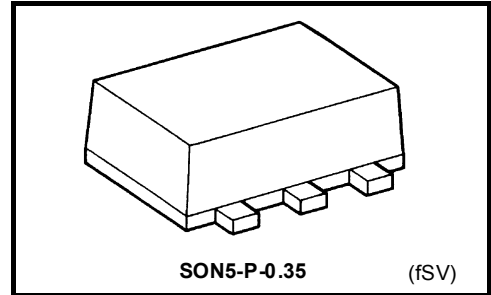


TC7SG05AFS

Inverter (Open Drain)

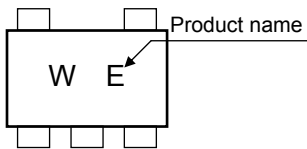
Features

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

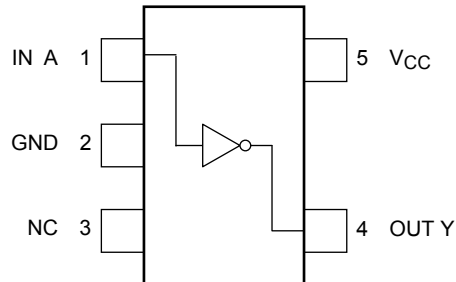


Weight: 0.001 g (typ.)

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
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	50	mW
Storage temperature	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.

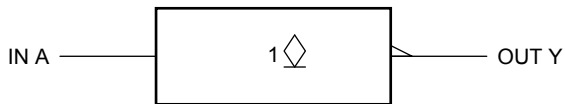
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: 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	Ta = 25°C			Ta = -40 to 85°C		Unit		
			V _{CC} (V)	Min	Typ.	Max	Min		Max	
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)

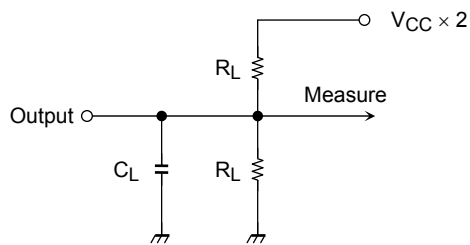
Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit			
			V _{CC} (V)	Min	Typ.	Max	Min		Max		
Propagation delay time	t _{pZL}	C _L = 10 pF, R _L = 100 kΩ	0.9	—	11.9	—	—	ns			
		C _L = 10 pF, R _L = 5 kΩ	1.1 to 1.3	—	6.3	11.5	1.0		15.0		
			1.4 to 1.6	—	4.2	6.5	1.0		9.5		
			1.65 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	
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.

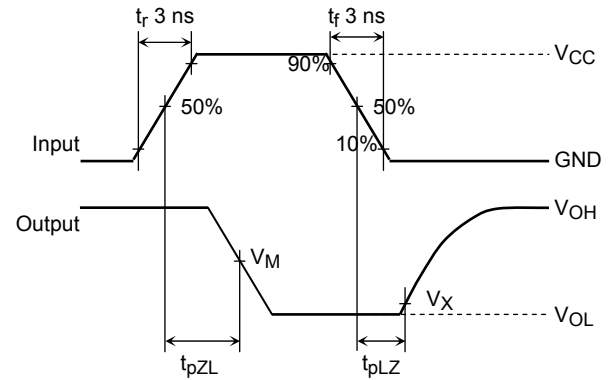
Average operating current can be obtained by the equation:

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

Measurement Circuit for AC Characteristic



Measurement Waveform

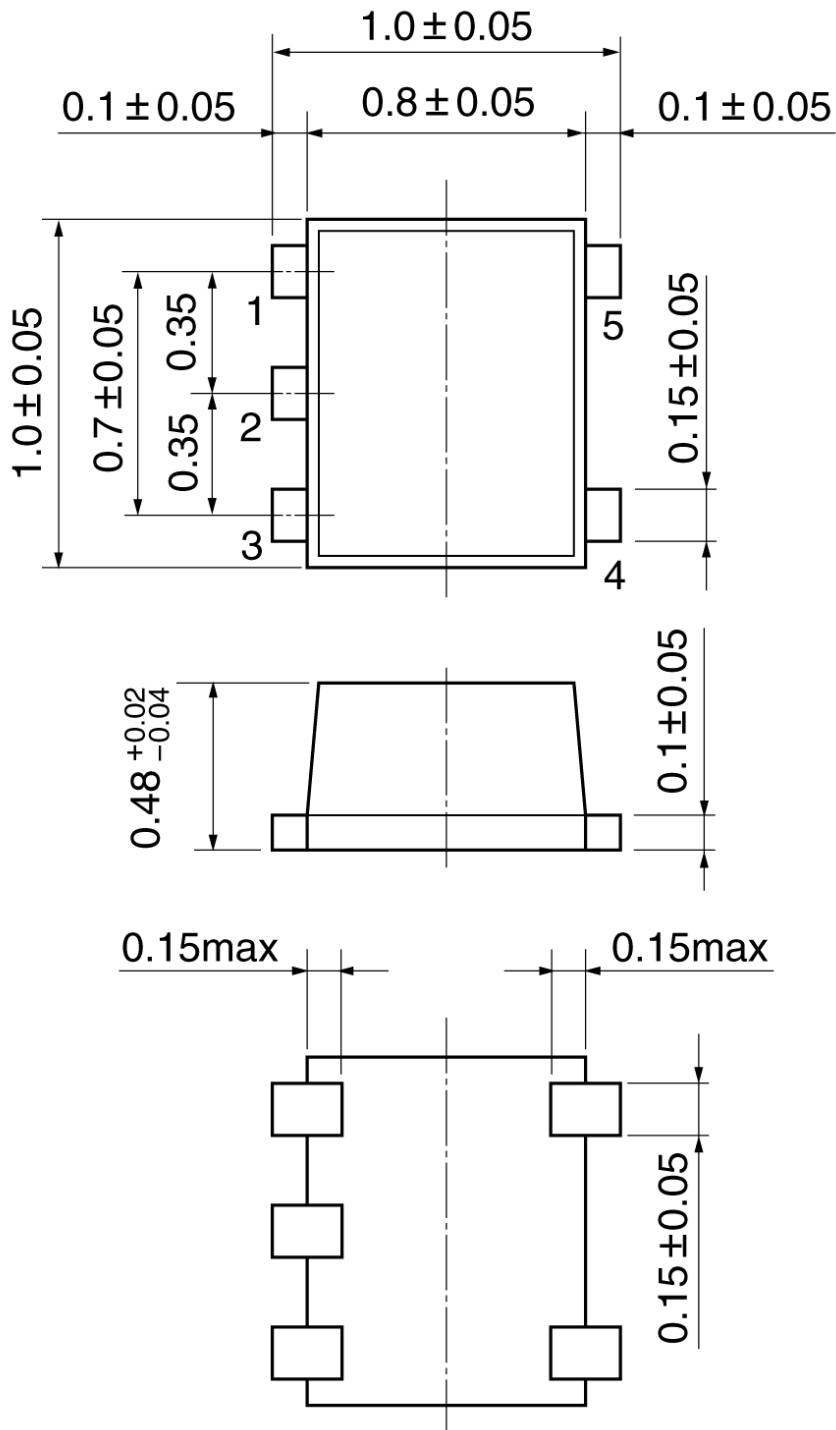


Symbol	V_{CC}					
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	$1.8 \pm 0.15 \text{ V}$	$1.5 \pm 0.1 \text{ V}$	$1.2 \pm 0.1 \text{ V}$	0.9 V
V_M	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$	$V_{CC} / 2$
V_X	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.1 \text{ V}$	$V_{OL} + 0.1 \text{ V}$	$V_{OL} + 0.1 \text{ V}$

Package Dimensions

SON5-P-0.35

Unit:mm



Weight: 0.001 g (typ.)

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