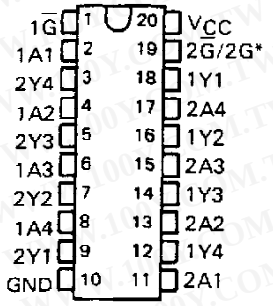
SN54LS240, SN54LS241, SN54LS244, SN54S240, SN54S241, SN54S244, SN74LS240, SN74LS241, SN74LS244, SN74S240, SN74S241, SN74S244
OCTAL BUFFERS AND LINE DRIVERS WITH 3-STATE OUTPUTS

SDLS144

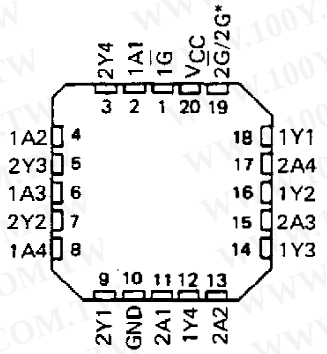
APRIL 1985 – REVISED MARCH 1988

- 3-State Outputs Drive Bus Lines or Buffer Memory Address Registers
- PNP Inputs Reduce D-C Loading
- Hysteresis at Inputs Improves Noise Margins

SN54LS', SN54S' . . . J OR W PACKAGE
SN74LS', SN74S' . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS', SN54S' . . . FK PACKAGE
(TOP VIEW)



*2G for 'LS241 and 'S241 or 2$\overline{G}$ for all other drivers.

description

These octal buffers and line drivers are designed specifically to improve both the performance and density of three-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. The designer has a choice of selected combinations of inverting and noninverting outputs, symmetrical $\overline{G}$ (active-low output control) inputs, and complementary G and $\overline{G}$ inputs. These devices feature high fan-out, improved fan-in, and 400-mV noise-margin. The SN74LS' and SN74S' can be used to drive terminated lines down to 133 ohms.

The SN54' family is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74' family is characterized for operation from 0°C to 70°C.

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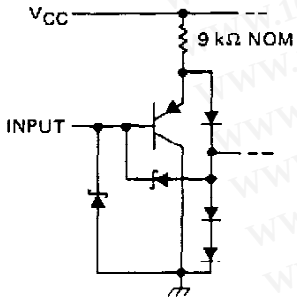
schematics of inputs and outputs

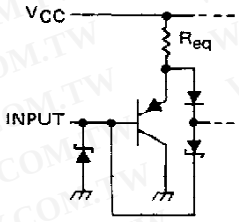
'LS240, 'LS241, 'LS244

EQUIVALENT OF EACH INPUT



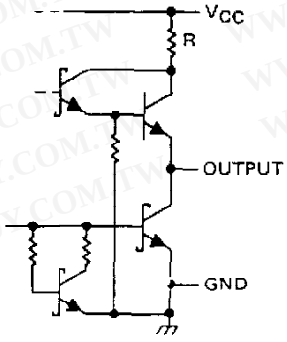
'S240, 'S241, 'S244

EQUIVALENT OF EACH INPUT



G and $\overline{G}$ inputs: R_{eq} = 2 kΩ NOM
A inputs: R_{eq} = 2.8 kΩ NOM

TYPICAL OF ALL OUTPUTS



'LS240, 'LS241, 'LS244;
R = 50 Ω NOM
'S240, 'S241, 'S244
R = 25 Ω NOM

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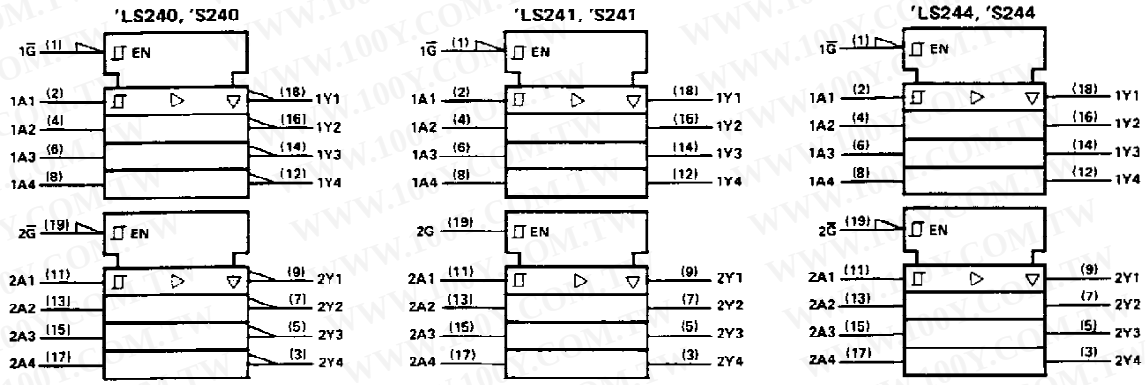
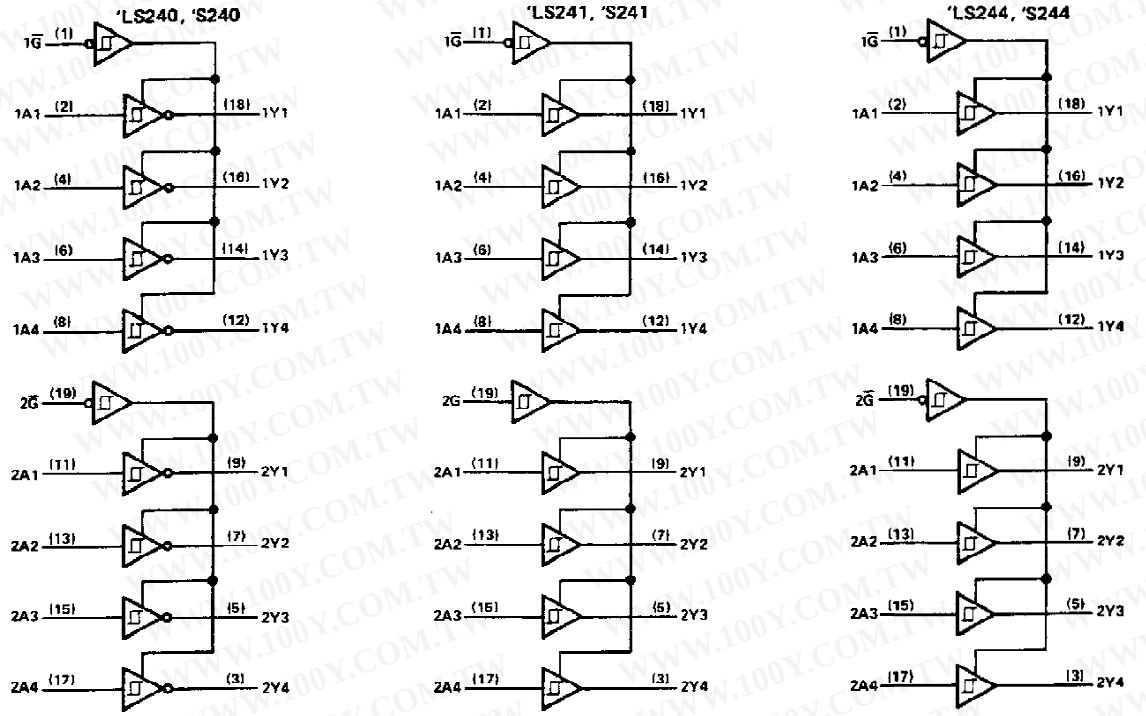
logic symbols†



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

logic diagrams (positive logic)



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

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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage: 'LS Circuits . . . . . 7 V
'S Circuits . . . . . 5.5 V
Off-state output voltage . . . . . 5.5 V
Operating free-air temperature range: SN54LS', SN54S' Circuits . . . . . −55°C to 125°C
SN74LS', SN74S' Circuits . . . . . 0°C to 70°C
Storage temperature range . . . . . −65°C to 150°C

NOTE 1: Voltage values are with respect to network ground terminal.

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recommended operating conditions

PARAMETER		SN54LS'			SN74LS'			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage (see Note 1)	4.5	5	5.5	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			−12			−15	mA
I_{OL}	Low-level output current			12			24	mA
T_A	Operating free-air temperature	−55		125	0		70	°C

NOTE 1: Voltage values are with respect to network ground terminal.

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_{IK}		V_{CC} = MIN, I_I = −18 mA					−1.5			−1.5	V
Hysteresis ($V_{T+} - V_{T-}$)		V_{CC} = MIN			0.2	0.4		0.2	0.4		V
V_{OH}		V_{CC} = MIN, I_{OH} = −3 mA	V_{IH} = 2 V,	V_{IL} = MAX,	2.4	3.4		2.4	3.4		V
		V_{CC} = MIN, I_{OH} = MAX	V_{IH} = 2 V,	V_{IL} = 0.5 V,	2			2			
V_{OL}		V_{CC} = MIN, V_{IL} = MAX	V_{IH} = 2 V,	I_{OL} = 12 mA			0.4			0.4	V
				I_{OL} = 24 mA						0.5	
I_{OZH}		V_{CC} = MAX, V_{IL} = MAX	V_{IH} = 2 V,	V_O = 2.7 V			20			20	μA
I_{OZL}				V_O = 0.4 V			−20			−20	
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_{IL} = 0.4 V				−0.2			−0.2	mA
I_{OS}§		V_{CC} = MAX			−40		−225	−40		−225	mA
I_{CC}	Outputs high	V_{CC} = MAX, Output open		All		17	27		17	27	mA
	Outputs low			'LS240		26	44		26	44	
				'LS241, 'LS244		27	46		27	46	
	All outputs disabled			'LS240		29	50		29	50	
				'LS241, 'LS244		32	54		32	54	

† 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	TEST CONDITIONS		'LS240			'LS241, 'LS244			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	R_L = 667 Ω, See Note 2	C_L = 45 pF,		9	14		12	18	ns
t_{PHL}				12	18		12	18	ns
t_{PZL}				20	30		20	30	ns
t_{PZH}				15	23		15	23	ns
t_{PLZ}	R_L = 667 Ω, See Note 2	C_L = 5 pF,		10	20		10	20	ns
t_{PHZ}				15	25		15	25	ns

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

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recommended operating conditions

PARAMETER		SN54S'			SN74S'			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage, (see Note 1)	4.5	5	5.5	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
I_{OH}	High-level output current			−12			−15	mA
I_{OL}	Low-level output current			48			64	mA
	External resistance between any input and V_{CC} or ground			40			40	kΩ
T_A	Operating free-air temperature (see Note 3)	−55		125	0		70	°C

NOTES: 1. Voltage values are with respect to network ground terminal.
3. An SN54S241J operating at free-air temperature above 116°C requires a heat sink that provides a thermal resistance from case to free-air $R_{\theta CA}$, of not more than 40°C/W.

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

PARAMETER		TEST CONDITIONS†				SN54S'			SN74S'			UNIT
						MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}		V_{CC} = MIN,	I_I = −18 mA					−1.2			−1.2	V
Hysteresis ($V_{T+} - V_{T-}$)		V_{CC} = MIN				0.2	0.4		0.2	0.4		V
V_{OH}		V_{CC} = MIN, I_{OH} = −1 mA	V_{IH} = 2 V,	V_{IL} = 0.8 V,					2.7			V
		V_{CC} = MIN, I_{OH} = −3 mA	V_{IH} = 2 V,	V_{IL} = 0.8 V,		2.4	3.4		2.4	3.4		
		V_{CC} = MIN, I_{OH} = MAX	V_{IH} = 2 V,	V_{IL} = 0.5 V,		2			2			
V_{OL}		V_{CC} = MIN, I_{OL} = MAX	V_{IH} = 2 V,	V_{IL} = 0.8 V,				0.55			0.55	V
I_{OZH}		V_{CC} = MAX, V_{IL} = 0.8 V,	V_{IH} = 2 V,	V_O = 2.4 V				50			50	μA
I_{OZL}				V_O = 0.5 V				−50			−50	
I_I		V_{CC} = MAX,	V_I = 5.5 V					1			1	mA
I_{IH}		V_{CC} = MAX,	V_I = 2.7 V					50			50	μA
I_{IL}	Any A	V_{CC} = MAX,	V_I = 0.5 V					−400			−400	μA
	Any G							−2			−2	mA
I_{OS}§		V_{CC} = MAX				−50		−225	−50		−225	mA
I_{CC}	Outputs high	V_{CC} = MAX,	Outputs open	'S240			80	123		80	135	mA
				'S241, 'S244			95	147		95	160	
	Outputs low			'S240			100	145		100	150	
				'S241, 'S244			120	170		120	180	
	Outputs disabled			'S240			100	145		100	150	
				'S241, 'S244			120	170		120	180	

† 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.

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

PARAMETER	TEST CONDITIONS		'S240			'S241, 'S244			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH}	R_L = 90 Ω, See Note 4	C_L = 50 pF,		4.5	7		6	9	ns
t_{PHL}				4.5	7		6	9	ns
t_{PZL}				10	15		10	15	ns
t_{PZH}				6.5	10		8	12	ns
t_{PLZ}	R_L = 90 Ω, See Note 4	C_L = 5 pF,		10	15		10	15	ns
t_{PHZ}				6	9		6	9	ns

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

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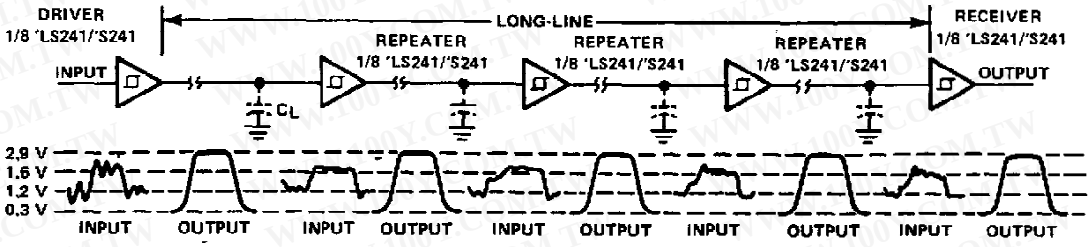

'LS241, 'S241 USED AS REPEATER/LEVEL RESTORER

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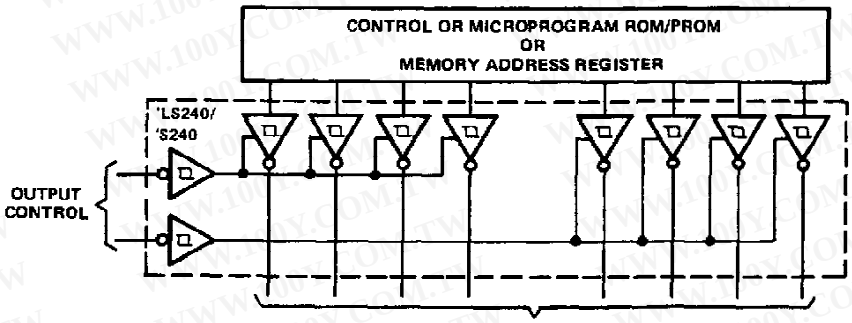
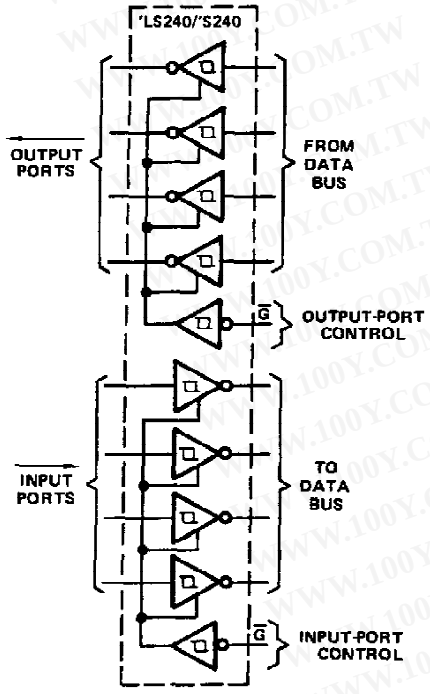
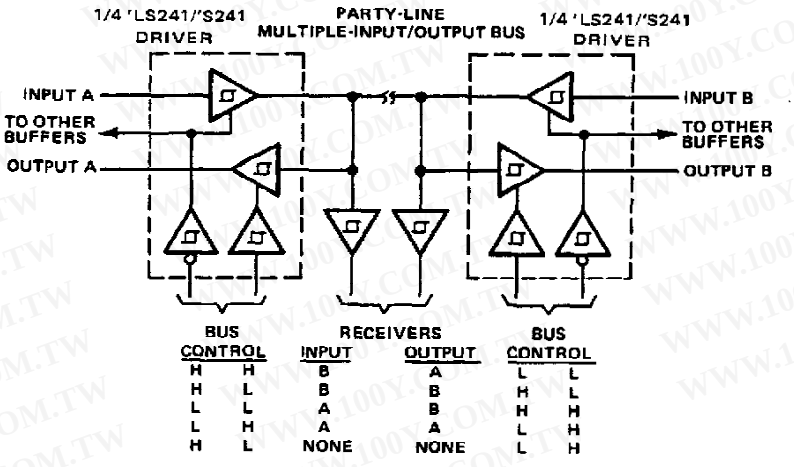


'LS240/'S240 USED AS SYSTEM AND/OR MEMORY BUS DRIVER—4-BIT ORGANIZATION CAN BE APPLIED TO HANDLE BINARY OR BCD



INDEPENDENT 4-BIT BUS DRIVERS/RECEIVERS IN A SINGLE PACKAGE



BUS CONTROL		RECEIVERS INPUT	RECEIVERS OUTPUT	BUS CONTROL	
H	H	B	A	L	L
H	L	B	B	H	L
L	L	A	B	H	H
L	H	A	A	L	H
H	L	NONE	NONE	L	H

PARTY-LINE BUS SYSTEM WITH MULTIPLE INPUTS, OUTPUTS, AND RECEIVERS

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