

# SN54HC595, SN74HC595 8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

SCLS041B – DECEMBER 1982 – REVISED MAY 1997

- 8-Bit Serial-In, Parallel-Out Shift
- High-Current 3-State Outputs Can Drive up to 15 LSTTL Loads
- Shift Register Has Direct Clear
- Package Options Include Plastic Small-Outline (D) and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

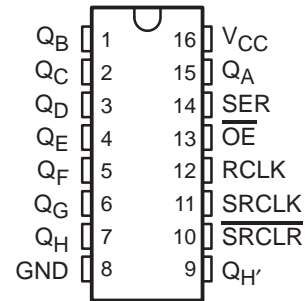
## description

The 'HC595 contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for both the shift and storage register. The shift register has a direct overriding clear ( $\overline{\text{SRCLR}}$ ) input, serial (SER) input, and serial outputs for cascading.

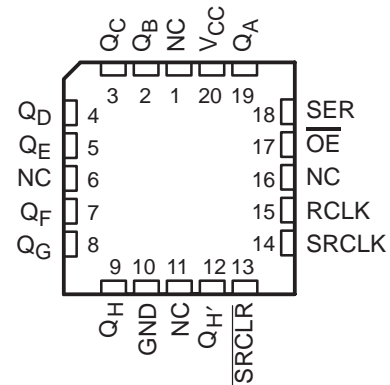
Both the shift register clock (RCLK) and storage register clock (SRCLK) are positive-edge triggered. If both clocks are connected together, the shift register is always one clock pulse ahead of the storage register.

The SN54HC595 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC595 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54HC595 . . . J OR W PACKAGE  
SN74HC595 . . . D OR N PACKAGE  
(TOP VIEW)



SN54HC595 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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.

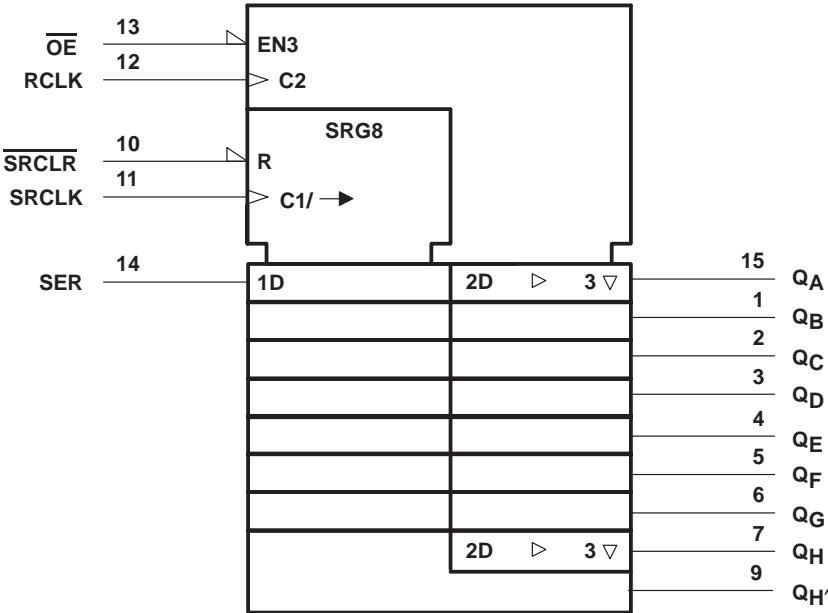
**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1997, Texas Instruments Incorporated

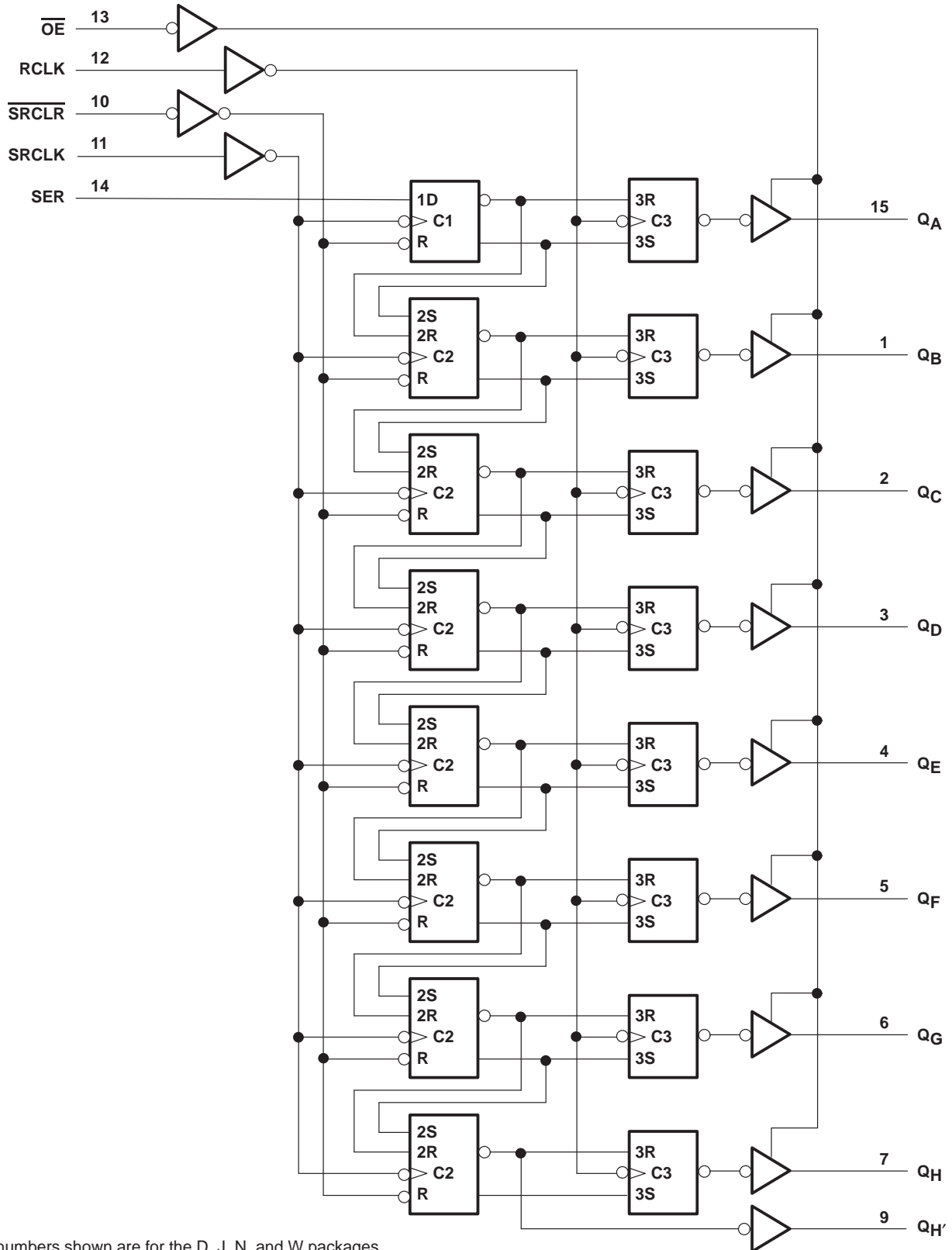
SN54HC595, SN74HC595  
8-BIT SHIFT REGISTERS  
WITH 3-STATE OUTPUT REGISTERS  
SCLS041B – DECEMBER 1982 – REVISED MAY 1997

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for the D, J, N, and W packages.

logic diagram (positive logic)



Pin numbers shown are for the D, J, N, and W packages.

# SN54HC595, SN74HC595

## 8-BIT SHIFT REGISTERS

### WITH 3-STATE OUTPUT REGISTERS

SCLS041B – DECEMBER 1982 – REVISED MAY 1997

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

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)	±20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1)	±20 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	±35 mA
Continuous current through $V_{CC}$ or GND	±70 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): D package	113°C/W
N package	78°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.

#### recommended operating conditions

			SN54HC595			SN74HC595			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage		2	5	6	2	5	6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 2$ V	1.5			1.5			V
		$V_{CC} = 4.5$ V	3.15			3.15			
		$V_{CC} = 6$ V	4.2			4.2			
$V_{IL}$	Low-level input voltage	$V_{CC} = 2$ V	0	0.5		0	0.5		V
		$V_{CC} = 4.5$ V	0	1.35		0	1.35		
		$V_{CC} = 6$ V	0	1.8		0	1.8		
$V_I$	Input voltage		0	$V_{CC}$		0	$V_{CC}$		V
$V_O$	Output voltage		0	$V_{CC}$		0	$V_{CC}$		V
$t_t^\ddagger$	Input transition (rise and fall) time	$V_{CC} = 2$ V	0	1000		0	1000		ns
		$V_{CC} = 4.5$ V	0	500		0	500		
		$V_{CC} = 6$ V	0	400		0	400		
$T_A$	Operating free-air temperature		–55	125		–40	85		°C

‡ If this device is used in the threshold region (from  $V_{ILmax} = 0.5$  V to  $V_{IHmin} = 1.5$  V), there is a potential to go into the wrong state from induced grounding, causing double clocking. Operating with the inputs at  $t_t = 1000$  ns and  $V_{CC} = 2$  V does not damage the device; however, functionally, the CLK inputs are not ensured while in the shift, count, or toggle operating modes.

**SN54HC595, SN74HC595**  
**8-BIT SHIFT REGISTERS**  
**WITH 3-STATE OUTPUT REGISTERS**  
SCLS041B – DECEMBER 1982 – REVISED MAY 1997

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			SN54HC595		SN74HC595		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		
		Q <sub>H'</sub> , I <sub>OH</sub> = -4 mA	4.5 V	3.98	4.3		3.7		3.84		
		Q <sub>A</sub> -Q <sub>H</sub> , I <sub>OH</sub> = -6 mA		3.98	4.3		3.7		3.84		
		Q <sub>H'</sub> , I <sub>OH</sub> = -5.2 mA	6 V	5.48	5.8		5.2		5.34		
		Q <sub>A</sub> -Q <sub>H</sub> , I <sub>OH</sub> = -7.8 mA		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		0.1	V
			4.5 V		0.001	0.1		0.1		0.1	
			6 V		0.001	0.1		0.1		0.1	
		Q <sub>H'</sub> , I <sub>OL</sub> = 4 mA	4.5 V		0.17	0.26		0.4		0.33	
		Q <sub>A</sub> -Q <sub>H</sub> , I <sub>OL</sub> = 6 mA			0.17	0.26		0.4		0.33	
		Q <sub>H'</sub> , I <sub>OL</sub> = 5.2 mA	6 V		0.15	0.26		0.4		0.33	
		Q <sub>A</sub> -Q <sub>H</sub> , I <sub>OL</sub> = 7.8 mA			0.15	0.26		0.4		0.33	
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0		6 V		±0.1	±100		±1000		±1000	nA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or 0		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>			2 V to 6 V		3	10		10		10	pF

# SN54HC595, SN74HC595

## 8-BIT SHIFT REGISTERS

### WITH 3-STATE OUTPUT REGISTERS

SCLS041B – 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		SN54HC595		SN74HC595		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency	2 V	0	6	0	4.2	0	5	MHz
		4.5 V	0	31	0	21	0	25	
		6 V	0	36	0	25	0	29	
t <sub>w</sub>	SRCLK or RCLK high or low	2 V	80		120		100		ns
		4.5 V	16		24		20		
		6 V	14		20		17		
	$\overline{\text{SRCLR}}$ low	2 V	80		120		100		
		4.5 V	16		24		20		
		6 V	14		20		17		
t <sub>su</sub>	SER before SRCLK↑	2 V	100		150		125		ns
		4.5 V	20		30		25		
		6 V	17		25		21		
	SRCLK↑ before RCLK↑†	2 V	75		113		94		
		4.5 V	15		23		19		
		6 V	13		19		16		
	$\overline{\text{SRCLR}}$ low before RCLK↑	2 V	50		75		65		
		4.5 V	10		15		13		
		6 V	9		13		11		
	$\overline{\text{SRCLR}}$ high (inactive) before SRCLK↑	2 V	50		75		60		
		4.5 V	10		15		12		
		6 V	9		13		11		
t <sub>h</sub>	Hold time, SER after SRCLK↑	2 V	0		0		0		ns
		4.5 V	0		0		0		
		6 V	0		0		0		

† This setup time ensures the output register sees stable data from the shift-register outputs. The clocks may be tied together, in which case the output register is one clock pulse behind the shift register.

**SN54HC595, SN74HC595**  
**8-BIT SHIFT REGISTERS**  
**WITH 3-STATE OUTPUT REGISTERS**  
 SCLS041B – DECEMBER 1982 – REVISED MAY 1997

switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC595		SN74HC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\max}$			2 V	6	26		4.2		5		MHz
			4.5 V	31	38		21		25		
			6 V	36	42		25		29		
$t_{pd}$	SRCLK	$Q_H'$	2 V		50	160		240		200	ns
			4.5 V		17	32		48		40	
			6 V		14	27		41		34	
	RCLK	$Q_A$ – $Q_H$	2 V		50	150		225		187	
			4.5 V		17	30		45		37	
			6 V		14	26		38		32	
$t_{PHL}$	$\overline{\text{SRCLR}}$	$Q_H'$	2 V		51	175		261		219	ns
			4.5 V		18	35		52		44	
			6 V		15	30		44		37	
$t_{en}$	$\overline{\text{OE}}$	$Q_A$ – $Q_H$	2 V		40	150		225		187	ns
			4.5 V		15	30		45		37	
			6 V		13	26		38		32	
$t_{dis}$	$\overline{\text{OE}}$	$Q_A$ – $Q_H$	2 V		42	200		300		250	ns
			4.5 V		23	40		60		50	
			6 V		20	34		51		43	
$t_t$		$Q_A$ – $Q_H$	2 V		28	60		90		75	ns
			4.5 V		8	12		18		15	
			6 V		6	10		15		13	
		$Q_H'$	2 V		28	75		110		95	
			4.5 V		8	15		22		19	
			6 V		6	13		19		16	

switching characteristics over recommended operating free-air temperature range,  $C_L = 150$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC595		SN74HC595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{pd}$	RCLK	$Q_A$ – $Q_H$	2 V		60	200		300		250	ns
			4.5 V		22	40		60		50	
			6 V		19	34		51		43	
$t_{en}$	$\overline{\text{OE}}$	$Q_A$ – $Q_H$	2 V		70	200		298		250	ns
			4.5 V		23	40		60		50	
			6 V		19	34		51		43	
$t_t$		$Q_A$ – $Q_H$	2 V		45	210		315		265	ns
			4.5 V		17	42		63		53	
			6 V		13	36		53		45	

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

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	No load	400	pF

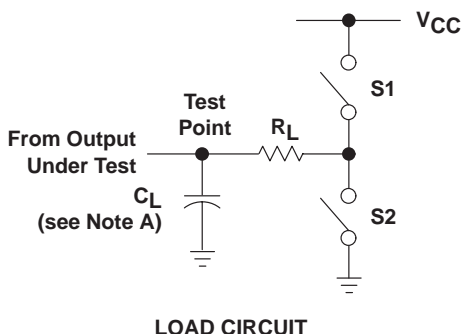
# SN54HC595, SN74HC595

## 8-BIT SHIFT REGISTERS

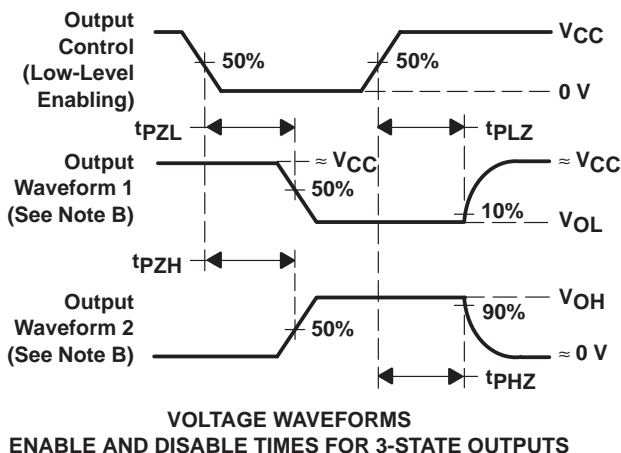
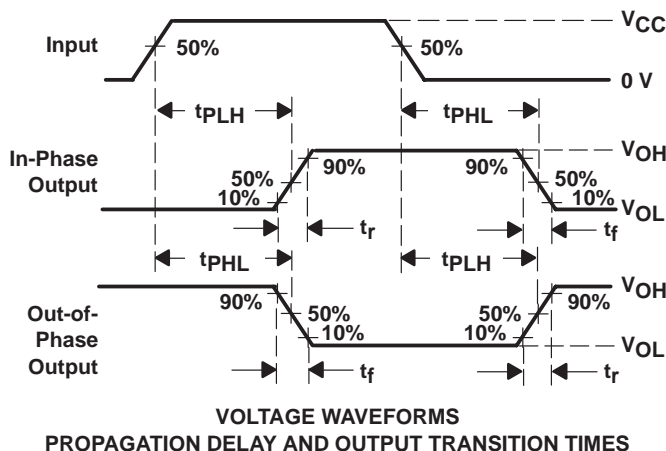
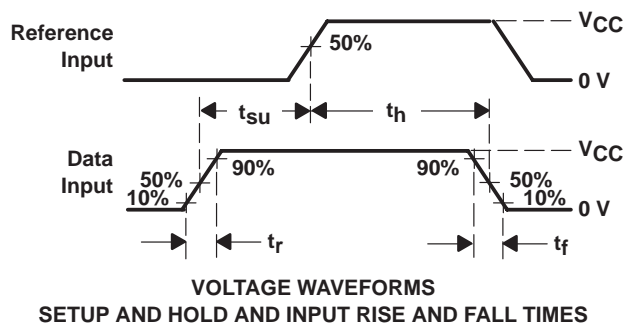
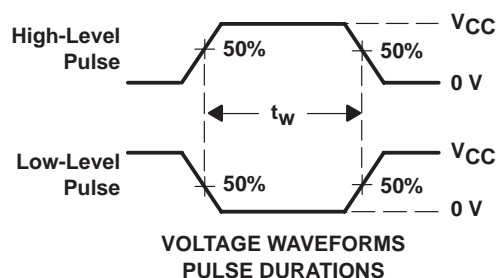
### WITH 3-STATE OUTPUT REGISTERS

SCLS041B – 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:
- $C_L$  includes probe and test-fixture capacitance.
  - 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.
  - 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.
  - For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
  - The outputs are measured one at a time with one input transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms



## **IMPORTANT NOTICE**

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.