ Max Input Voltage | V <sub>CC</sub> = Max, V <sub>I</sub> = 5.5V                                                 |      |              | 1    | mA    |
| I <sub>IH</sub> | High Level Input Current          | V <sub>CC</sub> = Max, V <sub>I</sub> = 2.4V                                                 |      |              | 40   | μA    |
| I <sub>IL</sub> | Low Level Input Current           | V <sub>CC</sub> = Max, V <sub>I</sub> = 0.4V                                                 |      |              | −1.6 | mA    |
| I <sub>OS</sub> | Short Circuit Output Current      | V <sub>CC</sub> = Max (Note 2)                                                               | DM54 | −20          | −57  | mA    |
|                 |                                   |                                                                                              | DM74 | −18          | −57  |       |
| I <sub>CC</sub> | Supply Current                    | V <sub>CC</sub> = Max (Note 3)                                                               |      | 45           | 65   | mA    |

Note 1: All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: With all outputs open and all DATA and CLEAR inputs at 4.5V, I<sub>CC</sub> is measured after a momentary ground, then 4.5V applied to the CLOCK input.

Note 4: T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

## '174 Switching Characteristics

at  $V_{CC} = 5V$  and  $T_A = 25^\circ C$  (See Section 1 for Test Waveforms and Output Load)

| Symbol    | Parameter                                          | From (Input)<br>To (Output) | $R_L = 400\Omega, C_L = 15 pF$ |     | Units |
|-----------|----------------------------------------------------|-----------------------------|--------------------------------|-----|-------|
|           |                                                    |                             | Min                            | Max |       |
| $f_{MAX}$ | Maximum Clock Frequency                            |                             | 30                             |     | MHz   |
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | Clock to<br>Any Q           |                                | 25  | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output | Clock to<br>Any Q           |                                | 25  | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output | Clear to<br>Any Q           |                                | 40  | ns    |

## Recommended Operating Conditions

| Symbol    | Parameter                      |            | DM54175 |     |      | DM74175 |     |      | Units      |
|-----------|--------------------------------|------------|---------|-----|------|---------|-----|------|------------|
|           |                                |            | Min     | Nom | Max  | Min     | Nom | Max  |            |
| $V_{CC}$  | Supply Voltage                 |            | 4.5     | 5   | 5.5  | 4.75    | 5   | 5.25 | V          |
| $V_{IH}$  | High Level Input Voltage       |            | 2       |     |      | 2       |     |      | V          |
| $V_{IL}$  | Low Level Input Voltage        |            |         |     | 0.8  |         |     | 0.8  | V          |
| $I_{OH}$  | High Level Output Current      |            |         |     | -0.8 |         |     | -0.8 | mA         |
| $I_{OL}$  | Low Level Output Current       |            |         |     | 16   |         |     | 16   | mA         |
| $f_{CLK}$ | Clock Frequency (Note 1)       |            | 0       |     | 30   | 0       |     | 30   | MHz        |
| $t_W$     | Pulse Width<br>(Note 1)        | Clock Low  | 25      |     |      | 25      |     |      | ns         |
|           |                                | Clock High | 10      |     |      | 10      |     |      |            |
|           |                                | Clear      | 20      |     |      | 20      |     |      |            |
| $t_{SU}$  | Data Setup Time (Note 1)       |            | 20      |     |      | 20      |     |      | ns         |
| $t_H$     | Data Hold Time (Note 1)        |            | 0       |     |      | 0       |     |      | ns         |
| $t_{REL}$ | Clear Release Time (Note 1)    |            | 30      |     |      | 30      |     |      | ns         |
| $T_A$     | Free Air Operating Temperature |            | -55     |     | 125  | 0       |     | 70   | $^\circ C$ |

Note 1:  $T_A = 25^\circ C$  and  $V_{CC} = 5V$ .

## '175 Electrical Characteristics

over recommended operating free air temperature range (unless otherwise noted)

| Symbol   | Parameter                         | Conditions                                                                               | Min  | Typ<br>(Note 1) | Max  | Units         |
|----------|-----------------------------------|------------------------------------------------------------------------------------------|------|-----------------|------|---------------|
| $V_I$    | Input Clamp Voltage               | $V_{CC} = \text{Min}, I_I = -12 \text{ mA}$                                              |      |                 | -1.5 | V             |
| $V_{OH}$ | High Level Output Voltage         | $V_{CC} = \text{Min}, I_{OH} = \text{Max}$<br>$V_{IL} = \text{Max}, V_{IH} = \text{Min}$ | 2.4  |                 |      | V             |
| $V_{OL}$ | Low Level Output Voltage          | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$<br>$V_{IH} = \text{Min}, V_{IL} = \text{Max}$ |      |                 | 0.4  | V             |
| $I_I$    | Input Current @ Max Input Voltage | $V_{CC} = \text{Max}, V_I = 5.5\text{V}$                                                 |      |                 | 1    | mA            |
| $I_{IH}$ | High Level Input Current          | $V_{CC} = \text{Max}, V_I = 2.4\text{V}$                                                 |      |                 | 40   | $\mu\text{A}$ |
| $I_{IL}$ | Low Level Input Current           | $V_{CC} = \text{Max}, V_I = 0.4\text{V}$                                                 |      |                 | -1.6 | mA            |
| $I_{OS}$ | Short Circuit Output Current      | $V_{CC} = \text{Max}$<br>(Note 2)                                                        | DM54 | -20             | -57  | mA            |
|          |                                   |                                                                                          | DM74 | -18             | -57  |               |
| $I_{CC}$ | Supply Current                    | $V_{CC} = \text{Max}$ (Note 3)                                                           |      | 30              | 45   | mA            |

## '175 Switching Characteristics

at  $V_{CC} = 5\text{V}$  and  $T_A = 25^\circ\text{C}$  (See Section 1 for Test Waveforms and Output Load)

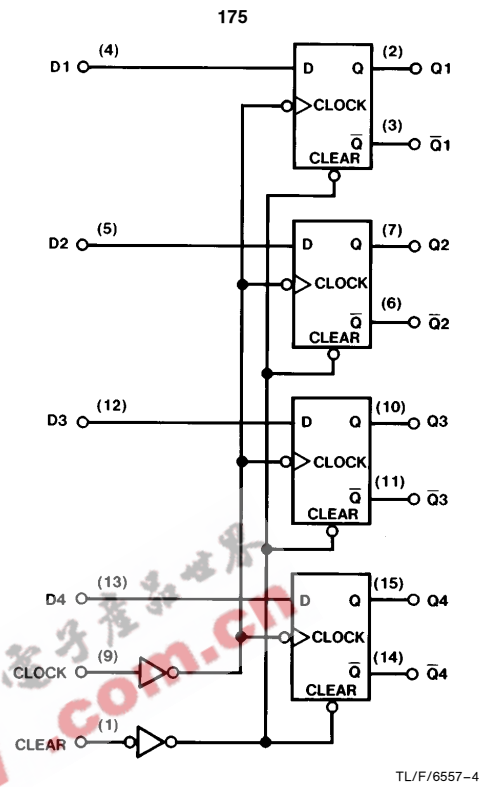
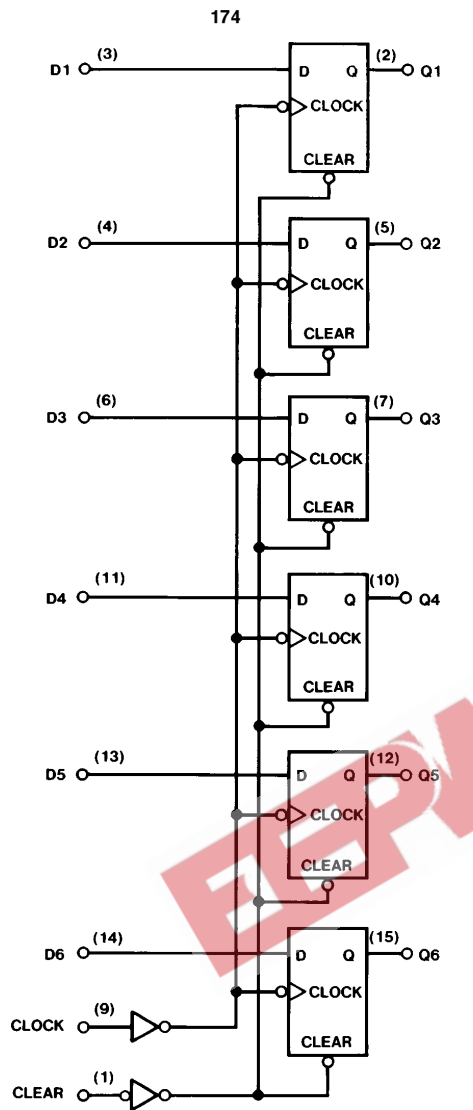
| Symbol    | Parameter                                          | From (Input)<br>To (Output)    | $R_L = 400\Omega, C_L = 15 \text{ pF}$ |     | Units |
|-----------|----------------------------------------------------|--------------------------------|----------------------------------------|-----|-------|
|           |                                                    |                                | Min                                    | Max |       |
| $f_{MAX}$ | Maximum Clock Frequency                            |                                | 30                                     |     | MHz   |
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | Clock to<br>Any Q or $\bar{Q}$ |                                        | 25  | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output | Clock to<br>Any Q or $\bar{Q}$ |                                        | 25  | ns    |
| $t_{PLH}$ | Propagation Delay Time<br>Low to High Level Output | Clear to<br>Any $\bar{Q}$      |                                        | 25  | ns    |
| $t_{PHL}$ | Propagation Delay Time<br>High to Low Level Output | Clear to<br>Any Q              |                                        | 40  | ns    |

**Note 1:** All typicals are at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ .

**Note 2:** Not more than one output should be shorted at a time.

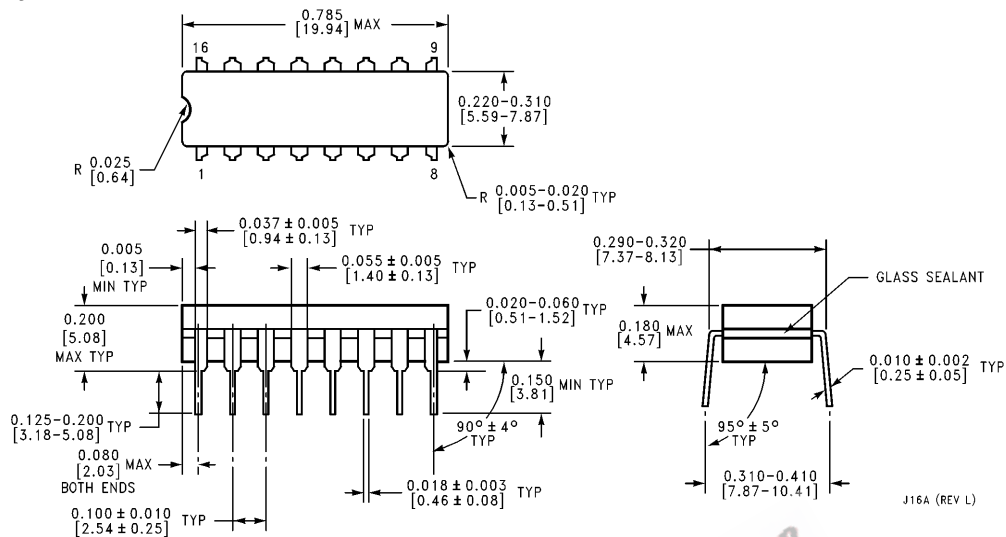
**Note 3:** With all outputs open and 4.5V applied to all DATA and CLEAR inputs,  $I_{CC}$  is measured after a momentary ground then 4.5V applied to the CLOCK.

## Logic Diagrams

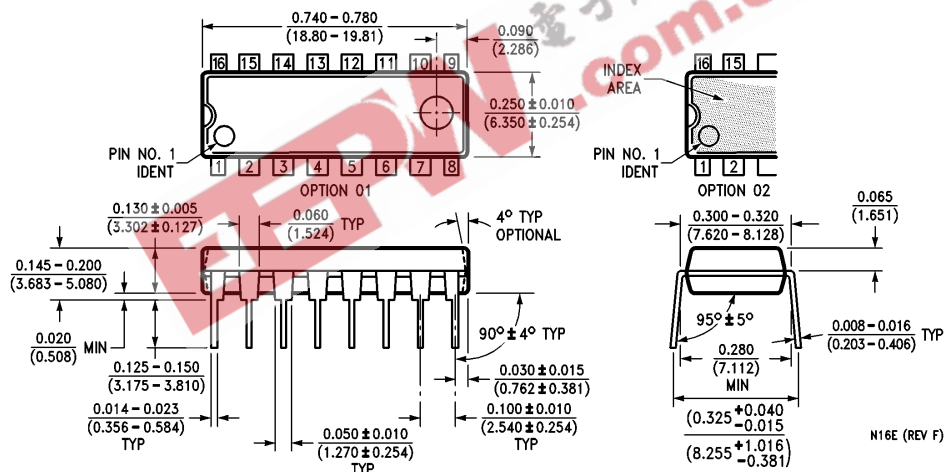


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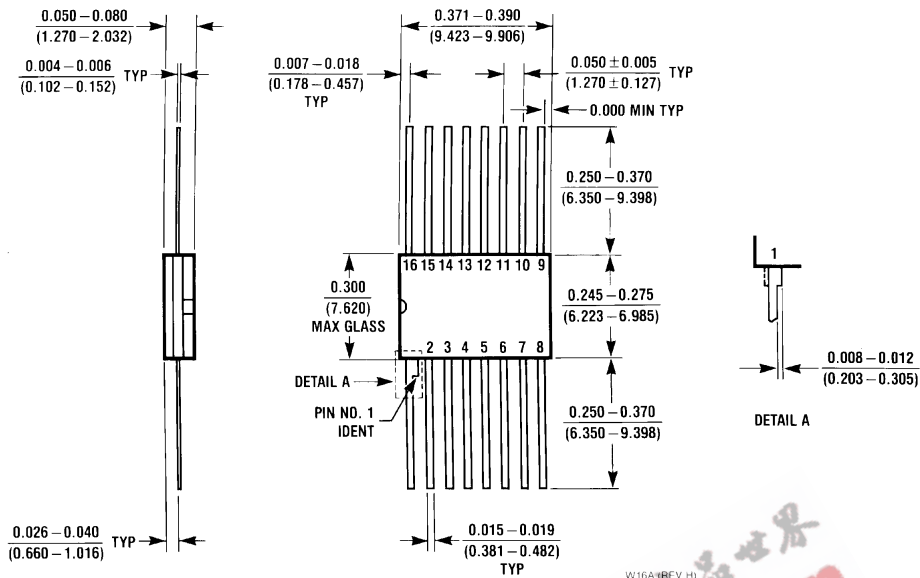
## Physical Dimensions inches (millimeters)



**16-Lead Ceramic Dual-In-Line Package (J)**  
**Order Number 54174DMQB, 54175DMQB, DM54174J or DM54175J**  
**NS Package Number J16A**



**16-Lead Molded Dual-In-Line Package (N)**  
**Order Number DM74174N or DM74175N**  
**NS Package Number N16E**

**Physical Dimensions** inches (millimeters) (Continued)

**16-Lead Ceramic Flat Package (W)**  
**Order Number 54174FMQB, 54175FMQB, DM54174W or DM54175W**  
**NS Package Number W16A**

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