

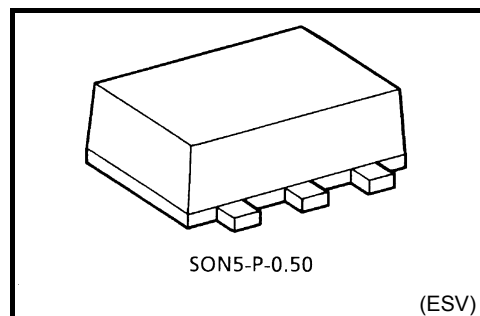
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SG125FE

Bus Buffer with 3-STATE Output

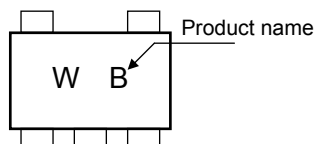
Features

- High output current: ± 8 mA (min) at $V_{CC} = 3.0$ V
- High-speed operation: $t_{pd} = 2.4$ ns (typ.)
at $V_{CC} = 3.3$ V, 15pF
- Operating voltage range: $V_{CC} = 0.9$ to 3.6 V
- 5.5-V tolerant inputs.
- 3.6-V power down protection output.

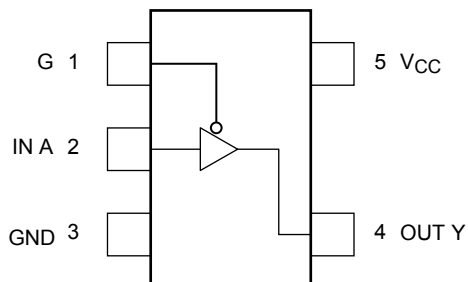


Weight: 0.003 g (typ.)

Marking



Pin Assignment (top view)



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

Characteristics	Symbol	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)	
Output diode current	I_{IK}	-20	mA
DC output current	I_{OK}	-20 (Note 3)	mA
DC V_{CC} /ground current	I_{OUT}	± 25	mA
Power dissipation	I_{CC}	± 50	mA
Storage temperature	P_D	150	mW
Power supply voltage	T_{stg}	-65 to 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.

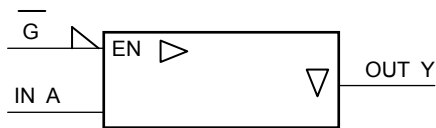
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

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

Note 2: High or Low State. Do not exceed I_{OUT} of absolute maximum ratings.

Note 3: $V_{OUT} < \text{GND}$

IEC Logic Symbol



Truth Table

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

Operating Ranges

Characteristics	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) 0 to V_{CC} (Note 5)	V
Output Current	I_{OH}/I_{OL}	± 8.0 (Note 6) ± 4.0 (Note 7) ± 3.0 (Note 8) ± 1.7 (Note 9) ± 0.3 (Note 10) ± 0.02 (Note 11)	mA
Operating temperature	T_{opr}	-40 to 85	°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 $3.6V$
Note 7: $V_{CC} = 2.3$ to $2.7V$
Note 8: $V_{CC} = 1.65$ to $1.95V$
Note 9: $V_{CC} = 1.4$ to $1.6V$
Note 10: $V_{CC} = 1.1$ to $1.3V$
Note 11: $V_{CC} = 0.9V$
Note 12: $V_{IN} = 0.8$ to $2.0V$, $V_{CC} = 3.0V$

Electrical Characteristics

DC Characteristics

Characteristics		Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
					V _{CC} (V)	Min	Typ.	Max	Min		Max
Input voltage	High level	V _{IH}	—		0.9	V _{CC}	—	—	V _{CC}	—	V
					1.1 to 1.3	V _{CC} × 0.7	—	—	V _{CC} × 0.7	—	
					1.4 to 1.6	V _{CC} × 0.65	—	—	V _{CC} × 0.65	—	
					1.65 to 1.95	V _{CC} × 0.65	—	—	V _{CC} × 0.65	—	
					2.3 to 2.7	1.7	—	—	1.7	—	
					3.0 to 3.6	2.0	—	—	2.0	—	
	Low level	V _{IL}	—		0.9	—	—	GND	—	GND	
					1.1 to 1.3	—	—	V _{CC} × 0.3	—	V _{CC} × 0.3	
					1.4 to 1.6	—	—	V _{CC} × 0.35	—	V _{CC} × 0.35	
					1.65 to 1.95	—	—	V _{CC} × 0.35	—	V _{CC} × 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 _{OH}	V _{IN} = V _{IL} or V _{IH}	I _{OH} = -0.02 mA	0.9	0.75	—	—	0.75	—	V
				I _{OH} = -0.3 mA	1.1 to 1.3	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	
				I _{OH} = -1.7 mA	1.4 to 1.6	V _{CC} × 0.75	—	—	V _{CC} × 0.75	—	
				I _{OH} = -3.0 mA	1.65 to 1.95	V _{CC} -0.45	—	—	V _{CC} -0.45	—	
				I _{OH} = -4.0 mA	2.3 to 2.7	2.0	—	—	2.0	—	
				I _{OH} = -8.0 mA	3.0 to 3.6	2.48	—	—	2.48	—	
	Low level	V _{OL}	V _{IN} = V _{IL}	I _{OL} = 0.02 mA	0.9	—	—	0.1	—	0.1	
				I _{OL} = 0.3 mA	1.1 to 1.3	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25	
				I _{OL} = 1.7 mA	1.4 to 1.6	—	—	V _{CC} × 0.25	—	V _{CC} × 0.25	
				I _{OL} = 3.0 mA	1.65 to 1.95	—	—	0.45	—	0.45	
				I _{OL} = 4.0 mA	2.3 to 2.7	—	—	0.4	—	0.4	
				I _{OL} = 8.0 mA	3.0 to 3.6	—	—	0.4	—	0.4	
Input leakage current		I _{IN}	V _{IN} = 0 to 5.5V	0 to 3.6	—	—	±0.1	—	±1.0	μA	
3-state output off-state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6V	0.9 to 3.6	—	—	1.0	—	10.0	μA	
Power off leakage current		I _{OFF}	V _{IN} = 5.5V or V _{OUT} = 3.6V	0.0	—	—	1.0	—	10.0	μA	
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND	3.6	—	—	1.0	—	10.0	μA	

AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit
			V _{CC} (V)	Min	Typ.	Max	Min	Max
Propagation delay time	t_{pLH} t_{pHL}	$C_L = 10$ pF, $R_L = 1$ M Ω	0.9	—	15.3	—	—	—
			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 Ω	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
			2.3 to 2.7	—	2.9	4.4	1.0	5.0
			3.0 to 3.6	—	2.4	3.4	1.0	3.9
		$C_L = 30$ pF, $R_L = 1$ M Ω	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} t_{pZH}	$C_L = 10$ pF, $R_L = 100$ k Ω	0.9	—	22.7	—	—	—
			1.1 to 1.3	—	10.9	18.7	1.0	29.8
		$C_L = 10$ pF, $R_L = 5$ k Ω	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 Ω	0.9	—	25.3	—	—	—
			1.1 to 1.3	—	11.9	20.7	1.0	34.7
		$C_L = 15$ pF, $R_L = 5$ k Ω	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
			3.0 to 3.6	—	2.5	3.4	1.0	3.7
		$C_L = 30$ pF, $R_L = 100$ k Ω	0.9	—	37.7	—	—	—
			1.1 to 1.3	—	17.1	30.7	1.0	50.5
		$C_L = 30$ pF, $R_L = 5$ k Ω	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
			3.0 to 3.6	—	3.1	4.1	1.0	4.5

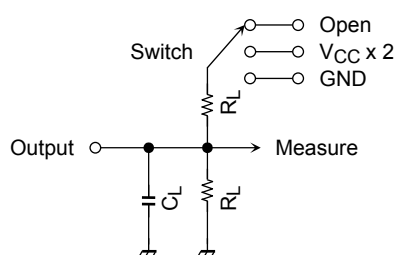
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit
			V _{CC} (V)	Min	Typ.	Max	Min	Max
Output disable time	t _{pLZ} t _{pHZ}	C _L = 10 pF, R _L = 100 kΩ	0.9	—	117.6	—	—	—
		C _L = 10 pF, R _L = 5 kΩ	1.1 to 1.3	—	9.2	16.0	1.0	22.4
			1.4 to 1.6	—	7.1	9.1	1.0	10.4
			1.65 to 1.95	—	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 _L = 15 pF, R _L = 100 kΩ	0.9	—	139.2	—	—	—
		C _L = 15 pF, R _L = 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
			3.0 to 3.6	—	6.8	7.7	1.0	9.5
		C _L = 30 pF, R _L = 100 kΩ	0.9	—	230.8	—	—	—
		C _L = 30 pF, R _L = 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 _{IN}	—	3.6	—	3	—	—	pF
Power dissipation capacitance	C _{PD}	(Note13)	0.9 to 3.6	—	8	—	—	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:

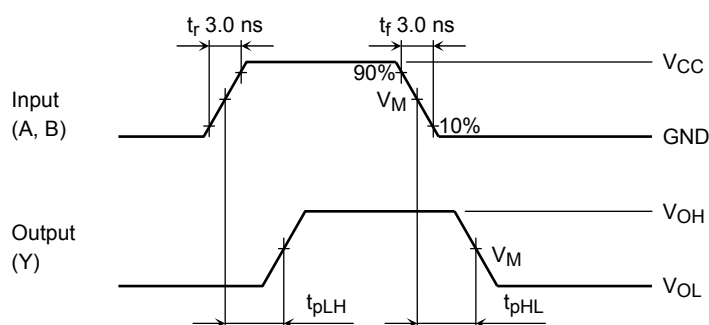
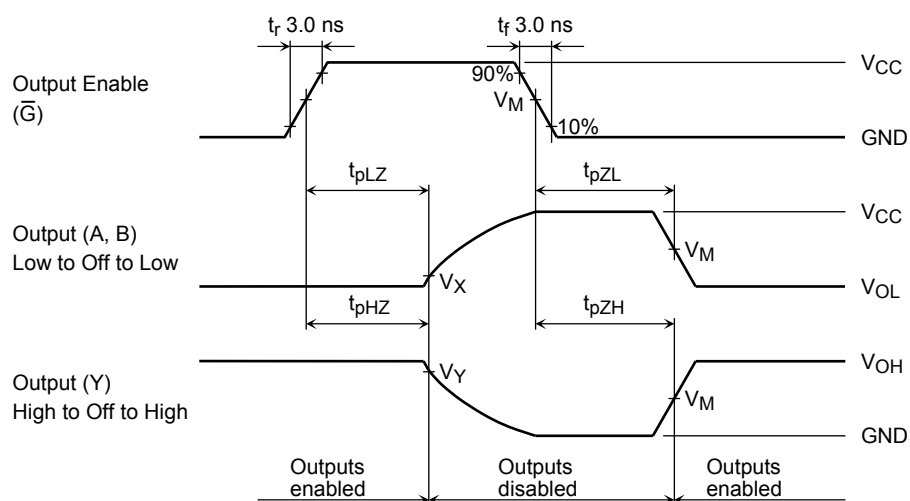
$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

AC Characteristics Measurement Circuit



Characteristics	Switch
t _{pLH} , t _{pHL}	Open
t _{pLZ} , t _{pZL}	V _{CC} x 2
t _{pHZ} , t _{pZH}	GND

Figure1 t_{pLH}, t_{pHL}

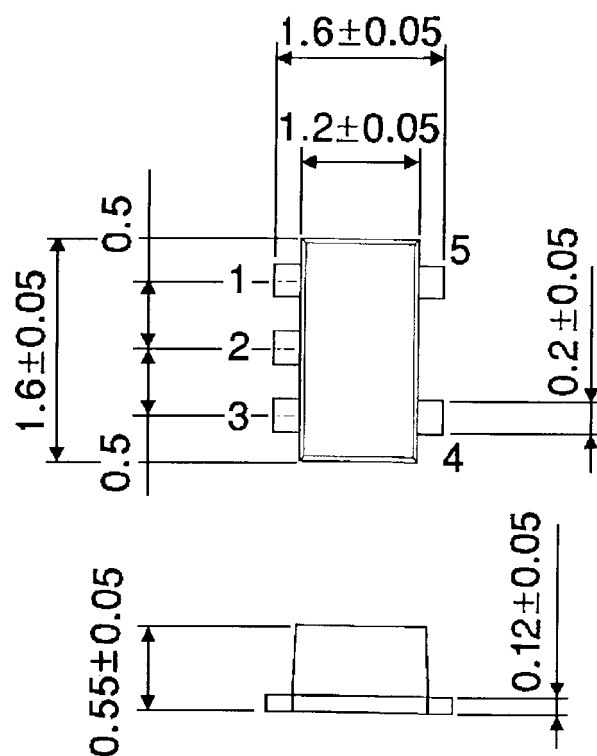
AC Characteristics Measurement Waveform

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 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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