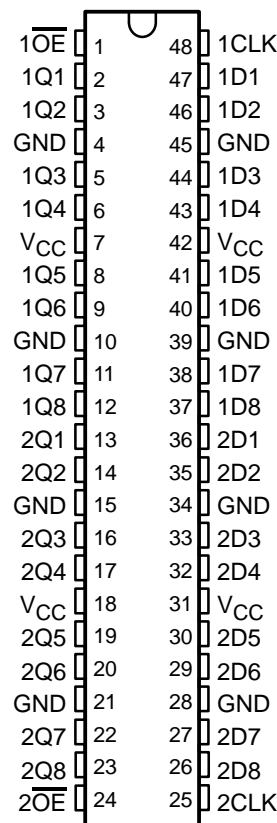


# 54AC16374, 74AC16374 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCAS123B – MARCH 1990 – REVISED APRIL 1996

- **Members of the Texas Instruments Widebus™ Family**
- **3-State True Outputs**
- **Full Parallel Access for Loading**
- **Flow-Through Architecture Optimizes PCB Layout**
- **Distributed V<sub>CC</sub> and GND Pin Configuration Minimizes High-Speed Switching Noise**
- **EPIC™ (Enhanced-Performance Implanted CMOS) 1-μm Process**
- **500-mA Typical Latch-Up Immunity at 125°C**
- **Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Packages Using 25-mil Center-to-Center Pin Spacings and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Pin Spacings**

54AC16374 . . . WD PACKAGE  
74AC16374 . . . DL PACKAGE  
(TOP VIEW)



## description

The 'AC16374 are 16-bit edge-triggered D-type flip-flops with 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 'AC16374 can be used as two 8-bit flip-flops or one 16-bit flip-flop. On the positive transition of the clock (CLK) input, the Q outputs of the flip-flop take on 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.

$\overline{OE}$  does not affect the 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.

The 74AC16374 is packaged in TI's shrink small-outline package, which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54AC16374 is characterized for operation over the full military temperature range of -55°C to 125°C. The 74AC16374 is characterized for operation from -40°C to 85°C.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

EPIC and Widebus are trademarks of Texas Instruments Incorporated.

UNLESS OTHERWISE NOTED this document contains PRODUCTION DATA information 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**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1996, Texas Instruments Incorporated

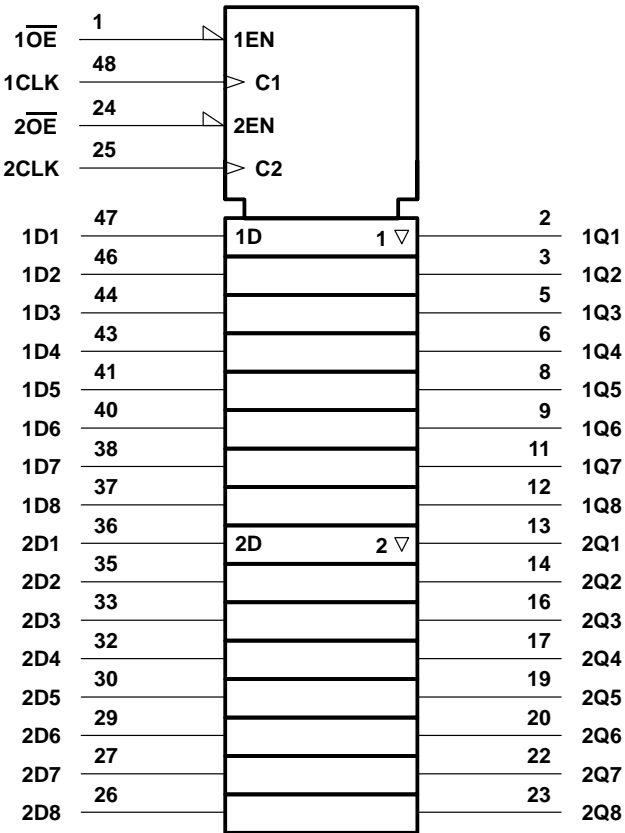
54AC16374, 74AC16374  
16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS  
WITH 3-STATE OUTPUTS

SCAS123B – MARCH 1990 – REVISED APRIL 1996

FUNCTION TABLE

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

logic symbol†

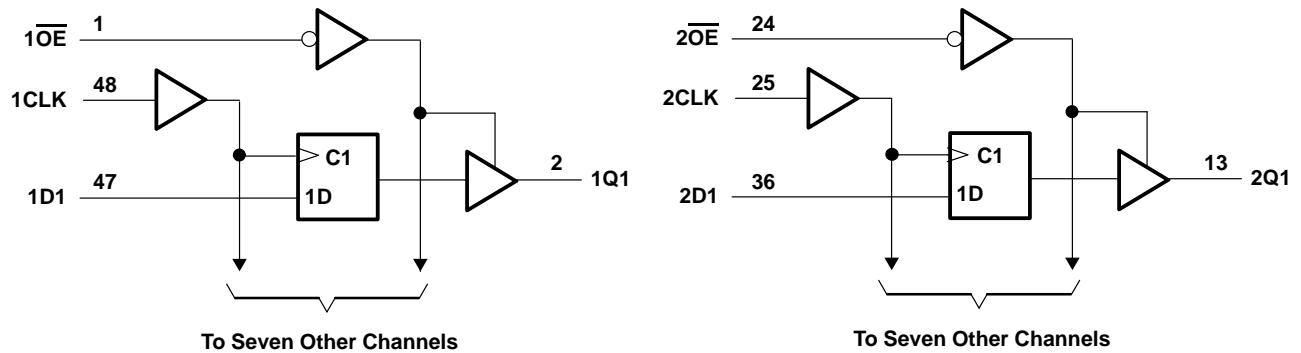


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**54AC16374, 74AC16374**  
**16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS**  
**WITH 3-STATE OUTPUTS**

SCAS123B – MARCH 1990 – REVISED APRIL 1996

**logic diagram (positive logic)**



**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 $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )	$\pm 50$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND	$\pm 400$ mA
Maximum power package dissipation at $T_A = 55^\circ\text{C}$ (in still air)(see Note 2): DL package	1.2 W
Storage temperature range, $T_{stg}$	$-65^\circ\text{C}$ to $150^\circ\text{C}$

† 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 voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The maximum package power dissipation is calculated using a junction temperature of  $150^\circ\text{C}$  and a board trace length of 750 mils.

# 54AC16374, 74AC16374

## 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

SCAS123B – MARCH 1990 – REVISED APRIL 1996

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

			54AC16374			74AC16374			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage		3	5	5.5	3	5	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 3 V	2.1			2.1			V
		V <sub>CC</sub> = 4.5 V	3.15			3.15			
		V <sub>CC</sub> = 5.5 V	3.85			3.85			
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 3 V			0.9			0.9	V
		V <sub>CC</sub> = 4.5 V			1.35			1.35	
		V <sub>CC</sub> = 5.5 V			1.65			1.65	
V <sub>I</sub>	Input voltage		0		V <sub>CC</sub>	0		V <sub>CC</sub>	V
V <sub>O</sub>	Output voltage		0		V <sub>CC</sub>	0		V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 3 V			–4			–4	mA
		V <sub>CC</sub> = 4.5 V			–24			–24	
		V <sub>CC</sub> = 5.5 V			–24			–24	
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 3 V			12			12	mA
		V <sub>CC</sub> = 4.5 V			24			24	
		V <sub>CC</sub> = 5.5 V			24			24	
Δt/Δv	Input transition rise or fall rate		0		10	0		10	ns/V
T <sub>A</sub>	Operating free-air temperature		–55		125	–40		85	°C

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

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			54AC16374		74AC16374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = –50 μA	3 V	2.9			2.9		2.9		V
		4.5 V	4.4			4.4		4.4		
		5.5 V	5.4			5.4		5.4		
	I <sub>OH</sub> = –4 mA	3 V	2.58			2.48		2.48		
		4.5 V	3.94			3.8		3.8		
		5.5 V	4.94			4.8		4.8		
	I <sub>OH</sub> = –75 mA†	5.5 V				3.85		3.85		
V <sub>OL</sub>	I <sub>OL</sub> = 50 μA	3 V			0.1		0.1		0.1	V
		4.5 V			0.1		0.1		0.1	
		5.5 V			0.1		0.1		0.1	
	I <sub>OL</sub> = 12 mA	3 V			0.36		0.44		0.44	
		4.5 V			0.36		0.44		0.44	
		5.5 V			0.36		0.44		0.44	
	I <sub>OL</sub> = 75 mA†	5.5 V				1.65		1.65		
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V			±0.1		±1		±1	μA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5.5 V			±0.5		±5		±5	μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V			8		80		80	μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V			3					pF
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5 V			11					pF

† Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



**54AC16374, 74AC16374**  
**16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS**  
**WITH 3-STATE OUTPUTS**

SCAS123B – MARCH 1990 – REVISED APRIL 1996

**timing requirements over recommended operating free-air temperature range**  
 **$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)**

			$T_A = 25^\circ\text{C}$		54AC16374		74AC16374		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{clock}}$	Clock frequency		0	60	0	60	0	60	MHz
$t_w$	Pulse duration	CLK high or low	8.3		8.3		8.3		ns
$t_{\text{su}}$	Setup time, data before CLK $\uparrow$		7.5		7.5		7.5		ns
$t_h$	Hold time, data after CLK $\uparrow$		0		0		0		ns

**timing requirements over recommended operating free-air temperature range**  
 **$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)**

			$T_A = 25^\circ\text{C}$		54AC16374		74AC16374		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{clock}}$	Clock frequency		0	100	0	100	0	100	MHz
$t_w$	Pulse duration	CLK high or low	5		5		5		ns
$t_{\text{su}}$	Setup time, data before CLK $\uparrow$		5		5		5		ns
$t_h$	Hold time, data after CLK $\uparrow$		0		0		0		ns

**switching characteristics over recommended operating free-air temperature range**  
 **$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			54AC16374		74AC16374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			60			60		60		MHz
$t_{\text{PLH}}$	CLK	Q	4.9	12.2	15	4.9	17	4.9	17	ns
$t_{\text{PHL}}$			4.8	11.9	14.3	4.8	15.7	4.8	15.7	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	Q	4.3	11.9	14.7	4.3	16.8	4.3	16.8	ns
$t_{\text{PZL}}$			5.3	15.5	18.7	5.3	21.2	5.3	21.2	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	Q	4	7.3	9	4	9.8	4	9.8	ns
$t_{\text{PLZ}}$			3.8	7.1	8.8	3.8	9.4	3.8	9.4	

**switching characteristics over recommended operating free-air temperature range**  
 **$V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			54AC16374		74AC16374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			100			100		100		MHz
$t_{\text{PLH}}$	CLK	Q	3.8	7.6	9.5	3.8	10.8	3.8	10.8	ns
$t_{\text{PHL}}$			3.8	7.6	9.5	3.8	10.6	3.8	10.6	
$t_{\text{PZH}}$	$\overline{\text{OE}}$	Q	3.2	7.2	9	3.2	10.2	3.2	10.2	ns
$t_{\text{PZL}}$			3.8	8.7	10.7	3.8	12.1	3.8	12.1	
$t_{\text{PHZ}}$	$\overline{\text{OE}}$	Q	3.7	6	7.5	3.7	8.2	3.7	8.2	ns
$t_{\text{PLZ}}$			3.5	5.8	7.3	3.5	7.9	3.5	7.9	

**operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$**

PARAMETER			TEST CONDITIONS		TYP	UNIT
$C_{\text{pd}}$	Power dissipation capacitance per flip-flop		$C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$		49	pF
					32	

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

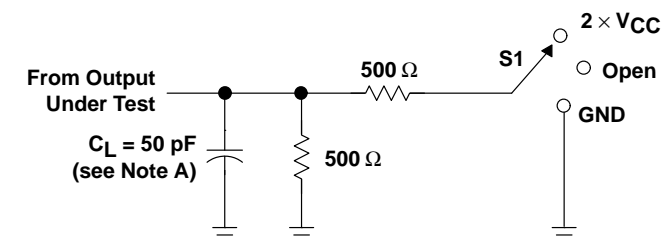
# 54AC16374, 74AC16374

## 16-BIT EDGE-TRIGGERED D-TYPE FLIP-FLOPS

### WITH 3-STATE OUTPUTS

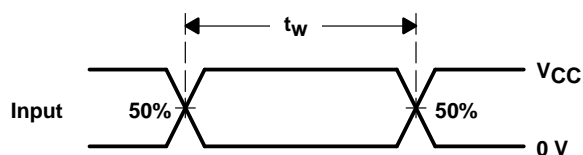
SCAS123B – MARCH 1990 – REVISED APRIL 1996

#### PARAMETER MEASUREMENT INFORMATION

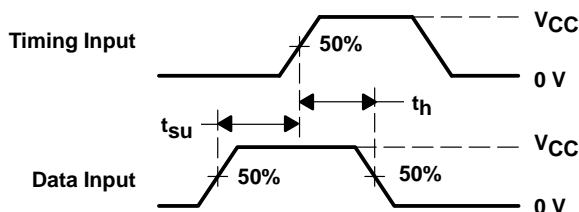


LOAD CIRCUIT

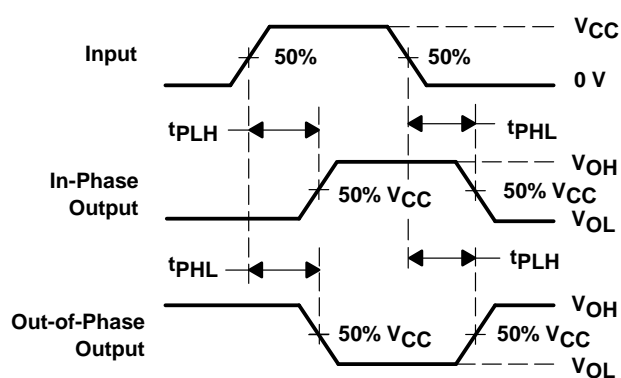
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	2 $\times V_{CC}$
$t_{PHZ}/t_{PZH}$	GND



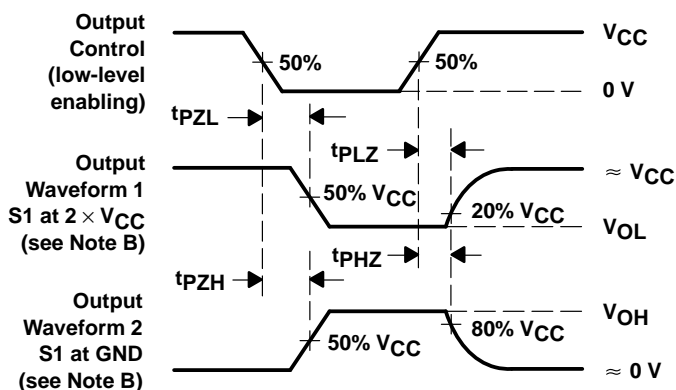
VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

- 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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 3 \text{ ns}$ ,  $t_f = 3 \text{ ns}$ .
  - D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

## **IMPORTANT NOTICE**

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

**TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.**

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.