

## NC7SZ374

### TinyLogic™ UHS D-Type Flip-Flop with 3-STATE Output

#### General Description

The NC7SZ374 is a single positive edge-triggered D-type CMOS Flip-Flop with 3-STATE output from Fairchild's Ultra High Speed Series of TinyLogic™ in the space saving SC70 6-lead package. The device is fabricated with advanced CMOS technology to achieve ultra high speed with high output drive while maintaining low static power dissipation over a very broad  $V_{CC}$  operating range. The device is specified to operate over the 1.8V–5.5V  $V_{CC}$  range. The inputs and output are high impedance when  $V_{CC}$  is 0V. Inputs tolerate voltages up to 7V independent of  $V_{CC}$  operating voltage. This single flip-flop will store the state of the D input that meets the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition.

The output tolerates voltages above  $V_{CC}$  in the 3-STATE condition.

#### Features

- Space saving SC70 6-lead package
- Ultra High Speed;  $t_{PD}$  2.6 ns Typ into 50 pF at 5V  $V_{CC}$
- High Output Drive;  $\pm 24$  mA at 3V  $V_{CC}$
- Broad  $V_{CC}$  Operating Range; 1.8V to 5.5V
- Matches the performance of LCX when operated at 3.3V  $V_{CC}$
- Power down high impedance inputs/output
- Overvoltage tolerant inputs facilitate 5V – 3V translation

#### Ordering Code:

| Order Number | Package Number | Package Top Mark | Package Description                 | Supplied As                |
|--------------|----------------|------------------|-------------------------------------|----------------------------|
| NC7SZ374P6   | MAA06A         | Z74              | 6-Lead SC70, EIAJ SC88, 1.25mm Wide | 250 Units on Tape and Reel |
| NC7SZ374P6X  | MAA06A         | Z74              | 6-Lead SC70, EIAJ SC88, 1.25mm Wide | 3k Units on Tape and Reel  |

#### Pin Descriptions

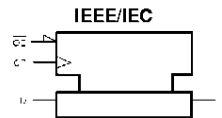
| Pin Names       | Description         |
|-----------------|---------------------|
| D               | Data Input          |
| CP              | Clock Pulse Input   |
| $\overline{OE}$ | Output Enable Input |
| Q               | Flip-Flop Output    |

#### Function Table

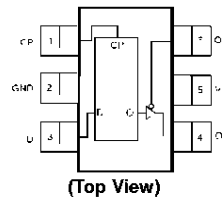
| Inputs |   |                 | Output |
|--------|---|-----------------|--------|
| CP     | D | $\overline{OE}$ | Q      |
| —      | L | L               | L      |
| —      | H | L               | H      |
| —      | X | L               | $Q_n$  |
| X      | X | H               | Z      |

H = HIGH Logic Level    Z = High Impedance    X = Immaterial  
L = LOW Logic Level     $Q_n$  = No change in data

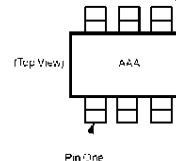
#### Logic Symbol



#### Connection Diagrams



#### Pin One Orientation Diagram



AAA represents Package Top Mark - see ordering code

**Note:** Orientation of Top Mark determines Pin One location. Read the top package mark left to right. Pin One is the lower left pin (see diagram)

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**Absolute Maximum Ratings**(Note 1)

|                                              |                 |
|----------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                  | 0.5V to +7.0V   |
| DC Input Voltage ( $V_{IN}$ )                | -0.5V to +7.0V  |
| DC Output Voltage ( $V_{OUT}$ )              | -0.5V to +7.0V  |
| DC Input Diode Current ( $I_{IK}$ )          |                 |
| $V_{IN} < 0V$                                | -50 mA          |
| DC Output Diode Current ( $I_{OK}$ )         |                 |
| $V_{OUT} < 0V$                               | -50 mA          |
| DC Output ( $I_{OUT}$ ) Source/Sink Current  | $\pm 50$ mA     |
| DC $V_{CC}/GND$ Current ( $I_{CC}/I_{GND}$ ) | $\pm 50$ mA     |
| Storage Temperature Range ( $T_{STG}$ )      | -65°C to +150°C |
| Junction Temperature under Bias ( $T_J$ )    | 150°C           |
| Junction Lead Temperature ( $T_L$ )          |                 |
| (Soldering, 10 seconds)                      | 260°C           |
| Power Dissipation ( $P_D$ ) @ +85°C          | 180 mW          |

**Recommended Operating Conditions**

|                                         |                |
|-----------------------------------------|----------------|
| Power Supply                            |                |
| Operating ( $V_{CC}$ )                  | 1.8V to 5.5V   |
| Data Retention                          | 1.5V to 5.5V   |
| Input Voltage ( $V_{IN}$ )              | 0V to 5.5V     |
| Output Voltage ( $V_{OUT}$ )            |                |
| Active State                            | 0V to $V_{CC}$ |
| 3-STATE                                 | 0V to 5.5V     |
| Input Rise and Fall Time ( $t_r, t_f$ ) |                |
| $V_{CC} = 1.8V, 2.5V \pm 0.2V$          | 0 to 20 ns/V   |
| $V_{CC} = 3.3V \pm 0.3V$                | 0 to 10 ns/V   |
| $V_{CC} = 5.5V \pm 0.5V$                | 0 to 5 ns/V    |
| Operating Temperature ( $T_A$ )         | -40°C to +85°C |
| Thermal Resistance ( $\theta_{JA}$ )    | 350° C/W       |

**Note 1:** Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

**DC Electrical Characteristics**

| 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                                                                                                  |                                                                                                         |  |
|------------------|--------------------------------------|------------------------|------------------------|------|-----|---------------------------------|-----|-----------------------------------|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--|
|                  |                                      |                        | Min                    | Typ  | Max | Min                             | Max |                                   |                                                                                                             |                                                                                                         |  |
| V <sub>IH</sub>  | HIGH Level Control<br>Input Voltage  | 1.8                    | 0.75 V <sub>CC</sub>   |      |     | 0.75 V <sub>CC</sub>            |     | V                                 |                                                                                                             |                                                                                                         |  |
|                  |                                      | 2.3 to 5.5             | 0.75 V <sub>CC</sub>   |      |     | 0.7 V <sub>CC</sub>             |     |                                   |                                                                                                             |                                                                                                         |  |
| V <sub>IL</sub>  | LOW Level Control<br>Input Voltage   | 1.8                    | 0.25 V <sub>CC</sub>   |      |     | 0.25 V <sub>CC</sub>            |     | V                                 |                                                                                                             |                                                                                                         |  |
|                  |                                      | 2.3 to 5.5             | 0.3 V <sub>CC</sub>    |      |     | 0.3 V <sub>CC</sub>             |     |                                   |                                                                                                             |                                                                                                         |  |
| V <sub>OH</sub>  | HIGH Level Control<br>Output Voltage | 1.8                    | 1.7                    | 1.8  | 1.7 |                                 | V   | V <sub>IN</sub> = V <sub>IH</sub> | I <sub>OH</sub> = -100 μA                                                                                   |                                                                                                         |  |
|                  |                                      | 2.3                    | 2.2                    | 2.3  | 2.2 |                                 |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 3.0                    | 2.9                    | 3.0  | 2.9 |                                 |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 4.5                    | 4.4                    | 4.5  | 4.4 |                                 |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 2.3                    | 1.9                    | 2.15 | 1.9 |                                 |     |                                   | I <sub>OH</sub> = -8 mA<br>I <sub>OH</sub> = -16 mA<br>I <sub>OH</sub> = -24 mA<br>I <sub>OH</sub> = -32 mA |                                                                                                         |  |
|                  |                                      | 3.0                    | 2.4                    | 2.8  | 2.4 |                                 |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 3.0                    | 2.3                    | 2.68 | 2.3 |                                 |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 4.5                    | 3.8                    | 4.2  | 3.8 |                                 |     |                                   |                                                                                                             |                                                                                                         |  |
| V <sub>OL</sub>  | LOW Level Control<br>Output Voltage  | 1.8                    | 0.0                    |      |     | 0.1                             |     | V                                 | V <sub>IN</sub> = V <sub>IH</sub>                                                                           | I <sub>OL</sub> = 100 μA                                                                                |  |
|                  |                                      | 2.3                    | 0.0                    |      |     | 0.1                             |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 3.0                    | 0.0                    |      |     | 0.1                             |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 4.5                    | 0.0                    |      |     | 0.1                             |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 2.3                    | 0.10                   |      |     | 0.3                             |     |                                   |                                                                                                             | I <sub>OL</sub> = 8 mA<br>I <sub>OL</sub> = 16 mA<br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 32 mA |  |
|                  |                                      | 3.0                    | 0.15                   |      |     | 0.4                             |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 3.0                    | 0.22                   |      |     | 0.55                            |     |                                   |                                                                                                             |                                                                                                         |  |
|                  |                                      | 4.5                    | 0.22                   |      |     | 0.55                            |     |                                   |                                                                                                             |                                                                                                         |  |
| I <sub>IN</sub>  | Input Leakage Current                | 0 to 5.5               | ±0.1                   |      |     | ±1.0                            |     | μA                                | 0 ≤ V <sub>IN</sub> ≤ 5.5V                                                                                  |                                                                                                         |  |
| I <sub>OZ</sub>  | 3-STATE Output Leakage               | 1.8 to 5.5             | ±0.5                   |      |     | ±5.0                            |     | μA                                | V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>0 ≤ V <sub>OUT</sub> ≤ 5.5V                         |                                                                                                         |  |
| I <sub>OFF</sub> | Power Off Leakage Current            | 0.0                    | 1.0                    |      |     | 10                              |     | μA                                | V <sub>IN</sub> or V <sub>OUT</sub> = 5.5V                                                                  |                                                                                                         |  |
| I <sub>CC</sub>  | Quiescent Supply Current             | 1.8 to 5.5             | 1.0                    |      |     | 10.0                            |     | μA                                | V <sub>IN</sub> = 5.5V, GND                                                                                 |                                                                                                         |  |

## AC Electrical Characteristics

| 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                                                                                                                                                                                                  | Fig. No.             |
|--------------------------------------|------------------------------|------------------------|------------------------|-----|------|---------------------------------|------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
|                                      |                              |                        | Min                    | Typ | Max  | Min                             | Max  |       |                                                                                                                                                                                                             |                      |
| f <sub>MAX</sub>                     | Maximum Clock Frequency      | 1.8                    |                        |     |      | 100                             |      | MHz   | C <sub>L</sub> = 50 pF<br>R <sub>L</sub> = 500Ω, S <sub>1</sub> = Open                                                                                                                                      | Figure 1<br>Figure 3 |
|                                      |                              | 2.5 ± 0.2              |                        |     |      | 125                             |      |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 3.3 ± 0.3              |                        |     |      | 150                             |      |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              |                        |     |      | 175                             |      |       |                                                                                                                                                                                                             |                      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>CP to Q | 1.8                    | 2.5                    | 6.5 | 10.0 | 2.5                             | 11.0 | ns    | C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 1 MΩ<br>S <sub>1</sub> = Open                                                                                                                                    | Figure 1<br>Figure 3 |
|                                      |                              | 2.5 ± 0.2              | 2.0                    | 3.8 | 6.5  | 2.0                             | 7.0  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 3.3 ± 0.3              | 1.5                    | 2.8 | 4.5  | 1.4                             | 5.0  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              | 1.0                    | 2.2 | 3.5  | 1.0                             | 3.8  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 3.3 ± 0.3              | 2.0                    | 3.4 | 5.5  | 1.6                             | 6.2  |       |                                                                                                                                                                                                             |                      |
| t <sub>pZL</sub><br>t <sub>pZH</sub> | Output Enable Time           | 1.8                    | 2.0                    | 6.0 | 9.0  | 2.0                             | 9.5  | ns    | C <sub>L</sub> = 50 pF, V <sub>I</sub> = 2x V <sub>CC</sub><br>R <sub>U</sub> , R <sub>D</sub> = 500 Ω<br>S <sub>1</sub> = GND for t <sub>pZH</sub><br>S <sub>1</sub> = V <sub>I</sub> for t <sub>pZL</sub> | Figure 1<br>Figure 4 |
|                                      |                              | 2.5 ± 0.2              | 2.0                    | 3.7 | 6.0  | 1.8                             | 6.6  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 3.3 ± 0.3              | 1.5                    | 2.8 | 5.0  | 1.4                             | 5.3  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              | 1.0                    | 2.2 | 3.7  | 1.0                             | 3.9  |       |                                                                                                                                                                                                             |                      |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub> | Output Disable Time          | 1.8                    | 2.0                    | 5.1 | 8.0  | 2.0                             | 8.5  | ns    | C <sub>L</sub> = 50 pF, V <sub>I</sub> = 2x V <sub>CC</sub><br>R <sub>U</sub> , R <sub>D</sub> = 500 Ω<br>S <sub>1</sub> = GND for t <sub>PHZ</sub><br>S <sub>1</sub> = V <sub>I</sub> for t <sub>PLZ</sub> | Figure 1<br>Figure 4 |
|                                      |                              | 2.5 ± 0.2              | 2.0                    | 3.5 | 6.0  | 1.8                             | 6.3  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 3.3 ± 0.3              | 1.5                    | 2.8 | 4.5  | 1.4                             | 4.7  |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              | 1.0                    | 2.3 | 3.7  | 1.0                             | 3.9  |       |                                                                                                                                                                                                             |                      |
| t <sub>S</sub>                       | Setup Time,<br>CP to D       | 2.5 ± 0.2              |                        |     |      | 2.5                             |      | ns    | C <sub>L</sub> = 50 pF<br>R <sub>L</sub> = 500 Ω, S <sub>1</sub> = Open                                                                                                                                     | Figure 1<br>Figure 5 |
|                                      |                              | 3.3 ± 0.3              |                        |     |      | 2.0                             |      |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              |                        |     |      | 1.5                             |      |       |                                                                                                                                                                                                             |                      |
| t <sub>H</sub>                       | Hold Time,<br>CP to D        | 2.5 ± 0.2              |                        |     |      | 1.5                             |      | ns    | C <sub>L</sub> = 50 pF<br>R <sub>L</sub> = 500 Ω, S <sub>1</sub> = Open                                                                                                                                     | Figure 1<br>Figure 5 |
|                                      |                              | 3.3 ± 0.3              |                        |     |      | 1.5                             |      |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              |                        |     |      | 1.5                             |      |       |                                                                                                                                                                                                             |                      |
| t <sub>W</sub>                       | Pulse Width, CP              | 2.5 ± 0.2              |                        |     |      | 3.0                             |      | ns    | C <sub>L</sub> = 50 pF<br>R <sub>L</sub> = 500 Ω, S <sub>1</sub> = Open                                                                                                                                     | Figure 1<br>Figure 5 |
|                                      |                              | 3.3 ± 0.3              |                        |     |      | 2.8                             |      |       |                                                                                                                                                                                                             |                      |
|                                      |                              | 5.0 ± 0.5              |                        |     |      | 2.5                             |      |       |                                                                                                                                                                                                             |                      |

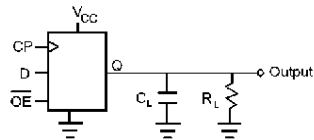
## Capacitance (Note 2)

| Symbol           | Parameter                              | Typ      | Max | Units | Conditions                                                      |
|------------------|----------------------------------------|----------|-----|-------|-----------------------------------------------------------------|
| C <sub>IN</sub>  | Input Capacitance                      | 3        |     | pF    | V <sub>CC</sub> = Open, V <sub>IN</sub> 0V or V <sub>CC</sub>   |
| C <sub>OUT</sub> | Output Capacitance                     | 4        |     | pF    | V <sub>CC</sub> = 3.3V, V <sub>IN</sub> = 0V or V <sub>CC</sub> |
| C <sub>PD</sub>  | Power Dissipation Capacitance (Note 3) | 10<br>12 |     | pF    | V <sub>CC</sub> = 3.3V<br>V <sub>CC</sub> = 5.0V                |

**Note 2:** T<sub>A</sub> = +25°C f = 1MHz

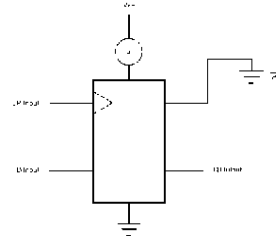
**Note 3:** C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output loading and operating at 50% duty cycle (See Figure 2) C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression  
I<sub>CCD</sub> = (C<sub>PD</sub>) (V<sub>CC</sub>) (f<sub>IN</sub>) + (I<sub>CCstatic</sub>)

## AC Loading and Waveforms



$C_L$  includes load and stray capacitance  
Input PRR = 1.0 MHz,  $t_w = 500$  ns

FIGURE 1. AC Test Circuit



CP Input = AC Waveform,  $t_r = t_f = 1.8$  ns,  
CP Input PRR = 10 MHz, Duty Cycle = 50%  
D Input PRR = 5 MHz, Duty Cycle = 50%

FIGURE 2.  $I_{CCD}$  Test Circuit

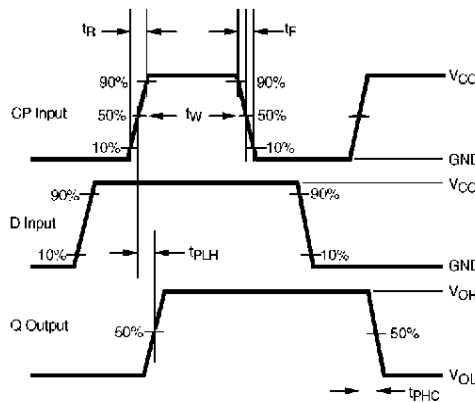


FIGURE 3. AC Waveforms

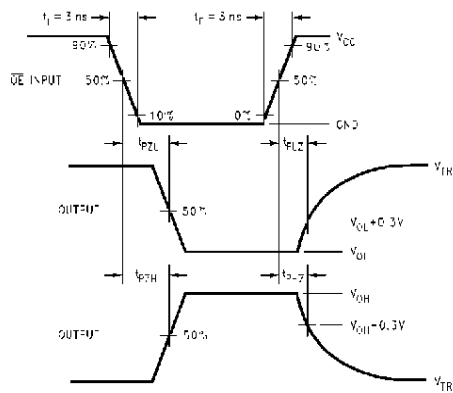


FIGURE 4. AC Waveforms

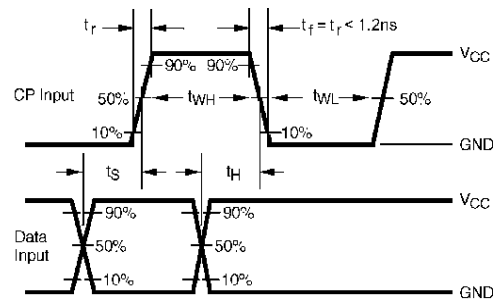


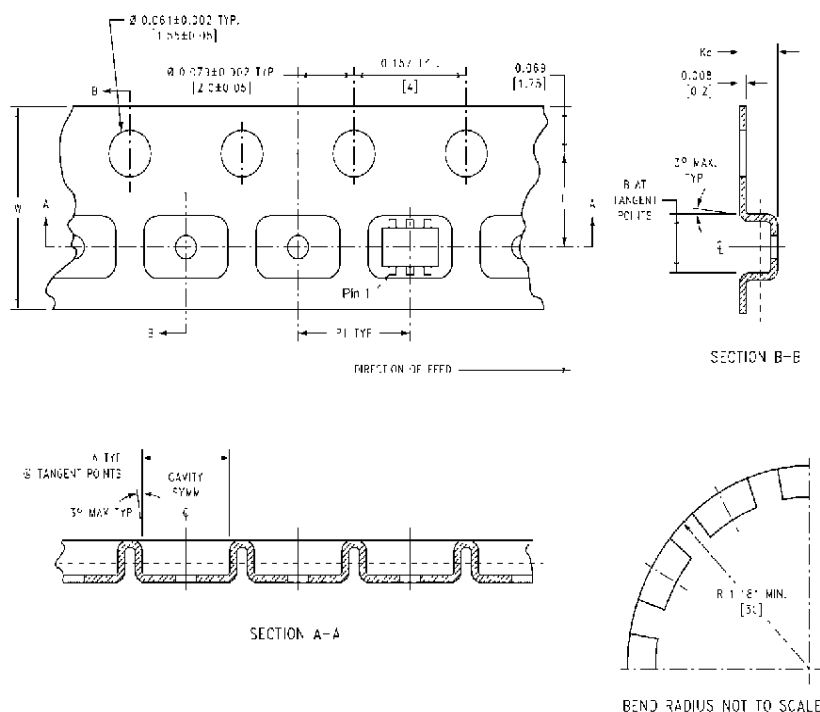
FIGURE 5. AC Waveforms

# Tape and Reel Specification

## TAPE FORMAT

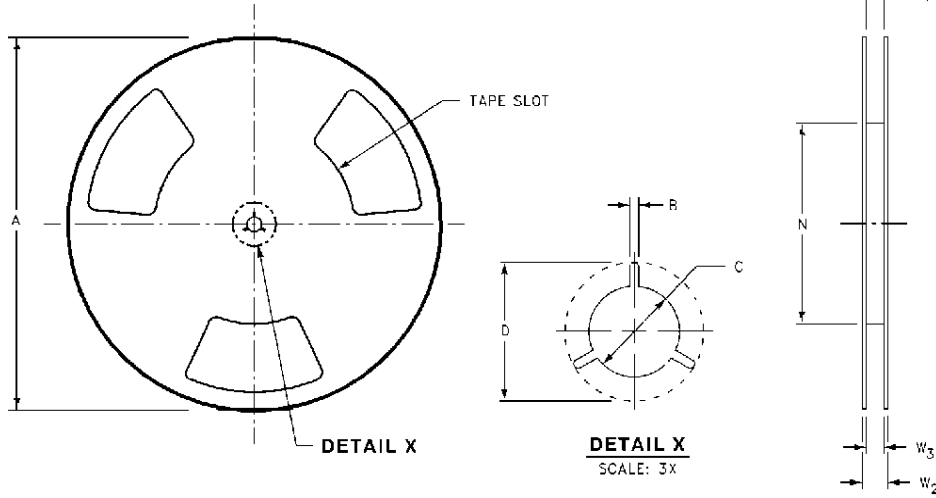
| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| P6                 | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 250             | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |
| P6X                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |

## TAPE DIMENSIONS inches (millimeters)



| Package | Tape Size | DIM A           | DIM B           | DIM F                         | DIM K <sub>0</sub>             | DIM P1       | DIM W                      |
|---------|-----------|-----------------|-----------------|-------------------------------|--------------------------------|--------------|----------------------------|
| SC70-6  | 8 mm      | 0.093<br>(2.35) | 0.096<br>(2.45) | 0.138 ± 0.004<br>(3.5 ± 0.10) | 0.053 ± 0.004<br>(1.35 ± 0.10) | 0.157<br>(4) | 0.315 ± 0.004<br>(8 ± 0.1) |

REEL DIMENSIONS inches (millimeters)



| Tape Size | A              | B               | C                | D                | N                | W1                                          | W2               | W3                                     |
|-----------|----------------|-----------------|------------------|------------------|------------------|---------------------------------------------|------------------|----------------------------------------|
| 8 mm      | 7.0<br>(177.8) | 0.059<br>(1.50) | 0.512<br>(13.00) | 0.795<br>(20.20) | 2.165<br>(55.00) | 0.331 + 0.059/-0.000<br>(8.40 + 1.50/-0.00) | 0.567<br>(14.40) | W1 + 0.078/-0.039<br>(W1 + 2.00/-1.00) |

