

# High Voltage, High Current Darlington Transistor Arrays

## ULN2003A, ULQ2003A

The seven NPN Darlington connected transistors in these arrays are well suited for driving lamps, relays, or printer hammers in a variety of industrial and consumer applications. Their high breakdown voltage and internal suppression diodes insure freedom from problems associated with inductive loads. Peak inrush currents to 500 mA permit them to drive incandescent lamps.

The ULx2003A with a 2.7 kΩ series input resistor is well suited for systems utilizing a 5.0 V TTL or CMOS Logic.

### Features

- These are Pb-Free Devices

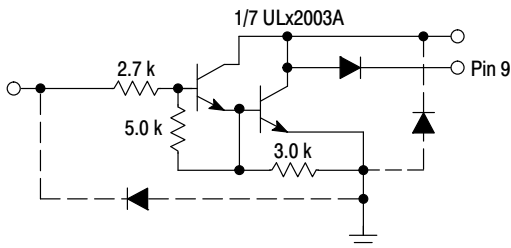


Figure 1. Representative Schematic Diagram

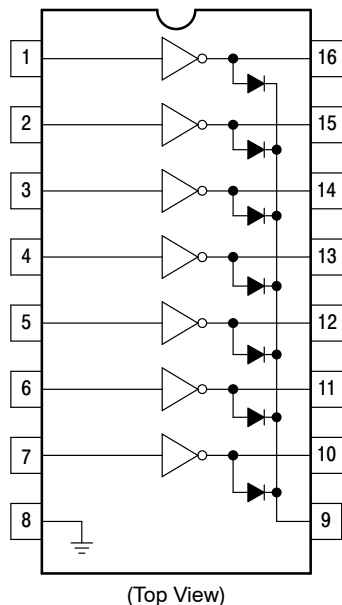
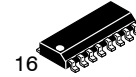


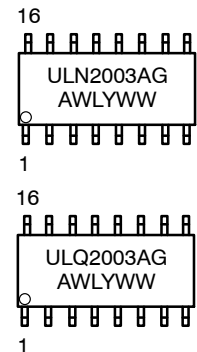
Figure 2. Pin Connections



1  
SOIC-16  
D SUFFIX  
CASE 751B

A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

### MARKING DIAGRAMS



### ORDERING INFORMATION

| Device       | Package              | Shipping†        |
|--------------|----------------------|------------------|
| ULN2003ADR2G | SOIC-16<br>(Pb-Free) | 2500 Tape & Reel |
| ULQ2003ADR2G | SOIC-16<br>(Pb-Free) | 2500 Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# ULN2003A, ULQ2003A

**MAXIMUM RATINGS** ( $T_A = 25\text{ }^{\circ}\text{C}$ , and rating apply to any one device in the package, unless otherwise noted.)

| Rating                                                                                                                  | Symbol           | Value                    | Unit                 |
|-------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------|----------------------|
| Output Voltage                                                                                                          | $V_O$            | 50                       | V                    |
| Input Voltage                                                                                                           | $V_I$            | 30                       | V                    |
| Collector Current - Continuous                                                                                          | $I_C$            | 500                      | mA                   |
| Base Current - Continuous                                                                                               | $I_B$            | 25                       | mA                   |
| Operating Ambient Temperature Range<br>ULN2003A<br>ULQ2003A                                                             | $T_A$            | -20 to +85<br>-40 to +85 | $^{\circ}\text{C}$   |
| Storage Temperature Range                                                                                               | $T_{\text{stg}}$ | -55 to +150              | $^{\circ}\text{C}$   |
| Junction Temperature                                                                                                    | $T_J$            | 150                      | $^{\circ}\text{C}$   |
| Thermal Resistance, Junction-to-Ambient<br>Case 751B, D Suffix                                                          | $R_{\theta JA}$  | 100                      | $^{\circ}\text{C/W}$ |
| Thermal Resistance, Junction-to-Case<br>Case 751B, D Suffix                                                             | $R_{\theta JC}$  | 20                       | $^{\circ}\text{C/W}$ |
| Electrostatic Discharge Sensitivity (ESD)<br>Human Body Model (HBM)<br>Machine Model (MM)<br>Charged Device Model (CDM) | ESD              | 2000<br>400<br>1500      | V                    |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

# ULN2003A, ULQ2003A

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)

| Characteristic                                                                                                                                                                                         | Symbol               | Min         | Typ                 | Max               | Unit |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------|---------------------|-------------------|------|
| Output Leakage Current<br>(V <sub>O</sub> = 50 V, T <sub>A</sub> = +85 °C)<br>(V <sub>O</sub> = 50 V, T <sub>A</sub> = +25 °C)                                                                         | I <sub>CEX</sub>     | –<br>–      | –<br>–              | 100<br>50         | μA   |
| Collector-Emitter Saturation Voltage<br>(I <sub>C</sub> = 350 mA, I <sub>B</sub> = 500 μA)<br>(I <sub>C</sub> = 200 mA, I <sub>B</sub> = 350 μA)<br>(I <sub>C</sub> = 100 mA, I <sub>B</sub> = 250 μA) | V <sub>CE(sat)</sub> | –<br>–<br>– | 1.1<br>0.95<br>0.85 | 1.6<br>1.3<br>1.1 | V    |
| Input Current - On Condition<br>(V <sub>I</sub> = 3.85 V)                                                                                                                                              | I <sub>I(on)</sub>   | –           | 0.93                | 1.35              | mA   |
| Input Voltage - On Condition<br>(V <sub>CE</sub> = 2.0 V, I <sub>C</sub> = 200 mA)<br>(V <sub>CE</sub> = 2.0 V, I <sub>C</sub> = 250 mA)<br>(V <sub>CE</sub> = 2.0 V, I <sub>C</sub> = 300 mA)         | V <sub>I(on)</sub>   | –<br>–<br>– | –<br>–<br>–         | 2.4<br>2.7<br>3.0 | V    |
| Input Current - Off Condition<br>(I <sub>C</sub> = 500 μA, T <sub>A</sub> = 85 °C)                                                                                                                     | I <sub>I(off)</sub>  | 50          | 100                 | –                 | μA   |
| DC Current Gain<br>(V <sub>CE</sub> = 2.0 V, I <sub>C</sub> = 350 mA)                                                                                                                                  | h <sub>FE</sub>      | 1000        | –                   | –                 | –    |
| Input Capacitance                                                                                                                                                                                      | C <sub>I</sub>       | –           | 15                  | 30                | pF   |
| Turn-On Delay Time<br>(50% E <sub>I</sub> to 50% E <sub>O</sub> )                                                                                                                                      | t <sub>on</sub>      | –           | 0.25                | 1.0               | μs   |
| Turn-Off Delay Time<br>(50% E <sub>I</sub> to 50% E <sub>O</sub> )                                                                                                                                     | t <sub>off</sub>     | –           | 0.25                | 1.0               | μs   |
| Clamp Diode Leakage Current<br>(V <sub>R</sub> = 50 V)<br>T <sub>A</sub> = +25 °C<br>T <sub>A</sub> = +85 °C                                                                                           | I <sub>R</sub>       | –<br>–      | –<br>–              | 50<br>100         | μA   |
| Clamp Diode Forward Voltage<br>(I <sub>F</sub> = 350 mA)                                                                                                                                               | V <sub>F</sub>       | –           | 1.5                 | 2.0               | V    |

# ULN2003A, ULQ2003A

Typical Performance Curves -  $T_A = 25^\circ\text{C}$

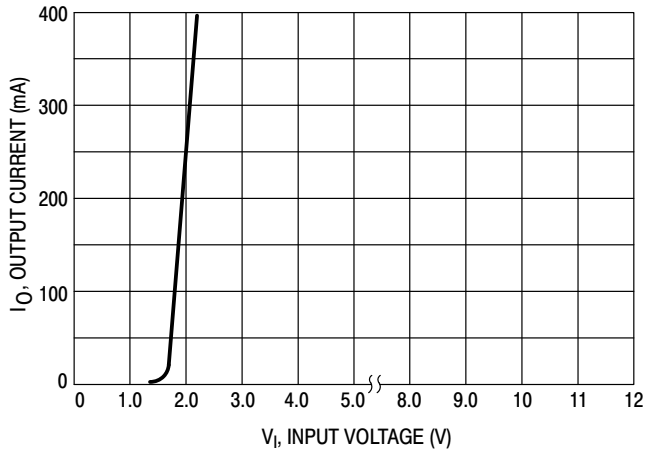


Figure 3. Output Current versus Input Voltage

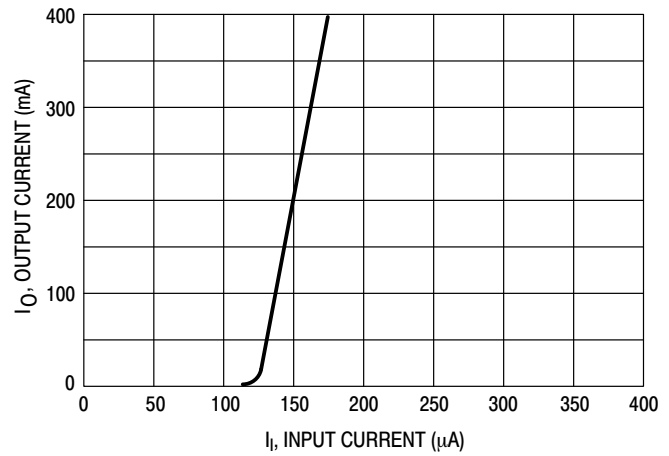


Figure 4. Output Current versus Input Current

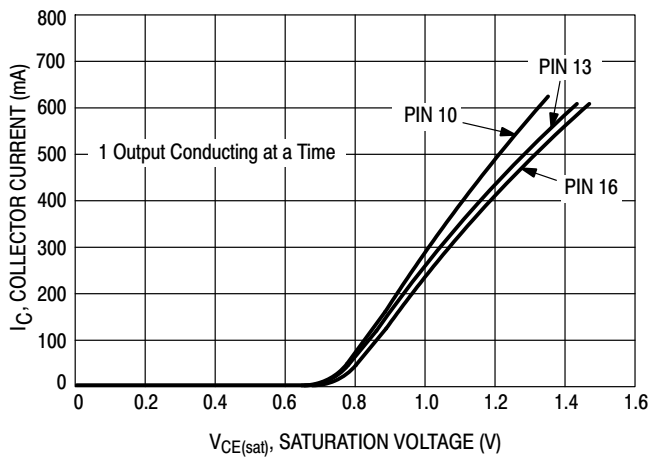


Figure 5. Typical Output Characteristics

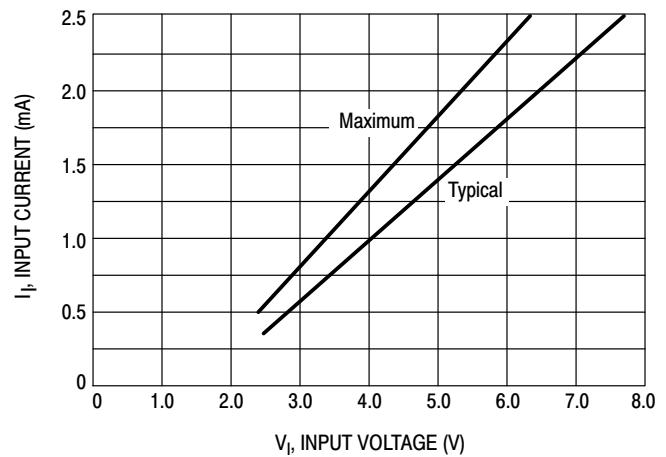


Figure 6. Input Characteristics

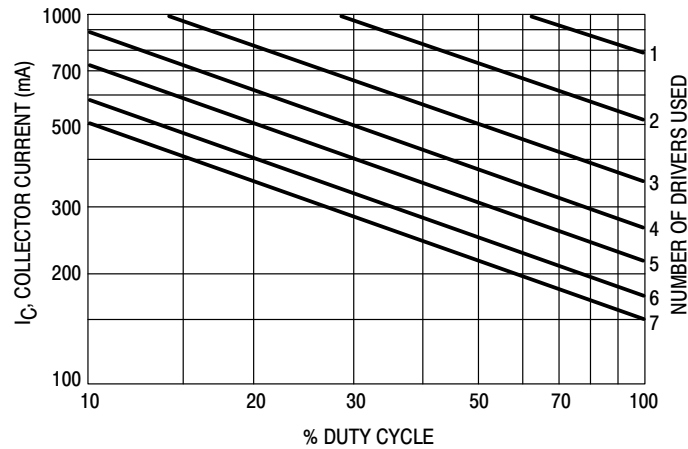
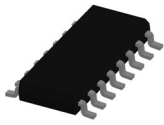


Figure 7. Maximum Collector Current  
versus Duty Cycle  
(and Number of Drivers in Use)

## ULN2003A, ULQ2003A

### REVISION HISTORY

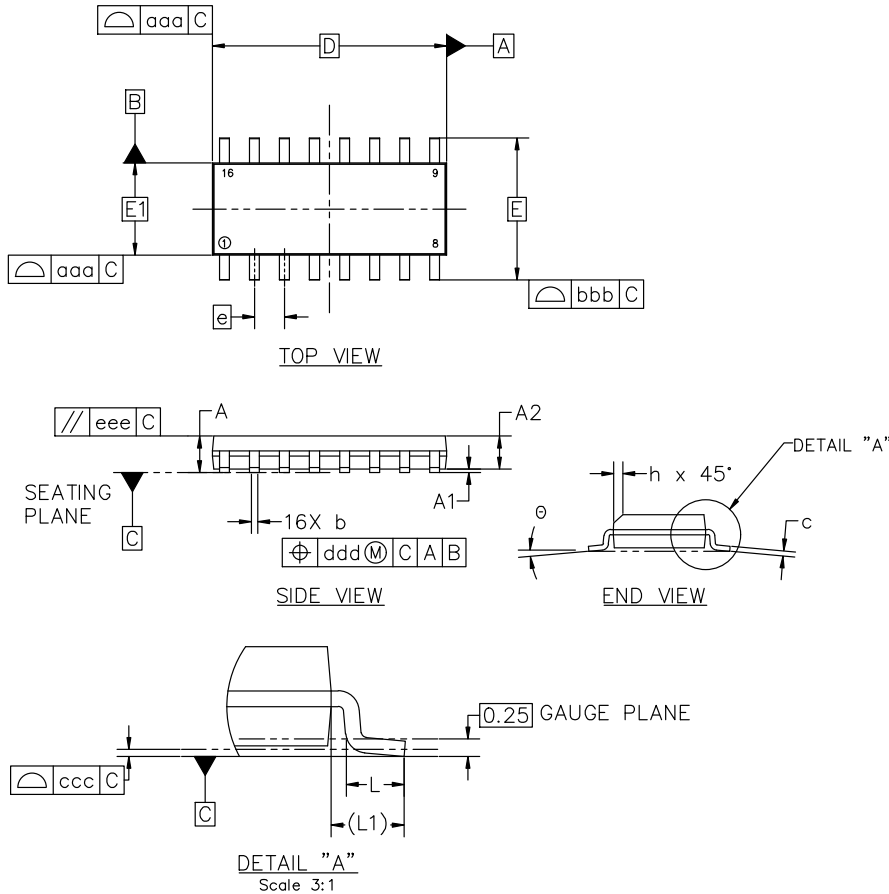
| Revision | Description of Changes                            | Date     |
|----------|---------------------------------------------------|----------|
| 1        | Rebranded the Data Sheet to <b>onsemi</b> format. | 6/3/2025 |


**SOIC-16 9.90x3.90x1.37 1.27P**  
**CASE 751B**  
**ISSUE M**

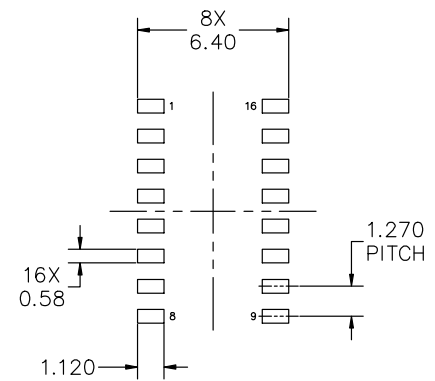
DATE 18 OCT 2024

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. DIMENSION IN MILLIMETERS. ANGLE IN DEGREES.
3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15mm PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127mm TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.



| MILLIMETERS                    |          |      |      |
|--------------------------------|----------|------|------|
| DIM                            | MIN      | NOM  | MAX  |
| A                              | 1.35     | 1.55 | 1.75 |
| A1                             | 0.10     | 0.18 | 0.25 |
| A2                             | 1.25     | 1.37 | 1.50 |
| b                              | 0.35     | 0.42 | 0.49 |
| c                              | 0.19     | 0.22 | 0.25 |
| D                              | 9.90 BSC |      |      |
| E                              | 6.00 BSC |      |      |
| E1                             | 3.90 BSC |      |      |
| e                              | 1.27 BSC |      |      |
| h                              | 0.25     | ---  | 0.50 |
| L                              | 0.40     | 0.83 | 1.25 |
| L1                             | 1.05 REF |      |      |
| θ                              | 0°       | ---  | 7°   |
| TOLERANCE OF FORM AND POSITION |          |      |      |
| aaa                            | 0.10     |      |      |
| bbb                            | 0.20     |      |      |
| ccc                            | 0.10     |      |      |
| ddd                            | 0.25     |      |      |
| eee                            | 0.10     |      |      |



\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE onsemi SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D

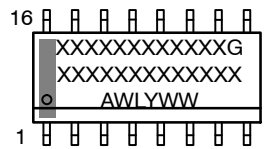
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SOIC-16 9.90x3.90x1.37 1.27P  
CASE 751B  
ISSUE M

DATE 18 OCT 2024

GENERIC  
MARKING DIAGRAM\*



XXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STYLE 1:<br>PIN 1. COLLECTOR<br>2. BASE<br>3. EMITTER<br>4. NO CONNECTION<br>5. EMITTER<br>6. BASE<br>7. COLLECTOR<br>8. COLLECTOR<br>9. BASE<br>10. EMITTER<br>11. NO CONNECTION<br>12. EMITTER<br>13. BASE<br>14. COLLECTOR<br>15. EMITTER<br>16. COLLECTOR                           | STYLE 2:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION<br>4. CATHODE<br>5. CATHODE<br>6. NO CONNECTION<br>7. ANODE<br>8. CATHODE<br>9. CATHODE<br>10. ANODE<br>11. NO CONNECTION<br>12. CATHODE<br>13. CATHODE<br>14. NO CONNECTION<br>15. ANODE<br>16. CATHODE | STYLE 3:<br>PIN 1. COLLECTOR, DYE #1<br>2. BASE, #1<br>3. EMITTER, #1<br>4. COLLECTOR, #1<br>5. COLLECTOR, #2<br>6. BASE, #2<br>7. EMITTER, #2<br>8. COLLECTOR, #2<br>9. COLLECTOR, #3<br>10. BASE, #3<br>11. EMITTER, #3<br>12. COLLECTOR, #3<br>13. COLLECTOR, #4<br>14. BASE, #4<br>15. EMITTER, #4<br>16. COLLECTOR, #4                                                                                         | STYLE 4:<br>PIN 1. COLLECTOR, DYE #1<br>2. COLLECTOR, #1<br>3. COLLECTOR, #2<br>4. COLLECTOR, #2<br>5. COLLECTOR, #3<br>6. COLLECTOR, #3<br>7. COLLECTOR, #4<br>8. COLLECTOR, #4<br>9. BASE, #4<br>10. EMITTER, #4<br>11. BASE, #3<br>12. EMITTER, #3<br>13. BASE, #2<br>14. EMITTER, #2<br>15. BASE, #1<br>16. EMITTER, #1 |
| STYLE 5:<br>PIN 1. DRAIN, DYE #1<br>2. DRAIN, #1<br>3. DRAIN, #2<br>4. DRAIN, #2<br>5. DRAIN, #3<br>6. DRAIN, #3<br>7. DRAIN, #4<br>8. DRAIN, #4<br>9. GATE, #4<br>10. SOURCE, #4<br>11. GATE, #3<br>12. SOURCE, #3<br>13. GATE, #2<br>14. SOURCE, #2<br>15. GATE, #1<br>16. SOURCE, #1 | STYLE 6:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE<br>4. CATHODE<br>5. CATHODE<br>6. CATHODE<br>7. CATHODE<br>8. CATHODE<br>9. ANODE<br>10. ANODE<br>11. ANODE<br>12. ANODE<br>13. ANODE<br>14. ANODE<br>15. ANODE<br>16. ANODE                                 | STYLE 7:<br>PIN 1. SOURCE N-CH<br>2. COMMON DRAIN (OUTPUT)<br>3. COMMON DRAIN (OUTPUT)<br>4. GATE P-CH<br>5. COMMON DRAIN (OUTPUT)<br>6. COMMON DRAIN (OUTPUT)<br>7. COMMON DRAIN (OUTPUT)<br>8. SOURCE P-CH<br>9. SOURCE P-CH<br>10. COMMON DRAIN (OUTPUT)<br>11. COMMON DRAIN (OUTPUT)<br>12. COMMON DRAIN (OUTPUT)<br>13. GATE N-CH<br>14. COMMON DRAIN (OUTPUT)<br>15. COMMON DRAIN (OUTPUT)<br>16. SOURCE N-CH |                                                                                                                                                                                                                                                                                                                             |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |                                                                                                                                                                                     |
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