

IRFR220

N-channel enhancement mode field effect transistor

Rev. 01 — 14 August 2001

Product data

1. Description

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

Product availability:

IRFR220 in SOT428 (D-PAK).

2. Features

- Fast switching
- Low on-state resistance
- Surface mount package.

3. Applications

- Switched mode power supplies
- DC to DC converters.

4. Pinning information

Table 1: Pinning - SOT428 (D-PAK), simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)	<p>Top view <small>MBK091</small></p> <p>SOT428 (D-PAK)</p>	<p><small>MBB076</small></p>
2	drain (d) [1]		
3	source (s)		
mb	mounting base; connected to drain (d)		

[1] It is not possible to make connection to pin 2 of the SOT428 package.

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



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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)	$T_j = 25$ to 150 °C	–	200	V
I_D	drain current (DC)	$T_{mb} = 25$ °C; $V_{GS} = 10$ V	–	4.8	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C	–	42	W
T_j	junction temperature		–	150	°C
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 2.9$ A	0.7	0.8	Ω

6. Limiting values

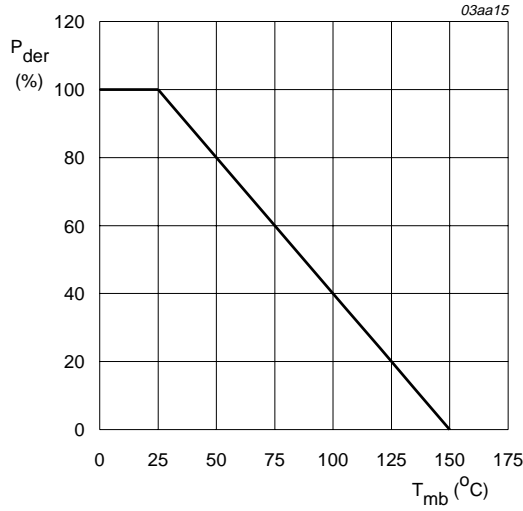
Table 3: Limiting values

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	–	200	V
V_{DGR}	drain-gate voltage (DC)	$T_j = 25$ to 150 °C; $R_{GS} = 20$ k Ω	–	200	V
V_{GS}	gate-source voltage (DC)		–	± 20	V
I_D	drain current (DC)	$T_{mb} = 25$ °C; $V_{GS} = 10$ V; Figure 2 and 3	–	4.8	A
		$T_{mb} = 100$ °C; $V_{GS} = 10$ V; Figure 2 and 3	–	3.0	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; $t_p \leq 10$ μ s	–	19	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Figure 1	–	42	W
T_{stg}	storage temperature		–55	+150	°C
T_j	operating junction temperature		–55	+150	°C

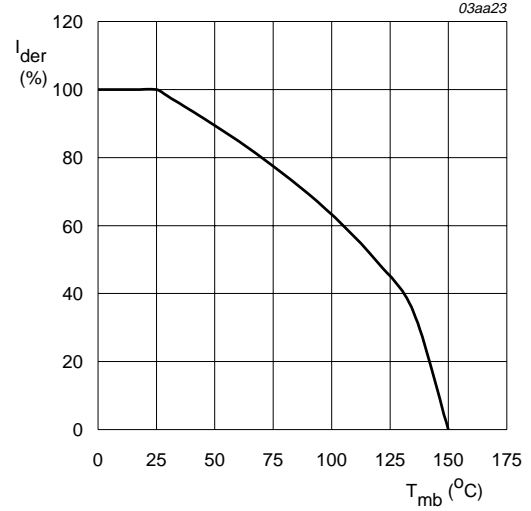
Source-drain (reverse) diode

I_S	source (diode forward) current (DC)	$T_{mb} = 25$ °C	–	4.8	A
I_{SM}	peak (diode forward) source current	$T_{mb} = 25$ °C; $t_p \leq 10$ μ s	–	19	A



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

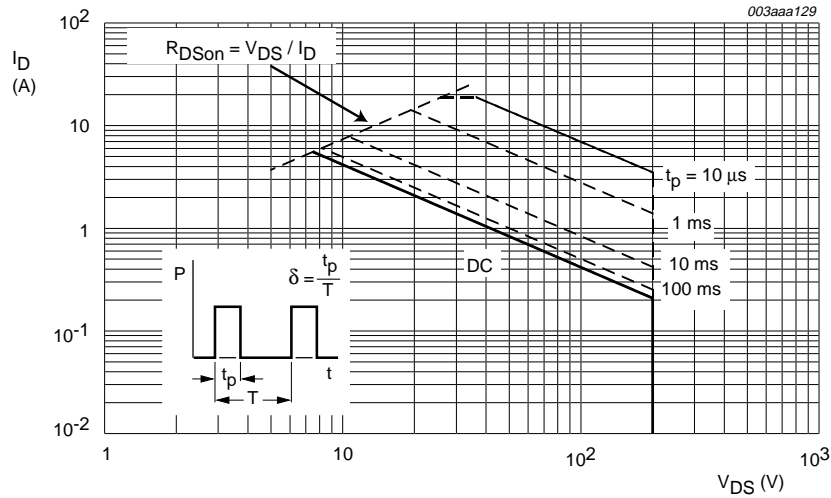
Fig 1. Normalized total power dissipation as a function of mounting base temperature.



V_{GS} ≥ 10 V

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

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



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

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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	mounted on a metal clad substrate; Figure 4	3	K/W

7.1 Transient thermal impedance

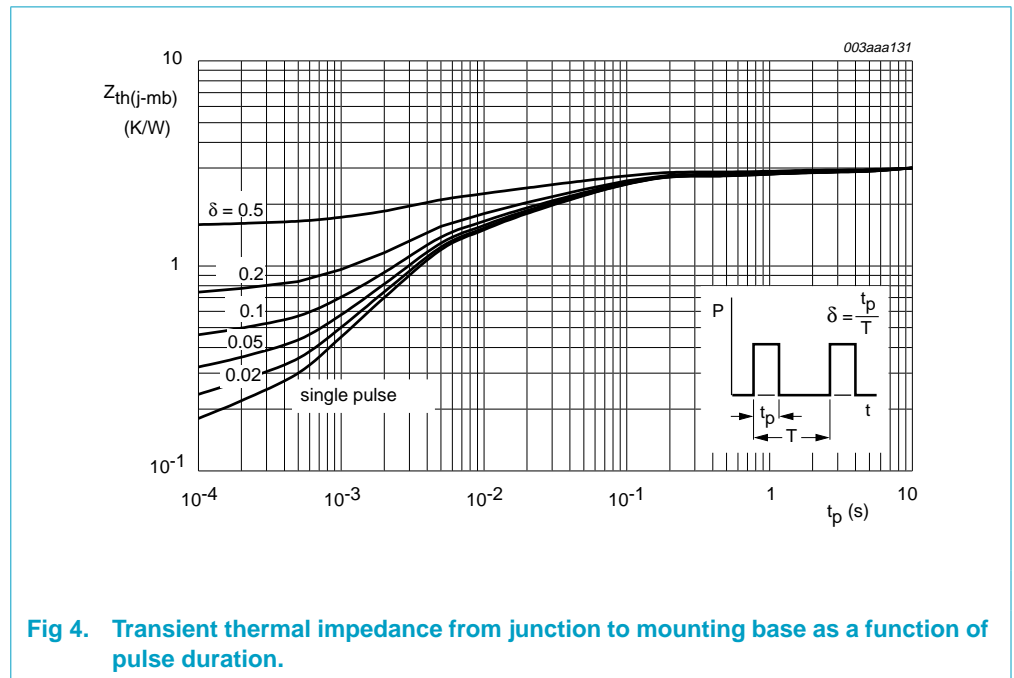
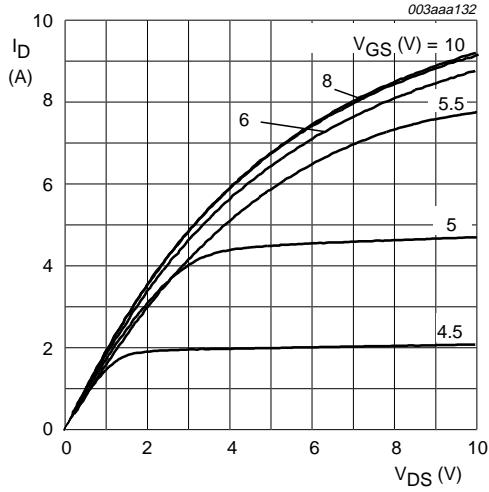


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

8. Characteristics

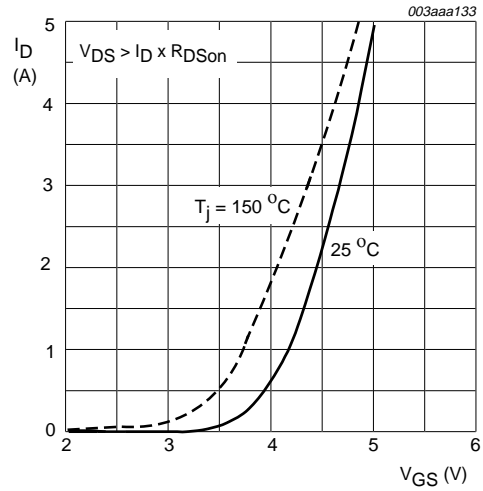
Table 5: Characteristics
T_j = 25 °C unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 250 μA; V _{GS} = 0 V	200	–	–	V
V _{GS(th)}	gate-source threshold voltage	I _D = 250 μA; V _{DS} = V _{GS} ; Figure 9	2	3	4	V
I _{DSS}	drain-source leakage current	V _{DS} = 200 V; V _{GS} = 0 V	–	–	25	μA
		V _{DS} = 160 V; V _{GS} = 0 V; T _j = 125 °C	–	–	250	μA
I _{GSS}	gate-source leakage current	V _{GS} = ±20 V; V _{DS} = 0 V	–	10	100	nA
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 2.9 A				
		T _j = 25 °C; Figure 7 and 8	–	0.7	0.8	Ω
		T _j = 150 °C; Figure 7 and 8	–	–	1.9	Ω
Dynamic characteristics						
g _{fs}	forward transconductance	V _{DS} = 50 V; I _D = 2.9 A	1.7	–	–	S
Q _{g(tot)}	total gate charge	I _D = 4.8 A; V _{DD} = 160 V; V _{GS} = 10 V; Figure 13	–	10	14	nC
Q _{gs}	gate-source charge		–	1.5	3.0	nC
Q _{gd}	gate-drain (Miller) charge		–	4.0	7.9	nC
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DD} = 25 V; f = 1 MHz; Figure 11	–	280	–	pF
C _{oss}	output capacitance		–	41	–	pF
C _{rss}	reverse transfer capacitance		–	25	–	pF
t _{d(on)}	turn-on delay time	V _{DD} = 100 V; R _D = 20 Ω; V _{GS} = 10 V;	–	5.0	–	ns
t _r	rise time	R _G = 18 Ω	–	17	–	ns
t _{d(off)}	turn-off delay time		–	22	–	ns
t _f	fall time		–	18	–	ns
Source-drain (reverse) diode						
V _{SD}	source-drain (diode forward) voltage	I _S = 4.8 A; V _{GS} = 0 V; Figure 12	–	–	1.8	V
t _{rr}	reverse recovery time	I _S = 4.8 A; dI _S /dt = –100 A/μs;	–	85	170	ns
Q _r	recovered charge	V _{GS} = 0 V; V _{DS} = 30 V	–	0.2	1.8	μC



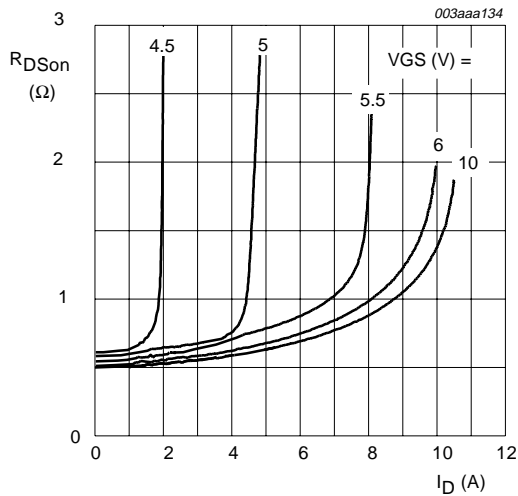
$T_j = 25\text{ }^\circ\text{C}$

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



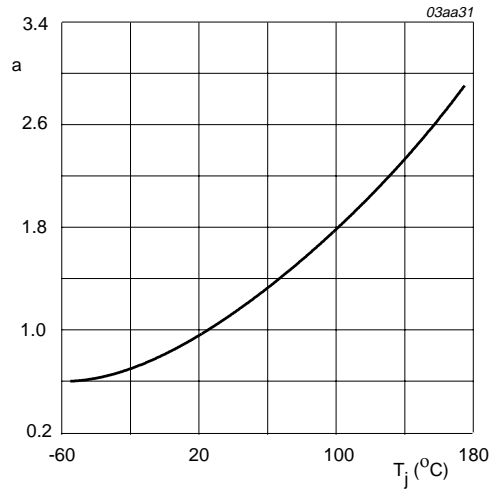
$T_j = 25\text{ }^\circ\text{C}$ and $150\text{ }^\circ\text{C}$; $V_{DS} > I_D \times R_{DSon}$

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



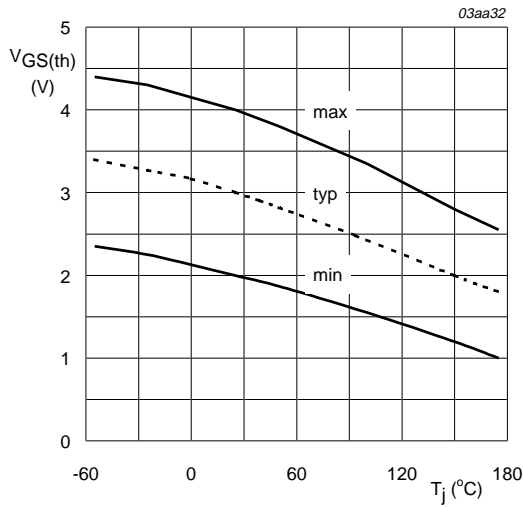
$T_j = 25\text{ }^\circ\text{C}$

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



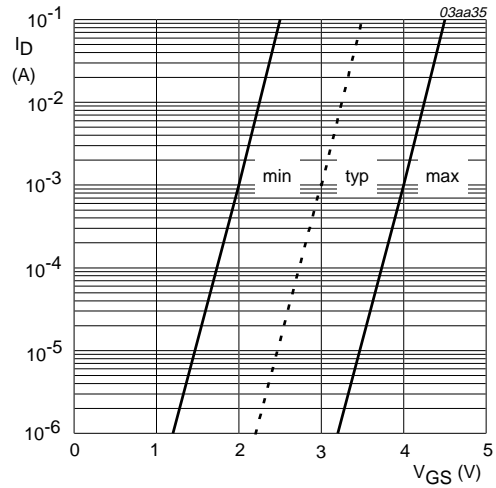
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



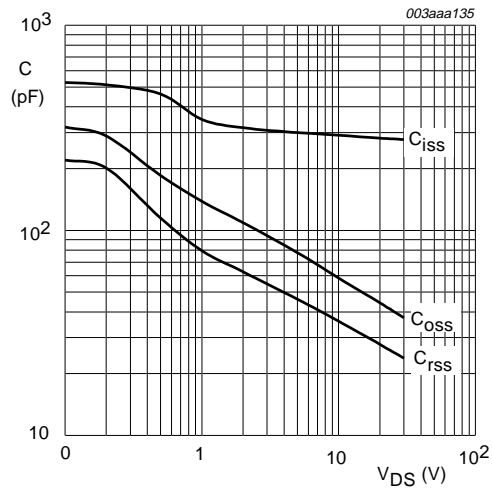
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



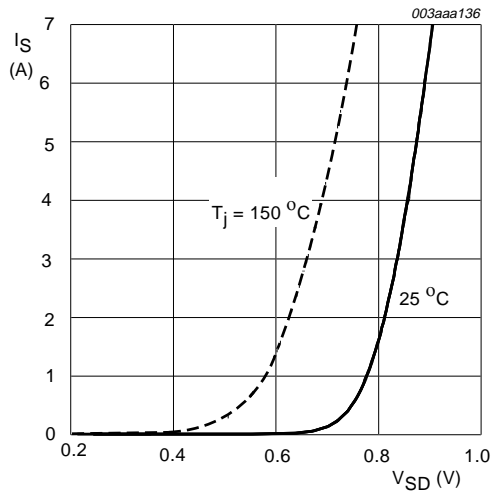
$T_j = 25 \text{ }^{\circ}C; V_{DS} = 5 \text{ V}$

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



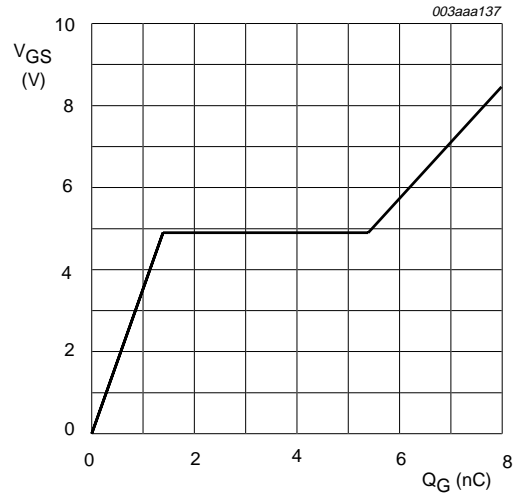
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



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

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



$I_D = 4.8\text{ A}$; $V_{DD} = 160\text{ V}$

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

9. Package outline

Plastic single-ended surface mounted package (Philips version of D-PAK); 3 leads (one lead cropped)

SOT428

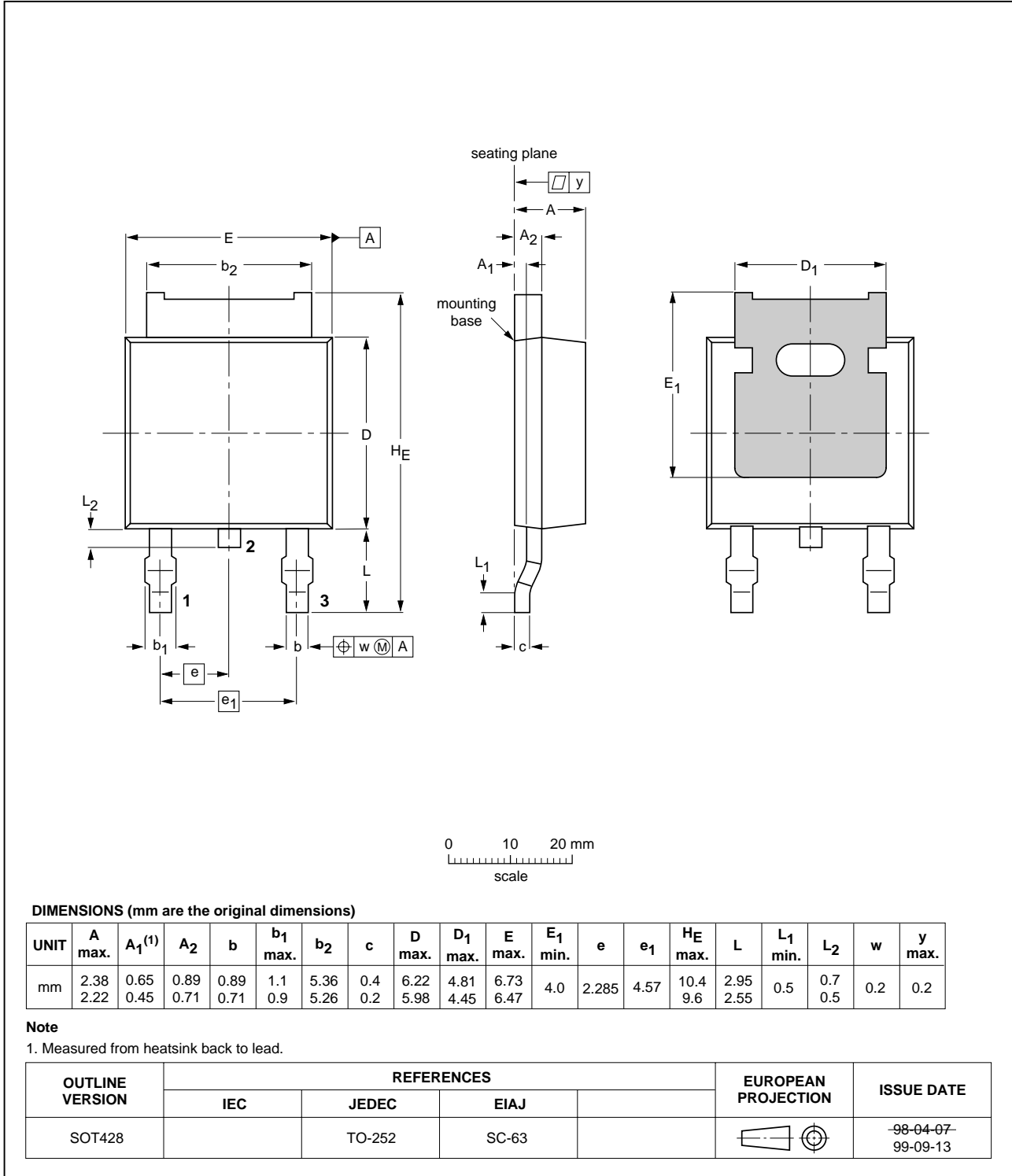


Fig 14. SOT428.

10. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20010814	-	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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[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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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

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