

DESCRIPTION

The ULN2003 is high-voltage, high-current darlington driver IC composed of 7 NPN darlington pairs. All units share the emitter in common, and each unit adopts open-collector output. A 2.7KΩ resistor is connected to each darlington pair in serial, which is compatible with TTL and 5V CMOS for data processing without logic buffer.

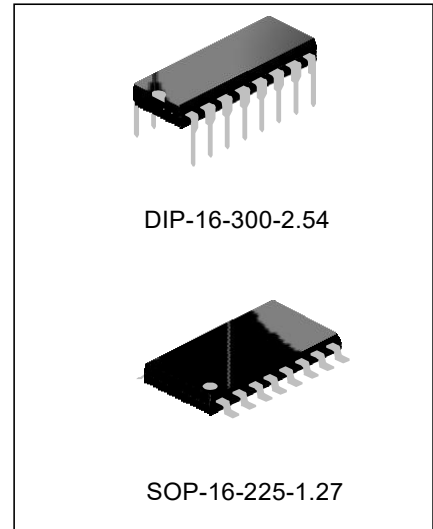
Sink current of ULN2003 is up to 500mA, when it is off state, the withstand voltage is 50V and the output can runs with high load current, which provides solutions for various interface.

FEATURES

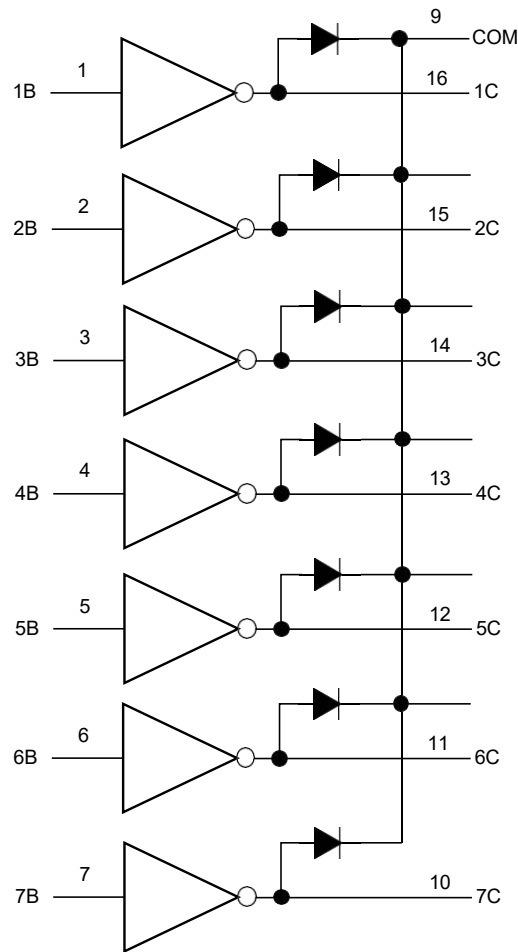
- ◆ Wide operating voltage range
- ◆ 7-ch darlington array
- ◆ High output voltage (up to 50V)
- ◆ High output current (up to 500mA)
- ◆ Able to connect to TTL, CMOS, PMOS directly
- ◆ Clamp diodes for switching inductive loads

APPLICATIONS

- ◆ Relay driver
- ◆ DC lamp driver
- ◆ Step motor driver
- ◆ Magnet valve
- ◆ DC brushless motor driver



BOLBK DIAGRAM



DARLINGTON ARRAY DRIVER IC

ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Ratings | Units |
|--------------------------------|-----------|---------|-------|
| Input Voltage | V_{IN} | -0.5~30 | V |
| Output Voltage | V_{OUT} | -0.5~50 | V |
| clamp Diode Reverse Voltage | V_R | 50 | V |
| Output Current | I_{OUT} | 500 | mA |
| Clamp Diode Forward Current | I_F | 25 | mA |
| Storage Temperature | T_{STG} | -55~150 | °C |
| Operating Temperature | T_{OPR} | -40~85 | °C |
| Operating Junction Temperature | T_J | -40~150 | °C |

ELECTRICAL CHARACTERISTICS (Ta = 25°C unless otherwise noted)

| Parameter | Symbol | Test conditions | Min. | Typ. | Max. | Units |
|-----------------------------|---------------|--|------|------|-----------|-------|
| Output Leakage Current | I_{CEX} | $T_A=25^{\circ}C, V_{CE}=50V$ (Figure 1) | | | 20 | uA |
| | | $T_A=85^{\circ}C, V_{CE}=50V$ (Figure 1) | | | 100 | |
| CE Saturation Voltage | $V_{CE(sat)}$ | $I_{OUT}=350mA, I_{IN}=500\text{ uA}$ (Figure 3) | | 1.3 | 1.6 | V |
| | | $I_{OUT}=250mA, I_{IN}=350\text{ uA}$ (Figure 3) | | 1.1 | 1.3 | |
| | | $I_{OUT}=100mA, I_{IN}=250\text{ uA}$ (Figure 3) | | 0.9 | 1.1 | |
| Input Current (Output On) | $I_{I(ON)}$ | $V_I=3.85V$ (Figure 4) | | 0.93 | 1.35 | mA |
| Input Current (Output Off) | $I_{I(OFF)}$ | $I_C=500\text{uA}$ (Figure 5) | 50 | 100 | | uA |
| | | $T_A=+25^{\circ}C$ | 50 | 100 | | |
| | | $T_A=+85^{\circ}C$ | 25 | 50 | | |
| Input Voltage (Output On) | $V_{I(ON)}$ | $V_{CE}=2.0V, I_C=200mA$ (Figure 6) | | | 2.4 | V |
| | | $V_{CE}=2.0V, I_C=250mA$ (Figure 6) | | | 2.7 | |
| | | $V_{CE}=2.0V, I_C=300mA$ (Figure 6) | | | 3.0 | |
| Input Capacitance | C_i | | | 15 | 30 | pF |
| Turn-on Delay | t_{MH} | $0.5V_I$ to $0.5V_O$ | | | 1.0 | μS |
| Turn-off Delay | t_{ML} | $0.5V_I$ to $0.5V_O$ | | | 1.0 | |
| Clamp Diode Reverse Current | I_R | $V_R=50V$ (Figure 7) | | | | μA |
| | | $T_A=+25^{\circ}C$ | | 5 | 10 | |
| | | $T_A=+85^{\circ}C$ | | 10 | 50 | |
| Clamp Diode Forward Voltage | V_F | $I_F=350mA$ (Figure 8) | | 1.7 | 2.0 | V |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied. Electrical Characteristics are for normal operating range;

2. All the conditions are suitable for darlington pairs unless otherwise noted;

3. In general, with 70°C, VCE (Sat)= 1.6V, pulse width=20ms, the continuous operating current of each channel is 350mA.

TYPICAL CHARACTERISTIC CURVES

Figure 1. Collector Current vs. Saturation Voltage Drop

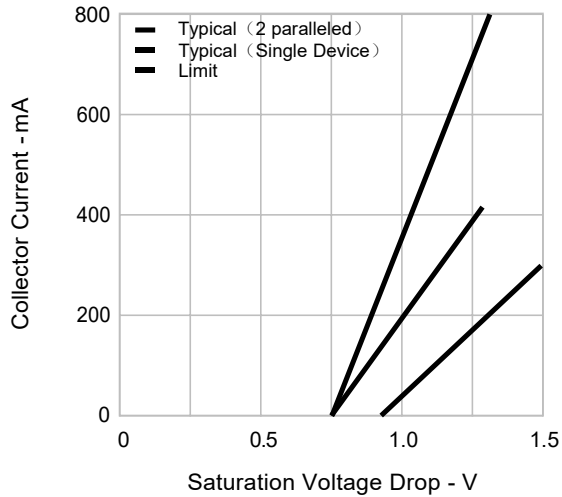


Figure 2. Collector Current vs. Input Current

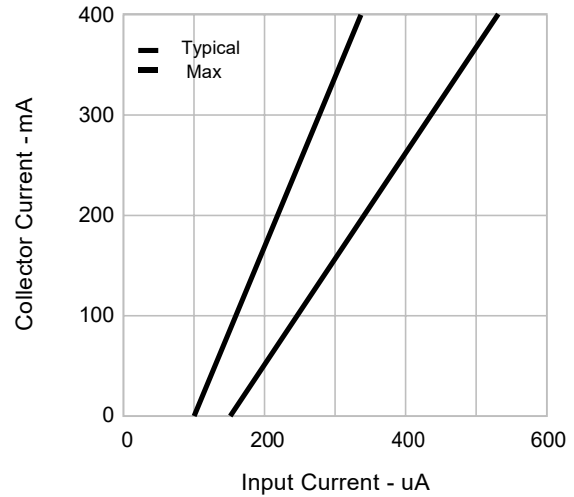


Figure 3. Input Current vs. Input Voltage

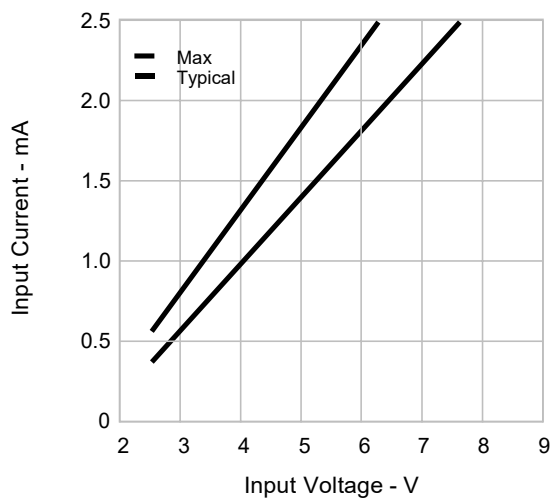
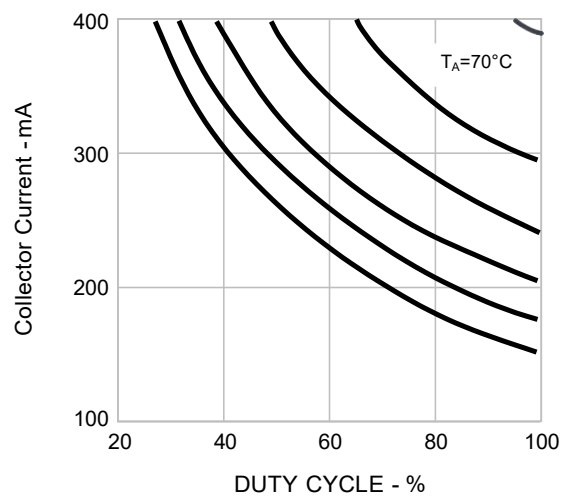
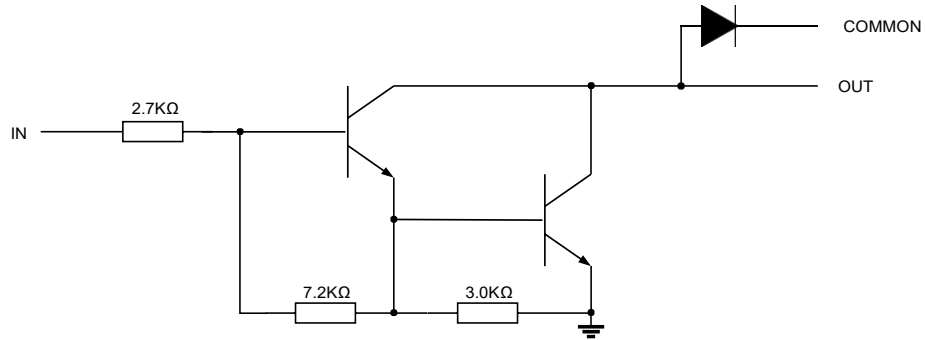


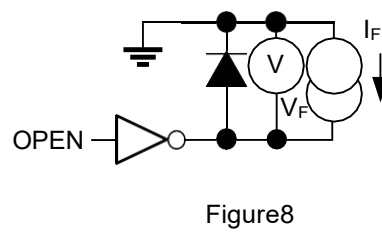
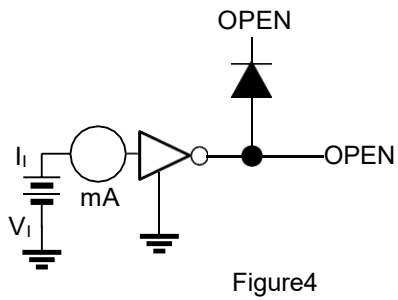
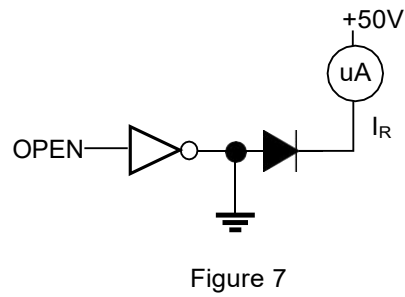
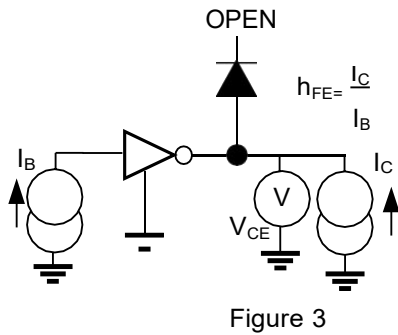
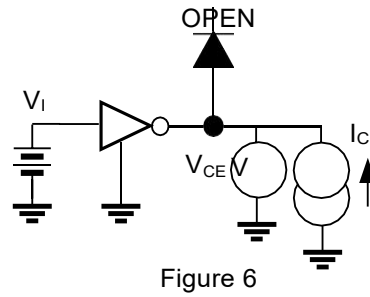
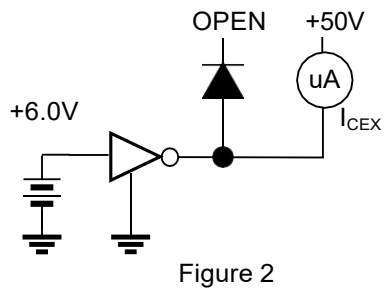
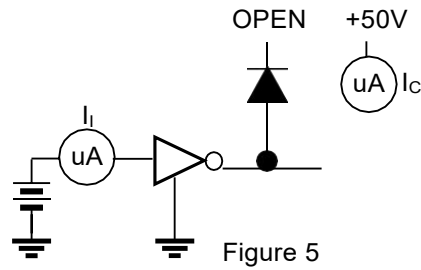
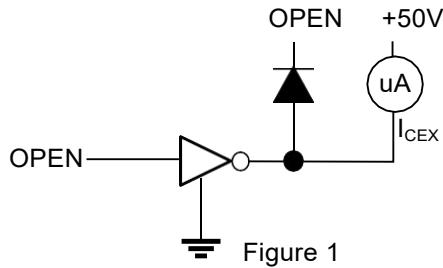
Figure 4. Collector Current vs. Duty Cycle



INTERNAL EQUIVALENT CIRCUIT



TEST CIRCUITS

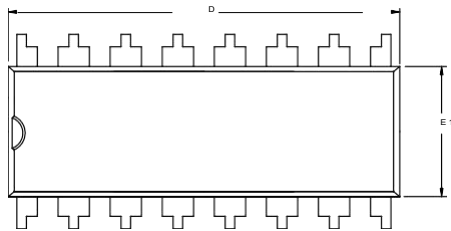
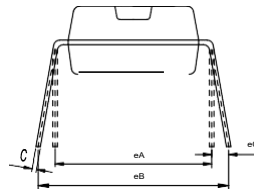
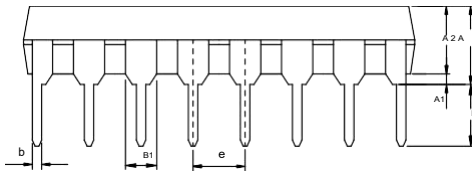


PACKAGE OUTLINE

DARLINGTON ARRAY DRIVER IC

DIP-16-300-2.54

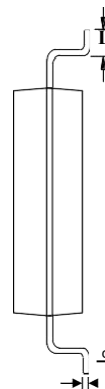
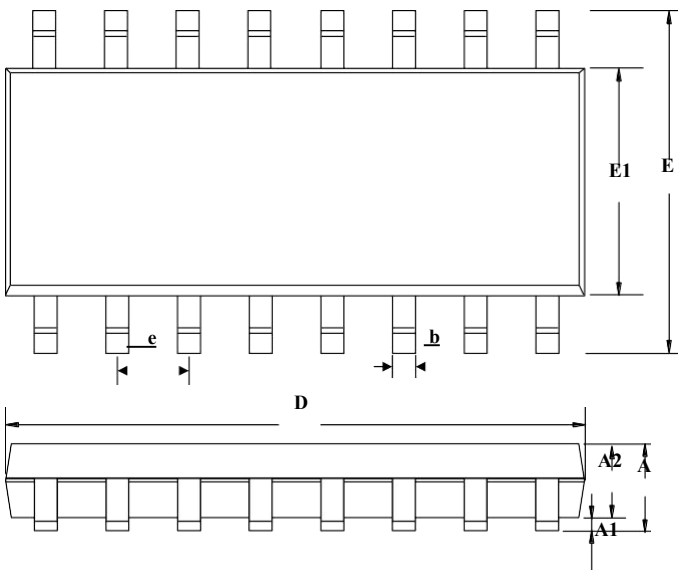
UNIT: mm



| SYMBOL | MILLIMETER | | |
|--------|------------|------|-------|
| | MIN | NOM | MAX |
| A | | | 4.45 |
| A1 | 0.50 | | — |
| A2 | 3.20 | | 3.70 |
| b | 0.38 | 0.46 | 0.54 |
| B1 | 1.52BSC | | |
| c | 0.20 | | 0.35 |
| D | 18.90 | | 19.45 |
| E1 | 6.15 | | 6.60 |
| e | 2.54BSC | | |
| eA | 7.62BSC | | |
| eB | 7.62 | | 9.30 |
| eC | 0 | | 1.52 |
| L | 3.00 | — | — |

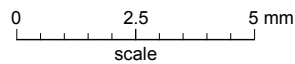
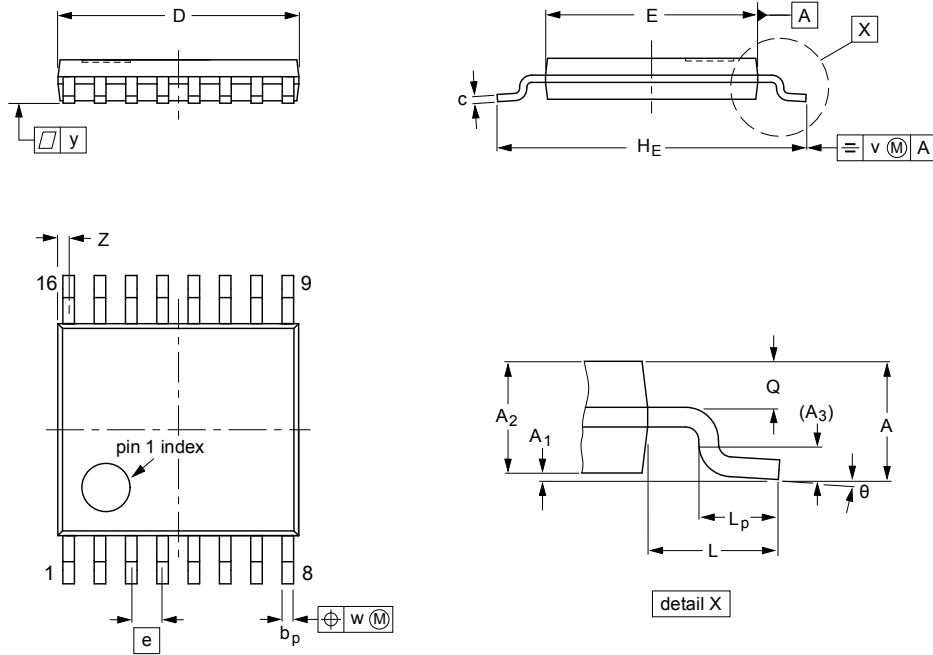
SOP-16-225-1.27

UNIT: mm



| SYMBOL | MILLIMETER | | |
|--------|------------|------|-------|
| | MIN | NOM | MAX |
| A | — | — | 1.80 |
| A1 | 0.10 | 0.15 | 0.25 |
| A2 | 1.25 | 1.45 | 1.65 |
| b | 0.33 | — | 0.51 |
| c | 0.17 | — | 0.25 |
| D | 9.50 | — | 10.20 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.70 | — | 4.10 |
| e | 1.27BSC | | |
| L | 0.45 | 0.60 | 0.80 |

TSSOP-16



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | HE | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.1 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.40 0.06 | 8° 0° |

Ordering information

| Order code | Package | Baseqty | Deliverymode |
|------------------|----------|---------|---------------|
| UMW ULN2003A | SOP-16 | 2500 | Tape and reel |
| UMW ULN2003APWR | TSSOP-16 | 5000 | Tape and reel |
| UMW ULN2003AIPWR | TSSOP-16 | 5000 | Tape and reel |

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