

## 74AC139 • 74ACT139 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.

### Features

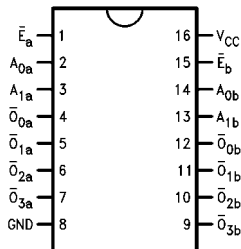
- $I_{CC}$  reduced by 50%
- Multifunction capability
- Two completely independent 1-of-4 decoders
- Active LOW mutually exclusive outputs
- Outputs source/sink 24 mA
- ACT139 has TTL-compatible inputs

### Ordering Code:

| Order Number | Package Number | Package Description   |
|--------------|----------------|---|
| 74AC139SC    | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body |
| 74AC139SJ    | M16D           | 16-Lead Small Outline Package (SOIC), EIAJ Type II, 5.3mm Wide                    |
| 74AC139MTC   | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide       |
| 74AC139PC    | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide            |
| 74ACT139SC   | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body |
| 74ACT139SJ   | M16D           | 16-Lead Small Outline Package (SOIC), EIAJ Type II, 5.3mm Wide                    |
| 74ACT139MTC  | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide       |
| 74ACT139PC   | N16E           | 16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide            |

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

### Connection Diagram

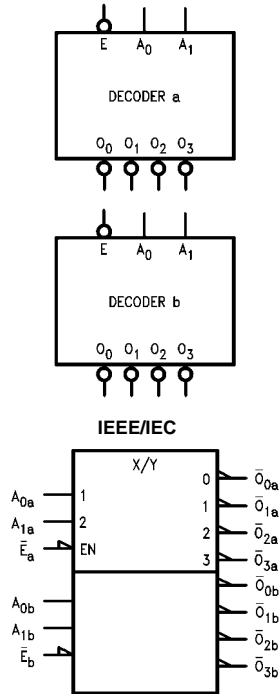


### Pin Descriptions

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

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### Logic Symbols



### 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 Figure 1, and thereby reducing the number of packages required in a logic network.

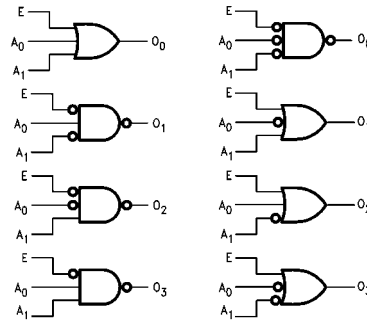


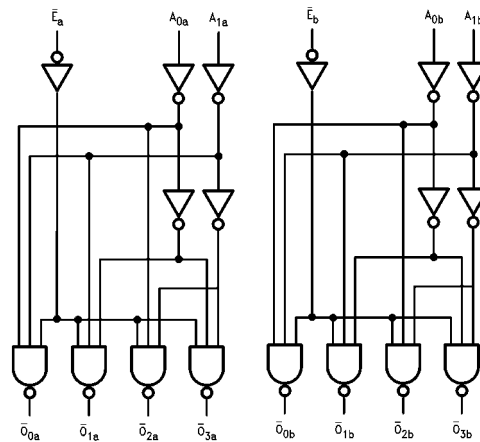
FIGURE 1. Gate Functions (Each Half)

### 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)

|   |                          |
|---|--------------------------|
| 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<br>or Sink Current ( $I_O$ )                             | $\pm 50$ mA              |
| DC $V_{CC}$ or Ground Current<br>per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | $\pm 50$ mA              |
| Storage Temperature ( $T_{STG}$ )   | -65°C to +150°C          |
| Junction Temperature ( $T_J$ )  |                          |
| PDIP  | 140°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 ( $T_A$ )                 | -40°C to +85°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, with-out exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of FACT™ circuits outside databook specifications.

**DC Electrical Characteristics for AC**

| Symbol               | Parameter                                  | $V_{CC}$<br>(V) | $T_A = +25^\circ\text{C}$ |                   | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ |                   | Units   | Conditions  |
|----------------------|--|-----------------|---------------------------|-------------------|---|-------------------|---------|---|
|                      |  |                 | Typ                       | Guaranteed Limits | Typ   | Guaranteed Limits |         |   |
| $V_{IH}$             | Minimum HIGH Level<br>Input Voltage        | 3.0             | 1.5                       | 2.1               | 2.1   |                   | V       | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$  |
|                      |  | 4.5             | 2.25                      | 3.15              | 3.15  |                   |         |   |
|                      |  | 5.5             | 2.75                      | 3.85              | 3.85  |                   |         |   |
| $V_{IL}$             | Maximum LOW Level<br>Input Voltage         | 3.0             | 1.5                       | 0.9               | 0.9   |                   | V       | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$  |
|                      |  | 4.5             | 2.25                      | 1.35              | 1.35  |                   |         |   |
|                      |  | 5.5             | 2.75                      | 1.65              | 1.65  |                   |         |   |
| $V_{OH}$             | Minimum HIGH Level<br>Output Voltage       | 3.0             | 2.99                      | 2.9               | 2.9   |                   | V       | $I_{OUT} = -50 \mu A$   |
|                      |  | 4.5             | 4.49                      | 4.4               | 4.4   |                   |         |   |
|                      |  | 5.5             | 5.49                      | 5.4               | 5.4   |                   |         |   |
|                      |  |                 | 3.0                       |                   | 2.56  | 2.46              | V       | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OH} = -12$ mA<br>$I_{OH} = -24$ mA<br>$I_{OH} = -24$ mA (Note 2) |
|                      |  |                 | 4.5                       |                   | 3.86  | 3.76              |         |   |
|                      |  |                 | 5.5                       |                   | 4.86  | 4.76              |         |   |
| $V_{OL}$             | Maximum LOW Level<br>Output Voltage        | 3.0             | 0.002                     | 0.1               | 0.1   |                   | V       | $I_{OUT} = 50 \mu A$  |
|                      |  | 4.5             | 0.001                     | 0.1               | 0.1   |                   |         |   |
|                      |  | 5.5             | 0.001                     | 0.1               | 0.1   |                   |         |   |
|                      |  |                 | 3.0                       |                   | 0.36  | 0.44              | V       | $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OL} = 12$ mA<br>$I_{OL} = 24$ mA<br>$I_{OL} = 24$ mA (Note 2)    |
|                      |  |                 | 4.5                       |                   | 0.36  | 0.44              |         |   |
|                      |  |                 | 5.5                       |                   | 0.36  | 0.44              |         |   |
| $I_{IN}$<br>(Note 4) | Maximum Input<br>Leakage Current           | 5.5             |                           | $\pm 0.1$         | $\pm 1.0$                                       |                   | $\mu A$ | $V_I = V_{CC}, GND$   |
| $I_{OLD}$            | Minimum Dynamic<br>Output Current (Note 3) | 5.5             |                           |                   | 75  |                   | mA      | $V_{OLD} = 1.65V$ Max   |
| $I_{OHD}$            | Output Current (Note 3)                    | 5.5             |                           |                   | -75   |                   | mA      | $V_{OHD} = 3.85V$ Min   |
| $I_{CC}$<br>(Note 4) | Maximum Quiescent<br>Supply Current        | 5.5             |                           | 4.0               | 40.0  |                   | $\mu A$ | $V_{IN} = V_{CC}$ 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:**  $I_{IN}$  and  $I_{CC}$  @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V  $V_{CC}$ .

## DC Electrical Characteristics for ACT

| Symbol           | Parameter                                  | V <sub>CC</sub><br>(V) | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -40°C to +85°C |    | Units   | Conditions |
|------------------|--|------------------------|------------------------|-------------------|---------------------------------|----|---|------------|
|                  |  |                        | Typ                    | Guaranteed Limits |                                 |    |   |            |
| V <sub>IH</sub>  | Minimum HIGH Level<br>Input Voltage        | 4.5                    | 1.5                    | 2.0               | 2.0                             | V  | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> - 0.1V  |            |
|                  |  | 5.5                    | 1.5                    | 2.0               | 2.0                             |    |   |            |
| V <sub>IL</sub>  | Maximum LOW Level<br>Input Voltage         | 4.5                    | 1.5                    | 0.8               | 0.8                             | V  | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> - 0.1V  |            |
|                  |  | 5.5                    | 1.5                    | 0.8               | 0.8                             |    |   |            |
| V <sub>OH</sub>  | Minimum HIGH Level<br>Output Voltage       | 4.5                    | 4.49                   | 4.4               | 4.4                             | V  | I <sub>OUT</sub> = -50 μA   |            |
|                  |  | 5.5                    | 5.49                   | 5.4               | 5.4                             |    |   |            |
|                  |  | 4.5                    |                        | 3.86              | 3.76                            | V  | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OH</sub> = -24 mA<br>I <sub>OH</sub> = -24 mA (Note 5) |            |
|                  |  | 5.5                    |                        | 4.86              | 4.76                            |    |   |            |
| V <sub>OL</sub>  | Maximum LOW Level<br>Output Voltage        | 4.5                    | 0.001                  | 0.1               | 0.1                             | V  | I <sub>OUT</sub> = 50 μA  |            |
|                  |  | 5.5                    | 0.001                  | 0.1               | 0.1                             |    |   |            |
|                  |  | 4.5                    |                        | 0.36              | 0.44                            | V  | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 24 mA (Note 5)   |            |
|                  |  | 5.5                    |                        | 0.36              | 0.44                            |    |   |            |
| I <sub>IN</sub>  | Maximum Input<br>Leakage Current           | 5.5                    |                        | ±0.1              | ±1.0                            | μA | V <sub>I</sub> = V <sub>CC</sub> , GND  |            |
| I <sub>CCT</sub> | Maximum<br>I <sub>CC</sub> /Input          | 5.5                    | 0.6                    |                   | 1.5                             | mA | V <sub>I</sub> = V <sub>CC</sub> - 2.1V   |            |
| I <sub>OLD</sub> | Minimum Dynamic<br>Output Current (Note 6) | 5.5                    |                        |                   | 75                              | mA | V <sub>OLD</sub> = 1.65V Max  |            |
| I <sub>OHD</sub> | Output Current (Note 6)                    | 5.5                    |                        |                   | -75                             | mA | V <sub>OHD</sub> = 3.85V Min  |            |
| I <sub>CC</sub>  | Maximum Quiescent<br>Supply Current        | 5.5                    |                        | 4.0               | 40.0                            | μA | V <sub>IN</sub> = V <sub>CC</sub><br>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.

## AC Electrical Characteristics for AC

| Symbol           | Parameter   | V <sub>CC</sub><br>(V)<br>(Note 7) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |      | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Units |
|------------------|---|------------------------------------|--|-----|------|---|------|-------|
|                  |   |                                    | Min  | Typ | Max  | Min   | Max  |       |
| t <sub>PLH</sub> | Propagation Delay<br>A <sub>n</sub> to $\overline{O}_n$   | 3.3                                | 4.0  | 8.0 | 11.5 | 3.5   | 13.0 | ns    |
|                  |   | 5.0                                | 3.0  | 6.5 | 8.5  | 2.5   | 9.5  |       |
| t <sub>PHL</sub> | Propagation Delay<br>A <sub>n</sub> to $\overline{O}_n$   | 3.3                                | 3.0  | 7.0 | 10.0 | 2.5   | 11.0 | ns    |
|                  |   | 5.0                                | 2.5  | 5.5 | 7.5  | 2.0   | 8.5  |       |
| t <sub>PLH</sub> | Propagation Delay<br>$\overline{E}_n$ to $\overline{O}_n$ | 3.3                                | 4.5  | 9.5 | 12.0 | 3.5   | 13.0 | ns    |
|                  |   | 5.0                                | 3.5  | 7.0 | 8.5  | 3.0   | 10.0 |       |
| t <sub>PHL</sub> | Propagation Delay<br>$\overline{E}_n$ to $\overline{O}_n$ | 3.3                                | 4.0  | 8.0 | 10.0 | 3.0   | 11.0 | ns    |
|                  |   | 5.0                                | 2.5  | 6.0 | 7.5  | 2.5   | 8.5  |       |

**Note 7:** Voltage Range 3.3 is 3.3V ± 0.3V.

Voltage Range 5.0 is 5.0V ± 0.5V

### AC Electrical Characteristics for ACT

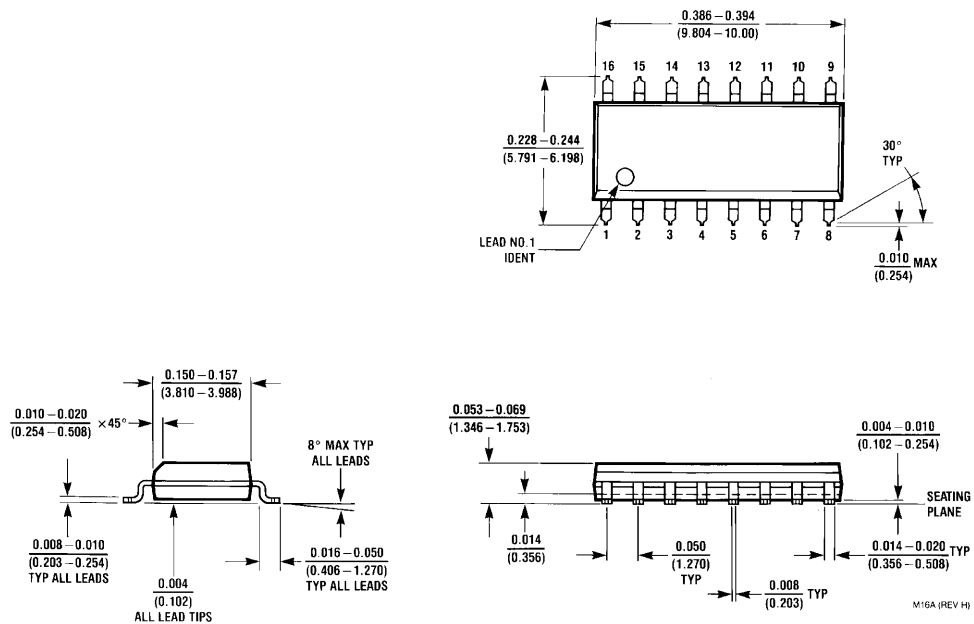
| Symbol           | Parameter   | V <sub>CC</sub><br>(V)<br>(Note 8) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |      | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |      | Units |
|------------------|---|------------------------------------|--|-----|------|---|------|-------|
|                  |   |                                    | Min  | Typ | Max  | Min   | Max  |       |
| t <sub>PLH</sub> | Propagation Delay<br>A <sub>n</sub> to $\overline{O}_n$   | 5.0                                | 1.5  | 6.0 | 8.5  | 1.5   | 9.5  | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>A <sub>n</sub> to $\overline{O}_n$   | 5.0                                | 1.5  | 6.0 | 9.5  | 1.5   | 10.5 | ns    |
| t <sub>PLH</sub> | Propagation Delay<br>$\overline{E}_n$ to $\overline{O}_n$ | 5.0                                | 2.5  | 7.0 | 10.0 | 2.0   | 11.0 | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>$\overline{E}_n$ to $\overline{O}_n$ | 5.0                                | 2.0  | 7.0 | 9.5  | 1.5   | 10.5 | ns    |

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

### Capacitance

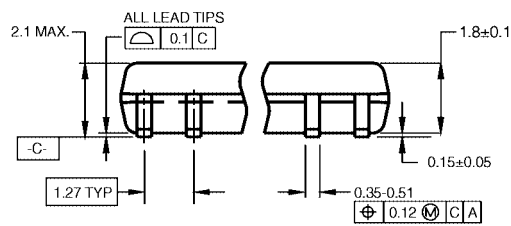
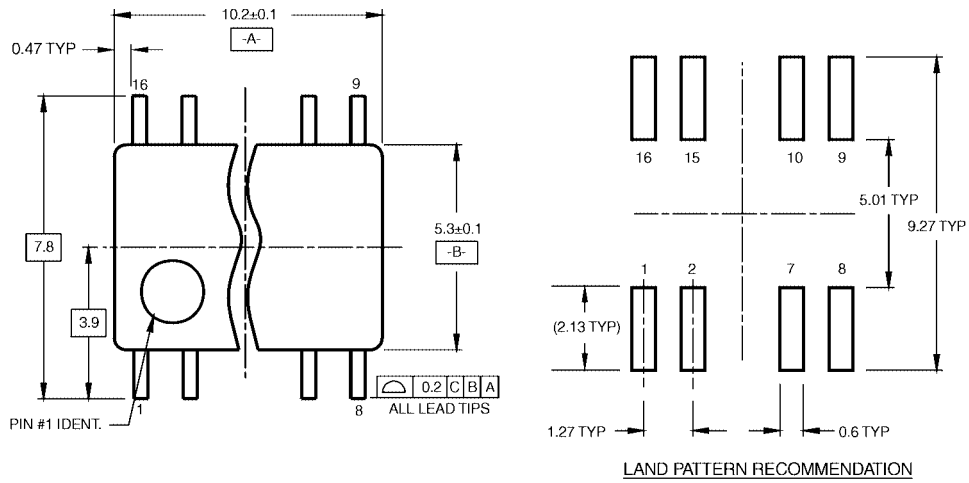
| Symbol          | Parameter                     | Typ  | Units | Conditions             |
|-----------------|-------------------------------|------|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance             | 4.5  | pF    | V <sub>CC</sub> = OPEN |
| C <sub>PD</sub> | Power Dissipation Capacitance | 40.0 | pF    | V <sub>CC</sub> = 5.0V |

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



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body  
Package Number M16A**

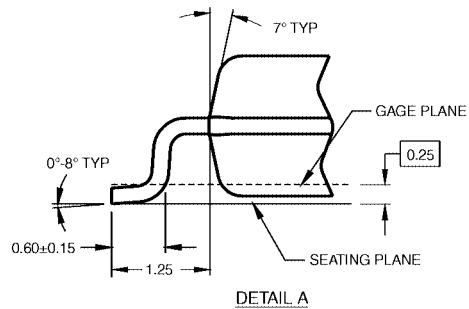
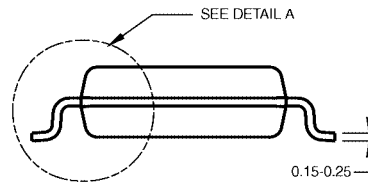
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

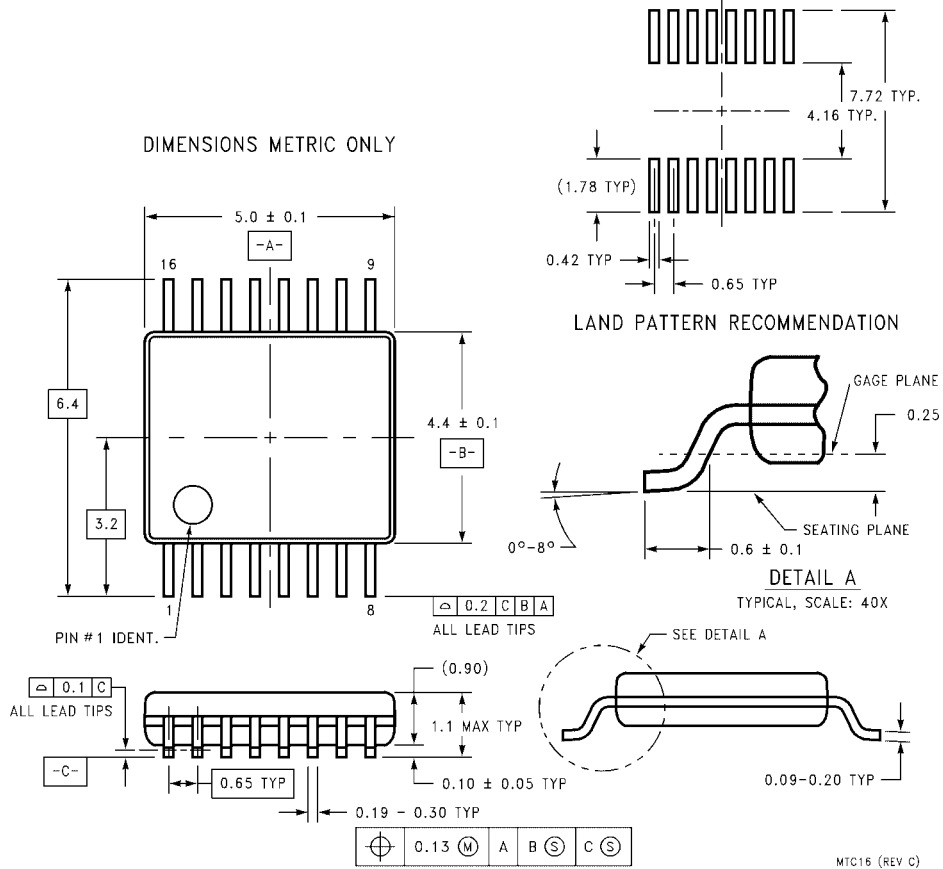
- NOTES:  
 A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.  
 B. DIMENSIONS ARE IN MILLIMETERS.  
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1



**16-Lead Small Outline Package (SOP), EIAJ Type II, 5.3mm Wide  
 Package Number M16D**

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

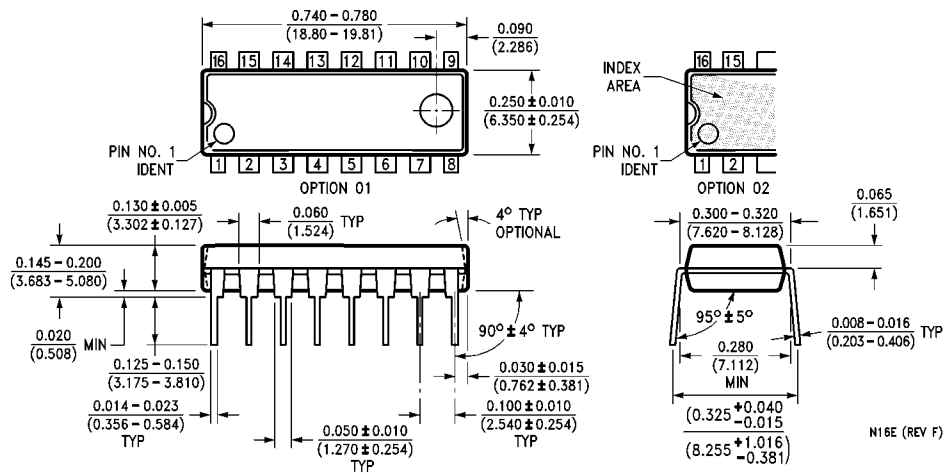


**16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC16**

MTC16 (REV C)



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



**16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E**

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