

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC4020AP, TC74HC4020AF TC74HC4040AP, TC74HC4040AF

TC74HC4020AP/AF 14-Stage Binary Counter

TC74HC4040AP/AF 12-Stage Binary Counter

The TC74HC4020A/TC74HC4040A are high speed CMOS BINARY COUNTER/DIVIDERS fabricated with silicon gate C²MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS dissipation.

The TC74HC4020A is a 14-STAGE BINARY COUNTER, and the TC74HC4040A is a 12-STAGE BINARY COUNTER.

Setting CLR to high resets the counter to low.

A negative transition on the CK input brings one increment into the counter.

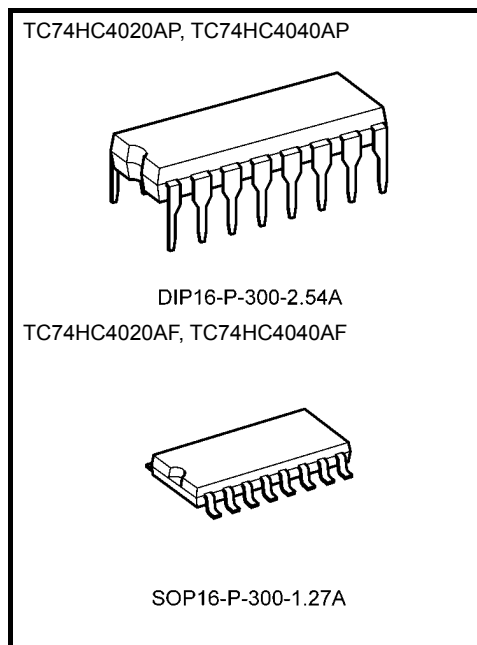
The TC74HC4020A provides 12 divided outputs: 1st stage and stage 4 thru stage 14. At Q14, a 1/16384 divided frequency will be output.

The TC74HC4040A provides all divided output stages, and at Q12, a 1/4096 divided frequency will be output.

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

Features

- High speed: $f_{max} = 73$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 4$ μ A (max) at $T_a = 25^\circ$ 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: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (opr) = 2\sim 6$ V
- Pin and function compatible with 4020B/4040B

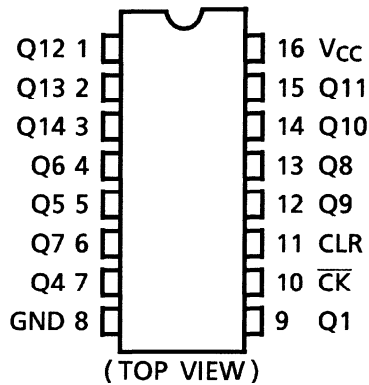


Weight

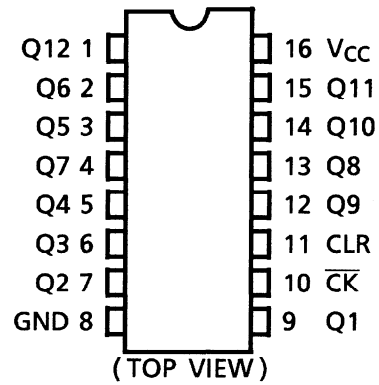
DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)

Pin Assignment

TC74HC4020A

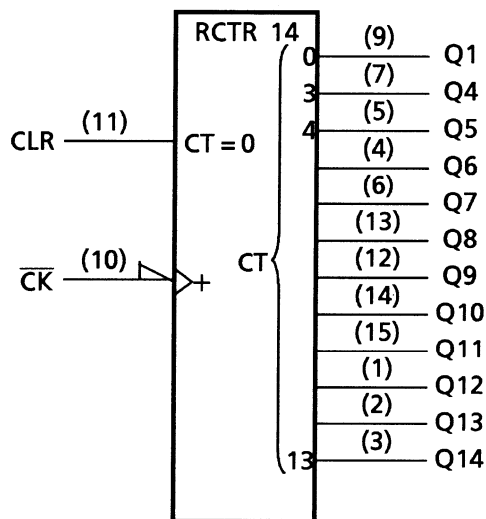


TC74HC4040A

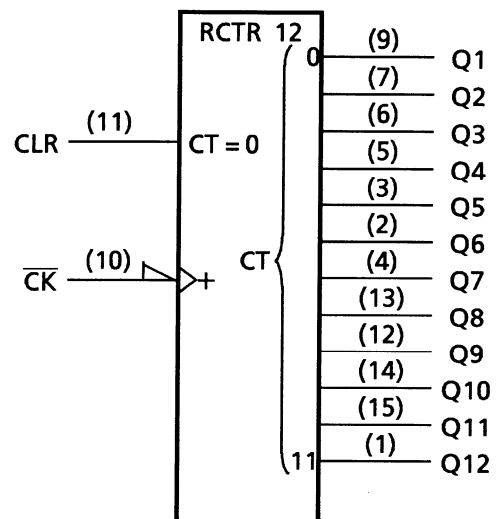


IEC Logic Symbol

TC74HC4020A



TC74HC4040A



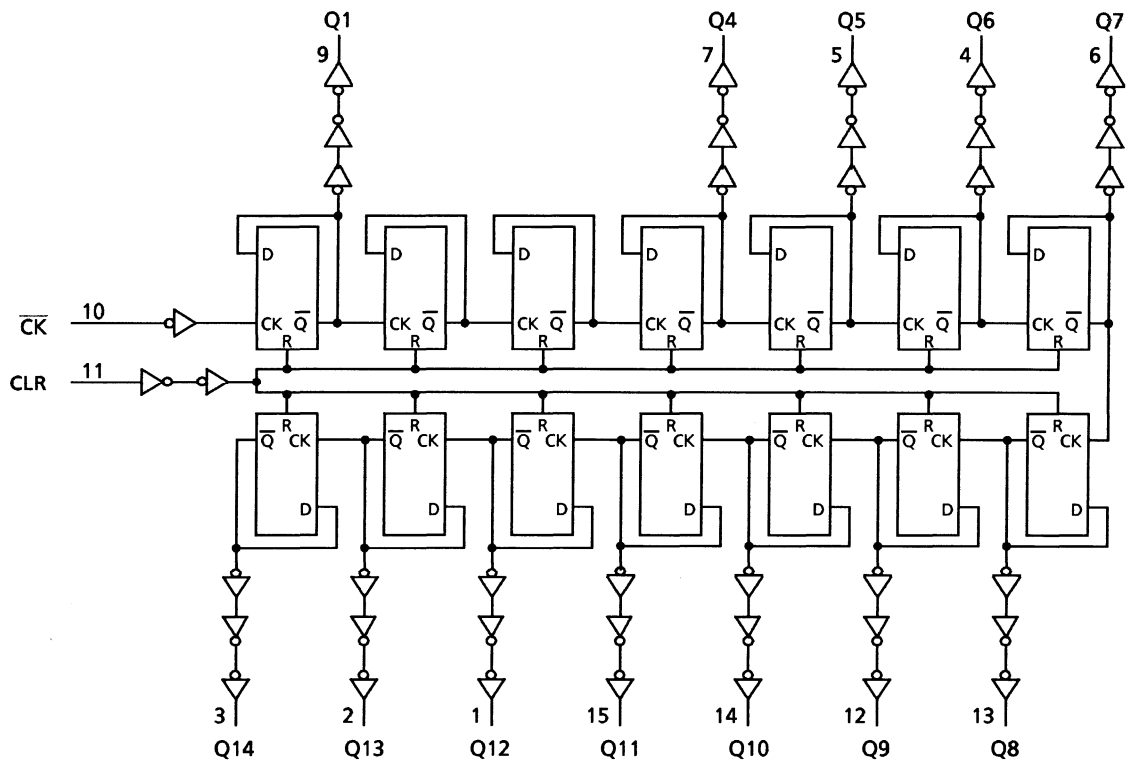
Truth Table

\overline{CK}	CLR	Output State
X	H	All Output = "L"
\uparrow	L	No Change
\downarrow	L	Advance to Next State

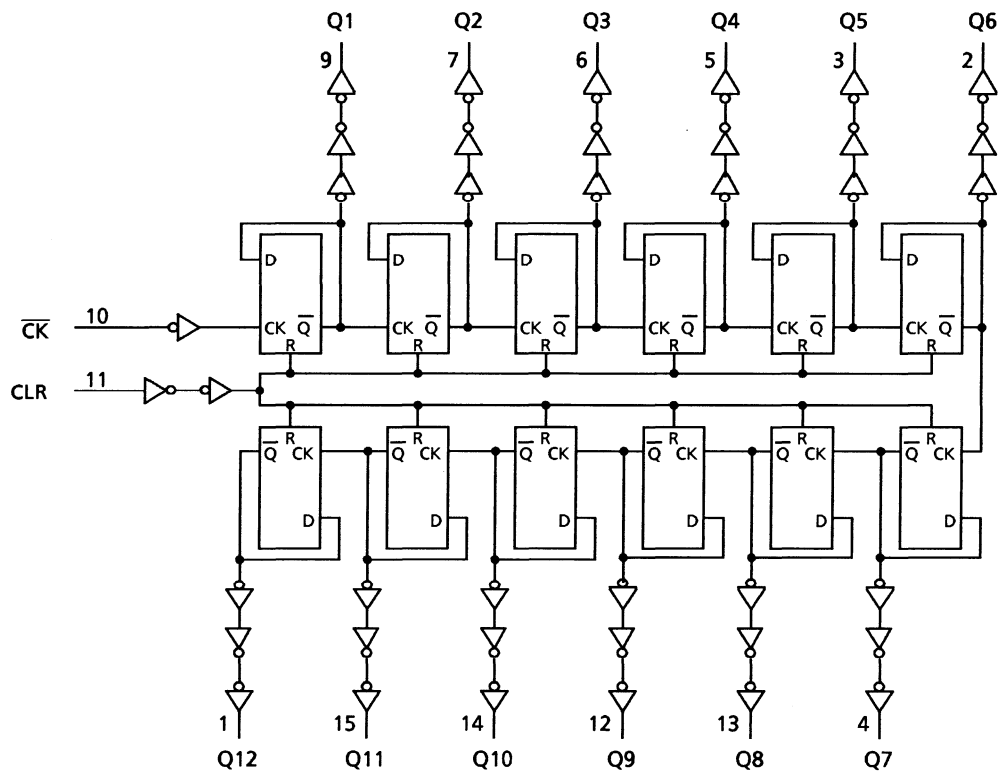
X: Don't care

System Diagram

TC74HC4020A



TC74HC4040A



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 $T_a = -40$ to 65°C . From $T_a = 65$ 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		Ta = 25°C			Ta = -40~85°C		Unit	
				V _{CC} (V)	Min	Typ.	Max	Min		Max
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	—	
				6.0	5.68	5.80	—	5.63	—	
				I _{OH} = -5.2 mA	4.5	—	—	—	—	
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	
				6.0	—	0.18	0.26	—	0.33	
				I _{OL} = 5.2 mA	4.5	—	—	—	—	
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		Ta = 25°C		Ta = -40~85°C	Unit	
				V _{CC} (V)	Typ.	Limit		Limit
Minimum pulse width (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	—	30	24	
				6.0	—	35	28	

AC Characteristics ($C_L = 15 \text{ pF}$, $V_{CC} = 5 \text{ V}$, $T_a = 25^\circ\text{C}$, input: $t_r = t_f = 6 \text{ ns}$)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t_{TLH} t_{THL}	—	—	4	8	ns
Propagation delay time ($\overline{\text{CK}} - Q1$)	t_{pLH} t_{pHL}	—	—	16	24	ns
Propagation delay time ($Q_n - Q_{n+1}$)	Δt_{pd}	—	—	5	14	ns
Propagation delay time (CLR)	t_{pHL}	—	—	14	24	ns
Maximum clock frequency	f_{max}	—	33	73	—	MHz

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	$T_a = 25^\circ\text{C}$			$T_a = -40 \sim 85^\circ\text{C}$		Unit
				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 ($\overline{\text{CK}} - Q1$)	t_{pLH} t_{pHL}	—	2.0	—	70	145	—	180	ns
			4.5	—	20	29	—	36	
			6.0	—	17	25	—	31	
Propagation delay time ($Q_n - Q_{n+1}$)	Δt_{pd}	—	2.0	—	20	75	—	95	ns
			4.5	—	6	15	—	19	
			6.0	—	4	13	—	16	
Propagation delay time (CLR)	t_{pHL}	—	2.0	—	55	140	—	175	ns
			4.5	—	17	28	—	35	
			6.0	—	14	24	—	30	
Maximum clock frequency	f_{max}	—	2.0	6	17	—	5	—	MHz
			4.5	30	66	—	24	—	
			6.0	35	78	—	28	—	
Input capacitance	C_{IN}	—	—	5	10	—	10	pF	
Power dissipation capacitance	CPD (Note)	TC74HC4020A	—	27	—	—	—	pF	
		TC74HC4040A	—	37	—	—	—		

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:

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

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

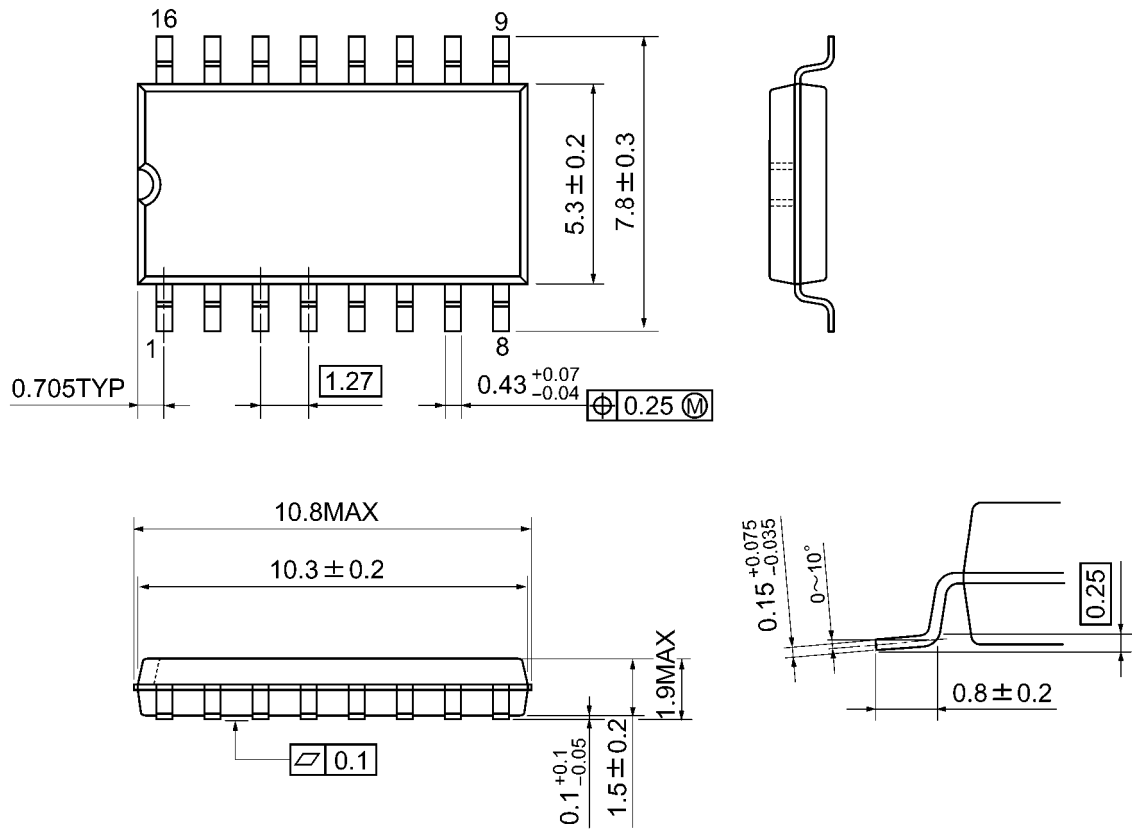


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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