

## 9601/DM9601 Retriggerable One Shot

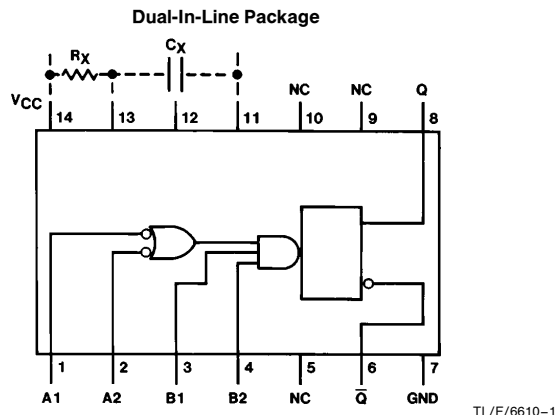
### General Description

These retriggerable one shots provide the designer with four inputs; two active high and two active low. This permits a choice of either leading-edge or trailing-edge triggering, independent of input transition times. When input conditions for triggering are met, a new cycle starts and the external capacitor is rapidly discharged and then allowed to charge again. The retriggerable feature allows for output pulse widths to be expanded. In fact a continuous true output can be maintained by having an input cycle time which is shorter than the output cycle time. Retriggering may be inhibited by tying the  $\bar{Q}$  output to an active low input.

### Features

- High speed operation—input repetition rate  $> 10$  MHz
- Flexibility of operation—optional retriggering/lock-out capability
- Output pulse width range—50 ns to  $\infty$
- Leading or trailing edge triggering
- Complementary outputs/inputs
- Input clamping diodes
- DTL/TTL compatible logic levels
- Alternate Military/Aerospace device (9601) is available. Contact a National Semiconductor Sales Office/Distributor for specifications.

### Connection Diagram



Order Number 9601DMQB, 9601FMQB, DM9601J, DM9601W or DM9601N  
See NS Package Number J14A, N14A or W14B

### Function Table

| Inputs |    |    |    | Outputs |           |
|--------|----|----|----|---------|-----------|
| A1     | A2 | B1 | B2 | Q       | $\bar{Q}$ |
| H      | H  | X  | X  | L       | H         |
| X      | X  | L  | X  | L       | H         |
| X      | X  | X  | L  | L       | H         |
| L      | X  | H  | H  | L       | H         |
| L      | X  | ↑  | H  | ⌊       | ⌋         |
| L      | X  | H  | ↑  | ⌊       | ⌋         |
| X      | L  | H  | H  | L       | H         |
| X      | L  | ↑  | H  | ⌊       | ⌋         |
| X      | L  | H  | ↑  | ⌊       | ⌋         |
| H      | ↓  | H  | H  | ⌊       | ⌋         |
| ↓      | ↓  | H  | H  | ⌊       | ⌋         |
| ↓      | H  | H  | H  | ⌊       | ⌋         |

H = High Logic Level  
L = Low Logic Level  
X = Either Low or High Logic Level  
↑ = Low to High Level Transition  
↓ = High to Low Level Transition  
⌊ = Positive Pulse  
⌋ = Negative Pulse

## Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 5.5V            |
| Operating Free Air Temperature Range |                 |
| Military                             | −55°C to +125°C |
| Commercial                           | 0° to +70°C     |
| Storage Temperature Range            | −65°C to +150°C |

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

## Recommended Operating Conditions

| Symbol          | Parameter                      | Military               |     |       | Commercial |     |       | Units |
|-----------------|--------------------------------|------------------------|-----|-------|------------|-----|-------|-------|
|                 |                                | Min                    | Nom | Max   | Min        | Nom | Max   |       |
| V <sub>CC</sub> | Supply Voltage                 | 4.5                    | 5   | 5.5   | 4.75       | 5   | 5.25  | V     |
| V <sub>IH</sub> | High Level Input Voltage       | T <sub>A</sub> = −55°C | 2   |       |            |     |       | V     |
|                 |                                | T <sub>A</sub> = 0°C   |     |       |            | 1.9 |       |       |
|                 |                                | T <sub>A</sub> = 25°C  | 1.7 |       |            | 1.8 |       |       |
|                 |                                | T <sub>A</sub> = 75°C  |     |       |            | 1.6 |       |       |
|                 |                                | T <sub>A</sub> = 125°C | 1.5 |       |            |     |       |       |
| V <sub>IL</sub> | Low Level Input Voltage        | T <sub>A</sub> = −55°C |     |       | 0.85       |     |       | V     |
|                 |                                | T <sub>A</sub> = 0°C   |     |       |            |     | 0.85  |       |
|                 |                                | T <sub>A</sub> = 25°C  |     |       | 0.9        |     | 0.85  |       |
|                 |                                | T <sub>A</sub> = 75°C  |     |       |            |     | 0.85  |       |
|                 |                                | T <sub>A</sub> = 125°C |     |       | 0.85       |     |       |       |
| I <sub>OH</sub> | High Level Output Current      |                        |     | −0.72 |            |     | −0.96 | mA    |
| I <sub>OL</sub> | Low Level Output Current       |                        |     | 10    |            |     | 12.8  | mA    |
| T <sub>A</sub>  | Free Air Operating Temperature | −55                    |     | 125   | 0          |     | 75    | °C    |

## Electrical Characteristics over recommended operating free air temperature range (unless otherwise noted)

| Symbol          | Parameter                    | Conditions (Note 3)  | Min                         | Typ (Note 1) | Max  | Units |
|-----------------|------------------------------|--|-----------------------------|--------------|------|-------|
| V <sub>I</sub>  | Input Clamp Voltage          | V <sub>CC</sub> = Min, I <sub>I</sub> = −12 mA   |                             |              | −1.5 | V     |
| V <sub>OH</sub> | High Level Output Voltage    | V <sub>CC</sub> = Min, I <sub>OH</sub> = Max<br>V <sub>IL</sub> = Max, V <sub>IH</sub> = Min, (Note 4)   | 2.4                         |              |      | V     |
| V <sub>OL</sub> | Low Level Output Voltage     | V <sub>CC</sub> = Min, I <sub>OL</sub> = Max<br>V <sub>IL</sub> = Max, V <sub>IH</sub> = Min<br>(Note 4) | MIL                         |              | 0.4  | V     |
|                 |                              |  | COM                         |              | 0.45 |       |
| I <sub>IH</sub> | High Level Input Current     | V <sub>CC</sub> = Max, V <sub>I</sub> = 4.5V   |                             |              | 60   | μA    |
| I <sub>IL</sub> | Low Level Input Current      | V <sub>CC</sub> = Max  | MIL V <sub>IN</sub> = 0.40V |              | −1.6 | mA    |
|                 |                              |  | COM V <sub>IN</sub> = 0.45V |              | −1.6 |       |
| I <sub>OS</sub> | Short Circuit Output Current | V <sub>CC</sub> = Max<br>(Notes 2 and 4)   | MIL                         | −10          | −40  | mA    |
|                 |                              |  | COM                         | −10          | −40  |       |
| I <sub>CC</sub> | Supply Current               | V <sub>CC</sub> = Max  |                             |              | 25   | mA    |

Note 1: All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

Note 2: Not more than one output should be shorted at a time.

Note 3: Unless otherwise noted, R<sub>X</sub> = 10k between PIN 13 and V<sub>CC</sub> on all tests.

Note 4: Ground PIN 11 for V<sub>OL</sub> test on PIN 6, V<sub>OH</sub> and I<sub>OS</sub> tests on PIN 8. Open PIN 11 for V<sub>OL</sub> test on PIN 8, V<sub>OH</sub> and I<sub>OS</sub> tests on PIN 6.

## Switching Characteristics at $V_{CC} = 5V$ and $T_A = 25^\circ C$ (See Section 1 for Test Waveforms and Output Load)

| Symbol        | Parameter                                       | From (Input) To (Output)                    | Conditions  | Min  | Max  | Units      |
|---------------|---|---|---|------|------|------------|
| $t_{PLH}$     | Propagation Delay Time Low to High Level Output | Negative Trigger Input to True Output       | $C_L = 15 \text{ pF}$<br>$C_X = 0$<br>$R_X = 5 \text{ k}\Omega$ |      | 40   | ns         |
| $t_{PHL}$     | Propagation Delay Time High to Low Level Output | Negative Trigger Input to Complement Output |   |      | 40   | ns         |
| $t_{PW(MIN)}$ | Minimum True Output Pulse Width                 |   |   |      | 65   | ns         |
| $t_{PW}$      | Pulse Width                                     |   | $R_X = 10 \text{ k}\Omega$<br>$C_X = 1000 \text{ pF}$           | 3.08 | 3.76 | $\mu s$    |
| $C_{STRAY}$   | Maximum Allowable Wiring Capacitance            |   | Pin 13 to GND   |      | 50   | pF         |
| $R_X$         | External Timing Resistor                        |   | DM96  |      | 25   | k $\Omega$ |
| $R_X$         | External Timing Resistor                        |   | DM86  |      | 50   | k $\Omega$ |

## Operating Rules

1. An external resistor  $R_X$  and an external capacitor  $C_X$  are required for operation. The value of  $R_X$  can vary between the limits shown in switching characteristics. The value of  $C_X$  is optional and may be adjusted to achieve the required output pulse width.

2. Output pulse width  $t_{PW}$  may be calculated as follows:

$$t_{PW} = K R_X C_X \left[ 1 + \frac{0.7}{R_X} \right] \quad (\text{for } C_X > 10^3 \text{ pF})$$

$K \approx 0.34$

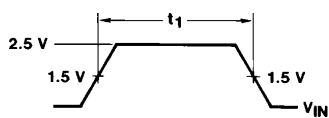
$R_X$  in k $\Omega$ ,  $C_X$  in pF and  $t_{PW}$  in ns.

(For  $C_X < 10^3$  pF, see curve.)

3.  $R_X$  and  $C_X$  must be kept as close as possible to the circuit in order to minimize stray capacitance and noise pickup. If remote trimming is required,  $R_X$  may be split up such that at least  $R_{X(MIN)}$  must be as close as possible to the circuit and the remote portion of the trimming resistor  $R < R_{X(MAX)} - R_X$ .

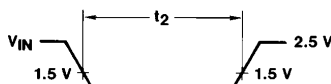
4. Set-up time ( $t_1$ ) for input trigger pulse must be  $> 40$  ns. (See Figure 1).

Release time ( $t_2$ ) for input trigger pulse must be  $> 40$  ns. (See Figure 2).



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FIGURE 1

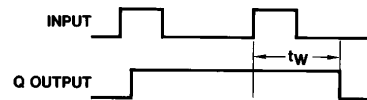


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FIGURE 2

5. Retrigger pulse width (see Figure 3) is calculated as follows:

$$t_W = t_{PW} + t_{PLH} = K R_X C_X \left[ 1 + \frac{0.7}{R_X} \right] + t_{PLH}$$

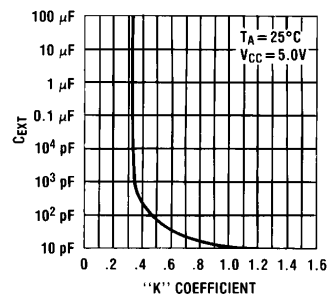


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FIGURE 3

### Typical "K" Coefficient Variation vs Timing Capacitance

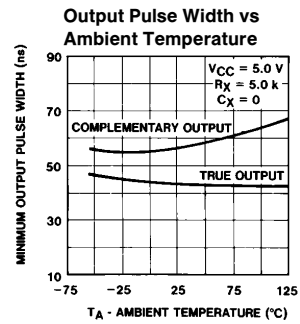
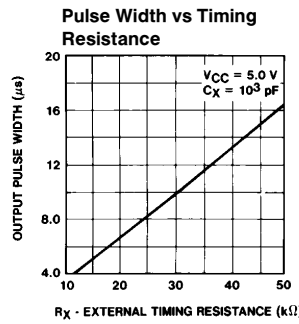
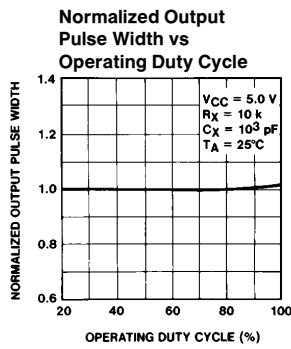
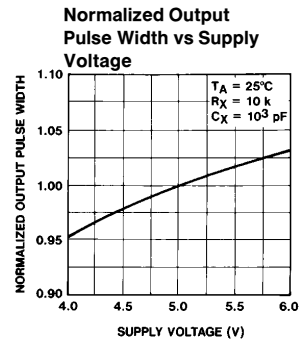
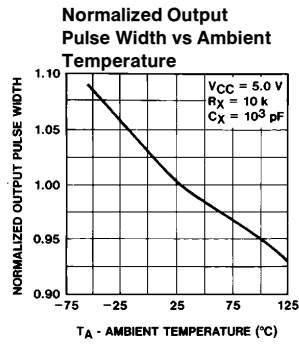
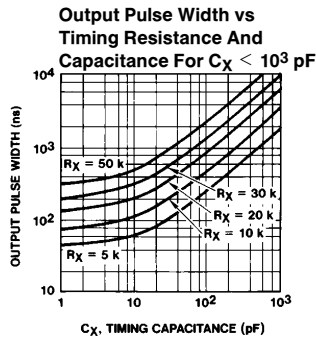
The multiplicative factor "K" varies as a function of the timing capacitor,  $C_X$ . The graph below details this characteristic:



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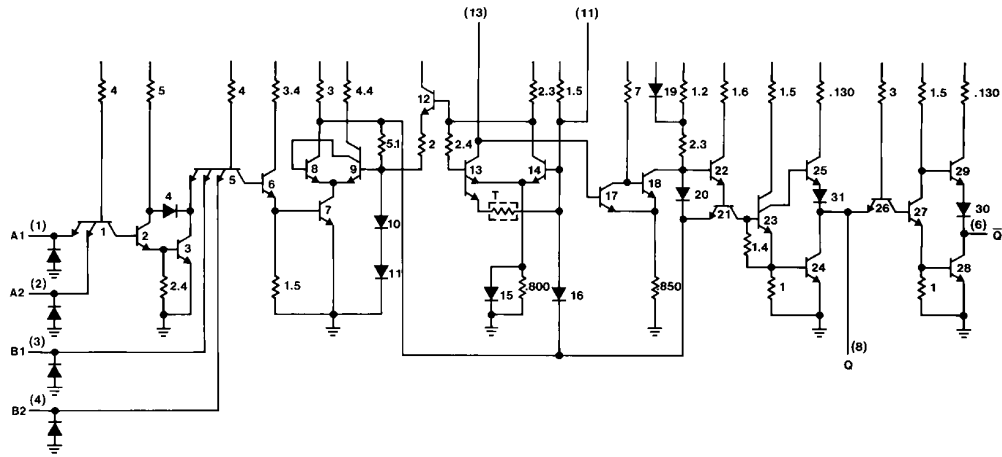
\*For further detailed device characteristics and output performance, please refer to the NSC one-shot application note, AN-366.

# Typical Performance Characteristics



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# Schematic Diagram



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**Physical Dimensions** inches (millimeters) (Continued)



**14-Lead Ceramic Flat Package (W)**  
**Order Number 9601FMQB or DM9601W**  
**NS Package Number W14B**

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