

August 1998

54AC139 • 54ACT139 Dual 1-of-4 Decoder/Demultiplexer

General Description

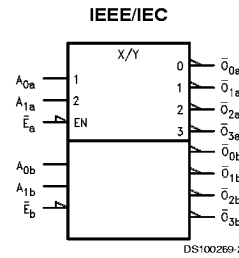
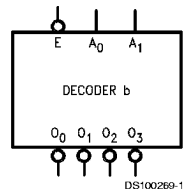
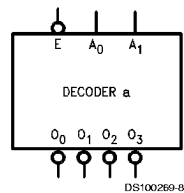
The 'AC/'ACT139 is a high-speed, dual 1-of-4 decoder/demultiplexer. The device has two independent decoders, each accepting two inputs and providing four mutually-exclusive active-LOW outputs. Each decoder has an active-LOW Enable input which can be used as a data input for a 4-output demultiplexer. Each half of the 'AC/'ACT139 can be used as a function generator providing all four minterms of two variables.

- Multifunction capability
- Two completely independent 1-of-4 decoders
- Active LOW mutually exclusive outputs
- Outputs source/sink 24 mA
- 'ACT139 has TTL-compatible inputs
- Standard Military Drawing (SMD)
 - 'AC139: 5962-87623
 - 'ACT139: 5962-87553

Features

- I_{CC} reduced by 50%

Logic Symbols

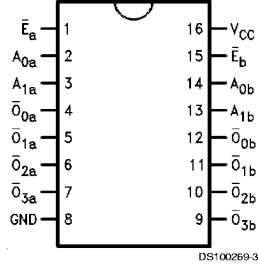


Pin Names	Description
A_0, A_1	Address Inputs
\bar{E}	Enable Inputs
$\bar{O}_0 - \bar{O}_3$	Outputs

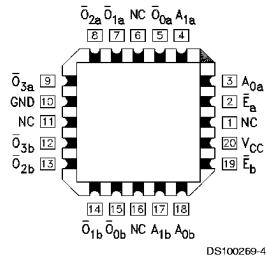
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Connection Diagrams

Pin Assignment for DIP and Flatpak



Pin Assignment for LCC



Functional Description

The 'AC/ACT139 is a high-speed dual 1-of-4 decoder/demultiplexer. The device has two independent decoders, each of which accepts two binary weighted inputs (A_0 - A_1) and provides four mutually exclusive active-LOW outputs (\bar{O}_0 - \bar{O}_3). Each decoder has an active-LOW enable (\bar{E}). When \bar{E} is HIGH all outputs are forced HIGH. The enable

can be used as the data input for a 4-output demultiplexer application. Each half of the 'AC/ACT139 generates all four minterms of two variables. These four minterms are useful in some applications, replacing multiple gate functions as shown in , and thereby reducing the number of packages required in a logic network.

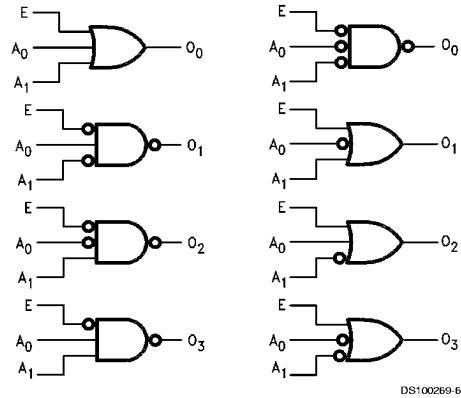


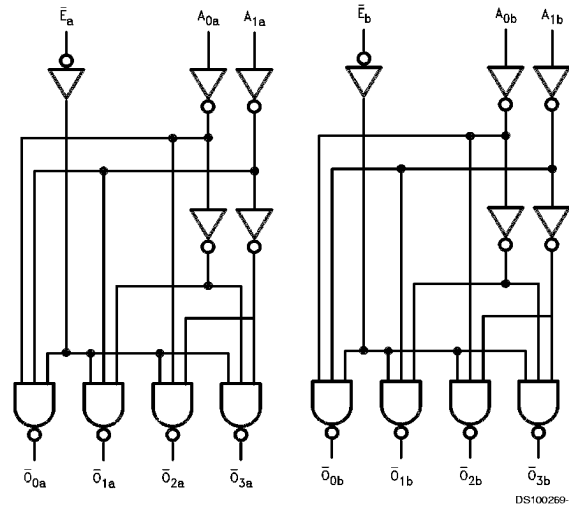
FIGURE 1. Gate Functions (Each Half)

Truth Table

Inputs			Outputs			
\bar{E}	A_0	A_1	\bar{O}_0	\bar{O}_1	\bar{O}_2	\bar{O}_3
H	X	X	H	H	H	H
L	L	L	L	H	H	H
L	H	L	H	L	H	H
L	L	H	H	H	L	H
L	H	H	H	H	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Logic Diagram



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)		Recommended Operating Conditions			
<p>If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.</p>		<p>Supply Voltage (V_{CC})</p>			
Supply Voltage (V_{CC})	-0.5V to +7.0V	'AC	2.0V to 6.0V		
DC Input Diode Current (I_{IK})		'ACT	4.5V to 5.5V		
$V_I = -0.5V$	-20 mA	Input Voltage (V_I)	0V to V_{CC}		
$V_I = V_{CC} + 0.5V$	+20 mA	Output Voltage (V_O)	0V to V_{CC}		
DC Input Voltage (V_I)	-0.5V to $V_{CC} + 0.5V$	Operating Temperature (T_A)			
DC Output Diode Current (I_{OK})		54AC/ACT	-55°C to +125°C		
$V_O = -0.5V$	-20 mA	Minimum Input Edge Rate ($\Delta V/\Delta t$)			
$V_O = V_{CC} + 0.5V$	+20 mA	'AC Devices			
DC Output Voltage (V_O)	-0.5V to $V_{CC} + 0.5V$	V_{IN} from 30% to 70% of V_{CC}			
DC Output Source		V_{CC} @ 3.3V, 4.5V, 5.5V	125 mV/ns		
or Sink Current (I_O)	± 50 mA	Minimum Input Edge Rate ($\Delta V/\Delta t$)			
DC V_{CC} or Ground Current		'ACT Devices			
per Output Pin (I_{CC} or I_{GND})	± 50 mA	V_{IN} from 0.8V to 2.0V			
Storage Temperature (T_{STG})	-65°C to +150°C	V_{CC} @ 4.5V, 5.5V	125 mV/ns		
Junction Temperature (T_J)		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.			
CDIP	175°C				
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	0.1	V	$I_{OUT} = 50 \mu A$
		4.5	0.1		
		5.5	0.1		
I_{IN}	Maximum Input Leakage Current	3.0	2.4	V	(Note 2) $V_{IN} = V_{IL}$ or V_{IH} $I_{OH} = -12 \text{ mA}$ $I_{OH} = -24 \text{ mA}$ $I_{OH} = -24 \text{ mA}$
		4.5	3.7		
		5.5	4.7		
I_{OL}	Maximum Low Level Output Voltage	3.0	0.1	V	(Note 2) $V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 12 \text{ mA}$ $I_{OL} = 24 \text{ mA}$ $I_{OL} = 24 \text{ mA}$
		4.5	0.1		
		5.5	0.1		
I_{IN}	Maximum Input Leakage Current	3.0	0.50	V	(Note 2) $V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 12 \text{ mA}$ $I_{OL} = 24 \text{ mA}$ $I_{OL} = 24 \text{ mA}$
		4.5	0.50		
		5.5	0.50		
I_{IN}	Maximum Input Leakage Current	5.5	± 1.0	μA	$V_I = V_{CC}, GND$

DC Characteristics for 'AC Family Devices (Continued)					
Symbol	Parameter	V _{CC} (V)	54AC	Units	Conditions
			T _A = -55°C to +125°C		
			Guaranteed Limits		
I _{OLD}	(Note 3) Minimum Dynamic Output Current	5.5	50	mA	V _{OLD} = 1.65V Max
I _{OHD}		5.5	-50	mA	V _{OHD} = 3.85V Min
I _{CC}	Maximum Quiescent Supply Current	5.5	80.0	μA	V _{IN} = V _{CC} or GND
<p>Note 2: All outputs loaded; thresholds on input associated with output under test.</p> <p>Note 3: Maximum test duration 2.0 ms, one output loaded at a time.</p> <p>Note 4: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}. I_{CC} for 54AC @ 25°C is identical to 74AC @ 25°C.</p>					
DC Characteristics for 'ACT Family Devices					
Symbol	Parameter	V _{CC} (V)	54ACT	Units	Conditions
			T _A = -55°C to +125°C		
			Guaranteed Limits		
V _{IH}	Minimum High Level Input Voltage	4.5 5.5	2.0 2.0	V	V _{OUT} = 0.1V or V _{CC} - 0.1V
V _{IL}	Maximum Low Level Input Voltage	4.5 5.5	0.8 0.8	V	V _{OUT} = 0.1V or V _{CC} - 0.1V
V _{OH}	Minimum High Level Output Voltage	4.5 5.5	4.4 5.4	V	I _{OUT} = -50 μA
		4.5 5.5	3.70 4.70	V	(Note 5) V _{IN} = V _{IL} or V _{IH} I _{OH} = -24 mA I _{OH} = -24 mA
V _{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.1 0.1	V	I _{OUT} = 50 μA
		4.5 5.5	0.50 0.50	V	(Note 5) V _{IN} = V _{IL} or V _{IH} I _{OL} = 24 mA I _{OL} = 24 mA
I _{IN}	Maximum Input Leakage Current	5.5	±1.0	μA	V _I = V _{CC} , GND
I _{CC1}	Maximum I _{CC} /Input	5.5	1.6	mA	V _I = V _{CC} - 2.1V
I _{OLD}	(Note 6) Minimum Dynamic Output Current	5.5	50	mA	V _{OLD} = 1.65V Max
I _{OHD}		5.5	-50	mA	V _{OHD} = 3.85V Min
I _{CC}	Maximum Quiescent Supply Current	5.5	80.0	μA	V _{IN} = V _{CC} or GND
<p>Note 5: All outputs loaded; thresholds on input associated with output under test.</p> <p>Note 6: Maximum test duration 2.0 ms, one output loaded at a time.</p> <p>Note 7: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.</p>					

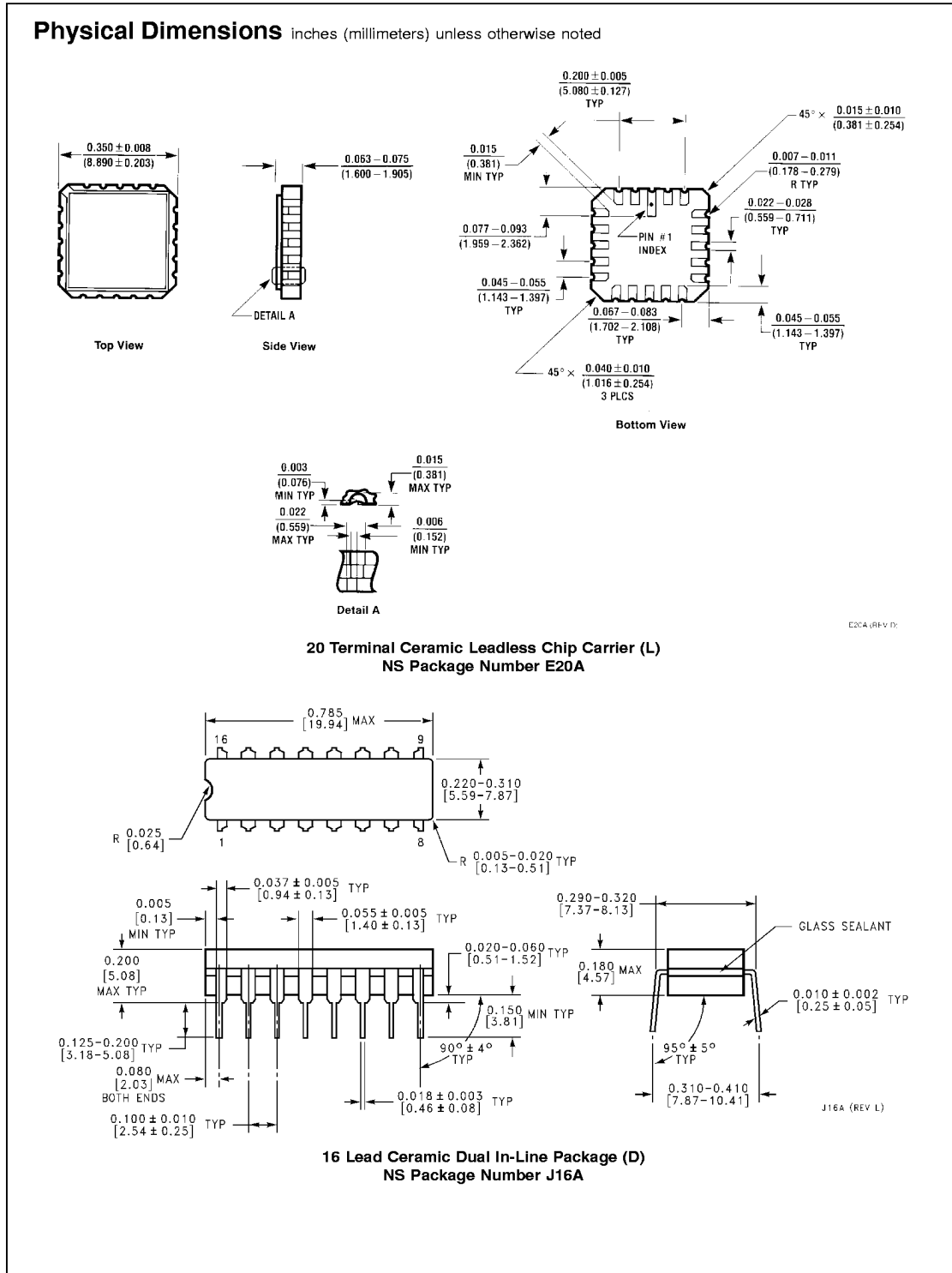
AC Electrical Characteristics						
Symbol	Parameter	V _{CC} (V) (Note 8)	54AC		Units	Fig. No.
			T _A = -55°C to +125°C C _L = 50 pF			
			Min	Max		
t _{PLH}	Propagation Delay A _n to \overline{O}_n	3.3	1.0	14.5	ns	
		5.0	1.0	11.0		
t _{PHL}	Propagation Delay A _n to \overline{O}_n	3.3	1.0	12.5	ns	
		5.0	1.0	10.0		
t _{PLH}	Propagation Delay \overline{E}_n to \overline{O}_n	3.3	1.0	14.5	ns	
		5.0	1.0	11.0		
t _{PHL}	Propagation Delay \overline{E}_n to \overline{O}_n	3.3	1.0	12.5	ns	
		5.0	1.0	10.0		

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

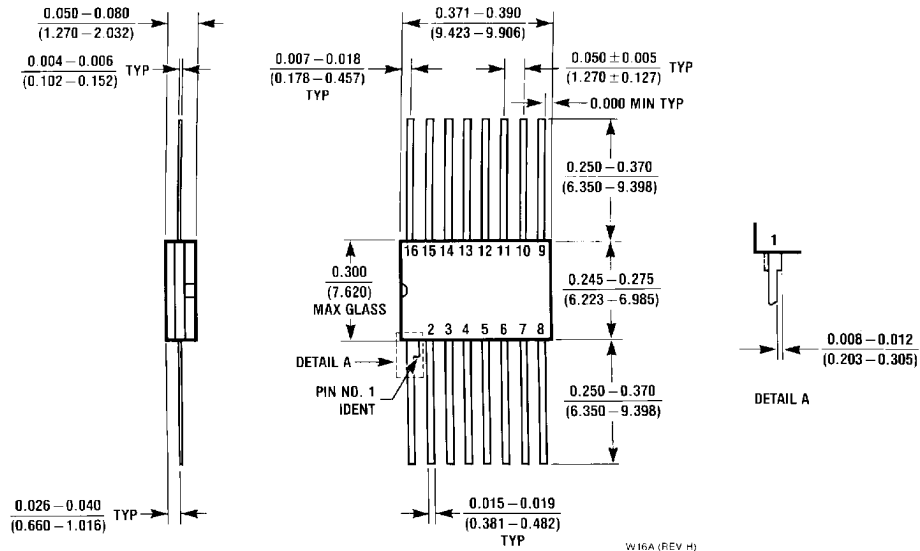
AC Electrical Characteristics						
Symbol	Parameter	V _{CC} (V) (Note 9)	54ACT		Units	Fig. No.
			T _A = -55°C to +125°C C _L = 50 pF			
			Min	Max		
t _{PLH}	Propagation Delay A _n to \overline{O}_n	5.0	1.0	12.0	ns	
t _{PHL}	Propagation Delay A _n to \overline{O}_n	5.0	1.0	11.0	ns	
t _{PLH}	Propagation Delay \overline{E}_n to \overline{O}_n	5.0	1.0	12.5	ns	
t _{PHL}	Propagation Delay \overline{E}_n to \overline{O}_n	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 _{IN}	Input Capacitance	4.5	pF	V _{CC} = OPEN
C _{PD}	Power Dissipation Capacitance	40.0	pF	V _{CC} = 5.0V



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



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

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