TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7S04F, TC7S04FU

Inverter

The TC7S04 is a high speed C^2MOS Inverter fabricated with silicon gate C^2MOS technology.

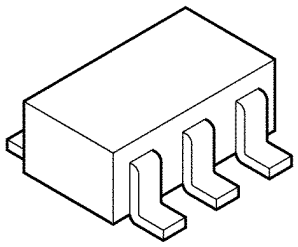
It achieves high speed operation similar to equivalent LSTTL while maintaining the C^2MOS low power dissipation.

The internal circuit is composed of 3 stages including buffer output, which enables high noise immunity and stable output.

The input is equipped with protection circuits against static discharge or transient excess voltage.

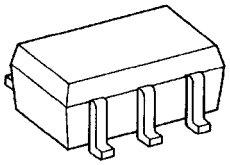
Output currents are 1/2 compared to TC74HC series models.

TC7S04F



SSOP5-P-0.95

TC7S04FU



SSOP5-P-0.65A

Weight
SSOP5-P-0.95: 0.016 g (typ.)
SSOP5-P-0.65A: 0.006 g (typ.)

Features

- High speed: t_{pd} = 7 ns (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 1 μA (max) at Ta = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)
- Output drive capability: 5 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL}$ = 2 mA (min)
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2 to 6 V

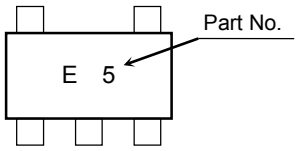
Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7	V
DC input voltage	V_{IN}	-0.5 to V_{CC} + 0.5	V
DC output voltage	V_{OUT}	-0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}	±20	mA
Output diode current	I_{OK}	±20	mA
DC output current	I_{OUT}	±12.5	mA
DC V_{CC}/ground current	I_{CC}	±25	mA
Power dissipation	P_D	200	mW
Storage temperature range	T_{stg}	-65 to 150	°C
Lead temperature (10 s)	T_L	260	°C

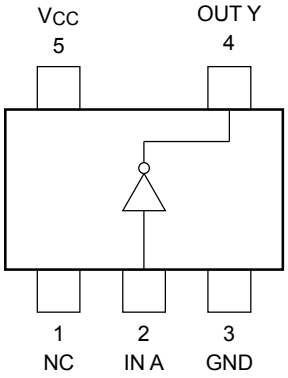
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

Start of commercial production
1987-08

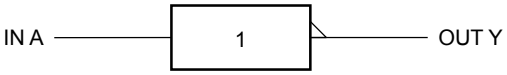
Marking



Pin Configuration (top view)



Logic Diagram



Truth Table

A	Y
L	H
H	L

Operating Ranges

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 6	V
Input voltage	V_{IN}	0 to V_{CC}	V
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature range	T_{opr}	-40 to 85	°C
Input rise and fall time	t_r, t_f	0 to 1000 (V_{CC} = 2.0 V)	ns
		0 to 500 (V_{CC} = 4.5 V)	
		0 to 400 (V_{CC} = 6.0 V)	

Electrical Characteristics

DC Electrical 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
Input voltage	High level	V_{IH}	—		2.0	1.5	—	—	1.5	—	V
					4.5	3.15	—	—	3.15	—	
					6.0	4.2	—	—	4.2	—	
	Low level	V_{IL}	—		2.0	—	—	0.5	—	0.5	
					4.5	—	—	1.35	—	1.35	
					6.0	—	—	1.8	—	1.8	
Output voltage	High level	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -20 μA	2.0	1.9	2.0	—	1.9	—	V
					4.5	4.4	4.5	—	4.4	—	
					6.0	5.9	6.0	—	5.9	—	
				I_{OH} = -2 mA	4.5	4.18	4.31	—	4.13	—	
				I_{OH} = -2.6 mA	6.0	5.68	5.80	—	5.63	—	
	Low level	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 20 μA	2.0	—	0	0.1	—	0.1	
					4.5	—	0	0.1	—	0.1	
					6.0	—	0	0.1	—	0.1	
				I_{OL} = 2 mA	4.5	—	0.17	0.26	—	0.33	
				I_{OL} = 2.6 mA	6.0	—	0.18	0.26	—	0.33	
Input leakage current		I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	—	1.0	—	10.0	μA

Note: Output currents are 1/2 compared to TC74HC series models.

AC Electrical Characteristics (C_L = 15 pF, input t_r = t_f = 6 ns, V_{CC} = 5 V)

Characteristics	Symbol	Test Condition	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Unit
Output transition time	t_{TLH} t_{THL}	—	—	5	10	ns
Propagation delay time	t_{pLH} t_{pHL}	—	—	7	15	ns

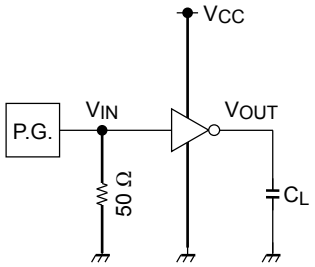
AC Electrical Characteristics (C_L = 50 pF, input $t_r = t_f$ = 6 ns)

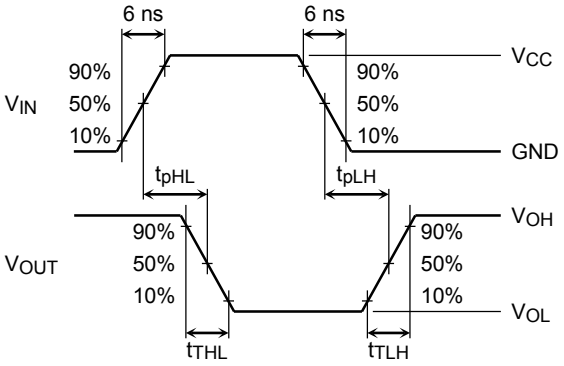
Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit
			V_{CC} (V)	Min	Typ.	Max	Min	Max	
Output transition time	t_{TLH} t_{THL}	—	2.0	—	50	125	—	155	ns
			4.5	—	14	25	—	31	
			6.0	—	12	21	—	26	
Propagation delay time	t_{pLH} t_{pHL}	—	2.0	—	48	100	—	125	ns
			4.5	—	12	20	—	25	
			6.0	—	9	17	—	21	
Input capacitance	C_{IN}	—		—	5	10	—	10	pF
Power dissipation capacitance	C_{PD}	(Note 1)		—	10	—	—	—	pF

Note 1: C_{PD} defined as the value of internal equivalent capacitance of IC which is calculated from the operating current consumption without load (refer to test circuit).
Average operating current can be obtained by the equation hereunder.

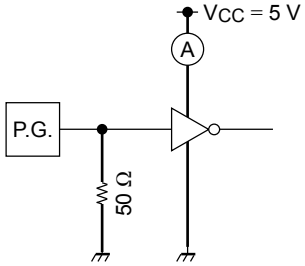
$I_{CC\ (opr)} = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

Switching Characteristics Test Circuit





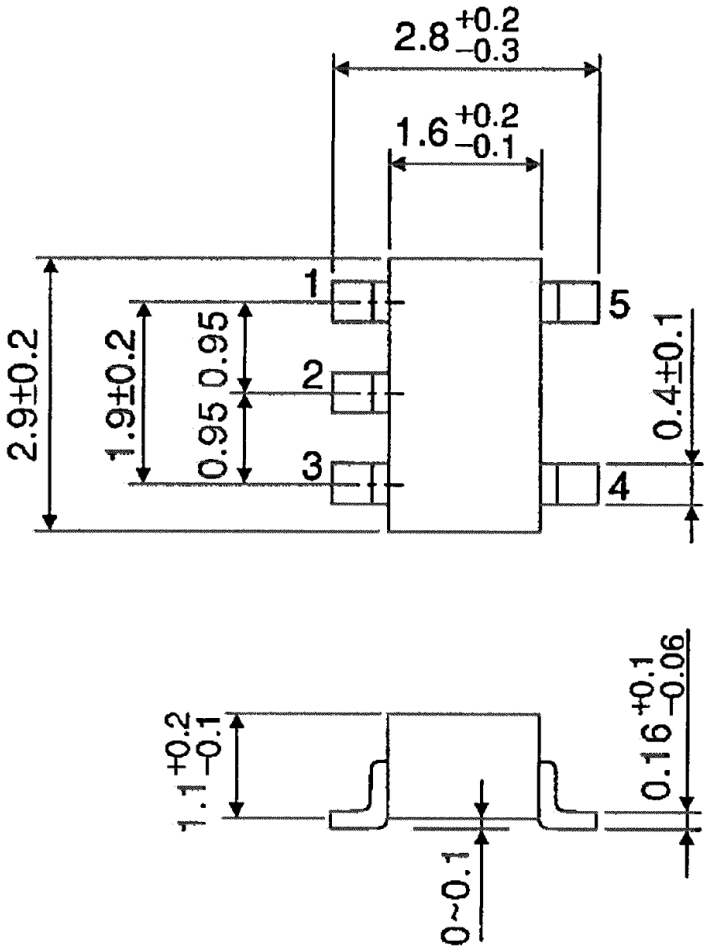
$I_{CC\ (opr)}$ Test Circuit



Input waveform is the same as that in case of switching characteristics test.

Package Dimensions

SSOP5-P-0.95 Unit : mm

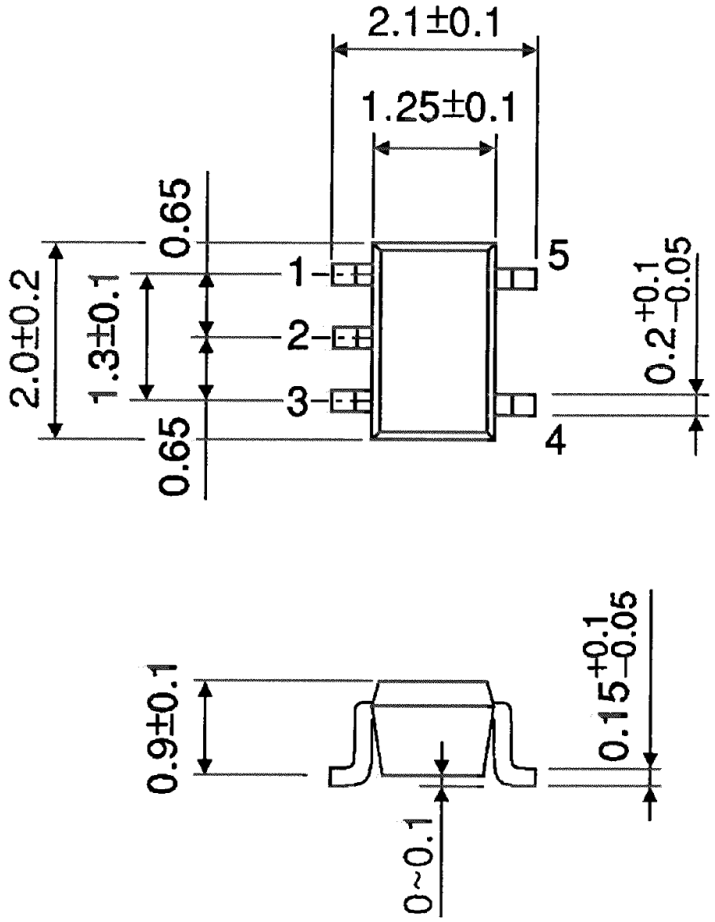


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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