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# NC7SP126 TinyLogic® ULP Buffer with Three-State Output

## Features

- 0.9V to 3.6V  $V_{CC}$  Supply Operation
- 3.6V Over-Voltage Tolerant I/O's at  $V_{CC}$  from 0.9V to 3.6V
- Extremely High Speed  $t_{PD}$ 
  - 3.0ns: Typical for 3.0V to 3.6V  $V_{CC}$
  - 4.0ns: Typical for 2.3V to 2.7V  $V_{CC}$
  - 5.0ns: Typical for 1.65V to 1.95V  $V_{CC}$
  - 6.0ns: Typical for 1.4V to 1.6V  $V_{CC}$
  - 10.0ns: Typical for 1.1V to 1.3V  $V_{CC}$
  - 26.0ns: Typical for 0.9V  $V_{CC}$
- Power-Off High-Impedance Inputs and Outputs
- Static Drive ( $I_{OH}/I_{OL}$ )
  - $\pm 2.6$ mA at 3.00V  $V_{CC}$
  - $\pm 2.1$ mA at 2.30V  $V_{CC}$
  - $\pm 1.5$ mA at 1.65V  $V_{CC}$
  - $\pm 1.0$ mA at 1.4V  $V_{CC}$
  - $\pm 0.5$ mA at 1.1V  $V_{CC}$
  - $\pm 0.20$  $\mu$ A at 0.9V  $V_{CC}$
- Uses Proprietary Quiet Series™ Noise/EMI Reduction Circuitry
- Ultra-Small MicroPak™ Leadfree Package
- Ultra-Low Dynamic Power

## Description

The NC7SP126 is a single Buffer with 3-STATE output 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.

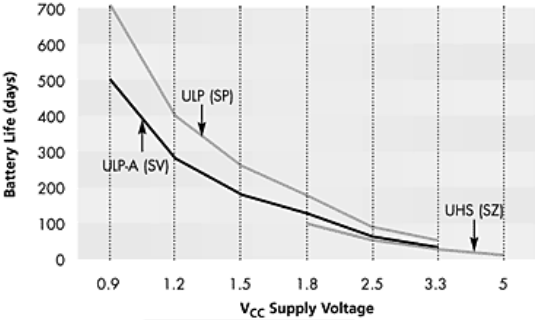
The NC7SP126, for lower drive requirements, is uniquely designed for optimized power and speed, and is fabricated with an advanced CMOS technology to achieve best in class speed operation while maintaining extremely low CMOS power dissipation.

## Ordering Information

Part Number	Top Mark	Package	Packing Method
NC7SP126P5X	P26	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3000 Units on Tape & Reel
NC7SP126L6X	L6	6-Lead MicroPak™, 1.00mm Wide	5000 Units on Tape & Reel
NC7SP126FHX	L6	6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch	5000 Units on Tape & Reel

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# Battery Life



**Notes:**

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

$$\text{Battery Life} = (V_{\text{battery}} \cdot I_{\text{battery}} \cdot .9) / (P_{\text{device}}) / 24\text{hrs/day}$$
 Where,  $P_{\text{device}} = (I_{\text{CC}} \cdot V_{\text{CC}}) + (C_{\text{PD}} + C_{\text{L}}) \cdot V_{\text{CC}}^2 \cdot f$
2. Assumes ideal 3.6V Lithium Ion battery with current rating of 900mAH and derated 90% and device frequency at 10MHz, with C<sub>L</sub> = 15pF load.

**Figure 1. Battery Life vs. V<sub>CC</sub> Supply Voltage**

# Connection Diagram



**Figure 2. Logic Symbol**

## Pin Configurations

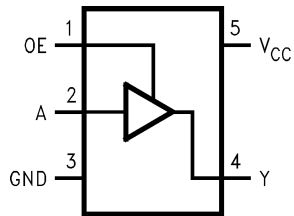


Figure 3. SC70 (Top View)

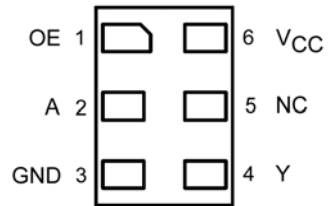


Figure 4. MicroPak™ (Top Through View)

## Pin Definitions

Pin # SC70	Pin # MicroPak™	Name	Description
1	1	OE	Input
2	2	A	Input
3	3	GND	Ground
4	4	Y	Output
5	6	V <sub>CC</sub>	Supply Voltage
	5	NC	No Connect

## Function Table

Inputs		Output
OE	A	Out Y
H	L	L
H	H	H
L	X	Z

H = HIGH Logic Level

L = LOW Logic Level

X = HIGH or LOW Logic Level

Z = HIGH Impedance State

## 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	Min.	Max.	Unit
$V_{CC}$	Supply Voltage	-0.5	4.6	V
$V_{IN}$	DC Input Voltage	-0.5	4.6	V
$V_{OUT}$	DC Output Voltage	HIGH or LOW State <sup>(3)</sup>	$V_{CC} + 0.5$	V
		$V_{CC}=0V$	4.6	
$I_{IK}$	DC Input Diode Current	$V_{IN} < 0V$	-50	mA
$I_{OK}$	DC Output Diode Current	$V_{OUT} < 0V$	-50	mA
		$V_{OUT} > V_{CC}$	+50	
$I_{OH}/I_{OL}$	DC Output Source/Sink Current		±50	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current per Supply Pin		±50	mA
$T_{STG}$	Storage Temperature Range	-65	+150	°C
$T_J$	Junction Temperature under Bias		+150	°C
$T_L$	Junction Lead Temperature, Soldering 10 Seconds		+260	°C
$P_D$	Power Dissipation at +85°C	SC70-5	150	mW
		MicroPak™-6	130	
		MicroPak2™-6	120	
ESD	Human Body Model, JEDEC:JESD22-A114		4000	V
	Charge Device Model, JEDEC:JESD22-C101		2000	

**Note:**

- IO absolute maximum rating must be observed.

## Recommended Operating Conditions

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	Conditions	Min.	Max.	Unit
$V_{CC}$	Supply Voltage Operating		0.9	3.6	V
$V_{IN}$	Input Voltage		0	3.6	V
$V_{OUT}$	Output Voltage	$V_{CC}=0V$	0	3.6	V
		HIGH or LOW State	0	$V_{CC}$	
$I_{OH}/I_{OL}$	Output Current	$V_{CC}=3.0V$ to $3.6V$		±2.6	mA
		$V_{CC}=2.3V$ to $2.7V$		±2.1	
		$V_{CC}=1.65V$ to $1.95V$		±1.5	
		$V_{CC}=1.4V$ to $1.6V$		±1.0	
		$V_{CC}=1.1V$ to $1.3V$		±0.5	
		$V_{CC}=0.9V$		±20	µA
$T_A$	Operating Temperature, Free Air		-40	+85	°C
$\Delta t/\Delta V$	Minimum Input Edge Rate	$V_{IN}=0.8V$ to $2.0$ , $V_{CC}=3.0V$		10	ns/V
$\theta_{JA}$	Thermal Resistance	SC70-5		425	°C/W
		MicroPak™-6		500	
		MicroPak2™-6		560	

**Note:**

- Unused inputs must be held HIGH or LOW. They may not float.

### DC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub>	Conditions	T <sub>A</sub> =+25°C		T <sub>A</sub> =-40 to +85°C		Units
				Min.	Max.	Min.	Max.	
V <sub>IH</sub>	HIGH Level Input Voltage	0.90		.65 x V <sub>CC</sub>		.65 x V <sub>CC</sub>		V
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		.65 x V <sub>CC</sub>		.65 x V <sub>CC</sub>		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		.65 x V <sub>CC</sub>		.65 x V <sub>CC</sub>		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		.65 x V <sub>CC</sub>		.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			.35 x V <sub>CC</sub>		.35 x V <sub>CC</sub>	V
		1.10 ≤ V <sub>CC</sub> ≤ 1.30			.35 x V <sub>CC</sub>		.35 x V <sub>CC</sub>	
		1.40 ≤ V <sub>CC</sub> ≤ 1.60			.35 x V <sub>CC</sub>		.35 x V <sub>CC</sub>	
		1.65 ≤ V <sub>CC</sub> ≤ 1.95			.35 x V <sub>CC</sub>		.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>OH</sub>	HIGH Level Output Voltage	0.90	I <sub>OH</sub> =-20μA	V <sub>CC</sub> -0.1		V <sub>CC</sub> -0.1		V
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		V <sub>CC</sub> -0.1		V <sub>CC</sub> -0.1		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		V <sub>CC</sub> -0.1		V <sub>CC</sub> -0.1		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		V <sub>CC</sub> -0.1		V <sub>CC</sub> -0.1		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		V <sub>CC</sub> -0.1		V <sub>CC</sub> -0.1		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		V <sub>CC</sub> -0.1		V <sub>CC</sub> -0.1		
		1.10 ≤ V <sub>CC</sub> ≤ 1.30	I <sub>OH</sub> =-0.5mA	.75 x V <sub>CC</sub>		.70 x V <sub>CC</sub>		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60	I <sub>OH</sub> =-1mA	1.07		0.99		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95	I <sub>OH</sub> =-1.5mA	1.24		1.22		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70	I <sub>OH</sub> =-2.1mA	1.95		1.87		
3.00 ≤ V <sub>CC</sub> ≤ 3.60	I <sub>OH</sub> =-2.6mA	2.61		2.55				
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		.30 x V <sub>CC</sub>		.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>IN</sub> ≤ 3.60		±0.1		±0.5	μA
I <sub>OZ</sub>	3-STATE Output Leakage	0.90 to 3.6	V <sub>IN</sub> =V <sub>IH</sub> or V <sub>IL</sub> 0 ≤ V <sub>IN</sub> ≤ 3.60		±0.5		±0.5	μA
I <sub>OFF</sub>	Power Off Leakage Current	0	0 ≤ (V <sub>IN</sub> , V <sub>O</sub> ) ≤ 3.60		0.5		0.5	μA
I <sub>CC</sub>	Quiescent Supply Current	0.90 to 3.60	V <sub>IN</sub> =V <sub>CC</sub> , or GND		0.9		0.9	μA

### AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub>	Conditions	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Units	Figure
				Min.	Typ.	Max.	Min.	Max.		
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay	0.90	C <sub>L</sub> =10pF, R <sub>L</sub> =1MΩ		26				ns	Figure 5 Figure 6
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		4.0	10.0	19.1	3.5	39.6		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		2.0	6.0	11.2	1.5	14.5		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		1.5	5.0	8.6	1.0	11.6		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	4.0	6.3	0.8	8.2		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3.0	5.3	0.5	7.2		
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	0.90	C <sub>L</sub> =10pF, R <sub>U</sub> =5000Ω R <sub>D</sub> =5000Ω		29				ns	Figure 5 Figure 6
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		4.0	8.0	17.5	3.5	40.4		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		2.0	6.0	11.9	1.5	14.8		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		1.5	5.0	9.7	1.0	12.3		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	4.0	7.7	0.8	10.5		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3.0	6.9	0.5	8.6		
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	0.90	C <sub>L</sub> =10pF, R <sub>U</sub> =5000Ω R <sub>D</sub> =5000Ω		28				ns	Figure 5 Figure 6
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		4.0	8.0	20.5	3.5	42.0		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		2.0	6.0	15.3	1.5	18.0		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		1.5	5.0	14.7	1.0	17.8		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	4.0	13.7	0.8	15.0		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3.0	13.5	0.5	14.8		
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay	0.90	C <sub>L</sub> =15pF, R <sub>L</sub> =1MΩ		28				ns	Figure 5 Figure 6
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		5.0	10.0	20.5	4.5	42.5		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		3.0	7.0	11.8	2.5	15.4		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	5.0	9.1	2.0	12.2		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.5	4.0	6.6	1.0	8.6		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3.0	5.6	0.5	7.5		
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	0.90	C <sub>L</sub> =15pF, R <sub>U</sub> =5000Ω R <sub>D</sub> =5000Ω		31				ns	Figure 5 Figure 6
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		5.0	11.0	18.2	4.5	43.3		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		3.0	7.0	12.5	2.5	15.5		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	5.0	10.2	2.0	12.9		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.5	4.0	8.0	1.0	9.9		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3.0	7.2	0.5	8.9		
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	0.90	C <sub>L</sub> =15pF, R <sub>U</sub> =5000Ω R <sub>D</sub> =5000Ω		30				ns	Figure 5 Figure 6
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		5.0	11.0	21.6	4.5	44.9		
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		3.0	7.0	15.9	2.5	18.8		
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	5.0	15.2	2.0	18.2		
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.5	4.0	14.1	1.0	15.4		
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		1.0	3.0	13.9	0.5	15.1		

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**AC Electrical Characteristics** (Continued)

Symbol	Parameter	V <sub>CC</sub>	Conditions	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C			Units	Figure
				Min.	Typ.	Min.	Typ.	Min.			
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay	0.90	C <sub>L</sub> =30pF, R <sub>L</sub> =1MΩ		34				ns	Figure 5 Figure 6	
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		5.5	12.0	23.4	5.0	51.1			
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		4.0	8.0	13.8	3.0	17.7			
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	6.0	10.6	2.0	14.0			
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	5.0	7.6	1.0	9.9			
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		0.8	4.0	6.4	0.5	8.9			
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	0.90	C <sub>L</sub> =30pF, R <sub>U</sub> =5000Ω R <sub>D</sub> =5000Ω		37				ns	Figure 5 Figure 6	
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		6.0	13.0	24.4	5.0	51.9			
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		4.0	8.0	14.5	3.0	17.9			
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	6.0	11.7	2.0	14.7			
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	5.0	9.1	1.0	11.1			
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		0.8	4.0	8.1	0.5	10.1			
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable Time	0.90	C <sub>L</sub> =30pF, R <sub>U</sub> =5000Ω R <sub>D</sub> =5000Ω		36				ns	Figure 5 Figure 6	
		1.10 ≤ V <sub>CC</sub> ≤ 1.30		6.0	13.0	24.8	5.0	53.5			
		1.40 ≤ V <sub>CC</sub> ≤ 1.60		4.0	8.0	17.1	3.0	21.1			
		1.65 ≤ V <sub>CC</sub> ≤ 1.95		2.0	6.0	16.5	2.0	20.5			
		2.30 ≤ V <sub>CC</sub> ≤ 2.70		1.0	5.0	15.2	1.0	16.7			
		3.00 ≤ V <sub>CC</sub> ≤ 3.60		0.8	4.0	14.8	0.5	16.3			
C <sub>IN</sub>	Input Capacitance	0.00			2				pF		
C <sub>OUT</sub>	Output Capacitance	0.00			4				pF		
C <sub>PD</sub>	Power Dissipation Capacitance	0.90 to 3.60	V <sub>IN</sub> =0V or V <sub>CC</sub> , f=10MHz		8					pF	



## AC Loadings and Waveforms

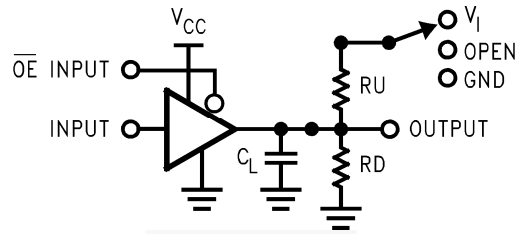


Figure 5. AC Test Circuit

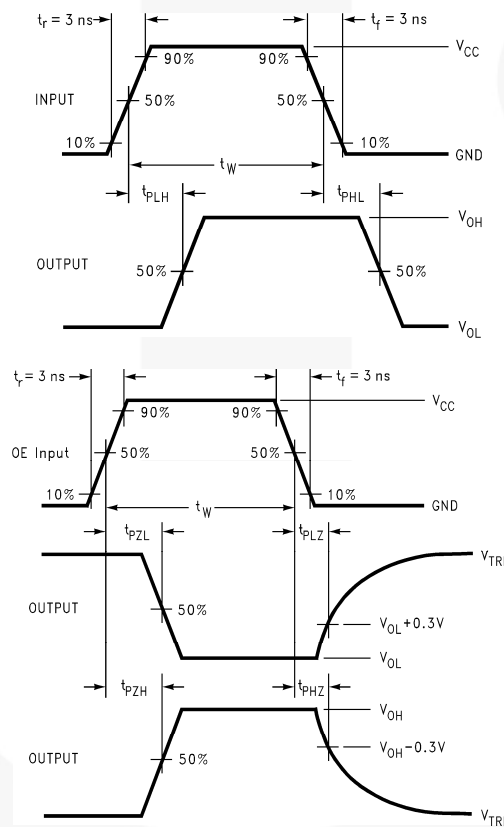
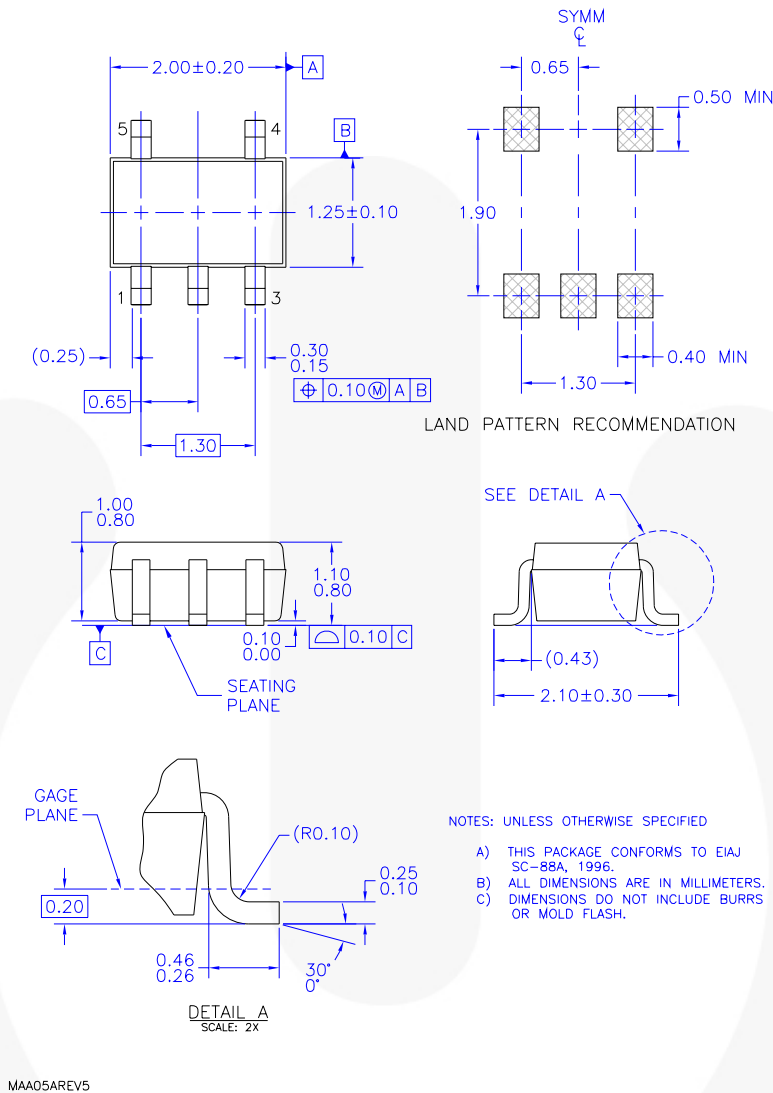


Figure 6. AC Waveforms

Symbol	$V_{CC}$					
	$3.3V \pm 0.3V$	$2.5V \pm 0.2V$	$1.8V \pm 0.15V$	$1.5V \pm 0.10V$	$1.2V \pm 0.10V$	$0.9V$
$V_{mi}$	1.5V	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$
$V_{mo}$	0.3V	0.15V	0.15V	0.10V	0.10V	0.10V

## Physical Dimensions



**Figure 7. 5-Lead, SC70, EIAJ SC-88a, 1.25mm Wide**

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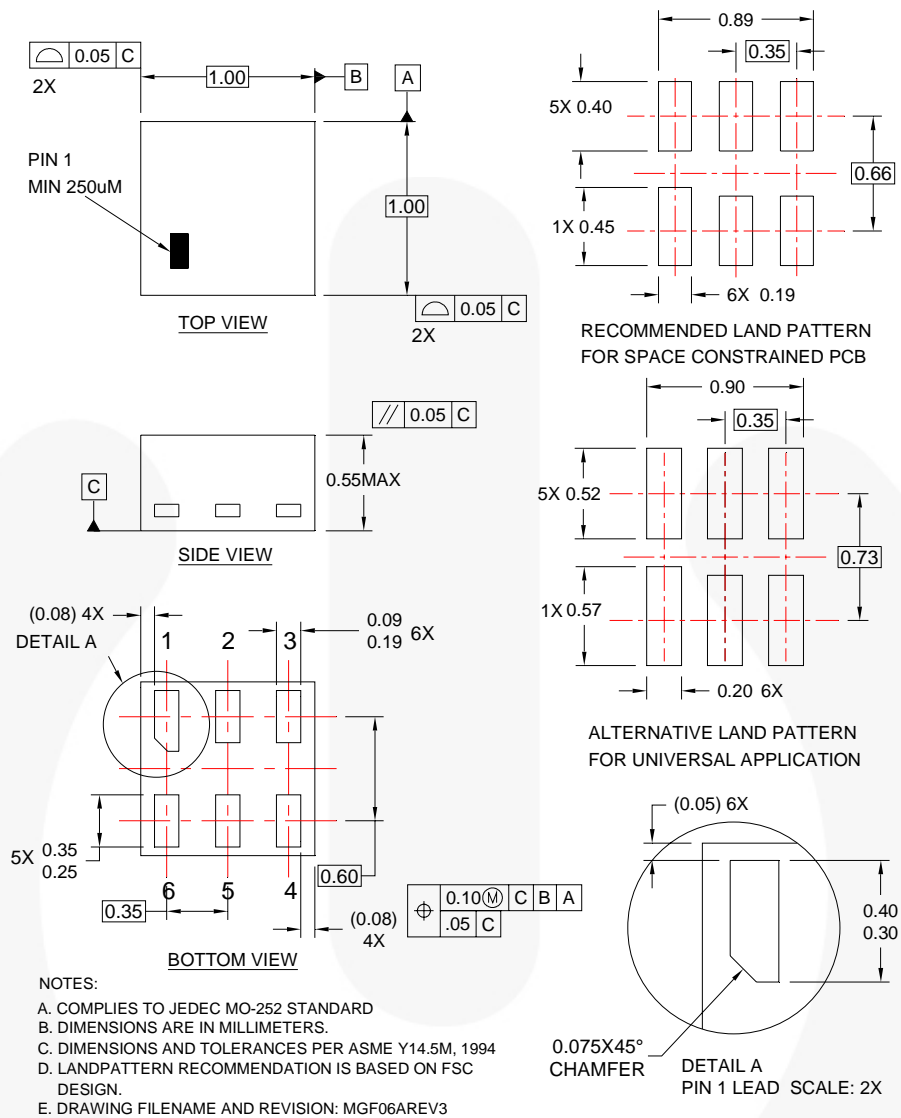
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Package Designator	Tape Section	Cavity Number	Cavity Status	Cover Type Status
P5X	Leader (Start End)	125 (Typical)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (Typical)	Empty	Sealed



## Physical Dimensions



**Figure 9. 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch**

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## Tape and Reel Specifications





Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications:  
[http://www.fairchildsemi.com/packaging/MicroPAK2\\_6L\\_tr.pdf](http://www.fairchildsemi.com/packaging/MicroPAK2_6L_tr.pdf)

Package Designator	Tape Section	Cavity Number	Cavity Status	Cover Type Status
FHX	Leader (Start End)	125 (Typical)	Empty	Sealed
	Carrier	5000	Filled	Sealed
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| EfficientMax™            | MicroPak™   | SPM®  | TRUECURRENT™  |
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| <b>F</b> ®               | MillerDrive™  | SuperFET®   |  SerDes® |
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