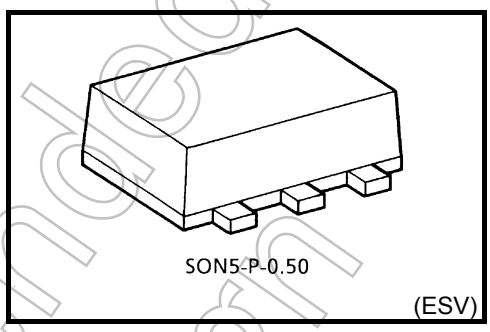
TO SHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SG05FE

Inverter (Open Drain)

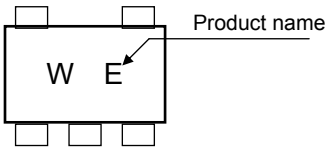
Features

- High output current: 8 mA (min) at V_{CC} = 3.0 V
- High-speed operation: t_{pZL} = 2.5 ns (typ.) at V_{CC} = 3.3 V, 15 pF
- Operating voltage range: V_{CC} = 0.9 to 3.6 V
- 5.5-V tolerant input.
- 3.6-V power down protection output

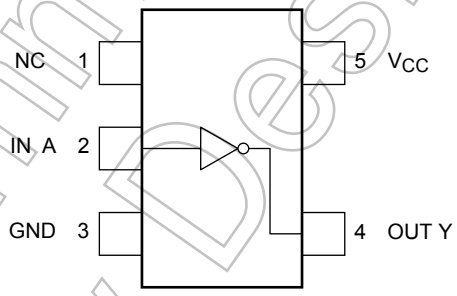


Weight: 0.003 g (typ.)

Marking



Pin Assignment (top view)



Absolute Maximum Ratings (Ta = 25°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
Input diode current	I_{IK}	−20	mA
Output diode current	I_{OK}	−20 (Note 2)	mA
DC output current	I_{OUT}	25	mA
DC V_{CC}/ground current	I_{CC}	±50	mA
Power dissipation	P_D	150	mW
Storage temperature	T_{stg}	−65 to 150	°C

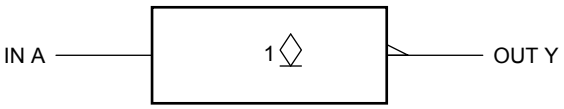
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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: Do not exceed I_{OUT} of absolute maximum ratings

Note 2: $V_{OUT} < GND$

Start of commercial production
2007-08

IEC Logic Symbol



Truth Table

A	Y
L	Z
H	L

Z: High Impedance

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		V
Output Current	I_{OL}	8.0	(Note 3)	mA
		4.0	(Note 4)	
		3.0	(Note 5)	
		1.7	(Note 6)	
		0.3	(Note 7)	
		0.02	(Note 8)	
Operating temperature	T_{opr}	−40 to 85		°C
Input rise and fall time	dt/dv	0 to 10	(Note 9)	ns/V

Note 3: V_{CC} = 3.0 to 3.6 V

Note 4: V_{CC} = 2.3 to 2.7 V

Note 5: V_{CC} = 1.65 to 1.95 V

Note 6: V_{CC} = 1.4 to 1.6 V

Note 7: V_{CC} = 1.1 to 1.3 V

Note 8: V_{CC} = 0.9 V

Note 9: V_{IN} = 0.8 to 2.0 V, V_{CC} = 3.0 V

Electrical Characteristics

DC Characteristics

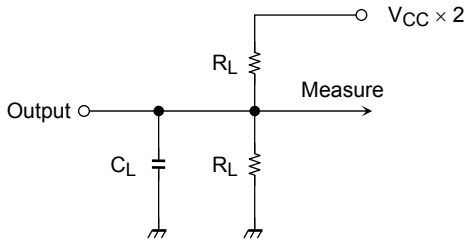
Characteristics	Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Unit
High-level input voltage	V_{IH}	—		0.9	V_{CC}	—	—	V_{CC}	—	V
				1.1 to 1.3	V_{CC} × 0.7	—	—	V_{CC} × 0.7	—	
				1.4 to 1.6	V_{CC} × 0.65	—	—	V_{CC} × 0.65	—	
				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 input voltage	V_{IL}	—		0.9	—	—	GND	—	GND	V
				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	
High-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 0.02 mA	0.9	—	—	0.1	—	0.1	V
			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
Output OFF state current	I_{OZ}	V_{IN} = 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)

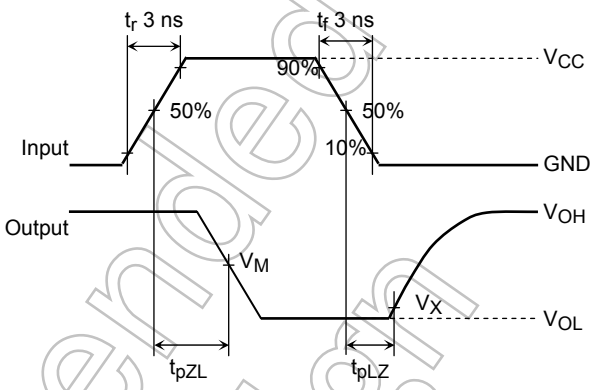
Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = −40 to 85°C		Unit
			V_{CC} (V)	Min.	Typ.	Max.	Min.	Max.	
Propagation delay time	t_{pZL}	C_L = 10 pF, R_L = 100 kΩ	0.9	—	11.9	—	—	—	ns
		C_L = 10 pF, R_L = 5 kΩ	1.1 to 1.3	—	6.3	11.5	1.0	15.0	
			1.4 to 1.6	—	4.2	6.5	1.0	9.5	
			1.65 to 1.95	—	3.4	5.5	1.0	7.1	
			2.3 to 2.7	—	2.7	3.9	1.0	4.5	
			3.0 to 3.6	—	2.3	3.4	1.0	3.9	
		C_L = 15 pF, R_L = 100 kΩ	0.9	—	12.8	—	—	—	
		C_L = 15 pF, R_L = 5 kΩ	1.1 to 1.3	—	7.2	12.8	1.0	17.5	
			1.4 to 1.6	—	4.6	7.7	1.0	10.5	
			1.65 to 1.95	—	3.9	6.6	1.0	7.9	
			2.3 to 2.7	—	3.2	4.5	1.0	5.5	
			3.0 to 3.6	—	2.5	3.7	1.0	4.6	
		C_L = 30 pF, R_L = 100 kΩ	0.9	—	16.4	—	—	—	
		C_L = 30 pF, R_L = 5 kΩ	1.1 to 1.3	—	9.4	17.8	1.0	21.5	
			1.4 to 1.6	—	5.7	9.8	1.0	12.1	
			1.65 to 1.95	—	4.4	7.5	1.0	10.3	
			2.3 to 2.7	—	3.6	5.3	1.0	6.5	
			3.0 to 3.6	—	2.8	4.1	1.0	5.1	
Propagation delay time	t_{pLZ}	C_L = 10 pF, R_L = 100 kΩ	0.9	—	112.5	—	—	—	ns
		C_L = 10 pF, R_L = 5 kΩ	1.1 to 1.3	—	8.6	15.7	1.0	22.7	
			1.4 to 1.6	—	7.5	9.5	1.0	10.6	
			1.65 to 1.95	—	7.1	8.7	1.0	9.6	
			2.3 to 2.7	—	6.8	7.9	1.0	8.8	
			3.0 to 3.6	—	6.5	7.5	1.0	8.4	
		C_L = 15 pF, R_L = 100 kΩ	0.9	—	134.9	—	—	—	
		C_L = 15 pF, R_L = 5 kΩ	1.1 to 1.3	—	10.5	16.8	1.0	24.7	
			1.4 to 1.6	—	9.0	10.4	1.0	11.3	
			1.65 to 1.95	—	8.5	9.7	1.0	10.5	
			2.3 to 2.7	—	7.9	8.8	1.0	10.1	
			3.0 to 3.6	—	7.6	8.3	1.0	9.5	
		C_L = 30 pF, R_L = 100 kΩ	0.9	—	214.5	—	—	—	
		C_L = 30 pF, R_L = 5 kΩ	1.1 to 1.3	—	14.1	18.6	1.0	26.7	
			1.4 to 1.6	—	13.5	14.5	1.0	16.0	
			1.65 to 1.95	—	12.7	13.8	1.0	15.0	
			2.3 to 2.7	—	12.2	13.5	1.0	14.7	
			3.0 to 3.6	—	11.9	12.8	1.0	14.4	
Input capacitance	C_{IN}	—	3.6	—	3	—	—	—	pF
Power dissipation capacitance	C_{PD}	(Note 10)	0.9 to 3.6	—	6	—	—	—	pF

Note 10: 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:
$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

Measurement Circuit for AC Characteristic



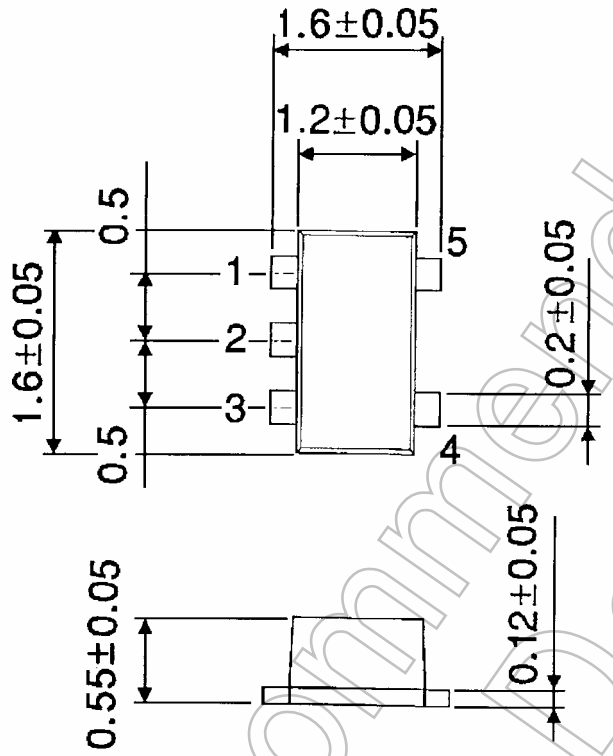
Measurement Waveform



Symbol	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

Package Dimensions

SON5-P-0.50 Unit : mm



Weight: 0.003 g (typ.)

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