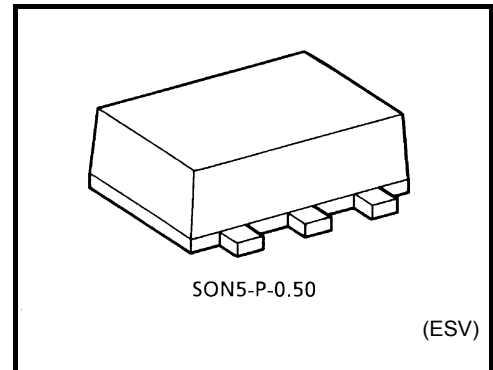


TC7SG04FE

Inverter

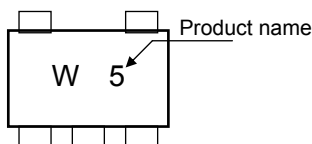
Features

- High-level output current: $I_{OH}/I_{OL} = \pm 8 \text{ mA}$ (min)
at $V_{CC} = 3.0 \text{ V}$
- High-speed operation: $t_{pd} = 2.3 \text{ ns}$ (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 input.
- 3.6-V power down protection output.

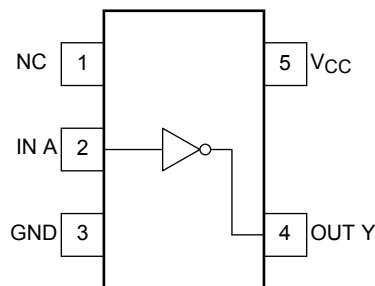


Weight: 0.003 g (typ.)

Marking



Pin Assignment (top view)



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}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	150	mW
Storage temperature	T_{stg}	$-65\sim 150$	$^\circ\text{C}$

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.

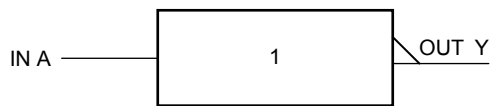
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

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	$^{\circ}C$
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: $V_{CC} = 3.0\sim 3.6 V$

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

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

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

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

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

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

DC Electrical Characteristics

Characteristics	Symbol	Test Condition	V _{CC} (V)	Ta = 25°C			Ta = -40~85°C		Unit	
				Min	Typ.	Max	Min	Max		
High-level input voltage	V _{IH}	—	0.9	V _{CC}	—	—	V _{CC}	—	V	
			1.1~1.3	V _{CC} × 0.7	—	—	V _{CC} × 0.7	—		
			1.4~1.6	V _{CC} × 0.65	—	—	V _{CC} × 0.65	—		
			1.65~1.95	V _{CC} × 0.65	—	—	V _{CC} × 0.65	—		
			2.3~2.7	1.7	—	—	1.7	—		
			3.0~3.6	2.0	—	—	2.0	—		
Low-level input voltage	V _{IL}	—	0.9	—	—	GND	—	GND	V	
			1.1~1.3	—	—	V _{CC} × 0.3	—	V _{CC} × 0.3		
			1.4~1.6	—	—	V _{CC} × 0.35	—	V _{CC} × 0.35		
			1.65~1.95	—	—	V _{CC} × 0.35	—	V _{CC} × 0.35		
			2.3~2.7	—	—	0.7	—	0.7		
			3.0~3.6	—	—	0.8	—	0.8		
High-level output voltage	V _{OH}	V _{IN} = V _{IL}	I _{OH} = -0.02 mA	0.9	0.75	—	—	0.75	—	V
			I _{OH} = -0.3 mA	1.1~1.3	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	
			I _{OH} = -1.7 mA	1.4~1.6	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	
			I _{OH} = -3.0 mA	1.65~1.95	V _{CC} -0.45	—	—	V _{CC} -0.45	—	
			I _{OH} = -4.0 mA	2.3~2.7	2.0	—	—	2.0	—	
			I _{OH} = -8.0 mA	3.0~3.6	2.48	—	—	2.48	—	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH}	I _{OL} = 0.02 mA	0.9	—	—	0.1	—	0.1	V
			I _{OL} = 0.3 mA	1.1~1.3	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25	
			I _{OL} = 1.7 mA	1.4~1.6	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25	
			I _{OL} = 3.0 mA	1.65~1.95	—	—	0.45	—	0.45	
			I _{OL} = 4.0 mA	2.3~2.7	—	—	0.4	—	0.4	
			I _{OL} = 8.0 mA	3.0~3.6	—	—	0.4	—	0.4	
Input leakage current	I _{IN}	V _{IN} = 0~5.5V	0~3.6	—	—	±0.1	—	±1.0	μA	
Power off leakage current	I _{OFF}	V _{IN} = 0~5.5V V _{OUT} = 0~3.6V	0	—	—	1.0	—	10.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	3.6	—	—	1.0	—	10.0	μA	

AC Electrical Characteristics (input $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Ta = 25°C			Ta = -40~85°C		Unit		
				Min	Typ.	Max	Min	Max			
Propagation delay time	t _{PLH} t _{PHL}	C _L = 10 pF, R _L = 1 MΩ	0.9	—	18.6	—	—	—	ns		
			1.1~1.3	—	8.7	18.4	1.0	34.2			
			1.4~1.6	—	4.9	8.5	1.0	10.0			
			1.65~1.95	—	3.8	6.2	1.0	6.7			
			2.3~2.7	—	2.6	3.9	1.0	4.4			
			3.0~3.6	—	2.1	3.1	1.0	3.7			
		C _L = 15 pF, R _L = 1 MΩ	0.9	—	21.0	—	—	—		ns	
			1.1~1.3	—	9.8	21.5	1.0	37.1			
			1.4~1.6	—	5.4	9.3	1.0	11.2			
			1.65~1.95	—	4.2	6.9	1.0	7.1			
			2.3~2.7	—	2.8	4.4	1.0	5.0			
			3.0~3.6	—	2.3	3.4	1.0	3.9			
		C _L = 30 pF, R _L = 1 MΩ	0.9	—	31.2	—	—	—			ns
			1.1~1.3	—	13.8	29.6	1.0	56.0			
			1.4~1.6	—	7.4	13.1	1.0	15.9			
			1.65~1.95	—	5.6	9.2	1.0	9.6			
			2.3~2.7	—	3.7	5.7	1.0	6.1			
			3.0~3.6	—	2.9	4.4	1.0	4.8			
Input capacitance	C _{IN}	—	3.6	—	3	—	—	pF			
Power dissipation capacitance	C _{PD}	(Note 13)	0.9~3.6	—	6	—	—	—	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.

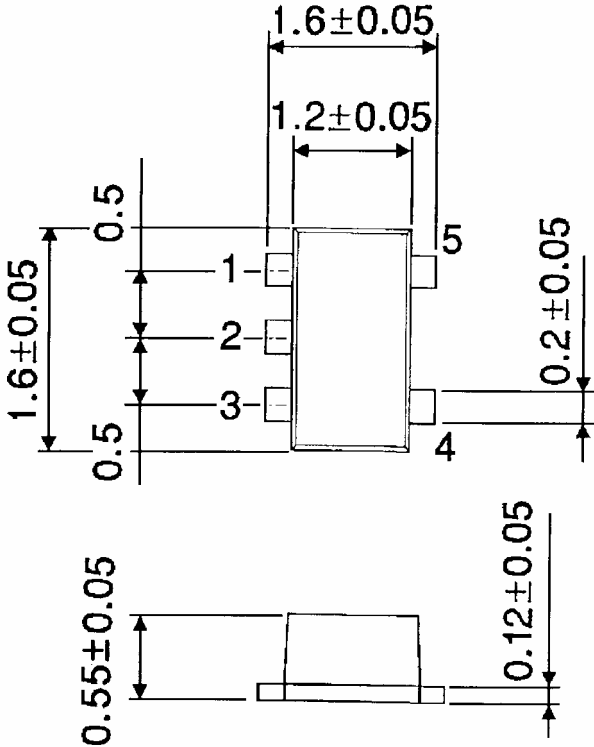
Average operating current can be obtained by the equation:

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

Package Dimensions

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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20070701-EN GENERAL

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