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

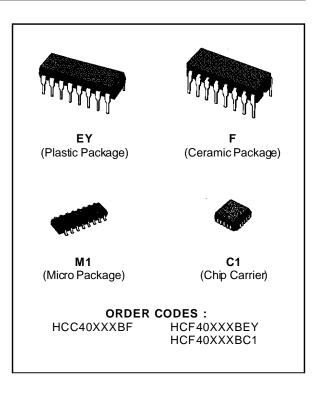
40163B - BINARY WITH SYNCHRONOUS CLEAR

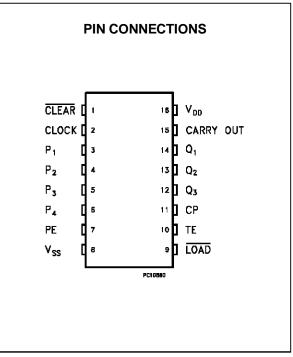
- INTERNAL LOOK-AHEAD FOR FAST COUNT-ING
- CARRY OUTPUT FOR CASCADING
- SYNCHRONOUSLY PROGRAMMABLE
- LOW-POWER TTL COMPATIBILITY
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED AT 20V FOR HCC DEVICE
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND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

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 CLEAR function of the HCC/HCF40162B and 40163B is synchronous and a low on the at the clear CLEAR input sets all four outputs low on the next positive CLOCK edge. The CLEAR function of the HCC/HCF40160B and 40161B is asynchronous and a low level at the CLEAR input sets all four outputs low regardless of the state of the CLOCK, LOAD or ENABLE inputs. A low level at the 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-





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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	-0.5 to +20	V
	HCF Types	-0.5 to +18	V
Vi	Input Voltage	-0.5 to V _{DD} + 0.5	V
lı	DC Input Current (any one input)	± 10	mA
P _{tot}	Total Power Dissipation (per package)	200	mW
	Dissipation per Output Transistor		
	for Top = Full Package Temperature Range	100	mW
T _{op}	Operating Temperature: HCC Types	-55 to +125	°C
,	HCF Types	-40 to +85	°C
T _{stg}	Storage Temperature	-65 to +150	°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.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{DD}	Supply Voltage: HCC Types	3 to 18	V
	HCF Types	3 to 15	V
VI	Input Voltage	0 to V _{DD}	V
T _{op}	Operating Temperature: HCC Types HCF Types	-55 to +125 -40 to +85	°C

TRUTH TABLE

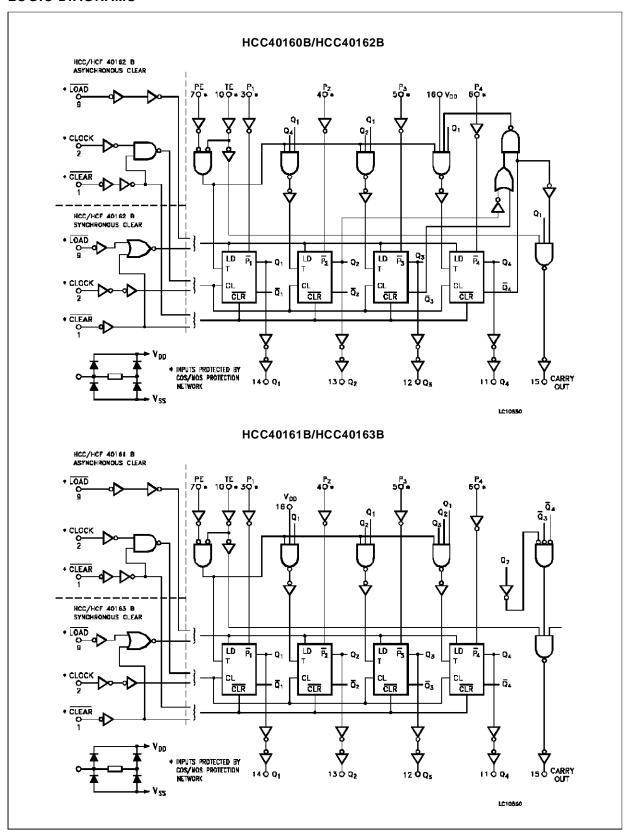
Clock	CLR	LOAD	PE	TE	Operation
」	1	0	Х	Х	Preset
	1	1	0	Х	NC
<u></u>	1	1	Х	0	NC
」	1	1	1	1	Count
Х	0	Х	Х	Х	Reset (HCC/HCF40160B, HCC/HCF40161B)
	0	X	Х	Х	Reset (HCC/HCF40162B, HCC/HCF40163B)
l	1	Х	Х	Х	NC (HCC/HCF40162B, HCC/HCF40163B)

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

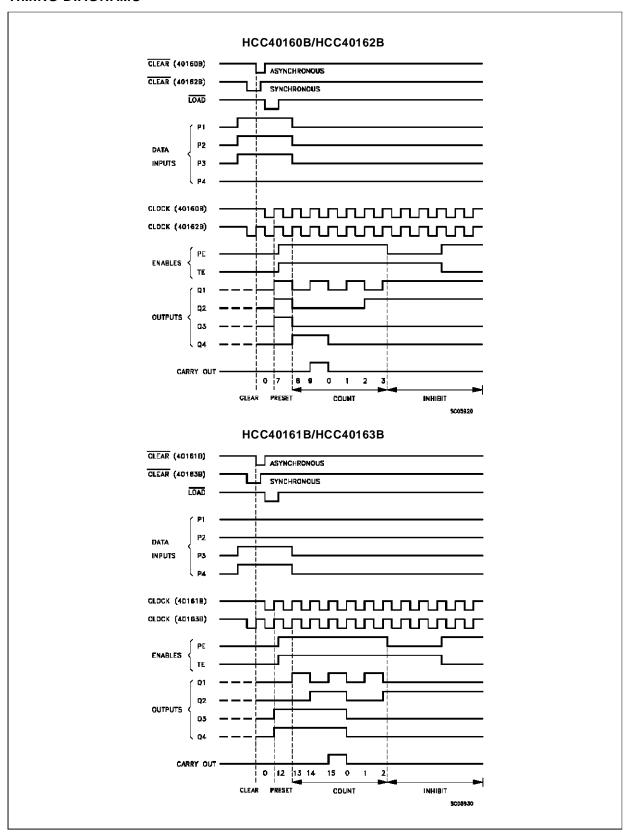


^{*} All voltage values are referred to V_{SS} pin voltage.

LOGIC DIAGRAMS



TIMING DIAGRAMS



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

				Test Con	ditios		Value							
Symbol	Parame	Parameter		V _I V _O		V _{DD}	TLO	w *		25 °C		T _{HIGH} *		Unit
			(V)	(V)	(μA)	(V)	Min.	Max.	Min.	Тур.	Max.	Min.	Max.	
ΙL	Quiescent		0/5			5		5		0.04	5		150	
	Current	HCC	0/10			10		10		0.04	10		300	
		Types	0/15			15		20		0.04	20		600	^
			0/20			20		100		0.08	100		3000	μΑ
		HCF	0/5			5		20		0.04	20		150	
		Types	0/10			10		40		0.04	40		300	
		',	0/15			15		80		0.04	80		600	
V _{OH}	Output High	•	0/5		< 1	5	4.95		4.95			4.95		
	Voltage		0/10		< 1	10	9.95		9.95			9.95		V
			0/15		< 1	15	14.95		14.95			14.95		
V _{OL}	Output Low		5/0		< 1	5		0.05			0.05		0.05	
	Voltage		10/0		< 1	10		0.05			0.05		0.05	V
			15/0		< 1	15		0.05			0.05		0.05	
V _{IH}	Input High			0.5/4.5	< 1	5	3.5		3.5			3.5		V
	Voltage			1/9	< 1	10	7		7			7		
				1.5/13.5	< 1	15	11		11			11		
V _{IL}	Input Low			4.5/0.5	< 1	5		1.5			1.5		1.5	
	Voltage			9/1	< 1	10		3			3		3	V
				13.5/1.5	< 1	15		4			4		4	
I _{OH}	Output		0/5	2.5		5	-2		-1.6	-3.2		-1.15		
	Drive	Orive HCC Current Types	0/5	4.6		5	-0.64		-0.51	-1		-0.36		
	Current		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		mA
			0/5	2.5		5	-1.53		-1.36	-3.2		-1.1		
		HCF	0/5	4.6		5	-0.52		-0.44	-1		-0.36		
		Types	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		
loL	Output	нсс	0/5	0.4		5	0.64		0.51	1		0.36		
	Sink	Types	0/10	0.5		10	1.6		1.3	2.6		0.9		
	Current	,,	0/15	1.5		15	4.2		3.4	6.8		2.4		mΑ
		HCF	0/5	0.4		5	0.53		0.44	1		0.36		
		Types	0/10	0.5		10	1.3		1.1	2.6		0.9		
		7,	0/15	1.5		15	3.6		3.0	6.8		2.4		
I _{IH} , I _{IL}	Input Leakage	HCC Types	0/18	Any In	nut	18		±0.1		±10 ⁻⁵	±0.1		±1	μΑ
	Current	HCC Types	0/15	Any in	ρ ι ι 	15		±0.3		±10 ⁻⁵	±0.3		±1	μΑ
Cı	Input Capaci	itance		Any In	put					5	7.5			pF

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

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



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

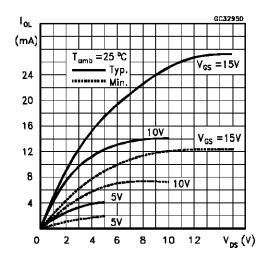
DYNAMIC ELECTRICAL CHARACTERISTICS ($T_{amb} = 25$ °C, $C_L = 50$ pF, $R_L = 200$ K Ω , typical temperature coefficent for all V_{DD} values is 03 %/°C, all input rise and fall times= 20 ns)

Symbol	Parameter -	Test Condition			Value		Unit
Cyllibol	i didiletei	V	DD (V)	Min.	Тур.	Max.	Oili
t _{PLH}	Propagation Delay Time		5		200	400	
t _{PHL}	Clock to Q		10		80	160	ns
			15		60	120	
t _{PLH}	Propagation Delay Time		5		225	450	
t _{PHL}	Clock to Cout		10		95	190	ns
			15		70	140	
t _{PLH}	Propagation Delay Time		5		125	250	
t _{PHL}	TE to C _{OUT}		10		55	110	ns
			15		40	80	
t _{setup}	Setup Time		5	240	120		
*Setup	Data to Clock		10	90	45		ns
			15	60	30		
+ .	Setup Time		5	240	120		
t _{setup}	Load to Clock						ns
	Load to Glock		10	90	45		110
	0.4 =		15	60	30		
t _{setup}	Setup Time		5	340	170		no
	PE or TE to Clock		10	140	70		ns
			15	100	50		
t _{hold}	Hold Time		5	0			
			10	0			ns
			15	0			
t _{THL} t _{TLH}	Transition Time		5		100	200	
			10		50	100	ns
			15		40	80	
t _W	CLock Input Pulse Width		5	170	85		
			10	70	35		ns
			15	50	25		
f _{CL}	Maximum Clock Input Frequency		5	2	3		
02	, , , , , , , , , , , , , , , , , , , ,		10	5.5	8.5		MH
			15	8	12		
t _r t _f	Clock Input Rise or Fall Time *					200	
" "						70	ns
						15	
t _{PHL}	Propagation Delay Time (40160B, 40161B)		5		250	500	
IPHL	Clear to Q		10		110	220	ns
	Olcar to Q		15		80		
1	Catus Time (40460B, 40460B)			240		160	
t _{setup}	Setup Time (40162B, 40163B) Clear to Clock	⊢	5	340	170		no
	CIGAL IU CIUCK	<u> </u>	10	140	70		ns
			15	100	50		
t _{hold}	Hold Time (40162B, 40163B)		5	0			
	Clear to Clock		10	0			ns
			15	0			
t _{rem}	Clear Removal Time (40162B, 40163B)	T	5	200	100		
			10	100	50		ns
			15	70	35		
tw	Clear Input Pulse Width Low Level (40160B,		5	170	85		
	40161B)	<u> </u>	10	70	35		ns
	·		15	50	25		
			10				

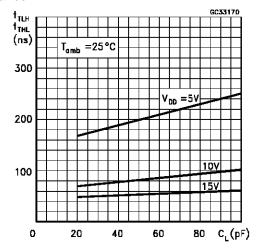
^{*} If more than one unit is cascated in the parallel clocked application, tr should be made less than or equal to the sum of the fixed propagation delay at 50 pF and the transition time of the carry output driving stage for the estimated capacitance



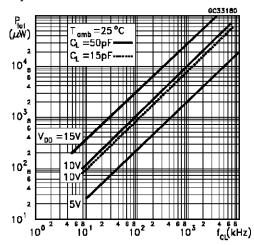
Output Low (sink) Current Characteristics



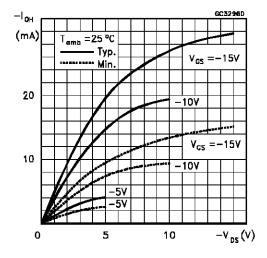
Typical Propagation Delay Time vs Load Capacitance



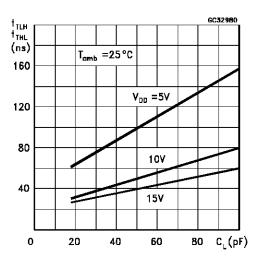
Typical Dynamic Power Dissipation vs Input Frequency



Output High (source) Current Characteristics

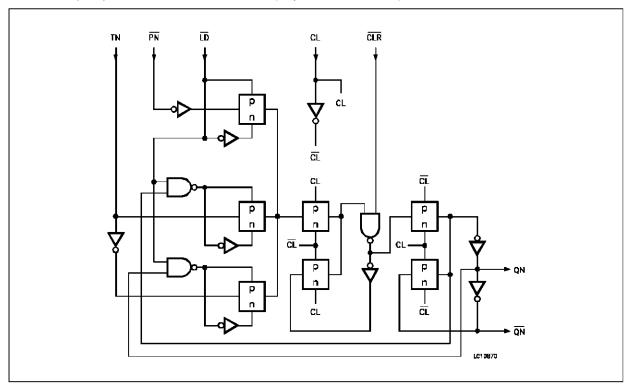


Typical Transition Time vs Load Capacitance

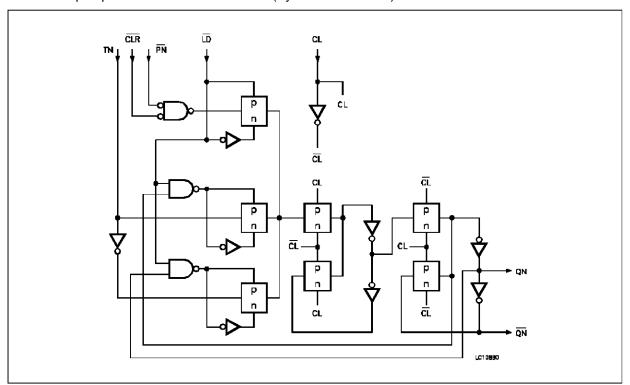


TYPICAL APPLICATIONS

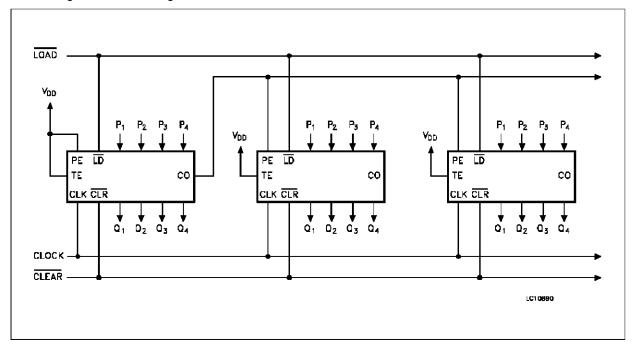
Detail of Flip-flops For 40160B And 40161B (Asynchronous Clear)



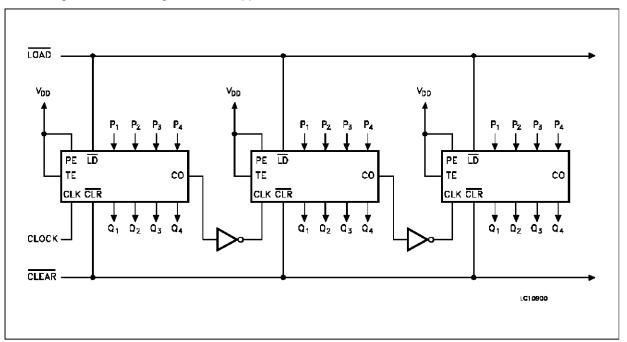
Detail of Flip-flops For 40162B And 40163B (Synchronous Clear)



Cascading Counter Packages In The Parallel-Clocked Mode

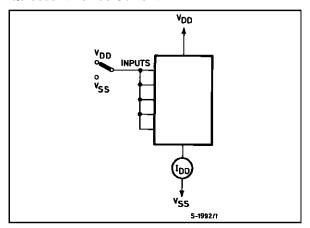


Cascading Counter Packages In The Ripple-Clocked Mode

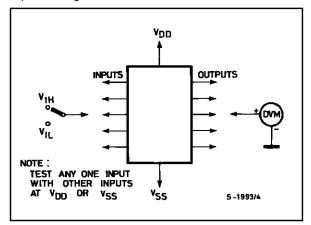


TEST CIRCUIT

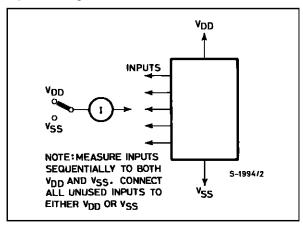
Quiescent Device Current.



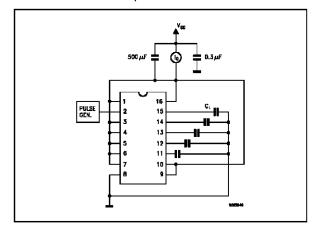
Input Voltage.



Input Leakage Current.

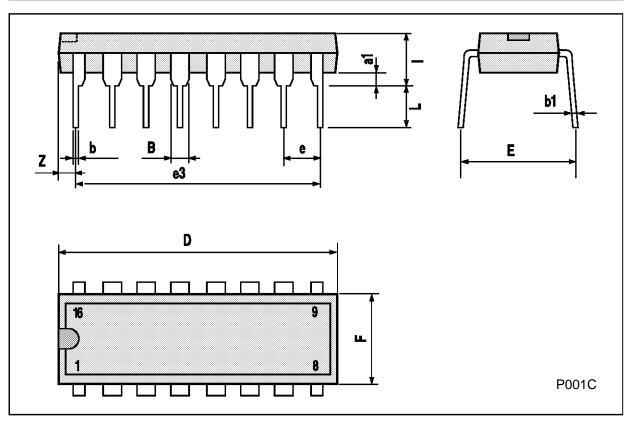


Dinamic Power Dissipation



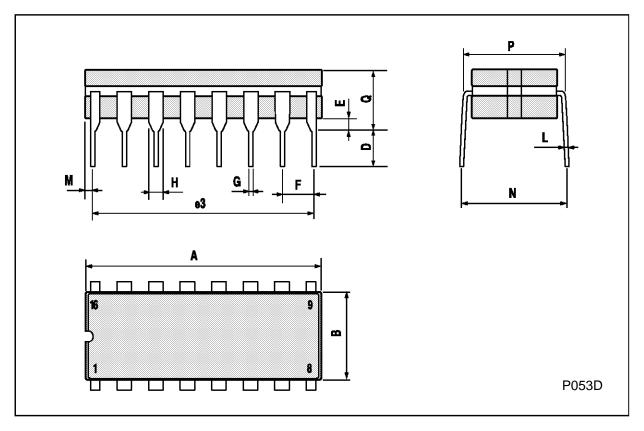
Plastic DIP16 (0.25) MECHANICAL DATA

DIM.		mm		inch				
5	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
a1	0.51			0.020				
В	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			
е		2.54			0.100			
e3		17.78			0.700			
F			7.1			0.280		
ı			5.1			0.201		
L		3.3			0.130			
Z			1.27			0.050		



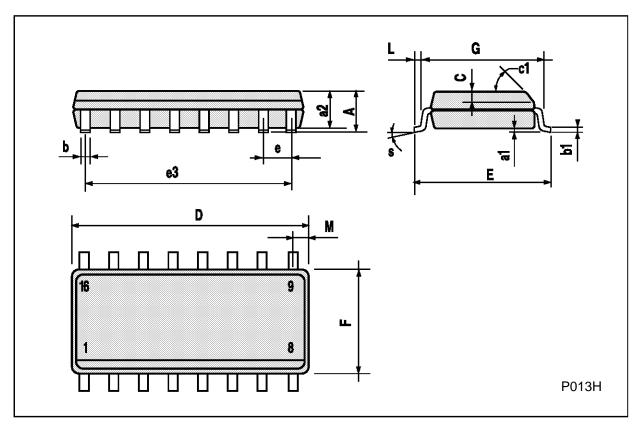
Ceramic DIP16/1 MECHANICAL DATA

DIM.		mm		inch			
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Α			20			0.787	
В			7			0.276	
D		3.3			0.130		
Е	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	
Н	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	
Р	7.8		8.05	0.307		0.317	
Q			5.08			0.200	



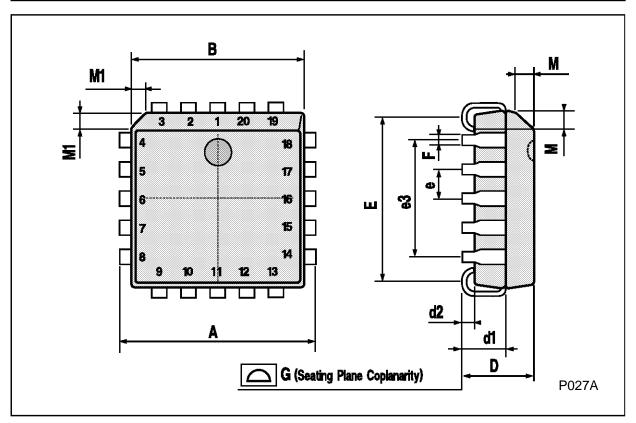
SO16 (Narrow) MECHANICAL DATA

DIM.		mm		inch				
D 11111	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
А			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		
С		0.5			0.019			
c1			45°	(typ.)				
D	9.8		10	0.385		0.393		
Е	5.8		6.2	0.228		0.244		
е		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		
М			0.62			0.024		
S			8° (r	nax.)				



PLCC20 MECHANICAL DATA

DIM.		mm		inch			
2	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Α	9.78		10.03	0.385		0.395	
В	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	
е		1.27			0.050		
e3		5.08			0.200		
F		0.38			0.015		
G			0.101			0.004	
М		1.27			0.050		
M1		1.14			0.045		



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