

## 54F/74F374

### Octal D-Type Flip-Flop with TRI-STATE® Outputs

#### General Description

The 'F374 is a high-speed, low-power octal D-type flip-flop featuring separate D-type inputs for each flip-flop and TRI-STATE outputs for bus-oriented applications. A buffered Clock (CP) and Output Enable (OE) are common to all flip-flops.

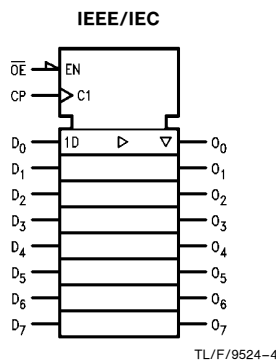
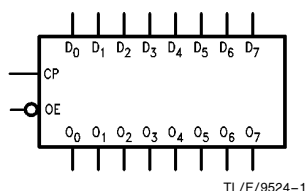
#### Features

- Edge-triggered D-type inputs
- Buffered positive edge-triggered clock
- TRI-STATE outputs for bus-oriented applications
- Guaranteed 4000V minimum ESD protection

| Commercial         | Military      | Package Number | Package Description                               |
|--------------------|---------------|----------------|---------------------------------------------------|
| 74F374PC           |               | N20A           | 20-Lead (0.300" Wide) Molded Dual-In-Line         |
|                    | 54F374DM (QB) | J20A           | 20-Lead Ceramic Dual-In-Line                      |
| 74F374SC (Note 1)  |               | M20B           | 20-Lead (0.300" Wide) Molded Small Outline, JEDEC |
| 74F374SJ (Note 1)  |               | M20D           | 20-Lead (0.300" Wide) Molded Small Outline, EIAJ  |
| 74F374MSA (Note 1) |               | MSA20          | 20-Lead Molded Shrink Small Outline, EIAJ Type II |
|                    | 54F374FM (QB) | W20A           | 20-Lead Cerpack                                   |
|                    | 54F374LM (QB) | E20A           | 20-Lead Ceramic Leadless Chip Carrier, Type C     |

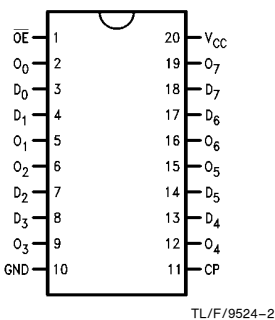
**Note 1:** Devices also available in 13" reel. Use suffix = SCX, SJX, and MSAX.

#### Logic Symbols

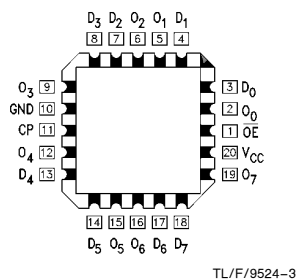


#### Connection Diagrams

Pin Assignment for DIP, SOIC, SSOP 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 <sub>0</sub> –D <sub>7</sub> | Data Inputs                                | 1.0/1.0          | 20 $\mu$ A/ –0.6 mA                             |
| CP                             | Clock Pulse Input (Active Rising Edge)     | 1.0/1.0          | 20 $\mu$ A/ –0.6 mA                             |
| $\overline{OE}$                | TRI-STATE Output Enable Input (Active LOW) | 1.0/1.0          | 20 $\mu$ A/ –0.6 mA                             |
| O <sub>0</sub> –O <sub>7</sub> | TRI-STATE Outputs                          | 150/40 (33.3)    | –3 mA/24 mA (20 mA)                             |

## Functional Description

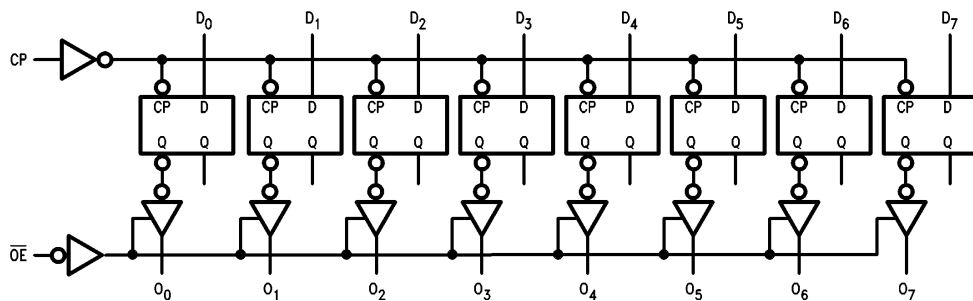
The 'F374 consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ( $\overline{OE}$ ) LOW, the contents of the eight 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 affected the state of the flip-flops.

## Truth Table

| Inputs         |                                                                                   |                 | Internal Register | Output         |
|----------------|-----------------------------------------------------------------------------------|-----------------|-------------------|----------------|
| D <sub>n</sub> | CP                                                                                | $\overline{OE}$ |                   | O <sub>n</sub> |
| H              |  | L               | H                 | H              |
| L              |  | L               | L                 | L              |
| X              | X                                                                                 | H               | X                 | Z              |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 = LOW-to-HIGH Clock Transition

## Logic Diagram



TL/F/9524–5

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)

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) |

ESD Last Passing Voltage (Min)

4000V

**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>ZZ</sub>  | Bus Drainage Test                 |                                                                                                                                                              |                                        |     | 500         | μA    | 0.0V            | V <sub>OUT</sub> = 5.25V                                                                                                                                       |
| I <sub>CCZ</sub> | Power Supply Current              |                                                                                                                                                              |                                        | 55  | 86          | mA    | Max             | V <sub>O</sub> = HIGH Z                                                                                                                                        |

## AC Electrical Characteristics

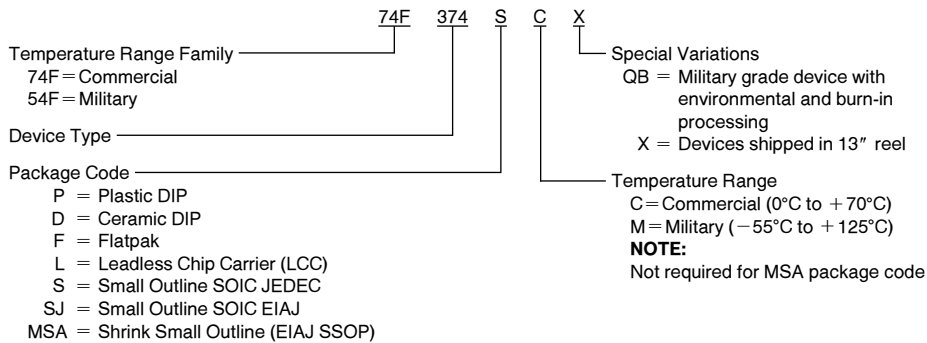
| Symbol           | Parameter               | 74F                                                                            |     |      | 54F                                                |      | 74F                                                |      | Units |
|------------------|-------------------------|--------------------------------------------------------------------------------|-----|------|----------------------------------------------------|------|----------------------------------------------------|------|-------|
|                  |                         | $T_A = +25^{\circ}\text{C}$<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                                                                            | 140 |      | 60                                                 |      | 70                                                 |      | MHz   |
| t <sub>PLH</sub> | Propagation Delay       | 4.0                                                                            | 6.5 | 8.5  | 4.0                                                | 10.5 | 4.0                                                | 10.0 | ns    |
| t <sub>PHL</sub> | CP to O <sub>n</sub>    | 4.0                                                                            | 6.5 | 8.5  | 4.0                                                | 11.0 | 4.0                                                | 10.0 |       |
| t <sub>PZH</sub> | Output Enable Time      | 2.0                                                                            | 9.0 | 11.5 | 2.0                                                | 14.0 | 2.0                                                | 12.5 | ns    |
| t <sub>PZL</sub> |                         | 2.0                                                                            | 5.8 | 7.5  | 2.0                                                | 10.0 | 2.0                                                | 8.5  |       |
| t <sub>PHZ</sub> | Output Disable Time     | 2.0                                                                            | 5.3 | 7.0  | 2.0                                                | 8.0  | 2.0                                                | 8.0  |       |
| t <sub>PLZ</sub> |                         | 1.5                                                                            | 4.3 | 5.5  | 1.5                                                | 7.5  | 1.5                                                | 6.5  |       |

## AC Operating Requirements

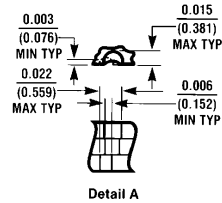
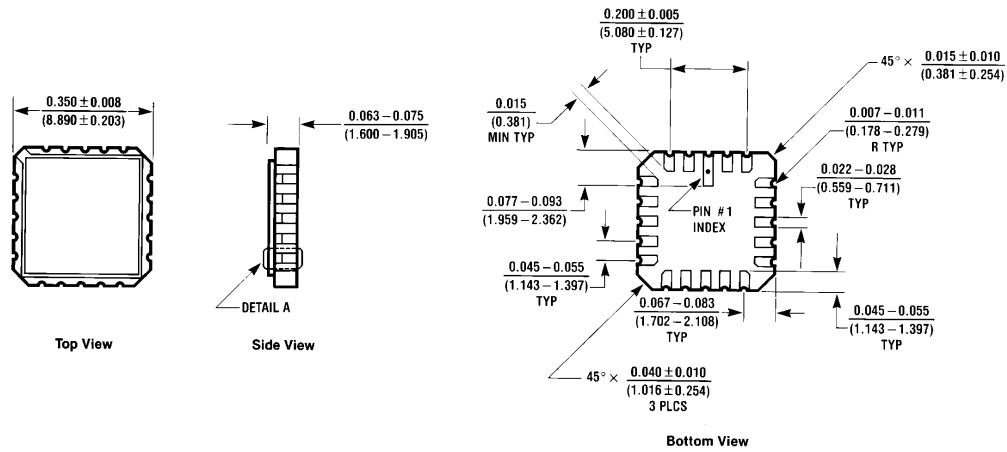
| Symbol          | Parameter               | 74F                                                    |     | 54F                        |     | 74F                        |     | Units |
|-----------------|-------------------------|--------------------------------------------------------|-----|----------------------------|-----|----------------------------|-----|-------|
|                 |                         | $T_A = +25^{\circ}\text{C}$<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 |       |
| $t_s(\text{H})$ | Setup Time, HIGH or LOW | 2.0                                                    |     | 2.5                        |     | 2.0                        |     | ns    |
| $t_s(\text{L})$ | $D_n$ to CP             | 2.0                                                    |     | 2.0                        |     | 2.0                        |     |       |
| $t_h(\text{H})$ | Hold Time, HIGH or LOW  | 2.0                                                    |     | 2.0                        |     | 2.0                        |     | ns    |
| $t_h(\text{L})$ | $D_n$ to CP             | 2.0                                                    |     | 2.5                        |     | 2.0                        |     |       |
| $t_w(\text{H})$ | CP Pulse Width          | 7.0                                                    |     | 7.0                        |     | 7.0                        |     | ns    |
| $t_w(\text{L})$ | HIGH or LOW             | 6.0                                                    |     | 6.0                        |     | 6.0                        |     |       |

## 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:

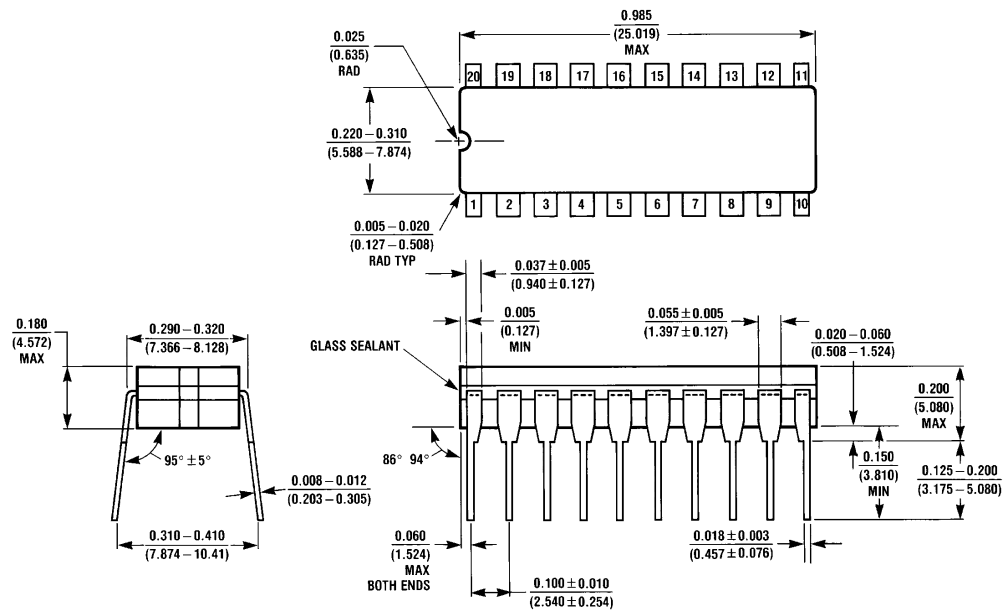


## Physical Dimensions inches (millimeters)



**20-Lead Ceramic Leadless Chip Carrier (L)**  
**NS Package Number E20A**

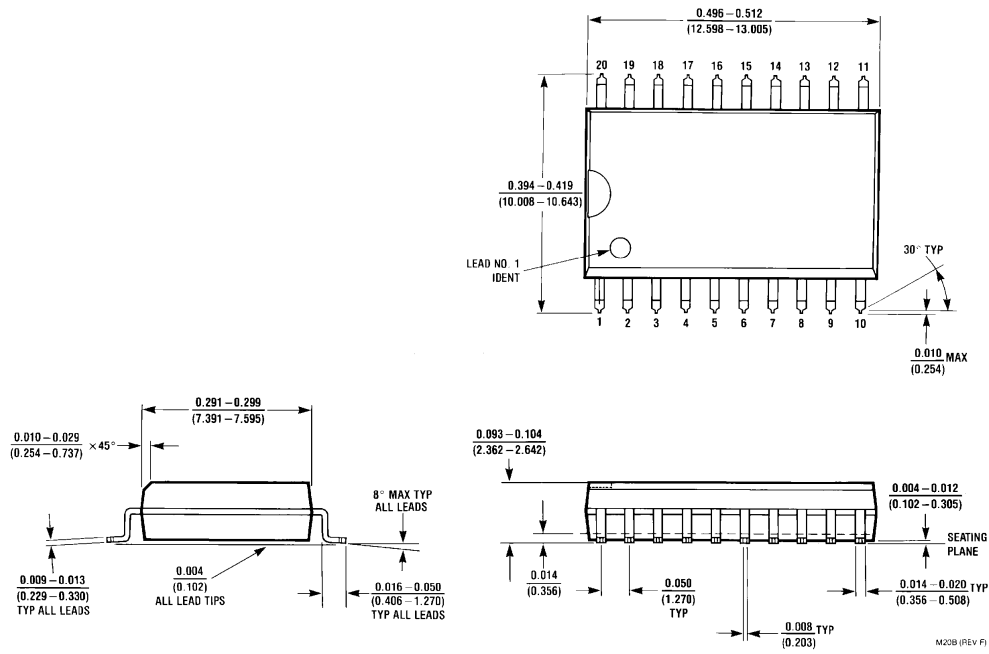
E20A (REV D)



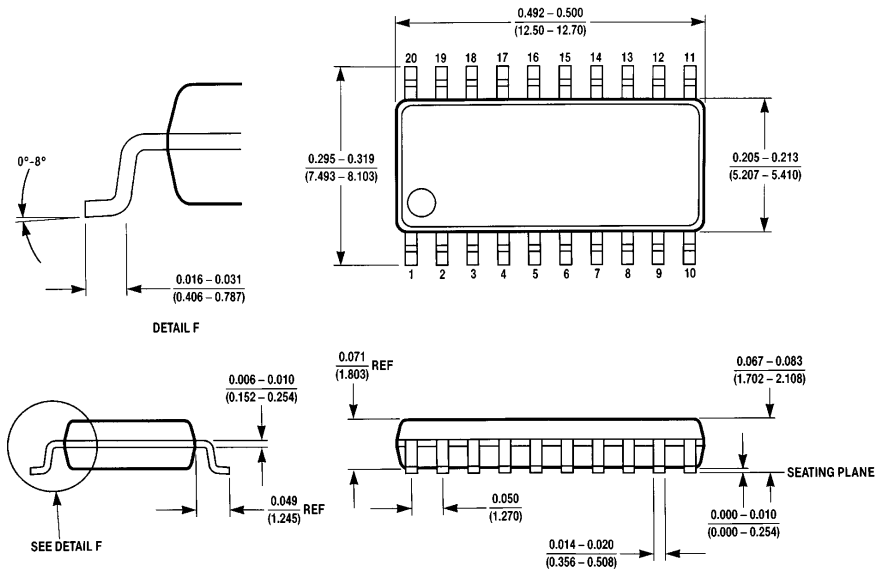
**20-Lead Ceramic Dual-In-Line Package (D)**  
**NS Package Number J20A**

J20A (REV M)

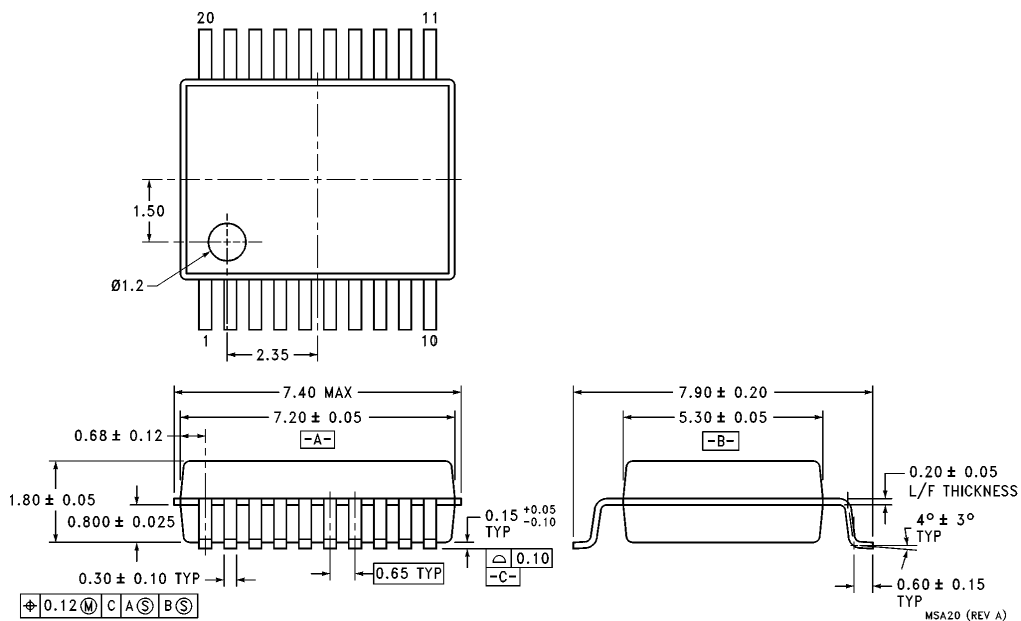
# Physical Dimensions inches (millimeters) (Continued)



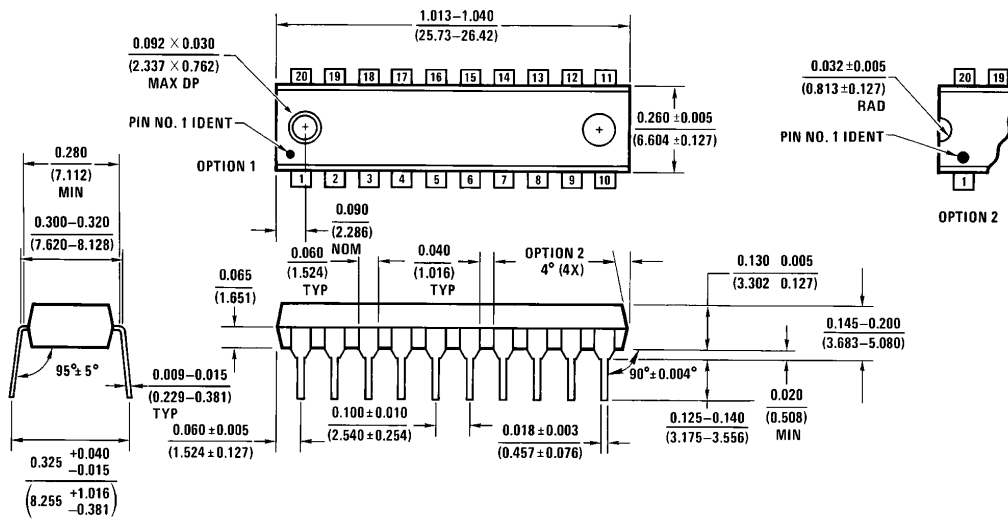
**20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC (S)  
NS Package Number M20B**



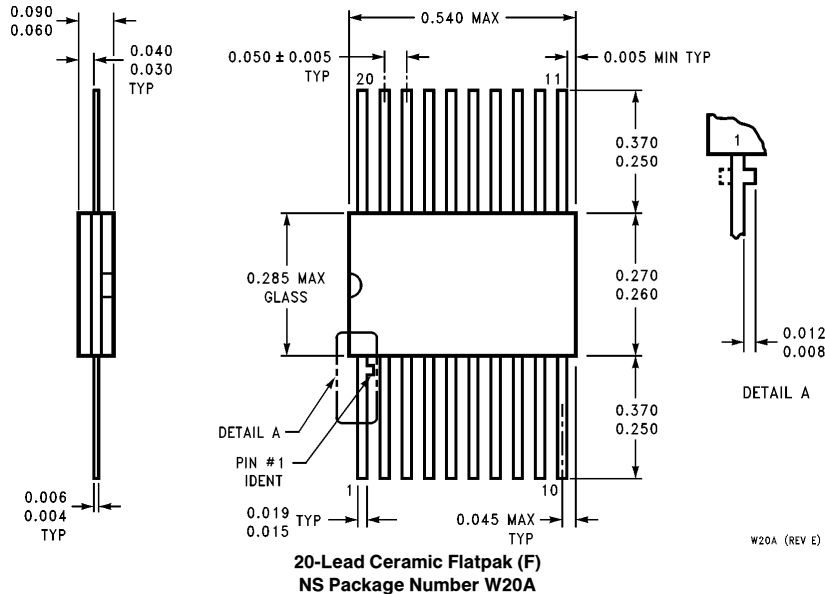
**20-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)  
NS Package Number M20D**

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

**20-Lead (0.300" Wide) Molded Shrink Small Outline Package, EIAJ, Type II (MSA)**  
**NS Package Number MSA20**



**20-Lead (0.300" Wide) Molded Dual-In-Line Package (P)  
NS Package Number N20A**

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

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