

ULN2003A, ULQ2003A

High Voltage, High Current Darlington Transistor Arrays

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

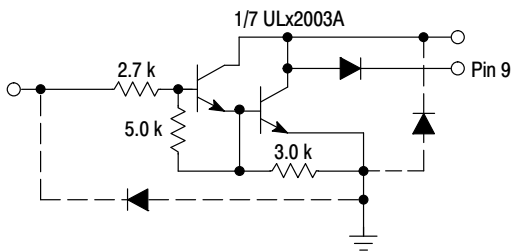


Figure 1. Representative Schematic Diagram

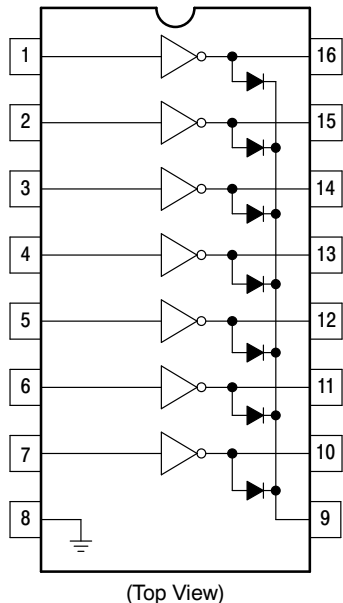


Figure 2. Pin Connections

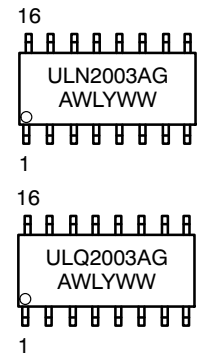


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MARKING DIAGRAMS



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

ORDERING INFORMATION

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

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MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, 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 ULN2003A ULQ2003A | T_A | -20 to +85 -40 to +85 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | -55 to +150 | $^\circ\text{C}$ |
| Junction Temperature | T_J | 150 | $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient Case 751B, D Suffix | $R_{\theta JA}$ | 100 | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Case Case 751B, D Suffix | $R_{\theta JC}$ | 20 | $^\circ\text{C}/\text{W}$ |
| Electrostatic Discharge Sensitivity (ESD) Human Body Model (HBM) Machine Model (MM) Charged Device Model (CDM) | ESD | 2000 400 1500 | V |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ULN2003A, ULQ2003A

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|---------------|-------------|---------------------|-------------------|---------------|
| Output Leakage Current ($V_O = 50\text{ V}$, $T_A = +85^\circ\text{C}$) ($V_O = 50\text{ V}$, $T_A = +25^\circ\text{C}$) | I_{CEX} | - - | - - | 100 50 | μA |
| Collector-Emitter Saturation Voltage ($I_C = 350\text{ mA}$, $I_B = 500\text{ }\mu\text{A}$) ($I_C = 200\text{ mA}$, $I_B = 350\text{ }\mu\text{A}$) ($I_C = 100\text{ mA}$, $I_B = 250\text{ }\mu\text{A}$) | $V_{CE(sat)}$ | - - - | 1.1 0.95 0.85 | 1.6 1.3 1.1 | V |
| Input Current - On Condition ($V_I = 3.85\text{ V}$) | $I_{I(on)}$ | - | 0.93 | 1.35 | mA |
| Input Voltage - On Condition ($V_{CE} = 2.0\text{ V}$, $I_C = 200\text{ mA}$) ($V_{CE} = 2.0\text{ V}$, $I_C = 250\text{ mA}$) ($V_{CE} = 2.0\text{ V}$, $I_C = 300\text{ mA}$) | $V_{I(on)}$ | - - - | - - - | 2.4 2.7 3.0 | V |
| Input Current - Off Condition ($I_C = 500\text{ }\mu\text{A}$, $T_A = 85^\circ\text{C}$) | $I_{I(off)}$ | 50 | 100 | - | μA |
| DC Current Gain ($V_{CE} = 2.0\text{ V}$, $I_C = 350\text{ mA}$) | h_{FE} | 1000 | - | - | - |
| Input Capacitance | C_I | - | 15 | 30 | pF |
| Turn-On Delay Time (50% E_I to 50% E_O) | t_{on} | - | 0.25 | 1.0 | μs |
| Turn-Off Delay Time (50% E_I to 50% E_O) | t_{off} | - | 0.25 | 1.0 | μs |
| Clamp Diode Leakage Current ($V_R = 50\text{ V}$) | I_R | - - | - - | 50 100 | μA |
| Clamp Diode Forward Voltage ($I_F = 350\text{ mA}$) | V_F | - | 1.5 | 2.0 | V |

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TYPICAL PERFORMANCE CURVES - $T_A = 25^\circ\text{C}$



Figure 3. Output Current versus Input Voltage

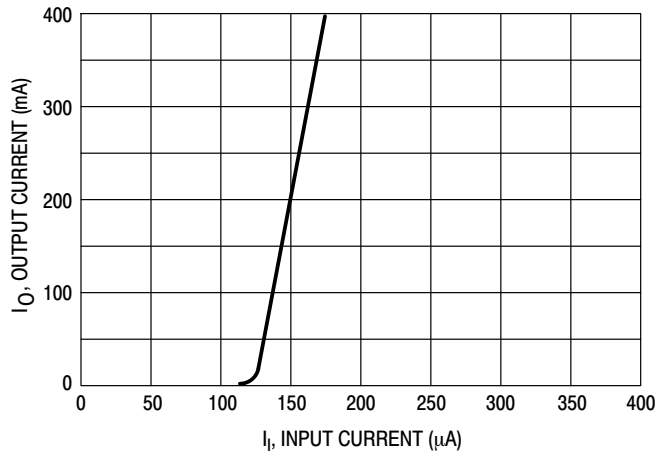


Figure 4. Output Current versus Input Current

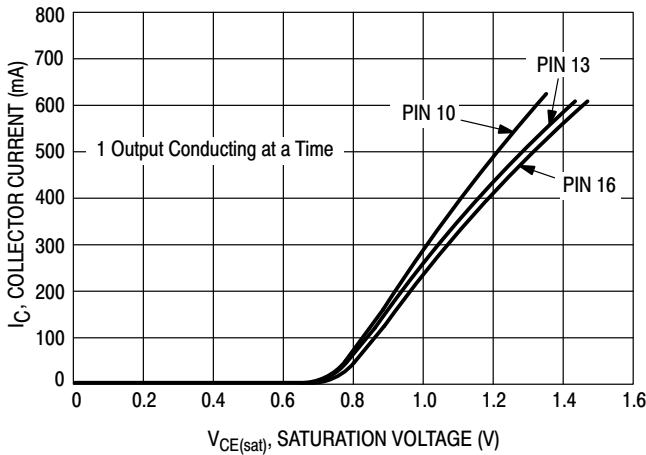


Figure 5. Typical Output Characteristics

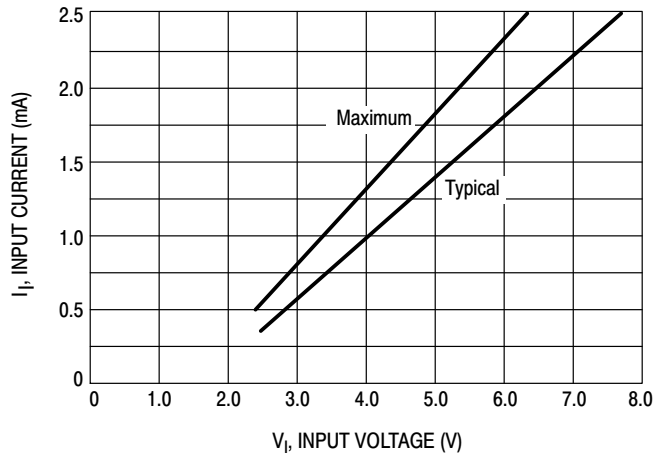


Figure 6. Input Characteristics



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

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

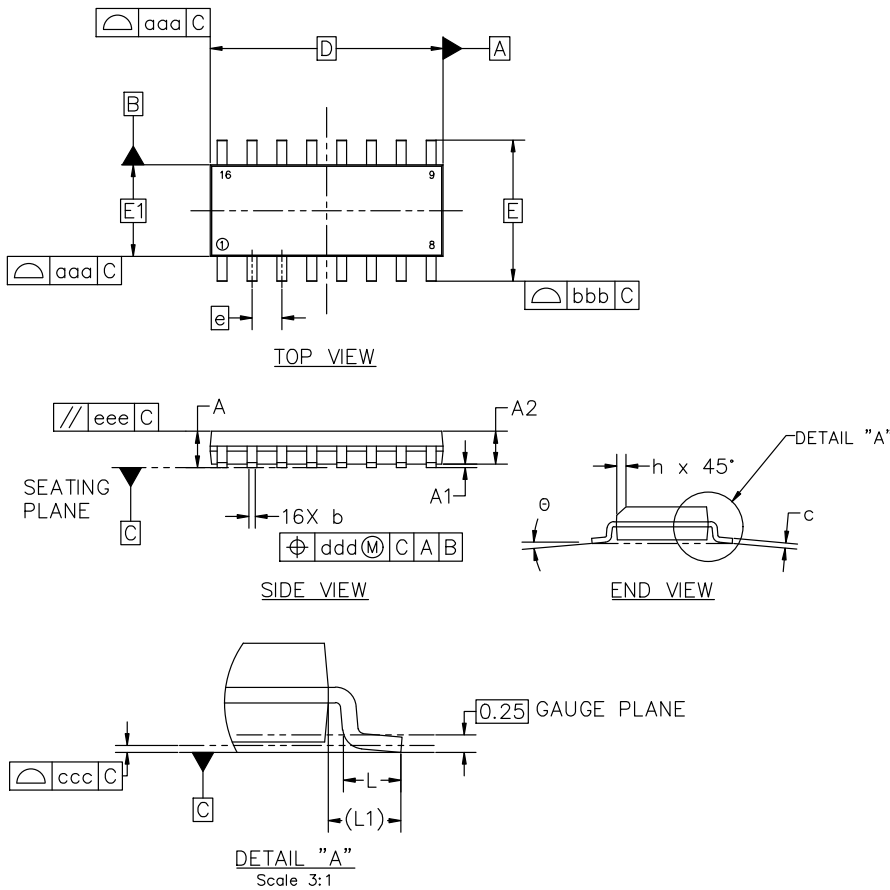


SOIC-16 9.90x3.90x1.50 1.27P
CASE 751B
ISSUE L

DATE 29 MAY 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 | 0.00 | 0.05 | 0.10 |
| A2 | 1.35 | 1.50 | 1.65 |
| 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 | | |



RECOMMENDED MOUNTING FOOTPRINT

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

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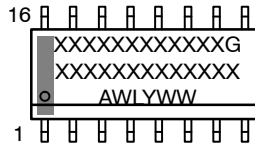
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS



SOIC-16 9.90x3.90x1.50 1.27P
CASE 751B
ISSUE L

DATE 29 MAY 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.

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

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