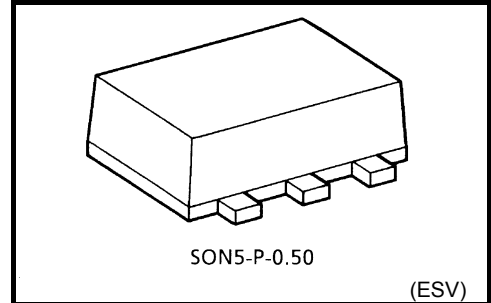


# TC7SH86FE

## 2-Input EXCLUSIVE OR Gate

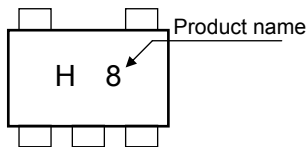
### Features

- High speed operation :  $t_{pd} = 4.8 \text{ ns (typ.)}$   
at  $V_{CC} = 5V, C_L = 15pF$
- Low power dissipation :  $I_{CC} = 2\mu A \text{ (max) at } T_a = 25^\circ C$
- High noise immunity :  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- 5.5-V tolerant inputs.
- Wide operating voltage range:  $V_{CC} = 2 \text{ to } 5.5 \text{ V}$

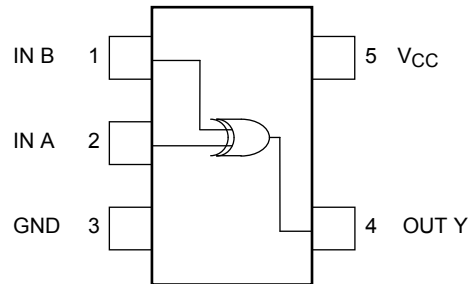


Weight: 0.003 g (typ.)

### Marking



### Pin Assignment (top view)



### Absolute Maximum Ratings ( $T_a = 25^\circ C$ )

| Characteristics             | Symbol    | Rating                  | Unit       |
|-----------------------------|-----------|-------------------------|------------|
| Supply voltage              | $V_{CC}$  | - 0.5 to 7              | V          |
| DC input voltage            | $V_{IN}$  | - 0.5 to 7              | V          |
| DC output voltage           | $V_{OUT}$ | - 0.5 to $V_{CC} + 0.5$ | V          |
| Input diode current         | $I_{IK}$  | - 20                    | mA         |
| Output diode current        | $I_{OK}$  | $\pm 20$ (Note 1)       | mA         |
| DC output current           | $I_{OUT}$ | $\pm 25$                | mA         |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$                | mA         |
| Power dissipation           | $P_D$     | 150                     | mW         |
| Storage temperature         | $T_{stg}$ | - 65 to 150             | $^\circ C$ |

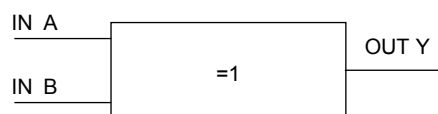
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1:  $V_{OUT} < GND, V_{OUT} > V_{CC}$

Start of commercial production  
2003-09

## IEC Logic Symbol



## Truth Table

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

## Operating Ranges

| Characteristics          | Symbol    | Rating                                  | Unit |
|--------------------------|-----------|---|------|
| Supply voltage           | $V_{CC}$  | 2 to 5.5                                | V    |
| Input voltage            | $V_{IN}$  | 0 to 5.5                                | V    |
| Output voltage           | $V_{OUT}$ | 0 to $V_{CC}$                           | V    |
| Operating temperature    | $T_{opr}$ | - 40 to 85                              | °C   |
| Input rise and fall time | dt/dv     | 0 to 100 ( $V_{CC} = 3.3 V \pm 0.3 V$ ) | ns/V |
|                          |           | 0 to 20 ( $V_{CC} = 5.0 V \pm 0.5 V$ )  |      |

## Electrical Characteristics

### DC Characteristics

| Characteristics           | Symbol          | Test Condition  | V <sub>CC</sub> (V)      | Ta = 25°C             |      |                       | Ta = -40 to 85°C      |                       | Unit |   |
|---------------------------|-----------------|---|--------------------------|-----------------------|------|-----------------------|-----------------------|-----------------------|------|---|
|                           |                 |   |                          | Min                   | Typ. | Max                   | Min                   | Max                   |      |   |
| High-level input voltage  | V <sub>IH</sub> | —   | 2.0                      | 1.5                   | —    | —                     | 1.5                   | —                     | V    |   |
|                           |                 |   | 3.0 to 5.5               | V <sub>CC</sub> × 0.7 | —    | —                     | V <sub>CC</sub> × 0.7 | —                     |      |   |
| Low-level input voltage   | V <sub>IL</sub> | —   | 2.0                      | —                     | —    | 0.5                   | —                     | 0.5                   | V    |   |
|                           |                 |   | 3.0 to 5.5               | —                     | —    | V <sub>CC</sub> × 0.3 | —                     | V <sub>CC</sub> × 0.3 |      |   |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OH</sub> = -50 μA | 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                   | —    |   |
|                           |                 |   | I <sub>OH</sub> = -4 mA  | 3.0                   | 2.58 | —                     | —                     | 2.48                  | —    |   |
|                           |                 |   |                          | 4.5                   | 3.94 | —                     | —                     | 3.80                  | —    |   |
| 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> = 50 μA  | 2.0                   | —    | 0                     | 0.1                   | —                     | 0.1  | V |
|                           |                 |   |                          | 3.0                   | —    | 0                     | 0.1                   | —                     | 0.1  |   |
|                           |                 |   |                          | 4.5                   | —    | 0                     | 0.1                   | —                     | 0.1  |   |
|                           |                 |   | I <sub>OL</sub> = 4 mA   | 3.0                   | —    | —                     | 0.36                  | —                     | 0.44 |   |
|                           |                 |   |                          | 4.5                   | —    | —                     | 0.36                  | —                     | 0.44 |   |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = 5.5 V or GND                          | 0 to 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                  | μA   |   |

## AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

| Characteristics               | Symbol           | Test Condition      |                     | Ta = 25°C |      |      | Ta = -40 to 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                  | —         | 7.0  | 11.0 | 1.0              | 13.0 | ns   |
|                               |                  |                     | 50                  | —         | 9.5  | 14.5 | 1.0              | 16.5 |      |
|                               | t <sub>pHL</sub> | 5.0 ± 0.5           | 15                  | —         | 4.8  | 6.8  | 1.0              | 8.0  |      |
|                               |                  |                     | 50                  | —         | 6.3  | 8.8  | 1.0              | 10.0 |      |
| Input capacitance             | C <sub>IN</sub>  |                     |                     | —         | 4    | 10   | —                | 10   | pF   |
| Power dissipation capacitance | C <sub>PD</sub>  | (Note 2)            |                     | —         | 18   | —    | —                | —    | pF   |

Note 2: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

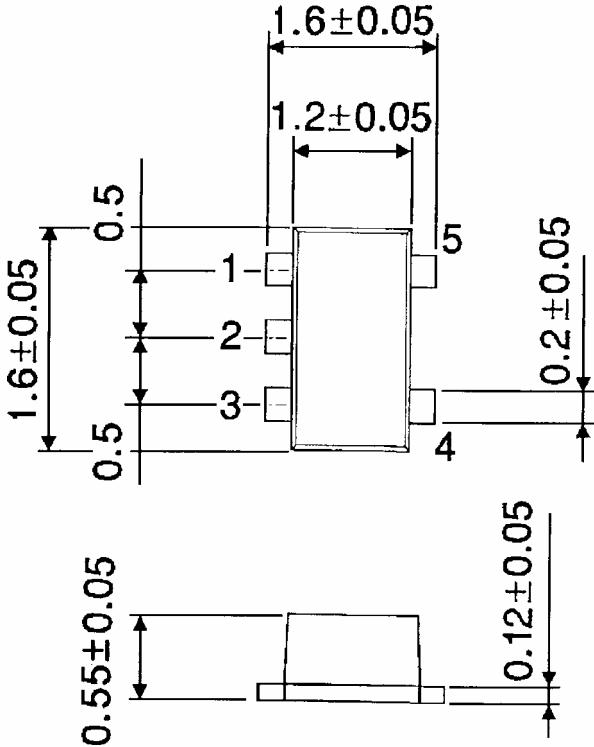
Average operating current can be obtained by the equation.

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

**Package Dimensions**

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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