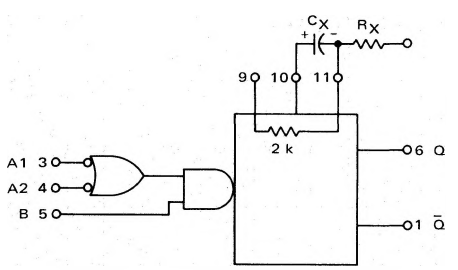
MONOSTABLE MULTIVIBRATOR

# MC54121F,L*
# MC74121F,L,P*

This monostable multivibrator produces accurate output pulses from either edge of an input pulse. The output pulse widths may be varied from 40 nanoseconds to 40 seconds by using appropriate external timing components. Internal compensation provides pulse width stability of better than 1.0% with variation of $V_{CC}$ and ambient temperature. In most applications, overall stability will be determined by the accuracy of the external components. Inputs A1 and A2 trigger on the negative-going edge of the input pulse, and input B triggers on the positive-going edge.




$V_{CC}$ = Pin 14
GND = Pin 7

Input Loading Factor = 1
Output Loading Factor = 10
Total Power Dissipation = 90 mW typ/pkg (50% duty cycle)

**TRUTH TABLE**

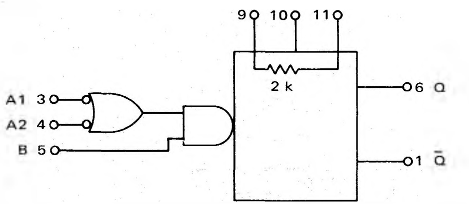
| $t_n$ INPUT | | | $t_{n+1}$ INPUT | | | OUTPUT |
|---|---|---|---|---|---|---|
| A1 | A2 | B | A1 | A2 | B | |
| 1 | 1 | 0 | 1 | 1 | 1 | Inhibit |
| 0 | X | 1 | 0 | X | 0 | Inhibit |
| X | 0 | 1 | X | 0 | 0 | Inhibit |
| 0 | X | 0 | 0 | X | 1 | Triggering |
| X | 0 | 0 | X | 0 | 1 | Triggering |
| 1 | 1 | 1 | X | 0 | 1 | Triggering |
| 1 | 1 | 1 | 0 | X | 1 | Triggering |
| X | 0 | 0 | X | 1 | 0 | Inhibit |
| 0 | X | 0 | 1 | X | 0 | Inhibit |
| X | 0 | 1 | 1 | 1 | 1 | Inhibit |
| 0 | X | 1 | 1 | 1 | 1 | Inhibit |
| 1 | 1 | 0 | X | 0 | 0 | Inhibit |
| 1 | 1 | 0 | 0 | X | 0 | Inhibit |

X = Don't care
$t_n$ = Time period prior to input transition
$t_{n+1}$ = Time period following input transition

*F suffix = TO-86 ceramic flat package (Case 607).
L suffix = TO-116 ceramic dual in-line package (Case 632).
P suffix = TO-116 plastic dual in-line package (Case 605).

## ELECTRICAL CHARACTERISTICS

Test procedures are shown for only one A input. The other A input is tested in the same manner.

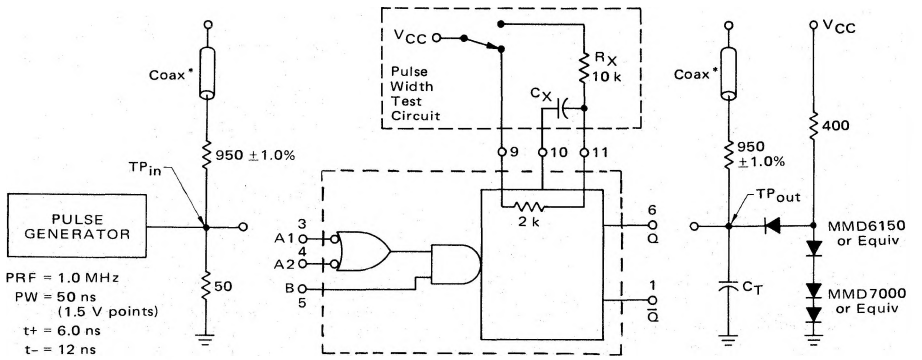



| | TEST CURRENT/VOLTAGE VALUES (All Temperatures) mA | | Volts | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $I_{OL}$ | $I_{OH}$ | $V_{IL}$ | $V_{IH}$ | $V_{IHH}$ | $V_R$ | $V_{th\,1}$ | $V_{th\,0}$ | $V_{CC}$ | $V_{CCL}$ | $V_{CCH}$ |
| MC54121 | 16 | -0.4 | 0.4 | 2.4 | 5.5 | 4.5 | 2.0 | 0.8 | 5.0 | 4.5 | 5.5 |
| MC74121 | 16 | -0.4 | 0.4 | 2.4 | 5.5 | 4.5 | 2.0 | 0.8 | 5.0 | 4.75 | 5.25 |

| Characteristic | Symbol | Pin Under Test | MC54121 Test Limits -55 to +125°C Min | Max | Unit | MC74121 Test Limits 0 to +70°C Min | Max | Unit | TEST CURRENT/VOLTAGE APPLIED TO PINS LISTED BELOW: $I_{OL}$ | $I_{OH}$ | $V_{IL}$ | $V_{IH}$ | $V_{IHH}$ | $V_R$ | $V_{th\,1}$ | $V_{th\,0}$ | $V_{CC}$ | $V_{CCL}$ | $V_{CCH}$ | Gnd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Input** | | | | | | | | | | | | | | | | | | | | |
| Forward Current | $I_F$ | 3 | – | -1.6 | mAdc | – | -1.6 | mAdc | – | – | 3 | – | – | 4 | – | – | – | – | 14 | 5,7 |
| | | 5 | – | -3.2 | mAdc | – | -3.2 | mAdc | – | – | 5 | – | – | 3,4 | – | – | – | – | 14 | 6*,7 |
| Leakage Current | $I_{R1}$ | 3 | – | 40 | µAdc | – | 40 | µAdc | – | – | – | 3 | – | – | – | – | – | – | 14 | 4,5,7 |
| | | 5 | – | 80 | µAdc | – | 80 | µAdc | – | – | – | 5 | – | 3,4 | – | – | – | – | 14 | 7 |
| | $I_{R2}$ | 3 | – | 1.0 | mAdc | – | 1.0 | mAdc | – | – | – | – | 3 | – | – | – | – | – | 14 | 4,5,7 |
| | | 5 | – | 1.0 | mAdc | – | 1.0 | mAdc | – | – | – | – | 5 | 3,4 | – | – | – | – | 14 | 7 |
| **Output** | | | | | | | | | | | | | | | | | | | | |
| Output Voltage | $V_{OL}$ | 6 | – | 0.4 | Vdc | – | 0.4 | Vdc | 6 | – | – | – | – | – | – | 3,4,5 | – | 14 | – | 7 |
| | $V_{OH}$ | 6 | 2.4 | – | Vdc | 2.4 | – | Vdc | – | 6 | – | – | – | – | – | 3,4,5 | – | 14 | – | 7,11 |
| Short-Circuit Current | $I_{SC}$ | 1 | -20 | -55 | mAdc | -18 | -55 | mAdc | – | – | – | – | – | – | – | – | – | – | 9,14 | 1,3,4,5,7 |
| | | 6 | -20 | -55 | mAdc | -18 | -55 | mAdc | – | – | – | – | – | – | – | – | – | – | 14 | 3,4,5,6,7,10,11** |
| **Power Requirements** | | | | | | | | | | | | | | | | | | | | |
| Power Supply Drain | $I_{PD}$ | 14 | – | 25 | mAdc | – | 25 | mAdc | – | – | – | – | – | – | – | 5 | – | – | 9,14 | 3,4,7 |
| | | 14 | – | 40 | mAdc | – | 40 | mAdc | – | – | – | – | – | – | 5 | – | – | – | 9,14 | 3,4,7 |
| **Switching Parameters** | | | | | | | | | Pulse In | Pulse Out | | | | | | | | | | |
| ($C_X$ = 80 pF unless otherwise noted.) | | | | | | | | | | | | | | | | | | | | |
| Turn-Off Delay – A to Q | $t_{pd+}$ | 6 | – | 70# | ns | – | 70# | ns | 3 | 6 | – | 4,5 | – | – | – | – | 9,14 | – | – | 7 |
| B to Q | | 6 | – | 55# | ns | – | 55# | ns | 5 | 6 | 3,4 | – | – | – | – | – | 9,14 | – | – | 7 |
| Turn-On Delay – A to Q̄ | $t_{pd-}$ | 1 | – | 80# | ns | – | 80# | ns | 3 | 1 | – | 4,5 | – | – | – | – | 9,14 | – | – | 7 |
| B to Q̄ | | 1 | – | 65# | ns | – | 65# | ns | 5 | 1 | 3,4 | – | – | – | – | – | 9,14 | – | – | 7 |
| Output Pulse Witdth With Internal Timing Resistor | PW | | | | | | | | | | | | | | | | | | | |
| With $C_X$ = 0 | | 5,1 | 70# | 150# | ns | 70# | 150# | ns | 5 | 1 | – | – | – | – | – | – | 9,14 | – | – | 3,4,7 |
| | | ↓ | 20# | 50# | ↓ | 20# | 50# | ↓ | ↓ | ↓ | – | – | – | – | – | – | 9,14 | – | – | ↓ |
| With $R_X$ = 10 kΩ, $C_X$ = 100 pF | | ↓ | 600# | 800# | ↓ | 600# | 800# | ↓ | ↓ | ↓ | – | – | – | – | – | – | 14 | – | – | ↓ |
| $R_X$ = 10 kΩ, $C_X$ = 1.0 µF | | ↓ | 6.0# | 8.0# | ms | 6.0# | 8.0# | ms | ↓ | ↓ | – | – | – | – | – | – | 14 | – | – | ↓ |
| Minimum Duration of Trigger Pulse | $t_{Hold}$ | 5,1 | – | 50# | ns | – | 50# | ns | 5 | 1 | – | – | – | – | – | – | 9,14 | – | – | 3,4,7 |

*Momentarily ground this pin before taking measurement.
**Pin 10 should be grounded after pin 11.
#Tested only at 25°C.

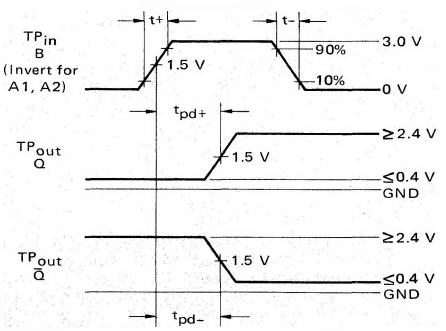
**TEST CIRCUIT AND VOLTAGE WAVEFORMS**



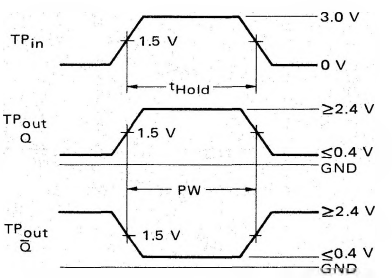

* The coax delays from input to scope and output to scope must be matched. The scope must be terminated in 50-ohm impedance. The 950-ohm resistor and the scope termination impedance constitute a 20:1 attenuator probe. Coax shall be CT-070-50 or equivalent.

$C_T$ = 15 pF = total parasitic capacitance, which includes probe, wiring, and load capacitances.

**SWITCHING TIMES**




**OUTPUT PULSE WIDTH**




## APPLICATIONS INFORMATION

Inputs A1 and A2 are negative-edge-triggered and will trigger the monostable multivibrator into the active state when either or both go low while B is high. The B input will trigger the one-shot when B goes high while either A or B is low. Triggering occurs at a particular voltage level and is independent of the input pulse transition time. The Schmitt-trigger capability of the B input can be used to obtain level detection and to process relatively slow leading edges. Jitter-free triggering is obtained with transition times as slow as 1.0 volt/second, providing the circuit with a typical noise immunity of 1.2 volts. Internal latching circuitry provides for a typical noise immunity of 1.5 volts on the $V_{CC}$ line.

During the active state, the outputs are independent of further transitions on the inputs and depend only on the external timing components. With no external timing components and pin 9 connected to $V_{CC}$ (pins 10 and 11 left open), an output pulse of approximately 30 nanoseconds is obtained. An external timing capacitor connected between pins 10 and 11 will extend the pulse width. Accurate repeatable pulse width may be obtained by leaving pin 9 open and connecting an external resistor between pin 11 and $V_{CC}$. This resistor should be at least 1.4 kilohms and may be as large as 40 kilohms for the MC74121 and 30 kilohms for the MC54121. The timing capacitor may be as large as 1000 μF. Within these limits, the output pulse width is given by:

$$PW = C_X R_X \log_e 2.$$

**FIGURE 1 – SCHMITT TRIGGER THRESHOLD VOLTAGE versus TEMPERATURE**

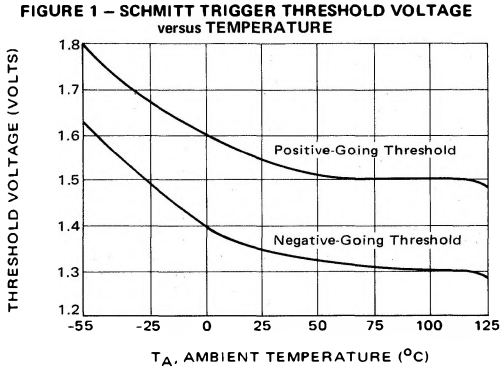



**FIGURE 2 – INTERNAL TIMING RESISTOR VARIATION versus TEMPERATURE**

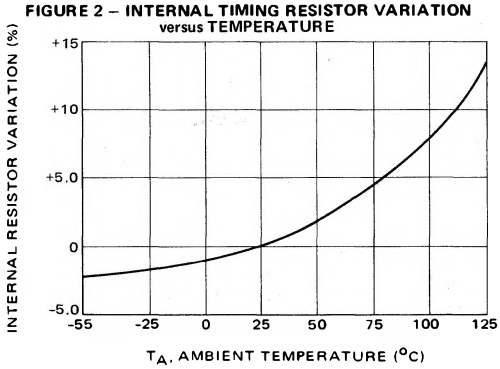



**FIGURE 3 – OUTPUT PULSE WIDTH VARIATION versus TEMPERATURE**

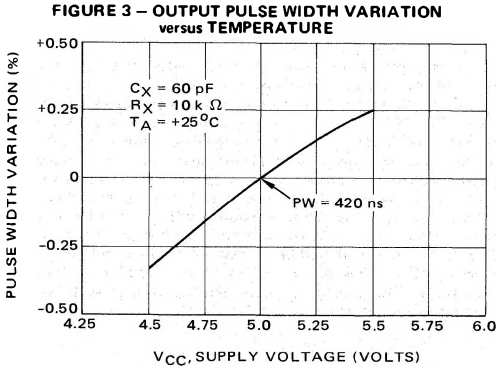
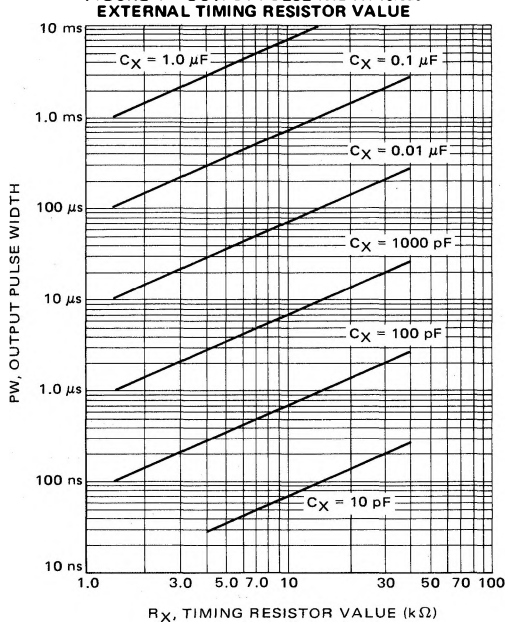



**FIGURE 4 – OUTPUT PULSE WIDTH versus EXTERNAL TIMING RESISTOR VALUE**



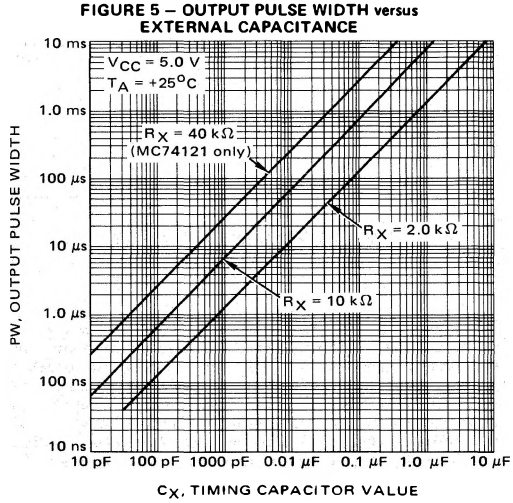


**FIGURE 5 – OUTPUT PULSE WIDTH versus EXTERNAL CAPACITANCE**