

12-STAGE BINARY COUNTER

- **HIGH SPEED**
 $f_{MAX} = 60 \text{ MHz (TYP.) at } V_{CC} = 5V$
- **LOW POWER DISSIPATION**
 $I_{CC} = 4 \mu A \text{ (MAX.) at } T_A = 25^\circ C$
- **HIGH NOISE IMMUNITY**
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**
 10 LSTTL LOADS
- **SYMMETRICAL OUTPUT IMPEDANCE**
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- **BALANCED PROPAGATION DELAYS**
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- **PIN AND FUNCTION COMPATIBLE**
 WITH 4040B

DESCRIPTION

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

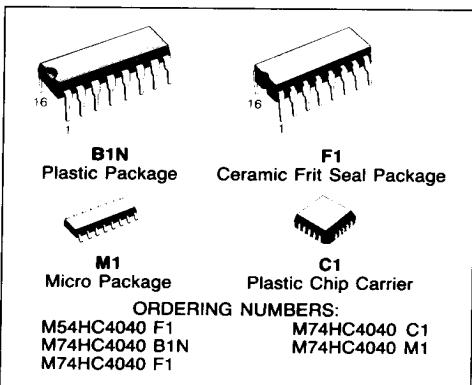
A clear input is used to reset the counter to the all low level state. A high level on CLEAR accomplishes the reset function. A negative transition on the CLOCK input increments the counter by one. Each division stage has an output; the final frequency is $f_x 1/4096$.

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

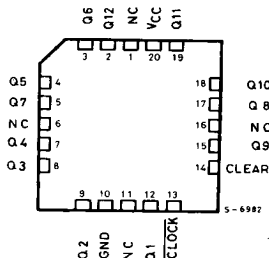
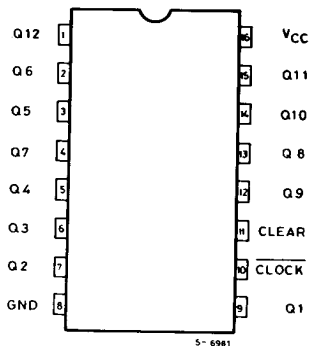
TRUTH TABLE

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

X: DON'T CARE

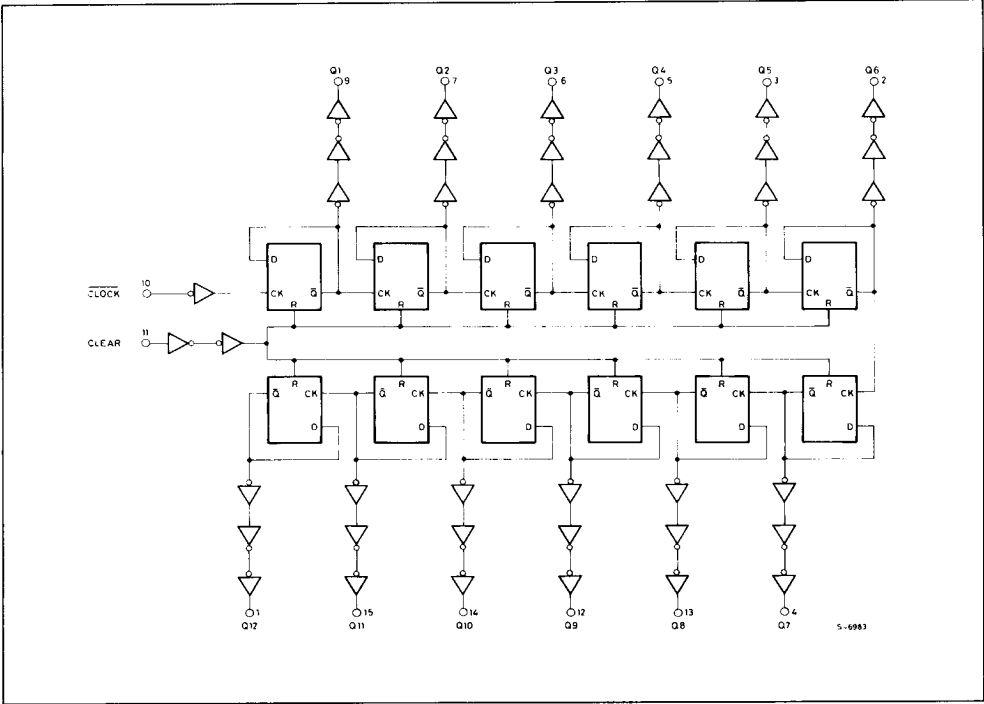


PIN CONNECTIONS (top view)



NC =
No Internal
Connection

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	$V_{CC} \begin{cases} 2 \text{ V} & 0 \text{ to } 1000 \\ 4.5 \text{ V} & 0 \text{ to } 500 \\ 6 \text{ V} & 0 \text{ to } 400 \end{cases}$	ns

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	V _I	I _O — 20 μA — 4.0 mA — 5.2 mA	1.9	2.0	—	1.9	—	1.9	—	V
		4.5	V _{IH} or		4.4	4.5	—	4.4	—	4.4	—	
		6.0	V _{IL}		5.9	6.0	—	5.9	—	5.9	—	
		4.5 6.0			4.18 5.68	4.31 5.8	— —	4.13 5.63	— —	4.10 5.60	— —	
V _{OL}	Low Level Output Voltage	2.0	V _{IH} or V _{IL}	20 μA 4.0 mA 5.2 mA	—	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 6.0			—	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 ($V_{CC} = 5V$, $T_A = 25^\circ C$, $C_L = 15pF$, 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

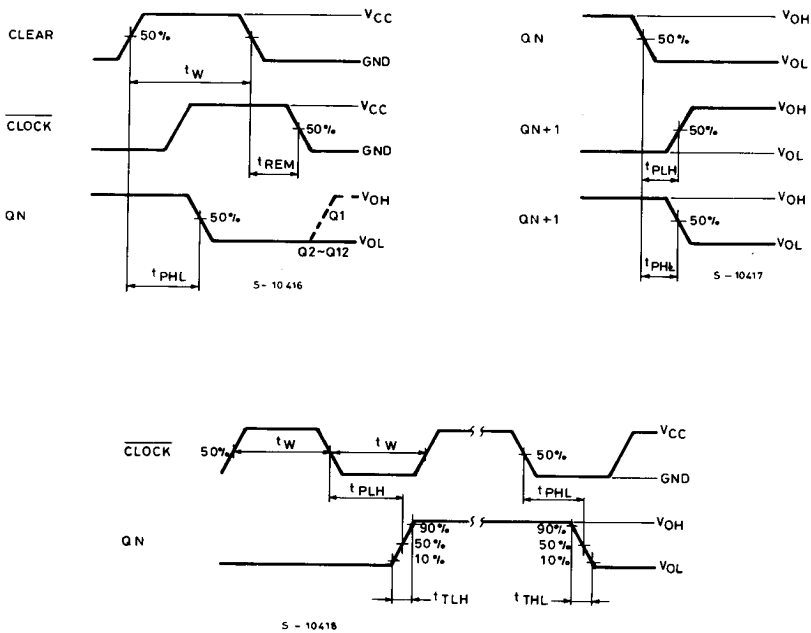
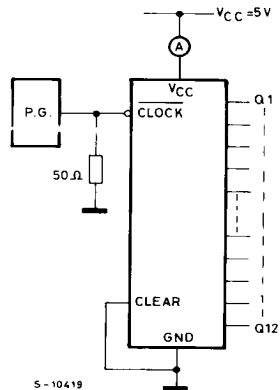
AC ELECTRICAL CHARACTERISTICS ($C_L = 50pF$, Input $t_r = t_f = 6ns$)

Symbol	Parameter	V_{CC}	Test Condition	$T_A = 25^\circ C$ 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 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
t_{PLH} t_{PHL}	Propagation Delay Time (CLOCK - Q1)	2.0 4.5 6.0		— — —	72 18 15	145 29 25	— — —	180 36 31	— — —	220 44 38	ns
t_{PLH} t_{PHL}	Propagation Delay Time (Qn - Qn + 1)	2.0 4.5 6.0		— — —	35 9 8	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
t_{PHL}	Propagation Delay Time (CLEAR)	2.0 4.5 6.0		— — —	104 26 22	205 41 35	— — —	255 51 43	— — —	310 62 53	ns
f_{MAX}	Maximum Clock Frequency	2.0 4.5 6.0		6 30 35	14 55 65	— — —	4.8 24 28	— — —	4.0 20 24	— — —	MHz
$t_{W(L)}$ $t_{W(H)}$	Minimum Pulse Width (CLOCK)	2.0 4.5 6.0		— — —	30 8 7	75 15 13	— — —	95 19 16	— — —	110 22 19	ns
$t_{W(H)}$	Minimum Pulse Width (CLEAR)	2.0 4.5 6.0		— — —	60 15 13	125 25 21	— — —	155 31 26	— — —	190 38 32	ns
t_{REM}	Minimum Removal Time	2.0 4.5 6.0		— — —	— — —	50 10 9	— — —	65 13 11	— — —	75 15 13	ns
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.