

2N7002E

TrenchMOS™ Logic Level FET

Rev. 01 — 11 February 2002

Product data

1. Description

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

Product availability:

2N7002E in SOT23.

2. Features

- TrenchMOS™ technology
- Very fast switching
- Logic level compatible
- Subminiature surface mount package.

3. Applications

- Relay driver
- High speed line driver
- Logic level translator.

4. Pinning information

Table 1: Pinning - SOT23, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	source (s)		
3	drain (d)		
		SOT23	N-channel MOSFET

1. TrenchMOS is a trademark of Koninklijke Philips Electronics N.V.



5. Quick reference data

Table 2: Quick reference data

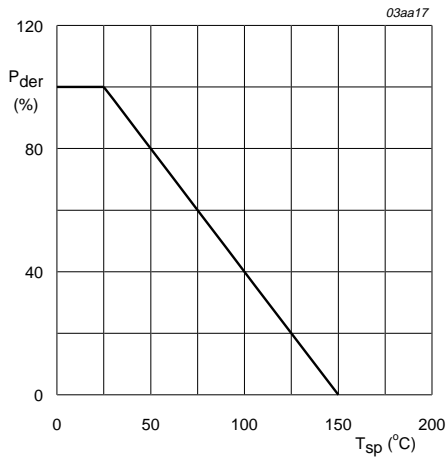
Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)	$T_j = 25$ to 150 °C	-	60	V
I_D	drain current (DC)	$T_{sp} = 25$ °C; $V_{GS} = 10$ V	-	385	mA
P_{tot}	total power dissipation	$T_{sp} = 25$ °C	-	0.83	W
T_j	junction temperature		-	150	°C
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 500$ mA; $T_j = 25$ °C	2.3	3	Ω
		$V_{GS} = 4.5$ V; $I_D = 75$ mA; $T_j = 25$ °C	3.1	4	Ω

6. Limiting values

Table 3: Limiting values

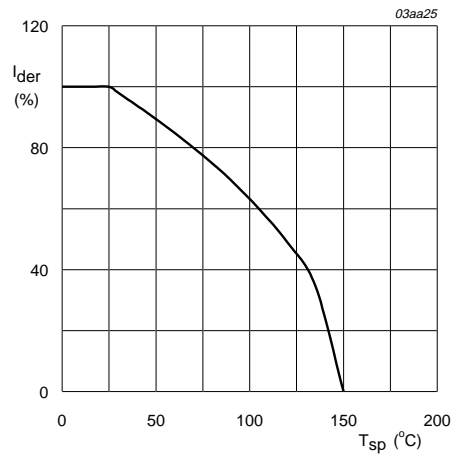
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	$T_j = 25$ to 150 °C	-	60	V
V_{DGR}	drain-gate voltage (DC)	$T_j = 25$ to 150 °C; $R_{GS} = 20$ k Ω	-	60	V
V_{GS}	gate-source voltage (DC)		-	± 30	V
V_{GSM}	peak gate-source voltage	$t_p \leq 50$ μ s; pulsed; duty cycle = 25%	-	± 40	V
I_D	drain current (DC)	$T_{sp} = 25$ °C; $V_{GS} = 10$ V; Figure 2 and 3	-	385	mA
		$T_{sp} = 100$ °C; $V_{GS} = 10$ V; Figure 2	-	245	mA
I_{DM}	peak drain current	$T_{sp} = 25$ °C; pulsed; $t_p \leq 10$ μ s; Figure 3	-	1.5	A
P_{tot}	total power dissipation	$T_{sp} = 25$ °C; Figure 1	-	0.83	W
T_{stg}	storage temperature		-65	+150	°C
T_j	operating junction temperature		-65	+150	°C
Source-drain diode					
I_S	source (diode forward) current (DC)	$T_{sp} = 25$ °C	-	385	mA
I_{SM}	peak source (diode forward) current	$T_{sp} = 25$ °C; pulsed; $t_p \leq 10$ μ s	-	1.5	A



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

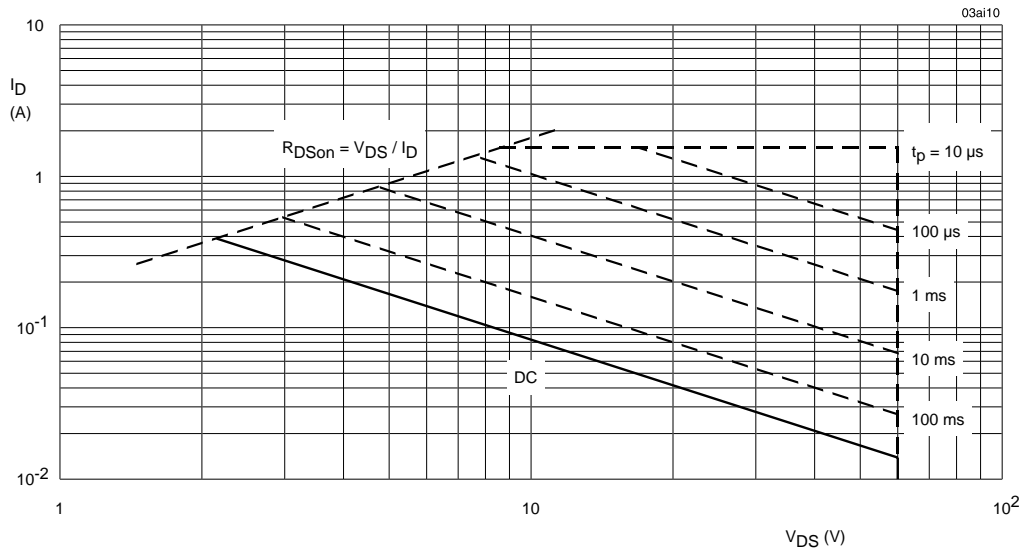
Fig 1. Normalized total power dissipation as a function of solder point temperature.



V_{GS} ≥ 4.5 V

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

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



T_{sp} = 25 °C; I_{DM} is single pulse; V_{GS} = 10 V.

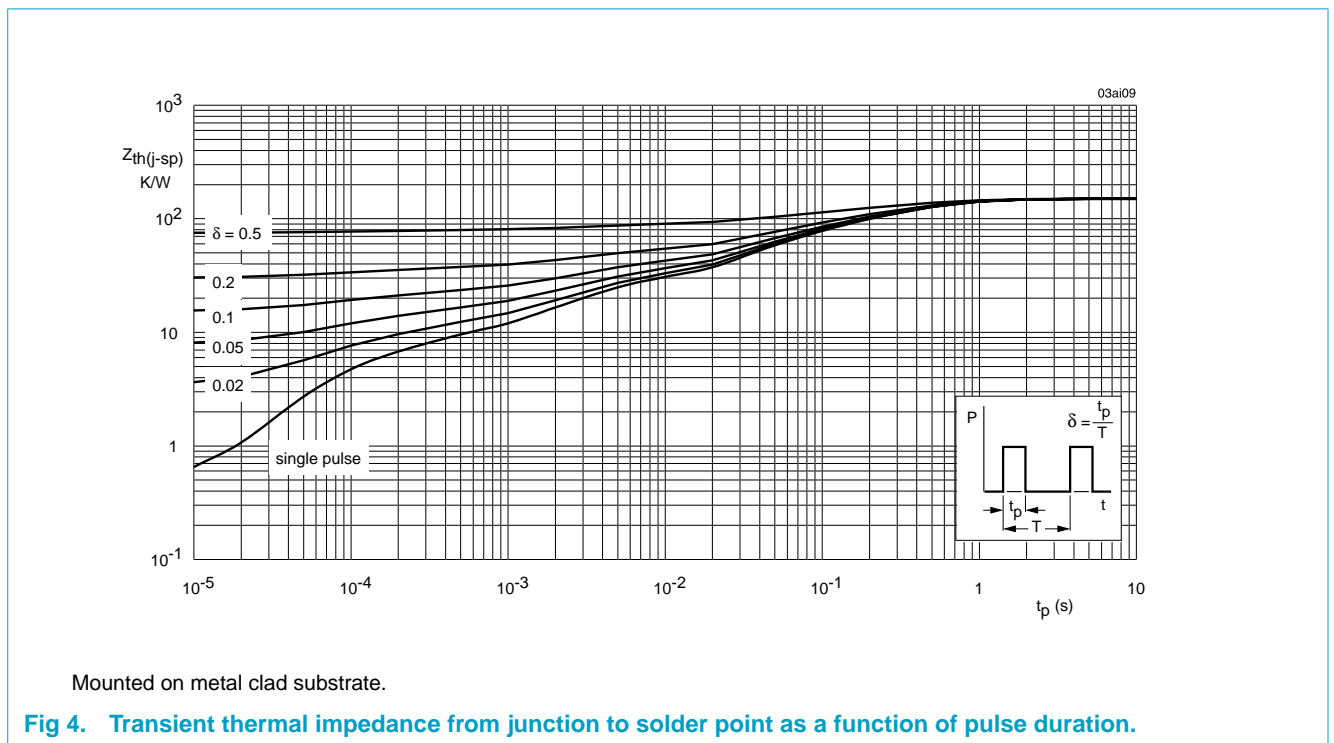
Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

7. Thermal characteristics

Table 4: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	mounted on a metal clad board; Figure 4	-	-	150	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on a printed circuit board; minimum footprint	-	-	350	K/W

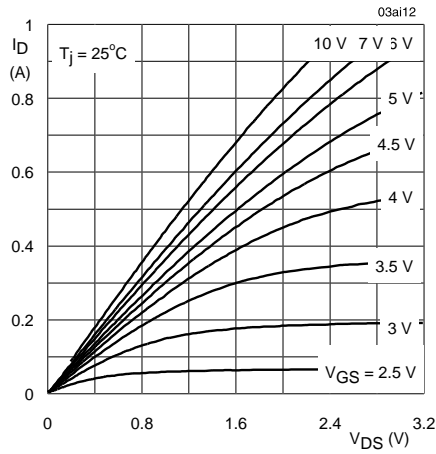
7.1 Transient thermal impedance



8. Characteristics

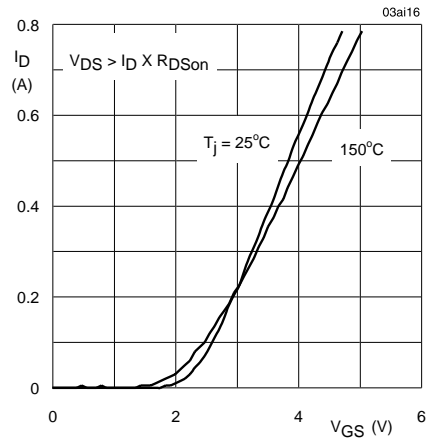
Table 5: Characteristics
T_j = 25 °C unless otherwise specified

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	75	-	V
		T _j = -55 °C	55	-	-	V
V _{GS(th)}	gate-source threshold voltage	I _D = 1 mA; V _{DS} = V _{GS} ; Figure 9 T _j = 25 °C	1	2	-	V
		T _j = 150 °C	0.6	-	-	V
		T _j = -55 °C	-	-	3.5	V
I _{DSS}	drain-source leakage current	V _{DS} = 48 V; V _{GS} = 0 V T _j = 25 °C	-	0.01	1.0	μA
		T _j = 150 °C	-	-	10	μA
I _{GSS}	gate-source 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; Figure 7 and 8 T _j = 25 °C	-	2.3	3	Ω
		T _j = 150 °C	-	4.2	5.55	Ω
		V _{GS} = 4.5 V; I _D = 75 mA; Figure 7 and 8 T _j = 25 °C	-	3.1	4	Ω
Dynamic characteristics						
g _{fs}	forward transconductance	V _{DS} = 10 V; I _D = 200 mA	100	300	-	mS
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 10 V; f = 1 MHz; Figure 11	-	25	40	pF
C _{oss}	output capacitance		-	18	30	pF
C _{rss}	reverse transfer capacitance		-	7.5	10	pF
t _{on}	turn-on time	V _{DD} = 50 V; R _D = 250 Ω; V _{GS} = 10 V;	-	3	10	ns
t _{off}	turn-off time	R _G = 50 Ω; R _{GS} = 50 Ω	-	12	15	ns
Source-drain diode						
V _{SD}	source-drain (diode forward) voltage	I _S = 300 mA; V _{GS} = 0 V; Figure 12	-	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	V _{DS} = 25 V	-	30	-	nC



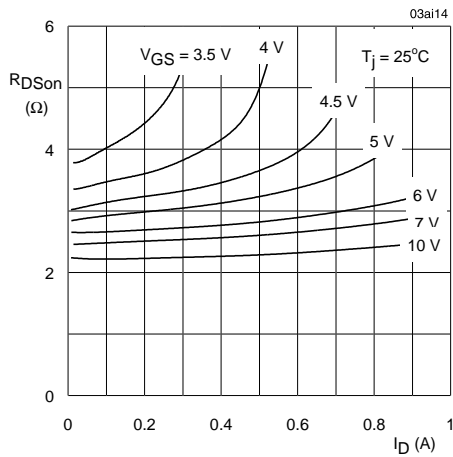
$T_j = 25^\circ\text{C}$.

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



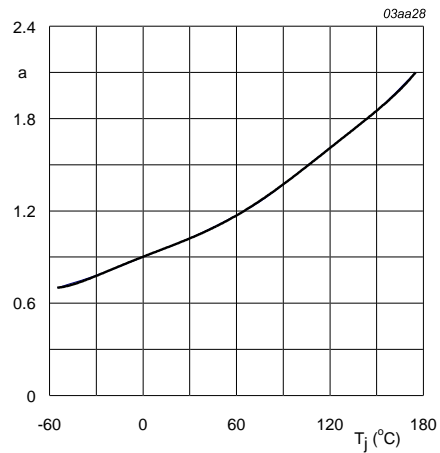
$T_j = 25^\circ\text{C}$ and 150°C ; $V_{DS} > I_D \times R_{DSon}$.

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



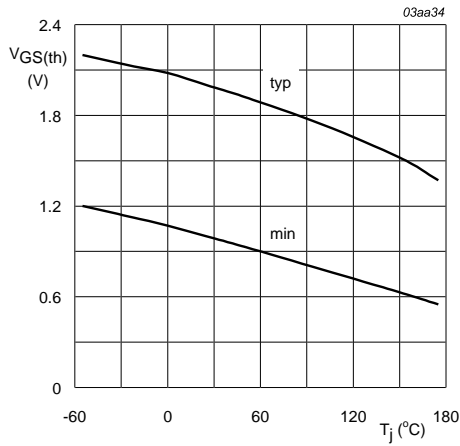
$T_j = 25^\circ\text{C}$.

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



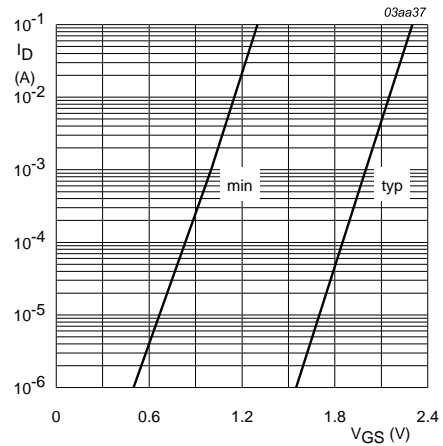
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



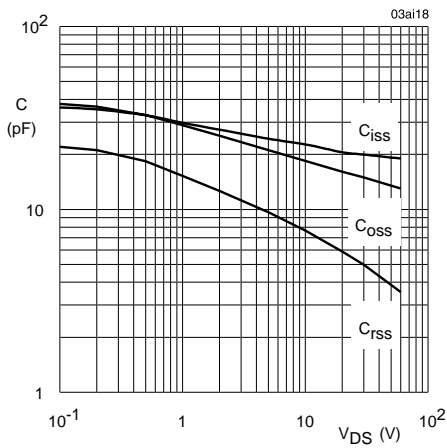
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$.

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



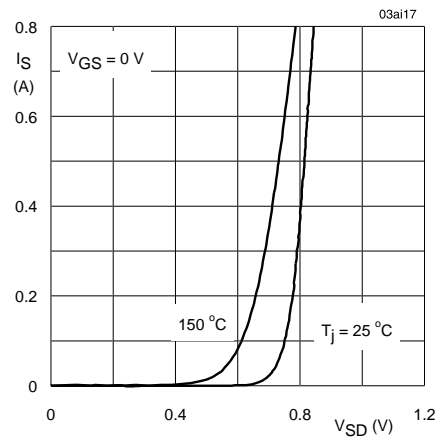
$T_j = 25 \text{ }^\circ\text{C}; V_{DS} = 5 \text{ V}$.

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.



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

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

9. Package outline

Plastic surface mounted package; 3 leads

SOT23

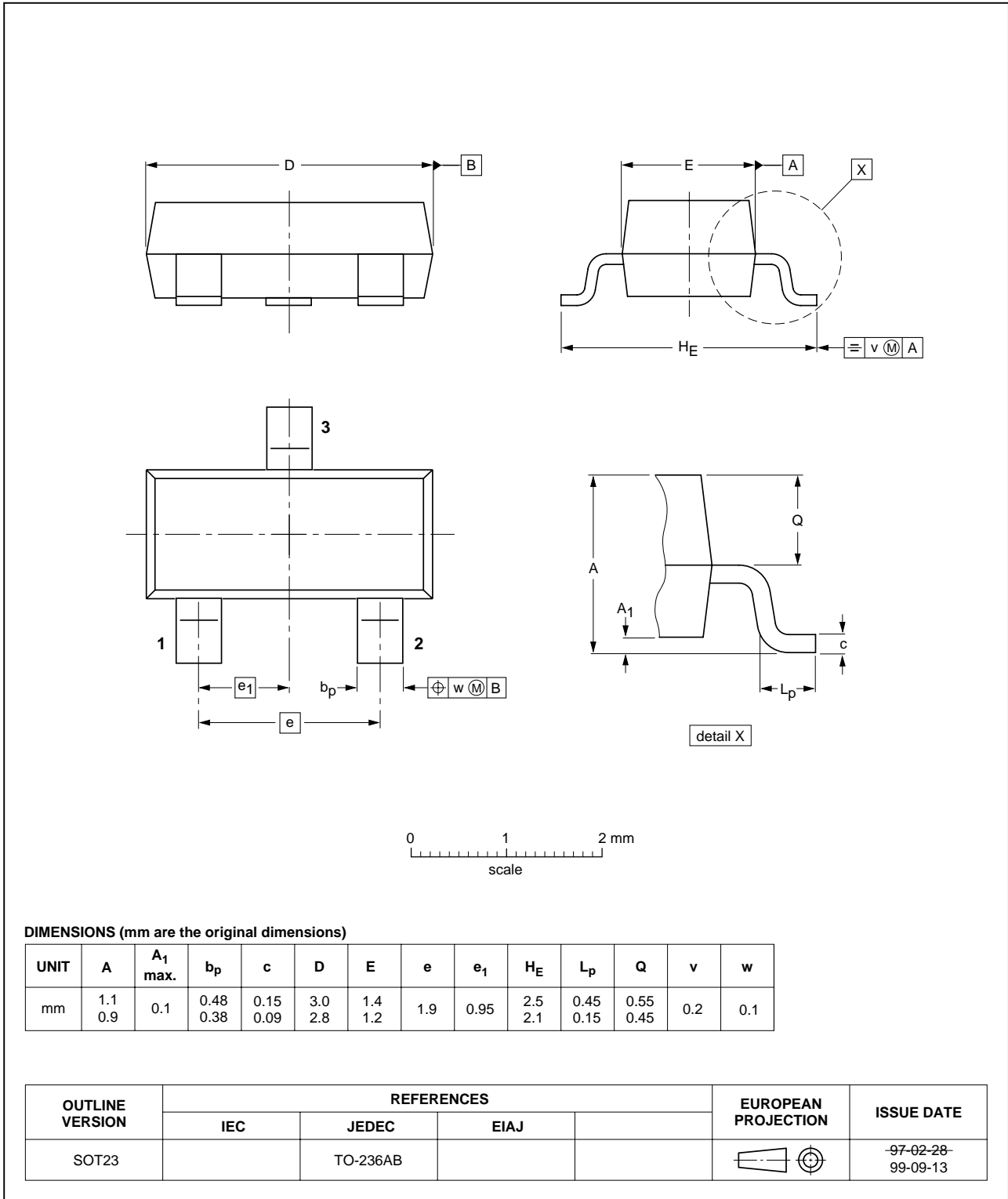


Fig 13. SOT23.

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20020211	-	Product spec; 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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