

**SN54ALS646 THRU SN54ALS649, SN54AS646, SN54AS648  
SN74ALS646 THRU SN74ALS649, SN74AS646, SN74AS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

D2661, DECEMBER 1983—MAY 1986

- Independent Registers 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
- Package Options Include Plastic "Small Outline" Packages, Both Plastic and Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs
- Dependable Texas Instruments Quality and Reliability

DEVICE	OUTPUT	LOGIC
'ALS646, 'AS646	3-State	True
'ALS647	Open-Collector	True
'ALS648, 'AS648	3-State	Inverting
'ALS649	Open-Collector	Inverting

**description**

These devices consist of bus transceiver circuits, with 3-state or open-collector outputs, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Data on the A or B bus will be clocked into the registers on the low-to-high transition of the appropriate clock pin (CAB or CBA). The following examples demonstrate the four fundamental bus-management functions that can be performed with the octal bus transceivers and registers.

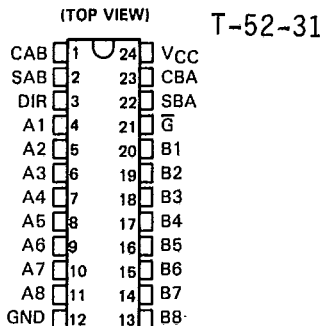
Enable ( $\bar{G}$ ) and direction (DIR) pins are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either register or in both. The select controls (SAB and SBA) can multiplex stored and real-time (transparent mode) data. 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. The direction control determines which bus will receive data when enable  $\bar{G}$  is active (low). In the isolation mode (control  $\bar{G}$  high), A data may be stored in one register and/or B data may be stored in the other register.

When an output function is disabled, the input function is still enabled and may be used to store and transmit data. Only one of the two buses, A or B, may be driven at a time.

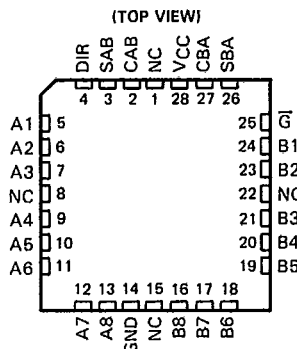
The -1 versions of the SN74ALS' parts are identical to the standard versions except that the recommended maximum I<sub>OL</sub> is increased to 48 milliamperes. There are no -1 versions of the SN54ALS' parts.

The SN54' family is characterized for operation over the full military temperature range of -55°C to 125°C. The SN74' family is characterized for operation from 0°C to 70°C.

SN54ALS', SN64AS' . . . JT PACKAGE  
SN74ALS', SN74AS' . . . DW OR NT PACKAGE



SN54ALS', SN54AS' . . . FK PACKAGE  
SN74ALS', SN74AS' . . . FN PACKAGE



NC—No internal connection

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**NOTICE**  
SEE ORDER OF DATA FOR ERRATA INFORMATION

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PRODUCTION DATA documents contain 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.



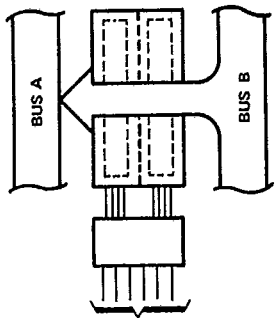
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**SN54ALS646 THRU SN54ALS649, SN54AS646, SN54AS648  
SN74ALS646 THRU SN74ALS649, SN74AS646, SN74AS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

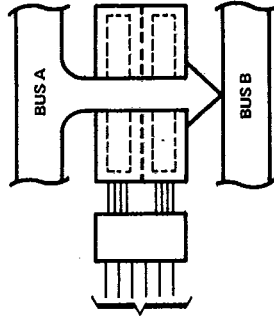
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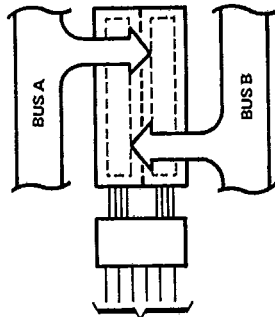
(21)	(3)	(1)	(23)	(2)	(22)
G	DIR	CAB	CBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER  
BUS B TO BUS A



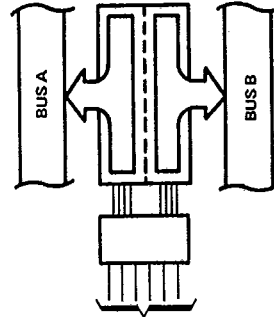
(21)	(3)	(1)	(23)	(2)	(22)
G	DIR	CAB	CBA	SAB	SBA
L	H	X	X	L	X

REAL-TIME TRANSFER  
BUS A TO BUS B



(21)	(3)	(1)	(23)	(2)	(22)
G	DIR	CAB	CBA	SAB	SBA
X	X	†	X	X	X
X	X	X	†	X	X
H	X	†	†	X	X

STORAGE FROM  
A, B, OR A AND B



(21)	(3)	(1)	(23)	(2)	(22)
G	DIR	CAB	CBA	SAB	SBA
L	L	X	HorL	X	H
L	H	HorL	X	H	X

TRANSFER  
STORED DATA  
TO A OR B

**SN54ALS646 THRU SN54ALS649, SN54AS646, SN54AS648  
SN74ALS646 THRU SN74ALS649, SN74AS646, SN74AS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

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FUNCTION TABLE

INPUTS						DATA I/O		OPERATION OR FUNCTION	
G	DIR	CAB	CBA	SAB	SBA	A1 THRU A8	B1 THRU B8	'ALS646, 'ALS647 'AS646	'ALS648, 'ALS649 'AS648
X	X	?	X	X	X	Input	Unspecified†	Store A, B unspecified†	Store A, B unspecified†
X	X	X	?	X	X	Unspecified†	Input	Store B, A unspecified†	Store B, A unspecified†
H	X	?	?	X	X	Input	Input	Store A and B Data	Store A and B Data
H	X	H or L	H or L	X	X			Isolation, hold storage	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-Time B Data to A Bus	Real-Time $\bar{B}$ Data to A Bus
L	L	X	H or L	X	H			Stored B Data to A Bus	Stored $\bar{B}$ Data to A Bus
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus	Real-Time $\bar{A}$ Data to B Bus
L	H	H or L	X	H	X			Stored A Data to B Bus	Stored $\bar{A}$ Data to B Bus

†The data output functions may be enabled or disabled by various signals at the  $\bar{G}$  and DIR 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.

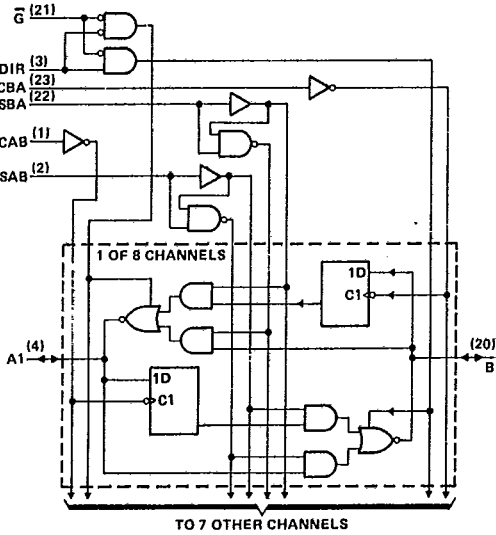
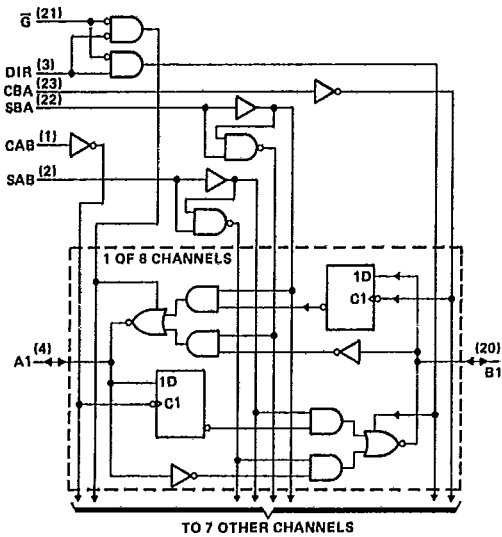
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ALS and AS Circuits

functional block diagrams (positive logic)

'ALS646, 'AS646, 'ALS647

'ALS648, 'AS648, 'ALS649



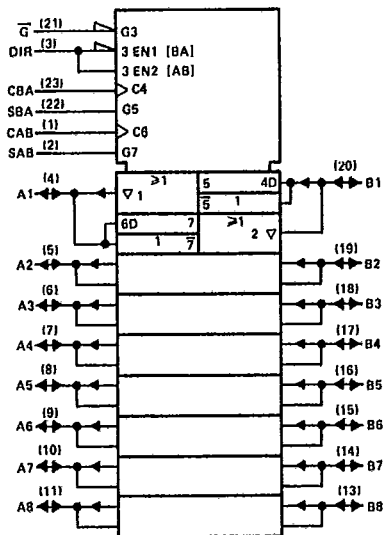
Pin numbers shown are for DW, JT, and NT packages.

**SN54ALS646 THRU SN54ALS649, SN54AS646, SN54AS648  
SN74ALS646 THRU SN74ALS649, SN74AS646, SN74AS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

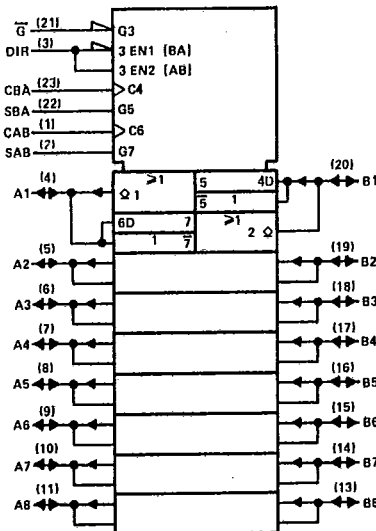
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logic symbols†

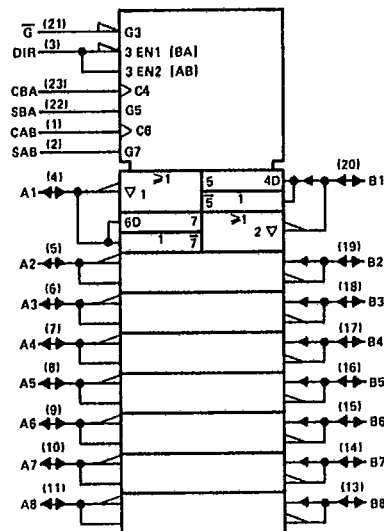
'ALS646, 'AS646



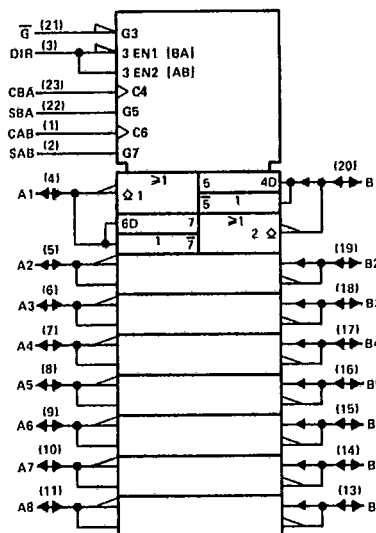
'ALS647



'ALS648, 'AS648



'ALS649



†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.

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**SN54ALS646, SN74ALS646  
OCTAL BUS TRANSCEIVERS AND REGISTERS  
WITH 3-STATE OUTPUTS**

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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: SN54ALS646 .....	-55°C to 125°C
SN74ALS646 .....	0°C to 70°C
Storage temperature range .....	-65°C to 150°C

recommended operating conditions

		SN54ALS646			SN74ALS646			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, clocks high or low	14.5			12.5			ns
$t_{su}$	Setup time, A before CAB† or B before CBA†	15			10			ns
$t_h$	Hold time, A after CAB† or B after CBA†	0			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 SN74ALS646-1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS646		SN74ALS646		UNIT	
		MIN	TYP‡	MAX	MIN		TYP‡
$V_{IK}$	$V_{CC} = 4.5 V, I_I = -18 mA$			-1.2		-1.2	V
$V_{OH}$	$V_{CC} = 4.5 V \text{ to } 5.5 V, I_{OH} = -0.4 mA$	$V_{CC}-2$			$V_{CC}-2$		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	V
	$V_{CC} = 4.5 V, I_{OL} = 24 mA$					0.35	
	$V_{CC} = 4.5 V, I_{OL} = 48 mA$ (for -1 version)					0.5	
$I_I$	Control inputs			0.1		0.1	mA
	A or B ports			0.1		0.1	
$I_{IH}$	Control inputs			20		20	$\mu A$
	A or B ports§			20		20	
$I_{IL}$	Control inputs			-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
$I_{CC}$	$V_{CC} = 5.5 V$	Outputs high	47	76	47	76	mA
		Outputs low	55	88	55	88	
		Outputs disabled	55	88	55	88	

‡All typical values are at  $V_{CC} = 5 V, T_A = 25^\circ C$

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

fThe 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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**SN54ALS646, SN74ALS646**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

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'ALS646 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	
			'ALS646			SN54ALS646		SN74ALS646		
			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	10	30	ns	
t <sub>PHL</sub>			11	15	5	20	5	17		
t <sub>PLH</sub>	A or B	B or A	11	17	5	22	5	20	ns	
t <sub>PHL</sub>			7.5	10	3	15	3	12		
t <sub>PLH</sub>	SBA or SAB† (with A or B low)	A or B	24	32	15	40	15	35	ns	
t <sub>PHL</sub>			13	17	5	23	5	20		
t <sub>PLH</sub>	SBA or SAB† (with A or B high)	A or B	17	22	8	30	8	25	ns	
t <sub>PHL</sub>			13	17	5	24	5	20		
t <sub>PZH</sub>	0	A or B	10	15	3	20	3	17	ns	
t <sub>PZL</sub>			10	15	5	22	5	20		
t <sub>PHZ</sub>	0	A or B	6	8	1	12	1	10	ns	
t <sub>PLZ</sub>			10	13	2	20	2	16		
t <sub>PZH</sub>	DIR	A or B	22	28	10	38	10	30	ns	
t <sub>PZL</sub>			14.5	20	5	30	5	25		
t <sub>PHZ</sub>	DIR	A or B	6	8	1	12	1	10	ns	
t <sub>PLZ</sub>			10	13	2	21	2	16		

† 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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**SN54ALS647, SN74ALS647**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH OPEN-COLLECTOR OUTPUTS**

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

Supply voltage, V <sub>CC</sub> .....	7 V
Input voltage .....	7 V
Operating free-air temperature range: SN54ALS647 .....	-55°C to 125°C
SN74ALS647 .....	0°C to 70°C
Storage temperature range .....	-65°C to 150°C

recommended operating conditions

		SN54ALS647			SN74ALS647			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage			0.7			0.8	V
V <sub>OH</sub>	High-level output voltage			5.5			5.5	V
I <sub>OL</sub>	Low-level output current			12			24 48†	mA
f <sub>clock</sub>	Clock frequency	0		25	0		30	MHz
t <sub>w</sub>	Pulse duration, clocks high or low	20			16.5			ns
t <sub>su</sub>	Setup time, A before CAB† or B before CBA†	15			10			ns
t <sub>h</sub>	Hold time, A after CAB† or B after CBA†	0			0			ns
T <sub>A</sub>	Operating free-air temperature	-55		125	0		70	°C

†The extended condition applies if V<sub>CC</sub> is maintained between 4.75 V and 5.25 V.  
 The 48-mA limit applies for the SN74ALS647-1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS647			SN74ALS647			UNIT
		MIN	TYP‡	MAX	MIN	TYP†	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA			-1.2			-1.2	V
I <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, V <sub>OH</sub> = 5.5 V			0.1			0.1	mA
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 12 mA		0.25	0.4				V
	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 24 mA (I <sub>OL</sub> = 48 mA for -1 versions)					0.35	0.5	
I <sub>I</sub>	A or B ports			0.1			0.1	mA
	Control inputs			0.1			0.1	
I <sub>IH</sub>	A or ports‡			20			20	µA
	Control inputs			20			20	
I <sub>IL</sub>	Control inputs			-0.2			-0.2	mA
	A or B ports‡			-0.2			-0.2	
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V	Outputs high		35	60	35		60
		Outputs low		40	65	40		65

‡All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C  
 †For I/O ports, the parameters I<sub>IH</sub> and I<sub>IL</sub> include the off-state output current.

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**SN54ALS647, SN74ALS647**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH OPEN-COLLECTOR OUTPUTS**

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'ALS647 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, C <sub>L</sub> = 50 pF, R <sub>L</sub> = 680 Ω, T <sub>A</sub> = 25°C			V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R <sub>L</sub> = 680 Ω, T <sub>A</sub> = MIN to MAX			UNIT	
			'ALS647			SN54ALS647		SN74ALS647		
			MIN	TYP	MAX	MIN	MAX	MIN		MAX
t <sub>max</sub>			40			25		30		MHz
t <sub>PLH</sub>	CBA or CAB	A or B	38 50			19 72		19 58		ns
t <sub>PHL</sub>			12 20			6 24		6 22		
t <sub>PLH</sub>	A or B	B or A	35 39			17 70		17 54		ns
t <sub>PHL</sub>			10 13			4 19		4 16		
t <sub>PLH</sub>	SBA or SAB† (with A or B low)	A or B	40 51			20 72		20 60		ns
t <sub>PHL</sub>			12 17			6 26		6 22		
t <sub>PLH</sub>	SBA or SAB† (with A or B high)	A or B	40 51			20 72		20 60		ns
t <sub>PHL</sub>			12 17			6 26		6 22		
t <sub>PLH</sub>	G̅	A or B	20 27			10 37		10 31		ns
t <sub>PHL</sub>			10 15			2 20		2 17		
t <sub>PLH</sub>	DIR	A or B	20 25			9 34		9 29		ns
t <sub>PHL</sub>			13 17			2 22		2 19		

†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.

2 ALS and AS Circuits



**SN54ALS648, SN74ALS648**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

**NOTICE**

SEE ORDER OF DATA FOR ERRATA INFORMATION                      T-52-31

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

Supply voltage, VCC	7 V
Input voltage: Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range: SN54ALS648	-55°C to 125°C
SN74ALS648	0°C to 70°C
Storage temperature range	-65°C to 150°C

recommended operating conditions

		SN54ALS648			SN74ALS648			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
VCC	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage			0.7			0.8	V
I <sub>OH</sub>	High-level output current			-12			-15	mA
I <sub>OL</sub>	Low-level output current			12			24	mA
							48 <sup>†</sup>	
f <sub>clock</sub>	Clock frequency	0	35		0	40		MHz
t <sub>w</sub>	Pulse duration, clocks high or low	14.5			12.5			ns
t <sub>su</sub>	Setup time, A before CAB <sup>†</sup> or B before CBA <sup>†</sup>	15			10			ns
t <sub>h</sub>	Hold time, A after CAB <sup>†</sup> or B after CBA <sup>†</sup>	0			0			ns
T <sub>A</sub>	Operating free-air temperature	-55		125	0		70	°C

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ALS and AS Circuits

<sup>†</sup>The extended condition applies if VCC is maintained between 4.75 V and 5.25 V.  
 The 48-mA limit applies for the SN74ALS648-1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS648			SN74ALS648			UNIT
		MIN	TYP <sup>‡</sup>	MAX	MIN	TYP <sup>‡</sup>	MAX	
V <sub>IK</sub>	VCC = 4.5 V, I <sub>I</sub> = -18 mA			-1.2			-1.2	V
V <sub>OH</sub>	VCC = 4.5 V to 5.5 V, I <sub>OH</sub> = -0.4 mA	VCC-2			VCC-2			V
	VCC = 4.5 V, I <sub>OH</sub> = -3 mA	2.4	3.2		2.4	3.2		
	VCC = 4.5 V, I <sub>OH</sub> = -12 mA	2						
	VCC = 4.5 V, I <sub>OH</sub> = -15 mA				2			
V <sub>OL</sub>	VCC = 4.5 V, I <sub>OL</sub> = 12 mA		0.25	0.4		0.25	0.4	V
	VCC = 4.5 V, I <sub>OL</sub> = 24 mA (I <sub>OL</sub> = 48 mA for -1 version)					0.35	0.5	
I <sub>I</sub>	Control inputs	VCC = 5.5 V, V <sub>I</sub> = 7 V		0.1		0.1		mA
	A or B ports	VCC = 5.5 V, V <sub>I</sub> = 5.5 V		0.1		0.1		
I <sub>IH</sub>	Control inputs	VCC = 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	VCC = 5.5 V, V <sub>I</sub> = 0.4 V		-0.2		-0.2		mA
	A or B ports <sup>§</sup>			-0.2		-0.2		
I <sub>O</sub> <sup>¶</sup>	VCC = 5.5 V, V <sub>O</sub> = 2.25 V	-30		-112	-30		-112	mA
I <sub>CC</sub>	VCC = 5.5 V	Outputs high	47	76	47	76		mA
		Outputs low	57	88	57	88		
		Outputs disabled	57	88	57	88		

<sup>‡</sup>All typical values are at VCC = 5 V, T<sub>A</sub> = 25°C

<sup>§</sup>For I/O 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>.

**SN54ALS648, SN74ALS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS  
WITH 3-STATE OUTPUTS**

T-52-31

'ALS648 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, C <sub>L</sub> = 50 pF, R <sub>1</sub> = 500 Ω, R <sub>2</sub> = 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, R <sub>1</sub> = 500 Ω, R <sub>2</sub> = 500 Ω, T <sub>A</sub> = MIN to MAX			UNIT	
			'ALS648			SN54ALS648		SN74ALS648		
			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		21	29	8	39	8	33	ns
t <sub>PHL</sub>				13	18	5	23	5	20	
t <sub>PLH</sub>	A or B	B or A		10	15	3	20	3	17	ns
t <sub>PHL</sub>				6	8	2	12	2	10	
t <sub>PLH</sub>	SBA or SAB† (with A or B low)	A or B		24	32	5	44	5	39	ns
t <sub>PHL</sub>				15	21	4	26	4	22	
t <sub>PLH</sub>	SBA or SAB† (with A or B high)	A or B		16	22	6	30	6	25	ns
t <sub>PHL</sub>				14	19	6	25	6	21	
t <sub>PZH</sub>	0	A or B		12	18	4	25	4	22	ns
t <sub>PZL</sub>				12	18	4	25	4	22	
t <sub>PHZ</sub>	0	A or B		5	8	1	12	1	10	ns
t <sub>PLZ</sub>				7	12	2	21	2	15	
t <sub>PZH</sub>	DIR	A or B		14	22	4	35	4	27	ns
t <sub>PZL</sub>				10	17	3	25	3	19	
t <sub>PHZ</sub>	DIR	A or B		7	12	1	17	1	14	ns
t <sub>PLZ</sub>				7	13	2	22	2	15	

† 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.

2 ALS and AS Circuits

**SN54ALS649, SN74ALS649  
OCTAL BUS TRANSCEIVERS AND REGISTERS  
WITH OPEN-COLLECTOR OUTPUTS**

T-52-31

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

Supply voltage, V <sub>CC</sub> .....	7 V
Input voltage .....	7 V
Operating free-air temperature range: SN54ALS649 .....	-55°C to 125°C
SN74ALS649 .....	0°C to 70°C
Storage temperature range .....	-65°C to 150°C

recommended operating conditions

	SN54ALS649			SN74ALS649			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub> Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V <sub>IH</sub> High-level input voltage	2			2			V
V <sub>IL</sub> Low-level input voltage			0.7			0.8	V
V <sub>OH</sub> High-level output voltage			5.5			5.5	V
I <sub>OL</sub> Low-level output current			12			24	mA
						48†	
f <sub>clock</sub> Clock frequency	0		25	0		30	MHz
t <sub>w</sub> Pulse duration, clocks high or low		20			16.5		ns
t <sub>su</sub> Setup time, A before CAB† or B before CBA†		15			10		ns
t <sub>h</sub> Hold time, A after CAB† or B after CBA†		0			0		ns
T <sub>A</sub> Operating free-air temperature	-55		125	0		70	°C

†The extended condition applies if V<sub>CC</sub> is maintained between 4.75 V and 5.25 V.  
The 48-mA limit applies for the SN74ALS649-1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS649		SN74ALS649		UNIT	
		MIN	TYP‡	MAX	MIN		TYP‡
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA		-1.2		-1.2	V	
I <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, V <sub>OH</sub> = 5.5 V		0.1		0.1	mA	
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 12 mA		0.25		0.4	V	
	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 24 mA (I <sub>OL</sub> = 48 mA for -1 versions)				0.35 0.5		
I <sub>I</sub>	A or B ports V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V		0.1		0.1	mA	
	Control inputs V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V		0.1		0.1		
I <sub>IH</sub>	A or ports§ V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V		20		20	µA	
	Control inputs		20		20		
I <sub>IL</sub>	Control inputs V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V		-0.2		-0.2	mA	
	A or B ports§		-0.2		-0.2		
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V	Outputs high	40	60	40	60	mA
		Outputs low	45	70	45	70	

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

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

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ALS and AS Circuits

**SN54ALS649, SN74ALS649**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH OPEN-COLLECTOR OUTPUTS**

T-52-31

'ALS649 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	VCC = 5 V, CL = 50 pF, RL = 680 Ω, TA = 25°C			VCC = 4.5 V to 5.5 V, CL = 50 pF, RL = 680 Ω, TA = MIN to MAX			UNIT	
			'ALS649			SN54ALS649		SN74ALS649		
			MIN	TYP	MAX	MIN	MAX	MIN		MAX
f <sub>max</sub>			40		25		30		MHz	
t <sub>PLH</sub>	CBA or CAB	A or B	40	52	19	77	19	62	ns	
t <sub>PHL</sub>			12	18	6	22	6	20		
t <sub>PLH</sub>	A or B	B or A	30	41	13	65	13	50	ns	
t <sub>PHL</sub>			6	9	2	11	2	10		
t <sub>PLH</sub>	SBA or SAB† (with A or B low)	A or B	35	46	20	72	20	55	ns	
t <sub>PHL</sub>			15	21	6	26	6	22		
t <sub>PLH</sub>	SBA or SAB† (with A or B high)	A or B	35	46	20	72	20	55	ns	
t <sub>PHL</sub>			15	21	6	26	6	22		
t <sub>PLH</sub>	0	A or B	16	22	8	28	8	25	ns	
t <sub>PHL</sub>			13	18	2	23	2	20		
t <sub>PLH</sub>	DIR	A or B	16	22	8	28	8	25	ns	
t <sub>PHL</sub>			13	17	2	23	2	20		

† 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.

2 ALS and AS Circuits

**SN54AS646, SN54AS648, SN74AS646, SN74AS648**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

T-52-31

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

Supply voltage, VCC	7 V
Input voltage: Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range: SN54AS646, SN54AS648	-55°C to 125°C
SN74AS646, SN74AS648	0°C to 70°C
Storage temperature range	-65°C to 150°C

recommended operating conditions

		SN54AS646 SN54AS648			SN74AS646 SN74AS648			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
VCC	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			0.8			0.8	V
IOH	High-level output current			-12			-15	mA
IOL	Low-level output current			32			48	mA
f <sub>clock</sub>	Clock frequency	0		75	0		90	MHz
t <sub>w</sub>	Pulse duration	Clock high		6			5	ns
		Clock high		7			6	
t <sub>su</sub>	Setup time, A before CAB† or B before CBA†			7			6	ns
t <sub>h</sub>	Hold time, A after CAB† or B after CBA†			0			0	ns
T <sub>A</sub>	Operating free-air temperature	-55		125	0		70	°C

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ALS and AS Circuits

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

PARAMETER	TEST CONDITIONS	SN54AS646- SN54AS648		SN74AS646 SN74AS648		UNIT	
		MIN	TYP†	MAX	MIN		TYP†
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA			-1.2		-1.2	V
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = -2 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		
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 32 mA	0.25	0.50				V
	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 48 mA				0.35	0.50	
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
				70		70	
I <sub>IL</sub>	Control inputs V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V			-0.5		-0.5	mA
				-0.75		-0.75	
I <sub>O§</sub>	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V	-30		-112	-30	-112	mA
I <sub>CC</sub>	'AS646 V <sub>CC</sub> = 5.5 V	Outputs high	120	195	120	195	mA
		Outputs low	130	211	130	211	
		Outputs disabled	130	211	130	211	
		Outputs high	110	185	110	185	
		Outputs low	120	195	120	195	
		Outputs disabled	120	195	120	195	

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

‡For I/O ports, the parameters I<sub>IH</sub> and I<sub>IL</sub> 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<sub>O§</sub>.

**SN54AS646, SN54AS648, SN74AS646, SN74AS648**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

T-52-31

'AS646 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
			SN54AS646		SN74AS646		
			MIN	MAX	MIN	MAX	
t <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 <sup>†</sup>	A or B	2	12	2	11	ns
t <sub>PHL</sub>			2	10	2	9	
t <sub>PZH</sub>	0	A or B	2	10	2	9	ns
t <sub>PZL</sub>			3	15	3	14	
t <sub>PHZ</sub>	0	A or B	2	11	2	9	ns
t <sub>PLZ</sub>			2	11	2	9	
t <sub>PZH</sub>	DIR	A or B	3	19	3	16	ns
t <sub>PZL</sub>			3	21	3	18	
t <sub>PHZ</sub>	DIR	A or B	2	12	2	10	ns
t <sub>PLZ</sub>			2	12	2	10	

'AS648 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> = 600 Ω, T <sub>A</sub> = MIN to MAX				UNIT
			SN64AS648		SN74AS648		
			MIN	MAX	MIN	MAX	
t <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 <sup>†</sup>	A or B	2	12	2	11	ns
t <sub>PHL</sub>			2	10	2	9	
t <sub>PZH</sub>	0	A or B	2	10	2	9	ns
t <sub>PZL</sub>			3	18	3	15	
t <sub>PHZ</sub>	0	A or B	2	11	2	9	ns
t <sub>PLZ</sub>			2	11	2	9	
t <sub>PZH</sub>	DIR	A or B	3	19	3	16	ns
t <sub>PZL</sub>			3	21	3	18	
t <sub>PHZ</sub>	DIR	A or B	2	12	2	10	ns
t <sub>PLZ</sub>			2	12	2	10	

<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.

2 ALS and AS Circuits