Signetics

7413, LS13
Gates

Dual 4-Input NAND Schmitt Trigger
Product Specification

Logic Products

DESCRIPTION

The '13 contains two 4-input NAND gates which accept standard TTL input signals and provide standard TTL output levels. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals. In addition, they have greater noise margin than conventional NAND gates.

Each circuit contains a 4-input Schmitt trigger followed by a Darlington level shifter and a phase splitter driving a TTL totem-pole output. The Schmitt trigger uses positive feedback to effectively speed-up slow input transitions, and provide different input threshold voltages for positive and negative-going transitions. This hysteresis between the positive-going and negative-going input threshold (typically 800mV) is determined by resistor ratios and is essentially insensitive to temperature and supply voltage variations. As long as three inputs remain at a more positive voltage than V_{t+MAX}, the gate will respond in the transitions of the other input as shown in Waveform 1.

TYPE	TYPICAL PROPAGATION DELAY	TYPICAL SUPPLY CURRENT (TOTAL)
7413	17ns	17mA
74LS13	17ns	3.5mA

ORDERING CODE

PACKAGES	COMMERCIAL RANGE V_{CC} = 5V ±5%; T_A = 0°C to +70°C
Plastic DIP	N7413N, N74LS13N

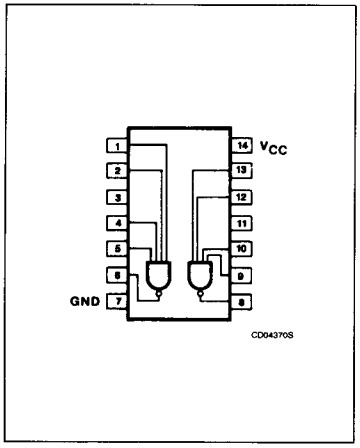
NOTE:
For information regarding devices processed to Military Specifications, see the Signetics Military Products Data Manual.

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

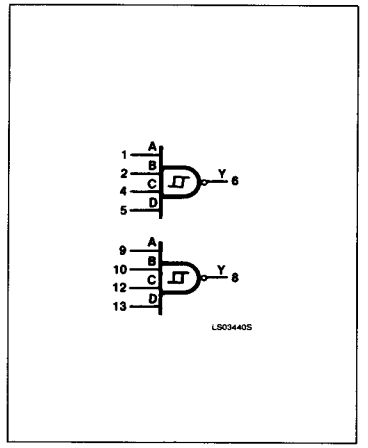
PINS	DESCRIPTION	74	74LS
All	Inputs	1ul	1LSul
Y	Output	10ul	10LSul

NOTE:
Where a 74 unit load (ul) is understood to be 40μA I_{IH} and −1.6mA I_{IL}, and 74LS unit load (LSul) is 20μA I_{IH} and −0.4mA I_{IL}.

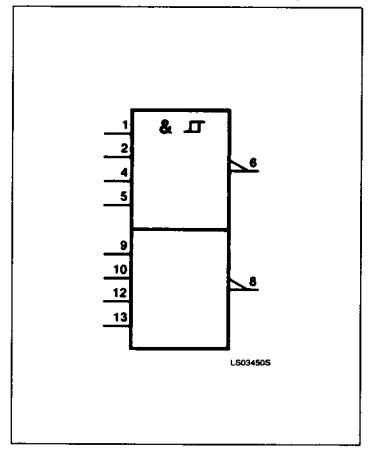
PIN CONFIGURATION



LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



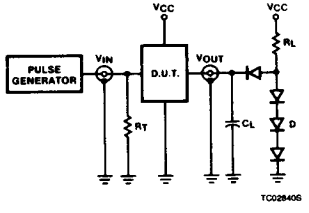
ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted.)

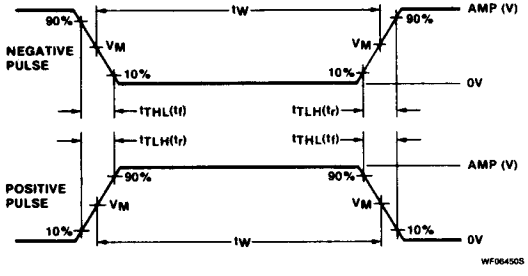
PARAMETER		74	74LS	UNIT
V_{CC}	Supply voltage	7.0	7.0	V
V_{IN}	Input voltage	−0.5 to +5.5	−0.5 to +7.0	V
I_{IN}	Input current	−30 to +5	−30 to +1	mA
V_{OUT}	Voltage applied to output in HIGH output state	−0.5 to +V_{CC}	−0.5 to +V_{CC}	V
T_A	Operating free-air temperature range	0 to 70		°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER		74			74LS			UNIT
		Min	Nom	Max	Min	Nom	Max	
V_{CC}	Supply voltage	4.75	5.0	5.25	4.75	5.0	5.25	V
I_{IK}	Input clamp current			−12			−18	mA
I_{OH}	HIGH-level output current			−800			−400	μA
I_{OL}	LOW-level output current			16			8	mA
T_A	Operating free-air temperature	0		70	0		70	°C

TEST CIRCUITS AND WAVEFORMS





V_M = 1.3V for 74LS; V_M = 1.5V for all other TTL families.

Test Circuit For 74 Totem-Pole Outputs

Input Pulse Definitions

DEFINITIONS
R_L = Load resistor to V_{CC}; see AC CHARACTERISTICS for value.
C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.
R_T = Termination resistance should be equal to Z_{OUT} of Pulse Generators.
D = Diodes are 1N916, 1N3064, or equivalent.
t_{TLH}, t_{THL} Values should be less than or equal to the table entries.

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	Pulse Width	t_{TLH}	t_{THL}
74	3.0V	1MHz	500ns	7ns	7ns
74LS	3.0V	1MHz	500ns	15ns	6ns
74S	3.0V	1MHz	500ns	2.5ns	2.5ns

DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

PARAMETER		TEST CONDITIONS[1]		7413			74LS13			UNIT
				Min	Typ[2]	Max	Min	Typ[2]	Max	
V_{T+}	Positive-going threshold	V_{CC} = 5.0V		1.5	1.7	2.0	1.4	1.6	1.9	V
V_{T-}	Negative-going threshold	V_{CC} = 5.0V		0.6	0.9	1.1	0.5	0.8	1.0	V
ΔV_T	Hysteresis ($V_{T+} - V_{T-}$)	V_{CC} = 5.0V		0.4	0.8		0.4	0.8		V
V_{OH}	HIGH-level output voltage	V_{CC} = MIN, $V_I = V_{T-MIN}$, I_{OH} = MAX		2.4	3.4		2.7	3.4		V
V_{OL}	LOW-level output voltage	V_{CC} = MIN, $V_I = V_{T+MAX}$	I_{OL} = MAX		0.2	0.4		0.35	0.5	V
			I_{OL} = 4mA (74LS)					0.25	0.4	V
V_{IK}	Input clamp voltage	V_{CC} = MIN, $I_I = I_{IK}$				−1.5			−1.5	V
I_{T+}	Input current at positive-going threshold	V_{CC} = 5.0V, $V_I = V_{T+}$			−0.65			−0.14		mA
I_{T-}	Input current at negative-going threshold	V_{CC} = 5.0V, $V_I = V_{T-}$			−0.85			−0.18		mA
I_I	Input current at maximum input voltage	V_{CC} = MAX	V_I = 5.5V			1.0				mA
			V_I = 7.0V						0.1	mA
I_{IH}	HIGH-level input current	V_{CC} = MAX	V_I = 2.4V			40				μA
			V_I = 2.7V						20	μA
I_{IL}	LOW-level input current	V_{CC} = MAX, V_I = 0.4V				−1.6			−0.4	mA
I_{OS}	Short-circuit output current[3]	V_{CC} = MAX		−18		−55	−20		−100	mA
I_{CC}	Supply current (total)	V_{CC} = MAX	I_{CCH} Outputs HIGH		14	23		2.9	6	mA
			I_{CCL} Outputs LOW		20	32		4.1	7	mA

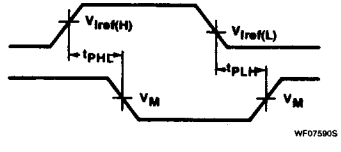
NOTES:
1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_A = 25°C.
3. I_{OS} is tested with V_{OUT} = +0.5V and $V_{CC} = V_{CC}$ MAX + 0.5V. Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

FUNCTION TABLE

INPUTS				OUTPUT
A	B	C	D	Y
L	X	X	X	H
X	L	X	X	H
X	X	L	X	H
X	X	X	L	H
H	H	H	H	L

H = HIGH voltage level
L = LOW voltage level
X = Don't care

AC WAVEFORM



V_M = 1.3V for 74LS; V_M = 1.5V for all other TTL families.
$V_{Iref(H)}$ = 1.7V for '13, 1.6V for 'LS13.
$V_{Iref(L)}$ = 0.9V for '13, 0.8V for 'LS13.

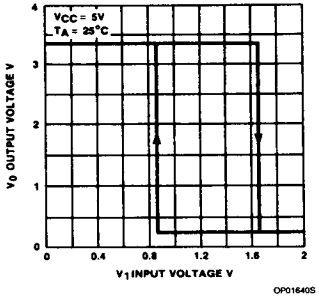
Waveform 1. Waveform For Inverting Outputs

AC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V_{CC} = 5.0V$

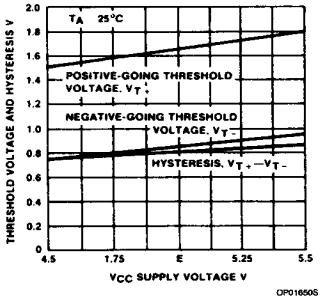
PARAMETER		TEST CONDITIONS	74		74LS		UNIT
			$C_L = 15pF$, $R_L = 400\Omega$		$C_L = 15pF$, $R_L = 2k\Omega$		
			Min	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation delay	Waveform 1		27 22		22 27	ns

TYPICAL PERFORMANCE CHARACTERISTICS

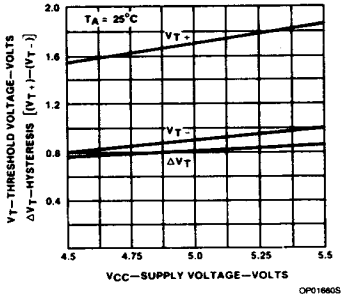
(74, 74LS)
V_{IN} vs V_{OUT}
Transfer Function



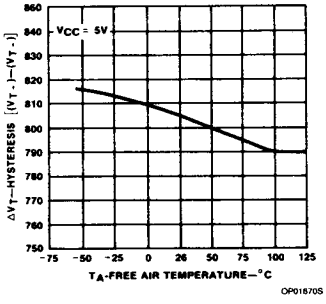
(74)
Threshold Voltage And
Hysteresis vs
Power Supply
Voltage



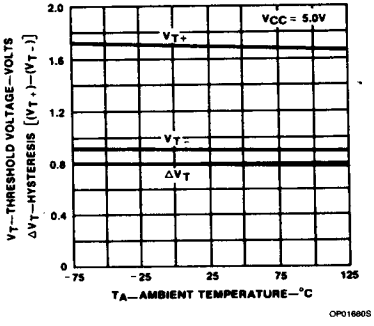
(74LS)
Threshold Voltage And
Hysteresis vs
Power Supply Voltage



(74)
Hysteresis vs Temperature



(74LS)
Threshold Voltage And
Hysteresis vs
Ambient Temperature



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