

## HC4020 14 STAGE BINARY COUNTER

## HC4040 12 STAGE BINARY COUNTER

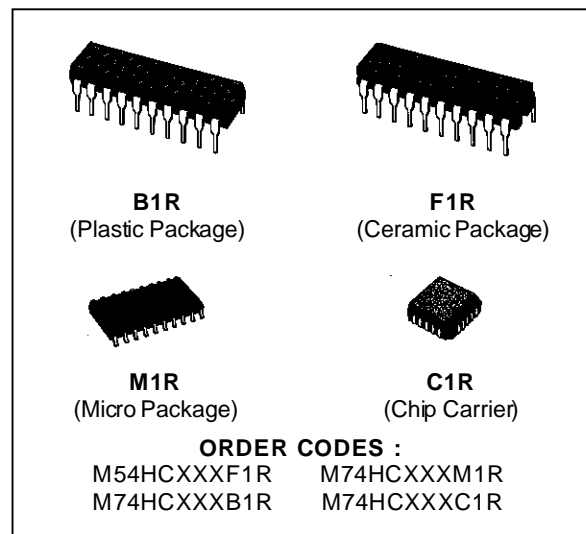
- **HIGH SPEED**  
 $f_{MAX} = 73 \text{ MHz (TYP.) at } V_{CC} = 5 \text{ V}$
- **LOW POWER DISSIPATION**  
 $I_{CC} = 4 \mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- **HIGH NOISE IMMUNITY**  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**  
 10 LSTTL LOADS
- **SYMMETRICAL OUTPUT IMPEDANCE**  
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- **BALANCED PROPAGATION DELAYS**  
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**  
 $V_{CC} \text{ (OPR)} = 2 \text{ V to } 6 \text{ V}$
- **PIN AND FUNCTION COMPATIBLE WITH**  
 4020B/4040B

### DESCRIPTION

The M54/74HC4020/HC4040 are high speed CMOS 14/12-STAGE BINARY COUNTER fabricated in silicon gate C<sup>2</sup>MOS technology. They have 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.

For HC4020 twelve kind of divided output are provided; 1st and 4th stage to 14th stage.

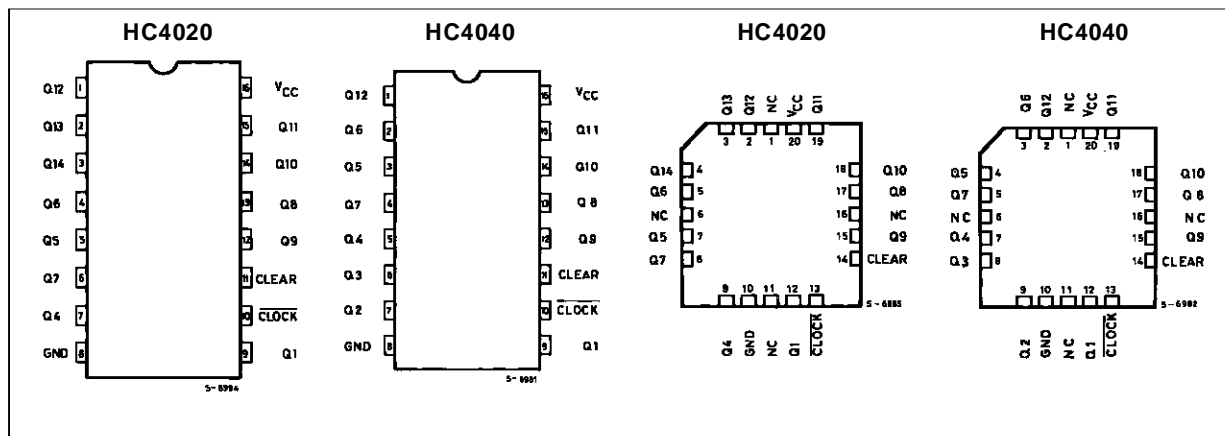


The maximum division available at last stage is  $1/16384 \times f_{IN}$  at clock.

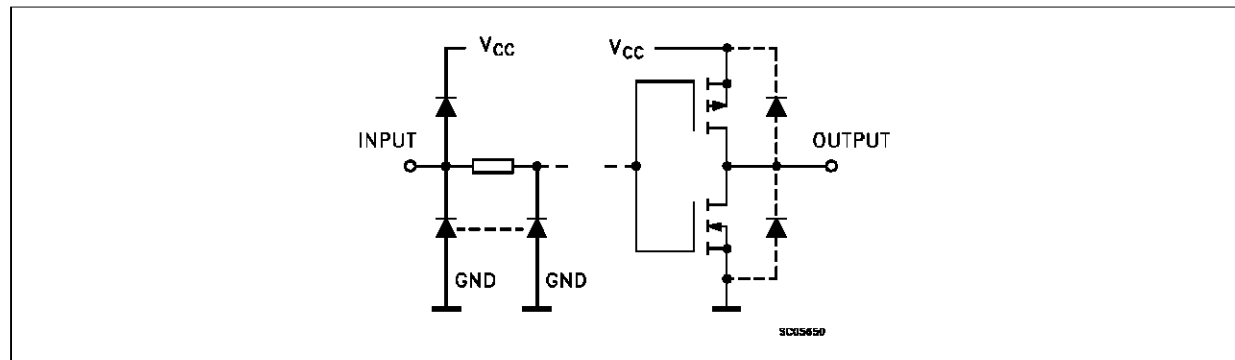
For HC4040 each division stage has an output; the final frequency is  $1/4096 \times f_{IN}$ .

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

### PIN CONNECTION (top view)



## INPUT AND OUTPUT EQUIVALENT CIRCUIT



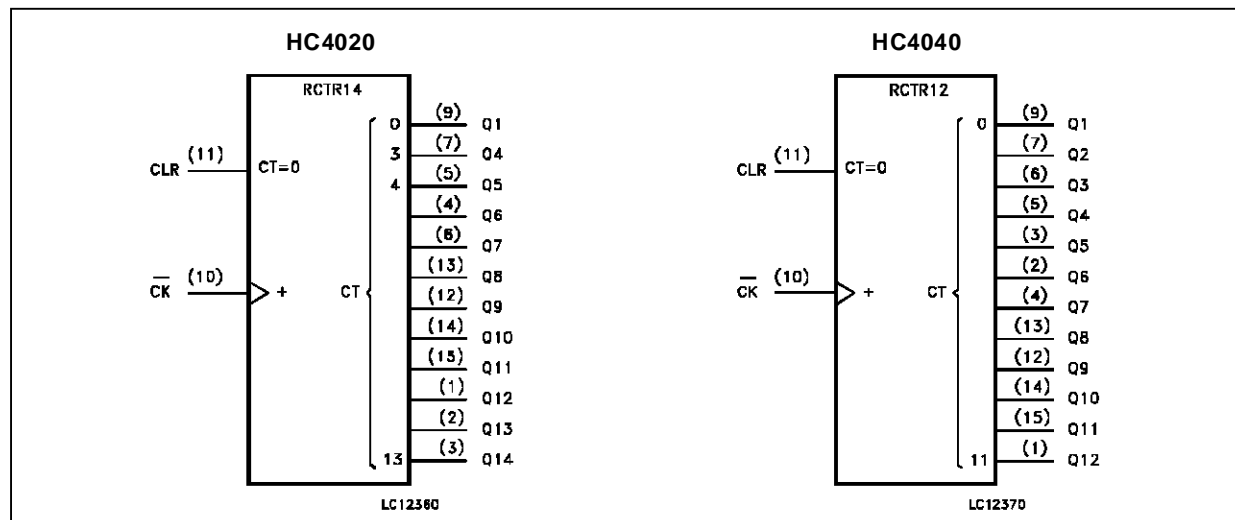
### PIN DESCRIPTION (HC4020)

PIN No	SYMBOL	NAME AND FUNCTION
9, 7, 6, 5, 3, 2, 4, 13, 12, 14, 15, 1	Q1, Q4 to Q14	Parallel Outputs
10	$\overline{\text{CLOCK}}$	Clock Input (LOW to HIGH, edge triggered)
11	CLEAR	Reset Inputs
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

### PIN DESCRIPTION (HC4040)

PIN No	SYMBOL	NAME AND FUNCTION
9, 7, 6, 5, 3, 2, 4, 13, 12, 14, 15, 1	Q1 to Q12	Parallel Outputs
10	$\overline{\text{CLOCK}}$	Clock Input (LOW to HIGH, edge triggered)
11	CLEAR	Reset Inputs
8	GND	Ground (0V)
16	V <sub>CC</sub>	Positive Supply Voltage

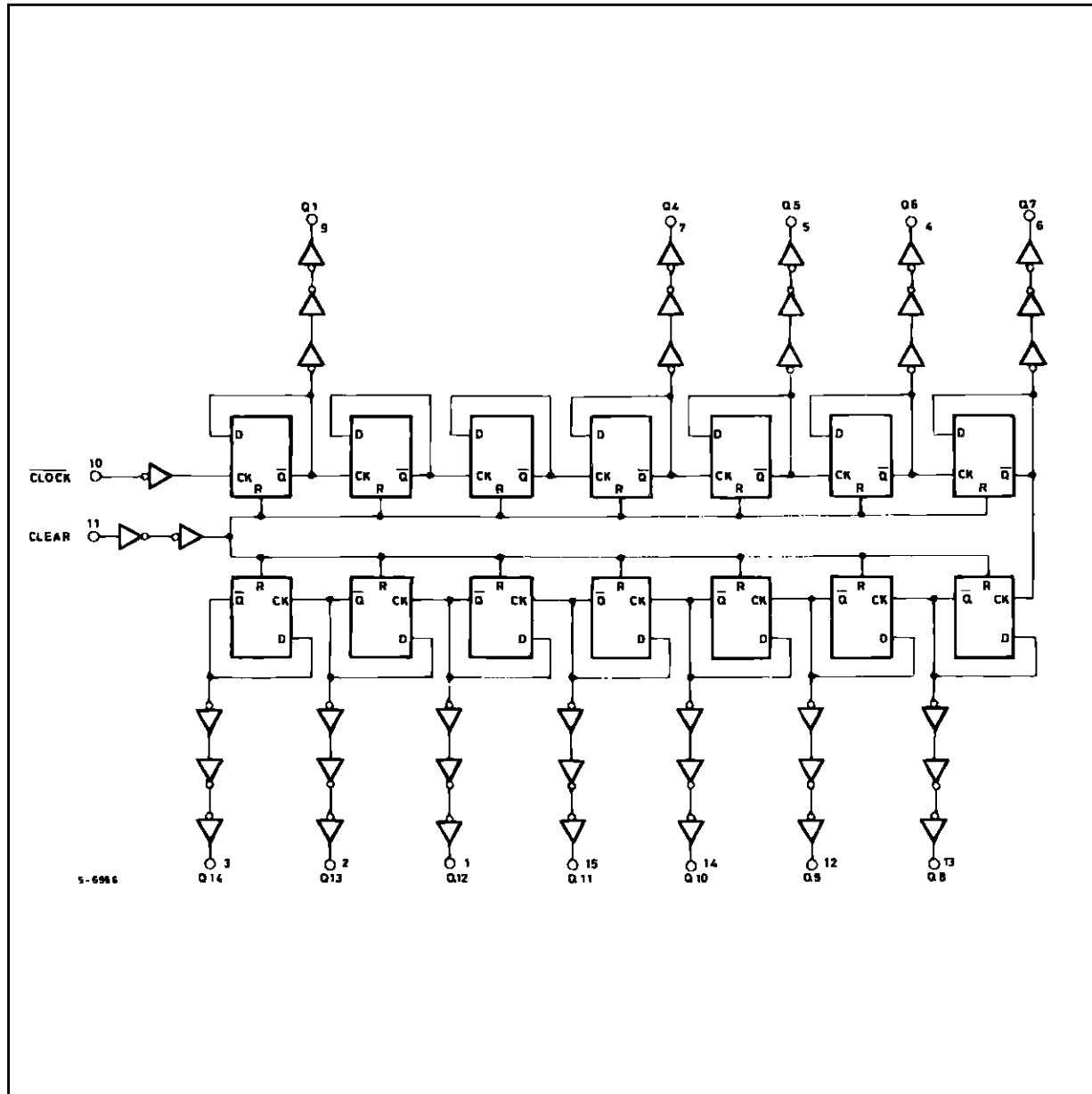
## IEC LOGIC SYMBOLS



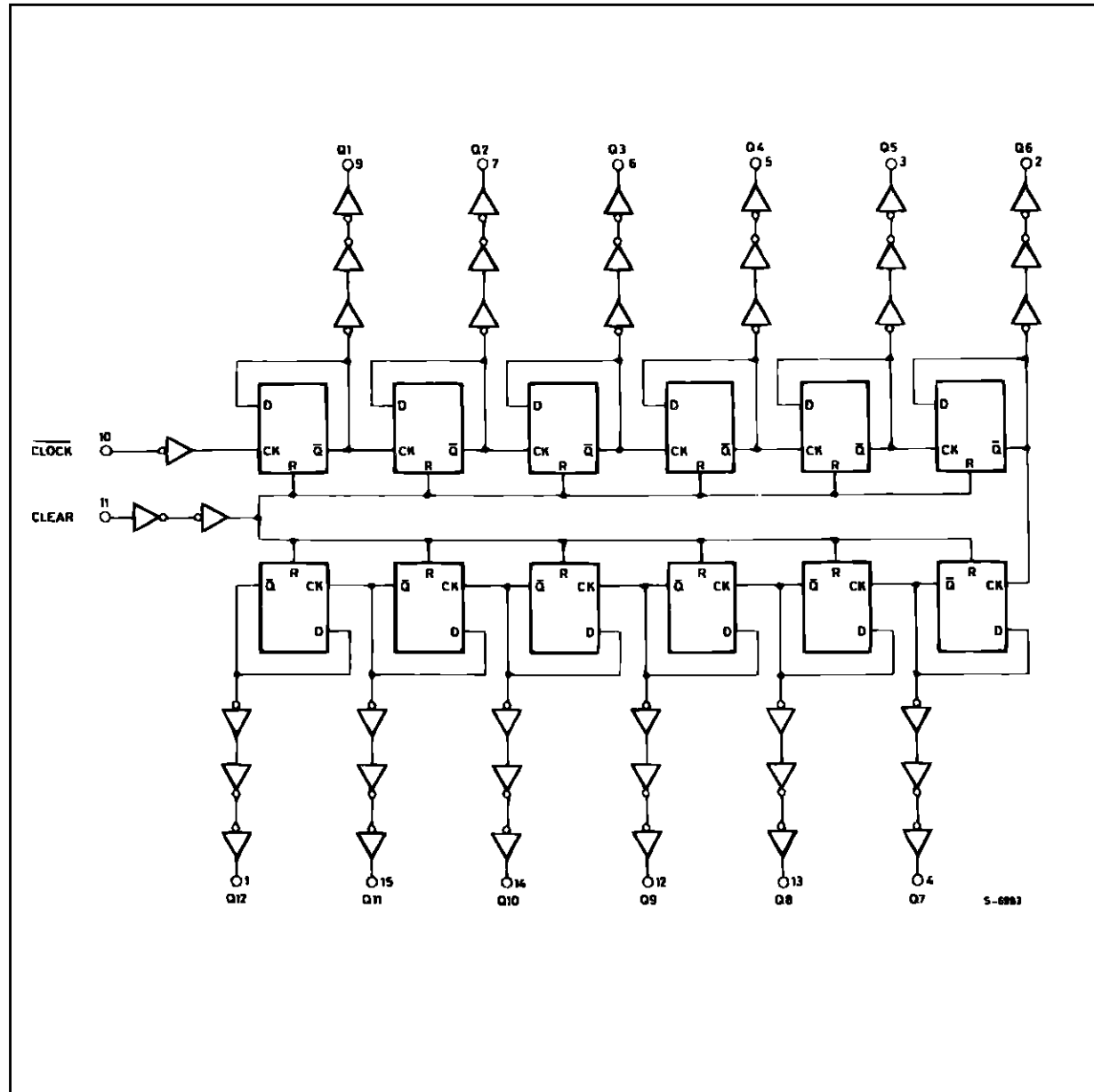
## TRUTH TABLE

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

## LOGIC DIAGRAM (HC4020)



LOGIC DIAGRAM (HC4040)



**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	°C
$T_L$	Lead Temperature (10 sec)	300	°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:  $\equiv 65^\circ\text{C}$  derate to 300 mW by 10mW/°C:  $65^\circ\text{C}$  to  $85^\circ\text{C}$

**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
$T_{op}$	Operating Temperature: <b>M54HC Series</b> <b>M74HC Series</b>	-55 to +125 -40 to +85	°C °C
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} = 2\text{ V}$ $V_{CC} = 4.5\text{ V}$ $V_{CC} = 6\text{ V}$	0 to 1000 0 to 500 0 to 400
			ns

**DC SPECIFICATIONS**

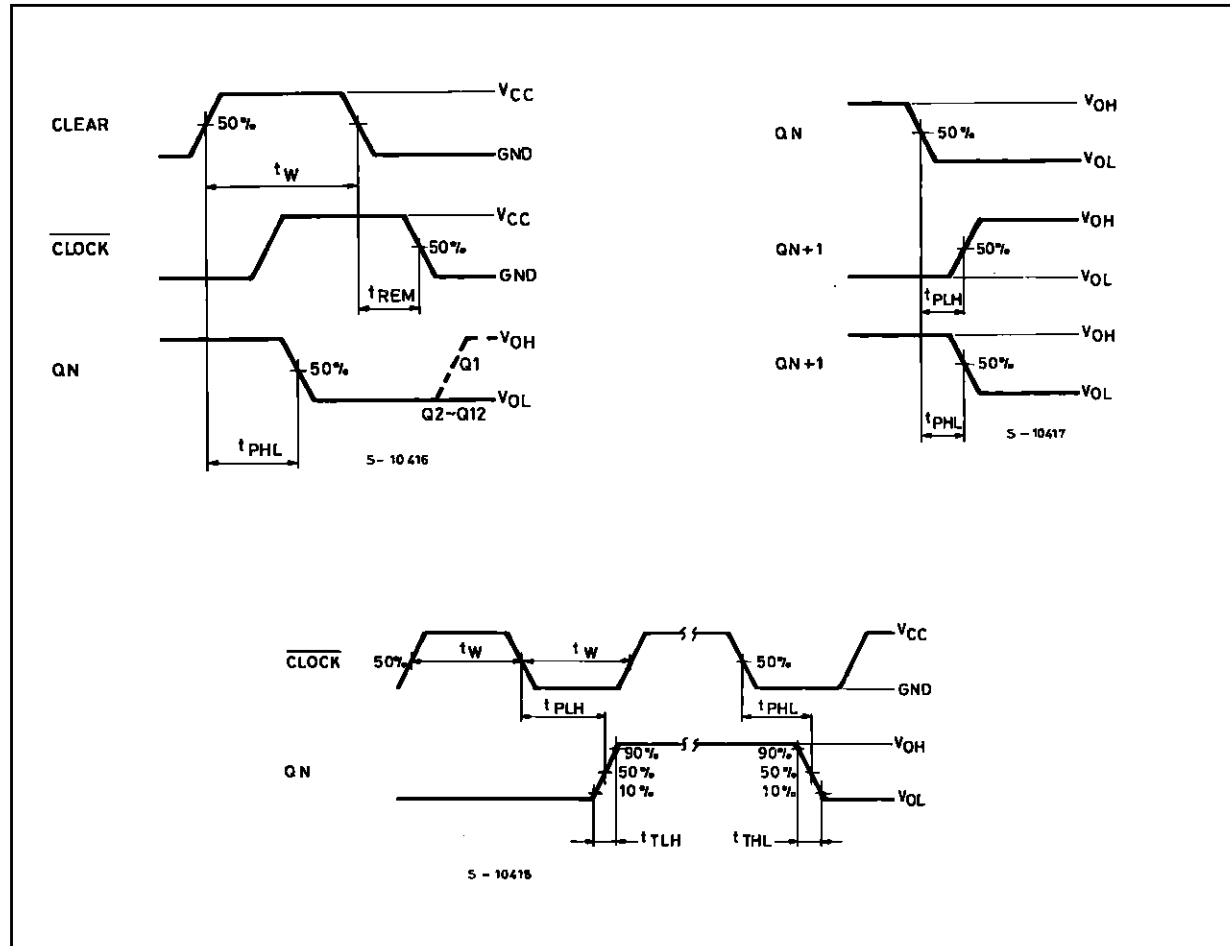
Symbol	Parameter	Test Conditions		Value						Unit		
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
V <sub>IH</sub>	High Level Input Voltage	2.0		1.5			1.5		1.5		V	
		4.5		3.15			3.15		3.15			
		6.0		4.2			4.2		4.2			
V <sub>IL</sub>	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 <sub>OH</sub>	High Level Output Voltage	2.0	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9		V
		4.5			4.4	4.5		4.4		4.4		
		6.0			5.9	6.0		5.9		5.9		
		4.5		I <sub>O</sub> =-4.0 mA	4.18	4.31		4.13		4.10		
		6.0		I <sub>O</sub> =-5.2 mA	5.68	5.8		5.63		5.60		
V <sub>OL</sub>	Low Level Output Voltage	2.0	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>O</sub> = 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		I <sub>O</sub> = 4.0 mA		0.17	0.26		0.33		0.40	
		6.0		I <sub>O</sub> = 5.2 mA		0.18	0.26		0.33		0.40	
I <sub>I</sub>	Input Leakage Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			±0.1		±1		±1	μA	
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			4		40		80	μA	

**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

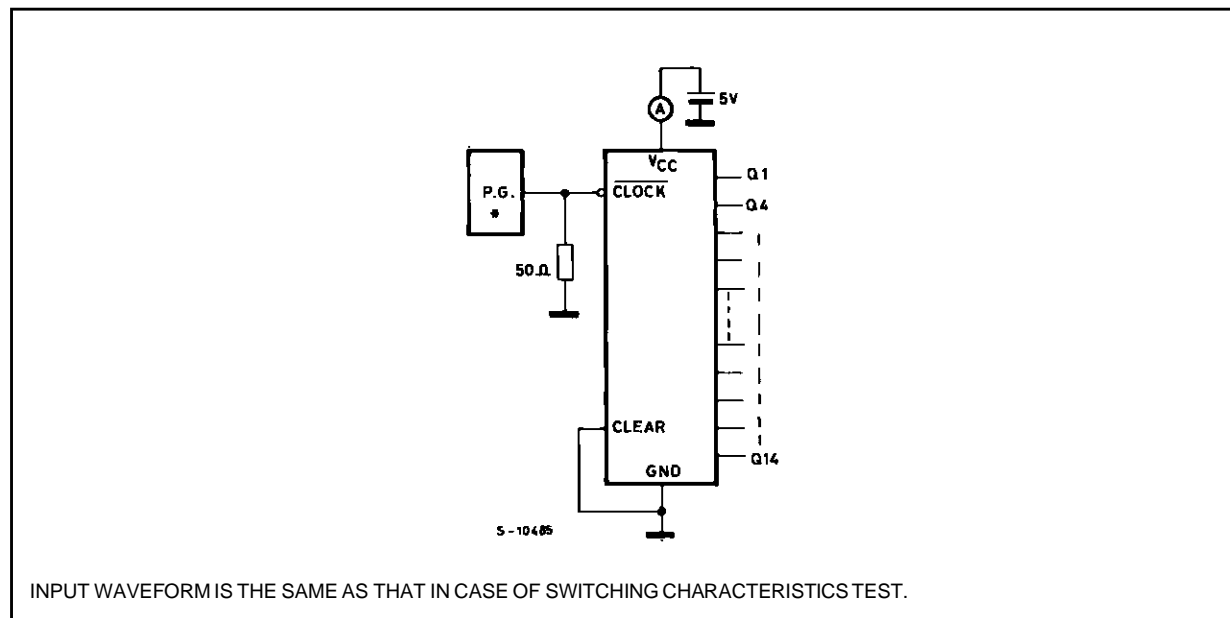
Symbol	Parameter	Test Conditions		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t <sub>TLH</sub> t <sub>THL</sub>	Output Transition Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (Q <sub>n</sub> - Q <sub>n+1</sub> )	2.0			20	50		65		75	ns
		4.5			5	10		13		15	
		6.0			4	9		11		13	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (CLOCK Q1)	2.0	for HC4020		76	145		180		220	ns
		4.5			21	29		36		44	
		6.0			18	25		31		38	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (CLOCK Q1)	2.0	for HC4040		48	145		180		220	ns
		4.5			17	29		36		44	
		6.0			13	25		31		38	
t <sub>PHL</sub>	Propagation Delay Time (CLEAR - Q <sub>n</sub> )	2.0	for HC4020		60	140		175		210	ns
		4.5			18	28		35		42	
		6.0			15	24		30		36	
t <sub>PHL</sub>	Propagation Delay Time (CLEAR - Q <sub>n</sub> )	2.0	for HC4040		56	140		175		210	ns
		4.5			18	28		35		42	
		6.0			15	24		30		36	
f <sub>MAX</sub>	Maximum Clock Frequency	2.0		6.0	15		4.8		4		MHz
		4.5		30	65		24		20		
		6.0		35	70		28		24		
t <sub>W(H)</sub> t <sub>W(L)</sub>	Minimum Pulse Width (CLOCK)	2.0			40	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
t <sub>W(H)</sub>	Minimum Pulse Width (CLEAR)	2.0	for HC4020		32	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
t <sub>W(H)</sub>	Minimum Pulse Width (CLEAR)	2.0	for HC4040		70	175		220		265	ns
		4.5			19	35		44		53	
		6.0			16	30		37		45	
t <sub>REM</sub>	Minimum Removal Time	2.0	for HC4020			0		0		0	ns
		4.5				0		0		0	
		6.0				0		0		0	
t <sub>REM</sub>	Minimum Removal Time	2.0	for HC4040			25		30		40	ns
		4.5				5		6		8	
		6.0				5		5		7	
C <sub>IN</sub>	Input Capacitance				5	10		10			pF
C <sub>PD</sub> (*)	Power Dissipation Capacitance				34						pF

(\*) C<sub>PD</sub> 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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC2}$  (per FLIP/FLOP)

SWITCHING CHARACTERISTICS TEST WAVEFORM



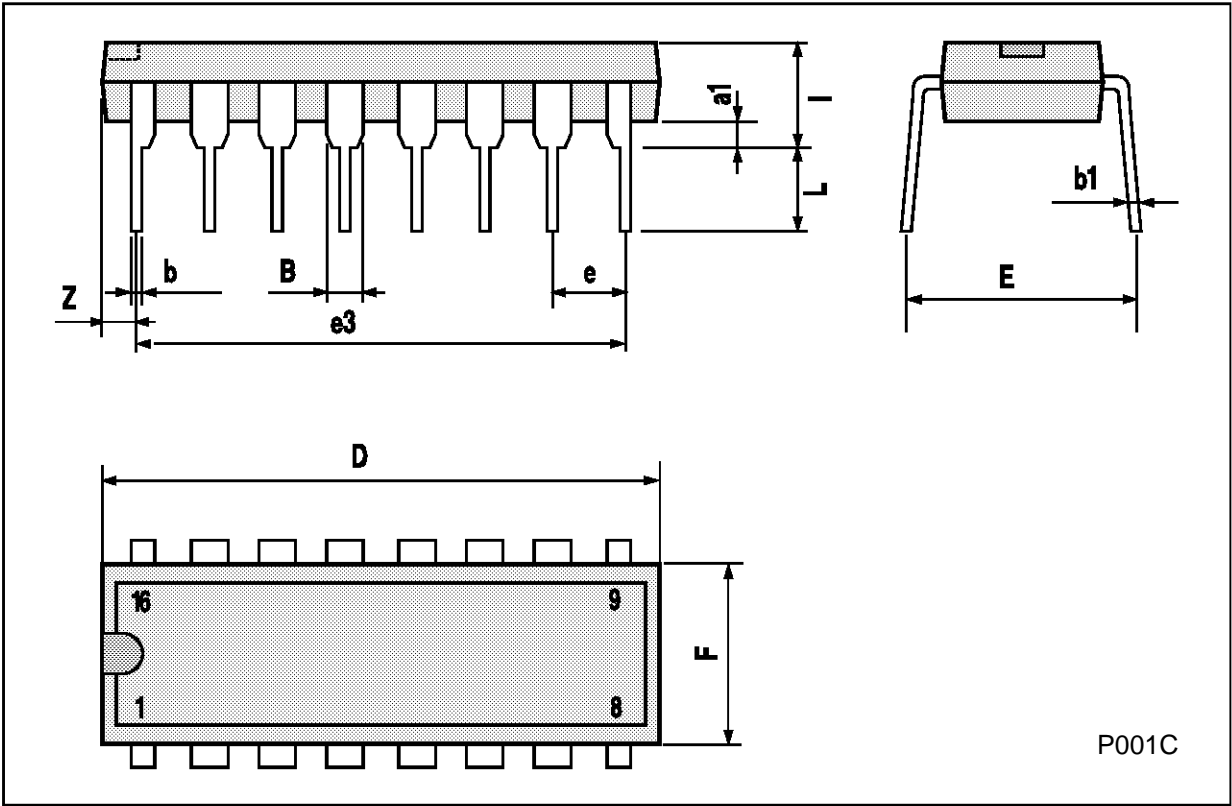
TEST CIRCUIT  $I_{CC}$  (Opr.)





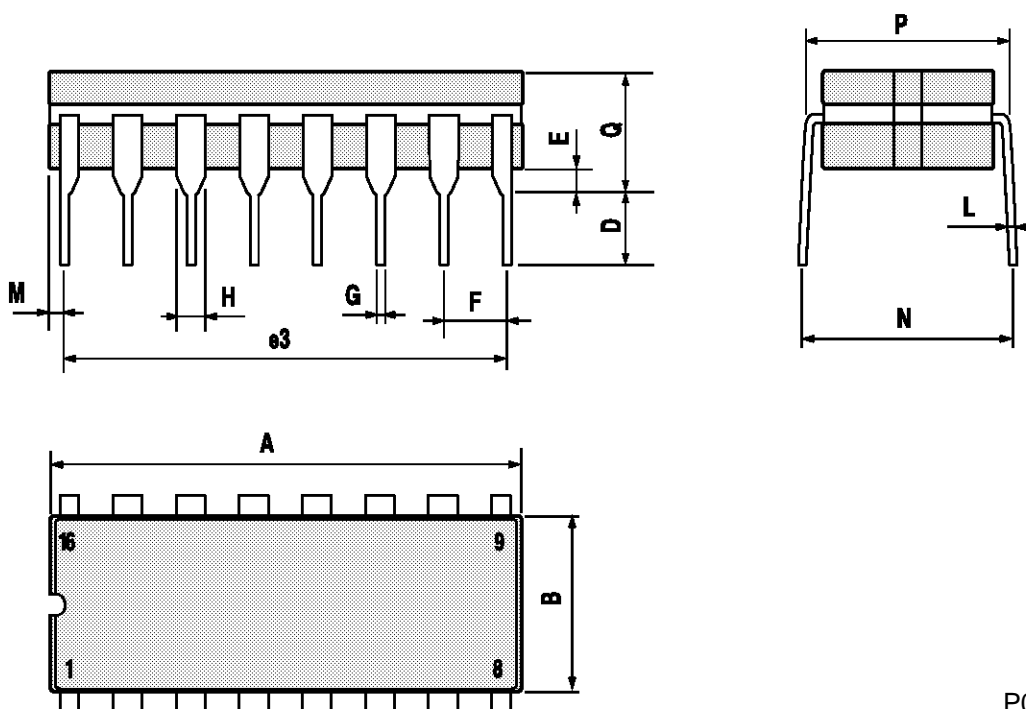
Plastic DIP16 (0.25) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



# Ceramic DIP16/1 MECHANICAL DATA

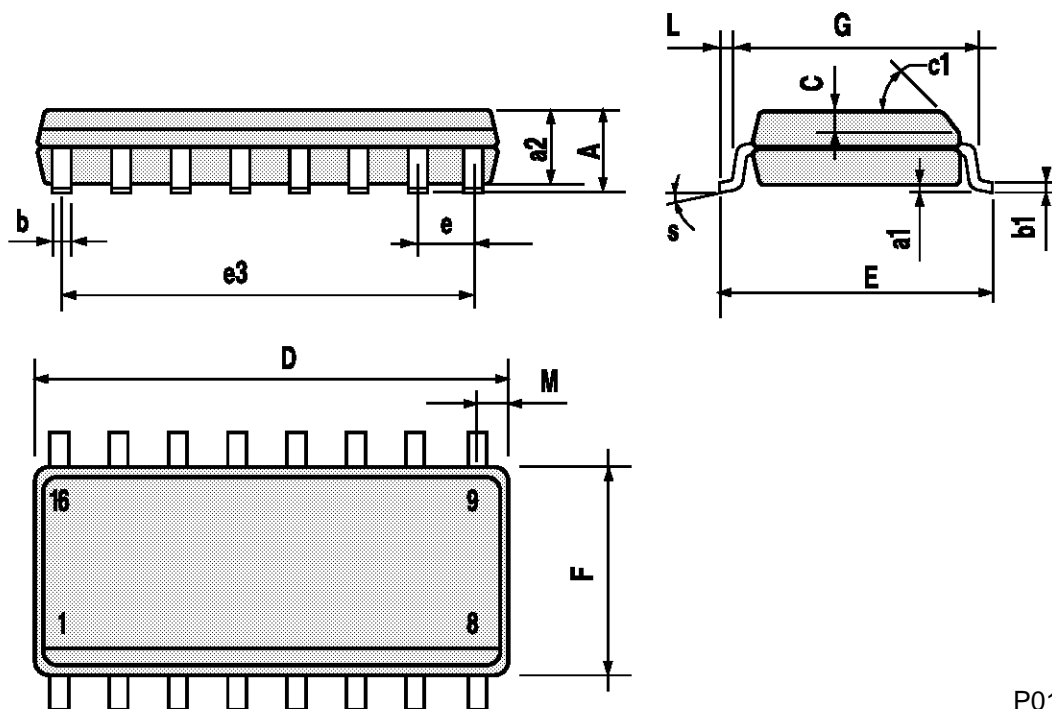
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



P053D

## SO16 (Narrow) MECHANICAL DATA

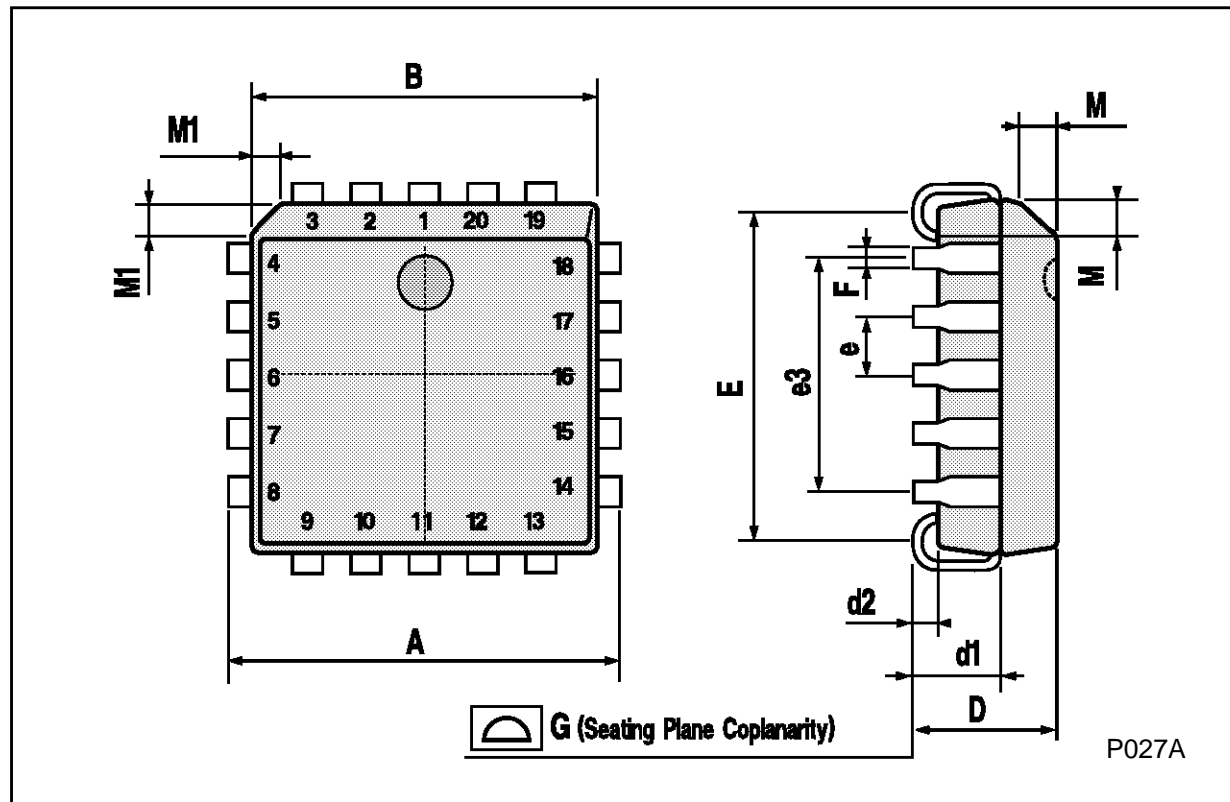
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



P013H

## PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



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