

# SN54ALS374, SN54AS374, SN74ALS374A, SN74AS374 OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOPS WITH 3-STATE OUTPUTS

SDAS167A - APRIL 1982 - REVISED DECEMBER 1994

- D-Type Flip-Flops in a Single Package With 3-State Bus-Driving True Outputs
- Full Parallel Access for Loading
- Buffered Control Inputs
- Package Options Include Plastic Small-Outline (DW) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

These octal D-type edge-triggered 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.

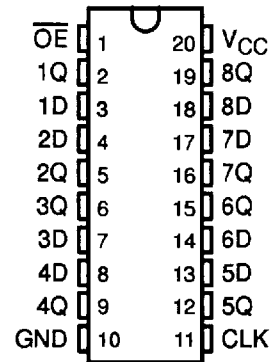
On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels set up at the data (D) inputs.

A buffered output-enable ( $\overline{OE}$ ) input places 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 the increased drive provide the capability to drive bus lines without interface or pullup components.

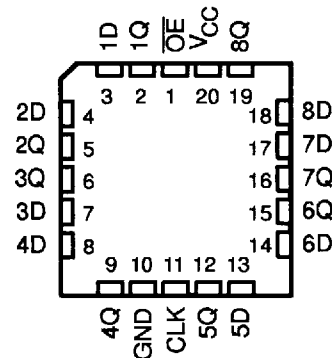
$\overline{OE}$  does not affect internal operations of the flip-flops. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The SN54ALS374 and SN54AS374 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS374A and SN74AS374 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN54ALS374, SN54AS374 . . . J PACKAGE  
SN74ALS374A, SN74AS374 . . . DW OR N PACKAGE  
(TOP VIEW)



SN54ALS374, SN54AS374 . . . FK PACKAGE  
(TOP VIEW)



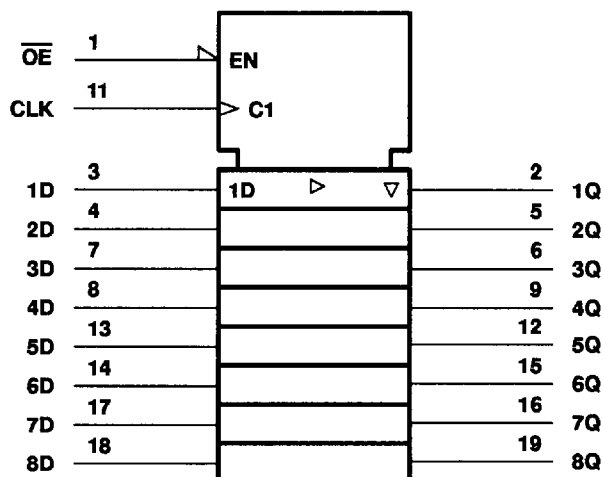
FUNCTION TABLE  
(each flip-flop)

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

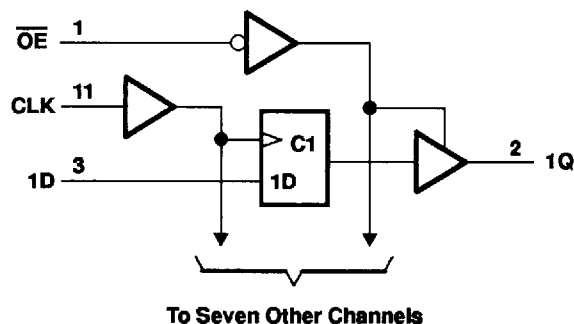
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## logic symbol†



## 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, $V_{CC}$	7 V
Input voltage, $V_I$	7 V
Voltage applied to a disabled 3-state output	5.5 V
Operating free-air temperature range, $T_A$ : SN54ALS374	-55°C to 125°C
SN74ALS374A	0°C to 70°C
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.

## recommended operating conditions

	SN54ALS374			SN74ALS374A			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$ Supply voltage	4.5	5	5.5	4.5	5	5.5	V
$V_{IH}$ High-level input voltage	2			2			V
$V_{IL}$ Low-level input voltage			0.7			0.8	V
$I_{OH}$ High-level output current			-1			-2.6	mA
$I_{OL}$ Low-level output current			12			24	mA
$f_{clock}$ Clock frequency	0		30	0		35	MHz
$t_w$ Pulse duration, CLK high or low	16.5			14			ns
$t_{su}$ Setup time, data before CLK $\uparrow$	10			10			ns
$t_h$ Hold time, data after CLK $\uparrow$	4			0			ns
$T_A$ Operating free-air temperature	-55		125	0		70	°C



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**WITH 3-STATE OUTPUTS**

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

PARAMETER	TEST CONDITIONS		SN54ALS374		SN74ALS374A		UNIT	
			MIN	TYP†	MAX	MIN		TYP†
$V_{IK}$	$V_{CC} = 4.5 V$ ,	$I_I = -18 mA$			-1.5		-1.5	V
$V_{OH}$	$V_{CC} = 4.5 V$ to $5.5 V$ ,	$I_{OH} = -0.4 mA$	$V_{CC} - 2$		$V_{CC} - 2$		V	
		$I_{OH} = -1 mA$	2.4	3.3				
	$I_{OH} = -2.6 mA$			2.4	3.2			
$V_{OL}$	$V_{CC} = 4.5 V$	$I_{OL} = 12 mA$	0.25	0.4	0.25	0.4	V	
		$I_{OL} = 24 mA$			0.35	0.5		
$I_{OZH}$	$V_{CC} = 5.5 V$ ,	$V_O = 2.7 V$			20		20	$\mu A$
$I_{OZL}$	$V_{CC} = 5.5 V$ ,	$V_O = 0.4 V$			-20		-20	$\mu A$
$I_I$	$V_{CC} = 5.5 V$ ,	$V_I = 7 V$			0.1		0.1	mA
$I_{IH}$	$V_{CC} = 5.5 V$ ,	$V_I = 2.7 V$			20		20	$\mu A$
$I_{IL}$	$V_{CC} = 5.5 V$ ,	$V_I = 0.4 V$			-0.2		-0.2	mA
$I_{O\ddagger}$	$V_{CC} = 5.5 V$ ,	$V_O = 2.25 V$	-20		-112	-30	-112	mA
$I_{CC}$	$V_{CC} = 5.5 V$	Outputs high		11	19		11	19
		Outputs low		19	28		19	28
		Outputs disabled		20	31		20	31

† All typical values are at  $V_{CC} = 5 V$ ,  $T_A = 25^\circ C$ .

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

switching characteristics (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 V$ to $5.5 V$ , $C_L = 50 pF$ , $R_1 = 500 \Omega$ , $R_2 = 500 \Omega$ , $T_A = MIN$ to $MAX$ §				UNIT
			SN54ALS374		SN74ALS374A		
			MIN	MAX	MIN	MAX	
$f_{max}$			30		35		MHz
$t_{PLH}$	CLK	Q	3	14	3	12	ns
$t_{PHL}$			5	17	5	16	
$t_{PZH}$	$\overline{OE}$	Q	5	18	3	17	ns
$t_{PZL}$			6	21	5	18	
$t_{PHZ}$	$\overline{OE}$	Q	2	11	1	10	ns
$t_{PLZ}$			3	19	2	18	

§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



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**WITH 3-STATE OUTPUTS**

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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$	7 V
Voltage applied to a disabled 3-state output	5.5 V
Operating free-air temperature range, $T_A$ : SN54AS374	-55°C to 125°C
SN74AS374	0°C to 70°C
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.

**recommended operating conditions**

		SN54AS374			SN74AS374			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage			0.7			0.8	V
$I_{OH}$	High-level output current			-12			-15	mA
$I_{OL}$	Low-level output current			32			48	mA
$f_{clock}^*$	Clock frequency	0		100	0		125	MHz
$t_w^*$	Pulse duration	CLK high		5.5	4		ns	
		CLK low		3	3			
$t_{su}^*$	Setup time, data before CLK↑	3			2			ns
$t_h^*$	Hold time, data after CLK↑	3			2			ns
$T_A$	Operating free-air temperature	-55		125	0		70	°C

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.



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

PARAMETER	TEST CONDITIONS		SN54AS374			SN74AS374			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA		-1.2			-1.2			V
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = -2 mA		V <sub>CC</sub> - 2			V <sub>CC</sub> - 2			V
	V <sub>CC</sub> = 4.5 V	I <sub>OH</sub> = -12 mA	2.4	3.2					
		I <sub>OH</sub> = -15 mA				2.4	3.3		
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 32 mA	0.29	0.5					
		I <sub>OL</sub> = 48 mA				0.34	0.5		
I <sub>OZH</sub>	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 2.7 V	50			50			μA
I <sub>OZL</sub>	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 0.4 V	-50			-50			μA
I <sub>I</sub>	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 7 V	0.1			0.1			mA
I <sub>IH</sub>	V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 2.7 V	20			20			μA
I <sub>I(L)</sub>	OE, CLK	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V	-0.5			-0.5			mA
	Data		-3			-2			
I <sub>O‡</sub>	V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 2.25 V	-30	-112	-30	-112			mA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V	Outputs high	77	120	77	120			mA
		Outputs low	84	128	84	128			
		Outputs disabled	84	128	84	128			

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I<sub>OS</sub>.

### switching characteristics (see Figure 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>1</sub> = 500 Ω, R <sub>2</sub> = 500 Ω, T <sub>A</sub> = MIN to MAX§				UNIT
			SN54AS374		SN74AS374		
			MIN	MAX	MIN	MAX	
t <sub>max</sub> *			100		125	MHz	
t <sub>PLH</sub>	CLK	Q	3	11	3	8	ns
t <sub>PHL</sub>			4	11.5	4	9	
t <sub>PZH</sub>	$\overline{\text{OE}}$	Q	2	7	2	6	ns
t <sub>PZL</sub>			3	11	3	10	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	Q	2	10	2	6	ns
t <sub>PLZ</sub>			2	7	2	6	

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.

§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



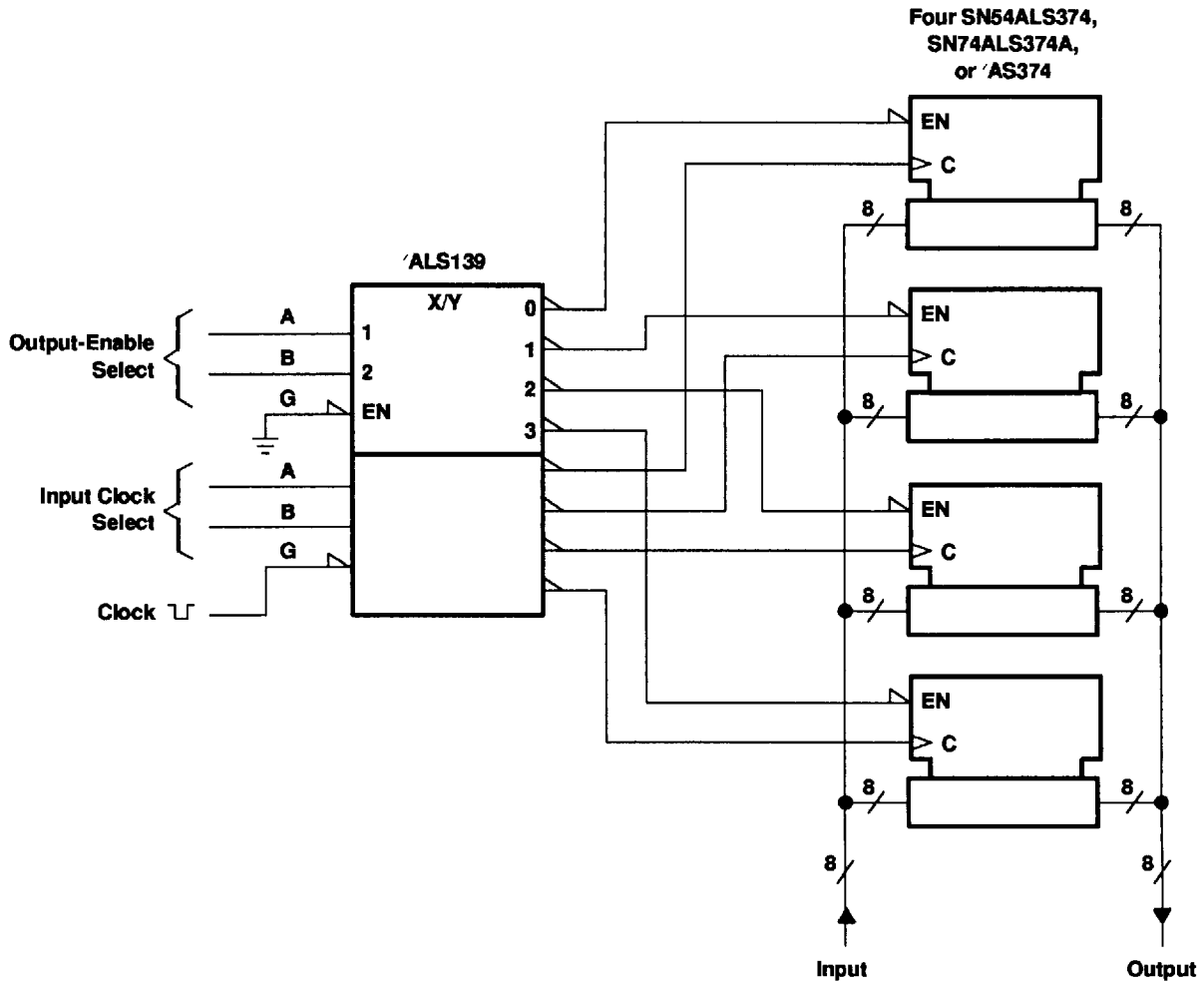
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**APPLICATION INFORMATION**

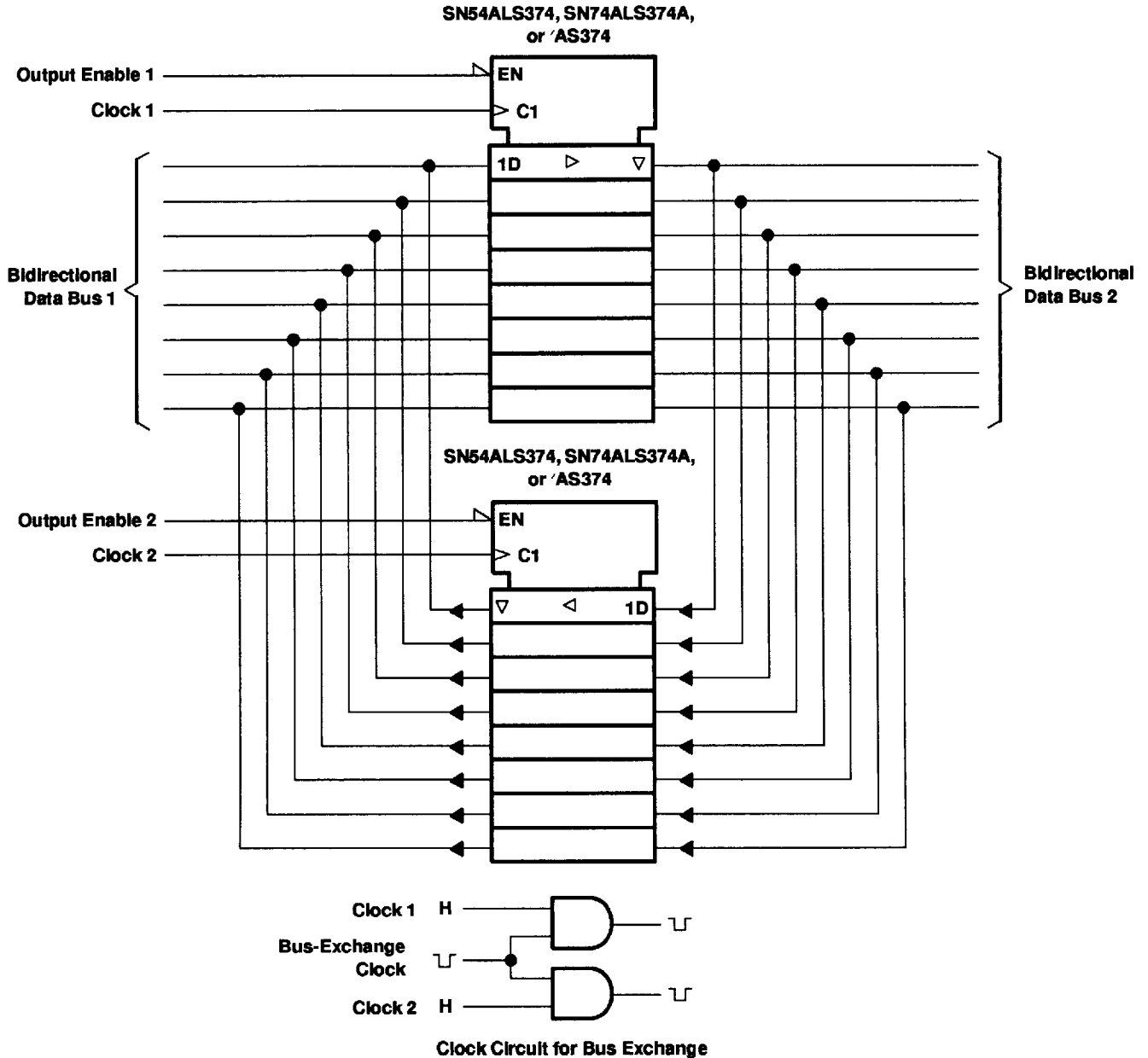


**Figure 1. Expandable 4-Word By 8-Bit General File Register**

# SN54ALS374, SN54AS374, SN74ALS374A, SN74AS374 OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOPS WITH 3-STATE OUTPUTS

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## APPLICATION INFORMATION

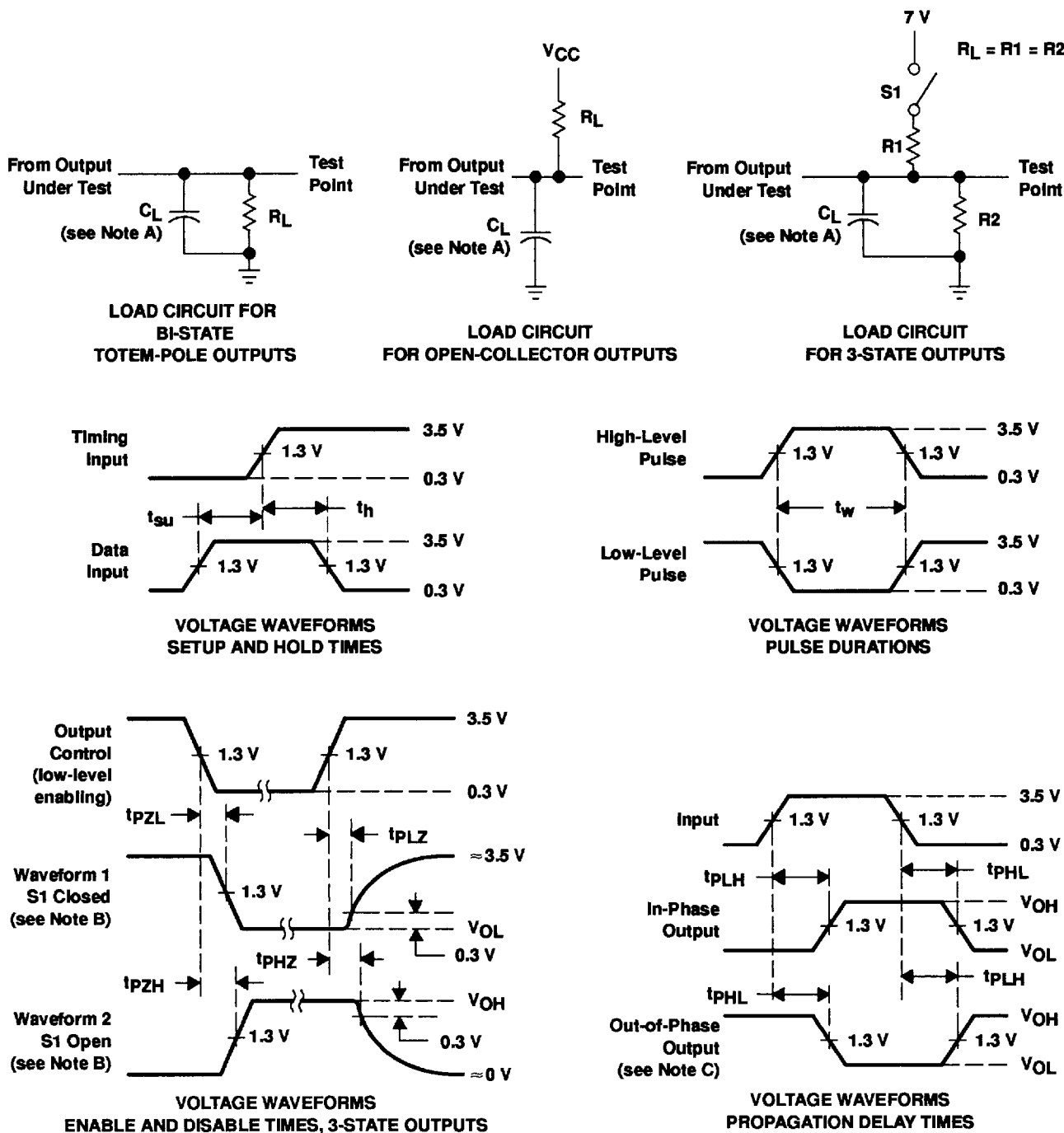


**Figure 2. Bidirectional Bus Driver**

# SN54ALS374, SN54AS374, SN74ALS374A, SN74AS374 OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOPS WITH 3-STATE OUTPUTS

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## PARAMETER MEASUREMENT INFORMATION SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
 D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
 E. The outputs are measured one at a time with one transition per measurement.

Figure 3. Load Circuits and Voltage Waveforms