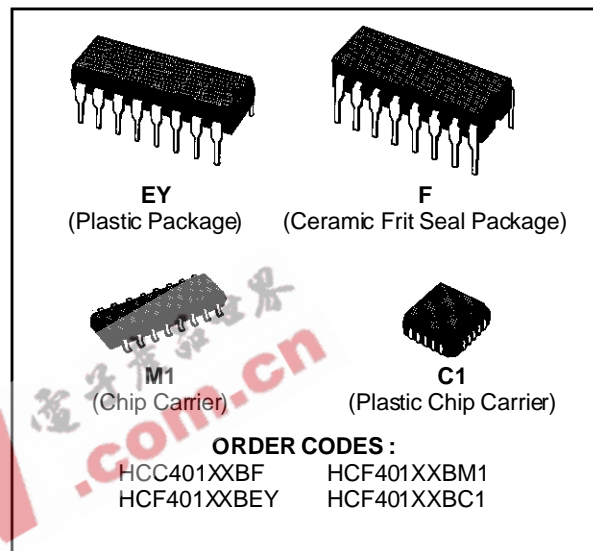


## PRESETTABLE UP/DOWN COUNTERS (DUAL CLOCK WITH RESET) 40192B – BCD TYPE 40193B – BINARY TYPE

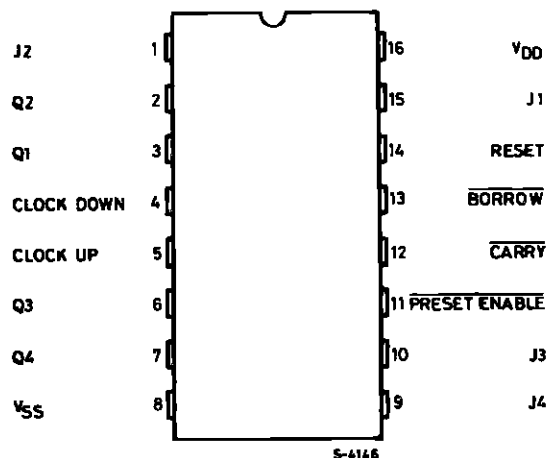
- INDIVIDUAL CLOCK LINES FOR COUNTING UP OR COUNTING DOWN
- SYNCHRONOUS HIGH-SPEED CARRY AND BORROW PROPAGATION DELAYS FOR CAS-CADING
- ASYNCHRONOUS RESET AND PRESET CA-PABILITY
- MEDIUM-SPEED OPERATION -  $f_{CL} = 8\text{MHz}$  (typ.) @ 10V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TEN-TATIVE STANDARD N° 13A, "STANDARD SPE-CIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



### DESCRIPTION

The **HCC40192B**, **HCC40193B**, (extended temperature range) and the **HCF40192B**, **HCF40193B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF40192B** Presettable BCD Up/Down Counter and the **HCC/HCF40193B** Presettable Binary Up/Down Counter each consist of 4 synchronously clocked, gated "D" type flip-flops connected as a counter. The inputs consist of 4 individual jam lines, a PRESET ENABLE control, individual CLOCK UP and CLOCK DOWN signals and a master RESET. Four buffered Q signal outputs as well as CARRY and BORROW outputs for multiple-stage counting schemes are provided. The counter is cleared so that all outputs are in a low state by a high on the RESET line. A RESET is accomplished asynchronously with the clock. Each output is individually programmable asynchronously with the clock to the level on the corresponding jam input when the PRESET ENABLE control is low. The counter counts up one count on the positive clock edge of the CLOCK UP signal provided the CLOCK DOWN line is high. The counter counts down one count on the positive clock edge of the CLOCK DOWN signal provided the CLOCK UP line

### PIN CONNECTIONS

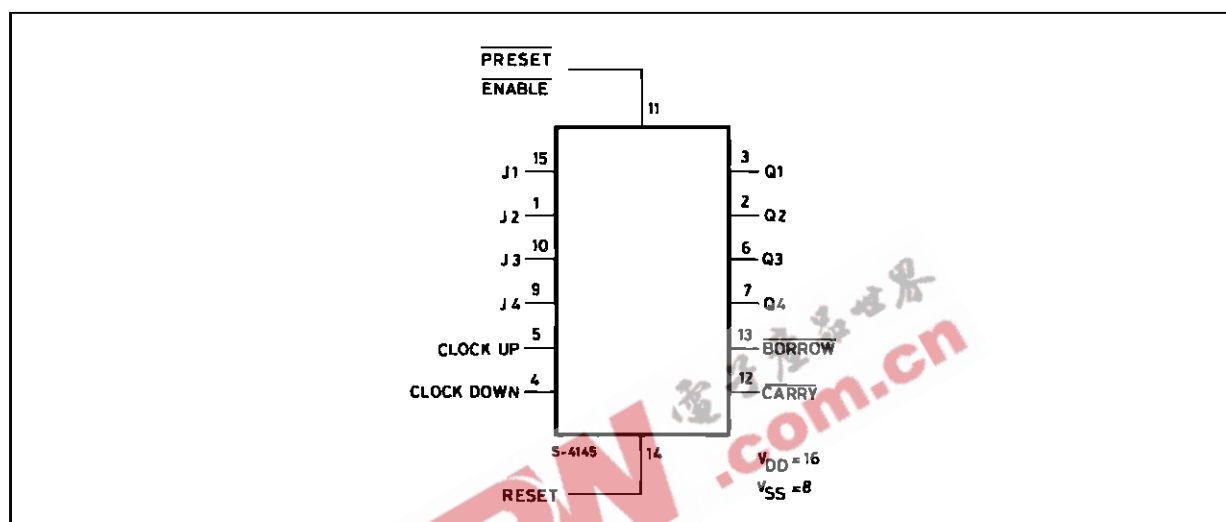


## HCC/HCF40192B/193B

is high. The  $\overline{\text{CARRY}}$  and  $\overline{\text{BORROW}}$  signals are high when the counter is counting up or down. The  $\overline{\text{CARRY}}$  signal goes low one-half clock cycle after the counter reaches its maximum count in the count-up mode. The  $\overline{\text{BORROW}}$  signal goes low one-half clock cycle after the counter reaches its minimum

count in the count-down mode. Cascading of multiple packages is easily accomplished without the need for additional external circuitry by tying the  $\overline{\text{BORROW}}$  and  $\overline{\text{CARRY}}$  outputs to the  $\overline{\text{CLOCK DOWN}}$  and  $\overline{\text{CLOCK UP}}$  inputs, respectively, of the succeeding package.

### FUNCTIONAL DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{DD}^*$	Supply Voltage : HCC Types HCF Types	- 0.5 to + 20 - 0.5 to + 18	V
$V_i$	Input Voltage	- 0.5 to $V_{DD} + 0.5$	V
$I_i$	DC Input Current (any one input)	$\pm 10$	mA
$P_{tot}$	Total Power Dissipation (per package) Dissipation per Output Transistor for $T_{op}$ = Full Package-temperature Range	200 100	mW
$T_{op}$	Operating Temperature : HCC Types HCF Types	- 55 to + 125 - 40 to + 85	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature	- 65 to + 150	$^{\circ}\text{C}$

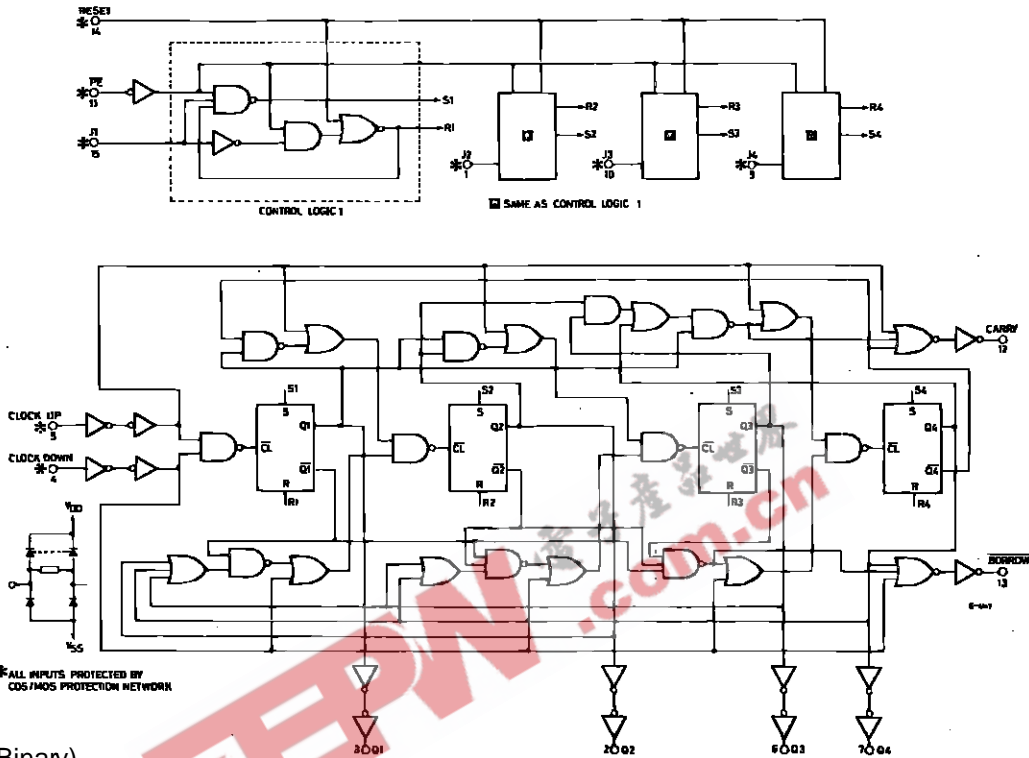
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.  
\* All voltages are with respect to  $V_{SS}$  (GND).

### RECOMMENDED OPERATING CONDITIONS

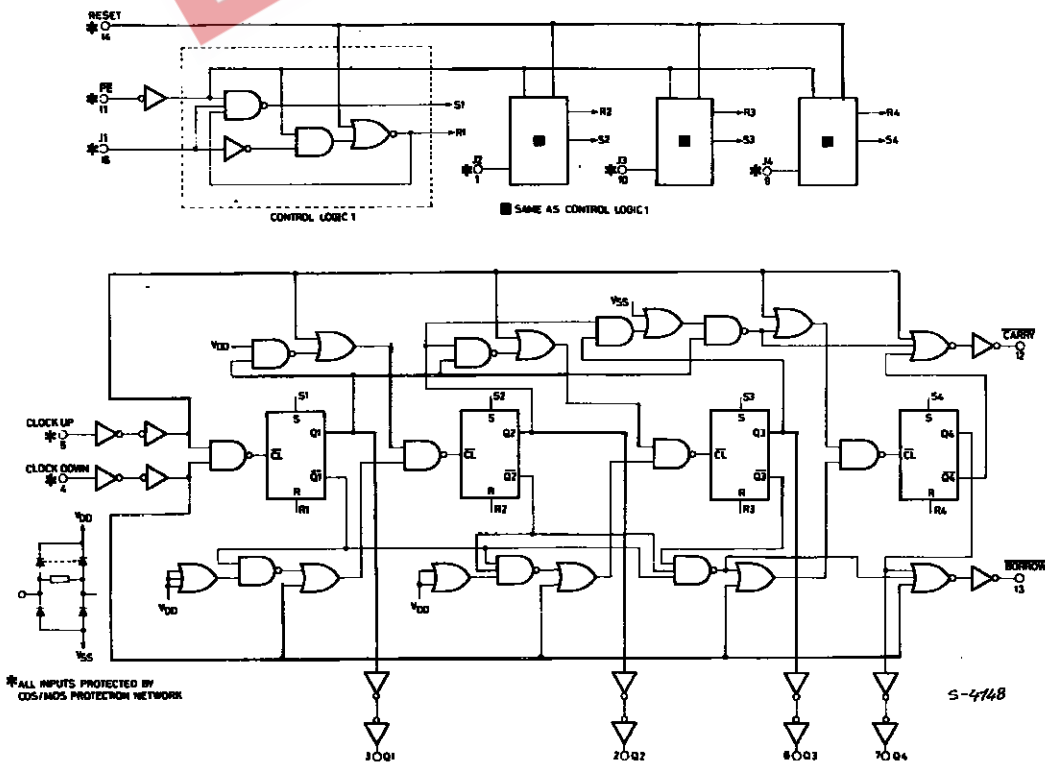
Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage : HCC Types HCF Types	3 to 18 3 to 15	V
$V_i$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature : HCC Types HCF Types	- 55 to + 125 - 40 to + 85	$^{\circ}\text{C}$

LOGIC DIAGRAMS

40192B (BCD).



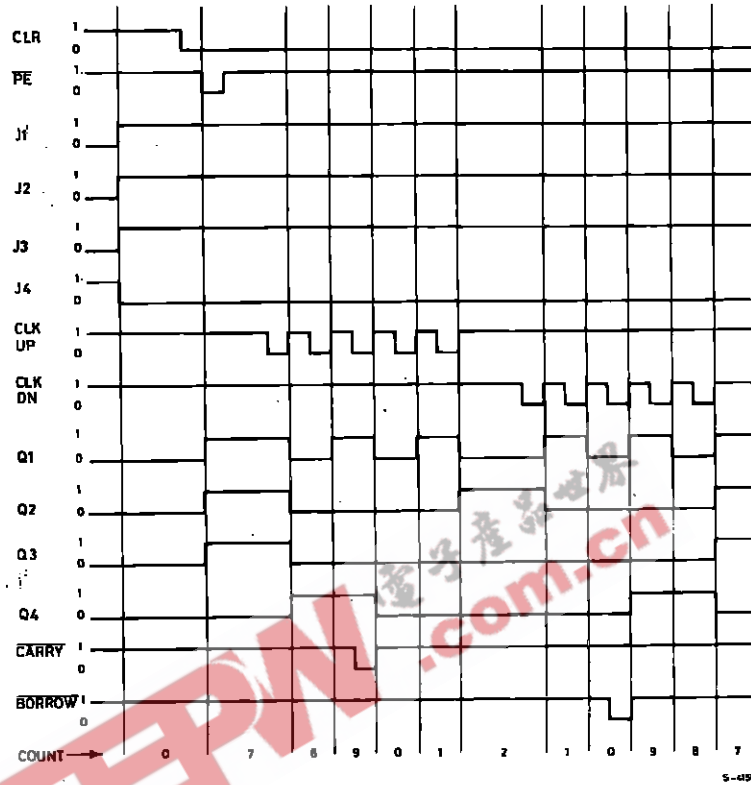
40193B (Binary).



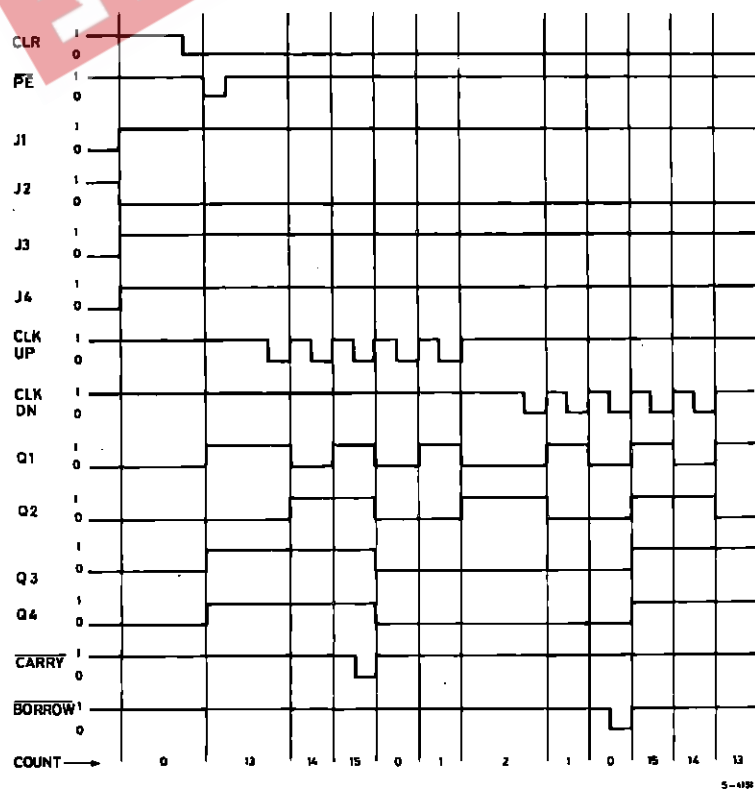
# HCC/HCF40192B/193B

## TIMING DIAGRAMS

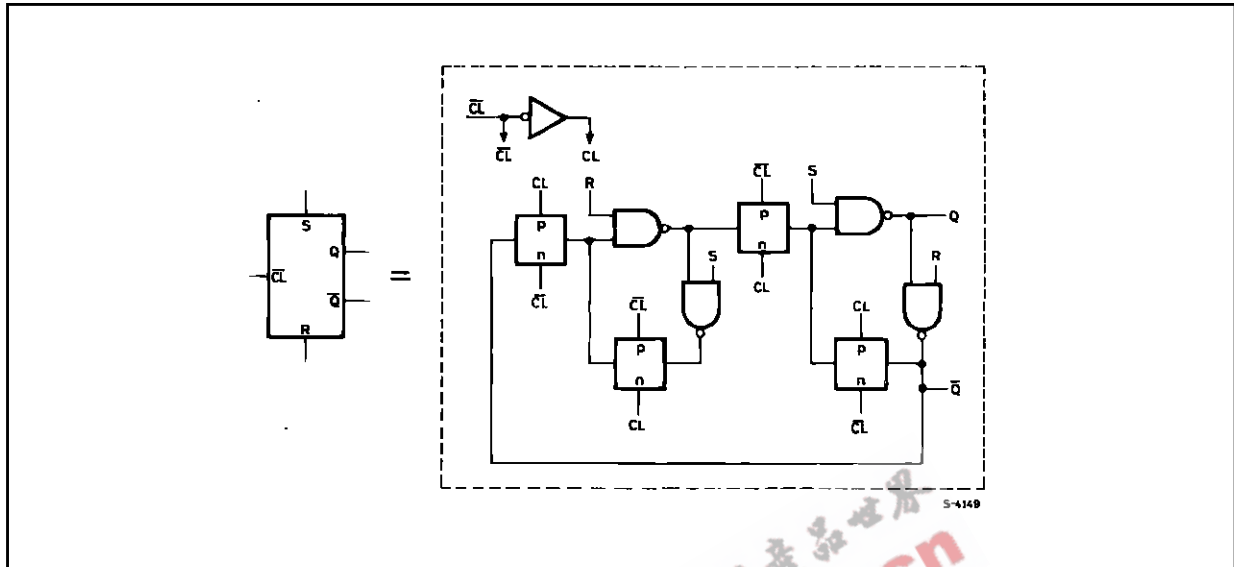
40192B (BCD).



40193B (Binary).



Internal Logic of Flip-flop.



TRUTH TABLE

Clock Up	Clock Down	Preset Enable	Reset	Action
	1	1	0	Count Up
	1	1	0	No Count
1		1	0	Count Down
1		1	0	No Count
X	X	0	0	Preset
X	X	X	1	Reset

1 = High Level    0 = Low Level    X = Don't Care.

## HCC/HCF40192B/193B

### STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditions				Value						Unit	
			V <sub>I</sub> (V)	V <sub>O</sub> (V)	I <sub>O</sub>   ( $\mu$ A)	V <sub>DD</sub> (V)	T <sub>Low</sub> *		25°C			T <sub>High</sub> *		
							Min.	Max.	Min.	Typ.	Max.	Min.		Max.
I <sub>L</sub>	Quiescent Current	HCC Types	0/ 5			5		5		0.04	5		150	$\mu$ A
			0/10			10		10		0.04	10		300	
			0/15			15		20		0.04	20		600	
			0/20			20		100		0.08	100		3000	
		HCF Types	0/ 5			5		20		0.04	20		150	
			0/10			10		40		0.04	40		300	
			0/15			15		80		0.04	80		600	
V <sub>OH</sub>	Output High Voltage		0/ 5		< 1	5	4.95		4.95			4.95		V
			0/10		< 1	10	9.95		9.95			9.95		
			0/15		< 1	15	14.95		14.95			14.95		
V <sub>OL</sub>	Output Low Voltage		5/0		< 1	5		0.05			0.05		0.05	V
			10/0		< 1	10		0.05			0.05		0.05	
			15/0		< 1	15		0.05			0.05		0.05	
V <sub>IH</sub>	Input High Voltage			0.5/4.5	< 1	5	3.5		3.5			3.5		V
				1/9	< 1	10	7		7			7		
				1.5/13.5	< 1	15	11		11			11		
V <sub>IL</sub>	Input Low Voltage			4.5/0.5	< 1	5		1.5			1.5		1.5	V
				9/1	< 1	10		3			3		3	
				13.5/1.5	< 1	15		4			4		4	
I <sub>OH</sub>	Output Drive Current	HCC Types	0/ 5	2.5		5	- 2		- 1.6	- 3.2		- 1.15		mA
			0/ 5	4.6		5	- 0.64		- 0.51	- 1		- 0.36		
			0/10	9.5		10	- 1.6		- 1.3	- 2.6		- 0.9		
			0/15	13.5		15	- 4.2		- 3.4	- 6.8		- 2.4		
		HCF Types	0/ 5	2.5		5	- 1.53		- 1.36	- 3.2		- 1.1		
			0/ 5	4.6		5	- 0.52		- 0.44	- 1		- 0.36		
			0/10	9.5		10	- 1.3		- 1.1	- 2.6		- 0.9		
	0/15	13.5		15	- 3.6		- 3.0	- 6.8		- 2.4				
I <sub>OL</sub>	Output Sink Current	HCC Types	0/ 5	0.4		5	0.64		0.51	1		0.36		mA
			0/10	0.5		10	1.6		1.3	2.6		0.9		
			0/15	1.5		15	4.2		3.4	6.8		2.4		
		HCF Types	0/ 5	0.4		5	0.52		0.44	1		0.36		
			0/10	0.5		10	1.3		1.1	2.6		0.9		
			0/15	1.5		15	3.6		3.0	6.8		2.4		
I <sub>IH</sub> , I <sub>IL</sub>	Input Leakage Current	HCC Types	0/18	Any Input		18		$\pm$ 0.1		$\pm 10^{-5}$	$\pm$ 0.1		$\pm$ 1	$\mu$ A
		HCF Types	0/15							15			$\pm$ 0.3	
C <sub>I</sub>	Input Capacitance			Any Input						5	7.5			pF

\* T<sub>Low</sub> = - 55°C for **HCC** device : - 40°C for **HCF** device.

\* T<sub>High</sub> = + 125°C for **HCC** device : + 85°C for **HCF** device.

The Noise Margin for both "1" and "0" level is : 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5V min. with V<sub>DD</sub> =

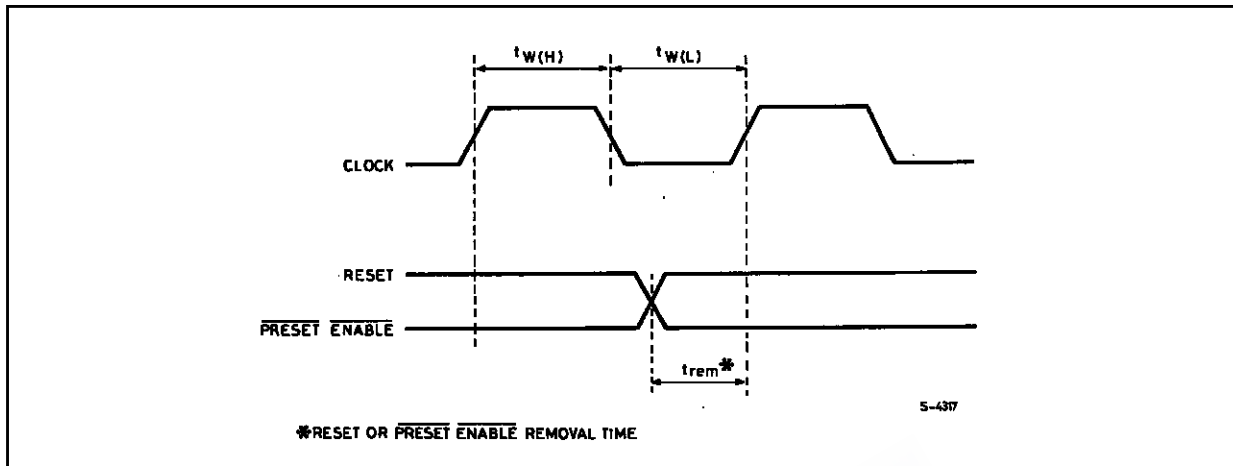
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD}$  values is  $0.3\%/^{\circ}\text{C}$ , all input rise and fall time = 20ns)

Symbol	Parameter	Test Conditions		Value			Unit
			$V_{DD}$ (V)	Min.	Typ.	Max.	
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Clock Up or Clock Down to Q Reset to Q		5		250	500	ns
			10		120	240	
			15		90	180	
	$\overline{PE}$ to Q		5		200	400	ns
			10		100	200	
			15		70	140	
	Clock Up to $\overline{Carry}$ Clock Down to Borrow		5		160	320	ns
			10		80	160	
			15		60	120	
$\overline{Reset}$ or $\overline{PR}$ to Borrow or $\overline{Carry}$		5		300	600	ns	
		10		150	300		
		15		110	220		
$t_{THL}$ , $t_{TLH}$	Transition Time		5		100	200	ns
			10		50	100	
			15		40	80	
$t_{rem}^*$	Removal Time Reset or $\overline{PE}$		5	80	40		ns
			10	40	20		
			15	30	15		
$t_w$	Clock Input Pulse Width Reset		5	480	240		ns
			10	300	150		
			15	260	130		
	$\overline{PE}$		5		120	240	ns
			10		85	170	
			15		70	140	
	Clock		5		90	180	ns
			10		45	90	
			15		30	60	
$t_r$ , $t_f$	Clock Input Rise or Fall Time		5			15	$\mu\text{s}$
			10			15	
			15			5	
$f_{CL}$	Maximum Clock Input Frequency		5	2	4		MHz
			10	5	8		
			15	5.5	11		

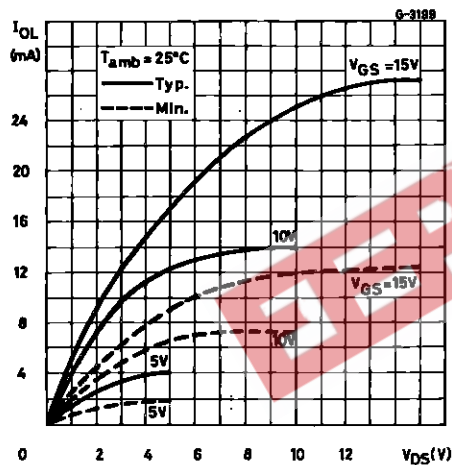
\* The time required for Reset or Preset Enable control to be removed before clocking (see timing diagram).

# HCC/HCF40192B/193B

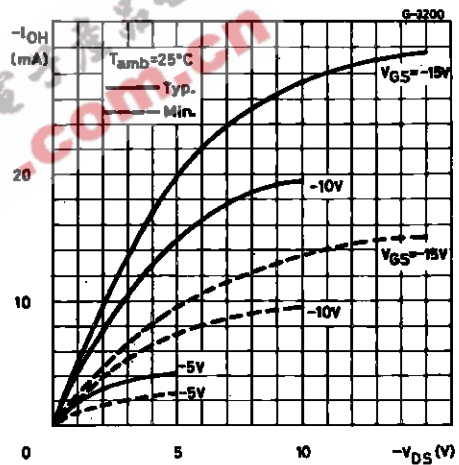
Timing Diagram Defining  $t_{rem}$ .



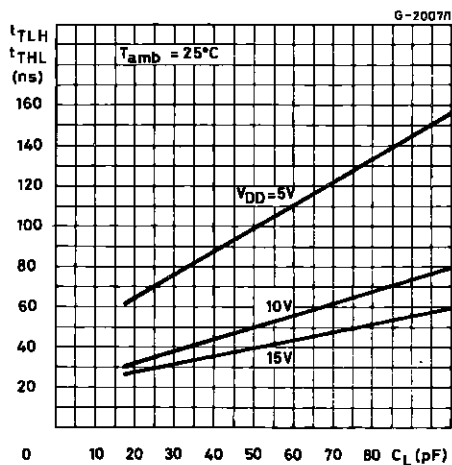
Output Low (sink) Current Characteristics.



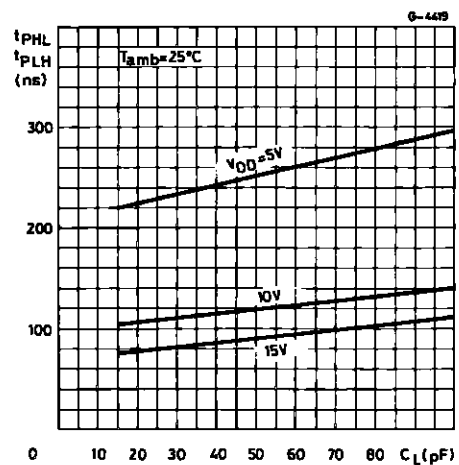
Output high (source) Current Characteristics.



Typical Transition Time vs. Load Capacitance.

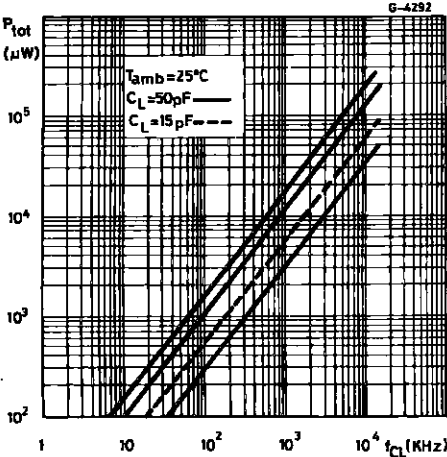


Typical Propagation Delay Time vs. Load Capacitance.



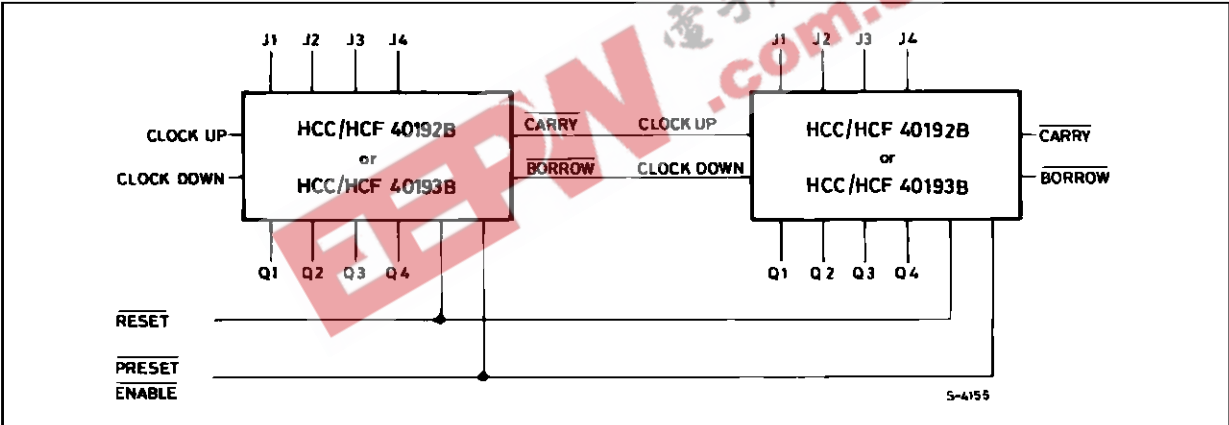


Typical Dynamic Power Dissipation.



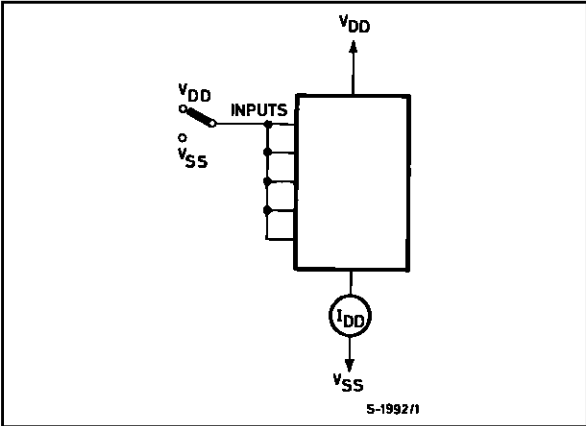
TYPICAL APPLICATION

CASCADED COUNTER PACKAGES

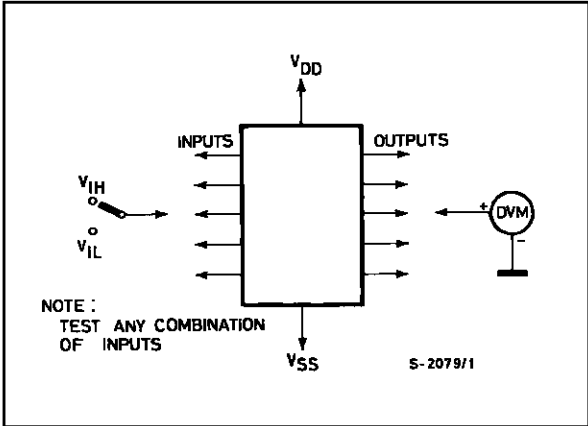


TEST CIRCUITS

Quiescent Device Current.



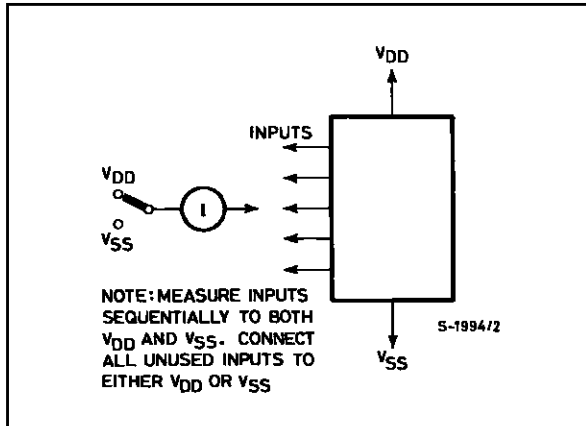
Input Voltage.



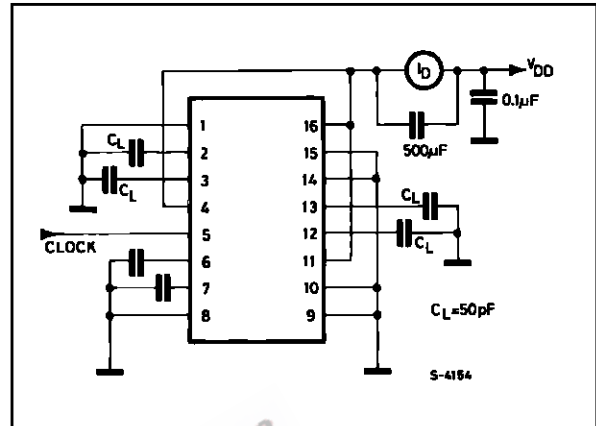
# HCC/HCF40192B/193B

## TEST CIRCUITS (continued)

### Input Leakage Current.

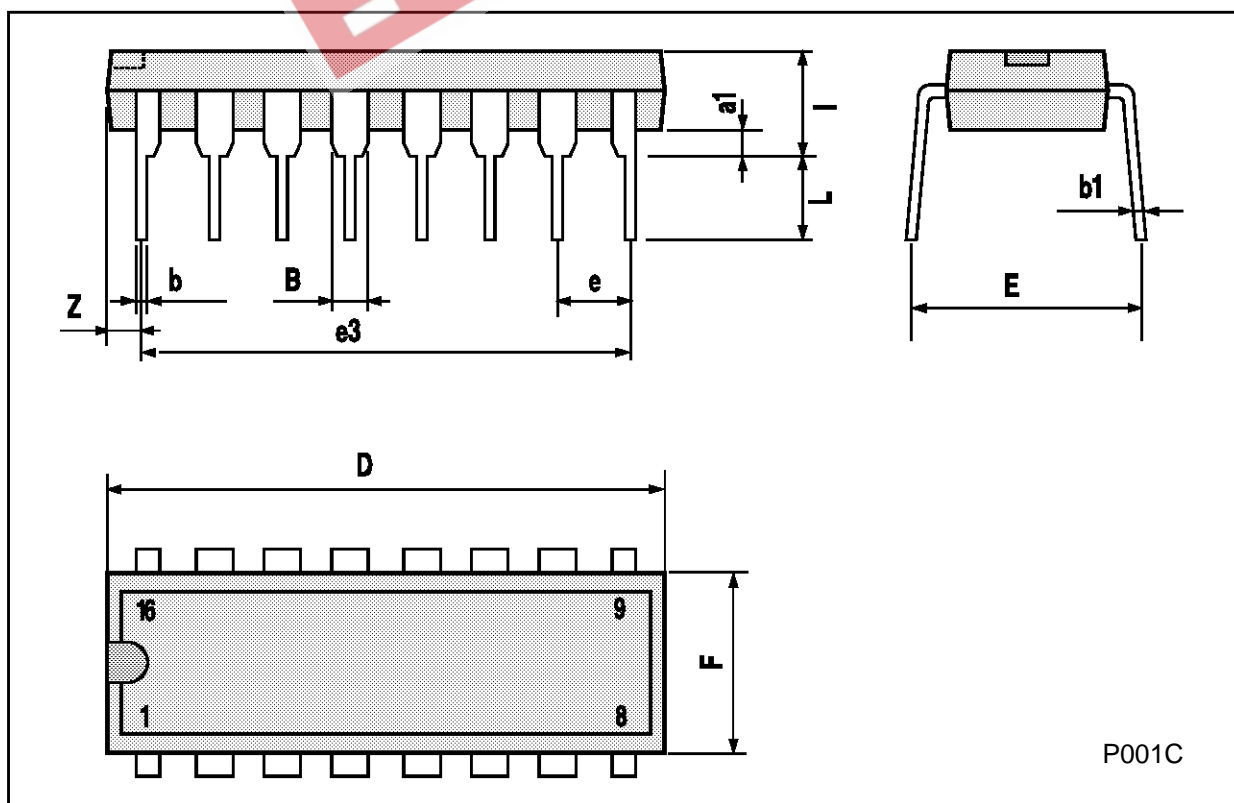


### Dynamic Power Dissipation.



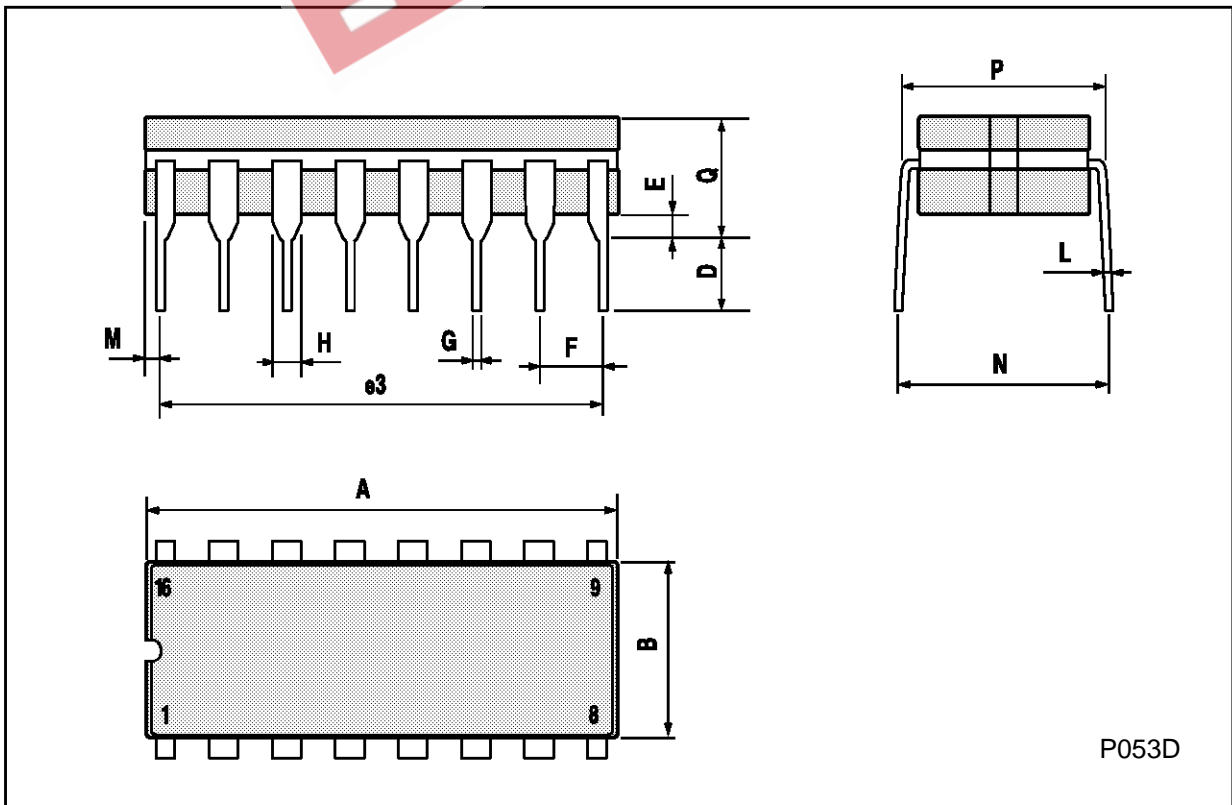
## Plastic DIP16 (0.25) MECHANICAL DATA

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



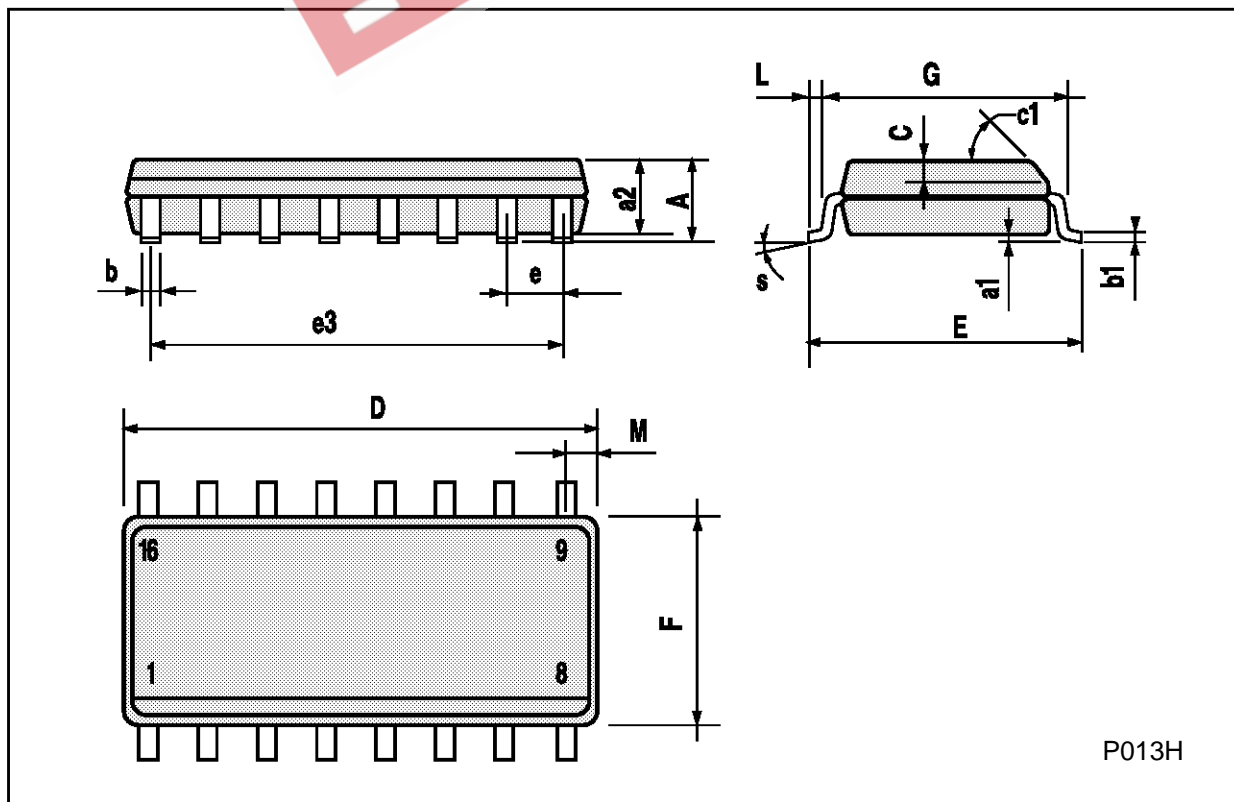
**Ceramic DIP16/1 MECHANICAL DATA**

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



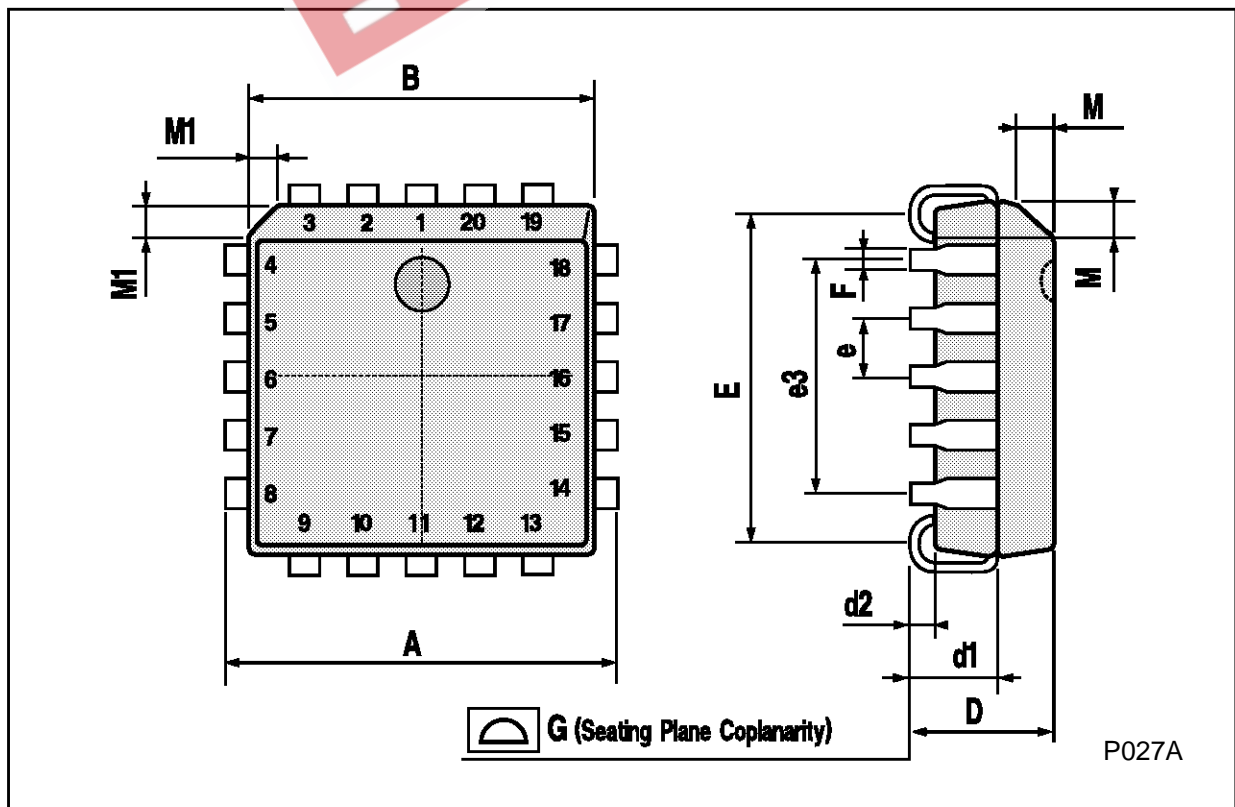
## SO16 (Narrow) MECHANICAL DATA

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.)					



**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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