

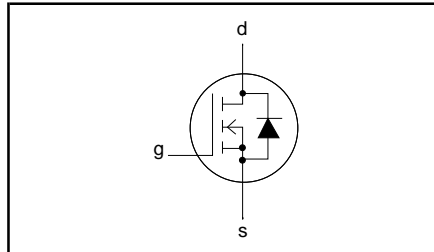
**N-channel TrenchMOS™ transistor**

**PHX9NQ20T , PHF9NQ20T**

**FEATURES**

- 'Trench' technology
- Low on-state resistance
- Fast switching
- Low thermal resistance

**SYMBOL**



**QUICK REFERENCE DATA**

$V_{DSS} = 200 \text{ V}$
$I_D = 5.2 \text{ A}$
$R_{DS(ON)} \leq 400 \text{ m}\Omega$

**GENERAL DESCRIPTION**

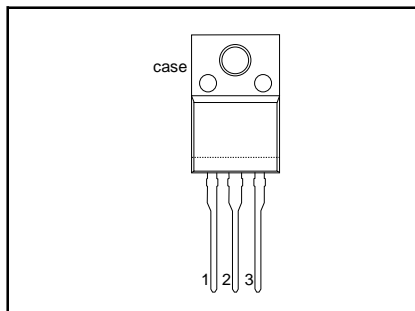
N-channel, enhancement mode field-effect power transistor using **Trench** technology, intended for use in off-line switched mode power supplies, T.V. and computer monitor power supplies, d.c. to d.c. converters, motor control circuits and general purpose switching applications.

The PHX9NQ20T is supplied in the SOT186A (FPAK) conventional leaded package

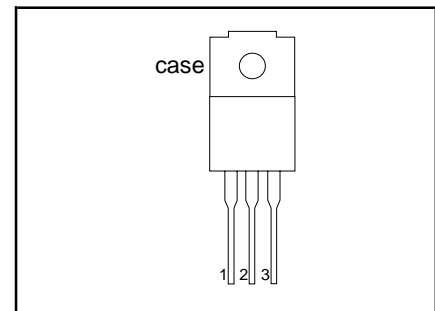
**PINNING**

PIN	DESCRIPTION
1	gate
2	drain
3	source
case	isolated

**SOT186A (FPAK)**



**SOT186 (FPAK)**



**LIMITING VALUES**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{DSS}$	Drain-source voltage	$T_j = 25 \text{ }^\circ\text{C}$ to $175 \text{ }^\circ\text{C}$	-	200	V
$V_{DGR}$	Drain-gate voltage	$T_j = 25 \text{ }^\circ\text{C}$ to $175 \text{ }^\circ\text{C}$ ; $R_{GS} = 20 \text{ k}\Omega$	-	200	V
$V_{GS}$	Gate-source voltage		-	$\pm 20$	V
$I_D$	Continuous drain current	$T_{hs} = 25 \text{ }^\circ\text{C}$ ; $V_{GS} = 10 \text{ V}$	-	5.2	A
		$T_{hs} = 100 \text{ }^\circ\text{C}$ ; $V_{GS} = 10 \text{ V}$	-	3.3	A
$I_{DM}$	Pulsed drain current	$T_{hs} = 25 \text{ }^\circ\text{C}$	-	21	A
$P_D$	Total power dissipation	$T_{hs} = 25 \text{ }^\circ\text{C}$	-	25	W
$T_j, T_{stg}$	Operating junction and storage temperature		- 55	150	$^\circ\text{C}$

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**AVALANCHE ENERGY LIMITING VALUES**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$E_{AS}$	Non-repetitive avalanche energy	Unclamped inductive load, $I_{AS} = 7.2A$ ; $t_p = 100 \mu s$ ; $T_j$ prior to avalanche = $25^\circ C$ ; $V_{DD} \leq 25 V$ ; $R_{GS} = 50 \Omega$ ; $V_{GS} = 10 V$ ; refer to fig;15	-	93	mJ
$I_{AS}$	Peak non-repetitive avalanche current		-	8.7	A

**THERMAL RESISTANCES**

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Thermal resistance junction to mounting base	SOT186A package, in free air	-	-	5	K/W
$R_{th\ j-a}$	Thermal resistance junction to ambient		-	55	-	K/W

**ELECTRICAL CHARACTERISTICS** $T_j = 25^\circ C$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0 V$ ; $I_D = 0.25 mA$ ; $T_j = -55^\circ C$	200 178	- -	- -	V V
$V_{GS(TO)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ ; $I_D = 1 mA$ $T_j = 150^\circ C$ $T_j = -55^\circ C$	2 1 -	3 -	4 -	V V V
$R_{DS(ON)}$	Drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 4.5 A$ $T_j = 150^\circ C$	-	300	400	m $\Omega$
$g_{fs}$	Forward transconductance	$V_{DS} = 25 V$ ; $I_D = 4.5 A$ $T_j = 150^\circ C$	3.8	6	-	S
$I_{GSS}$	Gate source leakage current	$V_{GS} = \pm 10 V$ ; $V_{DS} = 0 V$	-	10	100	nA
$I_{DSS}$	Zero gate voltage drain current	$V_{DS} = 200 V$ ; $V_{GS} = 0 V$ $T_j = 150^\circ C$	-	0.05	10	$\mu A$
$Q_{g(tot)}$	Total gate charge	$I_D = 9 A$ ; $V_{DD} = 160 V$ ; $V_{GS} = 10 V$	-	24	-	nC
$Q_{gs}$	Gate-source charge		-	4	-	nC
$Q_{gd}$	Gate-drain (Miller) charge		-	12	-	nC
$t_{d on}$	Turn-on delay time	$V_{DD} = 100 V$ ; $R_D = 10 \Omega$ ; $V_{GS} = 10 V$ ; $R_G = 5.6 \Omega$ Resistive load	-	8	-	ns
$t_r$	Turn-on rise time		-	19	-	ns
$t_{d off}$	Turn-off delay time		-	25	-	ns
$t_f$	Turn-off fall time		-	15	-	ns
$L_d$	Internal drain inductance	Measured from drain lead to centre of die	-	4.5	-	nH
$L_s$	Internal source inductance	Measured from source lead to source bond pad	-	7.5	-	nH
$C_{iss}$	Input capacitance	$V_{GS} = 0 V$ ; $V_{DS} = 25 V$ ; $f = 1 MHz$	-	959	-	pF
$C_{oss}$	Output capacitance		-	93	-	pF
$C_{rss}$	Feedback capacitance		-	54	-	pF

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**REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS** $T_j = 25^\circ\text{C}$  unless otherwise specified

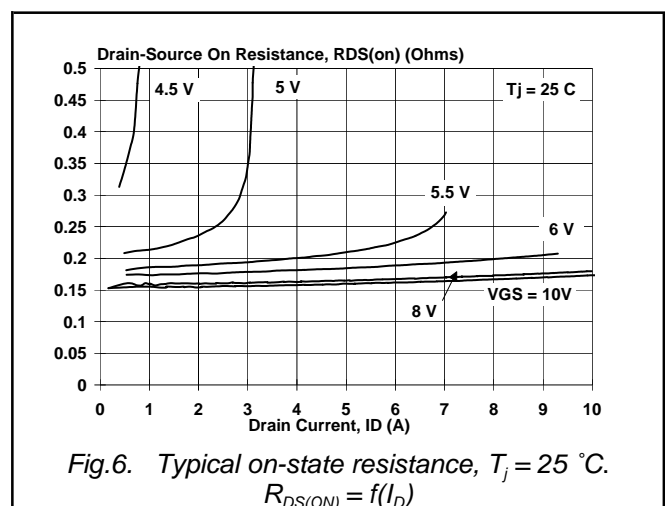
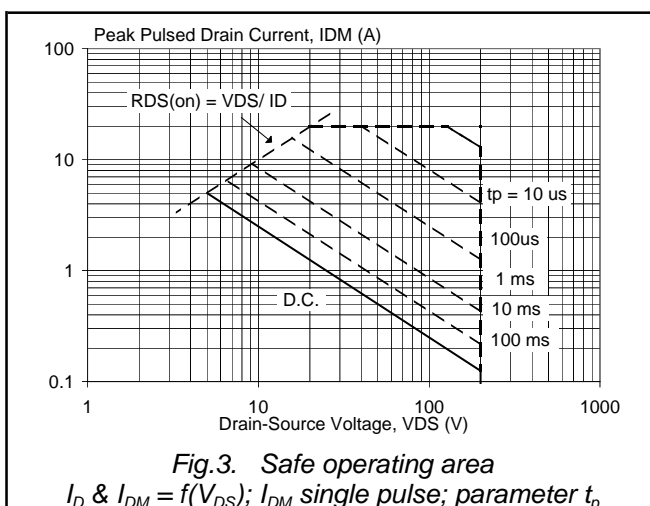
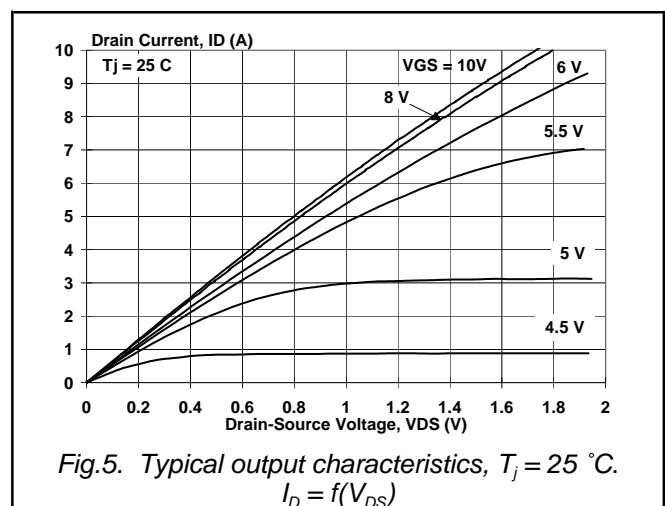
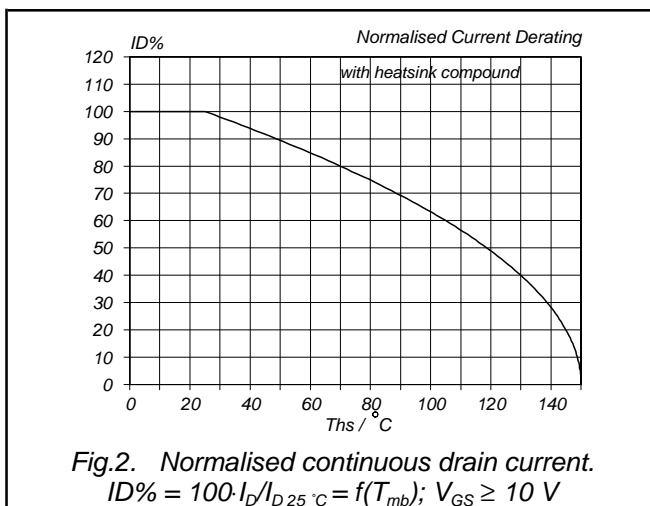
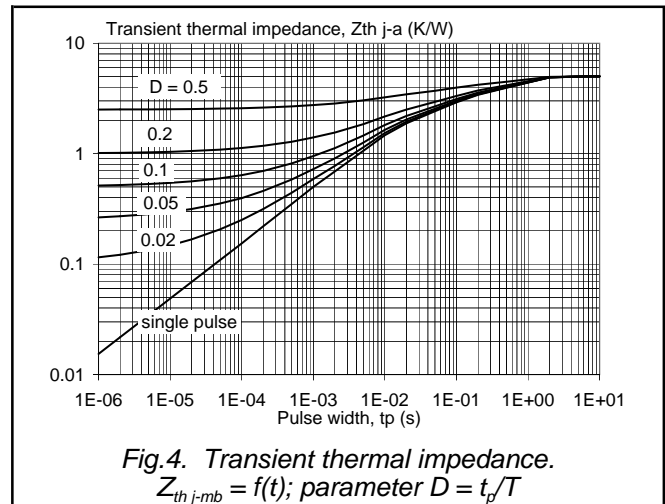
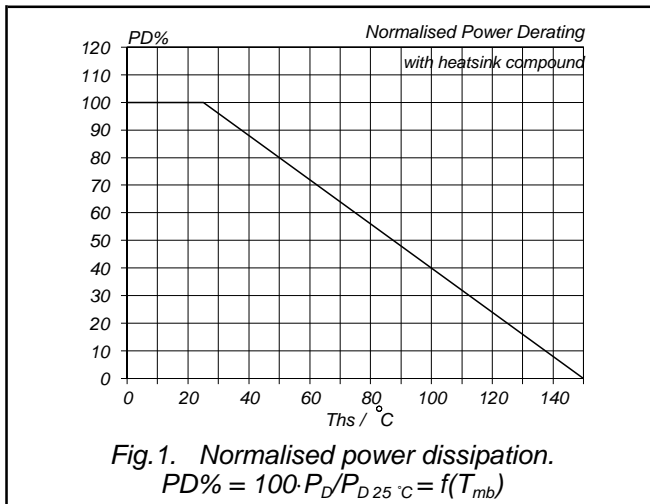
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_S$	Continuous source current (body diode)		-	-	8.7	A
$I_{SM}$	Pulsed source current (body diode)		-	-	35	A
$V_{SD}$	Diode forward voltage	$I_F = 9\text{ A}; V_{GS} = 0\text{ V}$	-	0.85	1.2	V
$t_{rr}$	Reverse recovery time	$I_F = 9\text{ A}; -di_F/dt = 100\text{ A}/\mu\text{s};$	-	92	-	ns
$Q_{rr}$	Reverse recovery charge	$V_{GS} = -10\text{ V}; V_R = 25\text{ V}$	-	0.5	-	$\mu\text{C}$

**ISOLATION LIMITING VALUE & CHARACTERISTIC** $T_{hs} = 25^\circ\text{C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{isol}$	R.M.S. isolation voltage from all three terminals to external heatsink	SOT186A package; $f = 50\text{-}60\text{ Hz}$ ; sinusoidal waveform; R.H. $\leq 65\%$ ; clean and dustfree	-		2500	V
$V_{isol}$	Repetitive peak voltage from all three terminals to external heatsink	SOT186 package; R.H. $\leq 65\%$ ; clean and dustfree	-		1500	V
$C_{isol}$	Capacitance from pin 2 to external heatsink	$f = 1\text{ MHz}$	-	10	-	pF

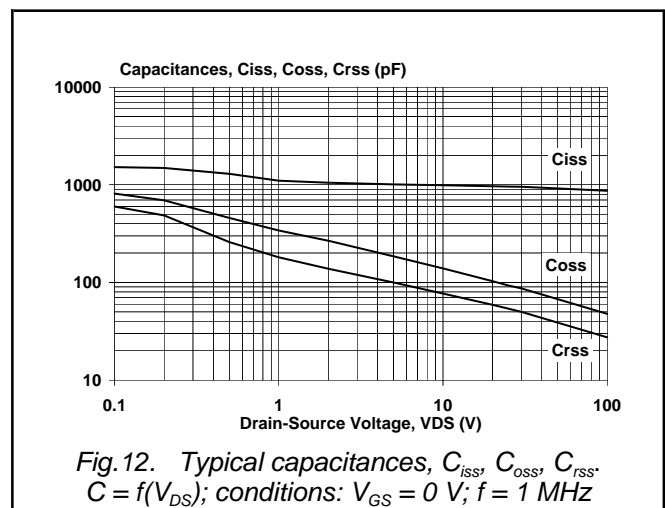
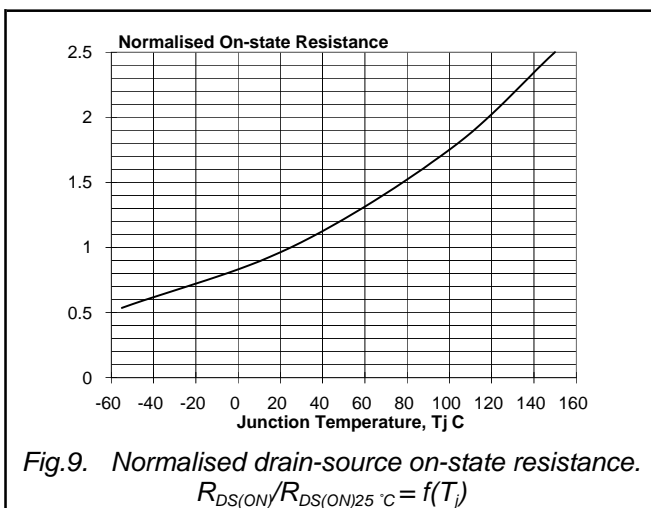
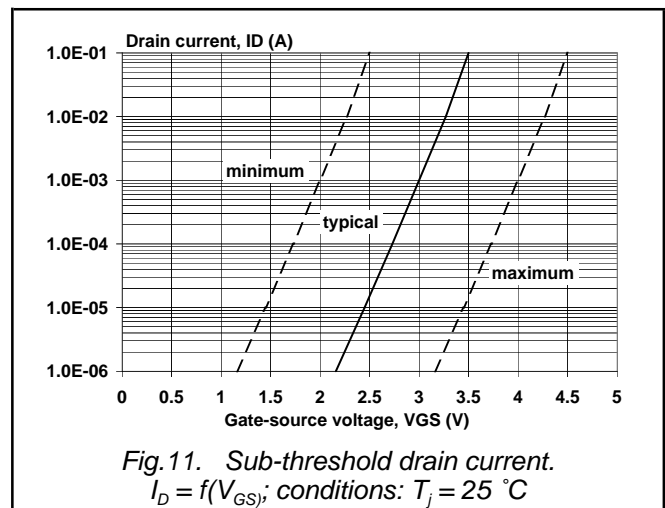
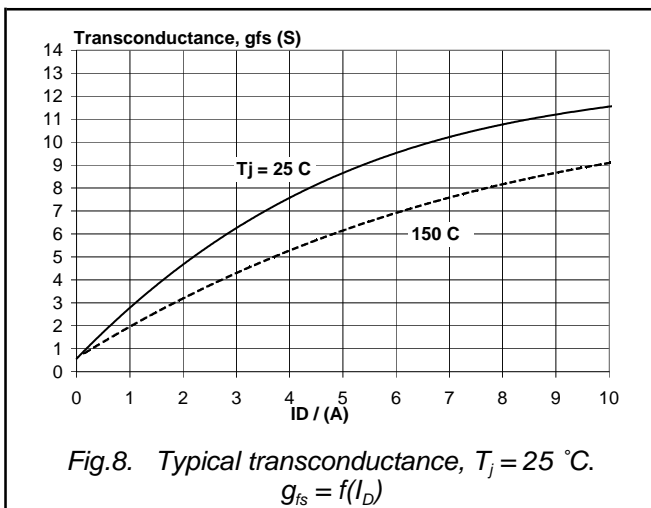
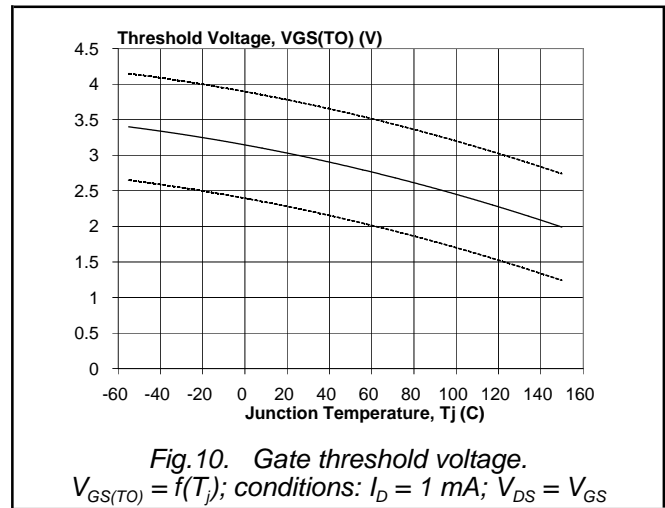
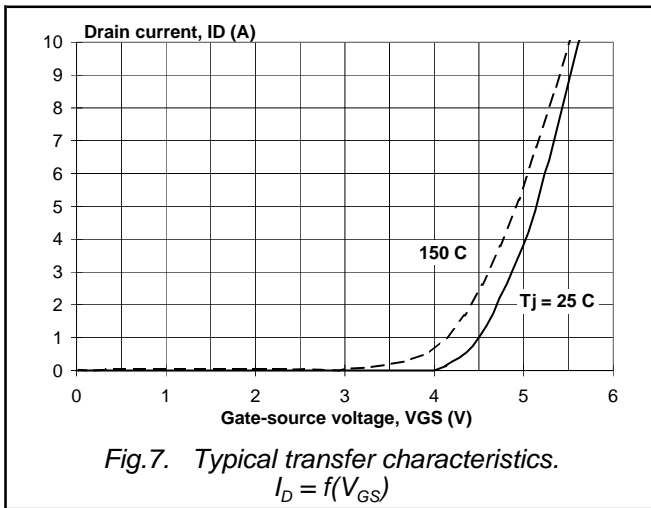
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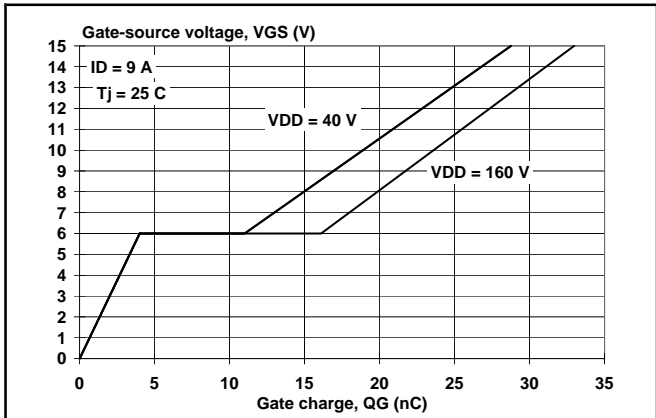


Fig. 13. Typical turn-on gate-charge characteristics.  $V_{GS} = f(Q_G)$

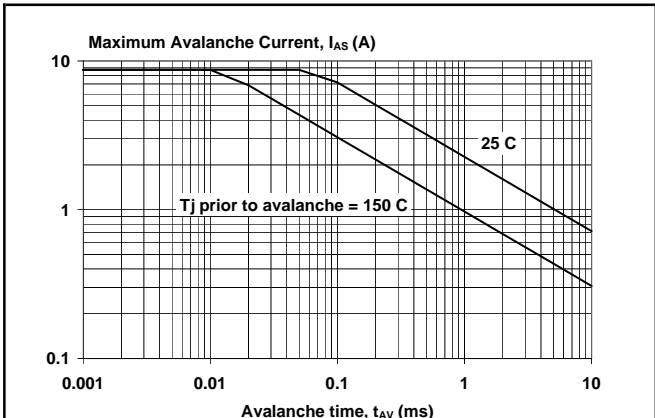


Fig. 15. Maximum permissible non-repetitive avalanche current ( $I_{AS}$ ) versus avalanche time ( $t_{AV}$ ); unclamped inductive load

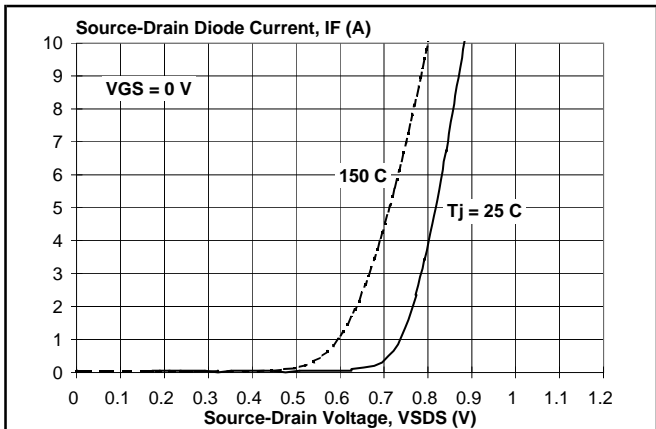


Fig. 14. Typical reverse diode current.  $I_F = f(V_{SDS})$ ; conditions:  $V_{GS} = 0 V$ ; parameter  $T_j$

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MECHANICAL DATA

Dimensions in mm

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 lead TO-220

SOT186A

Net Mass: 2 g

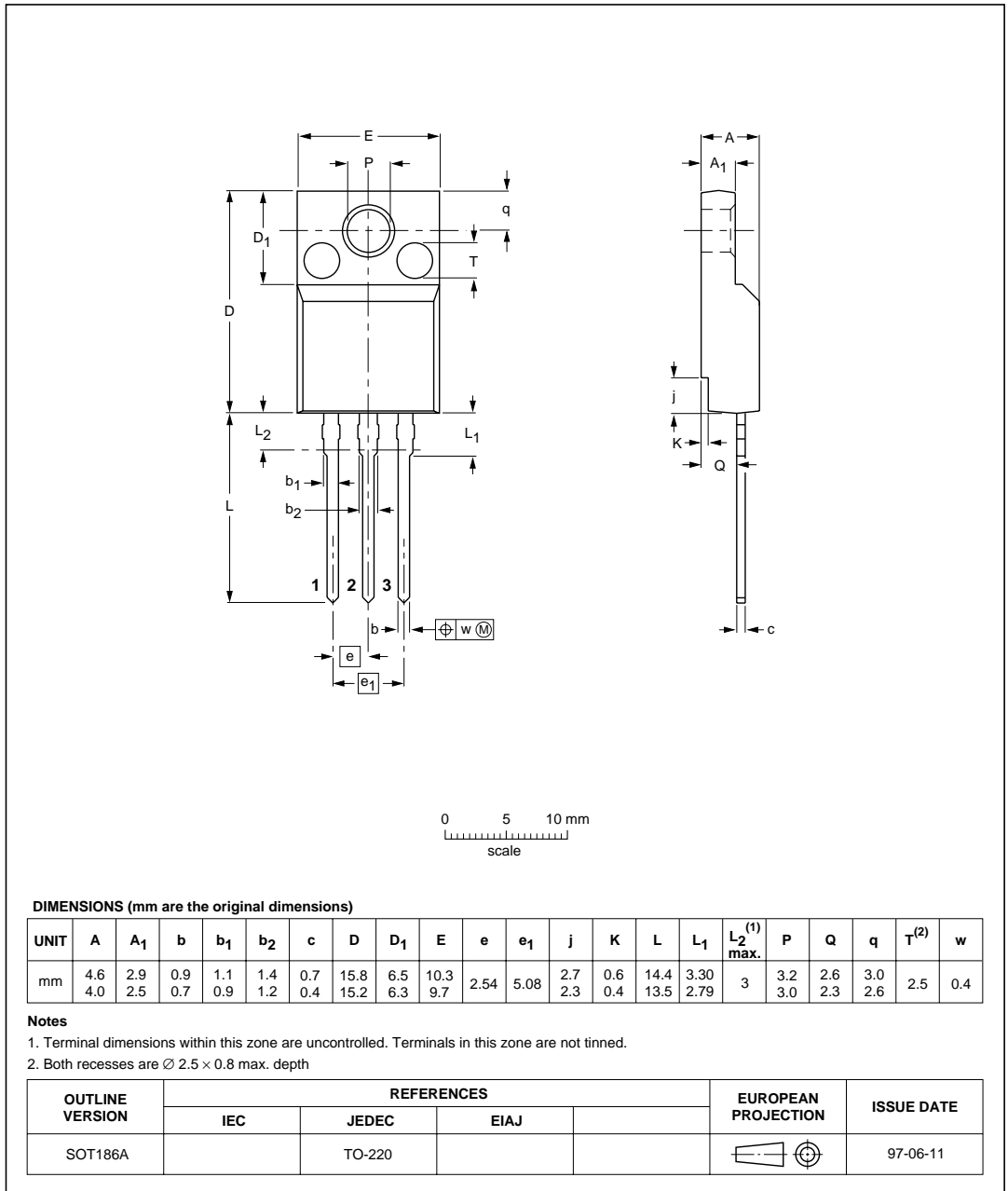


Fig. 16. SOT186A; The seating plane is electrically isolated from all terminals.

Notes

- Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
- Refer to mounting instructions for F-pack envelopes.
- Epoxy meets UL94 V0 at 1/8".

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PHX9NQ20T , PHF9NQ20T

MECHANICAL DATA

Dimensions in mm

Plastic single-ended package; isolated heatsink mounted;  
1 mounting hole; 3 lead TO-220 exposed tabs

SOT186

Net Mass: 2 g

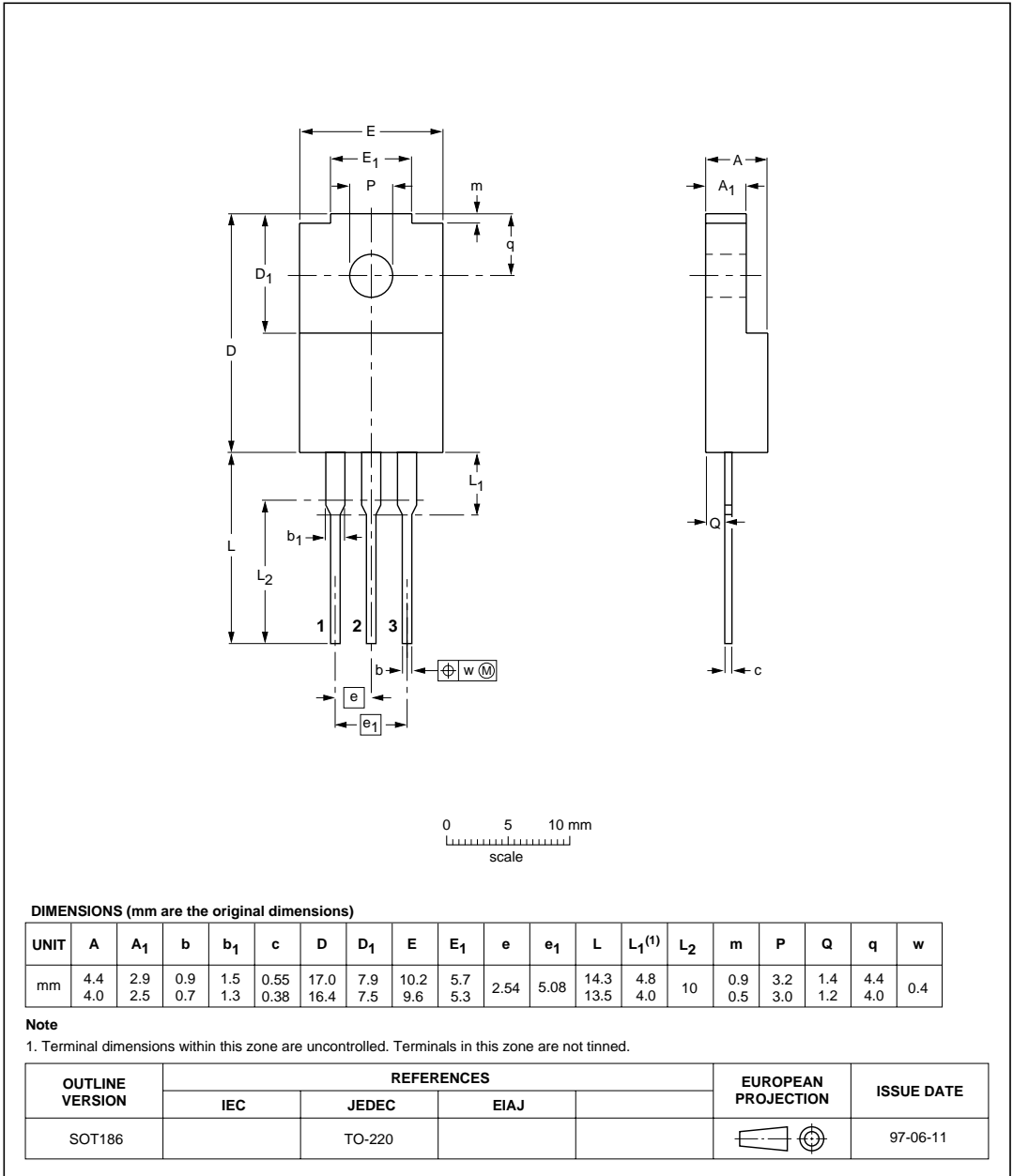


Fig. 17. SOT186; The seating plane is electrically isolated from all terminals.

Notes

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Refer to mounting instructions for F-pack envelopes.
3. Epoxy meets UL94 V0 at 1/8".



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**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	
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