



# PH2520U

## N-channel TrenchMOS ultra low level FET

Rev. 03 — 2 March 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Ultra low 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
- Interfaces directly with low voltage gate drivers

### 1.3 Applications

- DC-to-DC convertors
- Portable equipment
- Notebook computers
- Switched-mode power supplies

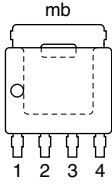
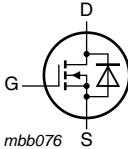
### 1.4 Quick reference data

Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$	-	-	20	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 4.5\text{ V}$ ; see <a href="#">Figure 1</a> ; see <a href="#">Figure 3</a>	-	-	100	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	-	62.5	W
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 4.5\text{ V}$ ; $I_D = 50\text{ A}$ ; $V_{DS} = 10\text{ V}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>	-	18	-	nC
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	-	2.1	2.7	m $\Omega$

## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p><b>SOT669 (LFPACK)</b></p>	 <p>mbb076</p>
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain		

## 3. Ordering information

Table 3. Ordering information

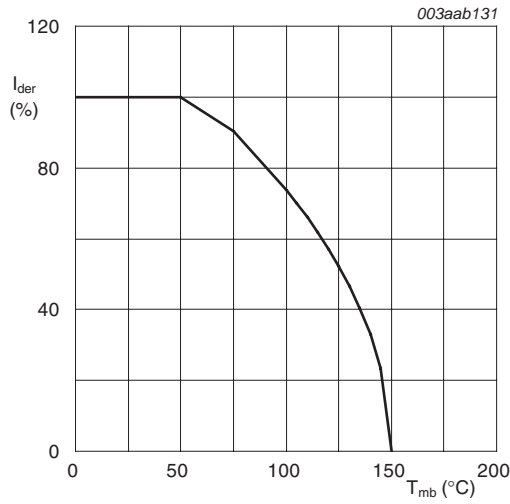
Type number	Package		Version
	Name	Description	
PH2520U	LFPACK	plastic single-ended surface-mounted package (LFPACK); 4 leads	SOT669

## 4. Limiting values

Table 4. Limiting values

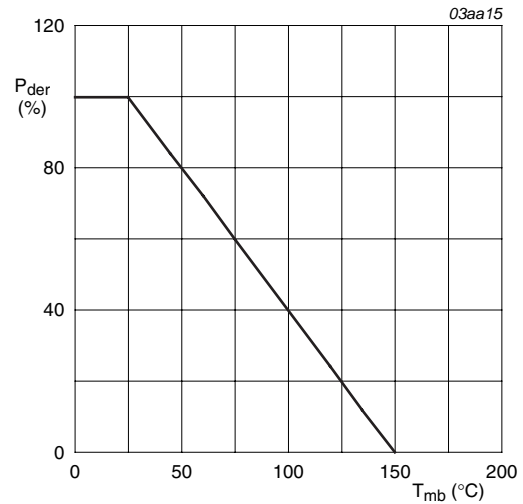
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$	-	20	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	20	V
$V_{GS}$	gate-source voltage		-10	10	V
$I_D$	drain current	$V_{GS} = 4.5\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>	-	73	A
		$V_{GS} = 4.5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a> ; see <a href="#">Figure 3</a>	-	100	A
$I_{DM}$	peak drain current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 3</a>	-	300	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	62.5	W
$T_{stg}$	storage temperature		-55	150	°C
$T_j$	junction temperature		-55	150	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$	-	52	A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$	-	150	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_j = 25\text{ °C}$ ; $I_D = 70.7\text{ A}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{sup} \leq 20\text{ V}$ ; $t_p = 0.1\text{ ms}$ ; unclamped	-	250	mJ



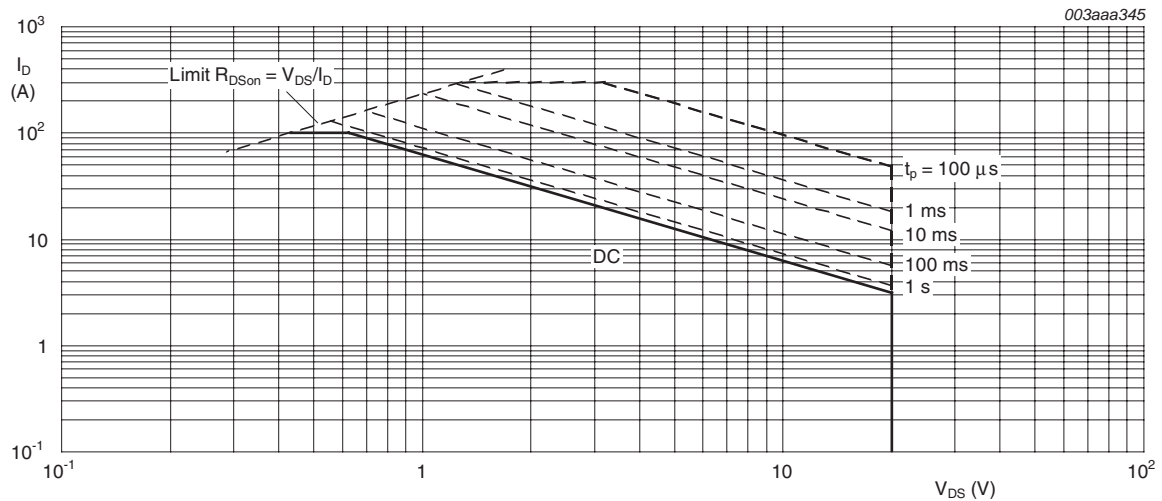
$$V_{GS} \geq 4.5V I_{der} = \frac{I_D}{I_{D(25^\circ C)}} \times 100\%$$

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



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

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



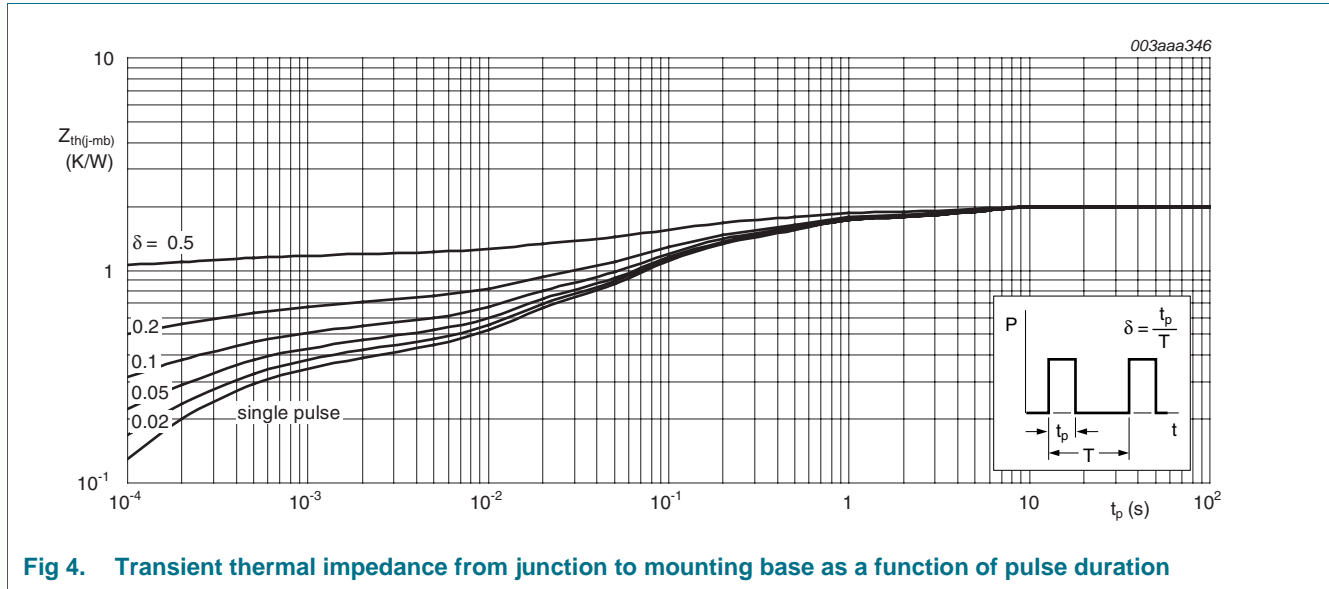
$T_{mb} = 25^\circ C; I_{DM}$  is single pulse

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 <a href="#">Figure 4</a>	-	-	2	K/W

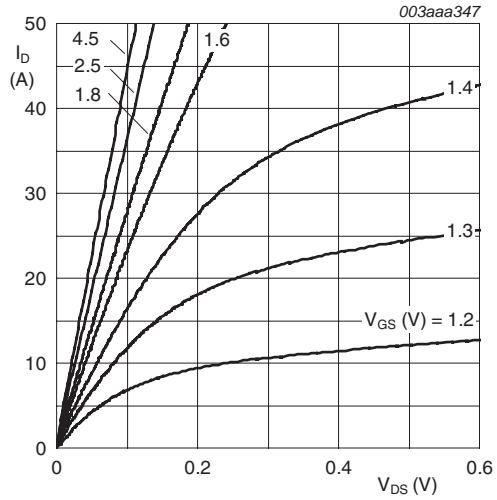


**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

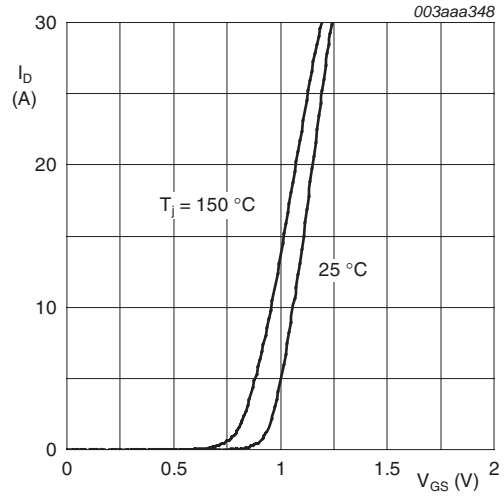
**Table 6. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	18	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	20	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> ; see <a href="#">Figure 8</a>	-	-	1.2	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 150 \text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> ; see <a href="#">Figure 8</a>	0.25	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 7</a> ; see <a href="#">Figure 8</a>	0.45	0.7	0.95	V
$I_{DSS}$	drain leakage current	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.06	1	$\mu\text{A}$
		$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	20	100	nA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	20	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 2.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	-	2.8	3.9	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$ see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	-	3.3	4.3	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	-	2.1	2.7	m $\Omega$
$R_G$	internal gate resistance (AC)	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ\text{C}$	-	1.65	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 50 \text{ A}; V_{DS} = 10 \text{ V}; V_{GS} = 4.5 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 11</a> ;	-	78	-	nC
$Q_{GS}$	gate-source charge	see <a href="#">Figure 12</a>	-	17	-	nC
$Q_{GD}$	gate-drain charge		-	18	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 50 \text{ A}; V_{DS} = 10 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>	-	2.2	-	V
$C_{iss}$	input capacitance	$V_{DS} = 10 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 13</a>	-	5850	-	pF
$C_{oss}$	output capacitance		-	1190	-	pF
$C_{rss}$	reverse transfer capacitance		-	831	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 10 \text{ V}; R_L = 1 \text{ } \Omega; V_{GS} = 4.5 \text{ V};$ $R_{G(ext)} = 4.7 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	34	-	ns
$t_r$	rise time		-	240	-	ns
$t_{d(off)}$	turn-off delay time		-	318	-	ns
$t_f$	fall time		-	234	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 14</a>	-	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}; di_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V};$ $V_{DS} = 20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	65	-	ns



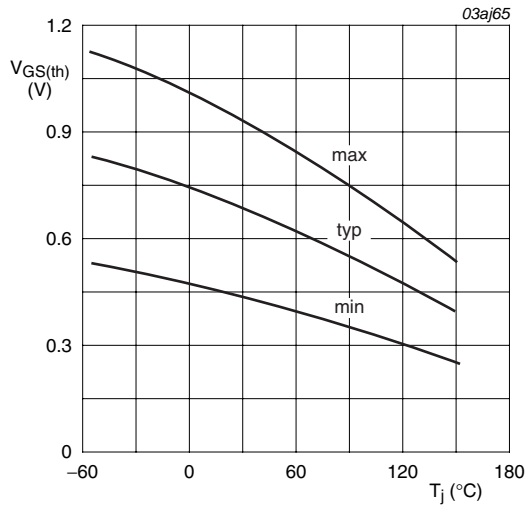
$T_j = 25^\circ\text{C}$

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



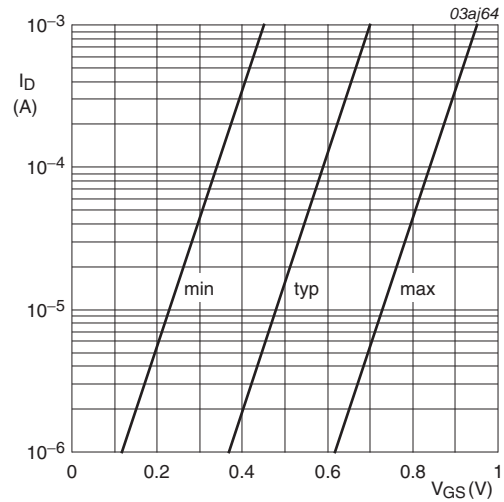
$T_j = 25^\circ\text{C}$  and  $150^\circ\text{C}; V_{DS} > I_D \times R_{DSon}$

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



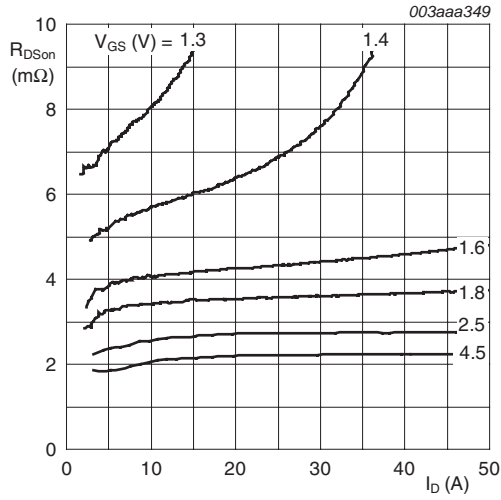
$I_D = 1\text{mA}; V_{DS} = V_{GS}$

Fig 7. Gate-source threshold voltage as a function of junction temperature



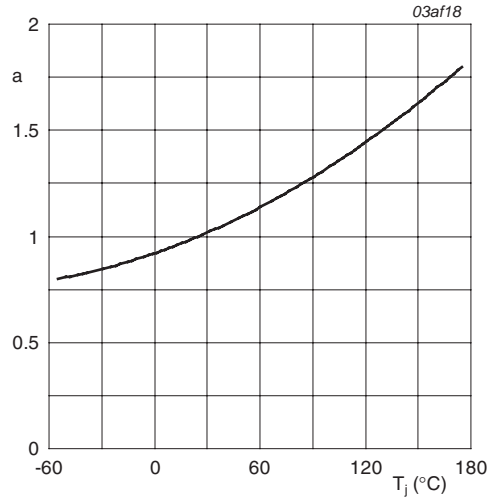
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$

Fig 8. Sub-threshold drain current as a function of gate-source voltage



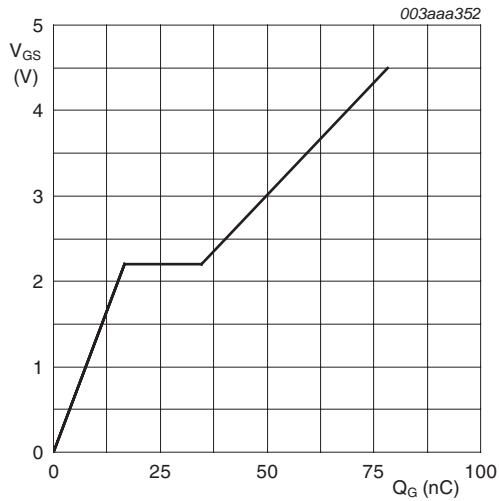
$T_j = 25^\circ C$

**Fig 9. Drain-source on-state resistance as a function of drain current; typical values**



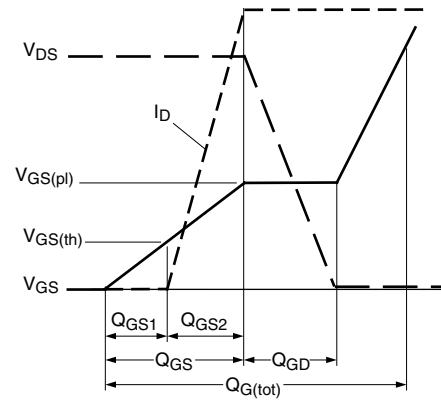
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ C)}}$$

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



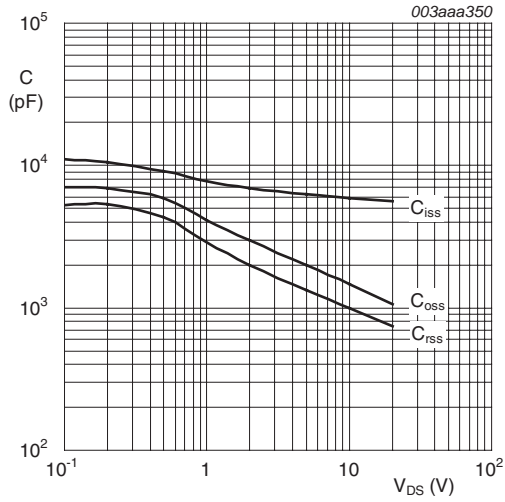
$I_D = 50A; V_{DS} = 10V$

**Fig 11. Gate-source voltage as a function of gate charge; typical values**



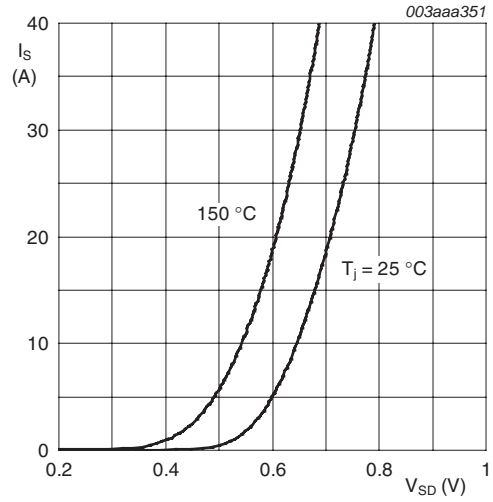
003aaa508

**Fig 12. Gate charge waveform definitions**



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

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



$T_j = 25^\circ C \text{ and } 150^\circ C; V_{GS} = 0V$

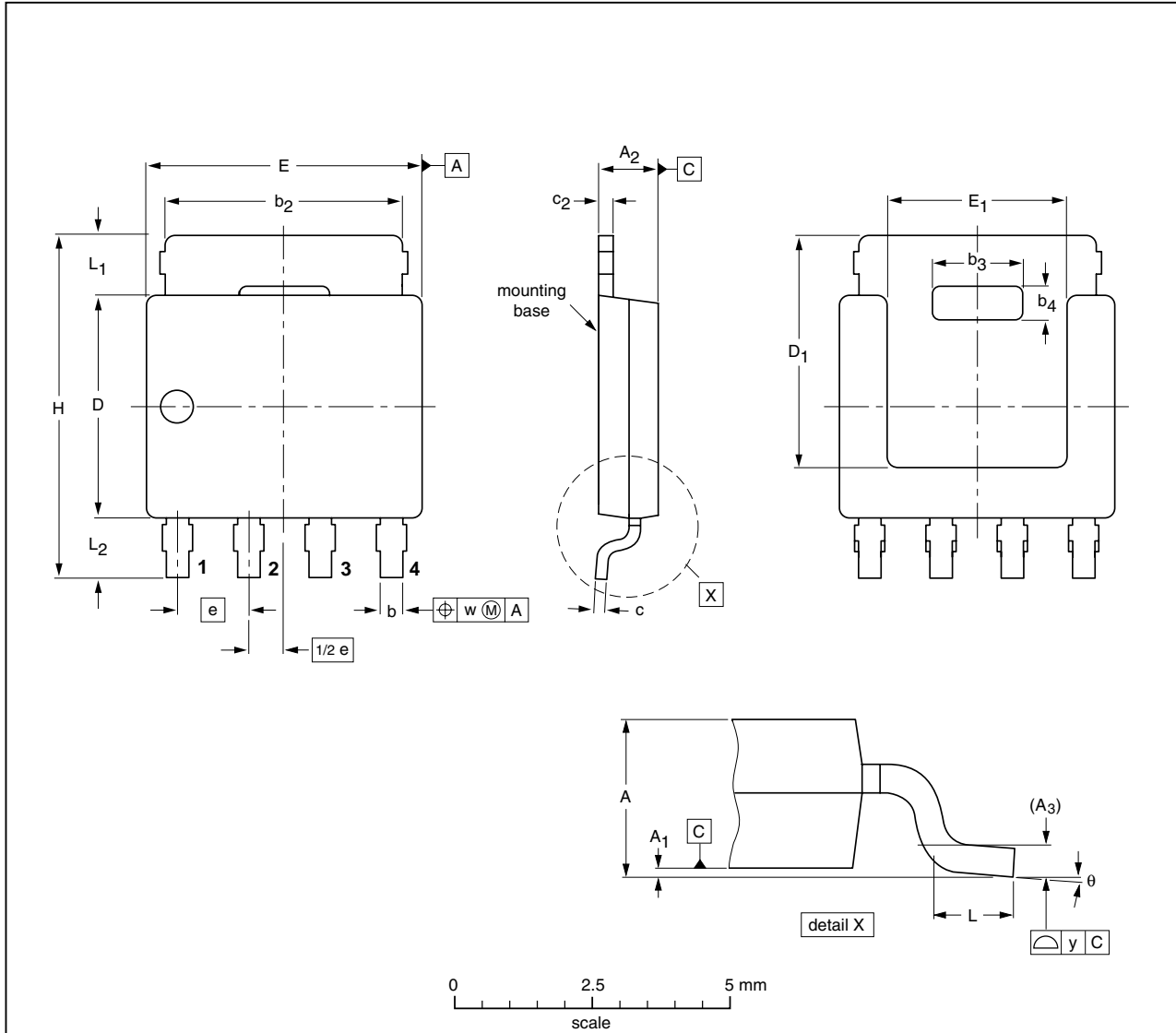
**Fig 14. Source current as a function of source-drain voltage; typical values**



7. Package outline

Plastic single-ended surface-mounted package (LFPACK); 4 leads

SOT669



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b	b <sub>2</sub>	b <sub>3</sub>	b <sub>4</sub>	c	c <sub>2</sub>	D <sup>(1)</sup>	D <sub>1</sub> <sup>(1)</sup> max	E <sup>(1)</sup>	E <sub>1</sub> <sup>(1)</sup>	e	H	L	L <sub>1</sub>	L <sub>2</sub>	w	y	θ
mm	1.20 1.01	0.15 0.00	1.10 0.95	0.25	0.50 0.35	4.41 3.62	2.2 2.0	0.9 0.7	0.25 0.19	0.30 0.24	4.10 3.80	4.20	5.0 4.8	3.3 3.1	1.27	6.2 5.8	0.85 0.40	1.3 0.8	1.3 0.8	0.25	0.1	8° 0°

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT669		MO-235				04-10-13 06-03-16

Fig 15. Package outline SOT669 (LFPACK)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PH2520U_3	20090302	Product data sheet	-	PH2520U_2
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></ul>		
PH2520U_2	20051115	Product data sheet	-	PH2520U-01
PH2520U-01 (9397 750 11406)	20030502	Product data	-	-

## 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".

[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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