

# SN54178, SN74178 4-BIT PARALLEL-ACCESS SHIFT REGISTERS

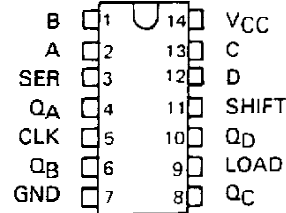
SDLS070

DECEMBER 1972 - REVISED MARCH 1988

- Typical Maximum Clock Frequency . . . 39 MHz
- Three Operating Modes:
  - Synchronous Parallel Load
  - Right Shift
  - Hold (Do Nothing)
- Negative-Edge-Triggered Clocking
- D-C Coupling Simplifies System Designs

SN54178 . . . J OR W PACKAGE

(TOP VIEW)



### description

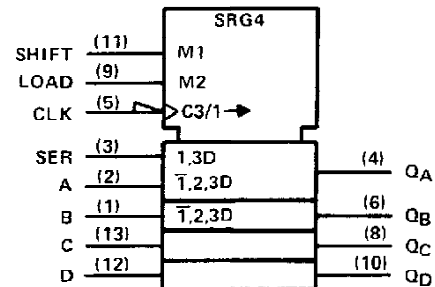
These shift registers utilize fully d-c coupled storage elements and feature synchronous parallel inputs and parallel outputs.

Parallel loading is accomplished by taking the shift input low, applying the four bits of data, and taking the load input high. The data is loaded into the associated flip-flop synchronously and appears at the outputs after a high-to-low transition of the clock. During loading, serial data flow is inhibited.

Shift right is also accomplished on the falling edge of the clock pulse when the shift input is high regardless of the level of the load input. Serial data for this mode is entered at the serial data input.

When both the shift and load inputs are low, clocking of the register can continue; however, data appearing at each output is fed back to the flip-flop input creating a mode in which the data is held unchanged. Thus, the system clock may be left free-running without changing the contents of the register.

### logic symbol†



†This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617.12.

### FUNCTION TABLE

INPUTS					OUTPUTS						
SHIFT	LOAD	CLOCK	SERIAL	PARALLEL				QA	QB	QC	QD
				A	B	C	D				
X	X	H	X	X	X	X	X	QA0	QB0	QC0	QD0
L	L	↓	X	X	X	X	X	QA0	QB0	QC0	QD0
L	H	↓	X	a	b	c	d	a	b	c	d
H	X	↓	H	X	X	X	X	H	QA <sub>n</sub>	QB <sub>n</sub>	QC <sub>n</sub>
H	X	↓	L	X	X	X	X	L	QA <sub>n</sub>	QB <sub>n</sub>	QC <sub>n</sub>

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.

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

QA<sub>n</sub>, QB<sub>n</sub>, QC<sub>n</sub> = the level of QA, QB, or QC, respectively, before the most-recent ↓ transition of the clock.

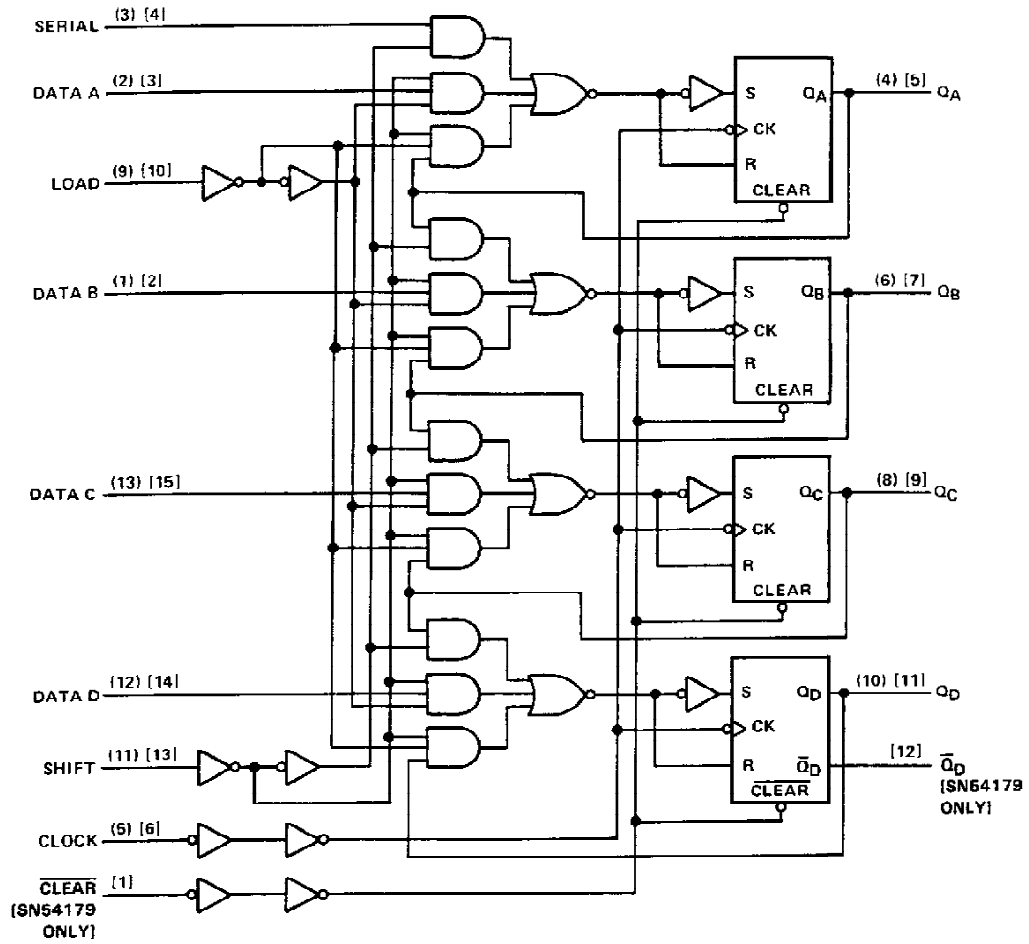
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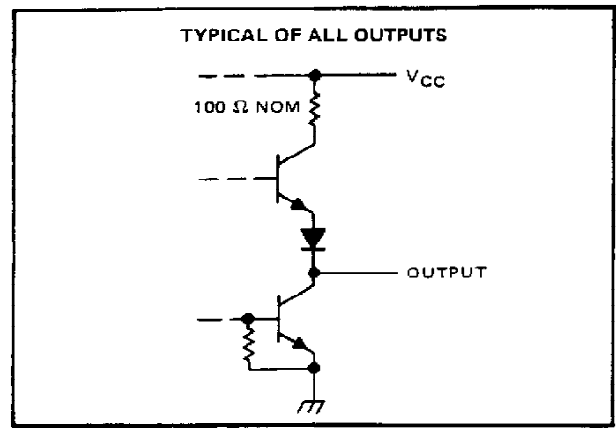
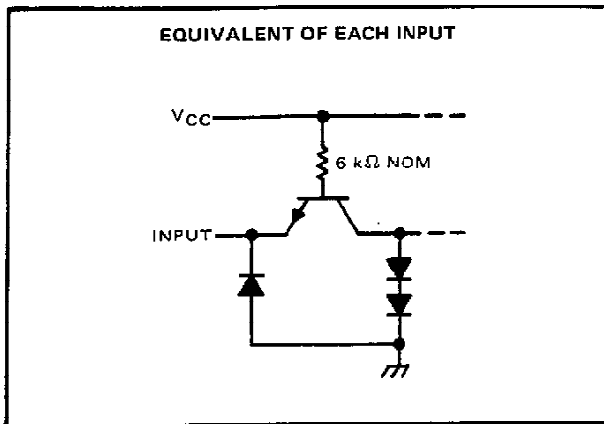
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logic diagram (positive logic)



schematics of inputs and outputs



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## 4-BIT PARALLEL-ACCESS SHIFT REGISTERS

### 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
Operating free-air temperature range: SN54178 .....	-55°C to 125°C
SN74178 .....	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

	SN54178			SN74178			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 or clear pulse, $t_w$ (see Figure 1)	20			20			ns
Setup time $t_{SU}$ (see Figure 1)	Shift (H or L) or load			35			ns
	Data			30			
Hold time at any input, $t_h$	5			5			ns
Operating free-air temperature, $T_A$	-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	SN54178			SN74178			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	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	$V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$			40			40	$\mu$ A
$I_{IL}$ Low-level input current	$V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$			-1.6			-1.6	mA
$I_{OS}$ Short-circuit output current§	$V_{CC} = \text{MAX}$	-20		-57	-18		-57	mA
$I_{CC}$ Supply current	$V_{CC} = \text{MAX}, \text{ See Note 2}$		46	70		46	75	mA

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

‡ 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.

NOTE 2:  $I_{CC}$  is measured as follows:

- a) 4.5 V is applied to serial inputs, load, shift, and clear.
- b) Parallel inputs A through D are grounded.
- c) 4.5 V is momentarily applied to clock which is then grounded.



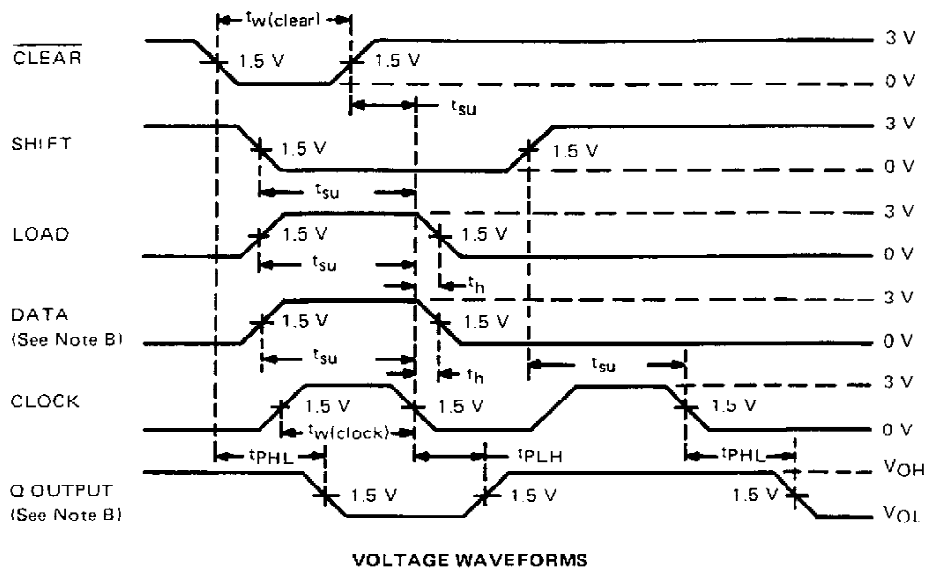
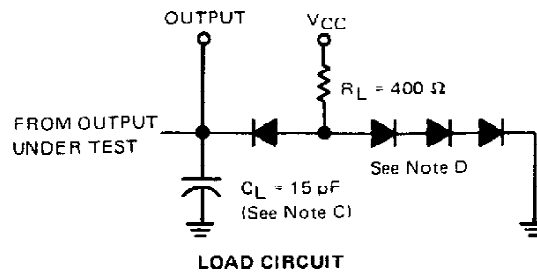
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switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{\max}$			$C_L = 15\text{ pF}$ , $R_L = 400\ \Omega$ , See Figure 1	25	39		MHz
$t_{PLH}$	Clear	$\overline{Q}_D$		15	23		ns
$t_{PHL}$		$Q_A, Q_B, Q_C, Q_D$		24	36		ns
$t_{PLH}$	Clock	Any output		17	26		ns
$t_{PHL}$				23	35		ns

† $f_{\max}$  = Maximum clock frequency  
 $t_{PHL}$  = Propagation delay time, high-to-low-level output  
 $t_{PLH}$  = Propagation delay time, low-to-high-level output

## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. Input pulses are supplied by generators having the following characteristics:  $t_{TLH} \leq 10\text{ ns}$ ,  $t_{THL} \leq 10\text{ ns}$ ,  $PRR \leq 1\text{ MHz}$ ,  $Z_{out} \approx 50\ \Omega$ .  
 B. Data input and Q output are any related pair. Serial and other data inputs are at GND. Serial data input is tested in conjunction with  $Q_A$  output in the shift mode.  
 C.  $C_L$  includes probe and jig capacitance.  
 D. All diodes are 1N3064 or equivalent.

FIGURE 1—SWITCHING TIMES

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