

# 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

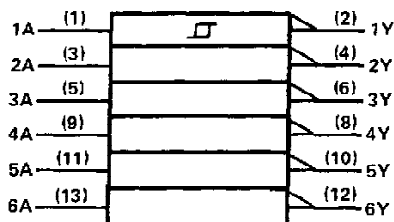
### description

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  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7414 and the SN74LS14 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

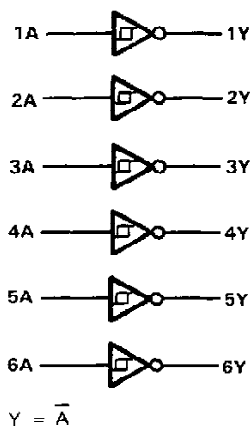
### logic symbol†



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

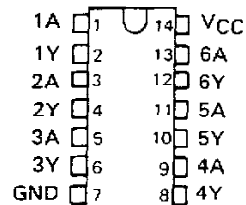
Pin numbers shown are for D, J, N, and W packages.

### logic diagram (positive logic)

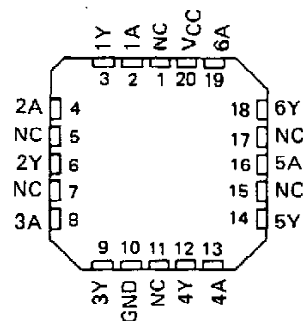


SN5414, SN54LS14 . . . J OR W PACKAGE  
SN7414 . . . N PACKAGE  
SN74LS14 . . . D OR N PACKAGE

(TOP VIEW)



SN54LS14 . . . FK PACKAGE  
(TOP VIEW)



NC—No internal connection

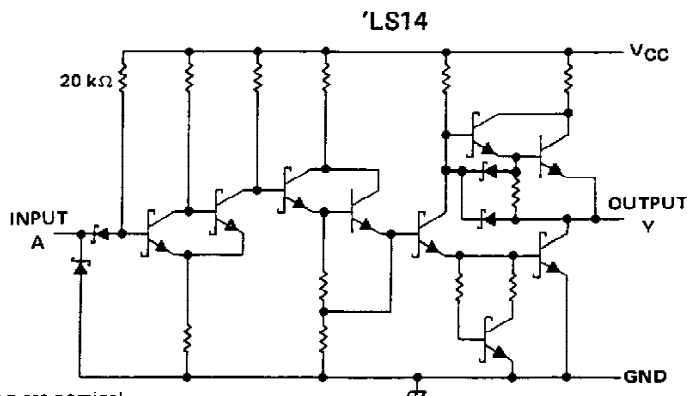
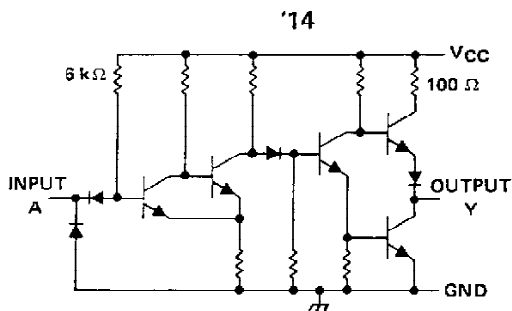
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# SN5414, SN54LS14, SN7414, SN74LS14 HEX SCHMITT-TRIGGER INVERTERS

## 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' .....	$-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$
SN74' .....	$0^{\circ}\text{C}$ to $70^{\circ}\text{C}$
Storage temperature range .....	$-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$

NOTE 1: Voltage values are with respect to network ground terminal.

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## 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	6.25	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
$I_{OS}\$$	$V_{CC} = \text{MAX}$	-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	$I_{OL} = 4\text{ mA}$		V
		$I_{OL} = 8\text{ mA}$				$I_{OL} = 8\text{ mA}$		
$I_{T+}$	$V_{CC} = 5\text{ V}$ , $V_I = V_{T+}$		-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, $V_{CC} = 5\text{ V}$ , $T_A = 25^\circ\text{C}$

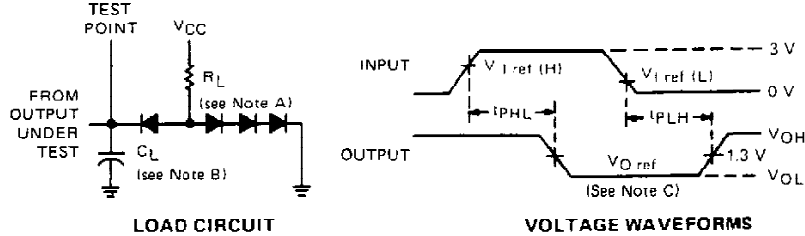
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$	A	Y	$R_L = 2\text{ k}\Omega$ , $C_L = 15\text{ pF}$		15	22	ns
$t_{PHL}$					15	22	ns

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

## PARAMETER MEASUREMENT INFORMATION



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  
vs  
FREE-AIR TEMPERATURE

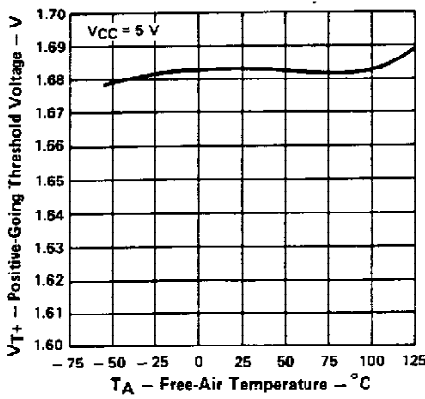


FIGURE 1

NEGATIVE-GOING THRESHOLD VOLTAGE  
vs  
FREE-AIR TEMPERATURE

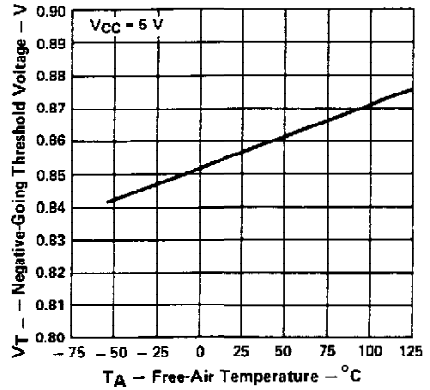


FIGURE 2

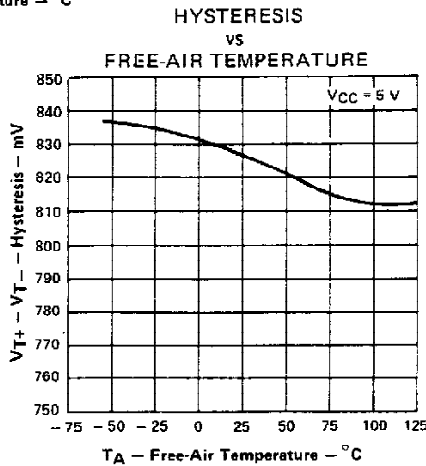


FIGURE 3

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**

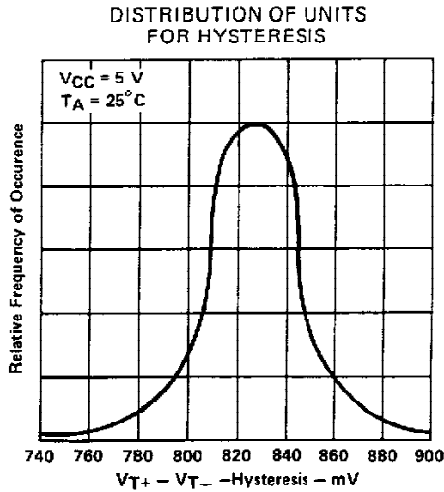


FIGURE 4

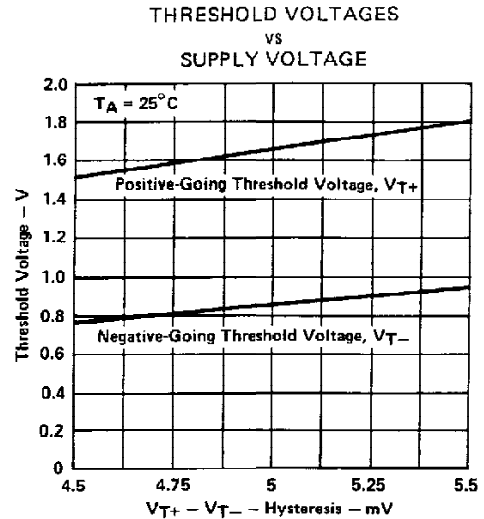


FIGURE 5

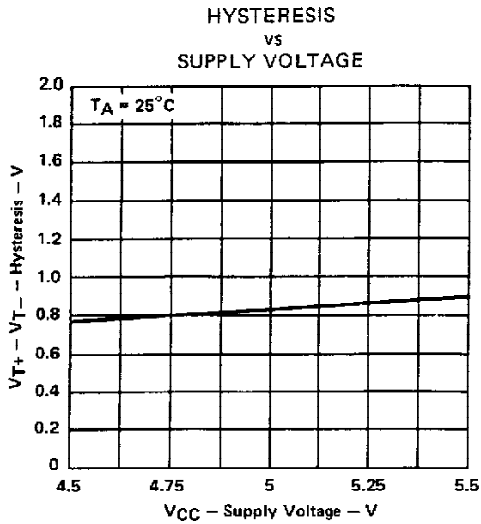


FIGURE 6

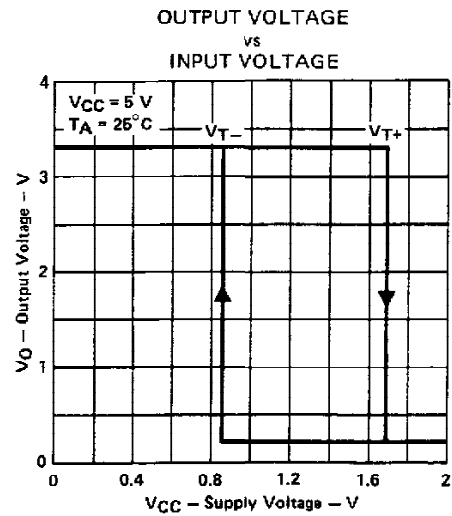


FIGURE 7

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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SN54LS14, SN74LS14  
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TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE  
VS  
FREE-AIR TEMPERATURE

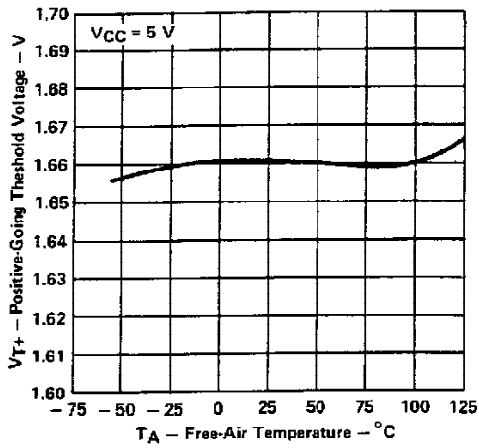


FIGURE 8

NEGATIVE-GOING THRESHOLD VOLTAGE  
VS  
FREE-AIR TEMPERATURE

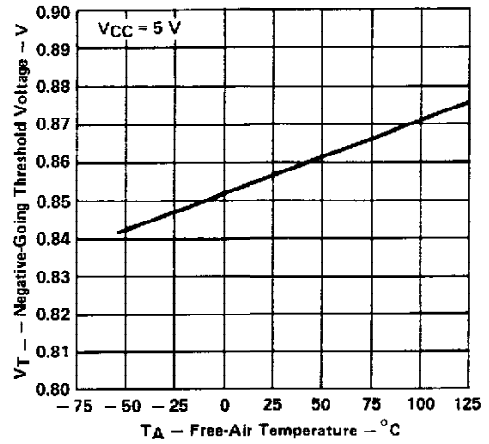


FIGURE 9

HYSTERESIS  
VS  
FREE-AIR TEMPERATURE

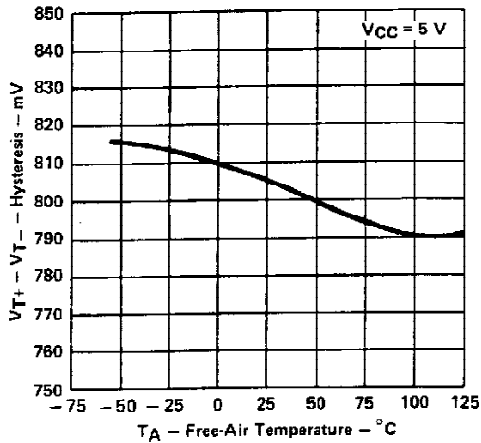


FIGURE 10

DISTRIBUTION OF UNITS  
FOR HYSTERESIS

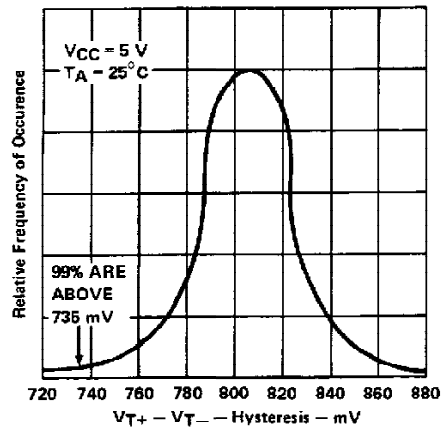


FIGURE 11

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.

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**TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS**

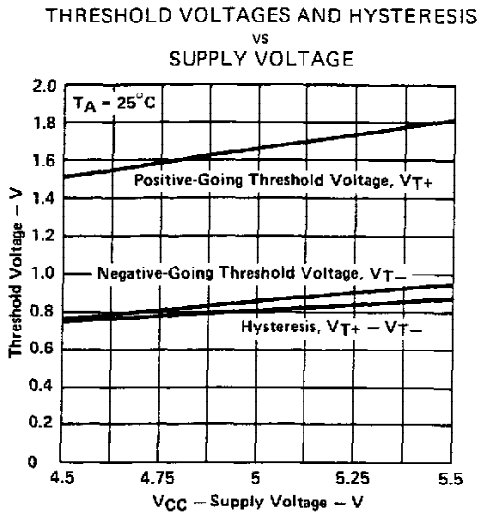


FIGURE 12

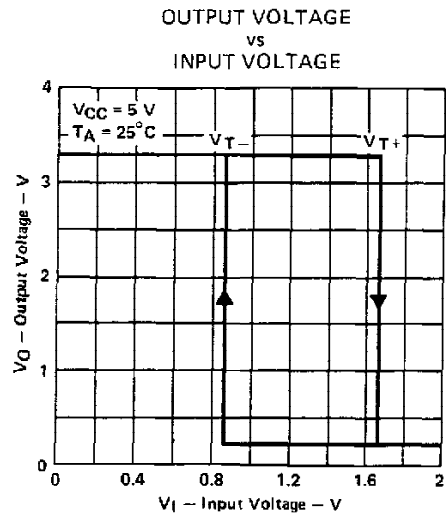


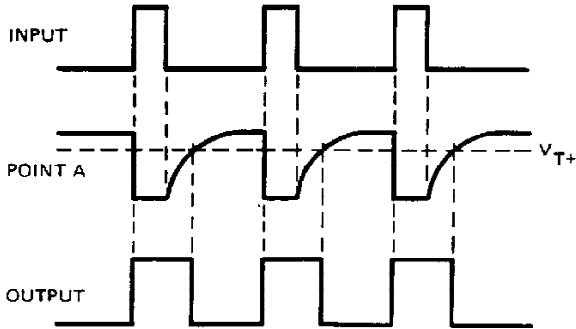
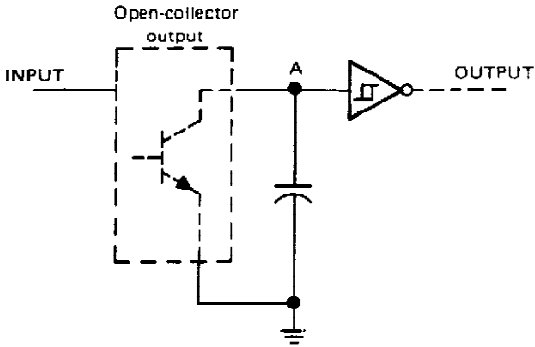
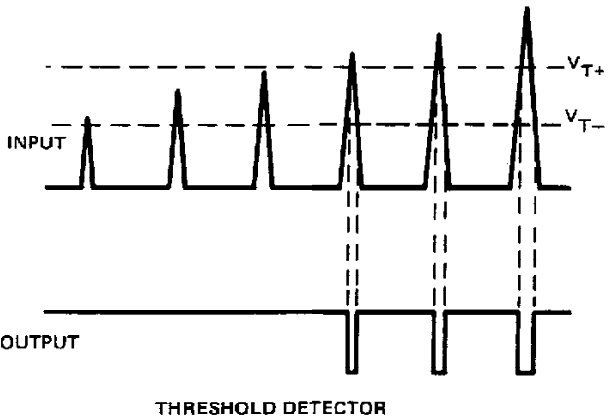
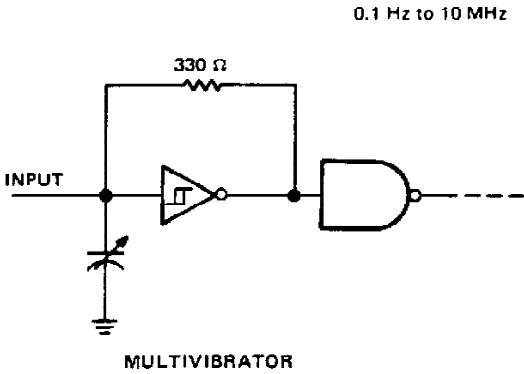
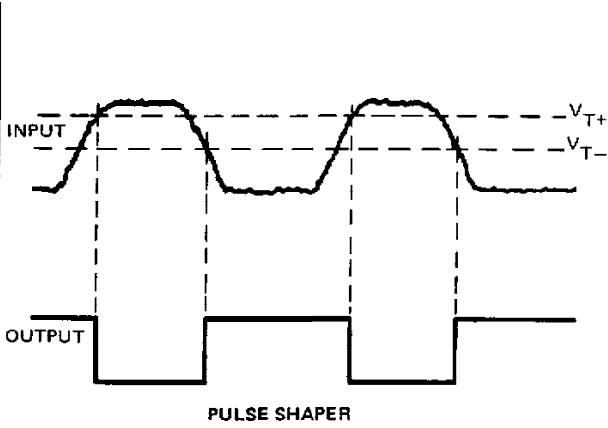
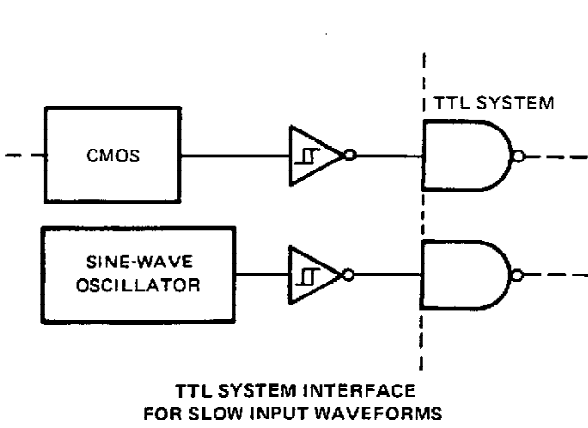
FIGURE 13

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



PULSE STRETCHER

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