

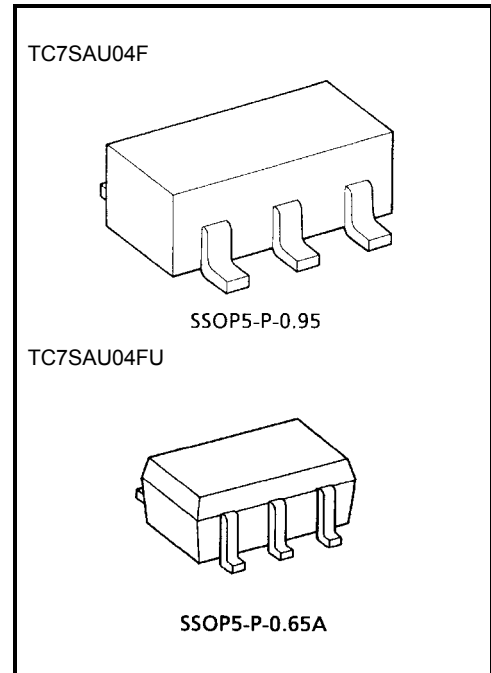
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SAU04F, TC7SAU04FU

Inverter (unbuffer) with 3.6 V Tolerant Input

Features

- Low voltage operation : $V_{CC} = 1.8\sim 3.6\text{ V}$
- Low power disipation : $I_{CC} < 20\ \mu\text{A}$ (max)
- $(V_{CC} = 3.6\text{ V}, T_a = -40\sim 85^\circ\text{C})$
- High speed operation : $t_{pd} = 3.5\text{ ns}$ (max) ($V_{CC} = 3.0\sim 3.6\text{ V}$)
 : $t_{pd} = 4.2\text{ ns}$ (max) ($V_{CC} = 2.3\sim 2.7\text{ V}$)
 : $t_{pd} = 8.4\text{ ns}$ (max) ($V_{CC} = 1.8\text{ V}$)
- High Output current : $I_{OH}/I_{OL} = \pm 24\text{ mA}$ (min) ($V_{CC} = 3.0\text{ V}$)
 : $I_{OH}/I_{OL} = \pm 18\text{ mA}$ (min) ($V_{CC} = 2.3\text{ V}$)
 : $I_{OH}/I_{OL} = \pm 6\text{ mA}$ (min) ($V_{CC} = 1.8\text{ V}$)
- Latch-up performance : $\pm 300\text{ mA}$ or more
- ESD performance : Human body model $> \pm 200\text{ V}$
 : Machine model $> \pm 2000\text{ V}$
- Power down protection is provided on all inputs and outputs.



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

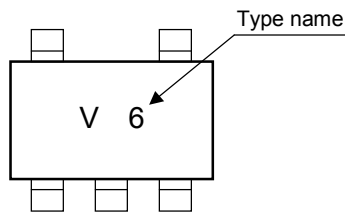
Maximum Ratings ($T_a = 25^\circ\text{C}$)

Characteristics	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}	$-0.5\sim V_{CC} + 0.5$ (Note 1)	V
Input diode current	I_{IK}	-50	mA
Output diode current	I_{OK}	± 50 (Note 2)	mA
DC output current	I_{OUT}	± 50	mA
Power dissipation	P_D	200	mW
DC V_{CC} /ground current	I_{CC}	± 100	mA
Storage temperature range	T_{stg}	$-65\sim 150$	$^\circ\text{C}$

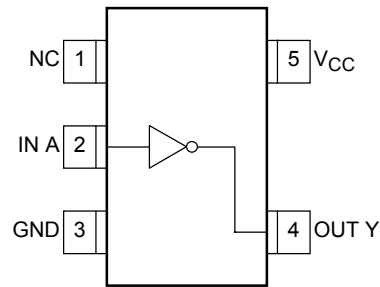
Note 1: High or low state. I_{OUT} absolute maximum rating be observed.

Note 2: $V_{OUT} < \text{GND}$, $V_{OUT} > V_{CC}$

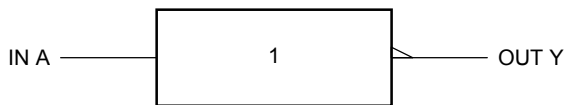
Marking



Pin Assignment (top view)



Logic Diagram



Truth Table

A	Y
L	H
H	L

Recommended Operating Range

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 3)	
Input voltage	V_{IN}	-0.3~3.6	V
Output voltage	V_{OUT}	0~ V_{CC} (Note 4)	V
Output current	I_{OH}/I_{OL}	± 24 (Note 5)	mA
		± 18 (Note 6)	
		± 6 (Note 7)	
Operating temperature range	T_{opr}	-40~85	$^{\circ}C$
Input rise and fall time	dt/dv	0~10 (Note 8)	ns/V

Note 3: Data retention only

Note 4: High or low state

Note 5: $V_{CC} = 3.0\sim 3.6$ V

Note 6: $V_{CC} = 2.3\sim 2.7$ V

Note 7: $V_{CC} = 1.8$ V

Note 8: $V_{IN} = 0.8\sim 2.0$ V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics (Ta = -40~85°C)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		1.8	0.85 × V _{CC}	—	V
					2.3~3.6	0.8 × V _{CC}	—	
	Low level	V _{IL}	—		1.8	—	0.15 × V _{CC}	
					2.3~3.6	—	0.2 × V _{CC}	
Output voltage	High level	V _{OH}	V _{IN} = V _{IL}	I _{OH} = -100 μA	1.8~3.6	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	1.8	1.4	—	
				I _{OH} = -12 mA	2.3	1.8	—	
				I _{OH} = -18 mA	2.3	1.7	—	
				I _{OH} = -12 mA	2.7	2.2	—	
				I _{OH} = -18 mA	3.0	2.4	—	
				I _{OH} = -24 mA	3.0	2.2	—	
	Low level	V _{OL}	V _{IN} = V _{IH}	I _{OL} = 100 μA	1.8~3.6	—	0.2	
				I _{OL} = 6 mA	1.8	—	0.3	
				I _{OL} = 12 mA	2.3	—	0.4	
				I _{OL} = 18 mA	2.3	—	0.6	
				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
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	

AC Characteristics (Ta = -40~85°C, input: tr = tf = 2.0 ns, CL = 30 pF, RL = 500 Ω)

Characteristics	Symbol	Test Condition	VCC (V)	Min	Max	Unit
			1.8	1.0	8.4	ns
2.5 ± 0.2	0.8	4.2				
3.3 ± 0.3	0.6	3.5				

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

Dynamic Switching Characteristics (Ta = 25°C, input: tr = tf = 2.0 ns, CL = 30 pF)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
			1.8	0.25	ns
2.5	0.6				
3.3	0.8				
Quiet output minimum dynamic VOL	VOLV	VIN = 1.8 V, VIL = 0 V (Note 9)	1.8	-0.25	ns
		VIN = 2.5 V, VIL = 0 V (Note 9)	2.5	-0.6	
		VIN = 3.3 V, VIL = 0 V (Note 9)	3.3	-0.8	
Quiet output minimum dynamic VOH	VOLP	VIN = 1.8 V, VIL = 0 V (Note 9)	1.8	1.5	ns
		VIN = 2.5 V, VIL = 0 V (Note 9)	2.5	1.9	
		VIN = 3.3 V, VIL = 0 V (Note 9)	3.3	2.2	

Note 9: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
			1.8, 2.5, 3.3	4	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note 10)	1.8, 2.5, 3.3	7	pF

Note 10: 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.

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

AC Test Circuit

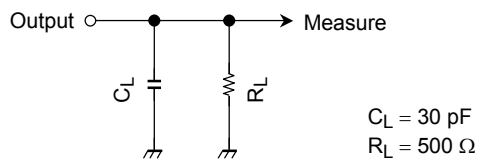
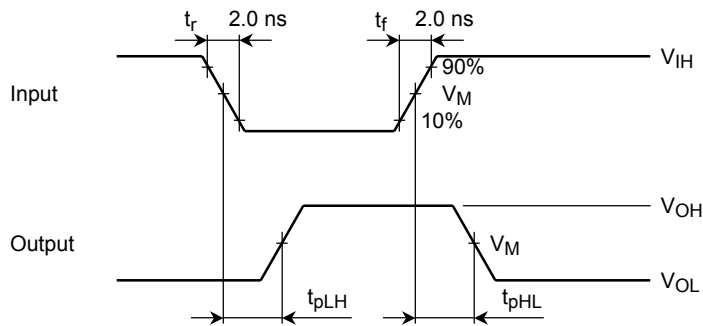


Figure 1

AC Waveform



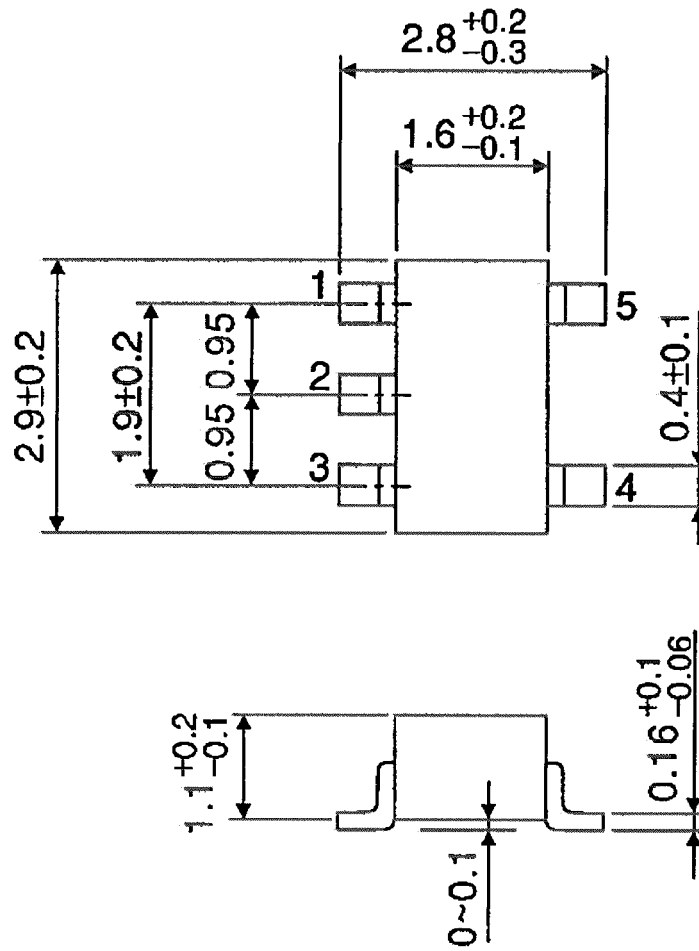
Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$

Figure 2 t_{pLH} , t_{pHL}

Package Dimensions

SSOP5-P-0.95

Unit : mm

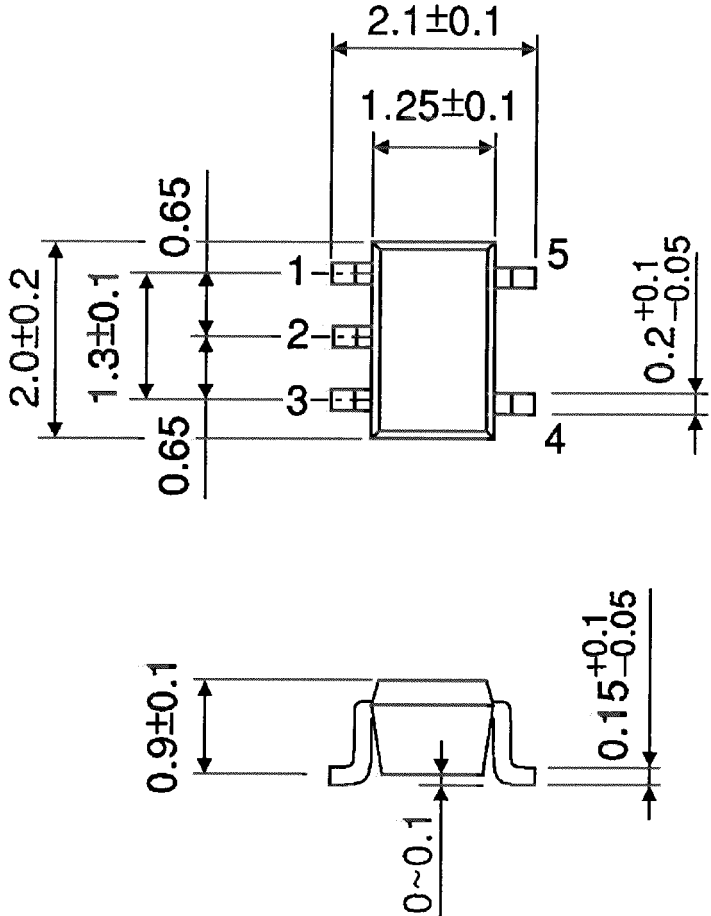


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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