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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

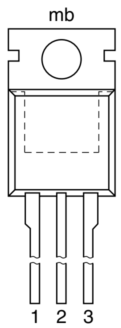
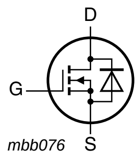
1.4 Quick reference data

Table 1. Quick reference data

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

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 SOT78 (TO-220AB)	
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

3. Ordering information

Table 3. Ordering information

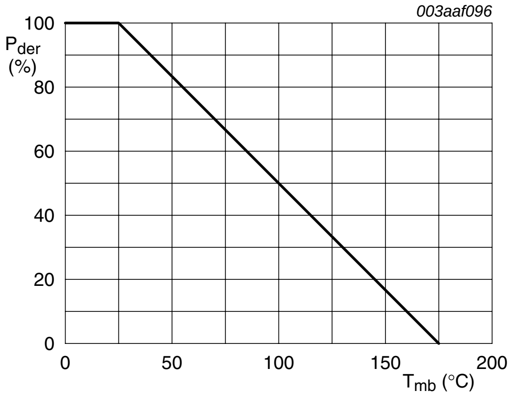
Type number	Package		
	Name	Description	Version
PHP20NQ20T	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

4. Limiting values

Table 4. Limiting values

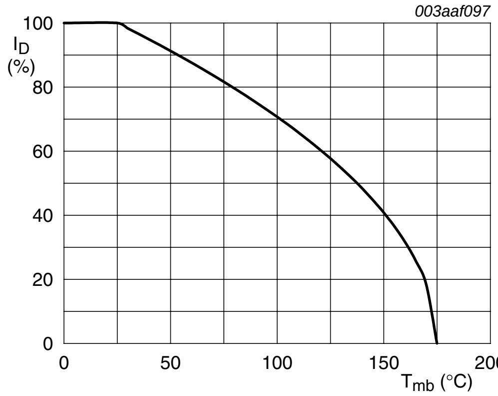
In accordance with the Absolute Maximum Rating System (IEC 60134).

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



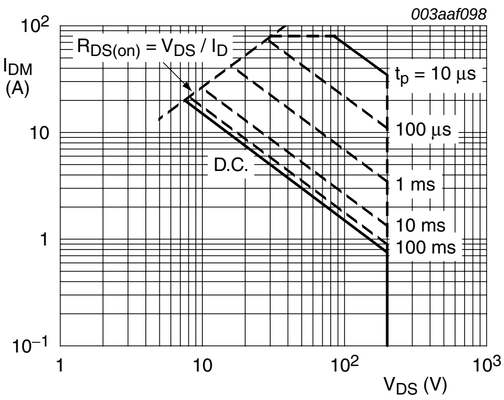
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\,\%$$

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



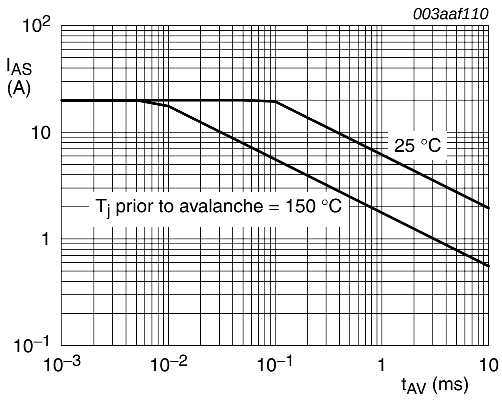
$$I_{der} = \frac{I_D}{I_{D(25^{\circ}C)}} \times 100\,\%$$

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



$T_{mb} = 25\ °C$; 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

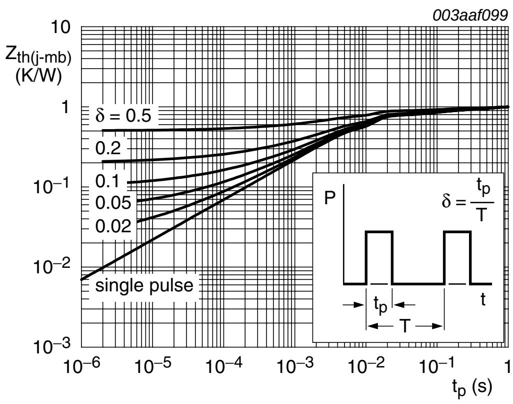
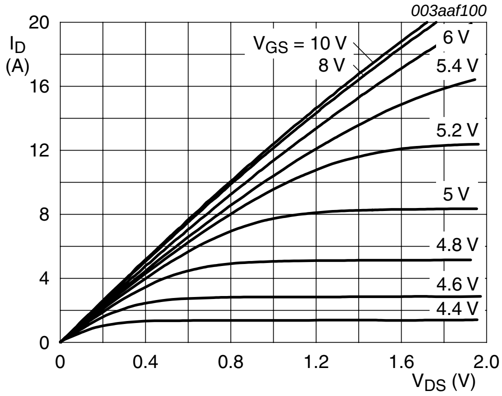


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

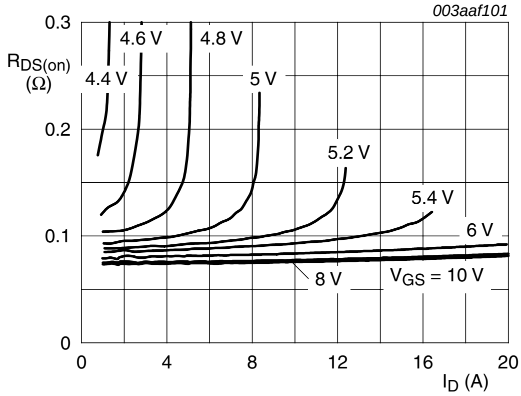
Table 6. Characteristics

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		-	0.74	-	µC



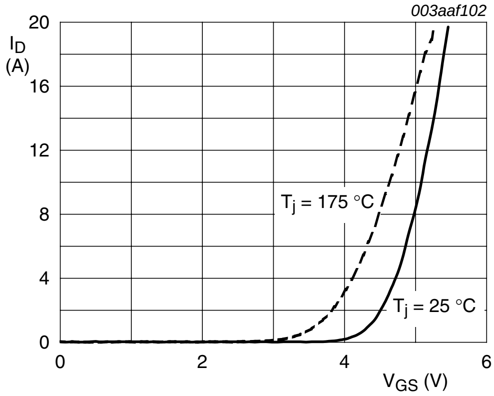
T_j = 25 °C

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



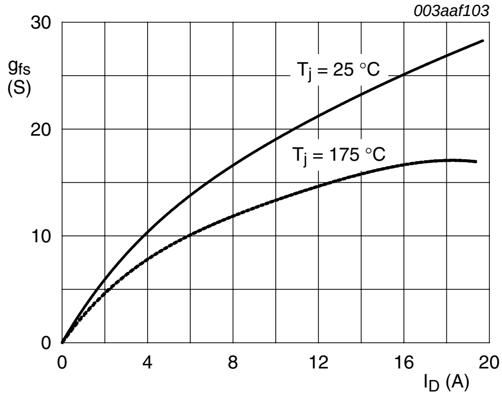
T_j = 25 °C

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



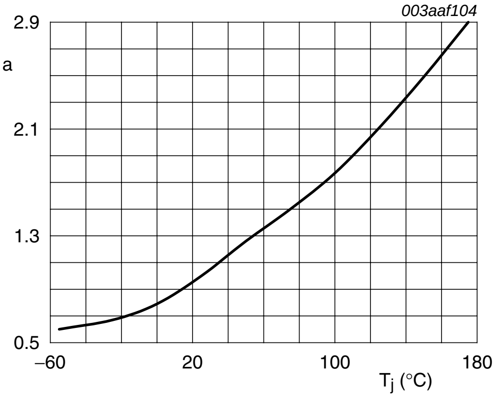
V_{DS} > I_D x R_{DSon}

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



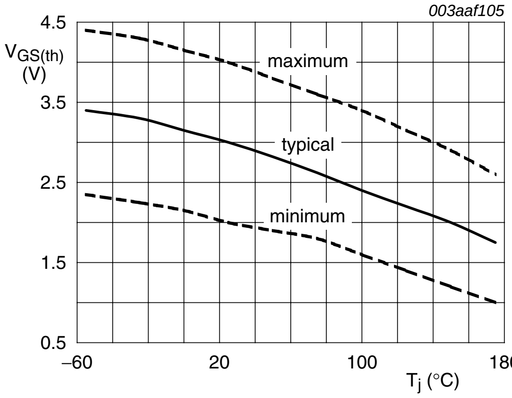
V_{DS} > I_D x R_{DSon}

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



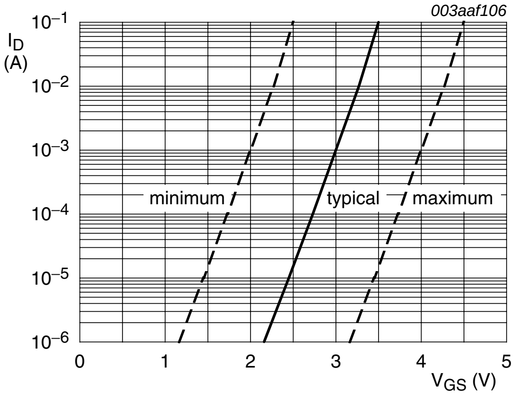
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



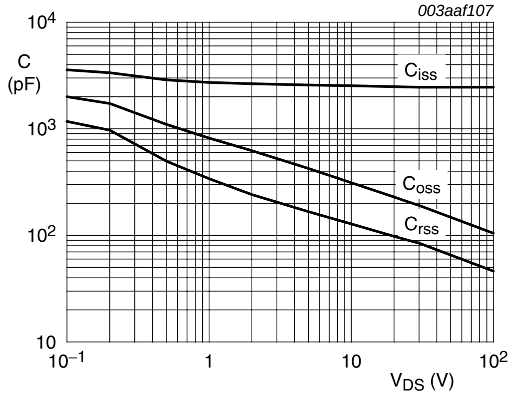
I_D = 1 mA; V_{DS} = V_{GS}

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



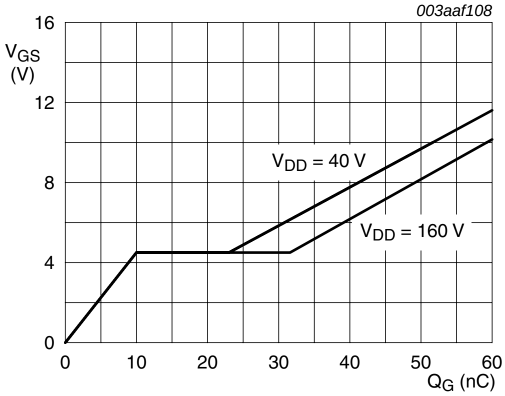
T_j = 25 °C; $V_{DS} = V_{GS}$

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



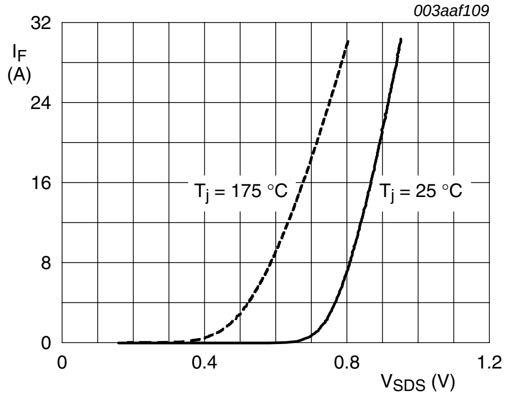
V_{GS} = 0 V; f = 1 MHz

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



T_j = 25 °C; I_D = 20 A

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

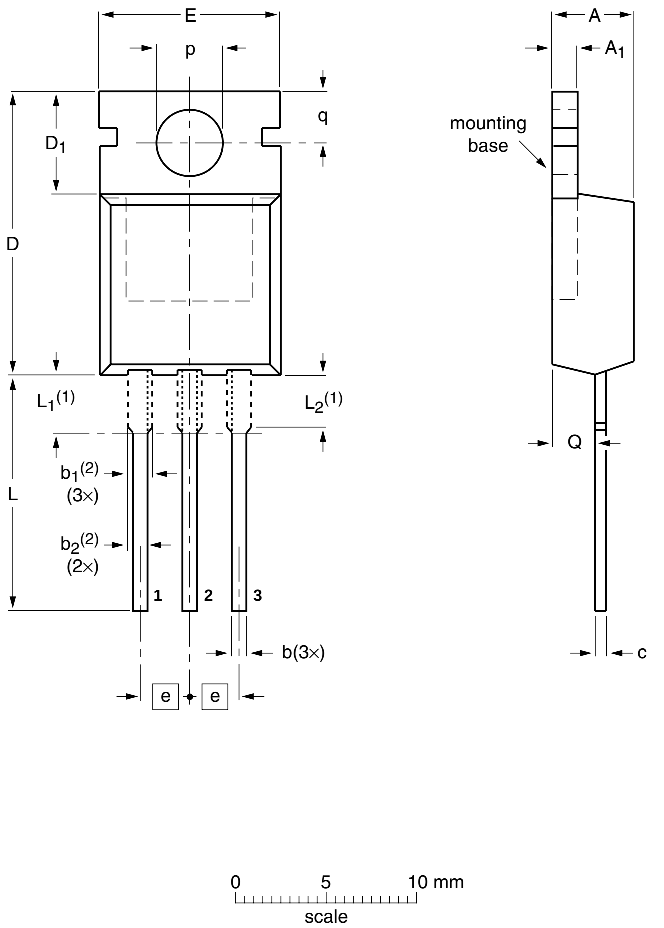


V_{GS} = 0 V

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**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1(2)	b_2(2)	c	D	D_1	E	e	L	L_1(1)	L_2(1) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

Notes

1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			~~08-04-23~~ 08-06-13

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

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Date of release: 16 December 2010
Document identifier: PHP20NQ20T