

## 54AC157 • 54ACT157 Quad 2-Input Multiplexer

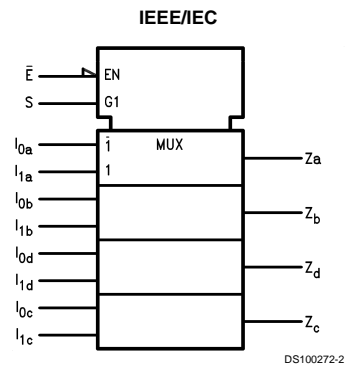
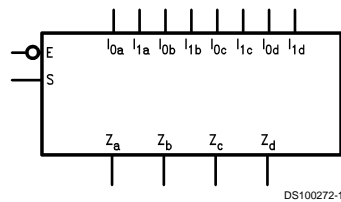
### General Description

The 'AC/'ACT157 is a high-speed quad 2-input multiplexer. Four bits of data from two sources can be selected using the common Select and Enable inputs. The four outputs present the selected data in the true (noninverted) form. The 'AC/'ACT157 can also be used as a function generator.

### Features

- $I_{CC}$  and  $I_{OZ}$  reduced by 50%
- Outputs source/sink 24 mA
- 'ACT157 has TTL-compatible inputs
- Standard Microcircuit Drawing (SMD)
  - 'AC157: 5962-89539
  - 'ACT157: 5962-89688

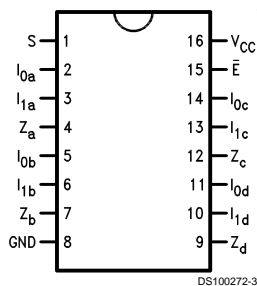
### Logic Symbols



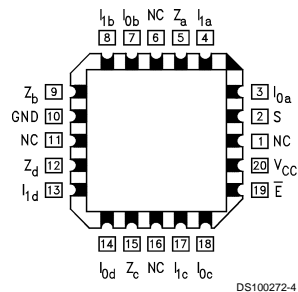
Pin Names	Description
$I_{0a}-I_{0d}$	Source 0 Data Inputs
$I_{1a}-I_{1d}$	Source 1 Data Inputs
$\bar{E}$	Enable Input
S	Select Input
$Z_a-Z_d$	Outputs

### Connection Diagrams

Pin Assignment  
for DIP and Flatpak



Pin Assignment  
for LCC



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## Functional Description

The 'AC/ACT157 is a quad 2-input multiplexer. It selects four bits of data from two sources under the control of a common Select input (S). The Enable input ( $\bar{E}$ ) is active-LOW. When  $\bar{E}$  is HIGH, all of the outputs (Z) are forced LOW regardless of all other inputs. The 'AC/ACT157 is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select input. The logic equations for the outputs are shown below:

$$Z_a = \bar{E} \cdot (I_{1a} \cdot S + I_{0a} \cdot \bar{S})$$

$$Z_b = \bar{E} \cdot (I_{1b} \cdot S + I_{0b} \cdot \bar{S})$$

$$Z_c = \bar{E} \cdot (I_{1c} \cdot S + I_{0c} \cdot \bar{S})$$

$$Z_d = \bar{E} \cdot (I_{1d} \cdot S + I_{0d} \cdot \bar{S})$$

A common use of the 'AC/ACT157 is the moving of data from two groups of registers to four common output busses. The particular register from which the data comes is determined by the state of the Select input. A less obvious use is as a function generator. The 'AC/ACT157 can generate any four

of the sixteen different functions of two variables with one variable common. This is useful for implementing gating functions.

## Truth Table

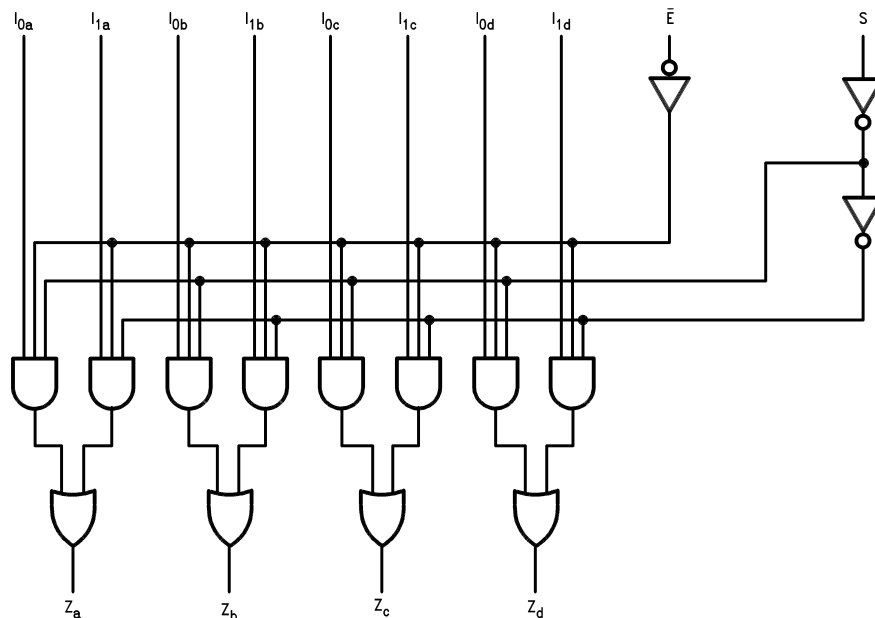
Inputs				Outputs
$\bar{E}$	S	$I_0$	$I_1$	Z
H	X	X	X	L
L	H	X	L	L
L	H	X	H	H
L	L	L	X	L
L	L	H	X	H

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

## Logic Diagram



DS100272-5

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> (V)	54AC	Units	Conditions
			T <sub>A</sub> = –55°C to +125°C		
			Guaranteed Limits		
V <sub>IH</sub>	Minimum High Level Input Voltage	3.0	2.1	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> – 0.1V
		4.5	3.15		
		5.5	3.85		
V <sub>IL</sub>	Maximum Low Level Input Voltage	3.0	0.9	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> – 0.1V
		4.5	1.35		
		5.5	1.65		
V <sub>OH</sub>	Minimum High Level Output Voltage	3.0	2.9	V	I <sub>OUT</sub> = –50 μA
		4.5	4.4		
		5.5	5.4		
		3.0	2.4	V	(Note 2) V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = –12 mA I <sub>OH</sub> = –24 mA I <sub>OH</sub> = –24 mA
		4.5	3.7		
		5.5	4.7		
V <sub>OL</sub>	Maximum Low Level Output Voltage	3.0	0.1	V	I <sub>OUT</sub> = 50 μA
		4.5	0.1		
		5.5	0.1		
		3.0	0.50	V	(Note 2) V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 12 mA I <sub>OL</sub> = 24 mA I <sub>OL</sub> = 24 mA
		4.5	0.50		
		5.5	0.50		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>OLD</sub>	Minimum Dynamic 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> (V)	54AC	Units	Conditions
			T <sub>A</sub> = –55°C to +125°C		
			Guaranteed Limits		
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5	80.0	μA	V <sub>IN</sub> = V <sub>CC</sub> 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> (V)	54ACT	Units	Conditions
			T <sub>A</sub> = –55°C to +125°C		
			Guaranteed Limits		
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5	2.0	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> – 0.1V
		5.5	2.0		
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5	0.8	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> – 0.1V
		5.5	0.8		
V <sub>OH</sub>	Minimum High Level Output Voltage	4.5	4.4	V	I <sub>OUT</sub> = –50 μA
		5.5	5.4		
		4.5	3.70	V	(Note 5) V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = –24 mA I <sub>OH</sub> = –24 mA
		5.5	4.70		
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5	0.1	V	I <sub>OUT</sub> = 50 μA
		5.5	0.1		
		4.5	0.50	V	(Note 5) V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 24 mA I <sub>OL</sub> = 24 mA
		5.5	0.50		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>CCT</sub>	Maximum 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 Supply Current	5.5	80.0	μA	V <sub>IN</sub> = V <sub>CC</sub> 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> (V) (Note 8)	54AC		Units
			T <sub>A</sub> = −55°C to +125°C C <sub>L</sub> = 50 pF		
			Min	Max	
t <sub>PLH</sub>	Propagation Delay S to Z <sub>n</sub>	3.3	1.0	16.0	ns
		5.0	1.0	12.0	
t <sub>PHL</sub>	Propagation Delay S to Z <sub>n</sub>	3.3	1.0	14.0	ns
		5.0	1.0	11.5	
t <sub>PLH</sub>	Propagation Delay Ē to Z <sub>n</sub>	3.3	1.0	16.0	ns
		5.0	1.0	12.0	
t <sub>PHL</sub>	Propagation Delay Ē to Z <sub>n</sub>	3.3	1.0	14.0	ns
		5.0	1.0	11.5	
t <sub>PLH</sub>	Propagation Delay I <sub>n</sub> to Z <sub>n</sub>	3.3	1.0	11.0	ns
		5.0	1.0	9.0	
t <sub>PHL</sub>	Propagation Delay I <sub>n</sub> to Z <sub>n</sub>	3.3	1.0	11.0	ns
		5.0	1.0	9.0	

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

Voltage Range 5.0 is 5.0V ±0.5V

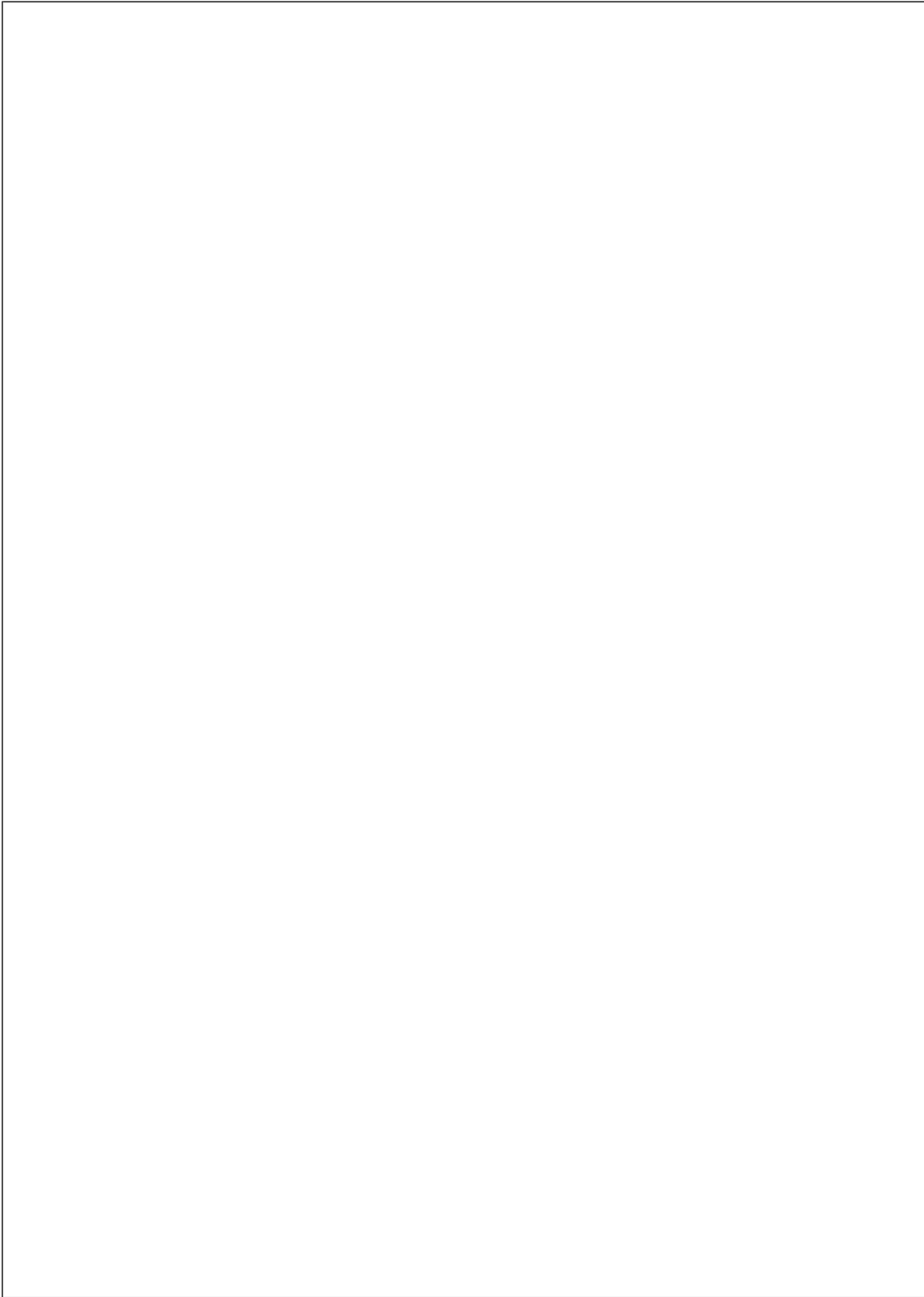
## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V) (Note 9)	54ACT		Units
			T <sub>A</sub> = −55°C to +125°C C <sub>L</sub> = 50 pF		
			Min	Max	
t <sub>PLH</sub>	Propagation Delay S to Z <sub>n</sub>	5.0	1.0	11.5	ns
t <sub>PHL</sub>	Propagation Delay S to Z <sub>n</sub>	5.0	1.0	11.5	ns
t <sub>PLH</sub>	Propagation Delay E̅ to Z <sub>n</sub>	5.0	1.0	12.0	ns
t <sub>PHL</sub>	Propagation Delay E̅ to Z <sub>n</sub>	5.0	1.0	10.0	ns
t <sub>PLH</sub>	Propagation Delay I <sub>n</sub> to Z <sub>n</sub>	5.0	1.0	8.5	ns
t <sub>PHL</sub>	Propagation Delay I <sub>n</sub> to Z <sub>n</sub>	5.0	1.0	9.0	ns

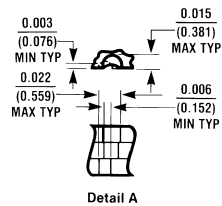
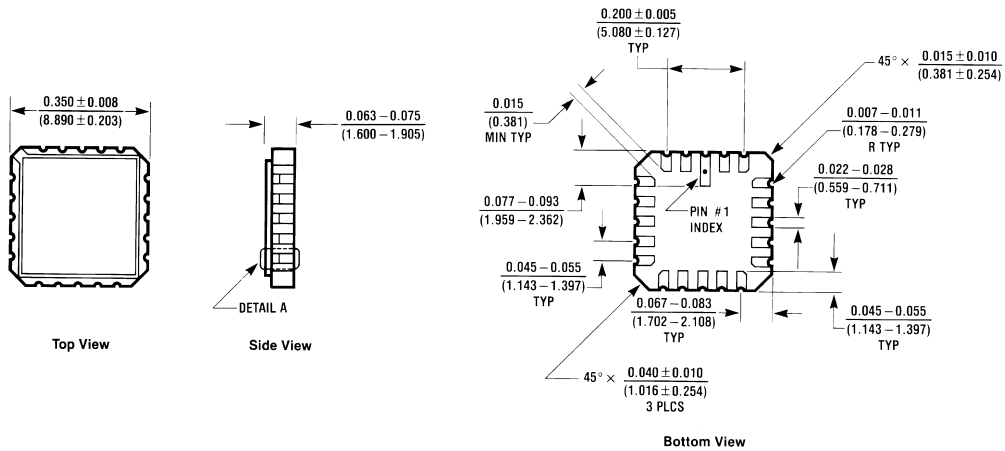
**Note 9:** Voltage Range 5.0 is 5.0V ±0.5V

## 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	50.0	pF	V <sub>CC</sub> = 5.0V

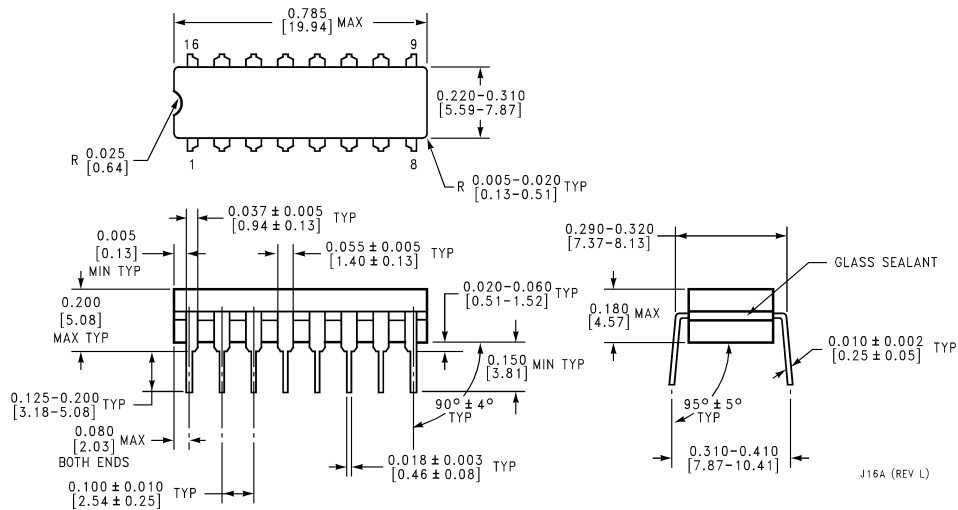


## Physical Dimensions inches (millimeters) unless otherwise noted



E20A (REV D)

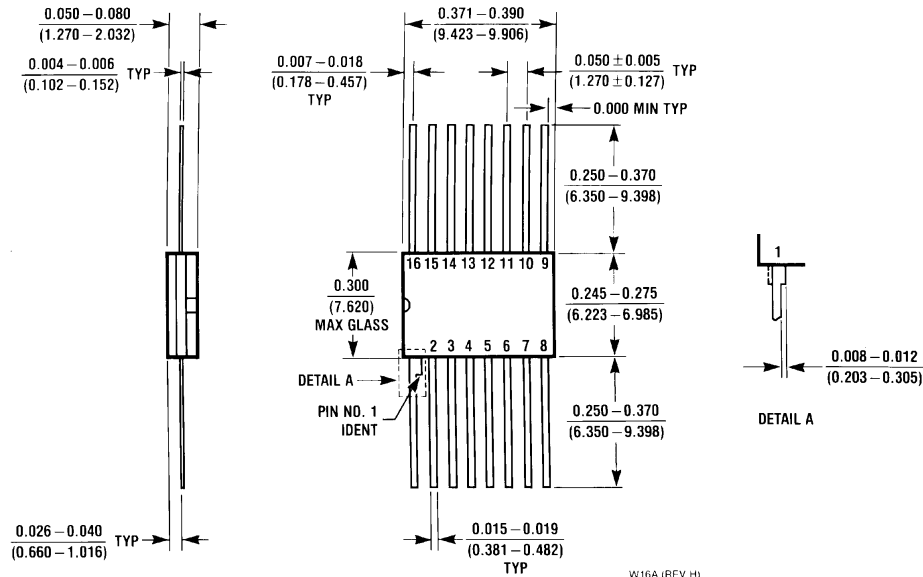
**20 Terminal Ceramic Leadless Chip Carrier (L)**  
**NS Package Number E20A**



J16A (REV L)

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

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



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

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**National Semiconductor Corporation**  
Americas  
Tel: 1-800-272-9959  
Fax: 1-800-737-7018  
Email: support@nsc.com

www.national.com

**National Semiconductor Europe**

Fax: +49 (0) 1 80-530 85 86  
Email: europe.support@nsc.com  
Deutsch Tel: +49 (0) 1 80-530 85 85  
English Tel: +49 (0) 1 80-532 78 32  
Français Tel: +49 (0) 1 80-532 93 58  
Italiano Tel: +49 (0) 1 80-534 16 80

**National Semiconductor Asia Pacific Customer Response Group**

Tel: 65-2544466  
Fax: 65-2504466  
Email: sea.support@nsc.com

**National Semiconductor Japan Ltd.**

Tel: 81-3-5620-6175  
Fax: 81-3-5620-6179