

DIP-18

### 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 $\Omega$  input resistor and Zener for 14-25 V PMOS; the ULN2803A has a 2.7 k $\Omega$  input resistor for 5 V TTL and CMOS; the ULN2804A has a 10.5 k $\Omega$  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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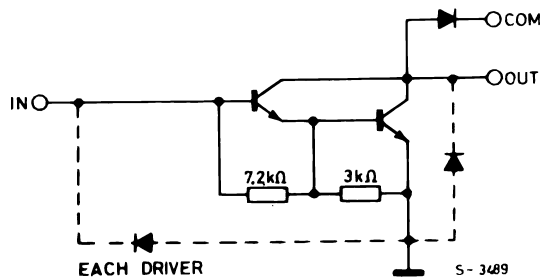
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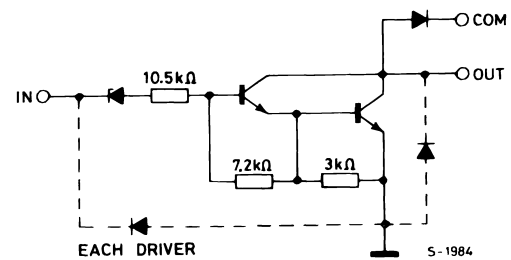


# 1 Diagram

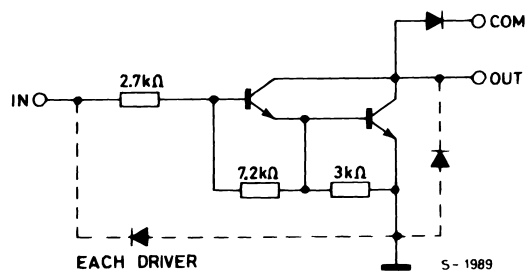
Figure 1. Schematic diagrams



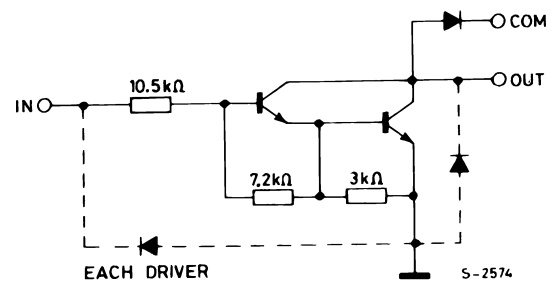
For ULN2801A (each driver for PMOS-CMOS)



For ULN2802A (each driver for 14-15V PMOS)



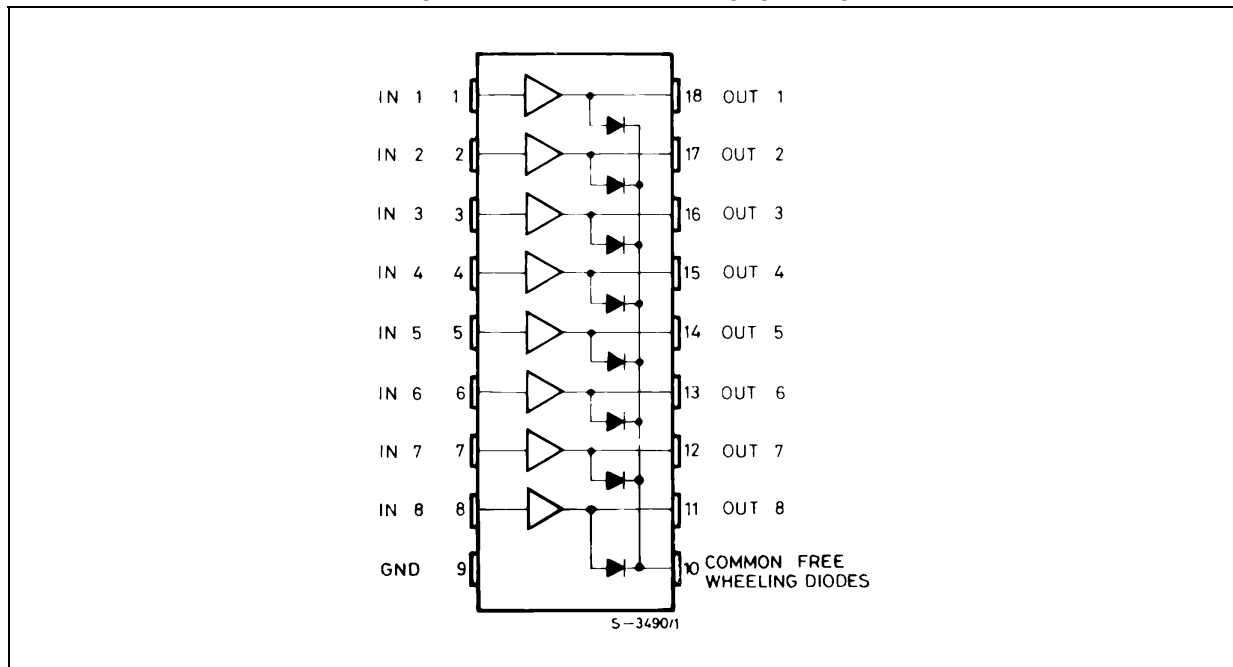
For ULN2803A (each driver for 5V, TTL/CMOS)



For ULN2804A (each driver for 6-15V CMOS/PMOS)

## 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

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

**Table 4. Electrical characteristics**

| Symbol        | Parameter                                       | Test condition                                                                                                                                                                                                                                                               | Min. | Typ. | Max.                                      | Unit          |
|---------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|-------------------------------------------|---------------|
| $I_{CEX}$     | Output leakage current                          | $V_{CE} = 50\text{ V}$                                                                                                                                                                                                                                                       |      |      |                                           | $\mu\text{A}$ |
|               |                                                 | $T_A = 70\text{ }^{\circ}\text{C}$ , $V_{CE} = 50\text{ V}$ (Figure 3)                                                                                                                                                                                                       |      |      | 50                                        |               |
|               |                                                 | $T_A = 70\text{ }^{\circ}\text{C}$ for ULN2802A, $V_{CE} = 50\text{ V}$ , $V_I = 6\text{ V}$ (Figure 4)                                                                                                                                                                      |      |      | 100                                       |               |
|               |                                                 | $T_A = 70\text{ }^{\circ}\text{C}$ 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)                        | $T_A = 70\text{ }^{\circ}\text{C}$ , $I_C = 500\text{ }\mu\text{A}$                                                                                                                                                                                                          | 50   | 65   |                                           | $\mu\text{A}$ |
| $V_{I(ON)}$   | Input voltage (Figure 8)                        | $V_{CE} = 2\text{ V}$ , for ULN2802A<br>$I_C = 300\text{ mA}$<br>for ULN2803A<br>$I_C = 200\text{ mA}$<br>$I_C = 250\text{ mA}$<br>$I_C = 300\text{ mA}$<br>for ULN2804A<br>$I_C = 125\text{ mA}$<br>$I_C = 200\text{ mA}$<br>$I_C = 275\text{ mA}$<br>$I_C = 350\text{ mA}$ |      |      | 13<br>2.4<br>2.7<br>3<br>5<br>6<br>7<br>8 | V             |
| $h_{FE}$      | DC Forward current gain (Figure 5)              | for ULN2801A, $V_{CE} = 2\text{ V}$ ,<br>$I_C = 350\text{ mA}$                                                                                                                                                                                                               | 1000 |      |                                           |               |
| $C_I$         | Input capacitance                               |                                                                                                                                                                                                                                                                              |      | 15   | 25                                        | pF            |
| $t_{PLH}$     | Turn-on delay time                              | $0.5\text{ V}_I$ to $0.5\text{ V}_O$                                                                                                                                                                                                                                         |      | 0.25 | 1                                         | $\mu\text{s}$ |
| $t_{PHL}$     | Turn-off delay time                             | $0.5\text{ V}_I$ to $0.5\text{ V}_O$                                                                                                                                                                                                                                         |      | 0.25 | 1                                         | $\mu\text{s}$ |
| $I_R$         | Clamp diode leakage current (Figure 9)          | $V_R = 50\text{ V}$                                                                                                                                                                                                                                                          |      |      | 50                                        | $\mu\text{A}$ |
|               |                                                 | $T_A = 70\text{ }^{\circ}\text{C}$ , $V_R = 50\text{ V}$                                                                                                                                                                                                                     |      |      | 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

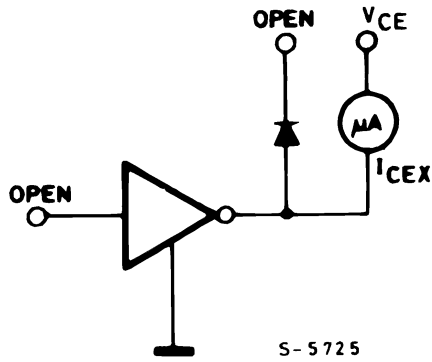


Figure 4. Output leakage current (for ULN2802A only)

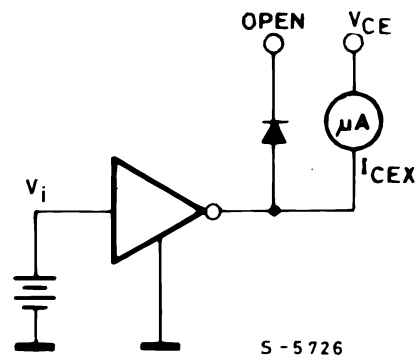


Figure 5. Collector-emitter saturation voltage

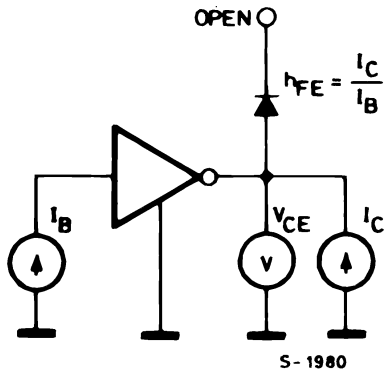


Figure 6. Input current (ON)

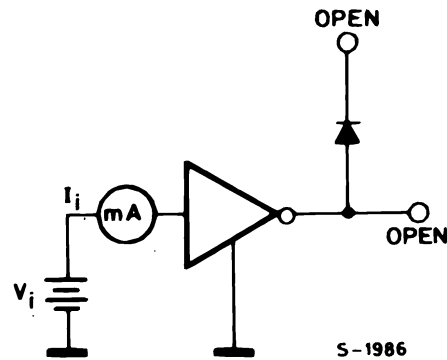


Figure 7. Input current (OFF)

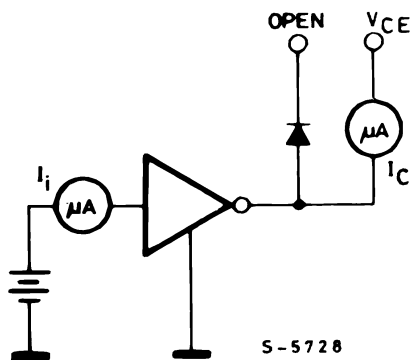


Figure 8. Input voltage

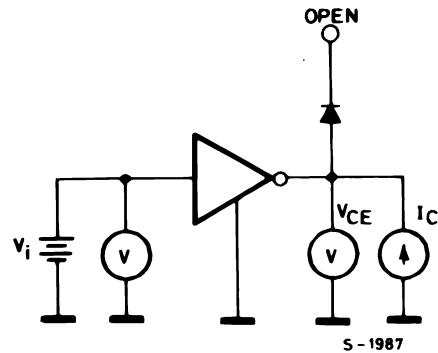


Figure 9. Clamp diode leakage current

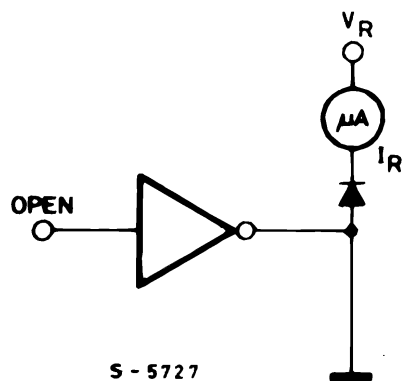
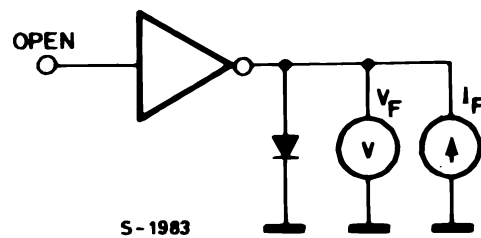
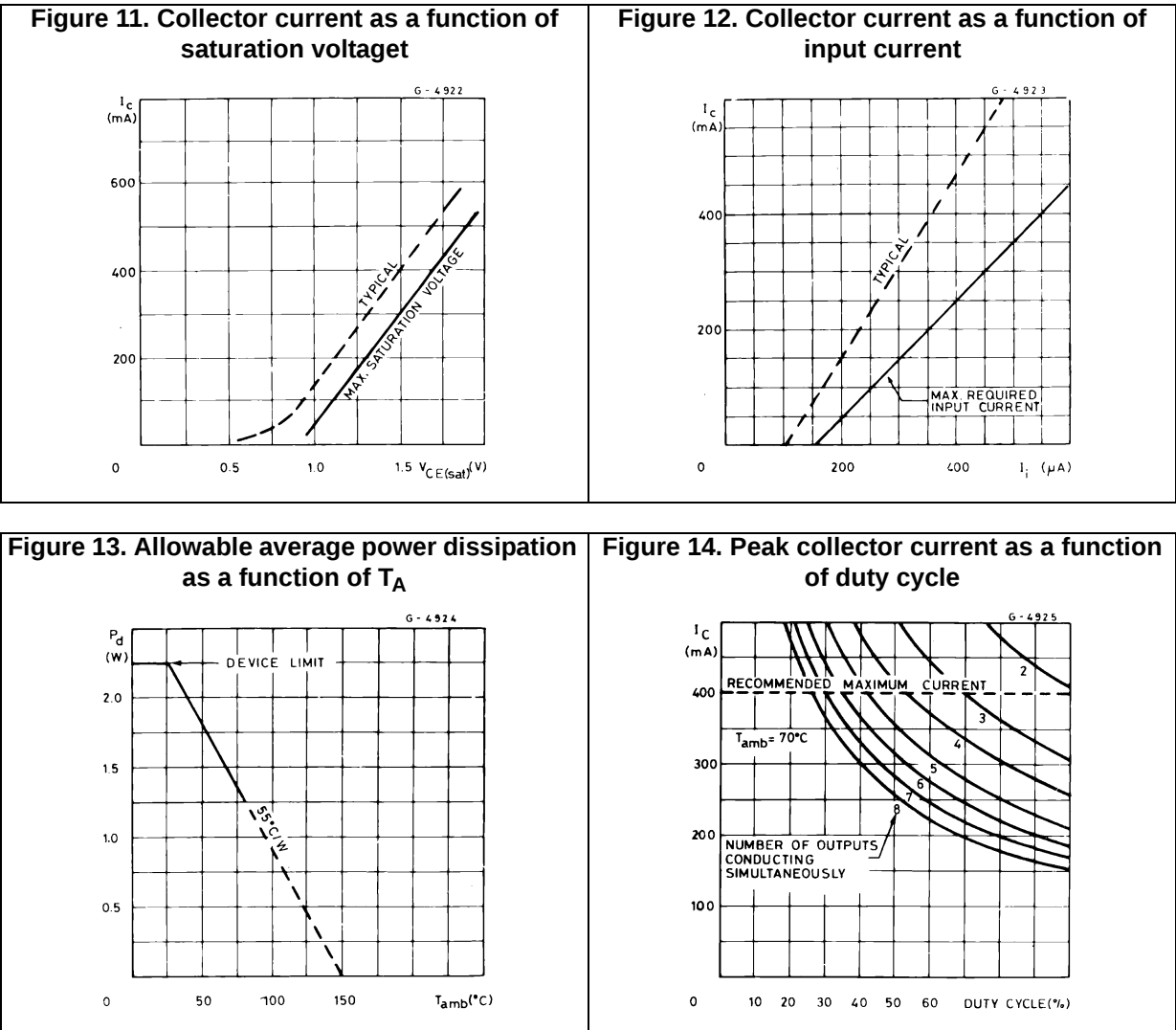
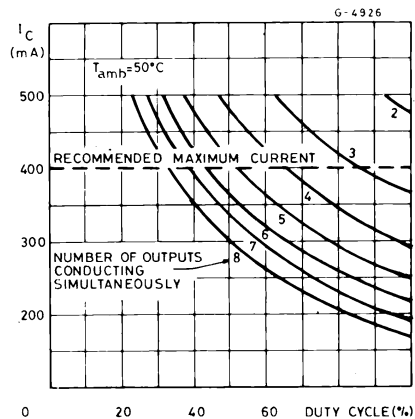
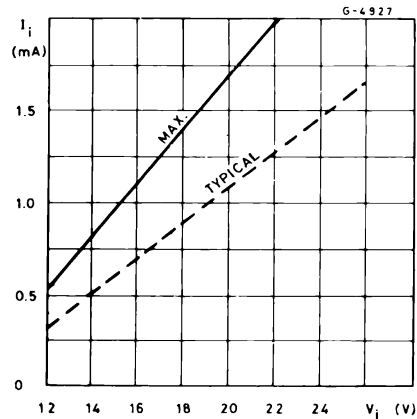
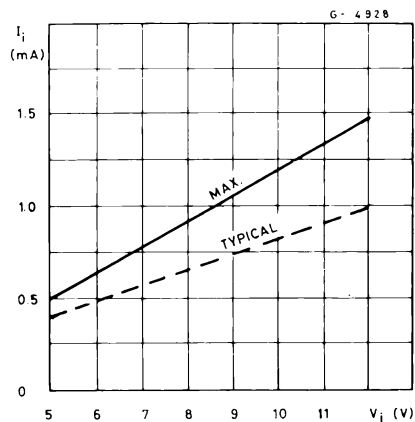
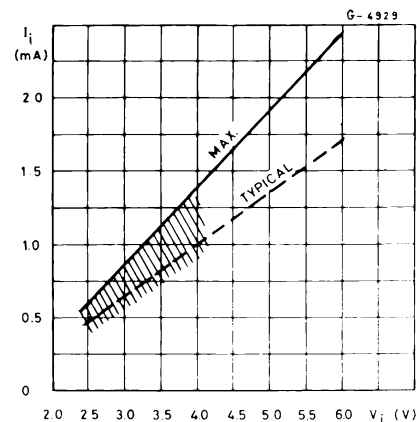


Figure 10. Clamp diode forward voltage



6 Typical performance characteristics



**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)**

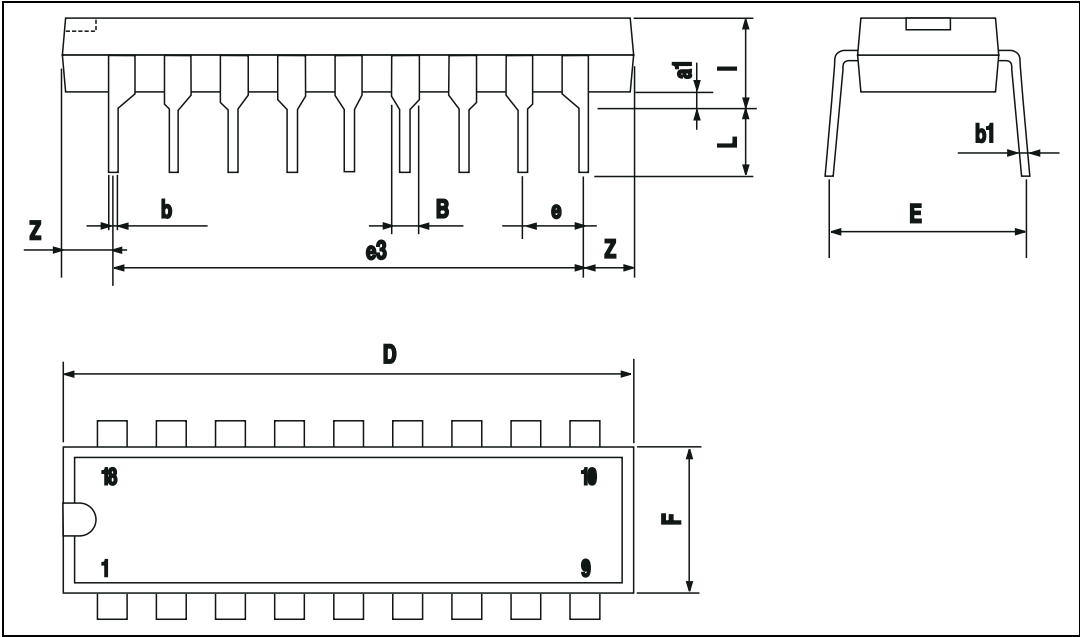
## 7 Package mechanical data

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](http://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 <a href="#">Table 4: Electrical characteristics</a> . |

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