

## SN5413, SN54LS13, SN7413, SN74LS13

### *Dual 4-Input Positive-Nand Schmitt Triggers*

Each circuit functions as a 4-input NAND gate, 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.

#### **Rochester Electronics Manufactured Components**

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

#### **Quality Overview**

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-38535
  - Class Q Military
  - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
  - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

*The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.*

**SN5413, SN54LS13, SN7413, SN74LS13**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**  
 DECEMBER 1983—REVISED MARCH 1988

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

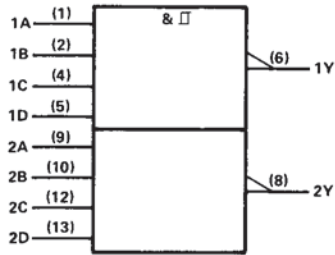
**description**

Each circuit functions as a 4-input NAND gate, 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.

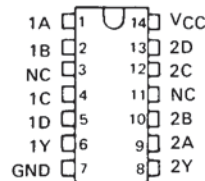
The SN5413 and SN54LS13 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN7413 and SN74LS13 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

**logic symbol†**

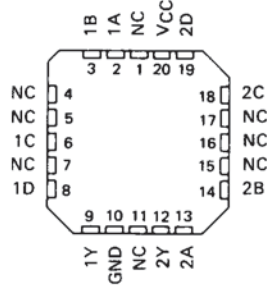


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-13. Pin numbers shown are for D, J, N, and W packages.

SN5413, SN54LS13 . . . J OR W PACKAGE  
 SN7413 . . . N PACKAGE  
 SN74LS13 . . . D OR N PACKAGE  
 (TOP VIEW)

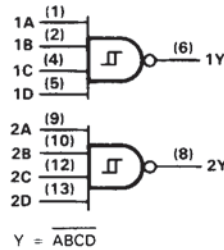


SN54LS13 . . . FK PACKAGE  
 (TOP VIEW)



NC—No internal connection

**logic diagram (positive logic)**



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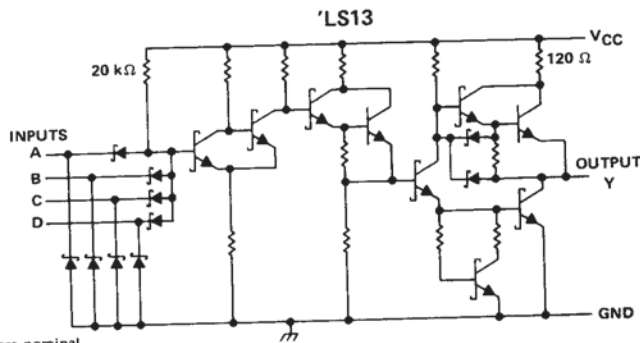
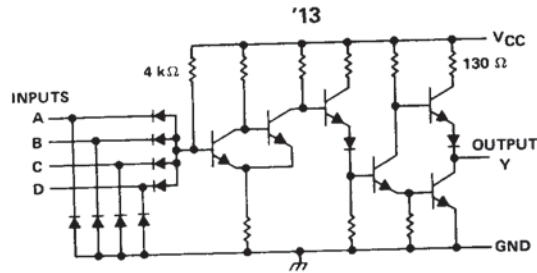
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**SN5413, SN54LS13, SN7413, SN74LS13**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**

schematics



Resistor values 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: '13	5.5 V
'LS13	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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**SN5413, SN7413**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**

**recommended operating conditions**

	SN5413			SN7413			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V
I <sub>OH</sub> High-level output current			-0.8			-0.8	mA
I <sub>OL</sub> Low-level output current			16			16	mA
T <sub>A</sub> 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 <sub>T+</sub>	V <sub>CC</sub> = 5 V	1.5	1.7	2	V
V <sub>T-</sub>	V <sub>CC</sub> = 5 V	0.6	0.9	1.1	V
Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> )	V <sub>CC</sub> = 5 V	0.4	0.8		V
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -12 mA			-1.5	V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>I</sub> = 0.6 V, I <sub>OH</sub> = -0.8 mA	2.4	3.4		V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>I</sub> = 2 V, I <sub>OL</sub> = 16 mA		0.2	0.4	V
I <sub>T+</sub>	V <sub>CC</sub> = 5 V, V <sub>I</sub> = V <sub>T+</sub>		-0.65		mA
I <sub>T-</sub>	V <sub>CC</sub> = 5 V, V <sub>I</sub> = V <sub>T-</sub>		-0.85		mA
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 5.5 V			1	mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2.4 V			40	μA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.4 V		-1	-1.6	mA
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	-18		-55	mA
I <sub>CCH</sub>	V <sub>CC</sub> = MAX		14	23	mA
I <sub>CCL</sub>	V <sub>CC</sub> = MAX		20	32	mA

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

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

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

**switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Any	Y	R <sub>L</sub> = 400 Ω,	C <sub>L</sub> = 15 pF		18	27	ns
t <sub>PHL</sub>						15	22	ns

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**SN54LS13, SN74LS13**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**

recommended operating conditions

	SN54LS13			SN74LS13			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.75	5	5.25	V
I <sub>OH</sub> High-level output current			-0.4			-0.4	mA
I <sub>OL</sub> Low-level output current			4			8	mA
T <sub>A</sub> Operating free-air temperature	-55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS†	SN54LS13			SN74LS13			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V <sub>T+</sub>	V <sub>CC</sub> = 5 V	1.4	1.6	1.9	1.4	1.6	1.9	V
V <sub>T-</sub>	V <sub>CC</sub> = 5 V	0.5	0.8	1	0.5	0.8	1	V
Hysteresis (V <sub>T+</sub> - V <sub>T-</sub> )	V <sub>CC</sub> = 5 V	0.4	0.8		0.4	0.8		V
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA			-1.5			-1.5	V
V <sub>OH</sub>	V <sub>CC</sub> = MIN, V <sub>I</sub> = 0.5 V, I <sub>OH</sub> = -0.4 mA	2.5	3.4		2.7	3.4		V
V <sub>OL</sub>	V <sub>CC</sub> = MIN, V <sub>I</sub> = 1.9 V		0.25	0.4		0.25	0.4	V
						0.35	0.5	
I <sub>T+</sub>	V <sub>CC</sub> = 5 V, V <sub>I</sub> = V <sub>T+</sub>		-0.14			-0.14		mA
I <sub>T-</sub>	V <sub>CC</sub> = 5 V, V <sub>I</sub> = V <sub>T-</sub>		-0.18			-0.18		mA
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7 V			0.1			0.1	mA
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>IH</sub> = 2.7 V			20			20	µA
I <sub>IL</sub>	V <sub>CC</sub> = MAX, V <sub>IL</sub> = 0.4 V			-0.4			-0.4	mA
I <sub>OS</sub> §	V <sub>CC</sub> = MAX	-20		-100	-20		-100	mA
I <sub>CCH</sub>	V <sub>CC</sub> = MAX		2.9	6		2.9	6	mA
I <sub>CCL</sub>	V <sub>CC</sub> = MAX		4.1	7		4.1	7	mA

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

‡ All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 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<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

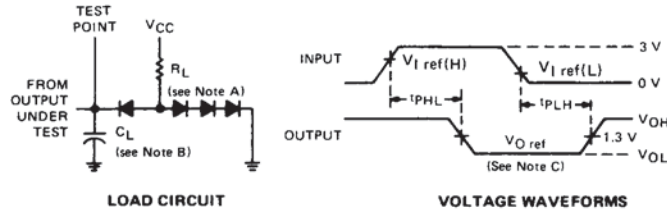
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>PLH</sub>	Any	Y	R <sub>L</sub> = 2 kΩ, C <sub>L</sub> = 15 pF		15	22	ns
t <sub>PHL</sub>					18	27	ns

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**SN5413, SN54LS13, SN7413, SN74LS13  
DUAL 4-INPUT  
POSITIVE-NAND SCHMITT TRIGGERS**

**PARAMETER MEASUREMENT INFORMATION**



NOTES: A. All diodes are 1N3064 or equivalent.  
B.  $C_L$  includes probe and jig capacitance.  
C. Generator characteristics and reference voltages 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 '13 CIRCUITS**

POSITIVE-GOING THRESHOLD VOLTAGE

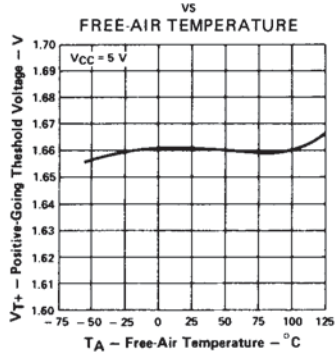


FIGURE 1

NEGATIVE-GOING THRESHOLD VOLTAGE

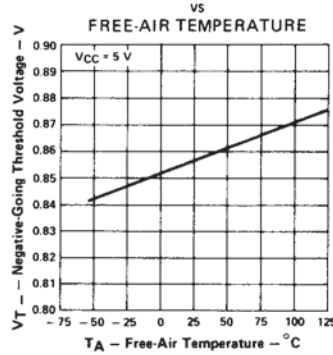


FIGURE 2

HYSTERESIS  
vs  
FREE-AIR TEMPERATURE

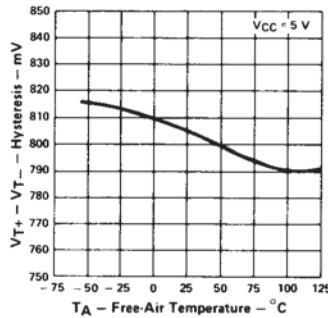


FIGURE 3

Data for temperatures below 0°C and 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN5413 only.

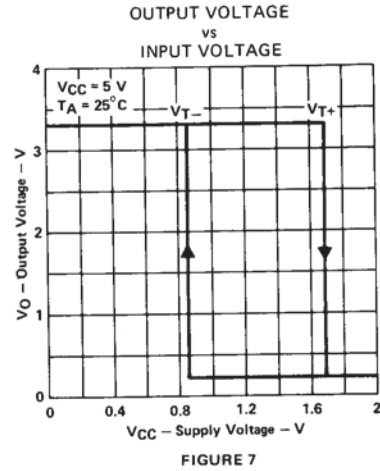
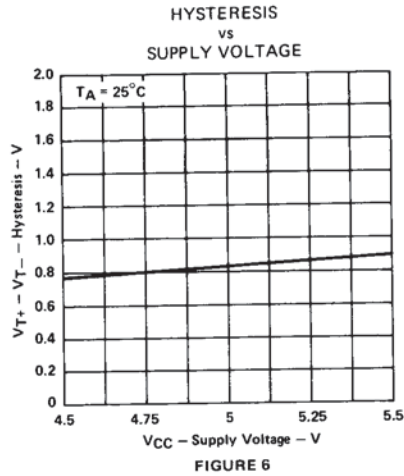
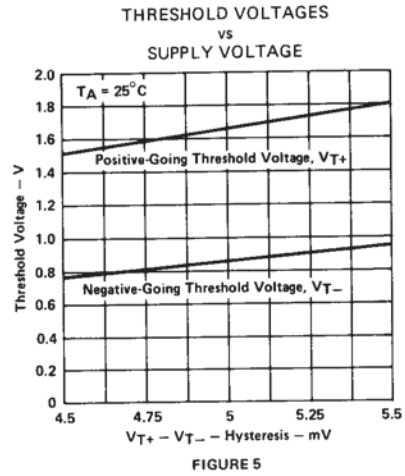
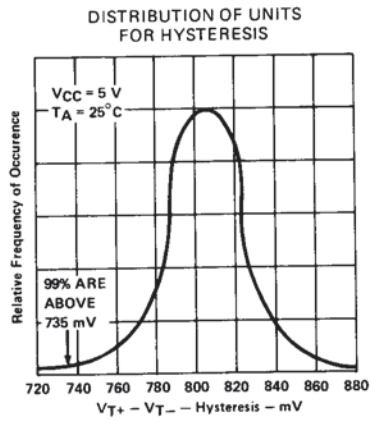
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**SN5413, SN7413**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**

TYPICAL CHARACTERISTICS OF '13 CIRCUITS

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Data for temperatures below 0°C and 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN5413 only.

**SN54LS13, SN74LS13**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**

**TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS**

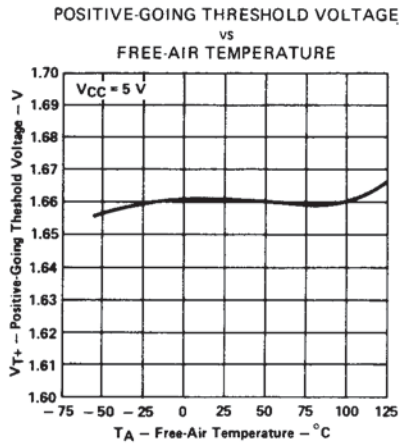


FIGURE 8

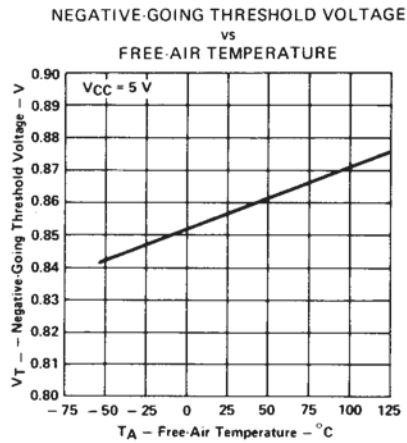


FIGURE 9

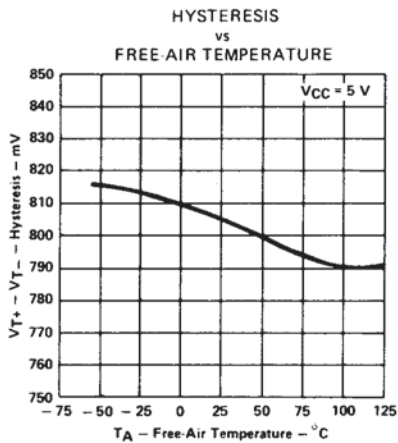


FIGURE 10

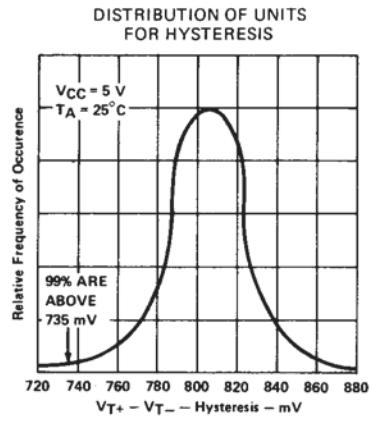


FIGURE 11

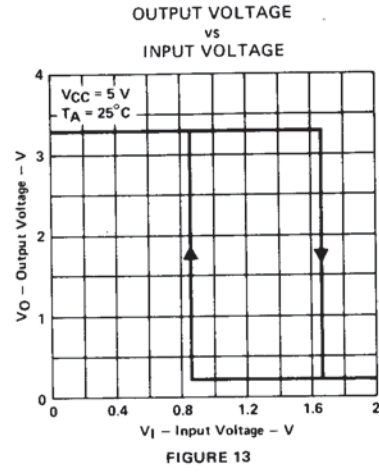
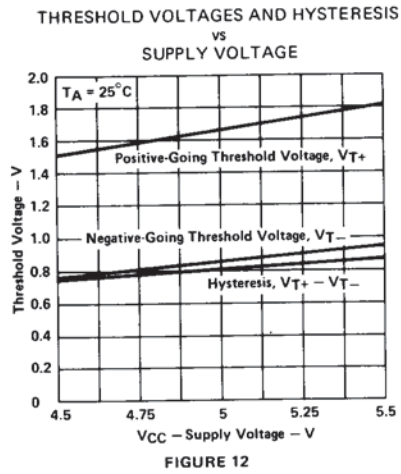
Data for temperatures below 0°C and above 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS13 only.



**SN54LS13, SN74LS13**  
**DUAL 4-INPUT**  
**POSITIVE-NAND SCHMITT TRIGGERS**

TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS

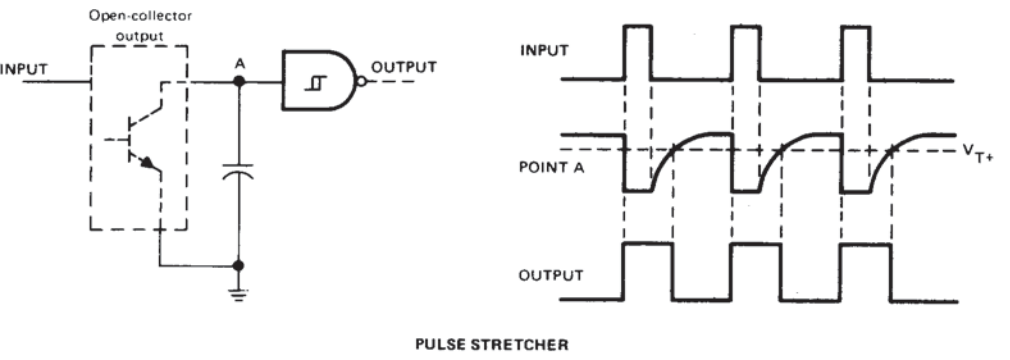
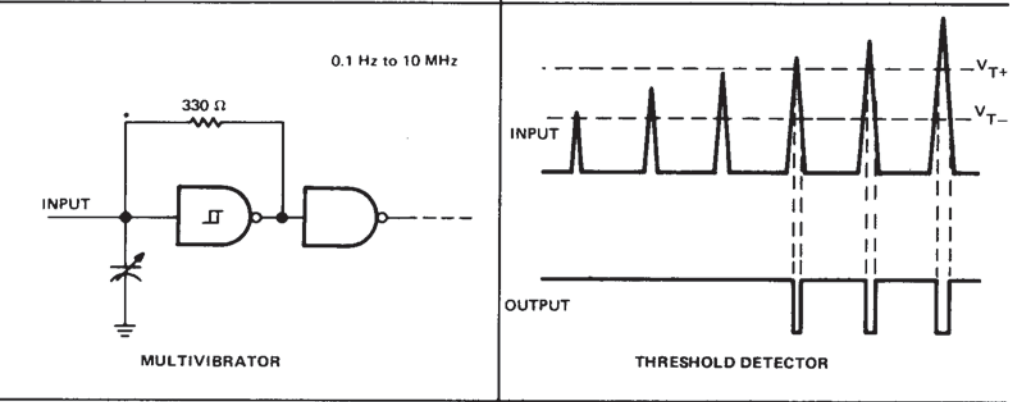
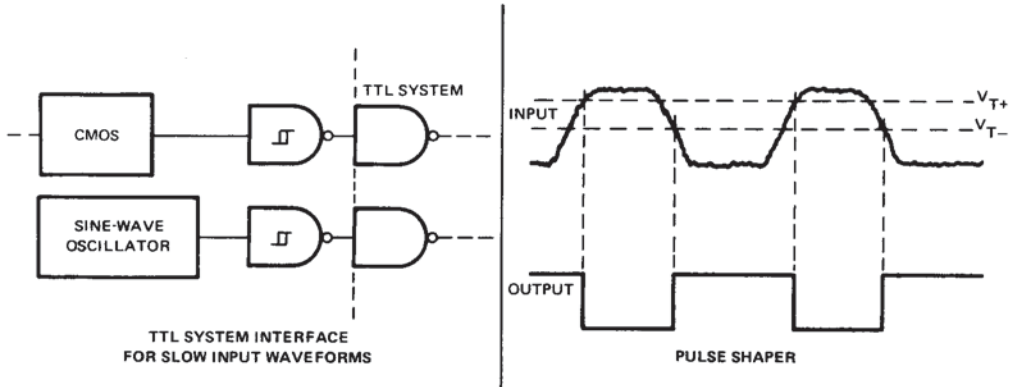
2  
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Data for temperatures below 0°C and above 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS13 only.

SN5413, SN54LS13, SN7413, SN74LS13  
 DUAL 4-INPUT  
 POSITIVE-NAND SCHMITT TRIGGERS

TYPICAL APPLICATION DATA



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