

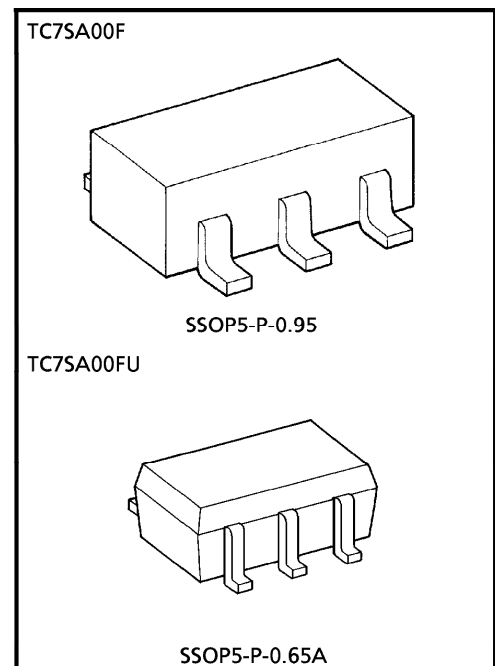
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

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}	$-0.5 \sim 4.6$	V
DC Input Voltage	V_{IN}	$-0.5 \sim 4.6$	V
DC Output Voltage	V_{OUT}	$-0.5 \sim 4.6$ (Note 1)	V
		$-0.5 \sim V_{CC} + 0.5$ (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}	$-65 \sim 150$	$^{\circ}\text{C}$

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

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

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

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}	$-0.3 \sim 3.6$	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}	$-40 \sim 85$	$^{\circ}\text{C}$
Input Rise And Fall Time	dt / dv	0~10 (Note 10)	ns / V

(Note 4) : Data Retention Only

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

(Note 6) : High or Low State

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

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

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

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

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		
Input Leakage Current		I _{IIN}	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 ≤ V_{CC} < 2.3 V)

PARAMETER		SYMBOL	TEST CONDITION		V _{CC} (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 _{IIN}	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		V _{CC} (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		V _{CC} (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

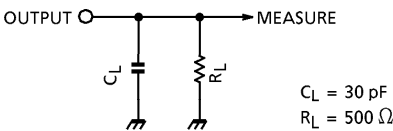
(Note 12) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

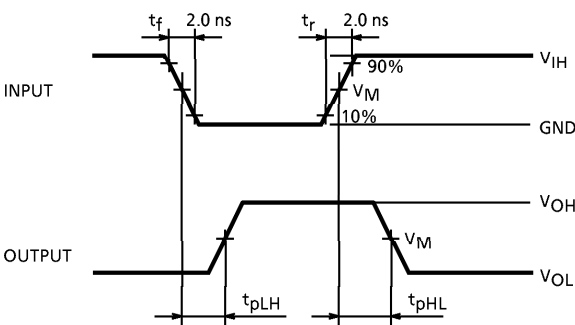
TEST CIRCUIT

Fig.1



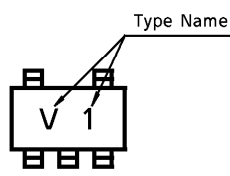
AC WAVEFORM

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

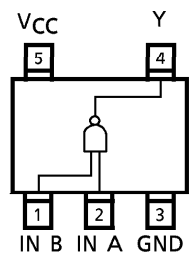


SYMBOL	V _{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V _{IH}	2.7 V	V _{CC}	V _{CC}
V _M	1.5 V	V _{CC} / 2	V _{CC} / 2

MARKING



PIN ASSIGNMENT (TOP VIEW)



TRUTH TABLE

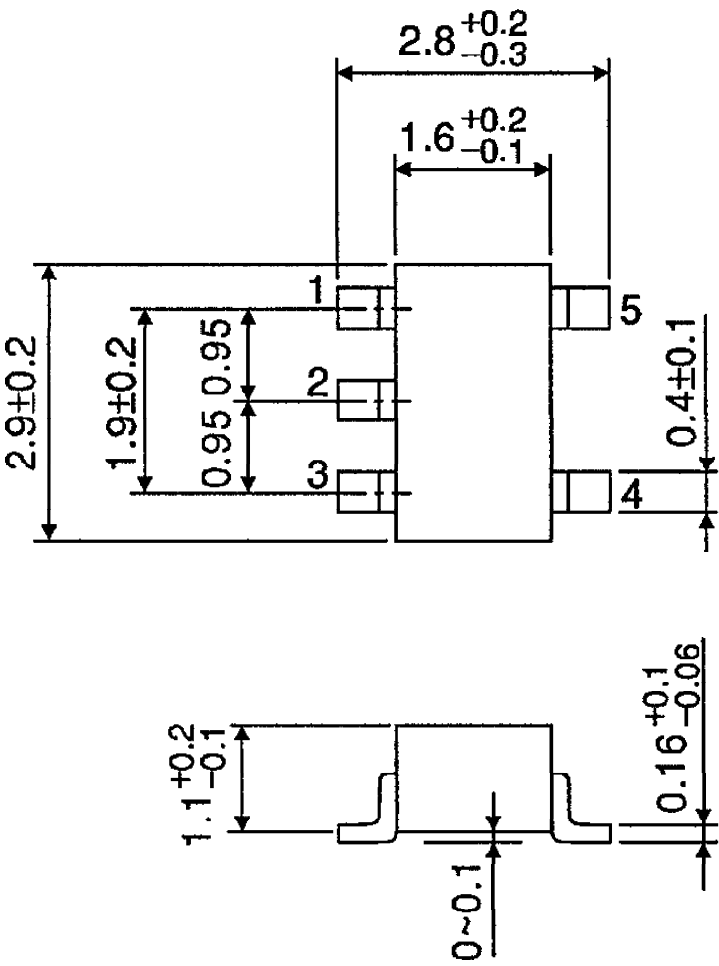
INPUTS		OUTPUTS
A	B	Y
L	L	H
L	H	H
H	L	H
H	H	L

LOGIC DIAGRAM



PACKAGE DIMENSIONS
SSOP5-P-0.95

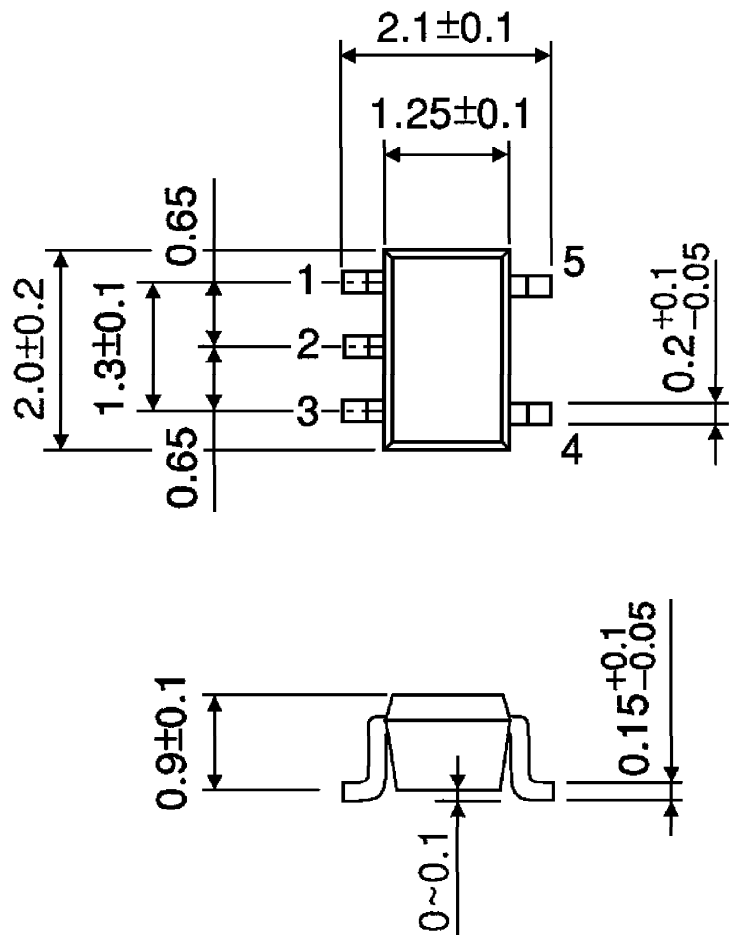
Unit : mm



Weight : 0.016 g (Typ.)

PACKAGE DIMENSIONS
SSOP5-P-0.65A

Unit : mm



Weight : 0.006 g (Typ.)