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.
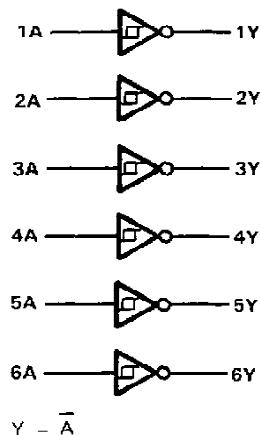
logic symbol†
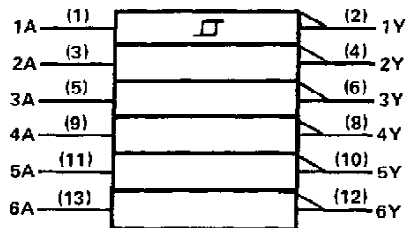
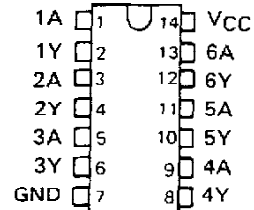† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.
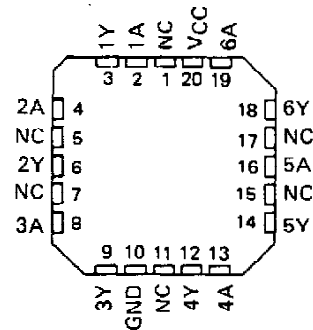
logic diagram (positive logic)

$$Y = \overline{A}$$

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

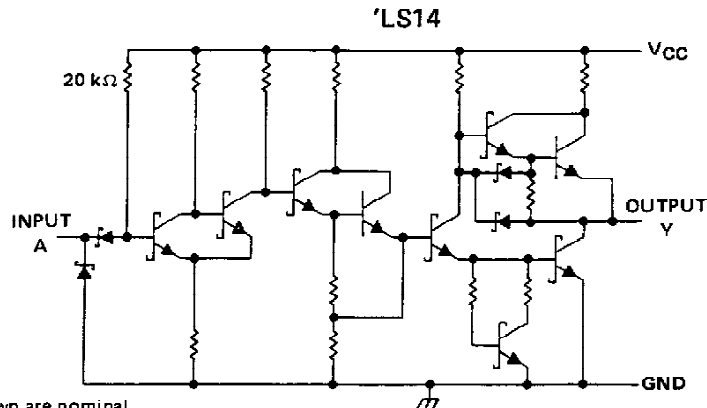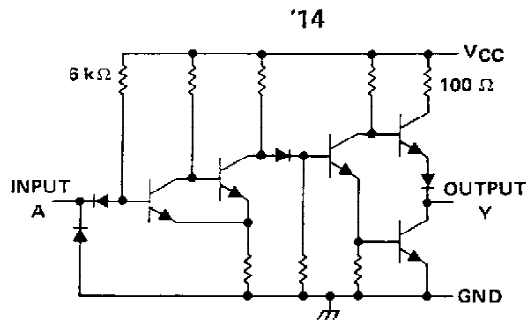**SN54LS14 . . . FK PACKAGE**
(TOP VIEW)

NC — No internal connection

TEXAS INSTRUMENTS

schematics

'14

'LS14

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.

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+}	$V_{CC} = 5$ V			1.5	1.7	2	V
V_{T-}	$V_{CC} = 5$ V			0.6	0.9	1.1	V
Hysteresis $(V_{T+} - V_{T-})$	$V_{CC} = 5$ V			0.4	0.8		V
V_{IK}	$V_{CC} = $ MIN,	$I_I = -12$ mA				−1.5	V
V_{OH}	$V_{CC} = $ MIN,	$V_I = 0.6$ V,	$I_{OH} = -0.8$ mA	2.4	3.4		V
V_{OL}	$V_{CC} = $ MIN,	$V_I = 2$ V,	$I_{OL} = 16$ mA		0.2	0.4	V
I_{T+}	$V_{CC} = 5$ V,	$V_I = V_{T+}$			−0.43		mA
I_{T-}	$V_{CC} = 5$ V,	$V_I = V_{T-}$			−0.56		mA
I_I	$V_{CC} = $ MAX,	$V_I = 5.5$ V				1	mA
I_{IH}	$V_{CC} = $ MAX,	$V_{IH} = 2.4$ V				40	μA
I_{IL}	$V_{CC} = $ MAX,	$V_{IL} = 0.4$ V			−0.8	−1.2	mA
I_{OS}§	$V_{CC} = $ MAX			−18		−55	mA
I_{CCH}	$V_{CC} = $ MAX				22	36	mA
I_{CCL}	$V_{CC} = $ 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 $V_{CC} = 5$ V, $T_A = 25°$C.
§ Not more than one output should be shorted at a time.

switching characteristics, $V_{CC} = 5$ V, $T_A = 25°$C

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

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+}	$V_{CC} = 5$ V			1.4	1.6	1.9	1.4	1.6	1.9	V
V_{T-}	$V_{CC} = 5$ V			0.5	0.8	1	0.5	0.8	1	V
Hysteresis $(V_{T+} - V_{T-})$	$V_{CC} = 5$ V			0.4	0.8		0.4	0.8		V
V_{IK}	$V_{CC} = $ MIN,	$I_I = -18$ mA				-1.5			-1.5	V
V_{OH}	$V_{CC} = $ MIN,	$V_I = 0.5$ V,	$I_{OH} = -0.4$ mA	2.5	3.4		2.7	3.4		V
V_{OL}	$V_{CC} = $ MIN,	$V_I = 1.9$ V	$I_{OL} = 4$ mA		0.25	0.4		0.25	0.4	V
			$I_{OL} = 8$ mA					0.35	0.5	
I_{T+}	$V_{CC} = 5$ V,	$V_I = V_{T+}$			-0.14			-0.14		mA
I_{T-}	$V_{CC} = 5$ V,	$V_I = V_{T-}$			-0.18			-0.18		mA
I_I	$V_{CC} = $ MAX,	$V_I = 7$ V				0.1			0.1	mA
I_{IH}	$V_{CC} = $ MAX,	$V_{IH} = 2.7$ V				20			20	μA
I_{IL}	$V_{CC} = $ MAX,	$V_{IL} = 0.4$ V				-0.4			-0.4	mA
I_{OS}§	$V_{CC} = $ MAX			-20		-100	-20		-100	mA
I_{CCH}	$V_{CC} = $ MAX				8.6	16		8.6	16	mA
I_{CCL}	$V_{CC} = $ 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 $V_{CC} = 5$ V, $T_A = 25$°C.
§ Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.
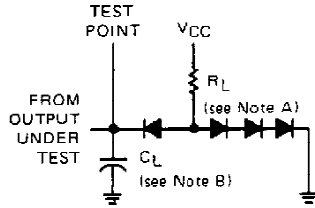
switching characteristics, $V_{CC} = 5$ V, $T_A = 25$°C

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

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
vs
FREE-AIR TEMPERATURE
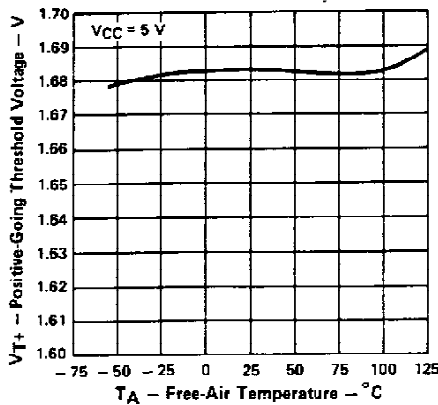
FIGURE 1

NEGATIVE-GOING THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE
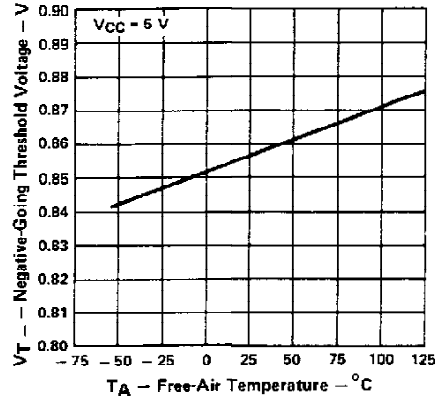
FIGURE 2

HYSTERESIS
vs
FREE-AIR TEMPERATURE
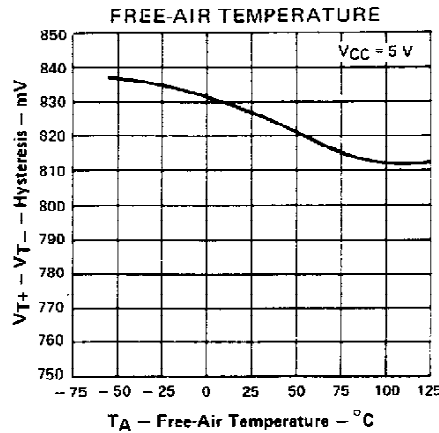
FIGURE 3

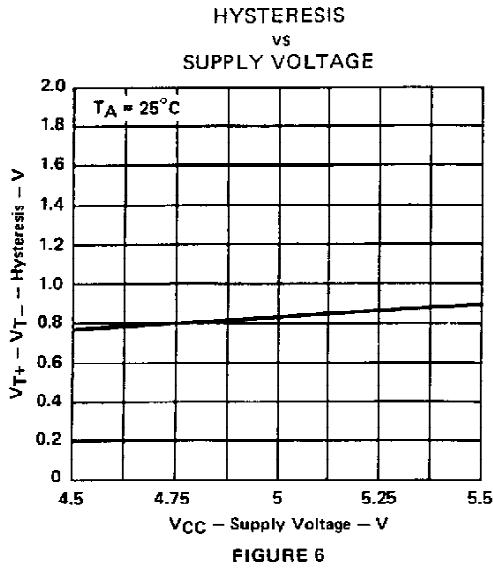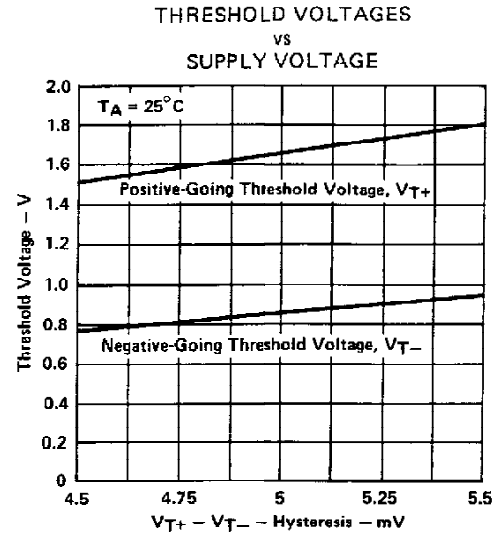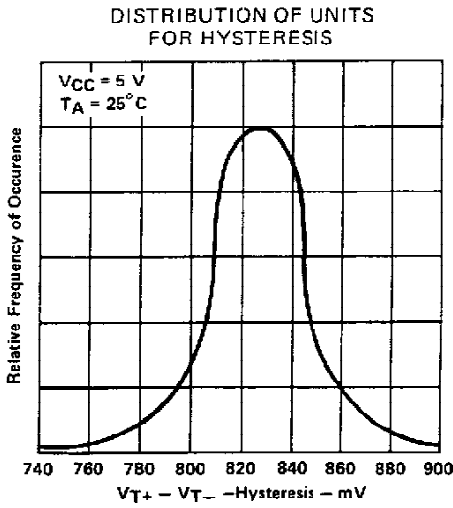Data for temperatures below 0°C and 70°C and supply voltages below 4.75V and above 5.25 V are applicable for SN5414 only.

TYPICAL CHARACTERISTICS OF '14 CIRCUITS

DISTRIBUTION OF UNITS
FOR HYSTERESIS

FIGURE 4

THRESHOLD VOLTAGES
vs
SUPPLY VOLTAGE

FIGURE 5

HYSTERESIS
vs
SUPPLY VOLTAGE

FIGURE 6

OUTPUT VOLTAGE
vs
INPUT VOLTAGE

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.

TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE
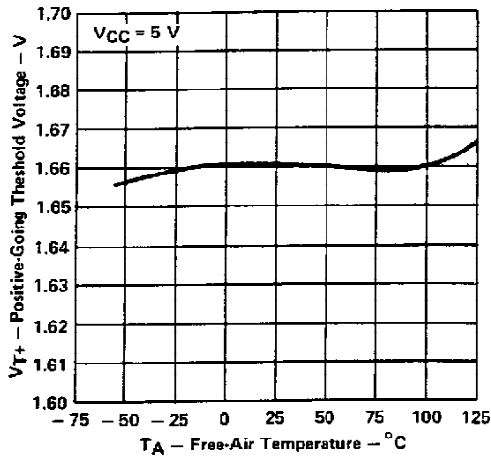
FIGURE 8

NEGATIVE-GOING THRESHOLD VOLTAGE
vs
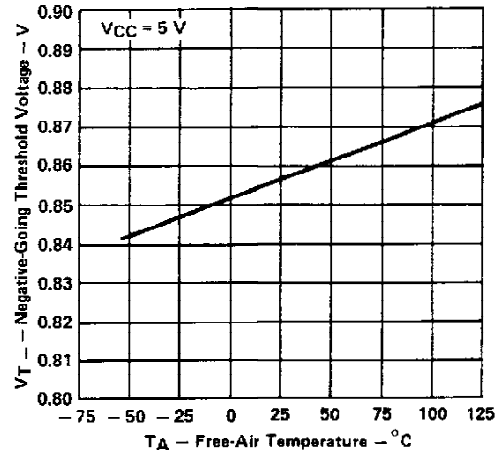### FREE-AIR TEMPERATURE

FIGURE 9

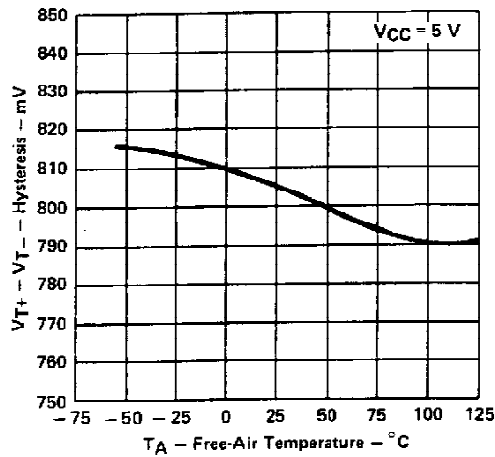### HYSTERESIS
vs
FREE-AIR TEMPERATURE

FIGURE 10

DISTRIBUTION OF UNITS
FOR HYSTERESIS
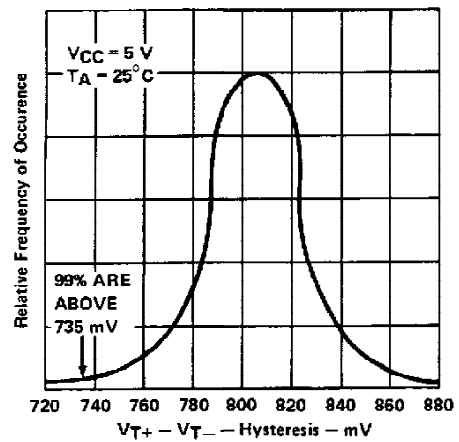

FIGURE 11

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.

TEXAS
INSTRUMENTS

TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

THRESHOLD VOLTAGES AND HYSTERESIS
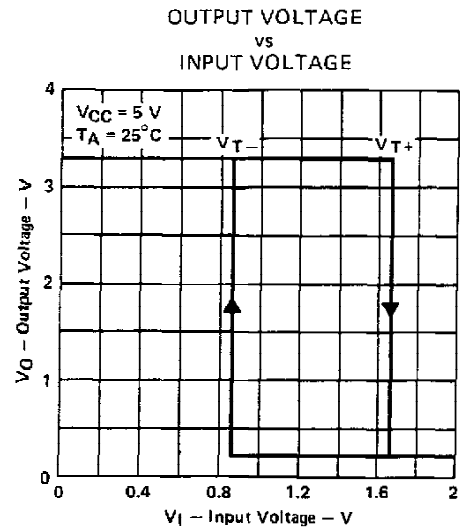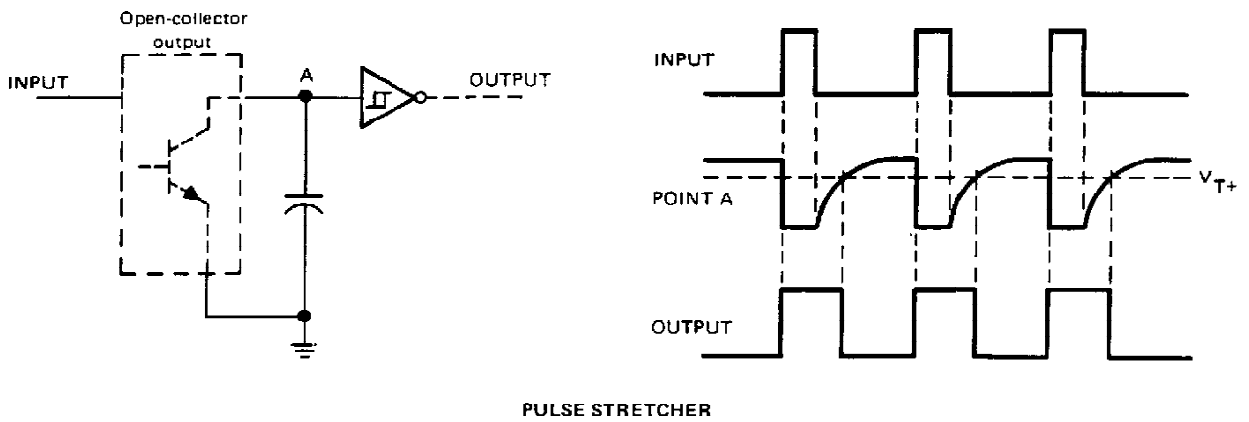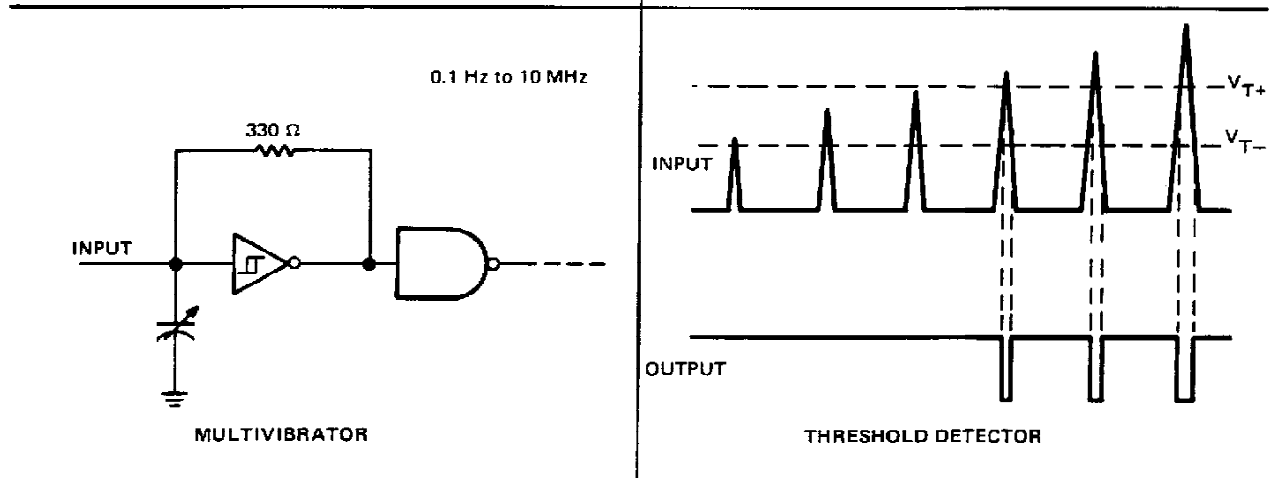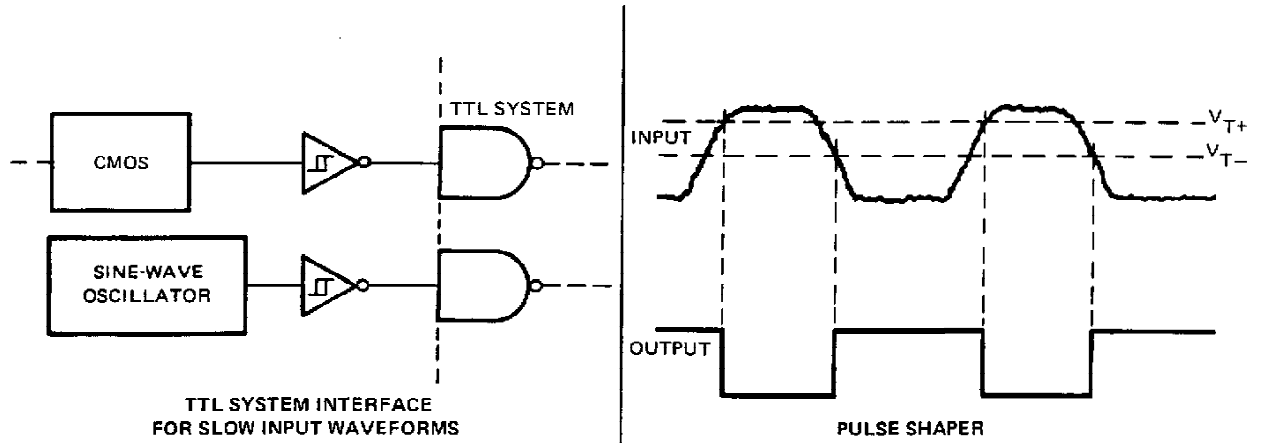vs
SUPPLY VOLTAGE

OUTPUT VOLTAGE
vs
INPUT VOLTAGE
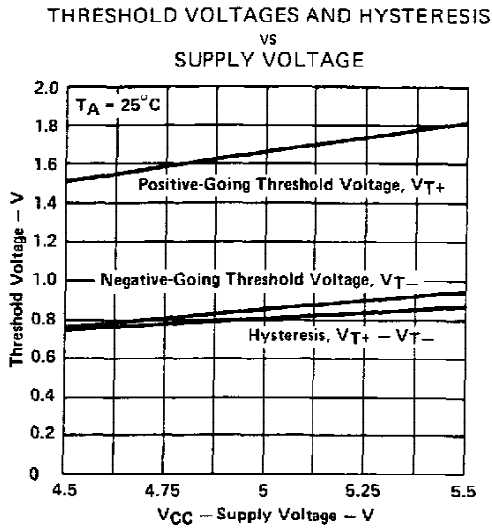
FIGURE 12

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.

TYPICAL APPLICATION DATA

TTL SYSTEM INTERFACE
FOR SLOW INPUT WAVEFORMS

PULSE SHAPER

0.1 Hz to 10 MHz

330 Ω

MULTIVIBRATOR

THRESHOLD DETECTOR

Open-collector
output

PULSE STRETCHER

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