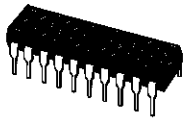
SGS-THOMSON MICROELECTRONICS

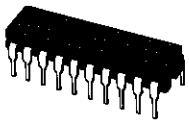
M54HC593
M74HC593

8 BIT BINARY COUNTER WITH INPUT REGISTER (3-STATE)

- HIGH SPEED
  f_{MAX} = 80 MHz (TYP.) AT V_{CC} = 5 V
- LOW POWER DISSIPATION
  I_{CC} = 4 µA (MAX.) AT T_A = 25 °C
- OUTPUT DRIVE CAPABILITY
  10 LSTTL LOADS FOR $\overline{RCO}$
  15 LSTTL LOADS FOR Qn
- BALANCED PROPAGATION DELAYS
  $t_{PLH} = t_{PHL}$
- SYMMETRICAL OUTPUT IMPEDANCE
  $I_{OL} = |I_{OH}|$ = 6 mA (MIN.) for Qn
  $I_{OL} = |I_{OH}|$ = 4 mA (MIN.) for $\overline{RCO}$
- HIGH NOISE IMMUNITY
  $V_{NIH} = V_{NIL}$ = 28 % V_{CC} (MIN.)
- WIDE OPERATING VOLTAGE RANGE
  V_{CC} (OPR) = 2 V TO 6 V
- PIN AND FUNCTION COMPATIBLE WITH 54/74LS593



B1R
(Plastic Package)



F1R
(Ceramic Package)

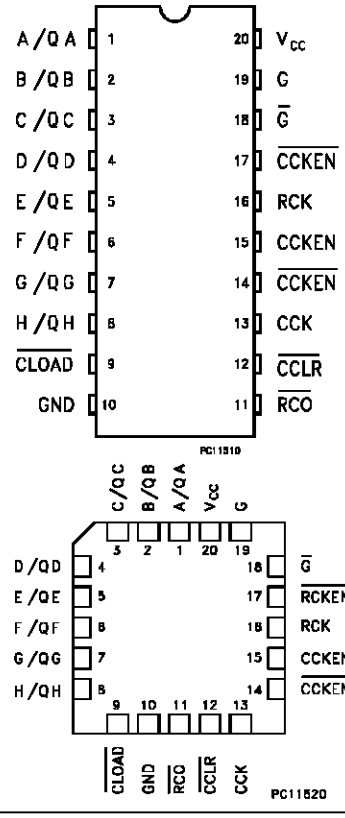
M1R
(Micro Package)

C1R
(Chip Carrier)

ORDER CODES :

M54HC593F1R	M74HC593M1R
M74HC593B1R	M74HC593C1R

PIN CONNECTIONS (top view)



NC =
No Internal
Connection

DESCRIPTION

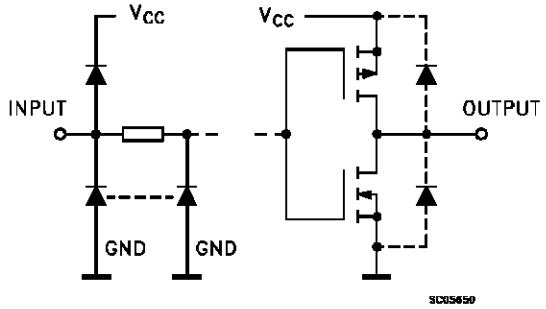
The M54/74HC593 is a high speed CMOS 8 BIT REGISTER COUNTER (3 STATE) fabricated with silicon gate C^2MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

The M54/74HC593 consists of a parallel input, 8 bit storage register feeding an 8 bit binary counter. Both the register and the counter have individual positive edge-triggered clock. In addition, the counter has direct load and clear functions. Expansion is easily accomplished by connecting $\overline{RCO}$ of first stage to the count enable $\overline{CCKEN}$, of the second stage etc.

The M54/74HC593 comes in a 20 pin package and has 3 state I/O, which provides parallel counter outputs.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

INPUT AND OUTPUT EQUIVALENT CIRCUIT



TRUTH TABLE

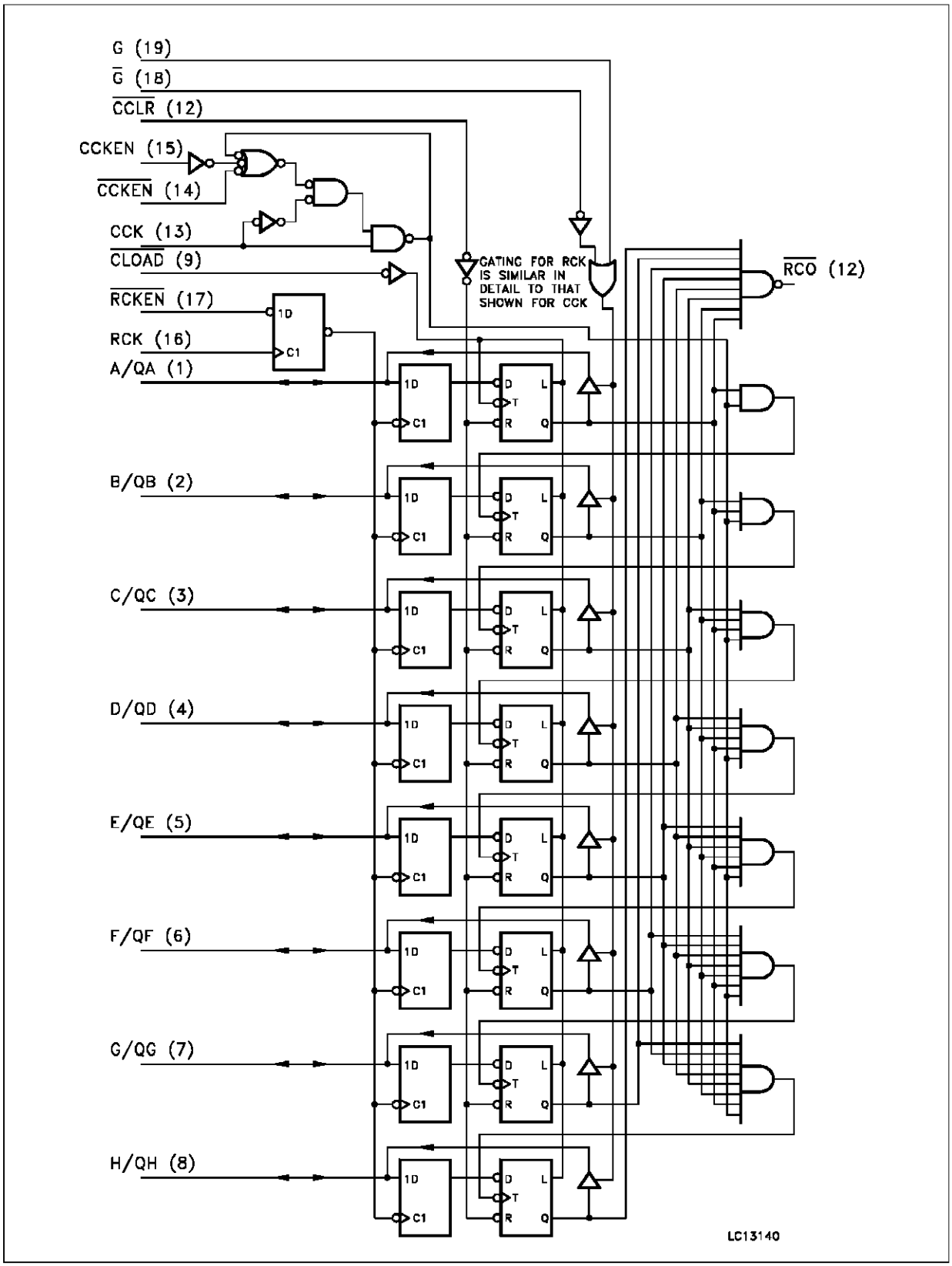
INPUTS									FUNCTION
G	$\overline{G}$	$\overline{CCLR}$	CCKEN	$\overline{CCKEN}$	CCK	$\overline{CLOAD}$	$\overline{RCKEN}$	RCK	
L	H	X	X	X	X	X	X	X	ALL Q BUS BECOME HIGH Z AND CAN BE APPLIED ANY DATA
H	X	X	X	X	X	X	X	X	THE OUTPUT DATA OF THE COUNTER IS ENABLE ON QA THRU QH
X	L	X	X	X	X	X	X	X	
X	X	L	X	X	X	H	X	X	COUNTER IS CLEARED TO ZERO
X	X	H	X	X	X	L	X	X	THE DATA OF Q BUS IS LOADED INTO COUNTER
X	X	H	H	X	↓	H	X	X	COUNTER ADVANCES THE COUNT
X	X	H	X	L	↓	H	X	X	
X	X	H	H	X	↑	H	X	X	NO COUNT
X	X	H	X	L	↑	H	X	X	
X	X	H	L	H	X	H	X	X	NO COUNT
X	X	X	X	X	X	X	H	X	REGISTER DATA IS NOT CHANGED
X	X	X	X	X	X	X	L	↑↓	REGISTER DATA IS NOT CHANGED
X	X	X	X	X	X	X	L		THE DATA OF Q BUS IS STORED INTO REGISTER

X: Don't Care

$\overline{RCO} = \overline{QA' \bullet QB' \bullet QC' \bullet QD' \bullet QE' \bullet QF' \bullet QG' \bullet QH'}$

(QA' to QH': Internal outputs of the counter)

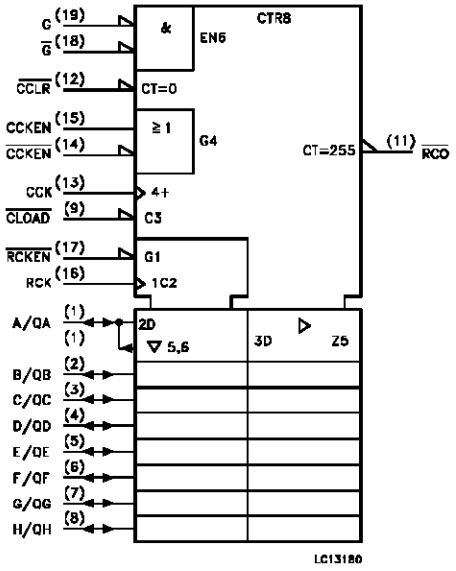
LOGIC DIAGRAM



PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 8	A/QA to H/QH	Binary Outputs
9	$\overline{CLOAD}$	Counter Clock Load Input
11	$\overline{RCO}$	Ripple Carry Output
12	$\overline{CCLR}$	Counter Clear Input
13	CCK	Counter Clock Input
14, 15	$\overline{CCKEN}$, CCKEN	Counter Clock Enable Inputs
16	RCK	Register Clock Input
17	$\overline{RCKEN}$	Register Clock Enable Input
18, 19	$\overline{G}$, G	Output Enable
10	GND	Ground (0V)
20	V_{CC}	Positive Supply Voltage

IEC LOGIC SYMBOL



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 ($\overline{RCO}$) (QA - QH)	± 20 ± 35	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 70	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	0 to 1000	ns
		V_{CC} = 4.5 V	0 to 500	
		V_{CC} = 6 V	0 to 400	

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 (RCO)	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 (QA - QH)	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=-6.0 mA	4.18	4.31		4.13		4.10		
		6.0		I_O=-7.8 mA	5.68	5.8		5.63		5.60		
V_{OL}	Low Level Output Voltage (RCO)	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 (QA - QH)	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= 6.0 mA		0.17	0.26		0.33		0.40	
		6.0		I_O= 7.8 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_{OZ}	3 State Output Off State Current	6.0	V_I = V_{IH} or V_{IL} V_O = V_{CC} or GND				±0.5		±5.0		±10	µA
I_{CC}	Quiescent Supply Current	6.0	V_I = V_{CC} or GND				4		40		80	µA

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 6$ ns)

Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	C_L (pF)		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 (RCO)	2.0	50			30	75		95		110	ns
		4.5				8	15		19		22	
		6.0				7	13		16		19	
t_{TLH} t_{THL}	Output Transition Time (Qn)	2.0	50			20	60		75		90	ns
		4.5				7	12		15		18	
		6.0				6	10		13		15	
t_{PLH} t_{PHL}	Propagation Delay Time (CCK - Qn)	2.0	50			108	210		265		315	ns
		4.5				27	42		53		63	
		6.0				23	36		45		54	
		2.0	150			124	240		300		360	ns
		4.5				31	48		60		72	
		6.0				26	41		51		61	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CLOAD}$ - Qn)	2.0	50			108	210		265		315	ns
		4.5				27	42		53		63	
		6.0				23	36		45		54	
		2.0	150			124	240		300		360	ns
		4.5				31	48		60		72	
		6.0				26	41		51		61	
t_{PHL}	Propagation Delay Time ($\overline{CCLR}$ - Qn)	2.0	50			112	220		275		330	ns
		4.5				28	44		55		66	
		6.0				24	37		47		56	
		2.0	150			128	250		315		375	ns
		4.5				32	50		63		75	
		6.0				27	43		54		64	
t_{PLH} t_{PHL}	Propagation Delay Time (CCK - $\overline{RCO}$)	2.0	50			144	250		315		375	ns
		4.5				36	50		63		75	
		6.0				31	10		54		64	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CLOAD}$ - RCO)	2.0	50			152	295		370		445	ns
		4.5				38	59		74		89	
		6.0				32	50		63		76	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{CCLR}$ - RCO)	2.0	50			116	225		280		340	ns
		4.5				29	45		56		68	
		6.0				25	38		48		58	
t_{PLH} t_{PHL}	Propagation Delay Time ($\overline{RCK}$ - $\overline{RCO}$)	2.0	50			188	360		450		540	ns
		4.5				47	72		90		108	
		6.0				40	61		77		93	
t_{PZL} t_{PZH}	3 State Output Enable Time	2.0	50	R_L = 1 KΩ		72	145		180		220	ns
		4.5				18	29		36		44	
		6.0				15	25		31		38	
		2.0	150	R_L = 1 KΩ		88	175		220		265	ns
		4.5				22	35		44		53	
		6.0				19	30		37		45	

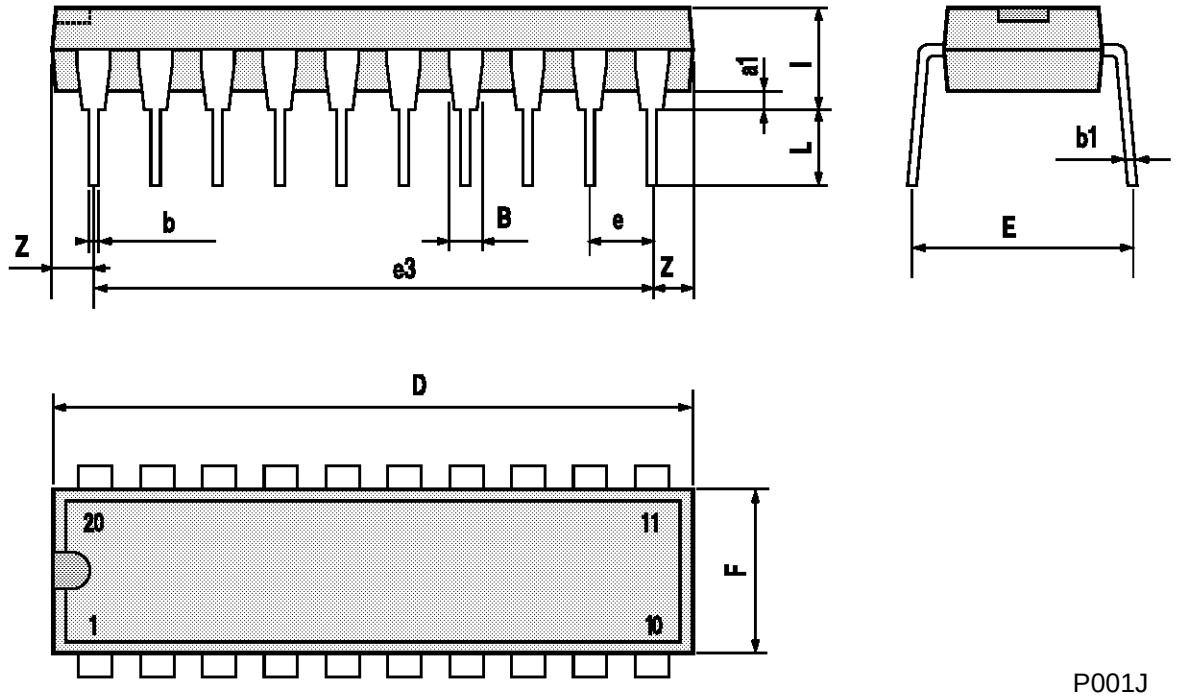
AC ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions			Value							Unit
		V_{CC} (V)	C_L (pF)		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_{PLZ} t_{PHZ}	3 State Output Disable Time	2.0	50	R_L = 1 KΩ		80	140		175		210	ns
		4.5				22	28		35		42	
		6.0				17	24		30		36	
f_{MAX}	Maximum Clock Frequency	2.0	50		5.4	4		4.4		3.6		MHz
		4.5			27	17		22		18		
		6.0			32	20		26		21		
$t_{W(H)}$ $t_{W(L)}$	Minimum Pulse Width (CCK, RCK)	2.0	50			44	100		125		150	ns
		4.5				11	20		25		30	
		6.0				9	17		21		26	
$t_{W(L)}$	Minimum Pulse Width ($\overline{CCLR}$, $\overline{CLOAD}$)	2.0	50			40	100		125		150	ns
		4.5				10	20		25		30	
		6.0				9	17		21		26	
t_S	Minimum Set-up Time ($\overline{CCKEN}$, CCKEN, CCK)	2.0	50			56	125		160		195	ns
		4.5				14	25		32		39	
		6.0				12	21		27		33	
t_S	Minimum Set-up Time ($\overline{RCKEN}$ - RCK)	2.0	50			32	75		95		110	ns
		4.5				8	15		19		22	
		6.0				7	13		16		19	
$t_{S(H)}$	Minimum Set-up Time (RCK - $\overline{CLOAD}$)	2.0	50			56	125		160		195	ns
		4.5				14	25		32		39	
		6.0				12	21		27		33	
t_S	Minimum Set-up Time (A to H - RCK)	2.0	50			16	50		60		70	ns
		4.5				4	10		12		14	
		6.0				3	9		11		12	
t_h	Minimum Hold Time	2.0	50			0	0		0		0	ns
		4.5				0	0		0		0	
		6.0				0	0		0		0	
t_{REM}	Minimum Clear Remuval Time ($\overline{CCLR}$, $\overline{CLOAD}$)	2.0	50				5				5	ns
		4.5					5		5		5	
		6.0					5		5		5	
C_{IN}	Input Capacitance					5	10		10		10	pF
C_{PD} (*)	Power Dissipation Capacitance					19						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 operting current can be obtained by the following equation. $I_{CC}(opr) = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}$

Plastic DIP20 (0.25) MECHANICAL DATA

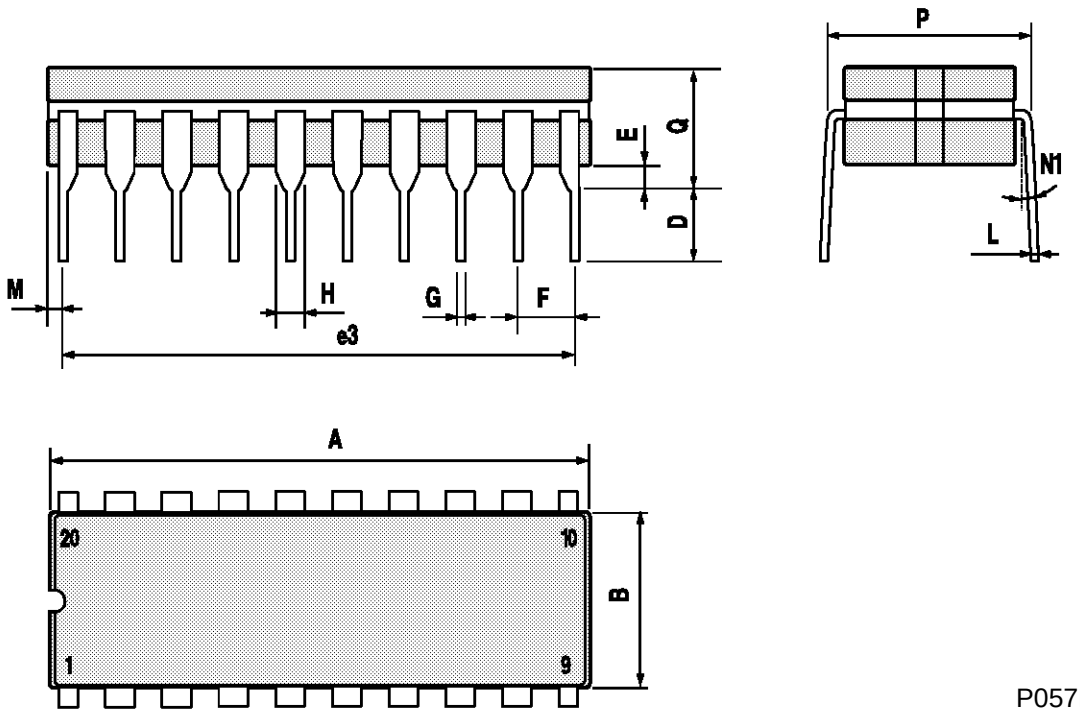
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.254			0.010		
B	1.39		1.65	0.055		0.065
b		0.45			0.018	
b1		0.25			0.010	
D			25.4			1.000
E		8.5			0.335	
e		2.54			0.100	
e3		22.86			0.900	
F			7.1			0.280
I			3.93			0.155
L		3.3			0.130	
Z			1.34			0.053



P001J

Ceramic DIP20 MECHANICAL DATA

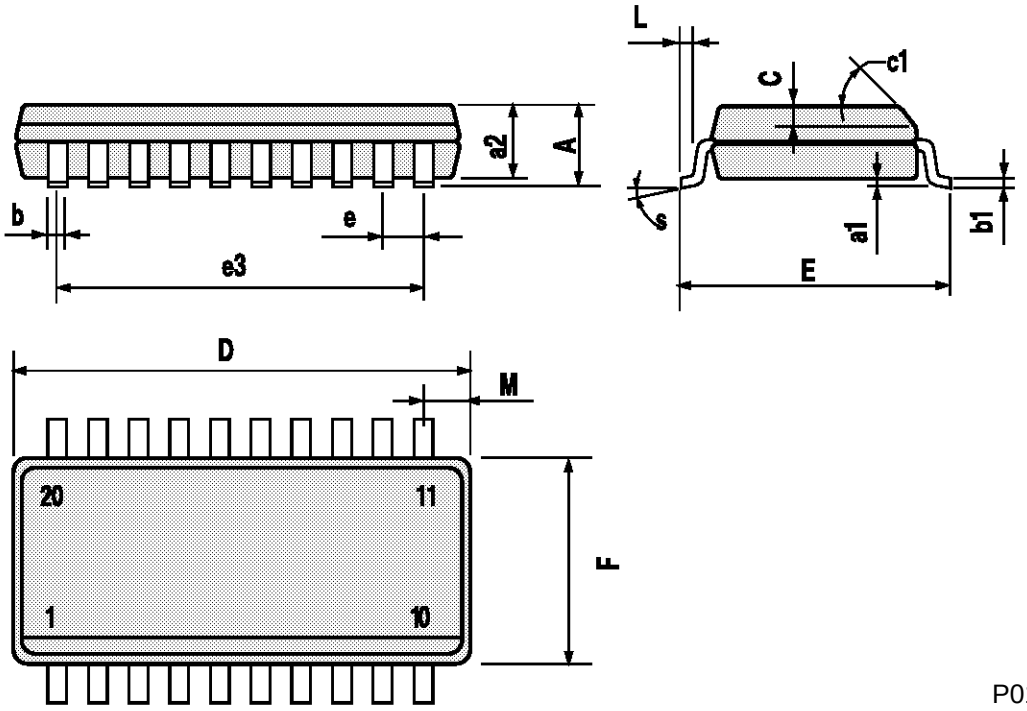
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			25			0.984
B			7.8			0.307
D		3.3			0.130	
E	0.5		1.78	0.020		0.070
e3		22.86			0.900	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
I	1.27		1.52	0.050		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N1	4° (min.), 15° (max.)					
P	7.9		8.13	0.311		0.320
Q			5.71			0.225



P057H

SO20 MECHANICAL DATA

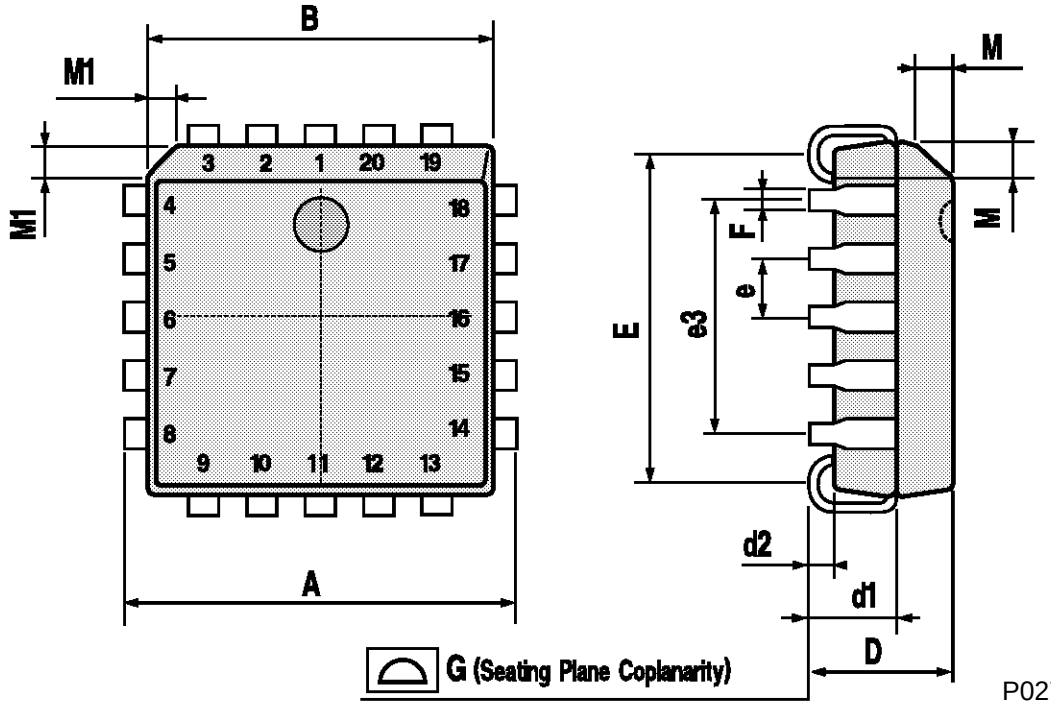
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.10		0.20	0.004		0.007
a2			2.45			0.096
b	0.35		0.49	0.013		0.019
b1	0.23		0.32	0.009		0.012
C		0.50			0.020	
c1	45° (typ.)					
D	12.60		13.00	0.496		0.512
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
e3		11.43			0.450	
F	7.40		7.60	0.291		0.299
L	0.50		1.27	0.19		0.050
M			0.75			0.029
S	8° (max.)					



P013L

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	



P027A