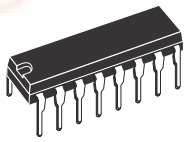
ULN200XA/XD1

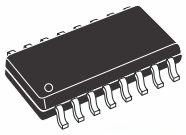
Seven darlington array

Features

- Seven darlingtons per package
- Output current 500mA per driver (600mA peak)
- Output voltage 50V
- Integrated suppression diodes for inductive loads
- Outputs can be paralleled for higher current
- TTL/CMOS/PMOS/DTL Compatible inputs
- Inputs pinned opposite outputs to simplify layout



DIP-16



SO-16 (Narrow)

Description

The ULN2001, ULN2002, ULN2003 and ULN 2004 are high voltage, high current darlington arrays each containing seven open collector darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout.

The versions interface to all common logic families:

ULN2001	General Purpose, DTL, TTL, PMOS, CMOS
ULN2002	14-25V PMOS
ULN2003	5V TTL, CMOS
ULN2004	6-15V CMOS, PMOS

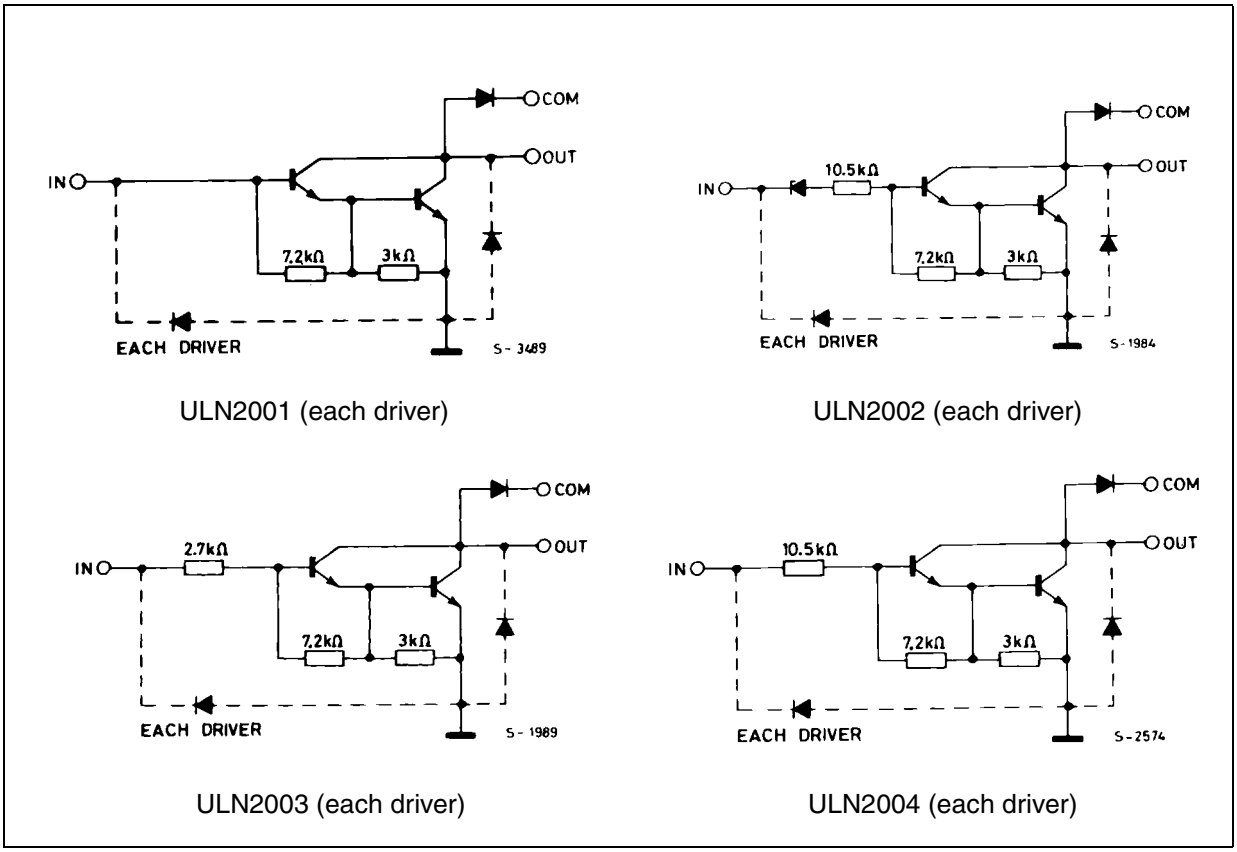
These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal printheads and high power buffers.

The ULN2001A/2002A/2003A and 2004A are supplied in 16 pin plastic DIP packages with a copper leadframe to reduce thermal resistance. They are available also in small outline package (SO-16) as ULN2001D1/2002D1/2003D1/ 2004D1.

Contents

1 Diagram

Figure 1. Schematic diagram



ULN2001 (each driver)

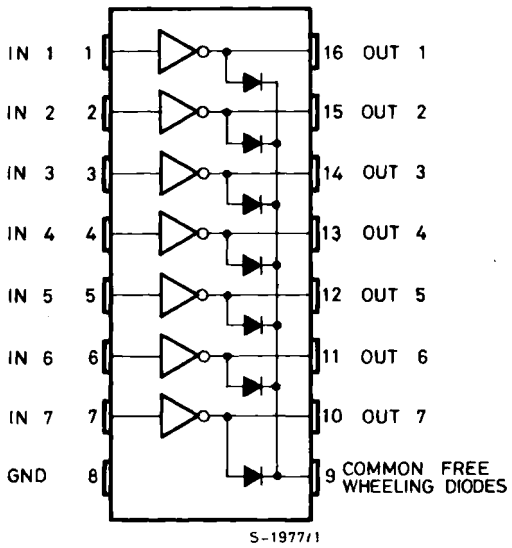
ULN2002 (each driver)

ULN2003 (each driver)

ULN2004 (each driver)

2 Pin configuration

Figure 2. Pin connections (top view)



3 Maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_O	Output voltage	50	V
V_I	Input voltage (for ULN2002A/D - 2003A/D - 2004A/D)	30	V
I_C	Continuous collector current	500	mA
I_B	Continuous base current	25	mA
T_A	Operating ambient temperature range	- 20 to 85	°C
T_{STG}	Storage temperature range	- 55 to 150	°C
T_J	Junction temperature	150	°C

Table 2. Thermal Data

Symbol	Parameter	DIP-16	SO-16	Unit
R_{thJA}	Thermal resistance junction-ambient, Max.	70	120	°C/W

4 Electrical characteristics

Table 3. Electrical characteristics
(T_A = 25°C unless otherwise specified).

Symbol	Parameter	Test	Min.	Typ.	Max.	Unit
I_{CEX}	Output leakage current	V_{CE} = 50V, (*Figure 3.*)			50	µA
		T_A = 70°C, V_{CE}= 50V (*Figure 3.*)			100	
		T_A = 70°C for ULN2002, V_{CE}= 50V, V_I = 6V (*Figure 4.*)			500	
		T_A = 70°C for ULN2002, V_{CE}= 50V, V_I = 1V (*Figure 4.*)			500	
$V_{CE(SAT)}$	Collector-emitter saturation voltage (*Figure 5.*)	I_C = 100mA, I_B = 250µA		0.9	1.1	V
		I_C = 200mA, I_B= 350µA		1.1	1.3	
		I_C = 350mA, I_B= 500µA		1.3	1.6	
$I_{I(ON)}$	Input current (*Figure 6.*)	for ULN2002, V_I = 17V		0.82	1.25	mA
		for ULN2003, V_I = 3.85V		0.93	1.35	
		for ULN2004, V_I = 5V		0.35	0.5	
		V_I = 12V		1	1.45	
$I_{I(OFF)}$	Input current (*Figure 7.*)	T_A = 70°C, I_C = 500µA	50	65		µA
$V_{I(ON)}$	Input voltage (*Figure 8.*)	V_{CE}= 2V, for ULN2002 I_C = 300mA for ULN2003 I_C = 200mA I_C = 250mA I_C = 300mA for ULN2004 I_C = 125mA I_C = 200mA I_C = 275mA I_C = 350mA			13 2.4 2.7 3 5 6 7 8	V
h_{FE}	DC Forward current gain (*Figure 5.*)	for ULN2001, V_{CE} = 2V, I_C = 350mA	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 = 50V			50	µA
		T_A = 70°C, V_R = 50V			100	
V_F	Clamp diode forward voltage (*Figure 10.*)	I_F = 350mA		1.7	2	V

5 Test circuits

Figure 3.

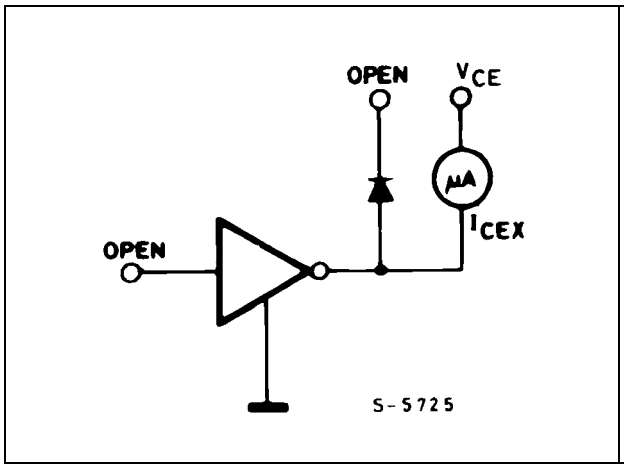


Figure 4.

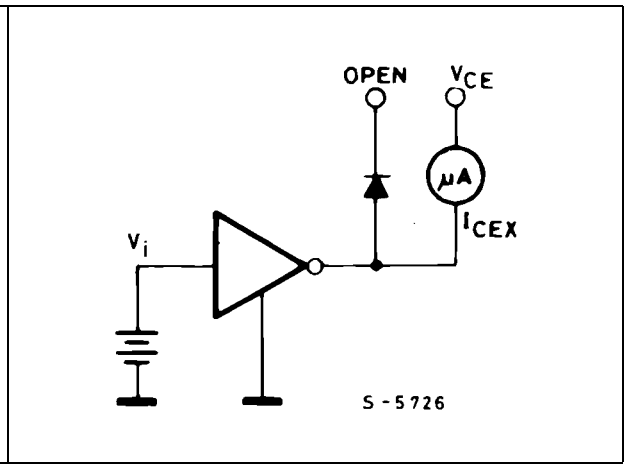


Figure 5.

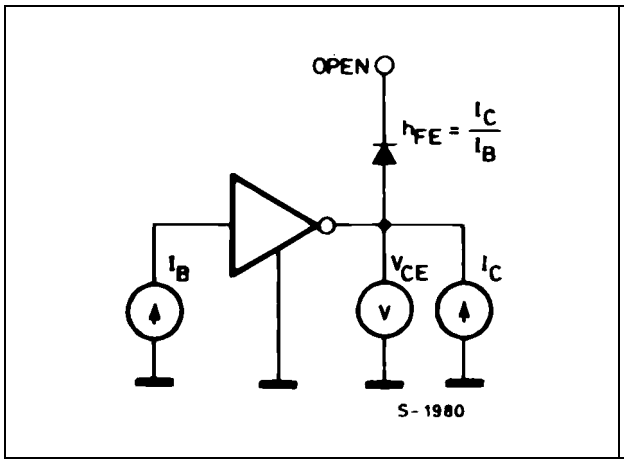


Figure 6.

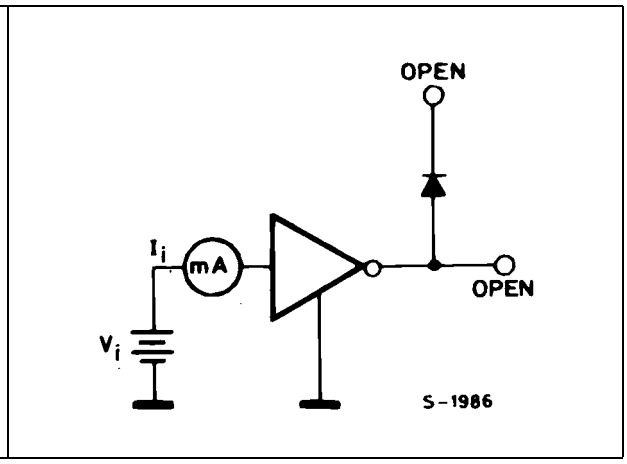


Figure 7.

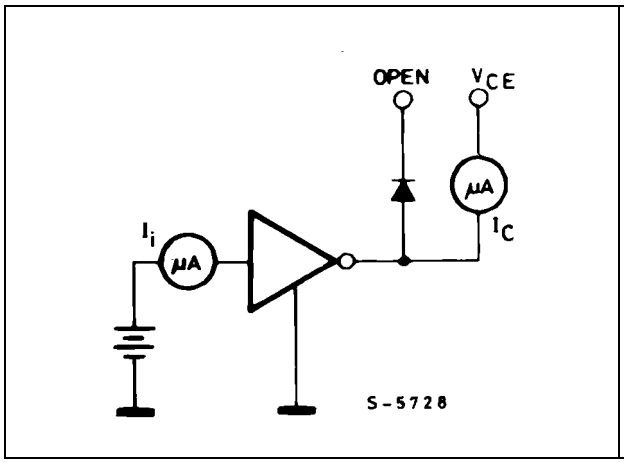


Figure 8.

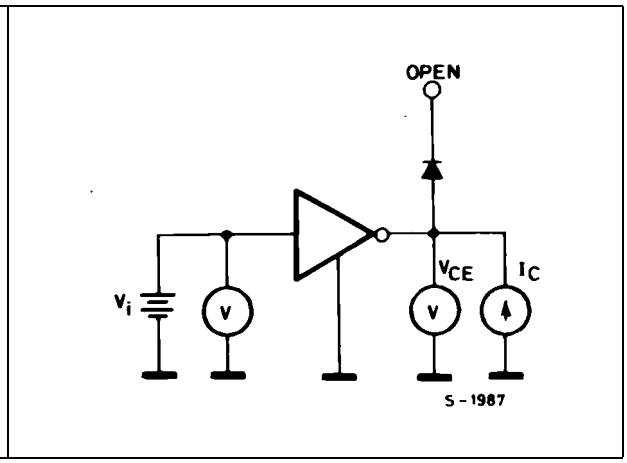


Figure 9.

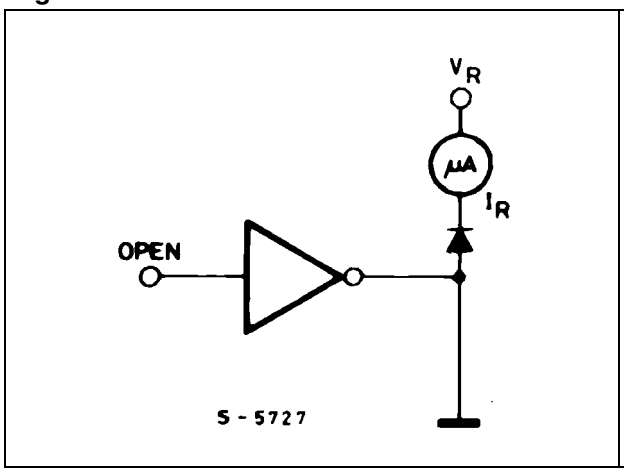


Figure 10.

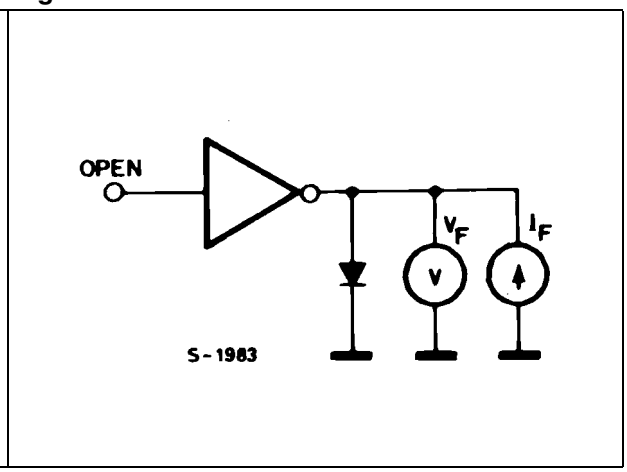


Figure 11. Collector current vs input current

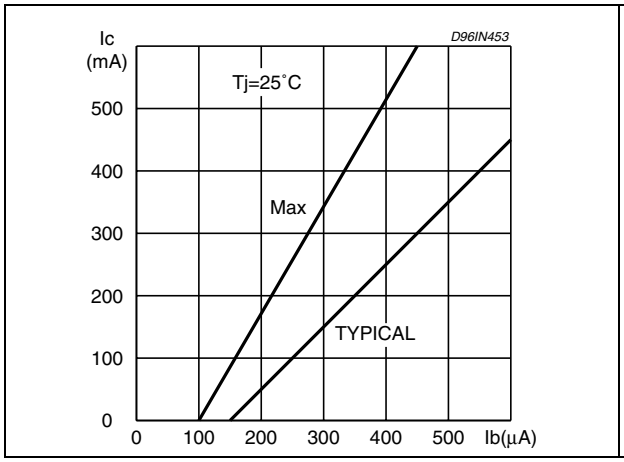


Figure 12. Collector current vs saturation voltage

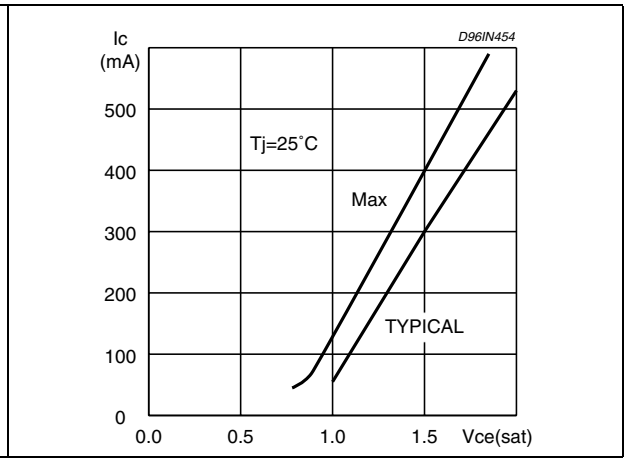


Figure 13. Peak collector current vs duty cycle

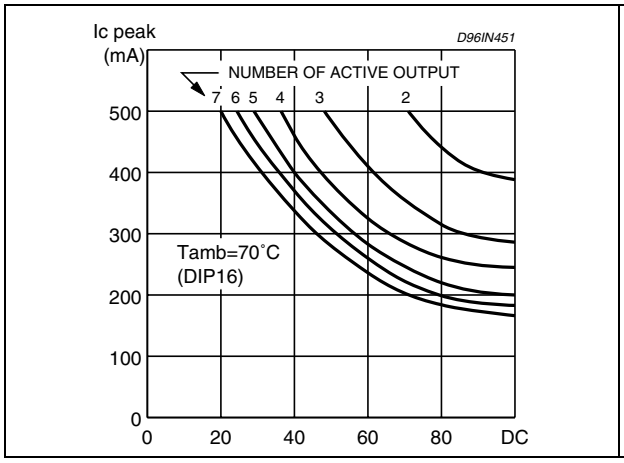
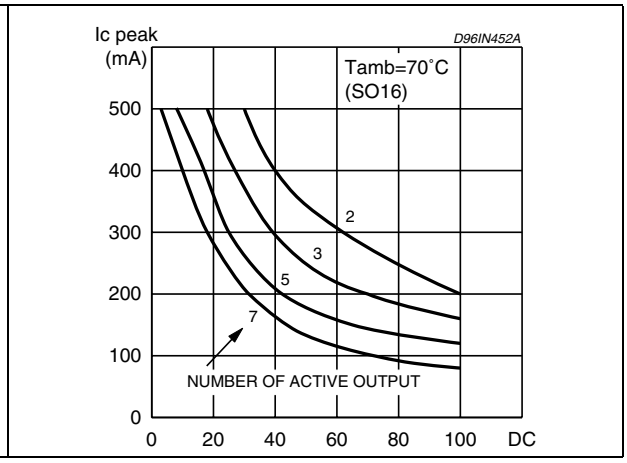


Figure 14. Peak collector current vs duty cycle

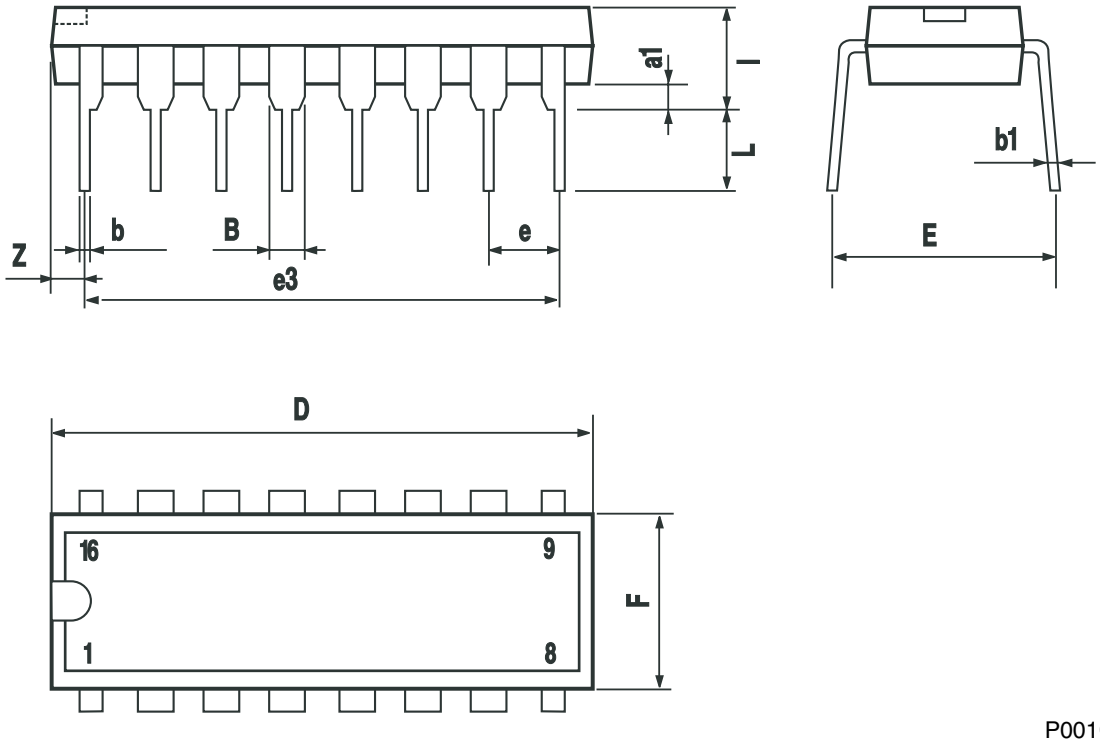


6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

Plastic DIP-16 (0.25) MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

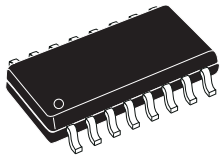


P001C

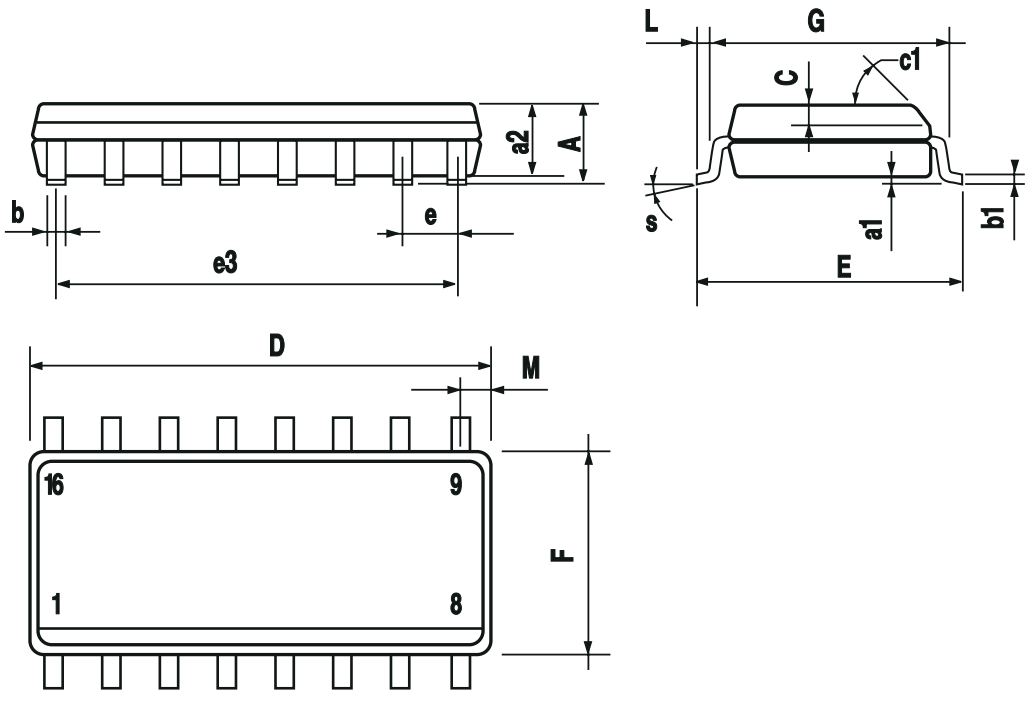
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.009
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1			45°	(typ.)		
D(1)	9.8		10	0.386		0.394
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F(1)	3.8		4.0	0.150		0.157
G	4.60		5.30	0.181		0.208
L	0.4		1.27	0.150		0.050
M			0.62			0.024
S	8 ° (max.)					

(1) "D" and "F" do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.006inc.)

OUTLINE AND MECHANICAL DATA



SO16 (Narrow)



0016020 D

7 Order code

Table 4. Order code

Part numbers	Package
ULN2001A	DIP-16
ULN2002A	DIP-16
ULN2003A	DIP-16
ULN2004A	DIP-16
ULN2001D1	SO-16
ULN2002D1	SO-16
ULN2003D1	SO-16
ULN2004D1	SO-16
ULN2001D1013TR	SO-16 in Tape & Reel
ULN2002D1013TR	SO-16 in Tape & Reel
ULN2003D1013TR	SO-16 in Tape & Reel
ULN2004D1013TR	SO-16 in Tape & Reel

8 Revision history

Table 5. Revision history

Date	Revision	Changes
05-Dec-2006	5	Order codes has been updated and document has been reformatted.

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