

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.

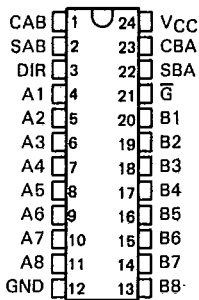
Enable ($\bar{G}$) and direction (DIR) pins are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either register or in both. The select controls (SAB and SBA) can multiplex stored and real-time (transparent mode) data. The 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.

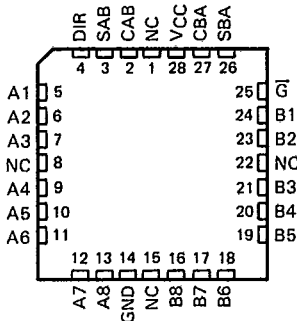
The -1 versions of the SN74ALS' parts are identical to the standard versions except that the recommended maximum IOL is increased to 48 milliamperes. There are no -1 versions of the SN54ALS' parts.

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', 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

2
ALS and AS Circuits

2823

F-04

NOTICE
SEE ORDER OF DATA FOR ERRATA INFORMATION

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.



POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

Copyright © 1983, Texas Instruments Incorporated

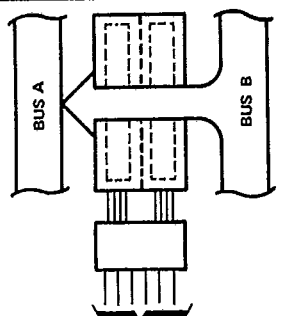
2-533

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

T-52-31

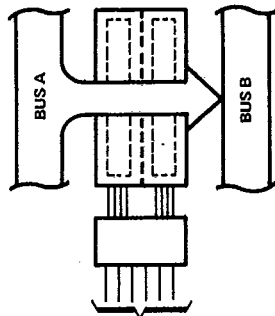
2

ALS and AS Circuits



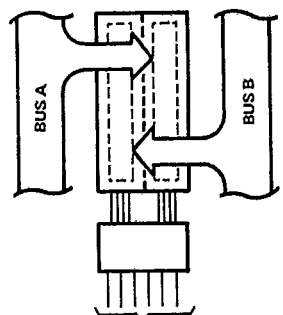
(21)	(3)	(1)	(23)	(2)	(22)
G	DIR	CAB	CBA	SAB	SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
 BUS B TO BUS A



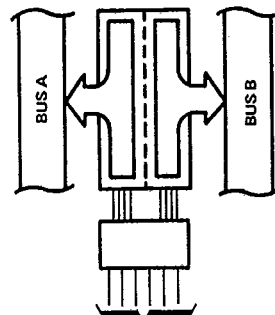
(21)	(3)	(1)	(23)	(2)	(22)
G	DIR	CAB	CBA	SAB	SBA
L	H	X	X	L	X

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
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**

FUNCTION TABLE

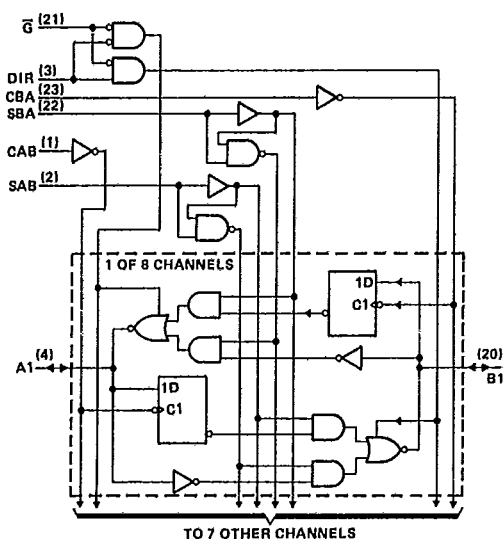
T-52-31

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 $\overline{B}$ Data to A Bus
L	L	X	H or L	X	H			Stored B Data to A Bus	Stored $\overline{B}$ Data to A Bus
L	H	X	X	L	X	Input	Output	Real-Time A Data to B Bus	Real-Time $\overline{A}$ Data to B Bus
L	H	H or L	X	H	X			Stored A Data to B Bus	Stored $\overline{A}$ Data to B Bus

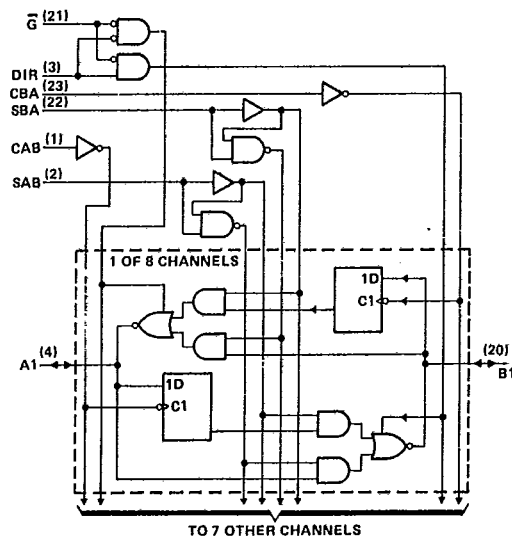
[†]The data output functions may be enabled or disabled by various signals at the $\overline{G}$ and DIR inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

functional block diagrams (positive logic)

'ALS646, 'AS646, 'ALS647



'ALS648, 'AS648, 'ALS649



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

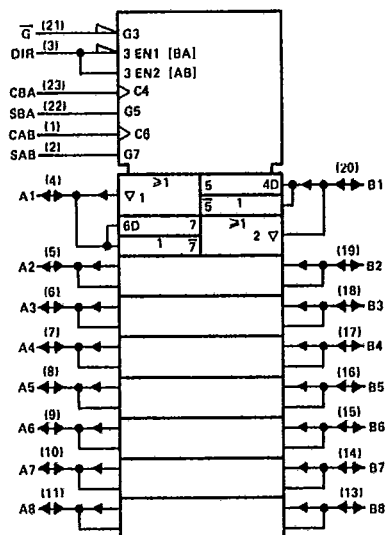
2
ALS and AS Circuits

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

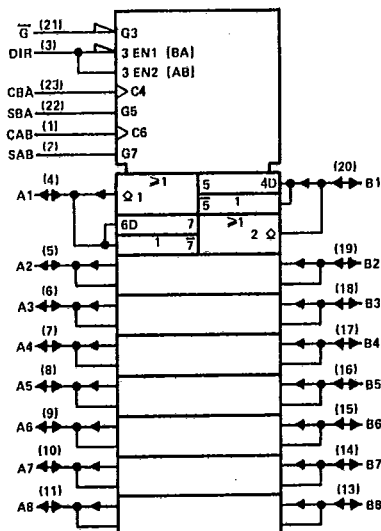
T-52-31

logic symbols†

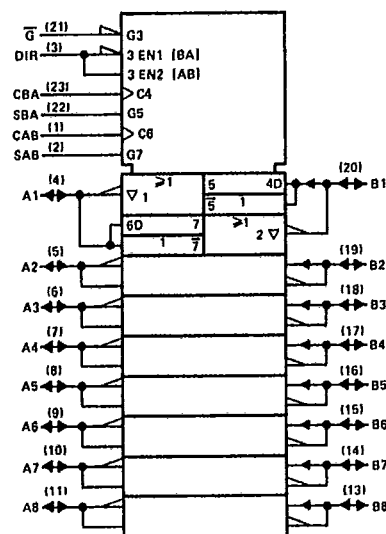
'ALS646, 'AS646



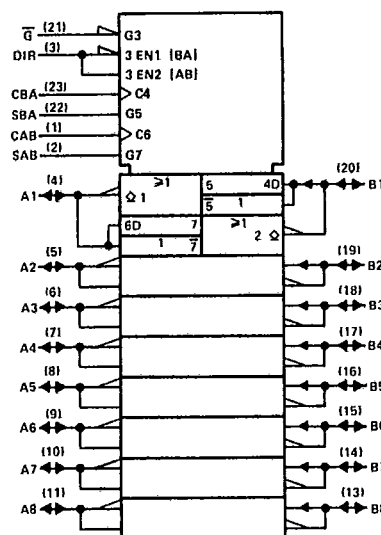
'ALS647



'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.

SN54ALS646, SN74ALS646
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, 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†	mA
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 CBA† or B before CBA†	15			10			ns
t_h	Hold time, A after CBA† or B after CBA†	0			0			ns
T_A	Operating free-air temperature	-65		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‡	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 version)						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				20			20		μ A
	A or B ports§	$V_{CC} = 5.5$ V, $V_I = 2.7$ V			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}		$V_{CC} = 5.5$ 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, $T_A = 25^\circ\text{C}$ §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} .

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

'ALS646 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = 25°C			V _{CC} = 4.5 V to 5.5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = MIN to MAX			UNIT
			'ALS646			SN54ALS646		SN74ALS646	
			MIN	TYP	MAX	MIN	MAX	MIN	MAX
f _{max}			50			35		40	MHz
t _{PLH}	CBA or CAB	A or B	20			10		10	ns
t _{PHL}			11			5		5	
t _{PLH}	A or B	B or A	11			5		5	ns
t _{PHL}			7.5			3		3	
t _{PLH}	SBA or SAB†	A or B	24			15		15	ns
t _{PHL}			13			5		5	
t _{PLH}	SBA or SAB†	A or B	17			8		8	ns
t _{PHL}			13			5		5	
t _{PZH}	$\bar{G}$	A or B	10			3		3	ns
t _{PZL}			10			5		5	
t _{PHZ}	$\bar{G}$	A or B	6			1		1	ns
t _{PLZ}			10			2		2	
t _{PZH}	DIR	A or B	22			10		10	ns
t _{PZL}			14.5			5		5	
t _{PHZ}	DIR	A or B	6			1		1	ns
t _{PLZ}			10			2		2	

† 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.

SN54ALS647, SN74ALS647

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, VCC	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	
VCC	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			5.5			5.5	V
I _{OL}	Low-level output current			12			24	mA
							48 [†]	
f _{clock}	Clock frequency	0		25	0		30	MHz
t _w	Pulse duration, clocks high or low	20			16.5			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 VCC 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	
V _{IK}		V _{CC} = 4.5 V,	I _I = -18 mA		-1.2		-1.2	V
I _{OH}		V _{CC} = 4.5 V,	V _{OH} = 5.5 V		0.1		0.1	mA
V _{OL}		V _{CC} = 4.5 V,	I _{OL} = 12 mA	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	A or B ports	V _{CC} = 5.5 V,	V _I = 7 V		0.1		0.1	mA
	Control inputs	V _{CC} = 5.5 V,	V _I = 7 V		0.1		0.1	
I _{IH}	A or ports [§]	V _{CC} = 5.5 V,	V _I = 2.7 V		20		20	μA
	Control inputs				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 _{CC}		V _{CC} = 5.5 V	Outputs high	35	60	35	60	mA
			Outputs low	40	65	40	65	

[‡]All typical values are at VCC = 5 V, T_A = 25°C
[§]For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.

2

ALS and AS Circuits

SN54ALS647, SN74ALS647

OCTAL BUS TRANSCEIVERS AND REGISTERS

WITH OPEN-COLLECTOR OUTPUTS

T-52-31

'ALS647 switching characteristics (see Note 1)

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

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

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: 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	
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 [†]	mA
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 SN74ALS648-1 only.

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

PARAMETER	TEST CONDITIONS	SN54ALS648			SN74ALS648			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 version)					-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	μ 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	
$I_O^¶$	$V_{CC} = 5.5$ V, $V_O = 2.25$ V	-30		-112	-30		-112	mA
I_{CC}	$V_{CC} = 5.5$ V							mA
	Outputs high		47	76		47	76	
	Outputs low		57	88		57	88	
	Outputs disabled		57	88		57	88	

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

[§]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} .

2

ALS and AS Circuits

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 _{CC} = 5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = 25°C			V _{CC} = 4.5 V to 5.5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = MIN to MAX			UNIT
			'ALS648			SN54ALS648		SN74ALS648	
			MIN	TYP	MAX	MIN	MAX	MIN	MAX
f _{max}				50		35		40	MHz
t _{PLH}	CBA or CAB	A or B		21	29	8	39	8	33
t _{PHL}				13	18	5	23	5	20
t _{PLH}	A or B	B or A		10	15	3	20	3	17
t _{PHL}				6	8	2	12	2	10
t _{PLH}	SBA or SAB† (with A or B low)	A or B		24	32	5	44	5	39
t _{PHL}				15	21	4	26	4	22
t _{PLH}	SBA or SAB† (with A or B high)	A or B		16	22	6	30	6	25
t _{PHL}				14	19	6	25	6	21
t _{PZH}	$\overline{Q}$	A or B		12	18	4	25	4	22
t _{PZL}				12	18	4	25	4	22
t _{PHZ}	$\overline{Q}$	A or B		5	8	1	12	1	10
t _{PLZ}				7	12	2	21	2	15
t _{PZH}	DIR	A or B		14	22	4	35	4	27
t _{PZL}				10	17	3	25	3	19
t _{PHZ}	DIR	A or B		7	12	1	17	1	14
t _{PLZ}				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.

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_{CC} 7 V

Supply voltage, V_{CC}	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 _{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			5.5			5.5	V
I _{OL}	Low-level output current			12			24	mA
							48†	
f _{clock}	Clock frequency	0		25	0		30	MHz
t _w	Pulse duration, clocks high or low	20			16.5			ns
t _{su}	Setup time, A before CBA† or B before CBA†	15			10			ns
t _h	Hold time, A after CBA† 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 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	
V _{IK}		V _{CC} = 4.5 V, I _I = -18 mA			-1.2		V
I _{OH}		V _{CC} = 4.5 V, V _{OH} = 5.5 V			0.1		mA
V _{OL}		V _{CC} = 4.5 V, I _{OL} = 12 mA	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	A or B ports	V _{CC} = 5.5 V, V _I = 7 V			0.1		mA
	Control inputs	V _{CC} = 5.5 V, V _I = 7 V			0.1		
I _{IH}	A or ports [§]	V _{CC} = 5.5 V, V _I = 2.7 V			20		μA
	Control inputs				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 _{CC}		V _{CC} = 5.5 V	Outputs high		40	60	mA
			Outputs low		45	70	

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

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

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)	V _{CC} = 5 V, C _L = 50 pF, R _L = 680 Ω, T _A = 25°C			V _{CC} = 4.5 V to 5.5 V, C _L = 50 pF, R _L = 680 Ω, T _A = MIN to MAX				UNIT
			'ALS649			SN54ALS649		SN74ALS649		
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{max}			40			25		30		MHz
t _{PLH}	CBA or CAB	A or B	40	52		19	77	19	62	ns
t _{PHL}			12	18		6	22	6	20	
t _{PLH}	A or B	B or A	30	41		13	65	13	50	ns
t _{PHL}			6	9		2	11	2	10	
t _{PLH}	SBA or SAB† (with A or B low)	A or B	35	46		20	72	20	55	ns
t _{PHL}			15	21		6	26	6	22	
t _{PLH}	SBA or SAB† (with A or B high)	A or B	35	46		20	72	20	55	ns
t _{PHL}			15	21		6	26	6	22	
t _{PLH}	G	A or B	16	22		8	28	8	25	ns
t _{PHL}			13	18		2	23	2	20	
t _{PLH}	DIR	A or B	16	22		8	28	8	25	ns
t _{PHL}			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.

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, V_{CC}	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	
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	Clock high	6			5			ns
		Clock high	7			6			
t _{su}	Setup time, A before CAB† or B before CBA†		7			6			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

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

PARAMETER		TEST CONDITIONS		SN54AS646- SN54AS648		SN74AS646 SN74AS648		UNIT
				MIN	TYP†	MAX	MIN	
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 _{CC} = 4.5 V, I _{OH} = -15 mA				2		
V _{OL}		V _{CC} = 4.5 V, I _{OL} = 32 mA		0.25	0.50			V
		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		μA
	A or B ports‡			70		70		
I _{IL}	Control inputs	V _{CC} = 5.5 V, V _I = 0.4 V		-0.5		-0.5		mA
	A or B ports§			-0.75		-0.75		
I _{OS} §		V _{CC} = 5.5 V, V _O = 2.25 V		-30	-112	-30	-112	mA
I _{CC}	'AS646	Outputs high		120	195	120	195	mA
		Outputs low		130	211	130	211	
		Outputs disabled		130	211	130	211	
	'AS648	Outputs high		110	185	110	185	
		Outputs low		120	195	120	195	
		Outputs disabled		120	195	120	195	

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

2

ALS and AS Circuits

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)	VCC = 4.5 V to 5.5 V, CL = 50 pF, R1 = 500 Ω, R2 = 500 Ω, TA = MIN to MAX				UNIT
			SN54AS646		SN74AS646		
			MIN	MAX	MIN	MAX	
tmax			75		90		MHz
tPLH	CBA or CAB	A or B	2	9.5	2	8.5	ns
tPHL			2	10	2	9	
tPLH	A or B	B or A	2	11	2	9	ns
tPHL			1	8	1	7	
tPLH	SBA or SAB†	A or B	2	12	2	11	ns
tPHL			2	10	2	9	
tPZH	G	A or B	2	10	2	9	ns
tPZL			3	15	3	14	
tPHZ	G	A or B	2	11	2	9	ns
tPLZ			2	11	2	9	
tPZH	DIR	A or B	3	19	3	16	ns
tPZL			3	21	3	18	
tPHZ	DIR	A or B	2	12	2	10	ns
tPLZ			2	12	2	10	

'AS648 switching characteristics (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC} = 4.5 V to 5.5 V, C _L = 50 pF, R ₁ = 500 Ω, R ₂ = 500 Ω, T _A = MIN to MAX				UNIT
			SN54AS648		SN74AS648		
			MIN	MAX	MIN	MAX	
t _{max}			75		90		MHz
t _{PLH}	CBA or CAB	A or B	2	9.5	2	8.5	ns
t _{PHL}			2	10	2	9	
t _{PLH}	A or B	B or A	2	9	2	8	ns
t _{PHL}			1	8	1	7	
t _{PLH}	SBA or SAB†	A or B	2	12	2	11	ns
t _{PHL}			2	10	2	9	
t _{PZH}	G	A or B	2	10	2	9	ns
t _{PZL}			3	18	3	15	
t _{PHZ}	G	A or B	2	11	2	9	ns
t _{PLZ}			2	11	2	9	
t _{PZH}	DIR	A or B	3	19	3	16	ns
t _{PZL}			3	21	3	18	
t _{PHZ}	DIR	A or B	2	12	2	10	ns
t _{PLZ}			2	12	2	10	

† 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.