Schmitt-Trigger Positive-NAND Gates and Inverters with Totem-Pole Outputs

FEATURES

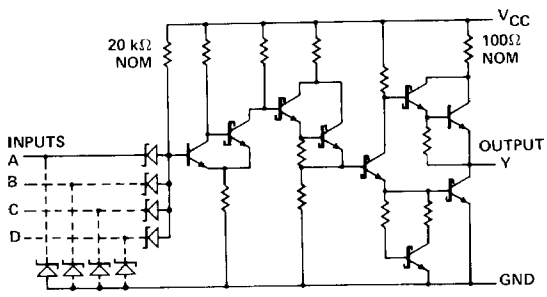
- Operation from Very Slow Transitions
- Temperature-Compensated Threshold Levels
- Temperature-Compensated Hysteresis, Typically 0.8V
- High Noise Immunity

DESCRIPTION

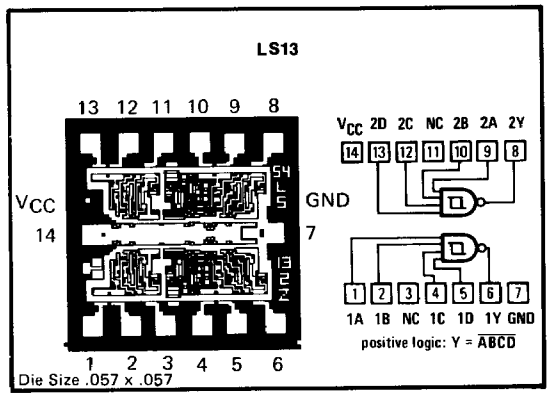
Each circuit functions as a NAND gate or inverter, but because of the Schmitt action, it has different input threshold levels for positive- and negative-going signals. The hysteresis or backlash, which is the difference between the two threshold levels, is typically 800 millivolts.

These circuits are temperature compensated and can be triggered from the slowest of input ramps and still give clean, jitter-free output signals.

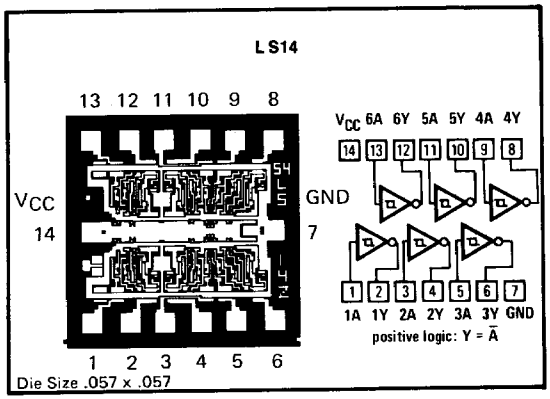
SCHEMATIC (EACH GATE)



PIN-OUT AND LOGIC DIAGRAMS



NC- No internal connection



Recommended Operating Conditions

	9LS/54LS			9LS/74LS			Unit
	Min	Nom	Max	Min	Nom	Max	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			-400			-400	μA
Low-level output current, I_{OL}			4			8	mA
Operating free-air temperature, T_A	-55		125	0		70	°C

RAYTHEON

Electrical Characteristics Over Recommended Free-Air Temperature Range (Unless Otherwise Noted)

Parameter	Test Conditions*		9LS/54LS			9LS/74LS			Unit
			Min	Typ**	Max	Min	Typ**	Max	
V_{T+}	V_{CC}=5V		1.4	1.6	1.9	1.4	1.6	1.9	V
V_{T-}	V_{CC}=5V		.5	.8	1.0	.5	.8	1.0	V
$V_{T+} - V_{T-}$	V_{CC}=5V		0.4	0.8		0.4	0.8		V
V_I	V_{CC}=MIN, I_I=-18mA				-1.5			-1.5	V
V_{OH}	V_{CC}=MIN, I_{OH}=-400μA, V_I=0.6V		2.5	3.4		2.7	3.4		V
V_{OL}	V_{CC}=MIN, V_I=2V	I_{OL}=4mA		0.25	0.4		0.25	0.4	V
		I_{OL}=8mA					0.35	0.5	
I_{T+}	V_{CC}=5V, V_I=V_{T+}			-0.14			-0.14		mA
I_{T-}	V_{CC}=5V, V_I=V_{T-}			-0.18			-0.18		mA
I_I	V_{CC}=MAX, V_I=7V				0.1			0.1	mA
I_{IH}	V_{CC}=MAX, V_I=2.7V				20			20	μA
I_{IL}	V_{CC}=MAX, V_I=0.4V				-0.4			-0.4	mA
I_{OS}	V_{CC}=MAX		-15		-100	-15		-100	mA
I_{CCH}	V_{CC}=MAX, V_I=0V	LS13		2.9	6		2.9	6	mA
		LS14		8.6	16		8.6	16	
I_{CCL}	V_{CC}=MAX, V_I=4.5V	LS13		4.1	7		4.1	7	mA
		LS14		12	21		12	21	

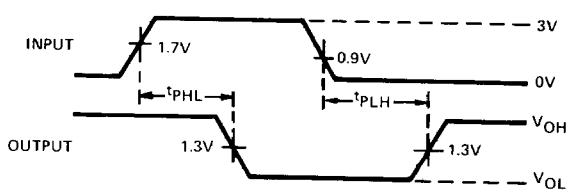
*For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable device type.
**All typical values are at V_{CC} = 5V, T_A = 25°C.
†Not more than one output should be shorted at a time.

Switching Characteristics, V_{CC} = 5V Over Recommended Free-Air Temperature Range

Parameter		−55°C			+25°C			+125°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Test Conditions: C_L = 15pF, R_L = 2kΩ (See Fig. A, page 2-174)											
t_{PLH}	LS13	16	28			15	22		16	30	ns
	LS14	16	28			15	22		16	30	ns
t_{PHL}	LS13	22	38			18	27		20	38	ns
	LS14	17	32			15	22		16	30	ns
Test Conditions: C_L = 50pF, R_L = 2kΩ (See Fig. A, page 2-174)											
t_{PLH}	LS13	20	38			20	27		20	38	ns
	LS14	20	38			20	27		21	38	ns
t_{PHL}	LS13	25	42			25	33		25	42	ns
	LS14	21	38			20	27		21	38	ns

Note: AC specification shown under −55°C and +125°C are for 9LS devices only. All 50pF specifications are for 9LS only.

PARAMETER MEASUREMENT INFORMATION

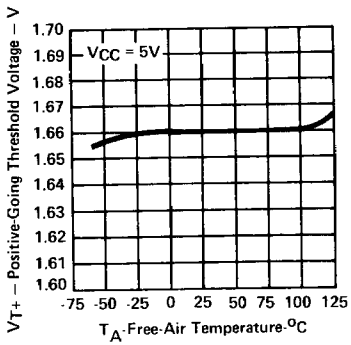


VOLTAGE WAVEFORMS

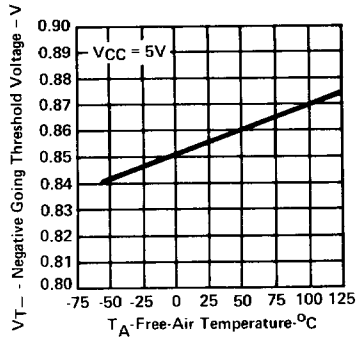
NOTES: A. The input waveform is supplied by a generator with the following characteristics: Z_{out} = 50Ω and PRR ≤ 1 MHz, t_r ≤ 15 ns, t_f ≤ 6 ns.
B. C_L includes probe and jig capacitance.
C. All diodes are 1N916 or 1N3064.

TYPICAL CHARACTERISTICS†

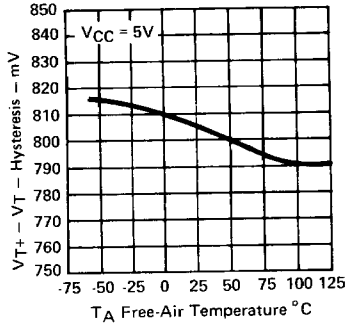
POSITIVE-GOING THRESHOLD VOLTAGE VS FREE-AIR TEMPERATURE



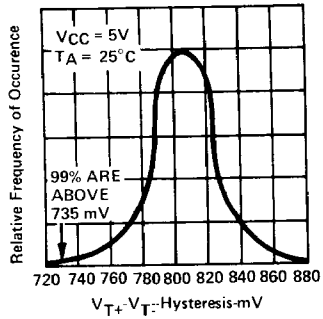
NEGATIVE-GOING THRESHOLD VOLTAGE VS FREE-AIR TEMPERATURE



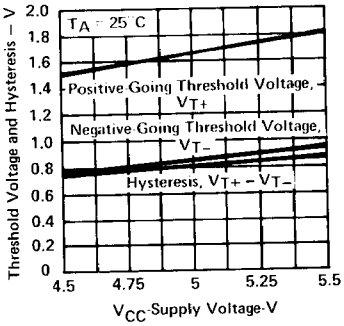
HYSTERESIS VS FREE-AIR TEMPERATURE



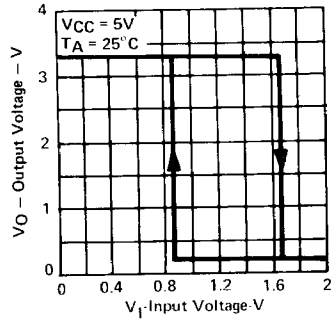
DISTRIBUTION OF UNITS FOR HYSTERESIS



THRESHOLD VOLTAGES AND HYSTERESIS VS SUPPLY VOLTAGE

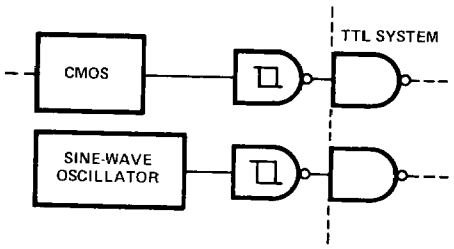


OUTPUT VOLTAGE VS INPUT VOLTAGE

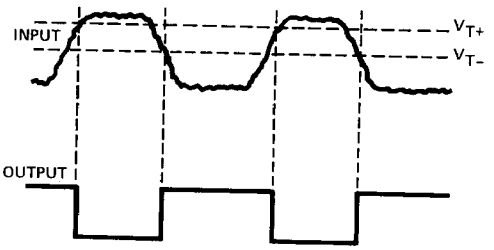


†Data for temperatures below 0°C and above 70°C and supply voltages below 4.75V and above 5.25 are applicable for 9LS/54LS13, and 9LS/54LS14.

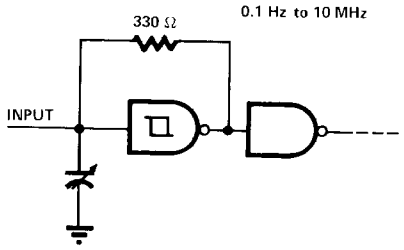
TYPICAL APPLICATION DATA



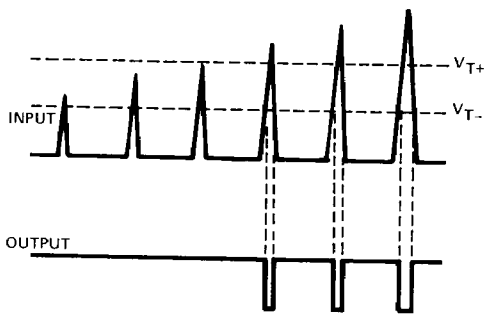
TTL SYSTEM INTERFACE FOR SLOW INPUT WAVEFORMS



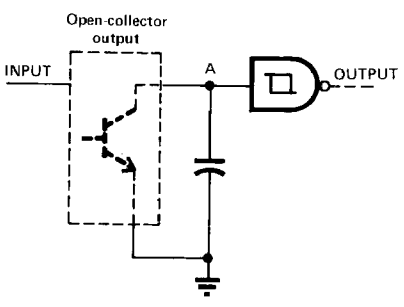
PULSE SHAPER

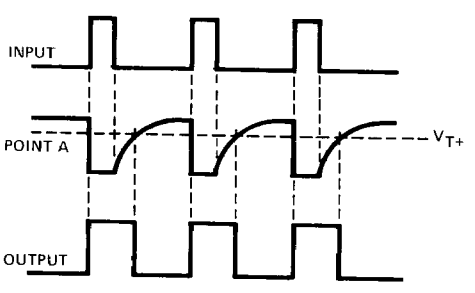


MULTIVIBRATOR



THRESHOLD DETECTOR





PULSE STRETCHER