TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC4024AP,TC74HC4024AF

7-Stage Binary Counter

The TC74HC4024A is a high speed CMOS 7-STAGE BINARY COUNTER fabricated with silicon gate C^2MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

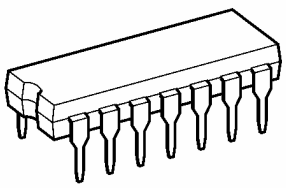
A negative transition on the $\overline{CK}$ input brings one increment to the counter.

A CLR input is used to reset the counter to the all low level state. A high level at CLR accomplishes the reset function.

All divided output stages are provided, and the last stage, 1/128 divided frequency will be obtained.

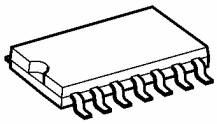
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

TC74HC4024AP



DIP14-P-300-2.54

TC74HC4024AF



SOP14-P-300-1.27A

Weight

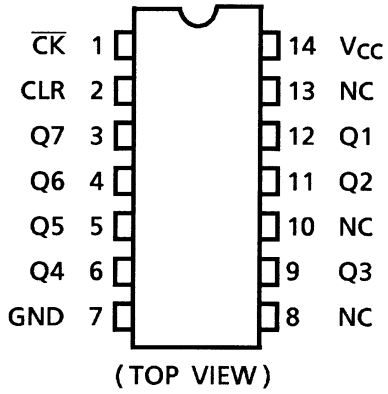
DIP14-P-300-2.54 : 0.96 g (typ.)

SOP14-P-300-1.27A : 0.18 g (typ.)

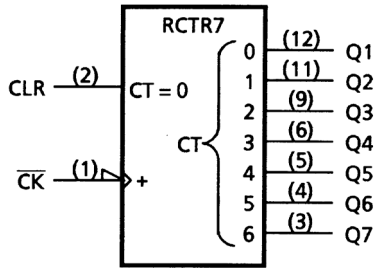
Features

- High speed: f_{max} = 70 MHz (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 4 μA (max) at Ta = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL}$ = 4 mA (min)
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2~6 V
- Pin and function compatible with 4024B

Pin Assignment



IEC Logic Symbol

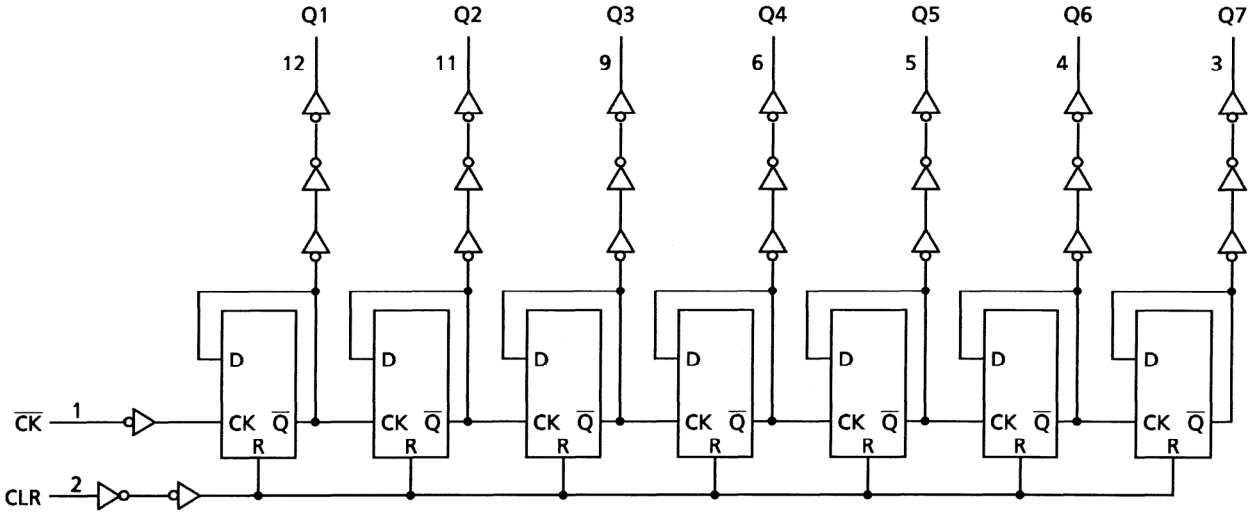


Truth Table

Inputs		Output Status
CK	CLR	
X	H	All Outputs = "L"
↑	L	No Change
↓	L	Advance to Next Stage

X: Don't care

System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5~7	V
DC input voltage	V_{IN}	−0.5~V_{CC} + 0.5	V
DC output voltage	V_{OUT}	−0.5~V_{CC} + 0.5	V
Input diode current	I_{IK}	±20	mA
Output diode current	I_{OK}	±20	mA
DC output current	I_{OUT}	±25	mA
DC V_{CC}/ground current	I_{CC}	±50	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	−65~150	°C

Note 1: 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).

Note 2: 500 mW in the range of Ta = −40 to 65°C. From Ta = 65 to 85°C a derating factor of −10 mW/°C shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2~6	V
Input voltage	V_{IN}	0~V_{CC}	V
Output voltage	V_{OUT}	0~V_{CC}	V
Operating temperature	T_{opr}	−40~85	°C
Input rise and fall time	t_r, t_f	0~1000 (V_{CC} = 2.0 V) 0~500 (V_{CC} = 4.5 V) 0~400 (V_{CC} = 6.0 V)	ns

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either VCC or GND.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition		V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40~85°C Min	Ta = −40~85°C Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	
				6.0	4.20	—	—	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −20 μA	2.0	1.9	2.0	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	
			I_{OH} = −4 mA	4.5	4.18	4.31	—	4.13	—	
			I_{OH} = −5.2 mA	6.0	5.68	5.80	—	5.63	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20 μA	2.0	—	0.0	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	
			I_{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33	
			I_{OL} = 5.2 mA	6.0	—	0.18	0.26	—	0.33	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	—	4.0	—	40.0	μA

Timing Requirements (input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Ta = 25°C Typ.	Ta = 25°C Limit	Ta = −40 ~85°C Limit	Unit
Minimum pulse width ($\overline{CK}$)	$t_{W(L)}$ $t_{W(H)}$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum pulse width (CLR)	$t_{W(H)}$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum removal time	t_{rem}	—	2.0	—	25	30	ns
			4.5	—	5	6	
			6.0	—	5	5	
Clock frequency	f	—	2.0	—	6	5	MHz
			4.5	—	31	25	
			6.0	—	36	29	

AC Characteristics (C_L = 15 pF, V_{CC} = 5 V, Ta = 25°C, input: $t_r = t_f$ = 6 ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH} t_{THL}	—	—	4	8	ns
Propagation delay time (CK-Q1)	t_{pLH} t_{pHL}	—	—	13	20	ns
Propagation delay time (Qn-Qn + 1)	Δt_{pd}	—	—	4	9	ns
Propagation delay time (CLR-Qn)	t_{pHL}	—	—	13	20	ns
Maximum clock frequency	f_{max}	—	34	70	—	MHz

AC Characteristics (C_L = 50 pF, input: $t_r = t_f$ = 6 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = −40~85°C		Unit
			V_{CC} (V)	Min	Typ.	Max	Min	Max	
Output transition time	t_{TLH} t_{THL}	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time ($\overline{CK}$-Q1)	t_{pLH} t_{pHL}	—	2.0	—	60	120	—	150	ns
			4.5	—	16	24	—	30	
			6.0	—	13	20	—	26	
Propagation delay time (Qn-Qn + 1)	Δt_{pd}	—	2.0	—	24	60	—	75	ns
			4.5	—	6	12	—	15	
			6.0	—	5	10	—	13	
Propagation delay time (CLR-Qn)	t_{pHL}	—	2.0	—	50	120	—	150	ns
			4.5	—	16	24	—	30	
			6.0	—	13	20	—	26	
Maximum clock frequency	f_{max}	—	2.0	6	17	—	5	—	MHz
			4.5	31	63	—	25	—	
			6.0	36	73	—	29	—	
Input capacitance	C_{IN}	—		—	5	10	—	10	pF
Power dissipation capacitance	C_{PD} (Note)	—		—	36	—	—	—	pF

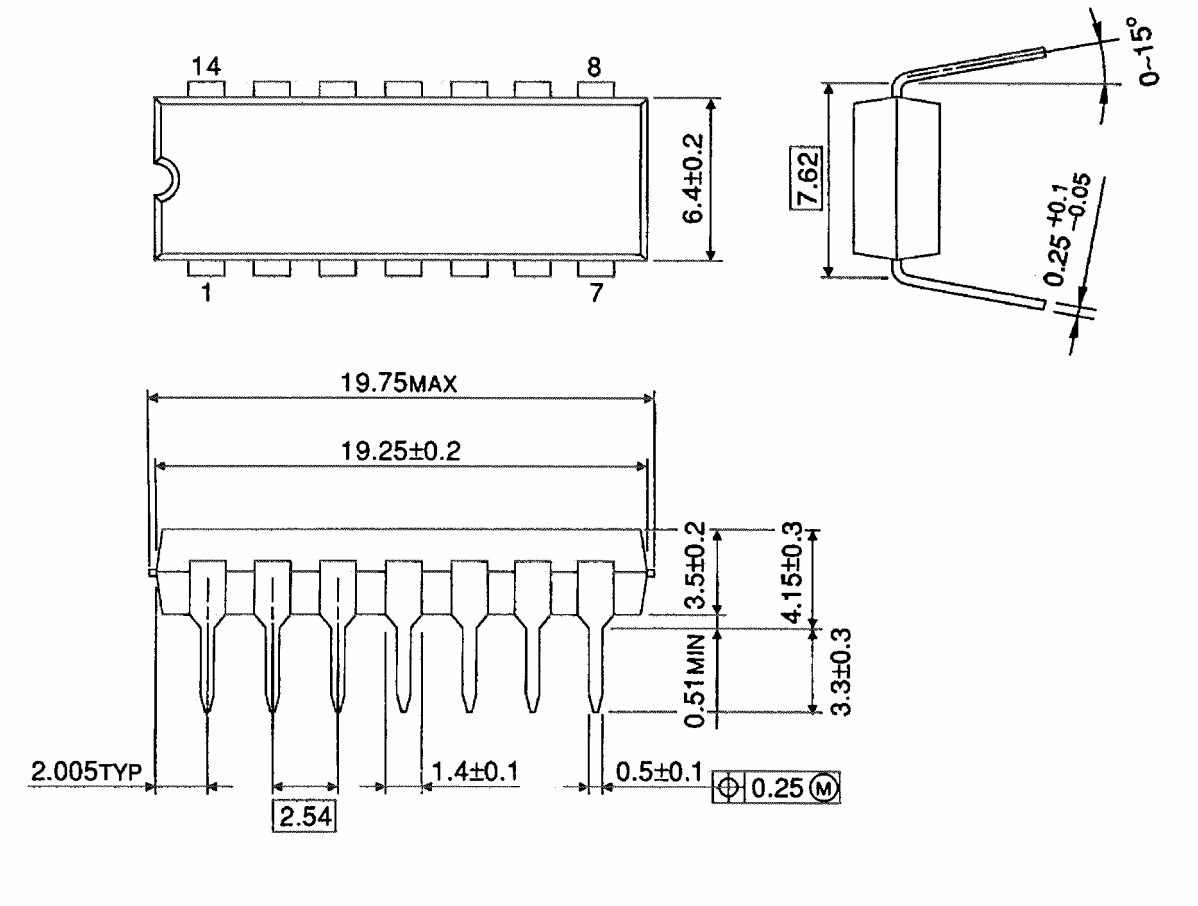
Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC}\ (opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

Package Dimensions

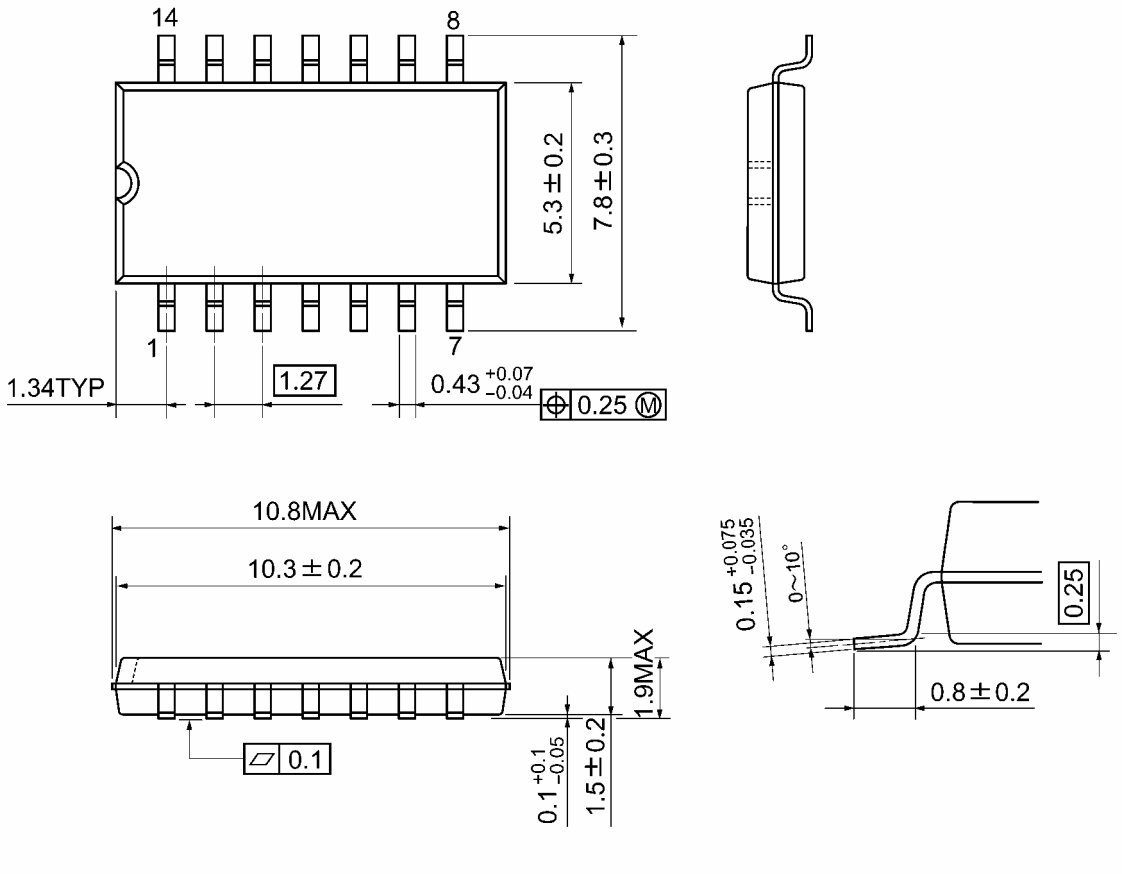
DIP14-P-300-2.54 Unit : mm



Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

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20070701-EN GENERAL

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