



2N7002

N-channel TrenchMOS FET

Rev. 06 — 28 April 2006

Product data sheet

1. Product profile

1.1 General description

N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology.

1.2 Features

- Logic level threshold compatible
- Surface-mounted package
- Very fast switching
- TrenchMOS technology

1.3 Applications

- Logic level translator
- High-speed line driver

1.4 Quick reference data

- $V_{DS} \leq 60 \text{ V}$
- $R_{DS(on)} \leq 5 \ \Omega$
- $I_D \leq 300 \text{ mA}$
- $P_{tot} \leq 0.83 \text{ W}$

2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	gate (G)	<p>SOT23</p>	<p>mbb076</p>
2	source (S)		
3	drain (D)		

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3. Ordering information

Table 2: Ordering information

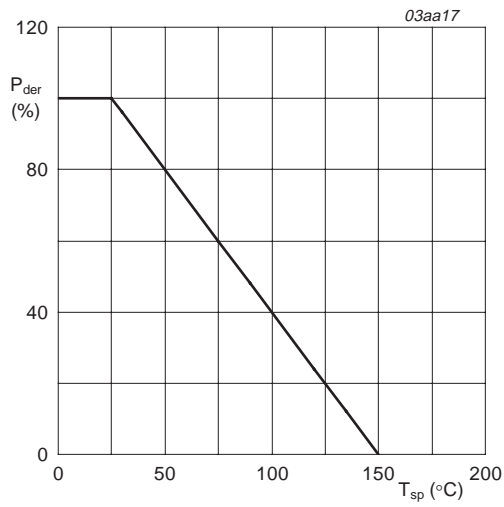
Type number	Package		Version
	Name	Description	
2N7002	TO-236AB	plastic surface mounted package; 3 leads	SOT23

4. Limiting values

Table 3: Limiting values

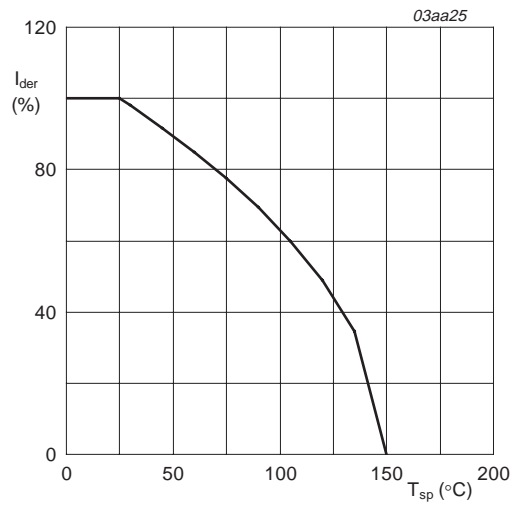
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 150\text{ °C}$	-	60	V
V_{DGR}	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 150\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	60	V
V_{GS}	gate-source voltage		-	± 30	V
V_{GSM}	peak gate-source voltage	$t_p \leq 50\text{ }\mu\text{s}$; pulsed; duty cycle = 25 %	-	± 40	V
I_D	drain current	$T_{sp} = 25\text{ °C}$; $V_{GS} = 10\text{ V}$; see Figure 2 and 3	-	300	mA
		$T_{sp} = 100\text{ °C}$; $V_{GS} = 10\text{ V}$; see Figure 2	-	190	mA
I_{DM}	peak drain current	$T_{sp} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; see Figure 3	-	1.2	A
P_{tot}	total power dissipation	$T_{sp} = 25\text{ °C}$; see Figure 1	-	0.83	W
T_{stg}	storage temperature		-65	+150	°C
T_j	junction temperature		-65	+150	°C
Source-drain diode					
I_S	source current	$T_{sp} = 25\text{ °C}$	-	300	mA
I_{SM}	peak source current	$T_{sp} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	1.2	A



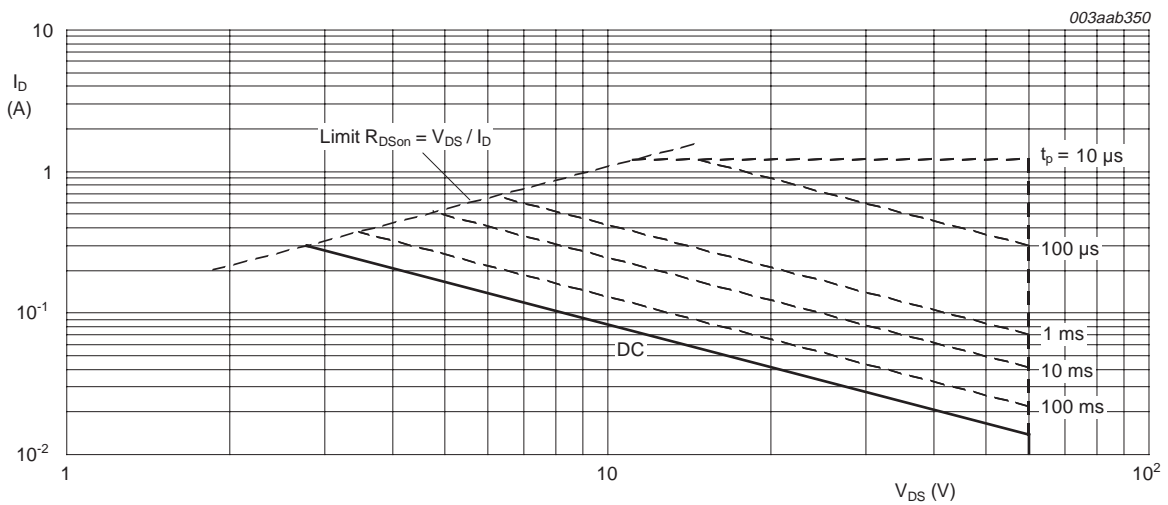
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ C)}} \times 100\%$$

Fig 1. Normalized total power dissipation as a function of solder point temperature



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

Fig 2. Normalized continuous drain current as a function of solder point temperature



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

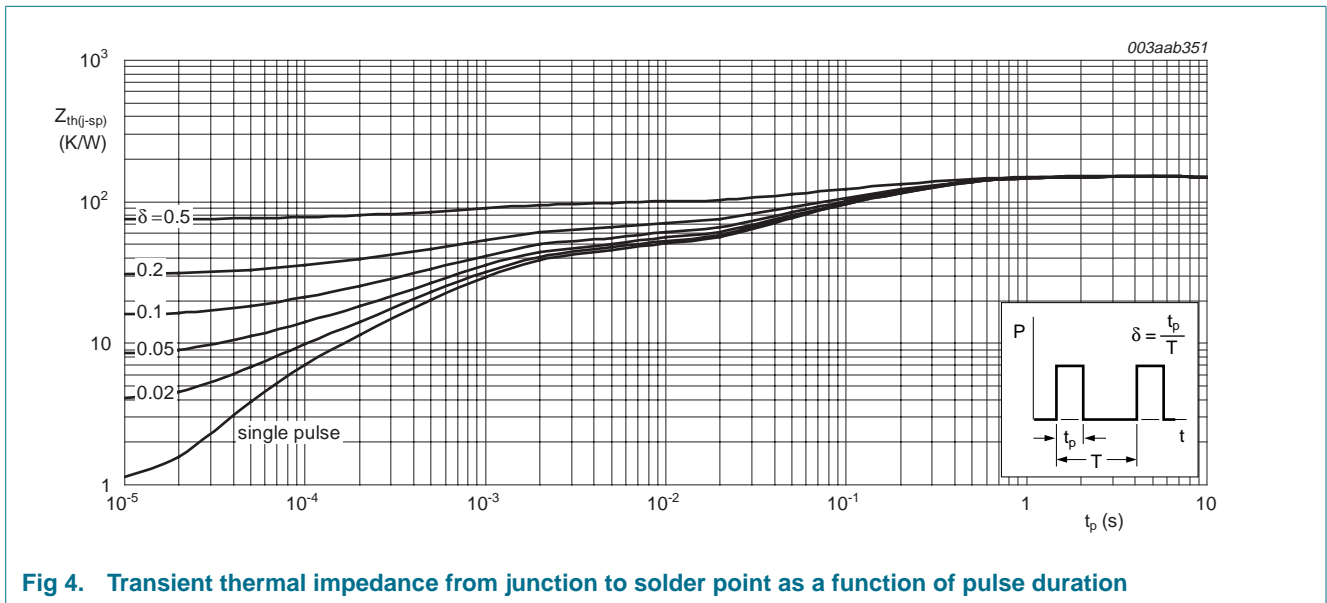
Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

5. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	see Figure 4	-	-	150	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		[1]	-	350	K/W

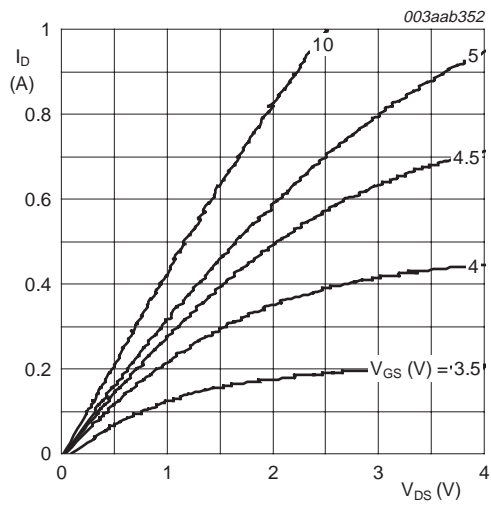
[1] Mounted on a printed-circuit board; minimum footprint; vertical in still air



6. Characteristics

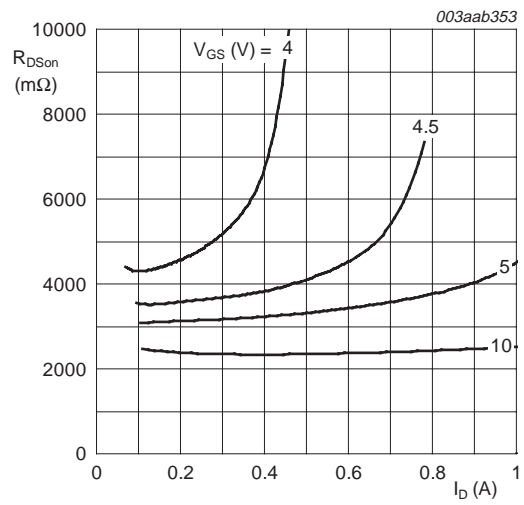
Table 5: Characteristics
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 10 μA; V _{GS} = 0 V				
		T _j = 25 °C	60	-	-	V
		T _j = -55 °C	55	-	-	V
V _{GS(th)}	gate-source threshold voltage	I _D = 0.25 mA; V _{DS} = V _{GS} ; see Figure 9 and 10				
		T _j = 25 °C	1	2	2.5	V
		T _j = 150 °C	0.6	-	-	V
		T _j = -55 °C	-	-	2.75	V
I _{DSS}	drain leakage current	V _{DS} = 48 V; V _{GS} = 0 V				
		T _j = 25 °C	-	0.01	1	μA
		T _j = 150 °C	-	-	10	μA
I _{GSS}	gate leakage current	V _{GS} = ±15 V; V _{DS} = 0 V	-	10	100	nA
R _{DS(on)}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 500 mA; see Figure 6 and 8				
		T _j = 25 °C	-	2.8	5	Ω
		T _j = 150 °C	-	-	9.25	Ω
		V _{GS} = 4.5 V; I _D = 75 mA; see Figure 6 and 8	-	3.8	5.3	Ω
Dynamic characteristics						
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 10 V; f = 1 MHz;	-	31	50	pF
C _{oss}	output capacitance	see Figure 12	-	6.8	30	pF
C _{rss}	reverse transfer capacitance		-	3.5	10	pF
t _{on}	turn-on time	V _{DS} = 50 V; R _L = 250 Ω; V _{GS} = 10 V;	-	2.5	10	ns
t _{off}	turn-off time	R _G = 50 Ω; R _{GS} = 50 Ω	-	11	15	ns
Source-drain diode						
V _{SD}	source-drain voltage	I _S = 300 mA; V _{GS} = 0 V; see Figure 11	-	0.85	1.5	V
t _{rr}	reverse recovery time	I _S = 300 mA; dI _S /dt = -100 A/μs; V _{GS} = 0 V	-	30	-	ns
Q _r	recovered charge		-	30	-	nC



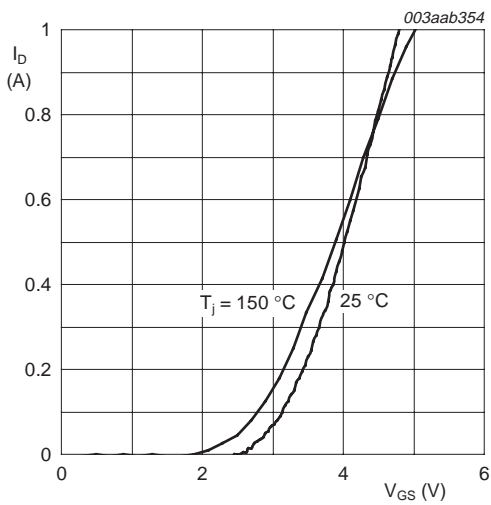
$T_j = 25\text{ }^\circ\text{C}$

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



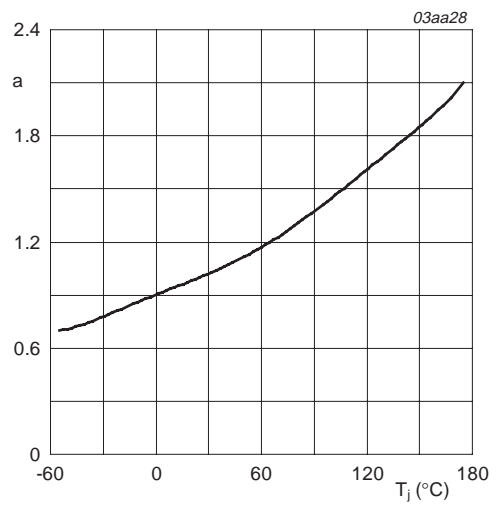
$T_j = 25\text{ }^\circ\text{C}$

Fig 6. Drain-source on-state resistance as a function of drain current; typical values



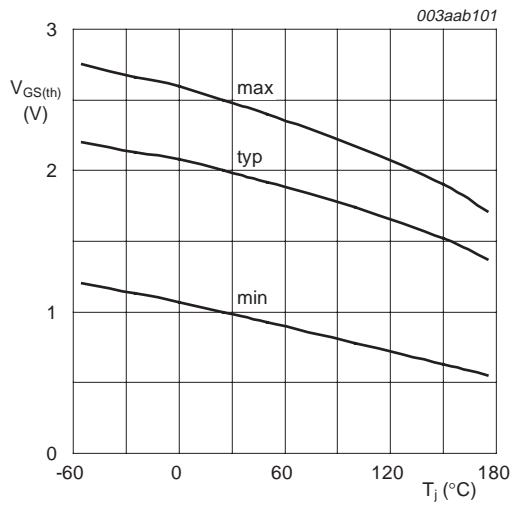
$T_j = 25\text{ }^\circ\text{C}$ and $150\text{ }^\circ\text{C}$; $V_{DS} > I_D \times R_{DS(on)}$

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values



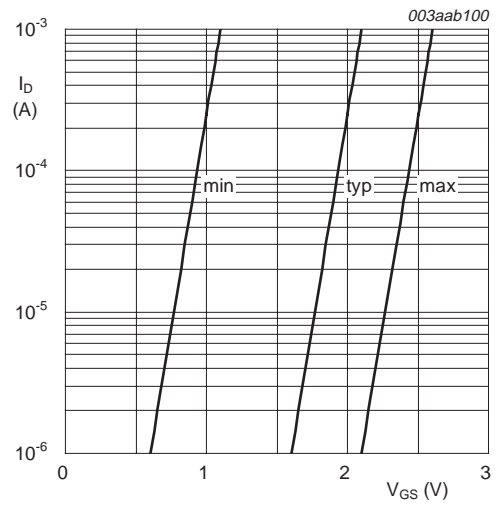
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25\text{ }^\circ\text{C})}}$$

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



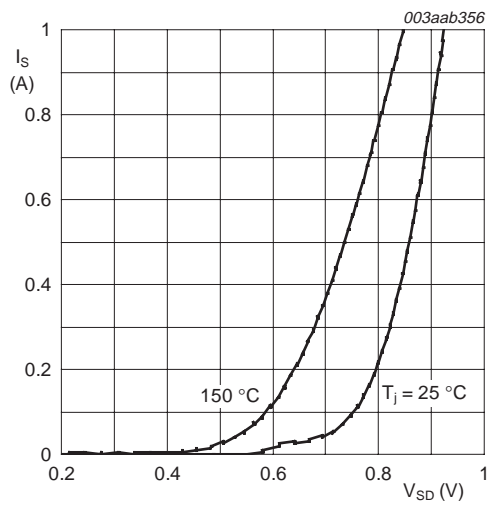
$I_D = 0.25 \text{ mA}; V_{DS} = V_{GS}$

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



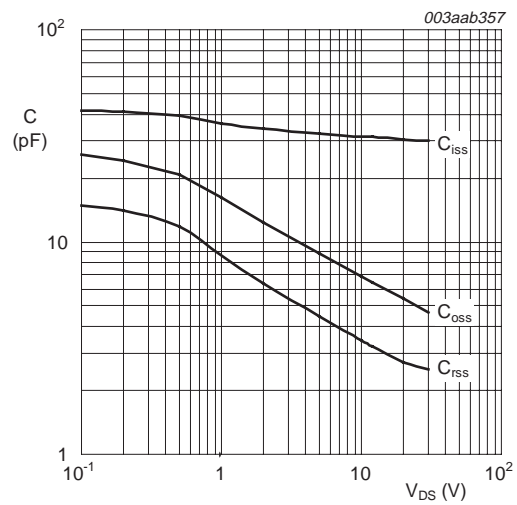
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 5 \text{ V}$

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



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

Fig 11. Source current as a function of source-drain voltage; typical values



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

Fig 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

7. Package outline

Plastic surface-mounted package; 3 leads

SOT23

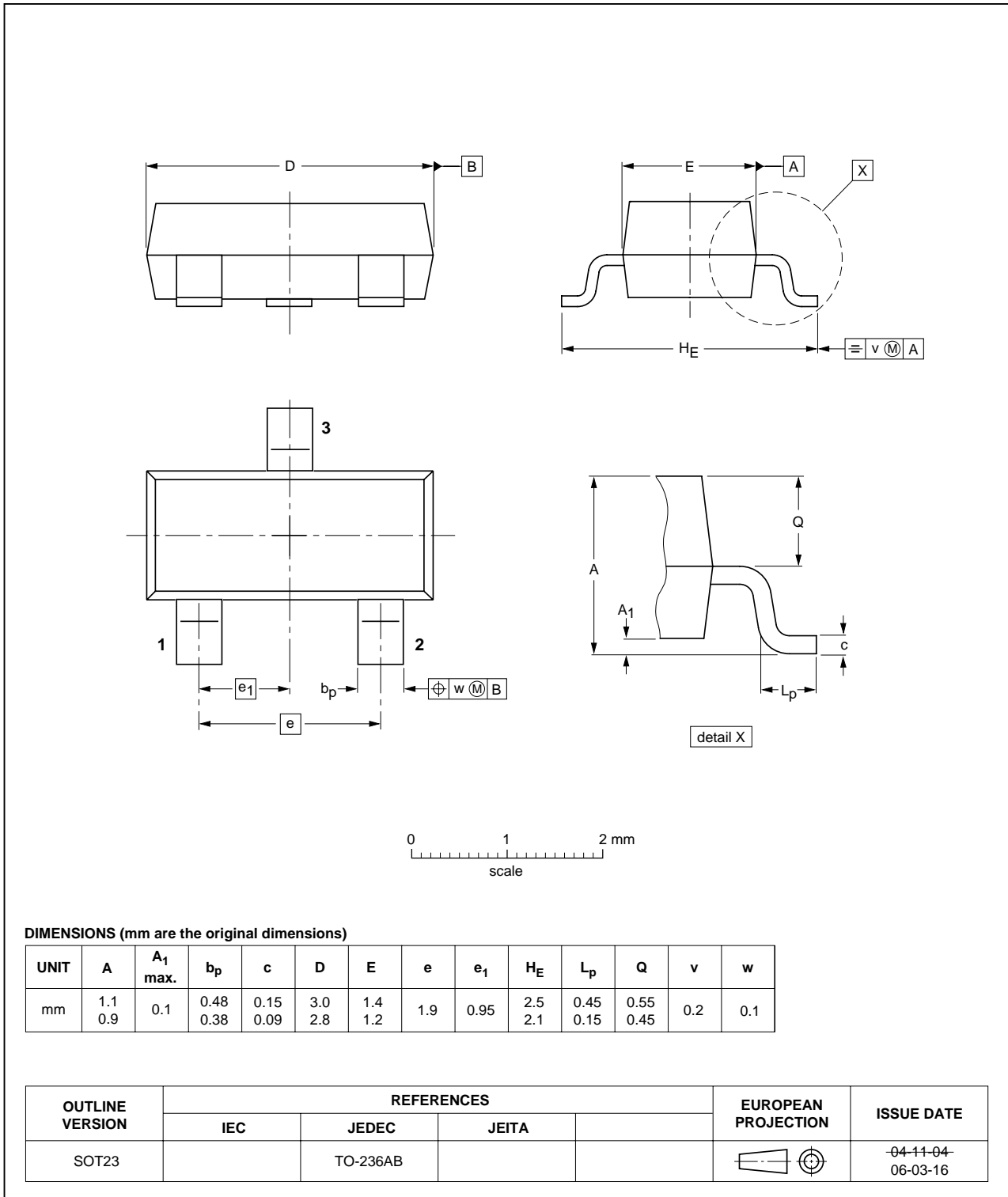


Fig 13. Package outline SOT23

8. Revision history

Table 6: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
2N7002_6	20060428	Product data sheet	-	-	2N7002_5
Modifications:	<ul style="list-style-type: none"> • Table 5 “Characteristics”: g_{fs} removed • Table 5 “Characteristics”: C_{iss}, C_{oss} and C_{rss} values modified • Table 5 “Characteristics”: t_{on} and t_{off} typical values modified • Figure 3, 4, 5, 6, 7, 11, and 12: modified 				
2N7002_5	20051115	Product data sheet	-	-	2N7002_4
2N7002_4	20050426	Product data sheet	-	9397 750 14915	2N7002-03
2N7002-03	20000727	Product specification	HZG336	9397 750 07319	2N7002_2
2N7002_2	19970617	Product specification	-	-	2N7002_1
2N7002_1	19901031	Product specification	-	-	-

9. Data sheet status

Level	Data sheet status ^[1]	Product status ^{[2] [3]}	Definition
I	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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Date of release: 28 April 2006
Document number: 2N7002_6

Published in The Netherlands