SN54147, SN54148, SN54LS147, SN54LS148
SN74147, SN74148, SN74LS147, SN74LS148

10-Line to 4-Line and 8-Line to 3-Line Priority Encoders

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.

Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-38535
    - Class Q Military
    - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
    - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer’s datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. ‘Typical’ values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

'147, 'LS147

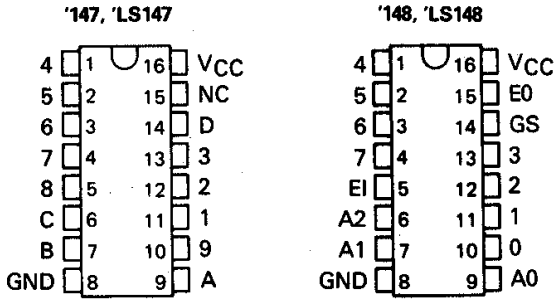
- Encodes 10-Line Decimal to 4-Line BCD
- Applications Include:
  - Keyboard Encoding
  - Range Selection

'148, 'LS148

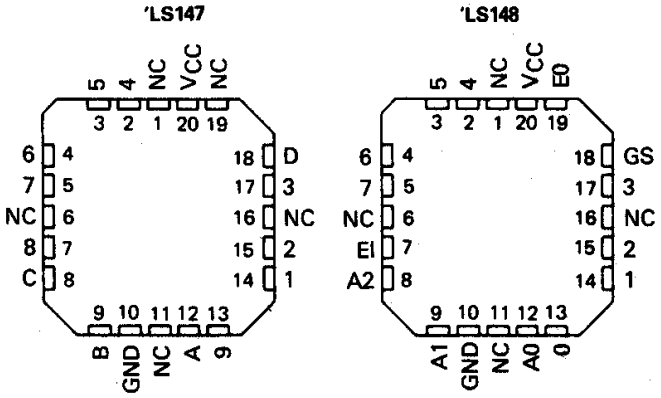
- Encodes 8 Data Lines to 3-Line Binary (Octal)
- Applications Include:
  - N-Bit Encoding
  - Code Converters and Generators

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

**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

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	X	L	H	H	H	H	H	L	H	L
X	X	X	L	H	H	H	H	H	H	L	H	H
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

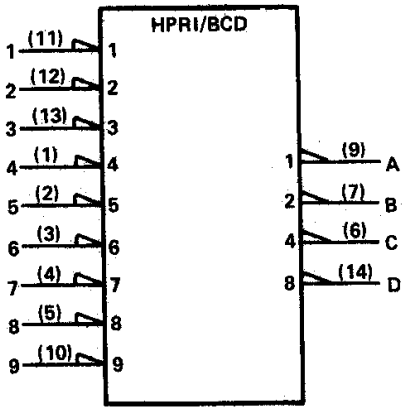
H = high logic level, L = low logic level, X = irrelevant

**'148, 'LS148
FUNCTION TABLE**

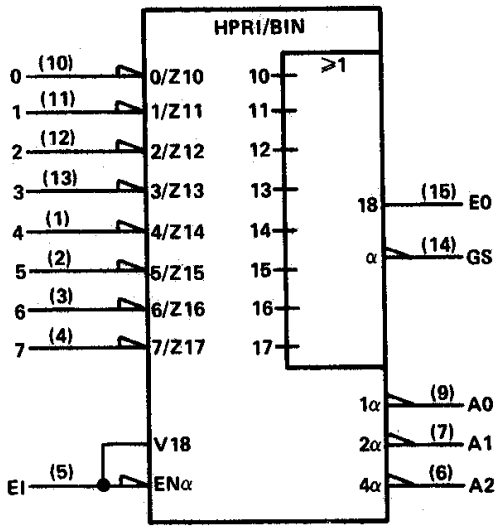
INPUTS									OUTPUTS				
EI	0	1	2	3	4	5	6	7	A2	A1	A0	GS	EO
H	X	X	X	X	X	X	X	X	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	H	H	L
L	X	X	X	X	X	X	X	L	L	L	L	L	H
L	X	X	X	X	X	X	L	H	L	L	H	L	H
L	X	X	X	X	X	L	H	H	L	H	L	L	H
L	X	X	X	X	L	H	H	H	L	H	H	L	H
L	X	X	X	L	H	H	H	H	H	L	L	L	H
L	X	X	L	H	H	H	H	H	H	L	H	L	H
L	X	L	H	H	H	H	H	H	H	H	L	L	H
L	L	H	H	H	H	H	H	H	H	H	H	L	H

logic symbols†

'147, 'LS147



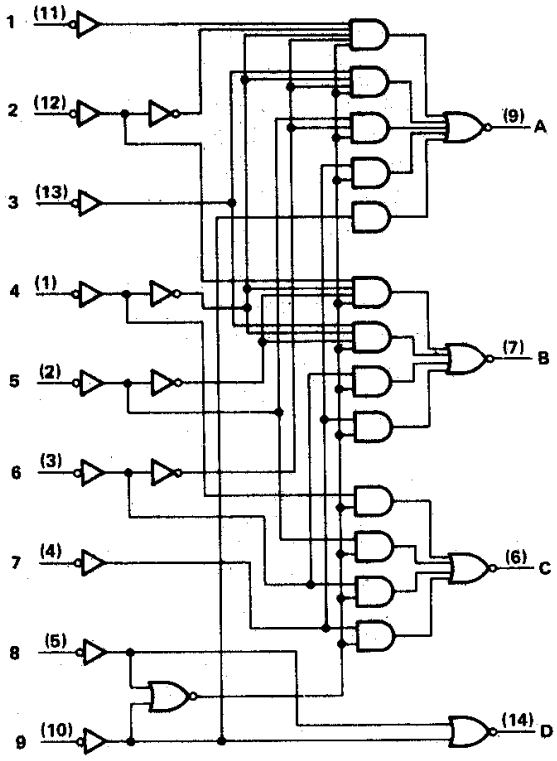
'148, 'LS148



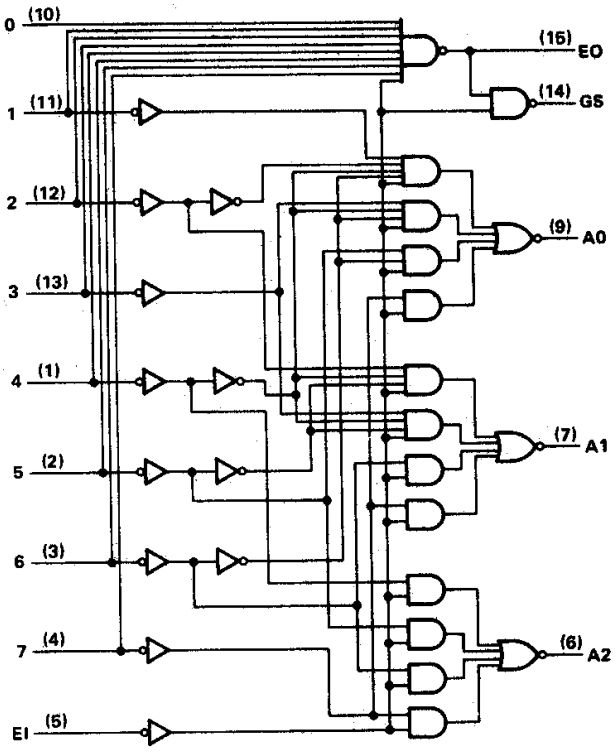
†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

logic diagrams

'147, 'LS147



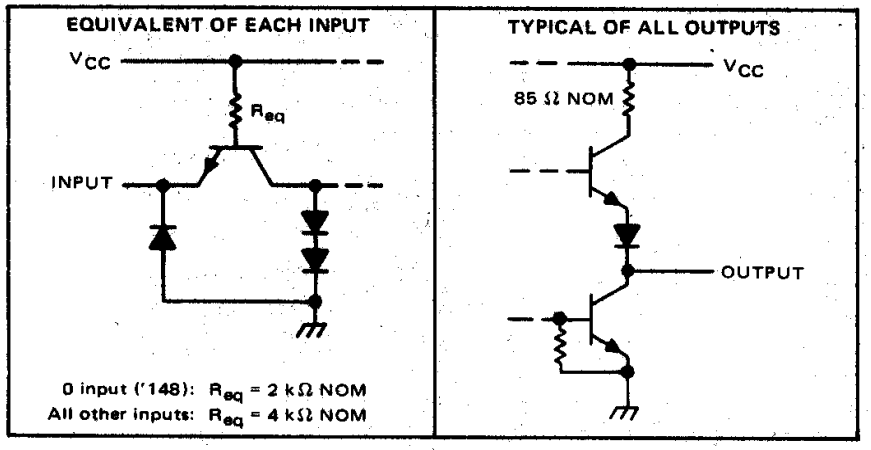
'148, 'LS148



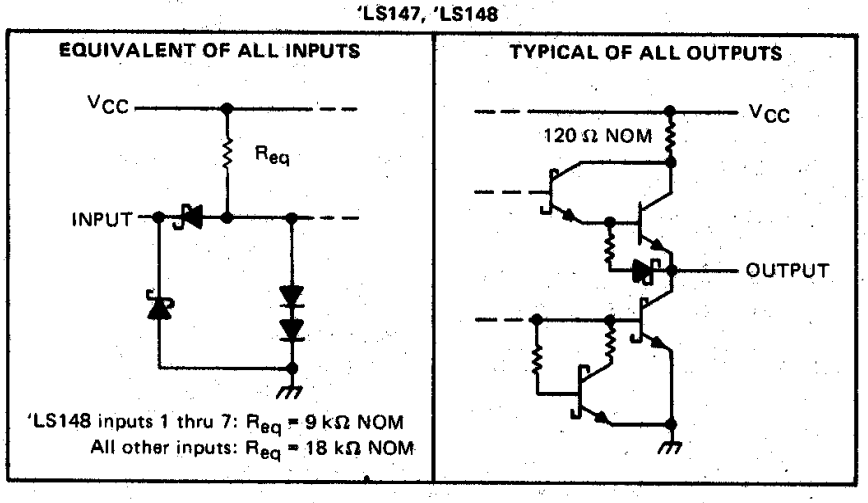
Pin numbers shown are for D, J, N, and W packages.

schematics of inputs and outputs

'147, '148



'LS147, 'LS148



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	°C

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

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

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 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.

SN54147, SN74147 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 = 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 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 = 400 Ω, 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.

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

PARAMETER			TEST CONDITIONS†		SN54LS' MIN	SN54LS' TYP‡	SN54LS' MAX	SN74LS' MIN	SN74LS' TYP‡	SN74LS' MAX	UNIT
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_{IL} = 0.8 V,	V_{IH} = 2 V, I_{OH} = −400 μA	2.5	3.4		2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IH} = 2 V, V_{IL} = V_{IL}max	I_{OL} = 4 mA		0.25	0.4		0.25	0.4	V
				I_{OL} = 8 mA					0.35	0.5	
I_I	Input current at maximum input voltage	'LS148 inputs 1 thru 7	V_{CC} = MAX,	V_I = 7 V			0.2			0.2	mA
		All other inputs					0.1			0.1	
I_{IH}	High-level input current	'LS148 inputs 1 thru 7	V_{CC} = MAX,	V_I = 2.7 V			40			40	μA
		All other inputs					20			20	
I_{IL}	Low-level input current	'LS148 inputs 1 thru 7	V_{CC} = MAX,	V_I = 0.4 V			−0.8			−0.8	mA
		All other inputs					−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, See Note 5	Condition 1		12	20		12	20	mA
				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	

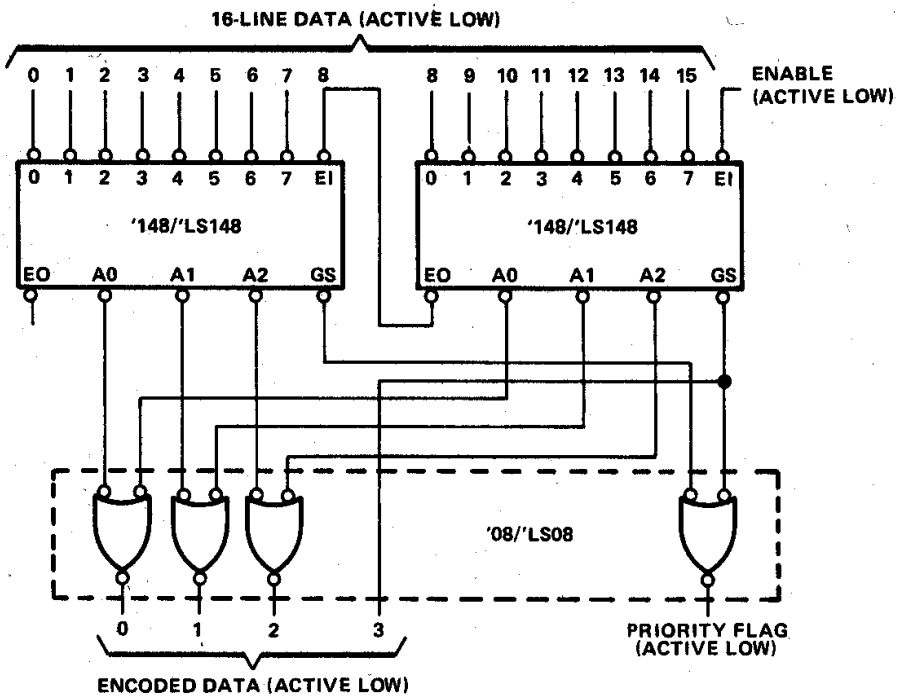
SN54LS148, SN74LS148 switching characteristics, V_{CC} = 5 V, T_A = 25°C

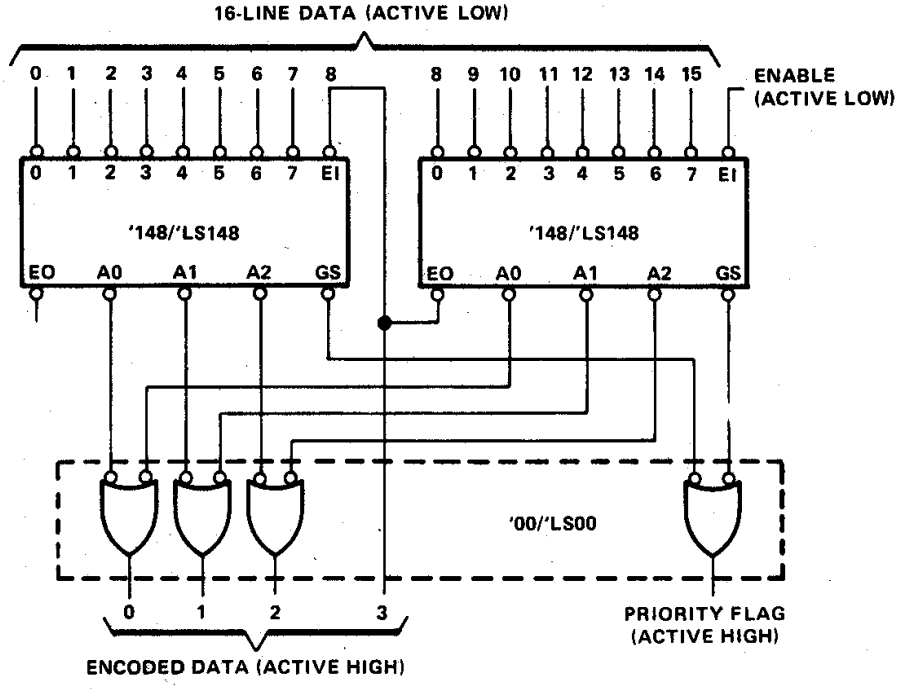
PARAMETER¶	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PLH}	1 thru 7	A0, A1, or A2	In-phase output	C_L = 15 pF, R_L = 2 kΩ, See Note 4		14	18	ns
t_{PHL}						15	25	
t_{PLH}	1 thru 7	A0, A1, or A2	Out-of-phase output			20	36	ns
t_{PHL}						16	29	
t_{PLH}	0 thru 7	EO	Out-of-phase 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.

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.

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