

# PHP20NQ20T

## N-channel TrenchMOS standard level FET

Rev. 02 — 16 December 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product is designed and qualified for use in computing, communications, consumer and industrial applications only.

### 1.2 Features and benefits

- Higher operating power due to low thermal resistance
- Low conduction losses due to low on-state resistance
- Suitable for high frequency applications due to fast switching characteristics

### 1.3 Applications

- DC-to-DC converters
- General purpose switching

### 1.4 Quick reference data

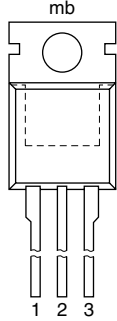
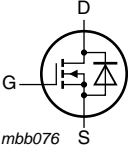
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	-	200	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$	-	-	20	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$	-	-	150	W
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 10\text{ A}$ ; $T_j = 25\text{ °C}$	-	120	130	mΩ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}$ ; $I_D = 20\text{ A}$ ; $V_{DS} = 160\text{ V}$ ; $T_j = 25\text{ °C}$	-	22	-	nC



## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

**SOT78 (TO-220AB)**

## 3. Ordering information

Table 3. Ordering information

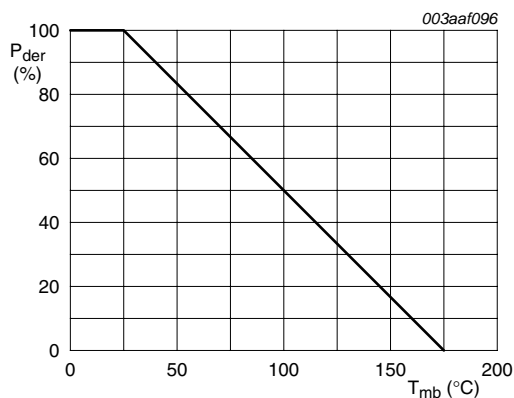
Type number	Package		
	Name	Description	Version
PHP20NQ20T	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 4. Limiting values

**Table 4. Limiting values**

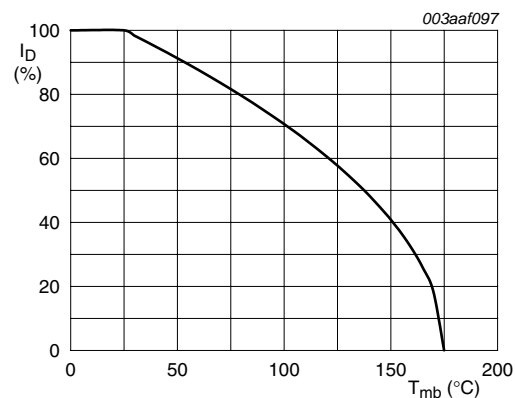
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	200	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}; R_{GS} = 20\text{ k}\Omega$	-	200	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ °C}$	-	14	A
		$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}$	-	20	A
$I_{DM}$	peak drain current	pulsed; $T_{mb} = 25\text{ °C}$	-	80	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$	-	150	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$	-	20	A
$I_{SM}$	peak source current	pulsed; $T_{mb} = 25\text{ °C}$	-	80	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}; T_{j(\text{init})} = 25\text{ °C}; I_D = 19\text{ A}; V_{sup} \leq 25\text{ V}; \text{unclamped}; t_p = 100\text{ }\mu\text{s}; R_{GS} = 50\text{ }\Omega$	-	252	mJ
$I_{AS}$	non-repetitive avalanche current	$V_{sup} \leq 25\text{ V}; V_{GS} = 10\text{ V}; T_{j(\text{init})} = 25\text{ °C}; R_{GS} = 50\text{ }\Omega; \text{unclamped}$	-	20	A



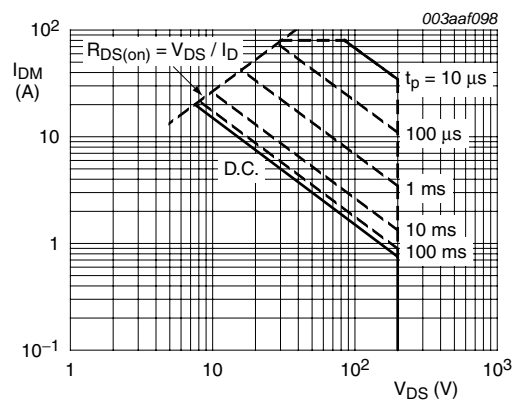
$$P_{der} = \frac{P_{tot}}{P_{tot(25\text{ °C})}} \times 100\%$$

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



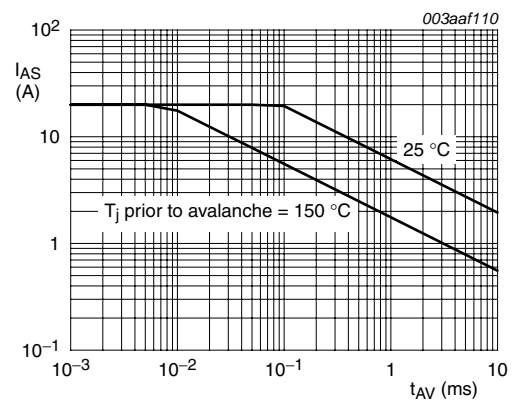
$$I_{der} = \frac{I_D}{I_{D(25\text{ °C})}} \times 100\%$$

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



$T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{DM}$  is single pulse

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



unclamped inductive load

Fig 4. Single-shot avalanche rating; avalanche current as a function of avalanche period

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base		-	-	1	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

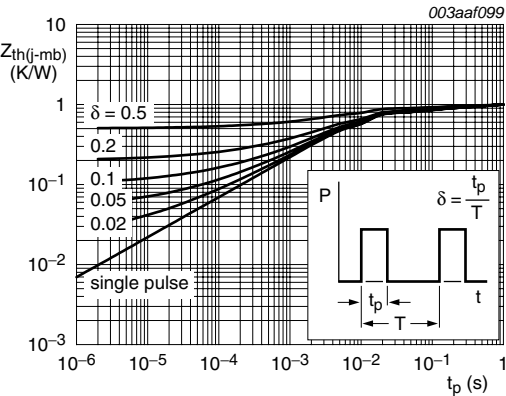
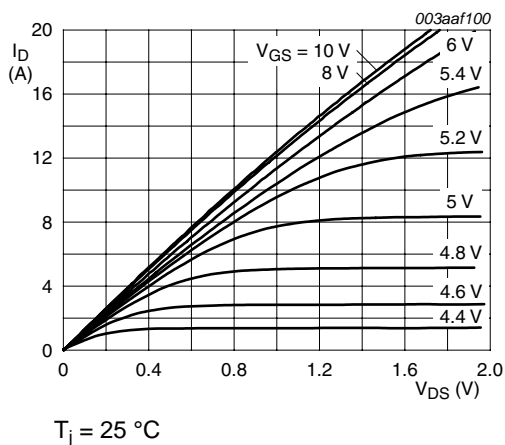


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

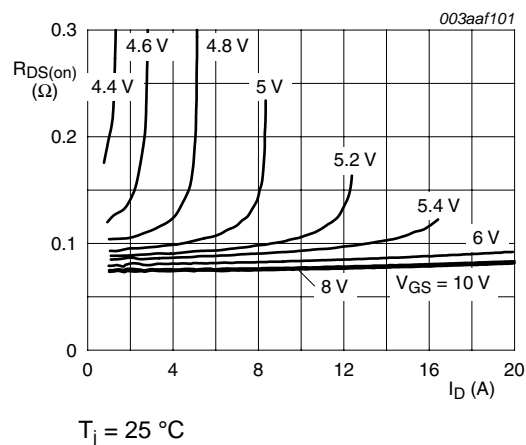
## 6. Characteristics

Table 6. Characteristics

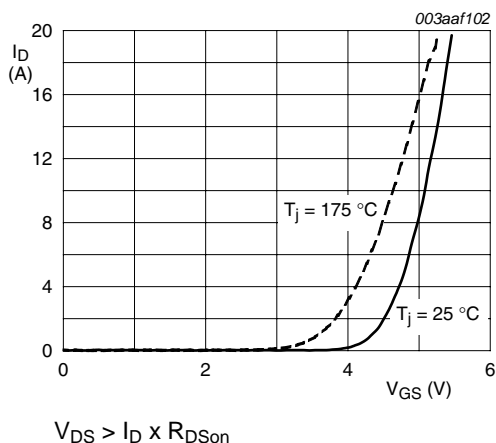
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = -55 °C	178	-	-	V
		I <sub>D</sub> = 0.25 mA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C	200	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 175 °C	1	-	-	V
		I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = -55 °C	-	-	6	V
		I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; T <sub>j</sub> = 25 °C	2	3	4	V
I <sub>DSS</sub>	drain leakage current	V <sub>DS</sub> = 200 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	0.05	10	µA
		V <sub>DS</sub> = 200 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 175 °C	-	-	500	µA
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = 10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	0.02	100	nA
		V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	0.02	100	nA
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 10 A; T <sub>j</sub> = 175 °C	-	-	377	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 10 A; T <sub>j</sub> = 25 °C	-	120	130	mΩ
Dynamic characteristics						
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 20 A; V <sub>DS</sub> = 160 V; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C	-	65	-	nC
Q <sub>GS</sub>	gate-source charge		-	10	-	nC
Q <sub>GD</sub>	gate-drain charge		-	22	-	nC
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 25 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>j</sub> = 25 °C	-	2470	-	pF
C <sub>oss</sub>	output capacitance		-	207	-	pF
C <sub>rss</sub>	reverse transfer capacitance		-	90	-	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 100 V; R <sub>L</sub> = 4.7 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 5.6 Ω; T <sub>j</sub> = 25 °C	-	15	-	ns
t <sub>r</sub>	rise time		-	46	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	50	-	ns
t <sub>f</sub>	fall time		-	38	-	ns
L <sub>D</sub>	internal drain inductance	measured from tab to centre of die ; T <sub>j</sub> = 25 °C	-	3.5	-	nH
		measured from drain lead to centre of die ; T <sub>j</sub> = 25 °C	-	4.5	-	nH
L <sub>S</sub>	internal source inductance	measured from source lead to source bond pad ; T <sub>j</sub> = 25 °C	-	7.5	-	nH
Source-drain diode						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 20 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C	-	0.95	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/µs; V <sub>GS</sub> = -10 V; V <sub>DS</sub> = 25 V; T <sub>j</sub> = 25 °C	-	124	-	ns
Q <sub>r</sub>	recovered charge	V <sub>DS</sub> = 25 V; T <sub>j</sub> = 25 °C	-	0.74	-	µC



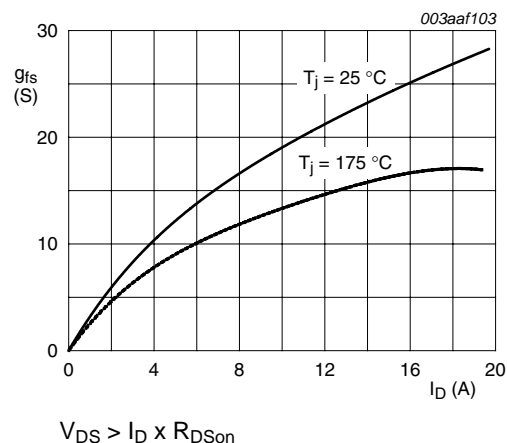
**Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values**



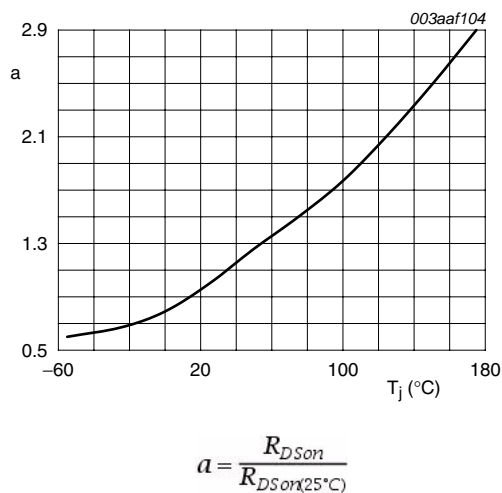
**Fig 7. Drain-source on-state resistance as a function of drain current; typical values**



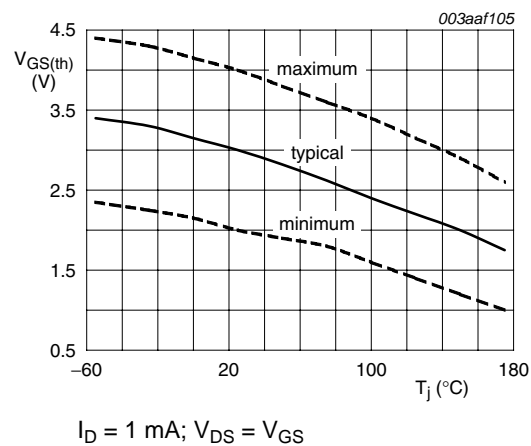
**Fig 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



**Fig 9. Forward transconductance as a function of drain current; typical values**



**Fig 10. Normalized drain-source on-state resistance factor as a function of junction temperature**



**Fig 11. Gate-source threshold voltage as a function of junction temperature**

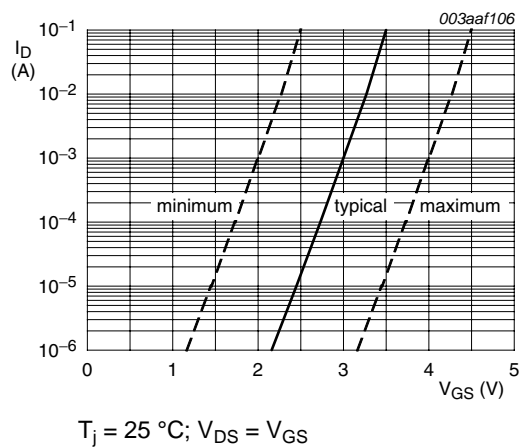


Fig 12. Sub-threshold drain current as a function of gate-source voltage

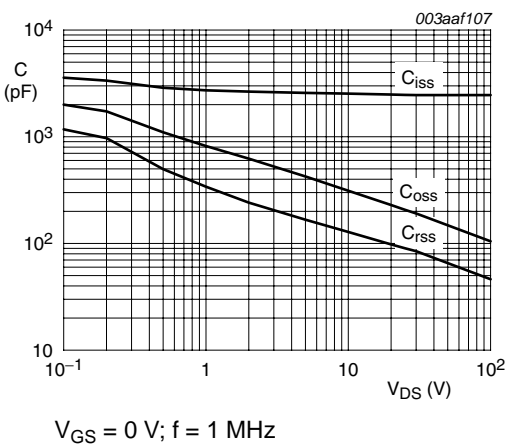


Fig 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

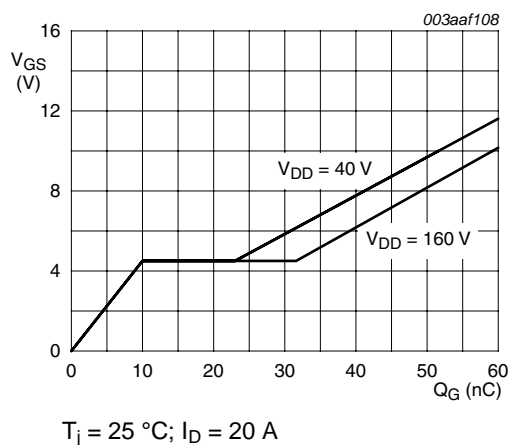


Fig 14. Gate-source voltage as a function of gate charge; typical values

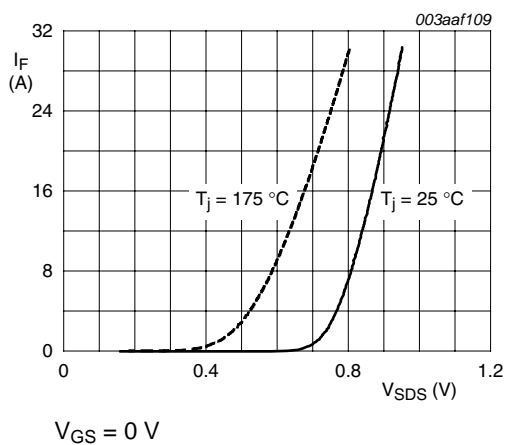


Fig 15. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values



7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB SOT78

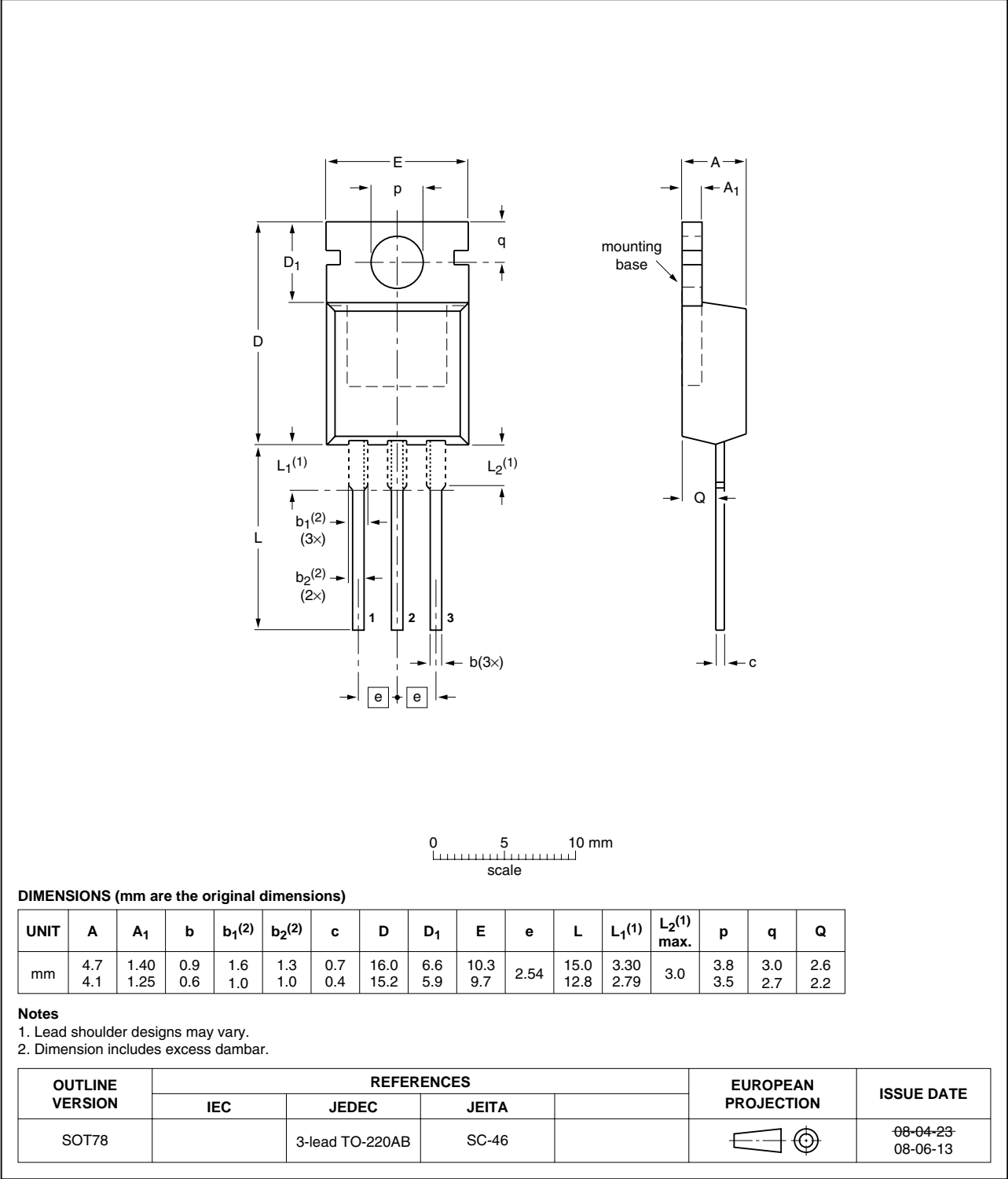


Fig 16. Package outline SOT78 (TO-220AB)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHP20NQ20T v.2	20101216	Product data sheet	-	PHB_PHP20NQ20T v.1
Modifications:	<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• Type number PHP20NQ20T separated from data sheet PHB_PHP20NQ20T v.1.</li></ul>			
PHB_PHP20NQ20T v.1	19990801	Product specification	-	-

## 9. Legal information

### 9.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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