

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74AC377P, TC74AC377F

Octal D-Type Flip-Flop

The TC74AC377 is an advanced high speed CMOS OCTAL D-TYPE FLIP FLOP fabricated with silicon gate and double-layer metal wiring C²MOS technology.

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

This 8-bit D-type flip-flop is controlled by a clock input (CK) and an enable input (\bar{G})

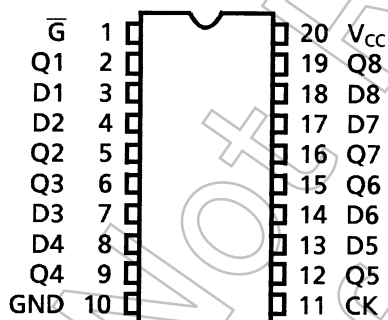
The signal level applied to the D inputs are transferred to Q outputs during the positive going transition of CK.

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

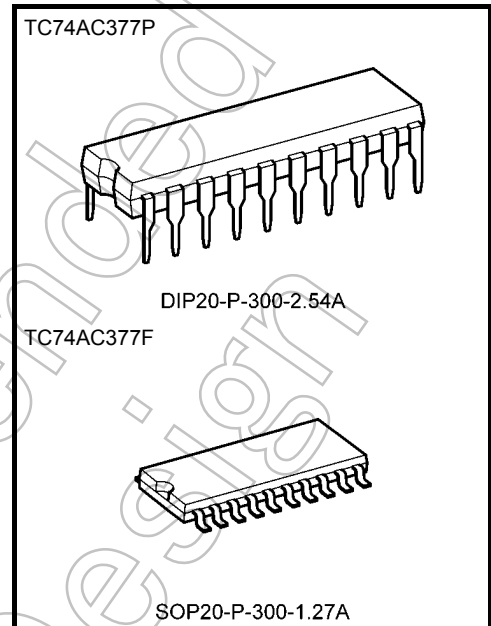
Features

- High speed: $f_{max} = 140$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 8$ μ A (max) at $T_a = 25^\circ$ C
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- Symmetrical output impedance: $|I_{OH}| = I_{OL} = 24$ mA (min)
 Capability of driving 50 Ω transmission lines.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (opr) = 2$ to 5.5 V
- Pin and function compatible with 74F377

Pin Assignment



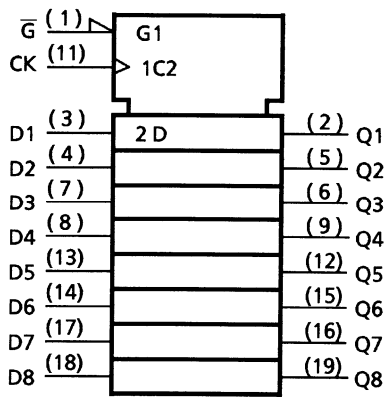
(TOP VIEW)



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

Start of commercial production
1989-11

IEC Logic Symbol



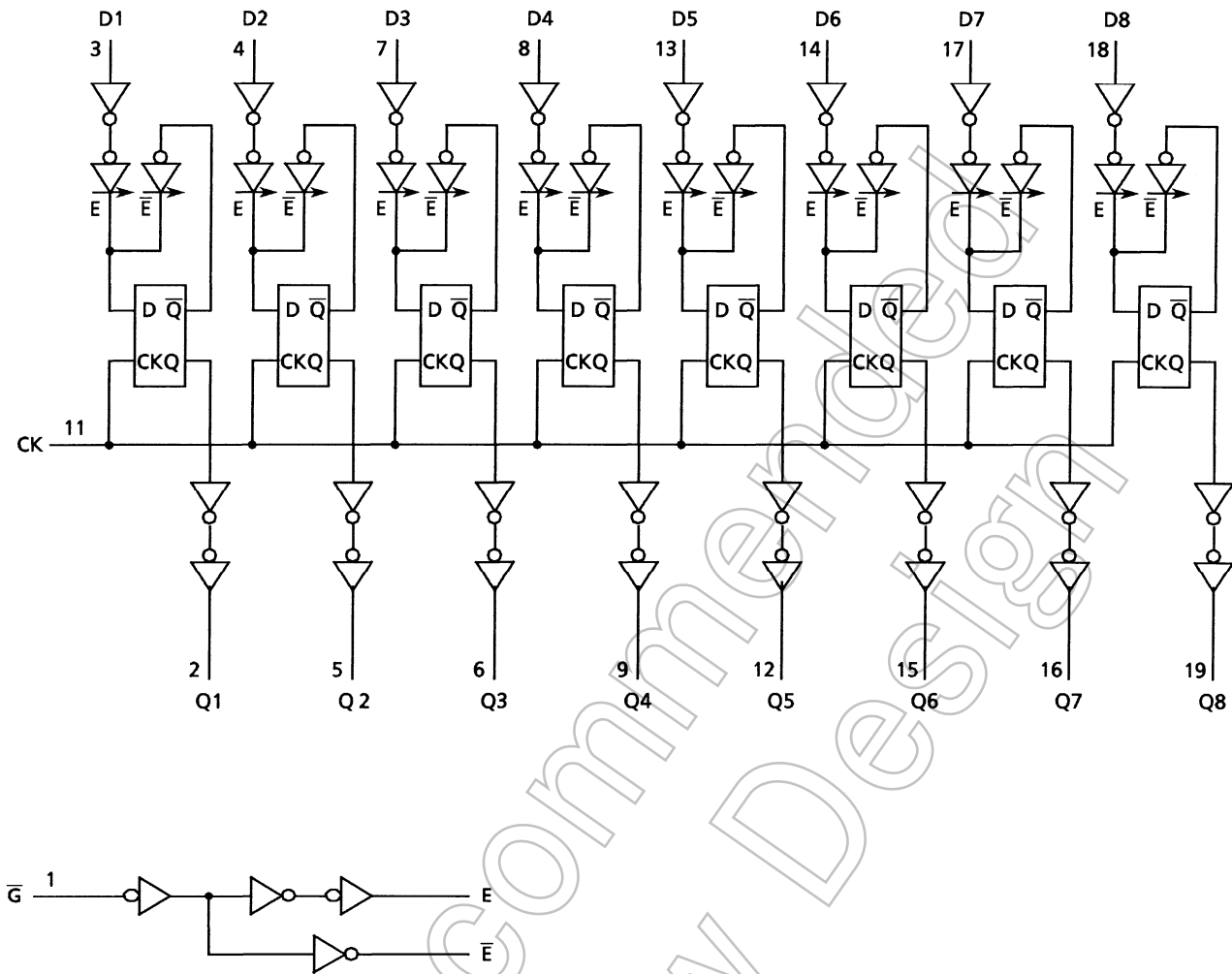
Truth Table

Inputs			Output
\bar{G}	CK	D	Q
H	X	X	No Change
L		L	L
L		H	H
X		X	No Change

X: Don't care

Not Recommended for New Design

System Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7.0	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}	± 50	mA
DC output current	I_{OUT}	± 50	mA
DC V_{CC} /ground current	I_{CC}	± 200	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	-65 to 150	$^{\circ}C$

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 $65^{\circ}C$. From $T_a = 65$ to $85^{\circ}C$, a derating factor of -10 mW/ $^{\circ}C$ should be applied up to 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.0 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	dt/dV	0 to 100 ($V_{CC} = 3.3 \pm 0.3$ V) 0 to 20 ($V_{CC} = 5 \pm 0.5$ V)	ns/V

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	$T_a = 25^\circ\text{C}$			$T_a = -40$ to 85°C		Unit		
			V_{CC} (V)	Min	Typ.	Max	Min		Max	
High-level input voltage	V_{IH}	—	2.0	1.50	—	—	1.50	—	V	
			3.0	2.10	—	—	2.10	—		
			5.5	3.85	—	—	3.85	—		
Low-level input voltage	V_{IL}	—	2.0	—	—	0.50	—	0.50	V	
			3.0	—	—	0.90	—	0.90		
			5.5	—	—	1.65	—	1.65		
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -50 \mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V
				3.0	2.9	3.0	—	2.9	—	
			$I_{OH} = -4 \text{ mA}$	4.5	4.4	4.5	—	4.4	—	
			$I_{OH} = -24 \text{ mA}$	3.0	2.58	—	—	2.48	—	
		$I_{OH} = -75 \text{ mA}$ (Note)	4.5	3.94	—	—	3.80	—		
			5.5	—	—	—	3.85	—		
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50 \mu\text{A}$	2.0	—	0.0	0.1	—	0.1	V
				3.0	—	0.0	0.1	—	0.1	
				4.5	—	0.0	0.1	—	0.1	
			$I_{OL} = 12 \text{ mA}$	3.0	—	—	0.36	—	0.44	
			$I_{OL} = 24 \text{ mA}$	4.5	—	—	0.36	—	0.44	
		$I_{OL} = 75 \text{ mA}$ (Note)	5.5	—	—	—	—	1.65		
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	—	—	8.0	—	80.0	μA	

Note: This spec indicates the capability of driving 50 Ω transmission lines.

One output should be tested at a time for a 10 ms maximum duration.

Timing Requirements (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40 to 85°C		Unit
			VCC (V)	Limit	Limit	Limit	
Minimum pulse width (CK)	$t_W (L)$	—	3.3 ± 0.3	8.0	8.0	8.0	ns
	$t_W (H)$		5.0 ± 0.5	5.0	5.0	5.0	
Minimum set-up time (D-CK)	t_s	—	3.3 ± 0.3 5.0 ± 0.5	8.0 4.0	8.0 4.0	8.0 4.0	ns
Minimum set-up time (\bar{G} -CK)	t_s	—	3.3 ± 0.3 5.0 ± 0.5	9.0 4.0	9.0 4.0	9.0 4.0	ns
Minimum hold time	t_h	—	3.3 ± 0.3	1.0	1.0	1.0	ns
			5.0 ± 0.5	1.0	1.0	1.0	

AC Characteristics (CL = 50 pF, RL = 500 Ω, input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40 to 85°C		Unit	
			VCC (V)	Min	Typ.	Max	Min		Max
Propagation delay time (CK-Q)	t_{pLH}	—	3.3 ± 0.3	—	10.6	17.6	1.0	20.0	ns
	t_{pHL}		5.0 ± 0.5	—	7.4	10.6	1.0	12.0	
Maximum clock frequency	f_{max}	—	3.3 ± 0.3	50	95	—	50	—	MHz
			5.0 ± 0.5	80	140	—	80	—	
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:

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

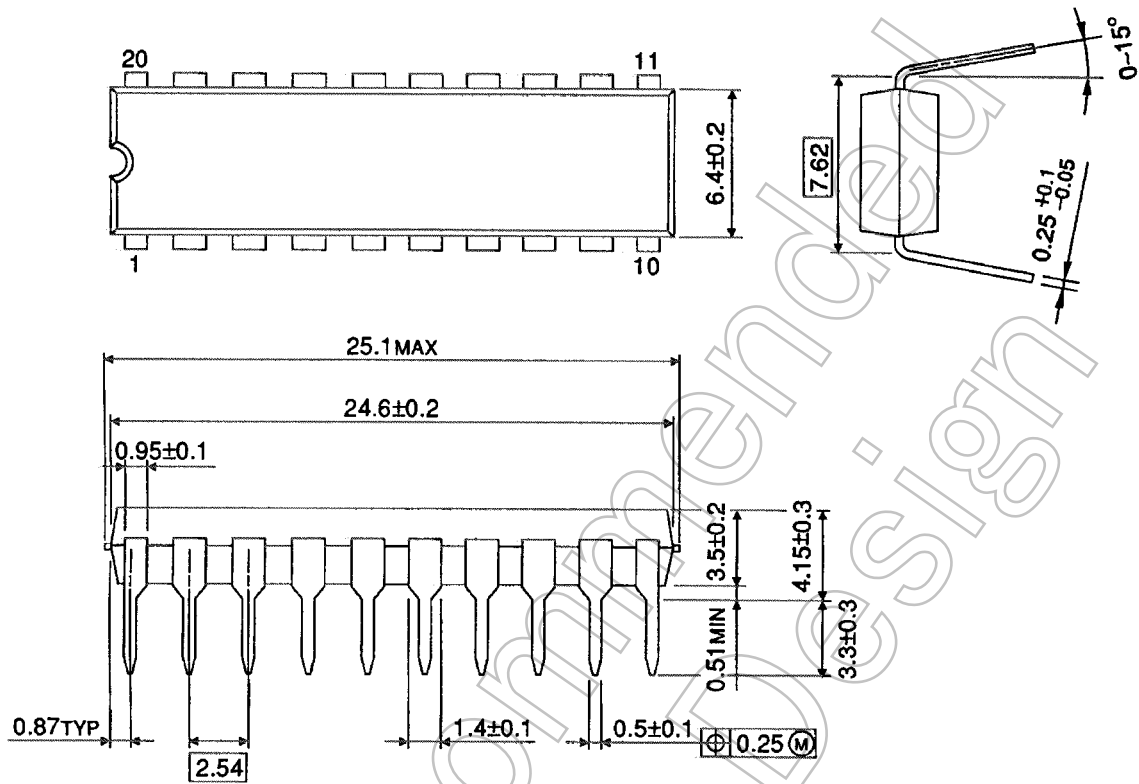
And the total C_{PD} when n pcs. of flip flop operate can be gained by the following equation:

$$C_{PD} (total) = 20 + 10 \cdot n$$

Package Dimensions

DIP20-P-300-2.54A

Unit : mm



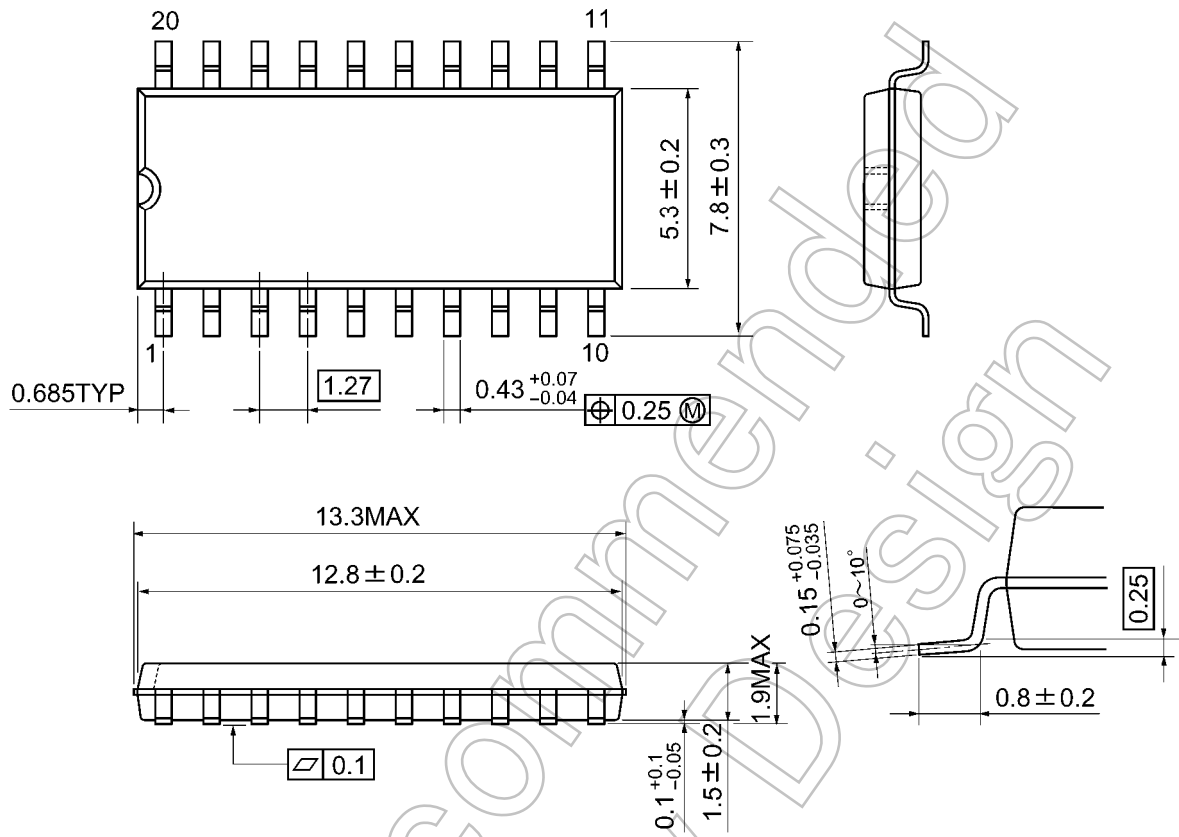
Weight: 1.30 g (typ.)

Not Recommended for New Design

Package Dimensions

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

Not Recommended for New Design

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