

January 1997

**NOT RECOMMENDED
FOR NEW DESIGNS**
Use CMOS Technology

BiCMOS FCT Interface Logic, Octal D-Type Flip-Flop, Three-State

Features

- Buffered Inputs
- Typical Propagation Delay: 6.6ns at $V_{CC} = 5V$, $T_A = 25^\circ C$, $C_L = 50pF$
- Positive Edge Triggered
- Noninverting
- SCR Latchup Resistant BiCMOS Process and Circuit Design
- Speed of Bipolar FAST™/AS/S
- 48mA Output Sink Current
- Output Voltage Swing Limited to 3.7V at $V_{CC} = 5V$
- Controlled Output Edge Rates
- Input/Output Isolation to V_{CC}
- BiCMOS Technology with Low Quiescent Power

Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT374E	0 to 70	20 Ld PDIP	E20.3
CD74FCT374M	0 to 70	20 Ld SOIC	M20.3
CD74FCT374SM	0 to 70	20 Ld SSOP	M20.209

NOTE: When ordering the suffix M and SM packages, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

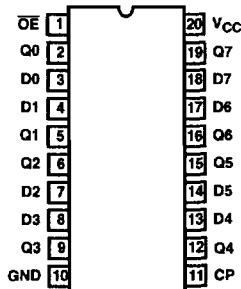
Description

The CD74FCT374 octal D-Type, three-state, positive edge triggered flip-flop uses a small geometry BiCMOS technology. The output stage is a combination of bipolar and CMOS transistors that limits the output HIGH level to two diode drops below V_{CC} . This resultant lowering of output swing (0V to 3.7V) reduces power bus ringing (a source of EMI) and minimizes V_{CC} bounce and ground bounce and their effects during simultaneous output switching. The output configuration also enhances switching speed and is capable of sinking 48 milliamperes.

The eight flip-flops enter data into their registers on the LOW to HIGH transition of the clock (CP). The Output Enable (\overline{OE}) controls the three state outputs and is independent of the register operation. When the Output Enable (\overline{OE}) is HIGH, the outputs are in the high impedance state. The CD74FCT374 outputs are noninverted. (For flow through pin configurations, see CD74FCT564 and CD74FCT574.)

Pinout

CD74FCT374
(PDIP, SOIC, SSOP)
TOP VIEW

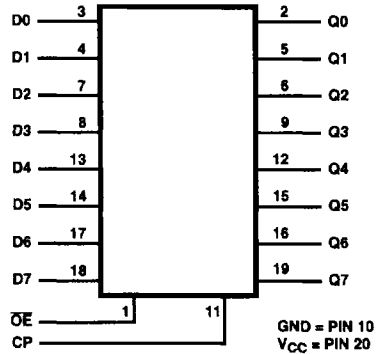


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BICMOS FCT
PRODUCTS

CD74FCT374

Functional Diagram



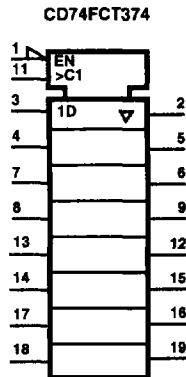
TRUTH TABLE (Note 1)

INPUTS			OUTPUTS
\overline{OE}	CP	Dn	Qn
L	↑	H	H
L	↑	L	L
L	L	X	Q0
H	X	X	Z

NOTE:

- H = HIGH Voltage Level (Steady State)
 L = LOW Voltage Level (Steady State)
 X = Immaterial
 ↑ = Transition from low to high level.
 Q0 = The level of Q before the indicated steady state input conditions were established.
 Z = HIGH Impedance

IEC Logic Symbol



CD74FCT374

Absolute Maximum Ratings

DC Supply Voltage (V_{CC})	-0.5V to 6V
DC Input Diode Current, I_{IK} (For $V_I < -0.5V$)	-20mA
DC Output Diode Current, I_{OK} (for $V_O < -0.5V$)	-50mA
DC Output Sink Current per Output Pin, I_O	70mA
DC Output Source Current per Output Pin, I_{O1}	-30mA
DC V_{CC} Current (I_{CC})	140mA
DC Ground Current (I_{GND})	400mA

Thermal Information

Thermal Resistance (Typical, Note 2)	θ_{JA} ($^{\circ}C/W$)
PDIP Package	135
SOIC Package	125
SSOP Package	130
Maximum Junction Temperature	150 $^{\circ}C$
Maximum Storage Temperature Range	-65 $^{\circ}C$ to 150 $^{\circ}C$
Maximum Lead Temperature (Soldering 10s)	300 $^{\circ}C$ (SOIC and SSOP-Lead Tips Only)

Operating Conditions

Operating Temperature Range (T_A)	0 $^{\circ}C$ to 70 $^{\circ}C$
Supply Voltage Range, V_{CC}	4.75V to 5.25V
DC Input Voltage, V_I	0 to V_{CC}
DC Output Voltage, V_O	0 to $\leq V_{CC}$
Input Rise and Fall Slew Rate, dt/dv_0	to 10ns/V

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_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications Commercial Temperature Range 0 $^{\circ}C$ to 70 $^{\circ}C$, V_{CC} Max = 5.25V, V_{CC} Min = 4.75V (Note 5)

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	AMBIENT TEMPERATURE (T_A)				UNITS
		V_I (V)	I_O (mA)		25 $^{\circ}C$		0 $^{\circ}C$ to 70 $^{\circ}C$		
					MIN	MAX	MIN	MAX	
High Level Input Voltage	V_{IH}			4.75 to 5.25	2	-	2	-	V
Low Level Input Voltage	V_{IL}			4.75 to 5.25	-	0.8	-	0.8	V
High Level Output Voltage	V_{OH}	V_{IH} or V_{IL}	-15	Min	2.4	-	2.4	-	V
Low Level Output Voltage	V_{OL}	V_{IH} or V_{IL}	48	Min	-	0.55	-	0.55	V
High Level Input Current	I_{IH}	V_{CC}		Max	-	0.1	-	1	μA
Low Level Input Current	I_{IL}	GND		Max	-	-0.1	-	-1	μA
Three State Leakage Current	I_{OZH}	V_{CC}		Max	-	0.5	-	10	μA
	I_{OZL}	GND		Max	-	-0.5	-	-10	μA
Input Clamp Voltage	V_{IK}	V_{CC} or GND	-18	Min	-	-1.2	-	-1.2	V
Short Circuit Output Current (Note 3)	I_{OS}	$V_O = 0$ V_{CC} or GND		Max	-60	-	-60	-	mA
Quiescent Supply Current, MSI	I_{CC}	V_{CC} or GND	0	Max	-	8	-	80	μA
Additional Quiescent Supply Current per Input Pin TTL Inputs High, 1 Unit Load	ΔI_{CC}	3.4V (Note 4)		Max	-	1.6	-	1.6	mA

NOTES:

- Not more than one output should be shorted at one time. Test duration should not exceed 100ms.
- Inputs that are not measured are at V_{CC} or GND.
- FCT Input Loading: All inputs are 1 unit load. Unit load is ΔI_{CC} limit specified in Electrical Specifications table, e.g., 1.6mA Max. at 70 $^{\circ}C$.

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PRODUCTS

CD74FCT374

Switching Specifications Over Operating Range FCT Series $t_r, t_f = 2.5\text{ns}$, $C_L = 50\text{pF}$, R_L (Figure 4) (Note 6)

PARAMETER	SYMBOL	V _{CC} (V)	25°C	0°C TO 70°C		UNITS
			TYP	MIN	MAX	
Propagation Delays						
Clock to Q	t_{PLH}, t_{PHL}	5	6.6	2	10	ns
Output Disable to Q	t_{PLZ}, t_{PHZ}	5	6	1.5	8	ns
Output Enable to Q	t_{PZL}, t_{PZH}	5	9	1.5	12.5	ns
Power Dissipation Capacitance	C_{PD} (Note 7)	-	33	-	-	pF
Minimum (Valley) V_{OHV} During Switching of Other Outputs (Output Under Test Not Switching)	V_{OHV}	5	0.5	-	-	V
Maximum (Peak) V_{OLP} During Switching of Other Outputs (Output Under Test Not Switching)	V_{OLP}	5	1	-	-	V
Input Capacitance	C_I	-	-	-	10	pF
Three State Output Capacitance	C_O	-	-	-	15	pF

NOTES:

6. 5V: Min is at 5.25V for 0°C to 70°C, Max is at 4.75V for 0°C to 70°C, Typ is at 5V.

7. C_{PD} , measured per flip-flop, is used to determine the dynamic power consumption.

$$P_D (\text{per package}) = V_{CC} I_{CC} + \Sigma(V_{CC}^2 f_I C_{PD} + V_O^2 f_O C_L + V_{CC} \Delta I_{CC} D) \text{ where:}$$

V_{CC} = supply voltage

ΔI_{CC} = flow through current x unit load

C_L = output load capacitance

D = duty cycle of input high

f_O = output frequency

f_I = input frequency

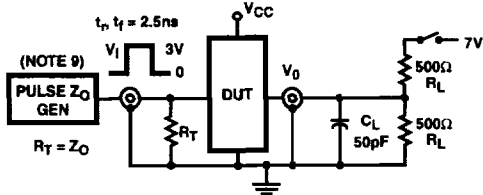
Prerequisite for Switching

PARAMETER	SYMBOL	V _{CC} (V)	25°C	0°C TO 70°C		UNITS
			TYP	MIN	MAX	
Setup Time Data to Clock	t_{SU}	5 (Note 8)	-	2	-	ns
Data to Clock Hold Time	t_H	5	-	2	-	ns
Clock Pulse Width	t_W	5	-	7	-	ns
Maximum Clock Frequency	f_{MAX}	5	-	70	-	MHz

NOTE:

8. 5V: Minimum is at 4.75V for 0°C to 70°C, Typical is at 5V.

Test Circuits and Waveforms



NOTE:

- 9. 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}	Open Drain
$t_{PHZ}, t_{PZH}, t_{PLH}, t_{PHL}$	Closed
	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.

$V_{IN} = 0\text{V}$ to 3V .

Input: $t_r = t_f = 2.5\text{ns}$ (10% to 90%), unless otherwise specified

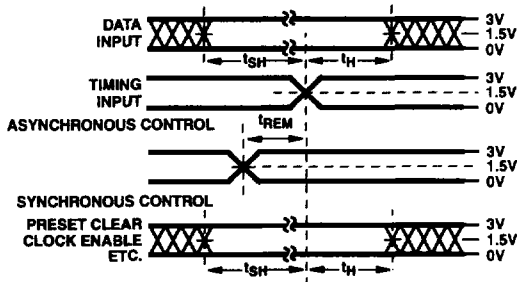


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

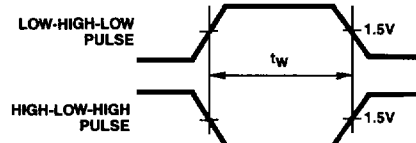


FIGURE 3. PULSE WIDTH

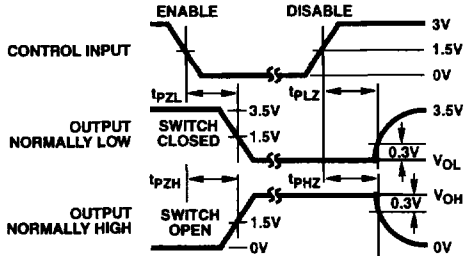


FIGURE 4. ENABLE AND DISABLE TIMING

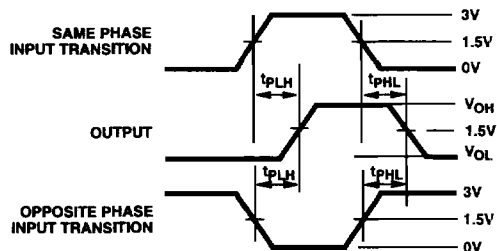
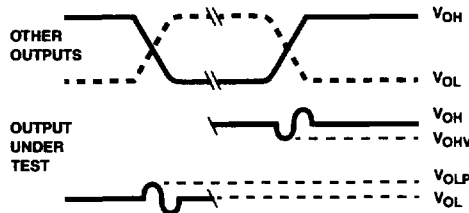


FIGURE 5. PROPAGATION DELAY



NOTES:

- 10. V_{OLP} is measured with respect to a ground reference near the output under test. V_{OHV} is measured with respect to V_{OH} .
- 11. Input pulses have the following characteristics:
 $F_{RR} \leq 1\text{MHz}$, $t_r = 2.5\text{ns}$, $t_f = 2.5\text{ns}$, skew 1ns.
- 12. R.F. fixture with 700MHz design rules required. IC should be soldered into test board and bypassed with $0.1\mu\text{F}$ capacitor. Scope and probes require 700MHz bandwidth.

FIGURE 6. SIMULTANEOUS SWITCHING TRANSIENT WAVEFORMS