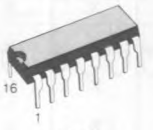
SGS-THOMSON MICROELECTRONICS

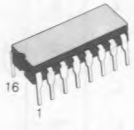
M54HC194
M74HC194

4 BIT PIPO SHIFT REGISTER

- HIGH SPEED
  t_{PD} = 13 ns (TYP.) at V_{CC} = 5V
- LOW POWER DISSIPATION
  I_{CC} = 4 μA (MAX.) at T_A = 25°C
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28% V_{CC} (MIN).
- OUTPUT DRIVE CAPABILITY
  10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE
  $|I_{OH}| = I_{OL}$ = 4mA (MIN).
- BALANCED PROPAGATION DELAYS
  $t_{PLH} = t_{PHL}$
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28% V_{CC} (MIN).
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE
  WITH 54/74LS194



B1N
Plastic Package



F1
Ceramic Frit Seal Package

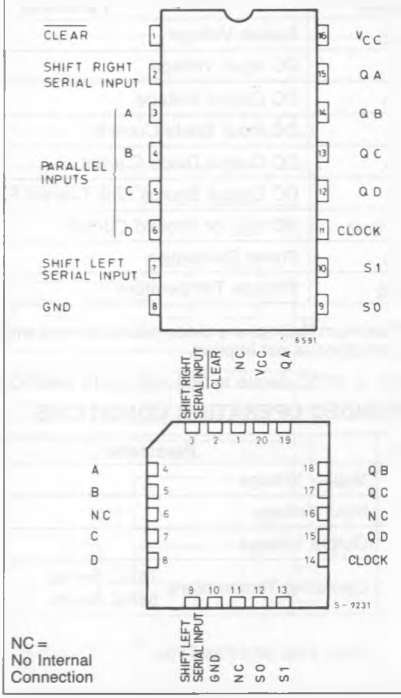
M1
Micro Package

C1
Plastic Chip Carrier

ORDERING NUMBERS:

M54HC194 F1
M74HC194 B1N
M74HC194 F1
M74HC194 C1
M74HC194 M1

PIN CONNECTIONS (top view)



NC = No Internal Connection

DESCRIPTION

The M54/74HC194 is a high speed CMOS 4 BIT PIPO SHIFT REGISTER fabricated in silicon gate C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

This 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, clear line. The register has four distinct modes of operation: PARALLEL (broadside) LOAD; SHIFT RIGHT (in the direction Q_A Q_D); SHIFT LEFT; INHIBIT CLOCK (do nothing). Synchronous parallel loading is accomplished by applying the four data bits and taking both mode control inputs, S0 and S1 high. The data are loaded into their respective 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 input. Clocking of the flip flops is inhibited when both mode control inputs are low. The mode control inputs should be changed only when the CLOCK input is high. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

TRUTH TABLE

INPUTS										OUTPUTS			
$\overline{CLEAR}$	MODE		CLOCK	SERIAL		PARALLEL				QA	QB	QC	QD
	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	↓	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	QA0	QB0	QC0	QD0

X : DON'T CARE
a ~ d : THE LEVEL OF STEADY STATE INPUT VOLTAGE AT INPUT A ~ D RESPECTIVELY
QAO ~ QDO : NO CHANGE
QAn ~ QDn : THE LEVEL OF QA, QB, QC, RESPECTIVELY, BEFORE THE MOST-RECENT POSITIVE TRANSITION OF THE CLOCK.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	− 0.5 to 7	V
V_I	DC Input Voltage	− 0.5 to V_{CC} + 0.5	V
V_O	DC Output Voltage	− 0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Source Sink Current Per Output Pin	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	500 (*)	mW
T_{stg}	Storage Temperature	− 65 to 150	°C

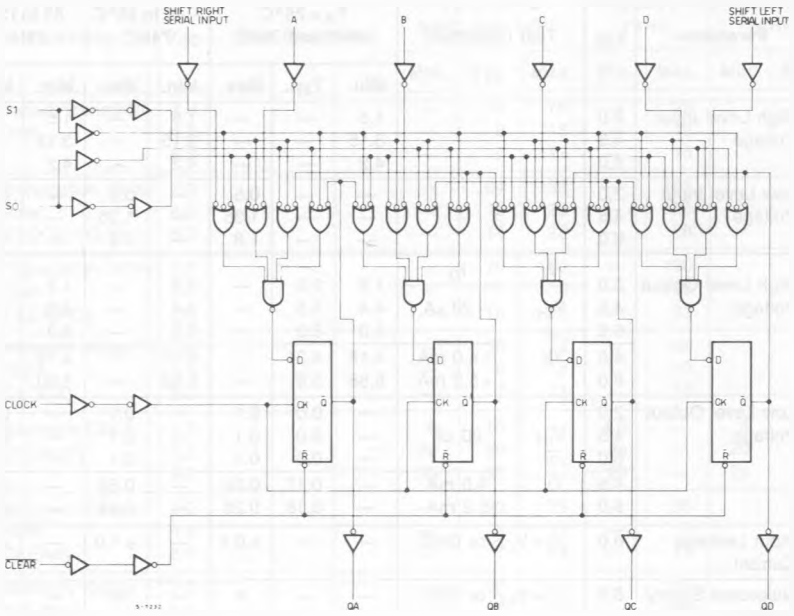
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(*) 500 mW: ≅ 65°C derate to 300 mW by 10 mW/°C: 65°C to 85°C.

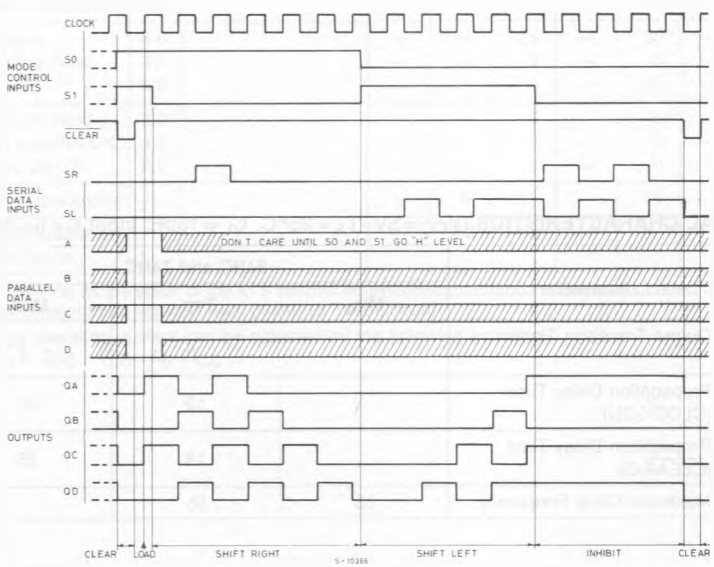
RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value		Unit
V_{CC}	Supply Voltage		2 to 6		V
V_I	Input Voltage		0 to V_{CC}		V
V_O	Output Voltage		0 to V_{CC}		V
T_A	Operating Temperature	74HC Series 54HC Series	− 40 to 85 − 55 to 125		°C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2 V V_{CC} = 4.5V V_{CC} = 6 V	0 to 1000 0 to 500 0 to 400		ns

LOGIC DIAGRAM



TIMING CHART



DC SPECIFICATIONS

Symbol	Parameter	V_{CC}	Test Condition		$T_A = 25°C$ 54HC and 74HC			− 40 to 85°C 74HC		− 55 to 125°C 54HC		Unit
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
V_{IH}	High Level Input Voltage	2.0 4.5 6.0			1.5 3.15 4.2	— — —	— — —	1.5 3.15 4.2	— — —	1.5 3.15 4.2	— — —	V
V_{IL}	Low Level Input Voltage	2.0 4.5 6.0			— — —	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	V
V_{OH}	High Level Output Voltage	2.0 4.5 6.0	V_I V_{IH} or V_{IL}	I_O − 20 μA	1.9 4.4 5.9	2.0 4.5 6.0	— — —	1.9 4.4 5.9	— — —	1.9 4.4 5.9	— — —	V
		4.5 6.0		− 4.0 mA − 5.2 mA	4.18 5.68	4.31 5.8	— —	4.13 5.63	— —	4.10 5.60	— —	
V_{OL}	Low Level Output Voltage	2.0 4.5 6.0	V_{IH} or V_{IL}	20 μA	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
		4.5 6.0		4.0 mA 5.2 mA	— —	0.17 0.18	0.26 0.26	— —	0.33 0.33	— —	0.40 0.40	
I_I	Input Leakage Current	6.0	$V_I = V_{CC}$ or GND		—	—	±0.1	—	±1.0	—	±1.0	μA
I_{CC}	Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND		—	—	4	—	40	—	80	μA

AC ELECTRICAL CHARACTERISTICS ($V_{CC} = 5V$, $T_A = 25°C$, $C_L = 15pF$, Input $t_r = t_f = 6ns$)

Symbol	Parameter	54HC and 74HC			Unit
		Min.	Typ.	Max.	
t_{TLH} t_{THL}	Output Transition Time		4	8	ns
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK-QN)		13	21	ns
t_{PHL}	Propagation Delay Time ($\overline{CLEAR}$-Q)		16	25	ns
f_{MAX}	Maximum Clock Frequency	33	55		MHz

AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input $t_r = t_f$ = 6ns)

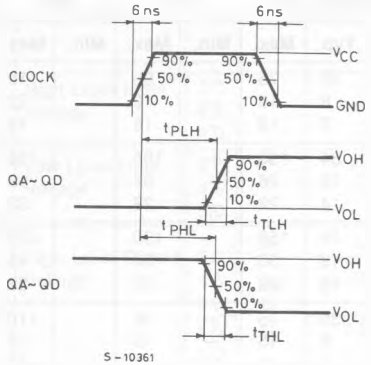
Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			−40 to 85°C 74HC		−55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - Q,N)	2.0		—	64	130	—	165		195	ns
		4.5		—	16	26	—	33		39	
		6.0		—	14	22	—	28		33	
t_{PLH}	Propagation Delay Time ($\overline{CLEAR}$-Q)	2.0		—	76	150	—	190		225	ns
		4.5		—	19	30	—	38		45	
		6.0		—	16	26	—	33		38	
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
f_{MAX}	Maximum Clock Frequency	2.0		6	10	—	4.8	—	4	—	MHz
		4.5		30	50	—	24	—	20	—	
		6.0		35	58	—	28	—	24	—	
$t_{W(L)}$	Minimum Pulse Width ($\overline{CLEAR}$)	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t_s	Minimum Set-up Data Time (SIN-PIN)	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t_s	Minimum Set-up Data Time (Mode Control-CK)	2.0		—	40	100	—	125	—	150	ns
		4.5		—	10	20	—	25	—	30	
		6.0		—	9	17	—	21	—	26	
t_{REM}	Minimum Removal Time ($\overline{CLEAR}$)	2.0		—	—	25	—	30	—	40	ns
		4.5		—	—	5	—	6	—	8	
		6.0		—	—	5	—	6	—	7	
t_h	Minimum Hold Time SIN/PIN-CK, Mode, Ctr-CK	2.0		—	—	0	—	0	—	0	ns
		4.5		—	—	0	—	0	—	0	
		6.0		—	—	0	—	0	—	0	
C_{IN}	Input Capacitance			—	5	10	—	10		10	pF
C_{PD} (*)	Power Dissipation Capacitance			—	102	—	—	—			pF

Note (*) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit)

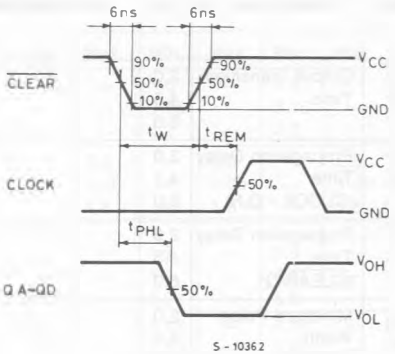
Average operating current can be obtained by the following equation.

$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

SWITCHING CHARACTERISTICS TEST WAVEFORM



S-10361



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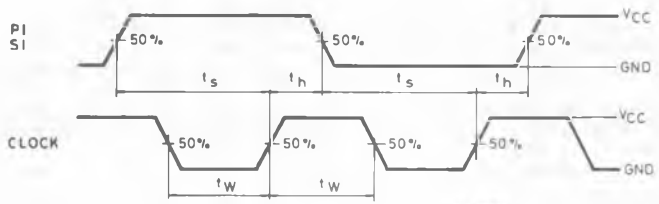

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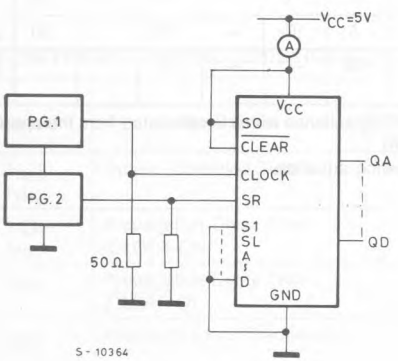
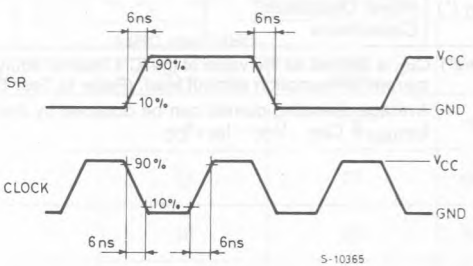
TEST CIRCUIT I_{CC} (Opr.)



S-10364



S-10365