

T-46-07-12

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# 74FCT823A • 74FCT823B

## 9-Bit D Flip-Flop

### General Description

The 'FCT823A/B is a 9-bit buffered register. It features Clock Enable and Clear which are ideal for parity bus interfacing in high performance microprogramming systems.

FACT™ FCTA/B utilizes NSC quiet series technology to provide improved quiet output switching and dynamic threshold performance.

FACT FCTA features GTO™ output control and undershoot corrector in addition to a split ground bus for superior performance.

FACT FCTB features an undershoot corrector in addition to a split ground bus for superior performance.

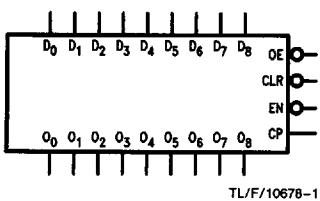
AC Specifications for 'FCT823A are preliminary.

### Features

- NSC 74FCT823A/B is pin and functionally equivalent to IDT 74ACT823A/B
- High speed parallel registers with positive edge-triggered D-type flip-flop
- Buffered common clock enable (EN) and asynchronous clear input (CLR)
- Input clamp diodes to limit bus reflections
- TTL/CMOS input and output level compatible
- I<sub>OL</sub> = 48 mA
- CMOS power levels
- 4 kV minimum ESD immunity

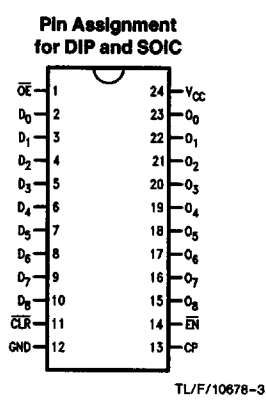
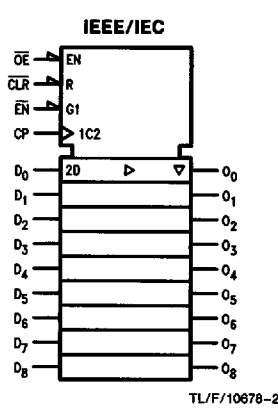
**Ordering Code:** See Section 8

### Logic Symbols



Pin Names	Description
D <sub>0</sub> -D <sub>8</sub>	Data Inputs
O <sub>0</sub> -O <sub>8</sub>	Data Outputs
OE	Output Enable
CLR	Clear
CP	Clock Input
EN	Clock Enable

### Connection Diagram



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### Functional Description

The 'FCT823A/B consists of nine D-type edge-triggered flip-flops. These have TRI-STATE® outputs for bus systems organized with inputs and outputs on opposite sides. The buffered clock (CP) and buffered Output Enable (OE) are common to all flip-flops. The flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH CP transition. With OE LOW, the contents of the flip-flops are available at the outputs. When OE is HIGH, the outputs go to the high impedance state. Operation of the OE input does not affect the

state of the flip-flops. In addition to the Clock and Output Enable pins, there are Clear (CLR) and Clock Enable (EN) pins. These devices are ideal for parity bus interfacing in high performance systems.

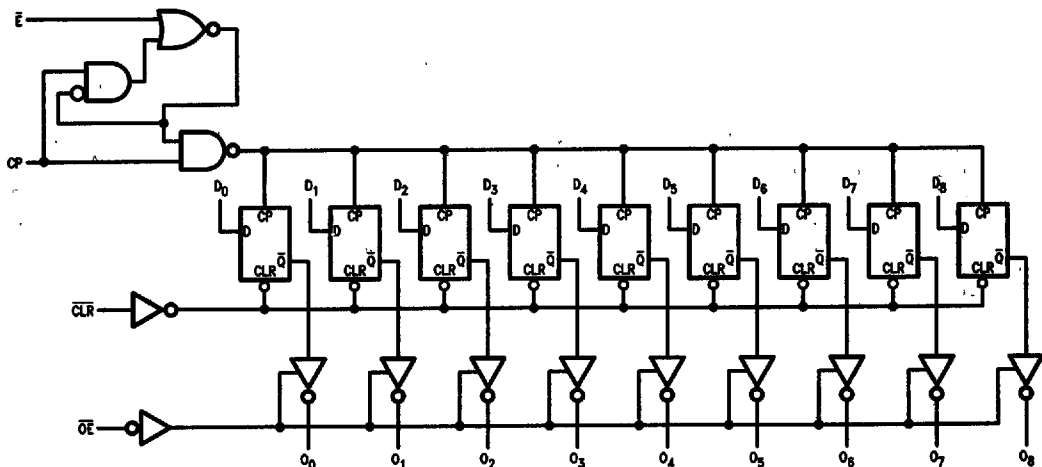
When CLR is LOW and OE is LOW, the outputs are LOW. When CLR is HIGH, data can be entered into the flip-flops. When EN is LOW, data on the inputs is transferred to the outputs on the LOW-to-HIGH clock transition. When the EN is HIGH, the outputs do not change state, regardless of the data or clock input transitions.

Function Table

Inputs				Internal	Output	Function	
OE	CLR	EN	CP	D	Q		O
H	X	L	↗	L	L	Z	High-Z
H	X	L	↗	H	H	Z	High-Z
H	L	X	X	X	L	Z	Clear
L	L	X	X	X	L	L	Clear
H	H	H	X	X	NC	Z	Hold
L	H	H	X	X	NC	NC	Hold
H	H	L	↗	L	L	Z	Load
H	H	L	↗	H	H	Z	Load
L	H	L	↗	L	L	L	Load
L	H	L	↗	H	H	H	Load

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 ↗ = LOW-to-HIGH Transition  
 NC = No Change

### Logic Diagram



TL/F/10878-6

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

### Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Terminal Voltage with Respect to GND ( $V_{TERM}$ )	
74FCTA/B	-0.5V to +7.0V
Temperature under Bias ( $T_{BIAS}$ )	
74FCTA/B	-55°C to +125°C
Storage Temperature ( $T_{STG}$ )	
74FCTA/B	-55°C to +125°C
Power Dissipation ( $P_T$ )	0.5W
DC Output Current ( $I_{O_{OUT}}$ )	120 mA

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. Exposure to absolute maximum ratings conditions for extended periods may affect reliability. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables.

### Recommended Operating Conditions

Supply Voltage ( $V_{CC}$ )	
74FCTA/B	4.75V to 5.25V
Input Voltage	0V to $V_{CC}$
Output Voltage	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	
74FCTA/B	-0°C to +70°C
Junction Temperature ( $T_J$ )	
PDIP	140°C

Note: All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from -40°C to +125°C.

### DC Characteristics for 'FCTA/B Family Devices

Typical values are at  $V_{CC} = 5.0V$ , 25°C ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com:  $V_{CC} = 5.0V \pm 5\%$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ ;  $V_{HC} = V_{CC} - 0.2V$ .

Symbol	Parameter	74FCTA/B			Units	Conditions	
		Min	Typ	Max			
$V_{IH}$	Minimum High Level Input Voltage	2.0			V		
$V_{IL}$	Maximum Low Level Input Voltage			0.8	V		
$I_{IH}$	Input High Current			5.0 5.0	$\mu A$	$V_{CC} = \text{Max}$	$V_I = V_{CC}$ $V_I = 2.7V$ (Note 2)
$I_{IL}$	Input Low Current			-5.0 -5.0	$\mu A$	$V_{CC} = \text{Max}$	$V_I = 0.5V$ (Note 2) $V_I = GND$
$I_{OZ}$	Maximum TRI-STATE Current			10.0 10.0 -10.0 -10.0	$\mu A$	$V_{CC} = \text{Max}$	$V_O = V_{CC}$ $V_O = 2.7V$ (Note 2) $V_O = 0.5V$ (Note 2) $V_O = GND$
$V_{IK}$	Clamp Diode Voltage		-0.7	-1.2	V	$V_{CC} = \text{Min}$ ; $I_N = -18 \text{ mA}$	
$I_{OS}$	Short Circuit Current	-75	-120		mA	$V_{CC} = \text{Max}$ (Note 1); $V_O = GND$	
$V_{OH}$	Minimum High Level Output Voltage	2.8 $V_{HC}$ 2.4 2.4	3.0 $V_{CC}$ 4.3 4.3		V	$V_{CC} = 3V$ ; $V_{IN} = 0.2V$ or $V_{HC}$ ; $I_{OH} = -32 \mu A$	$I_{OH} = -300 \mu A$ $I_{OL} = -24 \text{ mA}$ (Com)
$V_{OL}$	Maximum Low Level Output Voltage		GND GND 0.3 0.3	0.2 0.2 0.5 0.5	V	$V_{CC} = 3V$ ; $V_{IN} = 0.2V$ or $V_{HC}$ ; $I_{OL} = 300 \mu A$	$I_{OH} = 300 \mu A$ $I_{OL} = 48 \text{ mA}$ (Com)
$I_{CC}$	Maximum Quiescent Supply Current		0.2	1.5	mA	$V_{CC} = \text{Max}$ $V_{IN} \geq V_{HC}$ ; $V_{IN} \leq 0.2V$ $f_I = f_{CP} = 0$	
$\Delta I_{CC}$	Quiescent Supply Current; TTL Inputs HIGH		0.5	2.0	mA	$V_{CC} = \text{Max}$ $V_{IN} = 3.4V$ (Note 3)	
$I_{CCD}$	Dynamic Power Supply Current (Note 4)			0.35	mA/MHz	$V_{CC} = \text{Max}$ Outputs Open $\overline{OE} = GND$ One Bit Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$

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**DC Characteristics for 74FCTA/B Family Devices (Continued)**

Typical values are at  $V_{CC} = 5.0V$ ,  $25^{\circ}C$  ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type. Com:  $V_{CC} = 5.0V \pm 5\%$ ,  $T_A = 0^{\circ}C$  to  $+70^{\circ}C$ ;  $V_{HC} = V_{CC} - 0.2V$ .

Symbol	Parameter	74FCTA/B			Units	Conditions	
		Min	Typ	Max			
$I_C$	Total Power Supply Current (Note 6)			4.0	mA	$V_{CC} = \text{Max}$ Outputs Open $f_{CP} = 10 \text{ MHz}$ $\overline{OE} = \text{GND}$ $f_i = 5 \text{ MHz}$ One Bit Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
				6.0			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$
				9.5		(Note 5) $V_{CC} = \text{Max}$ Outputs Open $f_{CP} = 10 \text{ MHz}$ $\overline{OE} = \text{GND}$ $f_i = 2.5 \text{ MHz}$ Eight Bits Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
				16.8			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$

**Note 1:** Maximum test duration not to exceed one second, not more than one output shorted at one time.

**Note 2:** This parameter is guaranteed but not tested.

**Note 3:** Per TTL driven input ( $V_{IN} = 3.4V$ ); all other inputs at  $V_{CC}$  or GND.

**Note 4:** This parameter is not directly testable, but is derived for use in Total Power Supply calculations.

**Note 5:** Values for these conditions are examples of the  $I_{CC}$  formula. These limits are guaranteed but not tested.

**Note 6:**  $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$

$$I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$$

$I_{CC}$  = Quiescent Current

$\Delta I_{CC}$  = Power Supply Current for a TTL High Input ( $V_{IN} = 3.4V$ )

$D_H$  = Duty Cycle for TTL inputs High

$N_T$  = Number of 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 milliamperes and all frequencies are in megahertz.

**AC Electrical Characteristics:** See Section 2 for Waveforms

Symbol	Parameter	Test Conditions	74FCTA		74FCTB		Units	Fig. No.
			T <sub>A</sub> , V <sub>CC</sub> = Com		T <sub>A</sub> , V <sub>CC</sub> = Com			
			Min	Max	Min	Max		
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Clock to On (OE = Low)	C <sub>L</sub> = 50 pF R <sub>L</sub> = 500Ω	10.0		7.5		ns	2-9
		C <sub>L</sub> = 300 pF (Note 1) R <sub>L</sub> = 500Ω	20.0		15.0		ns	2-9
t <sub>SU</sub>	Data to C <sub>p</sub> Setup Time	C <sub>L</sub> = 50 pF R <sub>L</sub> = 500Ω	4.0		3.0		ns	2-10
t <sub>H</sub>	Data to C <sub>p</sub> Hold Time		2.0		1.5		ns	2-10
t <sub>SU</sub>	Enable (EN) to C <sub>p</sub> Setup Time		4.0		2.0		ns	2-10
t <sub>H</sub>	Enable (EN) Hold Time		2.0		1.5		ns	2-10
t <sub>PHL</sub>	Propagation Delay Clear to O <sub>1</sub>		14.0		9.0		ns	2-10
t <sub>REC</sub>	Clear Recovery (CLR) Time		6.0		6.0		ns	2-10
t <sub>p</sub>	Clock Pulse Width		7.0		6.0		ns	2-9
t <sub>p</sub>	Clear (CLR = Low) Pulse Width		6.0		6.0		ns	2-9
t <sub>pZH</sub> t <sub>pZL</sub>	Output Enable Time OE to On	C <sub>L</sub> = 50 pF R <sub>L</sub> = 500Ω	12.0		8.0		ns	2-11
		C <sub>L</sub> = 300 pF (Note 1) R <sub>L</sub> = 500Ω	23.0		15.0		ns	2-11
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time OE to On	C <sub>L</sub> = 5 pF (Note 1) R <sub>L</sub> = 500Ω	7.0		6.5		ns	2-11
		C <sub>L</sub> = 50 pF R <sub>L</sub> = 500Ω	8.0		7.5		ns	2-11

Note 1: These parameters are guaranteed but not tested.

**Capacitance** (T<sub>A</sub> = +25°C, f = 1.0 MHz)

Symbol	Parameter(1)	Conditions	Typ	Max	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = 0V	6	10	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	8	12	pF

Note 1: This parameter is measured at characterization but not tested.