TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HCT174AP, TC74HCT174AF

Hex D-Type Flip Flop with Clear

The TC74HCT174A is a high speed CMOS D-TYPE FLIP FLOP fabricated with silicon gate C^2MOS technology.

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

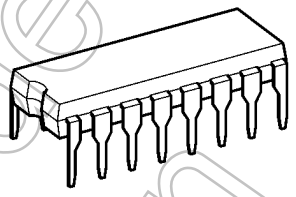
This device may be used as a level converter for interfacing TTL or NMOS to High Speed CMOS. The inputs are compatible with TTL, NMOS and CMOS output voltage levels.

Information signals applied to the D inputs are transferred to the Q outputs on the positive going edge of the clock pulse.

When the $\overline{CLR}$ input is held low, the Q outputs are in the low logic level independent of the other inputs.

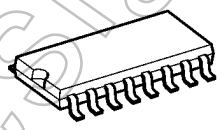
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

TC74HCT174AP



DIP16-P-300-2.54A

TC74HCT174AF



SOP16-P-300-1.27A

Weight

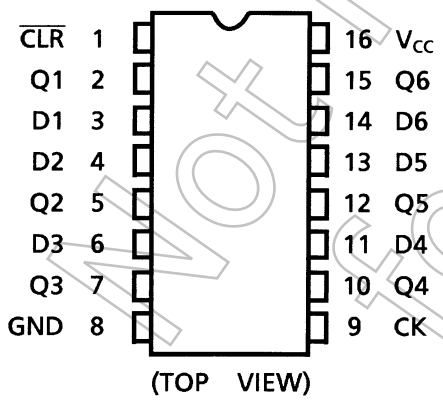
DIP16-P-300-2.54A : 1.00 g (typ.)

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

Features

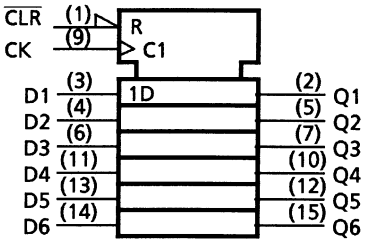
- High speed: f_{max} = 56 MHz (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 4 μA (max) at Ta = 25°C
- Compatible with TTL outputs: V_{IH} = 2.0 V (min)
  V_{IL} = 0.8 V (max)
- Wide interfacing ability: LSTTL, NMOS, CMOS
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL}$ = 4 mA (min)
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Pin and function compatible with 74LS174

Pin Assignment



Start of commercial production
1989-05

IEC Logic Symbol

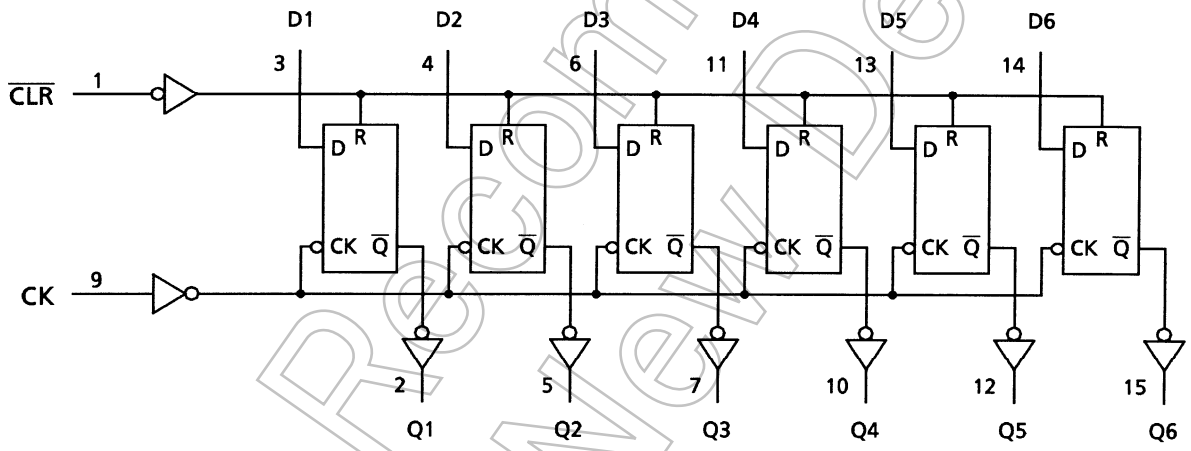


Truth Table

Inputs			Output	Function
$\overline{CLR}$	D	CK	Q	
L	X	X	L	Clear
H	L	↑	L	—
H	H	↑	H	—
H	X	↓	Qn	No Change

X: Don't care

System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5 to 7	V
DC input voltage	V_{IN}	−0.5 to V_{CC} + 0.5	V
DC output voltage	V_{OUT}	−0.5 to 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 to 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}	4.5 to 5.5	V
Input voltage	V_{IN}	0 to V_{CC}	V
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature	T_{opr}	−40 to 85	°C
Input rise and fall time	t_r, t_f	0 to 500	ns

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

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition		Ta = 25°C				Ta = −40 to 85°C		Unit
				V_{CC} (V)	Min	Typ.	Max	Min	Max	
High-level input voltage	V_{IH}	—		4.5 to 5.5	2.0	—	—	2.0	—	V
Low-level input voltage	V_{IL}	—		4.5 to 5.5	—	—	0.8	—	0.8	V
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −20 μA	4.5	4.4	4.5	—	4.4	—	V
			I_{OH} = −4 mA	4.5	4.18	4.31	—	4.13	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20 μA	4.5	—	0.0	0.1	—	0.1	V
			I_{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	4.0	—	40.0	μA
	I_C	Per input: V_{IN} = 0.5 V or 2.4 V Other input: V_{CC} or GND		5.5	—	—	2.0	—	2.9	mA

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = −40 to 85°C	Unit
			V_{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	$t_{W(L)}$	—	4.5	—	15	19	ns
	$t_{W(H)}$		5.5	—	14	18	
Minimum pulse width ($\overline{CLR}$)	$t_{W(L)}$	—	4.5	—	15	19	ns
			5.5	—	14	18	
Minimum set-up time	t_s	—	4.5	—	20	25	ns
			5.5	—	18	23	
Minimum hold time	t_h	—	4.5	—	5	5	ns
			5.5	—	5	5	
Minimum removal time ($\overline{CLR}$)	t_{rem}	—	4.5	—	10	10	ns
			5.5	—	10	10	
Clock frequency	f	—	4.5	—	30	24	MHz
			5.5	—	33	26	

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}	—	—	12	15	ns
Propagation delay time (CK-Q)	t_{pLH} t_{pHL}	—	—	29	36	ns
Propagation delay time ($\overline{CLR}$ -Q)	t_{pHL}	—	—	29	36	ns
Maximum clock frequency	f_{max}	—	32	61	—	MHz

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

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = −40 to 85°C		Unit
			V_{CC} (V)	Min	Typ.	Max	Min	Max	
Output transition time	t_{TLH}	—	4.5	—	8	15	—	19	ns
	t_{THL}		5.5	—	7	14	—	18	
Propagation delay time (CK-Q)	t_{pLH}	—	4.5	—	20	34	—	43	ns
	t_{pHL}		5.5	—	17	31	—	39	
Propagation delay time ($\overline{CLR}$ -Q)	t_{pHL}	—	4.5	—	20	34	—	43	ns
			5.5	—	17	31	—	39	
Maximum clock frequency	f_{max}	—	4.5	30	54	—	24	—	MHz
			5.5	33	57	—	26	—	
Input capacitance	C_{IN}	—		—	5	10	—	10	pF
Power dissipation capacitance	C_{PD} (Note)	—		—	30	—	—	—	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:

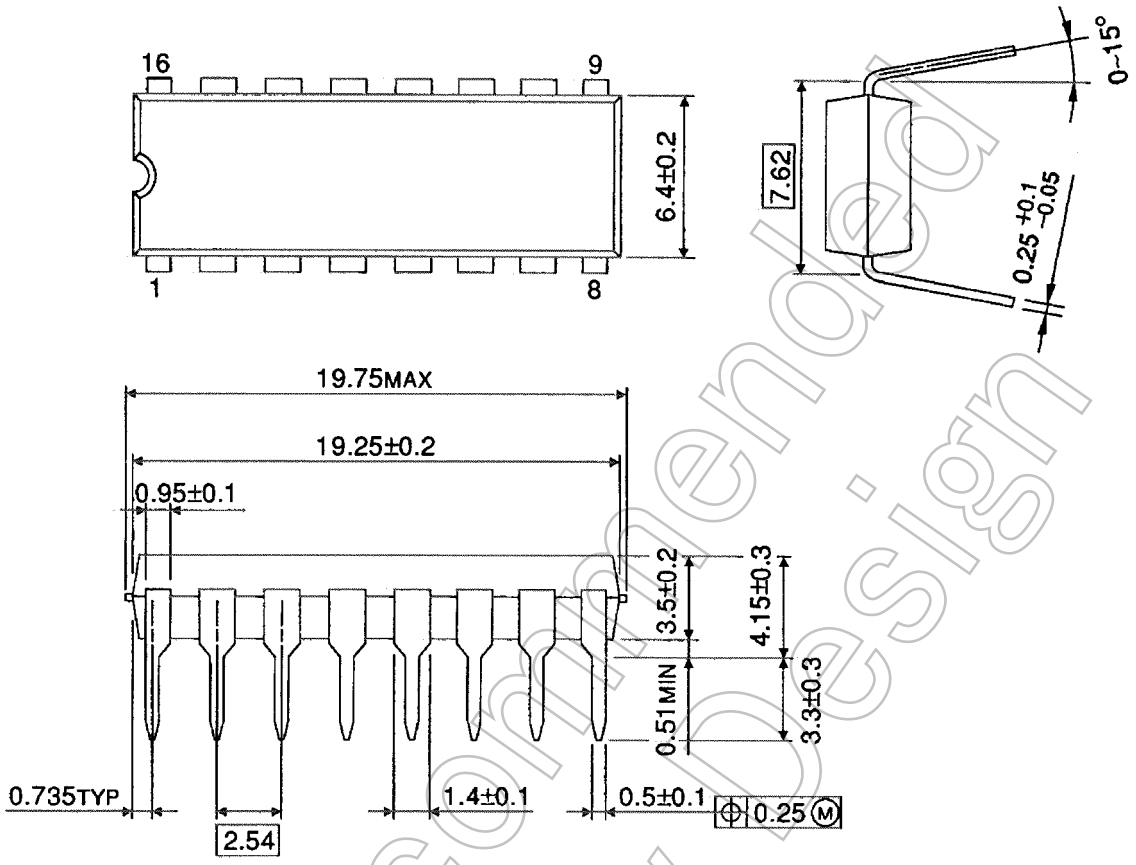
$$I_{CC}\ (opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6\ (per\ F/F)$$

And the total C_{PD} when n pcs. of flip flop operate can be gained by the following equation:

$$C_{PD}\ (total) = 18 + 12 \cdot n$$

Package Dimensions

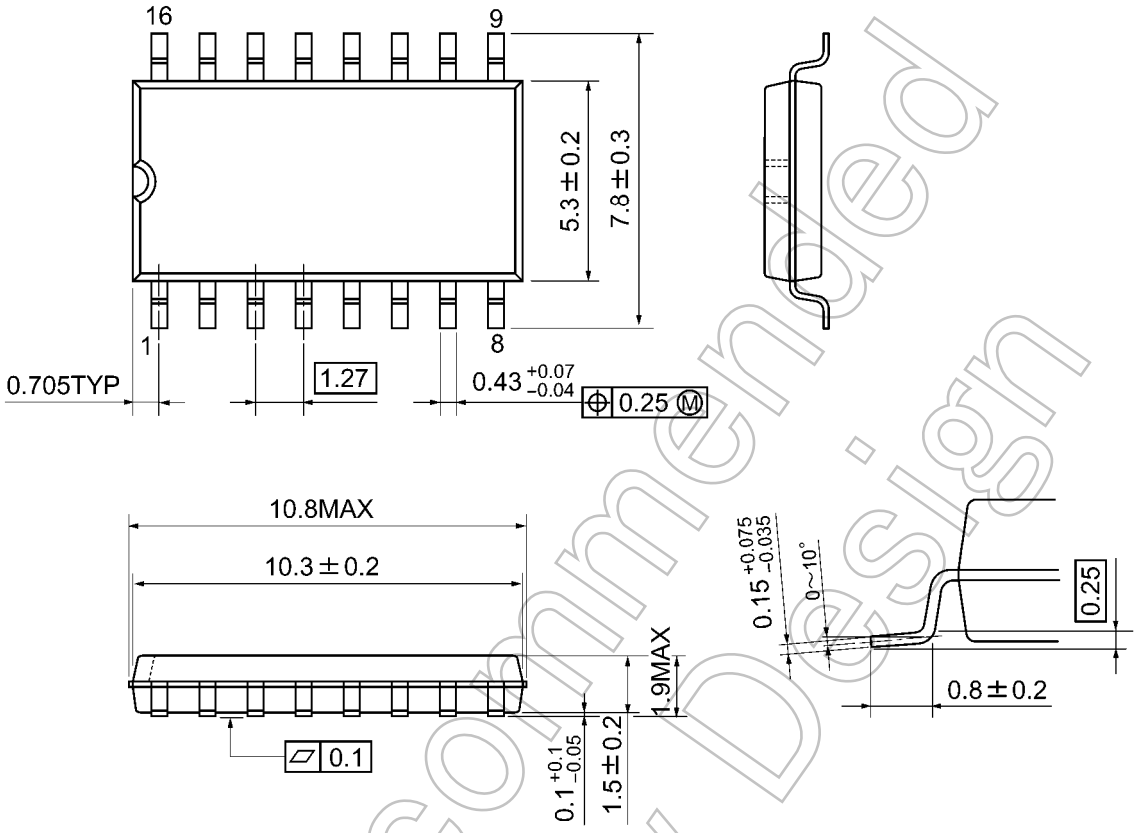
DIP16-P-300-2.54A Unit : mm



Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

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