TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC4024BP,TC4024BF,TC4024BFN

TC4024B 7 Stage Ripple-Carry Binary Counter/Dividers

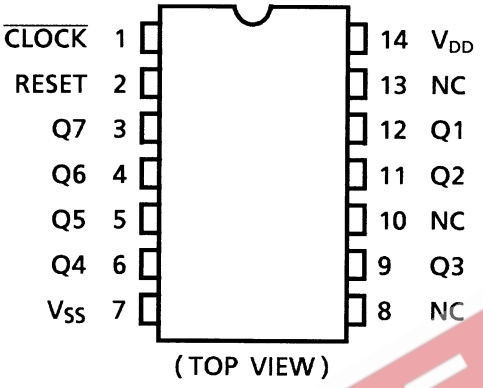
TC4024B is 7 stage ripple carry type binary counter having asynchronous clear function.

The counter advances its counting state by falling edge of $\overline{\text{CLOCK}}$ 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 $\overline{\text{CLOCK}}$ input.

This is suitable for frequency divider circuits and control circuits.

Pin Assignment



Truth Table

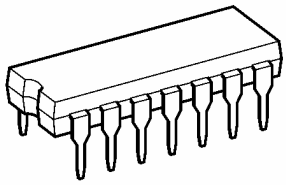
$\overline{\text{CLOCK}}$ Δ	RESET	Output State
*	H	All Outputs = "L"
↑	L	No Change
↓	L	Advance to Next State

Δ: Level change

*: Don't care

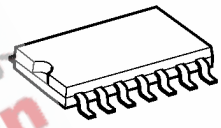
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4024BP



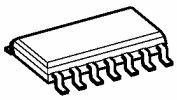
DIP14-P-300-2.54

TC4024BF



SOP14-P-300-1.27A

TC4024BFN

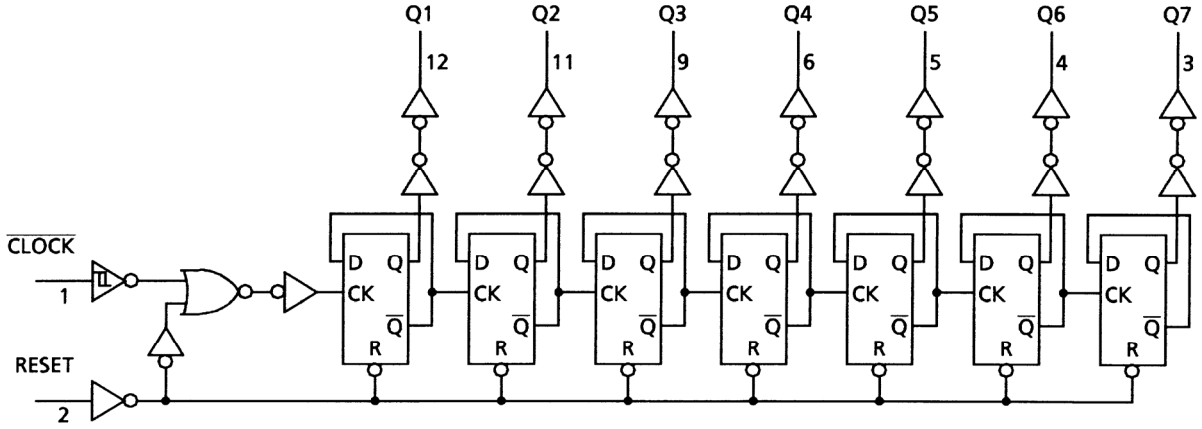


SOL14-P-150-1.27

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}	±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_{SS} = 0 V)

Characteristics	Sym-bol	Test Condition	V_{DD} (V)	–40°C Min	–40°C Max	25°C Min	25°C Typ.	25°C Max	85°C Min	85°C Max	Unit
High-level output voltage	V_{OH}	$\|I_{OUT}\| < 1$ μA $V_{IN} = V_{SS}, V_{DD}$	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_{OL}	$\|I_{OUT}\| < 1$ μA $V_{IN} = V_{SS}, V_{DD}$	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_{OH}	V_{OH} = 4.6 V	5	–0.61	—	–0.51	–1.0	—	–0.42	—	mA
		V_{OH} = 2.5 V	5	–2.50	—	–2.10	–4.0	—	–1.70	—	
		V_{OH} = 9.5 V	10	–1.50	—	–1.30	–2.2	—	–1.10	—	
		V_{OH} = 13.5 V	15	–4.00	—	–3.40	–9.0	—	–2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Output low current	I_{OL}	V_{OL} = 0.4 V	5	0.61	—	0.51	1.2	—	0.42	—	mA
		V_{OL} = 0.5 V	10	1.50	—	1.30	3.2	—	1.10	—	
		V_{OL} = 1.5 V	15	4.00	—	3.40	12.0	—	2.80	—	
		$V_{IN} = V_{SS}, V_{DD}$									
Input high voltage	V_{IH}	V_{OUT} = 0.5 V, 4.5 V	5	3.5	—	3.5	2.75	—	3.5	—	V
		V_{OUT} = 1.0 V, 9.0 V	10	7.0	—	7.0	5.50	—	7.0	—	
		V_{OUT} = 1.5 V, 13.5 V	15	11.0	—	11.0	8.25	—	11.0	—	
		$\|I_{OUT}\| < 1$ μA									
Input low voltage	V_{IL}	V_{OUT} = 0.5 V, 4.5 V	5	—	1.5	—	2.25	1.5	—	1.5	V
		V_{OUT} = 1.0 V, 9.0 V	10	—	3.0	—	4.50	3.0	—	3.0	
		V_{OUT} = 1.5 V, 13.5 V	15	—	4.0	—	6.75	4.0	—	4.0	
		$\|I_{OUT}\| < 1$ μA									
Input current "H" level	I_{IH}	V_{IH} = 18 V	18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
Input current "L" level	I_{IL}	V_{IL} = 0 V	18	—	–0.1	—	-10^{-5}	–0.1	—	–1.0	
Quiescent supply current	I_{DD}	$V_{IN} = V_{SS}, V_{DD}$ (Note)	5	—	5	—	0.005	5	—	150	μA
			10	—	10	—	0.010	10	—	300	
			15	—	20	—	0.015	20	—	600	

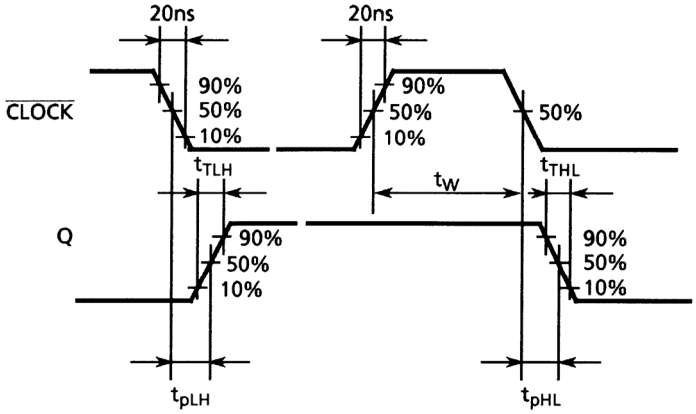
Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, V_{SS} = 0 V, C_L = 50 pF)

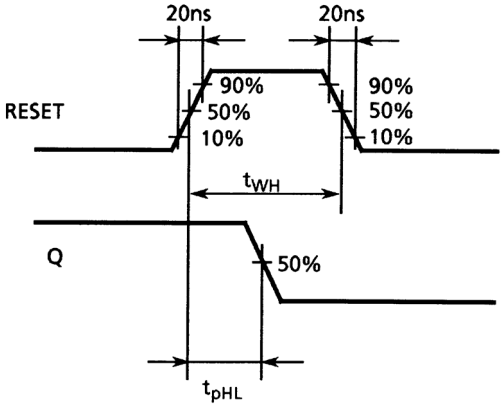
Characteristics	Symbol	Test Condition	V_{DD} (V)	Min	Typ.	Max	Unit
Output transition time (low to high)	t_{TLH}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Output transition time (high to low)	t_{THL}	—	5	—	70	200	ns
			10	—	35	100	
			15	—	30	80	
Propagation delay time ($\overline{CLOCK}$ -Q1)	t_{pLH}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

Waveforms for Measurement of Dynamic Characteristics

Waveform 1

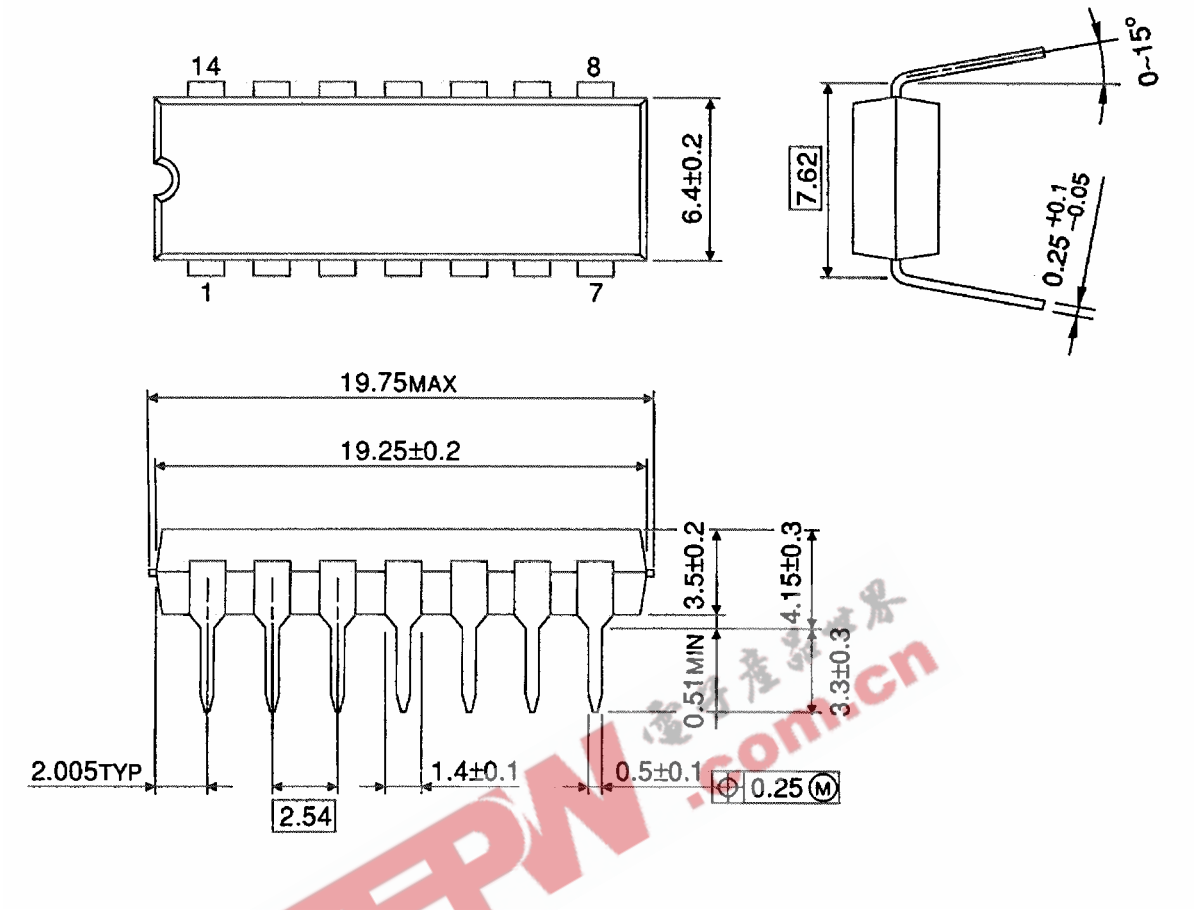


Waveform 2



Package Dimensions

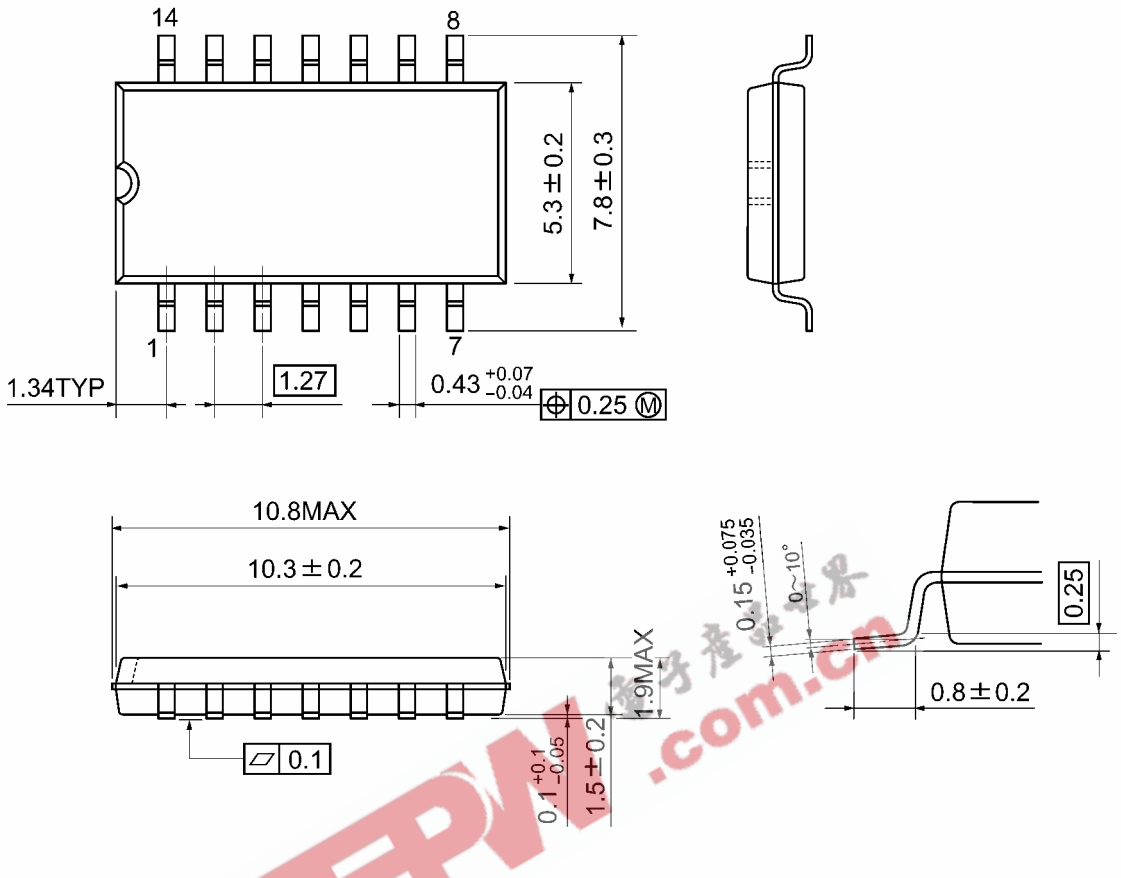
DIP14-P-300-2.54 Unit : mm



Weight: 0.96 g (typ.)

Package Dimensions

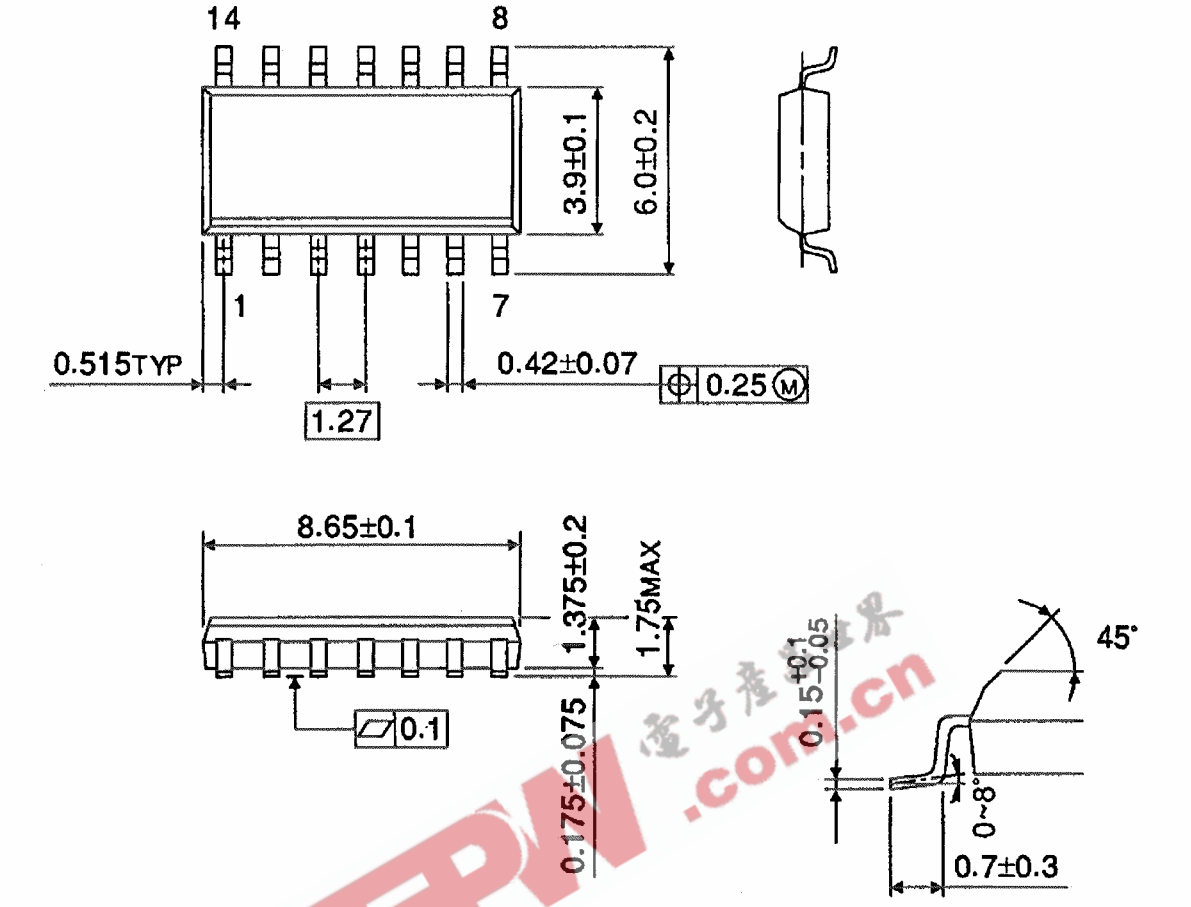
SOP14-P-300-1.27A Unit: mm



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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