

SN54LS295B, SN74LS295B 4-BIT RIGHT-SHIFT LEFT-SHIFT REGISTERS WITH 3-STATE OUTPUTS

SDLS154 - OCTOBER 1975 - REVISED MARCH 1988

- **'LS295B Offers Three Times the Sink-Current Capability of 'LS295A**
- **Schottky-Diode-Clamped Transistors**
- **Low Power Dissipation . . . 80 mW Typical (Enabled)**
- **Applications:**
 - N-Bit Serial-To-Parallel Converter**
 - N-Bit Parallel-To-Serial Converter**
 - N-Bit Storage Register**

description

These 4-bit registers feature parallel inputs, parallel outputs, and clock (CLK), serial (SER), mode (LD/SH), and outputs control (OC) 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)

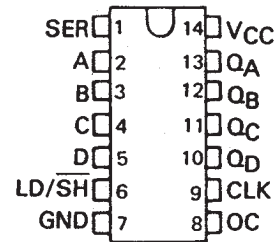
Parallel loading is accomplished by applying the four bits of data and taking the mode control input high. The data is loaded into the associated flip-flops and appears at the outputs after the high-to-low transition of the clock input. During parallel loading, the entry of serial data is inhibited.

Shift right is accomplished when the mode control is low; shift left is accomplished 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.

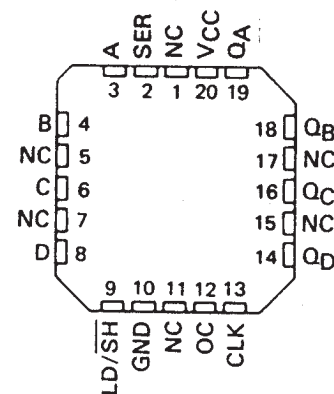
When the output control is high, the normal logic levels of the four outputs are available for driving the loads or bus lines. The outputs are disabled independently from the level of the clock by a low logic level at the output control input. The outputs then present a high impedance and neither load nor drive the bus line; however, sequential operation of the registers is not affected.

The SN54LS295B is characterized for operation over the full military temperature range of -55°C to 125°C ; the SN74LS295B is characterized for operation from 0°C to 70°C .

SN54LS295B . . . J OR W PACKAGE
SN74LS295B . . . D OR N PACKAGE
(TOP VIEW)

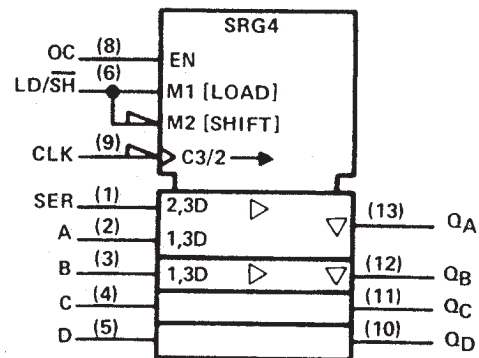


SN54LS295B . . . FK PACKAGE
(TOP VIEW)



NC - No internal connection

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.

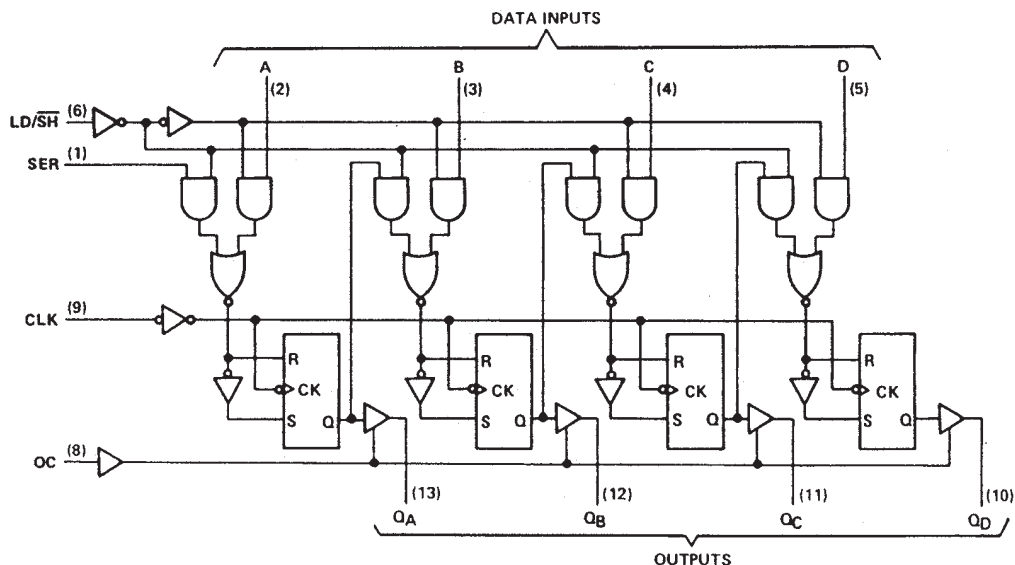
SN54LS295B, SN74LS295B

4-BIT RIGHT-SHIFT LEFT-SHIFT REGISTERS

WITH 3-STATE OUTPUTS

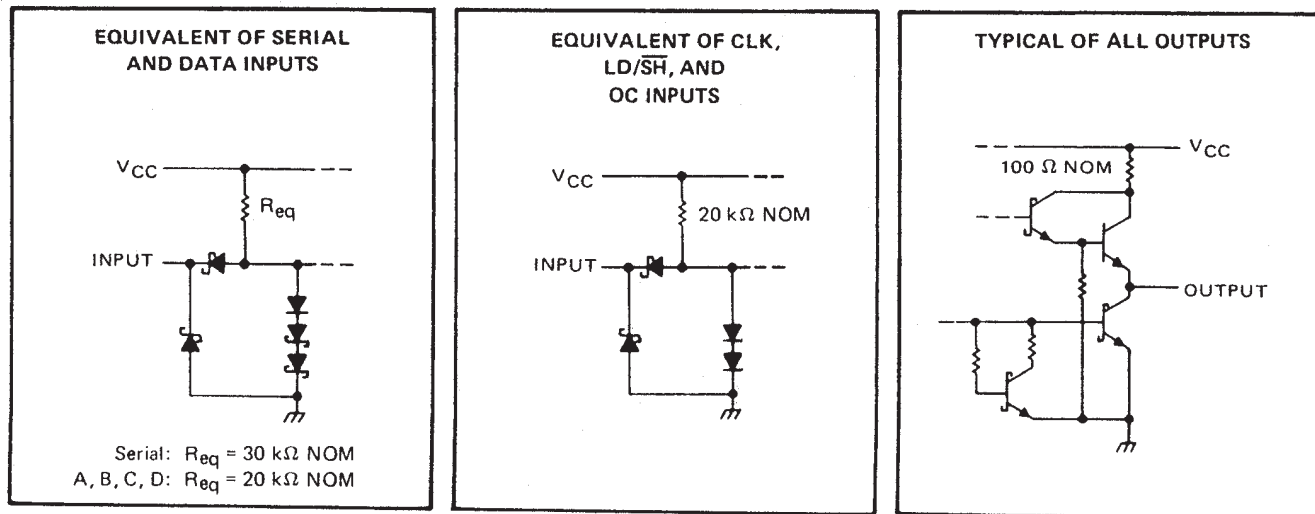
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logic diagram (positive logic)



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

schematics of inputs and outputs



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FUNCTION TABLE

INPUTS							OUTPUTS			
LD/ $\overline{\text{SH}}$	CLK	SER	PARALLEL				Q _A	Q _B	Q _C	Q _D
			A	B	C	D				
H	H	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}
H	↓	X	a	b	c	d	a	b	c	d
H	↓	X	Q _B [†]	Q _C [†]	Q _D [†]	d	Q _{Bn}	Q _{Cn}	Q _{Dn}	d
L	H	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}
L	↓	H	X	X	X	X	H	Q _{An}	Q _{Bn}	Q _{Cn}
L	↓	L	X	X	X	X	L	Q _{An}	Q _{Bn}	Q _{Cn}

When the output control is low, the outputs are disabled to the high-impedance state; however, sequential operation of the registers is not affected.

[†]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.

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.

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

Supply voltage, V _{CC} (see Note 1)	7 V
Input voltage	7 V
Operating free-air temperature range: SN54LS295B	–55°C to 125°C
SN74LS295B	0°C to 70°C
Storage temperature range	–65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

recommended operating conditions

			SN54LS295B			SN74LS295B			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		— 1			— 2.6			mA	
I _{OL}	Low-level output current		12			24			mA	
f _{clock}	Clock frequency		0	30		0	30		MHz	
t _{w(clock)}	Width of clock pulse		16			16			ns	
t _{su}	Setup time, high-level or low-level data		20			20			ns	
t _{su}	Setup time, LD/ $\overline{\text{SH}}$ to CLK	high-level	25			25			ns	
		low-level	30			30				
t _h	Hold time, high-level or low-level data		20			20			ns	
t _h	Hold time, high-level or low-level LD/ $\overline{\text{SH}}$ to CLK		0			0			ns	
T _A	Operating free-air temperature		— 55			125		0	70	°C



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SN54LS295B, SN74LS295B

4-BIT RIGHT-SHIFT LEFT-SHIFT REGISTERS

WITH 3-STATE OUTPUTS

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

PARAMETER	TEST CONDITIONS†	SN54LS295B			SN74LS295B			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	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	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = \text{MAX}$	2.4	3.4		2.4	3.1		V
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}$	$I_{OL} = 12 \text{ mA}$		0.25	0.4	0.25		0.4
		$I_{OL} = 24 \text{ mA}$				0.35		0.5
I_{OZH} Off-state output current, high-level voltage applied	$V_{CC} = \text{MAX}, V_{IL} = V_{IL \text{ max}}, V_O = 2.7 \text{ V}$			20			20	μA
I_{OZL} Off-state output current, low-level voltage applied	$V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V}, V_O = 0.4 \text{ V}$			-20			-20	μA
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	μA
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§	$V_{CC} = \text{MAX}$	-30		-130	-30		-130	mA
I_{CC} Supply current	$V_{CC} = \text{MAX}, \text{ See Note 2}$	Condition A		20	29	20		29
		Condition B		22	33	22		33

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

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

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

NOTE 2: I_{CC} is measured with the outputs open, the serial input and mode control at 4.5 V, and the data inputs grounded under the following conditions:

- Output control at 4.5 V and a momentary 3 V, then ground, applied to clock input.
- Output control and clock input grounded.

switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}, R_L = 667 \Omega$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max} Maximum clock frequency	$C_L = 45 \text{ pF}, \text{ See Note 3}$	30	45		MHz
t_{PLH} Propagation delay time, low-to-high-level output			14	20	ns
t_{PHL} Propagation delay time, high-to-low-level output			19	30	ns
t_{pZH} Output enable time to high level			18	26	ns
t_{pZL} Output enable time to low level			20	30	ns
t_{PHZ} Output disable time from high level	$C_L = 5 \text{ pF}, \text{ See Note 3}$		13	20	ns
t_{PLZ} Output disable time from low level			13	20	ns

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



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