

## 74AC821 • 74ACT821

### 10-Bit D-Type Flip-Flop with 3-STATE Outputs

#### General Description

The AC/ACT821 is a 10-bit D-type flip-flop with 3-STATE outputs arranged in a broadside pinout.

#### Features

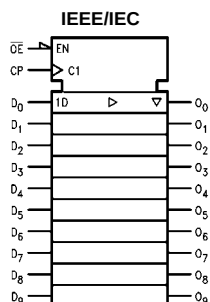
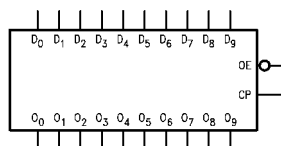
- 3-STATE outputs for bus interfacing
- Noninverting outputs
- Outputs source/sink 24 mA
- TTL compatible inputs

#### Ordering Code:

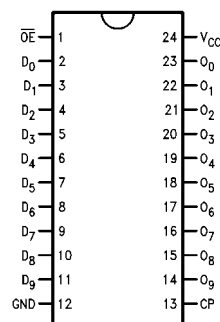
| Order Number | Package Number | Package Description                                                         |
|--------------|----------------|-----------------------------------------------------------------------------|
| 74AC821SC    | M24B           | 24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide   |
| 74AC821SPC   | N24C           | 24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide       |
| 74ACT821SC   | M24B           | 24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide   |
| 74ACT821MTC  | MTC24          | 24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74ACT821SPC  | N24C           | 24-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. (SPC not available in Tape and Reel.)

#### Logic Symbols



#### Connection Diagram



#### Pin Descriptions

| Pin Names                      | Description         |
|--------------------------------|---------------------|
| D <sub>0</sub> –D <sub>9</sub> | Data Inputs         |
| O <sub>0</sub> –O <sub>9</sub> | Data Outputs        |
| $\overline{OE}$                | Output Enable Input |
| CP                             | Clock Input         |

Functional Description

The AC/ACT821 consists of ten D-type edge-triggered flip-flops. The buffered Clock (CP) and buffered Output Enable ( $\overline{OE}$ ) are common to all flip-flops. The flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH CP transition.

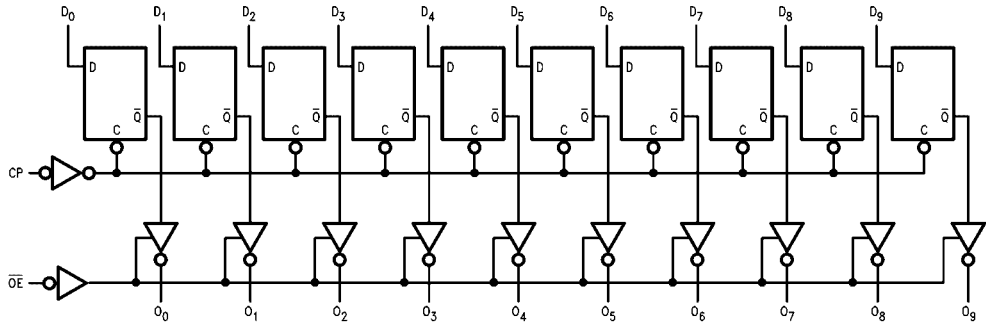
With  $\overline{OE}$  LOW the contents of the flip-flops are available at the outputs. When  $\overline{OE}$  is HIGH the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

Function Table

| Inputs          |    |   | Internal | Outputs | Function |
|-----------------|----|---|----------|---------|----------|
| $\overline{OE}$ | CP | D | Q        | O       |          |
| H               | ↗  | L | L        | Z       | High Z   |
| H               | ↗  | H | H        | Z       | High Z   |
| L               | ↗  | L | L        | L       | Load     |
| L               | ↗  | H | H        | H       | Load     |

H = HIGH Voltage Level  
L = LOW Voltage Level  
Z = HIGH Impedance  
↗ = LOW-to-HIGH Clock Transition

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                         |                           |
| or Sink Current ( $I_O$ )                | $\pm 50$ mA               |
| DC $V_{CC}$ or Ground Current            |                           |
| 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, 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.

**DC Electrical Characteristics for AC**

| 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  | 3.0                    | 1.5                    | 2.1               | 2.1                             |  | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> − 0.1V                                                                                                 |
|                          |                                      | 4.5                    | 2.25                   | 3.15              | 3.15                            |  |       |                                                                                                                                                      |
|                          |                                      | 5.5                    | 2.75                   | 3.85              | 3.85                            |  |       |                                                                                                                                                      |
| V <sub>IL</sub>          | Maximum LOW Level<br>Input Voltage   | 3.0                    | 1.5                    | 0.9               | 0.9                             |  | V     | V <sub>OUT</sub> = 0.1V<br>or V <sub>CC</sub> − 0.1V                                                                                                 |
|                          |                                      | 4.5                    | 2.25                   | 1.35              | 1.35                            |  |       |                                                                                                                                                      |
|                          |                                      | 5.5                    | 2.75                   | 1.65              | 1.65                            |  |       |                                                                                                                                                      |
| V <sub>OH</sub>          | Minimum HIGH Level<br>Output Voltage | 3.0                    | 2.99                   | 2.9               | 2.9                             |  | V     | I <sub>OUT</sub> = − 50 μA                                                                                                                           |
|                          |                                      | 4.5                    | 4.49                   | 4.4               | 4.4                             |  |       |                                                                                                                                                      |
|                          |                                      | 5.5                    | 5.49                   | 5.4               | 5.4                             |  |       |                                                                                                                                                      |
|                          |                                      | 3.0                    |                        | 2.56              | 2.46                            |  | V     | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OH</sub> = − 12 mA<br>I <sub>OH</sub> = − 24 mA<br>I <sub>OH</sub> = − 24 mA (Note 2) |
|                          |                                      | 4.5                    |                        | 3.86              | 3.76                            |  |       |                                                                                                                                                      |
|                          |                                      | 5.5                    |                        | 4.86              | 4.76                            |  |       |                                                                                                                                                      |
|                          |                                      |                        |                        |                   |                                 |  |       |                                                                                                                                                      |
| V <sub>OL</sub>          | Maximum LOW Level<br>Output Voltage  | 3.0                    | 0.002                  | 0.1               | 0.1                             |  | V     | I <sub>OUT</sub> = 50 μA                                                                                                                             |
|                          |                                      | 4.5                    | 0.001                  | 0.1               | 0.1                             |  |       |                                                                                                                                                      |
|                          |                                      | 5.5                    | 0.001                  | 0.1               | 0.1                             |  |       |                                                                                                                                                      |
|                          |                                      | 3.0                    |                        | 0.36              | 0.44                            |  | V     | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>I <sub>OL</sub> = 12 mA<br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 24 mA (Note 2)       |
|                          |                                      | 4.5                    |                        | 0.36              | 0.44                            |  |       |                                                                                                                                                      |
|                          |                                      | 5.5                    |                        | 0.36              | 0.44                            |  |       |                                                                                                                                                      |
|                          |                                      |                        |                        |                   |                                 |  |       |                                                                                                                                                      |
| I <sub>IN</sub> (Note 4) | Maximum Input Leakage Current        | 5.5                    |                        | ± 0.1             | ± 1.0                           |  | μA    | V <sub>I</sub> = V <sub>CC</sub> , GND                                                                                                               |
| I <sub>OZ</sub>          | Maximum 3-STATE Current              | 5.5                    |                        | ±0.5              | ±5.0                            |  | μA    | V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub><br>V <sub>I</sub> = V <sub>CC</sub> , GND<br>V <sub>O</sub> = V <sub>CC</sub> , GND          |
| I <sub>OLD</sub>         | Minimum Dynamic                      | 5.5                    |                        |                   | 75                              |  | mA    | V <sub>OLD</sub> = 1.65V Max                                                                                                                         |
| I <sub>OHD</sub>         | Output Current (Note 3)              | 5.5                    |                        |                   | −75                             |  | mA    | V <sub>OHD</sub> = 3.85V Min                                                                                                                         |
| I <sub>CC</sub> (Note 4) | Maximum Quiescent Supply Current     | 5.5                    |                        | 8.0               | 80.0                            |  | μA    | V <sub>IN</sub> = V <sub>CC</sub> 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><br>(Note 4) | Maximum Input<br>Leakage Current     | 5.5                    |                        | ±0.1              | ±1.0                            |  | μA    | V <sub>I</sub> = V <sub>CC</sub> , GND                                                                                  |
| I <sub>OZ</sub>             | Maximum 3-STATE<br>Current           | 5.5                    |                        | ±0.5              | ±5.0                            |  | μA    | V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub><br>V <sub>O</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                      | 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                    |                        | 8.0               | 80.0                            |  | 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          |       |
| f <sub>MAX</sub> | Maximum Clock<br>Frequency                  | 3.3<br>5.0                         | 110<br>120                                       | 145<br>160 |             | 100<br>110                                                |              | MHz   |
| t <sub>PLH</sub> | Propagation Delay<br>CP to O <sub>n</sub>   | 3.3<br>5.0                         | 3.0<br>2.0                                       | 8.0<br>6.0 | 13.0<br>9.5 | 3.0<br>2.0                                                | 15.0<br>10.5 | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>CP to O <sub>n</sub>   | 3.3<br>5.0                         | 3.0<br>2.0                                       | 8.0<br>5.5 | 13.0<br>9.5 | 3.0<br>2.0                                                | 15.0<br>10.5 | ns    |
| t <sub>PZH</sub> | Output Enable Time<br>OE to O <sub>n</sub>  | 3.3<br>5.0                         | 2.5<br>1.5                                       | 6.0<br>4.5 | 11.0<br>8.0 | 2.5<br>1.5                                                | 12.0<br>9.0  | ns    |
| t <sub>PZL</sub> | Output Enable Time<br>OE to O <sub>n</sub>  | 3.3<br>5.0                         | 2.5<br>1.5                                       | 6.5<br>5.0 | 11.0<br>8.0 | 2.5<br>1.5                                                | 12.0<br>9.0  | ns    |
| t <sub>PHZ</sub> | Output Disable Time<br>OE to O <sub>n</sub> | 3.3<br>5.0                         | 2.5<br>1.5                                       | 6.5<br>5.0 | 10.5<br>8.0 | 2.5<br>1.5                                                | 11.0<br>8.5  | ns    |
| t <sub>PLZ</sub> | Output Disable Time<br>OE to O <sub>n</sub> | 3.3<br>5.0                         | 2.5<br>1.5                                       | 6.0<br>4.5 | 10.5<br>8.0 | 2.5<br>1.5                                                | 11.0<br>8.5  | 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 | 3.3                                | -1.0                                             | 1.5                | 1.5                                                       | ns    |
|                | D <sub>n</sub> to CP    | 5.0                                | -1.0                                             | 1.5                | 1.5                                                       |       |
| t <sub>H</sub> | Hold Time, HIGH or LOW  | 3.3                                | -1.0                                             | 3.5                | 4.0                                                       | ns    |
|                | D <sub>n</sub> to CP    | 5.0                                | -1.0                                             | 3.5                | 4.0                                                       |       |
| t <sub>W</sub> | CP Pulse Width          | 3.3                                | 3.5                                              | 5.0                | 5.5                                                       | ns    |
|                | HIGH or LOW             | 5.0                                | 2.5                                              | 4.0                | 4.0                                                       |       |

**Note 8:** 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 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                                | 120                                              | 150 |      | 110                                                       |      | MHz   |
| t <sub>PLH</sub> | Propagation Delay<br>CP to O <sub>n</sub>   | 5.0                                | 2.0                                              | 6.0 | 9.5  | 1.5                                                       | 10.5 | ns    |
| t <sub>PHL</sub> | Propagation Delay<br>CP to O <sub>n</sub>   | 5.0                                | 2.5                                              | 6.0 | 9.5  | 2.0                                                       | 10.5 | ns    |
| t <sub>PZH</sub> | Output Enable Time<br>OE to O <sub>n</sub>  | 5.0                                | 2.5                                              | 7.0 | 10.5 | 2.0                                                       | 11.5 | ns    |
| t <sub>PZL</sub> | Output Enable Time<br>OE to O <sub>n</sub>  | 5.0                                | 2.5                                              | 7.0 | 10.5 | 2.0                                                       | 12.0 | ns    |
| t <sub>PHZ</sub> | Output Disable Time<br>OE to O <sub>n</sub> | 5.0                                | 1.5                                              | 7.5 | 12.0 | 1.0                                                       | 13.0 | ns    |
| t <sub>PLZ</sub> | Output Disable Time<br>OE to O <sub>n</sub> | 5.0                                | 1.5                                              | 7.0 | 10.5 | 1.0                                                       | 11.5 | ns    |

**Note 9:** Voltage Range 5.0 is 5.0V ± 0.5V

### AC Operating Requirements for ACT

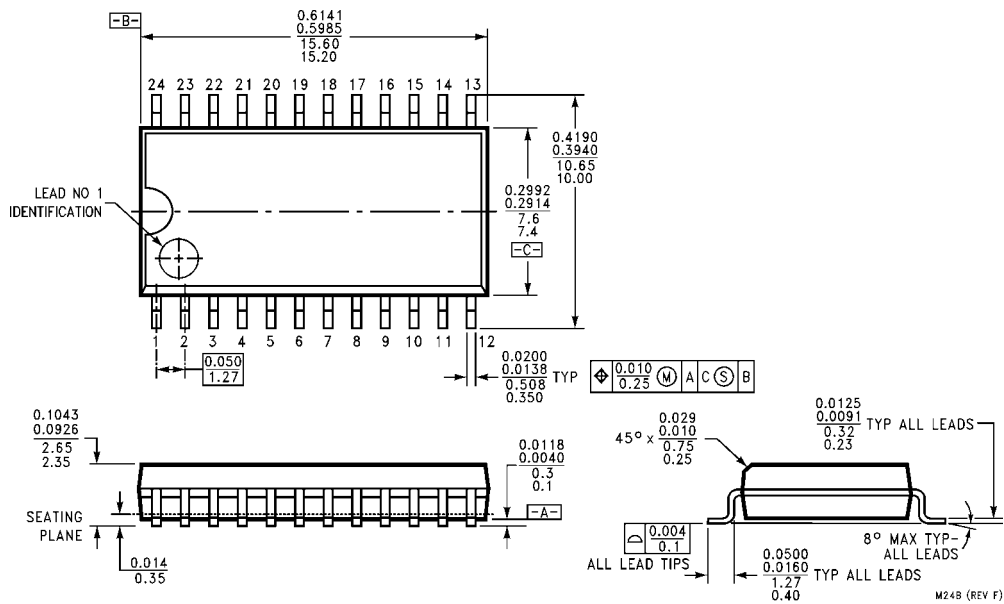
| Symbol         | Parameter                                       | V <sub>CC</sub><br>(V)<br>(Note 10) | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |                    | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF | Units |
|----------------|-------------------------------------------------|-------------------------------------|--------------------------------------------------|--------------------|-----------------------------------------------------------|-------|
|                |                                                 |                                     | Typ                                              | Guaranteed Minimum |                                                           |       |
| t <sub>S</sub> | Setup Time, HIGH or LOW<br>D <sub>n</sub> to CP | 5.0                                 | 2.5                                              | 2.0                | 2.5                                                       | ns    |
| t <sub>H</sub> | Hold Time, HIGH or LOW<br>D <sub>n</sub> to CP  | 5.0                                 | -0.5                                             | 2.0                | 2.5                                                       | ns    |
| t <sub>W</sub> | CP Pulse Width<br>HIGH or LOW                   | 5.0                                 | 3.0                                              | 4.5                | 5.5                                                       | ns    |

**Note 10:** Voltage Range 5.0 is 5.0V ± 0.5V

### Capacitance

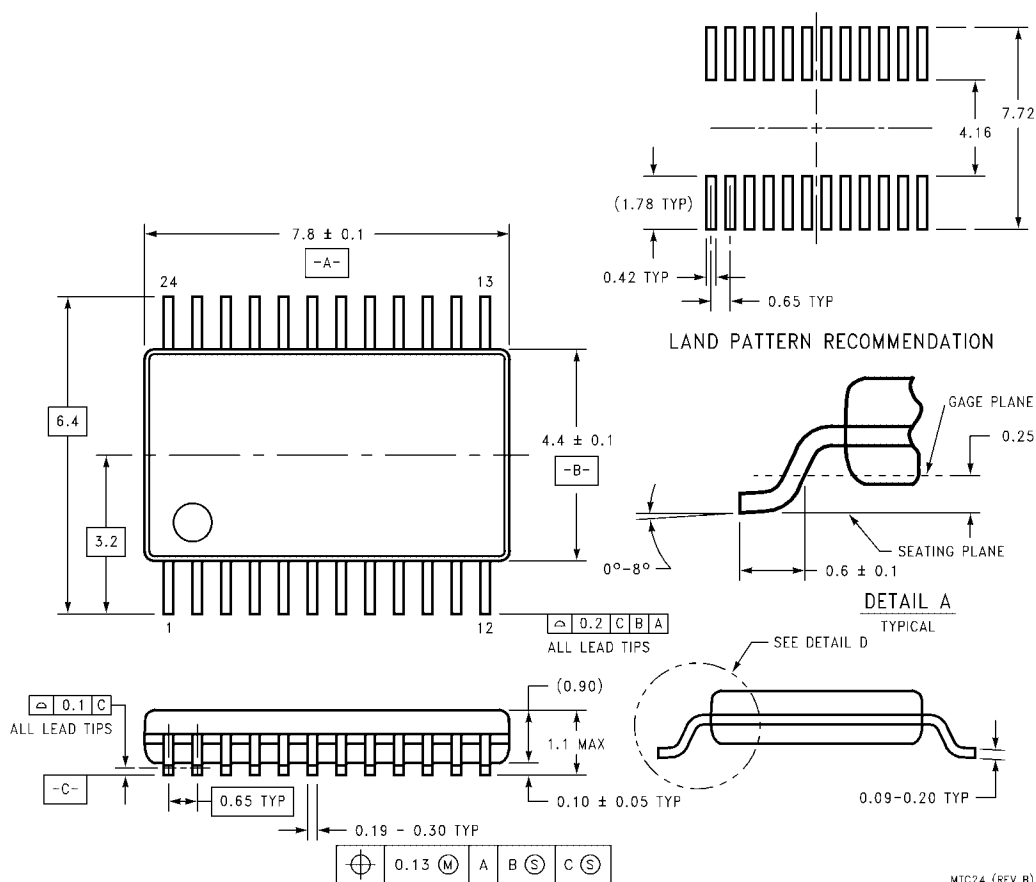
| Symbol          | Parameter                     | Typ  | Units | Conditions             |
|-----------------|-------------------------------|------|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance             | 4.5  | pF    | V <sub>CC</sub> = OPEN |
| C <sub>PD</sub> | Power Dissipation Capacitance | 35.0 | pF    | V <sub>CC</sub> = 5.0V |

# Physical Dimensions inches (millimeters) unless otherwise noted



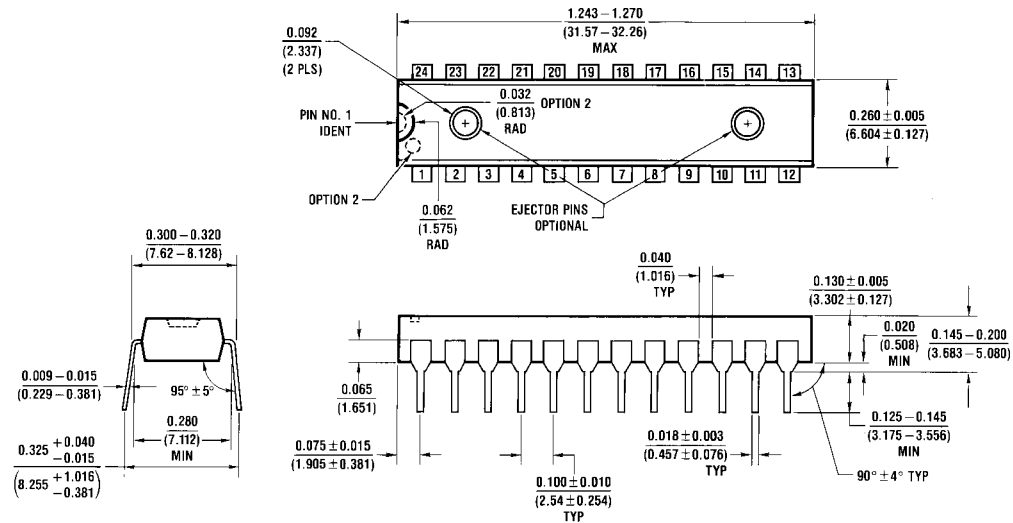
24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide  
Package Number M24B

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



**24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide**  
**Package Number MTC24**

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



N24C (REV F)

24-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide  
Package Number N24C

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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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