

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

**TC74HC564AP, TC74HC564AF, TC74HC574AP, TC74HC574AF**

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

TC74HC564AP/AF Inverting

TC74HC574AP/AF Non-Inverting

The TC74HC564A and HC574A are high speed CMOS OCTAL FLIP-FLOPs with 3-STATE OUTPUT fabricated with silicon gate C<sup>2</sup>MOS technology.

They achieve 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 ( $\overline{OE}$ ).

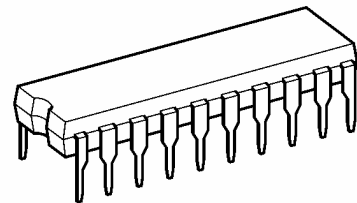
The TC74HC564A has inverting outputs, and the TC74HC574A has non-inverting outputs.

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

**Features**

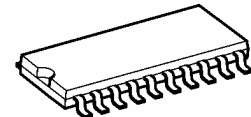
- High speed:  $f_{\max} = 62$  MHz (typ.) at  $V_{CC} = 5$  V
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability: 15 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 6$  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 74LS564/574

TC74HC564AP, TC74HC574AP



DIP20-P-300-2.54A

TC74HC564AF, TC74HC574AF



SOP20-P-300-1.27A

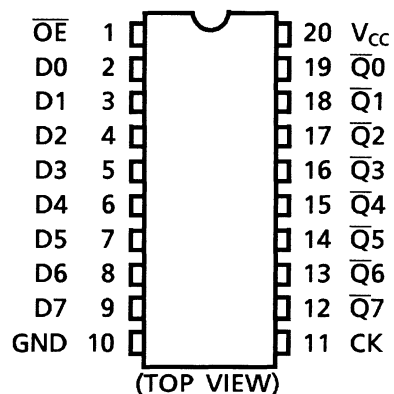
Weight

DIP20-P-300-2.54A : 1.30 g (typ.)

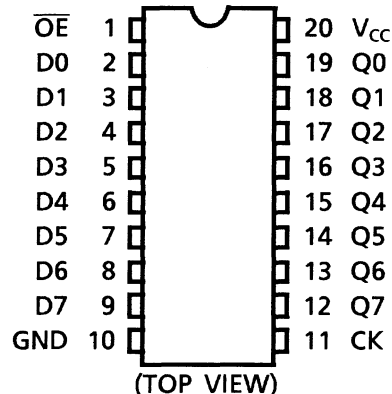
SOP20-P-300-1.27A : 0.22 g (typ.)

## Pin Assignment

### TC74HC564A

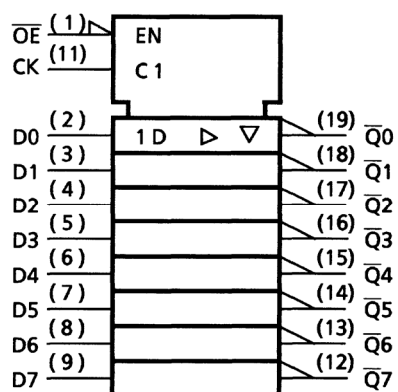


### TC74HC574A

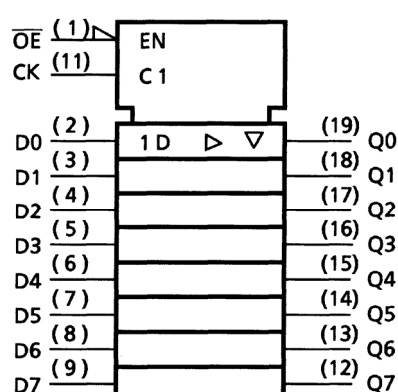


## IEC Logic Symbol

### TC74HC564A



### TC74HC574A



## Truth Table

Inputs			Outputs	
$\overline{OE}$	CK	D	Q (574A)	$\overline{Q}$ (564A)
H	X	X	Z	Z
L		X	$Q_n$	$\overline{Q}_n$
L		L	L	H
L		H	H	L

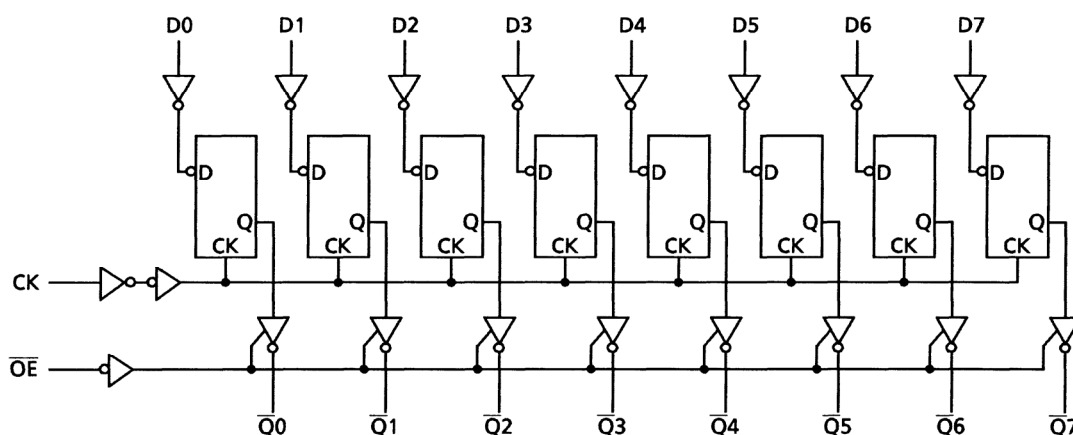
X: Don't care

Z: High impedance

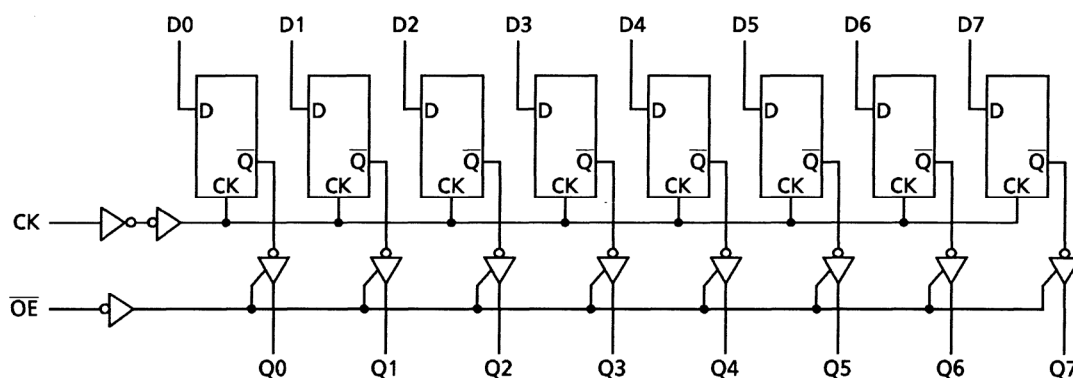
$Q_n$  ( $\overline{Q}_n$ ): No change

## System Diagram

### TC74HC564A



### TC74HC574A



## 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	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 35$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}\text{C}$

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  $65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10$  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 ( $V_{CC} = 2.0$ V) 0 to 500 ( $V_{CC} = 4.5$ V) 0 to 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 to 85°C		Unit	
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V <sub>IH</sub>	—		2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	V	
Low-level input voltage	V <sub>IL</sub>	—		2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	V	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = −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 <sub>OH</sub> = −6 mA I <sub>OH</sub> = −7.8 mA	4.5 6.0	4.18 5.68	4.31 5.80	— —	4.13 5.63	— —	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>		I <sub>OL</sub> = 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 <sub>OL</sub> = 6 mA I <sub>OL</sub> = 7.8 mA	4.5	—	0.17	0.26	—	0.33	
				6.0	—	0.18	0.26	—	0.33	
				3-state output off-state current	I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND		6.0	—	—
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND		6.0	—	—	4.0	—	40.0	μA

**Timing Requirements (input:  $t_r = t_f = 6 \text{ ns}$ )**

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C	Unit
			V <sub>CC</sub> (V)	Typ.	Limit	
Minimum pulse width (CK)	$t_W$ (H) $t_W$ (L)	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum set-up time (Dn)	$t_s$	—	2.0	—	75	ns
			4.5	—	15	
			6.0	—	13	
Minimum hold time (Dn)	$t_h$	—	2.0	—	0	ns
			4.5	—	0	
			6.0	—	0	
Clock frequency	f	—	2.0	—	6	MHz
			4.5	—	31	
			6.0	—	36	

## 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 <sub>CC</sub> (V)	Min	Typ.	Max	Min	Max	
Output transition time	$t_{TLH}$ $t_{THL}$	—	50	2.0	—	25	60	—	75	ns
				4.5	—	7	12	—	15	
				6.0	—	6	10	—	13	
Propagation delay time (CK-Q, $\bar{Q}$ )	$t_{pLH}$ $t_{pHL}$	—	50	2.0	—	70	150	—	190	ns
				4.5	—	20	30	—	38	
				6.0	—	15	26	—	33	
			150	2.0	—	88	190	—	240	
				4.5	—	25	38	—	48	
				6.0	—	19	33	—	41	
Output enable time	$t_{pZL}$ $t_{pZH}$	$R_L = 1 \text{ k}\Omega$	50	2.0	—	48	125	—	155	ns
				4.5	—	15	25	—	31	
				6.0	—	12	21	—	26	
			150	2.0	—	60	165	—	205	
				4.5	—	20	33	—	41	
				6.0	—	16	28	—	35	
Output disable time	$t_{pLZ}$ $t_{pHZ}$	$R_L = 1 \text{ k}\Omega$	50	2.0	—	34	125	—	155	ns
				4.5	—	17	25	—	31	
				6.0	—	15	21	—	26	
Maximum clock frequency	$f_{\max}$	—	50	2.0	6	17	—	5	—	MHz
				4.5	31	50	—	24	—	
				6.0	36	59	—	28	—	
Input capacitance	$C_{IN}$	—	—	—	—	5	10	—	10	pF
Output capacitance	$C_{OUT}$	—	—	—	—	10	—	—	—	pF
Power dissipation capacitance	$C_{PD}$ (Note)	—	—	—	—	54	—	—	—	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:

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

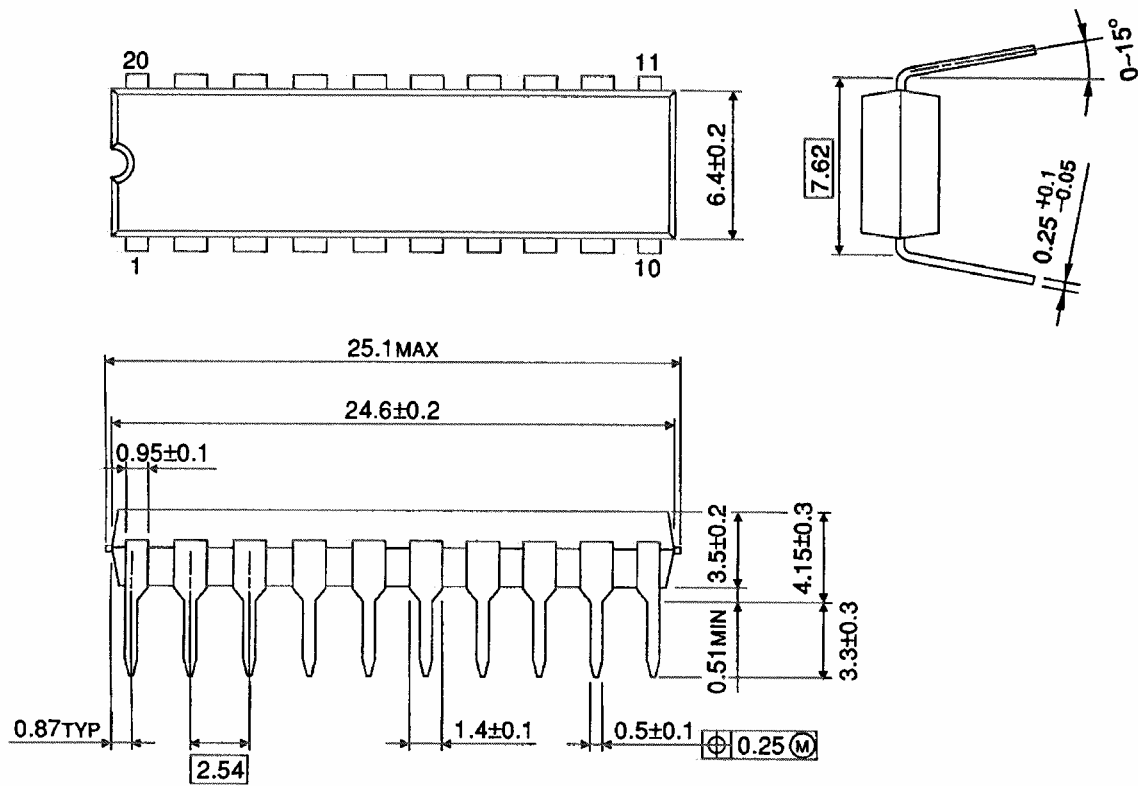
And the total  $C_{PD}$  when n pcs. of flip flop operate can be gained by the following equation:

$$C_{PD} (\text{total}) = 39 + 15 \cdot n$$

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm

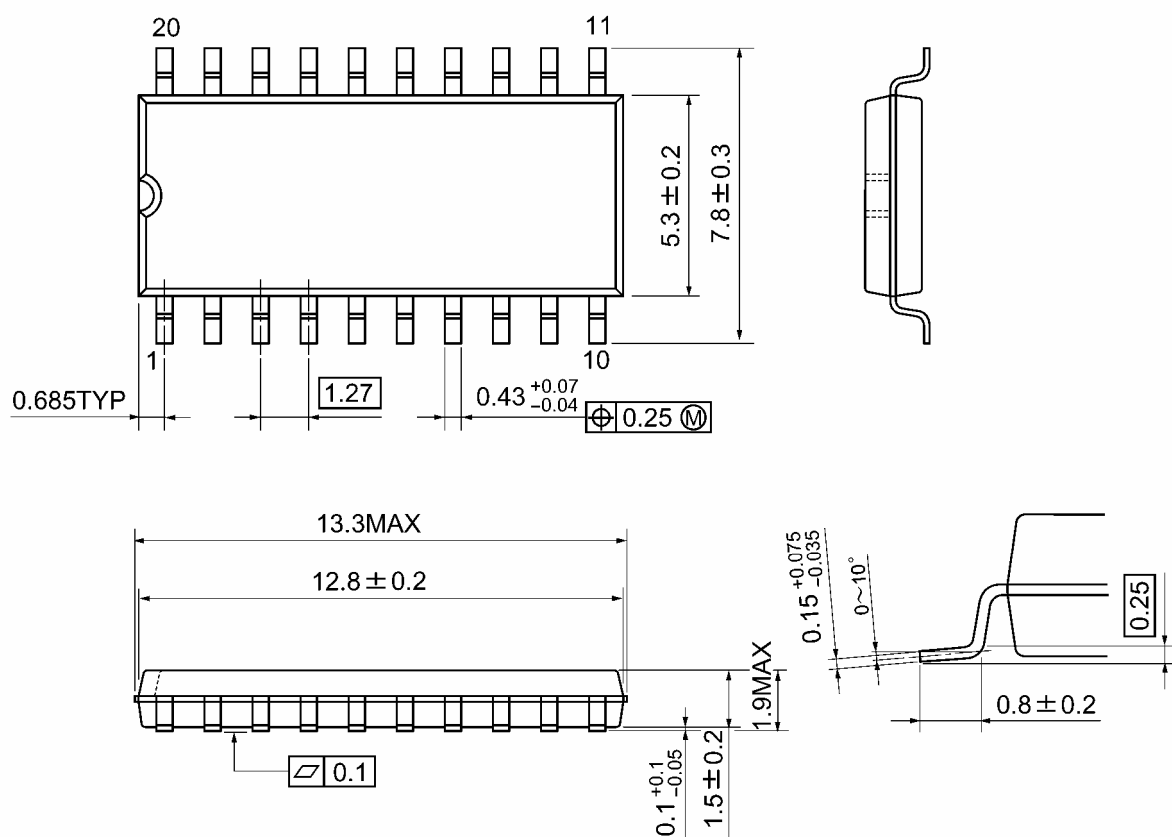


Weight: 1.30 g (typ.)

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)



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20070701-EN GENERAL

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