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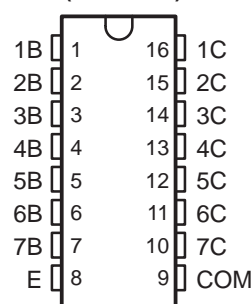
ULN2001A, ULN2002A, ULN2003A, ULN2004A, ULQ2003A, ULQ2004A HIGH-VOLTAGE HIGH-CURRENT DARLINGTON TRANSISTOR ARRAY

SLRS027G – DECEMBER 1976 – REVISED JUNE 2004

The ULN2001A is obsolete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

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)



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.

ORDERING INFORMATION

| T _A | PACKAGE† | | 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 |
| | | | ULN2003ADR | |
| | | Reel of 2500 | ULN2004AD | ULN2004A |
| | | | ULN2004ADR | |
| | SOP (NS) | Reel of 2000 | ULN2003ANSR | ULN2003A |
| | | | ULN2004ANSR | ULN2004A |
| | TSSOP (PW) | Tube of 90 | ULN2003APW | UN2003A |
| ULN2003APWR | | | | |
| -40°C to 85°C | PDIP (N) | Tube of 25 | ULQ2003AN | ULQ2003A |
| | | | ULQ2004AN | ULQ2004AN |
| | SOIC (D) | Tube of 40 | ULQ2003AD | ULQ2003A |
| | | | ULQ2003ADR | |
| | | Reel of 2500 | ULQ2004AD | ULQ2004A |
| | | | ULQ2004ADR | |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at 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.

 **TEXAS
INSTRUMENTS**

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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.

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

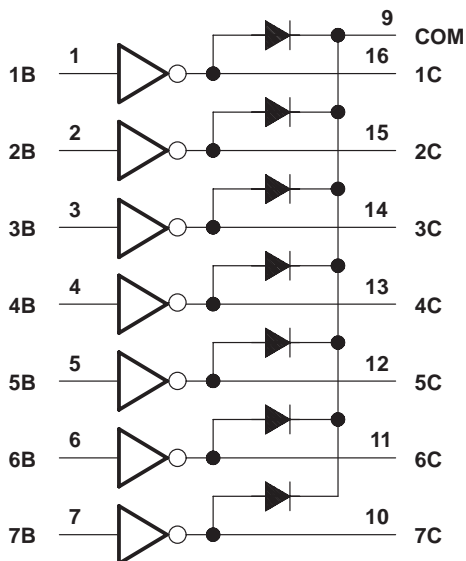
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The ULN2001A is obsolete
and is no longer supplied.

description/ordering information (continued)

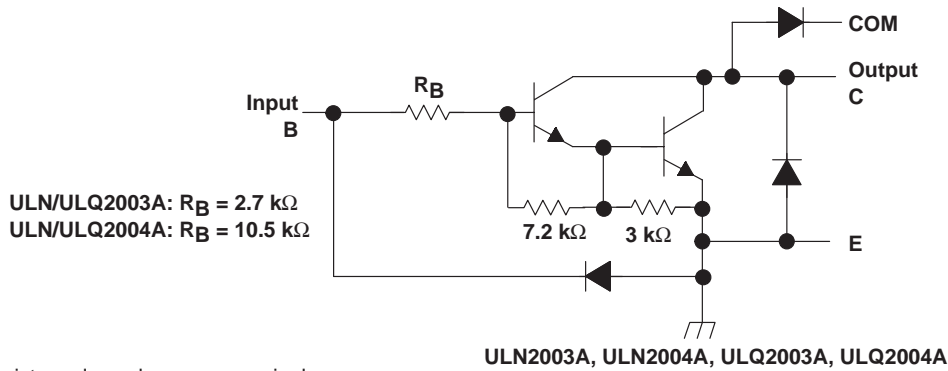
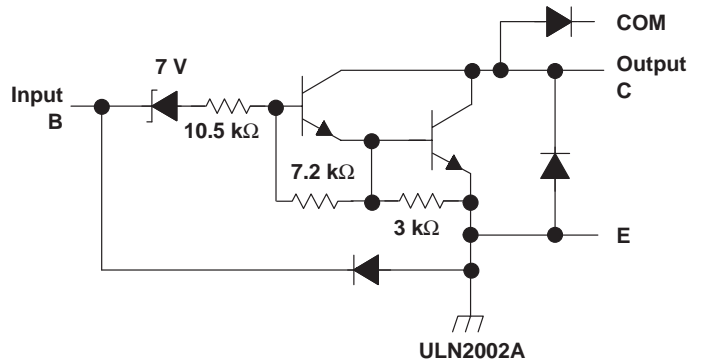
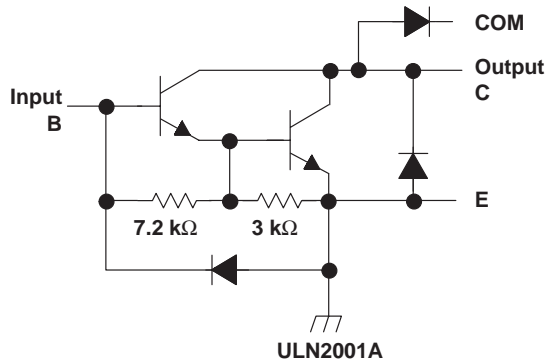
The ULN2001A is a general-purpose array and can be used with TTL and CMOS technologies. The ULN2002A is designed specifically for use with 14-V to 25-V PMOS devices. Each input of this device has a Zener diode and resistor in series to control the input current to a safe limit. The ULN2003A and ULQ2003A have a 2.7-k Ω 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 Ω 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



The ULN2001A is obsolete
and is no longer supplied.

schematics (each Darlington pair)



All resistor values shown are nominal.

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

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absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)†

| | |
|---|----------------|
| Collector-emitter voltage | 50 V |
| Clamp diode reverse voltage (see Note 1) | 50 V |
| Input voltage, V_I (see Note 1) | 30 V |
| Peak collector current (see Figures 14 and 15) | 500 mA |
| Output clamp current, I_{OK} | 500 mA |
| Total emitter-terminal current | -2.5 A |
| Operating free-air temperature range, T_A , ULN200xA | -20°C to 70°C |
| ULQ200xA | -40°C to 85°C |
| ULQ200xAT | -40°C to 105°C |
| Package thermal impedance, θ_{JA} (see Notes 2 and 3): D package | 73°C/W |
| N package | 67°C/W |
| NS package | 64°C/W |
| PW package | 108°C/W |
| Package thermal impedance, θ_{JC} (see Notes 4 and 5): D package | 36°C/W |
| N package | 54°C/W |
| Operating virtual junction temperature, T_J | 150°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°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.

- NOTES:
- All voltage values are with respect to the emitter/substrate terminal E, unless otherwise noted.
 - Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 - The package thermal impedance is calculated in accordance with JEDEC 51-7.
 - Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JC} , and T_C . The maximum allowable power dissipation at any allowable case temperature is $P_D = (T_J(\text{max}) - T_C)/\theta_{JC}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
 - 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 | |
| $V_{I(\text{on})}$ On-state input voltage | 6 | $V_{CE} = 2 \text{ V}$, $I_C = 300 \text{ mA}$ | | | | | | 13 | V |
| $V_{CE(\text{sat})}$ Collector-emitter saturation voltage | 5 | $I_I = 250 \mu\text{A}$, $I_C = 100 \text{ mA}$ | 0.9 | 1.1 | 0.9 | 1.1 | | | V |
| | | $I_I = 350 \mu\text{A}$, $I_C = 200 \text{ mA}$ | 1 | 1.3 | 1 | 1.3 | | | |
| | | $I_I = 500 \mu\text{A}$, $I_C = 350 \text{ mA}$ | 1.2 | 1.6 | 1.2 | 1.6 | | | |
| V_F Clamp forward voltage | 8 | $I_F = 350 \text{ mA}$ | 1.7 | 2 | 1.7 | 2 | | | V |
| I_{CEX} Collector cutoff current | 1 | $V_{CE} = 50 \text{ V}$, $I_I = 0$ | | | 50 | | | 50 | μA |
| | 2 | $V_{CE} = 50 \text{ V}$, $T_A = 70^\circ\text{C}$, $I_I = 0$, $V_I = 6 \text{ V}$ | | | 100 | | | 100 | |
| | | | | | | | | 500 | |
| $I_{I(\text{off})}$ Off-state input current | 3 | $V_{CE} = 50 \text{ V}$, $T_A = 70^\circ\text{C}$, $I_C = 500 \mu\text{A}$ | 50 | 65 | 50 | 65 | | | μA |
| I_I Input current | 4 | $V_I = 17 \text{ V}$ | | | | 0.82 | 1.25 | | mA |
| I_R Clamp reverse current | 7 | $V_R = 50 \text{ V}$, $T_A = 70^\circ\text{C}$ | | | 100 | | | 100 | μA |
| | | $V_R = 50 \text{ V}$ | | | 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 | | | pF |



The ULN2001A is obsolete
and is no longer supplied.

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 | |
| $V_{I(on)}$ 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 | |
| $V_{CE(sat)}$ Collector-emitter saturation voltage | 5 | $I_I = 250\ \mu\text{A}$, $I_C = 100\text{ mA}$ | 0.9 | 1.1 | 0.9 | 1.1 | | | V | |
| | | $I_I = 350\ \mu\text{A}$, $I_C = 200\text{ mA}$ | 1 | 1.3 | 1 | 1.3 | | | | |
| | | $I_I = 500\ \mu\text{A}$, $I_C = 350\text{ mA}$ | 1.2 | 1.6 | 1.2 | 1.6 | | | | |
| I_{CEX} Collector cutoff current | 1 | $V_{CE} = 50\text{ V}$, $I_I = 0$ | | 50 | | 50 | | | μA | |
| | 2 | $V_{CE} = 50\text{ V}$, $T_A = 70^\circ\text{C}$, $V_I = 1\text{ V}$ | | 100 | | 100 | | 500 | | |
| V_F Clamp forward voltage | 8 | $I_F = 350\text{ mA}$ | 1.7 | 2 | 1.7 | 2 | | | V | |
| $I_{I(off)}$ Off-state input current | 3 | $V_{CE} = 50\text{ V}$, $T_A = 70^\circ\text{C}$, $I_C = 500\ \mu\text{A}$ | 50 | 65 | 50 | 65 | | | μA | |
| 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 | | | μA | |
| | | $V_R = 50\text{ V}$, $T_A = 70^\circ\text{C}$ | | 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 | |
| $V_{I(on)}$ On-state input voltage | 6 | $V_{CE} = 2\text{ V}$ | $I_C = 125\text{ mA}$ | | | | | | 5 | V |
| | | | $I_C = 200\text{ mA}$ | | | | | | 6 | |
| | | | $I_C = 250\text{ mA}$ | | | | | | 2.7 | |
| | | | $I_C = 275\text{ mA}$ | | | | | | 2.9 | |
| | | | $I_C = 300\text{ mA}$ | | | | | | 3 | |
| | | | $I_C = 350\text{ mA}$ | | | | | | 7 | |
| $V_{CE(sat)}$ Collector-emitter saturation voltage | 5 | | $I_I = 250\text{ }\mu\text{A}$, $I_C = 100\text{ mA}$ | | 0.9 | 1.2 | | 0.9 | 1.1 | V |
| | | | $I_I = 350\text{ }\mu\text{A}$, $I_C = 200\text{ mA}$ | | 1 | 1.4 | | 1 | 1.3 | |
| | | | $I_I = 500\text{ }\mu\text{A}$, $I_C = 350\text{ mA}$ | | 1.2 | 1.7 | | 1.2 | 1.6 | |
| I_{CEX} Collector cutoff current | 1 | $V_{CE} = 50\text{ V}$, $I_I = 0$ | | | | | | 100 | μA | |
| | 2 | | $V_{CE} = 50\text{ V}$, $V_I = 1\text{ V}$ | | | | | 100 | | |
| V_F Clamp forward voltage | 8 | | $I_F = 350\text{ mA}$ | | 1.7 | 2.3 | | 1.7 | 2 | V |
| $I_{I(off)}$ Off-state input current | 3 | | $V_{CE} = 50\text{ V}$, $I_C = 500\text{ }\mu\text{A}$ | | 65 | | 50 | 65 | | μA |
| 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 | | $V_R = 50\text{ V}$, $T_A = 25^\circ\text{C}$ | | | 100 | | | 50 | μA |
| | | | $V_R = 50\text{ V}$ | | | 100 | | | 100 | |
| C_i Input capacitance | | | $V_I = 0$, $f = 1\text{ MHz}$ | | 15 | 25 | | 15 | 25 | pF |

switching characteristics, $T_A = 25^\circ\text{C}$

| PARAMETER | TEST CONDITIONS | ULN2001A, ULN2002A, ULN2003A, ULN2004A | | | UNIT |
|---|--|--|------------|-----|---------------|
| | | MIN | TYP | MAX | |
| t_{PLH} Propagation delay time, low- to high-level output | See Figure 9 | | 0.25 | 1 | μs |
| t_{PHL} Propagation delay time, high- to low-level output | See Figure 9 | | 0.25 | 1 | μs |
| V_{OH} High-level output voltage after switching | $V_S = 50\text{ V}$, $I_O \approx 300\text{ mA}$, See Figure 10 | | $V_S - 20$ | | mV |

switching characteristics over recommended operating conditions (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | ULQ2003A, ULQ2004A | | | UNIT |
|---|--|--------------------|-------------|-----|---------------|
| | | MIN | TYP | MAX | |
| t_{PLH} Propagation delay time, low- to high-level output | See Figure 9 | | 1 | 10 | μs |
| t_{PHL} Propagation delay time, high- to low-level output | See Figure 9 | | 1 | 10 | μs |
| V_{OH} High-level output voltage after switching | $V_S = 50\text{ V}$, $I_O \approx 300\text{ mA}$, See Figure 10 | | $V_S - 500$ | | mV |



The ULN2001A is obsolete and is no longer supplied.

PARAMETER MEASUREMENT INFORMATION

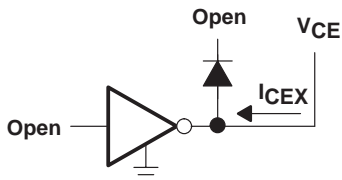


Figure 1. I_{CEX} Test Circuit

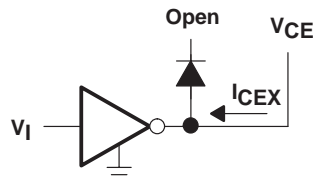


Figure 2. I_{CEX} Test Circuit

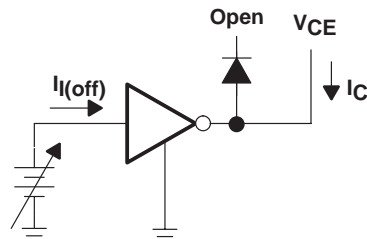


Figure 3. $I_{I(off)}$ Test Circuit

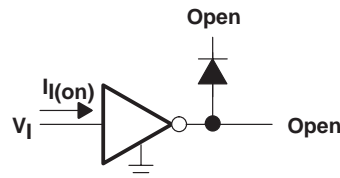
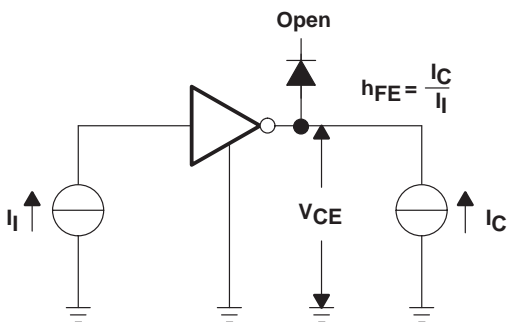


Figure 4. I_I Test Circuit



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

Figure 5. h_{FE} , $V_{CE(sat)}$ Test Circuit

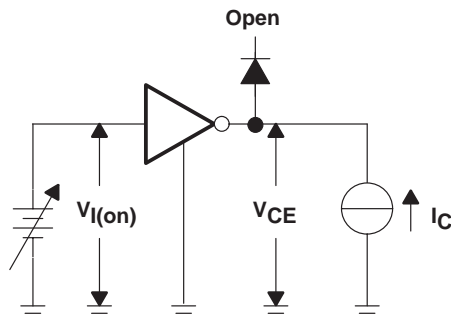


Figure 6. $V_{I(on)}$ Test Circuit

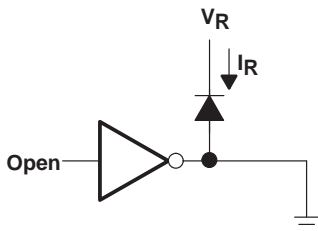


Figure 7. I_R Test Circuit

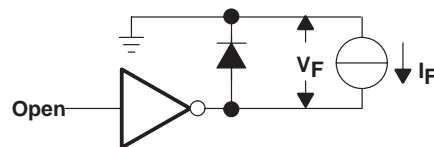


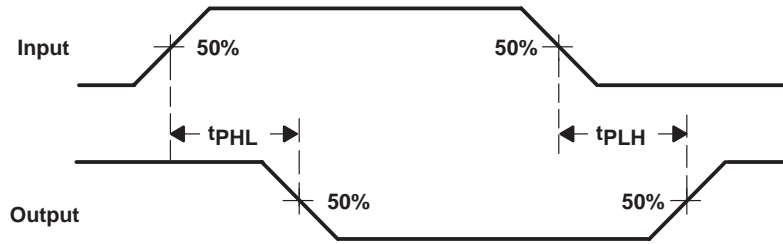
Figure 8. V_F Test Circuit

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

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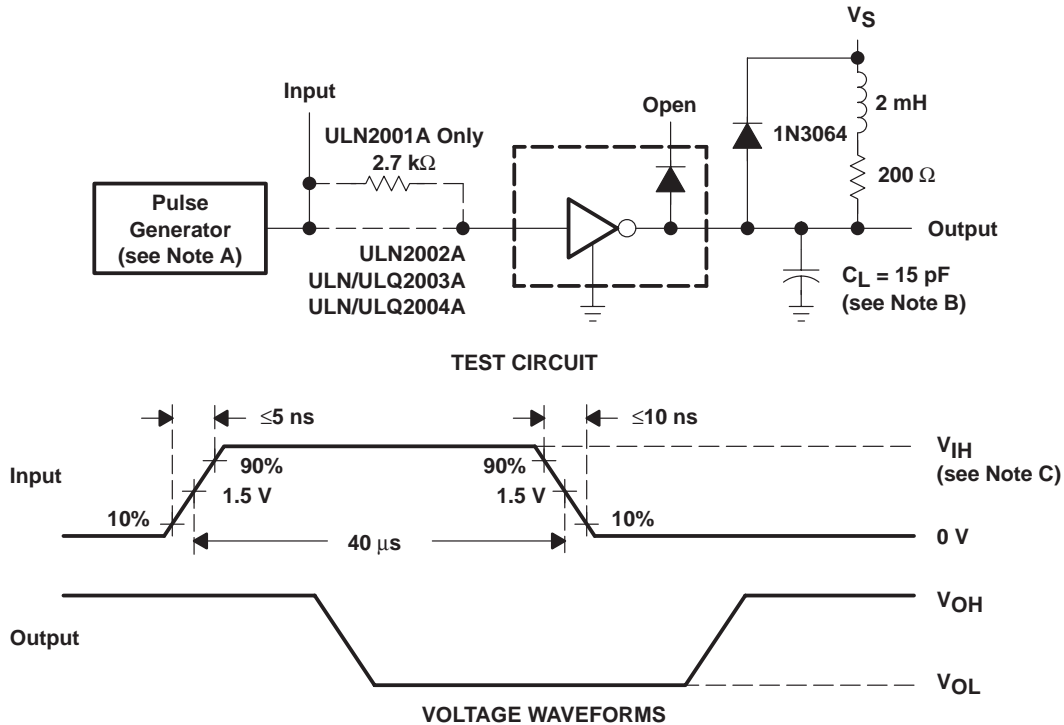
The ULN2001A is obsolete
 and is no longer supplied.

PARAMETER MEASUREMENT INFORMATION



VOLTAGE WAVEFORMS

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, $V_{IH} = 3 \text{ V}$; for the ULN2002A, $V_{IH} = 13 \text{ V}$; for the ULN2004A and the ULQ2004A, $V_{IH} = 8 \text{ V}$.

Figure 10. Latch-Up Test Circuit and Voltage Waveforms

The ULN2001A is obsolete and is no longer supplied.

TYPICAL CHARACTERISTICS

**COLLECTOR-EMITTER SATURATION VOLTAGE
vs
COLLECTOR CURRENT
(ONE DARLINGTON)**

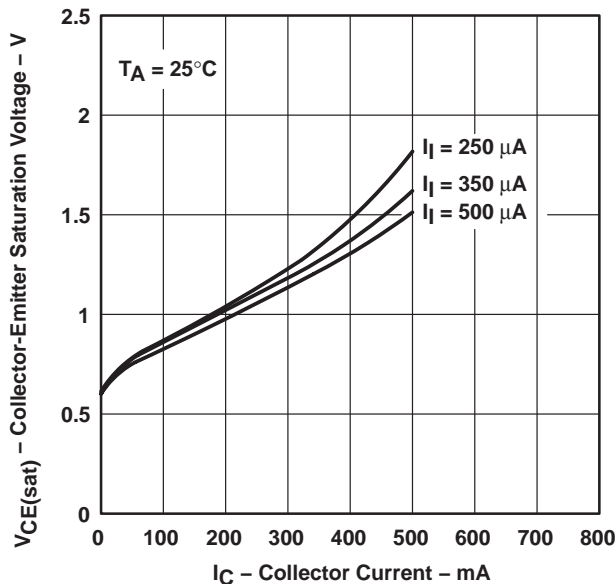


Figure 11

**COLLECTOR-EMITTER SATURATION VOLTAGE
vs
TOTAL COLLECTOR CURRENT
(TWO DARLINGTONS IN PARALLEL)**

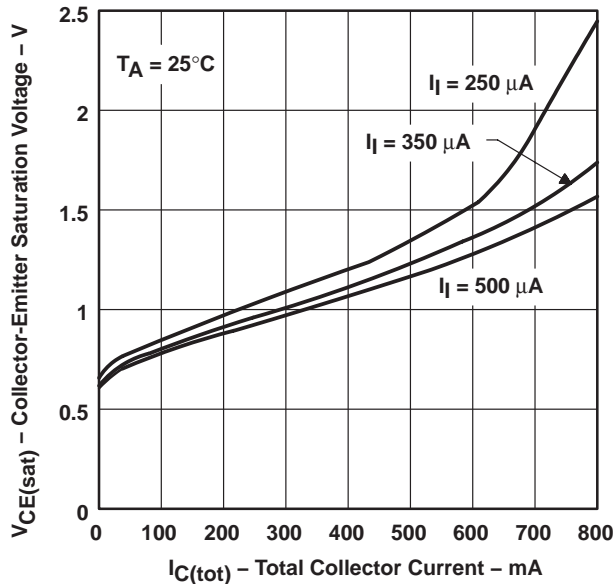


Figure 12

**COLLECTOR CURRENT
vs
INPUT CURRENT**

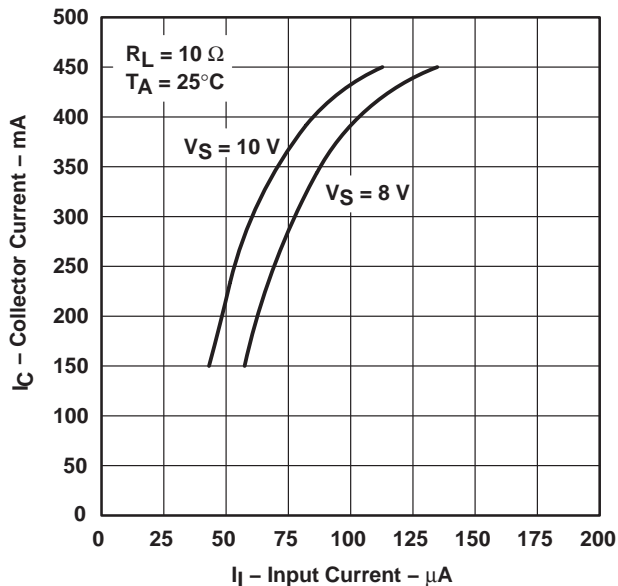


Figure 13

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

SLRS027G – DECEMBER 1976 – REVISED JUNE 2004

The ULN2001A is obsolete
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THERMAL INFORMATION

D PACKAGE
MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE

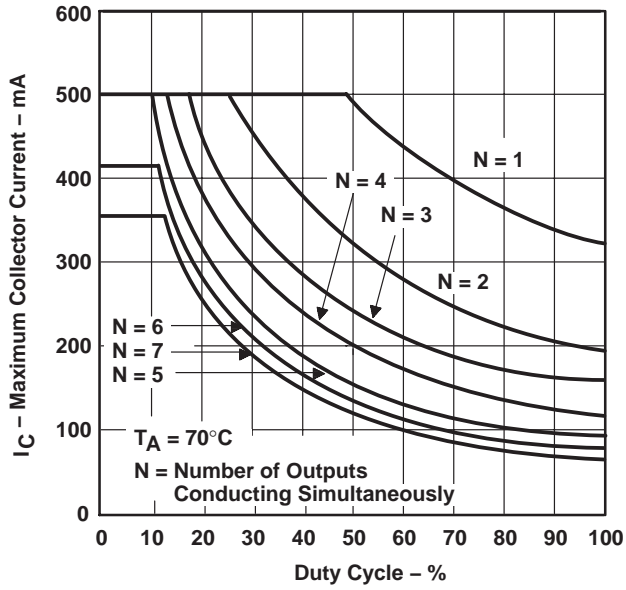


Figure 14

N PACKAGE
MAXIMUM COLLECTOR CURRENT
vs
DUTY CYCLE

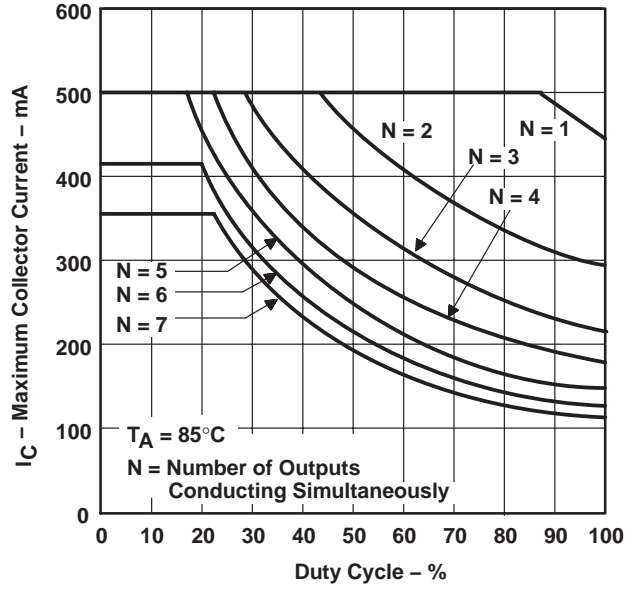


Figure 15

The ULN2001A is obsolete and is no longer supplied.

APPLICATION INFORMATION

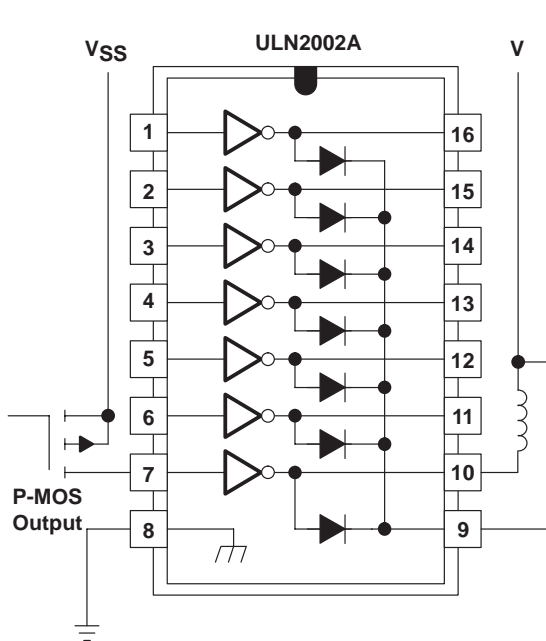


Figure 16. P-MOS to Load

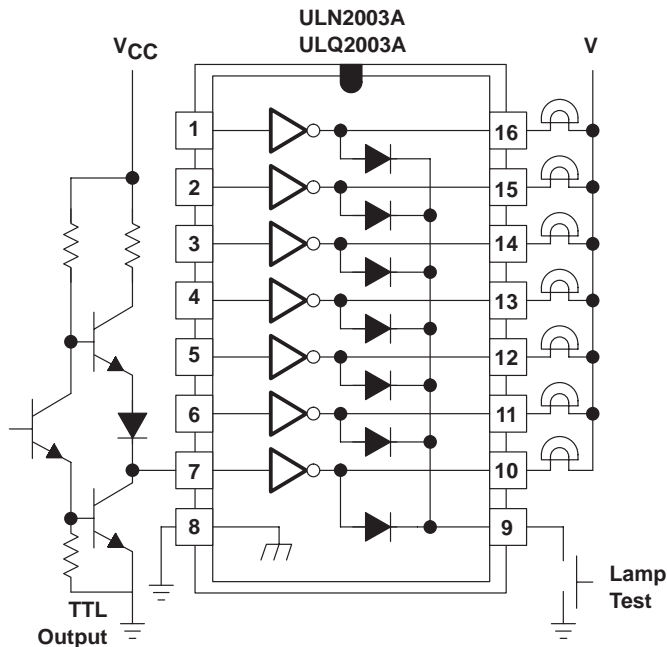


Figure 17. TTL to Load

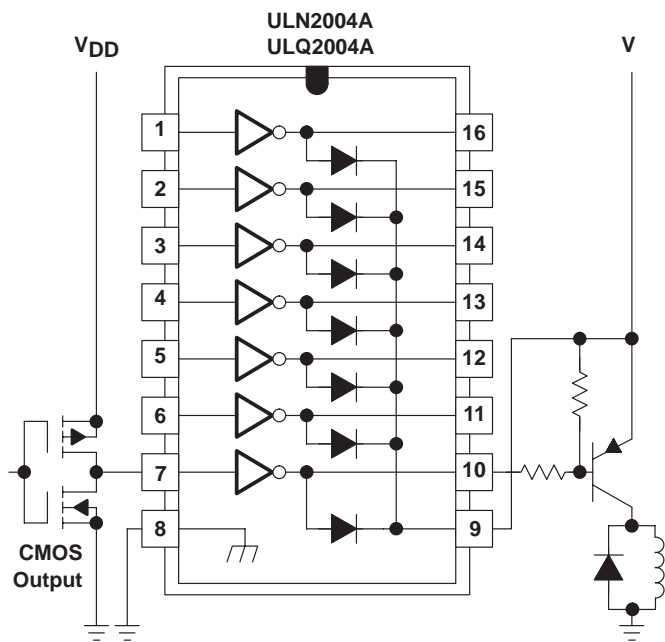


Figure 18. Buffer for Higher Current Loads

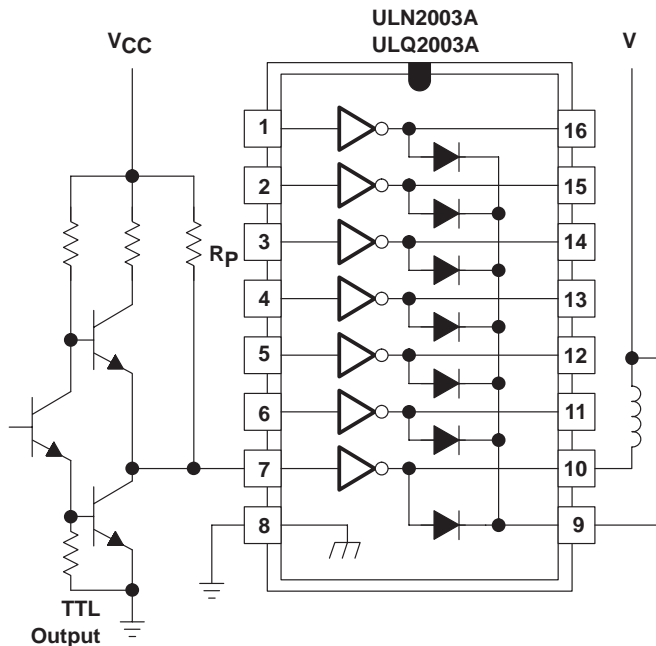


Figure 19. Use of Pullup Resistors to Increase Drive Current

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PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 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 ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|--|
| 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 |

⁽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.

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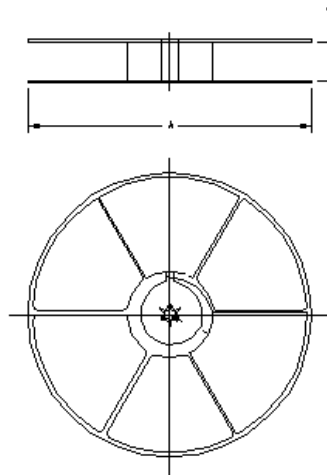
Carrier tape design is defined largely by the component length, width, and thickness.

| |
|--|
| 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. |



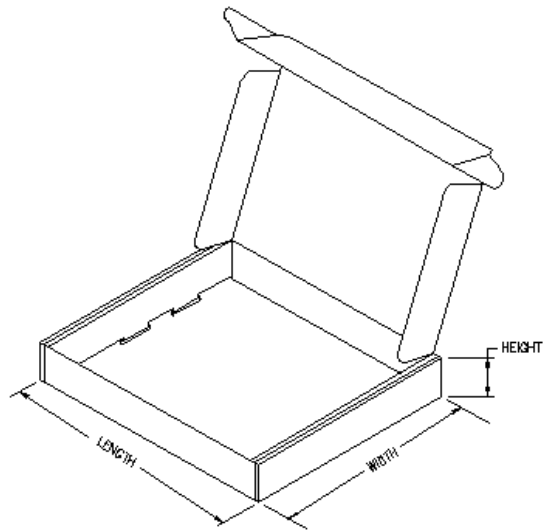
TAPE AND REEL INFORMATION

| 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



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

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

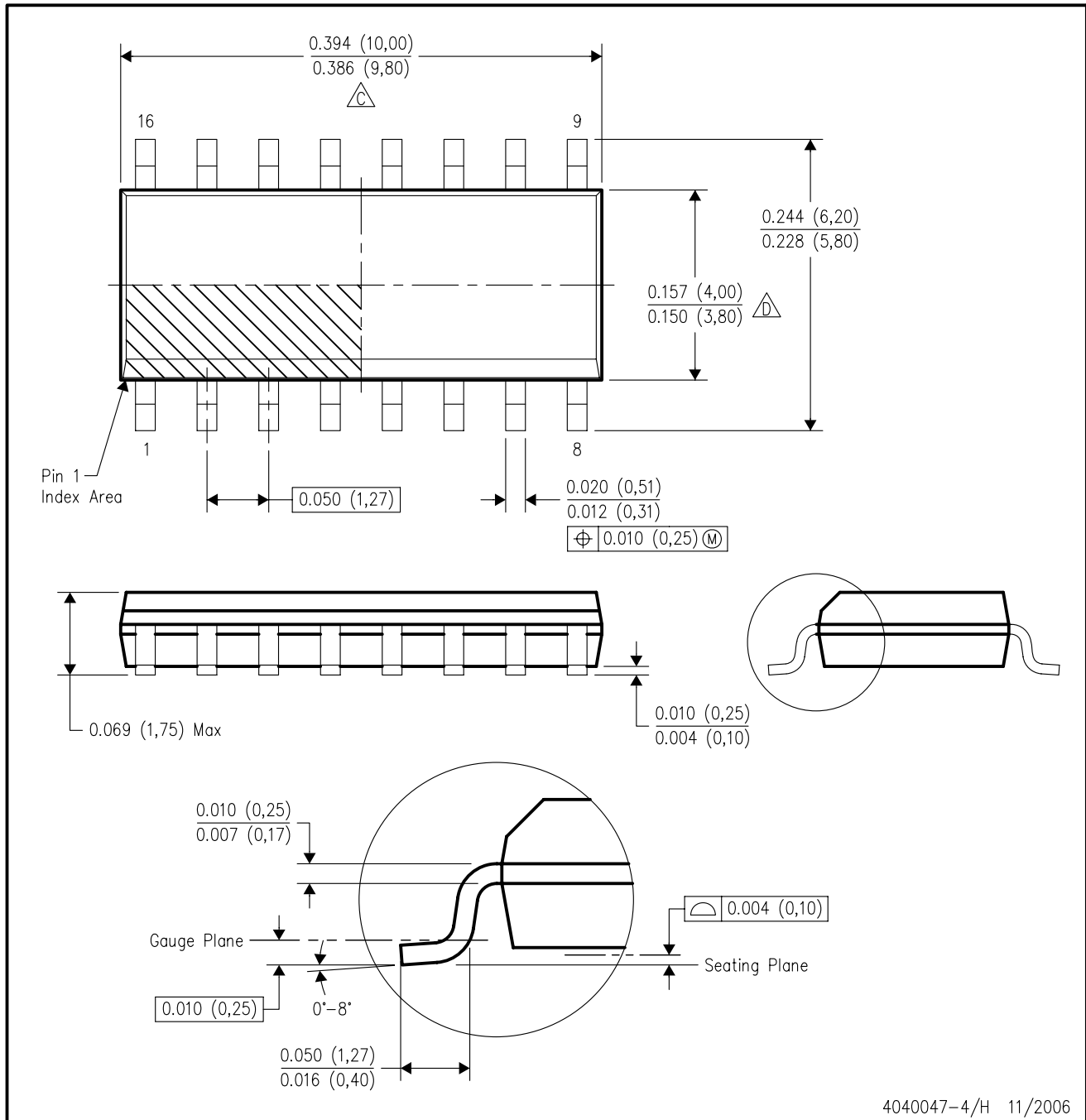
16 PINS SHOWN



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

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**)

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.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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. Falls within JEDEC MO-153

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