

PHU11NQ10T

TrenchMOS™ standard level FET

Rev. 01 — 28 May 2002

Product data

1. Description

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

Product availability:

PHU11NQ10T in SOT533 (I-pak).

2. Features

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

3. Applications

- Relay driver
- High speed line driver
- General purpose switch.

4. Pinning information

Table 1: Pinning - SOT533, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)	<p>Top view MBK915</p> <p>SOT533</p>	<p>MBB076</p>
2	drain (d)		
3	source (s)		
tab	drain (d)		



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5. Quick reference data

Table 2: Quick reference data

Symbol	Parameter	Conditions	Typ	Max	Unit
V_{DS}	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	100	V
I_D	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V}$	-	10.9	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$	-	57.7	W
T_j	junction temperature		-	175	°C
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 9\text{ A}; T_j = 25\text{ °C}$	150	180	mΩ

6. Limiting values

Table 3: Limiting values

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

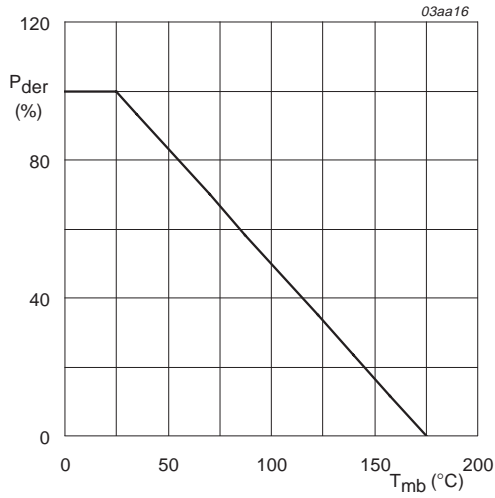
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	100	V
V_{DGR}	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}; R_{GS} = 20\text{ k}\Omega$	-	100	V
V_{GS}	gate-source voltage (DC)		-	±20	V
I_D	drain current (DC)	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ Figure 2 and 3	-	10.9	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 10\text{ V};$ Figure 2	-	7.7	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C};$ pulsed; $t_p \leq 10\text{ }\mu\text{s};$ Figure 3	-	43.6	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ Figure 1	-	57.7	W
T_{stg}	storage temperature		-55	+175	°C
T_j	junction temperature		-55	+175	°C

Source-drain diode

I_S	source (diode forward) current (DC)	$T_{mb} = 25\text{ °C}$	-	10.9	A
I_{SM}	peak source (diode forward) current	$T_{mb} = 25\text{ °C}; t_p \leq 10\text{ }\mu\text{s}$	-	43.6	A

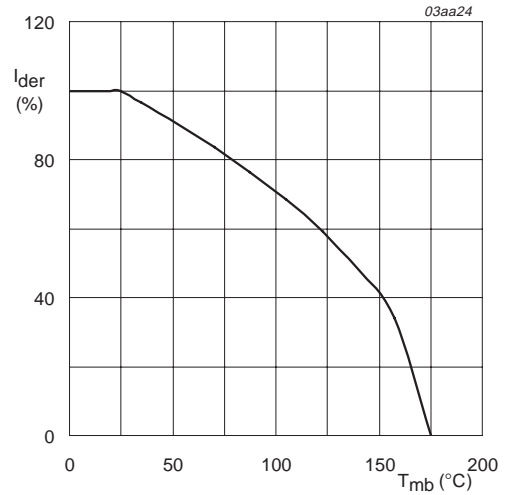
Avalanche ruggedness

$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 3.2\text{ A};$ $t_p = 0.2\text{ ms}; V_{DD} \leq 15\text{ V}; R_{GS} = 50\text{ }\Omega;$ $V_{GS} = 10\text{ V};$ starting $T_j = 25\text{ °C}$	-	35	mJ
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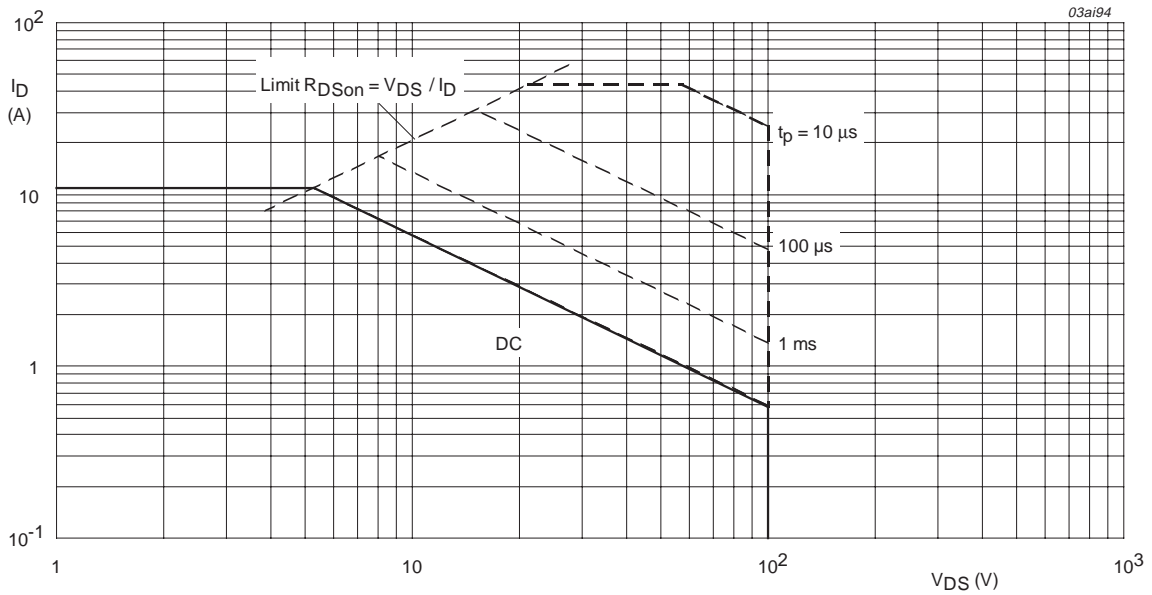
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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

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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	2.6	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	SOT533 package; vertical in still air	-	70	-	K/W

7.1 Transient thermal impedance

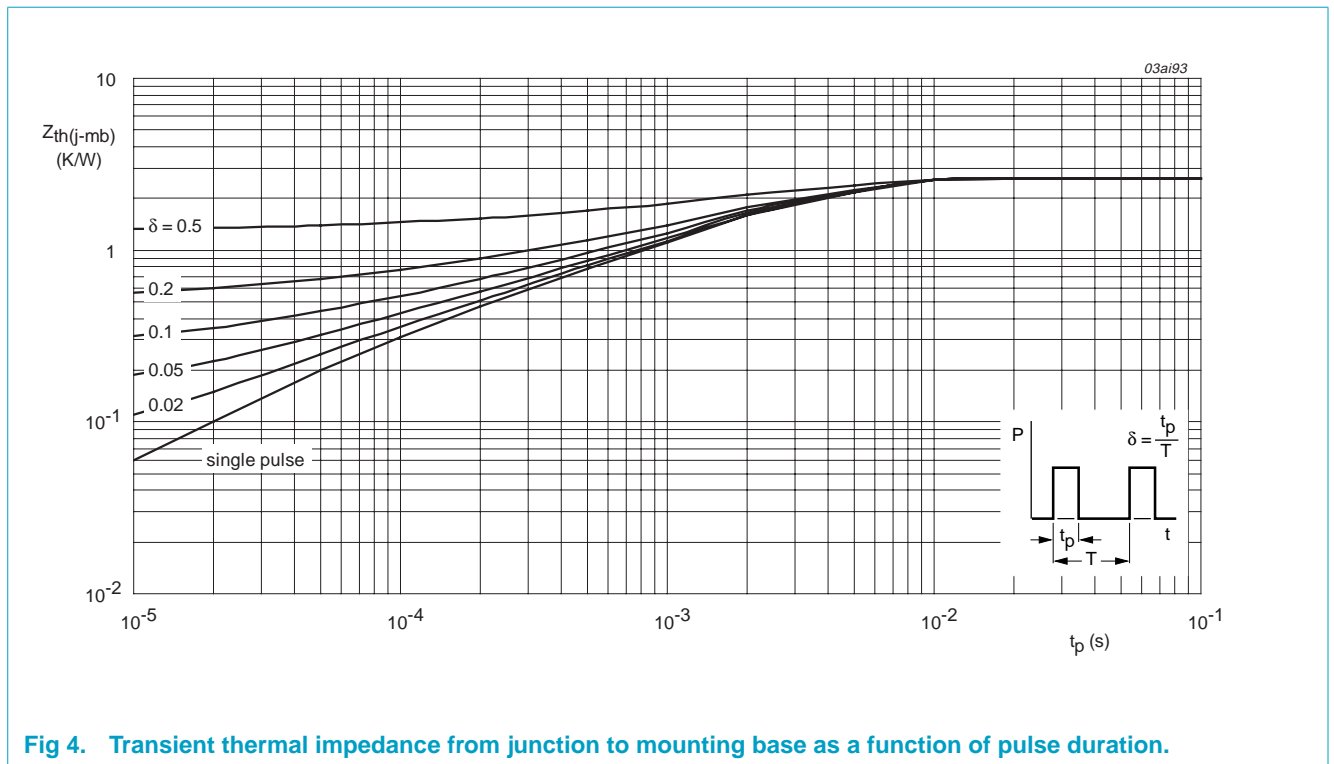
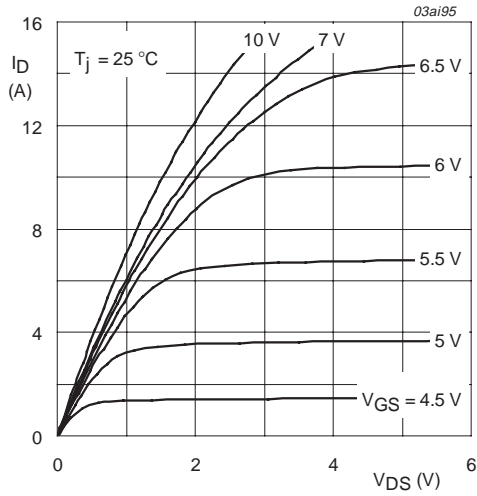


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

8. Characteristics

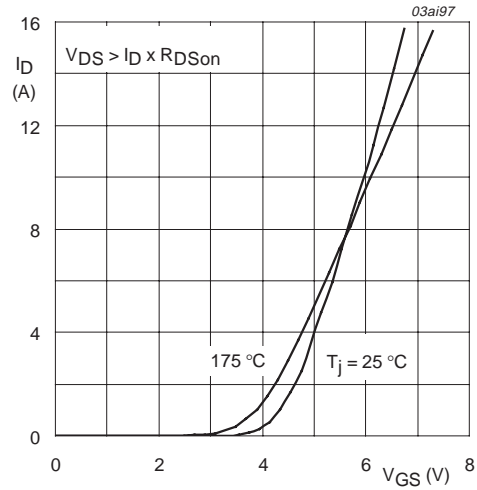
Table 5: Characteristics
 $T_j = 25\text{ °C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{GS} = 0\text{ V}$; $I_D = 250\text{ }\mu\text{A}$ $T_j = 25\text{ °C}$ $T_j = -55\text{ °C}$	100 89	130 -	- -	V V
$V_{GS(th)}$	gate-source threshold voltage	$V_{DS} = V_{GS}$; $I_D = 1\text{ mA}$; Figure 9 $T_j = 25\text{ °C}$ $T_j = 175\text{ °C}$ $T_j = -55\text{ °C}$	1 0.6 -	3 - -	4 - 4.6	V V V
I_{DSS}	drain-source leakage current	$V_{DS} = 100\text{ V}$; $V_{GS} = 0\text{ V}$ $T_j = 25\text{ °C}$ $T_j = 175\text{ °C}$	- - -	0.05 10 10	10 500	μA μA
I_{GSS}	gate-source leakage current	$V_{DS} = 0\text{ V}$; $V_{GS} = \pm 10\text{ V}$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 9\text{ A}$; Figure 7 and 8 $T_j = 25\text{ °C}$ $T_j = 175\text{ °C}$	- - -	150 - -	180 485	m Ω m Ω
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$I_D = 11\text{ A}$; $V_{DS} = 80\text{ V}$; $V_{GS} = 10\text{ V}$; Figure 13	-	14.7	-	nC
Q_{gs}	gate-source charge		-	2.3	-	nC
Q_{gd}	gate-drain (Miller) charge		-	5.3	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; Figure 11	-	360	-	pF
C_{oss}	output capacitance		-	60	-	pF
C_{rss}	reverse transfer capacitance		-	40	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 50\text{ V}$; $R_D = 4.7\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $R_G = 5.6\text{ }\Omega$	-	5.5	-	ns
t_r	rise time		-	23	-	ns
$t_{d(off)}$	turn-off delay time		-	11.5	-	ns
t_f	fall time		-	7.2	-	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 11\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 12	-	1	1.5	V
t_{rr}	reverse recovery time	$I_S = 4\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$	-	55	-	ns
Q_r	recovered charge		-	85	-	nC



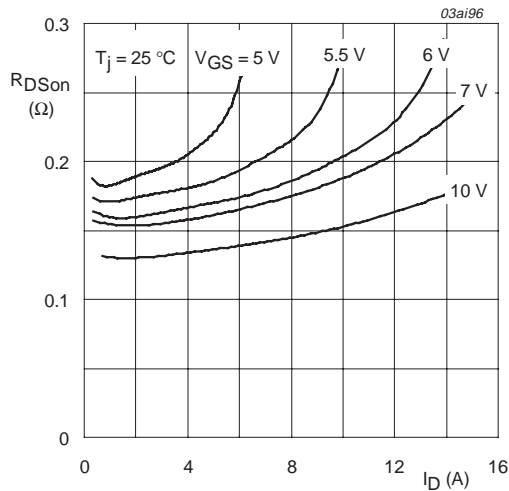
$T_j = 25\text{ }^\circ\text{C}$

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



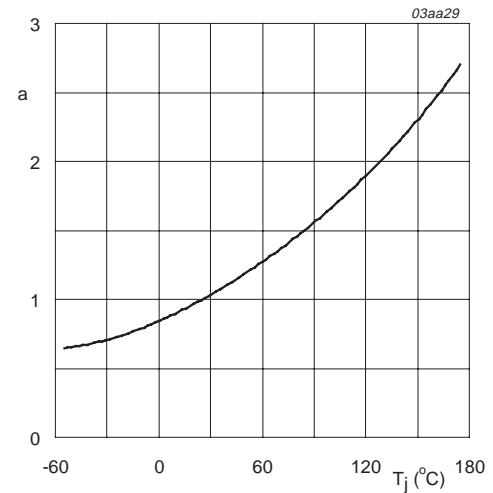
$T_j = 25\text{ }^\circ\text{C}$ and $175\text{ }^\circ\text{C}$; $V_{DS} > I_D \times R_{DSon}$

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



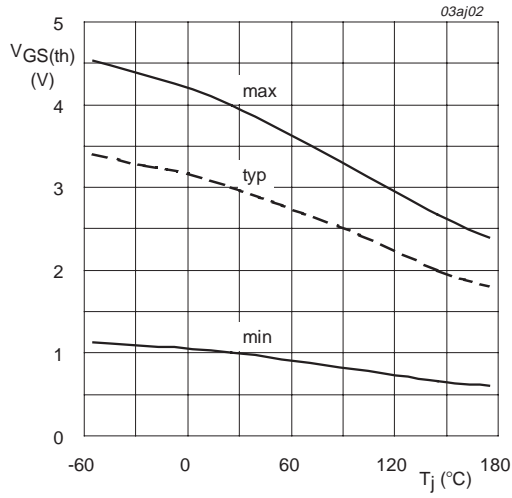
$T_j = 25\text{ }^\circ\text{C}$

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



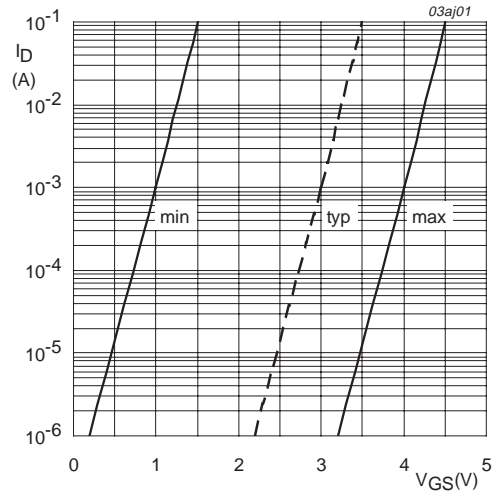
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



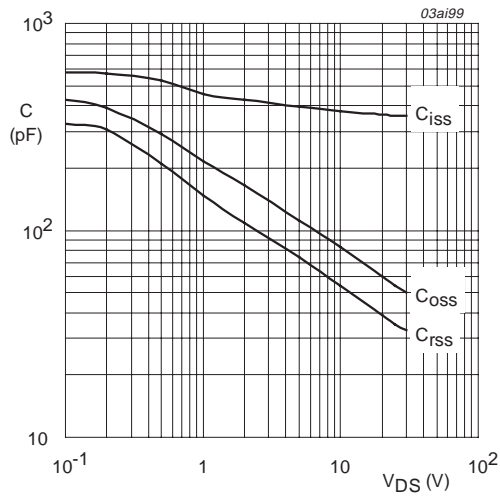
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



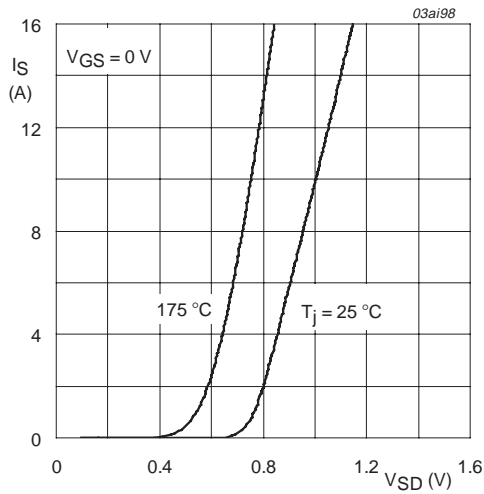
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 5 \text{ V}$

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



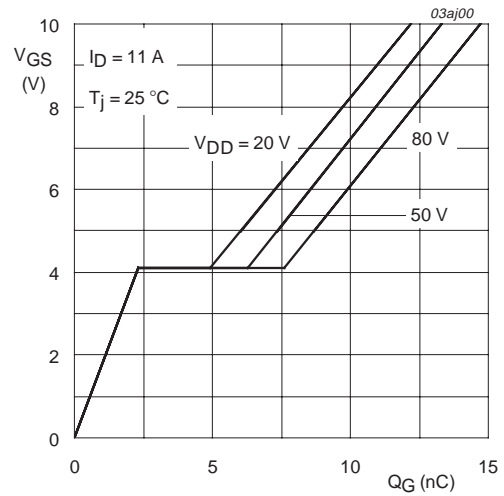
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



$T_j = 25$ °C and 175 °C; $V_{GS} = 0$ V

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



$I_D = 11$ A; $V_{DD} = 20$ V, 50 V, 80 V

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

9. Package outline

Plastic single-ended package (Philips version of I-PAK); 3 leads (in-line)

SOT533

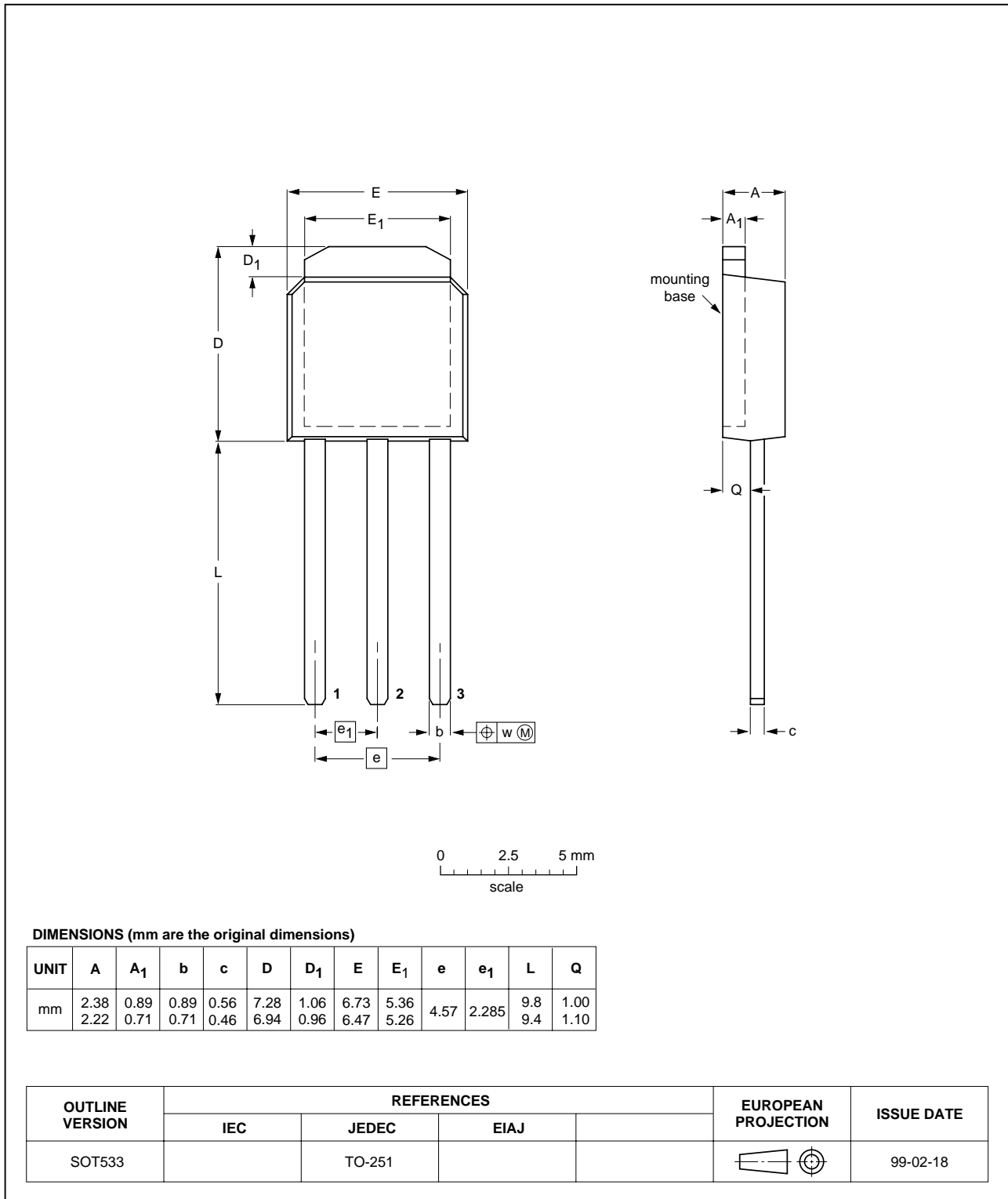


Fig 14. SOT533. (I-PAK)

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
1	20020528	-	Product data; 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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Contents

1	Description	1
2	Features	1
3	Applications	1
4	Pinning information	1
5	Quick reference data	2
6	Limiting values	2
7	Thermal characteristics	4
7.1	Transient thermal impedance	4
8	Characteristics	5
9	Package outline	9
10	Revision history	10
11	Data sheet status	11
12	Definitions	11
13	Disclaimers	11
14	Trademarks	11

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