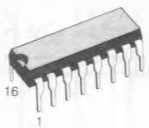
SGS-THOMSON MICROELECTRONICS

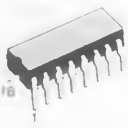
M54HC4040
M74HC4040

12-STAGE BINARY COUNTER

- HIGH SPEED
  f_{MAX} = 60 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 4040B



B1N
Plastic Package



F1
Ceramic Frit Seal Package

M1
Micro Package

C1
Plastic Chip Carrier

ORDERING NUMBERS:

M54HC4040 F1
M74HC4040 B1N
M74HC4040 F1
M74HC4040 C1
M74HC4040 M1

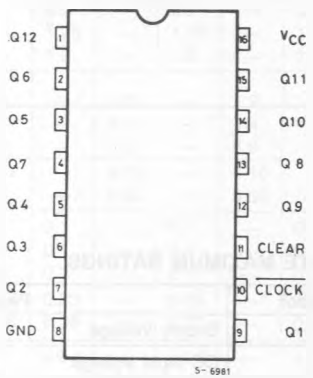
DESCRIPTION

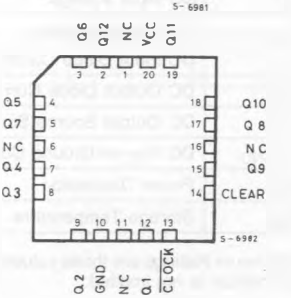
The M54/74HC4040 is a high speed CMOS 12-STAGE BINARY COUNTER fabricated in silicon gate C²MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low consumption.

A clear input is used to reset the counter to the all low level state. A high level on CLEAR accomplishes the reset function. A negative transition on the CLOCK input increments the counter by one. Each division stage has an output; the final frequency is fx 1/4096.

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

PIN CONNECTIONS (top view)





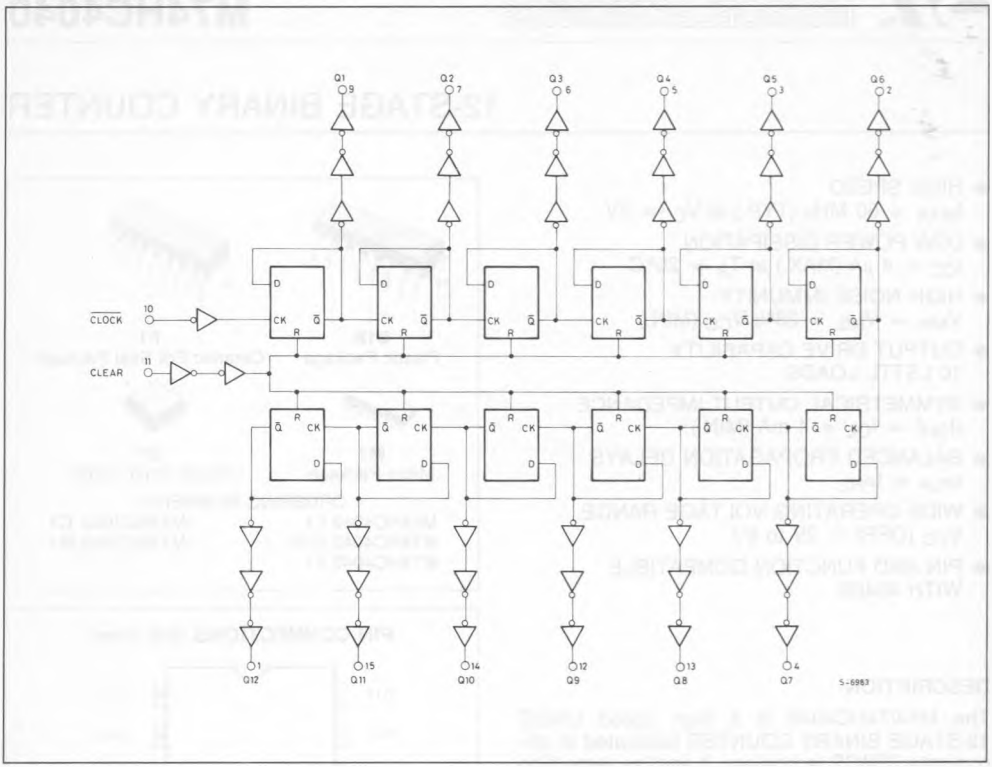
NC = No Internal Connection

TRUTH TABLE

CLOCK	CLEAR	OUTPUT STATE
X	H	ALL OUTPUTS = "L"
↓	L	NO CHANGE
↓	L	ADVANCE TO NEXT STATE

X: DON'T CARE

LOGIC DIAGRAM



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		Limit		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	0 to 1000	ns
			V_{CC} = 4.5V	0 to 500	
			V_{CC} = 6 V	0 to 400	

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			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 - Q1)		15	24	ns
t_{PLH} t_{PHL}	Propagation Delay Time (Qn - Qn + 1)		7	12	ns
t_{PLH} t_{PHL}	Propagation Delay Time (CLEAR)		22	35	ns
f_{MAX}	Maximum Clock Frequency	33	60		MHz

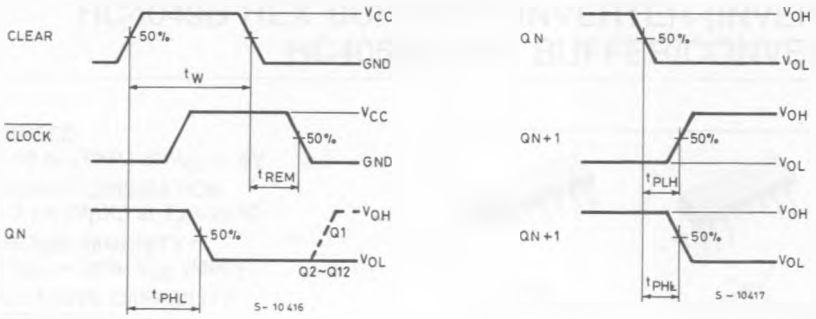
AC ELECTRICAL CHARACTERISTICS (C_L = 50pF, Input $t_r = t_f$ = 6ns)

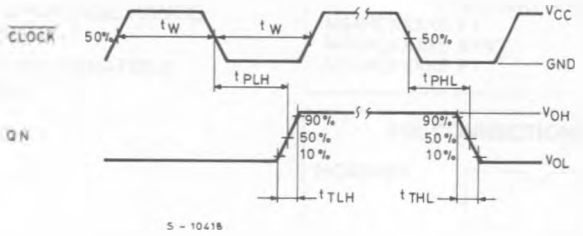
Symbol	Parameter	V_{CC}	Test Condition	T_A = 25°C 54HC and 74HC			−40 to 85°C 74HC		−55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t_{TLH} t_{THL}	Output Transition Time	2.0		—	30	75	—	95	—	110	ns
		4.5		—	8	15	—	19	—	22	
		6.0		—	7	13	—	16	—	19	
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - Q1)	2.0		—	72	145	—	180	—	220	ns
		4.5		—	18	29	—	36	—	44	
		6.0		—	15	25	—	31	—	38	
t_{PLH} t_{PHL}	Propagation Delay Time (Qn - Qn + 1)	2.0		—	35	75	—	95	—	110	ns
		4.5		—	9	15	—	19	—	22	
		6.0		—	8	13	—	16	—	19	
t_{PHL}	Propagation Delay Time (CLEAR)	2.0		—	104	205	—	255	—	310	ns
		4.5		—	26	41	—	51	—	62	
		6.0		—	22	35	—	43	—	53	
f_{MAX}	Maximum Clock Frequency	2.0		6	14	—	4.8	—	4.0	—	MHz
		4.5		30	55	—	24	—	20	—	
		6.0		35	65	—	28	—	24	—	
$t_{W(L)}$ $t_{W(H)}$	Minimum Pulse Width (CLOCK)	2.0		—	30	75	—	95	—	110	ns
		4.5		—	8	15	—	19	—	22	
		6.0		—	7	13	—	16	—	19	
$t_{W(H)}$	Minimum Pulse Width (CLEAR)	2.0		—	60	125	—	155	—	190	ns
		4.5		—	15	25	—	31	—	38	
		6.0		—	13	21	—	26	—	32	
t_{REM}	Minimum Removal Time	2.0		—	—	50	—	65	—	75	ns
		4.5		—	—	10	—	13	—	15	
		6.0		—	—	9	—	11	—	13	
C_{IN}	Input Capacitance			—	5	10	—	10	—	10	pF
C_{PD} (*)	Power Dissipation Capacitance			—	32	—	—	—	—	—	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.

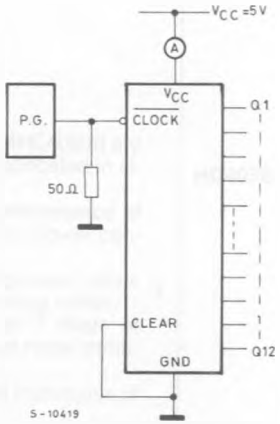
Average operating current can be obtained by the following equation: $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

SWITCHING CHARACTERISTICS TEST WAVEFORM





TEST CIRCUIT I_{CC} (Opr.)



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