MOTOROLA

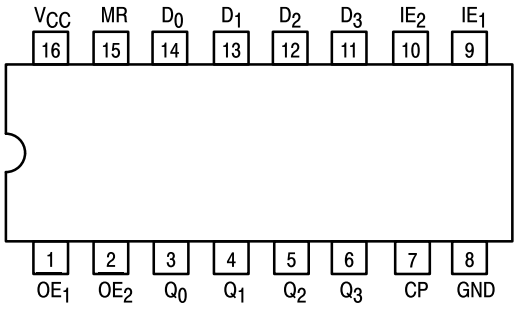
# SN54/74LS173A

# 4-BIT D-TYPE REGISTER WITH 3-STATE OUTPUTS

The SN54/74LS173A is a high-speed 4-Bit Register featuring 3-state outputs for use in bus-organized systems. The clock is fully edge-triggered allowing either a load from the D inputs or a hold (retain register contents) depending on the state of the Input Enable Lines ($IE_1$, $IE_2$). A HIGH on either Output Enable line ($OE_1$, $OE_2$) brings the output to a high impedance state without affecting the actual register contents. A HIGH on the Master Reset (MR) input resets the Register regardless of the state of the Clock (CP), the Output Enable ($OE_1$, $OE_2$) or the Input Enable ($IE_1$, $IE_2$) lines.

- Fully Edge-Triggered
- 3-State Outputs
- Gated Input and Output Enables
- Input Clamp Diodes Limit High-Speed Termination Effects

**CONNECTION DIAGRAM DIP** (TOP VIEW)




NOTE:
The Flatpak version has the same pinouts (Connection Diagram) as the Dual In-Line Package.

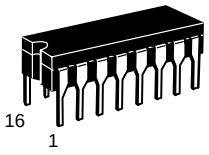
**PIN NAMES**

| | | LOADING (Note a) HIGH | LOW |
|---|---|---|---|
| $D_0-D_3$ | Data Inputs | 0.5 U.L. | 0.25 U.L. |
| $IE_1-IE_2$ | Input Enable (Active LOW) | 0.5 U.L. | 0.25 U.L. |
| $OE_1-OE_2$ | Output Enable (Active LOW) Inputs | 0.5 U.L. | 0.25 U.L. |
| CP | Clock Pulse (Active HIGH Going Edge) Input | 0.5 U.L. | 0.25 U.L. |
| MR | Master Reset Input (Active HIGH) | 0.5 U.L. | 0.25 U.L. |
| $Q_0-Q_3$ | Outputs (Note b) | 65 (25) U.L. | 15 (7.5) U.L. |

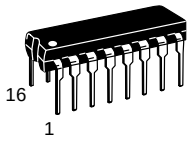
NOTES:
a. 1 TTL Unit Load (U.L.) = 40 µA HIGH/1.6 mA LOW.
b. The Output LOW drive factor is 2.5 U.L. for Military (54) and 5 U.L. for Commercial (74) Temperature Ranges.

**4-BIT D-TYPE REGISTER WITH 3-STATE OUTPUTS**

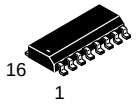
**LOW POWER SCHOTTKY**




**J SUFFIX**
CERAMIC
CASE 620-09




**N SUFFIX**
PLASTIC
CASE 648-08

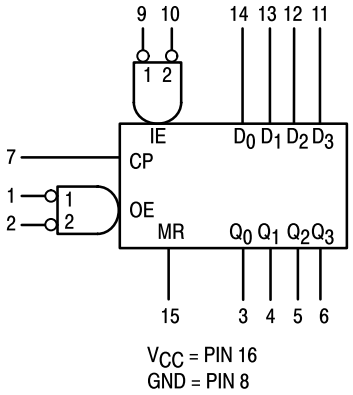



**D SUFFIX**
SOIC
CASE 751B-03

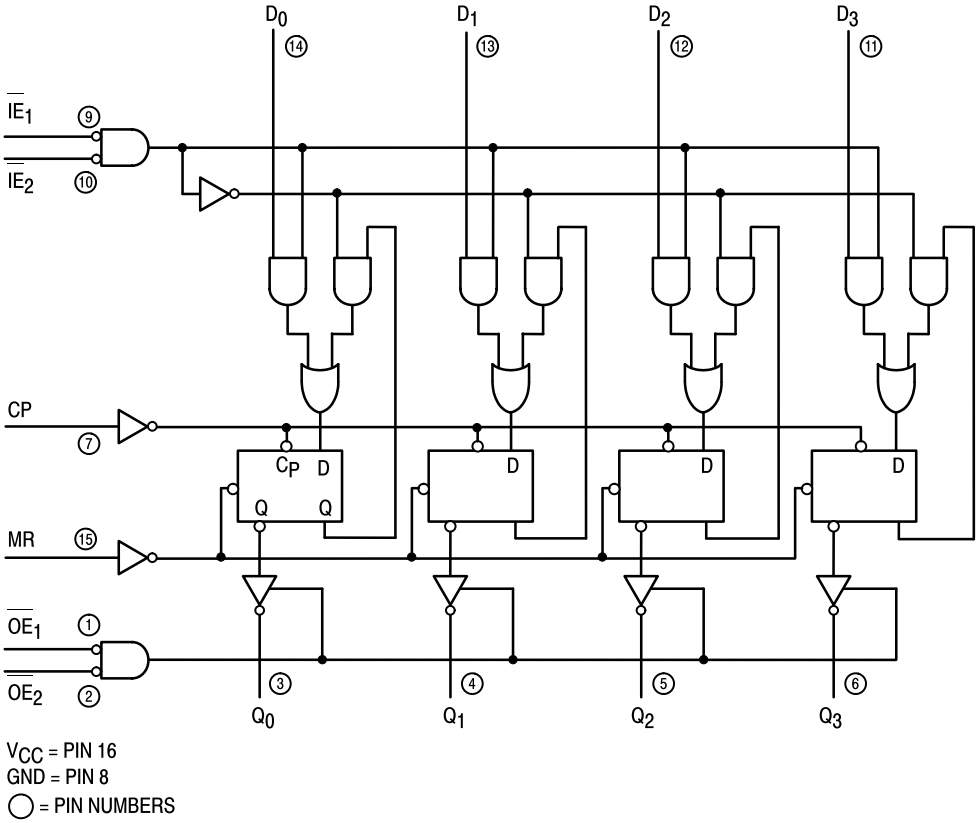
**ORDERING INFORMATION**

| | |
|---|---|
| SN54LSXXXJ | Ceramic |
| SN74LSXXXN | Plastic |
| SN74LSXXXD | SOIC |

**LOGIC SYMBOL**



**LOGIC DIAGRAM**




**TRUTH TABLE**

| MR | CP | $\overline{IE}_1$ | $\overline{IE}_2$ | $D_n$ | $Q_n$ |
|---|---|---|---|---|---|
| H | x | x | x | x | L |
| L | L | x | x | x | $Q_n$ |
| L | ⌐ | H | x | x | $Q_n$ |
| L | ⌐ | x | H | x | $Q_n$ |
| L | ⌐ | L | L | L | L |
| L | ⌐ | L | L | H | H |

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

When either $OE_1$, or $OE_2$ are HIGH, the output is in the off state (High Impedance); however this does not affect the contents or sequential operation of the register.

**GUARANTEED OPERATING RANGES**

| Symbol | Parameter | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 54<br>74 | 4.5<br>4.75 | 5.0<br>5.0 | 5.5<br>5.25 | V |
| $T_A$ | Operating Ambient Temperature Range | 54<br>74 | −55<br>0 | 25<br>25 | 125<br>70 | °C |
| $I_{OH}$ | Output Current — High | 54<br>74 | | | −1.0<br>−2.6 | mA |
| $I_{OL}$ | Output Current — Low | 54<br>74 | | | 12<br>24 | mA |

**DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE** (unless otherwise specified)

| Symbol | Parameter | | Limits Min | Limits Typ | Limits Max | Unit | Test Conditions | |
|---|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | | 2.0 | | | V | Guaranteed Input HIGH Voltage for All Inputs | |
| $V_{IL}$ | Input LOW Voltage | 54 | | | 0.7 | V | Guaranteed Input LOW Voltage for All Inputs | |
| | | 74 | | | 0.8 | | | |
| $V_{IK}$ | Input Clamp Diode Voltage | | | −0.65 | −1.5 | V | $V_{CC}$ = MIN, $I_{IN}$ = −18 mA | |
| $V_{OH}$ | Output HIGH Voltage | 54 | 2.4 | 3.4 | | V | $V_{CC}$ = MIN, $I_{OH}$ = MAX, $V_{IN}$ = $V_{IH}$ or $V_{IL}$ per Truth Table | |
| | | 74 | 2.4 | 3.1 | | V | | |
| $V_{OL}$ | Output LOW Voltage | 54, 74 | | 0.25 | 0.4 | V | $I_{OL}$ = 12 mA | $V_{CC}$ = $V_{CC}$ MIN, $V_{IN}$ = $V_{IL}$ or $V_{IH}$ per Truth Table |
| | | 74 | | 0.35 | 0.5 | V | $I_{OL}$ = 24 mA | |
| $I_{OZH}$ | Output Off Current HIGH | | | | 20 | μA | $V_{CC}$ = MAX, $V_O$ = 2.7 V | |
| $I_{OZL}$ | Output Off Current LOW | | | | −20 | μA | $V_{CC}$ = MAX, $V_O$ = 0.4 V | |
| $I_{IH}$ | Input HIGH Current | | | | 20 | μA | $V_{CC}$ = MAX, $V_{IN}$ = 2.7 V | |
| | | | | | 0.1 | mA | $V_{CC}$ = MAX, $V_{IN}$ = 7.0 V | |
| $I_{IL}$ | Input LOW Current | | | | −0.4 | mA | $V_{CC}$ = MAX, $V_{IN}$ = 0.4 V | |
| $I_{OS}$ | Short Circuit Current (Note 1) | | −30 | | −130 | mA | $V_{CC}$ = MAX | |
| $I_{CC}$ | Power Supply Current | | | | 30 | mA | $V_{CC}$ = MAX | |

Note 1: Not more than one output should be shorted at a time, nor for more than 1 second.

**AC CHARACTERISTICS** ($T_A$ = 25°C)

| Symbol | Parameter | Limits Min | Limits Typ | Limits Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| $f_{MAX}$ | Maximum Input Clock Frequency | 30 | 50 | | MHz | $V_{CC}$ = 5.0 V, $C_L$ = 45 pF, $R_L$ = 667 Ω |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, Clock to Output | | 17<br>22 | 25<br>30 | ns | |
| $t_{PHL}$ | Propagation Delay, MR to Output | | 26 | 35 | ns | |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time | | 15<br>18 | 23<br>27 | ns | |
| $t_{PLZ}$<br>$t_{PHZ}$ | Output Disable Time | | 11<br>11 | 17<br>17 | ns | $C_L$ = 5.0 pF, $R_L$ = 667 Ω |

**AC SETUP REQUIREMENTS** ($T_A$ = 25°C)

| Symbol | Parameter | Limits Min | Limits Typ | Limits Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| $t_W$ | Clock or MR Pulse Width | 20 | | | ns | $V_{CC}$ = 5.0 V |
| $t_s$ | Data Enable Setup Time | 35 | | | ns | |
| $t_s$ | Data Setup Time | 17 | | | ns | |
| $t_h$ | Hold Time, Any Input | 0 | | | ns | |
| $t_{rec}$ | Recovery Time | 10 | | | ns | |

## AC WAVEFORMS

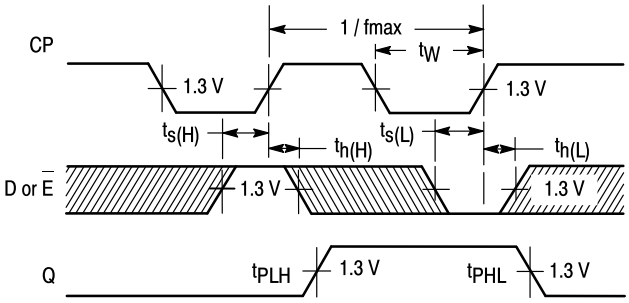



**Figure 1**

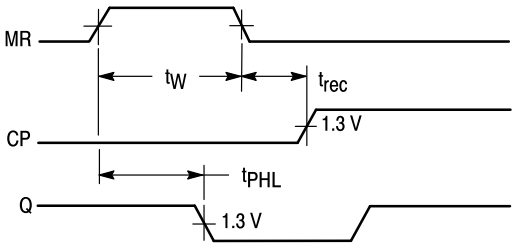



**Figure 2**

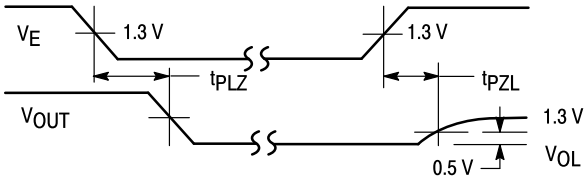



**Figure 3**

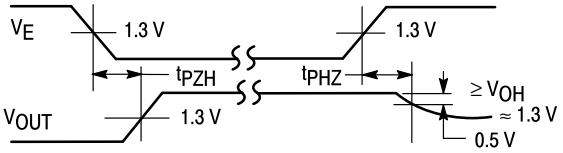
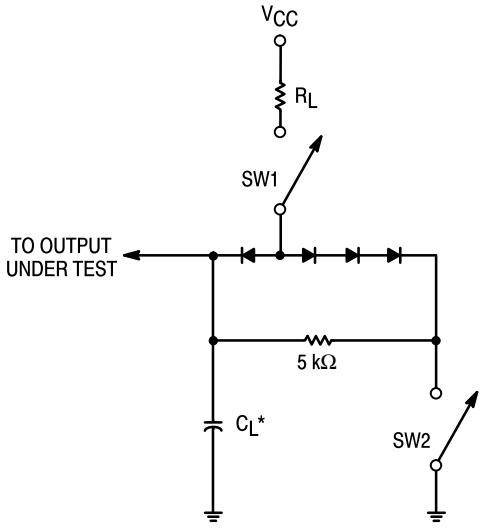



**Figure 4**

## AC LOAD CIRCUIT



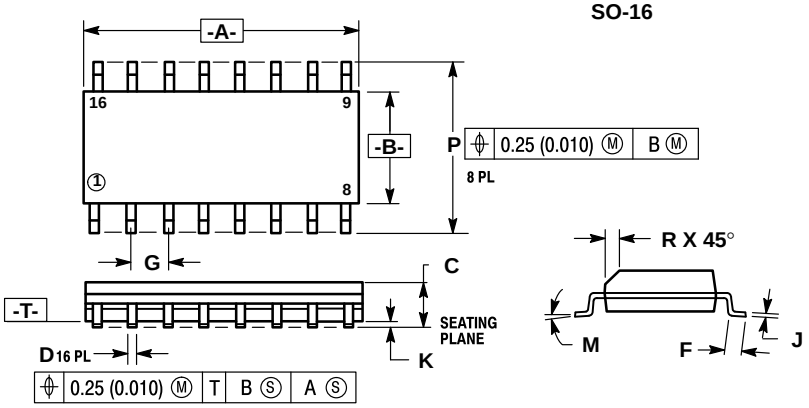

*Includes Jig and Probe Capacitance.

**Figure 5**

**SWITCH POSITIONS**

| SYMBOL | SW1 | SW2 |
|---|---|---|
| $t_{PZH}$ | Open | Closed |
| $t_{PZL}$ | Closed | Open |
| $t_{PLZ}$ | Closed | Closed |
| $t_{PHZ}$ | Closed | Closed |

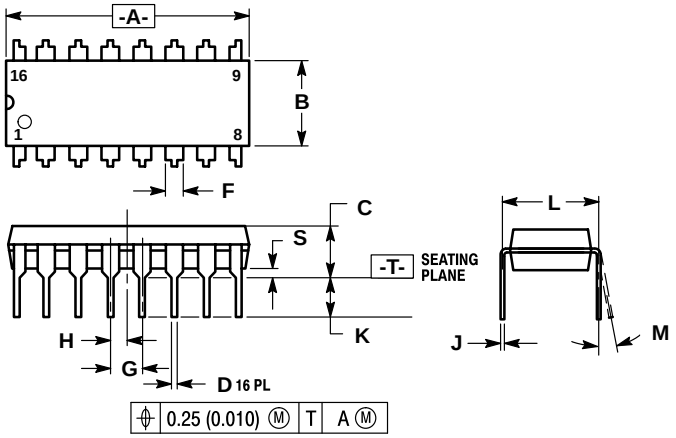
## Case 751B-03 D Suffix
## 16-Pin Plastic
## SO-16




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. 751B-01 IS OBSOLETE, NEW STANDARD 751B-03.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 9.80 | 10.00 | 0.386 | 0.393 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

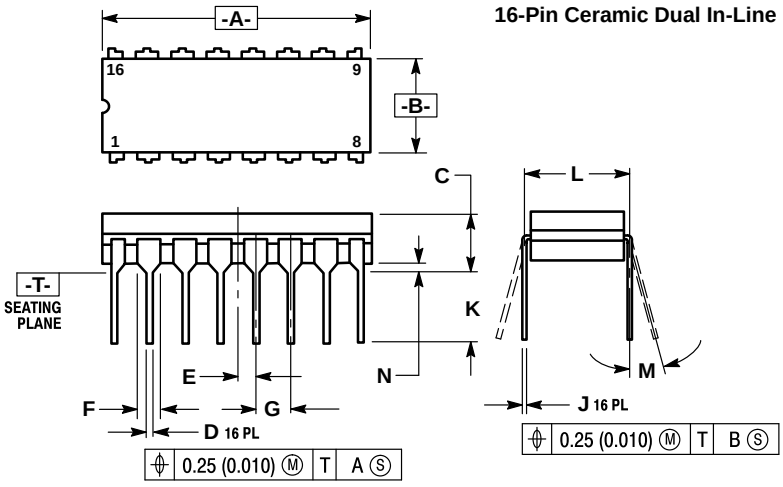
## Case 648-08 N Suffix
## 16-Pin Plastic




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.
6. 648-01 THRU -07 OBSOLETE, NEW STANDARD 648-08.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 18.80 | 19.55 | 0.740 | 0.770 |
| B | 6.35 | 6.85 | 0.250 | 0.270 |
| C | 3.69 | 4.44 | 0.145 | 0.175 |
| D | 0.39 | 0.53 | 0.015 | 0.021 |
| F | 1.02 | 1.77 | 0.040 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| H | 1.27 BSC | | 0.050 BSC | |
| J | 0.21 | 0.38 | 0.008 | 0.015 |
| K | 2.80 | 3.30 | 0.110 | 0.130 |
| L | 7.50 | 7.74 | 0.295 | 0.305 |
| M | 0° | 10° | 0° | 10° |
| S | 0.51 | 1.01 | 0.020 | 0.040 |

## Case 620-09 J Suffix
## 16-Pin Ceramic Dual In-Line




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.
5. 620-01 THRU -08 OBSOLETE, NEW STANDARD 620-09.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 19.05 | 19.55 | 0.750 | 0.770 |
| B | 6.10 | 7.36 | 0.240 | 0.290 |
| C | — | 4.19 | — | 0.165 |
| D | 0.39 | 0.53 | 0.015 | 0.021 |
| E | 1.27 BSC | | 0.050 BSC | |
| F | 1.40 | 1.77 | 0.055 | 0.070 |
| G | 2.54 BSC | | 0.100 BSC | |
| J | 0.23 | 0.27 | 0.009 | 0.011 |
| K | — | 5.08 | — | 0.200 |
| L | 7.62 BSC | | 0.300 BSC | |
| M | 0° | 15° | 0° | 15° |
| N | 0.39 | 0.88 | 0.015 | 0.035 |

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