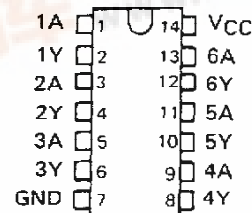


SDLS049

**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

SN5414, SN54LS14 . . . J OR W PACKAGE  
SN7414 . . . N PACKAGE  
SN74LS14 . . . D OR N PACKAGE  
(TOP VIEW)



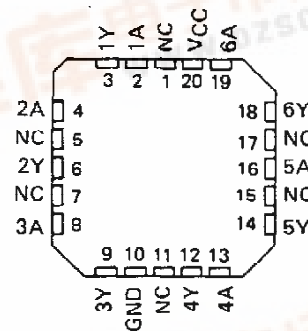
**description**

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.

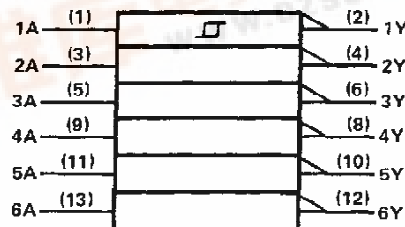
The SN5414 and SN54LS14 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7414 and the SN74LS14 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN54LS14 . . . FK PACKAGE  
(TOP VIEW)



NC—No internal connection

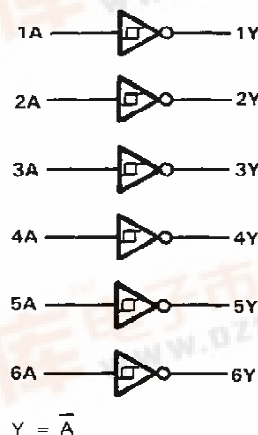
**logic symbol†**



† 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)**



PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

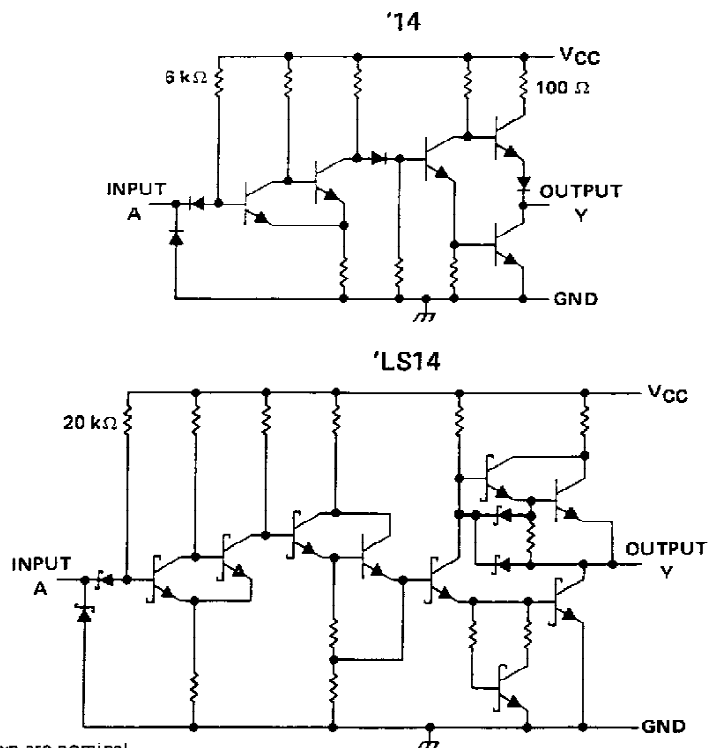
**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265



# **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.

# SN5414, SN7414

## HEX SCHMITT-TRIGGER INVERTERS

### 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<br>( $V_{T+} - V_{T-}$ ) | $V_{CC} = 5\text{ V}$  | 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   |
| $I_{OS}§$                           | $V_{CC} = \text{MAX}$  | -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<br>(INPUT) | TO<br>(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   |

# **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<br>( $V_{T+} - V_{T-}$ ) | $V_{CC} = 5\text{ V}$  |                        | 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  $V_{CC} = 5\text{ V}, T_A = 25^\circ\text{C}$ .

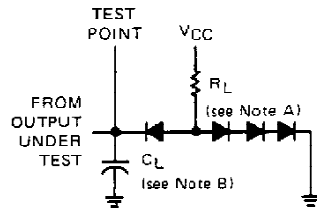
§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

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

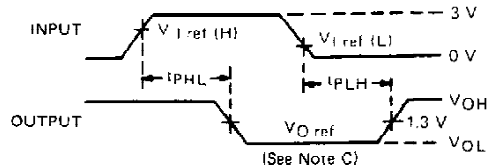
| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | TEST CONDITIONS                              | MIN | TYP | MAX | UNIT |
|-----------|-----------------|----------------|--|-----|-----|-----|------|
| $t_{PLH}$ | A               | Y              | $R_L = 2\text{ k}\Omega, C_L = 15\text{ pF}$ | 15  | 22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

# SN5414, SN54LS14, SN7414, SN74LS14 HEX SCHMITT-TRIGGER INVERTERS

## 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 $\Omega$               | 1 MHz | 10 ns | 10 ns | 1.7 V              | 0.9 V           | 1.5 V       |
| SN54LS' / SN74LS' | 50 $\Omega$               | 1 MHz | 15 ns | 6 ns  | 1.6 V              | 0.8 V           | 1.3 V       |

## TYPICAL CHARACTERISTICS OF '14 CIRCUITS

### POSITIVE-GOING THRESHOLD VOLTAGE

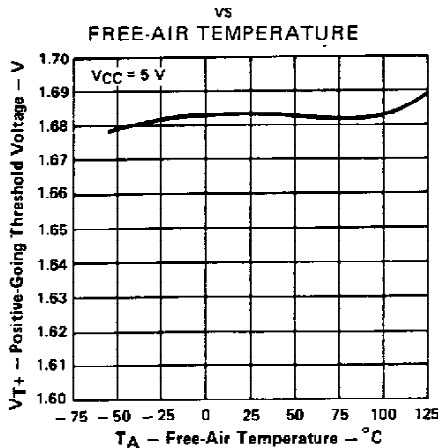


FIGURE 1

### NEGATIVE-GOING THRESHOLD VOLTAGE

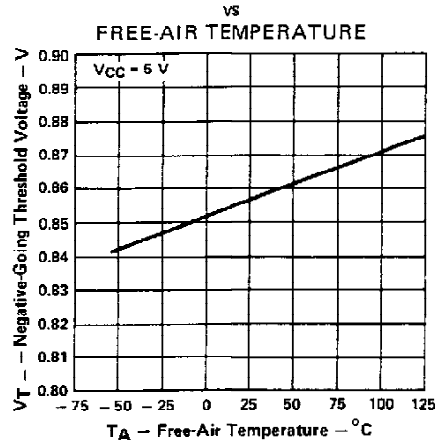


FIGURE 2

### HYSTERESIS

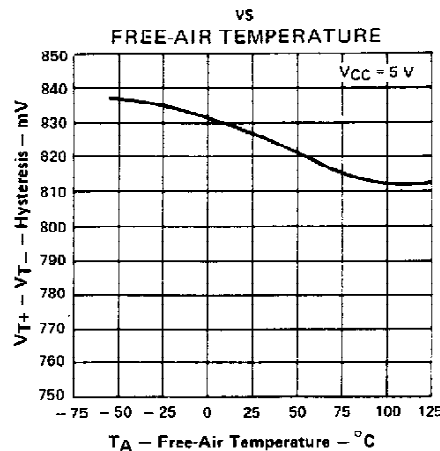


FIGURE 3

Data for temperatures below 0 $^{\circ}\text{C}$  and 70 $^{\circ}\text{C}$  and supply voltages below 4.75 V and above 5.25 V are applicable for SN5414 only.

TEXAS  
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

# SN5414, SN7414 HEX SCHMITT-TRIGGER INVERTERS

## TYPICAL CHARACTERISTICS OF '14 CIRCUITS

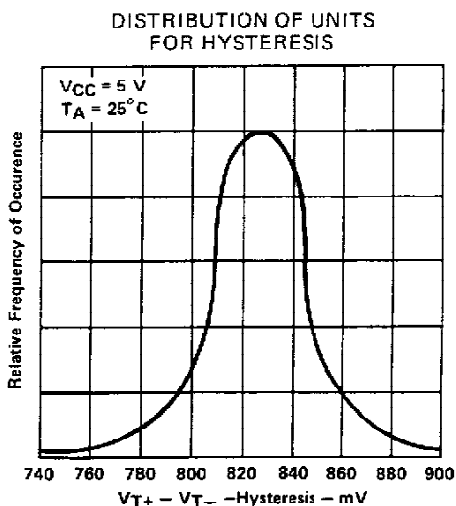


FIGURE 4

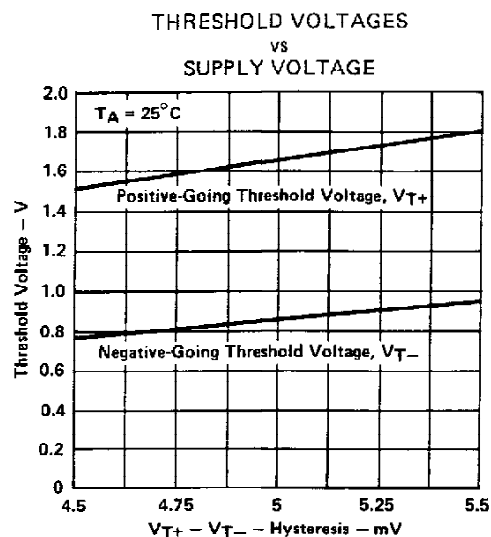


FIGURE 5

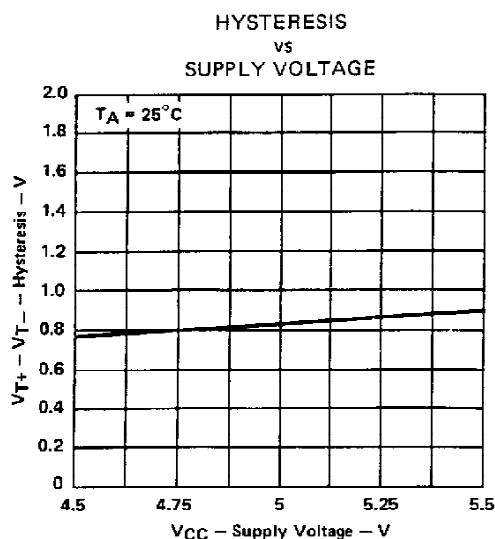


FIGURE 6

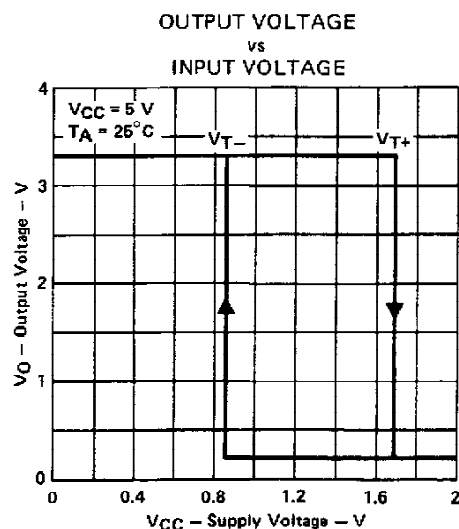


FIGURE 7

Data for temperatures below  $0^\circ\text{C}$  and  $70^\circ\text{C}$  and supply voltages below 4.75 V and above 5.25 V are applicable for SN5414 only.

# SN54LS14, SN74LS14 HEX SCHMITT-TRIGGER INVERTERS

## TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

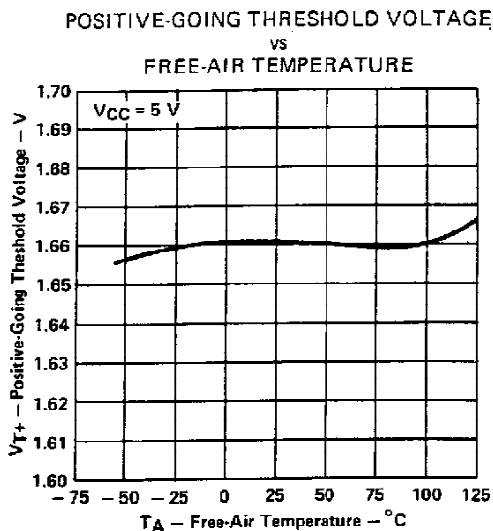


FIGURE 8

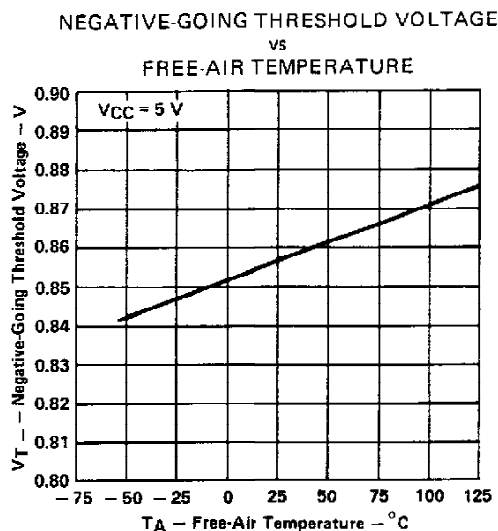


FIGURE 9

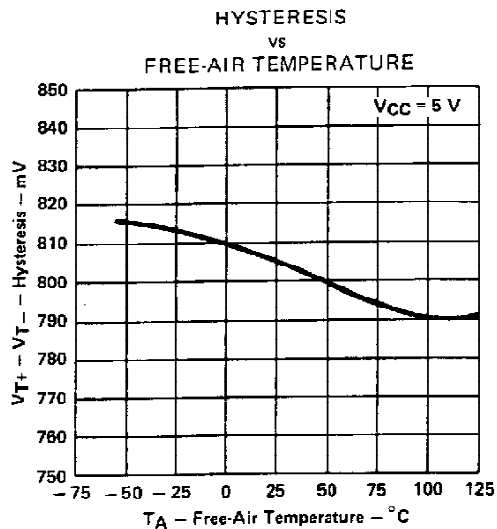


FIGURE 10

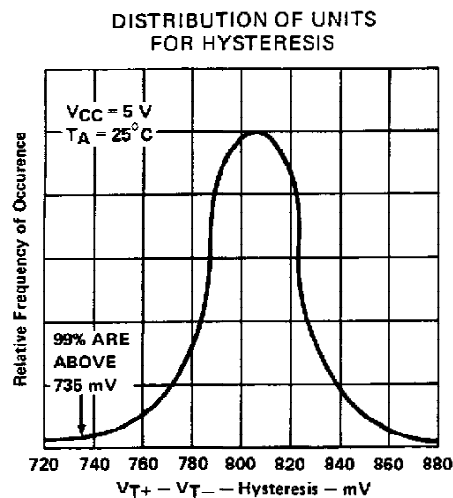
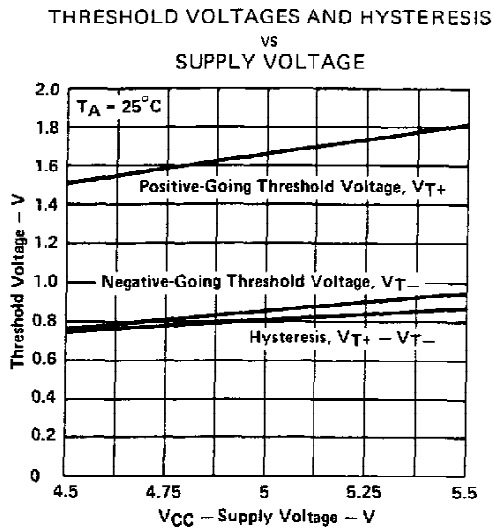


FIGURE 11

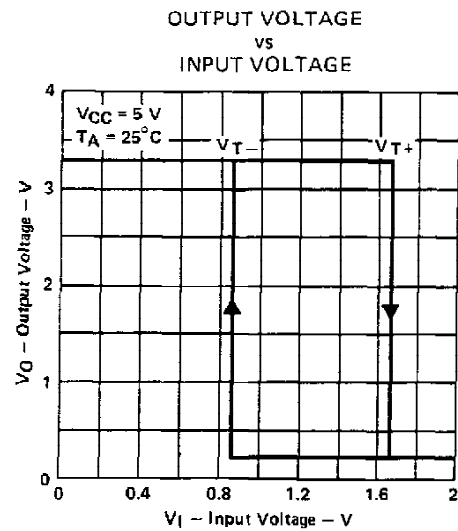
Data for temperatures below  $0^{\circ}\text{C}$  and above  $70^{\circ}\text{C}$  and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS14 only.

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

## **TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS**



**FIGURE 12**



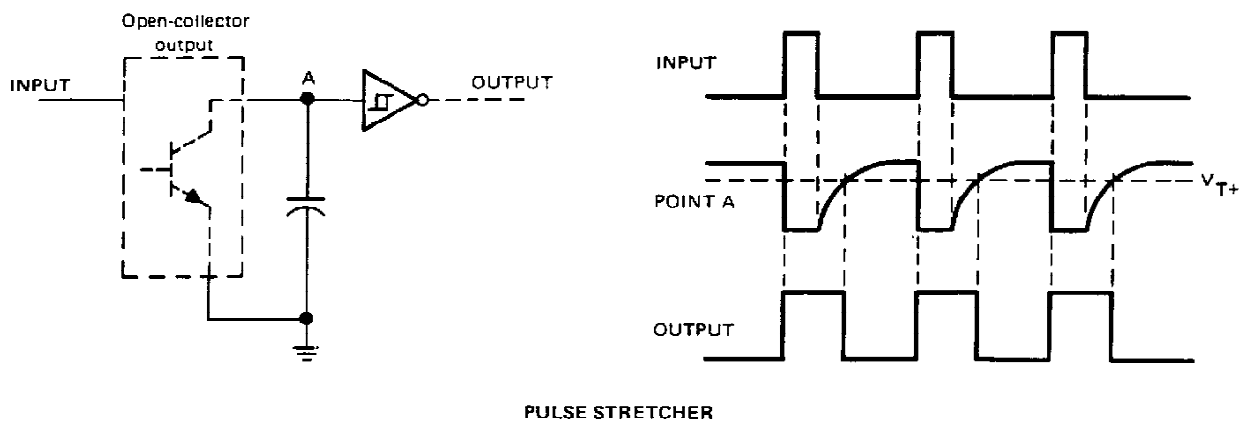
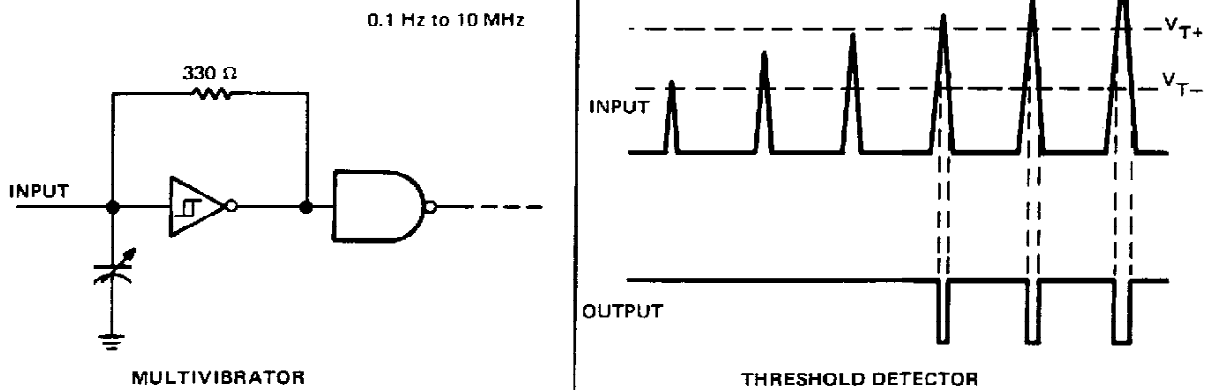
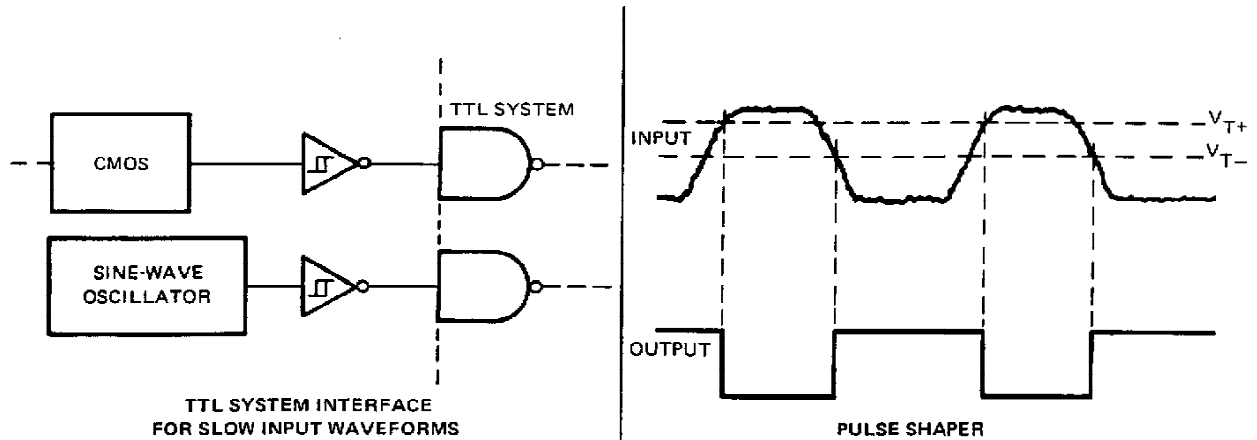
**FIGURE 13**

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.



**SN5414, SN54LS14,  
SN7414, SN74LS14  
HEX SCHMITT-TRIGGER INVERTERS**

**TYPICAL APPLICATION DATA**



## IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.

## **IMPORTANT NOTICE**

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.