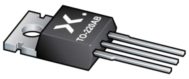


PHP9NQ20T

N-channel TrenchMOS standard level FET

Rev. 03 — 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
- Motor control circuits
- Off-line switched-mode power supplies
- TV and computer monitor power supplies

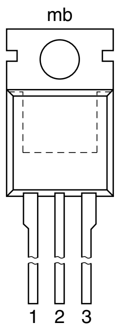
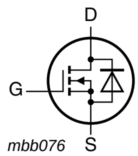
1.4 Quick reference data

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	-	-	8.7	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C	-	-	88	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 4.5$ A; $T_j = 25$ °C	-	300	400	mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 10$ V; $I_D = 9$ A; $V_{DS} = 160$ V; $T_j = 25$ °C	-	12	-	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

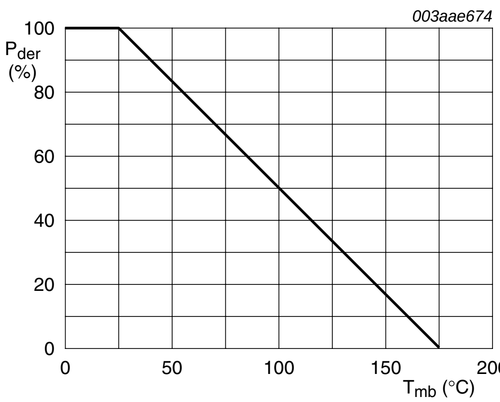
Type number	Package		
	Name	Description	Version
PHP9NQ20T	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

4. Limiting values

Table 4. Limiting values

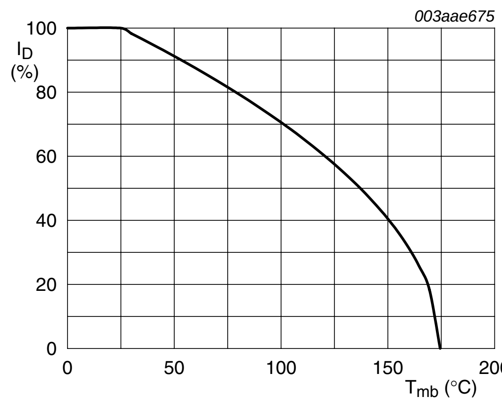
In accordance with the Absolute Maximum Rating System (IEC 60134).

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		-30	30	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 100 °C	-	6.2	A
		V_{GS} = 10 V; T_{mb} = 25 °C	-	8.7	A
I_{DM}	peak drain current	pulsed; T_{mb} = 25 °C	-	35	A
P_{tot}	total power dissipation	T_{mb} = 25 °C	-	88	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	-	8.7	A
I_{SM}	peak source current	pulsed; T_{mb} = 25 °C	-	35	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; I_D = 7.2 A; $V_{sup} \leq 25$ V; unclamped; t_p = 100 µs; R_{GS} = 50 Ω	-	93	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	-	8.7	A



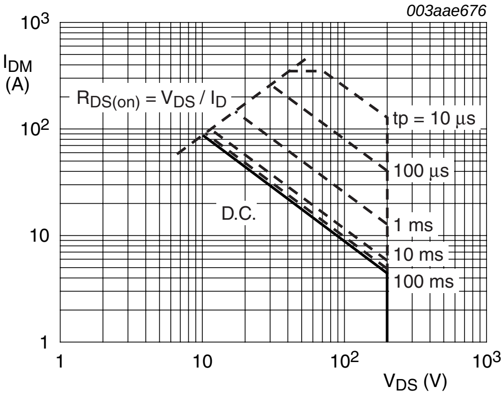
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ C)}} \times 100\,\%$$

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



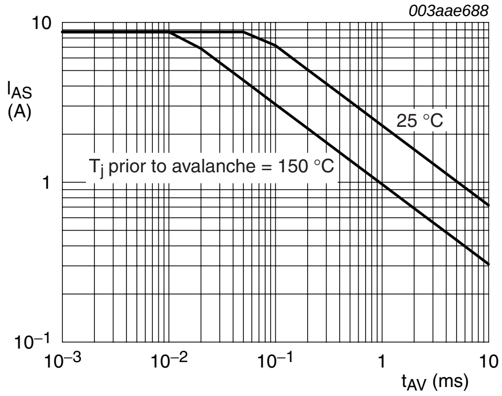
$$I_{der} = \frac{I_D}{I_{D(25^\circ C)}} \times 100\,\%$$

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		-	-	1.7	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	-	60	-	K/W

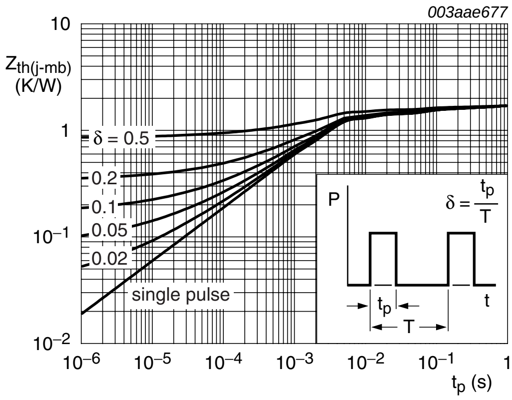
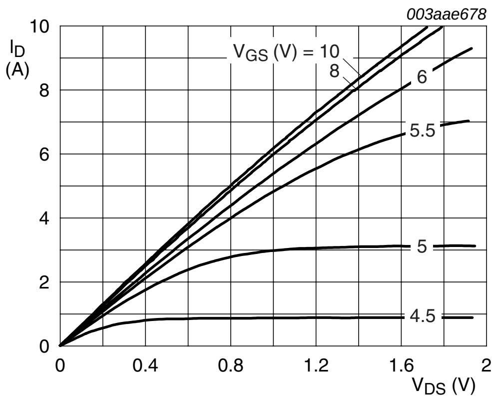


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

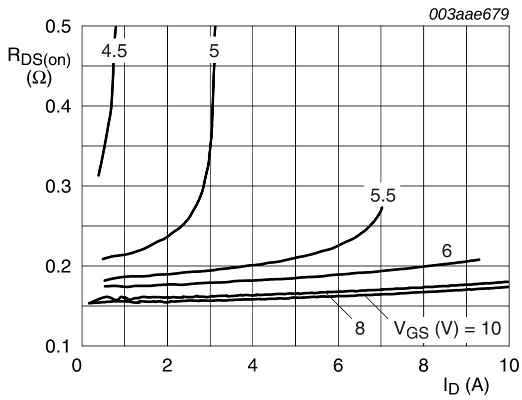
Table 6. Characteristics

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 = 25 °C	200	-	-	V
		I_D = 0.25 mA; V_{GS} = 0 V; T_j = -55 °C	178	-	-	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 = 25 °C	2	3	4	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C	-	-	6	V
I_{DSS}	drain leakage current	V_{DS} = 200 V; V_{GS} = 0 V; T_j = 175 °C	-	-	500	µA
		V_{DS} = 200 V; V_{GS} = 0 V; T_j = 25 °C	-	0.05	10	µA
I_{GSS}	gate leakage current	V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 °C	-	10	100	nA
		V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 °C	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 4.5 A; T_j = 175 °C	-	-	1.16	Ω
		V_{GS} = 10 V; I_D = 4.5 A; T_j = 25 °C	-	300	400	mΩ
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 9 A; V_{DS} = 160 V; V_{GS} = 10 V; T_j = 25 °C	-	24	-	nC
Q_{GS}	gate-source charge		-	4	-	nC
Q_{GD}	gate-drain charge		-	12	-	nC
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C	-	959	-	pF
C_{oss}	output capacitance		-	93	-	pF
C_{rss}	reverse transfer capacitance		-	54	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 100 V; R_L = 10 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 5.6 Ω; T_j = 25 °C	-	8	-	ns
t_r	rise time		-	19	-	ns
$t_{d(off)}$	turn-off delay time		-	25	-	ns
t_f	fall time		-	15	-	ns
g_{fs}	transfer conductance	V_{DS} = 25 V; I_D = 4.5 A; T_j = 25 °C	3.8	6	-	S
L_D	internal drain inductance	from drain lead to centre of die ; T_j = 25 °C	-	4.5	-	nH
		from tab to centre of die ; T_j = 25 °C	-	3.5	-	nH
L_S	internal source inductance	from source lead to source bond pad ; T_j = 25 °C	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 9 A; V_{GS} = 0 V; T_j = 25 °C	-	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 9 A; dI_S/dt = -100 A/µs; V_{GS} = -10 V; V_{DS} = 25 V; T_j = 25 °C	-	92	-	ns
Q_r	recovered charge		-	0.5	-	µC



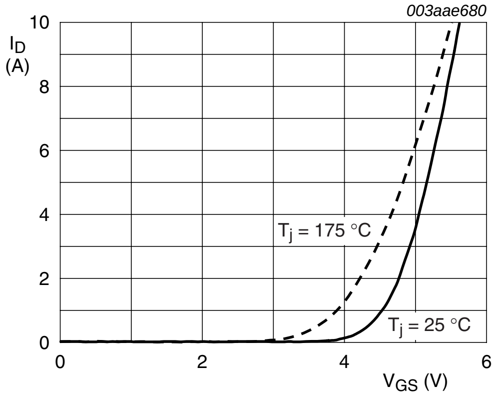
T_j = 25 °C

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



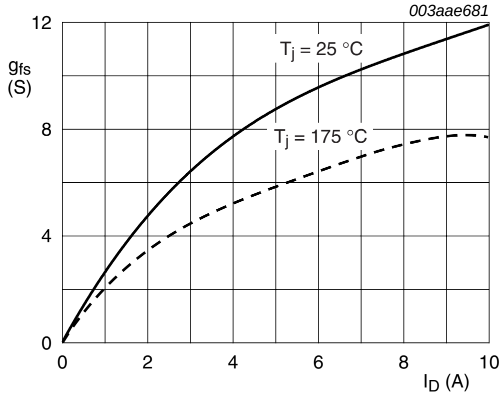
T_j = 25 °C

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



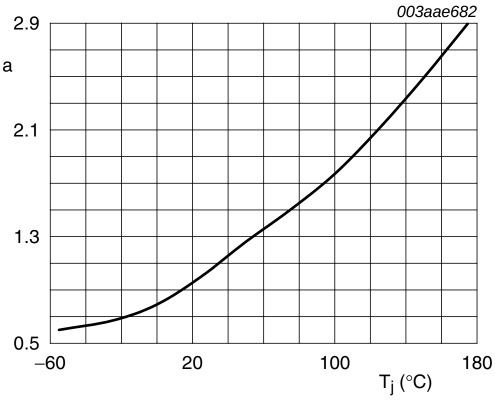
$V_{DS} > I_D \times R_{DSon}$

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



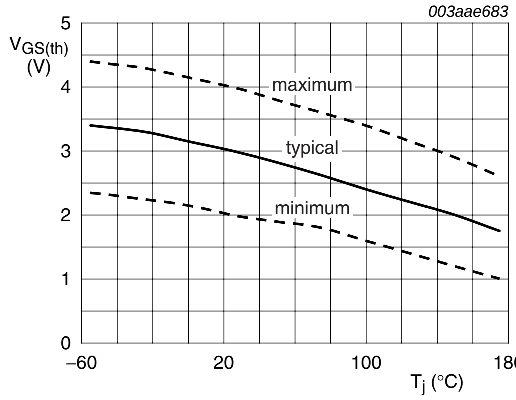
$V_{DS} > I_D \times R_{DSon}$

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



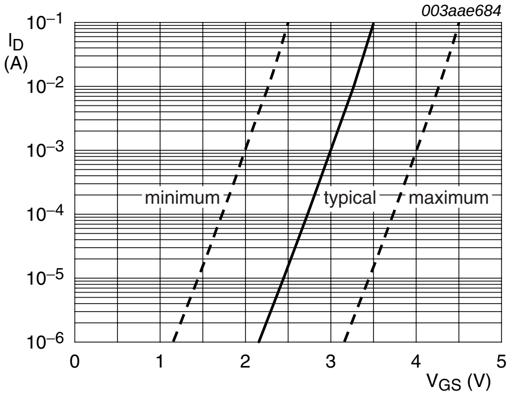
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



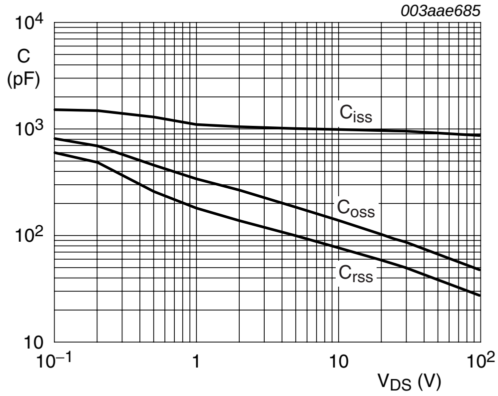
I_D = 1 mA; $V_{DS} = V_{GS}$

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



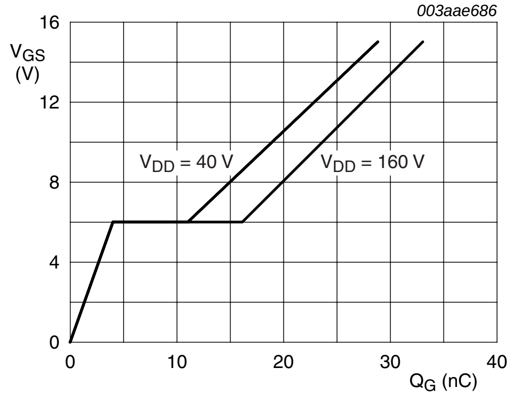
T_j = 25 °C; $V_{DS} = V_{GS}$

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



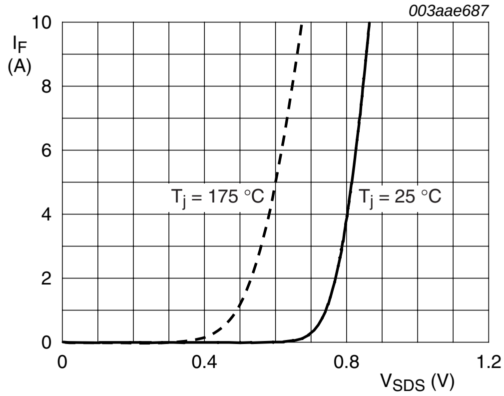
V_{GS} = 0 V; f = 1 MHz

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



T_j = 25 °C; I_D = 9 A

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

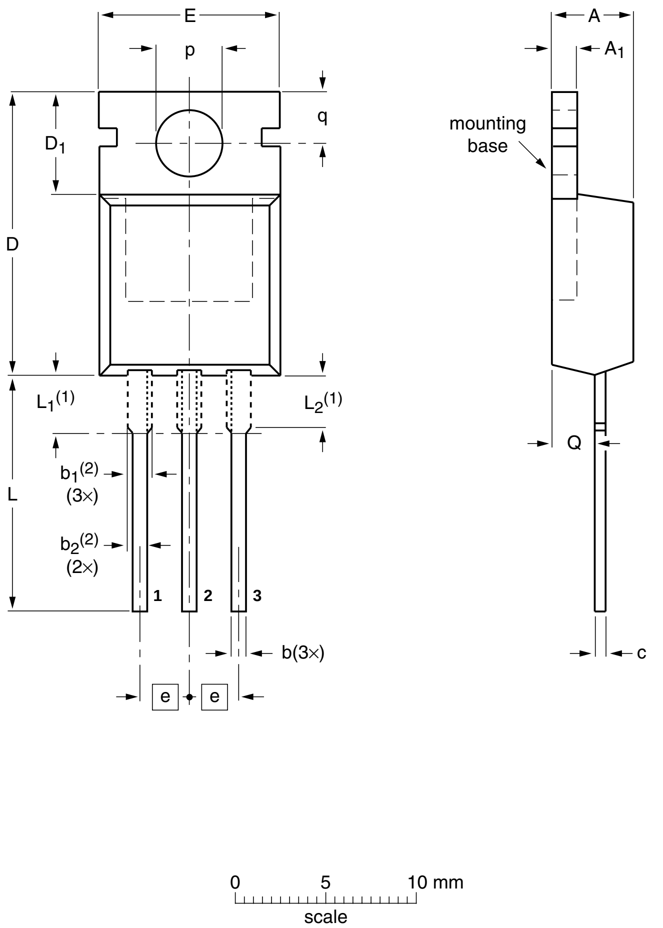


V_{GS} = 0 V

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.

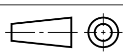
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			~~08-04-23~~ 08-06-13

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

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHP9NQ20T v.3	20101216	Product data sheet	-	PHB_PHD_PHP9NQ20T v.2
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 PHP9NQ20T separated from data sheet PHB_PHD_PHP9NQ20T v.2.			
PHB_PHD_PHP9NQ20T v.2	20001001	Product specification	-	PHB_PHD_PHP9NQ20T v.1

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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nexperia.com.

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11. Contents