

SN54LS846 THRU SN54LS649
 SN74LS646 THRU SN74LS649
 OCTAL BUS TRANSCEIVERS AND REGISTERS

SDLS190A – DECEMBER 1982 – REVISED MAY 2004

- 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
- Included Among the Package Options Are Compact 24-pin 300-mil-Wide Plastic and Ceramic DIPs, Ceramic Chip Carriers, and Plastic "Small Outline" Packages
- Dependable Texas Instruments Quality and Reliability

DEVICE	OUTPUT	LOGIC
'LS646	3-State	True
'LS647	Open-Collector	True
'LS648	3-State	Inverting
'LS649	Open-Collector	Inverting

description

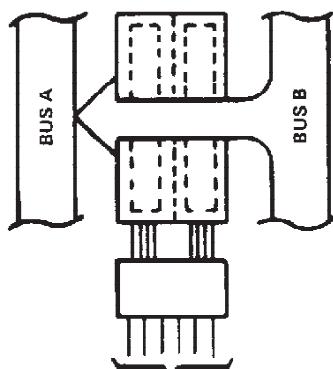
These devices consist of bus transceiver circuits with 3-state or open-collector outputs, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus will be clocked into the registers on the 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.

SN54LS'... JT PACKAGE
 SN74LS'... DW OR NT PACKAGE
 (TOP VIEW)

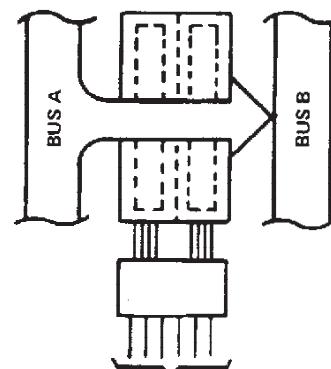
CAB	1	24	VCC
SAB	2	23	CBA
DIR	3	22	SBA
A1	4	21	G
A2	5	20	B1
A3	6	19	B2
A4	7	18	B3
A5	8	17	B4
A6	9	16	B5
A7	10	15	B6
A8	11	14	B7
GND	12	13	B8

SN54LS'... FK PACKAGE
 (TOP VIEW)

DIR	4	SAB	3	CAB	2	NC	1	VCC	CBA	SBA					
A1	5								25	G					
A2	6								24	B1					
A3	7								23	B2					
NC	8								22	NC					
A4	9								21	B3					
A5	10								20	B4					
A6	11								19	B5					
									12	13	14	15	16	17	18
									A7	A8	GND	NC	B8	B7	B6



REAL-TIME TRANSFER
 BUS B TO BUS A



REAL-TIME TRANSFER
 BUS A TO BUS B



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is 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.

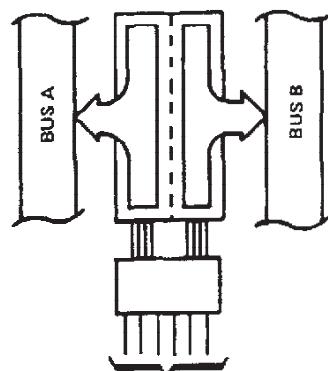
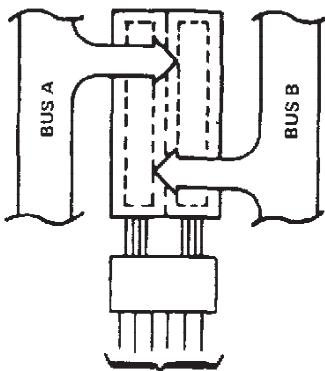
**TEXAS
 INSTRUMENTS**

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SN54LS646 THRU SN54LS649, SN74LS646 THRU SN74LS649 OCTAL BUS TRANSCEIVERS AND REGISTERS

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(21)	(3)	(1)	(23)	(2)	(22)
\bar{G}	DIR	CAB	CBA	SAB	SBA
X	X	\uparrow	X	X	X
X	X	X	\uparrow	X	X

STORAGE FROM
A, B, OR A AND B

(21)	(3)	(1)	(23)	(2)	(22)
\bar{G}	DIR	CAB	CBA	SAB	SBA
L	L	X	Hor L	X	H

TRANSFER
STORED DATA
TO A OR B

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 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 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° to 70°C .

FUNCTION TABLE

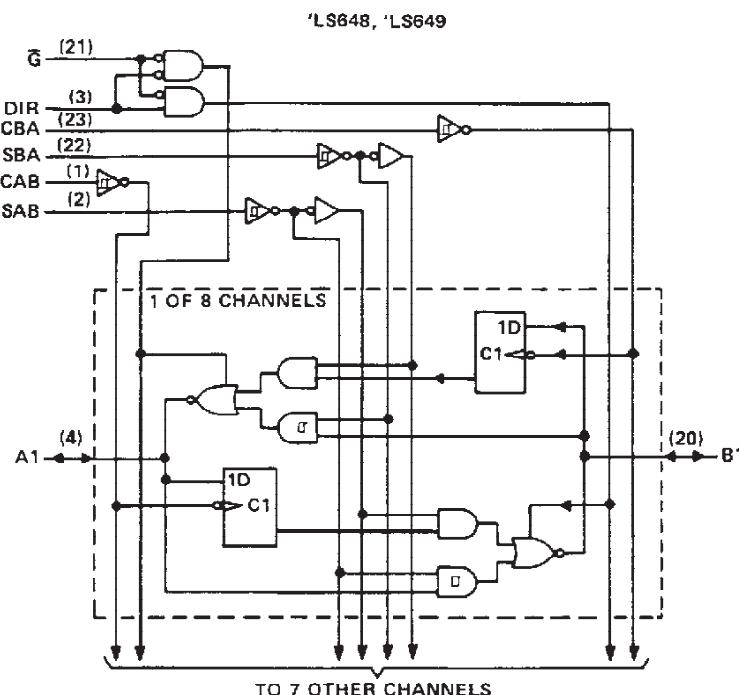
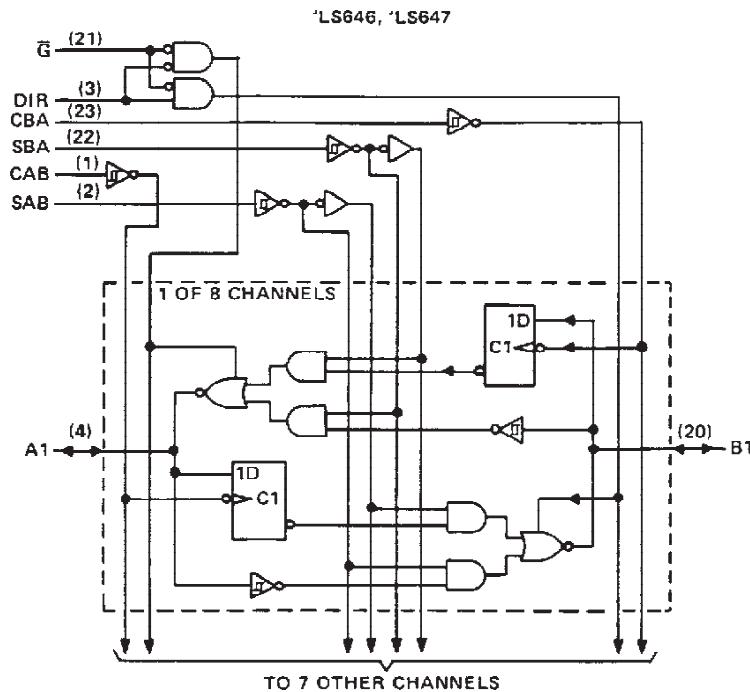
INPUTS						DATA I/O†		OPERATION OR FUNCTION	
\bar{G}	DIR	CAB	CBA	SAB	SBA	A1 THRU A8	B1 THRU B8	LS646, LS647	LS648, LS649
X	X	\uparrow	X	X	X	Input	Not specified	Store A, B unspecified	Store A, B unspecified
X	X	X	\uparrow	X	X	Not specified	Input	Store B, A unspecified	Store B, A unspecified
H	X	\uparrow	\uparrow	X	X	Input	Input	Store A and B Data	Store A and B Data
H	X	Hor L	Hor L	X	X	Input	Input	Isolation, hold storage	Isolation, hold storage
L	L	X	X	L		Output	Input	Real-Time B Data to A Bus	Real-Time \bar{B} Data to A Bus
L	L	X	Hor L	X	H	Output	Input	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	Hor L	X	H	X	Input	Output	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.

**SN54LS646 THRU SN54LS649, SN74LS646 THRU SN74LS649
OCTAL BUS TRANSCEIVERS AND REGISTERS**

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logic diagrams (positive logic)

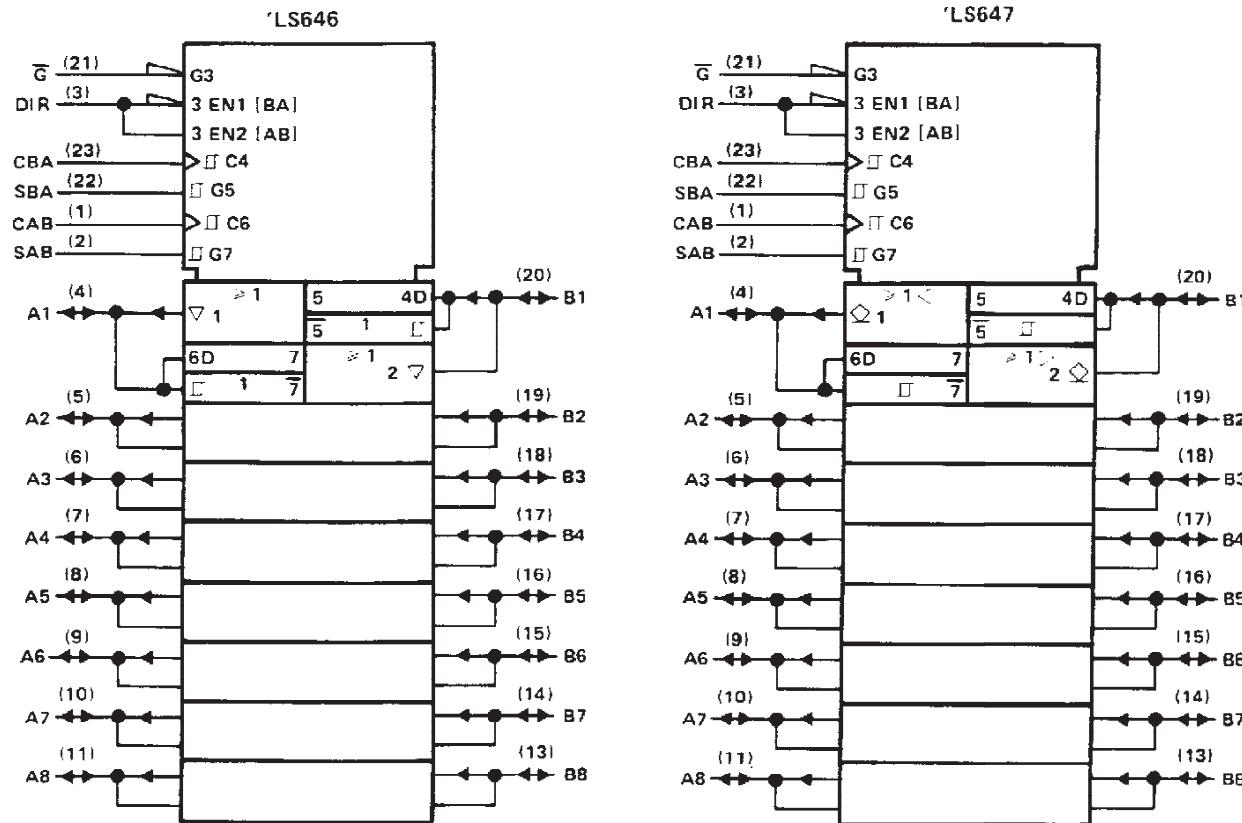


Pin numbers shown are for DW, JT, and NT packages.

SN54LS646, SN54LS647, SN74LS646, SN74LS647 OCTAL BUS TRANSCEIVERS AND REGISTERS

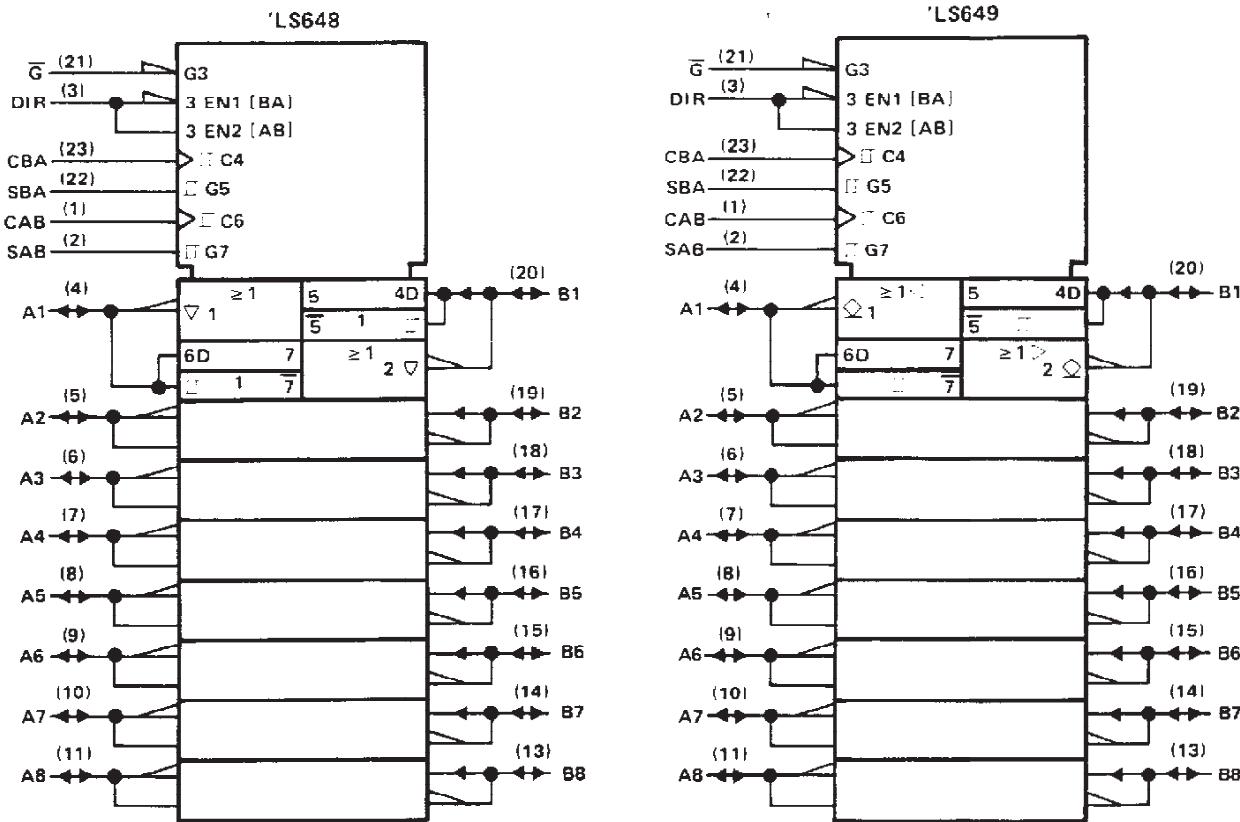
SDLS190A – DECEMBER 1982 – REVISED MAY 2004

logic symbols†



†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.

logic symbols[†] (continued)

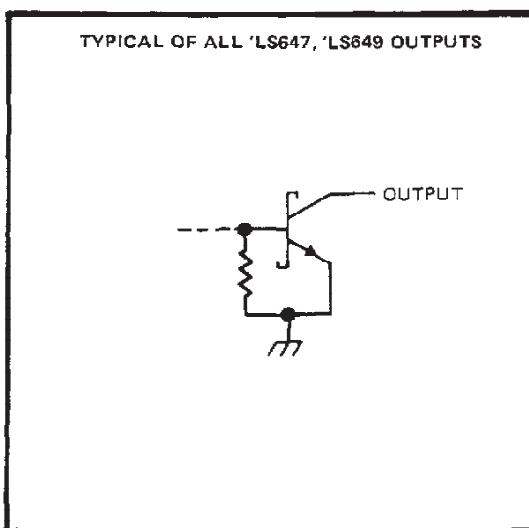
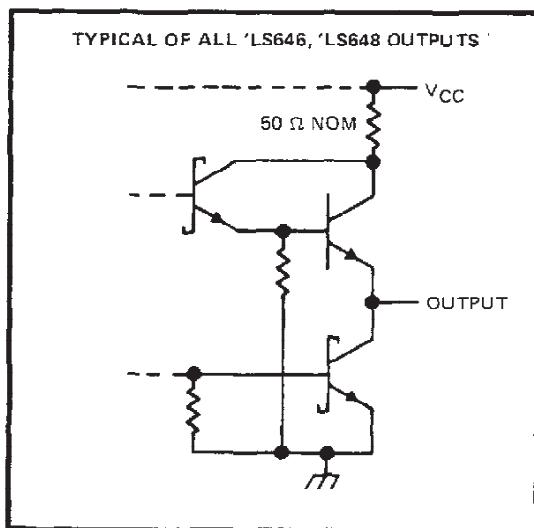
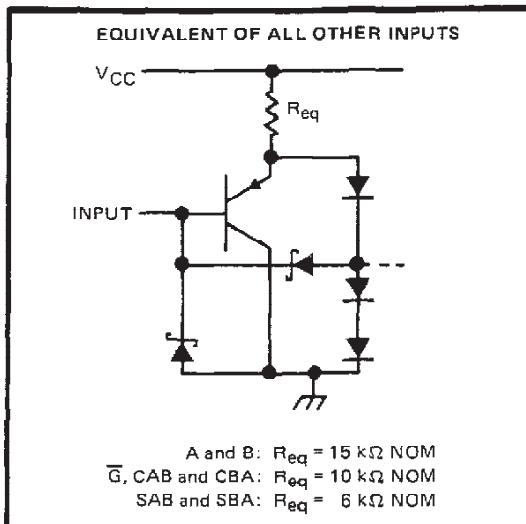
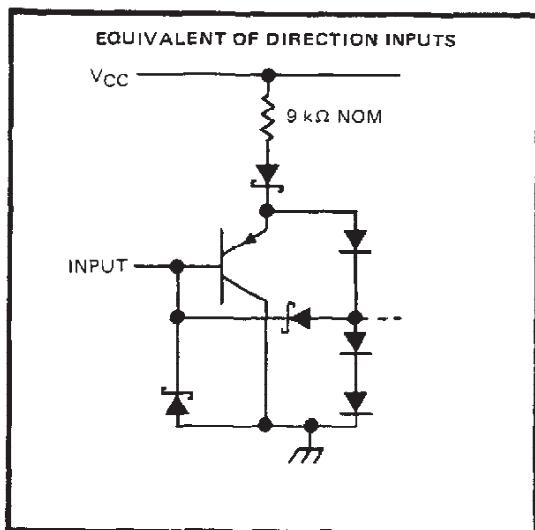


[†]These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers shown are for DW, JT, and NT packages.

SN54LS646 THRU SN54LS649 SN74LS646 THRU SN74LS649 OCTAL BUS TRANSCEIVERS AND REGISTERS

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schematics of inputs and outputs



SN54LS646, SN54LS648, SN74LS646, SN74LS648 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)

recommended operating conditions

			SN54LS646/648			SN74LS646/648			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V _{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
V _{IH}	High-level input voltage		2			2			V
V _{IL}	Low-level input voltage				0.5			0.6	V
I _{OH}	High-level output current				-12			-15	mA
I _{OL}	Low-level output current				12			24	mA
t _w	Pulse duration	CBA or CAB high			15			15	ns
		CBA or CAB low			30			30	
		Data high or low			30			30	
t _{su}	Setup time before CAB↑ or CBA↑	A or B			15			15	ns
t _h	Hold time after CAB↑ or CBA↑	A or B			0			0	
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 [†]			SN54LS646/648			SN74LS646/648			UNIT	
					MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX		
V _{IK}		V _{CC} = MIN, I _I = -18 mA			-1.5			-1.5			V	
Hysteresis (V _{T+} - V _{T-})	A or B input	V _{CC} = MIN			0.1	0.4		0.2	0.4		V	
V _{OH}		V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX			I _{OH} = -3 mA	2.4	3.4	2.4	3.4		V	
					I _{OH} = -12 mA	2						
					I _{OH} = -15 mA			2				
V _{OL}		V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX			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} = MAX, V _I = 7 V			0.1			0.1			mA	
	A or B ports	V _{CC} = MAX, V _I = 5.5 V			0.1			0.1				
I _{IH}	Control inputs	V _{CC} = MAX, V _I = 2.7 V			20			20			μA	
	A or B ports [†]				20			20				
I _{IL}	Control inputs	V _{CC} = MAX, V _I = 0.4 V			-0.4			-0.4			mA	
	A or B ports [†]				-0.4			-0.4				
I _{OS} [§]		V _{CC} = MAX, V _O = 0 V			-40	-225	-40	-225	-40	-225	mA	
I _{CC}	LS646	V _{CC} = MAX	Outputs high		91	145		91	145		mA	
			Outputs low		103	165		103	165			
			Outputs disabled		103	165		103	165			
	LS648		Outputs high		91	145		91	145			
			Outputs low		103	165		103	165			
			Outputs disabled		120	180		120	180			

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

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

5 Not more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.

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

SN54LS646, SN54LS648, SN74LS646, SN74LS648 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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switching characteristics, $V_{CC} = 5$ V, $T_A = 25^\circ C$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS646			'LS648			UNIT			
				MIN	TYP	MAX	MIN	TYP	MAX				
t _{PLH}	CAB or CBA	A or B	$R_L = 667 \Omega$, $C_L = 45 \text{ pF}$, See Note 2	15	25		15	25	ns				
t _{PHL}				23	35		24	40	ns				
t _{PLH}		B or A		12	18		12	18	ns				
t _{PHL}				13	20		15	25	ns				
t _{PLH}		SAB or SBA [†] with Bus input high		26	40		37	55	ns				
t _{PHL}				21	35		24	40	ns				
t _{PLH}				33	50		26	40	ns				
t _{PHL}				14	25		23	40	ns				
t _{PZH}				33	55		30	50	ns				
t _{PZL}	G	A or B	$R_L = 667 \Omega$, $C_L = 5 \text{ pF}$, See Note 2	42	65		37	55	ns				
t _{PZH}				28	45		23	40	ns				
t _{PZL}		DIR		39	60		30	45	ns				
t _{PHZ}	G			23	35		28	45	ns				
t _{PLZ}				22	35		22	35	ns				
t _{PHZ}	DIR			20	30		24	35	ns				
t _{PLZ}				19	30		19	30	ns				

[†] These parameters are measured with the internal output state of the storage register opposite to that of the input.

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

SN54LS647, SN54LS649, SN74LS647, SN74LS649 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH OPEN-COLLECTOR OUTPUTS

SDLS190A – DECEMBER 1982 – REVISED MAY 2004

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

recommended operating conditions

			SN54LS647			SN74LS647			UNIT
			SN54LS649			SN74LS649			
	MIN	NOM	MAX	MIN	NOM	MAX			
V _{CC} Supply voltage	4.5	5	5.5	4.75	5	5.25			V
V _{IH} High-level input voltage		2		2					V
V _{IL} Low-level input voltage				0.5			0.6		V
V _{OH} High-level output voltage				5.5			5.5		V
V _{OL} Low-level output voltage				12			24		mA
t _w Pulse duration	CBA or CAB high			15		15		ns	
	CBA or CAB low			30		30			
	Data high or low			30		30			
t _{su}	Setup time before CAB↑ or CBA↑	A or B			15		15		ns
t _h	Hold time after CAB↑ or CBA↑	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 [†]	SN54LS647			SN74LS647			UNIT
			MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
V _{IK}		V _{CC} = MIN, I _I = -18 mA			-1.5	-1.5			V
Hysteresis (V _{T+} - V _{T-})	A or B input	V _{CC} = MIN			0.1	0.4	0.2	0.4	V
I _{OH}		V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX, V _{OH} = 5.5 V			0.1			0.1	mA
V _{OL}		V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX		I _{OL} = 12 mA	0.25	0.4	0.25	0.4	V
I _I	A or B	V _{CC} = MAX		V _I = 5.5 V	0.1			0.1	mA
	All others			V _I = 7 V	0.1			0.1	
I _{IH}		V _{CC} = MAX, V _I = 2.7 V			20			20	μA
I _{IL}		V _{CC} = MAX, V _I = 0.4 V			-0.4			-0.4	mA
I _{CC}	'LS647	V _{CC} = MAX, Outputs open		Outputs high	79	130	79	130	mA
	'LS649	V _{CC} = MAX, Outputs open		Outputs low	94	150	94	150	
	'LS647			Outputs high	79	130	79	130	
	'LS649			Outputs low	94	150	94	150	

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

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

SN54LS647, SN54LS649, SN74LS647, SN74LS649
OCTAL BUS TRANSCEIVERS AND REGISTERS WITH OPEN-COLLECTOR OUTPUTS

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switching characteristics, $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS647			'LS649			UNIT	
				MIN	TYP	MAX	MIN	TYP	MAX		
t_{PLH}	CAB or CBA	A or B	$R_L = 667 \Omega$, $C_L = 45 \text{ pF}$, See Note 2	22	35		17	30		ns	
t_{PHL}				28	45		28	45		ns	
t_{PLH}	A or B	B or A		17	26		15	25		ns	
t_{PHL}				18	27		20	30		ns	
t_{PLH}	SAB or SBA [†] with Bus input high	A or B		33	50		37	55		ns	
t_{PHL}	SAB or SBA [†] with Bus input low			29	46		28	45		ns	
t_{PLH}				39	60		30	45		ns	
t_{PHL}				19	30		26	40		ns	
t_{PLH}	G	A or B		25	40		21	40		ns	
t_{PHL}				33	50		34	50		ns	
t_{PLH}	DIR			23	35		19	30		ns	
t_{PHL}				25	40		27	45		ns	

[†] These parameters are measured with the internal outputs state of the storage register opposite to that of the bus input.

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74LS646DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS646DWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS646DWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS646DWRE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS646NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS646NT3	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI
SN74LS646NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS647DW	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI
SN74LS647NT	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI
SN74LS648DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS648DWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS648NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS648NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS649NT	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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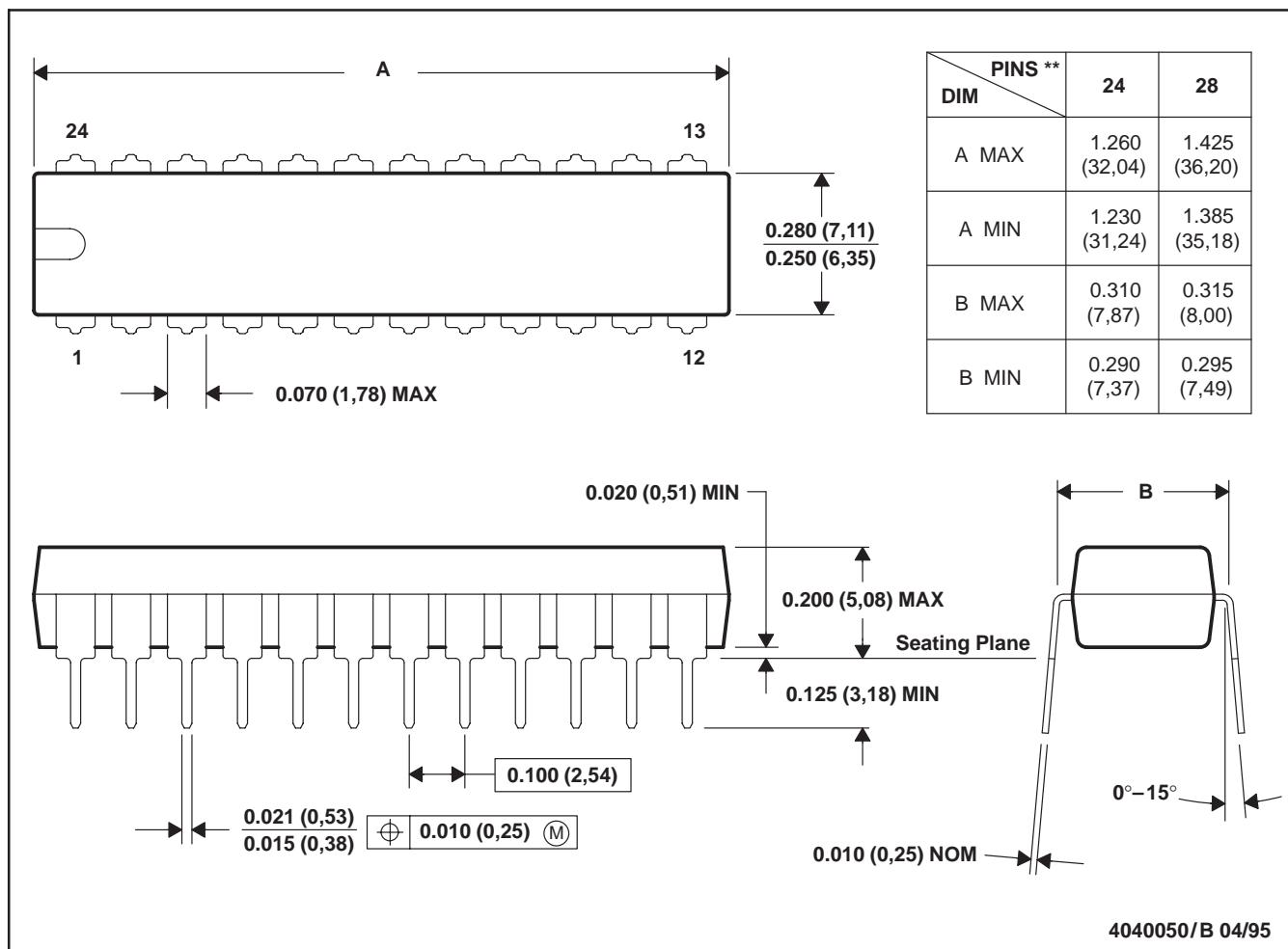
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NT (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

24 PINS SHOWN

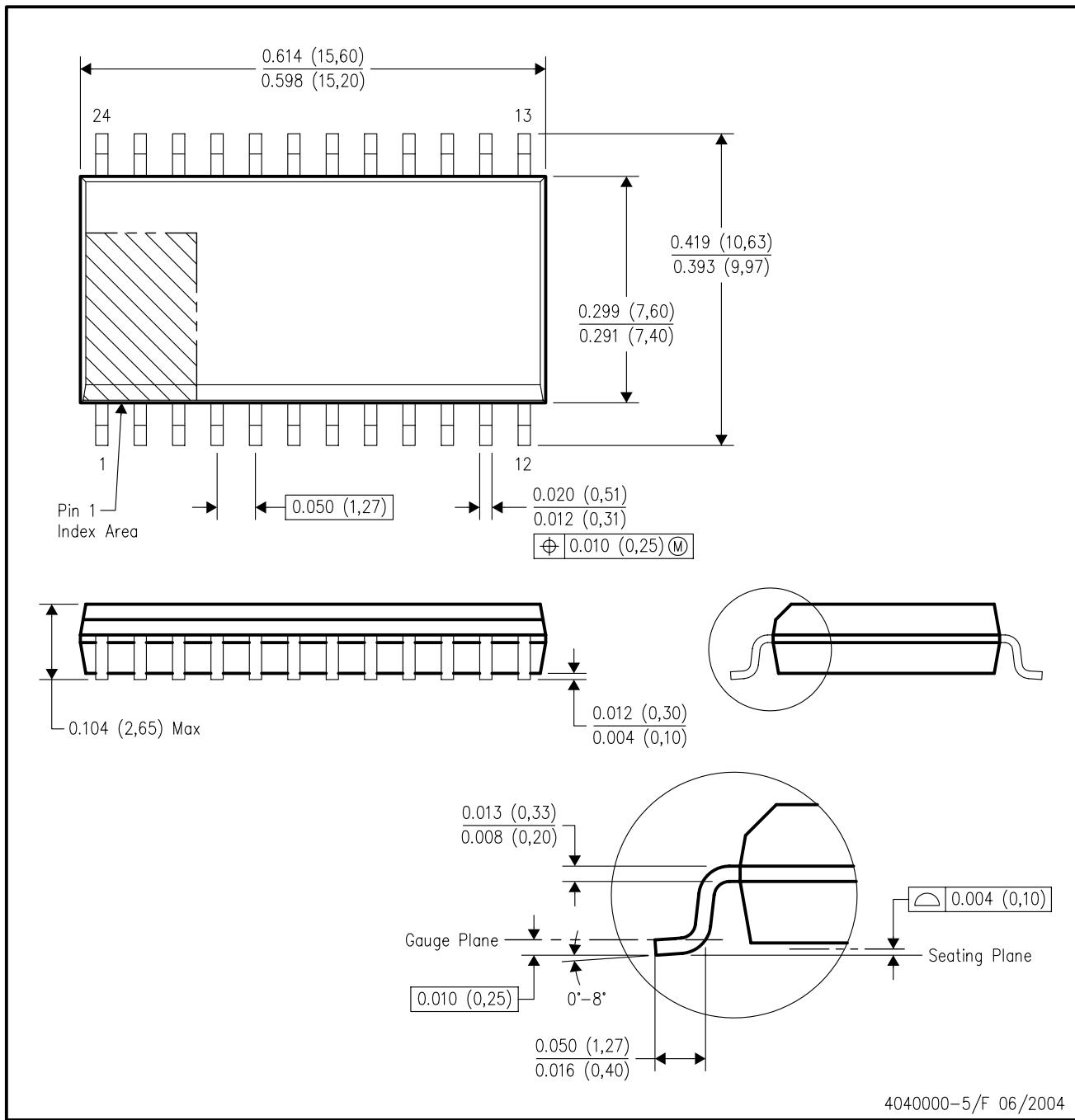


NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

DW (R-PDSO-G24)

PLASTIC SMALL-OUTLINE PACKAGE



NOTES:

- All linear dimensions are in inches (millimeters).
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0.15).
- Falls within JEDEC MS-013 variation AD.

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