

SN54173, SN54LS173A, SN74173, SN74LS173A

4-BIT D-TYPE REGISTERS

WITH 3-STATE OUTPUTS

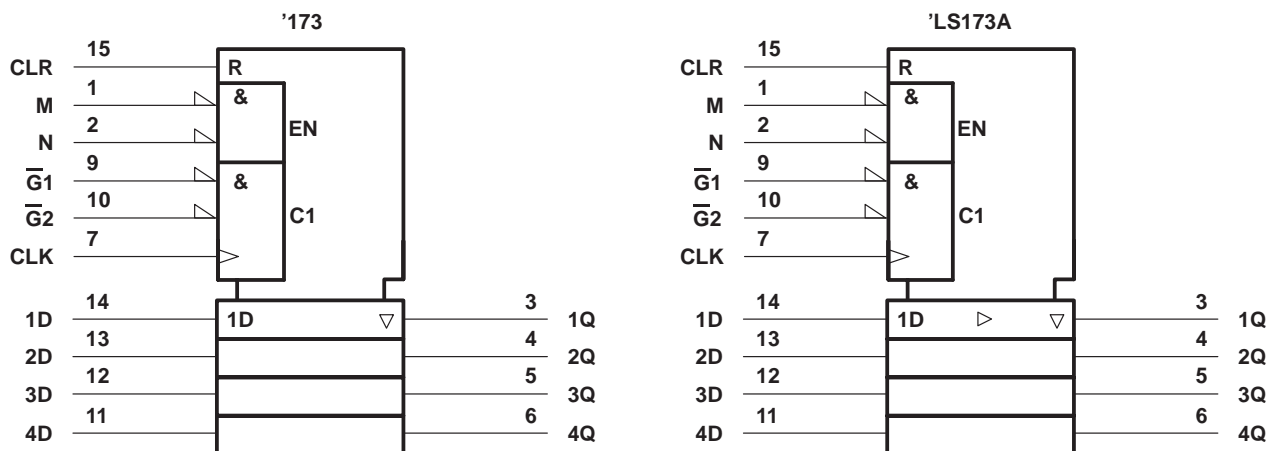
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FUNCTION TABLE

		INPUTS			OUTPUT Q
CLR	CLK	DATA ENABLE		DATA D	
		$\overline{G1}$	$\overline{G2}$		
H	X	X	X	X	L
L	L	X	X	X	Q_0
L	\uparrow	H	X	X	Q_0
L	\uparrow	X	H	X	Q_0
L	\uparrow	L	L	L	L
L	\uparrow	L	L	H	H

When either M or N (or both) is (are) high, the output is disabled to the high-impedance state; however, sequential operation of the flip-flops is not affected.

logic symbol†

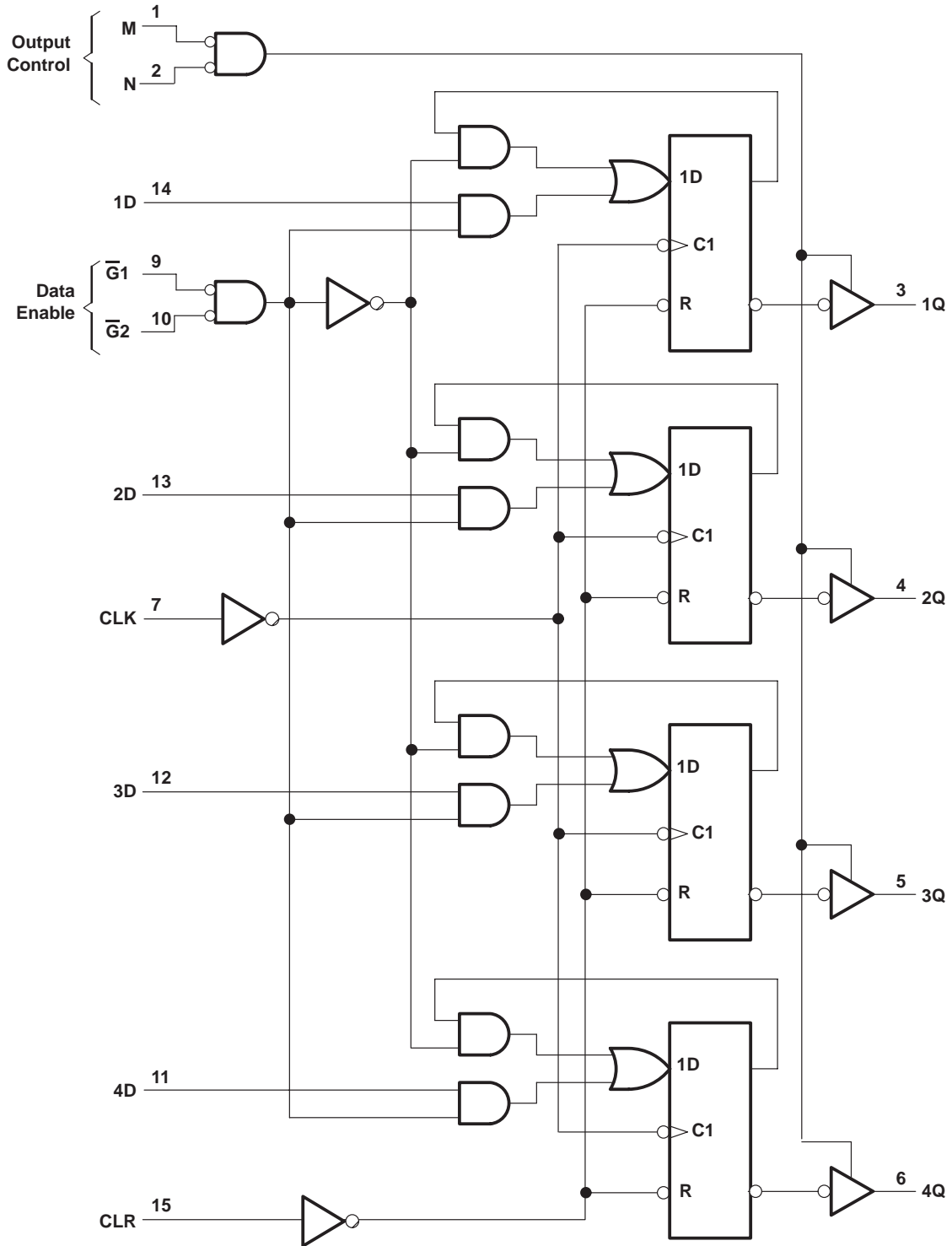


† This symbol is in accordance with ANSI/IEEE Standard 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

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logic diagram (positive logic)



Pin numbers shown are for D, J, N, and W packages.

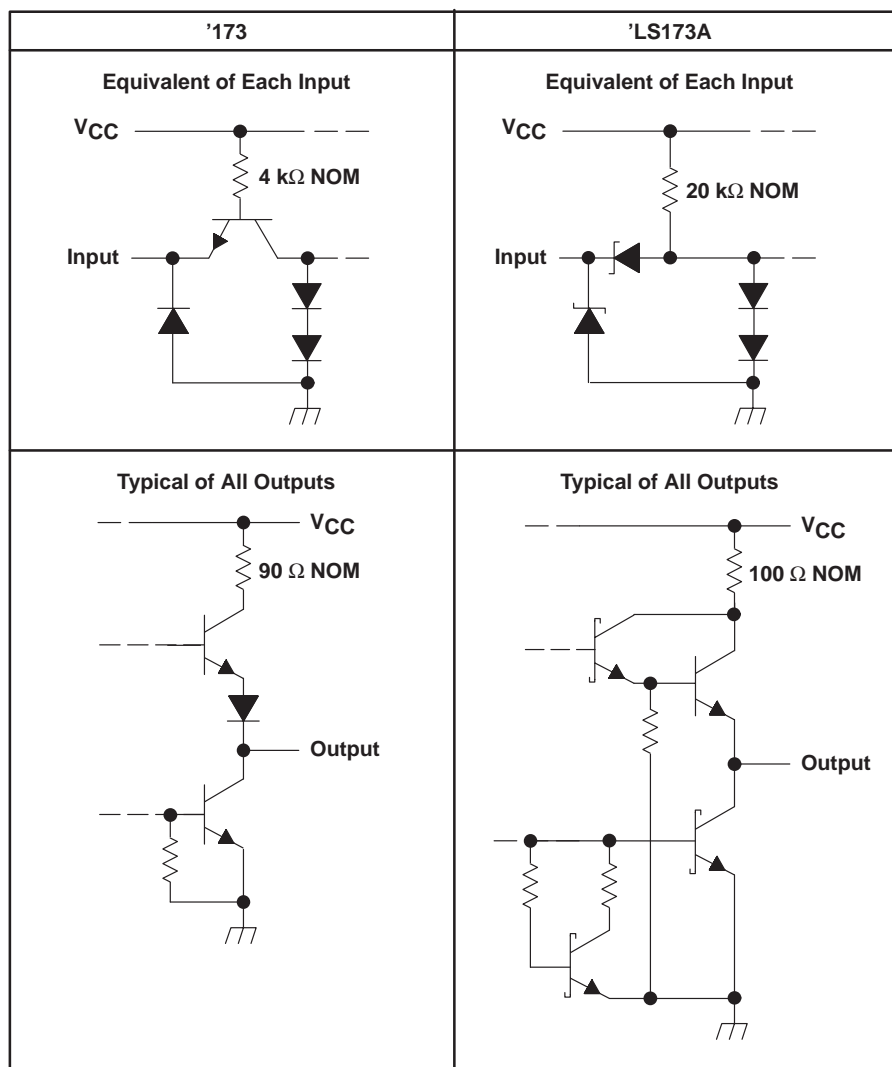
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4-BIT D-TYPE REGISTERS

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schematics of inputs and outputs



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

Supply voltage, V_{CC} (see Note 1)	–0.5 V to 7 V
Input voltage: '173	–0.5 V to 5.5 V
'LS173A	–0.5 V to 7 V
Off-state output voltage	–0.5 V to 5.5 V
Package thermal impedance, θ_{JA} (see Note 2): D package	113°C/W
N package	78°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. Voltage values are with respect to network ground terminal.

2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

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recommended operating conditions (see Note 3)

		SN54173			SN74173			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
I _{OH}	High-level output current			-2			-5.2	mA
I _{OL}	Low-level output current			16			16	mA
T _A	Operating free-air temperature	-55		125	0		70	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER	TEST CONDITIONS†	SN54173			SN74173			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IH}	High-level input voltage	2			2			V
V _{IL}	Low-level input voltage			0.8			0.8	V
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = -12 mA		-1.5			-1.5	V
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IL} = 0.8 V, V _{IH} = 2 V, I _{OH} = MAX		2.4			2.4	V
V _{OL}	Low-level output voltage	V _{CC} = MIN, V _{IL} = 0.8 V, V _{IH} = 2 V, I _{OL} = 16 mA					0.4	V
I _{O(off)}	Off-state (high-impedance state) output current	V _{CC} = MAX, V _{IH} = 2 V		V _O = 2.4 V		40		μA
				V _O = 0.4 V		-40		
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 5.5 V		1			1	mA
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.4 V		40			40	μA
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.4 V		-1.6			-1.6	mA
I _{OS}	Short-circuit output current§	V _{CC} = MAX		-30			-70	mA
I _{CC}	Supply current	V _{CC} = MAX, See Note 4		50	72	50	72	mA

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

‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

§ Not more than one output should be shorted at a time.

NOTE 4: I_{CC} is measured with all outputs open; CLR grounded, following momentary connection to 4.5 V, N, $\overline{G1}$, $\overline{G2}$, and all data inputs grounded; and CLK and M at 4.5 V.

timing requirements over recommended operating conditions (unless otherwise noted)

		SN54173		SN74173		UNIT
		MIN	MAX	MIN	MAX	
f _{clock}	Input clock frequency	25		25		MHz
t _w	Pulse duration	CLK or CLR		20	20	ns
t _{su}	Setup time	Data enable ($\overline{G1}$, $\overline{G2}$)		17	17	ns
		Data		10	10	
		CLR (inactive state)		10	10	
t _h	Hold time	Data enable ($\overline{G1}$, $\overline{G2}$)		2	2	ns
		Data		10	10	



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switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 400\ \Omega$ (see Figure 1)

PARAMETER	TEST CONDITIONS	SN54173			SN74173			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
f_{max}	Maximum clock frequency	25	35		25	35		MHz
t_{PHL}	Propagation delay time, high-to-low-level output from clear input		18	27		18	27	ns
t_{PLH}	Propagation delay time, low-to-high-level output from clock input		28	43		28	43	ns
t_{PHL}	Propagation delay time, high-to-low-level output from clock input		19	31		19	31	
t_{PZH}	Output enable time to high level	7	16	30	7	16	30	ns
t_{PZL}	Output enable time to low level	7	21	30	7	21	30	
t_{PHZ}	Output disable time from high level	3	5	14	3	5	14	ns
t_{PLZ}	Output disable time from low level	3	11	20	3	11	20	



SN54173, SN54LS173A, SN74173, SN74LS173A 4-BIT D-TYPE REGISTERS WITH 3-STATE OUTPUTS

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recommended operating conditions

		SN54LS173A			SN74LS173A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
I _{OH}	High-level output current			-1			-2.6	mA
I _{OL}	Low-level output current			12			24	mA
T _A	Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	SN54LS173A			SN74LS173A			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	UNIT
V _{IH}	High-level input voltage	2			2			V
V _{IL}	Low-level input voltage	0.7			0.8			V
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = -18 mA		-1.5	-1.5		V	
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IL} = V _{ILmax} , V _{IH} = 2 V, I _{OH} = MAX		2.4	3.4	2.4	3.1	V
V _{OL}	Low-level output voltage	V _{CC} = MIN, V _{IL} = 0.8 V, I _{OL} = 12 mA		0.25	0.4	0.25	0.4	V
		I _{OL} = 24 mA				0.35	0.5	V
I _{O(off)}	Off-state (high-impedance state) output current	V _{CC} = MAX, V _{IH} = 2 V, V _O = 2.7 V		20		20		V
		V _O = 0.4 V		-20		-20		
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 7 V		0.1		0.1		mA
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.7 V		20		20		μA
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.4 V		-0.4		-0.4		mA
I _{OS}	Short-circuit output current§	V _{CC} = MAX		-30	-130	-30	-130	mA
I _{CC}	Supply current	V _{CC} = MAX, See Note 4		19	30	19	24	mA

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

‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

§ Not more than one output should be shorted at a time.

NOTE 4: I_{CC} is measured with all outputs open; CLR grounded, following momentary connection to 4.5 V, N, $\overline{G1}$, $\overline{G2}$, and all data inputs grounded; and CLK and M at 4.5 V.

timing requirements over recommended operating conditions (unless otherwise noted)

		SN54LS173A		SN74LS173A		UNIT
		MIN	MAX	MIN	MAX	
f _{clock}	Input clock frequency	30		25		MHz
t _w	Pulse duration	CLK or CLR		25	25	ns
t _{su}	Setup time	Data enable ($\overline{G1}$, $\overline{G2}$)		35	35	ns
		Data		17	17	
		CLR (inactive state)		10	10	
t _h	Hold time	Data enable ($\overline{G1}$, $\overline{G2}$)		0	0	ns
		Data		3	3	



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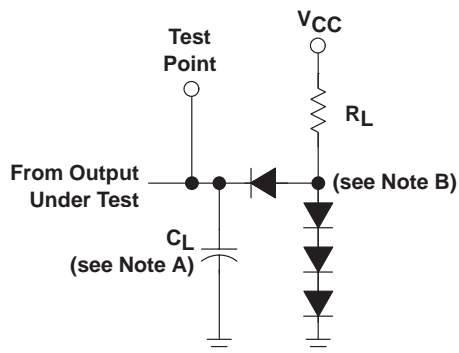
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switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, $R_L = 667\ \Omega$ (see Figure 2)

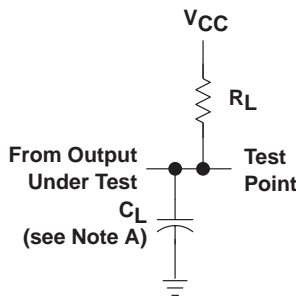
PARAMETER		TEST CONDITIONS	SN54LS173A			SN74LS173A			UNIT	
			MIN	TYP	MAX	MIN	TYP	MAX		
f_{max}	Maximum clock frequency	$C_L = 45\text{ pF}$	30	50		30	50		MHz	
t_{PHL}	Propagation delay time, high-to-low-level output from clear input			26	35		26	35		ns
t_{PLH}	Propagation delay time, low-to-high-level output from clock input			17	25		17	25		ns
t_{PHL}	Propagation delay time, high-to-low-level output from clock input			22	30		22	30		
t_{PZH}	Output enable time to high level			15	23		15	23		ns
t_{PZL}	Output enable time to low level			18	27		18	27		
t_{PHZ}	Output disable time from high level	$C_L = 5\text{ pF}$		11	20		11	20	ns	
t_{PLZ}	Output disable time from low level			11	17		11	17		



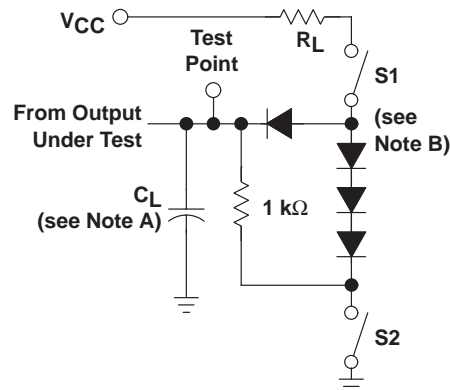
PARAMETER MEASUREMENT INFORMATION
SERIES 54/74 AND 54S/74S DEVICES



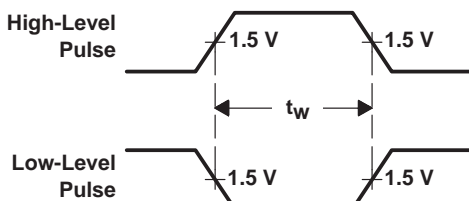
LOAD CIRCUIT
FOR 2-STATE TOTEM-POLE OUTPUTS



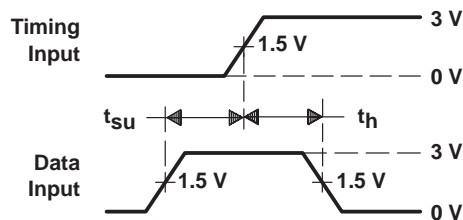
LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS



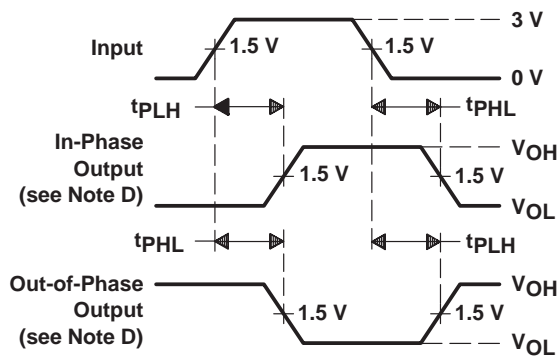
LOAD CIRCUIT
FOR 3-STATE OUTPUTS



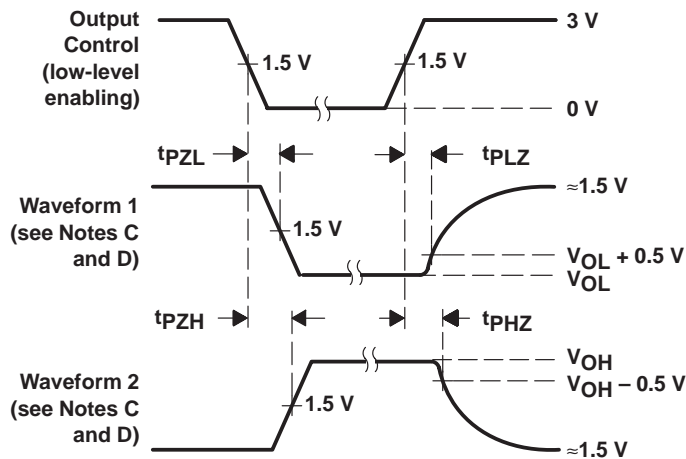
VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

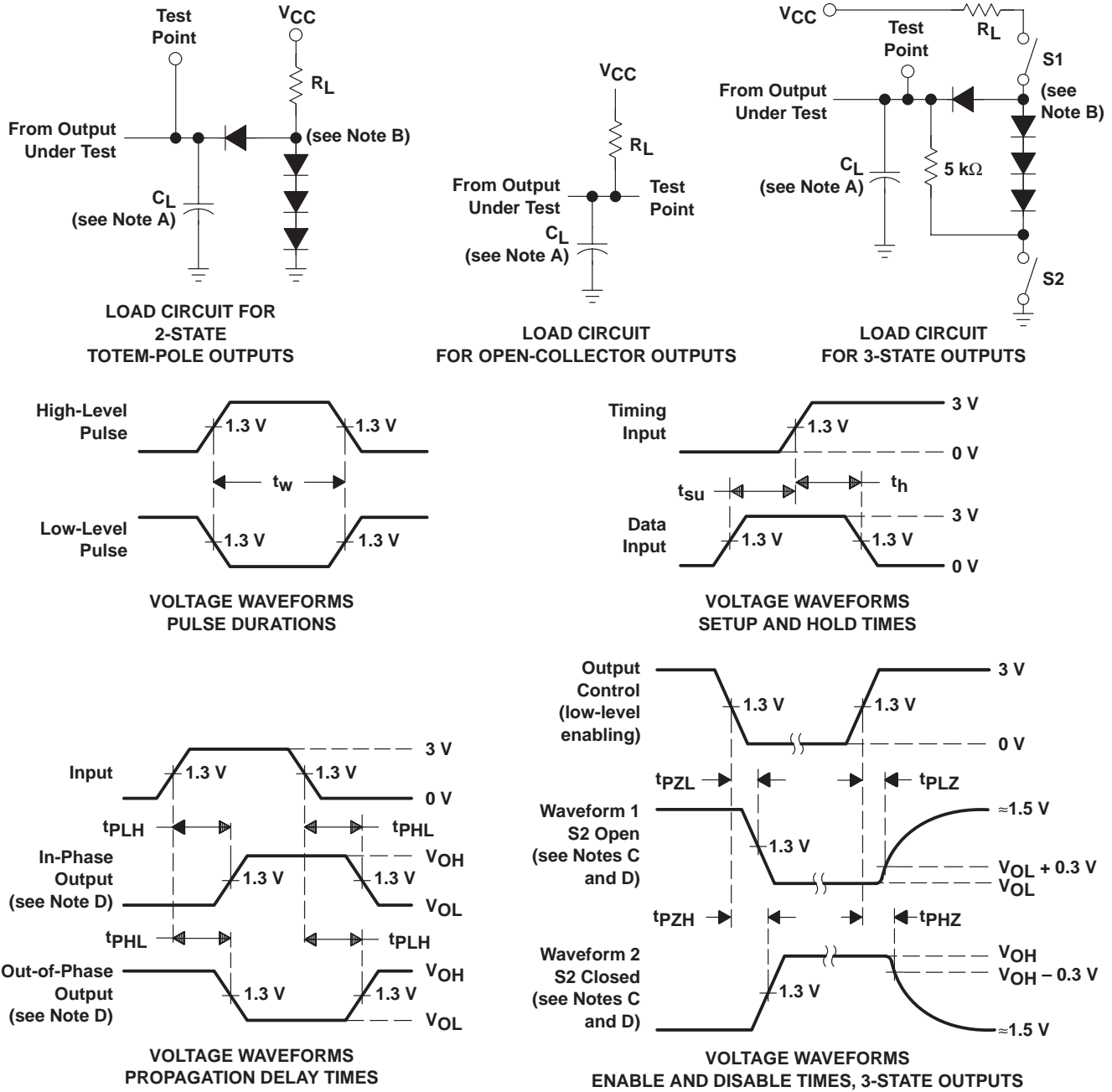
- NOTES: A. C_L includes probe and jig capacitance.
B. All diodes are 1N3064 or equivalent.
C. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
D. S1 and S2 are closed for t_{PLH} , t_{PHL} , t_{PHZ} , and t_{PLZ} ; S1 is open and S2 is closed for t_{PZH} ; S1 is closed and S2 is open for t_{PZL} .
E. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1$ MHz, $Z_O \approx 50 \Omega$, t_r and $t_f \leq 7$ ns for Series 54/74 devices and t_r and $t_f \leq 2.5$ ns for Series 54S/74S devices.
F. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

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PARAMETER MEASUREMENT INFORMATION
SERIES 54LS/74LS DEVICES



- NOTES: A. C_L includes probe and jig capacitance.
 B. All diodes are 1N3064 or equivalent.
 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. S1 and S2 are closed for t_{PLH} , t_{PHL} , t_{PHZ} , and t_{PLZ} ; S1 is open and S2 is closed for t_{PZH} ; S1 is closed and S2 is open for t_{PZL} .
 E. Phase relationships between inputs and outputs have been chosen arbitrarily for these examples.
 F. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1$ MHz, $Z_O \approx 50 \Omega$, $t_r \leq 15$ ns, $t_f \leq 6$ ns.
 G. The outputs are measured one at a time with one input transition per measurement.

Figure 2. Load Circuits and Voltage Waveforms

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