SN54LS31, SN74LS31
DELAY ELEMENTS

DECEMBER 1983 - REVISED MARCH 1988

- **Delay Elements for Generating Delay Lines**
- **Inverting and Non-inverting Elements**
- **Buffer NAND Elements Rated at I_{OL} of 12/24 mA**
- **PNP Inputs Reduce Fan-In (I_{IL} = −0.2 mA MAX)**
- **Worst Case MIN/MAX Delays Guaranteed Across Temperature and V_{CC} Ranges**

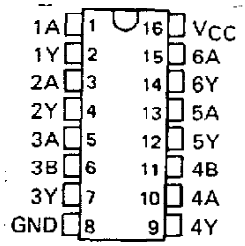
description

These 'LS31 delay elements are intended to provide well-defined delays across both temperature and V_{CC} ranges. Used in cascade, a limitless range of delay gating is possible.

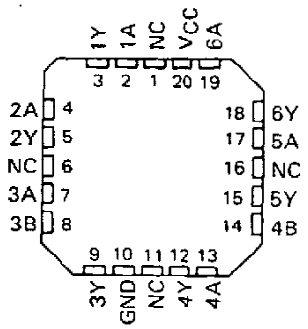
All inputs are PNP with I_{IL} MAX of −0.2 mA. Gates 1, 2, 5, and 6 have standard Low-Power Schottky output sink current capability of 4 and 8 mA I_{OL}. Buffers 3 and 4 are rated at 12 and 24 mA.

The SN54LS31 is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74LS31 is characterized for operation from 0°C to 70°C.

SN54LS31 . . . J OR W PACKAGE
SN74LS31 . . . D OR N PACKAGE
(TOP VIEW)

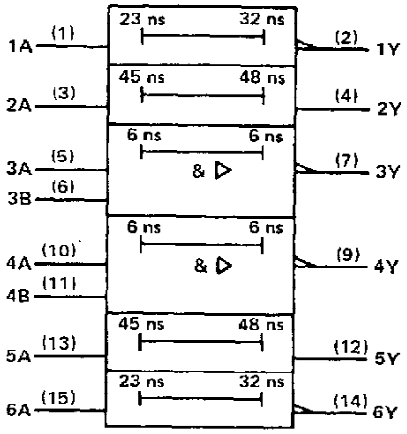


SN54LS31 . . . FK PACKAGE
(TOP VIEW)



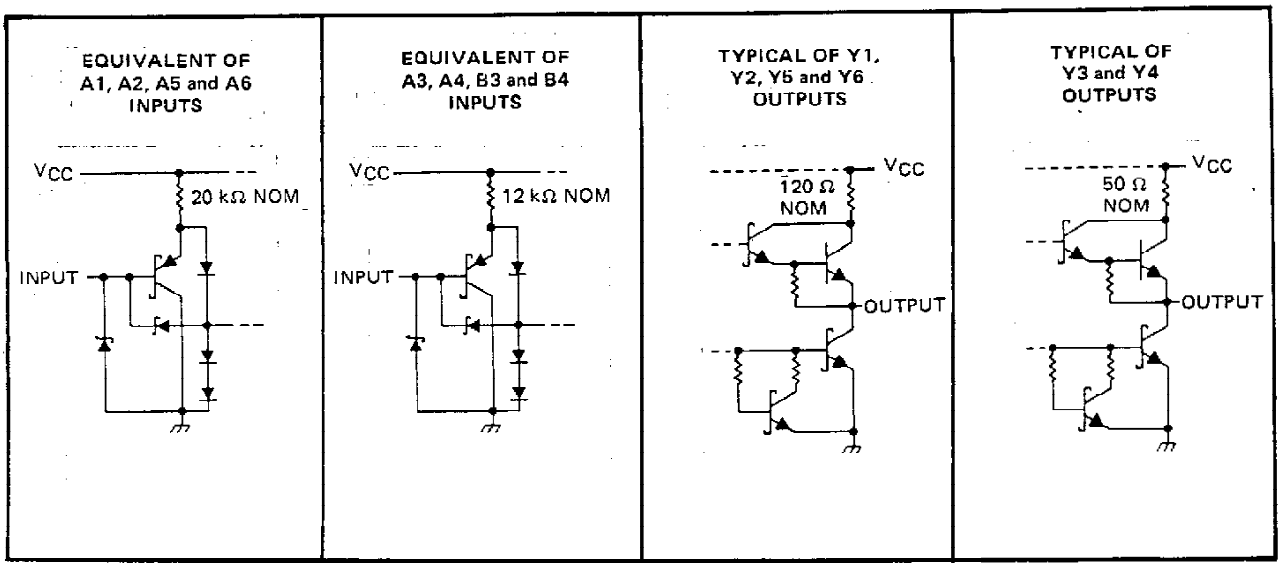
NC - No internal connection

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.

Delay Element	Logic	Typical Delays t_{PLH}	t_{PHL}	AVG.	Rated I_{OL}
Gates 1 and 6	Inverting	32 ns	23 ns	27.5 ns	4 and 8 mA
Gates 2 and 5	Non-Inverting	45 ns	48 ns	46.5 ns	4 and 8 mA
Buffers 3 and 4	2-Input NAND	6 ns	6 ns	6 ns	12 and 24 mA



absolute maximum ratings over operating free air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (See Note 1) . . . . . 7 V
Input voltage, V_I: All inputs . . . . . 7 V
Operating free-air temperature range: SN54LS31 . . . . . −55°C to 125°C
SN74LS31 . . . . . 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

			SN54LS31 MIN	NOM	MAX	SN74LS31 MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.5	5	55	4.75	5	5.25	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.7			0.8	V
I_{OH}	High-level output current	Y3, Y4 outputs			−1.2			−1.2	mA
		All other outpus			−0.4			−0.4	
I_{OL}	Low-level output current	Y3, Y4 outputs			12			24	mA
		All other outputs			4			8	
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†			SN54LS31			SN74LS31			UNIT
					MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}		V_{CC} = MIN, I_I = − 18 mA					− 1.5			− 1.5	V
V_{OH}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	Y3, Y4	I_{OH} = − 1.2 mA	2.4	3.1		2.4	3.1		V
			Others	I_{OH} = − 0.4 mA	2.5	3.1		2.7	3.1		
V_{OL}		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = MAX	Y3, Y4	I_{OL} = 12 mA		0.25	0.4		0.25	0.4	V
				I_{OL} = 24 mA					0.35	0.5	
			Others	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	
				I_{OL} = 8 mA					0.35	0.5	
I_I		V_{CC} = MAX, V_I = 7 V					0.1			0.1	mA
I_{IH}		V_{CC} = MAX, V_I = 2.7 V					20			20	µA
I_{IL}		V_{CC} = MAX, V_I = 0.4 V					− 0.2			− 0.2	mA
I_{OS}§		V_{CC} = MAX, A3, A4, B3, B4 = 0 V		Y3, Y4	− 30		− 130	− 30		− 130	mA
		V_{CC} = MAX, A1, A6 = 0 V, A2, A5 = 4.5 V		Y1, Y2, Y5, Y6	− 20		− 100	− 20		− 100	
I_{CC}	I_{CCH}	V_{CC} = MAX, A2, A5 = 4.5 V,	all other inputs 0 V			2.3	4		2.3	4	mA
	I_{CCL}	V_{CC} = MAX, A2, A5 = 0 V,	all other inputs 4.5 V			13	20		13	20	

† 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 the duration of the short-circuit should not exceed one second.

switching characteristics, (see note 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LS31			SN74LS31			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	A1, A6	Y1, Y6	15		70	22		65	ns
t_{PHL}			9		50	13		45	ns
t_{PLH}	A2, A5	Y2, Y5	22		90	31		80	ns
t_{PHL}			20		105	30		95	ns
t_{PLH}	A3, B3, A4, Y4	Y3, Y4	2		20	2		15	ns
t_{PHL}			2		20	2		15	ns

NOTE 2: V_{CC} = MIN to MAX
R_L = 667 Ω, C_L = 45 pF for Y3 and Y4.
R_L = 2 kΩ, C_L = 15 pF for Y1, Y2, Y5 and Y6.
T_A = MIN to MAX
Load circuits and voltage waveforms are shown in Section 1.

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Certain applications using semiconductor products may involve potential risks of death, personal injury, or severe property or environmental damage ("Critical Applications").

TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used.