

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

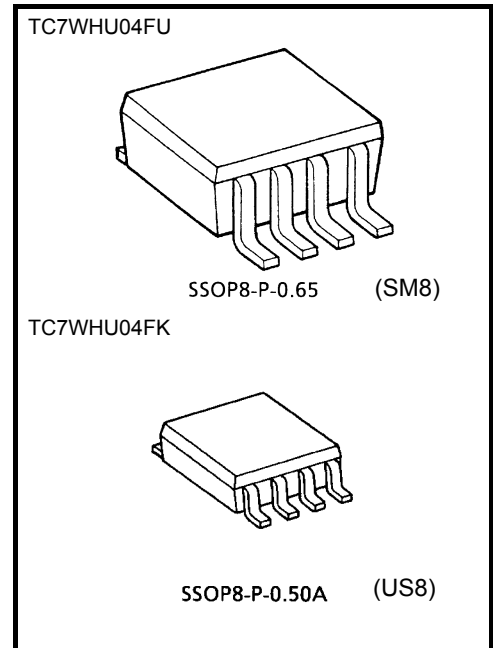
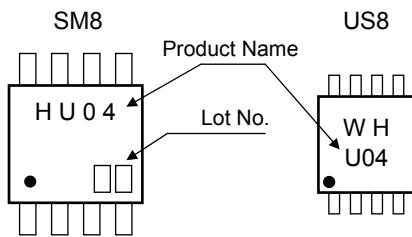
# TC7WHU04FU, TC7WHU04FK

Triple Inverter(Un-Buffer)

## Features

- High speed:  $t_{pd} = 3.5 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$ ,  $C_L = 15\text{pF}$
- Low power dissipation:  $I_{CC} = 2 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 10\% V_{CC}$  (min)
- 5.5-V Tolerant inputs.
- Wide operating voltage range:  $V_{CC} = 2\text{to}5.5 \text{ V}$
- Balanced propagation delays :  $t_{pLH} \approx t_{pHL}$
- Identical pin assignment and function with TC7WU04

## Marking

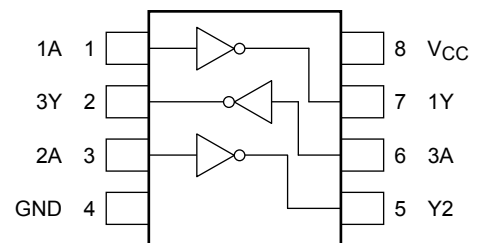


Weight  
 SSOP8-P-0.65: 0.02 g (typ.)  
 SSOP8-P-0.50A: 0.01 g (typ.)

## Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note1)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	300 (SM8) 200 (US8)	mW
Storage temperature	$T_{stg}$	-65 to 150	°C
Lead temperature (10 s)	$T_L$	260	°C

## Pin Assignment (top view)



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).

Note1:  $V_{OUT} < GND, V_{OUT} > V_{CC}$

## IEC Logic Symbol



## Truth Table

A	Y
L	H
H	L

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2.0 to 5.5	V
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 100 ( $V_{CC} = 3.3 \pm 0.3$ V)	ns/V
		0 to 20 ( $V_{CC} = 5.0 \pm 0.5$ V)	

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0	1.7	—	—	1.7	—	V
				3.0 to 5.5	V <sub>CC</sub> × 0.8	—	—	V <sub>CC</sub> × 0.8	—	
Low-level input voltage	V <sub>IL</sub>	—		2.0	—	—	0.3	—	0.3	V
				3.0 to 5.5	—	—	V <sub>CC</sub> × 0.2	—	V <sub>CC</sub> × 0.2	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	2.0	1.8	2.0	—	1.8	—	V
				3.0	2.7	3.0	—	2.7	—	
				4.5	4.4	4.5	—	4.0	—	
		V <sub>IN</sub> = GND	I <sub>OH</sub> = -4 mA	3.0	2.58	—	—	2.48	—	
I <sub>OH</sub> = -8 mA	4.5		3.94	—	—	3.80	—			
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 50 μA	2.0	—	0.0	0.2	—	0.2	V
				3.0	—	0.0	0.3	—	0.3	
				4.5	—	0.0	0.5	—	0.5	
		V <sub>IN</sub> = V <sub>CC</sub>	I <sub>OL</sub> = 4 mA	3.0	—	—	0.36	—	0.44	
I <sub>OL</sub> = 8 mA	4.5		—	—	0.36	—	0.44			
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND		0 to 5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		5.5	—	—	2.0	—	20.0	μA

## AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max	Min	Max		
Propagation delay time	t <sub>pLH</sub> t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	5.0	8.9	1.0	10.5	ns
				50	—	7.5	11.4	1.0	13.0	
			5.0 ± 0.5	15	—	3.5	5.5	1.0	6.5	
				50	—	5.0	7.0	1.0	8.0	
Input capacitance	C <sub>IN</sub>	—		—	5	10	—	10	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note2)		—	11	—	—	—	pF	

Note 2: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

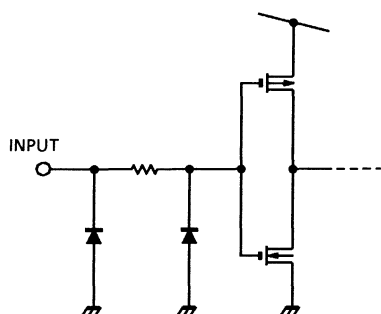
Average operating current can be obtained by the equation:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/3$$

## Noise Characteristics (Ta = 25°C, input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Limit	Unit
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-0.3	-0.8	V
Minimum high level dynamic V <sub>IH</sub>	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0	—	4.0	V
Maximum low level dynamic V <sub>IH</sub>	V <sub>ILD</sub>	C <sub>L</sub> = 50 pF	5.0	—	1.0	V

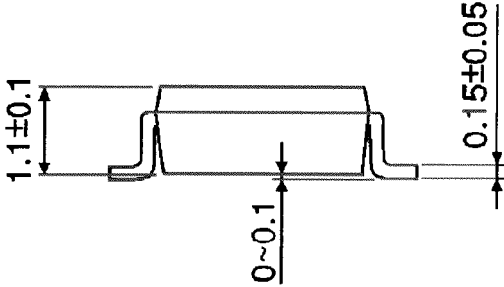
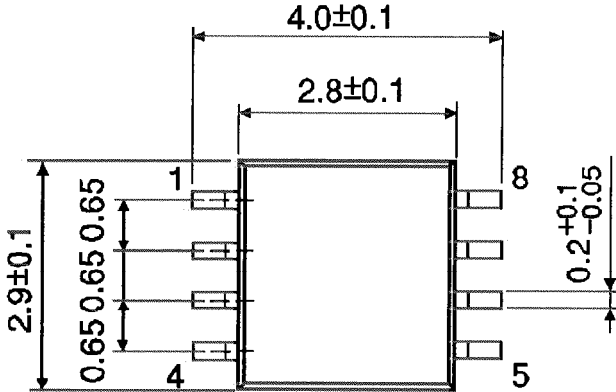
## Input Equivalent Circuit



**Package Dimensions**

SSOP8-P-0.65

Unit : mm



Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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