

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

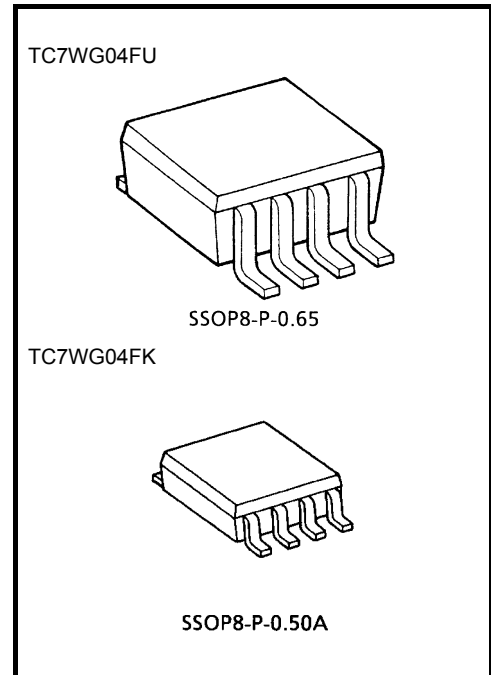
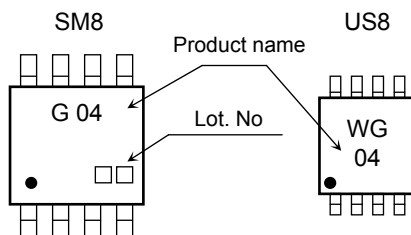
# TC7WG04FU, TC7WG04FK

Triple Inverter

## Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA}$  (min)  
at  $V_{CC} = 3 \text{ V}$
- High-speed operation:  $t_{pd} = 2.7 \text{ ns}$  (typ.)  
at  $V_{CC} = 3.3 \text{ V}, 15 \text{ pF}$
- Operating voltage range:  $V_{CC} = 0.9 \sim 3.6 \text{ V}$
- 5.5-V tolerant inputs
- 3.6-V power down protection outputs

## Marking



Weight

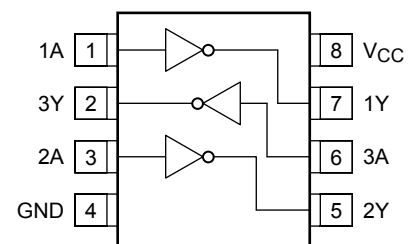
SSOP8-P-0.65 : 0.02 g (typ.)

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

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

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	$-0.5 \sim 4.6$	V
DC input voltage	$V_{IN}$	$-0.5 \sim 7.0$	V
DC output voltage	$V_{OUT}$	$-0.5 \sim 4.6$ (Note 1)	V
		$-0.5 \sim V_{CC} + 0.5$ (Note 2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	-20 (Note 3)	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	$T_{stg}$	$-65 \sim 150$	$^\circ\text{C}$

## 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).

Note 1:  $V_{CC} = 0 \text{ V}$

Note 2: High or Low State.  $I_{OUT}$  absolute maximum rating must be observed.

Note 3:  $V_{OUT} < \text{GND}$

IEC Logic Symbol



Truth Table

A	Y
L	H
H	L

Operating Ranges

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	0.9~3.6	V
Input voltage	$V_{IN}$	0~5.5	V
Output voltage	$V_{OUT}$	0~3.6 (Note 4)	V
		0~ $V_{CC}$ (Note 5)	
Output Current	$I_{OH}/I_{OL}$	±8.0 (Note 6)	mA
		±4.0 (Note 7)	
		±3.0 (Note 8)	
		±1.7 (Note 9)	
		±0.3 (Note 10)	
		±0.02 (Note 11)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dV	0~10 (Note 12)	ns/V

- Note 4:  $V_{CC} = 0V$
- Note 5: High or Low state
- Note 6:  $V_{CC} = 3.0\sim3.6\text{ V}$
- Note 7:  $V_{CC} = 2.3\sim2.7\text{ V}$
- Note 8:  $V_{CC} = 1.65\sim1.95\text{ V}$
- Note 9:  $V_{CC} = 1.4\sim1.6\text{ V}$
- Note 10:  $V_{CC} = 1.1\sim1.3\text{ V}$
- Note 11:  $V_{CC} = 0.9\text{ V}$
- Note 12:  $V_{IN} = 0.8\sim2.0\text{ V}$ ,  $V_{CC} = 3.0\text{ V}$

## Electrical Characteristics

## DC Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C				Ta = -40~85°C		Unit
					VCC (V)	Min	Typ.	Max	Min	Max	
Input voltage	High level	VIH	—		0.9	VCC	—	—	VCC	—	V
					1.1~1.3	VCC × 0.7	—	—	VCC × 0.7	—	
					1.4~1.6	VCC × 0.65	—	—	VCC × 0.65	—	
					1.65~ 1.95	VCC × 0.65	—	—	VCC × 0.65	—	
					2.3~2.7	1.7	—	—	1.7	—	
					3.0~3.6	2.0	—	—	2.0	—	
	Low level	VIL	—		0.9	—	—	GND	—	GND	
					1.1~1.3	—	—	VCC × 0.3	—	VCC × 0.3	
					1.4~1.6	—	—	VCC × 0.35	—	VCC × 0.35	
					1.65~ 1.95	—	—	VCC × 0.35	—	VCC × 0.35	
					2.3~2.7	—	—	0.7	—	0.7	
					3.0~3.6	—	—	0.8	—	0.8	
Output voltage	High level	VOH	VIN = VIL	I <sub>OH</sub> = -0.02 mA	0.9	0.75	—	—	0.75	—	V
				I <sub>OH</sub> = -0.3 mA	1.1~1.3	VCC × 0.75	—	—	VCC × 0.75	—	
				I <sub>OH</sub> = -1.7 mA	1.4~1.6	VCC × 0.75	—	—	VCC × 0.75	—	
				I <sub>OH</sub> = -3.0 mA	1.65~ 1.95	VCC -0.45	—	—	VCC -0.45	—	
				I <sub>OH</sub> = -4.0 mA	2.3~2.7	2.0	—	—	2.0	—	
				I <sub>OH</sub> = -8.0 mA	3.0~3.6	2.48	—	—	2.48	—	
	Low level	VOL	VIN = VIH	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	
				I <sub>OL</sub> = 0.3 mA	1.1~1.3	—	—	VCC × 0.25	—	VCC × 0.25	
				I <sub>OL</sub> = 1.7 mA	1.4~1.6	—	—	VCC × 0.25	—	VCC × 0.25	
				I <sub>OL</sub> = 3.0 mA	1.65~ 1.95	—	—	0.45	—	0.45	
				I <sub>OL</sub> = 4.0 mA	2.3~2.7	—	—	0.4	—	0.4	
				I <sub>OL</sub> = 8.0 mA	3.0~3.6	—	—	0.4	—	0.4	
Input leakage current		IIN	VIN = 0~5.5V	0~3.6	—	—	±0.1	—	±1.0	μA	
Power off leakage current		IOFF	VIN = 0~5.5V VOUT = 0~3.6V	0	—	—	1.0	—	10.0	μA	
Quiescent supply current		ICC	VIN = VCC or GND	3.6	—	—	1.0	—	10.0	μA	

AC Characteristics (Input:  $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min	Max
Propagation delay time	$t_{pLH}$ $t_{pHL}$	$C_L = 10 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	24.4	—	—	—
			1.1~1.3	—	11.6	21.7	1.0	40.5
			1.4~1.6	—	6.5	9.8	1.0	11.6
			1.65~1.95	—	4.9	7.0	1.0	7.6
			2.3~2.7	—	3.2	4.4	1.0	4.9
			3.0~3.6	—	2.4	3.5	1.0	4.1
		$C_L = 15 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	26.9	—	—	—
			1.1~1.3	—	12.7	24.2	1.0	42.1
			1.4~1.6	—	7.1	10.7	1.0	12.9
			1.65~1.95	—	5.3	7.5	1.0	7.7
			2.3~2.7	—	3.5	4.8	1.0	5.5
			3.0~3.6	—	2.7	3.8	1.0	4.4
		$C_L = 30 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	0.9	—	37.0	—	—	—
			1.1~1.3	—	17.1	33.9	1.0	64.1
			1.4~1.6	—	9.3	14.3	1.0	17.4
			1.65~1.95	—	6.9	9.8	1.0	10.2
			2.3~2.7	—	4.6	6.2	1.0	6.6
			3.0~3.6	—	3.7	4.8	1.0	5.2
Input capacitance	$C_{IN}$	—	3.6	—	3	—	—	pF
Power dissipation capacitance	$C_{PD}$	(Note 13)	0.9 ~ 3.6	—	10	—	—	pF

Note 13:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

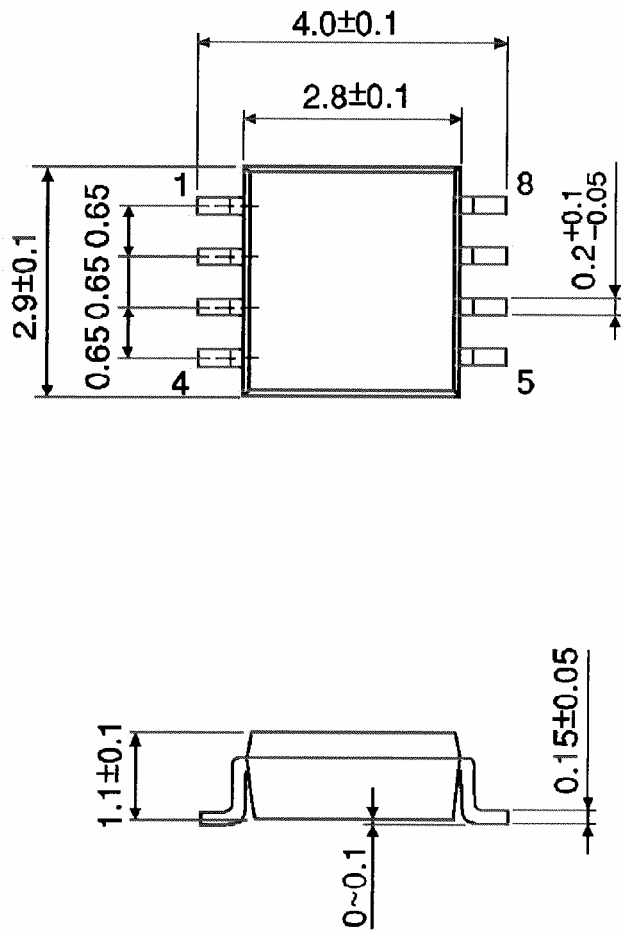
Average operating current can be obtained by the equation:

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

**Package Dimensions**

SSOP8-P-0.65

Unit : mm

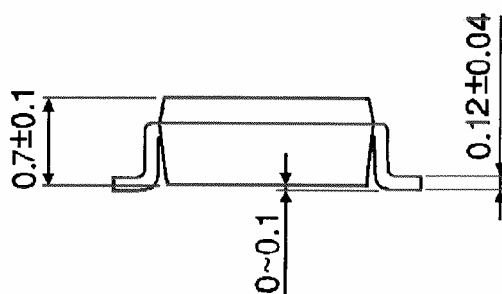
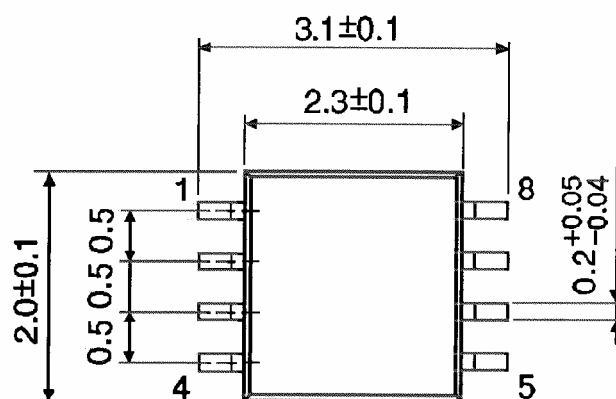


Weight: 0.02 g (typ.)

## Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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20070701-EN GENERAL

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