

August 1998

## 54AC251 • 54ACT251 8-Input Multiplexer with TRI-STATE® Output

### General Description

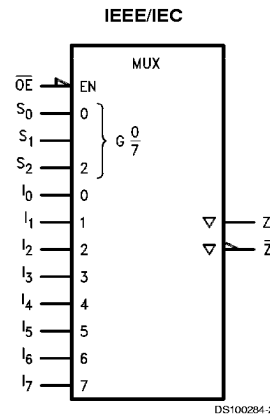
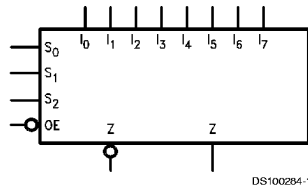
The 'AC/'ACT251 is a high-speed 8-input digital multiplexer. It provides, in one package, the ability to select one bit of data from up to eight sources. It can be used as universal function generator to generate any logic function of four variables. Both true and complementary outputs are provided.

- Multifunctional capability
- On-chip select logic decoding
- Inverting and noninverting TRI-STATE outputs
- Outputs source/sink 24 mA
- 'ACT251 has TTL-compatible inputs
- Standard Military Drawing (SMD)
  - 'AC251: 5962-87692
  - 'ACT251: 5962-89599

### Features

- I<sub>CC</sub> reduced by 50%

### Logic Symbols

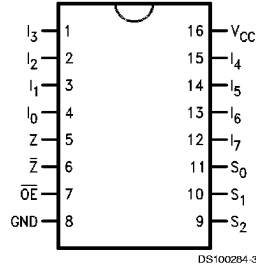


Pin Names	Description
S <sub>0</sub> -S <sub>2</sub>	Select Inputs
$\overline{OE}$	TRI-STATE Output Enable Input
I <sub>0</sub> -I <sub>7</sub>	Multiplexer Inputs
Z	TRI-STATE Multiplexer Output
$\overline{Z}$	Complementary TRI-STATE Multiplexer Output

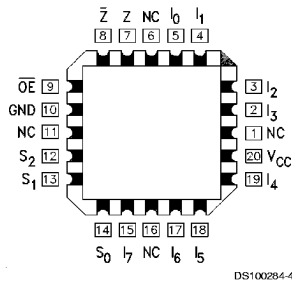
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FACT® is a registered trademark of Fairchild Semiconductor Corporation.

### Connection Diagrams

Pin Assignment for DIP and Flatpak



Pin Assignment for LCC



### Functional Description

This device is a logical implementation of a single-pole, 8-position switch with the switch position controlled by the state of three Select inputs,  $S_0, S_1, S_2$ . Both true and complementary outputs are provided. The Output Enable input ( $\overline{OE}$ ) is active LOW. When it is activated, the logic function provided at the output is:

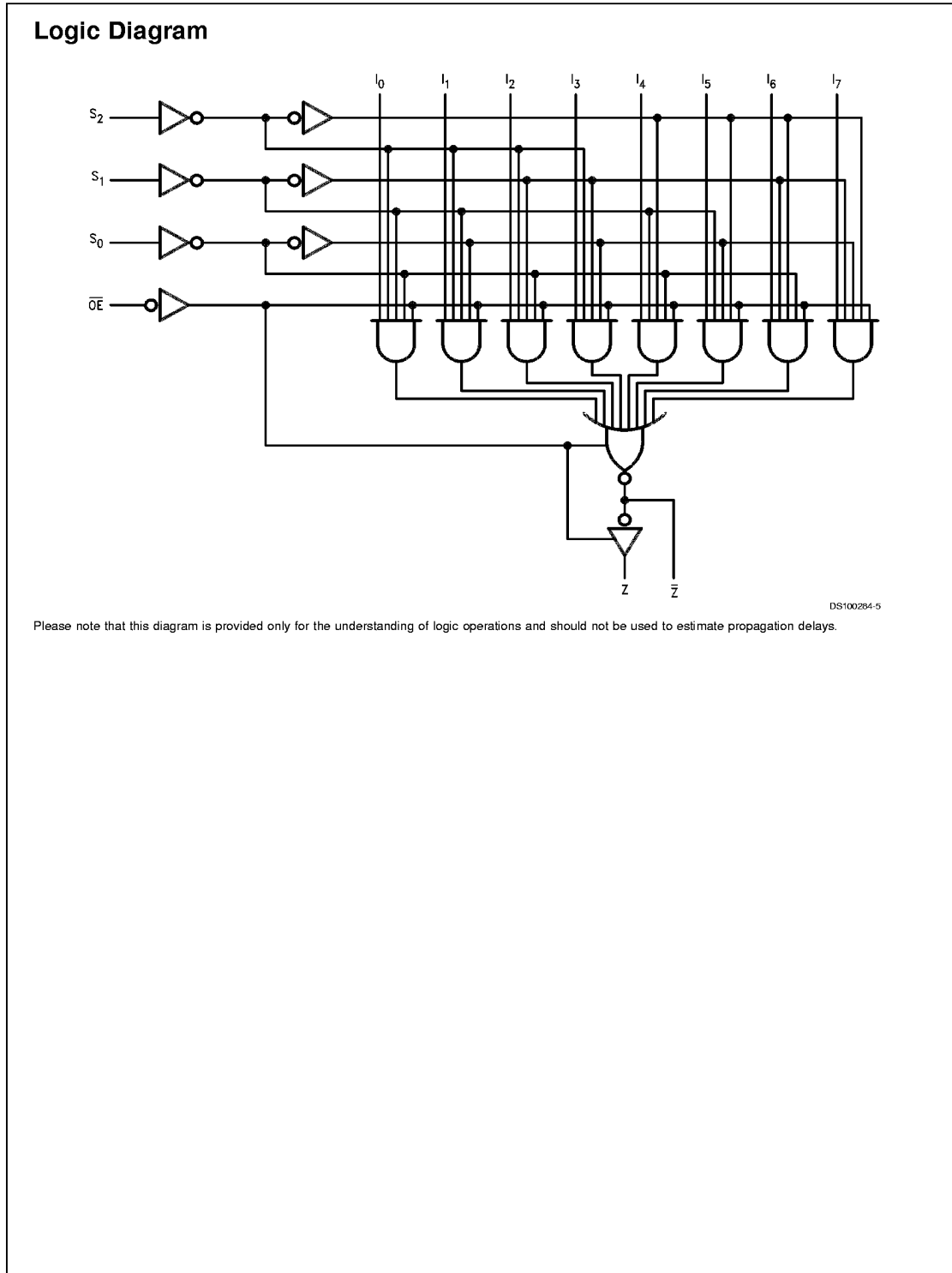
$$Z = \overline{OE} \cdot (I_0 \cdot \overline{S_0} \cdot \overline{S_1} \cdot \overline{S_2} + I_1 \cdot S_0 \cdot \overline{S_1} \cdot \overline{S_2} + I_2 \cdot \overline{S_0} \cdot S_1 \cdot \overline{S_2} + I_3 \cdot S_0 \cdot S_1 \cdot \overline{S_2} + I_4 \cdot \overline{S_0} \cdot \overline{S_1} \cdot S_2 + I_5 \cdot S_0 \cdot \overline{S_1} \cdot S_2 + I_6 \cdot \overline{S_0} \cdot S_1 \cdot S_2 + I_7 \cdot S_0 \cdot S_1 \cdot S_2)$$

When the Output Enable is HIGH, both outputs are in the high impedance (High Z) state. This feature allows multiplexer expansion by tying the outputs of up to 128 devices together. When the outputs of the TRI-STATE devices are tied together, all but one device must be in the high impedance state to avoid high currents that would exceed the maximum ratings. The Output Enable signals should be designed to ensure there is no overlap in the active-LOW portion of the enable voltages.

### Truth Table

$\overline{OE}$	Inputs			Outputs	
	$S_2$	$S_1$	$S_0$	$\overline{Z}$	Z
H	X	X	X	Z	Z
L	L	L	L	$\overline{I_0}$	$I_0$
L	L	L	H	$\overline{I_1}$	$I_1$
L	L	H	L	$\overline{I_2}$	$I_2$
L	L	H	H	$\overline{I_3}$	$I_3$
L	H	L	L	$\overline{I_4}$	$I_4$
L	H	L	H	$\overline{I_5}$	$I_5$
L	H	H	L	$\overline{I_6}$	$I_6$
L	H	H	H	$\overline{I_7}$	$I_7$

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance



Absolute Maximum Ratings (Note 1)		Recommended Operating Conditions				
<p>If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.</p>		Supply Voltage ( $V_{CC}$ )	2.0V to 6.0V			
Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V	'AC	4.5V to 5.5V			
DC Input Diode Current ( $I_{IK}$ )		'ACT	0V to $V_{CC}$			
$V_I = -0.5V$	-20 mA	Output Voltage ( $V_O$ )	0V to $V_{CC}$			
$V_I = V_{CC} + 0.5V$	+20 mA	Operating Temperature ( $T_A$ )				
DC Input Voltage ( $V_I$ )	-0.5V to $V_{CC} + 0.5V$	54AC/ACT	-55°C to +125°C			
DC Output Diode Current ( $I_{OK}$ )		Minimum Input Edge Rate ( $\Delta V/\Delta t$ )				
$V_O = -0.5V$	-20 mA	'AC Devices				
$V_O = V_{CC} + 0.5V$	+20 mA	$V_{IN}$ from 30% to 70% of $V_{CC}$				
DC Output Voltage ( $V_O$ )	-0.5V to $V_{CC} + 0.5V$	$V_{CC}$ @ 3.3V, 4.5V, 5.5V	125 mV/ns			
DC Output Source		Minimum Input Edge Rate ( $\Delta V/\Delta t$ )				
or Sink Current ( $I_O$ )	$\pm 50$ mA	'ACT Devices				
DC $V_{CC}$ or Ground Current		$V_{IN}$ from 0.8V to 2.0V				
per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 50$ mA	$V_{CC}$ @ 4.5V, 5.5V	125 mV/ns			
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C	<p><b>Note 1:</b> 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.</p> <p><b>Note 2:</b> All outputs loaded; thresholds on input associated with output under test.</p>				
Junction Temperature ( $T_J$ )	175°C					
CDIP						
DC Characteristics for 'AC Family Devices						
Symbol	Parameter	$V_{CC}$ (V)	54AC		Units	Conditions
			$T_A = -55^\circ\text{C to } +125^\circ\text{C}$			
			Guaranteed Limits			
$V_{IH}$	Minimum High Level Input Voltage	3.0	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	3.15			
		5.5	3.85			
$V_{IL}$	Maximum Low Level Input Voltage	3.0	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	1.35			
		5.5	1.65			
$V_{OH}$	Minimum High Level Output Voltage	3.0	2.9	V	$I_{OUT} = -50 \mu A$	
		4.5	4.4			
		5.5	5.4			
$V_{OL}$	Maximum Low Level Output Voltage	3.0	2.4	V	(Note 2) $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OH} = -12$ mA $I_{OH} = -24$ mA $I_{OH} = -24$ mA	
		4.5	3.7			
		5.5	4.7			
$V_{OL}$	Maximum Low Level Output Voltage	3.0	0.1	V	$I_{OUT} = 50 \mu A$	
		4.5	0.1			
		5.5	0.1			
$V_{OL}$	Maximum Low Level Output Voltage	3.0	0.50	V	(Note 2) $V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OL} = 12$ mA $I_{OL} = 24$ mA $I_{OL} = 24$ mA	
		4.5	0.50			
		5.5	0.50			
$I_{IN}$	Maximum Input Leakage Current	5.5	$\pm 1.0$	$\mu A$	$V_I = V_{CC}, GND$	

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>OZ</sub>	Maximum TRI-STATE Current	5.5	±5.0		μA	V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub> V <sub>I</sub> = V <sub>CC</sub> , V <sub>GND</sub> V <sub>O</sub> = V <sub>CC</sub> , GND
I <sub>OLD</sub>	Minimum Dynamic	5.5	50		mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>	Output Current (Note 3)	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
<p><b>Note 3:</b> Maximum test duration 2.0 ms, one output loaded at a time.</p> <p><b>Note 4:</b> 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.</p>						
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			
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			
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>OZ</sub>	Maximum TRI-STATE Current	5.5	±5.0		μA	V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub> V <sub>O</sub> = V <sub>CC</sub> , GND
I <sub>CC1</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
<p><b>Note 5:</b> All outputs loaded; thresholds on input associated with output under test.</p> <p><b>Note 6:</b> Maximum test duration 2.0 ms, one output loaded at a time.</p> <p><b>Note 7:</b> I<sub>CC</sub> for 54ACT @ 25°C is identical to 74ACT @ 25°C.</p>						

<b>AC Electrical Characteristics</b>					
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 <sub>n</sub> to Z or $\bar{Z}$	3.3	1.0	21.0	ns
		5.0	1.0	15.5	
t <sub>PHL</sub>	Propagation Delay S <sub>n</sub> to Z or $\bar{Z}$	3.3	1.0	21.0	ns
		5.0	1.0	15.5	
t <sub>PLH</sub>	Propagation Delay I <sub>n</sub> to Z or $\bar{Z}$	3.3	1.0	17.0	ns
		5.0	1.0	12.0	
t <sub>PHL</sub>	Propagation Delay I <sub>n</sub> to Z or $\bar{Z}$	3.3	1.0	16.5	ns
		5.0	1.0	12.0	
t <sub>PZH</sub>	Output Enable Time $\overline{OE}$ to Z or $\bar{Z}$	3.3	1.0	13.0	ns
		5.0	1.0	10.0	
t <sub>PZL</sub>	Output Enable Time $\overline{OE}$ to Z or $\bar{Z}$	3.3	1.0	13.0	ns
		5.0	1.0	10.0	
t <sub>PHZ</sub>	Output Disable Time $\overline{OE}$ to Z or $\bar{Z}$	3.3	3.5	14.0	ns
		5.0	2.5	11.0	
t <sub>PLZ</sub>	Output Disable Time $\overline{OE}$ to Z or $\bar{Z}$	3.3	4.0	13.0	ns
		5.0	3.0	10.0	

**Note 8:** Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

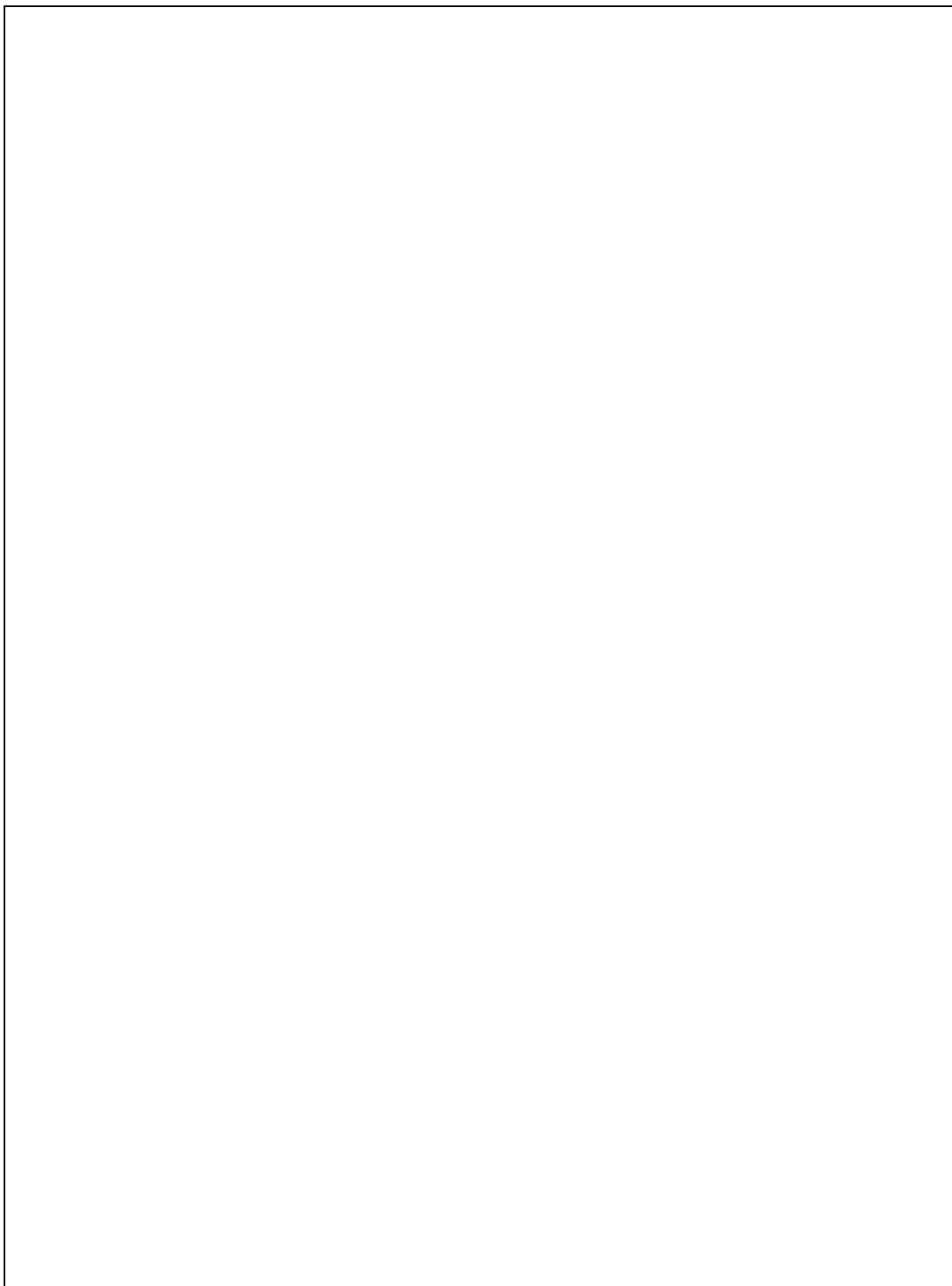
<b>AC Electrical Characteristics</b>					
Symbol	Parameter	V <sub>CC</sub> (V) (Note 9)	54ACT		Units
			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		
			Min	Max	
t <sub>PLH</sub>	Propagation Delay S <sub>n</sub> to Z or $\bar{Z}$	5.0	1.0	18.0	ns
t <sub>PHL</sub>	Propagation Delay S <sub>n</sub> to Z or $\bar{Z}$	5.0	1.0	18.0	ns
t <sub>PLH</sub>	Propagation Delay I <sub>n</sub> to Z or $\bar{Z}$	5.0	1.0	13.5	ns
t <sub>PHL</sub>	Propagation Delay I <sub>n</sub> to Z or $\bar{Z}$	5.0	1.0	13.5	ns
t <sub>PZH</sub>	Output Enable Time $\overline{OE}$ to Z or $\bar{Z}$	5.0	1.0	10.0	ns
t <sub>PZL</sub>	Output Enable Time $\overline{OE}$ to Z or $\bar{Z}$	5.0	1.0	9.5	ns
t <sub>PHZ</sub>	Output Disable Time $\overline{OE}$ to Z or $\bar{Z}$	5.0	1.0	12.5	ns
t <sub>PLZ</sub>	Output Disable Time $\overline{OE}$ to Z or $\bar{Z}$	5.0	1.0	8.5	ns

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

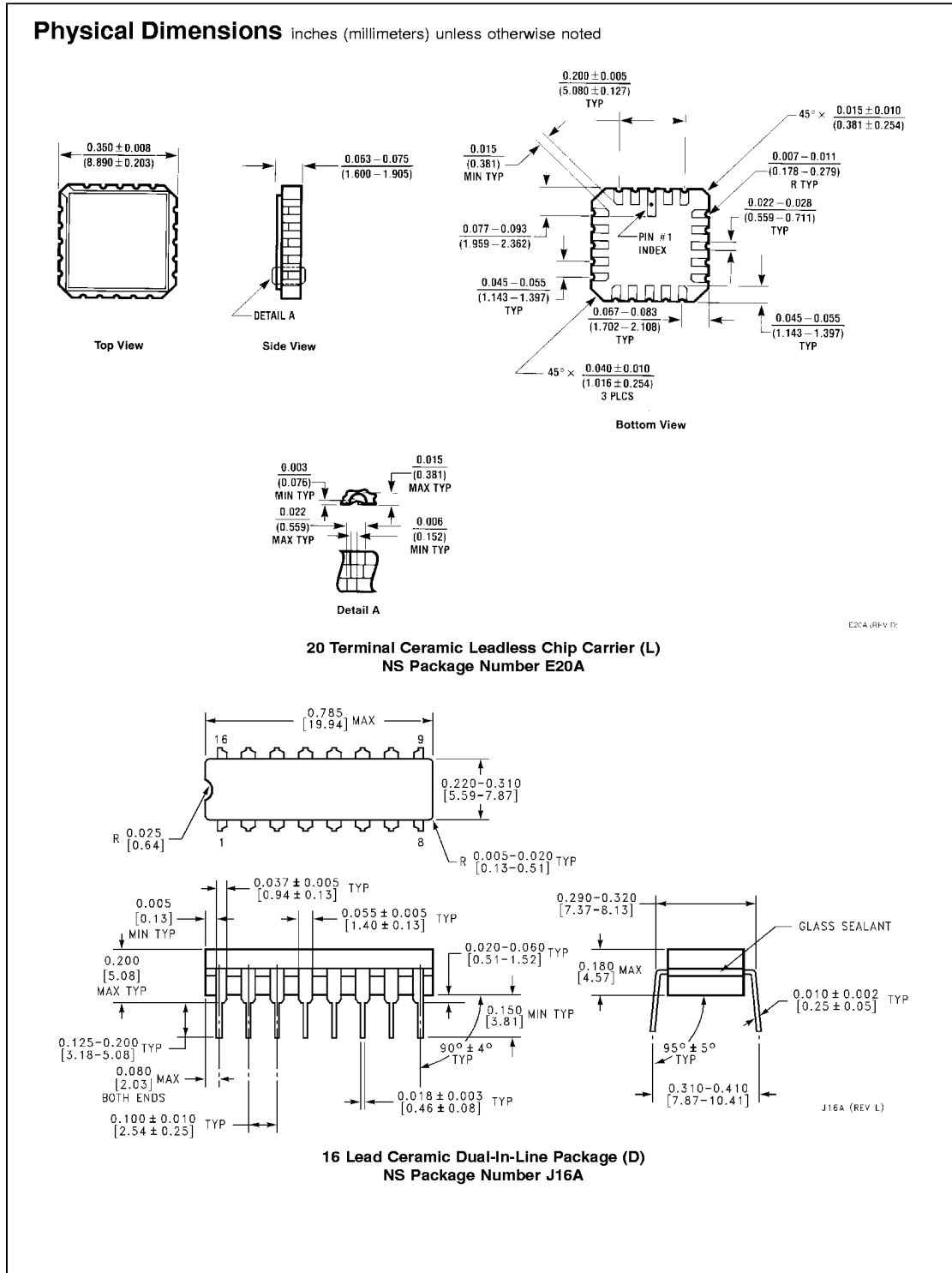
### Capacitance

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	70.0	pF	V <sub>CC</sub> = 5.0V

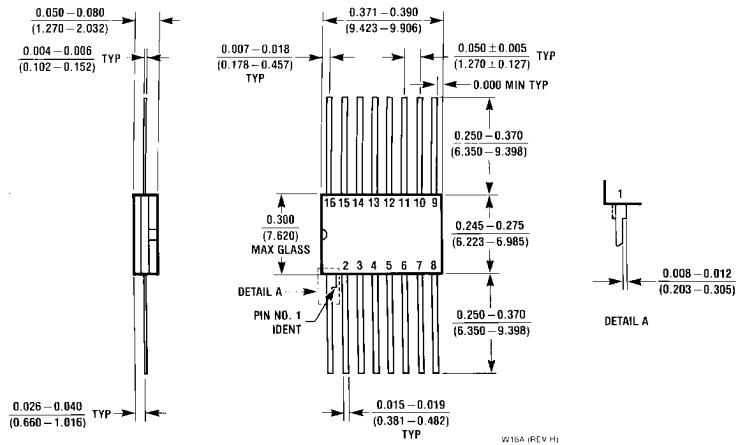
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**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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

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