TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7SH86F, TC7SH86FU

## EXCLUSIVE OR GATE

The TC7SH86 is an advanced high speed CMOS EXCLUSIVE OR GATE fabricated with silicon gate CMOS technology.

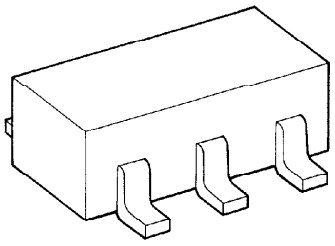
It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

The internal circuit is includes on output buffer, which provide high noise immunity and stable output.

An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V system and two supply system such as battery back up.

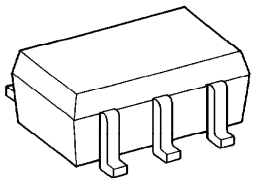
This circuit prevents device destruction due to mismatched supply and input voltages.

TC7SH86F



SSOP5-P-0.95

TC7SH86FU



SSOP5-P-0.65A

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

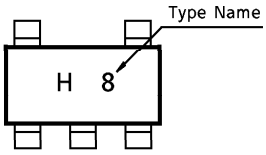
### FEATURES

- High Speed ..... $t_{pd}$ = 4.8ns (Typ.) at $V_{CC}$ = 5V
- Low Power Dissipation ..... $I_{CC}$ = 2$\mu$A (Max.) at Ta = 25°C
- High Noise Immunity ..... $V_{NIH} = V_{NIL}$ = 28% $V_{CC}$ (Min.)
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays ..... $t_{pLH} \fallingdotseq t_{pHL}$
- Wide Operation Voltage Range ... $V_{CC}$ (opr) = 2V~5.5V

### MAXIMUM RATINGS

| CHARACTERISTIC | SYMBOL | RATING | 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 (10 s) | $T_L$ | 260 | °C |

### MARKING

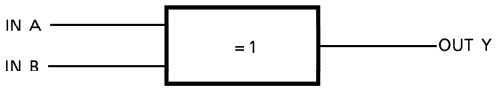



### TRUTH TABLE

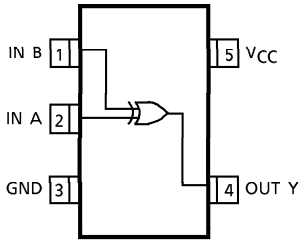
| A | B | Y |
|---|---|---|
| L | L | L |
| L | H | H |
| H | L | H |
| H | H | L |

961001EBA2

**LOGIC DIAGRAM**




**PIN ASSIGNMENT** (TOP VIEW)




**RECOMMENDED OPERATING CONDITIONS**

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 2.0~5.5 | V |
| Input Voltage | $V_{IN}$ | 0~5.5 | V |
| Output Voltage | $V_{OUT}$ | 0~$V_{CC}$ | V |
| Operating Temperature | $T_{opr}$ | −40~85 | °C |
| Input Rise and Fall Time | dt / dv | 0~100 ($V_{CC}$ = 3.3 ± 0.3V) | ns / V |
| | | 0~20 ($V_{CC}$ = 5 ± 0.5V) | |

**DC ELECTRICAL CHARACTERISTICS**

| CHARACTERISTIC | SYMBOL | TEST CONDITION | | $V_{CC}$ | Ta = 25°C MIN. | Ta = 25°C TYP. | Ta = 25°C MAX. | Ta = −40~85°C MIN. | Ta = −40~85°C MAX. | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| High-Level Input Voltage | $V_{IH}$ | | | 2.0 | 1.50 | — | — | 1.50 | — | V |
| | | | | 3.0~5.5 | $V_{CC}$ ×0.7 | — | — | $V_{CC}$ ×0.7 | — | |
| Low-Level Input Voltage | $V_{IL}$ | | | 2.0 | — | — | 0.50 | — | 0.50 | V |
| | | | | 3.0~5.5 | — | — | $V_{CC}$ ×0.3 | — | $V_{CC}$ ×0.3 | |
| High-Level Output Voltage | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = −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 | — | |
| | | | $I_{OH}$ = −4mA | 3.0 | 2.58 | — | — | 2.48 | — | |
| | | | $I_{OH}$ = −8mA | 4.5 | 3.94 | — | — | 3.80 | — | |
| Low-Level Output Voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 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 | |
| | | | $I_{OL}$ = 4mA | 3.0 | — | — | 0.36 | — | 0.44 | |
| | | | $I_{OL}$ = 8mA | 4.5 | — | — | 0.36 | — | 0.44 | |
| Input Leakage Current | $I_{IN}$ | $V_{IN}$ = 5.5V or GND | | 0~5.5 | — | — | ±0.1 | — | ±1.0 | μA |
| Quiescent Supply Current | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | 5.5 | — | — | 2.0 | — | 20.0 | μA |

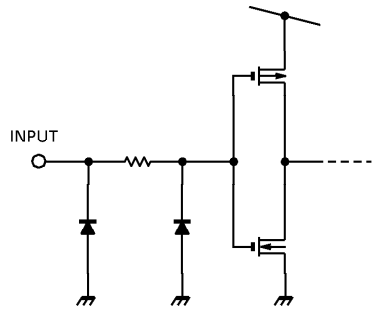
**AC ELECTRICAL CHARACTERISTICS** (Input $t_r = t_f = 3ns$)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | | | Ta = 25°C | | | Ta = −40~85°C | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | $C_L$ (pF) | MIN. | TYP. | MAX. | MIN. | MAX. | |
| Propagation Delay Time | $t_{pLH}$ $t_{pHL}$ | | 3.3 ± 0.3 | 15 | — | 7.0 | 11.0 | 1.0 | 13.0 | ns |
| | | | | 50 | — | 9.5 | 14.5 | 1.0 | 16.5 | |
| | | | 5.0 ± 0.5 | 15 | — | 4.8 | 6.8 | 1.0 | 8.0 | |
| | | | | 50 | — | 6.3 | 8.8 | 1.0 | 10.0 | |
| Input Capacitance | $C_{IN}$ | | | | — | 4 | 10 | — | 10 | pF |
| Power Dissipation Capacitance | $C_{PD}$ | (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 :

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

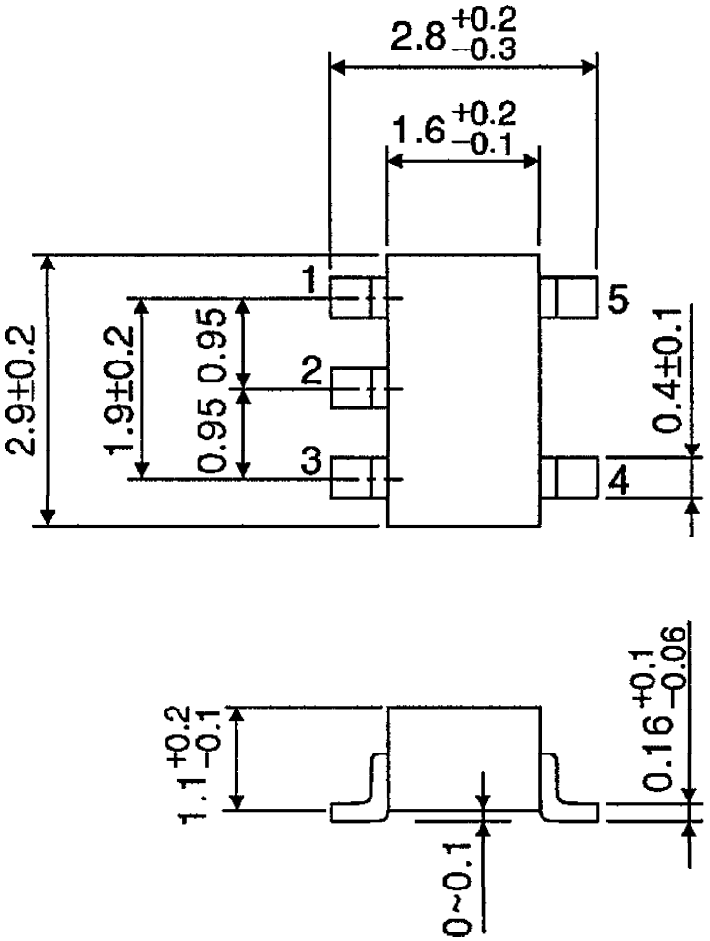
**INPUT EQUIVALENT CIRCUIT**



**OUTLINE DRAWING**

SSOP5-P-0.95

Unit : mm

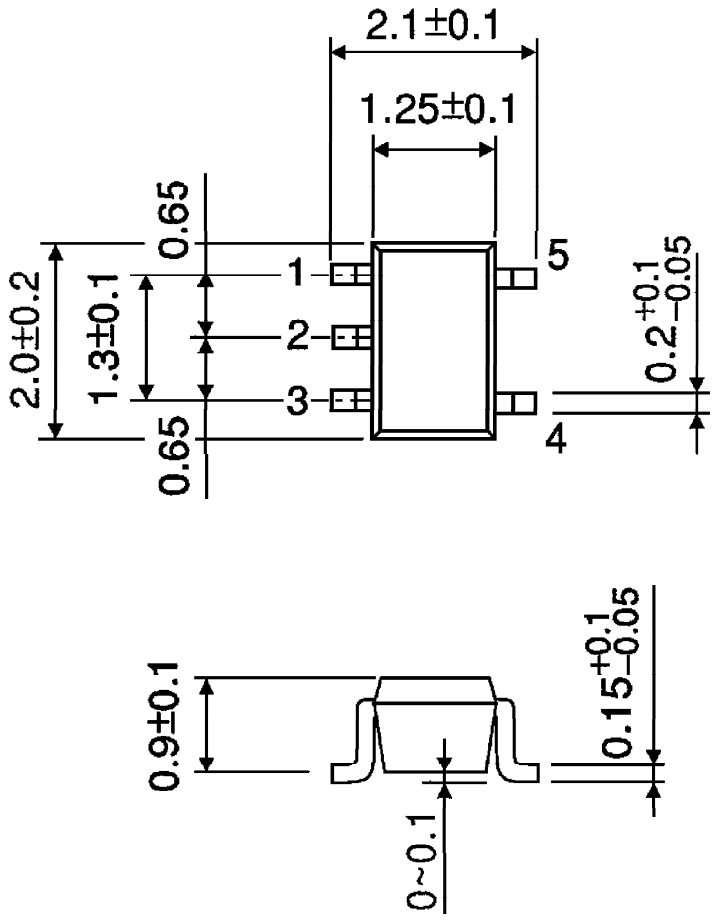



Weight : 0.016g (Typ.)

**OUTLINE DRAWING**

SSOP5-P-0.65A

Unit : mm




Weight : 0.006g (Typ.)