

## 1. Product profile

### 1.1 General description

Logic 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

- High efficiency due to low switching and conduction losses
- Suitable for logic level gate drive sources

### 1.3 Applications

- DC-to-DC converters
- Switched-mode power supplies
- Notebook computers
- Voltage regulators

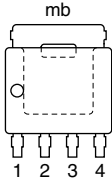
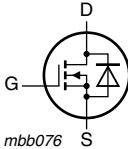
### 1.4 Quick reference data

Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$	-	-	30	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; 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	$V_{GS} = 4.5\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 12\text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	6.9	-	nC
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	-	2.3	3.3	mΩ

## 2. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p><b>SOT669 (LFAK)</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**

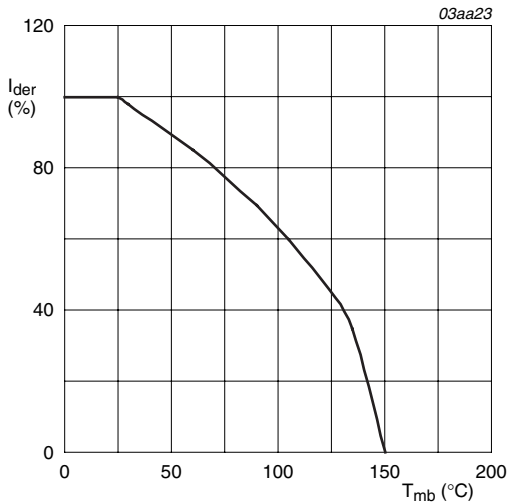
Type number	Package		Version
	Name	Description	
PH3330L	LFAK	plastic single-ended surface-mounted package (LFAK); 4 leads	SOT669

## 4. Limiting values

**Table 4. Limiting values**

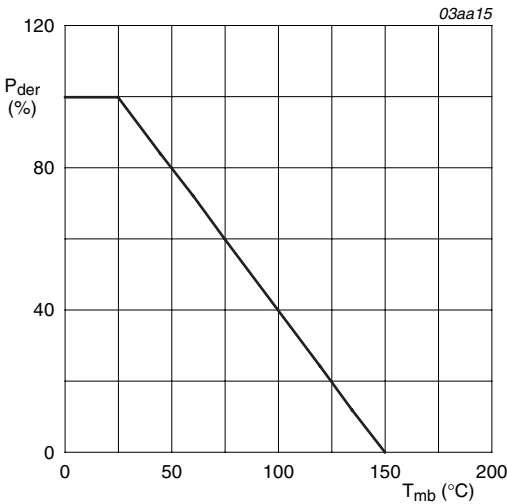
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$	-	30	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 150\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	30	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a> ; see <a href="#">Figure 3</a>	-	100	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>	-	54.2	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; $T_{mb} = 25\text{ °C}$	-	208	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; $I_D = 70\text{ A}$ ; $V_{sup} \leq 30\text{ V}$ ; $t_p = 0.15\text{ ms}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped	-	245	mJ



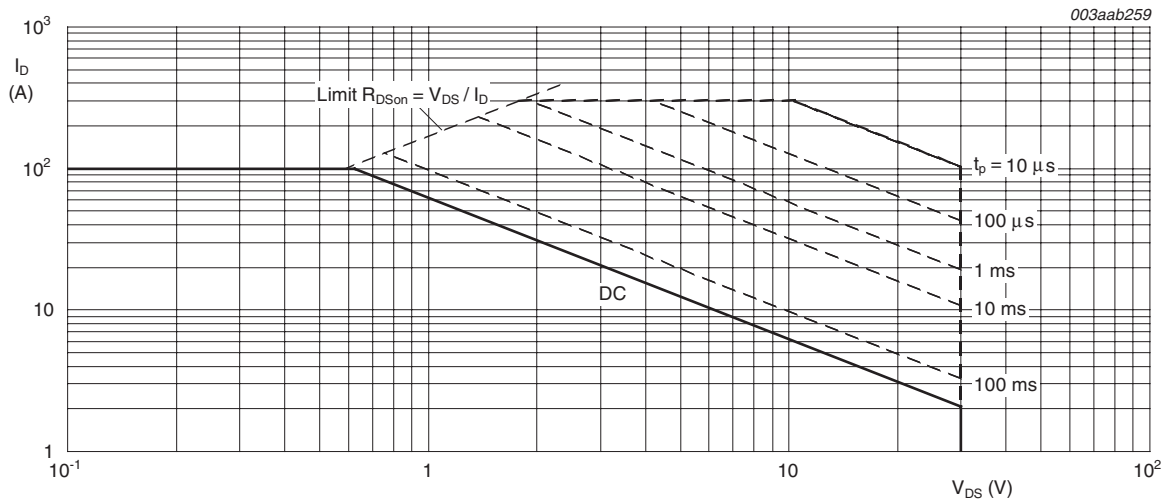
$$I_{der} = \frac{I_D}{I_{D(25^{\circ}\text{C})}} \times 100\%$$

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



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

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



$T_{mb} = 25^{\circ}\text{C}; I_{DM}$  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

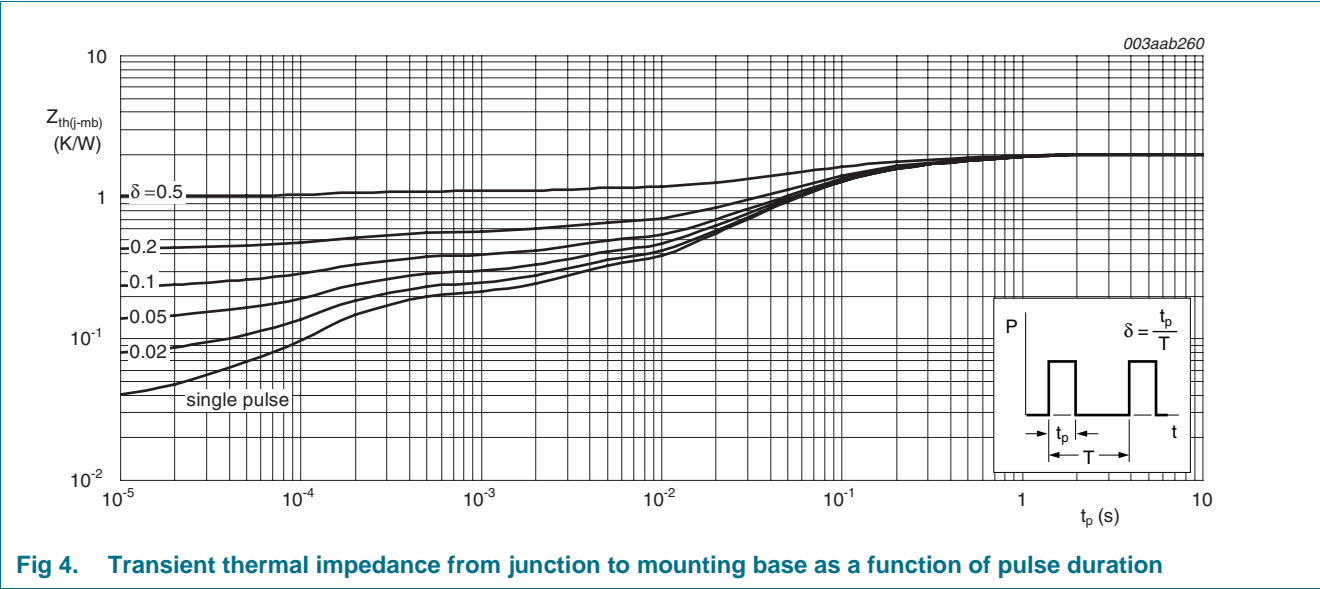


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

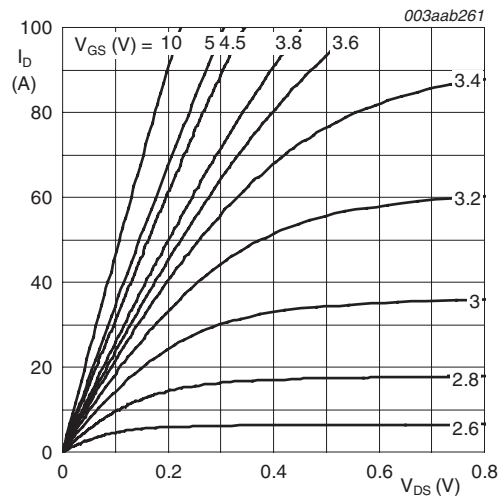
## 6. Characteristics

**Table 6. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 ^\circ C$	30	-	-	V
		$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = -55 ^\circ C$	27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 8</a> ; see <a href="#">Figure 9</a>	1.3	1.7	2.15	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 150 ^\circ C$ ; see <a href="#">Figure 8</a> ; see <a href="#">Figure 9</a>	0.8	-	-	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55 ^\circ C$ ; see <a href="#">Figure 8</a> ; see <a href="#">Figure 9</a>	-	-	2.6	V
$I_{DSS}$	drain leakage current	$V_{DS} = 30 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 ^\circ C$	-	-	1	$\mu A$
		$V_{DS} = 30 V$ ; $V_{GS} = 0 V$ ; $T_j = 150 ^\circ C$	-	-	100	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 16 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 ^\circ C$	-	-	100	nA
		$V_{GS} = -16 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 ^\circ C$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	-	2.3	3.3	m $\Omega$
		$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_j = 150 ^\circ C$ ; see <a href="#">Figure 11</a> ; see <a href="#">Figure 10</a>	-	4.1	6	m $\Omega$
		$V_{GS} = 4.5 V$ ; $I_D = 25 A$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	-	3.4	4.5	m $\Omega$
$R_G$	gate resistance	$f = 1 MHz$	-	0.7	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 A$ ; $V_{DS} = 12 V$ ; $V_{GS} = 4.5 V$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	30.5	-	nC
		$I_D = 0 A$ ; $V_{DS} = 0 V$ ; $V_{GS} = 4.5 V$	-	28.5	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 A$ ; $V_{DS} = 12 V$ ; $V_{GS} = 4.5 V$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	15.4	-	nC
$Q_{GS1}$	pre-threshold gate-source charge		-	7.7	-	nC
$Q_{GS2}$	post-threshold gate-source charge		-	7.7	-	nC
$Q_{GD}$	gate-drain charge		-	6.9	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 A$ ; $V_{DS} = 12 V$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	3.4	-	V
$C_{iss}$	input capacitance	$V_{DS} = 12 V$ ; $V_{GS} = 0 V$ ; $f = 1 MHz$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 14</a>	-	4840	-	pF
		$V_{DS} = 0 V$ ; $V_{GS} = 0 V$ ; $f = 1 MHz$ ; $T_j = 25 ^\circ C$	-	5380	-	pF
$C_{oss}$	output capacitance	$V_{DS} = 12 V$ ; $V_{GS} = 0 V$ ; $f = 1 MHz$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 14</a>	-	960	-	pF
$C_{rss}$	reverse transfer capacitance		-	410	-	pF

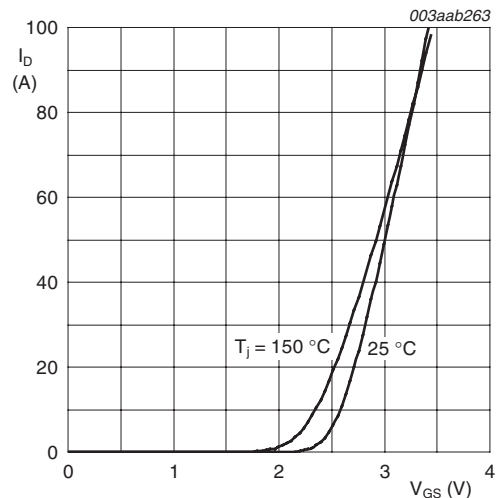
**Table 6.** Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 12 V; R <sub>L</sub> = 0.5 Ω; V <sub>GS</sub> = 4.5 V; R <sub>G(ext)</sub> = 5.6 Ω	-	41	-	ns
t <sub>r</sub>	rise time		-	75	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	52	-	ns
t <sub>f</sub>	fall time		-	27	-	ns
Source-drain diode						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; see <a href="#">Figure 15</a>	-	0.82	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/s; V <sub>GS</sub> = 0 V;	-	52	-	ns
Q <sub>r</sub>	recovered charge	V <sub>DS</sub> = 25 V	-	23	-	nC



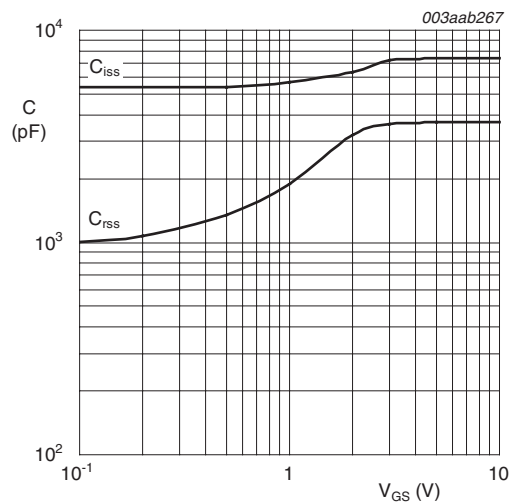
$T_j = 25\text{ }^{\circ}\text{C}$

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



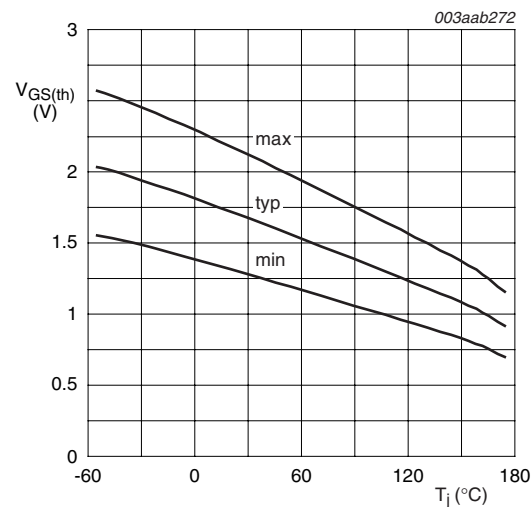
$V_{DS} > I_D \times R_{DSon}$

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



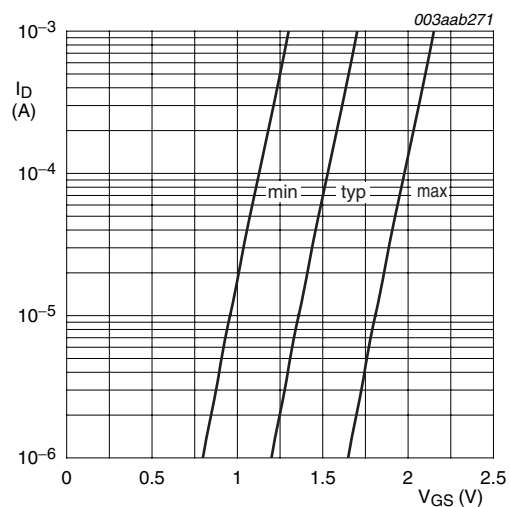
$V_{DS} = 0\text{ V}; f = 1\text{ MHz}$

Fig 7. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

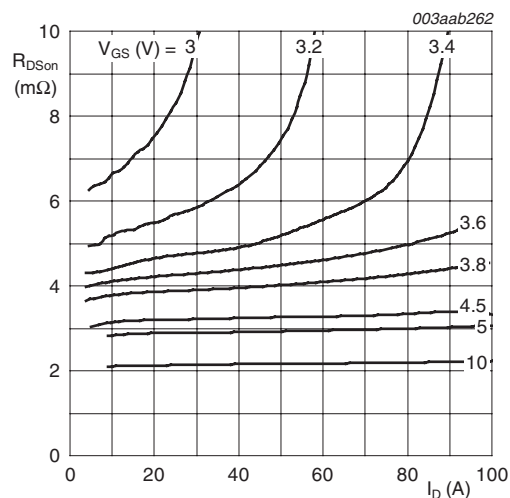


$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

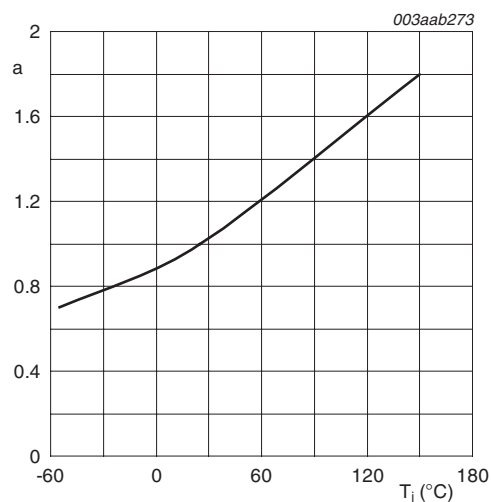
Fig 8. Gate-source threshold voltage as a function of junction temperature



**Fig 9. Sub-threshold drain current as a function of gate-source voltage**

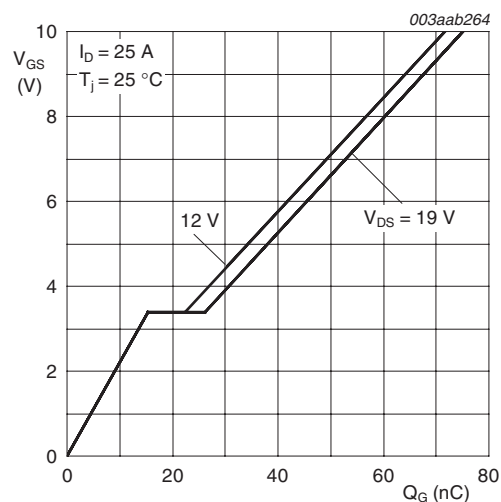


**Fig 10. Drain-source on-state resistance as a function of drain current; typical values**



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

**Fig 11. Normalized drain-source on-state resistance factor as a function of junction temperature**



**Fig 12. Gate-source voltage as a function of gate charge; typical values**

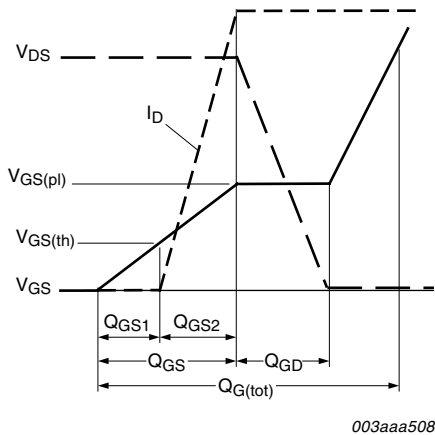
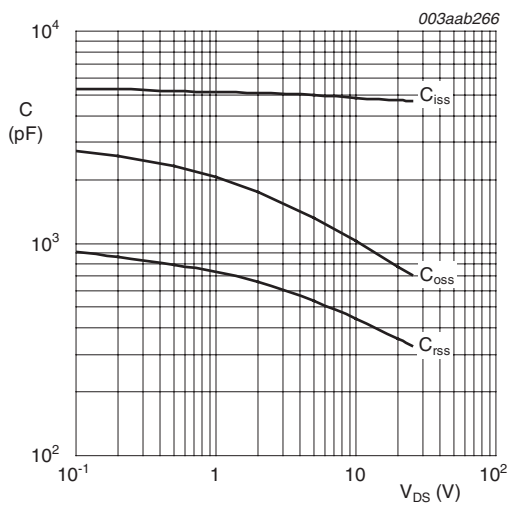
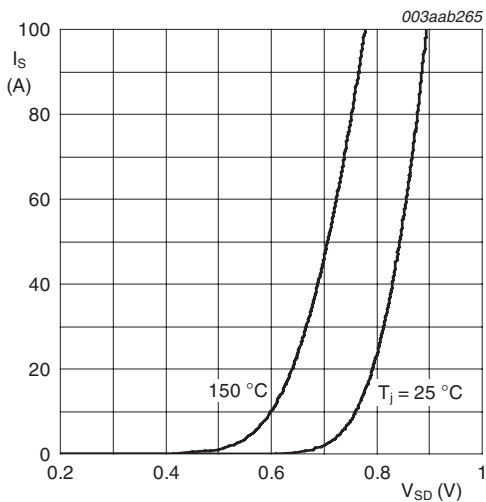


Fig 13. Gate charge waveform definitions



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

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 (LPAK); 4 leads

SOT669

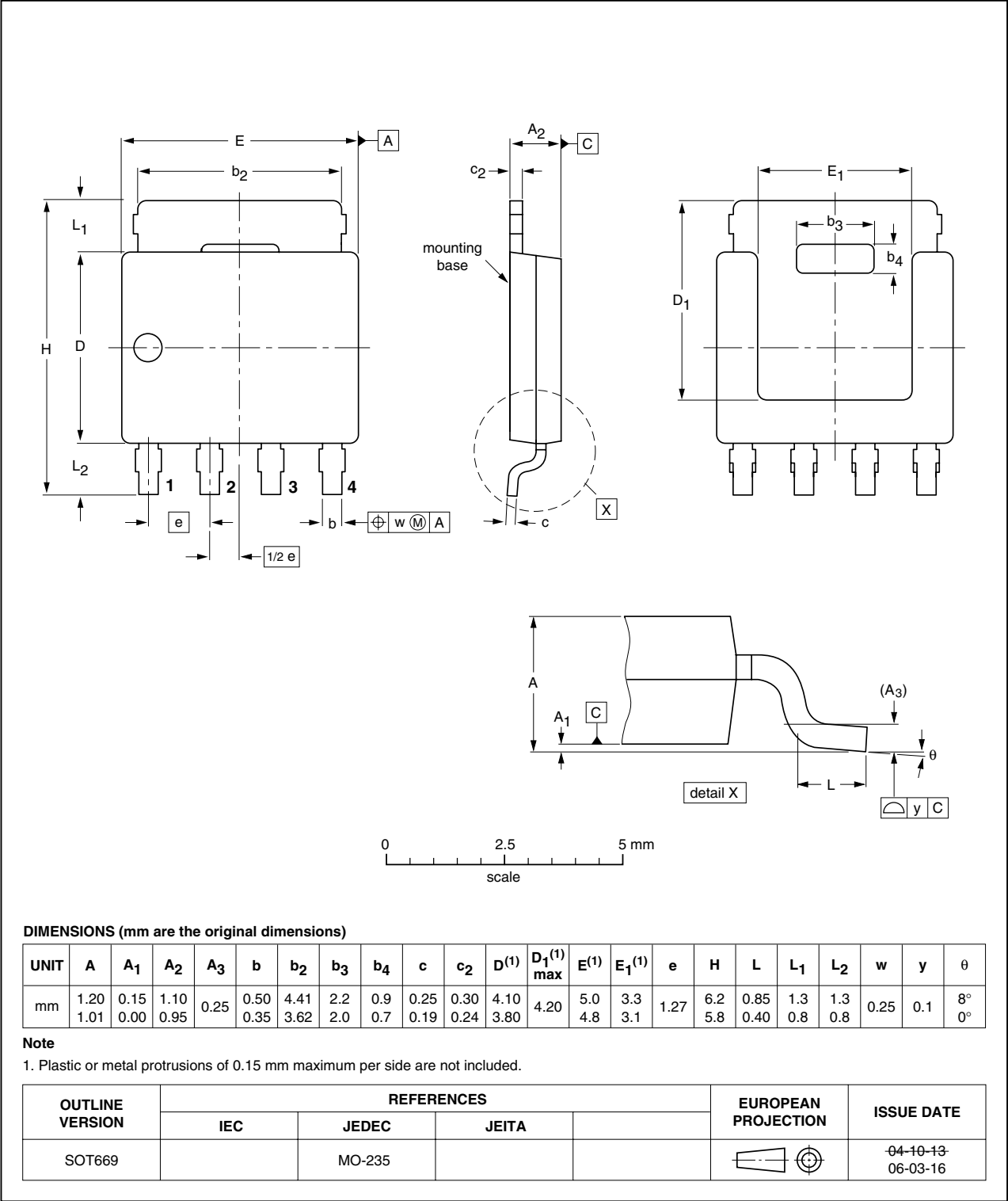


Fig 16. Package outline SOT669 (LPAK)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PH3330L_2	20081022	Product data sheet	-	PH3330L_1
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>			
PH3330L_1	20060201	Product data sheet	-	-

## 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.nxp.com>.

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