TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC4017BP,TC4017BF

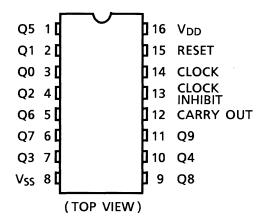
## TC4017BP/TC4017BF Decade Counter/Divider

TC4017BP/BF is decimal Johnson counter consisting of 5 stage D-type flip-flop equipped with the decoder to convert the output to decimal.

Depending on the number of count pulses fed to CLOCK or CLOCK INHIBIT one output among 10 output lines "Q0" through "Q9" becomes "H" level.

The counter advances its state at rising edge of CLOCK (CLOCK INHIBIT = "L") or falling edge of CLOCK INHIBIT (CLOCK = "H"). RESET input to "H" level resets the counter to Q0 = "H" and Q1 through Q9 = "L" regardless of CLOCK and CLOCK INHIBIT.

#### **Pin Assignment**



# TC4017BP DIP16-P-300-2.54A TC4017BF SOP16-P-300-1.27A Weight DIP16-P-300-2.54A : 1.00 g (typ.) SOP16-P-300-1.27A : 0.18 g (typ.)

## **Truth Table**

	Selected			
CLOCKA	CLOCK INHIBIT∆	RESET	Output	
*	*	Н	Q0	
*	Н	L	Qn (NC)	
L	*	L	Qn (NC)	
	L	L	Qn + 1	
$\neg$	L	L	Qn (NC)	
н		L	Qn (NC)	
Н		L	Qn + 1	

 $\Delta$ : Level change

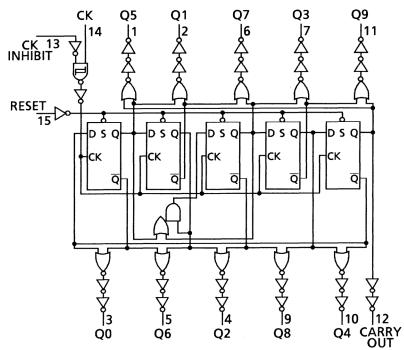
\*: Don't care

NC: No change

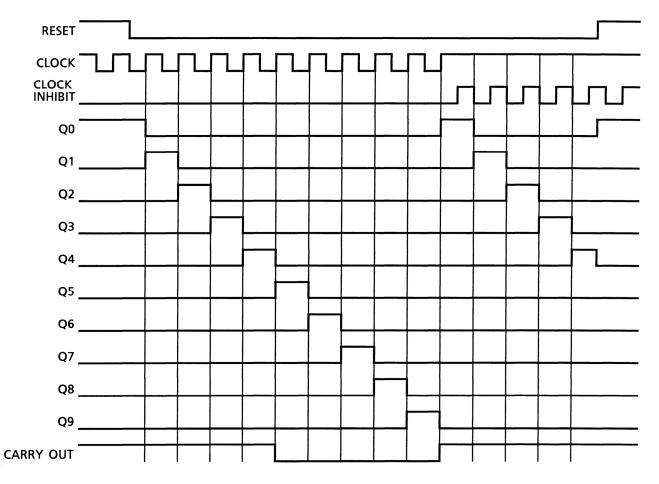
carry out { "H"..........Q0~Q4 = "H" { "L".......Q5~Q9 = "H"

## **TOSHIBA**

## Logic Diagram



## **Timing Chart**



## **Absolute Maximum Ratings (Note)**

Characteristics	Symbol	Rating	Unit
DC supply voltage	V <sub>DD</sub>	$V_{SS}-0.5V_{SS}+20$	V
Input voltage	V <sub>IN</sub>	$V_{SS} - 0.5 \text{-} V_{DD} + 0.5$	V
Output voltage	V <sub>OUT</sub>	$V_{SS} - 0.5 \text{-} V_{DD} + 0.5$	V
DC input current	I <sub>IN</sub>	±10	mA
Power dissipation	PD	300 (DIP)/180 (SOIC)	mW
Operating ambient temperature range	T <sub>opr</sub>	-40~85	°C
Storage temperature range	T <sub>stg</sub>	-65~150	°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<sub>SS</sub> = 0 V) (Note)**

Characteristics	Symbol	Test Condition	Min	Тур.	Max	Unit
DC supply voltage	V <sub>DD</sub>	—	3	_	18	V
Input voltage	V <sub>IN</sub>	_	0		V <sub>DD</sub>	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 ( $V_{SS} = 0 V$ )

		Sym-	Test Condition		-40°C		25°C			85°C		
		bol		V <sub>DD</sub> (V)	Min	Max	Min	Тур.	Max	Min	Max	Unit
				5	4.95	_	4.95	5.00	_	4.95	_	
High-level voltage	output	VOH	I <sub>OUT</sub>   < 1 μΑ V <sub>IN</sub> = V <sub>SS</sub> , V <sub>DD</sub>	10	9.95	—	9.95	10.00	—	9.95	—	V
Ū			VIN - VSS, VDD	15	14.95	_	14.95	15.00	_	14.95		
			I <sub>OUT</sub>   < 1 μΑ	5	—	0.05	—	0.00	0.05		0.05	
Low-level voltage	output	V <sub>OL</sub>	$V_{IN} = V_{SS}, V_{DD}$	10	—	0.05	—	0.00	0.05		0.05	V
Ū			VIN - VSS, VDD	15		0.05	—	0.00	0.05		0.05	
			V <sub>OH</sub> = 4.6 V	5	-0.61	—	-0.51	-1.0	—	-0.42	_	
			$V_{OH} = 2.5 V$	5	-2.50	—	-2.10	-4.0	—	-1.70	_	
Output hig	h current	IOH	V <sub>OH</sub> = 9.5 V	10	-1.50	—	-1.30	-2.2	—	-1.10	_	mA
			V <sub>OH</sub> = 13.5 V	15	-4.00	—	-3.40	-9.0	—	-2.80	_	
			$V_{IN}=V_{SS},V_{DD}$									
		I <sub>OL</sub>	V <sub>OL</sub> = 0.4 V	5	0.61		0.51	1.5	_	0.42		mA
Output Iou	( current		$V_{OL} = 0.5 V$	10	1.50	—	1.30	3.8	—	1.10	—	
Output low	Output low current		V <sub>OL</sub> = 1.5 V	15	4.00	—	3.40	15.0	—	2.80	_	ШA
			$V_{IN}=V_{SS},V_{DD}$									
		VIH	$V_{OUT} = 0.5 V, 4.5 V$	5	3.5	_	3.5	2.75	_	3.5	_	V
Input high	voltaga		V <sub>OUT</sub> = 1.0 V, 9.0 V	10	7.0	—	7.0	5.50	—	7.0	—	
input nigh	vollage		V <sub>OUT</sub> = 1.5 V, 13.5 V	15	11.0	—	11.0	8.25	—	11.0	—	
			$ I_{OUT}  < 1 \ \mu A$									
			$V_{OUT} = 0.5 V, 4.5 V$	5	_	1.5	_	2.25	1.5	_	1.5	
Input low	oltago		V <sub>OUT</sub> = 1.0 V, 9.0 V	10	—	3.0	—	4.50	3.0	_	3.0	
Input low voltage		VIL	V <sub>OUT</sub> = 1.5 V, 13.5 V	15	—	4.0	—	6.75	4.0	—	4.0	V
			$ I_{OUT}  < 1 \ \mu A$									
Input	"H" level	IIН	V <sub>IH</sub> = 18 V	18	_	0.1	_	10 <sup>-5</sup>	0.1		1.0	μA
current	"L" level	١ <sub>١L</sub>	$V_{IL} = 0 V$	18	_	-0.1	_	-10 <sup>-5</sup>	-0.1		μ	μA
				5		5	_	0.005	5		150	
Quiescent current	Quiescent supply current		$V_{IN} = V_{SS}, V_{DD}$	10	—	10	—	0.010	10		300	μA
			(Note)	15		15	_	0.015	20		600	

Note: All valid input combinations.

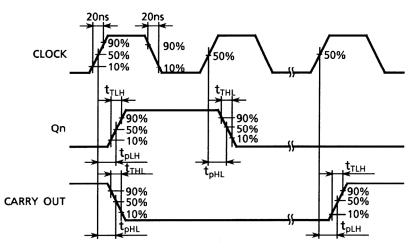
## Dynamic Electrical Characteristics (Ta = $25^{\circ}$ C, V<sub>SS</sub> = 0 V, C<sub>L</sub> = 50 pF)

	O maked	Test Condition	N/I	-	Maria	1 1 14	
Characteristics	Symbol		V <sub>DD</sub> (V)	Min	Тур.	Max	Unit
Output transition time			5		80	200	
Output transition time	t <sub>TLH</sub>	_	10	—	50	100	ns
(low to high)			15	—	40	80	
Output transition time			5	_	80	200	
Output transition time	t <sub>THL</sub>	—	10	—	50	100	ns
(high to low)			15	—	40	80	
Propagation delay time	t		5	—	325	650	
(CLOCK-Qn)	t <sub>pLH</sub> t	—	10	—	135	270	ns
	<sup>t</sup> pHL		15		85	170	
Propagation delay time	t		5	—	280	600	
(CLOCK-CARRY OUT)	t <sub>pLH</sub>	_	10	—	110	250	ns
	<sup>t</sup> pHL		15	—	75	160	
Propagation delay time	t		5	—	265	530	
RESET-Qn	t <sub>pLH</sub>	_	10	—	115	230	ns
RESET-CARRY OUT	<sup>t</sup> pHL		15	—	85	170	
			5	2.5	6.0		
Max clock frequency	f <sub>CL</sub>	—	10	5.0	12.0	—	MHz
			15	6.7	13.5	_	
			5	—	85	200	
Min clock pulse width	t <sub>W</sub>	—	10	—	40	90	ns
			15	_	35	60	
Min pulse width			5	—	50	260	
(RESET)	twH	—	10	—	20	110	ns
			15	—	15	60	
Max clock rise time	trcL	_	5	No limit			μs
Max clock fall time			10				
	t <sub>fCL</sub>		15		-	-	
Min set-up time			5	—	30	230	
(CLOCK INHIBIT-CLOCK)	tsu	_	10	—	15	100	ns
			15		10	70	
Min removal time			5	—	-55	400	
(RESET-CLOCK)	t <sub>rem</sub>	—	10	—	-20	275	ns
			15		-15	150	
Input capacitance	C <sub>IN</sub>	—		_	5	7.5	pF

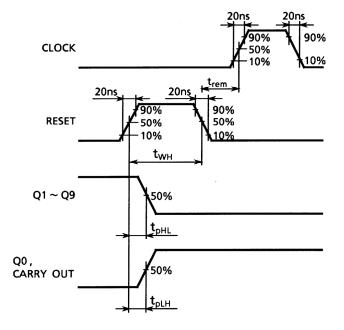
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## Waveforms for Measurement of Dynamic Characteristics

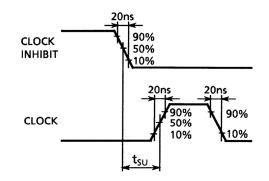
#### Waveform 1



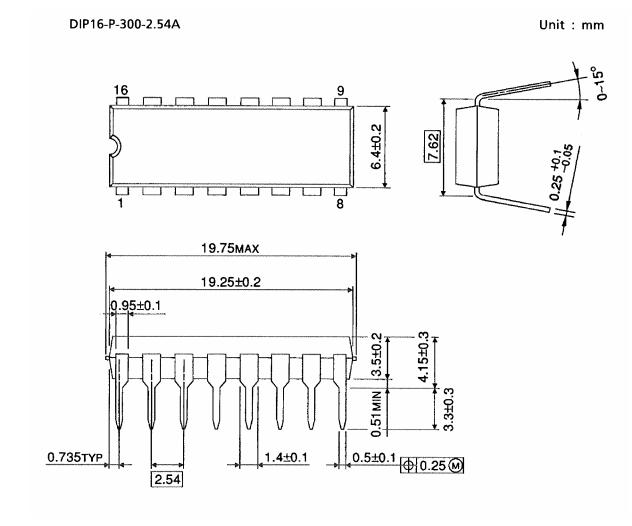
#### Waveform 2



Waveform 3



## **Package Dimensions**



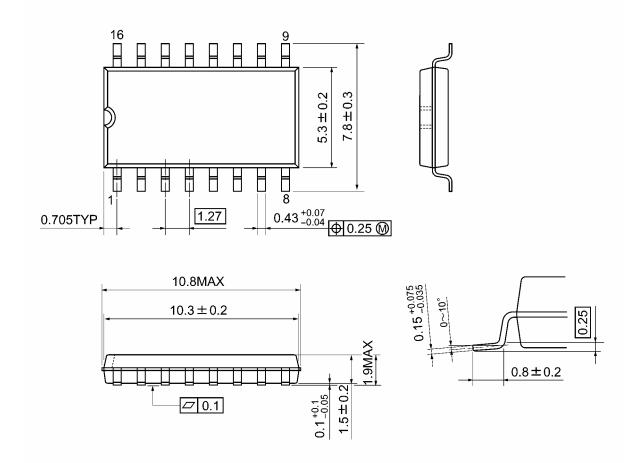
Weight: 1.00 g (typ.)

## **TOSHIBA**

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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20070701-EN GENERAL

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