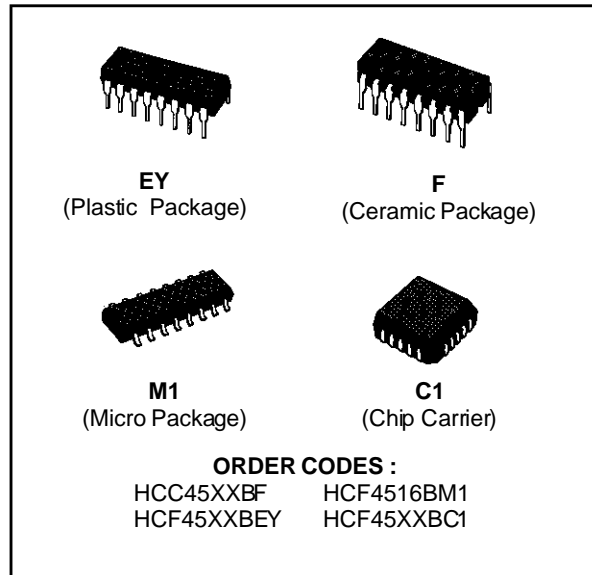


## PRESETTABLE UP/DOWN COUNTERS

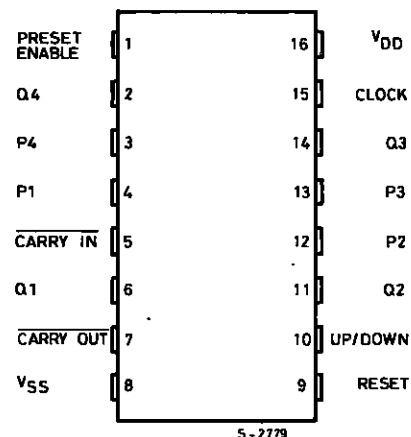
- MEDIUM SPEED OPERATION  $f_{CL} = 8\text{MHz TYP. AT } 10\text{V}$
- SYNCHRONOUS INTERNAL CARRY PROPAGATION
- RESET AND PRESET CAPABILITY
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD No. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"

### DESCRIPTION

The **HCC4510B**, **HCC4516B** (extended temperature range) and the **HCF4510B**, **HCF4516B** (intermediate temperature range) are monolithic integrated circuits available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4510B** Presettable BCD Up/Down Counter and the **HCC/HCF4516B** Presettable Binary Up/Down Counter consist of four synchronously clocked D-type flip-flops (with a gating structure to provide T-type flip-flop capability) connected as counters. These counters can be cleared by a high level on the RESET line, and can be preset to any binary number present on the jam inputs by a high level on the PRESET ENABLE line. The **HCC/HCF4510B** will count out of non-BCD counter states in a maximum of two clock pulses in the up mode, and a maximum of four clock pulses in the down mode. If the CARRY-IN input is held low, the counter advances up or down on each positive-going clock transition. Synchronous cascading is accomplished by connecting all clock inputs in parallel and connecting the CARRY-OUT of a less significant stage to the CARRY-IN of a more significant stage. The **HCC/HCF4510B** and **HCC/HCF4516B** can be cascaded in the ripple mode by connecting the CARRY-OUT to the clock of the next stage. If the UP/DOWN input changes during a terminal count, the CARRY-OUT must be gated with the clock, and the UP/DOWN input must change while the clock is high. This method provides a clean clock signal to the subsequent counting stage.

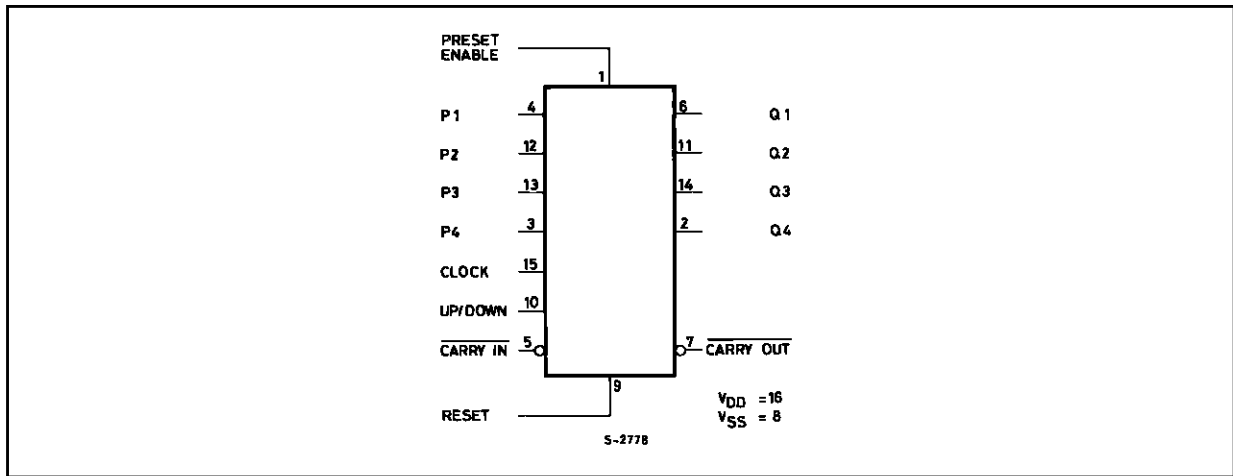


### PIN CONNECTIONS



# HCC/HCF4510B/4516B

## FUNCTIONAL DIAGRAM



CL	$\overline{CI}$	U/D	PE	R	Action
X	1	X	0	0	No Count
$\uparrow$	0	1	0	0	Count Up
$\downarrow$	0	0	0	0	Count Down
X	X	X	1	0	Preset
X	X	X	X	1	Reset

X = Don't care.

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{DD}^*$	Supply Voltage : <b>HCC</b> Types <b>HCF</b> Types	- 0.5 to + 20 - 0.5 to + 18	V 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 mW
$T_{op}$	Operating Temperature : <b>HCC</b> Types <b>HCF</b> Types	- 55 to + 125 - 40 to + 85	$^{\circ}C$ $^{\circ}C$
$T_{stg}$	Storage Temperature	- 65 to + 150	$^{\circ}C$

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.

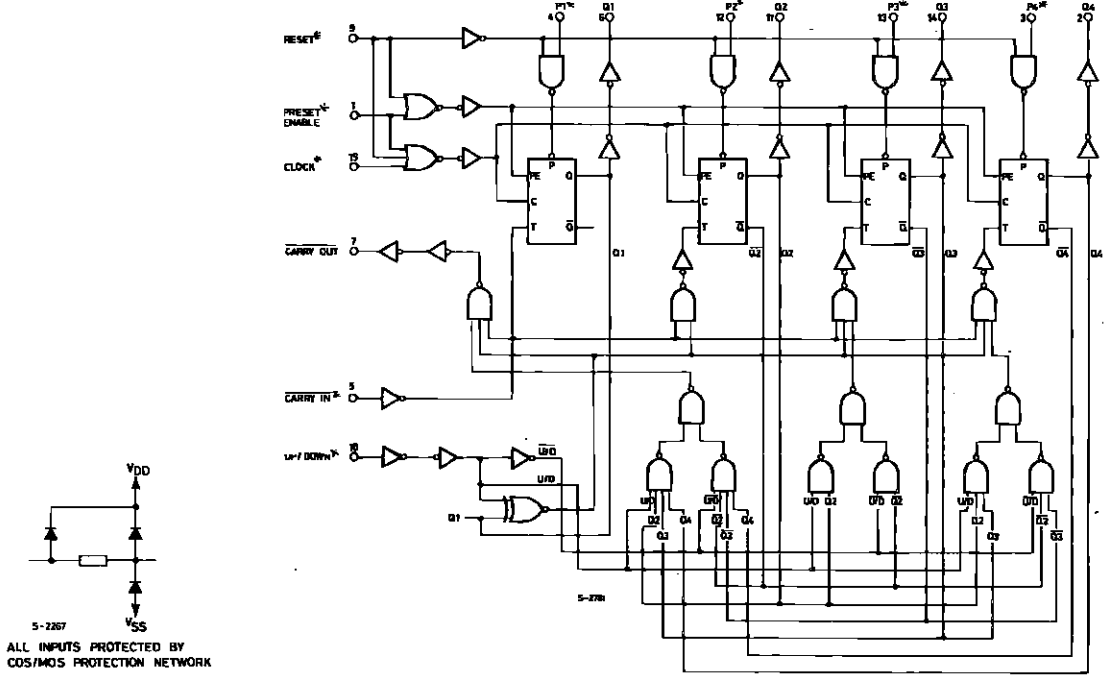
\* All voltage values are referred to  $V_{SS}$  pin voltage.

## RECOMMENDED OPERATING CONDITIONS

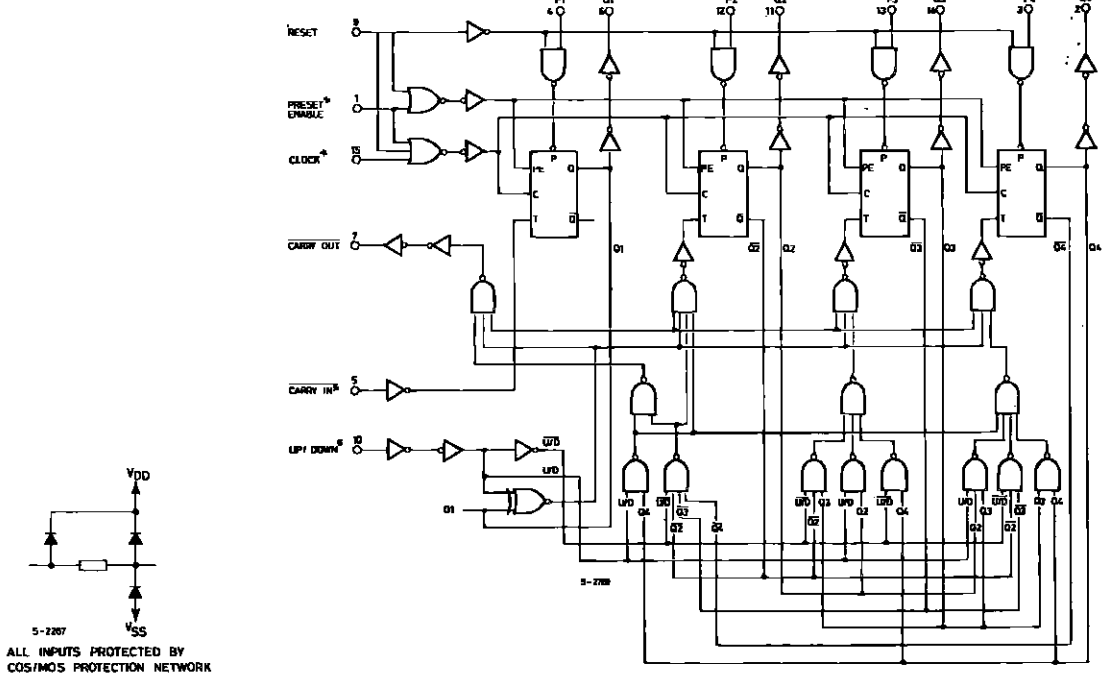
Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage : <b>HCC</b> Types <b>HCF</b> Types	3 to + 18 3 to + 15	V V
$V_I$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature : <b>HCC</b> Types <b>HCF</b> Types	- 55 to + 125 - 40 to + 85	$^{\circ}C$ $^{\circ}C$

LOGIC DIAGRAMS

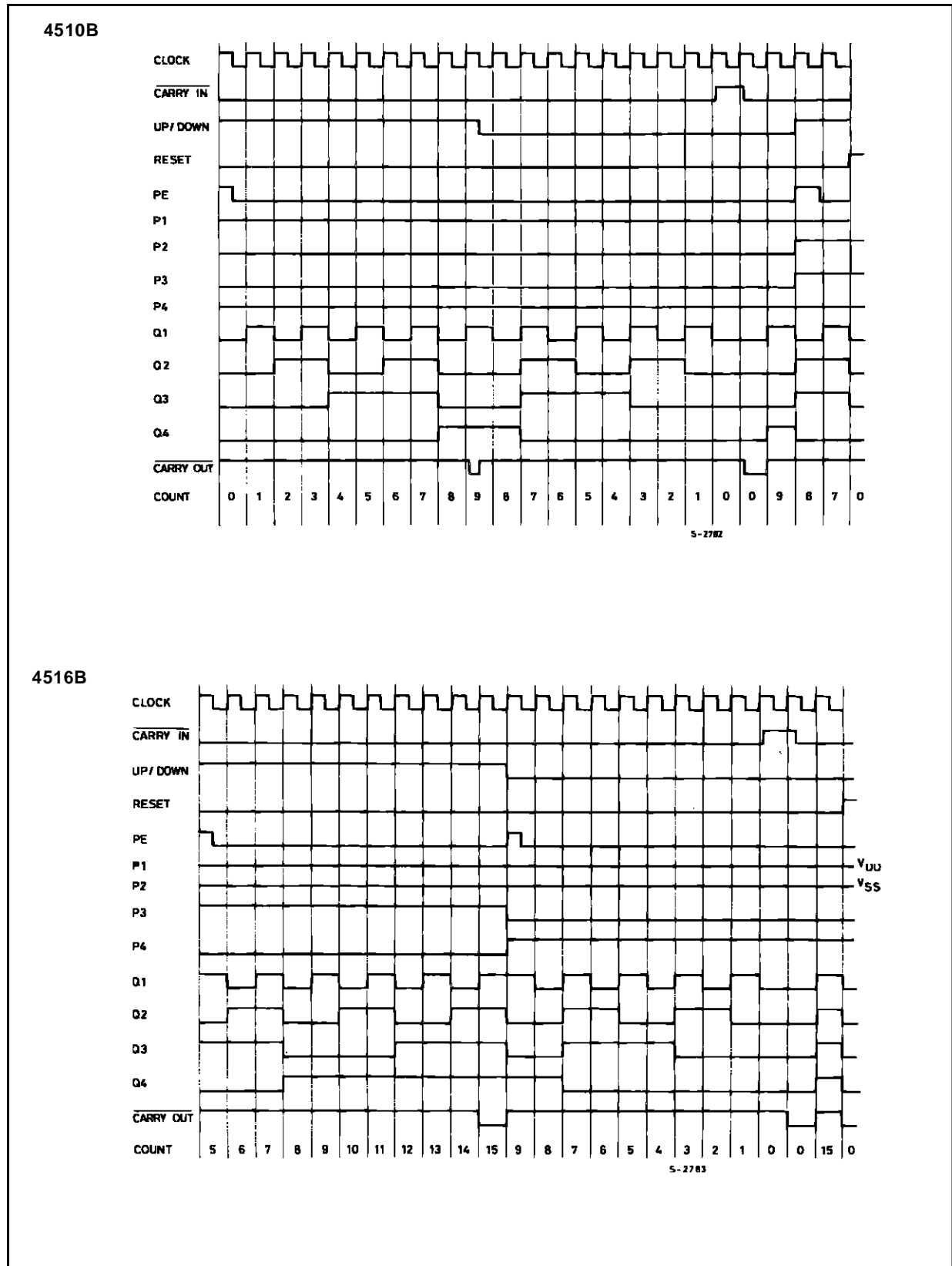
4510B



4516B



TIMING DIAGRAMS



## 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	
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	Any Input		15		$\pm 0.3$		$\pm 10^{-5}$	$\pm 0.3$		$\pm 1$	
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, 2.5 V min. with V<sub>DD</sub> = 15V.

## HCC/HCF4510B/4516B

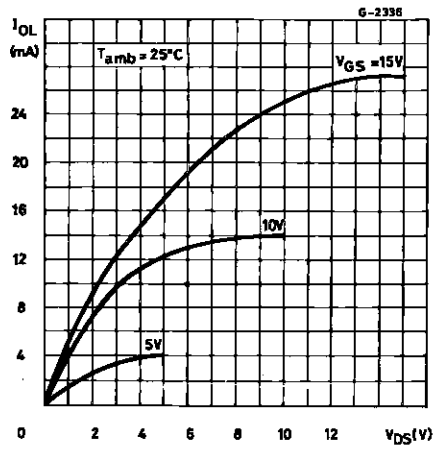
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$   
typical temperature coefficient for all  $V_{DD}$  values is  $0.3\%/^{\circ}\text{C}$ , all input rise and fall times = 20ns)

Symbol	Parameter	Test Conditions	Value			Unit	
			$V_{DD}$ (V)	Min.	Typ.		Max.
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Clock to Q Output		5		200	400	ns
			10		100	200	
			15		75	150	
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Preset or Reset to Q Output		5		210	420	ns
			10		105	210	
			15		80	160	
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Clock to Carry Out		5		240	480	ns
			10		120	240	
			15		90	180	
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Carry in to Carry Out		5		125	250	ns
			10		60	120	
			15		50	100	
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Preset or Reset to Carry Out		5		320	640	ns
			10		160	320	
			15		125	250	
$t_{THL}$ , $t_{TLH}$	Transition Time		5		100	200	ns
			10		50	100	
			15		40	80	
$f_{max}$	Max. Clock Frequency		5	2	4		MHz
			10	4	8		
			15	5.5	11		
$t_w$	Clock Pulse Width		5	150			ns
			10	75			
			15	60			
	•Preset Enable or Reset Removal Time		5	150			ns
			10	80			
			15	60			
$t_r$ , $t_f$	*Clock Rise and Fall Time		5			15	$\mu\text{s}$
			10			5	
			15			5	
$t_{setup}$	Carry in Setup Time		5	130			ns
			10	60			
			15	45			
$t_{setup}$	Up-down Setup Time		5	360			ns
			10	160			
			15	110			
$t_w$	Preset Enable or Reset Pulse Width		5	220			ns
			10	100			
			15	75			

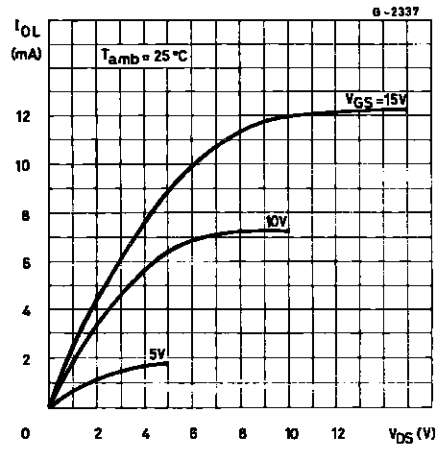
• Time required after the falling edge of the reset or preset enable inputs before the rising edge of the clock will trigger the counter (similar to setup time).

\* If more than unit is cascaded in the parallel clocked application,  $t_{CL}$  should be made less than or equal to the sum of the fixed propagation delay at 15pF and the transition time of the carry output driving stage for the estimated capacitive load.

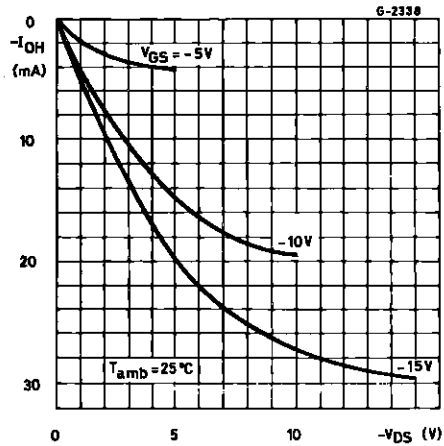
Typical Output Low (sink) Current Characteristics.



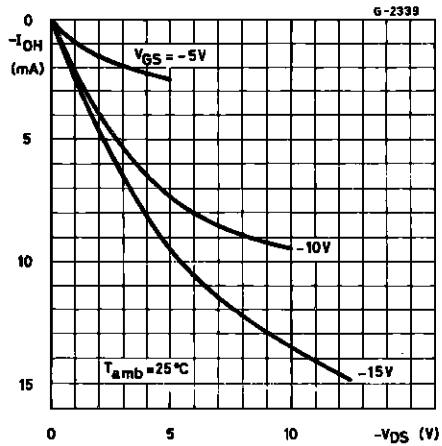
Minimum Output Low (sink) Current Characteristics.



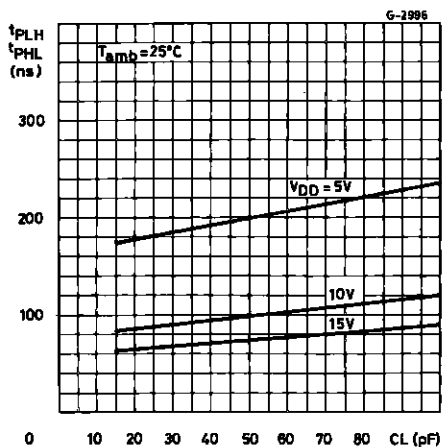
Typical Output High (source) Current Characteristics.



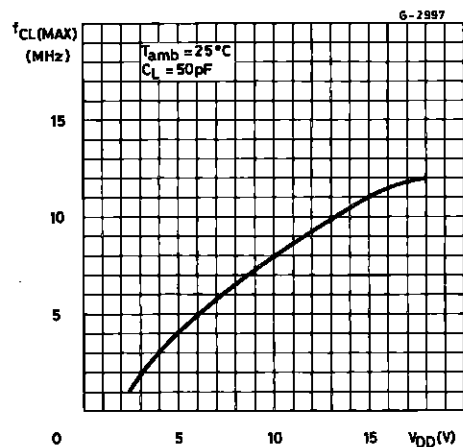
Minimum Output High (source) Current Characteristics.



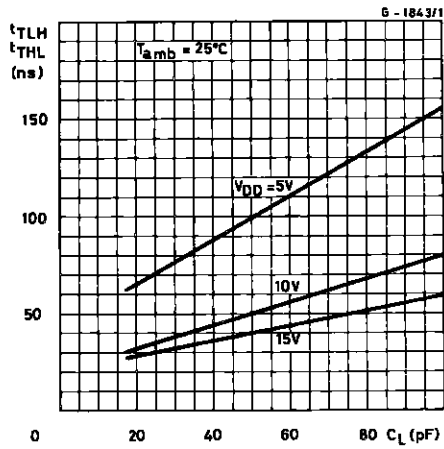
Typical Propagation Delay Time vs. Load Capacitance for Clock to Q Output.



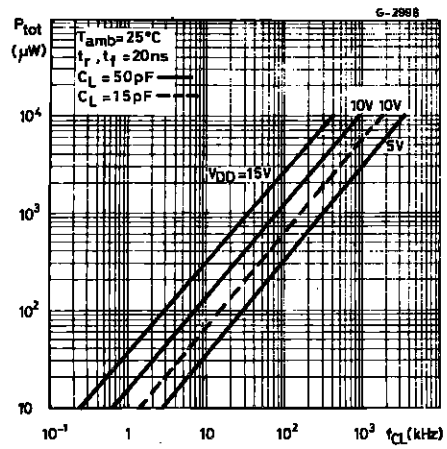
Typical Maximum Clock Input Frequency vs. Supply Voltage.



Typical Transition Time vs. Load Capacitance.

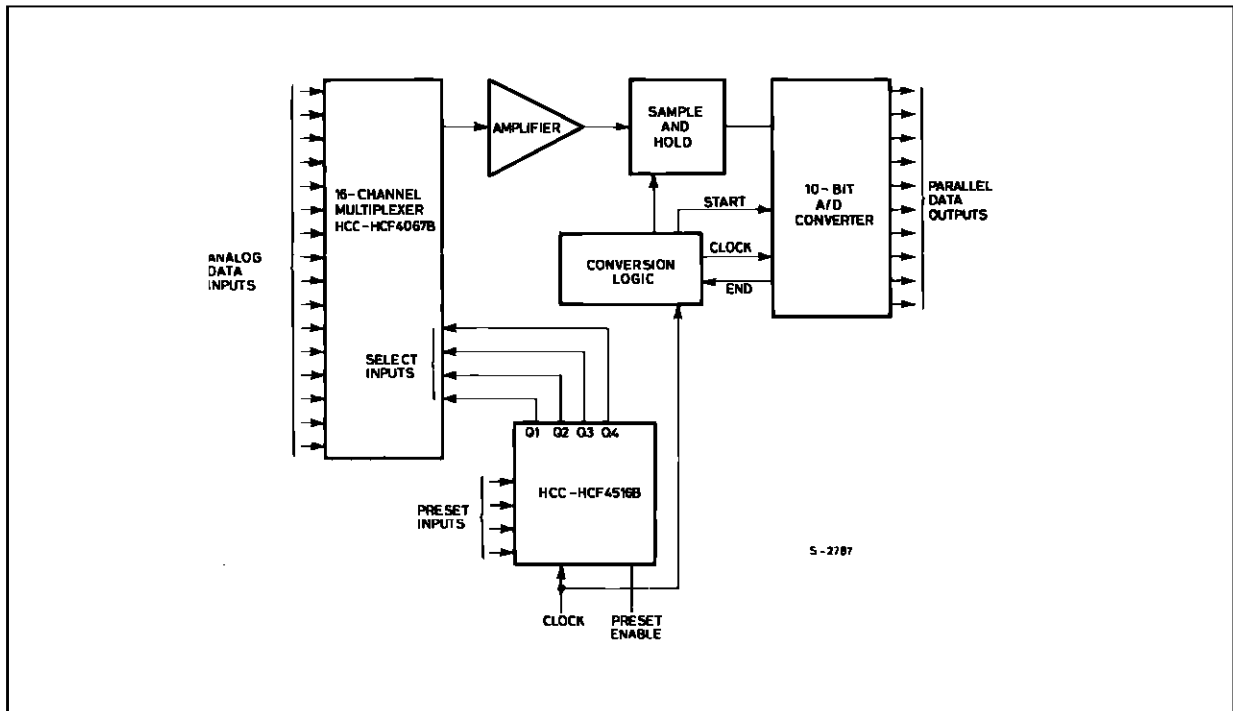


Typical Dynamic Power Dissipation vs. Frequency.



TYPICAL APPLICATIONS

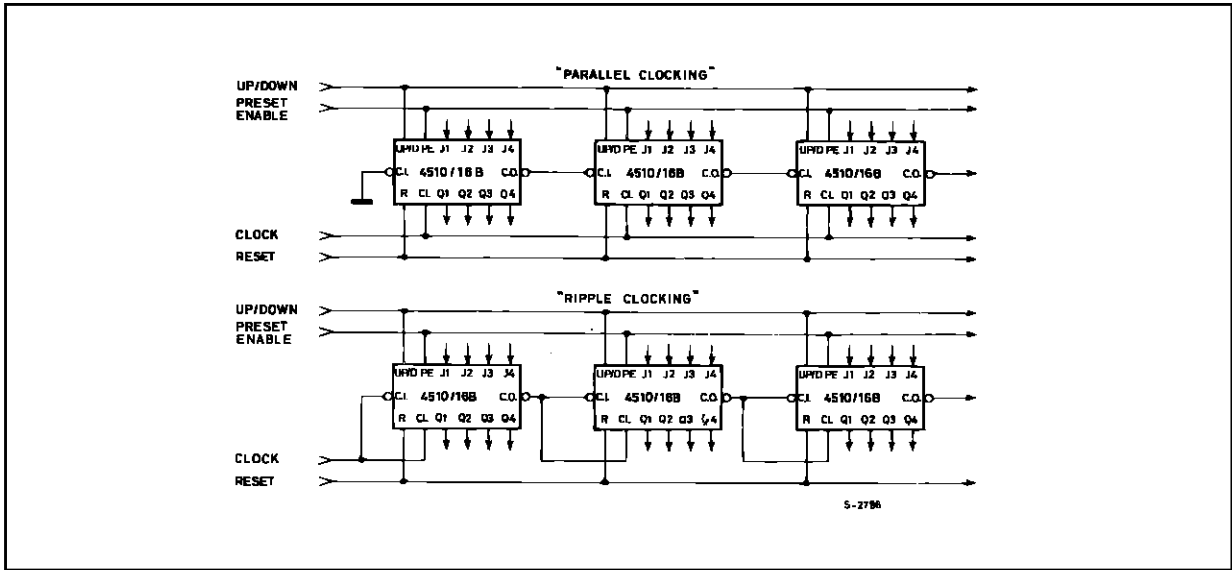
TYPICAL 16-CHANNEL, 10 BIT DATA ACQUISITION SYSTEM



This acquisition system can be operated in the random access mode by jamming in the channel number at the present inputs, or in the sequential mode by clocking the HCC/HCF4516B.

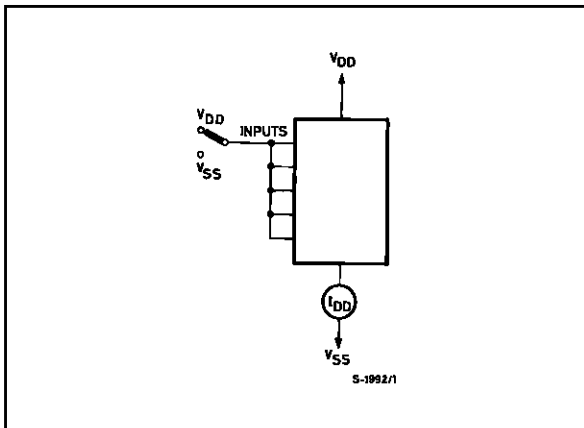


CASCADING COUNTER PACKAGES

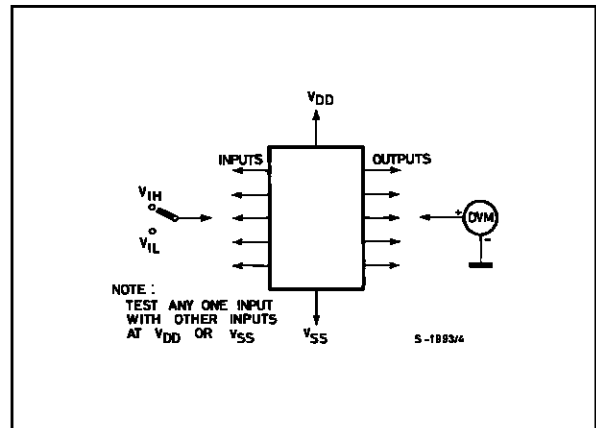


TEST CIRCUITS

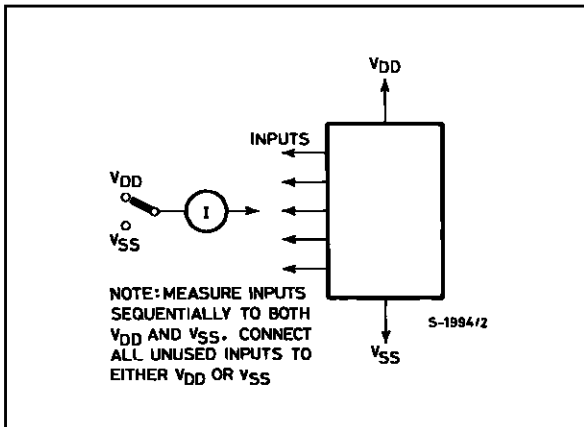
Quiescent Device Current.



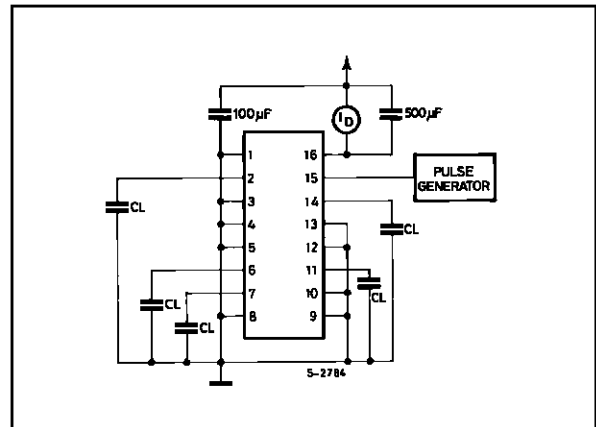
Noise Immunity.



Input Leakage Current.

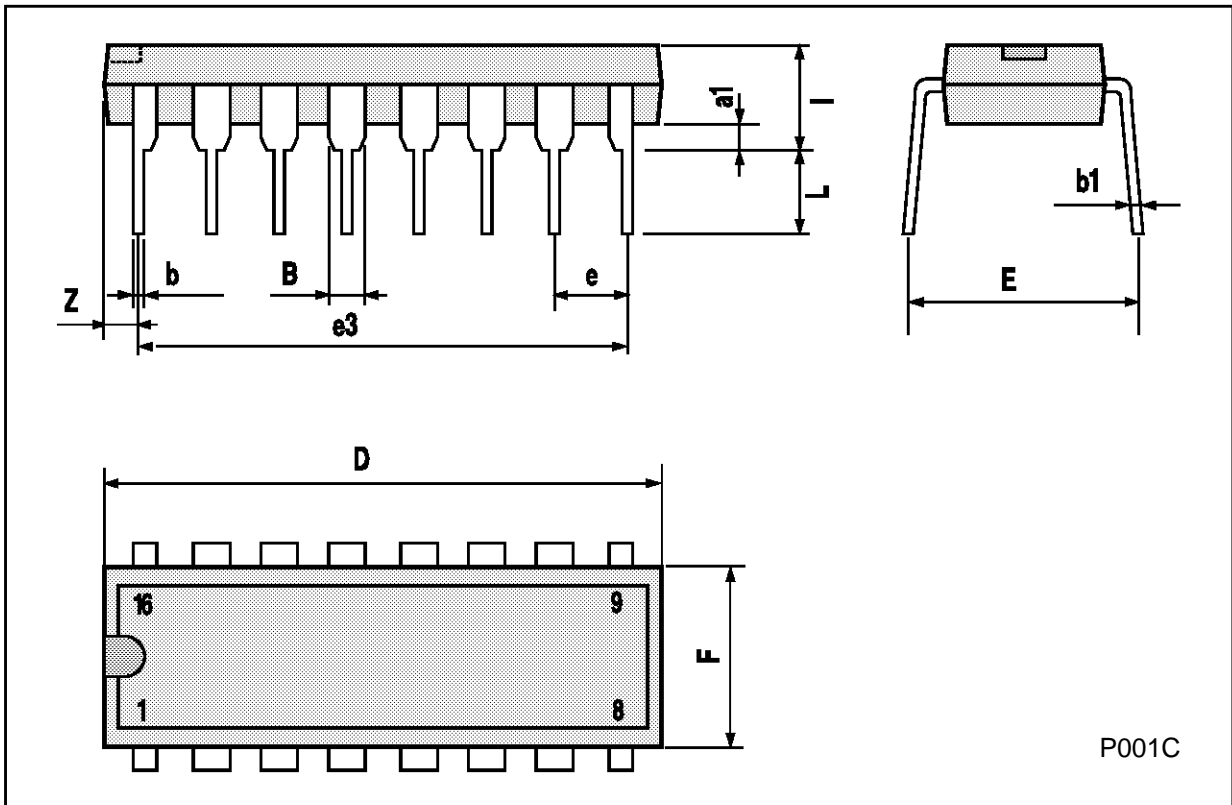


Power Dissipation and Input Waveform.



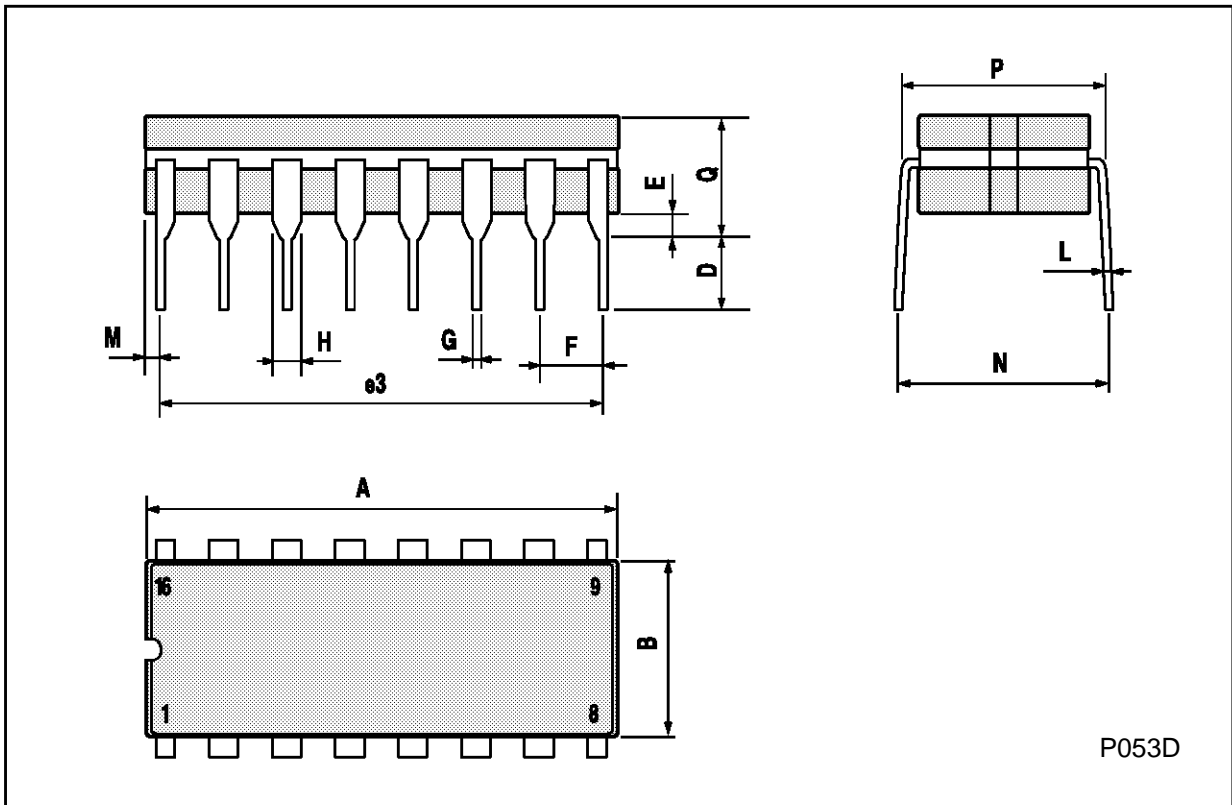
**Plastic DIP16 (0.25) MECHANICAL DATA**

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



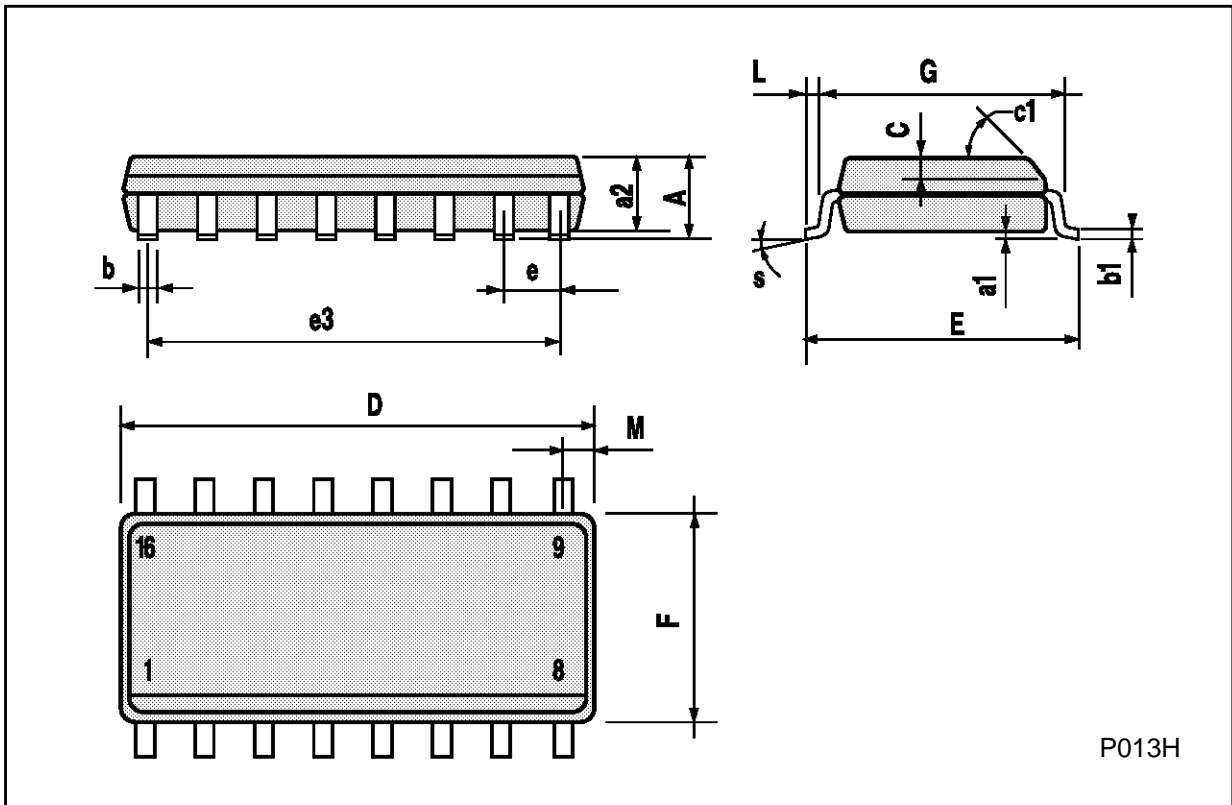
**Ceramic DIP16/1 MECHANICAL DATA**

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



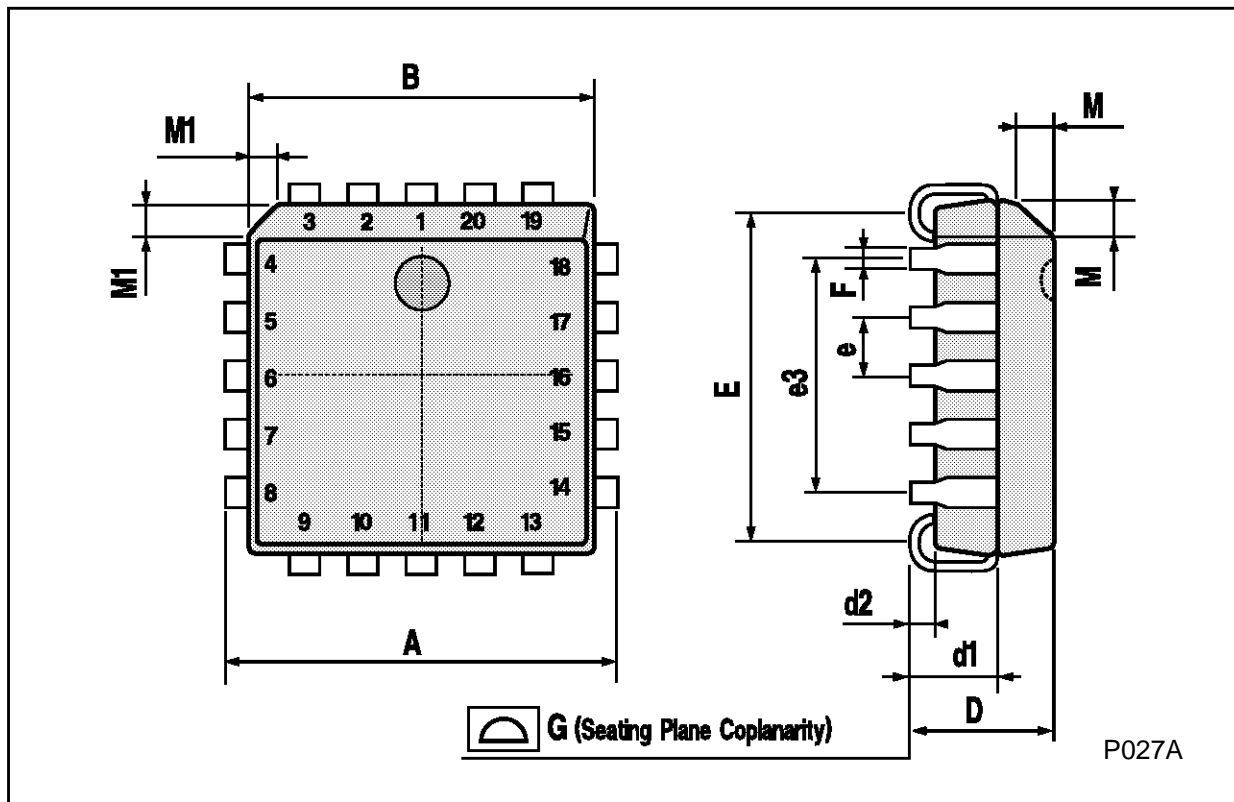
**SO16 (Narrow) MECHANICAL DATA**

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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