

SN54AHCT595, SN74AHCT595 8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

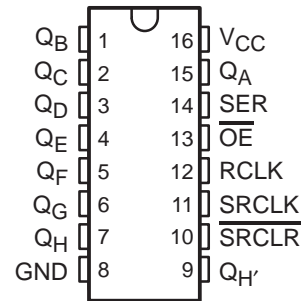
- Inputs Are TTL-Voltage Compatible
- 8-Bit Serial-In, Parallel-Out Shift
- Shift Register Has Direct Clear
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

description/ordering information

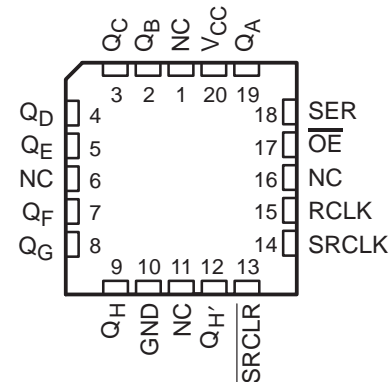
The 'AHCT595 devices contain an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. The storage register has parallel 3-state outputs. Separate clocks are provided for the shift and storage registers. The shift register has a direct overriding clear (SRCLR) input, serial (SER) input, and serial outputs for cascading. When the output-enable (\overline{OE}) input is high, the outputs are in the high-impedance state.

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

SN54AHCT595 . . . J OR W PACKAGE
SN74AHCT595 . . . D, DB, N, NS, OR PW PACKAGE
(TOP VIEW)



SN54AHCT595 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	PDIP – N	Tube	SN74AHCT595N	SN74AHCT595N
	SOIC – D	Tube	SN74AHCT595D	AHCT595
		Tape and reel	SN74AHCT595DR	
	SOP – NS	Tape and reel	SN74AHCT595NSR	AHCT595
	SSOP – DB	Tape and reel	SN74AHCT595DBR	HB595
	TSSOP – PW	Tube	SN74AHCT595PW	HB595
		Tape and reel	SN74AHCT595PWR	
–55°C to 125°C	CDIP – J	Tube	SNJ54AHCT595J	SNJ54AHCT595J
	CFP – W	Tube	SNJ54AHCT595W	SNJ54AHCT595W
	LCCC – FK	Tube	SNJ54AHCT595FK	SNJ54AHCT595FK

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



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 **TEXAS
INSTRUMENTS**

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8-BIT SHIFT REGISTERS
WITH 3-STATE OUTPUT REGISTERS

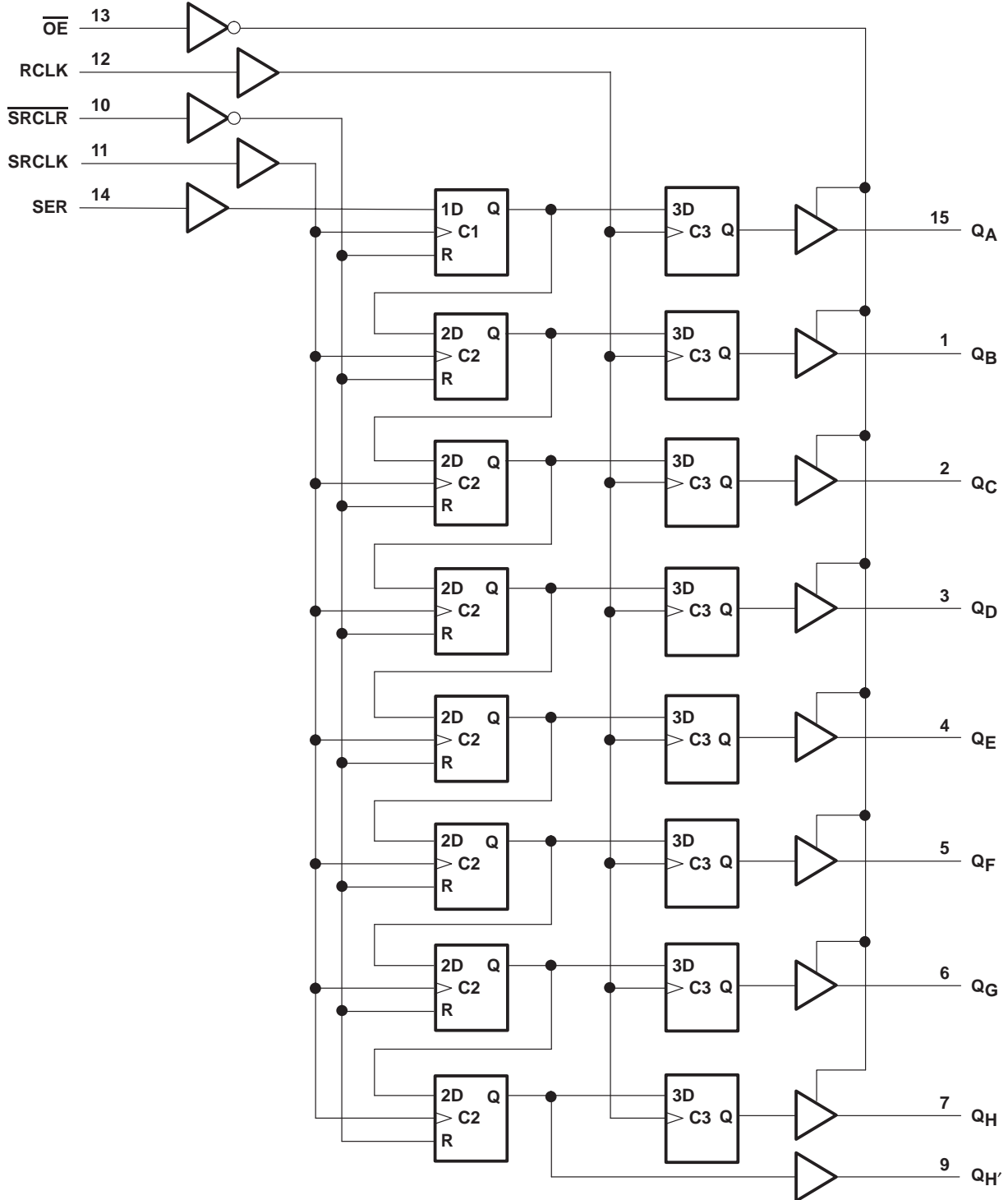
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FUNCTION TABLE

INPUTS					FUNCTION
SER	SRCLK	SRCLR	RCLK	OE	
X	X	X	X	H	Outputs Q _A –Q _H are disabled.
X	X	X	X	L	Outputs Q _A –Q _H are enabled.
X	X	L	X	X	Shift register is cleared.
L	↑	H	X	X	First stage of the shift register goes low. Other stages store the data of previous stage, respectively.
H	↑	H	X	X	First stage of the shift register goes high. Other stages store the data of previous stage, respectively.
X	X	X	↑	X	Shift-register data is stored in the storage register.

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8-BIT SHIFT REGISTERS
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SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

logic diagram (positive logic)

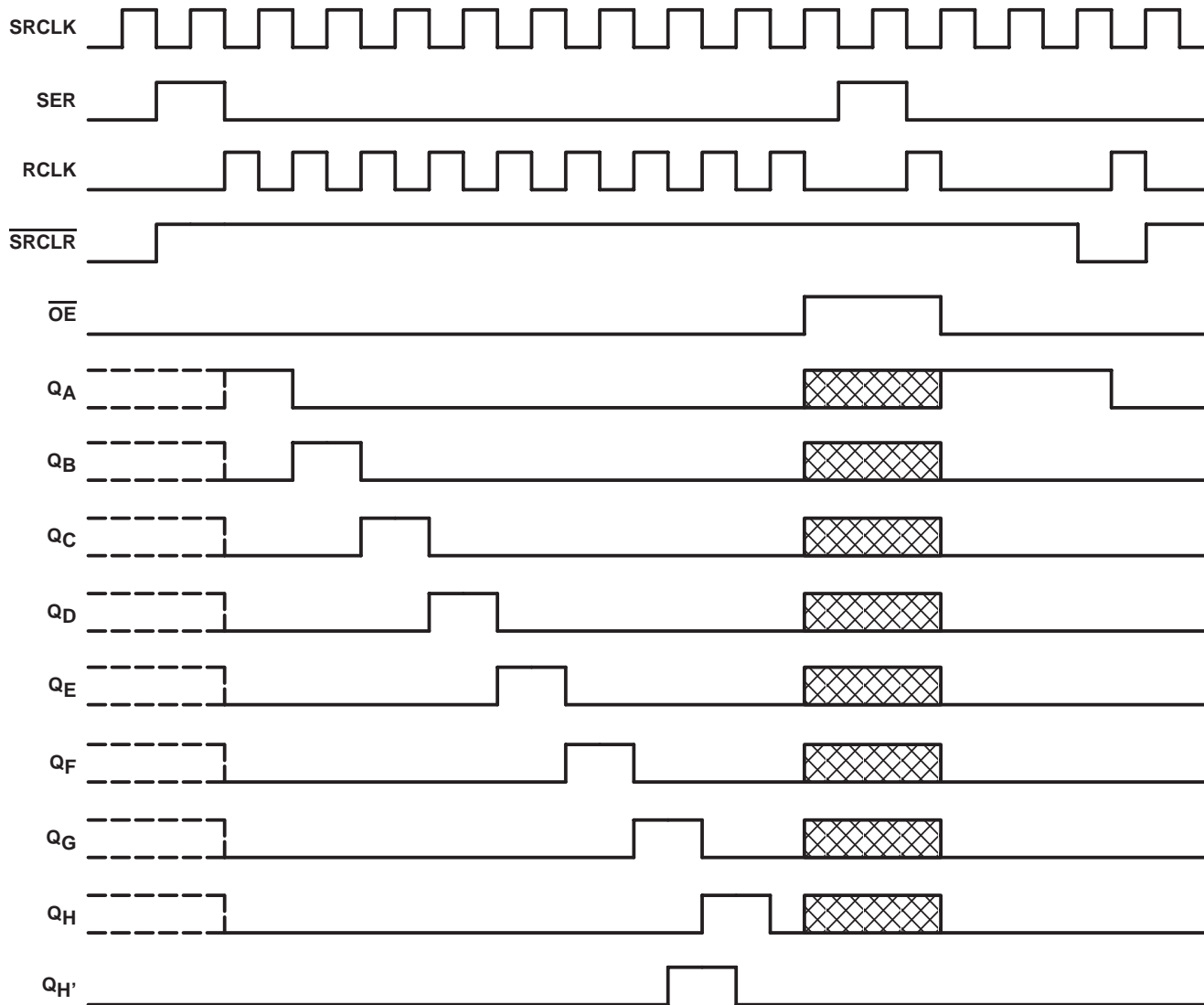



Pin numbers shown are for the D, DB, J, N, NS, PW, and W packages.

SN54AHCT595, SN74AHCT595 8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

timing diagram



NOTE:  implies that the output is in 3-State mode.

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SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC}	–0.5 V to 7 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7 V
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±25 mA
Continuous current through V_{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 2): D package	73°C/W
DB package	82°C/W
N package	67°C/W
NS package	64°C/W
PW package	108°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 51-7.

recommended operating conditions (see Note 3)

	SN54AHCT595		SN74AHCT595		UNIT
	MIN	MAX	MIN	MAX	
V_{CC} Supply voltage	4.5	5.5	4.5	5.5	V
V_{IH} High-level input voltage	2		2		V
V_{IL} Low-level input voltage		0.8		0.8	V
V_I Input voltage	0	5.5	0	5.5	V
V_O Output voltage	0	V_{CC}	0	V_{CC}	V
I_{OH} High-level output current		–8		–8	mA
I_{OL} Low-level output current		8		8	mA
$\Delta t/\Delta v$ Input transition rise or fall rate		20		20	ns/V
T_A Operating free-air temperature	–55	125	–40	85	°C

NOTE 3: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

SN54AHCT595, SN74AHCT595 8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

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

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54AHCT595		SN74AHCT595		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}	I _{OH} = -50 μA	4.5 V	4.4	4.5		4.4		4.4	V	
	I _{OH} = -8 mA		3.94			3.8		3.8		
V _{OL}	I _{OL} = 50 μA	4.5 V			0.1			0.1	V	
	I _{OL} = 8 mA				0.36		0.44	0.44		
I _I	V _I = 5.5 V or GND	0 V to 5.5 V			±0.1		±1*	±1	μA	
I _{OZ}	V _O = V _{CC} or GND, Q _A -Q _H	5.5 V			±0.25		±2.5	±2.5	μA	
I _{CC}	V _I = V _{CC} or GND, I _O = 0	5.5 V			4		40	40	μA	
ΔI _{CC} †	One input at 3.4V, Other inputs at V _{CC} or GND	5.5 V			2		2.2	2.2	mA	
C _i	V _I = V _{CC} or GND	5 V		3	10			10	pF	
C _o	V _O = V _{CC} or GND	5 V		5.5					pF	

* On products compliant to MIL-PRF-38535, this parameter is not production tested at V_{CC} = 0 V.

† This is the increase in supply current for each input at one of the specified TTL voltage levels, rather than 0 V or V_{CC}.

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

		T _A = 25°C		SN54AHCT595		SN74AHCT595		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t _w	Pulse duration	SRCLK high or low	5		5.5		5.5	ns
		RCLK high or low	5		5.5		5.5	
		SRCLR low	5		5		5	
t _{su}	Setup time	SER before SRCLK↑	3		3		3	ns
		SRCLK↑ before RCLK↑‡	5		5		5	
		SRCLR low before RCLK↑	5		5		5	
		SRCLR high (inactive) before SRCLK↑	3.4		3.8		3.8	
t _h	Hold time	SER after SRCLK↑	2		2		2	ns

‡ This setup time allows the storage register to receive stable data from the shift register. The clocks can be tied together, in which case the shift register is one clock pulse ahead of the storage register.

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SN54AHCT595, SN74AHCT595 8-BIT SHIFT REGISTERS WITH 3-STATE OUTPUT REGISTERS

SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54AHCT595		SN74AHCT595		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}$	135*	170*		115*		115		MHz
			$C_L = 50\text{ pF}$	95	140		85		85		
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 15\text{ pF}$		4.3*	7.4*	1*	8.5*	1	8.5	ns
t_{PHL}					4.3*	7.4*	1*	8.5*	1	8.5	
t_{PLH}	SRCLK	Q_H'	$C_L = 15\text{ pF}$		4.5*	8.2*	1*	9.4*	1	9.4	ns
t_{PHL}					4.5*	8.2*	1*	9.4*	1	9.4	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'	$C_L = 15\text{ pF}$		4.5*	8*	1*	9.1*	1	9.1	ns
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H	$C_L = 15\text{ pF}$		4.3*	8.6*	1*	10*	1	10	ns
t_{PZL}					5.4*	8.6*	1*	10*	1	10	
t_{PLH}	RCLK	Q_A-Q_H	$C_L = 50\text{ pF}$		5.6	9.4		10.5	1	10.5	ns
t_{PHL}					5.6	9.4	1	10.5	1	10.5	
t_{PLH}	SRCLK	Q_H'	$C_L = 50\text{ pF}$		6.4	10.2	1	11.4	1	11.4	ns
t_{PHL}					6.4	10.2	1	11.4	1	11.4	
t_{PHL}	$\overline{\text{SRCLR}}$	Q_H'	$C_L = 50\text{ pF}$		6.4	10	1	11.1	1	11.1	ns
t_{PZH}	$\overline{\text{OE}}$	Q_A-Q_H	$C_L = 50\text{ pF}$		5.7	10.6	1	12	1	12	ns
t_{PZL}					6.8	10.6	1	12	1	12	
t_{PHZ}	$\overline{\text{OE}}$	Q_A-Q_H	$C_L = 50\text{ pF}$		3.5	10.3	1	11	1	11	ns
t_{PLZ}					3.4	10.3	1	11	1	11	

* On products compliant to MIL-PRF-38535, this parameter is not production tested.

noise characteristics, $V_{CC} = 5\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 4)

PARAMETER		SN74AHCT595			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		1		V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		-0.6		V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		3.8		V
$V_{IH(D)}$	High-level dynamic input voltage	2			V
$V_{IL(D)}$	Low-level dynamic input voltage			0.8	V

NOTE 4: Characteristics are for surface-mount packages only.

operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load, $f = 1\text{ MHz}$	112	pF

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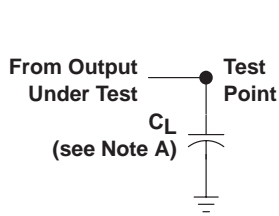


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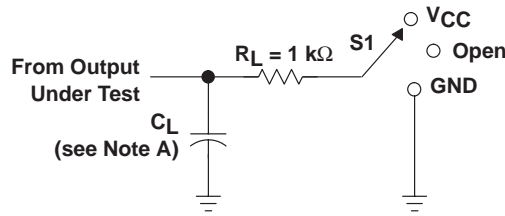
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SCLS374L – MAY 1997 – REVISED FEBRUARY 2004

PARAMETER MEASUREMENT INFORMATION

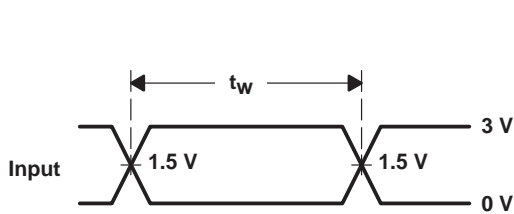


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

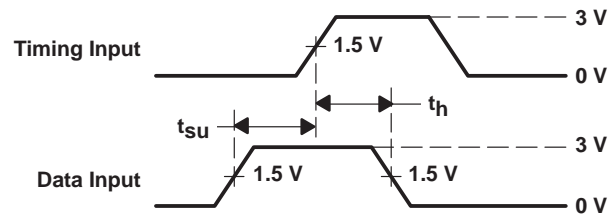


LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS

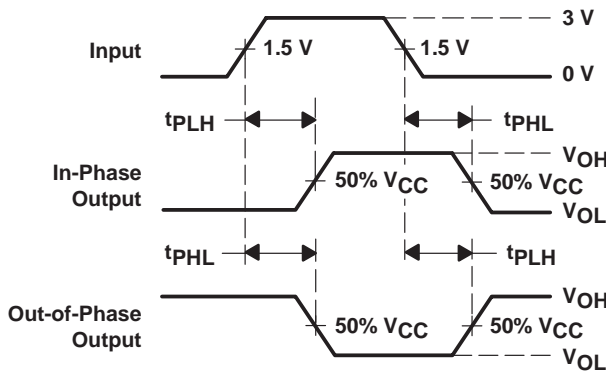
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND
Open Drain	V_{CC}



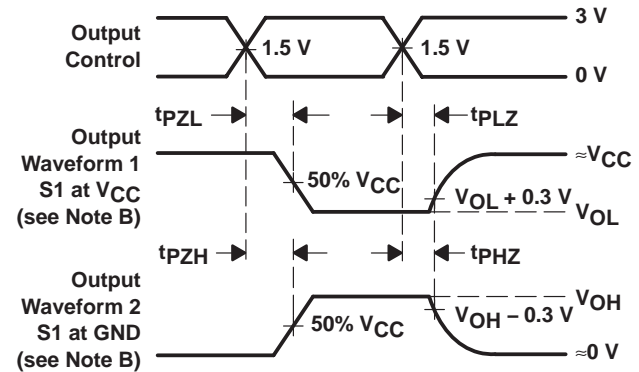
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

- NOTES:
- C_L includes probe and jig 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.
 - All input pulses are supplied by generators having the following characteristics: PRR $\leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 3\text{ ns}$, $t_f \leq 3\text{ ns}$.
 - The outputs are measured one at a time, with one input transition per measurement.
 - All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead shoulder width is a vendor option, either half or full width.

4040049/E 12/2002

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - 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-012 variation AC.

MECHANICAL DATA

NS (R-PDSO-G)**

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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