

# 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

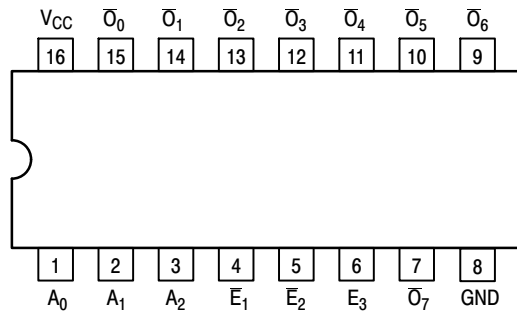


Figure 1. Pinout: 16-Lead Packages Conductors (Top View)

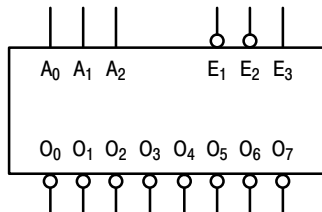
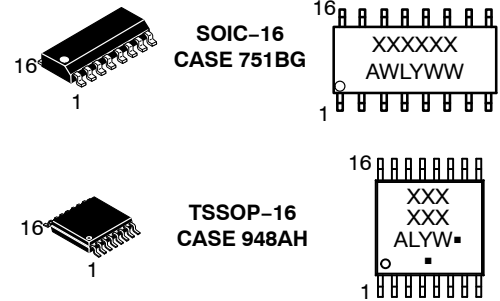


Figure 2. Logic Symbol

### 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

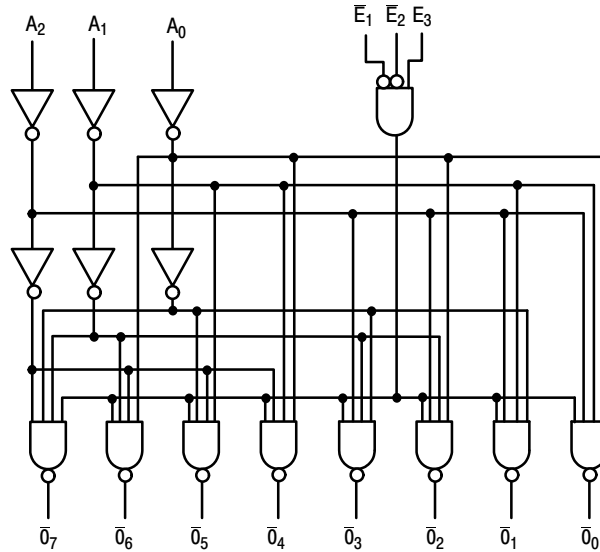
X = Immaterial

## 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

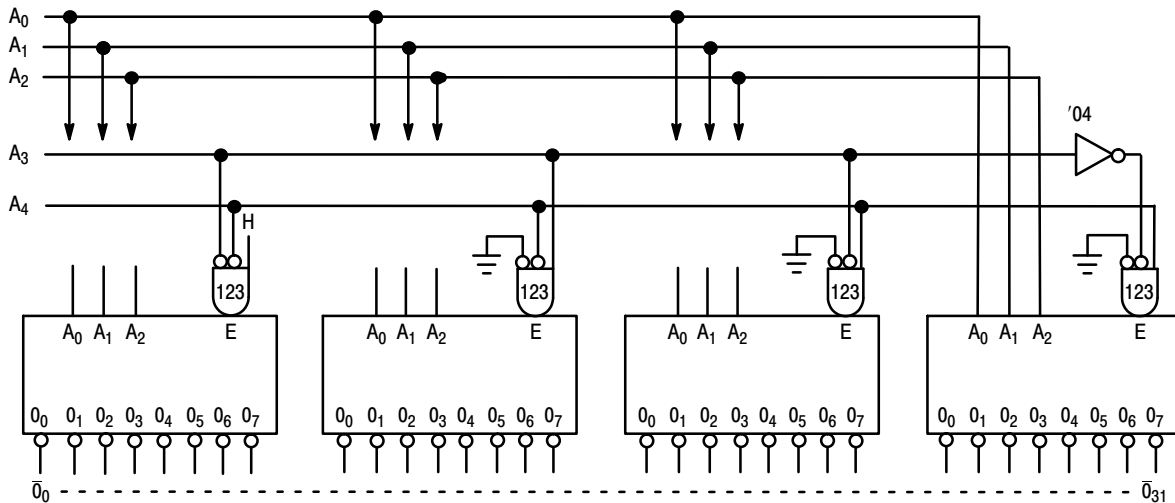


Figure 4. Expansion to 1-of-32 Decoding

## 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<br>$V_I = -0.5\text{ V}$<br>$V_I = V_{CC} + 0.5\text{ V}$  | -20<br>+20             | mA                 |
| $V_I$                 | DC Input Voltage  | -0.5 to $V_{CC} + 0.5$ | V                  |
| $I_{OK}$              | DC Output Diode Current<br>$V_O = -0.5\text{ V}$<br>$V_O = V_{CC} + 0.5\text{ V}$ | -20<br>+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<br>AC<br>ACT  | 2.0<br>4.5 | 6.0<br>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:<br>$V_{IN}$ 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:<br>$V_{IN}$ 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><br>(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><br>(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)<br>(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<br>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<br>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<br>$\bar{E}_1$ 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<br>$\bar{E}_1$ 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<br>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<br>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)<br>(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<br>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<br>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<br>$\bar{E}_1$ 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<br>$\bar{E}_1$ 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<br>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<br>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

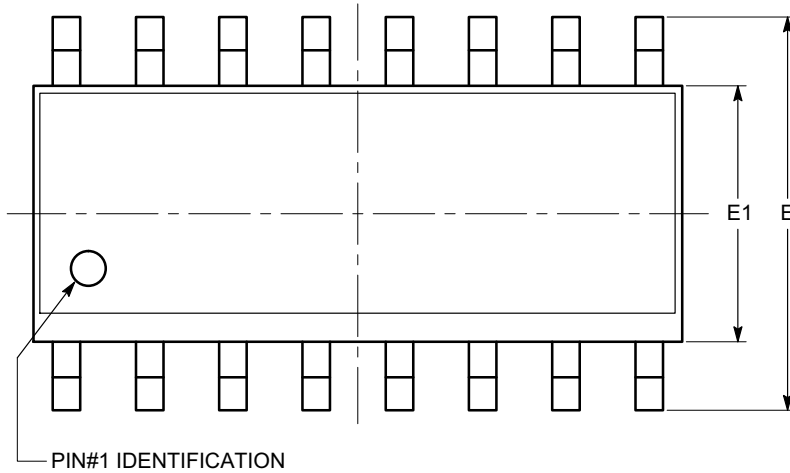
| Device      | Marking   | Package  | Shipping†          |
|-------------|-----------|----------|--------------------|
| 74AC138MTCX | AC<br>138 | TSSOP-16 | 96 Units / Rail    |
| 74AC138SC   | AC138     | SOIC-16  | 48 Units / Rail    |
| 74AC138SCX  | AC138     | SOIC-16  | 2500 / Tape & Reel |
| 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.



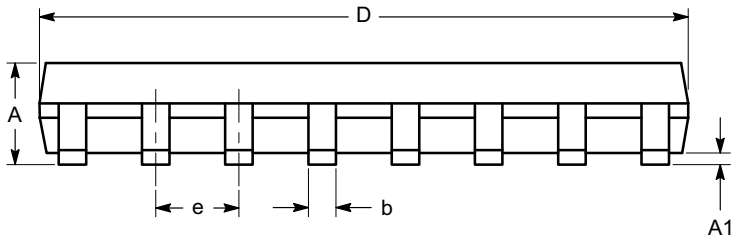
**SOIC-16, 150 mils**  
**CASE 751BG**  
**ISSUE O**

DATE 19 DEC 2008

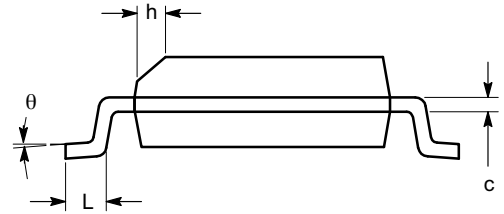


| SYMBOL   | MIN      | NOM  | MAX   |
|----------|----------|------|-------|
| A        | 1.35     |      | 1.75  |
| A1       | 0.10     |      | 0.25  |
| b        | 0.33     |      | 0.51  |
| c        | 0.19     |      | 0.25  |
| D        | 9.80     | 9.90 | 10.00 |
| E        | 5.80     | 6.00 | 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:**

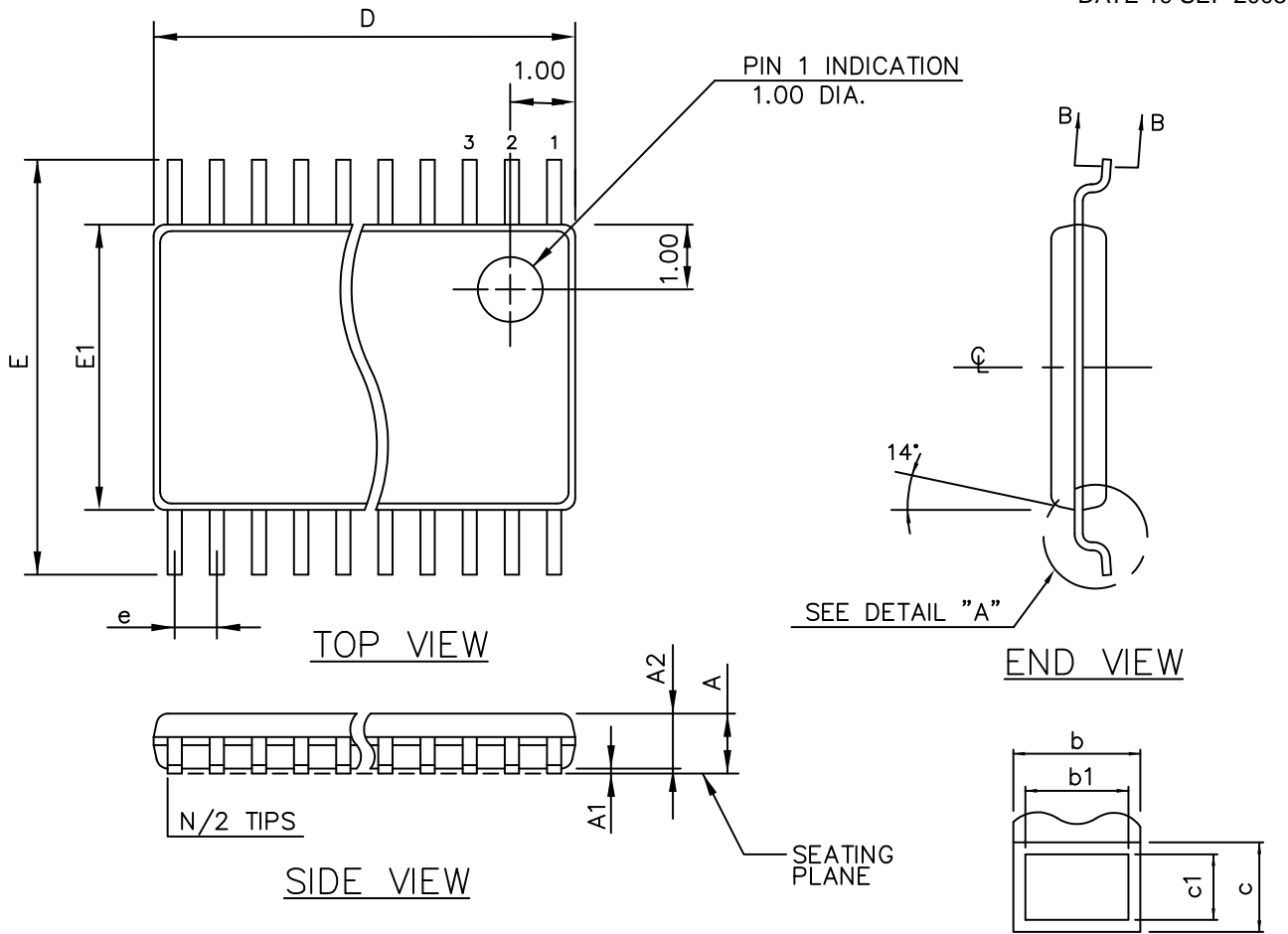
- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MS-012.

|                         |                          |   |
|-------------------------|--------------------------|---|
| <b>DOCUMENT NUMBER:</b> | <b>98AON34275E</b>       | Electronic versions are uncontrolled except when accessed directly from the Document Repository.<br>Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| <b>DESCRIPTION:</b>     | <b>SOIC-16, 150 mils</b> | <b>PAGE 1 OF 1</b>  |

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**TSSOP 16**  
**CASE 948AH**  
**ISSUE O**

DATE 19 SEP 2008



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 |
| b1             | 0.19              | 0.22  | 0.25 |                 |          |    |
| c              | 0.09              | —     | 0.20 |                 |          |    |
| c1             | 0.09              | 0.127 | 0.16 |                 |          |    |
| D              | SEE VARIATIONS    |       |      |                 |          |    |
| E1             | 4.30              | 4.40  | 4.50 |                 |          |    |
| e              | 0.65 BSC          |       |      |                 |          |    |
| E              | 6.40 BSC          |       |      |                 |          |    |
| L              | 0.50              | 0.60  | 0.70 |                 |          |    |
| L1             | 1.00 REF          |       |      |                 |          |    |
| N              | SEE VARIATIONS    |       |      |                 |          |    |
| X              | 0°                | —     | 8°   |                 |          |    |

ALL DIMENSIONS IN MILLIMETERS

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

|                         |                    |   |
|-------------------------|--------------------|---|
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| <b>DESCRIPTION:</b>     | <b>TSSOP 16</b>    | <b>PAGE 1 OF 1</b>  |

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