

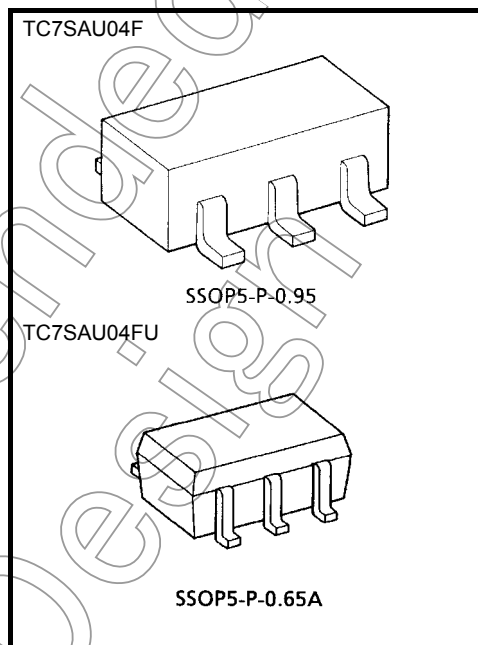
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SAU04F, TC7SAU04FU

Inverter (Un-Buffer)

Features

- Low voltage operation : $V_{CC} = 1.8 \sim 3.6 \text{ V}$
- 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 : $I_{OH}/I_{OL} = \pm 24 \text{ mA (min)} (V_{CC} = 3.0 \text{ V})$
 $I_{OH}/I_{OL} = \pm 18 \text{ mA (min)} (V_{CC} = 2.3 \text{ V})$
 $I_{OH}/I_{OL} = \pm 6 \text{ mA (min)} (V_{CC} = 1.8 \text{ V})$
- 3.6-V tolerant input



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

Absolute 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}	$-65 \sim 150$	$^\circ\text{C}$

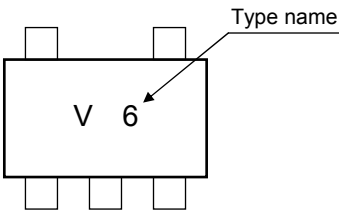
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

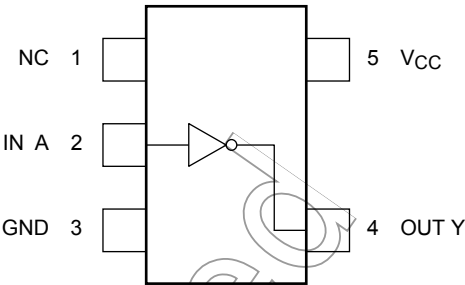
Note 1: High or low state. I_{OUT} absolute maximum rating must be observed.

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

Operating Ranges

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	°C

Note 3: Data retention only

Note 4: High or low state

Note 5: V_{CC} = 3.0~3.6 V

Note 6: V_{CC} = 2.3~2.7 V

Note 7: V_{CC} = 1.8 V

Electrical Characteristics

DC Characteristics (Ta = -40~85°C)

Characteristics		Symbol	Test Condition		Min	Max	Unit	
					V _{CC} (V)			
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}) ≤ 3.6 V	2.7~3.6	—	±20.0		

AC Characteristics (Ta = -40~85°C, input: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500$ Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time	t_{pLH} t_{pHL}	Figure 1, Figure 2	1.8	1.0	8.4	ns
			2.5 ± 0.2	0.8	4.2	
			3.3 ± 0.3	0.6	3.5	

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)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	$V_{IN} = 1.8$ V, $V_{IL} = 0$ V (Note 8)	1.8	0.25	V
		$V_{IN} = 2.5$ V, $V_{IL} = 0$ V (Note 8)	2.5	0.6	
		$V_{IN} = 3.3$ V, $V_{IL} = 0$ V (Note 8)	3.3	0.8	
Quiet output minimum dynamic V_{OL}	V_{OLV}	$V_{IN} = 1.8$ V, $V_{IL} = 0$ V (Note 8)	1.8	-0.25	V
		$V_{IN} = 2.5$ V, $V_{IL} = 0$ V (Note 8)	2.5	-0.6	
		$V_{IN} = 3.3$ V, $V_{IL} = 0$ V (Note 8)	3.3	-0.8	
Quiet output minimum dynamic V_{OH}	V_{OHV}	$V_{IN} = 1.8$ V, $V_{IL} = 0$ V (Note 8)	1.8	1.5	V
		$V_{IN} = 2.5$ V, $V_{IL} = 0$ V (Note 8)	2.5	1.9	
		$V_{IN} = 3.3$ V, $V_{IL} = 0$ V (Note 8)	3.3	2.2	

Note8: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}	—	1.8, 2.5, 3.3	4	pF
Power dissipation capacitance	C_{PD}	$f_{IN} = 10$ MHz (Note 9)	1.8, 2.5, 3.3	7	pF

Note 9: 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

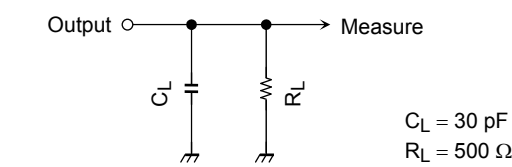


Figure 1

AC Waveforms

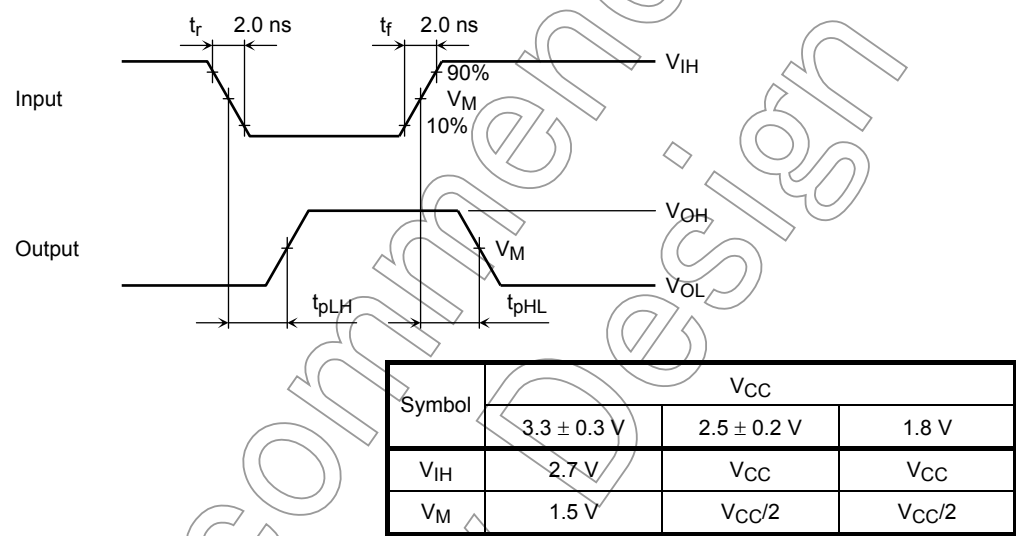
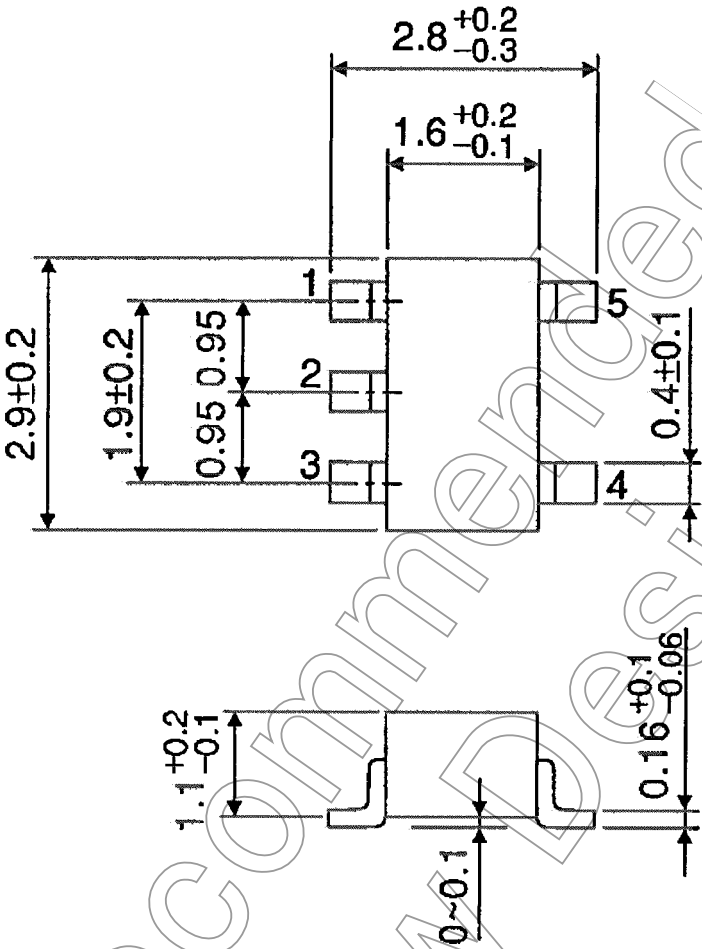


Figure 2 t_{PLH} , t_{PHL}

Package Dimensions

SSOP5-P-0.95

Unit : mm

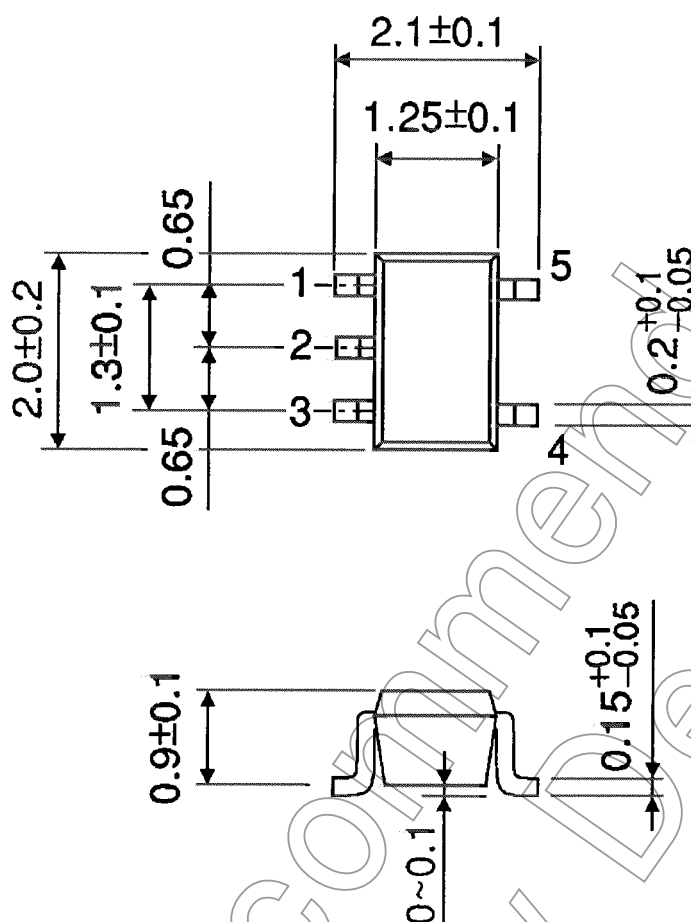


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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