

# NC7SP38

## TinyLogic® ULP 2-Input NAND Gate (Open Drain Output)

### 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
- $t_{PD}$ :
  - 3.0ns typ. for 3.0V to 3.6V  $V_{CC}$
  - 4.0ns typ. for 2.3V to 2.7V  $V_{CC}$
  - 5.0ns typ. for 1.65V to 1.95V  $V_{CC}$
  - 6.0ns typ. for 1.40V to 1.60V  $V_{CC}$
  - 9.0ns typ. for 1.10V to 1.30V  $V_{CC}$
  - 24.0ns typ. for 0.90V  $V_{CC}$
- Power-off high impedance inputs and outputs
- Static drive ( $I_{OH}/I_{OL}$ ):
  - $\pm 2.6\text{mA}$  @ 3.00V  $V_{CC}$
  - $\pm 2.1\text{mA}$  @ 2.30V  $V_{CC}$
  - $\pm 1.5\text{mA}$  @ 1.65V  $V_{CC}$
  - $\pm 1.0\text{mA}$  @ 1.40V  $V_{CC}$
  - $\pm 0.5\text{mA}$  @ 1.10V  $V_{CC}$
  - $\pm 20\mu\text{A}$  @ 0.9V  $V_{CC}$
- Uses patented Quiet Series™ noise/EMI reduction circuitry
- Ultra small MicroPak™ package
- Ultra low dynamic power

### General Description


The NC7SP38 is a single 2-Input NAND Gate with open drain output stage 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.

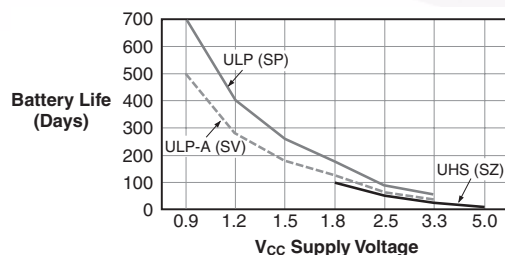
The NC7SP38, for lower drive requirements, is uniquely designed for optimized power and speed, and is fabricated with an advanced CMOS technology to achieve best in class speed operation while maintaining extremely low CMOS power dissipation.

### Ordering Information

Order Number	Package Number	Package Code Top Mark	Package Description	Supplied As
NC7SP38P5X	MAA05A	P38	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3k Units on Tape and Reel
NC7SP38L6X	MAC06A	K7	6-Lead MicroPak, 1.0mm Wide	5k Units on Tape and Reel

 All packages are lead free per JEDEC: J-STD-020B standard.

### 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.

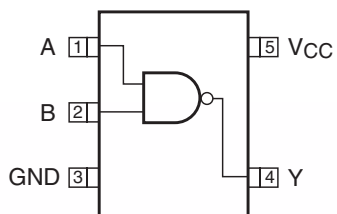
$$\text{Battery Life} = (V_{\text{battery}} \times I_{\text{battery}} \times 0.9) / (P_{\text{device}}) / 24\text{hrs/day}$$

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

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

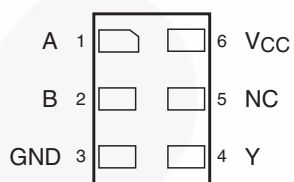
## Connection Diagrams

### Pin Assignment for SC70



(Top View)

### Pad Assignments for MicroPak



(Top Through View)

## Logic Symbol



## Function Table

$$Y = \overline{AB}$$

Inputs		Output
A	B	Y
L	L	*H
L	H	*H
H	L	*H
H	H	L

H = HIGH Logic Level

L = LOW Logic Level

\*H = HIGH Impedance Output State (Open Drain)

## Pin Description

Pin Names	Description
A, B	Input
Y	Output
NC	No Connect

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	-0.5V to +4.6V
$V_{IN}$	DC Input Voltage	-0.5V to +4.6V
$V_{OUT}$	DC Output Voltage HIGH or LOW State <sup>(1)</sup> $V_{CC} = 0V$	-0.5V to $V_{CC} + 0.5V$ -0.5V to +4.6V
$I_{IK}$	DC Input Diode Current @ $V_{IN} < 0V$	-50mA
$I_{OK}$	DC Output Diode Current $V_{OUT} < 0V$ $V_{OUT} > V_{CC}$	-50mA +50mA
$I_{OH}/I_{OL}$	DC Output Source/Sink Current	±50mA
$I_{CC}$ or Ground	DC $V_{CC}$ or Ground Current per Supply Pin	±50mA
$T_{STG}$	Storage Temperature Range	-65°C to +150°C
$T_J$	Junction Temperature Under Bias	150°C
$T_L$	Junction Lead Temperature (Soldering, 10 seconds)	260°C
$P_D$	Power Dissipation @ +85°C SC70-5 Micropak-6	150mW 130mW

## Recommended Operating Conditions<sup>(2)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	0.9V to 3.6V
$V_{IN}$	Input Voltage	0V to 3.6V
$V_{OUT}$	Output Voltage HIGH or LOW State $V_{CC} = 0V$	0V to $V_{CC}$ 0V to 3.6V
$I_{OH}/I_{OL}$	Output Current in $I_{OH}/I_{OL}$ $V_{CC} = 3.0V$ to 3.6V $V_{CC} = 2.3V$ to 2.7V $V_{CC} = 1.65V$ to 1.95V $V_{CC} = 1.40V$ to 1.60V $V_{CC} = 1.10V$ to 1.30V $V_{CC} = 0.9V$	±2.6mA ±2.1mA ±1.5mA ±1mA ±0.5mA ±20µA
$T_A$	Free Air Operating Temperature	-40°C to +85°C
$\Delta t/\Delta V$	Minimum Input Edge Rate @ $V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$	10ns/V
$\theta_{JA}$	Thermal Resistance SC70-5 Micropak-6	425°C/W 500°C/W

### Notes:

- $I_O$  Absolute Maximum Rating must be observed.
- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> =				Units
				+25°C		-40°C to +85°C		
				Min.	Max.	Min.	Max.	
V <sub>IH</sub>	HIGH Level Input Voltage	0.90		0.65 x V <sub>CC</sub>		0.65 x V <sub>CC</sub>		V
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		0.65 x V <sub>CC</sub>		0.65 x V <sub>CC</sub>		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		0.65 x V <sub>CC</sub>		0.65 x V <sub>CC</sub>		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		0.65 x V <sub>CC</sub>		0.65 x V <sub>CC</sub>		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.6		1.6		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		2.1		2.1		
V <sub>IL</sub>	LOW Level Input Voltage	0.90			0.35 x V <sub>CC</sub>		0.35 x V <sub>CC</sub>	V
		1.10 ≤ V <sub>CC</sub> ≤ 1.30			0.35 x V <sub>CC</sub>		0.35 x V <sub>CC</sub>	
		1.40 ≤ V <sub>CC</sub> ≤ 1.60			0.35 x V <sub>CC</sub>		0.35 x V <sub>CC</sub>	
		1.65 ≤ V <sub>CC</sub> ≤ 1.95			0.35 x V <sub>CC</sub>		0.35 x V <sub>CC</sub>	
		2.30 ≤ V <sub>CC</sub> ≤ 2.70			0.7		0.7	
		3.00 ≤ V <sub>CC</sub> ≤ 3.60			0.9		0.9	
V <sub>OL</sub>	LOW Level Output Voltage	0.90	I <sub>OL</sub> = 20μA		0.1		0.1	V
		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	I <sub>OL</sub> = 0.5mA		0.30 x V <sub>CC</sub>		0.30 x V <sub>CC</sub>	
		1.40 ≤ V <sub>CC</sub> ≤ 1.60	I <sub>OL</sub> = 1mA		0.31		0.37	
		1.65 ≤ V <sub>CC</sub> ≤ 1.95	I <sub>OL</sub> = 1.5mA		0.31		0.35	
		2.30 ≤ V <sub>CC</sub> ≤ 2.70	I <sub>OL</sub> = 2.1mA		0.31		0.33	
		3.00 ≤ V <sub>CC</sub> ≤ 3.60	I <sub>OL</sub> = 2.6mA		0.31		0.33	
I <sub>IN</sub>	Input Leakage Current	0.90 to 3.60	0 ≤ V <sub>I</sub> ≤ 3.6V		±0.1		±0.5	μA
I <sub>OFF</sub>	Power Off Leakage Current	0	0 ≤ (V <sub>I</sub> , V <sub>O</sub> ) ≤ 3.6V		0.5		0.5	μA
I <sub>CC</sub>	Quiescent Supply Current	0.90 to 3.60	V <sub>I</sub> = V <sub>CC</sub> or GND		0.9		0.9	μA

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40°C to +85°C		Units	Figure Number
				Min.	Typ.	Max.	Min.	Max.		
t <sub>PZL</sub> , t <sub>PLZ</sub>	Propagation Delay	0.9	C <sub>L</sub> = 10pF, R <sub>U</sub> = 5,000Ω, R <sub>D</sub> = 5,000Ω		24				ns	Figure 1 Figure 2
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		4.0	9	18.7	3.5	30.9		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		2.0	6	12.4	1.5	13.9		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		1.5	5	9.6	1.0	12.1		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	4	9.0	0.8	10.0		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3	8.7	0.5	9.0		
		0.90	C <sub>L</sub> = 15pF, R <sub>U</sub> = 5,000Ω, R <sub>D</sub> = 5,000Ω		27				ns	Figure 1 Figure 2
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		5.0	10	20.0	4.5	33.9		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		3.0	7	13.3	2.5	16.0		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	5	10.3	2.0	12.6		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.5	4	9.4	1.0	10.2		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3	9.1	0.5	9.7		
		0.90	C <sub>L</sub> = 30pF, R <sub>U</sub> = 5,000Ω, R <sub>D</sub> = 5,000Ω		34				ns	Figure 1 Figure 2
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		6.0	12	24.0	5.0	43.0		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		4.0	8	16.0	3.0	18.0		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	6	12.0	2.0	14.0		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	5	11.0	1.0	12.0		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		0.8	4	10.0	0.5	11.0		
C <sub>IN</sub>	Input Capacitance	0		2.0				pF		
C <sub>OUT</sub>	Output Capacitance	0		4.0				pF		
C <sub>PD</sub>	Power Dissipation Capacitance	0.9 to 3.60	V <sub>I</sub> = 0V or V <sub>CC</sub> , f = 10MHz	6				pF		

## AC Loading and Waveforms

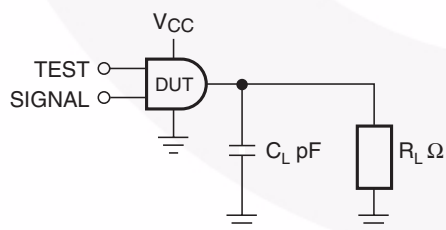


Figure 1. AC Test Circuit

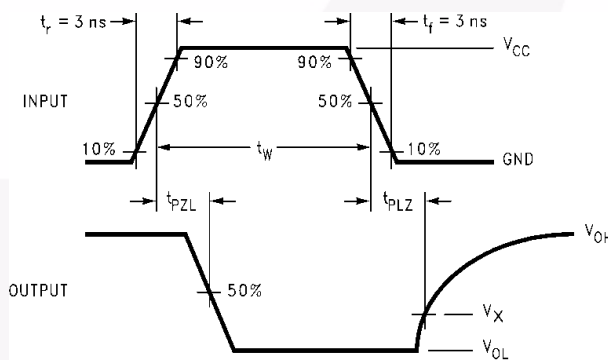


Figure 2. AC Waveforms

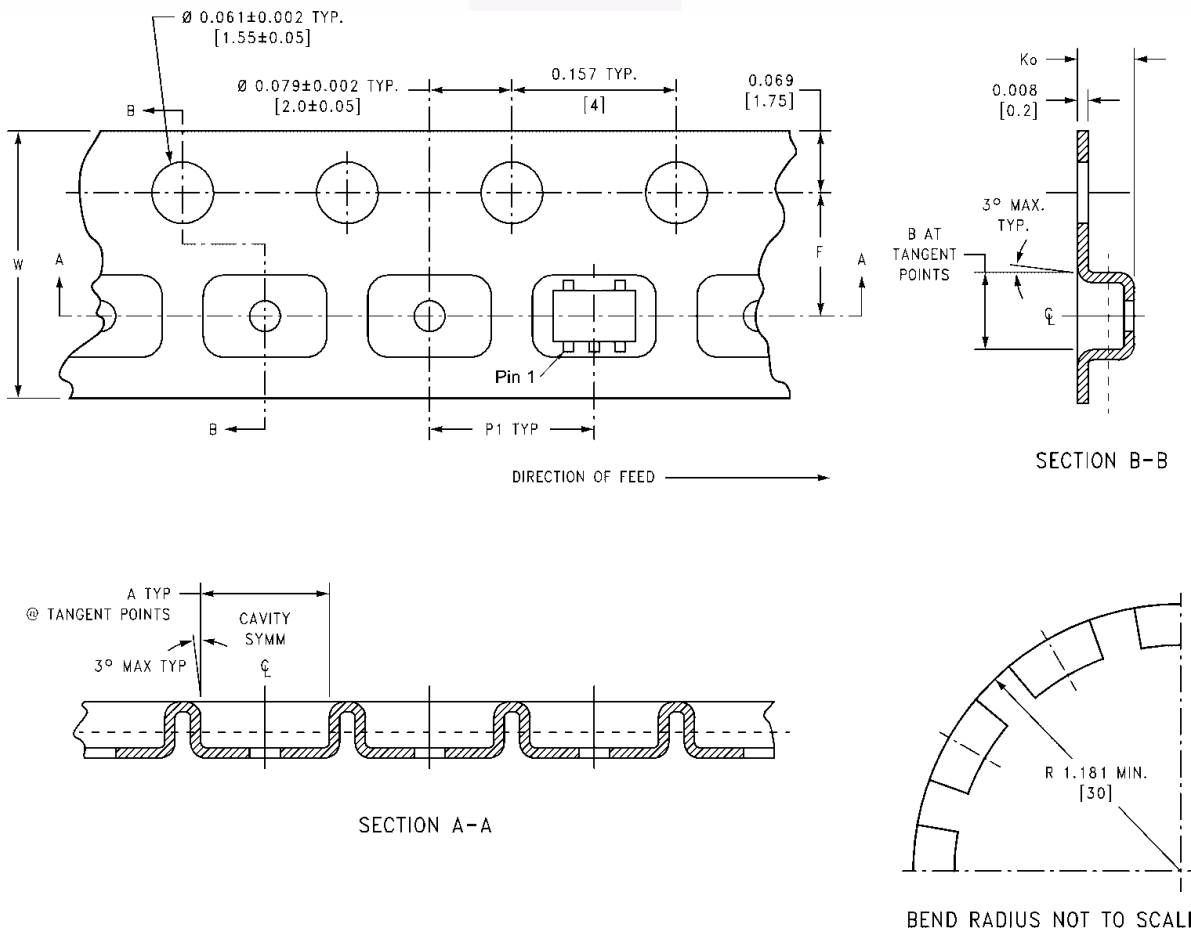
Symbol	V <sub>CC</sub>					
	3.3V ± 0.3V	2.5V ± 0.2V	1.8V ± 0.15V	1.5V ± 0.1V	1.2V ± 0.1V	0.9V
V <sub>mi</sub>	1.5V	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2
V <sub>x</sub>	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.15V	V <sub>OL</sub> + 0.15V	V <sub>OL</sub> + 0.1V	V <sub>OL</sub> + 0.1V	V <sub>OL</sub> + 0.1V

## 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 Dimension inches (millimeters)

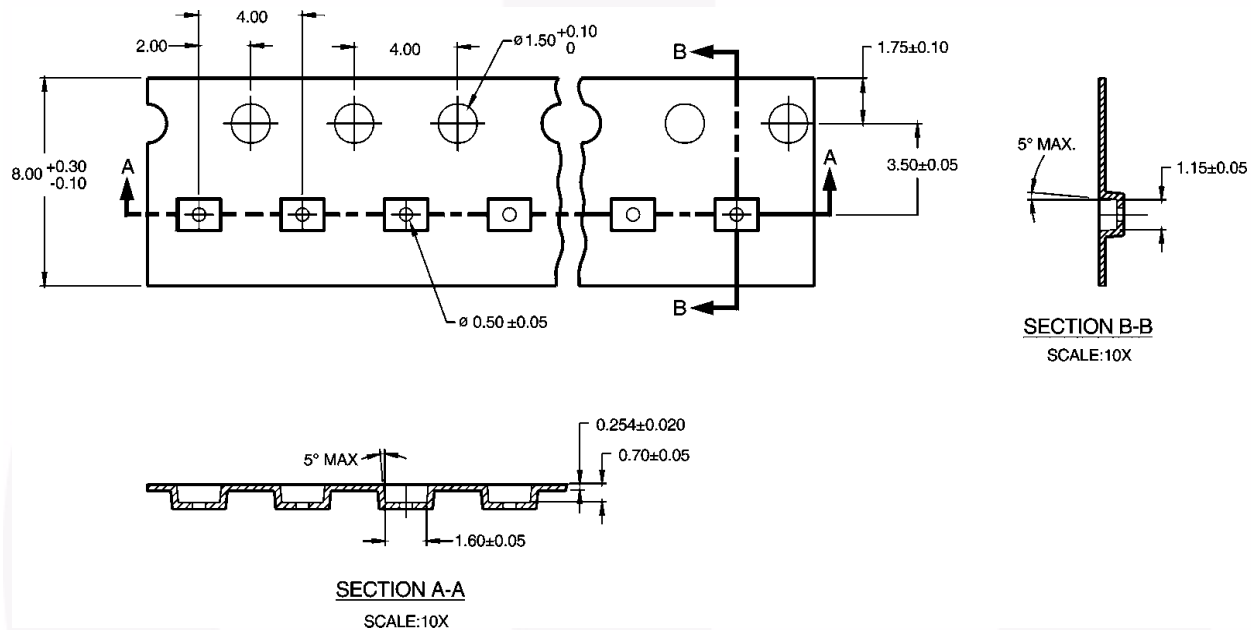


## Tape and Reel Specification (Continued)

### Tape Format for MicroPak

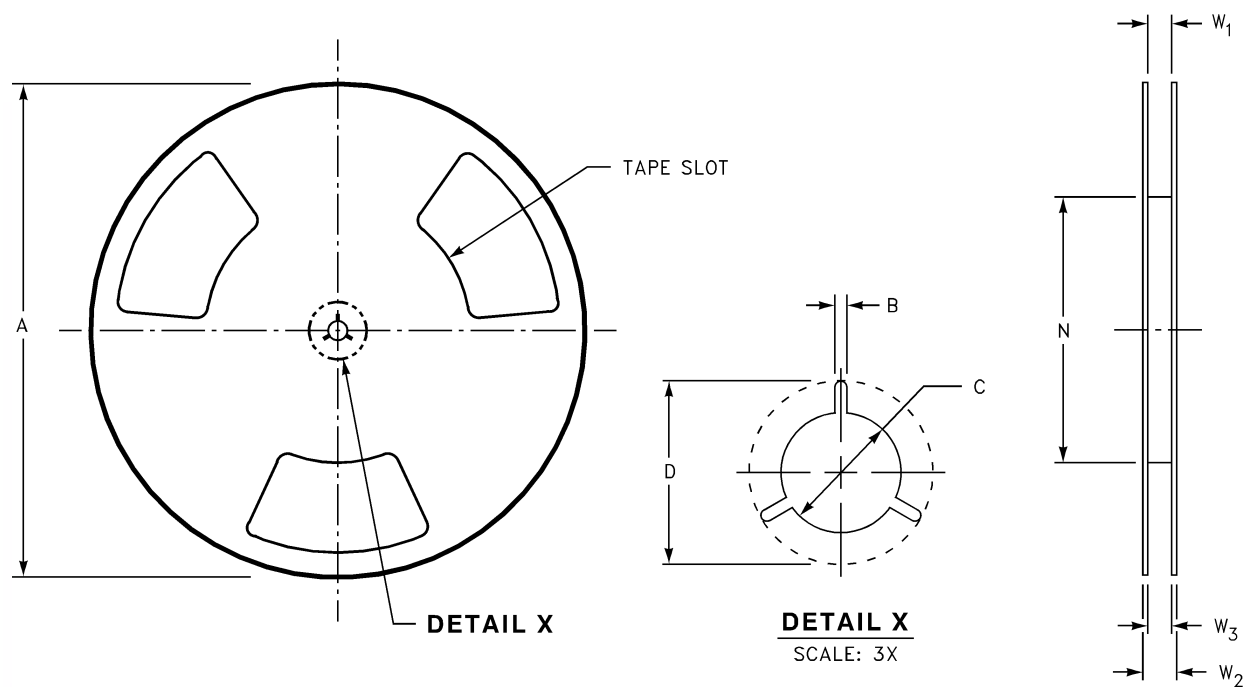
Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
L6X	Leader (Start End)	125 (typ.)	Empty	Sealed
	Carrier	5000	Filled	Sealed
	Trailer (Hub End)	75 (typ.)	Empty	Sealed

### Tape Dimension millimeters



**Tape and Reel Specification** (Continued)

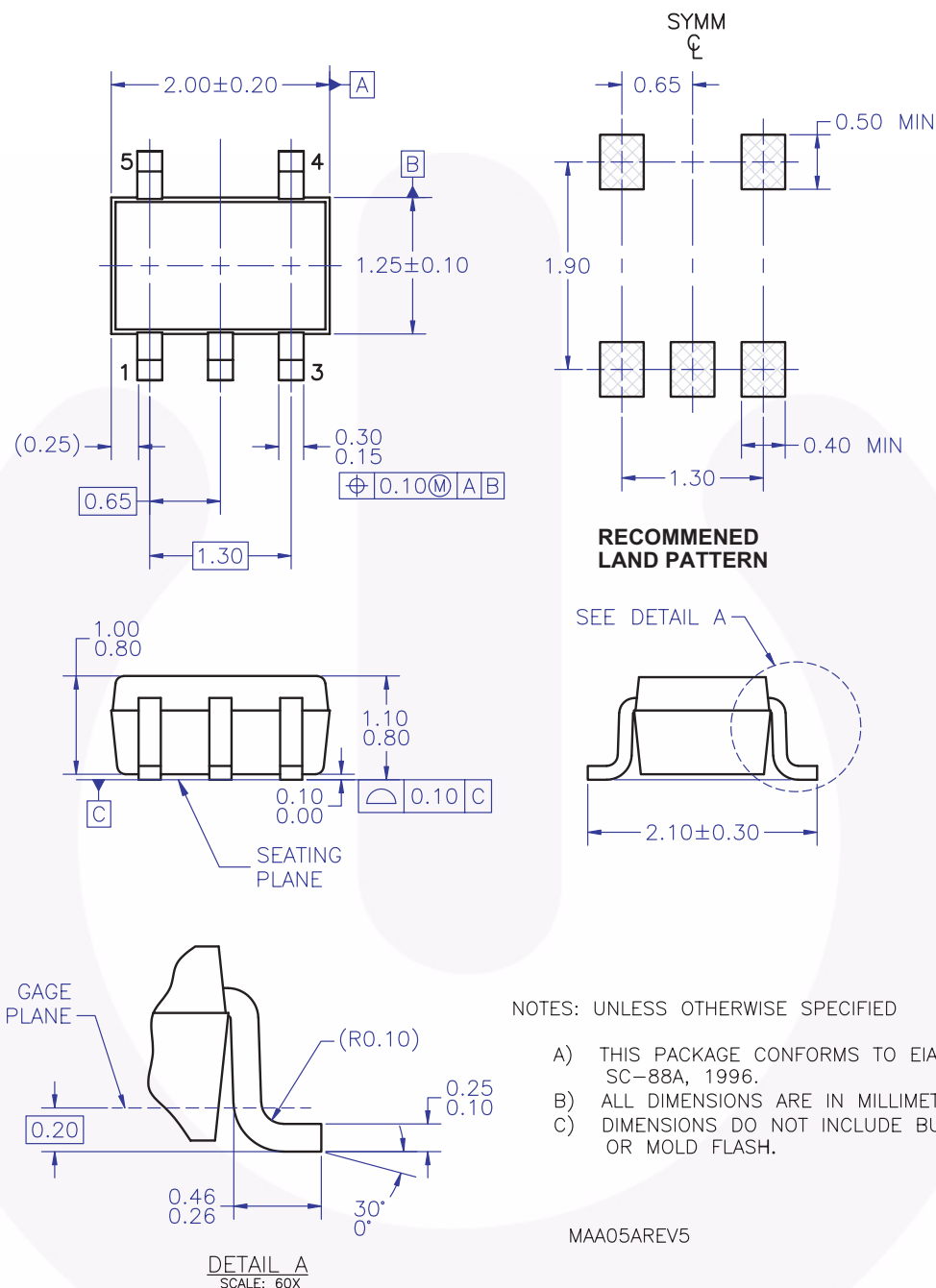
Reel Dimension for MicroPak inches (millimeters)



Tape Size	A	B	C	D	N	W <sub>1</sub>	W <sub>2</sub>	W <sub>3</sub>
8mm	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

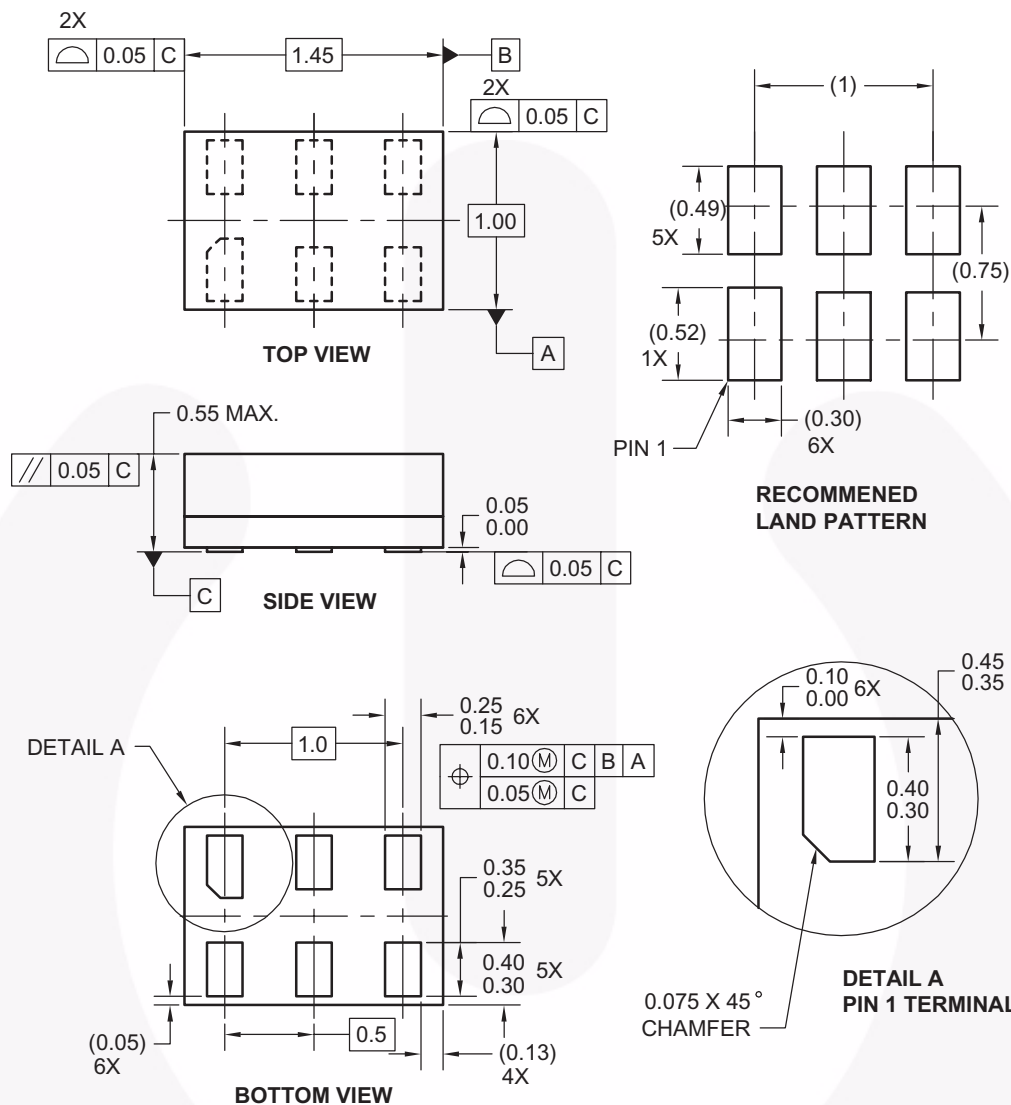


**Figure 3. 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide**

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### Physical Dimensions (Continued)



**Notes:**

1. CONFORMS TO JEDEC STANDARD M0-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06AREVC

**Figure 4. 6-Lead MicroPak, 1.0mm Wide**

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



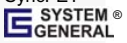
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