

PROGRAMMABLE DIVIDER/TIMER

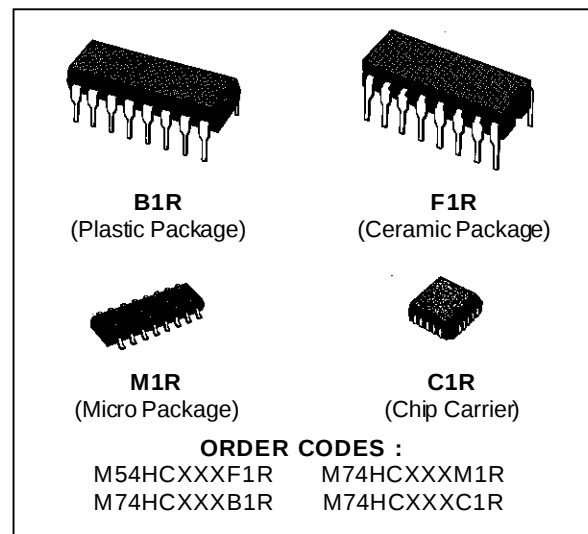
- **HIGH SPEED**
 $f_{MAX} = 70 \text{ MHz (TYP.) at } V_{CC} = 5 \text{ V}$
- **LOW POWER DISSIPATION**
 $I_{CC} = 4 \text{ mA (MAX.) at } T_A = 25^\circ\text{C}$
- **HIGH NOISE IMMUNITY**
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**
 10 LSTTL LOADS
- **SYMMETRICAL 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**
 54/74LS292/294

DESCRIPTION

The 54/74HC292/7292 and HC294/7294 are high speed CMOS PROGRAMMABLE DIVIDER/TIMER fabricated with silicon C²MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

These devices are programmable frequency dividers. The types have two clock inputs, either one may be used for clock gating. (see the function table). The HC292/7292 can divide from 2^2 to 2^{31} , and the HC294/7294 can divide from 2^2 to 2^{15} . The

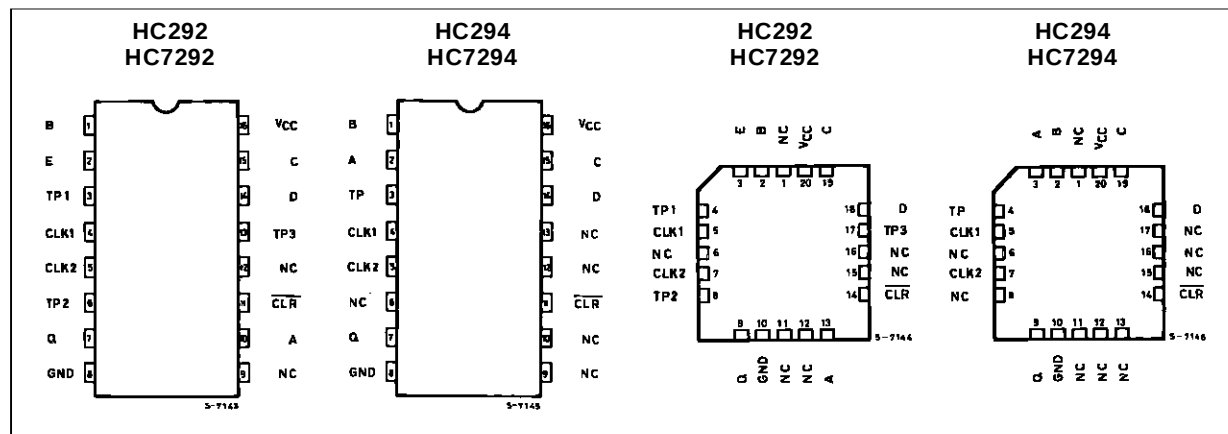


types feature an active-low clear input to initialize the state of all flip-flops. To facilitate incoming inspection, test points are provided. (TP1, TP2 and TP3 on the HC292/7292 and TP on the HC294/7294). All inputs are equipped with protection circuits against static discharge and transient excess voltage.

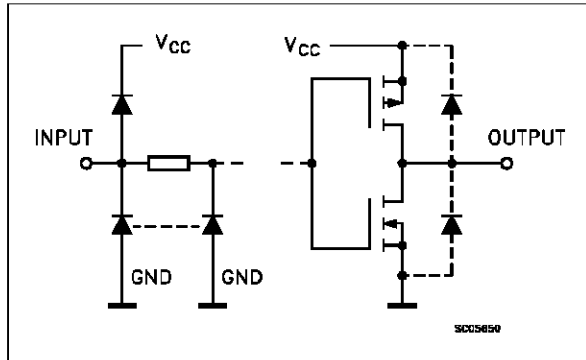
HC292/294 have Q output with "Totem pole" configuration and test point TP with "Open Drain" output configuration.

HC7292/7294 have all outputs "Totem Pole".

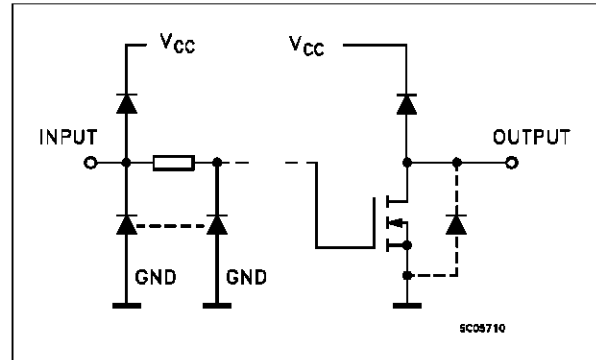
PIN CONNECTION (top view)



**INPUT AND OUTPUT EQUIVALENT CIRCUIT
(TOTEM POLE OUTPUT)**



**INPUT AND OUTPUT EQUIVALENT CIRCUIT
(OPEN DRAIN OUTPUT, HC292/294)**



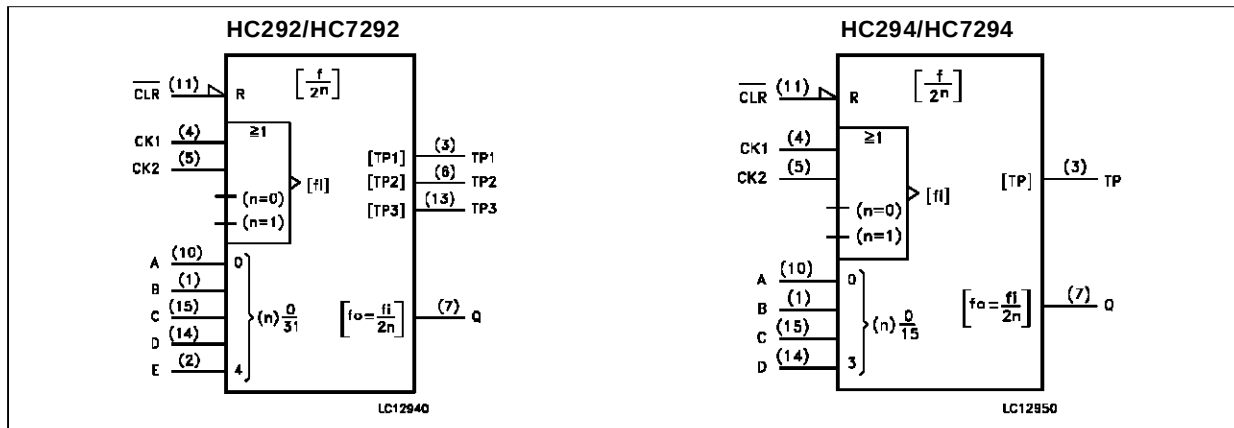
PIN DESCRIPTION (HC292/7292)

PIN No	SYMBOL	NAME AND FUNCTION
4, 5	CLK1, CLK2	input Clock
1, 2, 10, 14, 15	A to E	Program Inputs
3, 6, 13	TP1, TP2, TP3	Test Point Outputs
11	CLR	Clear (Active LOW)
7	Q	Output
8	GND	Ground (0V)
16	Vcc	Positive Supply Voltage

PIN DESCRIPTION (HC294/7294)

PIN No	SYMBOL	NAME AND FUNCTION
4, 5	CLK1, CLK2	input Clock
1, 2, 14, 15	A to D	Program Inputs
3	TP1	Test Point Output
11	CLR	Clear (Active LOW)
7	Q	Output
8	GND	Ground (0V)
16	Vcc	Positive Supply Voltage

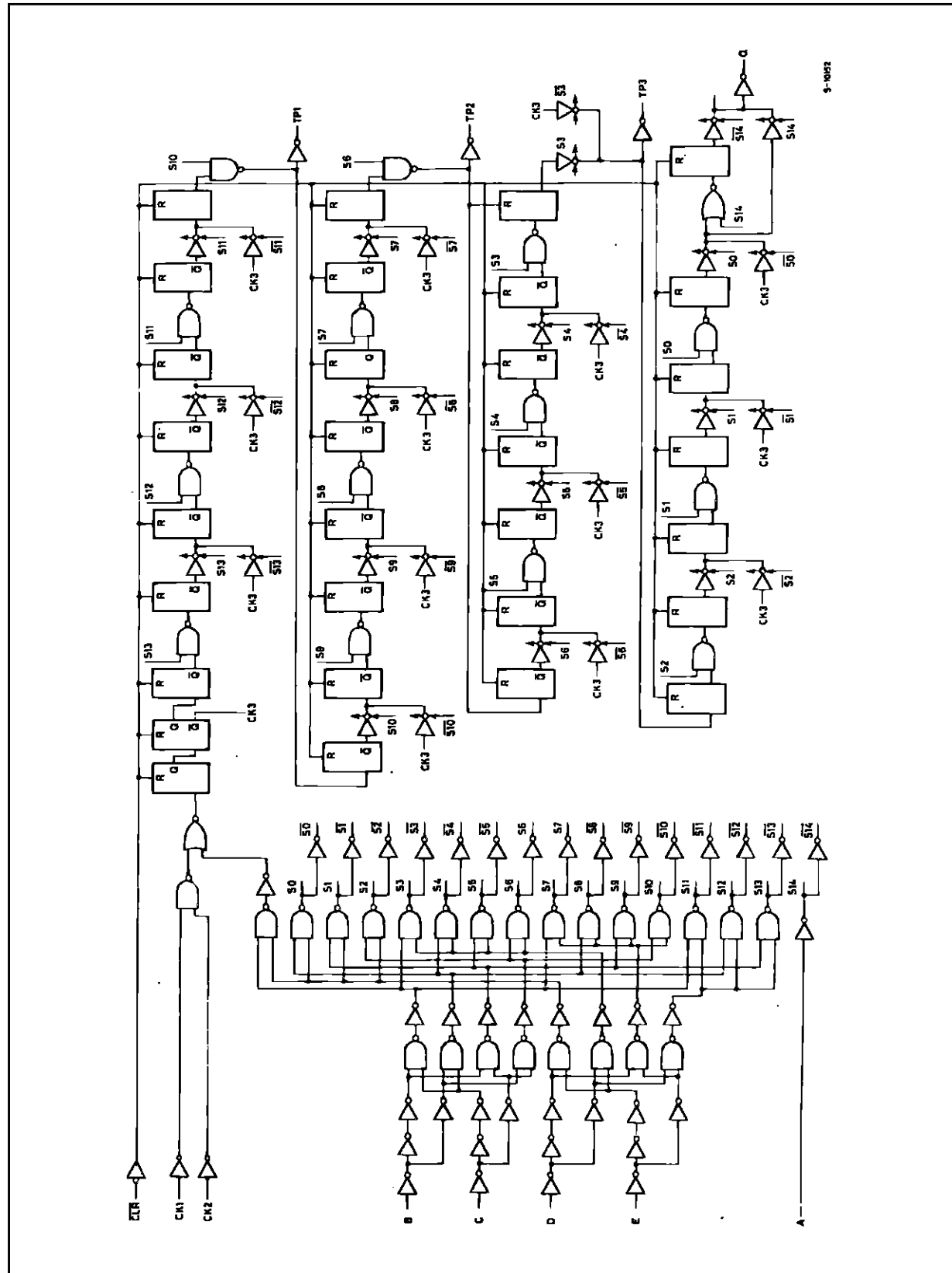
IEC LOGIC SYMBOLS



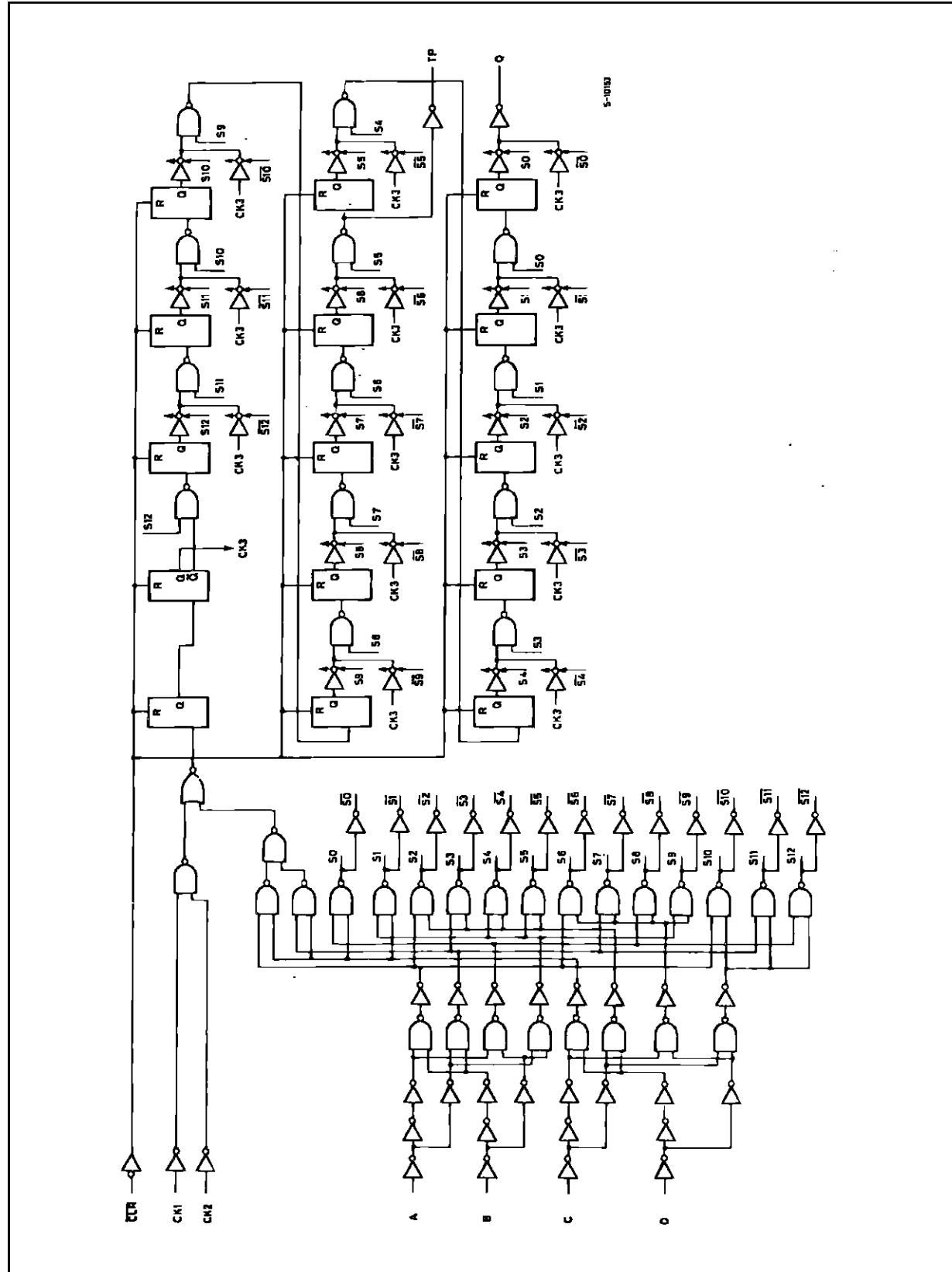
TRUTH TABLE

CLEAR	CLOCK1	CLOCK2	Q OUTPUT MODE
L	X	X	CLEARED TO L
H		L	UP COUNT
H	L		
H	H	X	NO CHANGE
H	X	H	

LOGIC DIAGRAM (HC292/7292)



LOGIC DIAGRAM (HC294/7294)



FUNCTION TABLE (HC292/7292)

PROGRAMMING INPUTS					FREQUENCY DIVISION							
					Q		TP1		TP2		TP3	
E	D	C	B	A	BINARY	DECIMAL	BINARY	DECIMAL	BINARY	DECIMAL	BINARY	DECIMAL
L	L	L	L	L	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
L	L	L	L	H	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit	Inhibit
L	L	L	H	L	2 ²	4	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
L	L	L	H	H	2 ³	8	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
L	L	H	L	L	2 ⁴	16	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
L	L	H	L	H	2 ⁵	32	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
L	L	H	H	L	2 ⁶	64	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
L	L	H	H	H	2 ⁷	128	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
L	H	L	L	L	2 ⁸	256	2 ⁹	512	2 ¹⁷	131,072	2 ²	4
L	H	L	L	H	2 ⁹	512	2 ⁹	512	2 ¹⁷	131,072	2 ²	4
L	H	L	H	L	2 ¹⁰	1,024	2 ⁹	512	2 ¹⁷	131,072	2 ⁴	16
L	H	L	H	H	2 ¹¹	2,048	2 ⁹	512	2 ¹⁷	131,072	2 ⁴	16
L	H	H	L	L	2 ¹²	4,096	2 ⁹	512	2 ¹⁷	131,072	2 ⁶	64
L	H	H	L	H	2 ¹³	8,192	2 ⁹	512	2 ¹⁷	131,072	2 ⁶	64
L	H	H	H	L	2 ¹⁴	16,384	2 ⁹	512	Disabled Low		2 ⁸	256
H	H	H	H	H	2 ¹⁵	32,768	2 ⁹	512	Disabled Low		2 ⁸	256
H	L	L	L	L	2 ¹⁶	65,536	2 ⁹	512	2 ³	8	2 ¹⁰	1,024
H	L	L	L	H	2 ¹⁷	131,072	2 ⁹	512	2 ³	8	2 ¹⁰	1,024
H	L	L	H	L	2 ¹⁸	262,144	2 ⁹	512	2 ⁵	32	2 ¹²	4,096
H	L	L	H	H	2 ¹⁹	524,288	2 ⁹	512	2 ⁵	32	2 ¹²	4,096
H	L	H	L	L	2 ²⁰	1,048,576	2 ⁹	512	2 ⁷	128	2 ¹⁴	16,384
H	L	H	L	H	2 ²¹	2,097,152	2 ⁹	512	2 ⁷	128	2 ¹⁴	16,384
H	L	H	H	L	2 ²²	4,194,304	Disabled Low		2 ⁹	512	2 ¹⁶	65,536
H	L	H	H	H	2 ²³	8,388,608	Disabled Low		2 ⁹	512	2 ¹⁶	65,536
H	H	L	L	L	2 ²⁴	16,777,216	2 ³	8	2 ¹¹	2,048	2 ¹⁸	262,144
H	H	L	L	H	2 ²⁵	33,554,432	2 ³	8	2 ¹¹	2,048	2 ¹⁸	262,144
H	H	L	H	L	2 ²⁶	67,108,864	2 ⁵	32	2 ¹³	8,192	2 ²⁰	1,048,576
H	H	L	H	H	2 ²⁷	134,217,728	2 ⁵	32	2 ¹³	8,192	2 ²⁰	1,048,576
H	H	H	L	L	2 ²⁸	268,435,456	2 ⁷	128	2 ¹⁵	32,768	2 ²²	4,194,304
H	H	H	L	H	2 ²⁹	536,870,912	2 ⁷	128	2 ¹⁵	32,768	2 ²²	4,194,304
H	H	H	H	L	2 ³⁰	1,073,741,824	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216
H	H	H	H	H	2 ³¹	2,147,483,648	2 ⁹	512	2 ¹⁷	131,072	2 ²⁴	16,777,216

FUNCTION TABLE (HC294/7294)

PROGRAMMING INPUTS				FREQUENCY DIVISION			
				Q		TP	
D	C	B	A	BINARY	DECIMAL	BINARY	DECIMAL
L	L	L	L	Inhibit	Inhibit	Inhibit	Inhibit
L	L	L	H	Inhibit	Inhibit	Inhibit	Inhibit
L	L	H	L	2 ²	4	2 ⁹	512
L	L	H	H	2 ³	8	2 ⁹	512
L	H	L	L	2 ⁴	16	2 ⁹	512
L	H	L	H	2 ⁵	32	2 ⁹	512
L	H	H	L	2 ⁶	64	2 ⁹	512
L	H	H	H	2 ⁷	128	Disabled Low	
H	L	L	L	2 ⁸	256	2 ²	4
H	L	L	H	2 ⁹	512	2 ³	8
H	L	H	L	2 ¹⁰	1,024	2 ⁴	16
H	L	H	H	2 ¹¹	2,048	2 ⁵	32
H	H	L	L	2 ¹²	4,096	2 ⁶	64
H	H	L	H	2 ¹³	8,192	2 ⁷	128
H	H	H	L	2 ¹⁴	16,384	2 ⁸	256
H	H	H	H	2 ¹⁵	32,768	2 ⁹	512

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	± 20	mA
I _{OK}	DC Output Diode Current	± 20	mA
I _O	DC Output Source Sink Current Per Output Pin	± 25	mA
I _{CC} or I _{GND}	DC V _{CC} or Ground Current	± 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 conditions is not implied.

(*) 500 mW: ≡ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °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: M54HC Series M74HC Series	-55 to +125 -40 to +85	°C °C
t _r , t _f	Input Rise and Fall Time	V _{CC} = 2 V V _{CC} = 4.5 V V _{CC} = 6 V	0 to 1000 0 to 500 0 to 400
			ns

DC SPECIFICATIONS

Symbol	Parameter	Test Conditions				Value						Unit	
		V _{CC} (V)			T _A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC			
					Min.	Typ.	Max.	Min.	Max.	Min.	Max.		
V _{IH}	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 _{IL}	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 _{OH}	High Level Output Voltage (Q)	2.0	V _I = V _{IH} or V _{IL}	I _O =-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 _O =-4.0 mA	4.18	4.31		4.13		4.10			
		6.0		I _O =-5.2 mA	5.68	5.8		5.63		5.60			
V _{OH}	High Level Output Voltage (TP) (for HC7292 HC7294 only)	2.0	V _I = V _{IH} or V _{IL}	I _O =-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 _O =-1.0 mA	4.18	4.31		4.13		4.10			
		6.0		I _O =-1.3 mA	5.68	5.8		5.63		5.60			
V _{OL}	Low Level Output Voltage (Q)	2.0	V _I = V _{IH} or V _{IL}	I _O = 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 _O = 4.0 mA		0.17	0.26		0.33		0.40		
		6.0		I _O = 5.2 mA		0.18	0.26		0.33		0.40		
V _{OL}	Low Level Output Voltage (TP)	2.0	V _I = V _{IH} or V _{IL}	I _O = 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 _O = 1.0 mA		0.17	0.26		0.33		0.40		
		6.0		I _O = 1.3 mA		0.18	0.26		0.33		0.40		
I _I	Input Leakage Current	6.0	V _I = V _{CC} or GND				±0.1		±1		±1	µA	
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND				4		40		80	µA	

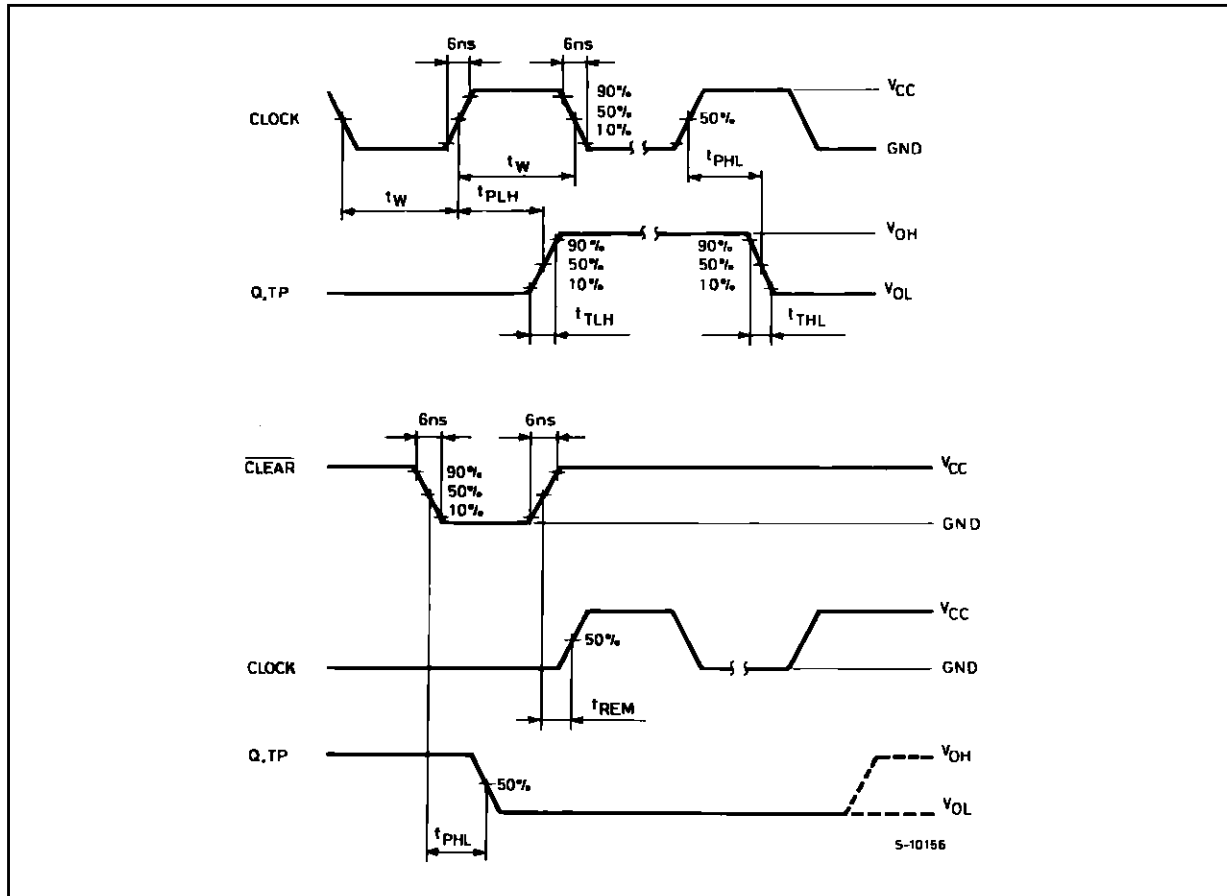
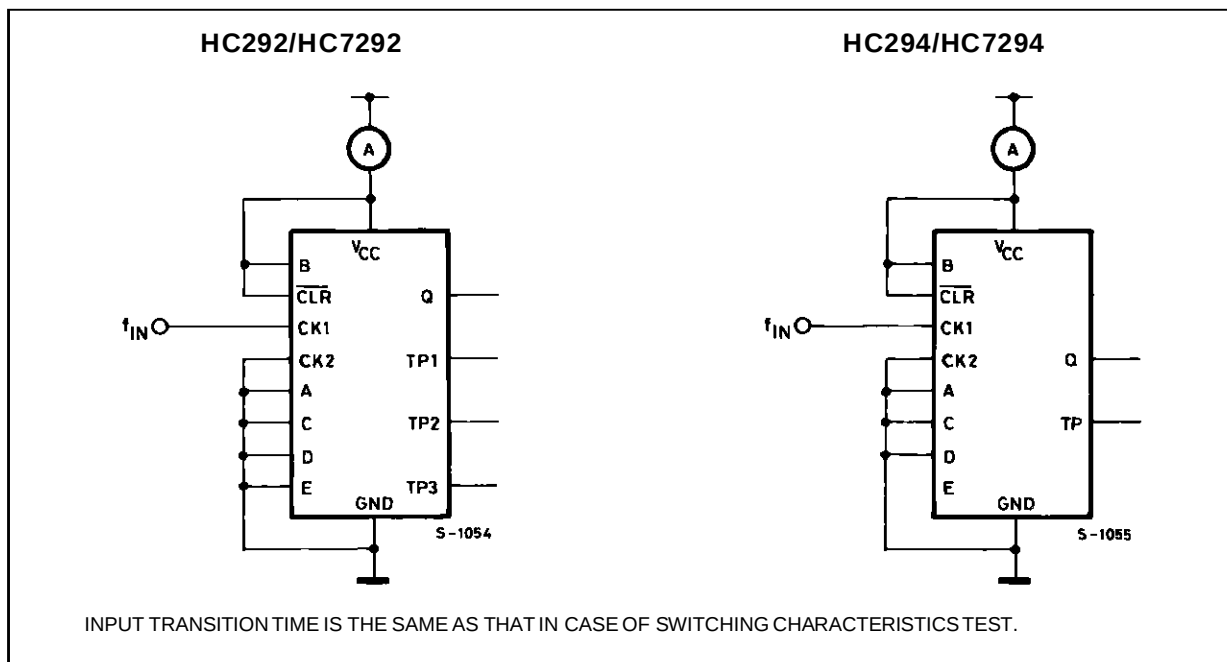
M54/M74HC292/7292/294/7294

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input t_r = t_f = 6 ns)

Symbol	Parameter	Test Conditions		Value						Unit		
		V _{CC} (V)		T _A = 25 °C 54HC and 74HC			-40 to 85 °C 74HC		-55 to 125 °C 54HC			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
t _{TLH} t _{THL}	Output Transition Time (Q)	2.0			30	75		95		110	ns	
		4.5			8	15		19		22		
		6.0			7	13		16		19		
t _{TLH} t _{THL}	Output Transition Time (TP)	2.0			116	225		280		340	ns	
		4.5			29	45		56		68		
		6.0			25	38		48		57		
t _{PLH} t _{PHL}	Propagation Delay Time (CK - Q)	2.0	for HC292/7292		160	350		440		ns		
		4.5			46	70		88		105		
		6.0			39	60		75		90		
t _{PLH} t _{PHL}	Propagation Delay Time (CK - Q)	2.0	for HC294/7294		145	330		415			ns	
		4.5			43	66		83		15		
		6.0			37	56		71		84		
t _{PHL}	Propagation Delay Time (CLR - Q)	2.0	for HC292/7292		130	320		400		210	ns	
		4.5			42	64		80		100		
		6.0			36	54		68		81		
t _{PHL}	Propagation Delay Time (CLR - Q)	2.0	for HC294/7294		110	260		325		390	ns	
		4.5			34	52		65		78		
		6.0			29	44		55		66		
f _{MAX}	Maximum Clock Frequency	2.0	for HC292/7292	5.0	21		4		3.4		MHz	
		4.5			27	64		22		18		
		6.0			32	75		26		21		
f _{MAX}	Maximum Clock Frequency	2.0	for HC294/7294	6.0	20		5		4		MHz	
		4.5			32	64		26		21		
		6.0			38	75		31		25		
t _{W(H)} t _{W(L)}	Minimum Pulse Width (CLOCK)	2.0			40	75		95		110	ns	
		4.5			8	15		19		22		
		6.0			7	13		16		20		
t _{W(L)}	Minimum Pulse Width (CLEAR)	2.0	for HC292/7292		48	125		155		190	ns	
		4.5			12	25		31		38		
		6.0			10	21		26		32		
t _{W(L)}	Minimum Pulse Width (CLEAR)	2.0	for HC294/7294		40	100		125		150	ns	
		4.5			10	20		25		30		
		6.0			9	17		21		26		
t _{REM}	Minimum Removal Time	2.0	for HC292/7292			5		5		5	ns	
		4.5				5		5		5		
		6.0				5		5		5		
t _{REM}	Minimum Removal Time	2.0	for HC294/7294			0		0		0	ns	
		4.5				0		0		0		
		6.0				0		0		0		
C _{IN}	Input Capacitance				5	10		10			pF	
C _{PD} (*)	Power Dissipation Capacitance		for HC292/7292 for HC294/7294		21 23						pF	

(*) C_{PD} 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} • V_{CC} • f_{IN} + I_{CC}

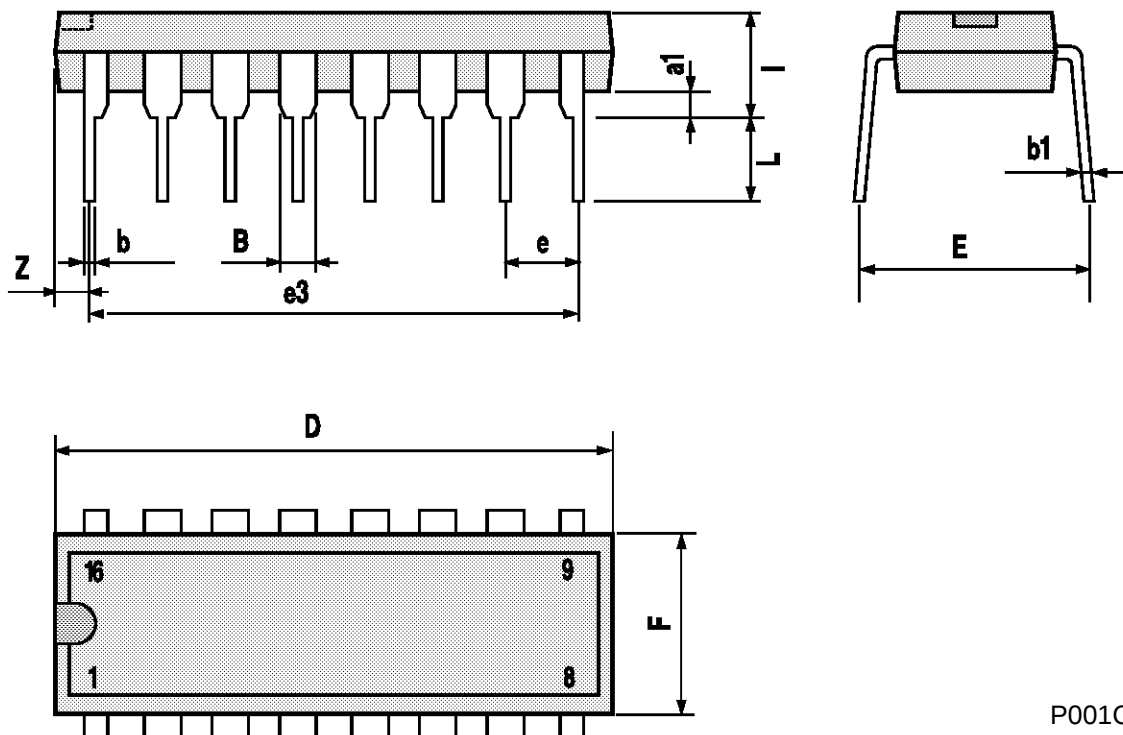
SWITCHING CHARACTERISTICS TEST WAVEFORM

TEST CIRCUIT I_{CC} (Opr.)

INPUT TRANSITION TIME IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST.

Plastic DIP16 (0.25) MECHANICAL DATA

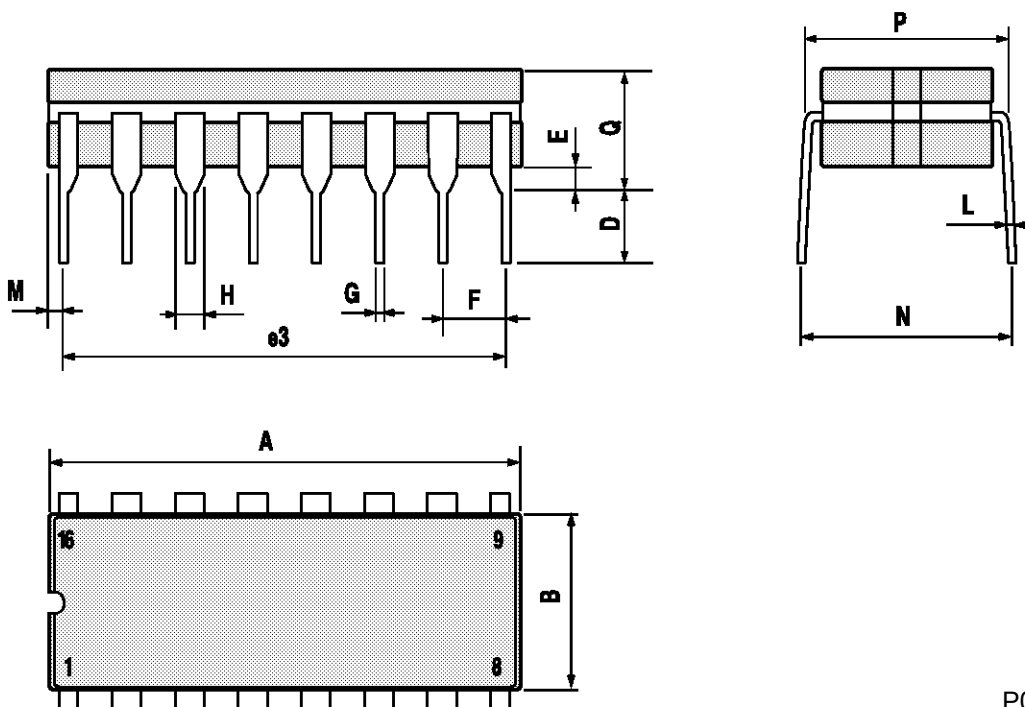
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C

Ceramic DIP16/1 MECHANICAL DATA

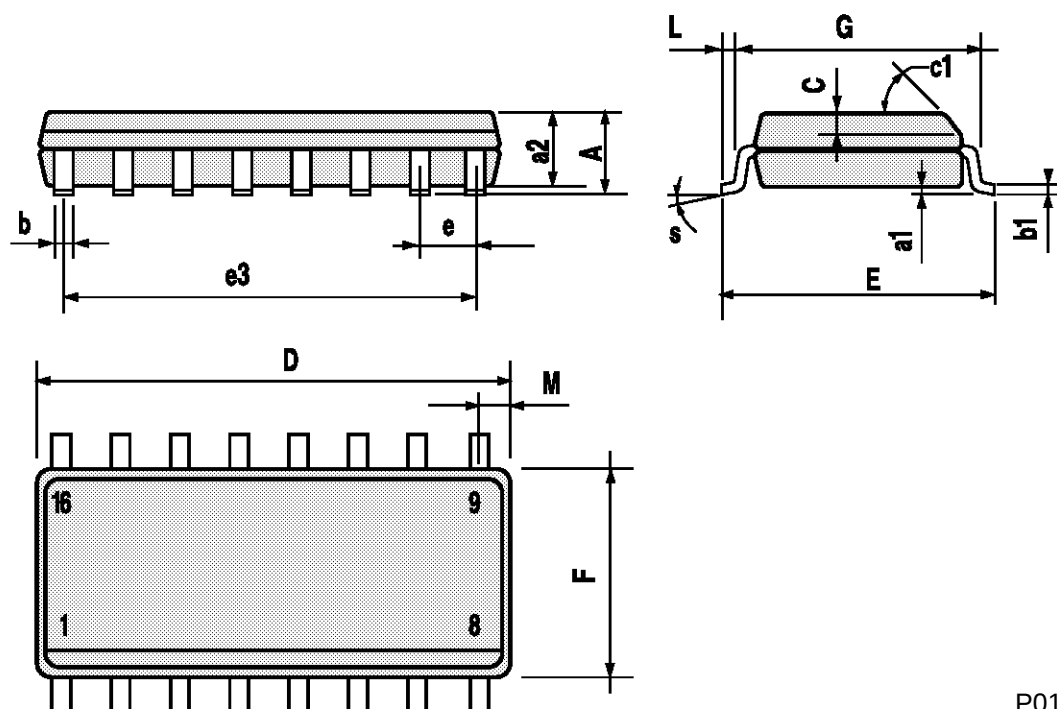
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q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



P053D

SO16 (Narrow) MECHANICAL DATA

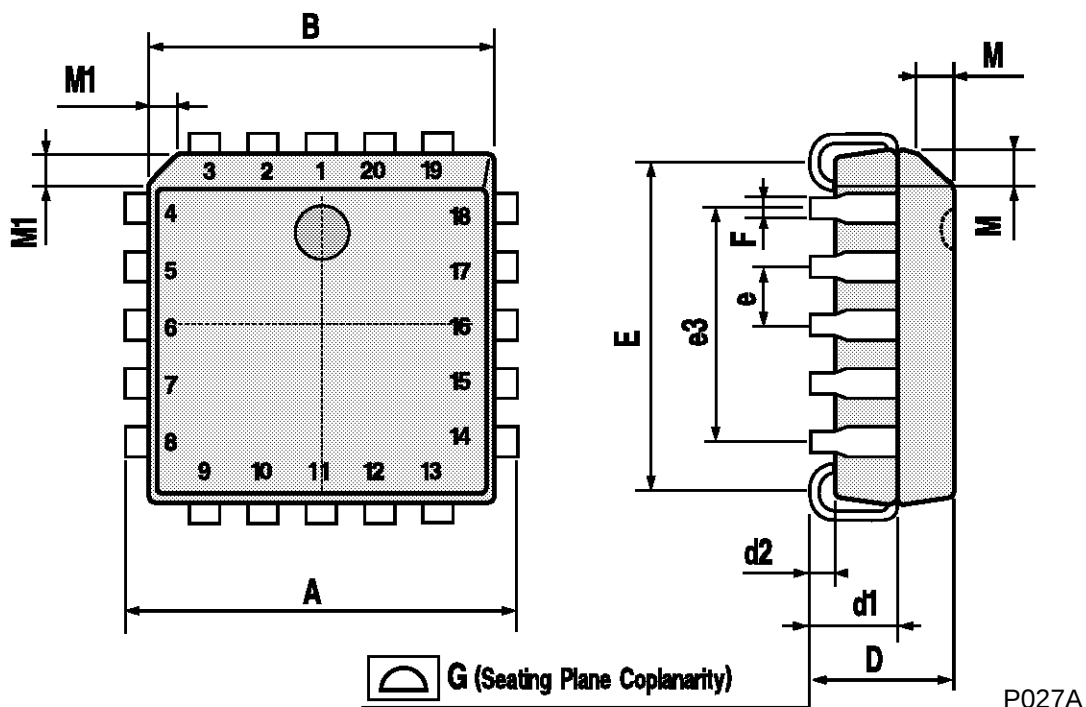
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157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