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NC7SP08 — TinyLogic® ULP Two-Input AND Gate

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
- Propagation Delay (t_{PD}):
 - 2.5ns Typical for 3.0V to 3.6V V_{CC}
 - 5.0ns Typical for 2.3V to 2.7V V_{CC}
 - 6.0ns Typical for 1.65V to 1.95V V_{CC}
 - 7.0ns Typical for 1.40V to 1.60V V_{CC}
 - 11.0ns Typical for 1.10V to 1.30V V_{CC}
 - 27.0ns Typical for 0.90V V_{CC}
- Power-Off High-Impedance Inputs and Outputs
- Static Drive (I_{OH}/I_{OL}):
 - ± 2.6mA at 3.00V V_{CC}
 - ± 2.1mA at 2.30V V_{CC}
 - ± 1.5mA at 1.65V V_{CC}
 - ± 1.0mA at 1.40V V_{CC}
 - ± 0.5mA at 1.10V V_{CC}
 - ± 20µA at 0.9V V_{CC}
- Quiet Series™ Noise / EMI Reduction Circuitry
- Ultra Small MicroPak™ Packages
- Ultra Low Dynamic Power

Description

The NC7SP08 is a single two-input AND gate 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.

The internal circuit is composed of a minimum of inverter stages, including the output buffer, to enable ultra low static and dynamic power.

The NC7SP08, 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 of operation, while maintaining extremely low CMOS power dissipation.

Ordering Information

| Part Number | Top Mark | Package | Packing Method |
|-------------|----------|---|---------------------------|
| NC7SP08P5X | P08 | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3000 Units on Tape & Reel |
| NC7SP08L6X | J9 | 6-Lead MicroPak™, 1.00mm Wide | 5000 Units on Tape & Reel |
| NC7SP08FHX | J9 | 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch | 5000 Units on Tape & Reel |

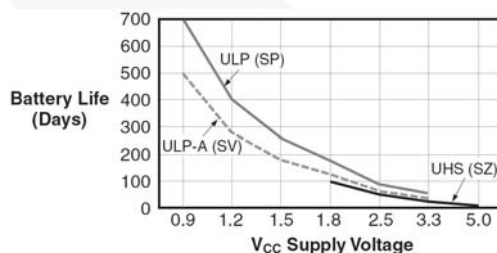


Figure 1. Battery Life vs. V_{CC} Supply Voltage

Notes:

1. TinyLogic ULP and ULP-A with up to 50% less power consumption can extend battery life significantly.
2. Battery Life = $(V_{\text{battery}} \times I_{\text{battery}} \times 0.9) / (P_{\text{device}}) / 24\text{hrs/day}$; where, $P_{\text{device}} = (I_{\text{CC}} \times V_{\text{CC}}) + (C_{\text{PD}} + C_{\text{L}}) \times V_{\text{CC}}^2 \times f$.
3. 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 Diagrams

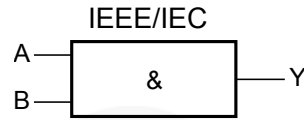


Figure 2. Logic Symbol

Pin Configurations

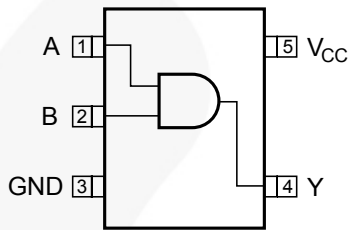


Figure 3. SC70 (Top View)

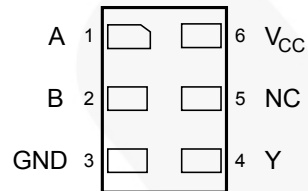


Figure 4. MicroPak™ (Top Through View)

Function Table

$$Y = AB$$

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

L = Low Logic Level
H = High Logic Level

Pin Definitions

| Pin # SC70 | Pin # MicroPak™ | Name | Description |
|------------|-----------------|-----------------|----------------|
| 1 | 1 | A | Input |
| 2 | 2 | B | Input |
| 3 | 3 | GND | Ground |
| 4 | 4 | Y | Output |
| | 5 | NC | No Connect |
| 5 | 6 | V _{CC} | Supply Voltage |

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 ⁽⁴⁾ | -0.5 | V_{CC} to +0.5 | V |
| | | $V_{CC}=0V$ | -0.5 | 4.6 | V |
| I_{IK} | DC Input Diode Current at $V_{IN} < 0V$ | | | -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 Ground | 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 |
| | Charged Device Model | JEDEC: JESD22-C101 | | 2000 | |

Note:

4. The I_O 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 ⁽⁵⁾ | | 0 | 3.6 | V |
| V_{OUT} | Output Voltage | HIGH or LOW State | 0 | V_{CC} | V |
| | | $V_{CC}=0V$ | 0 | 3.6 | |
| I_{OH} / I_{OL} | Output Current in I_{OH} / I_{OL} | $V_{CC}=3.0V$ to $3.6V$ | | ±2.6 | mA |
| | | $V_{CC}=2.3V$ to $2.7V$ | | ±2.1 | |
| | | $V_{CC}=1.65V$ to $1.95V$ | | ±1.5 | |
| | | $V_{CC}=1.40V$ to $1.60V$ | | ±1.0 | |
| | | $V_{CC}=1.10V$ to $1.30V$ | | ±0.5 | |
| | | $V_{CC}=0.9V$ | | 20.0 | µA |
| T_A | Free Air Operating Temperature | | -40 | +85 | °C |
| $\Delta t / \Delta V$ | Minimum Input Edge Rate | $V_{IN}=0.8V$ to $2.0V$, $V_{CC}=3.0V$ | | 10 | ns/V |
| θ_{JA} | Thermal Resistance | SC70-5 | | 425 | °C/W |
| | | MicroPak™-6 | | 500 | |
| | | MicroPak2™-6 | | 560 | |

Note:

5. 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 | | 0.65 x V _{CC} | | 0.65 x V _{CC} | | V |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | 0.65 x V _{CC} | | 0.65 x V _{CC} | | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | 0.65 x V _{CC} | | 0.65 x V _{CC} | | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | 0.65 x V _{CC} | | 0.65 x V _{CC} | | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | 1.6 | | 1.6 | | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | 2.1 | | 2.1 | | |
| V _{IL} | LOW Level Input Voltage | 0.90 | | | 0.35 x V _{CC} | | 0.35 x V _{CC} | V |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | | 0.35 x V _{CC} | | 0.35 x V _{CC} | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | | 0.35 x V _{CC} | | 0.35 x V _{CC} | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | | 0.35 x V _{CC} | | 0.35 x V _{CC} | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | | 0.7 | | 0.7 | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | | 0.9 | | 0.9 | |
| V _{OH} | HIGH Level Output Voltage | 0.90 | I _{OH} =-20μA | | V _{CC} - 0.1 | | V _{CC} - 0.1 | V |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | | V _{CC} - 0.1 | | V _{CC} - 0.1 | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | | V _{CC} - 0.1 | | V _{CC} - 0.1 | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | | V _{CC} - 0.1 | | V _{CC} - 0.1 | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | | V _{CC} - 0.1 | | V _{CC} - 0.1 | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | | V _{CC} - 0.1 | | V _{CC} - 0.1 | |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | I _{OH} =-0.5mA | 0.75 x V _{CC} | | 0.70 x V _{CC} | | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | I _{OH} =-1mA | 1.07 | | 0.99 | | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | I _{OH} =-1.5mA | 1.24 | | 1.22 | | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | I _{OH} =-2.1mA | 1.95 | | 1.87 | | |
| 3.00 ≤ V _{CC} ≤ 3.60 | I _{OH} =-2.6mA | 2.61 | | 2.55 | | | | |
| V _{OL} | LOW Level Output Voltage | 0.90 | I _{OL} =20μA | | 0.1 | | 0.1 | V |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | | 0.1 | | 0.1 | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | | 0.1 | | 0.1 | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | | 0.1 | | 0.1 | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | | 0.1 | | 0.1 | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | | 0.1 | | 0.1 | |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | I _{OL} =0.5mA | | 0.30 x V _{CC} | | 0.30 x V _{CC} | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | I _{OL} =1mA | | 0.31 | | 0.37 | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | I _{OL} =1.5mA | | 0.31 | | 0.35 | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | I _{OL} =2.1mA | | 0.31 | | 0.33 | |
| 3.00 ≤ V _{CC} ≤ 3.60 | I _{OL} =2.6mA | | 0.31 | | 0.33 | | | |
| I _{IN} | Input Leakage Current | 0.90 to 3.60 | 0 ≤ V _{IN} ≤ 3.6V | | ±0.1 | | ±0.5 | μA |
| I _{OFF} | Power Off Leakage Current | 0 | 0 ≤ (V _O , V _{IN}) ≤ 3.6V | | 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 |

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 _{PHL} , t _{PLH} | Propagation Delay | 0.90 | C _L =10pF, R _L =1MΩ | | 27.0 | | | | ns | Figure 1, Figure 2 |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | 3.5 | 11.0 | 21.8 | 3.0 | 34.3 | | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | 2.5 | 7.0 | 14.8 | 2.0 | 15.0 | | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | 2.0 | 6.0 | 12.0 | 1.5 | 12.2 | | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | 1.5 | 5.0 | 9.4 | 1.0 | 9.9 | | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | 1.0 | 4.0 | 8.3 | 1.0 | 9.0 | | |
| | | 0.90 | C _L =15pF, R _L =1MΩ | | 30.0 | | | | | |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | 4.0 | 11.0 | 22.8 | 3.5 | 37.3 | | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | 3.0 | 8.0 | 15.5 | 2.5 | 16.5 | | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | 2.5 | 6.0 | 12.6 | 2.0 | 13.6 | | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | 2.0 | 5.0 | 9.9 | 1.5 | 10.8 | | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | 1.5 | 4.0 | 8.7 | 1.0 | 9.5 | | |
| | | 0.90 | C _L =30pF, R _L =1MΩ | | 32.0 | | | | | |
| | | 1.10 ≤ V _{CC} ≤ 1.30 | | 5.0 | 13.0 | 25.9 | 4.0 | 46.3 | | |
| | | 1.40 ≤ V _{CC} ≤ 1.60 | | 4.0 | 9.0 | 17.8 | 3.5 | 18.2 | | |
| | | 1.65 ≤ V _{CC} ≤ 1.95 | | 3.0 | 7.0 | 14.4 | 2.0 | 15.9 | | |
| | | 2.30 ≤ V _{CC} ≤ 2.70 | | 2.0 | 6.0 | 11.3 | 1.5 | 12.8 | | |
| | | 3.00 ≤ V _{CC} ≤ 3.60 | | 1.5 | 5.0 | 9.2 | 1.0 | 10.7 | | |
| 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 | 6 | | | | pF | | |

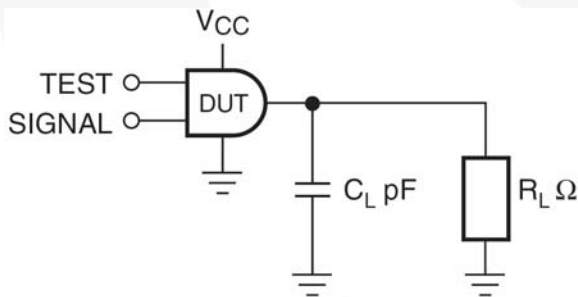


Figure 5. AC Test Circuit

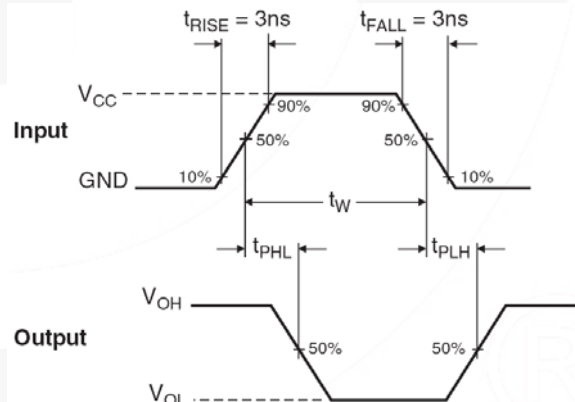
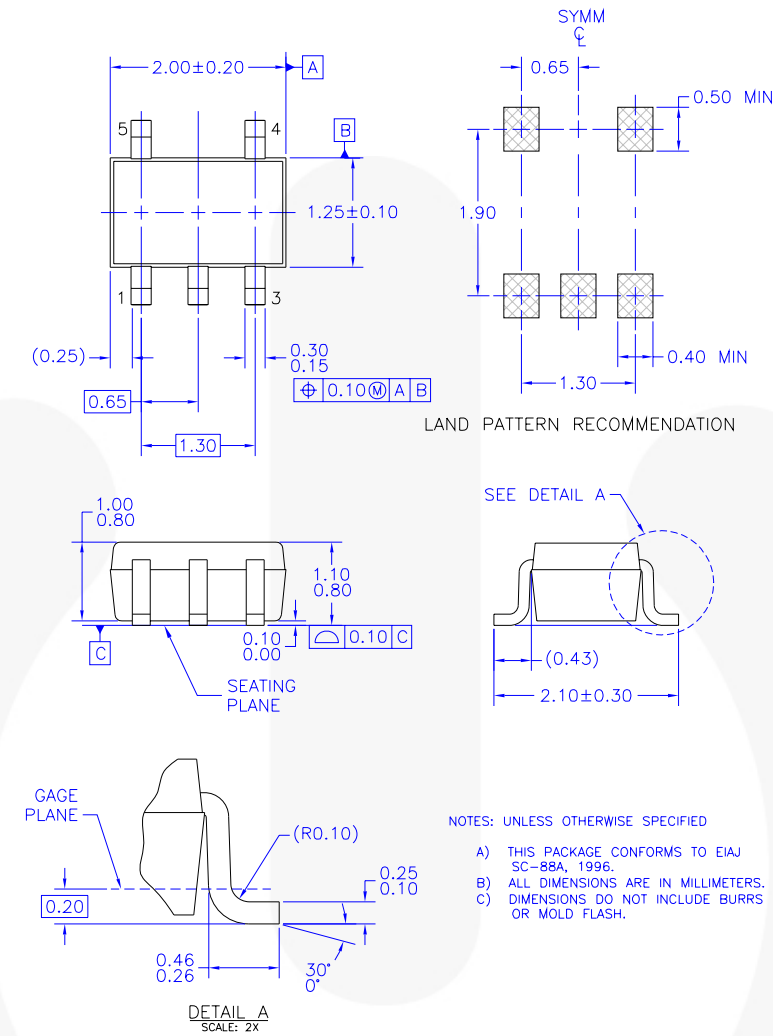


Figure 6. AC Waveforms

| 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} | 1.5V | V _{CC} / 2 | V _{CC} / 2 | V _{CC} / 2 | V _{CC} / 2 | V _{CC} / 2 |

Physical Dimensions



MAA05AREV5

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

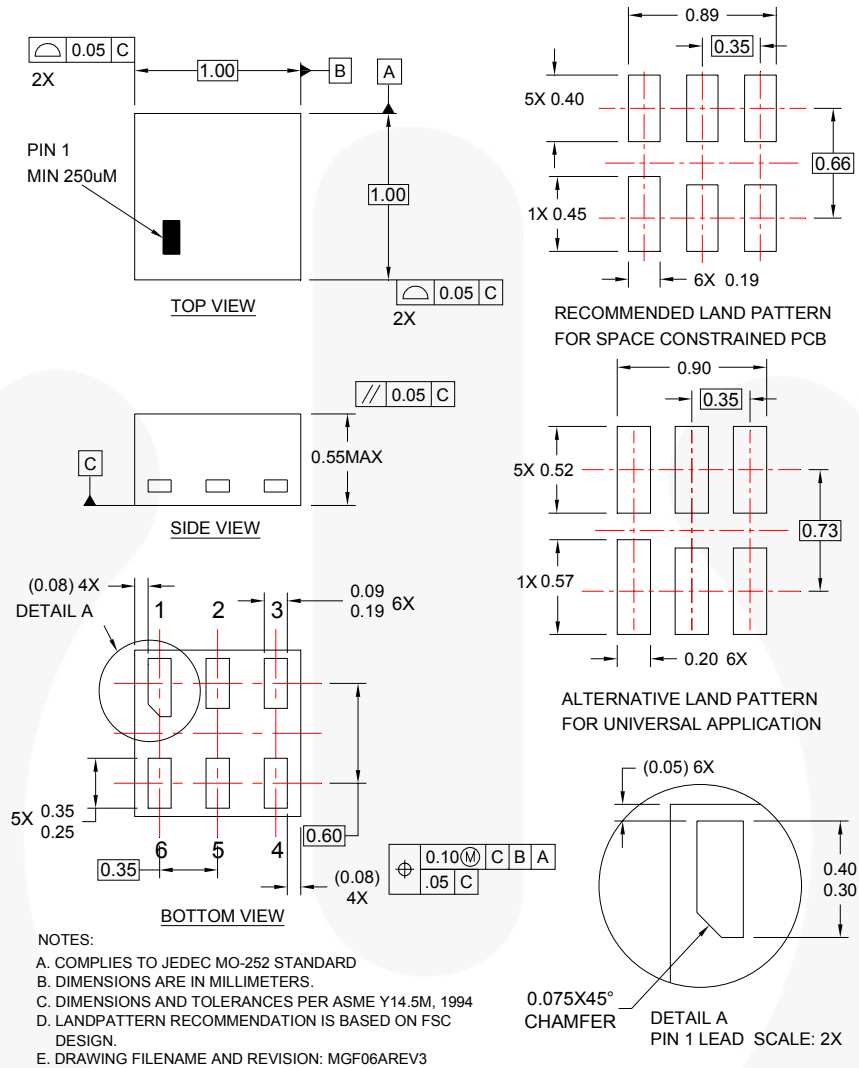


Figure 9. 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch

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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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| Build it Now™ | Green FPST™ | Programmable Active Droop™ | TinyBoost™ |
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| EfficientMax™ | MicroPak™ | SMART START™ | TRUECURRENT™* |
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| F ® | MillerDrive™ | STEALTH™ |  |
| Fairchild® | MotionMax™ | SuperFET® | UHC® |
| Fairchild Semiconductor® | Motion-SPM™ | SuperSOT™.3 | Ultra FRFET™ |
| FACT Quiet Series™ | mWSaver™ | SuperSOT™.6 | UniFET™ |
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| Datasheet Identification | Product Status | Definition |
|--------------------------|-----------------------|---|
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Rev. I52

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