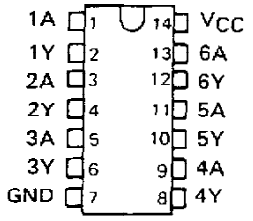
SN5414, SN54LS14, SN7414, SN74LS14
HEX SCHMITT-TRIGGER INVERTERS

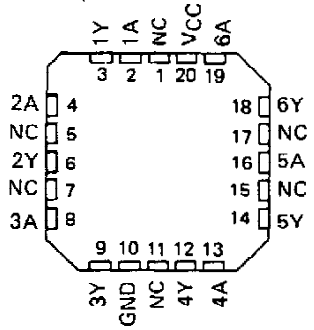
DECEMBER 1983—REVISED MARCH 1988

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

SN5414, SN54LS14 . . . J OR W PACKAGE
SN7414 . . . N PACKAGE
SN74LS14 . . . D OR N PACKAGE
(TOP VIEW)



SN54LS14 . . . FK PACKAGE
(TOP VIEW)



NC—No internal connection

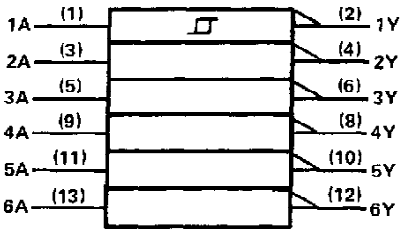
description

Each circuit functions as an inverter, 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.

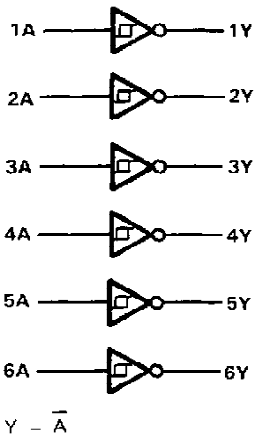
The SN5414 and SN54LS14 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN7414 and the SN74LS14 are characterized for operation from 0° C to 70° C.

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

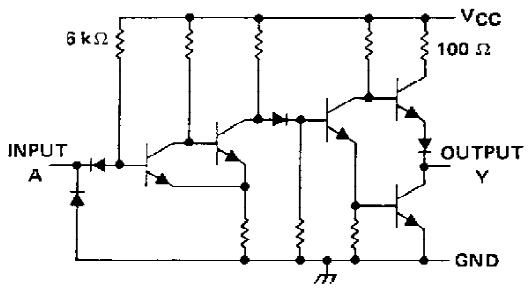
logic diagram (positive logic)



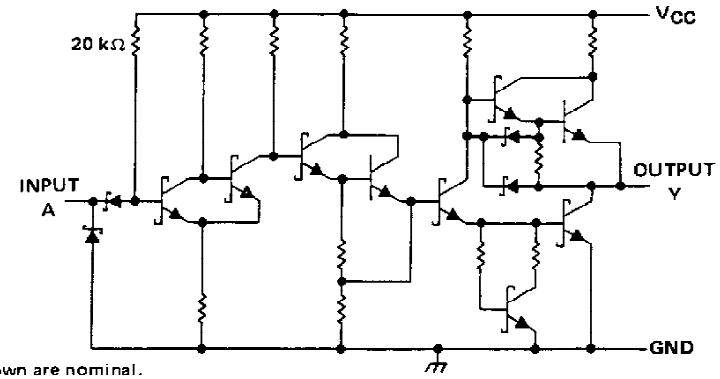
$Y = \overline{A}$

schematics

'14



'LS14



Resistor values shown 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: '14 . . . . . 5.5 V
'LS14 . . . . . 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.

recommended operating conditions

	SN5414			SN7414			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, $V_I = V_{T+}$		−0.43		mA
I_{T-}	V_{CC} = 5 V, $V_I = V_{T-}$		−0.56		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		−0.8	−1.2	mA
I_{OS}§	V_{CC} = MAX	−18		−55	mA
I_{CCH}	V_{CC} = MAX		22	36	mA
I_{CCL}	V_{CC} = MAX		39	60	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}	A	Y	R_L = 400 Ω, C_L = 15 pF		15	22	ns
t_{PHL}					15	22	ns

recommended operating conditions

		SN54LS14			SN74LS14			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)

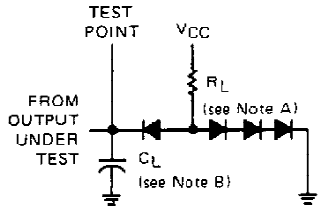
PARAMETER	TEST CONDITIONS†		SN54LS14			SN74LS14			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{T+}	V_{CC} = 5 V		1.4	1.6	1.9	1.4	1.6	1.9	V
V_{T-}	V_{CC} = 5 V		0.5	0.8	1	0.5	0.8	1	V
Hysteresis ($V_{T+} - V_{T-}$)	V_{CC} = 5 V		0.4	0.8		0.4	0.8		V
V_{IK}	V_{CC} = MIN, I_I = −18 mA				−1.5			−1.5	V
V_{OH}	V_{CC} = 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			8.6	16		8.6	16	mA
I_{CCL}	V_{CC} = MAX			12	21		12	21	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.

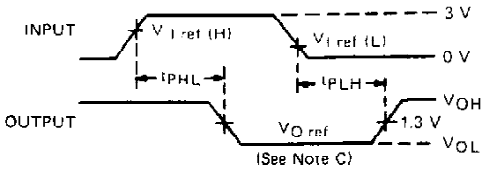
switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	A	Y	R_L = 2 kΩ, C_L = 15 pF		15	22	ns
t_{PHL}					15	22	ns

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 voltage 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 '14 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE

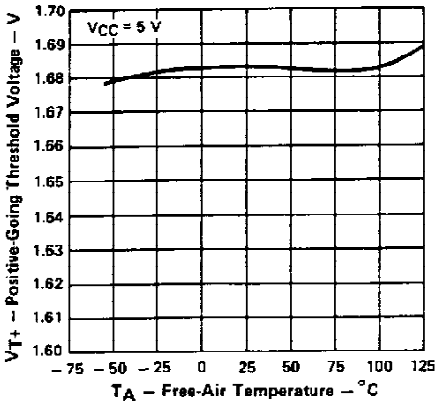


FIGURE 1

NEGATIVE-GOING THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE

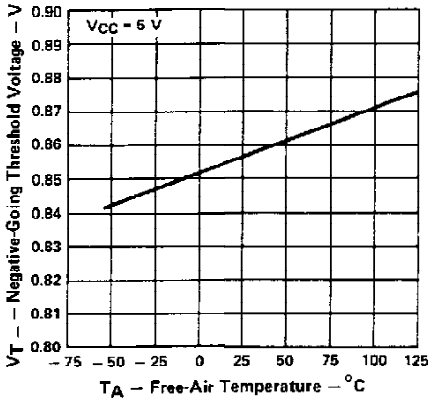


FIGURE 2

HYSTERESIS
vs
FREE-AIR TEMPERATURE

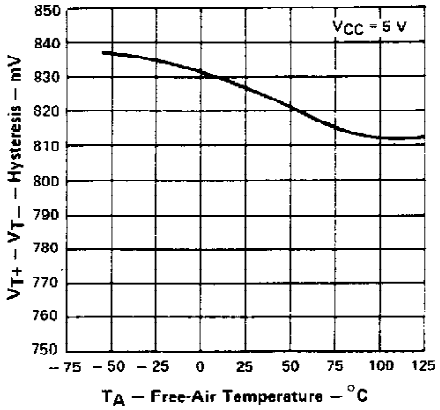


FIGURE 3

Data for temperatures below 0°C and 70°C and supply voltages below 4.75V and above 5.25 V are applicable for SN5414 only.

TYPICAL CHARACTERISTICS OF '14 CIRCUITS

DISTRIBUTION OF UNITS
FOR HYSTERESIS

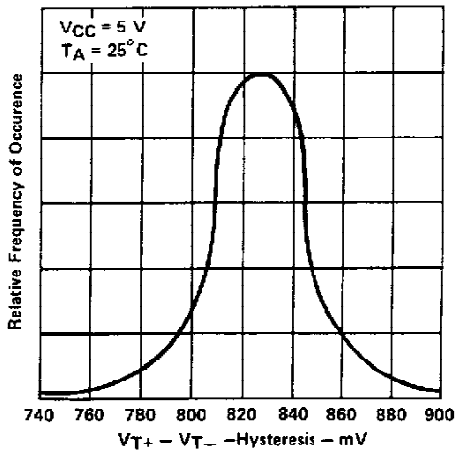


FIGURE 4

THRESHOLD VOLTAGES
vs
SUPPLY VOLTAGE

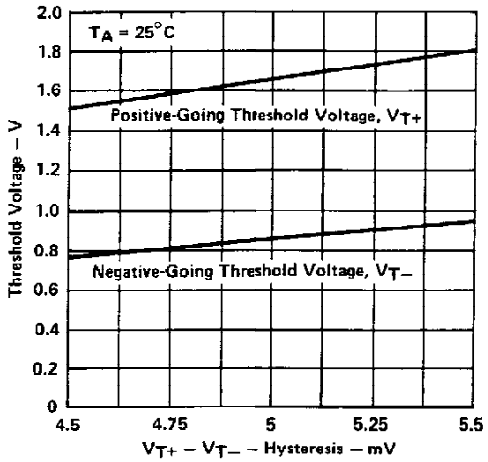


FIGURE 5

HYSTERESIS
vs
SUPPLY VOLTAGE

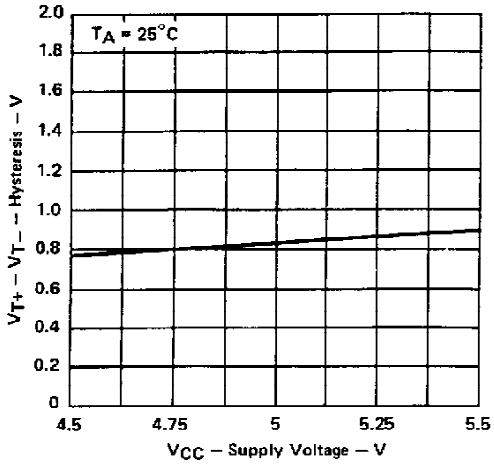


FIGURE 6

OUTPUT VOLTAGE
vs
INPUT VOLTAGE

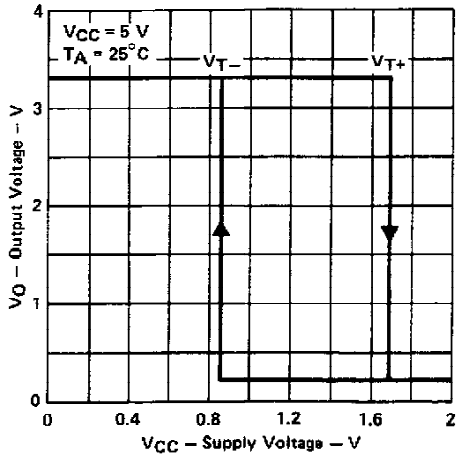


FIGURE 7

Data for temperatures below 0°C and 70°C and supply voltages below 4.75 V and above 5.25 V are applicable for SN5414 only.

TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

POSITIVE-GOING THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE

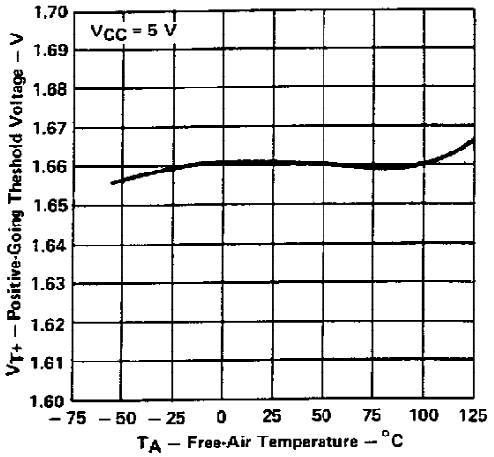


FIGURE 8

NEGATIVE-GOING THRESHOLD VOLTAGE
vs
FREE-AIR TEMPERATURE

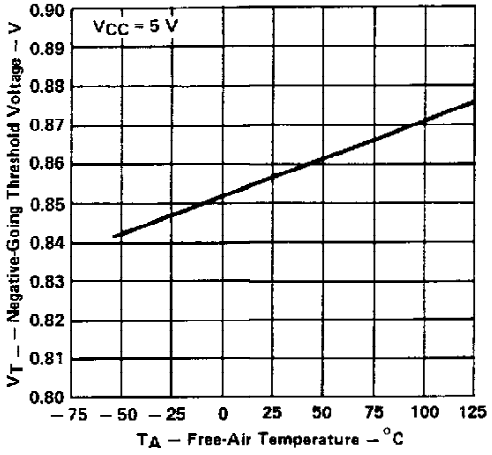


FIGURE 9

HYSTERESIS
vs
FREE-AIR TEMPERATURE

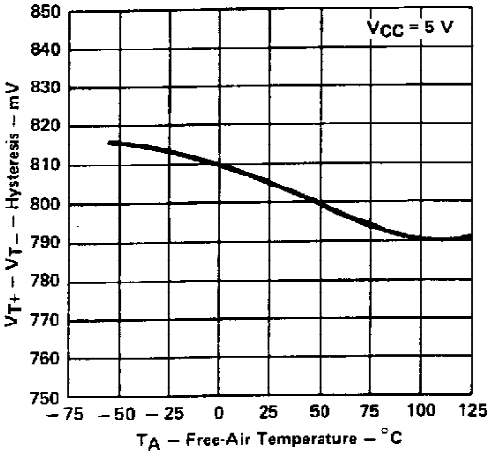


FIGURE 10

DISTRIBUTION OF UNITS
FOR HYSTERESIS

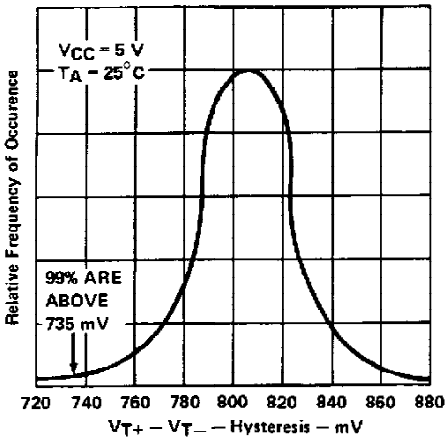


FIGURE 11

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 SN54LS14 only.

TYPICAL CHARACTERISTICS OF 'LS14 CIRCUITS

THRESHOLD VOLTAGES AND HYSTERESIS
vs
SUPPLY VOLTAGE

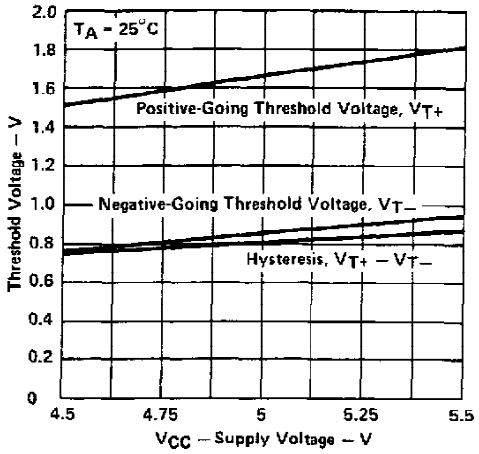


FIGURE 12

OUTPUT VOLTAGE
vs
INPUT VOLTAGE

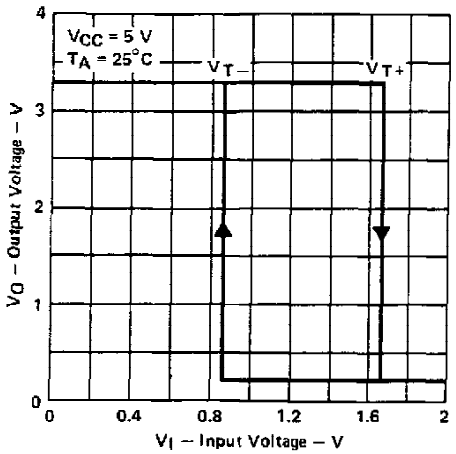
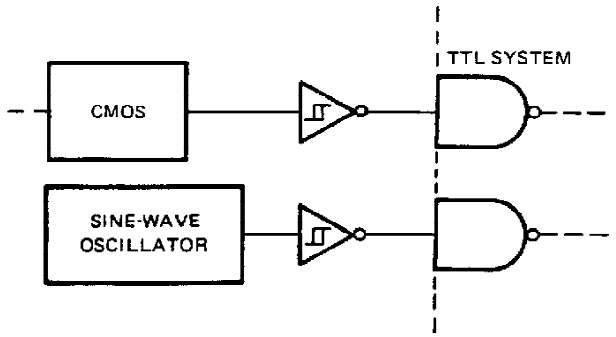


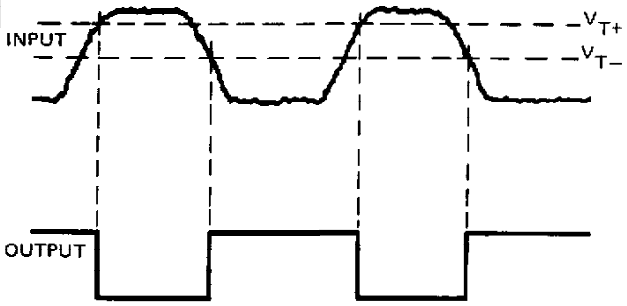
FIGURE 13

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 SN54LS14 only.

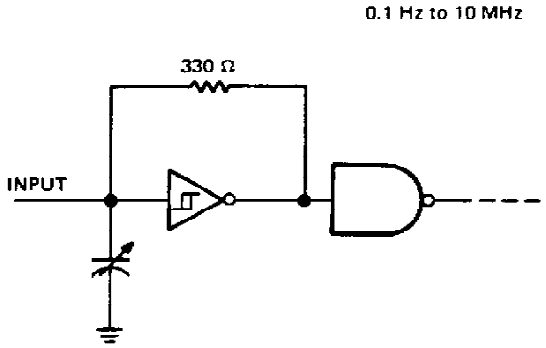
TYPICAL APPLICATION DATA



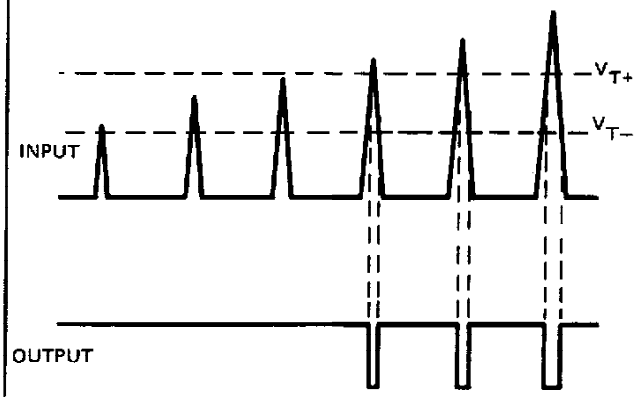
TTL SYSTEM INTERFACE
FOR SLOW INPUT WAVEFORMS



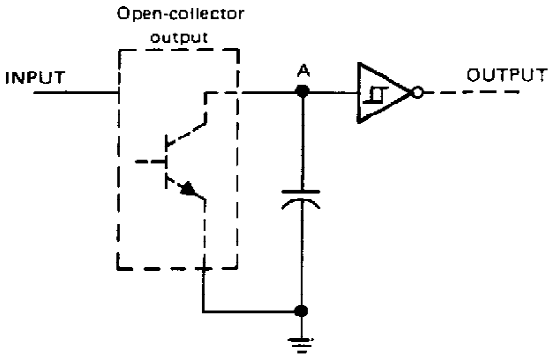
PULSE SHAPER

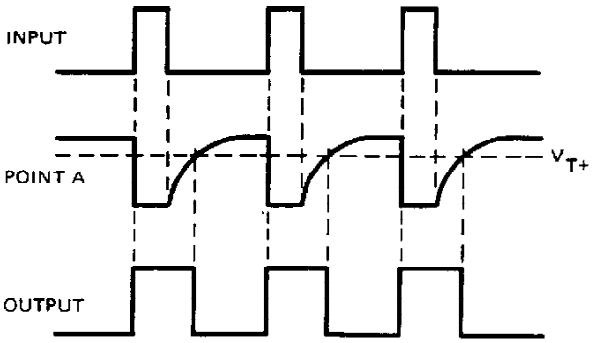


MULTIVIBRATOR



THRESHOLD DETECTOR





PULSE STRETCHER

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SN74LS14, Hex schmitt-trigger inverters

DEVICE STATUS: **ACTIVE**

PARAMETER NAME	SN74LS14
Voltage Nodes (V)	5
Vcc range (V)	4.75 to 5.25
Input Level	TTL
Output Level	TTL
Output Drive (mA)	-0.4/8
No. of Gates	6
Static Current	18.5
tpd(max) (ns)	22

FEATURES

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

DESCRIPTION

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Each circuit functions as an inverter, 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 SN5414 and SN54LS14 are characterized for operation over the full military temperature range of -55°C to 125°C. The SN7414 and the SN74LS14 are characterized for operation from 0°C to 70°C.

TECHNICAL DOCUMENTS

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To view the following documents, Acrobat Reader 3.x is required.
To download a document to your hard drive, right-click on the link and choose 'Save'.

DATASHEET

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Full datasheet in Acrobat PDF: sdls049.pdf (363 KB) (Updated: 03/01/1988)
Full datasheet in Zipped PostScript: sdls049.psz (395 KB)

APPLICATION NOTES

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View Application Reports for Digital Logic

- Designing With Logic (SDYA009C - Updated: 06/01/1997)
- Designing with the SN54/74LS123 (SDLA006A - Updated: 03/01/1997)
- Input and Output Characteristics of Digital Integrated Circuits (SDYA010 - Updated: 10/01/1996)
- Live Insertion (SDYA012 - Updated: 10/01/1996)

RELATED DOCUMENTS

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- Documentation Rules (SAP) And Ordering Information (SZZU001B, 4 KB - Updated: 05/06/1999)
- Logic Selection Guide Second Half 2000 (SDYU001N, 5035 KB - Updated: 04/17/2000)
- MicroStar Junior BGA Design Summary (SCET004, 167 KB - Updated: 07/28/2000)
- More Power In Less Space - Technical Article (SCAU001A, 850 KB - Updated: 03/01/1996)

PRICING/AVAILABILITY

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ORDERABLE DEVICE	PACKAGE	PINS	TEMP (°C)	STATUS	BUDGETARY PRICE US$/UNIT QTY=1000+	PACK QTY	PRICING/AVAILABILITY

SN74LS14D	D	14	0 TO 70	ACTIVE	0.28	50	Check stock or order
SN74LS14DBR	DB	14	0 TO 70	ACTIVE	0.28	2000	Check stock or order
SN74LS14DR	D	14	0 TO 70	ACTIVE	0.32	2500	Check stock or order
SN74LS14N	N	14	0 TO 70	ACTIVE	0.25	25	Check stock or order
SN74LS14N3	N	14	0 TO 70	OBSOLETE			
SN74LS14NSR	NS	14	0 TO 70	ACTIVE	0.37	2000	Check stock or order

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- Hex Schmitt Trigger Inverters (SDLM005, 50 KB - Updated: 08/08/2000)
  Hex Schmitt Trigger Inverters (SDLM005, 8 KB, ZIP - Updated: 08/08/2000)

Table Data Updated on: 11/17/2000