

54LS174/DM54LS174/DM74LS174, 54LS175/DM54LS175/DM74LS175 Hex/Quad D Flip-Flops with Clear

General Description

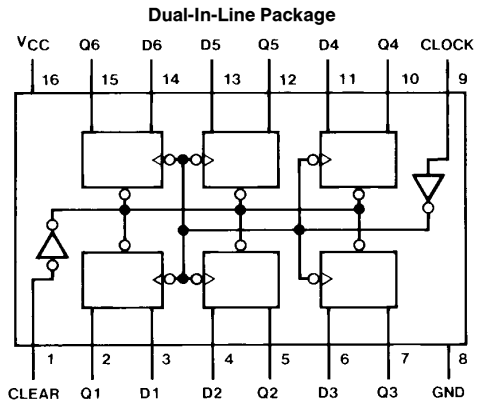
These positive-edge-triggered flip-flops utilize TTL circuitry to implement D-type flip-flop logic. All have a direct clear input, and the quad (175) versions feature complementary outputs from each flip-flop.

Information at the D inputs meeting the setup 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.

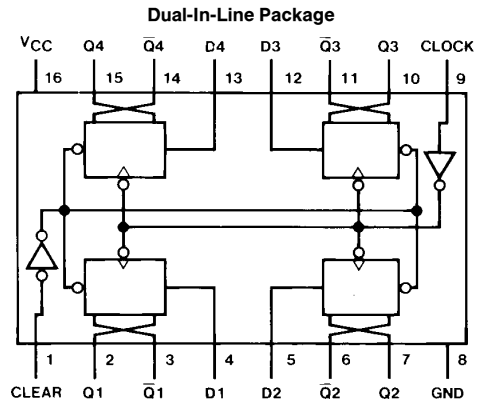
Features

- LS174 contains six flip-flops with single-rail outputs
- LS175 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 14 mW
- Alternate Military/Aerospace device (54LS174, 54LS175) is available. Contact a National Semiconductor Sales Office/Distributor for specifications.

Connection Diagrams



Order Number 54LS174DMQB, 54LS174FMQB, 54LS174LMQB, DM54LS174J, DM54LS174W, DM74LS174M or DM74LS174N
See NS Package Number E20A, J16A, M16A, N16E or W16A



Order Number 54LS175DMQB, 54LS175FMQB, 54LS175LMQB, DM54LS175J, DM54LS175W, DM74LS175M or DM74LS175N
See NS Package Number E20A, J16A, M16A, N16E or W16A

Function Table (Each Flip-Flop)

| Inputs | | | Outputs | |
|--------|-------|---|---------|-------------------|
| Clear | Clock | D | Q | \bar{Q}^\dagger |
| L | X | X | L | H |
| H | ↑ | H | H | L |
| H | ↑ | L | L | H |
| H | L | X | Q_0 | \bar{Q}_0 |

H = High Level (steady state)
L = Low Level (steady state)
X = Don't Care
↑ = Transition from low to high level
 Q_0 = The level of Q before the indicated steady-state input conditions were established.
 † = LS175 only

54LS174/DM54LS174/DM74LS174, 54LS175/DM54LS175/DM74LS175
Hex/Quad D Flip-Flops with Clear

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 | 7V |
| Operating Free Air Temperature Range | |
| DM54LS and 54LS | −55°C to +125°C |
| DM74LS | 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 | DM54LS174 | | | DM74LS174 | | | 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 | | | 0.7 | | | 0.8 | V |
| I _{OH} | High Level Output Current | | | −0.4 | | | −0.4 | mA |
| I _{OL} | Low Level Output Current | | | 4 | | | 8 | mA |
| f _{CLK} | Clock Frequency (Note 1) | 0 | | 30 | 0 | | 30 | MHz |
| f _{CLK} | Clock Frequency (Note 2) | 0 | | 25 | 0 | | 25 | MHz |
| t _W | Pulse Width (Note 6) | Clock | 20 | | 20 | | | ns |
| | | Clear | 20 | | 20 | | | |
| t _{SU} | Data Setup Time (Note 6) | 20 | | | 20 | | | ns |
| t _H | Data Hold Time (Note 6) | 0 | | | 0 | | | ns |
| t _{REL} | Clear Release Time (Note 6) | 25 | | | 25 | | | ns |
| T _A | Free Air Operating Temperature | −55 | | 125 | 0 | | 70 | °C |

'LS174 Electrical Characteristics

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

| Symbol | Parameter | Conditions | Min | Typ (Note 3) | Max | Units |
|-----------------|---------------------------------|--|-------|--------------|-------|-------|
| V _I | Input Clamp Voltage | V _{CC} = Min, I _I = −18 mA | | | −1.5 | V |
| V _{OH} | High Level Output Voltage | V _{CC} = Min, I _{OH} = Max V _{IL} = Max, V _{IH} = Min | DM54 | 2.5 | 3.4 | V |
| | | DM74 | 2.7 | 3.4 | | |
| V _{OL} | Low Level Output Voltage | V _{CC} = Min, I _{OL} = Max V _{IL} = Max, V _{IH} = Min | DM54 | | 0.25 | V |
| | | DM74 | | 0.35 | 0.5 | |
| | | I _{OL} = 4 mA, V _{CC} = Min | DM74 | | 0.25 | |
| I _I | Input Current@Max Input Voltage | V _{CC} = Max, V _I = 7V | | | 0.1 | mA |
| I _{IH} | High Level Input Current | V _{CC} = Max, V _I = 2.7V | | | 20 | μA |
| I _{IL} | Low Level Input Current | V _{CC} = Max V _I = 0.4V | Clock | | −0.4 | mA |
| | | | Clear | | −0.4 | |
| | | | Data | | −0.36 | |
| I _{OS} | Short Circuit Output Current | V _{CC} = Max (Note 4) | DM54 | −20 | −100 | mA |
| | | | DM74 | −20 | −100 | |
| I _{CC} | Supply Current | V _{CC} = Max (Note 5) | | 16 | 26 | mA |

Note 1: C_L = 15 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 2: C_L = 50 pF, R_L = 2 kΩ, T_A = 25°C and V_{CC} = 5V.

Note 3: All typicals are at V_{CC} = 5V, T_A = 25°C.

Note 4: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 5: 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.

Note 6: T_A = 25°C and V_{CC} = 5V.

'LS174 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) To (Output) | $R_L = 2\text{ k}\Omega$ | | | | Units |
|-----------|--|-----------------------------|--------------------------|-----|----------------------|-----|-------|
| | | | $C_L = 15\text{ pF}$ | | $C_L = 50\text{ pF}$ | | |
| | | | Min | Max | Min | Max | |
| f_{MAX} | Maximum Clock Frequency | | 30 | | 25 | | MHz |
| t_{PLH} | Propagation Delay Time Low to High Level Output | Clock to Output | | 30 | | 32 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | Clock to Output | | 30 | | 36 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | Clear to Output | | 35 | | 42 | ns |

Recommended Operating Conditions

| Symbol | Parameter | DM54LS175 | | | DM74LS175 | | | 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 | | | 0.7 | | | 0.8 | V |
| I_{OH} | High Level Output Current | | | -0.4 | | | -0.4 | mA |
| I_{OL} | Low Level Output Current | | | 4 | | | 8 | mA |
| f_{CLK} | Clock Frequency (Note 1) | 0 | | 30 | 0 | | 30 | MHz |
| f_{CLK} | Clock Frequency (Note 2) | 0 | | 25 | 0 | | 25 | MHz |
| t_W | Pulse Width (Note 3) | Clock | 20 | | 20 | | | ns |
| | | Clear | 20 | | 20 | | | |
| t_{SU} | Data Setup Time (Note 3) | 20 | | | 20 | | | ns |
| t_H | Data Hold Time (Note 3) | 0 | | | 0 | | | ns |
| t_{REL} | Clear Release Time (Note 3) | 25 | | | 25 | | | ns |
| T_A | Free Air Operating Temperature | -55 | | 125 | 0 | | 70 | $^\circ C$ |

Note 1: $C_L = 15\text{ pF}$, $R_L = 2\text{ k}\Omega$, $T_A = 25^\circ C$ and $V_{CC} = 5V$.

Note 2: $C_L = 50\text{ pF}$, $R_L = 2\text{ k}\Omega$, $T_A = 25^\circ C$ and $V_{CC} = 5V$.

Note 3: $T_A = 25^\circ C$ and $V_{CC} = 5V$.

'LS175 Electrical Characteristics

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

| Symbol | Parameter | Conditions | Min | Typ (Note 1) | Max | Units |
|----------|---------------------------------|--|--|--------------|-------|---------------|
| V_I | Input Clamp Voltage | $V_{CC} = \text{Min}, I_I = -18 \text{ mA}$ | | | -1.5 | V |
| V_{OH} | High Level Output Voltage | $V_{CC} = \text{Min}, I_{OH} = \text{Max}$ $V_{IL} = \text{Max}, V_{IH} = \text{Min}$ | DM54 | 2.5 | 3.4 | V |
| | | | DM74 | 2.7 | 3.4 | |
| V_{OL} | Low Level Output Voltage | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$ $V_{IL} = \text{Max}, V_{IH} = \text{Min}$ | DM54 | | 0.25 | V |
| | | | DM74 | | 0.35 | |
| | | | $I_{OL} = 4 \text{ mA}, V_{CC} = \text{Min}$ | DM74 | | 0.25 |
| I_I | Input Current@Max Input Voltage | $V_{CC} = \text{Max}, V_I = 7V$ | | | 0.1 | mA |
| I_{IH} | High Level Input Current | $V_{CC} = \text{Max}, V_I = 2.7V$ | | | 20 | μA |
| I_{IL} | Low Level Input Current | $V_{CC} = \text{Max}$ $V_I = 0.4V$ | Clock | | -0.4 | mA |
| | | | Clear | | -0.4 | |
| | | | Data | | -0.36 | |
| I_{OS} | Short Circuit Output Current | $V_{CC} = \text{Max}$ (Note 2) | DM54 | -20 | -100 | mA |
| | | | DM74 | -20 | -100 | |
| I_{CC} | Supply Current | $V_{CC} = \text{Max}$ (Note 3) | | 11 | 18 | mA |

'LS175 Switching Characteristics

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

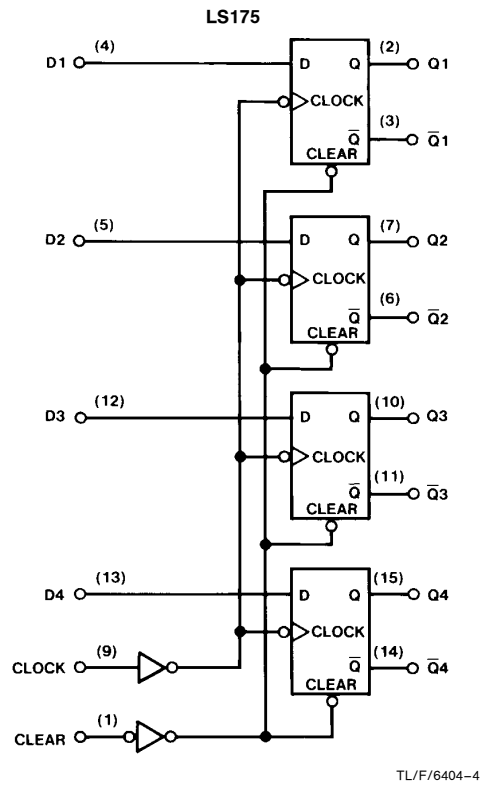
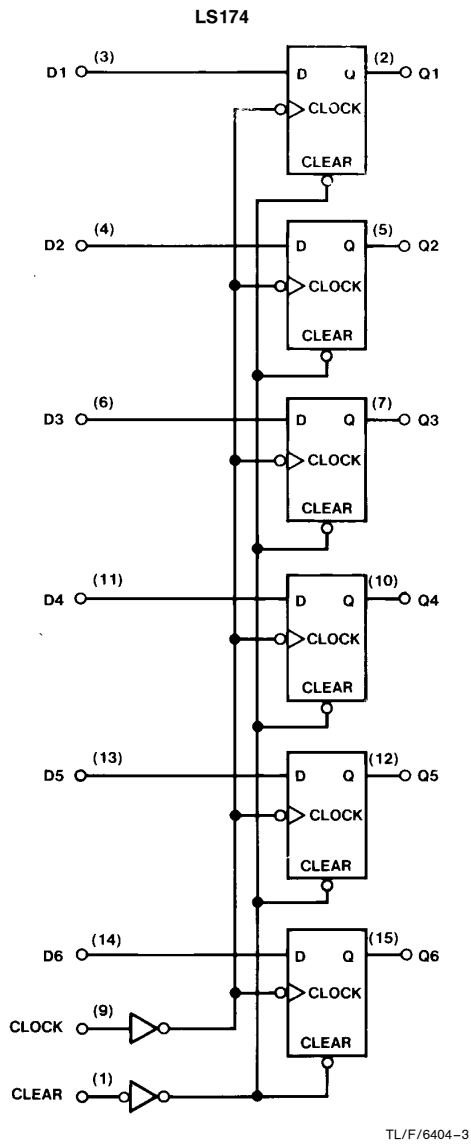
| Symbol | Parameter | From (Input) To (Output) | $R_L = 2 \text{ k}\Omega$ | | | | Units |
|------------------|--|------------------------------|---------------------------|-----|-----------------------|-----|-------|
| | | | $C_L = 15 \text{ pF}$ | | $C_L = 50 \text{ pF}$ | | |
| | | | Min | Max | Min | Max | |
| f_{MAX} | Maximum Clock Frequency | | 30 | | 25 | | MHz |
| t_{PLH} | Propagation Delay Time Low to High Level Output | Clock to Q or \bar{Q} | | 30 | | 32 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | Clock to Q or \bar{Q} | | 30 | | 36 | ns |
| t_{PLH} | Propagation Delay Time Low to High Level Output | Clear to \bar{Q} | | 25 | | 29 | ns |
| t_{PHL} | Propagation Delay Time High to Low Level Output | Clear to Q | | 35 | | 42 | ns |

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

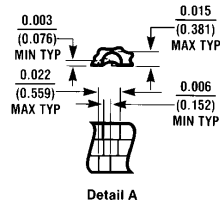
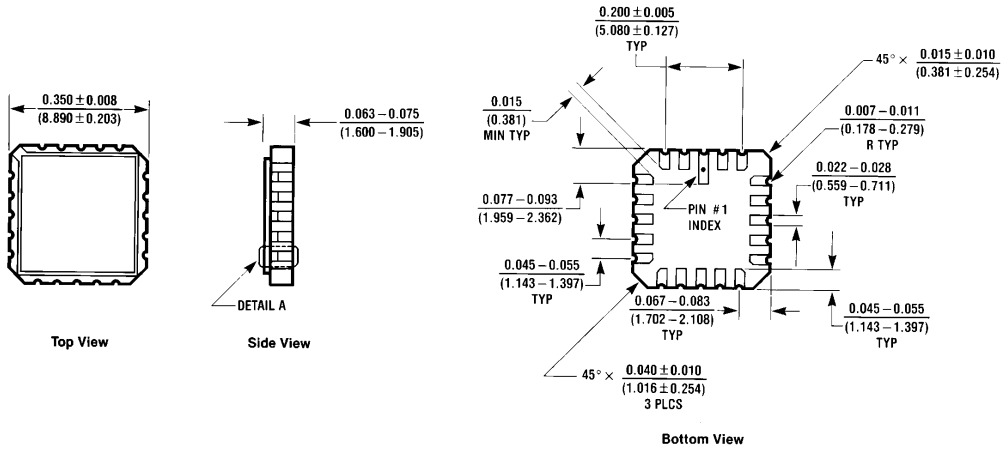
Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

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 input.

Logic Diagrams

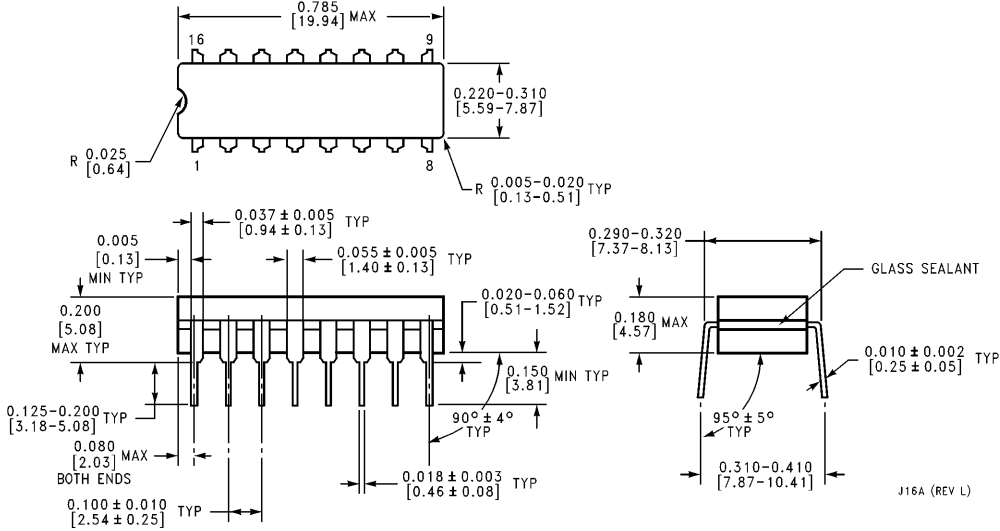


Physical Dimensions inches (millimeters)



Ceramic Leadless Chip Carrier (E)
 Order Number 54LS174LMQB or 54LS175LMQB
 NS Package Number E20A

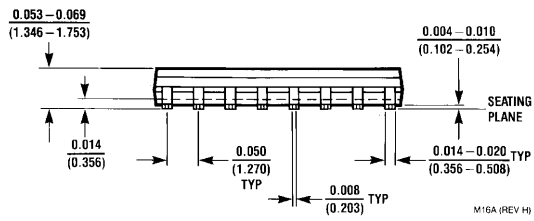
E20A (REV D)



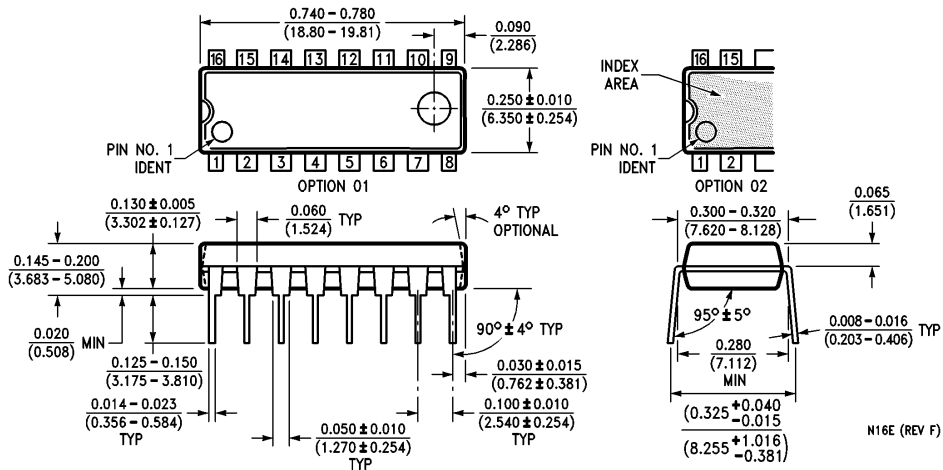
16-Lead Ceramic Dual-In-Line Package (J)
 Order Number DM54LS174DMQB, 54LS175DMQB, DM54LS174J or DM54LS175J
 NS Package Number J16A

J16A (REV L)

Physical Dimensions inches (millimeters) (Continued)

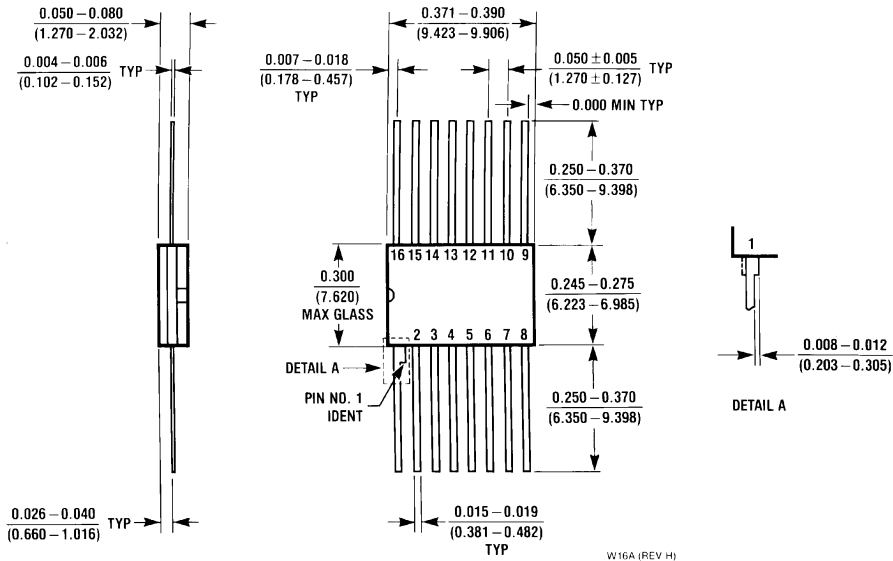


16-Lead Small Outline Molded Package (M)
Order Number DM74LS174M or DM74LS175M
NS Package Number M16A



16-Lead Molded Dual-In-Line Package (N)
Order Number DM74LS174N or DM74LS175N
NS Package Number N16E

Physical Dimensions inches (millimeters) (Continued)



16-Lead Ceramic Flat Package (W)

Order Number 54LS174FMQB, 54LS175FMQB, DM54LS174W or DM54LS175W
NS Package Number W16A

W16A (REV H)

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