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# NC7SV04

## TinyLogic® ULP-A Inverter

### Features

- 0.9V to 3.6V  $V_{CC}$  Supply Operation
- 3.6V Over-Voltage Tolerant I/Os at  $V_{CC}$  from 0.9V to 3.6V
- Extremely High Speed  $t_{PD}$ 
  - 1.5ns: Typical for 2.7V to 3.6V  $V_{CC}$
  - 1.8ns: Typical for 2.3V to 2.7V  $V_{CC}$
  - 2.0ns: Typical for 1.65V to 1.95V  $V_{CC}$
  - 3.2ns: Typical for 1.4V to 1.6V  $V_{CC}$
  - 6.0ns: Typical for 1.1V to 1.3V  $V_{CC}$
  - 12.0ns: Typical for 0.9V  $V_{CC}$
- Power-Off High-Impedance Inputs and Outputs
- High Static Drive ( $I_{OH}/I_{OL}$ )
  - $\pm 24$ mA at 3.00V  $V_{CC}$
  - $\pm 18$ mA at 2.30V  $V_{CC}$
  - $\pm 6$ mA at 1.65V  $V_{CC}$
  - $\pm 4$ mA at 1.4V  $V_{CC}$
  - $\pm 2$ mA at 1.1V  $V_{CC}$
  - $\pm 0.1$ mA at 0.9V  $V_{CC}$
- Uses Proprietary Quiet Series™ Noise/EMI Reduction Circuitry
- Ultra-Small MicroPak™ Packages
- Ultra-Low Dynamic Power

### Description

The NC7SV04 is a single inverter from Fairchild's Ultra-Low Power (ULP-A) Series of TinyLogic®. ULP-A is ideal for applications that require extreme high speed, high drive, and low power. This product is designed for a wide low-voltage operating range (0.9V to 3.6V  $V_{CC}$ ) and applications that require more drive and speed than the TinyLogic® ULP series, but still offer best-in-class, low-power operation.

The NC7SV04 is uniquely designed for optimized power and speed and is fabricated with an advanced CMOS technology to achieve high-speed operation while maintaining low CMOS power dissipation.

### Ordering Information

| Part Number | Top Mark | Package                                     | Packing Method            |
|-------------|----------|---|---------------------------|
| NC7SV04P5X  | V04      | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide       | 3000 Units on Tape & Reel |
| NC7SV04L6X  | F7       | 6-Lead MicroPak™, 1.00mm Wide               | 5000 Units on Tape & Reel |
| NC7SV04FHX  | F7       | 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch | 5000 Units on Tape & Reel |

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MicroPak™ and Quiet Series™ are trademarks of Fairchild Semiconductor Corporation.

## Battery Life

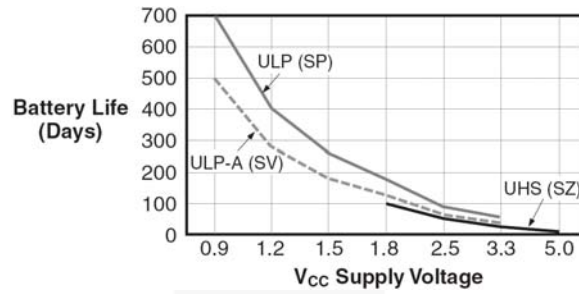


Figure 1. Battery Life vs. V<sub>CC</sub> Supply Voltage

### Notes:

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

## Connection Diagram



Figure 2. Logic Symbol

## Pin Configurations

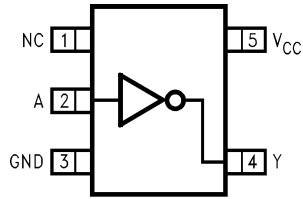


Figure 3. SC70 (Top View)

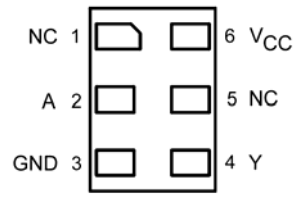


Figure 4. MicroPak™ (Top Through View)

## Pin Definitions

| Pin # SC70 | Pin # MicroPak™ | Name            | Description    |
|------------|-----------------|-----------------|----------------|
| 1          | 1, 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

| 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                             | 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                          |                                  | -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                   |                                  | $\pm 50$       | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current per Supply Pin    |                                  | $\pm 50$       | 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:**

3. 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                    |  | 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 in $I_{OH}/I_{OL}$ | $V_{CC}=3.0V$ to $3.6V$                |      | $\pm 24.0$ | mA   |
|                     |                                   | $V_{CC}=2.3V$ to $3.6V$                |      | $\pm 18.0$ |      |
|                     |                                   | $V_{CC}=1.65V$ to $1.95V$              |      | $\pm 6.0$  |      |
|                     |                                   | $V_{CC}=1.4V$ to $1.6V$                |      | $\pm 4.0$  |      |
|                     |                                   | $V_{CC}=1.1V$ to $1.3V$                |      | $\pm 2.0$  |      |
|                     |                                   | $V_{CC}=0.9V$                          |      | $\pm 0.1$  |      |
| $T_A$               | 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:**

4. 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                         |                       |       |
|                 |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |                         | 2.0                    |                       | 2.0                         |                       |       |
| 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                   |       |
|                 |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |                         |                        | 0.8                   |                             | 0.8                   |       |
| V <sub>OH</sub> | HIGH Level Output Voltage | 0.90                          | I <sub>OH</sub> =-100μA | 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> -0.2   |                       | V <sub>CC</sub> -0.2        |                       |       |
|                 |                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 |                         | V <sub>CC</sub> -0.2   |                       | V <sub>CC</sub> -0.2        |                       |       |
|                 |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 |                         | V <sub>CC</sub> -0.2   |                       | V <sub>CC</sub> -0.2        |                       |       |
|                 |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |                         | V <sub>CC</sub> -0.2   |                       | V <sub>CC</sub> -0.2        |                       |       |
|                 |                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 |                         | I <sub>OH</sub> =-2mA  | .75 x V <sub>CC</sub> |                             | .75 x V <sub>CC</sub> |       |
|                 |                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | I <sub>OH</sub> =-4mA   | .75 x V <sub>CC</sub>  |                       | .75 x V <sub>CC</sub>       |                       |       |
|                 |                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | I <sub>OH</sub> =-6mA   | 1.25                   |                       | 1.25                        |                       |       |
|                 |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 |                         | 2.0                    |                       | 2.0                         |                       |       |
|                 |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | I <sub>OH</sub> =-12mA  | 1.8                    |                       | 1.8                         |                       |       |
|                 |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |                         | 2.2                    |                       | 2.2                         |                       |       |
|                 |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | I <sub>OH</sub> =-18mA  | 1.7                    |                       | 1.7                         |                       |       |
|                 |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |                         | 2.4                    |                       | 2.4                         |                       |       |
|                 |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |                         | I <sub>OH</sub> =-24mA | 2.2                   |                             | 2.2                   |       |

Continued on following page...

### DC 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 |
|------------------|---------------------------|-------------------------------|--|----------------------|------------------------|-----------------------------|------------------------|-------|
|                  |                           |                               |  | Min.                 | Max.                   | Min.                        | Max.                   |       |
| V <sub>OL</sub>  | LOW Level Output Voltage  | 0.90                          | I <sub>OL</sub> =100μA                         |                      | 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 |  |                      | 0.2                    |                             | 0.2                    |       |
|                  |                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 |  |                      | 0.2                    |                             | 0.2                    |       |
|                  |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 |  |                      | 0.2                    |                             | 0.2                    |       |
|                  |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |  |                      | 0.2                    |                             | 0.2                    |       |
|                  |                           | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | I <sub>OL</sub> =2mA                           |                      | 0.25 x V <sub>CC</sub> |                             | 0.25 x V <sub>CC</sub> |       |
|                  |                           | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 | I <sub>OL</sub> =4mA                           |                      | 0.25 x V <sub>CC</sub> |                             | 0.25 x V <sub>CC</sub> |       |
|                  |                           | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | I <sub>OL</sub> =6mA                           |                      | 0.3                    |                             | 0.3                    |       |
|                  |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | I <sub>OL</sub> =12mA                          |                      | 0.4                    |                             | 0.4                    |       |
|                  |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |  |                      | 0.4                    |                             | 0.4                    |       |
|                  |                           | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 | I <sub>OL</sub> =18mA                          |                      | 0.6                    |                             | 0.6                    |       |
|                  |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 |  |                      | 0.4                    |                             | 0.4                    |       |
|                  |                           | 2.70 ≤ V <sub>CC</sub> ≤ 3.60 | I <sub>OL</sub> =24mA                          |                      | 0.55                   |                             | 0.55                   |       |
| 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>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    |
|                  |                           |                               | V <sub>CC</sub> ≤ V <sub>IN</sub> ≤ 3.6V       |                      |                        |                             | ±0.9                   |       |

### 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> =15pF, R <sub>L</sub> =1MΩ          |                      | 12   |      |                             |      | ns    | Figure 5<br>Figure 6 |
|                                     |                               | 1.10 ≤ V <sub>CC</sub> ≤ 1.30 | C <sub>L</sub> =15pF, R <sub>L</sub> =2kΩ          | 2.0                  | 6.0  | 9.0  | 1.0                         | 13.9 |       |                      |
|                                     |                               | 1.40 ≤ V <sub>CC</sub> ≤ 1.60 |  | 1.0                  | 3.2  | 5.1  | 0.9                         | 6.0  |       |                      |
|                                     |                               | 1.65 ≤ V <sub>CC</sub> ≤ 1.95 | C <sub>L</sub> =30pF,<br>R <sub>L</sub> =500Ω      | 1.0                  | 2.0  | 4.2  | 0.7                         | 5.2  |       |                      |
|                                     |                               | 2.30 ≤ V <sub>CC</sub> ≤ 2.70 |  | 0.8                  | 1.8  | 2.7  | 0.6                         | 3.4  |       |                      |
| 2.70 ≤ V <sub>CC</sub> ≤ 3.60       | 0.7                           | 1.5                           |  | 2.3                  | 0.5  | 2.8  |                             |      |       |                      |
| C <sub>IN</sub>                     | Input Capacitance             | 0                             |  |                      | 2    |      |                             |      | pF    |                      |
| C <sub>PD</sub>                     | Power Dissipation Capacitance | 0.90 to 3.60                  | V <sub>I</sub> =0V or V <sub>CC</sub> ,<br>f=10MHz |                      | 10   |      |                             |      | pF    |                      |

## AC Loadings and Waveforms

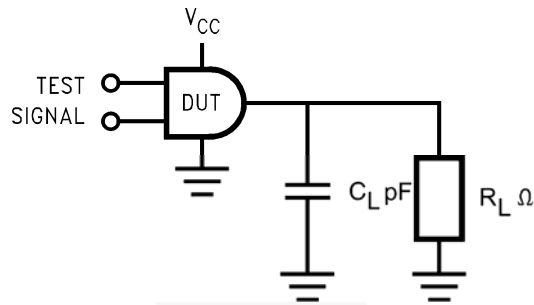


Figure 5. AC Test Circuit

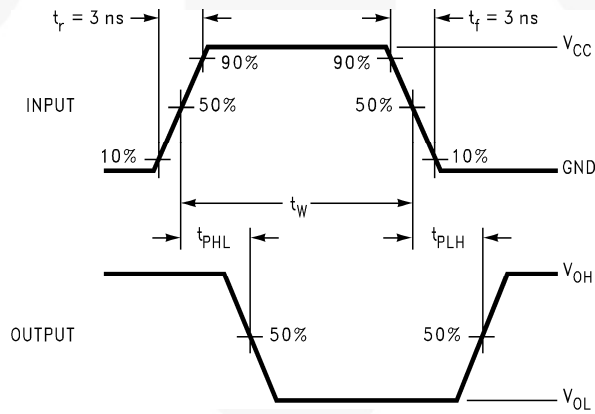
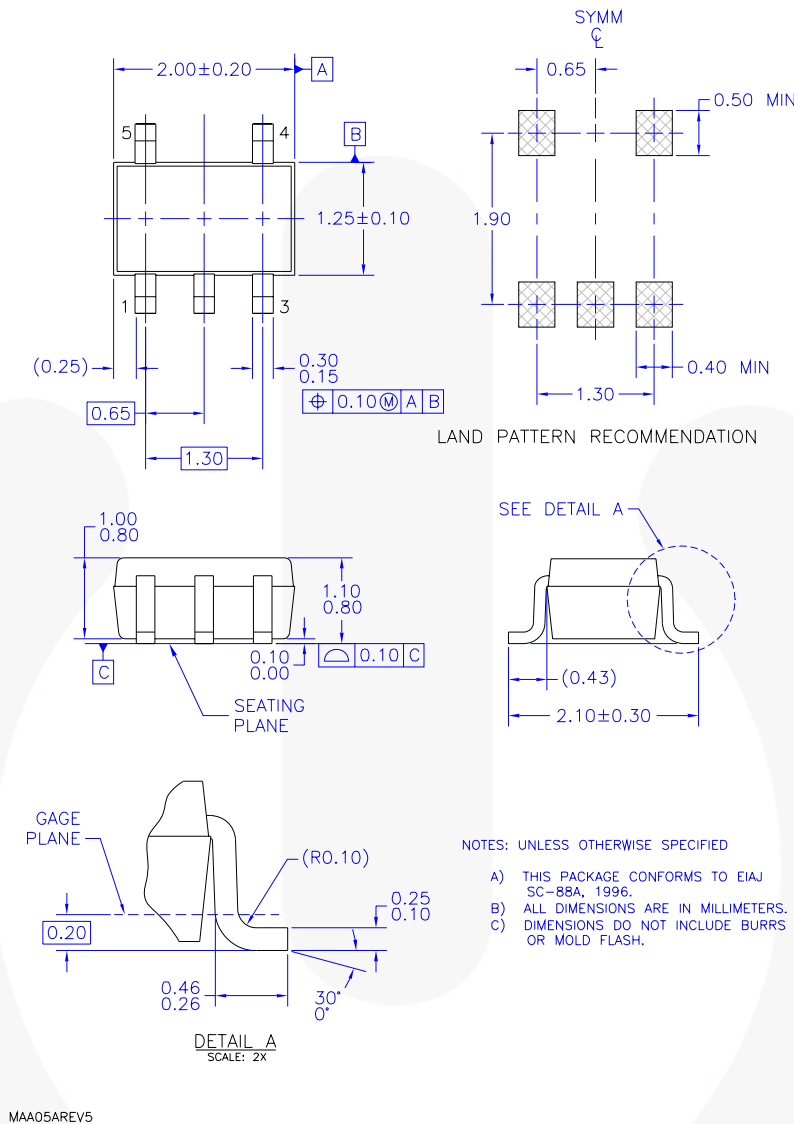


Figure 6. AC Waveforms

| Symbol   | $V_{CC}$        |                 |                  |                 |                 |            |
|----------|-----------------|-----------------|------------------|-----------------|-----------------|------------|
|          | $3.3V \pm 0.3V$ | $2.5V \pm 0.2V$ | $1.8V \pm 0.15V$ | $1.5V \pm 0.1V$ | $1.2V \pm 0.1V$ | $0.9V$     |
| $V_{mi}$ | 1.5V            | $V_{CC}/2$      | $V_{CC}/2$       | $V_{CC}/2$      | $V_{CC}/2$      | $V_{CC}/2$ |
| $V_{mo}$ | 1.5V            | $V_{CC}/2$      | $V_{CC}/2$       | $V_{CC}/2$      | $V_{CC}/2$      | $V_{CC}/2$ |



## Physical Dimensions



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

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

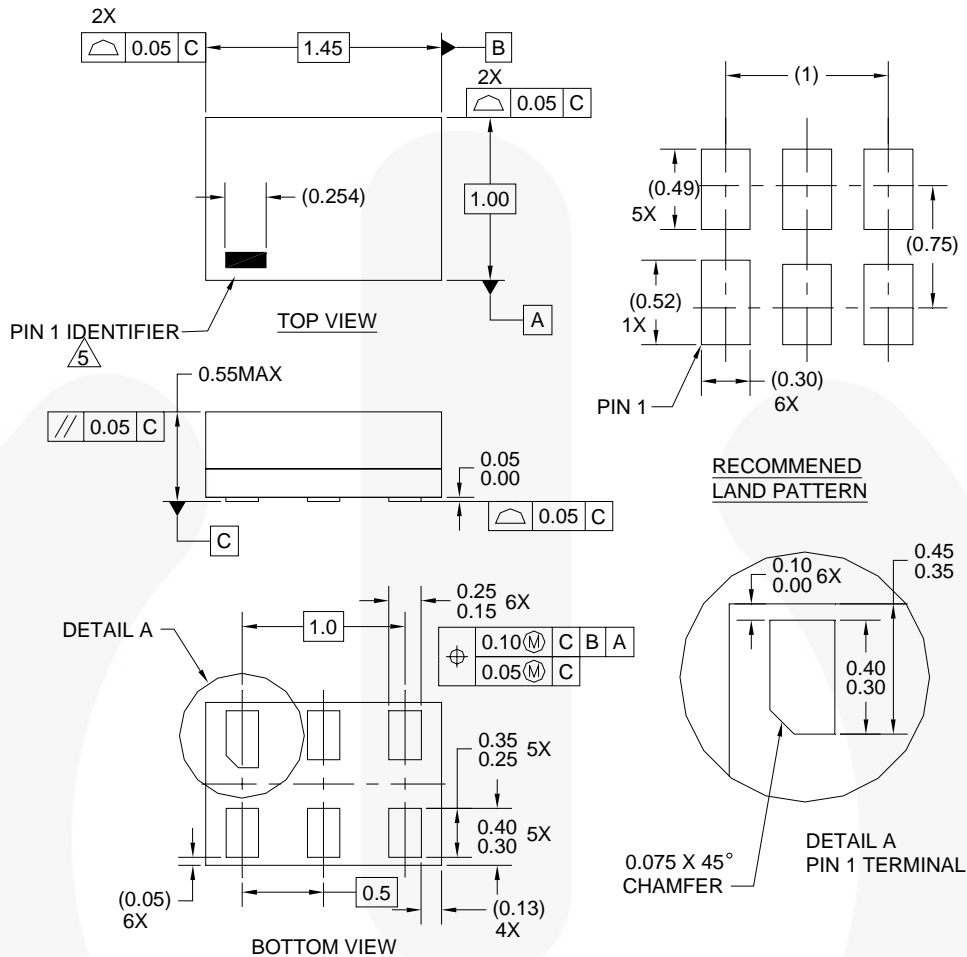
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:  
<http://www.fairchildsemi.com/packaging/>.

### Tape and Reel Specification

Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications:  
[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



**Notes:**

1. CONFORMS TO JEDEC STANDARD M0-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-1994
4. FILENAME AND REVISION: MAC06AREV4
5. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

**Figure 8. 6-Lead, MicroPak™, 1.0mm Wide**

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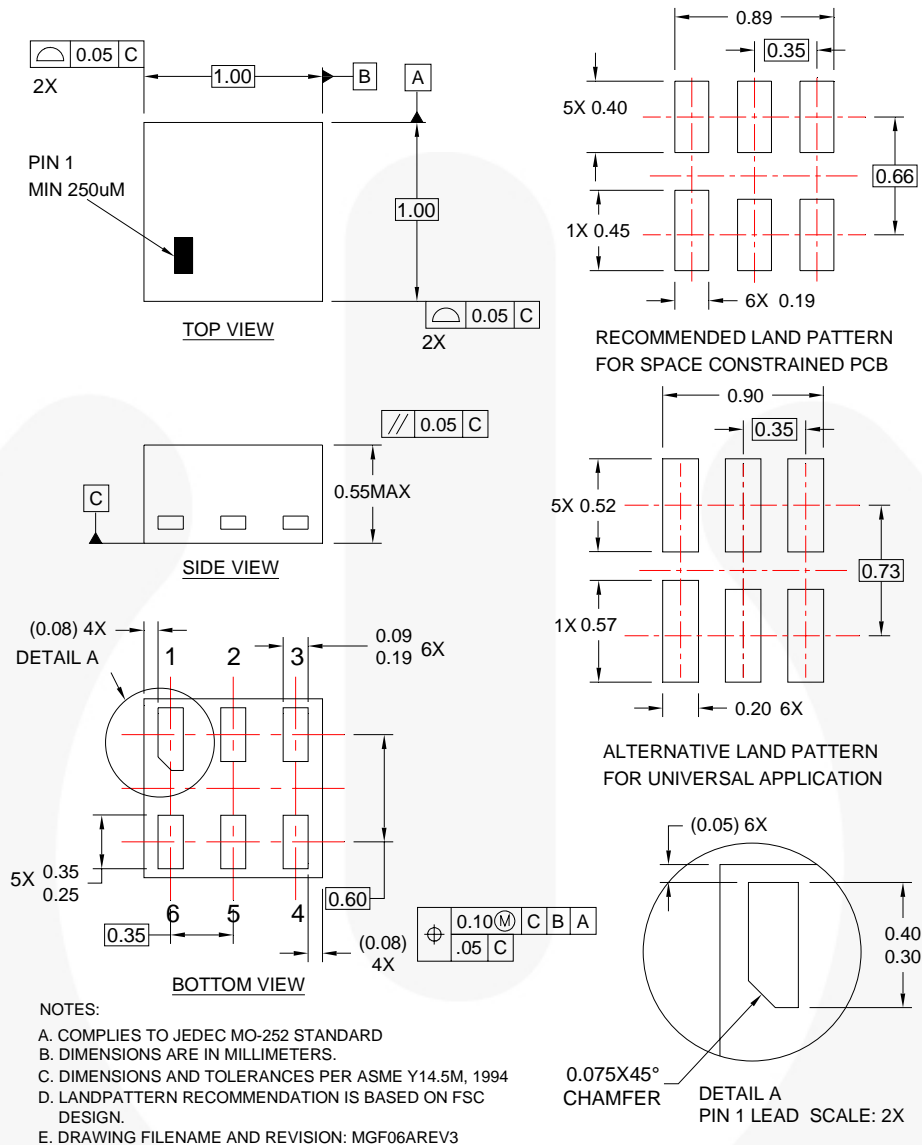
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| Package Designator | Tape Section       | Cavity Number | Cavity Status | Cover Type Status |
|--------------------|--------------------|---------------|---------------|-------------------|
| L6X                | Leader (Start End) | 125 (Typical)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

## Physical Dimensions



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

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| Package Designator | Tape Section       | Cavity Number | Cavity Status | Cover Type Status |
|--------------------|--------------------|---------------|---------------|-------------------|
| FHX                | Leader (Start End) | 125 (Typical) | Empty         | Sealed            |
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