

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4093BP, TC4093BF, TC4093BFN

## TC4093B Quad 2-Input NAND Schmitt Triggers

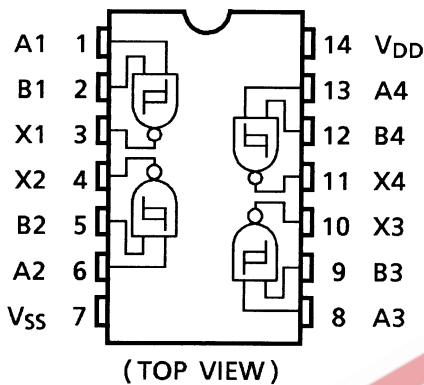
The TC4093B is a quad 2-input NAND gate having Schmitt trigger function for all the input terminals.

Since the circuit threshold voltage varies with rising time and falling time of the input waveform ( $V_P$  and  $V_N$ ), this gate can be used for a wide variety of applications to line receivers, waveform shaping, astable multivibrators, monostable multivibrators, etc.

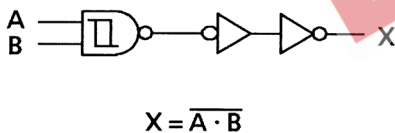
In addition to regular NAND gates.

As the TC4093B and the TC4011B are identical in pin assignment, they are compatible each other.

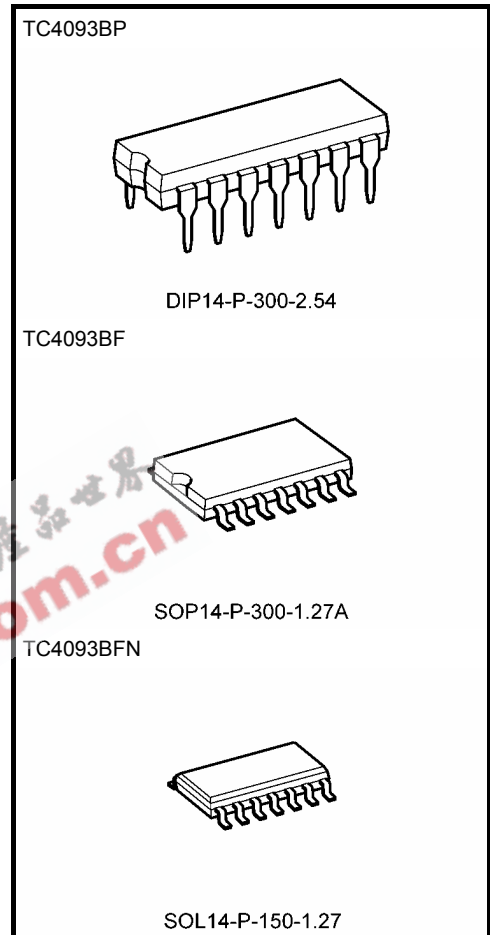
### Pin Assignment



### Logic Diagram

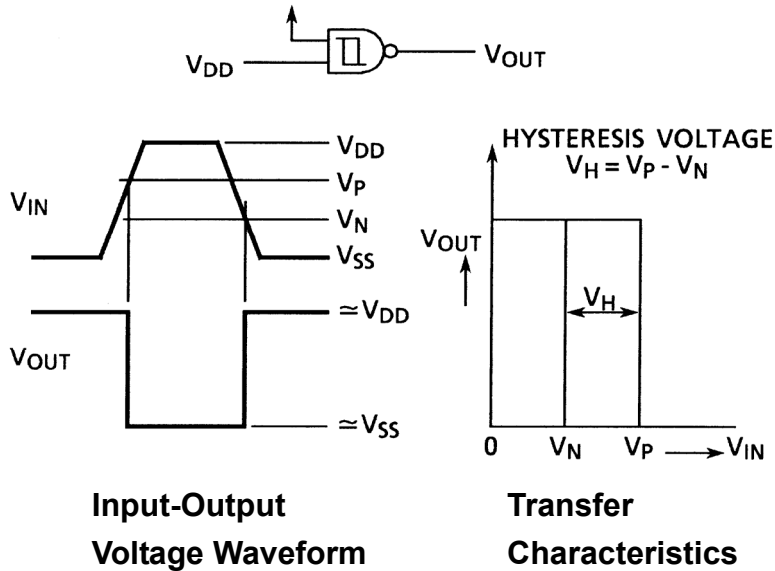


Note: xxxFN (JEDEC SOP) is not available in Japan.



Weight	
DIP14-P-300-2.54	: 0.96 g (typ.)
SOP14-P-300-1.27A	: 0.18 g (typ.)
SOL14-P-150-1.27	: 0.12 g (typ.)

## Input-Output Characteristic



**Input-Output  
Voltage Waveform**

**Transfer  
Characteristics**

## Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}$	$V_{SS} - 0.5 \sim V_{SS} + 20$	V
Input voltage	$V_{IN}$	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
Output voltage	$V_{OUT}$	$V_{SS} - 0.5 \sim V_{DD} + 0.5$	V
DC input current	$I_{IN}$	$\pm 10$	mA
Power dissipation	$P_D$	300 (DIP)/180 (SOIC)	mW
Operating temperature range	$T_{opr}$	$-40 \sim 85$	$^{\circ}\text{C}$
Storage temperature range	$T_{stg}$	$-65 \sim 150$	$^{\circ}\text{C}$

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

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 ( $V_{SS} = 0\text{ V}$ ) (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	$V_{DD}$	—	3	—	18	V
Input voltage	$V_{IN}$	—	0	—	$V_{DD}$	V

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{DD}$  or  $V_{SS}$ .

## Static Electrical Characteristics (V<sub>SS</sub> = 0 V)

Characteristics	Sym- bol	Test Condition	V <sub>DD</sub> (V)	-40°C		25°C			85°C		Unit	
				Min	Max	Min	Typ.	Max	Min	Max		
High-level output voltage	V <sub>OH</sub>	I <sub>OUT</sub>   < 1 μA V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	5	4.95	—	4.95	5.00	—	4.95	—	V	
			10	9.95	—	9.95	10.00	—	9.95	—		
			15	14.95	—	14.95	15.00	—	14.95	—		
Low-level output voltage	V <sub>OL</sub>	I <sub>OUT</sub>   < 1 μA V <sub>IN</sub> = V <sub>DD</sub>	5	—	0.05	—	0.00	0.05	—	0.05	V	
			10	—	0.05	—	0.00	0.05	—	0.05		
			15	—	0.05	—	0.00	0.05	—	0.05		
Output high current	I <sub>OH</sub>	V <sub>OH</sub> = 4.6 V V <sub>OH</sub> = 2.5 V V <sub>OH</sub> = 9.5 V V <sub>OH</sub> = 13.5 V V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	5	-0.61	—	-0.51	-1.0	—	-0.42	—	mA	
			5	-2.50	—	-2.10	-4.0	—	-1.70	—		
			10	-1.50	—	-1.30	-2.2	—	-1.10	—		
			15	-4.00	—	-3.40	-9.0	—	-2.80	—		
Output low current	I <sub>OL</sub>	V <sub>OL</sub> = 0.4 V V <sub>OL</sub> = 0.5 V V <sub>OL</sub> = 1.5 V V <sub>IN</sub> = V <sub>DD</sub>	5	0.61	—	0.51	1.5	—	0.42	—	mA	
			10	1.5	—	1.30	3.8	—	1.10	—		
			15	4.0	—	3.40	15.0	—	2.80	—		
High threshold voltage	V <sub>P</sub>	V <sub>OUT</sub> = 0.5 V, 4.5 V V <sub>OUT</sub> = 1.0 V, 9.0 V V <sub>OUT</sub> = 1.5 V, 13.5 V	5	—	—	2.05	2.8	3.55	—	—	V	
			10	—	—	4.10	5.3	7.00	—	—		
			15	—	—	6.20	7.8	10.40	—	—		
Low threshold voltage	V <sub>N</sub>	V <sub>OUT</sub> = 0.5 V, 4.5 V V <sub>OUT</sub> = 1.0 V, 9.0 V V <sub>OUT</sub> = 1.5 V, 13.5 V	5	—	—	1.5	2.3	3.15	—	—	V	
			10	—	—	3.2	4.5	6.30	—	—		
			15	—	—	4.8	6.6	9.30	—	—		
Hysteresis voltage	V <sub>H</sub>	—	5	—	—	0.20	0.5	0.85	—	—	V	
			10	—	—	0.30	0.8	1.40	—	—		
			15	—	—	0.45	1.2	1.90	—	—		
Input current	"H" level	I <sub>IH</sub>	V <sub>IH</sub> = 18 V	18	—	0.1	—	10 <sup>-5</sup>	0.1	—	1.0	μA
	"L" level	I <sub>IL</sub>	V <sub>IL</sub> = 0 V	18	—	-0.1	—	-10 <sup>-5</sup>	-0.1	—	-1.0	
Quiescent supply current	I <sub>DD</sub>	V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub> (Note)	5	—	1	—	0.001	1	—	7.5	μA	
			10	—	2	—	0.002	2	—	15.0		
			15	—	4	—	0.004	4	—	30.0		

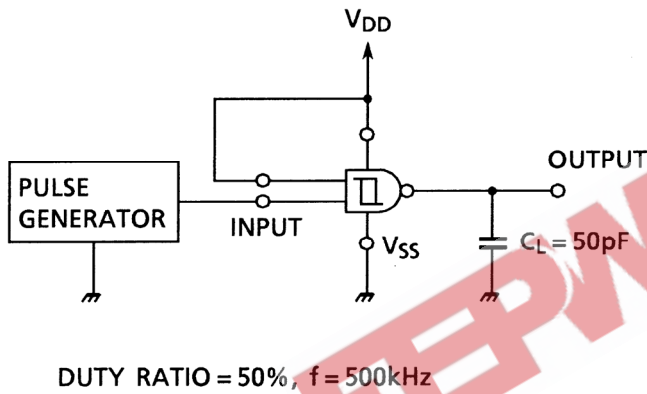
Note: All valid input combinations.

## Dynamic Electrical Characteristics (Ta = 25°C, VSS = 0 V, CL = 50 pF)

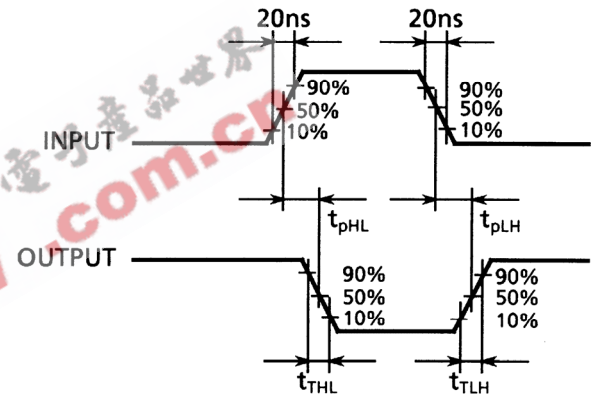
Characteristics	Symbol	Test Condition	VDD (V)	Min	Typ.	Max	Unit
			5	10	15		
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	80	200	ns
			10	—	50	100	
			15	—	40	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	80	200	ns
			10	—	50	100	
			15	—	40	80	
Propagation delay time	t <sub>pLH</sub>	—	5	—	130	260	ns
			10	—	60	120	
	t <sub>pHL</sub>		15	—	40	80	
Input capacitance	C <sub>IN</sub>	—	—	5	7.5	pF	

## Circuit and Waveform for Measurement of Dynamic Characteristics

### Circuit



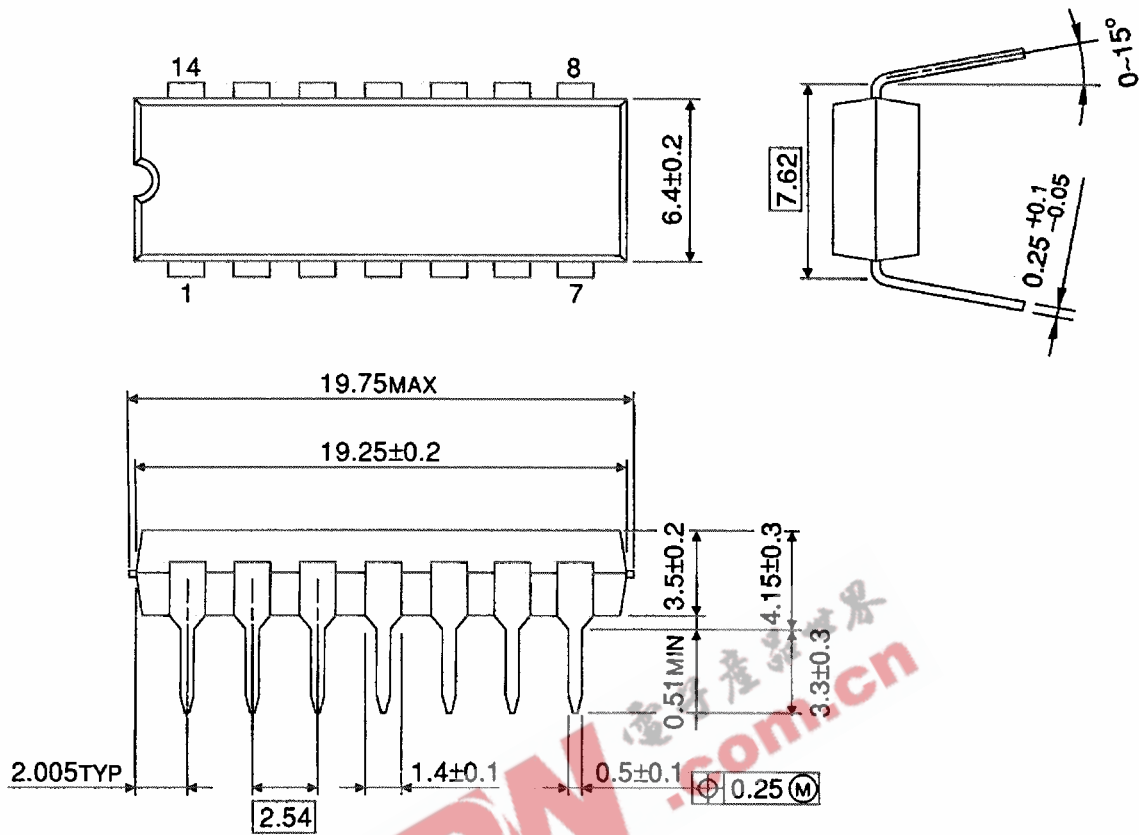
### Waveform



## Package Dimensions

DIP14-P-300-2.54

Unit : mm

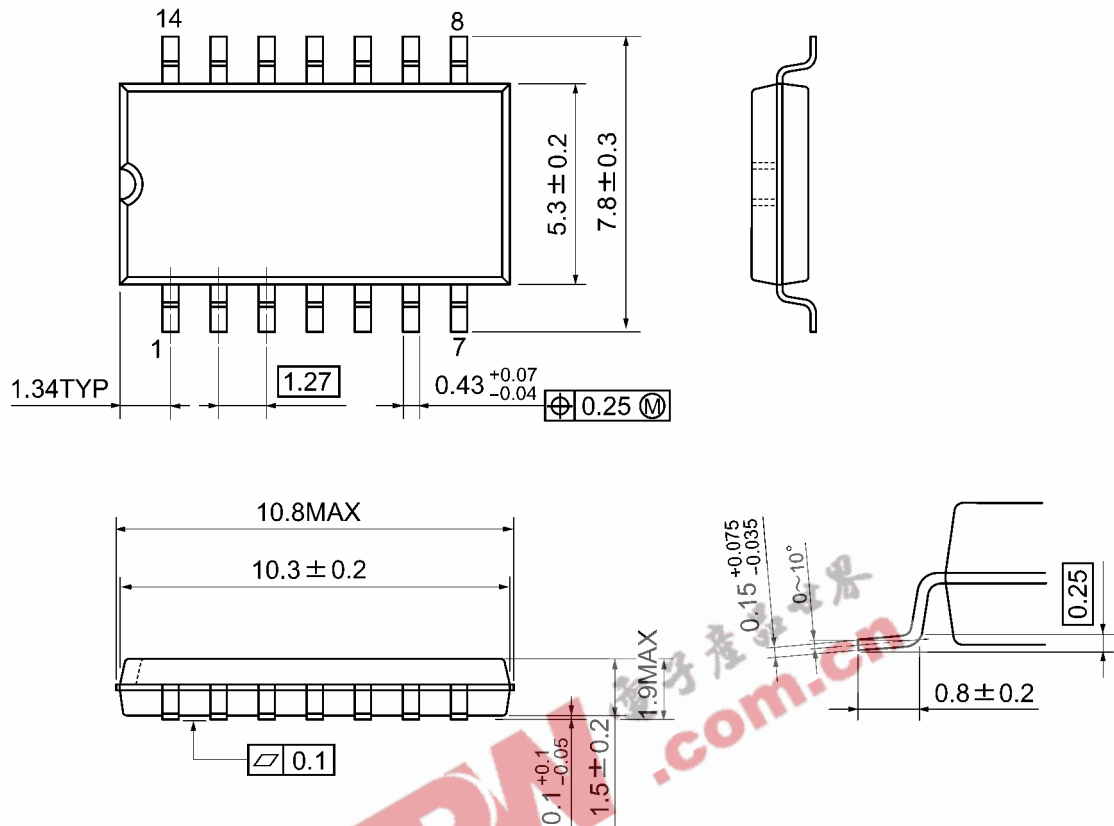


Weight: 0.96 g (typ.)

**Package Dimensions**

SOP14-P-300-1.27A

Unit: mm

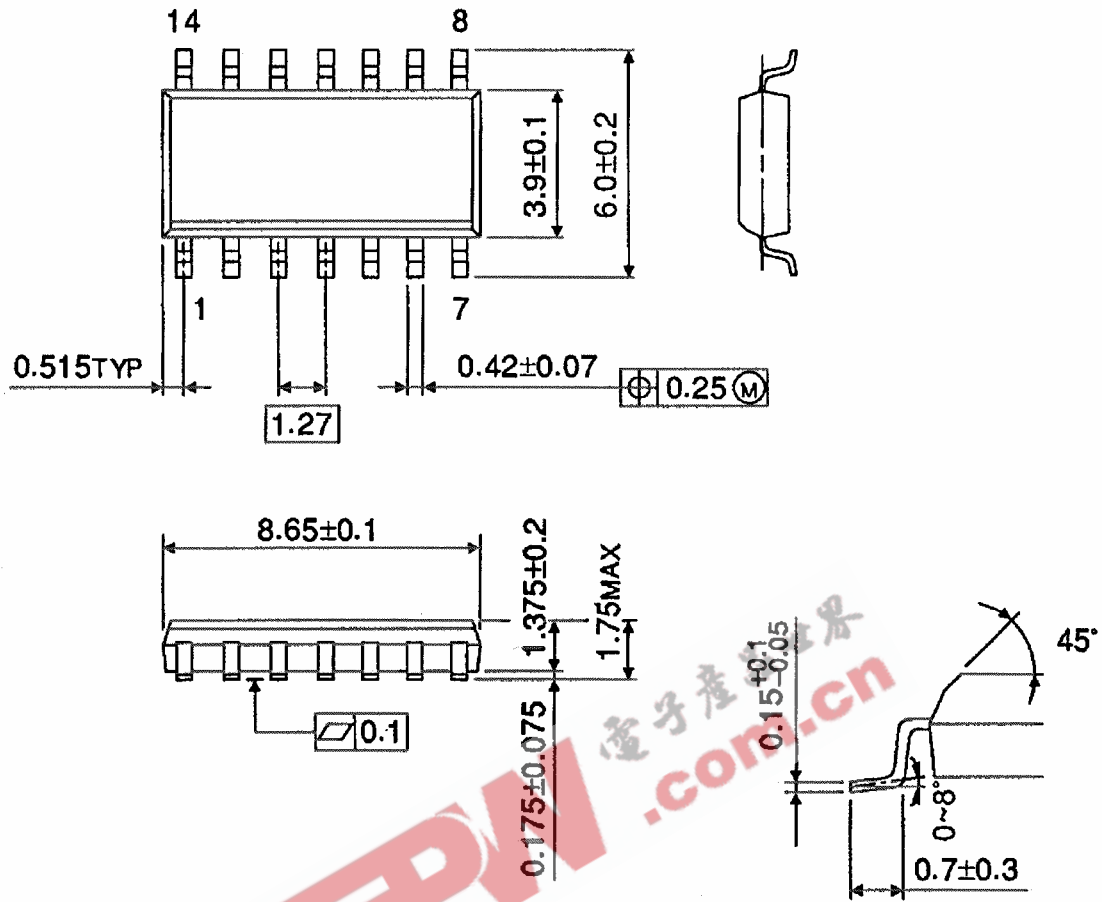


Weight: 0.18 g (typ.)

## Package Dimensions (Note)

SOL14-P-150-1.27

Unit : mm



Note: This package is not available in Japan.

Weight: 0.12 g (typ.)

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20070701-EN GENERAL

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