

SN5414, SN54LS14, SN7414, SN74LS14

HEX SCHMITT-TRIGGER INVERTERS

DECEMBER 1983—REVISED MARCH 1988

- Operation from Very Slow Edges
- Improved Line-Receiving Characteristics
- High Noise Immunity

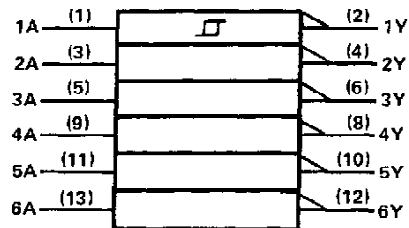
description

Each circuit functions as an inverter, but because of the Schmitt action, it has different input threshold levels for positive (V_{T+}) and for negative going (V_{T-}) signals.

These circuits are temperature-compensated and can be triggered from the slowest of input ramps and still give clean, jitter-free output signals.

The SN5414 and SN54LS14 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN7414 and the SN74LS14 are characterized for operation from 0°C to 70°C .

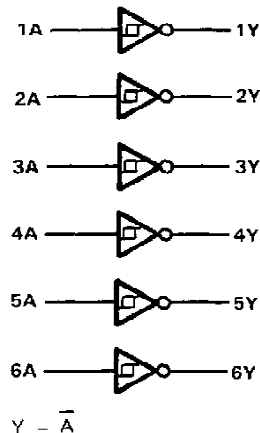
logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

logic diagram (positive logic)

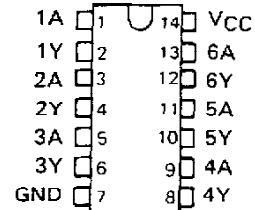


SN5414, SN54LS14 . . . J OR W PACKAGE

SN7414 . . . N PACKAGE

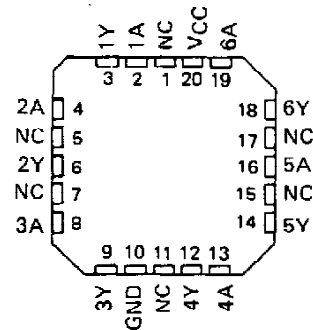
SN74LS14 . . . D OR N PACKAGE

(TOP VIEW)



SN54LS14 . . . FK PACKAGE

(TOP VIEW)



NC—No internal connection

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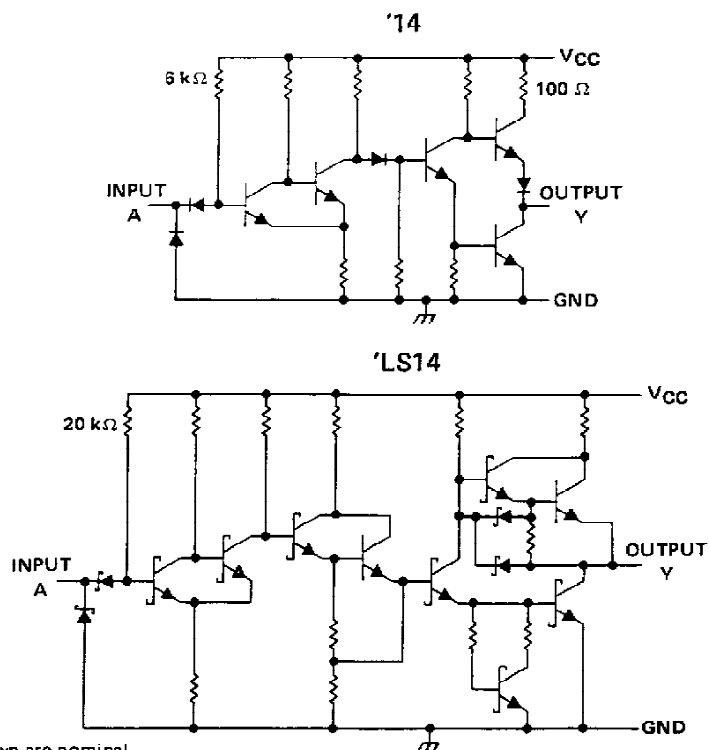
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SN5414, SN54LS14, SN7414, SN74LS14

HEX SCHMITT-TRIGGER INVERTERS

schematics



Resistor values shown are nominal.

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

| | |
|---------------------------------------|--|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Input voltage: '14 | 5.5 V |
| 'LS14 | 7 V |
| Operating free-air temperature: 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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SN5414, SN7414

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recommended operating conditions

| | SN5414 | | | SN7414 | | | UNIT |
|--------------------------------------|--------|-----|------|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| I_{OH} High-level output current | | | -0.8 | | | -0.8 | mA |
| I_{OL} Low-level output current | | | 16 | | | 16 | mA |
| T_A Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS† | MIN | TYP‡ | MAX | UNIT |
|-------------------------------------|---|-------|------|------|------|
| V_{T+} | $V_{CC} = 5\text{ V}$ | 1.5 | 1.7 | 2 | V |
| V_{T-} | $V_{CC} = 5\text{ V}$ | 0.6 | 0.9 | 1.1 | V |
| Hysteresis ($V_{T+} - V_{T-}$) | $V_{CC} = 5\text{ V}$ | 0.4 | 0.8 | | V |
| V_{IK} | $V_{CC} = \text{MIN.}$, $I_I = -12\text{ mA}$ | | | -1.5 | V |
| V_{OH} | $V_{CC} = \text{MIN.}$, $V_I = 0.6\text{ V}$, $I_{OH} = -0.8\text{ mA}$ | 2.4 | 3.4 | | V |
| V_{OL} | $V_{CC} = \text{MIN.}$, $V_I = 2\text{ V}$, $I_{OL} = 16\text{ mA}$ | | 0.2 | 0.4 | V |
| I_{T+} | $V_{CC} = 5\text{ V}$, $V_I = V_{T+}$ | -0.43 | | | mA |
| I_{T-} | $V_{CC} = 5\text{ V}$, $V_I = V_{T-}$ | -0.56 | | | mA |
| I_I | $V_{CC} = \text{MAX.}$, $V_I = 5.5\text{ V}$ | | | 1 | mA |
| I_{IH} | $V_{CC} = \text{MAX.}$, $V_{IH} = 2.4\text{ V}$ | | | 40 | µA |
| I_{IL} | $V_{CC} = \text{MAX.}$, $V_{IL} = 0.4\text{ V}$ | | -0.8 | -1.2 | mA |
| $I_{OS}\S$ | $V_{CC} = \text{MAX.}$ | -18 | | -55 | mA |
| I_{CCH} | $V_{CC} = \text{MAX.}$ | | 22 | 36 | mA |
| I_{CCL} | $V_{CC} = \text{MAX.}$ | | 39 | 60 | mA |

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

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

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

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

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|-----------------|----------------|--|-----|-----|-----|------|
| t_{PLH} | A | Y | $R_L = 400\ \Omega$, $C_L = 15\text{ pF}$ | | 15 | 22 | ns |
| t_{PHL} | | | | | 15 | 22 | ns |

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SN54LS14, SN74LS14 **HEX SCHMITT-TRIGGER INVERTERS**

recommended operating conditions

| | SN54LS14 | | | SN74LS14 | | | UNIT |
|--------------------------------------|----------|-----|------|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V_{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| I_{OH} High-level output current | | | -0.4 | | | -0.4 | mA |
| I_{OL} Low-level output current | | | 4 | | | 8 | mA |
| T_A Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS† | | | SN54LS14 | | | SN74LS14 | | | UNIT |
|-------------------------------------|--|------------------------|--|----------|------|------|----------|------|-----|------|
| | | | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V_{T+} | $V_{CC} = 5\text{ V}$ | | | 1.4 | 1.6 | 1.9 | 1.4 | 1.6 | 1.9 | V |
| V_{T-} | $V_{CC} = 5\text{ V}$ | | | 0.5 | 0.8 | 1 | 0.5 | 0.8 | 1 | V |
| Hysteresis ($V_{T+} - V_{T-}$) | $V_{CC} = 5\text{ V}$ | | | 0.4 | 0.8 | | 0.4 | 0.8 | | V |
| V_{IK} | $V_{CC} = \text{MIN}, I_I = -18\text{ mA}$ | | | -1.5 | | | -1.5 | | | V |
| V_{OH} | $V_{CC} = \text{MIN}, V_I = 0.5\text{ V}, I_{OH} = -0.4\text{ mA}$ | | | 2.5 | 3.4 | | 2.7 | 3.4 | | V |
| V_{OL} | $V_{CC} = \text{MIN}, V_I = 1.9\text{ V}$ | $I_{OL} = 4\text{ mA}$ | | 0.25 | 0.4 | | 0.25 | 0.4 | V | |
| | | $I_{OL} = 8\text{ mA}$ | | | | 0.35 | 0.5 | | | |
| I_{T+} | $V_{CC} = 5\text{ V}, V_I = V_{T+}$ | | | -0.14 | | | -0.14 | | | mA |
| I_{T-} | $V_{CC} = 5\text{ V}, V_I = V_{T-}$ | | | -0.18 | | | -0.18 | | | mA |
| I_I | $V_{CC} = \text{MAX}, V_I = 7\text{ V}$ | | | 0.1 | | | 0.1 | | | mA |
| I_{IH} | $V_{CC} = \text{MAX}, V_{IH} = 2.7\text{ V}$ | | | 20 | | | 20 | | | µA |
| I_{IL} | $V_{CC} = \text{MAX}, V_{IL} = 0.4\text{ V}$ | | | -0.4 | | | -0.4 | | | mA |
| $I_{OS}§$ | $V_{CC} = \text{MAX}$ | | | -20 | -100 | | -20 | -100 | | mA |
| I_{CCH} | $V_{CC} = \text{MAX}$ | | | 8.6 | 16 | | 8.6 | 16 | | mA |
| I_{CCL} | $V_{CC} = \text{MAX}$ | | | 12 | 21 | | 12 | 21 | | mA |

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

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

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

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

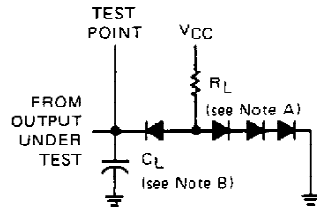
| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|-----------|-----------------|----------------|----------------------------|----------------------|-----|-----|-----|------|
| t_{PLH} | A | Y | $R_L = 2\text{ k}\Omega$, | $C_L = 15\text{ pF}$ | | 15 | 22 | ns |
| t_{PHL} | | | | | | 15 | 22 | ns |

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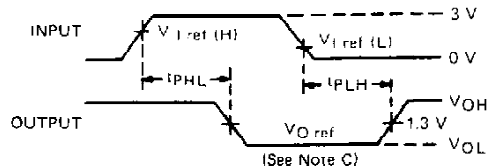
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PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT



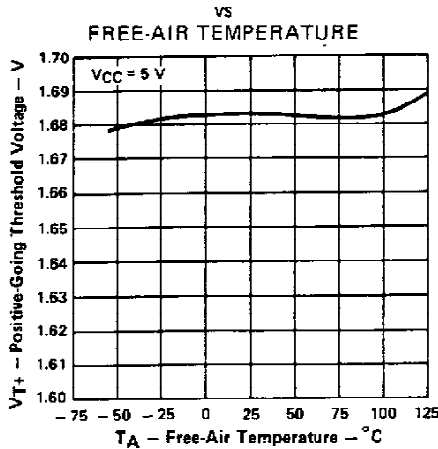
VOLTAGE WAVEFORMS

- NOTES: A. All diodes are 1N3064 or equivalent.
B. C_L includes probe and jig capacitance.
C. Generator characteristics and reference voltage are:

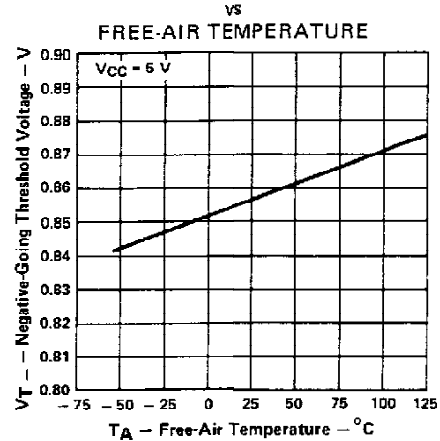
| | Generator Characteristics | | | | Reference Voltages | | |
|-----------------|---------------------------|-------|-------|-------|--------------------|----------------|-------------|
| | Z_{out} | PRR | t_r | t_f | $V_{I ref(H)}$ | $V_{I ref(L)}$ | $V_{O ref}$ |
| SN54'/SN74' | 50 Ω | 1 MHz | 10 ns | 10 ns | 1.7 V | 0.9 V | 1.5 V |
| SN54LS'/SN74LS' | 50 Ω | 1 MHz | 15 ns | 6 ns | 1.6 V | 0.8 V | 1.3 V |

TYPICAL CHARACTERISTICS OF '14 CIRCUITS

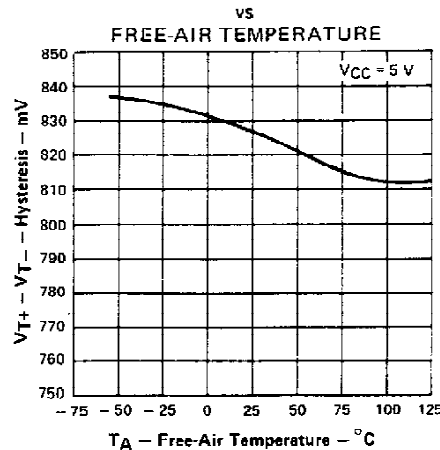
POSITIVE-GOING THRESHOLD VOLTAGE



NEGATIVE-GOING THRESHOLD VOLTAGE



HYSTERESIS



Data for temperatures below 0°C and 70°C and supply voltages below 4.75V and above 5.25 V are applicable for SN5414 only.

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TYPICAL CHARACTERISTICS OF '14 CIRCUITS

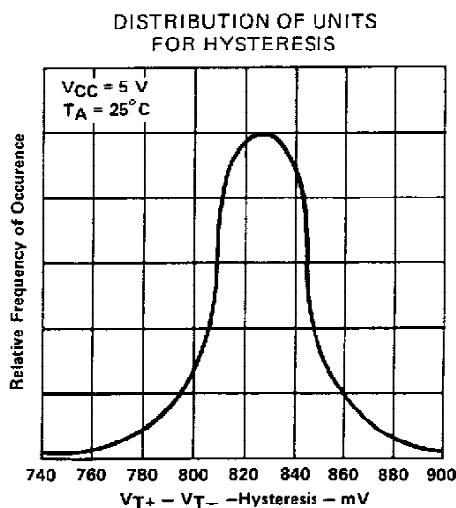


FIGURE 4

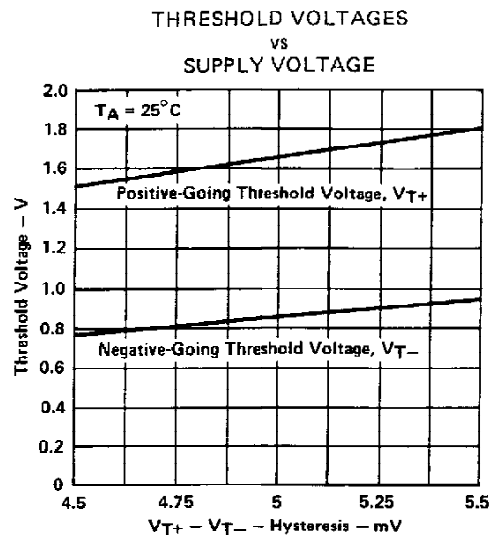


FIGURE 5

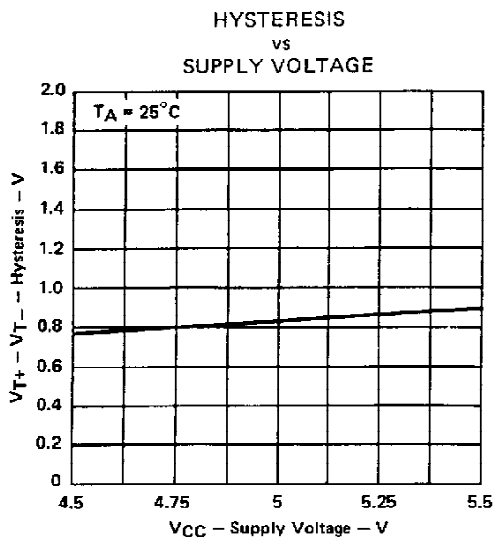


FIGURE 6

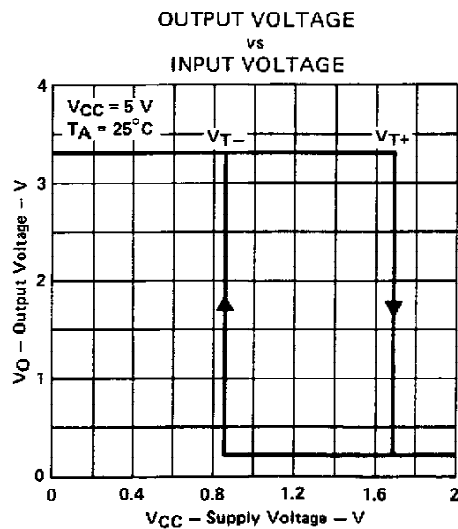


FIGURE 7

Data for temperatures below 0°C and 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN5414 only.

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TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

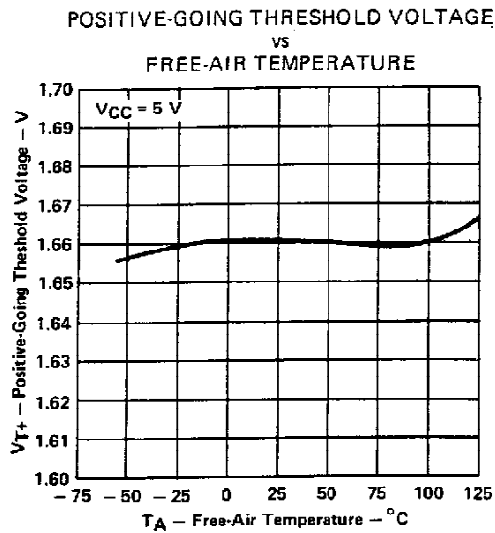


FIGURE 8

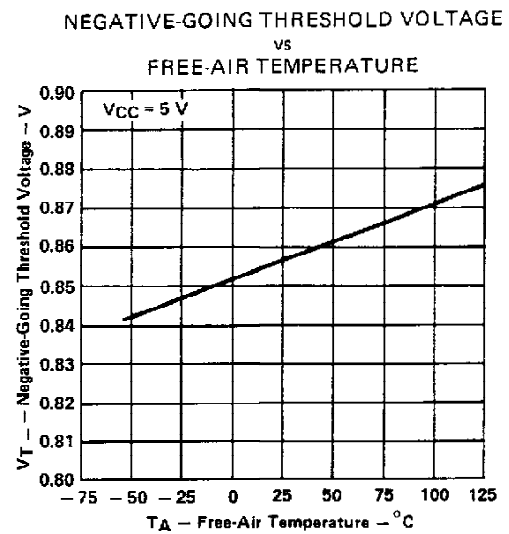


FIGURE 9

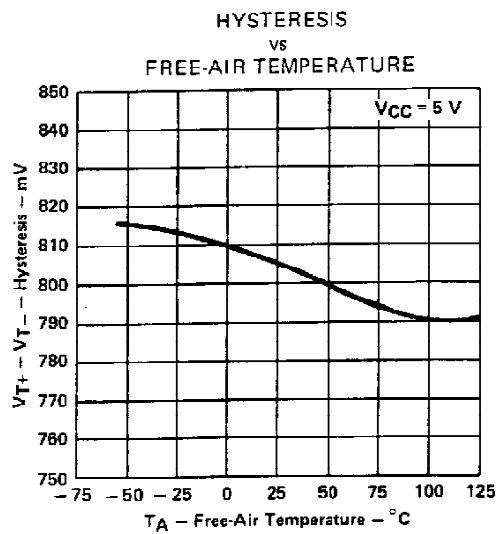


FIGURE 10

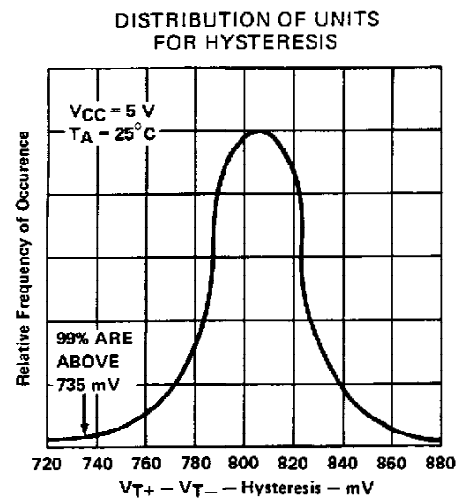


FIGURE 11

Data for temperatures below 0°C and above 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS14 only.

SN54LS14, SN74LS14 **HEX SCHMITT-TRIGGER INVERTERS**

TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

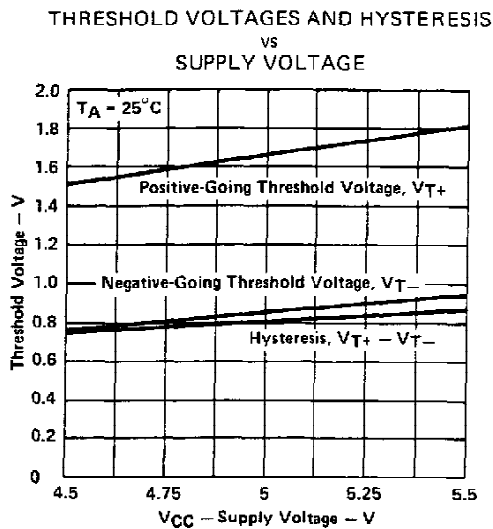


FIGURE 12

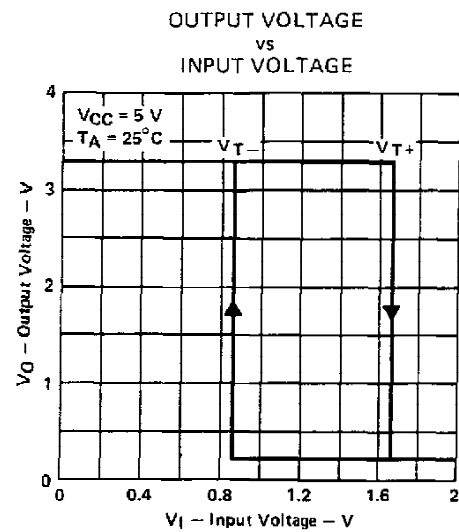
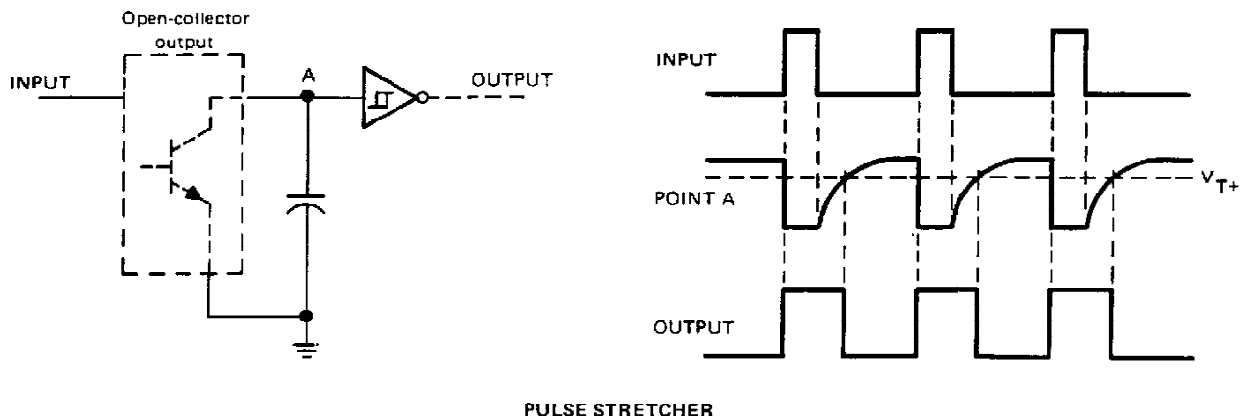
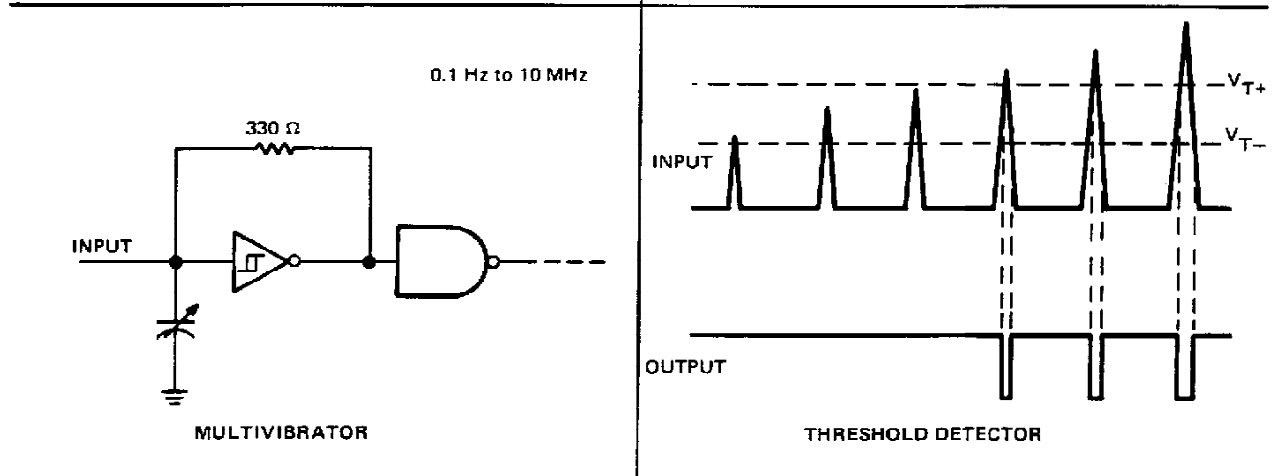
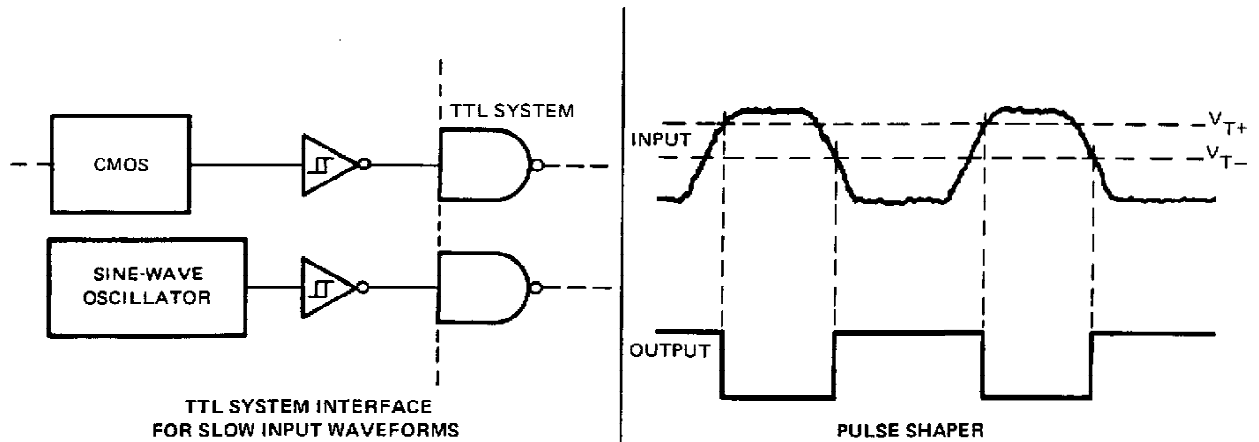


FIGURE 13

Data for temperatures below 0°C and above 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS14 only.

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TYPICAL APPLICATION DATA



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