

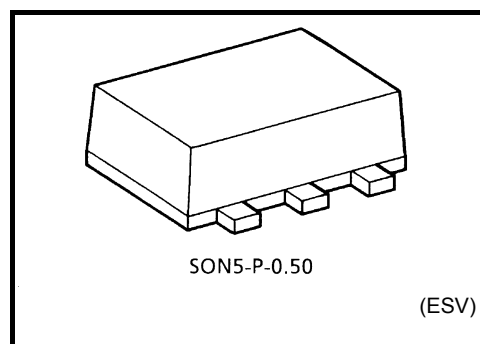
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7SG126FE

Bus Buffer with 3-STATE Output

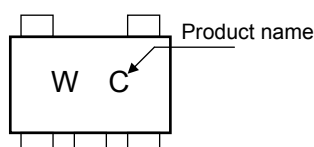
### Features

- 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 outputs

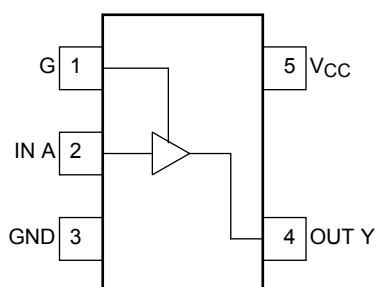


Weight: 0.003 g (typ.)

### 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
Input diode current		$-0.5 \sim V_{CC} + 0.5$ (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	$P_D$	150	mW
Power supply voltage	$T_{stg}$	$-65 \sim 150$	$^\circ\text{C}$

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.

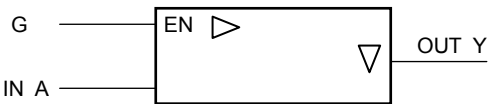
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

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

G	A	Y
L	X	Z
H	L	L
H	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) 0~ $V_{CC}$ (Note 5)	V
Output Current	$I_{OH}/I_{OL}$	$\pm 8.0$ (Note 6) $\pm 4.0$ (Note 7) $\pm 3.0$ (Note 8) $\pm 1.7$ (Note 9) $\pm 0.3$ (Note 10) $\pm 0.02$ (Note 11)	mA
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:  $V_{CC} = 3.0\sim 3.6\text{ V}$
- Note 7:  $V_{CC} = 2.3\sim 2.7\text{ V}$
- Note 8:  $V_{CC} = 1.65\sim 1.95\text{ V}$
- Note 9:  $V_{CC} = 1.4\sim 1.6\text{ V}$
- Note 10:  $V_{CC} = 1.1\sim 1.3\text{ V}$
- Note 11:  $V_{CC} = 0.9\text{ V}$
- Note 12:  $V_{IN} = 0.8\sim 2.0\text{ V}$ ,  $V_{CC} = 3.0\text{ V}$

## 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>	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> 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	1.1~1.3	—	—	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 (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	—	—	—
			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	—	22.7	—	—	—
		$C_L = 10 \text{ pF}$ , $R_L = 5 \text{ k}\Omega$	1.1~1.3	—	10.9	18.7	1.0	29.8
			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
		$C_L = 15 \text{ pF}$ , $R_L = 100 \text{ k}\Omega$	0.9	—	25.3	—	—	—
		$C_L = 15 \text{ pF}$ , $R_L = 5 \text{ k}\Omega$	1.1~1.3	—	11.9	20.7	1.0	34.7
			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
		$C_L = 30 \text{ pF}$ , $R_L = 100 \text{ k}\Omega$	0.9	—	37.7	—	—	—
		$C_L = 30 \text{ pF}$ , $R_L = 5 \text{ k}\Omega$	1.1~1.3	—	17.1	30.7	1.0	50.5
			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

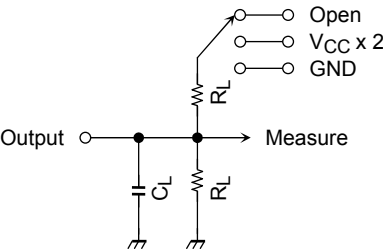
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit
			VCC (V)	Min	Typ.	Max	Min	Max
Output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 100 kΩ	0.9	—	117.6	—	—	—
		C <sub>L</sub> = 10 pF, R <sub>L</sub> = 5 kΩ	1.1~1.3	—	9.2	16.0	1.0	22.4
			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	—	—	—
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 5 kΩ	1.1~1.3	—	10.0	16.9	1.0	25.1
			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	—	—	—
		C <sub>L</sub> = 30 pF, R <sub>L</sub> = 5 kΩ	1.1~1.3	—	14.0	20.8	1.0	31.9
			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
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<sub>CC (opr.)</sub> = C<sub>PD</sub>·V<sub>CC</sub>·f<sub>IN</sub> + I<sub>CC</sub>

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

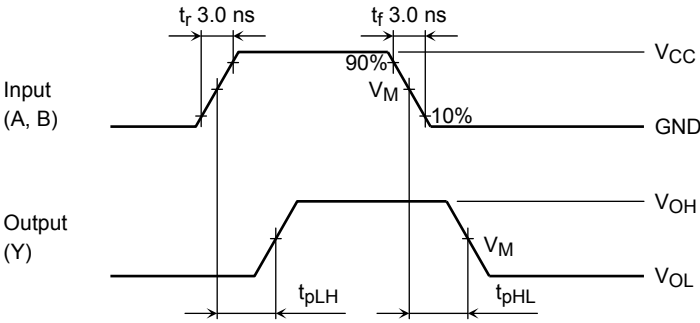


Figure2  $t_{PLH}$ ,  $t_{PHL}$

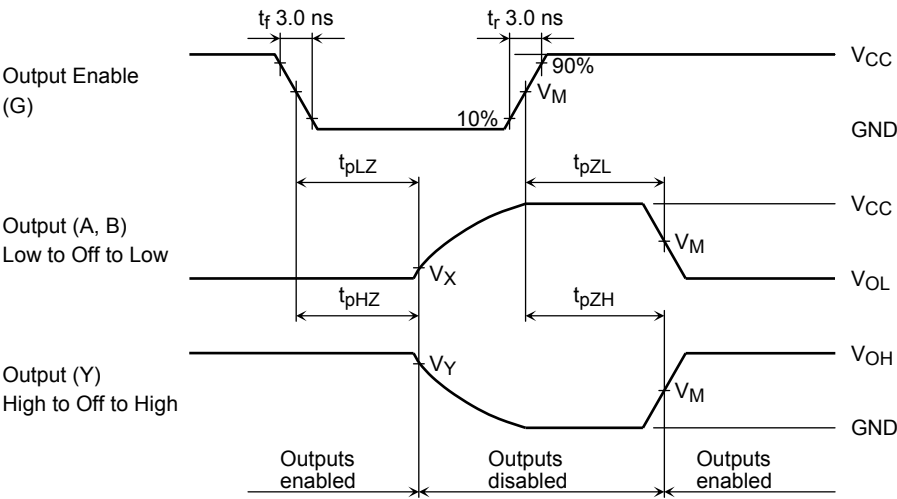


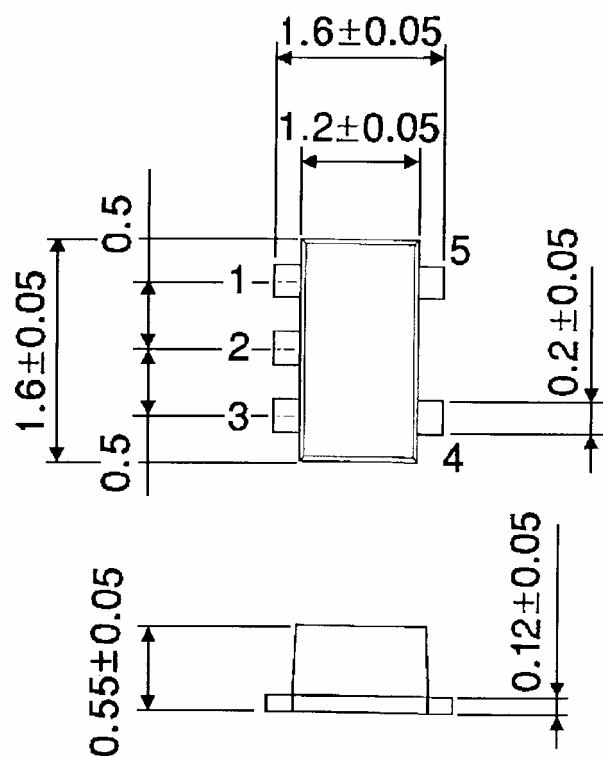
Figure3  $t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$

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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