

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

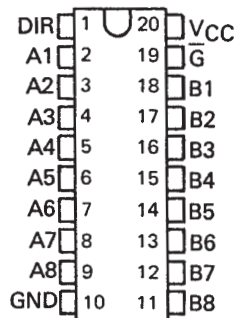
description

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.

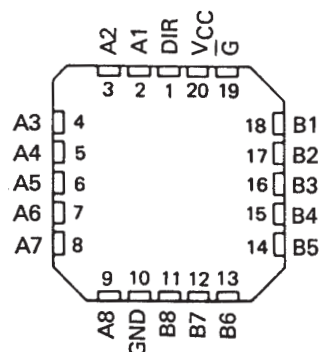
The -1 versions of the SN74LS640 thru SN74LS642, SN74LS644, and SN74LS645 are identical to the standard versions except that the recommended maximum I_{OL} is increased to 48 milliamperes. There are no -1 versions of the SN54LS640 thru SN54LS642, SN54LS644, and SN54LS645.

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

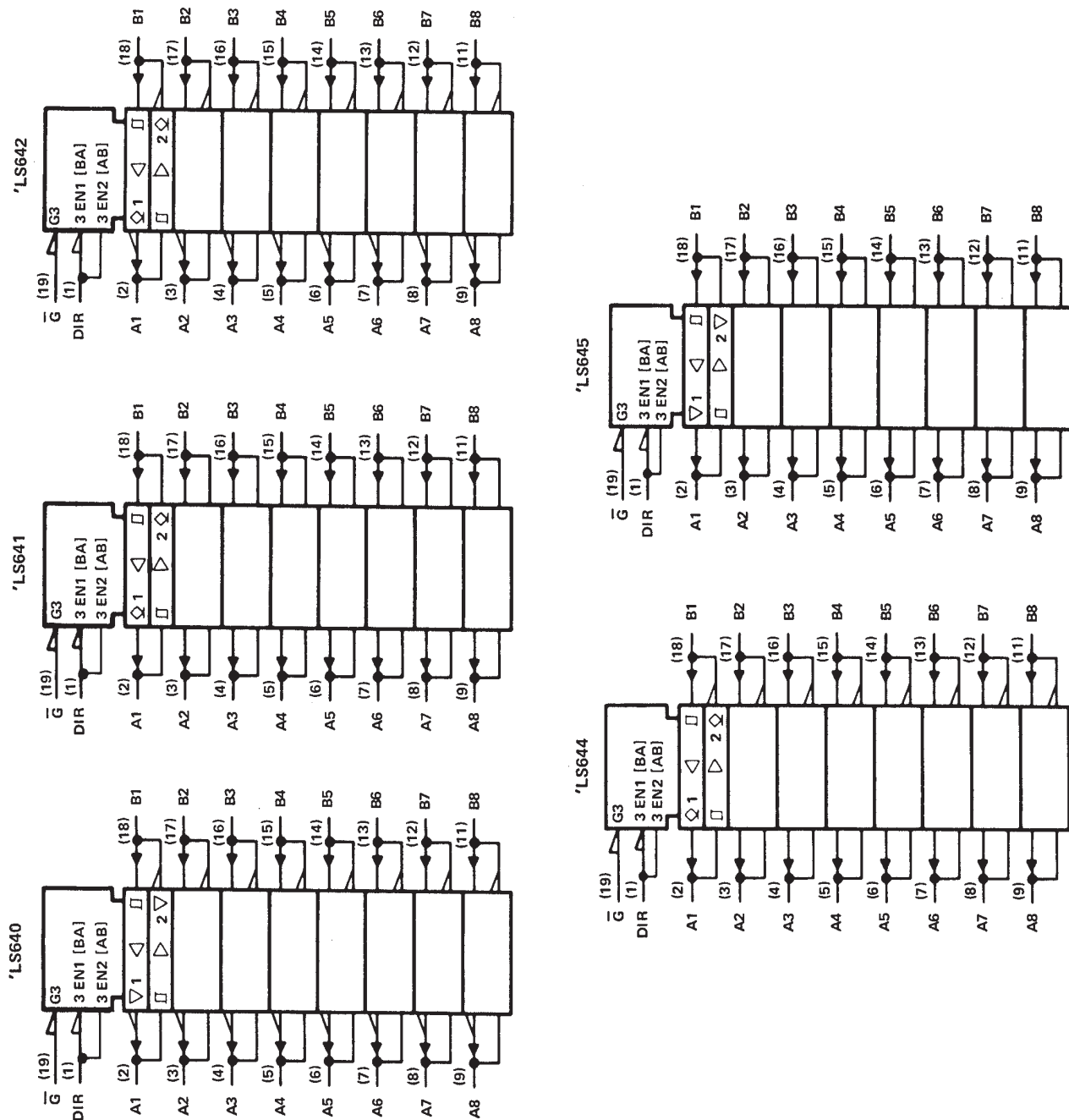
CONTROL INPUTS		OPERATION		
$\bar{G}$	DIR	'LS640 'LS642	'LS641 'LS645	'LS644
L	L	B data to A bus	B data to A bus	B data to A bus
L	H	A data to B bus	A data to B bus	$\bar{A}$ data to B bus
H	X	Isolation	Isolation	Isolation

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

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

SDLS189 – APRIL 1979 – REVISED MARCH 1988

logic symbols†

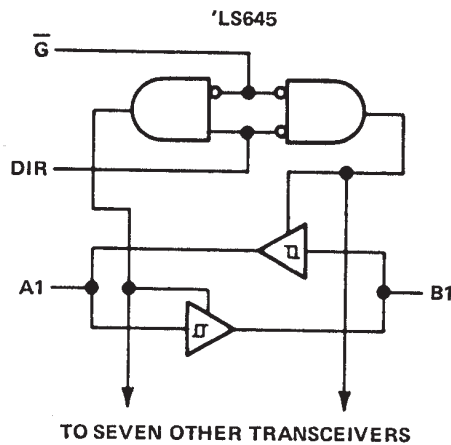
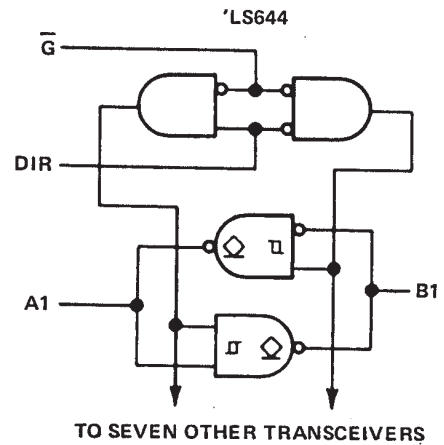
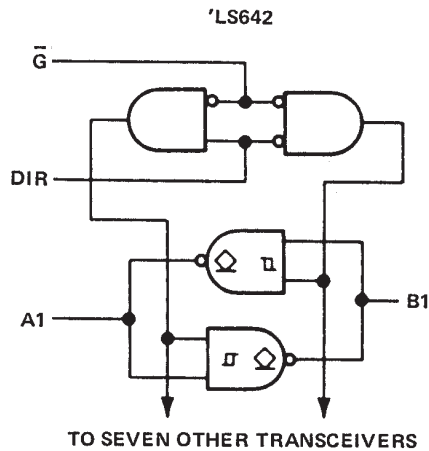
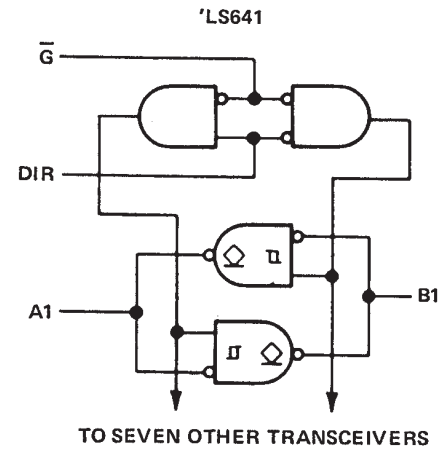
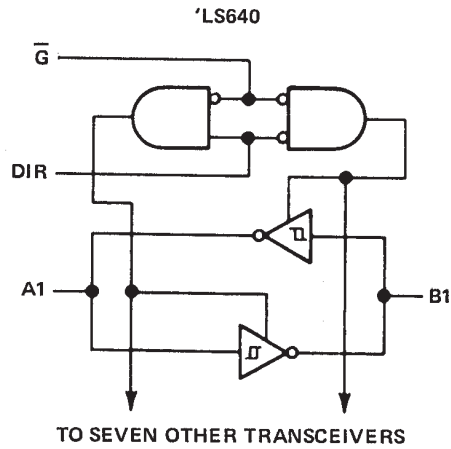


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for DW, J, and N packages.

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

SDLS189 – APRIL 1979 – REVISED MARCH 1988

logic diagrams (positive logic)



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

SDLS189 – APRIL 1979 – REVISED MARCH 1988

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.

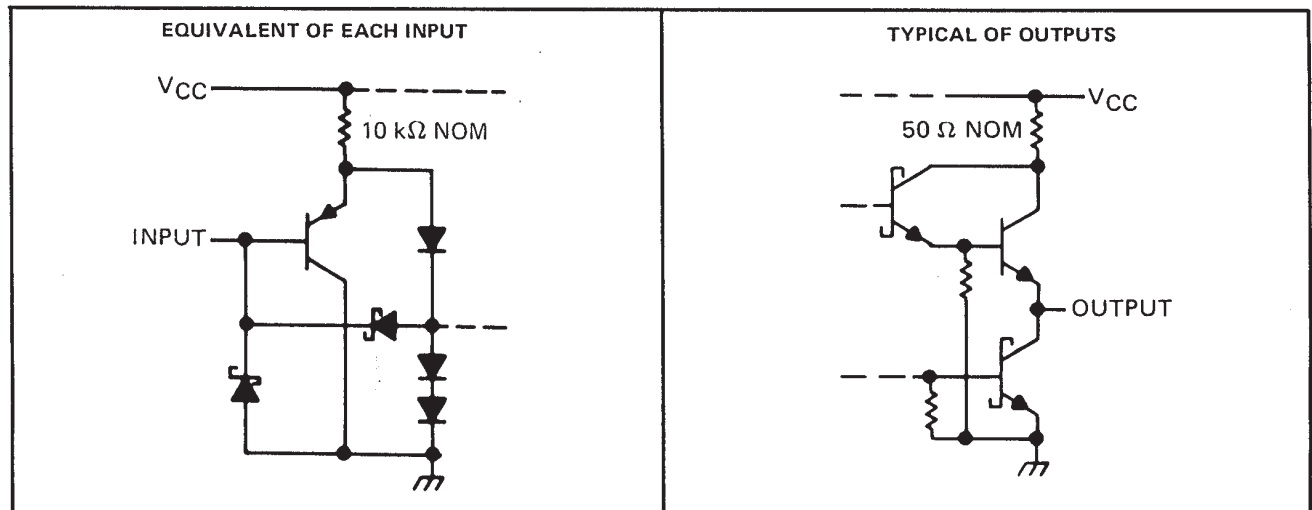


switching characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

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

SDLS189 – APRIL 1979 – REVISED MARCH 1988

TYPICAL CHARACTERISTICS

SN54LS'
INVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

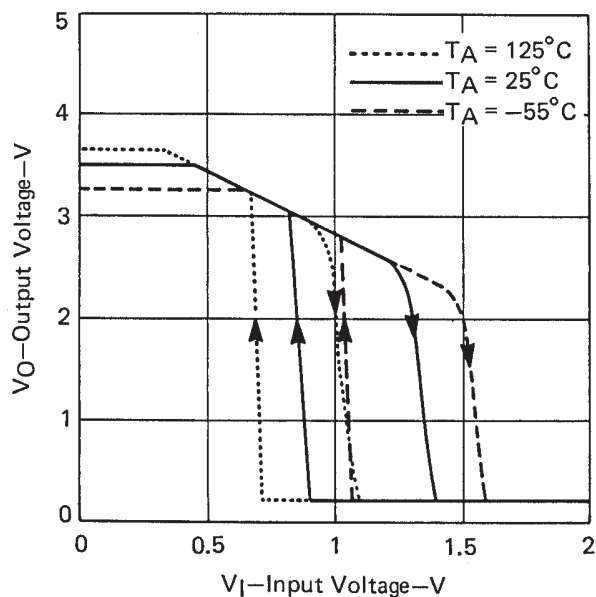


FIGURE 1

SN74LS'
INVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

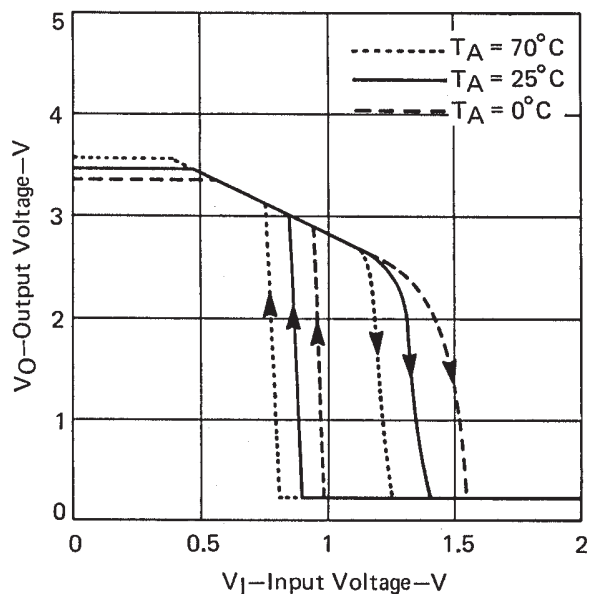


FIGURE 2

SN54LS'
NONINVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

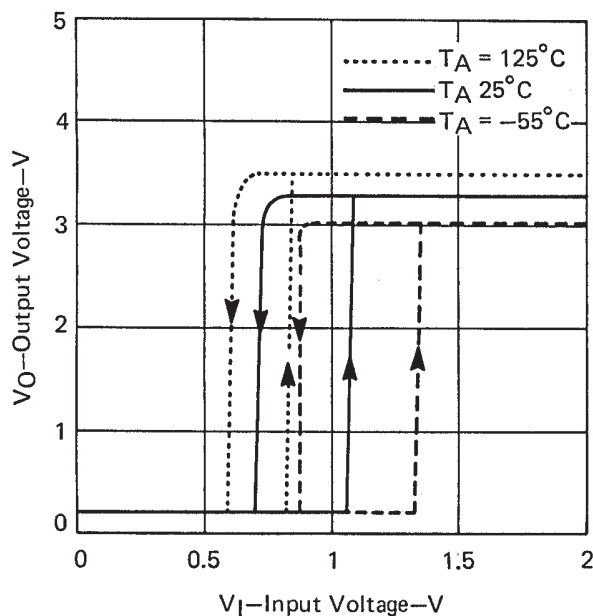


FIGURE 3

SN74LS'
NONINVERTING OUTPUT VOLTAGE
 vs
INPUT VOLTAGE

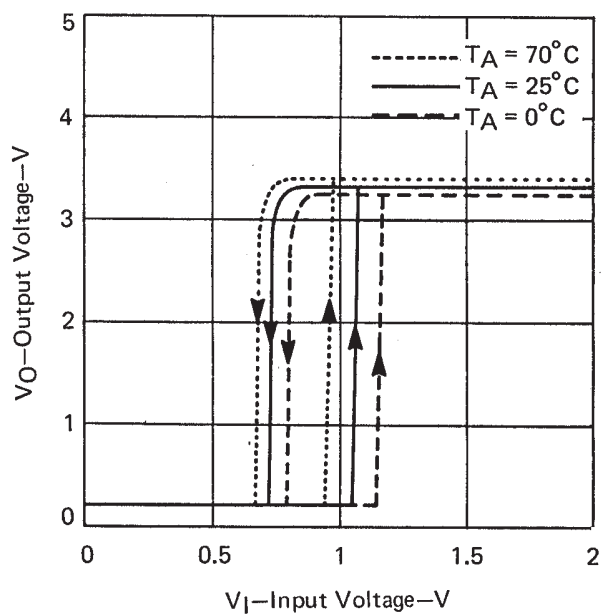


FIGURE 4

SN54LS641, SN54LS642, SN54LS644
SN74LS641, SN74LS642, SN74LS644
OCTAL BUS TRANSCEIVERS WITH OPEN-COLLECTOR OUTPUTS
SDLS189 – APRIL 1979 – REVISED MARCH 1988

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 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

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

recommended operating conditions

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

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

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

PARAMETER		TEST CONDITIONS†		SN54LS641 SN54LS642 SN54LS644		SN74LS641 SN74LS642 SN74LS644		UNIT
				MIN	TYP‡	MAX	MIN	
VIK		VCC = MIN,	II = − 18 mA	− 1.5		− 1.5		V
Hysteresis (VT+ − VT−)		VCC = MIN,	A or B input	0.1	0.4	0.2	0.4	V
IOH		VCC = MIN, VIL = MAX,	VIH = 2 V, VOH = 5.5 V	0.1		0.1		mA
VOL		VCC = MIN, VIH = 2 V, VIL = MAX	IOL = 12 mA	0.25	0.4	0.25	0.4	V
			IOL = 24 mA			0.35	0.5	
			IOL = 48 mA§			0.4	0.5	
II	A or B	VCC = MAX	VI = 5.5 V	0.1		0.1		mA
	DIR or G		VI = 7 V	0.1		0.1		
IIH		VCC = MAX,	VI = 2.7 V	20		20		μA
IIL		VCC = MAX,	VI = 0.4 V	− 0.4		− 0.4		mA
ICC	Outputs high	VCC = 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 $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$.

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

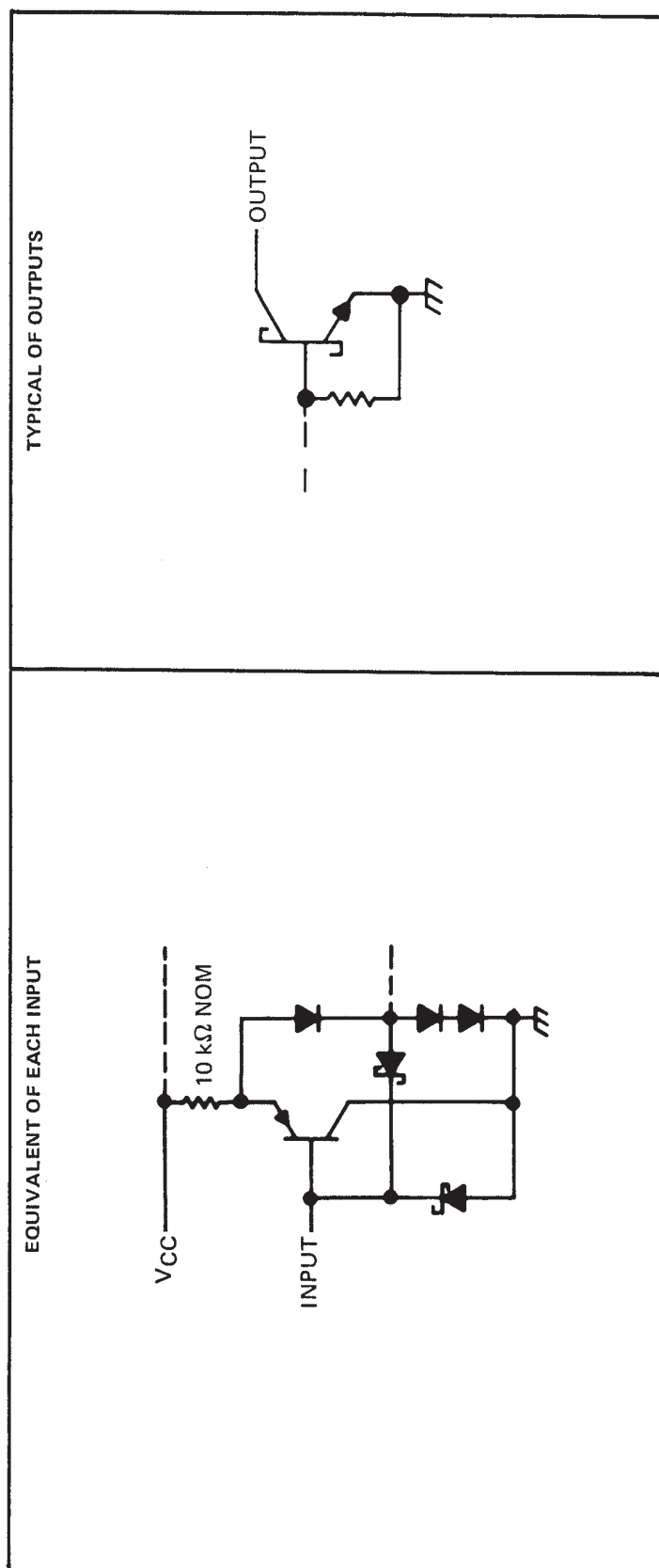
SDLS189 – APRIL 1979 – REVISED MARCH 1988

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} Propagation delay time, low-to-high-level output	A	B	C _L = 45 pF, R _L = 667 Ω, See Note 2	17	25	19	25	17	25	ns
	B	A		17	25	19	25	19	25	
t _{PHL} Propagation delay time, high-to-low-level output	A	B		16	25	14	25	14	25	ns
	B	A		16	25	14	25	16	25	
t _{PLH} Output disable time from low level	$\bar{G}$, DIR	A	23	40	26	40	26	40	ns	
	$\bar{G}$, DIR	B	25	40	28	40	25	40		
t _{PHL} Output enable time from high level	$\bar{G}$, DIR	A	34	50	43	60	43	60	ns	
	$\bar{G}$, DIR	B	37	50	39	60	37	50		

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

schematics of inputs and outputs



IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

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

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.