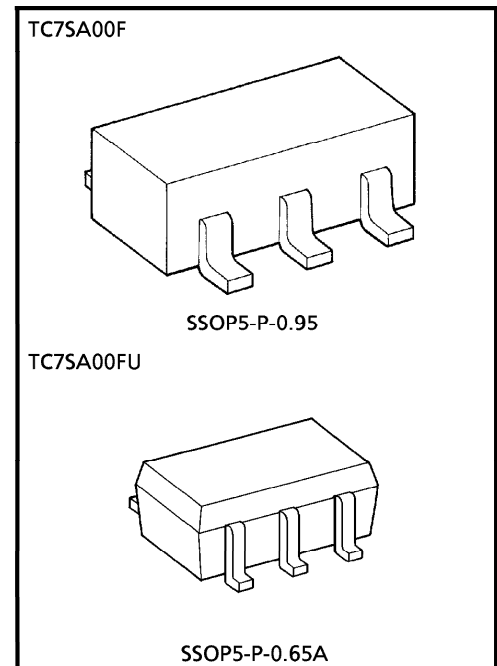


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC7SA08F, TC7SA08FU****LOW-VOLTAGE 2-INPUT AND 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.
- TC74VCX08FT 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	$I_{OK}$	$\pm 50$ (Note 3)	mA
DC Output Current	$I_{OUT}$	$\pm 50$	mA
Power Dissipation	$P_D$	200	mW
DC $V_{CC}$ / Ground Current	$I_{CC} / I_{GND}$	$\pm 100$	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	$I_{OH} / I_{OL}$	$\pm 24$ (Note 7)	mA
		$\pm 18$ (Note 8)	
		$\pm 6$ (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<sub>CC</sub> ≤ 3.6 V)

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

**ELECTRICAL CHARACTERISTICS**

DC characteristics (Ta = -40~85°C, 2.3 V ≤ V<sub>CC</sub> ≤ 2.7 V)

PARAMETER	SYMBOL	TEST CONDITION	V <sub>CC</sub> (V)	MIN.	MAX.	UNIT		
Input Voltage	"H" Level	V <sub>IH</sub>	2.3~2.7	1.6	—	V		
	"L" Level	V <sub>IL</sub>	2.3~2.7	—	0.7			
Output Voltage	"H" Level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OH</sub> = -100 μA	2.3~2.7	V <sub>CC</sub> - 0.2	V	
				I <sub>OH</sub> = -6 mA	2.3	2.0		
				I <sub>OH</sub> = -12 mA	2.3	1.8		
				I <sub>OH</sub> = -18 mA	2.3	1.7		
	"L" Level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	2.3~2.7	—		0.2
				I <sub>OL</sub> = 12 mA	2.3	—		0.4
				I <sub>OL</sub> = 18 mA	2.3	—		0.6
				I <sub>OL</sub> = 18 mA	2.3	—		0.6
Input Leakage Current	I <sub>IN</sub>	V <sub>IN</sub> = 0~3.6 V	2.3~2.7	—	± 5.0	μA		
Power Off Leakage Current	I <sub>OFF</sub>	V <sub>IN</sub> , V <sub>OUT</sub> = 0~3.6 V	0	—	10.0	μA		
Quiescent Supply Current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	2.3~2.7	—	20.0	μA		
		V <sub>CC</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V <sub>CC</sub>	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
					1.8~2.3			
Input Voltage	"H" Level	V <sub>IH</sub>			1.8~2.3	0.7 × V <sub>CC</sub>	—	V
	"L" Level	V <sub>IL</sub>			1.8~2.3	—	0.2 × V <sub>CC</sub>	
Output Voltage	"H" Level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OH</sub> = -100 μA	1.8	V <sub>CC</sub> - 0.2	—	V
				I <sub>OH</sub> = -6 mA	1.8	1.4	—	
	"L" Level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	1.8	—	0.2	
				I <sub>OL</sub> = 6 mA	1.8	—	0.3	
Input Leakage Current		I <sub>IN</sub>	V <sub>IN</sub> = 0~3.6 V		1.8	—	±5.0	μA
Power Off Leakage Current		I <sub>OFF</sub>	V <sub>IN</sub> , V <sub>OUT</sub> = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		1.8	—	20.0	μA
			V <sub>CC</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V		1.8	—	±20.0	

AC characteristics (Ta = -40~85°C, Input t<sub>r</sub> = t<sub>f</sub> = 2.0 ns, C<sub>L</sub> = 30 pF, R<sub>L</sub> = 500 Ω)

PARAMETER		SYMBOL	TEST CONDITION		VCC (V)	MIN.	MAX.	UNIT
					1.8			
Propagation Delay Time	t <sub>pLH</sub> t <sub>pHL</sub>	(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<sub>L</sub> = 50 pF, add approximately 300 ps to the AC maximum specification.

Dynamic switching characteristics (Ta = 25°C, Input t<sub>r</sub> = t<sub>f</sub> = 2.0 ns, C<sub>L</sub> = 30 pF)

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

(Note 11) : Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

PARAMETER	SYMBOL	TEST CONDITION	V <sub>CC</sub> (V)	TYP.	UNIT
			1.8, 2.5, 3.3		
Input Capacitance	C <sub>IN</sub>	—	1.8, 2.5, 3.3	6	pF
Power Dissipation Capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz (Note 12)	1.8, 2.5, 3.3	20	pF

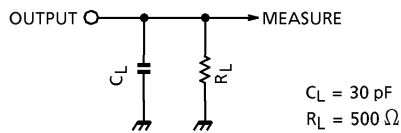
(Note 12) : C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

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

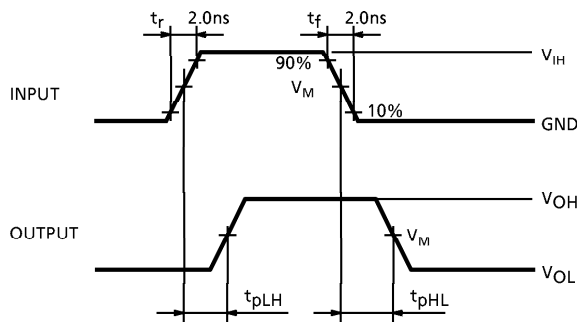
**TEST CIRCUIT**

Fig.1



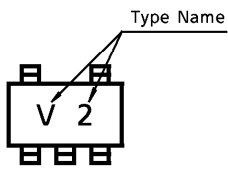
**AC WAVEFORM**

Fig.2 t<sub>pLH</sub>, t<sub>pHL</sub>

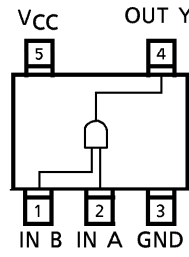


SYMBOL	V <sub>CC</sub>		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V <sub>IH</sub>	2.7 V	V <sub>CC</sub>	V <sub>CC</sub>
V <sub>M</sub>	1.5 V	V <sub>CC</sub> /2	V <sub>CC</sub> /2

**MARKING**



**PIN ASSIGNMENT (TOP VIEW)**



**TRUTH TABLE**

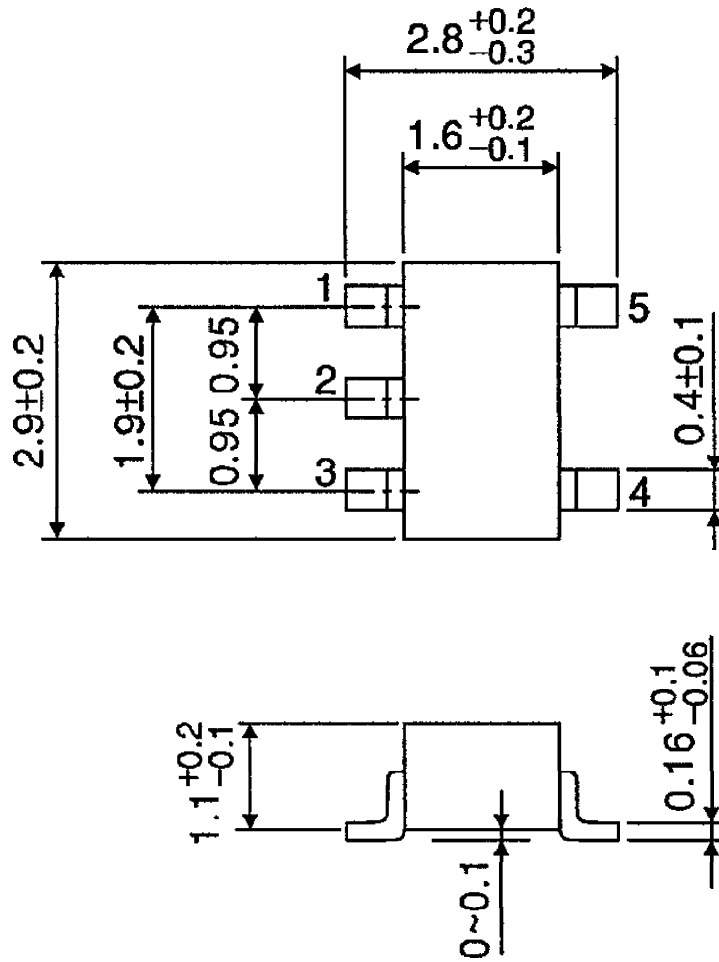
INPUTS		OUTPUTS
A	B	Y
L	L	L
L	H	L
H	L	L
H	H	H

**LOGIC DIAGRAM**



PACKAGE DIMENSIONS  
SSOP5-P-0.95

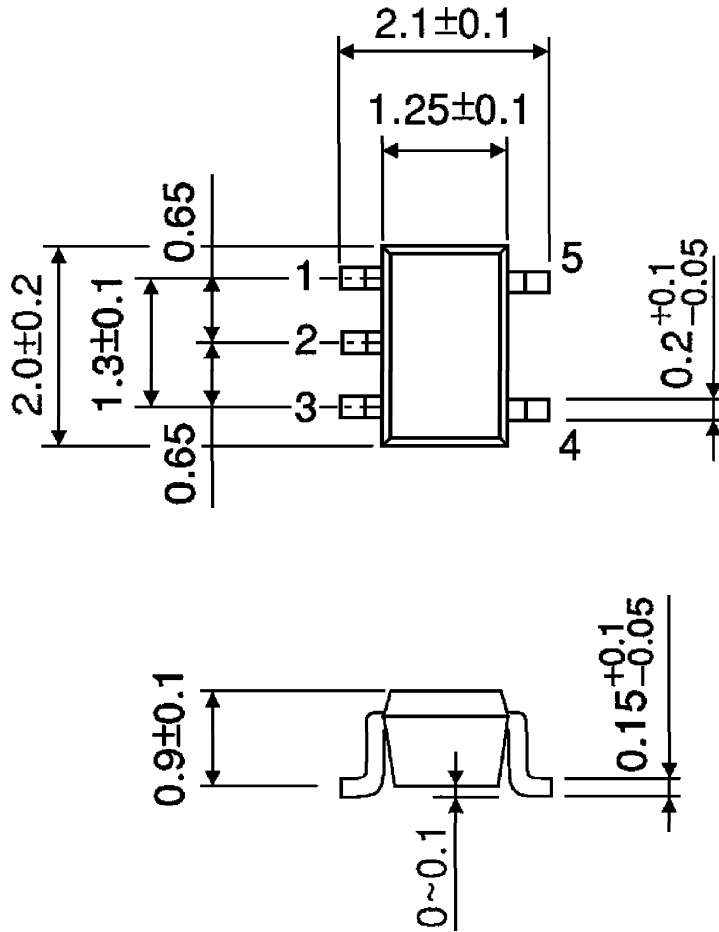
Unit : mm



Weight : 0.016 g (Typ.)

PACKAGE DIMENSIONS  
SSOP5-P-0.65A

Unit : mm



Weight : 0.006 g (Typ.)