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## DM54LS323/DM74LS323 8-Bit Universal Shift/Storage Register with Synchronous Reset and Common I/O Pins

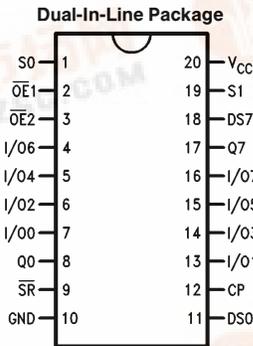
### General Description

The 'LS323 is an 8-bit universal shift/storage register with TRI-STATE® outputs. Its function is similar to the 'LS299 with the exception of Synchronous Reset. Parallel load inputs and flip-flop outputs are multiplexed to minimize pin count. Separate inputs and outputs are provided for flip-flops Q0 and Q7 to allow easy cascading. Four operation modes are possible: hold (store), shift left, shift right, and parallel load. All modes are activated on the LOW-to-HIGH transition of the Clock.

### Features

- Common I/O for reduced pin count
- Four operation modes: shift left, shift right, parallel load and store
- Separate continuous inputs and outputs from Q0 and Q7 allow easy cascading
- Fully synchronous reset
- TRI-STATE outputs for bus oriented applications

### Connection Diagram



TL/F/9829-1

Order Number DM54LS323J, DM54LS323W, DM74LS323WM or DM74LS323N  
See NS Package Number J20A, M20B, N20A or W20A

| Pin Names                        | Description                                           |
|----------------------------------|-------------------------------------------------------|
| CP                               | Clock Pulse Input (Active Rising Edge)                |
| DS0                              | Serial Data Input for Right Shift                     |
| DS7                              | Serial Data Input for Left Shift                      |
| S0, S1                           | Mode Select Inputs                                    |
| $\overline{SR}$                  | Synchronous Reset Input (Active LOW)                  |
| $\overline{OE}1, \overline{OE}2$ | TRI-STATE Output Enable Inputs (Active LOW)           |
| I/O0-I/O7                        | Parallel Data Inputs or TRI-STATE<br>Parallel Outputs |
| Q0, Q7                           | Serial Outputs                                        |

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## 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                               | −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                                                  | DM54LS323 |     |      | DM74LS323 |     |      | 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                                    |           |     | 0.7  |           |     | 0.8  | V     |
| I <sub>OH</sub>    | High Level Output Current                                  |           |     | −0.4 |           |     | −0.4 | mA    |
| I <sub>OL</sub>    | Low Level Output Current                                   |           |     | 4    |           |     | 8    | mA    |
| T <sub>A</sub>     | Free Air Operating Temperature                             | −55       |     | 125  | 0         |     | 70   | °C    |
| t <sub>s</sub> (H) | Setup Time HIGH or LOW                                     | 24        |     |      | 24        |     |      | ns    |
| t <sub>s</sub> (L) | S0 or S1 to CP                                             | 24        |     |      | 24        |     |      |       |
| t <sub>h</sub> (H) | Hold Time HIGH or LOW                                      | 5         |     |      | 0         |     |      | ns    |
| t <sub>h</sub> (L) | S0 or S1 to CP                                             | 5         |     |      | 0         |     |      |       |
| t <sub>s</sub> (H) | Setup Time HIGH or LOW                                     | 15        |     |      | 10        |     |      | ns    |
| t <sub>s</sub> (L) | I/O <sub>n</sub> , D <sub>S0</sub> , D <sub>S7</sub> to CP | 15        |     |      | 10        |     |      |       |
| t <sub>h</sub> (H) | Hold Time HIGH or LOW                                      | 5         |     |      | 0         |     |      | ns    |
| t <sub>h</sub> (L) | I/O <sub>n</sub> , D <sub>S0</sub> , D <sub>S7</sub> to CP | 5         |     |      | 0         |     |      |       |
| t <sub>s</sub> (H) | Setup Time HIGH or LOW                                     | 30        |     |      | 15        |     |      | ns    |
| t <sub>s</sub> (L) | SR to CP                                                   | 20        |     |      | 15        |     |      |       |
| t <sub>h</sub> (H) | Hold Time HIGH or LOW                                      | 0         |     |      | 0         |     |      | ns    |
| t <sub>h</sub> (L) | SR to CP                                                   | 0         |     |      | 0         |     |      |       |
| t <sub>w</sub> (H) | CP Pulse Width HIGH or LOW                                 | 15        |     |      | 15        |     |      | ns    |
| t <sub>w</sub> (L) |                                                            | 15        |     |      | 15        |     |      |       |

## 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               | $V_{CC} = \text{Min}, I_I = -18 \text{ mA}$                             |                            |                 | -1.5         | V             |
| $V_{OH}$  | High Level Output Voltage         | $V_{CC} = \text{Min}, I_{OH} = \text{Max}$<br>$V_{IL} = \text{Max}$     | DM54<br>2.5<br>DM74<br>2.7 | 3.4             |              | V             |
| $V_{OL}$  | Low Level Output Voltage          | $V_{CC} = \text{Min}, I_{OL} = \text{Max}$<br>$V_{IH} = \text{Min}$     | DM54<br>DM74               | 0.35            | 0.4<br>0.5   | V             |
|           |                                   | $I_{OL} = 4 \text{ mA}, V_{CC} = \text{Min}$                            | DM74                       | 0.25            | 0.4          |               |
| $I_I$     | Input Current @ Max Input Voltage | $V_{CC} = \text{Max}, V_I = 7 \text{ V}$<br>$V_I = 10 \text{ V (DM54)}$ | Others<br>$S_n$ Inputs     |                 | 0.1<br>0.2   | mA            |
| $I_{IH}$  | High Level Input Current          | $V_{CC} = \text{Max}, V_I = 2.7 \text{ V}$                              | Others<br>$S_n$ Inputs     |                 | 20<br>40     | $\mu\text{A}$ |
| $I_{IL}$  | Low Level Input Current           | $V_{CC} = \text{Max}, V_I = 0.4 \text{ V}$                              | Others<br>$S_n$ Inputs     |                 | -0.4<br>-0.8 | mA            |
| $I_{OS}$  | Short Circuit Output Current      | $V_{CC} = \text{Max}$<br>(Note 2)                                       | DM54<br>DM74               | -20<br>-20      | -100<br>-100 | mA            |
| $I_{CC}$  | Supply Current                    | $V_{CC} = \text{Max}$                                                   |                            |                 | 60           | mA            |
| $I_{OZH}$ | TRI-STATE Output Off Current HIGH | $V_{CC} = \text{Max}$<br>$V_O = 2.7 \text{ V}$                          |                            |                 | 40           | $\mu\text{A}$ |
| $I_{OZL}$ | TRI-STATE Output Off Current LOW  | $V_{CC} = \text{Max}$<br>$V_O = 0.4 \text{ V}$                          |                            |                 | -400         | $\mu\text{A}$ |

**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.

## Switching Characteristics $V_{CC} = +5.0 \text{ V}, T_A = +25^\circ\text{C}$

| Symbol                 | Parameter                                   | DM54LS323             |          | DM74LS323                                      |          | Units |
|------------------------|---------------------------------------------|-----------------------|----------|------------------------------------------------|----------|-------|
|                        |                                             | $C_L = 15 \text{ pF}$ |          | $R_L = 2 \text{ k}\Omega, C_L = 15 \text{ pF}$ |          |       |
|                        |                                             | Min                   | Max      | Min                                            | Max      |       |
| $f_{\text{max}}$       | Maximum Input Frequency                     | 35                    |          | 35                                             |          | MHz   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>CP to Q0 or Q7         |                       | 26<br>28 |                                                | 23<br>25 | ns    |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>CP to $I/O_n$          |                       | 25<br>35 |                                                | 25<br>29 | ns    |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time<br>$C_L = 50 \text{ pF}$ |                       | 18<br>25 |                                                | 18<br>23 | ns    |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time<br>$C_L = 5 \text{ pF}$ |                       | 15<br>20 |                                                | 15<br>15 | ns    |

## Functional Description

The 'LS323 contains eight edge-triggered D-type flip-flops and the interstage logic necessary to perform synchronous reset, shift left, shift right, parallel load and hold operations. The type of operation is determined by S0 and S1 as shown in the Mode Select Table. All flip-flop outputs are brought out through TRI-STATE buffers to separate I/O pins that also serve as data inputs in the parallel load mode. Q0 and Q7 are also brought out on other pins for expansion in serial shifting of longer words.

A LOW signal on  $\overline{SR}$  overrides the Select inputs and allows the flip-flops to be reset by the next rising edge of CP. All other state changes are also initiated by the LOW-to-HIGH CP transition. Inputs can change when the clock is in either state provided only that the recommended setup and hold times, relative to the rising edge of CP, are observed.

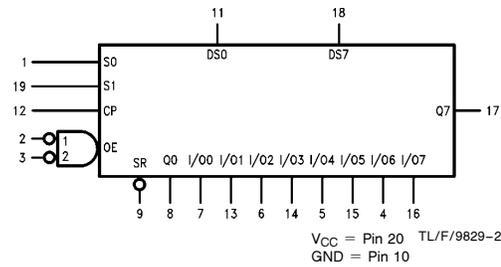
A HIGH signal on either  $\overline{OE}1$  or  $\overline{OE}2$  disables the TRI-STATE buffers and puts the I/O pins in the high impedance state. In this condition the shift, load, hold and reset operations can still occur. The TRI-STATE buffers are also disabled by HIGH signals on both S0 and S1 in preparation for a parallel load operation.

Mode Select Table

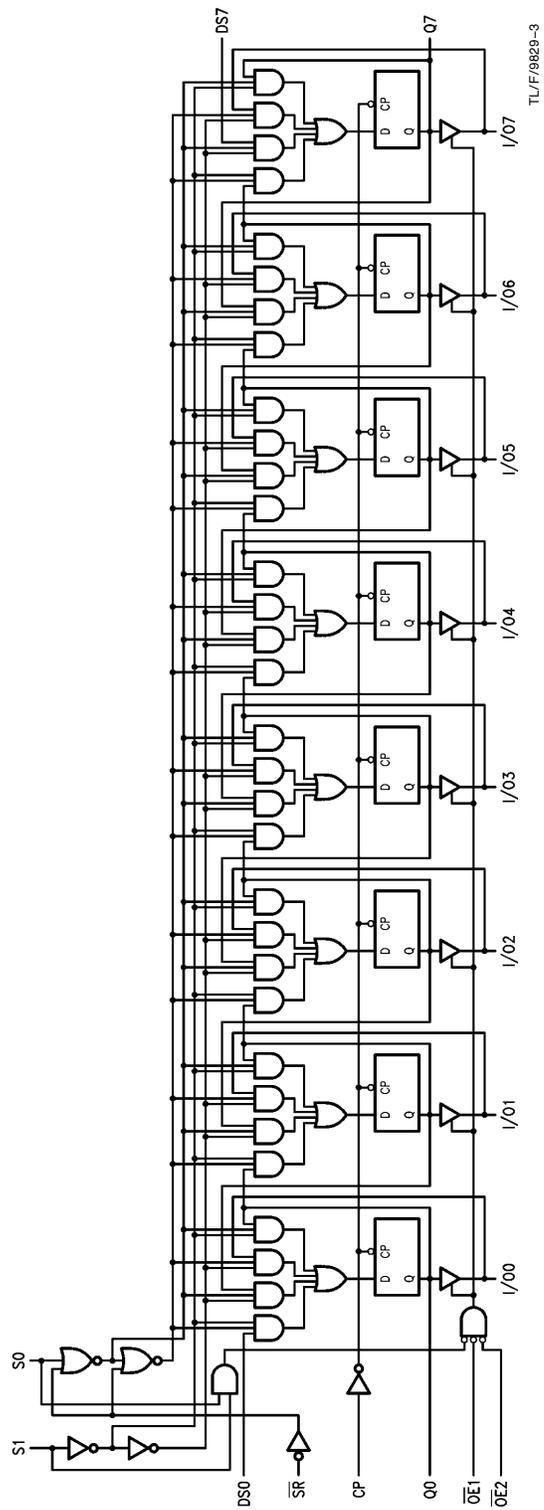
| Inputs          |    |    |    | Response                                         |
|-----------------|----|----|----|--------------------------------------------------|
| $\overline{SR}$ | S1 | S0 | CP |                                                  |
| L               | X  | X  | ↗  | Synchronous Reset; Q0-Q7 = LOW                   |
| H               | H  | H  | ↗  | Parallel Load; I/O <sub>n</sub> → Q <sub>n</sub> |
| H               | L  | H  | ↗  | Shift Right; DS0 → Q0, Q0 → Q1, etc.             |
| H               | H  | L  | ↗  | Shift Left; DS7 → Q7, Q7 → Q6, etc.              |
| H               | H  | H  | X  | Hold                                             |

H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Immaterial

## Logic Symbol

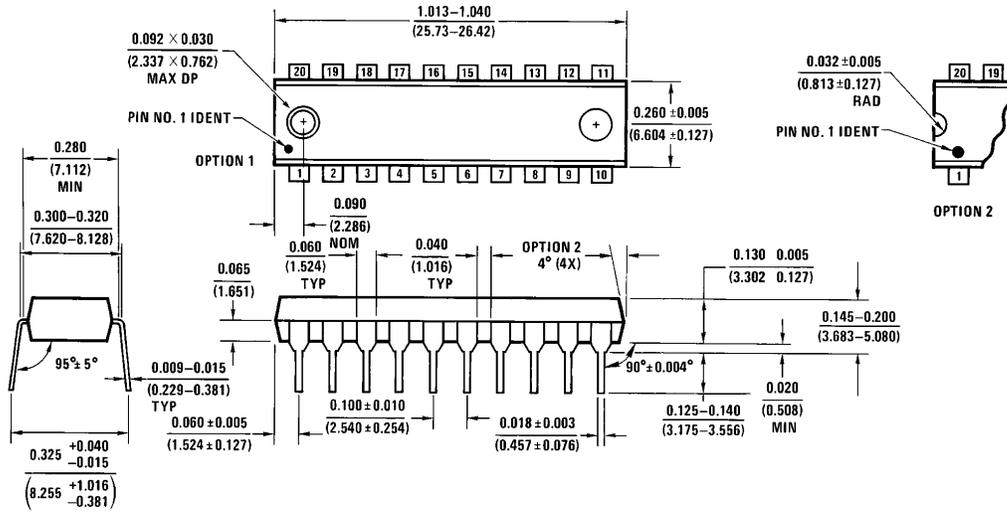


# Logic Diagram





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

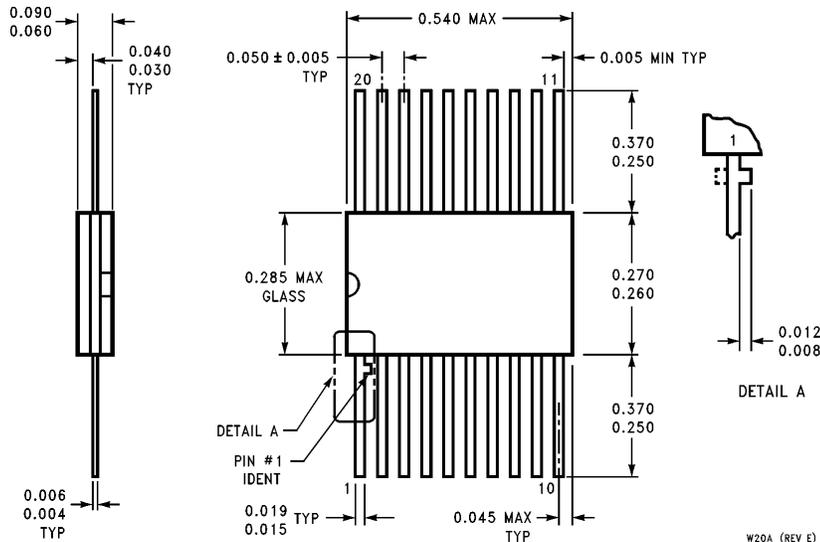


N20A (REV G)

**20-Lead Molded Dual-In-Line Package (N)**  
**Order Number DM74LS323N**  
**NS Package Number N20A**

**DM54LS323/DM74LS323 8-Bit Universal Shift/Storage Register  
with Synchronous Reset and Common I/O Pins**

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



**20-Lead Ceramic Flat Package (W)**  
**Order Number DM54LS323W**  
**NS Package Number W20A**

W20A (REV E)

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**National Semiconductor Corporation**  
 1111 West Bardin Road  
 Arlington, TX 76017  
 Tel: 1(800) 272-9959  
 Fax: 1(800) 737-7018

**National Semiconductor Europe**  
 Fax: (+49) 0-180-530 85 86  
 Email: cnjwge@tevm2.nsc.com  
 Deutsch Tel: (+49) 0-180-530 85 85  
 English Tel: (+49) 0-180-532 78 32  
 Français Tel: (+49) 0-180-532 93 58  
 Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
 13th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
 Tel: 81-043-299-2309  
 Fax: 81-043-299-2408