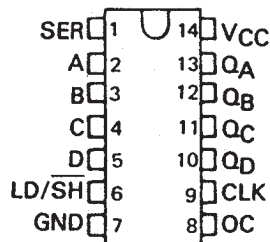


# SN54LS295B, SN74LS295B 4-BIT RIGHT-SHIFT LEFT-SHIFT REGISTERS WITH 3-STATE OUTPUTS

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**

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



## 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<sub>A</sub> toward Q<sub>D</sub>)
- Shift left (the direction Q<sub>D</sub> toward Q<sub>A</sub>)

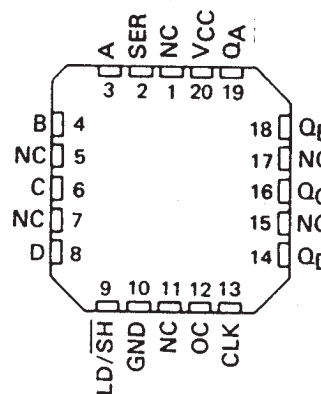
Parallel loading is accomplished by applying the four bits of data and taking the mode control input high. The data is loaded into the associated flip-flops and appears at the outputs after the high-to-low transition of the clock input. During parallel loading, the entry of serial data is inhibited.

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<sub>D</sub> 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.

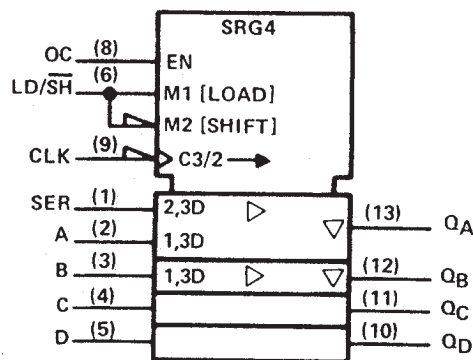
The SN54LS295B is characterized for operation over the full military temperature range of -55°C to 125°C; the SN74LS295B is characterized for operation from 0°C to 70°C.

SN54LS295B . . . FK PACKAGE  
(TOP VIEW)



NC - No internal connection

## logic symbol†



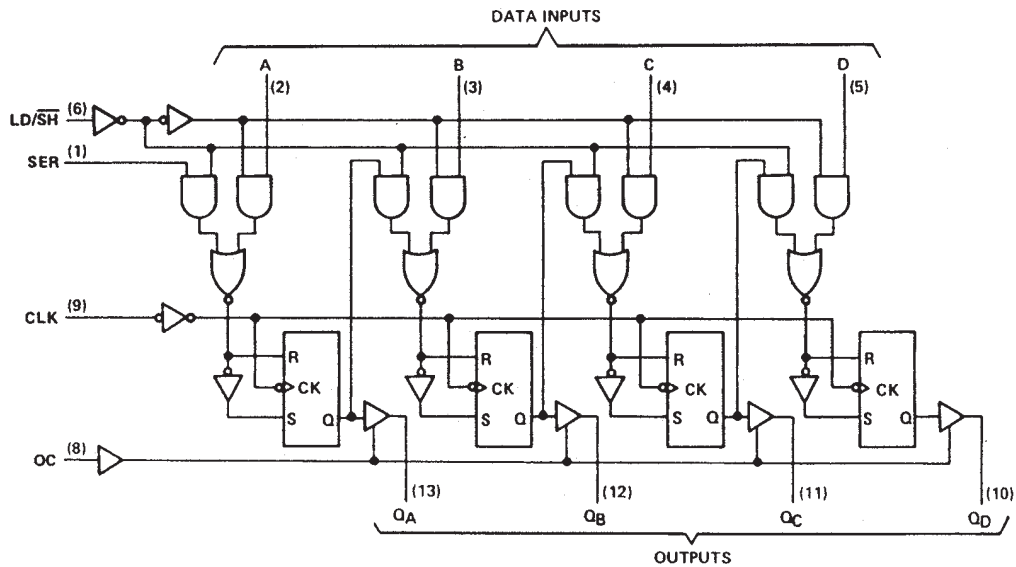
† This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

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

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

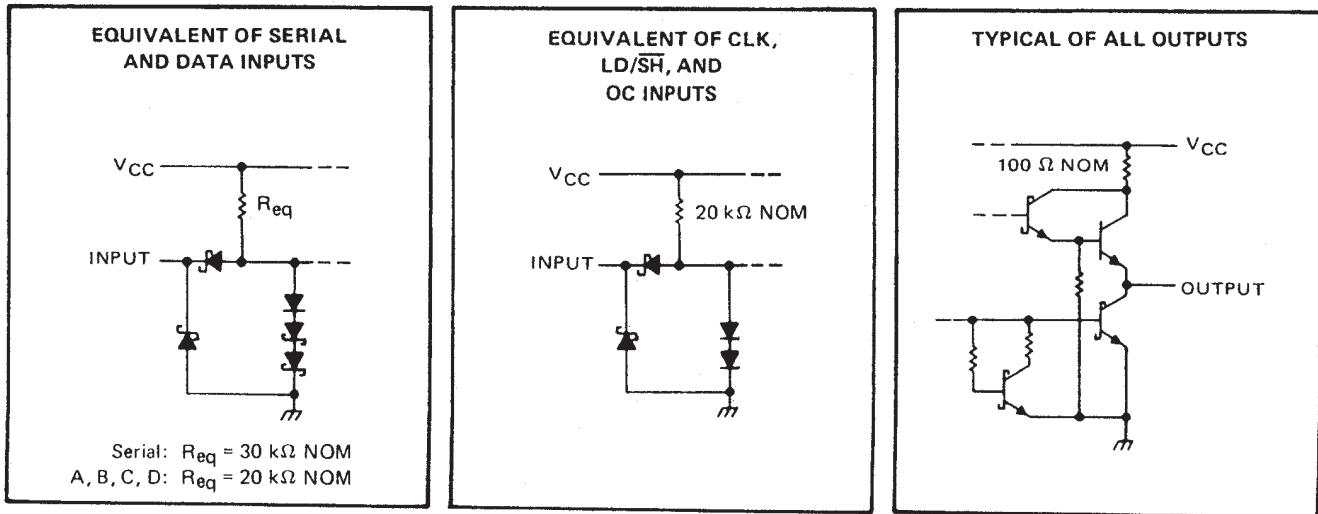
SDLS154 – OCTOBER 1975 – REVISED MARCH 1988

## logic diagram (positive logic)



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

## schematics of inputs and outputs



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

SDLS154 – OCTOBER 1975 – REVISED MARCH 1988

FUNCTION TABLE

LD/ $\overline{SH}$		INPUTS					OUTPUTS			
		CLK	SER	PARALLEL				Q <sub>A</sub>	Q <sub>B</sub>	Q <sub>C</sub>
A	B			C	D					
H	H	X	X	X	X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>C0</sub>	Q <sub>D0</sub>
H	↓	X	a	b	c	d	a	b	c	d
H	↓	X	Q <sub>B</sub> †	Q <sub>C</sub> †	Q <sub>D</sub> †	d	Q <sub>Bn</sub>	Q <sub>Cn</sub>	Q <sub>Dn</sub>	d
L	H	X	X	X	X	X	Q <sub>A0</sub>	Q <sub>B0</sub>	Q <sub>C0</sub>	Q <sub>D0</sub>
L	↓	H	X	X	X	X	H	Q <sub>An</sub>	Q <sub>Bn</sub>	Q <sub>Cn</sub>
L	↓	L	X	X	X	X	L	Q <sub>An</sub>	Q <sub>Bn</sub>	Q <sub>Cn</sub>

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<sub>B</sub> to A, Q<sub>C</sub> to B, and Q<sub>D</sub> 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<sub>A0</sub>, Q<sub>B0</sub>, Q<sub>C0</sub>, Q<sub>D0</sub> = the level of Q<sub>A</sub>, Q<sub>B</sub>, Q<sub>C</sub>, or Q<sub>D</sub>, respectively, before the indicated steady-state input conditions were established.

Q<sub>An</sub>, Q<sub>Bn</sub>, Q<sub>Cn</sub>, Q<sub>Dn</sub> = the level of Q<sub>A</sub>, Q<sub>B</sub>, Q<sub>C</sub>, or Q<sub>D</sub>, respectively, before the most-recent ↓ transition of the clock.

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

Supply voltage, V <sub>CC</sub> (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 <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
I <sub>OH</sub>	High-level output current			-1			-2.6	mA
I <sub>OL</sub>	Low-level output current			12			24	mA
f <sub>clock</sub>	Clock frequency	0		30	0		30	MHz
t <sub>w(clock)</sub>	Width of clock pulse	16			16			ns
t <sub>su</sub>	Setup time, high-level or low-level data	20			20			ns
t <sub>su</sub>	Setup time, LD/ $\overline{SH}$ to CLK	high-level		25	25		ns	
		low-level		30	30			
t <sub>h</sub>	Hold time, high-level or low-level data	20			20			ns
t <sub>h</sub>	Hold time, high-level or low-level LD/ $\overline{SH}$ to CLK	0			0			ns
T <sub>A</sub>	Operating free-air temperature	-55		125	0		70	°C



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

SDLS154 – OCTOBER 1975 – REVISED MARCH 1988

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 <sub>IH</sub> High-level input voltage		2			2			V
V <sub>IL</sub> Low-level input voltage				0.7			0.8	V
V <sub>IK</sub> Input clamp voltage	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 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> = V <sub>IL max</sub> , I <sub>OH</sub> = MAX	2.4	3.4		2.4	3.1		V
V <sub>OL</sub> Low-level output voltage	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2 V, V <sub>IL</sub> = V <sub>IL max</sub>	I <sub>OL</sub> = 12 mA	0.25	0.4	0.25	0.4		V
		I <sub>OL</sub> = 24 mA			0.35	0.5		
I <sub>OZH</sub> Off-state output current, high-level voltage applied	V <sub>CC</sub> = MAX, V <sub>IL</sub> = V <sub>IL max</sub> , V <sub>O</sub> = 2.7 V			20			20	μA
I <sub>OZL</sub> Off-state output current, low-level voltage applied	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2 V, V <sub>O</sub> = 0.4 V			-20			-20	μA
I <sub>I</sub> Input current at maximum input voltage	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V			0.1			0.1	mA
I <sub>IH</sub> High-level input current	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7 V			20			20	μA
I <sub>IL</sub> Low-level input current	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4 V			-0.4			-0.4	mA
I <sub>OS</sub> Short-circuit output current§	V <sub>CC</sub> = MAX	-30		-130	-30		-130	mA
I <sub>CC</sub> Supply current	V <sub>CC</sub> = MAX, See Note 2	Condition A	20	29	20	29		mA
		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<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°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<sub>CC</sub> 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:

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

switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, R<sub>L</sub> = 667 Ω

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f <sub>max</sub> Maximum clock frequency	C <sub>L</sub> = 45 pF, See Note 3	30	45		MHz
t <sub>PLH</sub> Propagation delay time, low-to-high-level output			14	20	ns
t <sub>PHL</sub> Propagation delay time, high-to-low-level output			19	30	ns
t <sub>PZH</sub> Output enable time to high level			18	26	ns
t <sub>PZL</sub> Output enable time to low level			20	30	ns
t <sub>PHZ</sub> Output disable time from high level	C <sub>L</sub> = 5 pF, See Note 3		13	20	ns
t <sub>PLZ</sub> Output disable time from low level			13	20	ns

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



**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>
SN54LS295BJ	OBSOLETE	CDIP	J	14		TBD	Call TI	Call TI
SN74LS295BN	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI
SN74LS295BN	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI

<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), Pb-Free (RoHS Exempt), 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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**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.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>	Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>