

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

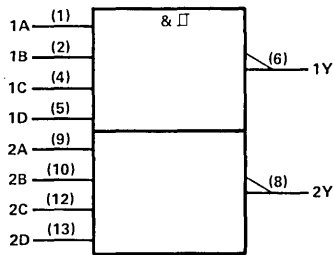
description

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.

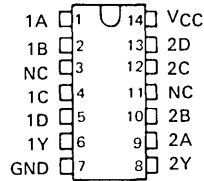
The SN5413 and SN54LS13 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN7413 and SN74LS13 are characterized for operation from 0°C to 70°C .

logic symbol†

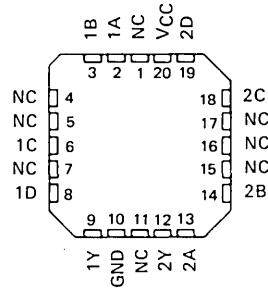


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-13.
Pin numbers shown are for D, J, N, and W packages.

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

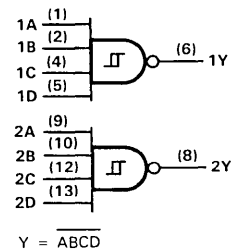


SN54LS13 . . . FK PACKAGE
(TOP VIEW)



NC—No internal connection

logic diagram (positive logic)



2

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PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS
INSTRUMENTS

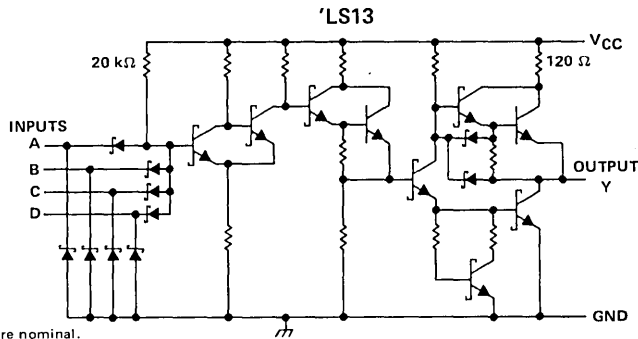
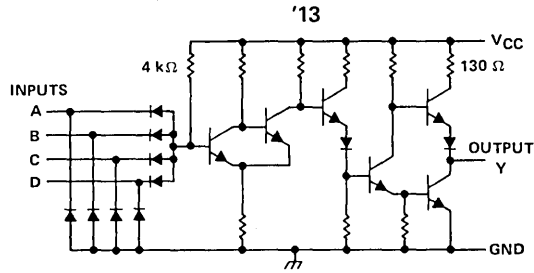
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2-67

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

schematics

2
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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.

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 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+}		-0.65		mA
I _{T-}	V _{CC} = 5 V, V _I = V _{T-}		-0.85		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		-1	-1.6	mA
I _{OS} §	V _{CC} = MAX,	-18		-55	mA
I _{CCH}	V _{CC} = MAX		14	23	mA
I _{CCL}	V _{CC} = 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 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}	Any	Y	R _L = 400 Ω, C _L = 15 pF		18	27	ns
t _{PHL}					15	22	ns

2

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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 _{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		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	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

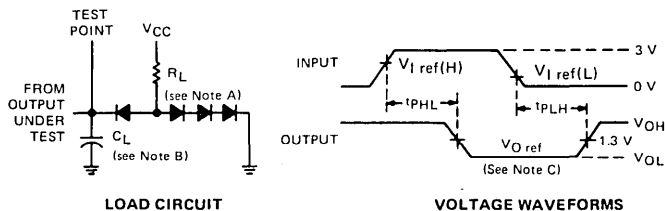
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	Any	Y	R _L = 2 kΩ, C _L = 15 pF	15 22		ns	
t _{PHL}				18 27			

2

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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 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

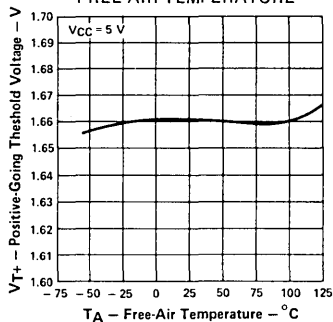


FIGURE 1

NEGATIVE-GOING THRESHOLD VOLTAGE
 vs
FREE-AIR TEMPERATURE

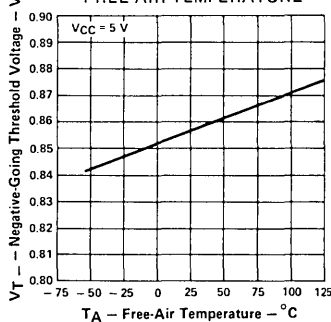


FIGURE 2

HYSTERESIS
 vs
FREE-AIR TEMPERATURE

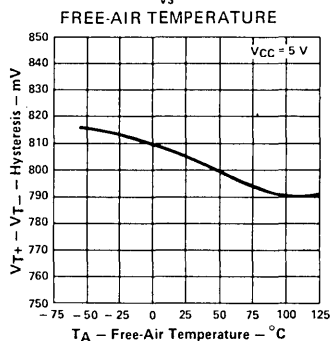


FIGURE 3

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
DUAL 4-INPUT
POSITIVE-NAND SCHMITT TRIGGERS

TYPICAL CHARACTERISTICS OF '13 CIRCUITS

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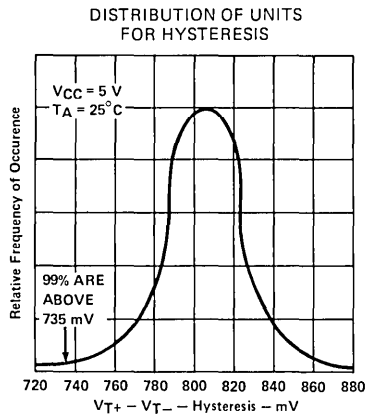


FIGURE 4

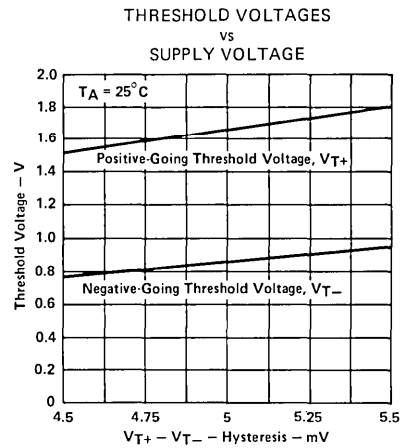


FIGURE 5

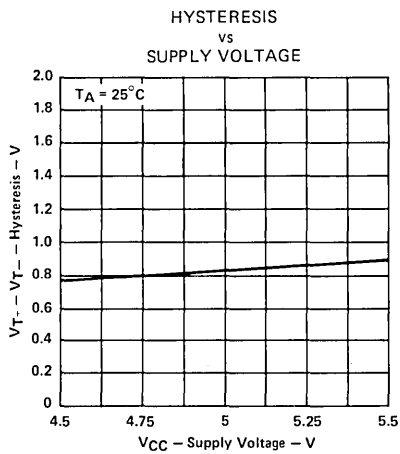


FIGURE 6

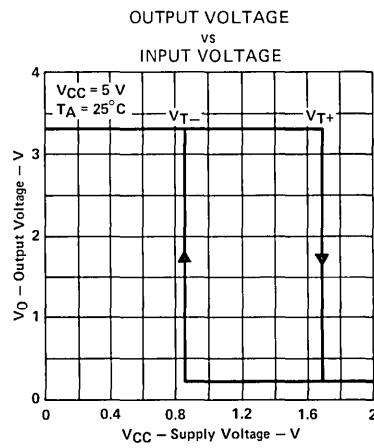


FIGURE 7

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

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

TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS

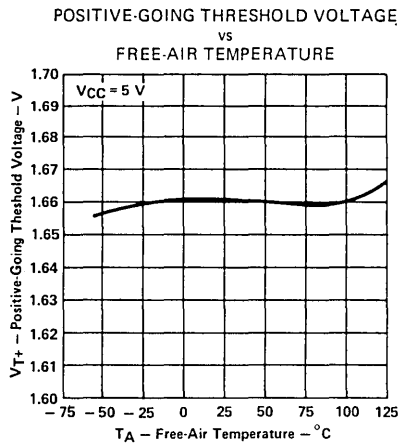


FIGURE 8

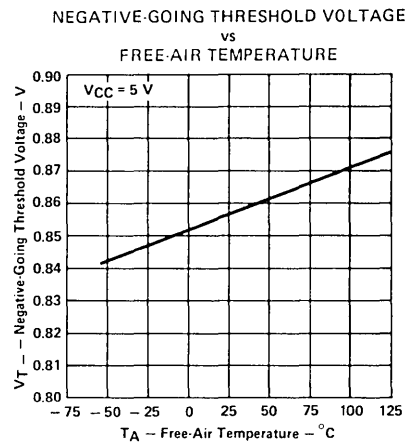


FIGURE 9

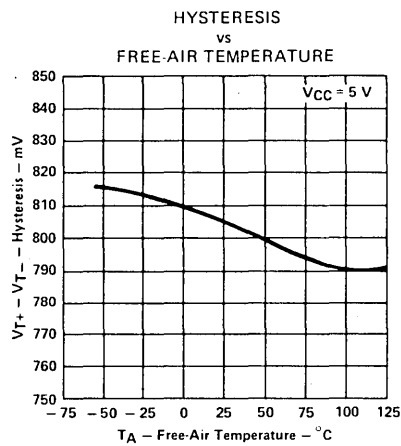


FIGURE 10

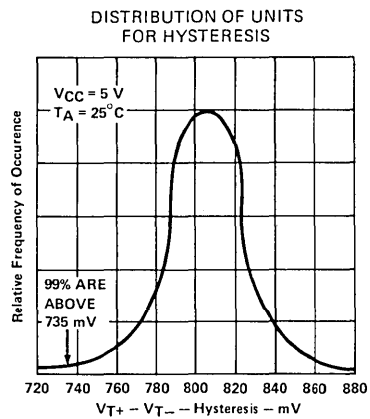


FIGURE 11

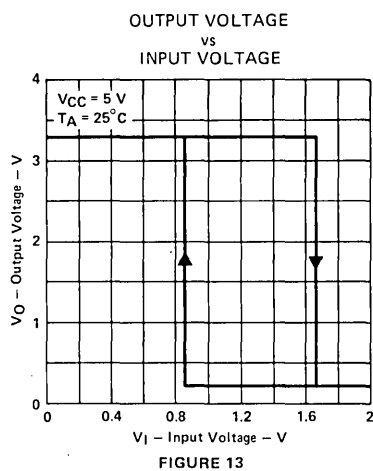
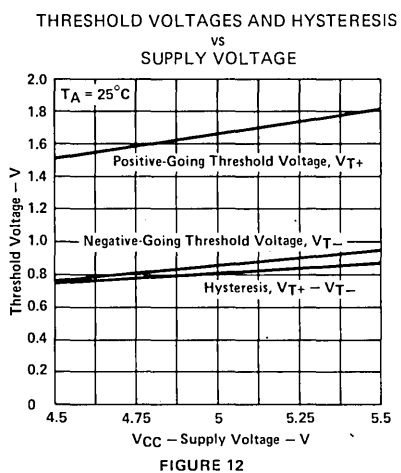
Data for temperatures below 0°C and above 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS13 only.

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

TYPICAL CHARACTERISTICS OF 'LS13 CIRCUITS

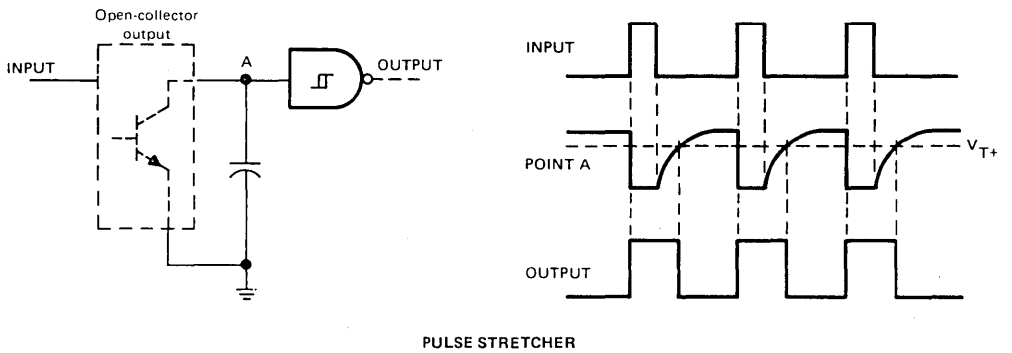
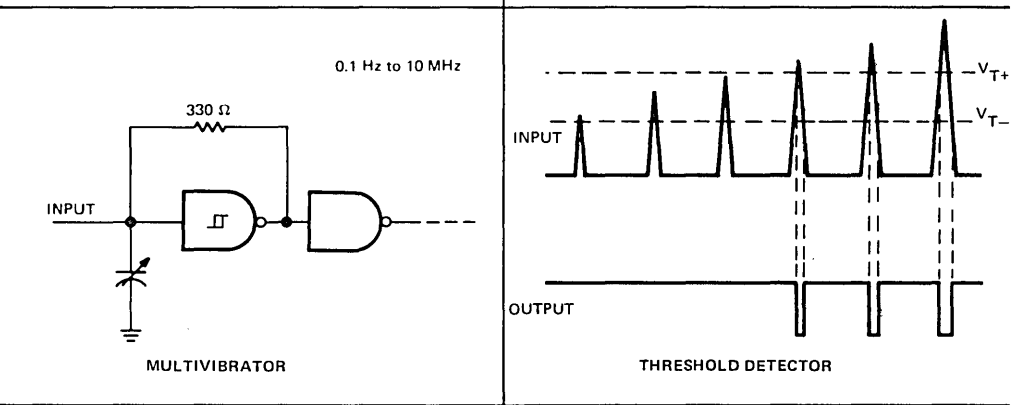
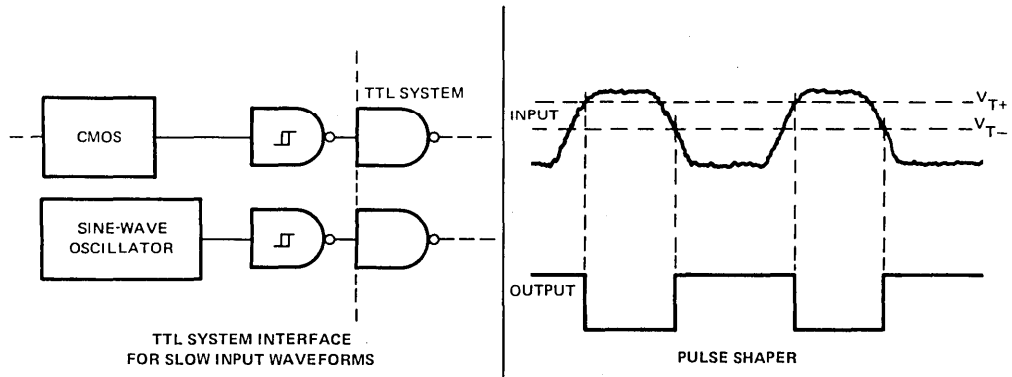
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Data for temperatures below 0°C and above 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN54LS13 only.

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

TYPICAL APPLICATION DATA



2
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