



November 1988  
Revised August 2000

## 74AC109 • 74ACT109 Dual JK Positive Edge-Triggered Flip-Flop

### General Description

The AC/ACT109 consists of two high-speed completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D-Type flip-flop (refer to AC/ACT74 data sheet) by connecting the J and K inputs together.

Asynchronous Inputs:

- LOW input to  $\overline{S}_D$  (Set) sets Q to HIGH level
- LOW input to  $\overline{C}_D$  (Clear) sets Q to LOW level
- Clear and Set are independent of clock
- Simultaneous LOW on  $\overline{C}_D$  and  $\overline{S}_D$  makes both Q and  $\overline{Q}$  HIGH

### Features

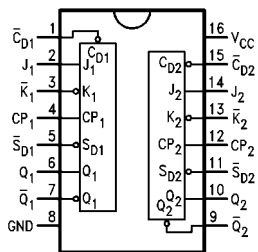
- $I_{CC}$  reduced by 50%
- Outputs source/sink 24 mA
- ACT109 has TTL-compatible inputs

### Ordering Code:

| Order Number | Package Number | Package Description   |
|--------------|----------------|---|
| 74AC109SC    | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow |
| 74AC109SJ    | M16D           | 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide               |
| 74AC109MTC   | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74AC109PC    | N16E           | 16-Lead Plastic Dual-in-Line Package (PDIP), JEDEC MS-001, 0.300" Wide      |
| 74ACT109SC   | M16A           | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow |
| 74ACT109MTC  | MTC16          | 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74ACT109PC   | 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



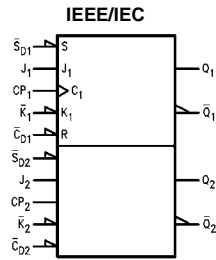
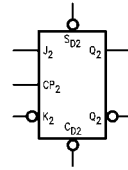
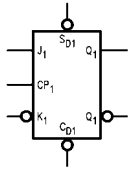
### Pin Descriptions

| Pin Names                                  | Description         |
|--|---------------------|
| $J_1, J_2, \overline{K}_1, \overline{K}_2$ | Data Inputs         |
| $CP_1, CP_2$                               | Clock Pulse Inputs  |
| $\overline{C}_{D1}, \overline{C}_{D2}$     | Direct Clear Inputs |
| $\overline{S}_{D1}, \overline{S}_{D2}$     | Direct Set Inputs   |
| $Q_1, Q_2, \overline{Q}_1, \overline{Q}_2$ | Outputs             |

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### Logic Symbols



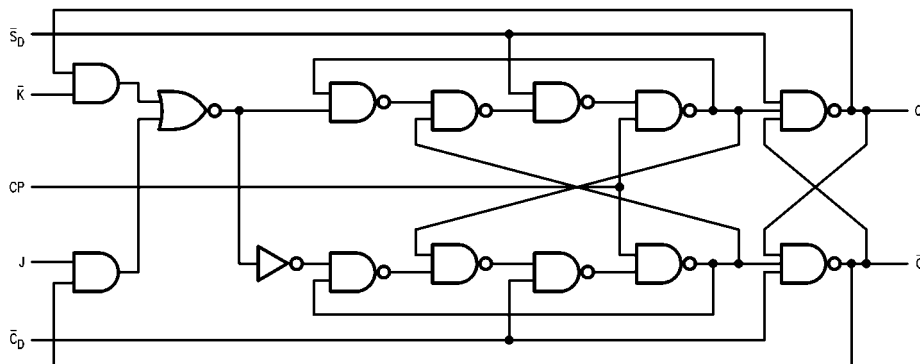
### Truth Table

(each half)

| Inputs      |             |    |   |           | Outputs |             |
|-------------|-------------|----|---|-----------|---------|-------------|
| $\bar{S}_D$ | $\bar{C}_D$ | CP | J | $\bar{K}$ | Q       | $\bar{Q}$   |
| L           | H           | X  | X | X         | H       | L           |
| H           | L           | X  | X | X         | L       | H           |
| L           | L           | X  | X | X         | H       | H           |
| H           | H           | ↗  | L | L         | L       | H           |
| H           | H           | ↗  | H | L         | Toggle  |             |
| H           | H           | ↗  | L | H         | $Q_0$   | $\bar{Q}_0$ |
| H           | H           | ↗  | H | H         | H       | L           |
| H           | H           | L  | X | X         | $Q_0$   | $\bar{Q}_0$ |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 ↗ = LOW-to-HIGH Transition  
 X = Immaterial  
 $Q_0(\bar{Q}_0)$  = Previous  $Q_0(\bar{Q}_0)$  before LOW-to-HIGH Transition of Clock

### Logic Diagram (one half shown)



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   |                    |
|--|--------------------------|--|--------------------|
| Supply Voltage ( $V_{CC}$ )              | -0.5V to +7.0V           | Supply Voltage ( $V_{CC}$ )  | AC<br>2.0V to 6.0V |
| DC Input Diode Current ( $I_{IK}$ )      |                          | ACT<br>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 ( $T_A$ )  | -40°C to +85°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          | <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. Fairchild does not recommend operation of FACT™ circuits outside databook specifications. |                    |
| Junction Temperature ( $T_J$ )           |                          |  |                    |
| PDIP                                     | 140°C                    |  |                    |

| 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 |   |         |  |   |
| $V_{IH}$                             | 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             |                           | $\pm 0.1$         | $\pm 1.0$                                       | $\mu A$ | $V_I = V_{CC}$ ,<br>GND                |   |
| $I_{OLD}$                            | Minimum Dynamic                      | 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             |                           | 2.0               | 20.0  | $\mu A$ | $V_{IN} = V_{CC}$<br>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  $V_{CC}$ .

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| 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 Leakage Current        | 5.5                    |                        | ± 0.1             | ± 1.0                           | μA | FV <sub>I</sub> = V <sub>CC</sub> , GND   |            |
| I <sub>CCT</sub>                      | Maximum 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                      | 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                    |                        | 2.0               | 20.0                            | μA | V <sub>IN</sub> = V <sub>CC</sub> 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.

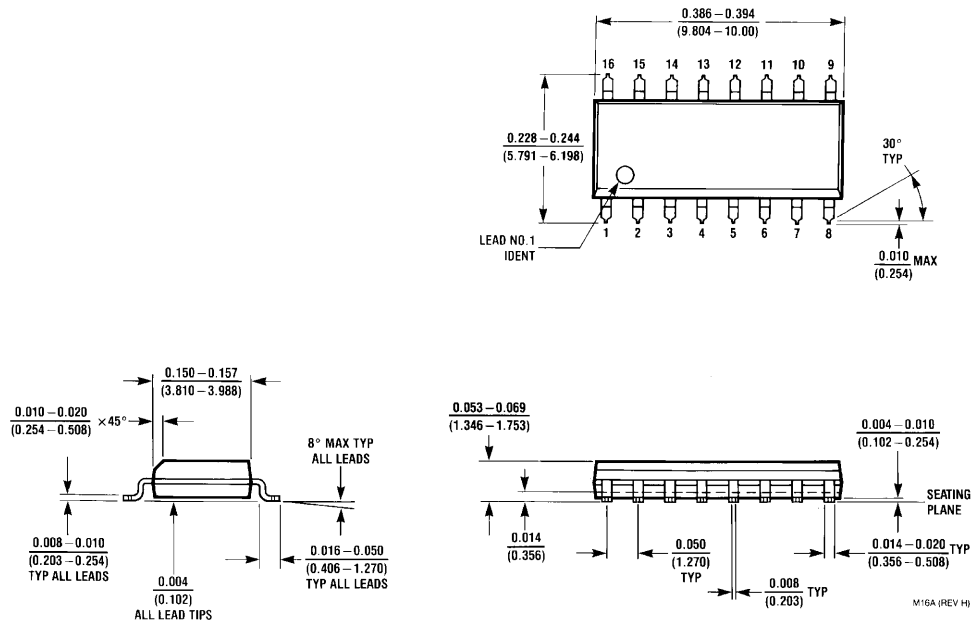
| AC Electrical Characteristics for AC |  |                                    |  |             |              |   |              |       |
|--------------------------------------|--|------------------------------------|--|-------------|--------------|---|--------------|-------|
| Symbol                               | 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          |       |
| f <sub>MAX</sub>                     | Maximum Clock<br>Frequency   | 3.3<br>5.0                         | 125<br>150                                       | 150<br>175  |              | 100<br>125  |              | MHz   |
| t <sub>PLH</sub>                     | Propagation Delay<br>C <sub>Pn</sub> to Q <sub>n</sub> or $\bar{Q}_n$                  | 3.3<br>5.0                         | 4.0<br>2.5                                       | 8.0<br>6.0  | 13.5<br>10.0 | 3.5<br>2.0  | 16.0<br>10.5 | ns    |
| t <sub>PHL</sub>                     | Propagation Delay<br>C <sub>Pn</sub> to Q <sub>n</sub> or $\bar{Q}_n$                  | 3.3<br>5.0                         | 3.0<br>2.0                                       | 8.0<br>6.0  | 14.0<br>10.0 | 3.0<br>1.5  | 14.5<br>10.5 | ns    |
| t <sub>PLH</sub>                     | Propagation Delay<br>$\bar{C}_{Dn}$ or $\bar{S}_{Dn}$ to Q <sub>n</sub> or $\bar{Q}_n$ | 3.3<br>5.0                         | 3.0<br>2.5                                       | 8.0<br>6.0  | 12.0<br>9.0  | 2.5<br>2.0  | 13.0<br>10.0 | ns    |
| t <sub>PHL</sub>                     | Propagation Delay<br>$\bar{C}_{Dn}$ or $\bar{S}_{Dn}$ to Q <sub>n</sub> or $\bar{Q}_n$ | 3.3<br>5.0                         | 3.0<br>2.0                                       | 10.0<br>7.5 | 12.0<br>9.5  | 3.0<br>2.0  | 13.5<br>10.5 | ns    |

**Note 7:** Voltage Range 3.3 is 3.3V ± 0.3V  
Voltage Range 5.0 is 5.0V ± 0.5V

| AC Operating Requirements for AC  |   |                                     |  |                        |   |   |       |       |
|---|---|-------------------------------------|--|------------------------|---|---|-------|-------|
| 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 |       |
|   |   |                                     | Typ  | Guaranteed Minimum     |   |   |       |       |
| t <sub>S</sub>  | Setup Time, HIGH or LOW<br>J <sub>n</sub> or $\overline{K}_n$ to CP <sub>n</sub>                      | 3.3                                 | 3.5  | 6.5                    | 7.5   |   | ns    |       |
|   |   | 5.0                                 | 2.0  | 4.5                    | 5.0   |   |       |       |
| t <sub>H</sub>  | Hold Time, HIGH or LOW<br>J <sub>n</sub> or $\overline{K}_n$ to CP <sub>n</sub>                       | 3.3                                 | -1.5   | 0                      | 0   |   | ns    |       |
|   |   | 5.0                                 | -0.5   | 0.5                    | 0.5   |   |       |       |
| t <sub>W</sub>  | Pulse Width<br>$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$   | 3.3                                 | 2.0  | 7.0                    | 7.5   |   | ns    |       |
|   |   | 5.0                                 | 2.0  | 4.5                    | 5.0   |   |       |       |
| t <sub>REC</sub>  | Recovery Time<br>$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to CP <sub>n</sub>                        | 3.3                                 | -2.5   | 0                      | 0   |   | ns    |       |
|   |   | 5.0                                 | -1.5   | 0                      | 0   |   |       |       |
| <b>Note 8:</b> Voltage Range 3.3 is 3.3V ± 0.3V<br>Voltage Range 5.0 is 5.0V ± 0.5V |   |                                     |  |                        |   |   |       |       |
| AC Electrical Characteristics for ACT   |   |                                     |  |                        |   |   |       |       |
| Symbol  | Parameter   | V <sub>CC</sub><br>(V)<br>(Note 9)  | 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   |       |
| f <sub>MAX</sub>  | Maximum Clock Frequency   | 5.0                                 | 145  | 210                    | 125   |   | MHz   |       |
| t <sub>PLH</sub>  | Propagation Delay<br>CP <sub>n</sub> to Q <sub>n</sub> or $\overline{Q}_n$                            | 5.0                                 | 4.0  | 7.0                    | 11.0  | 3.5   | 13.0  | ns    |
| t <sub>PHL</sub>  | Propagation Delay<br>CP <sub>n</sub> to Q <sub>n</sub> or $\overline{Q}_n$                            | 5.0                                 | 3.0  | 6.0                    | 10.0  | 2.5   | 11.5  | ns    |
| t <sub>PLH</sub>  | Propagation Delay<br>$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q <sub>n</sub> or $\overline{Q}_n$ | 5.0                                 | 2.5  | 5.5                    | 9.5   | 2.0   | 10.5  | ns    |
| t <sub>PHL</sub>  | Propagation Delay<br>$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to Q <sub>n</sub> or $\overline{Q}_n$ | 5.0                                 | 2.5  | 6.0                    | 10.0  | 2.0   | 11.5  | ns    |
| <b>Note 9:</b> Voltage Range 5.0 is 5.0V ± 0.5V                                     |   |                                     |  |                        |   |   |       |       |
| AC Operating Requirements for ACT   |   |                                     |  |                        |   |   |       |       |
| Symbol  | Parameter   | V <sub>CC</sub><br>(V)<br>(Note 10) | 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 |       |
|   |   |                                     | Typ  | Guaranteed Minimum     |   |   |       |       |
| t <sub>S</sub>  | Setup Time, HIGH or LOW<br>J <sub>n</sub> or $\overline{K}_n$ to CP <sub>n</sub>                      | 5.0                                 | 0.5  | 2.0                    | 2.5   |   | ns    |       |
| t <sub>H</sub>  | Hold Time, HIGH or LOW<br>J <sub>n</sub> or $\overline{K}_n$ to CP <sub>n</sub>                       | 5.0                                 | 0  | 2.0                    | 2.0   |   | ns    |       |
| t <sub>W</sub>  | Pulse Width<br>CP <sub>n</sub> or $\overline{C}_{Dn}$ or $\overline{S}_{Dn}$                          | 5.0                                 | 3.0  | 5.0                    | 6.0   |   | ns    |       |
| t <sub>rec</sub>  | Recovery Time<br>$\overline{C}_{Dn}$ or $\overline{S}_{Dn}$ to CP <sub>n</sub>                        | 5.0                                 | -2.5   | 0                      | 0   |   | ns    |       |
| <b>Note 10:</b> 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   | 35.0                                | pF   | V <sub>CC</sub> = 5.0V |   |   |       |       |

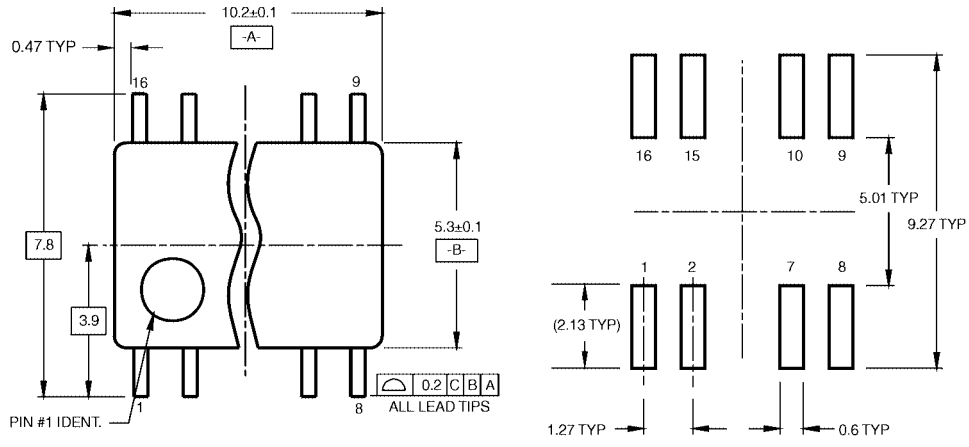
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**Physical Dimensions** inches (millimeters) unless otherwise noted

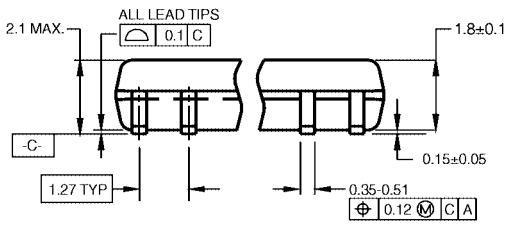


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow  
Package Number M16A**

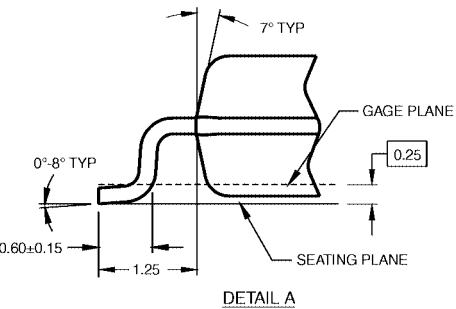
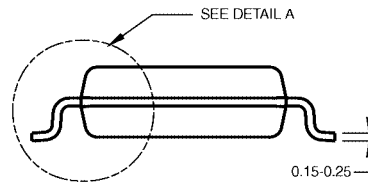
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



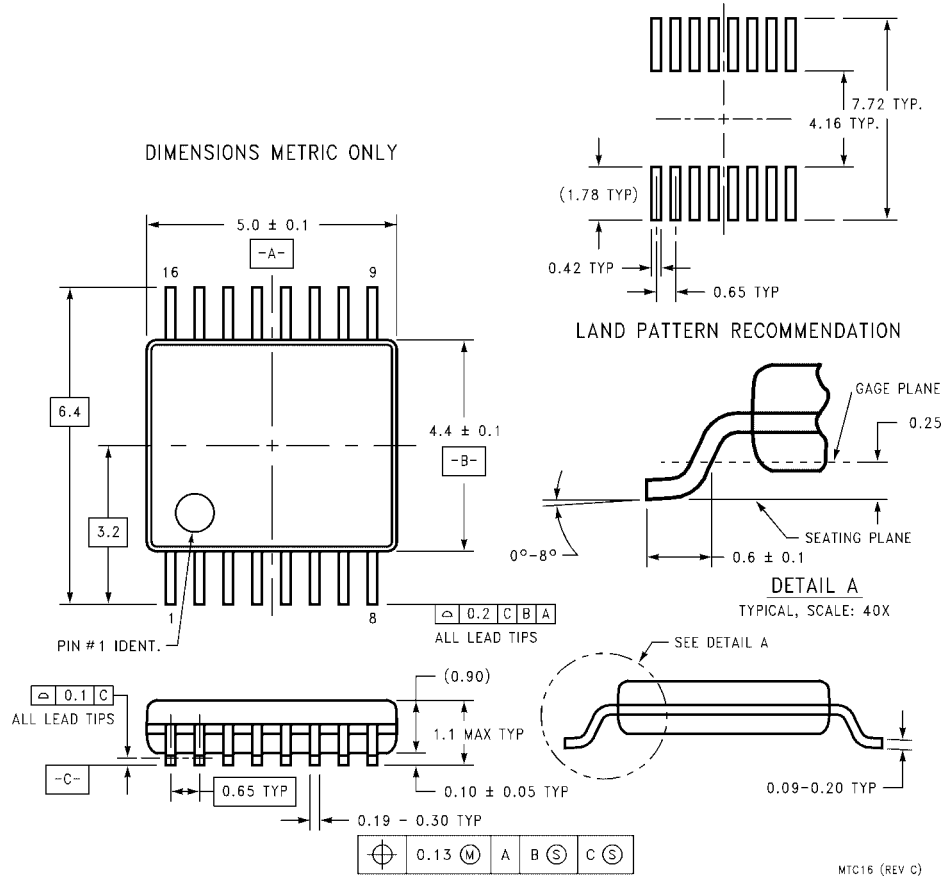
- NOTES:  
 A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.  
 B. DIMENSIONS ARE IN MILLIMETERS.  
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1

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

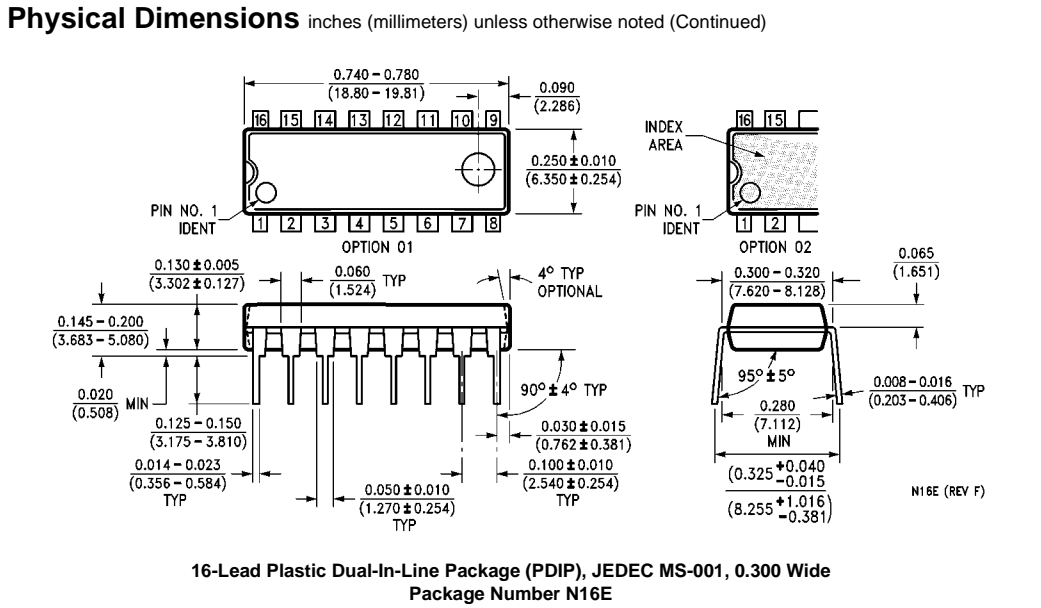
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**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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





Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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