

MM54HC195/MM74HC195 4-Bit Parallel Shift Register

General Description

The MM54HC195/MM74HC195 is a high speed 4-bit SHIFT REGISTER utilizes advanced silicon-gate CMOS technology to achieve the low power consumption and high noise immunity of standard CMOS integrated circuits, along with the ability to drive 10 LS-TTL loads at LS type speeds.

This shift register features parallel inputs, parallel outputs, J-K serial inputs, SHIFT/LOAD control input, and a direct overriding CLEAR. This shift register can operate in two modes: PARALLEL LOAD; SHIFT from Q_A towards Q_D.

Parallel loading is accomplished by applying the four bits of data, and taking the SHIFT/LOAD control input low. The data is loaded into the associated flip flops and appears at the outputs after the positive transition of the clock input. During parallel loading, serial data flow is inhibited. Serial shifting occurs synchronously when the SHIFT/LOAD con-

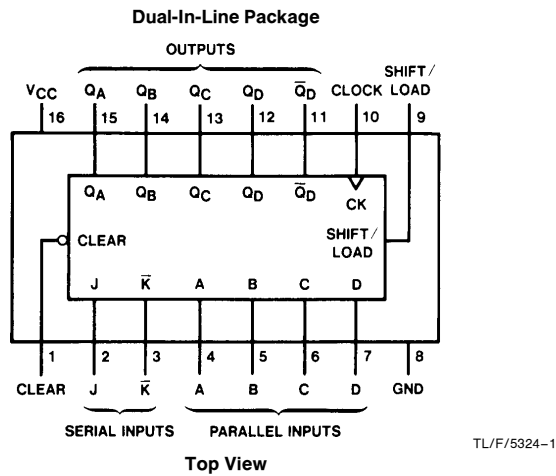
trol input is high. Serial data for this mode is entered at the J-K inputs. These inputs allow the first stage to perform as a J-K or TOGGLE flip flop as shown in the truth table.

The 54HC/74HC logic family is functionally as well as pin-out compatible with the standard 54LS/74LS logic family. All inputs are protected from damage due to static discharge by internal diode clamps to V_{CC} and ground.

Features

- Typical operating frequency: 45 MHz
- Typical propagation delay: 16 ns (clock to Q)
- Wide operating supply voltage range: 2-6V
- Low input current: 1 μA maximum
- Low quiescent current: 80 μA maximum (74HC Series)
- Fanout of 10 LS-TTL loads

Connection Diagram



Function Table

Clear	Shift/Load	Clock	Inputs				Outputs						
			Serial		Parallel		Q _A	Q _B	Q _C	Q _D	Q̄ _D		
			J	K̄	A	B	C	D					
L	X	X	X	X	X	X	X	X	L	L	L	L	H
H	L	↑	X	X	a	b	c	d	a	b	c	d	d̄
H	H	L	X	X	X	X	X	X	Q _{A0}	Q _{B0}	Q _{C0}	Q _{D0}	Q̄ _{D0}
H	H	↑	L	H	X	X	X	X	Q _{A0}	Q _{A0}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}
H	H	↑	L	L	X	X	X	X	L	Q _{An}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}
H	H	↑	H	H	X	X	X	X	H	Q _{An}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}
H	H	↑	H	L	X	X	X	X	Q̄ _{An}	Q _{An}	Q _{Bn}	Q _{Cn}	Q̄ _{Cn}

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.
 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} = the level of Q_A, Q_B, Q_C, respectively, before the most-recent transition of the clock.

Absolute Maximum Ratings (Notes 1 & 2)

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

Supply Voltage (V_{CC})	-0.5 to +7.0V
DC Input Voltage (V_{IN})	-1.5 to $V_{CC} + 1.5V$
DC Output Voltage (V_{OUT})	-0.5 to $V_{CC} + 0.5V$
Clamp Diode Current (I_{IK}, I_{OK})	± 20 mA
DC Output Current, per pin (I_{OUT})	± 25 mA
DC V_{CC} or GND Current, per pin (I_{CC})	± 50 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C
Power Dissipation (P_D) (Note 3)	600 mW
S.O. Package only	500 mW
Lead Temp. (T_L) (Soldering 10 seconds)	260°C

Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	2	6	V
DC Input or Output Voltage (V_{IN}, V_{OUT})	0	V_{CC}	V
Operating Temp. Range (T_A)			
MM74HC	-40	+85	°C
MM54HC	-55	+125	°C
Input Rise or Fall Times (t_r, t_f)			
$V_{CC} = 2.0V$		1000	ns
$V_{CC} = 4.5V$		500	ns
$V_{CC} = 6.0V$		400	ns

DC Electrical Characteristics (Note 4)

Symbol	Parameter	Conditions	V_{CC}	$T_A = 25^\circ C$			74HC		54HC		Units
							$T_A = -40$ to $85^\circ C$		$T_A = -55$ to $125^\circ C$		
				Typ	Guaranteed Limits						
V_{IH}	Minimum High Level Input Voltage		2.0V		1.5	1.5	1.5		V		
			4.5V		3.15	3.15	3.15	V			
			6.0V		4.2	4.2	4.2	V			
V_{IL}	Maximum Low Level Input Voltage**		2.0V		0.5	0.5	0.5		V		
			4.5V		1.35	1.35	1.35	V			
			6.0V		1.8	1.8	1.8	V			
V_{OH}	Minimum High Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} $ I_{OUT} \leq 20 \mu A$	2.0V	2.0	1.9	1.9	1.9		V		
			4.5V	4.5	4.4	4.4	4.4	V			
			6.0V	6.0	5.9	5.9	5.9	V			
		$V_{IN} = V_{IH}$ or V_{IL} $ I_{OUT} \leq 4.0$ mA $ I_{OUT} \leq 5.2$ mA	4.5V	4.2	3.98	3.84	3.7	V			
			6.0V	5.7	5.48	5.34	5.2	V			
V_{OL}	Maximum Low Level Output Voltage	$V_{IN} = V_{IH}$ or V_{IL} $ I_{OUT} \leq 20 \mu A$	2.0V	0	0.1	0.1	0.1		V		
			4.5V	0	0.1	0.1	0.1	V			
			6.0V	0	0.1	0.1	0.1	V			
		$V_{IN} = V_{IH}$ or V_{IL} $ I_{OUT} \leq 4.0$ mA $ I_{OUT} \leq 5.2$ mA	4.5V	0.2	0.26	0.33	0.4	V			
			6.0V	0.2	0.26	0.33	0.4	V			
I_{IN}	Maximum Input Current	$V_{IN} = V_{CC}$ or GND	6.0V		± 0.1	± 1.0	± 1.0	μA			
I_{CC}	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND $I_{OUT} = 0 \mu A$	6.0V		8.0	80	160	μA			

Note 1: Absolute Maximum Ratings are those values beyond which damage to the device may occur.

Note 2: Unless otherwise specified all voltages are referenced to ground.

Note 3: Power Dissipation temperature derating — plastic "N" package: -12 mW/°C from 65°C to 85°C; ceramic "J" package: -12 mW/°C from 100°C to 125°C.

Note 4: For a power supply of $5V \pm 10\%$ the worst case output voltages (V_{OH} , and V_{OL}) occur for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case V_{IH} and V_{IL} occur at $V_{CC} = 5.5V$ and 4.5V respectively. (The V_{IH} value at 5.5V is 3.85V.) The worst case leakage current (I_{IN} , I_{CC} , and I_{OZ}) occur for CMOS at the higher voltage and so the 6.0V values should be used.

** V_{IL} limits are currently tested at 20% of V_{CC} . The above V_{IL} specification (30% of V_{CC}) will be implemented no later than Q1, CY'89.

AC Electrical Characteristics $V_{CC} = 5V, T_A = 25^\circ C, C_L = 15 pF, t_r = t_f = 6 ns$

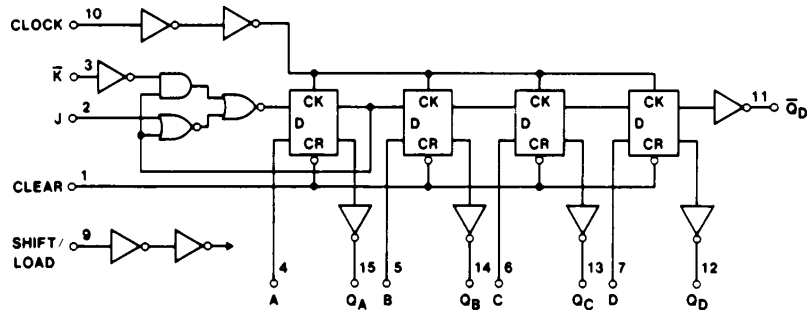
Symbol	Parameter	Conditions	Typ	Guaranteed Limit	Units
f_{MAX}	Maximum Operating Frequency		45	30	MHz
t_{PHL}, t_{PLH}	Maximum Propagation Delay, Clock to Q		14	24	ns
t_{PHL}	Maximum Propagation Delay, Reset to Q		16	25	ns
t_{REM}	Minimum Removal Time, Shift/Load to Clock			0	ns
t_{REM}	Minimum Removal Time, Reset Inactive to Clock			5	ns
t_S	Minimum Setup Time, (A, B, C, D, J, K to Clock)			20	ns
t_S	Minimum Setup Time, Shift/Load to Clock			20	ns
t_W	Minimum Pulse Width Clock or Reset			16	ns
t_H	Minimum Hold Time, any Input except Shift/Load			0	ns

AC Electrical Characteristics $C_L = 50 pF, t_r = t_f = 6 ns$ (unless otherwise specified)

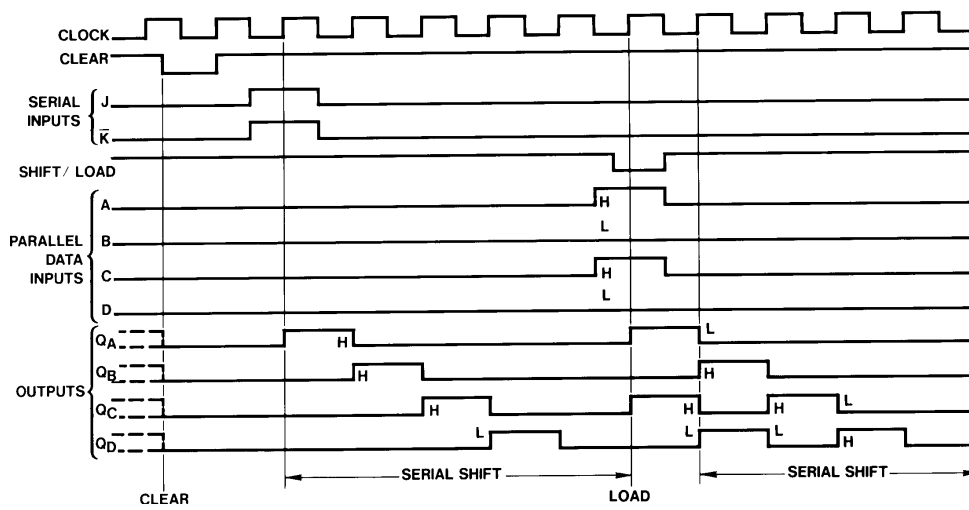
Symbol	Parameter	Conditions	V_{CC}	$T_A = 25^\circ C$			74HC $T_A = -40 to 85^\circ C$		54HC $T_A = -55 to 125^\circ C$		Units
				Typ	Guaranteed Limits		Guaranteed Limits				
f_{MAX}	Maximum Operating Frequency		2.0V	10	6	5	4	MHz			
			4.5V	45	30	24	20				
			6.0V	50	35	28	24				
t_{PHL}	Maximum Propagation Delay, Reset to Q or \bar{Q}		2.0V	70	150	189	224	ns			
			4.5V	15	30	38	45				
			6.0V	12	26	32	38				
t_{PHL}, t_{PLH}	Maximum Propagation Delay, Clock to Q or \bar{Q}		2.0V	70	145	183	216	ns			
			4.5V	15	29	37	43				
			6.0V	12	25	31	37				
t_{THL}, t_{TLH}	Maximum Output Rise and Fall Time		2.0V	30	75	95	110	ns			
			4.5V	8	15	19	22				
			6.0V	7	13	16	19				
t_{REM}	Minimum Removal Time, Shift Load to Clock		2.0V	-2	0	0	0	ns			
			4.5V	-2	0	0	0				
			6.0V	-2	0	0	0				
t_{REM}	Minimum Removal Time, Reset Inactive to Clock		2.0V		5	5	5	ns			
			4.5V		5	5	5				
			6.0V		5	5	5				
t_S	Minimum Setup Time, (A, B, C, D, J, K to Clock)		2.0V		100	125	150	ns			
			4.5V		20	25	30				
			6.0V		17	21	25				
t_S	Minimum Setup Time, Shift/Load to Clock		2.0V		100	125	150	ns			
			4.5V		20	25	30				
			6.0V		17	21	25				
t_H	Minimum Hold Time any Input except Shift/Load		2.0V	-10	0	0	0	ns			
			4.5V	-2	0	0	0				
			6.0V	-2	0	0	0				
t_W	Minimum Pulse Width, Clock or Reset		2.0V	30	80	100	120	ns			
			4.5V	10	16	20	24				
			6.0V	9	14	18	20				
t_r, t_f	Maximum Input Rise and Fall Time		2.0V		1000	1000	1000	ns			
			4.5V		500	500	500				
			6.0V		400	400	400				
C_{PD}	Power Dissipation Capacitance (Note 5)			100				pF			
C_{IN}	Maximum Input Capacitance			5	10	10	10	pF			

Note 5: C_{PD} determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$, and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$.

Logic and Timing Diagrams

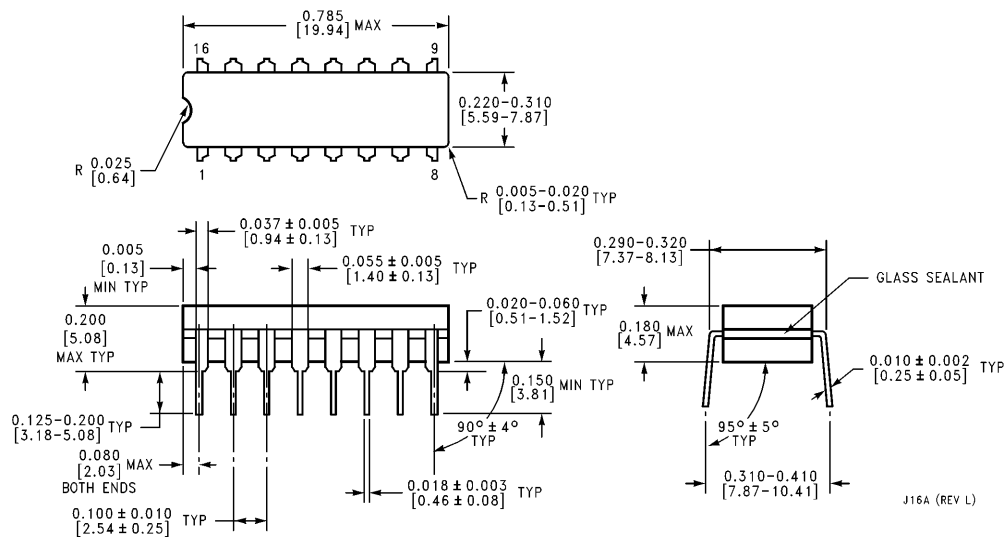


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TL/F/5324-3

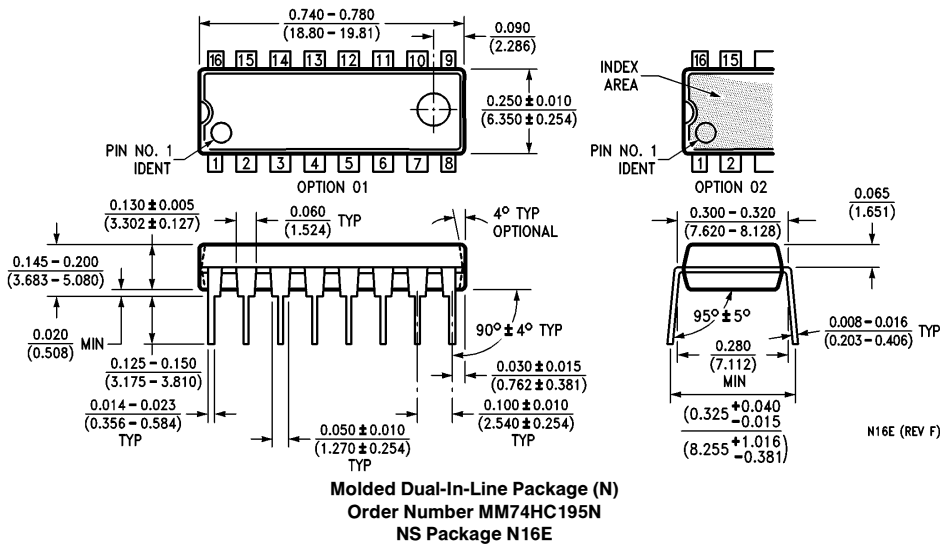
Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number MM54HC195J or MM74HC195J
NS Package Number J16A

J16A (REV L)

Physical Dimensions inches (millimeters) (Continued)



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National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 19th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
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