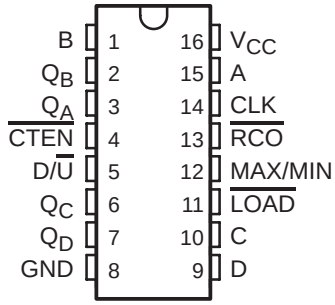
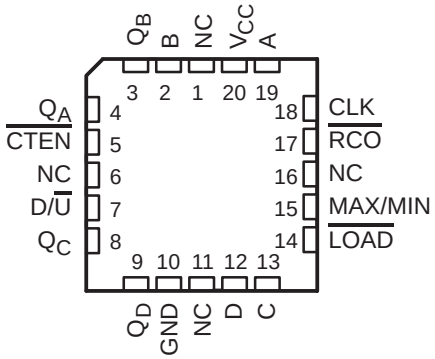
SDAS210C − DECEMBER 1982 − REVISED JULY 1996

- **Single Down/Up Count-Control Line**
- **Look-Ahead Circuitry Enhances Speed of Cascaded Counters**
- **Fully Synchronous in Count Modes**
- **Asynchronously Presettable 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**

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



SN54ALS191A . . . FK PACKAGE
(TOP VIEW)



NC − No internal connection

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 ($\overline{CTEN}$) input is low. A high at $\overline{CTEN}$ inhibits counting. The direction of the count is determined by the level of the down/up (D/$\overline{U}$) input. When D/$\overline{U}$ is low, the counter counts up, and when D/$\overline{U}$ is high, the counter counts down.

These counters feature a fully independent clock circuit. Changes at the control inputs ($\overline{CTEN}$ and D/$\overline{U}$) 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 $\overline{LOAD}$ 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, D/$\overline{U}$, and $\overline{LOAD}$ are buffered to lower the drive requirement, which significantly reduces the loading on (current required by) clock drivers, for long parallel words.

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.

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TEXAS INSTRUMENTS
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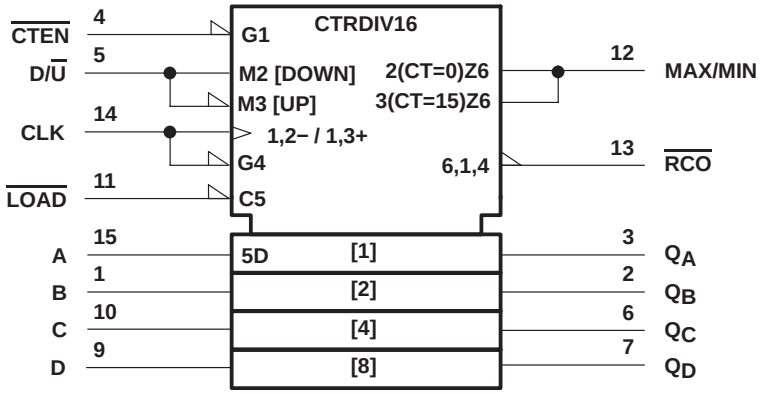
description (continued)

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.

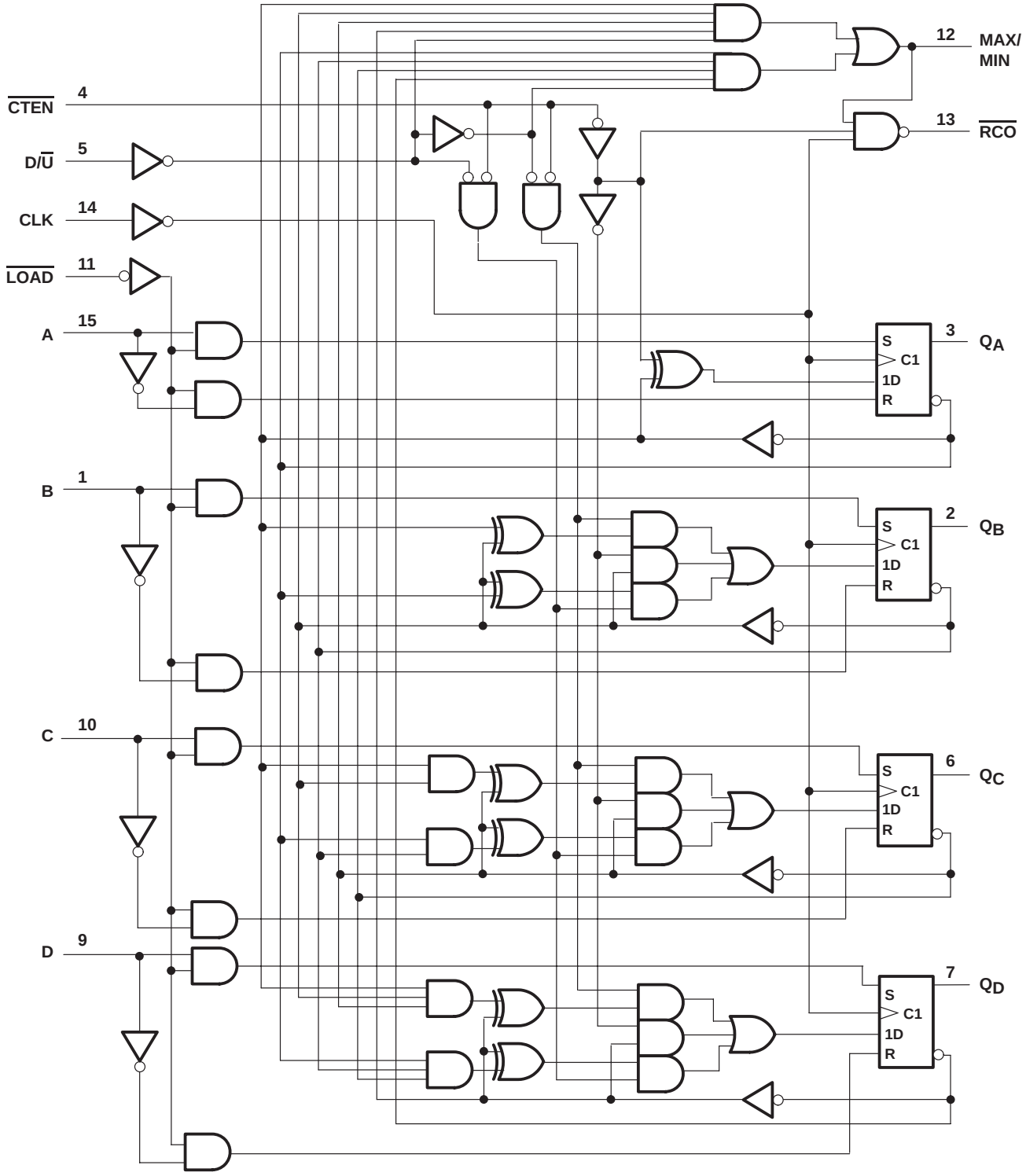
The SN54ALS191A is characterized for operation over the full military temperature range of −55°C to 125°C. The SN74ALS191A is characterized for operation from 0°C to 70°C.

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.

logic diagram (positive logic)

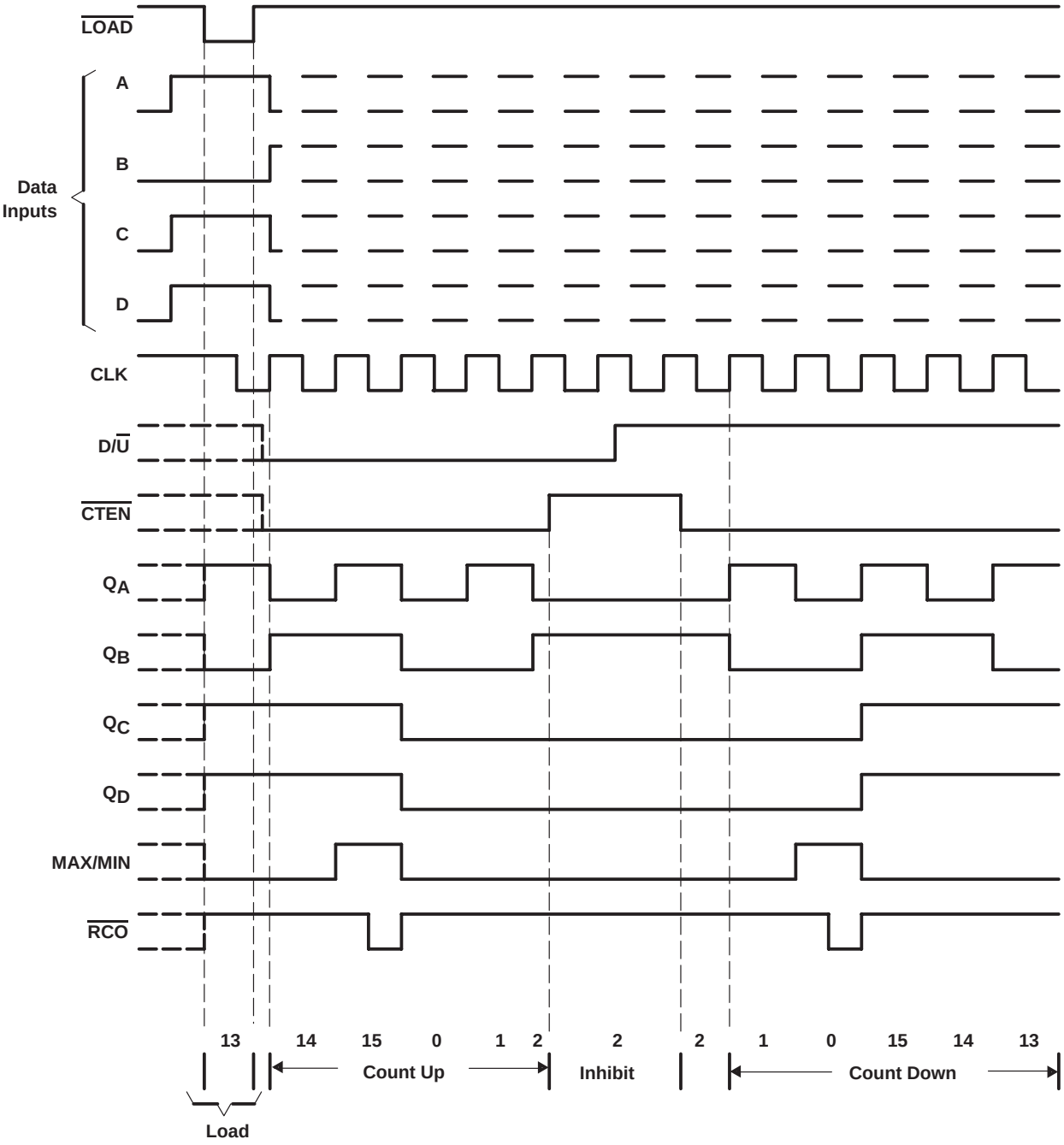


Pin numbers shown are for the D, J, and N packages.

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



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
		$\overline{\text{LOAD}}$ low	25			20			
t_{su}	Setup time	Data before $\overline{\text{LOAD}}\uparrow$	25			20			ns
		$\overline{\text{CTEN}}$ before CLK$\uparrow$	45			20			
		D/$\overline{\text{U}}$ before CLK$\uparrow$	30			20			
		$\overline{\text{LOAD}}$ inactive before CLK$\uparrow$	20			20			
t_h	Hold time	Data after $\overline{\text{LOAD}}\uparrow$	5			5			ns
		$\overline{\text{CTEN}}$ after CLK$\uparrow$	0			0			
		D/$\overline{\text{U}}$ after CLK$\uparrow$	0			0			
T_A	Operating free-air temperature		−55		125	0		70	°C

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

PARAMETER		TEST CONDITIONS		SN54ALS191A			SN74ALS191A			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
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}	$\overline{\text{CTEN}}$ 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

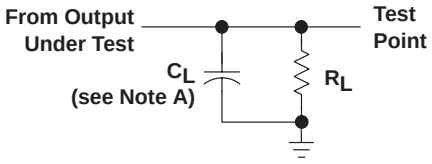
† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I_{OS}.

switching characteristics (see Figure 1)

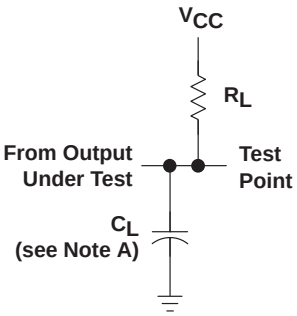
PARAMETER	FROM (OUTPUT)	TO (OUTPUT)	V_{CC} = 4.5 V to 5.5 V, C_L = 50 pF, R_L = 500 Ω, T_A = MIN to MAX§				UNIT
			SN54ALS191A		SN74ALS191A		
			MIN	MAX	MIN	MAX	
f_{max}			20		30		MHz
t_{PLH}	$\overline{\text{LOAD}}$	Any Q	7	37	7	30	ns
t_{PHL}			8	34	8	30	
t_{PLH}	A, B, C, D	Any Q	3	25	3	21	ns
t_{PHL}			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.

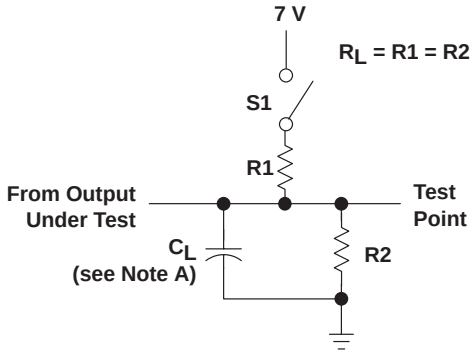
PARAMETER MEASUREMENT INFORMATION
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



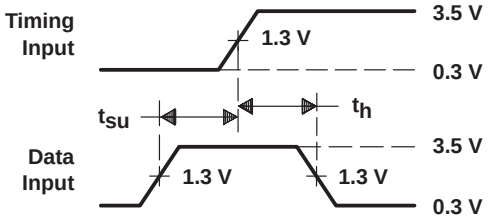
LOAD CIRCUIT FOR
BI-STATE
TOTEM-POLE OUTPUTS



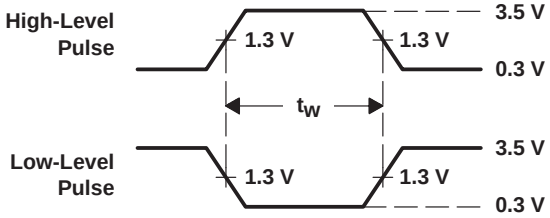
LOAD CIRCUIT
FOR OPEN-COLLECTOR OUTPUTS



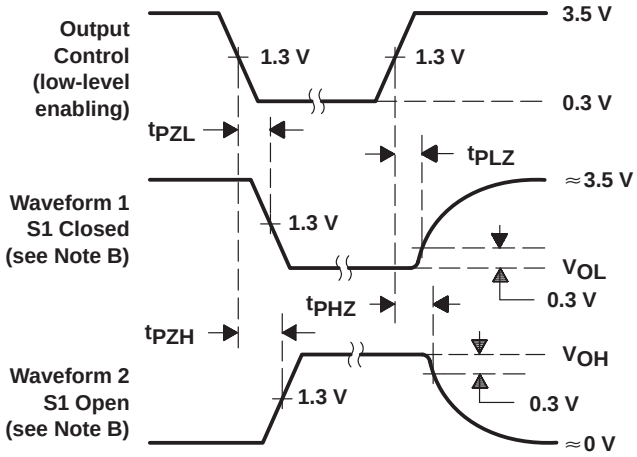
LOAD CIRCUIT
FOR 3-STATE OUTPUTS



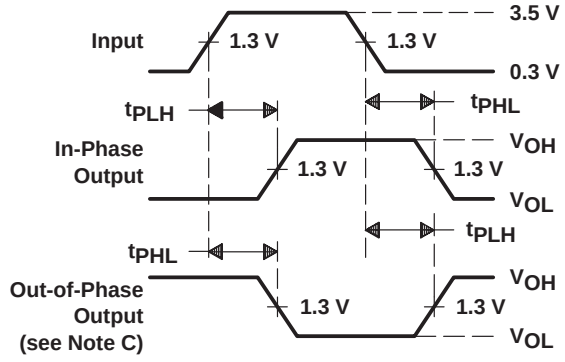
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

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 ≤ 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 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)
5962-86840012A	Active	Production	LCCC (FK) | 20	55 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-86840012A SNJ54ALS 191AFK
5962-8684001EA	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8684001EA SNJ54ALS191AJ
5962-8684001FA	Active	Production	CFP (W) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8684001FA SNJ54ALS191AW
SN74ALS191AD	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	0 to 70	ALS191A
SN74ALS191ADR	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS191A
SN74ALS191ADR.A	Active	Production	SOIC (D) | 16	2500 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS191A
SN74ALS191AN	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN74ALS191AN
SN74ALS191AN.A	Active	Production	PDIP (N) | 16	25 | TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN74ALS191AN
SNJ54ALS191AFK	Active	Production	LCCC (FK) | 20	55 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-86840012A SNJ54ALS 191AFK
SNJ54ALS191AFK.A	Active	Production	LCCC (FK) | 20	55 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-86840012A SNJ54ALS 191AFK
SNJ54ALS191AJ	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8684001EA SNJ54ALS191AJ
SNJ54ALS191AJ.A	Active	Production	CDIP (J) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8684001EA SNJ54ALS191AJ
SNJ54ALS191AW	Active	Production	CFP (W) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8684001FA SNJ54ALS191AW
SNJ54ALS191AW.A	Active	Production	CFP (W) | 16	25 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8684001FA SNJ54ALS191AW

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

(6) **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 SN54ALS191A, SN74ALS191A :

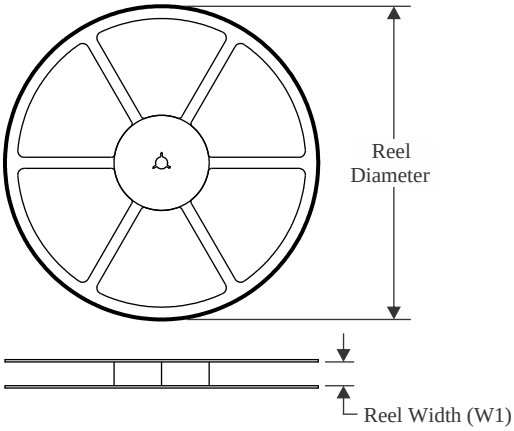
- Catalog : SN74ALS191A
- Military : SN54ALS191A

NOTE: Qualified Version Definitions:

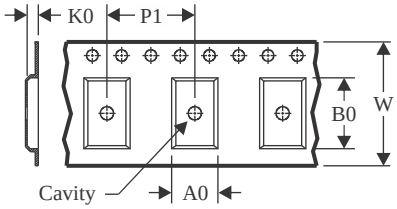
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

TAPE AND REEL INFORMATION

REEL DIMENSIONS

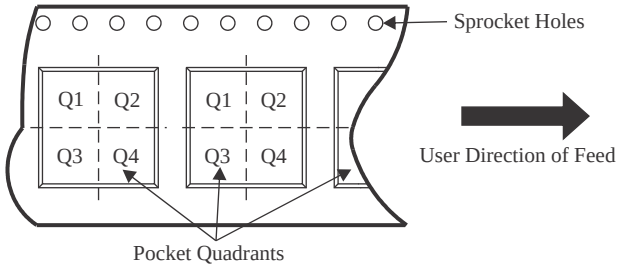


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

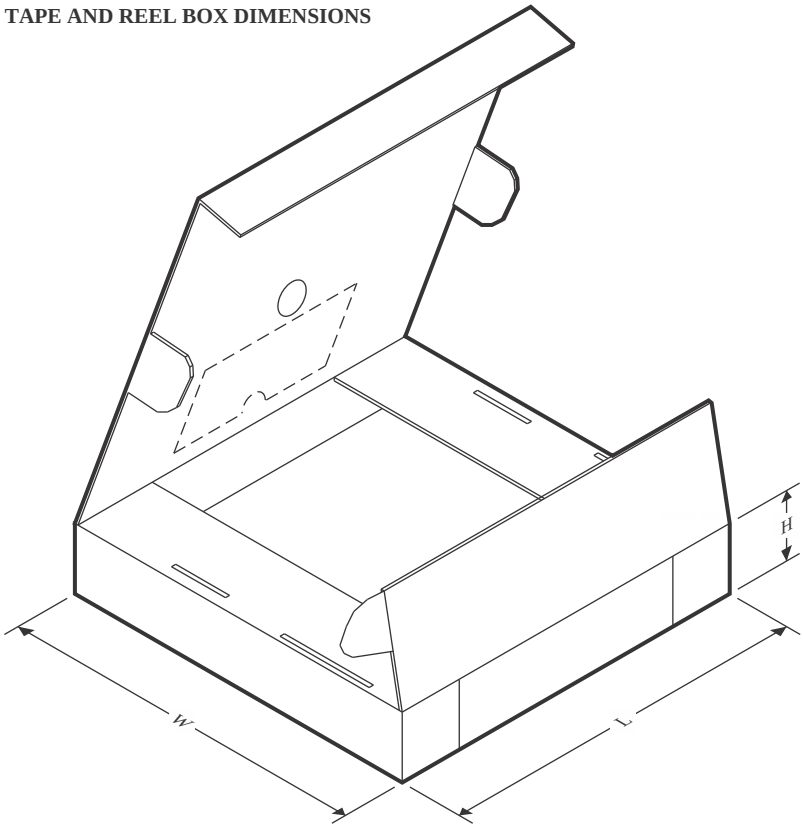
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74ALS191ADR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1

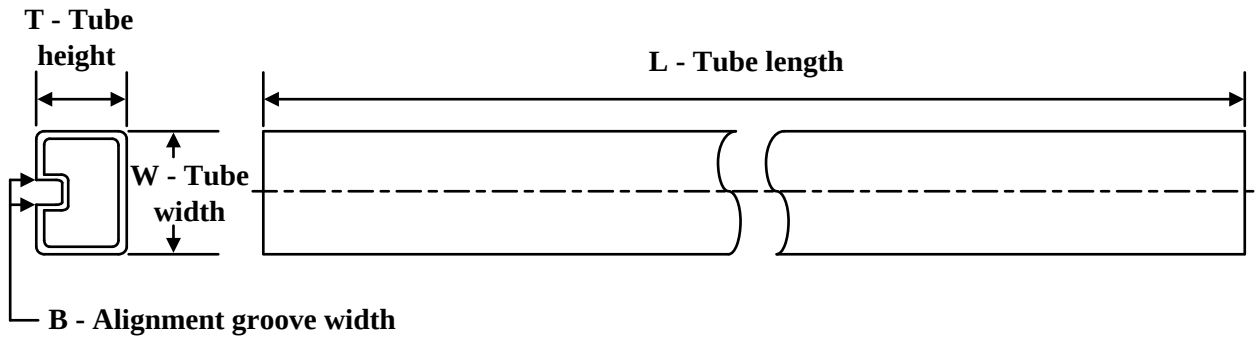
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALS191ADR	SOIC	D	16	2500	340.5	336.1	32.0

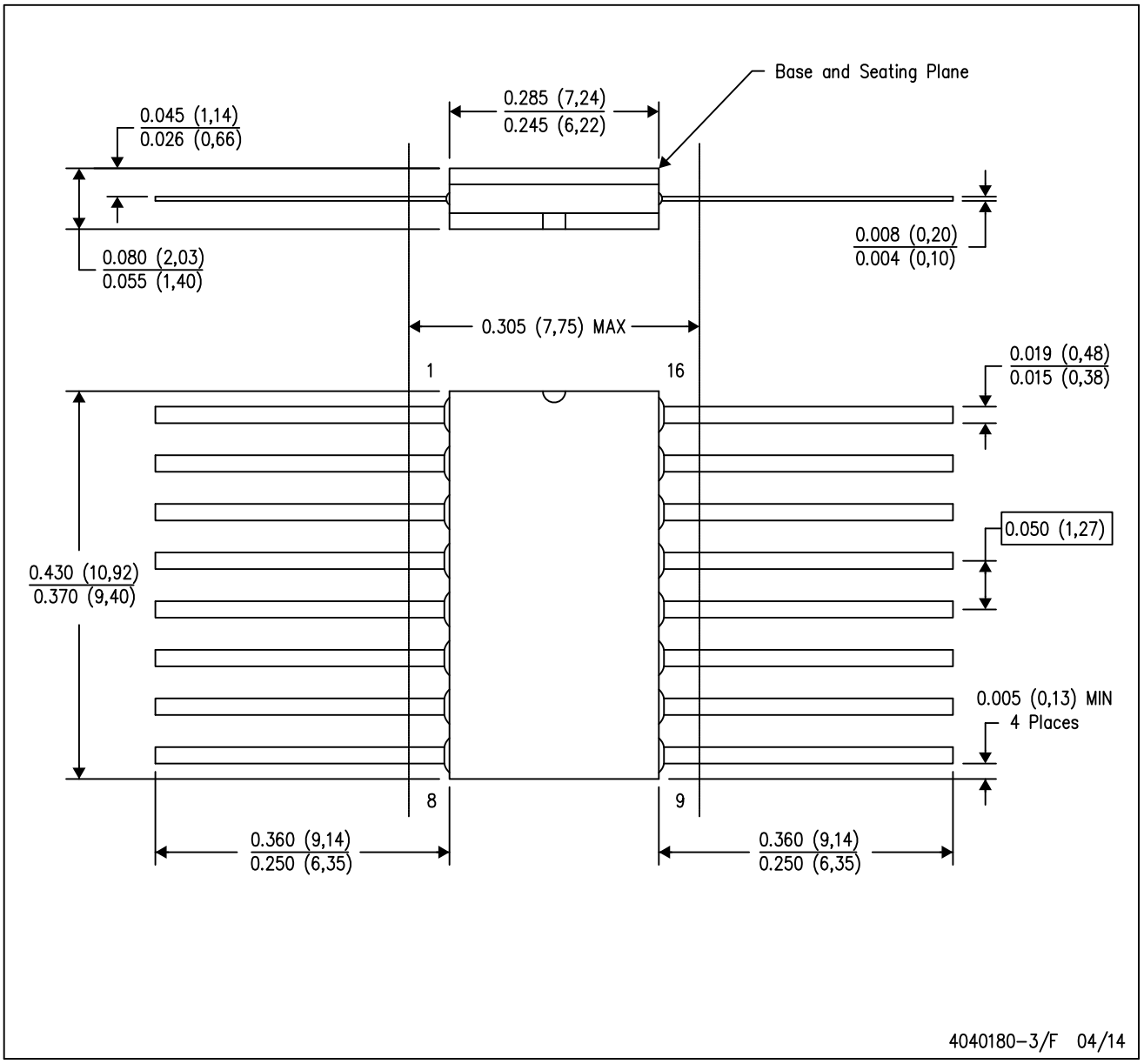
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
5962-86840012A	FK	LCCC	20	55	506.98	12.06	2030	NA
5962-8684001FA	W	CFP	16	25	506.98	26.16	6220	NA
SN74ALS191AN	N	PDIP	16	25	506	13.97	11230	4.32
SN74ALS191AN	N	PDIP	16	25	506	13.97	11230	4.32
SN74ALS191AN.A	N	PDIP	16	25	506	13.97	11230	4.32
SN74ALS191AN.A	N	PDIP	16	25	506	13.97	11230	4.32
SNJ54ALS191AFK	FK	LCCC	20	55	506.98	12.06	2030	NA
SNJ54ALS191AFK.A	FK	LCCC	20	55	506.98	12.06	2030	NA
SNJ54ALS191AW	W	CFP	16	25	506.98	26.16	6220	NA
SNJ54ALS191AW.A	W	CFP	16	25	506.98	26.16	6220	NA

W (R–GDFP–F16) CERAMIC DUAL FLATPACK



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

GENERIC PACKAGE VIEW

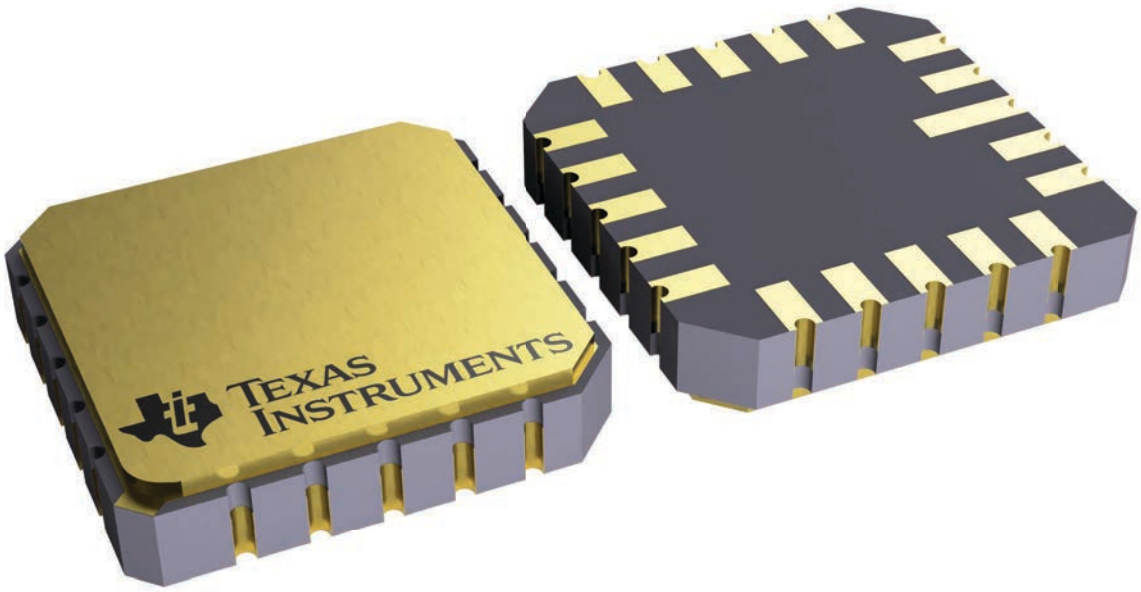
FK 20

LCCC - 2.03 mm max height

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

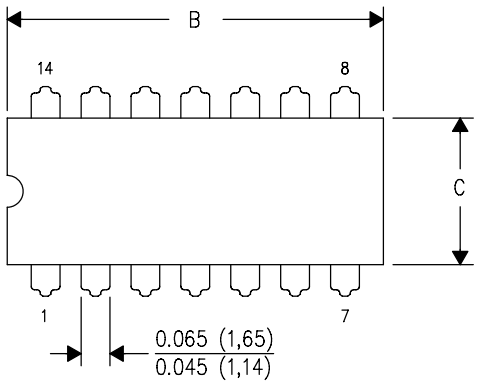


4229370VA\

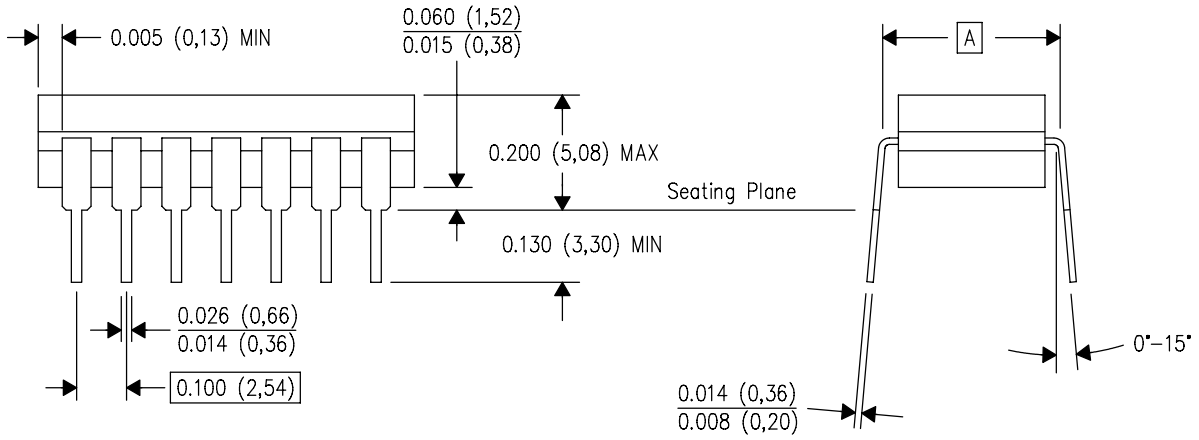
J (R–GDIP–T**)

14 LEADS SHOWN

CERAMIC DUAL IN–LINE PACKAGE



DIM \ PINS **	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)



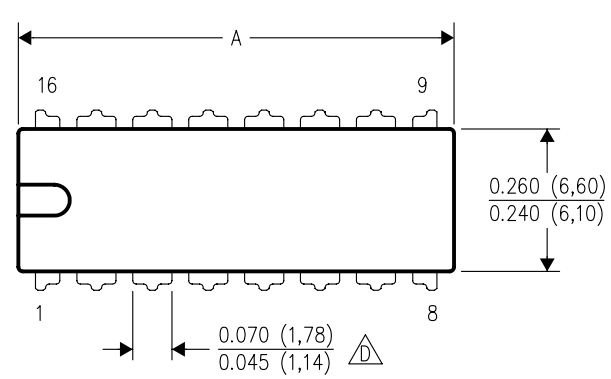
4040083/F 03/03

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.

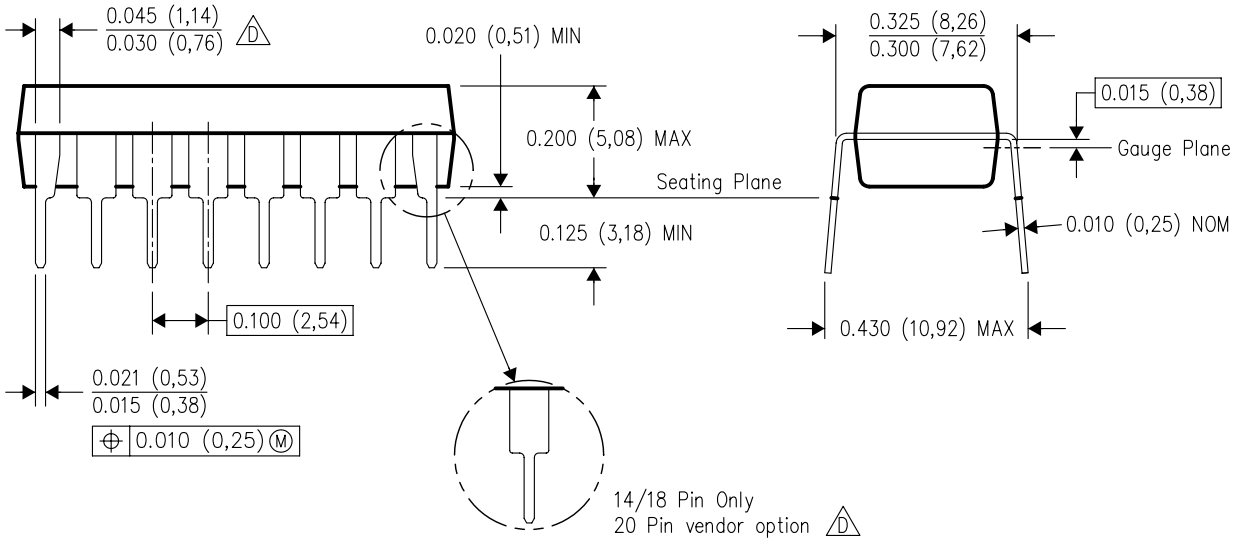
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



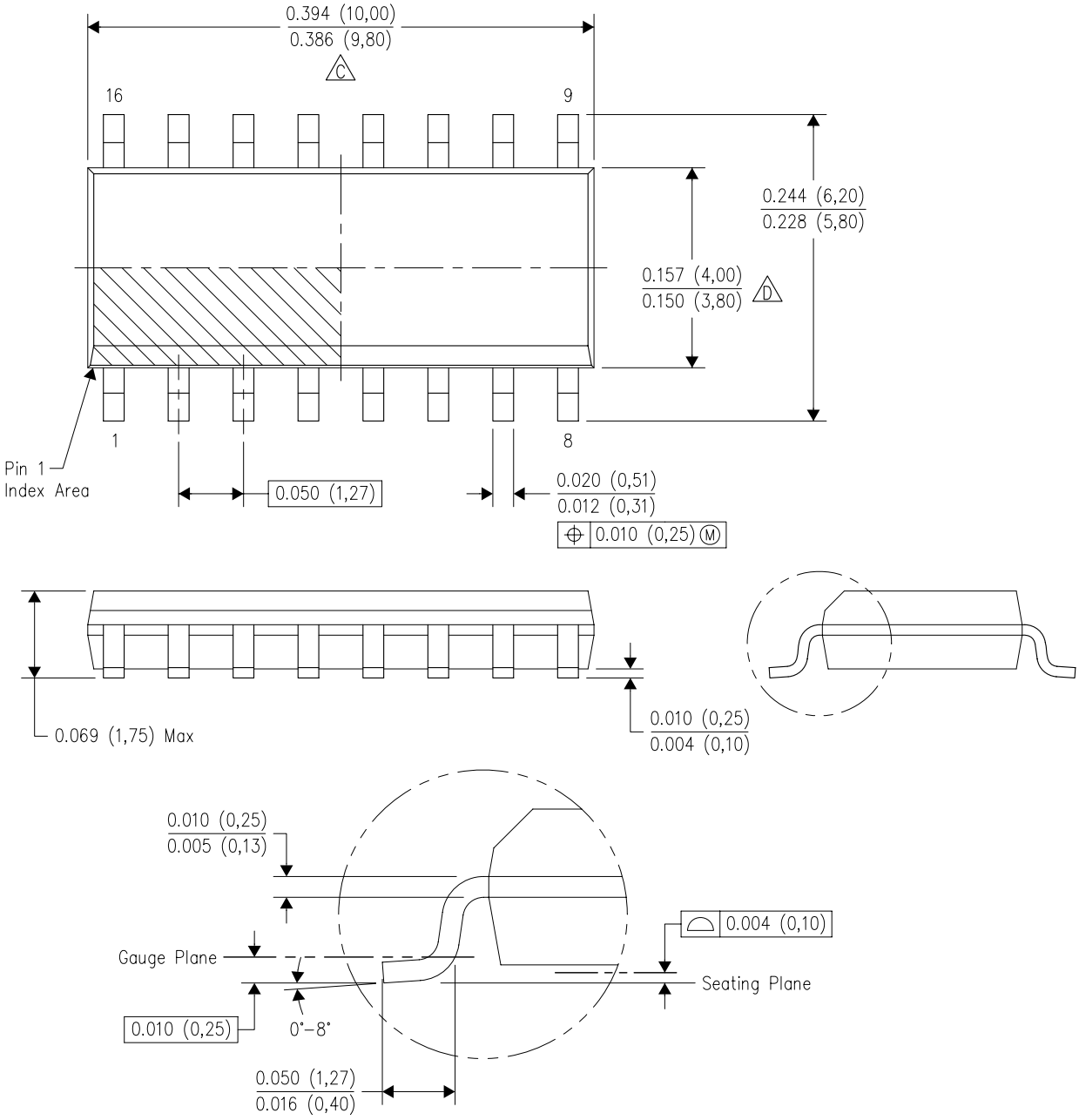
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



4040049/E 12/2002

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

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.

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