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NC7SZ57 / NC7SZ58 TinyLogic® UHS Universal Configurable Two-Input Logic Gates

Features

- Ultra High Speed
- Capable of Implementing any Two-Input Logic Functions
- Typical Usage Replaces Two (2) TinyLogic® Gate Devices
- Reduces Part Counts in Inventory
- Broad V_{CC} Operating Range: 1.65V to 5.5V
- Power Down High Impedance Input/Output
- Over-Voltage Tolerant Inputs Facilitate 5V to 3V Translation
- Proprietary Noise/EMI Reduction Circuitry Implemented

Description

The NC7SZ57 and NC7SZ58 are universal configurable two-input logic gates. 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 4 through 13* illustrate how to connect the NC7SZ57 and NC7SZ58, respectively, for the desired logic function. All inputs have been implemented with hysteresis.

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 1.65V to 5.5V V_{CC} operating range. The input and output are high impedance when V_{CC} is 0V. Inputs tolerate voltages up to 5.5V independent of V_{CC} operating range.

Ordering Information

| Part Number | Top Mark | Package | Packing Method |
|-------------|----------|---|---------------------------|
| NC7SZ57P6X | Z57 | 6-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3000 Units on Tape & Reel |
| NC7SZ57L6X | KK | 6-Lead Micropak™, 1.0mm Wide | 5000 Units on Tape & Reel |
| NC7SZ57FHX | KK | 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch | |
| NC7SZ58P6X | Z58 | 6-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3000 Units on Tape & Reel |
| NC7SZ58L6X | LL | 6-Lead Micropak™, 1.0mm Wide | 5000 Units on Tape & Reel |
| NC7SZ58FHX | LL | 6-Lead, MicroPak2™, 1x1mm Body, .35mm Pitch | |

Pin Configurations

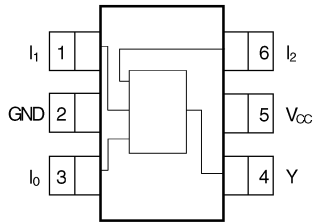


Figure 1. SC70 (Top View)

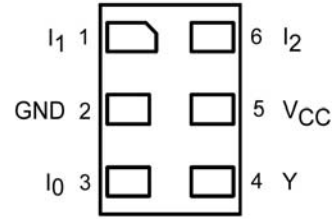


Figure 2. MicroPak™ (Top Through View)

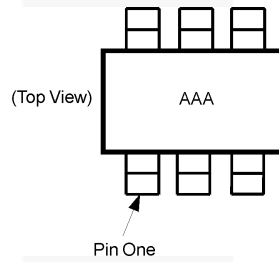


Figure 3. Pin 1 Orientation

Notes:

1. AAA represents product code top mark (see *Ordering Information*).
2. Orientation of top mark determines pin one location.
3. 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 | | | NC7SZ57 | NC7SZ58 |
|----------------|----------------|----------------|---|---|
| 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 | NC7SZ57 | Figure 4 |
| 2-Input AND with Inverted Input | NC7SZ58 | Figure 10, Figure 11 |
| 2-Input AND with Both Inputs Inverted | NC7SZ57 | Figure 7 |
| 2-Input NAND | NC7SZ58 | Figure 9 |
| 2-Input NAND with Inverted Input | NC7SZ57 | Figure 5, Figure 6 |
| 2-Input NAND with Both Inputs Inverted | NC7SZ58 | Figure 12 |
| 2-Input OR | NC7SZ58 | Figure 12 |
| 2-Input OR with Inverted Input | NC7SZ57 | Figure 5, Figure 6 |
| 2-Input OR with Both Inputs Inverted | NC7SZ58 | Figure 9 |
| 2-Input NOR | NC7SZ57 | Figure 7 |
| 2-Input NOR with Inverted Input | NC7SZ58 | Figure 9, Figure 10 |
| 2-Input NOR with Both Inputs Inverted | NC7SZ57 | Figure 4 |
| 2-Input XOR | NC7SZ58 | Figure 13 |
| 2-Input XNOR | NC7SZ57 | Figure 8 |

NC7SZ57 Logic Configurations

Figure 4 through Figure 8 show the logical functions that can be implemented using the NC7SZ57. 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.

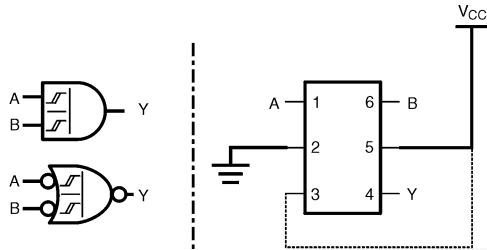


Figure 4. 2-Input AND Gate

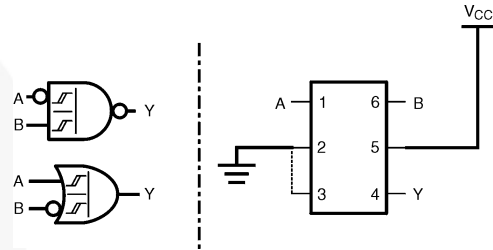


Figure 5. 2-Input NAND with Inverted A Input

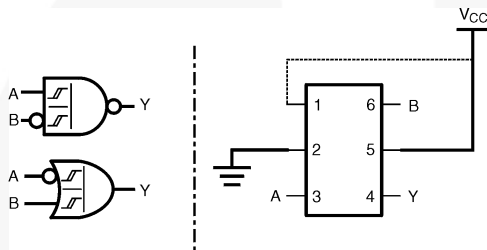


Figure 6. 2-Input NAND with Inverted B Input

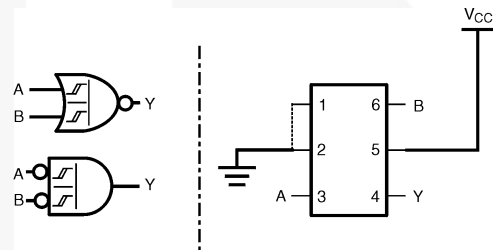


Figure 7. 2-Input NOR Gate



Figure 8. 2-Input XNOR Gate

NC7SZ58 Logic Configurations

Figure 9 through Figure 13 show the logical functions that can be implemented using the NC7SZ58. 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 9. 2-Input NAND Gate

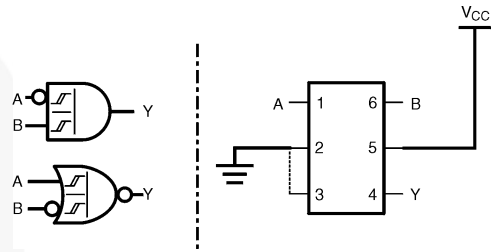


Figure 10. 2-Input AND with Inverted A Input

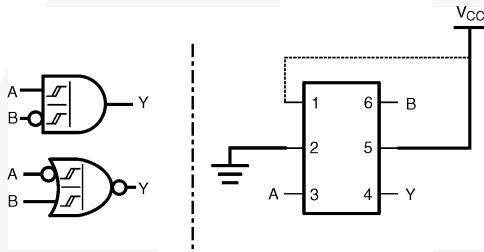


Figure 11. 2-Input AND with Inverted B Input

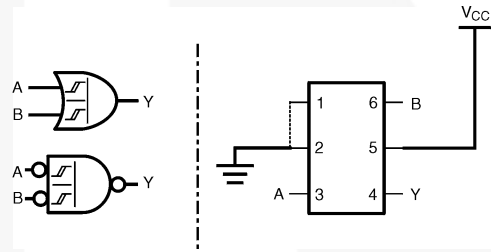


Figure 12. 2-Input OR Gate

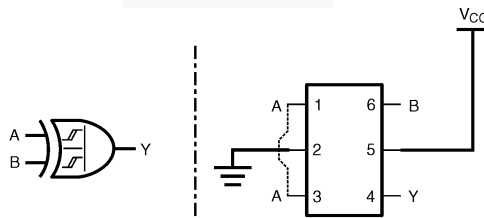


Figure 13. 2-Input XOR Gate

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. | Units |
|-----------------------|---|-------------------|------|------|-------|
| V_{CC} | Supply Voltage | | -0.5 | 7.0 | V |
| V_{IN} | DC Input Voltage | | -0.5 | 7.0 | V |
| V_{OUT} | DC Output Voltage | | -0.5 | 7.0 | V |
| I_{IK} | DC Input Diode Current | $V_{IN} < 0.5V$ | | -50 | mA |
| I_{OK} | DC Output Diode Current | $V_{OUT} < -0.5V$ | | -50 | mA |
| I_{OUT} | DC Output Source / Sink Current | | | ±50 | mA |
| I_{CC} or I_{GND} | DC V_{CC} or Ground Current | | | ±50 | mA |
| T_{STG} | Storage Temperature Range | | -65 | +150 | °C |
| T_J | Maximum Junction Temperature under Bias | | | +150 | °C |
| T_L | Lead Temperature, Soldering 10 Seconds | | | +260 | °C |
| P_D | Power Dissipation at +85°C | MicroPak™-6 | | 130 | mW |
| | | SC70-6 | | 180 | |
| | | MicroPak2™-6 | | 120 | |
| ESD | Human Body Model, JEDEC:JESD22-A114 | | | 4000 | V |
| | Charged 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. | Units |
|---------------|-------------------------------|--------------|------|----------|-------|
| V_{CC} | Supply Voltage Operating | | 1.65 | 5.5 | V |
| | Supply Voltage Data Retention | | 1.5 | 5.5 | |
| V_{IN} | Input Voltage | | 0 | 5.5 | V |
| V_{OUT} | Output Voltage | | 0 | V_{CC} | V |
| T_A | Operating Temperature | | -40 | +85 | °C |
| θ_{JA} | Thermal Resistance | SC70-6 | | 350 | °C/W |
| | | MicroPak™-6 | | 500 | |
| | | MicroPak2™-6 | | 560 | |

DC Electrical Characteristics

| Symbol | Parameter | V _{CC} | Conditions | T _A =+25°C | | | T _A =-40 to +85°C | | Units | |
|-----------------|----------------------------|-----------------|---|-------------------------|------|------|------------------------------|------|-------|--|
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| V _P | Positive Threshold Voltage | 1.65 | | 0.60 | 0.99 | 1.40 | 0.60 | 1.40 | V | |
| | | 2.30 | | 1.00 | 1.39 | 1.80 | 1.00 | 1.80 | | |
| | | 3.00 | | 1.30 | 1.77 | 2.20 | 1.30 | 2.20 | | |
| | | 4.50 | | 1.90 | 2.49 | 3.10 | 1.90 | 3.10 | | |
| | | 5.50 | | 2.20 | 2.95 | 3.60 | 2.20 | 3.60 | | |
| V _N | Negative Threshold Voltage | 1.65 | | 0.20 | 0.50 | 0.90 | 0.20 | 0.90 | V | |
| | | 2.30 | | 0.40 | 0.75 | 1.15 | 0.40 | 1.15 | | |
| | | 3.00 | | 0.60 | 0.99 | 1.50 | 0.60 | 1.50 | | |
| | | 4.50 | | 1.00 | 1.43 | 2.00 | 1.00 | 2.00 | | |
| | | 5.50 | | 1.20 | 1.70 | 2.30 | 1.20 | 2.30 | | |
| V _H | Hysteresis Voltage | 1.65 | | 0.15 | 0.48 | 0.90 | 0.15 | 0.90 | V | |
| | | 2.30 | | 0.25 | 0.64 | 1.10 | 0.25 | 1.10 | | |
| | | 3.00 | | 0.40 | 0.78 | 1.20 | 0.40 | 1.20 | | |
| | | 4.50 | | 0.60 | 1.06 | 1.50 | 0.60 | 1.50 | | |
| | | 5.50 | | 0.70 | 1.25 | 1.70 | 0.70 | 1.70 | | |
| V _{OH} | HIGH Level Output Voltage | 1.65 | V _{IN} =V _{IH} or V _{IL} I _{OH} = -100μA | 1.55 | 1.65 | | 1.55 | | V | |
| | | 2.30 | | 2.20 | 2.30 | | 2.20 | | | |
| | | 3.00 | | 2.90 | 3.00 | | 2.90 | | | |
| | | 4.50 | | 4.40 | 4.50 | | 4.40 | | | |
| | | 1.65 | V _{IN} =V _{IH} or V _{IL} | I _{OH} = -4mA | 1.29 | 1.52 | | 1.29 | | |
| | | 2.30 | | I _{OH} = -8mA | 1.90 | 2.15 | | 1.90 | | |
| | | 3.00 | | I _{OH} = -16mA | 2.40 | 2.80 | | 2.40 | | |
| | | 3.00 | | I _{OH} = -24mA | 2.30 | 2.68 | | 2.30 | | |
| | | 4.50 | | I _{OH} = -32mA | 3.80 | 4.20 | | 3.80 | | |
| | | 4.50 | | | | | | | | |

Continued on the following page...

DC Electrical Characteristics (Continued)

| Symbol | Parameter | V _{CC} | Conditions | T _A =+25°C | | | T _A =-40 to +85°C | | Units | |
|------------------|---------------------------|-----------------|---|-----------------------|------|------|------------------------------|------|-------|------|
| | | | | Min. | Typ. | Max. | Min. | Max. | | |
| V _{OL} | LOW Level Output Voltage | 1.65 | V _{IN} =V _{IH} or V _{IL} I _{OL} =100μA | | | 0.10 | | 0.10 | V | |
| | | 2.30 | | | | 0.10 | 0.10 | | | |
| | | 3.00 | | | | 0.10 | 0.10 | | | |
| | | 4.50 | | | | 0.10 | 0.10 | | | |
| | | 1.65 | V _{IN} =V _{IH} or V _{IL} I _{OL} =4mA | | 0.08 | 0.24 | | 0.24 | | |
| | | 2.30 | | I _{OL} =8mA | | 0.10 | 0.30 | | | 0.30 |
| | | 3.00 | | I _{OL} =16mA | | 0.15 | 0.40 | | | 0.40 |
| | | 3.00 | | I _{OL} =24mA | | 0.22 | 0.55 | | | 0.55 |
| 4.50 | I _{OL} =32mA | | 0.22 | 0.55 | | 0.55 | | | | |
| I _{IN} | Input Leakage Current | 0 to 5.50 | V _{IN} = 5.5V, GND | | | ±0.1 | | ±1.0 | μA | |
| I _{OFF} | Power Off Leakage Current | 0 | V _{IN} or V _{OUT} = 5.5V | | | 1 | | 10 | μA | |
| I _{CC} | Quiescent Supply Current | 1.65 to 5.5 | V _{IN} = 5.5V, GND | | | 1 | | 10 | μA | |

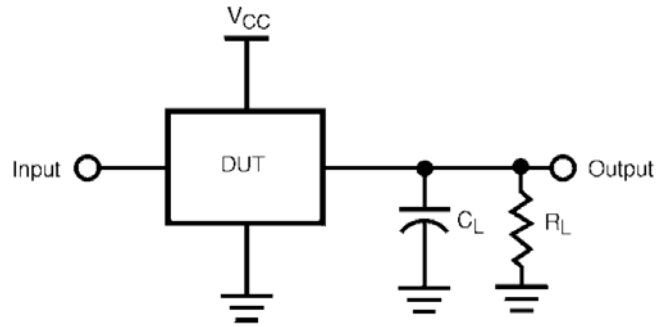
AC Electrical Characteristics

| 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 I _n to Y | 1.8 ± 0.15 | C _L =15pF, R _L =1MΩ | 3.0 | 8.0 | 14.0 | 3.0 | 14.5 | ns | Figure 14 Figure 16 |
| | | 2.5 ± 0.2 | | 1.5 | 4.9 | 8.0 | 1.5 | 8.5 | | |
| | | 3.3 ± 0.3 | | 1.2 | 3.7 | 5.3 | 1.2 | 5.7 | | |
| | | 5.0 ± 0.5 | | 0.8 | 2.8 | 4.3 | 0.8 | 4.6 | | |
| | | 3.3 ± 0.3 | C _L =50pF, R _L =500Ω | 1.5 | 4.2 | 6.0 | 1.5 | 6.5 | | |
| | | 5.0 ± 0.5 | | 1.0 | 3.4 | 4.9 | 1.0 | 5.3 | | |
| C _{IN} | Input Capacitance | 0 | | | 2 | | | | pF | |
| C _{PD} | Power Dissipation Capacitance | 3.3 | Note 4 | | 14 | | | | pF | Figure 15 |
| | | 5.0 | | | 17 | | | | | |

Note:

- C_{PD} is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I_{CCD}) at no output loading and operating at 50% duty cycle. (See Figure 12) C_{PD} is related to I_{CCD} dynamic operating current by the expression: I_{CCD} = (C_{PD})(V_{CC})(f_{in}) + (I_{CCstatic}).

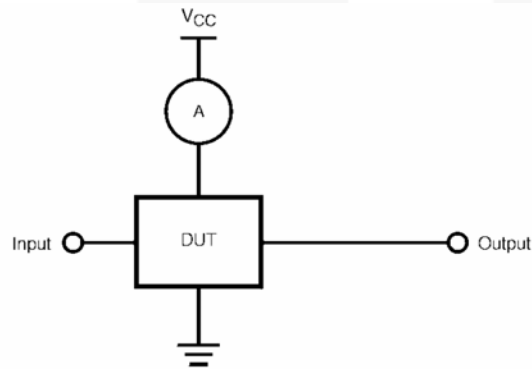
AC Loadings and Waveforms



Note:

- 5. C_L includes load and stray capacitance.
- 6. Input PRR = 1.0MHz, t_w = 500ns.

Figure 14. AC Test Circuit



Note:

- 7. Input = AC waveforms.
- 8. PRR = Variable; Duty Cycle = 50%.

Figure 15. I_{CCD} Test Circuit



Figure 16. AC Waveforms

Physical Dimensions

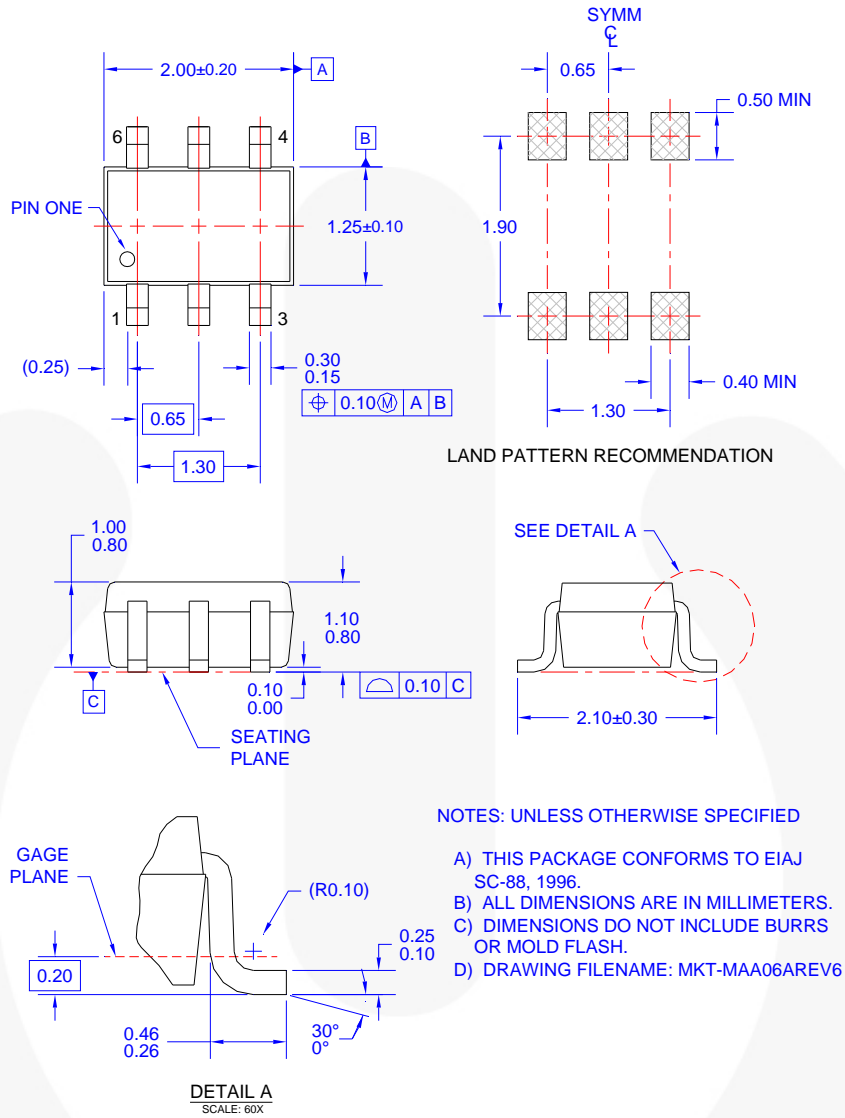


Figure 17. 6-Lead, SC70, EIAJ SC-88a, 1.25mm Wide

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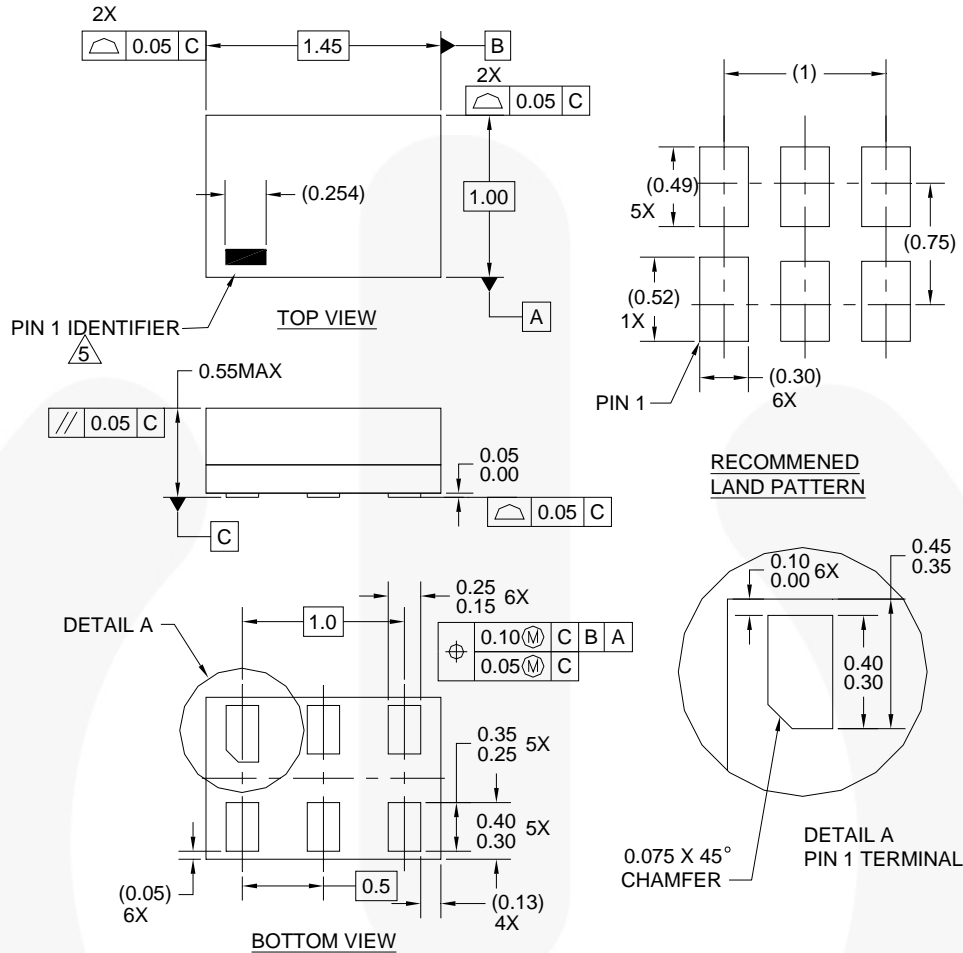
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:
<http://www.fairchildsemi.com/packaging/>.

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



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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| Auto-SPM™ | FRFET® | PowerTrench® | TinyBoost™ |
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| BitSic® | Green FPST™ | Programmable Active Droop™ | TinyCalc™ |
| Build it Now™ | Green FPST™ e-Series™ | QFET® | TinyLogic® |
| CorePLUS™ | Gmax™ | QST™ | TINYOPTO™ |
| CorePOWER™ | GTO™ | Quiet Series™ | TinyPower™ |
| CROSSVOL™ | IntelliMAX™ | RapidConfigure™ | TinyPWM™ |
| CTL™ | ISOPLANAR™ |  ™ | TinyWire™ |
| Current Transfer Logic™ | Making Small Speakers Sound Louder and Better™ | Saving our world, 1mW/W/kW at a time™ | TranSiC® |
| DEUXPEED® | MegaBuck™ | SignalWise™ | TriFault Detect™ |
| Dual Cool™ | MI CROCOUPLER™ | SmartMax™ | TRUECURRENT® |
| EcoSPARK® | MicroFET™ | SMART START™ | µSerDes™ |
| EfficientMax™ | MicroPak™ | SPM® |  ™ |
| ESBC™ | MicroPak2™ | STEALTH™ | UHC® |
|  ™ | MillerDrive™ | SuperFET® | Ultra FRFET™ |
| Fairchild® | MotionMax™ | SuperSOT™-3 | UniFET™ |
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| FACT® | OptoHiT™ | SupreMOS® | VoltagePlus™ |
| FAST® | OPTOLOGIC® | SyncFET™ | XST™ |
| FastvCore™ | OPTOPLANAR® | Sync-Lock™ | |
| FETBench™ | |  SYSTEM GENERAL® | |
| FlashWriter® | | | |

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FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

- Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
- A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

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. |

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