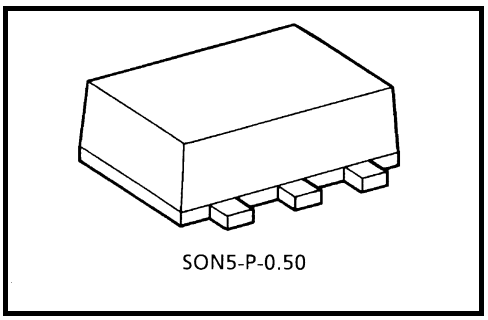
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SZ04AFE

Inverter

Features



Weight: 0.003 g (typ.)

- High output drive: ±24 mA (typ.)
  @V_{CC} = 3 V
- Super high speed operation: t_{PD} 2.4 ns (typ.)
  @V_{CC} = 5 V, 50 pF
- Operation voltage range: $V_{CC\ (opr)}$ = 1.8~5.5 V
- Supply voltage data retention: V_{CC} = 1.5~5.5 V
- Latch-up performance: ±500 mA
- ESD performance: Human body model > ±2000 V
  Machine model > ±200 V
- Power down protection is provided on all inputs.
- Matches the performance of TC74LCX series when operated at 3.3 V V_{CC}
- Input rise and fall time (tr, tf) (recommended operation condition)
  @V_{CC} = 1.8 V, 2.5 V ± 0.2 V: 0~20 ns/V
  @V_{CC} = 3.3 V ± 0.3 V: 0~10 ns/V
  @V_{CC} = 5.5 V ± 0.5 V: 0~5 ns/V

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5~6	V
DC input voltage	V_{IN}	−0.5~6	V
DC output voltage	V_{OUT}	−0.5~V_{CC} + 0.5	V
Input diode current	I_{IK}	±20	mA
Output diode current	I_{OK}	±20	mA
DC output current	I_{OUT}	±50	mA
DC V_{CC}/ground current	I_{CC}	±50	mA
Power dissipation	P_D	150	mW
Storage temperature	T_{stg}	−65~150	°C
Lead temperature (10 s)	T_L	260	°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).

Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	1.8~5.5	V
		1.5~5.5 (Note 1)	
Input voltage	V_{IN}	0~5.5	V
Output voltage	V_{OUT}	0~V_{CC}	V
Operating temperature	T_{opr}	−40~85	°C
Input rise and fall time	dt/dv	0~20 (V_{CC} = 1.8 V, 2.5 V ± 0.2 V)	ns/V
		0~10 (V_{CC} = 3.3 V ± 0.3 V)	
		0~5 (V_{CC} = 5.5 V ± 0.5 V)	

Note 1: Data retention only.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Circuit	Test Condition		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40~85°C Min	Ta = −40~85°C Max	Unit
High-level input voltage	V_{IH}	—	—		1.8	0.75 × V_{CC}	—	—	0.75 × V_{CC}	—	V
					2.3-5.5	0.7 × V_{CC}	—	—	0.7 × V_{CC}	—	
Low-level input voltage	V_{IL}	—	—		1.8	—	—	0.25 × V_{CC}	—	0.25 × V_{CC}	V
					2.3-5.5	—	—	0.3 × V_{CC}	—	0.3 × V_{CC}	
High-level output voltage	V_{OH}	—	V_{IN} = V_{IL}	I_{OH} = −100 μA	1.8	1.7	1.8	—	1.7	—	V
					2.3	2.2	2.3	—	2.2	—	
					3.0	2.9	3.0	—	2.9	—	
					4.5	4.4	4.5	—	4.4	—	
				I_{OH} = −8 mA	2.3	1.9	2.15	—	1.9	—	
				I_{OH} = −16 mA	3.0	2.4	2.8	—	2.4	—	
				I_{OH} = −24 mA	3.0	2.3	2.68	—	2.3	—	
				I_{OH} = −32 mA	4.5	3.8	4.2	—	3.8	—	
Low-level output voltage	V_{OL}	—	V_{IN} = V_{IH}	I_{OL} = 100 μA	1.8	—	0	0.1	—	0.1	V
					2.3	—	0	0.1	—	0.1	
					3.0	—	0	0.1	—	0.1	
					4.5	—	0	0.1	—	0.1	
				I_{OL} = 8 mA	2.3	—	0.1	0.3	—	0.3	
				I_{OL} = 16 mA	3.0	—	0.15	0.4	—	0.4	
				I_{OL} = 24 mA	3.0	—	0.22	0.55	—	0.55	
				I_{OL} = 32 mA	4.5	—	0.22	0.55	—	0.55	
Input leakage current	I_{IN}	—	V_{IN} = 5.5 V or GND		0-5.5	—	—	±1	—	±10	μA
Quiescent supply current	I_{CC}	—	V_{IN} = V_{CC} or GND		5.5	—	—	2	—	20	μA

AC Characteristics (input: $t_r = t_f = 3$ ns)

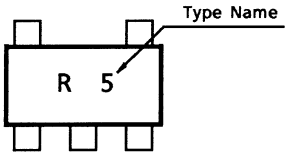
Characteristics	Symbol	Test Circuit	Test Condition		Ta = 25°C			Ta = −40~85°C		Unit
				V_{CC} (V)	Min	Typ.	Max	Min	Max	
Propagation delay time	t_{PLH} t_{PHL}	—	C_L = 15 pF, R_L = 1 MΩ	1.8	2.0	4.4	9.5	2.0	10.0	ns
				2.5 ± 0.2	0.8	2.9	6.5	0.8	7.0	
				3.3 ± 0.3	0.5	2.1	4.5	0.5	4.7	
				5.0 ± 0.5	0.5	1.8	3.9	0.5	4.1	
			C_L = 50 pF, R_L = 500 Ω	3.3 ± 0.3	1.5	2.9	5.0	1.5	5.2	
				5.0 ± 0.5	0.8	2.4	4.3	0.8	4.5	
Input capacitance	C_{IN}	—	—	0-5.5	—	4	—	—	—	pF
Power dissipation capacitance	C_{PD}	—	(Note)	3.3	—	21	—	—	—	pF
				5.5	—	34	—	—	—	

Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

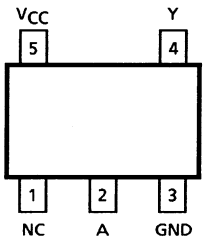
Average operating current can be obtained by the equation.

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

Marking



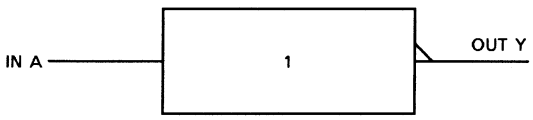
Pin Assignment (top view)



Truth Table

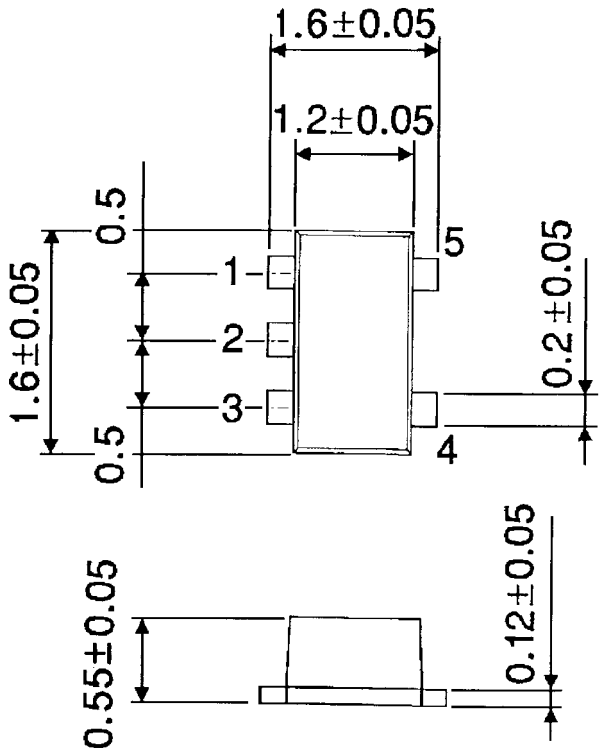
A	Y
L	H
H	L

Logic Diagram



Package Dimensions

SON5-P-0.50 Unit : mm



Weight: 0.003 g (typ.)

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