Signetics

# 74121
# Multivibrator

**Monostable Multivibrator**
***Product Specification***

**Logic Products**

## FEATURES

- **Very good pulse width stability**
- **Virtually immune to temperature and voltage variations**
- **Schmitt trigger input for slow input transitions**
- **Internal timing resistor provided**

| TYPE | TYPICAL PROPAGATION DELAY | TYPICAL SUPPLY CURRENT (TOTAL) |
|---|---|---|
| 74121 | 43ns | 18mA |

## ORDERING CODE

| PACKAGES | COMMERCIAL RANGE $V_{CC}$ = 5V ±5%; $T_A$ = 0°C to +70°C |
|---|---|
| Plastic DIP | N74121 N |
| Plastic SO | N74121 D |

**NOTE:**
For information regarding devices processed to Military Specifications, see the Signetics Military Products Data Manual.

## DESCRIPTION

These multivibrators feature dual active LOW going edge inputs and a single active HIGH going edge input which can be used as an active HIGH enable input. Complementary output pulses are provided.

Pulse triggering occurs at a particular voltage level and is not directly related to the transition time of the input pulse. Schmitt-trigger input circuitry (TTL hysteresis) for the B input allows jitter-free triggering from inputs with transition rates as slow as 1 volt/second, providing the circuit with an excellent noise immunity of typically 1.2 volts. A high immunity to $V_{CC}$ noise of typically 1.5 volts is also provided by internal latching circuitry. Once fired, the outputs are independent of further transitions of the inputs and are a function only of the timing components. Input pulses may be of any duration relative to the output pulse. Output pulse length may be varied from 20 nanoseconds to 28 seconds by choosing appropriate timing components. With no external timing components (i.e., $R_{int}$ connected to $V_{CC}$, $C_{ext}$ and $R_{ext}/C_{ext}$ open), an output pulse of typically 30 or 35 nanoseconds is achieved which may be used as a dc triggered reset signal. Output rise and fall times are TTL compatible and independent of pulse length.

Pulse width stability is achieved through internal compensation and is virtually independent of $V_{CC}$ and temperature. In most applications, pulse stability will only be limited by the accuracy of external timing components.

Jitter-free operation is maintained over the full temperature and $V_{CC}$ ranges for more than six decades of timing capacitance (10pF to 10μF) and more than one decade of timing resistance (2kΩ to 30kΩ for the 54121 and 2KΩ to 40kΩ for the 74121). Throughout these ranges, pulse width is defined by the relationship: (see Figure 1)

$$t_W(out) = \frac{C_{ext}\ R_{ext}\ \ln 2}{t_W(out) \cong 0.7\ C_{ext}\ R_{ext}}$$

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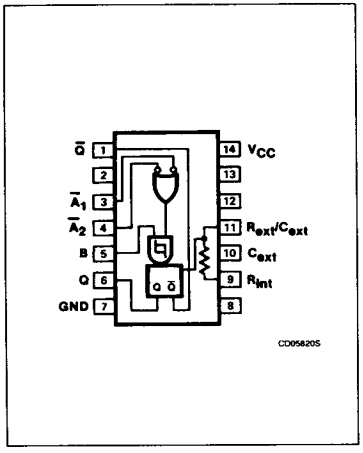
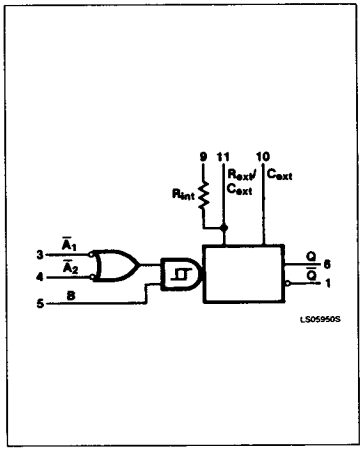
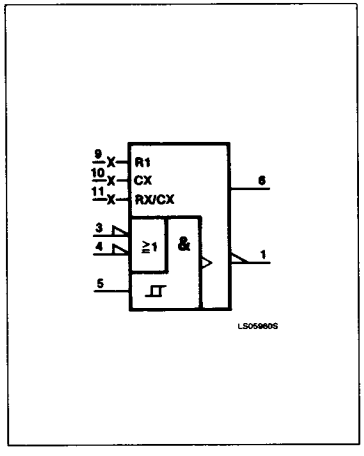
## PIN CONFIGURATION




## LOGIC SYMBOL




## LOGIC SYMBOL (IEEE/IEC)



## FUNCTION TABLE

| INPUTS | | | OUTPUTS | |
|---|---|---|---|---|
| $\overline{A}_1$ | $\overline{A}_2$ | B | Q | $\overline{Q}$ |
| L | X | H | L | H |
| X | L | H | L | H |
| X | X | L | L | H |
| H | H | X | L | H |
| H | ↓ | H | ⎍ | ⎎ |
| ↓ | H | H | ⎍ | ⎎ |
| ↓ | ↓ | H | ⎍ | ⎎ |
| L | X | ↑ | ⎍ | ⎎ |
| X | L | ↑ | ⎍ | ⎎ |

H = HIGH voltage level
L = LOW voltage level
X = Don't care
↑ = LOW-to-HIGH transition
↓ = HIGH-to-LOW transition

## INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

| PINS | DESCRIPTION | 74 |
|---|---|---|
| $\overline{A}_1$, $\overline{A}_2$ | Inputs | 1ul |
| B | Input | 2ul |
| Q, $\overline{Q}$ | Outputs | 10ul |

**NOTE:**
A 74 unit load (ul) is understood to be 40$\mu$A $I_{IH}$ and −1.6mA $I_{IL}$.

In circuits where pulse cutoff is not critical, timing capacitance up to 1000$\mu$F and timing resistance as low as 1.4k$\Omega$ may be used.

## ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted.)

| PARAMETER | | 74 | UNIT |
|---|---|---|---|
| $V_{CC}$ | Supply voltage | 7.0 | V |
| $V_{IN}$ | Input voltage | −0.5 to +5.5 | V |
| $I_{IN}$ | Input current | −30 to +5 | mA |
| $V_{OUT}$ | Voltage applied to output in HIGH output state | −0.5 to +$V_{CC}$ | V |
| $T_A$ | Operating free-air temperature range | 0 to 70 | °C |

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER | | | 74 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | Min | Nom | Max | |
| $V_{CC}$ | Supply voltage | | 4.75 | 5.0 | 5.25 | V |
| $I_{IK}$ | Input clamp current | | | | −12 | mA |
| $I_{OH}$ | HIGH-level output current | | | | −400 | $\mu$A |
| $I_{OL}$ | LOW-level output current | | | | 16 | mA |
| dv/dt | Rate of rise or fall of input pulse | B input | 1 | | | V/s |
| | | $\overline{A}_1$, $\overline{A}_2$ inputs | 1 | | | V/$\mu$s |
| $T_A$ | Operating free-air temperature | | 0 | | 70 | °C |

## DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

| PARAMETER | | TEST CONDITIONS[1] | | 74121 Min | 74121 Typ[2] | 74121 Max | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{T+}$ | Positive-going threshold at $\overline{A}$ and B | $V_{CC}$ = MIN | | | | 2.0 | V |
| $V_{T-}$ | Negative-going threshold at $\overline{A}$ and B | $V_{CC}$ = MIN | | 0.8 | | | V |
| $V_{OH}$ | HIGH-level output voltage | $V_{CC}$ = MIN, $V_{IH}$ = MIN, $V_{IL}$ = MAX, $I_{OH}$ = MAX | | 2.4 | 3.4 | | V |
| $V_{OL}$ | LOW-level output voltage | $V_{CC}$ = MIN, $V_{IH}$ = MIN, $V_{IL}$ = MAX, $I_{OL}$ = MAX | | | 0.2 | 0.4 | V |
| $V_{IK}$ | Input clamp voltage | $V_{CC}$ = MIN, $I_I$ = $I_{IK}$ | | | | −1.5 | V |
| $I_I$ | Input current at maximum input voltage | $V_{CC}$ = MAX, $V_I$ = 5.5V | | | | 1.0 | mA |
| $I_{IH}$ | HIGH-level input current | $V_{CC}$ = MAX, $V_I$ = 2.4V | $\overline{A}_1$, $\overline{A}_2$ inputs | | | 40 | μA |
| | | | B input | | | 80 | μA |
| $I_{IL}$ | LOW-level input current | $V_{CC}$ = MAX, $V_I$ = 0.4V | $\overline{A}_1$, $\overline{A}_2$ inputs | | | −1.6 | mA |
| | | | B input | | | −3.2 | mA |
| $I_{OS}$ | Short-circuit output current[3] | $V_{CC}$ = MAX | | −18 | | −55 | mA |
| $I_{CC}$ | Supply current (total) | $V_{CC}$ = MAX | Quiescent | | 13 | 25 | mA |
| | | | Triggered | | 23 | 40 | mA |

**NOTES:**
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at $V_{CC}$ = 5V, $T_A$ = 25°C.
3. $I_{OS}$ is tested with $V_{OUT}$ = +0.5V and $V_{CC}$ = $V_{CC}$ MAX + 0.5V. Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

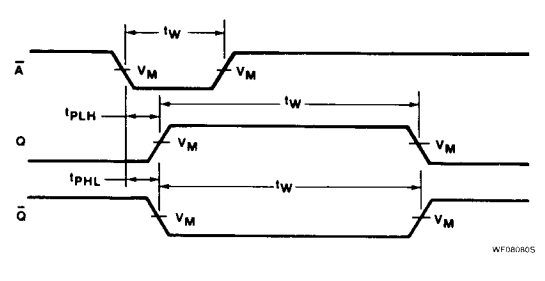
## AC ELECTRICAL CHARACTERISTICS $T_A$ = 25°C, $V_{CC}$ = 5.0V

| PARAMETER | | TEST CONDITIONS | 74 $C_L$ = 15pF, $R_L$ = 400Ω Min | 74 $C_L$ = 15pF, $R_L$ = 400Ω Max | UNIT |
|---|---|---|---|---|---|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>$\overline{A}$ input to Q & $\overline{Q}$ output | Waveform 1<br>$C_{ext}$ = 80pF, $R_{int}$ to $V_{CC}$ | | 70<br>80 | ns |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>B input to Q & $\overline{Q}$ output | Waveform 2<br>$C_{ext}$ = 80pF, $R_{int}$ to $V_{CC}$ | | 55<br>65 | ns |
| $t_W$ | Minimum output pulse width | $C_{ext}$ = 0pF, $R_{int}$ to $V_{CC}$ | 20 | 50 | ns |
| $t_W$ | Output pulse width | $C_{ext}$ = 80pF, $R_{int}$ to $V_{CC}$ | 70 | 150 | ns |
| | | $C_{ext}$ = 100pF, $R_{ext}$ = 10kΩ | 600 | 800 | ns |
| | | $C_{ext}$ = 1μF, $R_{ext}$ = 10kΩ | 6.0 | 8.0 | ms |

## AC SET-UP REQUIREMENTS $T_A = 25°C$, $V_{CC} = 5.0V$

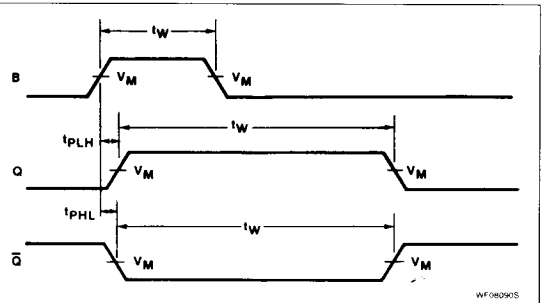
| PARAMETER | | TEST CONDITIONS | 74 | | UNIT |
|---|---|---|---|---|---|
| | | | Min | Max | |
| $t_W$ | Minimum input pulse width to trigger | Waveforms 1 & 2 | 50 | | ns |
| $R_{ext}$ | External timing resistor range | | 1.4 | 40 | kΩ |
| $C_{ext}$ | External timing capacitance range | | 0 | 1000 | μF |
| | Output duty cycle | $R_{ext} = 2k\Omega$ | | 67 | % |
| | | $R_{ext} = R_{ext}(Max)$ | | 90 | % |

## AC WAVEFORMS




$V_M$ = 1.5V for 74 and 74S; $V_M$ = 1.3V for 74LS

**Waveform 1. Propagation Delay $\overline{A}$ Input To Q And $\overline{Q}$ Outputs, Input And Output Pulse Widths**




$V_M$ = 1.5V for 74 and 74S; $V_M$ = 1.3V for 74LS

**Waveform 2. Propagation Delay B Input To Q And $\overline{Q}$ Output, Input And Output Pulse Widths**

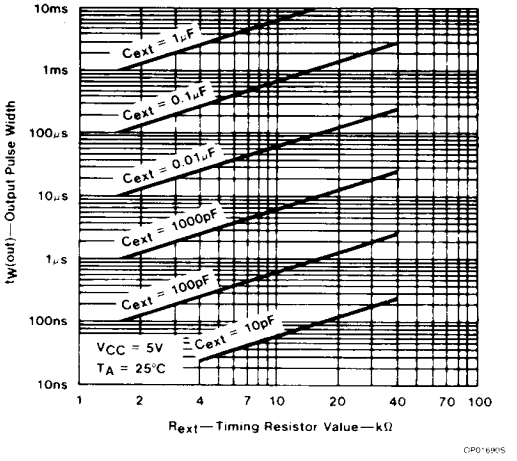
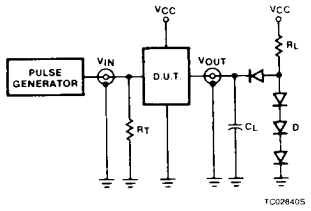
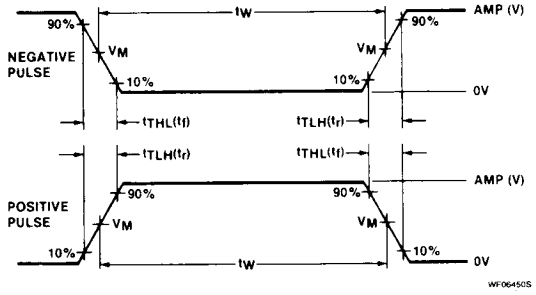



**Figure 1. Output Pulse Width vs. Timing Resistor Value**

## TEST CIRCUITS AND WAVEFORMS




**Test Circuit For 74 Totem-Pole Outputs**




$V_M$ = 1.3V for 74LS; $V_M$ = 1.5V for all other TTL families.

**Input Pulse Definition**

DEFINITIONS

$R_L$ = Load resistor to $V_{CC}$; see AC CHARACTERISTICS for value.
$C_L$ = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.
$R_T$ = Termination resistance should be equal to $Z_{OUT}$ of Pulse Generators.
D = Diodes are 1N916, 1N3064, or equivalent.
$t_{TLH}$, $t_{THL}$ Values should be less than or equal to the table entries.

| FAMILY | INPUT PULSE REQUIREMENTS | | | | |
|---|---|---|---|---|---|
| | Amplitude | Rep. Rate | Pulse Width | $t_{TLH}$ | $t_{THL}$ |
| 74 | 3.0V | 1MHz | 500ns | 7ns | 7ns |
| 74LS | 3.0V | 1MHz | 500ns | 15ns | 6ns |
| 74S | 3.0V | 1MHz | 500ns | 2.5ns | 2.5ns |

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