PHD20N06T

N-channel TrenchMOS standard level FET

Rev. 02 — 1 December 2009 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

- 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 convertors
- General purpose switching
- Switched-mode power supplies

1.4 Quick reference data

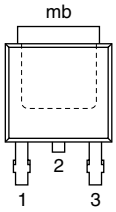
Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C	-	-	55	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; see Figure 1 and 3	-	-	18	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 2	-	-	51	W
Dynamic characteristics						
Q_{GD}	gate-drain charge	V_{GS} = 10 V; I_D = 25 A; V_{DS} = 44 V; T_j = 25 °C; see Figure 13	-	6	-	nC
Static characteristics						
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 10 A; T_j = 175 °C; see Figure 11 and 12	-	-	154	mΩ
		V_{GS} = 10 V; I_D = 10 A; T_j = 25 °C; see Figure 11 and 12	-	65	77	mΩ

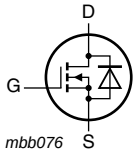
2. Pinning information

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		



SOT428 (DPAK)



3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PHD20N06T	DPAK	plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped)	SOT428

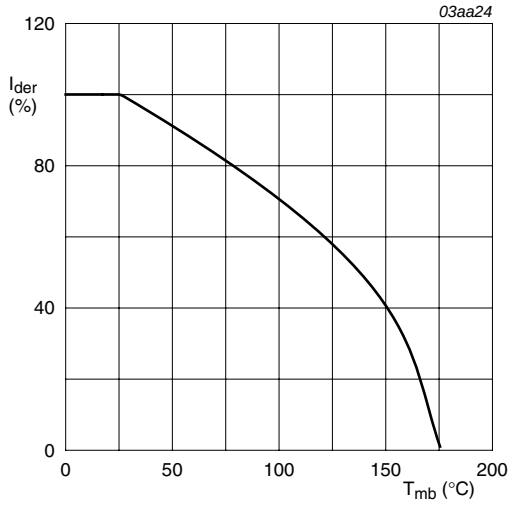
4. Limiting values

Table 4. Limiting values

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

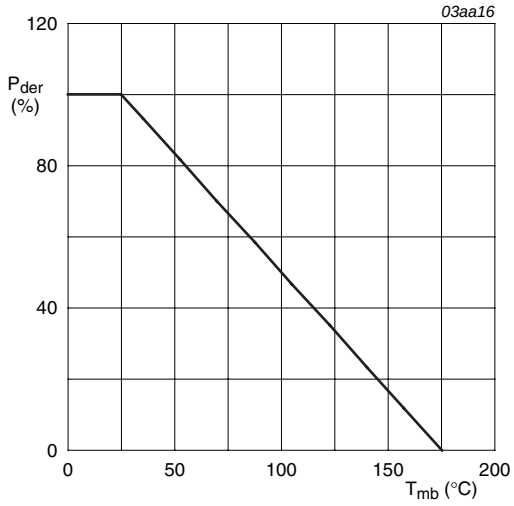
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	55	V
V_{DGR}	drain-gate voltage	R_{GS} = 20 kΩ		-	55	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 100 °C; see Figure 1		-	13	A
		V_{GS} = 10 V; T_{mb} = 25 °C; see Figure 1 and 3		-	18	A
I_{DM}	peak drain current	t_p ≤ 10 µs; pulsed; T_{mb} = 25 °C; see Figure 3	[1]	-	73	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 2		-	51	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		-	18	A
I_{SM}	peak source current	t_p ≤ 10 µs; pulsed; T_{mb} = 25 °C		-	73	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; T_j = 25 °C; I_D = 6 A; R_{GS} = 50 Ω; V_{sup} ≤ 55 V; unclamped inductive load		-	36	mJ

[1] Peak drain current is limited by chip, not package.



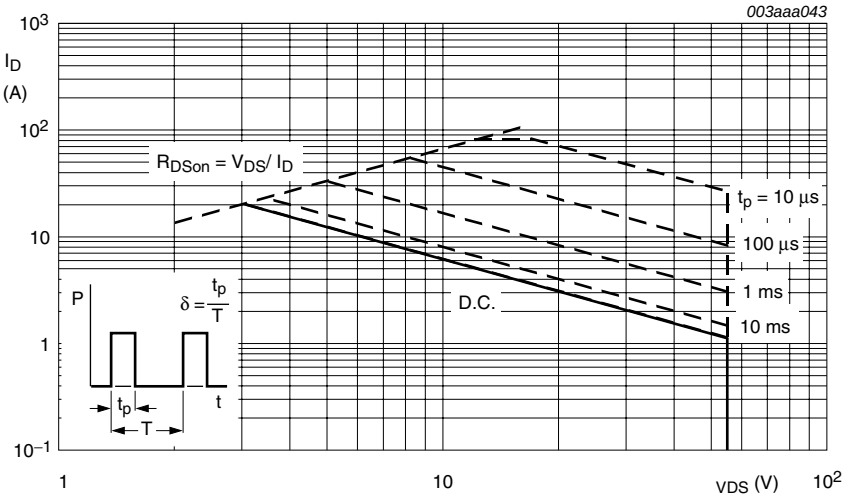
$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\,\%$$

Fig 1. Normalized continuous drain current as a function of mounting base temperature



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

Fig 2. Normalized total power dissipation as a function of mounting base temperature



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

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

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	see Figure 4	-	-	2.9	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint; FR4 board	-	71.4	-	K/W

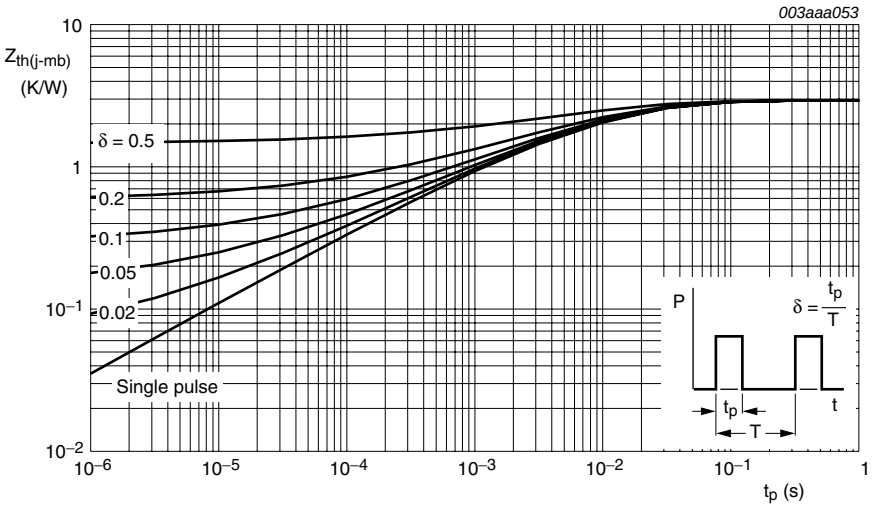
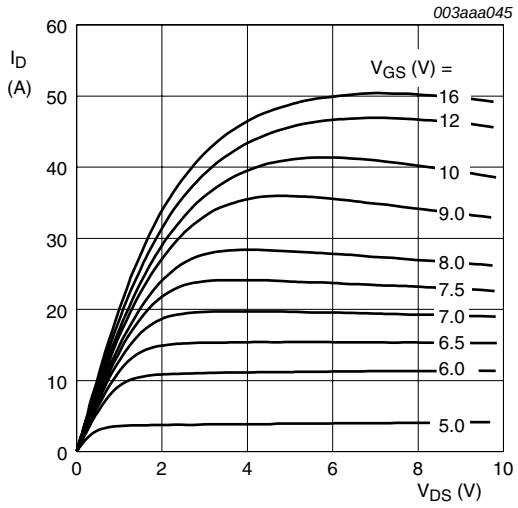


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

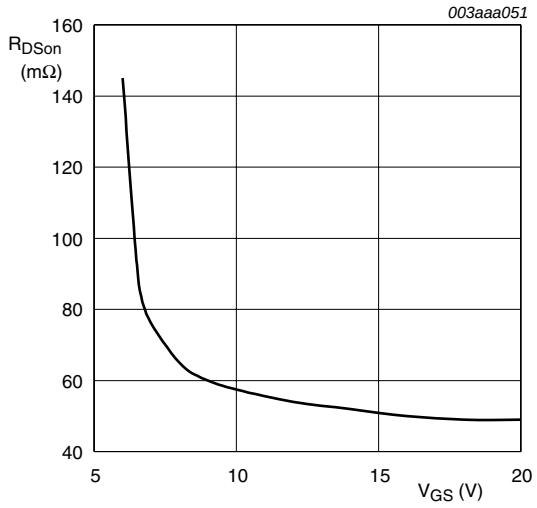
Table 6. Characteristics

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	50	-	-	V
		I_D = 0.25 mA; V_{GS} = 0 V; T_j = 25 °C	55	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}= V_{GS}; T_j = -55 °C; see Figure 10	-	-	4.4	V
		I_D = 1 mA; V_{DS}= V_{GS}; T_j = 175 °C; see Figure 10	1	-	-	V
		I_D = 1 mA; V_{DS}= V_{GS}; T_j = 25 °C; see Figure 10	2	3	4	V
I_{DSS}	drain leakage current	V_{DS} = 55 V; V_{GS} = 0 V; T_j = 25 °C	-	0.05	10	µA
		V_{DS} = 55 V; V_{GS} = 0 V; T_j = 175 °C	-	-	500	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C	-	2	100	nA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C	-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 10 A; T_j = 175 °C; see Figure 11 and 12	-	-	154	mΩ
		V_{GS} = 10 V; I_D = 10 A; T_j = 25 °C; see Figure 11 and 12	-	65	77	mΩ
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 44 V; V_{GS} = 10 V; T_j = 25 °C; see Figure 13	-	11	-	nC
Q_{GS}	gate-source charge		-	3	-	nC
Q_{GD}	gate-drain charge		-	6	-	nC
C_{iss}	input capacitance	V_{DS} = 25 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; see Figure 14	-	316	422	pF
C_{oss}	output capacitance		-	92	110	pF
C_{rss}	reverse transfer capacitance		-	64	87	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 10 Ω; T_j = 25 °C	-	10	-	ns
t_r	rise time		-	50	-	ns
$t_{d(off)}$	turn-off delay time		-	70	-	ns
t_f	fall time		-	40	-	ns
L_D	internal drain inductance	measured from drain lead from package to centre of die; T_j = 25 °C	-	2.5	-	nH
L_S	internal source inductance	measured from source lead from package to source bond pad; T_j = 25 °C	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 10 A; V_{GS} = 0 V; T_j = 25 °C; see Figure 15	-	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = -100 A/µs; V_{GS} = -10 V; V_{DS} = 30 V; T_j = 25 °C	-	32	-	ns
Q_r	recovered charge		-	120	-	nC



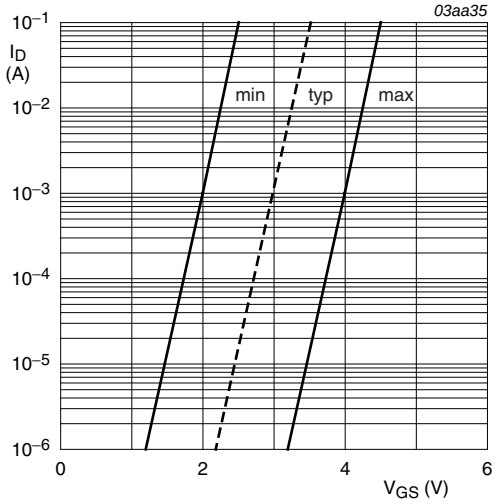
$T_j = 25°C$

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



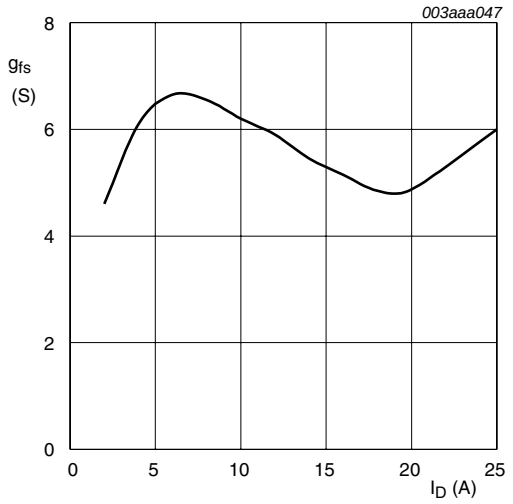
$T_j = 25°C; I_D = 10A$

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



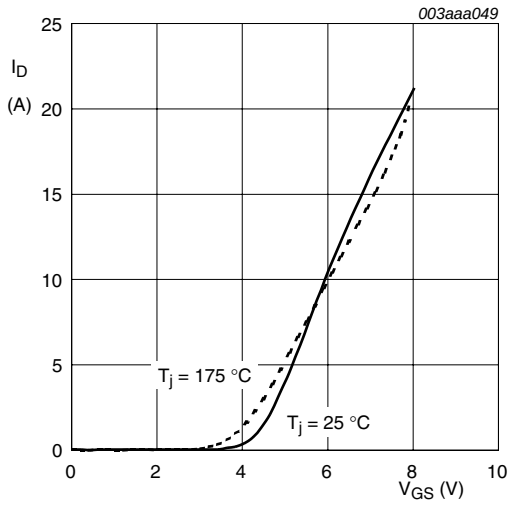
$T_j = 25°C; V_{DS} = 5V$

Fig 7. Sub-threshold drain current as a function of gate-source voltage



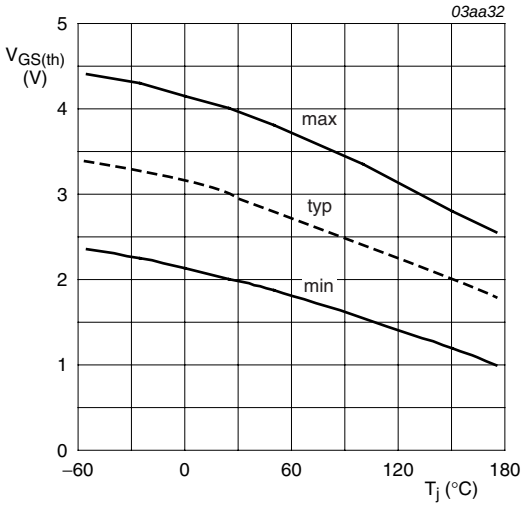
$T_j = 25°C; V_{DS} = 25V$

Fig 8. Forward transconductance as a function of drain current; typical values



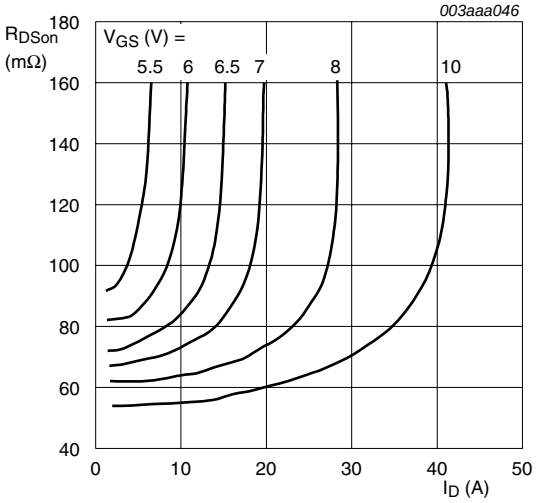
$V_{DS} = 25V$

Fig 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values



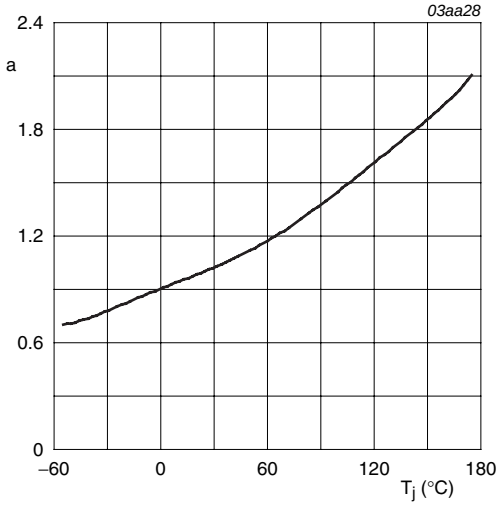
$I_D = 1mA; V_{DS} = V_{GS}$

Fig 10. Gate-source threshold voltage as a function of junction temperature



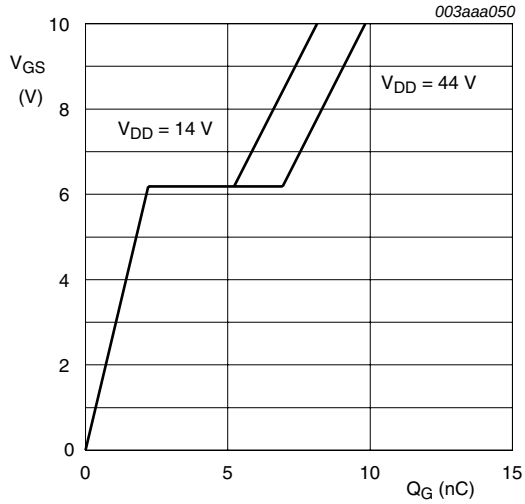
$T_j = 25°C$

Fig 11. Drain-source on-state resistance as a function of drain current; typical values



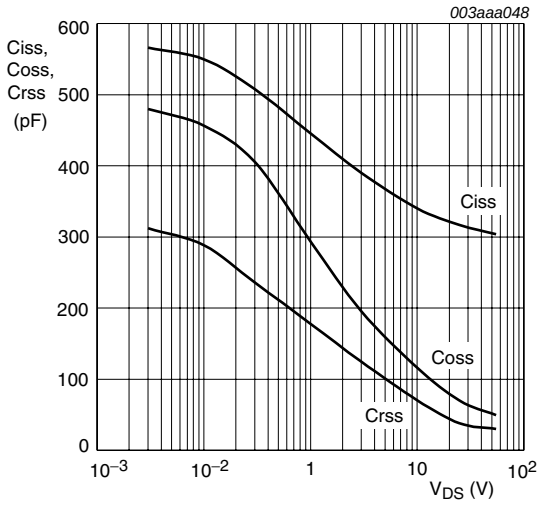
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

Fig 12. Normalized drain-source on-state resistance factor as a function of junction temperature



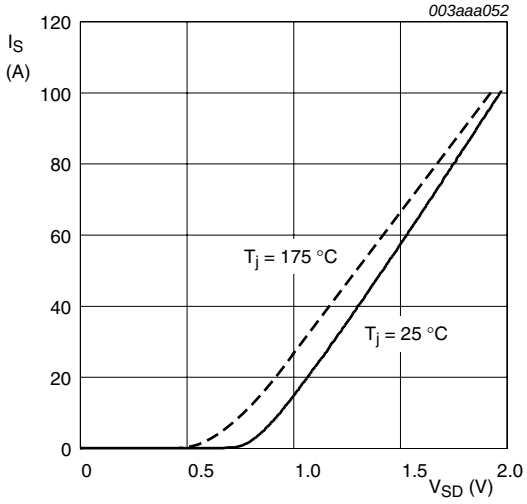
$T_j = 25°C; I_D = 25A$

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



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

Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

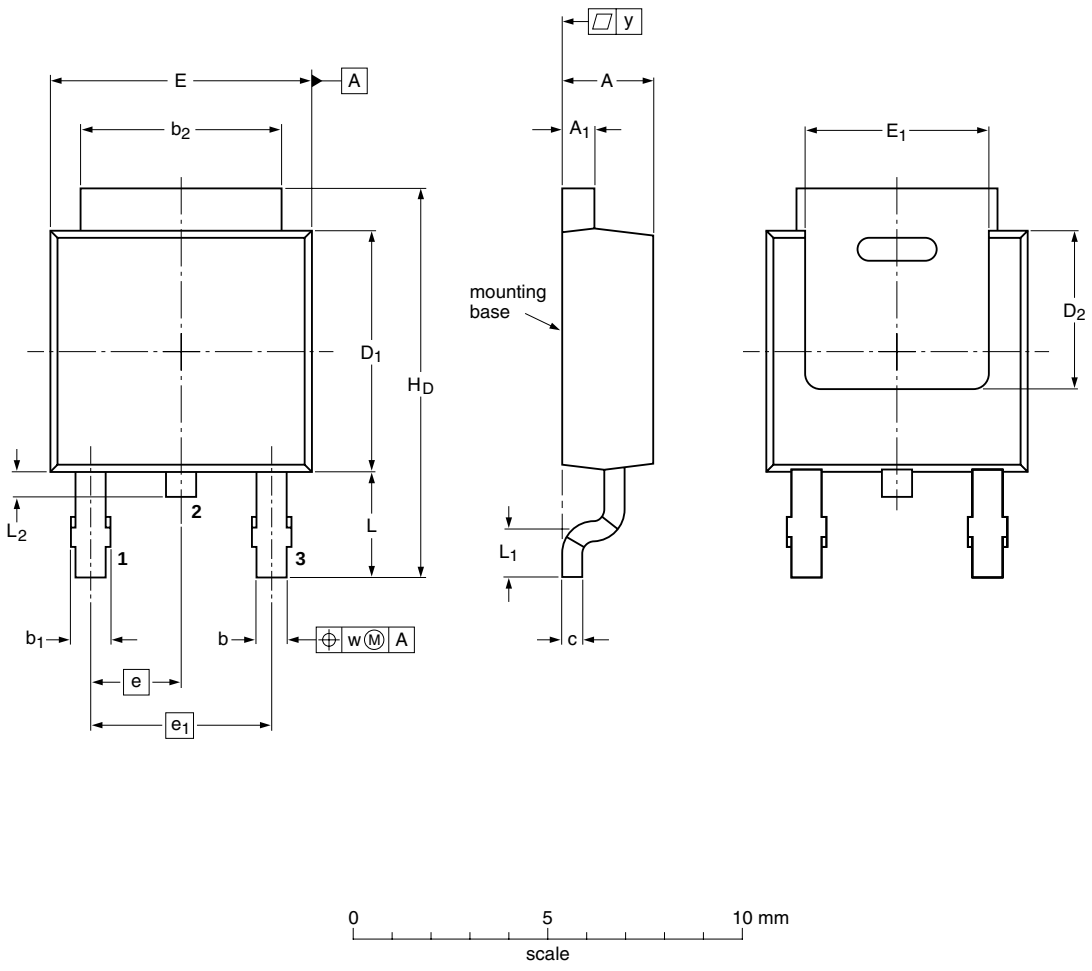


$V_{GS} = 0V$

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

7. Package outline

Plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped) **SOT428**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D_1	D_2 min	E	E_1 min	e	e_1	H_D	L	L_1 min	L_2	w	y max
mm	2.38 2.22	0.93 0.46	0.89 0.71	1.1 0.9	5.46 5.00	0.56 0.20	6.22 5.98	4.0	6.73 6.47	4.45	2.285	4.57	10.4 9.6	2.95 2.55	0.5	0.9 0.5	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT428		TO-252	SC-63			~~06-02-14~~ 06-03-16

Fig 16. Package outline SOT428 (DPAK)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PHD20N06T_2	20091201	Product data sheet	-	PHD20N06T-01
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.			
PHD20N06T-01 (9397 750 07895)	20010222	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".

[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

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Date of release: 01 December 2009