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Team Nexperia

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

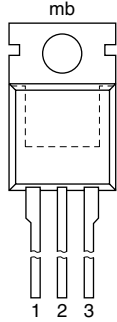
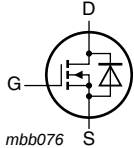
Table 1. Quick reference data

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
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 10\text{ A}$; $T_j = 25\text{ °C}$	-	120	130	mΩ
Dynamic characteristics						
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

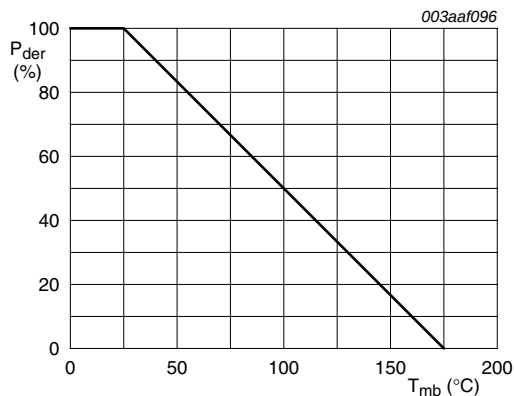
Type number	Package		
	Name	Description	Version
PHP20NQ20T	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

4. Limiting values

Table 4. Limiting values

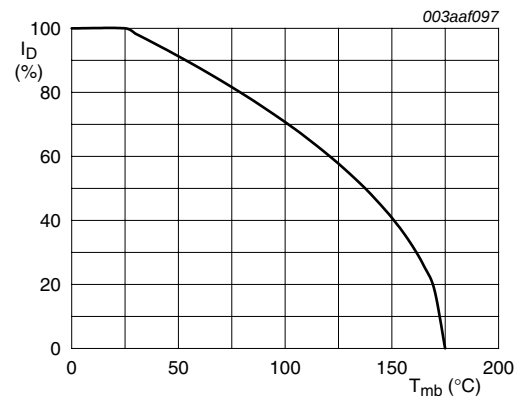
In accordance with the Absolute Maximum Rating System (IEC 60134).

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
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$	-	20	A
I_{SM}	peak source current	pulsed; $T_{mb} = 25\text{ °C}$	-	80	A
Avalanche ruggedness					
$E_{DS(AL)S}$	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



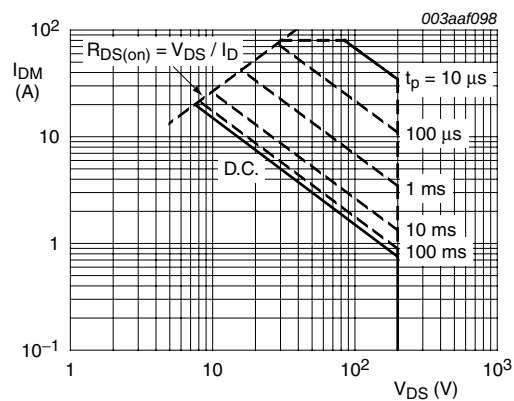
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100\%$$

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



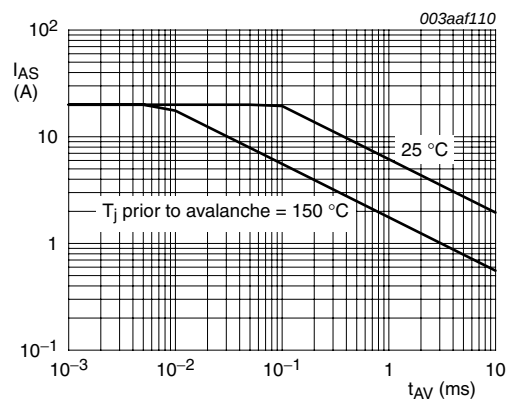
$$I_{der} = \frac{I_D}{I_{D(25^\circ\text{C})}} \times 100\%$$

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

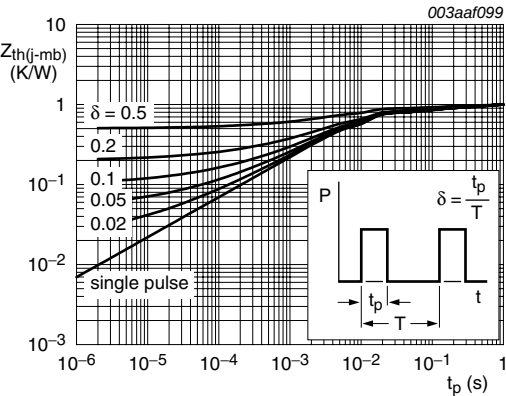


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

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

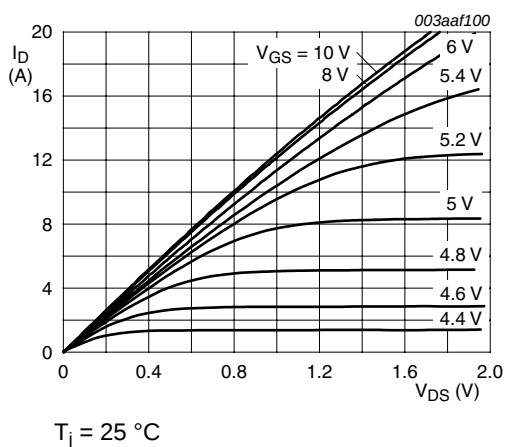


Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values

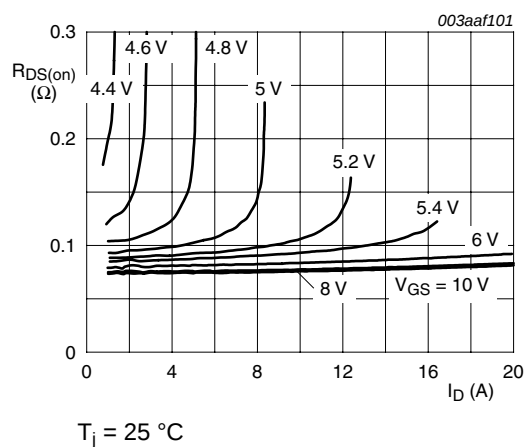


Fig 7. Drain-source on-state resistance as a function of drain current; typical values

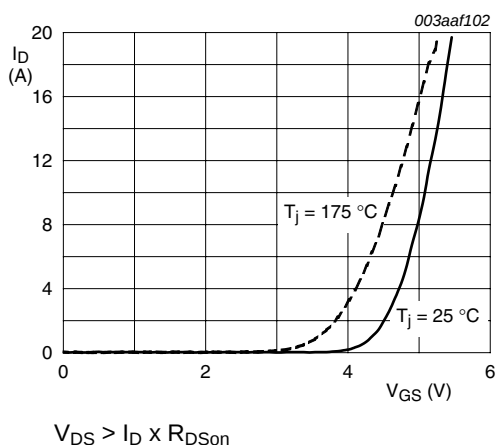


Fig 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

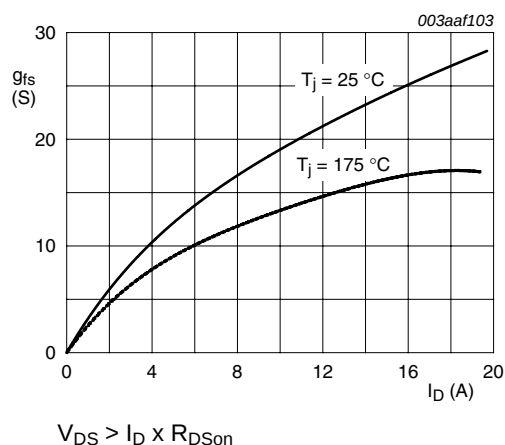


Fig 9. Forward transconductance as a function of drain current; typical values

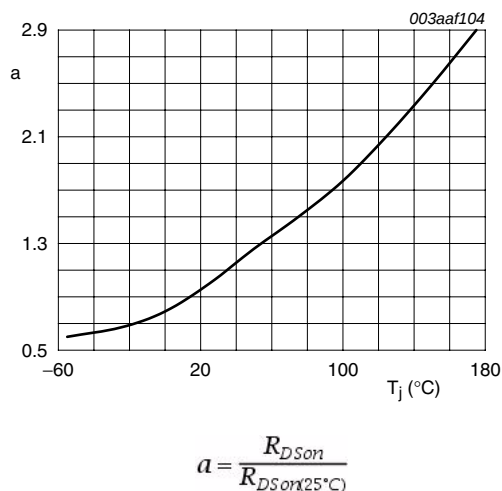


Fig 10. Normalized drain-source on-state resistance factor as a function of junction temperature

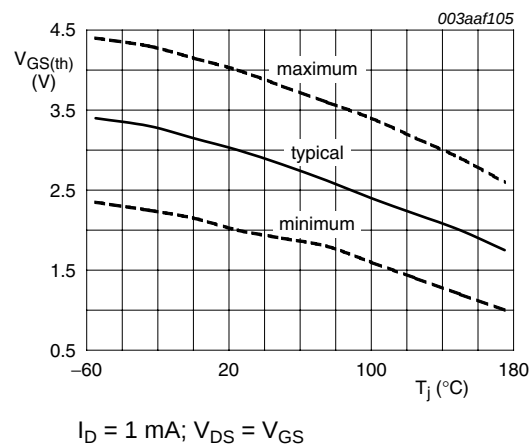


Fig 11. Gate-source threshold voltage as a function of junction temperature

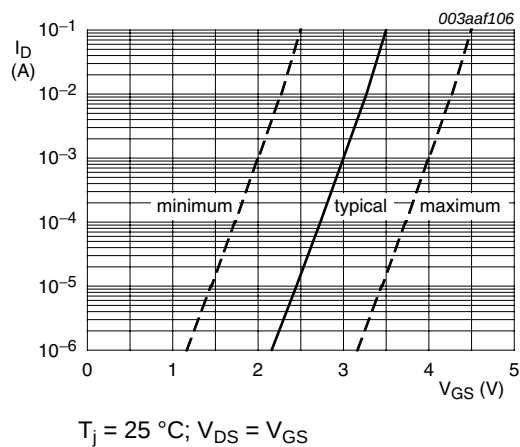


Fig 12. Sub-threshold drain current as a function of gate-source voltage

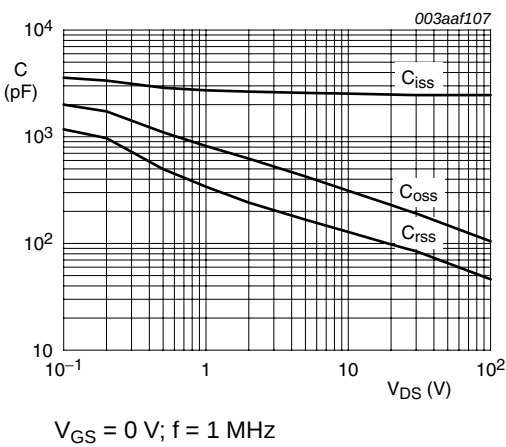


Fig 13. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

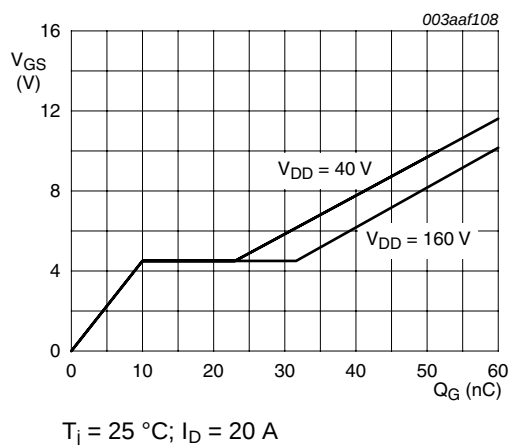


Fig 14. Gate-source voltage as a function of gate charge; typical values

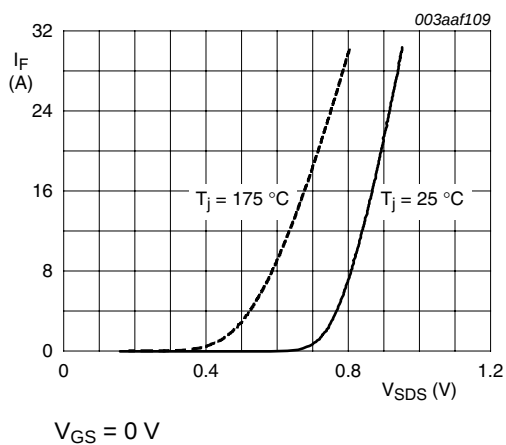


Fig 15. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

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

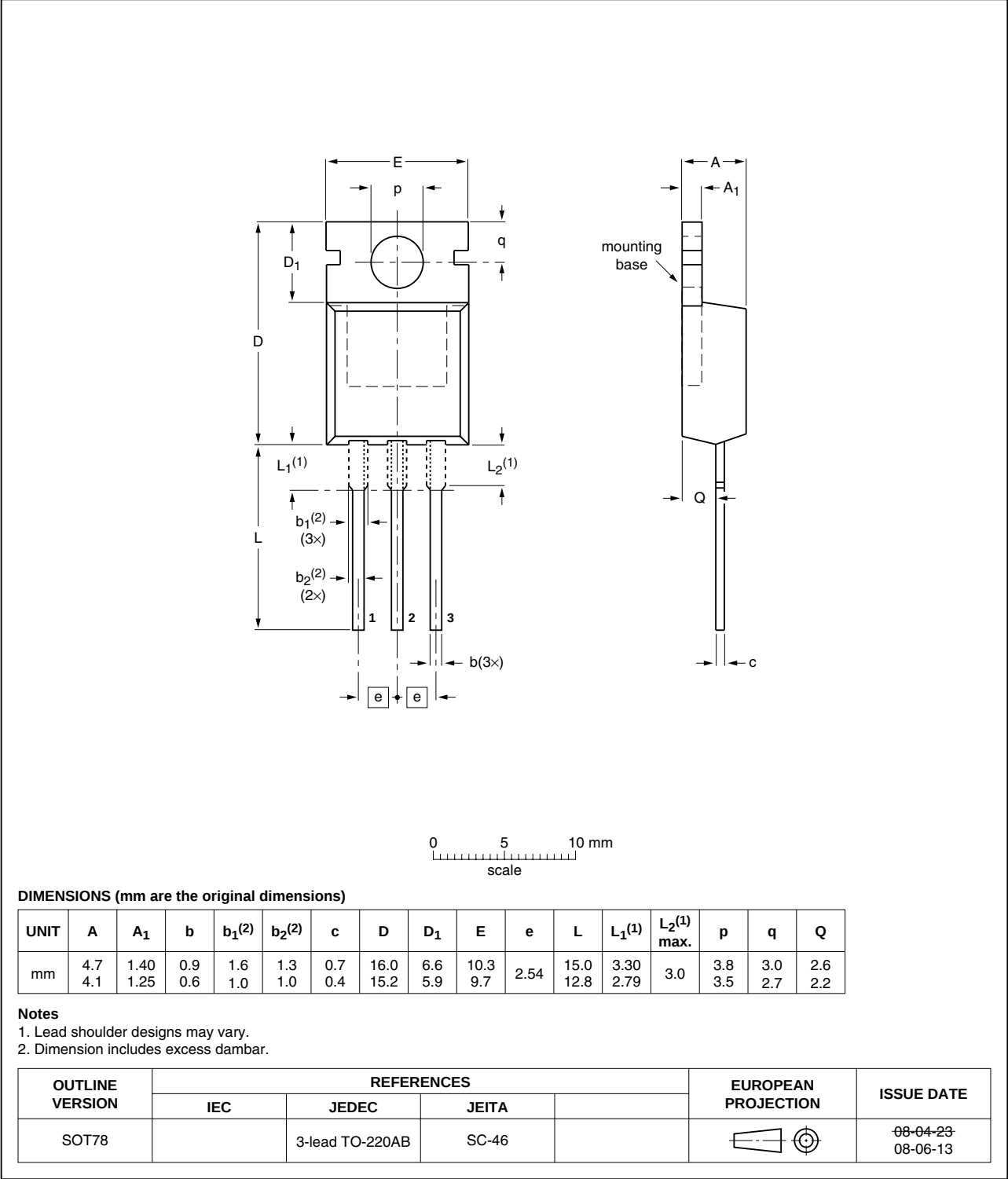


Fig 16. Package outline SOT78 (TO-220AB)

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:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Type number PHP20NQ20T separated from data sheet PHB_PHP20NQ20T v.1.			
PHB_PHP20NQ20T v.1	19990801	Product specification	-	-

9. Legal information

9.1 Data sheet status

Document status ^{[1][2]}	Product status ^[3]	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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11. Contents

1	Product profile	1
1.1	General description	1
1.2	Features and benefits	1
1.3	Applications	1
1.4	Quick reference data	1
2	Pinning information	2
3	Ordering information	2
4	Limiting values	3
5	Thermal characteristics	5
6	Characteristics	6
7	Package outline	9
8	Revision history	10
9	Legal information	11
9.1	Data sheet status	11
9.2	Definitions	11
9.3	Disclaimers	11
9.4	Trademarks	12
10	Contact information	12

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