

SN54147, SN54148, SN54LS147, SN54LS148 SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148 10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS

SDLS053A – OCTOBER 1976 – REVISED FEBRUARY 2001

'147, 'LS147

- Encodes 10-Line Decimal to 4-Line BCD
- Applications Include:
 - Keyboard Encoding
 - Range Selection

'148, 'LS148

- Encodes 8 Data Lines to 3-Line Binary (Octal)
- Applications Include:
 - N-Bit Encoding
 - Code Converters and Generators

TYPE	TYPICAL DATA DELAY	TYPICAL POWER DISSIPATION
'147	10 ns	225 mW
'148	10 ns	190 mW
'LS147	15 ns	60 mW
'LS148	15 ns	60 mW

description

These TTL encoders feature priority decoding of the inputs to ensure that only the highest-order data line is encoded. The '147 and 'LS147 encode nine data lines to four-line (8-4-2-1) BCD. The implied decimal zero condition requires no input condition as zero is encoded when all nine data lines are at a high logic level. The '148 and 'LS148 encode eight data lines to three-line (4-2-1) binary (octal). Cascading circuitry (enable input EI and enable output EO) has been provided to allow octal expansion without the need for external circuitry. For all types, data inputs and outputs are active at the low logic level. All inputs are buffered to represent one normalized Series 54/74 or 54LS/74LS load, respectively.

'147, 'LS147

FUNCTION TABLE

INPUTS									OUTPUTS			
1	2	3	4	5	6	7	8	9	D	C	B	A
H	H	H	H	H	H	H	H	H	H	H	H	H
X	X	X	X	X	X	X	X	L	L	H	H	L
X	X	X	X	X	X	X	L	H	L	H	H	H
X	X	X	X	X	X	L	H	H	H	L	L	L
X	X	X	X	X	L	H	H	H	H	L	L	H
X	X	X	L	H	H	H	H	H	H	L	H	L
X	X	L	H	H	H	H	H	H	H	H	L	L
X	L	H	H	H	H	H	H	H	H	H	L	H
L	H	H	H	H	H	H	H	H	H	H	H	L

H = high logic level, L = low logic level, X = irrelevant

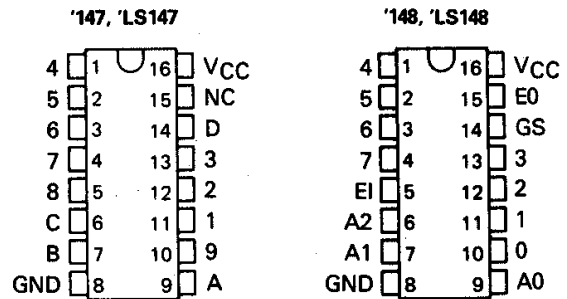
SN54147, SN54LS147,

SN54148, SN54LS148 ... J OR W PACKAGE

SN74147, SN74148 ... N PACKAGE

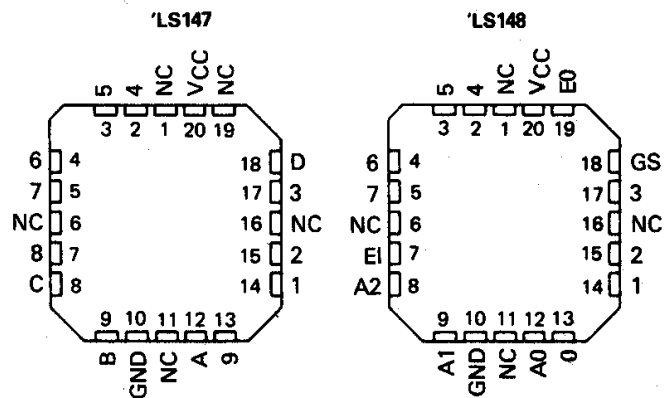
SN74LS147, SN74LS148 ... D OR N PACKAGE

(TOP VIEW)



SN54LS147, SN54LS148 ... FK PACKAGE

(TOP VIEW)



NC - No internal connection

'148, 'LS148

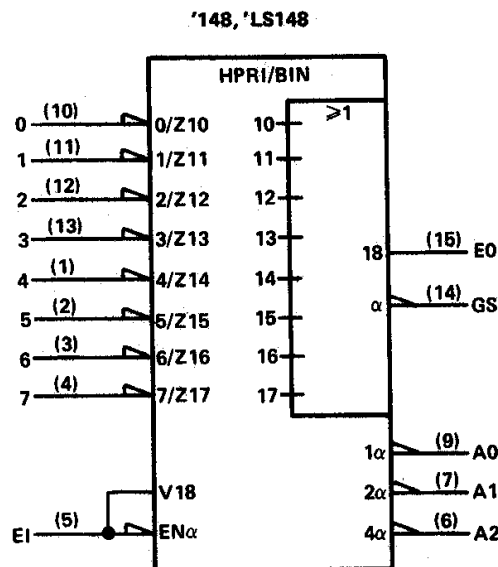
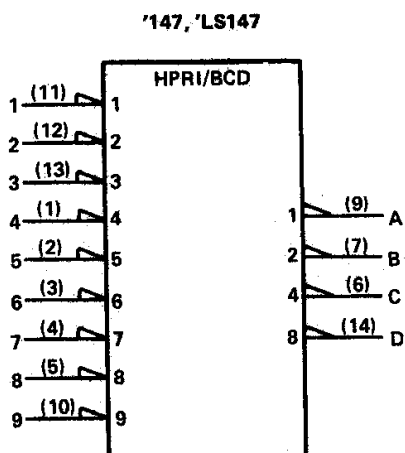
FUNCTION TABLE

EI	INPUTS							OUTPUTS			
	0	1	2	3	4	5	6	A2	A1	A0	GS EO
H	X	X	X	X	X	X	X	H	H	H	H H
L	H	H	H	H	H	H	H	H	H	H	H L
L	X	X	X	X	X	X	L	L	L	L	L H
L	X	X	X	X	X	L	H	L	L	H	L H
L	X	X	X	X	L	H	H	L	H	L	L H
L	X	X	X	L	H	H	H	L	H	H	L H
L	X	X	L	H	H	H	H	H	L	L	L H
L	X	L	H	H	H	H	H	H	L	L	L H
L	L	H	H	H	H	H	H	H	H	H	L H

SN54147, SN54148, SN54LS147, SN54LS148
 SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148
 10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS

SDLS053A - OCTOBER 1976 - REVISED FEBRUARY 2001

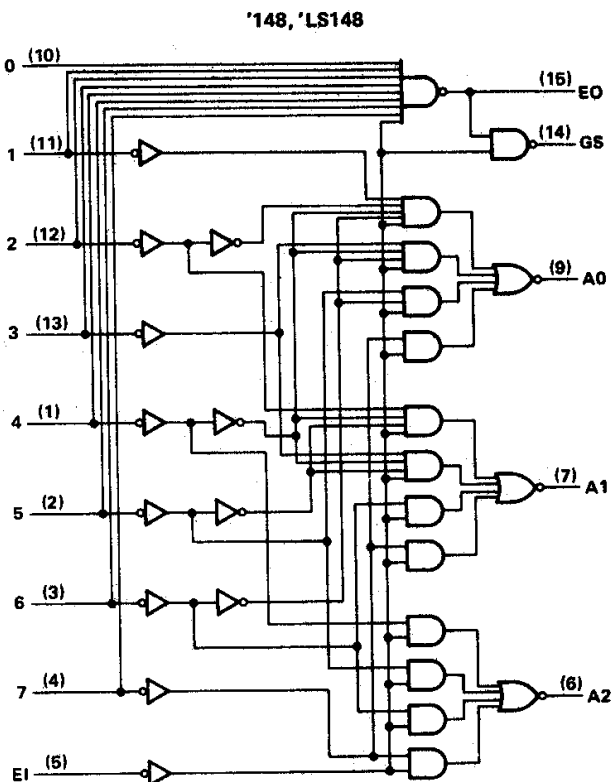
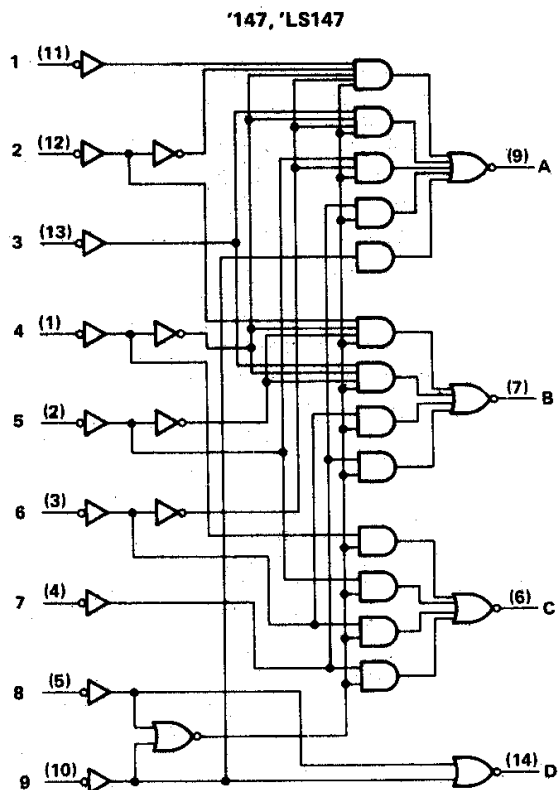
logic symbols†



†These symbols are 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 diagrams

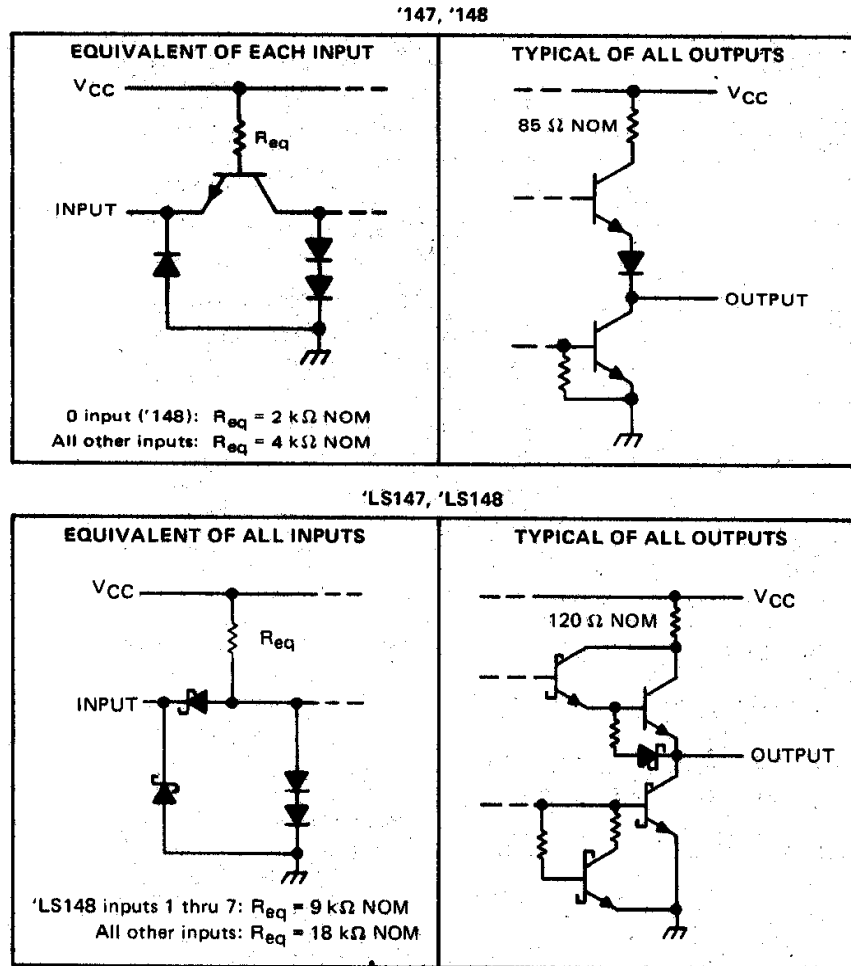


Pin numbers shown are for D, J, N, and W packages.

SN54147, SN54148, SN54LS147, SN54LS148
SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148
10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS

SDLS053A – OCTOBER 1976 – REVISED FEBRUARY 2001

schematics of inputs and outputs



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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage: '147, '148	5.5 V
'LS147, 'LS148	7 V
Interemitter voltage: 148 only (see Note 2)	5.5 V
Operating free-air temperature range: SN54', SN54LS Circuits	-55°C to 125°C
SN74', SN74LS Circuits	0°C to 70°C
Storage temperature range	-65°C to 150°C

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. For '148 circuits, this rating applies between any two of the eight data lines, 0 through 7.

recommended operating conditions

	SN54'			SN74'			SN54LS'			SN74LS'			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	4.75	5	5.25	4.5	5	5.5	4.75	5	5.25	V
High-level output current, I_{OH}			-800			-800			-400			-400	μA
Low-level output current, I_{OL}			16			16			4			8	mA
Operating free-air temperature, T_A	-55		125	0		70	-55		125	0		70	$^{\circ}\text{C}$

SN54147, SN54148, SN54LS147, SN54LS148
SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148
10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS

SDLS053A – OCTOBER 1976 – REVISED FEBRUARY 2001

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	'147			'148			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IH} High-level input voltage		2			2			V
V_{IL} Low-level input voltage				0.8			0.8	V
V_{IK} Input clamp voltage	$V_{CC} = \text{MIN}, I_I = -12 \text{ mA}$			-1.5			-1.5	V
V_{OH} High-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OH} = -800 \mu\text{A}$	2.4	3.3		2.4	3.3		V
V_{OL} Low-level output voltage	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = 0.8 \text{ V}, I_{OL} = 16 \text{ mA}$	0.2	0.4		0.2	0.4		V
I_I Input current at maximum input voltage	$V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$			1			1	mA
I_{IH} High-level input current	0 input						40	μA
	Any input except 0			40			80	
I_{IL} Low-level input current	0 input						-1.6	mA
	Any input except 0			-1.6			-3.2	
I_{OS} Short-circuit output current§	$V_{CC} = \text{MAX}$	-35		-85	-35		-85	mA
I_{CC} Supply current	$V_{CC} = \text{MAX},$ Condition 1	50	70		40	60		mA
	See Note 3, Condition 2	42	62		35	55		

NOTE 3: For '147, I_{CC} (condition 1) is measured with input 7 grounded, other inputs and outputs open; I_{CC} (condition 2) is measured with all inputs and outputs open. For '148, I_{CC} (condition 1) is measured with inputs 7 and E1 grounded, other inputs and outputs open; I_{CC} (condition 2) is measured with all inputs and outputs open.

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

§ Not more than one output should be shorted at a time.

SN54147, SN74147 switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$

PARAMETER [†]	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	Any	Any	In-phase output	C _L = 15 pF, R _L = 400 Ω, See Note 4		9	14	ns
t _{PHL}						7	11	
t _{PLH}	Any	Any	Out-of-phase output			13	19	ns
t _{PHL}						12	19	

SN54148, SN74148 switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$

PARAMETER [¶]	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	1 thru 7	A0, A1, or A2	In-phase output	$C_L = 15 \text{ pF},$ $R_L = 400 \Omega,$ See Note 4	10	15	ns	
t_{PHL}					9	14		
t_{PLH}	1 thru 7	A0, A1, or A2	Out-of-phase output		13	19	ns	
t_{PHL}					12	19		
t_{PLH}	0 thru 7	EO	Out-of-phase output		6	10	ns	
t_{PHL}					14	25		
t_{PLH}	0 thru 7	GS	In-phase output		18	30	ns	
t_{PHL}					14	25		
t_{PLH}	EI	A0, A1, or A2	In-phase output		10	15	ns	
t_{PHL}					10	15		
t_{PLH}	EI	GS	In-phase output		8	12	ns	
t_{PHL}					10	15		
t_{PLH}	EI	EO	In-phase output		10	15	ns	
t_{PHL}					17	30		

¶ t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.



**SN54147, SN54148, SN54LS147, SN54LS148
SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148
10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS**

SDLS053A – OCTOBER 1976 – REVISED FEBRUARY 2001

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	SN54LS*			SN74LS*			UNIT
			MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V _{IH}	High-level input voltage		2			2			V
V _{IL}	Low-level input voltage			0.7			0.8		V
V _{IK}	Input clamp voltage	V _{CC} = MIN, I _I = -18 mA		-1.5			-1.5		V
V _{OH}	High-level output voltage	V _{CC} = MIN, V _{IH} = 2 V V _{IL} = 0.8 V, I _{OH} = -400 µA	2.5	3.4		2.7	3.4		V
V _{OL}	Low-level output voltage	V _{CC} = MIN, I _{OL} = 4 mA	0.25	0.4		0.25	0.4		V
		V _{IH} = 2 V, V _{IL} = V _{ILmax} , I _{OL} = 8 mA				0.35	0.5		
I _I	Input current at maximum input voltage	V _{CC} = MAX, V _I = 7 V		0.2			0.2		mA
				0.1			0.1		
I _{IH}	High-level input current	V _{CC} = MAX, V _I = 2.7 V		40			40		µA
				20			20		
I _{IL}	Low-level input current	V _{CC} = MAX, V _I = 0.4 V		-0.8			-0.8		mA
				-0.4			-0.4		
I _{OS}	Short-circuit output current§	V _{CC} = MAX	-20	-100		-20	-100		mA
I _{CC}	Supply current	V _{CC} = MAX, Condition 1	12	20		12	20		mA
		See Note 5, Condition 2	10	17		10	17		mA

NOTE 5: For 'LS147, I_{CC} (condition 1) is measured with input 7 grounded, other inputs and outputs open; I_{CC} (condition 2) is measured with all inputs and outputs open. For 'LS148, I_{CC} (condition 1) is measured with inputs 7 and EI grounded, other inputs and outputs open, I_{CC} (condition 2) is measured with all inputs and outputs open.

† 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.

SN54LS147, SN74LS147 switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER [†]	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	Any	Any	In-phase output	C _L = 15 pF, R _L = 2 kΩ, See Note 4	12	18		ns
t _{PHL}					12	18		
t _{PLH}	Any	Any	Out-of-phase output		21	33		ns
t _{PHL}					15	23		

SN54LS148, SN74LS148 switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER†	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t _{PLH}	1 thru 7	A0, A1, or A2	In-phase output	C _L = 15 pF, R _L = 2 kΩ, See Note 4	14	18		ns
t _{PHL}					15	25		
t _{PLH}	1 thru 7	A0, A1, or A2	Out-of-phase output		20	36		ns
t _{PHL}					16	29		
t _{PLH}	0 thru 7	EO	Out-of-phase output		7	18		ns
t _{PHL}					25	40		
t _{PLH}	0 thru 7	GS	In-phase output		35	55		ns
t _{PHL}					9	21		
t _{PLH}	EI	A0, A1, or A2	In-phase output		16	25		ns
t _{PHL}					12	25		
t _{PLH}	EI	GS	In-phase output		12	17		ns
t _{PHL}					14	36		
t _{PLH}	EI	EO	In-phase output		12	21		ns
t _{PHL}					23	35		

† t_{PLH} ≡ propagation delay time, low-to-high level output

t_{PHL} ≡ propagation delay time, high-to-low level output

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.

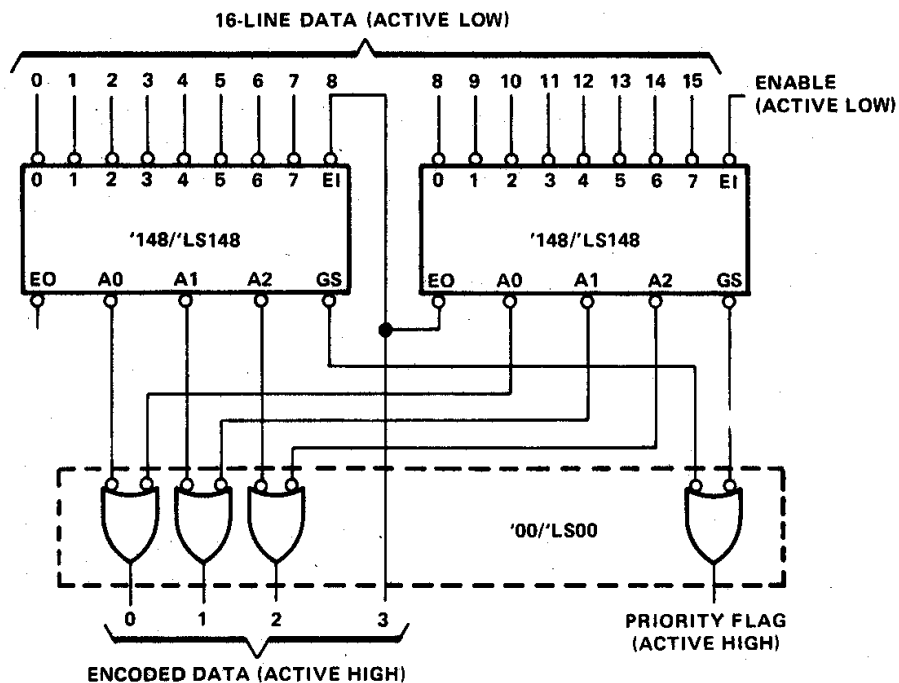
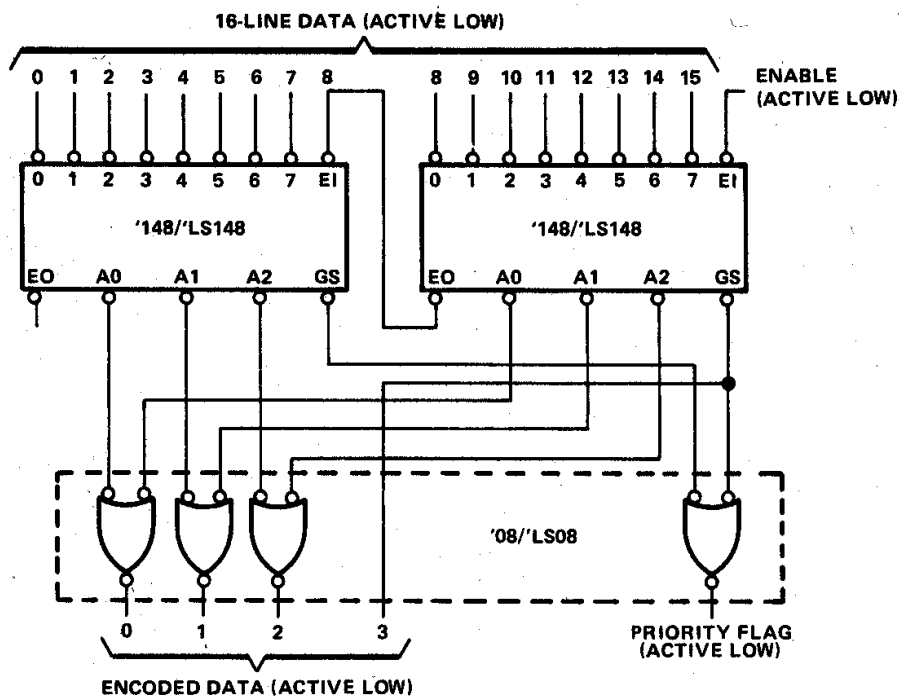


POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

**SN54147, SN54148, SN54LS147, SN54LS148
SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148
10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS**

SDLS053A - OCTOBER 1976 - REVISED FEBRUARY 2001

TYPICAL APPLICATION DATA



Since the '147/'LS147 and '148/'LS148 are combinational logic circuits, wrong addresses can appear during input transients. Moreover, for the '148/'LS148 a change from high to low at input Ei can cause a transient low on the GS output when all inputs are high. This must be considered when strobing the outputs.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265