FAIRCHILD SEMICONDUCTOR™

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# DM74LS194A
# 4-Bit Bidirectional Universal Shift Register

## General Description

This bidirectional shift register is designed to incorporate virtually all of the features a system designer may want in a shift register; they feature parallel inputs, parallel outputs, right-shift and left-shift serial inputs, operating-mode-control inputs, and a direct overriding clear line. The register has four distinct modes of operation, namely:

Parallel (broadside) load

Shift right (in the direction $Q_A$ toward $Q_D$)

Shift left (in the direction $Q_D$ toward $Q_A$)

Inhibit clock (do nothing)

Synchronous parallel loading is accomplished by applying the four bits of data and taking both mode control inputs, S0 and S1, high. The data is loaded into the associated flip-flops and appear at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited.

Shift right is accomplished synchronously with the rising edge of the clock pulse when S0 is high and S1 is low. Serial data for this mode is entered at the shift-right data input. When S0 is low and S1 is high, data shifts left synchronously and new data is entered at the shift-left serial input.

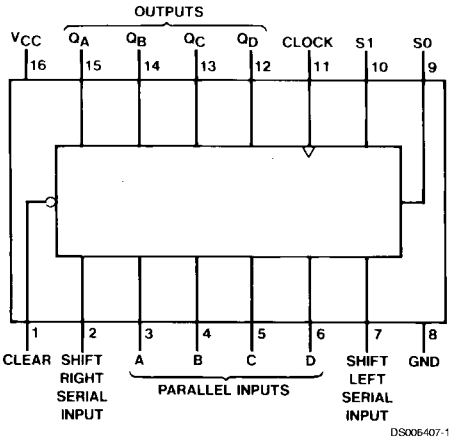
Clocking of the flip-flop is inhibited when both mode control inputs are low.

## Features

- Parallel inputs and outputs
- Four operating modes:
  - Synchronous parallel load
  - Right shift
  - Left shift
  - Do nothing
- Positive edge-triggered clocking
- Direct overriding clear

## Connection Diagram

**Dual-In-Line Package**




**Order Number 54LS194ADMQB, 54LS194AFMQB, 54LS194ALMQB, DM74LS194AM or DM74LS194AN**
**See Package Number E20A, J16A, M16A, N16E or W16A**

## Absolute Maximum Ratings (Note 1)

| | | | |
|---|---|---|---|
| Supply Voltage | 7V | 54LS | −55°C to +125°C |
| Input Voltage | 7V | DM74LS | 0°C to +70°C |
| Operating Free Air Temperature Range | | Storage Temperature Range | −65°C to +150°C |

## Recommended Operating Conditions

| Symbol | Parameter | | 54LS194A | | | DM74LS194A | | | 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 2) | | 30 | | 0 | 0 | | 25 | MHz |
| | Clock Frequency (Note 3) | | 22 | | | 0 | | 20 | |
| $t_W$ | Pulse Width | Clock | 17 | | | 20 | | | ns |
| | (Note 4) | Clear | 12 | | | 20 | | | |
| $t_{SU}$ | Setup Time | Mode | 25 | | | 30 | | | ns |
| | (Note 4) | Data | 16 | | | 20 | | | |
| $t_H$ | Hold Time (Note 4) | | 0 | | | 0 | | | ns |
| $t_{REL}$ | Clear Release Time (Note 4) | | 18 | | | 25 | | | ns |
| $T_A$ | Free Air Operating Temperature | | −55 | | 125 | 0 | | 70 | °C |

**Note 1:** *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.*

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

**Note 3:** $C_L$ = 50 pF, $R_L$ = 2 kΩ, $T_A$ = 25°C and $V_{CC}$ = 5V.

**Note 4:** $T_A$ = 25°C and $V_{CC}$ = 5V.

## Electrical Characteristics

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

| Symbol | Parameter | Conditions | | Min | Typ (Note 5) | Max | Units |
|---|---|---|---|---|---|---|---|
| $V_I$ | Input Clamp Voltage | $V_{CC}$ = Min, $I_I$ = −18 mA | | | | −1.5 | V |
| $V_{OH}$ | High Level Output | $V_{CC}$ = Min, $I_{OH}$ = Max | 54LS | 2.5 | | | V |
| | Voltage | $V_{IL}$ = Max, $V_{IH}$ = Min | DM74 | 2.7 | 3.4 | | |
| $V_{OL}$ | Low Level Output | $V_{CC}$ = Min, $I_{OL}$ = Max | 54LS | | | 0.4 | |
| | Voltage | $V_{IL}$ = Max, $V_{IH}$ = Min | DM74 | | 0.35 | 0.5 | V |
| | | $I_{OL}$ = 4 mA, $V_{CC}$ = Min | | | | 0.4 | |
| $I_I$ | 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 | | | | −0.4 | mA |
| $I_{OS}$ | Short Circuit | $V_{CC}$ = Max | 54LS | −20 | | −100 | mA |
| | Output Current | (Note 6) | DM74 | −20 | | −100 | |
| $I_{CC}$ | Supply Current | $V_{CC}$ = Max (Note 7) | | | 15 | 23 | mA |

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

**Note 6:** Not more than one output should be shorted at a time, and the duration should not exceed one second.

**Note 7:** With all outputs open, inputs A through D grounded, and 4.5V applied to S0, S1, CLEAR, and the serial inputs, $I_{CC}$ is tested with momentary ground, then 4.5V applied to CLOCK.

## Switching Characteristics

at $V_{CC}$ = 5V and $T_A$ = 25°C (See for Test Waveforms and Output Load)

| Symbol | Parameter | From (Input) To (Output) | 54LS $C_L$ = 15 pF | | DM74LS $C_L$ = 50 pF $R_L$ = 2 kΩ | | Units |
|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | |
| $f_{MAX}$ | Maximum Clock Frequency | | 30 | | 20 | | MHz |
| $t_{PLH}$ | Propagation Delay Time Low to High Level Output | Clock to Any Q | | 21 | | 26 | ns |
| $t_{PHL}$ | Propagation Delay Time High to Low Level Output | Clock to Any Q | | 24 | | 35 | ns |
| $t_{PHL}$ | Propagation Delay Time High to Low Output | Clear to Any Q | | 26 | | 38 | ns |

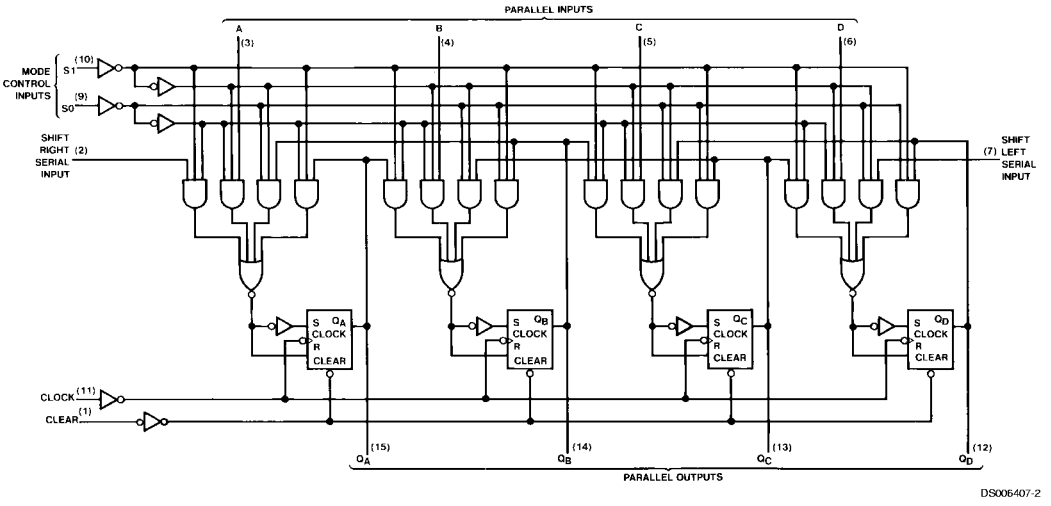
**Note 8:** All typicals are at $V_{CC}$ = 5V, $T_A$ = 25°C.

**Note 9:** Not more than one output should be shorted at a time, and the duration should not exceed one second.

**Note 10:** With all outputs open, inputs A through D grounded, and 4.5V applied to S0, S1, CLEAR, and the serial inputs, $I_{CC}$ is tested with momentary ground, then 4.5V applied to CLOCK.

## Logic Diagram

**LS194A**



## Function Table

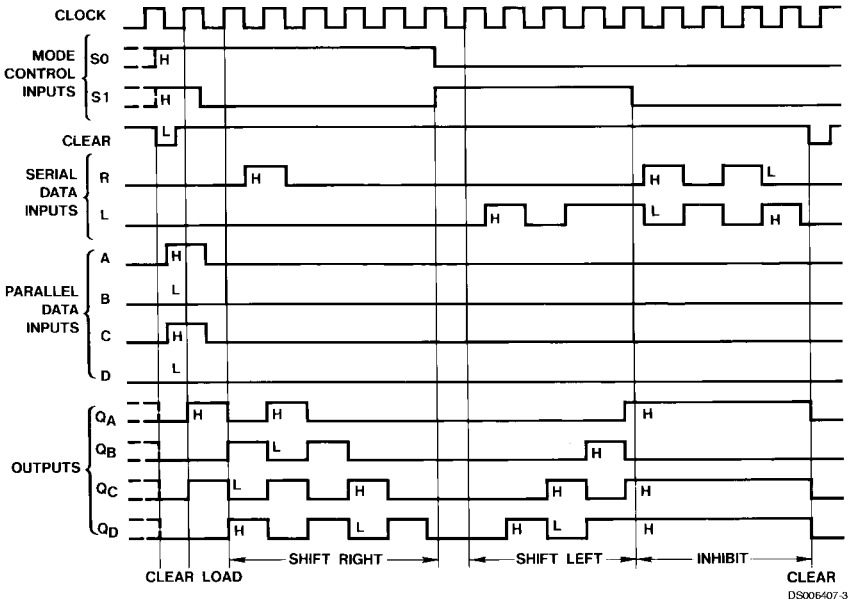
| Inputs | | | | | | | | | | Outputs | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clear | Mode | | Clock | Serial | | Parallel | | | | $Q_A$ | $Q_B$ | $Q_C$ | $Q_D$ |
| | S1 | S0 | | Left | Right | A | B | C | D | | | | |
| L | X | X | X | X | X | X | X | X | X | L | L | L | L |
| H | X | X | L | X | X | X | X | X | X | $Q_{A0}$ | $Q_{B0}$ | $Q_{C0}$ | $Q_{D0}$ |
| H | H | H | ↑ | X | X | a | b | c | d | a | b | c | d |
| H | L | H | ↑ | X | H | X | X | X | X | H | $Q_{An}$ | $Q_{Bn}$ | $Q_{Cn}$ |
| H | L | H | ↑ | X | L | X | X | X | X | L | $Q_{An}$ | $Q_{Bn}$ | $Q_{Cn}$ |
| H | H | L | ↑ | H | X | X | X | X | X | $Q_{Bn}$ | $Q_{Cn}$ | $Q_{Dn}$ | H |
| H | H | L | ↑ | L | X | X | X | X | X | $Q_{Bn}$ | $Q_{Cn}$ | $Q_{Dn}$ | L |
| H | L | L | X | X | X | X | X | X | X | $Q_{A0}$ | $Q_{B0}$ | $Q_{C0}$ | $Q_{D0}$ |

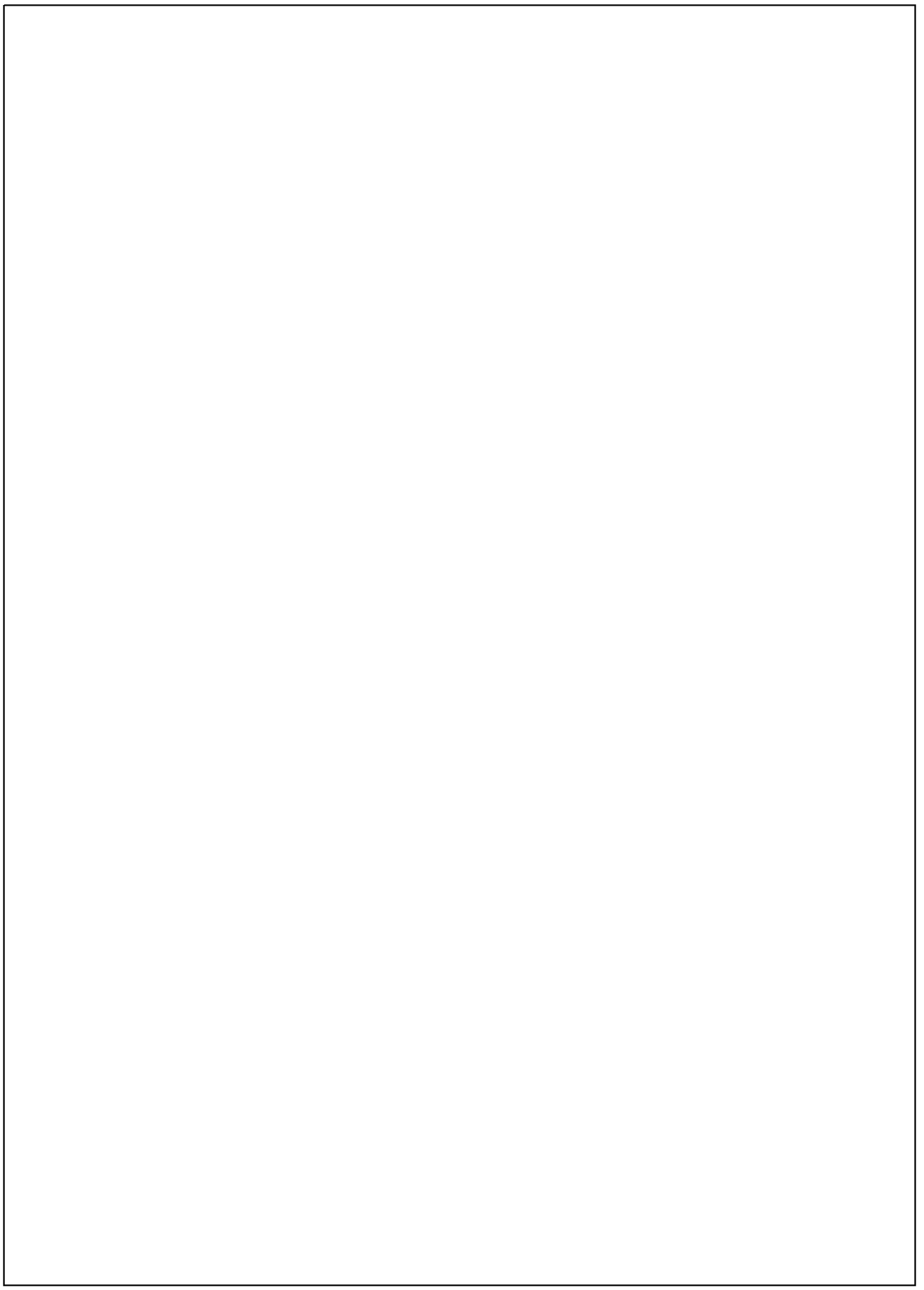
H = High Level (steady state), L = Low Level (steady state), X = Don't Care (any input, including transitions)
↑ = Transition from low to high level
a, b, c, d = The level of steady state input at inputs A, B, C or D, respectively.
$Q_{A0}$, $Q_{B0}$, $Q_{C0}$, $Q_{D0}$ = The level of $Q_A$, $Q_B$, $Q_C$, or $Q_D$, respectively, before the indicated steady state input conditions were established.
$Q_{An}$, $Q_{Bn}$, $Q_{Cn}$, $Q_{Dn}$ = The level of $Q_A$, $Q_B$, $Q_C$, respectively, before the most-recent ↑ transition of the clock.

## Timing Diagram

Book Extract End

**Typical Clear, Load, Right-Shift, Left-Shift, Inhibit, and Clear Sequences**







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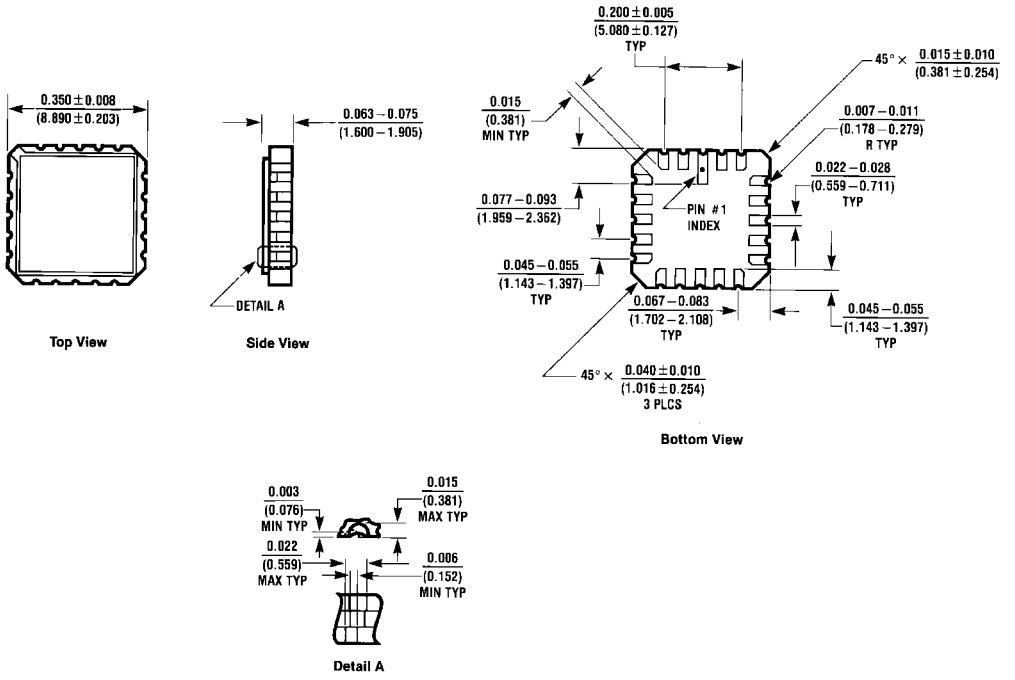
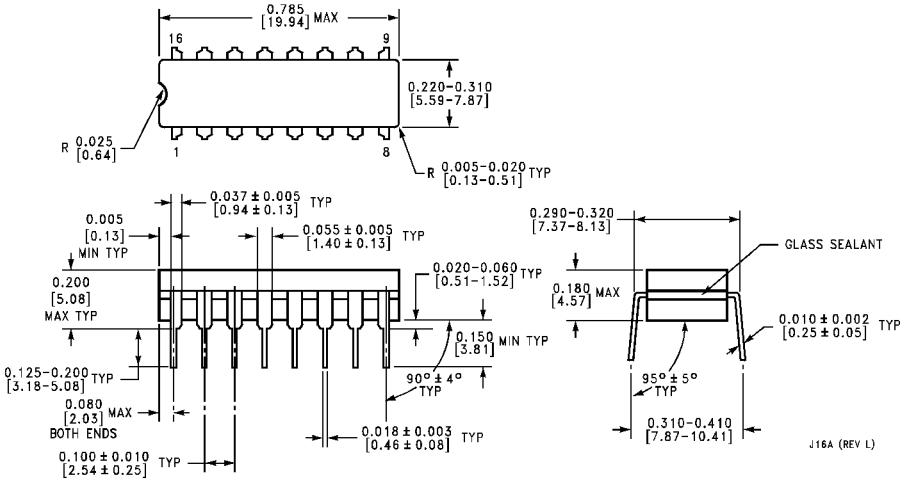
## Physical Dimensions inches (millimeters) unless otherwise noted

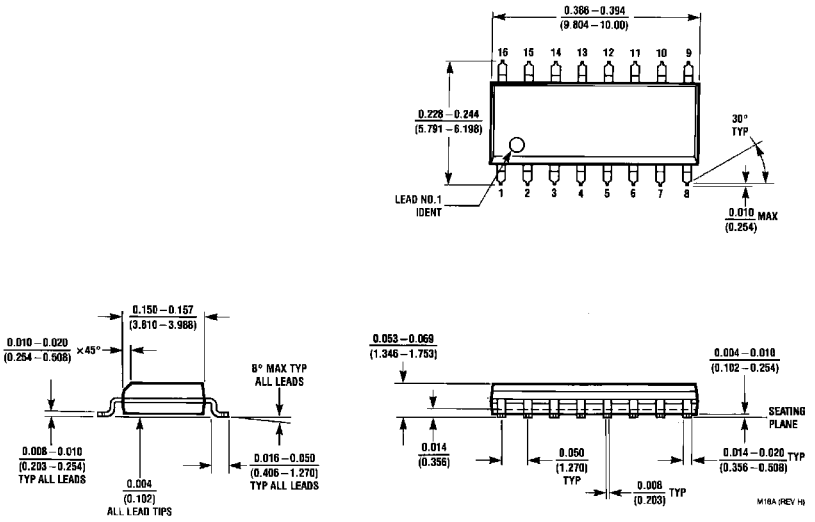



**Ceramic Leadless Chip Carrier Package (E)**
**Order Number 54LS194ALMQB**
**Package Number E20A**

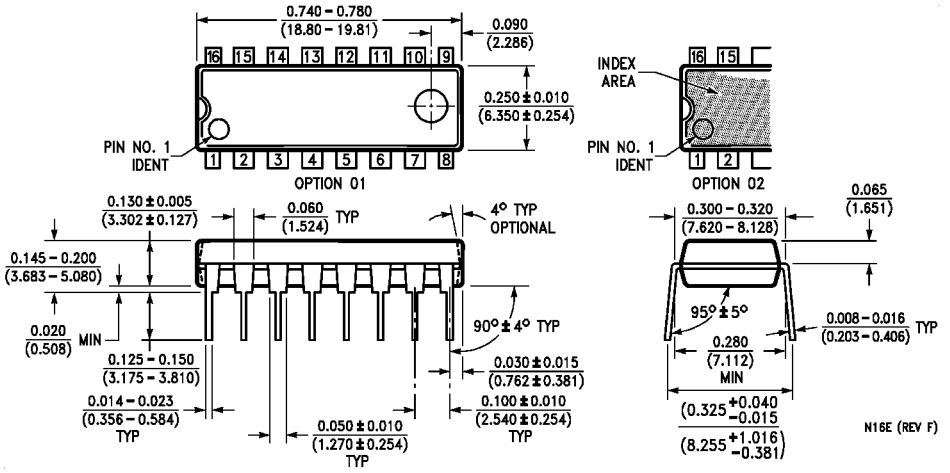



**16-Lead Ceramic Dual-In-Line Package (J)**
**Order Number 54LS194ADMQB**
**Package Number J16A**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

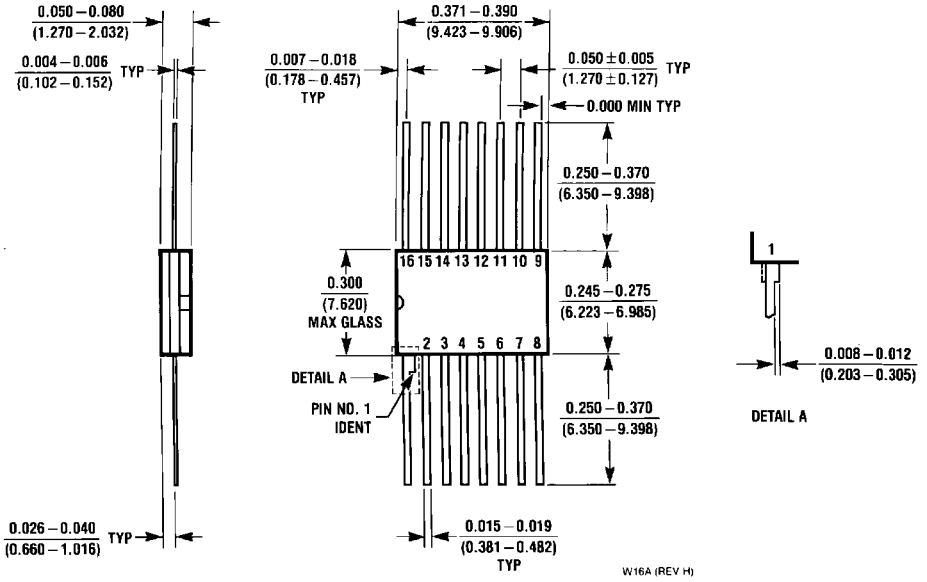



**16-Lead Small Outline Molded Package (M)**
**Order Number DM74LS194AM**
**Package Number M16A**




**16-Lead Molded Dual-In-Line Package (N)**
**Order Number DM74LS194AN**
**Package Number N16E**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)




**16-Lead Ceramic Flat Package (W)**
**Order Number 54LS194AFMQB**
**Package Number W16A**

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