

SN54122, SN54123, SN54130, SN54LS122, SN54LS123, SN74122, SN74123, SN74130, SN74LS122, SN74LS123 RETRIGGERABLE MONOSTABLE MULTIVIBRATORS

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- D-C Triggered from Active-High or Active-Low Gated Logic Inputs
- Retriggerable for Very Long Output Pulses, Up to 100% Duty Cycle
- Overriding Clear Terminates Output Pulse
- '122 and 'LS122 Have Internal Timing Resistors

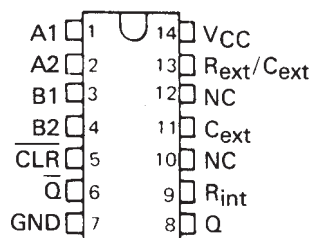
description

These d-c triggered multivibrators feature output pulse-duration control by three methods. The basic pulse time is programmed by selection of external resistance and capacitance values (see typical application data). The '122 and 'LS122 have internal timing resistors that allow the circuits to be used with only an external capacitor, if so desired. Once triggered, the basic pulse duration 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. Figure 1 illustrates pulse control by retriggering and early clear.

The 'LS122 and 'LS123 are provided enough Schmitt hysteresis to ensure jitter-free triggering from the B input with transition rates as slow as 0.1 millivolt per nanosecond.

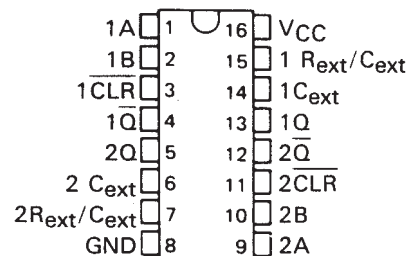
The R_{int} is nominally 10 k Ω for '122 and 'LS122.

SN54122, SN54LS122 . . . J OR W PACKAGE
SN74122 . . . N PACKAGE
SN74LS122 . . . D OR N PACKAGE
(TOP VIEW) (SEE NOTES 1 THRU 4)

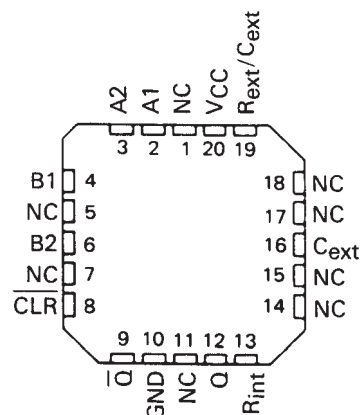


- NOTES: 1. An external timing capacitor may be connected between C_{ext} and R_{ext}/C_{ext} (positive).
2. To use the internal timing resistor of '122 or 'LS122, connect R_{int} to VCC.
3. For improved pulse duration accuracy and repeatability, connect an external resistor between R_{ext}/C_{ext} and VCC with R_{int} open-circuited.
4. To obtain variable pulse durations, connect an external variable resistance between R_{int} or R_{ext}/C_{ext} and VCC.

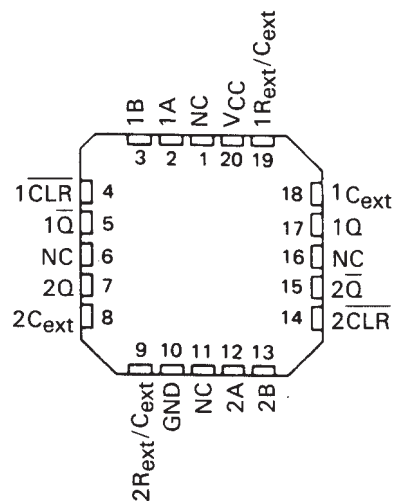
SN54123, SN54130, SN54LS123 . . . J OR W PACKAGE
SN74123, SN74130 . . . N PACKAGE
SN74LS123 . . . D OR N PACKAGE
(TOP VIEW) (SEE NOTES 1 THRU 4)



SN54LS122 . . . FK PACKAGE
(TOP VIEW) (SEE NOTES 1 THRU 4)



SN54LS123 . . . FK PACKAGE
(TOP VIEW) (SEE NOTES 1 THRU 4)

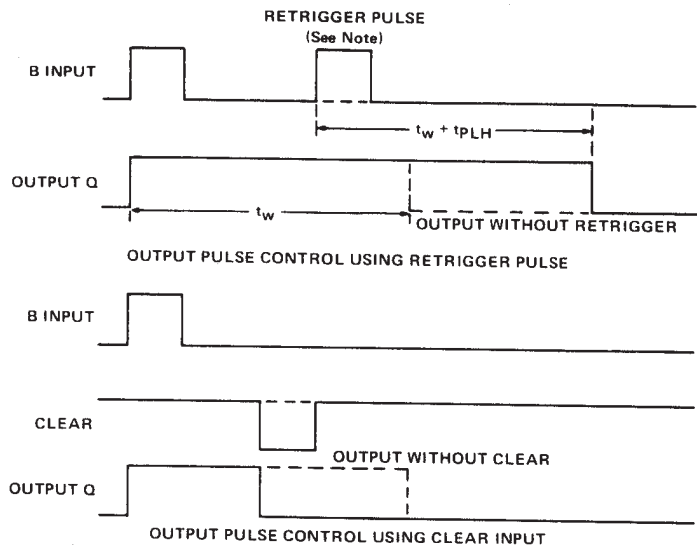


NC - No internal connection

SN54122, SN54123, SN54130, SN54LS122, SN54LS123,
SN74122, SN74123, SN74130, SN74LS122, SN74LS123
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description (continued)



NOTE: Retrigger pulses starting before $0.22 C_{ext}$ (in picoseconds) nanoseconds after the initial trigger pulse will be ignored and the output duration will remain unchanged.

FIGURE 1—TYPICAL INPUT/OUTPUT PULSES

'122, 'LS122
FUNCTION TABLE

| INPUTS | | | | | OUTPUTS | |
|--------|----|----|----|----|---------|-----------|
| CLEAR | A1 | A2 | B1 | B2 | Q | \bar{Q} |
| 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 | | |

'123, '130, 'LS123
FUNCTION TABLE

| INPUTS | | | OUTPUTS | |
|--------|---|---|---------|-----------|
| CLEAR | A | B | Q | \bar{Q} |
| L | X | X | L | H |
| X | H | X | L† | H† |
| X | X | L | L† | H† |
| H | L | ↑ | | |
| H | ↓ | H | | |
| ↑ | L | H | | |

See explanation of function tables on page

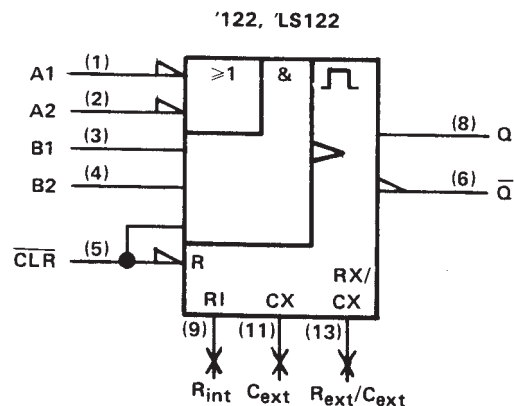
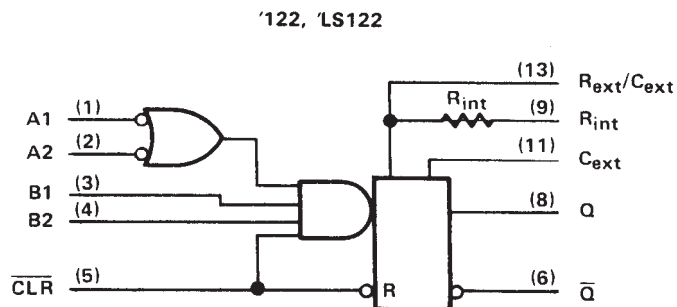
† These lines of the functional tables assume that the indicated steady-state conditions at the A and B inputs have been set up long enough to complete any pulse started before the set up.

SN54122, SN54123, SN54130, SN54LS122, SN54LS123, SN74122, SN74123, SN74130, SN74LS122, SN74LS123 RETRIGGERABLE MONOSTABLE MULTIVIBRATORS

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logic diagram (positive logic)

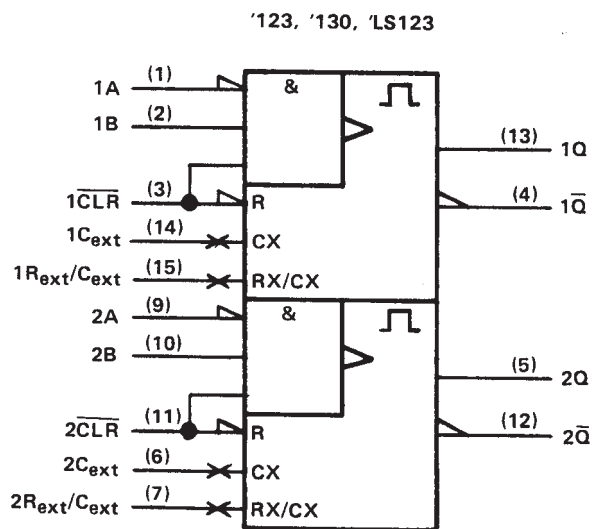
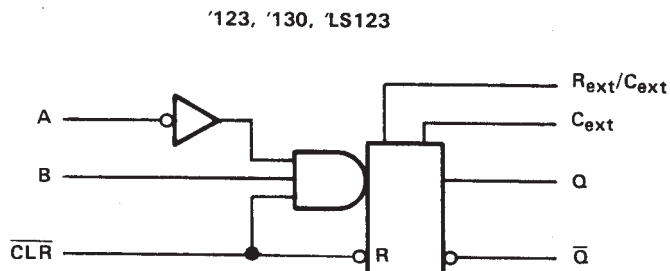
logic symbol†



R_{int} is nominally 10 k Ω for '122 and 'LS122

logic diagram (positive logic) (each multivibrator)

logic symbol†



Pin numbers shown are for D, J, N, and W packages.

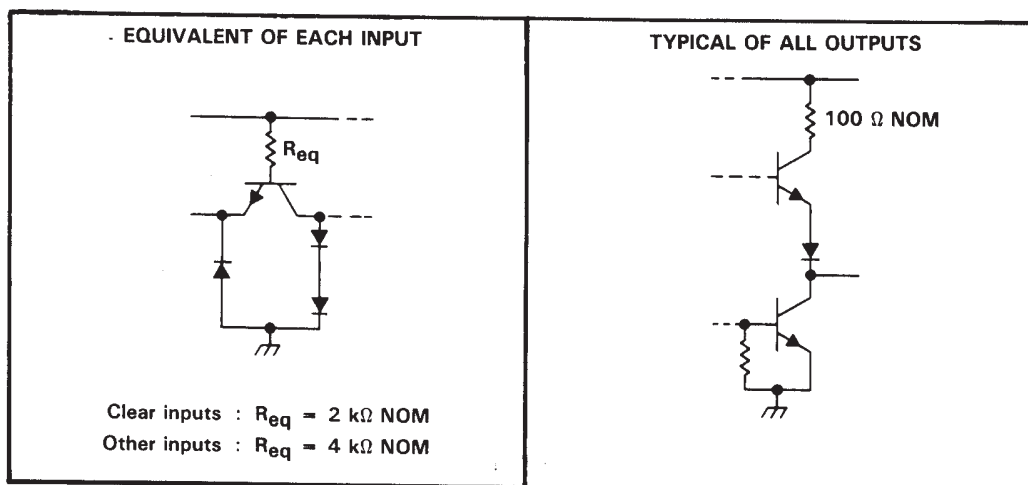
†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

SN54122, SN54123, SN54130, SN54LS122, SN54LS123, SN74122, SN74123, SN74130, SN74LS122, SN74LS123 RETRIGGERABLE MONOSTABLE MULTIVIBRATORS

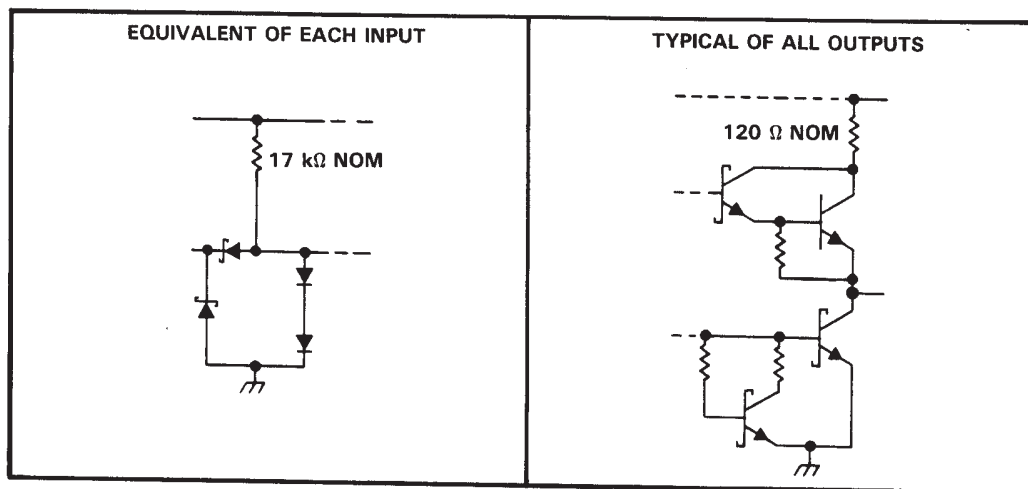
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schematics of inputs and outputs

'122, '123, '130 CIRCUITS



'LS122, 'LS123 CIRCUITS



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

| | |
|---|----------------|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Input voltage: '122, '123, '130 | 5.5 V |
| 'LS122, 'LS123 | 7 V |
| Operating free-air temperature range: SN54' | -55°C to 125°C |
| SN74' | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

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recommended operating conditions

| | SN54' | | | SN74' | | | UNIT |
|--|----------------|-----|------|----------------|-----|------|-------------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output current, I_{OH} | | | -800 | | | -800 | μA |
| Low-level output current, I_{OL} | | | 16 | | | 16 | mA |
| Pulse duration, t_W | 40 | | | 40 | | | ns |
| External timing resistance, R_{ext} | 5 | | 25 | 5 | | 50 | k Ω |
| External capacitance, C_{ext} | No restriction | | | No restriction | | | |
| Wiring capacitance at R_{ext}/C_{ext} terminal | | | 50 | | | 50 | pF |
| Operating free-air temperature, T_A | -55 | | 125 | 0 | | 70 | $^{\circ}C$ |

electrical characteristics over recommended free-air operating temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS† | '122 | | | '123, '130 | | | UNIT |
|-----------|---|---|------|------|------|------------|------|------|---------|
| | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V_{IH} | High-level input voltage | | 2 | | | 2 | | | V |
| V_{IL} | Low-level input voltage | | | | 0.8 | | | 0.8 | V |
| V_{IK} | Input clamp voltage | $V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$ | | | -1.5 | | | -1.5 | V |
| V_{OH} | High-level output voltage | $V_{CC} = \text{MIN}, I_{OH} = -800 \mu A$, See Note 5 | 2.4 | 3.4 | | 2.4 | 3.4 | | V |
| V_{OL} | Low-level output voltage | $V_{CC} = \text{MIN}, I_{OL} = 16 \text{ mA}$, See Note 5 | | 0.2 | 0.4 | | 0.2 | 0.4 | V |
| I_I | Input current at maximum input voltage | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$ | | | 1 | | | 1 | mA |
| I_{IH} | High-level input current | Data inputs | | | 40 | | | 40 | μA |
| | | Clear input | | | 80 | | | 80 | |
| I_{IL} | Low-level input current | Data inputs | | | -1.6 | | | -1.6 | mA |
| | | Clear input | | | -3.2 | | | -3.2 | |
| I_{OS} | Short-circuit output current§ | $V_{CC} = \text{MAX}$, See Note 5 | -10 | | -40 | -10 | | -40 | mA |
| I_{CC} | Supply current (quiescent or triggered) | $V_{CC} = \text{MAX}$, See Notes 6 and 7 | 23 | 36 | | 46 | 66 | | mA |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^{\circ}C$.

§ Not more than one output should be shorted at a time.

NOTES: 5. Ground C_{ext} to measure V_{OH} at Q, V_{OL} at \bar{Q} , or I_{OS} at Q. C_{ext} is open to measure V_{OH} at \bar{Q} , V_{OL} at Q, or I_{OS} at \bar{Q} .

6. Quiescent I_{CC} is measured (after clearing) with 4.5 V applied to all clear and A inputs, B inputs grounded, all outputs open and $R_{ext} = 25 \text{ k}\Omega$. R_{int} of '122 is open.

7. I_{CC} is measured in the triggered state with 2.4 V applied to all clear and B inputs, A inputs grounded, all outputs open, $C_{ext} = 0.02 \mu F$, and $R_{ext} = 25 \text{ k}\Omega$. R_{int} of '122 is open.

switching characteristics, $V_{CC} = 5 \text{ V}$, $T_A = 25^{\circ}C$, see note 8

| PARAMETER¶ | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | '122, '130 | | | '123 | | | UNIT |
|----------------------|--------------|-------------|--|------------|------|------|------|------|------|---------|
| | | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| t_{PLH} | A | Q | $C_{ext} = 0$, $R_{ext} = 5 \text{ k}\Omega$, $C_L = 15 \text{ pF}$, $R_L = 400 \Omega$ | 22 | 33 | | 22 | 33 | | ns |
| | B | Q | | 19 | 28 | | 19 | 28 | | |
| t_{PHL} | A | \bar{Q} | | 30 | 40 | | 30 | 40 | | ns |
| | B | \bar{Q} | | 27 | 36 | | 27 | 36 | | |
| t_{PHL} | Clear | Q | | 18 | 27 | | 18 | 27 | | ns |
| t_{PLH} | Clear | \bar{Q} | | 30 | 40 | | 30 | 40 | | |
| $t_{WQ}(\text{min})$ | A or B | Q | | 45 | 65 | | 45 | 76 | | ns |
| t_{WQ} | A or B | Q | $C_{ext} = 1000 \text{ pF}$, $R_{ext} = 10 \text{ k}\Omega$, $C_L = 15 \text{ pF}$, $R_L = 400 \Omega$ | 3.08 | 3.42 | 3.76 | 2.76 | 3.03 | 3.37 | μs |

¶ t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

t_{WQ} = duration of pulse at output Q.

NOTE 8: Load circuits and voltage waveforms are shown in Section 1.



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recommended operating conditions

| | SN54LS' | | | SN74LS' | | | UNIT |
|--|----------------|-----|------|----------------|-----|------|--------------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output current, I_{OH} | | | -400 | | | -400 | μ A |
| Low-level output current, I_{OL} | | | 4 | | | 8 | mA |
| Pulse duration, t_w | 40 | | | 40 | | | ns |
| External timing resistance, R_{ext} | 5 | | 180 | 5 | | 260 | k Ω |
| External capacitance, C_{ext} | No restriction | | | No restriction | | | |
| Wiring capacitance at R_{ext}/C_{ext} terminal | | | 50 | | | 50 | pF |
| Operating free-air temperature, T_A | -55 | | 125 | 0 | | 70 | $^{\circ}$ C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | SN54LS' | | | SN74LS' | | | UNIT |
|--|---|---------|------|-------------|---------|------|-------------|---------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V_{IH} High-level input voltage | | 2 | | | 2 | | | V |
| V_{IL} Low-level input voltage | | | | 0.7 | | | 0.8 | V |
| V_{IK} Input clamp voltage | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$ | | | -1.5 | | | -1.5 | V |
| V_{OH} High-level output voltage | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL\text{max}}, I_{OH} = -400 \mu\text{A}$ | 2.5 | 3.5 | | 2.7 | 3.5 | | V |
| V_{OL} Low-level output voltage | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL\text{max}}, I_{OL} = 4 \text{ mA}$ | 0.25 | 0.4 | | 0.25 | 0.4 | | V |
| | | | | | | | 0.35 0.5 | |
| I_I Input current at maximum input voltage | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$ | | | 0.1 | | | 0.1 | mA |
| I_{IH} High-level input current | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | | | 20 | | | 20 | μ A |
| I_{IL} Low-level input current | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | | | -0.4 | | | -0.4 | mA |
| I_{OS} Short-circuit output current§ | $V_{CC} = \text{MAX}$ | -20 | | -100 | -20 | | -100 | mA |
| I_{CC} Supply current (quiescent or triggered) | $V_{CC} = \text{MAX},$ See Note 13 | | | 'LS122 6 11 | | | 'LS123 6 11 | mA |
| | | | | | | | 12 20 | |

†For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}\text{C}$.

§Not more than one output should be shorted at a time and duration of the short-circuit should not exceed one second.

NOTES: 12. To measure V_{OH} at Q, V_{OL} at Q, or I_{OS} at Q, ground R_{ext}/C_{ext} , apply 2 V to B and clear, and pulse A from 2 V to 0 V.

13. With all outputs open and 4.5 V applied to all data and clear inputs. I_{CC} is measured after a momentary ground, then 4.5 V, is applied to A or B inputs.

switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^{\circ}\text{C}$ (see note 8)

| PARAMETER¶ | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------|-----------------|----------------|---|-----|-----|-----|------|
| tPLH | A | Q | Cext = 0, Rext = 5 kΩ, CL = 15 pF, RL = 2 kΩ | | 23 | 33 | ns |
| | B | | | | 23 | 44 | |
| tPHL | A | Q̄ | | | 32 | 45 | ns |
| | B | | | | 34 | 56 | |
| tPHL | Clear | Q | | | 20 | 27 | ns |
| tPLH | | Q̄ | | | 28 | 45 | |
| twQ (min) | A or B | Q | | | 116 | 200 | ns |
| twQ | A or B | Q | Cext = 1000 pF, Rext = 10 kΩ, CL = 15 pF, RL = 2 kΩ | 4 | 4.5 | 5 | μs |

¶ t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

t_{wQ} = duration of pulse at output Q.

NOTE 8: Load circuits and voltage waveforms are shown in Section 1.



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TYPICAL APPLICATION DATA FOR '122, '123, '130

For pulse durations when $C_{ext} \leq 1000$ pF, see Figure 4.

The output pulse duration is primarily a function of the external capacitor and resistor. For $C_{ext} > 1000$ pF, the output pulse duration (t_W) is defined as:

$$t_W = K \cdot R_T \cdot C_{ext} \left(1 + \frac{0.7}{R_T} \right)$$

where

K is 0.32 for '122, 0.28 for '123 and '130

R_T is in $k\Omega$ (internal or external timing resistance.)

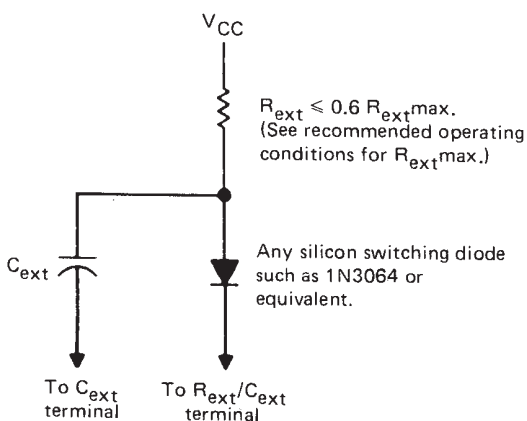
C_{ext} is in pF

t_W is in ns

To prevent reverse voltage across C_{ext} , it is recommended that the method shown in Figure 2 be employed when using electrolytic capacitors and in applications utilizing the clear function. In all applications using the diode, the pulse duration is:

$$t_W = K_D \cdot R_T \cdot C_{ext} \left(1 + \frac{0.7}{R_T} \right)$$

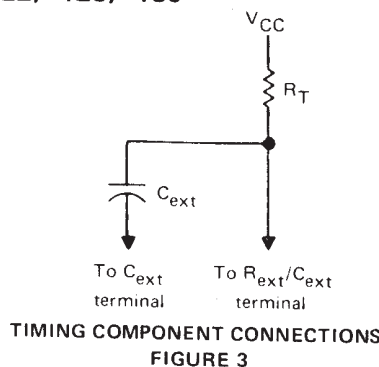
K_D is 0.28 for '122, 0.25 for '123 and '130



TIMING COMPONENT CONNECTIONS WHEN
 $C_{ext} > 1000$ pF AND CLEAR IS USED

FIGURE 2

Applications requiring more precise pulse durations (up to 28 seconds) and not requiring the clear feature can best be satisfied with the '121.



TYPICAL OUTPUT PULSE DURATION
vs
EXTERNAL TIMING CAPACITANCE

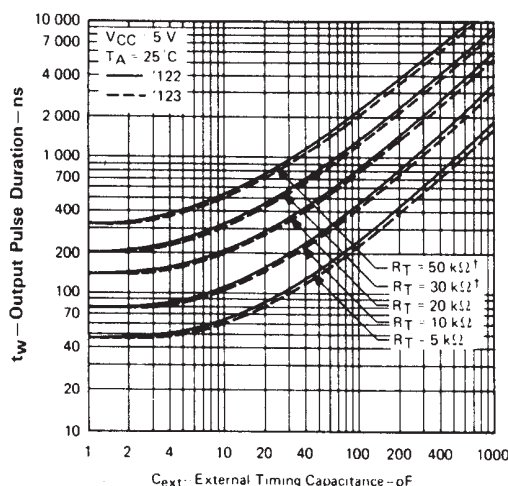


FIGURE 4

†These values of resistance exceed the maximum recommended for use over the full temperature range of the SN54' circuits.

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TYPICAL APPLICATION DATA FOR 'LS122, 'LS123

The basic output pulse duration is essentially determined by the values of external capacitance and timing resistance. For pulse durations when $C_{ext} \leq 1000$ pF, use Figure 6, or use Figure 7 where the pulse duration may be defined as:

$$t_w = K \cdot R_T \cdot C_{ext}$$

When $C_{ext} \geq 1 \mu F$, the output pulse width is defined as:

$$t_w = 0.33 \cdot R_T \cdot C_{ext}$$

For the above two equations, as applicable;

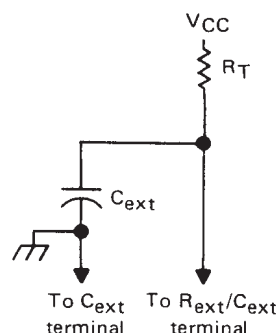
K is multiplier factor, see Figure 7

R_T is in $k\Omega$ (internal or external timing resistance)

C_{ext} is in pF

t_w is in ns

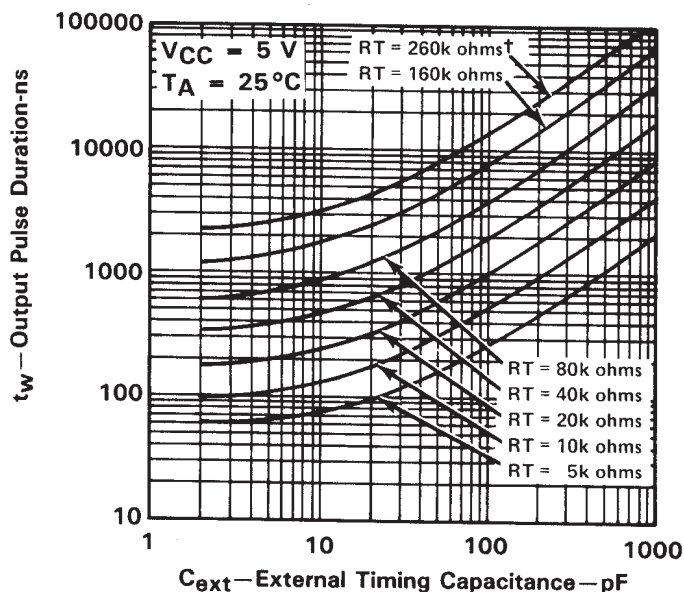
For maximum noise immunity, system ground should be applied to the C_{ext} node, even though the C_{ext} node is already tied to the ground lead internally. Due to the timing scheme used by the 'LS122 and 'LS123, a switching diode is not required to prevent reverse biasing when using electrolytic capacitors.



TIMING COMPONENT CONNECTIONS

FIGURE 5

'LS122, 'LS123 TYPICAL OUTPUT PULSE DURATION vs EXTERNAL TIMING CAPACITANCE



† This value of resistance exceeds the maximum recommended for use over the full temperature range of the SN54LS circuits.

FIGURE 6

SN54LS122, SN54LS123, SN74LS122, SN74LS123 RETRIGGERABLE MONOSTABLE MULTIVIBRATORS

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TYPICAL APPLICATION DATA FOR 'LS122, 'LS123†

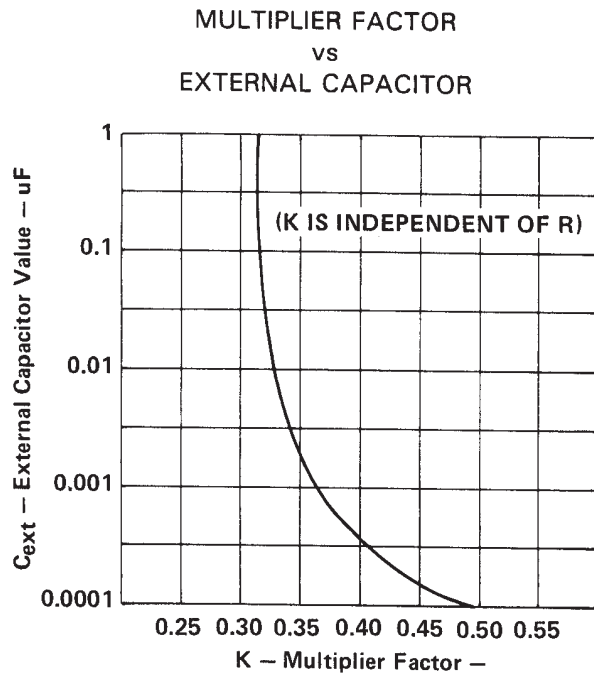


FIGURE 7

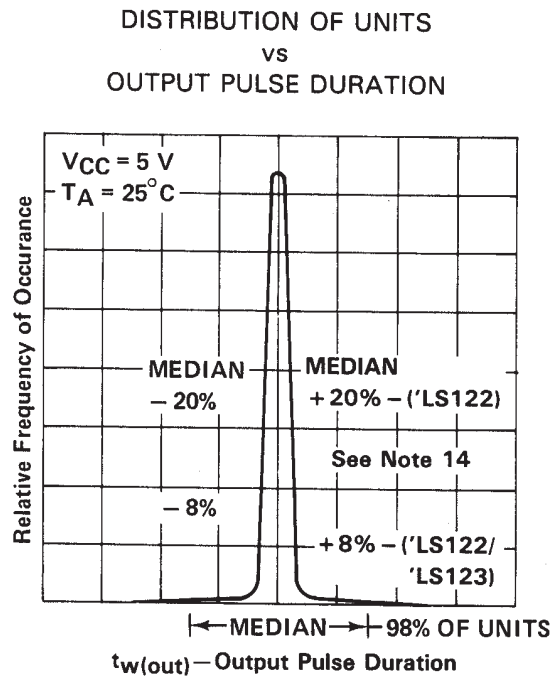


FIGURE 8

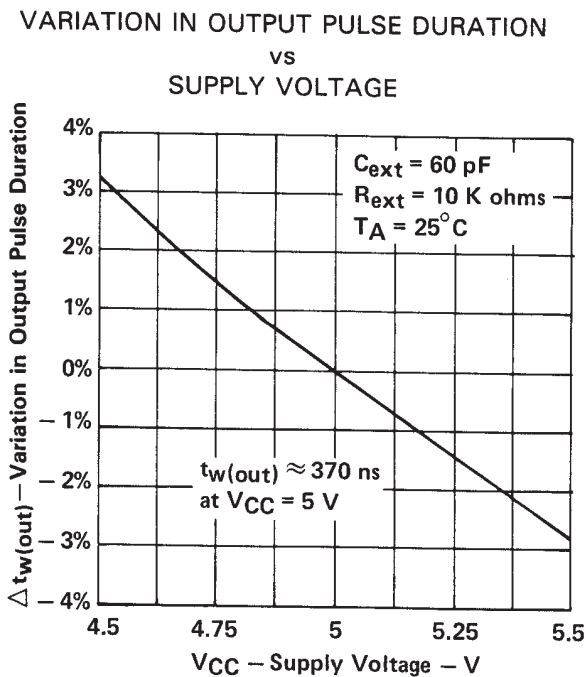


FIGURE 9

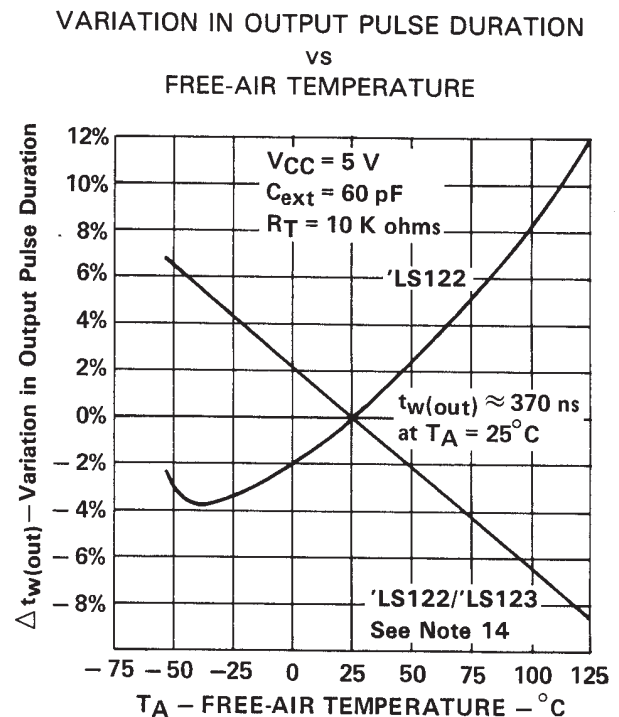


FIGURE 10

NOTE 14: For the 'LS122, the internal timing resistor, R_{int} was used. For the 'LS122/123, an external timing resistor was used for R_T .

†Data for temperatures below $0^\circ C$ and above $70^\circ C$ and for supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS122 and SN54LS123 only.

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| 5962-7603901VEA | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| 5962-7603901VFA | ACTIVE | CFP | W | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| 7603901EA | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| 7603901FA | ACTIVE | CFP | W | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| JM38510/01203BEA | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| JM38510/31401B2A | ACTIVE | LCCC | FK | 20 | 1 | None | Call TI | Level-NC-NC-NC |
| JM38510/31401BEA | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| JM38510/31401BFA | ACTIVE | CFP | W | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| SN54122J | OBSOLETE | CDIP | J | 14 | | None | Call TI | Call TI |
| SN54123J | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| SN54LS123J | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| SN74122N | OBSOLETE | PDIP | N | 14 | | None | Call TI | Call TI |
| SN74123N | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| SN74123N3 | OBSOLETE | PDIP | N | 16 | | None | Call TI | Call TI |
| SN74LS122D | ACTIVE | SOIC | D | 14 | 50 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LS122DR | ACTIVE | SOIC | D | 14 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LS122N | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| SN74LS122N3 | OBSOLETE | PDIP | N | 14 | | None | Call TI | Call TI |
| SN74LS122NSR | ACTIVE | SO | NS | 14 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LS123D | ACTIVE | SOIC | D | 16 | 40 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LS123DR | ACTIVE | SOIC | D | 16 | 2500 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SN74LS123J | OBSOLETE | CDIP | J | 16 | | None | Call TI | Call TI |
| SN74LS123N | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | Level-NC-NC-NC |
| SN74LS123N3 | OBSOLETE | PDIP | N | 16 | | None | Call TI | Call TI |
| SN74LS123NSR | ACTIVE | SO | NS | 16 | 2000 | Pb-Free (RoHS) | CU NIPDAU | Level-2-260C-1 YEAR/ Level-1-235C-UNLIM |
| SNJ54122J | OBSOLETE | CDIP | J | 14 | | None | Call TI | Call TI |
| SNJ54123J | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| SNJ54123W | ACTIVE | CFP | W | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| SNJ54LS123FK | ACTIVE | LCCC | FK | 20 | 1 | None | Call TI | Level-NC-NC-NC |
| SNJ54LS123J | ACTIVE | CDIP | J | 16 | 1 | None | Call TI | Level-NC-NC-NC |
| SNJ54LS123W | ACTIVE | CFP | W | 16 | 1 | None | Call TI | Level-NC-NC-NC |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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