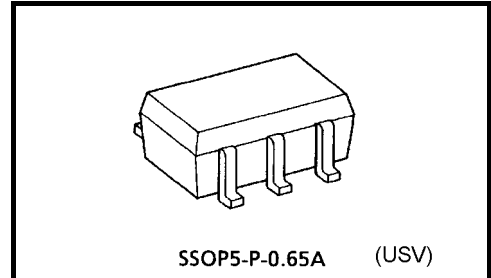


# TC7SG126FU

## Bus Buffer with 3-STATE Output

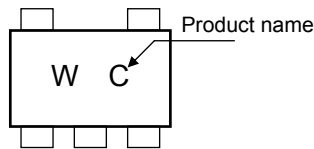
### Features

- High-level output current :  $\pm 8$  mA (min) at  $V_{CC} = 3.0$  V
- High-speed operation :  $t_{pd} = 2.4$  ns (typ.)  
at  $V_{CC} = 3.3$  V,  $C_L = 15$  pF
- Operating voltage range :  $V_{CC} = 0.9$  to  $3.6$  V
- 5.5-V tolerant inputs.
- 3.6-V power down protection output.
- ESD performance : Machine model  $\geq \pm 200$  V  
Human body model  $\geq \pm 2000$  V

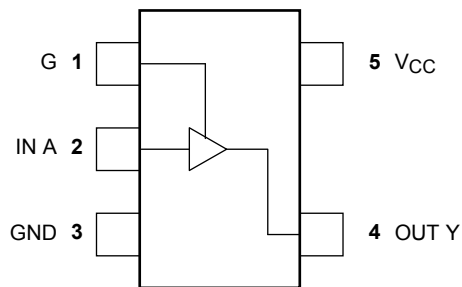


Weight: 6.2 mg (typ.)

### Marking



### Pin Assignment (top view)



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

Characteristic	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 (Note 1)	V
		-0.5 to $V_{CC} + 0.5$ (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	$P_D$	200	mW
Storage temperature	$T_{stg}$	-65 to 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.

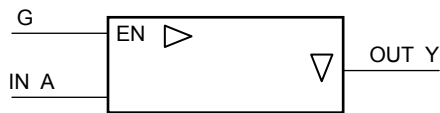
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

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

G	A	Y
L	X	Z
H	L	L
H	H	H

## Operating Ranges

Characteristic	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

Characteristic	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 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 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	V <sub>IL</sub>	—	0.9	—	—	GND	—	GND		
				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 to 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		
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = 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 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	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>	I <sub>OL</sub> = 0.02 mA	0.9	—	—	0.1	—	0.1	
				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		
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 to 3.6V	0.9 to 3.6	—	—	1.0	—	10.0	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	0.0	—	—	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)

Characteristic	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit			
			VCC (V)	Min	Typ.	Max	Min		Max		
Propagation delay time	$t_{pLH}$	$C_L = 10$ pF, $R_L = 1$ M $\Omega$	0.9	—	15.3	—	—	ns			
			1.1 to 1.3	—	8.3	18.4	1.0		34.2		
			1.4 to 1.6	—	5.0	8.5	1.0		10.0		
			1.65 to 1.95	—	4.0	6.2	1.0		6.7		
			2.3 to 2.7	—	2.6	3.9	1.0		4.4		
			3.0 to 3.6	—	2.1	3.1	1.0		3.7		
		$C_L = 15$ pF, $R_L = 1$ M $\Omega$	0.9	—	17.7	—	—		—		
			1.1 to 1.3	—	9.6	21.5	1.0		37.2		
			1.4 to 1.6	—	5.6	9.3	1.0		11.2		
			1.65 to 1.95	—	4.5	6.9	1.0		7.1		
	$C_L = 30$ pF, $R_L = 1$ M $\Omega$	0.9	—	29.0	—	—	—				
		1.1 to 1.3	—	14.5	29.6	1.0	56.0				
		1.4 to 1.6	—	8.2	13.1	1.0	15.9				
		1.65 to 1.95	—	6.0	9.2	1.0	9.6				
		2.3 to 2.7	—	4.0	5.7	1.0	6.1				
		3.0 to 3.6	—	3.3	4.4	1.0	4.8				
	Output enable time	$t_{pZL}$	$C_L = 10$ pF, $R_L = 100$ k $\Omega$	0.9	—	22.7	—		—	ns	
				1.1 to 1.3	—	10.9	18.7		1.0		29.8
			$C_L = 10$ pF, $R_L = 5$ k $\Omega$	1.4 to 1.6	—	5.9	8.7		1.0		9.8
				1.65 to 1.95	—	4.5	6.3		1.0		6.8
2.3 to 2.7				—	3.1	4.2	1.0	4.5			
3.0 to 3.6				—	2.4	3.2	1.0	3.5			
$C_L = 15$ pF, $R_L = 100$ k $\Omega$			0.9	—	25.3	—	—	—			
			1.1 to 1.3	—	11.9	20.7	1.0	34.7			
			1.4 to 1.6	—	6.5	9.5	1.0	11.1			
			1.65 to 1.95	—	4.9	6.8	1.0	7.2			
		2.3 to 2.7	—	3.3	4.4	1.0	4.8				
$C_L = 30$ pF, $R_L = 100$ k $\Omega$		0.9	—	37.7	—	—	—				
		1.1 to 1.3	—	17.1	30.7	1.0	50.5				
		1.4 to 1.6	—	8.8	13.1	1.0	15.1				
		1.65 to 1.95	—	6.6	9.2	1.0	9.9				
		2.3 to 2.7	—	4.1	5.4	1.0	5.8				
$C_L = 30$ pF, $R_L = 5$ k $\Omega$		0.9	—	37.7	—	—	—				
		1.1 to 1.3	—	17.1	30.7	1.0	50.5				
		1.4 to 1.6	—	8.8	13.1	1.0	15.1				
		1.65 to 1.95	—	6.6	9.2	1.0	9.9				
	2.3 to 2.7	—	4.1	5.4	1.0	5.8					
$C_L = 30$ pF, $R_L = 5$ k $\Omega$	3.0 to 3.6	—	3.1	4.1	1.0	4.5					

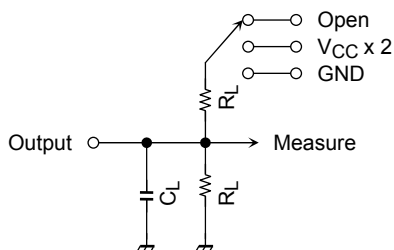
Characteristic	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max	
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 100 kΩ	0.9	—	117.6	—	—	ns		
		C <sub>L</sub> = 10 pF, R <sub>L</sub> = 5 kΩ	1.1 to 1.3	—	9.2	16.0	1.0		22.4	
			1.4 to 1.6	—	7.1	9.1	1.0		10.4	
			1.65 to 1.95	—	6.7	8.3	1.0		9.0	
			2.3 to 2.7	—	6.2	7.3	1.0		8.8	
			3.0 to 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	—	—		—	
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 5 kΩ	1.1 to 1.3	—	10.0	16.9	1.0		25.1	
			1.4 to 1.6	—	7.8	9.8	1.0		11.3	
			1.65 to 1.95	—	7.4	9.2	1.0		10.6	
			2.3 to 2.7	—	7.0	8.2	1.0		10.3	
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 100 kΩ	3.0 to 3.6	—	6.8	7.7	1.0		9.5	
			0.9	—	230.8	—	—		—	
			C <sub>L</sub> = 30 pF, R <sub>L</sub> = 5 kΩ	1.1 to 1.3	—	14.0	20.8		1.0	31.9
				1.4 to 1.6	—	12.2	13.5		1.0	14.9
				1.65 to 1.95	—	11.5	13.0		1.0	13.9
2.3 to 2.7	—	11.3		12.2	1.0	13.5				
3.0 to 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>	(Note 13)	0.9 to 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:

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

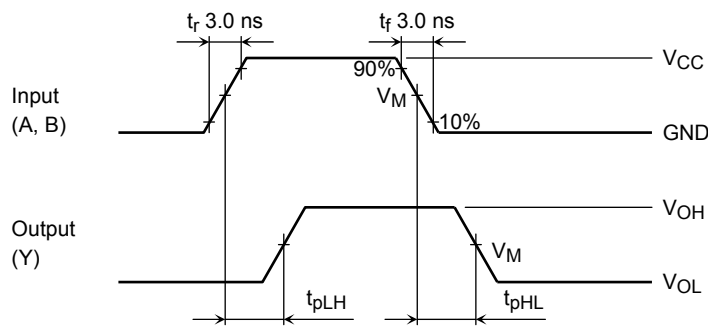
**AC Characteristics Measurement Circuit**



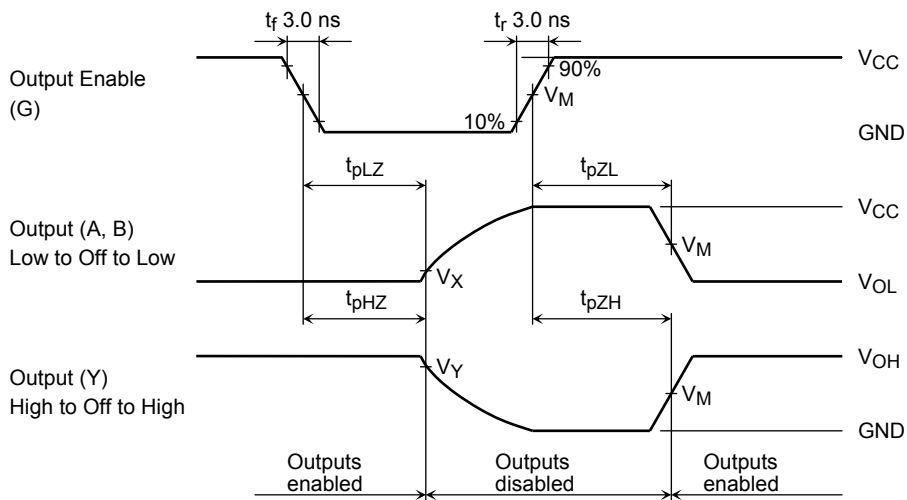
Characteristics	Switch
t <sub>pLH</sub> , t <sub>pHL</sub>	Open
t <sub>pLZ</sub> , t <sub>pZL</sub>	V <sub>CC</sub> x 2
t <sub>pHZ</sub> , t <sub>pZH</sub>	GND

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

**AC Characteristics Measurement Circuit**



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



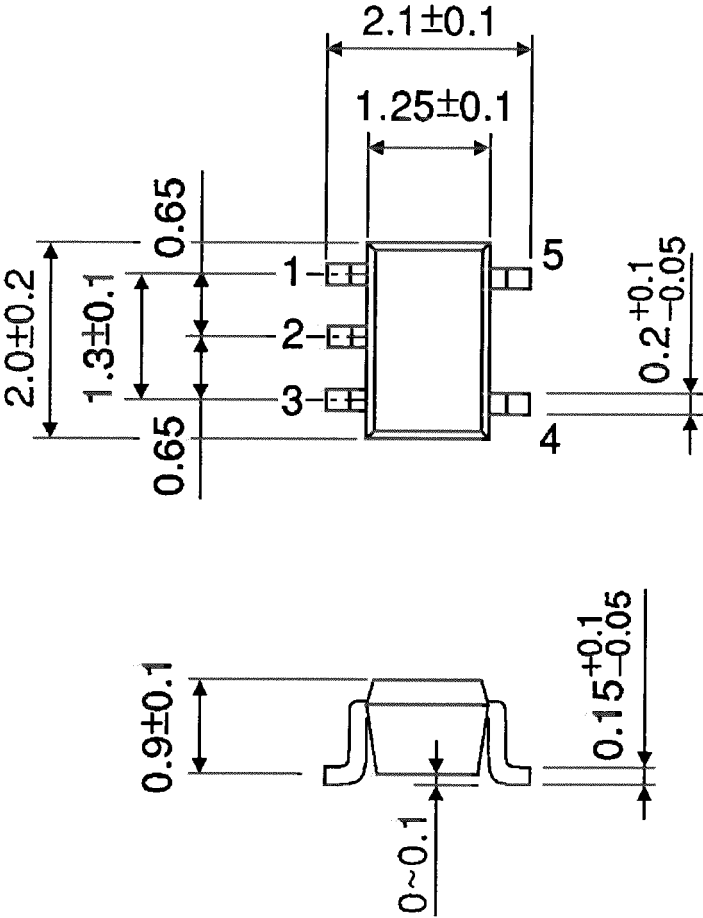
**Figure3  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$**

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

SSOP5-P-0.65A

Unit : mm



Weight: 6.2 mg (typ.)

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