

# SN74LS122, SN74LS123

## Retriggerable Monostable Multivibrators

These dc triggered multivibrators feature pulse width control by three methods. The basic pulse width is programmed by selection of external resistance and capacitance values. The LS122 has an internal timing resistor that allows the circuits to be used with only an external capacitor. Once triggered, the basic pulse width 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.

- Overriding Clear Terminates Output Pulse
- Compensated for  $V_{CC}$  and Temperature Variations
- DC Triggered from Active-High or Active-Low Gated Logic Inputs
- Retriggerable for Very Long Output Pulses, up to 100% Duty Cycle
- Internal Timing Resistors on LS122

### GUARANTEED OPERATING RANGES

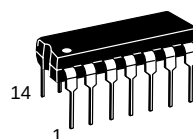
| Symbol            | Parameter                                        | Min            | Typ | Max  | Unit       |
|-------------------|--------------------------------------------------|----------------|-----|------|------------|
| $V_{CC}$          | Supply Voltage                                   | 4.75           | 5.0 | 5.25 | V          |
| $T_A$             | Operating Ambient Temperature Range              | 0              | 25  | 70   | °C         |
| $I_{OH}$          | Output Current – High                            |                |     | –0.4 | mA         |
| $I_{OL}$          | Output Current – Low                             |                |     | 8.0  | mA         |
| $R_{ext}$         | External Timing Resistance                       | 5.0            |     | 260  | k $\Omega$ |
| $C_{ext}$         | External Capacitance                             | No Restriction |     |      |            |
| $R_{ext}/C_{ext}$ | Wiring Capacitance at $R_{ext}/C_{ext}$ Terminal |                |     | 50   | pF         |



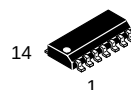
ON Semiconductor™

<http://onsemi.com>

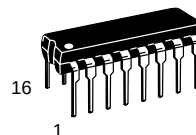
### LOW POWER SCHOTTKY



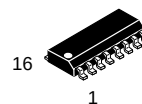
PLASTIC  
N SUFFIX  
CASE 646



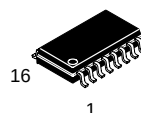
SOIC  
D SUFFIX  
CASE 751A



PLASTIC  
N SUFFIX  
CASE 648



SOIC  
D SUFFIX  
CASE 751B



SOEIAJ  
M SUFFIX  
CASE 966

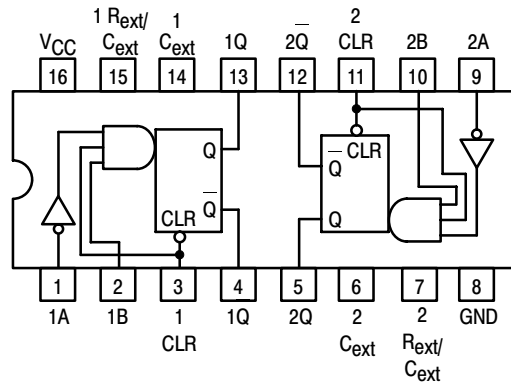
### ORDERING INFORMATION

| Device       | Package    | Shipping         |
|--------------|------------|------------------|
| SN74LS122N   | 14 Pin DIP | 2000 Units/Box   |
| SN74LS122D   | SOIC–14    | 55 Units/Rail    |
| SN74LS122DR2 | SOIC–14    | 2500/Tape & Reel |
| SN74LS123N   | 16 Pin DIP | 2000 Units/Box   |
| SN74LS123D   | SOIC–16    | 38 Units/Rail    |
| SN74LS123DR2 | SOIC–16    | 2500/Tape & Reel |
| SN74LS123M   | SOEIAJ–16  | See Note 1       |
| SN74LS123MEL | SOEIAJ–16  | See Note 1       |

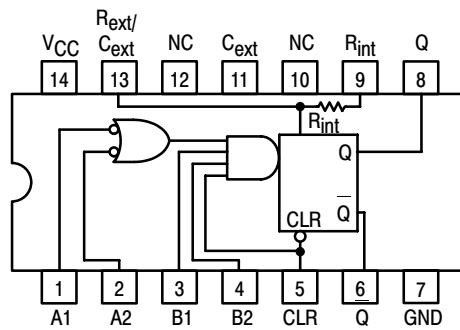
1. For ordering information on the EIAJ version of the SOIC package, please contact your local ON Semiconductor representative.

## SN74LS122, SN74LS123

**SN74LS123 (TOP VIEW)**  
(SEE NOTES 1 THRU 4)



**SN74LS122 (TOP VIEW)**  
(SEE NOTES 1 THRU 4)



NC — NO INTERNAL CONNECTION.

### 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 the LS122, connect  $R_{int}$  to  $V_{CC}$ .
3. For improved pulse width accuracy connect an external resistor between  $R_{ext}/C_{ext}$  and  $V_{CC}$  with  $R_{int}$  open-circuited.
4. To obtain variable pulse widths, connect an external variable resistance between  $R_{int}/C_{ext}$  and  $V_{CC}$ .

# SN74LS122, SN74LS123

LS122 FUNCTIONAL TABLE

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

## TYPICAL APPLICATION DATA

The output pulse  $t_W$  is a function of the external components,  $C_{ext}$  and  $R_{ext}$  or  $C_{ext}$  and  $R_{int}$  on the LS122. For values of  $C_{ext} \geq 1000$  pF, the output pulse at  $V_{CC} = 5.0$  V and  $V_{RC} = 5.0$  V (see Figures 1, 2, and 3) is given by

$$t_W = K R_{ext} C_{ext} \text{ where } K \text{ is nominally } 0.45$$

If  $C_{ext}$  is in pF and  $R_{ext}$  is in  $k\Omega$  then  $t_W$  is in nanoseconds.

The  $C_{ext}$  terminal of the LS122 and LS123 is an internal connection to ground, however for the best system performance  $C_{ext}$  should be hard-wired to ground.

Care should be taken to keep  $R_{ext}$  and  $C_{ext}$  as close to the monostable as possible with a minimum amount of inductance between the  $R_{ext}/C_{ext}$  junction and the  $R_{ext}/C_{ext}$  pin. Good groundplane and adequate bypassing should be designed into the system for optimum performance to ensure that no false triggering occurs.

It should be noted that the  $C_{ext}$  pin is internally connected to ground on the LS122 and LS123, but not on the LS221. Therefore, if  $C_{ext}$  is hard-wired externally to ground, substitution of a LS221 onto a LS123 socket will cause the LS221 to become non-functional.

The switching diode is not needed for electrolytic capacitance application and should not be used on the LS122 and LS123.

To find the value of K for  $C_{ext} \geq 1000$  pF, refer to Figure 4. Variations on  $V_{CC}$  or  $V_{RC}$  can cause the value of K to change, as can the temperature of the LS123, LS122.

LS123 FUNCTIONAL TABLE

| INPUTS |   |   | OUTPUTS                                                                             |                                                                                     |
|--------|---|---|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| CLEAR  | 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 |  |  |

Figures 5 and 6 show the behavior of the circuit shown in Figures 1 and 2 if separate power supplies are used for  $V_{CC}$  and  $V_{RC}$ . If  $V_{CC}$  is tied to  $V_{RC}$ , Figure 7 shows how K will vary with  $V_{CC}$  and temperature. Remember, the changes in  $R_{ext}$  and  $C_{ext}$  with temperature are not calculated and included in the graph.

As long as  $C_{ext} \geq 1000$  pF and  $5K \leq R_{ext} \leq 260K$ , the change in K with respect to  $R_{ext}$  is negligible.

If  $C_{ext} \leq 1000$  pF the graph shown on Figure 8 can be used to determine the output pulse width. Figure 9 shows how K will change for  $C_{ext} \leq 1000$  pF if  $V_{CC}$  and  $V_{RC}$  are connected to the same power supply. The pulse width  $t_W$  in nanoseconds is approximated by

$$t_W = 6 + 0.05 C_{ext} (\text{pF}) + 0.45 R_{ext} (k\Omega) C_{ext} + 11.6 R_{ext}$$

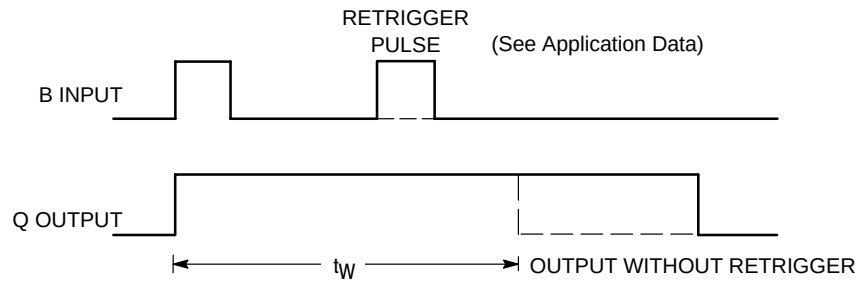
In order to trim the output pulse width, it is necessary to include a variable resistor between  $V_{CC}$  and the  $R_{ext}/C_{ext}$  pin or between  $V_{CC}$  and the  $R_{ext}$  pin of the LS122. Figure 10, 11, and 12 show how this can be done.  $R_{ext}$  remote should be kept as close to the monostable as possible.

Retriggering of the part, as shown in Figure 3, must not occur before  $C_{ext}$  is discharged or the retrigger pulse will not have any effect. The discharge time of  $C_{ext}$  in nanoseconds is guaranteed to be less than  $0.22 C_{ext} (\text{pF})$  and is typically  $0.05 C_{ext} (\text{pF})$ .

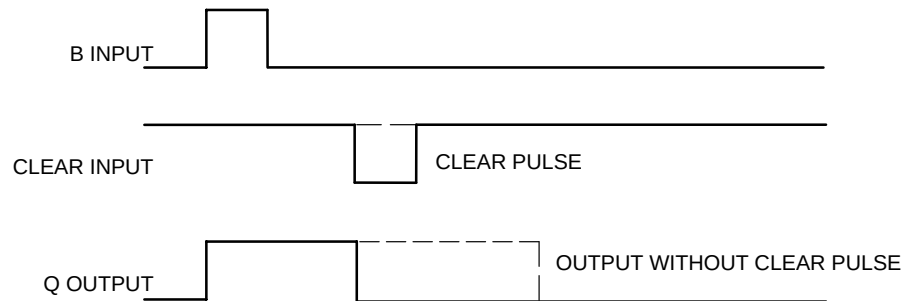
For the smallest possible deviation in output pulse widths from various devices, it is suggested that  $C_{ext}$  be kept  $\geq 1000$  pF.

# SN74LS122, SN74LS123

## WAVEFORMS



## EXTENDING PULSE WIDTH



## OVERRIDING THE OUTPUT PULSE

# SN74LS122, SN74LS123

## DC CHARACTERISTICS OVER OPERATING TEMPERATURE RANGE (unless otherwise specified)

| Symbol   | Parameter                      | Limits |       |      | Unit          | Test Conditions                                                                               |
|----------|--------------------------------|--------|-------|------|---------------|-----------------------------------------------------------------------------------------------|
|          |                                | Min    | Typ   | Max  |               |                                                                                               |
| $V_{IH}$ | Input HIGH Voltage             | 2.0    |       |      | V             | Guaranteed Input HIGH Voltage for All Inputs                                                  |
| $V_{IL}$ | Input LOW Voltage              |        |       | 0.8  | V             | Guaranteed Input LOW Voltage for All Inputs                                                   |
| $V_{IK}$ | Input Clamp Diode Voltage      |        | -0.65 | -1.5 | V             | $V_{CC} = \text{MIN}$ , $I_{IN} = -18 \text{ mA}$                                             |
| $V_{OH}$ | Output HIGH Voltage            | 2.7    | 3.5   |      | V             | $V_{CC} = \text{MIN}$ , $I_{OH} = \text{MAX}$ , $V_{IN} = V_{IH}$ or $V_{IL}$ per Truth Table |
| $V_{OL}$ | Output LOW Voltage             |        | 0.25  | 0.4  | V             | $I_{OL} = 4.0 \text{ mA}$                                                                     |
|          |                                |        | 0.35  | 0.5  | V             | $I_{OL} = 8.0 \text{ mA}$                                                                     |
| $I_{IH}$ | Input HIGH Current             |        |       | 20   | $\mu\text{A}$ | $V_{CC} = \text{MAX}$ , $V_{IN} = 2.7 \text{ V}$                                              |
|          |                                |        |       | 0.1  | mA            | $V_{CC} = \text{MAX}$ , $V_{IN} = 7.0 \text{ V}$                                              |
| $I_{IL}$ | Input LOW Current              |        |       | -0.4 | mA            | $V_{CC} = \text{MAX}$ , $V_{IN} = 0.4 \text{ V}$                                              |
| $I_{OS}$ | Short Circuit Current (Note 2) | -20    |       | -100 | mA            | $V_{CC} = \text{MAX}$                                                                         |
| $I_{CC}$ | Power Supply Current           | LS122  |       | 11   | mA            | $V_{CC} = \text{MAX}$                                                                         |
|          |                                | LS123  |       | 20   |               |                                                                                               |

2. Not more than one output should be shorted at a time, nor for more than 1 second.

## AC CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , $V_{CC} = 5.0 \text{ V}$ )

| Symbol                 | Parameter                                                                   | Limits |          |          | Unit          | Test Conditions                                                                                                       |
|------------------------|-----------------------------------------------------------------------------|--------|----------|----------|---------------|-----------------------------------------------------------------------------------------------------------------------|
|                        |                                                                             | Min    | Typ      | Max      |               |                                                                                                                       |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, A to Q<br>Propagation Delay, A to Q                      |        | 23<br>32 | 33<br>45 | ns            | $C_{ext} = 0$<br>$C_L = 15 \text{ pF}$<br>$R_{ext} = 5.0 \text{ k}\Omega$<br>$R_L = 2.0 \text{ k}\Omega$              |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, B to Q<br>Propagation Delay, B to Q                      |        | 23<br>34 | 44<br>56 | ns            |                                                                                                                       |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay, Clear to $\overline{Q}$<br>Propagation Delay, Clear to Q |        | 28<br>20 | 45<br>27 | ns            |                                                                                                                       |
| $t_W \text{ min}$      | A or B to Q                                                                 |        | 116      | 200      | ns            |                                                                                                                       |
| $t_{WQ}$               | A to B to Q                                                                 | 4.0    | 4.5      | 5.0      | $\mu\text{s}$ |                                                                                                                       |
|                        |                                                                             |        |          |          |               | $C_{ext} = 1000 \text{ pF}$ , $R_{ext} = 10 \text{ k}\Omega$ ,<br>$C_L = 15 \text{ pF}$ , $R_L = 2.0 \text{ k}\Omega$ |

## AC SETUP REQUIREMENTS ( $T_A = 25^\circ\text{C}$ , $V_{CC} = 5.0 \text{ V}$ )

| Symbol | Parameter   | Limits |     |     | Unit | Test Conditions |
|--------|-------------|--------|-----|-----|------|-----------------|
|        |             | Min    | Typ | Max |      |                 |
| $t_W$  | Pulse Width | 40     |     |     | ns   |                 |

# SN74LS122, SN74LS123

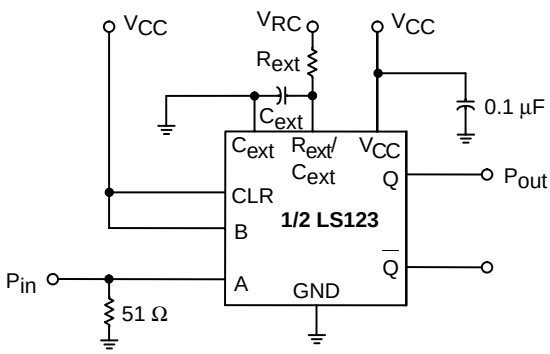


Figure 1.

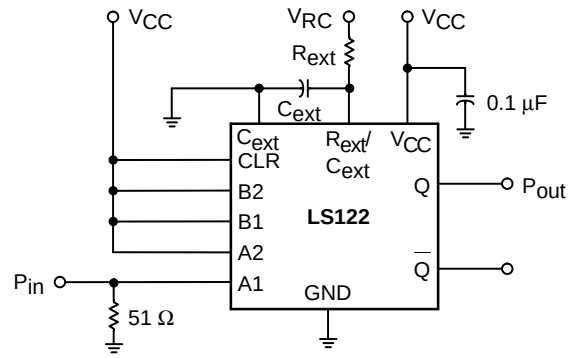


Figure 2.

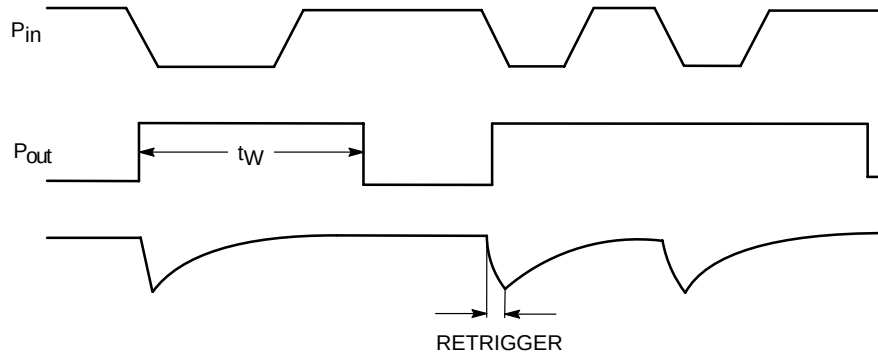


Figure 3.

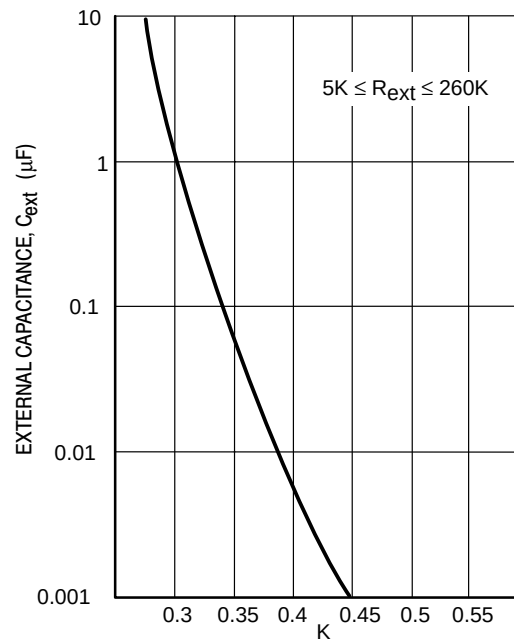


Figure 4.

# SN74LS122, SN74LS123

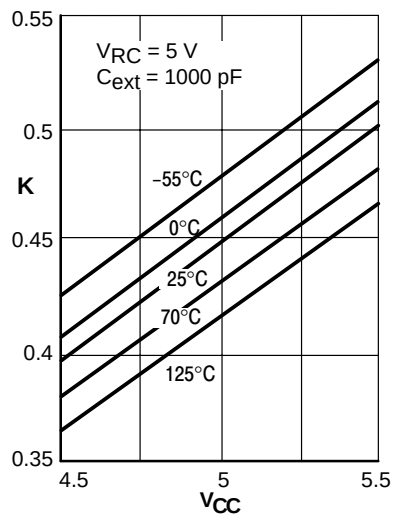


Figure 5. K versus  $V_{CC}$

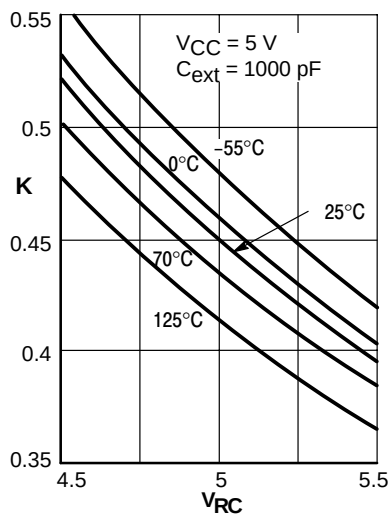


Figure 6. K versus  $V_{RC}$

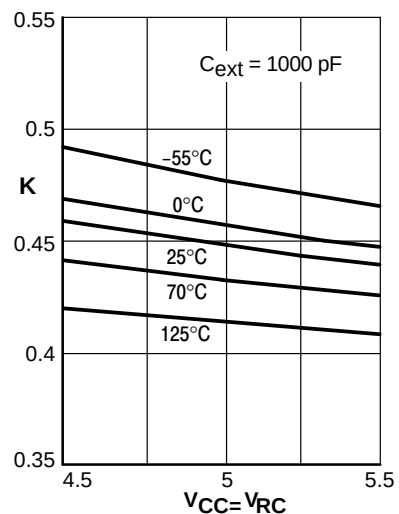


Figure 7. K versus  $V_{CC}$  and  $V_{RC}$

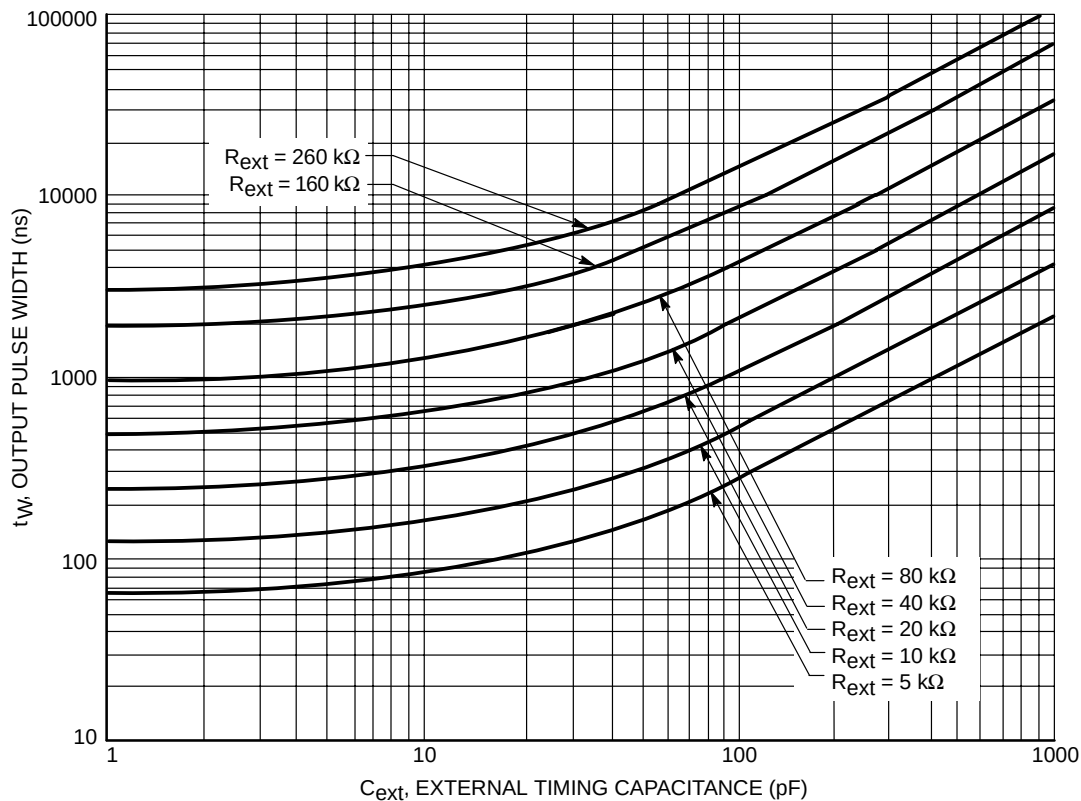


Figure 8.

# SN74LS122, SN74LS123

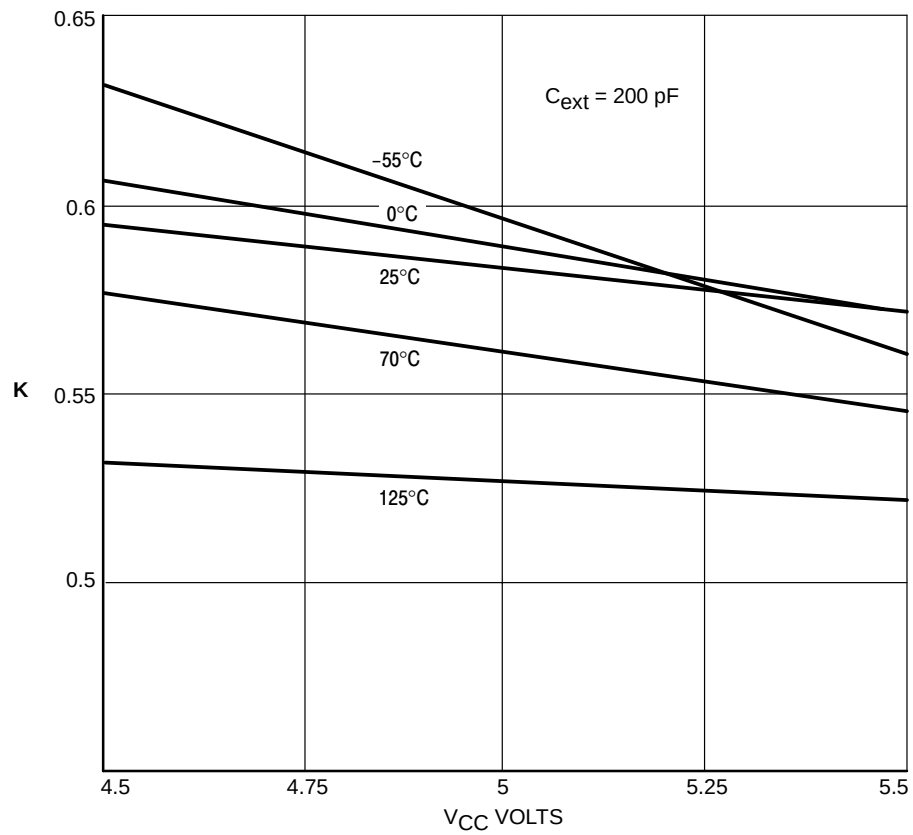


Figure 9.

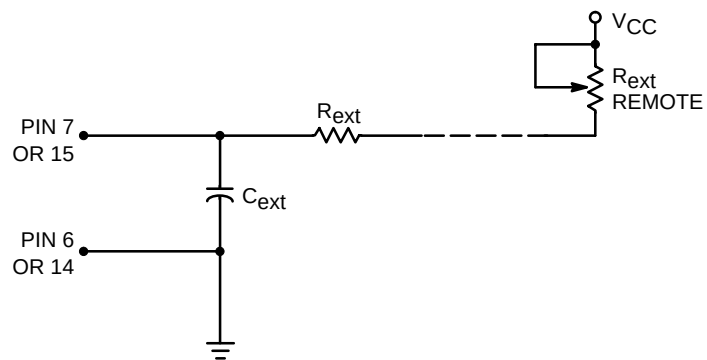


Figure 10. LS123 Remote Trimming Circuit



## SN74LS122, SN74LS123

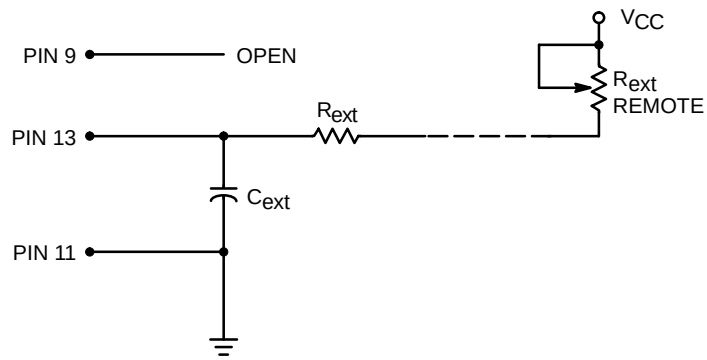


Figure 11. LS122 Remote Trimming Circuit Without  $R_{ext}$

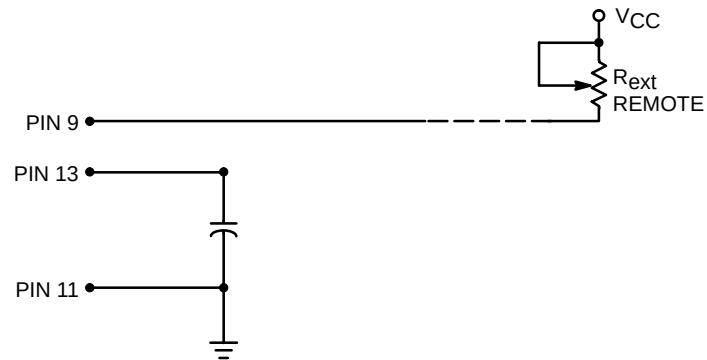
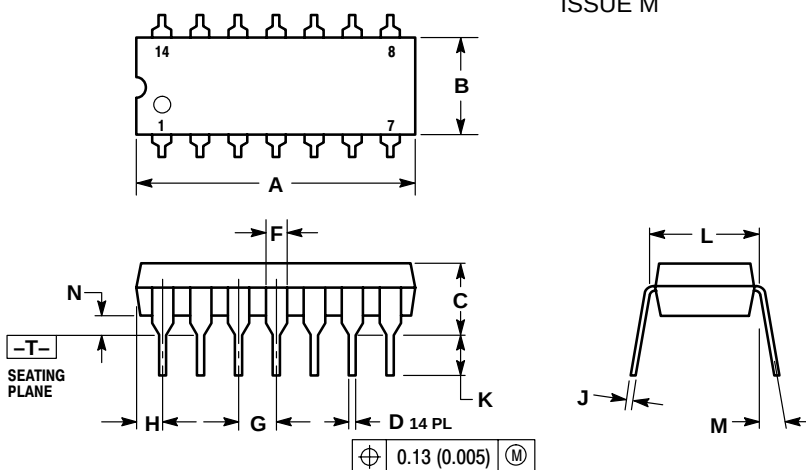


Figure 12. LS122 Remote Trimming Circuit with  $R_{int}$

# SN74LS122, SN74LS123

## PACKAGE DIMENSIONS

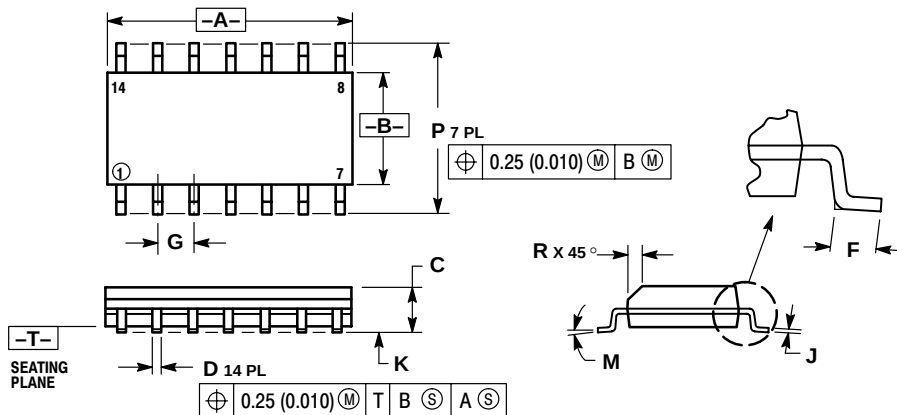
### N SUFFIX PLASTIC PACKAGE CASE 646-06 ISSUE M



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
  4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
  5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.715     | 0.770 | 18.16       | 18.80 |
| B   | 0.240     | 0.260 | 6.10        | 6.60  |
| C   | 0.145     | 0.185 | 3.69        | 4.69  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.78  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.052     | 0.095 | 1.32        | 2.41  |
| J   | 0.008     | 0.015 | 0.20        | 0.38  |
| K   | 0.115     | 0.135 | 2.92        | 3.43  |
| L   | 0.290     | 0.310 | 7.37        | 7.87  |
| M   | ---       | 10°   | ---         | 10°   |
| N   | 0.015     | 0.039 | 0.38        | 1.01  |

### D SUFFIX PLASTIC SOIC PACKAGE CASE 751A-03 ISSUE F



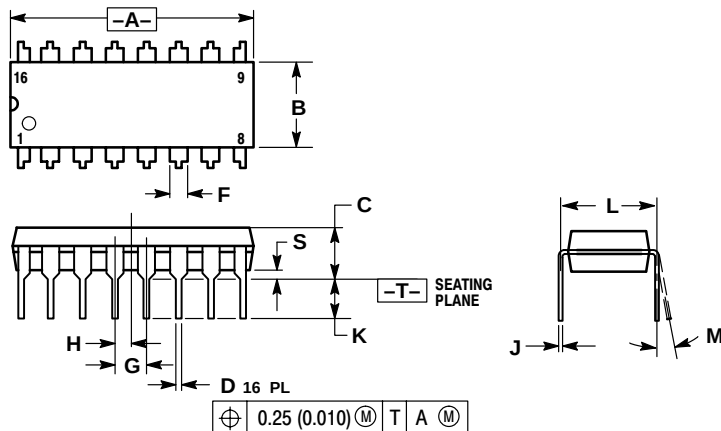
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 8.55        | 8.75 | 0.337     | 0.344 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.054     | 0.068 |
| D   | 0.35        | 0.49 | 0.014     | 0.019 |
| F   | 0.40        | 1.25 | 0.016     | 0.049 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| J   | 0.19        | 0.25 | 0.008     | 0.009 |
| K   | 0.10        | 0.25 | 0.004     | 0.009 |
| M   | 0°          | 7°   | 0°        | 7°    |
| P   | 5.80        | 6.20 | 0.228     | 0.244 |
| R   | 0.25        | 0.50 | 0.010     | 0.019 |

# SN74LS122, SN74LS123

## PACKAGE DIMENSIONS

### N SUFFIX PLASTIC PACKAGE CASE 648-08 ISSUE R

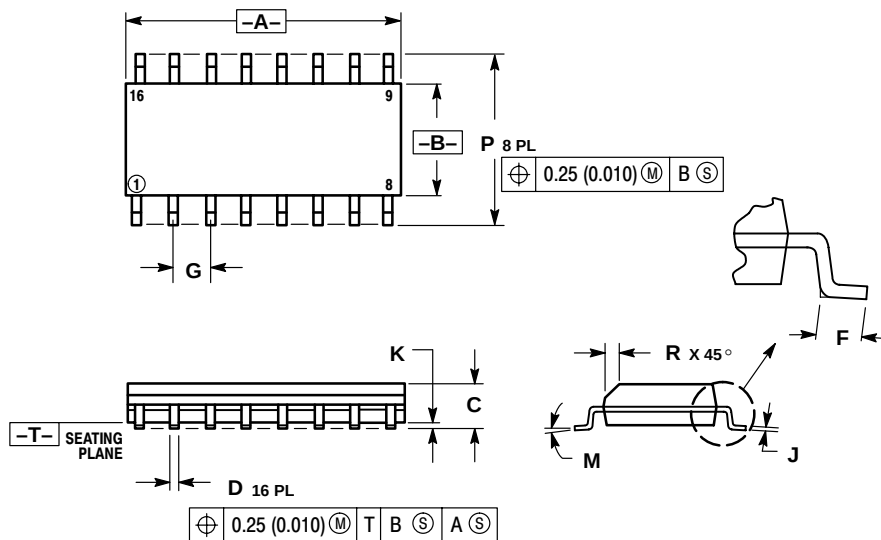


#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.70  | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        | 10°   | 0°          | 10°   |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |

### D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



#### NOTES:

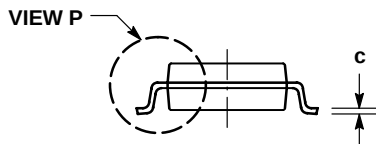
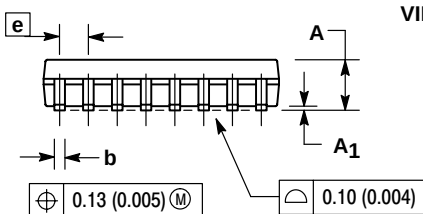
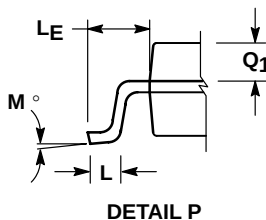
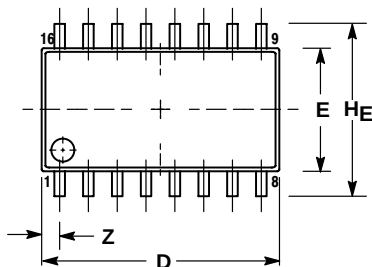
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 9.80        | 10.00 | 0.386     | 0.393 |
| B   | 3.80        | 4.00  | 0.150     | 0.157 |
| C   | 1.35        | 1.75  | 0.054     | 0.068 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.40        | 1.25  | 0.016     | 0.049 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.19        | 0.25  | 0.008     | 0.009 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0°          | 7°    | 0°        | 7°    |
| P   | 5.80        | 6.20  | 0.229     | 0.244 |
| R   | 0.25        | 0.50  | 0.010     | 0.019 |

# SN74LS122, SN74LS123

## PACKAGE DIMENSIONS

**M SUFFIX**  
SOEIAJ PACKAGE  
CASE 966-01  
ISSUE O



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | MIN         | MAX   | MIN       | MAX   |
| A              | ---         | 2.05  | ---       | 0.081 |
| A <sub>1</sub> | 0.05        | 0.20  | 0.002     | 0.008 |
| b              | 0.35        | 0.50  | 0.014     | 0.020 |
| c              | 0.18        | 0.27  | 0.007     | 0.011 |
| D              | 9.90        | 10.50 | 0.390     | 0.413 |
| E              | 5.10        | 5.45  | 0.201     | 0.215 |
| e              | 1.27 BSC    |       | 0.050 BSC |       |
| HE             | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| LE             | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0°          | 10°   | 0°        | 10°   |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 0.78  | ---       | 0.031 |

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