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December 2010



# NC7SV57 / NC7SV58
# TinyLogic® ULP-A Universal Configurable Two-Input Logic Gates

## 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 $t_{PD}$
  - 2.5ns: Typical for 2.7V to 3.6V $V_{CC}$
  - 3.1ns: Typical for 2.3V to 2.7V $V_{CC}$
  - 4.0ns: Typical for 1.65V to 1.95V $V_{CC}$
  - 6.0ns: Typical for 1.4V to 1.6V $V_{CC}$
  - 8.0ns: Typical for 1.1V to 1.3V $V_{CC}$
  - 23.0ns: Typical for 0.9V $V_{CC}$
- Power-Off High-Impedance Inputs and Outputs
- High Static Drive ($I_{OH}$/$I_{OL}$)
  - ±24mA at 3.00V $V_{CC}$
  - ±18mA at 2.30V $V_{CC}$
  - ±6mA at 1.65V $V_{CC}$
  - ±4mA at 1.4V $V_{CC}$
  - ±2mA at 1.1V $V_{CC}$
  - ±0.1mA at 0.9V $V_{CC}$
- Proprietary Quiet Series™ Noise/EMI Reduction
- Ultra-Small MicroPak™ Package
- Ultra-Low Dynamic Power

## Description

The NC7SV57 and NC7SV58 are universal configurable two-input logic gates 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.

Each device is capable of being configured for 1 of 5 unique two-input logic functions. Any possible two-input combinatorial logic function can be implemented, as shown in the *Function Selection Table*. Device functionality is selected by how the device is wired at the board level. *Figures 1 through 10* illustrate how to connect the NC7SV57 and NC7SV58, respectively, for the desired logic function. All inputs have been implemented with hysteresis.

The NC7SV57 and NC7SV58 are uniquely designed for optimized power and speed and are 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 |
|---|---|---|---|
| NC7SV57P6X | V57 | 6-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3000 Units on Tape & Reel |
| NC7SV57L6X | H3 | 6-Lead Micropak™, 1.0mm Wide | 5000 Units on Tape & Reel |
| NC7SV57FHX | H3 | 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch | |
| NC7SV58P6X | V58 | 6-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3000 Units on Tape & Reel |
| NC7SV58L6X | H4 | 6-Lead Micropak™, 1.0mm Wide | 5000 Units on Tape & Reel |
| NC7SV58FHX | H4 | 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch | |

## Battery Life

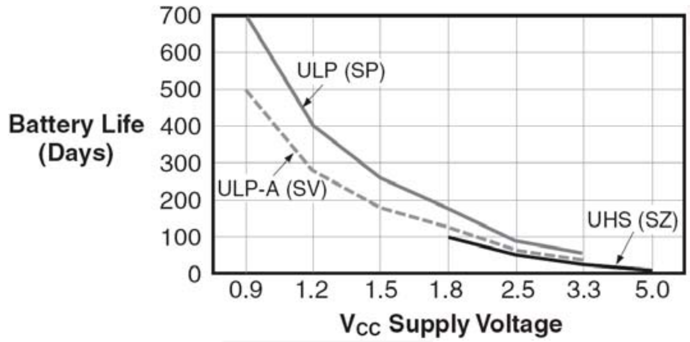


**Figure 1. Battery Life vs. $V_{CC}$ Supply Voltage**

**Notes:**

1. 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)/($P_{device}$)/24hrs/day
   where $P_{device} = (I_{CC} \cdot V_{CC}) + (C_{PD} + C_L) \cdot V_{CC}^2 \cdot f$.
2. Assumes ideal 3.6V Lithium Ion battery with current rating of 900mAH and derated 90% and device frequency at 10MHz, with $C_L$ = 15pF load.

## Pin Configurations

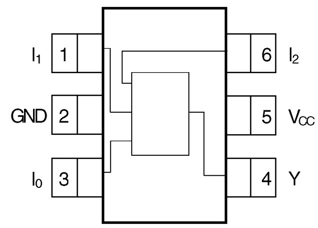


**Figure 2. SC70 (Top View)**

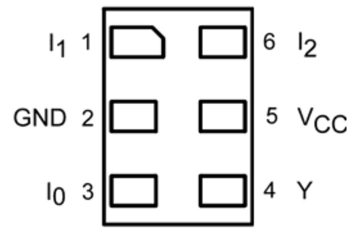


**Figure 3. MicroPak™ (Top Through View)**

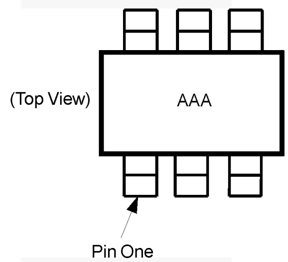


**Figure 4. Pin 1 Orientation**

**Notes:**

3. AAA represents product code top mark (*see Ordering Information*).
4. Orientation of top mark determines pin one location.
5. Reading the top mark left to right, pin one is the lower left pin.

## Pin Definitions

| Pin # SC70 | Pin # MicroPak™ | Name | Description |
|---|---|---|---|
| 1 | 1 | $I_1$ | Data Input |
| 2 | 2 | GND | Ground |
| 3 | 3 | $I_0$ | Data Input |
| 4 | 4 | Y | Output |
| 5 | 5 | $V_{CC}$ | Supply Voltage |
| 6 | 6 | $I_2$ | Data Input |

## Function Table

| Inputs | | | NC7SV57 | NC7SV58 |
|---|---|---|---|---|
| $I_2$ | $I_1$ | $I_0$ | $Y = \overline{(I_0)} \cdot \overline{(I_2)} + (I_1) \cdot (I_2)$ | $Y = (I_0) \cdot \overline{(I_2)} + \overline{(I_1)} \cdot (I_2)$ |
| L | L | L | H | L |
| L | L | H | L | H |
| L | H | L | H | L |
| L | H | H | L | H |
| H | L | L | L | H |
| H | L | H | L | H |
| H | H | L | H | L |
| H | H | H | H | L |

H = HIGH Logic Level
L = LOW Logic Level

## Function Selection Table

| 2-Input Logic Function | Device Selection | Connection Configuration |
|---|---|---|
| 2-Input AND | NC7SV57 | Figure 5 |
| 2-Input AND with Inverted Input | NC7SV58 | Figure 11, Figure 12 |
| 2-Input AND with Both Inputs Inverted | NC7SV57 | Figure 8 |
| 2-Input NAND | NC7SV58 | Figure 10 |
| 2-Input NAND with Inverted Input | NC7SV57 | Figure 6, Figure 7 |
| 2-Input NAND with Both Inputs Inverted | NC7SV58 | Figure 13 |
| 2-Input OR | NC7SV58 | Figure 13 |
| 2-Input OR with Inverted Input | NC7SV57 | Figure 6, Figure 7 |
| 2-Input OR with Both Inputs Inverted | NC7SV58 | Figure 10 |
| 2-Input NOR | NC7SV57 | Figure 8 |
| 2-Input NOR with Inverted Input | NC7SV58 | Figure 10, Figure 11 |
| 2-Input NOR with Both Inputs Inverted | NC7SV57 | Figure 5 |
| 2-Input XOR | NC7SV58 | Figure 14 |
| 2-Input XNOR | NC7SV57 | Figure 9 |

## NC7SV57 Logic Configurations

Figure 5 through Figure 9 show the logical functions that can be implemented using the NC7SV57. The diagrams show the DeMorgan's equivalent logic duals for a given two-input function. The logical implementation is next to the board-level physical implementation of how the pins of the function should be connected.

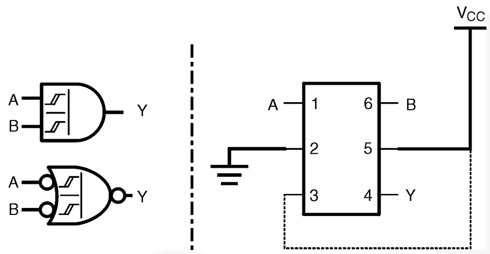


**Figure 5. 2-Input AND Gate**

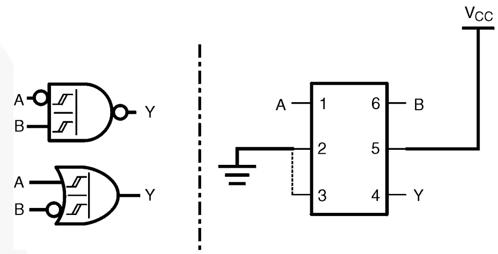


**Figure 6. 2-Input NAND Gate with Inverted A Input**

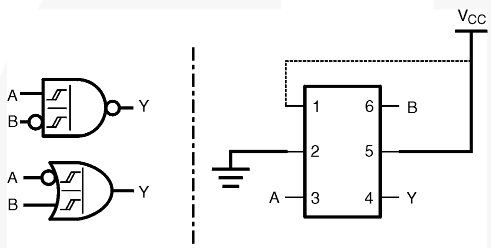


**Figure 7. 2-Input NAND with Inverted B Input**

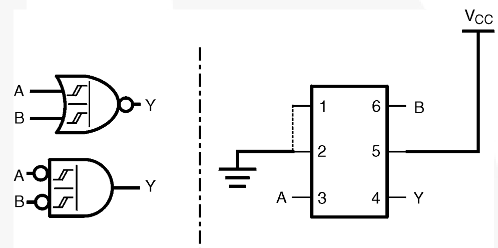


**Figure 8. 2-Input NOR Gate**

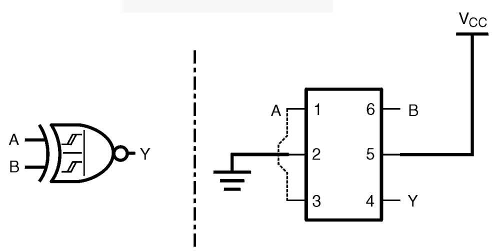


**Figure 9. 2-Input XNOR Gate**

## NC7SV58 Logic Configurations

Figure 10 through Figure 14 show the logical functions that can be implemented using the NC7SV58. The diagrams show the DeMorgan's equivalent logic duals for a given two-input function. The logical implementation is next to the board-level physical implementation of how the pins of the function should be connected.

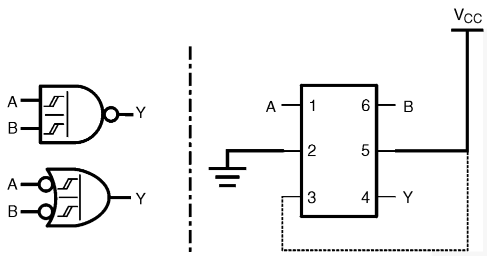


**Figure 10. 2-Input NAND Gate**

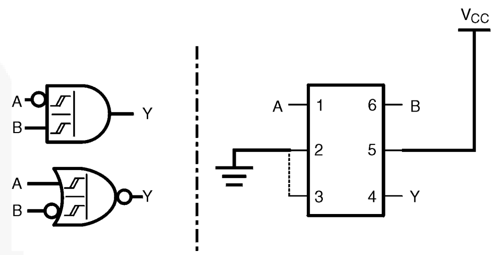


**Figure 11. 2-Input AND Gate with Inverted A Input**

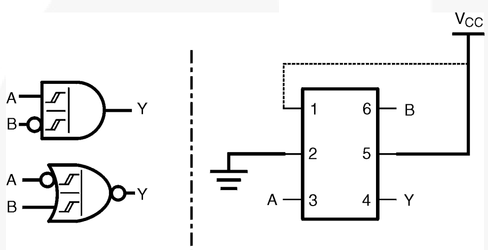


**Figure 12. 2-Input AND with Inverted B Input**

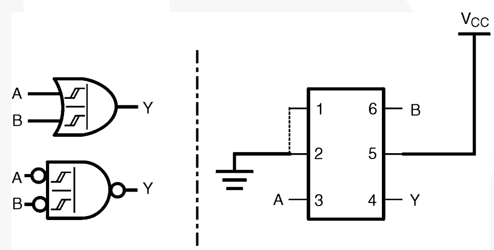


**Figure 13. 2-Input OR Gate**

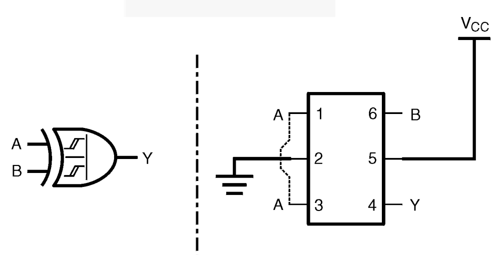


**Figure 14. 2-Input XOR Gate**

## 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[6] | -0.5 | $V_{CC}$ + 0.5 | V |
| | | $V_{CC}$=0V | -0.5 | 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 |
| $P_D$ | Power Dissipation at +85°C | MicroPak™-6 | | 130 | mW |
| | | SC70-6 | | 150 | |
| | | MicroPak2™-6 | | 120 | |
| ESD | Human Body Model, JEDEC:JESD22-A114 | | | 4000 | V |
| | Charged Device Model, JEDEC:JESD22-C101 | | | 2000 | |

**Note:**
6. 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 | | ±24.0 | mA |
| | | $V_{CC}$=2.3V to 2.7V | | ±18.0 | |
| | | $V_{CC}$=1.65V to 1.95V | | ±6.0 | |
| | | $V_{CC}$=1.4V to 1.6V | | ±4.0 | |
| | | $V_{CC}$=1.1V to 1.3V | | ±2.0 | |
| | | $V_{CC}$=0.9V | | ±0.1 | 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 | SC70-6 | | 425 | °C/W |
| | | MicroPak™-6 | | 500 | |
| | | MicroPak2™-6 | | 560 | |

**Note:**
7. Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ | Conditions | $T_A$=25°C | | $T_A$=-40 to 85°C | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Max. | Min. | Max. | |
| $V_P$ | Positive Threshold Voltage | 0.90 | | 0.30 | 0.70 | 0.30 | 0.70 | V |
| | | 1.10 | | 0.40 | 1.00 | 0.40 | 1.00 | |
| | | 1.40 | | 0.50 | 1.40 | 0.50 | 1.40 | |
| | | 1.65 | | 0.70 | 1.50 | 0.70 | 1.50 | |
| | | 2.30 | | 1.00 | 1.80 | 1.00 | 1.80 | |
| | | 2.70 | | 1.30 | 2.20 | 1.30 | 2.20 | |
| $V_N$ | Negative Threshold Voltage | 0.90 | | 0.10 | 0.60 | 0.10 | 0.60 | V |
| | | 1.10 | | 0.15 | 0.70 | 0.15 | 0.70 | |
| | | 1.40 | | 0.20 | 0.80 | 0.20 | 0.80 | |
| | | 1.65 | | 0.25 | 0.90 | 0.25 | 0.90 | |
| | | 2.30 | | 0.40 | 1.15 | 0.40 | 1.15 | |
| | | 2.70 | | 0.60 | 1.50 | 0.60 | 1.50 | |
| $V_H$ | Hysteresis Voltage | 0.90 | | 0.07 | 0.50 | 0.07 | 0.50 | V |
| | | 1.10 | | 0.08 | 0.60 | 0.08 | 0.60 | |
| | | 1.40 | | 0.10 | 0.80 | 0.10 | 0.80 | |
| | | 1.65 | | 0.15 | 1.00 | 0.15 | 1.00 | |
| | | 2.30 | | 0.25 | 1.10 | 0.25 | 1.10 | |
| | | 2.70 | | 0.40 | 1.20 | 0.40 | 1.20 | |
| $V_{OH}$ | HIGH Level Output Voltage | 0.90 | $I_{OH}$=-100µA | $V_{CC}$-0.1 | | $V_{CC}$-0.1 | | V |
| | | $1.10 \leq V_{CC} \leq 1.30$ | | $V_{CC}$-0.1 | | $V_{CC}$-0.1 | | |
| | | $1.40 \leq V_{CC} \leq 1.60$ | | $V_{CC}$-0.2 | | $V_{CC}$-0.2 | | |
| | | $1.65 \leq V_{CC} \leq 1.95$ | | $V_{CC}$-0.2 | | $V_{CC}$-0.2 | | |
| | | $2.30 \leq V_{CC} \leq 2.70$ | | $V_{CC}$-0.2 | | $V_{CC}$-0.2 | | |
| | | $2.70 \leq V_{CC} \leq 3.60$ | | $V_{CC}$-0.2 | | $V_{CC}$-0.2 | | |
| | | $1.10 \leq V_{CC} \leq 1.30$ | $I_{OH}$=-2mA | .75 x $V_{CC}$ | | .75 x $V_{CC}$ | | |
| | | $1.40 \leq V_{CC} \leq 1.60$ | $I_{OH}$=-4mA | .75 x $V_{CC}$ | | .75 x $V_{CC}$ | | |
| | | $1.65 \leq V_{CC} \leq 1.95$ | $I_{OH}$=-6mA | 1.25 | | 1.25 | | |
| | | $2.30 \leq V_{CC} \leq 2.70$ | | 2.0 | | 2.0 | | |
| | | $2.30 \leq V_{CC} \leq 2.70$ | $I_{OH}$=-12mA | 1.8 | | 1.8 | | |
| | | $2.70 \leq V_{CC} \leq 3.60$ | | 2.2 | | 2.2 | | |
| | | $2.30 \leq V_{CC} \leq 2.70$ | $I_{OH}$=-18mA | 1.7 | | 1.7 | | |
| | | $2.70 \leq V_{CC} \leq 3.60$ | | 2.4 | | 2.4 | | |
| | | $2.70 \leq V_{CC} \leq 3.60$ | $I_{OH}$=-24mA | 2.2 | | 2.2 | | |

*Continued on following page….*

## DC Electrical Characteristics (Continued)

| Symbol | Parameter | $V_{CC}$ | Conditions | $T_A$=25°C | | $T_A$=-40 to 85°C | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Max. | Min. | Max. | |
| $V_{OL}$ | LOW Level Output Voltage | 0.90 | $I_{OL}$=100µA | | 0.1 | | 0.1 | V |
| | | $1.10 \le V_{CC} \le 1.30$ | | | 0.1 | | 0.1 | |
| | | $1.40 \le V_{CC} \le 1.60$ | | | 0.2 | | 0.2 | |
| | | $1.65 \le V_{CC} \le 1.95$ | | | 0.2 | | 0.2 | |
| | | $2.30 \le V_{CC} \le 2.70$ | | | 0.2 | | 0.2 | |
| | | $2.70 \le V_{CC} \le 3.60$ | | | 0.2 | | 0.2 | |
| | | $1.10 \le V_{CC} \le 1.30$ | $I_{OL}$=2mA | | .25 x $V_{CC}$ | | .25 x $V_{CC}$ | |
| | | $1.40 \le V_{CC} \le 1.60$ | $I_{OL}$=4mA | | .25 x $V_{CC}$ | | .25 x $V_{CC}$ | |
| | | $1.65 \le V_{CC} \le 1.95$ | $I_{OL}$=6mA | | 0.3 | | 0.3 | |
| | | $2.30 \le V_{CC} \le 2.70$ | $I_{OL}$=12mA | | 0.4 | | 0.4 | |
| | | $2.70 \le V_{CC} \le 3.60$ | | | 0.4 | | 0.4 | |
| | | $2.30 \le V_{CC} \le 2.70$ | $I_{OL}$=18mA | | 0.6 | | 0.6 | |
| | | $2.70 \le V_{CC} \le 3.60$ | | | 0.4 | | 0.4 | |
| | | $2.70 \le V_{CC} \le 3.60$ | $I_{OL}$=24mA | | 0.55 | | 0.55 | |
| $I_{IN}$ | Input Leakage Current | 0.90 to 3.60 | $0 \le V_{IN} \le 3.6V$ | | ±0.1 | | ±0.5 | µA |
| $I_{OFF}$ | Power Off Leakage Current | 0 | $0 \le (V_{IN}, V_O) \le 3.60$ | | 0.5 | | 0.5 | µA |
| $I_{CC}$ | Quiescent Supply Current | 0.90 to 3.60 | $V_{IN}=V_{CC}$ or GND | | 0.9 | | 0.9 | µA |
| | | | $V_{CC} \le V_{IN} \le 3.6V$ | | | | ±0.9 | |

## AC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ | Conditions | $T_A$=25°C | | | $T_A$=-40 to 85°C | | Units | Figure |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Min. | Typ. | Min. | | |
| $t_{PHL}$, $t_{PLH}$ | Propagation Delay | 0.90 | $C_L$=15pF, $R_L$=1MΩ | | 15.0 | | | | ns | Figure 15<br>Figure 16 |
| | | $1.10 \le V_{CC} \le 1.30$ | $C_L$=15pF, $R_L$=2KΩ | 4.0 | 8.0 | 16.5 | 3.3 | 31.0 | | |
| | | $1.40 \le V_{CC} \le 1.60$ | | 2.0 | 6.0 | 10.0 | 2.0 | 12.0 | | |
| | | $1.65 \le V_{CC} \le 1.95$ | $C_L$=30pF, $R_L$=500Ω | 2.0 | 4.0 | 9.1 | 1.9 | 10.0 | | |
| | | $2.30 \le V_{CC} \le 2.70$ | | 1.5 | 3.1 | 6.2 | 1.4 | 6.7 | | |
| | | $2.70 \le V_{CC} \le 3.60$ | | 1.2 | 2.5 | 5.4 | 1.2 | 6.1 | | |
| $C_{IN}$ | Input Capacitance | 0 | | | 8 | | | | pF | |
| $C_{OUT}$ | Output Capacitance | 0 | | | 12 | | | | pF | |
| $C_{PD}$ | Power Dissipation Capacitance | 0.90 to 3.60 | $V_I$=0V or $V_{CC}$, f=10MHz | | 10 | | | | pF | |

## AC Loadings and Waveforms

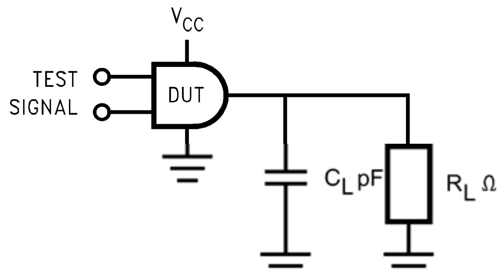


**Figure 15. AC Test Circuit**

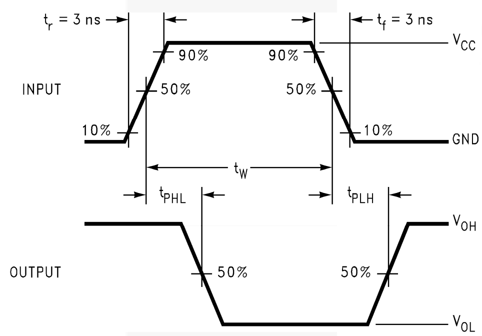


**Figure 16. AC Waveforms**

| **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 | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ | $V_{CC}/2$ |

## Physical Dimensions

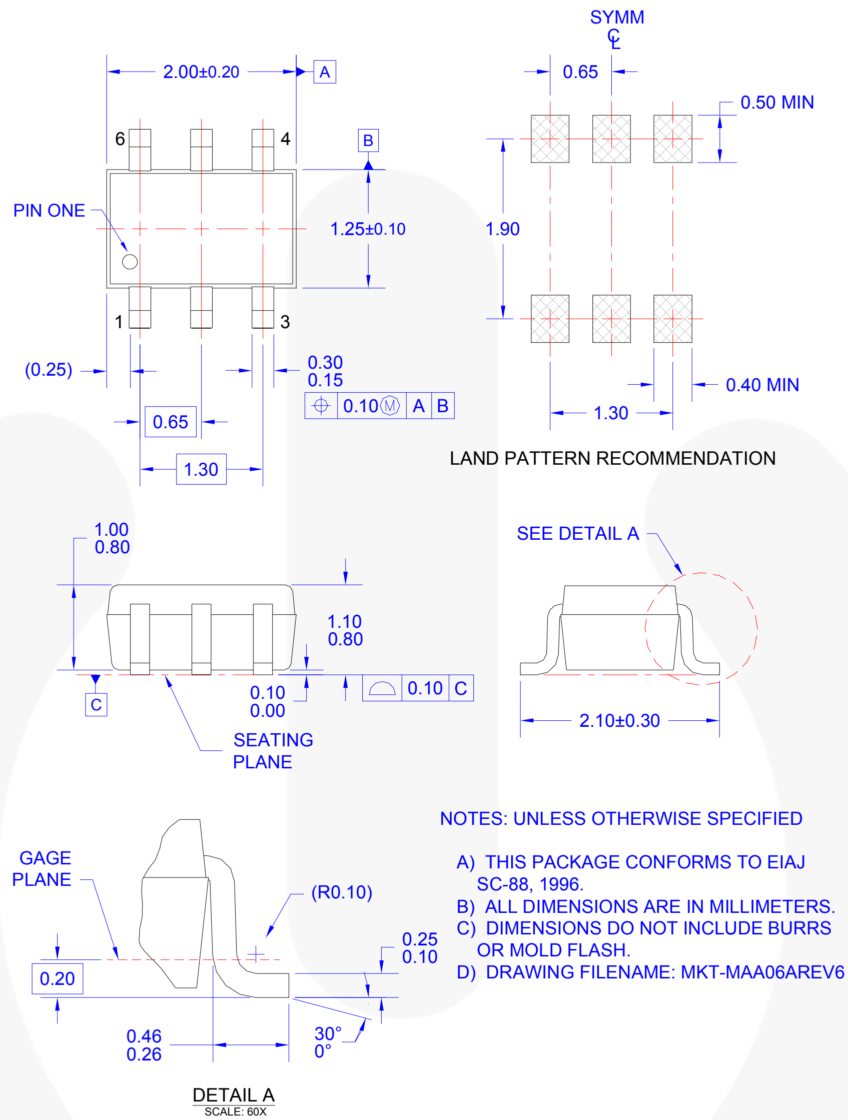


**Figure 17. 6-Lead, SC70, EIAJ SC-88a, 1.25mm Wide**

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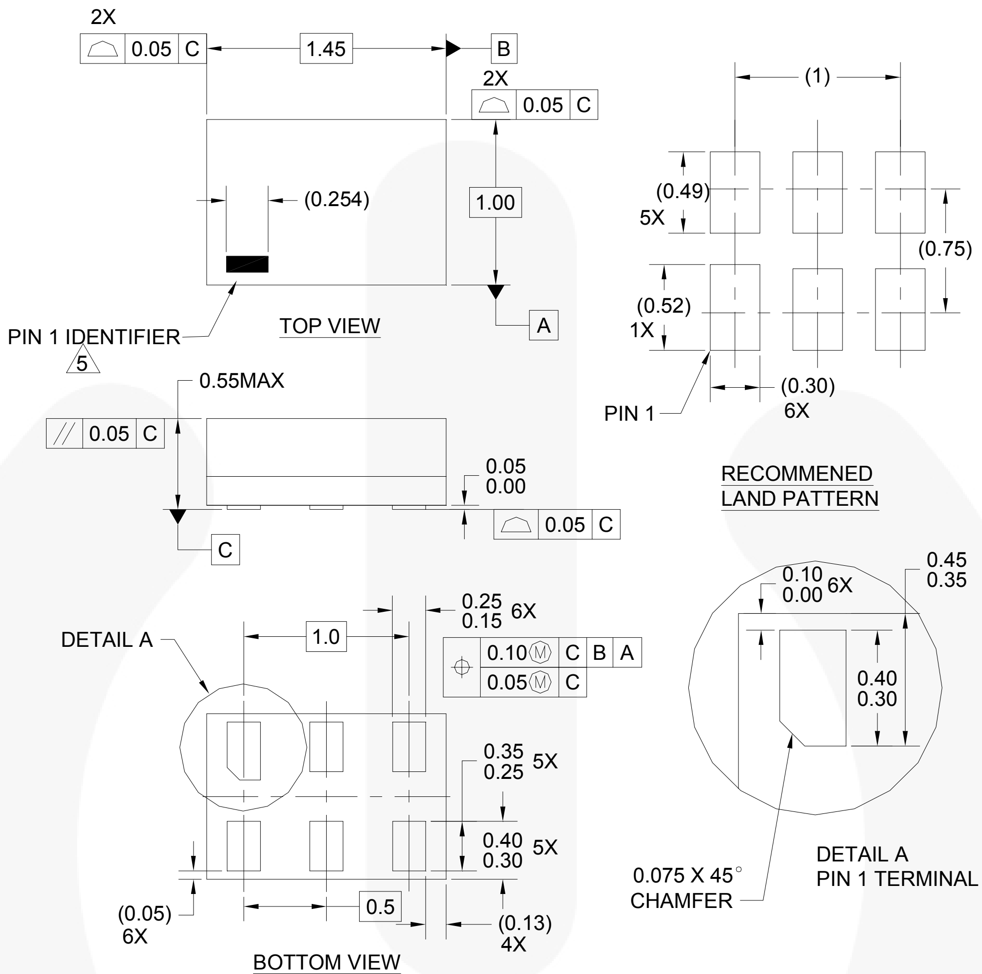
## Tape and Reel Specifications

*Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications:*
*http://www.fairchildsemi.com/products/analog/pdf/sc70-6_tr.pdf*

| Package Designator | Tape Section | Cavity Number | Cavity Status | Cover Type Status |
|---|---|---|---|---|
| P6X | 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 18. 6-Lead, MicroPak™, 1.0mm Wide**

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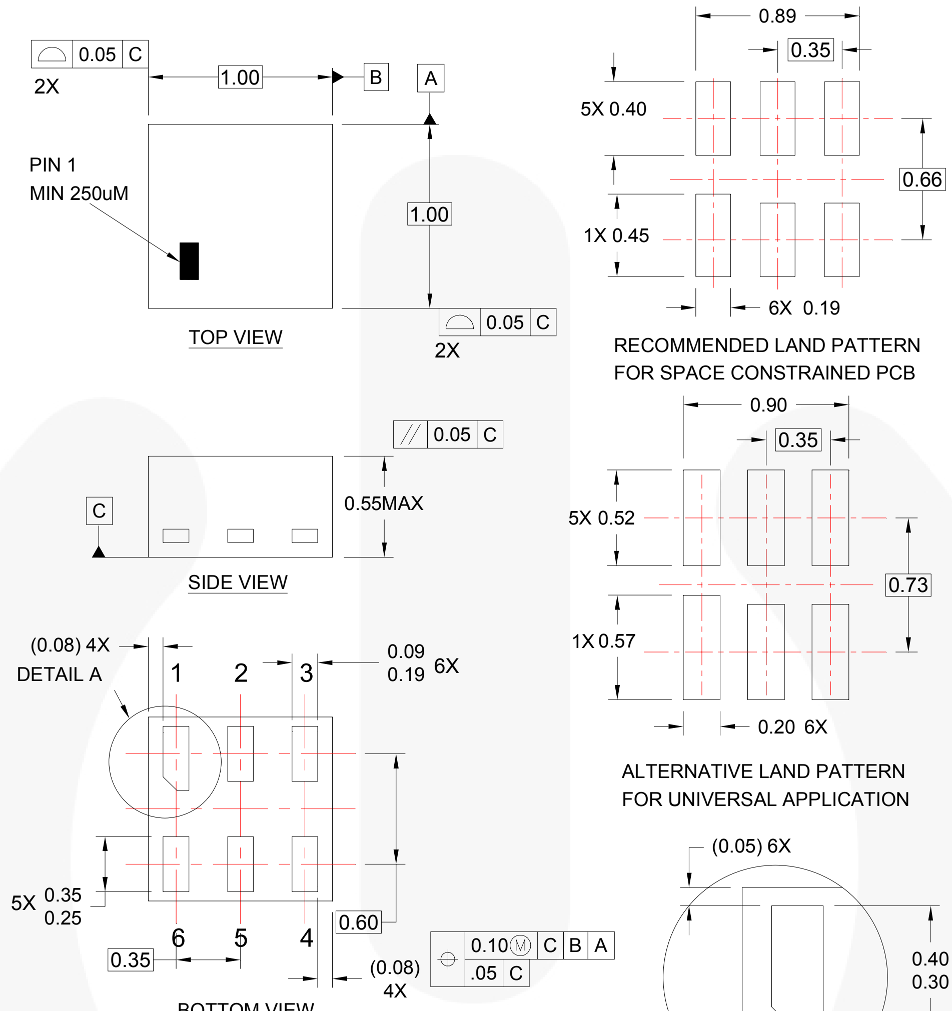
## Tape and Reel Specifications

*Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications:* *http://www.fairchildsemi.com/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




NOTES:

A. COMPLIES TO JEDEC MO-252 STANDARD
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994
D. LANDPATTERN RECOMMENDATION IS BASED ON FSC DESIGN.
E. DRAWING FILENAME AND REVISION: MGF06AREV3

**Figure 19. 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*
.

| 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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