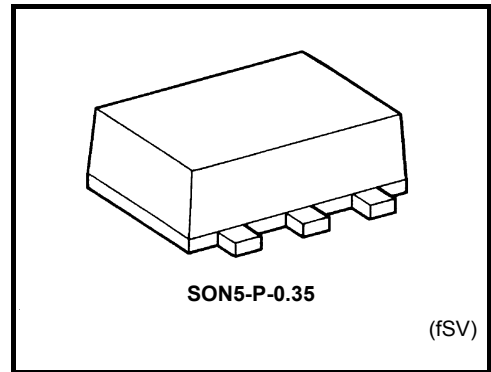


# TC7SG125AFS

## Bus Buffer with 3-STATE Output

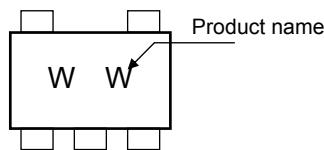
### Features

- 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.

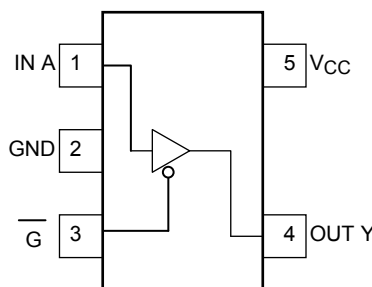


Weight: 0.001 g (typ.)

### Marking



### Pin Assignment (top view)



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

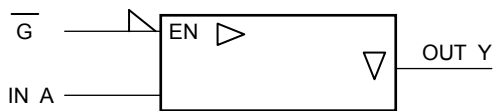
Characteristics	Symbol	Value	Unit
Power supply voltage	$V_{CC}$	-0.5~4.6	V
DC input voltage	$V_{IN}$	-0.5~7.0	V
DC output voltage	$V_{OUT}$	-0.5~ $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note 1)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$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

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:  $V_{OUT} < GND, V_{OUT} > V_{CC}$

## IEC 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~ $V_{CC}$	V
Output Current	$I_{OH}/I_{OL}$	$\pm 8.0$ (Note 2)	mA
		$\pm 4.0$ (Note 3)	
		$\pm 3.0$ (Note 4)	
		$\pm 1.7$ (Note 5)	
		$\pm 0.3$ (Note 6)	
		$\pm 0.02$ (Note 7)	
Operating temperature	$T_{opr}$	-40~85	°C
Input rise and fall time	dt/dV	0~10 (Note 8)	ns/V

Note 2:  $V_{CC} = 3.0\sim 3.6$  V

Note 3:  $V_{CC} = 2.3\sim 2.7$  V

Note 4:  $V_{CC} = 1.65\sim 1.95$  V

Note 5:  $V_{CC} = 1.4\sim 1.6$  V

Note 6:  $V_{CC} = 1.1\sim 1.3$  V

Note 7:  $V_{CC} = 0.9$  V

Note 8:  $V_{IN} = 0.8\sim 2.0$  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>IH</sub> or 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	1.1~1.3	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> = 0~3.6 V	0.9~3.6	—	—	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 (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	—	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
		$C_L = 15 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	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
			3.0~3.6	—	2.4	3.4	1.0		3.9
		$C_L = 30 \text{ pF}$ , $R_L = 1 \text{ M}\Omega$	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
			3.0~3.6	—	3.3	4.4	1.0		4.8
Output enable time	$t_{pZL}$ $t_{pZH}$	$C_L = 10 \text{ pF}$ , $R_L = 100 \text{ k}\Omega$	0.9	—	18.9	—	—	ns	
			1.1~1.3	—	9.8	16.9	1.0		24.8
		$C_L = 10 \text{ pF}$ , $R_L = 5 \text{ k}\Omega$	1.4~1.6	—	5.3	7.8	1.0		8.3
			1.65~1.95	—	3.9	5.5	1.0		5.9
			2.3~2.7	—	2.5	3.5	1.0		3.8
			3.0~3.6	—	2.1	2.7	1.0		3.0
		$C_L = 15 \text{ pF}$ , $R_L = 100 \text{ k}\Omega$	0.9	—	22.0	—	—		—
			1.1~1.3	—	11.0	18.7	1.0		28.4
		$C_L = 15 \text{ pF}$ , $R_L = 5 \text{ k}\Omega$	1.4~1.6	—	5.9	8.9	1.0		11.0
			1.65~1.95	—	4.4	6.3	1.0		6.5
			2.3~2.7	—	2.9	3.9	1.0		4.2
			3.0~3.6	—	2.3	3.0	1.0		3.3
			0.9	—	31.8	—	—		—
		$C_L = 30 \text{ pF}$ , $R_L = 100 \text{ k}\Omega$	1.1~1.3	—	15.6	27.3	1.0		43.2
			1.4~1.6	—	8.3	12.2	1.0		13.7
			1.65~1.95	—	6.1	8.6	1.0		9.7
			2.3~2.7	—	3.8	5.0	1.0		5.5
			3.0~3.6	—	2.9	3.8	1.0		4.2

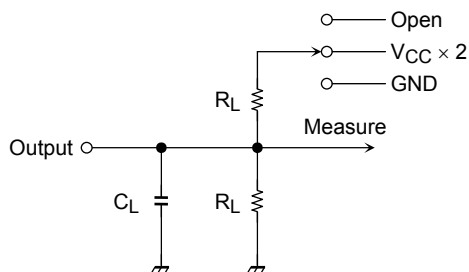
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit	
			VCC (V)	Min	Typ.	Max	Min		Max
Output disable time	tpLZ tpHZ	CL = 10 pF, RL = 100 kΩ	0.9	—	100.4	—	—	ns	
		CL = 10 pF, RL = 5 kΩ	1.1~1.3	—	9.1	14.4	1.0		22.4
			1.4~1.6	—	7.1	9.1	1.0		10.4
			1.65~1.95	—	6.5	8.3	1.0		9.0
			2.3~2.7	—	5.8	7.3	1.0		8.8
			3.0~3.6	—	5.4	6.9	1.0		7.6
		CL = 15 pF, RL = 100 kΩ	0.9	—	122.2	—	—		—
		CL = 15 pF, RL = 5 kΩ	1.1~1.3	—	9.8	15.3	1.0		25.1
			1.4~1.6	—	7.8	9.8	1.0		11.3
			1.65~1.95	—	7.2	9.2	1.0		10.6
			2.3~2.7	—	7.0	8.2	1.0		10.3
			3.0~3.6	—	6.6	7.7	1.0		9.5
		CL = 30 pF, RL = 100 kΩ	0.9	—	217.1	—	—		—
		CL = 30 pF, RL = 5 kΩ	1.1~1.3	—	13.2	19.6	1.0		31.9
			1.4~1.6	—	12.2	13.5	1.0		14.9
			1.65~1.95	—	11.4	12.7	1.0		13.9
2.3~2.7	—		11.3	12.2	1.0	13.5			
3.0~3.6	—		10.2	11.5	1.0	12.9			
Input capacitance	CIN	—	3.6	—	3	—	—	pF	
Power dissipation capacitance	CPD	(Note 9)	0.9 ~ 3.6	—	6	—	—	—	pF

Note 9:CPD 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:

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

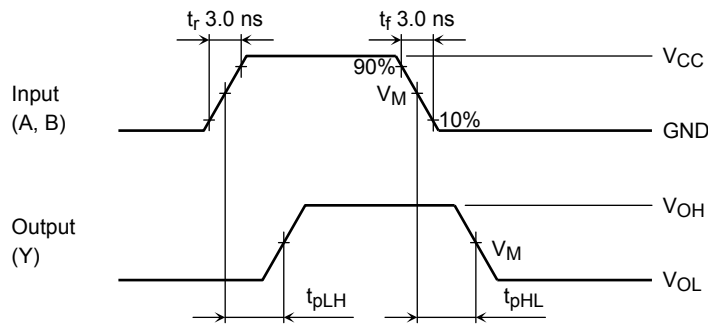
**AC Characteristics Measurement Circuit**



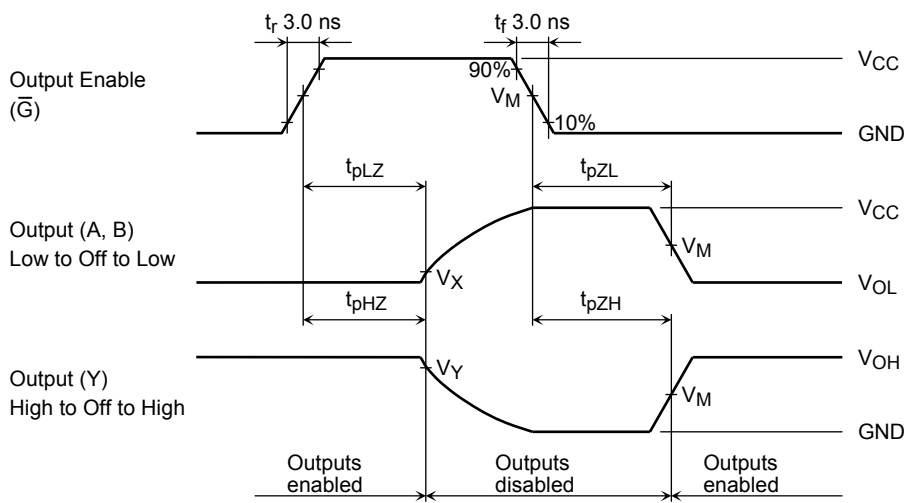
Characteristics	Switch
tpLH, tpHL	Open
tpLZ, tpZL	VCC x 2
tpHZ, tpZH	GND

**Figure1 tpLH, tpHL**

**AC Characteristics Measurement Circuit**



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



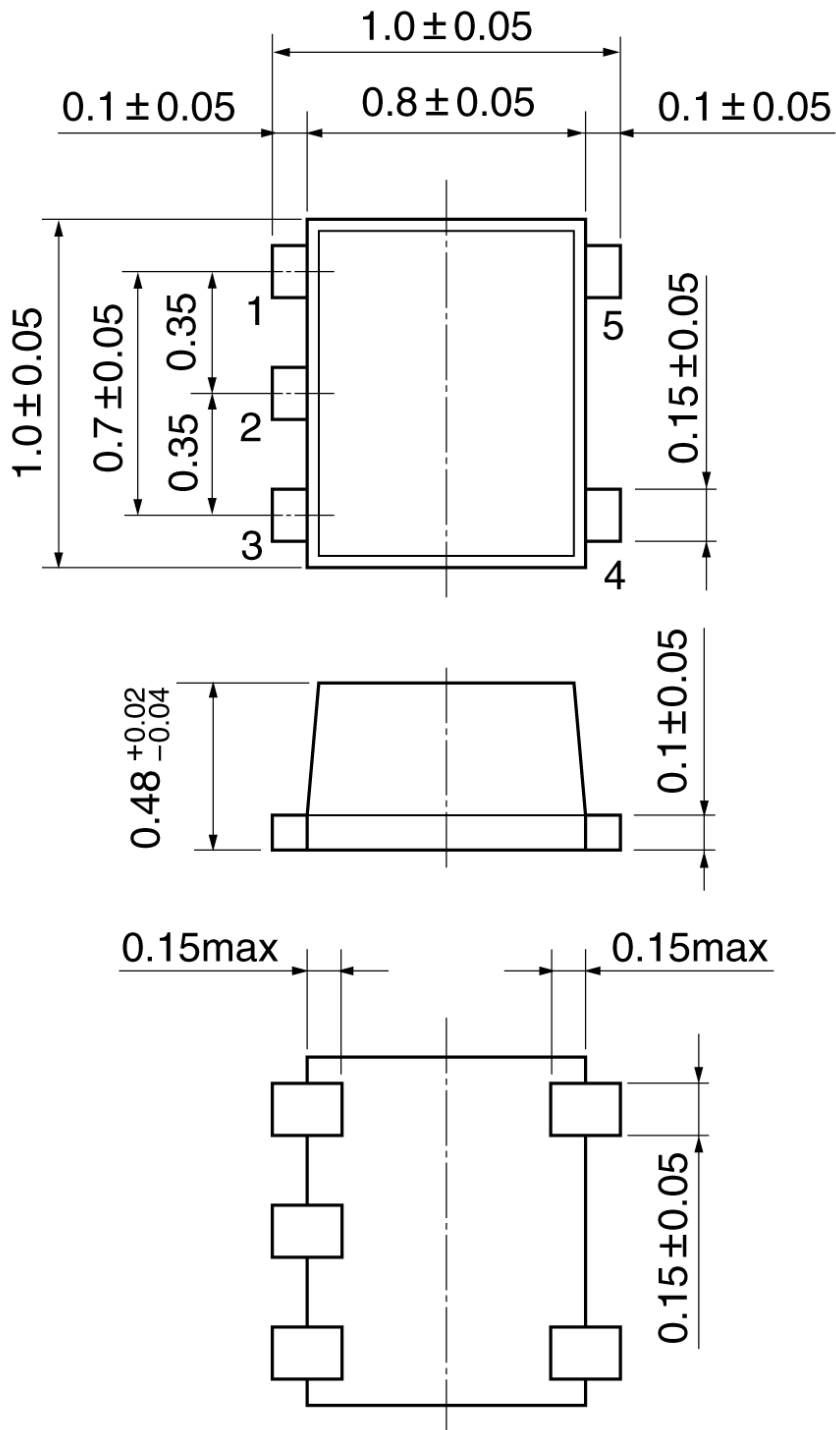
**Figure3  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$**

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-0.35

Unit:mm



Weight: 0.001 g (typ.)

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20070701-EN GENERAL

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