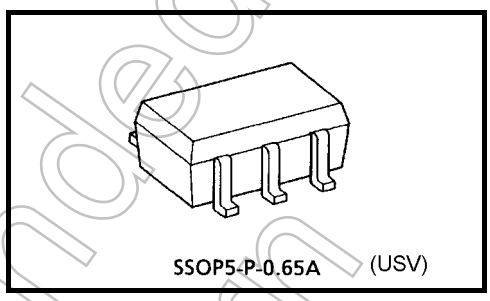
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SG125FU

Bus Buffer with 3-STATE Output

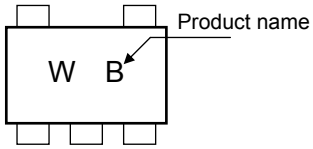
Features

- 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, C_L = 15pF
- 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 ≥ ±200 V
  Human body model ≥ ±2000 V

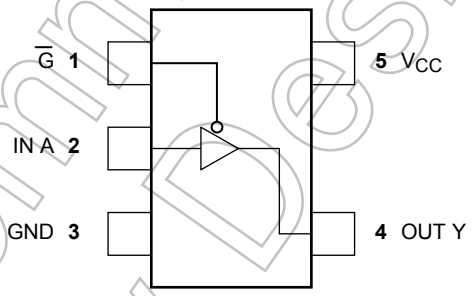


Weight: 0.006 g (typ.)

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) −0.5 to V_{CC} + 0.5 (Note 2)	V
Input diode current	I_{IK}	−20	mA
Output diode current	I_{OK}	−20 (Note 3)	mA
DC output current	I_{OUT}	±25	mA
DC V_{CC}/ground current	I_{CC}	±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).

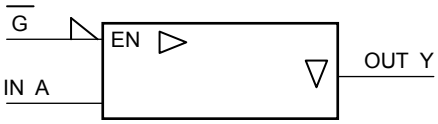
Note 1: V_{CC} = 0V

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

Note 3: V_{OUT} < GND

Start of commercial production
2005-04

IEC Logic Symbol



Truth Table

$\overline{G}$	A	Y
H	X	Z
L	L	L
L	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}	±8.0 (Note 6)	mA
		±4.0 (Note 7)	
		±3.0 (Note 8)	
		±1.7 (Note 9)	
		±0.3 (Note 10)	
		±0.02 (Note 11)	
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 3.6 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		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Unit
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} = 0 to 5.5V V_{OUT} = 0 to 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

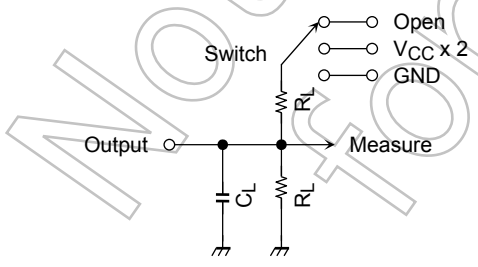
AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

Characteristic	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 MΩ	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 MΩ	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 MΩ	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 kΩ	0.9	—	22.7	—	—	—	ns
		C_L = 10 pF, R_L = 5 kΩ	1.1 to 1.3	—	10.9	18.7	1.0	29.8	
			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 kΩ	0.9	—	25.3	—	—	—	
		C_L = 15 pF, R_L = 5 kΩ	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	
			3.0 to 3.6	—	2.5	3.4	1.0	3.7	
		C_L = 30 pF, R_L = 100 kΩ	0.9	—	37.7	—	—	—	
		C_L = 30 pF, R_L = 5 kΩ	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	
			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_{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	—	—	—	ns
		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}	(Note 13)	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:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

AC Characteristics Measurement Circuit



Characteristics	Switch
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	V_{CC} x 2
t_{pHZ}, t_{pZH}	GND

Figure 1 t_{pLH}, t_{pHL}

AC Characteristics Measurement Waveform

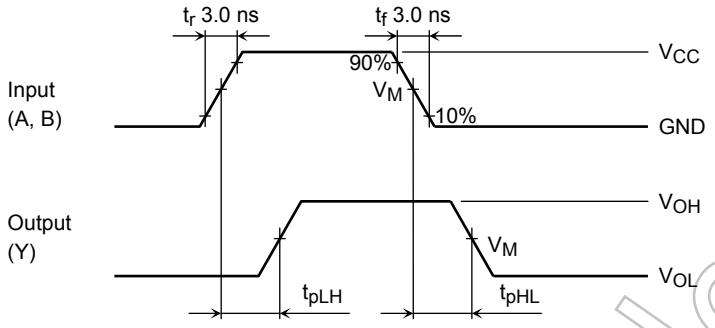


Figure 2 t_{pLH}, t_{pHL}

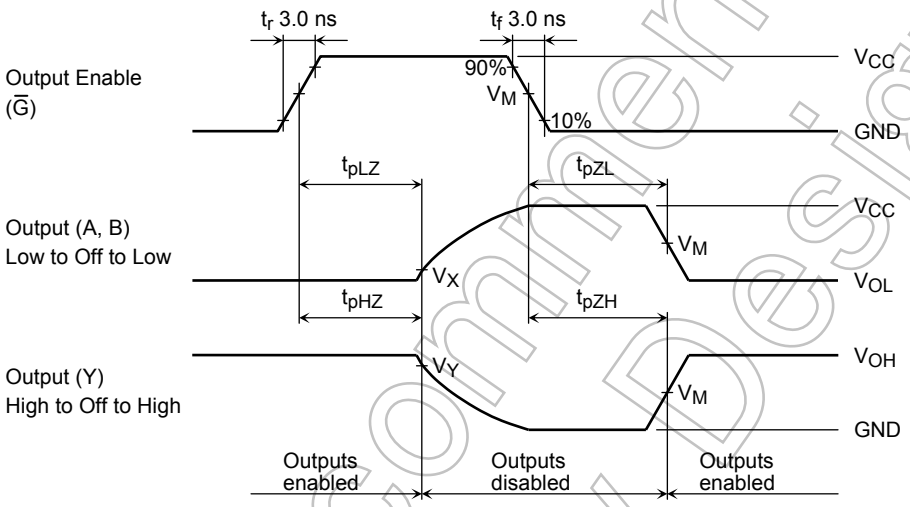
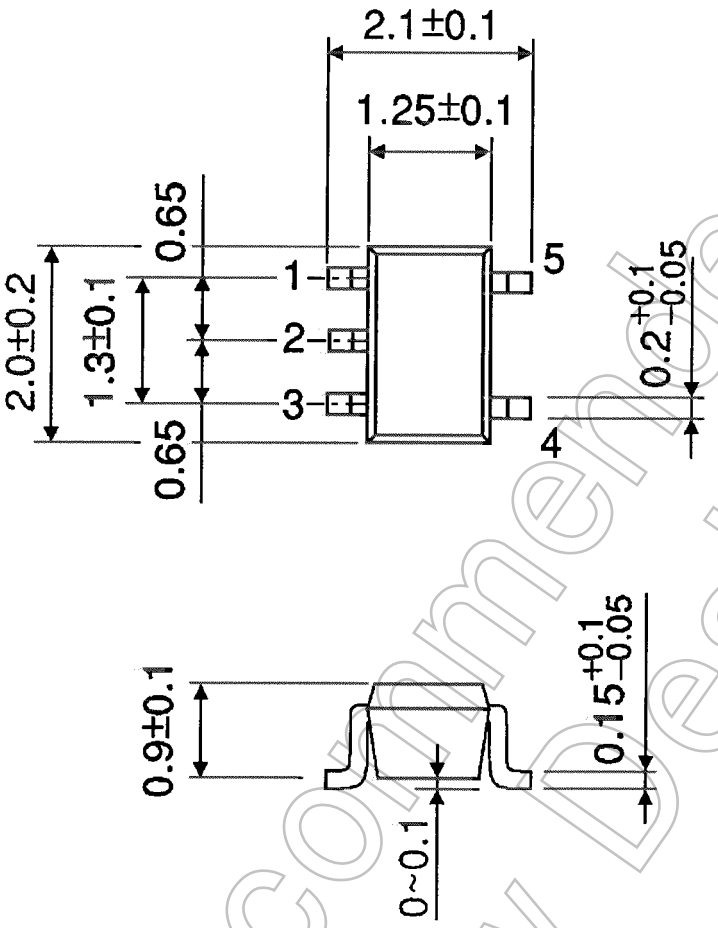


Figure 3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

UNIT	V_{CC}					
	3.3±0.3 V	2.5±0.2 V	1.8±0.15 V	1.5±0.1 V	1.2±0.1 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 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V	V_{OL} + 0.1 V	V_{OL} + 0.1 V	V_{OL} + 0.1 V
V_Y	V_{OH} - 0.3 V	V_{OH} - 0.15 V	V_{OH} - 0.15 V	V_{OH} - 0.1 V	V_{OH} - 0.1 V	V_{OH} - 0.1 V

Package Dimensions

SSOP5-P-0.65A Unit : mm



Weight: 0.006 g (typ.)

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