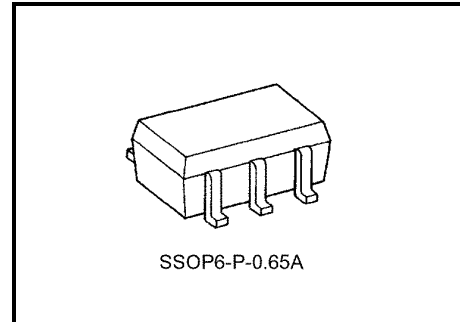


# TC7PAU04FU

Dual Inverter (unbuffer) with 3.6 V Tolerant Input

## Features

- Low voltage operation:  $V_{CC} = 1.8\sim 3.6\text{ V}$
- Quiescent supply current:  $I_{CC} < 20\ \mu\text{A}$  (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:  $\pm 300\text{ mA}$
- ESD Performance:  $\pm 200\text{ V}$  (JEITA)  
 $\pm 2000\text{ V}$  (MIL)
- 3.6 V tolerant function for input and power down protection are provided.



Weight: 0.0068 g (typ.)

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

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
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 100$	mA
Power dissipation	$P_D$	200	mW
Storage temperature	$T_{stg}$	-65~150	$^\circ\text{C}$

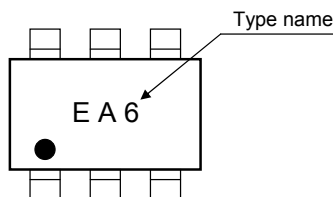
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

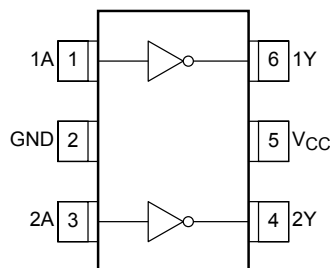
Note 1: Date retention only

Note 2: High or low state.  $V_{OUT}$  absolute maximum rating must be observed.

## Marking



## Pin Assignment (top view)



**Logic Diagram**



**Truth Table**

A	Y
L	H
H	L

**Operating Ranges**

Characteristics	Symbol	Rating	Unit
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	$I_{OH}/I_{OL}$	$\pm 24$ (Note 5)	mA
		$\pm 18$ (Note 6)	
		$\pm 6$ (Note 7)	
Operating temperature	$T_{opr}$	-40~85	°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:  $V_{CC} = 3.0$  V

## Electrical Characteristics

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

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit	
Input voltage	"H" level	V <sub>IH</sub>	—	1.8	0.85 × V <sub>CC</sub>	—	V	
				2.3~3.6	0.8 × V <sub>CC</sub>	—		
	"L" 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	"H" 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	—	V
				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	—	
	"L" 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>OH</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> , V <sub>OUT</sub> ) ≤ 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
Propagation delay time	t <sub>pLH</sub> t <sub>pHL</sub>	(Fig.1, 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 CL = 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
Quiet output maximum dynamic VOL	VOLP	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 maximum 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 maximum dynamic VOH	VOHP	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
Input capacitance	CIN	—	1.8, 2.5, 3.3	4	pF
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz (Note 10)	1.8, 2.5, 3.3	7	pF

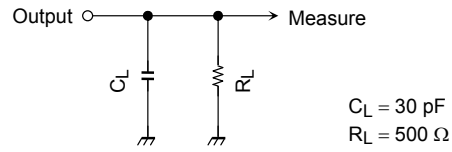
Note 10: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$$

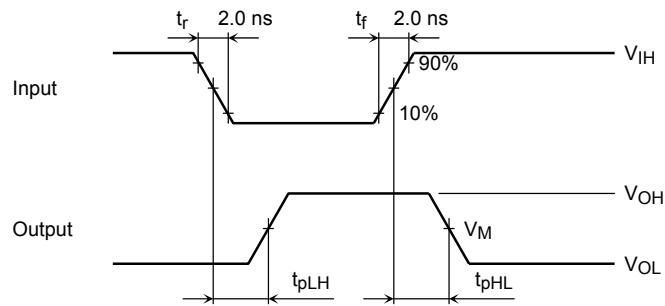
**Test Circuit**

**Figure 1**



**AC Waveform**

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

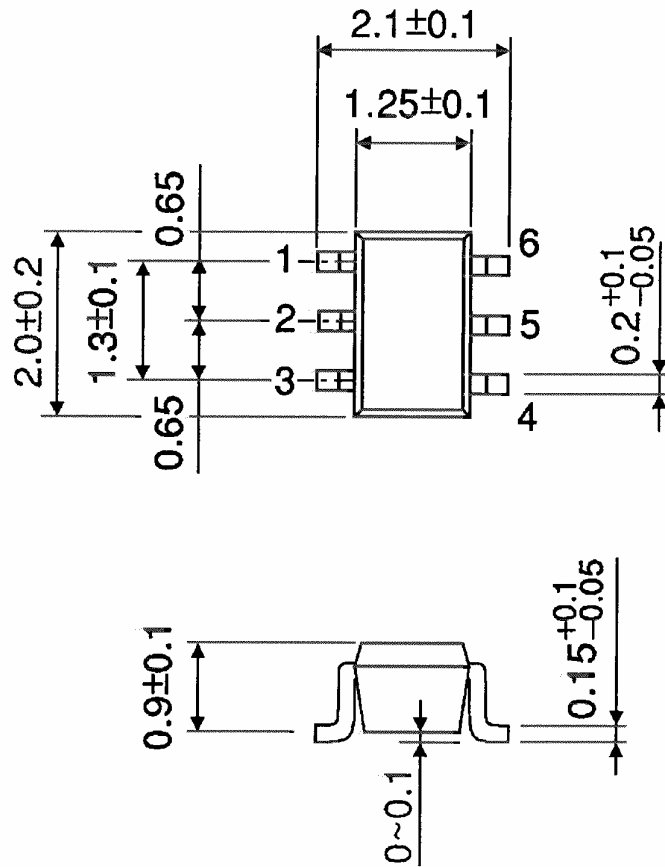


Symbol	$V_{CC}$		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
$V_{IH}$	2.7 V	$V_{CC}$	$V_{CC}$
$V_M$	1.5 V	$V_{CC}/2$	$V_{CC}/2$

## Package Dimensions

SSOP6-P-0.65A

Unit: mm



Weight: 0.0068 g (typ.)

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20070701-EN GENERAL

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