

# TC7WU04F,TC7WU04FU,TC7WU04FK

## 3 Inverters

The TC7WU04 is a high speed C<sup>2</sup>MOS Inverter fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the C<sup>2</sup>MOS low power dissipation.

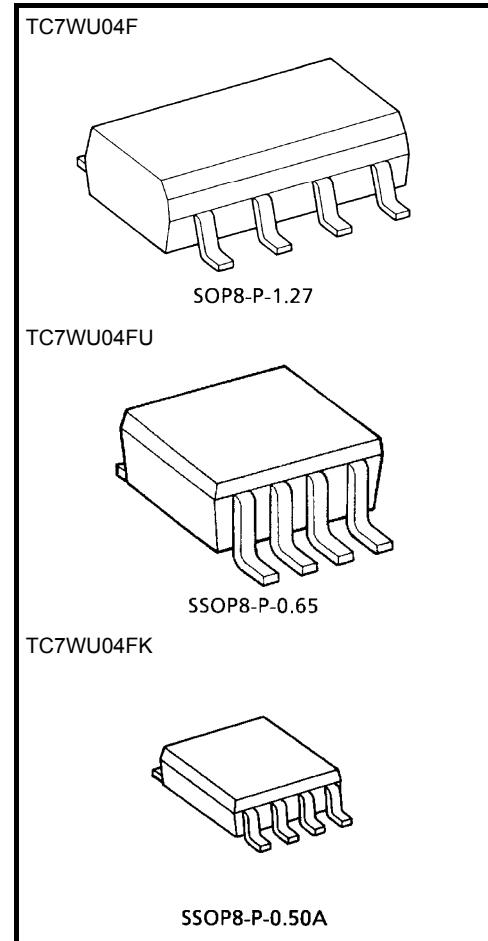
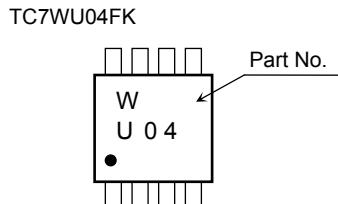
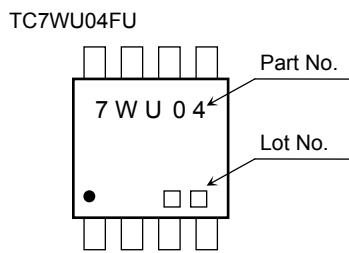
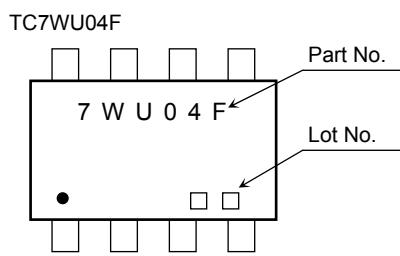
As the internal circuit is composed of single stage inverter, it can be applied for crystal oscillation.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## Features

- High speed:  $t_{pd} = 6$  ns (typ.) at  $V_{CC} = 4.5$  V
- Low power dissipation:  $I_{CC} = 1$   $\mu$ A (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 10\%$   $V_{CC}$  (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4$  mA (min)
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC}$  (opr) = 2 to 6 V

## Marking



### Weight

SOP8-P-1.27: 0.05 g (typ.)  
SSOP8-P-0.65: 0.02 g (typ.)  
SSOP8-P-0.50A: 0.01 g (typ.)

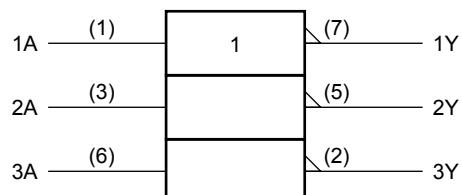
## Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V <sub>CC</sub>	-0.5 to 7	V
DC input voltage	V <sub>IN</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
DC output voltage	V <sub>OUT</sub>	-0.5 to V <sub>CC</sub> + 0.5	V
Input diode current	I <sub>IK</sub>	±20	mA
Output diode current	I <sub>OK</sub>	±20	mA
DC output current	I <sub>OUT</sub>	±25	mA
DC V <sub>CC</sub> /ground current	I <sub>CC</sub>	±25	mA
Power dissipation	P <sub>D</sub>	300 (FM8, SM8) 200 (US8)	mW
Storage temperature range	T <sub>STG</sub>	-65 to 150	°C
Lead temperature (10 s)	T <sub>L</sub>	260	°C

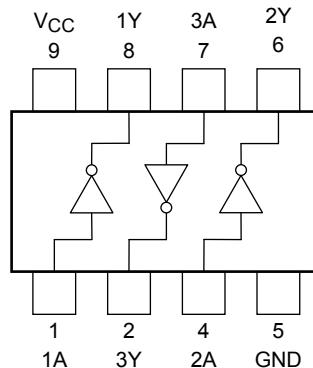
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.)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

## Logic Diagram



## Pin Configuration (top view)



## Truth Table

A	Y
L	H
H	L

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	V <sub>CC</sub>	2 to 6	V
Input voltage	V <sub>IN</sub>	0 to V <sub>CC</sub>	V
Output voltage	V <sub>OUT</sub>	0 to V <sub>CC</sub>	V
Operating temperature range	T <sub>opr</sub>	-40 to 85	°C

## Electrical Characteristics

## DC Electrical Characteristics

Characteristics		Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		
Input voltage	High level	V <sub>IH</sub>	—	2.0	1.7	—	—	1.7	—	
				4.5	3.6	—	—	3.6	—	
				6.0	4.8	—	—	4.8	—	
	Low level	V <sub>IL</sub>	—	2.0	—	—	0.3	—	0.3	
				4.5	—	—	0.9	—	0.9	
				6.0	—	—	1.2	—	1.2	
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -20 μA	2.0	1.8	2.0	—	1.8	—
					4.5	4.0	4.5	—	4.0	—
					6.0	5.5	5.9	—	5.5	—
			V <sub>IN</sub> = GND	I <sub>OH</sub> = -4 mA	4.5	4.18	4.31	—	4.13	—
					6.0	5.68	5.80	—	5.63	—
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 20 μA	2.0	—	0	0.2	—	0.2
					4.5	—	0	0.5	—	0.5
					6.0	—	0.1	0.5	—	0.5
			V <sub>IN</sub> = V <sub>CC</sub>	I <sub>OL</sub> = 4 mA	4.5	—	0.17	0.26	—	0.33
				I <sub>OL</sub> = 5.2 mA	6.0	—	0.18	0.26	—	0.33
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	1.0	—	10.0	μA

AC Electrical Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C)

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			Min	Typ.	Max	
Output transition time	t <sub>TLH</sub> t <sub>THL</sub>	—	—	4	8	ns
Propagation delay time	t <sub>pLH</sub> t <sub>pHL</sub>	—	—	4	8	ns

AC Electrical Characteristics ( $C_L = 50 \text{ pF}$ , input  $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit	
			$V_{CC}$ (V)	Min	Typ.	Max	Min		
Output transition time	$t_{TLH}$ $t_{THL}$	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time	$t_{pLH}$ $t_{pHL}$	—	2.0	—	18	60	—	75	ns
			4.5	—	6	12	—	15	
			6.0	—	5	10	—	13	
Input capacitance	$C_{IN}$	—	—	—	9	15	—	15	pF
Power dissipation capacitance	$C_{PD}$	(Note)	—	—	13	—	—	—	pF

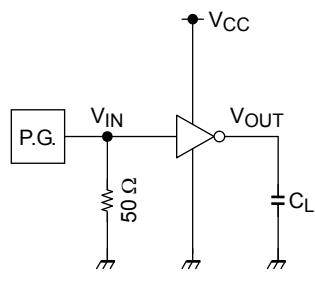
Note:  $C_{PD}$  is defined as the value of internal equivalent capacitance of IC which is calculated from the operating current consumption without load (refer to test circuit).

Average operating current can be obtained by the equation hereunder.

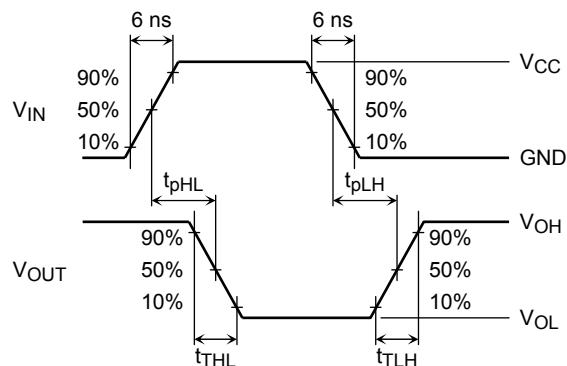
$$I_{CC \text{ (opr)}} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/3 \text{ (per gate)}$$

## Switching Characteristics

## Test Circuit

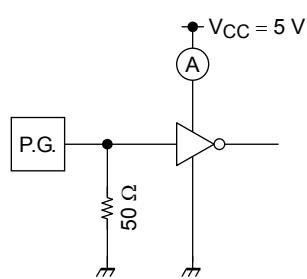


## Waveform



## Operating Current Consumption

## Test Circuit

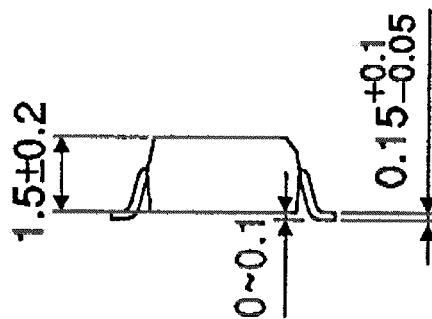
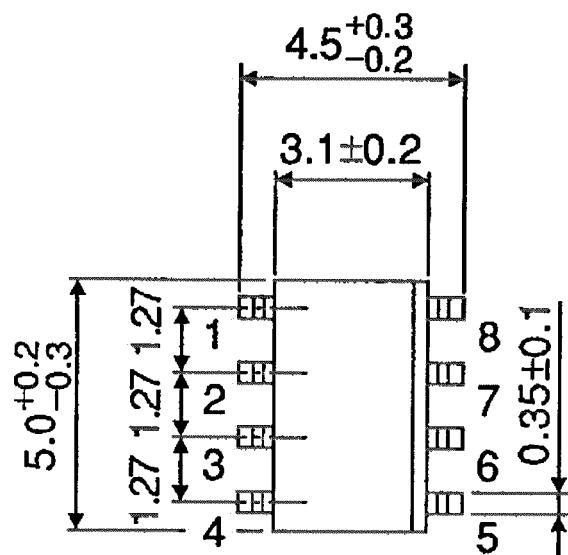


This input waveform is equal to the switching characteristics test circuit input waveform.

**Package Dimensions**

SOP8-P-1.27

Unit : mm

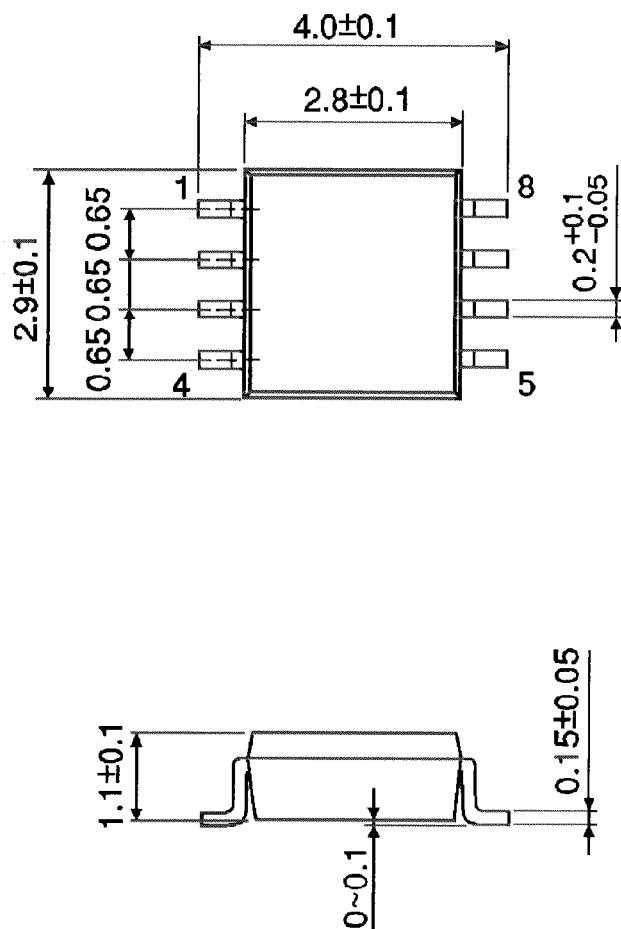


Weight: 0.05 g (typ.)

**Package Dimensions**

SSOP8-P-0.65

Unit : mm

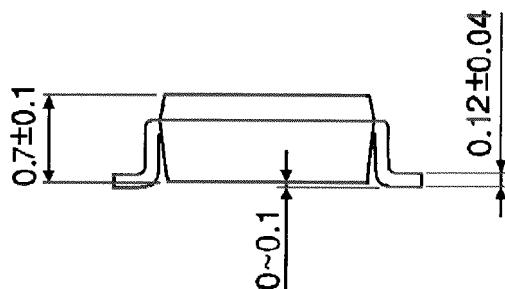
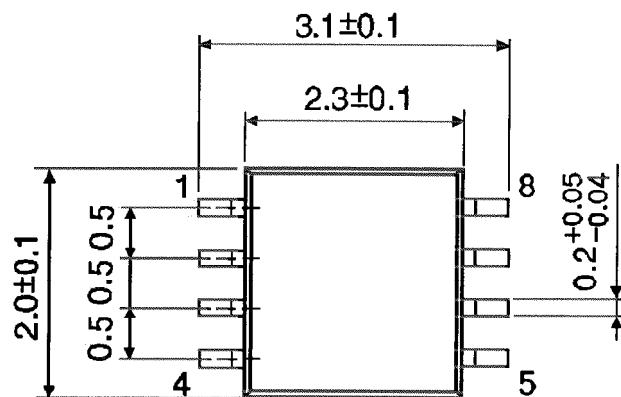


Weight: 0.02 g (typ.)

**Package Dimensions**

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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