

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HC374AP, TC74HC374AF

Octal D-Type Flip-Flop with 3-State Output

The TC74HC374A is a high speed CMOS OCTAL FLIP-FLOP with 3-STATE OUTPUT fabricated with silicon gate C²MOS technology.

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

These 8-bit D-type flip-flops are controlled by a clock input (CK) and an output enable input ($\overline{OE}$).

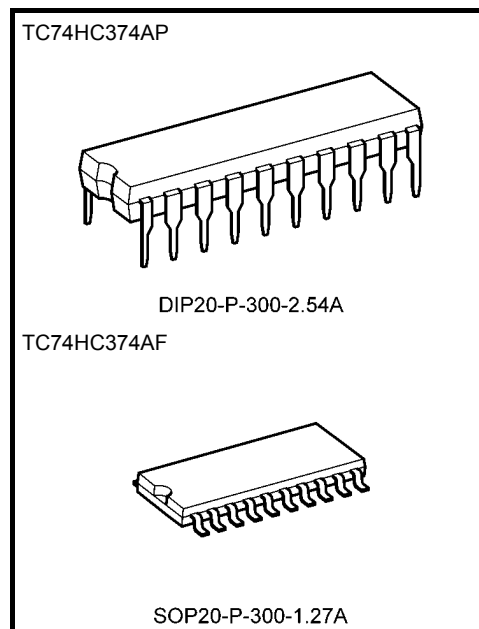
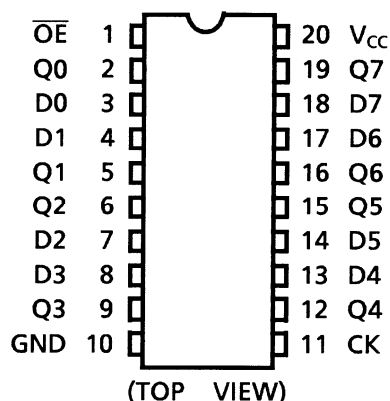
When the $\overline{OE}$ input is high, the eight outputs are in a high impedance state.

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

Features

- High speed: $f_{max} = 77$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 4$ μ A (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- Output drive capability: 15 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL} = 6$ mA (min)
- Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
- Wide operating voltage range: $V_{CC}(\text{opr}) = 2$ to 6 V
- Pin and function compatible with 74LS374

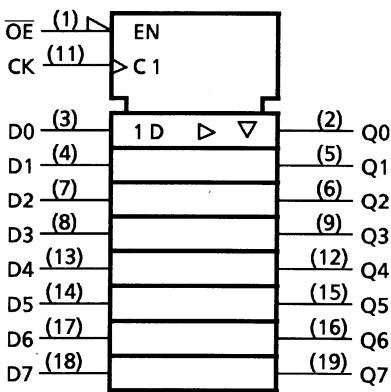
Pin Assignment



Weight	
DIP20-P-300-2.54A	: 1.30 g (typ.)
SOP20-P-300-1.27A	: 0.22 g (typ.)

Start of commercial production
1986-05

IEC Logic Symbol

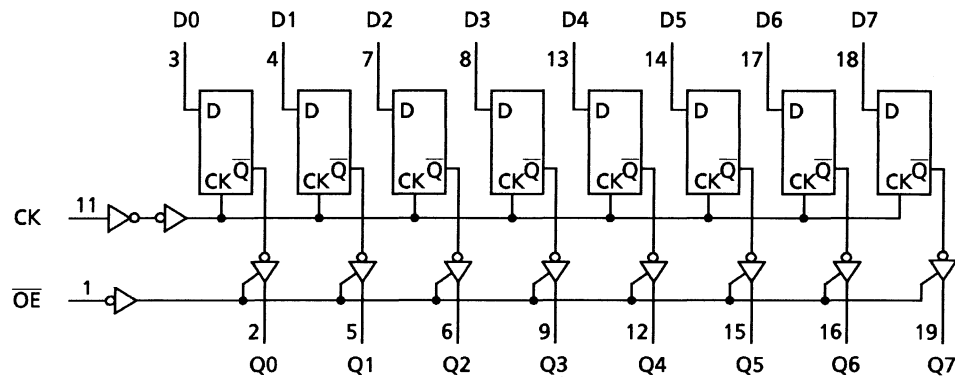


Truth Table

Inputs			Outputs
$\overline{OE}$	CK	D	Q
H	X	X	Z
L		X	Q_n
L		L	L
L		H	H

X: Don't care
Z: High impedance
 Q_n : No change

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}	± 35	mA
DC V_{CC} /ground current	I_{CC}	± 75	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 $T_a = -40$ to 65°C . From $T_a = 65$ to 85°C a derating factor of $-10\text{ mW}/^\circ\text{C}$ shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 6	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 1000 ($V_{CC} = 2.0\text{ V}$) 0 to 500 ($V_{CC} = 4.5\text{ V}$) 0 to 400 ($V_{CC} = 6.0\text{ V}$)	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}	—		2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	V	
Low-level input voltage	V _{IL}	—		2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	V	
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} = −6 mA I _{OH} = −7.8 mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 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
			4.5		—	0.0	0.1	—	0.1	
			6.0		—	0.0	0.1	—	0.1	
			I _{OL} = 6 mA I _{OL} = 7.8 mA	4.5 6.0	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	
3-state output off-state current	I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = V _{CC} or GND		6.0	—	—	±0.5	—	±5.0	μA
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 to 85°C	Unit
			VCC (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	tW (H) tW (L)	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time (Dn)	tS	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum hold time (Dn)	tH	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Clock frequency	f	—	2.0	—	6	5	MHz
			4.5	—	31	25	
			6.0	—	36	29	

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

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = -40 to 85°C		Unit
			CL (pF)	V _{CC} (V)	Min	Typ.	Max	Min	Max	
Output transition time	t_{TLH} t_{THL}	—	50	2.0	—	20	60	—	75	ns
				4.5	—	6	12	—	15	
				6.0	—	5	10	—	13	
Propagation delay time (CK-Q)	t_{pLH} t_{pHL}	—	50	2.0	—	45	140	—	175	ns
				4.5	—	15	28	—	35	
				6.0	—	13	24	—	30	
			150	2.0	—	60	190	—	240	
				4.5	—	20	38	—	48	
				6.0	—	17	32	—	41	
Output enable time	t_{pZL} t_{pZH}	$R_L = 1 \text{ k}\Omega$	50	2.0	—	39	135	—	170	ns
				4.5	—	13	27	—	34	
				6.0	—	11	23	—	29	
			150	2.0	—	54	185	—	230	
				4.5	—	18	37	—	46	
				6.0	—	15	31	—	39	
Output enable time	t_{pLZ} t_{pHZ}	$R_L = 1 \text{ k}\Omega$	50	2.0	—	30	135	—	170	ns
				4.5	—	13	27	—	34	
				6.0	—	12	23	—	29	
Maximum clock frequency	f_{max}	—	50	2.0	6	18	—	5	—	MHz
				4.5	31	75	—	25	—	
				6.0	36	90	—	29	—	
Input capacitance	C_{IN}	—	—	—	—	5	10	—	10	pF
Output capacitance	C_{OUT}	—	—	—	—	10	—	—	—	pF
Power dissipation capacitance	C_{PD} (Note)	—	—	—	—	47	—	—	—	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:

$$I_{\text{CC}}(\text{opr}) = C_{\text{PD}} \cdot V_{\text{CC}} \cdot f_{\text{IN}} + I_{\text{CC}}/8 \text{ (per flip flop)}$$

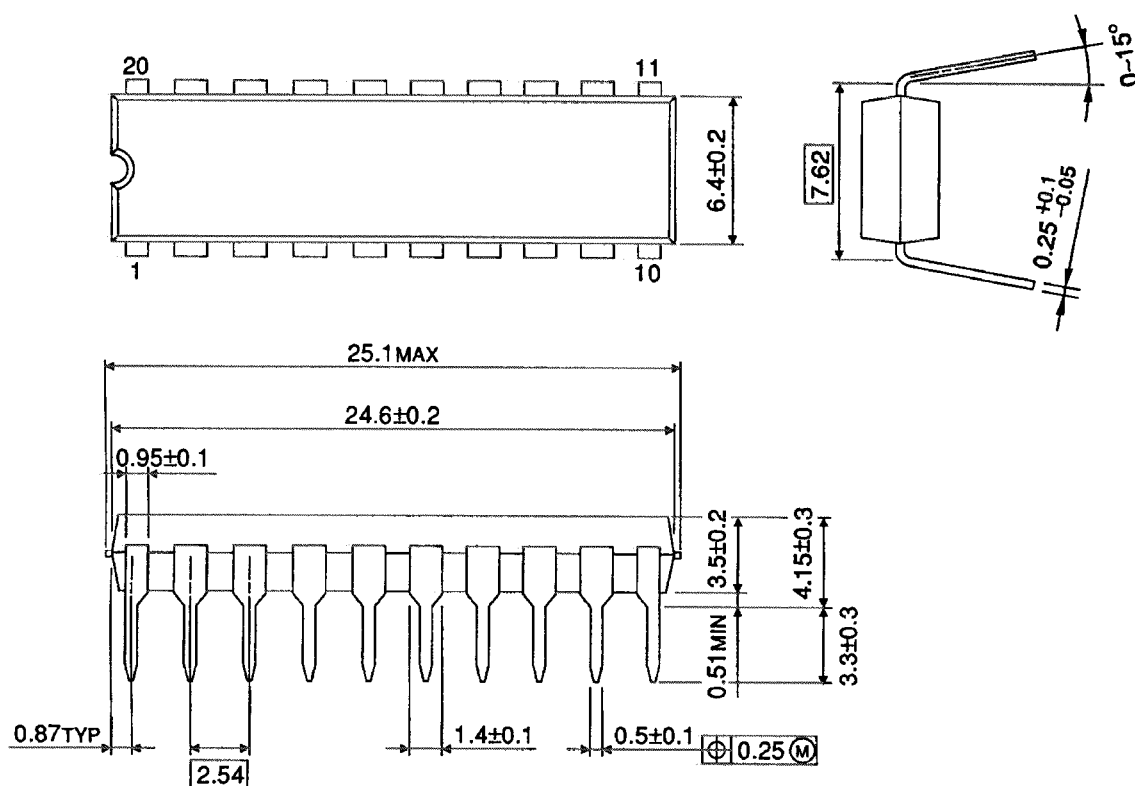
And the total C_{PD} when n pcs. of F/F operate can be gained by the following equation:

$$C_{\text{PD}}(\text{total}) = 30 + 17 \cdot n$$

Package Dimensions

DIP20-P-300-2.54A

Unit : mm

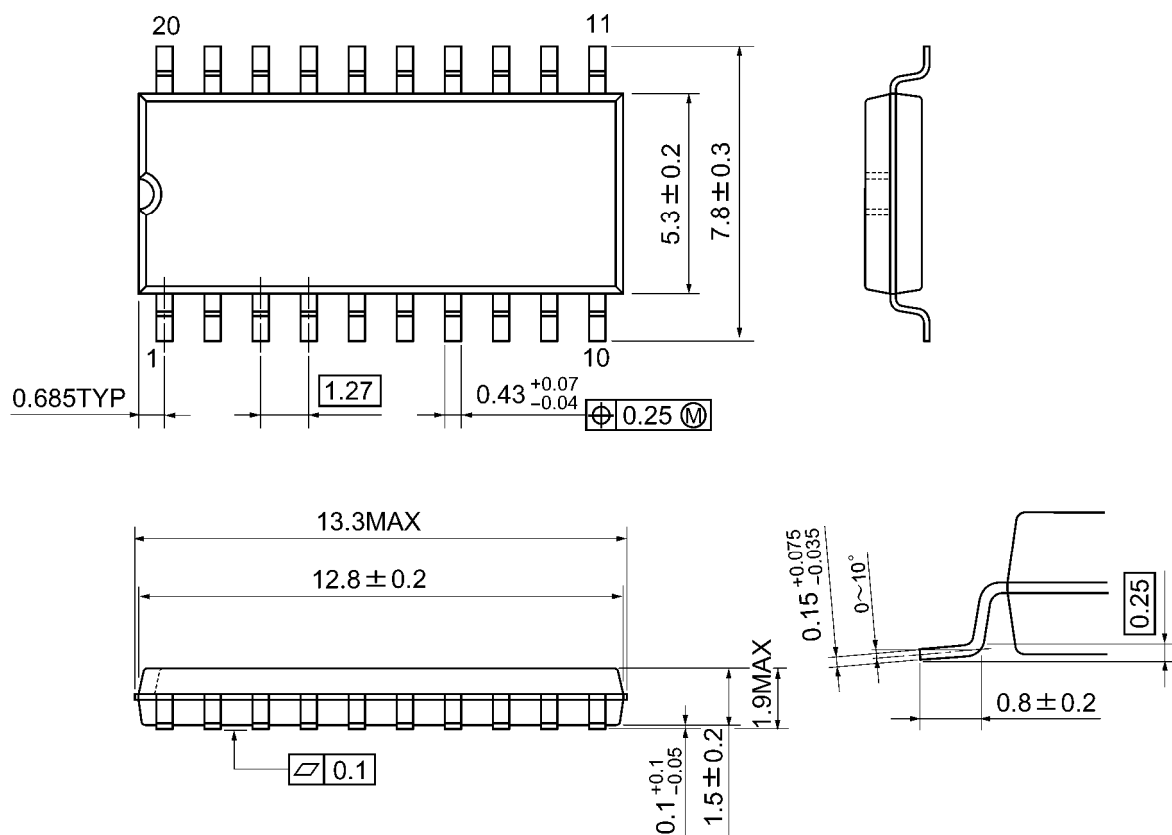


Weight: 1.30 g (typ.)

Package Dimensions

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

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