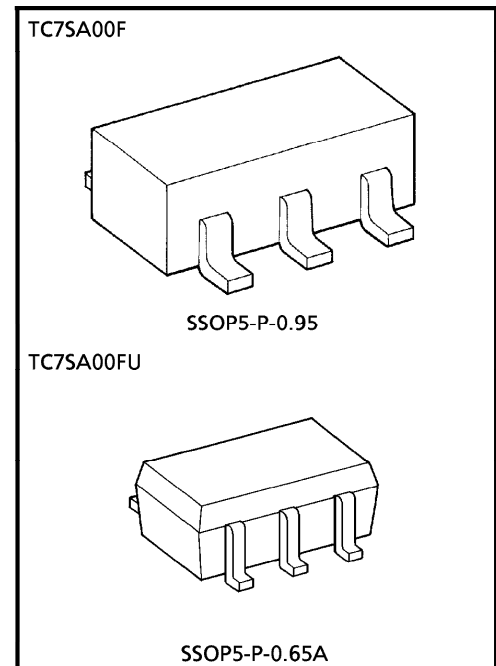


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC7SA00F, TC7SA00FU**LOW-VOLTAGE 2-INPUT NAND GATE
WITH 3.6 V TOLERANT INPUTS AND OUTPUTS****FEATURES**

- Low Voltage Operation : $V_{CC} = 1.8\sim 3.6\text{ V}$
- High Speed Operation : $t_{pd} = 2.8\text{ ns (max.)}$
at $V_{CC} = 3.0\sim 3.6\text{ V}$
 $t_{pd} = 3.7\text{ ns (max.)}$
at $V_{CC} = 2.3\sim 2.7\text{ V}$
 $t_{pd} = 7.4\text{ ns (max.)}$
at $V_{CC} = 1.8\text{ V}$
- 3.6 V Tolerant inputs and outputs.
- Output Current : $I_{OH}/I_{OL} = \pm 24\text{ mA (min.)}$
at $V_{CC} = 3.0\text{ V}$
 $I_{OH}/I_{OL} = \pm 18\text{ mA (min.)}$ at
 $V_{CC} = 2.3\text{ V}$
 $I_{OH}/I_{OL} = \pm 6\text{ mA (min.)}$ at
 $V_{CC} = 1.8\text{ V}$
- Latch-up Performance : $\pm 300\text{ mA}$
- ESD Performance : Human Body Model $> \pm 2000\text{ V}$
: Machine Model $> \pm 200\text{ V}$
- Power Down Protection is provided on all inputs and outputs.
- TC74VCX00FT Equivalent



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

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MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATING | UNIT |
|------------------------------|--------------------|-------------------------------|-------------|
| Power Supply Voltage | V_{CC} | -0.5~4.6 | V |
| DC Input Voltage | V_{IN} | -0.5~4.6 | V |
| DC Output Voltage | V_{OUT} | -0.5~4.6 (Note 1) | V |
| | | -0.5~ V_{CC} + 0.5 (Note 2) | |
| Input Diode Current | I_{IK} | -50 | mA |
| Output Diode Current | I_{OK} | ± 50 (Note 3) | mA |
| DC Output Current | I_{OUT} | ± 50 | mA |
| Power Dissipation | P_D | 200 | mW |
| DC V_{CC} / Ground Current | I_{CC} / I_{GND} | ± 100 | mA |
| Storage Temperature | T_{stg} | -65~150 | $^{\circ}C$ |

(Note 1) : $V_{CC} = 0V$

(Note 2) : High or Low State. I_{OUT} absolute maximum rating must be observed.

(Note 3) : $V_{OUT} < GND, V_{OUT} > V_{CC}$

RECOMMENDED OPERATING RANGE

| PARAMETER | SYMBOL | RATING | UNIT |
|--------------------------|-------------------|----------------------|-------------|
| Supply Voltage | V_{CC} | 1.8~3.6 | V |
| | | 1.2~3.6 (Note 4) | |
| Input Voltage | V_{IN} | -0.3~3.6 | V |
| Output Voltage | V_{OUT} | 0~3.6 (Note 5) | V |
| | | 0~ V_{CC} (Note 6) | |
| Output Current | I_{OH} / I_{OL} | ± 24 (Note 7) | mA |
| | | ± 18 (Note 8) | |
| | | ± 6 (Note 9) | |
| Operating Temperature | T_{opr} | -40~85 | $^{\circ}C$ |
| Input Rise And Fall Time | dt / dv | 0~10 (Note 10) | ns / V |

(Note 4) : Data Retention Only

(Note 5) : $V_{CC} = 0V$

(Note 6) : High or Low State

(Note 7) : $V_{CC} = 3.0\sim 3.6V$

(Note 8) : $V_{CC} = 2.3\sim 2.7V$

(Note 9) : $V_{CC} = 1.8V$

(Note 10) : $V_{IN} = 0.8\sim 2.0V, V_{CC} = 3.0V$

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = -40~85°C, 2.7 V < V_{CC} ≤ 3.6 V)

| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | MIN. | MAX. | UNIT | |
|---------------------------------------|------------------|---|--|---------------------------|---------|-----------------------|-----|
| | | | | | | | |
| Input Voltage | "H" Level | V _{IH} | 2.7~3.6 | 2.0 | — | V | |
| | "L" Level | V _{IL} | 2.7~3.6 | — | 0.8 | | |
| Output Voltage | "H" Level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100 μA | 2.7~3.6 | V _{CC} - 0.2 | V |
| | | | | I _{OH} = -12 mA | 2.7 | 2.2 | |
| | | | | I _{OH} = -18 mA | 3.0 | 2.4 | |
| | | | | I _{OH} = -24 mA | 3.0 | 2.2 | |
| | "L" Level | V _{OL} | V _{IN} = V _{IH} | I _{OL} = 100 μA | 2.7~3.6 | — | 0.2 |
| | | | | I _{OL} = 12 mA | 2.7 | — | 0.4 |
| | | | | I _{OL} = 18 mA | 3.0 | — | 0.4 |
| I _{OL} = 24 mA | | | | 3.0 | — | 0.55 | |
| Input Leakage Current | I _{IN} | V _{IN} = 0~3.6 V | 2.7~3.6 | — | ± 5.0 | μA | |
| Power Off Leakage Current | I _{OFF} | V _{IN} , V _{OUT} = 0~3.6 V | 0 | — | 10.0 | μA | |
| Quiescent Supply Current | I _{CC} | V _{IN} = V _{CC} or GND | 2.7~3.6 | — | 20.0 | μA | |
| | | V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V | 2.7~3.6 | — | ± 20.0 | | |
| Increase In I _{CC} Per Input | ΔI _{CC} | V _{IH} = V _{CC} - 0.6 V | 2.7~3.6 | — | 750 | μA | |

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = -40~85°C, 2.3 V ≤ V_{CC} ≤ 2.7 V)

| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | MIN. | MAX. | UNIT | |
|---------------------------|------------------|---|--|---------------------------|---------|-----------------------|-----|
| | | | | | | | |
| Input Voltage | "H" Level | V _{IH} | 2.3~2.7 | 1.6 | — | V | |
| | "L" Level | V _{IL} | 2.3~2.7 | — | 0.7 | | |
| Output Voltage | "H" Level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100 μA | 2.3~2.7 | V _{CC} - 0.2 | V |
| | | | | I _{OH} = -6 mA | 2.3 | 2.0 | |
| | | | | I _{OH} = -12 mA | 2.3 | 1.8 | |
| | | | | I _{OH} = -18 mA | 2.3 | 1.7 | |
| | "L" Level | V _{OL} | V _{IN} = V _{IH} | I _{OL} = 100 μA | 2.3~2.7 | — | 0.2 |
| | | | | I _{OL} = 12 mA | 2.3 | — | 0.4 |
| | | | | I _{OL} = 18 mA | 2.3 | — | 0.6 |
| I _{OL} = 18 mA | | | | 2.3 | — | 0.6 | |
| Input Leakage Current | I _{IN} | V _{IN} = 0~3.6 V | 2.3~2.7 | — | ± 5.0 | μA | |
| Power Off Leakage Current | I _{OFF} | V _{IN} , V _{OUT} = 0~3.6 V | 0 | — | 10.0 | μA | |
| Quiescent Supply Current | I _{CC} | V _{IN} = V _{CC} or GND | 2.3~2.7 | — | 20.0 | μA | |
| | | V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V _{CC} | 2.3~2.7 | — | ± 20.0 | | |

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = -40~85°C, 1.8 V ≤ VCC < 2.3 V)

| PARAMETER | SYMBOL | TEST CONDITION | VCC (V) | MIN. | MAX. | UNIT | | |
|---------------------------|------------------|---|--|---------------------------|-----------------------|-----------------------|---|-----|
| | | | | | | | | |
| Input Voltage | "H" Level | V _{IH} | 1.8~2.3 | 0.7 × V _{CC} | — | V | | |
| | "L" Level | V _{IL} | 1.8~2.3 | — | 0.2 × V _{CC} | | | |
| Output Voltage | "H" Level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100 μA | 1.8 | V _{CC} - 0.2 | V | |
| | | | | I _{OH} = -6 mA | 1.8 | 1.4 | | |
| | "L" Level | V _{OL} | V _{IN} = V _{IH} | I _{OL} = 100 μA | 1.8 | — | | 0.2 |
| | | | | I _{OL} = 6 mA | 1.8 | — | | 0.3 |
| Input Leakage Current | I _{IN} | V _{IN} = 0~3.6 V | 1.8 | — | ± 5.0 | μA | | |
| Power Off Leakage Current | I _{OFF} | V _{IN} , V _{OUT} = 0~3.6 V | 0 | — | 10.0 | μA | | |
| Quiescent Supply Current | I _{CC} | V _{IN} = V _{CC} or GND | 1.8 | — | 20.0 | μA | | |
| | | V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V | 1.8 | — | ± 20.0 | | | |

AC characteristics (Ta = -40~85°C, Input t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

| PARAMETER | SYMBOL | TEST CONDITION | VCC (V) | MIN. | MAX. | UNIT |
|------------------------|--------------------------------------|----------------|-----------|------|------|------|
| | | | | | | |
| Propagation Delay Time | t _{pLH} t _{pHL} | (Fig.1, 2) | 1.8 | 1.5 | 7.4 | ns |
| | | | 2.5 ± 0.2 | 1.0 | 3.7 | |
| | | | 3.3 ± 0.3 | 0.8 | 2.8 | |

For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Dynamic switching characteristics (Ta = 25°C, Input t_r = t_f = 2.0 ns, C_L = 30 pF)

| PARAMETER | SYMBOL | TEST CONDITION | VCC (V) | TYP. | UNIT |
|--|------------------|--|---------|-------|------|
| | | | | | |
| Quiet Output Maximum Dynamic V _{OL} | V _{OLP} | V _{IH} = 1.8 V, V _{IL} = 0 V (Note 11) | 1.8 | 0.25 | V |
| | | V _{IH} = 2.5 V, V _{IL} = 0 V (Note 11) | 2.5 | 0.6 | |
| | | V _{IH} = 3.3 V, V _{IL} = 0 V (Note 11) | 3.3 | 0.8 | |
| Quiet Output Minimum Dynamic V _{OL} | V _{OLV} | V _{IH} = 1.8 V, V _{IL} = 0 V (Note 11) | 1.8 | -0.25 | V |
| | | V _{IH} = 2.5 V, V _{IL} = 0 V (Note 11) | 2.5 | -0.6 | |
| | | V _{IH} = 3.3 V, V _{IL} = 0 V (Note 11) | 3.3 | -0.8 | |
| Quiet Output Minimum Dynamic V _{OH} | V _{OHV} | V _{IH} = 1.8 V, V _{IL} = 0 V (Note 11) | 1.8 | 1.5 | V |
| | | V _{IH} = 2.5 V, V _{IL} = 0 V (Note 11) | 2.5 | 1.9 | |
| | | V _{IH} = 3.3 V, V _{IL} = 0 V (Note 11) | 3.3 | 2.2 | |

(Note 11) : Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | TYP. | UNIT |
|-------------------------------|-----------------|------------------------------------|---------------------|------|------|
| | | | 1.8, 2.5, 3.3 | | |
| Input Capacitance | C _{IN} | — | 1.8, 2.5, 3.3 | 6 | pF |
| Power Dissipation Capacitance | C _{PD} | f _{IN} = 10 MHz (Note 12) | 1.8, 2.5, 3.3 | 20 | pF |

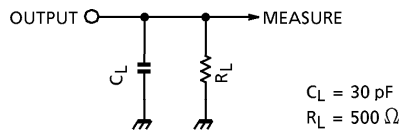
(Note 12) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

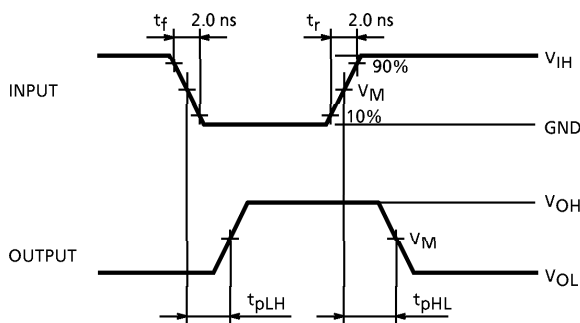
TEST CIRCUIT

Fig.1



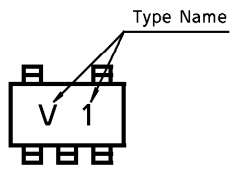
AC WAVEFORM

Fig.2 t_{pLH}, t_{pHL}

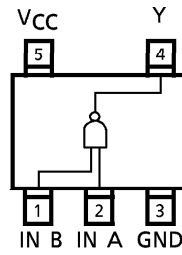


| SYMBOL | V _{CC} | | |
|-----------------|-----------------|--------------------|--------------------|
| | 3.3 ± 0.3 V | 2.5 ± 0.2 V | 1.8 V |
| V _{IH} | 2.7 V | V _{CC} | V _{CC} |
| V _M | 1.5 V | V _{CC} /2 | V _{CC} /2 |

MARKING



PIN ASSIGNMENT (TOP VIEW)



TRUTH TABLE

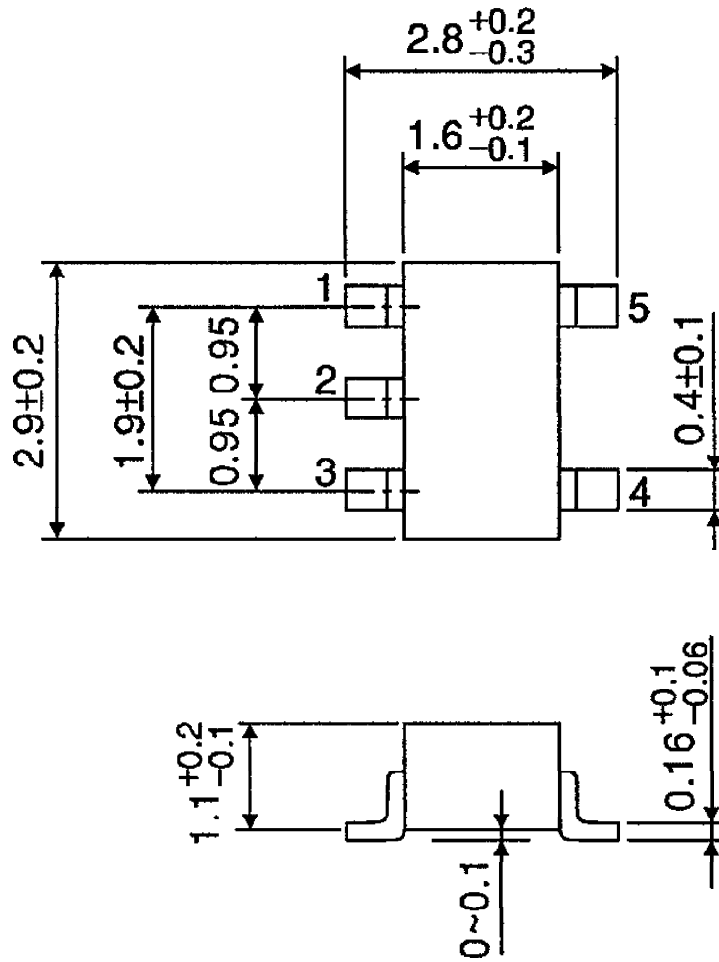
| INPUTS | | OUTPUTS |
|--------|---|---------|
| A | B | Y |
| L | L | H |
| L | H | H |
| H | L | H |
| H | H | L |

LOGIC DIAGRAM



PACKAGE DIMENSIONS
SSOP5-P-0.95

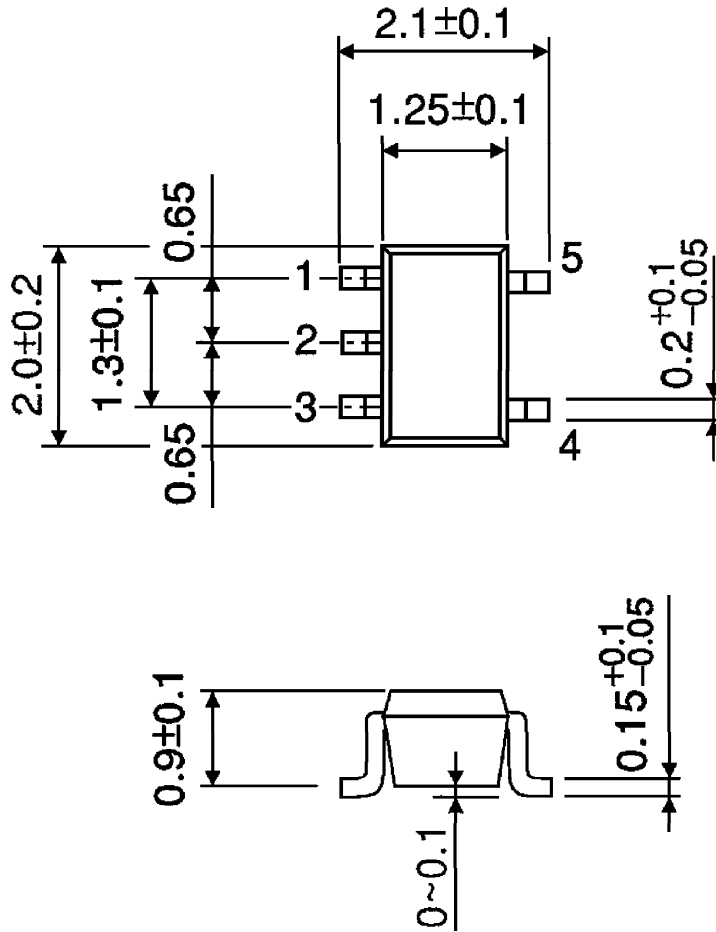
Unit : mm



Weight : 0.016 g (Typ.)

PACKAGE DIMENSIONS
SSOP5-P-0.65A

Unit : mm



Weight : 0.006 g (Typ.)