

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

REVISED DECEMBER 1983

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

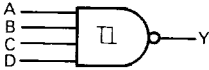
description

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°C to 125°C . The SN7413 and SN74LS13 are characterized for operation from 0°C to 70°C .

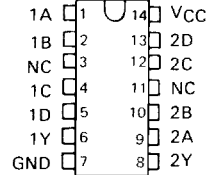
logic diagram



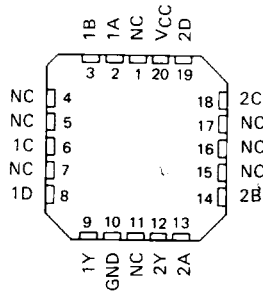
positive logic

$$Y = \overline{ABCD}$$

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



SN54LS13 ... FK PACKAGE
SN74LS13 ... FN PACKAGE
(TOP VIEW)



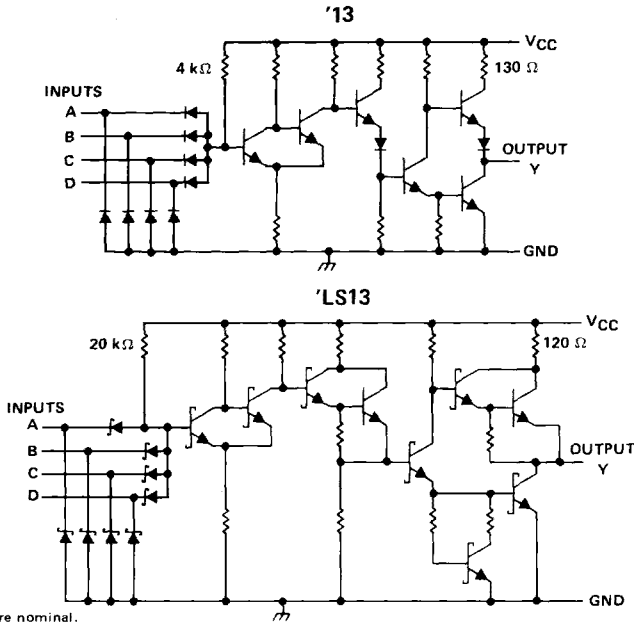
NC - No internal connection

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TTL DEVICES

TYPES 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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TTL DEVICES

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

recommended operating conditions

	SN5413			SN7413			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+}	$V_{CC} = 5\text{ V}$, $V_I = V_{T+}$		-0.65		mA
I_{T-}	$V_{CC} = 5\text{ V}$, $V_I = V_{T-}$		-0.85		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}	$V_{CC} = \text{MAX.}$, $V_{IL} = 0.4\text{ V}$		-1	-1.6	mA
I_{OS} §	$V_{CC} = \text{MAX.}$	-18		-55	mA
I_{CCH}	$V_{CC} = \text{MAX.}$		14	23	mA
I_{CCL}	$V_{CC} = \text{MAX.}$		20	32	mA

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

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

§ 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}	Any	Y	$R_L = 400\ \Omega$, $C_L = 15\text{ pF}$	18	27		ns
t_{PHL}				15	22		ns

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TYPES SN54LS13, SN74LS13

DUAL 4-INPUT

POSITIVE-NAND SCHMITT TRIGGERS

recommended operating conditions

	SN54LS13			SN74LS13			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†	SN54LS13			SN74LS13			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}	$V_{CC} = \text{MAX}$	2.9		6	2.9		6	mA
I_{CCL}	$V_{CC} = \text{MAX}$	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 $V_{CC} = 5\text{ V}, T_A = 25^\circ\text{C}$.

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

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

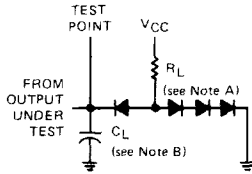
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		MIN	TYP	MAX	UNIT
t_{PLH}	Any	Y	$R_L = 2\text{ k}\Omega,$	$C_L = 15\text{ pF}$	15	22	ns	
t_{PHL}								18

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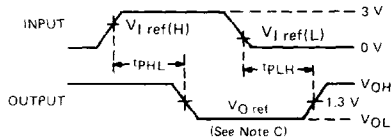
TTL DEVICES

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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 voltages are:

	Generator Characteristics				Reference Voltages		
	Z_{out}	PRR	t_r	t_f	$V_I \text{ ref(H)}$	$V_I \text{ ref(L)}$	$V_O \text{ ref}$
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 '13 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE

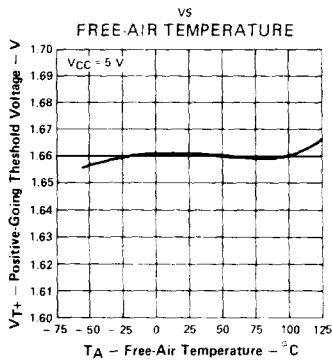


FIGURE 1

NEGATIVE-GOING THRESHOLD VOLTAGE

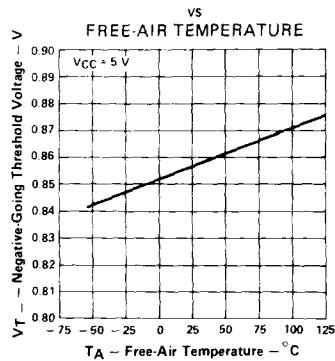


FIGURE 2

HYSTERESIS vs FREE-AIR TEMPERATURE

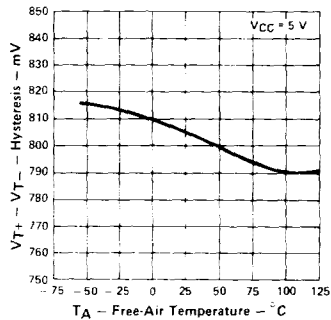


FIGURE 3

Data for temperatures below 0 $^{\circ}\text{C}$ and 70 $^{\circ}\text{C}$ and supply voltages below 4.75 V and above 5.25 V are applicable for SN5413 only.



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TYPES SN5413, SN7413
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POSITIVE-NAND SCHMITT TRIGGERS

TYPICAL CHARACTERISTICS OF '13 CIRCUITS

DISTRIBUTION OF UNITS FOR HYSTERESIS

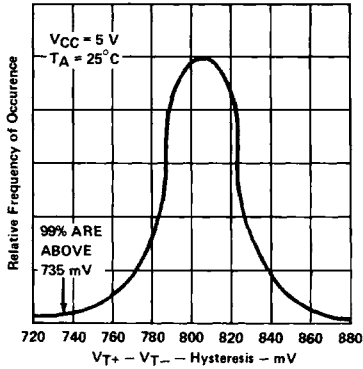


FIGURE 4

THRESHOLD VOLTAGES VS SUPPLY VOLTAGE

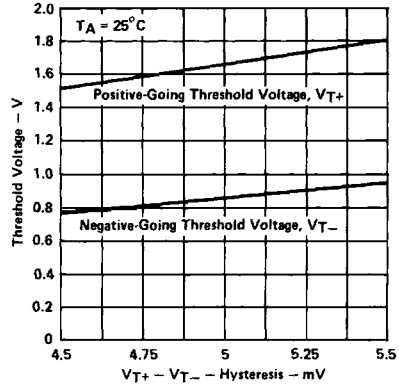


FIGURE 5

HYSTERESIS VS SUPPLY VOLTAGE

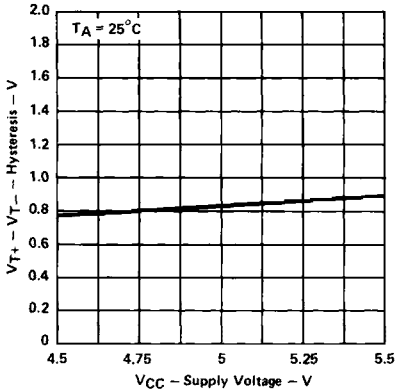


FIGURE 6

OUTPUT VOLTAGE VS INPUT VOLTAGE

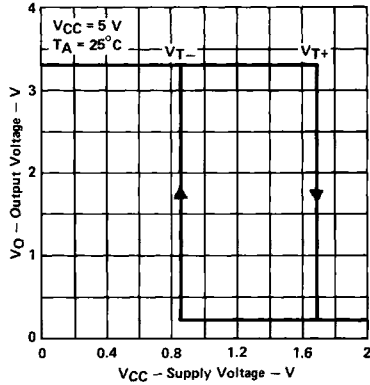


FIGURE 7

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

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

TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE
 vs
 FREE-AIR TEMPERATURE

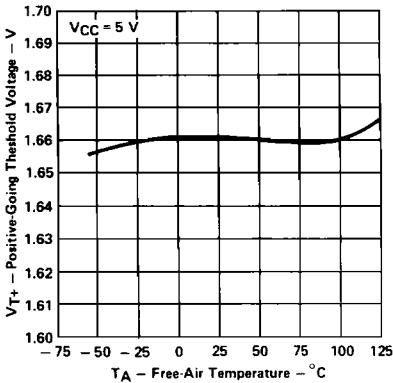


FIGURE 8

NEGATIVE-GOING THRESHOLD VOLTAGE
 vs
 FREE-AIR TEMPERATURE

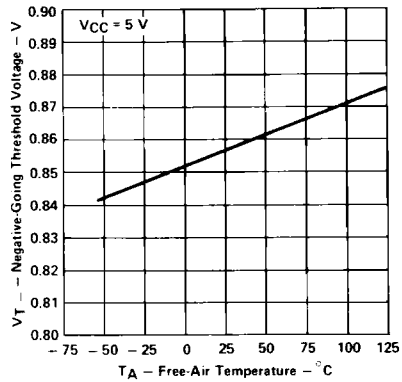


FIGURE 9

HYSTERESIS
 vs
 FREE-AIR TEMPERATURE

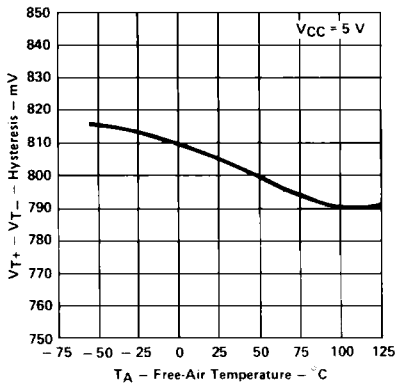


FIGURE 10

DISTRIBUTION OF UNITS
 FOR HYSTERESIS

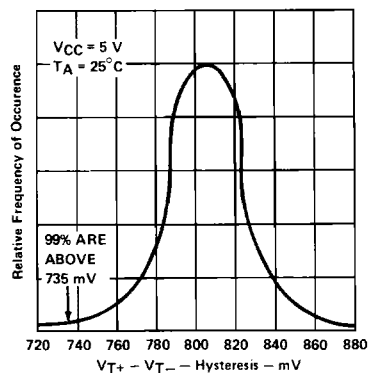


FIGURE 11

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TTL DEVICES

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.

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

TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS

THRESHOLD VOLTAGES AND HYSTERESIS
 VS
 SUPPLY VOLTAGE

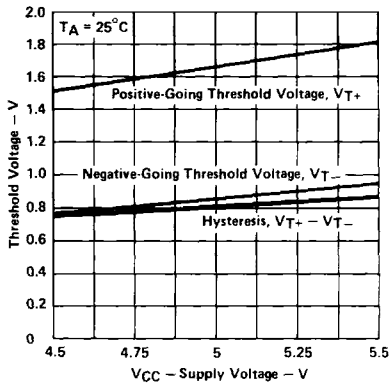


FIGURE 12

OUTPUT VOLTAGE
 VS
 INPUT VOLTAGE

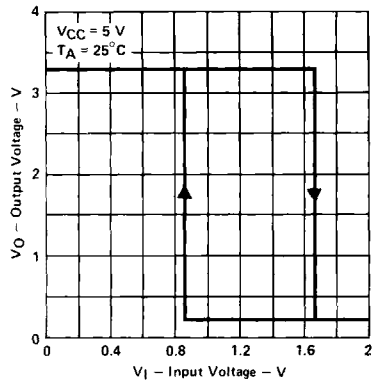


FIGURE 13

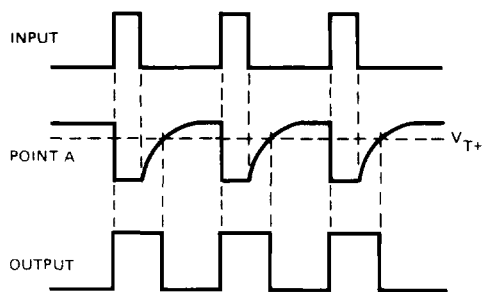
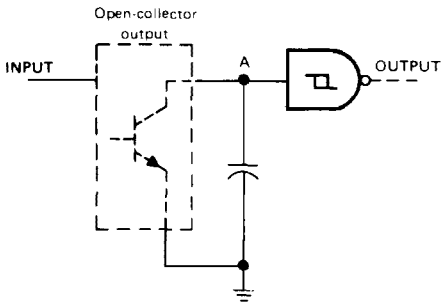
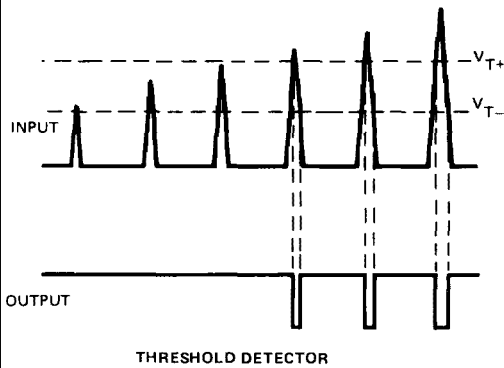
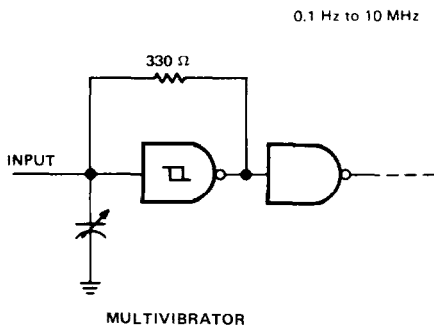
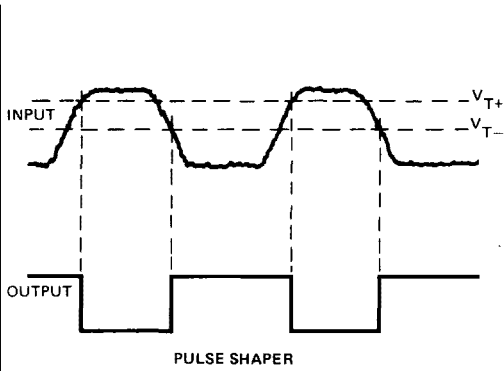
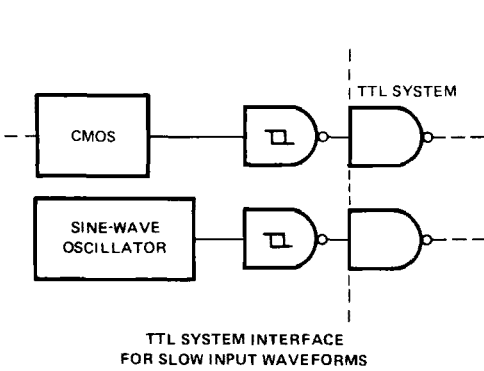
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TTL DEVICES

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.

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TYPICAL APPLICATION DATA



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TTL DEVICES

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