TEXAS INSTRUMENTS

Data sheet acquired from Harris Semiconductor
SCHS265

January 1997

NOT RECOMMENDED FOR NEW DESIGNS
Use CMOS Technology

CD74FCT823A, CD74FCT824A

BiCMOS FCT Interface Logic, 9-Bit D-Type Flip-Flops, Three-State

Features

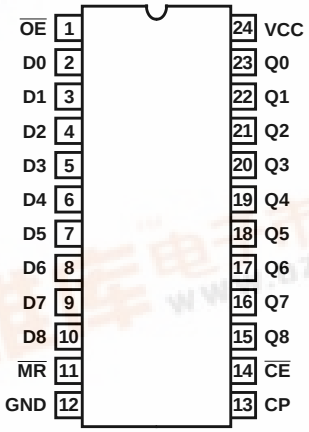
- Buffered Inputs
- Typical Propagation Delay: 7.5ns at V_{CC} = 5V, T_A = 25°C, C_L = 50pF
- Positive Edge Triggered
- CD74FCT824A
  - Inverting
- CD74FCT823A
  - Noninverting
- SCR Latchup Resistant BiCMOS Process and Circuit Design
- Speed of Bipolar FAST™/AS/S
- 48mA Output Sink Current
- Output 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

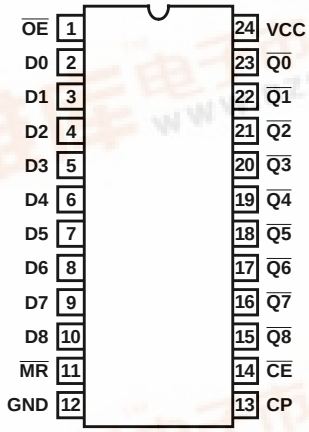
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT823AEN	0 to 70	24 Ld PDIP	E24.3
CD74FCT824AEN	0 to 70	24 Ld PDIP	E24.3

Pinout

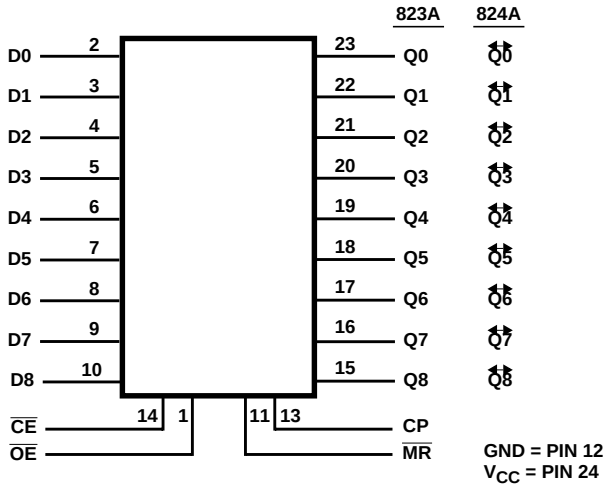
CD74FCT823A
(PDIP)
TOP VIEW



CD74FCT824A
(PDIP)
TOP VIEW



Functional Diagram



TRUTH TABLE (Note 1)

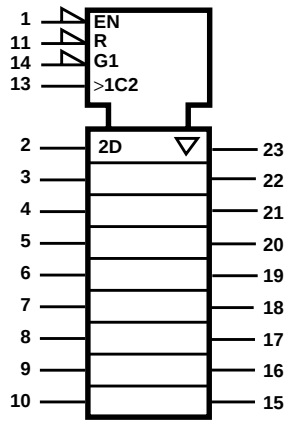
INPUTS					Q OUTPUTS		
$\overline{OE}$	$\overline{MR}$	$\overline{CE}$	D	CP	CD74FCT823A	CD74FCT824A	FUNCTION
H	X	L	L	↑	Z	Z	High Z
H	X	L	H	↑	Z	Z	
H	L	X	X	X	Z	Z	Reset
L	L	X	X	X	L	L	
H	H	H	X	X	Z	Z	Hold
L	H	H	X	X	NC	NC	
H	H	L	L	↑	Z	Z	Load
H	H	L	H	↑	Z	Z	
L	H	L	L	↑	L	H	
L	H	L	H	↑	H	L	

NOTE:

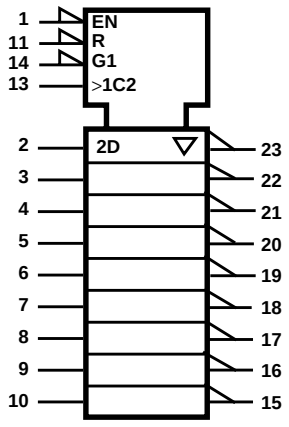
1. H= HIGH Voltage Level
   L = LOW Voltage Level
   NC = No Change
   ↑ = LOW to HIGH Transition
   X = Don't Care
   Z = HIGH Impedance

IEC Logic Symbol

CD74FCT823A



CD74FCT824A



Absolute Maximum Ratings

DC Supply Voltage (V_{CC}) . . . . . -0.5V to 6V
DC 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, IO 70mA
DC Output Source Current per Output Pin, IO . . . . . -30mA
DC V_{CC} Current (I_{CC}) 234mA
DC Ground Current (I_{GND}) 453mA

Operating Conditions

Operating Temperature Range, T_A . . . . . 0^oC to 70^oC
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

Thermal Information

Thermal Resistance (Typical, Note 2) θ_{JA} ($^oC/W$)
PDIP Package 75
Maximum Junction Temperature . . . . . 150^oC
Maximum Storage Temperature Range . . . . . -65^oC to 150^oC
Maximum Lead Temperature (Soldering 10s) . . . . . 300^oC

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:

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

Electrical Specifications Commercial Temperature Range 0^oC to 70^oC, V_{CC} Max = 5.25V, V_{CC} Min = 4.75V

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	AMBIENT TEMPERATURE (T_A)				UNITS
					25^oC		0^oC TO 70^oC		
		V_I (V)	I_O (mA)		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	-75	-	-75	-	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:

3. Not more than one output should be shorted at one time. Test duration should not exceed 100ms.
4. Inputs that are not measured are at V_{CC} or GND.
5. 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^oC.

Switching Specifications Over Operating Range FCT Series t_r, t_f = 2.5ns, C_L = 50pF, R_L (Figure 1)

PARAMETER		SYMBOL	V_{CC} (V)	25°C TYP	0°C TO 70°C MIN	0°C TO 70°C MAX	UNITS
Propagation Delays			(Note 6)				
Clock to Q	CD74FCT823A	t_{PLH}, t_{PHL}	5	7.5	1.5	10	ns
Clock to $\overline{Q}$	CD74FCT824A	t_{PLH}, t_{PHL}	5	7.5	1.5	10	ns
$\overline{MR}$ to Q		t_{PHL}	5	10.5	1.5	14	ns
Output Enable to Q	CD74FCT823A	t_{PZL}, t_{PZH}	5	9	1.5	12	ns
Output Disable to Q	CD74FCT823A	t_{PLZ}, t_{PHZ}	5	6	1.5	8	ns
Output Enable to $\overline{Q}$	CD74FCT824A	t_{PZL}, t_{PZH}	5	9	1.5	12	ns
Output Disable to $\overline{Q}$	CD74FCT824A	t_{PLZ}, t_{PHZ}	5	6	1.5	8	ns
Power Dissipation Capacitance		C_{PD} (Note 7)	-	-	-	-	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: Minimum is at 5.25V for 0°C to 70°C, Maximum is at 4.75V for 0°C to 70°C, Typical is at 5V.
7. C_{PD}, measured per flip-flop, is used to determine the dynamic power consumption.
   P_D (per package) = V_{CC} I_{CC} + $\Sigma(V_{CC}^2$ f_I C_{PD} + V_O^2 $f_O C_L$ + V_{CC} ΔI_{CC} D) 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

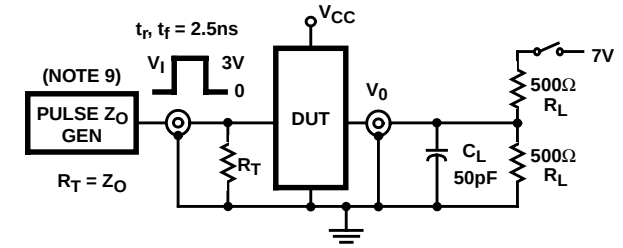
Prerequisite for Switching

PARAMETER	SYMBOL	V_{CC} (V)	25°C TYP	0°C TO 70°C MIN	0°C TO 70°C MAX	UNITS
Maximum Clock Frequency	f_{MAX}	5 (Note 8)	-	70	-	MHz
Master Reset Recovery Time	t_{REC}	5	-	7	-	ns
Setup Time, Data to Clock, $\overline{CE}$ to Clock	t_{SU}	5	-	4	-	ns
Hold Time - Data, $\overline{CE}$	t_H	5	-	2	-	ns
Pulse Width - Clock, $\overline{MR}$	t_W	5	-	7	-	ns

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 ≤ 1.0MHz; Z_{OUT} ≤ 50Ω; t_f, t_r ≤ 2.5ns.

FIGURE 1. TEST CIRCUIT

SWITCH POSITION

TEST	SWITCH
t_{PLZ}, t_{PZL}, Open Drain	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.

V_{IN} = 0V to 3V.

Input: t_r = t_f = 2.5ns (10% to 90%), unless otherwise specified

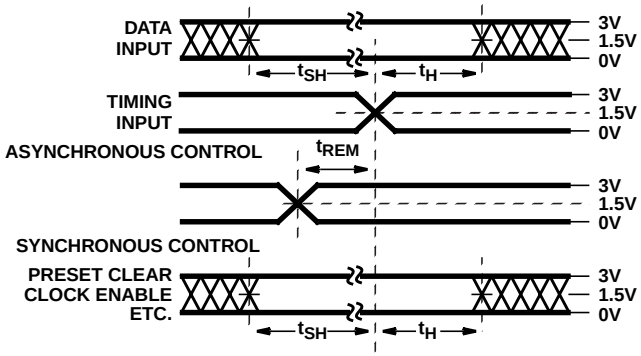


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

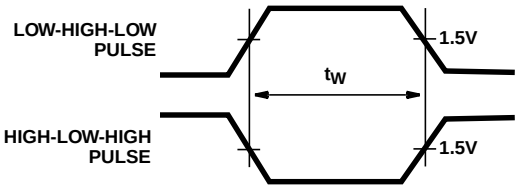


FIGURE 3. PULSE WIDTH

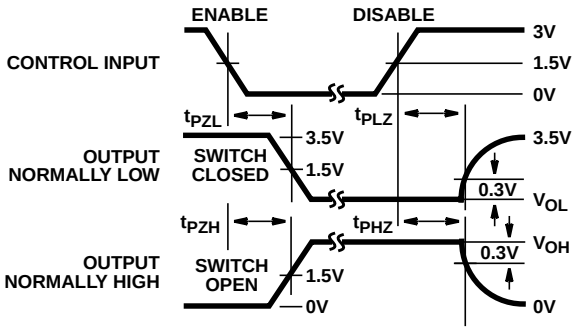


FIGURE 4. ENABLE AND DISABLE TIMING

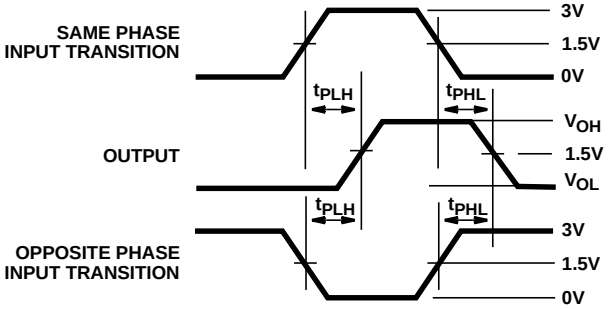
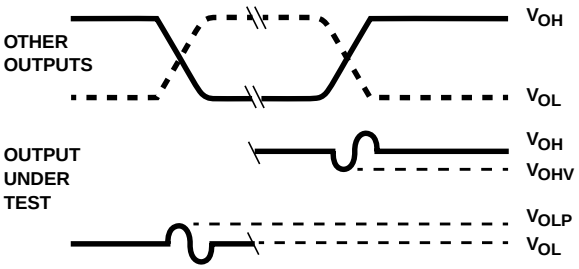


FIGURE 5. PROPAGATION DELAY

Test Circuits and Waveforms (Continued)



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:
    $P_{RR} \leq 1MHz$, $t_r = 2.5ns$, $t_f = 2.5ns$, skew 1ns.
12. R.F. fixture with 700MHz design rules required. IC should be soldered into test board and bypassed with 0.1µF capacitor. Scope and probes require 700MHz bandwidth.

FIGURE 6. SIMULTANEOUS SWITCHING TRANSIENT WAVEFORMS

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