

# SN54165, SN54LS165A, SN74165, SN74LS165A PARALLEL-LOAD 8-BIT SHIFT REGISTERS

SDLS062D – OCTOBER 1976 – REVISED FEBRUARY 2002

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

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

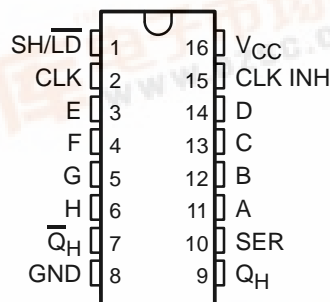
TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
'165	26 MHz	210 mW
'LS165A	35 MHz	90 mW

## description

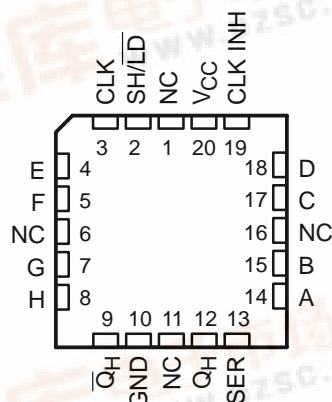
The '165 and 'LS165A are 8-bit serial shift registers that shift the data in the direction of  $Q_A$  toward  $Q_H$  when clocked. Parallel-in access to each stage is made available by eight individual, direct data inputs that are enabled by a low level at the shift/load ( $SH/\overline{LD}$ ) input. 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

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.

# SN54165, SN54LS165A, SN74165, SN74LS165A

## PARALLEL-LOAD 8-BIT SHIFT REGISTERS

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### ORDERING INFORMATION

T <sub>A</sub>	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](http://www.ti.com/sc/package).

### FUNCTION TABLE

INPUTS					INTERNAL OUTPUTS		OUTPUT Q <sub>H</sub>
SH/ $\overline{\text{LD}}$	CLK INH	CLK	SER	PARALLEL A . . . H	$\overline{\text{Q}}_{\text{A}}$	$\overline{\text{Q}}_{\text{B}}$	
L	X	X	X	a . . . h	a	b	h
H	L	L	X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>H0</sub>
H	L	↑	H	X	H	Q <sub>An</sub>	Q <sub>Gn</sub>
H	L	↑	L	X	L	Q <sub>An</sub>	Q <sub>Gn</sub>
H	H	X	X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>H0</sub>

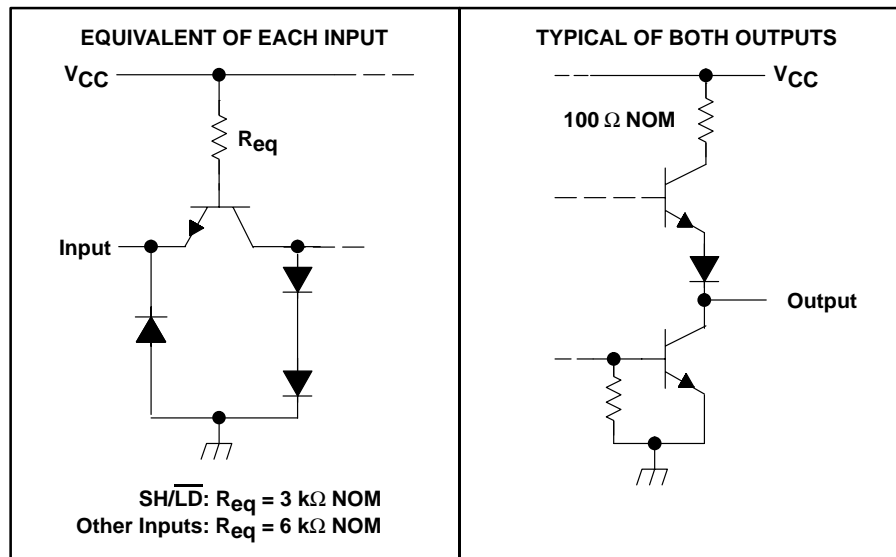
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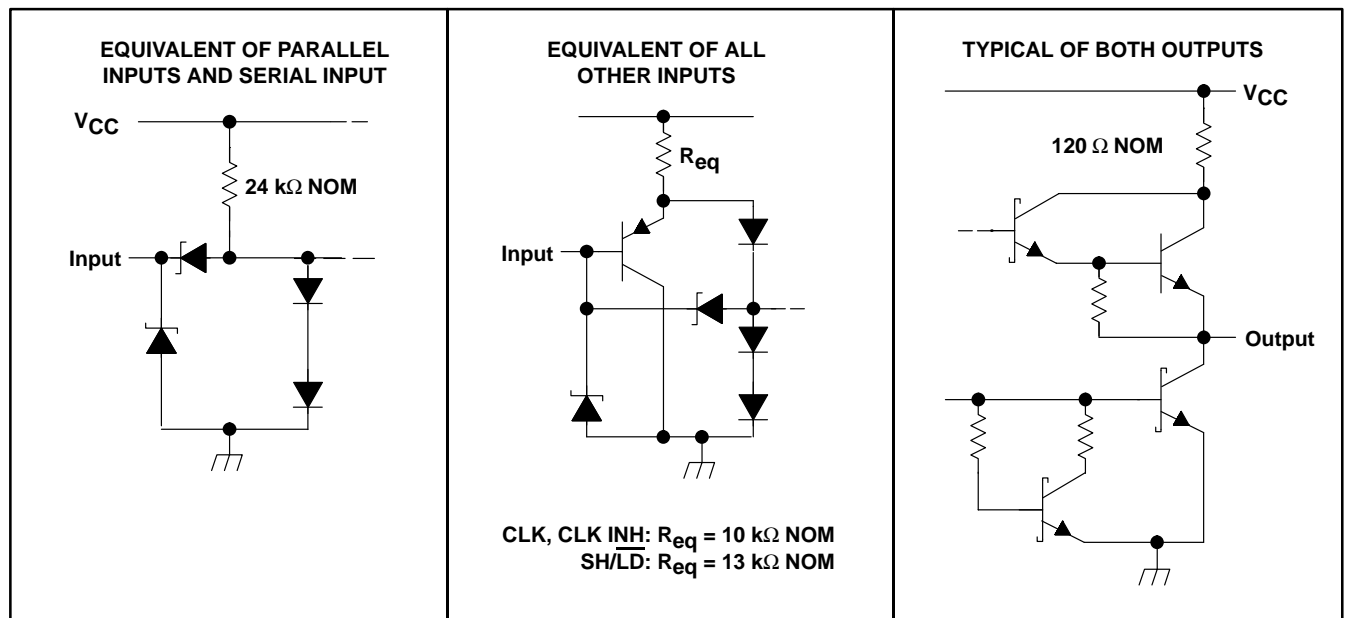
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## schematics of inputs and outputs

'165



'LS165A



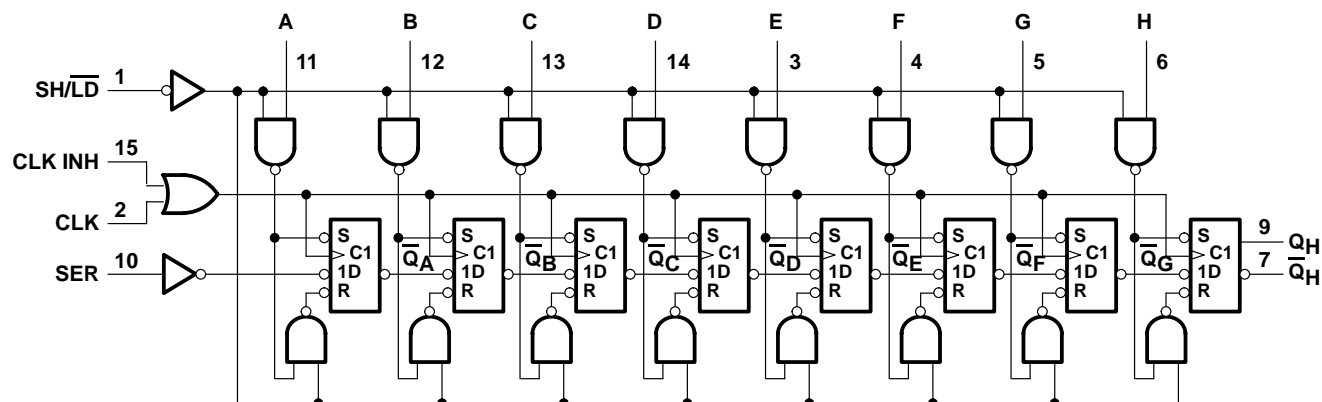
# SN54165, SN54LS165A, SN74165, SN74LS165A

## PARALLEL-LOAD 8-BIT SHIFT REGISTERS

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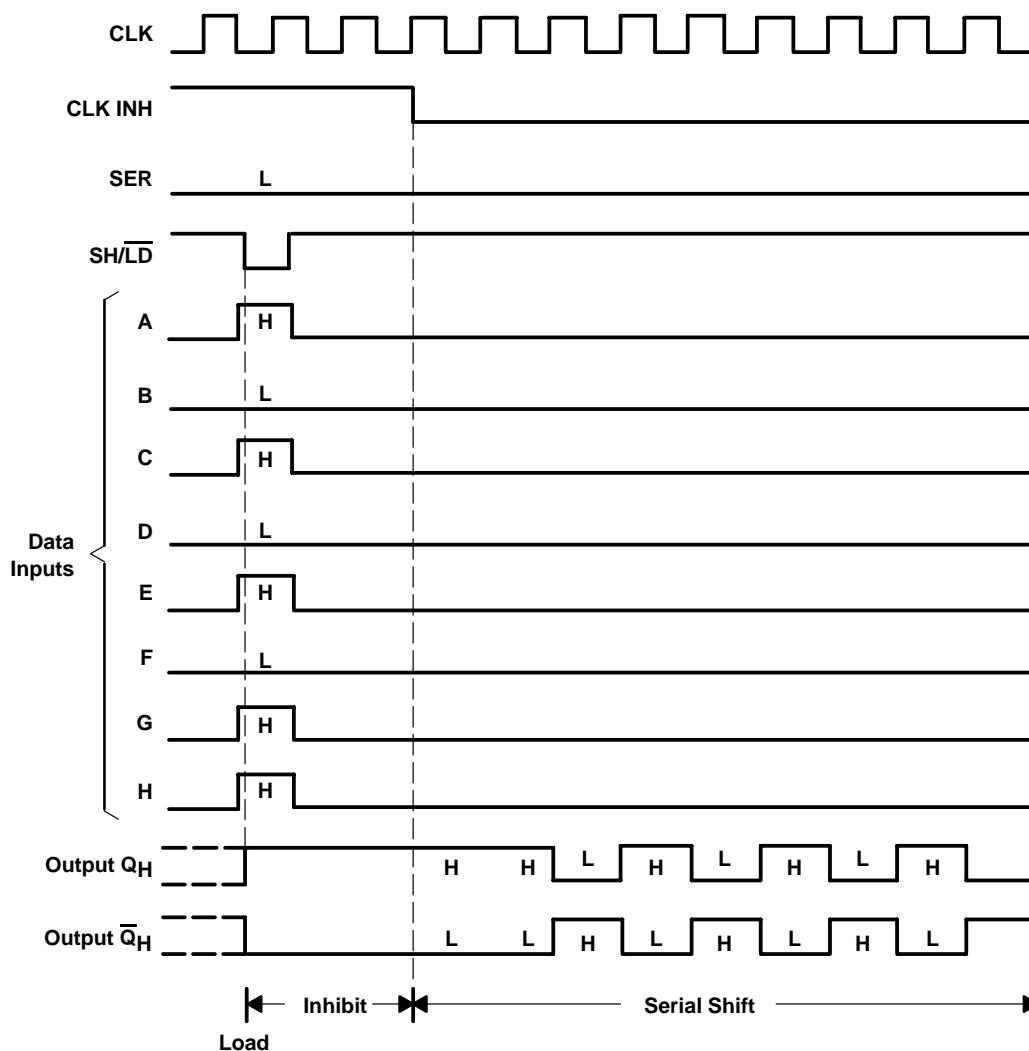
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### logic diagram (positive logic)



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

### typical shift, load, and inhibit sequences



# SN54165, SN54LS165A, SN74165, SN74LS165A PARALLEL-LOAD 8-BIT SHIFT REGISTERS

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## absolute maximum ratings over operating free-air temperature (unless otherwise noted)<sup>†</sup>

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 $\theta_{JA}$ (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

<sup>†</sup> 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  $\overline{SH/LD}$  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	$\mu A$
$I_{OL}$	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

# SN54165, SN54LS165A, SN74165, SN74LS165A

## PARALLEL-LOAD 8-BIT SHIFT REGISTERS

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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 <sub>IH</sub>	High-level input voltage		2			2			V
V <sub>IL</sub>	Low-level input voltage				0.8			0.8	V
V <sub>IK</sub>	Input clamp voltage	V <sub>CC</sub> = MIN, I <sub>I</sub> = –12 mA			–1.5			–1.5	V
V <sub>OH</sub>	High-level output voltage	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OH</sub> = –800 µA	2.4	3.4		2.4	3.4		V
V <sub>OL</sub>	Low-level output voltage	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = 0.8 V, I <sub>OL</sub> = 16 mA		0.2	0.4		0.2	0.4	V
I <sub>I</sub>	Input current at maximum input voltage	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V			1			1	mA
I <sub>IH</sub>	High-level input current	SH/LD			80			80	µA
		Other inputs			40			40	
I <sub>IL</sub>	Low-level input current	SH/LD			–3.2			–3.2	mA
		Other inputs			–1.6			–1.6	
I <sub>OS</sub>	Short-circuit output current§	V <sub>CC</sub> = MAX	–20		–55	–18		–55	mA
I <sub>CC</sub>	Supply current	V <sub>CC</sub> = 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/LD, I<sub>CC</sub> 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<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

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

### SN54165 and SN74165 switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (see Figure 1)

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f <sub>max</sub>				20	26		MHz
t <sub>PLH</sub>	LD	Any	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 400 Ω		21	31	ns
t <sub>PHL</sub>					27	40	
t <sub>PLH</sub>	CLK	Any	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 400 Ω		16	24	ns
t <sub>PHL</sub>					21	31	
t <sub>PLH</sub>	H	Q <sub>H</sub>	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 400 Ω		11	17	ns
t <sub>PHL</sub>					24	36	
t <sub>PLH</sub>	H	Q <sub>H</sub>	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 400 Ω		18	27	ns
t <sub>PHL</sub>					18	27	

¶ f<sub>max</sub> = maximum clock frequency, t<sub>PLH</sub> = propagation delay time, low-to-high-level output, t<sub>PHL</sub> = propagation delay time, high-to-low-level output

# SN54165, SN54LS165A, SN74165, SN74LS165A PARALLEL-LOAD 8-BIT SHIFT REGISTERS

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## recommended operating conditions

			SN54LS165A			SN74LS165A			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub>	High-level input voltage		2			2			V
V <sub>IL</sub>	Low-level input voltage		0.7			0.8			V
I <sub>OH</sub>	High-level output current		−0.4			−0.4			mA
I <sub>OL</sub>	Low-level output current		4			8			mA
f <sub>clock</sub>	Clock frequency		0	25		0	25		MHz
t <sub>w(clock)</sub>	Width of clock input pulse (see Figure 2)	Clock high	15			15			ns
		Clock low	25			25			
t <sub>w(load)</sub>	Width of load input pulse	Clock high	25			25			ns
		Clock low	17			17			
t <sub>su</sub>	Clock-enable setup time (see Figure 2)		30			30			ns
t <sub>su</sub>	Parallel input setup time (see Figure 2)		10			10			ns
t <sub>su</sub>	Serial input setup time (see Figure 2)		20			20			ns
t <sub>su</sub>	Shift setup time (see Figure 2)		45			45			ns
t <sub>h</sub>	Hold time at any input		0			0			ns
T <sub>A</sub>	Operating free-air temperature		−55			125			°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 <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = –18 mA				–1.5			–1.5			V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX, I <sub>OH</sub> = –0.4 mA				2.5	3.5		2.7	3.5		V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = MAX			I <sub>OL</sub> = 4 mA	0.25		0.4	0.25		0.4	V
				I <sub>OL</sub> = 8 mA			0.35		0.5		
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V				0.1			0.1			mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V				20			20			μA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V				–0.4			–0.4			mA
I <sub>OS</sub> §	V <sub>CC</sub> = MAX				–20	–100		–20	–100		mA
I <sub>CC</sub>	V <sub>CC</sub> = 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/LD, I<sub>CC</sub> 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<sub>CC</sub> = 5 V, T<sub>A</sub> = 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.

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## SN54LS165A and SN74LS165A switching characteristics, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$ (see Figure 2)

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

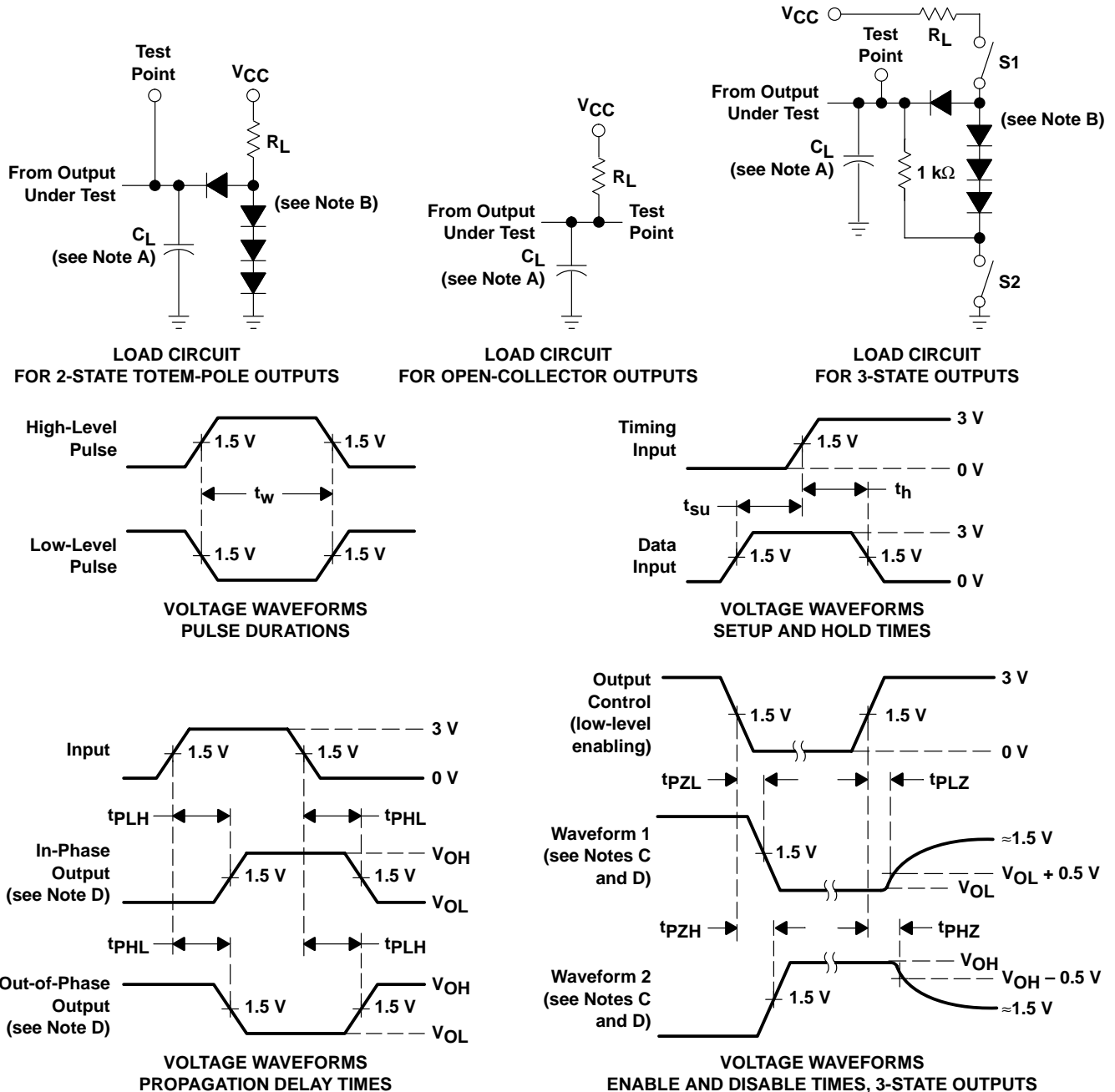


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## PARAMETER MEASUREMENT INFORMATION SERIES 54/74 DEVICES



- NOTES:
- $C_L$  includes probe and jig capacitance.
  - All diodes are 1N3064 or equivalent.
  - 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.
  - 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  $t_{PZL}$ .
  - 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.
  - The outputs are measured one at a time with one input transition per measurement.

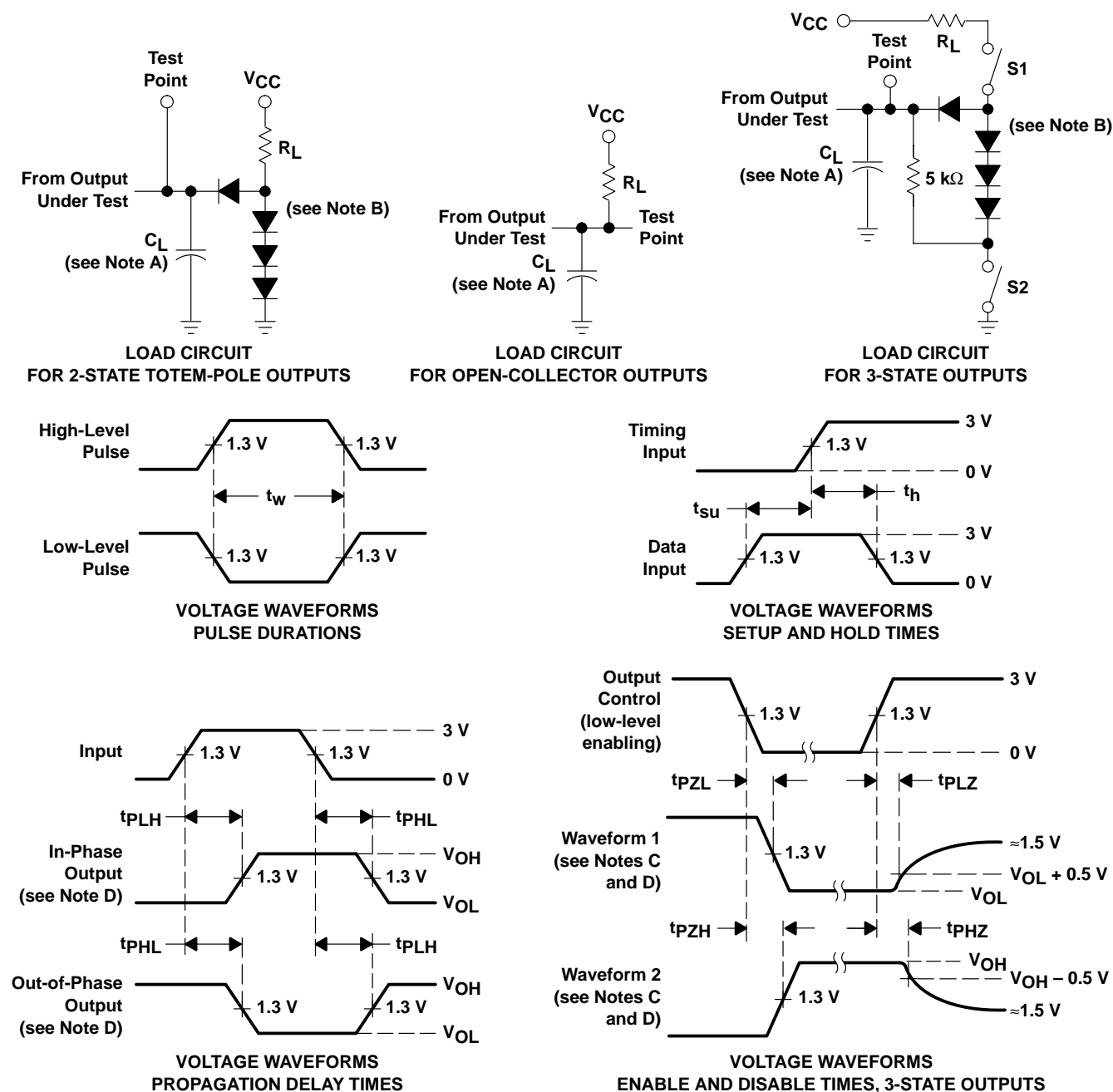
Figure 1. Load Circuits and Voltage Waveforms

# SN54165, SN54LS165A, SN74165, SN74LS165A PARALLEL-LOAD 8-BIT SHIFT REGISTERS

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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,  $Z_O \approx 50 \Omega$ ,  $t_r \leq 1.5$  ns,  $t_f \leq 2.6$  ns.
  - G. The outputs are measured one at a time with one input transition per measurement.

Figure 2. Load Circuits and Voltage Waveforms

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-7700601VEA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
5962-7700601VFA	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC
7700601EA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
7700601FA	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC
JM38510/30608B2A	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
JM38510/30608BEA	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
JM38510/30608BFA	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC
SN54LS165AJ	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
SN74165N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS165AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS165ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS165ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS165ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS165AJ	OBSOLETE	CDIP	J	16		TBD	Call TI	Call TI
SN74LS165AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74LS165AN3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74LS165ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS165ANSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SNJ54LS165AFK	ACTIVE	LCCC	FK	20	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS165AJ	ACTIVE	CDIP	J	16	1	TBD	Call TI	Level-NC-NC-NC
SNJ54LS165AW	ACTIVE	CFP	W	16	1	TBD	Call TI	Level-NC-NC-NC

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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