

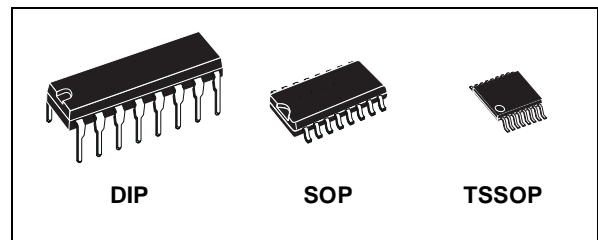
## DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

- HIGH SPEED :  
 $t_{PD} = 22 \text{ ns (TYP.) at } V_{CC} = 6V$
- LOW POWER DISSIPATION:  
 STAND BY STATE :  
 $I_{CC} = 4\mu A \text{ (MAX.) at } T_A = 25^\circ C$   
 ACTIVE STATE :  
 $I_{CC} = 700\mu A \text{ (TYP.) at } V_{CC} = 6V$
- HIGH NOISE IMMUNITY:  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 4mA \text{ (MIN.)}$
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:  
 $V_{CC} \text{ (OPR)} = 2V \text{ to } 6V$
- WIDE OUTPUT PULSE WIDTH RANGE :  
 $t_{WOUT} = 120 \text{ ns} \sim 60 \text{ s OVER AT } V_{CC} = 4.5 V$
- PIN AND FUNCTION COMPATIBLE WITH  
 74 SERIES 423

### DESCRIPTION

The M74HC423 is an high speed CMOS MONOSTABLE MULTIVIBRATOR fabricated with silicon gate C<sup>2</sup>MOS technology.

There are two trigger inputs, A INPUT (negative edge) and B INPUT (positive edge). These inputs are valid for slow rising/falling signals, ( $t_r = t_f = 1 \text{ sec}$ ). After triggering the output maintains the MONOSTABLE state for the time period



### ORDER CODES

PACKAGE	TUBE	T & R
DIP	M74HC423B1R	
SOP	M74HC423M1R	M74HC423RM13TR
TSSOP		M74HC423TTR

determined by the external resistor Rx and capacitor Cx.

The pulse width constant is  $K \approx 0.46$ .

Taking CLR low breaks this MONOSTABLE STATE. If the next trigger pulse occurs during the MONOSTABLE period it makes the MONOSTABLE period longer. Limit for values of Cx and Rx :

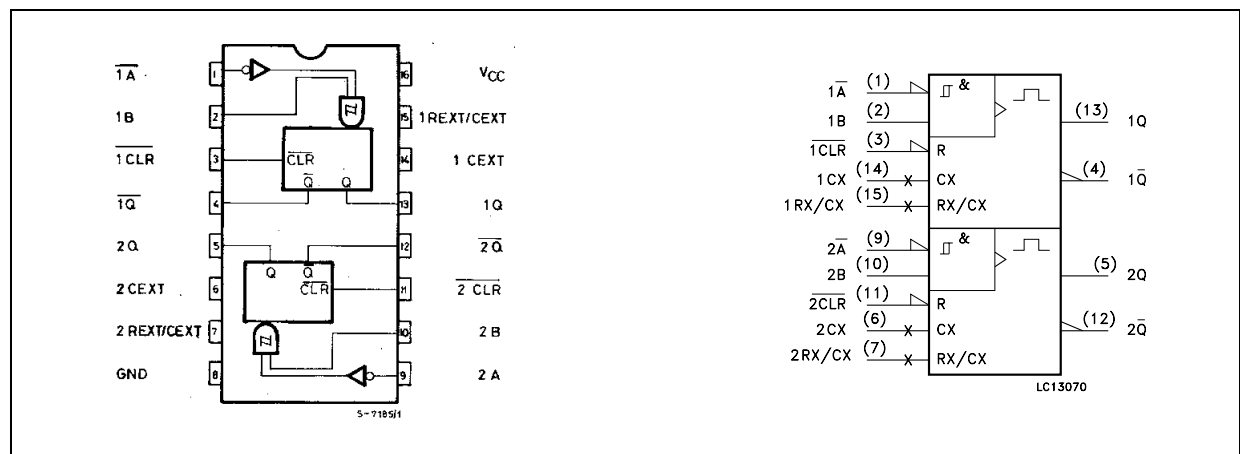
Cx : NO LIMIT

Rx :  $V_{CC} < 3.0V$  5KΩ to 1MΩ

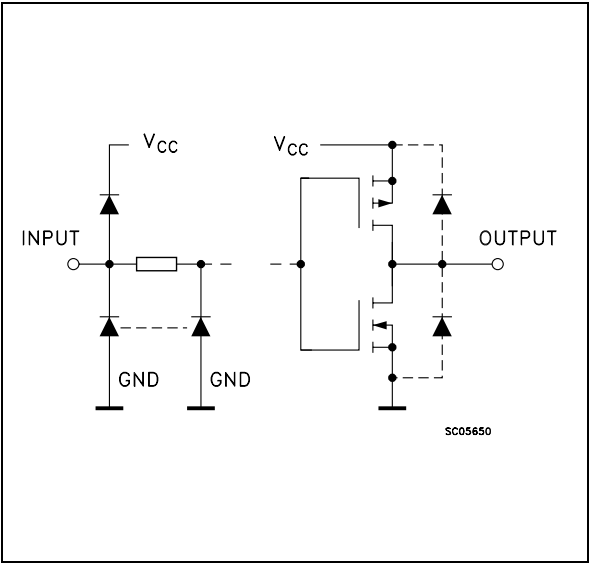
$V_{CC} \geq 3.0V$  1KΩ to 1MΩ

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

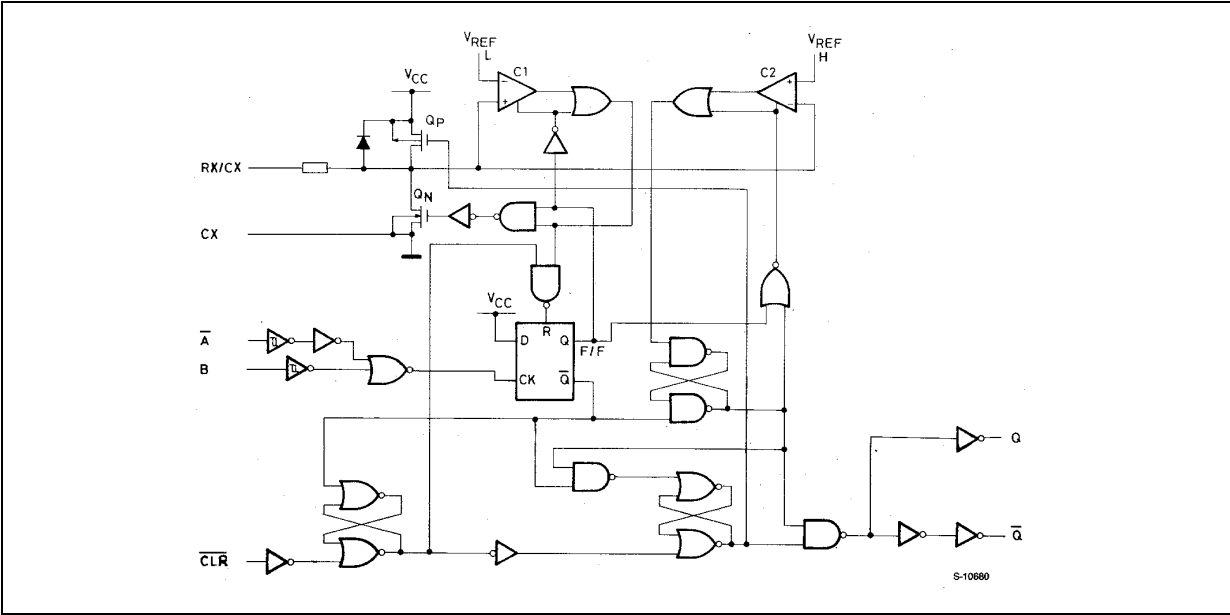
PIN No	SYMBOL	NAME AND FUNCTION
1,9	1A, 2A	Trigger Inputs (Negative Edge Triggered)
2, 10	1B, 2B	Trigger Inputs (Positive Edge Triggered)
3, 11	1 CLR 2 CLR	Direct Reset (Active LOW)
4, 12	1Q, 2Q	Outputs (Active Low)
7	2R <sub>X</sub> /C <sub>X</sub>	External Resistor Capacitor Connection
13, 5	1Q, 2Q	Outputs (Active High)
14, 6	1C <sub>X</sub> 2C <sub>X</sub>	External Capacitor Connection
15	1R <sub>X</sub> /C <sub>X</sub>	External Resistor Capacitor Connection
8	GND	Ground (0V)
16	Vcc	Positive Supply Voltage

TRUTH TABLE

INPUTS			OUTPUTS		NOTE
A	B	CLR	Q	Q	
	H	H			OUTPUT ENABLE
X	L	H	L	H	INHIBIT
H	X	H	L	H	INHIBIT
L		H			OUTPUT ENABLE
X	X	L	L	H	INHIBIT

X : Don't Care

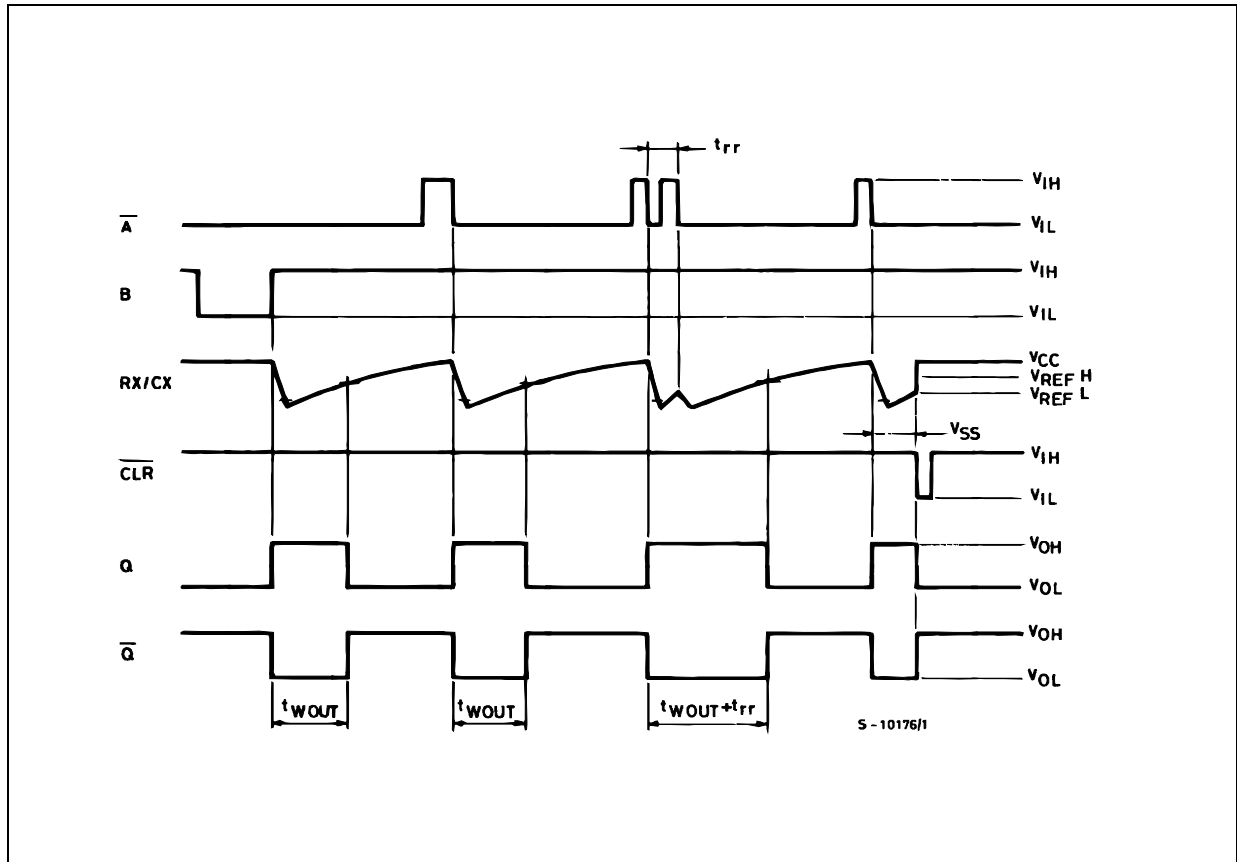
SYSTEM DIAGRAM



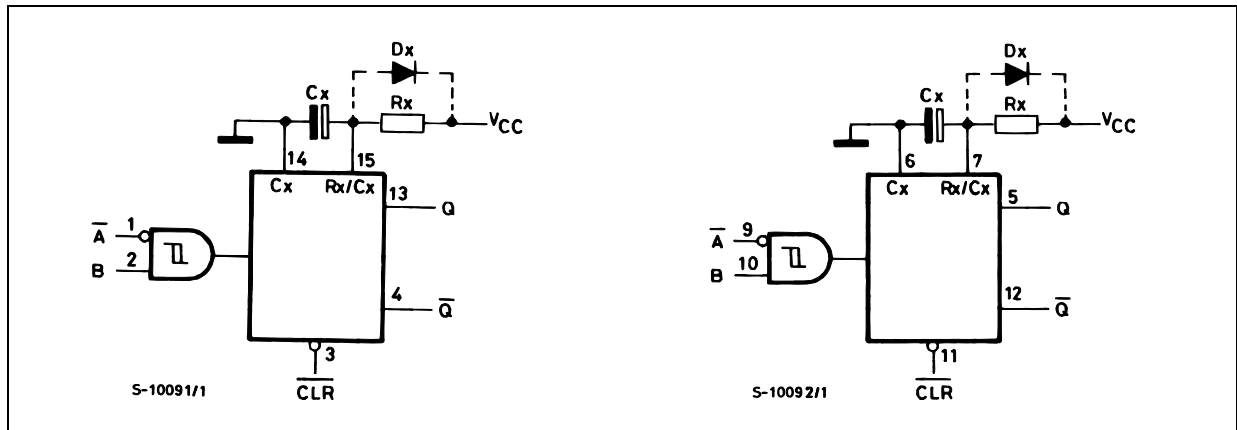
This logic diagram has not be used to estimate propagation delays



## TIMING CHART



## BLOCK DIAGRAM



1) Cx, Rx, Dx are external components.

(2) Dx is a clamping diode.

The external capacitor is charged to V<sub>CC</sub> in the stand-by-state, i.e. no trigger. When the supply voltage is turned off Cx is discharged mainly through an internal parasitic diode (see figures). If Cx is sufficiently large and V<sub>CC</sub> decreases rapidly, there will be some possibility of damaging the I.C. with a surge current or latch-up. If the voltage supply filter capacitor is large enough and V<sub>CC</sub> decreases slowly, the surge current is automatically limited and damage to the I.C. is avoided. The maximum forward current of the parasitic diode is approximately 20 mA. In cases where Cx is large the time taken for the supply voltage to fall to 0.4 V<sub>CC</sub> can be calculated as follows:

$$t_f \geq (V_{CC} - 0.7) \times Cx / 20\text{mA}$$

In cases where  $t_f$  is too short an external clamping diode is required to protect the I.C. from the surge current.

## FUNCTIONAL DESCRIPTION

### STAND-BY STATE

The external capacitor,  $C_x$ , is fully charged to  $V_{CC}$  in the stand-by state. Hence, before triggering, transistor  $Q_p$  and  $Q_n$  (connected to the  $R_x/C_x$  node) are both turned-off. The two comparators that control the timing and the two reference voltage sources stop operating. The total supply current is therefore only leakage current.

### TRIGGER OPERATION

Triggering occurs when :

- 1 st) A is "LOW" and B has a falling edge;
- 2 nd) B is "HIGH" and A has a rising edge;
- 3 rd) A is "LOW" and B is HIGH and C1 has a rising edge;

After the multivibrator has been retriggered comparator C1 and C2 start operating and  $Q_n$  is turned on.  $C_x$  then discharges through  $Q_n$ . The voltage at the node  $R/C$  external falls.

When it reaches  $V_{REFL}$  the output of comparator C1 becomes low. This in turn reset the flip-flop and  $Q_n$  is turned off.

At this point C1 stops functioning but C2 continues to operate.

The voltage at  $R/C$  external begins to rise with a time constant set by the external components  $R_x$ ,  $C_x$ .

Triggering the multivibrator causes  $Q$  to go high after internal delay due to the flip-flop and the gate.  $Q$  remains high until the voltage at  $R/C$  external rises again to  $V_{REFH}$ . At this point C2

output goes low and  $O$  goes low. C2 stop operating. That means that after triggering when the voltage  $R/C$  external returns to  $V_{REFH}$  the multivibrator has returned to its MONOSTABLE STATE. In the case where  $R_x \cdot C_x$  are large enough and the discharge time of the capacitor and the delay time in the I.C. can be ignored, the width of the output pulse  $t_w$  (out) is as follows :

$$t_w(OUT) = 0.46 C_x \cdot R_x$$

### RE - TRIGGERED OPERATION

When a second trigger pulse follows the first its effect will depend on the state of the multivibrator. If the capacitor  $C_x$  is being charged the voltage level of  $R/C$  external falls to  $V_{REFL}$  again and  $Q$  remains High i.e. the retrigger pulse arrives in a time shorter than the period  $R_x \cdot C_x$  seconds, the capacitor charging time constant. If the second trigger pulse is very close to the initial trigger pulse it is ineffective ; i.e. the second trigger must arrive in the capacitor discharge cycle to be ineffective; Hence the minimum time for a second trigger to be effective depends on  $V_{CC}$  and  $C_x$

### RESET OPERATION

$CL$  is normally high. If  $CL$  is low, the trigger is not effective because  $Q$  output goes low and trigger control flip-flop is reset.

Also transistor  $Op$  is turned on and  $C_x$  is charged quickly to  $V_{CC}$ . This means if  $CL$  input goes low the IC becomes waiting state both in operating and non operating state.

## 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	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Current	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	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

(\*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Value	Unit
V <sub>CC</sub>	Supply Voltage		2 to 6	V
V <sub>I</sub>	Input Voltage		0 to V <sub>CC</sub>	V
V <sub>O</sub>	Output Voltage		0 to V <sub>CC</sub>	V
T <sub>op</sub>	Operating Temperature		-55 to 125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Time	V <sub>CC</sub> = 2.0V	0 to 1000	ns
		V <sub>CC</sub> = 4.5V	0 to 500	ns
		V <sub>CC</sub> = 6.0V	0 to 400	ns
C <sub>x</sub>	External Capacitor		NO LIMITATION	pF
R <sub>x</sub>	External Resistor	V <sub>cc</sub> < 3V	5K to 1M	Ω
		V <sub>cc</sub> ≥ 3V	1K to 1M	

The Maximum allowable values of Cx and Rx are a function of leakage of capacitor Cx, the leakage of device and leakage due to the board layout and surface resistance. Susceptibility to externally induced noise may occur for  $R_x > 1M\Omega$

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value						Unit		
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C			
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.	
V <sub>IH</sub>	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 <sub>IL</sub>	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 <sub>OH</sub>	High Level Output Voltage	2.0	I <sub>O</sub> =-20 μA	1.9	2.0		1.9		1.9		V	
		4.5	I <sub>O</sub> =-20 μA	4.4	4.5		4.4		4.4			
		6.0	I <sub>O</sub> =-20 μA	5.9	6.0		5.9		5.9			
		4.5	I <sub>O</sub> =-4.0 mA	4.18	4.31		4.13		4.10			
		6.0	I <sub>O</sub> =-5.2 mA	5.68	5.8		5.63		5.60			
V <sub>OL</sub>	Low Level Output Voltage	2.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1	V	
		4.5	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1		
		6.0	I <sub>O</sub> =20 μA		0.0	0.1		0.1		0.1		
		4.5	I <sub>O</sub> =4.0 mA		0.17	0.26		0.33		0.40		
		6.0	I <sub>O</sub> =5.2 mA		0.18	0.26		0.33		0.40		
I <sub>I</sub>	Input Leakage Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			± 0.1		± 1		± 1	μA	
I <sub>I</sub>	R/C Terminal Off State Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			± 0.1		± 1		± 1	μA	
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND			4		40		80	μA	
I <sub>CC'</sub>	Active State Supply Current (1)	2.0	V <sub>I</sub> = V <sub>CC</sub> or GND Pin 7 or 15 V <sub>IN</sub> = V <sub>CC</sub> /2		45	200		260		320	μA	
		4.5			500	600		780		960	μA	
		6.0			0.7	1		1.3		1.6	mA	

(1) : Per Circuit

**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

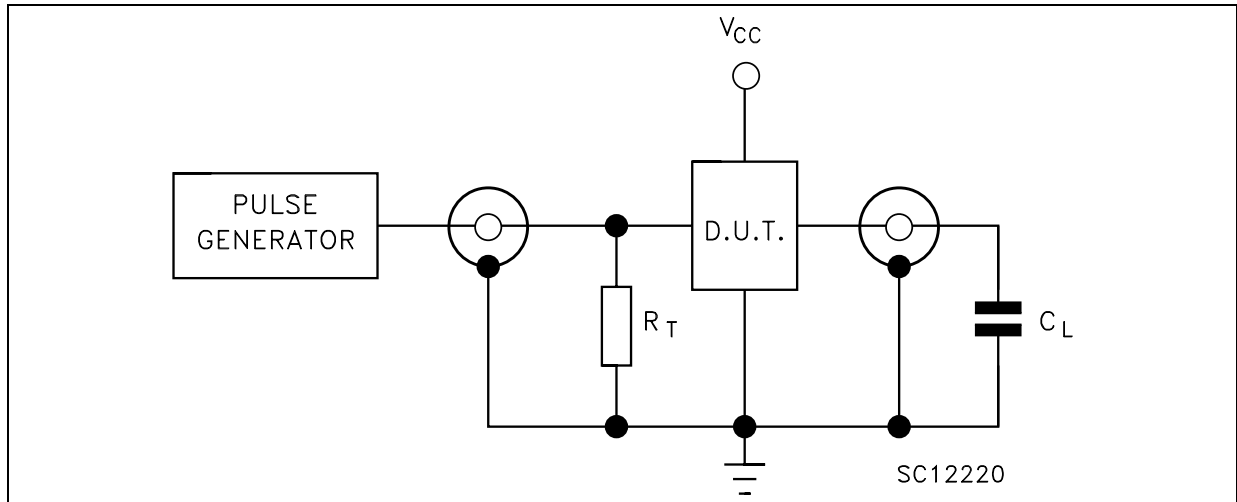
Symbol	Parameter	Test Condition		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t <sub>TLH</sub> t <sub>THL</sub>	Output Transition Time	2.0			30	75		95			ns
		4.5			8	15		19			
		6.0			7	13		16			
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time ( $\overline{A}$ , B - Q, $\overline{Q}$ )	2.0			102	210		265			ns
		4.5			29	42		53			
		6.0			22	36		45			
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time ( $\overline{\text{CLR}}$ - Q, $\overline{Q}$ )	2.0			68	160		200			ns
		4.5			20	32		40			
		6.0			16	27		34			
t <sub>WOUT</sub>	Output Pulse Width	2.0	Cx = 100 pF Rx = 10KΩ		1.3						μs
		4.5			1.1						
		6.0			1						
		2.0	Cx = 0.1μF Rx = 100KΩ		4.8						ms
		4.5			4.6						
		6.0			4.5						
Δt <sub>WOUT</sub>	Output Pulse Width Error Between Circuits in Same Package				±1						%
t <sub>W(H)</sub> t <sub>W(L)</sub>	Minimum Pulse Width	2.0				75		95			ns
		4.5				15		19			
		6.0				13		16			
t <sub>W(L)</sub>	Minimum Pulse Width (CLR)	2.0				75		95			ns
		4.5				15		19			
		6.0				13		16			
t <sub>rr</sub>	Minimum Retrigger Time	2.0	Cx = 100 pF Rx = 10KΩ		325						ns
		4.5			108						
		6.0			78						
		2.0	Cx = 0.1μF Rx = 100KΩ		5						μs
		4.5			1.4						
		6.0			1.2						

**CAPACITIVE CHARACTERISTICS**

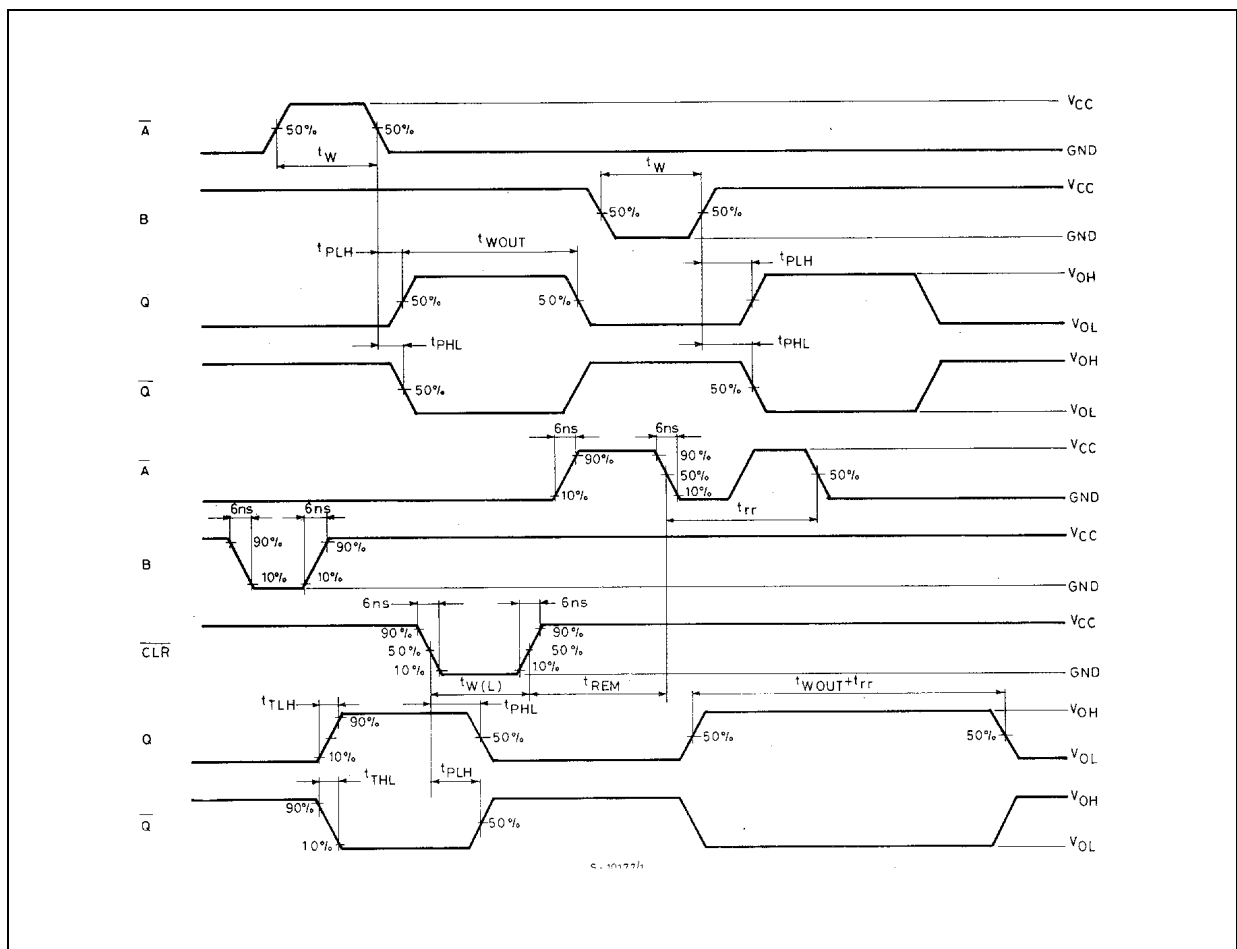
Symbol	Parameter	Test Condition		Value						Unit	
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C <sub>IN</sub>	Input Capacitance	5.0			5	10		10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	5.0			160						pF

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.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC'}$  Duty/100 +  $I_C/2$ (per monostable) ( $I_{CC'}$  : Active Supply current) (Duty : %)

## TEST CIRCUIT

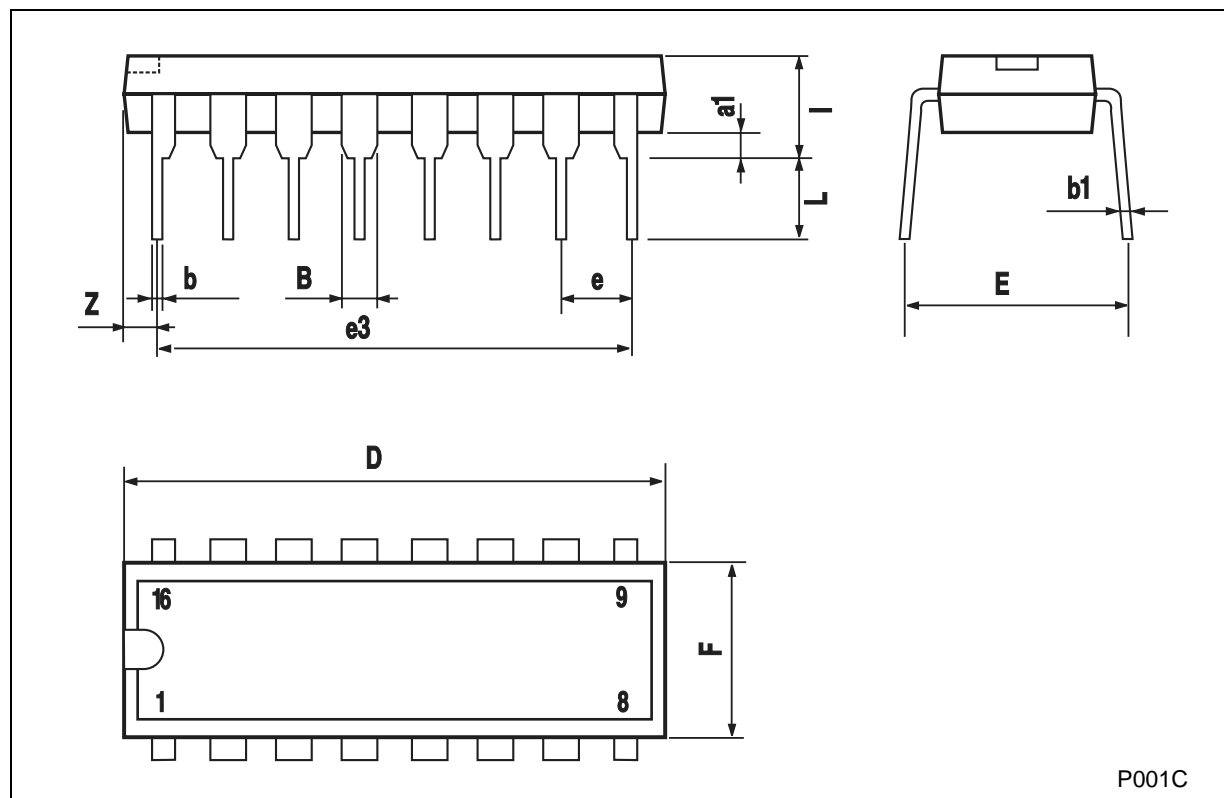


$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

SWITCHING CHARACTERISTICS TEST WAVEFORM ( $f=1\text{MHz}$ ; 50% duty cycle)

## Plastic DIP-16 (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

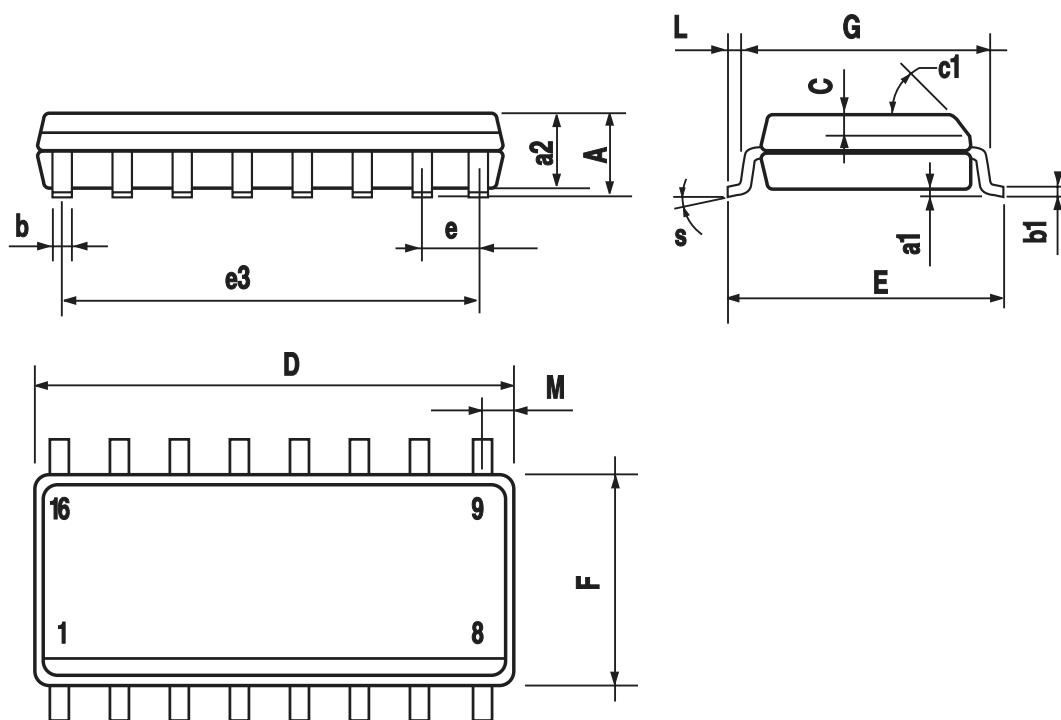


P001C



## SO-16 MECHANICAL DATA

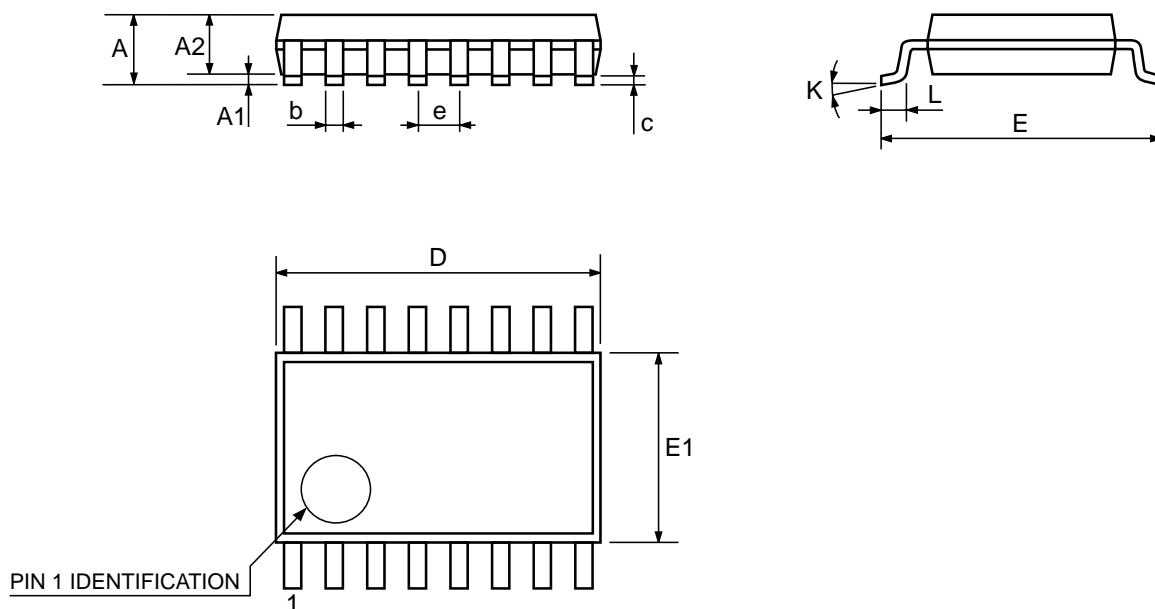
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
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.)					



PO13H

## TSSOP16 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	4.9	5	5.1	0.193	0.197	0.201
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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