

# SN54ALS996, SN74ALS996 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

SDAS098B – OCTOBER 1984 – REVISED JANUARY 1995

- 3-State I/O-Type Read-Back Inputs
- Bus-Structured Pinout
- $T/\overline{C}$  Determines True or Complementary Data at Q Outputs
- Package Options Include Plastic Small-Outline (DW) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (NT) and Ceramic (JT) 300-mil DIPs

## description

These 8-bit latches are designed specifically for storing the contents of the input data bus and providing the capability of reading back the stored data onto the input data bus. The Q outputs are designed with bus-driving capability.

The edge-triggered flip-flops enter the data on the low-to-high transition of the clock (CLK) input when the enable ( $\overline{EN}$ ) input is low. Data can be read back onto the data inputs by taking the read ( $\overline{RD}$ ) input low, in addition to having  $\overline{EN}$  low. When  $\overline{EN}$  is high, both the read-back and write modes are disabled. Transitions on  $\overline{EN}$  should only be made with CLK high to prevent false clocking.

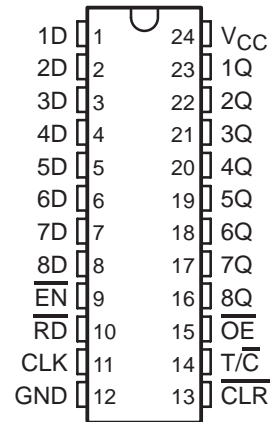
The polarity of the Q outputs can be controlled by the polarity ( $T/\overline{C}$ ) input. When  $T/\overline{C}$  is high, Q is the same as is stored in the flip-flops. When  $T/\overline{C}$  is low, the output data is inverted. The Q outputs can be placed in the high-impedance state by taking the output-enable ( $\overline{OE}$ ) input high.  $\overline{OE}$  does not affect the internal operation of the register. Old data can be retained or new data can be entered while the outputs are off.

A low level at the clear ( $\overline{CLR}$ ) input resets the internal registers low. The clear function is asynchronous and overrides all other register functions.

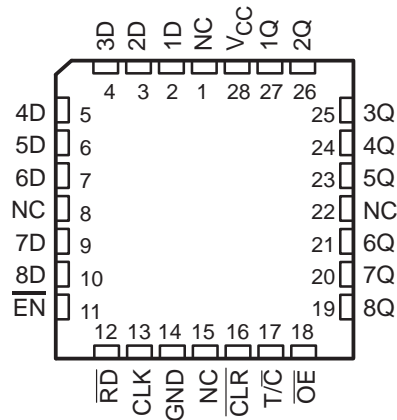
The -1 version of the SN74ALS996 is identical to the standard version, except that the recommended maximum  $I_{OL}$  for the -1 version is increased to 48 mA. There is no -1 version of the SN54ALS996.

The SN54ALS996 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS996 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

SN54ALS996 . . . JT PACKAGE  
SN74ALS996 . . . DW OR NT PACKAGE  
(TOP VIEW)



SN54ALS996 . . . FK PACKAGE  
(TOP VIEW)



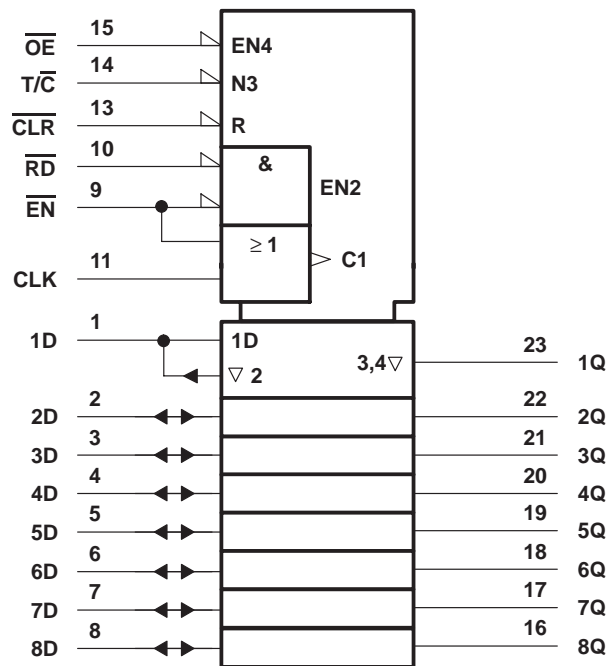
NC – No internal connection

# SN54ALS996, SN74ALS996

## 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

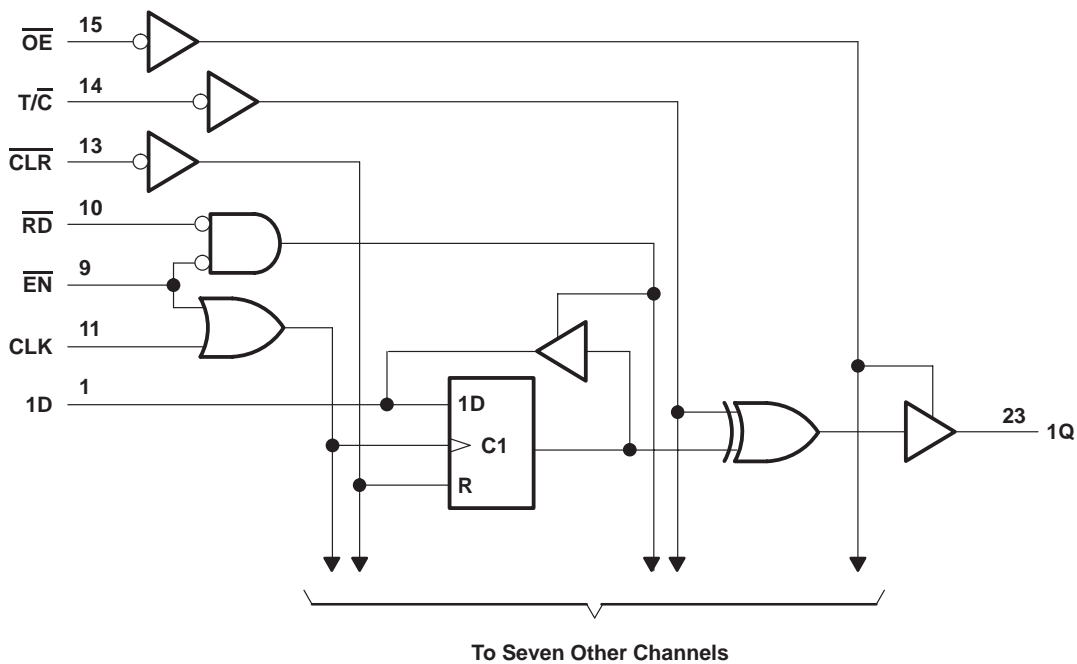
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### logic symbol†



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

### logic diagram (positive logic)



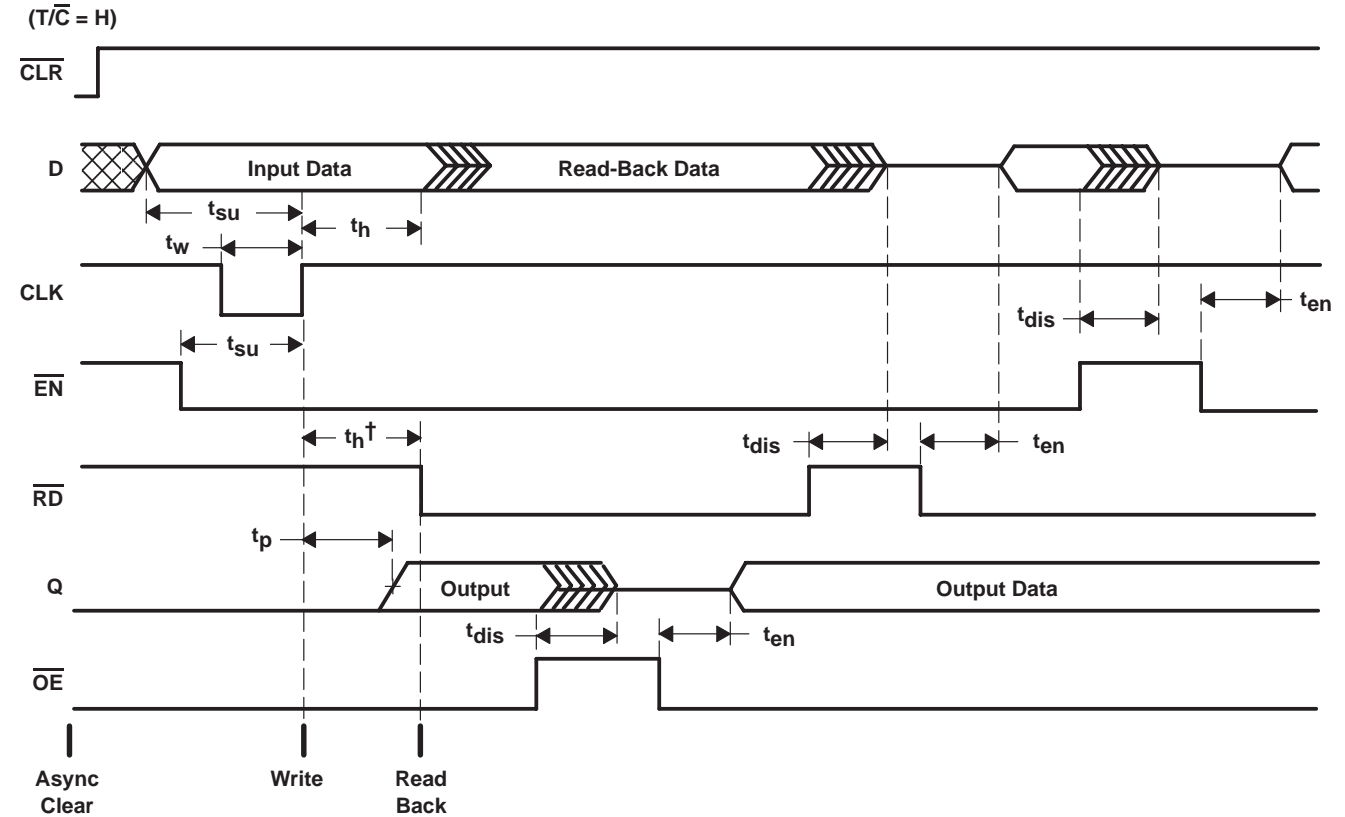
Pin numbers shown are for the DW, JT, and NT packages.

# SN54ALS996, SN74ALS996

## 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

SDAS098B – OCTOBER 1984 – REVISED JANUARY 1995

### timing diagram



<sup>†</sup> This hold time ensures that the read-back circuit will not create a conflict on the input data bus.

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>‡</sup>

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$ ( $\overline{OE}$ , $\overline{RD}$ , $\overline{EN}$ , CLK, $\overline{CLR}$ , and $\overline{T/C}$ )	7 V
Voltage applied to D inputs and to disabled 3-state outputs	5.5 V
Operating free-air temperature range, $T_A$ : SN54ALS996	–55°C to 125°C
SN74ALS996	0°C to 70°C
Storage temperature range	–65°C to 150°C

<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.



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# SN54ALS996, SN74ALS996

## 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

SDAS098B – OCTOBER 1984 – REVISED JANUARY 1995

### recommended operating conditions

			SN54ALS996			SN74ALS996			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	All inputs				2			V
		All inputs except $\overline{OE}$ , $\overline{RD}$	2						
		$\overline{OE}$ , $\overline{RD}$	2.2						
V <sub>IL</sub>	Low-level input voltage				0.8			0.8	V
I <sub>OH</sub>	High-level output current	Q			–1			–2.6	mA
		D			–0.4			–0.4	
I <sub>OL</sub>	Low-level output current	Q			12			24	mA
								48†	
		D			8			8	
f <sub>clock</sub>	Clock frequency		0		35	0		35	MHZ
t <sub>w</sub>	Pulse duration	$\overline{CLR}$ low	10			10			ns
		CLK low	14.5			14.5			
		CLK high	14.5			14.5			
t <sub>su</sub>	Setup time	Data before CLK↑	15			15			ns
		$\overline{EN}$ low before CLK↑	10			10			
		CLK high before $\overline{EN}$ ↑‡	15			15			
		$\overline{CLR}$ high (inactive) before CLK↑	10			10			
t <sub>h</sub>	Hold time	Data after CLK↑	1			0			ns
		$\overline{EN}$ low after CLK↑	5			5			
		$\overline{RD}$ high after CLK↑§	5			5			
T <sub>A</sub>	Operating free-air temperature		–55		125	0		70	°C

† Applies only to the -1 version and only if V<sub>CC</sub> is maintained between 4.75 V and 5.25 V

‡ This setup time ensures that  $\overline{EN}$  will not false clock the data register.

§ This hold time ensures that there will be no conflict on the input data bus.

# SN54ALS996, SN74ALS996

## 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

SDAS098B – OCTOBER 1984 – REVISED JANUARY 1995

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

PARAMETER		TEST CONDITIONS		SN54ALS996			SN74ALS996			UNIT
				MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{IK}$		$V_{CC} = 4.5\text{ V}$ ,	$I_I = -18\text{ mA}$			-1.2			-1.2	V
$V_{OH}$	All outputs	$V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ ,	$I_{OH} = -0.4\text{ mA}$	$V_{CC} - 2$			$V_{CC} - 2$			V
	Q	$V_{CC} = 4.5\text{ V}$	$I_{OH} = -1\text{ mA}$	2.4	3.2					
			$I_{OH} = -2.6\text{ mA}$				2.4	3.2		
$V_{OL}$	D	$V_{CC} = 4.5\text{ V}$	$I_{OL} = 4\text{ mA}$	0.25	0.4					V
			$I_{OL} = 8\text{ mA}$				0.35	0.5		
	Q	$V_{CC} = 4.5\text{ V}$	$I_{OL} = 12\text{ mA}$	0.25	0.4		0.25	0.4		
			$I_{OL} = 24\text{ mA}$				0.35	0.5		
			$I_{OL} = 48\text{ mA}^\ddagger$				0.35	0.5		
$I_{OZH}$	Q	$V_{CC} = 5.5\text{ V}$ ,	$V_O = 2.7\text{ V}$			20			20	$\mu\text{A}$
$I_{OZL}$	Q	$V_{CC} = 5.5\text{ V}$ ,	$V_O = 0.4\text{ V}$			-20			-20	$\mu\text{A}$
$I_I$	D inputs	$V_{CC} = 5.5\text{ V}$	$V_I = 5.5\text{ V}$			0.1			0.1	mA
	All others		$V_I = 7\text{ V}$			0.1			0.1	
$I_{IH}$	D inputs§	$V_{CC} = 5.5\text{ V}$ ,	$V_I = 2.7\text{ V}$			20			20	$\mu\text{A}$
	All others					20			20	
$I_{IL}$	D inputs§	$V_{CC} = 5.5\text{ V}$ ,	$V_I = 0.4\text{ V}$			-0.1			-0.1	mA
	All others					-0.1			-0.1	
$I_O^\P$		$V_{CC} = 5.5\text{ V}$ , $\text{CLR} = 2.5\text{ V}$	$V_O = 2.25\text{ V}$	-20		-112	-30		-112	mA
$I_{CC}$		$V_{CC} = 5.5\text{ V}$ , $\text{EN}, \text{RD low}$	Outputs high	35	55		35	55		mA
			Outputs low	55	85		55	85		
			Outputs disabled	42	65		42	65		

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

‡ Applies only to the -1 version and only if  $V_{CC}$  is maintained between 4.75 V and 5.25 V

§ For I/O ports ( $Q_A$  thru  $Q_H$ ), the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

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



# SN54ALS996, SN74ALS996

## 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

SDAS098B – OCTOBER 1984 – REVISED JANUARY 1995

### switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, T <sub>A</sub> = MIN to MAX†				UNIT
			SN54ALS996		SN74ALS996		
			MIN	MAX	MIN	MAX	
f <sub>max</sub>			35		35		MHz
t <sub>PLH</sub>	CLK (T/ $\overline{C}$ = H or L)	Q	5	30	5	28	ns
t <sub>PHL</sub>			5	24	5	28	
t <sub>PLH</sub>	$\overline{\text{CLR}}$ (T/ $\overline{C}$ = L)	Q	5	27	7	27	ns
t <sub>PHL</sub>	$\overline{\text{CLR}}$ (T/ $\overline{C}$ = H)		5	23	7	23	
t <sub>PLH</sub>	T/ $\overline{C}$	Q	4	23	5	23	ns
t <sub>PHL</sub>			5	23	5	23	
t <sub>PHL</sub>	$\overline{\text{CLR}}$	D	5	30	8	30	ns
t <sub>en</sub> <sup>‡</sup>	$\overline{\text{RD}}$	D	2	18	3	16	ns
t <sub>dis</sub> <sup>§</sup>			1	19	3	19	
t <sub>en</sub> <sup>‡</sup>	$\overline{\text{EN}}$	D	2	17	3	16	ns
t <sub>dis</sub> <sup>§</sup>			1	19	3	19	
t <sub>en</sub> <sup>‡</sup>	$\overline{\text{OE}}$	Q	2	15	4	15	ns
t <sub>dis</sub> <sup>§</sup>			1	11	1	10	

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

‡ t<sub>en</sub> = t<sub>PZH</sub> or t<sub>PZL</sub>

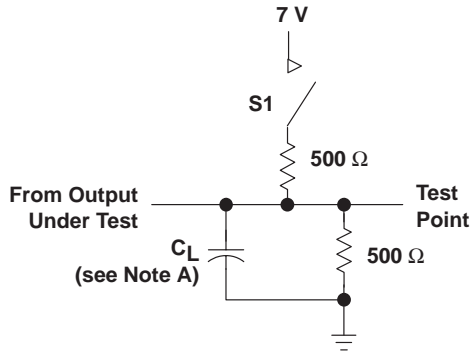
§ t<sub>dis</sub> = t<sub>PHZ</sub> or t<sub>PLZ</sub>



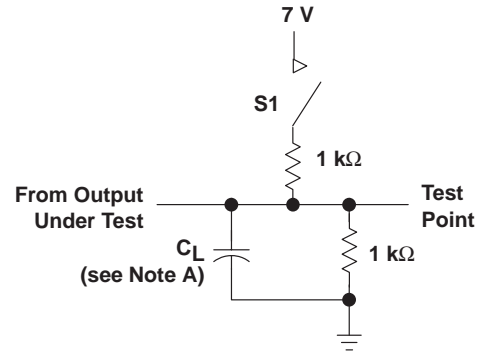
# SN54ALS996, SN74ALS996 8-BIT D-TYPE EDGE-TRIGGERED READ-BACK LATCHES

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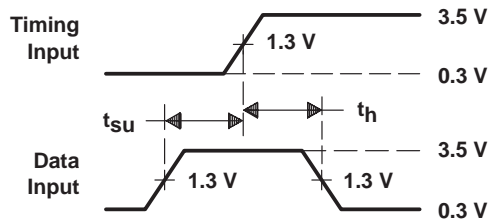
## PARAMETER MEASUREMENT INFORMATION



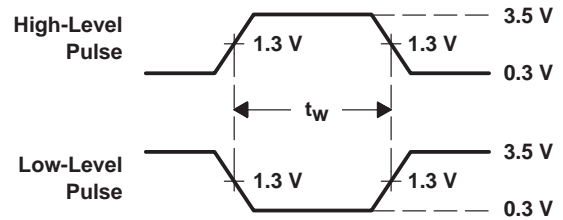
LOAD CIRCUIT FOR Q OUTPUTS



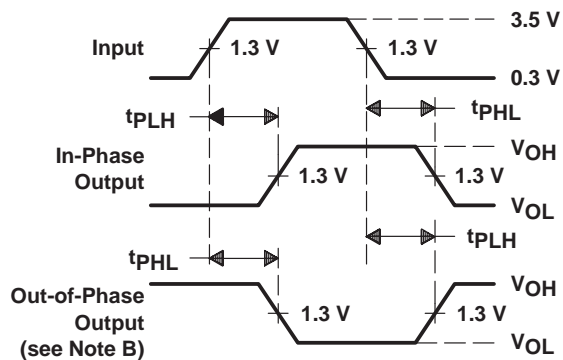
LOAD CIRCUIT FOR D OUTPUTS



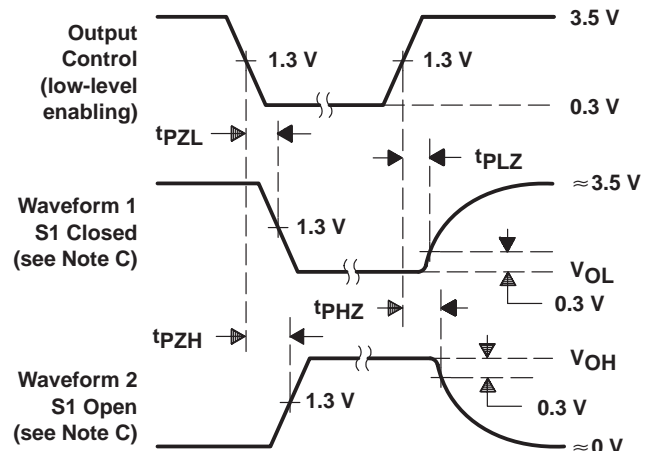
VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PULSE DURATIONS



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

NOTES: A.  $C_L$  includes probe and jig capacitance.

B. When measuring propagation delay times of 3-state outputs, switch S1 is open.

C. 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.

D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.

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)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-89945013A	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 89945013A SNJ54ALS 996FK	<a href="#">Samples</a>
5962-8994501LA	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8994501LA SNJ54ALS996JT	<a href="#">Samples</a>
SN74ALS996-1DWR	OBSOLETE	SOIC	DW	24		TBD	Call TI	Call TI	0 to 70		
SN74ALS996-1NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74ALS996-1NT	<a href="#">Samples</a>
SN74ALS996-1NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74ALS996-1NT	<a href="#">Samples</a>
SN74ALS996DW	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS996	<a href="#">Samples</a>
SN74ALS996DWG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS996	<a href="#">Samples</a>
SN74ALS996DWR	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS996	<a href="#">Samples</a>
SN74ALS996DWRE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS996	<a href="#">Samples</a>
SN74ALS996DWRG4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	ALS996	<a href="#">Samples</a>
SN74ALS996NT	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74ALS996NT	<a href="#">Samples</a>
SN74ALS996NT3	OBSOLETE	PDIP	NT	24		TBD	Call TI	Call TI	0 to 70		
SN74ALS996NTE4	ACTIVE	PDIP	NT	24	15	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 70	SN74ALS996NT	<a href="#">Samples</a>
SNJ54ALS996FK	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 89945013A SNJ54ALS 996FK	<a href="#">Samples</a>
SNJ54ALS996JT	ACTIVE	CDIP	JT	24	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8994501LA SNJ54ALS996JT	<a href="#">Samples</a>
SNJ54ALS996W	OBSOLETE	CFP	W	24		TBD	A42	N / A for Pkg Type	-55 to 125	5962-8994501KA SNJ54ALS996W	

(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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**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.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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#### **OTHER QUALIFIED VERSIONS OF SN54ALS996, SN74ALS996 :**

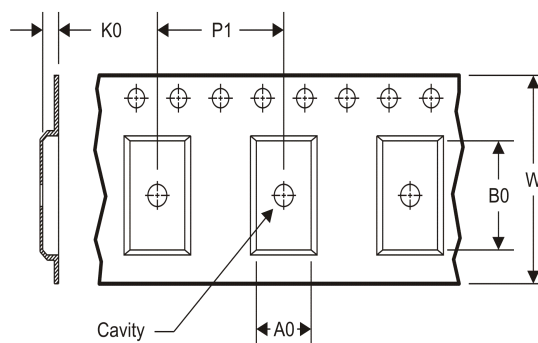
● Catalog: [SN74ALS996](#)

● Military: [SN54ALS996](#)

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

**TAPE AND REEL INFORMATION**

\*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
SN74ALS996DWR	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1

## TAPE AND REEL BOX DIMENSIONS



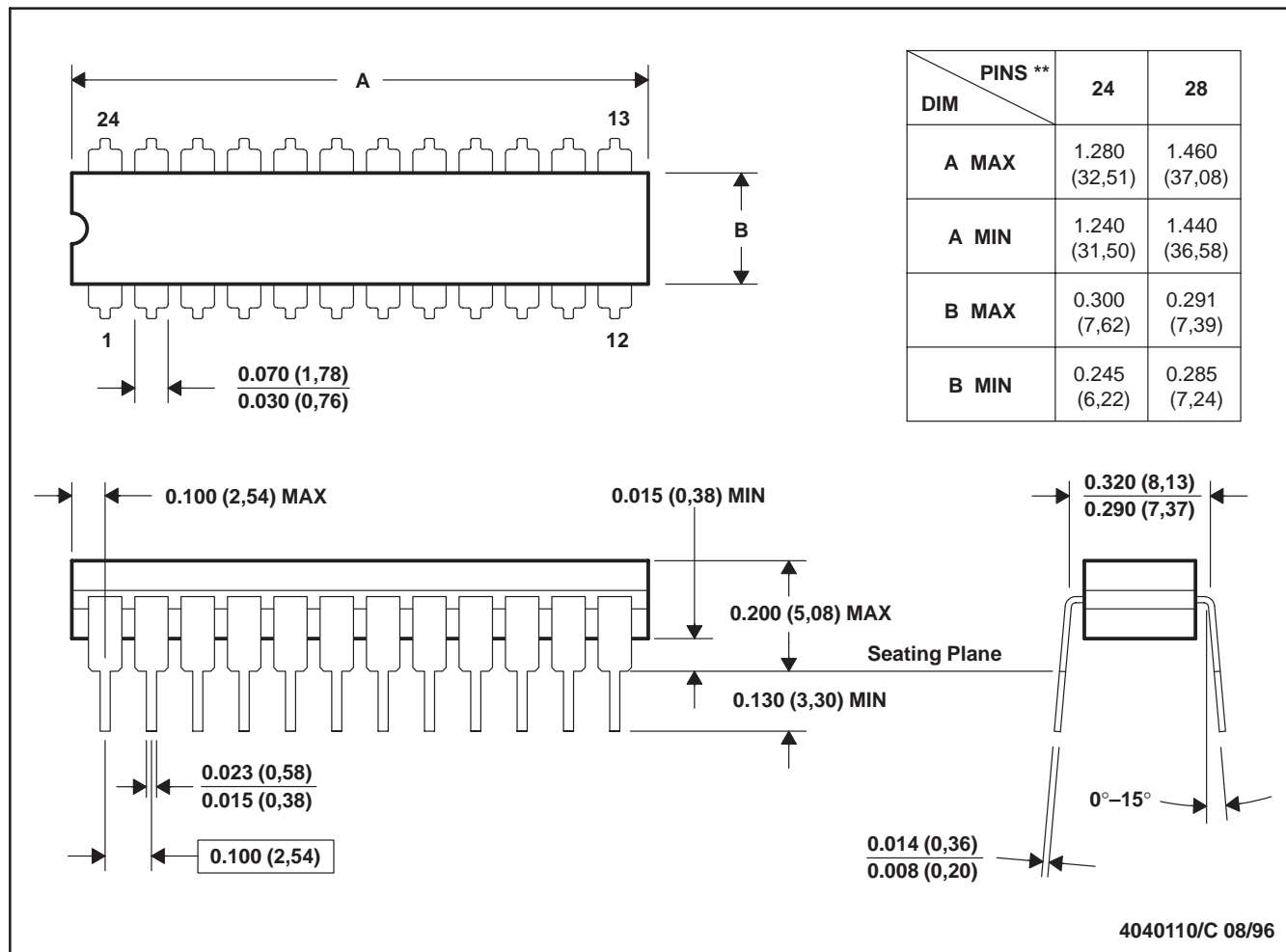
\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALS996DWR	SOIC	DW	24	2000	367.0	367.0	45.0

## JT (R-GDIP-T\*\*)

## CERAMIC DUAL-IN-LINE

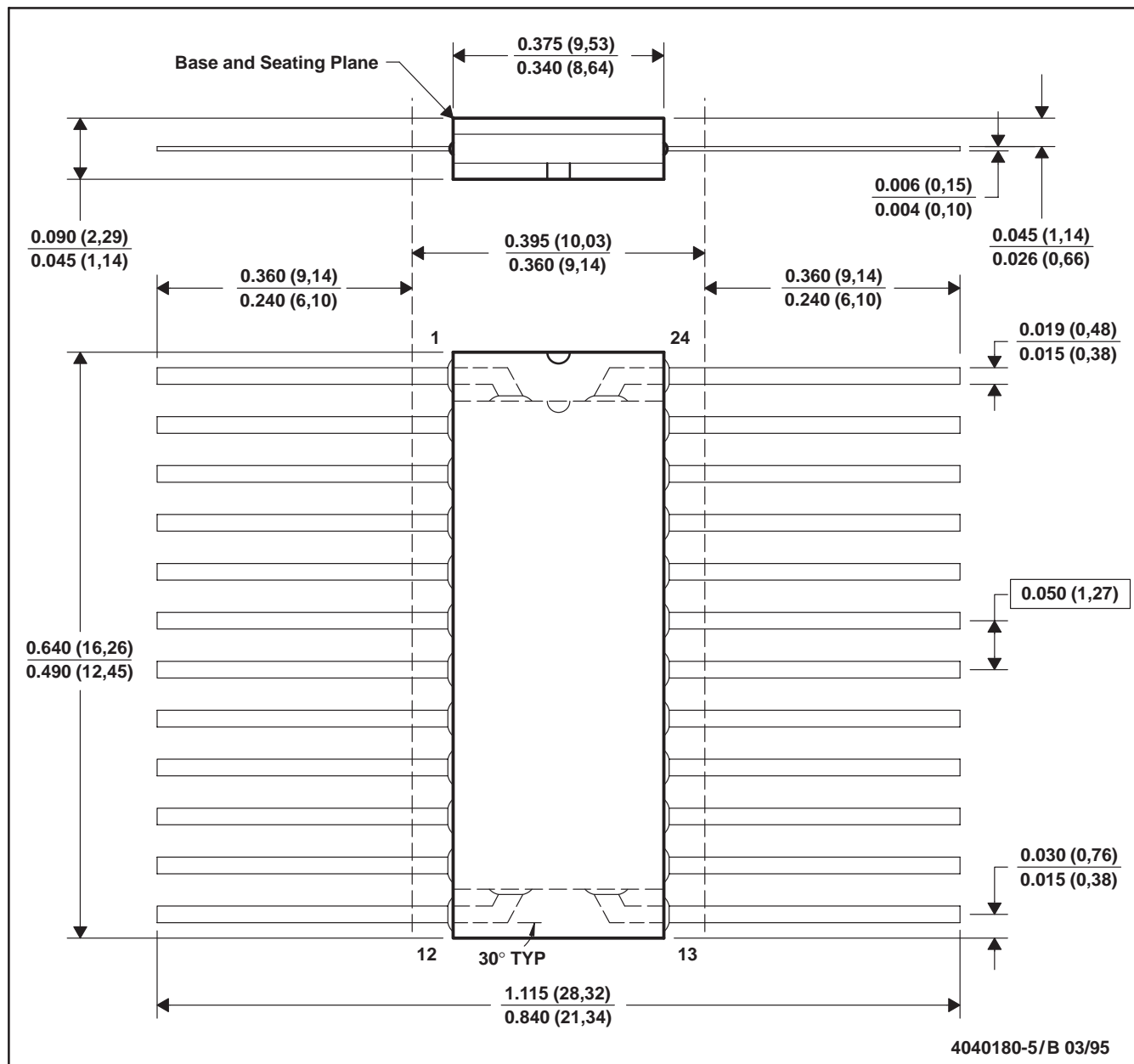
24 LEADS SHOWN



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification.
  - Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

## W (R-GDFP-F24)

## CERAMIC DUAL FLATPACK



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a ceramic lid using glass frit.
  - Falls within MIL-STD-1835 GDFP2-F24 and JEDEC MO-070AD
  - Index point is provided on cap for terminal identification only.

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 01/11

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package can be hermetically sealed with a metal lid.
  - Falls within JEDEC MS-004

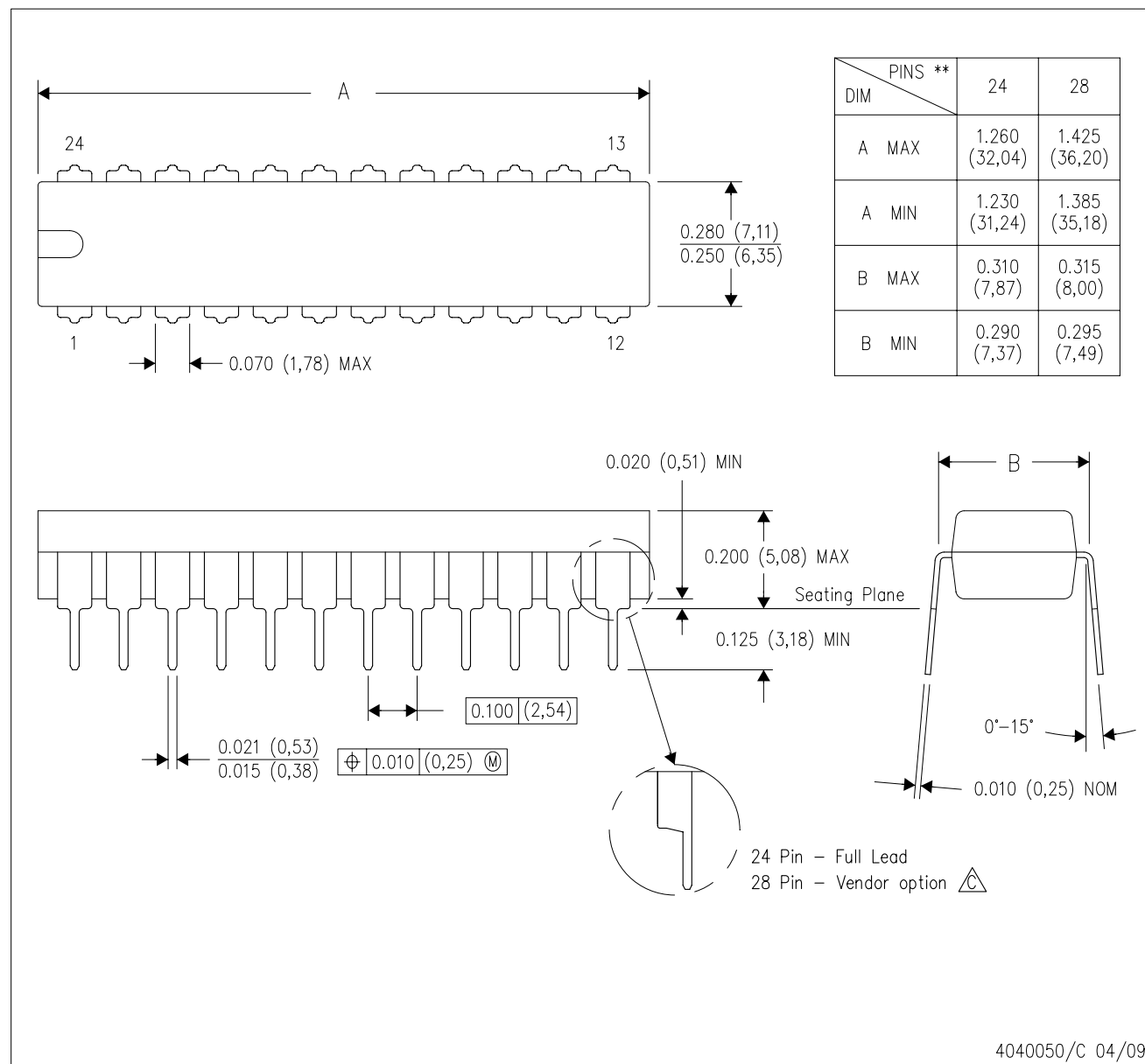


# MECHANICAL DATA

NT (R-PDIP-T\*\*)

24 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - $\triangle C$  The 28 pin end lead shoulder width is a vendor option, either half or full width.

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - Falls within JEDEC MS-013 variation AD.

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