

SN54ABT374, SN74ABT374A OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCBS111G – FEBRUARY 1991 – REVISED JANUARY 1997

- State-of-the-Art **EPIC-IITM** BiCMOS Design Significantly Reduces Power Dissipation
- 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 ($-32\text{-mA } I_{OH}$, $64\text{-mA } I_{OL}$)
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ($C = 200$ pF, $R = 0$)
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK), Plastic (N) and Ceramic (J) DIPs, and Ceramic Flat (W) Package

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.

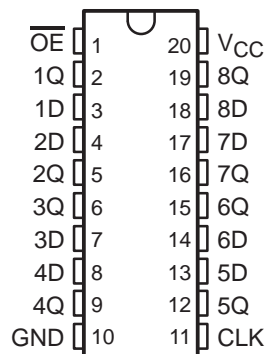
The eight flip-flops of the SN54ABT374 and SN74ABT374A are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels set up at the data (D) inputs.

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 internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

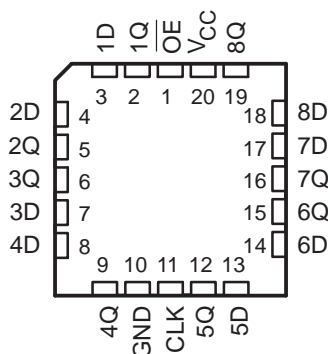
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54ABT374 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ABT374A is characterized for operation from -40°C to 85°C .

SN54ABT374 . . . J OR W PACKAGE
SN74ABT374A . . . DB, DW, N, OR PW PACKAGE
(TOP VIEW)



SN54ABT374 . . . FK PACKAGE
(TOP VIEW)



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**TEXAS
INSTRUMENTS**

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SN54ABT374, SN74ABT374A

OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS

WITH 3-STATE OUTPUTS

FUNCTION TABLE

INPUTS			OUTPUT Q
OE	CLK	D	
L	↑	H	H
L	↑	L	L
L	H or L	X	Q ₀
H	X	X	Z

Pin diagram of the 74VHC163 4-bit binary counter. The chip has 19 pins. Pin 1 is OE (Output Enable), pin 11 is CLK (Clock), and pin 3 is 1D (Data Input 1). Pin 2 is 1Q (Data Output 1). Pins 4 through 19 are data inputs and outputs 2D through 8D and 2Q through 8Q. The diagram shows the internal logic blocks and the connection of the clock signal to the C1 input.

The diagram shows a 74138 3-to-8 decoder. The inputs are OE (1), CLK (11), and 1D (3). The output is 1Q (2). The decoder is connected to seven other channels, indicated by a bracket and the text "To Seven Other Channels".

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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 or power-off state, V_O	–0.5 V to 5.5 V
Current into any output in the low state, I_O : SN54ABT374	96 mA
SN74ABT374A	128 mA
Input clamp current, I_{IK} ($V_I < 0$)	–18 mA
Output clamp current, I_{OK} ($V_O < 0$)	–50 mA
Package thermal impedance, θ_{JA} (see Note 2): DB package	115°C/W
DW package	97°C/W
N package	67°C/W
PW package	128°C/W
Storage temperature range, T_{stg}	–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 package thermal impedance is calculated in accordance with EIA/JEDEC Std JESD51, except for through-hole packages, which use a trace length of zero.

recommended operating conditions (see Note 3)

		SN54ABT374		SN74ABT374A		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 inputs must be held high or low to prevent them from floating.

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

PARAMETER	TEST CONDITIONS	T _A = 25°C			SN54ABT374		SN74ABT374A		UNIT
		MIN	TYP†	MAX	MIN	MAX	MIN	MAX	
V _{IK}	V _{CC} = 4.5 V, I _I = -18 mA			-1.2		-1.2		-1.2	V
V _{OH}	V _{CC} = 4.5 V, I _{OH} = -3 mA	2.5			2.5		2.5		V
	V _{CC} = 5 V, I _{OH} = -3 mA	3			3		3		
	V _{CC} = 4.5 V	I _{OH} = -24 mA	2		2				
		I _{OH} = -32 mA	2*				2		
V _{OL}	V _{CC} = 4.5 V	I _{OL} = 48 mA		0.55		0.55			V
		I _{OL} = 64 mA		0.55*				0.55	
V _{hys}			100						mV
I _I	V _{CC} = 5.5 V, V _I = V _{CC} or GND			±1		±1		±1	μA
I _{OZH}	V _{CC} = 5.5 V, V _O = 2.7 V			10‡		10‡		10‡	μA
I _{OZL}	V _{CC} = 5.5 V, V _O = 0.5 V			-10‡		-10‡		-10‡	μA
I _{off}	V _{CC} = 0, V _I or V _O ≤ 4.5 V			±100				±100	μA
I _{CEX}	V _{CC} = 5.5 V, V _O = 5.5 V			50		50		50	μA
I _{O§}	V _{CC} = 5.5 V, V _O = 2.5 V	-50	-100	-180	-50	-180	-50	-180	mA
I _{CC}	V _{CC} = 5.5 V, I _O = 0, V _I = V _{CC} or GND	Outputs high		250		250		250	μA
		Outputs low		30		30		30	mA
		Outputs disabled		250		250		250	μA
ΔI _{CC¶}	V _{CC} = 5.5 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 V or 0.5 V			3.5					pF
C _o	V _O = 2.5 V or 0.5 V			6.5					pF

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

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

‡ This data sheet limit may vary among suppliers.

§ 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.

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

			SN54ABT374				UNIT
			V _{CC} = 5 V, T _A = 25°C		MIN	MAX	
f _{clock}	Clock frequency		0	150	0	150	MHz
t _w	Pulse duration	CLK high or low	3.3		3.3		ns
t _{su}	Setup time before CLK↑	Data high	2		2.5		ns
		Data low	2		2.5		
t _h	Hold time after CLK↑	Data high or low	2		2.5		ns



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

			SN74ABT374A				UNIT
			$V_{CC} = 5\text{ V},$ $T_A = 25^{\circ}\text{C}$		MIN	MAX	
f _{clock}	Clock frequency		0	150	0	150	MHz
t _w	Pulse duration	CLK high or low	3.3		3.3		ns
t _{su}	Setup time before CLK↑	Data high	1		1		ns
		Data low	1.9		1.9		
t _h	Hold time after CLK↑	Data high or low	2.1†		2.1†		ns

\dagger This data sheet limit may vary among suppliers.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54ABT374					UNIT
			V _{CC} = 5 V, T _A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
f _{max}			150	200		150		MHz
t _{PLH}	CLK	Q	2.2	4.2	5.7	1.8	6.6	ns
t _{PHL}			3.1	5.1	6.6	2.6	7.6	
t _{PZH}	OE	Q	1.2	3.2	4.7	0.8	5.7	ns
t _{PZL}			2.3	4.7	6.2	1.5	7.2	
t _{PHZ}	OE	Q	2.3	4.5	6.1	1.3	7.2	ns
t _{PLZ}			1.9	4.5	6	1	7	

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN74ABT374A					UNIT
			V _{CC} = 5 V, T _A = 25°C			MIN	MAX	
			MIN	TYP	MAX			
f _{max}			150	200		150		MHz
t _{PLH}	CLK	Q	2.2	4.2	5.7	2.2	6.2	ns
t _{PHL}			3.1	5.1	6.6	3.1	7.1	
t _{PZH}	OE	Q	1.2	3.2	4.7	1.2	5.2	ns
t _{PZL}			2.7	4.7	6.2	2.7	6.7	
t _{PHZ}	OE	Q	2.5	4.5	6	2.5	6.7†	ns
t _{PLZ}			2	4.5	6	2	6.5	

\dagger This data sheet limit may vary among suppliers.

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PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

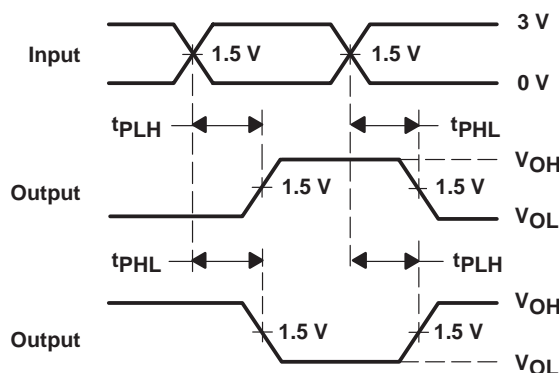
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open



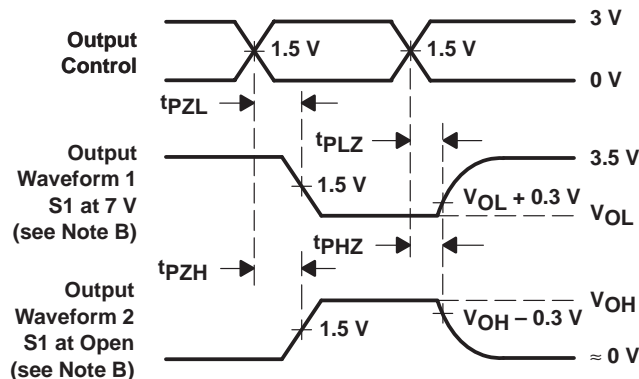
VOLTAGE WAVEFORMS
PULSE DURATION



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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Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.