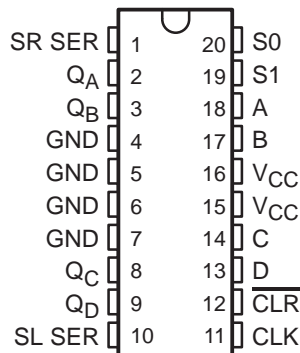


- Parallel-to-Serial, Serial-to-Parallel Conversions
- Left or Right Shifts
- Parallel Synchronous Loading
- Direct Overriding Clear
- Temporary Data Latching Capability
- Flow-Through Architecture to Optimize PCB Layout
- Center-Pin  $V_{CC}$  and GND Configurations to Minimize High-Speed Switching Noise
- EPIC™ (Enhanced-Performance Implanted CMOS) 1- $\mu$ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic Small-Outline Packages, and Standard Plastic 300-mil DIPs

DW OR N PACKAGE  
(TOP VIEW)



## description

This bidirectional shift register features parallel outputs, right-shift and left-shift serial inputs, operating-mode-control inputs, and a direct overriding clear line. The register has four distinct modes of operation:

- Parallel (broadside) load
- Shift right (in the direction  $Q_A$  toward  $Q_D$ )
- Shift left (in the direction  $Q_D$  toward  $Q_A$ )
- Inhibit clocking (do nothing).

Synchronous parallel loading is accomplished by applying the 4 bits of data and taking both mode control inputs, S0 and S1, high. The data are loaded into the associated flip-flops and appear at the outputs after the positive transition of the clock input. During loading, serial data flow is inhibited.

Shift right is accomplished synchronously with the rising edge of the clock pulse when S0 is high and S1 is low. Serial data for this mode is entered at the shift-right data input. When S0 is low and S1 is high, data shifts left synchronously, and new data is entered at the shift-left serial inputs. Clocking of the flip-flop is inhibited when both mode control inputs are low.

The 74AC11194 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

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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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# 74AC11194 4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER

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Function Table

CLEAR	MODE		CLOCK	INPUTS						OUTPUTS			
	S1	S0		SERIAL		PARALLEL				QA	QB	QC	QD
				LEFT	RIGHT	A	B	C	D				
L	X	X	X	X	X	X	X	X	X	L	L	L	L
H	X	X	L	X	X	X	X	X	X	QA0	QB0	QC0	QD0
H	H	H	↑	X	X	a	b	c	d	a	b	c	d
H	L	H	↑	X	H	X	X	X	X	H	QAn	QBn	QCn
H	L	H	↑	X	L	X	X	X	X	L	QAn	QBn	QCn
H	H	L	↑	H	X	X	X	X	X	QBn	QCn	QDn	H
H	H	L	↑	L	X	X	X	X	X	QBn	QCn	QDn	L
H	L	L	X	X	X	X	X	X	X	QAO	QBO	QCO	QDO

H = high level (steady state)

L = low level (steady state)

X = irrelevant (any input, including transitions)

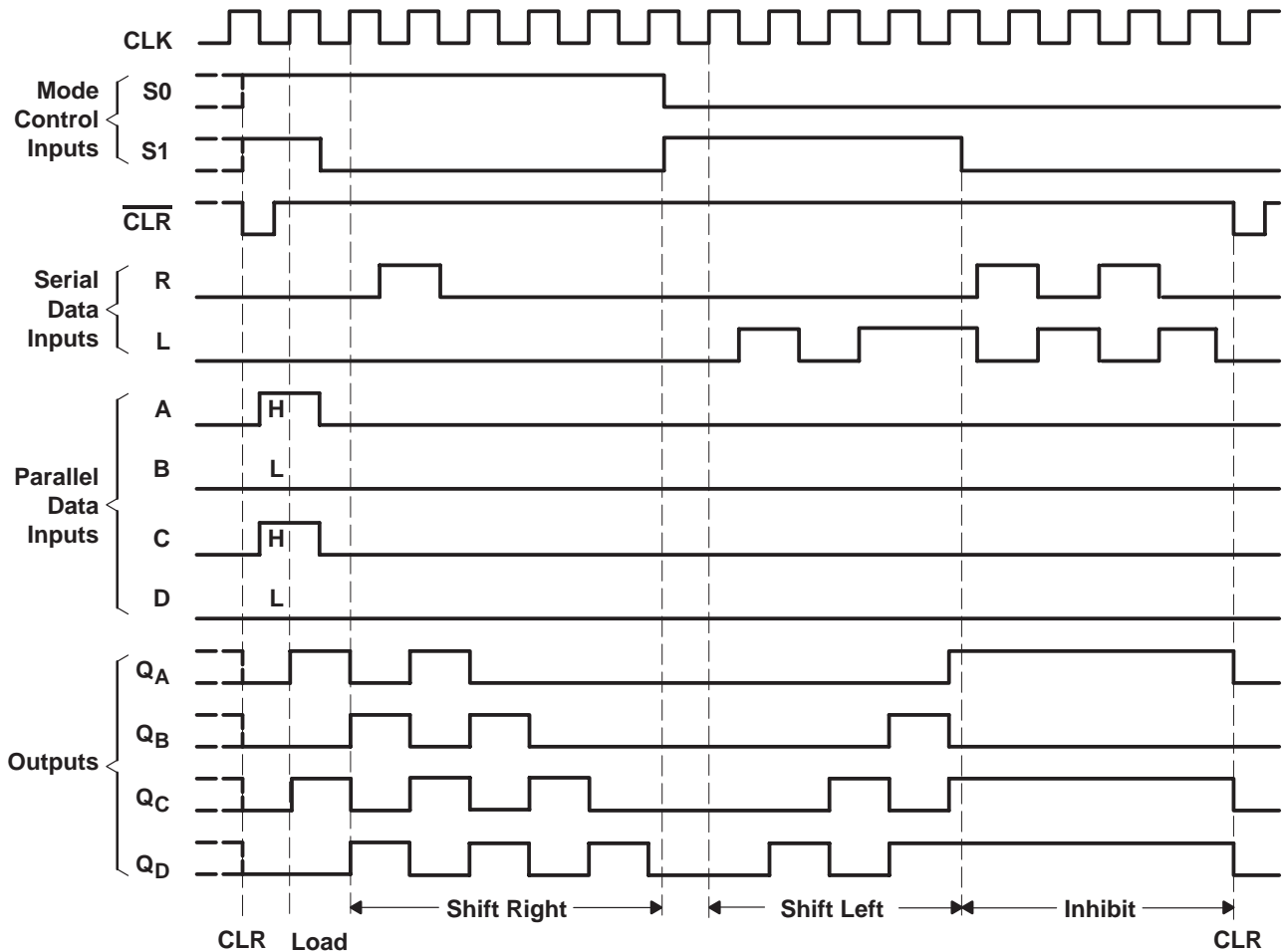
↑ = transition from low to high level

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

QA0, QB0, QC0, QD0 = the level of QA, QB, QC, or QD, respectively, before the indicated steady-state input conditions were established.

QAn, QBn, QCn, QDn = the level of QA, QB, QC, or QD respectively, before the most-recent ↑ transition of the clock.

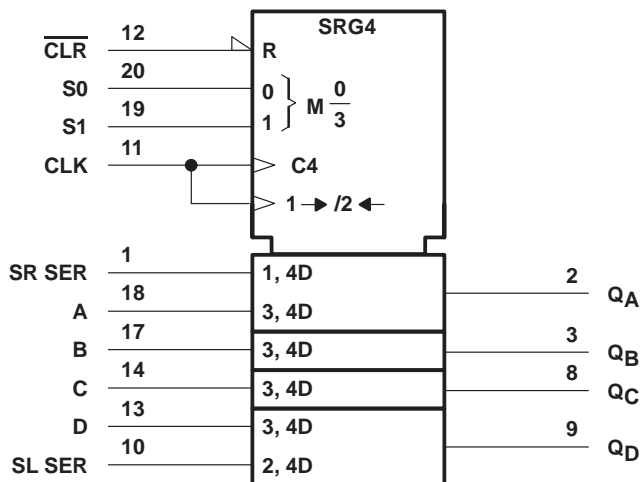
## timing clear, load, right-shift, inhibit, and clear sequences



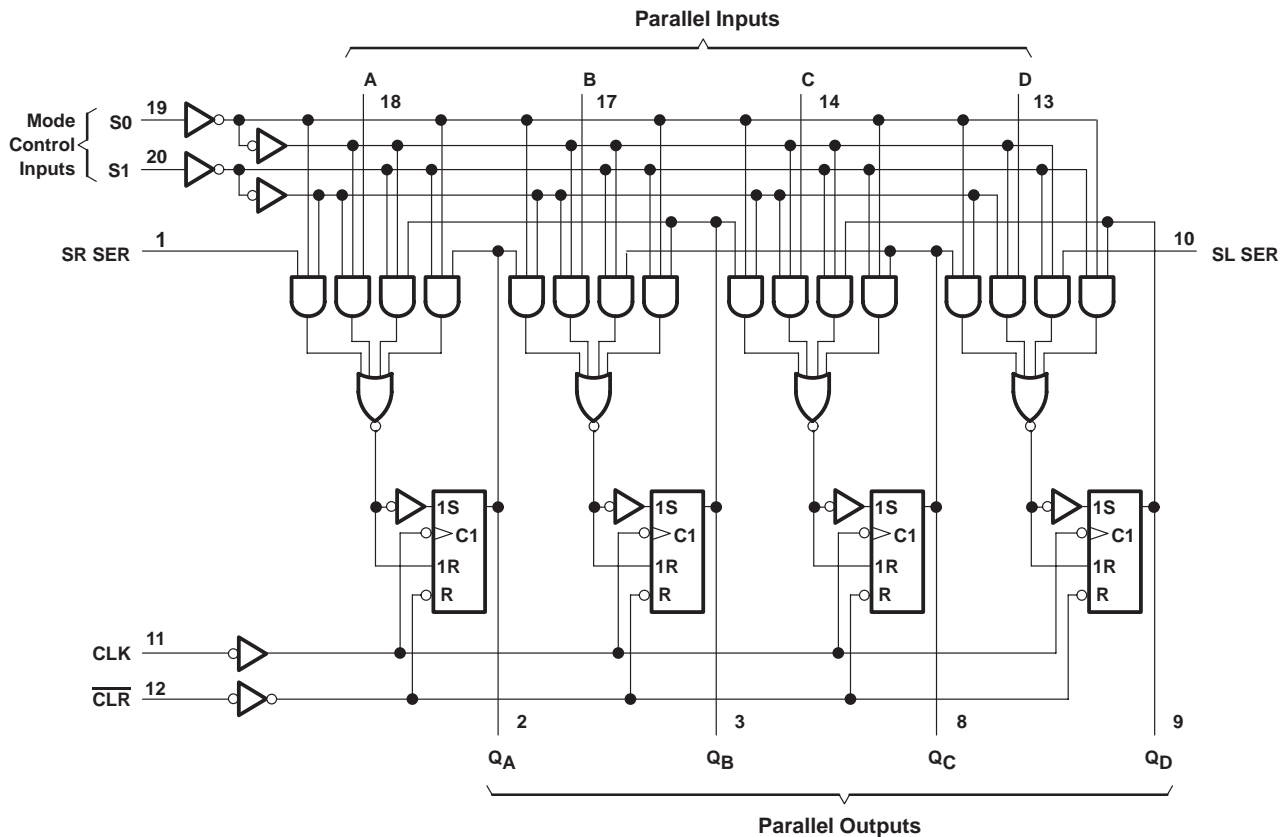
4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER

SCAS093 – NOVEMBER 1989 – REVISED APRIL 1993

logic symbol†



logic diagram (positive logic)



# 74AC11194

## 4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER

SCAS093 – NOVEMBER 1989 – REVISED APRIL 1993

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

Supply voltage range, $V_{CC}$ .....	-0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....	$\pm 50$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 50$ mA
Continuous current through $V_{CC}$ or GND pins .....	$\pm 100$ mA
Storage temperature range .....	-65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

### recommended operating conditions

		MIN	NOM	MAX	UNIT
$V_{CC}$	Supply voltage	3	5	5.5	V
$V_{IH}$	High-level input voltage	$V_{CC} = 3$ V	2.1		V
		$V_{CC} = 4.5$ V	3.15		
		$V_{CC} = 5.5$ V	3.85		
$V_{IL}$	Low-level input voltage	$V_{CC} = 3$ V		0.9	V
		$V_{CC} = 4.5$ V		1.35	
		$V_{CC} = 5.5$ V		1.65	
$I_{OH}$	High-level output current	$V_{CC} = 3$ V		-4	mA
		$V_{CC} = 4.5$ V		-24	
		$V_{CC} = 5.5$ V		-24	
$I_{OL}$	Low-level output current	$V_{CC} = 3$ V		12	mA
		$V_{CC} = 4.5$ V		24	
		$V_{CC} = 5.5$ V		24	
$V_I$	Input voltage	0		$V_{CC}$	V
$V_O$	Output voltage	0		$V_{CC}$	V
$\Delta t/\Delta v$	Input transition rise or fall rate	0		10	ns/V
$T_A$	Operating free-air temperature	-40		85	°C

## 4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER

SCAS093 – NOVEMBER 1989 – REVISED APRIL 1993

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			MIN	MAX	UNIT
			MIN	TYP	MAX			
V <sub>OH</sub>	I <sub>OH</sub> = -50 μA	3 V	2.9			2.9		V
		4.5 V	4.4			4.4		
		5.5 V	5.4			5.4		
	I <sub>OH</sub> = -4 mA	3 V	2.58			2.48		
		4.5 V	3.94			3.8		
		5.5 V	4.94			4.8		
I <sub>OH</sub> = -75 mA <sup>†</sup>	5.5 V				3.85			
V <sub>OL</sub>	I <sub>OL</sub> = 50 μA	3 V				0.1		V
		4.5 V				0.1		
		5.5 V				0.1		
	I <sub>OL</sub> = 12 mA	3 V				0.36		
		4.5 V				0.36		
	I <sub>OL</sub> = 24 mA	3 V				0.36		
		4.5 V				0.36		
I <sub>OL</sub> = 75 mA <sup>†</sup>	5.5 V				1.65			
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V				±0.1		μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V				8		μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V				4		pF

<sup>†</sup> Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

timing requirements over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER		T <sub>A</sub> = 25°C		MIN	MAX	UNIT
		MIN	MAX			
f <sub>clock</sub>	Clock frequency	0	90	0	90	MHz
t <sub>w</sub>	Pulse duration	CLK high	5.5	5.5		ns
		CLK low	5.5	5.5		
		CLR low	4.5	4.5		
t <sub>su</sub>	Setup time before CLK ↑	Select	5	5		ns
		Data	4	4		
t <sub>h</sub>	Hold time after CLK ↑	Select	1.5	1.5		ns
		Data	0.5	0.5		
t	Recovery time	1	1		ns	



# 74AC11194

## 4-BIT BIDIRECTIONAL UNIVERSAL SHIFT REGISTER

SCAS093 – NOVEMBER 1989 – REVISED APRIL 1993

timing requirements over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER		$T_A = 25^\circ\text{C}$		MIN	MAX	UNIT
		MIN	MAX			
$f_{\text{clock}}$	Clock frequency	0	100	0	100	MHz
$t_w$	Pulse duration	CLK high	5	5		ns
		CLK low	5	5		
		$\overline{\text{CLR}}$ low	4.5	4.5		
$t_{\text{su}}$	Setup time before CLK $\uparrow$	Select	4	4		ns
		Data	2.5	2.5		
$t_h$	Hold time after CLK $\uparrow$	Select	1.5	1.5		ns
		Data	1	1		
$t$	Recovery time	1		1		ns

switching characteristics over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
			MIN	TYP	MAX			
$f_{\text{max}}$			90	120		90		MHz
$t_{\text{PHL}}$	CLK	Any Q	1	5.8	8.4	1	9.5	ns
$t_{\text{PLH}}$			1	6.6	8.9	1	10.2	
$t_{\text{PHL}}$	$\overline{\text{CLR}}$	Any Q	1.7	7.1	9.5	1.7	10.7	ns

switching characteristics over recommended operating free-air temperature range,  $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$  (unless otherwise noted) (see Figure 1)

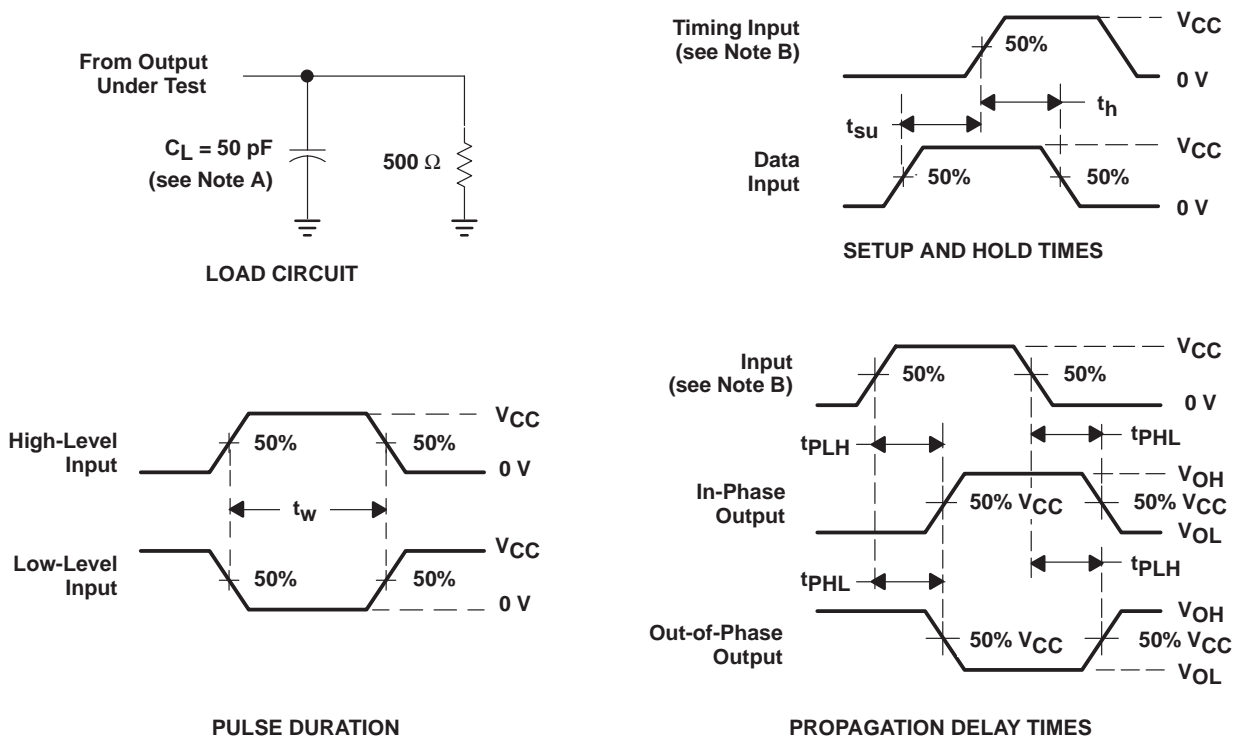
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			MIN	MAX	UNIT
			MIN	TYP	MAX			
$f_{\text{max}}$			100	130		100		MHz
$t_{\text{PHL}}$	CLK	Any Q	0.8	3.9	6.2	0.8	6.8	ns
$t_{\text{PLH}}$			1.1	4.4	6.6	1.1	7.7	
$t_{\text{PHL}}$	$\overline{\text{CLR}}$	Any Q	1.5	4.6	7	1.5	7.8	ns

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

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{\text{pd}}$	$C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$	66	pF



## PARAMETER MEASUREMENT INFORMATION



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 3$  ns,  $t_f = 3$  ns. For testing  $f_{max}$  and pulse duration:  $t_r = 1$  to 3 ns,  $t_f = 1$  to 3 ns.  
 C. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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