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FAIRCHILD SEMICONDUCTOR®

September 2011

# NC7SV05
# TinyLogic® ULP-A Inverter (Open-Drain Output)

## 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 $t_{PD}$
  - 1.0ns: Typical for 2.7V to 3.6V $V_{CC}$
  - 1.2ns: 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 $V_{CC}$
  - 13.0ns: 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 $V_{CC}$
- Uses Proprietary Quiet Series™ Noise/EMI Reduction Circuitry
- Ultra-Small MicroPak™ Packages
- Ultra-Low Dynamic Power

## Description

The NC7SV05 is a single inverter with open-drain output 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 NC7SV05 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 |
|---|---|---|---|
| NC7SV05P5X | V05 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3000 Units on Tape & Reel |
| NC7SV05L6X | F9 | 6-Lead MicroPak™, 1.00mm Wide | 5000 Units on Tape & Reel |
| NC7SV05FHX | F9 | 6-Lead, MicroPak2, 1x1mm Body, .35mm Pitch | 5000 Units on Tape & Reel |

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## Battery Life

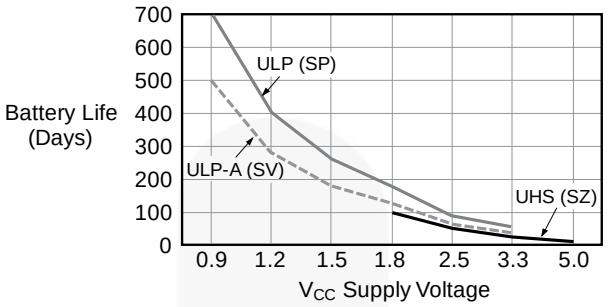


**Figure 1. Battery Life vs. $V_{CC}$ Supply Voltage**

**Notes:**

1. TinyLogic® ULP and ULP-A with up to 50% less power consumption can extend battery life significantly.
   Battery Life = $(V_{battery} \bullet I_{battery} \bullet .9)/(P_{device})/24hrs/day$
   where, $P_{device} = (I_{CC} \bullet V_{CC}) + (C_{PD} + C_L) \bullet V_{CC2} \bullet f$.
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.

## Connection Diagram

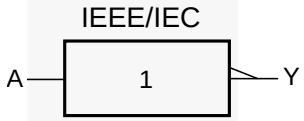


**Figure 2. Logic Symbol**

## Pin Configurations

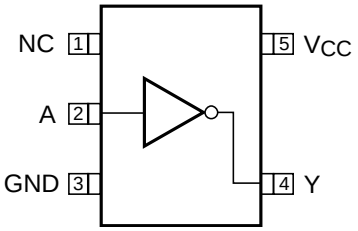


**Figure 3. SC70 (Top View)**

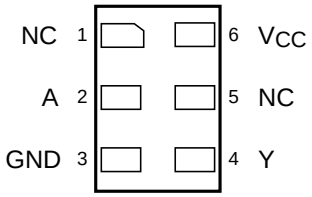


**Figure 4. MicroPak (Top Through View)**

## 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 | $V_{CC}$ | Supply Voltage |

## Function Table

| Inputs | Output |
|---|---|
| **A** | **Y** |
| L | *H |
| H | L |

H=HIGH Logic Level

L=LOW Logic Level

*H=HIGH Impedance Output Status (Open Drain)

## 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 | | -0.5 | 4.6 | V |
| $I_{IK}$ | DC Input Diode Current | $V_{IN}$ < 0V | | -50 | mA |
| $I_{OK}$ | DC Output Diode Current | $V_{OUT}$ < 0V | | -50 | mA |
| $I_{OL}$ | DC Output 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 | |

## 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 | | 0 | 3.6 | V |
| $I_{OL}$ | Output Current in $I_{OL}$ | $V_{CC}$=3.0V to 3.6V | | +24.0 | mA |
| | | $V_{CC}$=2.3V to 3.6V | | +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 | |
| $T_A$ | 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:**

3. 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. | |
| $V_{IH}$ | HIGH Level Input Voltage | 0.90 | | .65 x $V_{CC}$ | | .65 x $V_{CC}$ | | V |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | | .65 x $V_{CC}$ | | .65 x $V_{CC}$ | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | | .65 x $V_{CC}$ | | .65 x $V_{CC}$ | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | | .65 x $V_{CC}$ | | .65 x $V_{CC}$ | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | | 1.6 | | 1.6 | | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | | 2.0 | | 2.0 | | |
| $V_{IL}$ | LOW Level Input Voltage | 0.90 | | | .35 x $V_{CC}$ | | .35 x $V_{CC}$ | V |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | | | .35 x $V_{CC}$ | | .35 x $V_{CC}$ | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | | | .35 x $V_{CC}$ | | .35 x $V_{CC}$ | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | | | .35 x $V_{CC}$ | | .35 x $V_{CC}$ | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | | | 0.7 | | 0.7 | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | | | 0.8 | | 0.8 | |
| $V_{OL}$ | LOW Level Output Voltage | 0.90 | $I_{OL}$=100µA | | 0.1 | | 0.1 | V |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | | | 0.1 | | 0.1 | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | | | 0.2 | | 0.2 | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | | | 0.2 | | 0.2 | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | | | 0.2 | | 0.2 | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | | | 0.2 | | 0.2 | |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | $I_{OL}$=2mA | | 0.25 x $V_{CC}$ | | 0.25 x $V_{CC}$ | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | $I_{OL}$=4mA | | 0.25 x $V_{CC}$ | | 0.25 x $V_{CC}$ | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | $I_{OL}$=6mA | | 0.3 | | 0.3 | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | $I_{OL}$=12mA | | 0.4 | | 0.4 | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | | | 0.4 | | 0.4 | |
| | | 2.30≤ $V_{CC}$ ≤ 2.70 | $I_{OL}$=18mA | | 0.6 | | 0.6 | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | | | 0.4 | | 0.4 | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | $I_{OL}$=24mA | | 0.55 | | 0.55 | |
| $I_{IN}$ | Input Leakage Current | 0.90 to 3.60 | 0 ≤ $V_{IN}$ ≤ 3.60 | | ±0.1 | | ±0.5 | µA |
| $I_{OFF}$ | Power Off Leakage Current | 0 | 0 ≤ ($V_{IN,}$ $V_O$) ≤ 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 |
| | | | $V_{CC}$ ≤ $V_{IN}$ ≤ 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. | Max. | Min. | Max. | | |
| $t_{PZL}$, $t_{PLZ}$ | Propagation Delay | 0.90 | $C_L$=15pF, $R_U$=$R_D$=1kΩ | | 13 | | | | ns | Figure 5 Figure 6 |
| | | 1.10 ≤ $V_{CC}$ ≤ 1.30 | $C_L$=30pF, $R_U$=$R_D$=1kΩ | 3.0 | 6.0 | 15.0 | 1.0 | 18.6 | | |
| | | 1.40 ≤ $V_{CC}$ ≤ 1.60 | | 1.0 | 3.2 | 8.7 | 1.0 | 9.7 | | |
| | | 1.65 ≤ $V_{CC}$ ≤ 1.95 | $C_L$=30pF, $R_U$=$R_D$=1kΩ | 1.0 | 2.0 | 6.0 | 1.0 | 6.8 | | |
| | | 2.30 ≤ $V_{CC}$ ≤ 2.70 | | 0.8 | 1.2 | 3.6 | 0.7 | 4.7 | | |
| | | 2.70 ≤ $V_{CC}$ ≤ 3.60 | | 0.7 | 1.0 | 3.3 | 0.6 | 4.0 | | |
| $C_{IN}$ | Input Capacitance | 0 | | | 2 | | | | pF | |
| $C_{PD}$ | Power Dissipation Capacitance | 0.90 to 3.60 | $V_{IN}$=0V or $V_{CC}$, f=10MHz | | 10 | | | | pF | |

## AC Loadings and Waveforms

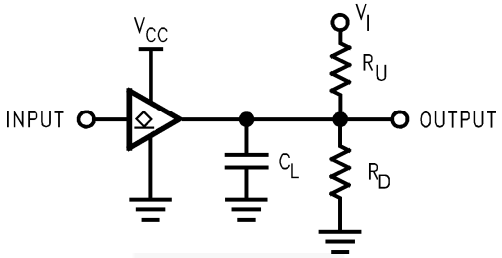


**Figure 5. AC Test Circuit**

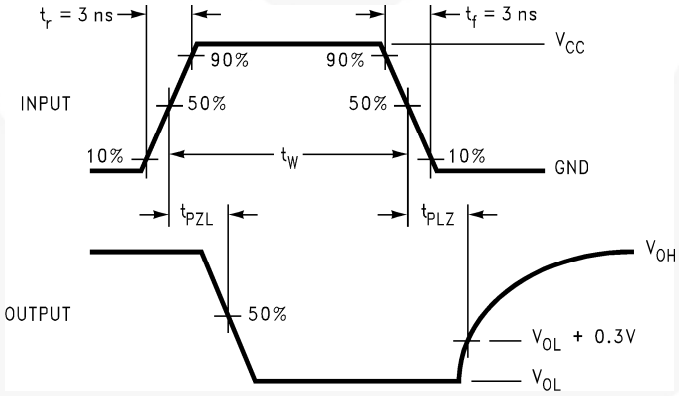


**Figure 6. AC Waveforms for Inverting and Non-Inverting Functions**

| Symbol | $V_{CC}$ | | | | | |
|---|---|---|---|---|---|---|
| | 3.3V ± 0.3V | 2.5V ± 0.2V | 1.8V ± 0.15V | 1.5V ± 0.1V | 1.2V ± 0.1V | 0.9V |
| $V_{mi}$ | 1.5V | $V_{CC}$/2 | $V_{CC}$/2 | $V_{CC}$/2 | $V_{CC}$/2 | $V_{CC}$/2 |
| $V_{mo}$ | $V_{OL}$ + 0.30V | $V_{OL}$ + 0.15V | $V_{OL}$ + 0.15V | $V_{OL}$ + 0.10V | $V_{OL}$ + 0.10V | $V_{OL}$ + 0.10V |

## Physical Dimensions

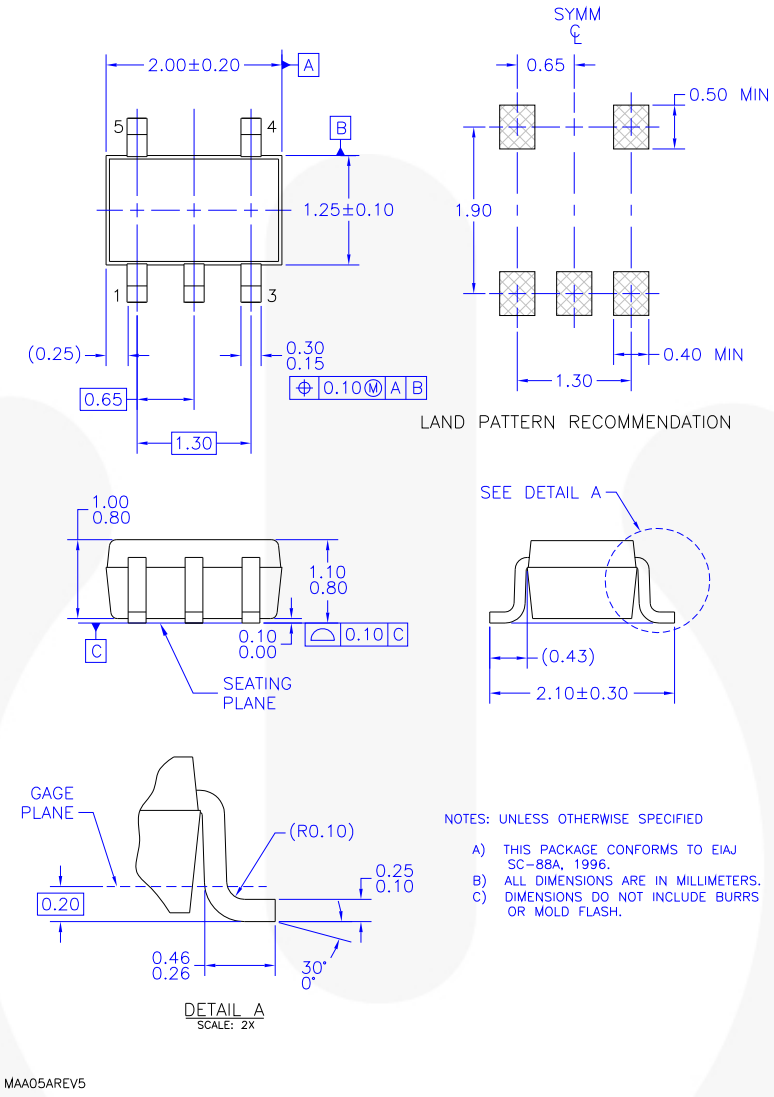


**Figure 7. 5-Lead, SC70, EIAJ SC-88a, 1.25mm Wide**

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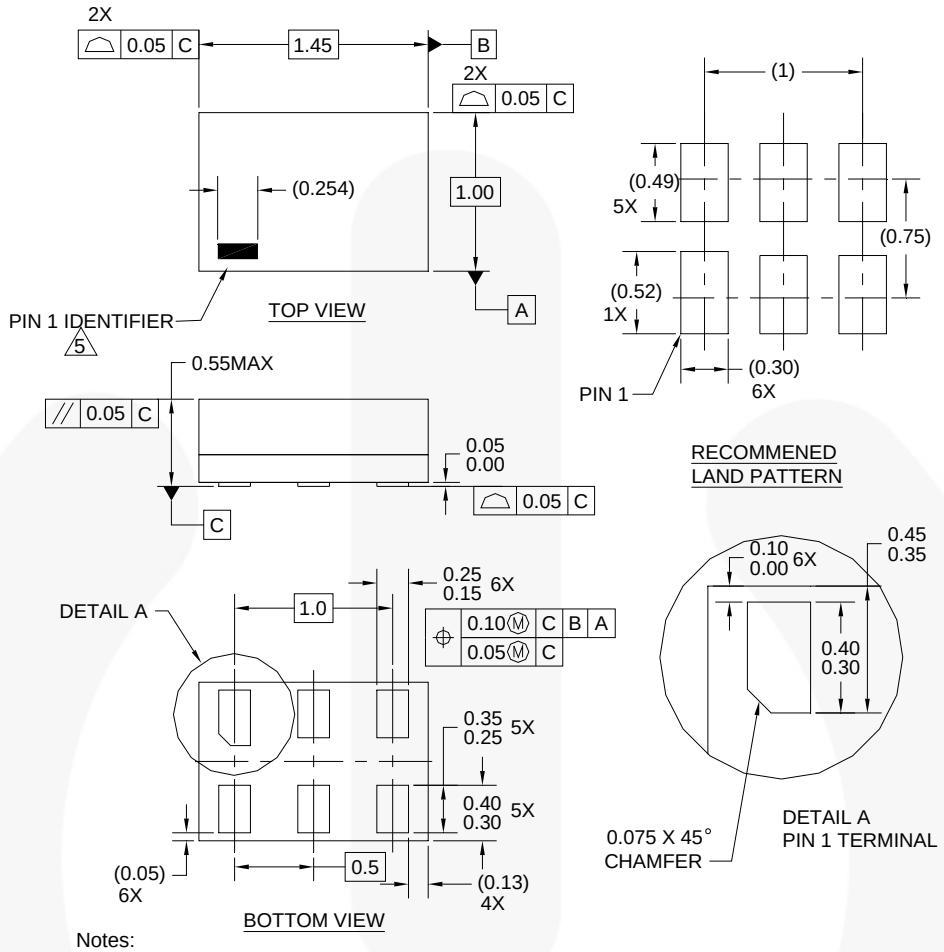
## Tape and Reel Specification

*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.*

| 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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*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

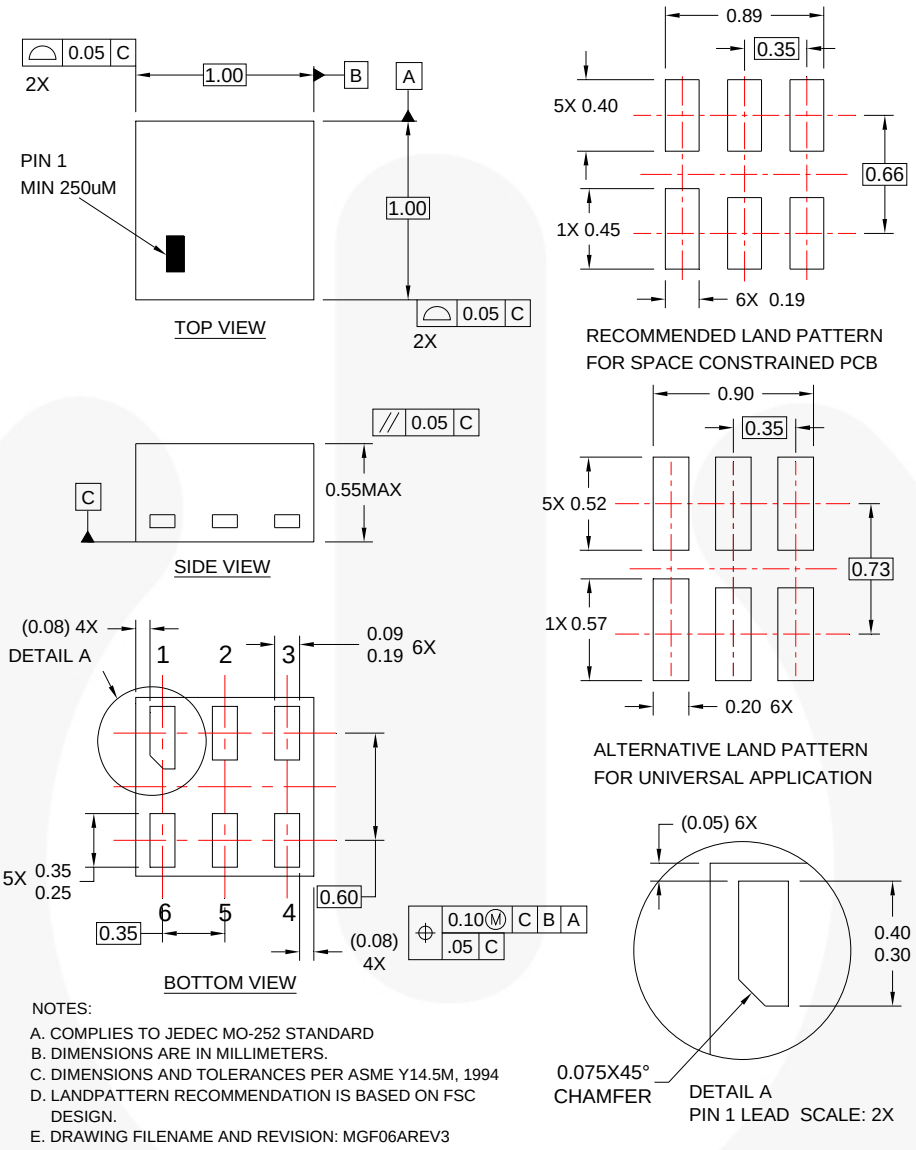


**Figure 9. 6-Lead, MicroPak2, 1x1mm Body, .35mm Pitch**

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## Tape and Reel Specification

*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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**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| 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. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

Rev. I57

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