

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

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

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

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

## description

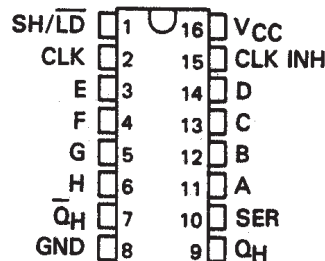
The '165 and 'LS165A are 8-bit serial shift registers that shift the data in the direction of  $Q_A$  toward  $Q_H$  when clocked. Parallel-in access to each stage is made available by eight individual direct data inputs that are enabled by a low level at the shift/load input. These registers also feature gated clock 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 2-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 the shift/load input high enables the other clock input. The clock-inhibit input should be changed to the high level only while the clock input is high. Parallel loading is inhibited as long as the shift/load input is high. Data at the parallel inputs are loaded directly into the register while the shift/load input is low independently of the levels of the clock, clock inhibit, or serial inputs.

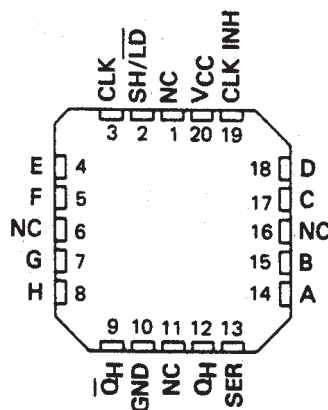
FUNCTION TABLE

SHIFT/LOAD	CLOCK INHIBIT	CLOCK	SERIAL	INPUTS				INTERNAL OUTPUTS		OUTPUT $Q_H$
				A...H	$Q_A$	$Q_B$	$Q_H$			
L	X	X	X	a...h	a	b			h	
H	L	L	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{H0}$		$Q_{H0}$	
H	L	↑	H	X	H	$Q_{An}$	$Q_{Gn}$		$Q_{Gn}$	
H	L	↑	L	X	L	$Q_{An}$	$Q_{Gn}$		$Q_{Gn}$	
H	H	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{H0}$		$Q_{H0}$	

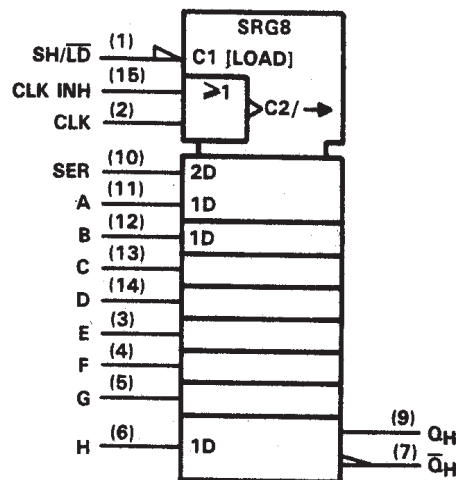
SN54165, SN54LS165A ... J OR W PACKAGE  
SN74165 ... N PACKAGE  
SN74LS165A ... D OR N PACKAGE  
(TOP VIEW)



SN54LS165A ... FK PACKAGE  
(TOP VIEW)



## logic symbol†



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

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

PRODUCTION DATA information is 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  
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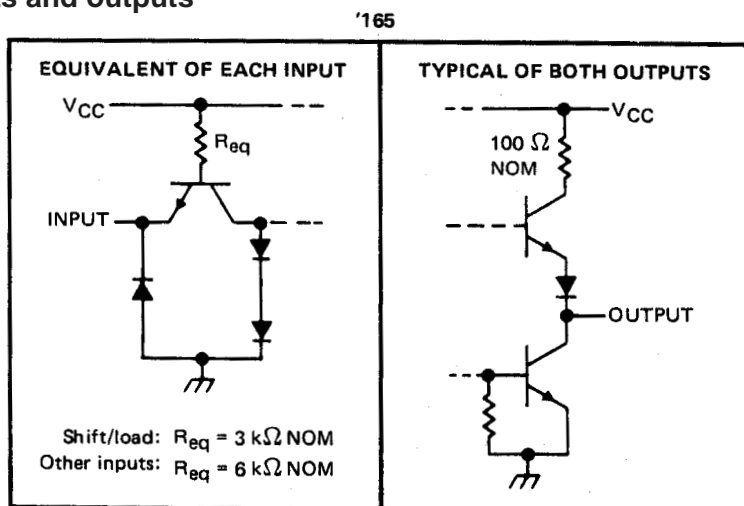
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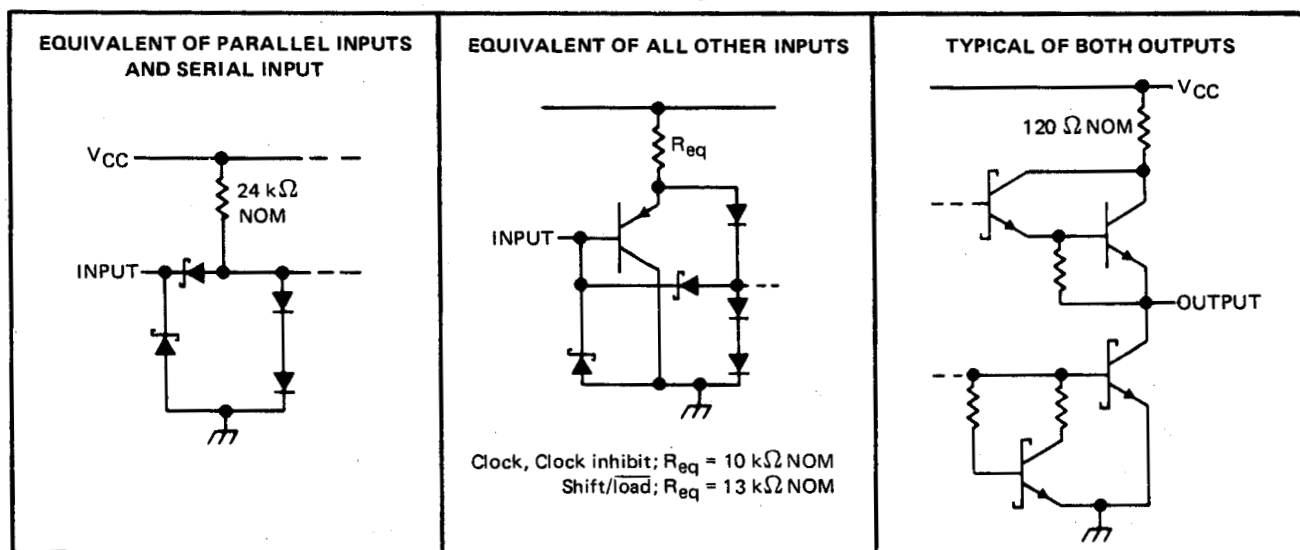
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## schematics of inputs and outputs



'LS165A

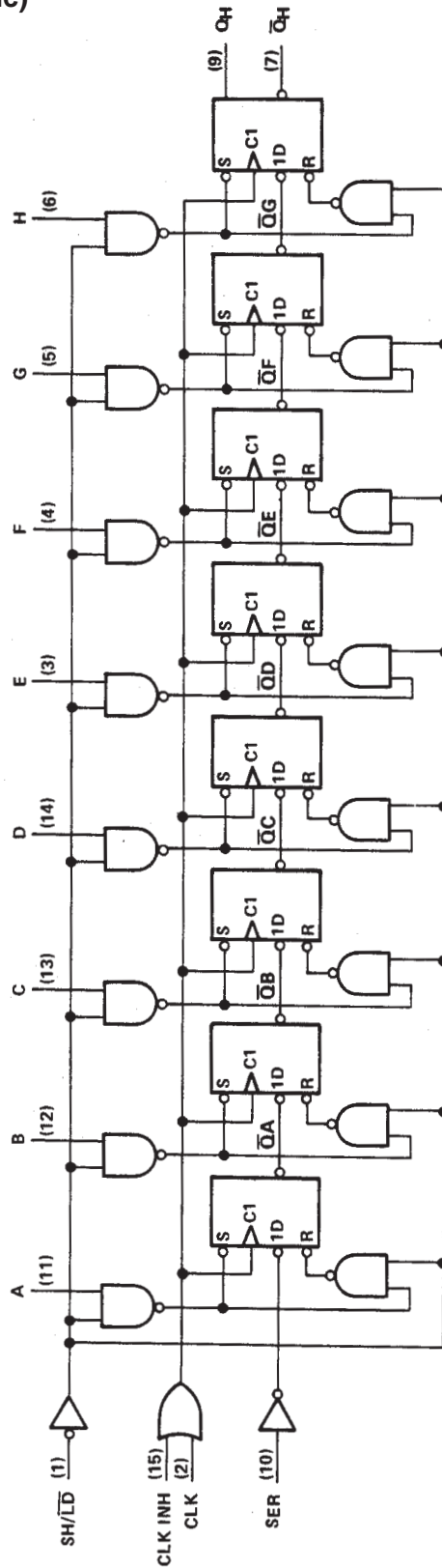


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logic diagram (positive logic)



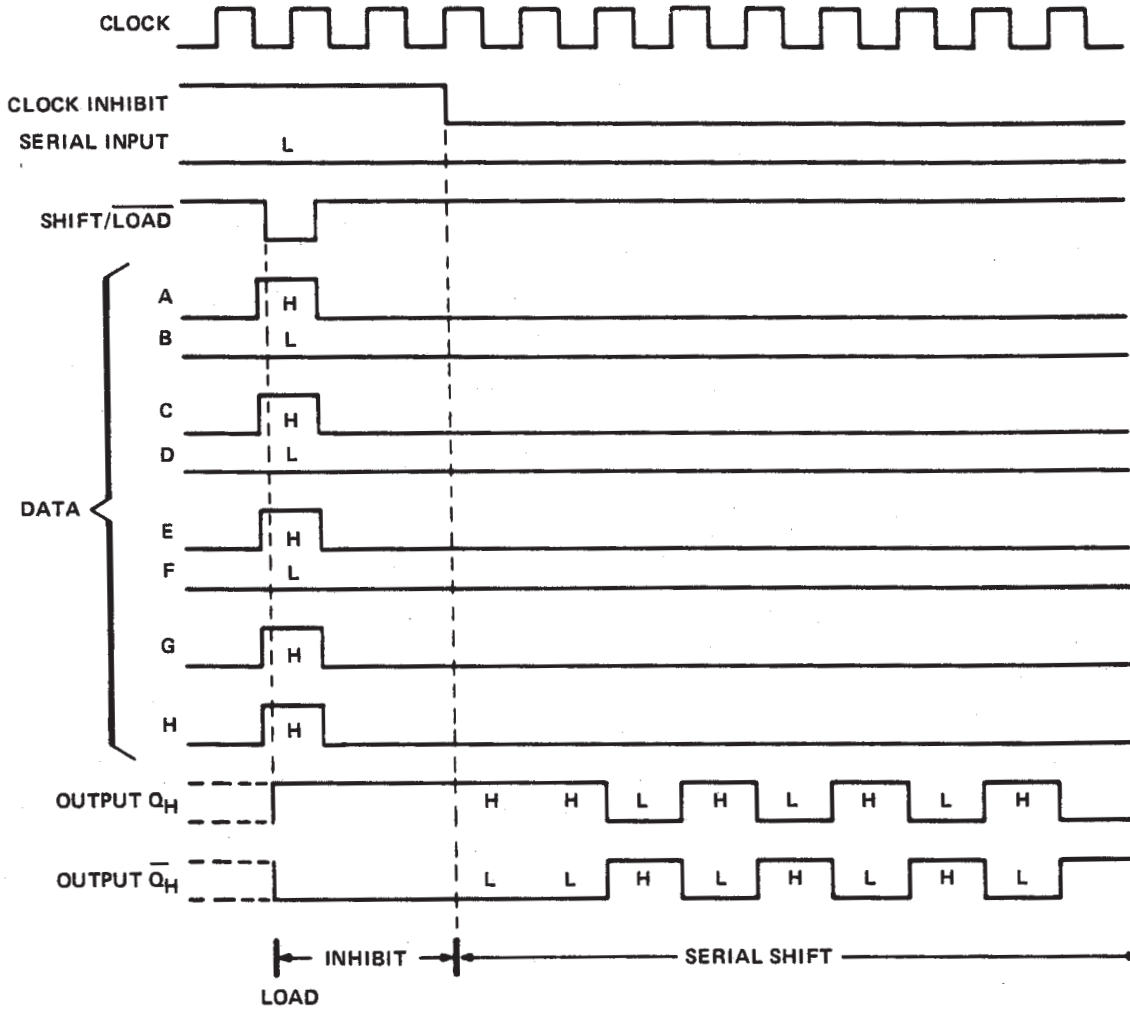
Pin numbers shown are for D, J, N, and W packages.

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

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## typical shift, load, and inhibit sequences



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

Supply voltage, $V_{CC}$ (see Note 1) .....	7 V
Input voltage: SN54165, SN74165 .....	5.5 V
SN54LS165A, SN74LS165A .....	7 V
Interemitter voltage (see Note 2) .....	5.5 V
Operating free-air temperature range: SN54165, SN54LS165A .....	- 55°C to 125°C
SN74165, SN74LS165A .....	0°C to 70°C
Storage temperature range .....	- 65°C to 150°C

- 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 shift/load input in conjunction with the clock-inhibit inputs.



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## recommended operating conditions

	SN54165			SN74165			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, $V_{CC}$	4.5	5	5.5	4.75	5	5.25	V
High-level output current, $I_{OH}$			-800			-800	$\mu A$
Low-level output current, $I_{OL}$			16			16	mA
Clock frequency, $f_{clock}$	0		20	0		20	MHz
Width of clock input pulse, $t_w(\text{clock})$	25			25			ns
Width of load input pulse, $t_w(\text{load})$	15			15			ns
Clock-enable setup time, $t_{SU}$ (see Figure 1)	30			30			ns
Parallel input setup time, $t_{SU}$ (see Figure 1)	10			10			ns
Serial input setup time, $t_{SU}$ (see Figure 2)	20			20			ns
Shift setup time, $t_{SU}$ (see Figure 2)	45			45			ns
Hold time at any input, $t_h$	0			0			ns
Operating free-air temperature, $T_A$	-55		125	0		70	$^{\circ}C$

## 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	$V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$			-1.5			-1.5	V
$V_{OH}$ High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -800 \mu A$	2.4	3.4		2.4	3.4		V
$V_{OL}$ Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$		0.2	0.4		0.2	0.4	V
$I_I$ Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1			1	mA
$I_{IH}$ High-level input current	Shift/ $\overline{\text{load}}$			80			80	$\mu A$
	Other inputs			40			40	
$I_{IL}$ Low-level input current	Shift/ $\overline{\text{load}}$			-3.2			-3.2	mA
	Other inputs			-1.6			-1.6	
$I_{OS}$ Short-circuit output current§	$V_{CC} = \text{MAX}$	-20		-55	-18		-55	mA
$I_{CC}$ Supply current	$V_{CC} = \text{MAX}, \text{ See Note 3}$		42	63		42	63	mA

NOTE 3: With the outputs open, clock inhibit and clock at 4.5 V, and a clock pulse applied to the shift/load input,  $I_{CC}$  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 value specified under recommended operating conditions.

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

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

## switching characteristics, SN54165 and SN74165, $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}C$

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{max}$				20	26		MHz
$t_{PLH}$	$\overline{\text{Load}}$	Any	$C_L = 15 \text{ pF}, R_L = 400 \Omega,$ See figures 1 thru 3		21	31	ns
$t_{PHL}$					27	40	
$t_{PLH}$	Clock	Any			16	24	ns
$t_{PHL}$					21	31	
$t_{PLH}$	H	$Q_H$			11	17	ns
$t_{PHL}$					24	36	
$t_{PLH}$	H	$\overline{Q}_H$			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



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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 1)	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 1)	30			30			ns
t <sub>su</sub>	Parallel input setup time (See Figure 1)	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	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 <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 3	18		30	18		30	mA

NOTE 3: With the outputs open, clock inhibit and clock at 4.5 V, and a clock pulse applied to the shift load input, 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 value 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.

## switching characteristics, SN54LS165A and SN74LS165A, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25° C

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f <sub>max</sub>			R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 15 pF See Figures 1 thru 3	25	35		MHz
t <sub>PLH</sub>	Load	Any			21	35	ns
t <sub>PHL</sub>					26	35	
t <sub>PLH</sub>	Clock	Any			14	25	ns
t <sub>PHL</sub>					16	25	
t <sub>PLH</sub>	H	Q <sub>H</sub>			13	25	ns
t <sub>PHL</sub>					24	30	
t <sub>PLH</sub>	H	Q̄ <sub>H</sub>			19	30	ns
t <sub>PHL</sub>				17	25		

† 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

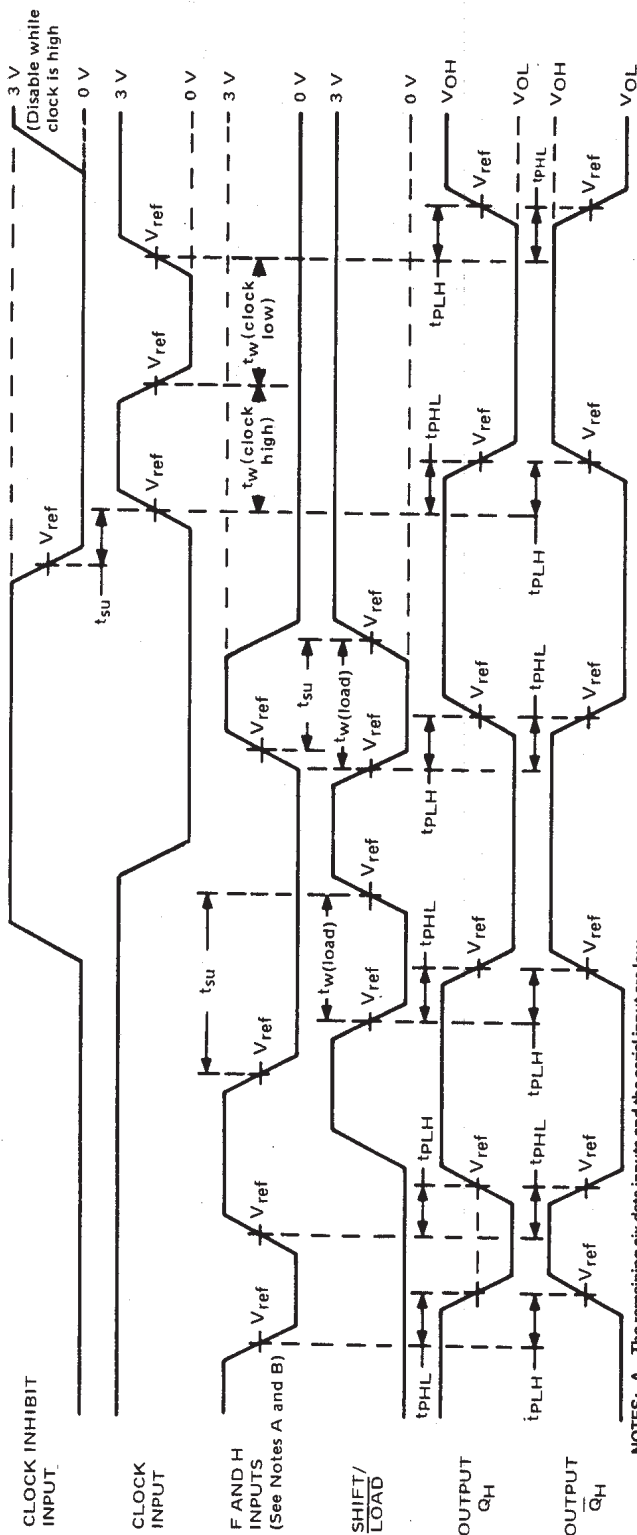




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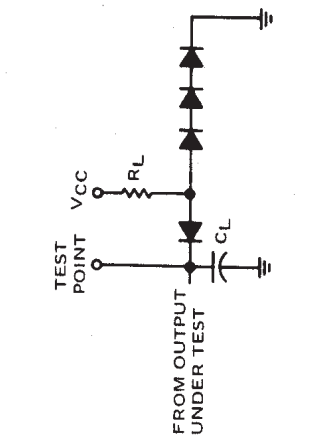
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PARAMETER MEASUREMENT INFORMATION



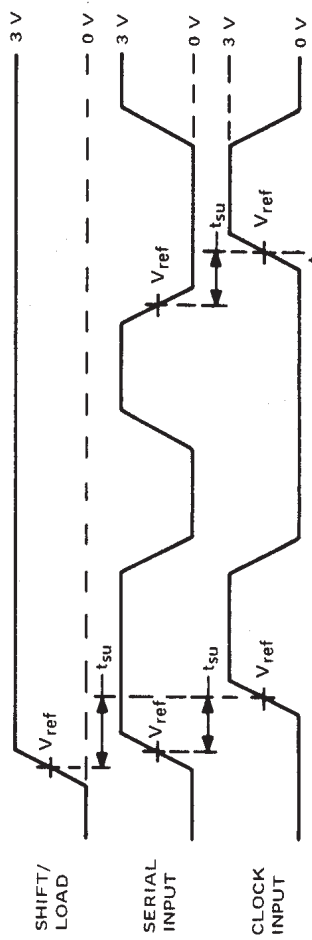
NOTES: A. The remaining six data inputs and the serial input are low.  
 B. Prior to test, high-level data is loaded into H input.  
 C. The input pulse generators have the following characteristics: PRR  $\leq$  1 MHz, duty cycle  $\leq$  50%  $Z_{out} \approx 50 \Omega$ ; for '165,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns;  
 for 'LS165A,  $t_r \leq 15$  ns,  $t_f \leq 6$  ns.  
 D. For '165,  $V_{ref} = 1.5$  V; for 'LS165A,  $V_{ref} = 1.3$  V.

FIGURE 1—VOLTAGE WAVEFORMS



NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All diodes are IN3064 or equivalent.

FIGURE 3—LOAD CIRCUIT FOR SWITCHING TESTS



NOTES: A. The eight data inputs and the clock-inhibit input are low. Results are monitored at output Q<sub>H</sub> at  $t_n + 7$ .  
 B. The input pulse generators have the following characteristics: PRR  $\leq$  1 MHz, duty cycle  $\leq$  50%,  $Z_{out} \approx 50 \Omega$ ; for '165,  $t_r \leq 10$  ns,  $t_f \leq 10$  ns; for 'LS165A,  $t_r \leq 15$  ns,  $t_f \leq 6$  ns.  
 C. For '165,  $V_{ref} = 1.5$  V; for 'LS165A,  $V_{ref} = 1.3$  V.

FIGURE 2—VOLTAGE WAVEFORMS

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