

BUK7213-40A

TrenchMOS™ standard level FET

Rev. 01 — 29 January 2004

Product data

1. Product profile

1.1 Description

N-channel enhancement mode field-effect power transistor in a plastic package using Philips General-Purpose Automotive TrenchMOS™ technology.

1.2 Features

- Very low on-state resistance
- 175 °C rated
- Q101 compliant
- Standard level compatible

1.3 Applications

- Automotive systems
- Motors, lamps and solenoids
- 12 V loads
- General purpose power switching

1.4 Quick reference data

- $V_{DS} \leq 40$ V
- $I_D \leq 78$ A
- $R_{DS(on)} = 10.3$ mΩ (typ)
- $P_{tot} \leq 150$ W.

2. Pinning information

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

Pin	Description	Simplified outline	Symbol
1	gate (g)	<p>Top view MBK091</p> <p>SOT428 (D-PAK)</p>	<p>MBB076</p>
2	drain (d)		
3	source (s)		
mb	drain (d)		



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3. Ordering information

Table 2: Ordering information

Type number	Package		Version
	Name	Description	
BUK7213-40A	D-PAK	Plastic single-ended surface mounted package (Philips version of D-PAK); 3 leads (one lead cropped)	SOT428

4. Limiting values

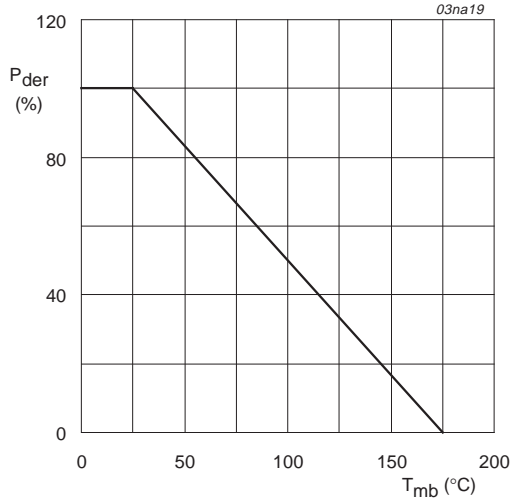
Table 3: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)		-	40	V
V_{DGR}	drain-gate voltage (DC)	$R_{GS} = 20 \text{ k}\Omega$	-	40	V
V_{GS}	gate-source voltage (DC)		-	± 20	V
I_D	drain current (DC)	$T_{mb} = 25 \text{ }^\circ\text{C}$; $V_{GS} = 10 \text{ V}$; Figure 2 and 3	[1] -	78	A
			[2] -	55	A
		$T_{mb} = 100 \text{ }^\circ\text{C}$; $V_{GS} = 10 \text{ V}$; Figure 2	[1] -	55	A
I_{DM}	peak drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$; Figure 3	-	312	A
P_{tot}	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$; Figure 1	-	150	W
T_{stg}	storage temperature		-55	+175	$^\circ\text{C}$
T_j	junction temperature		-55	+175	$^\circ\text{C}$
Source-drain diode					
I_{DR}	reverse drain current (DC)	$T_{mb} = 25 \text{ }^\circ\text{C}$	[1] -	78	A
			[2] -	55	A
I_{DRM}	peak reverse drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$	-	312	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive avalanche energy	unclamped inductive load; $I_D = 75 \text{ A}$; $V_{DS} \leq 40 \text{ V}$; $V_{GS} = 10 \text{ V}$; $R_{GS} = 50 \text{ }\Omega$; starting $T_{mb} = 25 \text{ }^\circ\text{C}$	-	244	mJ
Electrostatic discharge					
V_{esd}	electrostatic discharge voltage, all pins	human body model; $C = 100 \text{ pF}$; $R = 1.5 \text{ k}\Omega$	-	1.6	kV

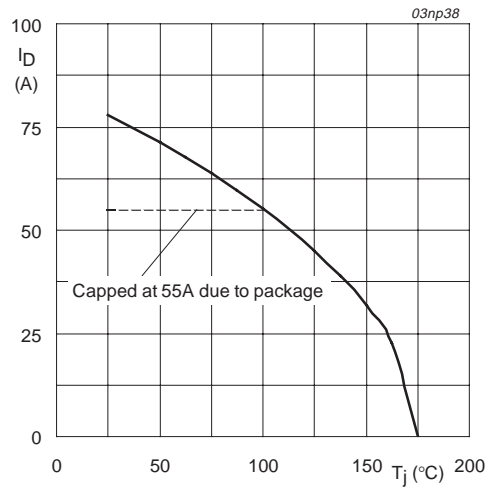
[1] Current is limited by power dissipation chip rating

[2] Continuous current is limited by package



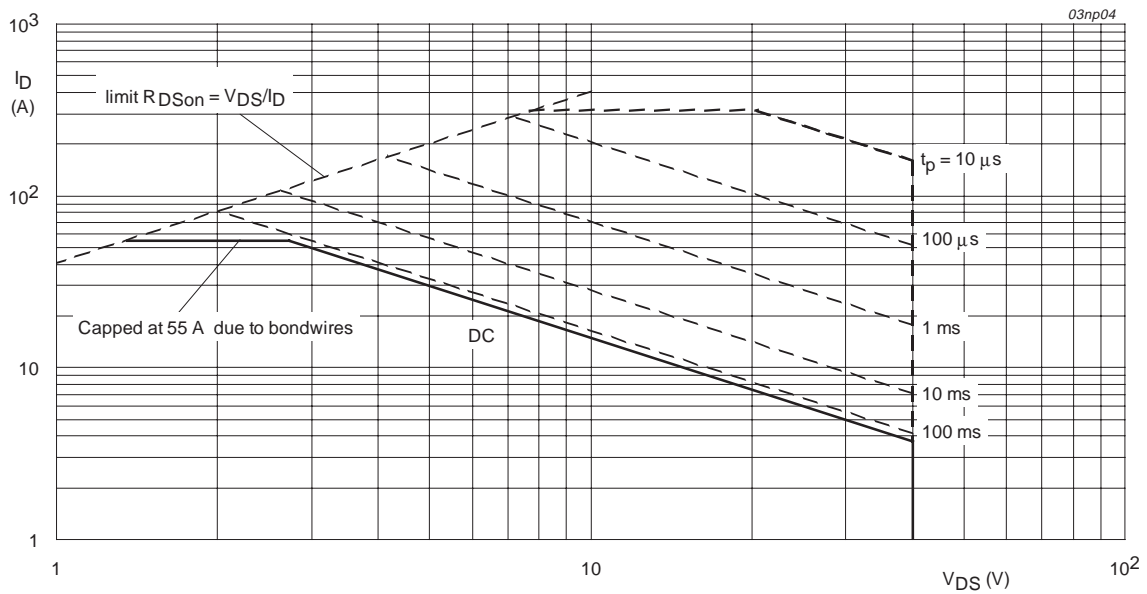
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ C)}} \times 100\%$$

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



$V_{GS} \geq 10\text{ V}$

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



$T_{mb} = 25^\circ\text{C}$; I_{DM} 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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	1	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air; SOT428 package	-	71.4	-	K/W

5.1 Transient thermal impedance

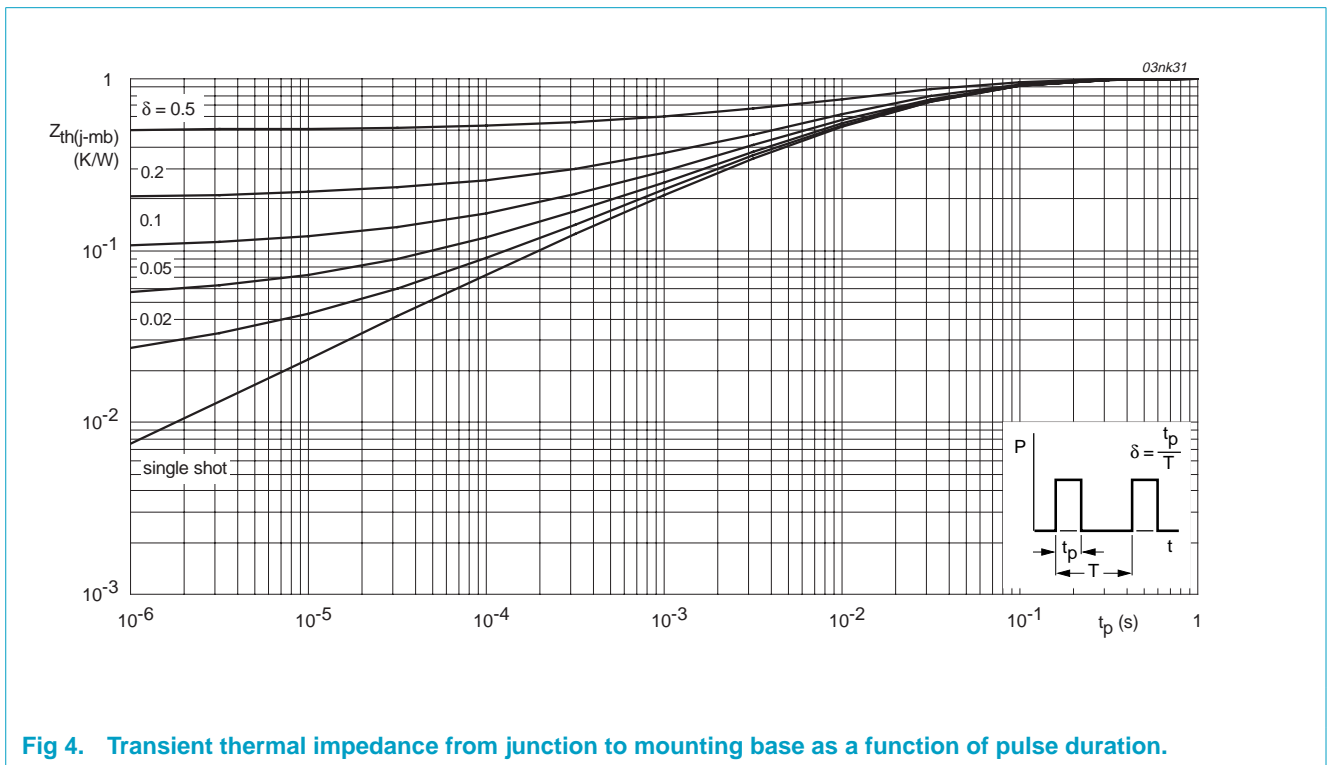


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

6. Characteristics

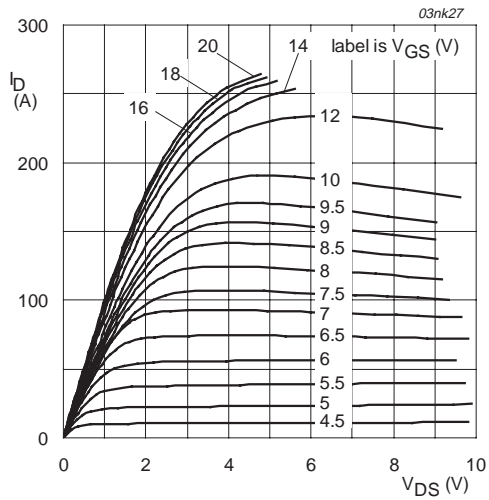
Table 5: Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}; V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	40	-	-	V
		$T_j = -55\text{ °C}$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}; V_{DS} = V_{GS};$ Figure 9				
		$T_j = 25\text{ °C}$	2	3	4	V
		$T_j = 175\text{ °C}$	1	-	-	V
		$T_j = -55\text{ °C}$	-	-	4.4	V
I_{DSS}	drain-source leakage current	$V_{DS} = 40\text{ V}; V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	0.05	10	μA
		$T_j = 175\text{ °C}$	-	-	500	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\text{ V}; V_{DS} = 0\text{ V}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A};$ Figure 7 and 8				
		$T_j = 25\text{ °C}$	-	10.3	13	m Ω
		$T_j = 175\text{ °C}$	-	-	24.7	m Ω
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$V_{GS} = 10\text{ V}; V_{DD} = 32\text{ V};$	-	47	-	nC
Q_{gs}	gate-to-source charge	$I_D = 25\text{ A};$ Figure 14	-	10	-	nC
Q_{gd}	gate-to-drain (Miller) charge		-	20	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V};$	-	1684	2245	pF
C_{oss}	output capacitance	$f = 1\text{ MHz};$ Figure 12	-	590	708	pF
C_{rss}	reverse transfer capacitance		-	389	532	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 30\text{ V}; R_L = 1.2\text{ }\Omega;$	-	16	-	ns
t_r	rise time	$V_{GS} = 10\text{ V}; R_G = 10\text{ }\Omega$	-	124	-	ns
$t_{d(off)}$	turn-off delay time		-	57	-	ns
t_f	fall time		-	68	-	ns
L_d	internal drain inductance	measured from drain to centre of die	-	2.5	-	nH
L_s	internal source inductance	measured from source lead to source bond pad	-	7.5	-	nH

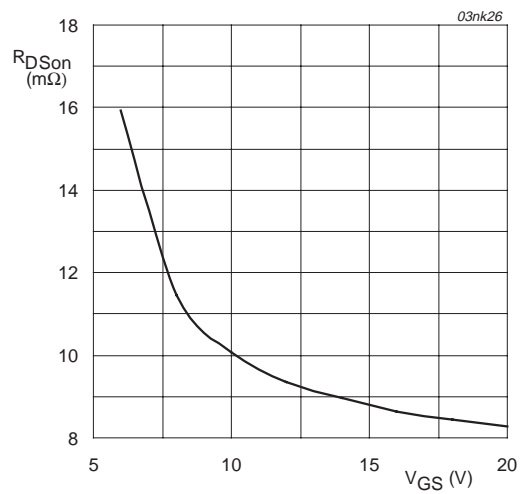
Table 5: Characteristics...continued*T_j = 25 °C unless otherwise specified.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V _{SD}	source-drain (diode forward) voltage	I _S = 25 A; V _{GS} = 0 V;	-	0.85	1.2	V
t _{rr}	reverse recovery time	I _S = 20 A; dI _S /dt = -100 A/μs	-	50	-	ns
Q _r	recovered charge	V _{GS} = -10 V; V _{DS} = 20 V	-	25	-	nC



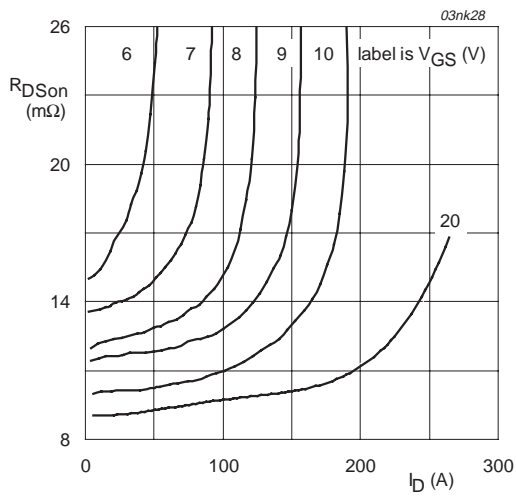
$T_j = 25\text{ }^\circ\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



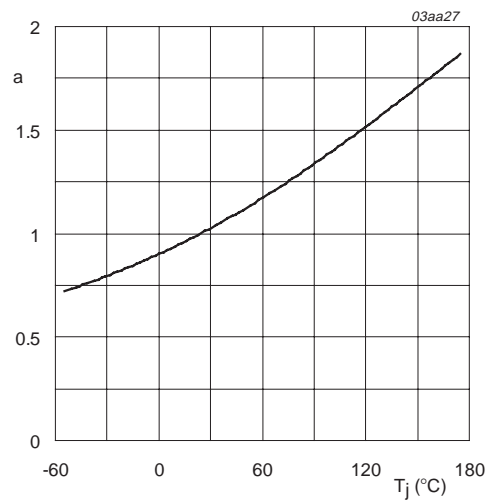
$T_j = 25\text{ }^\circ\text{C}$; $I_D = 25\text{ A}$

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



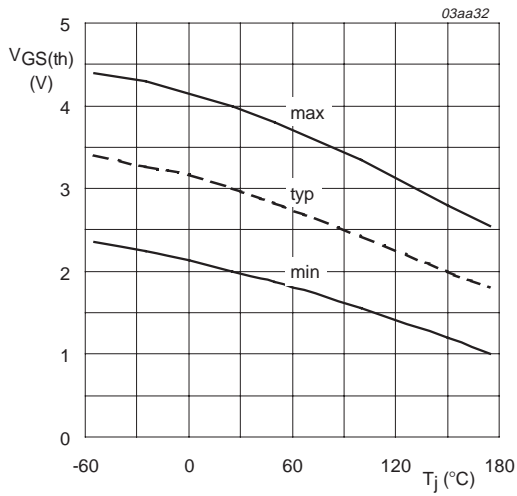
$T_j = 25\text{ }^\circ\text{C}$

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



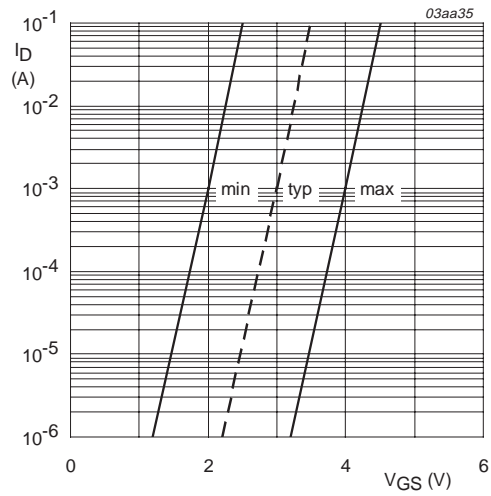
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



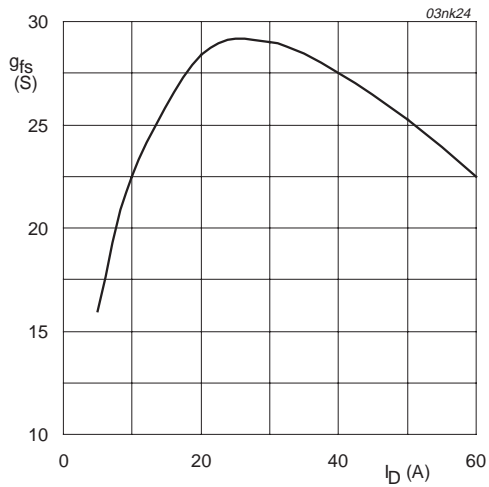
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



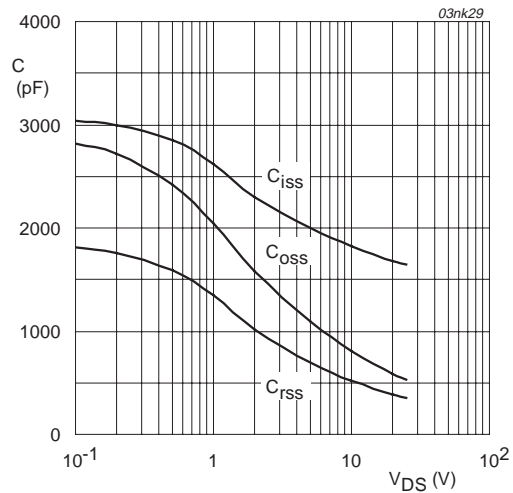
$T_J = 25 \text{ °C}; V_{DS} = V_{GS}$

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



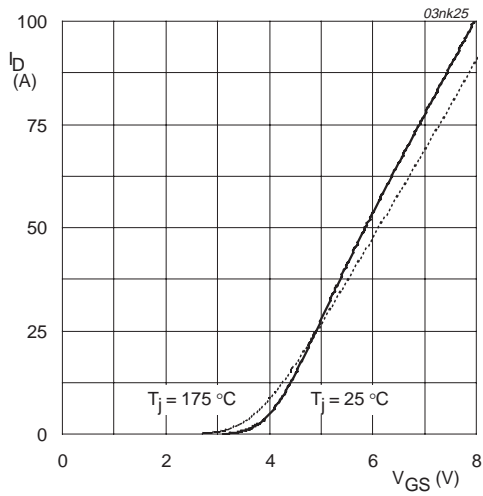
$T_J = 25 \text{ °C}; V_{DS} = 25 \text{ V}$

Fig 11. Forward transconductance as a function of drain current; typical values.



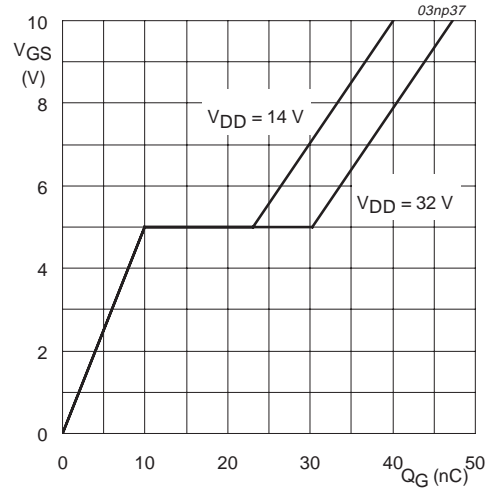
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



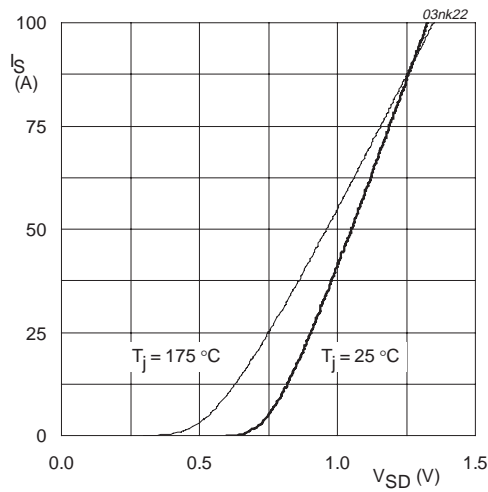
$V_{DS} = 25 \text{ V}$

Fig 13. Transfer characteristics: drain current as a function of gate-source voltage; typical values.



$T_j = 25 \text{ °C}; I_D = 25 \text{ A}$

Fig 14. Gate-source voltage as a function of turn-on gate charge; typical values.



$V_{GS} = 0 \text{ V}$

Fig 15. Reverse diode current as a function of reverse diode voltage; typical values.

7. Package outline

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

SOT428

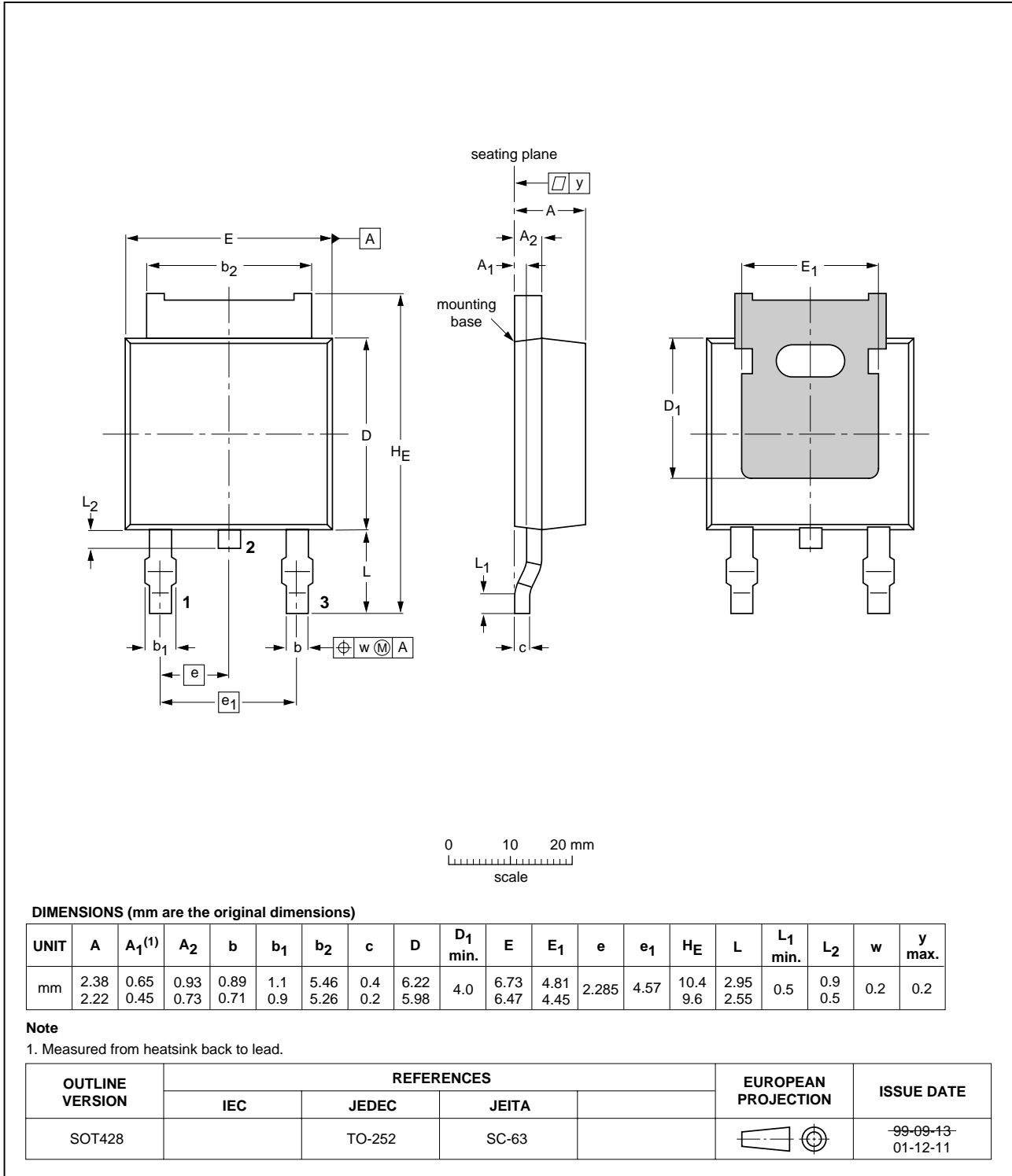


Fig 16. SOT428 (D-PAK).

9. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20040129	-	Product data; initial version (9397 750 12486)

10. 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.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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Date of release: 29 January 2004

Document order number: 9397 750 12486





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