M74LS221P

DUAL MONOSTABLE MULTIVIBRATOR

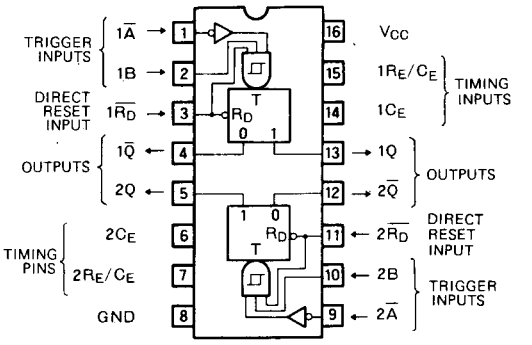
DESCRIPTION

The M74LS221P is a semiconductor integrated circuit containing two monostable multivibrator circuits with direct reset inputs.

FEATURES

- Pulse width excellent temperature characteristics and supply voltage
- Schmidt trigger inputs (B inputs) provided
- Wide output pulse width range (t_w = 47ns ~ 1s)
- Operation possible with duty cycle up to 90% (R_T=100kΩ)
- Direct reset inputs provided
- $\overline{A}$, B complementary inputs provided
- Q and $\overline{Q}$ outputs
- High input breakdown voltage ($V_I \geqq 15V$)
- Wide operating temperature range (T_a=−20~+75°C)

PIN CONFIGURATION (TOP VIEW)



Outline 16P4

APPLICATION

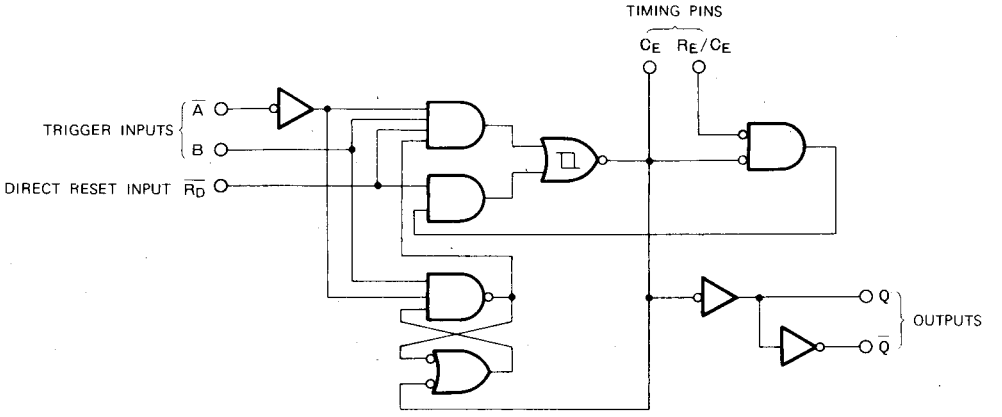
General purpose, for use in industrial and consumer equipment.

FUNCTIONAL DESCRIPTION

Positive pulses appear in output Q and negative pulses in output $\overline{Q}$ by connecting external resistor R_T and electrostatic capacitor C_T to timing pins R_E/C_E and C_E, as shown in Fig. 1, and by applying a trigger from input $\overline{A}$ or B. The width t_w 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. This IC is able to obtain an output pulse width with excellent supply voltage and temperature characteristics since both its supply voltage and temperature are assured.

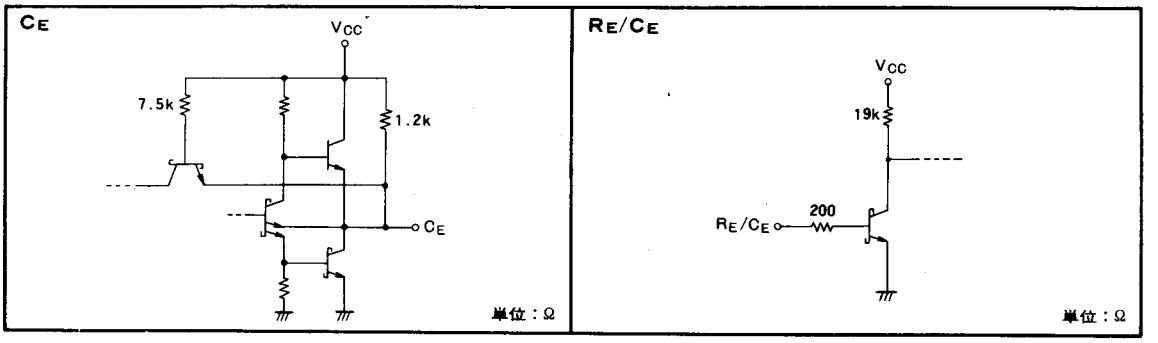
Q can be reset immediately low and $\overline{Q}$ high by setting direct reset input $\overline{R_D}$ low irrespective of the status of the outputs. If $\overline{R_D}$ changes from low to high when $\overline{A}$ is low and B is high, the trigger is applied and the pulse appears in the output.

BLOCK DIAGRAM (EACH MONOSTABLE MULTIVIBRATOR)



DUAL MONOSTABLE MULTIVIBRATOR

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.
↓ : Transition from high to low.
⎍: 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 electrostatic capacitor C_T are connected to timing pins R_E/C_E and C_E. Connect the negative to the R_E/C_E side and the positive to the C_E side when using C_T with polarity.

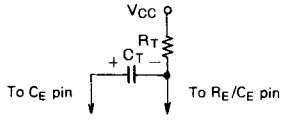


Fig. 1 Connection of external resistor R_T and capacitor C_T to timing pins R_E/C_E and C_E

2. Output pulse width t_w

The output pulse width t_w is set using R_T and C_T by the following formula:

$$t_w = C_T \cdot R_T \cdot \ln 2 \ (ns) \times (1 \pm 0.1)$$
$$\simeq 0.7 C_T \cdot R_T \ (ns) \times (1 \pm 0.1)$$

R_T is measured in kilohms and C_T in picofarads. Individual fluctuations of ±10% may occur in products.

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

3. Precautions with use

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.

Connect a capacitor of 0.01~0.1μF with good high-frequency characteristics between pins V_{CC} and GND. Mount this capacitor as close as possible to the IC.

ABSOLUTE MAXIMUM RATINGS (Ta = −20~+75℃, 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
T_{opr}	Operating free-air ambient temperature range		−20~+75	℃
T_{stg}	Storage temperature range		−65~+150	℃

RECOMMENDED OPERATING CONDITIONS (Ta = −20~+75℃, 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		1.4		100	kΩ
C_T	External timing capacitance		0		1000	μF

ELECTRICAL CHARACTERISTICS (T_a = −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	$\overline{A}$, B					0.8	V
		$\overline{R_D}$					0.5	
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=0.5, 0.8V V_I=2V, I_{OH}=−400μA		2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC}=4.75V	I_{OL}=4mA		0.25	0.4	V
			V_I=0.5V, 0.8V, V_I=2V	I_{OL}=8mA		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	$\overline{A}$	V_{CC}=5.25V				−0.4	mA
		B, $\overline{R_D}$	V_I=0.4V				−0.8	
I_{OS}	Short-circuit output current (Note 2)		V_{CC}=5.25V, V_O=0V		−20		−100	mA
I_{CC}	Supply current (static state)		V_{CC}=5.25V			4.7	11	mA
	Supply current (one-shot state)		V_{CC}=5.25V			19	27	mA

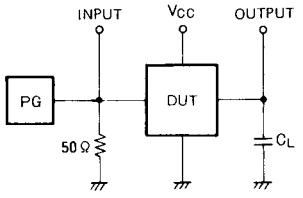
* : All typical values are at V_{CC}=5V, T_a=25°C.

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

SWITCHING CHARACTERISTICS (V_{CC}=5V, T_a=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=80pF R_T=2kΩ C_L=15pF (Note 3)			27	70	ns
t_{PLH}	Low-to-high-level output propagation time, from input B to output Q				24	55	ns
t_{PHL}	High-to-low-level output propagation time, from input $\overline{A}$ to output $\overline{Q}$				30	80	ns
t_{PHL}	High-to-low-level output propagation time, from input B to output $\overline{Q}$				26	65	ns
t_{PLH}	Low-to-high-level output propagation time, from input $\overline{R_D}$ to output $\overline{Q}$				23	65	ns
t_{PHL}	High-to-low-level output propagation time, from input $\overline{R_D}$ to output Q				18	55	ns
$t_{WQ(min)}$	Minimum output pulse width, from inputs $\overline{A}$, B to outputs Q, $\overline{Q}$	C_T=0pF, R_T=2kΩ C_L=15pF (Note 3)		20	30	70	ns
t_{WQ}	Output pulse width, from inputs $\overline{A}$, B to outputs Q, $\overline{Q}$	C_L=15pF (Note 3)	C_T=80pF, R_T=2kΩ	70	120	150	ns
			C_T=100pF, R_T=10kΩ	600	670	750	ns
			C_T=1μF, R_T=10kΩ	6	6.9	7.5	ms

Note 3: Measurement circuit



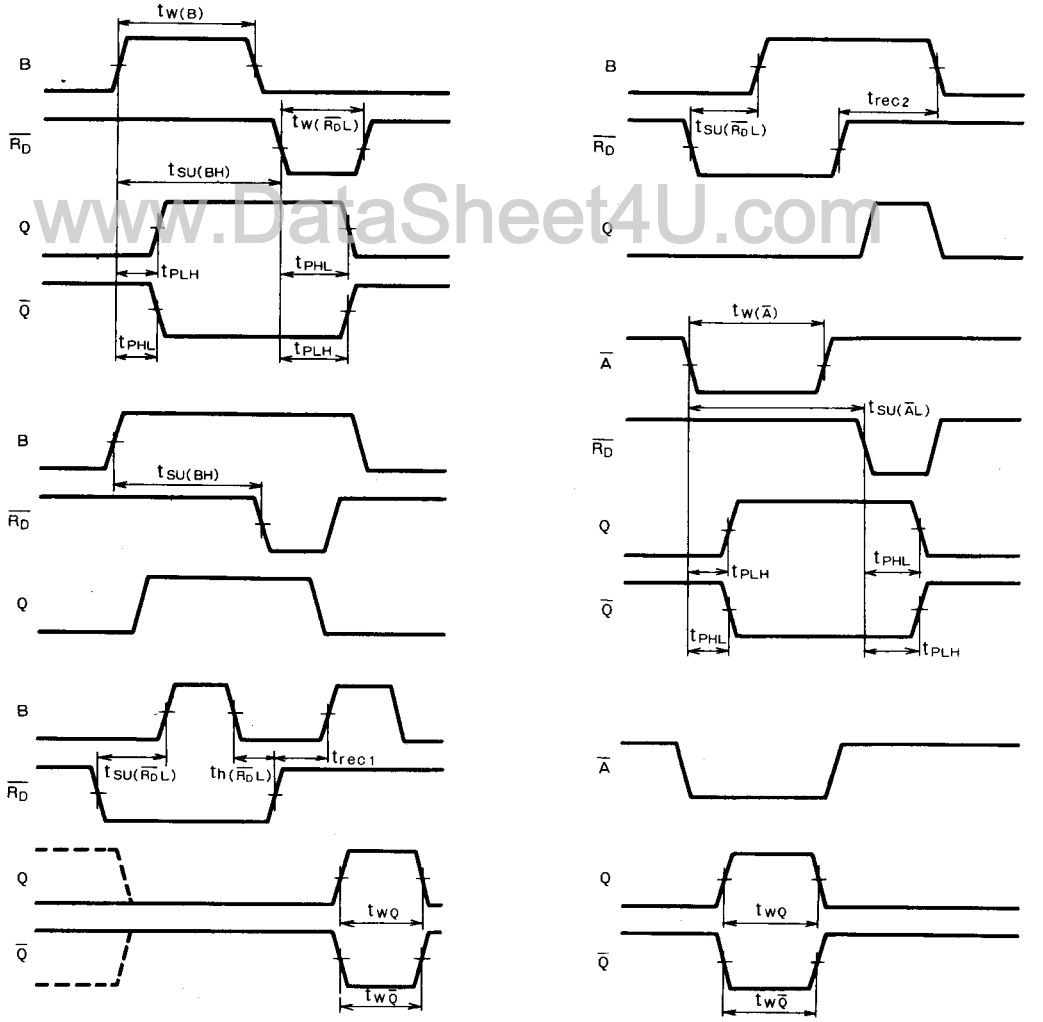
(1) The pulse generator (PG) has the following characteristics:
PRR=1MHz, t_r=6ns, t_f=6ns, t_w=40ns,
V_P=3V_{P-P}, Z_O=50Ω
(2) C_L includes probe and jig capacitance

DUAL MONOSTABLE MULTIVIBRATOR

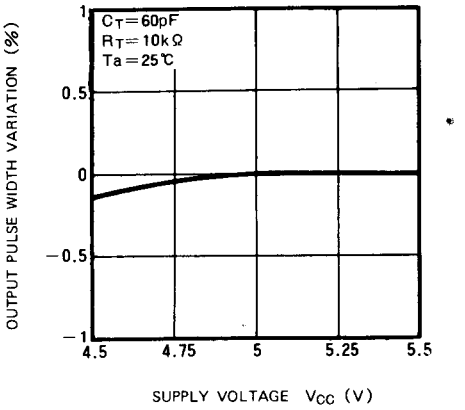
TIMING REQUIREMENTS (V_{CC}=5V, Ta=25℃, unless otherwise noted)

Symbol	Parameter		Test conditions	Limits Min	Limits Typ	Limits Max	Unit
tr, tf	Maximum rise, fall voltage rate of input pulse	$\overline{A}$		1			V/μs
		B		1			V/s
$t_{w(\overline{A})}$	Trigger $\overline{A}$ pulse width			40	35		ns
$t_{w(B)}$	Trigger B pulse width			40	35		ns
$t_{w(\overline{R_D})}$	Direct reset input pulse width			40	9		ns
O.D.C	Output duty cycle	R_T=2kΩ	(Note 3)			50	%
		R_T=100kΩ				90	%
$t_{su(\overline{A}L)}$	Setup time $\overline{A}$ low to $\overline{R_D}$			60	33		ns
$t_{su(BH)}$	Setup time B high to $\overline{R_D}$			60	25		ns
$t_{su(\overline{R_D}L)}$	Setup time $\overline{R_D}$ low to B			50	15		ns
t_{rec1}	Recovery time			15	−5		ns
t_{rec2}	Recovery time (when B is superimposed onto $\overline{R_D}$)			50	30		ns
$t_{h(\overline{R_D}L)}$	Hold time $\overline{R_D}$ low to B			0	−15		ns

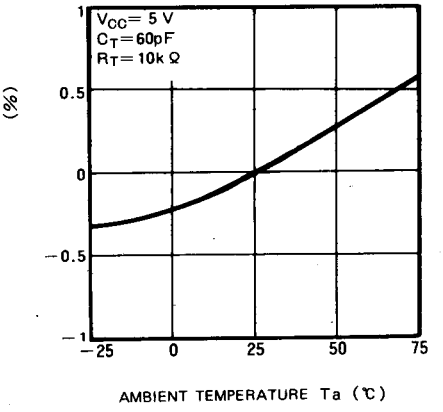
TIMING DIAGRAM (Reference level = 1.3V)



OUTPUT PULSE WIDTH VARIATION VS SUPPLY VOLTAGE



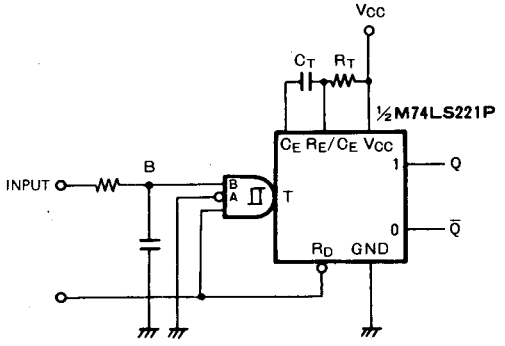
OUTPUT PULSE WIDTH VARIATION VS AMBIENT TEMPERATURE

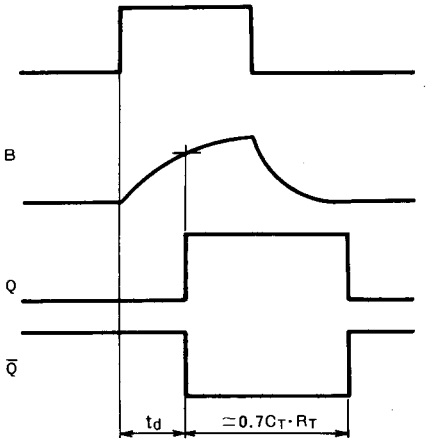


APPLICATION EXAMPLES

(1) Delay circuit

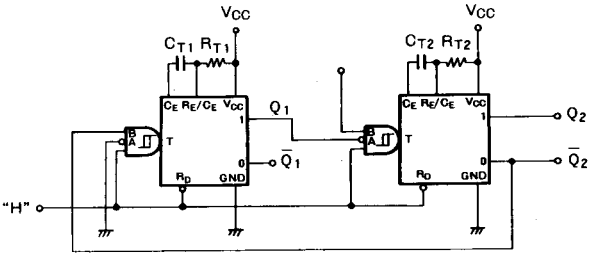
By connecting an integration circuit to the B input, a rectangular waveform applied to the input is changed to the waveform shown at B and delayed by time t_d. The width of the pulse output at Q and $\overline{Q}$ is determined as usual by the values of C_T, R_T connected externally to the circuit.

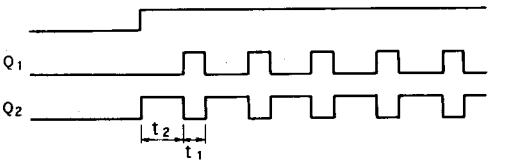




(2) Pulse generator

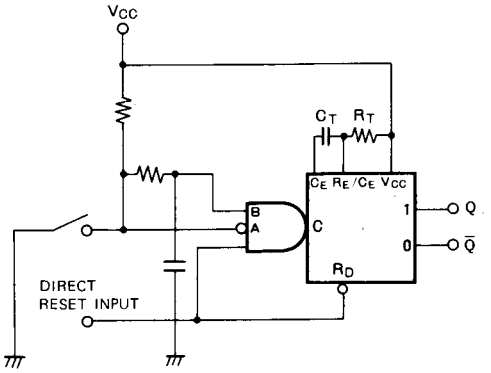
Using the fact that the output pulse width of the M74LS221P varies only slightly with changes in supply voltage and ambient temperature, a pulse generator with good supply voltage and temperature stability can be implemented. By choosing the values of externally connected components C_T and R_T, the duty cycle and frequency can be freely selected.

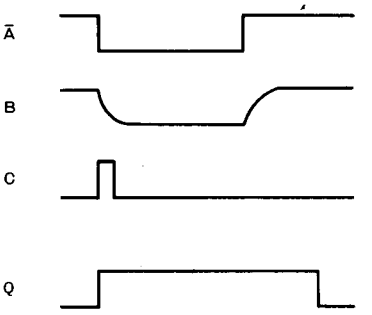




$t_1 \simeq 0.7 C_{T1} \cdot R_{T1}$
$t_2 \simeq 0.7 C_{T2} \cdot R_{T2}$

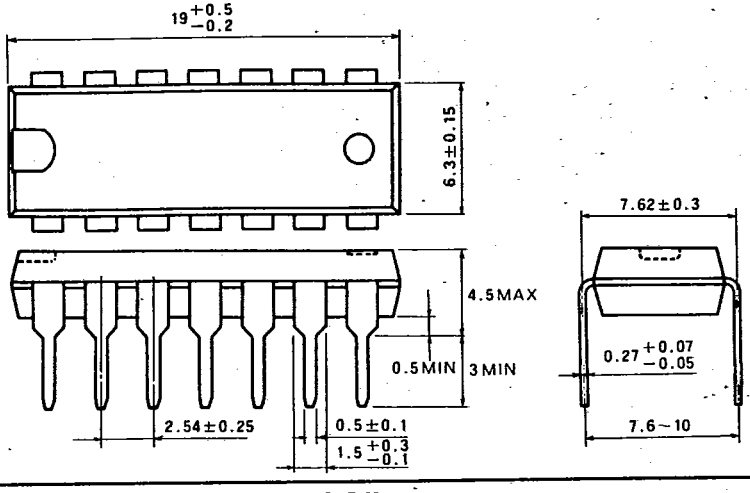
(3) ANTI-CHATTERING CIRCUIT





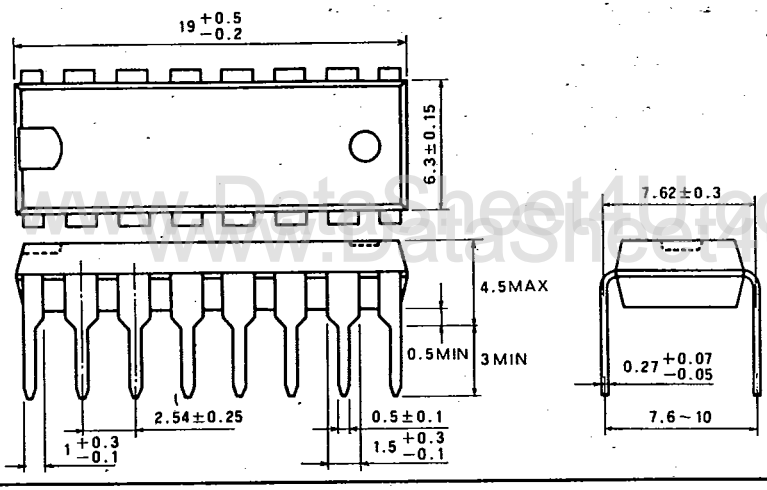
TYPE 14P4 14-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 16P4 16-PIN MOLDED PLASTIC DIL

Dimension in mm



TYPE 20P4 20-PIN MOLDED PLASTIC DIL

Dimension in mm