

PHD22NQ20T

N-channel TrenchMOS™ standard level FET

Rev. 01 — 08 March 2004

Product data

1. Product profile

1.1 Description

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

1.2 Features

- Low on-state resistance
- Fast switching.

1.3 Applications

- DC-to-DC converters
- General purpose switching.

1.4 Quick reference data

- $V_{DS} \leq 200 \text{ V}$
- $I_D \leq 21.1 \text{ A}$
- $P_{tot} \leq 150 \text{ W}$
- $R_{DS(on)} \leq 120 \text{ m}\Omega$.

2. Pinning information

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

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	drain (d) [1]		
3	source (s)		
mb	mounting base; connected to drain (d)		

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



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3. Ordering information

Table 2: Ordering information

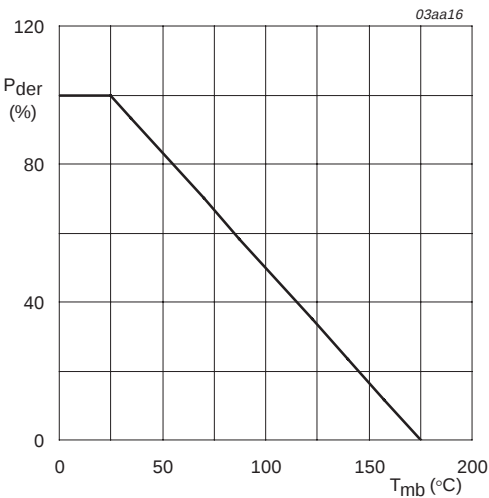
Type number	Package		
	Name	Description	Version
PHD22NQ20T	D-PAK	Plastic single-ended surface mounted package; 3 leads (one lead cropped)	SOT428

4. Limiting values

Table 3: Limiting values

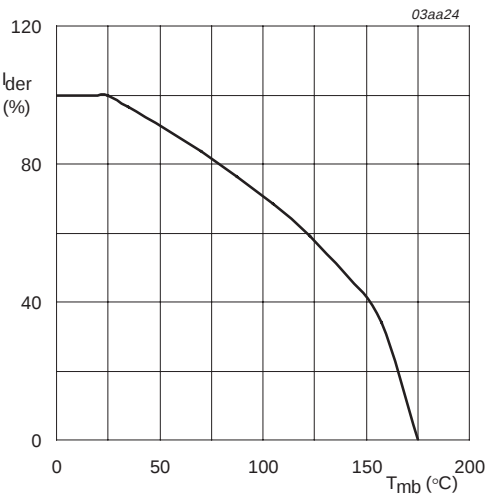
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	200	V
V_{DGR}	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	200	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	-	21.1	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 10\text{ V}$; Figure 2	-	14.9	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Figure 3	-	42.2	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Figure 1	-	150	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)	$T_{mb} = 25\text{ °C}$	-	21.6	A
I_{SM}	peak source (diode forward) current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	42.2	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 9.3\text{ A}$; $t_p = 0.13\text{ ms}$; $V_{DD} \leq 200\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; starting at $T_j = 25\text{ °C}$	-	150	mJ



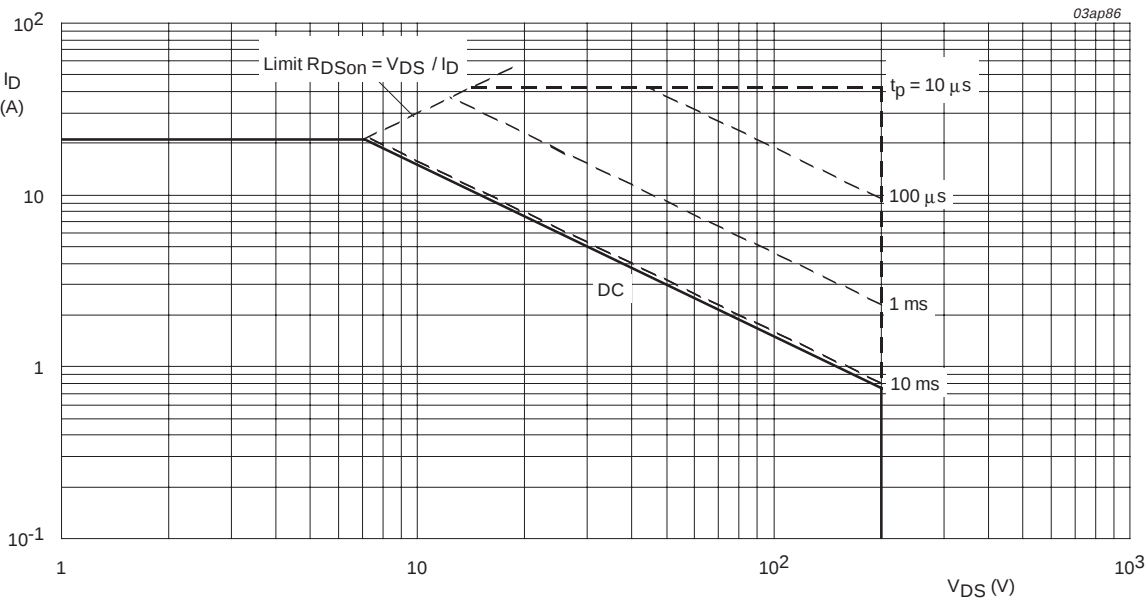
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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.



$T_{mb} = 25^{\circ}C$; I_{DM} is single pulse; $V_{GS} = 10 V$.

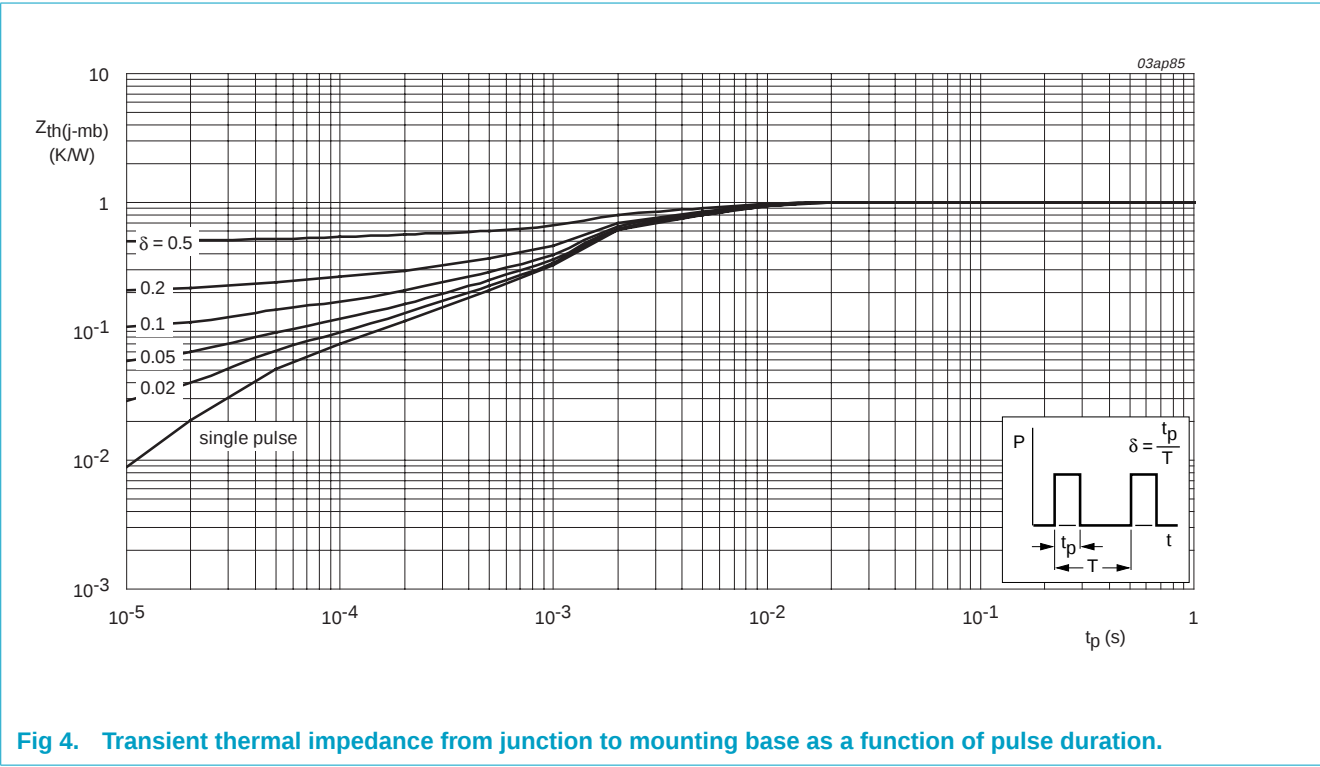
Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

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	-	-	1.0	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	mounted on a printed-circuit board; vertical in still air; SOT428 minimum footprint	-	75	-	K/W
		mounted on a printed-circuit board; vertical in still air; SOT404 minimum footprint	-	50	-	K/W

5.1 Transient thermal impedance

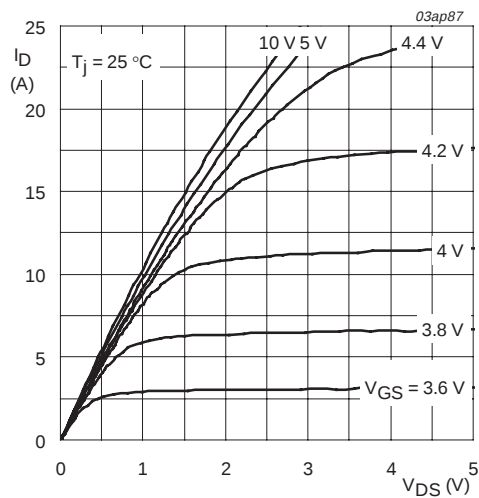


6. Characteristics

Table 5: Characteristics

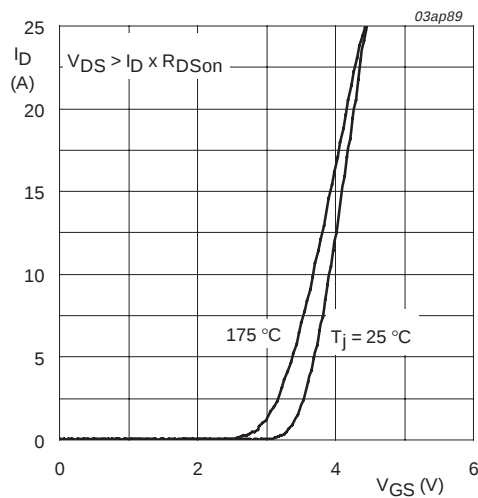
$T_j = 25\text{ °C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	200	-	-	V
		$T_j = -55\text{ °C}$	178	-	-	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	$V_{DS} = 160\text{ V}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	0.05	10	μA
		$T_j = 175\text{ °C}$	-	-	500	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\text{ V}$; $V_{DS} = 0\text{ V}$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 12\text{ A}$; Figure 7 and 8				
		$T_j = 25\text{ °C}$	-	98	120	m Ω
		$T_j = 175\text{ °C}$	-	274	336	m Ω
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$I_D = 15\text{ A}$; $V_{DD} = 160\text{ V}$; $V_{GS} = 10\text{ V}$; Figure 13	-	30.8	-	nC
Q_{gs}	gate-source charge		-	5	-	nC
Q_{gd}	gate-drain (Miller) charge		-	11.3	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; Figure 11	-	1380	-	pF
C_{oss}	output capacitance		-	145	-	pF
C_{rss}	reverse transfer capacitance		-	50	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 100\text{ V}$; $R_L = 5.6\text{ }\Omega$;	-	10	-	ns
t_r	rise time	$V_{GS} = 10\text{ V}$; $R_G = 5.6\text{ }\Omega$	-	30	-	ns
$t_{d(off)}$	turn-off delay time		-	30	-	ns
t_f	fall time		-	37	-	ns
Source-drain diode						
V_{SD}	source-drain (diode forward) voltage	$I_S = 20\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 12	-	0.86	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$	-	140	-	ns
Q_r	recovered charge		-	680	-	nC



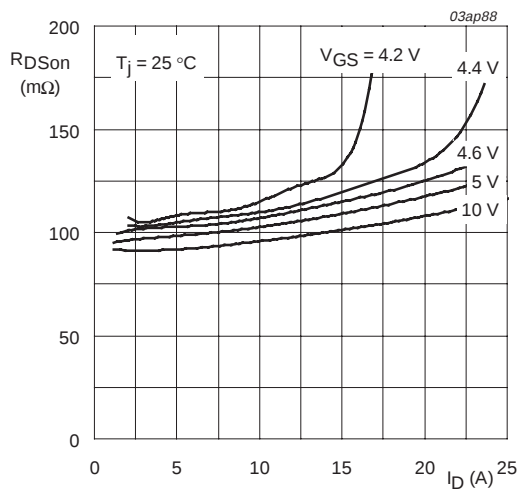
T_j = 25 °C

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



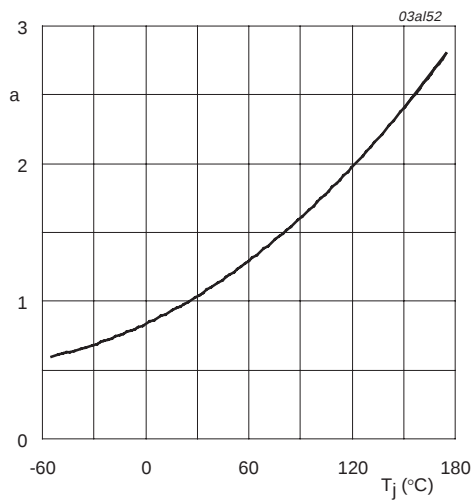
T_j = 25 °C and 175 °C; V_{DS} > I_D × R_{DSon}

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



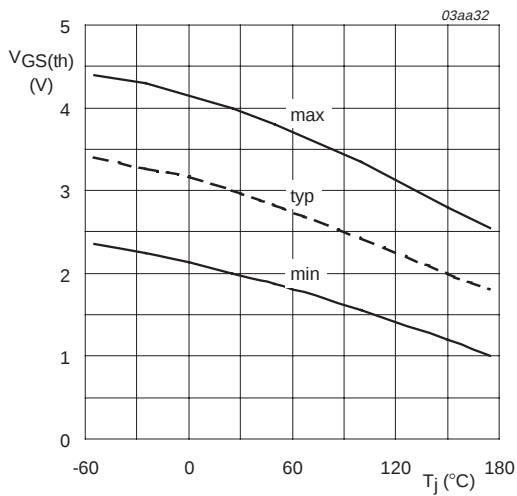
T_j = 25 °C

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



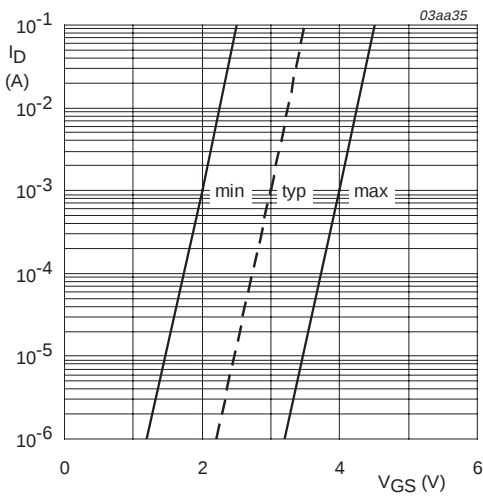
$$a = \frac{R_{DSon}}{R_{DSon(25^{\circ}C)}}$$

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



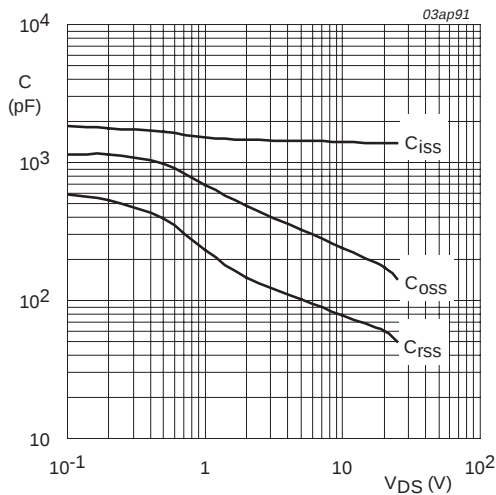
$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$

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



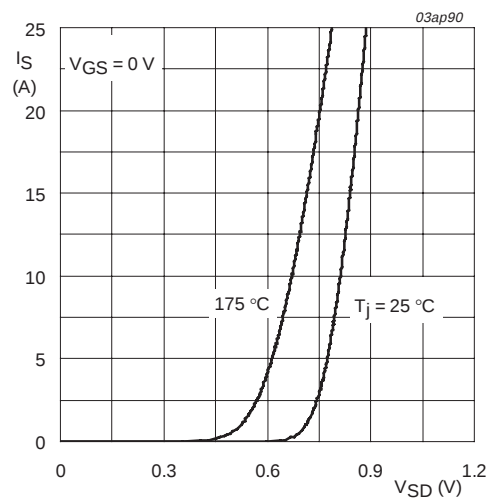
$T_j = 25\text{ °C}$; $V_{DS} = 5\text{ V}$

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



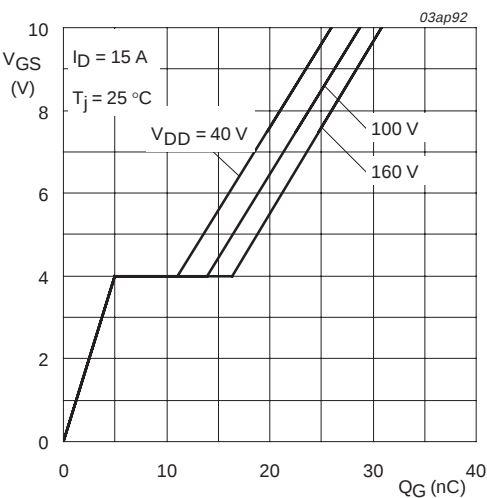
$V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$

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



$T_J = 25\text{ °C}$ and 175 °C ; $V_{GS} = 0\text{ V}$

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



$I_D = 15\text{ A}$; $V_{DD} = 40\text{ V}$, 100 V and 160 V

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

7. Package outline

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

SOT428

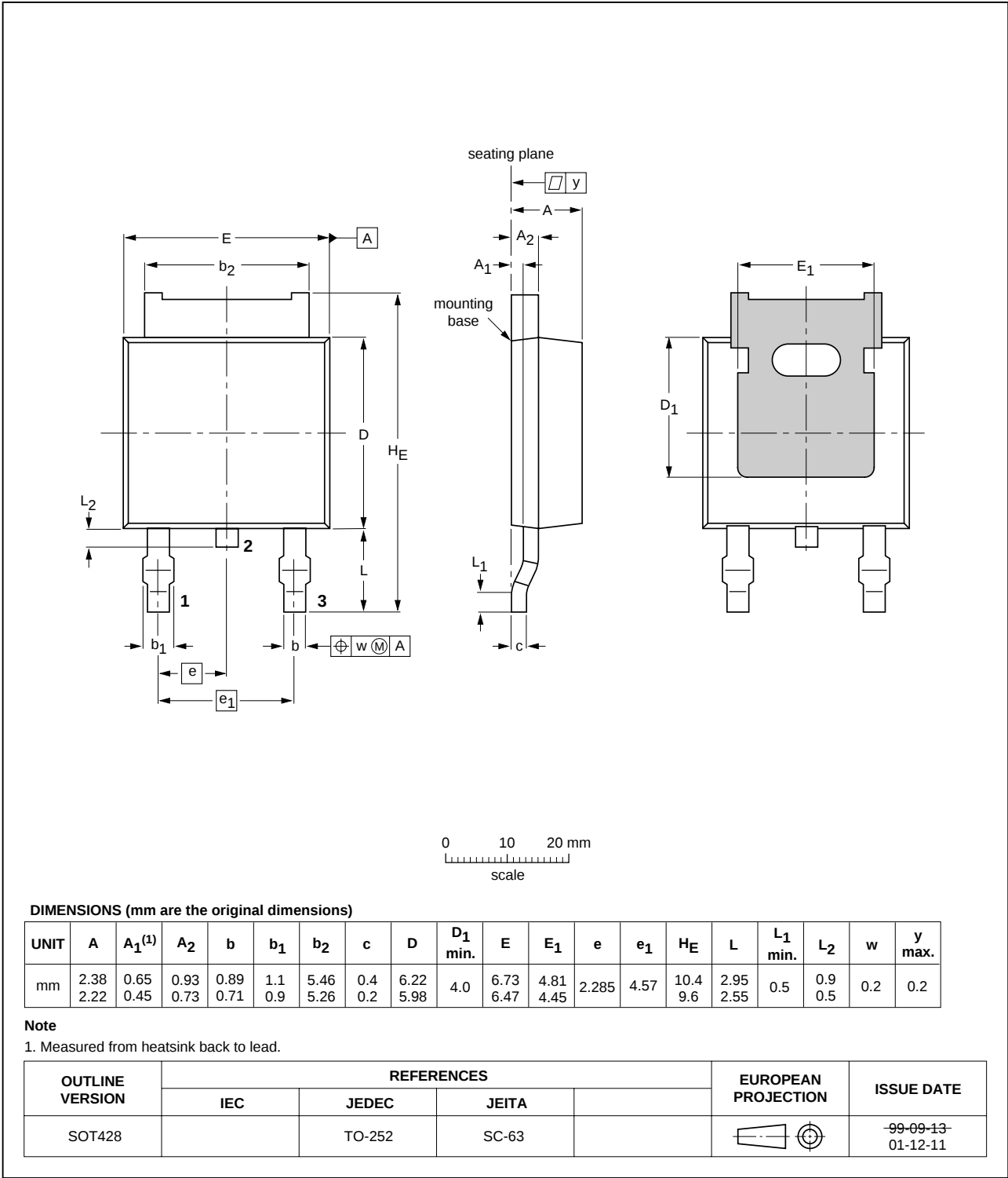


Fig 14. SOT428 (D-PAK).

8. Revision history

Table 6: Revision history

Rev	Date	CPCN	Description
01	20040308	-	Product data (9397 750 12882)

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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