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# NC7SP14
# TinyLogic® ULP Inverter with Schmitt Trigger Input

## General Description

The NC7SP14 is a single inverter with Schmitt trigger input 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 $V_{CC}$.

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

The NC7SP14, 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.

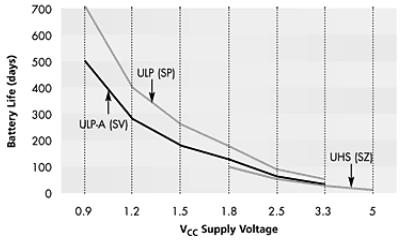
## Features

- 0.9V to 3.6V $V_{CC}$ supply operation
- 3.6V overvoltage tolerant I/O's at $V_{CC}$ from 0.9V to 3.6V
- $t_{PD}$
  - 4.0 ns typ for 3.0V to 3.6V $V_{CC}$
  - 5.0 ns typ for 2.3V to 2.7V $V_{CC}$
  - 6.0 ns typ for 1.65V to 1.95V $V_{CC}$
  - 7.0 ns typ for 1.40V to 1.60V $V_{CC}$
  - 11.0 ns typ for 1.10V to 1.30V $V_{CC}$
  - 27.0 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 μA @ 0.9V $V_{CC}$
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Ultra small MicroPak™ leadfree package
- Ultra low dynamic power

## Ordering Code:

| Order Number | Package Number | Product Code Top Mark | Package Description | Supplied As |
|---|---|---|---|---|
| NC7SP14P5X | MAA05A | P14 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| NC7SP14L6X | MAC06A | K3 | 6-Lead MicroPak, 1.0mm Wide | 5k Units on Tape and Reel |

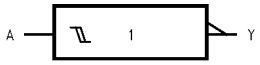
## Battery Life vs. $V_{CC}$ Supply Voltage




TinyLogic ULP and ULP-A with up to 50% less power consumption can extend your battery life significantly.
Battery Life = $(V_{battery} * I_{battery} * .9)/(P_{device})/24$hrs/day
Where, $P_{device} = (I_{CC} * V_{CC}) + (C_{PD} + C_L) * V_{CC}^2 * f$
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

## Logic Symbol

**IEEE/IEC**




## Pin Descriptions

| Pin Names | Description |
|---|---|
| A | Input |
| Y | Output |
| NC | No Connect |

## Function Table

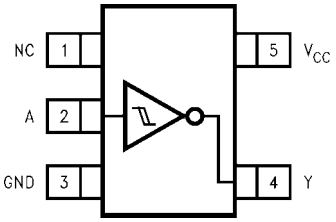
$Y = \overline{A}$

| Inputs | Output |
|---|---|
| **A** | **Y** |
| L | H |
| H | L |

H = HIGH Logic Level
L = LOW Logic Level

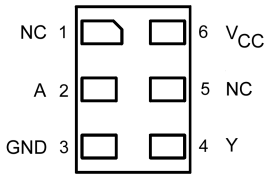
## Connection Diagrams

**Pin Assignments for SC70**




**(Top View)**

**Pad Assignments for MicroPak**




**(Top Thru View)**

## Absolute Maximum Ratings (Note 1)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.5V to +4.6V |
| DC Input Voltage ($V_{IN}$) | −0.5V to +4.6V |
| DC Output Voltage ($V_{OUT}$) | |
| HIGH or LOW State (Note 2) | −0.5V to $V_{CC}$ +0.5V |
| $V_{CC}$ = 0V | −0.5V to 4.6V |
| DC Input Diode Current ($I_{IK}$) $V_{IN}$ < 0V | ±50 mA |
| DC Output Diode Current ($I_{OK}$) | |
| $V_{OUT}$ < 0V | −50 mA |
| $V_{OUT}$ > $V_{CC}$ | +50 mA |
| DC Output Source/Sink Current ($I_{OH}/I_{OL}$) | ± 50 mA |
| DC $V_{CC}$ or Ground Current per | |
| Supply Pin ($I_{CC}$ or Ground) | ± 50 mA |
| Storage Temperature Range ($T_{STG}$) | −65°C to +150°C |

## Recommended Operating Conditions (Note 3)

| | |
|---|---|
| Supply Voltage | 0.9V to 3.6V |
| Input Voltage ($V_{IN}$) | 0.0V to 3.6V |
| Output Voltage ($V_{OUT}$) | |
| HIGH or LOW State | 0V to $V_{CC}$ |
| $V_{CC}$ = 0V | 0V to 3.6V |
| Output Current in $I_{OH}/I_{OL}$ | |
| $V_{CC}$ = 3.0V to 3.6V | ±2.6 mA |
| $V_{CC}$ = 2.3V to 2.7V | ± 2.1 mA |
| $V_{CC}$ = 1.65V to 1.95V | ± 1.5 mA |
| $V_{CC}$ = 1.40V to 1.60V | ± 1 mA |
| $V_{CC}$ = 1.10V to 1.30V | ±0.5 mA |
| $V_{CC}$ = 0.9V | ±20 µA |
| 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 | $V_{CC}$ (V) | $T_A$ = +25°C | | $T_A$ = −40°C to +85°C | | Units | Conditions |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | | |
| $V_P$ | Positive Threshold Voltage | 0.90 | 0.3 | 0.6 | 0.3 | 0.6 | V | |
| | | 1.10 | 0.4 | 1.0 | 0.4 | 1.0 | | |
| | | 1.40 | 0.5 | 1.2 | 0.5 | 1.2 | | |
| | | 1.65 | 0.7 | 1.5 | 0.7 | 1.5 | | |
| | | 2.30 | 1.0 | 1.9 | 1.0 | 1.9 | | |
| | | 3.00 | 1.5 | 2.6 | 1.5 | 2.6 | | |
| $V_N$ | Negative Threshold Voltage | 0.90 | 0.1 | 0.6 | 0.1 | 0.6 | V | |
| | | 1.10 | 0.15 | 0.7 | 0.15 | 0.7 | | |
| | | 1.40 | 0.2 | 0.8 | 0.2 | 0.8 | | |
| | | 1.65 | 0.25 | 0.9 | 0.25 | 0.9 | | |
| | | 2.30 | 0.4 | 1.15 | 0.4 | 1.15 | | |
| | | 3.00 | 0.6 | 1.5 | 0.6 | 1.5 | | |
| $V_H$ | Hysteresis Voltage | 0.90 | 0.07 | 0.5 | 0.07 | 0.5 | V | |
| | | 1.10 | 0.08 | 0.6 | 0.08 | 0.6 | | |
| | | 1.40 | 0.09 | 0.8 | 0.09 | 0.8 | | |
| | | 1.65 | 0.10 | 1.0 | 0.10 | 1.0 | | |
| | | 2.30 | 0.25 | 1.1 | 0.25 | 1.1 | | |
| | | 3.00 | 0.60 | 1.8 | 0.60 | 1.8 | | |

## DC Electrical Characteristics (Continued)

| Symbol | Parameter | $V_{CC}$ (V) | $T_A = +25°C$ | | $T_A = -40°C$ to $+85°C$ | | Units | Conditions |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | | |
| $V_{OH}$ | HIGH Level Output Voltage | 0.90 | $V_{CC}$ – 0.1 | | $V_{CC}$ – 0.1 | | V | $I_{OH}$ = –20 μA |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | $V_{CC}$ – 0.1 | | $V_{CC}$ – 0.1 | | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | $V_{CC}$ – 0.1 | | $V_{CC}$ – 0.1 | | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | $V_{CC}$ – 0.1 | | $V_{CC}$ – 0.1 | | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | $V_{CC}$ – 0.1 | | $V_{CC}$ – 0.1 | | | |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | $V_{CC}$ – 0.1 | | $V_{CC}$ – 0.1 | | | |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | 0.75 x $V_{CC}$ | | 0.70 x $V_{CC}$ | | | $I_{OH}$ = –0.5 mA |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | 1.07 | | 0.99 | | | $I_{OH}$ = –1 mA |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | 1.24 | | 1.22 | | | $I_{OH}$ = –1.5 mA |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | 1.95 | | 1.87 | | | $I_{OH}$ = –2.1 mA |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | 2.61 | | 2.55 | | | $I_{OH}$ = –2.6 mA |
| $V_{OL}$ | LOW Level Output Voltage | 0.90 | | 0.1 | | 0.1 | V | $I_{OL}$ = 20 μA |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | | 0.1 | | 0.1 | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | | 0.1 | | 0.1 | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | | 0.1 | | 0.1 | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | | 0.1 | | 0.1 | | |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | | 0.1 | | 0.1 | | |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | | 0.30 x $V_{CC}$ | | 0.30 x $V_{CC}$ | | $I_{OL}$ = 0.5 mA |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | | 0.31 | | 0.37 | | $I_{OL}$ = 1 mA |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | | 0.31 | | 0.35 | | $I_{OL}$ = 1.5 mA |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | | 0.31 | | 0.33 | | $I_{OL}$ = 2.1 mA |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | | 0.31 | | 0.33 | | $I_{OL}$ = 2.6 mA |
| $I_{IN}$ | Input Leakage Current | 0.90 to 3.60 | | ±0.1 | | ±0.5 | μA | 0 ≤ $V_I$ ≤ 3.6V |
| $I_{OFF}$ | Power Off Leakage Current | 0 | | 0.5 | | 0.5 | μA | 0 ≤ ($V_I$, $V_O$) ≤ 3.6V |
| $I_{CC}$ | Quiescent Supply Current | 0.90 to 3.60 | | 0.9 | | 0.9 | μA | $V_I$ = $V_{CC}$ or GND |

## AC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ (V) | $T_A = +25°C$ | | | $T_A = -40°C$ to $+85°C$ | | Units | Conditions | Figure Number |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | | | |
| $t_{PHL}$ | Propagation Delay | 0.90 | | 27 | | | | ns | $C_L$ = 10 pF $R_L$ = 1 MΩ | Figures 1, 2 |
| $t_{PLH}$ | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | 3.5 | 11 | 21.8 | 3.0 | 34.3 | | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | 2.5 | 7 | 14.8 | 2.0 | 15.0 | | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | 2.0 | 6 | 12.0 | 1.5 | 12.2 | | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | 1.5 | 5 | 9.4 | 1.0 | 9.9 | | | |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | 1.0 | 4 | 8.3 | 1.0 | 9.0 | | | |
| $t_{PHL}$ | Propagation Delay | 0.90 | | 30 | | | | ns | $C_L$ = 15 pF $R_L$ = 1 MΩ | Figures 1, 2 |
| $t_{PLH}$ | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | 4.0 | 11 | 22.8 | 3.5 | 37.3 | | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | 3.0 | 8 | 15.5 | 2.5 | 16.5 | | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | 2.5 | 6 | 12.6 | 2.0 | 13.6 | | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | 2.0 | 5 | 9.9 | 1.5 | 10.8 | | | |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | 1.5 | 4 | 8.7 | 1.0 | 9.5 | | | |
| $t_{PHL}$ | Propagation Delay | 0.90 | | 32 | | | | ns | $C_L$ = 30 pF $R_L$ = 1 MΩ | Figures 1, 2 |
| $t_{PLH}$ | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | 5.0 | 13 | 25.9 | 4.0 | 46.3 | | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | 4.0 | 9 | 17.8 | 3.5 | 18.2 | | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | 3.0 | 7 | 14.4 | 2.0 | 15.9 | | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | 2.0 | 6 | 11.3 | 1.5 | 12.8 | | | |
| | | 3.00 ≤ $V_{CC}$ ≤ 3.60 | 1.5 | 5 | 9.2 | 1.0 | 10.7 | | | |
| $C_{IN}$ | Input Capacitance | 0 | | 2.0 | | | | pF | | |
| $C_{OUT}$ | Output Capacitance | 0 | | 4.0 | | | | pF | | |
| $C_{PD}$ | Power Dissipation Capacitance | 0.9 to 3.60 | | 8 | | | | pF | $V_I$ = 0V or $V_{CC}$, f = 10 MHz | |

## AC Loading and Waveforms

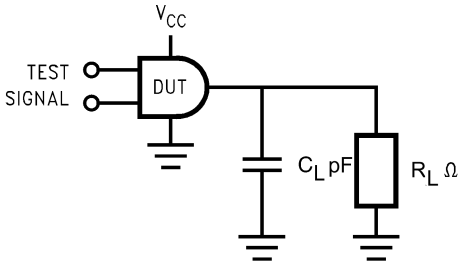



**FIGURE 1. AC Test Circuit**

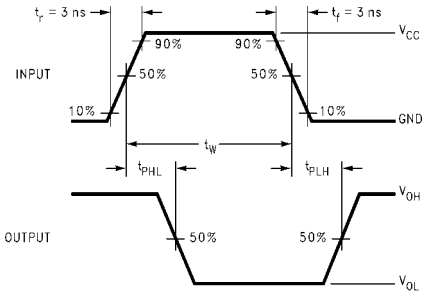



**FIGURE 2. AC Waveforms**

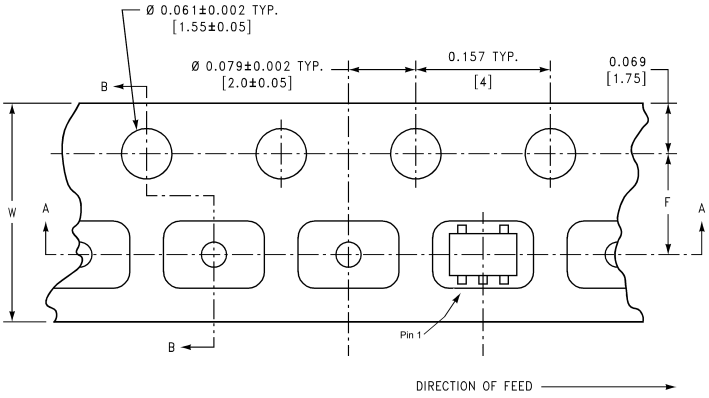
| Symbol | $V_{CC}$ | | | | | |
|---|---|---|---|---|---|---|
| | **3.3V ± 0.3V** | **2.5V ± 0.2V** | **1.8V ± 0.15V** | **1.5V ± 0.10V** | **1.2V ± 0.10V** | **0.9V** |
| $V_{mi}$ | 1.5V | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ |
| $V_{mo}$ | 1.5V | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ |

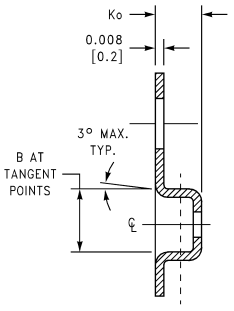
## Tape and Reel Specification

**TAPE FORMAT for SC70**

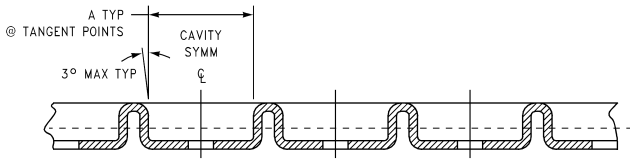
| Package Designator | Tape Section | Number Cavities | Cavity Status | Cover Tape Status |
|---|---|---|---|---|
| P5X | Leader (Start End) | 125 (typ) | Empty | Sealed |
| | Carrier | 3000 | Filled | Sealed |
| | Trailer (Hub End) | 75 (typ) | Empty | Sealed |

**TAPE DIMENSIONS** inches (millimeters)

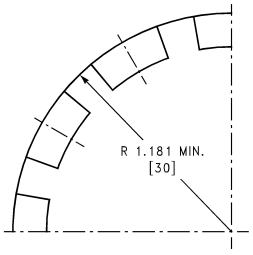



SECTION B–B




SECTION A–A



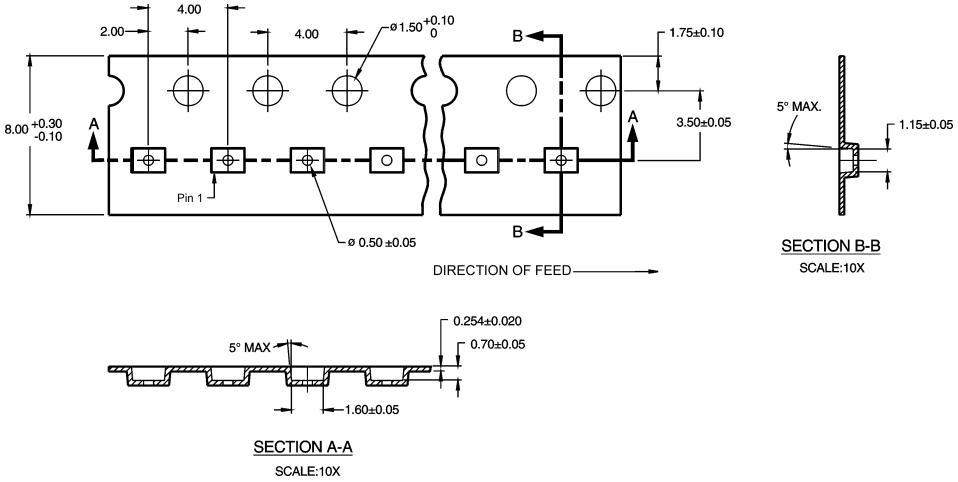

BEND RADIUS NOT TO SCALE

## Tape and Reel Specification (Continued)

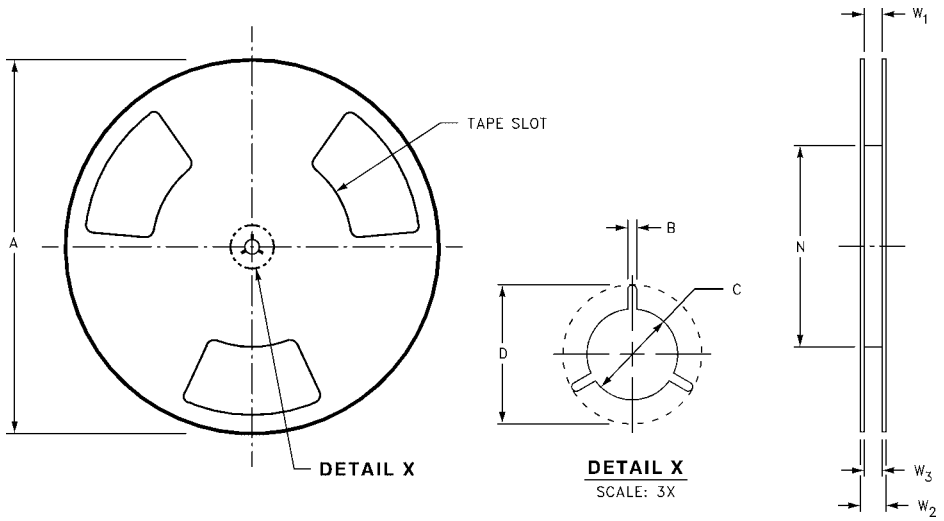
**TAPE FORMAT for MicroPak**

| Package Designator | Tape Section | Number Cavities | Cavity Status | Cover Tape Status |
|---|---|---|---|---|
| L6X | Leader (Start End) | 125 (typ) | Empty | Sealed |
| | Carrier | 5000 | Filled | Sealed |
| | Trailer (Hub End) | 75 (typ) | Empty | Sealed |

**TAPE DIMENSIONS** inches (millimeters)

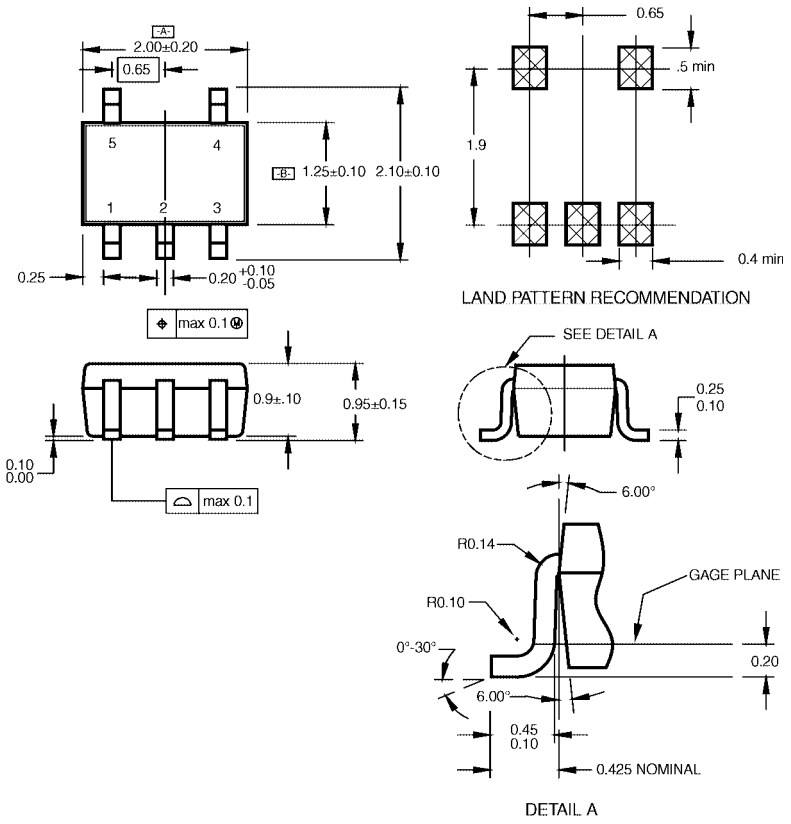



**REEL DIMENSIONS** inches (millimeters)




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

## Physical Dimensions inches (millimeters) unless otherwise noted



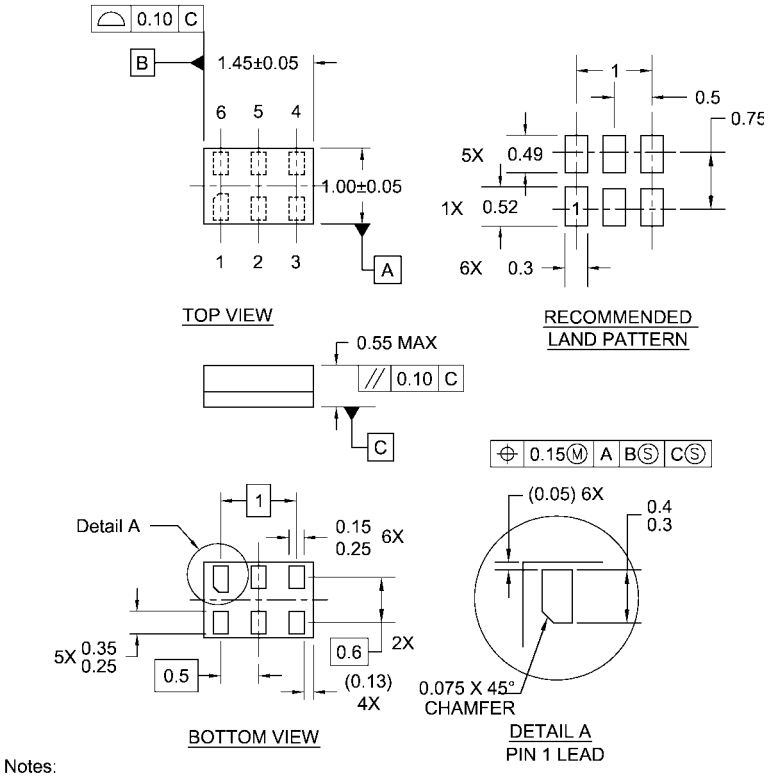

NOTES:

A. CONFORMS TO EIAJ REGISTERED OUTLINE DRAWING SC88A.
B. DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH.
C. DIMENSIONS ARE IN MILLIMETERS.

MAA05ARevC

**5-Lead SC70, EIAJ SC-88a, 1.25mm Wide**
**Package Number MAA05A**

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




Notes:

1. JEDEC PACKAGE REGISTRATION IS ANTICIPATED
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06ARevB

**6-Lead MicroPak, 1.0mm Wide**
**Package Number MAC06A**



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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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