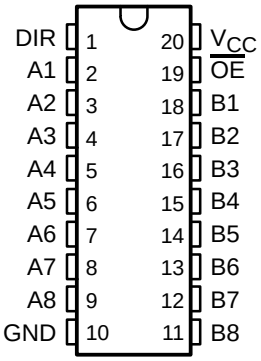
SDAS123A – DECEMBER 1983 – REVISED JANUARY 1995

- **Bidirectional Bus Transceivers in High-Density 20-Pin Packages**
- **Choice of True or Inverting Logic**
- **A-Bus Outputs Are Open Collector; B-Bus Outputs Are 3 State**
- **Package Options Include Plastic Small-Outline (DW) Packages and Standard Plastic (N) 300-mil DIPs**

DW OR N PACKAGE
(TOP VIEW)



DEVICE	A OUTPUT	B OUTPUT	LOGIC
SN74ALS638A, SN74AS638A	Open collector	3 state	Inverting
SN74ALS639A, SN74AS639	Open collector	3 state	True

description

These octal bus transceivers are designed for asynchronous two-way communication between open-collector and 3-state buses. The devices transmit data from the A bus (open-collector) to the B bus (3 state) or from the B bus to the A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ($\overline{OE}$) input can be used to disable the device so the buses are isolated.

The -1 version of SN74ALS638A is identical to the standard version, except that the recommended maximum I_{OL} is increased to 48 mA.

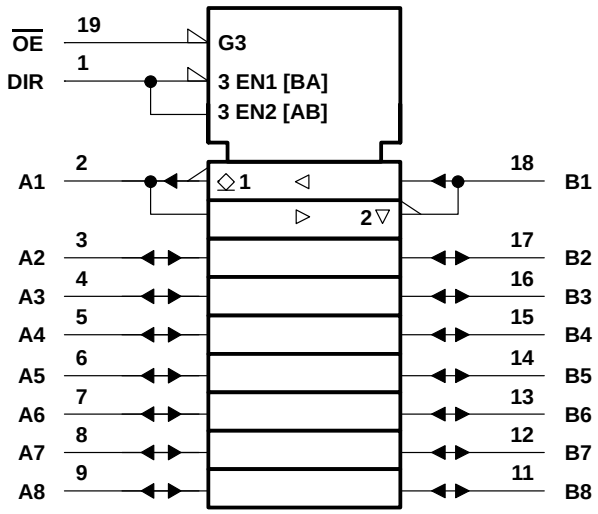
The SN74ALS638A, SN74ALS639A, SN74AS638A, and SN74AS639 are characterized for operation from 0°C to 70°C.

FUNCTION TABLE

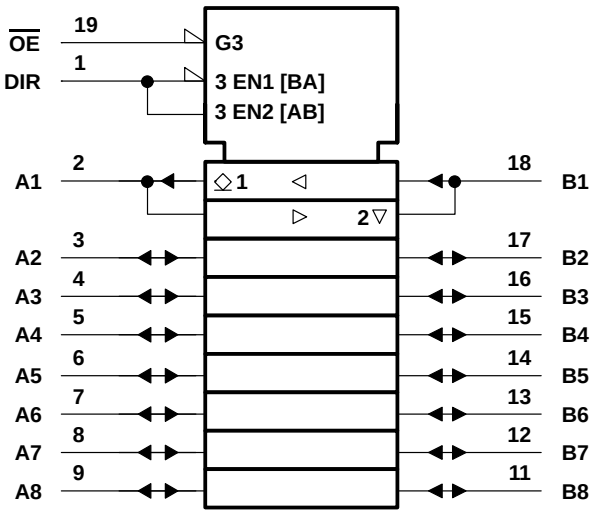
INPUTS		OPERATION	
$\overline{OE}$	DIR	SN74ALS638A SN74AS638A	SN74ALS639A SN74AS639
L	L	$\overline{B}$ data to A bus	B data to A bus
L	H	$\overline{A}$ data to B bus	A data to B bus
H	X	Isolation	Isolation

logic symbols†

SN74ALS638A, SN74AS638A



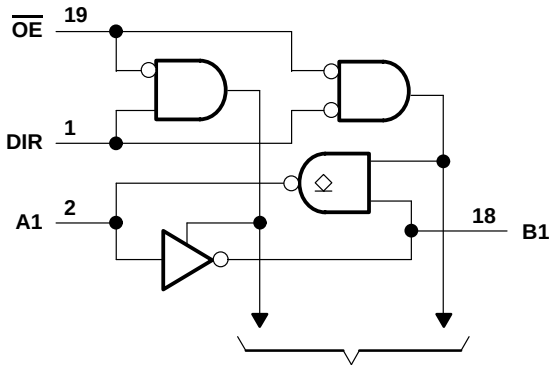
SN74ALS639A, SN74AS639



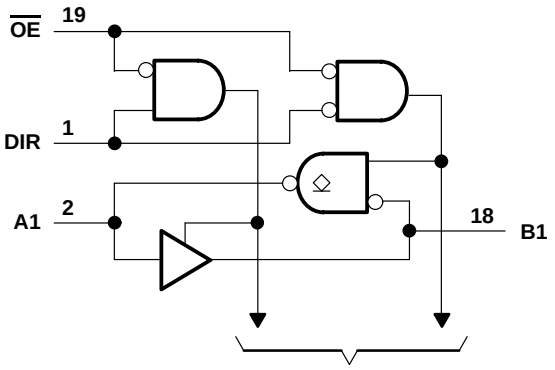
† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagrams (positive logic)

SN74ALS638A, SN74AS638A



SN74ALS639A, SN74AS639



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
A-bus I/O ports . . . . . 7 V
B-bus I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN74ALS638A, SN74ALS639A . . . . . 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

			SN74ALS638A SN74ALS639A			UNIT
			MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	V
V_{IH}	High-level input voltage		2			V
V_{IL}	Low-level input voltage				0.8	V
V_{OH}	High-level output voltage	A ports			5.5	V
I_{OH}	High-level output current	B ports			–15	mA
I_{OL}	Low-level output current	A or B ports			24	mA
					48†	
T_A	Operating free-air temperature		0		70	°C

† Applies only to the SN74ALS638A-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		SN74ALS638A SN74ALS639A			UNIT
				MIN	TYP‡	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.5	V
I_{OH}	A ports	V_{CC} = 4.5 V,	V_{OH} = 5.5 V			0.1	mA
V_{OH}	B ports	V_{CC} = 4.5 V to 5.5 V,	I_{OH} = –0.4 mA	V_{CC} –2			V
		V_{CC} = 4.5 V	I_{OH} = –3 mA	2.4	3.2		
			I_{OH} = –15 mA	2			
V_{OL}	A or B ports	V_{CC} = 4.5 V	I_{OL} = 12 mA		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	mA
	A or B ports		V_I = 5.5 V			0.1	
I_{IH}	Control inputs	V_{CC} = 5.5 V,	V_I = ?Z?Y? v			20	µA
	A or B ports§					20	
I_{IL}	Control inputs	V_{CC} = 5.5 V,	V_I = ?U?X? v			–0.1	mA
	A or B ports§					–0.1	
I_O¶	B ports	V_{CC} = 5.5 V,	V_O = 2.25 V	–30		–112	mA
I_{CC}	SN74ALS638A	V_{CC} = 5.5 V	Outputs high		18	30	mA
			Outputs low		26	41	
			Outputs disabled		16	30	
	SN74ALS639A	V_{CC} = 5.5 V	Outputs high		25	40	
			Outputs low		30	50	
			Outputs disabled		33	54	

† Applies only to the SN74ALS638A-1 version and only if V_{CC} is between 4.75 V and 5.25 V
‡ 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, R_L = 680 Ω (A outputs), R1 = R2 = 500 Ω (B outputs), T_A = MIN to MAX†				UNIT
			SN74ALS638A		SN74ALS639A		
			MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2	12	2	12	ns
t_{PHL}			2	12	2	12	
t_{PLH}	B	A	8	25	10	30	ns
t_{PHL}			8	30	5	22	
t_{PLH}	$\overline{OE}$	A	5	25	10	30	ns
t_{PHL}			10	45	10	35	
t_{PZH}	$\overline{OE}$	B	5	20	6	21	ns
t_{PZL}			5	22	8	25	
t_{PHZ}	$\overline{OE}$	B	2	10	2	10	ns
t_{PLZ}			3	15	3	16	

† 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
A-bus I/O ports . . . . . 7 V
B-bus I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN74AS638A, SN74AS639 . . . . . 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

			SN74AS638A SN74AS639			UNIT
			MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	V
V_{IH}	High-level input voltage		2			V
V_{IL}	Low-level input voltage				0.8	V
V_{OH}	High-level output voltage	A ports			5.5	V
I_{OH}	High-level output current	B ports			–15	mA
I_{OL}	Low-level output current	A or B ports			64	mA
T_A	Operating free-air temperature		0		70	°C

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

PARAMETER		TEST CONDITIONS		SN74AS638A SN74AS639			UNIT
				MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2	V
I_{OH}	A ports	V_{CC} = 4.5 V,	V_{OH} = 5.5 V			0.1	mA
V_{OH}	B ports	V_{CC} = 4.5 V to 5.5 V,	I_{OH} = –2 mA	V_{CC} –2			V
		V_{CC} = 4.5 V	I_{OH} = –3 mA	2.4	3.2		
			I_{OH} = –15 mA	2.4			
V_{OL}	A or B ports	V_{CC} = 4.5 V,	I_{OL} = 64 mA		0.35	0.55	V
I_I	Control inputs	V_{CC} = 5.5 V	V_I = 7 V			0.1	mA
	A or B ports		V_I = 5.5 V			0.1	
I_{IH}	Control inputs	V_{CC} = 5.5 V,	V_I = ?Z?Y? v			20	µA
	A or B ports‡					70	
I_{IL}	Control inputs	V_{CC} = 5.5 V,	V_I = ?U?4? v			–0.5	mA
	A or B ports‡					–0.75	
I_O§		V_{CC} = 5.5 V,	V_O = 2.25 V	–50		–150	mA
I_{CC}	SN74AS638A	V_{CC} = 5.5 V	Outputs high		24	54	mA
			Outputs low		75	122	
			Outputs disabled		37	61	
	SN74AS639	V_{CC} = 5.5 V	Outputs high		56	92	
			Outputs low		95	154	
			Outputs disabled		62	100	

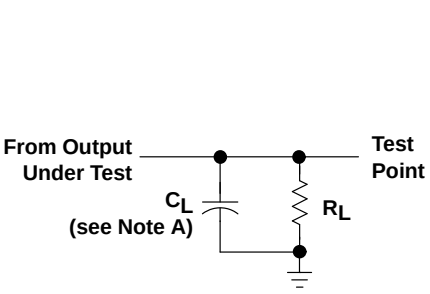
† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.
§ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

switching characteristics (see Figure 1)

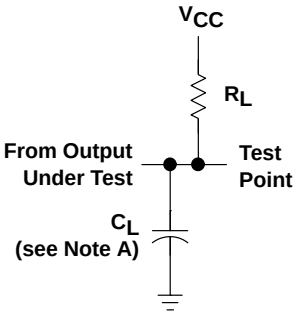
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R_L = 500 Ω (A outputs), R1 = R2 = 500 Ω (B outputs), T_A = MIN to MAX¶				UNIT
			SN74AS638A		SN74AS639		
			MIN	MAX	MIN	MAX	
t_{PLH}	A	B	2	7	2	9.5	ns
t_{PHL}			2	6.5	2	9	
t_{PLH}	B	A	5	20	5	22	ns
t_{PHL}			2	7	2	9	
t_{PLH}	$\overline{OE}$	A	5	19	5	21.5	ns
t_{PHL}			2	9	2	11.5	
t_{PZH}	$\overline{OE}$	B	2	8	2	10.5	ns
t_{PZL}			2	10	2	10.5	
t_{PHZ}	$\overline{OE}$	B	2	7	2	7	ns
t_{PLZ}			2	10	2	10.5	

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

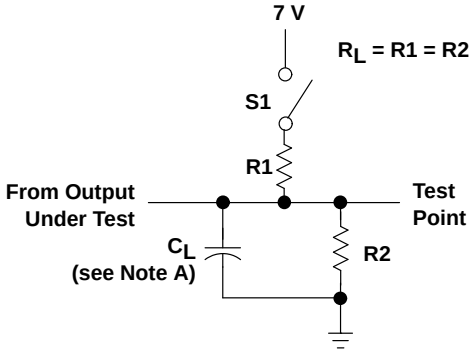
PARAMETER MEASUREMENT INFORMATION
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



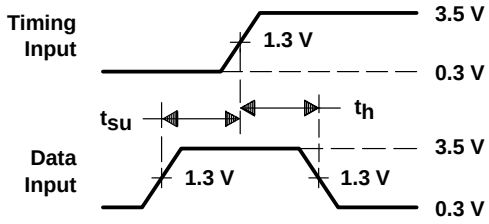
LOAD CIRCUIT FOR
BI-STATE
TOTEM-POLE OUTPUTS



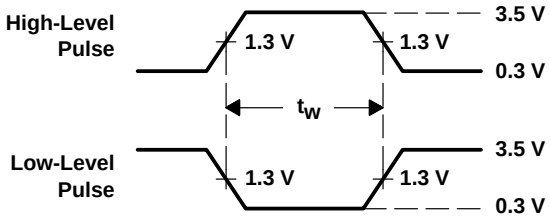
LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS



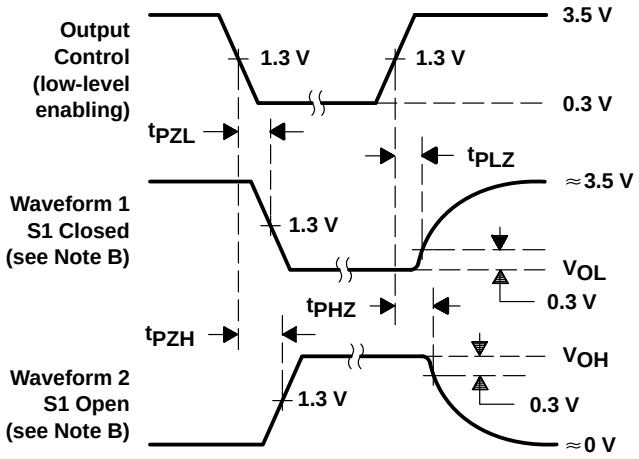
LOAD CIRCUIT
FOR 3-STATE OUTPUTS



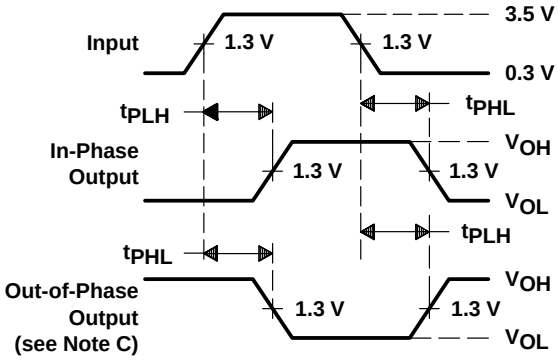
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



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

IMPORTANT NOTICE

Texas Instruments (TI) reserves the right to make changes to its products or to discontinue any semiconductor product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

TI warrants performance of its semiconductor products and related software 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, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS.

Inclusion of TI products in such applications is understood to be fully at the risk of the customer. Use of TI products in such applications requires the written approval of an appropriate TI officer. Questions concerning potential risk applications should be directed to TI through a local SC sales office.

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

TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein. Nor does TI 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.