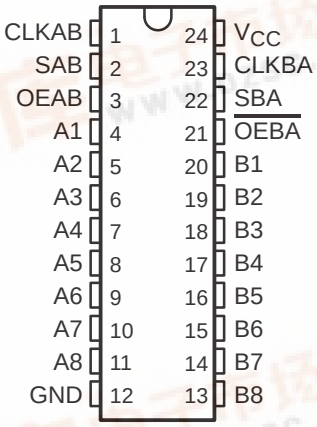
SN54ALS652, SN54ALS653, SN54AS651, SN54AS652
SN74ALS651A, SN74ALS652A, SN74ALS653, SN74ALS654, SN74AS651, SN74AS652
OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SDAS066F – DECEMBER 1983 – REVISED OCTOBER 1996

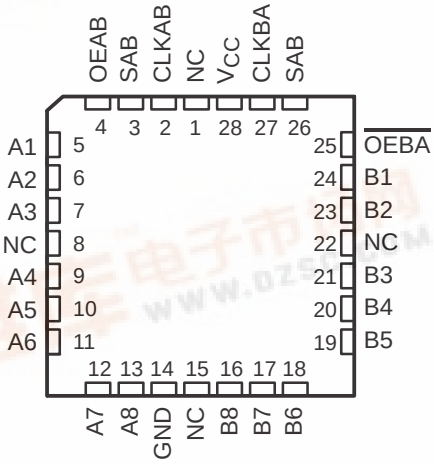
- **Bus Transceivers/Registers**
- **Independent Registers and Enables for A and B Buses**
- **Multiplexed Real-Time and Stored Data**
- **Choice of True or Inverting Data Paths**
- **Choice of 3-State or Open-Collector Outputs to A Bus**
- **Package Options Include Plastic Small-Outline (DW) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs**

DEVICE	A OUTPUT	B OUTPUT	LOGIC
SN74ALS651A, 'AS651	3 State	3 State	Inverting
SN54ALS652, SN74ALS652A, 'AS652	3 State	3 State	True
'ALS653	Open Collector	3 State	Inverting
SN74ALS654	Open Collector	3 State	True

SN54ALS', SN54AS' . . . JT PACKAGE
SN74ALS', SN74AS' . . . DW OR NT PACKAGE
(TOP VIEW)



SN54ALS', SN54AS' . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

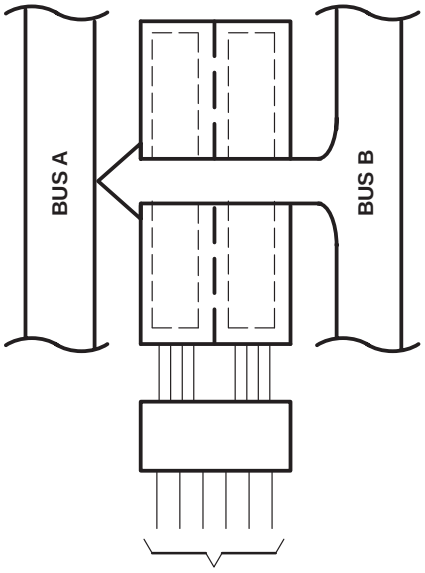
These devices consist of bus-transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Output-enable (OEAB and $\overline{\text{OEBA}}$) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select real-time or stored data transfer. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. A low input level selects real-time data, and a high input level selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the octal bus transceivers and registers.

Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) terminals, regardless of the select- or output-control terminals. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input. When all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last state.

description (continued)

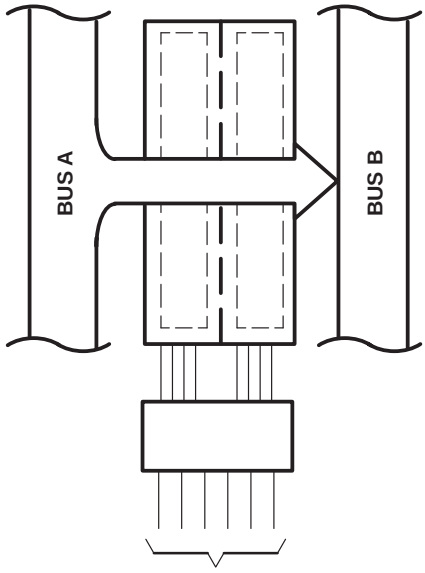
The -1 versions of the SN74ALS651A and SN74ALS652A are identical to the standard versions except that the recommended maximum I_{OL} for the -1 versions is increased to 48 mA. There are no -1 versions of the SN54ALS652, SN54ALS653, SN74ALS653, and SN74ALS654.

The SN54ALS' and SN54AS' families are characterized for operation over the full military temperature range of –55°C to 125°C. The SN74ALS' and SN74AS' families are characterized for operation from 0°C to 70°C.



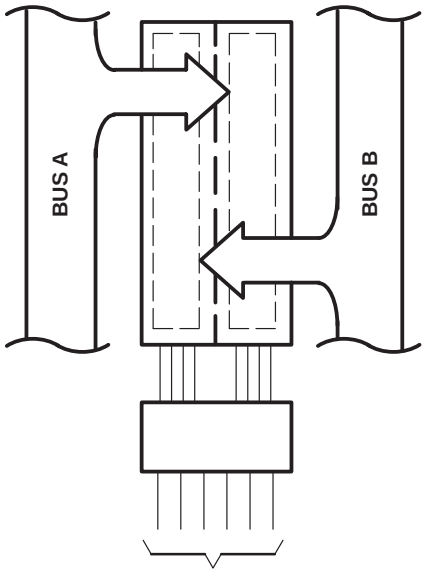
3	21	1	23	2	22
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



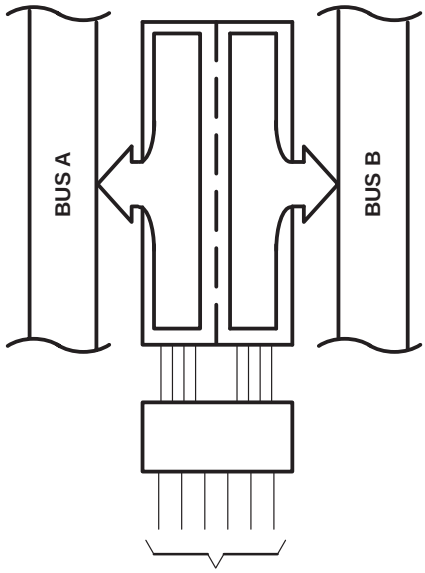
3	21	1	23	2	22
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA
H	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



3	21	1	23	2	22
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

STORAGE FROM
A, B, OR A AND B



3	21	1	23	2	22
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA
H	L	H or L	H or L	H	H

TRANSFER STORED DATA
TO A AND/OR B

Pin numbers are for the DW, JT, and NT packages.

Figure 1. Bus-Management Functions

FUNCTION TABLES

**SN54ALS653, SN54AS651,
SN74ALS651A, SN74ALS653, SN74AS651**

INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified‡	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified‡	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time $\overline{\text{B}}$ data to A bus
L	L	X	H or L	X	H	Output	Input	Stored $\overline{\text{B}}$ data to A bus
H	H	X	X	L	X	Input	Output	Real-time $\overline{\text{A}}$ data to B bus
H	H	H or L	X	H	X	Input	Output	Stored $\overline{\text{A}}$ data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored $\overline{\text{A}}$ data to B bus and stored $\overline{\text{B}}$ data to A bus

† The data output functions may be enabled or disabled by a variety of level combinations at OEAB or $\overline{\text{OEBA}}$. Data input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition on the clock inputs.
‡ Select control = L; clocks can occur simultaneously.
Select control = H; clocks must be staggered to load both registers.

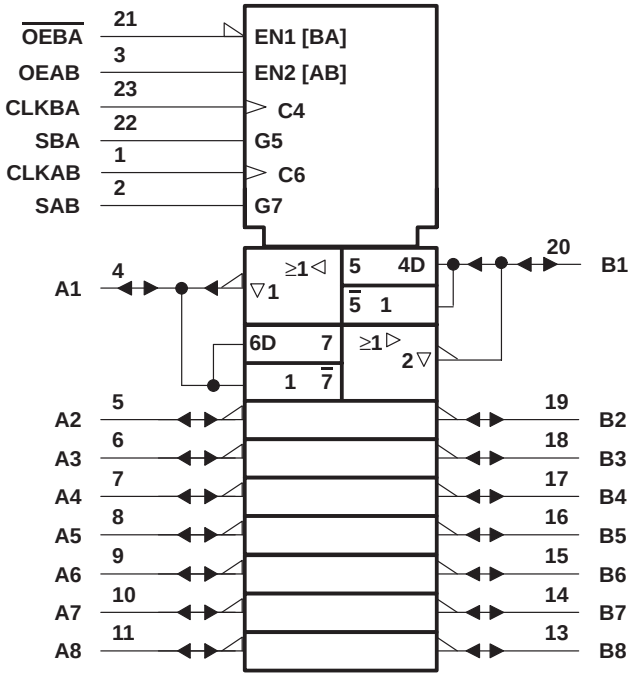
**SN54ALS652, SN54AS652,
SN74ALS652A, SN74ALS654, SN74AS652**

INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified‡	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified‡	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
H	H	X	X	L	X	Input	Output	Real-time A data to B bus
H	H	H or L	X	H	X	Input	Output	Stored A data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored A data to B bus and stored B data to A bus

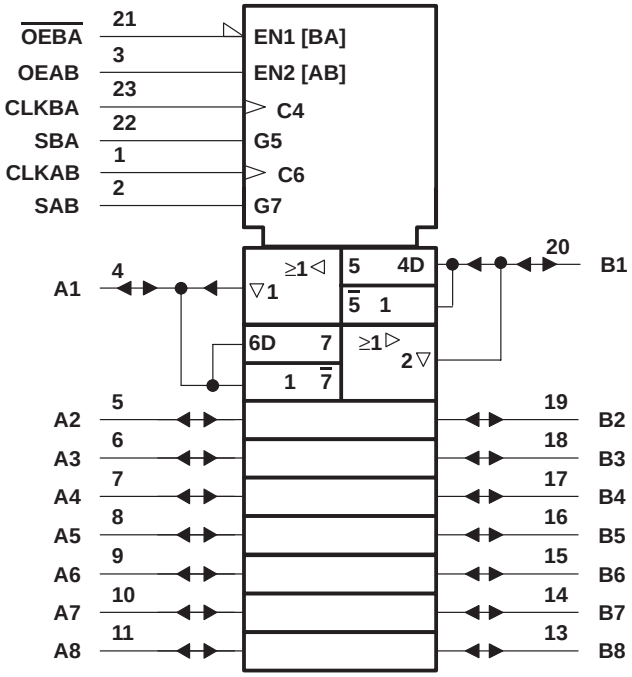
† The data output functions may be enabled or disabled by a variety of level combinations at OEAB or $\overline{\text{OEBA}}$. Data input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition on the clock inputs.
‡ Select control = L; clocks can occur simultaneously.
Select control = H; clocks must be staggered to load both registers.

logic symbols†

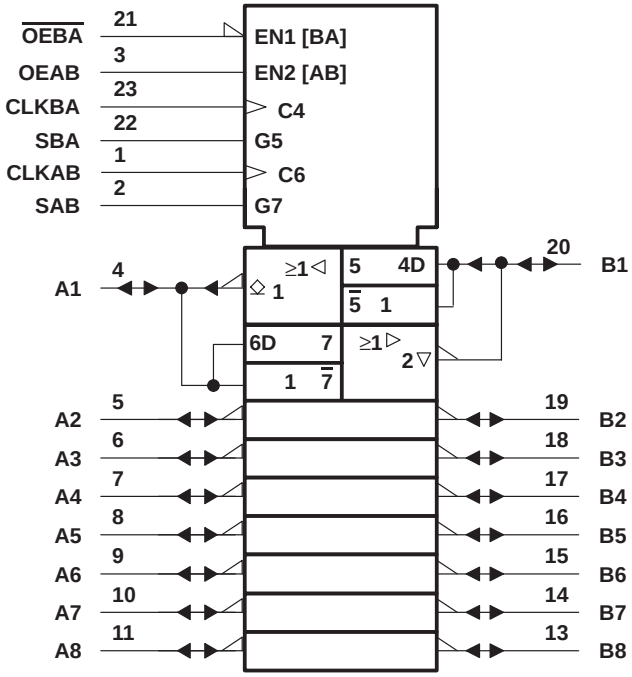
SN54AS651,
SN74ALS651A, SN74AS651



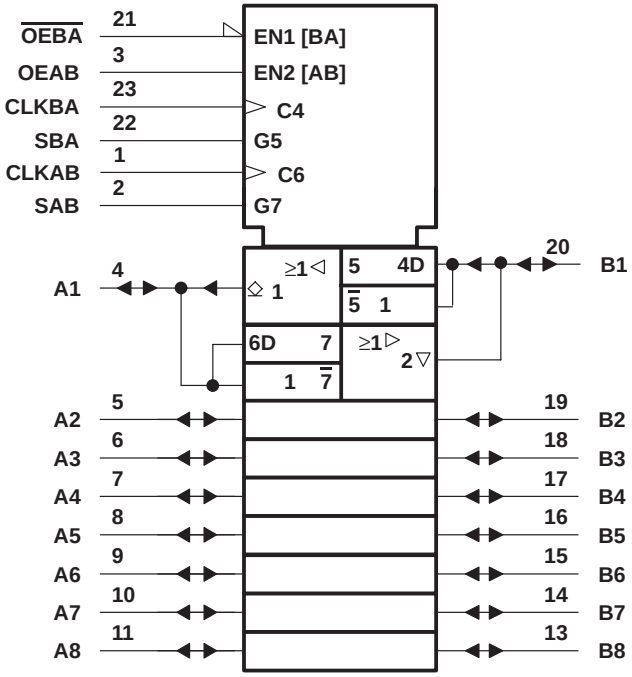
SN54ALS652, SN54AS652,
SN74ALS652A, SN74AS652



SN54ALS653, SN74ALS653

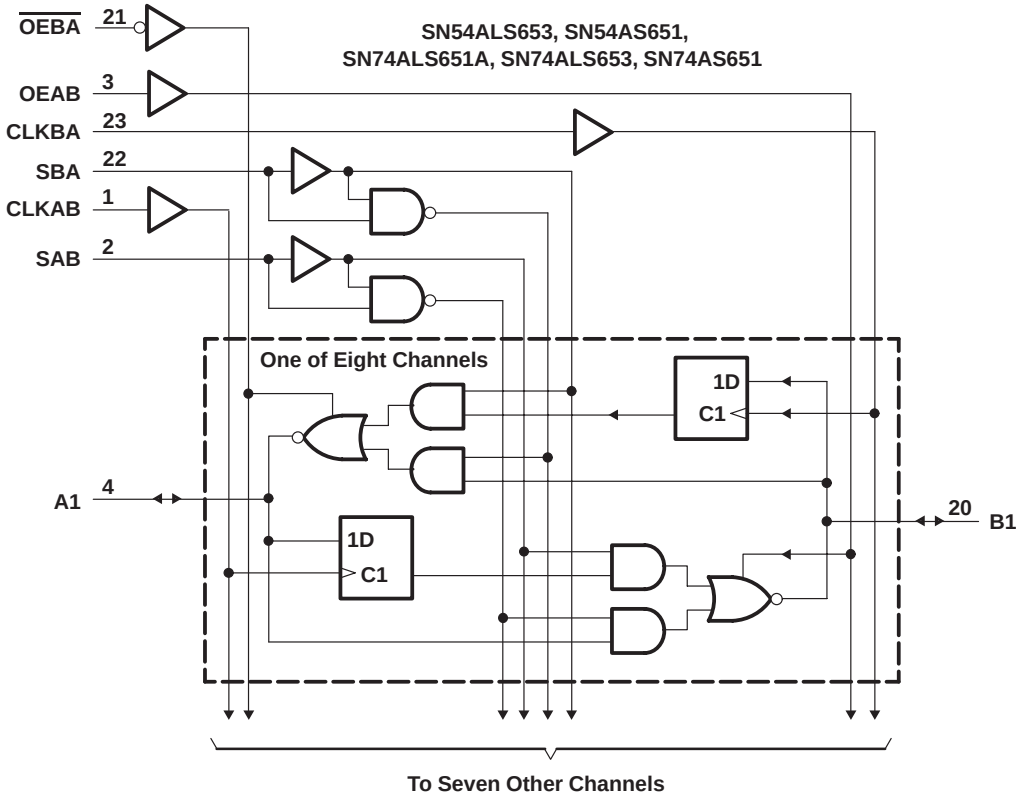


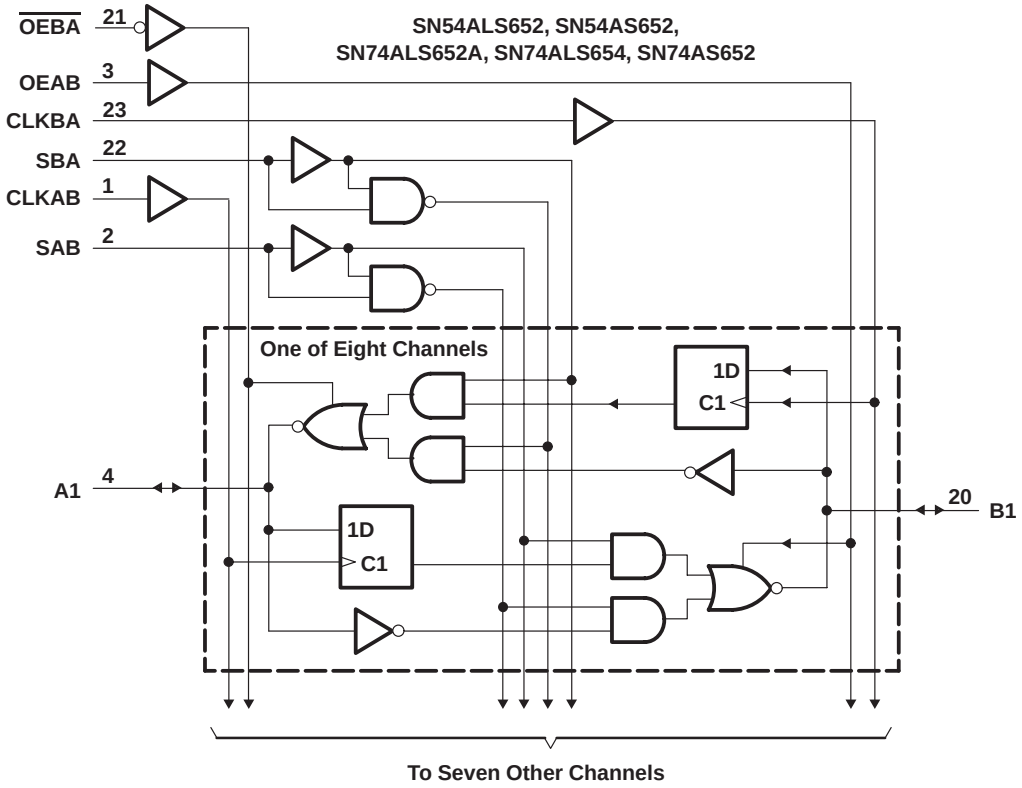
SN74ALS654



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

logic diagrams (positive logic)





Pin numbers shown are for the DW, JT, and NT packages.

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

Supply voltage, V_{CC} . . . . . 7 V
Input voltage, V_I: Control inputs . . . . . 7 V
I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN54ALS652 . . . . . −55°C to 125°C
SN74ALS651A, SN74ALS652A . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . −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

			SN74ALS651A			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
I_{OH}	High-level output current				−15	mA
I_{OL}	Low-level output current				24	mA
					48‡	
f_{clock}	Clock frequency		0		40	MHz
t_w	Pulse duration	CLKBA or CLKAB high	12.5			ns
		CLKBA or CLKAB low	12.5			
t_{su}	Setup time before CLKAB↑ or CLKBA↑	A or B	10			ns
t_h	Hold time after CLKAB↑ or CLKBA↑	A or B	0			ns
T_A	Operating free-air temperature		0		70	°C

‡ Applies only to the SN74ALS651A-1 and only if V_{CC} is maintained between 4.75 V and 5.25 V

recommended operating conditions

			SN54ALS652			SN74ALS652A			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‡	
f_{clock}	Clock frequency		0		35	0		40	MHz
t_w	Pulse duration	CLKBA or CLKAB high	14.5			12.5			ns
		CLKBA or CLKAB low	14.5			12.5			
t_{su}	Setup time before CLKAB↑ or CLKBA↑	A or B	15			10			ns
t_h	Hold time after CLKAB↑ or CLKBA↑	A or B	5			0			ns
T_A	Operating free-air temperature		−55		125	0		70	°C

‡ Applies only to the SN74ALS652A-1 and only if V_{CC} is maintained between 4.75 V and 5.25 V

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

PARAMETER		TEST CONDITIONS		SN74ALS651A			UNIT
				MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2	V
V_{OH}		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}		V_{CC} = 4.5 V	I_{OL} = 12 mA		0.25	0.4	V
			I_{OL} = 24 mA		0.35	0.5	
		V_{CC} = 4.75 V,	I_{OL} = 48 mA (-1 versions)		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_{CC} = 5.5 V,	V_I = 5.5 V			0.1	
I_{IH}	Control inputs	V_{CC} = 5.5 V,	V_I = 2.7 V			20	µA
	A or B ports‡					20	
I_{IL}	Control inputs	V_{CC} = 5.5 V,	V_I = 0.4 V			–0.2	mA
	A or B ports‡					–0.2	
I_O§		V_{CC} = 5.5 V,	V_O = 2.25 V	–30		–112	mA
I_{CC}		V_{CC} = 5.5 V	Outputs high		42	68	mA
			Outputs low		52	82	
			Outputs disabled		52	82	

† 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}.

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

PARAMETER		TEST CONDITIONS		SN54ALS652			SN74ALS652A			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} = –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	
		V_{CC} = 4.75 V,	I_{OL} = 48 mA (-1 versions)					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_{CC} = 5.5 V,	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			–0.2			–0.2	mA
	A or B ports‡					–0.2			–0.2	
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		47	76		47	76	mA
			Outputs low		55	88		55	88	
			Outputs disabled		55	88		55	88	

† 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 2)

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
			SN74ALS651A		
			MIN	MAX	
f_{max}			40		MHz
t_{PLH}	CLKBA or CLKAB	A or B	8	32	ns
t_{PHL}			5	17	
t_{PLH}	A or B	B or A	2	18	ns
t_{PHL}			2	10	
t_{PLH}	SBA or SAB‡ (with A or B high)	A or B	8	38	ns
t_{PHL}			6	21	
t_{PLH}	SBA or SAB‡ (with A or B low)	A or B	8	25	ns
t_{PHL}			7	21	
t_{PZH}	$\overline{OEBA}$	A	3	20	ns
t_{PZL}			5	18	
t_{PHZ}	$\overline{OEBA}$	A	2	9	ns
t_{PLZ}			3	12	
t_{PZH}	OEAB	B	3	22	ns
t_{PZL}			6	21	
t_{PHZ}	OEAB	B	2	12	ns
t_{PLZ}			2	14	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

switching characteristics (see Figure 2)

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
			SN54ALS652		SN74ALS652A		
			MIN	MAX	MIN	MAX	
f_{max}			35		40		MHz
t_{PLH}	CLKBA or CLKAB	A or B	10	35	8	30	ns
t_{PHL}			5	20	5	17	
t_{PLH}	A or B	B or A	5	20	4	18	ns
t_{PHL}			3	15	3	12	
t_{PLH}	SBA or SAB‡ (with A or B high)	A or B	15	40	8	35	ns
t_{PHL}			6	23	6	20	
t_{PLH}	SBA or SAB‡ (with A or B low)	A or B	8	30	8	25	ns
t_{PHL}			5	24	5	20	
t_{PZH}	$\overline{OEBA}$	A	3	20	3	17	ns
t_{PZL}			5	22	5	18	
t_{PHZ}	$\overline{OEBA}$	A	1	12	1	10	ns
t_{PLZ}			2	20	2	16	
t_{PZH}	OEAB	B	8	25	3	22	ns
t_{PZL}			6	21	5	18	
t_{PHZ}	OEAB	B	1	12	1	10	ns
t_{PLZ}			2	21	2	16	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

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

Supply voltage, V_{CC} . . . . . 7 V
Input voltage, V_I: All inputs and A I/O ports . . . . . 7 V
B I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN54ALS653 . . . . . –55°C to 125°C
SN74ALS653, SN74ALS654 . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . –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

			SN54ALS653			SN74ALS653			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
V_{OH}	High-level output voltage	A ports			5.5			5.5	V
I_{OH}	High-level output current	B ports			–12			–15	mA
I_{OL}	Low-level output current				12			24	mA
f_{clock}	Clock frequency		0		25	0		35	MHz
t_w	Pulse duration	CLKBA or CLKAB high	20			14.5			ns
		CLKBA or CLKAB low	20			14.5			
t_{su}	Setup time before CLKAB↑ or CLKBA↑	A or B	15			10			ns
t_h	Hold time after CLKAB↑ or CLKBA↑	A or B	5			0			ns
T_A	Operating free-air temperature		–55		125	0		70	°C

recommended operating conditions

			SN74ALS654			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				24	mA
f_{clock}	Clock frequency		0		35	MHz
t_w	Pulse duration	CLKBA or CLKAB high	14.5			ns
		CLKBA or CLKAB low	14.5			
t_{su}	Setup time before CLKAB↑ or CLKBA↑	A or B	10			ns
t_h	Hold time after CLKAB↑ or CLKBA↑	A or B	0			ns
T_A	Operating free-air temperature		0		70	°C

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

PARAMETER		TEST CONDITIONS		SN54ALS653			SN74ALS653			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}	B ports	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_I	Control inputs	V_{CC} = 5.5 V,	V_I = 7 V			0.1			0.1	mA
	A or B ports	V_{CC} = 5.5 V,	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			–0.2			–0.2	mA
	A or B ports‡					–0.2			–0.2	
I_{OH}	A ports	V_{CC} = 4.5 V,	V_{OH} = 5.5 V			0.1			0.1	mA
I_O§	B ports	V_{CC} = 5.5 V,	V_O = 2.25 V	–20		–112	–30		–112	mA
I_{CC}		V_{CC} = 5.5 V	Outputs high		47	76		47	76	mA
			Outputs low		55	88		55	88	
			Outputs disabled		55	88		55	88	

† 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}.

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

PARAMETER		TEST CONDITIONS		SN74ALS654			UNIT
				MIN	TYP†	MAX	
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA			–1.2	V
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}		V_{CC} = 4.5 V	I_{OL} = 12 mA		0.25	0.4	V
			I_{OL} = 24 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_{CC} = 5.5 V,	V_I = 5.5 V			0.1	
I_{IH}	Control inputs	V_{CC} = 5.5 V,	V_I = 2.7 V			20	μA
	A or B ports‡					20	
I_{IL}	Control inputs	V_{CC} = 5.5 V,	V_I = 0.4 V			–0.2	mA
	A or B ports‡					–0.2	
I_{OH}	A ports	V_{CC} = 4.5 V,	V_{OH} = 5.5 V			0.1	mA
I_O§	B ports	V_{CC} = 5.5 V,	V_O = 2.25 V	–30		–112	mA
I_{CC}		V_{CC} = 5.5 V	Outputs high		47	76	mA
			Outputs low		55	88	
			Outputs disabled		55	88	

† 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 2)

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
			SN54ALS653		SN74ALS653		
			MIN	MAX	MIN	MAX	
f_{max}			25		35		MHz
t_{PLH}	CLKBA	A	16	71	16	64	ns
t_{PHL}			6	24	6	22	
t_{PLH}	CLKAB	B	10	35	10	30	ns
t_{PHL}			5	20	5	17	
t_{PLH}	A	B	5	20	5	18	ns
t_{PHL}			1.5	18	2	15	
t_{PLH}	B	A	8	63	12	56	ns
t_{PHL}			2	18	2	15	
t_{PLH}	SBA‡ (with B high)	A	12	68	19	62	ns
t_{PHL}			5	27	5	25	
t_{PLH}	SBA‡ (with B low)	A	12	68	19	62	ns
t_{PHL}			5	27	5	25	
t_{PLH}	SAB‡ (with A high)	B	8	30	15	35	ns
t_{PHL}			6	25	6	22	
t_{PLH}	SAB‡ (with A low)	B	12	40	8	25	ns
t_{PHL}			6	25	6	22	
t_{PLH}	$\overline{OEBA}$	A	6	35	6	30	ns
t_{PHL}			6	27	6	24	
t_{PZH}	OEAB	B	7	25	8	22	ns
t_{PZL}			6	25	6	22	
t_{PHZ}	OEAB	B	1	16	1	14	ns
t_{PLZ}			2	21	2	16	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

switching characteristics (see Figure 2)

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
			SN74ALS654		
			MIN	MAX	
f_{max}			35		MHz
t_{PLH}	CLKBA	A	16	64	ns
t_{PHL}			6	22	
t_{PLH}	CLKAB	B	10	30	ns
t_{PHL}			5	17	
t_{PLH}	A	B	5	18	ns
t_{PHL}			2	15	
t_{PLH}	B	A	12	56	ns
t_{PHL}			2	21	
t_{PLH}	SBA‡ (with B low)	A	19	62	ns
t_{PHL}			5	25	
t_{PLH}	SBA‡ (with B high)	A	19	62	ns
t_{PHL}			5	25	
t_{PLH}	SAB‡ (with A low)	B	15	35	ns
t_{PHL}			6	22	
t_{PLH}	SAB‡ (with A high)	B	8	25	ns
t_{PHL}			6	22	
t_{PLH}	$\overline{OEBA}$	A	6	30	ns
t_{PHL}			6	24	
t_{PZH}	OEAB	B	6	22	ns
t_{PZL}			6	22	
t_{PHZ}	OEAB	B	1	14	ns
t_{PLZ}			2	16	

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

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

Supply voltage, V_{CC} . . . . . 7 V
Input voltage, V_I: Control inputs . . . . . 7 V
I/O ports . . . . . 5.5 V
Operating free-air temperature range, T_A: SN54AS651, SN54AS652 . . . . . –55°C to 125°C
SN74AS651, SN74AS652 . . . . . 0°C to 70°C
Storage temperature range, T_{stg} . . . . . –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

			SN54AS651 SN54AS652			SN74AS651 SN74AS652			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				32			48	mA
f_{clock}*	Clock frequency		0		75	0		90	MHz
t_w*	Pulse duration	CLKBA or CLKAB high	6			5			ns
		CLKBA or CLKAB low	7			6			
t_{su}*	Setup time before CLKAB↑ or CLKBA↑	A or B	7			6			ns
t_h*	Hold time after CLKAB↑ or CLKBA	A or B	0			0			ns
T_A	Operating free-air temperature		–55		125	0		70	°C

* On products compliant to MIL-PRF-38535, this parameter is based on characterized data but is not production tested.

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

PARAMETER		TEST CONDITIONS		SN54AS651 SN54AS652			SN74AS651 SN74AS652			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						
			I_{OH} = –15 mA				2			
V_{OL}		V_{CC} = 4.5 V	I_{OL} = 32 mA		0.25	0.5				V
			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_{CC} = 5.5 V,	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 input	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	–30		–112	–30		–112	mA
I_{CC}	′AS651	V_{CC} = 5.5 V	Outputs high		110	185		110	185	mA
			Outputs low		120	195		120	195	
			Outputs disabled		130	195		130	195	
	′AS652	V_{CC} = 5.5 V	Outputs high		120	195		120	195	
			Outputs low		130	211		130	211	
			Outputs disabled		130	211		130	211	

† 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 2)

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
			SN54AS651		SN74AS651		
			MIN	MAX	MIN	MAX	
f_{max}*			75		90		MHz
t_{PLH}	CLKBA or CLKAB	A or B	2	11	2	8.5	ns
t_{PHL}			2	10	2	9	
t_{PLH}	A or B	B or A	2	12	2	8	ns
t_{PHL}			1	8	1	7	
t_{PLH}	SBA or SAB‡	A or B	2	15	2	11	ns
t_{PHL}			2	11	2	9	
t_{PZH}	$\overline{OEBA}$	A	2	11	2	10	ns
t_{PZL}			3	18	3	16	
t_{PHZ}	$\overline{OEBA}$	A	2	10	2	9	ns
t_{PLZ}			2	10	2	9	
t_{PZH}	OEAB	B	3	12	3	11	ns
t_{PZL}			3	20	3	16	
t_{PHZ}	OEAB	B	2	11	2	10	ns
t_{PLZ}			2	12	2	11	

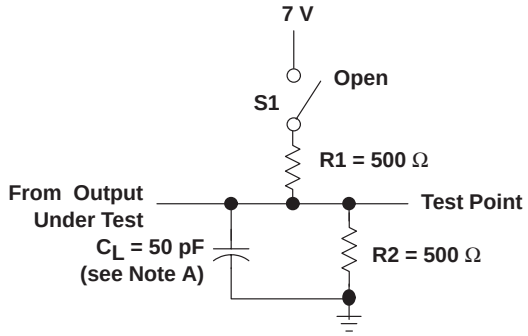
* On products compliant to MIL-PRF-38535, this parameter is based on characterized data but is not production tested.
† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

switching characteristics (see Figure 2)

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
			SN54AS652		SN74AS652		
			MIN	MAX	TYP	MAX	
f_{max}*			75		90		MHz
t_{PLH}	CLKBA or CLKAB	A or B	2	11	2	8.5	ns
t_{PHL}			2	10	2	9	
t_{PLH}	A or B	B or A	2	12	2	9	ns
t_{PHL}			1	8	1	7	
t_{PLH}	SBA or SAB‡	A or B	2	15	2	11	ns
t_{PHL}			2	11	2	9	
t_{PZH}	$\overline{OEBA}$	A	2	11	2	10	ns
t_{PZL}			3	18	3	16	
t_{PHZ}	$\overline{OEBA}$	A	2	10	2	9	ns
t_{PLZ}			2	10	2	9	
t_{PZH}	OEAB	B	3	12	3	11	ns
t_{PZL}			3	20	3	16	
t_{PHZ}	OEAB	B	2	11	2	10	ns
t_{PLZ}			2	12	2	11	

* On products compliant to MIL-PRF-38535, this parameter is based on characterized data but is not production tested.
† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

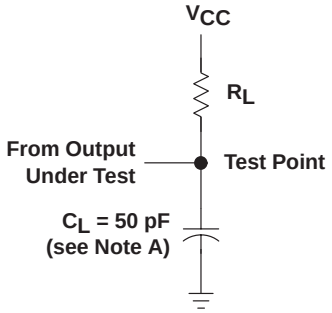
PARAMETER MEASUREMENT INFORMATION



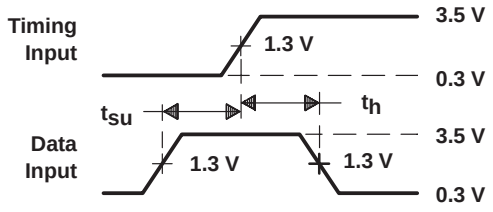
LOAD CIRCUIT
FOR 3-STATE OUTPUTS

SWITCH POSITION TABLE

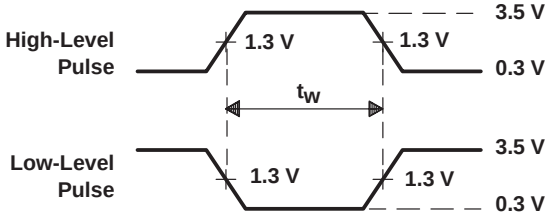
TEST	S1
t_{PLH}	Open
t_{PHL}	Open
t_{PZH}	Open
t_{PZL}	Closed
t_{PHZ}	Open
t_{PLZ}	Closed



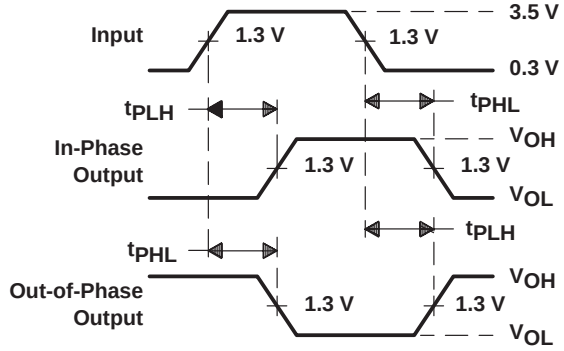
LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS



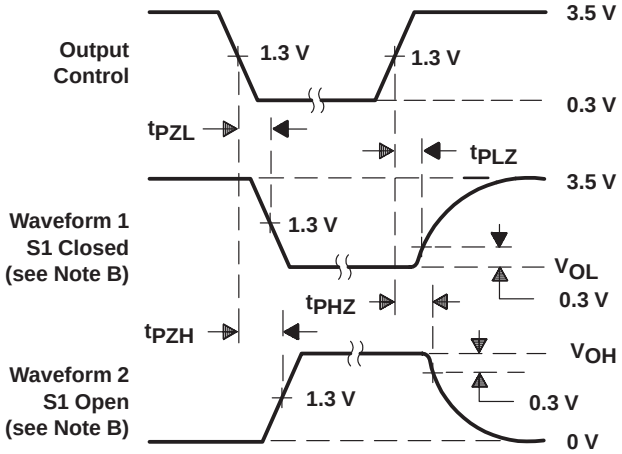
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

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. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r ≤ 2 ns, t_f ≤ 2 ns.
D. The outputs are measured one at a time with one transition per measurement.

Figure 2. Load Circuits and Voltage Waveforms

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