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## NC7SP74 TinyLogic® ULP D-Type Flip-Flop with Preset and Clear

### General Description

The NC7SP74 is a single D-type CMOS Flip-Flop with preset and clear from Fairchild's Ultra Low Power (ULP) Series of TinyLogic®. Ideal for applications where battery life is critical, this product is designed for ultra low power consumption within the  $V_{CC}$  operating range of 0.9V to 3.6V.

The internal circuit is composed of a minimum of inverter stages including the output buffer, to enable ultra low static and dynamic power.

The NC7SP74, for lower drive requirements, is uniquely designed for optimized power and speed, and is fabricated with an advanced CMOS technology to achieve best in class speed operation while maintaining extremely low CMOS power dissipation.

The signal level applied to the D input is transferred to the Q output during the positive going transition of the CLK pulse.

### Features

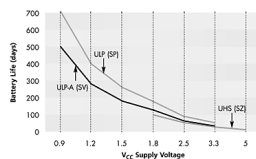
- Space saving US8 surface mount package
- MicroPak™ Pb-Free leadless package
- 0.9V to 3.6V  $V_{CC}$  supply operation
- 3.6V overvoltage tolerant I/Os at  $V_{CC}$  from 0.9V to 3.6V
- $t_{PD}$ 
  - 3.0 ns typ for 3.0V to 3.6V  $V_{CC}$
  - 4.0 ns typ for 2.3V to 2.7V  $V_{CC}$
  - 5.0 ns typ for 1.65V to 1.95V  $V_{CC}$
  - 6.0 ns typ for 1.40V to 1.60V  $V_{CC}$
  - 9.0 ns typ for 1.10V to 1.30V  $V_{CC}$
  - 24.0 ns typ for 0.90V  $V_{CC}$
- Power-Off high impedance inputs and outputs
- Static Drive ( $I_{OH}/I_{OL}$ )
  - ±2.6 mA @ 3.00V  $V_{CC}$
  - ±2.1 mA @ 2.30V  $V_{CC}$
  - ±1.5 mA @ 1.65V  $V_{CC}$
  - ±1.0 mA @ 1.40V  $V_{CC}$
  - ±0.5 mA @ 1.10V  $V_{CC}$
  - ±20  $\mu$ A @ 0.9V  $V_{CC}$
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Ultra low dynamic power

### Ordering Code:

| Order Number | Package Number | Product Code Top Mark | Package Description                               | Supplied As               |
|--------------|----------------|-----------------------|---------------------------------------------------|---------------------------|
| NC7SP74K8X   | MAB08A         | P74                   | 8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide | 3k Units on Tape and Reel |
| NC7SP74L8X   | MAC08A         | X9                    | Pb-Free 8-Lead MicroPak, 1.6 mm Wide              | 5k Units on Tape and Reel |

Pb-Free package per JEDEC J-STD-020B.

### Battery Life vs. $V_{CC}$ Supply Voltage



TinyLogic ULP and ULP-A with up to 50% less power consumption can extend your battery life significantly.

$$\text{Battery Life} = (V_{\text{battery}} \cdot I_{\text{battery}} \cdot 9) / (P_{\text{device}}) / 24 \text{hrs/day}$$

$$\text{Where, } P_{\text{device}} = (I_{CC} \cdot V_{CC}) + (C_{PD} + C_L) \cdot V_{CC}^2 \cdot f$$

Assumes ideal 3.6V Lithium Ion battery with current rating of 900mAh and derated 90% and device frequency at 10MHz, with  $C_L = 15$  pF load

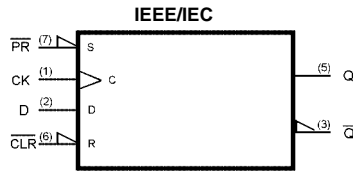
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**Pin Descriptions**

| Pin Names                | Description         |
|--------------------------|---------------------|
| D                        | Data Input          |
| CK                       | Clock Pulse Input   |
| $\overline{\text{CLR}}$  | Direct Clear Input  |
| Q, $\overline{\text{Q}}$ | Flip-Flop Output    |
| $\overline{\text{PR}}$   | Direct Preset Input |

**Logic Symbol**



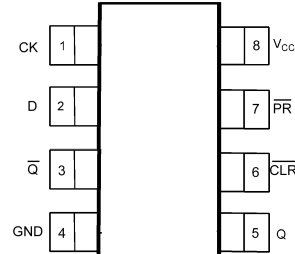
**Truth Table**

| Inputs                  |                        |   |    | Outputs      |                         | Function  |
|-------------------------|------------------------|---|----|--------------|-------------------------|-----------|
| $\overline{\text{CLR}}$ | $\overline{\text{PR}}$ | D | CK | Q            | $\overline{\text{Q}}$   |           |
| L                       | H                      | X | X  | L            | H                       | Clear     |
| H                       | L                      | X | X  | H            | L                       | Preset    |
| L                       | L                      | X | X  | H            | H                       | —         |
| H                       | H                      | L | ↑  | L            | H                       | —         |
| H                       | H                      | H | ↑  | H            | L                       | —         |
| H                       | H                      | X | ↓  | $\text{Q}_n$ | $\overline{\text{Q}}_n$ | No Change |

H = HIGH Logic Level  
 L = LOW Logic Level  
 $\text{Q}_n$  = No change in data  
 X = Immaterial  
 Z = High Impedance  
 ↑ = Rising Edge  
 ↓ = Falling edge

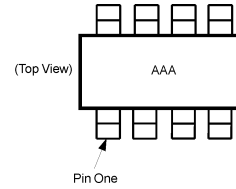
**Connection Diagrams**

**Pin Assignments for US8**



(Top View)

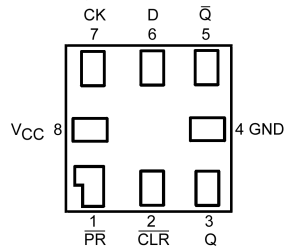
**Pin One Orientation Diagram**



AAA represents Product Code Top Mark - see ordering code

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

**Pad Assignments for MicroPak**



(Top Thru View)

| Absolute Maximum Ratings (Note 1)                 |                          | Recommended Operating Conditions (Note 3)       |                   |
|---------------------------------------------------|--------------------------|-------------------------------------------------|-------------------|
| Supply Voltage ( $V_{CC}$ )                       | -0.5V to +4.6V           | Power Supply                                    | 0.9V to 3.6V      |
| DC Input Voltage ( $V_{IN}$ )                     | -0.5V to +4.6V           | Input Voltage ( $V_{IN}$ )                      | 0V to 3.6V        |
| DC Output Voltage ( $V_{OUT}$ )                   | -0.5V to +7.0V           | Output Voltage ( $V_{OUT}$ )                    | HIGH or LOW State |
| HIGH or LOW State (Note 2)                        | -0.5V to $V_{CC} + 0.5V$ | HIGH or LOW State                               | 0V to $V_{CC}$    |
| $V_{CC} = 0V$                                     | -0.5V to 4.6V            | $V_{CC} = 0V$                                   | 0V to 3.6V        |
| DC Input Diode Current ( $I_{IK}$ ) $V_{IN} < 0V$ | $\pm 50$ mA              | Output Current in ( $I_{OH}/I_{OL}$ )           |                   |
| DC Output Diode Current ( $I_{OK}$ )              |                          | $V_{CC} = 3.0V$ to 3.6V                         | $\pm 2.6$ mA      |
| $V_{OUT} < 0V$                                    | -50 mA                   | $V_{CC} = 2.3V$ to 2.7V                         | $\pm 2.1$ mA      |
| $V_{OUT} > V_{CC}$                                | +50 mA                   | $V_{CC} = 1.65V$ to 1.95V                       | $\pm 1.5$ mA      |
| DC Output Source/Sink Current ( $I_{OH}/I_{OL}$ ) | $\pm 50$ mA              | $V_{CC} = 1.40V$ to 1.60V                       | $\pm 1.0$ mA      |
| DC $V_{CC}$ or Ground Current per                 |                          | $V_{CC} = 1.10V$ to 1.30V                       | $\pm 0.5$ mA      |
| Supply Pin ( $I_{CC}$ or Ground)                  | $\pm 50$ mA              | $V_{CC} = 0.9V$                                 | $\pm 20$ $\mu A$  |
| Storage Temperature Range ( $T_{STG}$ )           | -65°C to +150°C          | Free Air Operating Temperature ( $T_A$ )        | -40°C to +85°C    |
|                                                   |                          | Minimum Input Edge Rate ( $\Delta t/\Delta V$ ) |                   |
|                                                   |                          | $V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$        | 10 ns/V           |

**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.

**Note 2:**  $I_O$  Absolute Maximum rating must be observed.

**Note 3:** Unused inputs must be held HIGH or LOW. They may not float.

### DC Electrical Characteristics

| Symbol                       | Parameter                    | $V_{CC}$<br>(V)              | $T_A = +25^\circ C$ |                 | $T_A = -40^\circ C$ to $+85^\circ C$ |                 | Units | Conditions           |
|------------------------------|------------------------------|------------------------------|---------------------|-----------------|--------------------------------------|-----------------|-------|----------------------|
|                              |                              |                              | Min                 | Max             | Min                                  | Max             |       |                      |
| $V_{IH}$                     | HIGH Level<br>Input Voltage  | 0.90                         | 0.65 x $V_{CC}$     |                 | 0.65 x $V_{CC}$                      |                 | V     |                      |
|                              |                              | $1.10 \leq V_{CC} \leq 1.30$ | 0.65 x $V_{CC}$     |                 | 0.65 x $V_{CC}$                      |                 |       |                      |
|                              |                              | $1.40 \leq V_{CC} \leq 1.60$ | 0.65 x $V_{CC}$     |                 | 0.65 x $V_{CC}$                      |                 |       |                      |
|                              |                              | $1.65 \leq V_{CC} \leq 1.95$ | 0.65 x $V_{CC}$     |                 | 0.65 x $V_{CC}$                      |                 |       |                      |
|                              |                              | $2.30 \leq V_{CC} \leq 2.70$ | 1.6                 |                 | 1.6                                  |                 |       |                      |
|                              |                              | $3.00 \leq V_{CC} \leq 3.60$ | 2.1                 |                 | 2.1                                  |                 |       |                      |
| $V_{IL}$                     | LOW Level<br>Input Voltage   | 0.90                         |                     | 0.35 x $V_{CC}$ |                                      | 0.35 x $V_{CC}$ | V     |                      |
|                              |                              | $1.10 \leq V_{CC} \leq 1.30$ |                     | 0.35 x $V_{CC}$ |                                      | 0.35 x $V_{CC}$ |       |                      |
|                              |                              | $1.40 \leq V_{CC} \leq 1.60$ |                     | 0.35 x $V_{CC}$ |                                      | 0.35 x $V_{CC}$ |       |                      |
|                              |                              | $1.65 \leq V_{CC} \leq 1.95$ |                     | 0.35 x $V_{CC}$ |                                      | 0.35 x $V_{CC}$ |       |                      |
|                              |                              | $2.30 \leq V_{CC} \leq 2.70$ |                     | 0.7             |                                      | 0.7             |       |                      |
|                              |                              | $3.00 \leq V_{CC} \leq 3.60$ |                     | 0.9             | 0.9                                  |                 |       |                      |
| $V_{OH}$                     | HIGH Level<br>Output Voltage | 0.90                         | $V_{CC} - 0.1$      |                 | $V_{CC} - 0.1$                       |                 | V     | $I_{OH} = -20 \mu A$ |
|                              |                              | $1.10 \leq V_{CC} \leq 1.30$ | $V_{CC} - 0.1$      |                 | $V_{CC} - 0.1$                       |                 |       |                      |
|                              |                              | $1.40 \leq V_{CC} \leq 1.60$ | $V_{CC} - 0.1$      |                 | $V_{CC} - 0.1$                       |                 |       |                      |
|                              |                              | $1.65 \leq V_{CC} \leq 1.95$ | $V_{CC} - 0.1$      |                 | $V_{CC} - 0.1$                       |                 |       |                      |
|                              |                              | $2.30 \leq V_{CC} \leq 2.70$ | $V_{CC} - 0.1$      |                 | $V_{CC} - 0.1$                       |                 |       |                      |
|                              |                              | $3.00 \leq V_{CC} \leq 3.60$ | $V_{CC} - 0.1$      |                 | $V_{CC} - 0.1$                       |                 |       |                      |
|                              |                              | $1.10 \leq V_{CC} \leq 1.30$ | 0.75 x $V_{CC}$     |                 | 0.70 x $V_{CC}$                      |                 |       |                      |
|                              |                              | $1.40 \leq V_{CC} \leq 1.60$ | 1.07                |                 | 0.99                                 |                 |       |                      |
|                              |                              | $1.65 \leq V_{CC} \leq 1.95$ | 1.24                |                 | 1.22                                 |                 |       |                      |
| $2.30 \leq V_{CC} \leq 2.70$ | 1.95                         |                              | 1.87                |                 |                                      |                 |       |                      |
|                              | $3.00 \leq V_{CC} \leq 3.60$ | 2.61                         |                     | 2.55            |                                      |                 |       |                      |

| DC Electrical Characteristics (Continued) |                             |                               |                        |                        |                                 |                        |       |                                               |
|-------------------------------------------|-----------------------------|-------------------------------|------------------------|------------------------|---------------------------------|------------------------|-------|-----------------------------------------------|
| 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                    | Max                    | Min                             | Max                    |       |                                               |
| V <sub>OL</sub>                           | LOW Level<br>Output Voltage | 0.90                          |                        | 0.1                    |                                 | 0.1                    | V     | I <sub>OL</sub> = 20 μA                       |
|                                           |                             | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 |                        | 0.1                    |                                 | 0.1                    |       |                                               |
|                                           |                             | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 |                        | 0.1                    |                                 | 0.1                    |       |                                               |
|                                           |                             | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 |                        | 0.1                    |                                 | 0.1                    |       |                                               |
|                                           |                             | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 |                        | 0.1                    |                                 | 0.1                    |       |                                               |
|                                           |                             | 3.00 ≤ V <sub>CC</sub> ≤ 3.60 |                        | 0.1                    |                                 | 0.1                    |       |                                               |
|                                           |                             | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 |                        | 0.30 × V <sub>CC</sub> |                                 | 0.30 × V <sub>CC</sub> |       |                                               |
|                                           |                             | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 |                        | 0.31                   |                                 | 0.37                   |       |                                               |
|                                           |                             | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 |                        | 0.31                   |                                 | 0.35                   |       |                                               |
| 2.30 ≤ V <sub>CC</sub> ≤ 2.70             |                             | 0.31                          |                        | 0.33                   |                                 |                        |       |                                               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             |                             | 0.31                          |                        | 0.33                   |                                 |                        |       |                                               |
| I <sub>IN</sub>                           | Input Leakage Current       | 0.90 to 3.60                  |                        | ±0.1                   |                                 | ±0.5                   | μA    | 0 ≤ V <sub>I</sub> ≤ 3.6V                     |
| I <sub>OFF</sub>                          | Power Off Leakage Current   | 0                             |                        | 0.5                    |                                 | 0.5                    | μA    | 0 ≤ (V <sub>I</sub> , V <sub>O</sub> ) ≤ 3.6V |
| I <sub>CC</sub>                           | Quiescent Supply Current    | 0.90 to 3.60                  |                        | 0.9                    |                                 | 0.9                    | μA    | V <sub>I</sub> = V <sub>CC</sub> or GND       |

| AC Electrical Characteristics (10pF, 1MΩ) |                                                                                         |                               |                        |      |      |                                 |      |       |                                                 |               |
|-------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------|------------------------|------|------|---------------------------------|------|-------|-------------------------------------------------|---------------|
| 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                                      | Figure Number |
|                                           |                                                                                         |                               | Min                    | Typ  | Max  | Min                             | Max  |       |                                                 |               |
| f <sub>MAX</sub>                          | Maximum Clock Frequency                                                                 | 0.90                          |                        | 40.0 |      |                                 |      | MHz   | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 5  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 50                     |      |      | 50                              |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 75                     |      |      | 75                              |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 100                    |      |      | 100                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 125                    |      |      | 125                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 150                                                                                     |                               |                        | 150  |      |                                 |      |       |                                                 |               |
| t <sub>PLH</sub><br>t <sub>PHL</sub>      | Propagation Delay<br>CK to Q, $\bar{Q}$                                                 | 0.90                          |                        | 24.0 |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 3  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 4.0                    | 15.0 | 22.0 | 3.5                             | 31.0 |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 2.0                    | 9.0  | 13.0 | 1.5                             | 14.0 |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 1.5                    | 7.0  | 11.0 | 1.0                             | 13.0 |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.0                    | 5.0  | 8.0  | 0.8                             | 9.0  |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                                     | 4.0                           | 7.0                    | 0.5  | 8.0  |                                 |      |       |                                                 |               |
| t <sub>PLH</sub><br>t <sub>PHL</sub>      | Propagation Delay<br>$\overline{\text{CLR}}$ , $\overline{\text{PR}}$ , to Q, $\bar{Q}$ | 0.90                          |                        | 6.5  |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 3  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 4.0                    | 12.0 | 23.0 | 4.0                             | 34.0 |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 2.0                    | 9.0  | 12.0 | 2.0                             | 14.0 |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 1.5                    | 7.0  | 11.0 | 1.5                             | 13.0 |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.0                    | 5.0  | 9.0  | 1.0                             | 9.0  |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                                     | 4.0                           | 7.0                    | 1.0  | 8.0  |                                 |      |       |                                                 |               |
| t <sub>S</sub>                            | Setup Time,<br>CK to D                                                                  | 0.90                          |                        | 10.0 |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 7.0                    |      |      | 7.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    |      |      | 2.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.5                    |      |      | 1.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                                     |                               |                        | 1.0  |      |                                 |      |       |                                                 |               |
| t <sub>H</sub>                            | Hold Time,<br>CK to D                                                                   | 0.90                          |                        | 1.0  |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 0.5                                                                                     |                               |                        | 0.5  |      |                                 |      |       |                                                 |               |
| t <sub>W</sub>                            | Pulse Width,<br>CK, $\overline{\text{PR}}$ , $\overline{\text{CLR}}$                    | 0.90                          |                        | 5.0  |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 5  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 5.0                    |      |      | 5.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 2.0                                                                                     |                               |                        | 2.0  |      |                                 |      |       |                                                 |               |
| t <sub>REC</sub>                          | Recover Time<br>$\overline{\text{CLR}}$ , $\overline{\text{PR}}$ to CK                  | 0.90                          |                        | 12.0 |      |                                 |      | ns    | C <sub>L</sub> = 10 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 8.5                    |      |      | 8.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.5                    |      |      | 3.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 2.0                                                                                     |                               |                        | 2.0  |      |                                 |      |       |                                                 |               |

| AC Electrical Characteristics (15pF, 1MΩ) |                                                                           |                               |                        |      |      |                                 |      |       |                                                 |               |
|-------------------------------------------|---------------------------------------------------------------------------|-------------------------------|------------------------|------|------|---------------------------------|------|-------|-------------------------------------------------|---------------|
| 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                                      | Figure Number |
|                                           |                                                                           |                               | Min                    | Typ  | Max  | Min                             | Max  |       |                                                 |               |
| f <sub>MAX</sub>                          | Maximum Clock Frequency                                                   | 0.90                          |                        | 40.0 |      |                                 |      | MHz   | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 5  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 50                     |      |      | 150                             |      |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 75                     |      |      | 200                             |      |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 100                    |      |      | 250                             |      |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 125                    |      |      | 175                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 150                                                                       |                               |                        | 200  |      |                                 |      |       |                                                 |               |
| t <sub>PLH</sub><br>t <sub>PHL</sub>      | Propagation Delay<br>CK to Q, $\bar{Q}$                                   | 0.90                          |                        | 27.0 |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 3  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 5.0                    | 16.0 | 23.0 | 4.5                             | 34.0 |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    | 10.0 | 14.0 | 2.5                             | 16.0 |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    | 7.0  | 11.0 | 2.0                             | 13.0 |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.5                    | 5.0  | 8.0  | 1.0                             | 9.0  |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                       | 4.0                           | 7.0                    | 0.5  | 8.0  |                                 |      |       |                                                 |               |
| t <sub>PLH</sub><br>t <sub>PHL</sub>      | Propagation Delay<br>$\overline{CLR}$ , $\overline{PR}$ , to Q, $\bar{Q}$ | 0.90                          |                        | 27.0 |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 3  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 5.0                    | 15.0 | 24.0 | 5.0                             | 37.0 |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    | 10.0 | 13.0 | 3.0                             | 16.0 |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    | 7.0  | 11.0 | 2.0                             | 13.0 |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.5                    | 5.0  | 9.0  | 1.5                             | 9.0  |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                       | 4.0                           | 7.0                    | 1.0  | 8.0  |                                 |      |       |                                                 |               |
| t <sub>S</sub>                            | Setup Time,<br>CK to D                                                    | 0.90                          |                        | 10.0 |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 7.0                    |      |      | 7.0                             |      |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    |      |      | 2.0                             |      |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.5                    |      |      | 1.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                       |                               |                        | 1.0  |      |                                 |      |       |                                                 |               |
| t <sub>H</sub>                            | Hold Time,<br>CK to D                                                     | 0.90                          |                        | 1.0  |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 0.5                                                                       |                               |                        | 0.5  |      |                                 |      |       |                                                 |               |
| t <sub>W</sub>                            | Pulse Width,<br>CK, $\overline{PR}$ , $\overline{CLR}$                    | 0.90                          |                        | 5.0  |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 5  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 5.0                    |      |      | 5.0                             |      |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 2.0                                                                       |                               |                        | 2.0  |      |                                 |      |       |                                                 |               |
| t <sub>REC</sub>                          | Recover Time<br>$\overline{CLR}$ , $\overline{PR}$ to CK                  | 0.90                          |                        | 12.0 |      |                                 |      | ns    | C <sub>L</sub> = 15 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 8.5                    |      |      | 8.5                             |      |       |                                                 |               |
|                                           |                                                                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.5                    |      |      | 3.5                             |      |       |                                                 |               |
|                                           |                                                                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 2.0                                                                       |                               |                        | 2.0  |      |                                 |      |       |                                                 |               |

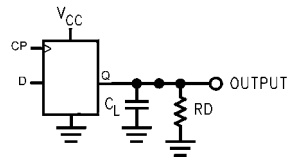
| AC Electrical Characteristics (30pF, 1MΩ) |                                                                                         |                               |                        |      |      |                                 |      |       |                                                 |               |
|-------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------|------------------------|------|------|---------------------------------|------|-------|-------------------------------------------------|---------------|
| 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                                      | Figure Number |
|                                           |                                                                                         |                               | Min                    | Typ  | Max  | Min                             | Max  |       |                                                 |               |
| f <sub>MAX</sub>                          | Maximum Clock Frequency                                                                 | 0.90                          |                        | 40.0 |      |                                 |      | MHz   | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 5  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 50                     |      |      | 150                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 75                     |      |      | 200                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 100                    |      |      | 250                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 125                    |      |      | 175                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 150                                                                                     |                               |                        | 200  |      |                                 |      |       |                                                 |               |
| t <sub>PLH</sub><br>t <sub>PHL</sub>      | Propagation Delay<br>CK to Q, $\bar{Q}$                                                 | 0.90                          |                        | 34.0 |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 3  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 6.0                    | 18.0 | 27.0 | 5.0                             | 43.0 |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 4.0                    | 11.0 | 17.0 | 3.0                             | 18.0 |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    | 8.0  | 13.0 | 2.0                             | 15.0 |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.0                    | 6.0  | 10.0 | 1.0                             | 11.0 |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 0.8                                                                                     | 5.0                           | 8.0                    | 0.5  | 10.0 |                                 |      |       |                                                 |               |
| t <sub>PLH</sub><br>t <sub>PHL</sub>      | Propagation Delay<br>$\overline{\text{CLR}}$ , $\overline{\text{PR}}$ , to Q, $\bar{Q}$ | 0.90                          |                        | 34.0 |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 3  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 6.0                    | 17.0 | 28.0 | 5.5                             | 46.0 |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 4.0                    | 11.0 | 16.0 | 3.5                             | 18.0 |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    | 8.0  | 13.0 | 2.5                             | 15.0 |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.0                    | 6.0  | 9.0  | 1.5                             | 11.0 |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 0.8                                                                                     | 5.0                           | 8.0                    | 1.0  | 10.0 |                                 |      |       |                                                 |               |
| t <sub>S</sub>                            | Setup Time,<br>CK to D                                                                  | 0.90                          |                        | 10.0 |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 7.0                    |      |      | 7.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.0                    |      |      | 2.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 1.5                    |      |      | 1.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 1.0                                                                                     |                               |                        | 1.0  |      |                                 |      |       |                                                 |               |
| t <sub>H</sub>                            | Hold Time,<br>CK to D                                                                   | 0.90                          |                        | 1.0  |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 0.5                    |      |      | 0.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 0.5                                                                                     |                               |                        | 0.5  |      |                                 |      |       |                                                 |               |
| t <sub>W</sub>                            | Pulse Width,<br>CK, $\overline{\text{PR}}$ , $\overline{\text{CLR}}$                    | 0.90                          |                        | 5.0  |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 5  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 5.0                    |      |      | 4.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 2.5                    |      |      | 2.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.5                    |      |      | 3.0                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 2.0                                                                                     |                               |                        | 2.0  |      |                                 |      |       |                                                 |               |
| t <sub>REC</sub>                          | Recover Time<br>$\overline{\text{CLR}}$ , $\overline{\text{PR}}$ to CK                  | 0.90                          |                        | 12.0 |      |                                 |      | ns    | C <sub>L</sub> = 30 pF<br>R <sub>D</sub> = 1 MΩ | Figures 1, 4  |
|                                           |                                                                                         | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | 8.5                    |      |      | 8.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | 3.5                    |      |      | 3.5                             |      |       |                                                 |               |
|                                           |                                                                                         | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | 3.0                    |      |      | 3.0                             |      |       |                                                 |               |
|                                           |                                                                                         | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | 2.5                    |      |      | 2.5                             |      |       |                                                 |               |
| 3.00 ≤ V <sub>CC</sub> ≤ 3.60             | 2.0                                                                                     |                               |                        | 2.0  |      |                                 |      |       |                                                 |               |

| Capacitance      |                               |     |     |       |                                                      |               |
|------------------|-------------------------------|-----|-----|-------|------------------------------------------------------|---------------|
| Symbol           | Parameter                     | Typ | Max | Units | Conditions                                           | Figure Number |
| C <sub>IN</sub>  | Input Capacitance             | 2.0 |     | pF    | V <sub>CC</sub> = 0V                                 |               |
| C <sub>OUT</sub> | Output Capacitance            | 4.0 |     | pF    | V <sub>CC</sub> = 0V                                 |               |
| C <sub>PD</sub>  | Power Dissipation Capacitance | 8.0 |     | pF    | V <sub>I</sub> = 0V or V <sub>CC</sub><br>f = 10 MHz | Figure 2      |

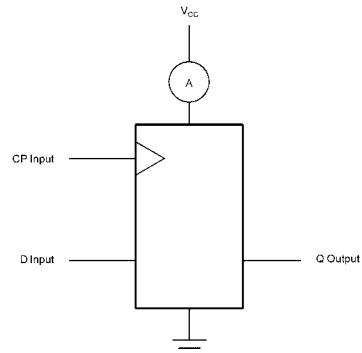


## AC Loading and Waveforms



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

FIGURE 1. AC Test Circuit



CP Input = AC Waveform;  $t_r = t_f = 2.5$  ns;  
 CP Input PRR = 10 MHz; Duty Cycle = 50%  
 D Input PRR = 5MHz; Duty Cycle = 50%

FIGURE 2.  $I_{CCD}$  Test Circuit

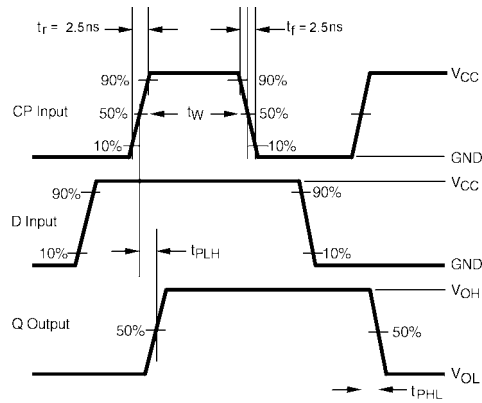


FIGURE 3. AC Waveforms

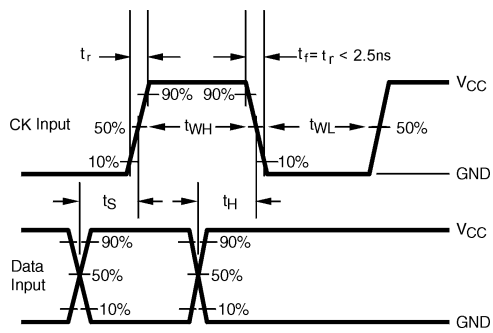


FIGURE 4. AC Waveforms

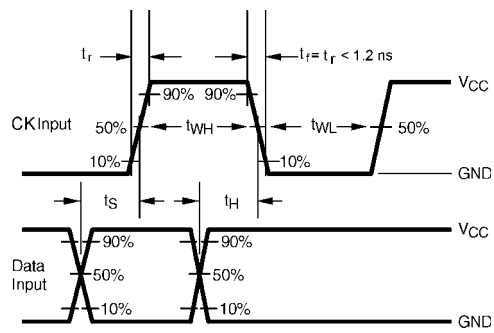


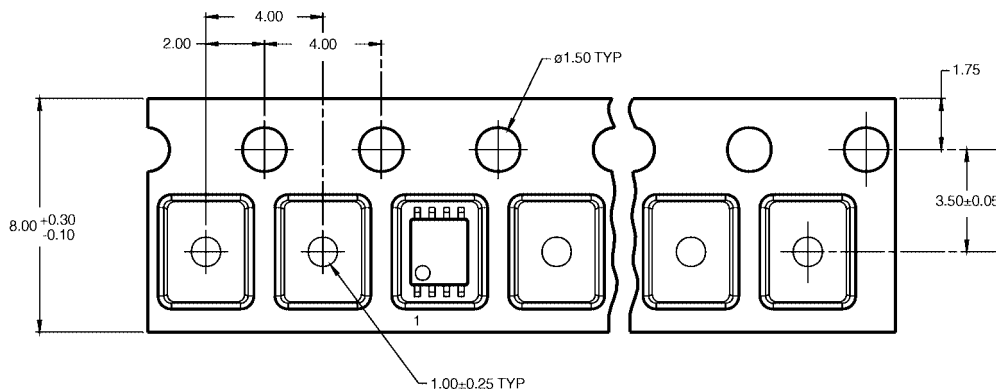
FIGURE 5. AC Waveforms

## Tape and Reel Specification

### TAPE FORMAT for US8

| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| K8X                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |

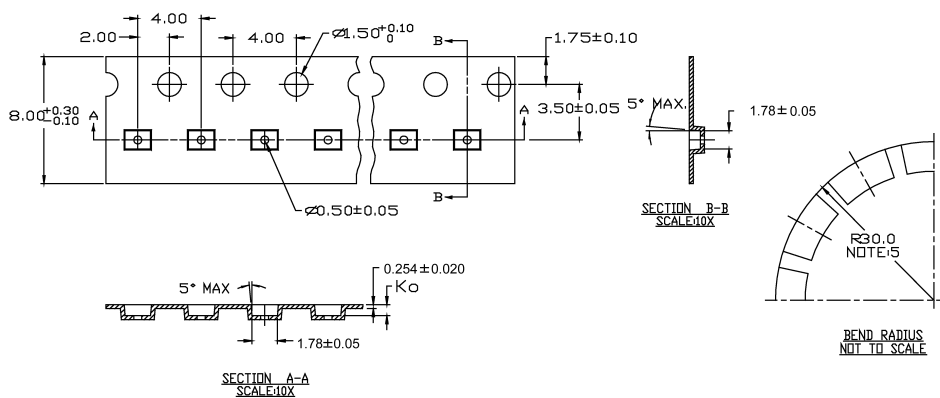
### TAPE DIMENSIONS inches (millimeters)



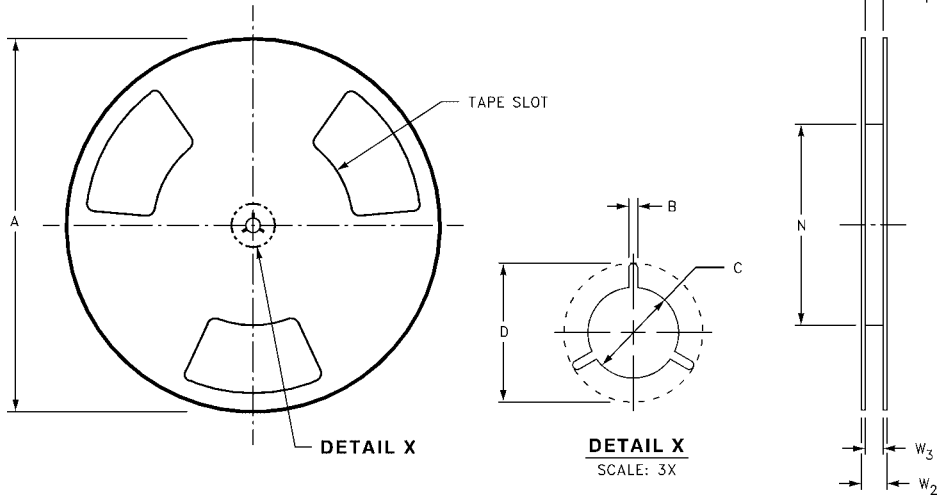
### TAPE FORMAT for MicroPak

| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| L8X                | Leader (Start End) | 125 (typ)       | Empty         | Sealed            |
|                    | Carrier            | 3000            | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ)        | Empty         | Sealed            |

### TAPE DIMENSIONS inches (millimeters)

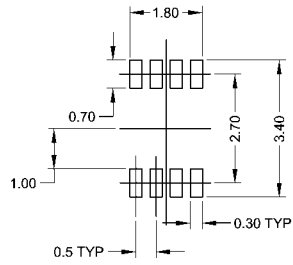
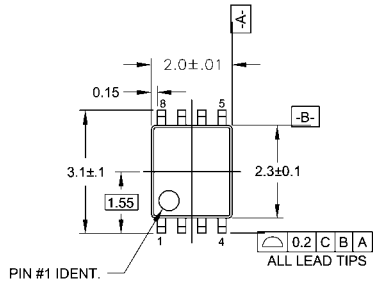


**Tape and Reel Specification** (Continued)  
**REEL DIMENSIONS** inches (millimeters)

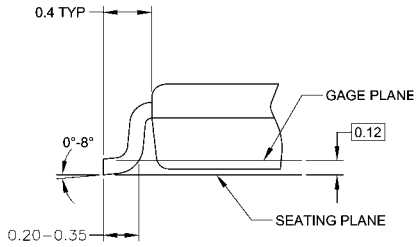
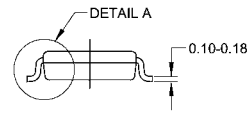
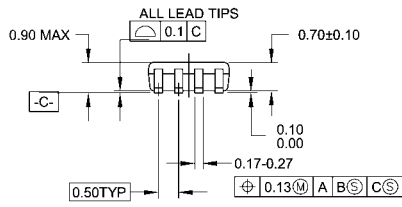


| Tape Size | A              | B               | C                | D                | N                | W1                                                | W2               | W3                                           |
|-----------|----------------|-----------------|------------------|------------------|------------------|---------------------------------------------------|------------------|----------------------------------------------|
| 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>( $W1 + 2.00/-1.00$ ) |

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



LAND PATTERN RECOMMENDATION



DETAIL A

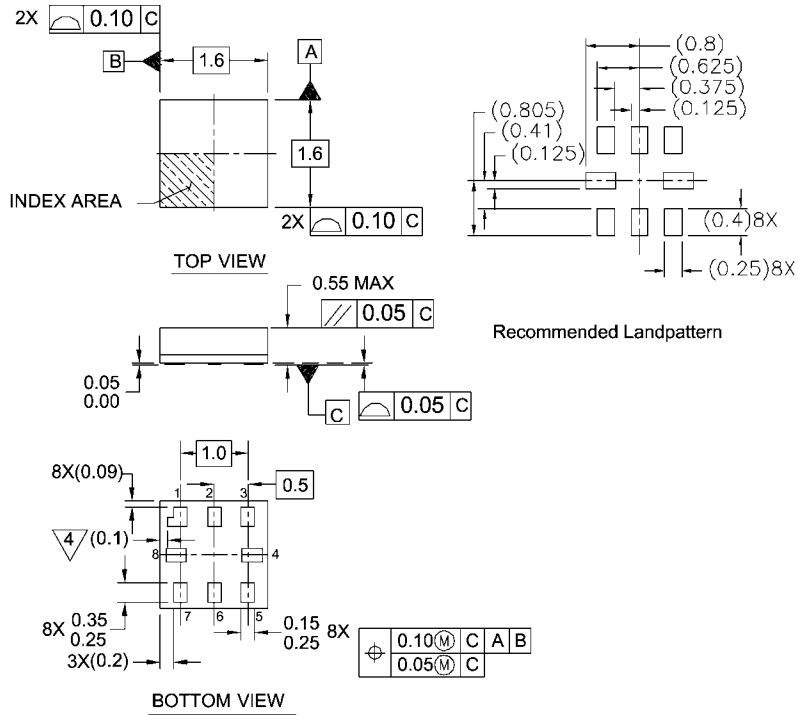
NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-187
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MAB08AREVC

**8-Lead US8, JEDEC MO-187, Variation CA 3.1mm Wide  
Package Number MAB08A**

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



**Notes:**

1. PACKAGE CONFORMS TO JEDEC MO-255 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y.14M-1994
4. PIN 1 FLAG, END OF PACKAGE OFFSET.

MAC08AREVC

**Pb-Free 8-Lead MicroPak, 1.6 mm Wide  
Package Number MAC08A**

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