

# SN74LS19A, SN74LS24A SCHMITT-TRIGGER POSITIVE-NAND GATES AND INVERTERS WITH TOTEM-POLE OUTPUTS

JANUARY 1981 — REVISED MARCH 1988

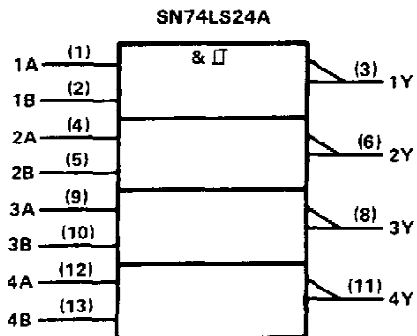
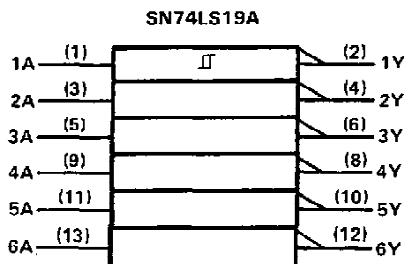
- Functionally and Mechanically Identical to 'LS13, 'LS14, and 'LS132, Respectively
- Improved Line-Receiving Characteristics
- P-N-P Inputs Reduce System Loading
- Excellent Noise Immunity with Typical Hysteresis of 0.8 V

### description

Each circuit functions as a NAND gate or inverter, but because of the Schmitt action, it has different input threshold levels for positive-going ( $V_{T+}$ ) and for negative-going ( $V_{T-}$ ) signals. The hysteresis or backlash, which is the difference between the two threshold levels ( $V_{T+} - V_{T-}$ ), is typically 800 millivolts.

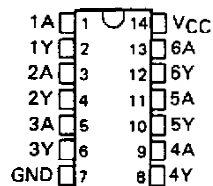
These circuits are temperature-compensated and can be triggered from the slowest of input ramps and still give clean, jitter-free output signals.

### logic symbols †

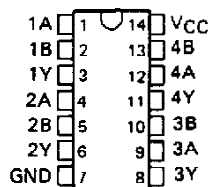


† These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

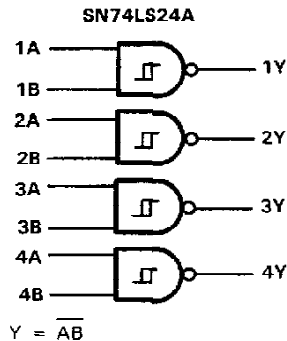
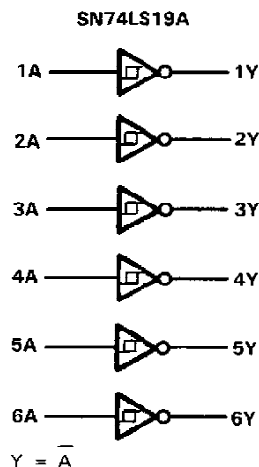
SN74LS19A . . . D, J, OR N PACKAGE  
(TOP VIEW)



SN74LS24A . . . D, J, OR N PACKAGE  
(TOP VIEW)



### logic diagrams (positive logic)



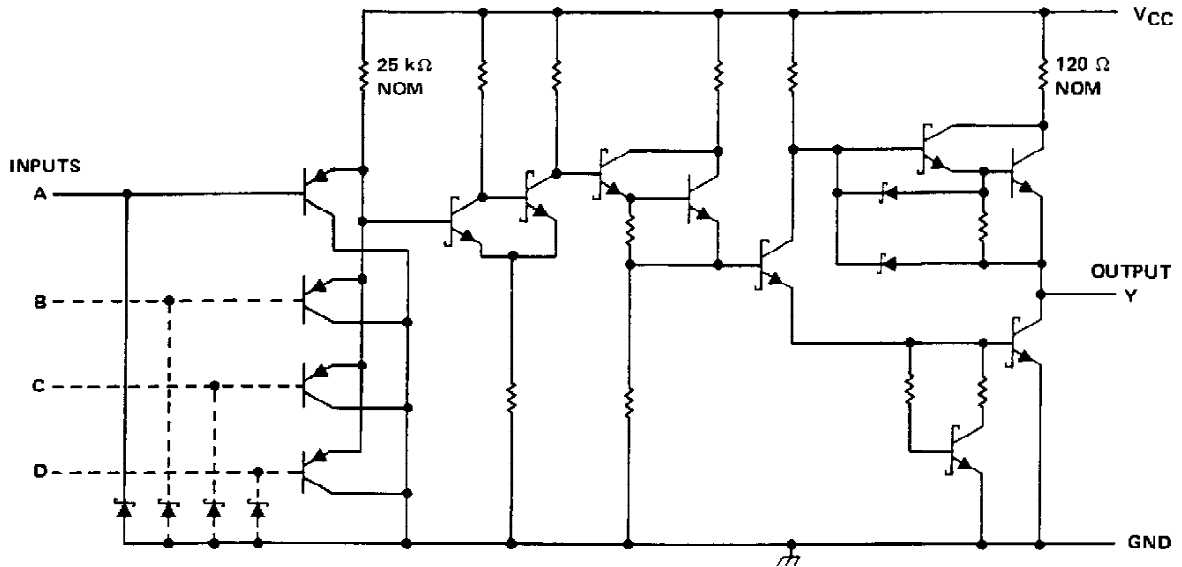
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INSTRUMENTS

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**SN74LS19A, SN74LS24A**  
**SCHMITT-TRIGGER POSITIVE-NAND GATES**  
**AND INVERTERS WITH TOTEM-POLE OUTPUTS**

schematic (each gate)



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

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage	7 V
Operating free-air temperature range	0°C to 70°C
Storage temperature range	-65°C to 150°C

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, $V_{CC}$	4.75	5	5.25	V
High-level output current, $I_{OH}$			-400	$\mu$ A
Low-level output current, $I_{OL}$			8	mA
Operating free-air temperature, $T_A$	0		70	°C

**SN74LS19A, SN74LS24A**  
**SCHMITT-TRIGGER POSITIVE-NAND GATES**  
**AND INVERTERS WITH TOTEM-POLE OUTPUTS**

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

PARAMETER	TEST CONDITIONS†	MIN TYP‡ MAX			UNIT	
		MIN	TYP‡	MAX		
$V_{T+}$	$V_{CC} = 5\text{ V}$	1.65	1.9	2.15	V	
$V_{T-}$	$V_{CC} = 5\text{ V}$	0.75	1.0	1.25	V	
Hysteresis ( $V_{T+} - V_{T-}$ )	$V_{CC} = 5\text{ V}$	0.4	0.9		V	
$V_{IK}$	$V_{CC} = \text{MIN.}$ $I_I = -18\text{ mA}$		-1.5		V	
$V_{OH}$	$V_{CC} = \text{MIN.}$ $V_I = V_{T-\text{min}}$ $I_{OH} = -0.4\text{ mA}$	2.7	3.4		V	
$V_{OL}$	$V_{CC} = \text{MIN.}$ $V_I = V_{T+\text{max}}$	$I_{OL} = 4\text{ mA}$	0.25	0.4	V	
		$I_{OL} = 8\text{ mA}$	0.35	0.5		
$I_{T+}$	$V_{CC} = 5\text{ V.}$ $V_I = V_{T+}$		-2	-20	$\mu\text{A}$	
$I_{T-}$	$V_{CC} = 5\text{ V.}$ $V_I = V_{T-}$		-5	-30	$\mu\text{A}$	
$I_I$	$V_{CC} = \text{MAX.}$ $V_I = 7\text{ V}$		0.1		mA	
$I_{IH}$	$V_{CC} = \text{MAX.}$ $V_I = 2.7\text{ V}$			20	$\mu\text{A}$	
$I_{IL}$	$V_{CC} = \text{MAX.}$ $V_I = 0.4\text{ V}$			-50	$\mu\text{A}$	
$I_{OS}^{\S}$	$V_{CC} = \text{MAX.}$ $V_I = V_O = 0\text{ V}$		-20	-100	mA	
$I_{CCH}$	$V_{CC} = \text{MAX.}$ $V_I = 0\text{ V}$	'LS19A		9.9	18	mA
		'LS24A		6.6	12	
$I_{CCL}$	$V_{CC} = \text{MAX.}$ $V_I = 4.5\text{ V}$	'LS19A		17	30	mA
		'LS24A		11	20	

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

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

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second.

**switching characteristics,  $V_{CC} = 5\text{ V,}$   $T_A = 25^\circ\text{C}$  (see Figure 1)**

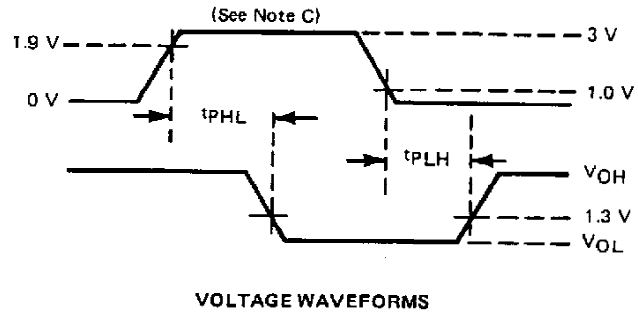
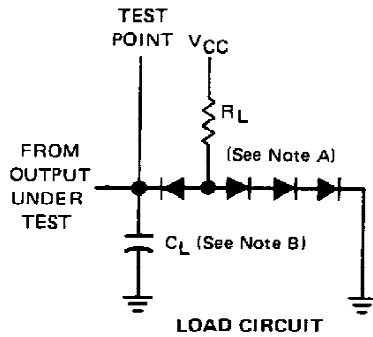
PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	SN74LS19A			SN74LS24A			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
$t_{PLH}$	Any	Y	$R_L = 2\text{ k}\Omega,$ $C_L = 15\text{ pF}$		13	20		13	20	ns
$t_{PHL}$	Any	Y			18	30		25	40	ns

$t_{PLH}$  = Propagation delay time, low-to-high-level output

$t_{PHL}$  = Propagation delay time, high-to-low-level output

**SN74LS19A, SN74LS24A**  
**SCHMITT-TRIGGER POSITIVE-NAND GATES**  
**AND INVERTERS WITH TOTEM-POLE OUTPUTS**

**PARAMETER MEASUREMENT INFORMATION**



- NOTES: A. All diodes are IN3064 or equivalent.  
 B.  $C_L$  includes probe and circuit capacitance.  
 C. The generator characteristics are: PRR = 1 MHz,  $t_r = 15$  ns,  $t_p = 6$  ns,  $Z_o = 50 \Omega$ .

**FIGURE 1**

PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
SN74LS19AD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ADE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ADG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ADR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ADRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ADRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19AN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS19ANE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS19ANSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ANSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ANSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS24AD	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI
SN74LS24AN	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
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SN74LS19ADRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ADRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19AN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS19ANE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LS19ANSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ANSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS19ANSRG4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LS24AD	OBSOLETE	SOIC	D	14		TBD	Call TI	Call TI
SN74LS24AN	OBSOLETE	PDIP	N	14		TBD	Call TI	Call TI

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**TAPE AND REEL INFORMATION**



**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
SN74LS19ADR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74LS19ANSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	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)
SN74LS19ADR	SOIC	D	14	2500	346.0	346.0	33.0
SN74LS19ANSR	SO	NS	14	2000	346.0	346.0	33.0

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

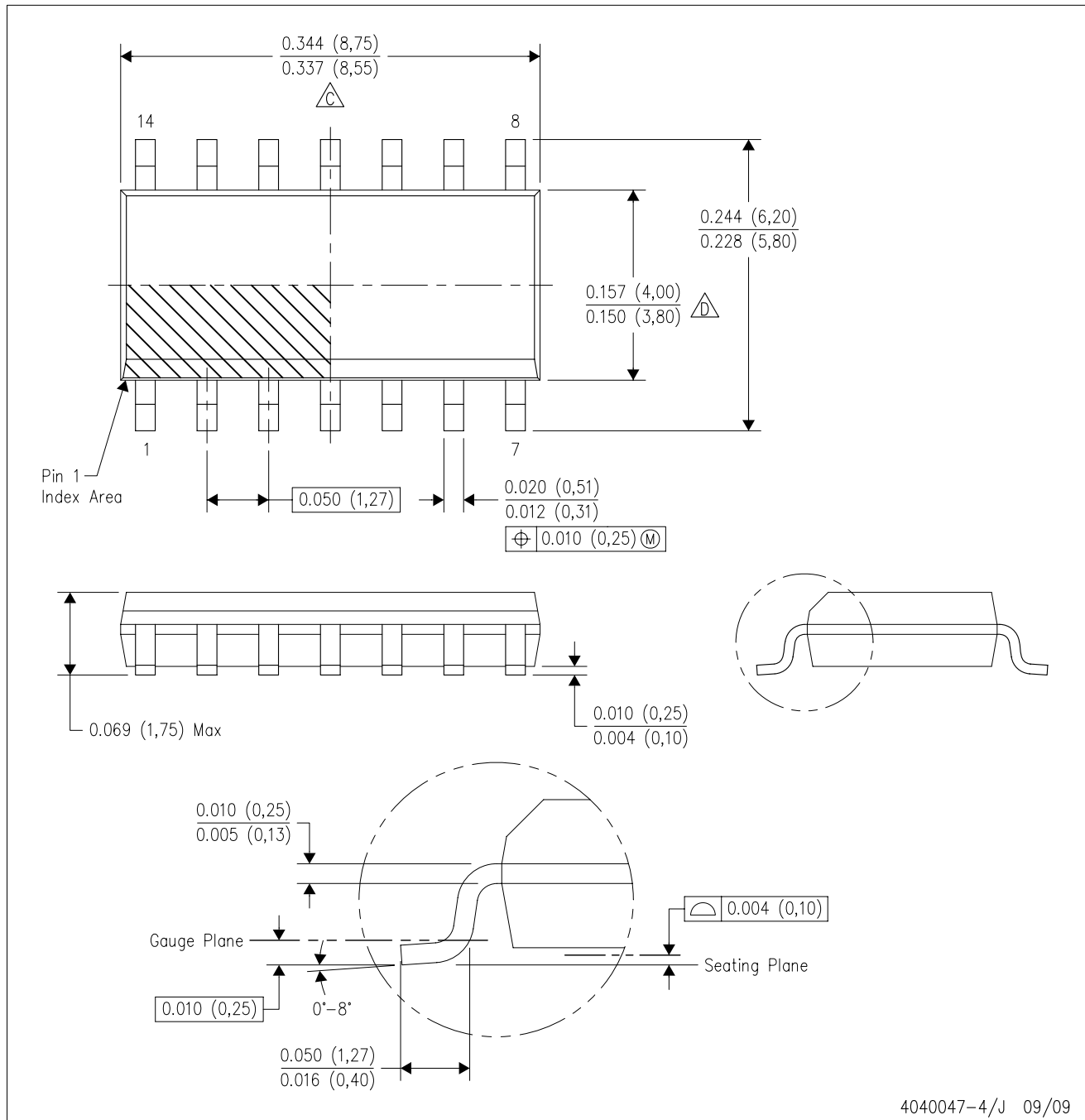
14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
  - E. Reference JEDEC MS-012 variation AB.

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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.

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