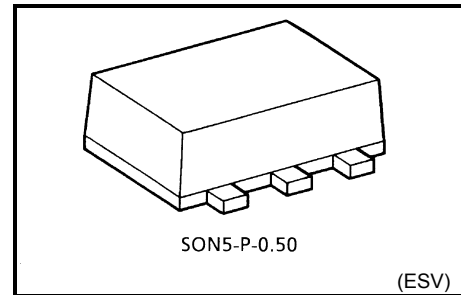


# TC7SG125FE

## Bus Buffer with 3-STATE Output

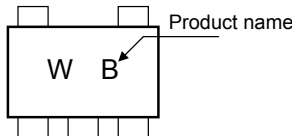
### Features

- High-level output current:  $I_{OH}/I_{OL} = \pm 8 \text{ mA (min)}$   
at  $V_{CC} = 3.0 \text{ V}$
- High-speed operation:  $t_{pd} = 2.4 \text{ ns (typ.)}$   
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 output.

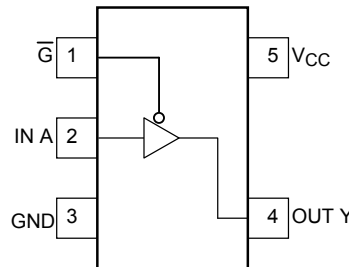


質量: 0.003 g (標準)

### Marking



### Pin Assignment (top view)



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

Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	-0.5~4.6	V
DC input voltage	$V_{IN}$	-0.5~7.0	V
DC output voltage	$V_{OUT}$	-0.5~ 4.6 (Note 1)	V
		-0.5~ $V_{CC} + 0.5$ (Note 2)	
Output diode current	$I_{IK}$	-20	mA
DC output current	$I_{OK}$	-20 (Note 3)	mA
DC $V_{CC}$ /ground current	$I_{OUT}$	$\pm 25$	mA
Power dissipation	$I_{CC}$	$\pm 50$	mA
Storage temperature	$P_D$	200	mW
Power supply voltage	$T_{stg}$	-65~150	°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.

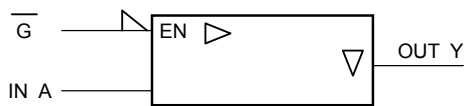
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

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

Note 3:  $V_{OUT} < GND$

## Logic Symbol



## Truth Table

$\overline{G}$	A	Y
H	X	Z
L	L	L
L	H	H

## 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	$I_{OH}/I_{OL}$	$\pm 8.0$ (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	$T_{opr}$	-40~85	°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:  $V_{CC} = 3.0\sim 3.6 V$

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

**Electrical Characteristics**

**DC Characteristics**

Characteristics		Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit		
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max	
Input voltage	High level	V <sub>IH</sub>	—	0.9	V <sub>CC</sub>	—	—	V <sub>CC</sub>	—	V	
				1.1~1.3	V <sub>CC</sub> × 0.7	—	—	V <sub>CC</sub> × 0.7	—		
				1.4~1.6	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
				1.65~1.95	V <sub>CC</sub> × 0.65	—	—	V <sub>CC</sub> × 0.65	—		
				2.3~2.7	1.7	—	—	1.7	—		
				3.0~3.6	2.0	—	—	2.0	—		
	Low level	V <sub>IL</sub>	—	0.9	—	—	GND	—	GND		
				1.1~1.3	—	—	V <sub>CC</sub> × 0.3	—	V <sub>CC</sub> × 0.3		
				1.4~1.6	—	—	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		
				2.3~2.7	—	—	0.7	—	0.7		
				3.0~3.6	—	—	0.8	—	0.8		
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>	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	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
				I <sub>OH</sub> = -1.7 mA	1.4~1.6	V <sub>CC</sub> × 0.75	—	—	V <sub>CC</sub> × 0.75	—	
				I <sub>OH</sub> = -3.0 mA	1.65~1.95	V <sub>CC</sub> -0.45	—	—	V <sub>CC</sub> -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	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	
				I <sub>OL</sub> = 0.3 mA	1.1~1.3	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 0.25	
				I <sub>OL</sub> = 1.7 mA	1.4~1.6	—	—	V <sub>CC</sub> × 0.25	—	V <sub>CC</sub> × 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		I <sub>IN</sub>	V <sub>IN</sub> = 0~5.5V	0~3.6	—	—	±0.1	—	±1.0	μA	
3-state output off-state current		I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = 0~3.6V	0.9~3.6	—	—	1.0	—	10.0	μA	
Power off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> = 5.5V or V <sub>OUT</sub> = 3.6V	0.0	—	—	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 = -40~85°C		Unit			
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max		
Propagation delay time	$t_{pLH}$ $t_{pHL}$	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 1 MΩ	0.9	—	15.3	—	—	ns			
			1.1~1.3	—	8.3	18.4	1.0		34.2		
			1.4~1.6	—	5.0	8.5	1.0		10.0		
			1.65~ 1.95	—	4.0	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 <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	0.9	—	17.7	—	—		—		
			1.1~1.3	—	9.6	21.5	1.0		37.2		
			1.4~1.6	—	5.6	9.3	1.0		11.2		
			1.65~ 1.95	—	4.5	6.9	1.0		7.1		
			2.3~2.7	—	2.9	4.4	1.0		5.0		
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 1 MΩ	0.9	—	29.0	—	—		—		
			1.1~1.3	—	14.5	29.6	1.0		56.0		
			1.4~1.6	—	8.2	13.1	1.0		15.9		
			1.65~ 1.95	—	6.0	9.2	1.0		9.6		
			2.3~2.7	—	4.0	5.7	1.0		6.1		
		Output enable time	$t_{pZL}$ $t_{pZH}$	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 100 kΩ	0.9	—	22.7		—	—	ns
					1.1~1.3	—	10.9		18.7	1.0	
C <sub>L</sub> = 10 pF, R <sub>L</sub> = 5 kΩ	1.4~1.6			—	5.9	8.7	1.0	9.8			
	1.65~ 1.95			—	4.5	6.3	1.0	6.8			
	2.3~2.7			—	3.1	4.2	1.0	4.5			
	3.0~3.6			—	2.4	3.2	1.0	3.5			
C <sub>L</sub> = 15 pF, R <sub>L</sub> = 100 kΩ	0.9			—	25.3	—	—	—			
	1.1~1.3			—	11.9	20.7	1.0	34.7			
C <sub>L</sub> = 15 pF, R <sub>L</sub> = 5 kΩ	1.4~1.6			—	6.5	9.5	1.0	11.1			
	1.65~ 1.95			—	4.9	6.8	1.0	7.2			
	2.3~2.7			—	3.3	4.4	1.0	4.8			
	3.0~3.6			—	2.5	3.4	1.0	3.7			
C <sub>L</sub> = 30 pF, R <sub>L</sub> = 100 kΩ	0.9			—	37.7	—	—	—			
	1.1~1.3			—	17.1	30.7	1.0	50.5			
C <sub>L</sub> = 30 pF, R <sub>L</sub> = 5 kΩ	1.4~1.6			—	8.8	13.1	1.0	15.1			
	1.65~ 1.95			—	6.6	9.2	1.0	9.9			
	2.3~2.7			—	4.1	5.4	1.0	5.8			
	3.0~3.6			—	3.1	4.1	1.0	4.5			

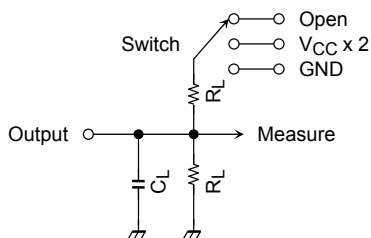
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 100 kΩ	0.9	—	117.6	—	—	—	ns
			1.1~1.3	—	9.2	16.0	1.0	22.4	
		C <sub>L</sub> = 10 pF, R <sub>L</sub> = 5 kΩ	1.4~1.6	—	7.1	9.1	1.0	10.4	
			1.65~ 1.95	—	6.7	8.3	1.0	9.0	
			2.3~2.7	—	6.2	7.3	1.0	8.8	
			3.0~3.6	—	5.8	6.9	1.0	7.6	
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 100 kΩ	0.9	—	139.2	—	—	—	
			1.1~1.3	—	10.0	16.9	1.0	25.1	
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 5 kΩ	1.4~1.6	—	7.8	9.8	1.0	11.3	
			1.65~ 1.95	—	7.4	9.2	1.0	10.6	
			2.3~2.7	—	7.0	8.2	1.0	10.3	
			3.0~3.6	—	6.8	7.7	1.0	9.5	
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 100 kΩ	0.9	—	230.8	—	—	—	
			1.1~1.3	—	14.0	20.8	1.0	31.9	
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 5 kΩ	1.4~1.6	—	12.2	13.5	1.0	14.9	
			1.65~ 1.95	—	11.5	13.0	1.0	13.9	
			2.3~2.7	—	11.3	12.2	1.0	13.5	
			3.0~3.6	—	10.9	11.8	1.0	12.9	
3.0~3.6	—		10.9	11.8	1.0	12.9			
Input capacitance	C <sub>IN</sub>	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	C <sub>PD</sub>	(Note13)	0.9 ~ 3.6	—	8	—	—	pF	

Note 13: 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:

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

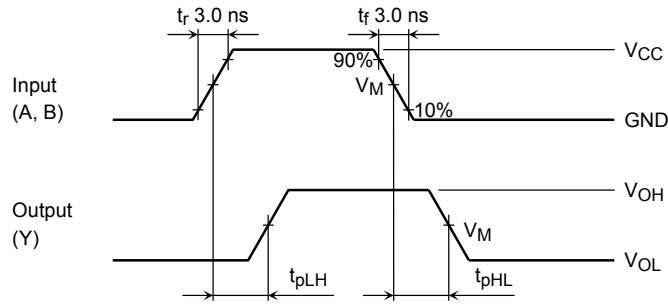
**AC Characteristics Measurement Circuit**



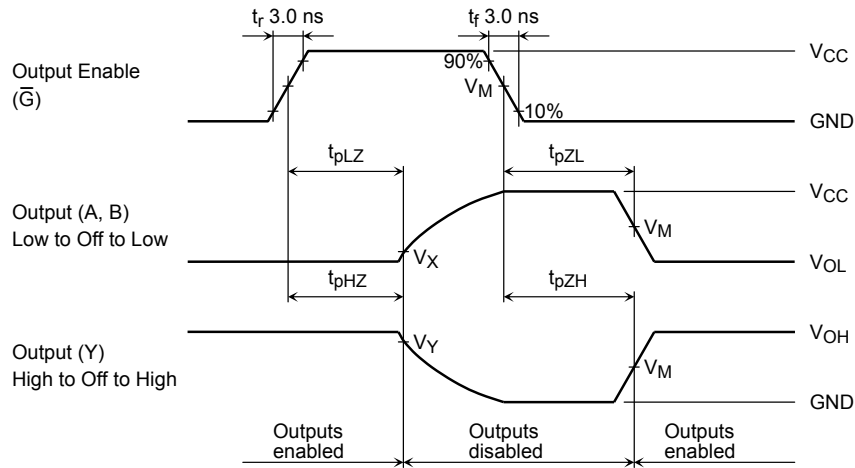
Characteristics	Switch
t <sub>pLH</sub> , t <sub>pHL</sub>	Open
t <sub>pLZ</sub> , t <sub>pZL</sub>	V <sub>CC</sub> x 2
t <sub>pHZ</sub> , t <sub>pZH</sub>	GND

**Figure1 t<sub>pLH</sub>, t<sub>pHL</sub>**

**AC Characteristics Measurement Circuit**



**Figure2  $t_{pLH}$ ,  $t_{pHL}$**



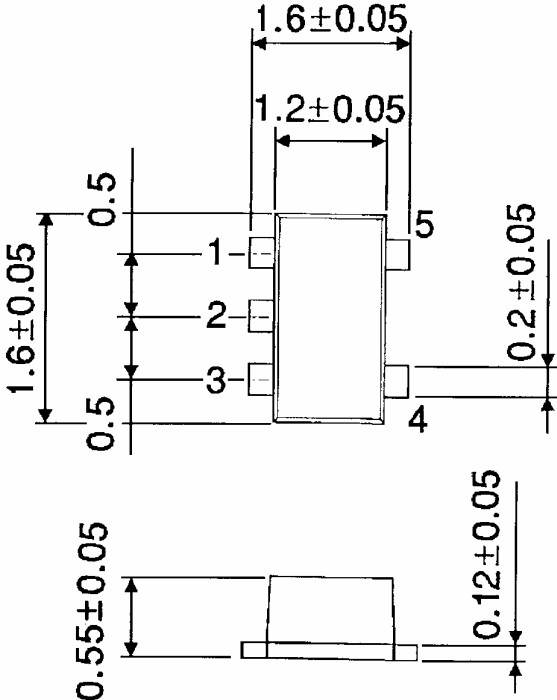
**Figure3  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$**

UNIT	$V_{CC}$					
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	$1.8 \pm 0.15 \text{ V}$	$1.5 \pm 0.1 \text{ V}$	$1.2 \pm 0.1 \text{ V}$	$0.9 \text{ V}$
$V_M$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$
$V_X$	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.1 \text{ V}$	$V_{OL} + 0.1 \text{ V}$	$V_{OL} + 0.1 \text{ V}$
$V_Y$	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.1 \text{ V}$	$V_{OH} - 0.1 \text{ V}$	$V_{OH} - 0.1 \text{ V}$

**Package Dimensions**

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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20070701-EN GENERAL

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