

## MM54C221/MM74C221 Dual Monostable Multivibrator

### General Description

The MM54C221/MM74C221 dual monostable multivibrator is a monolithic complementary MOS integrated circuit. Each multivibrator features a negative-transition-triggered input and a positive-transition-triggered input, either of which can be used as an inhibit input, and a clear input.

Once fired, the output pulses are independent of further transitions of the A and B inputs and are a function of the external timing components  $C_{EXT}$  and  $R_{EXT}$ . The pulse width is stable over a wide range of temperature and  $V_{CC}$ .

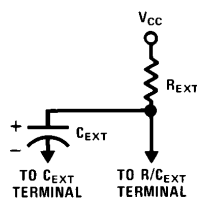
Pulse stability will be limited by the accuracy of external timing components. The pulse width is approximately defined by the relationship  $t_{W(OUT)} \approx C_{EXT} R_{EXT}$ . For further information and applications, see AN-138.

### Features

- Wide supply voltage range 4.5V to 15V
- Guaranteed noise margin 1.0V
- High noise immunity 0.45  $V_{CC}$  (typ.)
- Low power TTL compatibility fan out of 2 driving 74L

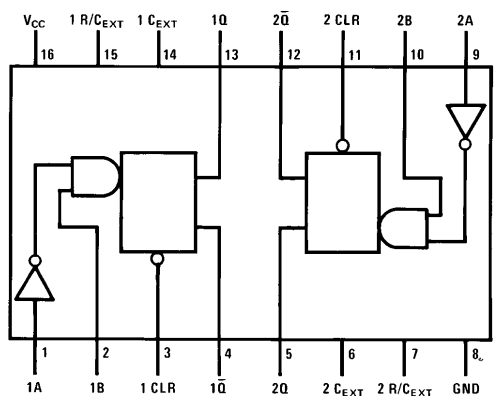
### Connection Diagrams

Timing Component



TL/F/5904-1

Dual-In-Line Package



TL/F/5904-2

Top View

Order Number MM54C221 or MM74C221

### Truth 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 | ⌊       | ⌋         |

- H = High level
- L = Low level
- ↑ = Transition from low to high
- ↓ = Transition from high to low
- ⌊ = One high level pulse
- ⌋ = One low level pulse
- X = Irrelevant

## Absolute Maximum Ratings (Note 1)

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

|                             |                                                           |
|-----------------------------|-----------------------------------------------------------|
| Voltage at Any Pin          | −0.3V to $V_{CC} + 0.3V$                                  |
| Operating Temperature Range | −55°C to +125°C<br>MM54C221<br>−40°C to +85°C<br>MM74C221 |
| Storage Temperature Range   | −65°C to +150°C                                           |

|                                          |             |
|------------------------------------------|-------------|
| Power Dissipation                        | 700 mW      |
| Dual-In-Line                             | 500 mW      |
| Small Outline                            |             |
| Operating $V_{CC}$ Range                 | 4.5V to 15V |
| Absolute Maximum $V_{CC}$                | 18V         |
| $R_{EXT} \geq 80 V_{CC} (\Omega)$        |             |
| Lead Temperature (Soldering, 10 seconds) | 260°C       |

## DC Electrical Characteristics Max/min limits apply across temperature range, unless otherwise noted

| Symbol                                                                                      | Parameter                               | Conditions                                                                      | Min                              | Typ    | Max        | Units   |
|---------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------|----------------------------------|--------|------------|---------|
| <b>CMOS to CMOS</b>                                                                         |                                         |                                                                                 |                                  |        |            |         |
| $V_{IN(1)}$                                                                                 | Logical "1" Input Voltage               | $V_{CC} = 5V$<br>$V_{CC} = 10V$                                                 | 3.5<br>8.0                       |        |            | V<br>V  |
| $V_{IN(0)}$                                                                                 | Logical "0" Input Voltage               | $V_{CC} = 5V$<br>$V_{CC} = 10V$                                                 |                                  |        | 1.5<br>2.0 | V<br>V  |
| $V_{OUT(1)}$                                                                                | Logical "1" Output Voltage              | $V_{CC} = 5V, I_O = -10 \mu A$<br>$V_{CC} = 10V, I_O = -10 \mu A$               | 4.5<br>9.0                       |        |            | V<br>V  |
| $V_{OUT(0)}$                                                                                | Logical "0" Output Voltage              | $V_{CC} = 5V, I_O = +10 \mu A$<br>$V_{CC} = 10V, I_O = +10 \mu A$               |                                  |        | 0.5<br>1   | V<br>V  |
| $I_{IN(1)}$                                                                                 | Logical "1" Input Current               | $V_{CC} = 15V, V_{IN} = 15V$                                                    |                                  | 0.005  | 1.0        | $\mu A$ |
| $I_{IN(0)}$                                                                                 | Logical "0" Input Current               | $V_{CC} = 15V, V_{IN} = 0V$                                                     | −1.0                             | −0.005 |            | $\mu A$ |
| $I_{CC}$                                                                                    | Supply Current (Standby)                | $V_{CC} = 15V, R_{EXT} = \infty$ ,<br>Q1, Q2 = Logic "0" (Note 3)               |                                  | 0.05   | 300        | $\mu A$ |
| $I_{CC}$                                                                                    | Supply Current<br>(During Output Pulse) | $V_{CC} = 15V, Q1 = \text{Logic "1"},$<br>$Q2 = \text{Logic "0"} (Figure 4)$    |                                  | 15     |            | mA      |
|                                                                                             |                                         | $V_{CC} = 5V, Q1 = \text{Logic "1"},$<br>$Q2 = \text{Logic "0"} (Figure 4)$     |                                  | 2      |            | mA      |
|                                                                                             | Leakage Current at R/ $C_{EXT}$ Pin     | $V_{CC} = 15V, V_{CEXT} = 5V$                                                   |                                  | 0.01   | 3.0        | $\mu A$ |
| <b>CMOS/LPTTL Interface</b>                                                                 |                                         |                                                                                 |                                  |        |            |         |
| $V_{IN(1)}$                                                                                 | Logical "1" Input Voltage               | 54C $V_{CC} = 4.5V$<br>74C $V_{CC} = 4.75V$                                     | $V_{CC} - 1.5$<br>$V_{CC} - 1.5$ |        |            | V<br>V  |
| $V_{IN(0)}$                                                                                 | Logical "0" Input Voltage               | 54C $V_{CC} = 4.5V$<br>74C $V_{CC} = 4.75V$                                     |                                  |        | 0.8<br>0.8 | V<br>V  |
| $V_{OUT(1)}$                                                                                | Logical "1" Output Voltage              | 54C $V_{CC} = 4.5V, I_O = -360 \mu A$<br>74C $V_{CC} = 4.75V, I_O = -360 \mu A$ | 2.4<br>2.4                       |        |            | V<br>V  |
| $V_{OUT(0)}$                                                                                | Logical "0" Output Voltage              | 54C $V_{CC} = 4.5V, I_O = 360 \mu A$<br>74C $V_{CC} = 4.75V, I_O = 360 \mu A$   |                                  |        | 0.4<br>0.4 | V<br>V  |
| <b>Output Drive (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)</b> |                                         |                                                                                 |                                  |        |            |         |
| $I_{SOURCE}$                                                                                | Output Source Current<br>(P-Channel)    | $V_{CC} = 5V$<br>$T_A = 25^\circ C, V_{OUT} = 0V$                               | −1.75                            |        |            | mA      |
| $I_{SOURCE}$                                                                                | Output Source Current<br>(P-Channel)    | $V_{CC} = 10V$<br>$T_A = 25^\circ C, V_{OUT} = 0V$                              | −8                               |        |            | mA      |
| $I_{SINK}$                                                                                  | Output Sink Current<br>(N-Channel)      | $V_{CC} = 5V$<br>$T_A = 25^\circ C, V_{OUT} = V_{CC}$                           | 1.75                             |        |            | mA      |
| $I_{SINK}$                                                                                  | Output Sink Current<br>(N-Channel)      | $V_{CC} = 10V$<br>$T_A = 25^\circ C, V_{OUT} = V_{CC}$                          | 8                                |        |            | mA      |

## AC Electrical Characteristics\* $T_A = 25^\circ\text{C}$ , $C_L = 50\text{ pF}$ , unless otherwise noted

| Symbol         | Parameter                                                          | Conditions                                                                                     | Min | Typ  | Max  | Units         |
|----------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----|------|------|---------------|
| $t_{pd\ A, B}$ | Propagation Delay from Trigger Input (A, B) to Output Q, $\bar{Q}$ | $V_{CC} = 5\text{V}$                                                                           |     | 250  | 500  | ns            |
|                |                                                                    | $V_{CC} = 10\text{V}$                                                                          |     | 120  | 250  | ns            |
| $t_{pd\ CL}$   | Propagation Delay from Clear Input (CL) to Output Q, $\bar{Q}$     | $V_{CC} = 5\text{V}$                                                                           |     | 250  | 500  | ns            |
|                |                                                                    | $V_{CC} = 10\text{V}$                                                                          |     | 120  | 250  | ns            |
| $t_S$          | Time Prior to Trigger Input (A, B) that Clear must be Set          | $V_{CC} = 5\text{V}$                                                                           | 150 | 50   |      | ns            |
|                |                                                                    | $V_{CC} = 10\text{V}$                                                                          | 60  | 20   |      | ns            |
| $t_{W(A, B)}$  | Trigger Input (A, B) Pulse Width                                   | $V_{CC} = 5\text{V}$                                                                           | 150 | 50   |      | ns            |
|                |                                                                    | $V_{CC} = 10\text{V}$                                                                          | 70  | 30   |      | ns            |
| $t_{W(CL)}$    | Clear Input (CL) Pulse Width                                       | $V_{CC} = 5\text{V}$                                                                           | 150 | 50   |      | ns            |
|                |                                                                    | $V_{CC} = 10\text{V}$                                                                          | 70  | 30   |      | ns            |
| $t_{W(OUT)}$   | Q or $\bar{Q}$ Output Pulse Width                                  | $V_{CC} = 5\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 0\text{ pF}$                        |     | 900  |      | ns            |
|                |                                                                    | $V_{CC} = 10\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 0\text{ pF}$                       |     | 350  |      | ns            |
|                |                                                                    | $V_{CC} = 15\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 0\text{ pF}$                       |     | 320  |      | ns            |
|                |                                                                    | $V_{CC} = 5\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 1000\text{ pF}$ (Figure 1)          | 9.0 | 10.6 | 12.2 | $\mu\text{s}$ |
|                |                                                                    | $V_{CC} = 10\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 1000\text{ pF}$ (Figure 1)         | 9.0 | 10   | 11   | $\mu\text{s}$ |
|                |                                                                    | $V_{CC} = 15\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 1000\text{ pF}$ (Figure 1)         | 8.9 | 9.8  | 10.8 | $\mu\text{s}$ |
|                |                                                                    | $V_{CC} = 5\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 0.1\text{ }\mu\text{F}$ (Figure 2)  | 900 | 1020 | 1200 | $\mu\text{s}$ |
|                |                                                                    | $V_{CC} = 10\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 0.1\text{ }\mu\text{F}$ (Figure 2) | 900 | 1000 | 1100 | $\mu\text{s}$ |
|                |                                                                    | $V_{CC} = 15\text{V}$ , $R_{EXT} = 10\text{k}$ , $C_{EXT} = 0.1\text{ }\mu\text{F}$ (Figure 2) | 900 | 990  | 1100 | $\mu\text{s}$ |
| $R_{ON}$       | ON Resistance of Transistor between R/ $C_{EXT}$ to $C_{EXT}$      | $V_{CC} = 5\text{V}$ (Note 4)                                                                  |     | 50   | 150  | $\Omega$      |
|                |                                                                    | $V_{CC} = 10\text{V}$ (Note 4)                                                                 |     | 25   | 65   | $\Omega$      |
|                |                                                                    | $V_{CC} = 15\text{V}$ (Note 4)                                                                 |     | 16.7 | 45   | $\Omega$      |
|                | Output Duty Cycle                                                  | $R = 10\text{k}$ , $C = 1000\text{ pF}$                                                        |     |      | 90   | %             |
|                |                                                                    | $R = 10\text{k}$ , $C = 0.1\text{ }\mu\text{F}$ (Note 5)                                       |     |      | 90   | %             |
| $C_{IN}$       | Input Capacitance                                                  | R/ $C_{EXT}$ Input (Note 2)                                                                    |     | 15   | 25   | pF            |
|                |                                                                    | Any Other Input (Note 2)                                                                       |     | 5    |      | pF            |

\*AC Parameters are guaranteed by DC correlated testing.

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** Capacitance is guaranteed by periodic testing.

**Note 3:** In Standby (Q = Logic "0") the power dissipated equals the leakage current plus  $V_{CC}/R_{EXT}$ .

**Note 4:** See AN-138 for detailed explanation  $R_{ON}$ .

**Note 5:** Maximum output duty cycle =  $R_{EXT}/R_{EXT} + 1000$ .

## Typical Performance Characteristics

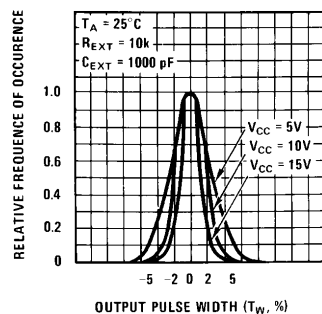


FIGURE 1. Typical Distribution of Units for Output Pulse Width

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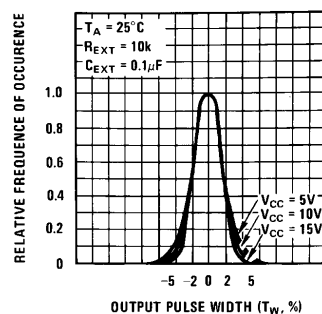


FIGURE 2. Typical Distribution of Units for Output Pulse Width

TL/F/5904-4

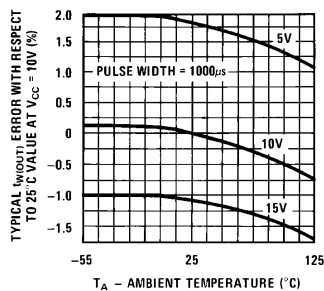


FIGURE 3. Typical Variation in Output Pulse Width vs Temperature

TL/F/5904-5

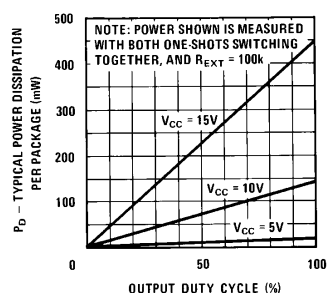


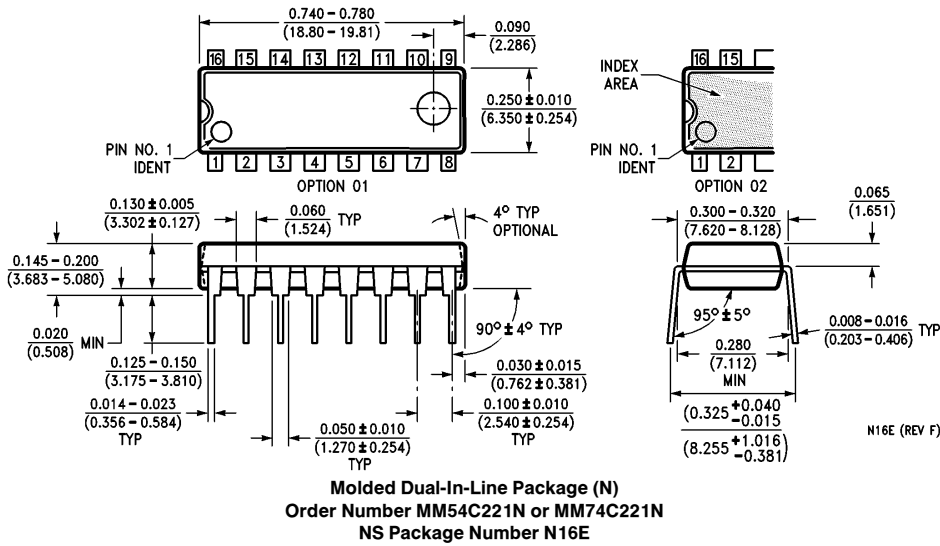
FIGURE 4. Typical Power Dissipation per Package

TL/F/5904-6

The image contains three mechanical drawings of the J16A package:

- Top View:** Shows a rectangular package with 16 pins. Dimensions include a total width of  $0.785 \pm 0.005$  [19.94] MAX, a pin pitch of  $0.037 \pm 0.005$  [0.94  $\pm$  0.13] TYP, and a pin diameter of  $0.025$  [0.64]. The package body width is  $0.220-0.310$  [5.59-7.87].
- Side View:** Shows the package height and pin profile. Dimensions include a maximum height of  $0.200$  [5.08] MAX TYP, a pin height of  $0.125-0.200$  [3.18-5.08] TYP, and a pin diameter of  $0.010 \pm 0.010$  [2.54  $\pm$  0.25] TYP. The package body thickness is  $0.010 \pm 0.002$  [0.25  $\pm$  0.05] TYP.
- Detail View:** Shows the package body with a glass sealant. Dimensions include a body width of  $0.290-0.320$  [7.37-8.13], a body thickness of  $0.180$  [4.57] MAX, and a body height of  $0.310-0.410$  [7.87-10.41]. The package is shown at a  $95^\circ \pm 5^\circ$  angle.

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**Physical Dimensions** inches (millimeters) (Continued)**LIFE SUPPORT POLICY**

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