



# DM54194 4-Bit Bidirectional Universal Shift Registers

## General Description

This bidirectional shift register is designed to incorporate virtually all of the features a system designer may want in a shift register; it features parallel inputs, 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, namely:

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

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

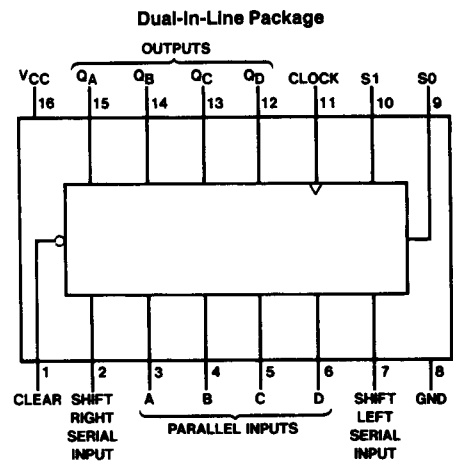
Shift right is accomplished synchronously with the rising edge of the clock pulse when S0 is high and S1 is low. Serial data for this mode is entered at the shift-right data input. When S0 is low and S1 is high, data shifts left synchronously and new data is entered at the shift-left serial input.

Clocking of the flip-flop is inhibited when both mode control inputs are low. The mode controls of the DM54194/DM74194 should be changed only while the clock input is high.

## Features

- Parallel inputs and outputs
- Four operating modes:
  - Synchronous parallel load
  - Right shift
  - Left shift
  - Do nothing
- Positive edge-triggered clocking
- Direct overriding clear
- Typical clock frequency 36 MHz
- Typical power dissipation 195 mW

## Connection Diagram



TL/F/6564-1

Order Number DM54194J or DM54194W  
See NS Package Number J16A or W16A

## Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage	7V
Input Voltage	5.5V
Operating Free Air Temperature Range	
DM54	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

## Recommended Operating Conditions

Symbol	Parameter	DM54194			Units
		Min	Nom	Max	
V <sub>CC</sub>	Supply Voltage	4.5	5	5.5	V
V <sub>IH</sub>	High Level Input Voltage	2			V
V <sub>IL</sub>	Low Level Input Voltage			0.8	V
I <sub>OH</sub>	High Level Output Current			-0.8	mA
I <sub>OL</sub>	Low Level Output Current			16	mA
f <sub>CLK</sub>	Clock Frequency (Note 4)	0	36	25	MHz
t <sub>w</sub>	Pulse Width (Note 4)	Clock	20		ns
		Clear	20		
t <sub>SU</sub>	Setup Time (Note 4)	Mode	30		ns
		Data	20		
t <sub>H</sub>	Hold Time (Note 4)	0			ns
t <sub>REL</sub>	Clear Release Time (Note 4)	25			ns
T <sub>A</sub>	Free Air Operating Temperature	-55		125	°C

## Electrical Characteristics over recommended operating free air temperature range (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ (Note 1)	Max	Units
V <sub>I</sub>	Input Clamp Voltage	V <sub>CC</sub> = Min, I <sub>I</sub> = -12 mA			-1.5	V
V <sub>OH</sub>	High Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OH</sub> = Max V <sub>IL</sub> = Max, V <sub>IH</sub> = Min	2.4	3.4		V
V <sub>OL</sub>	Low Level Output Voltage	V <sub>CC</sub> = Min, I <sub>OL</sub> = Max V <sub>IH</sub> = Min, V <sub>IL</sub> = Max		0.2	0.4	V
I <sub>I</sub>	Input Current @ Max Input Voltage	V <sub>CC</sub> = Max, V <sub>I</sub> = 5.5V			1	mA
I <sub>IH</sub>	High Level Input Current	V <sub>CC</sub> = Max, V <sub>I</sub> = 2.4V			40	μA
I <sub>IL</sub>	Low Level Input Current	V <sub>CC</sub> = Max, V <sub>I</sub> = 0.4V			-1.6	mA
I <sub>OS</sub>	Short Circuit Output Current	V <sub>CC</sub> = Max (Note 2)	-20		-57	mA
I <sub>CC</sub>	Supply Current	V <sub>CC</sub> = Max (Note 3)		39	63	mA

Note 1: All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: With all outputs open, inputs A through D grounded, and 4.5V applied to S0, S1, CLEAR and the serial inputs, I<sub>CC</sub> is tested with a momentary ground, then 4.5V applied to CLOCK.

Note 4: T<sub>A</sub> = 25°C and V<sub>CC</sub> = 5V.

**Switching Characteristics** at  $V_{CC} = 5V$  and  $T_A = 25^\circ C$  (See Section 1 for Test Waveforms and Output Load)

Symbol	Parameter	From (Input) To (Output)	$R_L = 400\Omega, C_L = 15\text{ pF}$		Units
			Min	Max	
$f_{MAX}$	Maximum Clock Frequency		25		MHz
$t_{PLH}$	Propagation Delay Time Low to High Level Output	Clock to Q		22	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output	Clock to Q		26	ns
$t_{PHL}$	Propagation Delay Time High to Low Level Output	Clear to Q		30	ns

**Function Table**

Inputs							Outputs						
Clear	Mode		Clock	Serial		Parallel				$Q_A$	$Q_B$	$Q_C$	$Q_D$
	S1	S0		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	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$
H	H	H	↑	X	X	a	b	c	d	a	b	c	d
H	L	H	↑	X	H	X	X	X	X	H	$Q_{An}$	$Q_{Bn}$	$Q_{Cn}$
H	L	H	↑	X	L	X	X	X	X	L	$Q_{An}$	$Q_{Bn}$	$Q_{Cn}$
H	H	L	↑	H	X	X	X	X	X	$Q_{Bn}$	$Q_{Cn}$	$Q_{Dn}$	H
H	H	L	↑	L	X	X	X	X	X	$Q_{Bn}$	$Q_{Cn}$	$Q_{Dn}$	L
H	L	L	X	X	X	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$	$Q_{A0}$	$Q_{B0}$	$Q_{C0}$	$Q_{D0}$

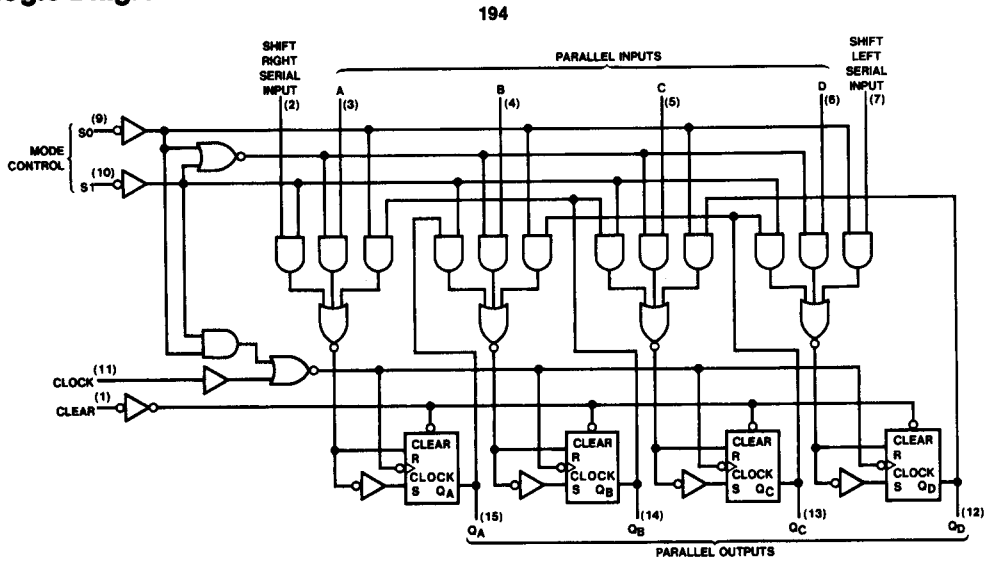
H = High Level (steady state), L = Low Level (steady state), X = Don't Care (any input, including transitions)

↑ = Transition from low to high level; a, b, c, d = The level of steady state input at inputs A, B, C, or D, respectively

$Q_{A0}, Q_{B0}, Q_{C0}, Q_{D0}$  = 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  $Q_A, Q_B, Q_C,$  respectively, before the most recent ↑ transition of the clock.

# Logic Diagram



# Timing Diagram

Typical Clear, Load, Right-Shift, Left-Shift, Inhibit and Clear Sequences

