

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

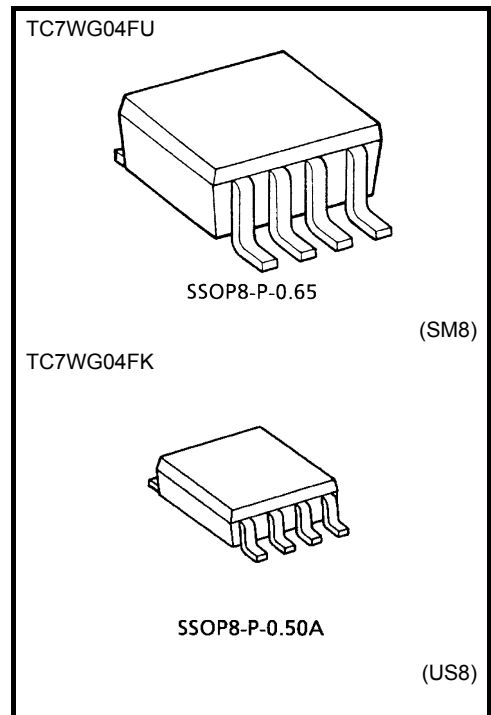
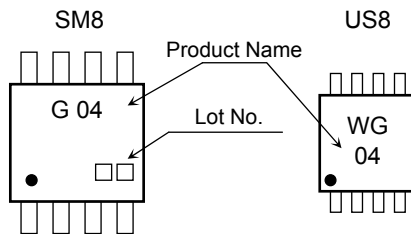
# TC7WG04FU, TC7WG04FK

## Triple Inverter

### Features

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

### Marking

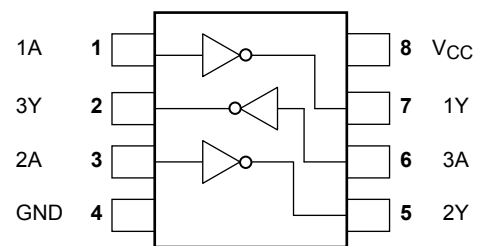


Weight  
 SSOP8-P-0.65 : 0.02 g (typ.)  
 SSOP8-P-0.50A : 0.01 g (typ.)

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

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	-0.5 to 4.6	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to 4.6 (Note1)	V
		-0.5 to $V_{CC}+0.5$ (Note2)	
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 $V_{CC}/GND$ current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	300 (SM8)	mW
		200 (US8)	
Storage temperature	$T_{stg}$	-65 to 150	°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:  $V_{CC} = 0$  V

Note 2: High or Low State. Do not exceed  $I_{OUT}$  of absolute maximum ratings

Note 3:  $V_{OUT} < GND$

## IEC Logic Symbol



## Truth Table

A	Y
L	H
H	L

## Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	0.9 to 3.6	V
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 3.6 (Note 4)	V
		0 to $V_{CC}$ (Note 5)	
Output current	$I_{OH}/I_{OL}$	$\pm 8.0$ (Note 6)	mA
		$\pm 4.0$ (Note 7)	
		$\pm 3.0$ (Note 8)	
		$\pm 1.7$ (Note 9)	
		$\pm 0.3$ (Note 10)	
		$\pm 0.02$ (Note 11)	
Operating temperature	$T_{opr}$	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dv	0 to 10 (Note 12)	ns/V

Note 4:  $V_{CC} = 0V$

Note 5: High or Low state.

Note 6:  $V_{CC} = 3.0$  to  $3.6 V$

Note 7:  $V_{CC} = 2.3$  to  $2.7 V$

Note 8:  $V_{CC} = 1.65$  to  $1.95 V$

Note 9:  $V_{CC} = 1.4$  to  $1.6 V$

Note 10:  $V_{CC} = 1.1$  to  $1.3 V$

Note 11:  $V_{CC} = 0.9 V$

Note 12:  $V_{IN} = 0.8$  to  $2.0 V$ ,  $V_{CC} = 3.0 V$

## 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>	—	0.9	V <sub>CC</sub>	—	—	V <sub>CC</sub>	—	V	
			1.1 to 1.3	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—		
			1.4 to 1.6	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
			1.65 to 1.95	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
			2.3 to 2.7	1.7	—	—	1.7	—		
			3.0 to 3.6	2.0	—	—	2.0	—		
Low-level input voltage	V <sub>IL</sub>	—	0.9	—	—	GND	—	GND	V	
			1.1 to 1.3	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3		
			1.4 to 1.6	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35		
			1.65~1.95	—	—	V <sub>CC</sub> × 0.35	—	V <sub>CC</sub> × 0.35		
			2.3 to 2.7	—	—	0.7	—	0.7		
			3.0 to 3.6	—	—	0.8	—	0.8		
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -0.02 mA	0.9	0.75	—	—	0.75	—	V
			I <sub>OH</sub> = -0.3 mA	1.1 to 1.3	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
			I <sub>OH</sub> = -1.7 mA	1.4 to 1.6	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
			I <sub>OH</sub> = -3.0 mA	1.65 to 1.95	V <sub>CC</sub> -0.45	—	—	V <sub>CC</sub> -0.45	—	
			I <sub>OH</sub> = -4.0 mA	2.3 to 2.7	2.0	—	—	2.0	—	
			I <sub>OH</sub> = -8.0 mA	3.0 to 3.6	2.48	—	—	2.48	—	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	V
			I <sub>OL</sub> = 0.3 mA	1.1 to 1.3	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
			I <sub>OL</sub> = 1.7 mA	1.4 to 1.6	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
			I <sub>OL</sub> = 3.0 mA	1.65 to 1.95	—	—	0.45	—	0.45	
			I <sub>OL</sub> = 4.0 mA	2.3 to 2.7	—	—	0.4	—	0.4	
			I <sub>OL</sub> = 8.0 mA	3.0 to 3.6	—	—	0.4	—	0.4	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 5.5V	0 to 3.6	—	—	±0.1	—	±1.0	μA	
Power off leakage current	I <sub>OFF</sub>	V <sub>IN</sub> = 0 to 5.5V V <sub>OUT</sub> = 0 to 3.6V	0	—	—	1.0	—	10.0	μA	
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6	—	—	1.0	—	10.0	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)	Min	Typ	Max	Min		Max
Propagation delay time	$t_{pLH}$ $t_{pHL}$	$C_L = 10$ pF, $R_L = 1$ M $\Omega$	0.9	—	24.4	—	—	ns	
			1.1 to 1.3	—	11.6	21.7	1.0		40.5
			1.4 to 1.6	—	6.5	9.8	1.0		11.6
			1.65 to 1.95	—	4.9	7.0	1.0		7.6
			2.3 to 2.7	—	3.2	4.4	1.0		4.9
			3.0 to 3.6	—	2.4	3.5	1.0		4.1
		$C_L = 15$ pF, $R_L = 1$ M $\Omega$	0.9	—	36.9	—	—		—
			1.1 to 1.3	—	12.7	24.2	1.0		42.1
			1.4 to 1.6	—	7.1	10.7	1.0		12.9
			1.65 to 1.95	—	5.3	7.5	1.0		7.7
			2.3 to 2.7	—	3.5	4.8	1.0		5.5
		$C_L = 30$ pF, $R_L = 1$ M $\Omega$	3.0 to 3.6	—	2.7	3.8	1.0		4.4
			0.9	—	37.0	—	—		—
			1.1 to 1.3	—	17.1	33.9	1.0		64.1
			1.4 to 1.6	—	9.3	14.3	1.0		17.4
			1.65 to 1.95	—	6.9	9.8	1.0		10.2
			2.3 to 2.7	—	4.6	6.2	1.0		6.6
		3.0 to 3.6	—	3.7	4.8	1.0	5.2		
Input capacitance	$C_{IN}$	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	$C_{PD}$	(Note13)	0.9 to 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.

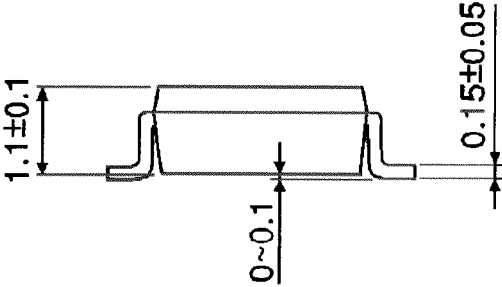
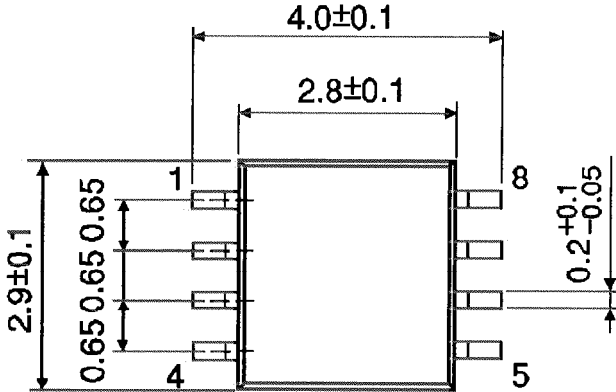
Average operating current can be obtained by the equation:

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

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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