

## 54F/74F821 10-Bit D-Type Flip-Flop

### General Description

The 'F821 is a 10-bit D-type flip-flop with TRI-STATE® true outputs arranged in a broadside pinout. The 'F821 is functionally and pin compatible with the AMD's Am29821.

### Features

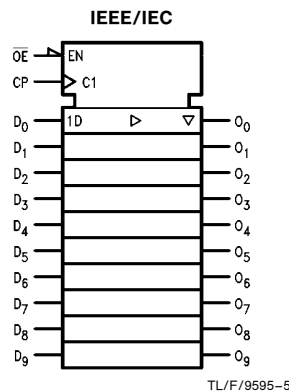
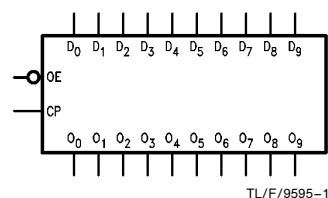
- TRI-STATE Outputs
- Direct replacement for AMD's Am29821

| Commercial        | Military           | Package Number | Package Description                               |
|-------------------|--------------------|----------------|---|
| 74F821SPC         |                    | N24C           | 24-Lead (0.300" Wide) Molded Dual-In-Line         |
|                   | 54F821SDM (Note 2) | J24F           | 24-Lead (0.300" Wide) Ceramic Dual-In-Line        |
| 74F821SC (Note 1) |                    | M24B           | 24-Lead (0.300" Wide) Molded Small Outline, JEDEC |
|                   | 54F821FM (Note 2)  | W24C           | 24-Lead Cerpack                                   |
|                   | 54F821LM (Note 2)  | E28A           | 24-Lead Ceramic Leadless Chip Carrier, Type C     |

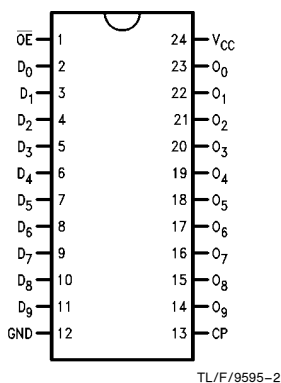
**Note 1:** Devices also available in 13" reel. Use suffix = SCX.

**Note 2:** Military grade device with environmental and burn-in processing. Use suffix = SDM QB, FM QB and LM QB.

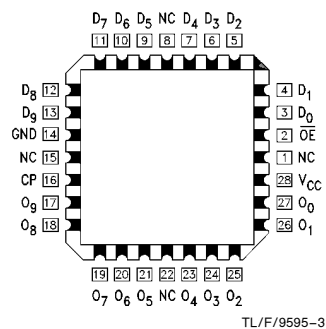
### Logic Symbols



Pin Assignment  
for DIP, SOIC and Flatpak



Pin Assignment  
for LCC



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## Unit Loading/Fan Out

| Pin Names       | Description       | 54F/74F          |   |
|-----------------|-------------------|------------------|---|
|                 |                   | U.L.<br>HIGH/LOW | Input $I_{IH}/I_{IL}$<br>Output $I_{OH}/I_{OL}$ |
| $D_0-D_9$       | Data Inputs       | 1.0/1.0          | 20 $\mu A$ / -0.6 mA                            |
| $\overline{OE}$ | Output Enable     | 1.0/1.0          | 20 $\mu A$ / -0.6 mA                            |
| CP              | TRI-STATE Input   | 1.0/1.0          | 20 $\mu A$ / -0.6 mA                            |
| $O_0-O_9$       | Clock Input       | 1.0/1.0          | 20 $\mu A$ / -0.6 mA                            |
|                 | TRI-STATE Outputs | 150/40 (33.3)    | -3.0 mA/24 mA (20 mA)                           |

## Functional Description

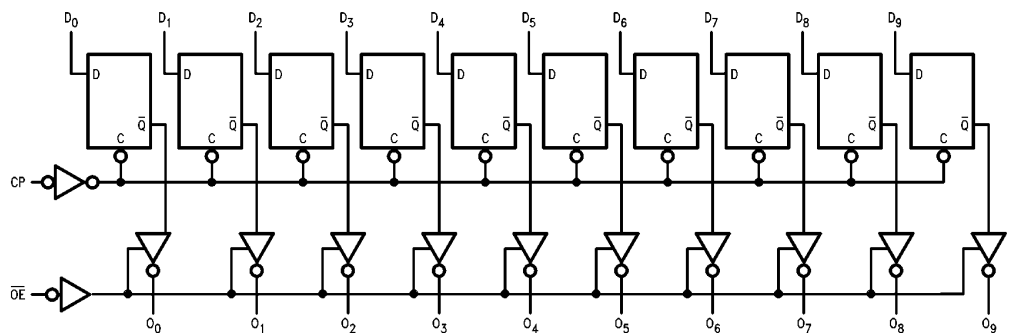
The 'F821 consists of ten D-type edge-triggered flip-flops. This device has TRI-STATE true outputs for bus systems organized in a broadside pinning. The buffered Clock (CP) and buffered Output Enable ( $\overline{OE}$ ) are common to all flip-flops. The flip-flops will store the state of their individual D inputs that meet the setup and hold times requirements on the LOW-to-HIGH CP transition. With the  $\overline{OE}$  LOW the content of the flip-flops are available at the outputs. When the  $\overline{OE}$  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       | Output | Function          |
|-----------------|------------|---|----------------|--------|-------------------|
| $\overline{OE}$ | CP         | D | $\overline{Q}$ | O      |                   |
| H               | H          | X | NC             | Z      | Hold              |
| H               | L          | X | NC             | Z      | Hold              |
| H               | $\nearrow$ | L | H              | Z      | Load              |
| H               | $\nearrow$ | H | L              | Z      | Load              |
| L               | $\nearrow$ | L | H              | L      | Data Available    |
| L               | $\nearrow$ | H | L              | H      | Data Available    |
| L               | H          | X | NC             | NC     | No Change in Data |
| L               | L          | X | NC             | NC     | No Change in Data |

L = LOW Voltage Level  
H = HIGH Voltage Level  
X = Immaterial  
Z = High Impedance  
 $\nearrow$  = LOW-to-HIGH Transition  
NC = No Change

## 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.

TL/F/9595-4

## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|   |                          |
|---|--------------------------|
| Storage Temperature   | −65°C to +150°C          |
| Ambient Temperature under Bias                                      | −55°C to +125°C          |
| Junction Temperature under Bias                                     | −55°C to +175°C          |
| Plastic   | −55°C to +150°C          |
| V <sub>CC</sub> Pin Potential to Ground Pin                         | −0.5V to +7.0V           |
| Input Voltage (Note 2)  | −0.5V to +7.0V           |
| Input Current (Note 2)  | −30 mA to +5.0 mA        |
| Voltage Applied to Output in HIGH State (with V <sub>CC</sub> = 0V) |                          |
| Standard Output   | −0.5V to V <sub>CC</sub> |
| TRI-STATE Output  | −0.5V to +5.5V           |

Current Applied to Output in LOW State (Max) twice the rated I<sub>OL</sub> (mA)

**Note 1:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Either voltage limit or current limit is sufficient to protect inputs.

## Recommended Operating Conditions

|                              |                 |
|------------------------------|-----------------|
| Free Air Ambient Temperature |                 |
| Military                     | −55°C to +125°C |
| Commercial                   | 0°C to +70°C    |
| Supply Voltage               |                 |
| Military                     | +4.5V to +5.5V  |
| Commercial                   | +4.5V to +5.5V  |

## DC Electrical Characteristics

| Symbol           | Parameter                         | 54F/74F  |  |             | Units | V <sub>CC</sub> | Conditions   |
|------------------|-----------------------------------|--|--|-------------|-------|-----------------|--|
|                  |                                   | Min  | Typ                                    | Max         |       |                 |  |
| V <sub>IH</sub>  | Input HIGH Voltage                | 2.0  |  |             | V     |                 | Recognized as a HIGH Signal  |
| V <sub>IL</sub>  | Input LOW Voltage                 |  |  | 0.8         | V     |                 | Recognized as a LOW Signal   |
| V <sub>CD</sub>  | Input Clamp Diode Voltage         |  |  | −1.2        | V     | Min             | I <sub>IN</sub> = −18 mA   |
| V <sub>OH</sub>  | Output HIGH Voltage               | 54F 10% V <sub>CC</sub><br>54F 10% V <sub>CC</sub><br>74F 10% V <sub>CC</sub><br>74F 10% V <sub>CC</sub><br>74F 5% V <sub>CC</sub><br>74F 5% V <sub>CC</sub> | 2.5<br>2.4<br>2.5<br>2.4<br>2.7<br>2.7 |             | V     | Min             | I <sub>OH</sub> = −1 mA<br>I <sub>OH</sub> = −3 mA<br>I <sub>OH</sub> = −1 mA<br>I <sub>OH</sub> = −3 mA<br>I <sub>OH</sub> = −1 mA<br>I <sub>OH</sub> = −3 mA |
| V <sub>OL</sub>  | Output LOW Voltage                | 54F 10% V <sub>CC</sub><br>74F 10% V <sub>CC</sub>   |  | 0.5<br>0.5  | V     | Min             | I <sub>OL</sub> = 20 mA<br>I <sub>OL</sub> = 24 mA   |
| I <sub>IH</sub>  | Input HIGH Current                | 54F<br>74F   |  | 20.0<br>5.0 | μA    | Max             | V <sub>IN</sub> = 2.7V   |
| I <sub>BVI</sub> | Input HIGH Current Breakdown Test | 54F<br>74F   |  | 100<br>7.0  | μA    | Max             | V <sub>IN</sub> = 7.0V   |
| I <sub>CEX</sub> | Output HIGH Leakage Current       | 54F<br>74F   |  | 250<br>50   | μA    | Max             | V <sub>OUT</sub> = V <sub>CC</sub>   |
| V <sub>ID</sub>  | Input Leakage Test                | 74F  | 4.75                                   |             | V     | 0.0             | I <sub>ID</sub> = 1.9 μA,<br>All Other Pins Grounded   |
| I <sub>OD</sub>  | Output Leakage Circuit Current    | 74F  |  | 3.75        | μA    | 0.0             | V <sub>IOD</sub> = 150 mV<br>All Other Pins Grounded   |
| I <sub>IL</sub>  | Input LOW Current                 |  |  | −0.6        | mA    | Max             | V <sub>IN</sub> = 0.5V   |
| I <sub>OZH</sub> | Output Leakage Current            |  |  | 50          | μA    | Max             | V <sub>OUT</sub> = 2.7V  |
| I <sub>OZL</sub> | Output Leakage Current            |  |  | −50         | μA    | Max             | V <sub>OUT</sub> = 0.5V  |
| I <sub>OS</sub>  | Output Short-Circuit Current      |  | −60                                    | −150        | mA    | Max             | V <sub>OUT</sub> = 0V  |
| I <sub>CCZ</sub> | Power Supply Current              |  | 78                                     | 100         | mA    | Max             | V <sub>O</sub> = HIGH Z  |

## AC Electrical Characteristics

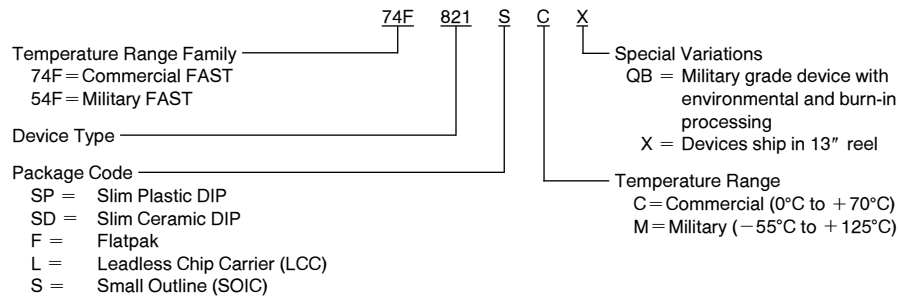
| Symbol           | Parameter               | 74F  |     |      | 54F  |      | 74F  |      | Units |
|------------------|-------------------------|--|-----|------|--|------|--|------|-------|
|                  |                         | $T_A = +25^{\circ}\text{C}$<br>$V_{CC} = +5.0\text{V}$<br>$C_L = 50\text{ pF}$ |     |      | $T_A, V_{CC} = \text{Mil}$<br>$C_L = 50\text{ pF}$ |      | $T_A, V_{CC} = \text{Com}$<br>$C_L = 50\text{ pF}$ |      |       |
|                  |                         | Min  | Typ | Max  | Min  | Max  | Min  | Max  |       |
| f <sub>max</sub> | Maximum Clock Frequency | 100  | 150 |      | 60   |      | 70   |      | MHz   |
| t <sub>PLH</sub> | Propagation Delay       | 2.0  | 6.4 | 9.5  | 2.0  | 10.5 | 2.0  | 10.5 | ns    |
| t <sub>PHL</sub> | CP to O <sub>n</sub>    | 2.0  | 6.2 | 9.5  | 2.0  | 10.5 | 2.0  | 10.5 |       |
| t <sub>pZH</sub> | Output Enable Time      | 2.0  | 5.8 | 10.5 | 2.0  | 13.0 | 2.0  | 11.5 | ns    |
| t <sub>pZL</sub> | OE to O <sub>n</sub>    | 2.0  | 6.3 | 10.5 | 2.0  | 13.0 | 2.0  | 11.5 |       |
| t <sub>PHZ</sub> | Output Disable Time     | 1.5  | 3.4 | 7.0  | 1.0  | 7.5  | 1.5  | 7.5  |       |
| t <sub>PLZ</sub> | OE to O <sub>n</sub>    | 1.5  | 3.5 | 7.0  | 1.0  | 7.5  | 1.5  | 7.5  |       |

## AC Operating Requirements

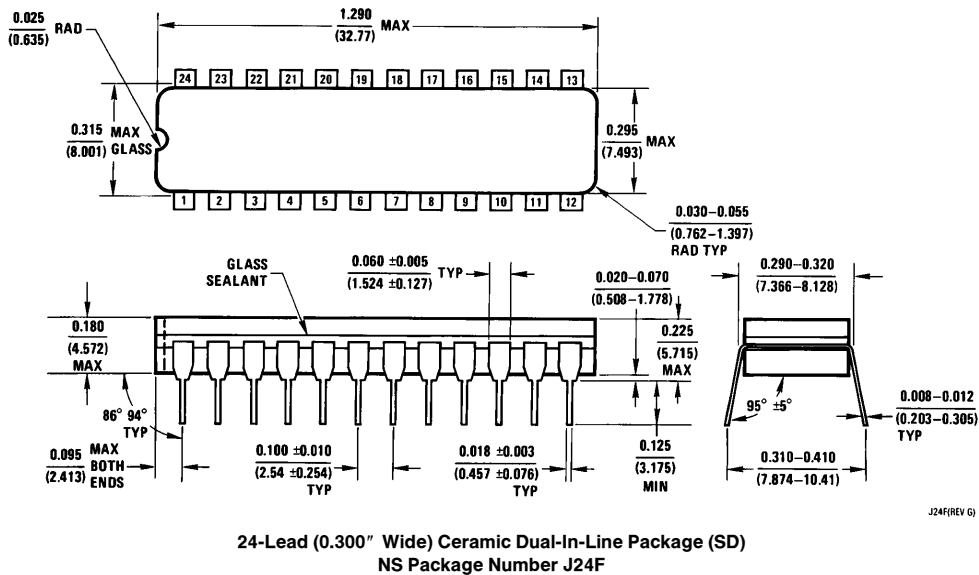
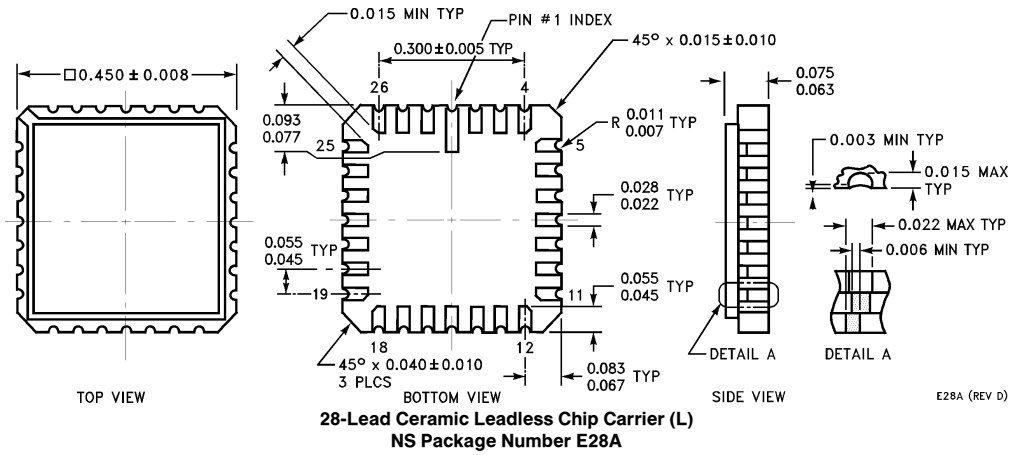
| Symbol                             | Parameter                              | 74F  |     | 54F                        |     | 74F                        |     | Units |
|------------------------------------|--|--|-----|----------------------------|-----|----------------------------|-----|-------|
|                                    |  | $T_A = +25^{\circ}\text{C}$<br>$V_{CC} = +5.0\text{V}$ |     | $T_A, V_{CC} = \text{Mil}$ |     | $T_A, V_{CC} = \text{Com}$ |     |       |
|                                    |  | Min  | Max | Min                        | Max | Min                        | Max |       |
| $t_s(\text{H})$<br>$t_s(\text{L})$ | Setup Time, HIGH or LOW<br>$D_n$ to CP | 2.5<br>2.5   |     | 4.0<br>4.0                 |     | 3.0<br>3.0                 |     | ns    |
| $t_h(\text{H})$<br>$t_h(\text{L})$ | Hold Time, HIGH or LOW<br>$D_n$ to CP  | 2.5<br>2.5   |     | 2.5<br>2.5                 |     | 2.5<br>2.5                 |     |       |
| $t_w(\text{H})$<br>$t_w(\text{L})$ | CP Pulse Width<br>HIGH or LOW          | 5.0<br>5.0   |     | 6.0<br>6.0                 |     | 6.0<br>6.0                 |     | ns    |

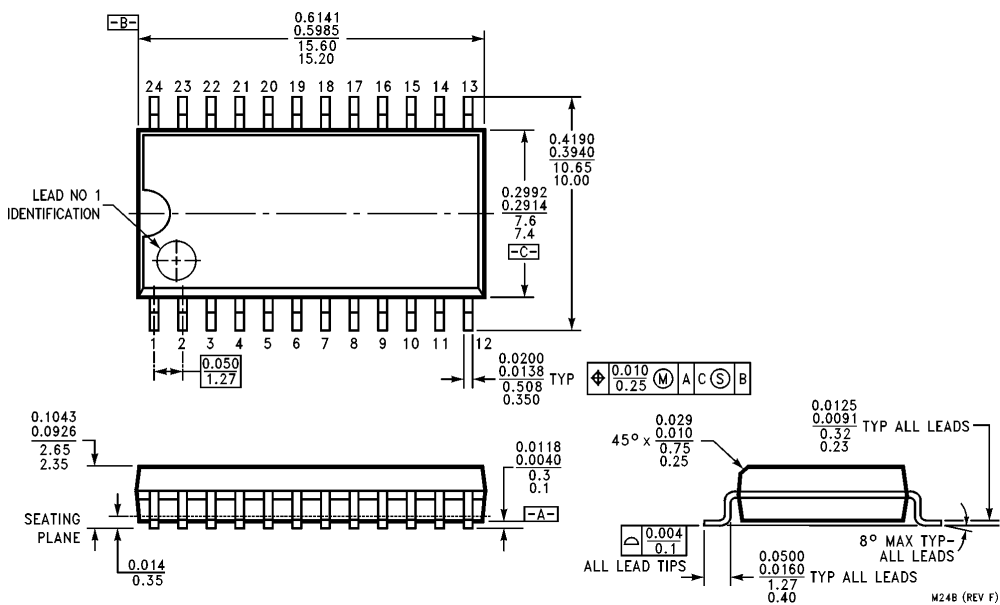
## Ordering Information

The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:

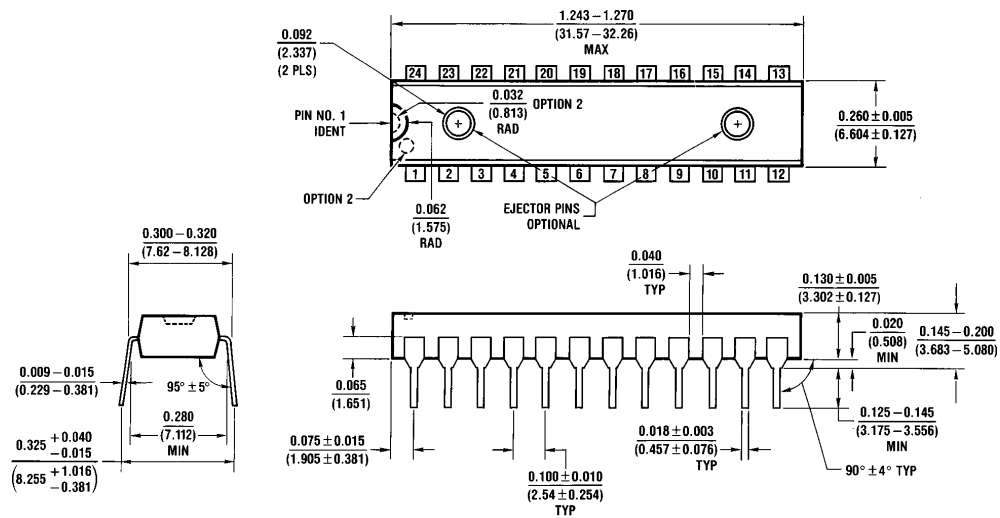


## Physical Dimensions inches (millimeters)

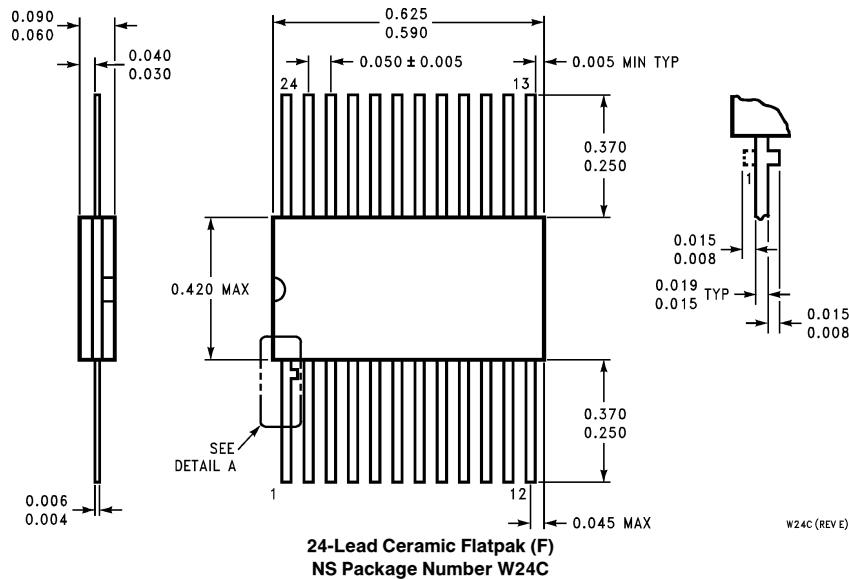


**Physical Dimensions** inches (millimeters) (Continued)

**24-Lead (0.300" Wide) Molded Small Outline Package, JEDEC (S)  
NS Package Number M24B**



**24-Lead (0.300" Wide) Molded Dual-In-Line Package (SP)**  
**NS Package Number N24C**

**Physical Dimensions** inches (millimeters) (Continued)**LIFE SUPPORT POLICY**

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