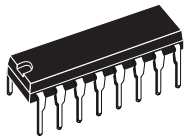
ULQ2001
ULQ2003 - ULQ2004

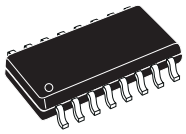
Seven Darlington array

Features

- Seven Darlington per package
- Extended temperature range: -40 to 105 °C
- Output current 500 mA per driver (600 mA peak)
- Output voltage 50 V
- Automotive Grade product in SO16 package
- 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



SO16
(Narrow)

Description

The ULQ2001, ULQ2003 and ULQ2004 are high voltage, high current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each channel rated at 500 mA and can withstand peak currents of 600 mA. 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. These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors, LED displays filament lamps, thermal print-heads and high power buffers. The ULQ2001A/2003A and 2004A are supplied in 16 pin plastic DIP packages with a copper lead-frame to reduce thermal resistance. They are available also in small outline package (SO16) as ULQ2003D1/2004D1. The ULQ2003 is available as Automotive Grade in SO16 package. The commercial part numbers is shown in the order codes. This device is qualified according to the specification AEC-Q100 of the Automotive market, in the temperature range -40 °C to 125 °C and the statistical tests PAT, SYL, SBL are performed.

Table 1. Device summary

Part numbers	Order codes	Description	Packages
ULQ2001	ULQ2001A	General purpose, DTL, TTL, PMOS, CMOS	DIP-16
ULQ2003	ULQ2003A	5 V TTL, CMOS	DIP-16
ULQ2004	ULQ2004A	6–15 V CMOS, PMOS	DIP-16
ULQ2003	ULQ2003D1013TR		SO16 in tape and reel
ULQ2003	ULQ2003D1013TRY (1)		SO16 in tape and reel
ULQ2004	ULQ2004D1013TR		SO16 in tape and reel

1. Automotive Grade products.

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2 Pin configuration 4

3 Maximum ratings 5

4 Electrical characteristics 6

5 Test circuits 8

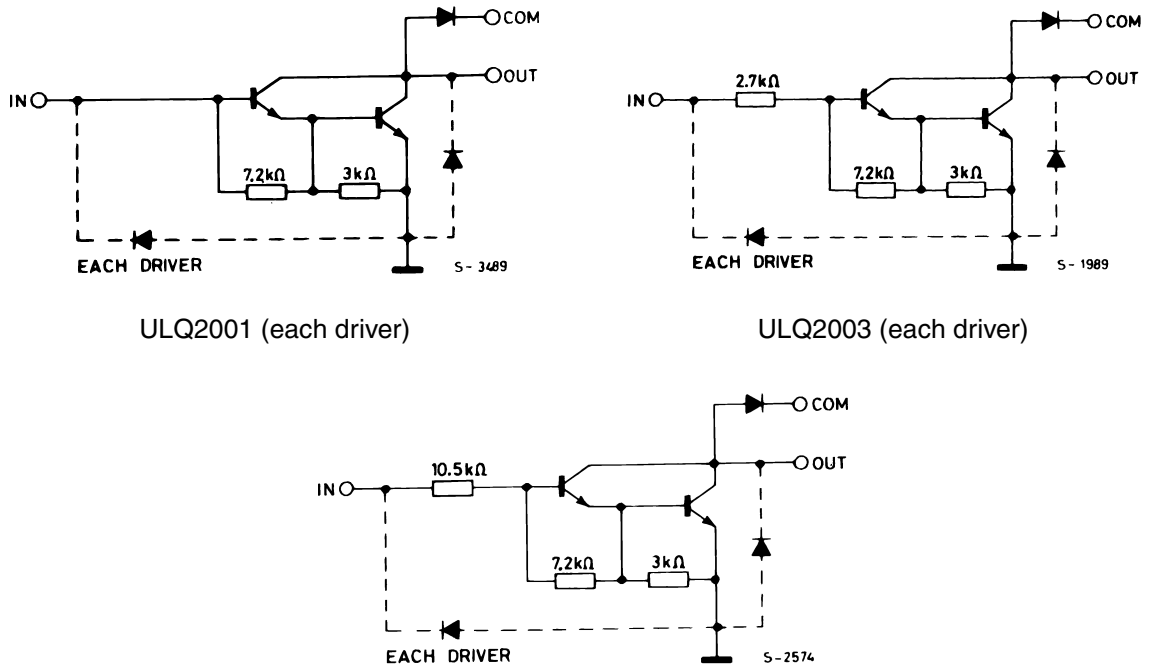
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1 Diagram

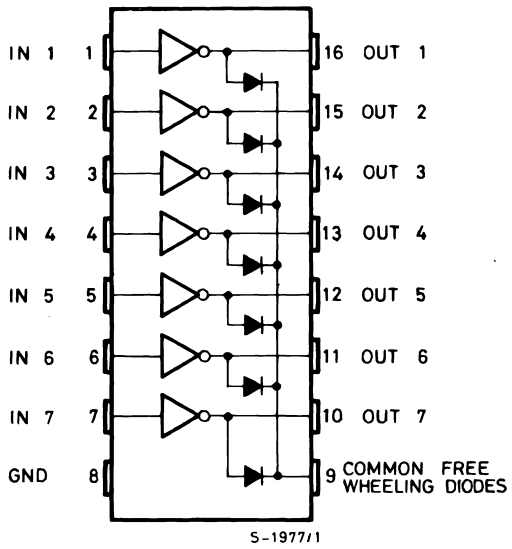
Figure 1. Schematic diagram



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2 Pin configuration

Figure 2. Pin connections (top view)



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3 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_O	Output voltage	50	V
V_{IN}	Input voltage (for ULQ2003A/D1 - 2004A/D1)	30	V
I_C	Continuous collector current	500	mA
I_B	Continuous base current	25	mA
T_A	Operating ambient temperature range	-40 to 105	°C
T_{STG}	Storage temperature range	-55 to 150	°C
T_J	Junction temperature	150	°C

Table 3. Thermal data

Symbol	Parameter	DIP-16	SO16	Unit
R_{thJA}	Thermal resistance junction-ambient, max.	70	120	°C/W

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4 Electrical characteristics

T_J = -40 to 105 °C for DIP16 unless otherwise specified,
T_J = -25 to 105 °C for SO16 unless otherwise specified.

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Output leakage current	V_{CE} = 50V, (*Figure 3*)			50	µA
		T_J = 105°C, V_{CE}= 50V (*Figure 3*)			100	
		T_J = 105°C for ULQ2004, 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 ULQ2003, V_I = 3.85V		0.93	1.35	mA
		for ULQ2004, V_I = 5V		0.35	0.5	
		for ULQ2004, V_I = 12V		1	1.45	
$I_{I(OFF)}$	Input current (*Figure 7*)	T_J = 105°C, I_C = 500µA	50	65		µA
$V_{I(ON)}$	Input voltage (*Figure 8*)	for ULQ2003 V_{CE}= 2V, I_C = 200mA V_{CE}= 2V, I_C = 250mA V_{CE}= 2V, I_C = 300mA for ULQ2004 V_{CE}= 2V, I_C = 125mA V_{CE}= 2V, I_C = 200mA V_{CE}= 2V, I_C = 275mA V_{CE}= 2V, I_C = 350mA			2.4 2.7 3 5 6 7 8	V
h_{FE}	DC forward current gain (*Figure 5*)	for ULQ2001, V_{CE} = 2V, I_C = 350mA	1000			
C_I	Input capacitance			15	25 (1)	pF
t_{PLH}	Turn-on delay time	0.5 V_I to 0.5V_O		0.25	1 (1)	µs
t_{PHL}	Turn-off delay time	0.5 V_I to 0.5V_O		0.25	1 (1)	µs
I_R	Clamp diode leakage current (*Figure 9*)	V_R = 50V			50	µA
		T_J = 105°C, V_R = 50V			100	
V_F	Clamp diode forward voltage (*Figure 10*)	I_F = 350mA		1.7	2	V

1. Guaranteed by design.

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T_J = -40 to 125 °C for SO16 unless otherwise specified.

Table 5. Electrical characteristics for ULQ2003D1013TRY (Automotive Grade)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CEX}	Output leakage current (*Figure 3*)	V_{CE} = 50V			50	µA
$V_{CE(SAT)}$	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*)	V_I = 3.85V		0.93	1.35	mA
$I_{I(OFF)}$	Input current (*Figure 7*)	I_C = 500µA	50	65		µA
$V_{I(ON)}$	Input voltage (*Figure 8*)	V_{CE} = 2V, I_C = 200mA V_{CE} = 2V, I_C = 250mA V_{CE} = 2V,I_C = 300mA			2.4 2.7 3	V
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
V_F	Clamp diode forward voltage (*Figure 10*)	I_F = 350mA		1.7	2	V

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5 Test circuits

Figure 3. Output leakage current

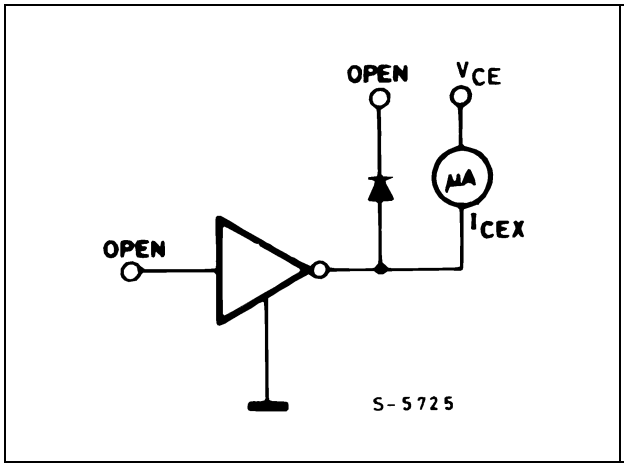


Figure 4. Output leakage current (for ULN2002 only)

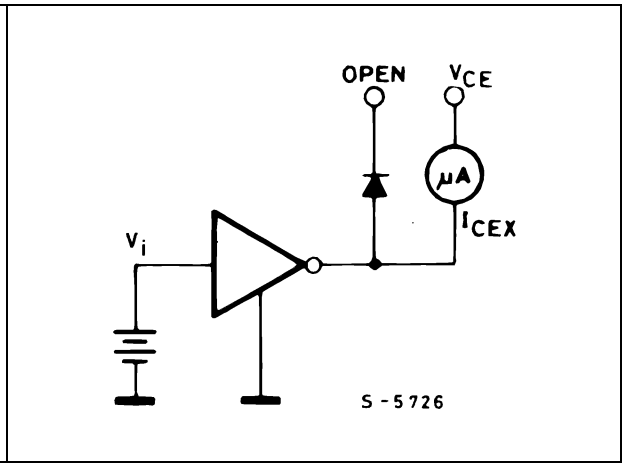


Figure 5. Collector-emitter saturation voltage

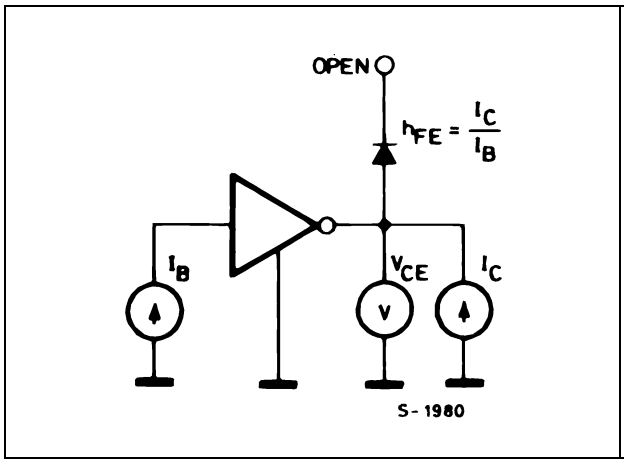


Figure 6. Input current (ON)

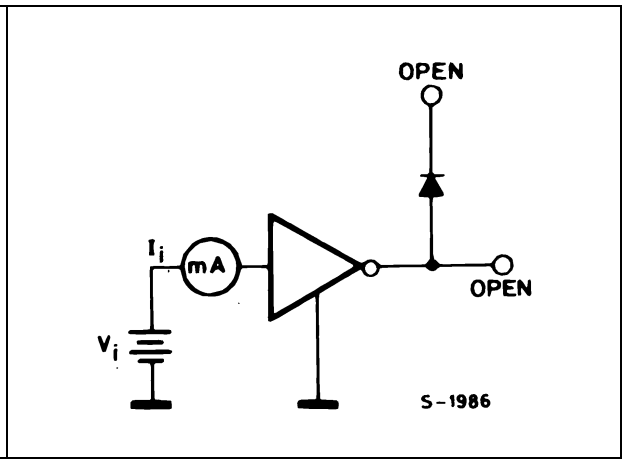


Figure 7. Input current (OFF)

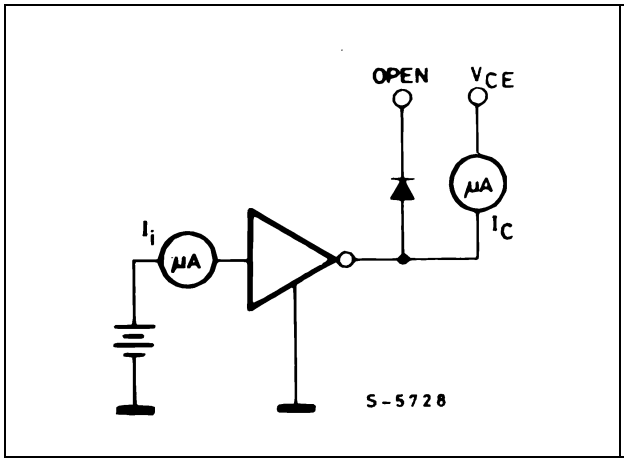
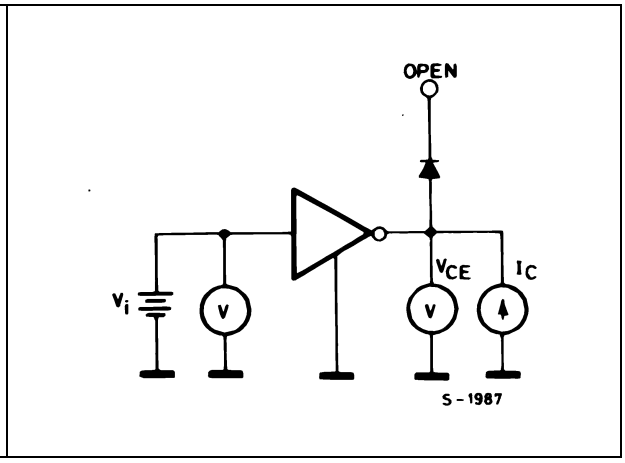


Figure 8. Input voltage



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Figure 9. Clamp diode leakage current

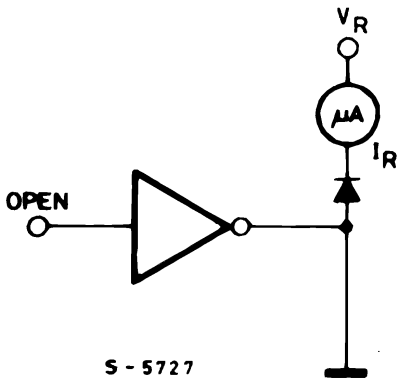
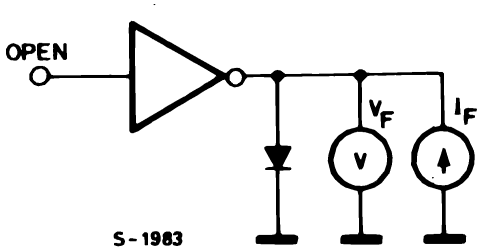


Figure 10. Clamp diode forward voltage



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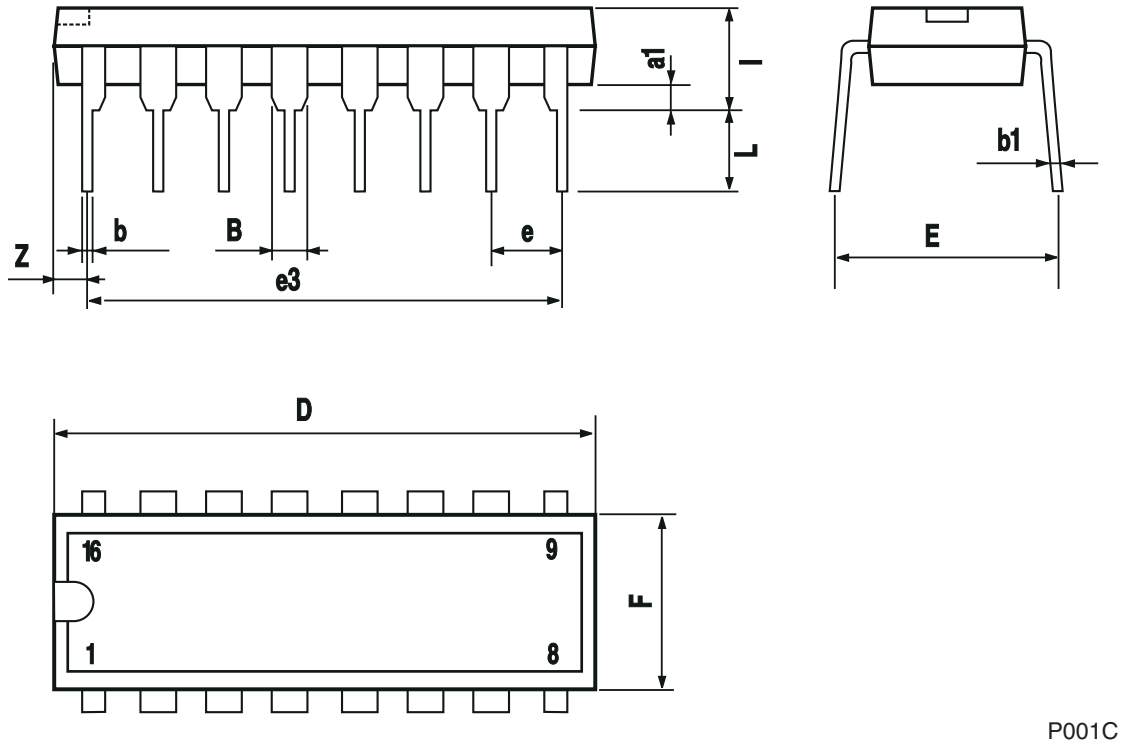
6 Package mechanical data

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.

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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



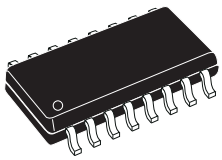
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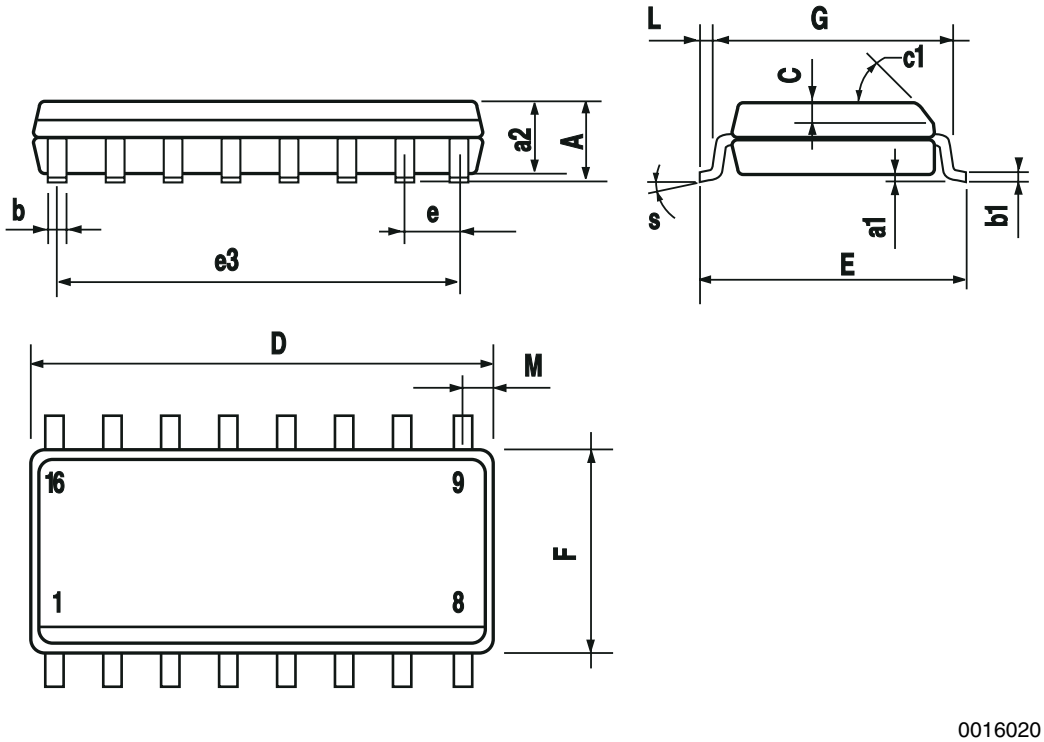
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.009
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1			45°	(typ.)		
D(1)	9.8		10	0.386		0.394
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F(1)	3.8		4.0	0.150	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

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7 Revision history

Table 6. Document revision history

Date	Revision	Changes
05-Dec-2006	2	Order codes updated.
23-May-2007	3	Order codes updated.
17-Apr-2008	4	Added new order codes for Automotive grade products see *Table 1 on page 1*.
25-Aug-2008	5	Modified: *Table 4 on page 6* and *Table 5 on page 7*.
11-Feb-2011	6	Modified: T_J = -25 to 105 °C *Table 4 on page 6*.

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