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## NC7SZ38 TinyLogic<sup>®</sup> UHS 2-Input NAND Gate, Open Drain Output

#### **Features**

- Ultra-High Speed: t<sub>PD</sub> 2.4ns (Typical) into 50pF at 5V V<sub>CC</sub>
- Open Drain Output Stage for OR Tied Applications
- High Output Sink Drive: 24mA at 3V V<sub>CC</sub>
- Broad V<sub>CC</sub> Operating Range: 1.65V to 5.5V
- Matches Performance of LCX Operated at 3.3V V<sub>CC</sub>
- Power Down High-Impedance Inputs/Outputs
- Over-Voltage Tolerance Inputs Facilitate 5V to 3V Translation
- Proprietary Noise/EMI Reduction Circuitry
- Ultra-Small MicroPak<sup>™</sup> Packages
- Space-Saving SOT23 and SC70 Packages

#### Description

The NC7SZ38 is a single 2-Input NAND gate with open drain output stage from Fairchild's Ultra-High Speed Series of TinyLogic<sup>®</sup>. 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 very broad Vcc operating range. The device is specified to operate over the 1.65V to 5.5V V<sub>CC</sub> range. The inputs and output are high impedance when V<sub>CC</sub> is 0V. Inputs tolerate voltages up to 6V independent of V<sub>CC</sub> operating voltage. The open drain output stage tolerates voltages up to 6V independent of V<sub>CC</sub> when in the high impedance state.

| Ordering | Information |
|----------|-------------|
|----------|-------------|

| _           |          |            |   |                              |
|-------------|----------|------------|---|------------------------------|
| Part Number | Top Mark | Eco Status | Package                                       | Packing Method               |
| NC7SZ38M5X  | 7Z38     | RoHS       | 5-Lead SOT23, JEDEC MO-178 1.6mm              | 3000 Units on<br>Tape & Reel |
| NC7SZ38P5X  | Z38      | RoHS       | 5-Lead SC70, EIAJ SC-88a, 1.25mm Wide         | 3000 Units on<br>Tape & Reel |
| NC7SZ38L6X  | A6       | RoHS       | 6-Lead MicroPak™, 1.00mm Wide                 | 5000 Units on<br>Tape & Reel |
| NC7SZ38FHX  | A6       | Green      | 6-Lead, MicroPak2, 1x1mm Body, .35mm<br>Pitch | 5000 Units on<br>Tape & Reel |

Ø For Fairchild's definition of Eco Status, please visit: <u>http://www.fairchildsemi.com/company/green/rohs\_green.html</u>.

### **Pin Definitions**

**Pin Configurations** 

GND 3

| Pin # SC70 / SOT23 | Pin # MicroPak | Name            | Description    |
|--------------------|----------------|-----------------|----------------|
| 1                  | 1              | A               | Input          |
| 2                  | 2              | В               | Input          |
| 3                  | 3              | GND             | Ground         |
| 4                  | 4              | Y               | Output         |
| 5                  | 6              | V <sub>CC</sub> | Supply Voltage |
|                    | 5              | NC              | No Connect     |

### **Function Table**

Y=/AB

| Inj | outs | Output |
|-----|------|--------|
| A   | В    | Y      |
| L   | L    | *H     |
| L   | н    | *H     |
| Н   | L    | *H     |
| Н   | Н    | L      |

H = HIGH Logic Level

L = LOW Logic Level

\*H = High Impedance Output State, Open Drain

NC7SZ38 — UHS 2-Input NAND Gate, Open Drain Output

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#### **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                | Para                                    | ameter                     | Min. | Max. | Unit |
|-----------------------|---|----------------------------|------|------|------|
| V <sub>cc</sub>       | Supply Voltage                          |                            | -0.5 | 6.0  | V    |
| V <sub>IN</sub>       | DC Input Voltage                        |                            | -0.5 | 6.0  | V    |
| V <sub>OUT</sub>      | DC Output Voltage                       |                            | -0.5 | 6.0  | V    |
| l                     | DC Input Diada Current                  | V <sub>IN</sub> < -0.5V    |      | -50  | mA   |
| I <sub>IK</sub>       | DC Input Diode Current                  | V <sub>IN</sub> > 6.0V     |      | +20  | mA   |
|                       | I <sub>OK</sub> DC Output Diode Current | V <sub>OUT</sub> < -0.5V   |      | -50  | ~^^  |
| IOK                   | DC Output Diode Current                 | $V_{OUT} > 6V, V_{CC}=GND$ |      | +20  | mA   |
| IOUT                  | DC Output Current                       |                            |      | +50  | mA   |
| $I_{CC}$ or $I_{GND}$ | DC V <sub>CC</sub> or Ground Current    |                            |      | ±50  | mA   |
| T <sub>STG</sub>      | Storage Temperature Range               |                            | -65  | +150 | °C   |
| TJ                    | Junction Temperature Under B            | ias                        |      | +150 | °C   |
| TL                    | Junction Lead Temperature (Se           | oldering, 10 Seconds)      |      | +260 | °C   |
|                       |   | SOT-23                     |      | 200  |      |
| Р                     | Dower Dissinction at 185°C              | SC70-5                     |      | 150  |      |
| PD                    | Power Dissipation at +85°C              | MicroPak-6                 |      | 130  | mW   |
|                       |   | MicroPak2-6                |      | 120  |      |
|                       | Human Body Model, JEDEC:JE              | SD22-A114                  |      | 4000 | v    |
| ESD                   | Charge Device Model, JEDEC:             | JESD22-C101                |      | 2000 | V    |

### **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   |
|---------------------------------|-------------------------------|------------------------------------|------|------|--------|
| N/                              | Supply Voltage Operating      |                                    | 1.65 | 5.50 | V      |
| V <sub>cc</sub>                 | Supply Voltage Data Retention |                                    | 1.50 | 5.50 | V      |
| V <sub>IN</sub>                 | Input Voltage                 |                                    | 0    | 5.5  | V      |
| Vout                            | Output Voltage                |                                    | 0    | 5.5  | V      |
| T <sub>A</sub>                  | Operating Temperature         |                                    | -40  | +85  | °C     |
|                                 |                               | V <sub>CC</sub> =1.8V, 2.5V ± 0.2V | 0    | 20   | $\leq$ |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Times     | $V_{CC}=3.3V \pm 0.3V$             | 0    | 10   | ns/V   |
|                                 |                               | $V_{CC}=5.0V \pm 0.5V$             | 0    | 5    |        |
|                                 |                               | SOT-23                             |      | 300  |        |
| 0                               | Thermal Resistance            | SC70-5                             |      | 425  | _ ∘c/w |
| $	heta_{JA}$                    |                               | MicroPak-6                         |      | 500  | 0.0/00 |
|                                 |                               | MicroPak2-6                        |      | 560  |        |

Note:

1. Unused inputs must be held HIGH or LOW. They may not float.

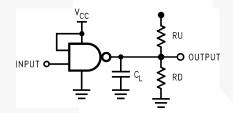
| Currench al      | Devenueter                    | V               |   | T,           | T <sub>A</sub> =+25°C |              |              | T <sub>A</sub> =-40 to +85°C |         |  |
|------------------|-------------------------------|-----------------|---|--------------|-----------------------|--------------|--------------|------------------------------|---------|--|
| Symbol           | Parameter                     | V <sub>cc</sub> | Conditions  | Min.         | Тур.                  | Max.         | Min.         | Max.                         | - Units |  |
| M                | HIGH Level Input 1.65 to 1.95 |                 |   | $0.75V_{CC}$ |                       |              | $0.75V_{CC}$ |                              | V       |  |
| VIH              | Voltage                       | 2.30 to 5.50    |   | $0.70V_{CC}$ |                       |              | $0.70V_{CC}$ |                              | V       |  |
| VIL              | LOW Level Input               | 1.65 to 1.95    |   |              |                       | $0.25V_{CC}$ |              | $0.25V_{CC}$                 | V       |  |
| VIL              | Voltage                       | 2.30 to 5.50    |   |              |                       | $0.30V_{CC}$ |              | 0.30V <sub>CC</sub>          | v       |  |
| I <sub>LKG</sub> | HIGH Level<br>Output Leakage  | 5.50            | $V_{IN}=V_{IL}, V_{OUT}=V_{CC} \text{ or } GND$         |              |                       | ±5           |              | ±10                          | μA      |  |
|                  |                               | 1.65            |   |              | 0.00                  | 0.10         |              | 0.10                         |         |  |
|                  |                               | 1.80            |   |              | 0.00                  | 0.10         |              | 0.10                         |         |  |
|                  |                               | 2.30            | V <sub>IN</sub> =V <sub>IH</sub> , I <sub>OL</sub> =100 |              | 0.00                  | 0.10         |              | 0.10                         |         |  |
|                  |                               | 3.00            |   |              | 0.00                  | 0.10         |              | 0.10                         |         |  |
| Vol              | LOW Level                     | 4.50            |   |              | 0.00                  | 0.10         |              | 0.10                         | V       |  |
| VOL              | Output Voltage                | 1.65            |   |              | 0.80                  | 0.24         |              | 0.24                         | v       |  |
|                  |                               | 2.30            | I <sub>OL</sub> =8mA                                    |              | 0.10                  | 0.30         |              | 0.30                         |         |  |
|                  |                               | 3.00            | I <sub>OL</sub> =16mA                                   |              | 0.15                  | 0.40         |              | 0.40                         |         |  |
|                  |                               | 3.00            | I <sub>OL</sub> =24mA                                   |              | 0.22                  | 0.55         |              | 0.55                         |         |  |
|                  |                               | 4.50            | I <sub>OL</sub> =32mA                                   |              | 0.22                  | 0.55         |              | 0.55                         |         |  |
| I <sub>IN</sub>  | Input Leakage<br>Current      | 5.50            | V <sub>IN</sub> =5.5V, GND                              |              |                       | ±1           |              | ±10                          | μA      |  |
| I <sub>OFF</sub> | Power Off<br>Leakage Current  | 0               | V <sub>IN</sub> or V <sub>OUT</sub> =5.5V               |              |                       | 1            |              | 10                           | μA      |  |
| I <sub>CC</sub>  | Quiescent Supply<br>Current   | 5.50            | V <sub>IN</sub> =5.5V, GND                              |              |                       | 2            |              | 20                           | μA      |  |

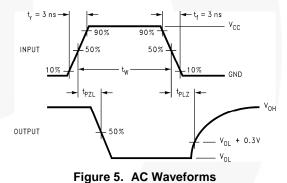
| NC7SZ38                  |
|--------------------------|
| 80<br>                   |
| UHS                      |
| HS 2-Input NAND Gate, (  |
| It NA                    |
| ND G                     |
| ate, C                   |
| Open                     |
| Drain                    |
| <b>Open Drain Output</b> |

| Symbol Parameter             |                            |                      | T,  | T <sub>A</sub> =+25°C |      | T <sub>A</sub> =-40 to +85°C |      |       |        |                      |
|------------------------------|----------------------------|----------------------|---|-----------------------|------|------------------------------|------|-------|--------|----------------------|
|                              | V <sub>cc</sub>            | Conditions           | Min.  | Тур.                  | Max. | Min.                         | Max. | Units | Figure |                      |
|                              |                            | 1.65                 |   | 1.5                   | 6.5  | 12.7                         | 1.5  | 13.2  |        |                      |
|                              |                            | 1.80                 | $C_L=50pF$ ,                                  | 1.5                   | 5.4  | 10.5                         | 1.5  | 11.0  |        |                      |
| t <sub>PZL</sub>             | $-2$ $1250 \pm 020$        | RU=500Ω,<br>RD-500Ω, | 0.8   | 3.5                   | 7.0  | 0.8                          | 7.5  |       |        |                      |
|                              |                            | 3.30 ± 0.30          | V <sub>IN</sub> =2•V <sub>CC</sub>            | 0.8                   | 2.8  | 5.0                          | 0.8  | 5.2   | - ns   | Figure 4<br>Figure 5 |
|                              | Dress existing Delays      | 5.00 ± 0.50          |   | 0.5                   | 2.2  | 4.3                          | 0.5  | 4.5   |        |                      |
|                              | Propagation Delay          | 1.65                 | C <sub>L</sub> =50pF,<br>RU=500Ω,<br>RD-500Ω, | 1.5                   | 5.5  | 12.7                         | 1.5  | 13.2  |        |                      |
|                              |                            | 1.80                 |   | 1.5                   | 4.6  | 10.5                         | 1.5  | 11.0  |        |                      |
| t <sub>PLZ</sub>             |                            | 2.50 ± 0.20          |   | 0.8                   | 3.0  | 7.0                          | 0.8  | 7.5   |        |                      |
|                              |                            | 3.30 ± 0.30          | $V_{IN}=2 \cdot V_{CC}$                       | 0.8                   | 2.1  | 6.0                          | 0.8  | 5.2   |        |                      |
|                              | 5.00 ± 0.50                |                      | 0.5   | 1.3                   | 4.3  | 0.5                          | 4.5  |       |        |                      |
| C <sub>IN</sub>              | Input Capacitance          | 0.00                 |   |                       | 4.0  |                              |      |       | pF     |                      |
| C <sub>OUT</sub>             | Output Capacitance         | 0.00                 |   |                       | 5.0  |                              |      |       | pF     |                      |
| C <sub>PD</sub> Powe<br>Capa | Power Dissipation          | 3.30                 |   |                       | 5.1  |                              |      |       | ъĘ     | Figuro               |
|                              | Capacitance <sup>(2)</sup> | 5.00                 |   |                       | 7.3  |                              |      |       | pF     | Figure 6             |

#### Note:

2. CPD 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. C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression:  $I_{CCD}=(C_{PD})(V_{CC})(f_{IN})+(I_{CC}static)$ .

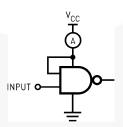




#### Note:

3. C<sub>L</sub> includes load and stray capacitance. Input PRR=10MHz tw=500ns.

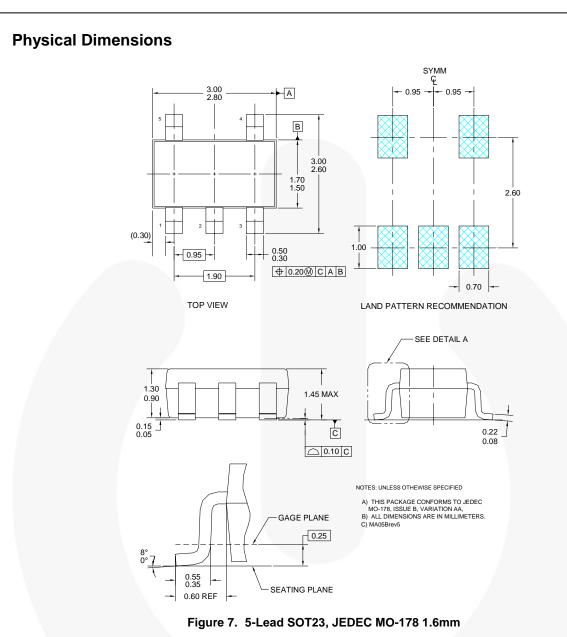
Figure 4. AC Test Circuit



#### Note:

4. Input=AC Waveform; t<sub>r</sub>=t<sub>f</sub>=1.8ns; PRR=10MHz; Duty Cycle=50%.

Figure 6. Test Circuit



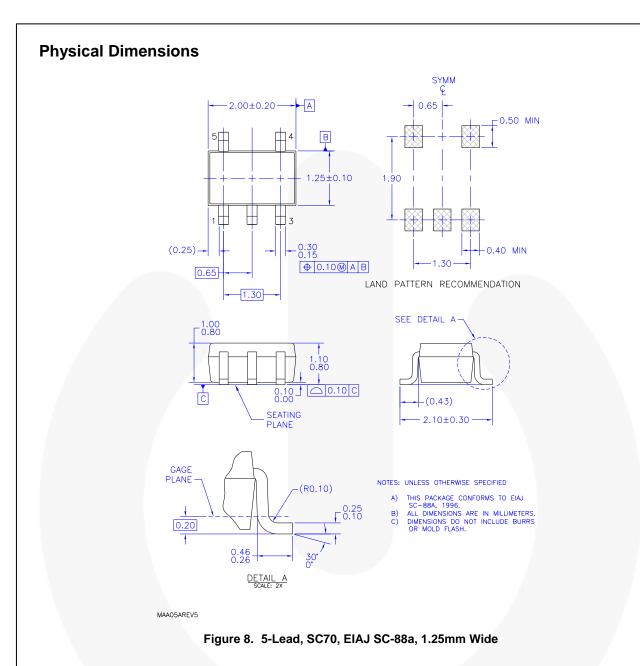
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### **Tape and Reel Specifications**

Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications: <u>http://www.fairchildsemi.com/packaging/SOT23-5L\_tr.pdf</u>.

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



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#### **Tape and Reel Specifications**

Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications: <u>http://www.fairchildsemi.com/products/analog/pdf/sc70-5\_tr.pdf</u>.

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



(1)

(0.30)

6X

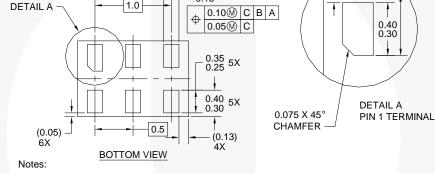
RECOMMENED LAND PATTERN

0.10 6X

(0.75)

0.45 0.35

#### **Physical Dimensions** 2X □ 0.05 C 1.45 В 2X △ 0.05 C (0.49 1.00 5X T. (0.52) А TOP VIEW 1X | 0.55MAX PIN 1 // 0.05 C 0.05 □ 0.05 C С 0.25 0.15 6X



1. CONFORMS TO JEDEC STANDARD M0-252 VARIATION UAAD

2. DIMENSIONS ARE IN MILLIMETERS

3. DRAWING CONFORMS TO ASME Y14.5M-1994

1.0

MAC06AREVC

#### Figure 9. 6-Lead, MicroPak<sup>™</sup>, 1.0mm Wide

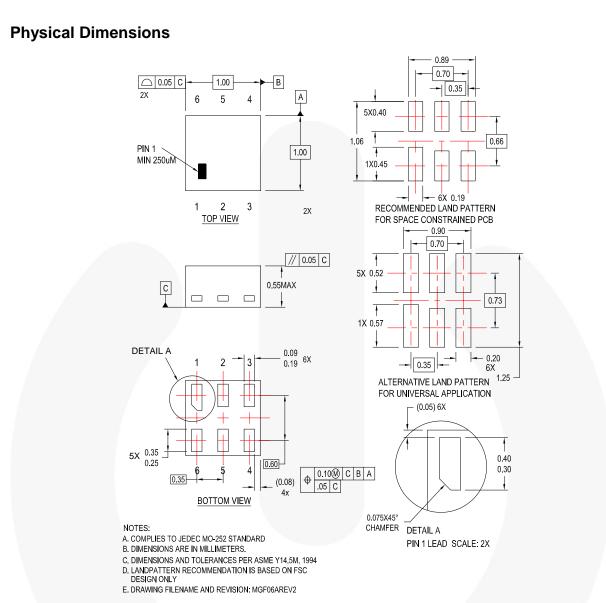
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### **Tape and Reel Specifications**

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 |
|--------------------|--------------------|---------------|---------------|-------------------|
|                    | Leader (Start End) | 125 (Typical) | Empty         | Sealed            |
| L6X                | Carrier            | 5000          | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (Typical)  | Empty         | Sealed            |



#### Figure 10. 6-Lead, MicroPak2, 1x1mm Body, .35mm Pitch

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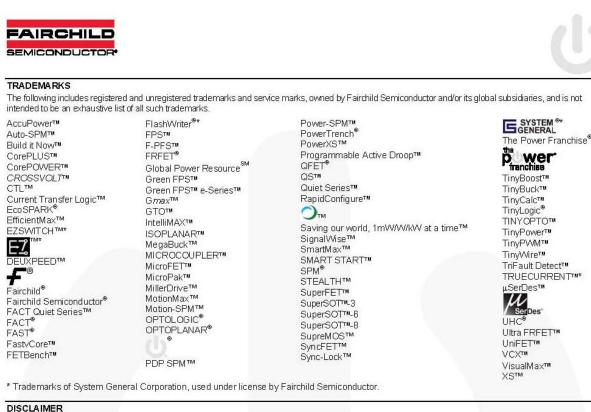
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#### **Tape and Reel Specifications**

Please visit Fairchild Semiconductor's online packaging area for the most recent tape and reel specifications: <u>http://www.fairchildsemi.com/packaging/MicroPAK2\_6L\_tr.pdf</u>.

| 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            |

NC7SZ38 — UHS 2-Input NAND Gate, Open Drain Output



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#### 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<br>any manner without notice.  |  |  |
| Preliminary                             | First Production      | t Production Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild<br>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<br>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.<br>The datasheet is for reference information only.   |  |  |

Rev. 143

NC7SZ38 — UHS 2-Input NAND Gate, Open Drain Output

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