

December 1996

## Fast CMOS Octal D Flip-Flop with Clock Enable

### Features

- Advanced 0.8 micron CMOS Technology
- The CD74FCT377T is Pin Compatible With Bipolar FAST™ Series at a Higher Speed And Lower Power Consumption
- TTL Input and Output Levels
- Octal D Flip-Flops with Clock Enable
- Extremely Low Static Power
- Hysteresis on All Inputs

### Description

The CD74FCT377T is an 8-bit wide octal designed with eight edge-triggered D-type flip-flops with individual D inputs and O outputs. When Clock Enable ( $\overline{CE}$ ) is LOW, the common buffered Clock (CP) loads all flip-flops simultaneously. The register is fully edge-triggered. The D input state, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's O output. The  $\overline{CE}$  input must be stable only one setup time prior to the LOW-to-HIGH transition for predictable operation.

### Ordering Information

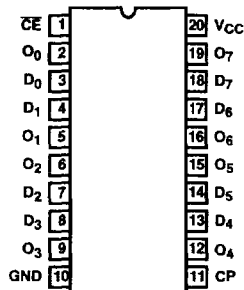
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT377ATM	-40 to 85	20 Ld SOIC	M20.3-P
CD74FCT377ATQM	-40 to 85	20 Ld QSOP	M20.15-P
CD74FCT377CTM	-40 to 85	20 Ld SOIC	M20.3-P
CD74FCT377CTQM	-40 to 85	20 Ld QSOP	M20.15-P
CD74FCT377DTM	-40 to 85	20 Ld SOIC	M20.3-P
CD74FCT377DTQM	-40 to 85	20 Ld QSOP	M20.15-P
CD74FCT377TM	-40 to 85	20 Ld SOIC	M20.3-P
CD74FCT377TQM	-40 to 85	20 Ld QSOP	M20.15-P

NOTE: QSOP is commonly known as SSOP.

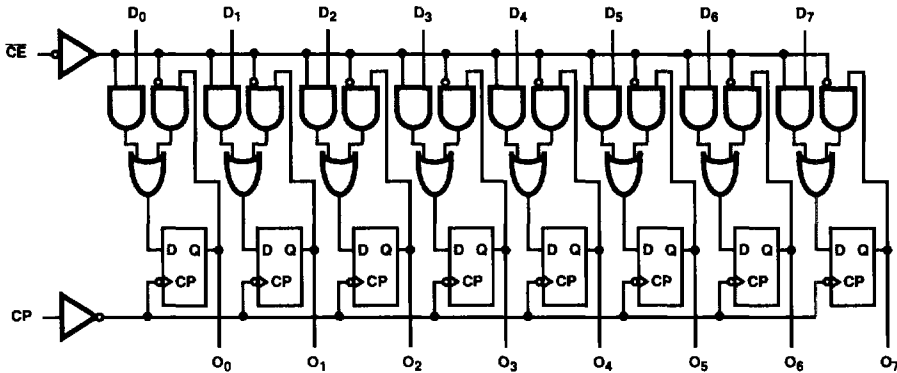
When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

### Pinout

CD74FCT377T  
(QSOP, SOIC)  
TOP VIEW



**Functional Block Diagram**



**TRUTH TABLE**

MODE	(NOTE 1) INPUTS			(NOTE 1) OUTPUTS
	CP	CE	D <sub>N</sub>	O <sub>N</sub>
Load *1*	↑	l	h	H
Load *0*	↑	l	l	L
Hold (Do Nothing)	↑ H	h H	X X	NC NC

NOTE:

- 1. H = HIGH Voltage Level
- h = HIGH Voltage Level One Setup Time Prior to the LOW-to-HIGH Clock Transition
- L = LOW Voltage Level
- l = LOW Voltage Level One Setup Time Prior to the LOW-to-HIGH Clock Transition
- X = Don't Care
- NC = No Change
- ↑ = LOW-to-HIGH Clock Transition

**Pin Descriptions**

PIN NAME	DESCRIPTION
CE	Clock Enable (Active LOW)
CP	Clock Pulse Input
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
O <sub>0</sub> -O <sub>7</sub>	Data Outputs
GND	Ground
V <sub>CC</sub>	Power

# CD74FCT377T

## Absolute Maximum Ratings

DC Input Voltage ..... -0.5V to 7.0V  
 DC Output Current ..... 120mA

## Operating Conditions

Operating Temperature Range ..... -40°C to 85°C  
 Supply Voltage to Ground Potential  
 Inputs and V<sub>CC</sub> Only ..... -0.5V to 7.0V  
 Supply Voltage to Ground Potential  
 Outputs and D/O Only ..... -0.5V to 7.0V

## Thermal Information

Thermal Resistance (Typical, Note 2) θ<sub>JA</sub> (°C/W)  
 SOIC Package ..... 87  
 QSOP Package ..... 110  
 Maximum Junction Temperature ..... 150°C  
 Maximum Storage Temperature Range ..... -65°C to 150°C  
 Maximum Lead Temperature (Soldering 10s) ..... 300°C  
 (Lead Tips Only)

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied*

### NOTE:

- θ<sub>JA</sub> is measured with the component mounted on an evaluation PC board in free air.

## Electrical Specifications

PARAMETER	SYMBOL	(NOTE 3) TEST CONDITIONS	MIN	(NOTE 4) TYP	MAX	UNITS
<b>DC ELECTRICAL SPECIFICATIONS</b> Over the Operating Range, T <sub>A</sub> = -40°C to 85°C, V <sub>CC</sub> = 5.0V ±5%						
Output HIGH Voltage	V <sub>OH</sub>	V <sub>CC</sub> = Min, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -15.0mA	2.4	3.0	- V
Output LOW Voltage	V <sub>OL</sub>	V <sub>CC</sub> = Min, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 64mA	-	0.3	0.50 V
Input HIGH Voltage	V <sub>IH</sub>	Guaranteed Logic HIGH Level		2.0	-	- V
Input LOW Voltage	V <sub>IL</sub>	Guaranteed Logic LOW Level		-	-	0.8 V
Input HIGH Current	I <sub>IH</sub>	V <sub>CC</sub> = Max	V <sub>IN</sub> = V <sub>CC</sub>	-	-	1 μA
Input LOW Current	I <sub>IL</sub>	V <sub>CC</sub> = Max	V <sub>IN</sub> = GND	-	-	-1 μA
Clamp Diode Voltage	V <sub>IK</sub>	V <sub>CC</sub> = Min, I <sub>IN</sub> = -18mA		-	-0.7	-1.2 V
Short Circuit Current	I <sub>OS</sub>	V <sub>CC</sub> = Max (Note 5), V <sub>OUT</sub> = GND		-60	-120	- mA
Power Down Disable	I <sub>OFF</sub>	V <sub>CC</sub> = GND, V <sub>OUT</sub> = 4.5V		-	-	100 μA
Input Hysteresis	V <sub>H</sub>			-	200	- mV
<b>CAPACITANCE</b> T <sub>A</sub> = 25°C, f = 1MHz						
Input Capacitance (Note 6)	C <sub>IN</sub>	V <sub>IN</sub> = 0V		-	6	10 pF
Output Capacitance (Note 6)	C <sub>OUT</sub>	V <sub>OUT</sub> = 0V		-	8	12 pF
<b>POWER SUPPLY SPECIFICATIONS</b>						
Quiescent Power Supply Current	I <sub>CC</sub>	V <sub>CC</sub> = Max	V <sub>IN</sub> = GND or V <sub>CC</sub>	-	0.1	500 μA
Supply Current per Input at TTL HIGH	ΔI <sub>CC</sub>	V <sub>CC</sub> = Max	V <sub>IN</sub> = 3.4V (Note 7)	-	0.5	2.0 mA
Supply Current per Input per MHz (Note 8)	I <sub>CCD</sub>	V <sub>CC</sub> = Max, Outputs Open CE = GND One Input Toggling 50% Duty Cycle	V <sub>IN</sub> = V <sub>CC</sub> V <sub>IN</sub> = GND	-	0.15	0.25 mA/MHz

**4**  
 OCTAL 5V FCT  
 5V FCT 25C

## CD74FCT377T

### Electrical Specifications (Continued)

PARAMETER	SYMBOL	(NOTE 3) TEST CONDITIONS		MIN	(NOTE 4) TYP	MAX	UNITS
Total Power Supply Current (Note 10)	I <sub>CC</sub>	V <sub>CC</sub> = Max, Outputs Open f <sub>CP</sub> = 10MHz, 50% Duty Cycle CE = GND, 50% Duty Cycle One Bit Toggling at f <sub>i</sub> = 5MHz	V <sub>IN</sub> = V <sub>CC</sub> V <sub>IN</sub> = GND	-	1.5	3.5 (Note 9)	mA
			V <sub>IN</sub> = 3.4V V <sub>IN</sub> = GND	-	2.0	5.5 (Note 9)	mA
		V <sub>CC</sub> = Max, Outputs Open f <sub>CP</sub> = 10MHz, 50% Duty Cycle CE = GND Eight Bits Toggling at f <sub>i</sub> = 2.5MHz 50% Duty Cycle	V <sub>IN</sub> = V <sub>CC</sub> V <sub>IN</sub> = GND	-	3.8	7.3 (Note 9)	mA
			V <sub>IN</sub> = 3.4V V <sub>IN</sub> = GND	-	6.0	16.3 (Note 9)	mA

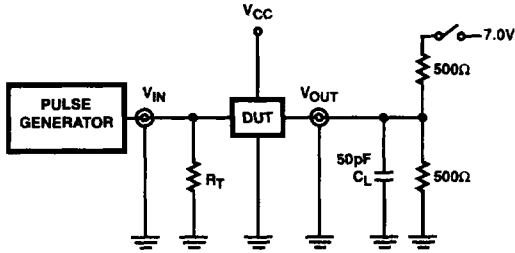
### Switching Specifications Over Operating Range

PARAMETER	SYMBOL	(NOTE 11) TEST CONDITIONS	T		AT		CT		DT		UNITS
			(NOTE 12)		(NOTE 12)		(NOTE 12)		(NOTE 12)		
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
Propagation Delay CP to O <sub>N</sub>	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF R <sub>L</sub> = 500Ω	2.0	13.0	2.0	7.2	2.0	5.2	2.0	4.5	ns
Setup Time, HIGH or LOW, D <sub>N</sub> to CP	t <sub>SU</sub>		2.5	-	2.0	-	2.0	-	2.0	-	ns
Hold Time, HIGH or LOW, D <sub>N</sub> to CP	t <sub>H</sub>		2.0	-	1.5	-	1.5	-	1.5	-	ns
Setup Time HIGH or LOW, CE to CP	t <sub>SU</sub>		4.0	-	3.5	-	3.5	-	2.0	-	ns
Hold Time HIGH or LOW, CE to CP	t <sub>H</sub>		1.5	-	1.5	-	1.5	-	1.5	-	ns
Clock Pulse Width (Note 13) HIGH or LOW	t <sub>W</sub>		7.0	-	6.0	-	6.0	-	3.0	-	ns

**NOTES:**

3. For conditions shown as Max or Min, use appropriate value specified under Electrical Specifications for the applicable device type.
4. Typical values are at V<sub>CC</sub> = 5.0V, 25°C ambient and maximum loading.
5. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
6. This parameter is determined by device characterization but is not production tested.
7. Per TTL driven input (V<sub>IN</sub> = 3.4V); all other inputs at V<sub>CC</sub> or GND.
8. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
9. Values for these conditions are examples of the I<sub>CC</sub> formula. These limits are guaranteed but not tested.
10. I<sub>CC</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>  
 $I_{CC} = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$   
 I<sub>CC</sub> = Quiescent Current  
 ΔI<sub>CC</sub> = Power Supply Current for a TTL High Input (V<sub>IN</sub> = 3.4V)  
 D<sub>H</sub> = Duty Cycle for TTL Inputs High  
 N<sub>T</sub> = Number of TTL Inputs at D<sub>H</sub>  
 I<sub>CCD</sub> = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)  
 f<sub>CP</sub> = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 f<sub>i</sub> = Input Frequency  
 N<sub>i</sub> = Number of Inputs at f<sub>i</sub>  
 All currents are in milliamps and all frequencies are in megahertz.
11. See test circuit and wave forms.
12. Minimum limits are guaranteed but not tested on Propagation Delays.
13. This parameter guaranteed but not production tested.

**Test Circuits and Waveforms**



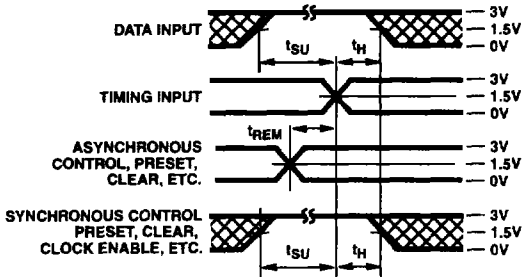
14. Pulse Generator for All Pulses: Rate  $\leq 1.0\text{MHz}$ ;  $Z_{OUT} \leq 50\Omega$ ;  
 $t_r, t_f \leq 2.5\text{ns}$ .

**FIGURE 1. TEST CIRCUIT**

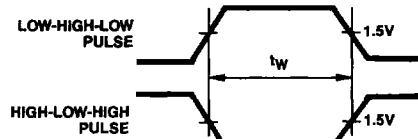
SWITCH POSITION	
TEST	SWITCH
$t_{PLZ}, t_{PZL}$	Closed
$t_{PHZ}, t_{PZH}, t_{PLH}, t_{PHL}$	Open

**DEFINITIONS:**

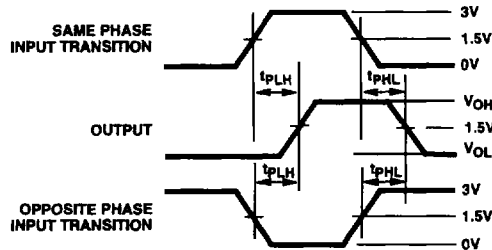
$C_L$  = Load capacitance, includes jig and probe capacitance.  
 $R_T$  = Termination resistance, should be equal to  $Z_{OUT}$  of the Pulse Generator.



**FIGURE 2. SETUP, HOLD, AND RELEASE TIMING**



**FIGURE 3. PULSE WIDTH**



**FIGURE 4. PROPAGATION DELAY**

4  
 OCTAL 5V FCT  
 5V FCT 25Ω