

# SN54HCT652, SN74HCT652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCLS179B – MARCH 1984 – REVISED MAY 1997

- Inputs Are TTL-Voltage Compatible
- Independent Registers and Enables 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
- Package Options Include Plastic Small-Outline (DW) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs

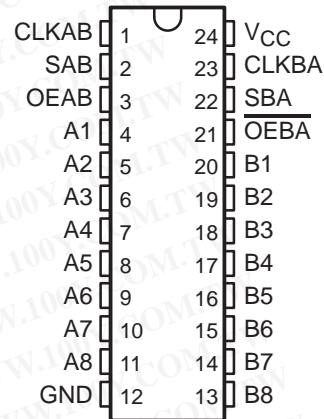
## description

The 'HCT652 consist of bus-transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Output-enable (OEAB and  $\overline{OEBA}$ ) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select real-time or stored data transfer. A low input level selects real-time data; a high input level selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'HCT652.

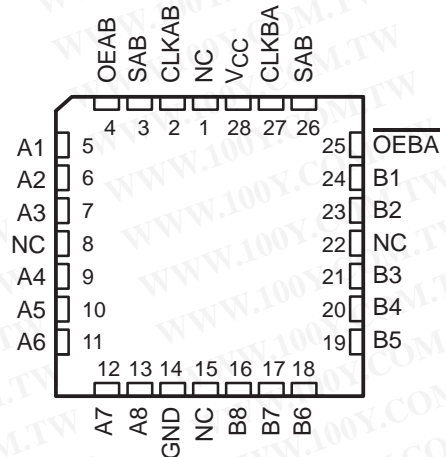
Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) terminals regardless of the select- or output-control terminals. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and  $\overline{OEBA}$ . In this configuration, each output reinforces its input. When all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last state.

The SN54HCT652 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HCT652 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54HCT652 . . . JT OR W PACKAGE  
SN74HCT652 . . . DW OR NT PACKAGE  
(TOP VIEW)



SN54HCT652 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

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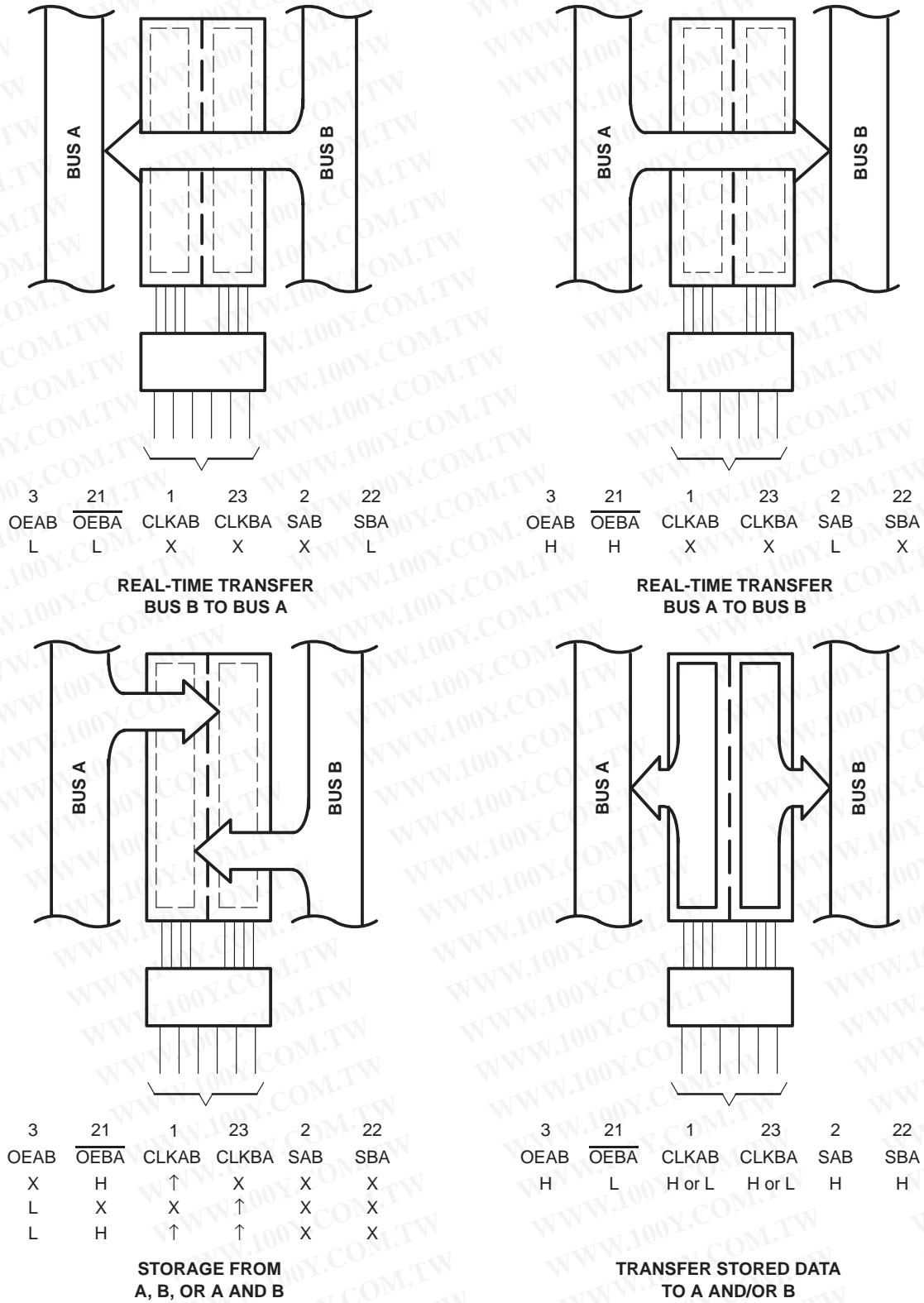
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**SN54HCT652, SN74HCT652**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

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

**Figure 1. Bus-Management Functions**



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**FUNCTION TABLE**

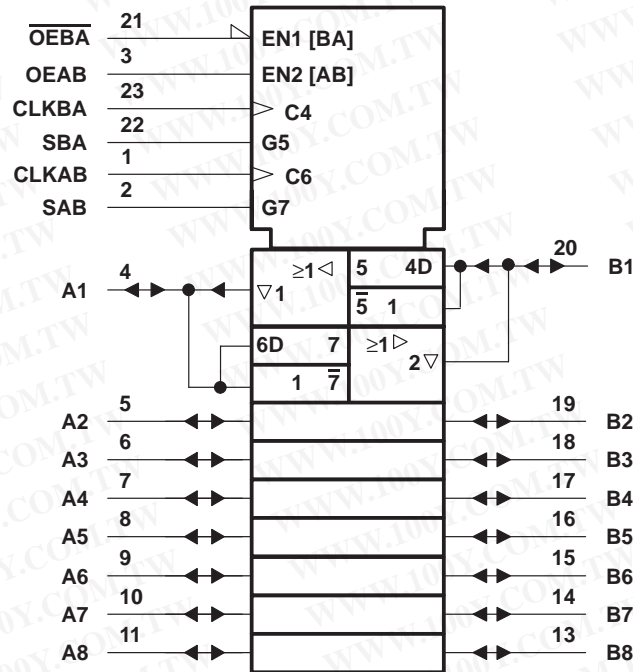
INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	OEBA	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified‡	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified‡	Input	Hold A, store B
L	L	↑	↑	X	X‡	Output	Input	Store B in both registers
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
H	H	X	X	L	X	Input	Output	Real-time A data to B bus
H	H	H or L	X	H	X	Input	Output	Stored A data to B bus
H	L	H or L	H or L	H	H	Output	Output	Stored A data to B bus and stored B data to A bus

† The data-output functions can be enabled or disabled by a variety of level combinations at OEAB or OEBA. Data-input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition on the clock inputs.

‡ Select control = L; clocks can occur simultaneously.

Select control = H; clocks must be staggered to load both registers.

## logic symbols§



§ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers are for the DW, JT, NT, and W packages.

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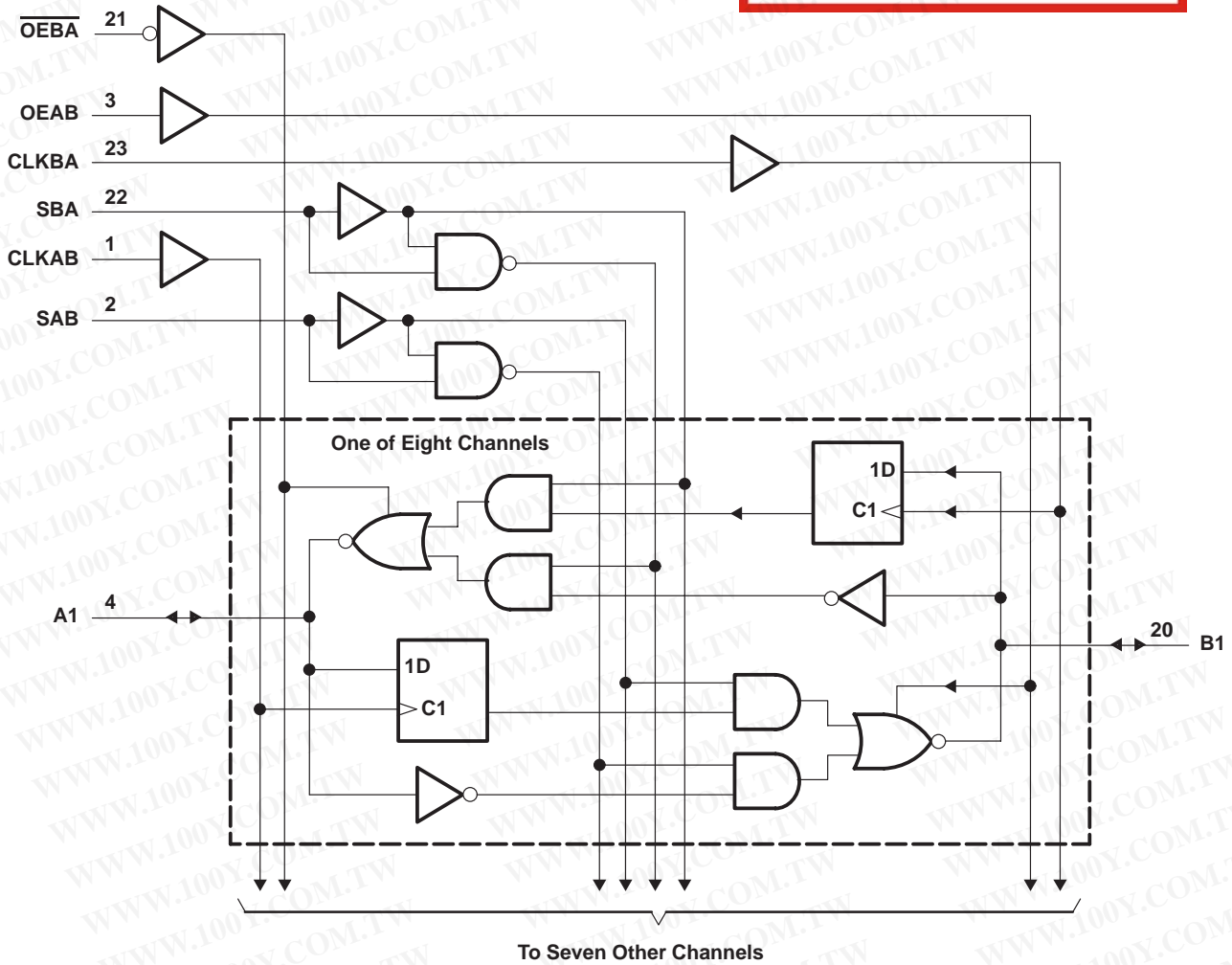
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## logic diagram (positive logic)



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

## absolute maximum ratings over operating free-air temperature range†

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 .....	81°C/W
NT package .....	67°C/W
Storage temperature range, $T_{stg}$ .....	-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.

- 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, except for through-hole packages, which use a trace length of zero.



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## recommended operating conditions

		SN54HCT652			SN74HCT652			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			2	V
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V		0	0.8		0	V
V <sub>I</sub>	Input voltage	0	V <sub>CC</sub>		0	V <sub>CC</sub>		V
V <sub>O</sub>	Output voltage	0	V <sub>CC</sub>		0	V <sub>CC</sub>		V
t <sub>f</sub>	Input transition (rise and fall) time	0		500	0		500	ns
T <sub>A</sub>	Operating free-air temperature	-55		125	-40		85	°C

## 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			SN54HCT652		SN74HCT652		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	4.5 V	I <sub>OH</sub> = -20 μA		4.4	4.499	4.4	4.4	V	
			I <sub>OH</sub> = -6 mA		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>	4.5 V	I <sub>OL</sub> = 20 μA		0.001	0.1	0.1	0.1	V	
			I <sub>OL</sub> = 6 mA		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, V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> , Data = 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		SN54HCT652		SN74HCT652		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	4.5 V	0	25	0	17	0	20	MHz
		5.5 V	0	28	0	19	0	22	
t <sub>w</sub>	Pulse duration, CLKBA or CLKAB high or low	4.5 V	20		30	25		ns	
		5.5 V	18		27	23			
t <sub>su</sub>	Setup time, A before CLKAB↑ or B before CLKBA↑	4.5 V	15		23	19		ns	
		5.5 V	14		21	17			
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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switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HCT652		SN74HCT652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{max}$			4.5 V	25	35		17		20	MHz	
			5.5 V	28	40		19		22		
$t_{pd}$	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	
$t_{en}$	$\overline{OEBA}$ or OEAB	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
$t_{dis}$	$\overline{OEBA}$ or OEAB	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,  $C_L = 150$  pF (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HCT652		SN74HCT652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	CLKBA or CLKAB	A or B	4.5 V		24	53		80		66	ns
			5.5 V		22	47		72		60	
	A or B	B or A	4.5 V		22	44		70		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	
$t_{en}$	$\overline{OEBA}$ or OEAB	A or B	4.5 V		33	66		100		82	ns
			5.5 V		30	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
$C_{pd}$ Power dissipation capacitance	No load	50	pF

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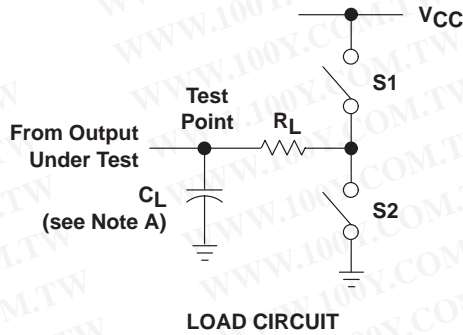


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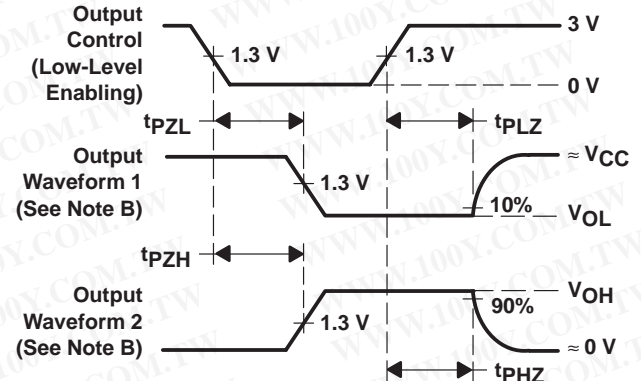
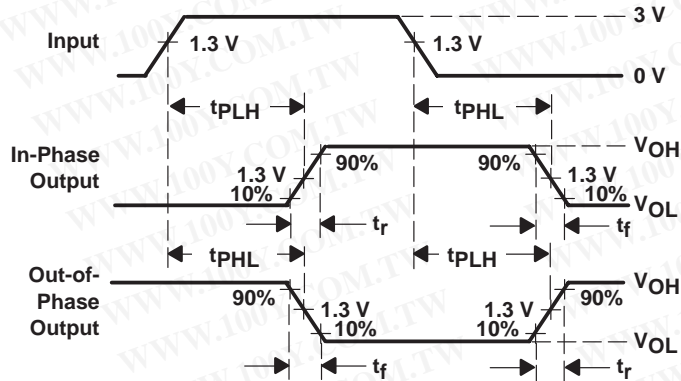
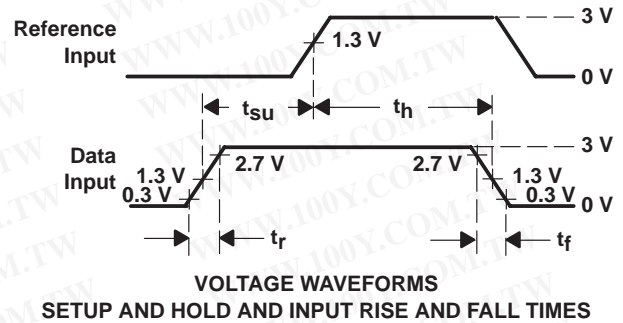
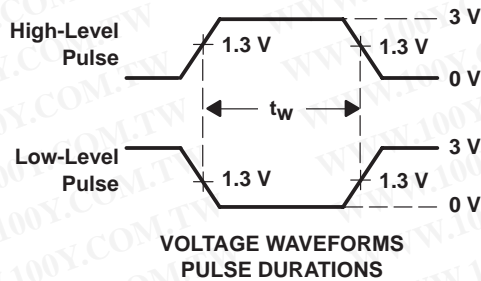
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## PARAMETER MEASUREMENT INFORMATION



PARAMETER	$R_L$	$C_L$	S1	S2	
$t_{en}$	$t_{PZH}$	1 k $\Omega$	50 pF or 150 pF	Open	Closed
	$t_{PZL}$			Closed	Open
$t_{dis}$	$t_{PHZ}$	1 k $\Omega$	50 pF	Open	Closed
	$t_{PLZ}$			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 1. Load Circuit and Voltage Waveforms

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