



# DM54S373/DM74S373, DM54S374/DM74S374

## TRI-STATE® Octal D-Type Transparent Latches and Edge-Triggered Flip-Flops

### General Description

These 8-bit registers feature totem-pole TRI-STATE outputs designed specifically for driving highly-capacitive or relatively low-impedance loads. The high-impedance state and increased high-logic-level drive provide these registers with the capability of being connected directly to and driving the bus lines in a bus-organized system without need for interface or pull-up components. They are particularly attractive for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight latches of the DM54/74S373 are transparent D-type latches meaning that while the enable (G) is high the Q outputs will follow the data (D) inputs. When the enable is taken low the output will be latched at the level of the data that was set up.

The eight flip-flops of the DM54/74S374 are edge-triggered D-type flip-flops. On the positive transition of the clock, the Q outputs will be set to the logic states that were set up at the D inputs.

Schmitt-trigger buffered inputs at the enable/clock lines simplify system design as ac and dc noise rejection is improved by typically 400 mV due to the input hysteresis. A buffered output control input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or a high-impedance state. In the high-impedance state the outputs neither load nor drive the bus lines significantly.

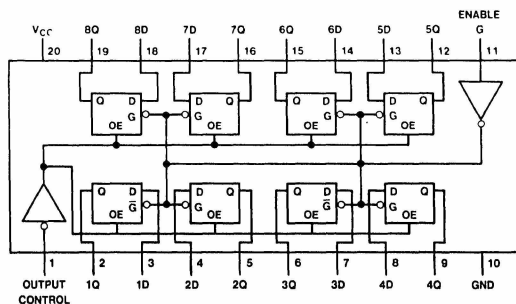
The output control does not affect the internal operation of the latches or flip-flops. That is, the old data can be retained or new data can be entered even while the outputs are off.

### Features

- Choice of 8 latches or 8 D-type flip-flops in a single package
- TRI-STATE bus-driving outputs
- Full parallel-access for loading
- Buffered control inputs
- P-N-P input reduce D-C loading on data lines

### Connection Diagrams

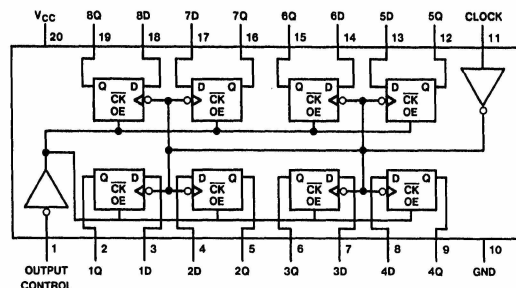
Dual-In-Line Package



Order Number DM54S373J,  
DM74S373WM or  
DM74S373N  
See NS Package Number  
J20A, M20B or N20A

TL/F/6486-1

Dual-In-Line Package



Order Number DM54S374J,  
DM74S374WM or  
DM74S374N  
See NS Package Number  
J20A, M20B or N20A

TL/F/6486-2

## 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 |                 |
| DM54S                                | -55°C to +125°C |
| DM74S                                | 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.

## Function Tables

DM54/74S373  
Truth Table

| Output Control | Enable G | D | Output         |
|----------------|----------|---|----------------|
| L              | H        | H | H              |
| L              | H        | L | L              |
| L              | L        | X | Q <sub>0</sub> |
| H              | X        | X | Z              |

DM54/74S374  
Truth Table

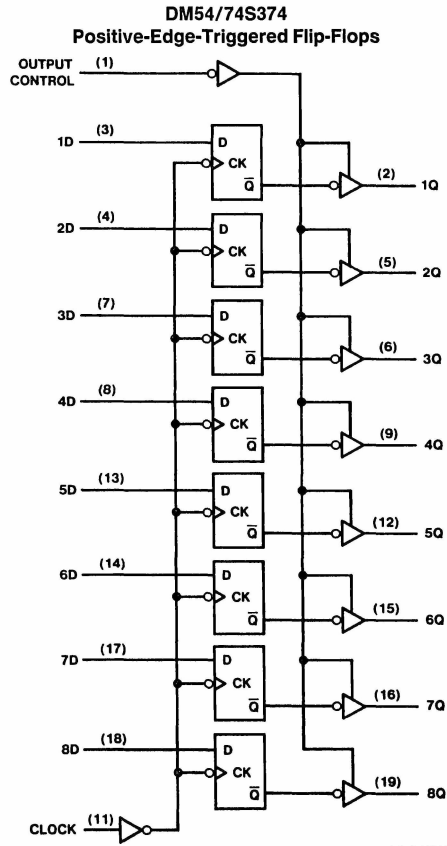
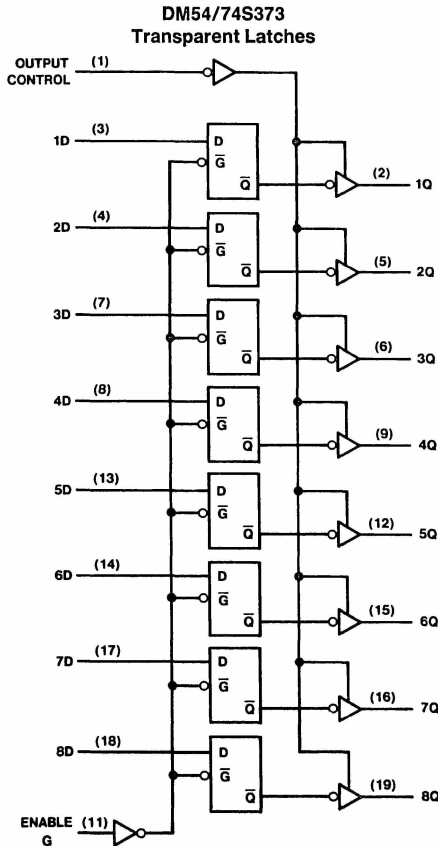
| Output Control | Clock | D | Output         |
|----------------|-------|---|----------------|
| L              | ↑     | H | H              |
| L              | ↑     | L | L              |
| L              | L     | X | Q <sub>0</sub> |
| H              | X     | X | Z              |

H = High Level (Steady State), L = Low Level (Steady State), X = Don't Care

↑ = Transition from low-to-high level, Z = High Impedance State

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

## Logic Diagrams



# 'S373 Recommended Operating Conditions (See Section 1 for Test Waveforms and Output Load)

| Symbol   | Parameter                       |             | DM54S373 |     |     | DM74S373 |     |      | 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       |             |          |     | -2  |          |     | -6.5 | mA    |
| $I_{OL}$ | Low Level Output Current        |             |          |     | 20  |          |     | 20   | mA    |
| $t_w$    | Pulse Width<br>(Note 2)         | Enable High | 6        |     |     | 6        |     |      | ns    |
|          |                                 | Enable Low  | 7.3      |     |     | 7.3      |     |      |       |
| $t_{SU}$ | Data Setup Time (Notes 1 and 3) |             | 0 ↓      |     |     | 0 ↓      |     |      | ns    |
| $t_H$    | Data Hold Time (Notes 1 and 3)  |             | 10 ↓     |     |     | 10 ↓     |     |      | ns    |
| $T_A$    | Free Air Operating Temperature  |             | -55      |     | 125 | 0        |     | 70   | °C    |

**Note 1:** The symbol (↓) indicates the falling edge of the clock pulse is used for reference.

**Note 2:**  $C_L = 15$  pF,  $R_L = 280\Omega$ ,  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 5\text{V}$ .

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

## 'S373 Electrical Characteristics over recommended operating free air temperature (unless otherwise noted)

| Symbol    | Parameter                                                       | Conditions                                                                                       |                     | Min | Typ<br>(Note 4) | Max  | Units         |
|-----------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------|-----|-----------------|------|---------------|
| $V_I$     | Input Clamp Voltage                                             | $V_{CC} = \text{Min}$ , $I_I = -18$ mA                                                           |                     |     |                 | -1.2 | V             |
| $V_{OH}$  | High Level Output Voltage                                       | $V_{CC} = \text{Min}$<br>$I_{OH} = \text{Max}$<br>$V_{IL} = \text{Max}$<br>$V_{IH} = \text{Min}$ | DM54                | 2.4 | 3.4             |      | V             |
|           |                                                                 |                                                                                                  | DM74                | 2.4 | 3.2             |      |               |
| $V_{OL}$  | Low Level Output Voltage                                        | $V_{CC} = \text{Min}$ , $I_{OL} = \text{Max}$<br>$V_{IH} = \text{Min}$ , $V_{IL} = \text{Max}$   |                     |     |                 | 0.5  | 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                                        | $V_{CC} = \text{Max}$ , $V_I = 2.7\text{V}$                                                      |                     |     |                 | 50   | $\mu\text{A}$ |
| $I_{IL}$  | Low Level Input Current                                         | $V_{CC} = \text{Max}$ , $V_I = 0.5\text{V}$                                                      |                     |     |                 | -250 | $\mu\text{A}$ |
| $I_{OZH}$ | Off-State Output Current with High Level Output Voltage Applied | $V_{CC} = \text{Max}$ , $V_O = 2.4\text{V}$<br>$V_{IH} = \text{Min}$ , $V_{IL} = \text{Max}$     |                     |     |                 | 50   | $\mu\text{A}$ |
| $I_{OZL}$ | Off-State Output Current with Low Level Output Voltage Applied  | $V_{CC} = \text{Max}$ , $V_O = 0.5\text{V}$<br>$V_{IH} = \text{Min}$ , $V_{IL} = \text{Max}$     |                     |     |                 | -50  | $\mu\text{A}$ |
| $I_{OS}$  | Short Circuit Output Current                                    | $V_{CC} = \text{Max}$<br>(Note 5)                                                                | DM54                | -40 |                 | -100 | mA            |
|           |                                                                 |                                                                                                  | DM74                | -40 |                 | -100 |               |
| $I_{CC}$  | Supply Current                                                  | $V_{CC} = \text{Max}$                                                                            | Outputs High or Low |     | 105             | 160  | mA            |
|           |                                                                 |                                                                                                  | Outputs Disabled    |     |                 | 190  |               |

**Note 4:** All typicals are at  $V_{CC} = 5\text{V}$ ,  $T_A = 25^\circ\text{C}$ .

**Note 5:** Not more than one output should be shorted at a time, and the duration should not exceed one second.

**'S373 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 <sub>L</sub> = 280Ω  |     |                        |     | Units |
|------------------|---------------------------------------------------|-----------------------------|------------------------|-----|------------------------|-----|-------|
|                  |                                                   |                             | C <sub>L</sub> = 15 pF |     | C <sub>L</sub> = 50 pF |     |       |
|                  |                                                   |                             | Min                    | Max | Min                    | Max |       |
| t <sub>PLH</sub> | Propagation Delay Time Low to High Level Output   | Data to Any Q               |                        | 12  |                        | 14  | ns    |
| t <sub>PHL</sub> | Propagation Delay Time High to Low Level Output   | Data to Any Q               |                        | 12  |                        | 16  | ns    |
| t <sub>PLH</sub> | Propagation Delay Time Low to High Level Output   | Enable to Any Q             |                        | 14  |                        | 14  | ns    |
| t <sub>PHL</sub> | Propagation Delay Time High to Low Level Output   | Enable to Any Q             |                        | 18  |                        | 21  | ns    |
| t <sub>PZH</sub> | Enable Time to High Level Output                  | Output Control to Any Q     |                        | 15  |                        | 17  | ns    |
| t <sub>PZL</sub> | Output Enable Time to Low Level Output            | Output Control to Any Q     |                        | 18  |                        | 23  | ns    |
| t <sub>PHZ</sub> | Output Disable Time to High Level Output (Note 1) | Output Control to Any Q     |                        | 9   |                        |     | ns    |
| t <sub>PLZ</sub> | Output Disable Time to Low Level Output (Note 1)  | Output Control to Any Q     |                        | 12  |                        |     | ns    |

Note 1:  $C_L = 5\text{ pF}$ **'S374 Recommended Operating Conditions**

(See Section 1 for Test Waveforms and Output Load)

| Symbol    | Parameter                       |            | DM54S374     |     |     | DM74S374     |     |      | 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            |     |     |              |     |      | V          |
| $V_{IL}$  | Low Level Input Voltage         |            |              |     | 0.8 |              |     | 0.8  | V          |
| $I_{OH}$  | High Level Output Current       |            |              |     | -2  |              |     | -6.5 | mA         |
| $I_{OL}$  | Low Level Output Current        |            |              |     | 20  |              |     | 20   | mA         |
| $f_{CLK}$ | Clock Frequency (Note 2)        |            | 0            | 100 | 75  | 0            | 100 | 75   | MHz        |
| $f_{CLK}$ | Clock Frequency (Note 3)        |            | 0            | 100 | 75  | 0            | 100 | 75   | MHz        |
| $t_W$     | Pulse Width (Note 2)            | Clock High | 6            |     |     | 6            |     |      | ns         |
|           |                                 | Clock Low  | 7.3          |     |     | 7.3          |     |      |            |
|           | Pulse Width (Note 3)            | Clock High | 15           |     |     | 15           |     |      |            |
|           |                                 | Clock Low  | 15           |     |     | 15           |     |      |            |
| $t_{SU}$  | Data Setup Time (Notes 1 and 4) |            | 5 $\uparrow$ |     |     | 5 $\uparrow$ |     |      | ns         |
| $t_H$     | Data Hold Time (Notes 1 and 4)  |            | 2 $\uparrow$ |     |     | 2 $\uparrow$ |     |      | ns         |
| $T_A$     | Free Air Operating Temperature  |            | -55          |     | 125 | 0            |     | 70   | $^\circ C$ |

Note 1: The symbol ( $\uparrow$ ) indicates the rising edge of the clock pulse is used for reference.Note 2:  $C_L = 15\text{ pF}$ ,  $R_L = 280\Omega$ ,  $T_A = 25^\circ C$  and  $V_{CC} = 5V$ .Note 3:  $C_L = 50\text{ pF}$ ,  $R_L = 280\Omega$ ,  $T_A = 25^\circ C$  and  $V_{CC} = 5V$ .Note 4:  $T_A = 25^\circ C$  and  $V_{CC} = 5V$ .

**'S374 Electrical Characteristics**

over recommended operating free air temperature (unless otherwise noted)

| Symbol    | Parameter                                                       | Conditions                                                                               |                  | Min | Typ<br>(Note 1) | Max  | Units         |
|-----------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------|-----|-----------------|------|---------------|
| $V_I$     | Input Clamp Voltage                                             | $V_{CC} = \text{Min}, I_I = -18 \text{ mA}$                                              |                  |     |                 | -1.2 | V             |
| $V_{OH}$  | High Level Output Voltage                                       | $V_{CC} = \text{Min}$<br>$I_{OH} = \text{Max}$                                           | DM54             | 2.4 | 3.4             |      | V             |
|           |                                                                 | $V_{IL} = \text{Max}$<br>$V_{IH} = \text{Min}$                                           | DM74             | 2.4 | 3.2             |      |               |
| $V_{OL}$  | Low Level Output Voltage                                        | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$<br>$V_{IH} = \text{Min}, V_{IL} = \text{Max}$ |                  |     |                 | 0.5  | V             |
| $I_I$     | Input Current @ Max Input Voltage                               | $V_{CC} = \text{Max}, V_I = 5.5 \text{ V}$                                               |                  |     |                 | 1    | mA            |
| $I_H$     | High Level Input Current                                        | $V_{CC} = \text{Max}, V_I = 2.7 \text{ V}$                                               |                  |     |                 | 50   | $\mu\text{A}$ |
| $I_{IL}$  | Low Level Input Current                                         | $V_{CC} = \text{Max}, V_I = 0.5 \text{ V}$                                               |                  |     |                 | -250 | $\mu\text{A}$ |
| $I_{OZH}$ | Off-State Output Current with High Level Output Voltage Applied | $V_{CC} = \text{Max}, V_O = 2.4 \text{ V}$<br>$V_{IH} = \text{Min}, V_{IL} = \text{Max}$ |                  |     |                 | 50   | $\mu\text{A}$ |
| $I_{OZL}$ | Off-State Output Current with Low Level Output Voltage Applied  | $V_{CC} = \text{Max}, V_O = 0.5 \text{ V}$<br>$V_{IH} = \text{Min}, V_{IL} = \text{Max}$ |                  |     |                 | -50  | $\mu\text{A}$ |
| $I_{OS}$  | Short Circuit Output Current                                    | $V_{CC} = \text{Max}$<br>(Note 2)                                                        | DM54             | -40 |                 | -100 | mA            |
|           |                                                                 |                                                                                          | DM74             | -40 |                 | -100 |               |
| $I_{CC}$  | Supply Current                                                  | $V_{CC} = \text{Max}$                                                                    | Outputs High     |     |                 | 110  | mA            |
|           |                                                                 |                                                                                          | Outputs Low      |     | 90              | 140  |               |
|           |                                                                 |                                                                                          | Outputs Disabled |     |                 | 160  |               |

**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, and the duration should not exceed one second.**'S374 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 <sub>L</sub> = 280Ω  |     |                        |     | Units |
|------------------|-----------------------------------------------------|-----------------------------|------------------------|-----|------------------------|-----|-------|
|                  |                                                     |                             | C <sub>L</sub> = 15 pF |     | C <sub>L</sub> = 50 pF |     |       |
|                  |                                                     |                             | Min                    | Max | Min                    | Max |       |
| f <sub>MAX</sub> | Maximum Clock Frequency                             |                             |                        | 75  |                        | 75  | MHz   |
| t <sub>PLH</sub> | Propagation Delay Time Low to High Level Output     | Clock to Any Q              |                        | 15  |                        | 15  | ns    |
| t <sub>PHL</sub> | Propagation Delay Time High to Low Level Output     | Clock to Any Q              |                        | 17  |                        | 20  | ns    |
| t <sub>PZH</sub> | Output Enable Time to High Level Output             | Output Control to Any Q     |                        | 15  |                        | 17  | ns    |
| t <sub>PZL</sub> | Output Enable Time to Low Level Output              | Output Control to Any Q     |                        | 18  |                        | 23  | ns    |
| t <sub>PHZ</sub> | Output Disable Time from High Level Output (Note 1) | Output Control to Any Q     |                        | 9   |                        |     | ns    |
| t <sub>PLZ</sub> | Output Disable Time from Low Level Output (Note 1)  | Output Control to Any Q     |                        | 12  |                        |     | ns    |

**Note 1:**  $C_L = 5 \text{ pF}$