SN54LS299, SN54S299, SN74LS299, SN74S299
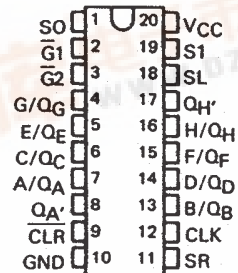# 8-BIT UNIVERSAL SHIFT/STORAGE REGISTERS

SDLS156 – MARCH 1974 – REVISED MARCH 1988

- **Multiplexed Inputs/Outputs Provide Improved Bit Density**

- **Four Modes of Operations:**
  - Hold (Store)   Shift Left
  - Shift Right   Load Data

- **Operates with Outputs Enabled or at High Z**

- **3-State Outputs Drive Bus Lines Directly**

- **Can Be Cascaded for N-Bit Word Lengths**

- **SN54LS323 and SN74LS323 Are Similar But Have Synchronous Clear**

- **Applications:**
  - Stacked or Push-Down Registers
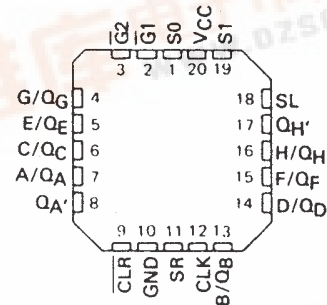 - Buffer Storage, and Accumulator Registers

TYPE	GUARANTEED SHIFT (CLOCK) FREQUENCY	TYPICAL POWER DISSIPATION
'LS299	25 MHz	175 mW
'S299	50 MHz	700 mW

SN54LS299, SN54S299 . . . J OR W PACKAGE
SN74LS299, SN74S299 . . . DW OR N PACKAGE
(TOP VIEW)

```
        S0  [1   U  20]  VCC
        G1  [2      19]  S1
        G2  [3      18]  SL
      G/QG  [4      17]  QH'
      E/QE  [5      16]  H/QH
      C/QC  [6      15]  F/QF
      A/QA  [7      14]  D/QD
       QA'  [8      13]  B/QB
       CLR  [9      12]  CLK
       GND  [10     11]  SR
```

SN54LS299, SN54S299 . . . FK PACKAGE
(TOP VIEW)

```
              G2 G1 S0 VCC S1
              3  2  1  20 19
      G/QG  [4            18]  SL
      E/QE  [5            17]  QH'
      C/QC  [6            16]  H/QH
      A/QA  [7            15]  F/QF
       QA'  [8            14]  D/QD
              9  10 11 12 13
             CLR GND SR CLK B/QB
```

description

These Schottky TTL eight-bit universal registers feature multiplexed inputs/outputs to achieve full eight-bit data handling in a single 20-pin package. Two function-select inputs and two output-control inputs can be used to choose the modes of operation listed in the function table.

Synchronous parallel loading is accomplished by taking both function-select lines, S0 and S1, high. This places the three-state outputs in a high-impedance state, which permits data that is applied on the input/output lines to be clocked into the register. Reading out of the register can be accomplished while the outputs are enabled in any mode. A direct overriding input is provided to clear the register whether the outputs are enabled or off.

FUNCTION TABLE

MODE	CLR	S1	S0	G1†	G2†	CLK	SL	SR	A/QA	B/QB	C/QC	D/QD	E/QE	F/QF	G/QG	H/QH	QA'	QH'
		FUNCTION SELECT		OUTPUT CONTROL			SERIAL		INPUTS/OUTPUTS								OUTPUTS	
Clear	L	X	X	L	L	X	X	X	L	L	L	L	L	L	L	L	L	L
	L	L	X	L	L	X	X	X	L	L	L	L	L	L	L	L	L	L
	L	H	H	X	X	X	X	X	X	X	X	X	X	X	X	X	L	L
Hold	H	L	L	L	L	X	X	X	QA0	QB0	QC0	QD0	QE0	QF0	QG0	QH0	QA0	QH0
	H	X	X	L	L	L	X	X	QA0	QB0	QC0	QD0	QE0	QF0	QG0	QH0	QA0	QH0
Shift Right	H	L	H	L	L	↑	X	H	H	QAn	QBn	QCn	QDn	QEn	QFn	QGn	H	QGn
	H	L	H	L	L	↑	X	L	L	QAn	QBn	QCn	QDn	QEn	QFn	QGn	L	QGn
Shift Left	H	H	L	L	L	↑	H	X	QBn	QCn	QDn	QEn	QFn	QGn	QHn	H	QBn	H
	H	H	L	L	L	↑	L	X	QBn	QCn	QDn	QEn	QFn	QGn	QHn	L	QBn	L
Load	H	H	H	X	X	↑	X	X	a	b	c	d	e	f	g	h	a	h

†When one or both output controls are high the eight input/output terminals are disabled to the high-impedance state; however, sequential operation or clearing of the register is not affected.
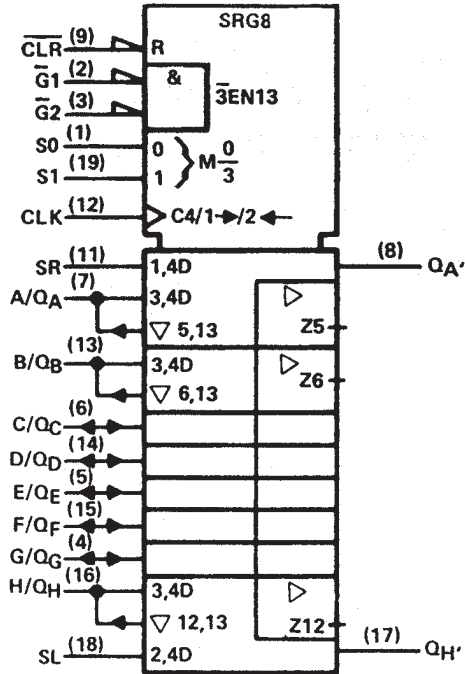
a . . . h = the level of the steady-state input at inputs A through H, respectively. These data are loaded into the flip-flops while the flip-flop outputs are isolated from the input/output terminals.

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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 DW, J, N, and W packages.
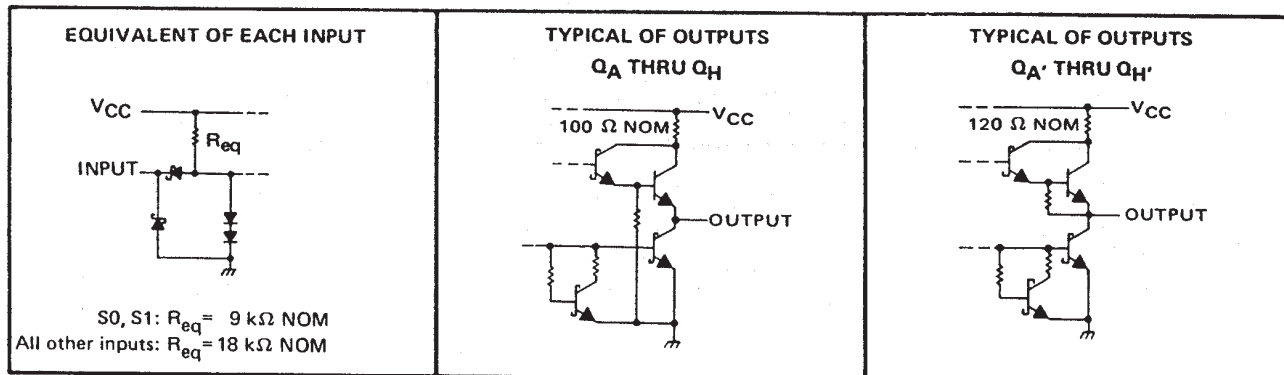
logic diagram (positive logic)

I/O PORTS NOT SHOWN:
(6) C/Q_C (5) E/Q_E
(14) D/Q_D (15) F/Q_F

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

schematics of inputs and outputs

EQUIVALENT OF EACH INPUT	TYPICAL OF OUTPUTS Q_A THRU Q_H	TYPICAL OF OUTPUTS $Q_{A'}$ THRU $Q_{H'}$
S0, S1: R_{eq} = 9 kΩ NOM All other inputs: R_{eq} = 18 kΩ NOM	100 Ω NOM	120 Ω NOM

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
Off-state output voltage . . . . 5.5 V
Operating free-air temperature range: SN54LS299 . . . . −55°C to 125°C
 SN74LS299 . . . . 0°C to 70°C
Storage temperature . . . . −65°C to 150°C

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

recommended operating conditions

		SN54LS299			SN74LS299			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}	Q_A thru Q_H			−1			−2.6	mA
	$Q_{A'}$ or $Q_{H'}$			−0.4			−0.4	
Low-level output current, I_{OL}	Q_A thru Q_H			12			24	mA
	$Q_{A'}$ or $Q_{H'}$			4			8	
Clock frequency, f_{clock}		0		20	0		20	MHz
Width of clock pulse, $t_{w(clock)}$	Clock high	30			30			ns
	Clock low	18			10			
Width of clear pulse, $t_{w(clear)}$	Clear low	25			20			ns
Setup time, t_{su}	Select	35†			35†			ns
	High-level data†	20†			20†			
	Low-level data†	20†			20†			
	Clear inactive-state	24†			20†			
Hold time, t_h	Select	10†			10†			ns
	Data†	3†			0†			
Operating free-air temperature, T_A		−55		125	0		70	°C

† Data includes the two serial inputs and the eight input/output data lines.

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

PARAMETER		TEST CONDITIONS†			SN54LS299			SN74LS299			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} = MIN,	I_I = −18 mA				−1.5			−1.5	V
V_{OH}	High-level output voltage	Q_A thru Q_H	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max, I_{OH} = MAX		2.4	3.2		2.4	3.1		V
		Q_A' or Q_H'			2.5	3.4		2.7	3.4		
V_{OL}	Low-level output voltage	Q_A thru Q_H	V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max	I_{OL} = 12 mA		0.25	0.4		0.25	0.4	V
				I_{OL} = 24 mA					0.35	0.5	
		Q_A' or Q_H'		I_{OL} = 4 mA		0.25	0.4		0.25	0.4	
				I_{OL} = 8 mA					0.35	0.5	
I_{OZH}	Off-state output current, high-level voltage applied	Q_A thru Q_H	V_{CC} = MAX, V_{IH} = 2 V, V_O = 2.7 V				40			40	µA
I_{OZL}	Off-state output current, low-level voltage applied	Q_A thru Q_H	V_{CC} = MAX, V_{IH} = 2 V, V_O = 0.4 V				−400			−400	µA
I_I	Input current at maximum input voltage	S0, S1	V_{CC} = MAX	V_I = 7 V			200			200	µA
		A thru H		V_I = 5.5 V			100			100	
		Any other		V_I = 7 V			100			100	
I_{IH}	High-level input current	A thru H, S0, S1	V_{CC} = MAX, V_I = 2.7 V				40			40	µA
		Any other					20			20	
I_{IL}	Low-level input current	S0, S1	V_{CC} = MAX, V_I = 0.4 V				−0.8			−0.8	mA
		Any other					−0.4			−0.4	
I_{OS}	Short-circuit output current§	Q_A thru Q_H	V_{CC} = MAX		−30		−130	−30		−130	mA
		Q_A' or Q_H'			−20		−100	−20		−100	
I_{CC}	Supply current		V_{CC} = MAX			33	53		33	53	mA

†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 duration of the short-circuit should not exceed one second.

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

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			See Note 2	20	35		MHz
t_{PLH}	CLK	Q_A' or Q_H'	R_L = 2 kΩ, C_L = 15 pF		22	33	ns
t_{PHL}					26	39	
t_{PHL}	$\overline{CLR}$	Q_A' or Q_H'			27	40	ns
t_{PLH}	CLK	Q_A thru Q_H	R_L = 665 Ω, C_L = 45 pF		17	25	ns
t_{PHL}					26	39	
t_{PHL}	$\overline{CLR}$	Q_A thru Q_H			26	40	ns
t_{PZH}	$\overline{G1}$, $\overline{G2}$	Q_A thru Q_H			13	21	ns
t_{PZL}					19	30	
t_{PHZ}	$\overline{G1}$, $\overline{G2}$	Q_A thru Q_H	R_L = 665 Ω, C_L = 5 pF		10	20	ns
t_{PLZ}					10	15	

¶ 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
t_{PZH} ≡ output enable time to high level
t_{PZL} ≡ output enable time to low level
t_{PHZ} ≡ output disable time from high level
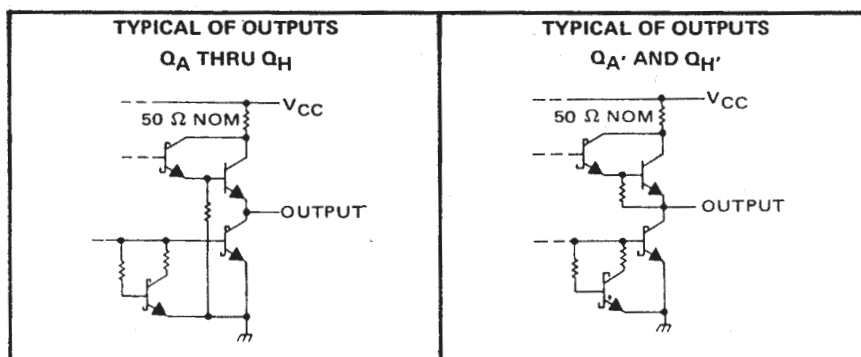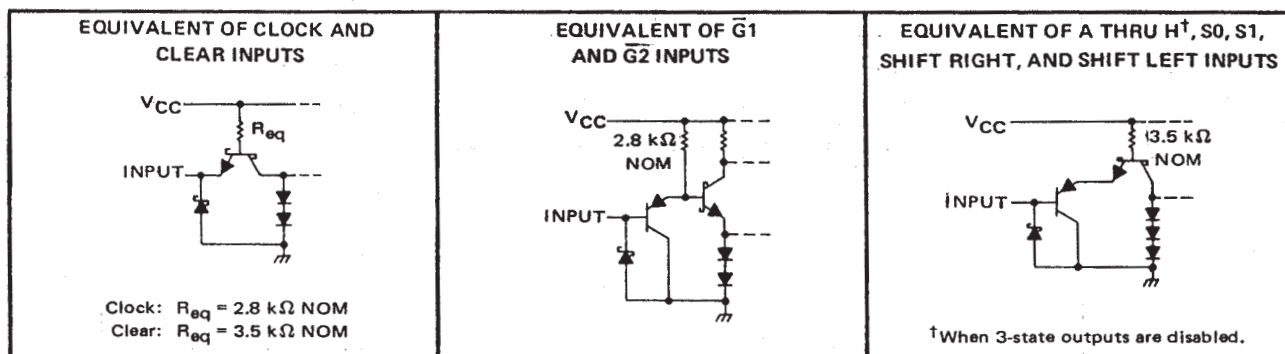t_{PLZ} ≡ output disable time from low level
NOTE 2: For testing f_{max}, all outputs are loaded simultaneously, each with C_L and R_L as specified for the propagation times. Load circuits and voltage waveforms are shown in Section 1.

schematics of inputs and outputs

EQUIVALENT OF CLOCK AND CLEAR INPUTS

Clock: R_{eq} = 2.8 kΩ NOM
Clear: R_{eq} = 3.5 kΩ NOM

EQUIVALENT OF $\overline{G1}$ AND $\overline{G2}$ INPUTS

EQUIVALENT OF A THRU H†, S0, S1, SHIFT RIGHT, AND SHIFT LEFT INPUTS

†When 3-state outputs are disabled.

TYPICAL OF OUTPUTS Q_A THRU Q_H

TYPICAL OF OUTPUTS Q_A' AND Q_H'

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

Supply voltage, V_{CC} (see Note 1) . . . . 7 V
Input voltage . . . . 5.5 V
Off-state output voltage . . . . 5.5 V
Operating free-air temperature range: SN54S299 (See Note 1) . . . . −55°C to 125°C
                                          SN74S299 . . . . 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

		SN54S299			SN74S299			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}	Q_A thru Q_H			−2			−6.5	mA
	Q_A' or Q_H'			−0.5			−0.5	
Low-level output current, I_{OL}	Q_A thru Q_H			20			20	mA
	Q_A' or Q_H'			6			6	
Clock frequency, f_{clock}		0		50	0		50	MHz
Width of clock pulse, $t_{w(clock)}$	Clock high	10			10			ns
	Clock low	10			10			
Width of clear pulse, $t_{w(clear)}$	Clear low	10			10			ns
Setup time, t_{su}	Select	15↑			15↑			ns
	High-level data‡	7↑			7↑			
	Low-level data‡	5↑			5↑			
	Clear inactive-state	10↑			10↑			
Hold time, t_h	Select	5↑			5↑			ns
	Data‡	5↑			5↑			
Operating free-air temperature, T_A		−55		125	0		70	°C

‡ Data includes the two serial inputs and the eight input/output data lines.

TEXAS
INSTRUMENTS

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

PARAMETER		TEST CONDITIONS†		MIN	TYP‡	MAX	UNIT
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IK}	Input clamp voltage		V_{CC} = MIN, I_I = −18 mA			−1.2	V
V_{OH}	High-level output voltage	Q_A thru Q_H	V_{CC} = MIN, V_{IH} = 2 V,	2.4	3.2		V
		Q_A' or Q_H'	V_{IL} = 0.8 V, I_{OH} = MAX	2.7	3.4		
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = 0.8 V, I_{OL} = MAX			0.5	V
I_{OZH}	Off-state output current, high-level voltage applied	Q_A thru Q_H	V_{CC} = MAX, V_{IH} = 2 V, V_O = 2.4 V			100	µA
I_{OZL}	Off-state output current, low-level voltage applied	Q_A thru Q_H	V_{CC} = MAX, V_{IH} = 2 V, V_O = 0.5 V			−250	µA
I_I	Input current at maximum input voltage		V_{CC} = MAX, V_I = 5.5 V			1	mA
I_{IH}	High-level input current	A thru H, S0, S1	V_{CC} = MAX, V_I = 2.7 V			100	µA
		Any other				50	
I_{IL}	Low-level input current	CLK or CLR				−2	mA
		S0, S1	V_{CC} = MAX, V_I = 0.5 V			−500	µA
		Any other				−250	µA
I_{OS}	Short-circuit output current§	Q_A thru Q_H	V_{CC} = MAX	−40		−100	mA
		Q_A' or Q_H'		−20		−100	
I_{CC}	Supply current		V_{CC} = MAX		140	225	mA

† 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 duration of the short-circuit should not exceed one second.

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

PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{max}			See Note 2	50	70		MHz
t_{PLH}	CLK	Q_A' or Q_H'	R_L = 1 kΩ, C_L = 15 pF		12	20	ns
t_{PHL}					13	20	
t_{PHL}	$\overline{CLR}$	Q_A' or Q_H'			14	21	ns
t_{PLH}	CLK	Q_A thru Q_H			15	21	ns
t_{PHL}			R_L = 280 Ω, C_L = 45 pF		15	21	
t_{PHL}	$\overline{CLR}$	Q_A thru Q_H			16	24	ns
t_{PZH}	$\overline{G1}, \overline{G2}$	Q_A thru Q_H			10	18	ns
t_{PZL}					12	18	
t_{PHZ}	$\overline{G1}, \overline{G2}$	Q_A thru Q_H	R_L = 280 Ω, C_L = 5 pF		7	12	ns
t_{PLZ}					7	12	

¶ 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
  t_{PZH} = output enable time to high level
  t_{PZL} = output enable time to low level
  t_{PHZ} = output disable time from high level
  t_{PLZ} = output disable time from low level
NOTE 2: For testing f_{max}, all outputs are loaded simultaneously, each with C_L and R_L as specified for the propagation times.
       Load circuits and voltage waveforms are shown in Section 1.

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