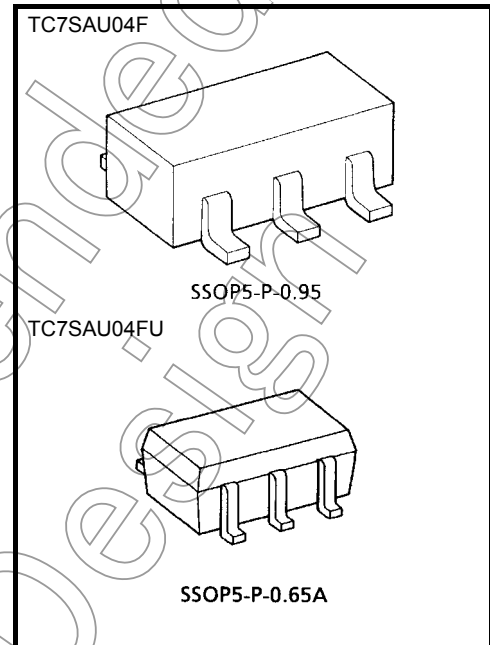


# TC7SAU04F, TC7SAU04FU

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 (Ta = 25°C)

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

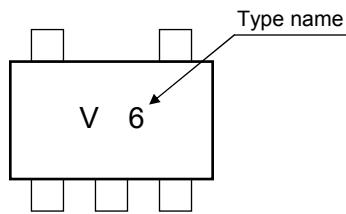
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

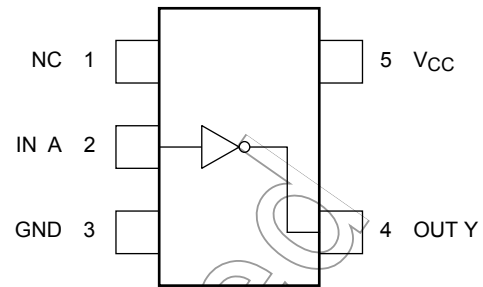
Note 1: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

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

## 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:  $V_{CC} = 3.0\sim 3.6\text{ V}$

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

Note 7:  $V_{CC} \neq 1.8\text{ V}$

## Electrical Characteristics

### DC Characteristics (Ta = -40~85°C)

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit	
Input voltage	High level	V <sub>IH</sub>	—	1.8	0.85 × V <sub>CC</sub>	—	V	
				2.3~3.6	0.8 × V <sub>CC</sub>	—		
	Low level	V <sub>IL</sub>		1.8	—	0.15 × V <sub>CC</sub>		
				2.3~3.6	—	0.2 × V <sub>CC</sub>		
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -100 μA	1.8~3.6	V <sub>CC</sub> - 0.2	—	
				I <sub>OH</sub> = -6 mA	1.8	1.4	—	
				I <sub>OH</sub> = -12 mA	2.3	1.8	—	
				I <sub>OH</sub> = -18 mA	2.3	1.7	—	
				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	—	
	Low level	V <sub>OL</sub>		V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 100 μA	1.8~3.6	—	0.2
					I <sub>OL</sub> = 6 mA	1.8	—	0.3
					I <sub>OL</sub> = 12 mA	2.3	—	0.4
					I <sub>OL</sub> = 18 mA	2.3	—	0.6
					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
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> ) ≧ 3.6 V		2.7~3.6	—	±20.0	

Not for New

**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	V
2.5	0.6				
3.3	0.8				
Quiet output minimum dynamic VOL	VOLV	VIN = 1.8 V, VIL = 0 V (Note 8)	1.8	-0.25	V
		VIN = 2.5 V, VIL = 0 V (Note 8)	2.5	-0.6	
		VIN = 3.3 V, VIL = 0 V (Note 8)	3.3	-0.8	
Quiet output minimum dynamic VOH	VOHV	VIN = 1.8 V, VIL = 0 V (Note 8)	1.8	1.5	V
		VIN = 2.5 V, VIL = 0 V (Note 8)	2.5	1.9	
		VIN = 3.3 V, VIL = 0 V (Note 8)	3.3	2.2	

Note8: Parameter guaranteed by design.

**Capacitive Characteristics (Ta = 25°C)**

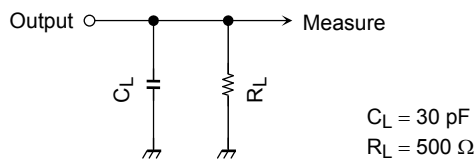
Characteristics	Symbol	Test Condition	VCC (V)	Typ.	Unit
			1.8, 2.5, 3.3	4	pF
Power dissipation capacitance	CPD	fIN = 10 MHz (Note 9)	1.8, 2.5, 3.3	7	pF

Note 9: CPD 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.

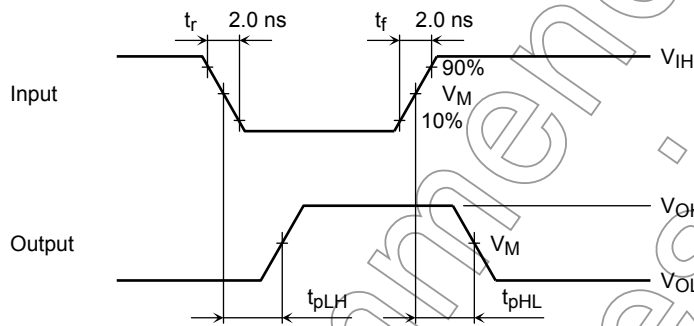
$$I_{CC (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

**AC Test Circuit**



**Figure 1**

**AC Waveforms**



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	$V_{CC}/2$	$V_{CC}/2$

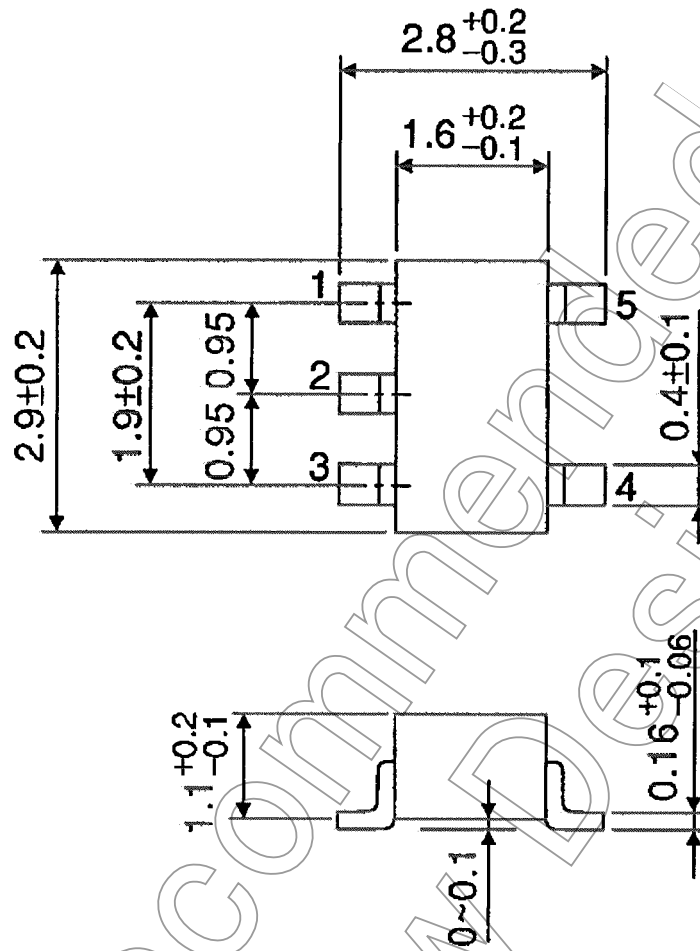
**Figure 2  $t_{pLH}$ ,  $t_{pHL}$**

Not Recommended for New Design

## Package Dimensions

SSOP5-P-0.95

Unit : mm



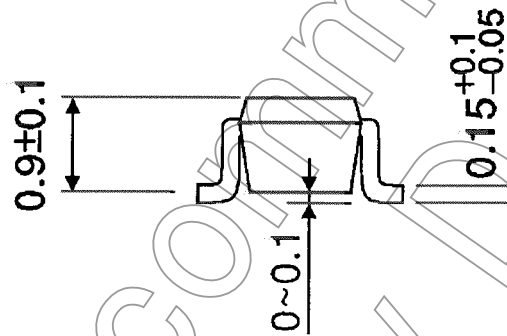
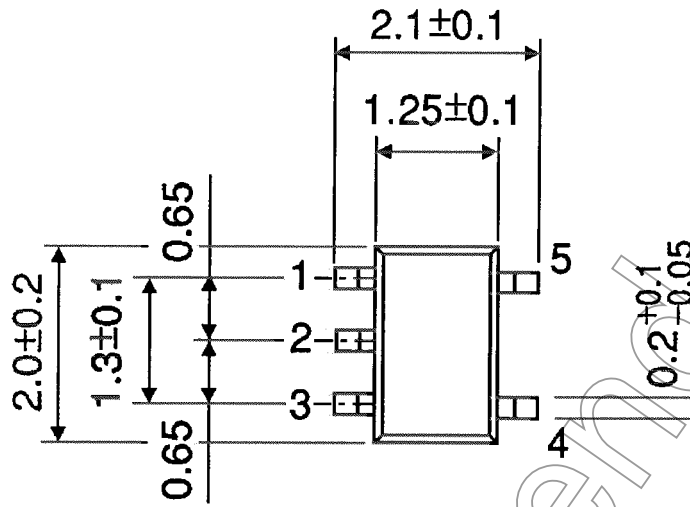
Weight: 0.016 g (typ.)

Not Recommended for New Design

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

Not Recommended for New Design

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