

## 54F/74F398 • 54F/74F399 Quad 2-Port Register

### General Description

The 'F398 and 'F399 are the logical equivalents of a quad 2-input multiplexer feeding into four edge-triggered flip-flops. A common Select input determines which of the two 4-bit words is accepted. The selected data enters the flip-flops on the rising edge of the clock. The 'F399 is the 16-pin version of the 'F398, with only the Q outputs of the flip-flops available.

### Features

- Select inputs from two data sources
- Fully positive edge-triggered operation
- Both true and complement outputs—'F398
- Guaranteed 4000V minimum ESD protection—'F399

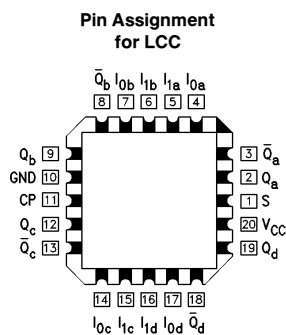
| Commercial        | Military          | Package Number | Package Description                               |
|-------------------|-------------------|----------------|---|
| 74F398PC          |                   | N20A           | 20-Lead (0.300" Wide) Molded Dual-In-Line         |
|                   | 54F398DM (Note 2) | J20A           | 20-Lead Ceramic Dual-In-Line                      |
| 74F398SC (Note 1) |                   | M20B           | 20-Lead (0.300" Wide) Molded Small Outline, JEDEC |
|                   | 54F398FM (Note 2) | W20A           | 20-Lead Cerpack                                   |
|                   | 54F398LM (Note 2) | E20A           | 20-Lead Ceramic Leadless Chip Carrier, Type C     |
| 74F399PC          |                   | N20A           | 20-Lead (0.300" Wide) Molded Dual-In-Line         |
|                   | 54F399DM (Note 2) | J20A           | 20-Lead Ceramic Dual-In-Line                      |
| 74F399SC (Note 1) |                   | M20B           | 20-Lead (0.300" Wide) Molded Small Outline, JEDEC |
| 74F399SJ (Note 1) |                   | M20D           | 20-Lead (0.300" Wide) Molded Small Outline, EIAJ  |
|                   | 54F399FM (Note 2) | W20A           | 20-Lead Cerpack                                   |
|                   | 54F399LM (Note 2) | E20A           | 20-Lead Ceramic Leadless Chip Carrier, Type C     |

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

**Note 2:** Military grade device with environmental and burn-in processing. Use suffix = DMQB, FMQB and LMQB.

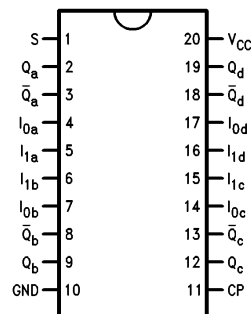
### Connection Diagrams

'F398



TL/F/9533-5

**Pin Assignment for DIP, SOIC and Flatpak**

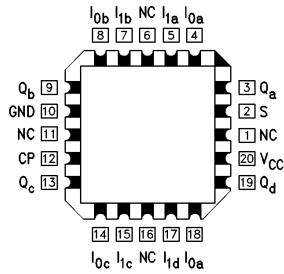


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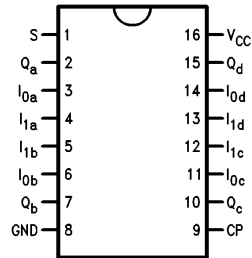
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## Connection Diagrams (Continued)

'F399

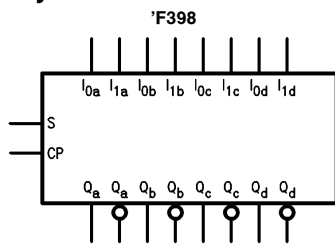


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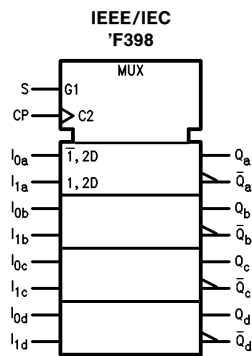


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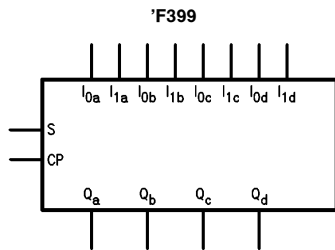
## Logic Symbols



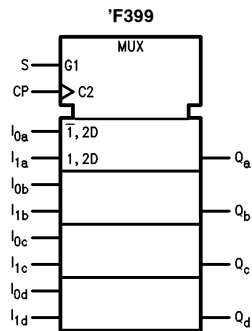
TL/F/9533-2



TL/F/9533-1



TL/F/9533-4



TL/F/9533-3

## Unit Loading/Fan Out

| Pin Names             | Description                            | 54F/74F          |   |
|-----------------------|--|------------------|---|
|                       |  | U.L.<br>HIGH/LOW | Input $I_{IH}/I_{IL}$<br>Output $I_{OH}/I_{OL}$ |
| S                     | Common Select Input                    | 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                             |
| $I_{0a}-I_{0d}$       | Data Inputs from Source 0              | 1.0/1.0          | 20 $\mu$ A/ -0.6 mA                             |
| $I_{1a}-I_{1d}$       | Data Inputs from Source 1              | 1.0/1.0          | 20 $\mu$ A/ -0.6 mA                             |
| $Q_a-Q_d$             | Register True Outputs                  | 50/33.3          | -1 mA/20 mA                                     |
| $\bar{Q}_a-\bar{Q}_d$ | Register Complementary Outputs ('F398) | 50/33.3          | -1 mA/20 mA                                     |

## Functional Description

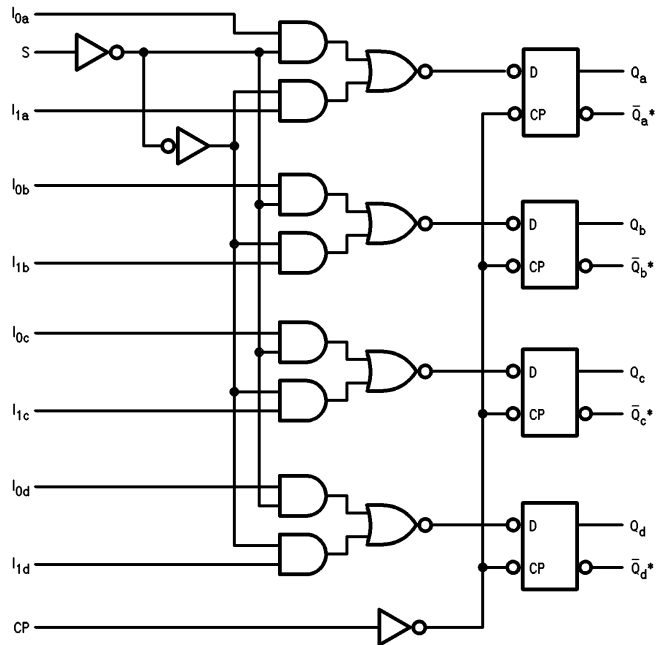
The 'F398 and 'F399 are high-speed quad 2-port registers. They select four bits of data from either of two sources (Ports) under control of a common Select input (S). The selected data is transferred to a 4-bit output register synchronous with the LOW-to-HIGH transition of the Clock input (CP). The 4-bit D-type output register is fully edge-triggered. The Data inputs ( $I_{0x}$ ,  $I_{1x}$ ) and Select input (S) must be stable only a setup time prior to and hold time after the LOW-to-HIGH transition of the Clock input for predictable operation. The 'F398 has both Q and  $\bar{Q}$  outputs.

Function Table

| S | Inputs |       | Outputs |             |
|---|--------|-------|---------|-------------|
|   | $I_0$  | $I_1$ | Q       | $\bar{Q}^*$ |
| l | l      | X     | L       | H           |
| l | h      | X     | H       | L           |
| h | X      | l     | L       | H           |
| h | X      | h     | H       | L           |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 h = HIGH Voltage Level one setup time prior to the LOW-to-HIGH clock transition  
 l = LOW Voltage Level one setup time prior to the LOW-to-HIGH clock transition  
 X = Immaterial  
 \*'F398 only

## Logic Diagram



\*'F398 Only

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

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## 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)—F399 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>74F 10% V <sub>CC</sub><br>74F 5% V <sub>CC</sub> | 2.5<br>2.5<br>2.7 |             | V     | Min             | I <sub>OH</sub> = –1 mA<br>I <sub>OH</sub> = –1 mA<br>I <sub>OH</sub> = –1 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> = 20 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>OS</sub>  | Output Short-Circuit Current      |  | –60               | –150        | mA    | Max             | V <sub>OUT</sub> = 0V   |
| I <sub>CCH</sub> | Power Supply Current (F398)       |  | 25                | 38          | mA    | Max             | V <sub>O</sub> = HIGH   |
| I <sub>CCL</sub> | Power Supply Current (F398)       |  | 25                | 38          | mA    | Max             | V <sub>O</sub> = LOW  |
| I <sub>CCH</sub> | Power Supply Current (F399)       |  | 22                | 34          | mA    | Max             | V <sub>O</sub> = HIGH   |
| I <sub>CCL</sub> | Power Supply Current (F399)       |  | 22                | 34          | mA    | Max             | V <sub>O</sub> = LOW  |

## AC Electrical Characteristics

| Symbol                               | Parameter                                 | 74F   |     |     | 54F  |     | 74F  |     | Units |
|--------------------------------------|---|---|-----|-----|--|-----|--|-----|-------|
|                                      |   | T <sub>A</sub> = +25°C<br>V <sub>CC</sub> = +5.0V<br>C <sub>L</sub> = 50 pF |     |     | T <sub>A</sub> , V <sub>CC</sub> = Mil<br>C <sub>L</sub> = 50 pF |     | T <sub>A</sub> , V <sub>CC</sub> = Com<br>C <sub>L</sub> = 50 pF |     |       |
|                                      |   | Min   | Typ | Max | Min  | Max | Min  | Max |       |
| f <sub>max</sub>                     | Input Clock Frequency                     | 100   | 140 |     | 80   |     | 100  |     | MHz   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>CP to Q or $\bar{Q}$ | 3.0*  | 5.7 | 7.5 | 3.0  | 9.5 | 3.0  | 8.5 | ns    |

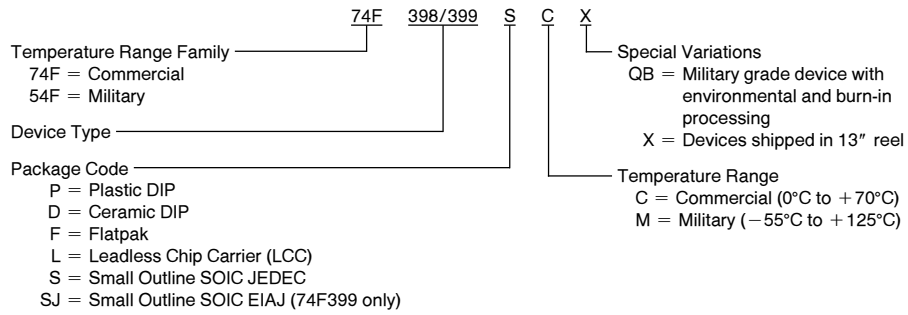
\*F398 3.3 ns

## AC Operating Requirements

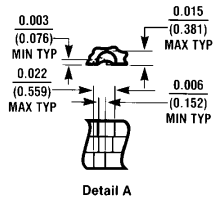
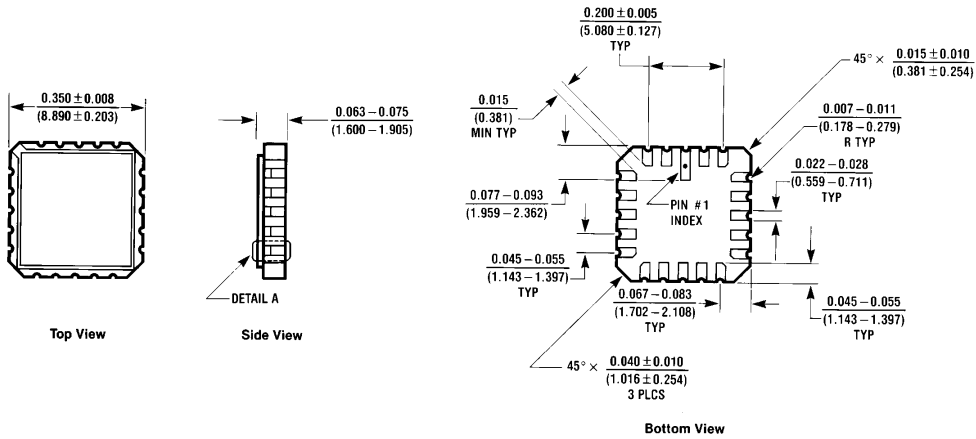
| Symbol                                   | Parameter                                       | 74F   |     | 54F                                    |     | 74F                                    |     | Units |
|--|---|---|-----|--|-----|--|-----|-------|
|  |   | T <sub>A</sub> = +25°C<br>V <sub>CC</sub> = +5.0V |     | T <sub>A</sub> , V <sub>CC</sub> = Mil |     | T <sub>A</sub> , V <sub>CC</sub> = Com |     |       |
|  |   | Min   | Max | Min                                    | Max | Min                                    | Max |       |
| t <sub>s</sub> (H)<br>t <sub>s</sub> (L) | Setup Time, HIGH or LOW<br>I <sub>n</sub> to CP | 3.0   |     | 4.5                                    |     | 3.0                                    |     | ns    |
| t <sub>h</sub> (H)<br>t <sub>h</sub> (L) | Hold Time, HIGH or LOW<br>I <sub>n</sub> to CP  | 1.0   |     | 1.5                                    |     | 1.0                                    |     |       |
| t <sub>s</sub> (H)<br>t <sub>s</sub> (L) | Setup Time, HIGH or LOW<br>S to CP ('F398)      | 7.5   |     | 10.5                                   |     | 8.5                                    |     | ns    |
| t <sub>s</sub> (H)<br>t <sub>s</sub> (L) | Setup Time, HIGH or LOW<br>S to CP ('F399)      | 7.5   |     | 9.5                                    |     | 8.5                                    |     |       |
| t <sub>h</sub> (H)<br>t <sub>h</sub> (L) | Hold Time, HIGH or LOW<br>S to CP               | 0   |     | 0                                      |     | 0                                      |     |       |
| t <sub>w</sub> (H)<br>t <sub>w</sub> (L) | CP Pulse Width<br>HIGH or LOW                   | 4.0   |     | 4.0                                    |     | 4.0                                    |     | 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:

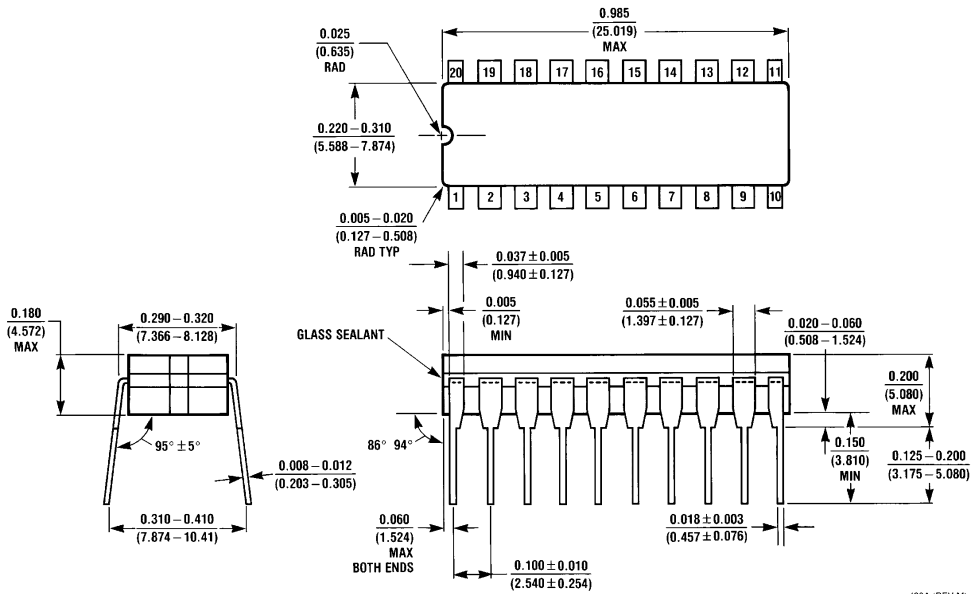


**Physical Dimensions** inches (millimeters)



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

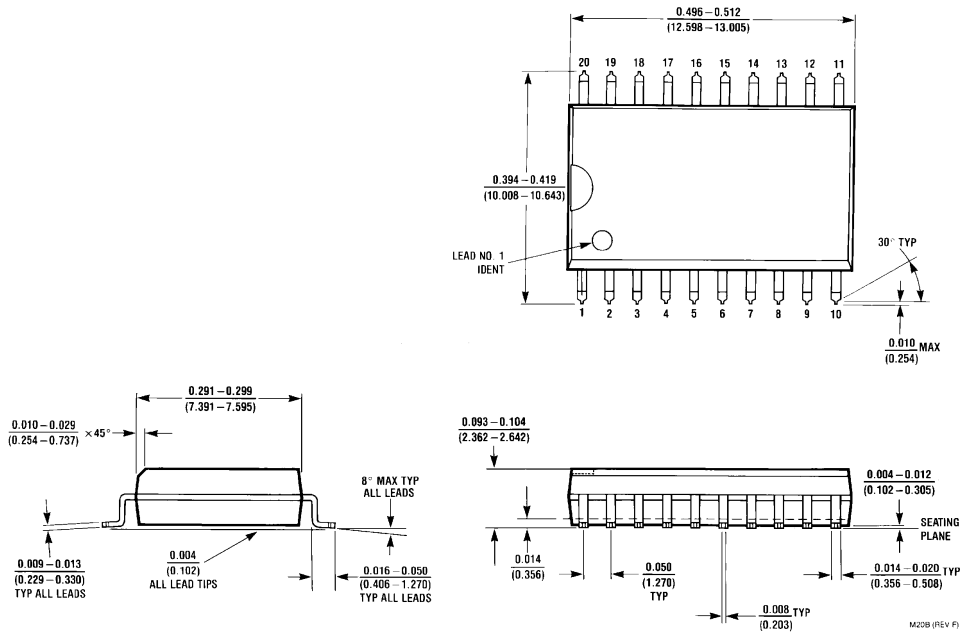
E20A (REV D)



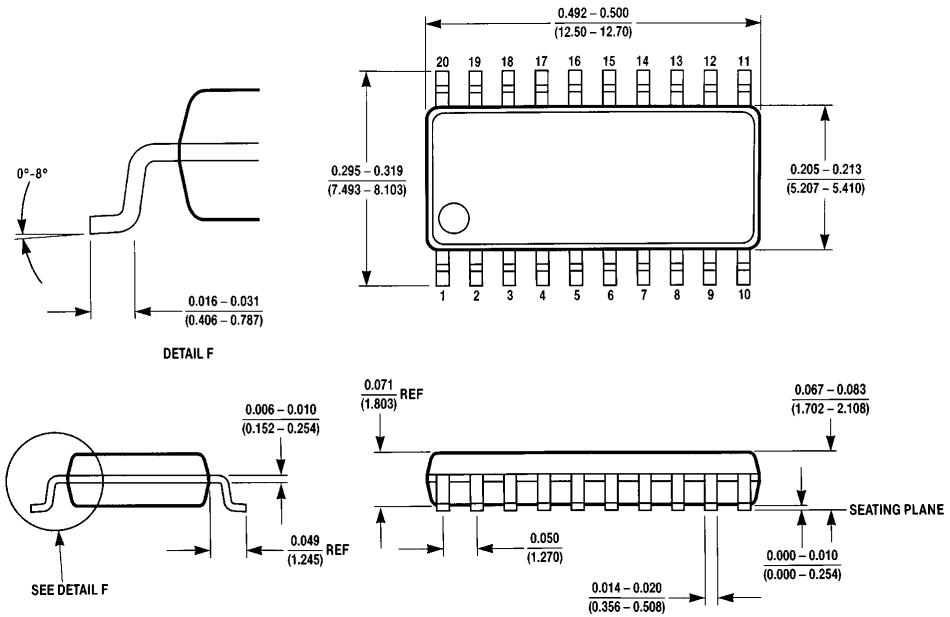
**20-Lead Ceramic Dual-In-Line Package (D)**  
 NS Package Number J20A

J20A (REV M)

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



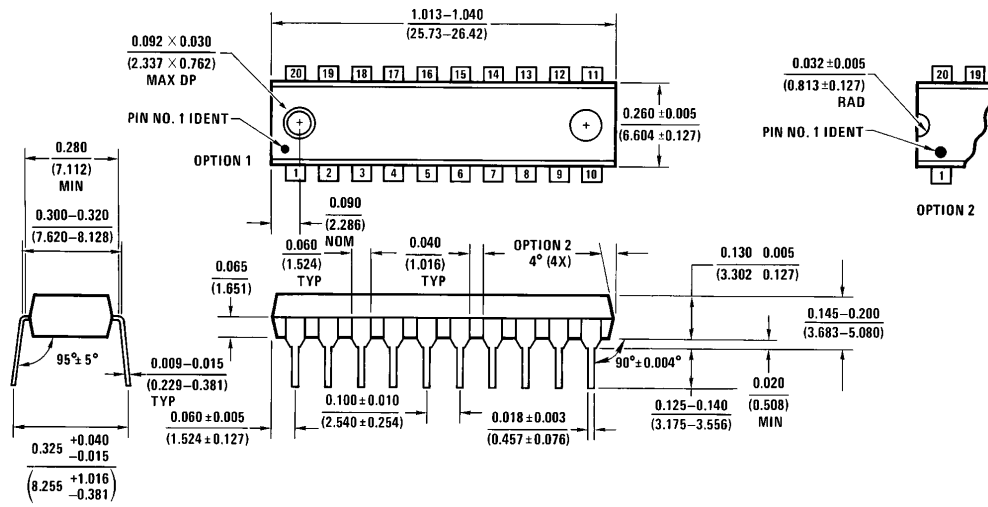
**20-Lead (0.300" Wide) Molded Small Outline Package, JEDEC (S)  
NS Package Number M20B**



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



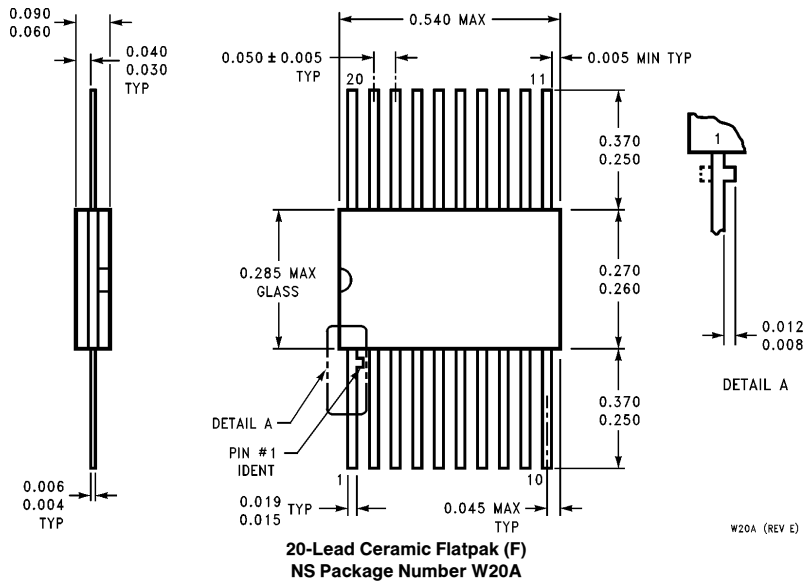
**Physical Dimensions** inches (millimeters) (Continued)



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

N20A (REV G)

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



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