National Semiconductor

# MM54C914/MM74C914 Hex Schmitt Trigger with Extended Input Voltage

## General Description

The MM54C914/MM74C914 is a monolithic CMOS Hex Schmitt trigger with special input protection scheme. This scheme allows the input voltage levels to exceed $V_{CC}$ or ground by at least 10V ($V_{CC}$ − 25V to GND + 25V), and is valuable for applications involving voltage level shifting or mismatched power supplies.

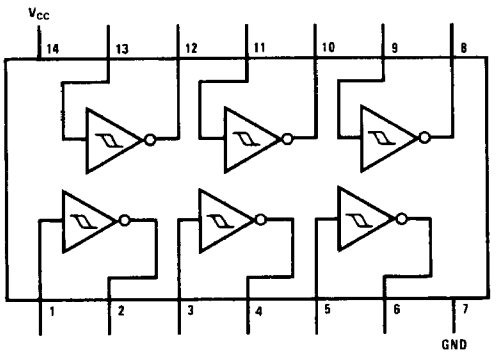
The positive and negative-going threshold voltages, $V_{T+}$ and $V_{T-}$, show low variation with respect to temperature (typ 0.0005V/°C at $V_{CC}$ = 10V). And the hysteresis, $V_{T+} - V_{T-} \geq 0.2\ V_{CC}$ is guaranteed.

## Features

| | |
|---|---|
| ■ Hysteresis | 0.45 $V_{CC}$ (typ.)<br>0.2 $V_{CC}$ guaranteed |
| ■ Special input protection | Extended Input Voltage Range |
| ■ Wide supply voltage range | 3V to 15V |
| ■ High noise immunity | 0.7 $V_{CC}$ (typ.) |
| ■ Low power TTL compatibility | Fan out of 2 driving 74L |

## Connection Diagram

**Dual-In-Line Package**

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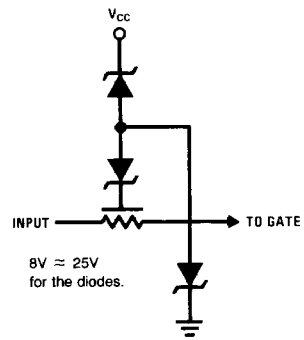
**Top View**

**Order Number MM54C914* or MM74C914***

*Please look into Section 8, Appendix D for availability of various package types.

**Special Input Protection**

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## Absolute Maximum Ratings (Note 1)

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

| | |
|---|---|
| Voltage at any Input Pin | $V_{CC}$ − 25V to GND + 25V |
| Voltage at any other Pin | −0.3V to $V_{CC}$ + 0.3V |
| Operating Temperature Range ($T_A$) | |
| MM54C914 | −55°C to +125°C |
| MM74C914 | −40°C to +85°C |
| Storage Temperature Range ($T_S$) | −65°C to +150°C |
| Power Dissipation | |
| Dual-In-Line | 700 mW |
| Small Outline | 500 mW |
| Operating $V_{CC}$ Range | 3V to 15V |
| Absolute Maximum ($V_{CC}$) | 18V |
| Lead Temperature ($T_L$) (Soldering, 10 seconds) | 300°C |

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **CMOS TO CMOS** | | | | | | |
| $V_{T+}$ | Positive Going Threshold Voltage | $V_{CC}$ = 5V<br>$V_{CC}$ = 10V<br>$V_{CC}$ = 15V | 3.0<br>6.0<br>9.0 | 3.6<br>6.8<br>10 | 4.3<br>8.6<br>12.9 | V<br>V |
| $V_{T-}$ | Negative Going Threshold Voltage | $V_{CC}$ = 5V<br>$V_{CC}$ = 10V<br>$V_{CC}$ = 15V | 0.7<br>1.4<br>2.1 | 1.4<br>3.2<br>5 | 2.0<br>4.0<br>6.0 | V<br>V |
| $V_{T+} - V_{T-}$ | Hysteresis | $V_{CC}$ = 5V<br>$V_{CC}$ = 10V<br>$V_{CC}$ = 15V | 1.0<br>2.0<br>3.0 | 2.2<br>3.6<br>5 | 3.6<br>7.2<br>10.8 | V<br>V<br>V |
| $V_{OUT(1)}$ | Logical "1" Output Voltage | $V_{CC}$ = 5V, $I_O$ = −10 μA<br>$V_{CC}$ = 10V, $I_O$ = −10 μA | 4.5<br>9.0 | | | V<br>V |
| $V_{OUT(0)}$ | Logical "0" Output Voltage | $V_{CC}$ = 5V, $I_O$ = +10 μA<br>$V_{CC}$ = 10V, $I_O$ = +10 μA | | | 0.5<br>1.0 | V<br>V |
| $I_{IN(1)}$ | Logical "1" Input Current | $V_{CC}$ = 15V, $V_{IN}$ = 25V | | 0.005 | 5.0 | μA |
| $I_{IN(0)}$ | Logical "0" Input Current | $V_{CC}$ = 15V, $V_{IN}$ = −10V | −100 | −0.005 | | μA |
| $I_{CC}$ | Supply Current | $V_{CC}$ = 15V, $V_{IN}$ = − 10V/25V<br>$V_{CC}$ = 5V, $V_{IN}$ = − 2.5V (Note 4)<br>$V_{CC}$ = 10V, $V_{IN}$ = 5V (Note 4)<br>$V_{CC}$ = 15V, $V_{IN}$ = 7.5V (Note 4) | | 0.05<br>20<br>200<br>600 | 300 | μA<br>μA<br>μA<br>μA |
| **CMOS/LPTTL INTERFACE** | | | | | | |
| $V_{IN(1)}$ | Logical "1" Input Voltage | $V_{CC}$ = 5V | 4.3 | | | V |
| $V_{IN(0)}$ | Logical "0" Input Voltage | $V_{CC}$ = 5V | | | 0.7 | V |
| $V_{OUT(1)}$ | Logical "1" Output Voltage | 54C, $V_{CC}$ = 4.5V, $I_O$ = −360 μA<br>74C, $V_{CC}$ = 4.75V, $I_O$ = −360 μA | 2.4<br>2.4 | | | V<br>V |
| $V_{OUT(0)}$ | Logical "0" Output Voltage | 54C, $V_{CC}$ = 4.5V, $I_O$ = 360 μA<br>74C, $V_{CC}$ = 4.75V, $I_O$ = 360 μA | | | 0.4<br>0.4 | V<br>V |
| **OUTPUT DRIVE (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)** | | | | | | |
| $I_{SOURCE}$ | Output Source Current (P-Channel) | $V_{CC}$ = 5V, $V_{OUT}$ = 0V, $T_A$ = 25°C | −1.75 | −3.3 | | mA |
| $I_{SOURCE}$ | Output Source Current (P-Channel) | $V_{CC}$ = 10V, $V_{OUT}$ = 0V, $T_A$ = 25°C | −8.0 | −15 | | mA |
| $I_{SINK}$ | Output Sink Current (N-Channel) | $V_{CC}$ = 5V, $V_{OUT}$ = $V_{CC}$, $T_A$ = 25°C | 1.75 | 3.6 | | mA |
| $I_{SINK}$ | Output Sink Current (N-Channel) | $V_{CC}$ = 10V, $V_{OUT}$ = $V_{CC}$, $T_A$ = 25°C | 8.0 | 16 | | mA |

## AC Electrical Characteristics* $T_A = 25°C$, $C_L = 50$ pF, unless otherwise specified

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $t_{PHL}$, $t_{PLH}$ | Propagation Delay from Input to Output | $V_{CC} = 5V$ | | 220 | 400 | ns |
| | | $V_{CC} = 10V$ | | 80 | 200 | ns |
| $C_{IN}$ | Input Capacitance | Any Input (Note 2) | | 5 | | pF |
| $C_{PD}$ | Power Dissipation Capacitance | (Note 3) Per Gate | | 20 | | 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.

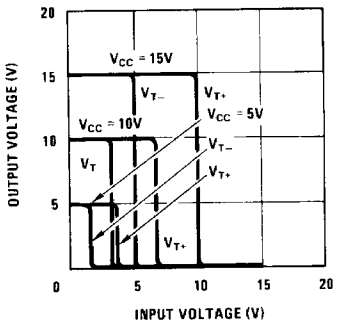
**Note 2:** Capacitance is guaranteed by periodic testing.

**Note 3:** $C_{PD}$ determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics Application Note, AN-90.

**Note 4:** Only one input is at ½ $V_{CC}$, the others are either at $V_{CC}$ or GND.

## Typical Performance Characteristics

### Typical Transfer Characteristics

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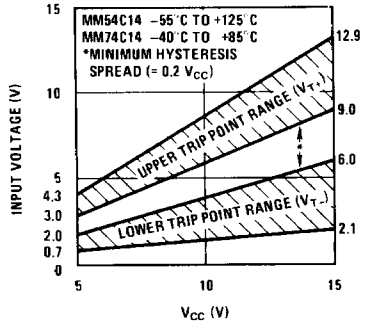
### Guaranteed Trip Point Range

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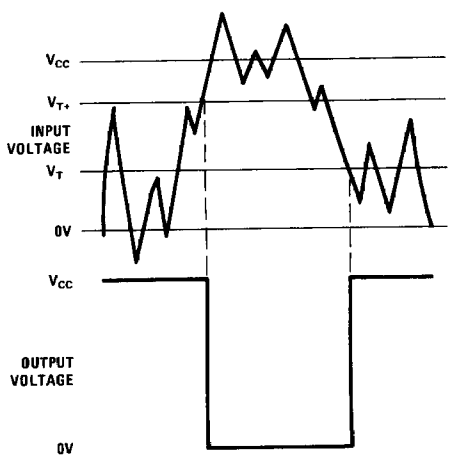


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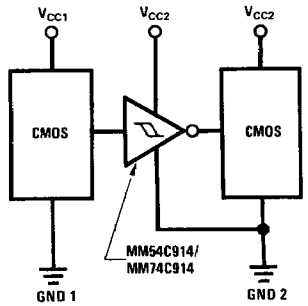
## Typical Application

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**Note:** $V_{CC1} = V_{CC2}$
GND1 = GND2