HARRIS SEMICONDUCTOR

CD74FCT821T, CD74FCT823T, CD74FCT825T, CD74FCT2821T, CD74FCT2823T

December 1996

Fast CMOS Bus Interface Registers

Features

- **Advanced 0.8 micron CMOS Technology**
- **These Devices are Pin Compatible with Bipolar FAST™ Series at a Higher Speed and Lower Power Consumption**
- **25Ω Series Resistor on All Outputs (CD74FCT2821T, CD74FCT2823T Only)**
- **TTL Input and Output Levels**
- **Low Ground Bounce Outputs**
- **Extremely Low Static Power**
- **Hysteresis on All Inputs**

Description

The CD74FCT821T and CD74FCT2821T are 10-bit wide registers designed with ten D-type flip-flops with a buffered common clock and buffered three-state outputs. The CD74FCT823T and CD74FCT2823T are 9-bit wide registers designed with Clock Enable and Clear. The CD74FCT825T is an 8-bit wide register with all CD74FCT823T controls plus multiple enables. When output enable ($\overline{OE}$) is LOW, the outputs are enabled. When $\overline{OE}$ is HIGH, the outputs are in the high impedance state. Input data meeting the setup and hold time requirements of the D inputs is transferred to the Y outputs on the LOW-to-HIGH transition of the clock input.

The CD74FCT2821T and CD74FCT2823T devices have a built-in 25Ω series resistor on all outputs to reduce noise due to reflections, thus eliminating the need for an external terminating resistor.

Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD74FCT821ATM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT821ATQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT821BTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT821BTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT821CTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT821CTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT823ATM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT823ATQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT823BTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT823BTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT823CTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT823CTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT825ATM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT825ATQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT825BTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT825BTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT825CTM	-40 to 85	24 Ld SOIC	M24 3-P
CD74FCT825CTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT2821ATM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT2821ATQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT2821BTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT2821BTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT2823ATM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT2823ATQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT2823BTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT2823BTQM	-40 to 85	24 Ld QSOP	M24.15-P
CD74FCT2823CTM	-40 to 85	24 Ld SOIC	M24.3-P
CD74FCT2823CTQM	-40 to 85	24 Ld QSOP	M24.15-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.

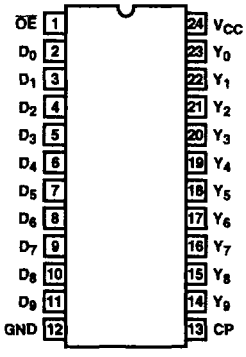
CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

FAST™ is a trademark of Fairchild Semiconductor.

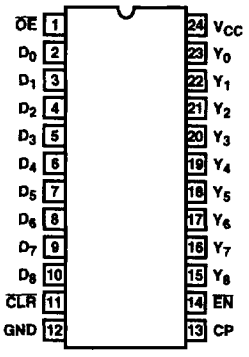
File Number **4176.2**

Pinouts

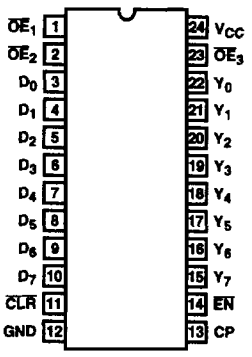
CD74FCT821T, CD74FCT2821T
(QSOP, SOIC)
TOP VIEW



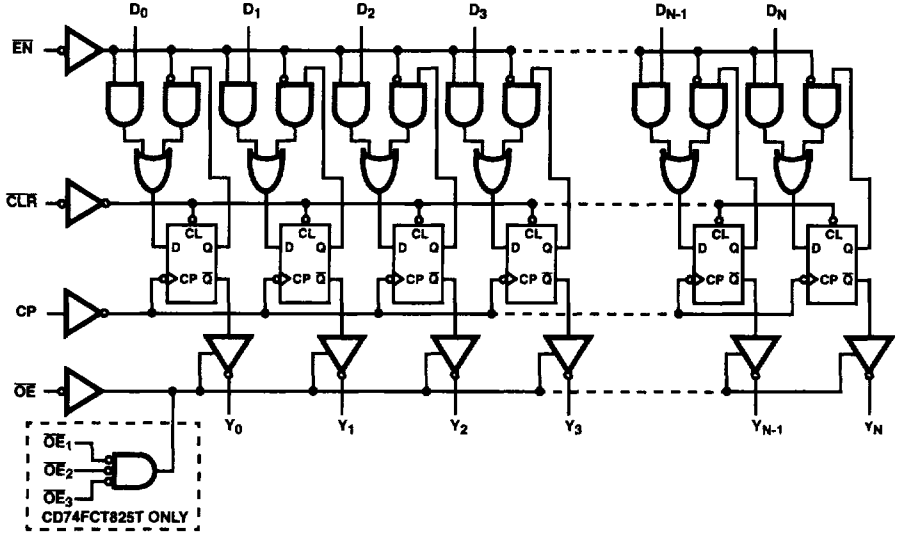
CD74FCT823, CD74FCT2823T
(QSOP, SOIC)
TOP VIEW



CD74FCT825T
(QSOP, SOIC)
TOP VIEW



Functional Block Diagram



TRUTH TABLE (NOTE 1)

FUNCTION	INPUTS					OUTPUTS	INTERNAL
	$\overline{CLR}$	$\overline{EN}$	$\overline{OE}$	CP	D_N	Y_N	Q_N
High-Z	H	L	H	↑	L	Z	L
	H	L	H	↑	H	Z	H
Clear	L	X	H	X	X	Z	L
	L	X	L	X	X	L	L
Hold	H	H	H	X	X	Z	NC
	H	H	L	X	X	NC	NC
Load	H	L	H	↑	L	Z	L
	H	L	H	↑	H	Z	H
	H	L	L	↑	L	L	L
	H	L	L	↑	H	H	H

NOTE:

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

Pin Descriptions

PIN NAME	DESCRIPTION
$\overline{OE}$	Output Enable Input (Active LOW)
CP	Clock Pulse for the Register, Enters Data on LOW-to-HIGH Transition
D_N	Data Inputs
Y_N	Three-State Outputs
$\overline{CLR}$	Clear Input (Active LOW) (823/825/2823 Only)
$\overline{EN}$	Clock Enable Input (Active LOW)
GND	Ground
V_{CC}	Power

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_{CC} 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_{JA} (°C/W)
SOIC Package	75
QSOP Package	100

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:

2. θ_{JA} 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
DC ELECTRICAL SPECIFICATIONS Over the Operating Range, T_A = -40°C to 85°C, V_{CC} = 5.0V ± 5%							
Output HIGH Voltage	V_{OH}	V_{CC} = Min, V_{IN} = V_{IH} or V_{IL}	I_{OH} = -15.0mA	2.4	3.0	-	V
Output LOW Voltage	V_{OL}	V_{CC} = Min, V_{IN} = V_{IH} or V_{IL}	I_{OL} = 48mA	-	0.3	0.50	V
Output LOW Voltage	V_{OL}	V_{CC} = Min, V_{IN} = V_{IH} or V_{IL}	I_{OL} = 12mA (25Ω series)	-	0.3	0.50	V
Input HIGH Voltage	V_{IH}	Guaranteed Logic HIGH Level		2.0	-	-	V
Input LOW Voltage	V_{IL}	Guaranteed Logic LOW Level		-	-	0.8	V
Input HIGH Current	I_{IH}	V_{CC} = Max	V_{IN} = V_{CC}	-	-	1	µA
Input LOW Current	I_{IL}	V_{CC} = Max	V_{IN} = GND	-	-	-1	µA
High Impedance Output Current	I_{OZH}, I_{OZL}	V_{CC} = Max	V_{OUT} = 2.7V			1	µA
			V_{OUT} = 0.5V			-1	µA
Clamp Diode Voltage	V_{IK}	V_{CC} = Min, I_{IN} = -18mA		-	-0.7	-1.2	V
Short Circuit Current	I_{OS}	V_{CC} = Max (Note 5), V_{OUT} = GND		-60	-120	-	mA
Power Down Disable	I_{OFF}	V_{CC} = GND, V_{OUT} = 4.5V		-	-	100	µA
Input Hysteresis	V_H			-	200	-	mV
CAPACITANCE T_A = 25°C, f = 1MHz							
Input Capacitance (Note 6)	C_{IN}	V_{IN} = 0V		-	6	10	pF
Output Capacitance (Note 6)	C_{OUT}	V_{OUT} = 0V		-	8	12	pF
POWER SUPPLY SPECIFICATIONS							
Quiescent Power Supply Current	I_{CC}	V_{CC} = Max	V_{IN} = GND or V_{CC}	-	0.1	500	µA
Supply Current per Input at TTL HIGH	ΔI_{CC}	V_{CC} = Max	V_{IN} = 3.4V (Note 7)	-	0.5	2.0	mA
Supply Current per Input per MHz (Note 8)	I_{CCD}	V_{CC} = Max, Outputs Open $\overline{OE}$ = $\overline{EN}$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	-	0.15	0.25	mA/ MHz

Electrical Specifications (Continued)

PARAMETER	SYMBOL	(NOTE 3) TEST CONDITIONS		MIN	(NOTE 4) TYP	MAX	UNITS
Total Power Supply Current (Note 10)	I_C	V_{CC} = Max, Outputs Open f_{CP} = 10MHz, 50% Duty Cycle $\overline{OE}$ = $\overline{EN}$ = GND f_i = 5MHz One Bit Toggling	$V_{IN} = V_{CC}$ V_{IN} = GND	-	1.5	3.5 (Note 9)	mA
			V_{IN} = 3.4V V_{IN} = GND	-	2.0	5.5 (Note 9)	mA
		V_{CC} = Max, Outputs Open f_{CP} = 10MHz, 50% Duty Cycle $\overline{OE}$ = $\overline{EN}$ = GND Eight Bits Toggling f_i = 2.5MHz 50% Duty Cycle	$V_{IN} = V_{CC}$ V_{IN} = GND	-	3.8	7.3 (Note 9)	mA
			V_{IN} = 3.4V V_{IN} = GND	-	6.0	16.3 (Note 9)	mA

Switching Specifications Over Operating Range

PARAMETER	SYMBOL	(NOTE 11) TEST CONDITIONS	AT (NOTE 12) MIN	AT MAX	BT (NOTE 12) MIN	BT MAX	CT (NOTE 14) (NOTE 12) MIN	CT MAX	UNIT
CD74FCT821T, CD74FCT2821T									
Propagation Delay CP to Y_N ($\overline{OE}$ = LOW)	t_{PLH}, t_{PHL}	C_L = 50pF, R_L = 500Ω	1.5	10.0	1.5	7.5	1.5	6.0	ns
		C_L = 300pF (Note 13), R_L = 500Ω	1.5	20.0	1.5	15.0	1.5	12.5	ns
Setup Time HIGH or LOW, D_N to CP	t_{SU}	C_L = 50pF, R_L = 500Ω	4.0	-	3.0	-	3.0	-	ns
Hold Time HIGH or LOW, D_N to CP	t_H	C_L = 50pF, R_L = 500Ω	2.0	-	1.5	-	1.5	-	ns
Setup Time HIGH or LOW, $\overline{EN}$ to CP	t_{SU}	C_L = 50pF, R_L = 500Ω	4.0	-	3.0	-	3.0	-	ns
Hold Time HIGH or LOW, $\overline{EN}$ to CP	t_H	C_L = 50pF, R_L = 500Ω	2.0	-	0	-	0	-	ns
Propagation Delay $\overline{CLR}$ to Y_N	t_{PHL}	C_L = 50pF, R_L = 500Ω	1.5	14.0	1.5	9.0	1.5	8.0	ns
Recovery Time, $\overline{CLR}$ to CP (Note 13)	t_{REM}	C_L = 50pF, R_L = 500Ω	6.0	-	6.0	-	6.0	-	ns
Clock Pulse Width HIGH or LOW (Note 13)	t_W	C_L = 50pF, R_L = 500Ω	7.0	-	5.0	-	6.0	-	ns
$\overline{CLR}$ Pulse Width LOW (Note 13)	t_W	C_L = 50pF, R_L = 500Ω	6.0	-	6.0	-	6.0	-	ns
Output Enable Time $\overline{OE}$ to Y_N	t_{PZH}	C_L = 50pF, R_L = 500Ω	1.5	11.5	1.5	8.0	1.5	7.0	ns
	t_{PZL}	C_L = 300pF (Note 13), R_L = 500Ω	1.5	23.0	1.5	15.0	1.5	12.5	ns
Output Disable Time $\overline{OE}$ to Y_N	t_{PHZ}	C_L = 50pF, R_L = 500Ω	1.5	7.0	1.5	6.5	1.5	6.2	ns
	t_{PLZ}	C_L = 300pF (Note 13), R_L = 500Ω	1.5	8.0	1.5	7.5	1.5	6.5	ns
CD74FCT823T, CD74FCT2823T, CD74FCT825T									
Propagation Delay CP to Y_N ($\overline{OE}$ = LOW)	t_{PLH}, t_{PHL}	C_L = 50pF, R_L = 500Ω	1.5	10.0	1.5	7.5	1.5	6.0	ns
		C_L = 300pF (Note 13), R_L = 500Ω	1.5	20.0	1.5	15.0	1.5	12.5	ns

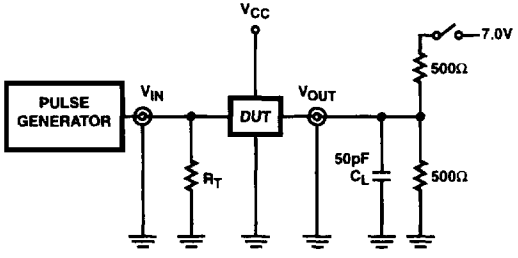
Switching Specifications Over Operating Range

PARAMETER	SYMBOL	(NOTE 11) TEST CONDITIONS	AT (NOTE 12) MIN	AT MAX	BT (NOTE 12) MIN	BT MAX	CT (NOTE 14) (NOTE 12) MIN	CT MAX	UNIT
Setup Time HIGH or LOW, D_N to CP	t_{SU}	C_L = 50pF R_L = 500Ω	4.0	-	3.0	-	3.0	-	ns
Hold Time HIGH or LOW, D_N to CP	t_H	C_L = 50pF R_L = 500Ω	2.0	-	1.5	-	1.5	-	ns
Setup Time HIGH or LOW, $\overline{EN}$ to CP	t_{SU}	C_L = 50pF R_L = 500Ω	4.0	-	3.0	-	3.0	-	ns
Hold Time HIGH or LOW, $\overline{EN}$ to CP	t_H	C_L = 50pF R_L = 500Ω	2.0	-	0	-	0	-	ns
Propagation Delay $\overline{CLR}$ to Y_N	t_{PHL}	C_L = 50pF R_L = 500Ω	1.5	13.0	1.5	9.0	1.5	8.0	ns
Recovery Time, $\overline{CLR}$ to CP (Note 13)	t_{REM}	C_L = 50pF R_L = 500Ω	6.0	-	6.0	-	6.0	-	ns
Clock Pulse Width HIGH or LOW (Note 13)	t_W	C_L = 50pF R_L = 500Ω	7.0	-	5.0	-	6.0	-	ns
$\overline{CLR}$ Pulse Width LOW (Note 13)	t_W	C_L = 50pF R_L = 500Ω	6.0	-	6.0	-	6.0	-	ns
Output Enable Time $\overline{OE}$ to Y_N	t_{PZH}	C_L = 50pF R_L = 500Ω	1.5	11.5	1.5	8.0	1.5	7.0	ns
	t_{PZL}	C_L = 300pF (Note 13) R_L = 500Ω	1.5	23.0	1.5	15.0	1.5	12.5	ns
Output Disable Time $\overline{OE}$ to Y_N	t_{PHZ}	C_L = 50pF R_L = 500Ω	1.5	7.0	1.5	6.5	1.5	6.2	ns
	t_{PLZ}	C_L = 300pF (Note 13) R_L = 500Ω	1.5	8.0	1.5	7.5	1.5	6.5	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_{CC} = 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_{IN} = 3.4V); all other inputs at V_{CC} 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_{CC} formula. These limits are guaranteed but not tested.
10. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
    $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$
    I_{CC} = Quiescent Current
    ΔI_{CC} = Power Supply Current for a TTL High Input (Vin = 3.4V)
    D_H = Duty Cycle for TTL Inputs High
    N_T = Number of TTL Inputs at D_H
    I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)
    f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)
    f_i = Input Frequency
    N_i = Number of Inputs at f_i
    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 is guaranteed but not production tested.
14. The CD74FCT2821CT type is not available.

Test Circuits and Waveforms



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.

NOTE:

15. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; Z_{OUT} ≤ 50Ω; t_f, t_r ≤ 2.5ns.

FIGURE 1. TEST CIRCUIT

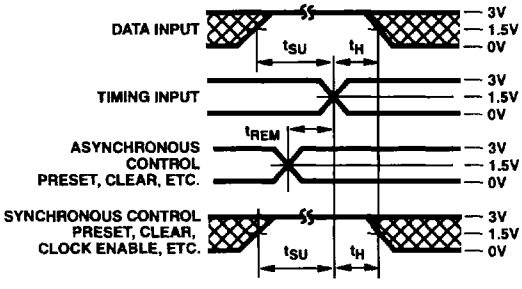


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

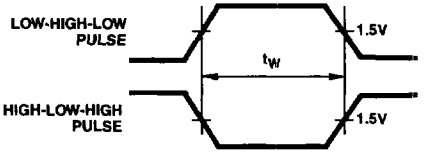


FIGURE 3. PULSE WIDTH

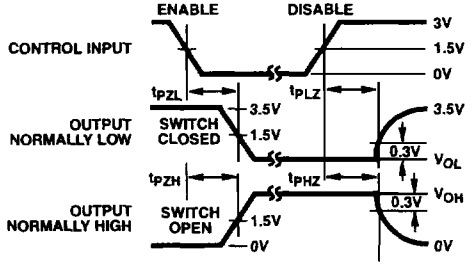


FIGURE 4. ENABLE AND DISABLE TIMING

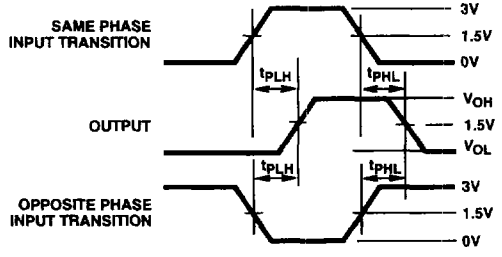


FIGURE 5. PROPAGATION DELAY