

# SN54ABT574, SN74ABT574 OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCBS191A – JANUARY 1991 – REVISED JULY 1994

- State-of-the-Art *EPIC-II B*™ BiCMOS Design Significantly Reduces Power Dissipation
- ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- 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-mA  $I_{OH}$ , 64-mA  $I_{OL}$ )
- Package Options Include Plastic Small-Outline (DW) and Shrink Small-Outline (DB) Packages, Ceramic Chip Carriers (FK), and Plastic (N) and Ceramic (J) DIPs

## description

These 8-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight flip-flops of the 'ABT574 are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels that were set up at the data (D) inputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) 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.

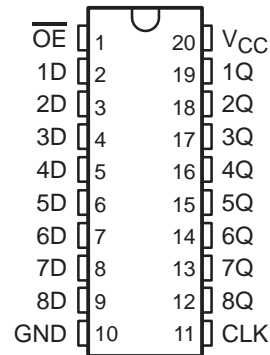
$\overline{OE}$  does not affect the internal operations of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

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.

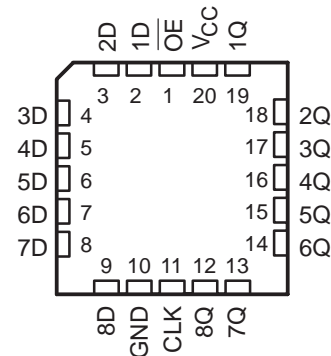
The SN74ABT574 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54ABT574 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74ABT574 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54ABT574 . . . J PACKAGE  
SN74ABT574 . . . DB, DW, OR N PACKAGE  
(TOP VIEW)



SN54ABT574 . . . FK PACKAGE  
(TOP VIEW)



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

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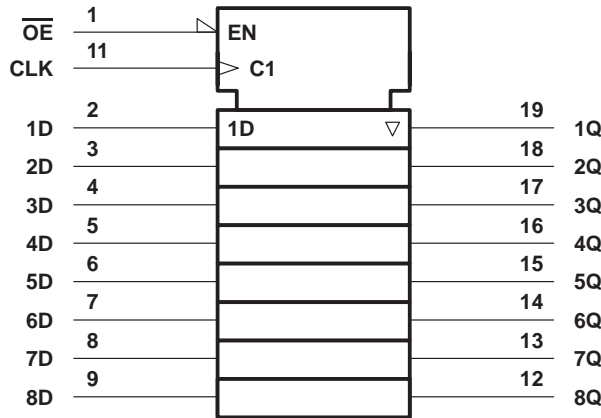
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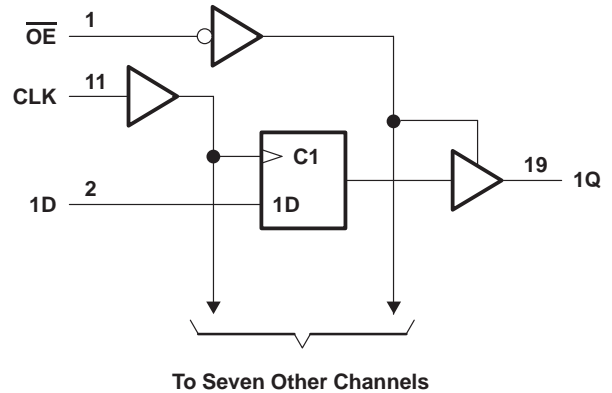
FUNCTION TABLE  
(each flip-flop)

INPUTS			OUTPUT
$\overline{OE}$	CLK	D	Q
L	↑	H	H
L	↑	L	L
L	H or L	X	Q <sub>0</sub>
H	X	X	Z

## logic symbol†



## logic diagram (positive logic)



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

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

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, $I_O$ : SN54ABT574	96 mA
SN74ABT574	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	0.6 W
DW package	1.6 W
N package	1.3 W
Storage temperature range	–65°C to 150°C

‡ Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” 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 N package, which has a trace length of zero. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

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## recommended operating conditions (see Note 3)

		SN54ABT574		SN74ABT574		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	Outputs enabled		5	5	ns/V
$T_A$	Operating free-air temperature	-55	125	-40	85	°C

NOTE 3: Unused or floating inputs must be held high or low.

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

PARAMETER	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			SN54ABT574		SN74ABT574		UNIT
		MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
$V_{IK}$	$V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$			-1.2	-1.2	-1.2			V
$V_{OH}$	$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -3\text{ mA}$	2.5			2.5		2.5		V
	$V_{CC} = 5\text{ V}$ , $I_{OH} = -3\text{ mA}$	3			3		3		
	$V_{CC} = 4.5\text{ V}$	$I_{OH} = -24\text{ mA}$	2			2			
$I_{OH} = -32\text{ mA}$		2*					2		
$V_{OL}$	$V_{CC} = 4.5\text{ V}$	$I_{OL} = 48\text{ mA}$		0.55	0.55				V
		$I_{OL} = 64\text{ mA}$		0.55*			0.55		
$I_I$	$V_{CC} = 5.5\text{ V}$ , $V_I = V_{CC}$ or GND			$\pm 1$	$\pm 1$	$\pm 1$			$\mu\text{A}$
$I_{OZH}$	$V_{CC} = 5.5\text{ V}$ , $V_O = 2.7\text{ V}$			50	10	50			$\mu\text{A}$
$I_{OZL}$	$V_{CC} = 5.5\text{ V}$ , $V_O = 0.5\text{ V}$			-50	-10	-50			$\mu\text{A}$
$I_{off}$	$V_{CC} = 0$ , $V_I$ or $V_O \leq 4.5\text{ V}$			$\pm 100$	$\pm 500$	$\pm 100$			$\mu\text{A}$
$I_{CEX}$	$V_{CC} = 5.5\text{ V}$ , $V_O = 5.5\text{ V}$   Outputs high			50	50	50			$\mu\text{A}$
$I_{O}^\ddagger$	$V_{CC} = 5.5\text{ V}$ , $V_O = 2.5\text{ V}$	-50	-100	-180	-50	-180	-50	-180	mA
$I_{CC}$	$V_{CC} = 5.5\text{ V}$ , $I_O = 0$ , $V_I = V_{CC}$ or GND	Outputs high		1	250	250	250		$\mu\text{A}$
		Outputs low		24	30	30	30		mA
		Outputs disabled		0.5	250	250	250		$\mu\text{A}$
$\Delta I_{CC}^\S$	$V_{CC} = 5.5\text{ V}$ , One input at 3.4 V, Other inputs at $V_{CC}$ or GND			1.5	1.5	1.5			mA
$C_i$	$V_I = 2.5\text{ V}$ or $0.5\text{ V}$			3					pF
$C_o$	$V_O = 2.5\text{ V}$ or $0.5\text{ V}$			8					pF

\* On products compliant to MIL-STD-883, Class B, this parameter does not apply.

† All typical values are at  $V_{CC} = 5\text{ V}$ .

‡ 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  $V_{CC}$  or GND.

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**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		SN54ABT574		SN74ABT574		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	150		150		150		MHz
t <sub>w</sub>	Pulse duration, CLK high or low	3.3		3.3		3.3		ns
t <sub>su</sub>	Setup time, data before CLK↑	High		1		1		ns
		Low		1.5		1.5		
t <sub>h</sub>	Hold time, data after CLK↑	High or low		1.5†		1.5†		ns

† This data sheet limit may vary among suppliers.

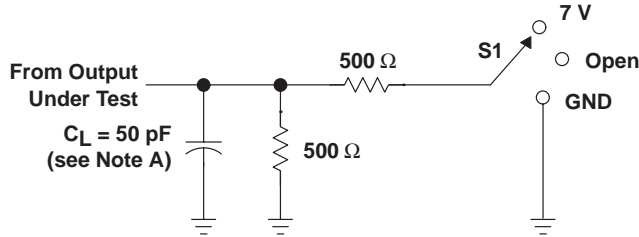
**switching characteristics over recommended ranges of supply voltage and operating free-air temperature, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C			SN54ABT574		SN74ABT574		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f <sub>max</sub>			150	200		150		150	MHz	
t <sub>PLH</sub>	CLK	Q	2.2	3.9	6.2	2.2	7	2.2	6.8	ns
t <sub>PHL</sub>			3	4.8	6.6	3	7.4	3	7.1	
t <sub>PZH</sub>	$\overline{OE}$	Q	1	3.3	4.3	1	5.8	1	5.1	ns
t <sub>PZL</sub>			2.5	4.7	5.9	2.5	7.2	2.5	6.7	
t <sub>PHZ</sub>	$\overline{OE}$	Q	2.4	4.9	6.2	2.4	7.2	2.4	7	ns
t <sub>PLZ</sub>			2	4	5.8	2	6.7	2	6.5	

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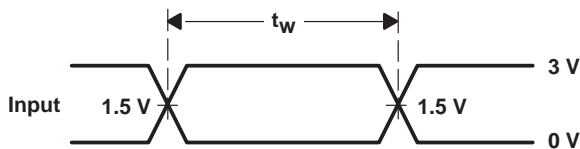
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## PARAMETER MEASUREMENT INFORMATION

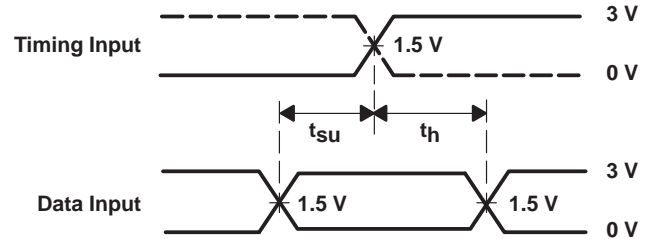


TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	7 V
$t_{PHZ}/t_{PZH}$	Open

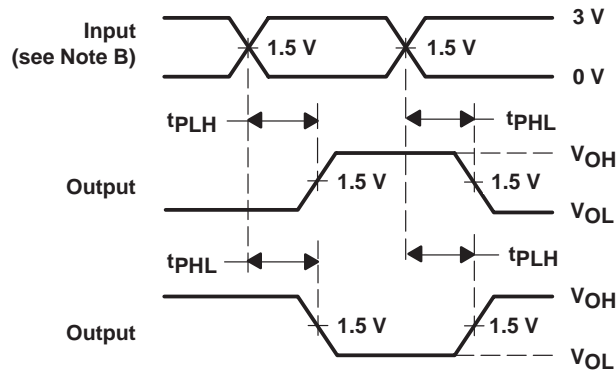
**LOAD CIRCUIT FOR OUTPUTS**



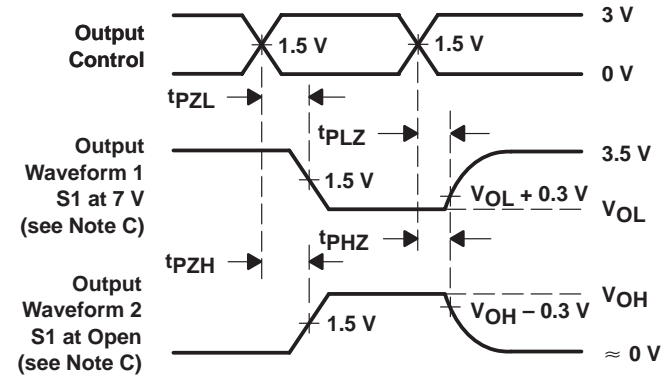
**VOLTAGE WAVEFORMS  
PULSE DURATION**



**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. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
 C. 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.  
 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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