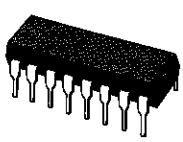
SGS-THOMSON MICROELECTRONICS

HCC/HCF40160B-40161B
HCC/HCF40162B-40163B

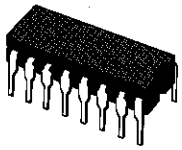
SYNCHRONOUS PROGRAMMABLE 4-BIT COUNTERS

40160B - DECADE WITH ASYNCHRONOUS CLEAR
40161B - BINARY WITH ASYNCHRONOUS CLEAR
40162B - DECADE WITH SYNCHRONOUS CLEAR
40163B - BINARY WITH SYNCHRONOUS CLEAR

- INTERNAL LOOK-AHEAD FOR FAST COUNTING
- CARRY OUTPUT FOR CASCADING
- SYNCHRONOUSLY PROGRAMMABLE
- LOW-POWER TTL COMPATIBILITY
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED AT 20V FOR HCC DEVICE
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25oC FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N. 13A, " STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES "



EY
(Plastic Package)



F
(Ceramic Package)

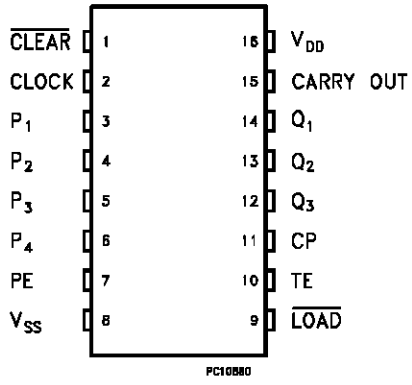
M1
(Micro Package)

C1
(Chip Carrier)

ORDER CODES :

HCC40XXXBF
HCF40XXXBEY
HCF40XXXBC1

PIN CONNECTIONS



DESCRIPTION

The **HCC40160B, 40161B, 40162B, 40163B** (extended temperature range) and **HCF40160B, 40161B, 40162B, 40163B** (intermediate temperature range) are monolithic integrated circuits, available in 16-lead dual in line plastic or ceramic package and plastic micropackage.

HCC/HCF40160B, 40161B, 40162B and **40163B** are 4-bit synchronous programmable counters. The $\overline{\text{CLEAR}}$ function of the **HCC/HCF40162B** and **40163B** is synchronous and a low on the at the clear $\overline{\text{CLEAR}}$ input sets all four outputs low on the next positive CLOCK edge. The $\overline{\text{CLEAR}}$ function of the **HCC/HCF40160B** and **40161B** is asynchronous and a low level at the $\overline{\text{CLEAR}}$ input sets all four outputs low regardless of the state of the CLOCK, $\overline{\text{LOAD}}$ or ENABLE inputs. A low level at the $\overline{\text{LOAD}}$ input disables the counter and causes the output to agree with the set-up data after the next CLOCK pulse regardless of the conditions of the ENABLE in-

cascading counter for n-bit synchronour application without additional gating. Instrumental in accomplishing this function are two count-enable input and a carry output (COUT). Counting is enable when both PE and TE inputs are high. The TE input is fed forward to enable COUT. This enable output produces a positive output pulse with a duration approximately equal to the positive portion of the Q1 output. This positive overflow carry pulse can be used to enable successive cascaded stages. Logic transitions at the PE or TE inputs may occur when the clock is either high or low.

ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{DD} *	Supply Voltage: **HCC** Types **HCF** 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)	± 10	mA
P_{tot}	Total Power Dissipation (per package) Dissipation per Output Transistor for Top = Full Package Temperature Range	200 100	mW mW
T_{op}	Operating Temperature: **HCC** Types **HCF** Types	-55 to +125 -40 to +85	^oC ^oC
T_{stg}	Storage Temperature	-65 to +150	^oC

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: **HCC** Types **HCF** Types	3 to 18 3 to 15	V V
V_I	Input Voltage	0 to V_{DD}	V
T_{op}	Operating Temperature: **HCC** Types **HCF** Types	-55 to +125 -40 to +85	^oC ^oC

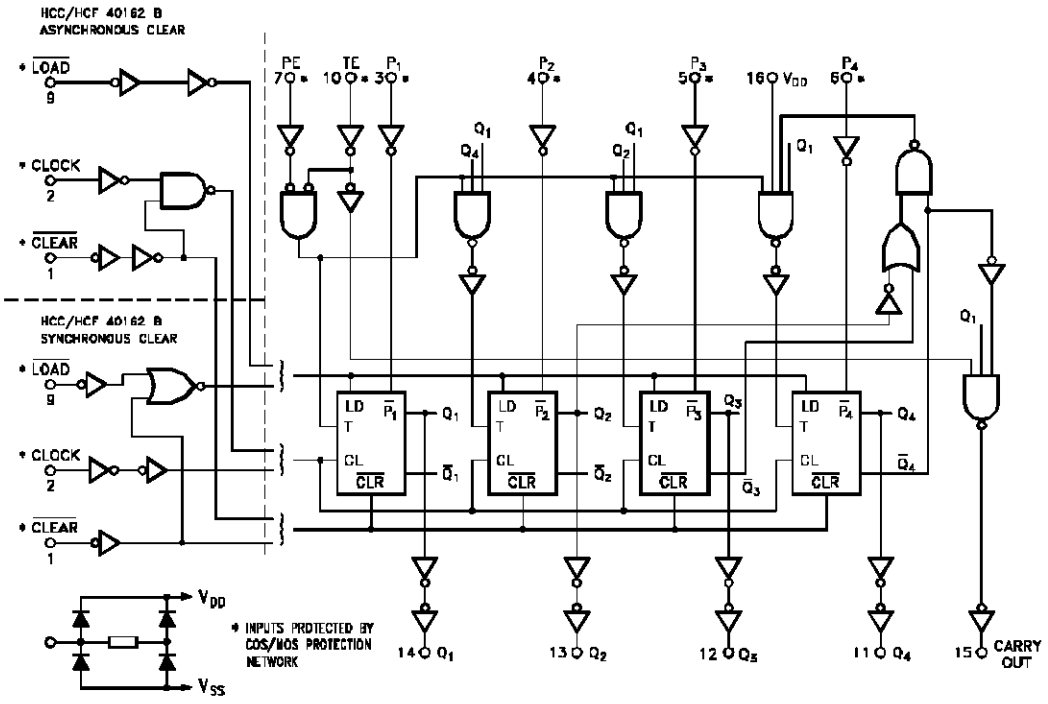
TRUTH TABLE

Clock	$\overline{CLR}$	$\overline{LOAD}$	PE	TE	Operation
⎍	1	0	X	X	Preset
⎍	1	1	0	X	NC
⎍	1	1	X	0	NC
⎍	1	1	1	1	Count
X	0	X	X	X	Reset (HCC/HCF40160B, HCC/HCF40161B)
⎍	0	X	X	X	Reset (HCC/HCF40162B, HCC/HCF40163B)
⎏	1	X	X	X	NC (HCC/HCF40162B, HCC/HCF40163B)

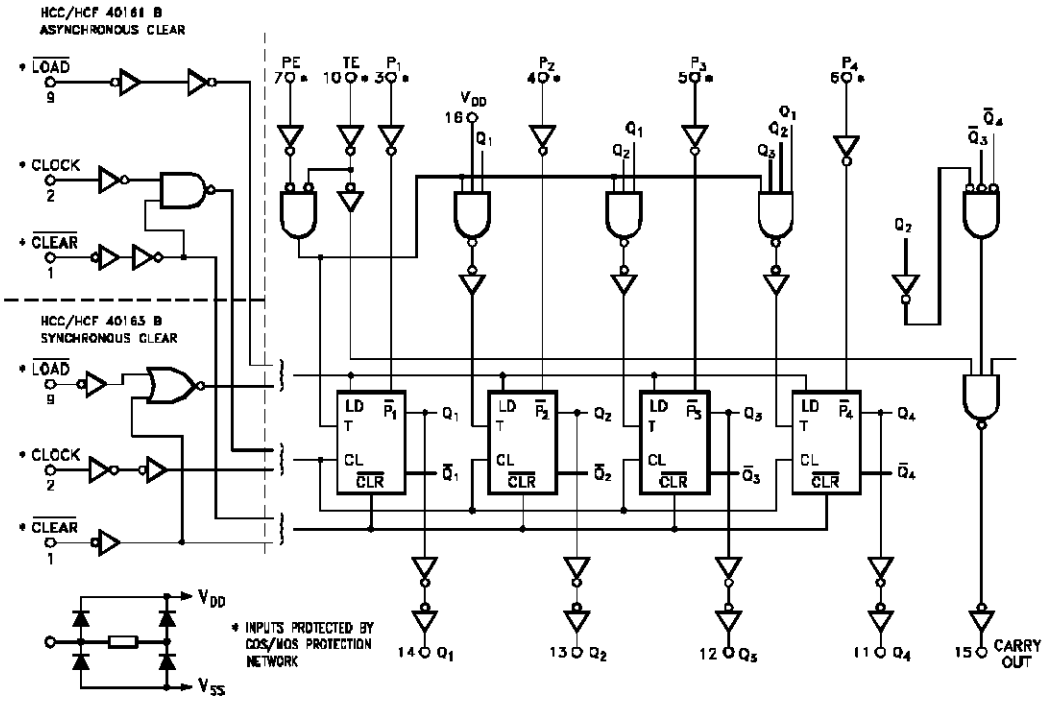
1 = HIGH LEVEL, 0 = LOW LEVEL, X = DON'T CARE, NC = NO CHANGE

LOGIC DIAGRAMS

HCC40160B/HCC40162B

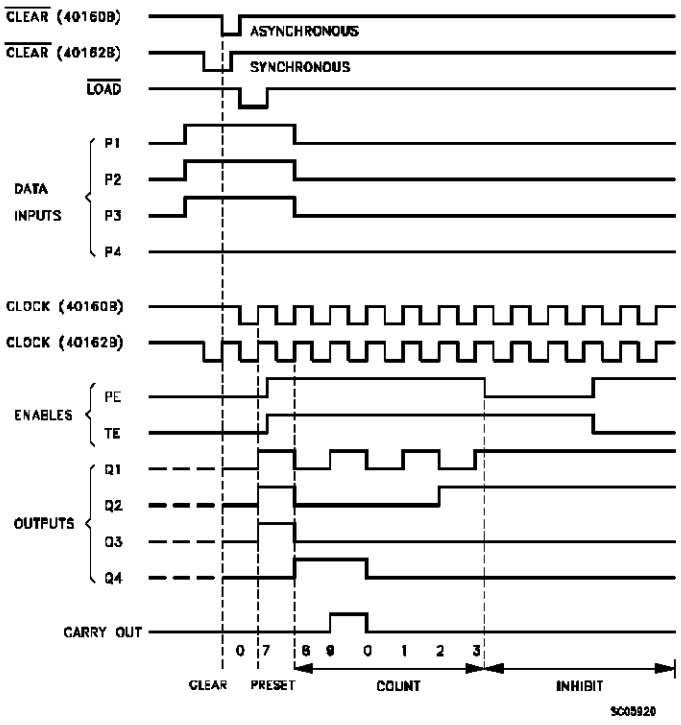


HCC40161B/HCC40163B

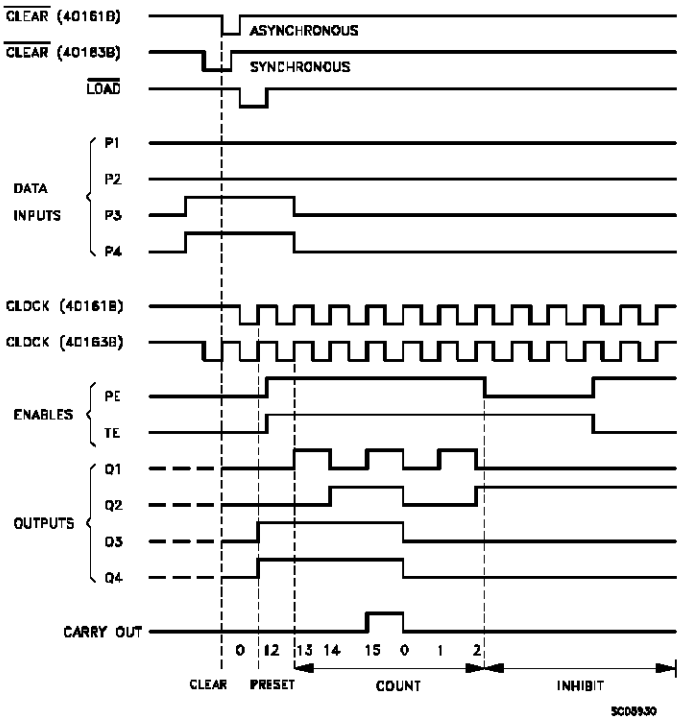


TIMING DIAGRAMS

HCC40160B/HCC40162B



HCC40161B/HCC40163B



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

Symbol	Parameter		Test Conditios				Value							Unit
			V_I (V)	V_O (V)	$\|I_O\|$ (µA)	V_{DD} (V)	T_{LOW} * Min.	T_{LOW} * Max.	25 °C Min.	25 °C Typ.	25 °C Max.	T_{HIGH} * Min.	T_{HIGH} * Max.	
I_L	Quiescent Current	HCC Types	0/5			5		5		0.04	5		150	µA
			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_{OH}	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_{OL}	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_{IH}	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_{IL}	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_{OH}	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_{OL}	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	0.53		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_{IH}, I_{IL}	Input Leakage Current	HCC Types	0/18	Any Input		18		±0.1		$±10^{-5}$	±0.1		±1	µA
		HCC Types	0/15			15		±0.3		$±10^{-5}$	±0.3		±1	
C_I	Input Capacitance			Any Input						5	7.5			pF

* T_{LOW} = -55 °C for **HCC** device: -40 °C for **HCF** device.

* T_{HIGH} = +125 °C for **HCC** device: +85 °C for **HCF** device.

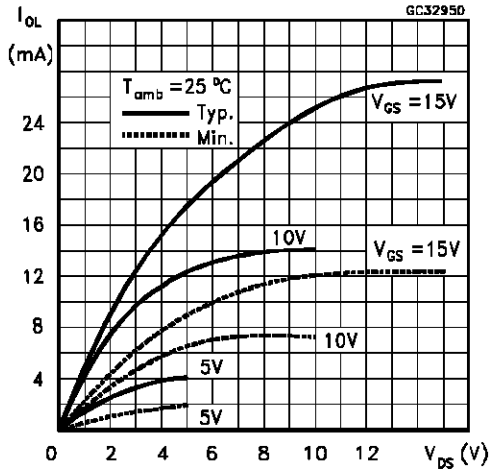
The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD} = 5 V, 2 V min. with V_{DD} = 10 V, 2.5 V min. with V_{DD} = 15 V

DYNAMIC ELECTRICAL CHARACTERISTICS (T_{amb} = 25 °C, C_L = 50 pF, R_L = 200 KΩ, typical temperature coefficent for all V_{DD} values is 03 %/°C, all input rise and fall times= 20 ns)

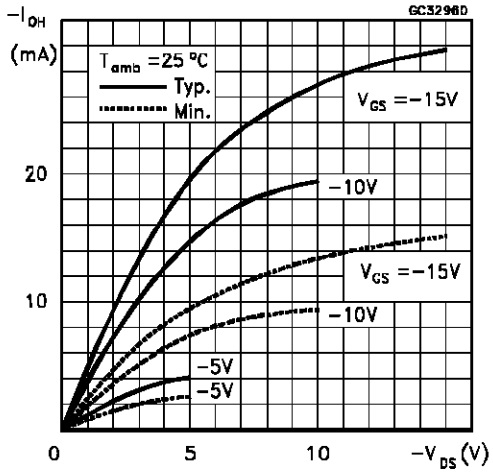
Symbol	Parameter	Test Conditions		Value			Unit
			V_{DD} (V)	Min.	Typ.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time Clock to Q		5		200	400	ns
			10		80	160	
			15		60	120	
t_{PLH} t_{PHL}	Propagation Delay Time Clock to C_{OUT}		5		225	450	ns
			10		95	190	
			15		70	140	
t_{PLH} t_{PHL}	Propagation Delay Time TE to C_{OUT}		5		125	250	ns
			10		55	110	
			15		40	80	
t_{setup}	Setup Time Data to Clock		5	240	120		ns
			10	90	45		
			15	60	30		
t_{setup}	Setup Time Load to Clock		5	240	120		ns
			10	90	45		
			15	60	30		
t_{setup}	Setup Time PE or TE to Clock		5	340	170		ns
			10	140	70		
			15	100	50		
t_{hold}	Hold Time		5	0			ns
			10	0			
			15	0			
t_{THL} t_{TLH}	Transition Time		5		100	200	ns
			10		50	100	
			15		40	80	
t_W	CLock Input Pulse Width		5	170	85		ns
			10	70	35		
			15	50	25		
f_{CL}	Maximum Clock Input Frequency		5	2	3		MHz
			10	5.5	8.5		
			15	8	12		
t_r t_f	Clock Input Rise or Fall Time *					200	ns
						70	
						15	
t_{PHL}	Propagation Delay Time (40160B, 40161B) Clear to Q		5		250	500	ns
			10		110	220	
			15		80	160	
t_{setup}	Setup Time (40162B, 40163B) Clear to Clock		5	340	170		ns
			10	140	70		
			15	100	50		
t_{hold}	Hold Time (40162B, 40163B) Clear to Clock		5	0			ns
			10	0			
			15	0			
t_{rem}	$\overline{\text{Clear}}$ Removal Time (40162B, 40163B)		5	200	100		ns
			10	100	50		
			15	70	35		
t_W	$\overline{\text{Clear}}$ Input Pulse Width Low Level (40160B, 40161B)		5	170	85		ns
			10	70	35		
			15	50	25		

* If more than one unit is cascated in the parallel clocked application, tr should be made less than or equal to the sum of the fixed propagation delay at 50 pF and the transition time of the carry output driving stage for the estimated capacitance

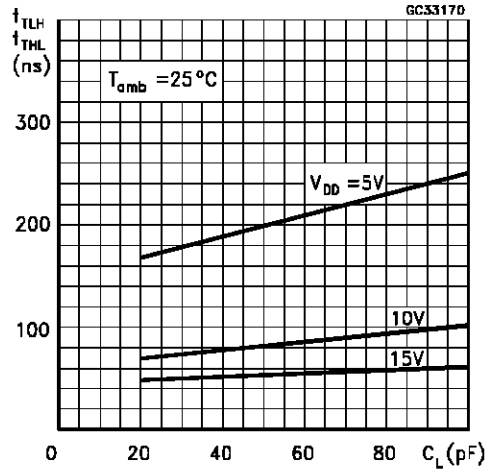
Output Low (sink) Current Characteristics



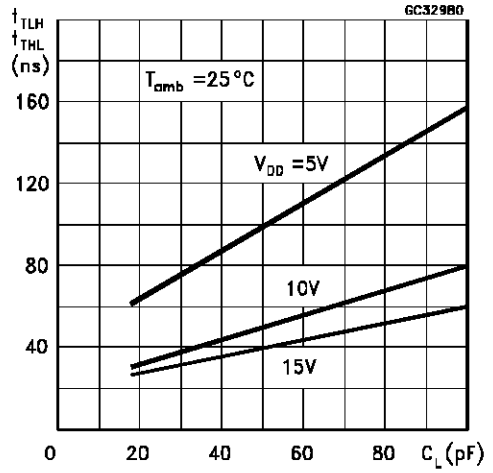
Output High (source) Current Characteristics



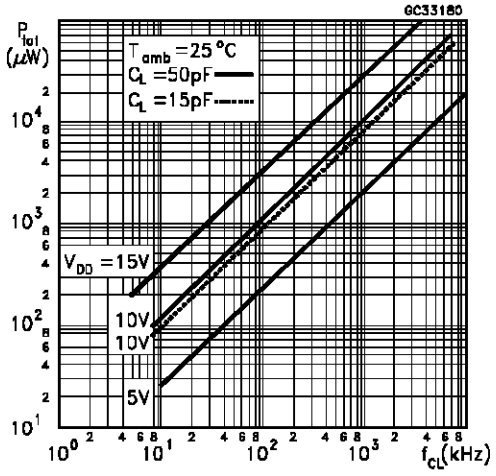
Typical Propagation Delay Time vs Load Capacitance



Typical Transition Time vs Load Capacitance

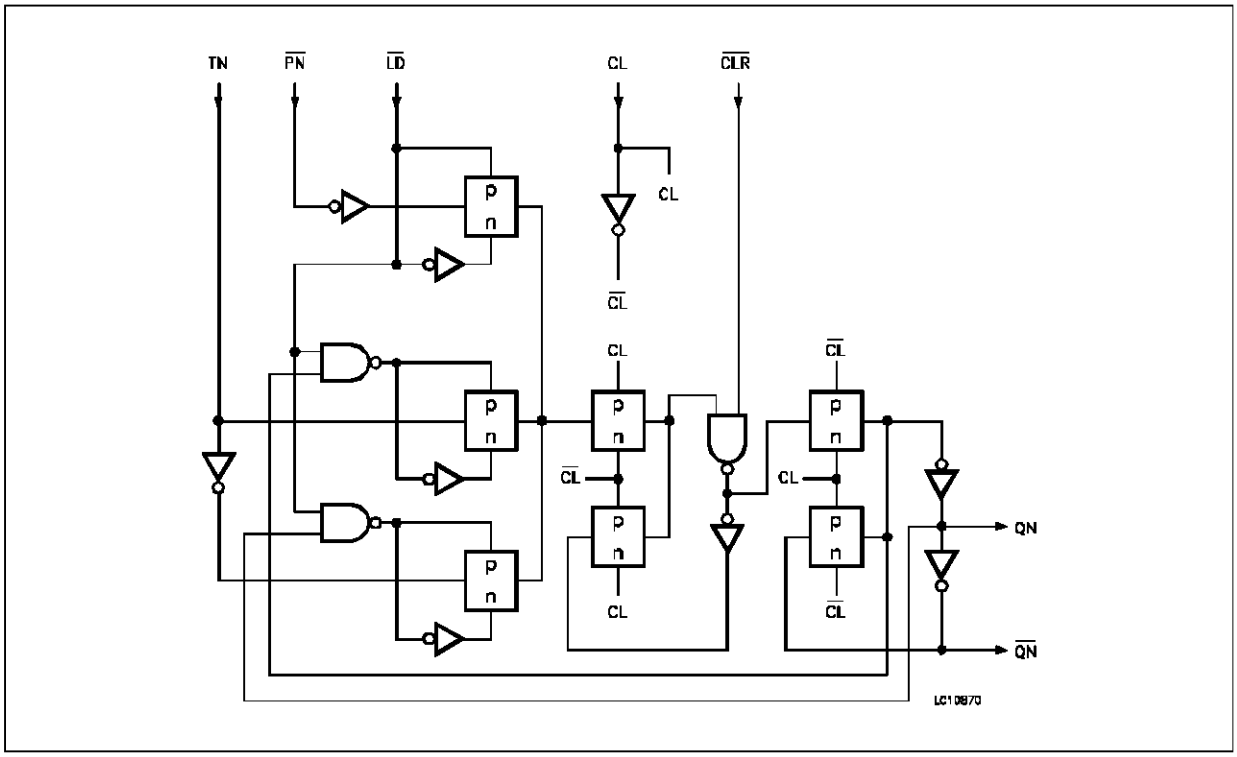


Typical Dynamic Power Dissipation vs Input Frequency

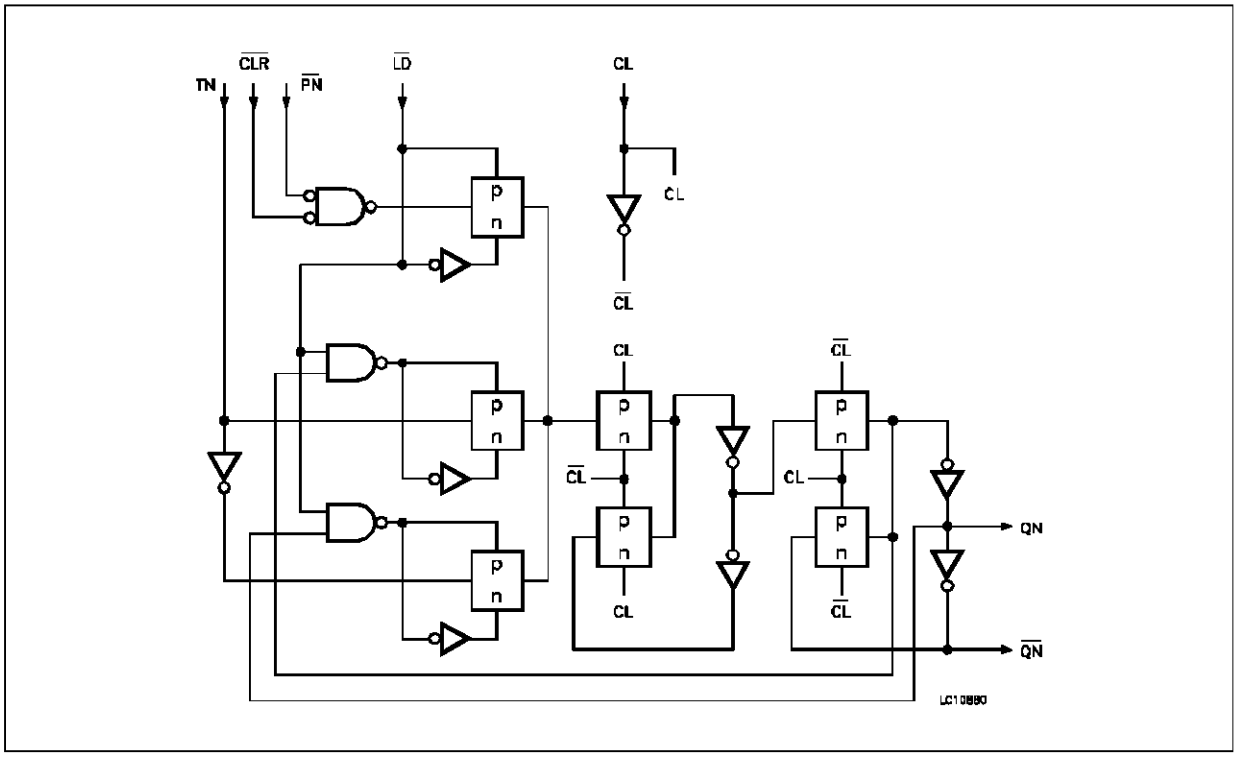


TYPICAL APPLICATIONS

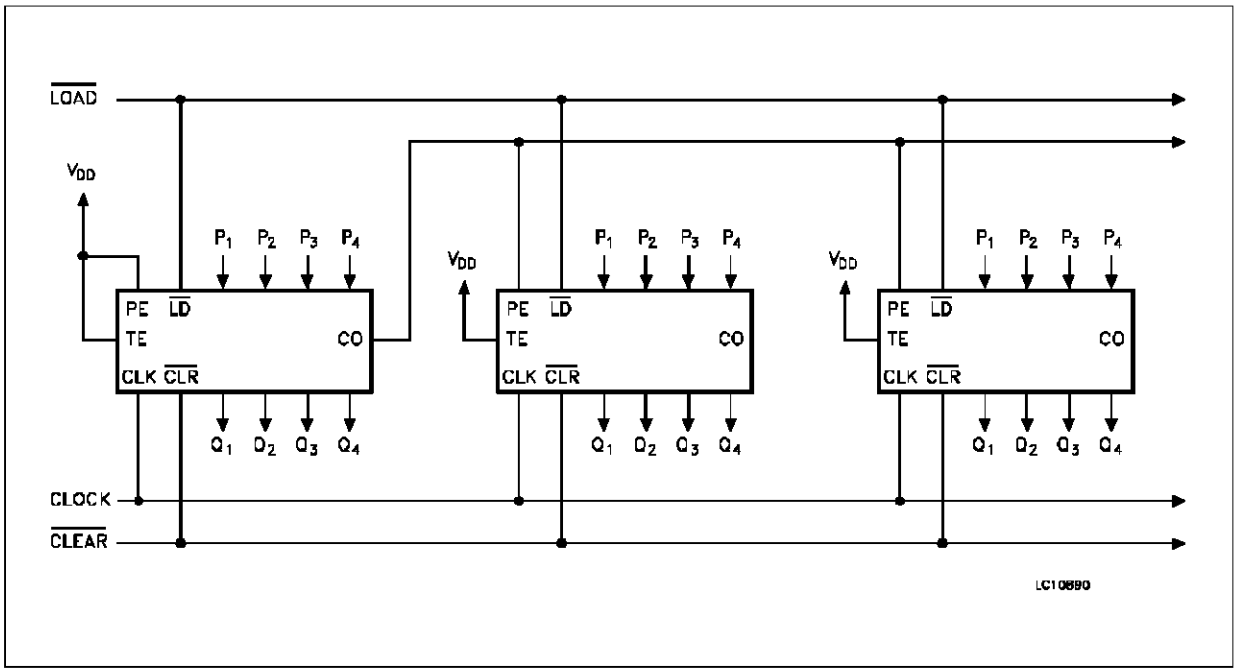
Detail of Flip-flops For 40160B And 40161B (Asynchronous Clear)



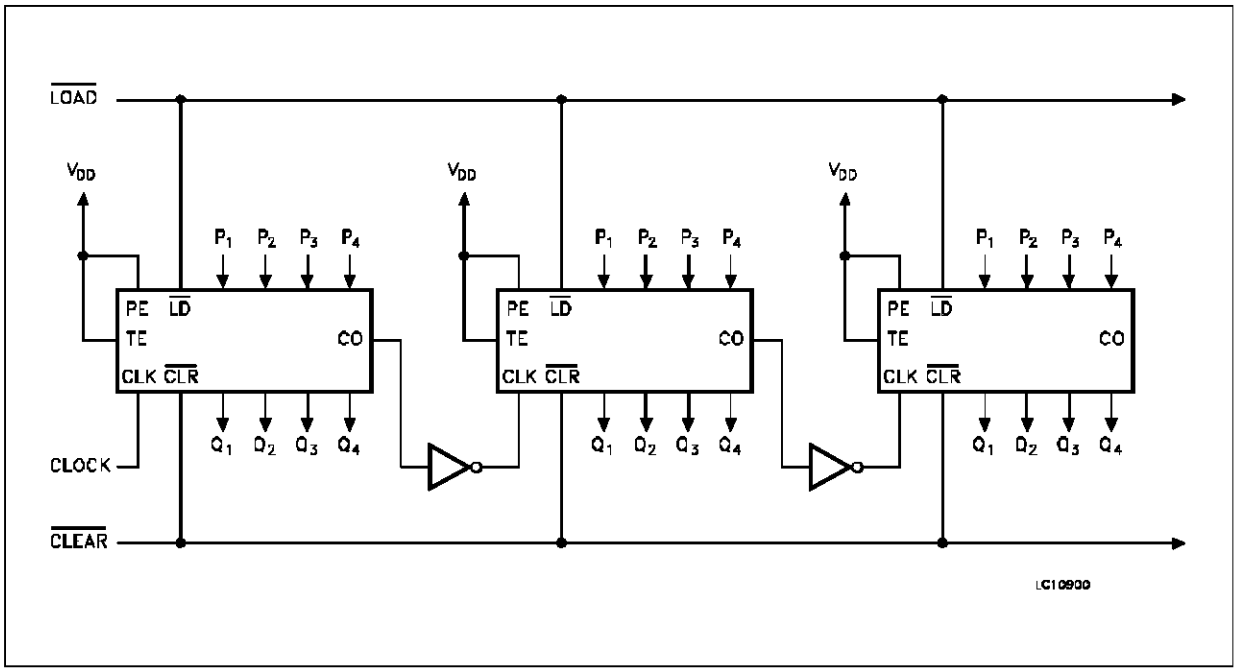
Detail of Flip-flops For 40162B And 40163B (Synchronous Clear)



Cascading Counter Packages In The Parallel-Clocked Mode

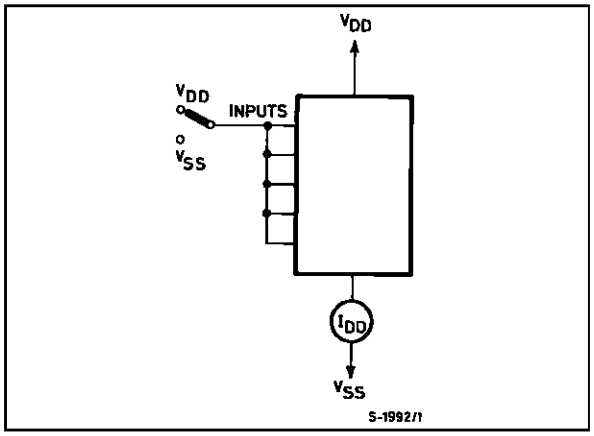


Cascading Counter Packages In The Ripple-Clocked Mode

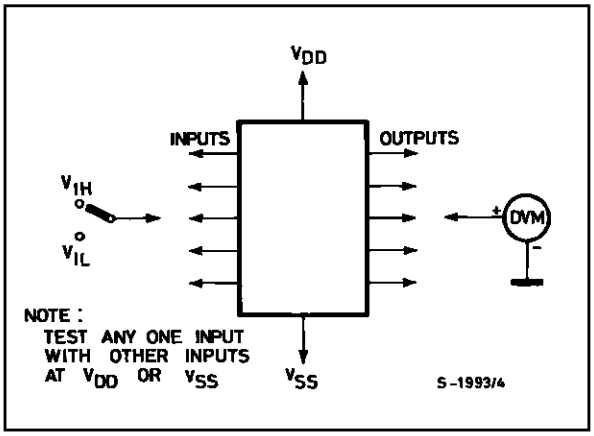


TEST CIRCUIT

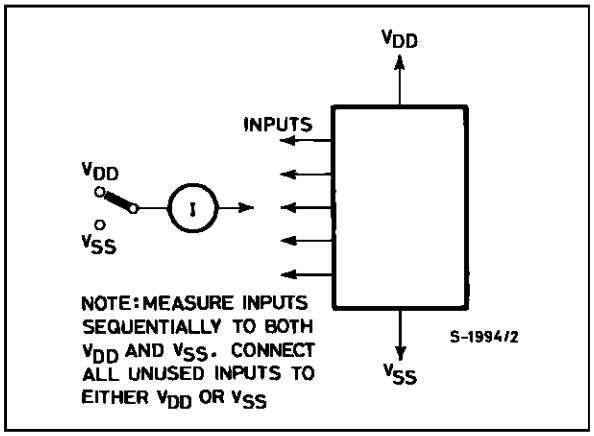
Quiescent Device Current.



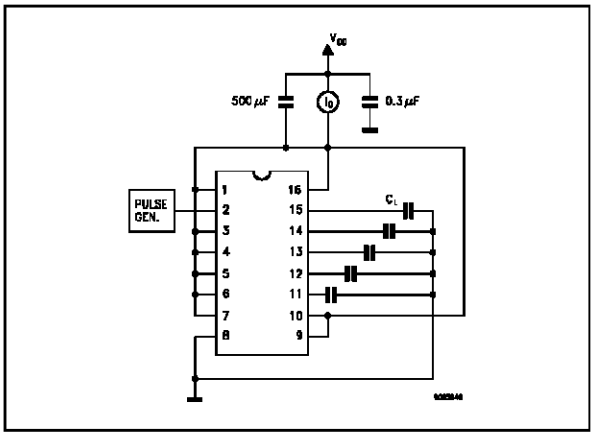
Input Voltage.



Input Leakage Current.

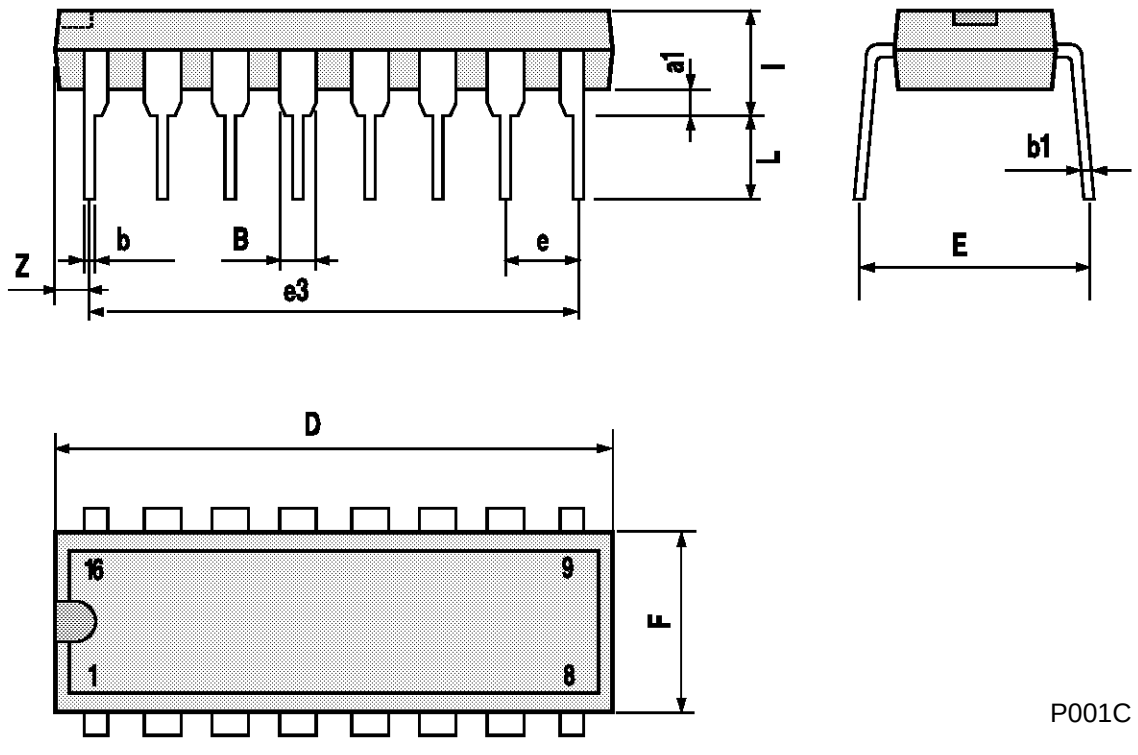


Dinamic Power Dissipation



Plastic DIP16 (0.25) MECHANICAL DATA

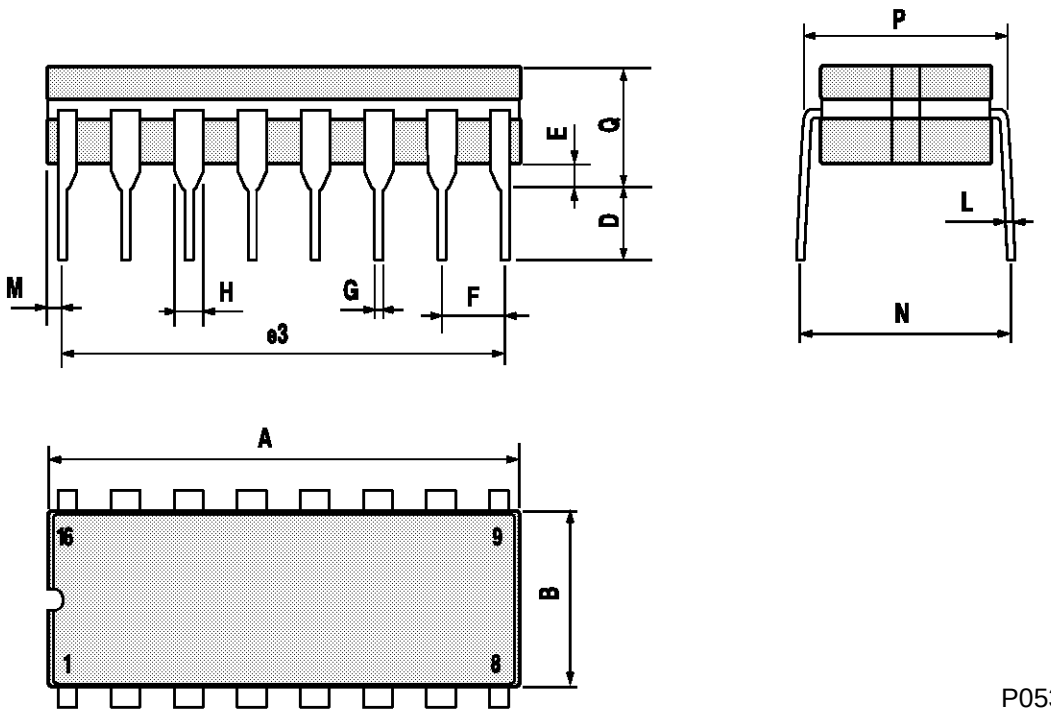
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

Ceramic DIP16/1 MECHANICAL DATA

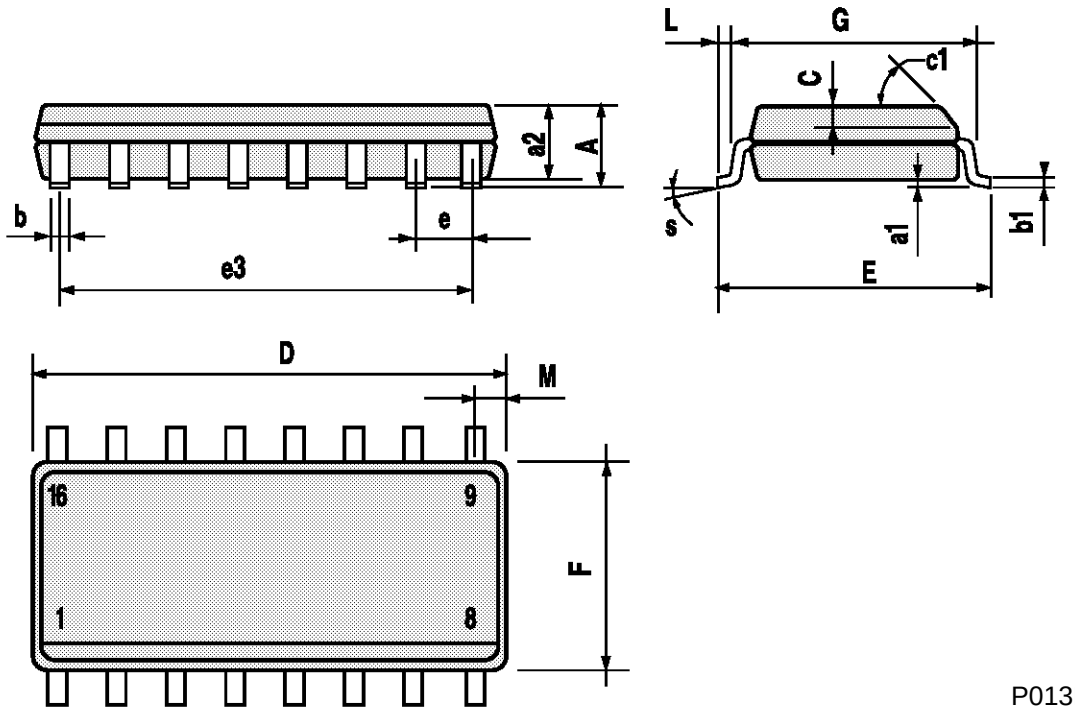
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q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



P053D

SO16 (Narrow) MECHANICAL DATA

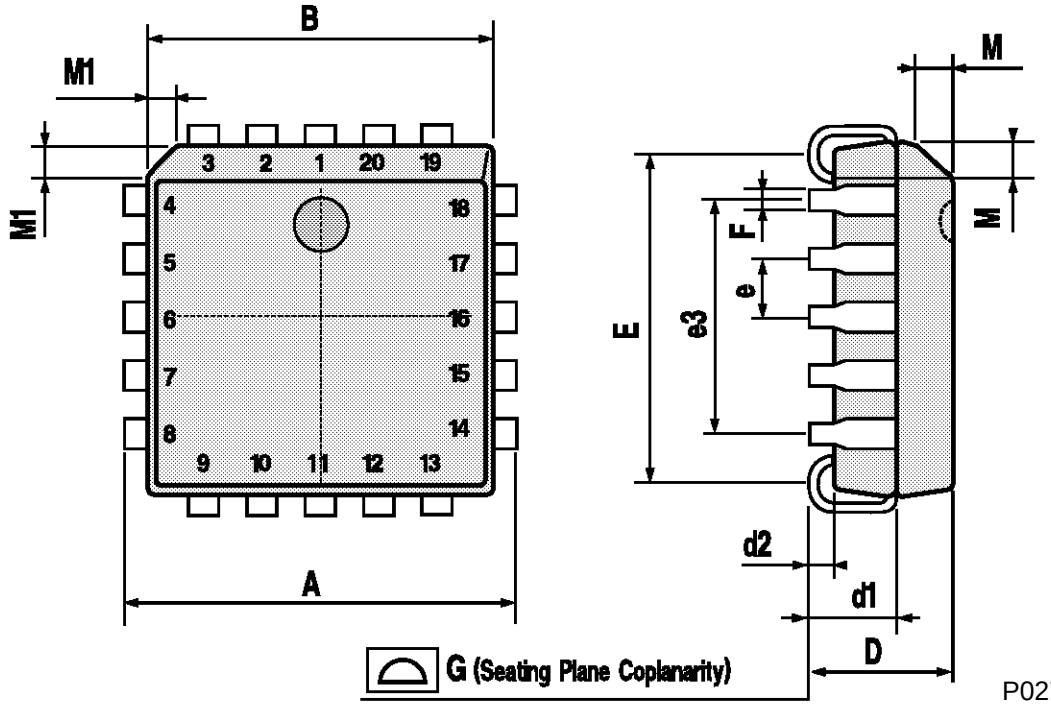
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157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