

# SN54ALS646, SN54ALS648, SN54AS646 SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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- 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 (DW) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs

DEVICE	OUTPUT	LOGIC
SN54ALS646, SN74ALS646A, 'AS646	3 state	True
SN54ALS648, SN74ALS648A, SN74AS648	3 state	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 is clocked into the registers on the low-to-high transition of the appropriate clock (CLKAB or CLKBA) input. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the octal bus transceivers and registers.

Output-enable ( $\overline{OE}$ ) and direction-control (DIR) inputs control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either or both registers.

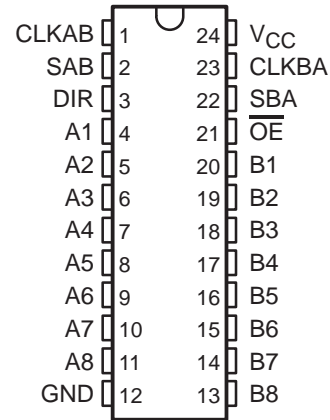
The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. DIR determines which bus receives data when  $\overline{OE}$  is low. In the isolation mode ( $\overline{OE}$  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 can be used to store and transmit data. Only one of the two buses, A or B, may be driven at a time.

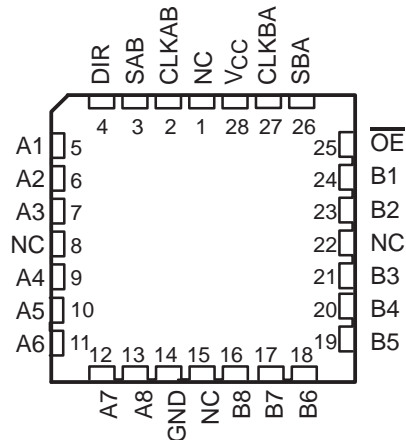
The -1 version of the SN74ALS646A is identical to the standard version, except that the recommended maximum  $I_{OL}$  in the -1 version is increased to 48 mA. There are no -1 versions of the SN54ALS646, SN54ALS648, or SN74ALS648A.

The SN54ALS646, SN54ALS648, and SN54AS646 are characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS646A, SN74ALS648A, SN74AS646, and SN74AS648 are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN54ALS646, SN54ALS648, SN54AS646 . . . JT PACKAGE  
SN74ALS646A, SN74ALS648A, SN74AS646,  
SN74AS648 . . . DW OR NT PACKAGE  
(TOP VIEW)



SN54ALS646, SN54ALS648, SN54AS646 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

SN54ALS646, SN54ALS648, SN54AS646  
 SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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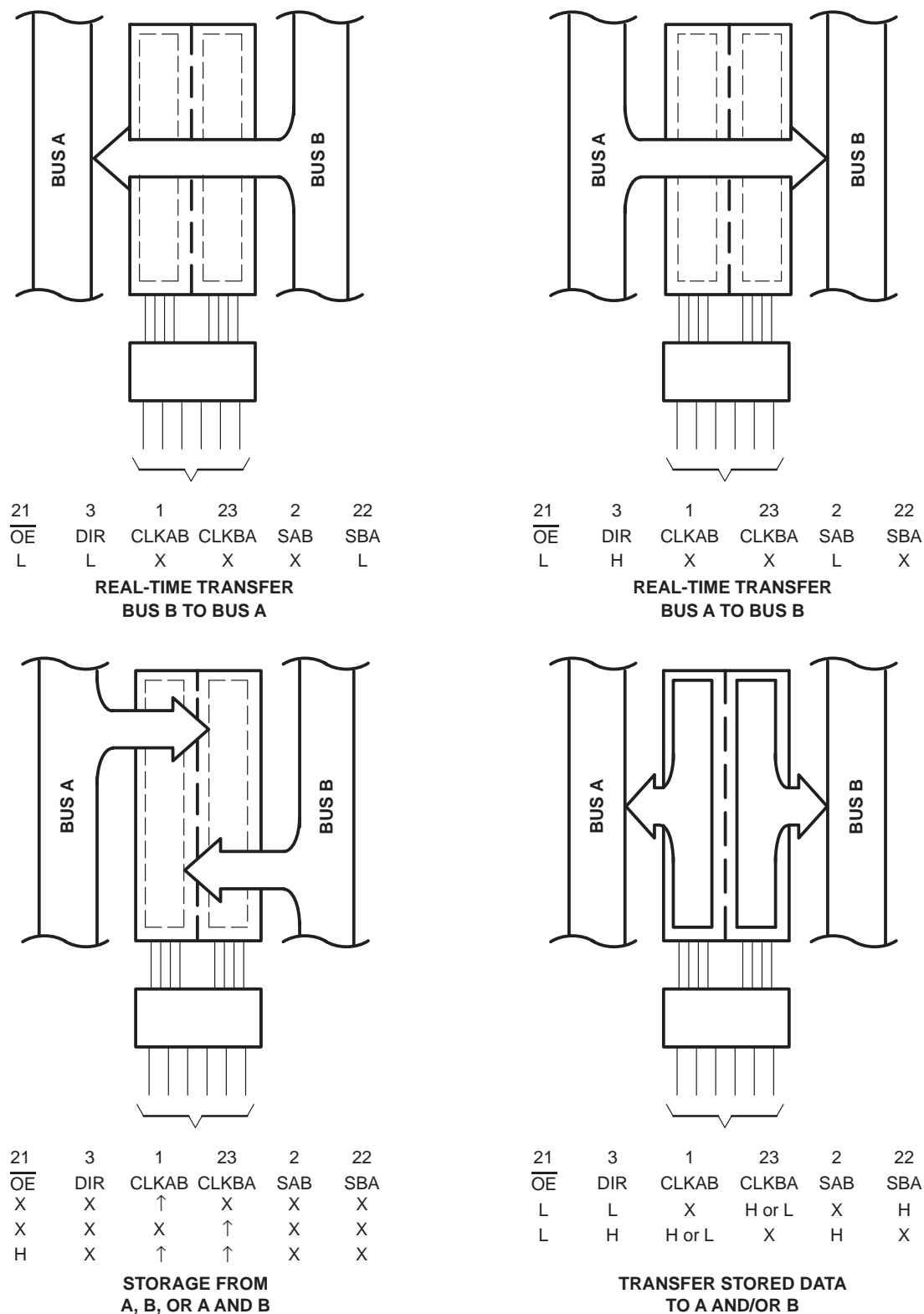


Figure 1. Bus-Management Functions

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

SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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**Function Tables**

**SN54ALS646, SN54AS646, SN74ALS646A, SN74AS646**

INPUTS						DATA I/O		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
X	X	↑	X	X	X	Input	Unspecified <sup>†</sup>	Store A, B unspecified <sup>†</sup>
X	X	X	↑	X	X	Unspecified <sup>†</sup>	Input	Store B, A unspecified <sup>†</sup>
H	X	↑	↑	X	X	Input	Input	Store A and B data
H	X	H or L	H or L	X	X	Input disabled	Input disabled	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
L	H	X	X	L	X	Input	Output	Real-time A data to B bus
L	H	H or L	X	H	X	Input	Output	Stored A data to B bus

<sup>†</sup> The data output functions can be enabled or disabled by various signals at  $\overline{OE}$  and DIR. Data input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.

**SN54ALS648, SN74ALS648A, SN74AS648**

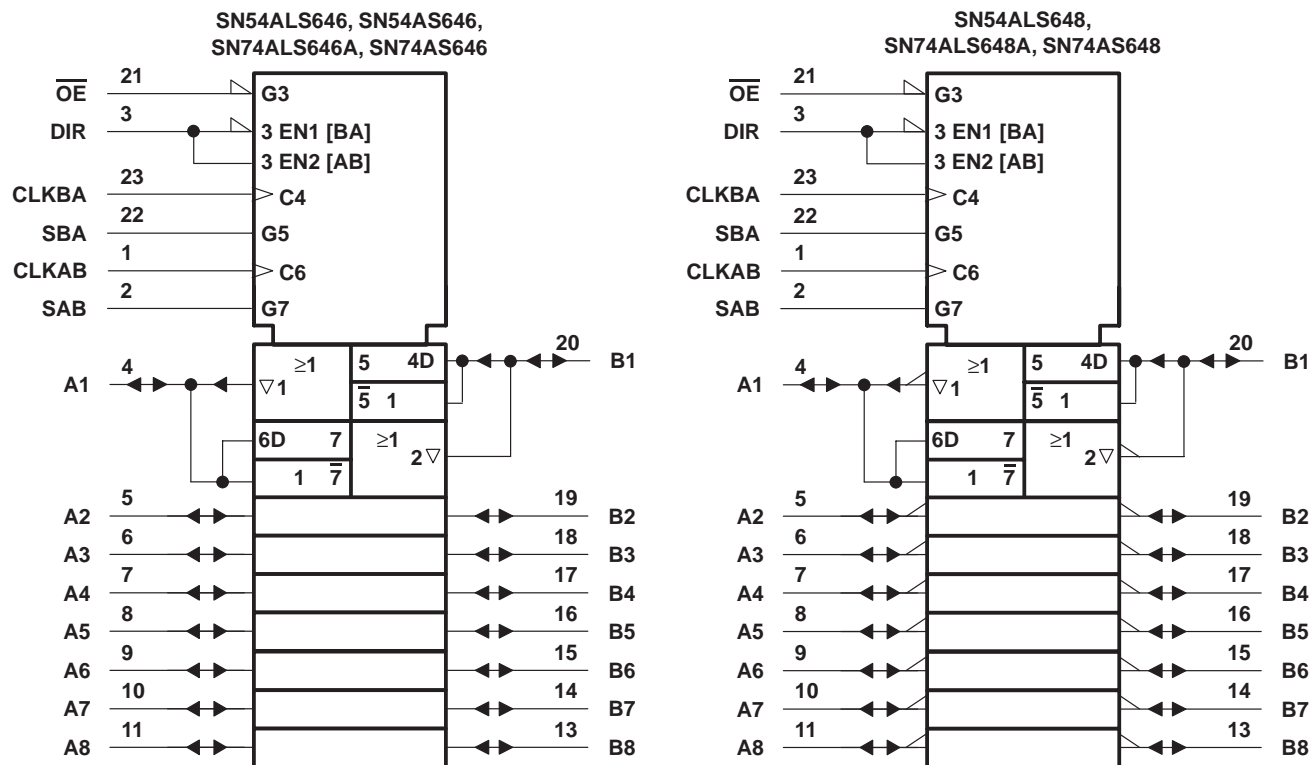
INPUTS						DATA I/O		OPERATION OR FUNCTION
$\overline{OE}$	DIR	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
X	X	↑	X	X	X	Input	Unspecified <sup>†</sup>	Store A, B unspecified <sup>†</sup>
X	X	X	↑	X	X	Unspecified <sup>†</sup>	Input	Store B, A unspecified <sup>†</sup>
H	X	↑	↑	X	X	Input	Input	Store A and B data
H	X	H or L	H or L	X	X	Input disabled	Input disabled	Isolation, hold storage
L	L	X	X	X	L	Output	Input	Real-time $\overline{B}$ data to A bus
L	L	X	H or L	X	H	Output	Input	Stored $\overline{B}$ data to A bus
L	H	X	X	L	X	Input	Output	Real-time $\overline{A}$ data to B bus
L	H	H or L	X	H	X	Input	Output	Stored $\overline{A}$ data to B bus

<sup>†</sup> The data output functions can be enabled or disabled by various signals at  $\overline{OE}$  and DIR. Data input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.

# SN54ALS646, SN54ALS648, SN54AS646 SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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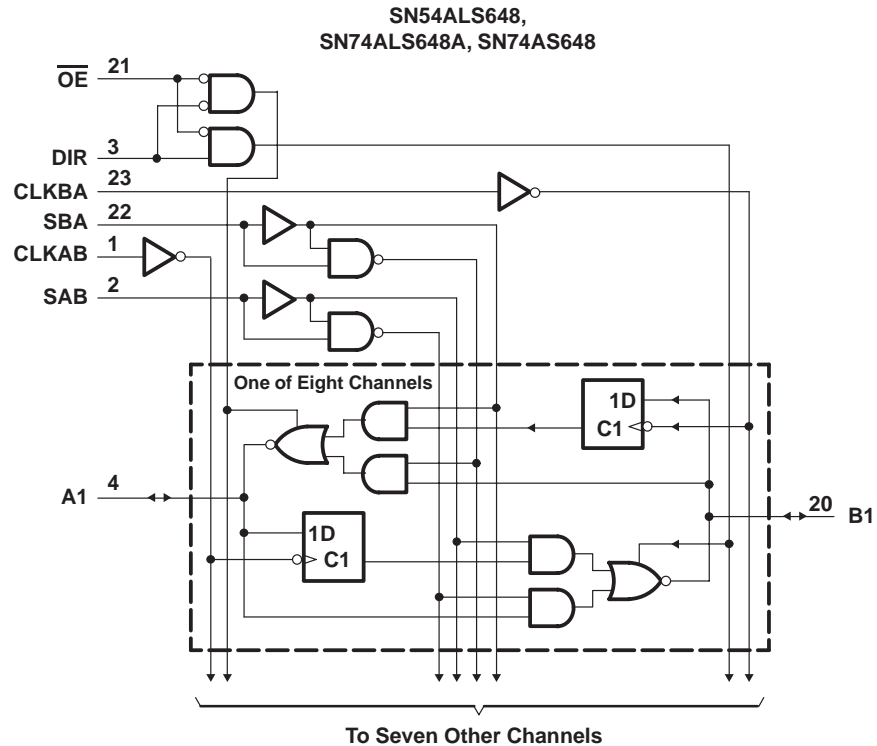
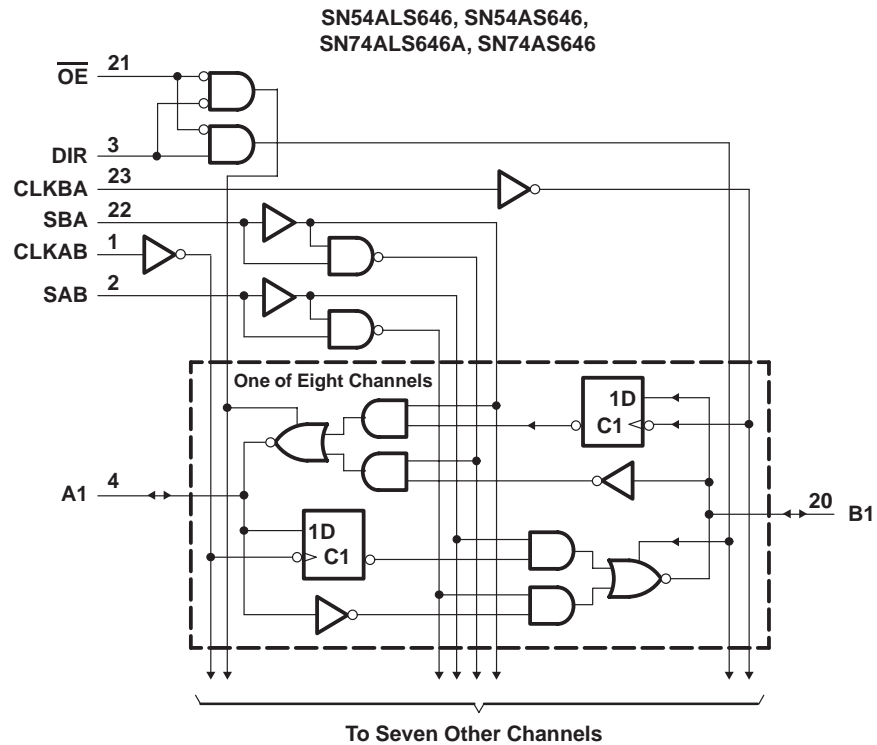
## logic symbols†



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

SN54ALS646, SN54ALS648, SN54AS646  
 SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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logic diagrams (positive logic)



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

**SN54ALS646, SN54ALS648, SN54AS646**  
**SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648**  
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**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>**

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$ : Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range, $T_A$ : SN54ALS646	–55°C to 125°C
SN74ALS646A	0°C to 70°C
Storage temperature range	–65°C to 150°C

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**recommended operating conditions**

		SN54ALS646			SN74ALS646A			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 <sup>‡</sup>	
$f_{clock}$	Clock frequency	0		35	0		40	MHz
$t_w$	Pulse duration, CLKBA or CLKAB high or low	14.5			12.5			ns
$t_{su}$	Setup time, A before CLKAB $\uparrow$ or B before CLKBA $\uparrow$	15			10			ns
$t_h$	Hold time, A after CLKAB $\uparrow$ or B after CLKBA $\uparrow$	0			0			ns
$T_A$	Operating free-air temperature	–55		125	0		70	°C

<sup>‡</sup> Applies only to the -1 version and only if  $V_{CC}$  is maintained between 4.75 V and 5.25

**SN54ALS646, SN54ALS648, SN54AS646**  
**SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS**

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

PARAMETER		TEST CONDITIONS	SN54ALS646			SN74ALS646A			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
V <sub>OH</sub>		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	
			I <sub>OH</sub> = −12 mA		2				
			I <sub>OH</sub> = −15 mA				2		
V <sub>OL</sub>		V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 12 mA		0.25	0.4	0.25	0.4	V
			I <sub>OL</sub> = 24 mA				0.35	0.5	
			I <sub>OL</sub> = 48 mA‡				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>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§		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>O</sub> ¶		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V	−20		−112		−30 −112		mA
I <sub>CC</sub>		V <sub>CC</sub> = 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  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

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

§ 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,  $I_{OS}$ .

SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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switching characteristics (see Figure 2)

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
			SN54ALS646		SN74ALS646A		
			MIN	MAX	MIN	MAX	
f <sub>max</sub>			35		40		MHz
t <sub>PLH</sub>	CLKBA or CLKAB	A or B	10	35	7	30	ns
t <sub>PHL</sub>			5	20	5	17	
t <sub>PLH</sub>	A or B	B or A	5	22	3	20	ns
t <sub>PHL</sub>			3	15	3	12	
t <sub>PLH</sub>	SBA or SAB‡ (stored data low)	A or B	10	40	7	35	ns
t <sub>PHL</sub>			5	23	5	20	
t <sub>PLH</sub>	SBA or SAB‡ (stored data high)	A or B	8	30	6	25	ns
t <sub>PHL</sub>			5	24	5	20	
t <sub>PZH</sub>	OE	A or B	3	20	2	17	ns
t <sub>PZL</sub>			5	22	4	20	
t <sub>PHZ</sub>	OE	A or B	1	12	1	10	ns
t <sub>PLZ</sub>			1	20	2	16	
t <sub>PZH</sub>	DIR	A or B	5	38	3	30	ns
t <sub>PZL</sub>			5	30	4	25	
t <sub>PHZ</sub>	DIR	A or B	1	12	1	10	ns
t <sub>PLZ</sub>			2	21	2	16	

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.



**SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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, $V_I$ : Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range, $T_A$ : SN54ALS648	–55°C to 125°C
SN74ALS648A	0°C to 70°C
Storage temperature range	–65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**recommended operating conditions**

		SN54ALS648			SN74ALS648A			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
$f_{clock}$	Clock frequency	0		35	0		40	MHz
$t_w$	Pulse duration, CLKBA or CLKAB high or low	14.5			12.5			ns
$t_{su}$	Setup time, A before CLKAB↑ or B before CLKBA↑	15			10			ns
$t_h$	Hold time, A after CLKAB↑ or B after CLKBA↑	0			0			ns
$T_A$	Operating free-air temperature	–55		125	0		70	°C



SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		SN54ALS648		SN74ALS648A		UNIT
				MIN	TYP†	MAX	MIN	
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> = −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	
			I <sub>OH</sub> = −12 mA	2				
			I <sub>OH</sub> = −15 mA			2		
V <sub>OL</sub>		V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 12 mA	0.25	0.4	0.25	0.4	V
			I <sub>OL</sub> = 24 mA			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>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‡		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>O</sub> §		V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V	−20	−112	−30	−112	mA	
I <sub>CC</sub>		V <sub>CC</sub> = 5.5 V	Outputs high	47	76	47	76	mA
			Outputs low	57	88	57	88	
			Outputs disabled	57	88	57	88	

† 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.

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

SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
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switching characteristics (see Figure 2)

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
			SN54ALS648		SN74ALS648A		
			MIN	MAX	MIN	MAX	
f <sub>max</sub>			35		40		MHz
t <sub>PLH</sub>	CLKBA or CLKAB	A or B	8	39	7	33	ns
t <sub>PHL</sub>			5	23	5	20	
t <sub>PLH</sub>	A or B	B or A	3	20	2	17	ns
t <sub>PHL</sub>			2	12	2	10	
t <sub>PLH</sub>	SBA or SAB‡ (stored data low)	A or B	5	44	5	39	ns
t <sub>PHL</sub>			4	26	4	22	
t <sub>PLH</sub>	SBA or SAB‡ (stored data high)	A or B	6	30	6	25	ns
t <sub>PHL</sub>			6	25	6	21	
t <sub>PZH</sub>	OE	A or B	4	25	2	22	ns
t <sub>PZL</sub>			4	25	4	22	
t <sub>PHZ</sub>	OE	A or B	1	12	1	10	ns
t <sub>PLZ</sub>			2	21	2	15	
t <sub>PZH</sub>	DIR	A or B	4	35	2	27	ns
t <sub>PZL</sub>			3	25	3	19	
t <sub>PHZ</sub>	DIR	A or B	1	17	1	14	ns
t <sub>PLZ</sub>			2	22	2	15	

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

**SN54ALS646, SN54ALS648, SN54AS646**  
**SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648**  
**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, $V_I$ : Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range, $T_A$ : SN54AS646	–55°C to 125°C
SN74AS646	0°C to 70°C
Storage temperature range	–65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**recommended operating conditions**

			SN54AS646			SN74AS646			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		0.8			0.8			V
I <sub>OH</sub>	High-level output current		−12			−15			mA
I <sub>OL</sub>	Low-level output current		32			48			mA
f <sub>clock</sub> *	Clock frequency		0	75		0	90		MHz
t <sub>w</sub> *	Pulse duration	CLKBA or CLKAB high	6			5			ns
		CLKBA or CLKAB low	7			6			
t <sub>su</sub> *	Setup time, A before CLKAB↑ or B before CLKBA↑		7			6			ns
t <sub>h</sub> *	Hold time, A after CLKAB↑ or B before CLKBA		0			0			ns
T <sub>A</sub>	Operating free-air temperature		−55			125			°C

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.



**SN54ALS646, SN54ALS648, SN54AS646**  
**SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648**  
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**electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	SN54AS646			SN74AS646			UNIT
			MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{IK}$		$V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$			-1.2			-1.2	V
$V_{OH}$		$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ , $I_{OH} = -2\text{ mA}$	$V_{CC} - 2$			$V_{CC} - 2$			V
		$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -3\text{ mA}$	2.4	3.2		2.4	3.2		
		$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -12\text{ mA}$	2						
		$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -15\text{ mA}$				2			
$V_{OL}$		$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 32\text{ mA}$	0.25	0.5					V
		$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 48\text{ mA}$				0.35	0.5		
$I_I$	Control inputs	$V_{CC} = 5.5\text{ V}$ , $V_I = 7\text{ V}$			0.1			0.1	mA
	A or B ports	$V_{CC} = 5.5\text{ V}$ , $V_I = 5.5\text{ V}$			0.1			0.1	
$I_{IH}$	Control inputs	$V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$			20			20	$\mu\text{A}$
	A or B ports‡				70			70	
$I_{IL}$	Control input	$V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$			-0.5			-0.5	mA
	A or B ports‡				-0.75			-0.75	
$I_{OS}§$		$V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$	-30		-112	-30		-112	mA
$I_{CC}$		$V_{CC} = 5.5\text{ V}$ , Outputs high	120	195		120	195		mA
		$V_{CC} = 5.5\text{ V}$ , Outputs low	130	211		130	211		
		$V_{CC} = 5.5\text{ V}$ , Outputs disabled	130	211		130	211		

† 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.

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

SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS  
SDAS039F – DECEMBER 1983 – REVISED JANUARY 1995

switching characteristics (see Figure 2)

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	
f <sub>max</sub> *			75		90		MHz
t <sub>PLH</sub>	CLKBA or CLKAB	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	11.5	2	9	ns
t <sub>PHL</sub>			1	8	1	7	
t <sub>PLH</sub>	SBA or SAB‡	A or B	2	13.5	2	11	ns
t <sub>PHL</sub>			2	11	2	9	
t <sub>PZH</sub>	$\overline{OE}$	A or B	2	11	2	9	ns
t <sub>PZL</sub>			3	15	3	14	
t <sub>PHZ</sub>	$\overline{OE}$	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	21	3	16	ns
t <sub>PZL</sub>			3	24	3	18	
t <sub>PHZ</sub>	DIR	A or B	2	12	2	10	ns
t <sub>PLZ</sub>			2	12	2	10	

\* On products compliant to MIL-STD-883, Class B, this parameter is based on characterization data but is not production tested.

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.

SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
**OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS**

SDAS039F – DECEMBER 1983 – REVISED JANUARY 1995

**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>**

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$ : Control inputs	7 V
I/O ports	5.5 V
Operating free-air temperature range, $T_A$ : SN74AS648	0°C to 70°C
Storage temperature range	–65°C to 150°C

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**recommended operating conditions**

		SN74AS648			UNIT
		MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	V
$V_{IH}$	High-level input voltage	2			V
$V_{IL}$	Low-level input voltage			0.8	V
$I_{OH}$	High-level output current			–15	mA
$I_{OL}$	Low-level output current			48	mA
$f_{clock}$	Clock frequency	0		90	MHz
$t_w$	Pulse duration	CLKBA or CLKAB high		5	ns
		CLKBA or CLKAB low		6	
$t_{su}$	Setup time, A before CLKAB $\uparrow$ or B before CLKBA $\uparrow$	6			ns
$t_h$	Hold time, A after CLKAB $\uparrow$ or B before CLKBA	0			ns
$T_A$	Operating free-air temperature	0		70	°C

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

PARAMETER		TEST CONDITIONS		SN74AS648		UNIT
				MIN	TYP <sup>‡</sup>	MAX
$V_{IK}$		$V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$				–1.2
$V_{OH}$		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$ , $I_{OH} = -2\text{ mA}$		$V_{CC} - 2$		V
		$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -3\text{ mA}$		2.4	3.2	
		$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -15\text{ mA}$		2		
$V_{OL}$		$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 48\text{ mA}$		0.35	0.5	V
$I_I$	Control inputs	$V_{CC} = 5.5\text{ V}$	$V_I = 7\text{ V}$			0.1
	A or B ports		$V_I = 5.5\text{ V}$			0.1
$I_{IH}$	Control inputs	$V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$				20
	A or B ports <sup>§</sup>					70
$I_{IL}$	Control input	$V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$				–0.5
	A or B ports <sup>§</sup>					–0.75
$I_{O\uparrow}$		$V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$		–30		–112
$I_{CC}$		$V_{CC} = 5.5\text{ V}$	Outputs high		110	185
			Outputs low		120	195
			Outputs disabled		120	195

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

<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,  $I_{OS}$ .



SN54ALS646, SN54ALS648, SN54AS646  
SN74ALS646A, SN74ALS648A, SN74AS646, SN74AS648  
OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS  
SDAS039F – DECEMBER 1983 – REVISED JANUARY 1995

switching characteristics (see Figure 2)

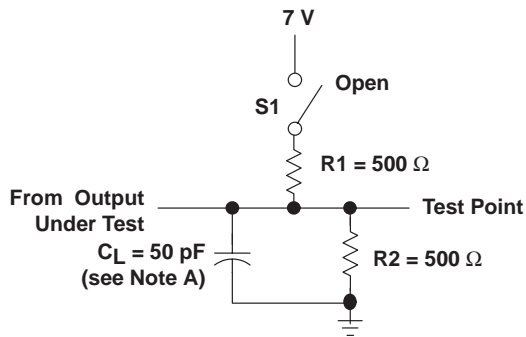
PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = MIN to MAX†		UNIT
			SN74AS648		
			MIN	MAX	
f <sub>max</sub>			90		MHz
t <sub>PLH</sub>	CLKBA or CLKAB	A or B	2	8.5	ns
t <sub>PHL</sub>			2	9	
t <sub>PLH</sub>	A or B	B or A	2	8	ns
t <sub>PHL</sub>			1	7	
t <sub>PLH</sub>	SBA or SAB‡	A or B	2	11	ns
t <sub>PHL</sub>			2	9	
t <sub>PZH</sub>	$\overline{OE}$	A or B	2	9	ns
t <sub>PZL</sub>			3	15	
t <sub>PHZ</sub>	$\overline{OE}$	A or B	2	9	ns
t <sub>PLZ</sub>			2	9	
t <sub>PZH</sub>	DIR	A or B	3	16	ns
t <sub>PZL</sub>			3	18	
t <sub>PHZ</sub>	DIR	A or B	2	10	ns
t <sub>PLZ</sub>			2	10	

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

‡ These parameters are measured with the internal output state of the storage register opposite that of the bus input.



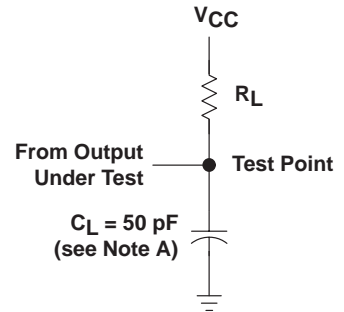
## PARAMETER MEASUREMENT INFORMATION



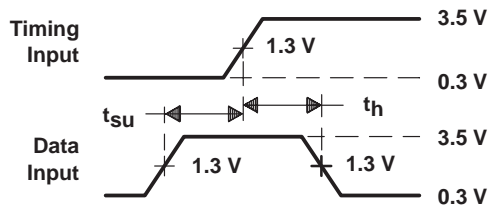
**LOAD CIRCUIT  
FOR 3-STATE OUTPUTS**

**SWITCH POSITION TABLE**

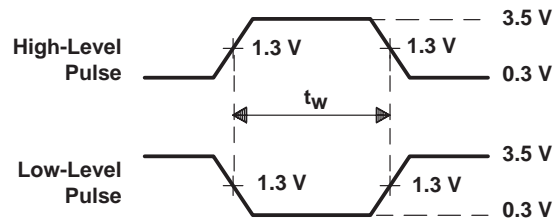
TEST	S1
$t_{PLH}$	Open
$t_{PHL}$	Open
$t_{PZH}$	Open
$t_{PZL}$	Closed
$t_{PHZ}$	Open
$t_{PLZ}$	Closed



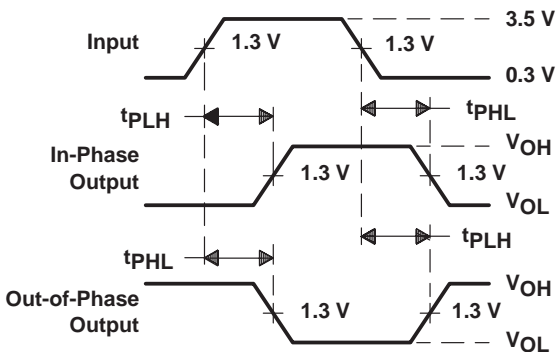
**LOAD CIRCUIT  
FOR OPEN-COLLECTOR OUTPUTS**



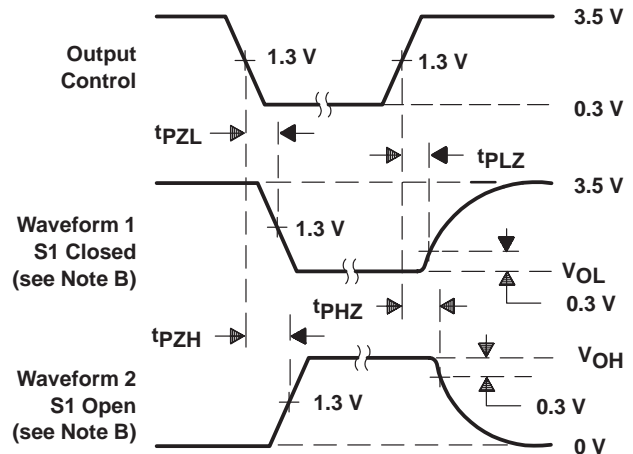
**VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS  
PULSE DURATION**



**VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS**

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2 \text{ ns}$ ,  $t_f \leq 2 \text{ ns}$ .  
D. The outputs are measured one at a time with one transition per measurement.

**Figure 2. Load Circuits and Voltage Waveforms**

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-87595013A	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
5962-8759501KA	ACTIVE	CFP	W	24	1	TBD	A42	N / A for Pkg Type
5962-8759501LA	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
5962-89956013A	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
5962-8995601LA	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
5962-9052301LA	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SN54AS646JT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SN74ALS646A-1DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646A-1DWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646A-1DWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646A-1DWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646A-1DWRE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646A-1DWRG4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646A-1NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ALS646A-1NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ALS646ADW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646ADWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646ADWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646ADWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646ADWRE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646ADWRG4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS646ANT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ALS646ANTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ALS648ADW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS648ADWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS648ADWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74ALS648ANT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74ALS648ANTE4	ACTIVE	PDIP	NT	24	15	Pb-Free	CU NIPDAU	N / A for Pkg Type

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
(RoHS)								
SN74AS646DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS646DWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS646DWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS646NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74AS646NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74AS648DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS648DWE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS648DWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74AS648NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74AS648NT3	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI
SN74AS648NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SNJ54ALS646FK	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54ALS646JT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SNJ54ALS646W	OBSOLETE	CFP	W	24		TBD	Call TI	Call TI
SNJ54ALS648FK	OBSOLETE	LCCC	FK	24		TBD	Call TI	Call TI
SNJ54ALS648JT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SNJ54ALS648W	OBSOLETE	CFP	W	24		TBD	Call TI	Call TI
SNJ54AS646FK	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54AS646JT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type
SNJ54AS646W	ACTIVE	CFP	W	24	1	TBD	A42	N / A for Pkg Type

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

temperature.

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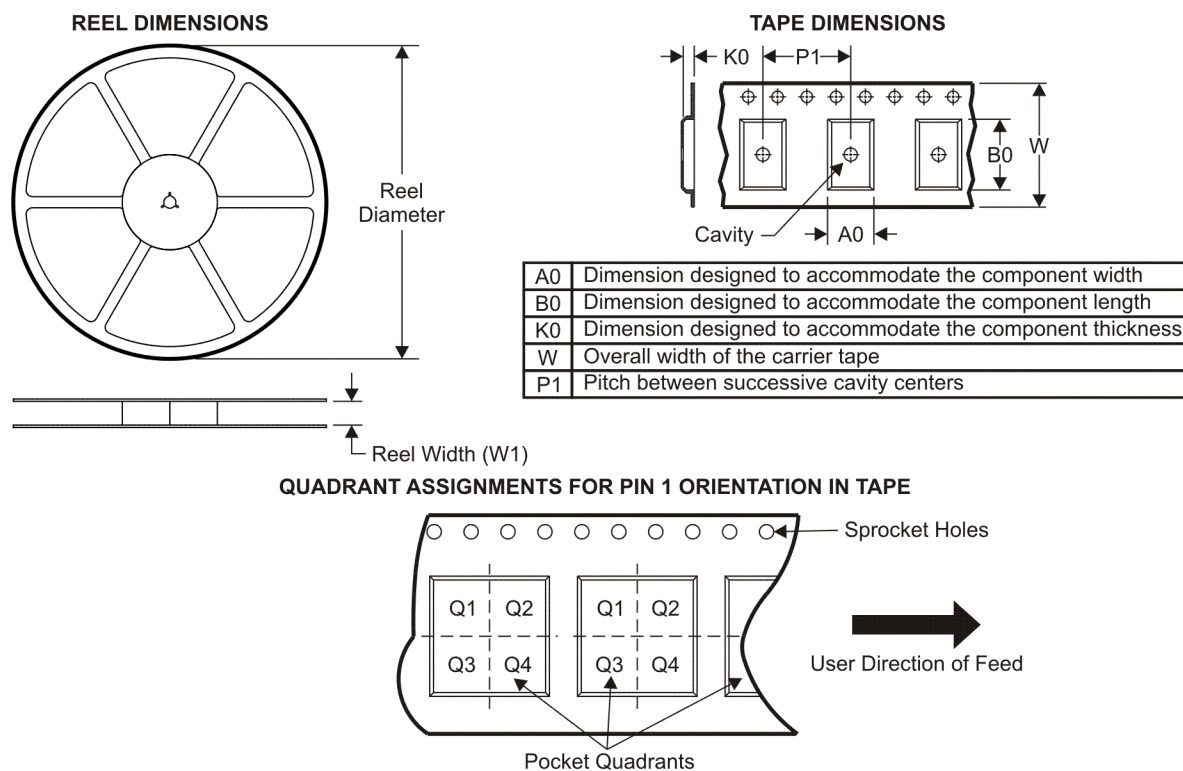
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF SN54ALS646, SN54ALS648, SN54AS646, SN74AS646 :**

- Catalog: [SN74ALS646](#), [SN74ALS648](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74ALS646A-1DWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
SN74ALS646ADWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1

## TAPE AND REEL BOX DIMENSIONS



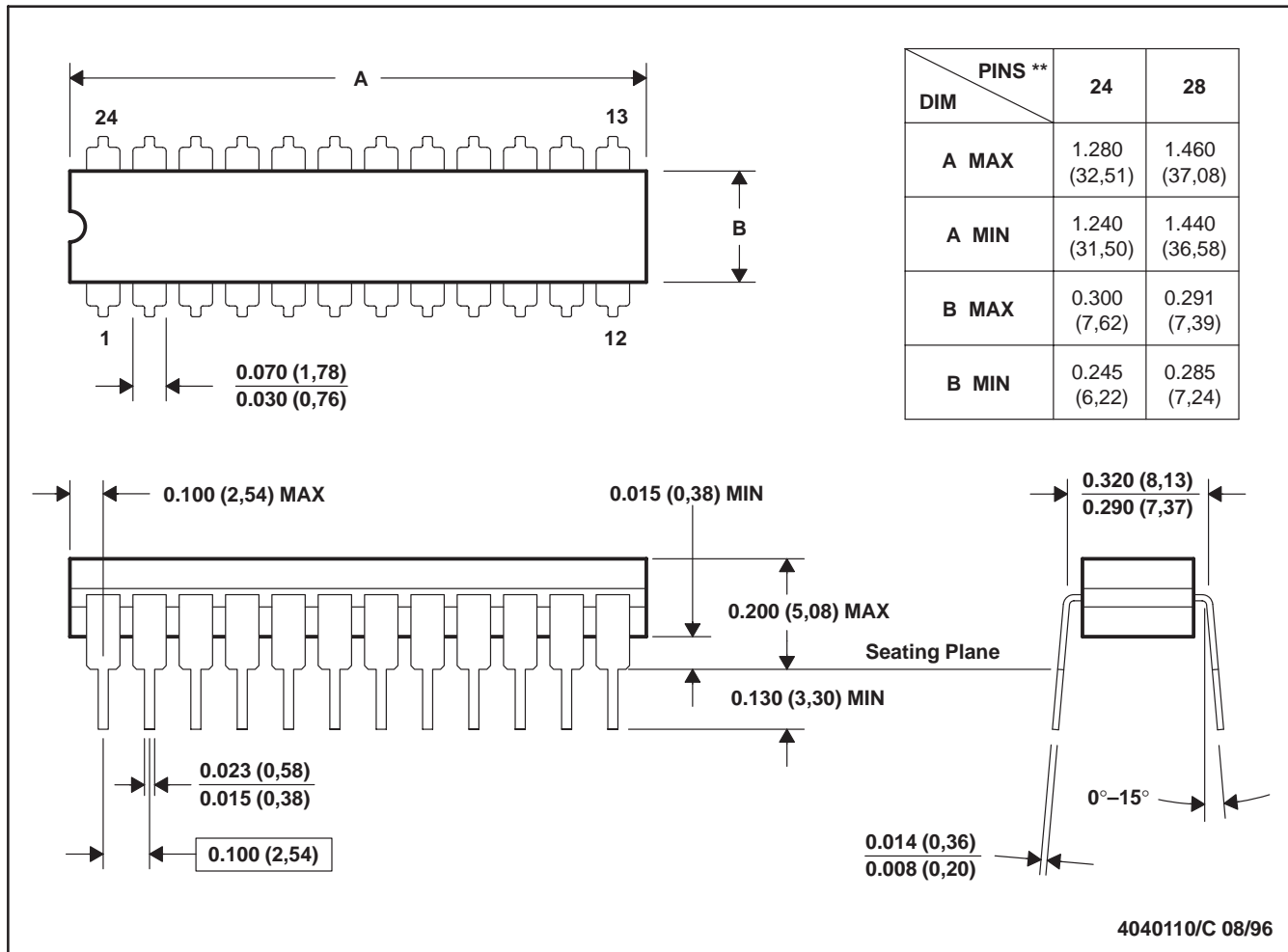
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALS646A-1DWR	SOIC	DW	24	2000	346.0	346.0	41.0
SN74ALS646ADWR	SOIC	DW	24	2000	346.0	346.0	41.0

## JT (R-GDIP-T\*\*)

24 LEADS SHOWN

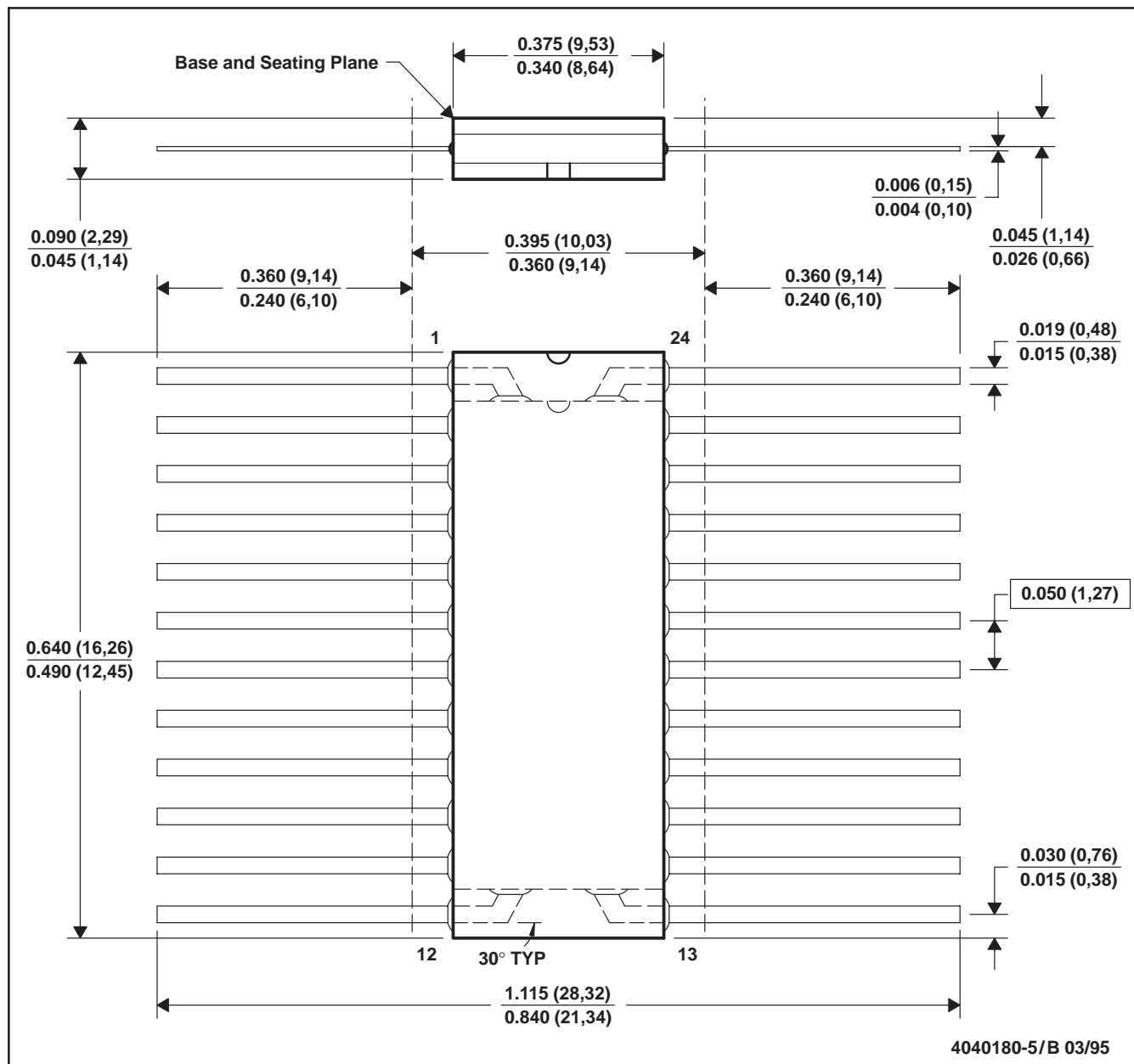
## CERAMIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. This package can be hermetically sealed with a ceramic lid using glass frit.  
 D. Index point is provided on cap for terminal identification.  
 E. Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

## W (R-GDFP-F24)

## CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Falls within MIL-STD-1835 GDFP2-F24 and JEDEC MO-070AD
  - E. Index point is provided on cap for terminal identification only.



FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



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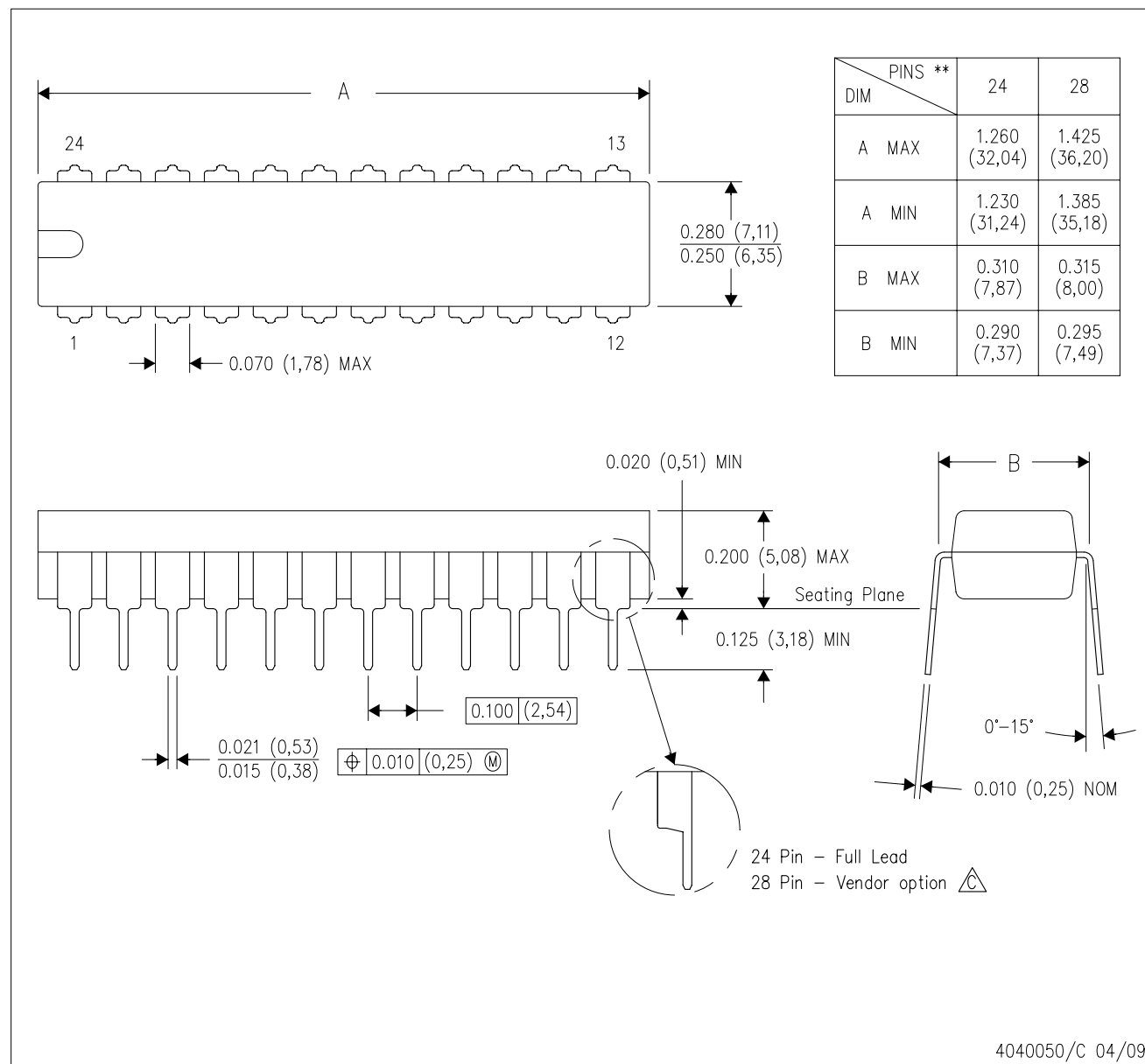
- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

# MECHANICAL DATA

NT (R-PDIP-T\*\*)

24 PINS SHOWN

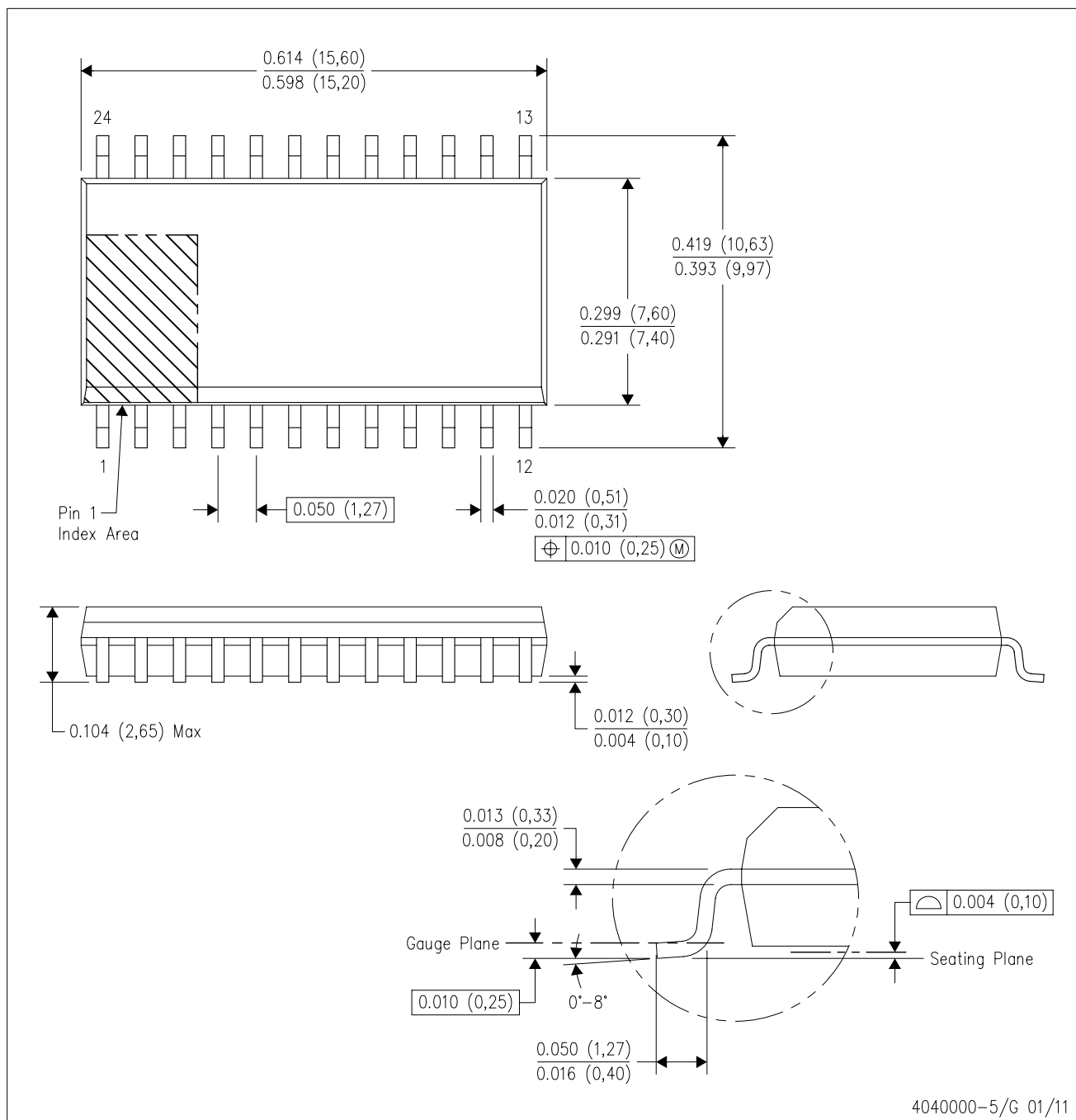
PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - $\triangle C$  The 28 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-013 variation AD.

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