

Si9956DY

N-channel enhancement mode field-effect transistor

Rev. 01 — 16 July 2001

Product data

1. Description

Dual N-channel enhancement mode field-effect transistor in a plastic package using TrenchMOS™¹ technology.

Product availability:

Si9956DY in SOT96-1 (SO8).

2. Features

- Low on-state resistance
- Fast switching
- TrenchMOS™ technology.

3. Applications

- DC to DC convertors
- DC motor control
- Lithium-ion battery applications
- Notebook PC
- Portable equipment applications.

4. Pinning information

Table 1: Pinning - SOT96-1, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	source 1 (s ₁)		
2	gate 1 (g ₁)		
3	source 2 (s ₂)		
4	gate 2 (g ₂)		
5,6	drain 2 (d ₂)		
7,8	drain 1 (d ₁)		

1. TrenchMOS is a trademark of Royal Philips Electronics.



5. Quick reference data

Table 2: Quick reference data

Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)	$T_j = 25$ to 150 °C	–	20	V
I_D	drain current (DC)	$T_{amb} = 25$ °C; pulsed; $t_p \leq 10$ s	–	3.5	A
P_{tot}	total power dissipation	$T_{amb} = 25$ °C; pulsed; $t_p \leq 10$ s	–	2	W
T_j	junction temperature		–	150	°C
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 2.2$ A	55	100	mΩ
		$V_{GS} = 4.5$ V; $I_D = 1$ A	70	200	mΩ

6. Limiting values

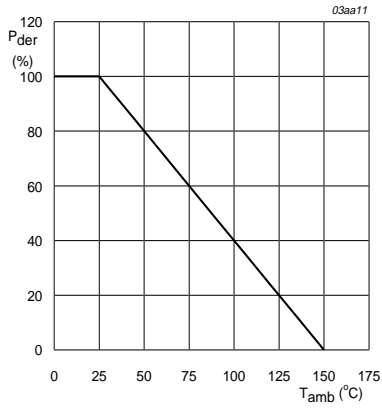
Table 3: Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	$T_j = 25$ to 150 °C	–	20	V
V_{GS}	gate-source voltage (DC)		–	±20	V
I_D	drain current (DC)	$T_{amb} = 25$ °C; pulsed; $t_p \leq 10$ s; Figure 2 and 3	–	3.5	A
		$T_{amb} = 70$ °C; pulsed; $t_p \leq 10$ s; Figure 2	–	2.8	A
I_{DM}	peak drain current	$T_{amb} = 25$ °C; pulsed; $t_p \leq 10$ μs; Figure 3	–	14	A
P_{tot}	total power dissipation	$T_{amb} = 25$ °C; pulsed; $t_p \leq 10$ s; Figure 1	–	2	W
		$T_{amb} = 70$ °C; pulsed; $t_p \leq 10$ s; Figure 1	–	1.3	W
T_{stg}	storage temperature		–55	+150	°C
T_j	operating junction temperature		–55	+150	°C

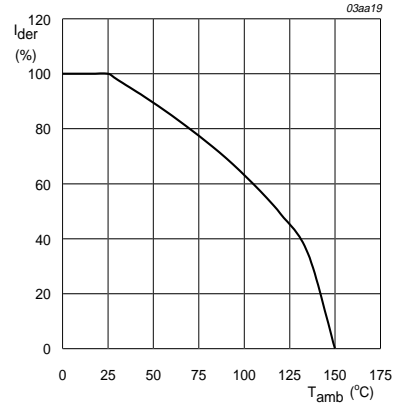
Source-drain diode

I_S	source (diode forward) current (DC)	$T_{amb} = 25$ °C	–	1.3	A
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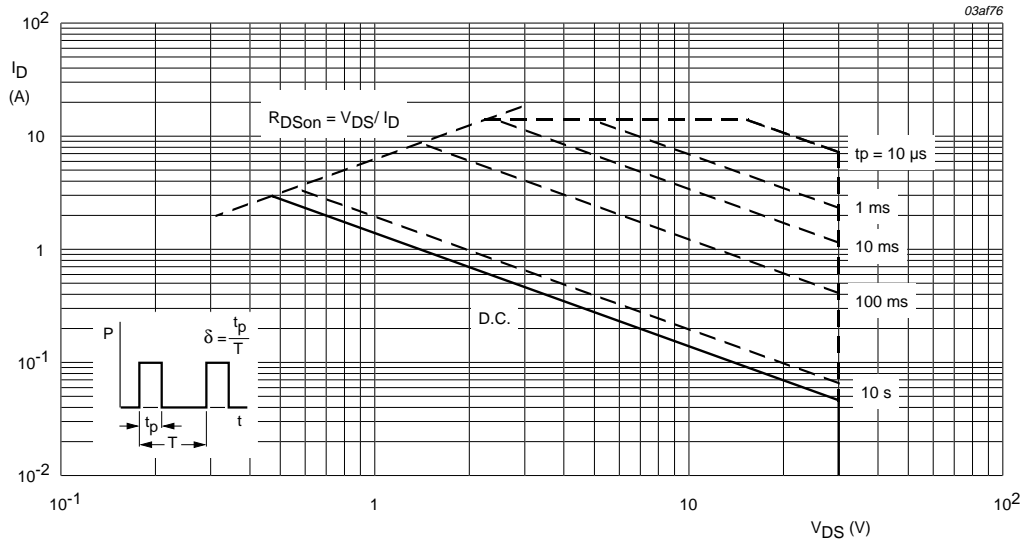
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

Fig 1. Normalized total power dissipation as a function of mounting base temperature.



$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\%$$

Fig 2. Normalized continuous drain current as a function of mounting base temperature.



T_{amb} = 25 °C; I_{DM} is single pulse.

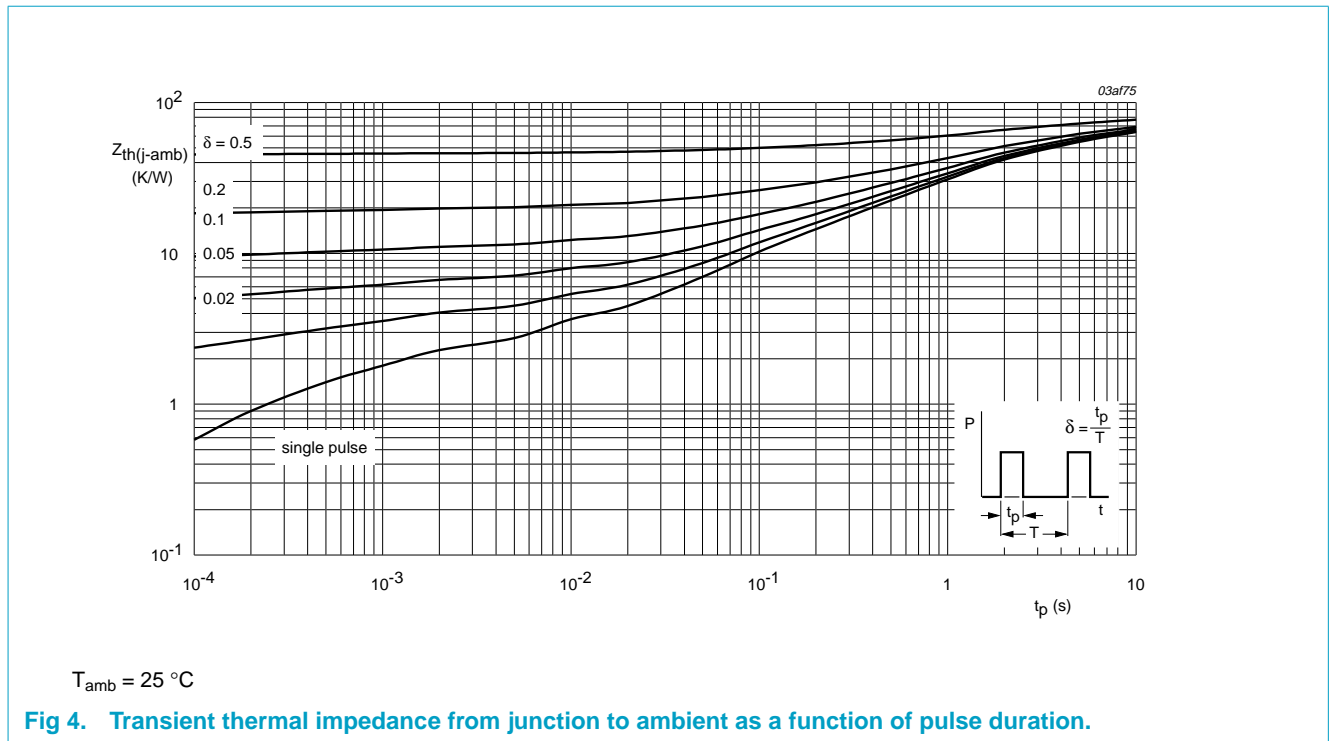
Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

7. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Value	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on a printed circuit board; $t_p \leq 10$ s; minimum footprint; Figure 4	62.5	K/W

7.1 Transient thermal impedance

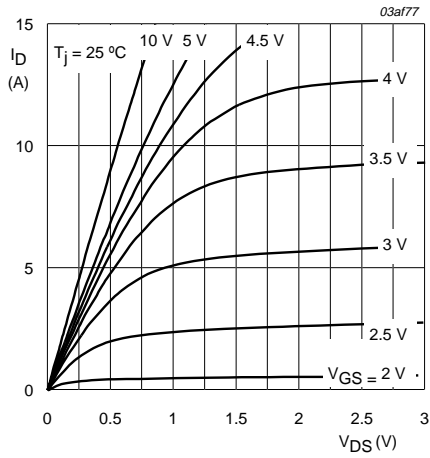


8. Characteristics

Table 5: Characteristics

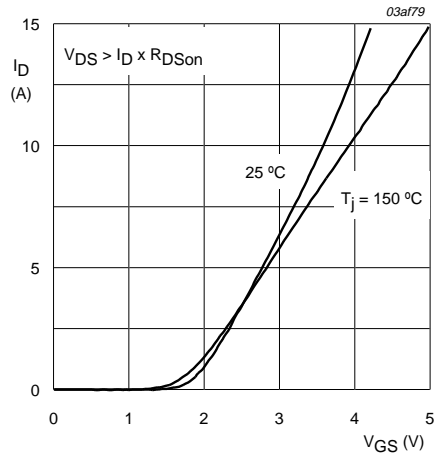
$T_j = 25\text{ °C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 250\ \mu\text{A}$; $V_{DS} = V_{GS}$	1	–	–	V
I_{DSS}	drain-source leakage current	$V_{DS} = 16\ \text{V}$; $V_{GS} = 0\ \text{V}$				
		$T_j = 25\text{ °C}$	–	–	2	μA
		$T_j = 55\text{ °C}$	–	–	25	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\ \text{V}$; $V_{DS} = 0\ \text{V}$	–	–	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ \text{V}$; $I_D = 2.2\ \text{A}$; Figure 7 and 8	–	55	100	m Ω
		$V_{GS} = 4.5\ \text{V}$; $I_D = 1\ \text{A}$; Figure 7 and 8	–	70	200	m Ω
Dynamic characteristics						
g_{fs}	forward transconductance	$V_{DS} = 15\ \text{V}$; $I_D = 3.5\ \text{A}$	–	5.7	–	S
$Q_{g(tot)}$	total gate charge	$I_D = 1.8\ \text{A}$; $V_{DS} = 10\ \text{V}$; $V_{GS} = 10\ \text{V}$; Figure 13	–	8	30	nC
Q_{gs}	gate-source charge		–	0.8	–	nC
Q_{gd}	gate-drain (Miller) charge		–	1.7	–	nC
$t_{d(on)}$	turn-on delay time	$V_{DD} = 10\ \text{V}$; $R_D = 10\ \Omega$; $V_{GS} = 10\ \text{V}$; $R_G = 6\ \Omega$	–	6	20	ns
t_r	turn-on rise time		–	8	20	ns
$t_{d(off)}$	turn-off delay time		–	14	90	ns
t_f	turn-off fall time		–	8	50	ns
Source-drain (reverse) diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 2.3\ \text{A}$; $V_{GS} = 0\ \text{V}$; Figure 12	–	0.75	1.2	V
t_{rr}	reverse recovery time	$I_S = 1.7\ \text{A}$; $di_S/dt = -100\ \text{A}/\mu\text{s}$; $V_{GS} = 0\ \text{V}$	–	50	100	ns



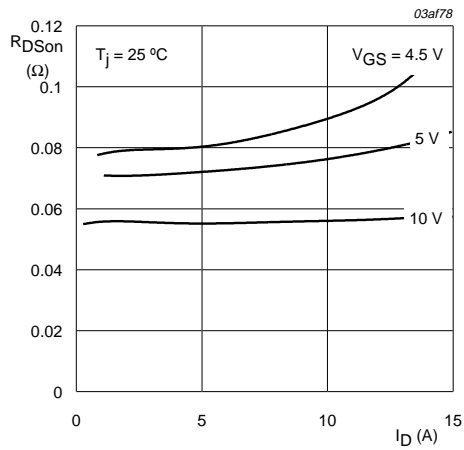
$T_j = 25\text{ }^\circ\text{C}$

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values.



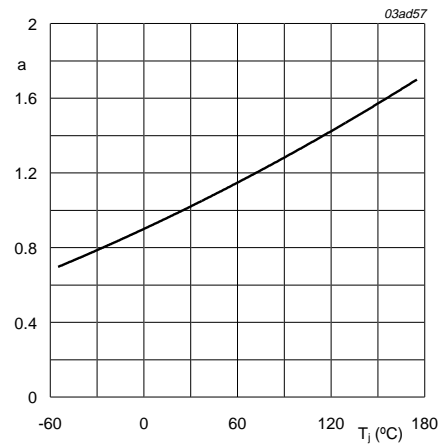
$T_j = 25\text{ }^\circ\text{C}$ and $150\text{ }^\circ\text{C}$; $V_{DS} > I_D \times R_{DSon}$

Fig 6. Transfer characteristics: drain current as a function of gate-source voltage; typical values.



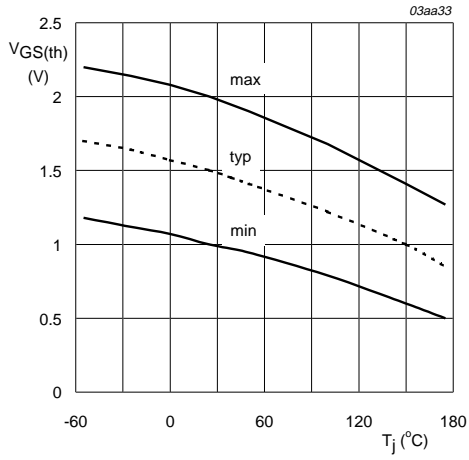
$T_j = 25\text{ }^\circ\text{C}$

Fig 7. Drain-source on-state resistance as a function of drain current; typical values.



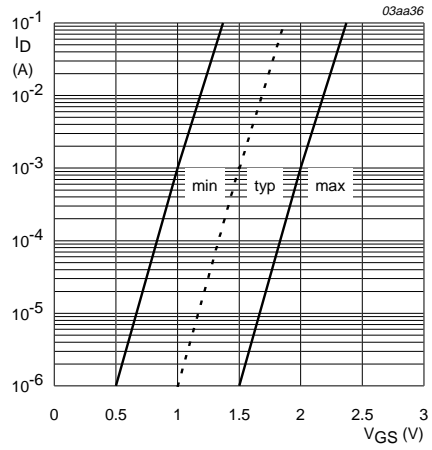
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature.



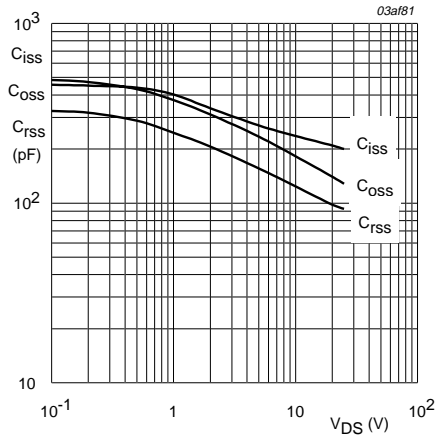
$I_D = 250 \mu A; V_{DS} = V_{GS}$

Fig 9. Gate-source threshold voltage as a function of junction temperature.



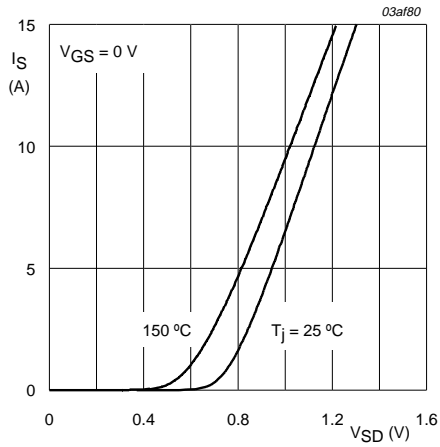
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 5 \text{ V}$

Fig 10. Sub-threshold drain current as a function of gate-source voltage.



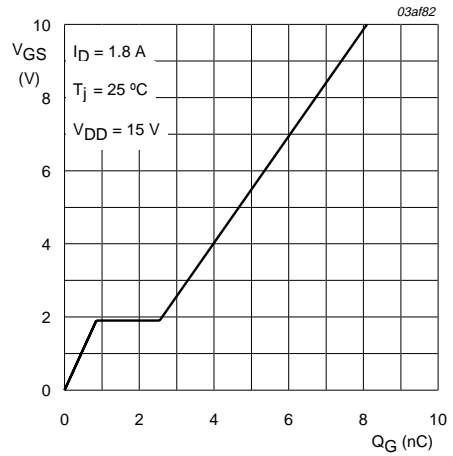
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

Fig 11. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.



$T_j = 25^\circ\text{C}$ and 150°C ; $V_{GS} = 0$ V

Fig 12. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values.



$I_D = 1.8$ A; $V_{DD} = 15$ V

Fig 13. Gate-source voltage as a function of gate charge; typical values.

9. Package outline

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1

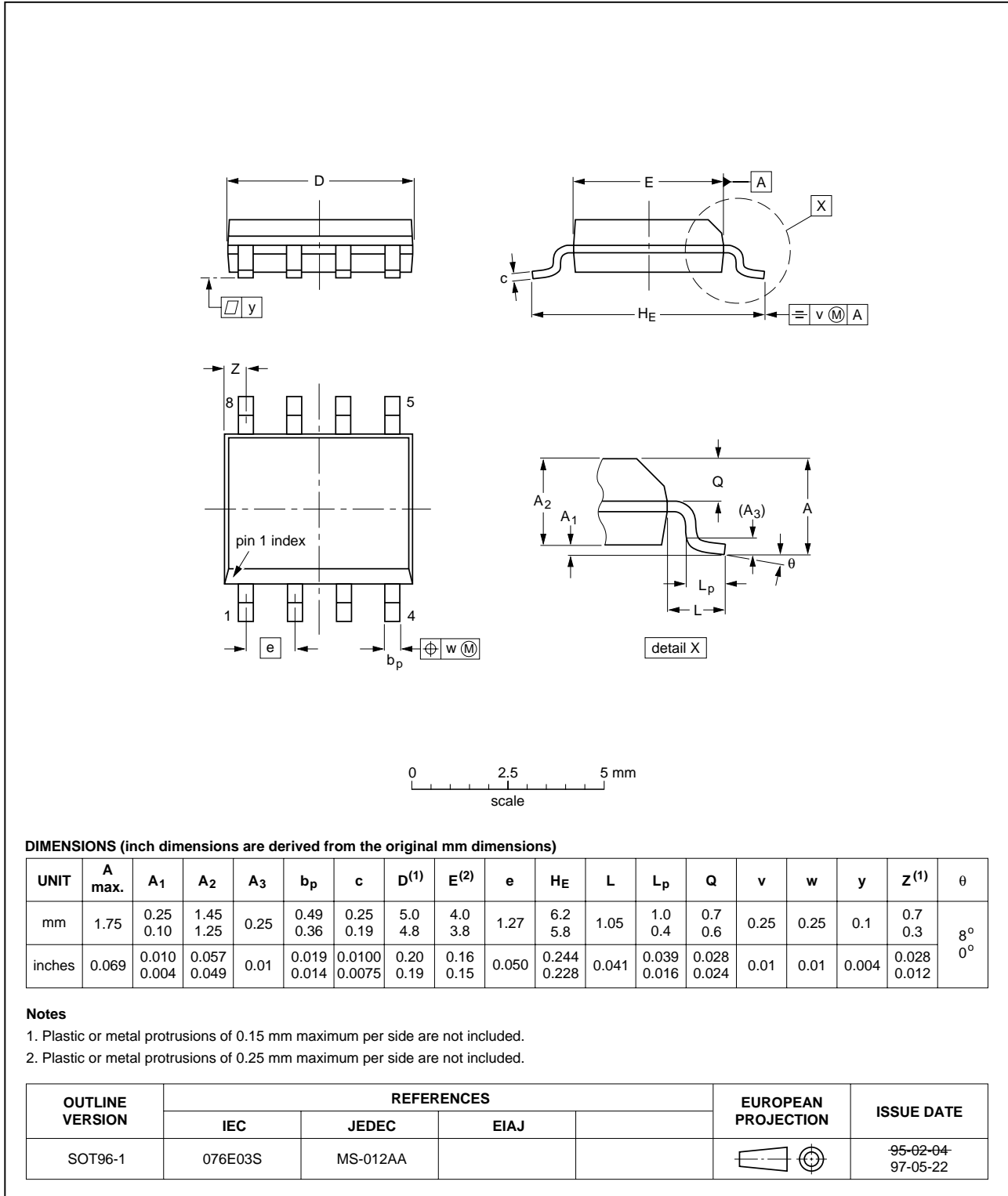


Fig 14. SOT96-1 (SO8).

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20010716	-	Product specification; initial version

11. Data sheet status

Data sheet status ^[1]	Product status ^[2]	Definition
Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

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Argentina: see South America

Australia: Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

Austria: Tel. +43 160 101, Fax. +43 160 101 1210

Belarus: Tel. +375 17 220 0733, Fax. +375 17 220 0773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Tel. +359 268 9211, Fax. +359 268 9102

Canada: Tel. +1 800 234 7381

China/Hong Kong: Tel. +852 2 319 7888, Fax. +852 2 319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Tel. +45 3 288 2636, Fax. +45 3 157 0044

Finland: Tel. +358 961 5800, Fax. +358 96 158 0920

France: Tel. +33 1 4728 6600, Fax. +33 1 4728 6638

Germany: Tel. +49 40 23 5360, Fax. +49 402 353 6300

Hungary: Tel. +36 1 382 1700, Fax. +36 1 382 1800

India: Tel. +91 22 493 8541, Fax. +91 22 493 8722

Indonesia: see Singapore

Ireland: Tel. +353 17 64 0000, Fax. +353 17 64 0200

Israel: Tel. +972 36 45 0444, Fax. +972 36 49 1007

Italy: Tel. +39 039 203 6838, Fax. +39 039 203 6800

Japan: Tel. +81 33 740 5130, Fax. +81 3 3740 5057

Korea: Tel. +82 27 09 1412, Fax. +82 27 09 1415

Malaysia: Tel. +60 37 50 5214, Fax. +60 37 57 4880

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For all other countries apply to: Philips Semiconductors,
Marketing Communications,
Building BE, P.O. Box 218, 5600 MD EINDHOVEN,
The Netherlands, Fax. +31 40 272 4825

Netherlands: Tel. +31 40 278 2785, Fax. +31 40 278 8399

New Zealand: Tel. +64 98 49 4160, Fax. +64 98 49 7811

Norway: Tel. +47 22 74 8000, Fax. +47 22 74 8341

Philippines: Tel. +63 28 16 6380, Fax. +63 28 17 3474

Poland: Tel. +48 22 5710 000, Fax. +48 22 5710 001

Portugal: see Spain

Romania: see Italy

Russia: Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: Tel. +27 11 471 5401, Fax. +27 11 471 5398

South America: Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Tel. +34 33 01 6312, Fax. +34 33 01 4107

Sweden: Tel. +46 86 32 2000, Fax. +46 86 32 2745

Switzerland: Tel. +41 14 88 2686, Fax. +41 14 81 7730

Taiwan: Tel. +886 22 134 2451, Fax. +886 22 134 2874

Thailand: Tel. +66 23 61 7910, Fax. +66 23 98 3447

Turkey: Tel. +90 216 522 1500, Fax. +90 216 522 1813

Ukraine: Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Tel. +44 208 730 5000, Fax. +44 208 754 8421

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