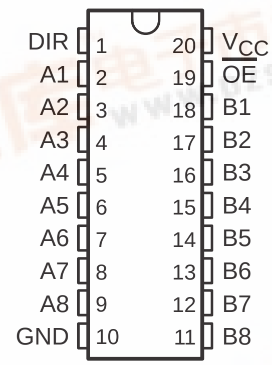
SN54ALS645A, SN54AS645, SN74ALS645A, SN74AS645
OCTAL BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

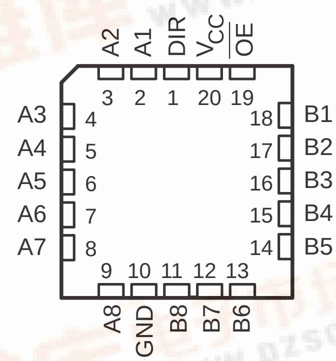
SDAS278 – JANUARY 1995

- **Bidirectional Bus Transceivers in High-Density 20-Pin Packages**
- **True Logic**
- **3-State Outputs**
- **Package Options Include Plastic Small-Outline (DW) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs**

SN54ALS645A, SN54AS645 . . . J PACKAGE
SN74ALS645A, SN74AS645 . . . DW OR N PACKAGE
(TOP VIEW)



SN54ALS645A, SN54AS645 . . . FK PACKAGE
(TOP VIEW)



description

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

The -1 version of the SN74ALS645A is identical to the standard version, except that the recommended maximum I_{OL} is increased to 48 mA. There is no -1 version of the SN54ALS645A.

The SN54ALS645A and SN54AS645 are characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ALS645A and SN74AS645 are characterized for operation from 0°C to 70°C.

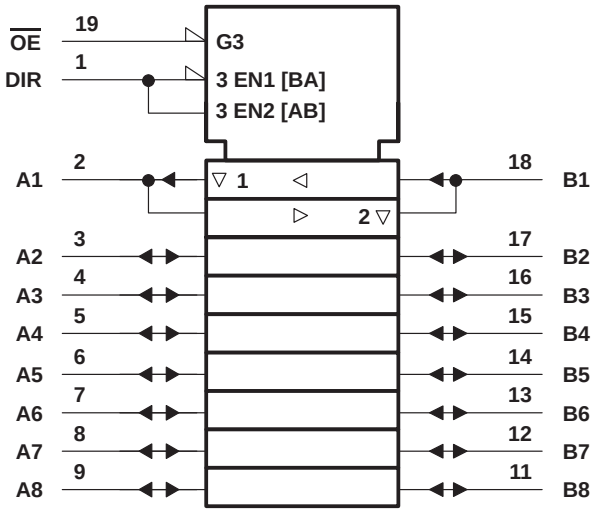
FUNCTION TABLE

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

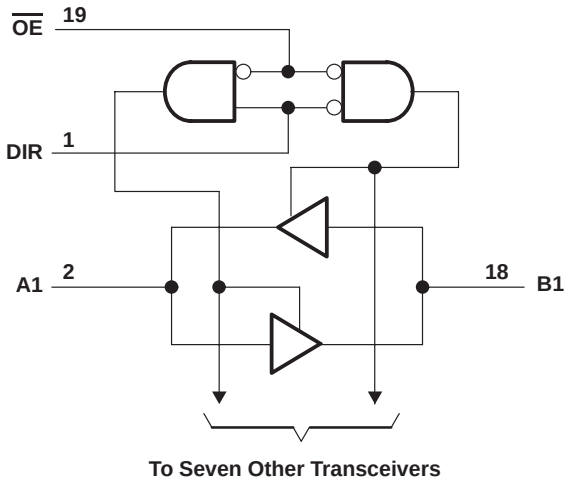
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

TEXAS INSTRUMENTS

logic symbol†



logic diagram (positive logic)



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

Supply voltage, V_{CC} . . . . . 7 V
Input voltage, V_I: All inputs . . . . . 7 V
I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN54ALS645A . . . . . –55°C to 125°C
SN74ALS645A . . . . . 0°C to 70°C
Storage temperature range . . . . . –65°C to 150°C

‡ Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

recommended operating conditions

		SN54ALS645A			SN74ALS645A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	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
							48§	
T_A	Operating free-air temperature	–55		125	0		70	°C

§ Applies only to the -1 version and only if V_{CC} is between 4.75 V and 5.25 V

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

PARAMETER		TEST CONDITIONS		SN54ALS645A			SN74ALS645A			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.5			–1.5	V
V_{OH}		V_{CC} = 4.5 V to 5.5 V,	I_{OH} = –0.4 mA	V_{CC} –2			V_{CC} –2			V
		V_{CC} = 4.5 V	I_{OH} = –3 mA	2.4	3.2		2.4	3.2		
			I_{OH} = –12 mA	2						
			I_{OH} = –15 mA				2			
V_{OL}		V_{CC} = 4.5 V	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‡					0.35	0.5	
I_I	Control inputs	V_{CC} = 5.5 V	V_I = 7 V			0.1			0.1	mA
	A or B ports		V_I = 5.5 V			0.1			0.1	
I_{IH}	Control inputs	V_{CC} = 5.5 V,	V_I = 2.7 V			20			20	µA
	A or B ports§					20			20	
I_{IL}	Control inputs	V_{CC} = 5.5 V,	V_I = 0.4 V			–0.1			–0.1	mA
	A or B ports§					–0.1			–0.1	
I_O¶		V_{CC} = 5.5 V,	V_O = 2.25 V	–20		–112	–30		–112	mA
I_{CC}		V_{CC} = 5.5 V	Outputs high		30	48		30	45	mA
			Outputs low		36	60		36	55	
			Outputs disabled		38	63		38	58	

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ Applies only to the -1 version and only if V_{CC} is between 4.75 V and 5.25 V
§ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.
¶ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = MIN to MAX#				UNIT
			SN54ALS645A		SN74ALS645A		
			MIN	MAX	MIN	MAX	
t_{PLH}	A or B	B or A	1	19	3	10	ns
t_{PHL}			1	14	3	10	
t_{PZH}	$\overline{OE}$	A or B	2	30	5	20	ns
t_{PZL}			2	29	5	20	
t_{PHZ}	$\overline{OE}$	A or B	2	14	2	10	ns
t_{PLZ}			2	30	4	15	

For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

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

Supply voltage, V_{CC} . . . . . 7 V
Input voltage, V_I: All inputs . . . . . 7 V
I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN54AS645 . . . . . –55°C to 125°C
SN74AS645 . . . . . 0°C to 70°C
Storage temperature range . . . . . –65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

recommended operating conditions

		SN54AS645			SN74AS645			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	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
T_A	Operating free-air temperature	–55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS		SN54AS645			SN74AS645			UNIT
				MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2			–1.2	V
V_{OH}		V_{CC} = 4.5 V to 5.5 V,	I_{OH} = –2 mA	V_{CC} –2			V_{CC} –2			V
		V_{CC} = 4.5 V	I_{OH} = –3 mA	2.4	3.2		2.4	3.2		
			I_{OH} = –12 mA	2.4						
			I_{OH} = –15 mA				2.4			
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 48 mA		0.3	0.55				V
			I_{OL} = 64 mA					0.35	0.55	
I_I	Control inputs	V_{CC} = 5.5 V	V_I = 7 V			0.1			0.1	mA
	A or B ports		V_I = 5.5 V			0.1			0.1	
I_{IH}	Control inputs	V_{CC} = 5.5 V,	V_I = 2.7 V			20			20	µA
	A or B ports§					70			70	
I_{IL}	Control inputs	V_{CC} = 5.5 V,	V_I = 0.4 V			–0.5			–0.5	mA
	A or B ports§					–0.75			–0.75	
I_O¶		V_{CC} = 5.5 V,	V_O = 2.25 V	–50		–150	–50		–150	mA
I_{CC}		V_{CC} = 5.5 V	Outputs high		62	97		62	97	mA
			Outputs low		95	149		95	149	
			Outputs disabled		79	123		79	123	

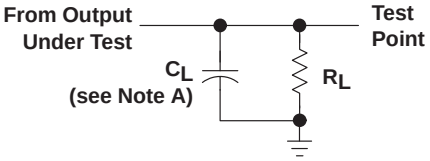
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.
§ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.
¶ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

switching characteristics (see Figure 1)

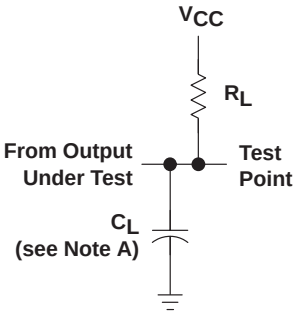
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T_A = MIN to MAX†				UNIT
			SN54AS645		SN74AS645		
			MIN	MAX	MIN	MAX	
t_{PLH}	A or B	B or A	2	11	2	9.5	ns
t_{PHL}			2	10.5	2	9	
t_{PZH}	$\overline{OE}$	A or B	2	12	2	11	ns
t_{PZL}			2	12	2	10	
t_{PHZ}	$\overline{OE}$	A or B	2	8	2	7	ns
t_{PLZ}			2	13	2	12	

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

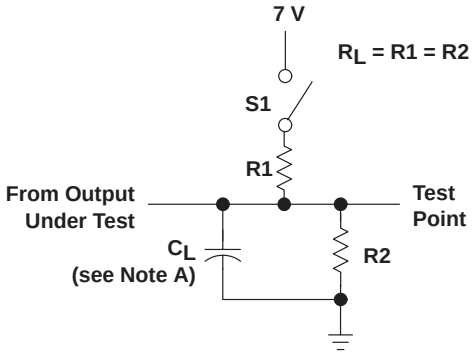
PARAMETER MEASUREMENT INFORMATION
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



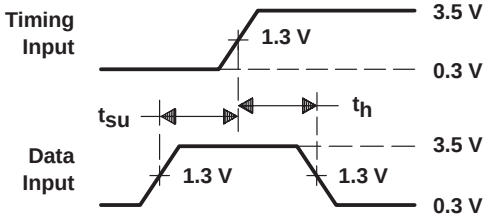
LOAD CIRCUIT FOR
BI-STATE
TOTEM-POLE OUTPUTS



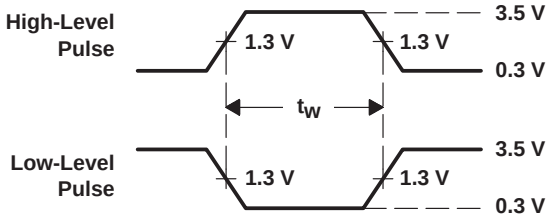
LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS



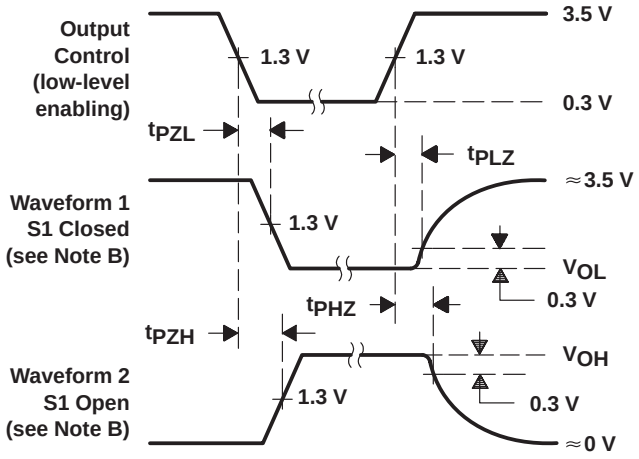
LOAD CIRCUIT
FOR 3-STATE OUTPUTS



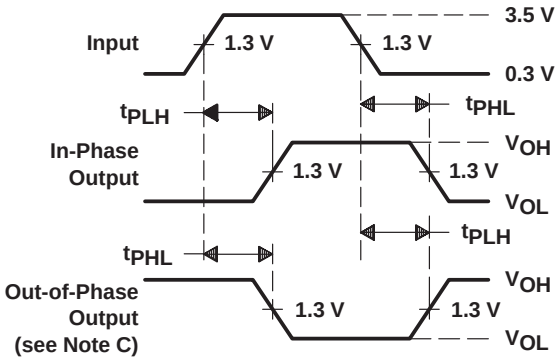
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. When measuring propagation delay items of 3-state outputs, switch S1 is open.
D. All input pulses have the following characteristics: PRR ≤ 1 MHz, $t_r = t_f = 2$ ns, duty cycle = 50%.
E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

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