

CD74FCT821A, CD74FCT822A

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

January 1997

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

Features

- Buffered Inputs
- Typical Propagation Delay: 7.5ns at $V_{CC} = 5V$, $T_A = 25^\circ C$, $C_L = 50pF$
- CD74FCT821A
 - Noninverting
- CD74FCT822A
 - Inverting
- 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

Description

The CD74FCT821A and CD74FCT822A ten bit, D-Type, three-state, positive edge triggered flip-flops use 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.

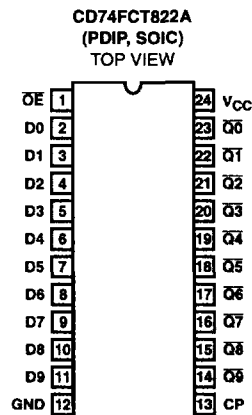
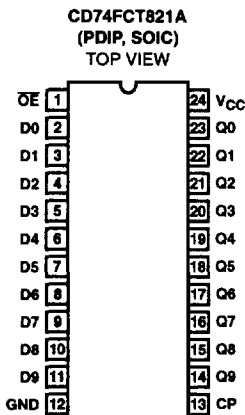
The ten flip-flops enter data into their registers on the LOW to HIGH transition of the clock (CP). The Output Enable (\overline{OE}) controls the three state outputs and is independent of the register operation. When the Output Enable (\overline{OE}) is HIGH, the outputs are in the high impedance state. The CD74FCT821A and CD74FCT822A share the same configurations, but the CD74FCT821A outputs are noninverted while the CD74FCT822A devices have inverted outputs.

Ordering Information

| PART NUMBER | TEMP. RANGE (°C) | PACKAGE | PKG. NO. |
|---------------|------------------|------------|----------|
| CD74FCT821AEN | 0 to 70 | 24 Ld PDIP | E24.3 |
| CD74FCT822AEN | 0 to 70 | 24 Ld PDIP | E24.3 |
| CD74FCT821AM | 0 to 70 | 24 Ld SOIC | M24.3 |

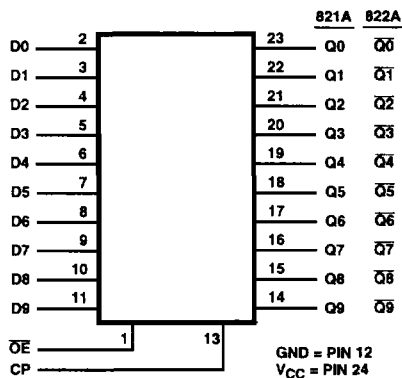
NOTE: When ordering the suffix M packages, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

Pinouts



CD74FCT821A, CD74FCT822A

Functional Diagram



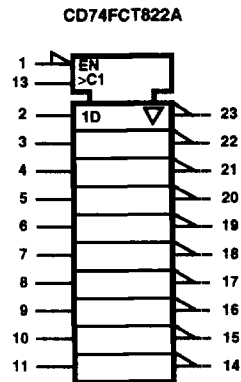
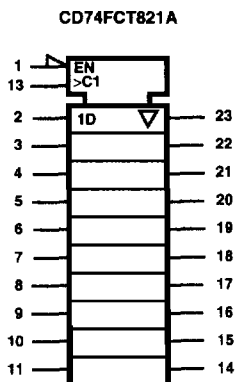
TRUTH TABLE

| INPUTS | | | OUTPUTS | |
|-----------------|----|----|-------------|-----------------|
| | | | CD74FCT821A | CD74FCT822A |
| \overline{OE} | CP | DN | QN | \overline{QN} |
| L | ↑ | H | H | L |
| L | ↑ | L | L | H |
| L | L | X | NC | NC |
| H | X | X | Z | Z |

NOTE:

- 1. H = HIGH level (steady state)
- L = LOW level (steady state)
- X = Immaterial
- ↑ = Transition from LOW to HIGH level
- Z = HIGH impedance
- NC = No change

IEC Logic Symbol



CD74FCT821A, CD74FCT822A

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, I_O | 70mA |
| DC Output Source Current per Output Pin, I_O | -30mA |
| DC V_{CC} Current (I_{CC}) | 260mA |
| DC Ground Current (I_{GND}) | 500mA |

Thermal Information

| | |
|---|------------------------------------|
| Thermal Resistance (Typical, Note 2) | θ_{JA} ($^{\circ}C/W$) |
| PDIP Package | 75 |
| SOIC Package | 75 |
| Maximum Junction Temperature | 150 $^{\circ}C$ |
| Maximum Storage Temperature Range | -65 $^{\circ}C$ to 150 $^{\circ}C$ |
| Maximum Lead Temperature (Soldering 10s) (SOIC-Lead Tips Only) | 300 $^{\circ}C$ |

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

| PARAMETER | SYMBOL | TEST CONDITIONS | | V_{CC} (V) | AMBIENT TEMPERATURE (T_A) | | | | UNITS |
|---|-----------------|------------------------------|-----|--------------|-------------------------------|------|---------------------------------|------|---------|
| | | | | | 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 | -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:

- 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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BICMOS FCT
PRODUCTS

CD74FCT821A, CD74FCT822A

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

| PARAMETER | SYMBOL | V_{CC} (V) | 25°C | 0°C TO 70°C | | UNITS | |
|---|-------------|--------------------|---------------------|-------------|-----|-------|----|
| | | | TYP | MIN | MAX | | |
| Propagation Delays (Note 6) | | | | | | | |
| Clock to Q | CD74FCT821A | t_{PLH}, t_{PHL} | 5 | 7.5 | 1.5 | 10 | ns |
| Clock to \bar{Q} | CD74FCT822A | t_{PLH}, t_{PHL} | 5 | 7.5 | 1.5 | 10 | ns |
| Output Enable to Q | CD74FCT821A | t_{PZL}, t_{PZH} | 5 | 9 | 1.5 | 12 | ns |
| Output Disable to Q | CD74FCT821A | t_{PLZ}, t_{PHZ} | 5 | 6 | 1.5 | 8 | ns |
| Output Enable to \bar{Q} | CD74FCT822A | t_{PZL}, t_{PZH} | 5 | 9 | 1.5 | 12 | ns |
| Output Disable to \bar{Q} | CD74FCT822A | t_{PLZ}, t_{PHZ} | 5 | 6 | 1.5 | 8 | ns |
| Power Dissipation Capacitance (Note 7) | C_{PD} | - | | | | pF | |
| Minimum (Valley) V_{OH} During Switching of Other Outputs (Output Under Test Not Switching) | V_{OHV} | 5 | 0.5 Typical at 25°C | | | V | |
| Maximum (Peak) V_{OL} During Switching of Other Outputs (Output Under Test Not Switching) | V_{OLP} | 5 | 1 Typical at 25°C | | | V | |
| Input Capacitance | C_I | - | - | - | 10 | pF | |
| Three-State Output Capacitance | C_O | - | - | - | 15 | pF | |

NOTES:

- 5V: Minimum is at 5.25V for 0°C to 70°C, Maximum is at 4.75 for 0°C to 70°C, Typical is at 5V.
- C_{PD} , measured per flip-flop, is used to determine the dynamic power consumption.
 P_D (per package) = $V_{CC} I_{CC} + \Sigma (V_{CC}^2 f_i C_{PD} + V_O^2 f_{OL} + V_{CC} \Delta I_{CC} D)$ 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

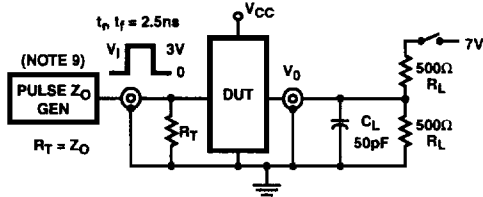
Prerequisite for Switching

| PARAMETER | SYMBOL | V_{CC} (V) | 25°C | 0°C TO 70°C | | UNITS |
|----------------------------|-----------|--------------|------|-------------|-----|-------|
| | | | TYP | MIN | MAX | |
| Maximum Frequency (Note 8) | f_{MAX} | 5 | - | 70 | - | MHz |
| Data to Clock Setup Time | t_{SU} | 5 | - | 4 | - | ns |
| Data to Clock Hold Time | t_H | 5 | - | 2 | - | ns |
| Clock Pulse Width | t_W | 5 | - | 7 | - | ns |

NOTE:

- 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

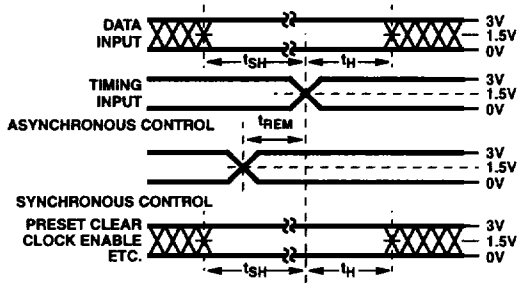


FIGURE 2. SETUP, HOLD, AND RELEASE TIMING

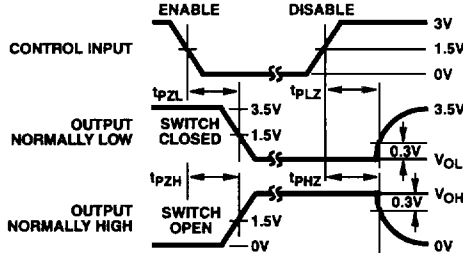


FIGURE 4. ENABLE AND DISABLE TIMING

| SWITCH POSITION | |
|---------------------------------------|--------|
| TEST | SWITCH |
| $t_{PLZ}, t_{PZL}, \text{Open Drain}$ | 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.

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

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

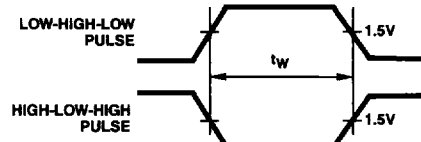


FIGURE 3. PULSE WIDTH

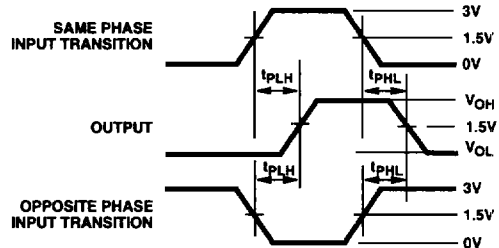
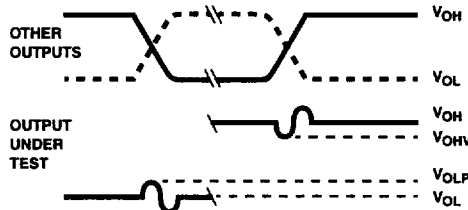


FIGURE 5. PROPAGATION DELAY



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:
 $PRR \leq 1\text{MHz}$, $t_r = 2.5\text{ns}$, $t_f = 2.5\text{ns}$, 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