

SN54LS640 THRU SN54LS642, SN54LS644, SN54LS645 SN74LS640 THRU SN74LS642, SN74LS644, SN74LS645 OCTAL BUS TRANSCEIVERS

SDLS189 – APRIL 1979 – REVISED MARCH 1988

- **SN74LS64X-1 Versions Rated at I_{OL} of 48 mA**
- **Bi-directional Bus Transceivers in High-Density 20-Pin Packages**
- **Hysteresis at Bus Inputs Improves Noise Margins**
- **Choice of True or Inverting Logic**
- **Choice of 3-State or Open-Collector Outputs**

DEVICE	OUTPUT	LOGIC
'LS640	3-State	Inverting
'LS641	Open-Collector	True
'LS642	Open-Collector	Inverting
'LS644	Open-Collector	True and inverting
'LS645	3-State	True

description

These octal bus transceivers are designed for asynchronous two-way communication between data buses. The devices transmit data from the A bus to the B bus or from the B bus to the A bus depending upon the level at the direction control (DIR) input. The enable input ($\bar{G}$) can be used to disable the device so the buses are effectively isolated.

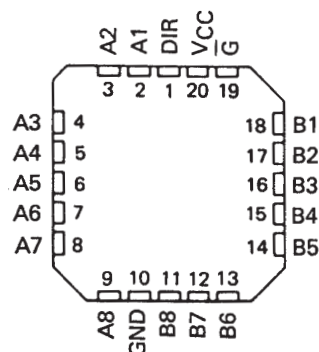
The -1 versions of the SN74LS640 thru SN74LS642, SN74LS644, and SN74LS645 are identical to the standard versions except that the recommended maximum I_{OL} is increased to 48 milliamperes. There are no -1 versions of the SN54LS640 thru SN54LS642, SN54LS644, and SN54LS645.

The SN54LS640 thru SN54LS642, SN54LS644, and SN54LS645 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LS640 thru SN74LS642, SN74LS644, and SN74LS645 are characterized for operation from 0°C to 70°C .

SN54LS' . . . J PACKAGE
SN74LS' . . . DW OR N PACKAGE
(TOP VIEW)



SN54LS' . . . FK PACKAGE
(TOP VIEW)



FUNCTION TABLE

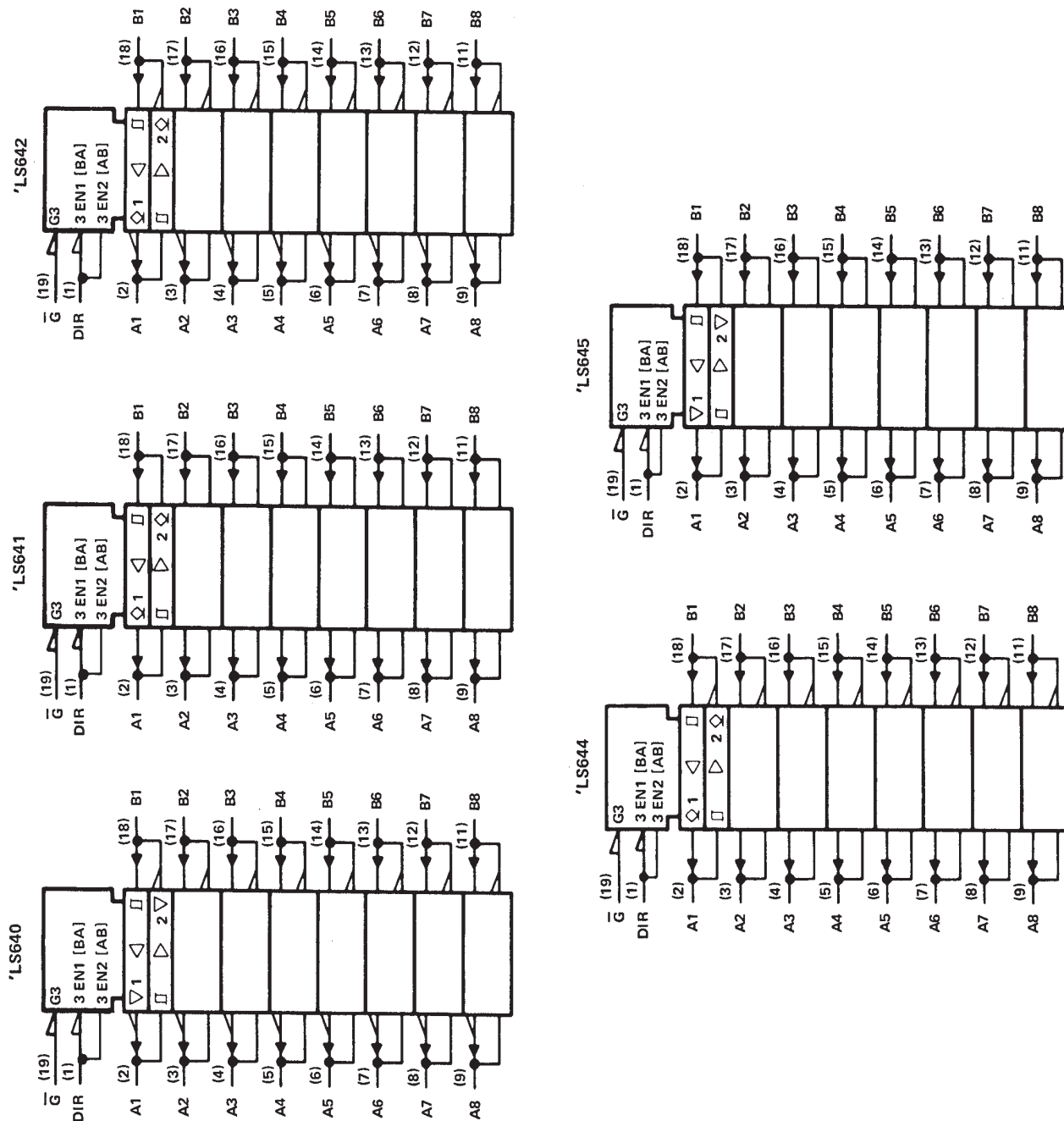
CONTROL INPUTS		OPERATION		
$\bar{G}$	DIR	'LS640 'LS642	'LS641 'LS645	'LS644
L	L	B data to A bus	B data to A bus	B data to A bus
L	H	A data to B bus	A data to B bus	$\bar{A}$ data to B bus
H	X	Isolation	Isolation	Isolation

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

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logic symbols†

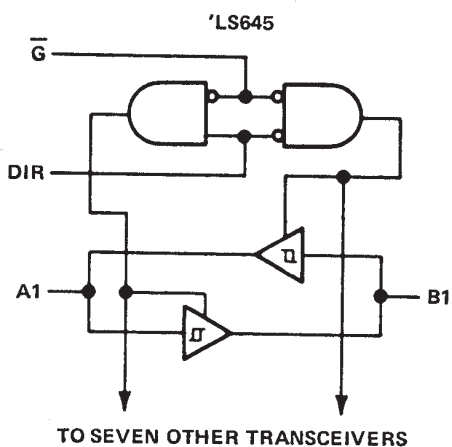
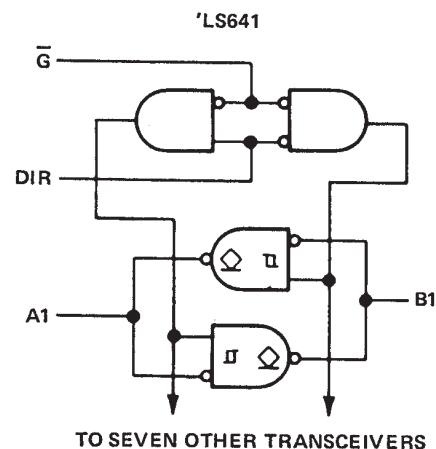
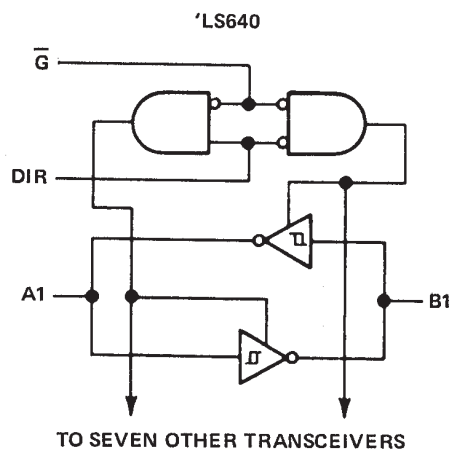


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for DW, J, and N packages.

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 SN74LS640 THRU SN74LS642, SN74LS644, SN74LS645
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logic diagrams (positive logic)



SN54LS640, SN54LS645
SN74LS640, SN74LS645
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage: All inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range: SN54LS640, SN54LS645	– 55 °C to 125 °C
SN74LS640, SN74LS645	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

PARAMETER	SN54LS640 SN54LS645			SN74LS640 SN74LS645			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC} Supply voltage	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			0.5			0.6	V
I_{OH} High-level output current			– 12			– 15	mA
I_{OL} Low-level output current			12			24	mA
						48†	
T_A Operating free-air temperature	– 55		125	0		70	°C

†The 48-mA limit applies for the SN74LS640-1 and SN74LS645-1 only.

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

PARAMETER		TEST CONDITIONS†		SN54LS640 SN54LS645		SN74LS640 SN74LS645		UNIT
				MIN	TYP‡	MAX	MIN	
V _{IK}		V _{CC} = MIN, I _I = – 18 mA		– 1.5		– 1.5		V
Hysteresis (V _{T+} – V _{T–})		V _{CC} = MIN,	A or B input	0.1	0.4	0.2	0.4	V
V _{OH}		V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX	I _{OH} = – 3 mA	2.4	3.4	2.4	3.4	
			I _{OH} = MAX	2		2		
V _{OL}		V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX	I _{OL} = 12 mA	0.25	0.4	0.25	0.4	V
			I _{OL} = 24 mA			0.35	0.5	
			I _{OL} = 48 mA #			0.4	0.5	
I _{OZH}		V _{CC} = MAX, $\bar{G}$ at 2 V, V _O = 2.7 V		20		20		μA
I _{OZL}		V _{CC} = MAX, $\bar{G}$ at 2 V, V _O = 0.4 V		– 0.4		– 0.4		mA
I _I	A or B	V _{CC} = MAX	V _I = 5.5 V	0.1		0.1		mA
	DIR or $\bar{G}$		V _I = 7 V	0.1		0.1		
I _{IH}		V _{CC} = MAX, V _{IH} = 2.7 V		20		20		μA
I _{IL}		V _{CC} = MAX, V _{IL} = 0.4 V		– 0.4		– 0.4		mA
I _{OS} †		V _{CC} = MAX		– 40	– 225	– 40	– 225	mA
I _{CC}	Outputs high	V _{CC} = MAX, Outputs open		48	70	48	70	mA
	Outputs low			62	90	62	90	
	Outputs at Hi-Z			64	95	64	95	

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

‡The 48-mA condition applies for the SN74LS640-1 and SN74LS645-1 only.

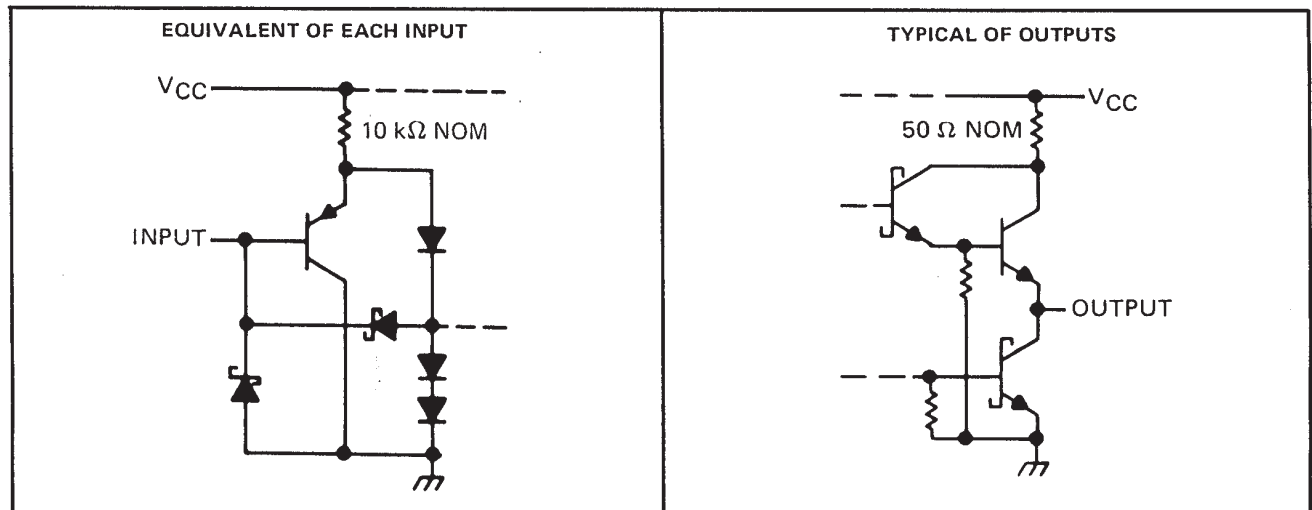


switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS640, 'LS640-1			'LS645, 'LS645-1			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t_{PLH} Propagation delay time, low-to-high-level output	A	B	$C_L = 45\text{ pF}$, $R_L = 667\ \Omega$, See Note 2		6	10		8	15	ns
	B	A			6	10		8	15	
t_{PHL} Propagation delay time, high-to-low-level output	A	B			8	15		11	15	ns
	B	A			8	15		11	15	
t_{PZL} Output enable time to low level	$\overline{G}$	A			31	40		31	40	ns
	$\overline{G}$	B			31	40		31	40	
t_{PZH} Output enable time to high level	$\overline{G}$	A			23	40		26	40	ns
	$\overline{G}$	B			23	40		26	40	
t_{PLZ} Output disable time from low level	$\overline{G}$	A	$C_L = 5\text{ pF}$, $R_L = 667\ \Omega$, See Note 2		15	25		15	25	ns
	$\overline{G}$	B			15	25		15	25	
t_{PHZ} Output disable time from high level	$\overline{G}$	A			15	25		15	25	ns
	$\overline{G}$	B			15	25		15	25	

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

schematics of inputs and outputs



SN54LS640, SN54LS645
SN74LS640, SN74LS645
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

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TYPICAL CHARACTERISTICS

SN54LS'
INVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

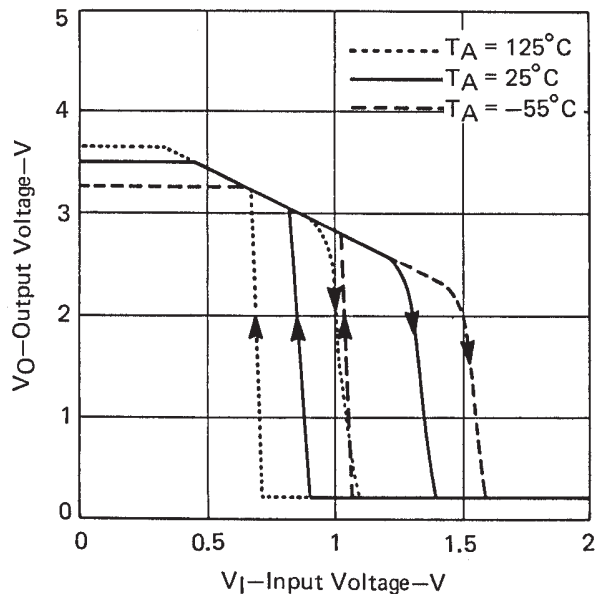


FIGURE 1

SN74LS'
INVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

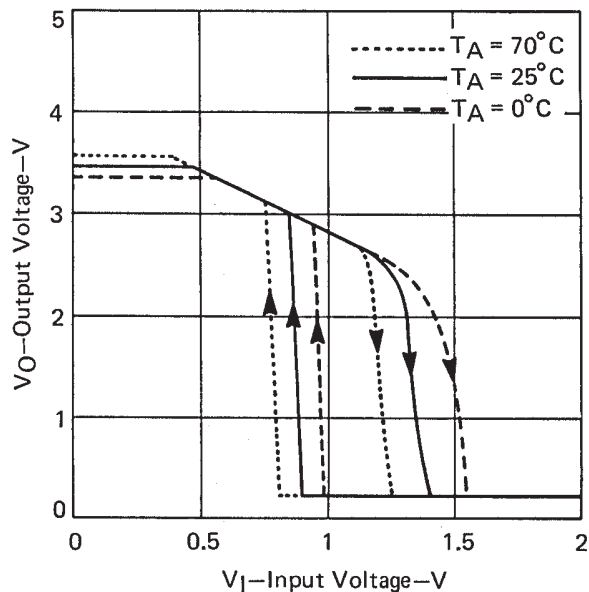


FIGURE 2

SN54LS'
NONINVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE



FIGURE 3

SN74LS'
NONINVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE



FIGURE 4

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Supply voltage, V _{CC} (see Note 1)	7 V
Input voltage: All inputs and I/O ports	7 V
Operating free-air temperature range: SN54LS641, SN54LS642, SN54LS644	– 55°C to 125°C
SN74LS641, SN74LS642, SN74LS644	0°C to 70°C
Storage temperature range	– 65°C to 150°C

PARAMETER	SN54LS641 SN54LS642 SN54LS644			SN74LS641 SN74LS642 SN74LS644			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC} Supply voltage	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			0.5			0.6	V
V _{OH} High-level output voltage			5.5			5.5	V
I _{OL} Low-level output current			12			24	mA
						48 §	
T _A Operating free-air temperature	− 55		125	0		70	°C

PARAMETER		TEST CONDITIONS†	SN54LS641 SN54LS642 SN54LS644		SN74LS641 SN74LS642 SN74LS644		UNIT			
			MIN	TYP‡	MAX	MIN	TYP‡	MAX		
V_{IK}			$V_{CC} = \text{MIN},$	$I_I = -18 \text{ mA}$		-1.5		-1.5		V
Hysteresis ($V_{T+} - V_{T-}$)			$V_{CC} = \text{MIN},$	A or B input		0.1	0.4	0.2	0.4	V
I_{OH}			$V_{CC} = \text{MIN},$ $V_{IH} = 2 \text{ V},$ $V_{IL} = \text{MAX},$ $V_{OH} = 5.5 \text{ V}$			0.1		0.1		mA
V_{OL}			$V_{CC} = \text{MIN},$ $V_{IH} = 2 \text{ V},$ $V_{IL} = \text{MAX}$	$I_{OL} = 12 \text{ mA}$		0.25	0.4	0.25	0.4	V
				$I_{OL} = 24 \text{ mA}$				0.35	0.5	
				$I_{OL} = 48 \text{ mA}§$				0.4	0.5	
I_I	A or B	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		0.1		0.1		mA	
	DIR or $\overline{G}$		$V_I = 7 \text{ V}$		0.1		0.1			
I_{IH}		$V_{CC} = \text{MAX},$	$V_I = 2.7 \text{ V}$		20		20		μA	
I_{IL}		$V_{CC} = \text{MAX},$	$V_I = 0.4 \text{ V}$		-0.4		-0.4		mA	
I_{CC}	Outputs high	$V_{CC} = \text{MAX},$	Outputs open		48	70	48	70	mA	
	Outputs low				62	90	62	90		
	Outputs at Hi-Z				64	95	64	95		

§ The 48 mA condition applies for the SN74LS641-1, SN74LS642-1, and SN74LS644-1 only.

SN54LS641, SN54LS642, SN54LS644
 SN74LS641, SN74LS642, SN74LS644
 OCTAL BUS TRANSCEIVERS WITH OPEN-COLLECTOR OUTPUTS

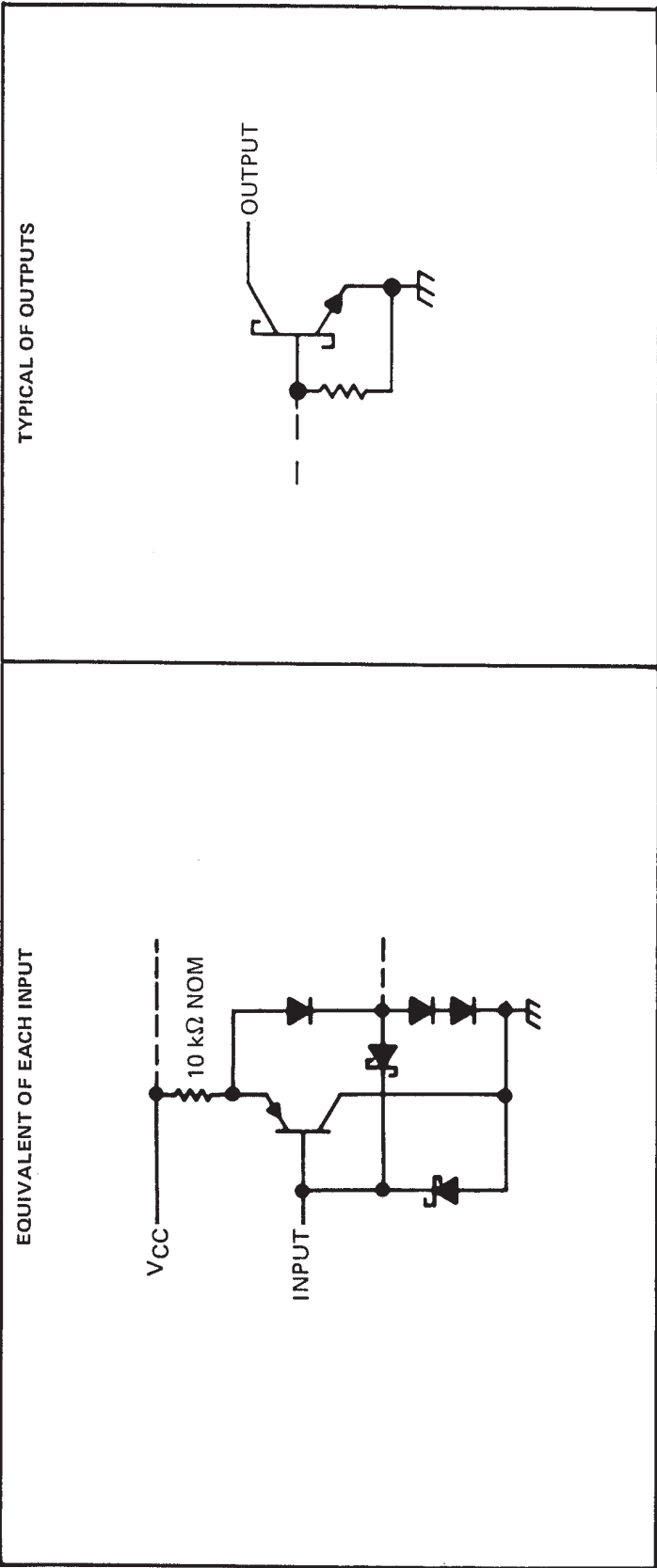
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switching characteristics at $V_{CC} = 5\text{ V}$, $T_A = 25^{\circ}\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS641, 'LS641-1		'LS642, 'LS642-1		'LS644, 'LS644-1		UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t _{PLH} low-to-high-level output	A	B	C _L = 45 pF, R _L = 667 Ω, See Note 2	17	25	25	19	25	25	ns
	B	A		17	25	25	19	25	25	
t _{PHL} high-to-low-level output	A	B		16	25	25	14	25	25	ns
	B	A		16	25	25	14	25	25	
Output disable time from low level	$\bar{G}$, DIR	A		23	40	40	26	40	40	ns
	$\bar{G}$, DIR	B		25	40	40	28	40	40	
Output enable time from high level	$\bar{G}$, DIR	A		34	50	50	43	60	60	ns
	$\bar{G}$, DIR	B		37	50	50	39	60	60	

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

schematics of inputs and outputs



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