

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4021BP, TC4021BF

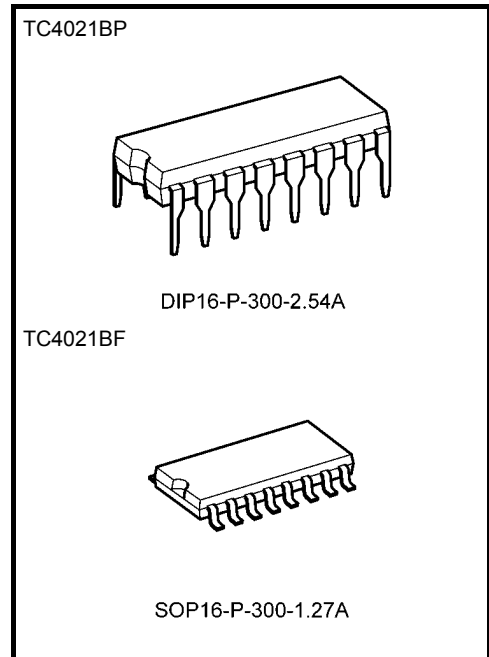
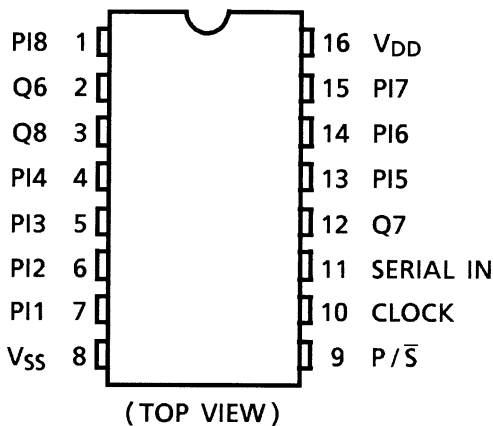
## TC4021B 8-Stage Static Shift Register

(asynchronous parallel input or synchronous serial input/serial output)

TC4021B is 8 stage parallel in/serial out shift register, which can be used also for serial in/serial out operations. In the case of parallel operation, the data of PARALLEL IN is input to each F/F asynchronously with CLOCK and the output is obtained. In the case of serial operations, each F/F is triggered by rising edge of CLOCK. (asynchronous parallel or synchronous serial input)

Switching of PARALLEL operation and SERIAL operation is achieved by P/ $\bar{S}$  CONTROL input. When P/ $\bar{S}$  CONTROL input is "H", PARALLEL operation is designated and when it is "L", SERIAL operation is designated.

### Pin Assignment



Weight  
 DIP16-P-300-2.54A : 1.00 g (typ.)  
 SOP16-P-300-1.27A : 0.18 g (typ.)

### Truth Table

Inputs					Outputs $\Delta$	
CLOCK $\Delta\Delta$	P/ $\bar{S}$	PI1	PI $n$	SI	Q1	Q $n$
	L	*	*	L	L	Q $n$ - 1
	L	*	*	H	H	Q $n$ - 1
	L	*	*	*	No Change	
*	H	L	L	*	L	L
*	H	L	H	*	L	H
*	H	H	L	*	H	L
*	H	H	H	*	H	H

n: 2 to 8

$\Delta$ : Q1 to Q5 internal

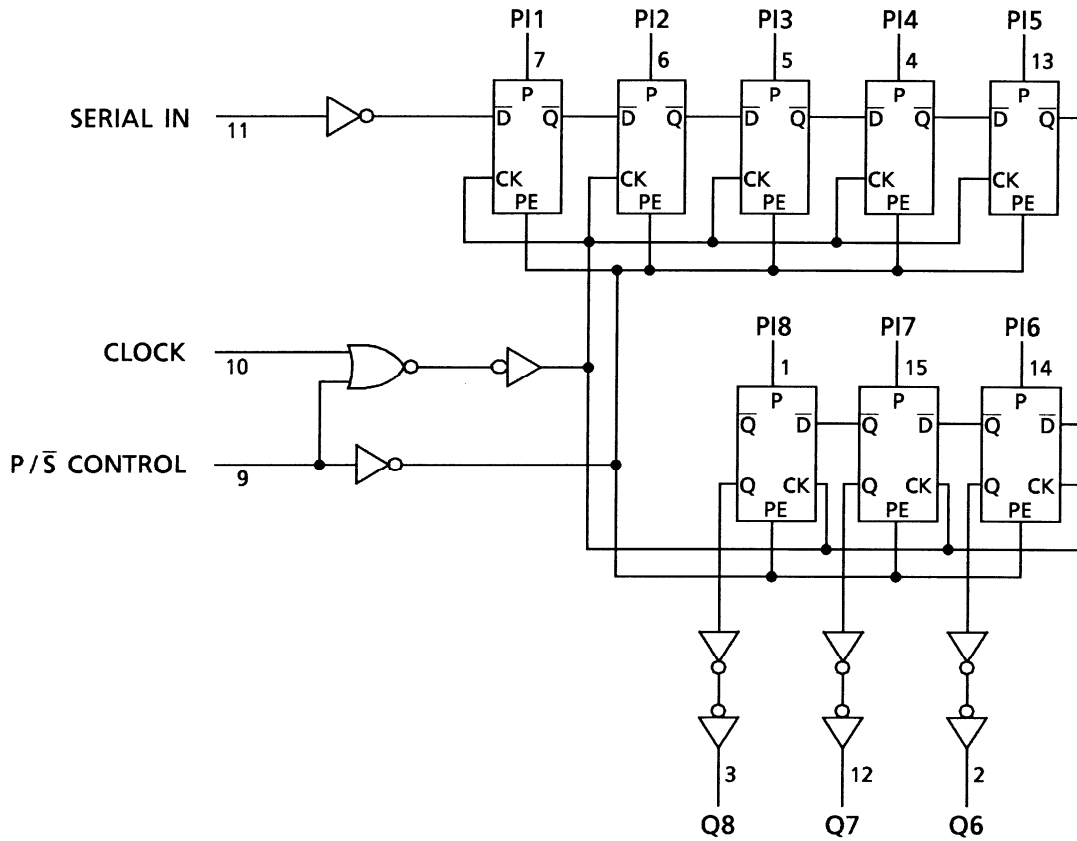
$\Delta\Delta$ : Level change

\*: Don't care

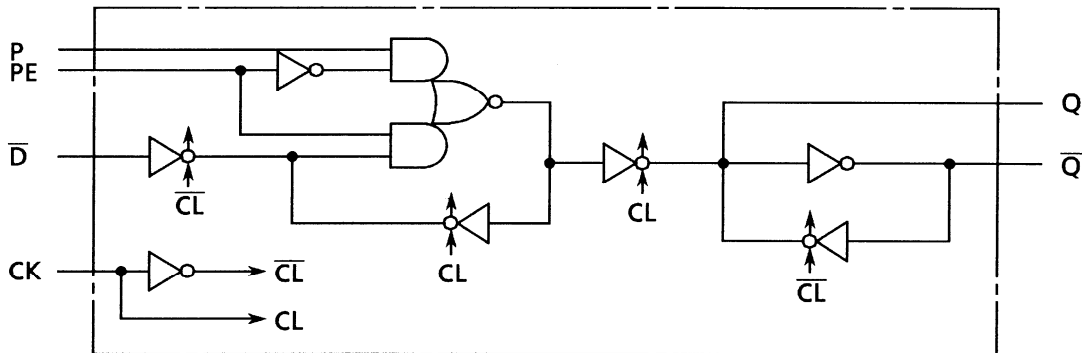
Start of commercial production  
 1978-04

**Logic Diagram**

**Parallel**



**Internal Flip Flop**



## Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}$	$V_{SS} - 0.5$ to $V_{SS} + 20$	V
Input voltage	$V_{IN}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Output voltage	$V_{OUT}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
DC input current	$I_{IN}$	$\pm 10$	mA
Power dissipation	$P_D$	300 (DIP)/180 (SOP)	mW
Operating temperature range	$T_{opr}$	-40 to 85	°C
Storage temperature range	$T_{stg}$	-65 to 150	°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 ( $V_{SS} = 0$ 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>SS</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>SS</sub> , V <sub>DD</sub>	5	0.61	—	0.51	1.5	—	0.42	—	mA	
			10	1.50	—	1.30	3.8	—	1.10	—		
			15	4.00	—	3.40	15.0	—	2.80	—		
			—	—	—	—	—	—	—	—		
Input high voltage	V <sub>IH</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  I <sub>OUT</sub>   < 1 μA	5	3.5	—	3.5	2.75	—	3.5	—	V	
			10	7.0	—	7.0	5.50	—	7.0	—		
			15	11.0	—	11.0	8.25	—	11.0	—		
			—	—	—	—	—	—	—	—		
Input low voltage	V <sub>IL</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  I <sub>OUT</sub>   < 1 μA	5	—	1.5	—	2.25	1.5	—	1.5	V	
			10	—	3.0	—	4.50	3.0	—	3.0		
			15	—	4.0	—	6.75	4.0	—	4.0		
			—	—	—	—	—	—	—	—		
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	—	5	—	0.005	5	—	150	μA	
			10	—	10	—	0.010	10	—	300		
			15	—	20	—	0.020	20	—	600		

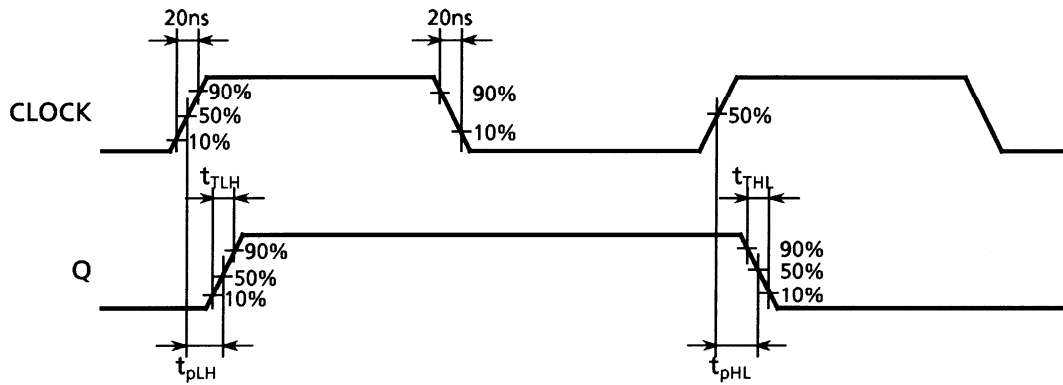
Note: All valid input combinations.

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

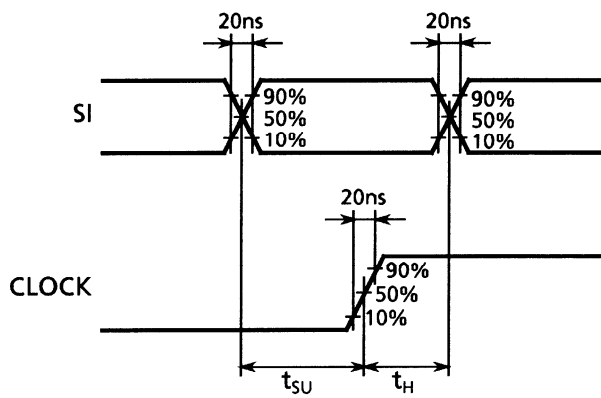
Characteristics	Symbol	Test Condition	VDD (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	80	200	ns
			10	—	50	100	
			15	—	40	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	80	200	ns
			10	—	50	100	
			15	—	40	80	
Propagation delay time (CLOCK-Q)	t <sub>pLH</sub> t <sub>pHL</sub>	—	5	—	150	320	ns
			10	—	65	160	
			15	—	45	120	
Propagation delay time (P/S -Q)	t <sub>pLH</sub> t <sub>pHL</sub>	—	5	—	230	460	ns
			10	—	90	180	
			15	—	60	120	
Max clock frequency	f <sub>CL</sub>	—	5	3.0	6.5	—	MHz
			10	6.0	18.0	—	
			15	8.5	24.0	—	
Min clock pulse width	t <sub>w</sub>	—	5	—	80	180	ns
			10	—	30	80	
			15	—	20	50	
Max clock rise time Max clock fall time	t <sub>rCL</sub> t <sub>fCL</sub>	—	5	20.0	—	—	μs
			10	2.5	—	—	
			15	1.0	—	—	
Min set-up time (SI-CLOCK)	t <sub>su</sub>	—	5	—	40	120	ns
			10	—	20	80	
			15	—	15	60	
Min set-up time (PI-P/S)	t <sub>su</sub>	—	5	—	25	50	ns
			10	—	15	30	
			15	—	10	20	
Min hold time (SI-CLOCK), (PI-P/S)	t <sub>H</sub>	—	5	—	35	70	ns
			10	—	20	40	
			15	—	15	30	
Min pulse width (P/S -CONTROL)	t <sub>WH</sub>	—	5	—	90	180	ns
			10	—	30	80	
			15	—	10	50	
Min removal time (P/S -CLOCK)	t <sub>rem</sub>	—	5	—	45	280	ns
			10	—	20	140	
			15	—	15	100	
Input capacitance	C <sub>IN</sub>	—	—	5	7.5	pF	

**Waveforms for Measurement of Dynamic Characteristics**

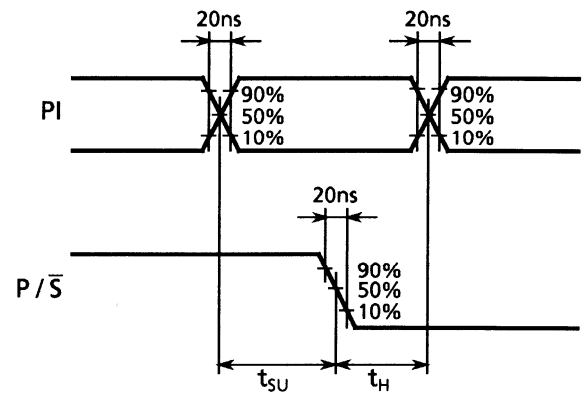
**Waveform 1**



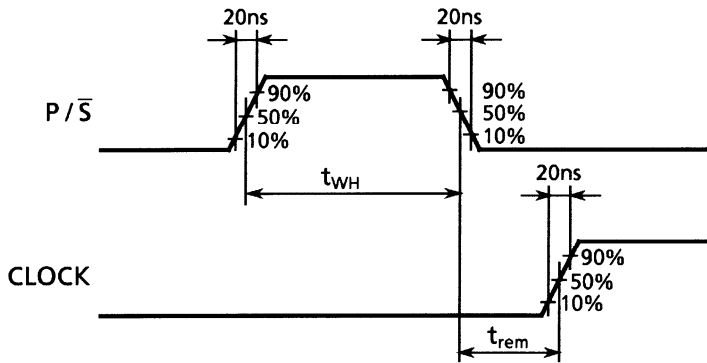
**Waveform 2**



**Waveform 3**



**Waveform 4**



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

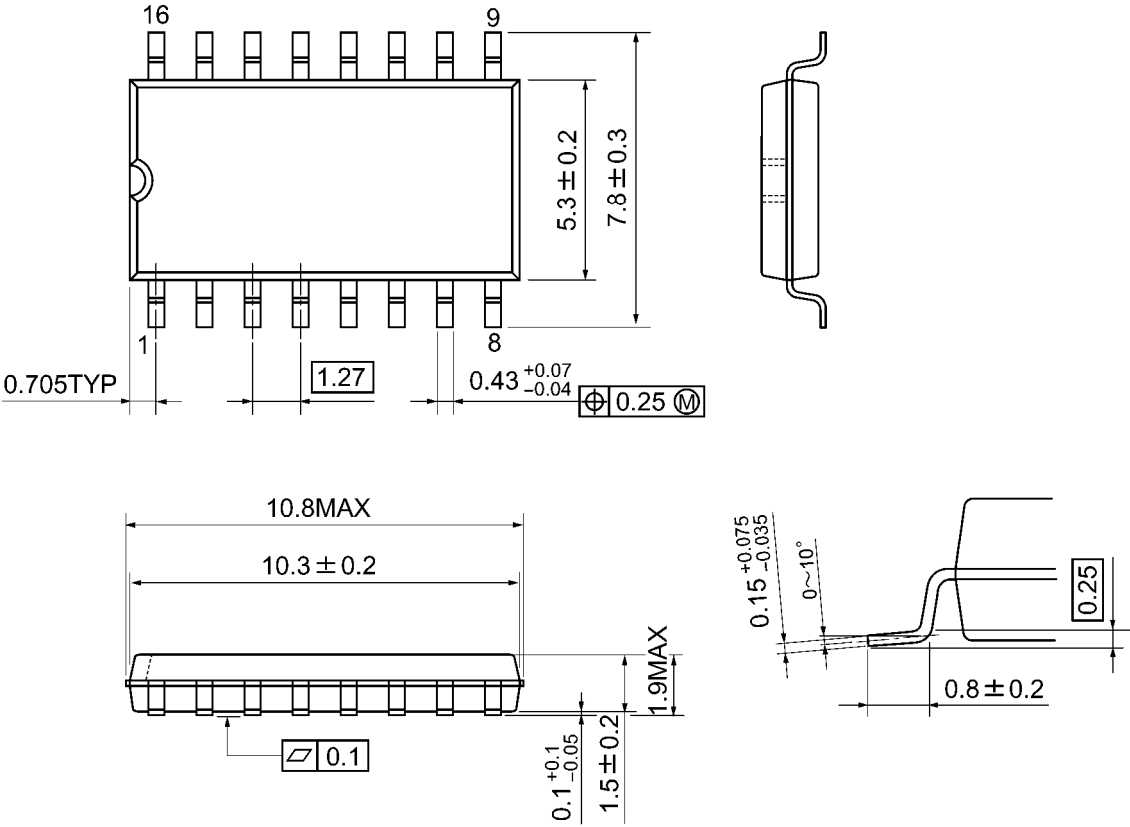


Weight: 1.00g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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