

Features

- Eight Darlington transistors with common emitters
- Output current to 500 mA
- Output voltage to 50 V
- Integral suppression diodes
- Versions for all popular logic families
- Output can be paralleled
- Inputs pinned opposite outputs to simplify board layout

Description

The ULN2801A, ULN2802A, ULN2803A and ULN2804A each contain eight Darlington transistors with common emitters and integral suppression diodes for inductive loads. Each Darlington features a peak load current rating of 600 mA (500 mA continuous) and can withstand at least 50 V in the OFF state. Outputs may be paralleled for higher current capability.

Four versions are available to simplify interfacing to standard logic families: the ULN2801A is designed for general purpose applications with a current limit resistor; the ULN2802A has a 10.5 k Ω input resistor and Zener for 14-25 V PMOS; the ULN2803A has a 2.7 k Ω input resistor for 5 V TTL and CMOS; the ULN2804A has a 10.5 k Ω input resistor for 6-15 V CMOS.

All types are supplied in an 18-lead plastic DIP with a copper lead form and feature the convenient input-opposite-output pinout to simplify board layout.

Table 1. Device summary

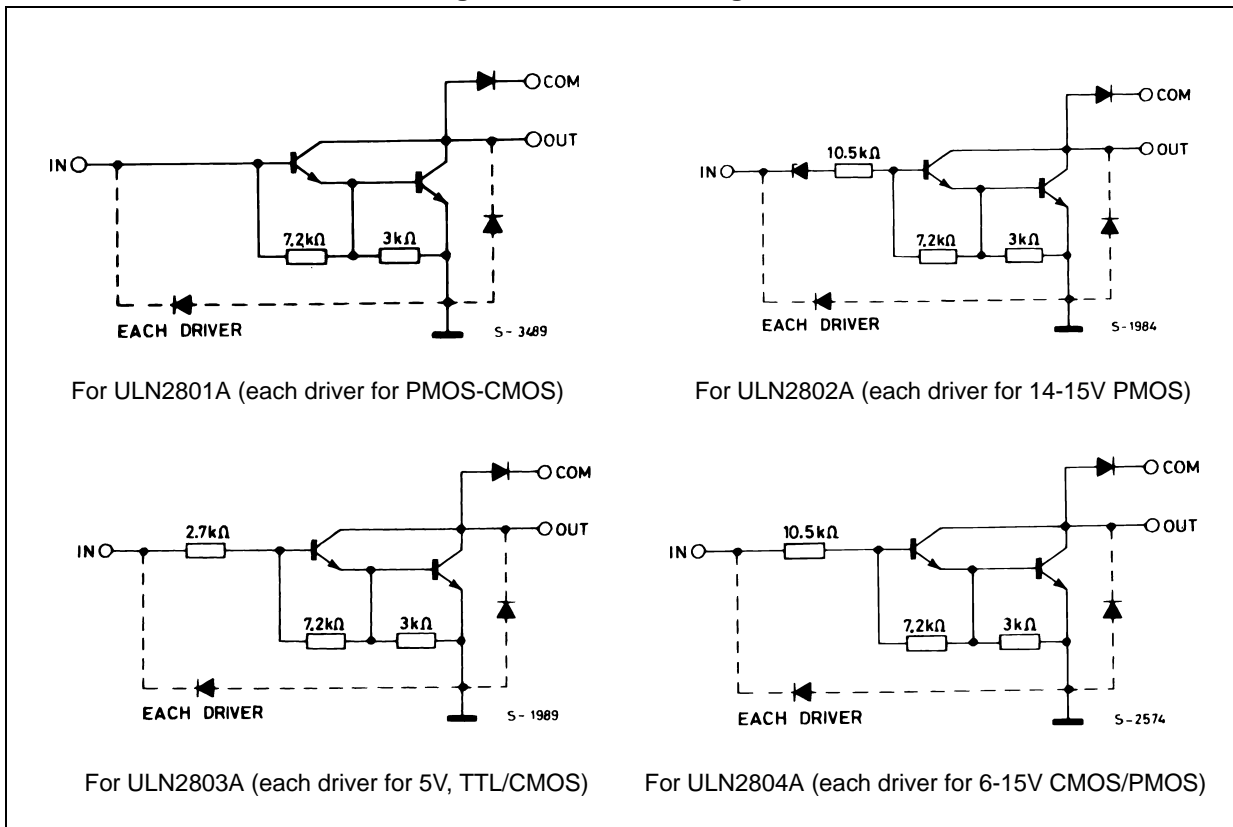
| Order codes | Package |
|-------------|---------|
| ULN2801A | DIP-18 |
| ULN2802A | |
| ULN2803A | |
| ULN2804A | |

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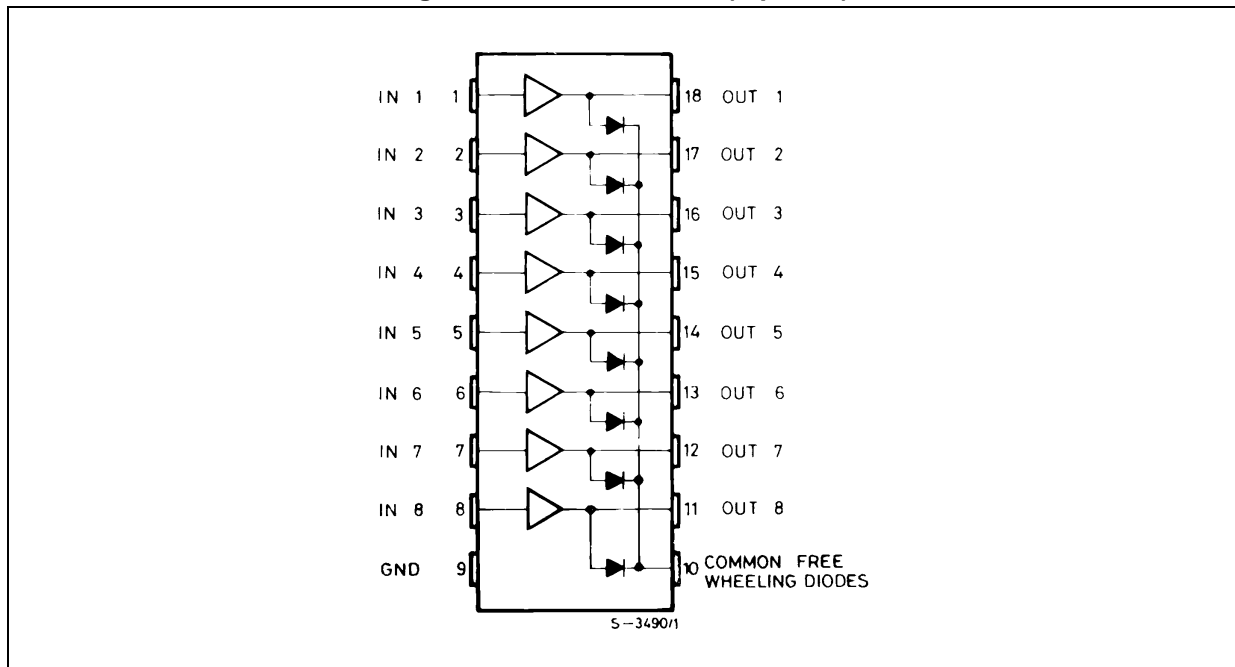
1 Diagram

Figure 1. Schematic diagrams



2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|-----------|--|-------------|------|
| V_O | Output voltage | 50 | V |
| V_I | Input voltage (for ULN2802A - ULN2803A - ULN2804A) | 30 | V |
| I_C | Continuous collector current | 500 | mA |
| I_B | Continuous base current | 25 | mA |
| P_{TOT} | Power Dissipation (one Darlington pair) | 1 | W |
| | Power Dissipation (total package) | 2.25 | |
| T_A | Operating ambient temperature range | - 20 to 85 | °C |
| T_{STG} | Storage temperature range | - 55 to 150 | °C |
| T_J | Junction temperature | -20 to 150 | °C |

Table 3. Thermal data

| Symbol | Parameter | Value | Unit |
|------------|-------------------------------------|-------|------|
| R_{thJA} | Thermal resistance junction-ambient | 55 | °C/W |

4 Electrical characteristics

$T_A = 25\text{ °C}$ unless otherwise specified.

Table 4. Electrical characteristics

| Symbol | Parameter | Test condition | Min. | Typ. | Max. | Unit |
|-----------------------|---|---|------|------|------|---------------|
| I_{CEX} | Output leakage current | $V_{CE} = 50\text{ V}$ | | | | μA |
| | | $T_A = 70\text{ °C}$, $V_{CE} = 50\text{ V}$ (Figure 3) | | | 50 | |
| | | $T_A = 70\text{ °C}$ for ULN2802A, $V_{CE} = 50\text{ V}$, $V_I = 6\text{ V}$ (Figure 4) | | | 100 | |
| | | $T_A = 70\text{ °C}$ for ULN2804A, $V_{CE} = 50\text{ V}$, $V_I = 1\text{ V}$ (Figure 4) | | | 500 | |
| $V_{CE(SAT)}$ | Collector-emitter saturation voltage (Figure 5) | $I_C = 100\text{ mA}$, $I_B = 250\text{ }\mu\text{A}$ | | 0.9 | 1.1 | V |
| | | $I_C = 200\text{ mA}$, $I_B = 350\text{ }\mu\text{A}$ | | 1.1 | 1.3 | |
| | | $I_C = 350\text{ mA}$, $I_B = 500\text{ }\mu\text{A}$ | | 1.3 | 1.6 | |
| $I_{I(ON)}$ | Input current (Figure 6) | for ULN2802A, $V_I = 17\text{ V}$ | | 0.82 | 1.25 | mA |
| | | for ULN2803A, $V_I = 3.85\text{ V}$ | | 0.93 | 1.35 | |
| | | for ULN2804A, $V_I = 5\text{ V}$ | | 0.35 | 0.5 | |
| | | $V_I = 12\text{ V}$ | | 1 | 1.45 | |
| $I_{I(OFF)}$ | Input current (Figure 7) | $T_A = 70\text{ °C}$, $I_C = 500\text{ }\mu\text{A}$ | 50 | 65 | | μA |
| $V_{I(ON)}$ | Input voltage (Figure 8) | $V_{CE} = 2\text{ V}$, for ULN2802A | | | 13 | V |
| | | $I_C = 300\text{ mA}$ | | | 2.4 | |
| | | for ULN2803A | | | 2.7 | |
| | | $I_C = 200\text{ mA}$ | | | 3 | |
| | | $I_C = 250\text{ mA}$ | | | 5 | |
| | | for ULN2804A | | | 6 | |
| | | $I_C = 125\text{ mA}$ | | | 7 | |
| | | $I_C = 200\text{ mA}$ | | | 8 | |
| $I_C = 275\text{ mA}$ | | | | | | |
| $I_C = 350\text{ mA}$ | | | | | | |
| h_{FE} | DC Forward current gain (Figure 5) | for ULN2801A, $V_{CE} = 2\text{ V}$, $I_C = 350\text{ mA}$ | 1000 | | | |
| C_I | Input capacitance | | | 15 | 25 | pF |
| t_{PLH} | Turn-on delay time | $0.5 V_I$ to $0.5V_O$ | | 0.25 | 1 | μs |
| t_{PHL} | Turn-off delay time | $0.5 V_I$ to $0.5V_O$ | | 0.25 | 1 | μs |
| I_R | Clamp diode leakage current (Figure 9) | $V_R = 50\text{ V}$ | | | 50 | μA |
| | | $T_A = 70\text{ °C}$, $V_R = 50\text{ V}$ | | | 100 | |
| V_F | Clamp diode forward voltage (Figure 10) | $I_F = 350\text{ mA}$ | | 1.7 | 2 | V |

5 Test circuits

Figure 3. Output leakage current

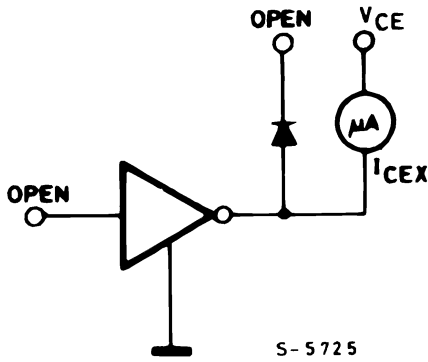


Figure 4. Output leakage current (for ULN2802A only)

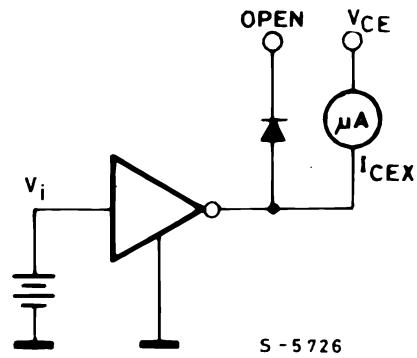


Figure 5. Collector-emitter saturation voltage

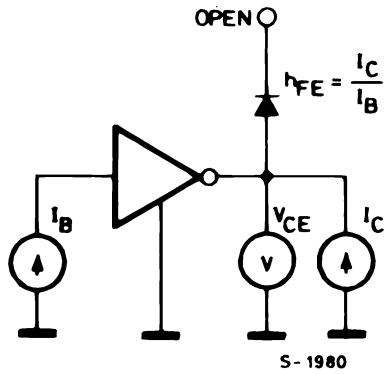


Figure 6. Input current (ON)

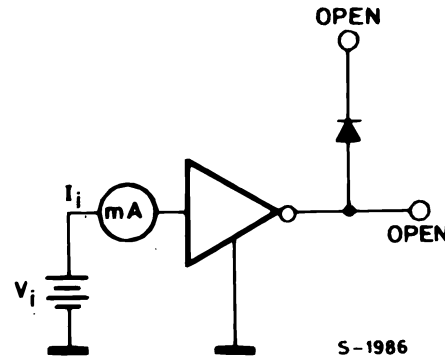


Figure 7. Input current (OFF)

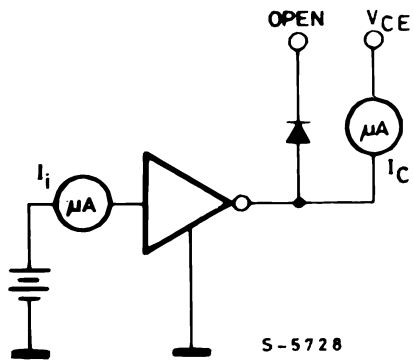
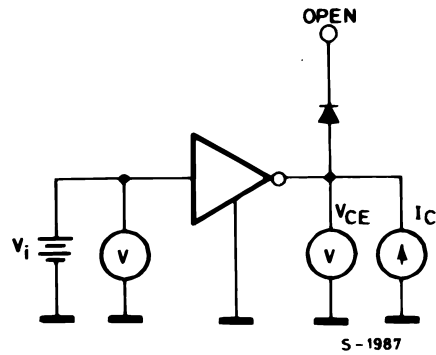
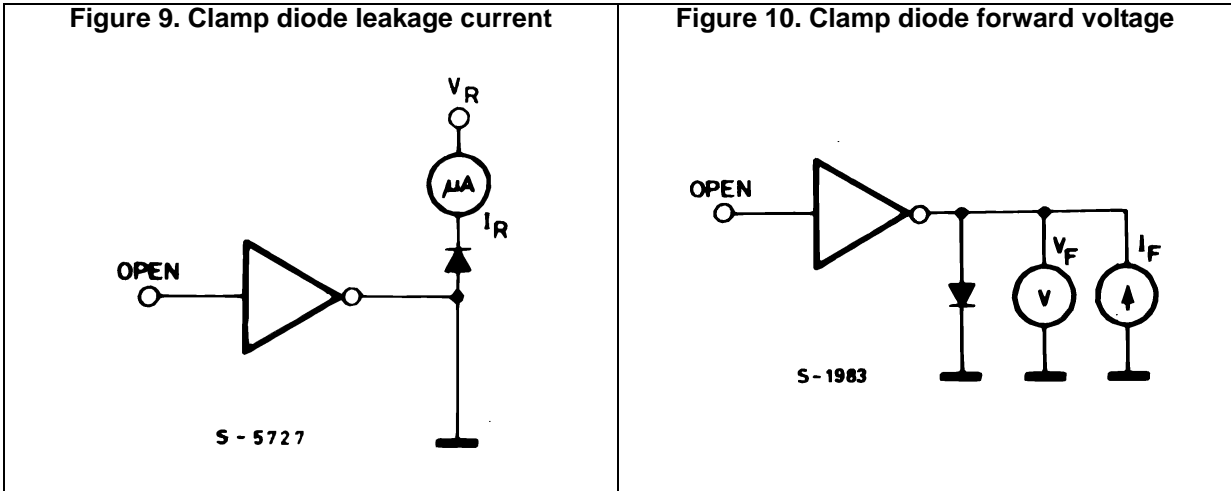


Figure 8. Input voltage





6 Typical performance characteristics

Figure 11. Collector current as a function of saturation voltage

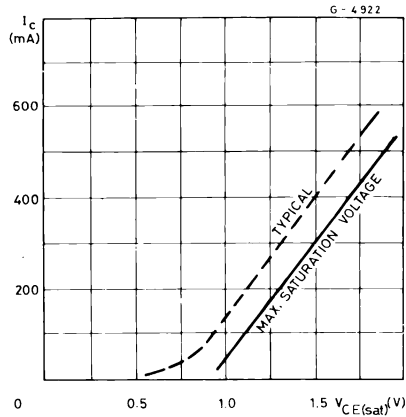


Figure 12. Collector current as a function of input current

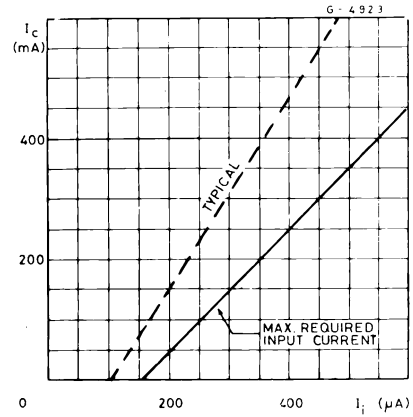


Figure 13. Allowable average power dissipation as a function of T_A

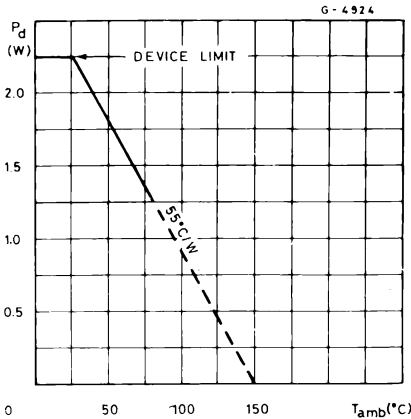


Figure 14. Peak collector current as a function of duty cycle

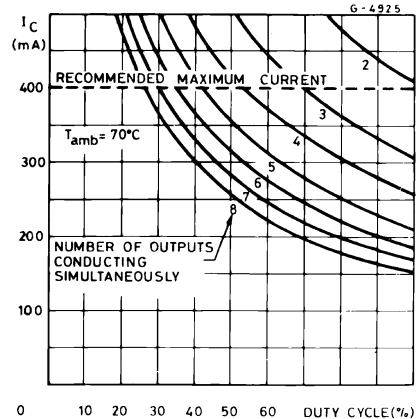


Figure 15. Peak collector current as a function of duty cycle

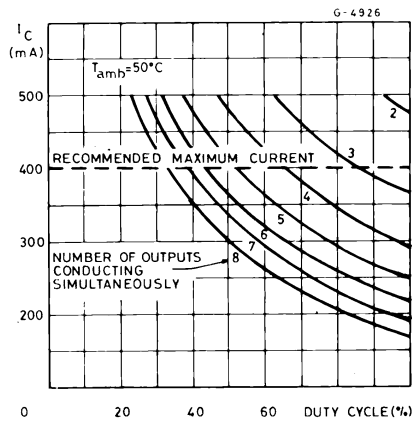


Figure 16. Input current as a function of input voltage (for ULN2802A)

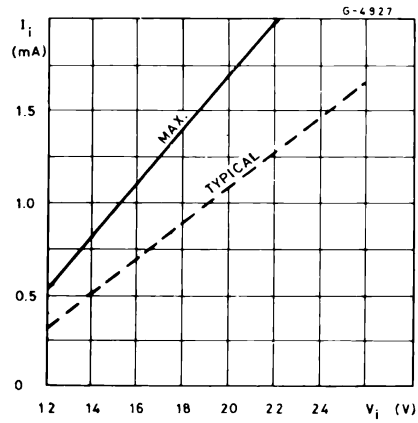


Figure 17. Input current as a function of input voltage (for ULN2804A)

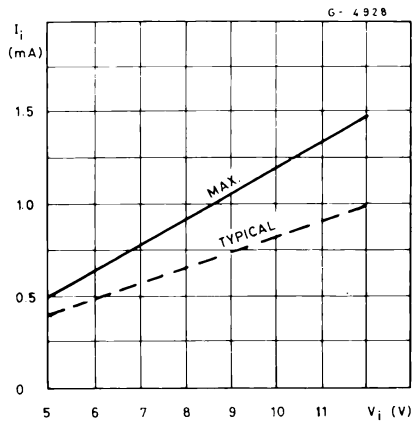
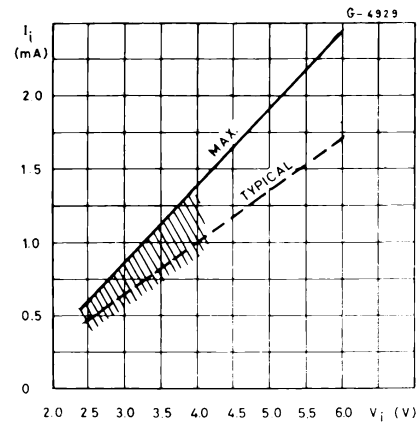


Figure 18. Input current as a function of input voltage (for ULN2803A)



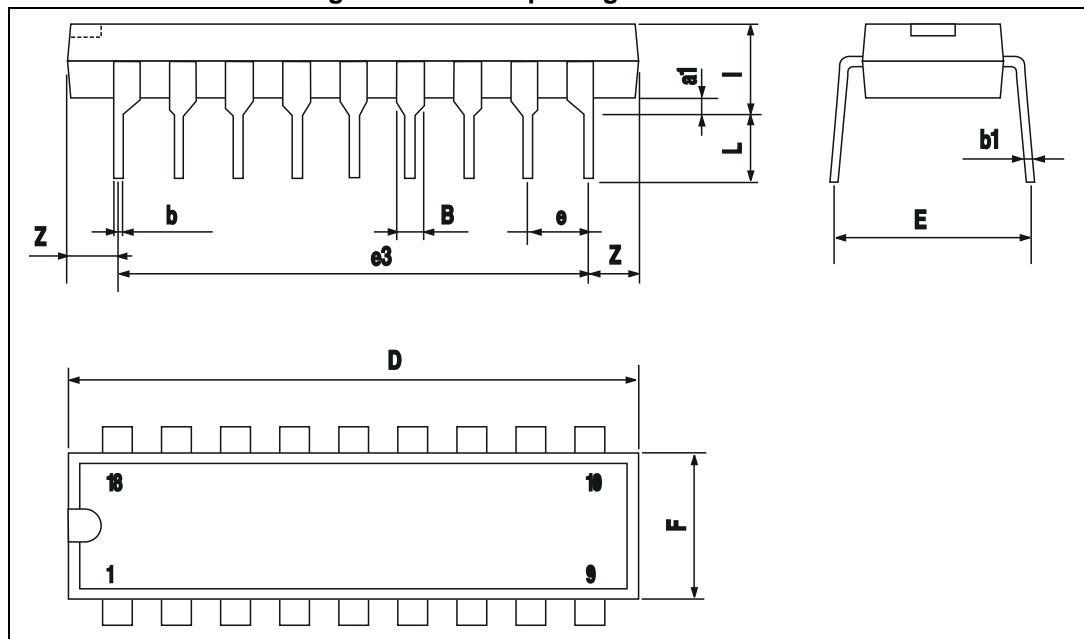
7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK[®] is an ST trademark.

Table 5. DIP-18 mechanical data

| Dim. | mm. | | |
|------|-------|-------|-------|
| | Min. | Typ. | Max. |
| a1 | 0.254 | | |
| B | 1.39 | | 1.65 |
| b | | 0.46 | |
| b1 | | 0.25 | |
| D | | | 23.24 |
| E | | 8.5 | |
| e | | 2.54 | |
| e3 | | 20.32 | |
| F | | | 7.1 |
| I | | | 3.93 |
| L | | 3.3 | |
| Z | | 1.27 | 1.59 |

Figure 19. DIP-18 package dimensions



8 Revision history

Table 6. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 18-Sep-2003 | 1 | First release |
| 10-Mar-2010 | 2 | Updated package mechanical data |
| 19-Nov-2012 | 3 | Modified input voltage values Table 4 on page 6. |
| 27-Jun-2018 | 4 | Updated: $I_{I(ON)}$ test condition in Table 4: Electrical characteristics . |

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