The SN54165 and SN74165 devices are obsolete and are no longer supplied.

SDLS062D – OCTOBER 1976 – REVISED FEBRUARY 2002

- **Complementary Outputs**
- **Direct Overriding Load (Data) Inputs**
- **Gated Clock Inputs**
- **Parallel-to-Serial Data Conversion**

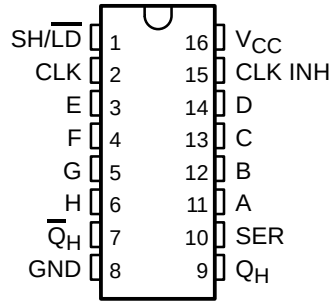
TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
’165	26 MHz	210 mW
’LS165A	35 MHz	90 mW

description

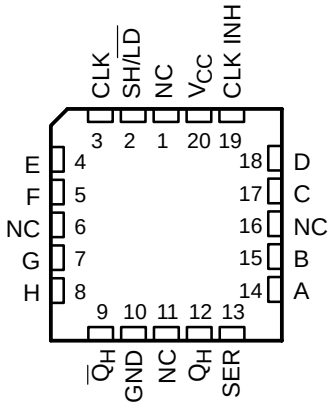
The ’165 and ’LS165A are 8-bit serial shift registers that shift the data in the direction of Q_A toward Q_H when clocked. Parallel-in access to each stage is made available by eight individual, direct data inputs that are enabled by a low level at the shift/load (SH/$\overline{LD}$) input. These registers also feature gated clock (CLK) inputs and complementary outputs from the eighth bit. All inputs are diode-clamped to minimize transmission-line effects, thereby simplifying system design.

Clocking is accomplished through a two-input positive-NOR gate, permitting one input to be used as a clock-inhibit function. Holding either of the clock inputs high inhibits clocking, and holding either clock input low with SH/$\overline{LD}$ high enables the other clock input. Clock inhibit (CLK INH) should be changed to the high level only while CLK is high. Parallel loading is inhibited as long as SH/$\overline{LD}$ is high. Data at the parallel inputs are loaded directly into the register while SH/$\overline{LD}$ is low, independently of the levels of CLK, CLK INH, or serial (SER) inputs.

SN54165, SN54LS165A . . . J OR W PACKAGE
SN74165 . . . N PACKAGE
SN74LS165A . . . D, N, OR NS PACKAGE
(TOP VIEW)



SN54LS165A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

The SN54165 and SN74165 devices are obsolete and are no longer supplied.

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – N	Tube	SN74LS165AN	SN74LS165AN
	SOIC – D	Tube	SN74LS165AD	LS165A
		Tape and reel	SN74LS165ADR	
	SOP – NS	Tape and reel	SN74LS165ANSR	74LS165A
–55°C to 125°C	CDIP – J	Tube	SN54LS165AJ	SN54LS165AJ
		Tube	SNJ54LS165AJ	SNJ54LS165AJ
	CFP – W	Tube	SNJ54LS165AW	SNJ54LS165AW
	LCCC – FK	Tube	SNJ54LS165AFK	SNJ54LS165AFK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE

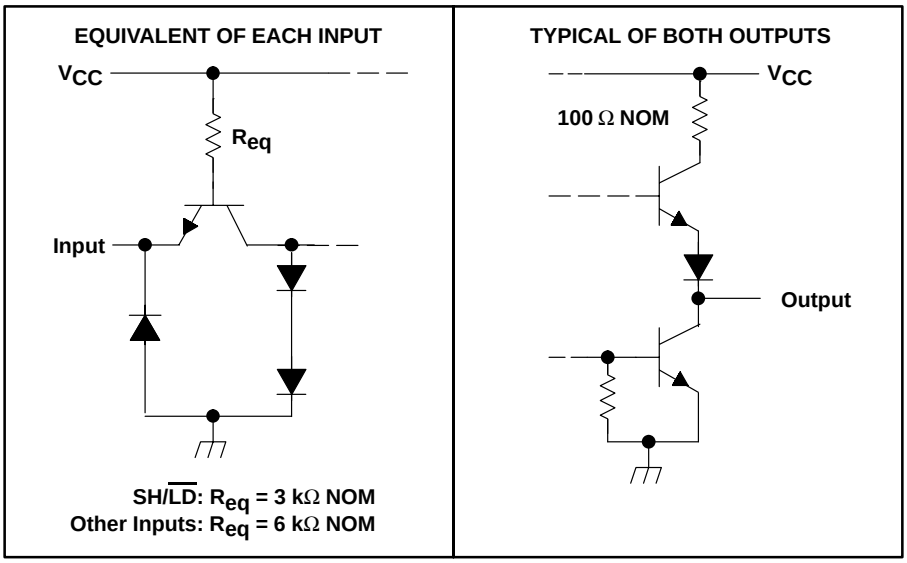
INPUTS					INTERNAL OUTPUTS		OUTPUT Q_H
SH/$\overline{LD}$	CLK INH	CLK	SER	PARALLEL A . . . H	$\overline{Q}_A$	$\overline{Q}_B$	
L	X	X	X	a . . . h	a	b	h
H	L	L	X	X	Q_{A0}	Q_{B0}	Q_{H0}
H	L	↑	H	X	H	Q_{An}	Q_{Gn}
H	L	↑	L	X	L	Q_{An}	Q_{Gn}
H	H	X	X	X	Q_{A0}	Q_{B0}	Q_{H0}

The SN54165 and SN74165 devices are obsolete and are no longer supplied.

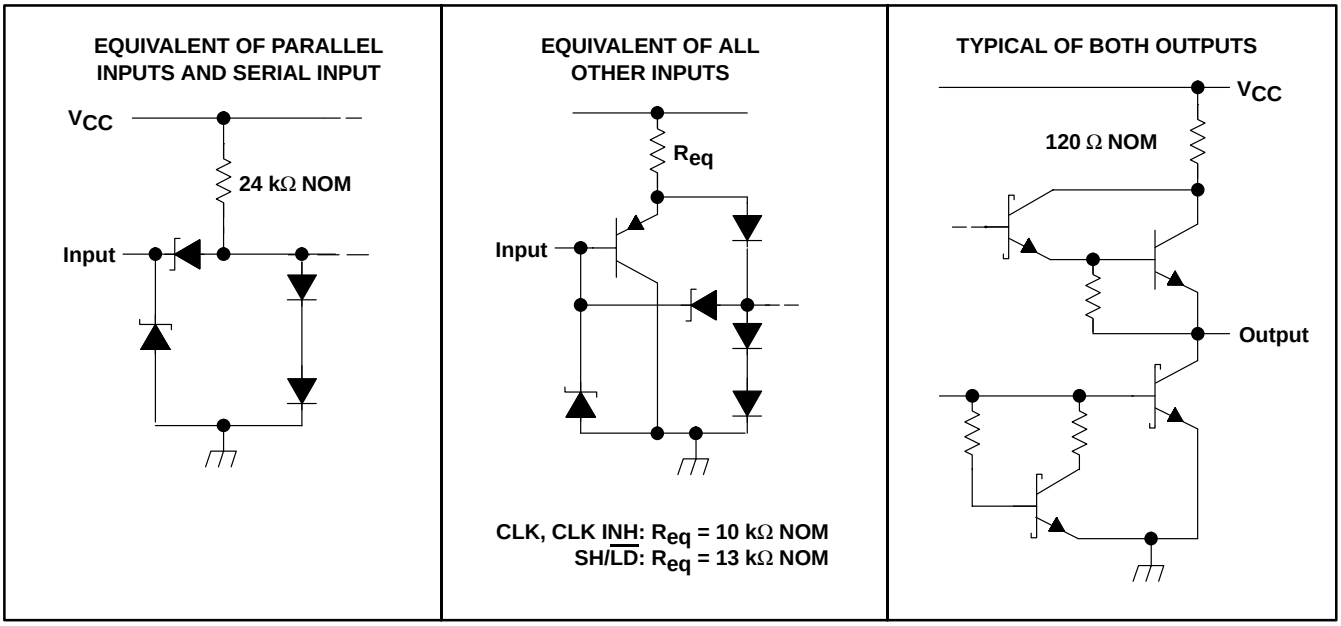
SDLS062D – OCTOBER 1976 – REVISED FEBRUARY 2002

schematics of inputs and outputs

'165

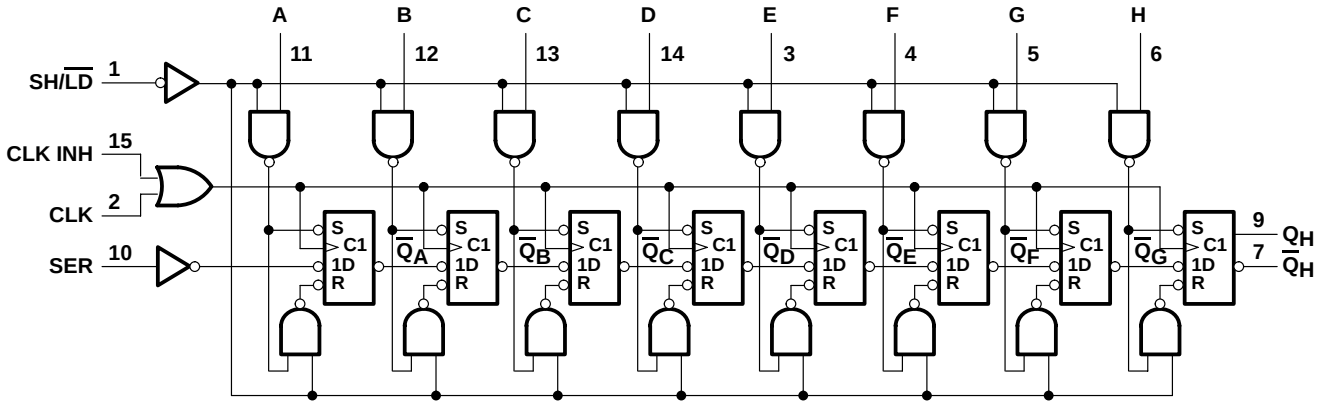


'LS165A



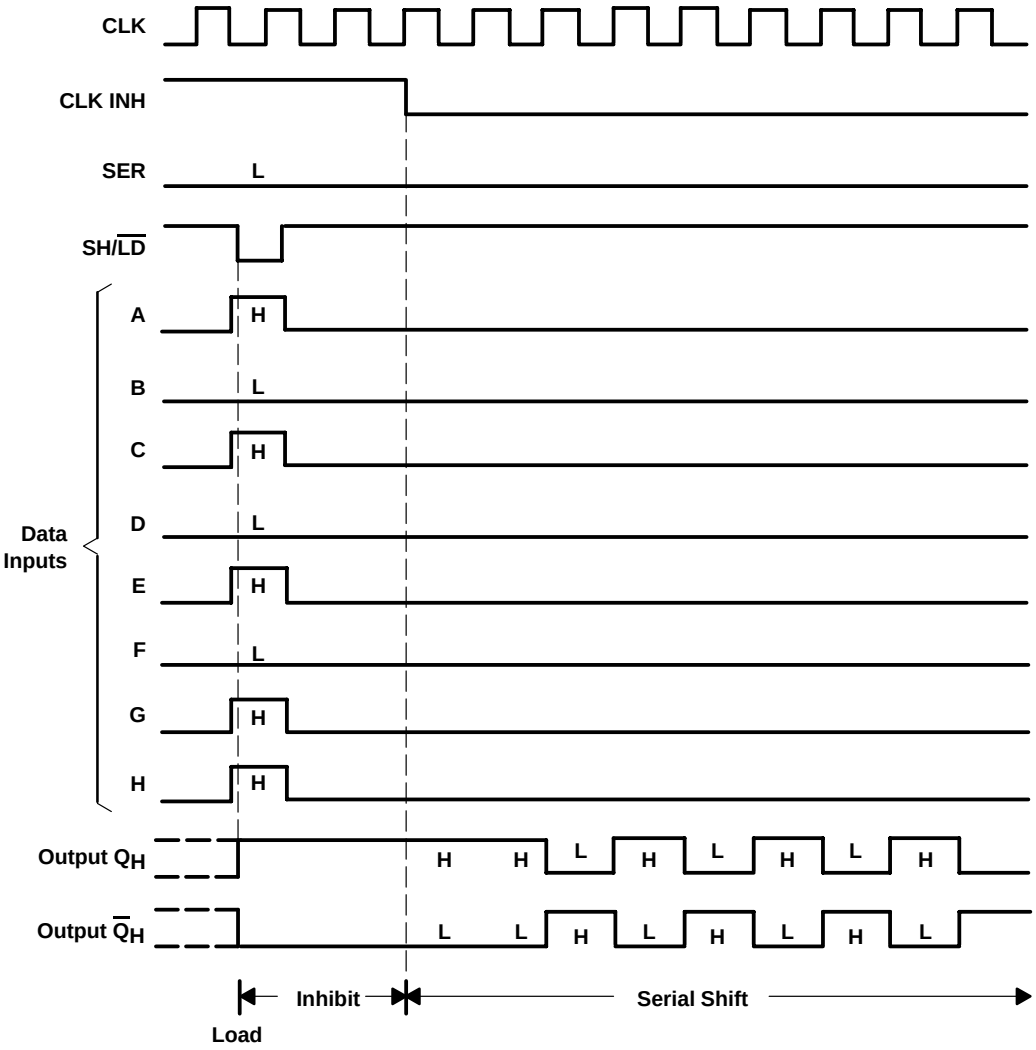
The SN54165 and SN74165 devices are obsolete and are no longer supplied.

logic diagram (positive logic)



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

typical shift, load, and inhibit sequences



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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage, V_I: SN54165, SN74165 . . . . . 5.5 V
SN54LS165A, SN74LS165A . . . . . 7 V
Interemitter voltage (see Note 2) . . . . . 5.5 V
Package thermal impedance θ_{JA} (see Note 3): D package . . . . . 73°C/W
N package . . . . . 67°C/W
NS package . . . . . 64°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, except interemitter voltage, are with respect to network ground terminal.
2. This is the voltage between two emitters of a multiple-emitter transistor. This rating applies for the '165 to the SH/$\overline{LD}$ input in conjunction with the CLK INH input.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

		SN54165			SN74165			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			–800			–800	μA
I_{OL}	Low-level output current			16			16	mA
f_{clock}	Clock frequency	0		20	0		20	MHz
$t_{w(clock)}$	Width of clock input pulse	25			25			ns
$t_{w(load)}$	Width of load input pulse	15			15			ns
t_{su}	Clock-enable setup time (see Figure 1)	30			30			ns
t_{su}	Parallel input setup time (see Figure 1)	10			10			ns
t_{su}	Serial input setup time (see Figure 1)	20			20			ns
t_{su}	Shift setup time (see Figure 1)	45			45			ns
t_h	Hold time at any input	0			0			ns
T_A	Operating free-air temperature	–55		125	0		70	°C

The SN54165 and SN74165 devices are obsolete and are no longer supplied.

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

PARAMETER			TEST CONDITIONS†	SN54165			SN74165			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_{IH} = 2 V, V_{IL} = 0.8 V, I_{OH} = –800 μA	2.4	3.4		2.4	3.4		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = 16 mA		0.2	0.4		0.2	0.4	V
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	SH/$\overline{LD}$	V_{CC} = MAX, V_I = 2.4 V			80			80	μA
		Other inputs				40			40	
I_{IL}	Low-level input current	SH/$\overline{LD}$	V_{CC} = MAX, V_I = 0.4 V			–3.2			–3.2	mA
		Other inputs				–1.6			–1.6	
I_{OS}	Short-circuit output current§		V_{CC} = MAX	–20		–55	–18		–55	mA
I_{CC}	Supply current		V_{CC} = MAX, See Note 4		42	63		42	63	mA

NOTE 4: With the outputs open, CLK INH and CLK at 4.5 V, and a clock pulse applied to SH/$\overline{LD}$, I_{CC} is measured first with the parallel inputs at 4.5 V, then with the parallel inputs grounded.

† For conditions shown as MIN or MAX, use the appropriate values 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.

SN54165 and SN74165 switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Figure 1)

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}				20	26		MHz
t_{PLH}	$\overline{LD}$	Any	C_L = 15 pF, R_L = 400 Ω		21	31	ns
t_{PHL}					27	40	
t_{PLH}	CLK	Any	C_L = 15 pF, R_L = 400 Ω		16	24	ns
t_{PHL}					21	31	
t_{PLH}	H	Q_H	C_L = 15 pF, R_L = 400 Ω		11	17	ns
t_{PHL}					24	36	
t_{PLH}	H	$\overline{Q}_H$	C_L = 15 pF, R_L = 400 Ω		18	27	ns
t_{PHL}					18	27	

¶ f_{max} = maximum clock frequency, t_{PLH} = propagation delay time, low-to-high-level output, t_{PHL} = propagation delay time, high-to-low-level output

The SN54165 and SN74165 devices are obsolete and are no longer supplied.

recommended operating conditions

			SN54LS165A			SN74LS165A			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	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				–0.4			–0.4	mA
I_{OL}	Low-level output current				4			8	mA
f_{clock}	Clock frequency		0		25	0		25	MHz
$t_{w(clock)}$	Width of clock input pulse (see Figure 2)	Clock high	15			15			ns
		Clock low	25			25			
$t_{w(load)}$	Width of load input pulse	Clock high	25			25			ns
		Clock low	17			17			
t_{su}	Clock-enable setup time (see Figure 2)		30			30			ns
t_{su}	Parallel input setup time (see Figure 2)		10			10			ns
t_{su}	Serial input setup time (see Figure 2)		20			20			ns
t_{su}	Shift setup time (see Figure 2)		45			45			ns
t_h	Hold time at any input		0			0			ns
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†			SN54LS165A			SN74LS165A			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}	V_{CC} = MIN, I_I = –18 mA					–1.5			–1.5	V
V_{OH}	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX,		I_{OH} = –0.4 mA	2.5	3.5		2.7	3.5		V
V_{OL}	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX		I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
			I_{OL} = 8 mA					0.35	0.5	
I_I	V_{CC} = MAX, V_I = 7 V					0.1			0.1	mA
I_{IH}	V_{CC} = MAX, V_I = 2.7 V					20			20	µA
I_{IL}	V_{CC} = MAX, V_I = 0.4 V					–0.4			–0.4	mA
I_{OS}§	V_{CC} = MAX			–20		–100	–20		–100	mA
I_{CC}	V_{CC} = MAX, See Note 4				18	30		18	30	mA

NOTE 4. With the outputs open, CLK INH and CLK at 4.5 V, and a clock pulse applied to SH/$\overline{LD}$, I_{CC} is measured first with the parallel inputs at 4.5 V, then with the parallel inputs grounded.

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

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

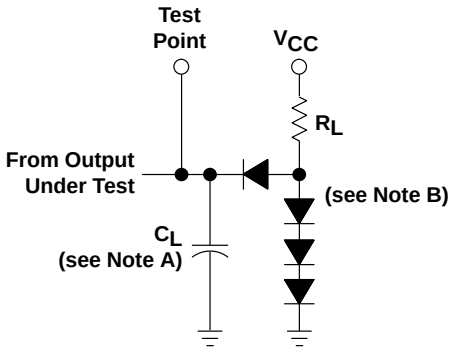
§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

SN54LS165A and SN74LS165A switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Figure 2)

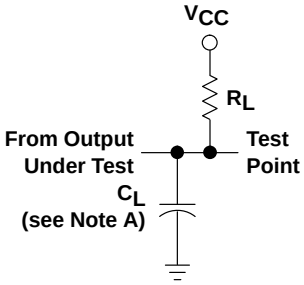
PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}				25	35		MHz
t_{PLH}	$\overline{LD}$	Any	R_L = 2 kΩ, C_L = 15 pF		21	35	ns
t_{PHL}					26	35	
t_{PLH}	CLK	Any	R_L = 2 kΩ, C_L = 15 pF		14	25	ns
t_{PHL}					16	25	
t_{PLH}	H	Q_H	R_L = 2 kΩ, C_L = 15 pF		13	25	ns
t_{PHL}					24	30	
t_{PLH}	H	$\overline{Q}_H$	R_L = 2 kΩ, C_L = 15 pF		19	30	ns
t_{PHL}					17	25	

† f_{max} = maximum clock frequency, t_{PLH} = propagation delay time, low-to-high-level output, t_{PHL} = propagation delay time, high-to-low-level output

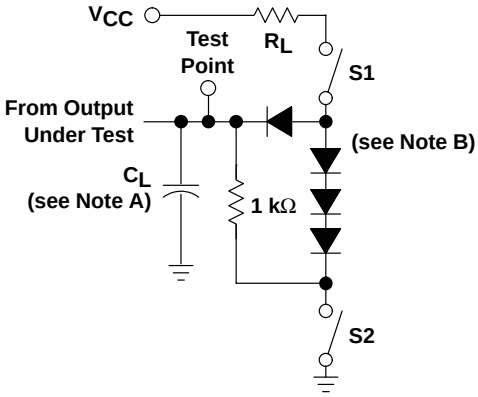
PARAMETER MEASUREMENT INFORMATION
SERIES 54/74 DEVICES



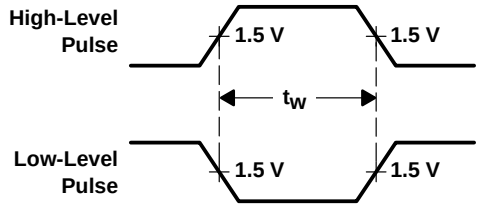
LOAD CIRCUIT FOR 2-STATE TOTEM-POLE OUTPUTS



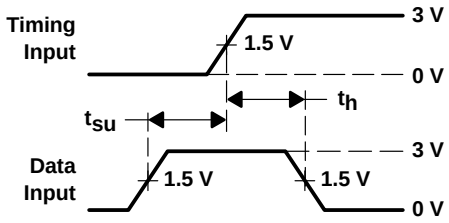
LOAD CIRCUIT FOR OPEN-COLLECTOR OUTPUTS



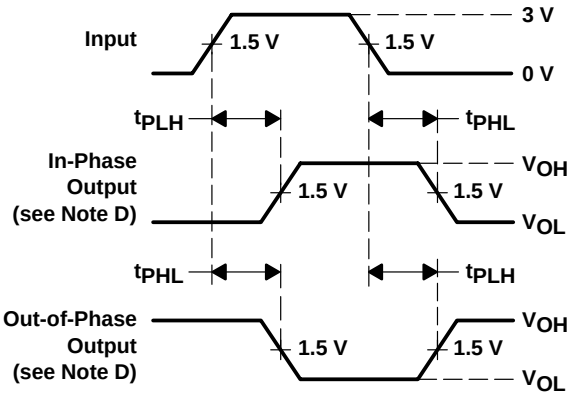
LOAD CIRCUIT FOR 3-STATE OUTPUTS



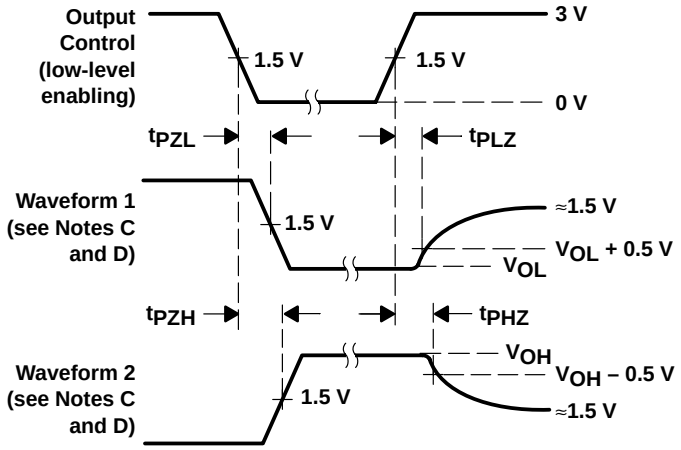
VOLTAGE WAVEFORMS PULSE DURATIONS



VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES

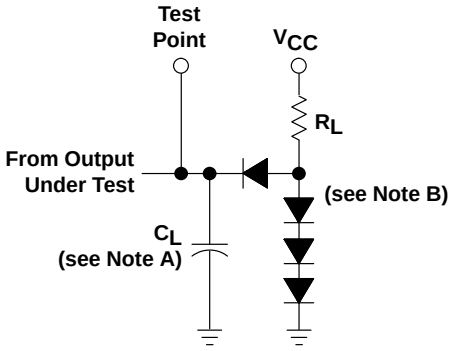


VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

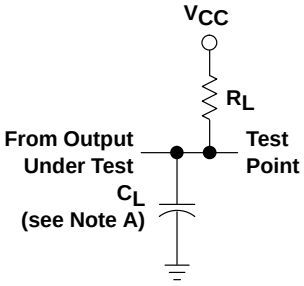
NOTES: A. C_L includes probe and jig capacitance.
B. All diodes are 1N3064 or equivalent.
C. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except 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 ≤ 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

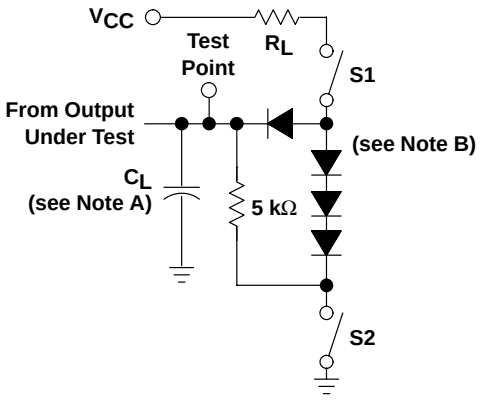
PARAMETER MEASUREMENT INFORMATION
SERIES 54LS/74LS DEVICES



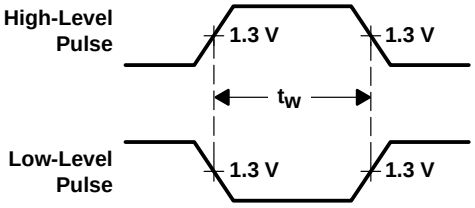
LOAD CIRCUIT FOR 2-STATE TOTEM-POLE OUTPUTS



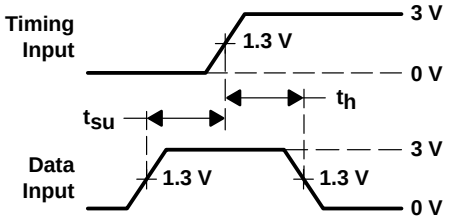
LOAD CIRCUIT FOR OPEN-COLLECTOR OUTPUTS



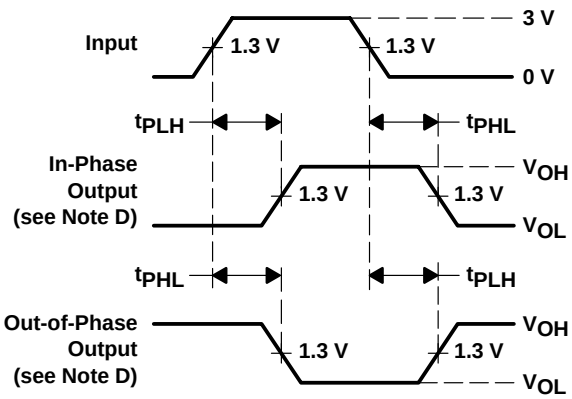
LOAD CIRCUIT FOR 3-STATE OUTPUTS



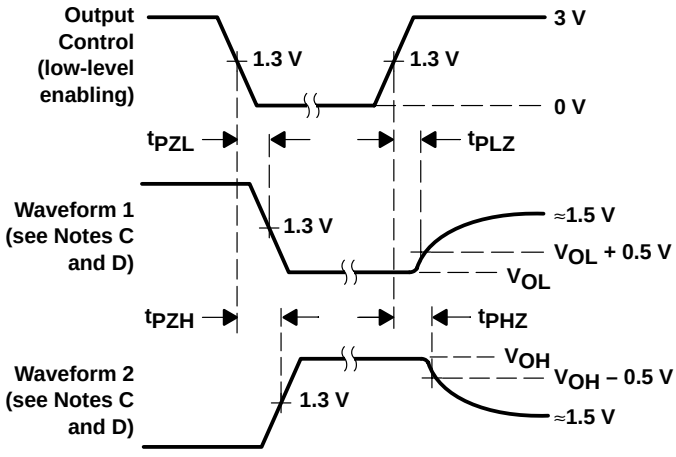
VOLTAGE WAVEFORMS PULSE DURATIONS



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. 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 ≤ 1 MHz, $Z_O \approx 50\ \Omega$, $t_r \le 1.5$ ns, $t_f \le 2.6$ 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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Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265