

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.

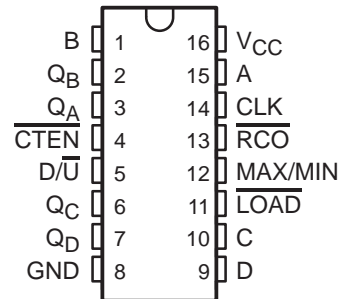
The outputs of the four flip-flops are triggered on a low-to-high-level transition of the clock (CLK) input if the count enable ($\overline{\text{CTEN}}$) input is low. A high at $\overline{\text{CTEN}}$ inhibits counting. The direction of the count is determined by the level of the down/up ($\text{D}/\overline{\text{U}}$)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

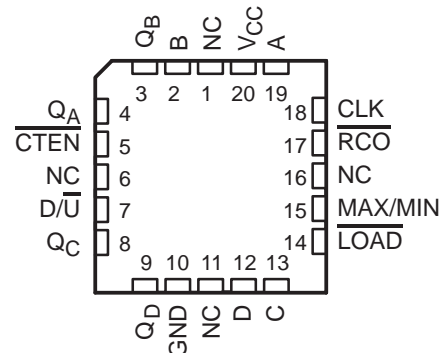
These counters are fully programmable. Each output can be preset to either level by placing a low on the $\overline{\text{LOAD}}$ input and entering the desired data at the data inputs. The output changes to agree with the data inputs independently of the level of the clock input. This feature allows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



NC – No internal connection



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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**

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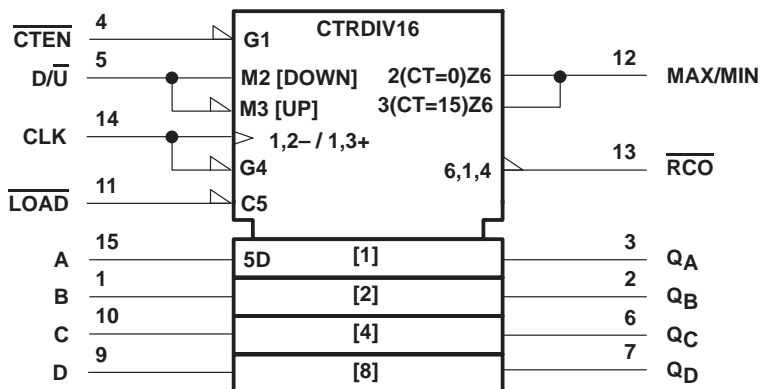
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description (continued)

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†

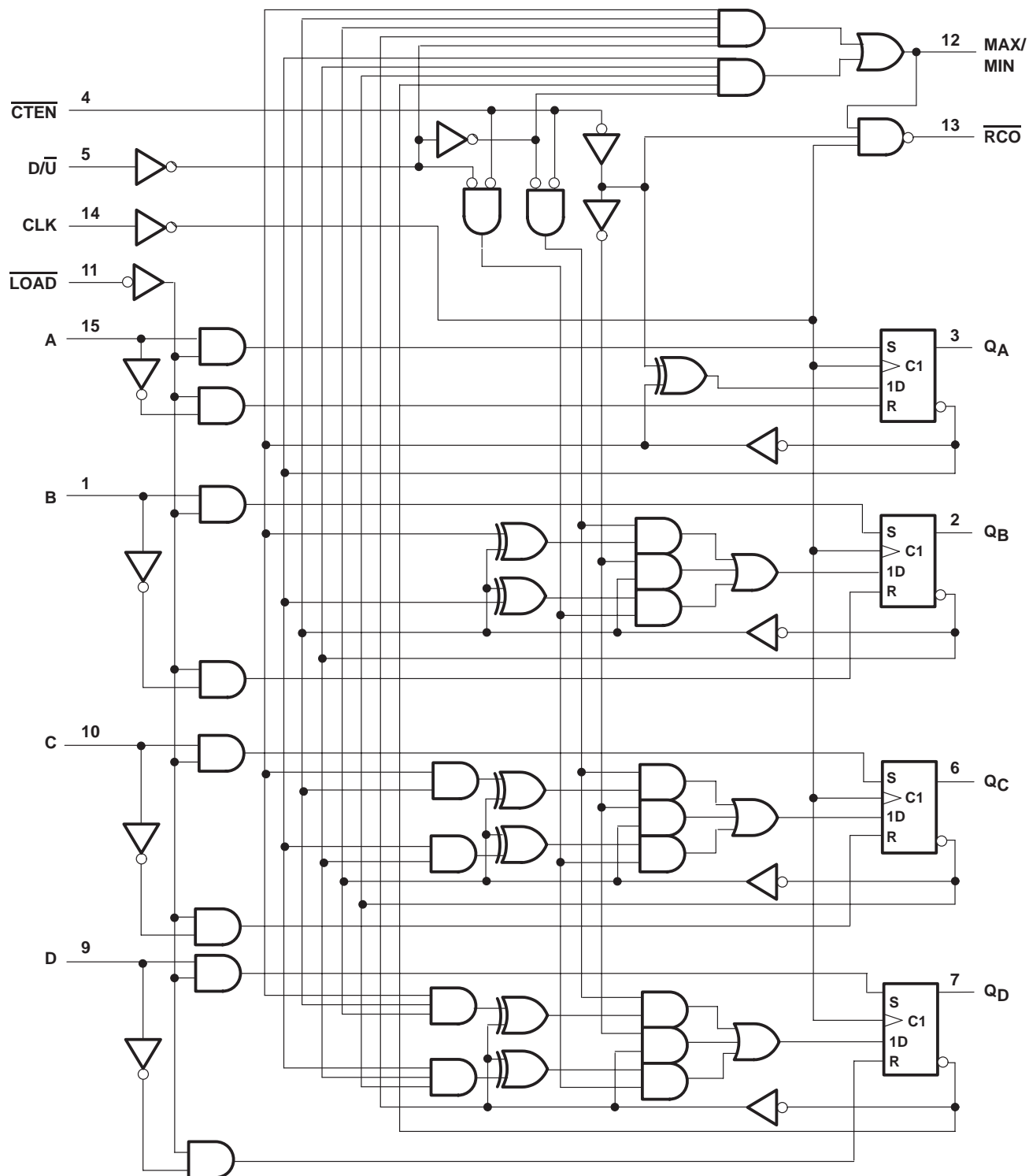


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the D, J, and N packages.

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logic diagram (positive logic)



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

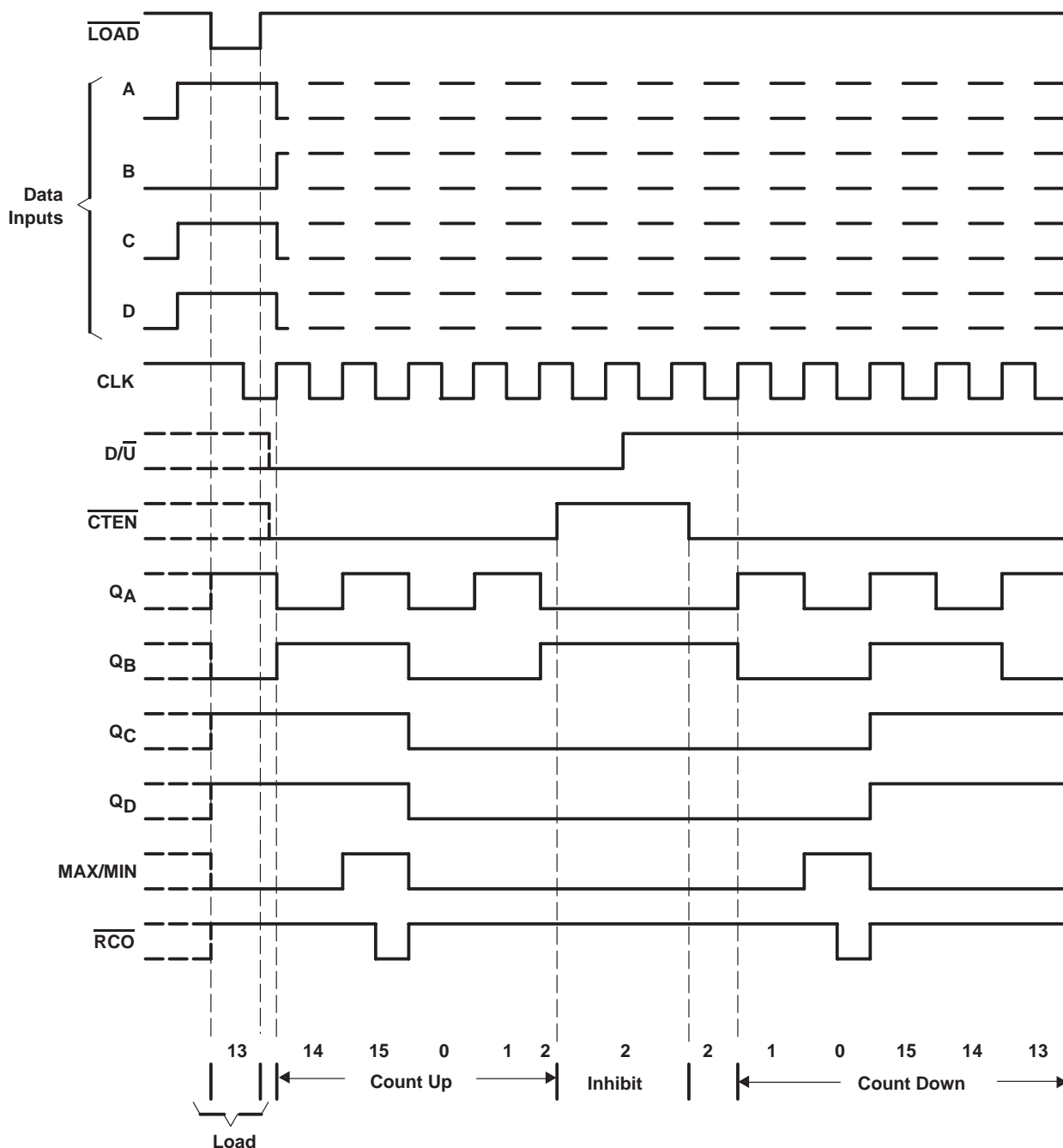
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typical load, count, and inhibit sequences

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



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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



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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	V
		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 V, T_A = 25°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}	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	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/Ū	RCO	8	45	8	37	ns
t _{PHL}			10	36	10	28	
t _{PLH}	D/Ū	MAX/MIN	8	35	8	25	ns
t _{PHL}			8	30	8	25	
t _{PLH}	CTEN	RCO	4	21	4	18	ns
t _{PHL}			4	23	4	18	

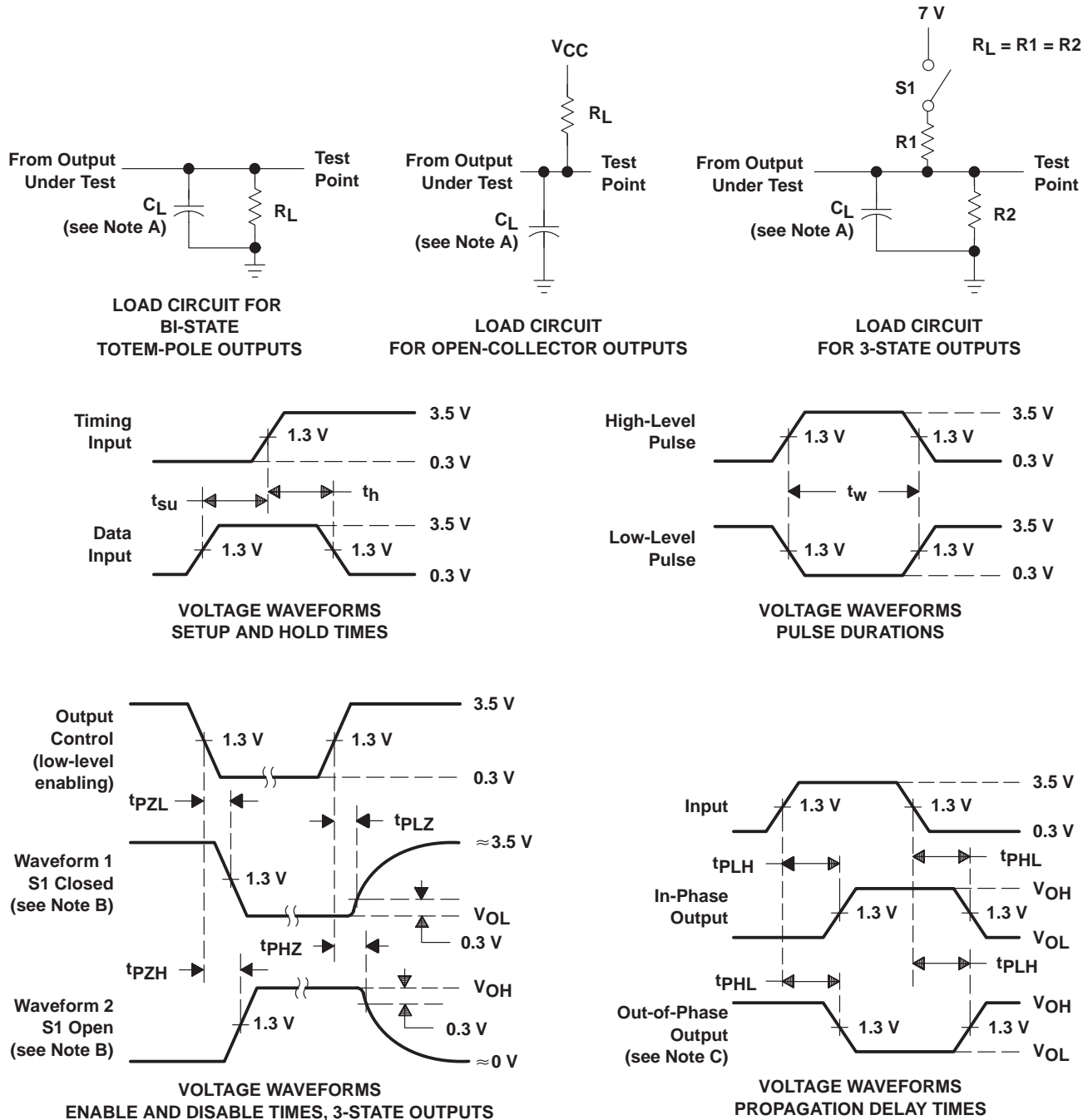
§ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



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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

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
5962-86840012A	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
5962-8684001EA	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
5962-8684001FA	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC
SN54ALS191AJ	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SN74ALS191AD	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74ALS191ADR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74ALS191AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
SN74ALS191ANSR	ACTIVE	SO	NS	16	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SNJ54ALS191AFK	ACTIVE	LCCC	FK	20	1	None	Call TI	Level-NC-NC-NC
SNJ54ALS191AJ	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
SNJ54ALS191AW	ACTIVE	CFP	W	16	1	None	Call TI	Level-NC-NC-NC

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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