

# SN54HC652, SN74HC652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCLS151B – DECEMBER 1982 – REVISED MAY 1997

- 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

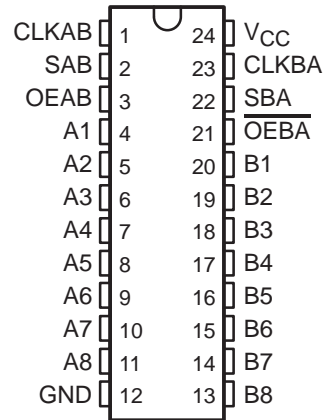
## description

These devices 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 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, and a high input level selects stored data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'HC652.

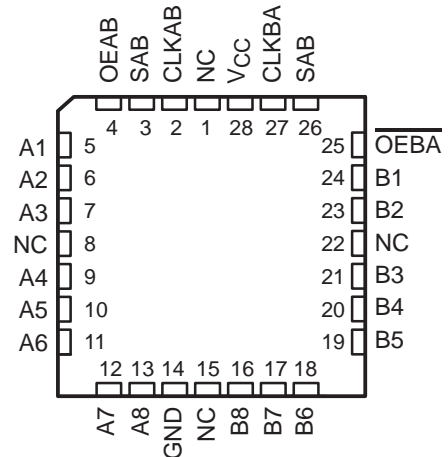
Data on the A or B data bus, or both, can be stored in the internal D-type flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) terminals regardless of the select- or output-control terminals. When SAB and SBA are in the real-time transfer mode, it is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and 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 SN54HC652 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC652 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54HC652 . . . JT OR W PACKAGE  
SN74HC652 . . . DW OR NT PACKAGE  
(TOP VIEW)



SN54HC652 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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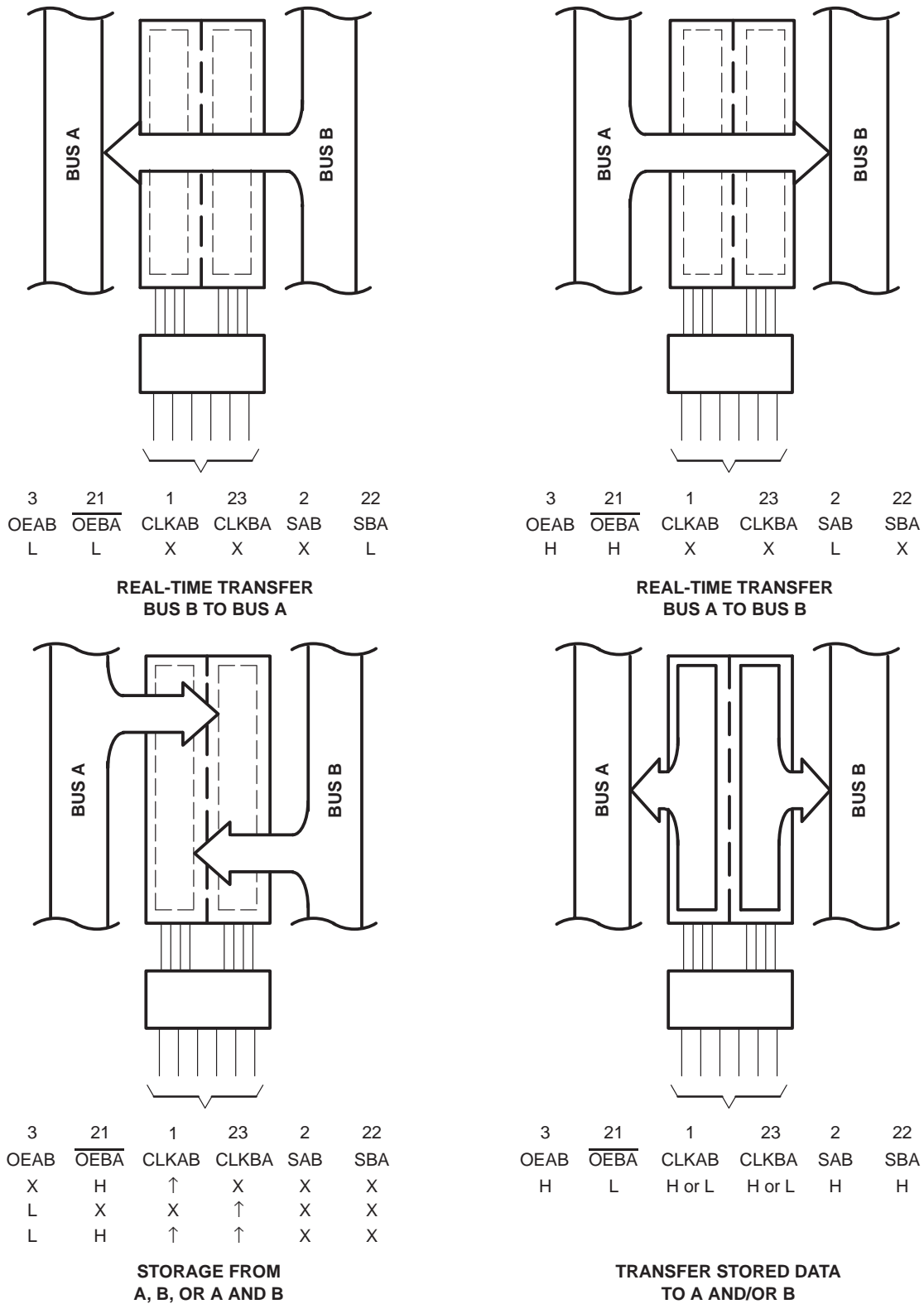
**TEXAS  
INSTRUMENTS**

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SCLS151B – DECEMBER 1982 – REVISED MAY 1997



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

Figure 1. Bus-Management Functions

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SCLS151B – DECEMBER 1982 – REVISED MAY 1997

**FUNCTION TABLE**

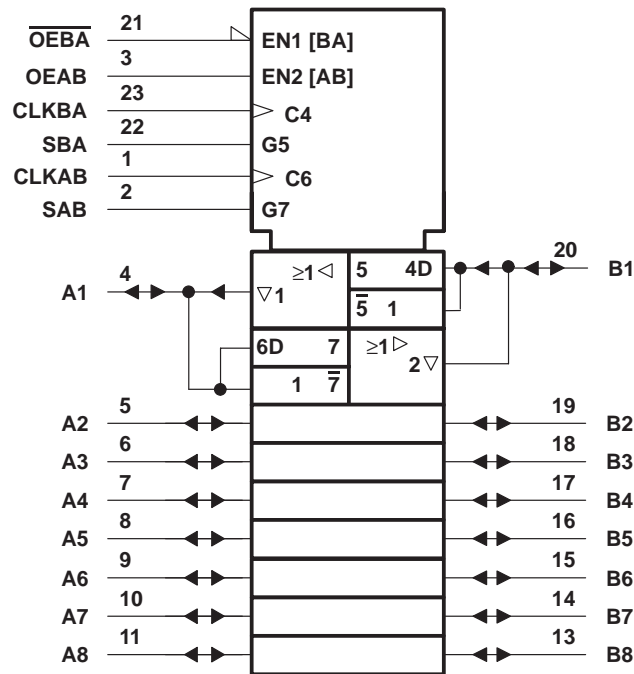
INPUTS						DATA I/O†		OPERATION OR FUNCTION
OEAB	OEBA	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	H or L	X	X	Input	Unspecified‡	Store A, hold B
H	H	↑	↑	X‡	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified‡	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 are 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§

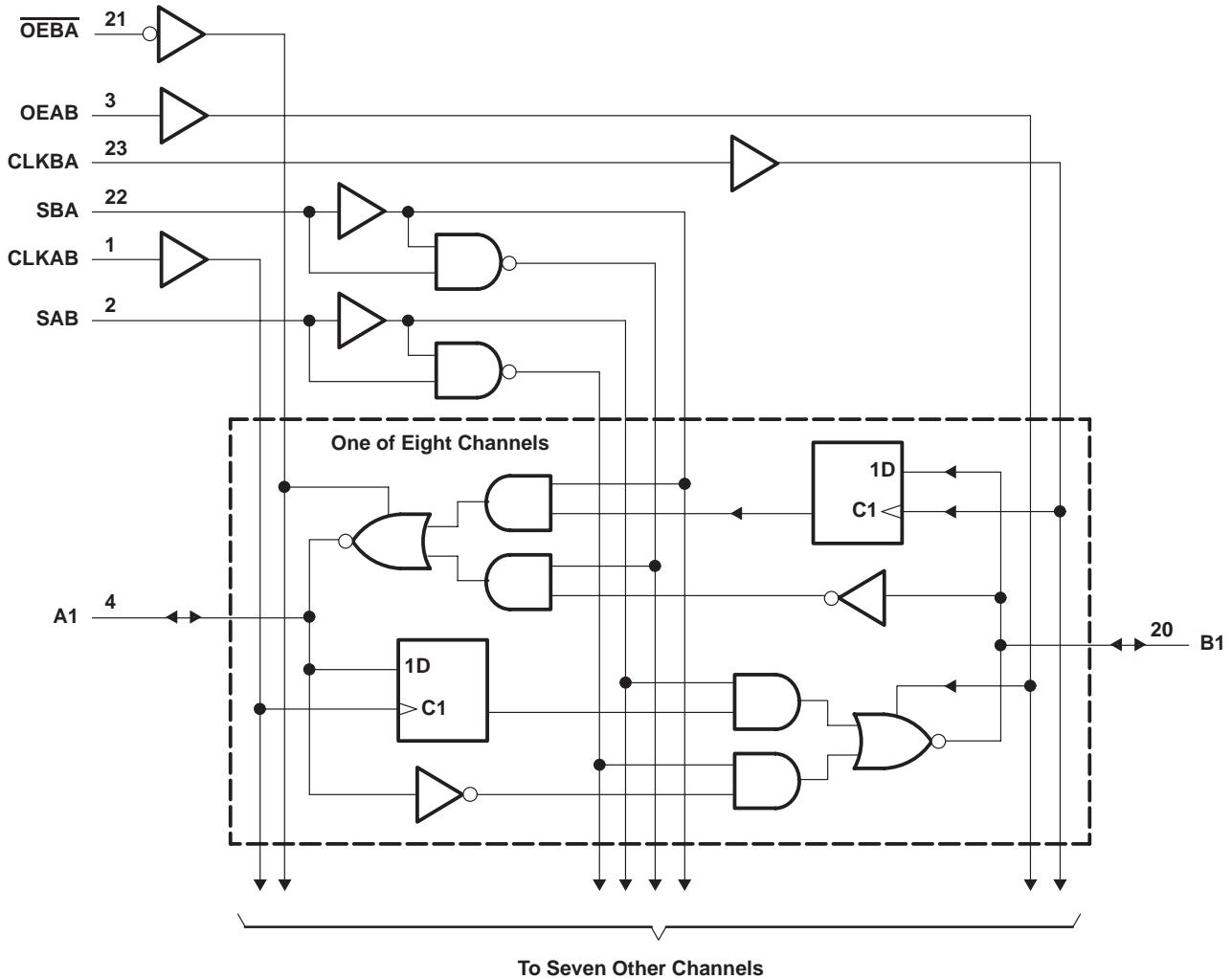


§ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the DW, JT, NT, and W packages.

# SN54HC652, SN74HC652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCLS151B – DECEMBER 1982 – REVISED MAY 1997

## 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†

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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SCLS151B – DECEMBER 1982 – REVISED MAY 1997

## recommended operating conditions

		SN54HC652			SN74HC652			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	2	5	6	2	5	6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V		1.5	1.5		V	
		V <sub>CC</sub> = 4.5 V		3.15	3.15			
		V <sub>CC</sub> = 6 V		4.2	4.2			
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V		0	0.5	0	0.5	V
		V <sub>CC</sub> = 4.5 V		0	1.35	0	1.35	
		V <sub>CC</sub> = 6 V		0	1.8	0	1.8	
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>t</sub>	Input transition (rise and fall) time	V <sub>CC</sub> = 2 V		0	1000	0	1000	ns
		V <sub>CC</sub> = 4.5 V		0	500	0	500	
		V <sub>CC</sub> = 6 V		0	400	0	400	
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			SN54HC652		SN74HC652		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>	I <sub>OH</sub> = -20 μA	2 V	1.9	1.998		1.9		1.9	V	
			4.5 V	4.4	4.499		4.4		4.4		
			6 V	5.9	5.999		5.9		5.9		
		I <sub>OH</sub> = -6 mA	4.5 V	3.98	4.3		3.7		3.84		
		I <sub>OH</sub> = -7.8 mA	6 V	5.48	5.8		5.2		5.34		
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 μA	2 V		0.002	0.1		0.1		V	
			4.5 V		0.001	0.1		0.1			0.1
			6 V		0.001	0.1		0.1			0.1
		I <sub>OL</sub> = 6 mA	4.5 V		0.17	0.26		0.4			0.33
		I <sub>OL</sub> = 7.8 mA	6 V		0.15	0.26		0.4			0.33
I <sub>I</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or 0	6 V		±0.1	±100		±1000		±1000	nA
I <sub>OZ</sub>	A or B	V <sub>O</sub> = V <sub>CC</sub> or GND	6 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	6 V			8		160		80	μA
C <sub>i</sub>	Control inputs		2 V to 6 V		3	10		10		10	pF

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# SN54HC652, SN74HC652 OCTAL BUS TRANSCEIVERS AND REGISTERS WITH 3-STATE OUTPUTS

SCLS151B – DECEMBER 1982 – REVISED MAY 1997

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

	V <sub>CC</sub>	T <sub>A</sub> = 25°C		SN54HC652		SN74HC652		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub> Clock frequency	2 V	0	6	0	4.3	0	5.5	MHz
	4.5 V	0	31	0	22	0	27	
	6 V	0	36	0	25	0	31	
t <sub>w</sub> Pulse duration, CLKBA or CLKAB high or low	2 V	80		115		95		ns
	4.5 V	16		23		19		
	6 V	14		20		16		
t <sub>su</sub> Setup time, A before CLKAB↑ or B before CLKBA↑	2 V	100		150		125		ns
	4.5 V	20		30		25		
	6 V	17		26		21		
t <sub>h</sub> Hold time, A after CLKAB↑ or B after CLKBA↑	2 V	5		5		5		ns
	4.5 V	5		5		5		
	6 V	5		5		5		

switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54HC652		SN74HC652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f <sub>max</sub>			2 V	6	10		4.3		5.5	MHz	
			4.5 V	31	40		22		27		
			6 V	36	45		25		31		
t <sub>pd</sub>	CLKBA or CLKAB	A or B	2 V		65	180		270		225	ns
			4.5 V		18	36		54		45	
			6 V		14	31		46		38	
	A or B	B or A	2 V		50	135		205		170	
			4.5 V		14	27		41		34	
			6 V		11	23		35		29	
	SBA or SAB†	A or B	2 V		70	190		285		240	
			4.5 V		20	38		57		48	
			6 V		16	32		48		41	
t <sub>en</sub>	OEBA or OEAB	A or B	2 V		85	245		370		305	ns
			4.5 V		25	49		74		61	
			6 V		20	42		63		52	
t <sub>dis</sub>	OEBA or OEAB	A or B	2 V		50	245		370		305	ns
			4.5 V		23	49		74		61	
			6 V		20	42		63		52	
t <sub>t</sub>		Any	2 V		28	60		90		75	ns
	4.5 V			8	12		18		15		
	6 V			6	10		15		13		

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

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SCLS151B – DECEMBER 1982 – REVISED MAY 1997

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)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC652		SN74HC652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	CLKBA or CLKAB	A or B	2 V	90	265	400	330	ns			
			4.5 V	24	53	80	66				
			6 V	18	46	68	57				
	A or B	B or A	2 V	70	220	335	275				
			4.5 V	20	44	70	55				
			6 V	15	38	57	48				
	SBA or SAB <sup>†</sup>	A or B	2 V	80	275	415	345				
			4.5 V	24	55	83	69				
			6 V	20	47	70	60				
$t_{en}$	$\overline{\text{OEBA}}$ or OEAB	A or B	2 V	100	330	500	410	ns			
			4.5 V	33	66	100	82				
			6 V	27	57	85	71				
$t_t$		Any	2 V	45	210	315	265	ns			
			4.5 V	17	42	63	53				
			6 V	13	36	53	43				

<sup>†</sup> 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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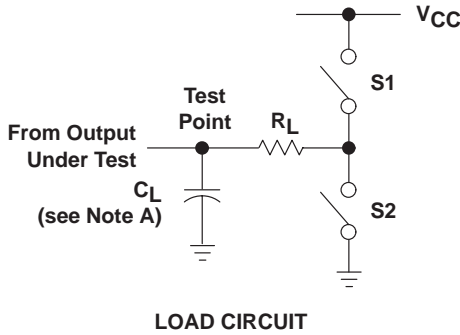


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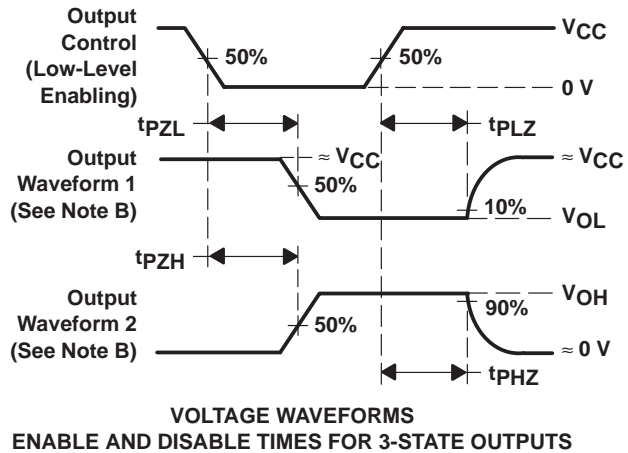
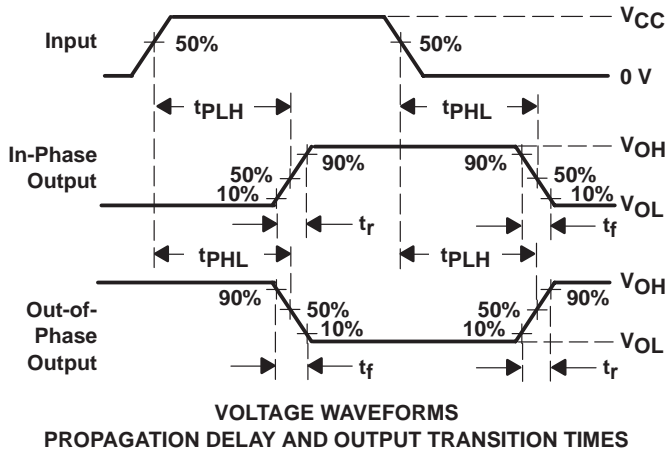
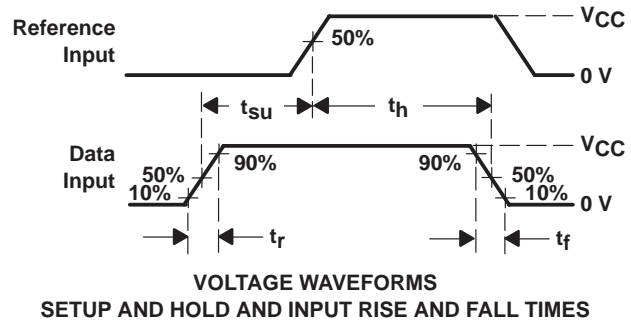
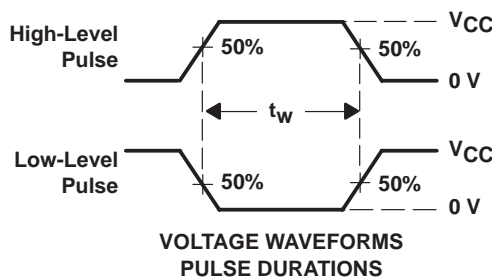
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SCLS151B – DECEMBER 1982 – REVISED MAY 1997

## 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



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