



M74HC593

8 BINARY COUNTER REGISTER WITH INPUT REGISTER (3 STATE)

- HIGH SPEED:
 $f_{MAX} = 20 \text{ MHz (TYP.) at } V_{CC} = 6V$
- LOW POWER DISSIPATION:
 $I_{CC} = 4\mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- SYMMETRICAL OUTPUT IMPEDANCE:
 $I_{OL} = |I_{OH}| = 6\text{mA (MIN) for } \underline{Q_n}$
 $I_{OL} = |I_{OH}| = 4\text{mA (MIN) for } \underline{RCO}$
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \cong t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- PIN AND FUNCTION COMPATIBLE WITH
 74 SERIES 593



ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC593B1R	
SOP	M74HC593M1R	M74HC593RM13TR
TSSOP		M74HC593TTR

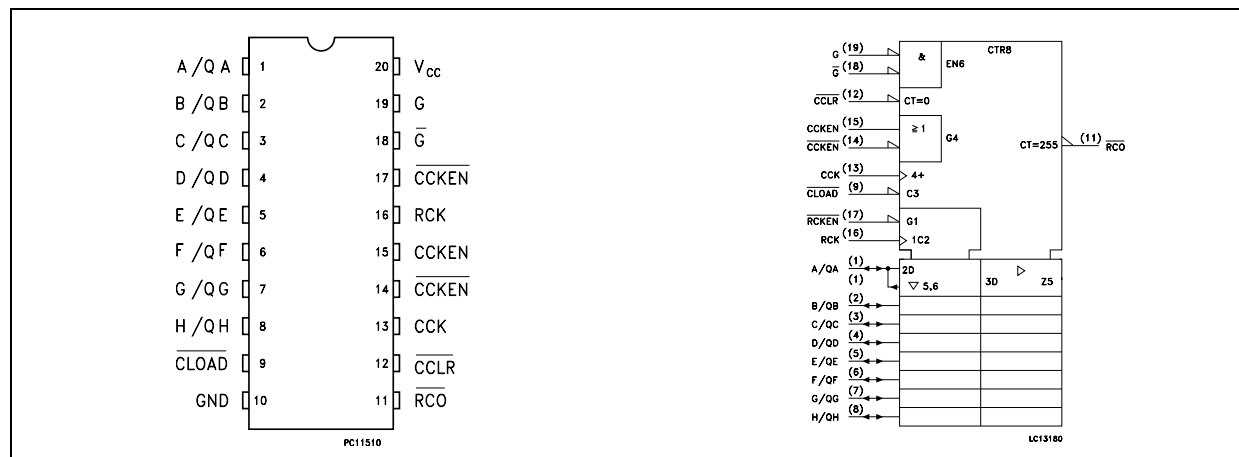
DESCRIPTION

The M74HC593 is an high speed CMOS 8-BIT REGISTER COUNTER (3 STATE) fabricated with silicon gate C²MOS technology. This device consists of a parallel input, 8 bit storage register feeding an 8 bit binary counter. Both the counter and register clocks are positive edge triggered. In addition, the counter has direct load and clear functions. Expansions is easily

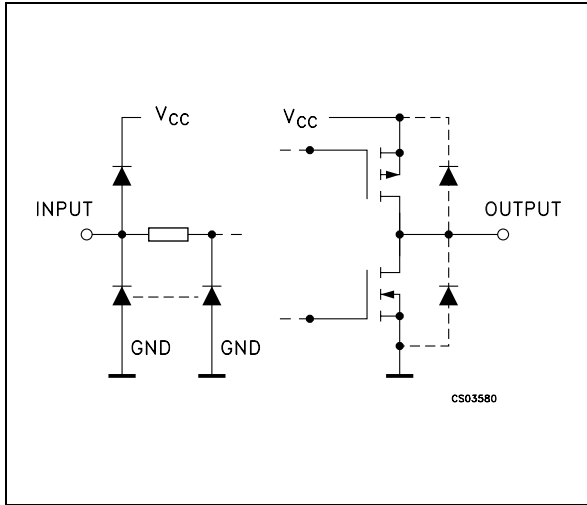
accomplished by connecting \overline{RCO} of first stage to the count enable \overline{CCKEN} , of the second stage etc. The M74HC593 comes in a 20 pin package and has 3 state I/O, which provides parallel counter outputs.

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

PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

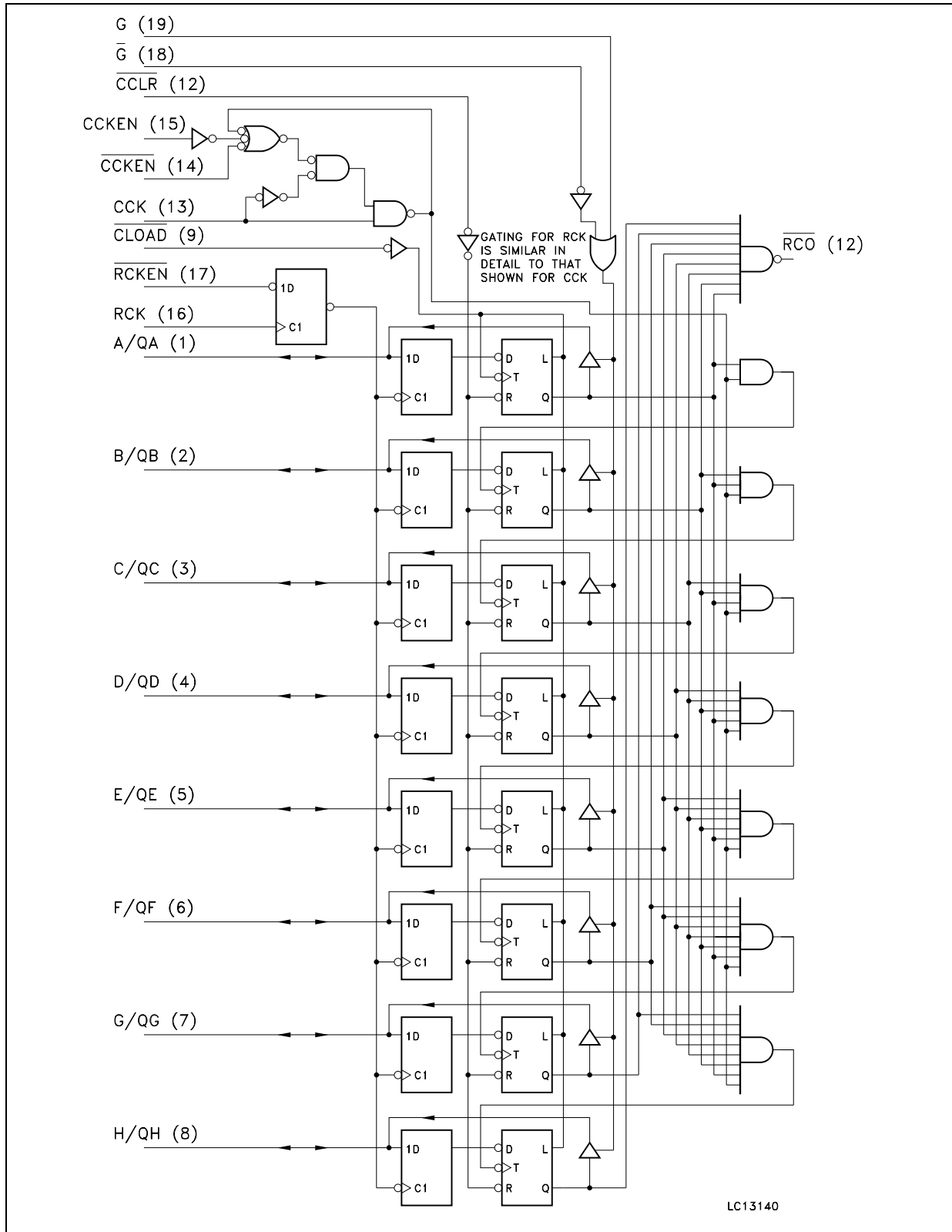
PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3, 4, 5, 6, 7, 8	A/QA to H/QH	Binary Outputs
9	CLOAD	Counter Clock Load Input
11	RCO	Ripple Carry Output
12	CCLR	Counter Clear Input
13	CCK	Counter Clock Input
14, 15	CCKEN, CCKEN	Counter Clock Enable Inputs
16	RCK	Register Clock Input
17	RCKEN	Register Clock Enable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

TRUTH TABLE

INPUTS									FUNCTION
G	\bar{G}	CCLR	CCKEN	\overline{CCKEN}	CCK	CLOAD	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
 RCO = QA'·QB'·QC'·QD'·QE'·QF'·QG'·QH' (QA' to QH' : INTERNAL OUTPUTS OF THE COUNTER)

LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

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 (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

(*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 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	-55 to 125	°C	
t_r, t_f	Input Rise and Fall Time	$V_{CC} = 2.0V$	0 to 1000	ns
		$V_{CC} = 4.5V$	0 to 500	ns
		$V_{CC} = 6.0V$	0 to 400	ns

DC SPECIFICATION

Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				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 (for RCO Output)	2.0	I _O =-20 μA	1.9	2.0		1.9		1.9		V
		4.5	I _O =-20 μA	4.4	4.5		4.4		4.4		
		6.0	I _O =-20 μA	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 (for QA to QH Outputs)	2.0	I _O =-20 μA	1.9	2.0		1.9		1.9		V
		4.5	I _O =-20 μA	4.4	4.5		4.4		4.4		
		6.0	I _O =-20 μA	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 (for RCO Output)	2.0	I _O =20 μA		0.0	0.1		0.1		0.1	V
		4.5	I _O =20 μA		0.0	0.1		0.1		0.1	
		6.0	I _O =20 μA		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 (for QA to QH Outputs)	2.0	I _O =20 μA		0.0	0.1		0.1		0.1	V
		4.5	I _O =20 μA		0.0	0.1		0.1		0.1	
		6.0	I _O =20 μA		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}	High Impedance Output Leakage Current	6.0	V _I = V _{IH} or V _{IL} V _O = V _{CC} or GND			± 0.5		± 5		± 10	μA
I _{CC}	Quiescent Supply Current	6.0	V _I = V _{CC} or GND			4		40		80	μA

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

Symbol	Parameter	Test Condition			Value						Unit	
		V _{CC} (V)	C _L (pF)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t _{TLH} t _{THL}	Output Transition Time(RCO)	2.0	50			30	75		95		115	ns
		4.5			8	15		19		23		
		6.0			7	13		16		20		
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 (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 (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 - 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 (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 (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 (RCK - 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}	High Impedance 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	
t _{PLZ} t _{PHZ}	High Impedance 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	

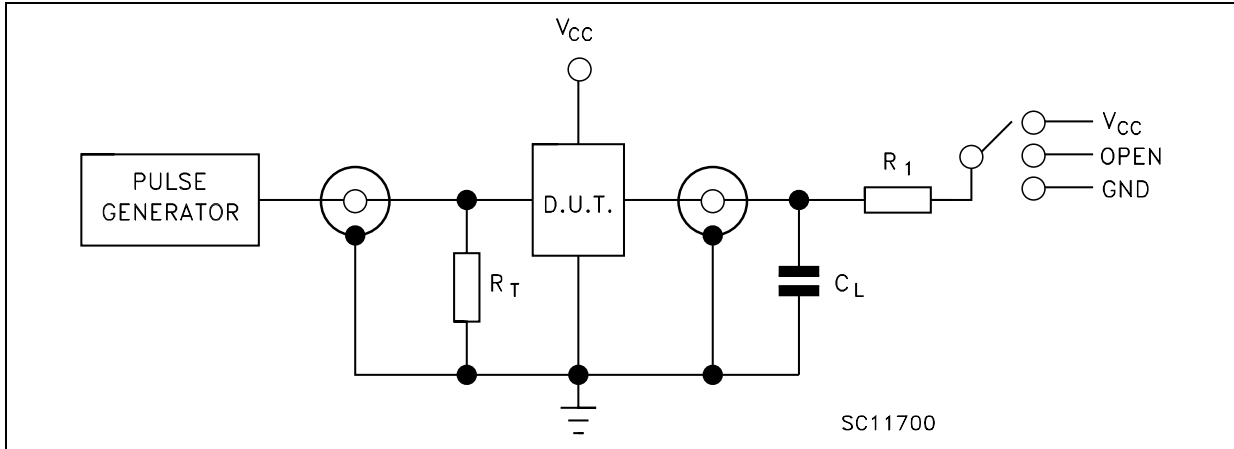
Symbol	Parameter	Test Condition			Value						Unit	
		V _{CC} (V)	C _L (pF)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
f _{MAX}	Maximum Clock Frequency	2.0	50		5.4	4		4.4		3.6		MHz
		4.5		27	17		22		18			
		6.0		32	20		26		21			
t _{W(H)} t _{W(L)}	Minimum Pulse 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 (CCLR, 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 (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 (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 - 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	ns
		4.5				0		0		0		
		6.0				0		0		0		
t _{REM}	Minimum Removal Time (CCLR, CLOAD)	2.0	50				5		5		5	ns
		4.5				5		5		5		
		6.0				5		5		5		

CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition			Value						Unit	
		V _{CC} (V)			T _A = 25°C			-40 to 85°C		-55 to 125°C		
					Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C _{IN}	Input Capacitance					5	10		10		10	pF
C _{PD}	Power Dissipation Capacitance (note 1)					19						pF

1) 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(oper)} = C_{PD} × V_{CC} × f_{IN} + I_{CC}

TEST CIRCUIT

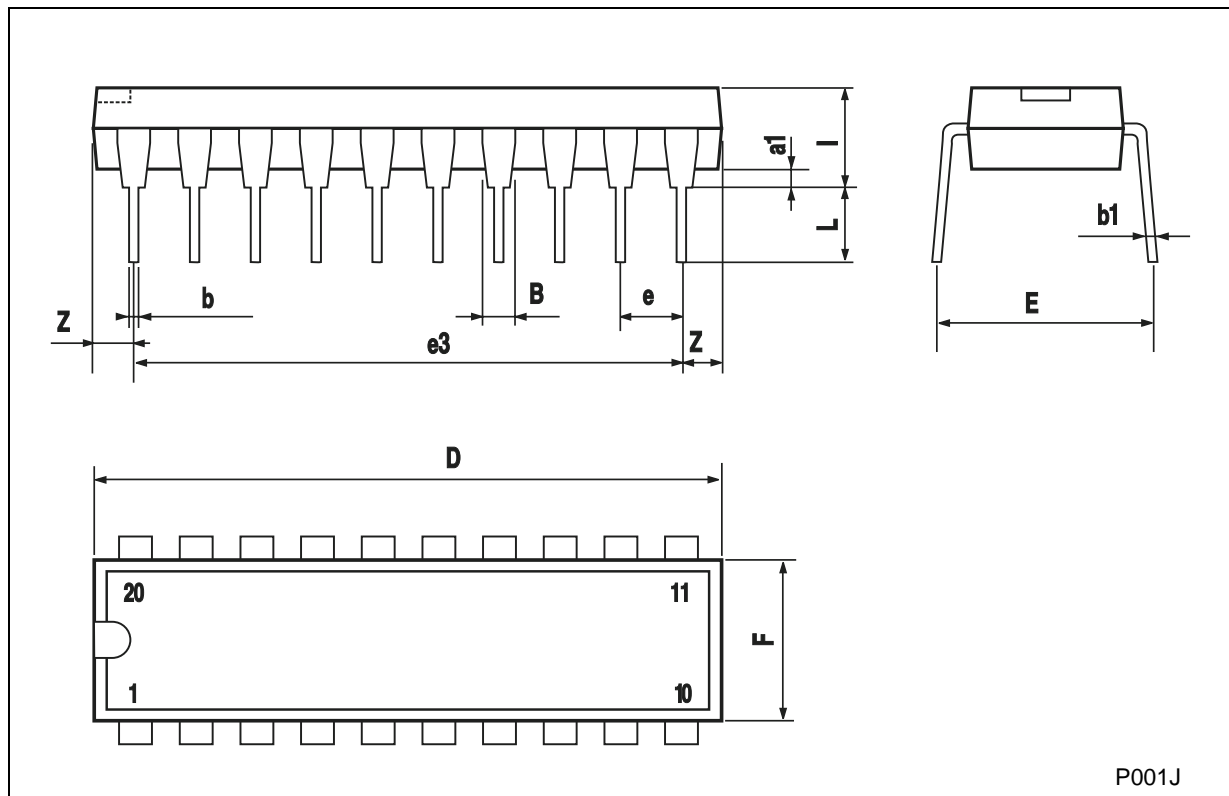


TEST	SWITCH
t_{PLH} , t_{PHL}	Open
t_{PZL} , t_{PLZ}	V_{CC}
t_{PZH} , t_{PHZ}	GND

$C_L = 50\text{pF}/150\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_1 = 1\text{K}\Omega$ or equivalent
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Plastic DIP-20 (0.25) MECHANICAL DATA

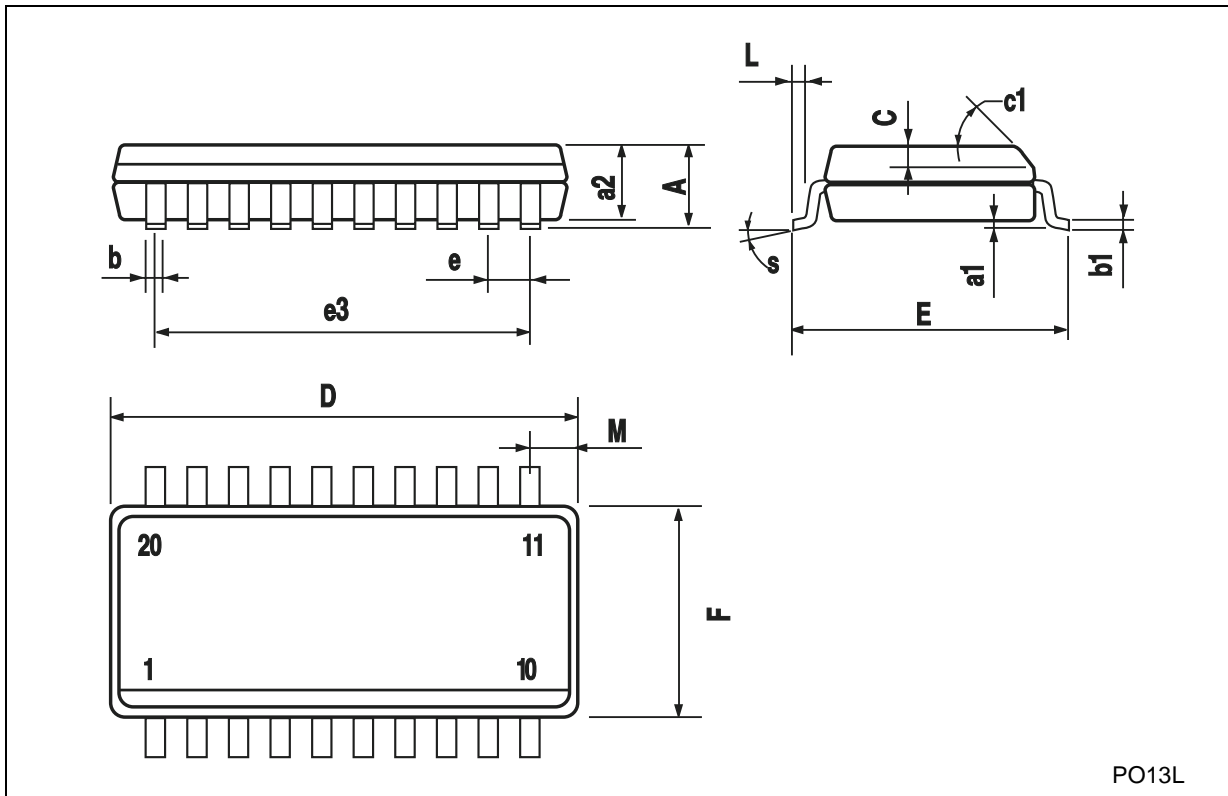
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.254			0.010		
B	1.39		1.65	0.055		0.065
b		0.45			0.018	
b1		0.25			0.010	
D			25.4			1.000
E		8.5			0.335	
e		2.54			0.100	
e3		22.86			0.900	
F			7.1			0.280
I			3.93			0.155
L		3.3			0.130	
Z			1.34			0.053



P001J

SO-20 MECHANICAL DATA

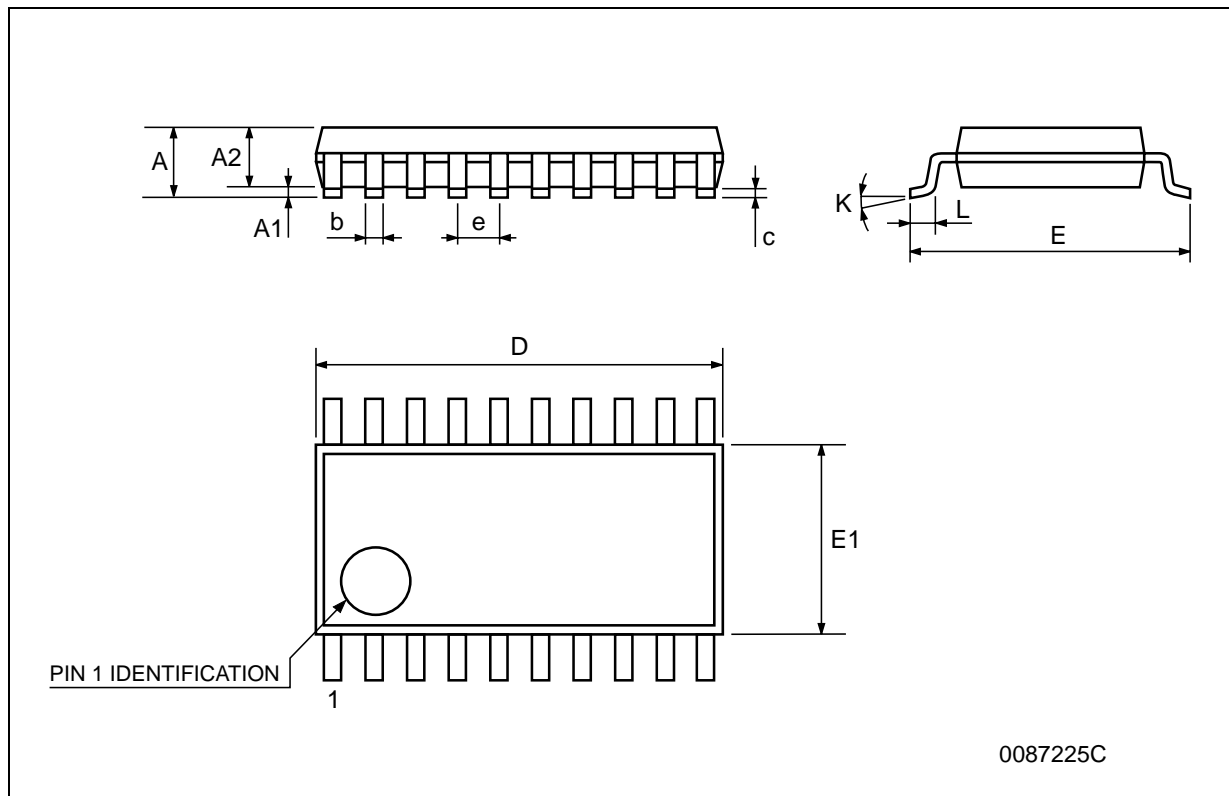
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.2	0.004		0.008
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.012
C		0.5			0.020	
c1	45° (typ.)					
D	12.60		13.00	0.496		0.512
E	10.00		10.65	0.393		0.419
e		1.27			0.050	
e3		11.43			0.450	
F	7.40		7.60	0.291		0.300
L	0.50		1.27	0.020		0.050
M			0.75			0.029
S	8° (max.)					



PO13L

TSSOP20 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0089
D	6.4	6.5	6.6	0.252	0.256	0.260
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



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