

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

description

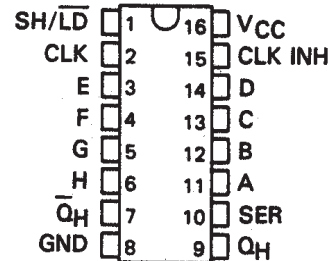
The '165 and 'LS165A are 8-bit serial shift registers that shift the data in the direction of Q_A toward Q_H when clocked. Parallel-in access to each stage is made available by eight individual direct data inputs that are enabled by a low level at the shift/load input. These registers also feature gated 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.

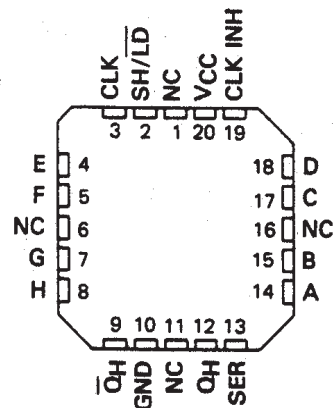
FUNCTION TABLE

SHIFT/ LOAD	CLOCK INHIBIT	CLOCK	SERIAL	INPUTS	INTERNAL OUTPUTS	OUTPUT Q_H
				PARALLEL A...H		
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}

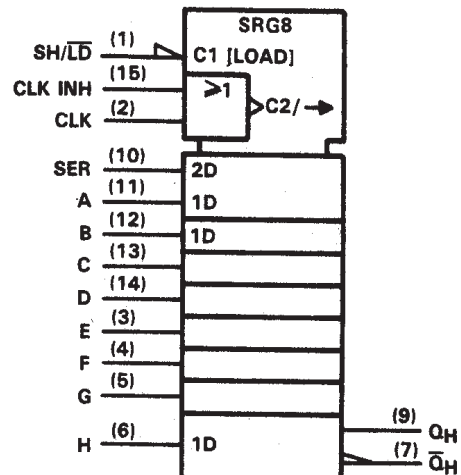
SN54165, SN54LS165A ... J OR W PACKAGE
SN74165 ... N PACKAGE
SN74LS165A ... D OR N PACKAGE
(TOP VIEW)



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.

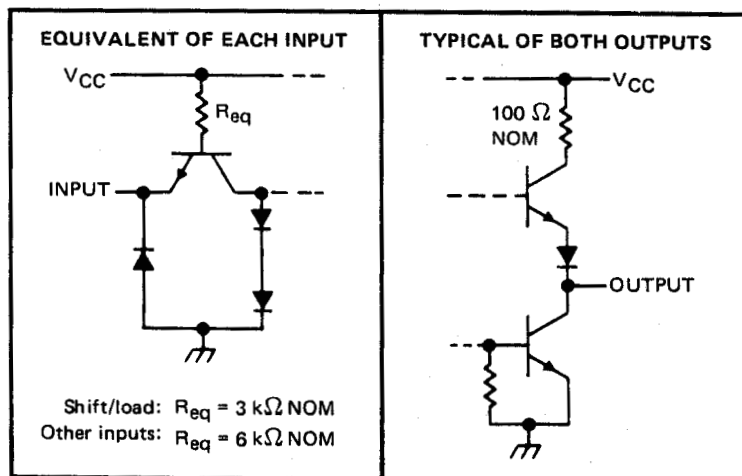
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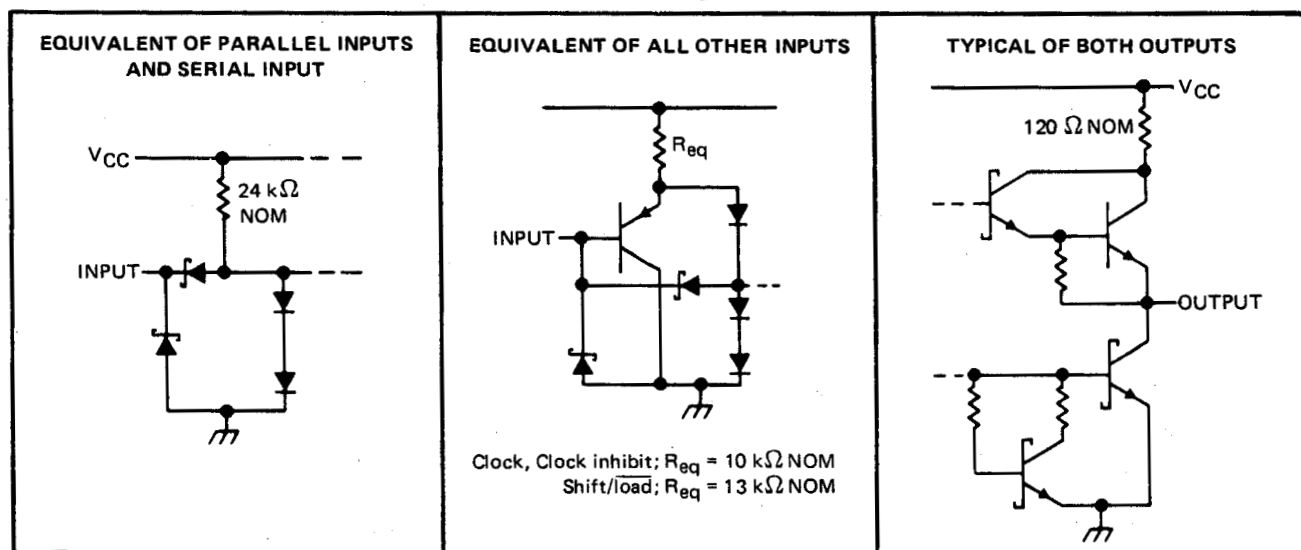
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schematics of inputs and outputs

'165



'LS165A

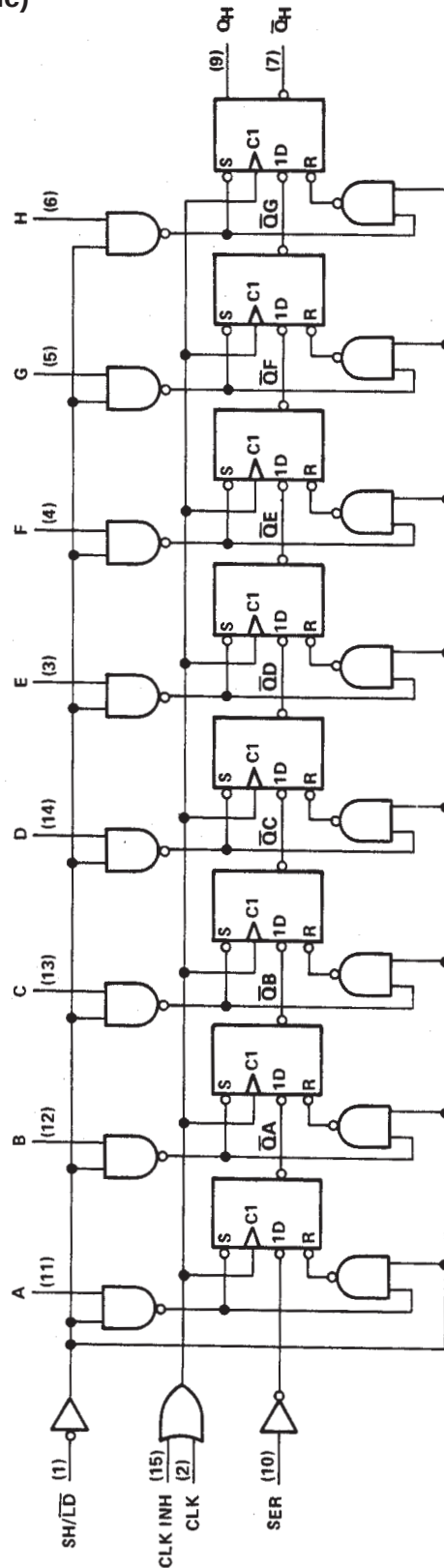


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logic diagram (positive logic)



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



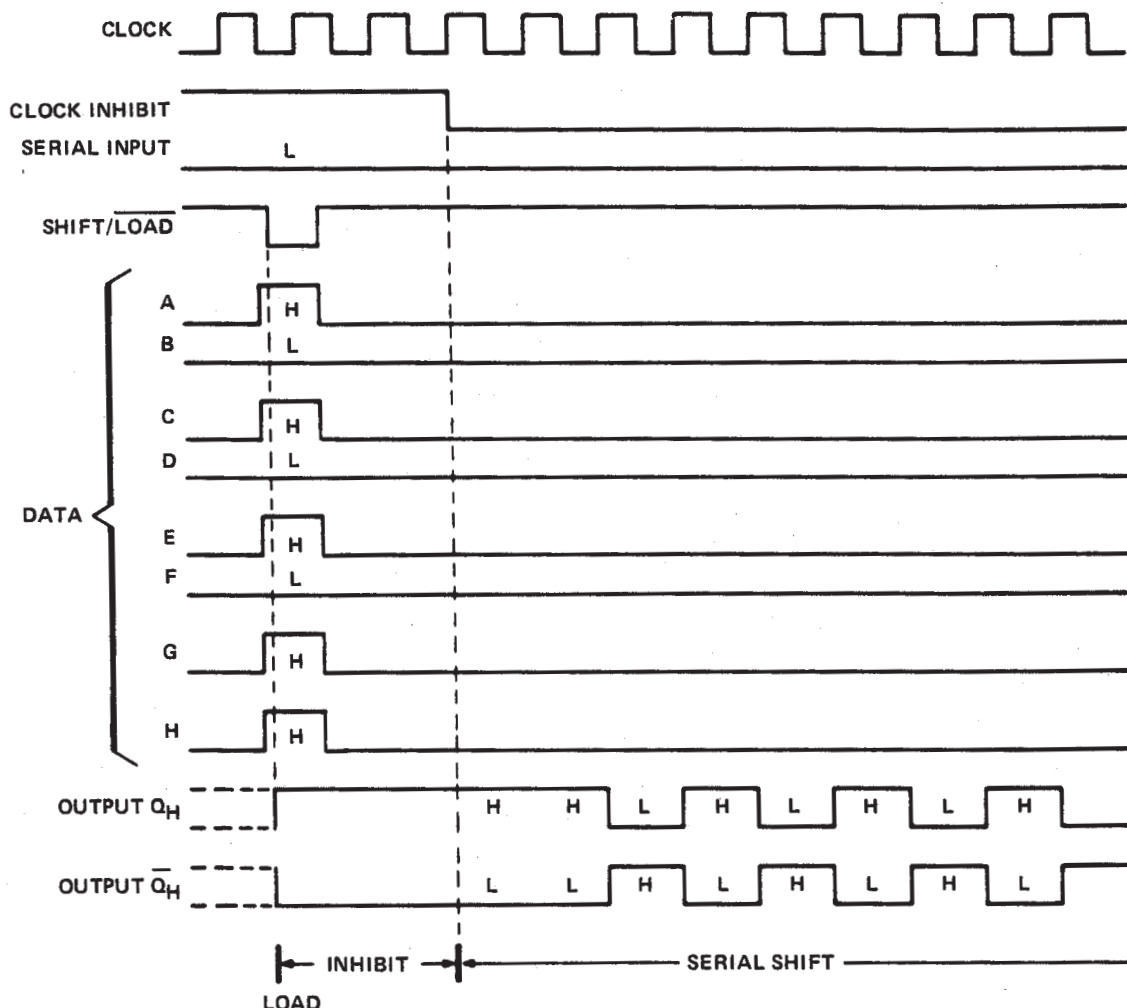
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typical shift, load, and inhibit sequences



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	μA
Low-level output current, I_{OL}			16			16	mA
Clock frequency, f_{clock}	0		20	0		20	MHz
Width of clock input pulse, $t_{w(clock)}$	25			25			ns
Width of load input pulse, $t_{w(load)}$	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/load			80			80	μA
		Other inputs			40			40	
I_{IL}	Low-level input current	Shift/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	$V_{CC} = \text{MAX}$, 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}			C _L = 15 pF, R _L = 400 Ω, See figures 1 thru 3	20	26		MHz
t _{PLH}	Load	Any			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	Q̄ _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 _{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 1)	clock high			15			ns
		clock low			25			
t _{W(load)}	Width of load input pulse	clock high			25			ns
		clock low			17			
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 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)

See Note 3

PARAMETER	TEST CONDITIONS	SN54LS165A		SN74LS165A		UNIT		
		MIN	TYP†	MAX	MIN		TYP†	MAX
V _{IK}	V _{CC} = MIN, I _I = -18 mA			-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		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 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_{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 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.

switching characteristics, SN54LS165A and SN74LS165A, V_{CC} = 5 V, T_A = 25° C

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f _{max}			R _L = 2 kΩ, C _L = 15 pF See Figures 1 thru 3	25	35		MHz
t _{PLH}	<u>Load</u>	Any			21	35	ns
t _{PHL}					26	35	
t _{PLH}	Clock	Any.			14	25	ns
t _{PHL}					16	25	
t _{PLH}	H	Q _H			13	25	ns
t _{PHL}					24	30	
t _{PLH}	H	<u>Q_H</u>			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

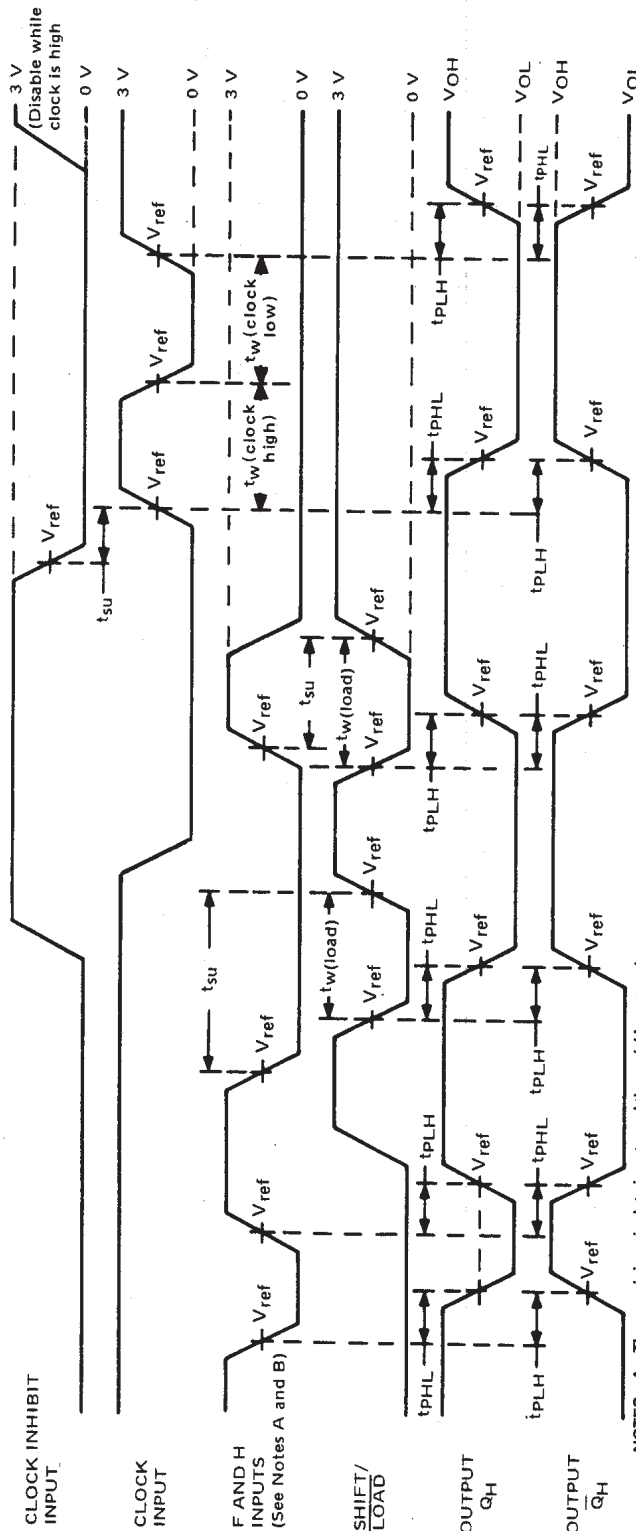


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PARAMETER MEASUREMENT INFORMATION



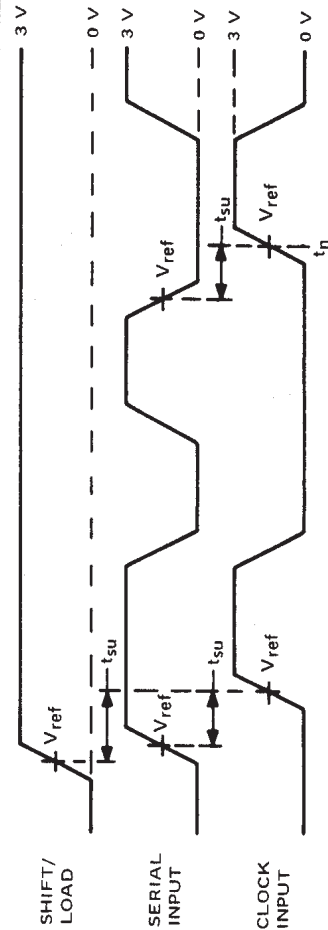
NOTES: A. The remaining six data inputs and the serial input are low.

B. Prior to test, high-level data is loaded into H input.

C. The input pulse generators have the following characteristics: PRR ≤ 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

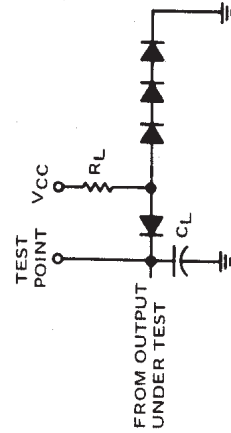


NOTES: A. The eight data inputs and the clock-inhibit input are low. Results are monitored at output Q_H at $t_n + 7$.

B. The input pulse generators have the following characteristics: PRR ≤ 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



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

FIGURE 3—LOAD CIRCUIT FOR SWITCHING TESTS

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