

# 54F/74F153 Dual 4-Input Multiplexer

## General Description

The 'F153 is a high-speed dual 4-input multiplexer with common select inputs and individual enable inputs for each section. It can select two lines of data from four sources. The two buffered outputs present data in the true (non-inverted)

form. In addition to multiplexer operation, the 'F153 can generate any two functions of three variables.

## Features

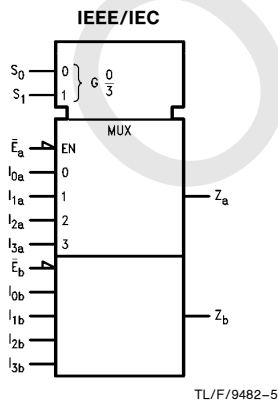
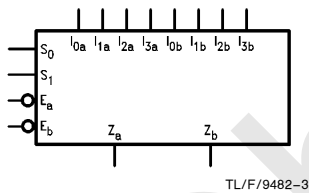
- Guaranteed 4000V minimum ESD protection

| Commercial        | Military          | Package Number | Package Description                               |
|-------------------|-------------------|----------------|---|
| 74F153PC          |                   | N16E           | 16-Lead (0.300" Wide) Molded Dual-In-Line         |
|                   | 54F153DM (Note 2) | J16A           | 16-Lead Ceramic Dual-In-Line                      |
| 74F153SC (Note 1) |                   | M16A           | 16-Lead (0.150" Wide) Molded Small Outline, JEDEC |
| 74F153SJ (Note 1) |                   | M16D           | 16-Lead (0.300" Wide) Molded Small Outline, EIAJ  |
|                   | 54F153FM (Note 2) | W16A           | 16-Lead Cerpack                                   |
|                   | 54F153LM (Note 2) | E20A           | 20-Lead Ceramic Leadless Chip Carrier, Type C     |

**Note 1:** Devices also available in 13" reel. Use suffix = SCX and SJX.

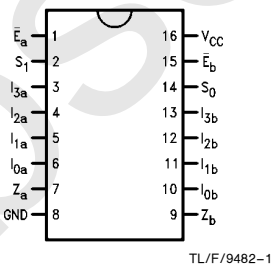
**Note 2:** Military grade device with environmental and burn-in processing. Use suffix = DMOB, FMOB and LMOB.

## Logic Symbols

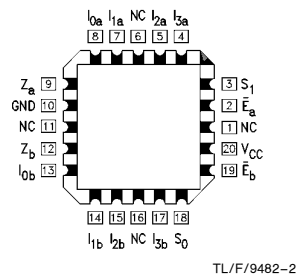


## Connection Diagrams

Pin Assignment  
for DIP, SOIC and Flatpak



Pin Assignment  
for LCC



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## Unit Loading/Fan Out

| Pin Names                        | Description                      | 54F/74F          |   |
|----------------------------------|----------------------------------|------------------|---|
|                                  |                                  | U.L.<br>HIGH/LOW | Input I <sub>IH</sub> /I <sub>IL</sub><br>Output I <sub>OH</sub> /I <sub>OL</sub> |
| I <sub>0a</sub> -I <sub>3a</sub> | Side A Data Inputs               | 1.0/1.0          | 20 μA/ -0.6 mA  |
| I <sub>0b</sub> -I <sub>3b</sub> | Side B Data Inputs               | 1.0/1.0          | 20 μA/ -0.6 mA  |
| S <sub>0</sub> , S <sub>1</sub>  | Common Select Inputs             | 1.0/1.0          | 20 μA/ -0.6 mA  |
| $\bar{E}_a$                      | Side A Enable Input (Active LOW) | 1.0/1.0          | 20 μA/ -0.6 mA  |
| $\bar{E}_b$                      | Side B Enable Input (Active LOW) | 1.0/1.0          | 20 μA/ -0.6 mA  |
| Z <sub>a</sub>                   | Side A Output                    | 50/33.3          | -1 mA/20 mA   |
| Z <sub>b</sub>                   | Side B Output                    | 50/33.3          | -1 mA/20 mA   |

## Functional Description

The 'F153 is a dual 4-input multiplexer. It can select two bits of data from up to four sources under the control of the common Select inputs (S<sub>0</sub>, S<sub>1</sub>). The two 4-input multiplexer circuits have individual active LOW Enables ( $\bar{E}_a$ ,  $\bar{E}_b$ ) which can be used to strobe the outputs independently. When the Enables ( $\bar{E}_a$ ,  $\bar{E}_b$ ) are HIGH, the corresponding outputs (Z<sub>a</sub>, Z<sub>b</sub>) are forced LOW. The 'F153 is the logic implementation of a 2-pole, 4-position switch, where the position of the switch is determined by the logic levels supplied to the two Select inputs. The logic equations for the outputs are as follows:

$$Z_a = \bar{E}_a \cdot (I_{0a} \cdot \bar{S}_1 \cdot \bar{S}_0 + I_{1a} \cdot \bar{S}_1 \cdot S_0 + I_{2a} \cdot S_1 \cdot \bar{S}_0 + I_{3a} \cdot S_1 \cdot S_0)$$

$$Z_b = \bar{E}_b \cdot (I_{0b} \cdot \bar{S}_1 \cdot \bar{S}_0 + I_{1b} \cdot \bar{S}_1 \cdot S_0 + I_{2b} \cdot S_1 \cdot \bar{S}_0 + I_{3b} \cdot S_1 \cdot S_0)$$

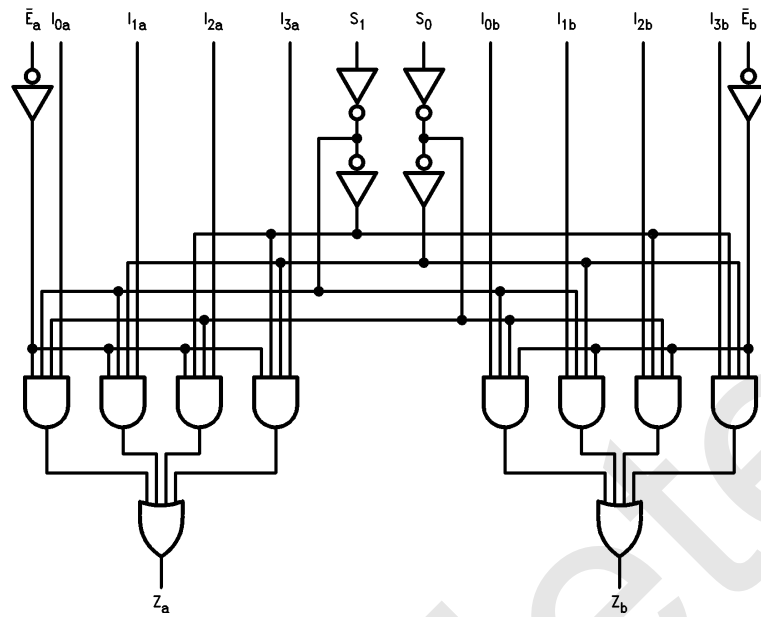
The 'F153 can be used to move data from a group of registers to a common output bus. The particular register from which the data came would be determined by the state of the Select inputs. A less obvious application is as a function generator. The 'F153 can generate two functions of three variables. This is useful for implementing highly irregular random logic.

## Truth Table

| Select Inputs  |                | Inputs (a or b) |                |                |                |                | Output |
|----------------|----------------|-----------------|----------------|----------------|----------------|----------------|--------|
| S <sub>0</sub> | S <sub>1</sub> | $\bar{E}$       | I <sub>0</sub> | I <sub>1</sub> | I <sub>2</sub> | I <sub>3</sub> | Z      |
| X              | X              | H               | X              | X              | X              | X              | L      |
| L              | L              | L               | L              | X              | X              | X              | L      |
| L              | L              | L               | H              | X              | X              | X              | H      |
| H              | L              | L               | X              | L              | X              | X              | L      |
| H              | L              | L               | X              | H              | X              | X              | H      |
| L              | H              | L               | X              | X              | L              | X              | L      |
| L              | H              | L               | X              | X              | H              | X              | H      |
| H              | H              | L               | X              | X              | X              | L              | L      |
| H              | H              | L               | X              | X              | X              | H              | H      |

H = HIGH Voltage Level  
L = LOW  
X = Immaterial

## Logic Diagram



TL/F/9482-4

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|   |                          |
|---|--------------------------|
| Storage Temperature   | -65°C to +150°C          |
| Ambient Temperature under Bias                                      | -55°C to +125°C          |
| Junction Temperature under Bias                                     | -55°C to +175°C          |
| Plastic   | -55°C to +150°C          |
| V <sub>CC</sub> Pin Potential to Ground Pin                         | -0.5V to +7.0V           |
| Input Voltage (Note 2)  | -0.5V to +7.0V           |
| Input Current (Note 2)  | -30 mA to +5.0 mA        |
| Voltage Applied to Output in HIGH State (with V <sub>CC</sub> = 0V) |                          |
| Standard Output   | -0.5V to V <sub>CC</sub> |
| TRI-STATE® Output   | -0.5V to +5.5V           |

Current Applied to Output in LOW State (Max) twice the rated I<sub>OL</sub> (mA)

**Note 1:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Either voltage limit or current limit is sufficient to protect inputs.

## Recommended Operating Conditions

|                              |                 |
|------------------------------|-----------------|
| Free Air Ambient Temperature |                 |
| Military                     | -55°C to +125°C |
| Commercial                   | 0°C to +70°C    |
| Supply Voltage               |                 |
| Military                     | +4.5V to +5.5V  |
| Commercial                   | +4.5V to +5.5V  |

## DC Electrical Characteristics

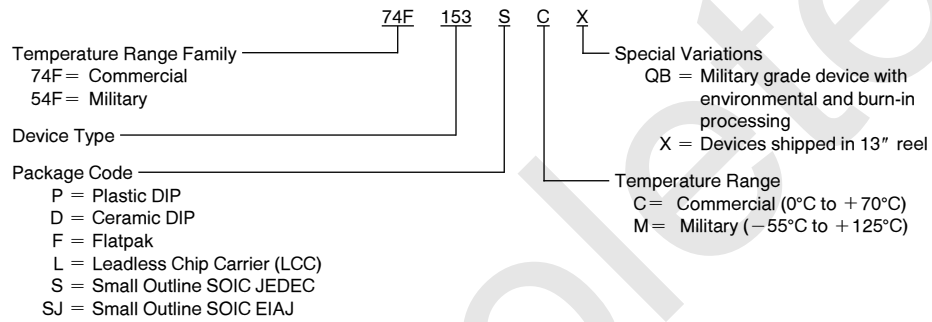
| Symbol           | Parameter                         | 54F/74F  |                   |             | Units | V <sub>CC</sub> | Conditions  |
|------------------|-----------------------------------|--|-------------------|-------------|-------|-----------------|---|
|                  |                                   | Min  | Typ               | Max         |       |                 |   |
| V <sub>IH</sub>  | Input HIGH Voltage                | 2.0  |                   |             | V     |                 | Recognized as a HIGH Signal   |
| V <sub>IL</sub>  | Input LOW Voltage                 |  |                   | 0.8         | V     |                 | Recognized as a LOW Signal  |
| V <sub>CD</sub>  | Input Clamp Diode Voltage         |  |                   | -1.2        | V     | Min             | I <sub>IN</sub> = -18 mA  |
| V <sub>OH</sub>  | Output HIGH Voltage               | 54F 10% V <sub>CC</sub><br>74F 10% V <sub>CC</sub><br>74F 5% V <sub>CC</sub> | 2.5<br>2.5<br>2.7 |             | V     | Min             | I <sub>OH</sub> = -1 mA<br>I <sub>OH</sub> = -1 mA<br>I <sub>OH</sub> = -1 mA |
| V <sub>OL</sub>  | Output LOW Voltage                | 54F 10% V <sub>CC</sub><br>74F 10% V <sub>CC</sub>                           |                   | 0.5<br>0.5  | V     | Min             | I <sub>OL</sub> = 20 mA<br>I <sub>OL</sub> = 20 mA                            |
| I <sub>IH</sub>  | Input HIGH Current                | 54F<br>74F   |                   | 20.0<br>5.0 | μA    | Max             | V <sub>IN</sub> = 2.7V  |
| I <sub>BVI</sub> | Input HIGH Current Breakdown Test | 54F<br>74F   |                   | 100<br>7.0  | μA    | Max             | V <sub>IN</sub> = 7.0V  |
| I <sub>CEX</sub> | Output High Leakage Current       | 54F<br>74F   |                   | 250<br>50   | μA    | Max             | V <sub>OUT</sub> = V <sub>CC</sub>  |
| V <sub>ID</sub>  | Input Leakage Test                | 74F  | 4.75              |             | V     | 0.0             | I <sub>ID</sub> = 1.9 μA<br>All Other Pins Grounded                           |
| I <sub>OD</sub>  | Output Leakage Circuit Current    | 74F  |                   | 3.75        | μA    | 0.0             | V <sub>IOD</sub> = 150 mV<br>All Other Pins Grounded                          |
| I <sub>IL</sub>  | Input LOW Current                 |  |                   | -0.6        | mA    | Max             | V <sub>IN</sub> = 0.5V  |
| I <sub>OS</sub>  | Output Short-Circuit Current      |  |                   | -60         | mA    | Max             | V <sub>OUT</sub> = 0V   |
| I <sub>CC1</sub> | Power Supply Current              |  | 12                | 20          | mA    | Max             | V <sub>O</sub> = LOW  |

## AC Electrical Characteristics

| Symbol                               | Parameter   | 74F   |            |             | 54F  |              | 74F  |              | Units |
|--------------------------------------|---|---|------------|-------------|--|--------------|--|--------------|-------|
|                                      |   | T <sub>A</sub> = +25°C<br>V <sub>CC</sub> = +5.0V<br>C <sub>L</sub> = 50 pF |            |             | T <sub>A</sub> , V <sub>CC</sub> = Mil<br>C <sub>L</sub> = 50 pF |              | T <sub>A</sub> , V <sub>CC</sub> = Com<br>C <sub>L</sub> = 50 pF |              |       |
|                                      |   | Min   | Typ        | Max         | Min  | Max          | Min  | Max          |       |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>S <sub>n</sub> to Z <sub>n</sub> | 4.5<br>3.5  | 8.1<br>7.0 | 10.5<br>9.0 | 4.5<br>3.5   | 14.0<br>11.0 | 4.5<br>3.5   | 12.0<br>10.5 | ns    |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>E <sub>n</sub> to Z <sub>n</sub> | 4.5<br>3.0  | 7.1<br>5.7 | 9.0<br>7.0  | 4.5<br>2.5   | 11.5<br>9.0  | 4.5<br>2.5   | 10.5<br>8.0  | ns    |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>I <sub>n</sub> to Z <sub>n</sub> | 3.0<br>2.5  | 5.3<br>5.1 | 7.0<br>6.5  | 2.5<br>2.5   | 9.0<br>8.0   | 3.0<br>2.5   | 8.0<br>7.5   | ns    |

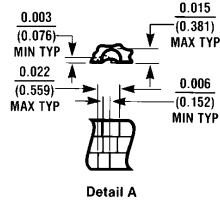
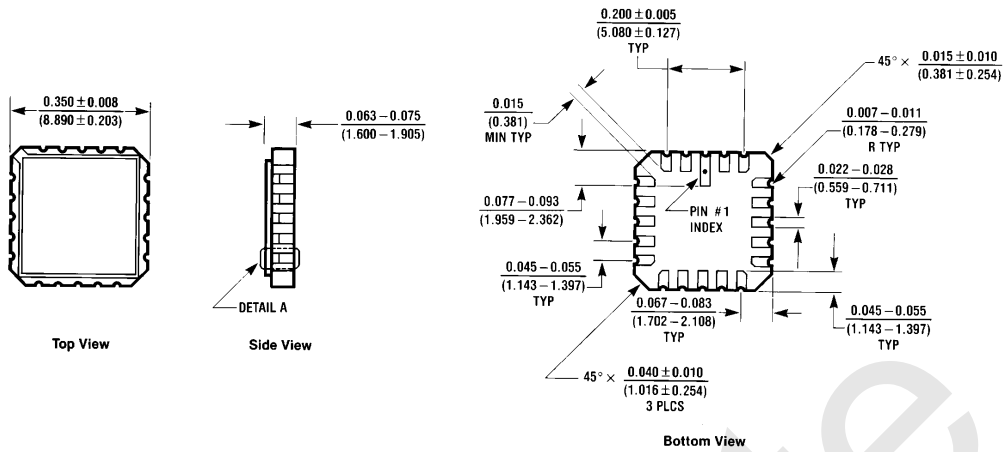
## Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



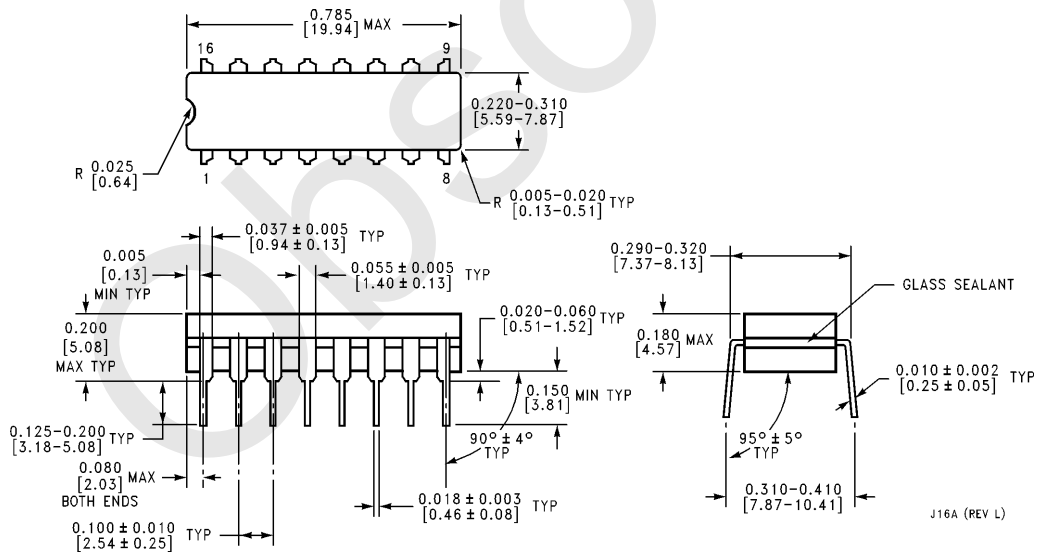
Obsolete

**Physical Dimensions** inches (millimeters)



**20-Lead Ceramic Leadless Chip Carrier (L)**  
**NS Package Number E20A**

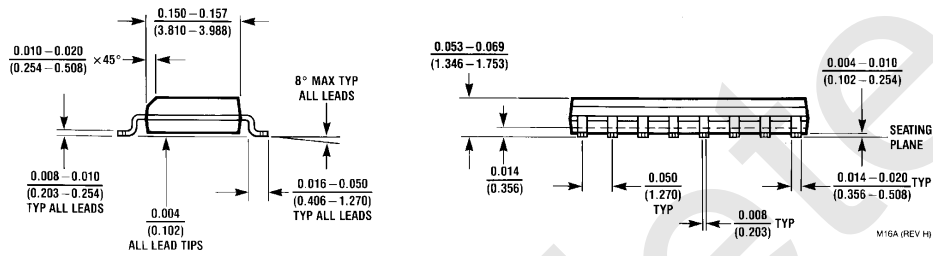
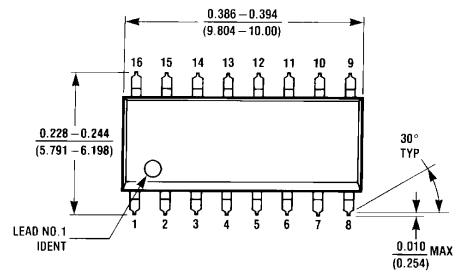
E20A (REV D)



**16-Lead Ceramic Dual-In-Line Package (D)**  
**NS Package Number J16A**

J16A (REV L)

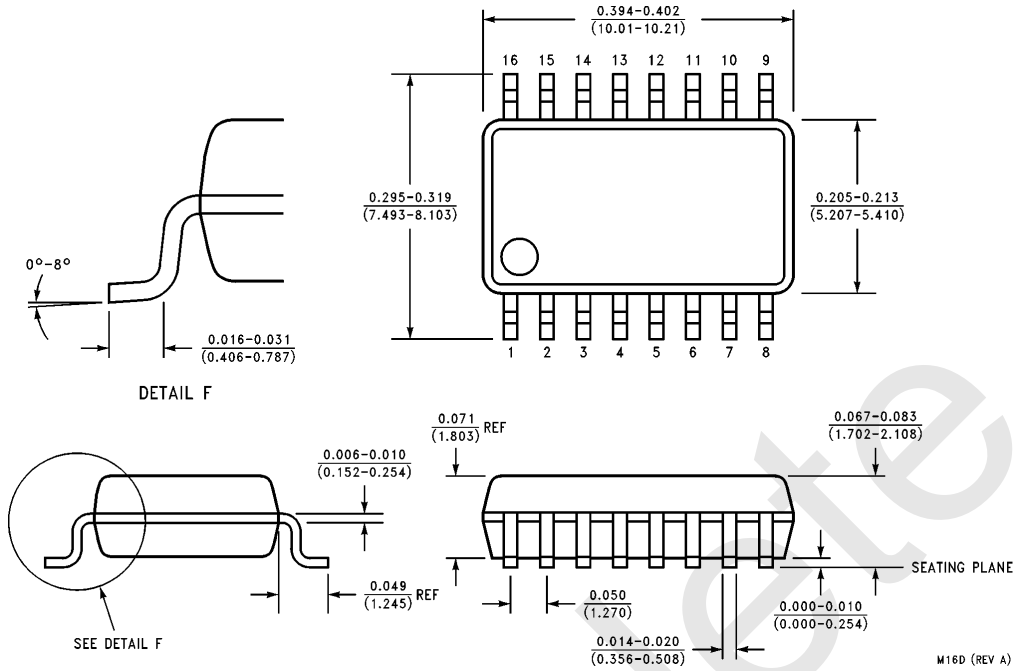
**Physical Dimensions** inches (millimeters) (Continued)



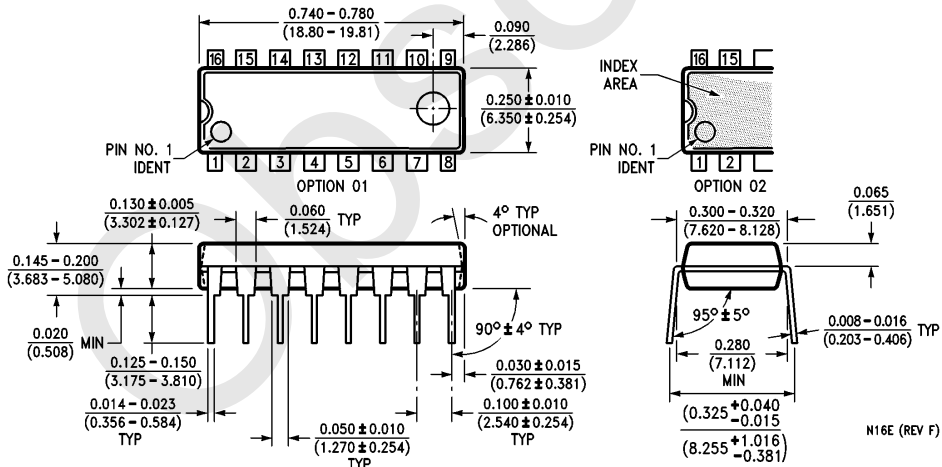
**16-Lead (0.150" Wide) Molded Small Outline Package, JEDEC (S)  
NS Package Number M16A**



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

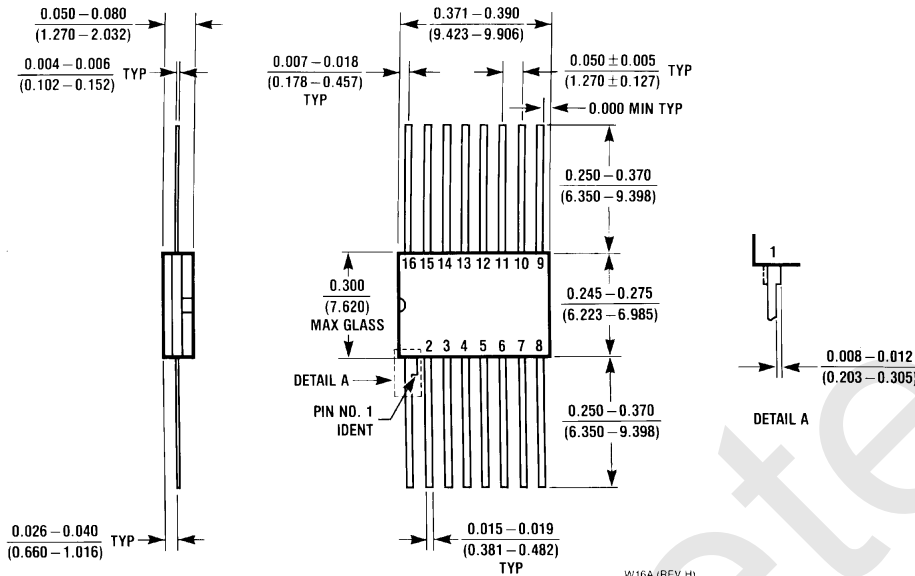


**16-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)**  
NS Package Number M16D



**16-Lead (0.300" Wide) Molded Dual-In-Line Package (P)**  
NS Package Number N16E

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



**16-Lead Ceramic Flatpak (F)  
NS Package Number W16A**

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