

# SN54ALS651 THRU SN54ALS654, SN54AS651, SN54AS652 SN74ALS651 THRU SN74ALS654, SN74AS651, SN74AS652 OCTAL BUS TRANSCEIVERS AND REGISTERS

D2661, DECEMBER 1983 - REVISED NOVEMBER 1985

- Bus Transceivers/Registers
- Independent Registers and Enables for A and B Buses
- Multiplexed Real-Time and Stored Data
- Choice of True and Inverting Data Paths
- Choice of 3-State or Open-Collector Outputs to A Bus
- Included Among the Package Options Are Compact 24-Pin 300-mil-Wide DIPs and Both 28-Pin Plastic and Ceramic Chip Carriers
- Dependable Texas Instruments Quality and Reliability

DEVICE	A OUTPUT	B OUTPUT	LOGIC
'ALS651, 'AS651	3 State	3 State	Inverting
'ALS652, 'AS652	3 State	3 State	True
'ALS653	Open Collector	3 State	Inverting
'ALS654	Open Collector	3 State	True

## description

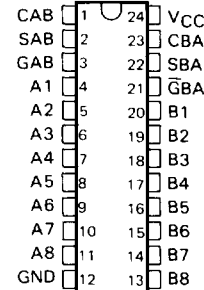
These devices consist of bus transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Enable GAB and  $\bar{G}BA$  are provided to control the transceiver functions. SAB and SBA control pins are provided to select whether real-time or stored data is transferred. The circuitry used for select control will eliminate the typical decoding glitch which occurs in a multiplexer during the transition between stored and real-time data. A low input level selects real-time data, and a high selects stored data. The following examples demonstrate 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 flip-flops by low-to-high transitions at the appropriate clock pins (CAB or CBA) regardless of the select or enable control pins. When SAB and SBA are in the real-time transfer mode, it is also possible to store data without using the internal D-type flip-flops by simultaneously enabling GAB and  $\bar{G}BA$ . In this configuration each output reinforces its input. Thus, when all other data sources to the two sets of bus lines are at high impedance, each set of bus lines will remain at its last state.

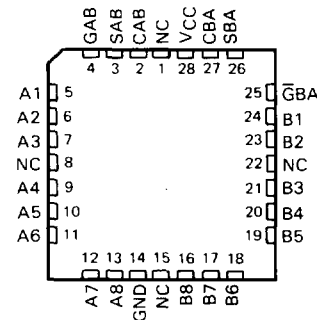
The -1 versions of the SN74ALS651 through SN74ALS654 are identical to the standard versions except that the recommended maximum  $I_{OL}$  is increased to 48 milliamperes. There are no -1 versions of the SN54ALS651 through SN54ALS654.

The SN54' family is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74' family is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

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



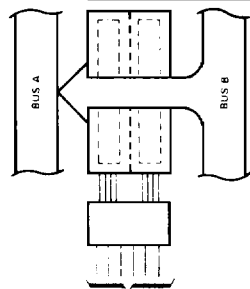
SN54ALS', SN54AS' . . . FK PACKAGE  
SN74ALS', SN74AS' . . . FN PACKAGE  
(TOP VIEW)



NC No internal connection

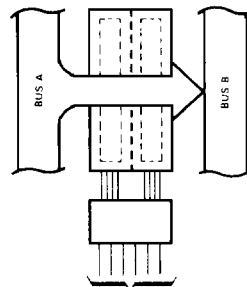
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**SN54ALS651 THRU SN54ALS654, SN54AS651, SN54AS652  
SN74ALS651 THRU SN74ALS654, SN74AS651, SN74AS652  
OCTAL BUS TRANSCEIVERS AND REGISTERS**



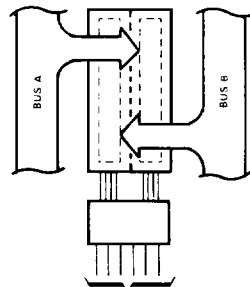
GAB	$\bar{G}BA$	CAB	CBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER  
BUS B TO BUS A



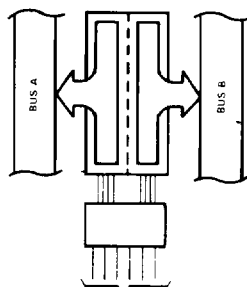
GAB	$\bar{G}BA$	CAB	CBA	SAB	SBA
H	H	X	X	L	X

REAL-TIME TRANSFER  
BUS A TO BUS B



GAB	$\bar{G}BA$	CAB	CBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

STORAGE FROM  
A AND/OR B



GAB	$\bar{G}BA$	CAB	CBA	SAB	SBA
H	L	HorL	HorL	H	H

TRANSFER  
STORED DATA  
TO A AND/OR B

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**SN54ALS651 THRU SN54ALS654, SN54AS651, SN54AS652  
SN74ALS651 THRU SN74ALS654, SN74AS651, SN74AS652  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

FUNCTION TABLE

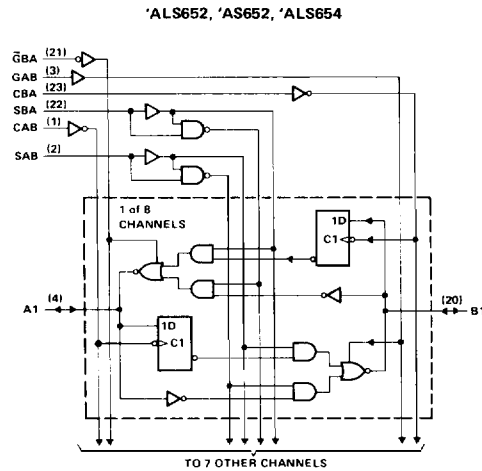
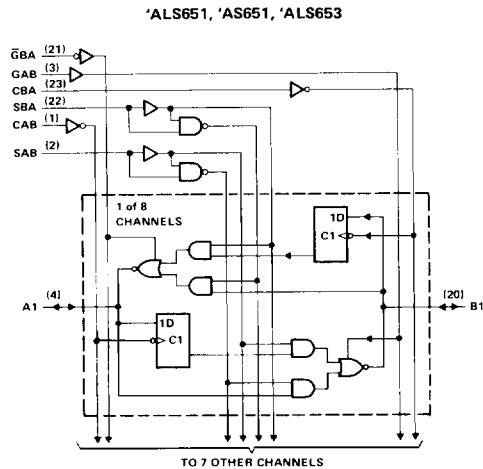
INPUTS						DATA I/O		OPERATION OR FUNCTION	
GAB	G̅BA	CAB	CBA	SAB	SBA	A1 THRU A8	B1 THRU B8	'ALS651, 'ALS653 'AS651	'ALS652, 'ALS654 'AS652
L	H	H or L	H or L	X	X	Input	Input	Isolation	Isolation
L	H	.	.	X	X	Input	Input	Store A and B Data	Store A and B Data
X	H	.	H or L	X	X	Input	Unspecified <sup>†</sup>	Store A, Hold B	Store A, Hold B
H	H	.	.	X <sup>‡</sup>	X	Output	Output	Store A in both registers	Store A in both registers
L	X	H or L	.	X	X	Unspecified <sup>†</sup>	Input	Hold A, Store B	Hold A, Store B
L	L	.	.	X	X <sup>‡</sup>	Output	Input	Store B in both registers	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-Time B̅ Data to A Bus	Real-Time B Data to A Bus
L	L	X	H or L	X	H	Output	Input	Stored B̅ Data to A Bus	Stored B Data to A Bus
H	H	X	X	L	X	Input	Output	Real-Time A̅ Data to B Bus	Real-Time A Data to B Bus
H	H	H or L	X	H	X	Input	Output	Stored A̅ Data to B Bus	Stored A Data to B Bus
H	L	H or L	H or L	H	H	Output	Output	Stored A̅ Data to B Bus and Stored B̅ Data to A Bus	Stored A Data to B Bus and Stored B Data to A Bus

<sup>†</sup>The data output functions may be enabled or disabled by various signals at the GAB or G̅BA inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

<sup>‡</sup>Select control = L: clocks can occur simultaneously.

Select control = H: clocks must be staggered in order to load both registers.

logic diagrams (positive logic)



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

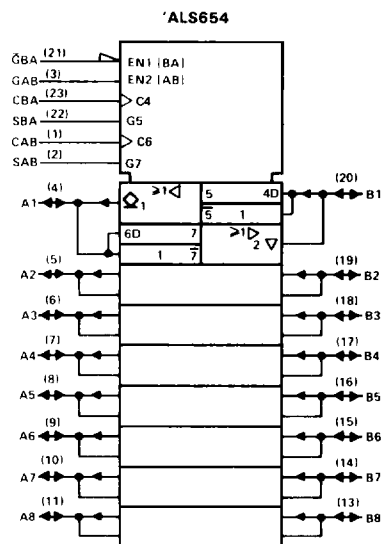
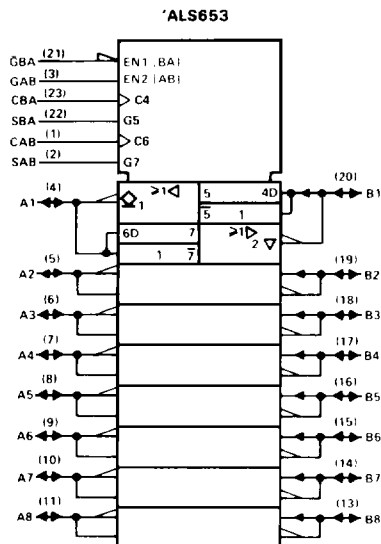
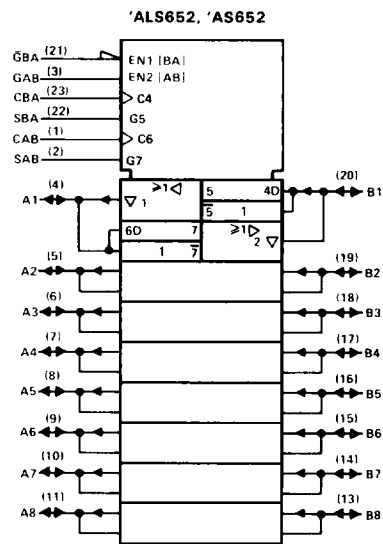
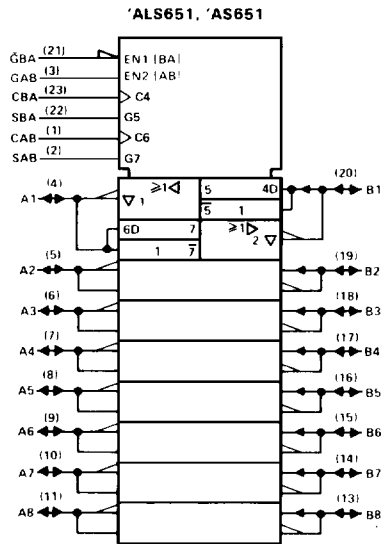
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**SN54ALS651 THRU SN54ALS654, SN54AS651, SN54AS652  
SN74ALS651 THRU SN74ALS654, SN74AS651, SN74AS652  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

logic symbols†

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

# SN54ALS651, SN54ALS652, SN74ALS651, SN74ALS652 OCTAL BUS TRANSCEIVERS AND REGISTERS

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

Supply voltage, $V_{CC}$	7 V
Input voltage: Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range: SN54ALS651, SN54ALS652	-55 °C to 125 °C
SN74ALS651, SN74ALS652	0 °C to 70 °C
Storage temperature range	-65 °C to 150 °C

## recommended operating conditions

		SN54ALS651 SN54ALS652			SN74ALS651 SN74ALS652			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			12			24	mA
							48†	
$f_{clock}$	Clock frequency	0	35		0	40		MHz
$t_w$	Pulse duration	CBA or CAB high		14.5	12.5			ns
		CBA or CAB low		14.5	12.5			
$t_{su}$	Setup time before CAB† or CBA†	A or B		15	10			ns
$t_h$	Hold time after CAB† or CBA†	A or B		5	0			ns
$T_A$	Operating free-air temperature	-55	125		0	70		°C

† The extended condition applies if  $V_{CC}$  is maintained between 4.75 V and 5.25 V. The 48-mA limit applies for the SN74ALS651 - 1 and SN74ALS652 - 1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS651 SN54ALS652			SN74ALS651 SN74ALS652			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		
	$V_{CC} = 4.5$ V, $I_{OH} = -12$ mA	2						
	$V_{CC} = 4.5$ V, $I_{OH} = -15$ mA				2			
$V_{OL}$	$V_{CC} = 4.5$ V, $I_{OL} = 12$ mA		0.25	0.4		0.25	0.4	V
	$V_{CC} = 4.5$ V, $I_{OL} = 24$ mA ( $I_{OL} = 48$ mA for -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	$\mu$ A
	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	
$I_O^f$	$V_{CC} = 5.5$ V, $V_O = 2.25$ V	-30		-112	-30		-112	mA
$I_{CC}$	'ALS651	$V_{CC} = 5.5$ V	Outputs high	42	68	42	68	mA
			Outputs low	52	82	52	82	
	Outputs disabled		52	82	52	82		
	'ALS652		Outputs high	47	76	47	76	
			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,  $I_{OS}$ .

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**SN54ALS651, SN54ALS652, SN74ALS651, SN74ALS652**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**

**\*ALS651 switching characteristics (see Note 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = 25°C			V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = MIN to MAX			UNIT			
			*ALS651			SN54ALS651		SN74ALS651				
			MIN	TYP	MAX	MIN	MAX	MIN		MAX		
f <sub>max</sub>			50			35		40		MHz		
t <sub>PLH</sub>	CBA or CAB	A or B	20			27		10		38		ns
t <sub>PHL</sub>			11			15		5		21		
t <sub>PLH</sub>	A or B	B or A	9			13		4		20		ns
t <sub>PHL</sub>			5			8		2		12		
t <sub>PLH</sub>	SBA or SAB <sup>†</sup> (with A or B high)	A or B	24			31		13		45		ns
t <sub>PHL</sub>			13			18		7		25		
t <sub>PLH</sub>	SBA or SAB <sup>†</sup> (with A or B low)	A or B	15			20		8		30		ns
t <sub>PHL</sub>			13			18		7		25		
t <sub>PZH</sub>	$\overline{\text{G}}\text{BA}$	A	12			16		5		22		ns
t <sub>PZL</sub>			11			15		5		21		
t <sub>PHZ</sub>	$\overline{\text{G}}\text{BA}$	A	4			7		2		10		ns
t <sub>PLZ</sub>			7			10		3		16		
t <sub>PZH</sub>	GAB	B	14			19		7		25		ns
t <sub>PZL</sub>			13			18		7		25		
t <sub>PHZ</sub>	GAB	B	5			10		2		14		ns
t <sub>PLZ</sub>			7			10		2		20		

**\*ALS652 switching characteristics (see Note 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = 25°C			V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = MIN to MAX			UNIT			
			*ALS652			SN54ALS652		SN74ALS652				
			MIN	TYP	MAX	MIN	MAX	MIN		MAX		
f <sub>max</sub>			50			35		40		MHz		
t <sub>PLH</sub>	CBA or CAB	A or B	20			25		10		35		ns
t <sub>PHL</sub>			11			15		5		20		
t <sub>PLH</sub>	A or B	B or A	11			15		5		20		ns
t <sub>PHL</sub>			8			10		3		15		
t <sub>PLH</sub>	SBA or SAB <sup>†</sup> (with A or B high)	A or B	24			32		15		40		ns
t <sub>PHL</sub>			13			17		6		23		
t <sub>PLH</sub>	SBA or SAB <sup>†</sup> (with A or B low)	A or B	17			22		8		30		ns
t <sub>PHL</sub>			13			17		5		24		
t <sub>PZH</sub>	$\overline{\text{G}}\text{BA}$	A	10			15		3		20		ns
t <sub>PZL</sub>			10			14		5		22		
t <sub>PHZ</sub>	$\overline{\text{G}}\text{BA}$	A	6			8		1		12		ns
t <sub>PLZ</sub>			10			13		2		20		
t <sub>PZH</sub>	GAB	B	15			20		8		25		ns
t <sub>PZL</sub>			12			16		6		21		
t <sub>PHZ</sub>	GAB	B	6			8		1		12		ns
t <sub>PLZ</sub>			10			13		2		21		

<sup>†</sup> These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

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

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

Supply voltage, $V_{CC}$ . . . . .	7 V
Input voltage: All inputs and A I/O ports . . . . .	7 V
B I/O ports . . . . .	5.5 V
Operating free-air temperature range: SN54ALS653, SN54ALS654 . . . . .	- 55 °C to 125 °C
SN74ALS653, SN74ALS654 . . . . .	0 °C to 70 °C
Storage temperature range . . . . .	- 65 °C to 150 °C

**recommended operating conditions**

		SN54ALS653 SN54ALS654			SN74ALS653 SN74ALS654			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
$V_{OH}$	High-level output voltage			5.5			5.5	V
$I_{OH}$	High-level output current	A ports			B ports			
				-12			-15	mA
$I_{OL}$	Low-level output current			12			24	mA
							48 <sup>†</sup>	
$f_{clock}$	Clock frequency							MHz
$t_w$	Pulse duration	CBA or CAB high						ns
		CBA or CAB low						
$t_{su}$	Setup time before CAB <sup>†</sup> or CBA <sup>†</sup>	A or B						ns
$t_h$	Hold time after CAB <sup>†</sup> or CBA <sup>†</sup>	A or B						ns
$T_A$	Operating free-air temperature	-55	125		0	70		°C

<sup>†</sup> The extended condition applies if  $V_{CC}$  is maintained between 4.75 V and 5.25 V. The 48-mA limit applies for the SN74ALS653 - 1 and SN74ALS654 - 1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS653 SN54ALS654			SN74ALS653 SN74ALS654			UNIT
		MIN	TYP <sup>†</sup>	MAX	MIN	TYP <sup>†</sup>	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA			-1.5			-1.5	V
V <sub>OH</sub>	B ports	V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = -0.4 mA	V <sub>CC</sub> -2		V <sub>CC</sub> -2			V
		V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -3 mA	2.4	3.2	2.4	3.2		
		V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -12 mA	2					
		V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -15 mA			2			
I <sub>OH</sub>	A ports	V <sub>CC</sub> = 4.5 V, V <sub>OH</sub> = 5.5 V		0.1		0.1	mA	
V <sub>OL</sub>	A ports	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 12 mA	0.25	0.4	0.25	0.4	V	
		V <sub>CC</sub> = 4.75 V, I <sub>OL</sub> = 24 mA (I <sub>OL</sub> = 48 mA for -1 versions)			0.35	0.5		
I <sub>I</sub>	Control inputs	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V		0.1		0.1	mA	
	A or B ports	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V		0.1		0.1		
I <sub>IH</sub>	Control inputs	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V	20		20		μA	
	A or B ports <sup>‡</sup>		20		20			
I <sub>IL</sub>	Control inputs	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V	-0.1		-0.1		mA	
	A or B ports <sup>‡</sup>		-0.2		-0.2			
I <sub>O</sub> <sup>§</sup>	B ports	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V	-30	-112	-30	-112	mA	
I <sub>CC</sub>	'ALS653	V <sub>CC</sub> = 5.5 V	Outputs high	52		52	mA	
			Outputs low	57		57		
			Outputs disabled	58		58		
			Outputs high	60		60		
			Outputs low	68		68		
			Outputs disabled	68		68		
'ALS654	V <sub>CC</sub> = 5.5 V	Outputs high	52		52	mA		
		Outputs low	57		57			
		Outputs disabled	58		58			
		Outputs high	60		60			
		Outputs low	68		68			
		Outputs disabled	68		68			

<sup>†</sup> All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

<sup>‡</sup> For I/P ports, the parameters I<sub>IH</sub> and I<sub>IL</sub> include the off-state output current.

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I<sub>OS</sub>.

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'ALS653 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ $C_L = 50 \text{ pF}$ $R_L = 680 \Omega$ , (A outputs) $R_1 = R_2 = 500 \Omega$ , (B outputs) $T_A = \text{MIN to MAX}$						UNIT
			SN54ALS653			SN74ALS653			
			MIN	TYP <sup>†</sup>	MAX	MIN	TYP <sup>†</sup>	MAX	
$f_{\text{max}}$									MHz
$t_{\text{PLH}}$	CBA	A		24		24			ns
$t_{\text{PHL}}$				15		15			
$t_{\text{PLH}}$	CAB	B		11		11		ns	
$t_{\text{PHL}}$				13		13			
$t_{\text{PLH}}$	A	B		10		10		ns	
$t_{\text{PHL}}$				12		12			
$t_{\text{PLH}}$	B	A		24		24		ns	
$t_{\text{PHL}}$				10		10			
$t_{\text{PLH}}$	SBA <sup>‡</sup> (with B high)	A		26		26		ns	
$t_{\text{PHL}}$				15		15			
$t_{\text{PLH}}$	SBA <sup>‡</sup> (with B low)	A		26		26		ns	
$t_{\text{PHL}}$				15		15			
$t_{\text{PLH}}$	SAB <sup>‡</sup> (with A high)	B		16		16		ns	
$t_{\text{PHL}}$				16		16			
$t_{\text{PLH}}$	SAB <sup>‡</sup> (with A low)	B		15		15		ns	
$t_{\text{PHL}}$				15		15			
$t_{\text{PLH}}$	GBA	A		24		24		ns	
$t_{\text{PHL}}$				17		17			
$t_{\text{PZH}}$	GAB	B		19		19		ns	
$t_{\text{PZL}}$				22		22			
$t_{\text{PHZ}}$	GAB	B		12		12		ns	
$t_{\text{PLZ}}$				14		14			

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

<sup>‡</sup>These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

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

Additional information on these products can be obtained from the factory as it becomes available.

**2**  
LSI Devices

'ALS654 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>L</sub> = 680 Ω, (A outputs) R <sub>1</sub> = R <sub>2</sub> = 500 Ω, (B outputs) T <sub>A</sub> = MIN to MAX						UNIT
			SN54ALS654			SN74ALS654			
			MIN	TYP <sup>†</sup>	MAX	MIN	TYP <sup>†</sup>	MAX	
f <sub>max</sub>									MHz
t <sub>PLH</sub>	CBA	A	24			24			ns
t <sub>PHL</sub>			15			15			
t <sub>PLH</sub>	CAB	B	11			11			ns
t <sub>PHL</sub>			13			13			
t <sub>PLH</sub>	A	B	8			8			ns
t <sub>PHL</sub>			8			8			
t <sub>PLH</sub>	B	A	24			24			ns
t <sub>PHL</sub>			10			10			
t <sub>PLH</sub>	SBA <sup>‡</sup> (with B high)	A	26			26			ns
t <sub>PHL</sub>			15			15			
t <sub>PLH</sub>	SBA <sup>‡</sup> (with B low)	A	26			26			ns
t <sub>PHL</sub>			15			15			
t <sub>PLH</sub>	SBA <sup>‡</sup> (with A high)	B	16			16			ns
t <sub>PHL</sub>			16			16			
t <sub>PLH</sub>	SAB <sup>‡</sup> (with A low)	B	15			15			ns
t <sub>PHL</sub>			12			12			
t <sub>PLH</sub>	GBA	A	24			24			ns
t <sub>PHL</sub>			17			17			
t <sub>PZH</sub>	GAB	B	19			19			ns
t <sub>PZL</sub>			22			22			
t <sub>PHZ</sub>	GAB	B	12			12			ns
t <sub>PLZ</sub>			14			14			

<sup>†</sup> All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

<sup>‡</sup> These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

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

Additional information on these products can be obtained from the factory as it becomes available.

2  
LSI Devices

# SN54AS651, SN54AS652, SN74AS651, SN74AS652

## OCTAL BUS TRANSCEIVERS AND REGISTERS

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

Supply voltage, $V_{CC}$ .....	7 V
Input voltage: Control inputs .....	7 V
I/O ports .....	5.5 V
Operating free-air temperature range: SN54AS651, SN54AS652 .....	- 55 °C to 125 °C
SN74AS651, SN74AS652 .....	0 °C to 70 °C
Storage temperature range .....	- 65 °C to 150 °C

### 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
$f_{clock}$		0		75	0		90	MHz
$t_w$	Pulse duration	CBA or CAB high		6	5			ns
		CBA or CAB low		7	6			
$t_{su}$	Setup time before CAB <sup>†</sup> or CBA <sup>†</sup>	A or B		7	6			ns
$t_h$	Hold time after CAB <sup>†</sup> or CBA <sup>†</sup>	A or B		0	0			ns
$T_A$	Operating free-air temperature	- 55		125	0		70	°C

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

PARAMETER	TEST CONDITIONS	SN54AS651 SN54AS652			SN74AS651 SN74AS652			UNIT
		MIN	TYP <sup>†</sup>	MAX	MIN	TYP <sup>†</sup>	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		
	$V_{CC} = 4.5 V, I_{OH} = - 12 mA$	2						
$V_{OL}$	$V_{CC} = 4.5 V, I_{OH} = - 15 mA$				2			V
	$V_{CC} = 4.5 V, I_{OL} = 32 mA$		0.25	0.50				
	$V_{CC} = 4.5 V, I_{OL} = 48 mA$				0.35	0.50		
$I_I$	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		$\mu A$	
	A or B ports <sup>‡</sup>			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 <sup>‡</sup>			- 0.75	- 0.75			
$I_O^{\S}$	$V_{CC} = 5.5 V, V_O = 2.25 V$	- 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		Outputs high	120	195	120	195	
			Outputs low	130	211	130	211	
	Outputs disabled		130	211	130	211		

<sup>†</sup>All typical values are at  $V_{CC} = 5 V, T_A = 25 °C$ .

<sup>‡</sup>For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>§</sup>The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

**SN54AS651, SN54AS654, SN74AS651, SN74AS652**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**

**'AS651 switching characteristics (see Note 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>1</sub> = 500 Ω, R <sub>2</sub> = 500 Ω, T <sub>A</sub> = MIN to MAX				UNIT
			SN54AS651		SN74AS651		
			MIN	MAX	MIN	MAX	
f <sub>max</sub>			75		90		MHz
t <sub>PLH</sub>	CBA or CAB	A or B	2	9.5	2	8.5	ns
t <sub>PHL</sub>			2	10	2	9	
t <sub>PLH</sub>	A or B	B or A	2	9	2	8	ns
t <sub>PHL</sub>			1	8	1	7	
t <sub>PLH</sub>	SBA or SAB†	A or B	2	12	2	11	ns
t <sub>PHL</sub>			2	10	2	9	
t <sub>PZH</sub>	G <sub>B</sub> A	A	2	11	2	10	ns
t <sub>PZL</sub>			3	18	3	16	
t <sub>PHZ</sub>	G <sub>B</sub> A	A	2	10	2	9	ns
t <sub>PLZ</sub>			2	10	2	9	
t <sub>PZH</sub>	GAB	B	3	12	3	11	ns
t <sub>PZL</sub>			3	20	3	16	
t <sub>PHZ</sub>	GAB	B	2	11	2	10	ns
t <sub>PLZ</sub>			2	12	2	11	

**'AS652 switching characteristics (see Note 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>1</sub> = 500 Ω, R <sub>2</sub> = 500 Ω, T <sub>A</sub> = MIN to MAX				UNIT
			SN54AS652		SN74AS652		
			MIN	MAX	MIN	MAX	
f <sub>max</sub>			75		90		MHz
t <sub>PLH</sub>	CBA or CAB	A or B	2	9.5	2	8.5	ns
t <sub>PHL</sub>			2	10	2	9	
t <sub>PLH</sub>	A or B	B or A	2	11	2	9	ns
t <sub>PHL</sub>			1	8	1	7	
t <sub>PLH</sub>	SBA or SAB†	A or B	2	12	2	11	ns
t <sub>PHL</sub>			2	10	2	9	
t <sub>PZH</sub>	G <sub>B</sub> A	A	2	11	2	10	ns
t <sub>PZL</sub>			3	18	3	16	
t <sub>PHZ</sub>	G <sub>B</sub> A	A	2	10	2	9	ns
t <sub>PLZ</sub>			2	10	2	9	
t <sub>PZH</sub>	GAB	B	3	12	3	11	ns
t <sub>PZL</sub>			3	20	3	16	
t <sub>PHZ</sub>	GAB	B	2	11	2	10	ns
t <sub>PLZ</sub>			2	12	2	11	

† These parameters are measured with the internal output state of the storage register opposite to that of the bus input.  
 NOTE 1: Load circuit and voltage waveforms are shown in Section 1.