

SN54ALS191A, SN74ALS191A SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

SDAS210C – DECEMBER 1982 – REVISED JULY 1996

- Single Down/Up Count-Control Line
- Look-Ahead Circuitry Enhances Speed of Cascaded Counters
- Fully Synchronous in Count Modes
- Asynchronously Presetable With Load Control
- Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

description

The 'ALS191A are synchronous 4-bit reversible up/down binary counters. Synchronous counting operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincidentally with each other when instructed by the steering logic. This mode of operation eliminates the output counting spikes normally associated with asynchronous (ripple-clock) counters.

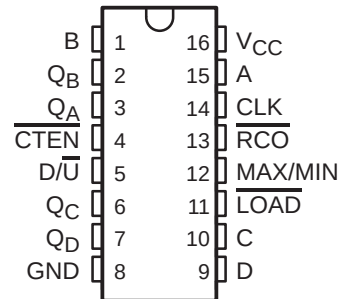
The outputs of the four flip-flops are triggered on a low-to-high-level transition of the clock (CLK) input if the count enable ($\overline{\text{CTEN}}$) input is low. A high at $\overline{\text{CTEN}}$ inhibits counting. The direction of the count is determined by the level of the down/up ($\text{D}/\overline{\text{U}}$) input. When $\text{D}/\overline{\text{U}}$ is low, the counter counts up, and when $\text{D}/\overline{\text{U}}$ is high, the counter counts down.

These counters feature a fully independent clock circuit. Changes at the control inputs ($\overline{\text{CTEN}}$ and $\text{D}/\overline{\text{U}}$) that modify the operating mode have no effect on the contents of the counter until clocking occurs. The function of the counter is dictated solely by the conditions meeting the stable setup and hold times.

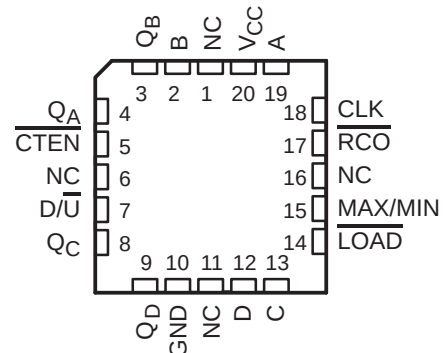
These counters are fully programmable. Each output can be preset to either level by placing a low on the $\overline{\text{LOAD}}$ input and entering the desired data at the data inputs. The output changes to agree with the data inputs independently of the level of the clock input. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

CLK, $\text{D}/\overline{\text{U}}$, and $\overline{\text{LOAD}}$ are buffered to lower the drive requirement, which significantly reduces the loading on (current required by) clock drivers, for long parallel words.

SN54ALS191A ... J PACKAGE
SN74ALS191A ... D OR N PACKAGE
(TOP VIEW)



SN54ALS191A ... FK PACKAGE
(TOP VIEW)



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 © 1996, Texas Instruments Incorporated

SN54ALS191A, SN74ALS191A

SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

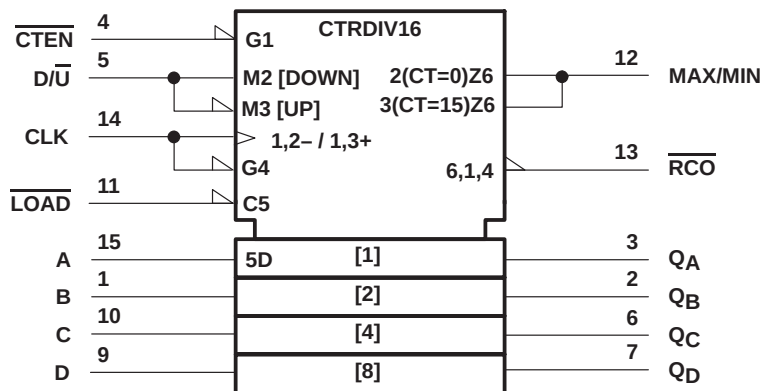
SDAS210C – DECEMBER 1982 – REVISED JULY 1996

description (continued)

Two outputs are available to perform the cascading function: ripple clock and maximum/minimum count. The latter output produces a high-level output pulse with a duration approximately equal to one complete cycle of the clock while the count is minimum (0) counting down or maximum (15) counting up. The ripple-clock output ($\overline{RCO}$) produces a low-level output pulse under those same conditions, but only while the clock input is low. The counter easily can be cascaded by feeding the ripple-clock output to the enable input of the succeeding counter if parallel clocking is used, or to the clock input if parallel enabling is used. The maximum/minimum count (MAX/MIN) output can be used to accomplish look ahead for high-speed operation.

The SN54ALS191A is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74ALS191A is characterized for operation from 0°C to 70°C .

logic symbol†

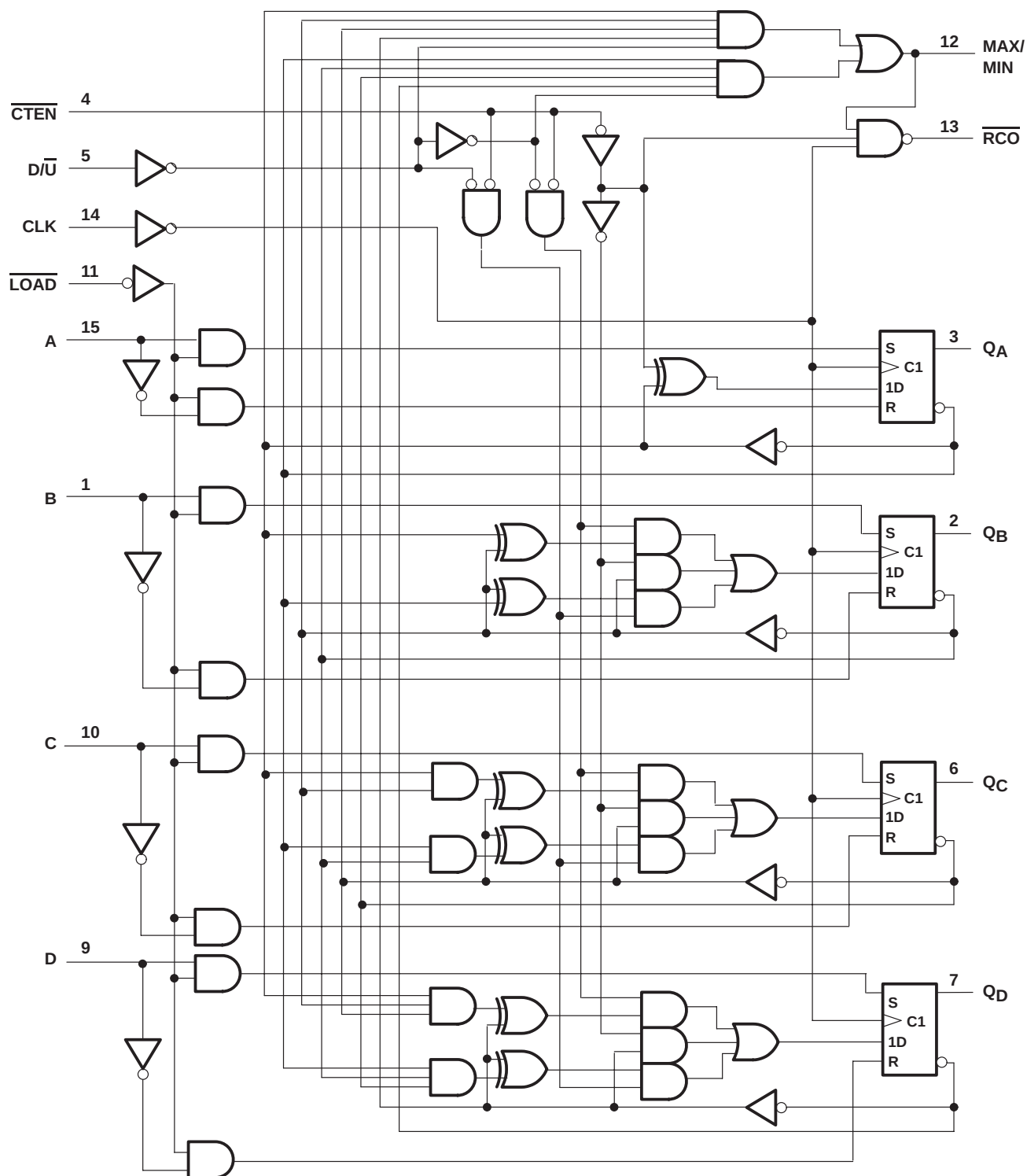


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the D, J, and N packages.

SN54ALS191A, SN74ALS191A SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

SDAS210C – DECEMBER 1982 – REVISED JULY 1996

logic diagram (positive logic)



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

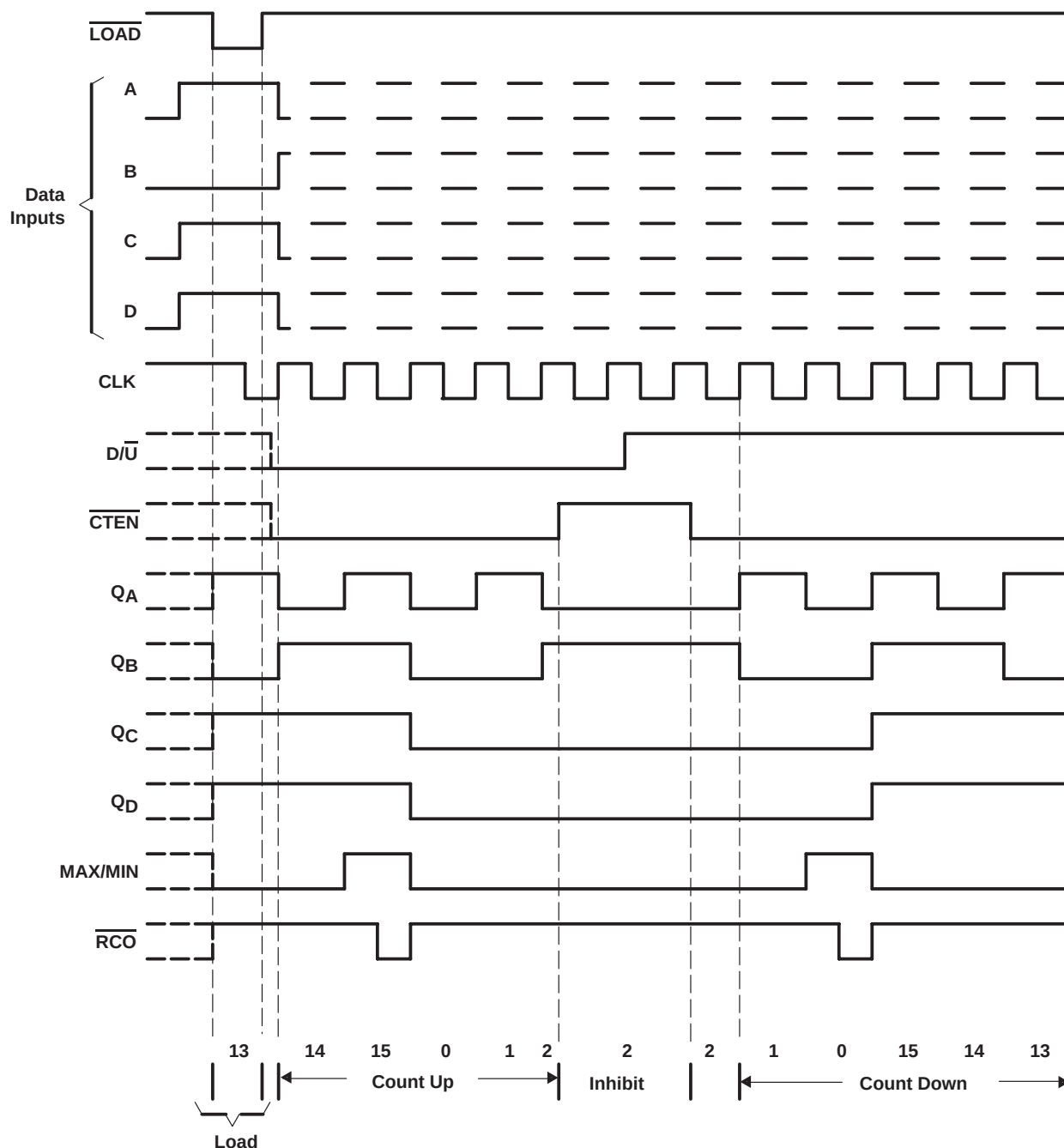
SN54ALS191A, SN74ALS191A SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

SDAS210C – DECEMBER 1982 – REVISED JULY 1996

typical load, count, and inhibit sequences

The following sequence is illustrated below:

1. Load (preset) to binary 13
2. Count up to 14, 15 (maximum), 0, 1, and 2
3. Inhibit
4. Count down to 1, 0 (minimum), 15, 14, and 13



SN54ALS191A, SN74ALS191A

SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

SDAS210C – DECEMBER 1982 – REVISED JULY 1996

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

Supply voltage, V_{CC}	7 V
Input voltage, V_I	7 V
Operating free-air temperature range, T_A : SN54ALS191A	–55°C to 125°C
SN74ALS191A	0°C to 70°C
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.

recommended operating conditions

			SN54ALS191A			SN74ALS191A			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage		2			2			V
V_{IL}	Low-level input voltage				0.7			0.8	V
I_{OH}	High-level output current				–0.4			–0.4	mA
I_{OL}	Low-level output current				4			8	mA
f_{clock}	Clock frequency		0		20	0		30	MHz
t_w	Pulse duration	CLK high or low	20			16.5			ns
		LOAD low	25			20			
t_{su}	Setup time	Data before $\overline{LOAD}\uparrow$	25			20			ns
		$\overline{CTEN}$ before $CLK\uparrow$	45			20			
		D/ $\overline{U}$ before $CLK\uparrow$	30			20			
		LOAD inactive before $CLK\uparrow$	20			20			
t_h	Hold time	Data after $\overline{LOAD}\uparrow$	5			5			ns
		$\overline{CTEN}$ after $CLK\uparrow$	0			0			
		D/ $\overline{U}$ after $CLK\uparrow$	0			0			
T_A	Operating free-air temperature		–55		125	0		70	°C



SN54ALS191A, SN74ALS191A

SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

SDAS210C – DECEMBER 1982 – REVISED JULY 1996

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

PARAMETER		TEST CONDITIONS		SN54ALS191A		SN74ALS191A		UNIT
				MIN	TYP†	MAX	MIN	
V _{IK}		V _{CC} = 4.5 V, I _I = −18 mA		−1.5		−1.5		V
V _{OH}		V _{CC} = 4.5 V to 5.5 V, I _{OH} = −0.4 mA		V _{CC} − 2		V _{CC} − 2		V
V _{OL}		V _{CC} = 4.5 V	I _{OL} = 4 mA	0.25	0.4	0.25	0.4	
			I _{OL} = 8 mA			0.35	0.5	
I _I		V _{CC} = 5.5 V, V _I = 7 V		0.2		0.1		mA
I _{IH}		V _{CC} = 5.5 V, V _I = 2.7 V		20		20		μA
I _{IL}	CTEN or CLK	V _{CC} = 5.5 V, V _I = 0.4 V		−0.2		−0.2		mA
	All others			−0.2		−0.1		
I _O †		V _{CC} = 5.5 V, V _O = 2.25 V		−20	−112	−30	−112	mA
I _{CC}		V _{CC} = 5.5 V, All inputs at 0		12	22	12	22	mA

† All typical values are at $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS} .

switching characteristics (see Figure 1)

PARAMETER	FROM (OUTPUT)	TO (OUTPUT)	V _{CC} = 4.5 V to 5.5 V, C _L = 50 pF, R _L = 500 Ω, T _A = MIN to MAX§				UNIT
			SN54ALS191A		SN74ALS191A		
			MIN	MAX	MIN	MAX	
f _{max}			20		30		MHz
t _{PLH}	$\overline{\text{LOAD}}$	Any Q	7	37	7	30	ns
t _{PHL}			8	34	8	30	
t _{PLH}	A, B, C, D	Any Q	3	25	3	21	ns
t _{PHL}			4	25	4	21	
t _{PLH}	CLK	$\overline{\text{RCO}}$	5	24	5	20	ns
t _{PHL}			5	25	5	20	
t _{PLH}	CLK	Any Q	3	26	3	18	ns
t _{PHL}			3	22	3	18	
t _{PLH}	CLK	MAX/MIN	8	37	8	31	ns
t _{PHL}			8	34	8	31	
t _{PLH}	D/ $\overline{\text{U}}$	$\overline{\text{RCO}}$	8	45	8	37	ns
t _{PHL}			10	36	10	28	
t _{PLH}	D/ $\overline{\text{U}}$	MAX/MIN	8	35	8	25	ns
t _{PHL}			8	30	8	25	
t _{PLH}	$\overline{\text{CTEN}}$	$\overline{\text{RCO}}$	4	21	4	18	ns
t _{PHL}			4	23	4	18	

§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

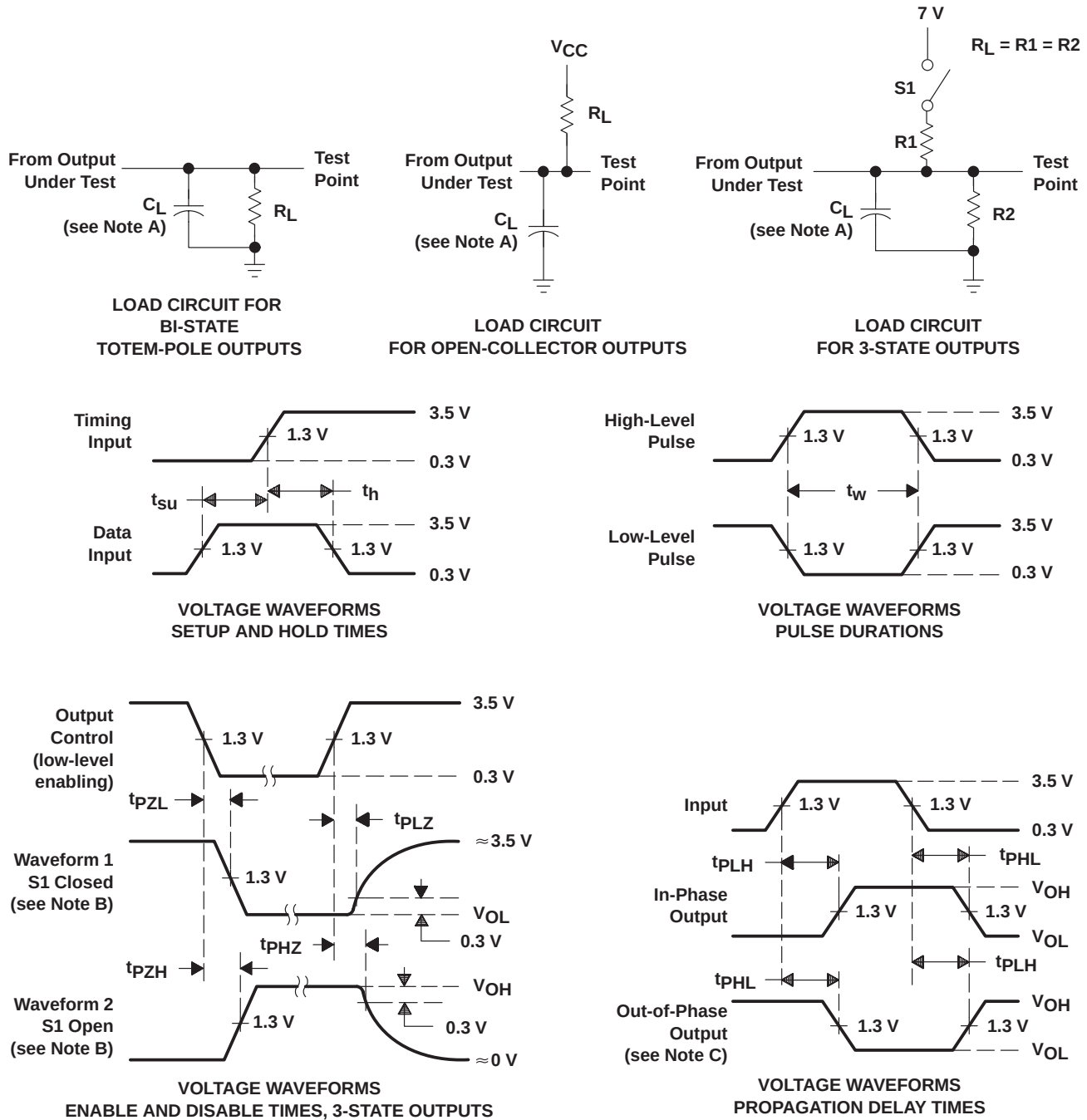


POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN54ALS191A, SN74ALS191A SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS

SDAS210C – DECEMBER 1982 – REVISED JULY 1996

PARAMETER MEASUREMENT INFORMATION SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- NOTES: A. C_L includes probe and jig 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. When measuring propagation delay items of 3-state outputs, switch S1 is open.
 D. All input pulses have the following characteristics: $PRR \leq 1$ MHz, $t_r = t_f = 2$ ns, duty cycle = 50%.
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits 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.