

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC4024BP, TC4024BF, TC4024BFN

## TC4024B 7 Stage Ripple-Carry Binary Counter/Dividers

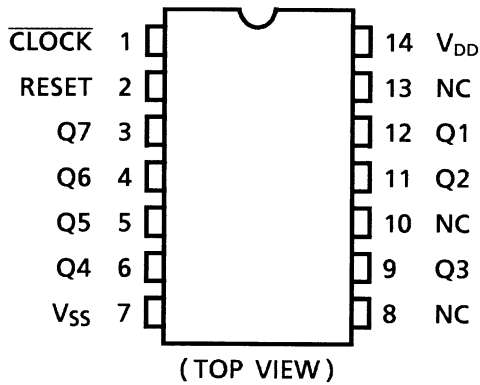
TC4024B is 7 stage ripple carry type binary counter having asynchronous clear function.

The counter advances its counting state by falling edge of CLOCK input.

When RESET input is placed at "H", all the internal flip-flop are reset making all the outputs Q1 through Q7 to be "L" regardless of CLOCK input.

This is suitable for frequency divider circuits and control circuits.

### Pin Assignment



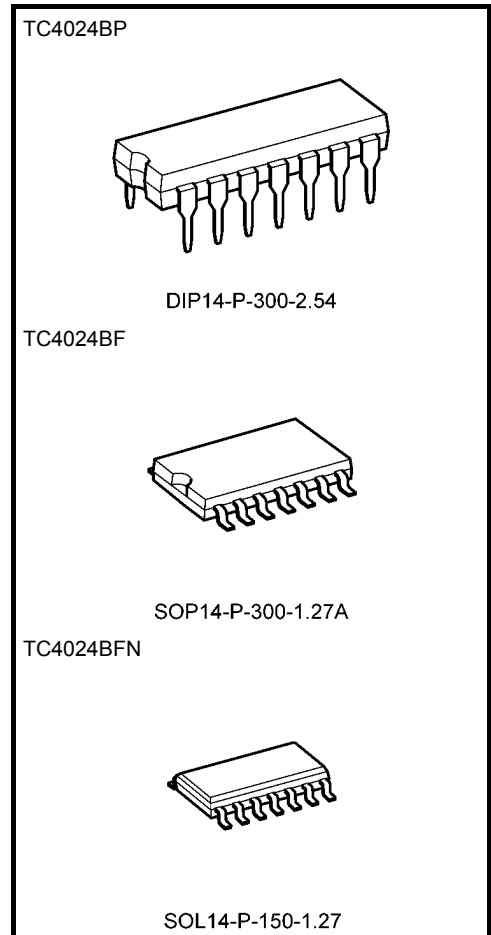
### Truth Table

<u>CLOCK</u> Δ	RESET	Output State
*	H	All Outputs = "L"
	L	No Change
	L	Advance to Next State

Δ: Level change

\*: Don't care

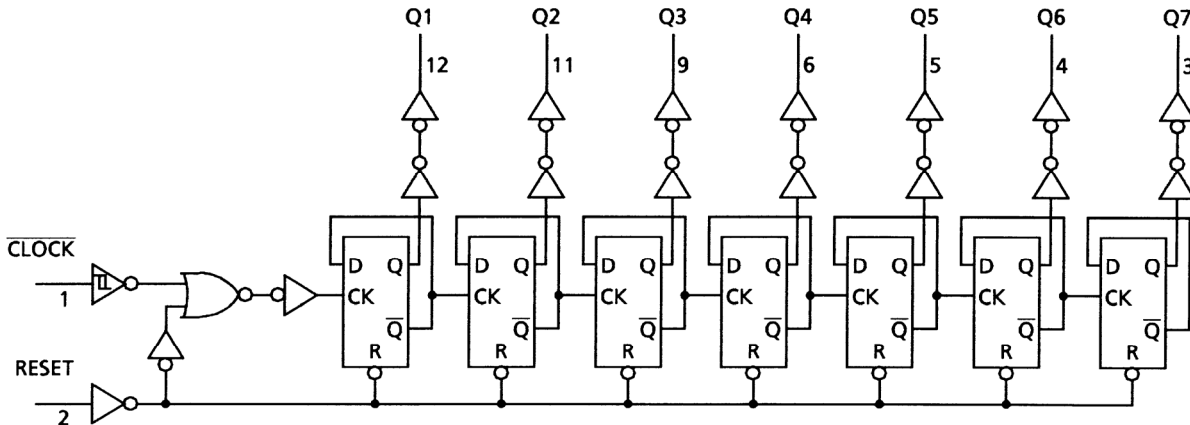
Note: xxxFN (JEDEC SOP) is not available in Japan.



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.)

**Logic Diagram**



**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 (SOIC)	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	1.2	—	0.42	—	mA	
			10	1.50	—	1.30	3.2	—	1.10	—		
			15	4.00	—	3.40	12.0	—	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	—	0.015	20	—	600		

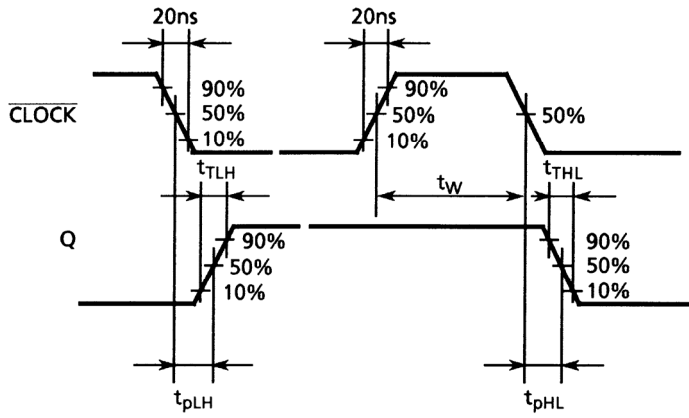
Note: All valid input combinations.

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

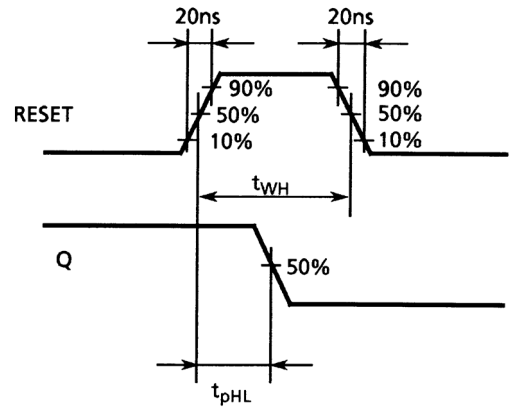
Characteristics	Symbol	Test Condition	VDD (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t <sub>TLH</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t <sub>THL</sub>	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q1)	t <sub>pLH</sub>	—	5	—	140	360	ns
			10	—	70	160	
			15	—	50	130	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q1)	t <sub>pHL</sub>	—	5	—	140	360	ns
			10	—	70	160	
			15	—	50	130	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q7)	t <sub>pLH</sub>	—	5	—	400	1200	ns
			10	—	160	520	
			15	—	115	430	
Propagation delay time ( $\overline{\text{CLOCK}}$ -Q7)	t <sub>pHL</sub>	—	5	—	400	1200	ns
			10	—	160	520	
			15	—	115	430	
Propagation delay time (RESET-Q)	t <sub>pHL</sub>	—	5	—	140	280	ns
			10	—	70	120	
			15	—	50	100	
Max clock frequency	f <sub>CL</sub>	—	5	3.5	14	—	MHz
			10	8.0	30	—	
			15	12.0	40	—	
Max clock input rise time Max clock input fall time	t <sub>rCL</sub> t <sub>rCL</sub>	—	5	No limit			μs
			10				
			15				
Max clock pulse width	t <sub>w</sub>	—	5	—	40	140	ns
			10	—	20	60	
			15	—	15	40	
Max pulse width (RESET)	t <sub>WH</sub>	—	5	—	40	200	ns
			10	—	20	80	
			15	—	15	60	
Minimum removal time	t <sub>rem</sub>	—	5	—	0	350	ns
			10	—	0	150	
			15	—	0	100	
Input capacitance	C <sub>IN</sub>	—	—	5	7.5	pF	

**Waveforms for Measurement of Dynamic Characteristics**

**Waveform 1**



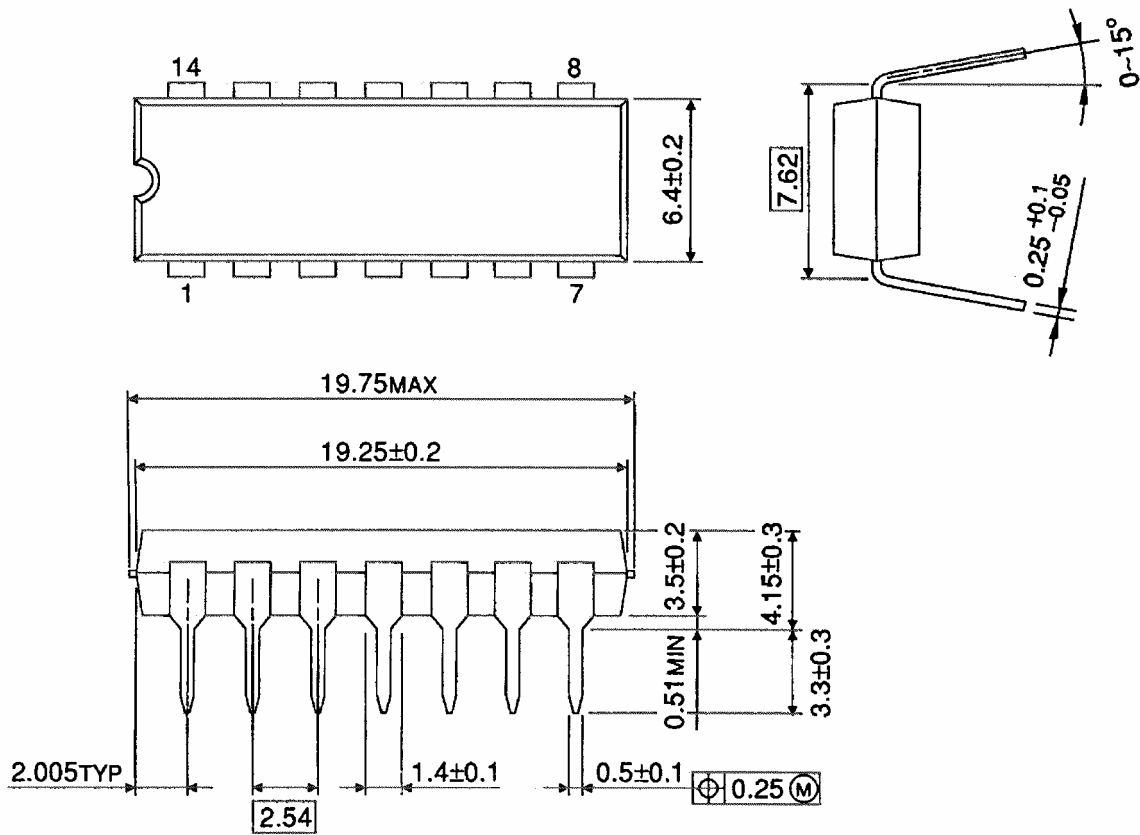
**Waveform 2**



## Package Dimensions

DIP14-P-300-2.54

Unit : mm

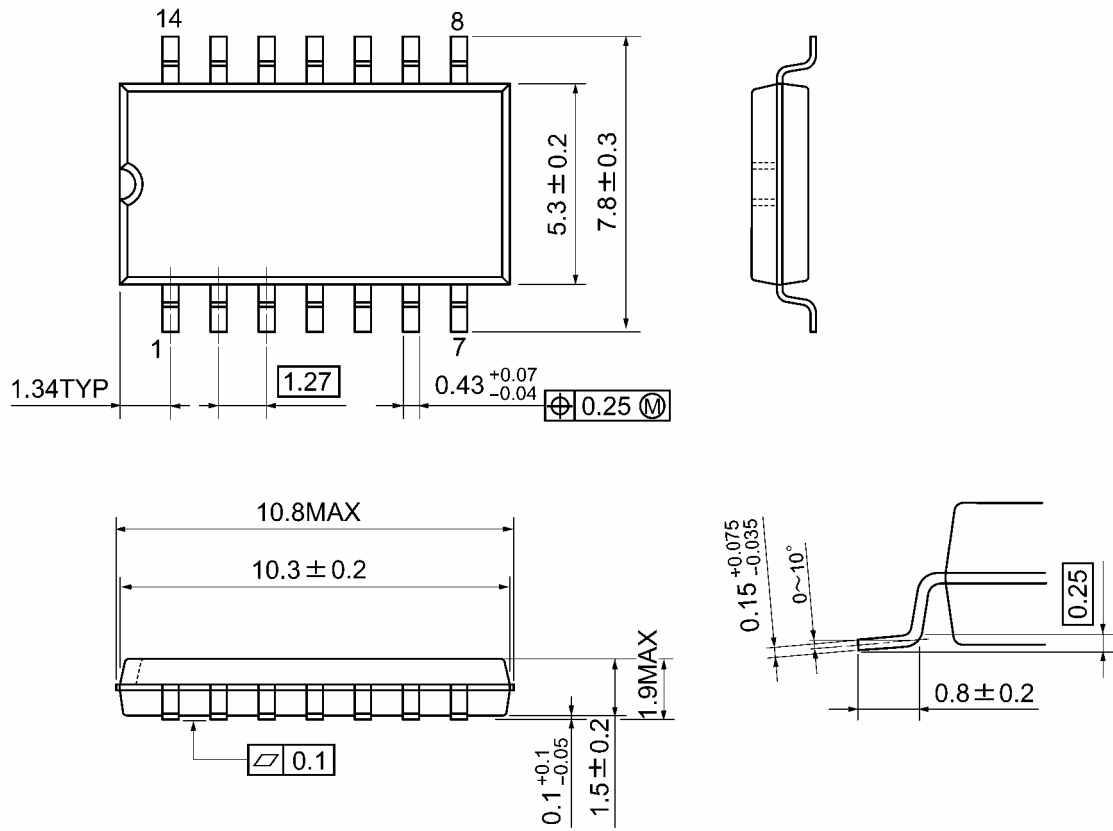


Weight: 0.96 g (typ.)

**Package Dimensions**

SOP14-P-300-1.27A

Unit: mm

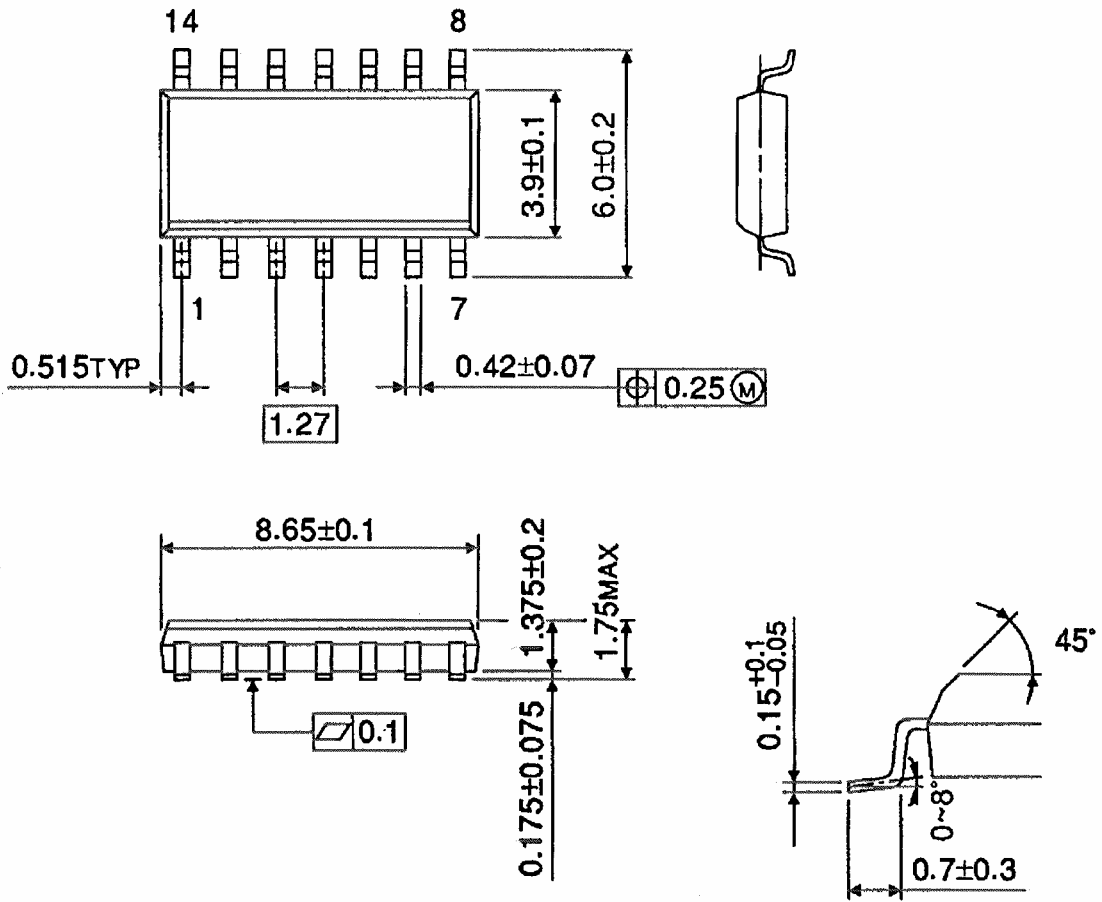


Weight: 0.18 g (typ.)

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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