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# NC7SZU04 TinyLogic® UHS Unbuffered Inverter


## Features

- Unbuffered for Crystal Oscillator and Analog Applications
- Balanced Output Drive:  $\pm 16\text{mA}$  at  $4.5\text{V } V_{CC}$
- Broad  $V_{CC}$  Operating Range:  $1.65\text{V}$  to  $5.5\text{V}$
- Matches Performance of LCX Operated at  $3.3\text{V } V_{CC}$
- Low Quiescent Power:  $I_{CC} < 2\mu\text{A}$ ,  $V_{CC} = 5.5\text{V}$ ,  $T_A = 25^\circ\text{C}$
- Ultra-Small MicroPak™ Packages
- Space-Saving SOT23 and SC70 Packages

## Description

The NC7SZU04 is a single unbuffered inverter from Fairchild's Ultra-High Speed series of TinyLogic®. The special purpose unbuffered circuit design is primarily intended for crystal oscillator or analog applications. The device is fabricated with advanced CMOS technology to achieve ultra-high speed with high output drive while maintaining low static power dissipation over a broad  $V_{CC}$  operating range. The device is specified to operate over the  $1.65\text{V}$  to  $5.5\text{V } V_{CC}$  range.

## Ordering Information

Part Number	Top Mark	 Eco Status	Package	Packing Method
NC7SZU04M5X	7ZU4	RoHS	5-Lead SOT23, JEDEC MO-178 1.6mm	3000 Units on Tape & Reel
NC7SZU04P5X	ZU4	RoHS	5-Lead SC70, EIAJ SC-88a, 1.25mm Wide	3000 Units on Tape & Reel
NC7SZU04L6X	C5	RoHS	6-Lead MicroPak™, 1.00mm Wide	5000 Units on Tape & Reel
NC7SZU04FHX	C5	Green	6-Lead, MicroPak2, 1x1mm Body, .35mm Pitch	5000 Units on Tape & Reel

 For Fairchild's definition of Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

## Connection Diagrams

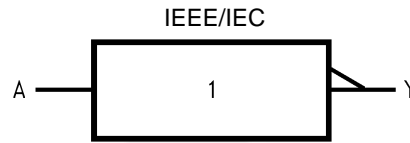


Figure 1. Logic Symbol

## Pin Configurations

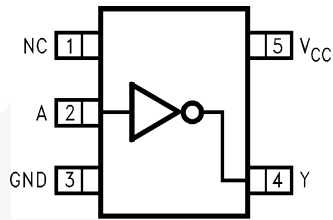


Figure 2. SC70 and SOT23 (Top View)

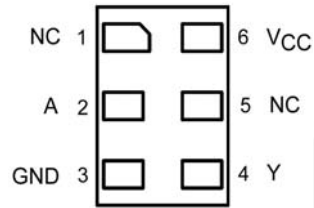


Figure 3. MicroPak (Top Through View)

## Pin Definitions

Pin # SC70 / SOT23	Pin # MicroPak	Name	Description
1	1,5	NC	No Connect
2	2	A	Input
3	3	GND	Ground
4	4	Y	Output
5	6	V <sub>CC</sub>	Supply Voltage

## Function Table

$Y = \overline{A}$

Inputs	Output
<b>A</b>	<b>Y</b>
L	H
H	L

H = HIGH Logic Level

L = LOW Logic Level

## 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	6.0	V	
$V_{IN}$	DC Input Voltage	-0.5	6.0	V	
$V_{OUT}$	DC Output Voltage	-0.5	6.0	V	
$I_{IK}$	DC Input Diode Current	$V_{IN} < -0.5V$		-50	mA
		$V_{IN} > V_{CC}+5.0V$		+20	
$I_{OK}$	DC Output Diode Current	$V_{OUT} < -0.5V$		-50	mA
		$V_{OUT} > 0.5V, V_{CC}=GND$		+50	
$I_{OUT}$	DC Output Current		$\pm 50$	mA	
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current		$\pm 100$	mA	
$T_{STG}$	Storage Temperature Range	-65	+150	$^{\circ}C$	
$T_J$	Junction Temperature Under Bias		+150	$^{\circ}C$	
$T_L$	Junction Lead Temperature (Soldering, 10 Seconds)		+260	$^{\circ}C$	
$P_D$	Power Dissipation at +85 $^{\circ}C$	SOT-23		200	mW
		SC70-5		150	
		MicroPak-6		130	
		MicroPak2-6		120	
ESD	Human Body Model, JEDEC:JESD22-A114		4000	V	
	Charge Device Model, JEDEC:JESD22-C101		2000		

## 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		1.65	5.50	V
	Supply Voltage Data Retention		1.50	5.50	
$V_{IN}$	Input Voltage		0	5.5	V
$V_{OUT}$	Output Voltage		0	$V_{CC}$	V
$T_A$	Operating Temperature		-40	+85	$^{\circ}C$
$\theta_{JA}$	Thermal Resistance	SOT-23		300	$^{\circ}C/W$
		SC70-5		425	
		MicroPak-6		500	
		MicroPak2-6		560	

### Note:

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

### DC Electrical Characteristics

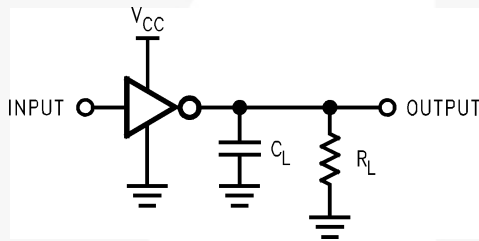
Symbol	Parameter	V <sub>CC</sub>	Conditions	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Units	
				Min.	Typ.	Max.	Min.	Max.		
V <sub>IH</sub>	HIGH Level Input Voltage	1.8 to 2.7		0.85V <sub>CC</sub>			0.85V <sub>CC</sub>		V	
		3.0 to 5.5		0.80V <sub>CC</sub>			0.80V <sub>CC</sub>			
V <sub>IL</sub>	LOW Level Input Voltage	1.8 to 2.7				0.15V <sub>CC</sub>		0.15V <sub>CC</sub>	V	
		3.0 to 5.5				0.20V <sub>CC</sub>		0.20V <sub>CC</sub>		
V <sub>OH</sub>	HIGH Level Output Voltage	1.65	V <sub>IN</sub> =V <sub>IL</sub> , I <sub>OH</sub> =-100μA	1.55	1.65		1.55		V	
		1.80		1.60	1.80		1.60			
		2.30		2.10	2.30		2.10			
		3.00		2.70	3.00		2.70			
		4.50		4.00	4.40		4.00			
		1.65	V <sub>IN</sub> =GND	I <sub>OH</sub> =-4mA	1.29	1.52		1.29		
		2.30		I <sub>OH</sub> =-4mA	1.90	2.14		1.90		
		3.00		I <sub>OH</sub> =-8mA	2.40	2.75		2.40		
		3.00		I <sub>OH</sub> =-12mA	2.30	2.61		2.30		
		4.50		I <sub>OH</sub> =-16mA	3.80	4.13		3.80		
V <sub>OL</sub>	LOW Level Output Voltage	1.65	V <sub>IN</sub> =V <sub>IH</sub> , I <sub>OL</sub> =100μA		0.00	0.10		0.10	V	
		1.80			0.00	0.20		0.20		
		2.30			0.00	0.20		0.20		
		3.00			0.00	0.30		0.30		
		4.50			0.00	0.50		0.50		
		1.65	V <sub>IN</sub> =V <sub>CC</sub>	I <sub>OL</sub> =4mA		0.80	0.24			0.24
		2.30		I <sub>OL</sub> =4mA		0.10	0.30			0.30
		3.00		I <sub>OL</sub> =8mA		0.17	0.40			0.40
		3.00		I <sub>OL</sub> =12mA		0.25	0.55			0.55
		4.50		I <sub>OL</sub> =16mA		0.226	0.55			0.55
I <sub>IN</sub>	Input Leakage Current	0 to 5.5	V <sub>IN</sub> =5.5V, GND			±1		±10	μA	
I <sub>CC</sub>	Quiescent Supply Current	1.65 to 5.50	V <sub>IN</sub> =5.5V, GND			2		20	μA	
I <sub>CCPEAK</sub>	Peak Supply Current in Analog Operation	1.8	V <sub>OUT</sub> =Open, V <sub>IN</sub> =Adjust for Peak I <sub>CC</sub> Current		2				mA	
		2.5			4					
		3.3			10					
		5.0			30					

## AC Electrical Characteristics

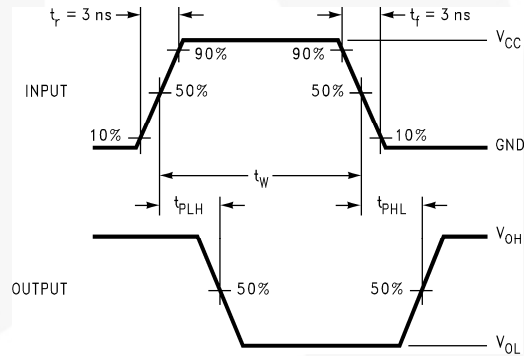
Symbol	Parameter	V <sub>CC</sub>	Conditions	T <sub>A</sub> =+25°C			T <sub>A</sub> =-40 to +85°C		Units	Figure
				Min.	Typ.	Max.	Min.	Max.		
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay	1.65	C <sub>L</sub> =15pF, R <sub>L</sub> =1MΩ,	1.0		11.7	1.0	12.1	ns	Figure 4 Figure 5
		1.80		1.0		8.5	1.0	9.0		
		2.50 ± 0.20		0.8		6.2	0.8	6.5		
		3.30 ± 0.30		0.5		4.5	0.5	4.8		
		5.00 ± 0.50		0.5		3.9	0.5	4.1		
		3.30 ± 0.30		1.0		6.0	1.0	6.5		
		5.00 ± 0.50		0.8		5.0	0.8	5.5		
C <sub>IN</sub>	Input Capacitance	0.00			4.5			pF		
C <sub>PD</sub>	Power Dissipation Capacitance <sup>(2)</sup>	3.30			6.3			pF	Figure 6	
		5.00			9.5					

**Note:**

- C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output lading and operating at 50% duty cycle. C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression: I<sub>CCD</sub>=(C<sub>PD</sub>)(V<sub>CC</sub>)(f<sub>IN</sub>)+(I<sub>CC</sub>Static).



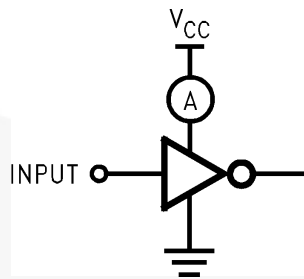
**Figure 4. AC Test Circuit**



**Figure 5. AC Waveforms**

**Note:**

- C<sub>L</sub> includes load and stray capacitance.
- Input PRR=1.0MHz; t<sub>w</sub>=500ns

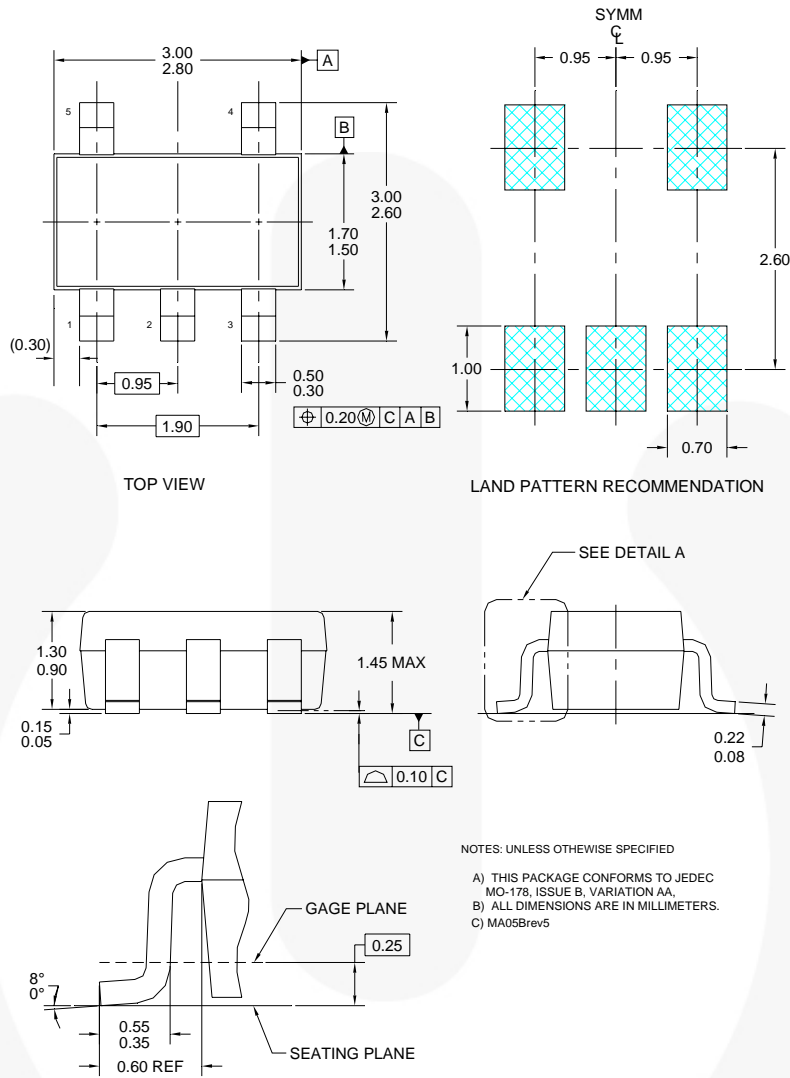


**Figure 6. Test Circuit**

**Note:**

- When operating the NC7SZU04's unbuffered output stage in its linear range, as in oscillator applications, care must be taken to observe maximum power rating for the device and package. The high drive nature of the design of the output stage results in substantial simultaneous conduction currents when the stage is in the linear region. See the I<sub>CCPEAK</sub> specification in the DC Electrical Characteristics table.
- Input=AC Waveform; t<sub>r</sub>=t<sub>f</sub>=1.8ns; PRR=variable; Duty Cycle =50%.

## Physical Dimensions



**Figure 7. 5-Lead SOT23, JEDEC MO-178 1.6mm**

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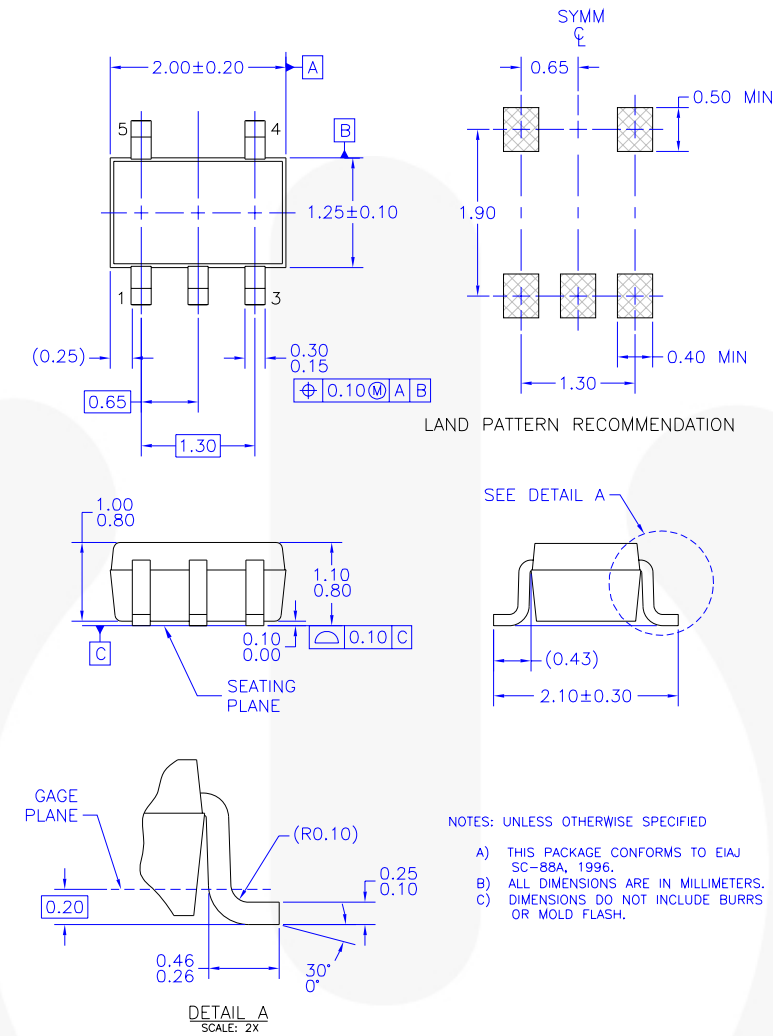
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## Tape and Reel Specifications

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[http://www.fairchildsemi.com/packaging/SOT23-5L\\_tr.pdf](http://www.fairchildsemi.com/packaging/SOT23-5L_tr.pdf).

Package Designator	Tape Section	Cavity Number	Cavity Status	Cover Type Status
M5X	Leader (Start End)	125 (Typical)	Empty	Sealed
	Carrier	3000	Filled	Sealed
	Trailer (Hub End)	75 (Typical)	Empty	Sealed

## Physical Dimensions



MAA05AREV5

**Figure 8. 5-Lead, SC70, EIAJ SC-88a, 1.25mm Wide**

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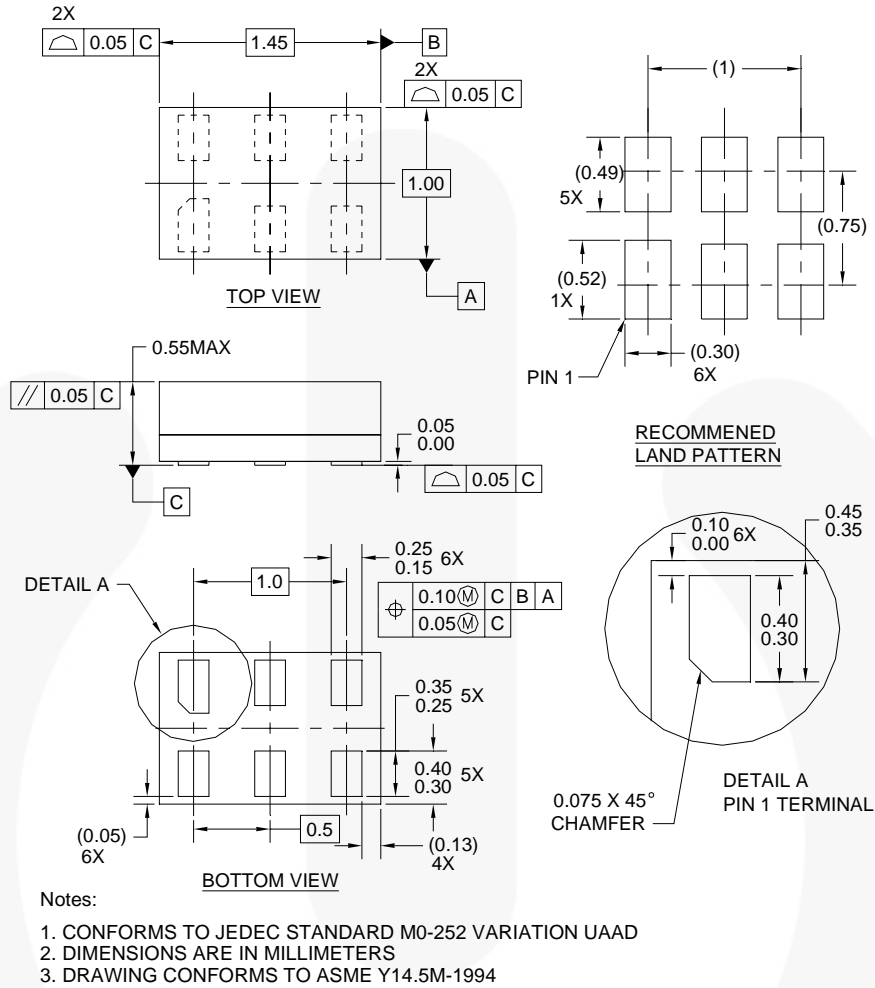
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[http://www.fairchildsemi.com/products/analog/pdf/sc70-5\\_tr.pdf](http://www.fairchildsemi.com/products/analog/pdf/sc70-5_tr.pdf)

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



MAC06AREVC

**Figure 9. 6-Lead, MicroPak™, 1.0mm Wide**

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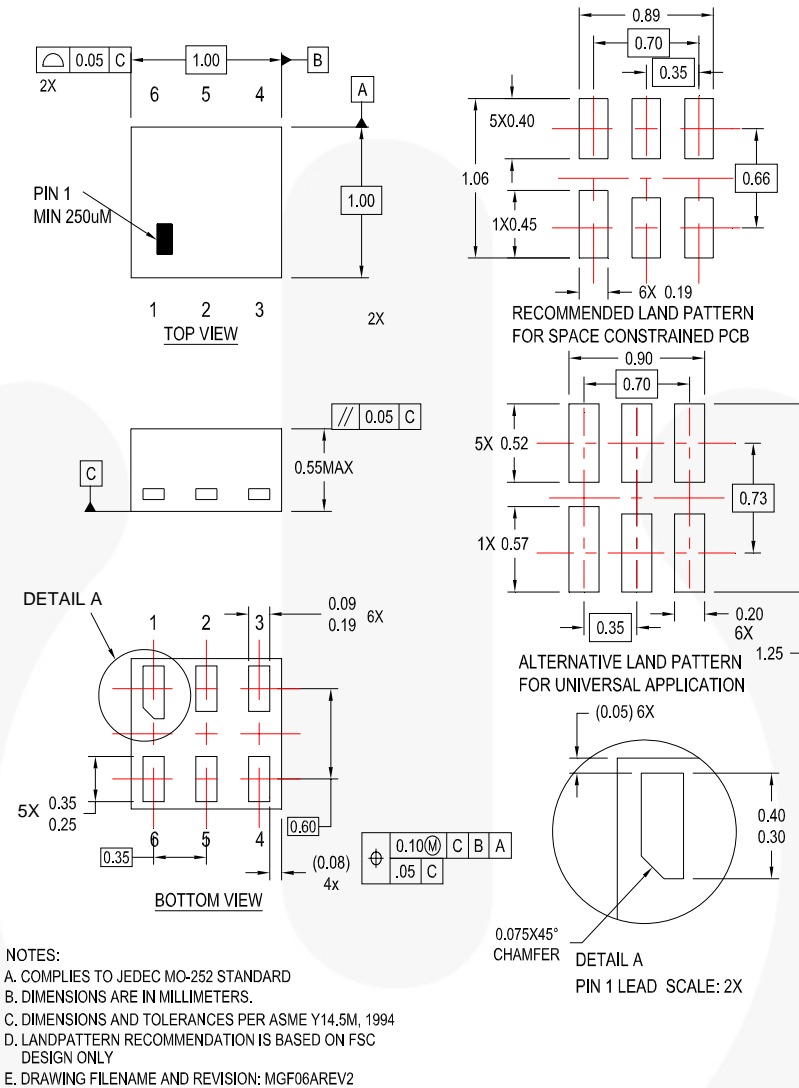
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[http://www.fairchildsemi.com/products/logic/pdf/micropak\\_tr.pdf](http://www.fairchildsemi.com/products/logic/pdf/micropak_tr.pdf)

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

## Physical Dimensions



**Figure 10.6-Lead, MicroPak2, 1x1mm Body, .35mm Pitch**

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[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
	Trailer (Hub End)	75 (Typical)	Empty	Sealed



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Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
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