M74LS123P

DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR WITH RESET

DESCRIPTION

The M74LS123P is a semiconductor integrated circuit containing two retriggerable monostable multivibrator circuits with direct reset inputs.

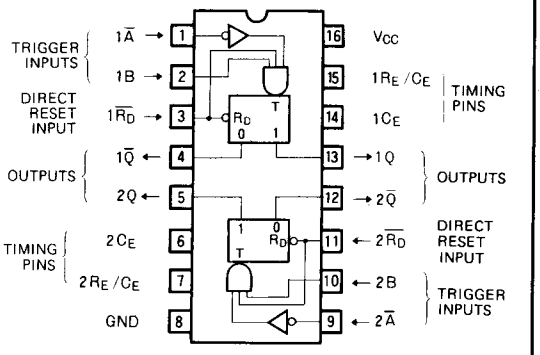
FEATURES

- Long pulse widths can be generated using the retriggerable function
- Output pulses can be stopped at any time with direct reset inputs
- $\overline{A}$, B complementary inputs provided
- High breakdown input voltage ($V_I \geqq 15V$)
- Q and $\overline{Q}$ outputs provided
- Wide operating temperature range (T_a=–20~+75°C)

APPLICATION

General purpose, for use in industrial and consumer equipment.

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

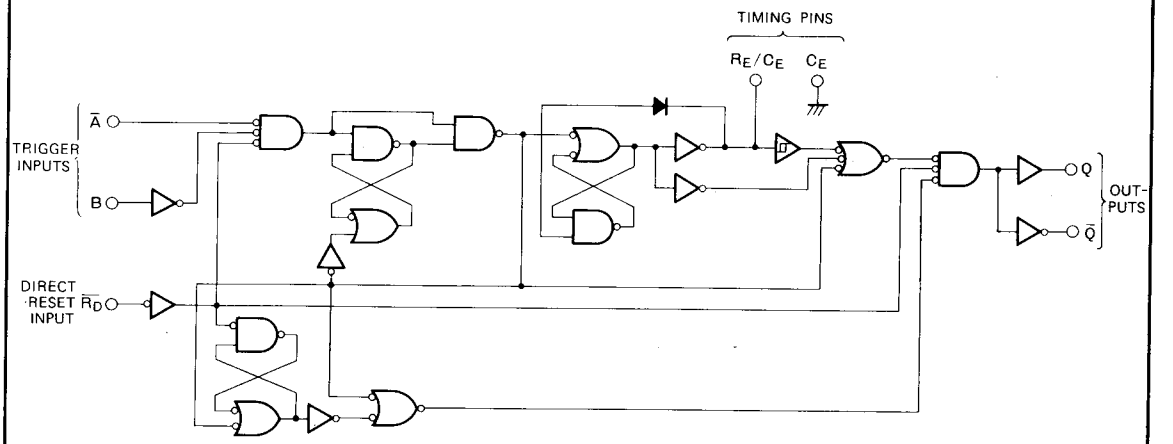
FUNCTIONAL DESCRIPTION

Positive pulses appear in output Q and negative pulses in output $\overline{Q}$ by connecting external resistor R_T and capacitor C_T to timing pins R_E/C_E and C_E, as shown in Fig. 1 on the next page, and by applying a trigger from input $\overline{A}$ or B. (Fig. 2(a)) The width tw of the pulses appearing in the outputs is set by R_T and C_T. When $\overline{A}$ changes from high to low or when B changes from low to high, the trigger is applied.

The retriggerable function is used to obtain long output pulse widths and when the trigger is applied from $\overline{A}$ or B immediately before the output pulse is completed, the output pulse width can be extended. (Fig. 2(b))

Q can be reset immediately low and $\overline{Q}$ high by setting direct reset input $\overline{R_D}$ low irrespective of the status of the outputs. The output pulse width can therefore be made as short as preferred by the $\overline{R_D}$ signal. (Fig. 2(c)) When $\overline{R_D}$ changes from low to high with $\overline{A}$ at low and B at high, the trigger is applied and the status of Q and $\overline{Q}$ changes.

BLOCK DIAGRAM (EACH MONOSTABLE MULTIVIBRATOR)



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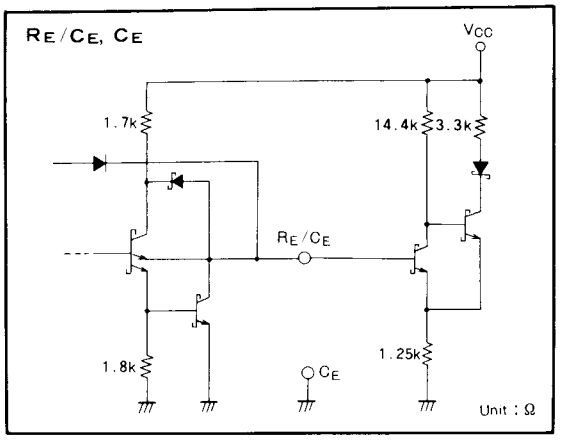
TIMING PIN EQUIVALENT CIRCUIT



FUNCTION TABLE (Note 1)

$\overline{R_D}$	$\overline{A}$	B	Q	$\overline{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⊓	⊔
H	↓	H	⊓	⊔
↑	L	H	⊓	⊔

Note 1. ↑ : Transition from low to high. (positive edge triggering)
↓ : Transition from high to low. (negative edge triggering)
⊓ : Positive one-shot operation.
⊔ : Negative one-shot operation.
X : Irrelevant

OPERATION DESCRIPTION

1. How to use the timing pins

As shown in Fig. 1, external resistor R_T and capacitor C_T are connected to timing pins R_E/C_E and C_E. Connect the positive to the R_E/C_E side and the negative to the C_E side when using C_T with polarity. In this case, it is not necessary to connect a switching diode required with the same type of TTL IC. With malfunctions caused by noise, connect C_E to the GND line (neighboring on pin 8) as shown by the dotted line in Fig. 1.

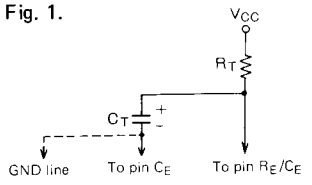


Fig. 1 Connection of external resistor R_T and capacitor C_T to timing pins R_E/C_E and C_E

2. Output pulse width t_w

The output pulse width t_w is set by R_T and C_T

2-1. When CT is greater than 1000pF

$t_W = 0.45 \cdot R_T \cdot C_T$ (ns) $\times (1 \pm 0.1)$

Refer to K-C_T characteristics indicated in TYPICAL CHARACTERISTICS for value of K. (No change is brought to K by value of R_T.)

R_T is measured in kilohms and C_T in picofarads

Depending on the product, fluctuations in the order of 3/-10%may occur.

R_T is measured in kilohms and C_T in picofarads

2-2. When CT is equal to or less than 1000pF

Refer to the output pulse width versus–C_T, R_T given in the typical characteristics.

3. Output pulse width control

The output pulse width can be controlled in 3 ways by using, or not using, the trigger signal and $\overline{R_D}$ signal.

3-1. Normal use

This is the normal method of use as a regular monostable multivibrator such as that shown in Fig. 2(a) and the output pulse width t_w can be set as for the formula and figure in section 2 above.

3-2. Extension of output pulse width with retrigger function

As shown in Fig. 2(b), the output pulse width can be extended as desired by applying a trigger pulse before the output pulse is completed.

3-3. Shortening of the output pulse width with $\overline{R_D}$ signal

As shown in Fig. 2(c), the output pulse which has been generated by the trigger signal can be terminated with the $\overline{R_D}$ signal and it is possible to shorten its width as required.

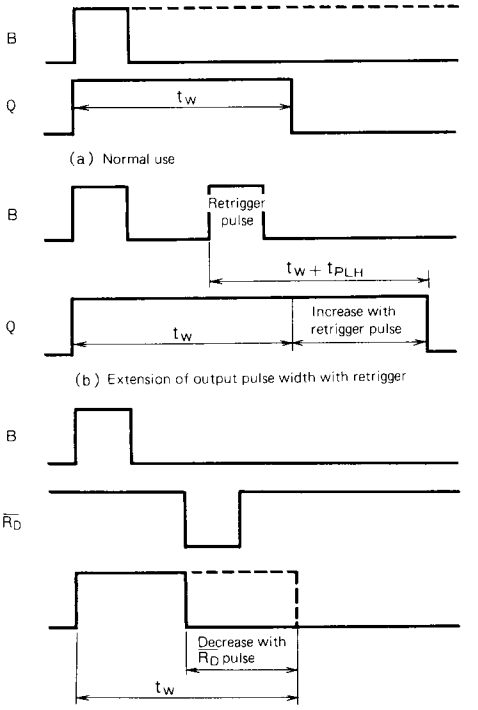


Fig. 2 Output pulse width control

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4. Precautions with use

4-1. Apply the retrigger pulse after a wait of $0.22C_T$ (ns) upon application of the trigger pulse. C_T is measured in picofarads. The retrigger pulse during this period is ineffective.

4-2. In order to minimize the floating capacitance and to safeguard against malfunction caused by noise, make the R_T and C_T wiring as short as possible and avoid signal wires which may be conducive to noise.

4-3. Connect an external capacitor of 0.01~0.1μF with good high-frequency characteristics between pins V_{CC} and GND.

4-4. The output pulse is generated when the power is switched on.

ABSOLUTE MAXIMUM RATINGS (Ta = −20 ~ +75°C, unless otherwise noted)

Symbol	Parameter	Conditions	Limits	Unit
V_{CC}	Supply voltage		−0.5 ~ +7	V
V_I	Input voltage		−0.5 ~ +15	V
V_O	Output voltage	High-level state	−0.5 ~ V_{CC}	V
Topr	Operating free-air ambient temperature range		−20 ~ +75	°C
Tstg	Storage temperature range		−65 ~ +150	°C

RECOMMENDED OPERATING CONDITIONS (Ta = −20 ~ +75°C, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min	Typ	Max	
V_{CC}	Supply voltage		4.75	5	5.25	V
I_{OH}	High-level output current	$V_{OH} \geq 2.7V$	0		−400	μA
I_{OL}	Low-level output current	$V_{OL} \leq 0.4V$	0		4	mA
		$V_{OL} \leq 0.5V$	0		8	mA
R_T	External timing resistance		5		260	kΩ
C_T	External timing capacitance		None			
C_R	R_E/C_E pin wiring capacitance				50	pF

ELECTRICAL CHARACTERISTICS (Ta = −20 ~ +75°C, unless otherwise noted)

Symbol	Parameter	Test conditions		Limits			Unit
				Min	Typ *	Max	
V_{IH}	High-level input voltage			2			V
V_{IL}	Low-level input voltage					0.8	V
V_{IC}	Input clamp voltage	V_{CC} = 4.75V, I_{IC} = −18mA				−1.5	V
V_{OH}	High-level output voltage	V_{CC} = 4.75V, V_I = 0.8V V_I = 2V, I_{OH} = −400μA		2.7	3.5		V
V_{OL}	Low-level output voltage	V_{CC} = 4.75V	I_{OL} = 4 mA		0.25	0.4	V
		V_I = 0.8V, V_I = 2V	I_{OL} = 8 mA		0.35	0.5	V
I_{IH}	High-level input current	V_{CC} = 5.25V, V_I = 2.7V				20	μA
		V_{CC} = 5.25V, V_I = 10V				0.1	mA
I_{IL}	Low-level input current	V_{CC} = 5.25V, V_I = 0.4V				−0.4	mA
I_{OS}	Short-circuit output current (Note 2)	V_{CC} = 5.25V, V_O = 0V		−20		−100	mA
I_{CC}	Supply current	V_{CC} = 5.25V (Note 3)			12	20	mA

* : All typical values are at V_{CC} = 5V, T_a = 25°C.

Note 2: All measurements should be done quickly and not more than one output should be shorted at a time.

Note 3: I_{CC} is measured with R_E/C_E and C_E open, 4.5V applied to $\overline{R_D}$, A and B and $\overline{A}$ set from 0V momentarily to 4.5V.

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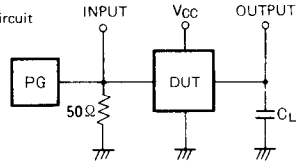
SWITCHING CHARACTERISTICS (V_{CC} = 5 V, Ta = 25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
t_{PLH}	Low-to-high-level output propagation time, from input $\overline{A}$ to output Q	C_T = 0 pF, R_T = 5 kΩ, C_L = 15 pF (Note 4)		19	33	ns
t_{PLH}	Low-to-high-level output propagation time, from input B to output Q			20	44	ns
t_{PHL}	High-to-low-level output propagation time, from input $\overline{A}$ to output $\overline{Q}$			21	45	ns
t_{PHL}	High-to-low-level output propagation time, from input B to output $\overline{Q}$			23	56	ns
t_{PHL}	High-to-low-level output propagation time, from input $\overline{R_D}$ to output Q			18	27	ns
t_{PLH}	Low-to-high-level output propagation time, from input $\overline{R_D}$ to output $\overline{Q}$			23	45	ns
$t_{WQ(min)}$	Minimum output pulse width, from inputs $\overline{A}$, B to output Q			66	200	ns
t_{WQ}	Output pulse width, from inputs $\overline{A}$, B to output Q	C_T = 1000 pF, R_T = 10 kΩ, C_L = 15 pF (Note 4)	4	4.55	5	μs

Note 4: Measurement circuit

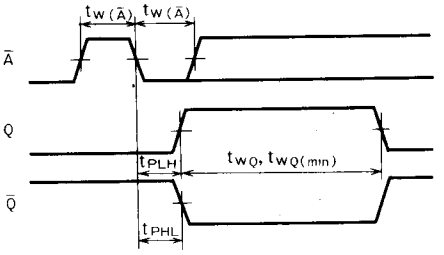


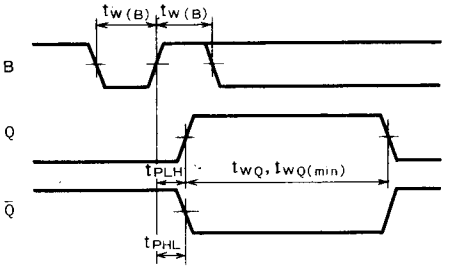
(1) The pulse generator (PG) has the following characteristics:
PRR = 1MHz (100kHz with t_{WQ} measurement), t_r = 6ns, t_f = 6ns, $t_w \geq 40$ns, V_P = 3V_{P-P}, Z_O = 50Ω.
(2) C_L includes probe and jig capacitance

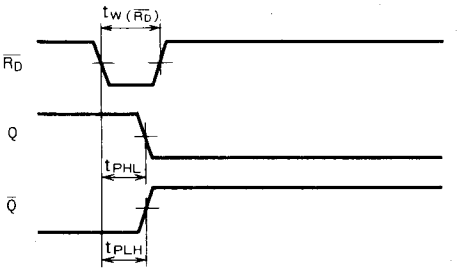
TIMING REQUIREMENTS (V_{CC} 5 V, Ta 25°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$t_{W(\overline{A})}$	Trigger input $\overline{A}$ pulse width		40	15		ns
$t_{W(B)}$	Trigger input B pulse width		40	10		ns
$t_{W(\overline{R_D})}$	Direct reset input pulse width $\overline{R_D}$		40	15		ns

TIMING DIAGRAM (Reference level = 1.3V)



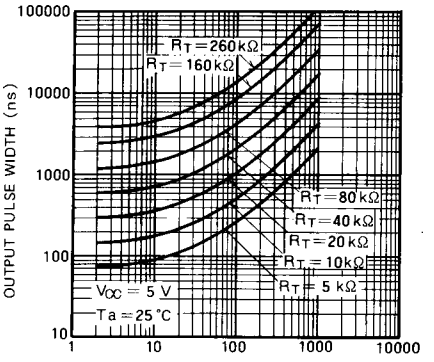




DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR WITH RESET

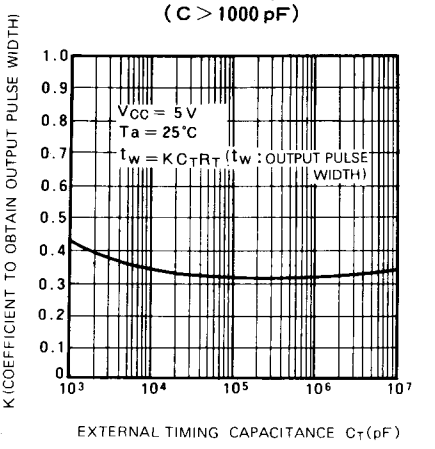
TYPICAL CHARACTERISTICS

OUTPUT PULSE WIDTH VS C_T, R_T ($C_T \leqq 1000$ pF)

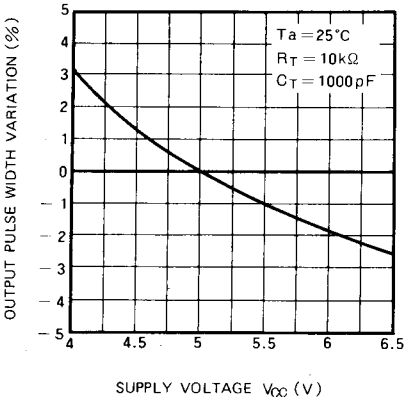


Note 5. Error within ±20% of output width given in the figure above.

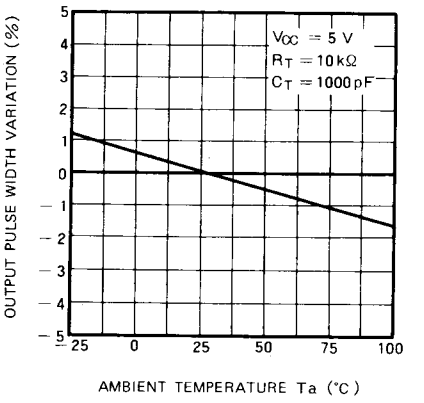
K VS C_T ($C > 1000$ pF)



OUTPUT PULSE WIDTH VARIATION VS SUPPLY VOLTAGE



OUTPUT PULSE WIDTH VARIATION VS AMBIENT TEMPERATURE



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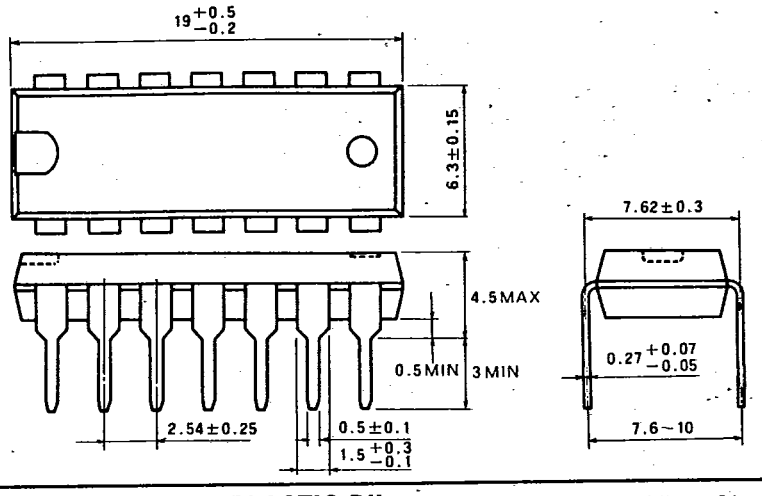
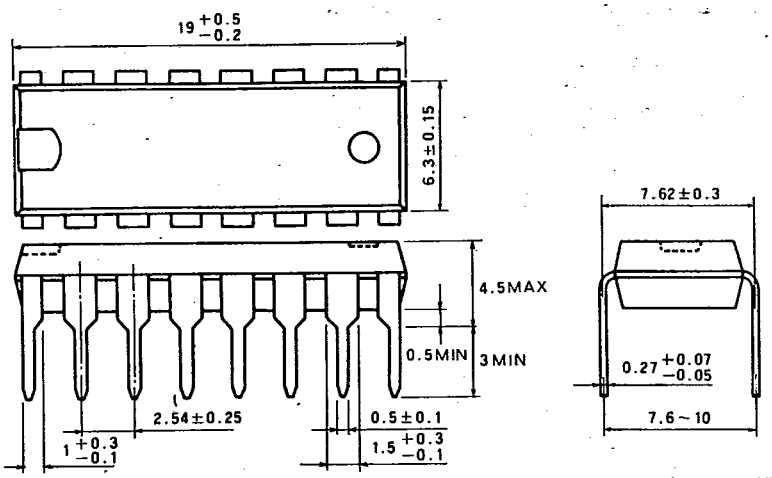
TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm