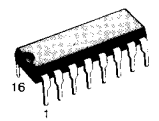
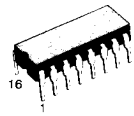
8 BIT PISO SHIFT REGISTER

- HIGH SPEED
  f_{MAX} = 50 MHz (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} = 4 mA (MIN.)
- BALANCED PROPAGATION DELAYS
  t_{PLH} = t_{PHL}
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE
  WITH 54/74LS166



B1N
Plastic Package



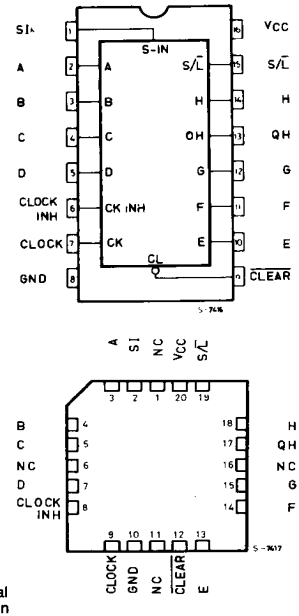
F1
Ceramic Frit Seal Package

M1
Micro Package

C1
Plastic Chip Carrier

ORDERING NUMBERS:
M54HC166 F1
M74HC166 B1N
M74HC166 F1
M74HC166 C1
M74HC166 M1

PIN CONNECTIONS (top view)



NC = No Internal Connection

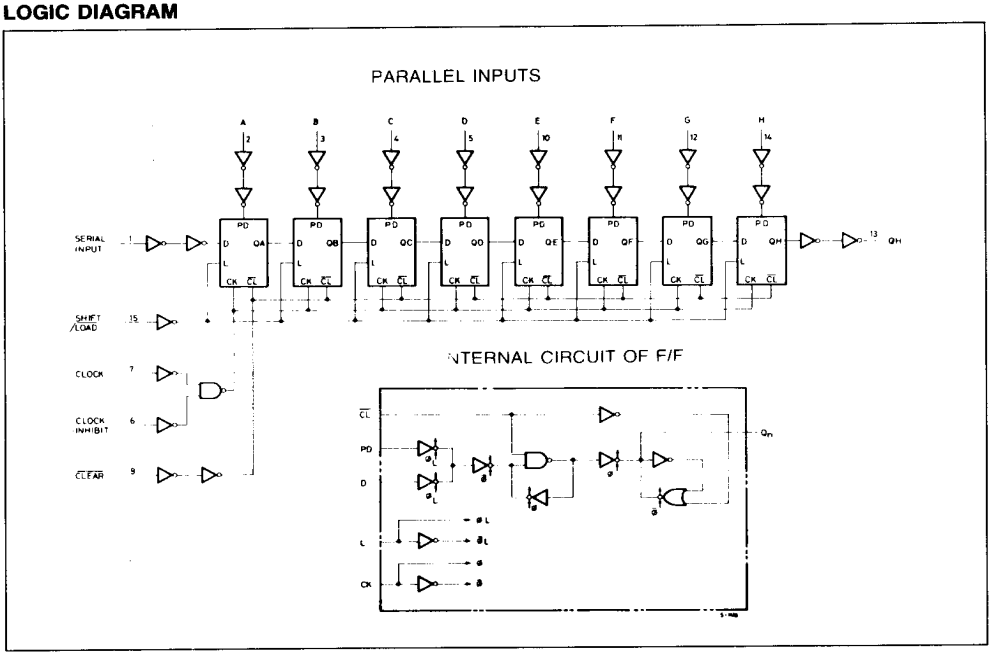
DESCRIPTION

The M54/74HC166 is a high speed C²MOS 8 BIT PISO SHIFT REGISTER fabricated in silicon gate C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

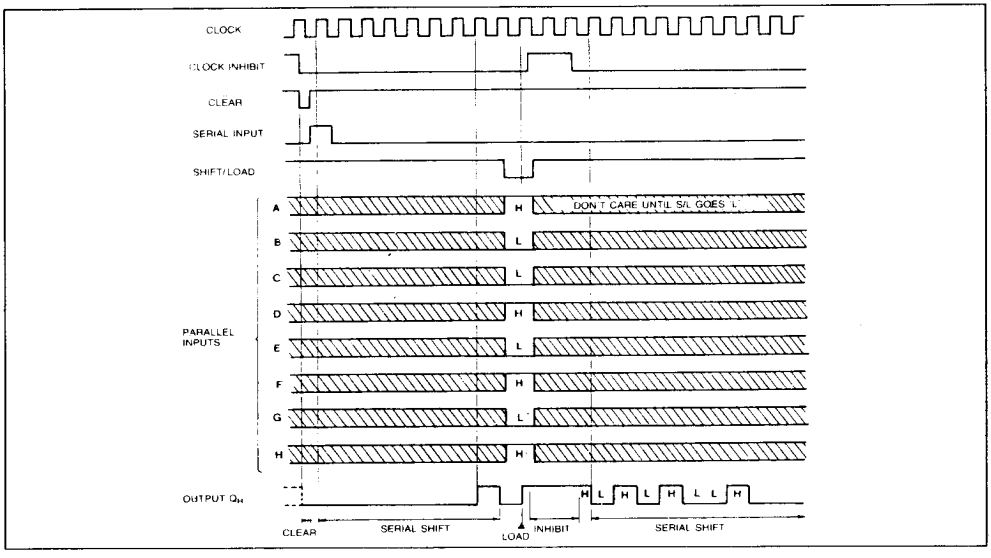
It consists of parallel or serial inputs and a serial-out 8-bit shift register with gated clock inputs and an overriding clear input. The parallel-in or serial-in modes are controlled by the SHIFT/$\overline{\text{LOAD}}$ input. When the SHIFT/$\overline{\text{LOAD}}$ input is held high, the serial data input is enabled and the eight flip-flops perform serial shifting with each clock pulse. When held low, the parallel data inputs are enabled and synchronous loading occurs on the next clock pulse. Clocking is accomplished on the low-to-high level edge of the clock pulse. The CLOCK-INHIBIT input should be changed to the high only while the CLOCK input is held high. A direct clear input overrides all other inputs, including the clock, and sets all flip-flops to zero. Functional details are shown in the truth table and the timing chart.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

LOGIC DIAGRAM



TIMING CHART



TRUTH TABLE

INPUTS						INTERNAL OUTPUTS		OUTPUT
$\overline{CLEAR}$	SHIFT/$\overline{LOAD}$	CLOCK INH.	CLOCK	SERIAL IN	PARALLEL A·····H	QA	QB	QH
L	X	X	X	X	X	L	L	L
H	X	X	↓	X	X	NO CHANGE		
H	L	L	↑	X	a ..... h	a	b	h
H	H	L	↑	H	X	H	QAn	QGn
H	H	L	↑	L	X	L	QAn	QGn
H	X	H	X	X	X	NO CHANGE		

X: DON'T CARE

a·····h : THE LEVEL OF STEADY STATE INPUT VOLTAGE AT INPUTS A TROUGH H RESPECTIVELY

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: ≅ 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

DC ELECTRICAL CHARACTERISTICS

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			1.5	—	—	1.5	—	1.5	—	V
		4.5			3.15	—	—	3.15	—	3.15	—	
		6.0			4.2	—	—	4.2	—	4.2	—	
V_{IL}	Low Level Input Voltage	2.0			—	—	0.5	—	0.5	—	0.5	V
		4.5			—	—	1.35	—	1.35	—	1.35	
		6.0			—	—	1.8	—	1.8	—	1.8	
V_{OH}	High Level Output Voltage	2.0	V_I	I_O	1.9	2.0	—	1.9	—	1.9	—	V
		4.5	V_{IH} or V_{IL}	−20 μA	4.4	4.5	—	4.4	—	4.4	—	
		6.0			5.9	6.0	—	5.9	—	5.9	—	
		4.5		−4.0 mA	4.18	4.31	—	4.13	—	4.10	—	
		6.0		−5.2 mA	5.68	5.8	—	5.63	—	5.60	—	
V_{OL}	Low Level Output Voltage	2.0	V_{IH} or V_{IL}	20 μA	—	0.0	0.1	—	0.1	—	0.1	V
		4.5			—	0.0	0.1	—	0.1	—	0.1	
		6.0			—	0.0	0.1	—	0.1	—	0.1	
		4.5		4.0 mA	—	0.17	0.26	—	0.33	—	0.40	
		6.0		5.2 mA	—	0.18	0.26	—	0.33	—	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-QH)		16	25	ns
t_{PHL}	Propagation Delay Time ($\overline{CLEAR}$-QH)		16	25	ns
f_{MAX}	Maximum Clock frequency	33	55		MHz

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

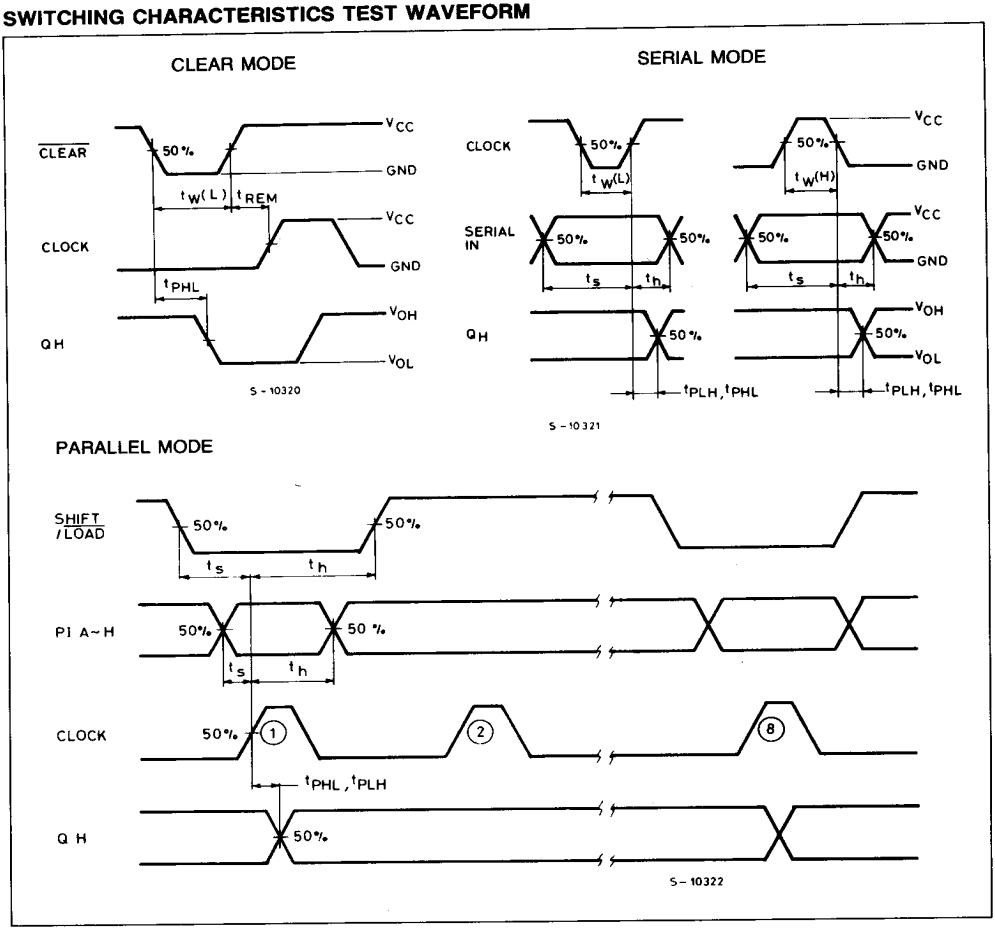
Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			−40 to 85°C 74HC		−55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - QH)	2.0		—	80	150	—	190		225	ns
		4.5		—	20	30	—	38		45	
		6.0		—	17	26	—	33		38	
t_{PHL}	Propagation Delay Time ($\overline{CLEAR}$-QH)	2.0		—	76	150	—	190		225	ns
		4.5		—	19	30	—	38		45	
		6.0		—	16	26	—	32		38	
f_{MAX}	Maximum Clock Frequency	2.0		6	14	—	4.8	—	3.8	—	MHz
		4.5		30	50	—	24	—	19	—	
		6.0		35	60	—	28	—	22	—	
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CLOCK)	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
$t_{W(L)}$	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_{REM}	Minimum Removal Time ($\overline{CLEAR}$)	2.0		—	—	0	—	0	—	0	ns
		4.5		—	—	0	—	0	—	0	
		6.0		—	—	0	—	0	—	0	
t_s	Minimum Set-up Time (SI, PI)	2.0		—	20	75	—	95		110	ns
		4.5		—	5	15	—	19		22	
		6.0		—	4	13	—	16		19	
t_s	Minimum Set-up Time ($S/\overline{L}$)	2.0		—	30	75	—	95		110	ns
		4.5		—	8	15	—	19		22	
		6.0		—	7	13	—	16		19	
t_h	Minimum Hold Time (SI, PI)	2.0		—	—	50	—	65	—	75	ns
		4.5		—	—	10	—	13	—	15	
		6.0		—	—	9	—	11	—	13	
t_h	Minimum Hold Time ($S/\overline{L}$)	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			—	58	—	—	—			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.

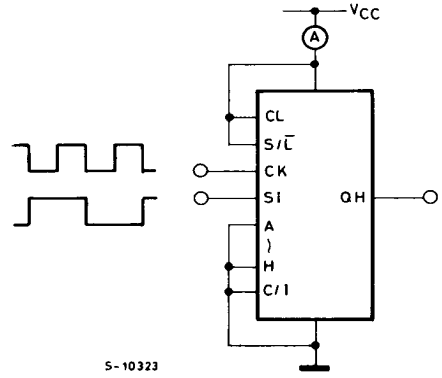
Average operating current can be obtained by the following equation.

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

SWITCHING CHARACTERISTICS TEST WAVEFORM



TEST CIRCUIT I_{CC} (Opr.)



INPUT WAVEFORM IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST

INPUT AND OUTPUT EQUIVALENT CIRCUIT