

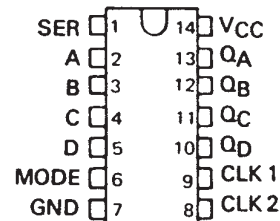
# SN5495A, SN54LS95B SN7495A, SN74LS95B

## 4-BIT PARALLEL-ACCESS SHIFT REGISTERS

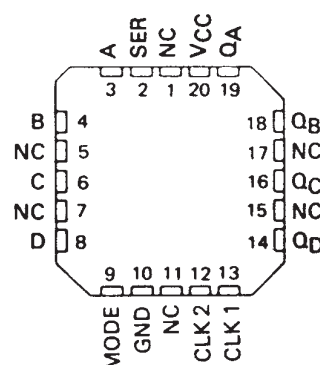
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TYPE	TYPICAL MAXIMUM CLOCK FREQUENCY	TYPICAL POWER DISSIPATION
'95A	36 MHz	195 mW
'LS95B	36 MHz	65 mW

SN5495A, SN54LS95B . . . J OR W PACKAGE  
SN7495A . . . N PACKAGE  
SN74LS95B . . . D OR N PACKAGE  
(TOP VIEW)



SN54LS95B . . . FK PACKAGE  
(TOP VIEW)



NC - No internal connection

### description

These 4-bit registers feature parallel and serial inputs, parallel outputs, mode control, and two clock inputs. The registers have three modes of operation:

- Parallel (broadside) load
- Shift right (the direction  $Q_A$  toward  $Q_D$ )
- Shift left (the direction  $Q_D$  toward  $Q_A$ )

Parallel loading is accomplished by applying the four bits of data and taking the mode control input high. The data is loaded into the associated flip-flops and appears at the outputs after the high-to-low transition of the clock-2 input. During loading, the entry of serial data is inhibited.

Shift right is accomplished on the high-to-low transition of clock 1 when the mode control is low; shift left is accomplished on the high-to-low transition of clock 2 when the mode control is high by connecting the output of each flip-flop to the parallel input of the previous flip-flop ( $Q_D$  to input C, etc.) and serial data is entered at input D. The clock input may be applied commonly to clock 1 and clock 2 if both modes can be clocked from the same source. Changes at the mode control input should normally be made while both clock inputs are low; however, conditions described in the last three lines of the function table will also ensure that register contents are protected.

FUNCTION TABLE

INPUTS				OUTPUTS							
MODE CONTROL	CLOCKS		SERIAL	PARALLEL				$Q_A$	$Q_B$	$Q_C$	$Q_D$
	2 (L)	1 (R)		A	B	C	D				
H	H	X	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
H	↓	X	X	a	b	c	d	a	b	c	d
H	↓	X	X	$Q_{Bn}$ †	$Q_{Cn}$ †	$Q_{Dn}$ †	d	$Q_{Bn}$	$Q_{Cn}$	$Q_{Dn}$	d
L	L	H	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
L	X	↓	H	X	X	X	X	H	$Q_{An}$	$Q_{Bn}$	$Q_{Cn}$
L	X	↓	L	X	X	X	X	L	$Q_{An}$	$Q_{Bn}$	$Q_{Cn}$
↑	L	L	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
↓	L	L	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
↓	L	H	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
↑	H	L	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
↑	H	H	X	X	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$

†Shifting left requires external connection of  $Q_B$  to A,  $Q_C$  to B, and  $Q_D$  to C. Serial data is entered at input D.

H = high level (steady state), L = low level (steady state), X = irrelevant (any input, including transitions)

↓ = transition from high to low level, ↑ = transition from low to high level

a, b, c, d = the level of steady-state input at inputs A, B, C, or D, respectively.

$Q_{A0}$ ,  $Q_{B0}$ ,  $Q_{C0}$ ,  $Q_{D0}$  = the level of  $Q_A$ ,  $Q_B$ ,  $Q_C$ , or  $Q_D$ , respectively, before the indicated steady-state input conditions were established.

$Q_{An}$ ,  $Q_{Bn}$ ,  $Q_{Cn}$ ,  $Q_{Dn}$  = the level of  $Q_A$ ,  $Q_B$ ,  $Q_C$ , or  $Q_D$ , respectively, before the most-recent ↓ transition of the clock.

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.



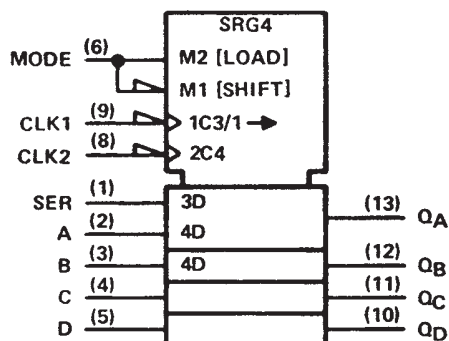
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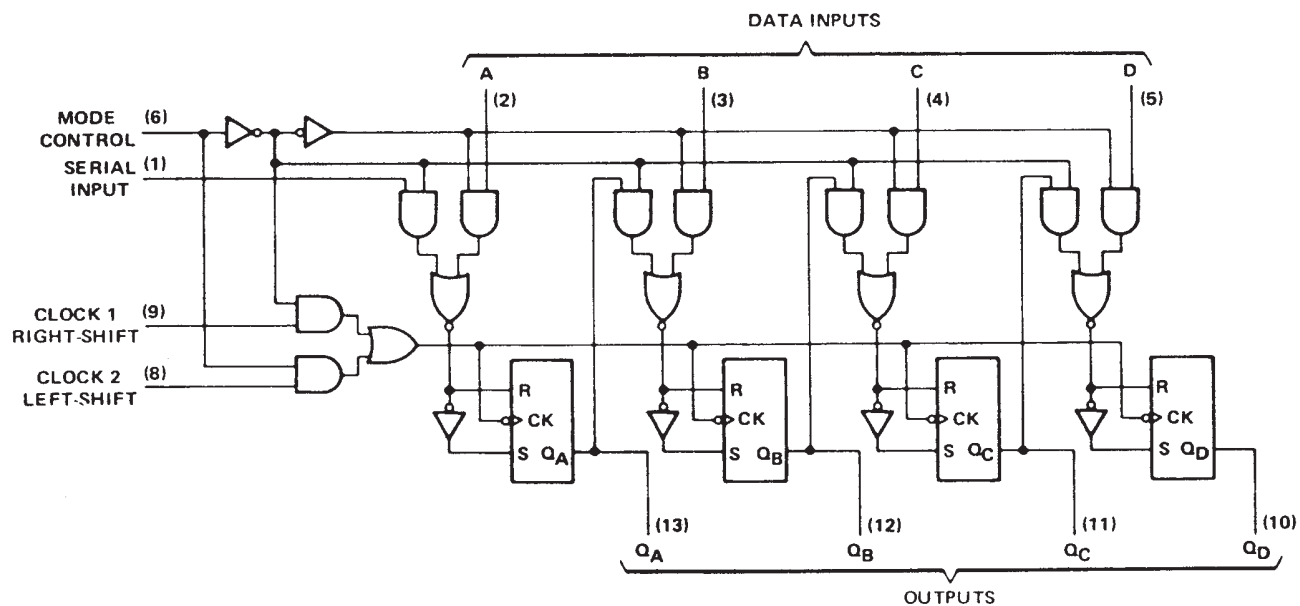
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logic symbol†



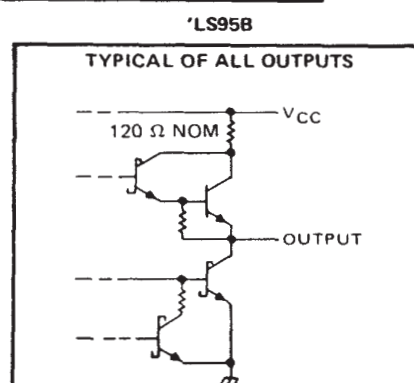
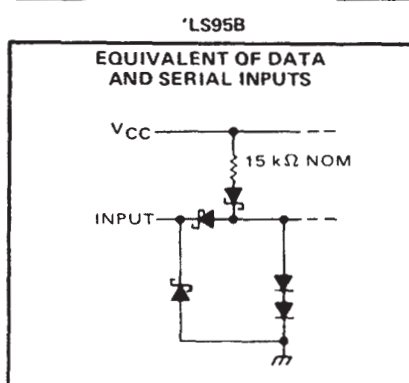
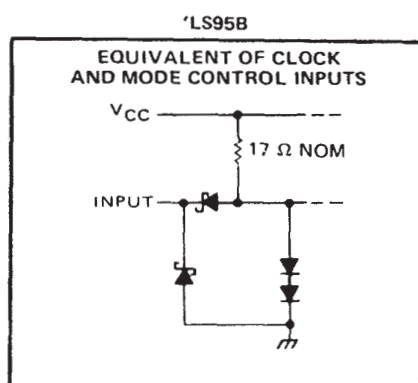
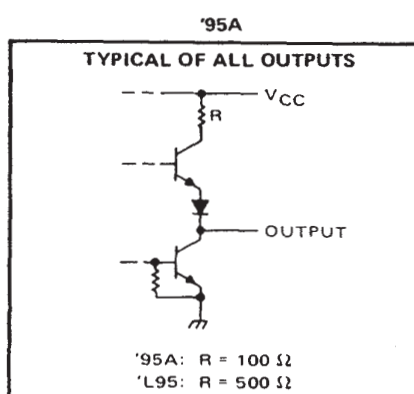
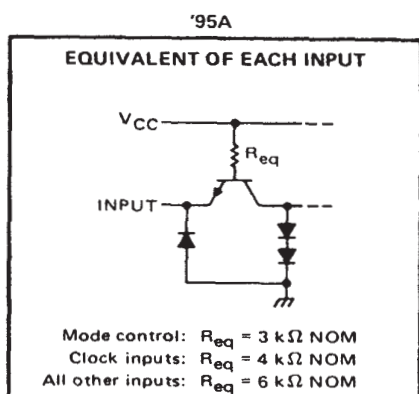
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

logic diagram (positive logic)



SN5495A, SN54LS95B  
SN7495A, SN74LS95B  
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schematics of inputs and outputs



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

	SN54'	SN54LS'	SN74'	SN74LS'	UNIT
Supply voltage, $V_{CC}$ (see Note 1)	7	7	7	7	V
Input voltage	5.5	7	5.5	7	V
Interemitter voltage (see Note 2)	5.5		5.5		V
Operating free-air temperature range	- 55 to 125		0 to 70		°C
Storage temperature range	- 65 to 150		- 65 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 input transistor. This rating applies between the clock-2 input and the mode control input of the '95A.

**SN5495A, SN54LS95B**  
**SN7495A, SN74LS95B**  
**4-BIT PARALLEL-ACCESS SHIFT REGISTERS**

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**recommended operating conditions**

	SN5495A			SN7495A			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		25	0		25	MHz
Width of clock pulse, $t_{w(clock)}$ (See Figure 1)	20			20			ns
Setup time, high-level or low-level data, $t_{SU}$ (See Figure 1)	15			15			ns
Hold time, high-level or low-level data, $t_H$ (See Figure 1)	0			0			ns
Time to enable clock 1, $t_{enable 1}$ (See Figure 2)	15			15			ns
Time to enable clock 2 (See Figure 2)	15			15			ns
Time to inhibit clock 1, $t_{inhibit 1}$ (See Figure 2)	5			5			ns
Time to inhibit clock 2, $t_{inhibit 2}$ (See Figure 2)	5			5			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 <sup>†</sup>	SN5495A			SN7495A			UNIT
			MIN	TYP <sup>‡</sup>	MAX	MIN	TYP <sup>‡</sup>	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	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -800 \mu\text{A}$	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	Serial, A, B, C, D, Clock 1 or 2			40			40	$\mu$ A
		Mode control			80			80	
$I_{IL}$	Low-level input current	Serial, A, B, C, D, Clock 1 or 2			-1.6			-1.6	mA
		Mode control			-3.2			-3.2	
$I_{OS}$	Short-circuit output current <sup>§</sup>	$V_{CC} = \text{MAX}$	-18		-57	-18		-57	mA
$I_{CC}$	Supply current	$V_{CC} = \text{MAX}$ , See Note 3		39	63		39	63	mA

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

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

<sup>§</sup> Not more than one output should be shorted at a time.

NOTE 3:  $I_{CC}$  is measured with all outputs and serial input open; A, B, C, and D inputs grounded; mode control at 4.5 V; and a momentary 3 V, then ground, applied to both clock inputs.

**switching characteristics,  $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}\text{C}$**

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{max}$ Maximum clock frequency	$C_L = 15 \text{ pF}, R_L = 400 \Omega,$ See Figure 1	25	36		MHz
$t_{PLH}$ Propagation delay time, low-to-high-level output from clock			18	27	ns
$t_{PHL}$ Propagation delay time, high-to-low-level output from clock				21	32



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recommended operating conditions

	SN54LS95B			SN74LS95B			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, $I_{OH}$			-400			-400	$\mu$ A
Low-level output current, $I_{OL}$			4			8	mA
Clock frequency, $f_{clock}$	0		25	0		25	MHz
Width of clock pulse, $t_w(\text{clock})$ (see Figure 1)	20			20			ns
Setup time, high-level or low-level data, $t_{SU}$ (see Figure 1)	20			20			ns
Hold time, high-level or low-level data, $t_H$ (see Figure 1)	20			10			ns
Time to enable clock 1, $t_{enable 1}$ (see Figure 2)	20			20			ns
Time to enable clock 2, $t_{enable 2}$ (see Figure 2)	20			20			ns
Time to inhibit clock 1, $t_{inhibit 1}$ (see Figure 2)	20			20			ns
Time to inhibit clock 2, $t_{inhibit 2}$ (see Figure 2)	20			20			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 <sup>†</sup>	SN54LS95B			SN74LS95B			UNIT
		MIN	TYP <sup>‡</sup>	MAX	MIN	TYP <sup>‡</sup>	MAX	
$V_{IH}$ High-level input voltage		2			2			V
$V_{IL}$ Low-level input voltage				0.7			0.8	V
$V_{IK}$ Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$			-1.5			-1.5	V
$V_{OH}$ High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = -400 \mu\text{A}$	2.5	3.4		2.7	3.4		V
$V_{OL}$ Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 4 \text{ mA}$		0.25	0.4		0.25	0.4	V
	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 8 \text{ mA}$					0.35	0.5	
$I_I$ Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 7 \text{ V}$			0.1			0.1	mA
$I_{IH}$ High-level input current	$V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$			20			20	$\mu$ A
$I_{IL}$ Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-0.4			-0.4	mA
$I_{OS}$ Short-circuit output current <sup>§</sup>	$V_{CC} = \text{MAX}$	-20		-100	-20		-100	mA
$I_{CC}$ Supply current	$V_{CC} = \text{MAX},$ See Note 3		13	21		13	21	mA

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

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

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

NOTE 3:  $I_{CC}$  is measured with all outputs and serial input open; A, B, C, and D inputs grounded; mode control at 4.5 V; and a momentary 3 V, then ground, applied to both clock inputs.

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

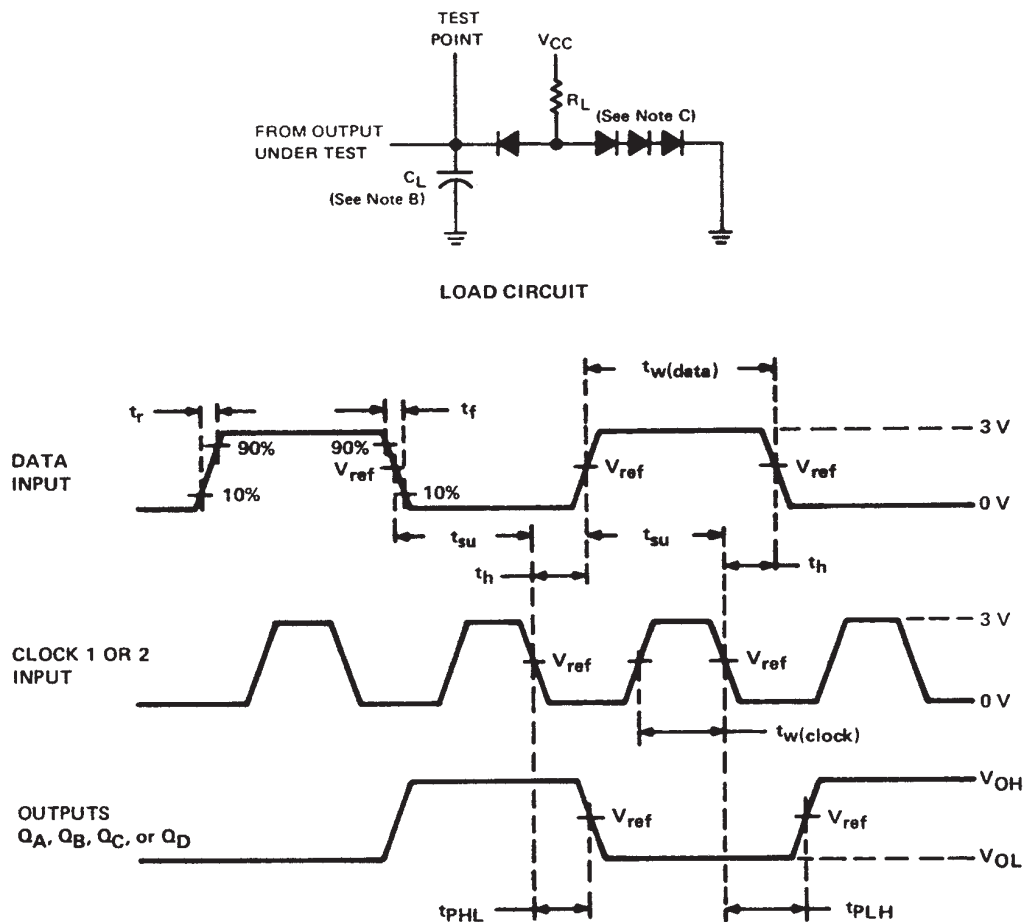
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{max}$ Maximum clock frequency	$C_L = 15 \text{ pF}, R_L = 2 \text{ k}\Omega,$ See Figure 1	25	36		MHz
$t_{PLH}$ Propagation delay time, low-to-high-level output from clock			18	27	ns
$t_{PHL}$ Propagation delay time, high-to-low-level output from clock			21	32	ns



SN5495A, SN54LS95B  
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PARAMETER MEASUREMENT INFORMATION

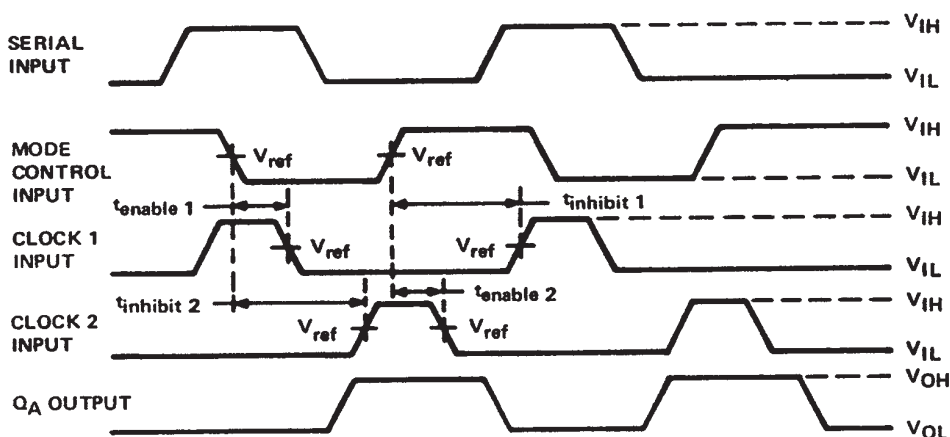


- NOTES: A. Input pulses are supplied by a generator having the following characteristics:  $t_r \leq 10$  ns,  $t_f \leq 10$  ns, and  $Z_{out} \approx 50 \Omega$ . For the data pulse generator, PRR = 500 kHz; for the clock pulse generator, PRR = 1 MHz. When testing  $f_{max}$ , vary PRR. For '95A,  $t_w(data) \geq 20$  ns,  $t_w(clock) \geq 15$  ns. For 'LS95B,  $t_w(data) \geq 20$  ns,  $t_w(clock) \geq 15$  ns.
- B.  $C_L$  includes probe and jig capacitance.
- C. All diodes are 1N3064 equivalent.
- D. For '95A,  $V_{ref} = 1.5$  V; for 'LS95B,  $V_{ref} = 1.3$  V.

VOLTAGE WAVEFORMS  
 FIGURE 1-SWITCHING TIMES



PARAMETER MEASUREMENT INFORMATION



NOTES: A. Input is at a low level.  
 B. For '95A,  $V_{ref} = 1.5\text{ V}$ ; for 'LS958,  $V_{ref} = 1.3\text{ V}$ .

VOLTAGE WAVEFORMS  
 FIGURE 2-CLOCK ENABLE/INHIBIT TIMES

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