

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

SDLS046

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

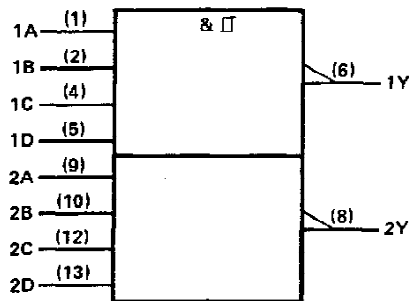
description

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.

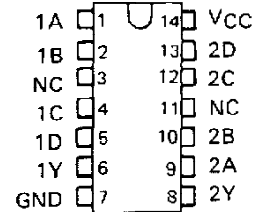
The SN5413 and SN54LS13 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN7413 and SN74LS13 are characterized for operation from 0°C to 70°C .

logic symbol†

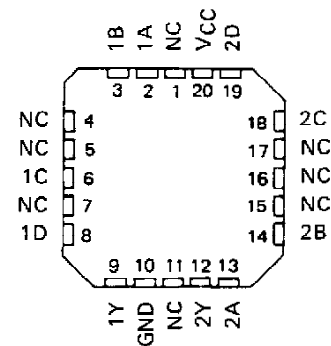


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-13.
 Pin numbers shown are for D, J, N, and W packages.

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

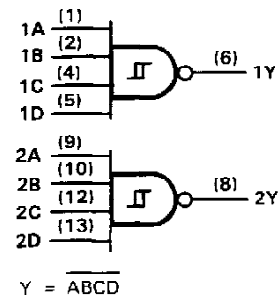


SN54LS13 . . . FK PACKAGE
 (TOP VIEW)



NC—No internal connection

logic diagram (positive logic)



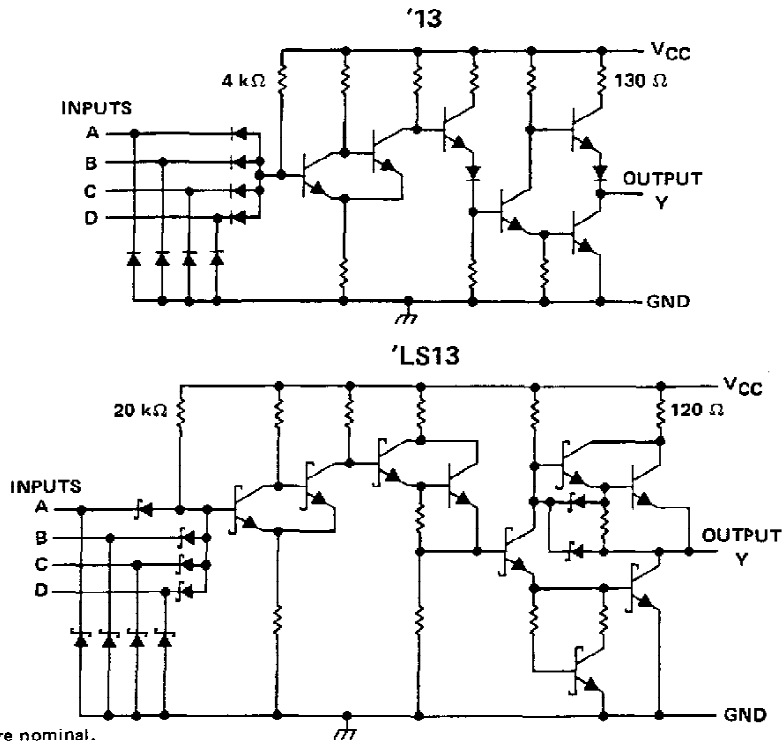
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SN5413, SN54LS13, SN7413, SN74LS13
DUAL 4-INPUT
POSITIVE-NAND SCHMITT TRIGGERS

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
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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


TEXAS
INSTRUMENTS

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SN54LS13, SN74LS13
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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 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
		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	2.9		6	2.9		6	mA
I _{CCL}	V _{CC} = 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 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.

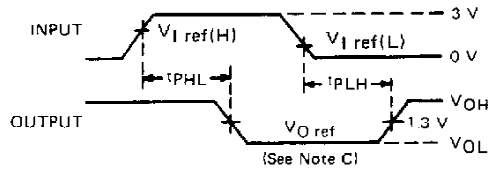
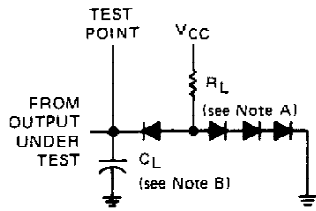
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	Any	Y	R _L = 2 kΩ, C _L = 15 pF	15	22		ns
t _{PHL}				18	27		ns



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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
 vs
 FREE-AIR TEMPERATURE**

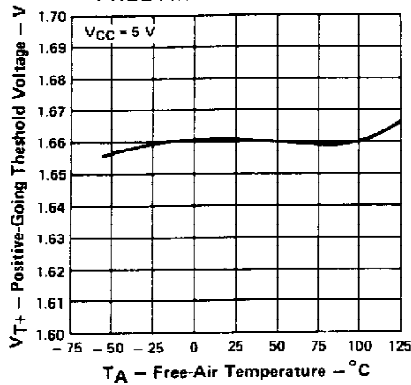


FIGURE 1

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

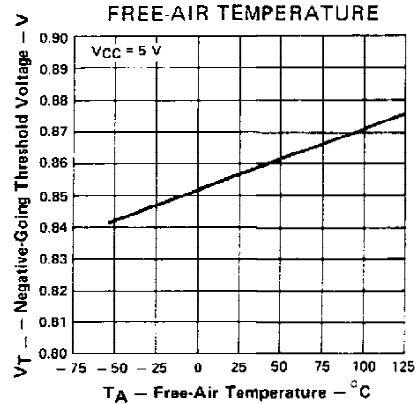


FIGURE 2

**HYSTERESIS
 vs
 FREE-AIR TEMPERATURE**

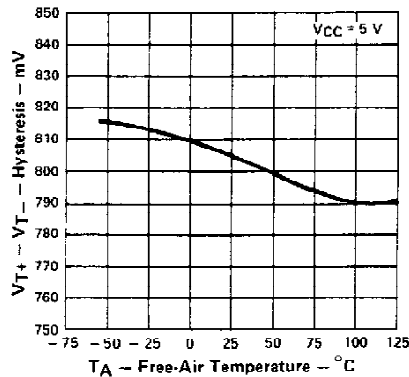
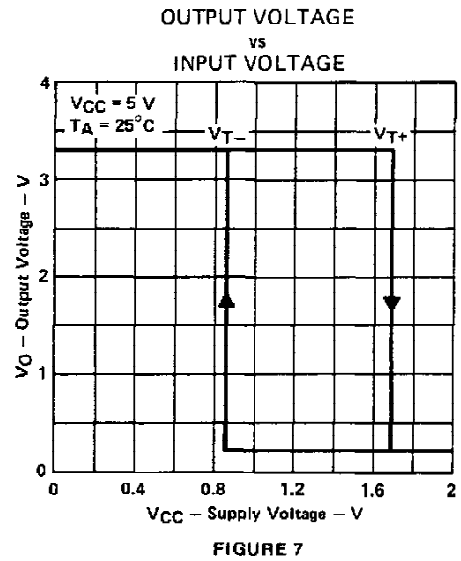
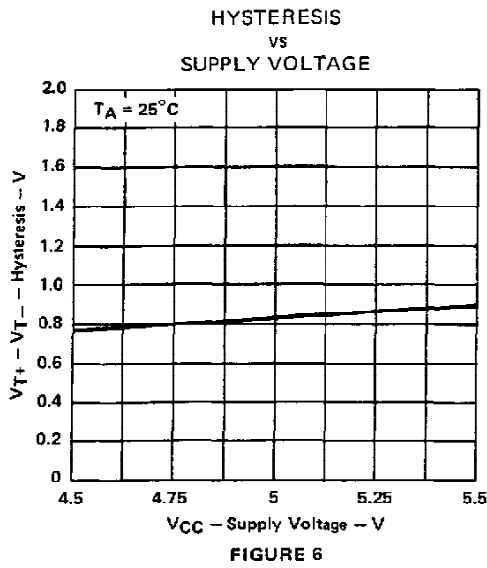
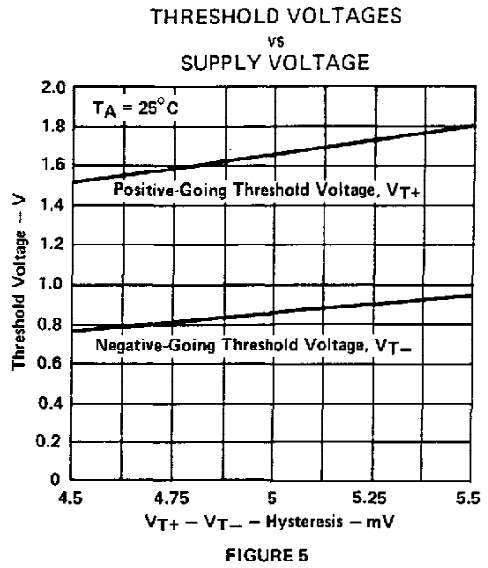
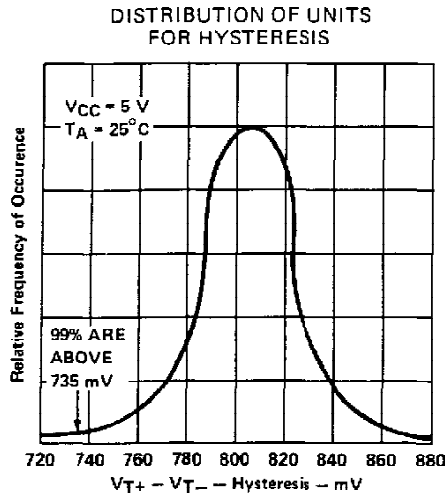


FIGURE 3

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

SN5413, SN7413
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TYPICAL CHARACTERISTICS OF '13 CIRCUITS



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
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TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE
 vs
 FREE-AIR TEMPERATURE

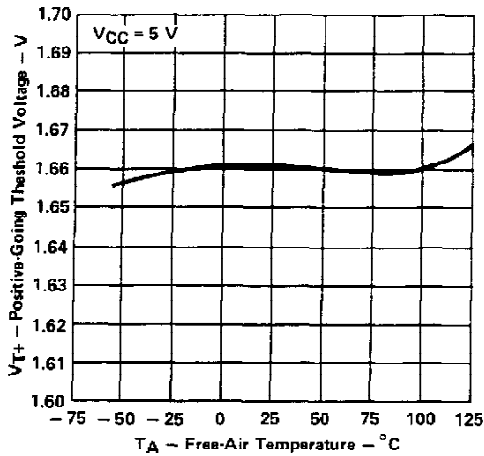


FIGURE 8

NEGATIVE GOING THRESHOLD VOLTAGE
 vs
 FREE-AIR TEMPERATURE

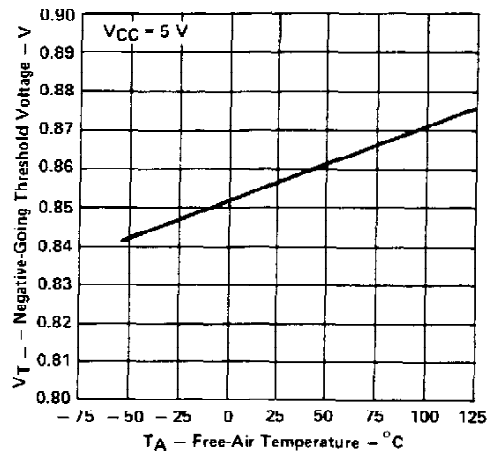


FIGURE 9

HYSTERESIS
 vs
 FREE-AIR TEMPERATURE

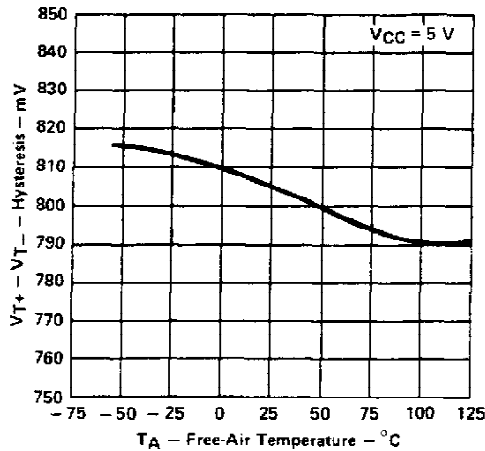


FIGURE 10

DISTRIBUTION OF UNITS
 FOR HYSTERESIS

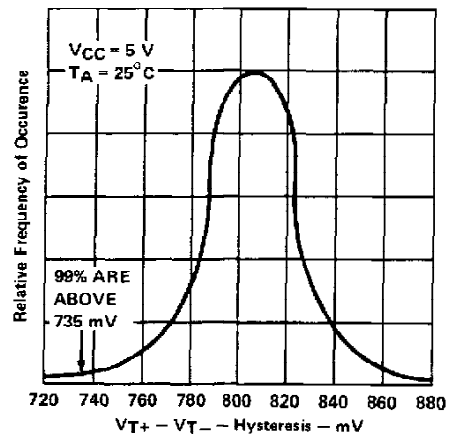


FIGURE 11

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

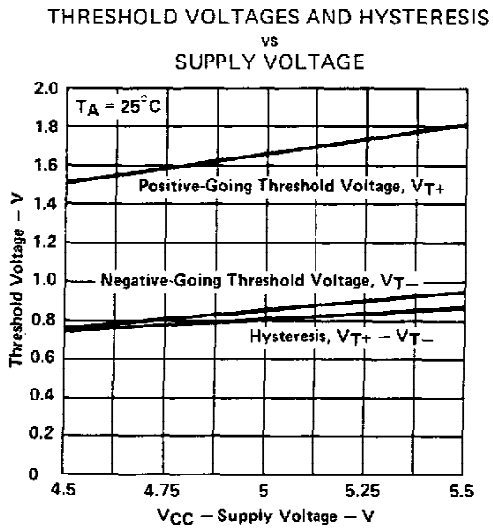


FIGURE 12

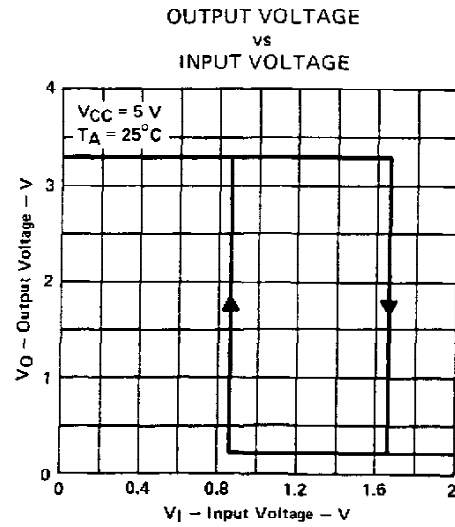


FIGURE 13

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 SN54LS13 only.

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

TYPICAL APPLICATION DATA

