

## 54AC153 • 54ACT153 Dual 4-Input Multiplexer

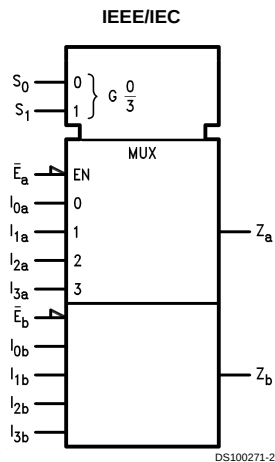
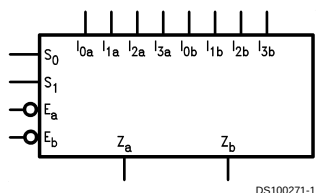
### General Description

The 'AC/'ACT153 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 'AC/'ACT153 can act as a function generator and generate any two functions of three variables.

### Features

- $I_{CC}$  reduced by 50%
- Outputs source/sink 24 mA
- 'ACT153 has TTL-compatible inputs
- Standard Microcircuit Drawings (SMD)
  - 'AC153: 5962-87625
  - 'ACT153: 5962-87698

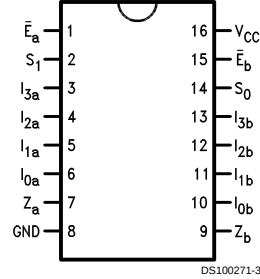
### Logic Symbols



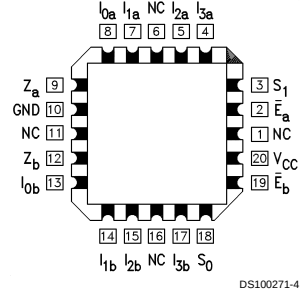
| Pin Names           | Description          |
|---------------------|----------------------|
| $I_{0a}$ – $I_{3a}$ | Side A Data Inputs   |
| $I_{0b}$ – $I_{3b}$ | Side B Data Inputs   |
| $S_0, S_1$          | Common Select Inputs |
| $\bar{E}_a$         | Side A Enable Input  |
| $\bar{E}_b$         | Side B Enable Input  |
| $Z_a$               | Side A Output        |
| $Z_b$               | Side B Output        |

## Connection Diagrams

Pin Assignment  
for DIP and Flatpak



Pin Assignment  
for LCC



## Functional Description

The 'AC/ACT153 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 ( $S_0$ ,  $S_1$ ). 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  $Z_a$ ,  $Z_b$  are forced LOW. The 'AC/ACT153 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 Select inputs. The logic equations for the outputs are shown below.

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

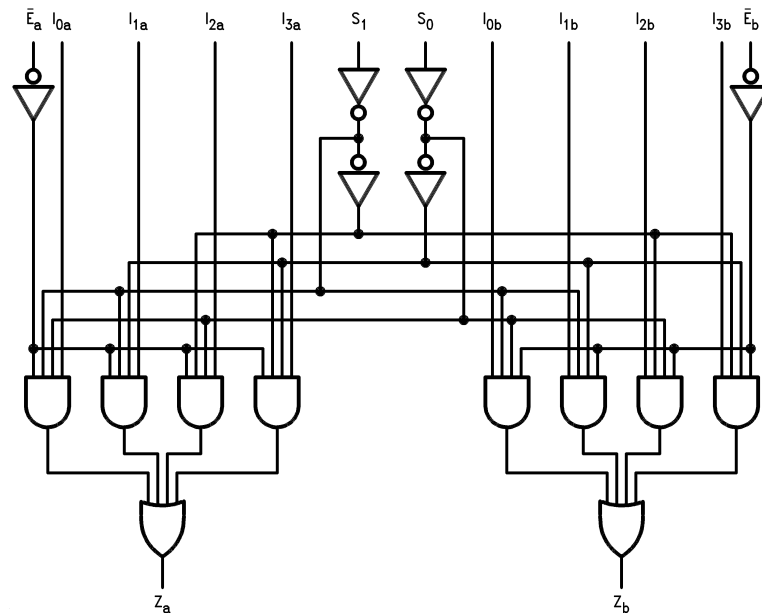
$$Z_b = \bar{E}_b \cdot (I_{0b} \cdot \bar{S}_1 \cdot \bar{S}_0 + I_{1b} \cdot \bar{S}_1 \cdot S_0 + I_{2b} \cdot S_1 \cdot \bar{S}_0 + I_{3b} \cdot S_1 \cdot S_0)$$

## Truth Table

| Select Inputs |       | Inputs (a or b) |       |       |       |       | Output |
|---------------|-------|-----------------|-------|-------|-------|-------|--------|
| $S_0$         | $S_1$ | $\bar{E}$       | $I_0$ | $I_1$ | $I_2$ | $I_3$ | $Z$    |
| 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 Voltage Level  
X = Immaterial

## Logic Diagram



DS100271-5

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.

|                                                                        |                          |
|------------------------------------------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )                                            | -0.5V to +7.0V           |
| DC Input Diode Current ( $I_{IK}$ )                                    |                          |
| $V_I = -0.5V$                                                          | -20 mA                   |
| $V_I = V_{CC} + 0.5V$                                                  | +20 mA                   |
| DC Input Voltage ( $V_I$ )                                             | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Diode Current ( $I_{OK}$ )                                   |                          |
| $V_O = -0.5V$                                                          | -20 mA                   |
| $V_O = V_{CC} + 0.5V$                                                  | +20 mA                   |
| DC Output Voltage ( $V_O$ )                                            | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Source or Sink Current ( $I_O$ )                             | ±50 mA                   |
| DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | ±50 mA                   |
| Storage Temperature ( $T_{STG}$ )                                      | -65°C to +150°C          |
| Junction Temperature ( $T_J$ )                                         |                          |
| CDIP                                                                   | 175°C                    |

## Recommended Operating Conditions

|                                                 |                 |
|-------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                     |                 |
| 'AC                                             | 2.0V to 6.0V    |
| 'ACT                                            | 4.5V to 5.5V    |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$  |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$  |
| Operating Temperature ( $T_A$ )                 |                 |
| 54AC/ACT                                        | -55°C to +125°C |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                 |
| 'AC Devices                                     |                 |
| $V_{IN}$ from 30% to 70% of $V_{CC}$            |                 |
| $V_{CC}$ @ 3.3V, 4.5V, 5.5V                     | 125 mV/ns       |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                 |
| 'ACT Devices                                    |                 |
| $V_{IN}$ from 0.8V to 2.0V                      |                 |
| $V_{CC}$ @ 4.5V, 5.5V                           | 125 mV/ns       |

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT® circuits outside databook specifications.

## DC Characteristics for 'AC Family Devices

| Symbol           | Parameter                                                                                                                                            | V <sub>CC</sub><br>(V) | 54AC                                | Units | Conditions                                           |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------|-------|------------------------------------------------------|
|                  |                                                                                                                                                      |                        | T <sub>A</sub> =<br>-55°C to +125°C |       |                                                      |
|                  |                                                                                                                                                      |                        | Guaranteed<br>Limits                |       |                                                      |
| V <sub>IH</sub>  | Minimum High Level<br>Input Voltage                                                                                                                  | 3.0                    | 2.1                                 | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> - 0.1V |
|                  |                                                                                                                                                      | 4.5                    | 3.15                                |       |                                                      |
|                  |                                                                                                                                                      | 5.5                    | 3.85                                |       |                                                      |
| V <sub>IL</sub>  | Maximum Low Level<br>Input Voltage                                                                                                                   | 3.0                    | 0.9                                 | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> - 0.1V |
|                  |                                                                                                                                                      | 4.5                    | 1.35                                |       |                                                      |
|                  |                                                                                                                                                      | 5.5                    | 1.65                                |       |                                                      |
| V <sub>OH</sub>  | Minimum High Level<br>Output Voltage                                                                                                                 | 3.0                    | 2.9                                 | V     | I <sub>OUT</sub> = -50 μA                            |
|                  |                                                                                                                                                      | 4.5                    | 4.4                                 |       |                                                      |
|                  |                                                                                                                                                      | 5.5                    | 5.4                                 |       |                                                      |
|                  | (Note 2)<br>V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OH</sub> = -12 mA<br>I <sub>OH</sub> = -24 mA<br>I <sub>OH</sub> = -24 mA | 3.0                    | 2.4                                 | V     |                                                      |
|                  |                                                                                                                                                      | 4.5                    | 3.7                                 |       |                                                      |
|                  |                                                                                                                                                      | 5.5                    | 4.7                                 |       |                                                      |
|                  |                                                                                                                                                      |                        |                                     |       |                                                      |
| V <sub>OL</sub>  | Maximum Low Level<br>Output Voltage                                                                                                                  | 3.0                    | 0.1                                 | V     | I <sub>OUT</sub> = 50 μA                             |
|                  |                                                                                                                                                      | 4.5                    | 0.1                                 |       |                                                      |
|                  |                                                                                                                                                      | 5.5                    | 0.1                                 |       |                                                      |
|                  | (Note 2)<br>V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OL</sub> = 12 mA<br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 24 mA    | 3.0                    | 0.50                                | V     |                                                      |
|                  |                                                                                                                                                      | 4.5                    | 0.50                                |       |                                                      |
|                  |                                                                                                                                                      | 5.5                    | 0.50                                |       |                                                      |
|                  |                                                                                                                                                      |                        |                                     |       |                                                      |
| I <sub>IN</sub>  | Maximum Input<br>Leakage Current                                                                                                                     | 5.5                    | ±1.0                                | μA    | V <sub>I</sub> = V <sub>CC</sub> , GND               |
| I <sub>OLD</sub> | Minimum Dynamic<br>Output Current (Note 3)                                                                                                           | 5.5                    | 50                                  | mA    | V <sub>OLD</sub> = 1.65V Max                         |
| I <sub>OHD</sub> |                                                                                                                                                      | 5.5                    | -50                                 | mA    | V <sub>OHD</sub> = 3.85V Min                         |

## DC Characteristics for 'AC Family Devices (Continued)

| Symbol          | Parameter                           | V <sub>CC</sub><br>(V) | 54AC                                | Units | Conditions                                  |
|-----------------|-------------------------------------|------------------------|-------------------------------------|-------|---------------------------------------------|
|                 |                                     |                        | T <sub>A</sub> =<br>-55°C to +125°C |       |                                             |
|                 |                                     |                        | Guaranteed<br>Limits                |       |                                             |
| I <sub>CC</sub> | Maximum Quiescent<br>Supply Current | 5.5                    | 80.0                                | μA    | V <sub>IN</sub> = V <sub>CC</sub><br>or GND |

**Note 2:** All outputs loaded; thresholds on input associated with output under test.

**Note 3:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 4:** I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

I<sub>CC</sub> for 54AC @ 25°C is identical to 74AC @ 25°C.

## DC Characteristics for 'ACT Family Devices

| Symbol           | Parameter                            | V <sub>CC</sub><br>(V) | 54ACT                               | Units | Conditions                                                                                                               |
|------------------|--------------------------------------|------------------------|-------------------------------------|-------|--------------------------------------------------------------------------------------------------------------------------|
|                  |                                      |                        | T <sub>A</sub> =<br>-55°C to +125°C |       |                                                                                                                          |
|                  |                                      |                        | Guaranteed<br>Limits                |       |                                                                                                                          |
| V <sub>IH</sub>  | Minimum High Level<br>Input Voltage  | 4.5                    | 2.0                                 | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> - 0.1V                                                                     |
|                  |                                      | 5.5                    | 2.0                                 |       |                                                                                                                          |
| V <sub>IL</sub>  | Maximum Low Level<br>Input Voltage   | 4.5                    | 0.8                                 | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> - 0.1V                                                                     |
|                  |                                      | 5.5                    | 0.8                                 |       |                                                                                                                          |
| V <sub>OH</sub>  | Minimum High Level<br>Output Voltage | 4.5                    | 4.4                                 | V     | I <sub>OUT</sub> = -50 μA                                                                                                |
|                  |                                      | 5.5                    | 5.4                                 |       |                                                                                                                          |
|                  |                                      | 4.5                    | 3.70                                | V     | (Note 5)<br>V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OH</sub> = -24 mA<br>I <sub>OH</sub> = -24 mA |
|                  |                                      | 5.5                    | 4.70                                |       |                                                                                                                          |
| V <sub>OL</sub>  | Maximum Low Level<br>Output Voltage  | 4.5                    | 0.1                                 | V     | I <sub>OUT</sub> = 50 μA                                                                                                 |
|                  |                                      | 5.5                    | 0.1                                 |       |                                                                                                                          |
|                  |                                      | 4.5                    | 0.50                                | V     | (Note 5)<br>V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 24 mA   |
|                  |                                      | 5.5                    | 0.50                                |       |                                                                                                                          |
| I <sub>IN</sub>  | Maximum Input<br>Leakage Current     | 5.5                    | ±1.0                                | μA    | V <sub>I</sub> = V <sub>CC</sub> , GND                                                                                   |
| I <sub>CCT</sub> | Maximum<br>I <sub>CC</sub> /Input    | 5.5                    | 1.6                                 | mA    | V <sub>I</sub> = V <sub>CC</sub> - 2.1V                                                                                  |
| I <sub>OLD</sub> | Minimum Dynamic                      | 5.5                    | 50                                  | mA    | V <sub>OLD</sub> = 1.65V Max                                                                                             |
| I <sub>OHD</sub> | Output Current (Note 6)              | 5.5                    | -50                                 | mA    | V <sub>OHD</sub> = 3.85V Min                                                                                             |
| I <sub>CC</sub>  | Maximum Quiescent<br>Supply Current  | 5.5                    | 80.0                                | μA    | V <sub>IN</sub> = V <sub>CC</sub><br>or GND                                                                              |

**Note 5:** All outputs loaded; thresholds on input associated with output under test.

**Note 6:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 7:** I<sub>CC</sub> for 54ACT @ 25°C is identical to 74ACT @ 25°C.

## AC Electrical Characteristics

| Symbol           | Parameter                                             | V <sub>CC</sub><br>(V)<br>(Note 8) | 54AC                                                          |      | Units |
|------------------|-------------------------------------------------------|------------------------------------|---------------------------------------------------------------|------|-------|
|                  |                                                       |                                    | T <sub>A</sub> = −55°C<br>to +125°C<br>C <sub>L</sub> = 50 pF |      |       |
|                  |                                                       |                                    | Min                                                           | Max  |       |
| t <sub>PLH</sub> | Propagation Delay<br>S <sub>n</sub> to Z <sub>n</sub> | 3.3                                | 1.0                                                           | 19.5 | ns    |
|                  |                                                       | 5.0                                | 1.0                                                           | 14.0 |       |
| t <sub>PHL</sub> | Propagation Delay<br>S <sub>n</sub> to Z <sub>n</sub> | 3.3                                | 1.0                                                           | 18.0 | ns    |
|                  |                                                       | 5.0                                | 1.0                                                           | 13.5 |       |
| t <sub>PLH</sub> | Propagation Delay<br>E̅ to Z <sub>n</sub>             | 3.3                                | 1.0                                                           | 16.5 | ns    |
|                  |                                                       | 5.0                                | 1.0                                                           | 12.5 |       |
| t <sub>PHL</sub> | Propagation Delay<br>E̅ to Z <sub>n</sub>             | 3.3                                | 1.0                                                           | 14.0 | ns    |
|                  |                                                       | 5.0                                | 1.0                                                           | 10.0 |       |
| t <sub>PLH</sub> | Propagation Delay<br>I <sub>n</sub> to Z <sub>n</sub> | 3.3                                | 1.0                                                           | 16.0 | ns    |
|                  |                                                       | 5.0                                | 1.0                                                           | 11.5 |       |
| t <sub>PHL</sub> | Propagation Delay<br>I <sub>n</sub> to Z <sub>n</sub> | 3.3                                | 1.0                                                           | 14.5 | ns    |
|                  |                                                       | 5.0                                | 1.0                                                           | 10.5 |       |

**Note 8:** Voltage Range 3.3 is 3.3V ±0.3V

Voltage Range 5.0 is 5.0V ±0.5V

## AC Electrical Characteristics

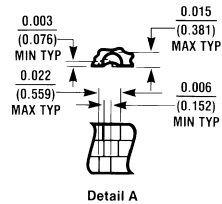
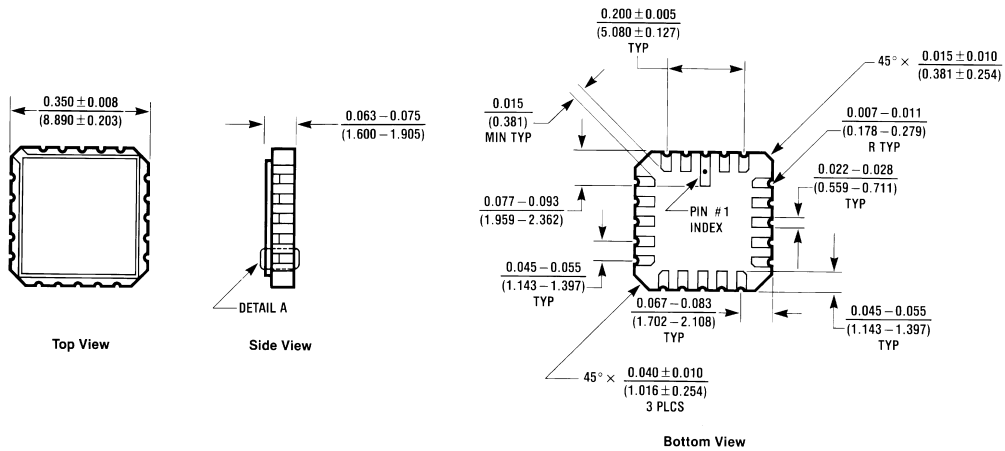
| Symbol           | Parameter                                             | V <sub>CC</sub><br>(V)<br>(Note 9) | 54ACT                                                         |      | Units |
|------------------|-------------------------------------------------------|------------------------------------|---------------------------------------------------------------|------|-------|
|                  |                                                       |                                    | T <sub>A</sub> = −55°C<br>to +125°C<br>C <sub>L</sub> = 50 pF |      |       |
|                  |                                                       |                                    | Min                                                           | Max  |       |
| t <sub>PLH</sub> | Propagation Delay<br>S <sub>n</sub> to Z <sub>n</sub> | 5.0                                | 1.0                                                           | 15.0 | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>S <sub>n</sub> to Z <sub>n</sub> | 5.0                                | 1.0                                                           | 14.5 | ns    |
| t <sub>PLH</sub> | Propagation Delay<br>E <sub>n</sub> to Z <sub>n</sub> | 5.0                                | 1.0                                                           | 13.5 | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>E <sub>n</sub> to Z <sub>n</sub> | 5.0                                | 1.0                                                           | 11.5 | ns    |
| t <sub>PLH</sub> | Propagation Delay<br>I <sub>n</sub> to Z <sub>n</sub> | 5.0                                | 1.0                                                           | 12.5 | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>I <sub>n</sub> to Z <sub>n</sub> | 5.0                                | 1.0                                                           | 12.0 | ns    |

**Note 9:** Voltage Range 5.0 is 5.0V ±0.5V

## Capacitance

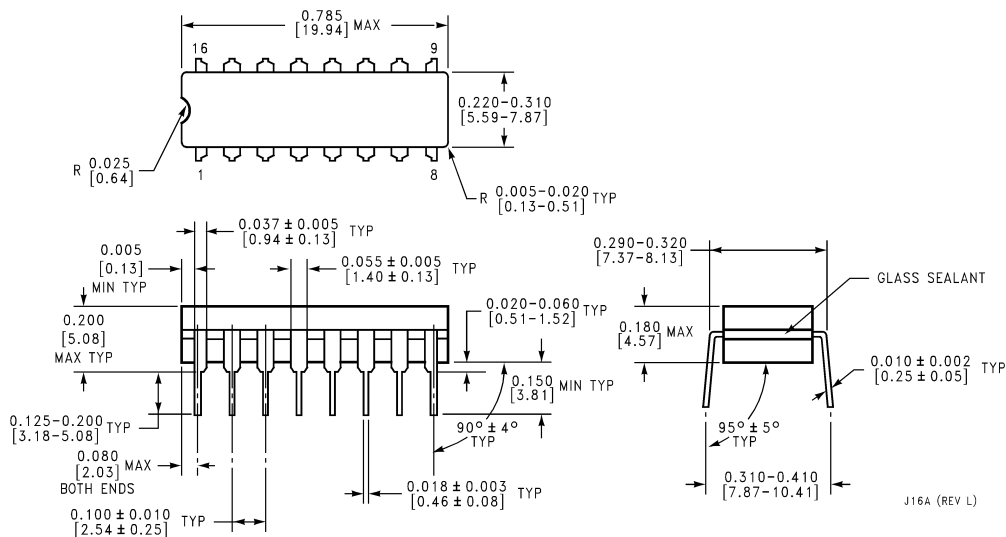
| Symbol          | Parameter                     | Typ  | Units | Conditions             |
|-----------------|-------------------------------|------|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance             | 4.5  | pF    | V <sub>CC</sub> = OPEN |
| C <sub>PD</sub> | Power Dissipation Capacitance | 65.0 | pF    | V <sub>CC</sub> = 5.0V |

## Physical Dimensions inches (millimeters) unless otherwise noted



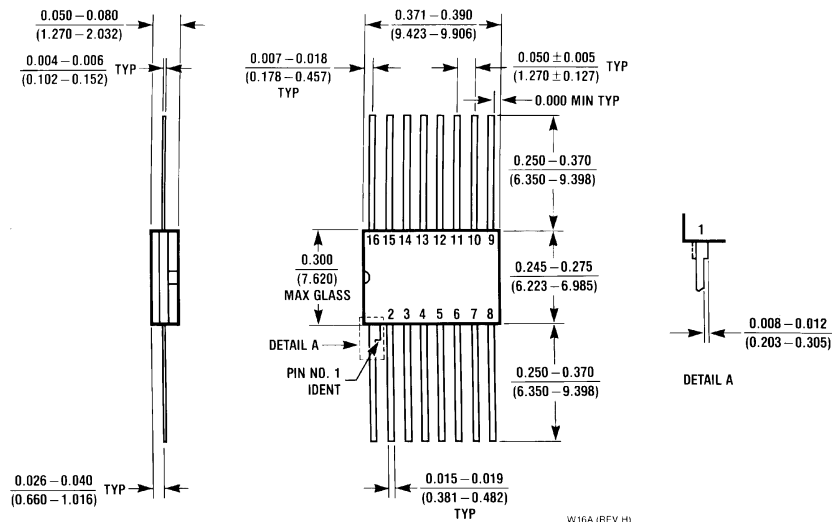
**20 Terminal Ceramic Leadless Chip Carrier (L)**  
NS Package Number E20A

E20A (REV D)



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

J16A (REV L)

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

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

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