

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

SDLS053 OCTOBER 1978 - REVISED MARCH 1988

'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	L	H	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,

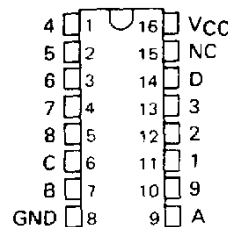
SN54148, SN54LS148 . . . J OR W PACKAGE

SN74147, SN74148 . . . N PACKAGE

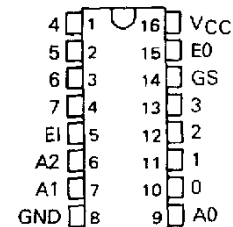
SN74LS147, SN74LS148 . . . D OR N PACKAGE

(TOP VIEW)

'147, 'LS147



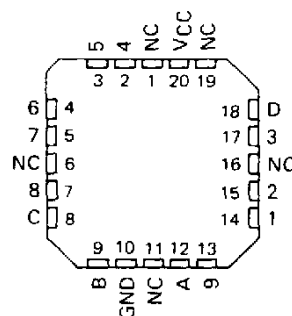
'148, 'LS148



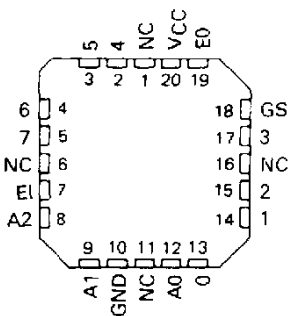
SN54LS147, SN54LS148 . . . FK PACKAGE

(TOP VIEW)

'LS147



'LS148



NC - No internal connection

'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	L	H	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

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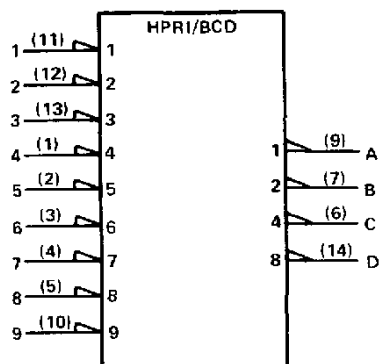
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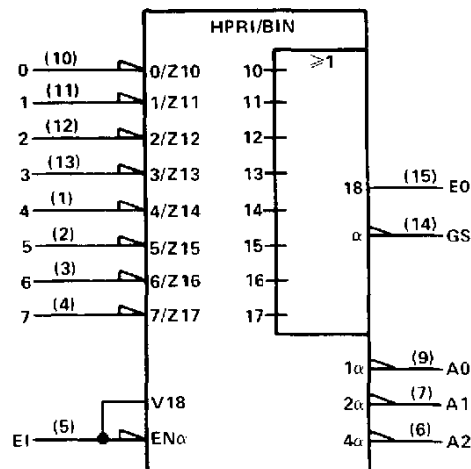
**SN54147, SN54148, SN54LS147, SN54LS148,
SN74147, SN74148 (TIM9907), SN74LS147, SN74LS148
10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS**

logic symbols†

'147, 'LS147



'148, 'LS148

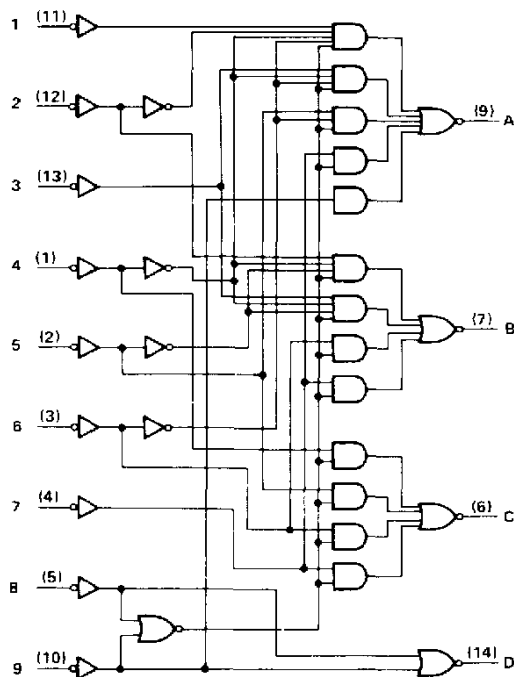


†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

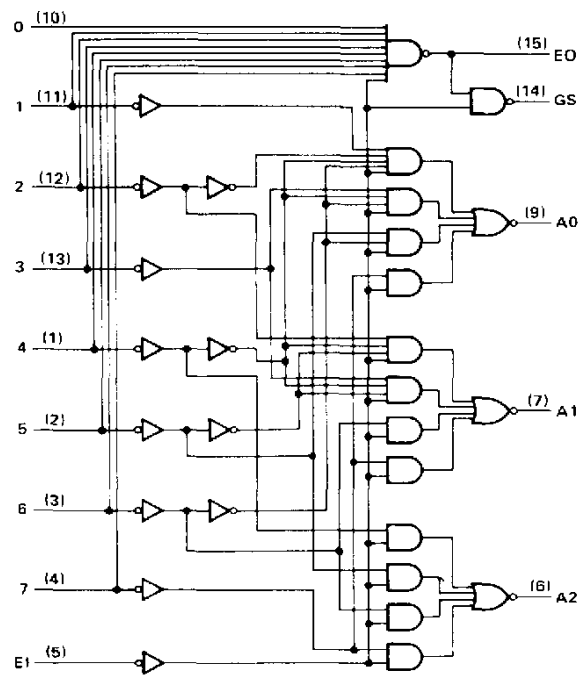
Pin numbers shown are for D, J, N, and W packages.

logic diagrams

'147, 'LS147



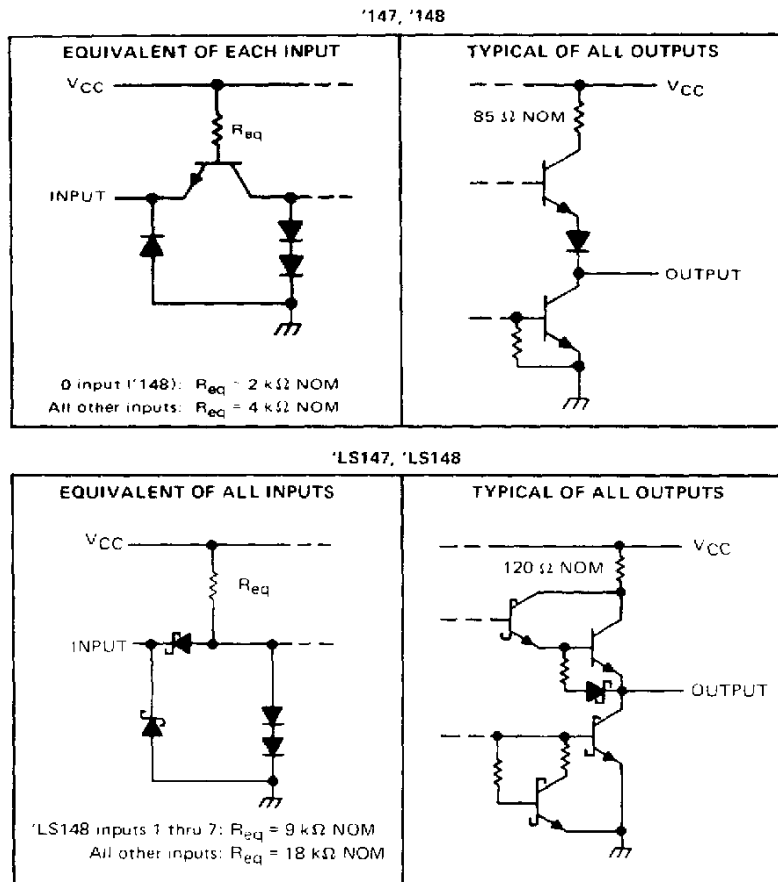
'148, 'LS148



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

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

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, SN74147, SN74148 (TIM9907)
10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS

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} = 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						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} = MAX	-35	-85		-35	-85		mA
I _{CC}	Supply current	V _{CC} = 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 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
¹ PLH	Any	Any	In-phase output	C _L = 15 pF, R _L = 400 Ω, See Note 4		9	14	ns
¹ PHL						7	11	
¹ PLH	Any	Any	Out-of-phase output			13	19	ns
¹ PHL						12	19	

SN54148, SN74148 switching characteristics, V_{CC} = 5 V, T_A = 25°C

PARAMETER ¹	FROM (INPUT)	TO (OUTPUT)	WAVEFORM	TEST CONDITIONS	MIN	TYP	MAX	UNIT
¹ 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	
¹ PHL					9	14		
¹ PLH	1 thru 7	A0, A1, or A2	Out-of-phase output		13	19	ns	
¹ PHL					12	19		
¹ PLH	0 thru 7	EO	Out-of-phase output		6	10	ns	
¹ PHL					14	25		
¹ PLH	0 thru 7	GS	In-phase output		18	30	ns	
¹ PHL					14	25		
¹ PLH	E1	A0, A1, or A2	In-phase output		10	15	ns	
¹ PHL					10	15		
¹ PLH	E1	GS	In-phase output		8	12	ns	
¹ PHL					10	15		
¹ PLH	E1	EO	In-phase output		10	15	ns	
¹ 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.

SN54LS147, SN54LS148, SN74LS147, SN74LS148 **10-LINE TO 4-LINE AND 8-LINE TO 3-LINE PRIORITY ENCODERS**

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

PARAMETER			TEST CONDITIONS†		SN54LS*		SN74LS*		UNIT	
					MIN	TYP‡	MAX	MIN		TYP‡
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, I _{OL} = 8 mA				0.35 0.5			
			V _{IL} = V _{ILmax}							
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, 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 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 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 ¹	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	$C_L = 15\text{ pF}$, $R_L = 2\text{ k}\Omega$, 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}	E1	A0, A1, or A2	In-phase output		16	25	ns	
t_{PHL}					12	25		
t_{PLH}	E1	GS	In-phase output		12	17	ns	
t_{PHL}					14	36		
t_{PLH}	E1	EO	In-phase output		12	21	ns	
t_{PHL}					23	35		

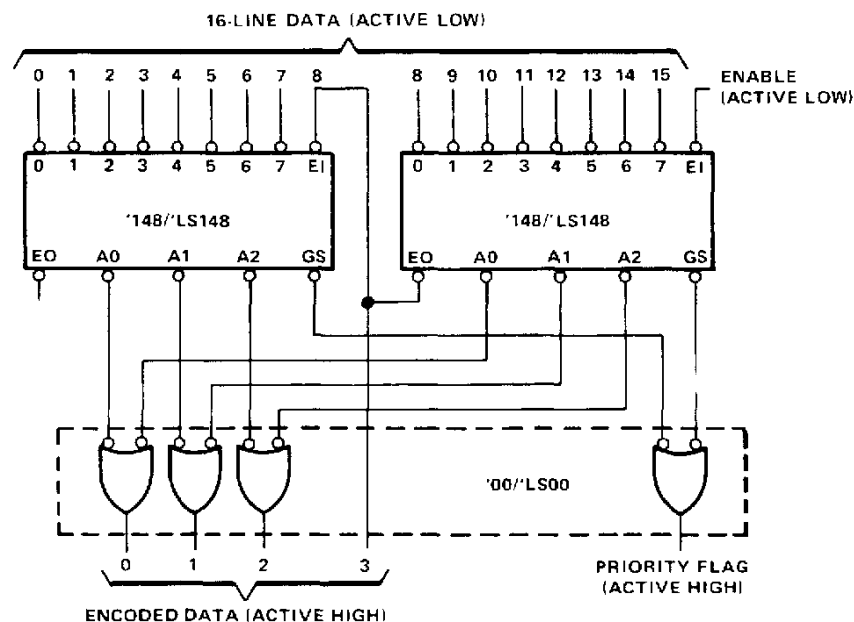
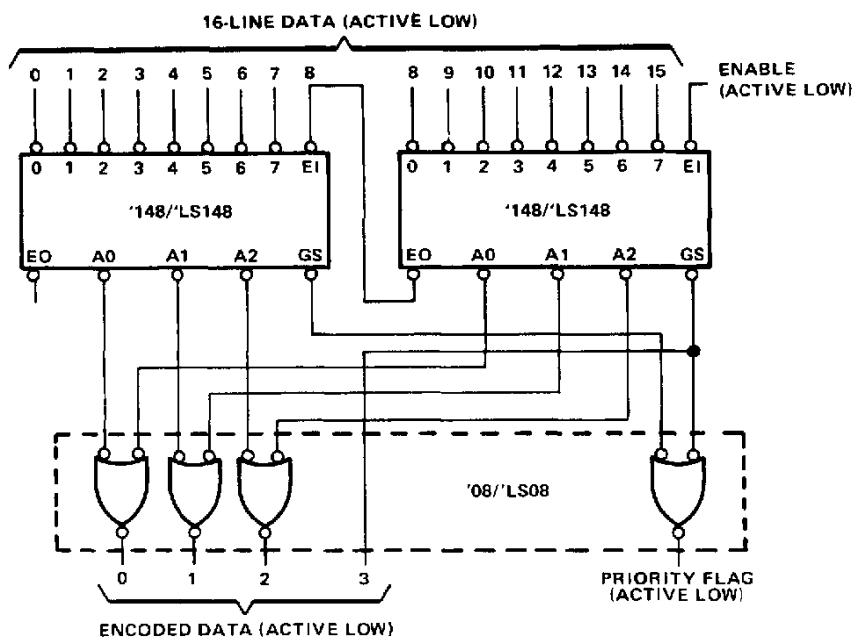
* t_{PLH} = propagation delay time, low to high level output

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

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

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

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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