

# PHX18NQ11T

N-channel TrenchMOS™ standard level FET

Rev. 02 — 24 March 2005

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a fully isolated plastic package using TrenchMOS™ technology.

### 1.2 Features

- Standard level threshold
- Low on-state resistance
- Low thermal resistance
- Isolated mounting base
- Fast switching
- Lead-free

### 1.3 Applications

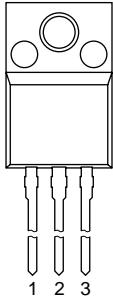
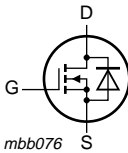
- DC-to-DC converters
- Class-D amplifiers
- Switched-mode power supplies

### 1.4 Quick reference data

- $V_{DS} \leq 110 \text{ V}$
- $R_{DS(on)} \leq 90 \text{ m}\Omega$
- $I_D \leq 12.5 \text{ A}$
- $P_{tot} \leq 31.2 \text{ W}$

## 2. Pinning information

Table 1: Pinning

Pin	Description	Simplified outline	Symbol
1	gate		
2	drain		
3	source		
mb	mounting base; isolated		

SOT186A (3-lead TO-220F)

# PHILIPS

### 3. Ordering information

**Table 2: Ordering information**

Type number	Package		Version
	Name	Description	
PHX18NQ11T	TO-220F	plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 leads	SOT186A

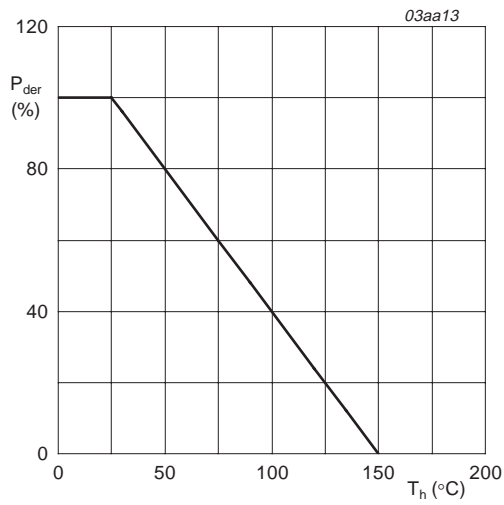
### 4. Limiting values

**Table 3: Limiting values**

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

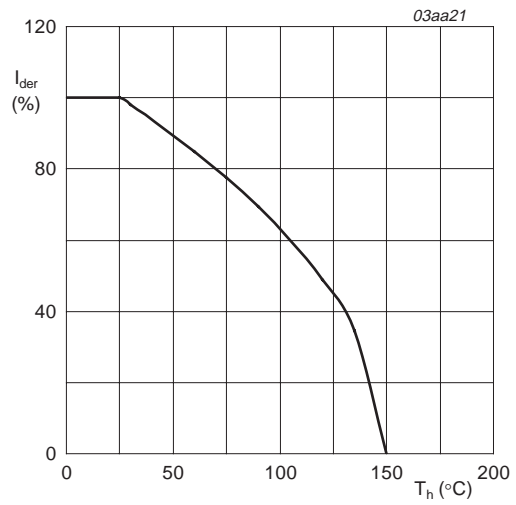
Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{DS}$	drain-source voltage (DC)	$25\text{ °C} \leq T_j \leq 150\text{ °C}$	-	110	V	
$V_{DGR}$	drain-gate voltage (DC)	$25\text{ °C} \leq T_j \leq 150\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	110	V	
$V_{GS}$	gate-source voltage (DC)		-	$\pm 20$	V	
$I_D$	drain current (DC)	$T_h = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Figure 2</a> and <a href="#">3</a>	[1]	-	12.5	A
		$T_h = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Figure 2</a>	[1]	-	7.9	A
$I_{DM}$	peak drain current	$T_h = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <a href="#">Figure 3</a>	[1]	-	50.2	A
$P_{tot}$	total power dissipation	$T_h = 25\text{ °C}$ ; <a href="#">Figure 1</a>	[1]	-	31.2	W
$T_{stg}$	storage temperature		-55	+150	°C	
$T_j$	junction temperature		-55	+150	°C	
<b>Source-drain diode</b>						
$I_S$	source (diode forward) current (DC)	$T_h = 25\text{ °C}$	[1]	-	12.5	A
$I_{SM}$	peak source (diode forward) current	$T_h = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	[1]	-	50.2	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 7.5\text{ A}$ ; $t_p = 0.09\text{ ms}$ ; $V_{DD} \leq 15\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; starting at $T_j = 25\text{ °C}$	-	56	mJ	

[1] External heatsink connected to mounting base.



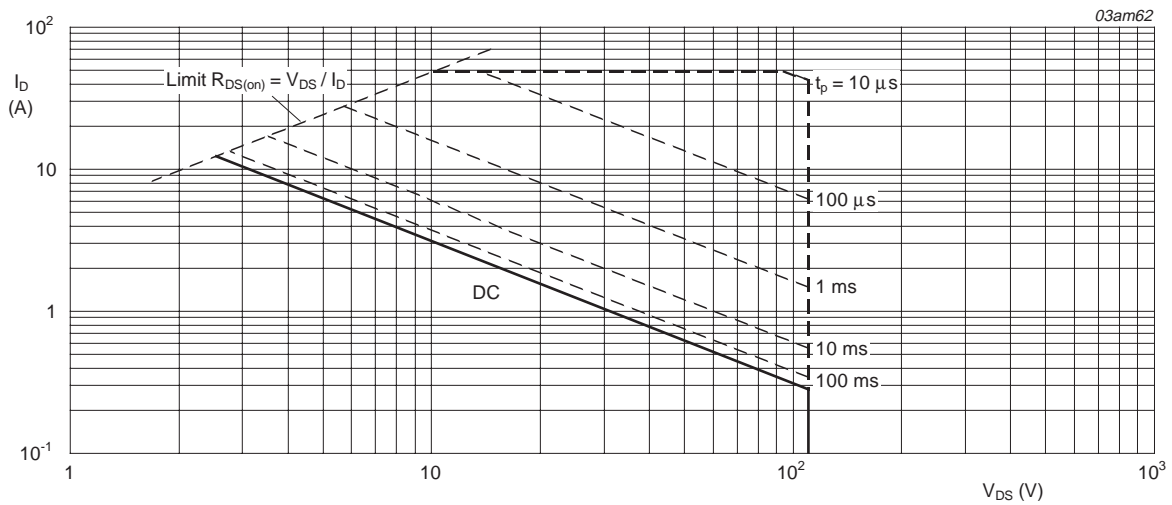
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100\%$$

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



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

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



$T_h = 25^\circ\text{C}$ ;  $I_{DM}$  is single pulse;  $V_{GS} = 10\text{ V}$

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
$R_{th(j-h)}$	thermal resistance from junction to heatsink	<a href="#">Figure 4</a>	[1]	-	4	K/W

[1] External heatsink connected to mounting base.

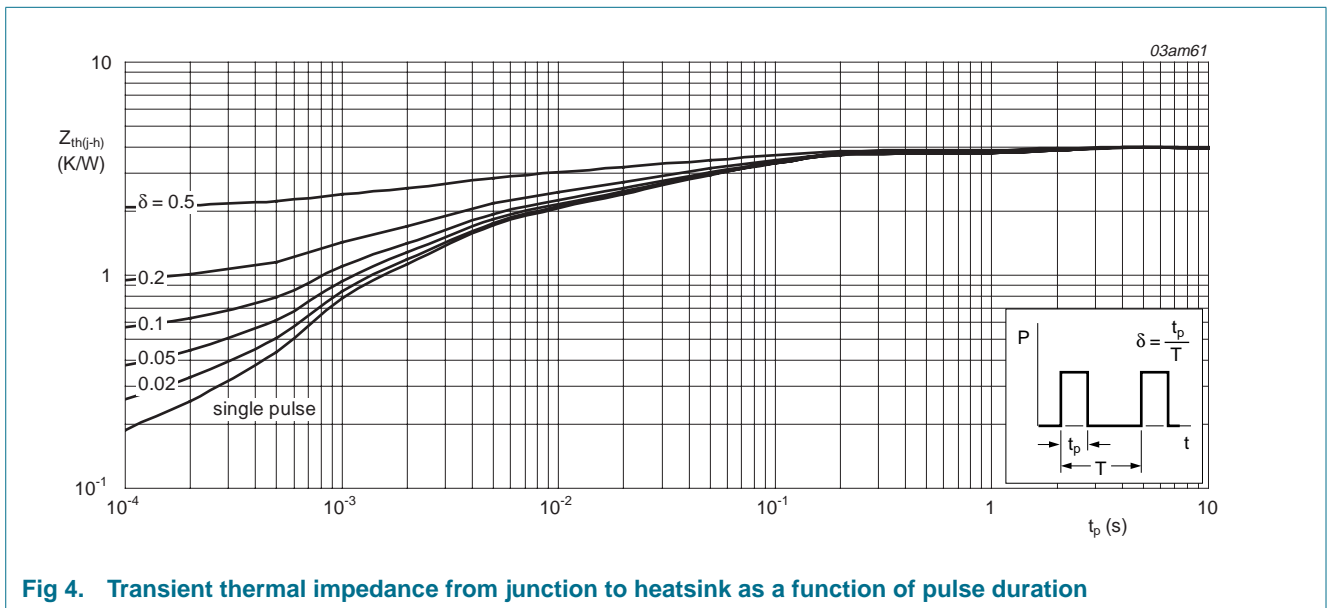
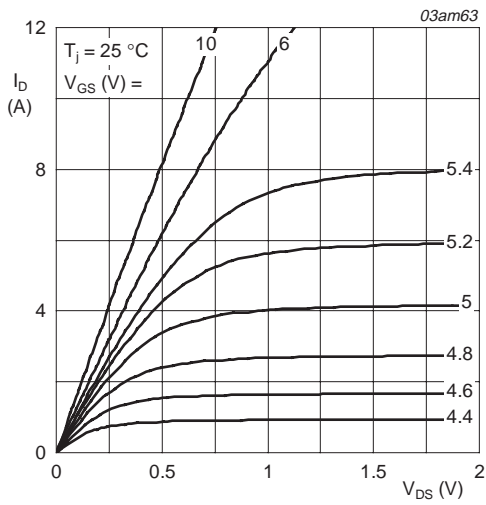


Fig 4. Transient thermal impedance from junction to heatsink as a function of pulse duration

## 6. Characteristics

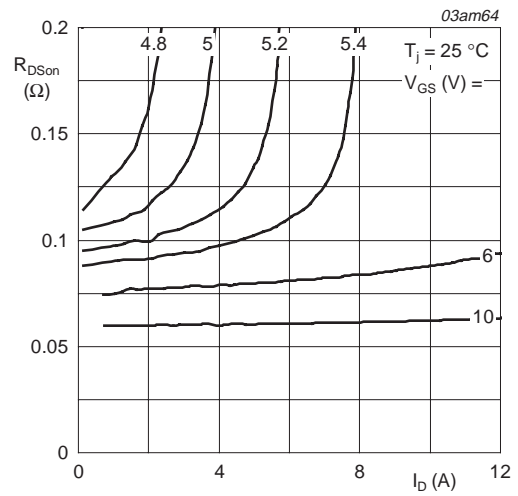
**Table 5: Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V				
		T <sub>j</sub> = 25 °C	110	-	-	V
		T <sub>j</sub> = -55 °C	99	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; <a href="#">Figure 9</a> and <a href="#">10</a>				
		T <sub>j</sub> = 25 °C	2	3	4	V
		T <sub>j</sub> = 150 °C	1.2	-	-	V
		T <sub>j</sub> = -55 °C	-	-	4.4	V
I <sub>DSS</sub>	drain-source leakage current	V <sub>DS</sub> = 100 V; V <sub>GS</sub> = 0 V				
		T <sub>j</sub> = 25 °C	-	-	1	μA
		T <sub>j</sub> = 150 °C	-	-	500	μA
I <sub>GSS</sub>	gate-source leakage current	V <sub>GS</sub> = ±10 V; V <sub>DS</sub> = 0 V	-	10	100	nA
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 9 A; <a href="#">Figure 6</a> and <a href="#">8</a>				
		T <sub>j</sub> = 25 °C	-	67	90	mΩ
		T <sub>j</sub> = 150 °C	-	148	198	mΩ
<b>Dynamic characteristics</b>						
Q <sub>g(tot)</sub>	total gate charge	I <sub>D</sub> = 3 A; V <sub>DD</sub> = 80 V; V <sub>GS</sub> = 10 V; <a href="#">Figure 13</a>	-	21	-	nC
Q <sub>gs</sub>	gate-source charge		-	2.5	-	nC
Q <sub>gd</sub>	gate-drain (Miller) charge		-	8	-	nC
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz; <a href="#">Figure 11</a>	-	635	-	pF
C <sub>oss</sub>	output capacitance		-	105	-	pF
C <sub>rss</sub>	reverse transfer capacitance		-	60	-	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DD</sub> = 50 V; R <sub>L</sub> = 15 Ω; V <sub>GS</sub> = 10 V;	-	6	-	ns
t <sub>r</sub>	rise time	R <sub>G</sub> = 5.6 Ω	-	12	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	20	-	ns
t <sub>f</sub>	fall time		-	10	-	ns
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain (diode forward) voltage	I <sub>S</sub> = 12 A; V <sub>GS</sub> = 0 V; <a href="#">Figure 12</a>	-	0.87	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 12 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V	-	55	-	ns
Q <sub>r</sub>	recovered charge		-	135	-	nC



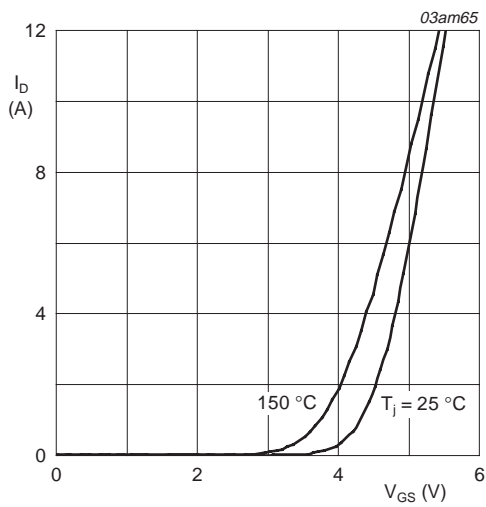
$T_j = 25\text{ °C}$

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



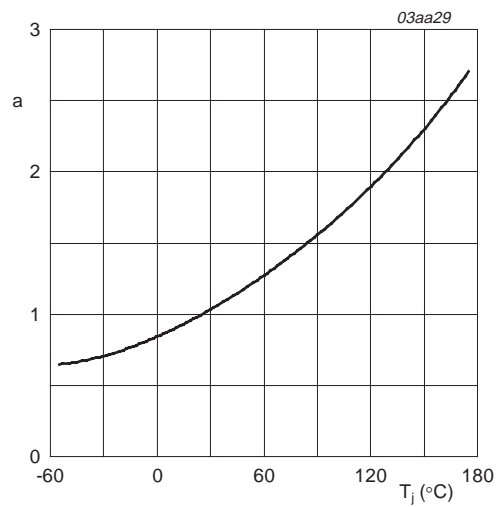
$T_j = 25\text{ °C}$

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



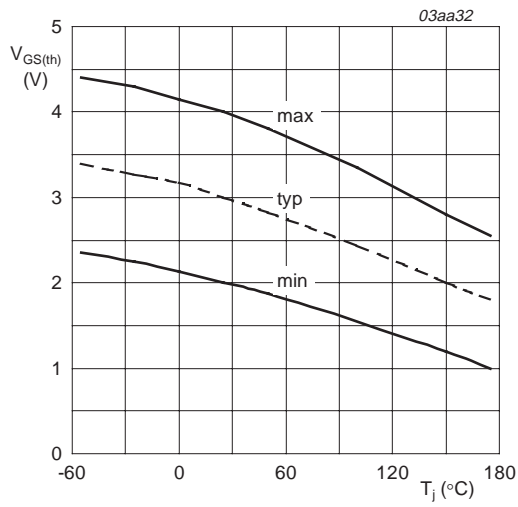
$T_j = 25\text{ °C and } 150\text{ °C}; V_{DS} > I_D \times R_{DSon}$

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values



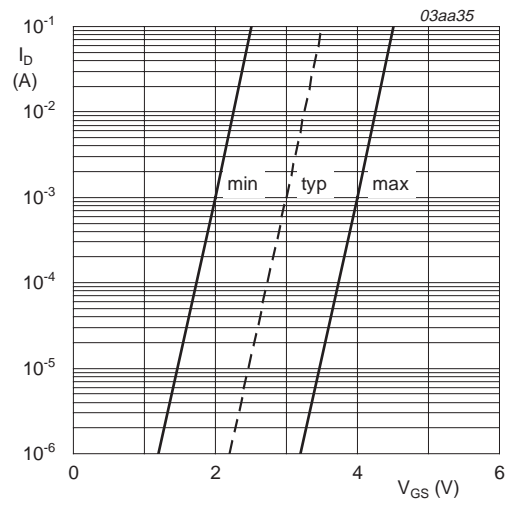
$$a = \frac{R_{DSon}}{R_{DSon(25\text{ °C})}}$$

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



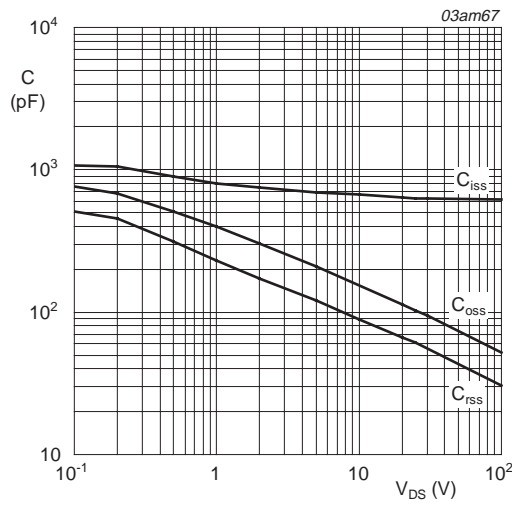
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



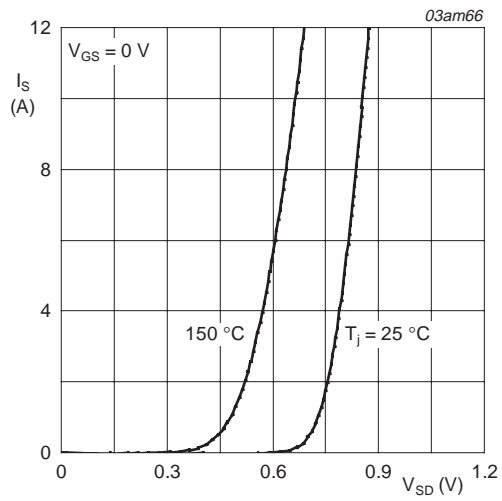
$T_j = 25 \text{ °C}; V_{DS} = 5 \text{ V}$

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



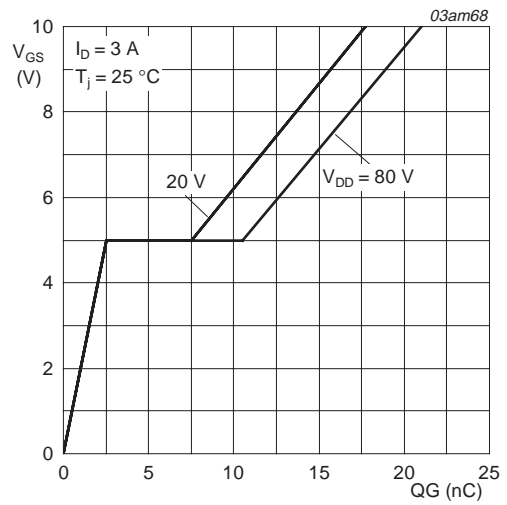
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

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



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

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



$I_D = 3\text{ A}$ ;  $V_{DD} = 20\text{ V}$  and  $80\text{ V}$

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

## 7. Isolation characteristics

Table 6: Isolation Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{(isol)RMS}$	RMS isolation voltage from all three terminals to external heatsink	$f = 50\text{-}60\text{ Hz}$ ; sinusoidal waveform; $RH \leq 65\%$ ; clean and dust-free	-	-	2500	V
$C_{(d-h)}$	Capacitance from drain to external heatsink		-	10	-	pF



8. Package outline

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

SOT186A

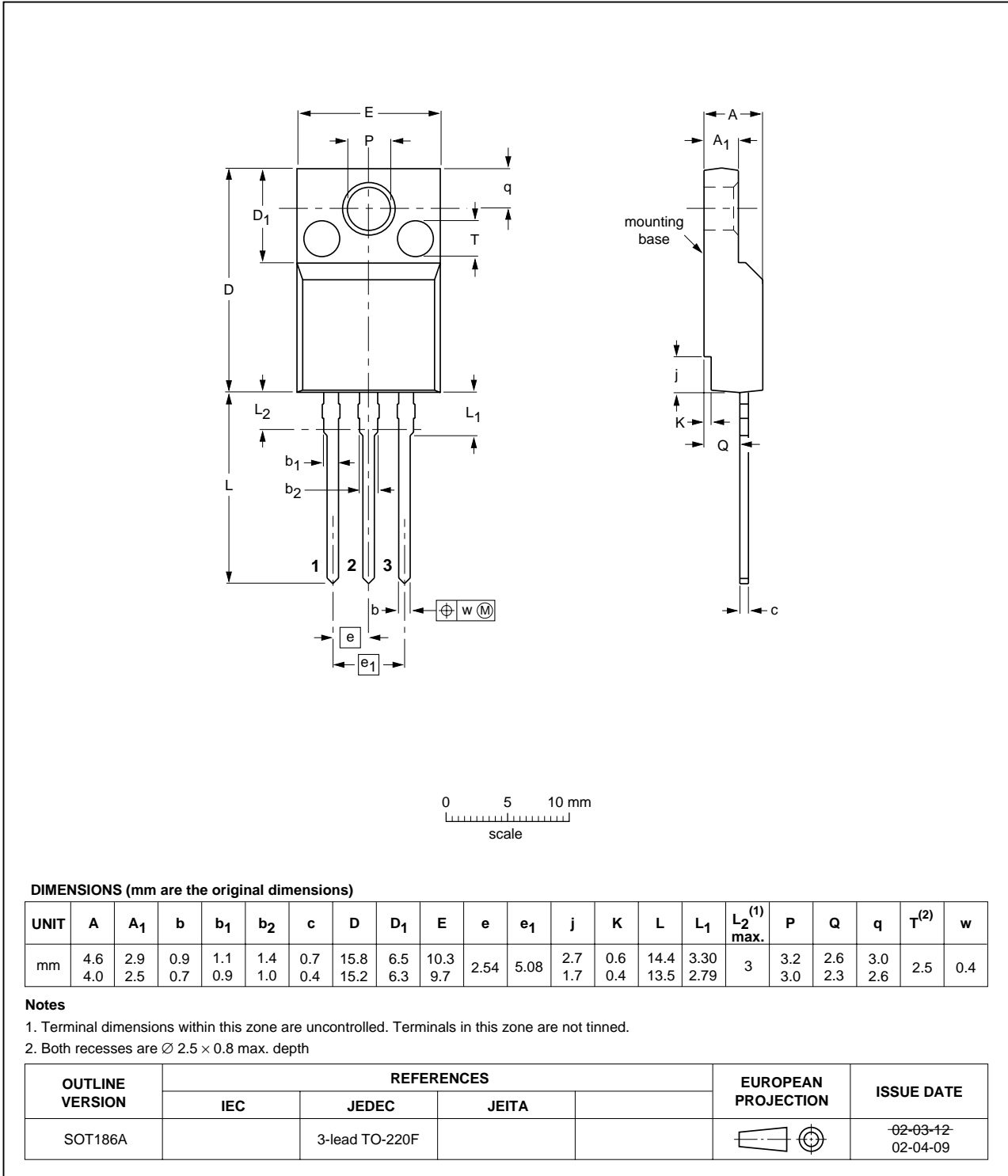


Fig 14. Package outline SOT186A (3-lead TO-220F)

## 9. Revision history

Table 7: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
PHX18NQ11T_2	20050324	Product data sheet	-	9397 750 14444	PHX18NQ11T-01
Modifications:					
					<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors.</li><li>• <a href="#">Table 1 "Pinning"</a>: description corrected</li><li>• <a href="#">Section 1.2 "Features"</a> and <a href="#">Section 1.3 "Applications"</a>: information added</li></ul>
PHX18NQ11T-01	20040213	Product data	-	9397 750 12915	-

## 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.
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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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 the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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