

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7S86F, TC7S86FU

## EXCLUSIVE OR GATE

The TC7S86 is a high speed C<sup>2</sup>MOS EXCLUSIVE OR GATE fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves the high speed operation similar to equivalent LSTTL while maintaining the C<sup>2</sup>MOS low power dissipation.

Input and output buffers are provided which offer high noise immunity and stable output. All inputs are equipped with protection circuits against static discharge or transient excess voltage.

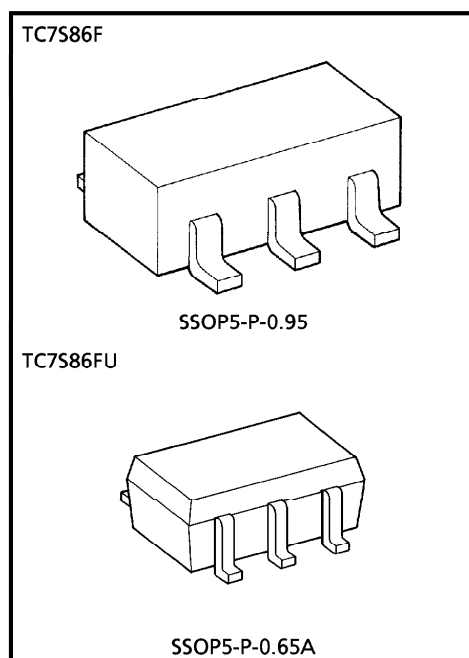
Output current are 1/2 compared to TC74HC series models.

### FEATURES

- High Speed .....  $t_{pd} = 10\text{ns}$  (Typ.) at  $V_{CC} = 5\text{V}$
- Low Power Dissipation .....  $I_{CC} = 1\mu\text{A}$  (Max.) at  $T_a = 25^\circ\text{C}$
- High Noise Immunity .....  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Output Drive Capability ..... 5 LSTTL Loads
- Symmetrical Output Impedance ...  $|I_{OH}| = I_{OL} = 2\text{mA}$  (Min.)
- Balanced Propagation Delays .....  $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range ...  $V_{CC}(\text{opr}) = 2 \sim 6\text{V}$

### MAXIMUM RATINGS

| CHARACTERISTIC               | SYMBOL    | RATING                   | UNIT             |
|------------------------------|-----------|--------------------------|------------------|
| Supply Voltage Range         | $V_{CC}$  | $-0.5 \sim 7$            | V                |
| DC Input Voltage             | $V_{IN}$  | $-0.5 \sim V_{CC} + 0.5$ | V                |
| DC Output Voltage            | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$ | V                |
| Input Diode Current          | $I_{IK}$  | $\pm 20$                 | mA               |
| Output Diode Current         | $I_{OK}$  | $\pm 20$                 | mA               |
| DC Output Current            | $I_{OUT}$ | $\pm 12.5$               | mA               |
| DC $V_{CC}$ / Ground Current | $I_{CC}$  | $\pm 25$                 | mA               |
| Power Dissipation            | $P_D$     | 200                      | mW               |
| Storage Temperature          | $T_{stg}$ | $-65 \sim 150$           | $^\circ\text{C}$ |
| Lead Temperature (10s)       | $T_L$     | 260                      | $^\circ\text{C}$ |



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

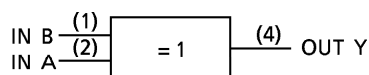
### TRUTH TABLE

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

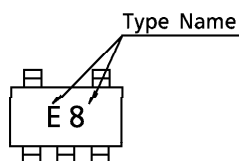
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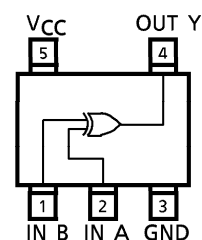
## LOGIC DIAGRAM



## MARKING



## PIN ASSIGNMENT (TOP VIEW)



## RECOMMENDED OPERATING CONDITIONS

| CHARACTERISTIC           | SYMBOL     | RATING   | UNIT |
|--------------------------|------------|--|------|
| Supply Voltage           | $V_{CC}$   | 2~6  | V    |
| Input Voltage            | $V_{IN}$   | 0~ $V_{CC}$  | V    |
| Output Voltage           | $V_{OUT}$  | 0~ $V_{CC}$  | V    |
| Operating Temperature    | $T_{opr}$  | -40~85   | °C   |
| Input Rise and Fall Time | $t_r, t_f$ | 0~1000 ( $V_{CC}=2.0V$ )<br>0~500 ( $V_{CC}=4.5V$ )<br>0~400 ( $V_{CC}=6.0V$ ) | ns   |

## DC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC            | SYMBOL   | TEST CONDITION  | $T_a = 25^{\circ}\text{C}$ |                    |                   |                    | $T_a = -40 \sim 85^{\circ}\text{C}$ |                    | UNIT          |
|---------------------------|----------|---|----------------------------|--------------------|-------------------|--------------------|-------------------------------------|--------------------|---------------|
|                           |          |   | $V_{CC}$                   | MIN.               | TYP.              | MAX.               | MIN.                                | MAX.               |               |
| High-Level Input Voltage  | $V_{IH}$ | —   | 2.0<br>4.5<br>6.0          | 1.5<br>3.15<br>4.2 | —<br>—<br>—       | —<br>—<br>—        | 1.5<br>3.15<br>4.2                  | —<br>—<br>—        | V             |
| Low-Level Input Voltage   | $V_{IL}$ | —   | 2.0<br>4.5<br>6.0          | —<br>—<br>—        | —<br>—<br>—       | 0.5<br>1.35<br>1.8 | —<br>—<br>—                         | 0.5<br>1.35<br>1.8 | V             |
| High-Level Output Voltage | $V_{OH}$ | $V_{IN} = V_{IH}$<br>or $V_{IL}$<br>$I_{OH} = -20\mu\text{A}$ | 2.0<br>4.5<br>6.0          | 1.9<br>4.4<br>5.9  | 2.0<br>4.5<br>6.0 | —<br>—<br>—        | 1.9<br>4.4<br>5.9                   | —<br>—<br>—        | V             |
|                           |          |   | 4.5<br>6.0                 | 4.18<br>5.68       | 4.31<br>5.80      | —<br>—             | 4.13<br>5.63                        | —<br>—             |               |
|                           |          |   | —                          | —                  | —                 | —                  | —                                   | —                  |               |
| Low-Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH}$<br>or $V_{IL}$<br>$I_{OL} = 20\mu\text{A}$  | 2.0<br>4.5<br>6.0          | —<br>—<br>—        | 0.0<br>0.0<br>0.0 | 0.1<br>0.1<br>0.1  | —<br>—<br>—                         | 0.1<br>0.1<br>0.1  | V             |
|                           |          |   | 4.5<br>6.0                 | —<br>—             | 0.17<br>0.18      | 0.26<br>0.26       | —<br>—                              | 0.33<br>0.33       |               |
|                           |          |   | —                          | —                  | —                 | —                  | —                                   | —                  |               |
| Input Leakage Current     | $I_{IN}$ | $V_{IN} = V_{CC}$ or GND                                      | 6.0                        | —                  | —                 | $\pm 0.1$          | —                                   | $\pm 1.0$          | $\mu\text{A}$ |
| Quiescent Supply Current  | $I_{CC}$ | $V_{IN} = V_{CC}$ or GND                                      | 6.0                        | —                  | —                 | 1.0                | —                                   | 10.0               | $\mu\text{A}$ |

Output currents are 1/2 compared to TC74HC series models.

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**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 15\text{pF}$ ,  $V_{CC} = 5\text{V}$ ,  $T_a = 25^\circ\text{C}$ , Input  $t_r = t_f = 6\text{ns}$ )

| CHARACTERISTIC         | SYMBOL                 | TEST CONDITION | $T_a = 25^\circ\text{C}$ |      |      | UNIT |
|------------------------|------------------------|----------------|--------------------------|------|------|------|
|                        |                        |                | MIN.                     | TYP. | MAX. |      |
| Output Transition Time | $t_{TLH}$<br>$t_{THL}$ | —              | —                        | 4    | 8    | ns   |
| Propagation Delay Time | $t_{pLH}$<br>$t_{pHL}$ | —              | —                        | 10   | 17   |      |

**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50\text{pF}$ , Input  $t_r = t_f = 6\text{ns}$ )

| CHARACTERISTIC                | SYMBOL                               | TEST CONDITION | V <sub>CC</sub> | Ta = 25°C |      |      | Ta = - 40~85°C |      | UNIT |
|-------------------------------|--------------------------------------|----------------|-----------------|-----------|------|------|----------------|------|------|
|                               |                                      |                |                 | MIN.      | TYP. | MAX. | MIN.           | MAX. |      |
| Output Transition Time        | t <sub>TLH</sub><br>t <sub>THL</sub> | —              | 2.0             | —         | 50   | 125  | —              | 155  | ns   |
|                               |                                      |                | 4.5             | —         | 14   | 25   | —              | 31   |      |
|                               |                                      |                | 6.0             | —         | 12   | 21   | —              | 26   |      |
| Propagation Delay Time        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0             | —         | 48   | 100  | —              | 125  |      |
|                               |                                      |                | 4.5             | —         | 12   | 20   | —              | 25   |      |
|                               |                                      |                | 6.0             | —         | 9    | 17   | —              | 21   |      |
| Input Capacitance             | C <sub>IN</sub>                      | —              | —               | 5         | 10   | —    | 10             | pF   |      |
| Power Dissipation Capacitance | C <sub>PD</sub>                      | (Note 1)       | —               | 18        | —    | —    | —              | pF   |      |

Note 1 :  $C_{PD}$  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.

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