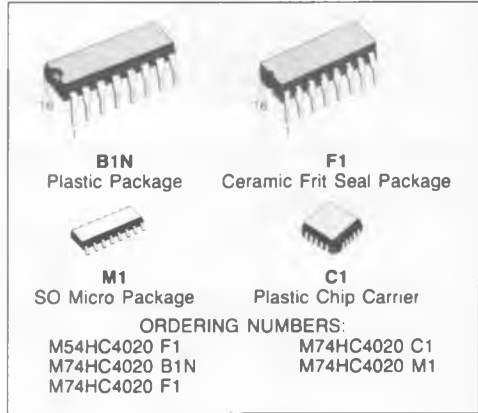


## 14-STAGE BINARY COUNTER

- **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 4020B





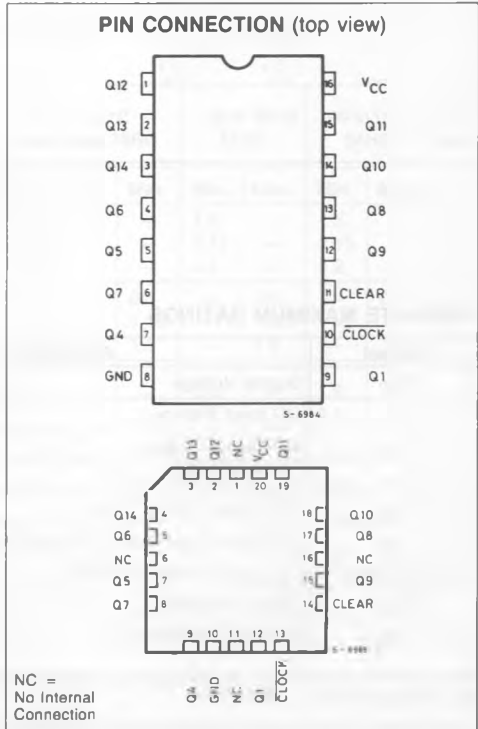
### DESCRIPTION

The M54/74HC4020 is a high speed CMOS 14-STAGE BINARY COUNTER fabricated in silicon gate C<sup>2</sup>MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low consumption.

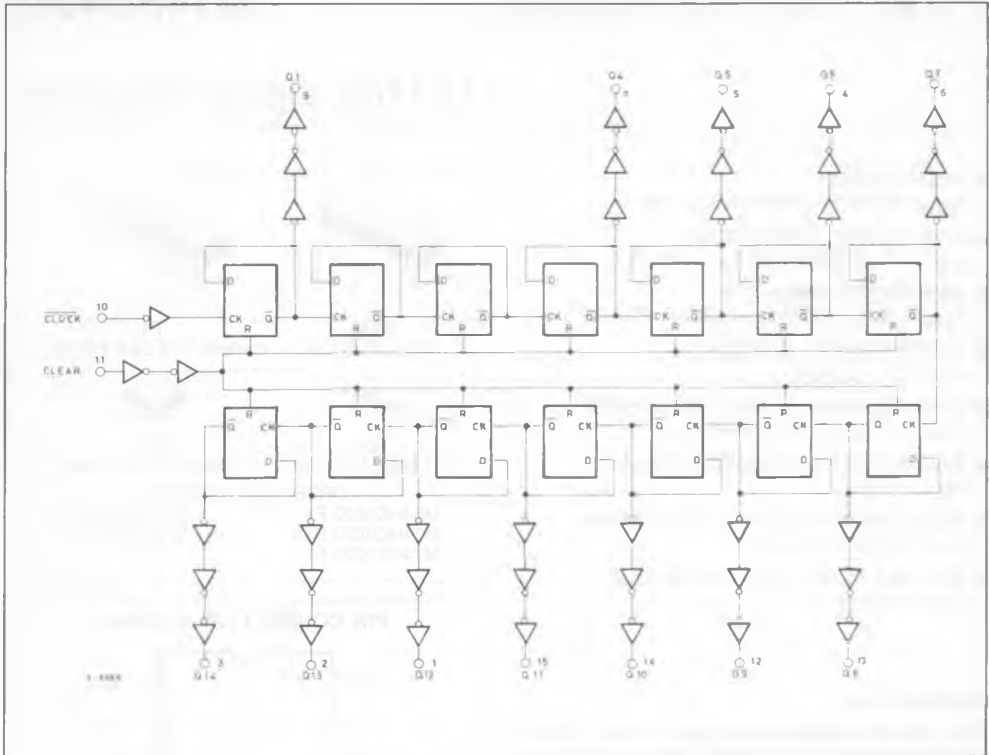
A clear input is used to reset the counter to the all low level state. A high level on CLEAR accomplishes the reset function. A negative transition on the CLOCK input increments the counter by one. Twelve kinds of divided output are provided; 1<sup>st</sup> and 4<sup>th</sup> stage to 14<sup>th</sup> stage. The Maximum division available at last stage is  $1/16384 \times f_{IN}$  at clock. 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



## 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	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Source Sink Current Per Output Pin	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	500 (*)	mW
$T_{stg}$	Storage Temperature	-65 to 150	$^{\circ}C$

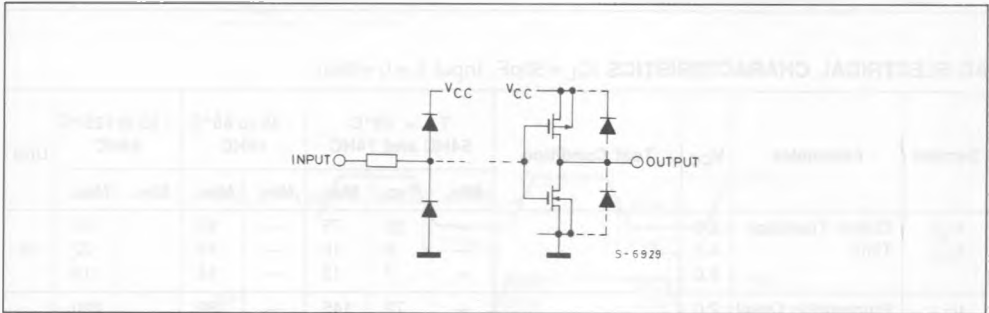
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

(\*) 500 mW:  $\cong$  65 $^{\circ}C$  derate to 300 mW by 10 mW/ $^{\circ}C$ : 65 $^{\circ}C$  to 85 $^{\circ}C$ .

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

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	$V_{CC}$	Test Condition	$T_A = 25^\circ\text{C}$ 54HC and 74HC			$-40 \text{ to } 85^\circ\text{C}$ 74HC		$-55 \text{ to } 125^\circ\text{C}$ 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			-20 $\mu\text{A}$	4.4	4.5	—	4.4	—	4.4		—
		6.0				5.9	6.0	—	5.9	—	5.9		—
		4.5			$V_{IH}$ or $V_{IL}$	-4.0 mA -5.2 mA	4.18	4.31	—	4.13	—		4.10
6.0	5.68	5.8	—	5.63			—	5.60	—				
$V_{OL}$	Low Level Output Voltage	2.0	$V_{IH}$ or $V_{IL}$	20 $\mu\text{A}$	—	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 5.2 mA	—	0.17	0.26	—	0.33	—		0.40
6.0	—	0.18	0.26	—		0.33	—	0.40					
$I_I$	Input Leakage Current	6.0	$V_I = V_{CC}$ or GND	—	—	$\pm 0.1$	—	$\pm 1.0$	—	$\pm 1.0$	$\mu\text{A}$		
$I_{CC}$	Quiescent Supply Current	6.0	$V_I = V_{CC}$ or GND	—	—	4	—	40	—	80	$\mu\text{A}$		

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
$t_{PHL}$ $t_{PHL}$	Propagation Delay Time ( $Q_n - Q_{n+1}$ )		7	12	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time (CLEAR)		22	35	ns
$f_{MAX}$	Maximum Clock Frequency	33	60		MHz

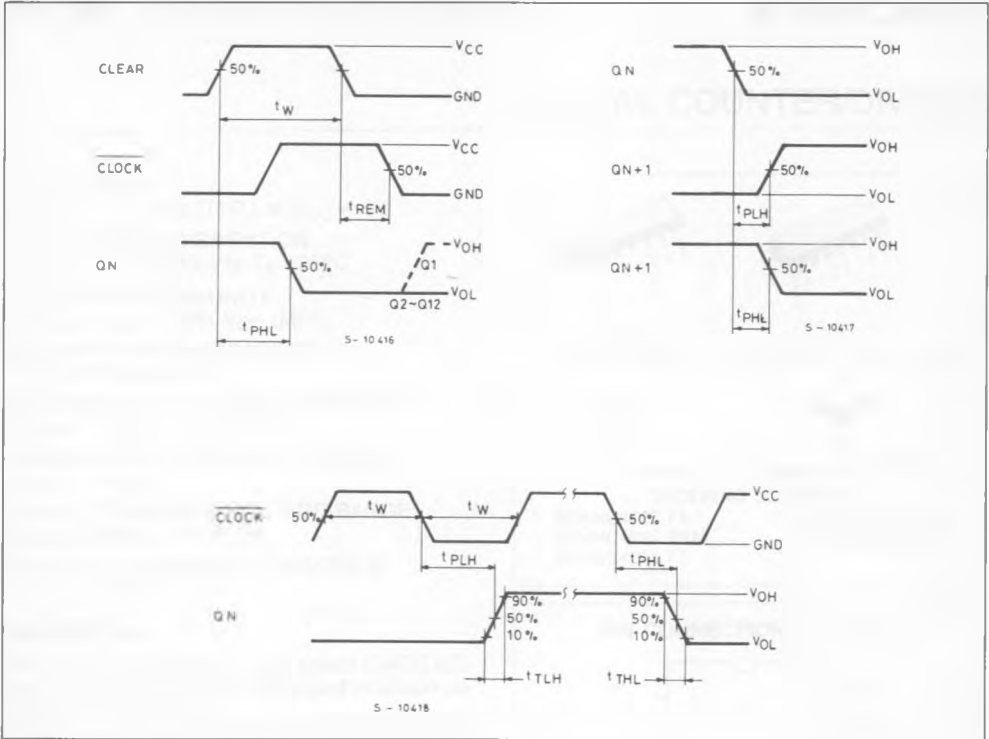
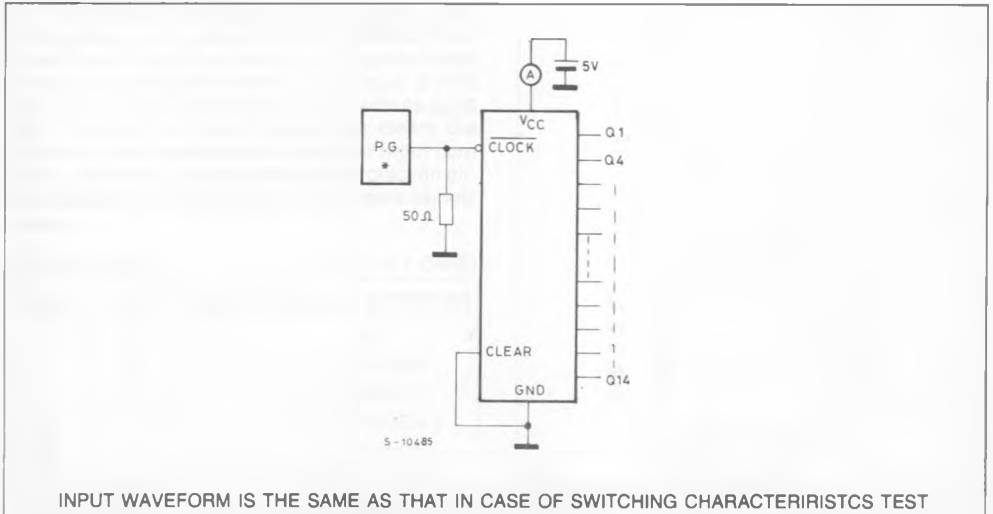
AC ELECTRICAL CHARACTERISTICS ( $C_L = 50pF$ , Input  $t_r = t_f = 6ns$ )

Symbol	Parameter	$V_{CC}$	Test Condition	$T_A = 25^\circ C$ 54HC and 74HC			$-40$ to $85^\circ C$ 74HC		$-55$ to $125^\circ C$ 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	
$t_{PLH}$ $t_{PHL}$	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 ( $Q_n - Q_{n+1}$ )	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			—	25	—	—	—	—	—	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)

$$\text{Average operating current is: } I_{CC(oper)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

## SWITCHING CHARACTERISTICS TEST WAVEFORM

TEST CIRCUIT  $I_{CC}$  (Opr)

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