

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7SH02F, TC7SH02FU

## 2-INPUT NOR GATE

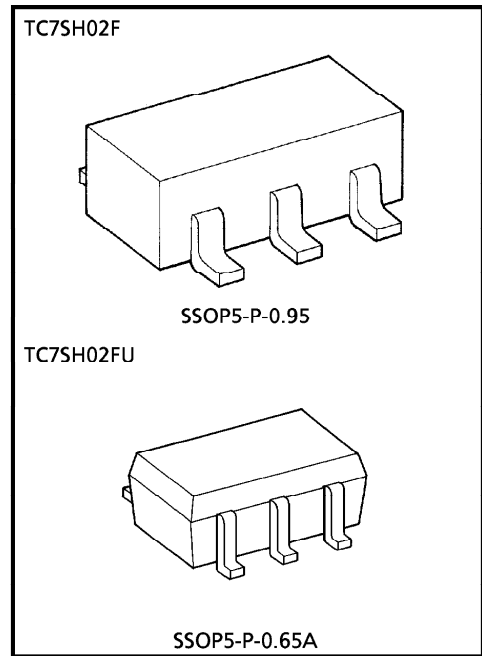
The TC7SH02 is an advanced high speed CMOS 2-INPUT NOR GATE fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output. An input protection circuit ensures that 0 to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interphase 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### FEATURES

- High Speed .....  $t_{pd} = 3.6ns$  (Typ.) at  $V_{CC} = 5V$
- Low Power Dissipation .....  $I_{CC} = 2\mu A$  (Max.) at  $T_a = 25^\circ C$
- High Noise Immunity .....  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays .....  $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range .....  $V_{CC(opr)} = 2 \sim 5.5V$

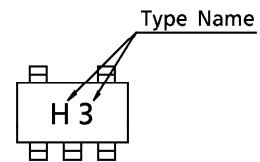
### MAXIMUM RATINGS

| PARAMETER                    | SYMBOL    | VALUE                | UNIT |
|------------------------------|-----------|----------------------|------|
| Supply Voltage Range         | $V_{CC}$  | -0.5~7.0             | V    |
| DC Input Voltage             | $V_{IN}$  | -0.5~7.0             | V    |
| DC Output Voltage            | $V_{OUT}$ | -0.5~ $V_{CC} + 0.5$ | V    |
| Input Diode Current          | $I_{IK}$  | -20                  | mA   |
| Output Diode Current         | $I_{OK}$  | ±20                  | mA   |
| DC Output Current            | $I_{OUT}$ | ±25                  | mA   |
| DC $V_{CC}$ / Ground Current | $I_{CC}$  | ±50                  | mA   |
| Power Dissipation            | $P_D$     | 200                  | mW   |
| Storage Temperature          | $T_{stg}$ | -65~150              | °C   |
| Lead Temperature (10s)       | $T_L$     | 260                  | °C   |



Weight SSOP5-P-0.95 : 0.016g (Typ.)  
SSOP5-P-0.65A : 0.006g (Typ.)

### MARKING



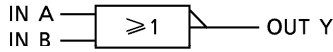
### TRUTH TABLE

| A | B | Y |
|---|---|---|
| L | L | H |
| L | H | L |
| H | L | L |
| H | H | L |

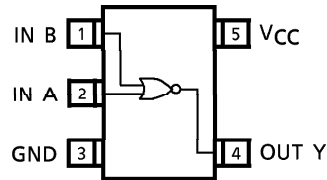
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LOGIC DIAGRAM



PIN ASSIGNMENT (TOP VIEW)



RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL                          | VALUE                                | UNIT   |
|--------------------------|---------------------------------|--------------------------------------|--------|
| Supply Voltage           | V <sub>CC</sub>                 | 2.0~5.5                              | V      |
| Input Voltage            | V <sub>IN</sub>                 | 0~5.5                                | V      |
| Output Voltage           | V <sub>OUT</sub>                | 0~V <sub>CC</sub>                    | V      |
| Operating Temperature    | T <sub>opr</sub>                | -40~85                               | °C     |
| Input Rise and Fall Time | d <sub>t</sub> / d <sub>v</sub> | 0~100 (V <sub>CC</sub> = 3.3 ± 0.3V) | ns / V |
|                          |                                 | 0~20 (V <sub>CC</sub> = 5 ± 0.5V)    |        |

DC ELECTRICAL CHARACTERISTICS

| PARAMETER                 | SYMBOL          | TEST CIRCUIT | TEST CONDITION  | Ta = 25°C               |                                  |             | Ta = -40~85°C                    |             | UNIT  |      |   |
|---------------------------|-----------------|--------------|---|-------------------------|----------------------------------|-------------|----------------------------------|-------------|-------|------|---|
|                           |                 |              |   | V <sub>CC</sub>         | MIN.                             | TYP.        | MAX.                             | MIN.        |       | MAX. |   |
| High-Level Input Voltage  | V <sub>IH</sub> | —            | —   | 2.0<br>3.0~<br>5.5      | 1.50<br>V <sub>CC</sub><br>× 0.7 | —<br>—<br>— | 1.50<br>V <sub>CC</sub><br>× 0.7 | —<br>—<br>— | V     |      |   |
| Low-Level Input Voltage   | V <sub>IL</sub> | —            | —   | 2.0<br>3.0~<br>5.5      | —<br>—<br>—                      | —<br>—<br>— | 0.50<br>V <sub>CC</sub><br>× 0.3 | —<br>—<br>— | V     |      |   |
| High Level Output-Voltage | V <sub>OH</sub> | —            | V <sub>IN</sub> = V <sub>IL</sub>                       | I <sub>OH</sub> = -50μA | 2.0                              | 1.9         | 2.0                              | —           | 1.9   | —    | V |
|                           |                 |              |   |                         | 3.0                              | 2.9         | 3.0                              | —           | 2.9   | —    |   |
|                           |                 |              |   |                         | 4.5                              | 4.4         | 4.5                              | —           | 4.4   | —    |   |
| Low-Level Output-Voltage  | V <sub>OL</sub> | —            | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 50μA  | 2.0                              | —           | 0.0                              | 0.1         | —     | 0.1  | V |
|                           |                 |              |   |                         | 3.0                              | —           | 0.0                              | 0.1         | —     | 0.1  |   |
|                           |                 |              |   |                         | 4.5                              | —           | 0.0                              | 0.1         | —     | 0.1  |   |
| Low-Level Output-Voltage  | V <sub>OL</sub> | —            | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 4mA   | 3.0                              | —           | —                                | 0.36        | —     | 0.44 | V |
|                           |                 |              |   |                         | 4.5                              | —           | —                                | 0.36        | —     | 0.44 |   |
|                           |                 |              |   |                         | 4.5                              | —           | —                                | 0.36        | —     | 0.44 |   |
| Input Leakage Current     | I <sub>IN</sub> | —            | V <sub>IN</sub> = 5.5V or GND                           | 0~<br>5.5               | —                                | —           | ± 0.1                            | —           | ± 1.0 | μA   |   |
| Quiescent Supply Current  | I <sub>CC</sub> | —            | V <sub>IN</sub> = V <sub>CC</sub> or GND                | 5.5                     | —                                | —           | 2.0                              | —           | 20.0  |      |   |

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**AC ELECTRICAL CHARACTERISTICS** (Input  $t_r = t_f = 3\text{ns}$ )

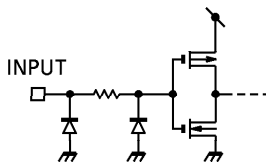
| PARAMETER                     | SYMBOL           | TEST CIR-CUIT | TEST CONDITION      |                     | Ta = 25°C |      |      | Ta = - 40~85°C |      | UNIT |    |
|-------------------------------|------------------|---------------|---------------------|---------------------|-----------|------|------|----------------|------|------|----|
|                               |                  |               | V <sub>CC</sub> (V) | C <sub>L</sub> (pF) | MIN.      | TYP. | MAX. | MIN.           | MAX. |      |    |
| Propagation Delay Time        | t <sub>PLH</sub> | —             | —                   | 3.3 ± 0.3           | 15        | —    | 5.6  | 7.9            | 1.0  | 9.5  | ns |
|                               |                  |               |                     |                     | 50        | —    | 8.1  | 11.4           | 1.0  | 13.0 |    |
|                               | t <sub>PHL</sub> |               |                     | 5.0 ± 0.5           | 15        | —    | 3.6  | 5.5            | 1.0  | 6.5  |    |
|                               |                  |               |                     |                     | 50        | —    | 5.1  | 7.5            | 1.0  | 8.5  |    |
| Input Capacitance             | C <sub>IN</sub>  | —             | —                   |                     | —         | 4    | 10   | —              | 10   | pF   |    |
| Power Dissipation Capacitance | C <sub>PD</sub>  | —             | Note (1)            |                     | —         | 15   | —    | —              | —    |      |    |

Note (1) : C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

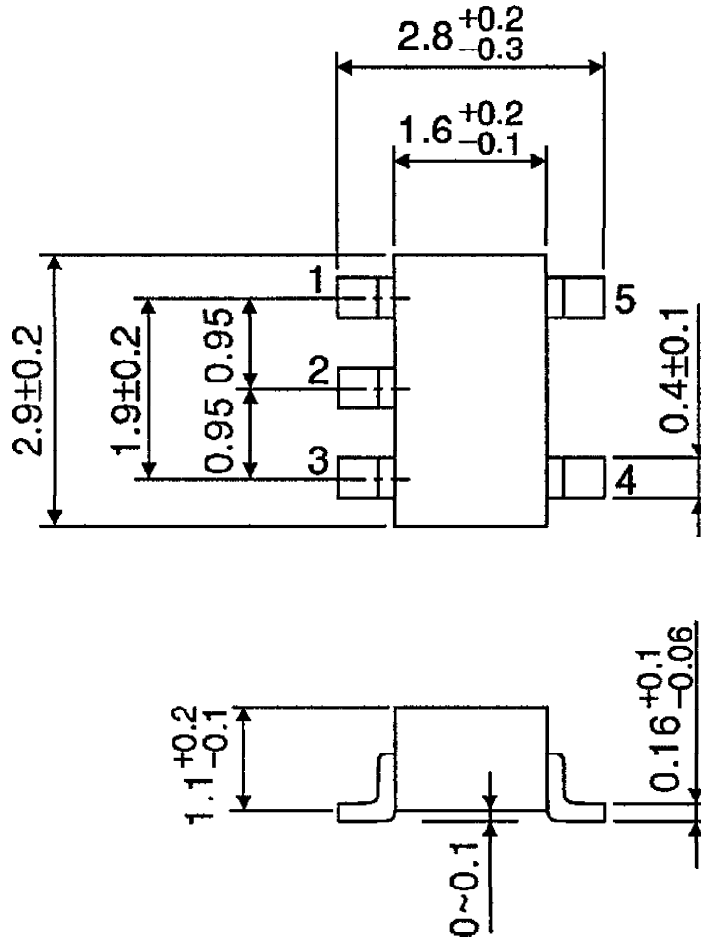
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

**INPUT EQUIVALENT CIRCUIT**



OUTLINE DRAWING  
SSOP5-P-0.95

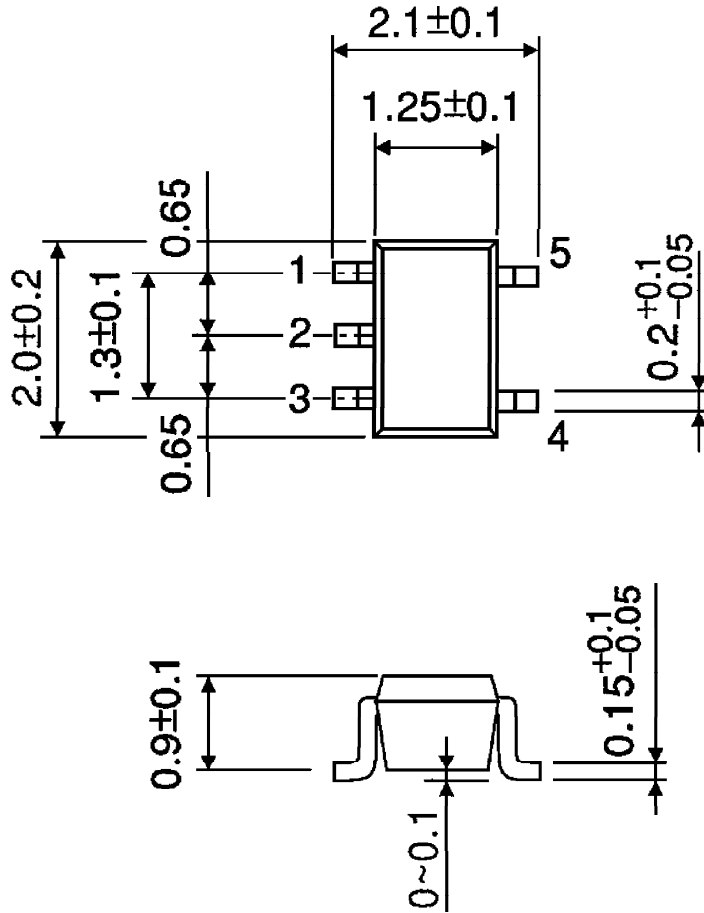
Unit : mm



Weight : 0.016g (Typ.)

OUTLINE DRAWING  
SSOP5-P-0.65A

Unit : mm



Weight : 0.006g (Typ.)