MOTOROLA

SN54LS/74LS122
SN54LS/74LS123

RETRIGGERABLE MONOSTABLE MULTIVIBRATORS

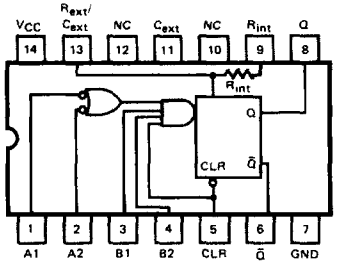
LOW POWER SCHOTTKY

DESCRIPTION — These d-c triggered multivibrators feature pulse width control by three methods. The basic pulse width is programmed by selection of external resistance and capacitance values. The LS122 has an internal timing resistor that allows the circuits to be used with only an external capacitor. Once triggered, the basic pulse width may be extended by retriggering the gated low-level-active (A) or high-level-active (B) inputs, or be reduced by use of the overriding clear.

The LS122 and LS123 have Schmitt trigger inputs to ensure jitter-free triggering from the B input with transition rates as slow as 0.1 millivolt per nanosecond.

- **OVERRIDING CLEAR TERMINATES OUTPUT PULSE**
- **COMPENSATED FOR V_{CC} AND TEMPERATURE VARIATIONS**
- **D-C TRIGGERED FROM ACTIVE-HIGH OR ACTIVE-LOW GATED LOGIC INPUTS**
- **RETRIGGERABLE FOR VERY LONG OUTPUT PULSES, UP TO 100% DUTY CYCLE**
- **INTERNAL TIMING RESISTORS ON LS122**

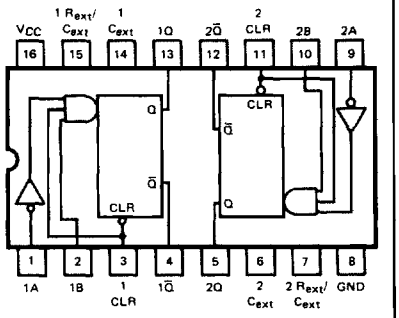
SN54LS/74LS122
(TOP VIEW) (SEE NOTES 1 THRU 4)



J Suffix — Case 632-07 (Ceramic)
N Suffix — Case 646-05 (Plastic)

NC — NO internal connection

SN54LS/74LS123
(TOP VIEW) (SEE NOTES 1 THRU 4)



J Suffix — Case 620-08 (Ceramic)
N Suffix — Case 648-05 (Plastic)

LS122
FUNCTIONAL TABLE

INPUTS					OUTPUTS	
CLEAR	A1	A2	B1	B2	Q	Q̄
L	X	X	X	X	L	H
X	H	H	X	X	L	H
X	X	X	L	X	L	H
X	X	X	X	L	L	H
H	L	X	↑	H	⎍	⎎
H	L	X	H	↑	⎍	⎎
H	X	L	↑	H	⎍	⎎
H	X	L	H	↑	⎍	⎎
H	H	↓	H	H	⎍	⎎
H	↓	↓	H	H	⎍	⎎
H	↓	H	H	H	⎍	⎎
↑	L	X	H	H	⎍	⎎
↑	X	L	H	H	⎍	⎎

LS123
FUNCTIONAL TABLE

INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⎍	⎎
H	↓	H	⎍	⎎
↑	L	H	⎍	⎎

NOTES:

1. An external timing capacitor may be connected between C_{ext} and R_{ext}/C_{ext} (positive).
2. To use the internal timing resistor of the LS122, connect R_{int} to V_{CC}.
3. For improved pulse width accuracy connect an external resistor between R_{ext}/C_{ext} and V_{CC} with R_{int} open-circuited.
4. To obtain variable pulse widths, connect an external variable resistance between R_{int}/C_{ext} and V_{CC}.

TYPICAL APPLICATION DATA

The output pulse t_W is a function of the external components, C_{ext} and R_{ext} or C_{ext} and R_{int} on the LS122. For values of $C_{ext} \geq 1000$ pF, the output pulse at $V_{CC} = 5.0$ V and $V_{RC} = 5.0$ V (see Figures 1, 2, and 3) is given by

$t_W = K\, R_{ext}\, C_{ext}$ where K is nominally 0.45

If C_{ext} is on pF and R_{ext} is in kΩ then t_W is in nanoseconds.

The C_{ext} terminal of the LS122 and LS123 is an internal connection to ground, however for the best system performance C_{ext} should be hard-wired to ground.

Care should be taken to keep R_{ext} and C_{ext} as close to the monostable as possible with a minimum amount of inductance between the R_{ext}/C_{ext} junction and the R_{ext}/C_{ext} pin. Good groundplane and adequate bypassing should be designed into the system for optimum performance to insure that no false triggering occurs.

It should be noted that the C_{ext} pin is internally connected to ground on the LS122 and LS123, but not on the LS221. Therefore, if C_{ext} is hard-wired externally to ground, substitution of a LS221 onto a LS123 socket will cause the LS221 to become non-functional.

The switching diode is not needed for electrolytic capacitance application and should not be used on the LS122 and LS123.

To find the value of K for $C_{ext} \geq 1000$ pF, refer to Figure 4. Variations on V_{CC} or V_{RC} can cause the value of K to change, as can the temperature of the LS123, LS122. Figures 5 and 6 show the behaviour of the circuit shown in Figures 1 and 2 if separate power supplies are used for V_{CC} and V_{RC}. If V_{CC} is tied to V_{RC}, Figure 7 shows how K will vary with V_{CC} and temperature. Remember, the changes in R_{ext} and C_{ext} with temperature are not calculated and included in the graph.

As long as $C_{ext} \geq 1000$ pF and $5K \leq R_{ext} \leq 260$ K (SN74LS122/123) or $5K \leq R_{ext} \leq 160$ K (SN54LS122/123), the change in K with respect to R_{ext} is negligable.

If $C_{ext} \leq 1000$ pF the graph shown on Figure 8 can be used to determine the output pulse width. Figure 9 shows how K will change for $C_{ext} \leq 1000$ pF if V_{CC} and V_{RC} are connected to the same power supply. The pulse width t_W in nanoseconds is approximated by

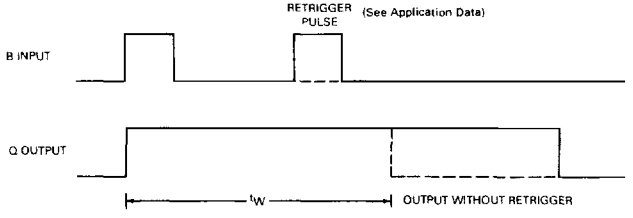
$$t_W = 6 + 0.05\, C_{ext}\,(pF) + 0.45\, R_{ext}\,(k\Omega)\, C_{ext} + 11.6\, R_{ext}$$

In order to trim the output pulse width, it is necessary to include a variable resistor between V_{CC} and the R_{ext}/C_{ext} pin or between V_{CC} and the R_{ext} pin of the LS122. Figure 10, 11, and 12 show how this can be done. R_{ext} remote should be kept as close to the monostable as possible.

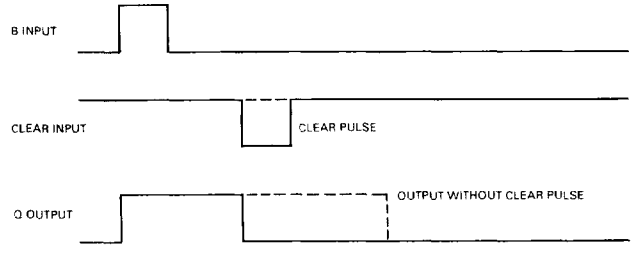
Retriggering of the part, as shown in Figure 3, must not occur before C_{ext} is discharged or the retrigger pulse will not have any effect. The discharge time of C_{ext} in nanoseconds is guaranteed to be less than 0.22 C_{ext} (pF) and is typically 0.05 C_{ext} (pF).

For the smallest possible deviation in output pulse widths from various devices, it is suggested that C_{ext} be kept ≥ 1000 pF.

WAVEFORMS



EXTENDING PULSE WIDTH



OVERRIDING THE OUTPUT PULSE

GUARANTEED OPERATING RANGES

SYMBOL	PARAMETER		MIN	TYP	MAX	UNIT
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
T_A	Operating Ambient Temperature Range	54 74	−55 0	25 25	125 70	°C
I_{OH}	Output Current — High	54,74			−0.4	mA
I_{OL}	Output Current — Low	54 74			4.0 8.0	mA
R_{ext}	External Timing Resistance	54 74	5.0 5.0		180 260	kΩ
C_{ext}	External Capacitance	54,74	No Restriction			
R_{ext}/C_{ext}	Wiring Capacitance at R_{ext}/C_{ext} Terminal	54,74			50	pF

DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

SYMBOL	PARAMETER		LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS	TEST CONDITIONS	
V_{IH}	Input HIGH Voltage		2.0			V	Guaranteed Input HIGH Voltage for All Inputs	
V_{IL}	Input LOW Voltage	54			0.7	V	Guaranteed Input LOW Voltage for All Inputs	
		74			0.8			
V_{IK}	Input Clamp Diode Voltage			−0.65	−1.5	V	V_{CC} = MIN, I_{IN} = −18 mA	
V_{OH}	Output HIGH Voltage	54	2.5	3.5		V	V_{CC} = MIN, I_{OH} = MAX, V_{IN} = V_{IH} or V_{IL} per Truth Table	
		74	2.7	3.5		V		
V_{OL}	Output LOW Voltage	54,74		0.25	0.4	V	I_{OL} = 4.0 mA	V_{CC} = V_{CC} MIN, V_{IN} = V_{IL} or V_{IH} per Truth Table
		74		0.35	0.5	V	I_{OL} = 8.0 mA	
I_{IH}	Input HIGH Current				20	μA	V_{CC} = MAX, V_{IN} = 2.7 V	
					0.1	mA	V_{CC} = MAX, V_{IN} = 7.0 V	
I_{IL}	Input LOW Current				−0.4	mA	V_{CC} = MAX, V_{IN} = 0.4 V	
I_{OS}	Short Circuit Current		−20		−100	mA	V_{CC} = MAX	
I_{CC}	Power Supply Current	LS122			11	mA	V_{CC} = MAX	
		LS123			20			

AC CHARACTERISTICS: T_A = 25°C, V_{CC} = 5.0 V

SYMBOL	PARAMETER	LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS	TEST CONDITIONS
t_{PLH}	Propagation Delay, A to Q		23	33	ns	C_{ext} = 0 C_L = 15 pF R_{ext} = 5.0 kΩ R_L = 2.0 kΩ
t_{PHL}	Propagation Delay, A to $\overline{Q}$		32	45		
t_{PLH}	Propagation Delay, B to Q		23	44	ns	
t_{PHL}	Propagation Delay, B to $\overline{Q}$		34	56		
t_{PLH}	Propagation Delay, Clear to $\overline{Q}$		28	45	ns	
t_{PHL}	Propagation Delay, Clear to Q		20	27		
$t_{W\ min}$	A or B to Q		116	200	ns	
t_{WQ}	A to B to Q	4.0	4.5	5.0	μs	C_{ext} = 1000 pF, R_{ext} = 10 kΩ, C_L = 15 pF, R_L = 2.0 kΩ

AC SETUP REQUIREMENTS: T_A = 25°C, V_{CC} = 5.0 V

SYMBOL	PARAMETER	LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS
t_W	Pulse Width	40			ns

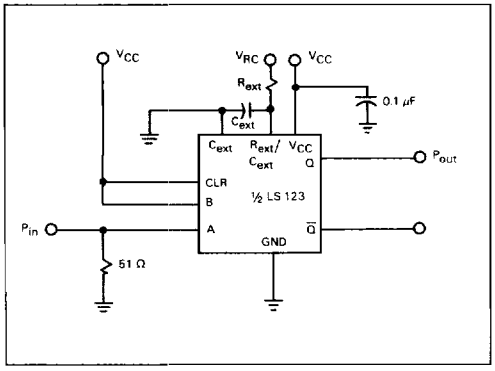


Fig. 1

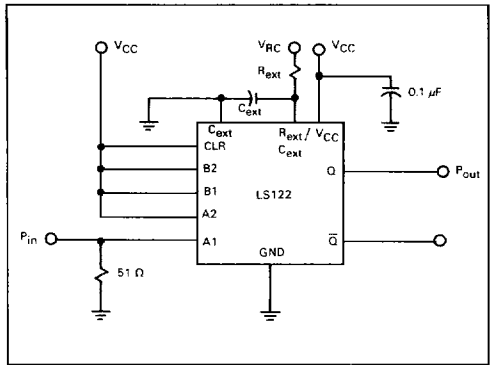


Fig. 2

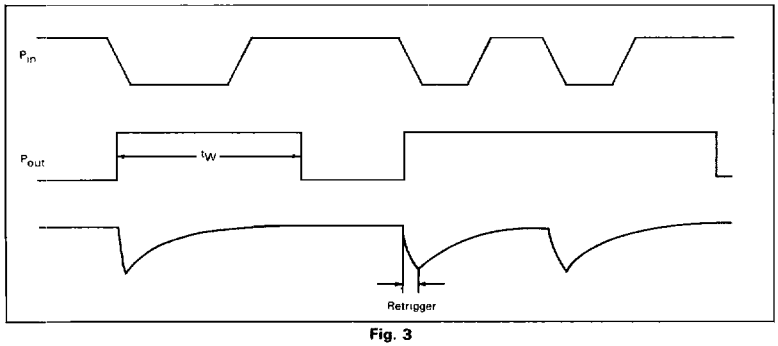


Fig. 3

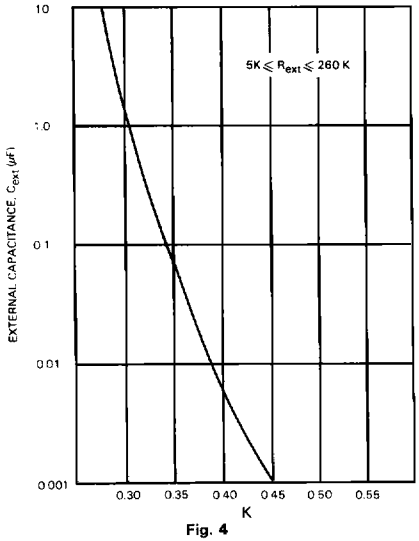


Fig. 4

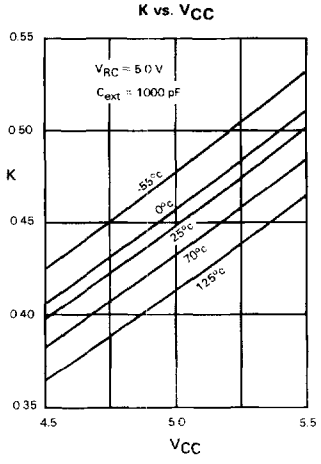


Fig. 5

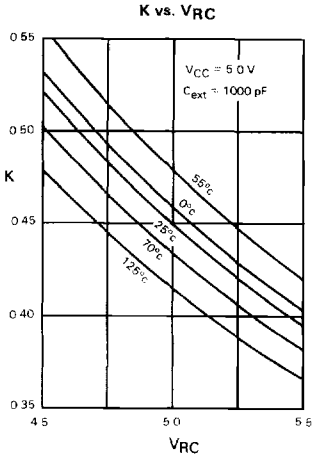


Fig. 6

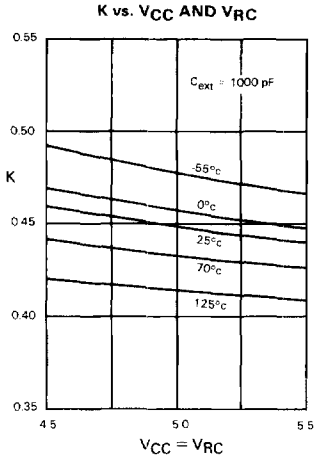


Fig. 7

4

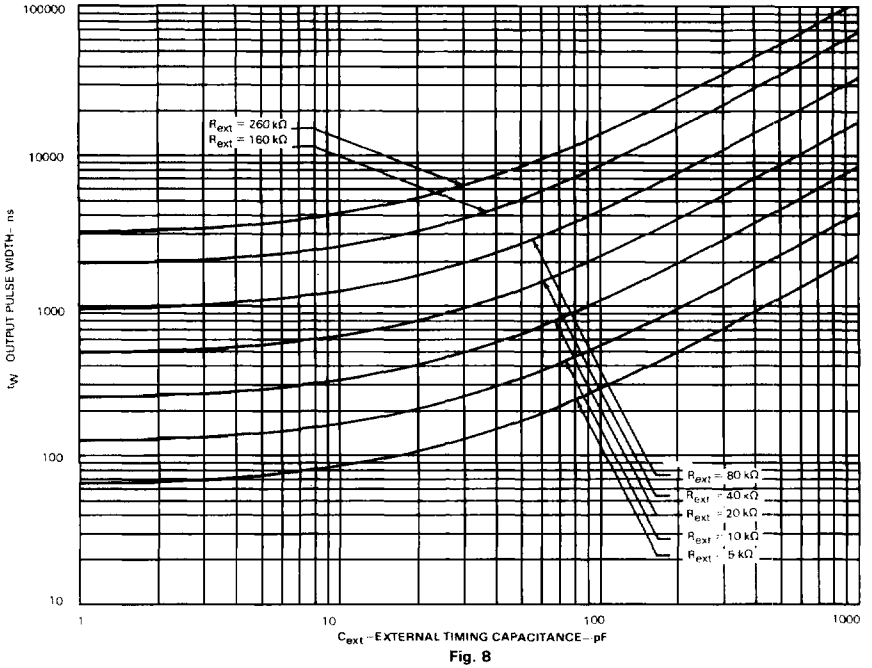


Fig. 8

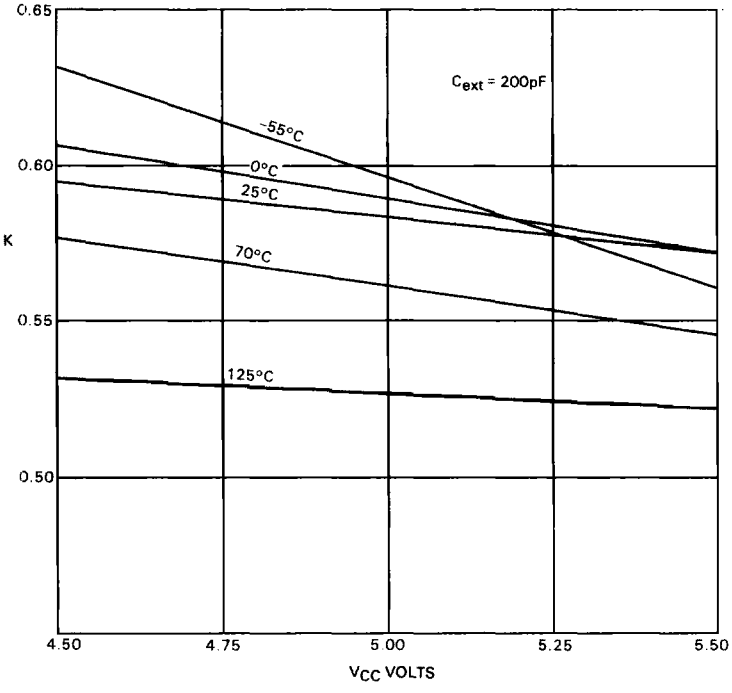


Fig. 9

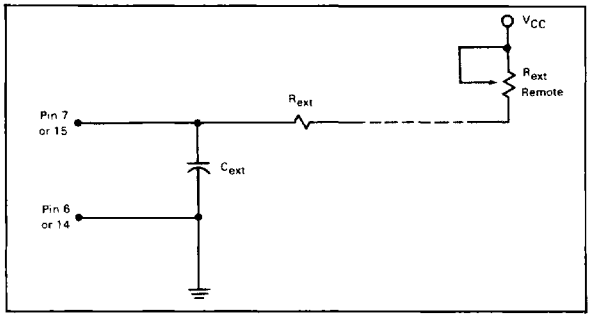


Fig. 10 — LS123 REMOTE TRIMMING CIRCUIT

4

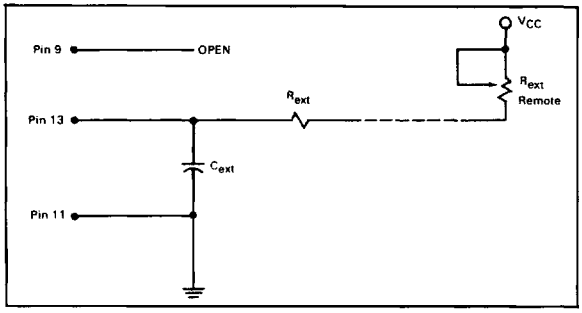


Fig. 11—LS122 REMOTE TRIMMING CIRCUIT WITHOUT R_{ext}

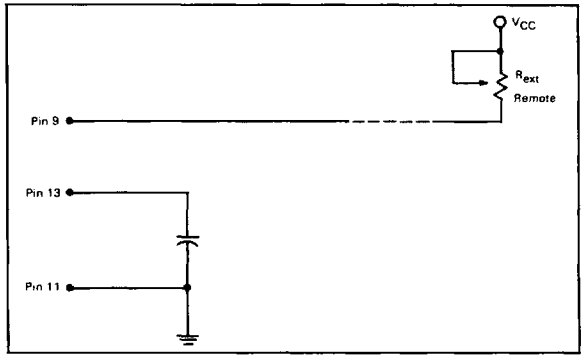


Fig. 12—LS122 REMOTE TRIMMING CIRCUIT WITH R_{int}