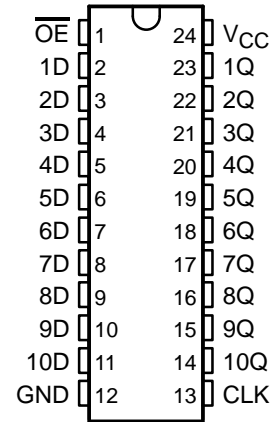


# SN54ABT821, SN74ABT821A 10-BIT BUS-INTERFACE FLIP-FLOPS WITH 3-STATE OUTPUTS

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- State-of-the-Art **EPIC-II<sup>TM</sup>** BiCMOS Design Significantly Reduces Power Dissipation
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Typical  $V_{OLP}$  (Output Ground Bounce)  $< 1$  V at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$
- High-Drive Outputs ( $-32\text{-mA } I_{OH}$ ,  $64\text{-mA } I_{OL}$ )
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages, Ceramic Chip Carriers (FK), and Plastic (NT) and Ceramic (JT) DIPs

SN54ABT821 . . . JT PACKAGE  
SN74ABT821A . . . DB, DW, OR NT PACKAGE  
(TOP VIEW)



## description

These 10-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing wider buffer registers, I/O ports, bidirectional bus drivers with parity, and working registers.

The ten flip-flops are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the devices provide true data at the Q outputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the ten outputs in either a normal logic state (high or low level) or a high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without need for interface or pullup components.

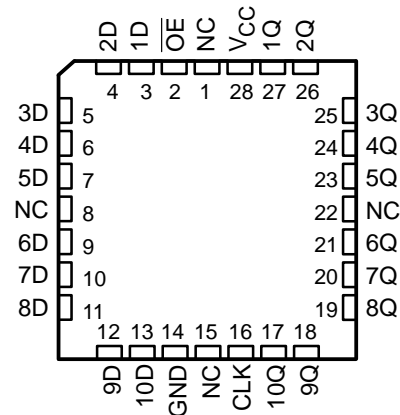
$\overline{OE}$  does not affect the internal operations of the latch. Previously stored data can be retained or new data can be entered while the outputs are in the high-impedance state.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN74ABT821A is available in TI's shrink small-outline package, which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54ABT821 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT821A is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54ABT821 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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**TEXAS  
INSTRUMENTS**

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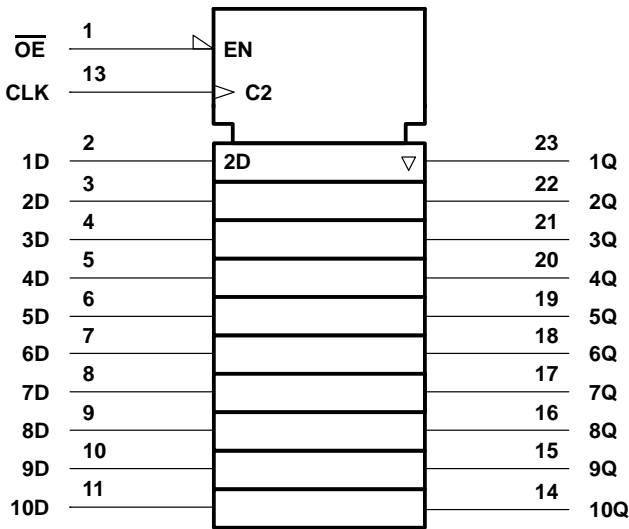
SN54ABT821, SN74ABT821A  
10-BIT BUS-INTERFACE FLIP-FLOPS  
WITH 3-STATE OUTPUTS

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FUNCTION TABLE  
(each flip-flop)

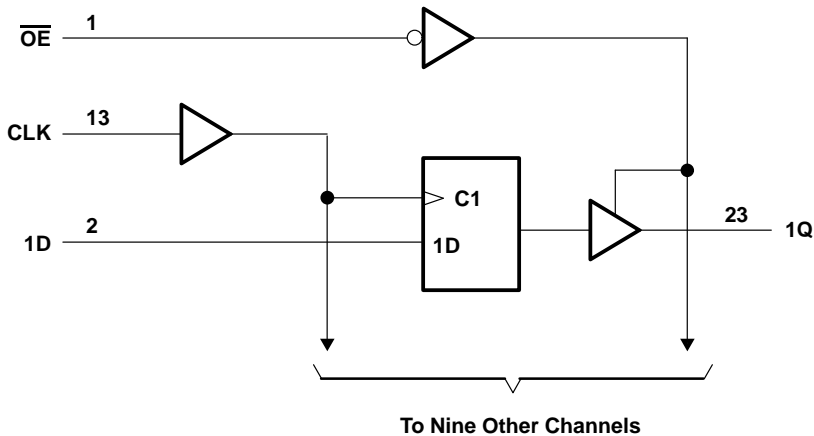
INPUTS			OUTPUT Q
$\overline{\text{OE}}$	CLK	D	
L	$\uparrow$	H	H
L	$\uparrow$	L	L
L	H or L	X	$Q_0$
H	X	X	Z

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



Pin numbers shown are for the DB, DW, JT, and NT packages.

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## 10-BIT BUS-INTERFACE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

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#### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1)	–0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, $V_O$	–0.5 V to 5.5 V
Current into any output in the low state, $I_O$ : SN54ABT821	96 mA
SN74ABT821A	128 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ )	–18 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ )	–50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DB package	0.65 W
DW package	1.7 W
NT package	1.3 W
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions beyond those indicated in the "recommended operating conditions" section of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils, except for the NT package, which has a trace length of zero. For more information, refer to the *Package Thermal Considerations* application note in the *ABT Advanced BiCMOS Technology Data Book*.

#### recommended operating conditions (see Note 3)

		SN54ABT821		SN74ABT821A		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	4.5	5.5	4.5	5.5	V
$V_{IH}$	High-level input voltage	2		2		V
$V_{IL}$	Low-level input voltage		0.8		0.8	V
$V_I$	Input voltage	0	$V_{CC}$	0	$V_{CC}$	V
$I_{OH}$	High-level output current		–24		–32	mA
$I_{OL}$	Low-level output current		48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate		10		10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200		200		μs/V
$T_A$	Operating free-air temperature	–55	125	–40	85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

# SN54ABT821, SN74ABT821A

## 10-BIT BUS-INTERFACE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

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**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

PARAMETER	TEST CONDITIONS			T <sub>A</sub> = 25°C			SN54ABT821		SN74ABT821A		UNIT
				MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = −18 mA			−1.2			−1.2		−1.2		V
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = −3 mA			2.5			2.5		2.5		V
	V <sub>CC</sub> = 5 V, I <sub>OH</sub> = −3 mA			3			3		3		
	V <sub>CC</sub> = 4.5 V	I <sub>OH</sub> = −24 mA		2			2				
		I <sub>OH</sub> = −32 mA		2*					2		
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 48 mA		0.55			0.55				V
		I <sub>OL</sub> = 64 mA		0.55*					0.55		
I <sub>I</sub>	V <sub>CC</sub> = 0 to 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND			±1			±1		±1		μA
I <sub>OZPU</sub>	V <sub>CC</sub> = 0 to 2.1 V, V <sub>O</sub> = 0.5 to 2.7 V, $\overline{OE} = X$			±50*					±50		μA
I <sub>OZPD</sub>	V <sub>CC</sub> = 2.1 V to 0, V <sub>O</sub> = 0.5 to 2.7 V, $\overline{OE} = X$			±50*					±50		μA
I <sub>OZH</sub>	V <sub>CC</sub> = 2.1 V to 5.5 V, V <sub>O</sub> = 2.7 V, $\overline{OE} \geq 2$ V			10			10		10		μA
I <sub>OZL</sub>	V <sub>CC</sub> = 2.1 V to 5.5 V, V <sub>O</sub> = 0.5 V, $\overline{OE} \geq 2$ V			−10			−10		−10		μA
I <sub>off</sub>	V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> ≤ 4.5 V			±100					±100		μA
I <sub>CEX</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 5.5 V Outputs high			50			50		50		μA
I <sub>O</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.5 V			−50	−100	−180	−50	−180	−50	−180	mA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = V <sub>CC</sub> or GND	I <sub>O</sub> = 0,	Outputs high	1 250		250		250		μA	
			Outputs low	24 38		38		38		mA	
			Outputs disabled	0.5 250		250		250		μA	
ΔI <sub>CC</sub> §	V <sub>CC</sub> = 5.5 V, One input at 3.4 V, Other inputs at V <sub>CC</sub> or GND			1.5			1.5		1.5		mA
C <sub>i</sub>	V <sub>I</sub> = 2.5 V or 0.5 V			3.5							pF
C <sub>o</sub>	V <sub>O</sub> = 2.5 V or 0.5 V			7.5							pF

\* On products compliant to MIL-PRF-38535, this parameter does not apply.

† All typical values are at V<sub>CC</sub> = 5 V.

‡ Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V<sub>CC</sub> or GND.

**timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 1)**

			V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C		SN54ABT821		SN74ABT821A		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency		0	125	0	125	0	125	MHz
t <sub>w</sub>	Pulse duration, CLK high or low		High		2.9		2.9		ns
			Low		3.8		3.8		
t <sub>su</sub>	Setup time, data before CLK↑		2.1		2.1		2.1		ns
t <sub>h</sub>	Hold time, data after CLK↑		1.3		1.3		1.3		ns



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**WITH 3-STATE OUTPUTS**

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$			SN54ABT821		UNIT
			MIN	TYP	MAX	MIN	MAX	
$f_{\max}$			125			125		MHz
$t_{PLH}$	CLK	Q	1.6†	4.1	5.6	1.6†	6.9	ns
$t_{PHL}$			2.1†	4.6	6.2	2.1†	6.9	
$t_{PZH}$	$\overline{OE}$	Q	1	3	4.5	1	6	ns
$t_{PZL}$			2.2	4.1	5.6	2.2	6.5	
$t_{PHZ}$	$\overline{OE}$	Q	2.7	4.7	6.2	2.7	7	ns
$t_{PLZ}$			1.7†	4.6	6.1	1.7†	7	

† This data sheet limit may vary among suppliers.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$			SN74ABT821A		UNIT
			MIN	TYP	MAX	MIN	MAX	
$f_{\max}$			125			125		MHz
$t_{PLH}$	CLK	Q	1.6†	4.1	5.6	1.6†	6.2	ns
$t_{PHL}$			2.3†	4.6	6.2	2.3†	6.7	
$t_{PZH}$	$\overline{OE}$	Q	1	3	4.5	1	5.8	ns
$t_{PZL}$			2.2	4.1	5.6	2.2	6.3	
$t_{PHZ}$	$\overline{OE}$	Q	2.7	4.7	6.2	2.7	6.7	ns
$t_{PLZ}$			1.7†	4.6	6.1	1.7†	6.5	

† This data sheet limit may vary among suppliers.

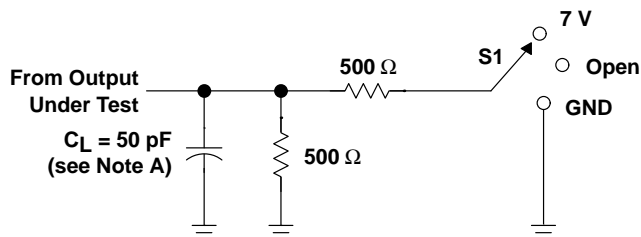
# SN54ABT821, SN74ABT821A

## 10-BIT BUS-INTERFACE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

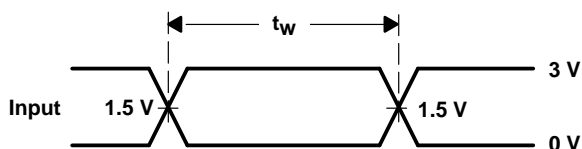
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#### PARAMETER MEASUREMENT INFORMATION

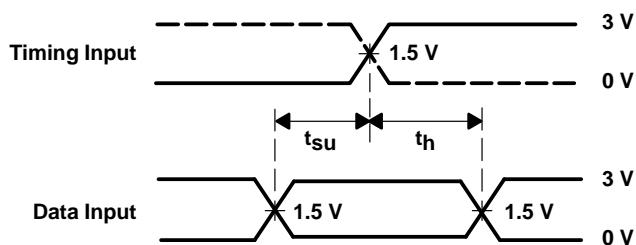


LOAD CIRCUIT

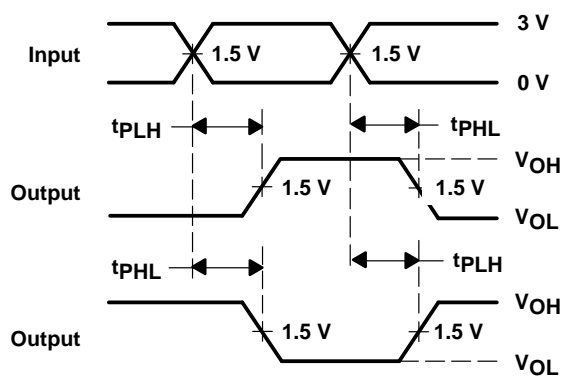
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open



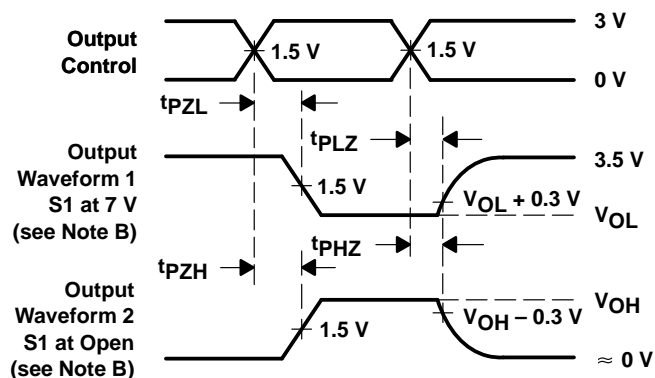
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- NOTES: A.  $C_L$  includes probe and jig capacitance.
- B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
- C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
- D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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