



M54HC123

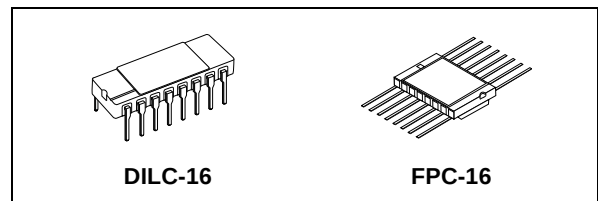
RAD-HARD DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

- HIGH SPEED: $t_{PD} = 23 \text{ ns}$ (TYP.) at $V_{CC} = 6V$
- LOW POWER DISSIPATION:
STAND BY STATE:
 $I_{CC} = 4\mu A$ (MAX.) at $T_A = 25^\circ C$
ACTIVE STATE:
 $I_{CC} = 200\mu A$ (MAX.) at $V_{CC} = 5V$
- HIGH NOISE IMMUNITY:
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:
 $|I_{OH}| = I_{OL} = 4mA$ (MIN)
- BALANCED PROPAGATION DELAYS:
 $t_{PLH} \approx t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
 V_{CC} (OPR) = 2V to 6V
- WIDE OUTPUT PULSE WIDTH RANGE:
 $t_{WOUT} = 120 \text{ ns} \sim 60 \text{ s}$ OVER AT $V_{CC} = 4.5 \text{ V}$
- PIN AND FUNCTION COMPATIBLE WITH 54 SERIES 123
- SPACE GRADE-1: ESA SCC QUALIFIED
- 50 krad QUALIFIED, 100 krad AVAILABLE ON REQUEST
- NO SEL UNDER HIGH LET HEAVY IONS IRRADIATION
- DEVICE FULLY COMPLIANT WITH SCC-9207-006

DESCRIPTION

The M54HC123 is an high speed CMOS MONOSTABLE MULTIVIBRATOR fabricated with silicon gate C²MOS technology.

There are two trigger inputs, A INPUT (negative edge) and B INPUT (positive edge). These inputs



ORDER CODES

PACKAGE	FM	EM
DILC	M54HC123D	M54HC123D1
FPC	M54HC123K	M54HC123K1

are valid for slow rising/falling signals, ($t_r = t_f = 1 \text{ sec}$). The device may also be triggered by using the CLR input (positive-edge) because of the Schmitt-trigger input; after triggering the output maintains the MONOSTABLE state for the time period determined by the external resistor R_X and capacitor C_X . When $C_X \geq 10nF$ and $R_X \geq 10K\Omega$, the output pulse width value is approximately given by the formula: $t_{W(OUT)} = K \cdot C_X \cdot R_X$. ($K \approx 0.45$).

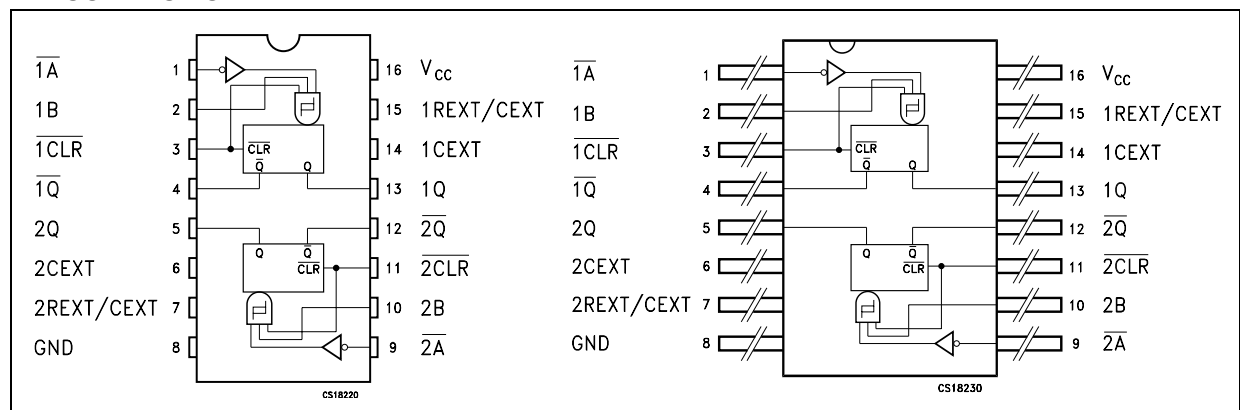
Taking CLR low breaks this MONOSTABLE STATE. If the next trigger pulse occurs during the MONOSTABLE period it makes the MONOSTABLE period longer. Limit for values of C_X and R_X : C_X : NO LIMIT

R_X : $V_{CC} < 3.0V$ 5K Ω to 1M Ω

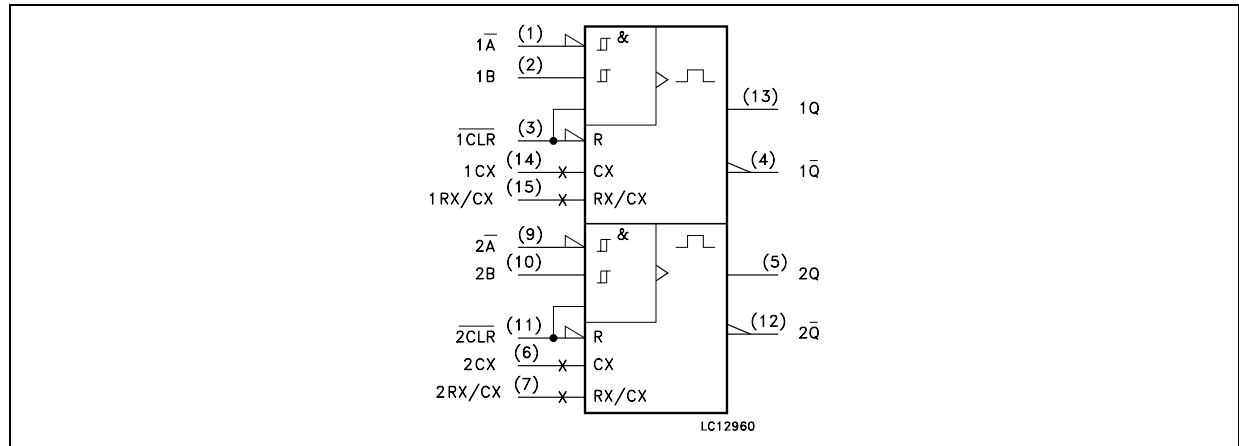
$V_{CC} \geq 3.0V$ 1K Ω to 1M Ω

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

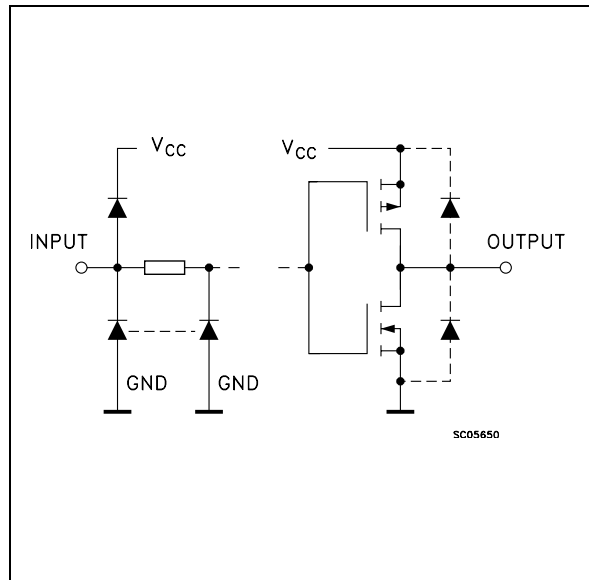
PIN CONNECTION



IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

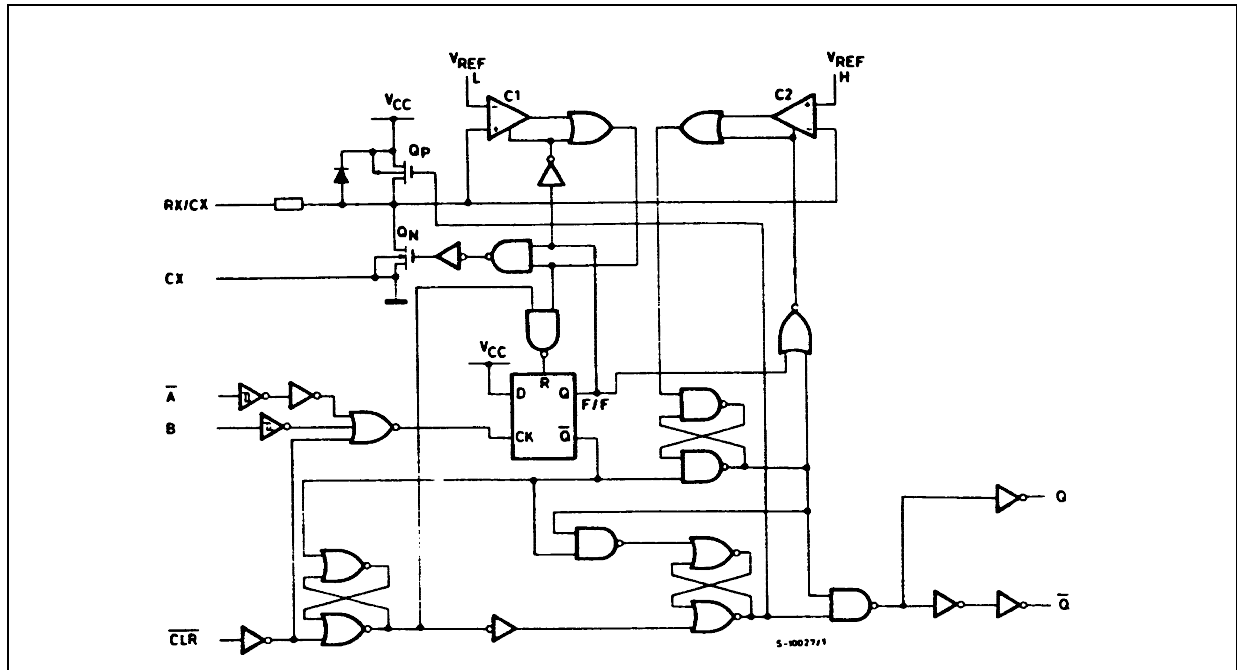
PIN N°	SYMBOL	NAME AND FUNCTION
1,9	1 $\bar{A}$, 2 $\bar{A}$	Trigger Inputs (Negative Edge Triggered)
2, 10	1B, 2B	Trigger Inputs (Positive Edge Triggered)
3, 11	1 $\overline{\text{CLR}}$ 2 $\overline{\text{CLR}}$	Direct Reset LOW and trigger Action at Positive Edge
4, 12	1 $\bar{Q}$, 2 $\bar{Q}$	Outputs (Active Low)
7	2R _X /C _X	External Resistor Capacitor Connection
13, 5	1Q, 2Q	Outputs (Active High)
14, 6	1C _X 2C _X	External Capacitor Connection
15	1R _X /C _X	External Resistor Capacitor Connection
8	GND	Ground (0V)
16	V _{CC}	Positive Supply Voltage

TRUTH TABLE

INPUTS			OUTPUTS		NOTE
$\bar{A}$	B	$\overline{\text{CLR}}$	Q	$\bar{Q}$	
	H	H			OUTPUT ENABLE
X	L	H	L	H	INHIBIT
H	X	H	L	H	INHIBIT
L		H			OUTPUT ENABLE
L	H				OUTPUT ENABLE
X	X	L	L	H	INHIBIT

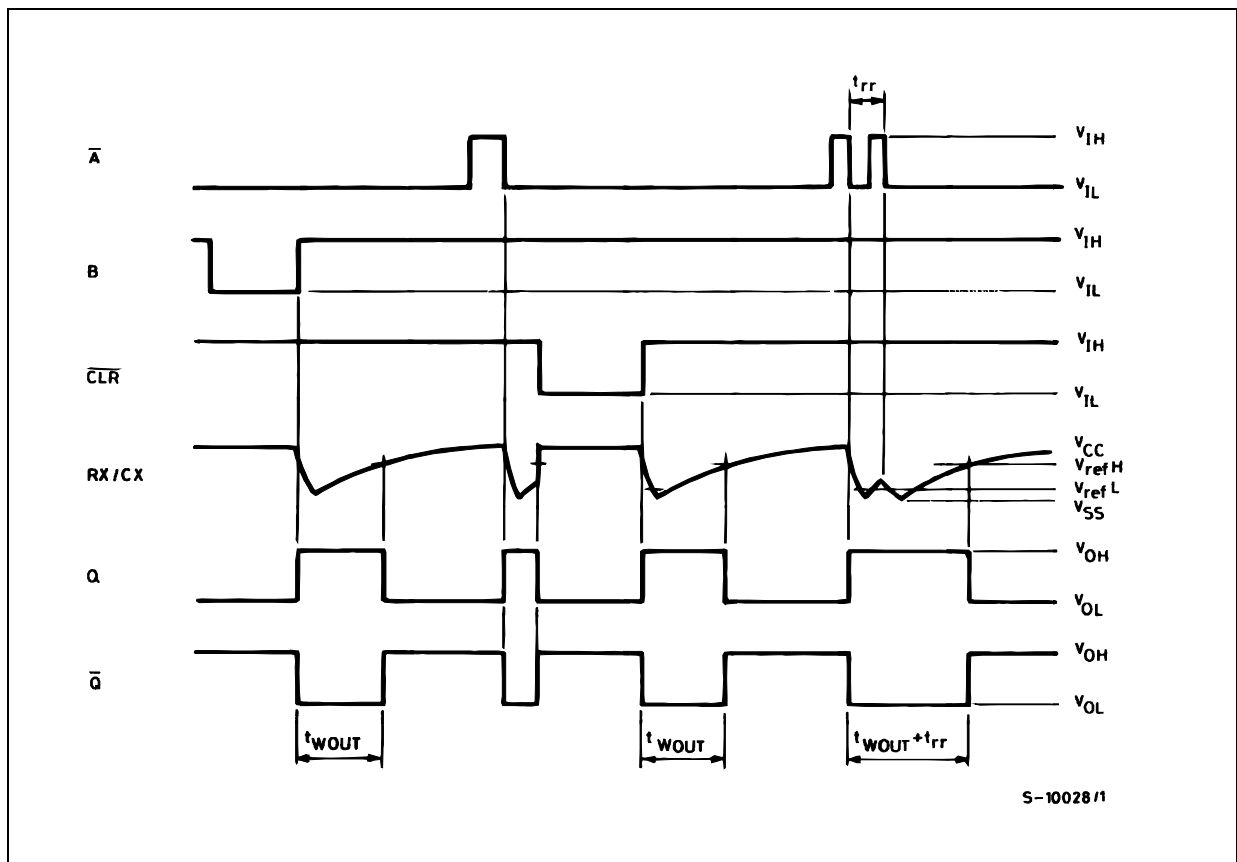
X : Don't Care

SYSTEM DIAGRAM

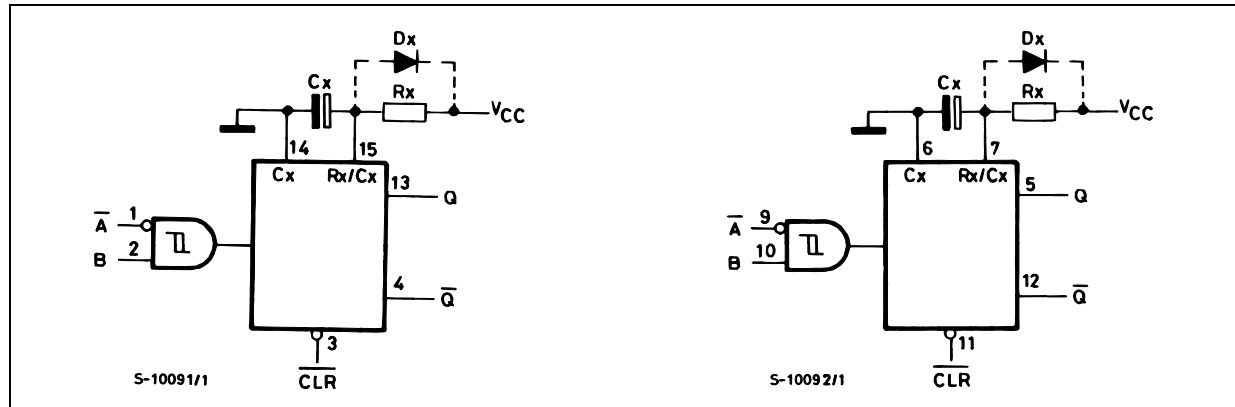


This logic diagram has not been used to estimate propagation delays

TIMING CHART



BLOCK DIAGRAM



(1) Cx, Rx, Dx are external components.

(2) Dx is a clamping diode.

The external capacitor is charged to V_{CC} in the stand-by-state, i.e. no trigger. When the supply voltage is turned off C_x is discharged mainly through an internal parasitic diode (see figures). If C_x is sufficiently large and V_{CC} 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_{CC} decrease 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 C_x is large the time taken for the supply voltage to fall to 0.4 V_{CC} can be calculated as follows:

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

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:

$$t_{w(OUT)} = 0.45 C_x \cdot R_x$$

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 Q_p is turned on and C_x is charged quickly to V_{CC} . This means if C_L 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	± 20	mA
I_{OK}	DC Output Diode Current	± 20	mA
I_O	DC Output Current	± 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	± 50	mA
P_D	Power Dissipation	300	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	265	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

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
C _x	External Capacitor		NO LIMITATION	pF
R _x	External Resistor	V _{CC} < 3V	5K to 1M	Ω
		V _{CC} ≥ 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 _{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		

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 _{OH}	High Level Output Voltage	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 _{OL}	Low Level Output Voltage	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	
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
I _{CC} '	Active State Supply Current (1)	2.0	V _I = V _{CC} or GND Pin 7 or 15 V _{IN} = V _{CC} /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 $t_r = t_f = 6 \text{ ns}$)

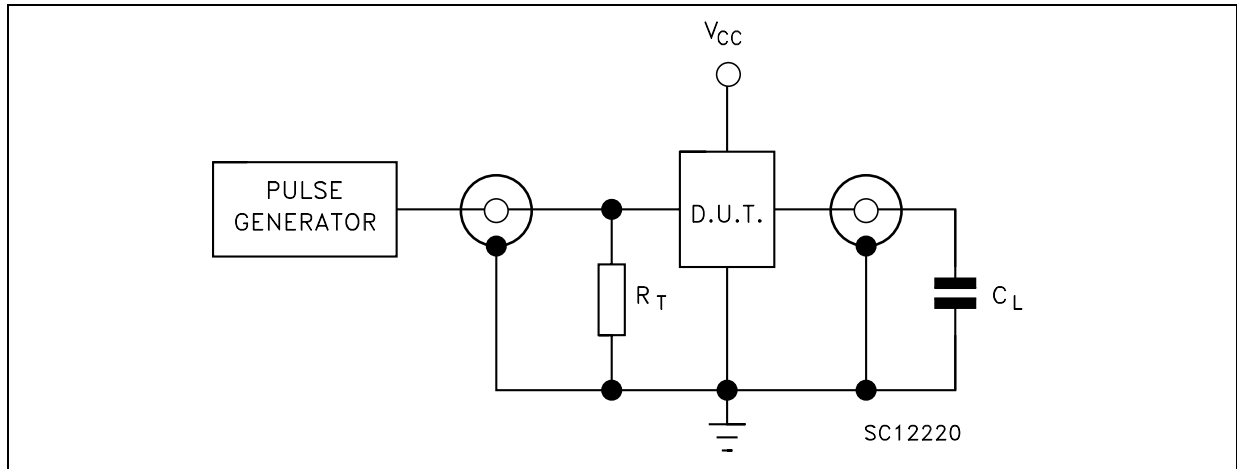
Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
t _{TLH} t _{THL}	Output Transition Time	2.0			30	75		95		110	ns
		4.5			8	15		19		22	
		6.0			7	13		16		19	
t _{PLH} t _{PHL}	Propagation Delay Time (A, B - Q, Q)	2.0			102	210		265		315	ns
		4.5			29	42		53		63	
		6.0			22	36		45		54	
t _{PLH} t _{PHL}	Propagation Delay Time (CLR TRIGGER - Q, Q)	2.0			102	235		295		355	ns
		4.5			31	47		59		71	
		6.0			23	40		50		60	
t _{PLH} t _{PHL}	Propagation Delay Time (CLR - Q, Q)	2.0			68	160		200		240	ns
		4.5			20	32		40		48	
		6.0			16	27		34		41	
t _{WOUT}	Output Pulse Width	2.0	Cx = 100 pF Rx = 10KΩ		1.4						μs
		4.5			1.2						
		6.0			1.1						
		2.0	Cx = 0.1μF Rx = 100KΩ		4.6						ms
		4.5			4.4						
		6.0			4.3						
Δt _{WOUT}	Output Pulse Width Error Between Circuits in Same Package				±1						%
t _{W(H)} t _{W(L)}	Minimum Pulse Width	2.0				75		95		110	ns
		4.5				15		19		22	
		6.0				13		16		19	
t _{W(L)}	Minimum Pulse Width (CLR)	2.0				75		95		110	ns
		4.5				15		19		22	
		6.0				13		16		19	
t _{rr}	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

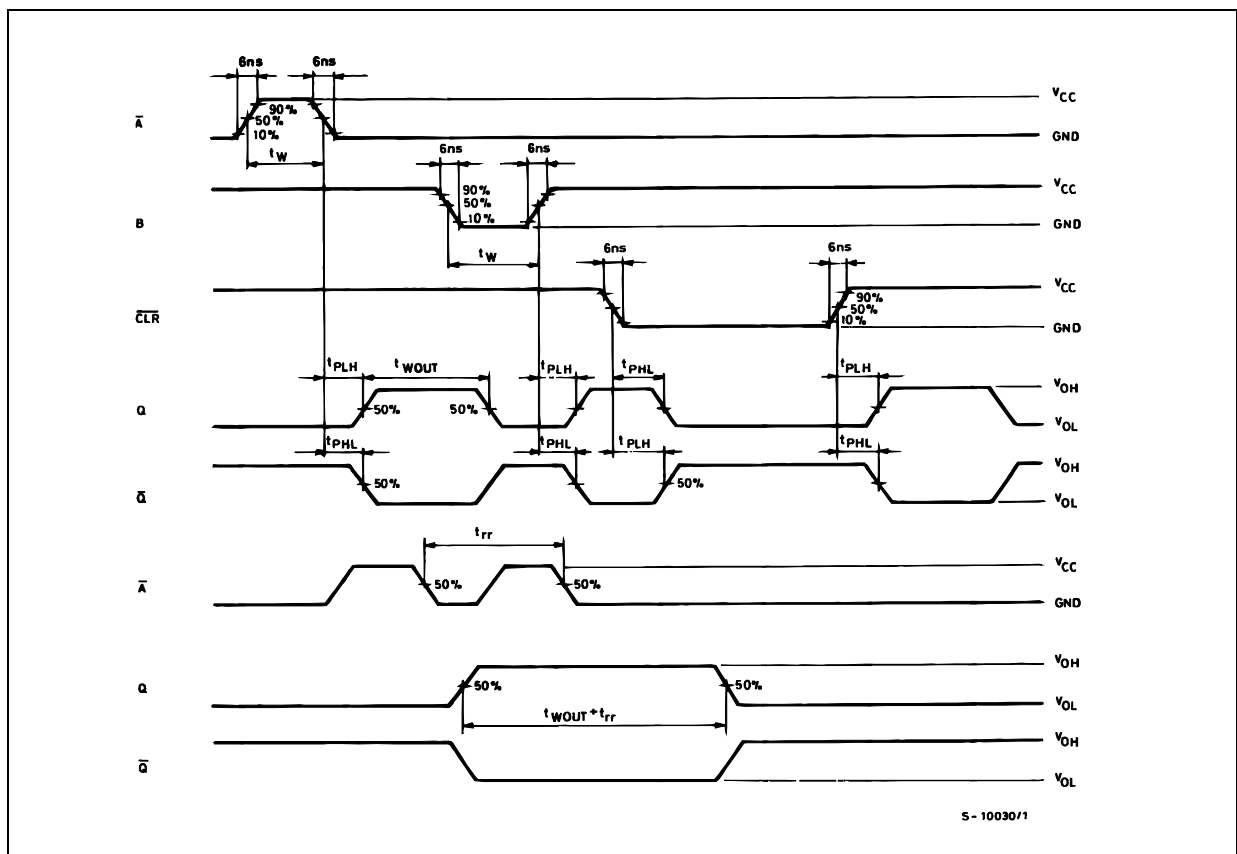
Symbol	Parameter	Test Condition		Value						Unit	
		V _{CC} (V)		T _A = 25°C			-40 to 85°C		-55 to 125°C		
				Min.	Typ.	Max.	Min.	Max.	Min.		Max.
C _{IN}	Input Capacitance	5.0			5	10		10		10	pF
C _{PD}	Power Dissipation Capacitance (note 1)	5.0			162						pF

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

TEST CIRCUIT

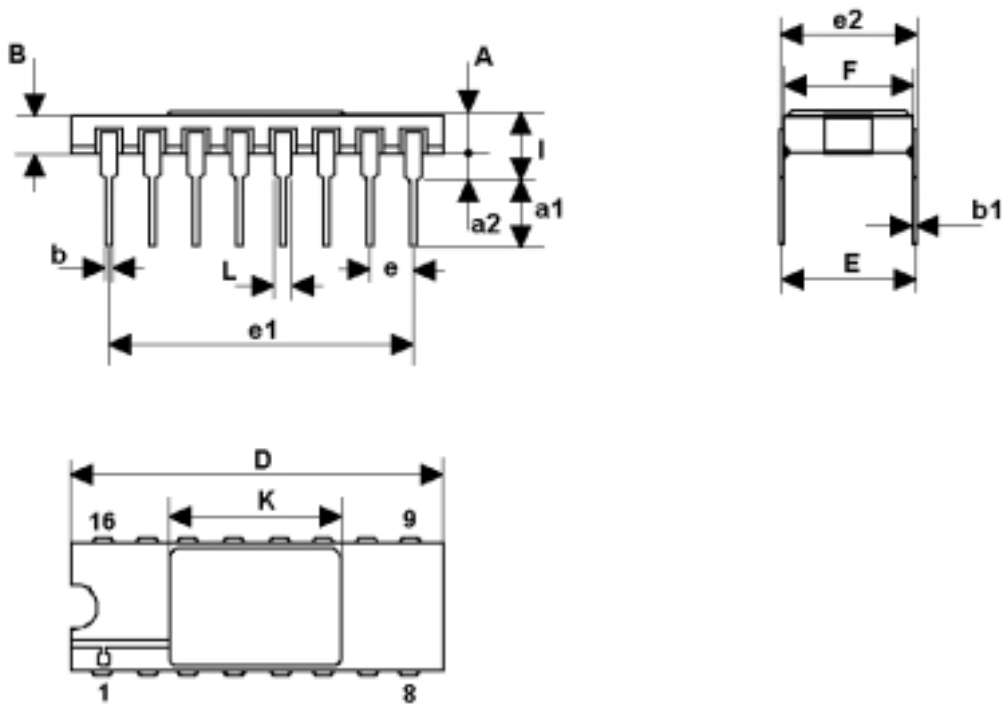


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

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

DILC-16 MECHANICAL DATA

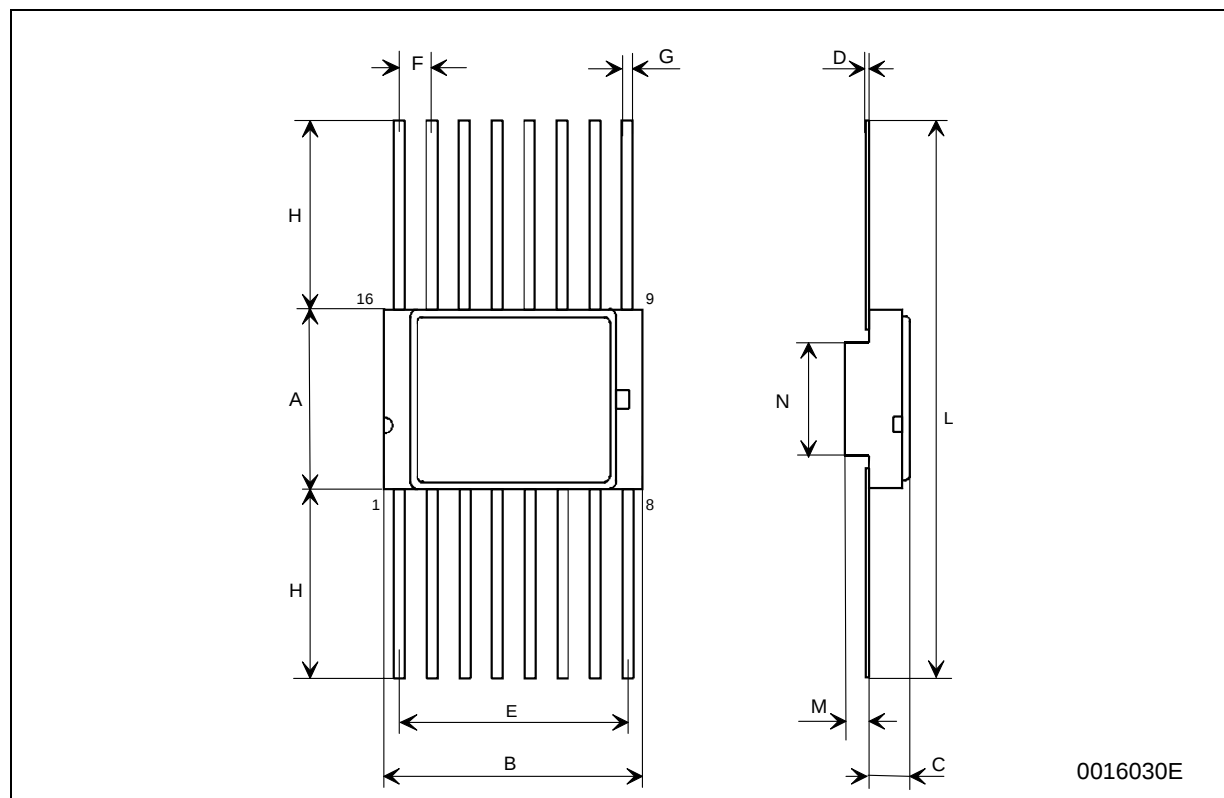
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.1		2.71	0.083		0.107
a1	3.00		3.70	0.118		0.146
a2	0.63	0.88	1.14	0.025	0.035	0.045
B	1.82		2.39	0.072		0.094
b	0.40	0.45	0.50	0.016	0.018	0.020
b1	0.20	0.254	0.30	0.008	0.010	0.012
D	20.06	20.32	20.58	0.790	0.800	0.810
e	7.36	7.62	7.87	0.290	0.300	0.310
e1		2.54			0.100	
e2	17.65	17.78	17.90	0.695	0.700	0.705
e3	7.62	7.87	8.12	0.300	0.310	0.320
F	7.29	7.49	7.70	0.287	0.295	0.303
I			3.83			0.151
K	10.90		12.1	0.429		0.476
L	1.14		1.5	0.045		0.059



0056437F

FPC-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	6.75	6.91	7.06	0.266	0.272	0.278
B	9.76	9.94	10.14	0.384	0.392	0.399
C	1.49		1.95	0.059		0.077
D	0.102	0.127	0.152	0.004	0.005	0.006
E	8.76	8.89	9.01	0.345	0.350	0.355
F		1.27			0.050	
G	0.38	0.43	0.48	0.015	0.017	0.019
H	6.0			0.237		
L	18.75		22.0	0.738		0.867
M	0.33	0.38	0.43	0.013	0.015	0.017
N		4.31			0.170	



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