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October 1995 Revised August 2004

## **NC7S86**

## TinyLogic® HS 2-Input Exclusive-OR Gate

## **General Description**

The NC7S86 is a single 2-Input high performance CMOS Exclusive-OR Gate. Advanced Silicon Gate CMOS fabrication assures high speed and low power circuit operation over a broad  $V_{CC}$  range. ESD protection diodes inherently guard both inputs and output with respect to the  $V_{CC}$  and GND rails. Inputs are well buffered from the output to assure high noise immunity and reduced sensitivity to input edge rate.

### **Features**

- Space saving SOT23 or SC70 5-lead package
- Ultra small MicroPak™ leadless package
- High Speed; t<sub>PD</sub> 4.5 ns typ
- $\blacksquare$  Low Quiescent Power; I\_CC < 1  $\mu A$
- Balanced Output Drive; 2 mA I<sub>OL</sub>, -2 mA I<sub>OH</sub>
- Broad V<sub>CC</sub> Operating Range; 2V–6V
- Balanced Propagation Delays
- Specified for 3V operation

## **Ordering Code:**

| Order Number | Package<br>Number | Product Code<br>Top Mark | Package Description                   | Supplied As               |
|--------------|-------------------|--------------------------|---------------------------------------|---------------------------|
| NC7S86M5X    | MA05B             | 7S86                     | 5-Lead SOT23, JEDEC MO-178, 1.6mm     | 3k Units on Tape and Reel |
| NC7S86P5X    | MAA05A            | S86                      | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide | 3k Units on Tape and Reel |
| NC7S86L6X    | MAC06A            | ZZ                       | 6-Lead MicroPak, 1.0mm Wide           | 5k Units on Tape and Reel |

## **Logic Symbol**



## **Pin Descriptions**

| Pin Names | Description |
|-----------|-------------|
| A, B      | Input       |
| Y         | Output      |
| NC        | No Connect  |

#### **Function Table**

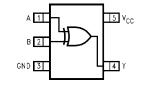
$$\mathbf{Y} = \mathbf{A} \oplus \mathbf{B}$$

| Inp | uts | Output |  |  |  |
|-----|-----|--------|--|--|--|
| Α   | В   | Y      |  |  |  |
| L   | L   | L      |  |  |  |
| L   | Н   | Н      |  |  |  |
| Н   | L   | Н      |  |  |  |
| Н   | Н   | L      |  |  |  |
|     |     |        |  |  |  |

H = HIGH Logic Level

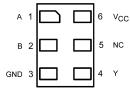
L = LOW Logic Level

# Connection Diagrams Pin Assignments for SC70 and SOT23



(Top View)

### Pad Assignment for MicroPak



(Top Thru View)

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## **Absolute Maximum Ratings**(Note 1)

#### 

DC Output Diode Current (I<sub>OK</sub>)

DC Output Source

or Sink Current ( $I_{OUT}$ )  $\pm 12.5 \text{ mA}$ 

DC  $\rm V_{\rm CC}$  or Ground Current

per Output Pin (I $_{\rm CC}$  or I $_{\rm GND}$ )  $\pm 25$  mA Storage Temperature (T $_{\rm STG}$ )  $-65^{\circ}{\rm C}$  to  $+150^{\circ}{\rm C}$ 

Junction Temperature (T<sub>J</sub>)

Lead Temperature (T<sub>L</sub>); (Soldering, 10 seconds)

Power Dissipation (P<sub>D</sub>) @ +85°C

SOT23-5 200 mW SC70-5 150 mW

# Recommended Operating Conditions (Note 2)

Input Rise and Fall Time  $(t_r, t_f)$ 

 V<sub>CC</sub> @ 2.0V
 0 to 1000 ns

 V<sub>CC</sub> @ 3.0V
 0 to 750 ns

 V<sub>CC</sub> @ 4.5V
 0 to 500 ns

 V<sub>CC</sub> @ 6.0V
 0 to 400 ns

Thermal Resistance ( $\theta_{JA}$ )

SOT23-5 300°C/W SC70-5 425°C/W

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of circuits outside databook specifications.

Note 2: Unused inputs must be held HIGH or LOW. They may not float.

#### **DC Electrical Characteristics**

| Symbol          | Parameter                 | V <sub>CC</sub> | 1                   | $\Gamma_{A} = +25^{\circ}$ | С                             | $T_A = -40^{\circ}C \text{ to } +85^{\circ}C$ |                               | Units | Conditions  |
|-----------------|---------------------------|-----------------|---------------------|----------------------------|-------------------------------|---|-------------------------------|-------|---|
| Symbol          |                           | (V)             | Min                 | Тур                        | Max                           | Min   | Max                           | ]     | Conditions  |
| V <sub>IH</sub> | HIGH Level Input Voltage  | 2.0             | 1.50                |                            |                               | 1.50  |                               | V     |   |
|                 |                           | 3.0-6.0         | 0.7 V <sub>CC</sub> |                            |                               | 0.7 V <sub>CC</sub>                           |                               | V     |   |
| V <sub>IL</sub> | LOW Level Input Voltage   | 2.0             |                     |                            | 0.50                          |   | 0.50                          | V     |   |
|                 |                           | 3.0-6.0         |                     |                            | $0.3\mathrm{V}_{\mathrm{CC}}$ |   | $0.3\mathrm{V}_{\mathrm{CC}}$ | V     |   |
| V <sub>OH</sub> | HIGH Level Output Voltage | 2.0             | 1.90                | 2.0                        |                               | 1.90  |                               |       |   |
|                 |                           | 3.0             | 2.90                | 3.0                        |                               | 2.90  |                               | V     | $I_{OH} = -20 \mu A$ $V_{IN} = V_{IH}, V_{IL}$              |
|                 |                           | 4.5             | 4.40                | 4.5                        |                               | 4.40  |                               | V     | $V_{IN} = V_{IH}, V_{IL}$                                   |
|                 |                           | 6.0             | 5.90                | 6.0                        |                               | 5.90  |                               |       |   |
|                 |                           |                 |                     |                            |                               |   |                               |       | $V_{IN} = V_{IH}, V_{IL}$                                   |
|                 |                           | 3.0             | 2.68                | 2.85                       |                               | 2.63  |                               | V     | $I_{OH} = -1.3 \text{ mA}$                                  |
|                 |                           | 4.5             | 4.18                | 4.35                       |                               | 4.13  |                               | V     | $I_{OH} = -2 \text{ mA}$                                    |
|                 |                           | 6.0             | 5.68                | 5.85                       |                               | 5.63  |                               |       | $I_{OH} = -2.6 \text{ mA}$                                  |
| V <sub>OL</sub> | LOW Level Output Voltage  | 2.0             |                     | 0.0                        | 0.10                          |   | 0.10                          |       |   |
|                 |                           | 3.0             |                     | 0.0                        | 0.10                          |   | 0.10                          | V     | $I_{OL} = 20 \mu A$<br>$V_{IN} = V_{IH} \text{ or } V_{IL}$ |
|                 |                           | 4.5             |                     | 0.0                        | 0.10                          |   | 0.10                          | l v   | $V_{IN} = V_{IH}$ or $V_{IL}$                               |
|                 |                           | 6.0             |                     | 0.0                        | 0.10                          |   | 0.10                          |       |   |
|                 |                           |                 |                     |                            |                               |   |                               |       | $V_{IN} = V_{IH}$ or $V_{IL}$                               |
|                 |                           | 3.0             |                     | 0.1                        | 0.26                          |   | 0.33                          | V     | I <sub>OL</sub> = 1.3 mA                                    |
|                 |                           | 4.5             |                     | 0.1                        | 0.26                          |   | 0.33                          | •     | $I_{OL} = 2 \text{ mA}$                                     |
|                 |                           | 6.0             |                     | 0.1                        | 0.26                          |   | 0.33                          |       | $I_{OL} = 2.6 \text{ mA}$                                   |
| I <sub>IN</sub> | Input Leakage Current     | 6.0             |                     |                            | ±0.1                          |   | ±1.0                          | μΑ    | $V_{IN} = V_{CC}$ , GND                                     |
| I <sub>CC</sub> | Quiescent Supply Current  | 6.0             |                     |                            | 1.0                           |   | 10.0                          | μΑ    | $V_{IN} = V_{CC}$ , GND                                     |
| ICC             | Quiescent Supply Current  | 6.0             |                     |                            | 1.0                           |   | 10.0                          | μА    | $V_{IN} = V_{CC}, GND$                                      |

150°C

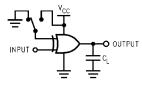
260°C

## **AC Electrical Characteristics**

| Symbol             | Parameter                     | V <sub>CC</sub> | T <sub>A</sub> = +25°C |     |     | $T_A = -40^{\circ}C \text{ to } +85^{\circ}C$ |     | Units | Conditions             | Figure          |  |
|--------------------|-------------------------------|-----------------|------------------------|-----|-----|---|-----|-------|------------------------|-----------------|--|
|                    | r arameter                    | (V)             | Min                    | Тур | Max | Min   | Max | Oille | Contantions            | Number          |  |
| t <sub>PLH</sub> , | Propagation Delay             | 5.0             |                        | 4.5 | 17  |   |     | ns    | $C_L = 15  pF$         |                 |  |
| $t_{PHL}$          |                               | 2.0             |                        | 22  | 100 |   | 125 |       |                        |                 |  |
|                    |                               | 3.0             |                        | 12  | 27  |   | 35  | 200   | C <sub>I</sub> = 50 pF | F 1, 3          |  |
|                    |                               | 4.5             |                        | 8.5 | 20  |   | 25  | ns    | OL = 50 pr             |                 |  |
|                    |                               | 6.0             |                        | 7   | 17  |   | 21  |       |                        |                 |  |
| t <sub>TLH</sub> , | Output Transition Time        | 5.0             |                        | 3   | 8   |   |     | ns    | C <sub>L</sub> = 15 pF |                 |  |
| $t_{THL}$          |                               | 2.0             |                        | 25  | 125 |   | 155 |       |                        | 1               |  |
|                    |                               | 3.0             |                        | 16  | 35  |   | 45  | 200   | C = 50 pF              | Figures<br>1, 3 |  |
|                    |                               | 4.5             |                        | 11  | 25  |   | 31  | ns    | $C_L = 50 pF$          | ., 0            |  |
|                    |                               | 6.0             |                        | 9   | 21  |   | 26  |       |                        |                 |  |
| C <sub>IN</sub>    | Input Capacitance             | Open            |                        | 2   | 10  |   | 10  | pF    |                        |                 |  |
| C <sub>PD</sub>    | Power Dissipation Capacitance | 5.0             |                        | 8   |     |   |     | pF    | (Note 3)               | Figure 2        |  |

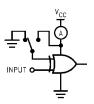
Note 3: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output loading and operating at 50% duty cycle. (See Figure 2.) C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression: I<sub>CCD</sub> = (C<sub>PD</sub>)(V<sub>CC</sub>)(f<sub>IN</sub>) + (I<sub>CC</sub>static).

## **AC Loading and Waveforms**



 $\mathrm{C_L}$  includes load and stray capacitance Input PRR = 1.0 MHz;  $\mathrm{t_W} = 500~\mathrm{ns}$ 

FIGURE 1. AC Test Circuit



Input = AC Waveform;

PRR = variable; Duty Cycle = 50%

FIGURE 2. I<sub>CCD</sub> Test Circuit

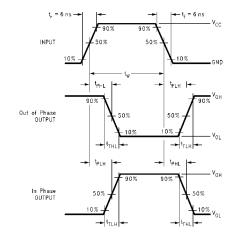


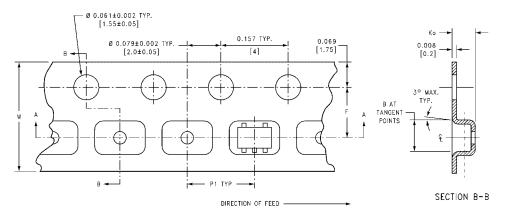
FIGURE 3. AC Waveforms

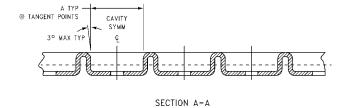
## **Tape and Reel Specification**

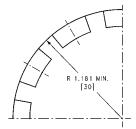
TAPE FORMAT for SC70 and SOT23

| Package    | Tape               | Number    | Cavity | Cover Tape |  |
|------------|--------------------|-----------|--------|------------|--|
| Designator | Section            | Cavities  | Status | Status     |  |
|            | Leader (Start End) | 125 (typ) | Empty  | Sealed     |  |
| M5X, P5X   | Carrier            | 3000      | Filled | Sealed     |  |
|            | Trailer (Hub End)  | 75 (typ)  | Empty  | Sealed     |  |

## TAPE DIMENSIONS inches (millimeters)



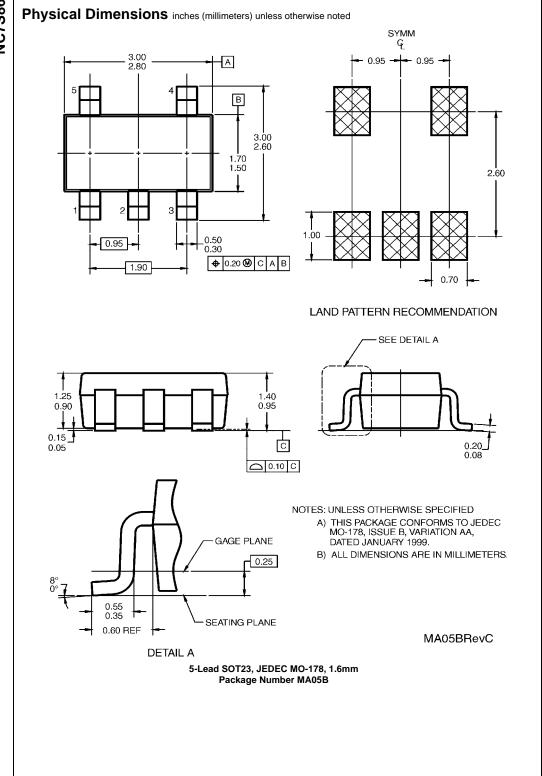


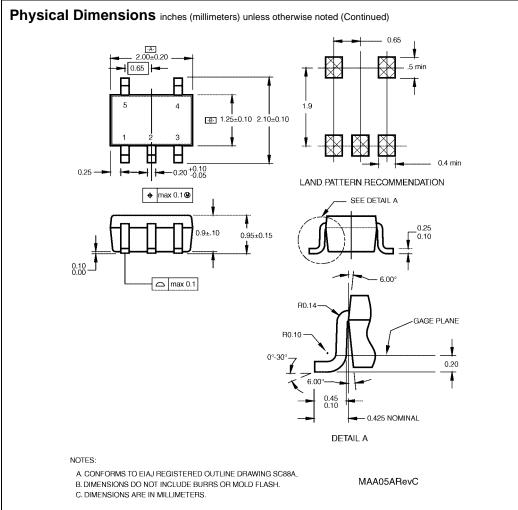


BEND RADIUS NOT TO SCALE

| Package | Tape Size | DIM A  | DIM B  | DIM F        | DIM K <sub>o</sub> | DIM P1 | DIM W        |
|---------|-----------|--------|--------|--------------|--------------------|--------|--------------|
| SC70-5  | 8 mm      | 0.093  | 0.096  | 0.138 ±0.004 | 0.053 ±0.004       | 0.157  | 0.315 ±0.004 |
|         |           | (2.35) | (2.45) | (3.5 ±0.10)  | (1.35 ±0.10)       | (4)    | (8 ±0.1)     |
| SOT23-5 | 8 mm      | 0.130  | 0.130  | 0.138 ±0.002 | 0.055 ±0.004       | 0.157  | 0.315 ±0.012 |
|         |           | (3.3)  | (3.3)  | (3.5 ±0.05)  | (1.4 ±0.11)        | (4)    | (8 ±0.3)     |

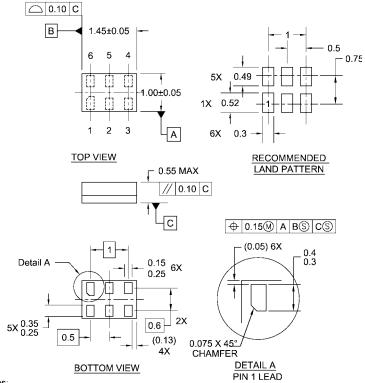
#### Tape and Reel Specification (Continued) TAPE FORMAT for MicroPak Package Tape Number Cavity Cover Tape Designator Section Cavities Status Status Leader (Start End) 125 (typ) Empty Sealed L6X Carrier 5000 Filled Sealed Trailer (Hub End) 75 (typ) **Empty** Sealed 2.00-1.75±0.10 В 8.00 <sup>+0.30</sup> -0.10 3.50±0.05 1.15±0.05 **-** → В◄ -ø 0.50 ±0.05 SECTION B-B DIRECTION OF FEED SCALE:10X 0.254±0.020 Г 0.70±0.05 SECTION A-A SCALE:10X **REEL DIMENSIONS** inches (millimeters) TAPE SLOT DETAIL X **DETAIL X** SCALE: 3X Tape Α В С D N W1 W2 W3 Size 0.331 +0.059/-0.000 0.567 W1 +0.078/-0.039 0.059 0.512 0.795 2.165 8 mm (177.8)(1.50)(13.00)(20.20)(55.00)(8.40 +1.50/-0.00) (14.40)(W1 +2.00/-1.00)





5-Lead SC70, EIAJ SC-88a, 1.25mm Wide Package Number MAA05A

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



#### Notes:

- 1. JEDEC PACKAGE REGISTRATION IS ANTICIPATED 2. DIMENSIONS ARE IN MILLIMETERS
- 3. DRAWING CONFORMS TO ASME Y14.5M-1994

MAC06ARevB

6-Lead MicroPak, 1.0mm Wide Package Number MAC06A

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многоканальный

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## Офис по работе с юридическими лицами:

105318, г. Москва, ул. Щербаковская д. 3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru moschip.ru\_6 moschip.ru\_4 moschip.ru\_9