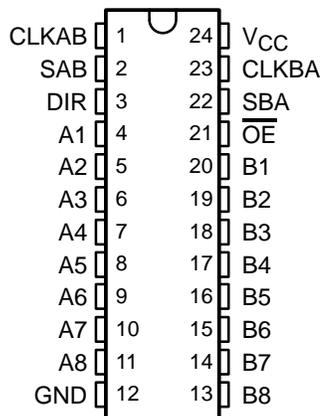


# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

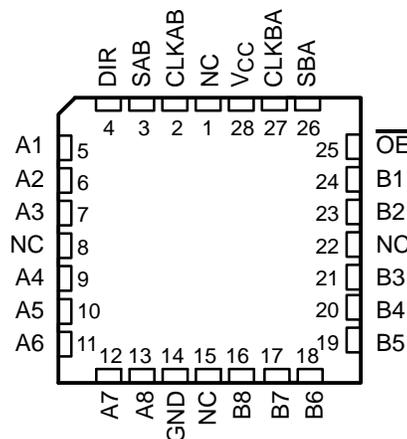
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- Operating Voltage Range of 4.5 V to 5.5 V
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 12$  ns
- $\pm 6$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Inputs Are TTL-Voltage Compatible
- Independent Registers for A and B Buses
- Multiplexed Real-Time and Stored Data
- True Data Paths
- High-Current 3-State Outputs Can Drive Up To 15 LSTTL Loads

SN54HCT646 . . . JT OR W PACKAGE  
SN74HCT646 . . . DW OR NT PACKAGE  
(TOP VIEW)



SN54HCT646 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

## description/ordering information

The 'HCT646 devices consist of bus-transceiver circuits with 3-state 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 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 'HCT646 devices.

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

## ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP – NT	Tube	SN74HCT646NT	SN74HCT646NT
	SOIC – DW	Tube	SN74HCT646DW	HCT646
		Tape and reel	SN74HCT646DWR	
-55°C to 125°C	CDIP – JT	Tube	SNJ54HCT646JT	SNJ54HCT646JT
	CFP – W	Tube	SNJ54HCT646W	SNJ54HCT646W
	LCCC – FK	Tube	SNJ54HCT646FK	SNJ54HCT646FK

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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 **TEXAS  
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# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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## description/ordering information (continued)

The select-control (SAB and SBA) inputs can multiplex stored and real-time (transparent mode) data. DIR determines which bus receives data when  $\overline{OE}$  is active (low). In the isolation mode ( $\overline{OE}$  high), A data can be stored in one register and/or B data can be stored in the other register.

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

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

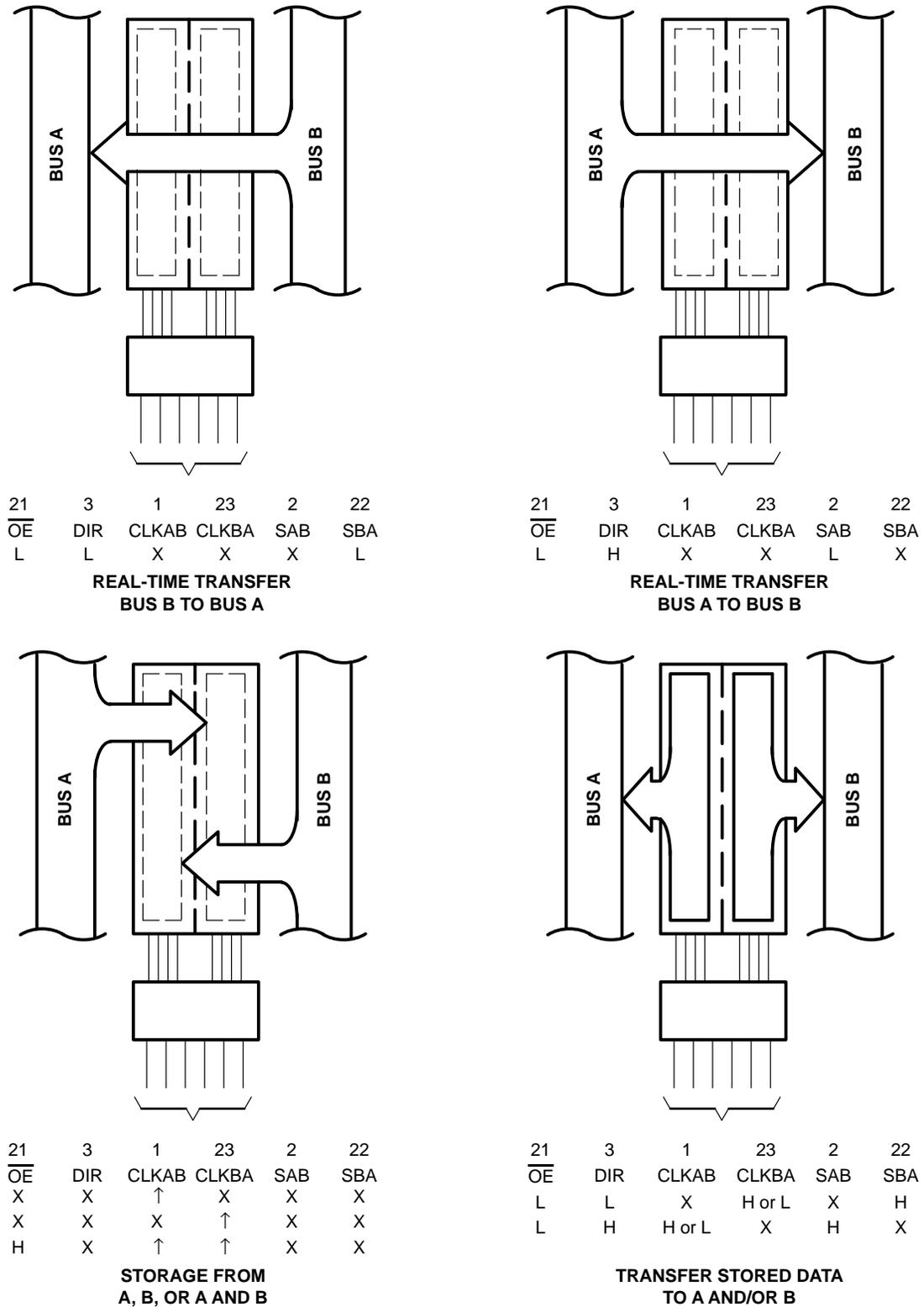
FUNCTION TABLE

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†	Store A, B unspecified†
X	X	X	↑	X	X	Unspecified†	Input	Store B, A unspecified†
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

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

# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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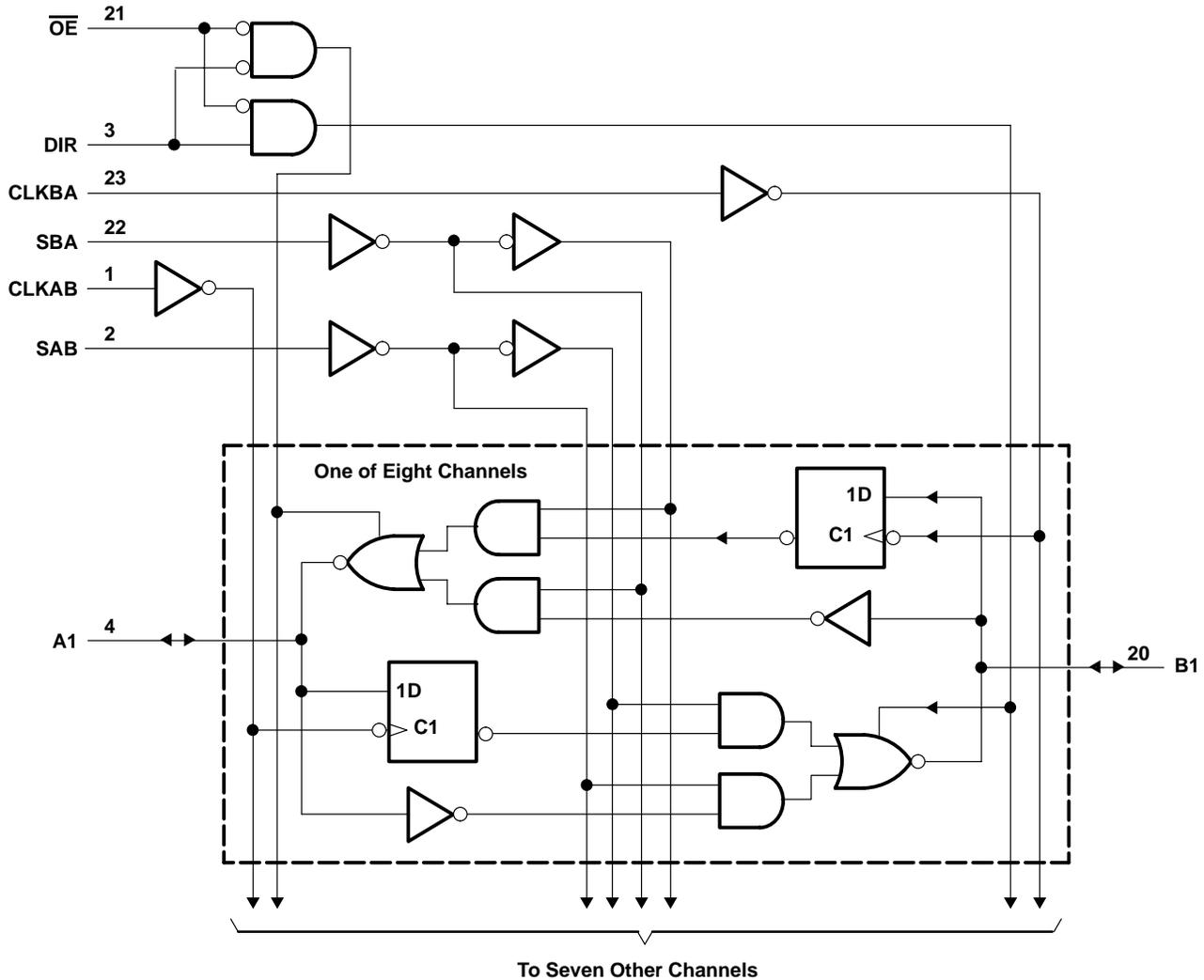
Pin numbers shown are for the DW, JT, NT, and W packages.

Figure 1. Bus-Management Functions

# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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## logic diagram (positive logic)



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

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

Supply voltage range, $V_{CC}$ .....	-0.5 V to 7 V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1) .....	$\pm 20$ mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 35$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 70$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DW package .....	46°C/W
(see Note 3): NT package .....	67°C/W
Storage temperature range, $T_{stg}$ .....	-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.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The package thermal impedance is calculated in accordance with JESD 51-7.  
 3. The package thermal impedance is calculated in accordance with JESD 51-3.



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# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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## recommended operating conditions (see Note 4)

		SN54HCT646			SN74HCT646			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	V <sub>CC</sub> = 4.5 V to 5.5 V			2			V
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V			0.8			V
V <sub>I</sub>	Input voltage	0			V <sub>CC</sub>			V
V <sub>O</sub>	Output voltage	0			V <sub>CC</sub>			V
t <sub>t</sub>	Input transition (rise and fall) time	500			500			ns
T <sub>A</sub>	Operating free-air temperature	-55			125			°C

NOTE 4: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER		TEST CONDITIONS		V <sub>CC</sub>	T <sub>A</sub> = 25°C		SN54HCT646		SN74HCT646		UNIT
					MIN	TYP	MAX	MIN	MAX	MIN	
V <sub>OH</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -20 μA I <sub>OH</sub> = -6 mA	4.5 V	4.4	4.499	4.4	4.4	V			
				3.98	4.3	3.7	3.84				
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA I <sub>OL</sub> = 6 mA	4.5 V	0.001	0.1	0.1	0.1	V			
				0.17	0.26	0.4	0.33				
I <sub>I</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or 0	5.5 V	±0.1	±100	±1000	±1000	nA			
I <sub>OZ</sub>	A or B	V <sub>O</sub> = V <sub>CC</sub> or 0	5.5 V	±0.01	±0.5	±10	±5	μA			
I <sub>CC</sub>		V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0	5.5 V	8		160	80	μA			
ΔI <sub>CC</sub> †		One input at 0.5 V or 2.4 V, Other inputs at 0 or V <sub>CC</sub>	5.5 V	1.4	2.4	3	2.9	mA			
C <sub>i</sub>	Control inputs		4.5 V to 5.5 V	3	10	10	10	pF			

† This is the increase in supply current for each input that is at one of the specified TTL voltage levels, rather than 0 V or V<sub>CC</sub>.

## timing requirements over recommended operating free-air temperature range (unless otherwise noted)

		V <sub>CC</sub>	T <sub>A</sub> = 25°C		SN54HCT646		SN74HCT646		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	4.5 V	31		22		27		MHz
		5.5 V	36		24		29		
t <sub>w</sub>	Pulse duration, CLKBA or CLKAB high or low	4.5 V	16		23		19		ns
		5.5 V	14		21		17		
t <sub>su</sub>	Setup time, A before CLKAB↑ or B before CLKBA↑	4.5 V	20		30		25		ns
		5.5 V	18		27		23		
t <sub>h</sub>	Hold time, A after CLKAB↑ or B after CLKBA↑	4.5 V	5		5		5		ns
		5.5 V	5		5		5		

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# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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switching characteristics over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$  (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HCT646		SN74HCT646		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			4.5 V	31	54		22		27	MHz	
			5.5 V	36	64		24		29		
$t_{\text{pd}}$	CLKBA or CLKAB	A or B	4.5 V		18	36		54		45	ns
			5.5 V		16	32		49		41	
	A or B	B or A	4.5 V		14	27		41		34	
			5.5 V		12	24		37		31	
	SBA or SAB†	A or B	4.5 V		20	38		57		48	
			5.5 V		17	34		51		43	
$t_{\text{en}}$	$\overline{\text{OE}}$	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
$t_{\text{dis}}$	$\overline{\text{OE}}$	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
$t_{\text{en}}$	DIR	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
$t_{\text{dis}}$	DIR	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
$t_t$		Any	4.5 V		9	12		18		15	ns
			5.5 V		7	11		16		14	

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

switching characteristics over recommended operating free-air temperature range,  $C_L = 150 \text{ pF}$  (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HCT646		SN74HCT646		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{\text{pd}}$	CLKBA or CLKAB	A or B	4.5 V		24	53		80		66	ns
			5.5 V		22	47		52		60	
	A or B	B or A	4.5 V		22	44		67		55	
			5.5 V		20	39		60		50	
	SBA or SAB†	A or B	4.5 V		26	55		83		69	
			5.5 V		24	49		74		62	
$t_{\text{en}}$	$\overline{\text{OE}}$	A or B	4.5 V		33	66		100		87	ns
			5.5 V		22	59		90		74	
	DIR	A or B	4.5 V		33	66		100		87	
			5.5 V		22	59		90		74	
$t_t$		Any	4.5 V		17	42		63		53	ns
			5.5 V		14	38		57		48	

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

operating characteristics,  $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{\text{pd}}$ Power dissipation capacitance	No load	50	pF

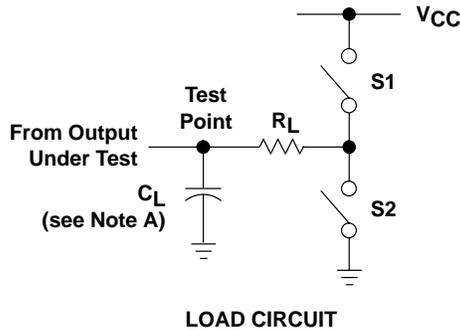
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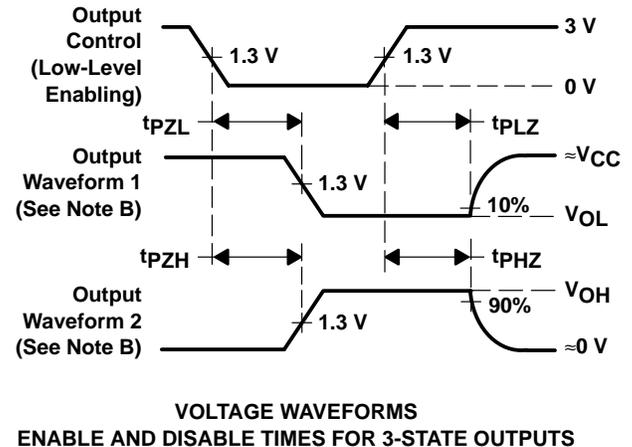
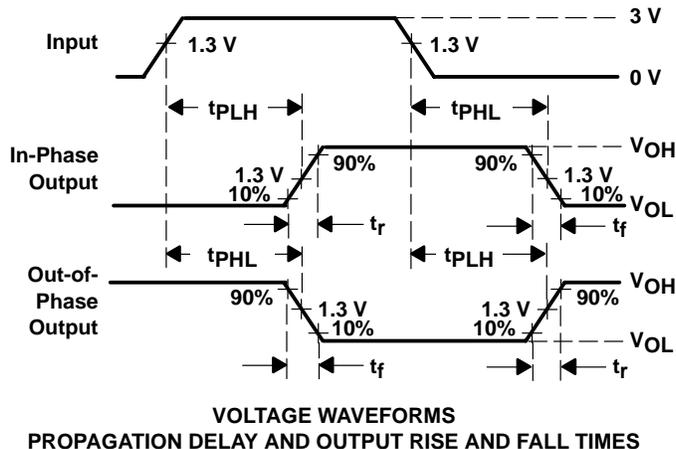
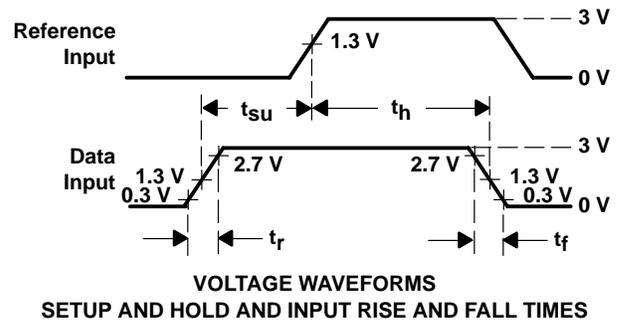
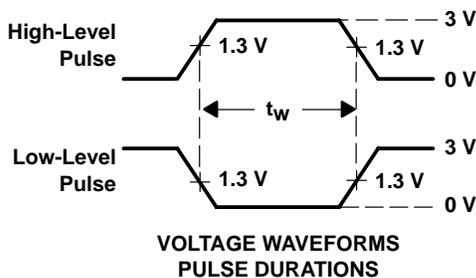
# SN54HCT646, SN74HCT646 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

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## PARAMETER MEASUREMENT INFORMATION



PARAMETER	$R_L$	$C_L$	S1	S2
$t_{en}$	1 k $\Omega$	50 pF or 150 pF	Open	Closed
			Closed	Open
$t_{dis}$	1 k $\Omega$	50 pF	Open	Closed
			Closed	Open
$t_{pd}$ or $t_t$	—	50 pF or 150 pF	Open	Open



- NOTES: A.  $C_L$  includes probe and test-fixture 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. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.  
 D. For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.  
 E. The outputs are measured one at a time with one input transition per measurement.  
 F.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
 G.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
 H.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

**Figure 2. Load Circuit 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>
SN74HCT646DW	ACTIVE	SOIC	DW	24	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74HCT646DWR	ACTIVE	SOIC	DW	24	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
SN74HCT646NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74HCT646NT3	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI

<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) 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.

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

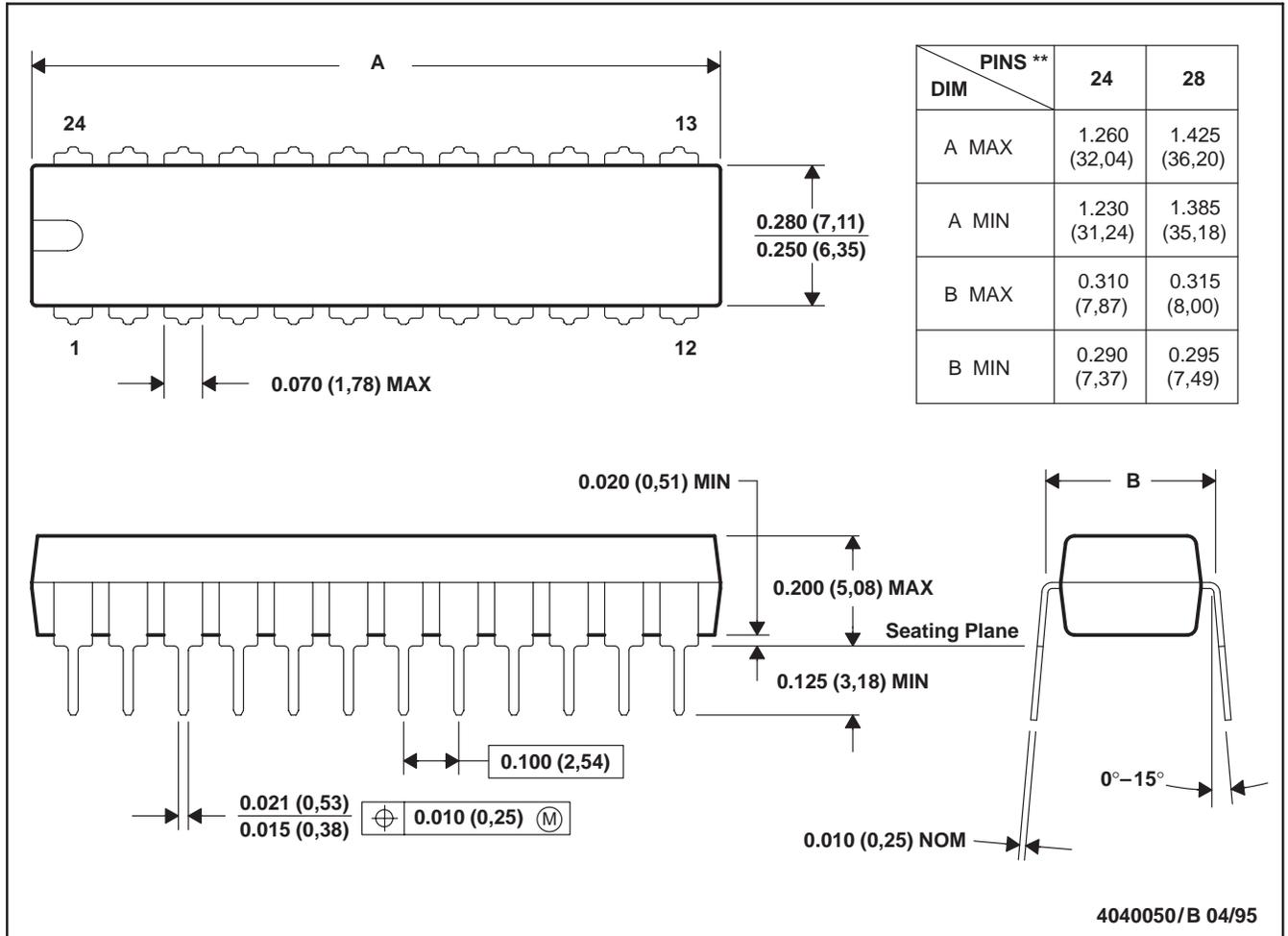
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NT (R-PDIP-T\*\*)

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.



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