

# **SN54ALS193A, SN74ALS193A SYNCHRONOUS 4-BIT UP/DOWN BINARY COUNTERS WITH DUAL CLOCK AND CLEAR**

SDAS211C – DECEMBER 1982 – REVISED JULY 1996

- Look-Ahead Circuitry Enhances Cascaded Counters
  - Fully Synchronous in Count Modes
  - Parallel Asynchronous Load for Modulo-N Count Lengths
  - Asynchronous Clear
  - Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

### **description**

The 'ALS193A are synchronous, reversible, 4-bit up/down binary counters. Synchronous counting operation is provided by having all flip-flops clocked simultaneously so that the outputs change coincident 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 either count/clock (UP or DOWN) input. The direction of the count is determined by which count input is pulsed while the other count input is high.

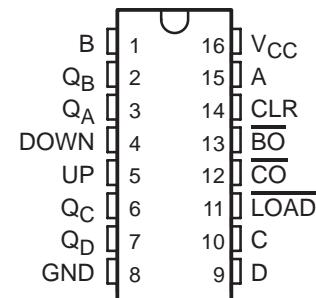
All four counters are fully programmable; that is, each output may be preset to either level by placing a low on the load (LOAD) input and entering the desired data at the data inputs. The output changes to agree with the data inputs independently of the count pulses. This feature allows the counters to be used as modulo-N dividers by simply modifying the count length with the preset inputs.

A high level applied to the clear (CLR) input forces all outputs to the low level. The clear function is independent of the count and LOAD inputs. The UP, DOWN, and LOAD inputs are buffered to lower the drive requirement, which significantly reduces the loading on, or current required by, clock drivers, etc., for long parallel words.

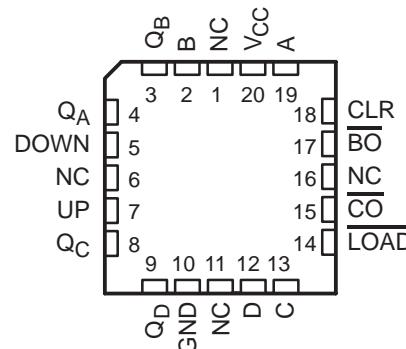
These counters are designed to be cascaded without the need for external circuitry. The borrow ( $\overline{BO}$ ) output produces a low-level pulse while the count is zero (all Q outputs low) and the DOWN input is low. Similarly, the carry ( $\overline{CO}$ ) output produces a low-level pulse while the count is 9 or 15 (all Q outputs high) and the UP input is low. The counters can then be easily cascaded by feeding  $\overline{BO}$  and  $\overline{CO}$  to the count-down and count-up inputs, respectively, of the succeeding counter.

The SN54ALS193A is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS193A is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

**SN54ALS193A . . . J PACKAGE  
SN74ALS193A . . . D OR N PACKAGE  
(TOP VIEW)**



**SN54ALS193A . . . FK PACKAGE  
(TOP VIEW)**



NC – No internal connection



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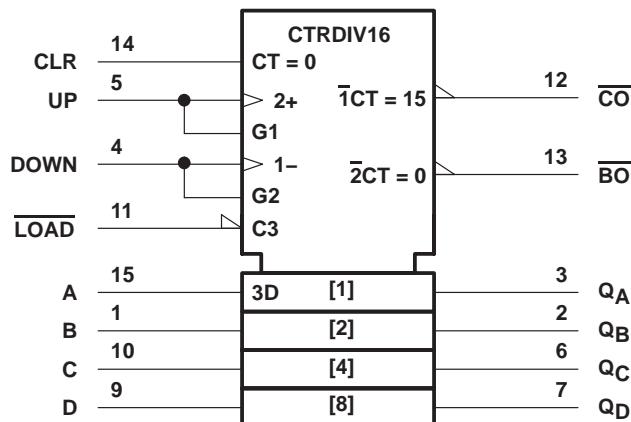
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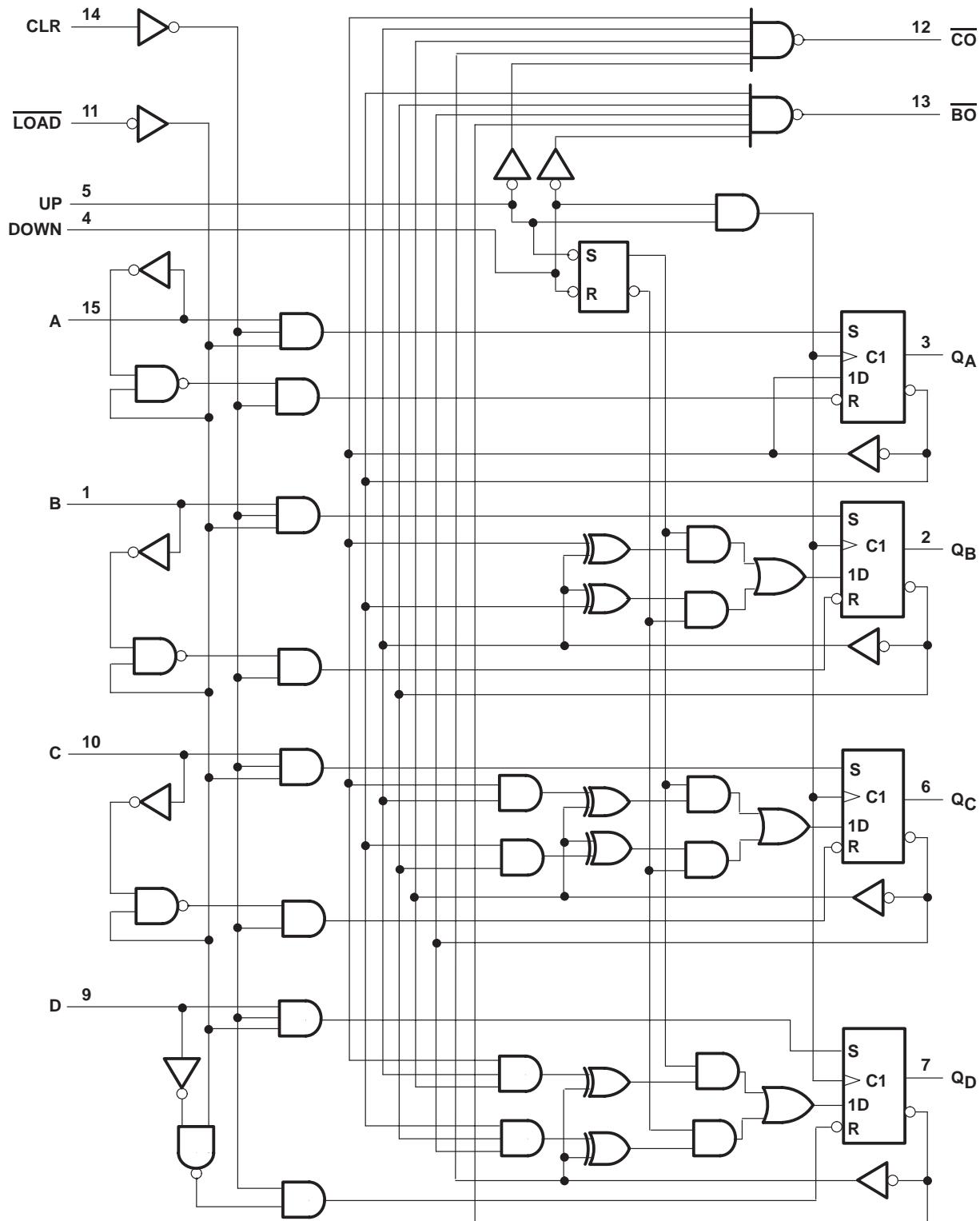
**logic symbol†**



† 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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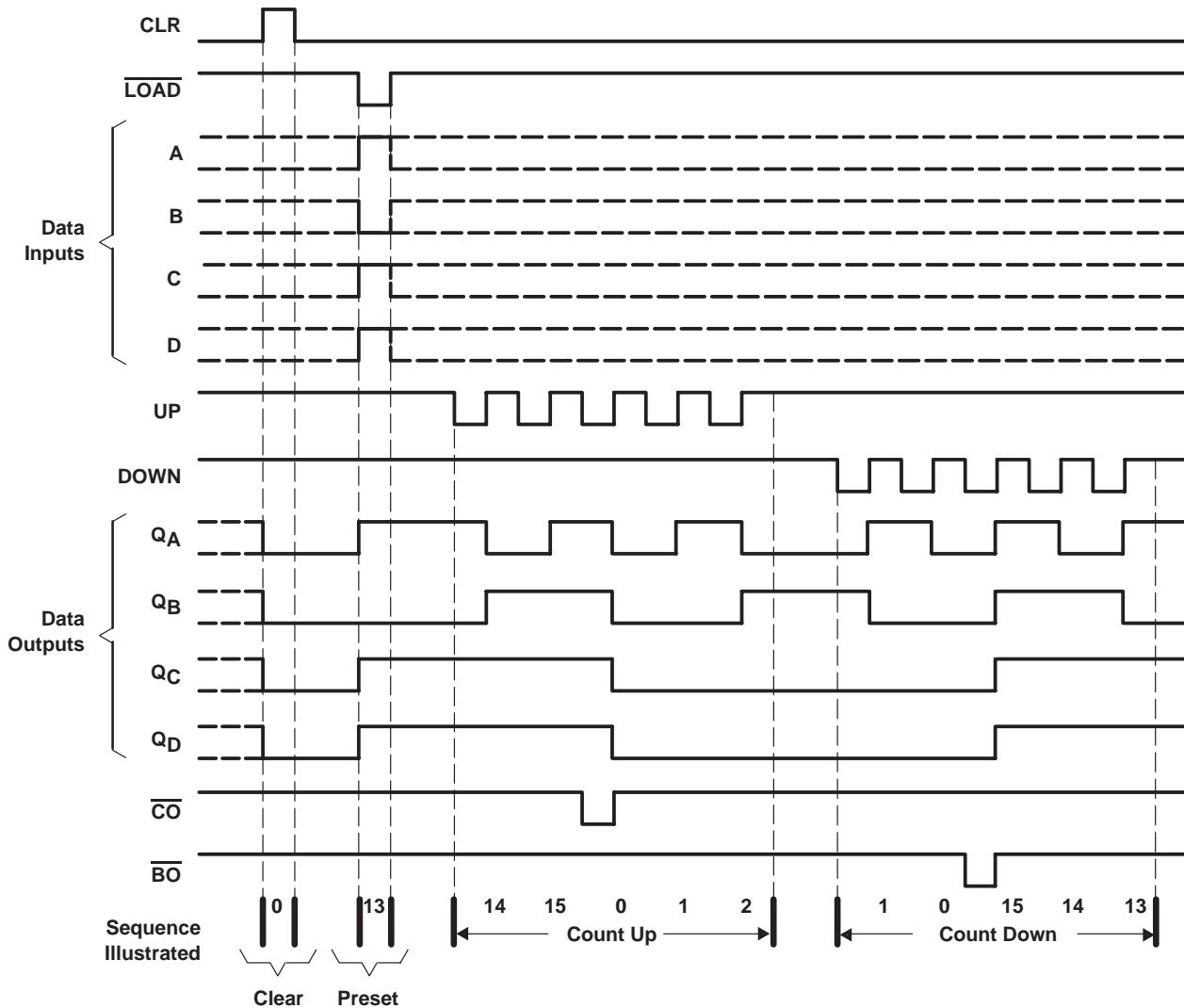
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SDAS211C - DECEMBER 1982 - REVISED JULY 1996

**typical clear, load, and count sequence**

the following sequence is illustrated below:

1. Clear outputs to zero
2. Load (preset) to binary 13
3. Count up to 14, 15 (carry), 0, 1, and 2
4. Count down to 1, 0 (borrow), 15, 14, and 13



- NOTES: A. Clear overrides load, data, and count inputs.  
B. When counting up, count-down input must be high; when counting down, count-up input must be high.

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SDAS211C – DECEMBER 1982 – REVISED JULY 1996

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

<sup>†</sup> 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**

		SN54ALS193A			SN74ALS193A			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage			0.7			0.8	V
I <sub>OH</sub>	High-level output current			-0.4			-0.4	mA
I <sub>OL</sub>	Low-level output current			4			8	mA
f <sub>clock</sub>	Clock frequency	0	20		0	30		MHz
t <sub>w</sub>	Pulse duration	CLR high	10		10			ns
		LOAD low	25		20			
		UP or DOWN high or low	30		16.5			
t <sub>su</sub>	Setup time	Data before LOAD↑	25		20			ns
		CLR inactive before UP or DOWN	20		20			
		LOAD inactive before UP or DOWN	20		20			
t <sub>h</sub>	Hold time	Data after LOAD↑	5		5			ns
		UP high after DOWN↑	5		0			
		DOWN high after UP↑	5		0			
T <sub>A</sub>	Operating free-air temperature	-55	125		0	70		°C

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

PARAMETER	TEST CONDITIONS	SN54ALS193A			SN74ALS193A			UNIT
		MIN	TYP‡	MAX	MIN	TYP‡	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA		-1.5			-1.5		V
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = -0.4 mA	V <sub>CC</sub> - 2		V <sub>CC</sub> - 2				V
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 4 mA		0.25	0.4		0.25	0.4
		I <sub>OL</sub> = 8 mA					0.35	0.5
I <sub>I</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V			0.1		0.35	0.1	mA
I <sub>IH</sub>	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V			20		20		µA
I <sub>IL</sub>	UP or DOWN			-0.2		-0.2		mA
	All others	V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V		-0.1		-0.1		
I <sub>O</sub> §	V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V	-20	-112	-30	-112			mA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, See Note 1		12	22		12	22	mA

<sup>‡</sup>All typical values are at  $V_{CC} = 5$  V,  $T_A = 25^\circ\text{C}$ .

NOTE 1:  $I_{CC}$  is measured with the clear and load inputs grounded and all other inputs at 4.5 V.

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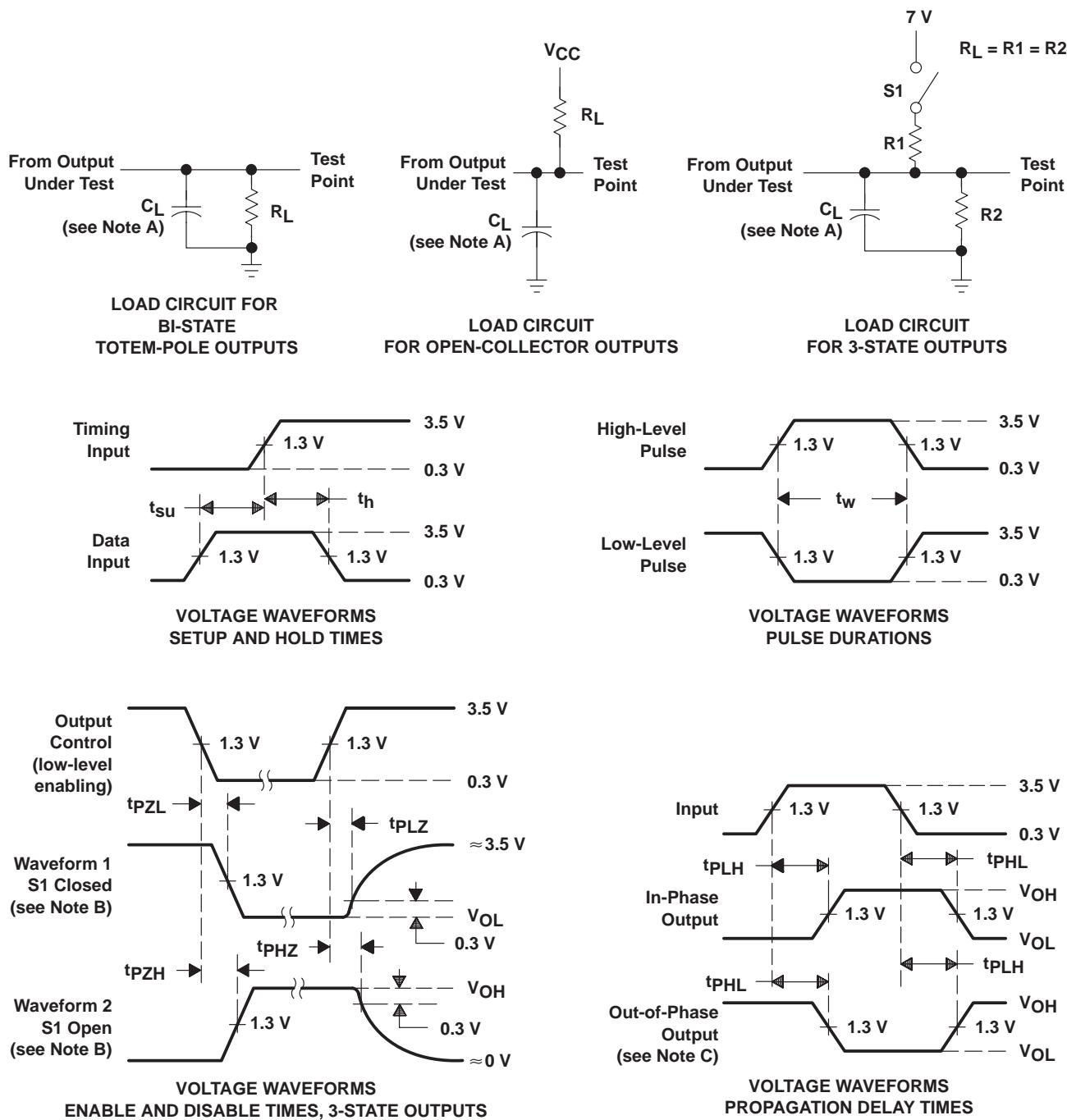
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**switching characteristics (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ , $C_L = 50 \text{ pF}$ , $R1 = R2 = 500 \Omega$ , $T_A = \text{MIN to MAX}^{\dagger}$				UNIT	
			SN54ALS193A		SN74ALS193A			
			MIN	MAX	MIN	MAX		
$f_{max}$			25		30		MHz	
$t_{PLH}$	UP	$\overline{CO}$	3	20	3	16	ns	
$t_{PHL}$			3	21	5	18		
$t_{PLH}$	DOWN	$\overline{BO}$	4	20	4	16	ns	
$t_{PHL}$			5	22	5	18		
$t_{PLH}$	UP or DOWN	Any Q	3	27	3	19	ns	
$t_{PHL}$			4	23	4	17		
$t_{PLH}$	$\overline{\text{LOAD}}$	Any Q	7	38	7	30	ns	
$t_{PHL}$			8	37	8	28		
$t_{PHL}$	CLR	Any Q	5	20	5	17	ns	

<sup>†</sup> For conditions shown MIN or MAX, use the appropriate value specified under recommended operating conditions.

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



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

**Figure 1. Load Circuits and Voltage Waveforms**

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
5962-8869801EA	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8869801EA SNJ54ALS193AJ
5962-8869801FA	Active	Production	CFP (W)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8869801FA SNJ54ALS193AW
SN54ALS193AJ	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	SN54ALS193AJ
SN54ALS193AJ.A	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	SN54ALS193AJ
SN74ALS193AD	Active	Production	SOIC (D)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS193A
SN74ALS193AD.A	Active	Production	SOIC (D)   16	40   TUBE	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS193A
SN74ALS193AN	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN74ALS193AN
SN74ALS193AN.A	Active	Production	PDIP (N)   16	25   TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN74ALS193AN
SNJ54ALS193AJ	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8869801EA SNJ54ALS193AJ
SNJ54ALS193AJ.A	Active	Production	CDIP (J)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8869801EA SNJ54ALS193AJ
SNJ54ALS193AW	Active	Production	CFP (W)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8869801FA SNJ54ALS193AW
SNJ54ALS193AW.A	Active	Production	CFP (W)   16	25   TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8869801FA SNJ54ALS193AW

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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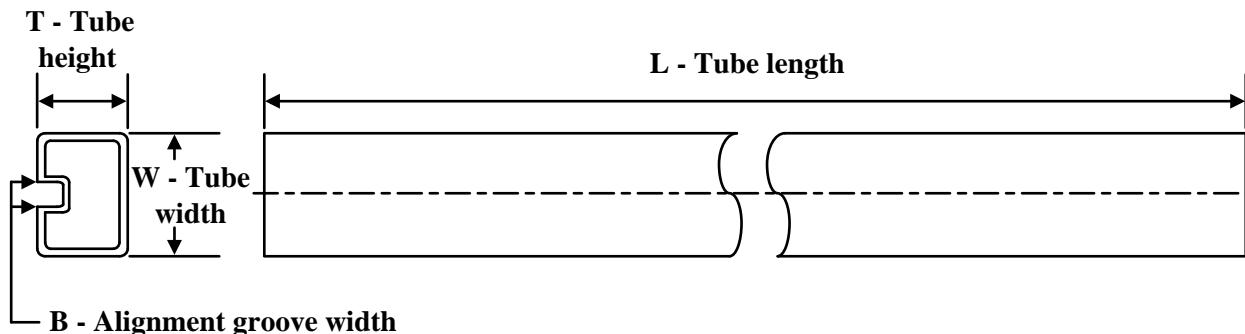
**OTHER QUALIFIED VERSIONS OF SN54ALS193A, SN74ALS193A :**

- Catalog : [SN74ALS193A](#)
- Military : [SN54ALS193A](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TUBE

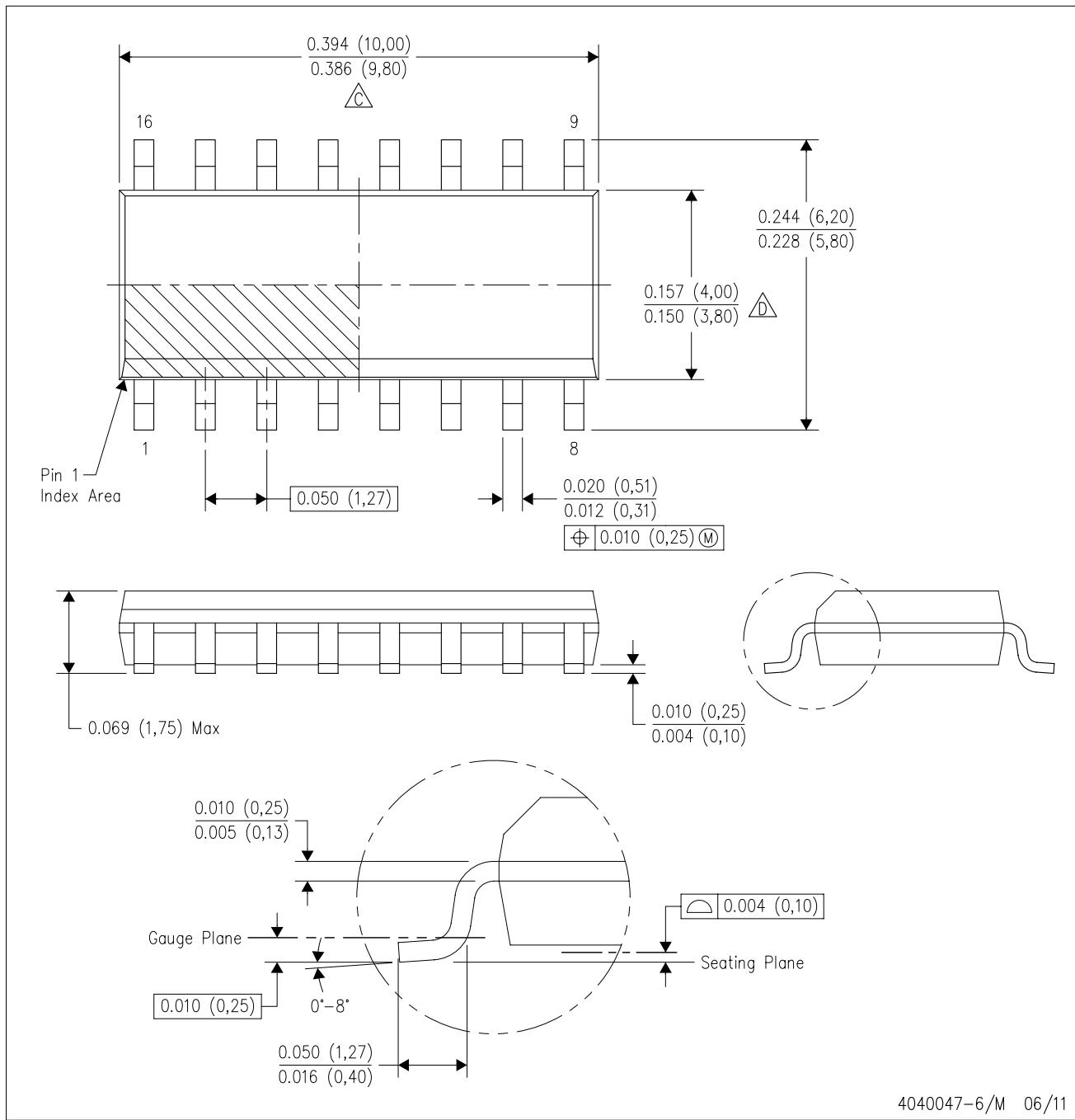


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T ( $\mu$ m)	B (mm)
5962-8869801FA	W	CFP	16	25	506.98	26.16	6220	NA
SN74ALS193AD	D	SOIC	16	40	507	8	3940	4.32
SN74ALS193AD.A	D	SOIC	16	40	507	8	3940	4.32
SN74ALS193AN	N	PDIP	16	25	506	13.97	11230	4.32
SN74ALS193AN	N	PDIP	16	25	506	13.97	11230	4.32
SN74ALS193AN.A	N	PDIP	16	25	506	13.97	11230	4.32
SN74ALS193AN.A	N	PDIP	16	25	506	13.97	11230	4.32
SNJ54ALS193AW	W	CFP	16	25	506.98	26.16	6220	NA
SNJ54ALS193AW.A	W	CFP	16	25	506.98	26.16	6220	NA

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters).

B. This drawing is subject to change without notice.

C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.

D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.

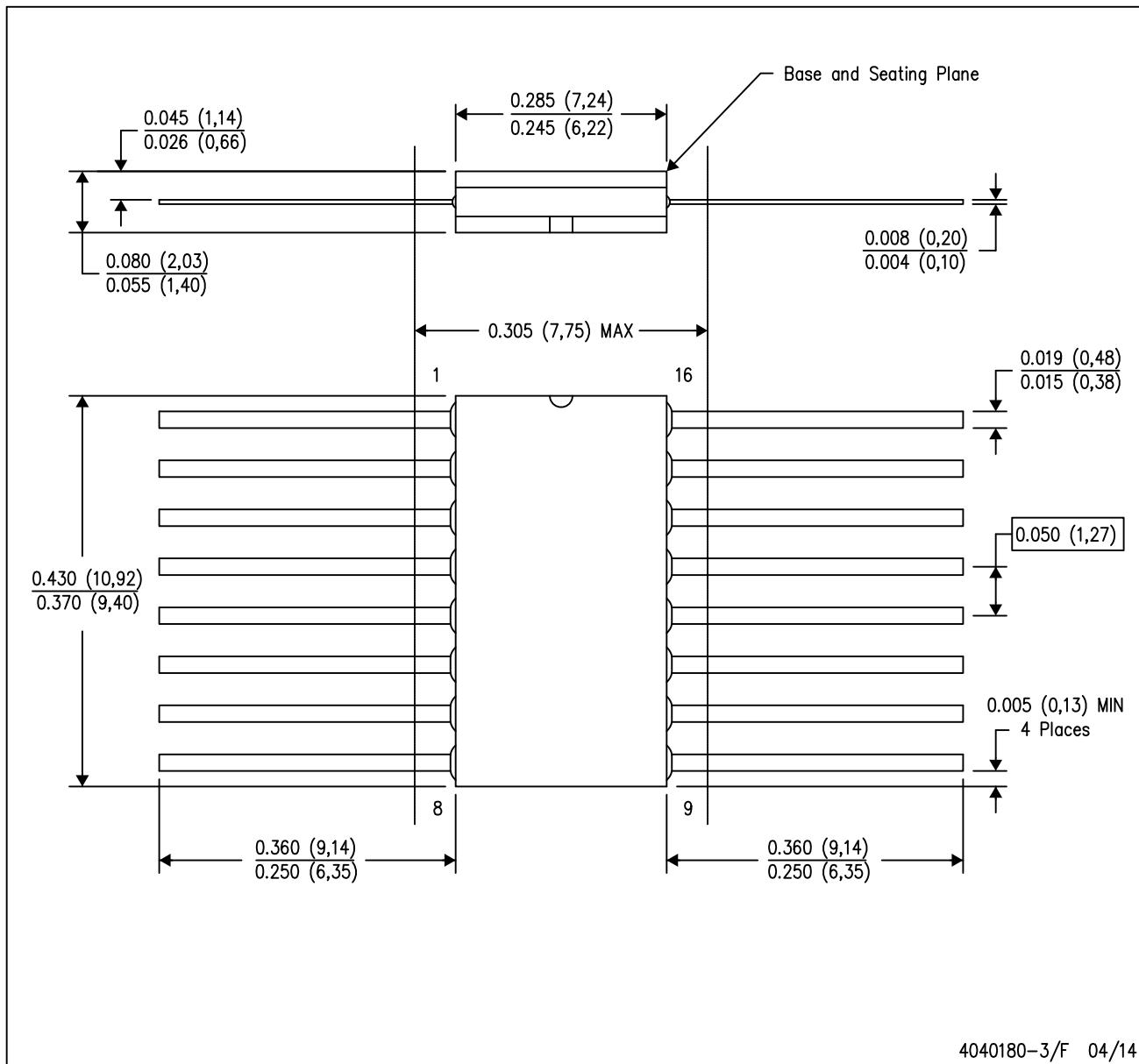
E. Reference JEDEC MS-012 variation AC.

4040047-6/M 06/11

## MECHANICAL DATA

W (R-GDFP-F16)

## CERAMIC DUAL FLATPACK



4040180-3/F 04/14

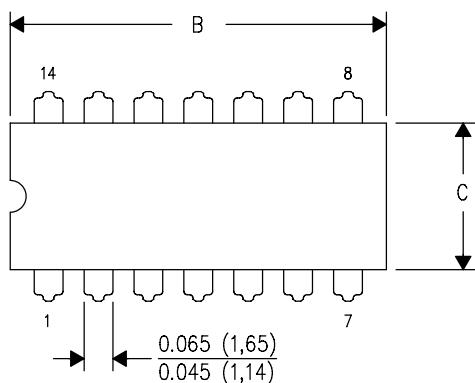
NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only.
- E. Falls within MIL STD 1835 GDFP2-F16

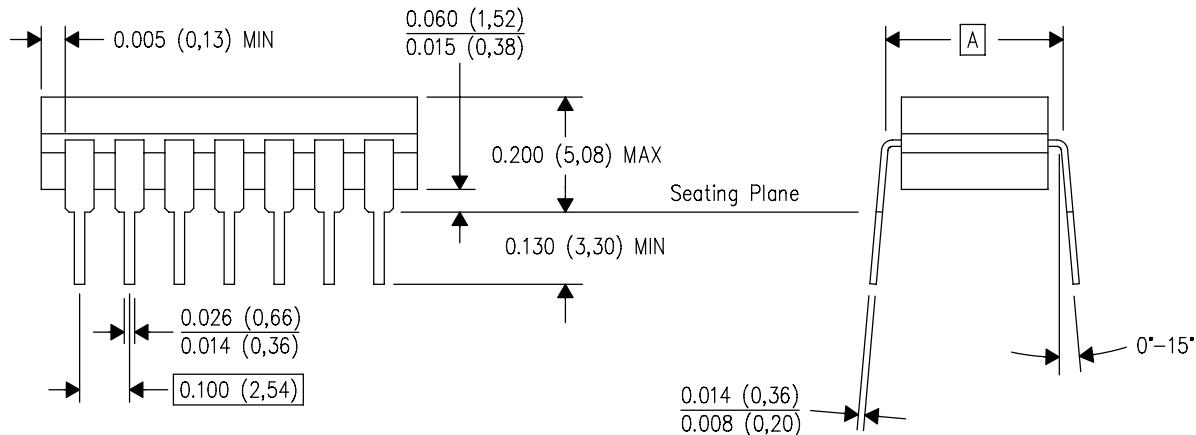
J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS **\nDIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



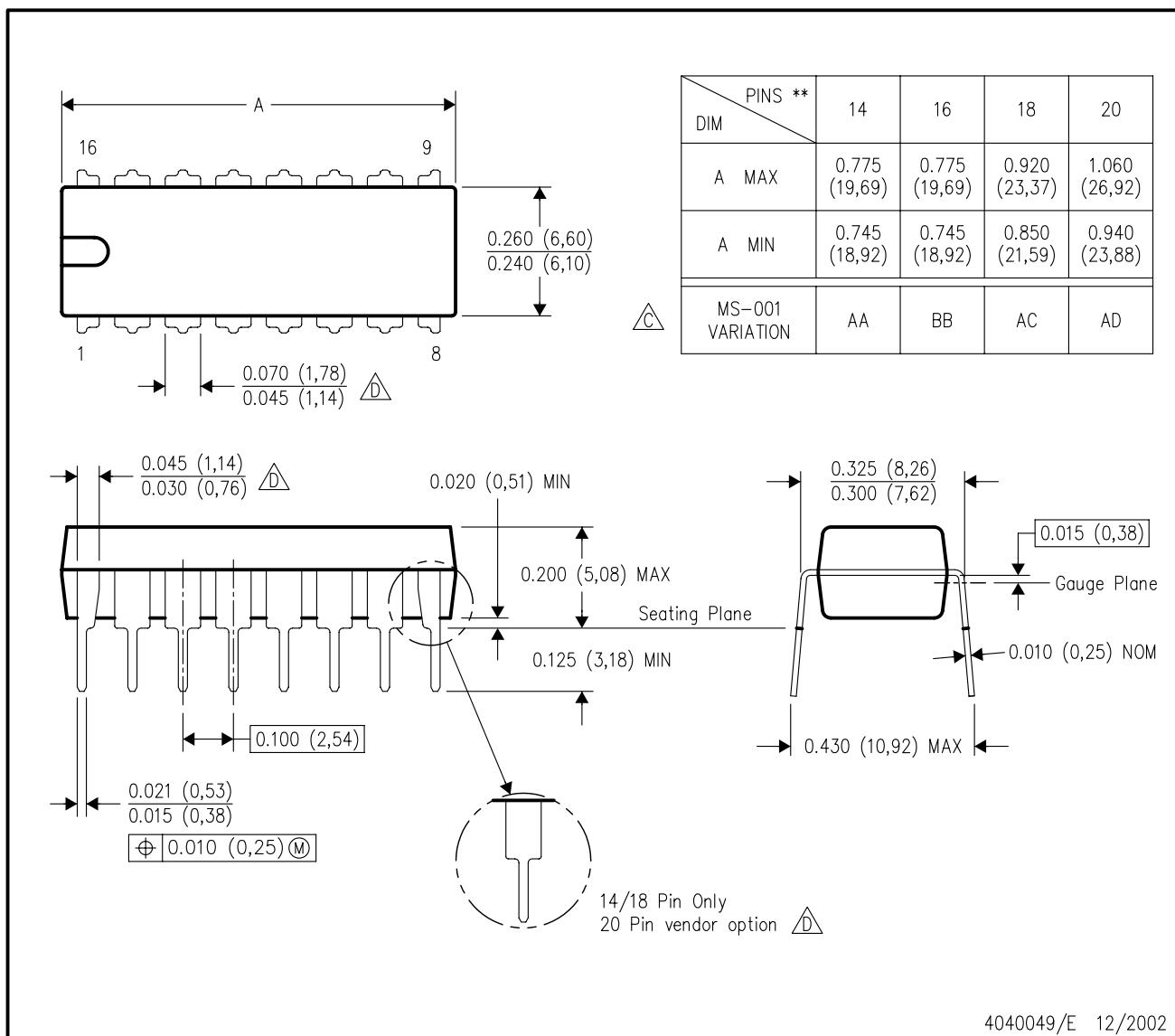
4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package is hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



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