

# TYPES SN54LS640 THRU SN54LS645, SN74LS640 THRU SN74LS645 OCTAL BUS TRANSCEIVERS

D2420, APRIL 1979—REVISED DECEMBER 1983

- **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
'LS643	3-State	True and inverting
'LS644	Open-Collector	True and inverting
'LS645	3-State	True

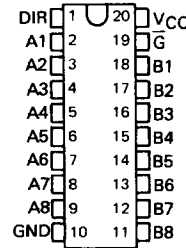
## description

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.

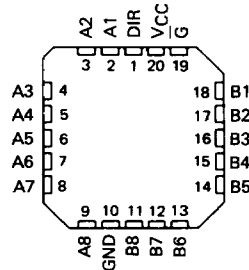
The -1 versions of the SN74LS640 thru SN74LS645 are identical to the standard versions except that the recommended maximum  $I_{OL}$  is increased to 48 milliamperes. There are no -1 versions of the SN54LS640 thru SN54LS645.

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

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



SN54LS' ... FK PACKAGE  
SN74LS' ... FN PACKAGE  
(TOP VIEW)



FUNCTION TABLE

CONTROL INPUTS		OPERATION		
G	DIR	'LS640 'LS642	'LS641 'LS645	'LS643 '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

## PRODUCTION DATA

This document contains information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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INSTRUMENTS

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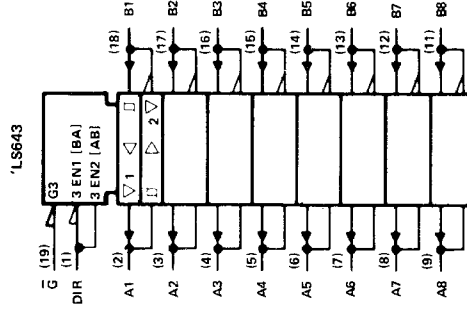
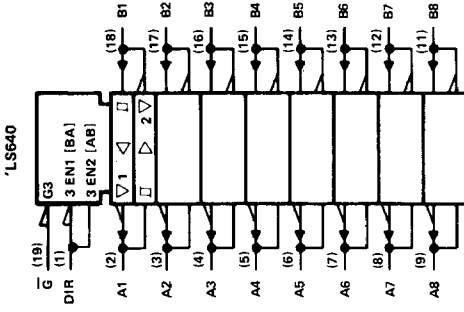
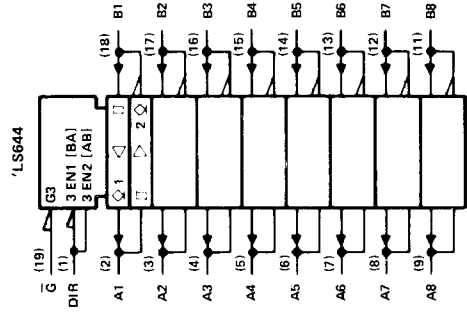
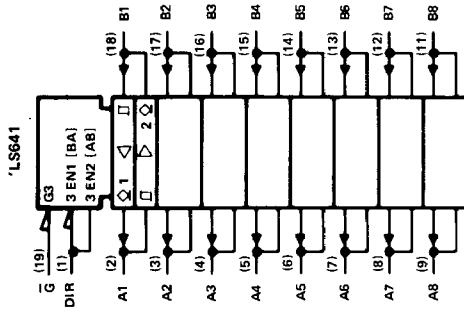
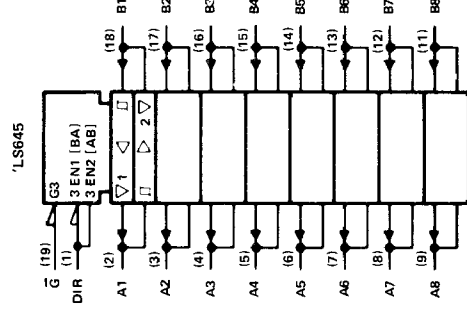
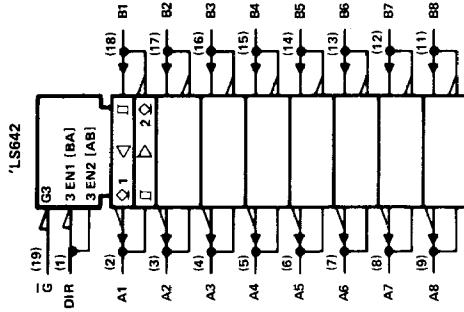
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TYPES SN54LS640 THRU SN54LS645,  
SN74LS640 THRU SN74LS645  
OCTAL BUS TRANSCEIVERS

logic symbols



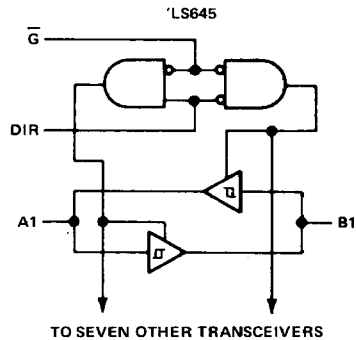
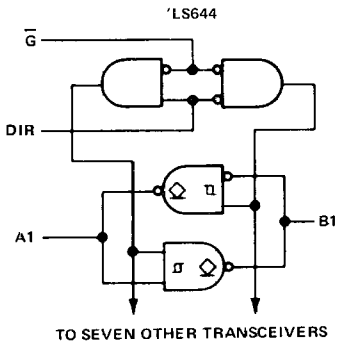
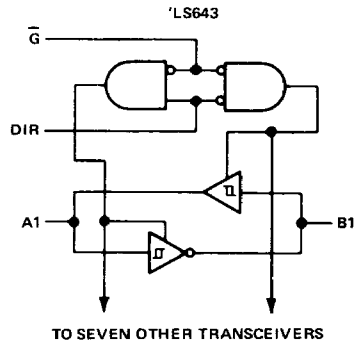
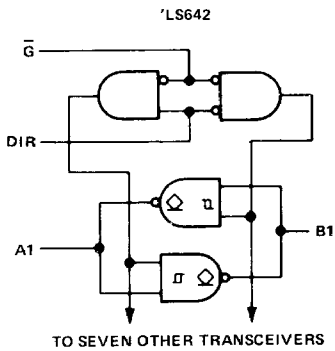
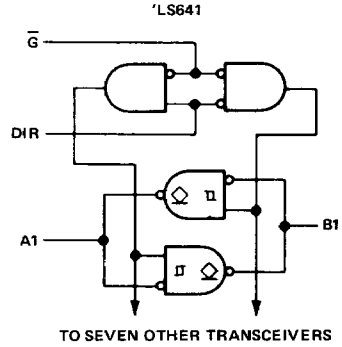
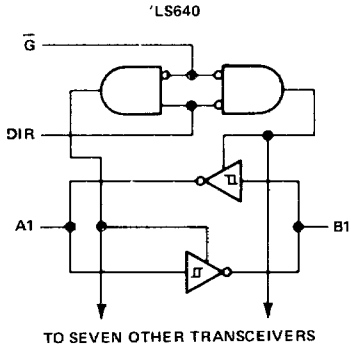
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Pin numbers shown on logic notation are for DW, J or N packages.

TYPES SN54LS640 THRU SN54LS645,  
SN74LS640 THRU SN74LS645  
OCTAL BUS TRANSCEIVERS

logic diagrams



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TTL DEVICES

**TYPES SN54LS640, SN54LS643, SN54LS645,  
SN74LS640, SN74LS643, SN74LS645  
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS**

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, SN54LS643, SN54LS645	-55°C to 125°C
SN74LS640, SN74LS643, 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 SN54LS643 SN54LS645			SN74LS640 SN74LS643 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, SN74LS643-1, and SN74LS645-1 only.

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

PARAMETER	TEST CONDITIONS †			SN54LS640 SN54LS643 SN54LS645			SN74LS640 SN74LS643 SN74LS645			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			V	
$V_{OH}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = \text{MAX}$			$I_{OH} = -3 \text{ mA}$			2.4 3.4			V	
				$I_{OH} = \text{MAX}$			2				
$V_{OL}$	$V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = \text{MAX}$			$I_{OL} = 12 \text{ mA}$			0.25 0.4			V	
				$I_{OL} = 24 \text{ mA}$			0.35 0.5				
				$I_{OL} = 48 \text{ mA} ¶$			0.4 0.5				
$I_{OZH}$	$V_{CC} = \text{MAX}, \bar{G} \text{ at } 2 \text{ V}, V_O = 2.7 \text{ V}$			20			20			µA	
$I_{OZL}$	$V_{CC} = \text{MAX}, \bar{G} \text{ at } 2 \text{ V}, V_O = 0.4 \text{ V}$			-0.4			-0.4			mA	
$I_I$	A or B	$V_{CC} = \text{MAX}$			$V_I = 5.5 \text{ V}$			0.1			mA
	DIR or $\bar{G}$				$V_I = 7 \text{ V}$			0.1			
$I_{IH}$	$V_{CC} = \text{MAX}, V_{IH} = 2.7 \text{ V}$			20			20			µA	
$I_{IL}$	$V_{CC} = \text{MAX}, V_{IL} = 0.4 \text{ V}$			-0.4			-0.4			mA	
$I_{OS} §$	$V_{CC} = \text{MAX}$			-40			-225			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			

† 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, SN74LS643-1, and SN74LS645-1 only.

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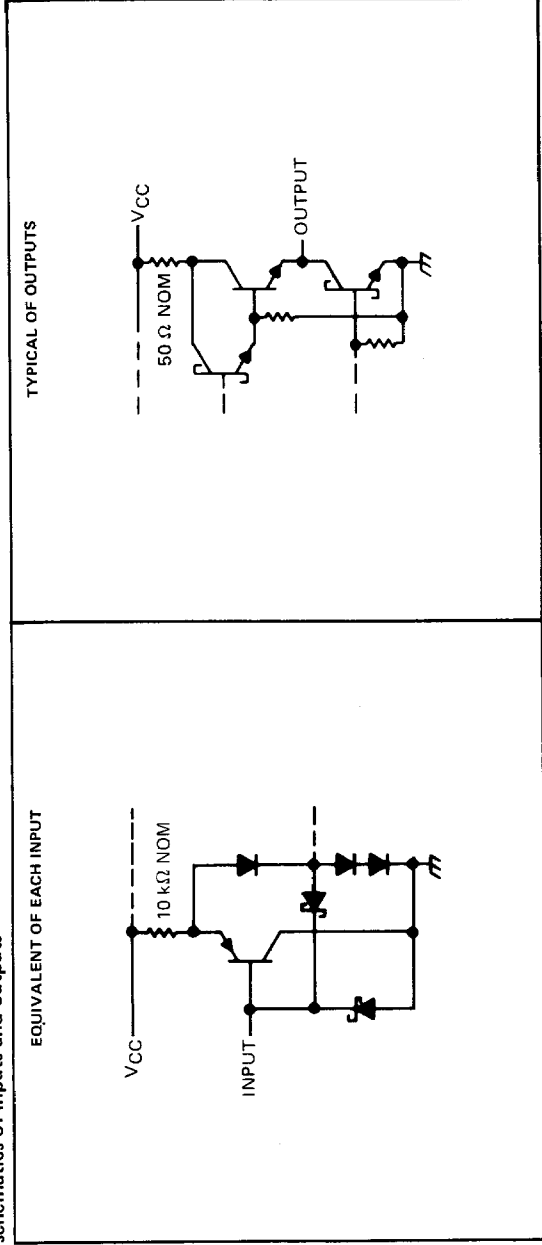
**TYPES SN54LS640, SN54LS643, SN54LS645,  
SN74LS640, SN74LS643, SN74LS645  
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS**

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS		'LS640, 'LS640-1			'LS643, 'LS643-1			'LS645, 'LS645-1			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX			
t <sub>PLH</sub> Propagation delay time, low-to-high-level output	A	B	6	10	6	10	6	10	8	15	8	15	ns	
	B	A	6	10	8	15	8	15	8	15	8	15		
t <sub>PHL</sub> Propagation delay time, high-to-low-level output	A	B	8	15	8	15	9	15	11	15	11	15	ns	
	B	A	8	15	11	15	11	15	11	15	11	15		
t <sub>pZL</sub> Output enable time to low level	G	A	31	40	32	45	31	40	31	40	31	40	ns	
	B	A	31	40	32	45	31	40	31	40	31	40		
t <sub>pZH</sub> Output enable time to high level	G	A	23	40	27	40	26	40	26	40	26	40	ns	
	B	A	23	40	23	40	23	40	26	40	26	40		
t <sub>PLZ</sub> Output disable time from low level	G	A	15	25	15	25	15	25	15	25	15	25	ns	
	B	A	15	25	15	25	15	25	15	25	15	25		
t <sub>PHZ</sub> Output disable time from high level	G	A	15	25	15	25	15	25	15	25	15	25	ns	
	B	A	15	25	15	25	15	25	15	25	15	25		

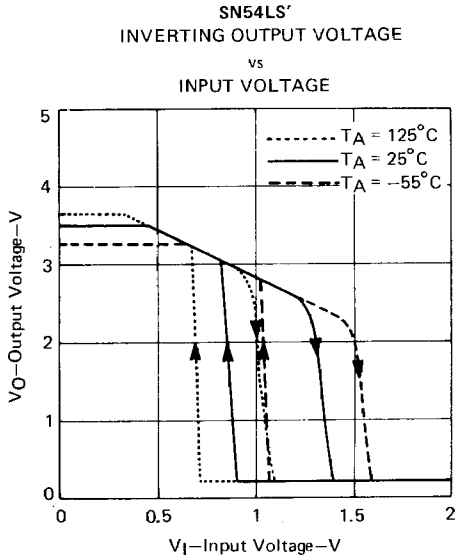
NOTE 2: See General Information Section for load circuits and voltage waveforms.

**schematics of inputs and outputs**

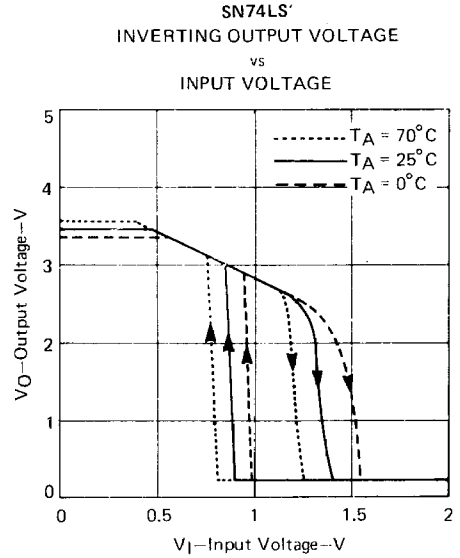


**TYPES SN54LS640, SN54LS643, SN54LS645,  
SN74LS640, SN74LS643, SN74LS645  
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS**

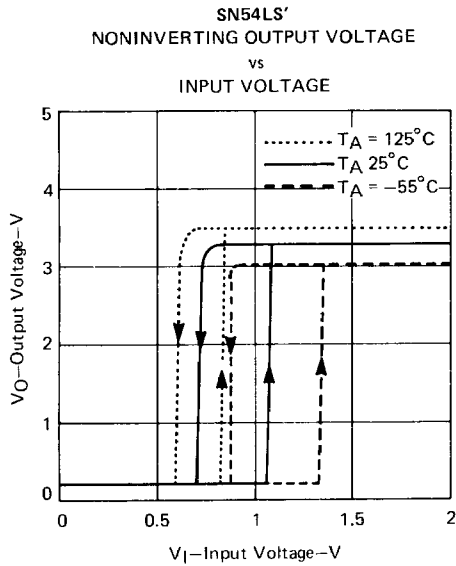
**TYPICAL CHARACTERISTICS**



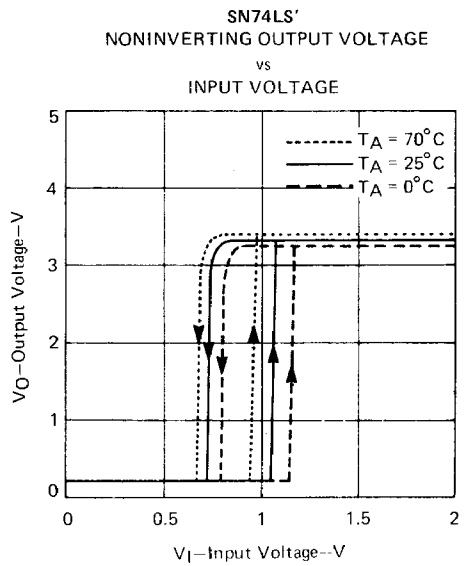
**FIGURE 1**



**FIGURE 2**



**FIGURE 3**



**FIGURE 4**

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**TTL DEVICES**

# TYPES SN54LS641, SN54LS642, SN54LS644, SN74LS641, SN74LS642, SN74LS644

## OCTAL BUS TRANSCEIVERS WITH OPEN-COLLECTOR OUTPUTS

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

<sup>†</sup> For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

<sup>‡</sup> All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$ .

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

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TTL DEVICES



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



TTL DEVICES

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

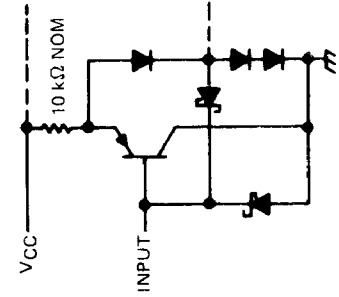
PARAMETER	FROM (INPUT)	TO (OUTPUT)	LS641, LS641-1			LS642, LS642-1			LS644, LS644-1			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
t <sub>PLH</sub> Propagation delay time, low-to-high-level output	A	B	17	25	19	25	17	25	17	25	ns	
	B	A	17	25	19	25	19	25	19	25		
t <sub>PHL</sub> Propagation delay time, high-to-low-level output	A	B	16	25	14	25	14	25	14	25	ns	
	B	A	16	25	14	25	14	25	16	25		
t <sub>PLH</sub> Output disable time from low level	$\bar{G}$ , DIR	A	23	40	26	40	26	40	26	40	ns	
	$\bar{G}$ , DIR	B	25	40	28	40	25	40	25	40		
t <sub>PHL</sub> Output enable time from high level	$\bar{G}$ , DIR	A	34	50	43	60	43	60	43	60	ns	
	$\bar{G}$ , DIR	B	37	50	39	60	37	50	37	50		

TEST CONDITIONS  
 $C_L = 45\text{ pF}$ ,  
 $R_L = 667\ \Omega$ ,  
 See Note 2

NOTE 2: See General Information Section for load circuits and voltage waveforms.

schematics of inputs and outputs

EQUIVALENT OF EACH INPUT



TYPICAL OF OUTPUTS

