



# PH2520U

N-channel TrenchMOS ultra low level FET

Rev. 02 — 15 November 2005

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.

### 1.2 Features

- Low level threshold
- Low thermal resistance
- SO8 equivalent area footprint
- Low on-state resistance

### 1.3 Applications

- DC-to-DC converters
- Portable appliances
- Switched-mode power supplies
- Notebook computers

### 1.4 Quick reference data

- $V_{DS} \leq 20 \text{ V}$
- $R_{DSon} \leq 2.7 \text{ m}\Omega$
- $I_D \leq 100 \text{ A}$
- $P_{tot} \leq 62.5 \text{ W}$

## 2. Pinning information

Table 1: Pinning

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

### 3. Ordering information

**Table 2: Ordering information**

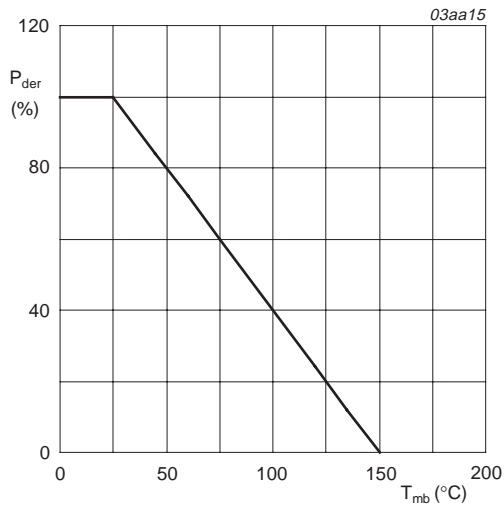
Type number	Package		Version
	Name	Description	
PH2520U	LFPAK	plastic single-ended surface mounted package; 4 leads	SOT669

### 4. Limiting values

**Table 3: Limiting values**

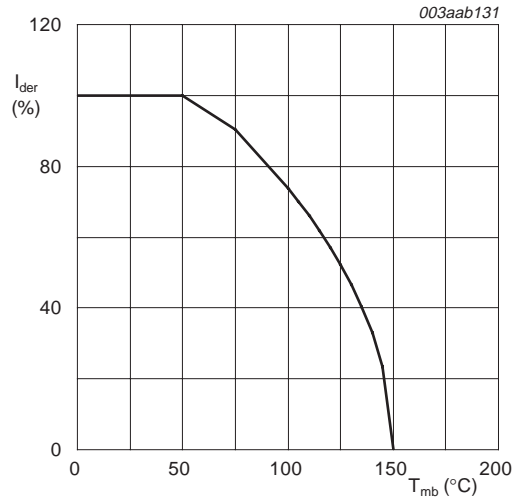
In accordance with the Absolute Maximum Rating System (IEC 60134).

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



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

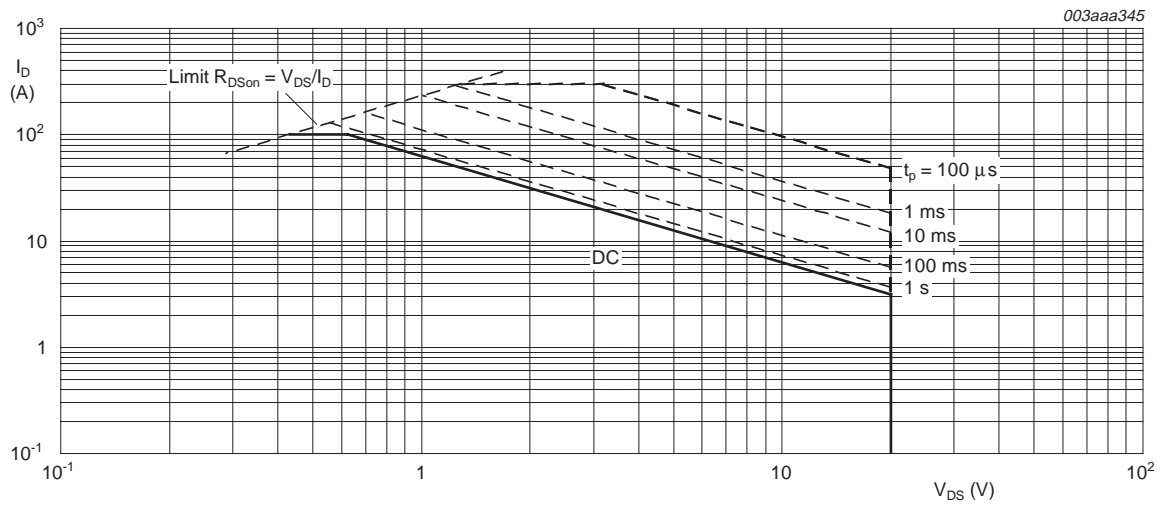
Fig 1. Normalized total power dissipation as a function of mounting base temperature



$$V_{GS} \geq 4.5\text{ V}$$

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

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



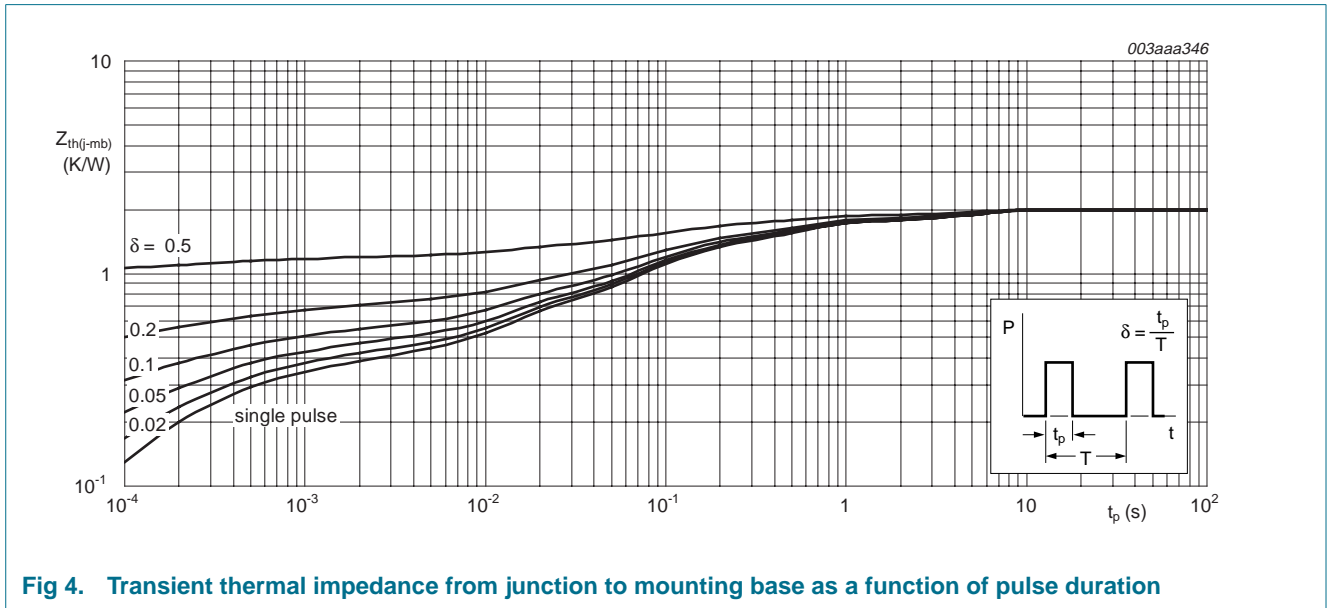
$T_{mb} = 25^\circ C$ ;  $I_{DM}$  is single pulse

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

### 5. Thermal characteristics

Table 4: Thermal characteristics

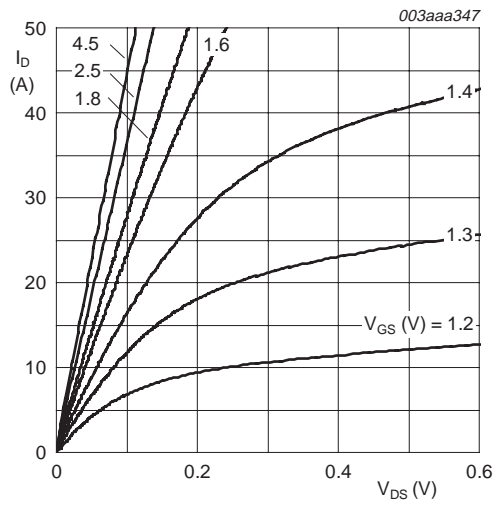
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see <a href="#">Figure 4</a>	-	-	2	K/W



## 6. Characteristics

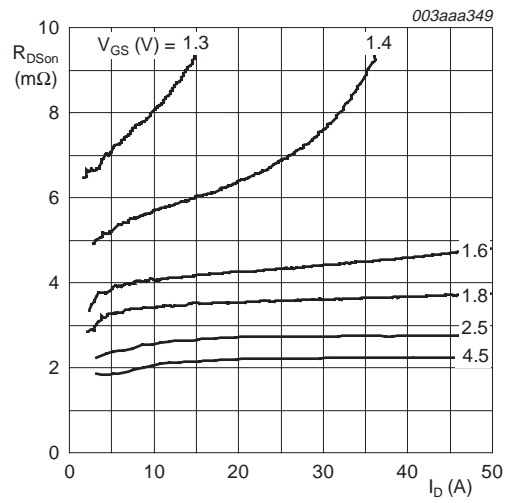
**Table 5: Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V T <sub>j</sub> = 25 °C	20	-	-	V
		T <sub>j</sub> = -55 °C	18	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; see <a href="#">Figure 9</a> and <a href="#">10</a> T <sub>j</sub> = 25 °C	0.45	0.7	0.95	V
		T <sub>j</sub> = 150 °C	0.25	-	-	V
		T <sub>j</sub> = -55 °C	-	-	1.2	V
I <sub>DSS</sub>	drain leakage current	V <sub>DS</sub> = 20 V; V <sub>GS</sub> = 0 V T <sub>j</sub> = 25 °C	-	0.06	1	μA
		T <sub>j</sub> = 150 °C	-	-	500	μA
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = ±10 V; V <sub>DS</sub> = 0 V	-	20	100	nA
R <sub>G</sub>	gate resistance	f = 1 MHz	-	1.65	-	Ω
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 25 A; see <a href="#">Figure 6</a> and <a href="#">8</a> T <sub>j</sub> = 25 °C	-	2.1	2.7	mΩ
		T <sub>j</sub> = 150 °C	-	3.3	4.3	mΩ
		V <sub>GS</sub> = 2.5 V; I <sub>D</sub> = 25 A; see <a href="#">Figure 6</a> and <a href="#">8</a>	-	2.8	3.9	mΩ
<b>Dynamic characteristics</b>						
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 50 A; V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 4.5 V; see <a href="#">Figure 11</a> and <a href="#">12</a>	-	78	-	nC
Q <sub>GS</sub>	gate-source charge		-	17	-	nC
Q <sub>GD</sub>	gate-drain charge		-	18	-	nC
V <sub>GS(pl)</sub>	gate-source plateau voltage		-	2.2	-	V
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 10 V; f = 1 MHz; see <a href="#">Figure 14</a>	-	5850	-	pF
C <sub>oss</sub>	output capacitance		-	1190	-	pF
C <sub>rss</sub>	reverse transfer capacitance		-	831	-	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 10 V; R <sub>L</sub> = 1 Ω; V <sub>GS</sub> = 4.5 V; R <sub>G</sub> = 4.7 Ω	-	34	-	ns
t <sub>r</sub>	rise time		-	240	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	318	-	ns
t <sub>f</sub>	fall time		-	234	-	ns
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; see <a href="#">Figure 13</a>	-	0.85	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V	-	65	-	ns



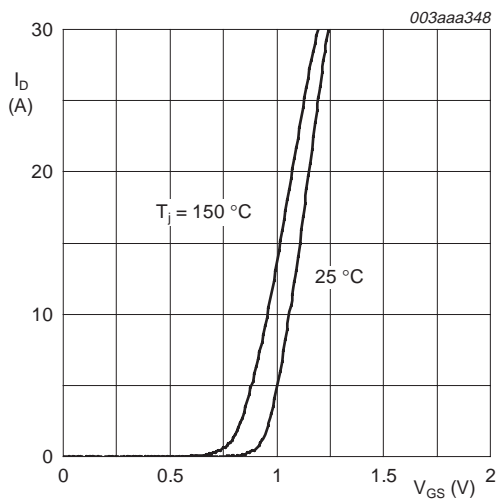
$T_j = 25\text{ }^\circ\text{C}$

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



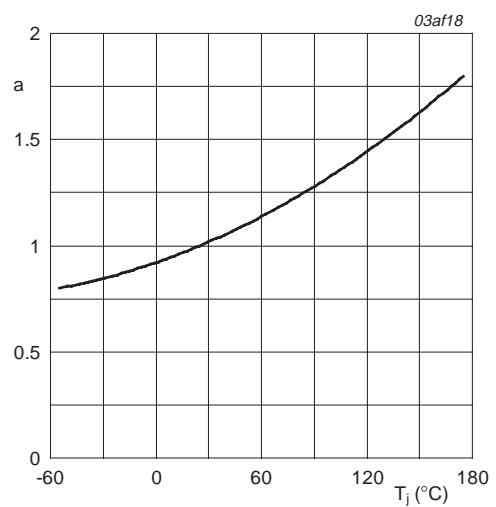
$T_j = 25\text{ }^\circ\text{C}$

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



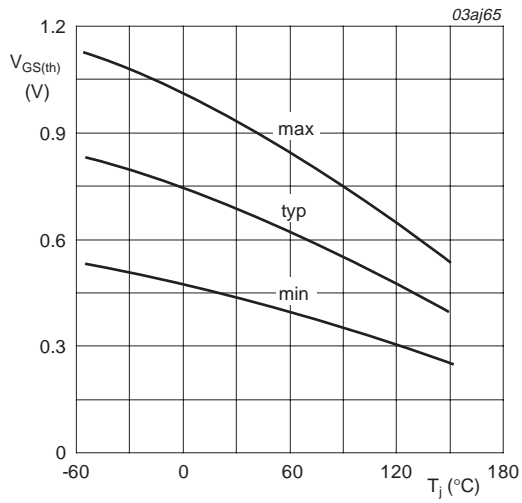
$T_j = 25\text{ }^\circ\text{C}$  and  $150\text{ }^\circ\text{C}$ ;  $V_{DS} > I_D \times R_{DS(on)}$

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values



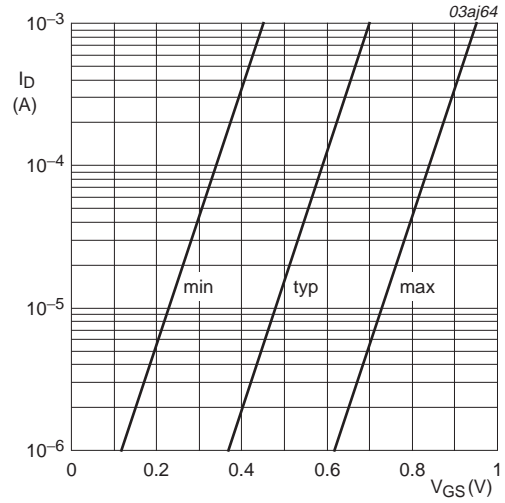
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25\text{ }^\circ\text{C})}}$$

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature



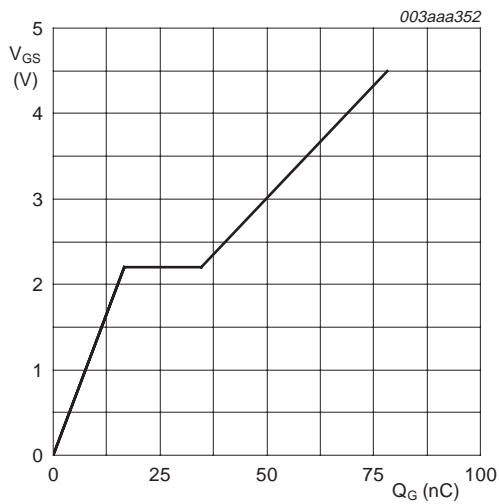
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

Fig 9. Gate-source threshold voltage as a function of junction temperature



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

Fig 10. Sub-threshold drain current as a function of gate-source voltage



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

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

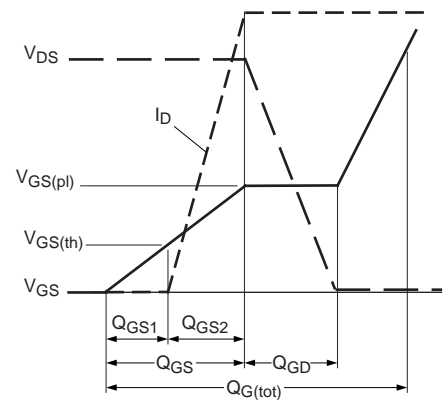
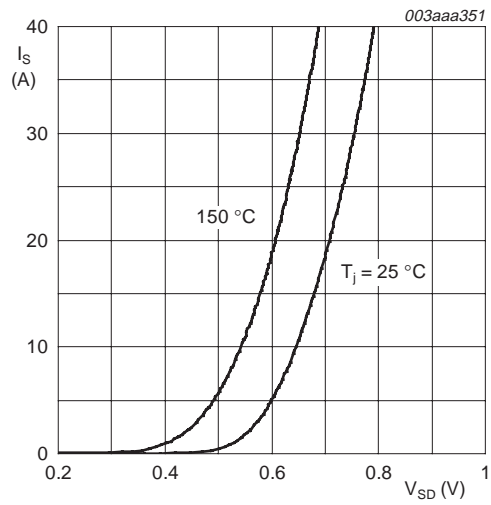
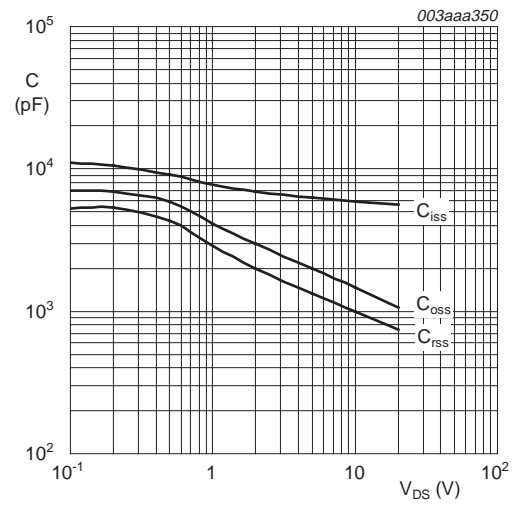


Fig 12. Gate charge waveform definitions



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

Fig 13. Source current as a function of source-drain voltage; typical values



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

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



7. Package outline

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

SOT669

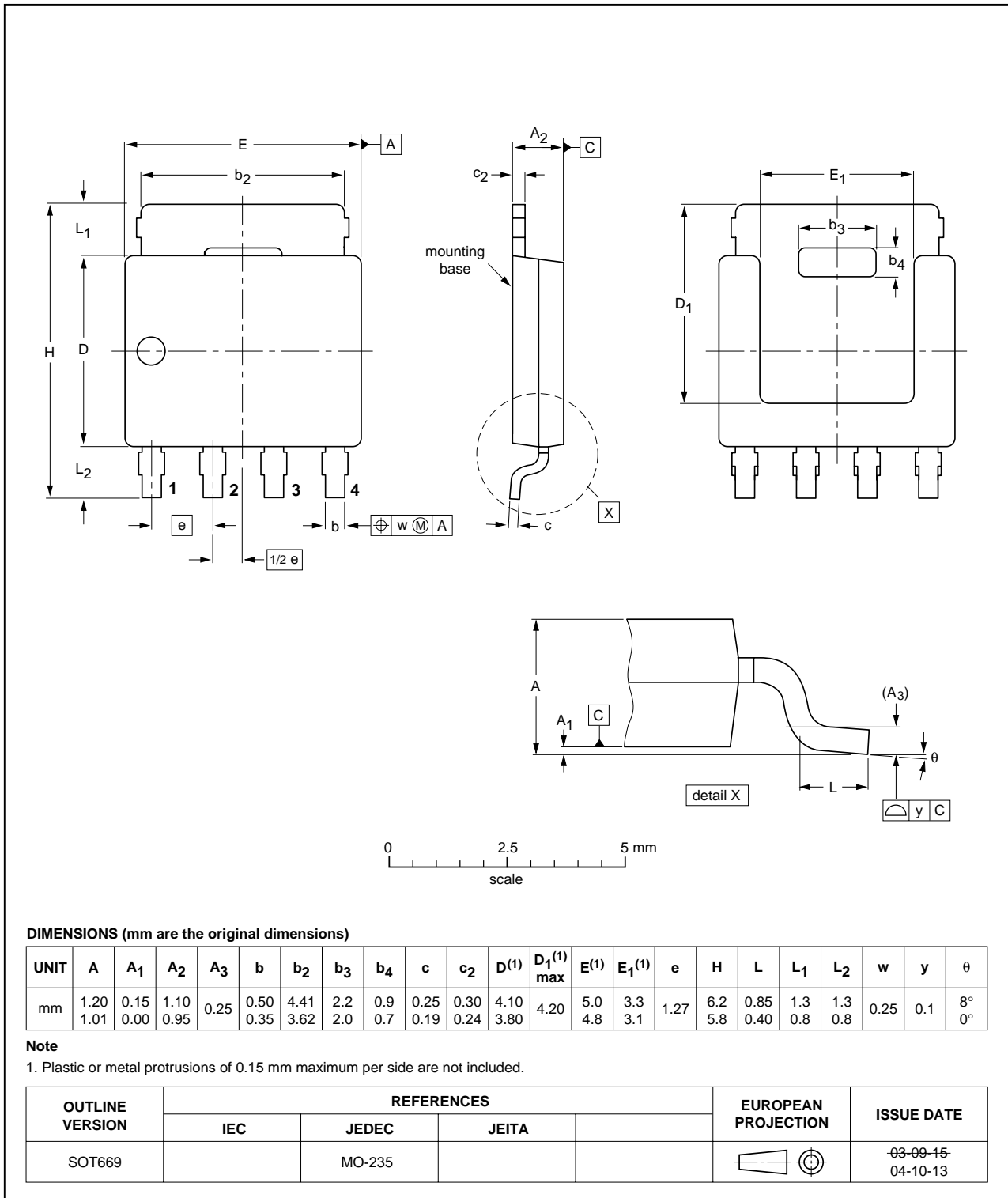


Fig 15. Package outline SOT669 (LPAK)

## 8. Revision history

**Table 6: Revision history**

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
PH2520U_2	20051115	Product data sheet	-	-	PH2520U-01
Modifications:	<ul style="list-style-type: none"> <li>The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors.</li> <li><a href="#">Section 1.4 "Quick reference data"</a>: <math>I_D</math> and <math>R_{DSon}</math> maximum limits modified.</li> <li><a href="#">Section 4 "Limiting values"</a>: <math>I_D</math> and <math>I_{DM}</math> maximum limits modified.</li> <li><a href="#">Section 6 "Characteristics"</a>: <math>V_{GS(th)}</math>, <math>R_G</math> and <math>V_{GS(pl)}</math> values added.</li> <li><a href="#">Section 6 "Characteristics"</a>: <math>R_{DSon}</math> maximum limits modified.</li> <li><a href="#">Figure 5</a> and <a href="#">6</a> modified</li> </ul>				
PH2520U-01	20030502	Product data	-	9397 750 11406	-

## 9. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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## 14. Contents

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<b>1</b>	<b>Product profile</b> .....	<b>1</b>
1.1	General description .....	1
1.2	Features .....	1
1.3	Applications .....	1
1.4	Quick reference data .....	1
<b>2</b>	<b>Pinning information</b> .....	<b>1</b>
<b>3</b>	<b>Ordering information</b> .....	<b>2</b>
<b>4</b>	<b>Limiting values</b> .....	<b>2</b>
<b>5</b>	<b>Thermal characteristics</b> .....	<b>4</b>
<b>6</b>	<b>Characteristics</b> .....	<b>5</b>
<b>7</b>	<b>Package outline</b> .....	<b>9</b>
<b>8</b>	<b>Revision history</b> .....	<b>10</b>
<b>9</b>	<b>Data sheet status</b> .....	<b>11</b>
<b>10</b>	<b>Definitions</b> .....	<b>11</b>
<b>11</b>	<b>Disclaimers</b> .....	<b>11</b>
<b>12</b>	<b>Trademarks</b> .....	<b>11</b>
<b>13</b>	<b>Contact information</b> .....	<b>11</b>



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