

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7SHU04F, TC7SHU04FU

## INVERTER

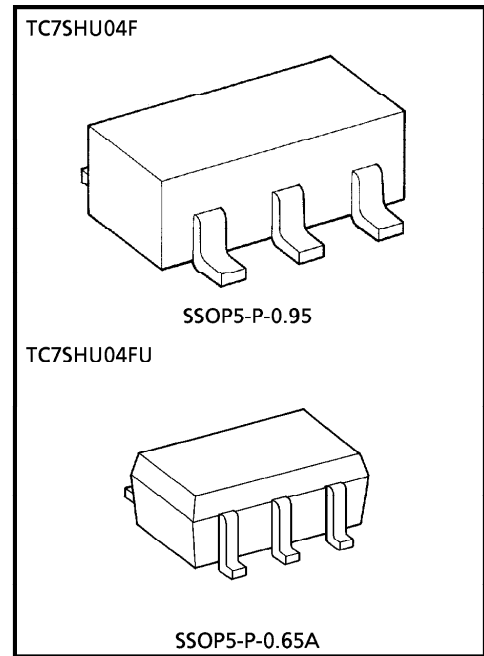
The TC7SHU04 is an advanced high speed CMOS INVERTER fabricated with silicon gate C<sup>2</sup>MOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. Since the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillators. An input protection circuit ensures that 0 to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interfase 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### FEATURES

- High Speed .....  $t_{pd} = 3.5ns$  (Typ.) at  $V_{CC} = 5V$
- Low Power Dissipation .....  $I_{CC} = 2\mu A$  (Max.) at  $T_a = 25^\circ C$
- High Noise Immunity .....  $V_{NIH} = V_{NIL} = 10\% V_{CC}$  (Min.)
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays .....  $t_{pLH} \approx t_{pHL}$
- Wide Operating Voltage Range .....  $V_{CC(opr)} = 2 \sim 5.5V$

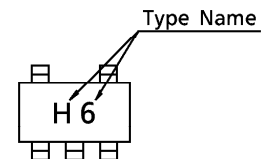
### MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage Range	$V_{CC}$	-0.5~7.0	V
DC Input Voltage	$V_{IN}$	-0.5~7.0	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	$I_{OUT}$	±25	mA
DC $V_{CC}$ / Ground Current	$I_{CC}$	±50	mA
Power Dissipation	$P_D$	200	mW
Storage Temperature	$T_{stg}$	-65~150	°C
Lead Temperature (10s)	$T_L$	260	°C



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

### MARKING



### TRUTH TABLE

A	Y
L	H
H	L

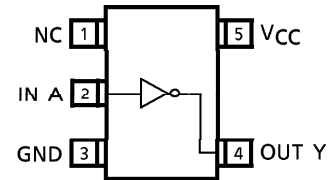
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**LOGIC DIAGRAM**



**PIN ASSIGNMENT (TOP VIEW)**



**RECOMMENDED OPERATING CONDITIONS**

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V <sub>CC</sub>	2.0~5.5	V
Input Voltage	V <sub>IN</sub>	0~5.5	V
Output Voltage	V <sub>OUT</sub>	0~V <sub>CC</sub>	V
Operating Temperature	T <sub>opr</sub>	-40~85	°C

**DC ELECTRICAL CHARACTERISTICS**

PARAMETER	SYMBOL	TEST CIRCUIT	TEST CONDITION	Ta = 25°C			Ta = -40~85°C		UNIT		
				V <sub>CC</sub>	MIN.	TYP.	MAX.	MIN.		MAX.	
High-Level Input Voltage	V <sub>IH</sub>	—	—	2.0	1.7	—	—	1.7	V		
				3.0~5.5	V <sub>CC</sub> × 0.8	—	—	V <sub>CC</sub> × 0.8		—	
Low-Level Input Voltage	V <sub>IL</sub>	—	—	2.0	—	—	0.30	—	0.30	V	
				3.0~5.5	—	—	V <sub>CC</sub> × 0.2	—	V <sub>CC</sub> × 0.2		—
High Level Output-Voltage	V <sub>OH</sub>	—	V <sub>IN</sub> = V <sub>IL</sub>	I <sub>OH</sub> = -50μA	2.0	1.8	2.0	—	1.8	V	
					3.0	2.7	3.0	—	2.7		—
			V <sub>IN</sub> = GND	I <sub>OH</sub> = -4mA I <sub>OH</sub> = -8mA	3.0	2.58	—	—	2.48		—
					4.5	3.94	—	—	3.80		—
Low-Level Output-Voltage	V <sub>OL</sub>	—	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OL</sub> = 50μA	2.0	—	0.0	0.2	—	0.2	V
					3.0	—	0.0	0.3	—	0.3	
			V <sub>IN</sub> = V <sub>CC</sub>	I <sub>OL</sub> = 4mA I <sub>OL</sub> = 8mA	3.0	—	—	0.36	—	0.44	
					4.5	—	—	0.36	—	0.44	
Input Leakage Current	I <sub>IN</sub>	—	V <sub>IN</sub> = 5.5V or GND	0~5.5	—	—	±0.1	—	±1.0	μA	
Quiescent Supply Current	I <sub>CC</sub>	—	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	—	—	2.0	—	20.0		

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**AC ELECTRICAL CHARACTERISTICS** (Input  $t_r = t_f = 3\text{ns}$ )

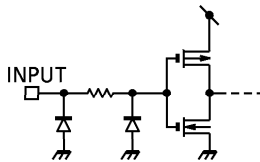
PARAMETER	SYMBOL	TEST CIR-CUIT	TEST CONDITION		Ta = 25°C			Ta = - 40~85°C		UNIT	
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	MIN.	TYP.	MAX.	MIN.	MAX.		
Propagation Delay Time	t <sub>PLH</sub>	—	—	3.3 ± 0.3	15	—	5.0	8.9	1.0	10.5	ns
					50	—	7.5	11.4	1.0	13.0	
	t <sub>PHL</sub>			5.0 ± 0.5	15	—	3.5	5.5	1.0	6.5	
					50	—	5.0	7.0	1.0	8.0	
Input Capacitance	C <sub>IN</sub>	—	—		—	5	10	—	10	pF	
Power Dissipation Capacitance	C <sub>PD</sub>	—	Note (1)		—	6	—	—	—		

Note (1) : C<sub>PD</sub> 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 :

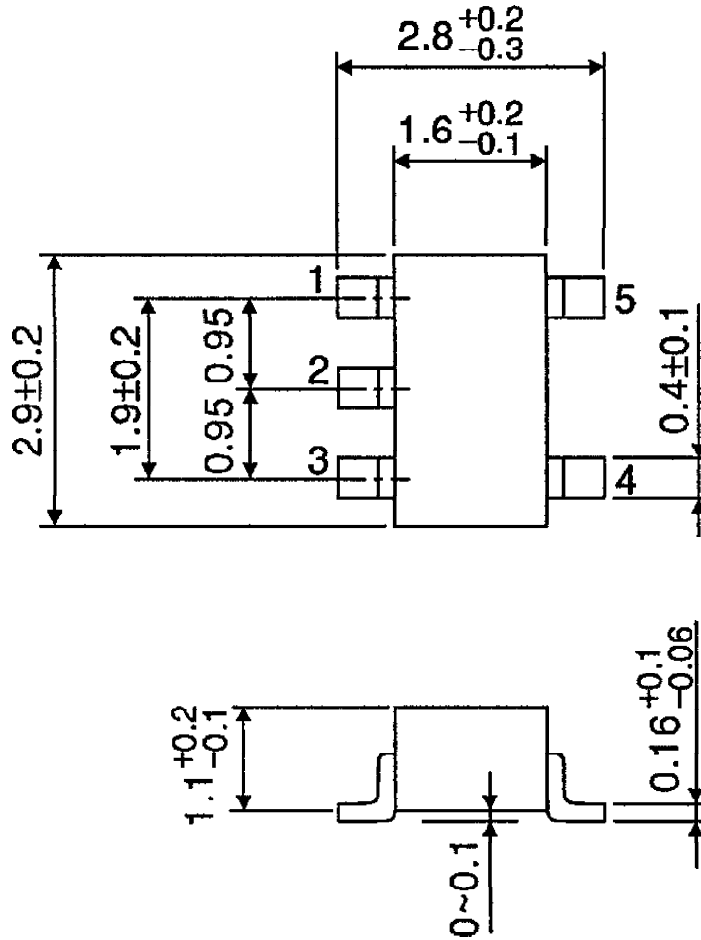
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

**INPUT EQUIVALENT CIRCUIT**



OUTLINE DRAWING  
SSOP5-P-0.95

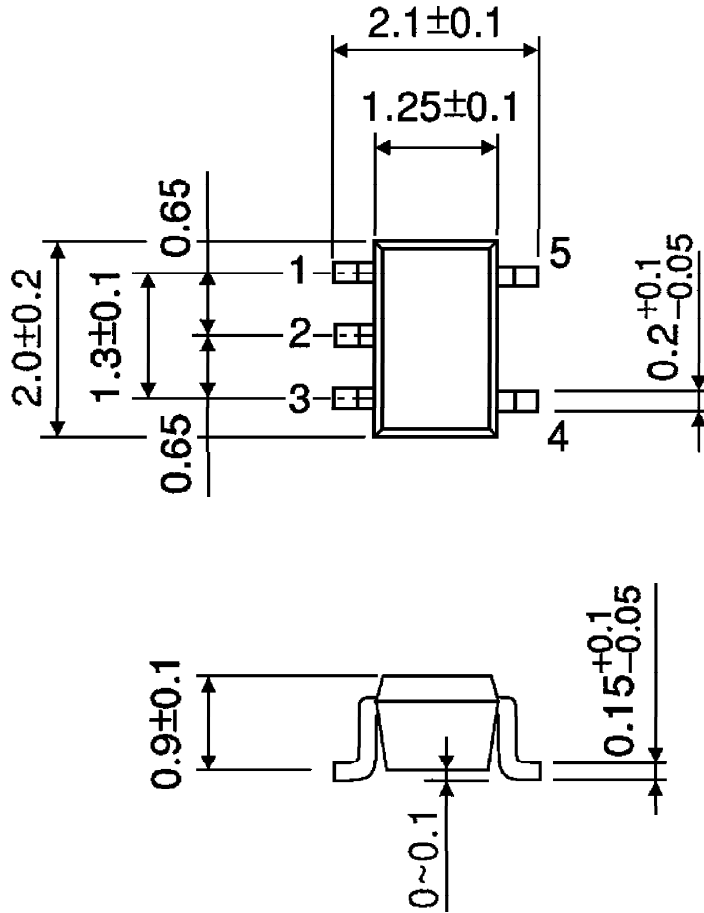
Unit : mm



Weight : 0.016g (Typ.)

OUTLINE DRAWING  
SSOP5-P-0.65A

Unit : mm



Weight : 0.006g (Typ.)