

# Dual 1-of-8 Decoder/Demultiplexer

## 74AC138, 74ACT138

### General Description

The AC138/ACT138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three AC138/ACT138 devices or a 1-of-32 decoder using four AC138/ACT138 devices and one inverter.

### Features

- I<sub>CC</sub> Reduced by 50%
- Demultiplexing Capability
- Multiple Input Enable for Easy Expansion
- Active LOW Mutually Exclusive Outputs
- Outputs Source/Sink 24 mA
- ACT138 Has TTL Compatible Inputs
- These are Pb-Free Devices

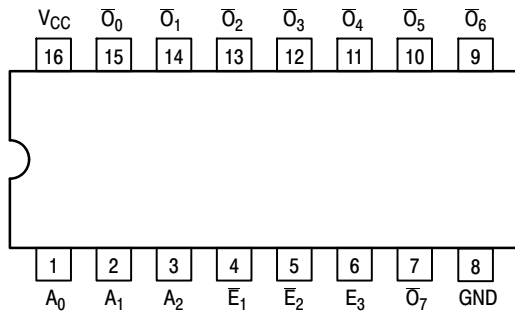


Figure 1. Pinout: 16-Lead Packages Conductors (Top View)

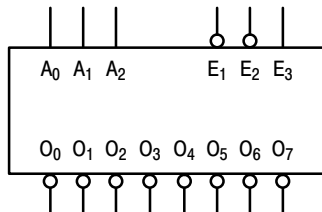
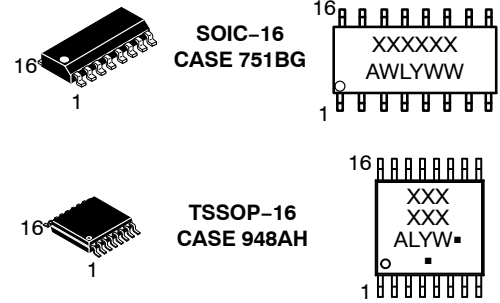


Figure 2. Logic Symbol

### MARKING DIAGRAMS



XXX = Specific Device Code  
A = Assembly Location  
WL or L = Wafer Lot  
Y = Year  
WW or W = Work Week  
G or ▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

## 74AC138, 74ACT138

### PIN DESCRIPTIONS

PIN	FUNCTION
$A_0, A_1$	Address Inputs
$\bar{E}$	Enable Inputs
$E_3$	Enable Input
$\bar{O}_0-\bar{O}_3$	Outputs

### TRUTH TABLE

Inputs						Outputs							
$\bar{E}_1$	$\bar{E}_2$	$E_3$	$A_0$	$A_1$	$A_2$	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Voltage Level

L = LOW Voltage Level

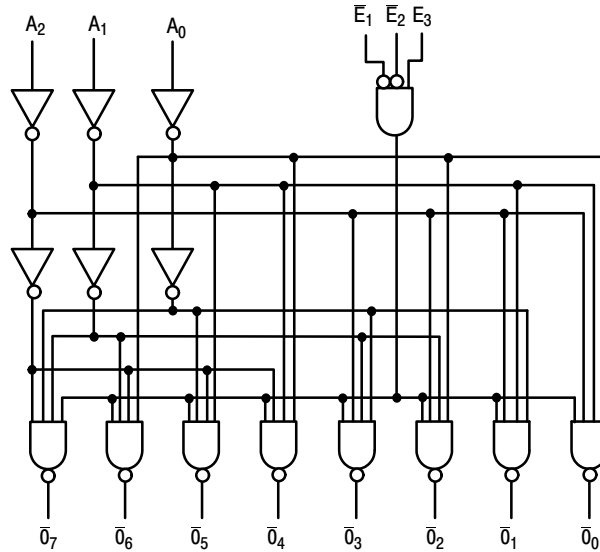
X = Immaterial

## 74AC138, 74ACT138

### Functional Description

The AC138/ACT138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs ( $A_0$ ,  $A_1$ ,  $A_2$ ) and, when enabled, provides eight mutually exclusive active-LOW outputs ( $\bar{O}_0$ - $\bar{O}_7$ ). The AC138/7ACT138 features three Enable inputs, two active-LOW ( $\bar{E}_1$ ,  $\bar{E}_2$ ) and one active-HIGH ( $E_3$ ). All outputs will be HIGH unless  $\bar{E}_1$  and  $\bar{E}_2$  are LOW and  $E_3$  is HIGH. This multiple enabled function allows easy parallel

expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four AC138/ACT138 devices and one inverter (Figure 4). The AC138/ACT138 can be used as an 8-output demultiplexer by using one of the active LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active-HIGH or active-LOW state.



NOTE: This diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Figure 3. Logic Diagram

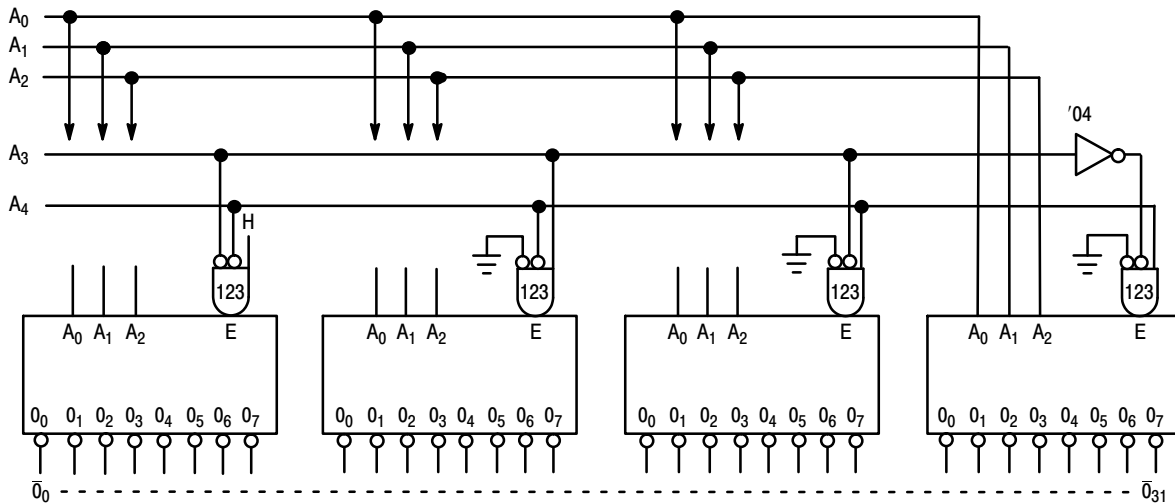


Figure 4. Expansion to 1-of-32 Decoding

## 74AC138, 74ACT138

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
$V_{CC}$	Supply Voltage	-0.5 to +6.5	V
$I_{IK}$	DC Input Diode Current $V_I = -0.5\text{ V}$ $V_I = V_{CC} + 0.5\text{ V}$	-20 +20	mA
$V_I$	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{OK}$	DC Output Diode Current $V_O = -0.5\text{ V}$ $V_O = V_{CC} + 0.5\text{ V}$	-20 +20	mA
$V_O$	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
$I_O$	DC Output Source or Sink Current	$\pm 50$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current per Output Pin	$\pm 50$	mA
$T_{STG}$	Storage Temperature	-65 to +150	$^{\circ}\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Supply Voltage AC ACT	2.0 4.5	6.0 5.5	V
$V_I$	Input Voltage	0	$V_{CC}$	V
$V_O$	Output Voltage	0	$V_{CC}$	V
$T_A$	Operating Temperature	-40	85	$^{\circ}\text{C}$
$\Delta V/\Delta t$	Minimum Input Edge Rate, AC Devices: $V_{IN}$ from 30% to 70% $V_{CC}$ , $V_{CC}$ @ 3.3 V, 4.5 V, 5.5 V	125		mV/ns
$\Delta V/\Delta t$	Minimum Input Edge Rate, ACT Devices: $V_{IN}$ from 0.8 V to 2.0 V, $V_{CC}$ @ 4.5 V, 5.5 V	125		mV/ns

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

# 74AC138, 74ACT138

## DC ELECTRICAL CHARACTERISTICS FOR AC

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C		Unit	
				Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH Level Input Voltage	3.0	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V	1.5	2.1	2.1		V	
		4.5		2.25	3.15	3.15			
		5.5		2.75	3.85	3.85			
V <sub>IL</sub>	Maximum LOW Level Input Voltage	3.0	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V	1.5	0.9	0.9		V	
		4.5		2.25	1.35	1.35			
		5.5		2.75	1.65	1.65			
V <sub>OH</sub>	Minimum HIGH Level Output Voltage	3.0	I <sub>OUT</sub> = -50 μA	2.99	2.9	2.9		V	
		4.5		4.49	4.4	4.4			
		5.5		5.49	5.4	5.4			
		3.0				2.56	2.46		
		4.5				3.86	3.76		
		5.5				4.86	4.76		
V <sub>OL</sub>	Maximum LOW Level Output Voltage	3.0	I <sub>OUT</sub> = 50 μA	0.002	0.1	0.1		V	
		4.5		0.001	0.1	0.1			
		5.5		0.001	0.1	0.1			
		3.0				0.36	0.44		
		4.5				0.36	0.44		
		5.5				0.36	0.44		
I <sub>IN</sub> (Note 2)	Maximum Input Leakage Current	5.5	V <sub>I</sub> = V <sub>CC</sub> , GND		±0.1	±1.0		μA	
I <sub>OLD</sub>	Minimum Dynamic Output Current (Note 3)	5.5	V <sub>OLD</sub> = 1.65 V Max			75		mA	
I <sub>OHD</sub>		5.5	V <sub>OHD</sub> = 3.85 V Min			-75		mA	
I <sub>CC</sub> (Note 2)	Maximum Quiescent Supply Current	5.5	V <sub>IN</sub> = V <sub>CC</sub> or GND		4.0	40.0		μA	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. All outputs loaded; thresholds on input associated with output under test.
2. I<sub>IN</sub> and I<sub>CC</sub> @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V<sub>CC</sub>.
3. Maximum test duration 2.0 ms, one output loaded at a time.

## 74AC138, 74ACT138

### DC ELECTRICAL CHARACTERISTICS FOR ACT

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C		Unit
				Typ	Guaranteed Limits			
V <sub>IH</sub>	Minimum HIGH Level Input Voltage	4.5	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V	1.5	2.0	2.0		V
		5.5		1.5	2.0	2.0		
V <sub>IL</sub>	Maximum LOW Level Input Voltage	4.5	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> - 0.1 V	1.5	0.8	0.8		V
		5.5		1.5	0.8	0.8		
V <sub>OH</sub>	Minimum HIGH Level Output Voltage	4.5	I <sub>OUT</sub> = -50 μA	4.49	4.4	4.4		V
		5.5		5.49	5.4	5.4		
		4.5	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> , I <sub>OH</sub> = -24 mA		3.86	3.76		
		5.5		V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> , I <sub>OH</sub> = -24 mA (Note 4)		4.86	4.76	
V <sub>OL</sub>	Maximum LOW Level Output Voltage	4.5	I <sub>OUT</sub> = 50 μA	0.001	0.1	0.1		V
		5.5		0.001	0.1	0.1		
		4.5	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> , I <sub>OL</sub> = 24 mA		0.36	0.44		
		5.5		V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> , I <sub>OL</sub> = 24 mA (Note 4)		0.36	0.44	
I <sub>IN</sub>	Maximum Input Leakage Current	5.5	V <sub>I</sub> = V <sub>CC</sub> , GND		±0.1	±1.0		μA
I <sub>CCCT</sub>	Maximum I <sub>CC</sub> /Input	5.5	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V	0.6		1.5		mA
I <sub>OLD</sub>	Minimum Dynamic Output Current (Note 5)	5.5	V <sub>OLD</sub> = 1.65 V Max			75		mA
I <sub>OHD</sub>		5.5	V <sub>OHD</sub> = 3.85 V Min			-75		mA
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5	V <sub>IN</sub> = V <sub>CC</sub> or GND		4.0	40.0		μA

4. All outputs loaded; thresholds on input associated with output under test.

5. Maximum test duration 2.0 ms, one output loaded at a time.

## 74AC138, 74ACT138

### AC ELECTRICAL CHARACTERISTICS FOR AC

Symbol	Parameter	V <sub>CC</sub> (V) (Note 6)	T <sub>A</sub> = +25°C, C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C, C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay A <sub>n</sub> to $\bar{O}_n$	3.3	1.5	8.5	13.0	1.5	15.0	ns
		5.0	1.5	6.5	9.5	1.5	10.5	
t <sub>PHL</sub>	Propagation Delay A <sub>n</sub> to $\bar{O}_n$	3.3	1.5	8.0	12.5	1.5	14.0	ns
		5.0	1.5	6.0	9.0	1.5	10.5	
t <sub>PLH</sub>	Propagation Delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	3.3	1.5	11.0	15.0	1.5	16.0	ns
		5.0	1.5	8.0	11.0	1.5	12.0	
t <sub>PHL</sub>	Propagation Delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	3.3	1.5	9.5	13.5	1.5	15.0	ns
		5.0	1.5	7.0	9.5	1.5	10.5	
t <sub>PLH</sub>	Propagation Delay E <sub>3</sub> to $\bar{O}_n$	3.3	1.5	11.0	15.5	1.5	16.5	ns
		5.0	1.5	8.0	11.0	1.5	12.5	
t <sub>PHL</sub>	Propagation Delay E <sub>3</sub> to $\bar{O}_n$	3.3	1.5	8.5	13.0	1.5	14.0	ns
		5.0	1.5	6.0	8.0	1.0	9.5	

6. Voltage range 3.3 is 3.3 V ± 0.3 V.  
Voltage range 5.0 is 5.0 V ± 0.5 V.

### AC ELECTRICAL CHARACTERISTICS FOR ACT

Symbol	Parameter	V <sub>CC</sub> (V) (Note 7)	T <sub>A</sub> = +25°C, C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C, C <sub>L</sub> = 50 pF		Unit
			Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay A <sub>n</sub> to $\bar{O}_n$	5.0	1.5	7.0	10.5	1.5	11.5	ns
t <sub>PHL</sub>	Propagation Delay A <sub>n</sub> to $\bar{O}_n$	5.0	1.5	6.5	10.5	1.5	11.5	ns
t <sub>PLH</sub>	Propagation Delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	5.0	2.5	8.0	11.5	2.0	12.5	ns
t <sub>PHL</sub>	Propagation Delay $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	5.0	2.0	7.5	11.5	2.0	12.5	ns
t <sub>PLH</sub>	Propagation Delay E <sub>3</sub> to $\bar{O}_n$	5.0	2.5	8.0	12.0	2.0	13.0	ns
t <sub>PHL</sub>	Propagation Delay E <sub>3</sub> to $\bar{O}_n$	5.0	2.0	6.5	10.5	1.5	11.5	ns

7. Voltage range 5.0 is 5.0 V ± 0.5 V.

### CAPACITANCE

Symbol	Parameter	Conditions	Typ	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = OPEN	4.5	pF
C <sub>PD</sub>	Power Dissipation Capacitance	V <sub>CC</sub> = 5.0 V	60.0	pF

## 74AC138, 74ACT138

### ORDERING INFORMATION

Device	Marking	Package	Shipping†
74AC138MTCX	AC 138	TSSOP-16	96 Units / Rail
74AC138SC	AC138	SOIC-16	48 Units / Rail
74AC138SCX	AC138	SOIC-16	2500 / Tape & Reel
74ACT138SC	ACT138	SOIC-16	48 Units / Rail
74ACT138SCX	ACT138	SOIC-16	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



# MECHANICAL CASE OUTLINE

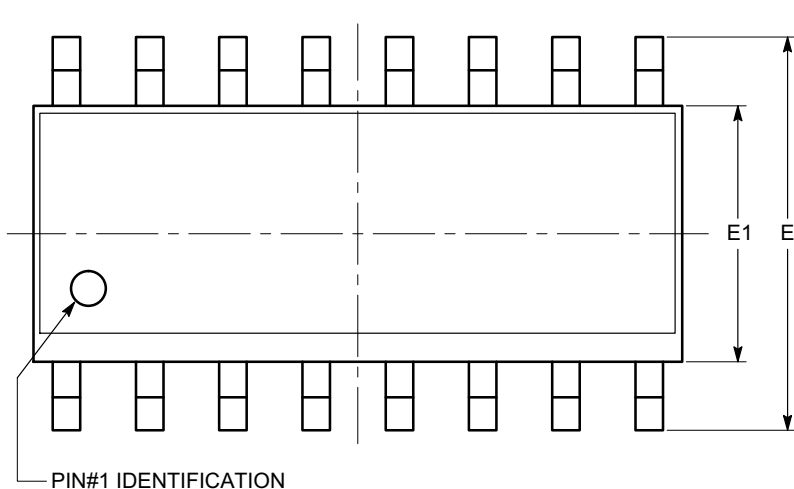
## PACKAGE DIMENSIONS

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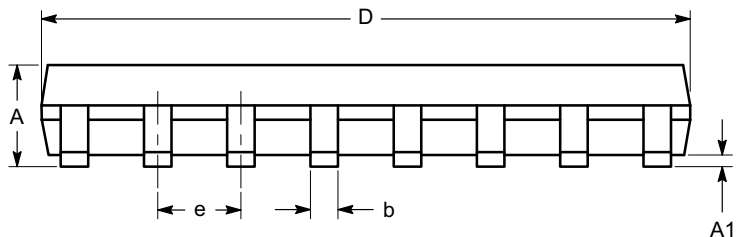
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CASE 751BG-01  
ISSUE O

DATE 19 DEC 2008

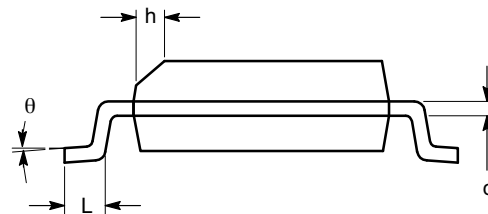


SYMBOL	MIN	NOM	MAX
A	1.35		1.75
A1	0.10		0.25
b	0.33		0.51
c	0.19		0.25
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27 BSC		
h	0.25		0.50
L	0.40		1.27
$\theta$	0°		8°

TOP VIEW



SIDE VIEW



END VIEW

**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

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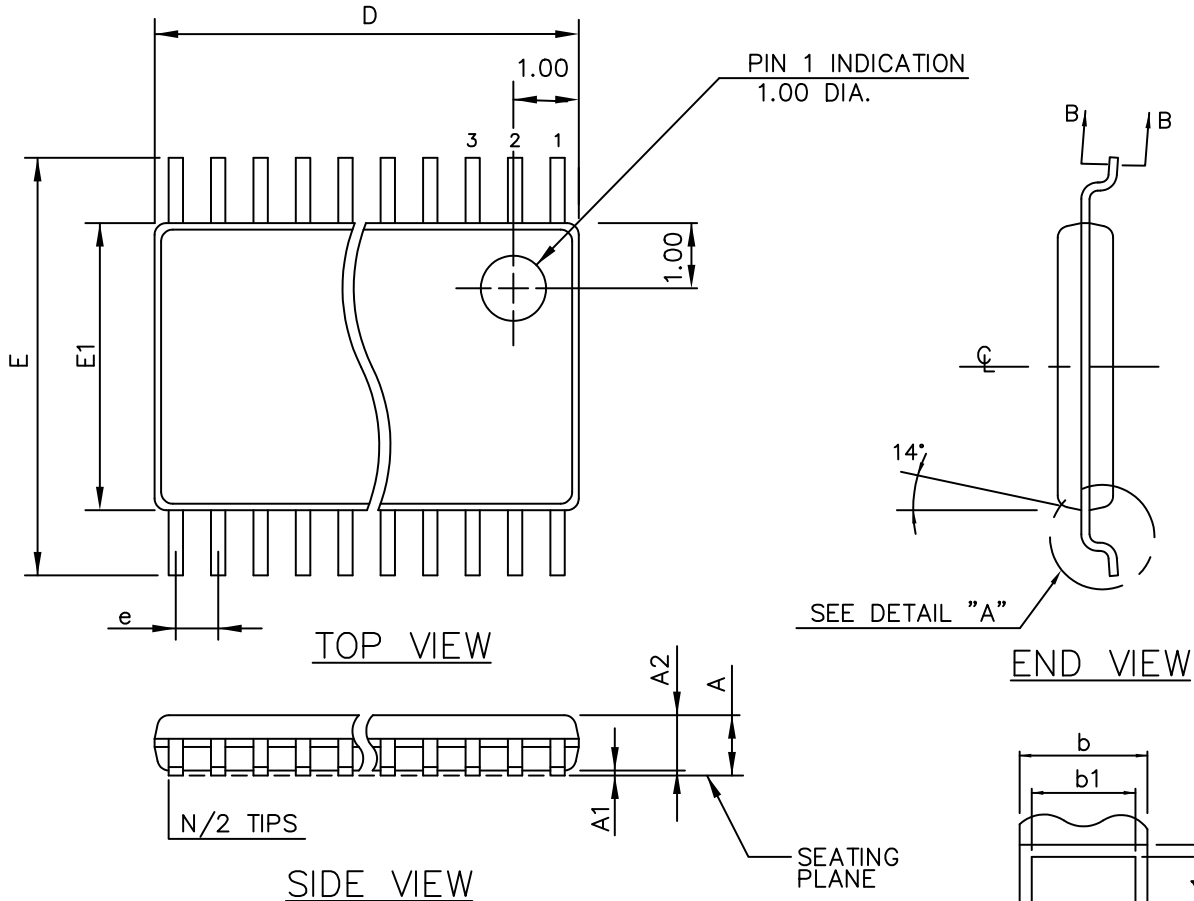
## PACKAGE DIMENSIONS

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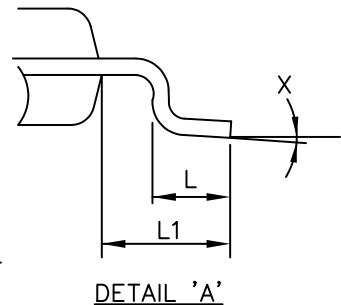


THIS TABLE FOR 0.65mm PITCH

SYMBOL	COMMON DIMENSIONS			NOTE VARIATIONS	D	N
	MIN.	NOM.	MAX.			
A	—	—	1.10	AA/AAT	3.00 BSC	8
A <sub>1</sub>	0.05	—	0.15	AB-1/ABT	5.00 BSC	14
A <sub>2</sub>	0.85	0.90	0.95	AB/ABT	5.00 BSC	16
b	0.19	—	0.30	AD/ADT	7.80 BSC	24
b <sub>1</sub>	0.19	0.22	0.25			
c	0.09	—	0.20			
c <sub>1</sub>	0.09	0.127	0.16			
D	SEE VARIATIONS					
E <sub>1</sub>	4.30	4.40	4.50			
e	0.65 BSC					
E	6.40 BSC					
L	0.50	0.60	0.70			
L <sub>1</sub>	1.00 REF					
N	SEE VARIATIONS					
X	0°	—	8°			

ALL DIMENSIONS IN MILLIMETERS

SECTION "B-B"



MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15mm ON D PER SIDE

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