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Jameco Part Number 34294TI

The ULN2001A is obsolete  
and is no longer supplied.

- 500-mA-Rated Collector Current (Single Output)
- High-Voltage Outputs . . . 50 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay-Driver Applications

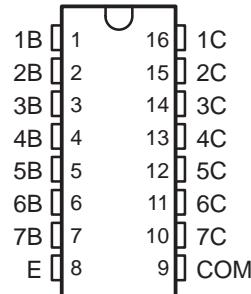
#### description/ordering information

The ULN2001A, ULN2002A, ULN2003A, ULN2004A, ULQ2003A, and ULQ2004A are high-voltage, high-current Darlington transistor arrays. Each consists of seven npn Darlington pairs that feature high-voltage outputs

with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington pairs can be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers. For 100-V (otherwise interchangeable) versions of the ULN2003A and ULN2004A, see the SN75468 and SN75469, respectively.

ULN2001A . . . D OR N PACKAGE  
ULN2002A . . . N PACKAGE  
ULN2003A . . . D, N, NS, OR PW PACKAGE  
ULN2004A . . . D, N, OR NS PACKAGE  
ULQ2003A, ULQ2004A . . . D OR N PACKAGE

(TOP VIEW)



#### ORDERING INFORMATION

TA	PACKAGE <sup>†</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-20°C to 70°C	PDIP (N)	Tube of 25	ULN2002AN	ULN2002AN
			ULN2003AN	ULN2003AN
			ULN2004AN	ULN2004AN
	SOIC (D)	Tube of 40	ULN2003AD	ULN2003A
		Reel of 2500	ULN2003ADR	
		Tube of 40	ULN2004AD	ULN2004A
		Reel of 2500	ULN2004ADR	
	SOP (NS)	Reel of 2000	ULN2003ANSR	ULN2003A
			ULN2004ANSR	ULN2004A
	TSSOP (PW)	Tube of 90	ULN2003APW	ULN2003A
		Reel of 2000	ULN2003APWR	
-40°C to 85°C	PDIP (N)	Tube of 25	ULQ2003AN	ULQ2003A
			ULQ2004AN	ULQ2004AN
	SOIC (D)	Tube of 40	ULQ2003AD	ULQ2003A
		Reel of 2500	ULQ2003ADR	ULQ2003A
		Tube of 40	ULQ2004AD	ULQ2004A
		Reel of 2500	ULQ2004ADR	ULQ2004A

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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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.



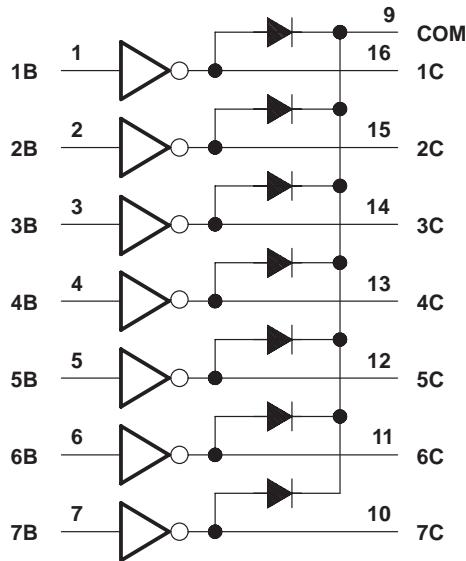
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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

## description/ordering information (continued)

The ULN2001A is a general-purpose array and can be used with TTL and CMOS technologies. The ULN2002A is designed specifically for use with 14-V to 25-V PMOS devices. Each input of this device has a Zener diode and resistor in series to control the input current to a safe limit. The ULN2003A and ULQ2003A have a 2.7-k $\Omega$  series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices. The ULN2004A and ULQ2004A have a 10.5-k $\Omega$  series base resistor to allow operation directly from CMOS devices that use supply voltages of 6 V to 15 V. The required input current of the ULN/ULQ2004A is below that of the ULN/ULQ2003A, and the required voltage is less than that required by the ULN2002A.

## logic diagram



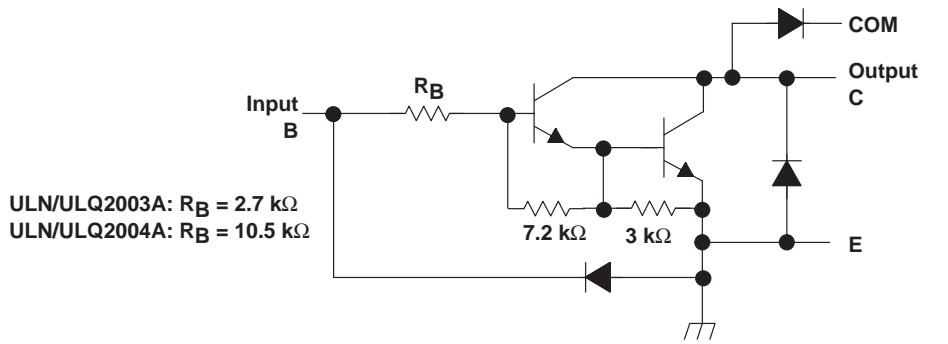
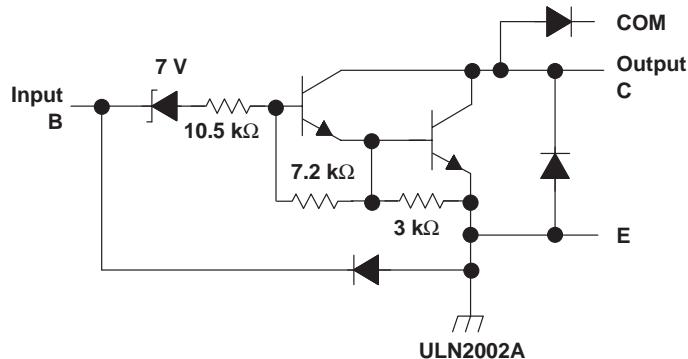
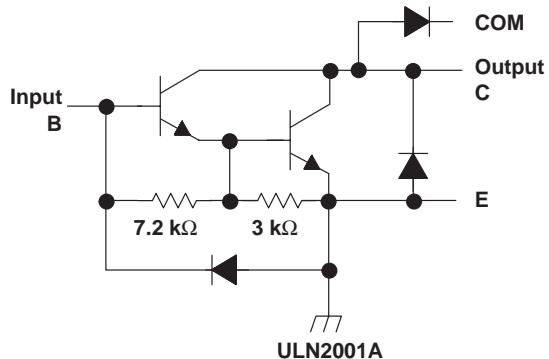
# ULN2001A, ULN2002A, ULN2003A, ULN2004A, ULQ2003A, ULQ2004A

The ULN2001A is obsolete  
and is no longer supplied.

HIGH-VOLTAGE HIGH-CURRENT  
DARLINGTON TRANSISTOR ARRAY

SLRS027G – DECEMBER 1976 – REVISED JUNE 2004

## schematics (each Darlington pair)



All resistor values shown are nominal.

ULN2003A, ULN2004A, ULQ2003A, ULQ2004A

# **ULN2001A, ULN2002A, ULN2003A, ULN2004A, ULQ2003A, ULQ2004A HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY**

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**The ULN2001A is obsolete  
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**absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)**

† 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.

NOTES: 1. All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.

2. Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\max) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
3. The package thermal impedance is calculated in accordance with JESD 51-7.
4. Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JC}$ , and  $T_C$ . The maximum allowable power dissipation at any allowable case temperature is  $P_D = (T_J(\max) - T_C)/\theta_{JC}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
5. The package thermal impedance is calculated in accordance with MIL-STD-883.

electrical characteristics,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER	TEST FIGURE	TEST CONDITIONS	ULN2001A			ULN2002A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{I(on)}$	On-state input voltage	6	$V_{CE} = 2 \text{ V}$ , $I_C = 300 \text{ mA}$					13	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	5	$I_I = 250 \mu\text{A}$ , $I_C = 100 \text{ mA}$	0.9	1.1	0.9	1.1	0.9	V
			$I_I = 350 \mu\text{A}$ , $I_C = 200 \text{ mA}$	1	1.3	1	1.3	1	
			$I_I = 500 \mu\text{A}$ , $I_C = 350 \text{ mA}$	1.2	1.6	1.2	1.6	1.2	
$V_F$	Clamp forward voltage	8	$I_F = 350 \text{ mA}$	1.7	2	1.7	2	1.7	V
$I_{CEX}$	Collector cutoff current	1	$V_{CE} = 50 \text{ V}$ , $I_I = 0$	50		50		50	$\mu\text{A}$
		2	$V_{CE} = 50 \text{ V}$ , $T_A = 70^\circ\text{C}$	100		100		100	
			$V_I = 6 \text{ V}$					500	
$I_{I(off)}$	Off-state input current	3	$V_{CE} = 50 \text{ V}$ , $I_C = 500 \mu\text{A}$ , $T_A = 70^\circ\text{C}$	50	65	50	65	50	$\mu\text{A}$
$I_I$	Input current	4	$V_I = 17 \text{ V}$			0.82	1.25	0.82	mA
$I_R$	Clamp reverse current	7	$V_R = 50 \text{ V}$ , $T_A = 70^\circ\text{C}$	100		100		100	$\mu\text{A}$
			$V_R = 50 \text{ V}$	50		50		50	
$h_{FE}$	Static forward-current transfer ratio	5	$V_{CE} = 2 \text{ V}$ , $I_C = 350 \text{ mA}$	1000					
$C_I$	Input capacitance		$V_I = 0$ , $f = 1 \text{ MHz}$	15	25	15	25	15	pF

# ULN2001A, ULN2002A, ULN2003A, ULN2004A, ULQ2003A, ULQ2004A

The ULN2001A is obsolete  
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## HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

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### electrical characteristics, $T_A = 25^\circ\text{C}$ (unless otherwise noted) (continued)

PARAMETER	TEST FIGURE	TEST CONDITIONS	ULN2003A			ULN2004A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{I(\text{on})}$ On-state input voltage	6	$V_{CE} = 2\text{ V}$	$I_C = 125\text{ mA}$					5	V
			$I_C = 200\text{ mA}$		2.4			6	
			$I_C = 250\text{ mA}$		2.7				
			$I_C = 275\text{ mA}$					7	
			$I_C = 300\text{ mA}$		3				
			$I_C = 350\text{ mA}$					8	
$V_{CE(\text{sat})}$ Collector-emitter saturation voltage	5	$I_I = 250\text{ }\mu\text{A}, I_C = 100\text{ mA}$		0.9	1.1		0.9	1.1	V
		$I_I = 350\text{ }\mu\text{A}, I_C = 200\text{ mA}$		1	1.3		1	1.3	
		$I_I = 500\text{ }\mu\text{A}, I_C = 350\text{ mA}$		1.2	1.6		1.2	1.6	
$I_{CEX}$ Collector cutoff current	1	$V_{CE} = 50\text{ V}, I_I = 0$			50			50	$\mu\text{A}$
	2	$V_{CE} = 50\text{ V}, T_A = 70^\circ\text{C}$	$I_I = 0$		100			100	
			$V_I = 1\text{ V}$					500	
$V_F$ Clamp forward voltage	8	$I_F = 350\text{ mA}$		1.7	2		1.7	2	V
$I_I(\text{off})$ Off-state input current	3	$V_{CE} = 50\text{ V}, I_C = 500\text{ }\mu\text{A}, T_A = 70^\circ\text{C}$		50	65		50	65	$\mu\text{A}$
$I_I$ Input current	4	$V_I = 3.85\text{ V}$		0.93	1.35				mA
		$V_I = 5\text{ V}$					0.35	0.5	
		$V_I = 12\text{ V}$					1	1.45	
$I_R$ Clamp reverse current	7	$V_R = 50\text{ V}$			50			50	$\mu\text{A}$
		$V_R = 50\text{ V}, T_A = 70^\circ\text{C}$			100			100	
$C_i$ Input capacitance		$V_I = 0, f = 1\text{ MHz}$		15	25		15	25	pF

# ULN2001A, ULN2002A, ULN2003A, ULN2004A, ULQ2003A, ULQ2004A

## HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

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The ULN2001A is obsolete  
and is no longer supplied.

### electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST FIGURE	TEST CONDITIONS	ULQ2003A			ULQ2004A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
VI(on)	6	V <sub>CE</sub> = 2 V	I <sub>C</sub> = 125 mA					5	V
			I <sub>C</sub> = 200 mA		2.7			6	
			I <sub>C</sub> = 250 mA		2.9				
			I <sub>C</sub> = 275 mA					7	
			I <sub>C</sub> = 300 mA		3				
			I <sub>C</sub> = 350 mA					8	
V <sub>CE(sat)</sub>	5	I <sub>I</sub> = 250 $\mu$ A, I <sub>C</sub> = 100 mA	0.9	1.2		0.9	1.1		V
		I <sub>I</sub> = 350 $\mu$ A, I <sub>C</sub> = 200 mA	1	1.4		1	1.3		
		I <sub>I</sub> = 500 $\mu$ A, I <sub>C</sub> = 350 mA	1.2	1.7		1.2	1.6		
I <sub>CEX</sub>	1	V <sub>CE</sub> = 50 V, I <sub>I</sub> = 0			100			50	$\mu$ A
		V <sub>CE</sub> = 50 V	I <sub>I</sub> = 0					100	
			V <sub>I</sub> = 1 V					500	
V <sub>F</sub>	8	I <sub>F</sub> = 350 mA		1.7	2.3	1.7	2	V	
I <sub>I(off)</sub>	3	V <sub>CE</sub> = 50 V, I <sub>C</sub> = 500 $\mu$ A	65			50	65		$\mu$ A
I <sub>I</sub>	4	V <sub>I</sub> = 3.85 V		0.93	1.35				mA
		V <sub>I</sub> = 5 V						0.35	
		V <sub>I</sub> = 12 V						1	
I <sub>R</sub>	7	V <sub>R</sub> = 50 V, T <sub>A</sub> = 25°C	100			50			$\mu$ A
		V <sub>R</sub> = 50 V	100			100			
C <sub>i</sub>		V <sub>I</sub> = 0, f = 1 MHz	15	25		15	25		pF

### switching characteristics, T<sub>A</sub> = 25°C

PARAMETER	TEST CONDITIONS	ULN2001A, ULN2002A, ULN2003A, ULN2004A			UNIT
		MIN	TYP	MAX	
t <sub>PLH</sub>	Propagation delay time, low- to high-level output	See Figure 9		0.25	1 $\mu$ s
t <sub>PHL</sub>	Propagation delay time, high- to low-level output	See Figure 9		0.25	1 $\mu$ s
V <sub>OH</sub>	High-level output voltage after switching	V <sub>S</sub> = 50 V, I <sub>O</sub> $\approx$ 300 mA, See Figure 10	V <sub>S</sub> -20		mV

### switching characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	ULQ2003A, ULQ2004A			UNIT
		MIN	TYP	MAX	
t <sub>PLH</sub>	Propagation delay time, low- to high-level output	See Figure 9		1	10 $\mu$ s
t <sub>PHL</sub>	Propagation delay time, high- to low-level output	See Figure 9		1	10 $\mu$ s
V <sub>OH</sub>	High-level output voltage after switching	V <sub>S</sub> = 50 V, I <sub>O</sub> $\approx$ 300 mA, See Figure 10	V <sub>S</sub> -500		mV

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HIGH-VOLTAGE HIGH-CURRENT  
DARLINGTON TRANSISTOR ARRAY

SLRS027G – DECEMBER 1976 – REVISED JUNE 2004

## PARAMETER MEASUREMENT INFORMATION

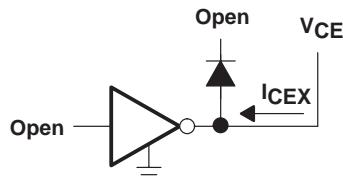


Figure 1. ICEX Test Circuit

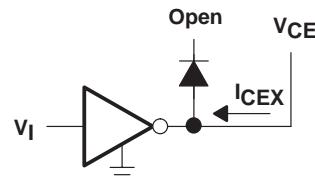


Figure 2. ICEX Test Circuit

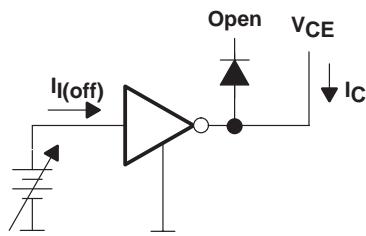


Figure 3. I\_I(off) Test Circuit

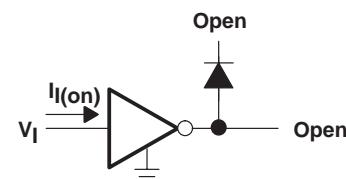
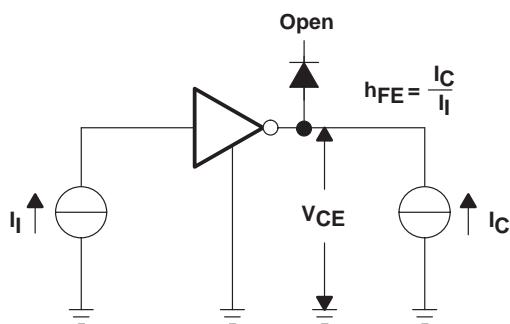


Figure 4. I\_I Test Circuit



NOTE:  $I_I$  is fixed for measuring  $V_{CE}(\text{sat})$ , variable for measuring  $h_{FE}$ .

Figure 5. hFE, VCE(sat) Test Circuit

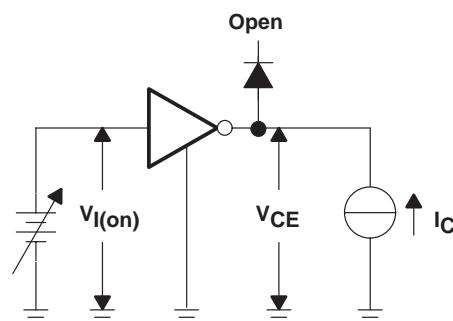


Figure 6. V\_I(on) Test Circuit

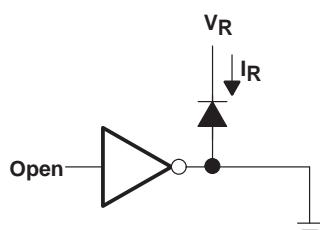


Figure 7. I\_R Test Circuit

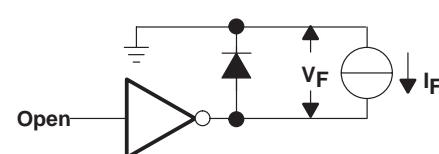


Figure 8. V\_F Test Circuit

The ULN2001A is obsolete  
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## PARAMETER MEASUREMENT INFORMATION

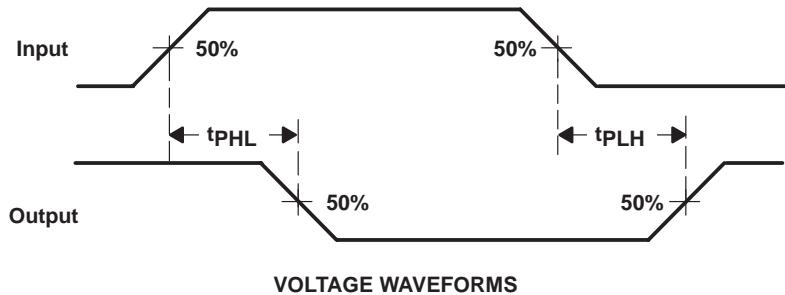
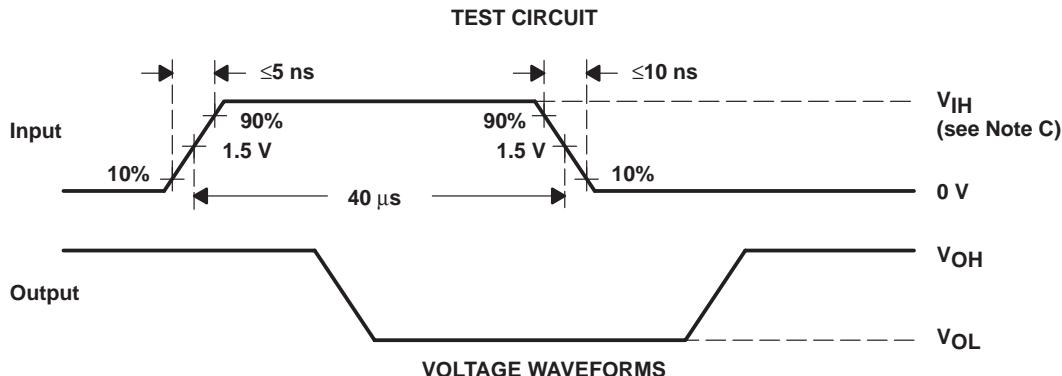
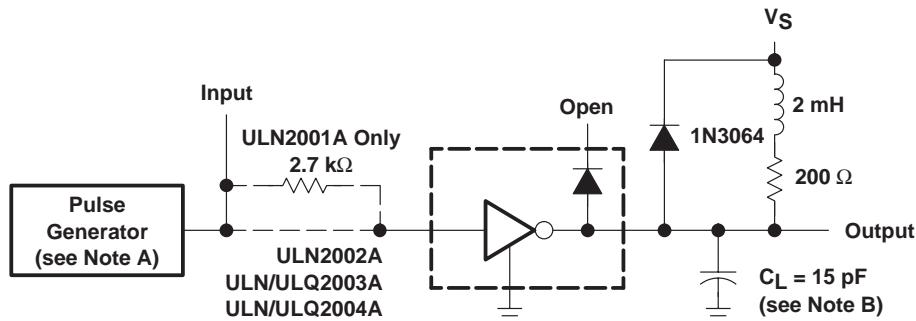


Figure 9. Propagation Delay-Time Waveforms



NOTES: A. The pulse generator has the following characteristics: PRR = 12.5 kHz,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and jig capacitance.  
 C. For testing the ULN2001A, the ULN2003A, and the ULQ2003A,  $V_{IH} = 3$  V; for the ULN2002A,  $V_{IH} = 13$  V; for the ULN2004A and the ULQ2004A,  $V_{IH} = 8$  V.

Figure 10. Latch-Up Test Circuit and Voltage Waveforms

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## TYPICAL CHARACTERISTICS

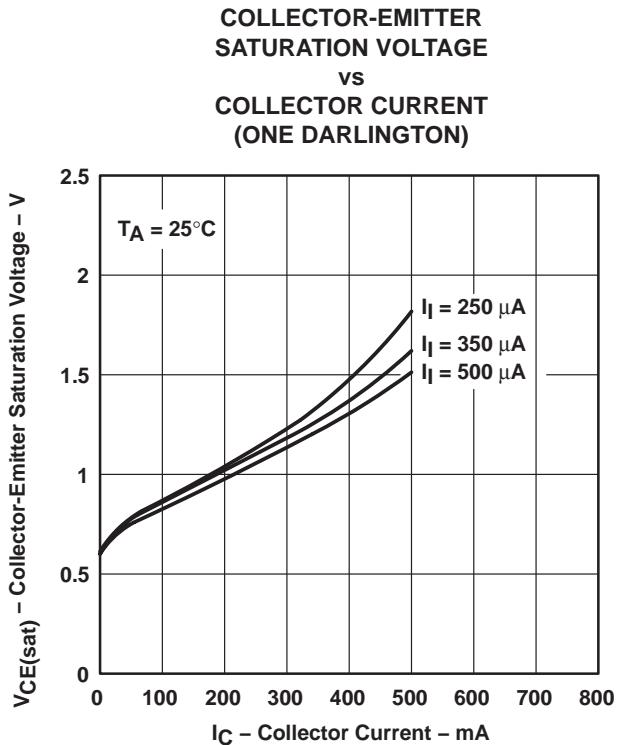


Figure 11

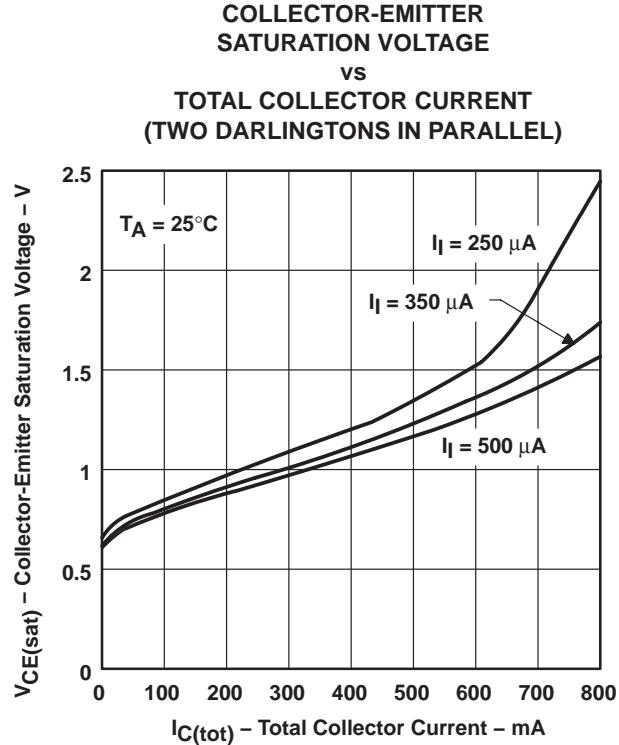


Figure 12

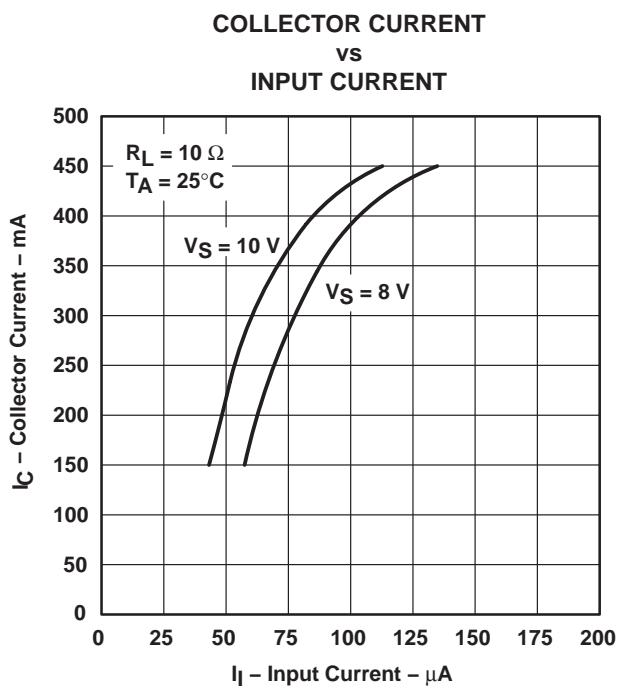


Figure 13

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## THERMAL INFORMATION

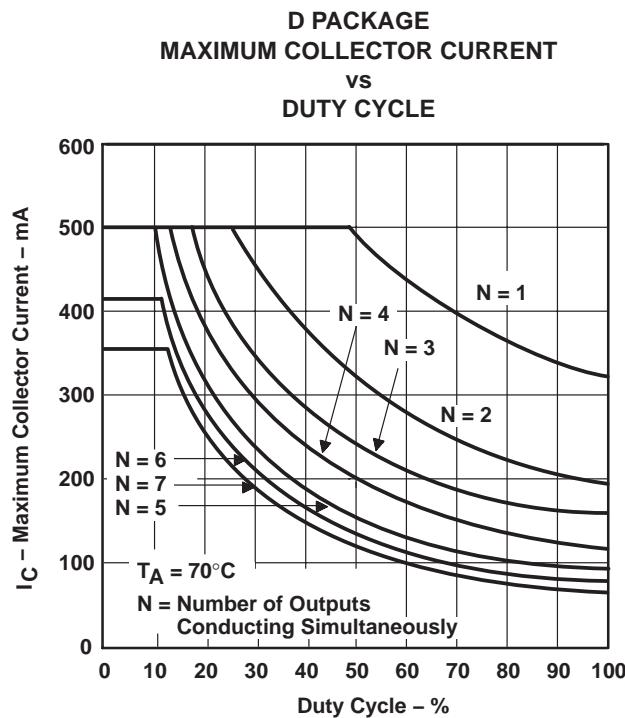


Figure 14

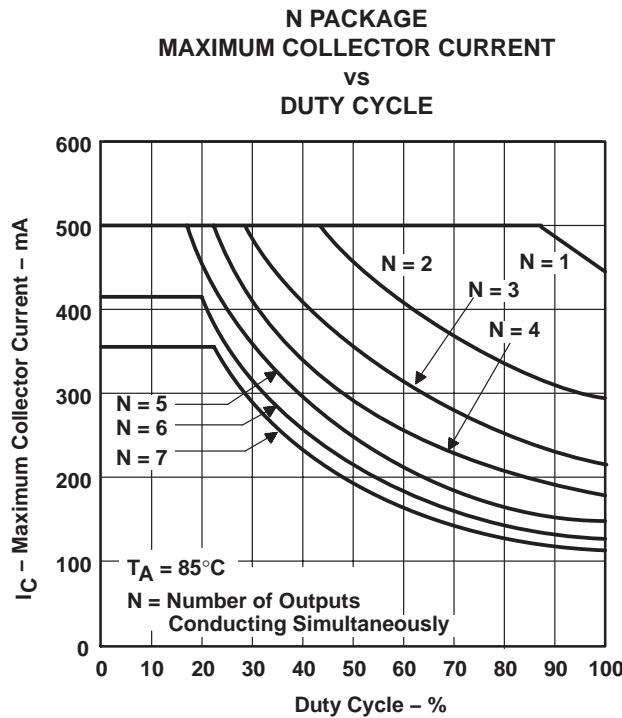


Figure 15

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## APPLICATION INFORMATION

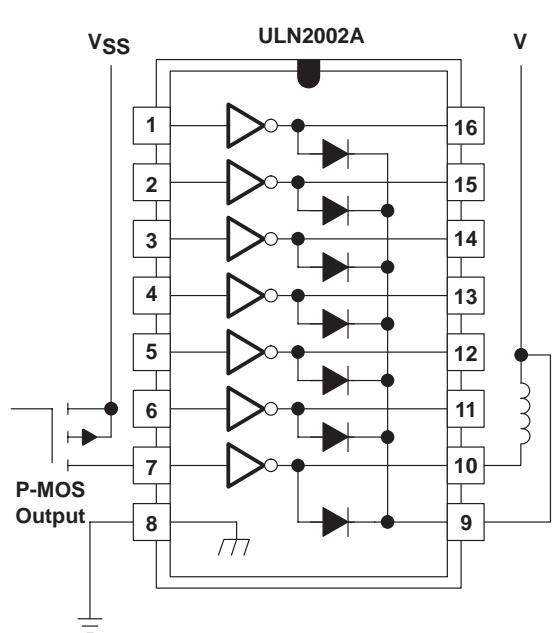


Figure 16. P-MOS to Load

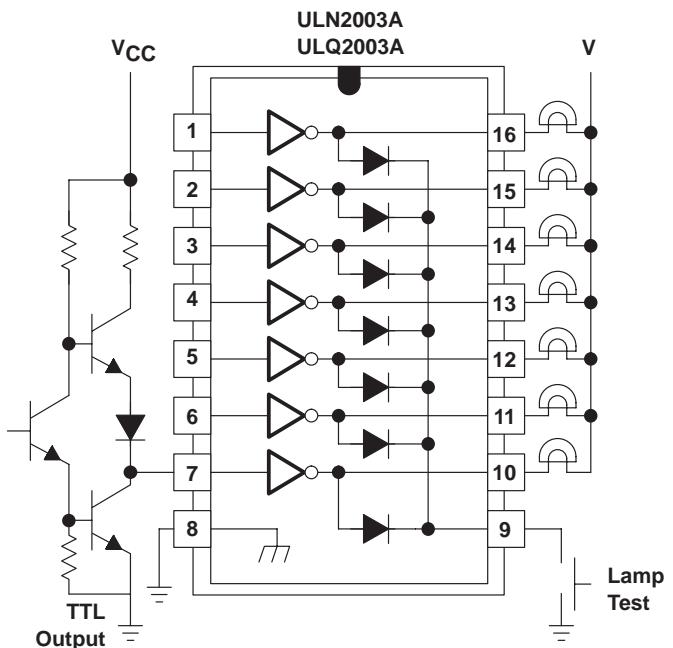


Figure 17. TTL to Load

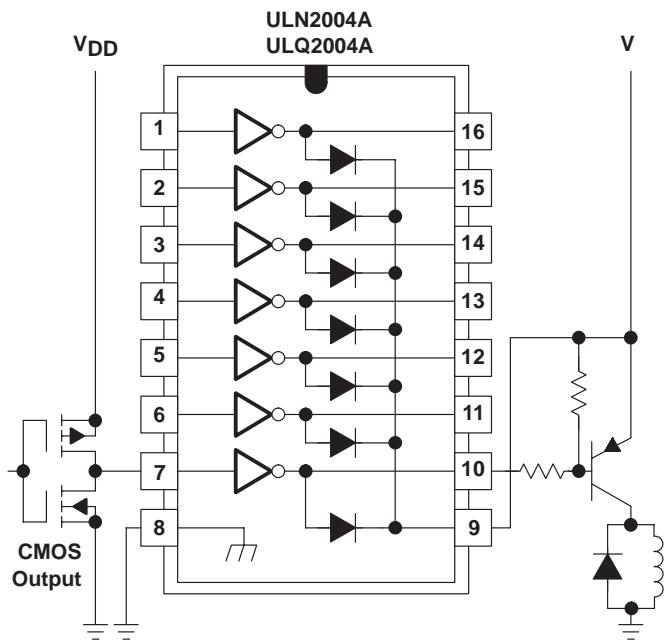
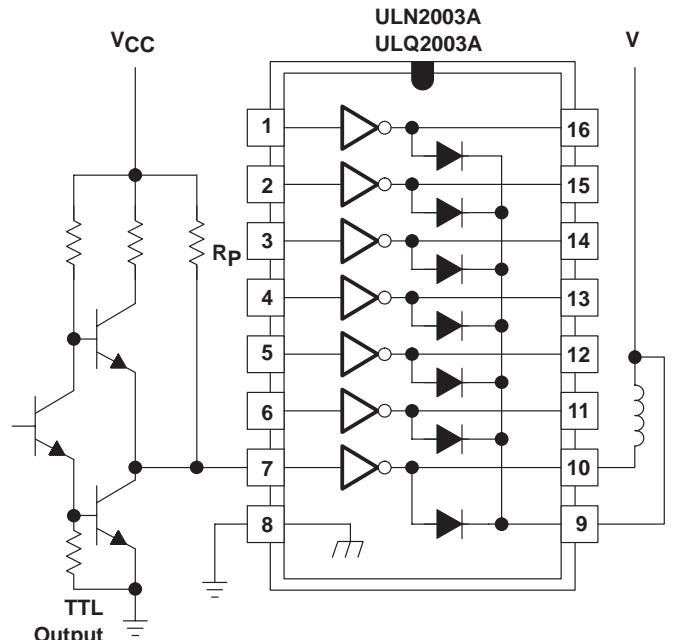


Figure 18. Buffer for Higher Current Loads

Figure 19. Use of Pullup Resistors  
to Increase Drive Current

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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>
ULN2001AD	OBsolete	SOIC	D	16		TBD	Call TI	Call TI
ULN2001ADR	OBsolete	SOIC	D	16		TBD	Call TI	Call TI
ULN2001AN	OBsolete	PDIP	N	16		TBD	Call TI	Call TI
ULN2002AD	OBsolete	SOIC	D	16		TBD	Call TI	Call TI
ULN2002AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2002ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2003AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003AJ	OBsolete	CDIP	J	16		TBD	Call TI	Call TI
ULN2003AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2003ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2003ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ANSRE4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003ANSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003APW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003APWE4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003APWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003APWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2003APWRE4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004AD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004ADE4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004ADG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004ADR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

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>
ULN2004ADRE4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004ADRG4	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2004ANE4	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULN2004ANSR	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULN2004ANSRG4	ACTIVE	SO	NS	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
ULQ2003AD	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
ULQ2003ADR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
ULQ2003AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
ULQ2004AD	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
ULQ2004ADR	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
ULQ2004AN	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type

<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)

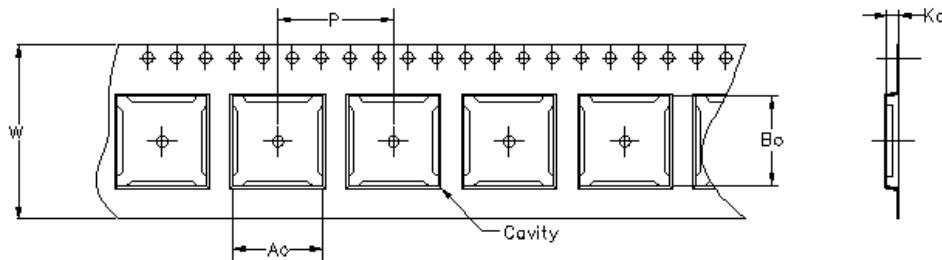
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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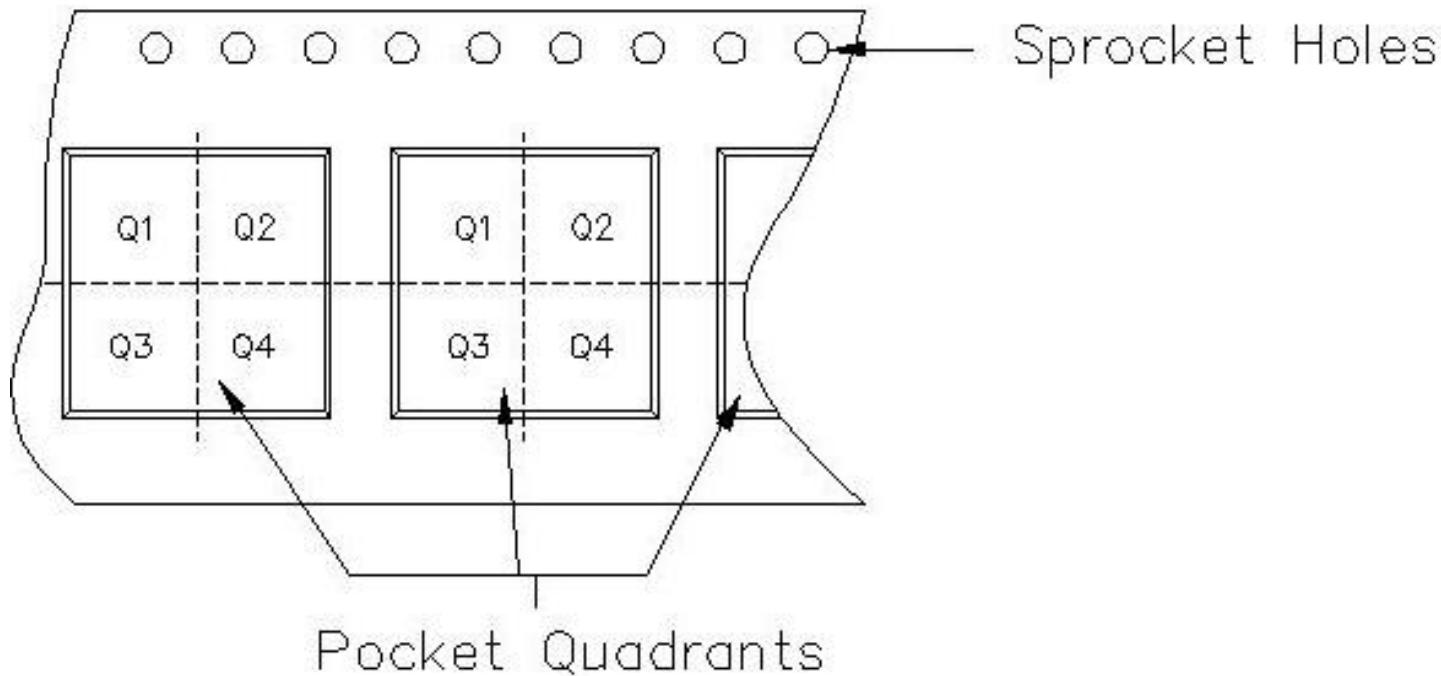
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to Customer on an annual basis.



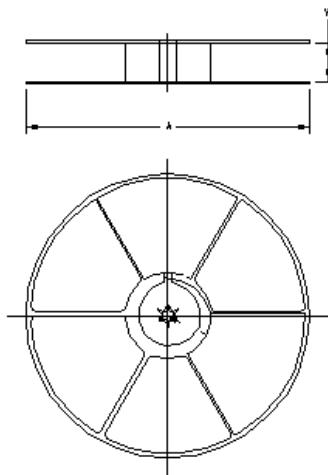
Carrier tape design is defined largely by the component length, width, and thickness.

$A_o$ = Dimension designed to accommodate the component width.
$B_o$ = Dimension designed to accommodate the component length.
$K_o$ = Dimension designed to accommodate the component thickness.
$W$ = Overall width of the carrier tape.
$P$ = Pitch between successive cavity centers.

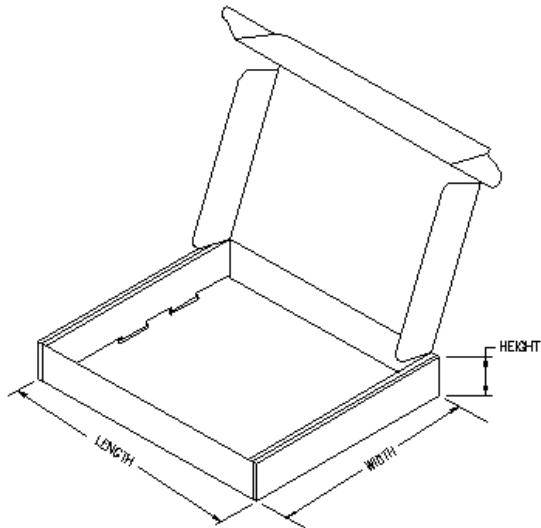


#### TAPE AND REEL INFORMATION

Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ULN2003ADR	D	16	MLA	330	16	6.5	10.3	12.1	2	16	Q1
ULN2003ADR	D	16	FMX	0	16	6.5	10.3	12.1	2	16	Q1
ULN2003ANSR	NS	16	MLA	330	16	8.2	10.5	2.5	12	16	Q1
ULN2003APWR	PW	16	MLA	330	12	7.0	5.6	1.6	8	12	Q1
ULN2004ADR	D	16	MLA	330	16	6.5	10.3	12.1	2	16	Q1
ULN2004ADR	D	16	FMX	0	16	6.5	10.3	12.1	2	16	Q1
ULN2004ANSR	NS	16	MLA	330	16	8.2	10.5	2.5	12	16	Q1


**TAPE AND REEL BOX INFORMATION**

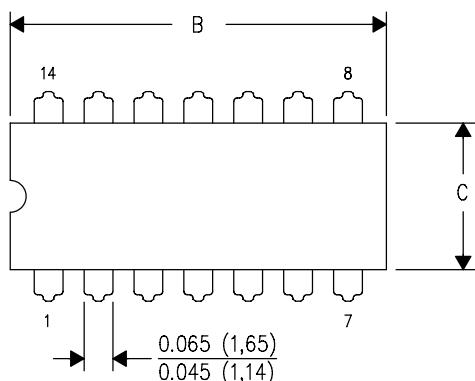
Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
ULN2003ADR	D	16	MLA	333.2	333.2	28.58
ULN2003ADR	D	16	FMX	333.2	333.2	28.58
ULN2003ANSR	NS	16	MLA	333.2	333.2	28.58
ULN2003APWR	PW	16	MLA	338.1	340.5	20.64
ULN2004ADR	D	16	MLA	333.2	333.2	28.58
ULN2004ADR	D	16	FMX	333.2	333.2	28.58
ULN2004ANSR	NS	16	MLA	333.2	333.2	28.58



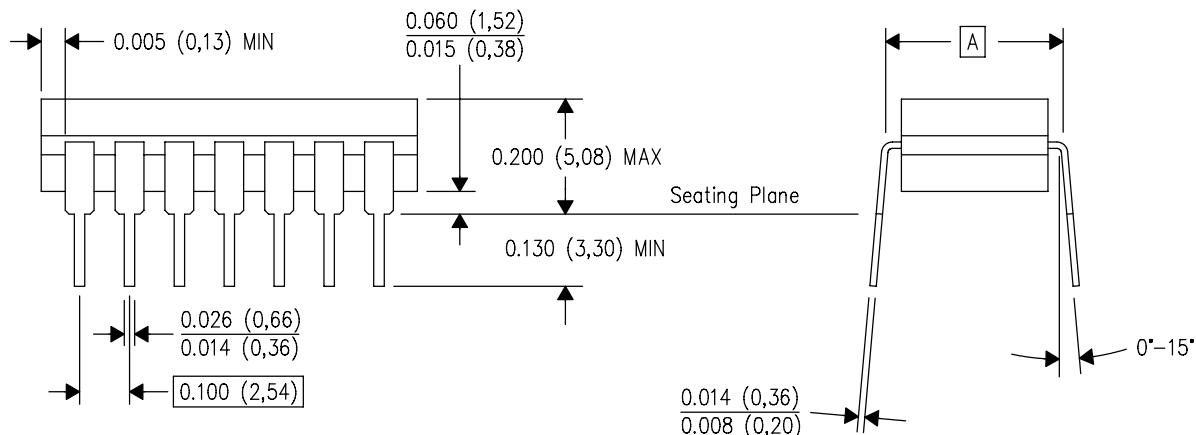
J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	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)



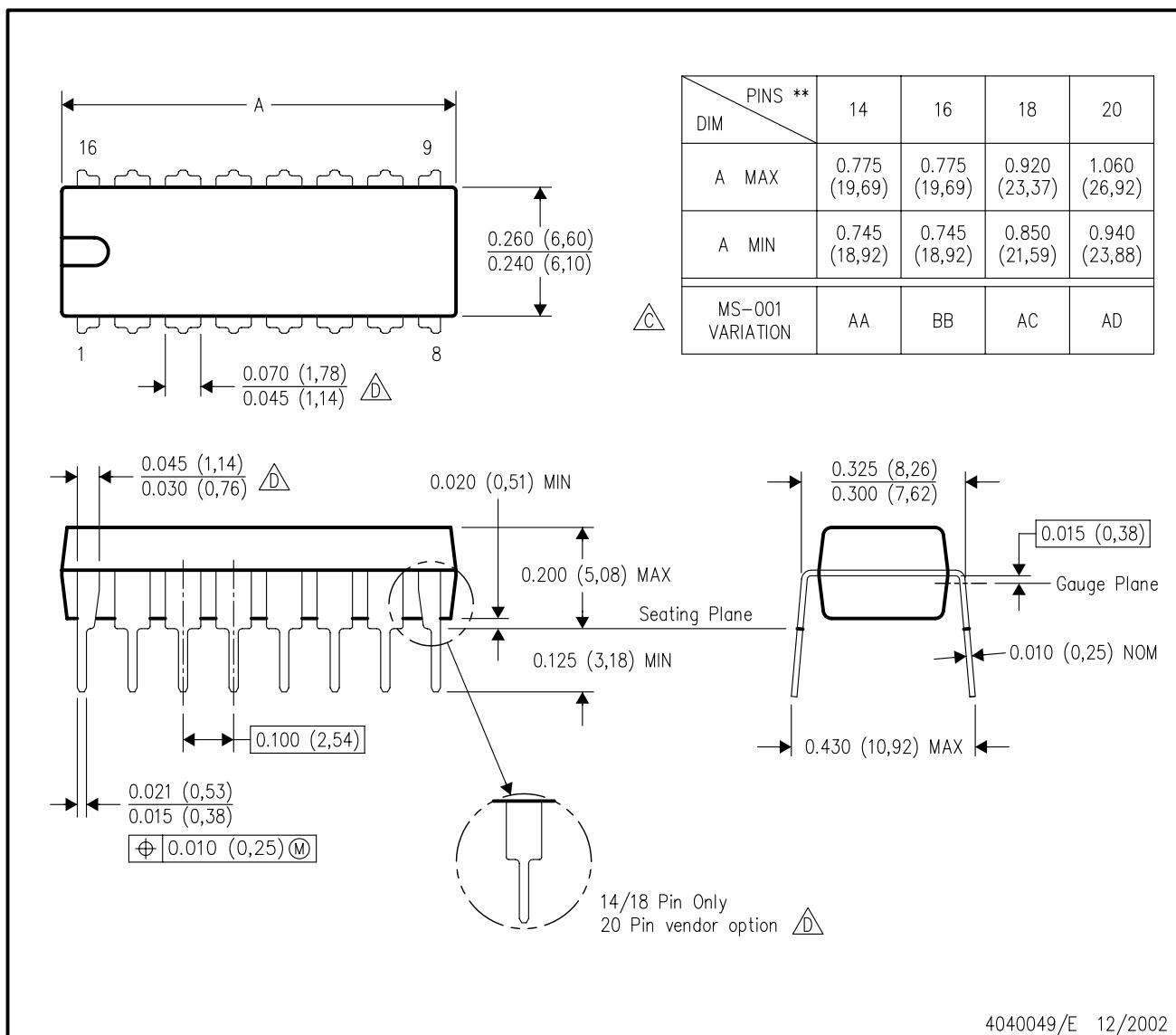
4040083/F 03/03

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\*\*)

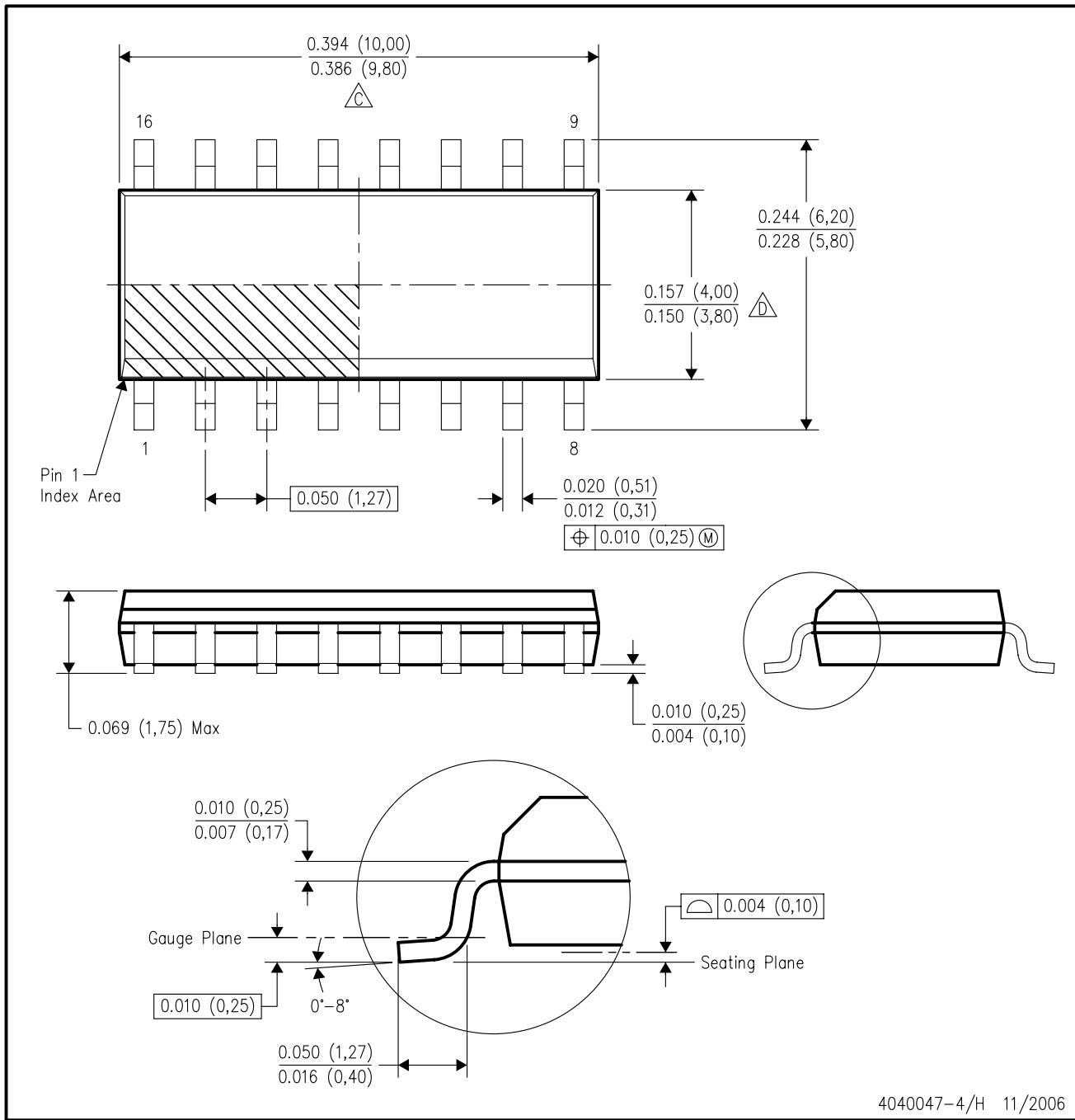
16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



## D (R-PDSO-G16)

## PLASTIC SMALL-OUTLINE PACKAGE



4040047-4/H 11/2006

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 .006 (0,15) per end.

△D Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.

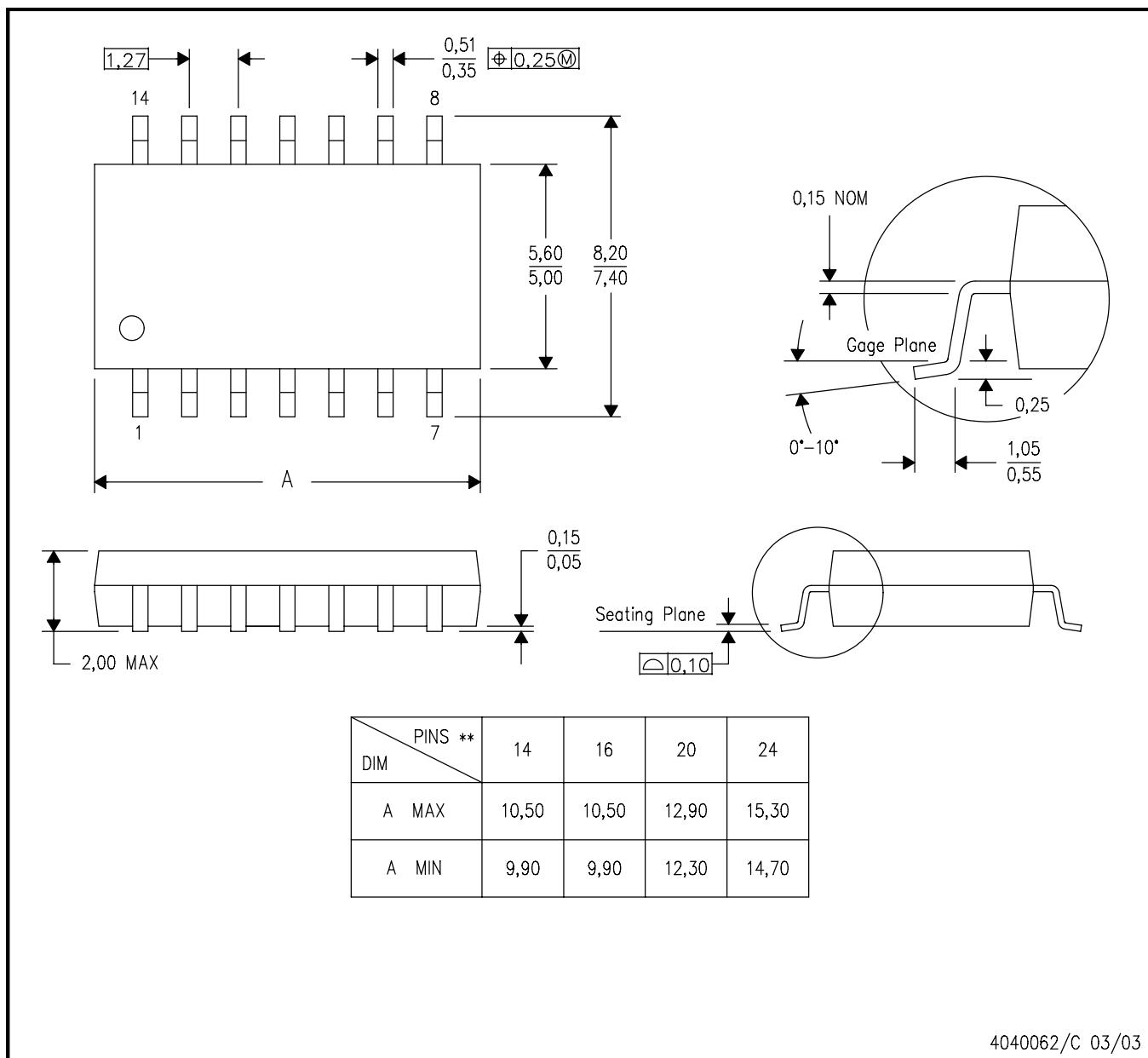
E. Reference JEDEC MS-012 variation AC.

## MECHANICAL DATA

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

14-PINS SHOWN

PLASTIC SMALL-OUTLINE PACKAGE



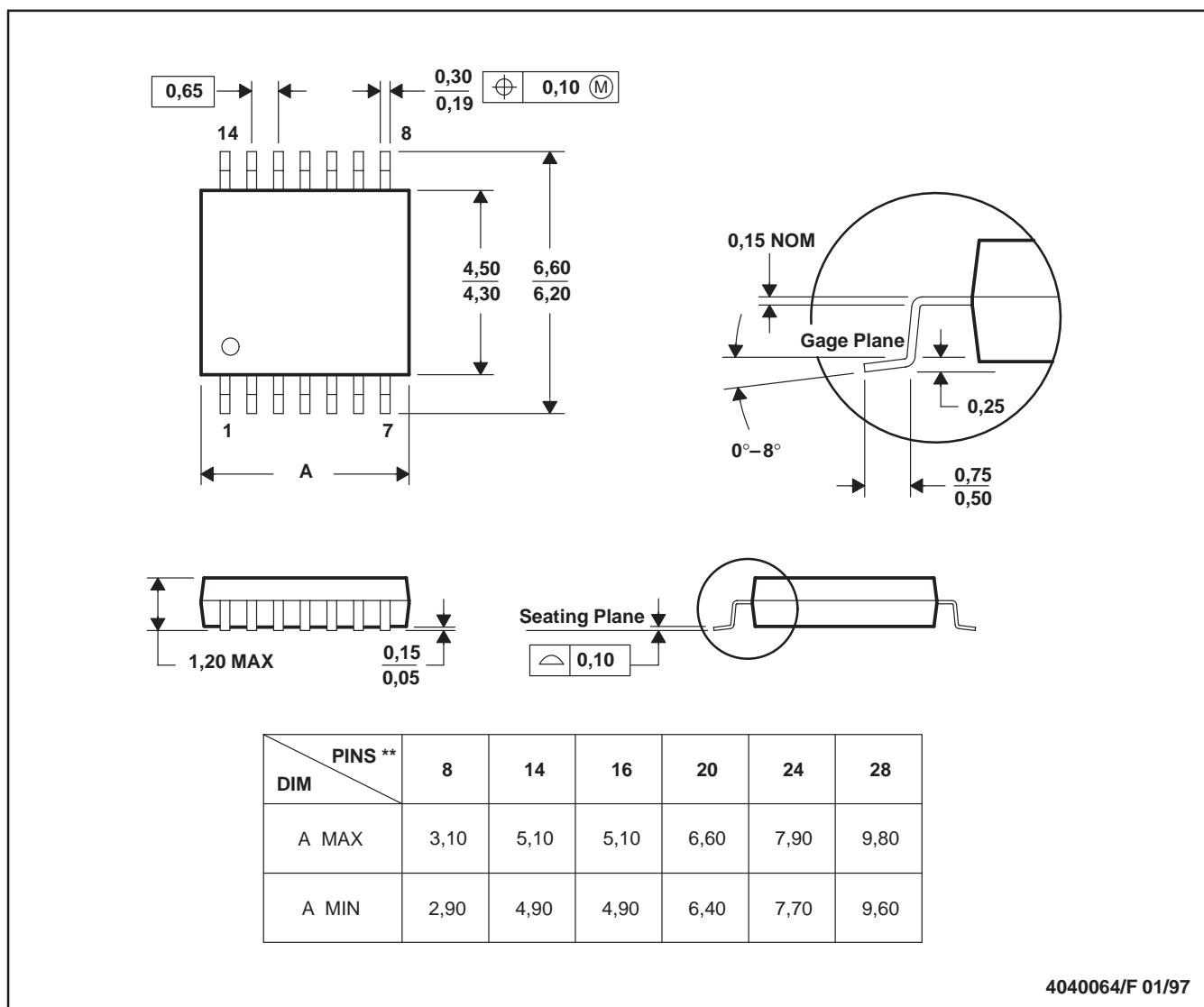
NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

4040062/C 03/03

## PW (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Body dimensions do not include mold flash or protrusion not to exceed 0,15.
- Falls within JEDEC MO-153

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