

# PSMN5R5-60YS

N-channel LPAK 60 V, 5.2 mΩ standard level FET

Rev. 02 — 24 December 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel MOSFET in LPAK package qualified to 175 °C. This product is designed and qualified for use in a wide range of industrial, communications and domestic equipment.

### 1.2 Features and benefits

- Advanced TrenchMOS provides low  $R_{DS(on)}$  and low gate charge
- High efficiency in switching power converters
- Improved mechanical and thermal characteristics
- LPAK provides maximum power density in a Power SO8 package

### 1.3 Applications

- DC-to-DC converters
- Lithium-ion battery protection
- Load switching
- Motor control
- Server power supplies

### 1.4 Quick reference data

Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	-	60	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a> <sup>[1]</sup>	-	-	100	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	-	130	W
$T_j$	junction temperature		-55	-	175	°C
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; $I_D = 100\text{ A}$ ; $V_{sup} \leq 60\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped	-	-	170	mJ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}$ ; $I_D = 75\text{ A}$ ;	-	11.2	-	nC
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30\text{ V}$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	56	-	nC



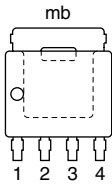
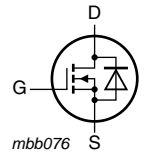
Table 1. Quick reference ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 15\text{ A}$ ; $T_j = 100\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 12</a>	-	-	8.3	mΩ
		$V_{GS} = 10\text{ V}$ ; $I_D = 15\text{ A}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 13</a>	-	3.6	5.2	mΩ

[1] Continuous current is limited by package.

## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source		
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain		

SOT669 (LPAK)

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PSMN5R5-60YS	LPAK	plastic single-ended surface-mounted package (LPAK); 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	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	60	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	60	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>	-	74	A
		$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a> [1]	-	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>	-	418	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	130	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
$T_{sld(M)}$	peak soldering temperature		-	260	°C

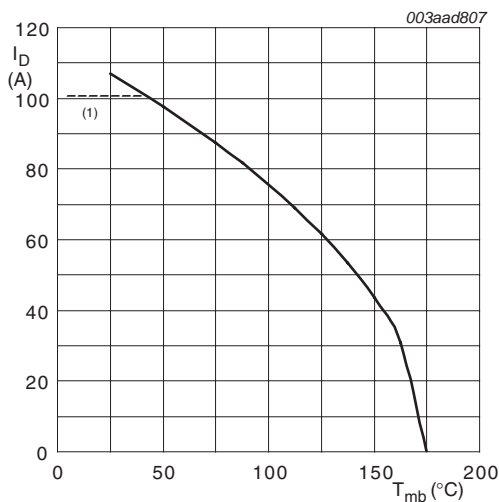
### Source-drain diode

$I_S$	source current	$T_{mb} = 25\text{ °C}$ ; [1]	-	100	A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$	-	418	A

### Avalanche ruggedness

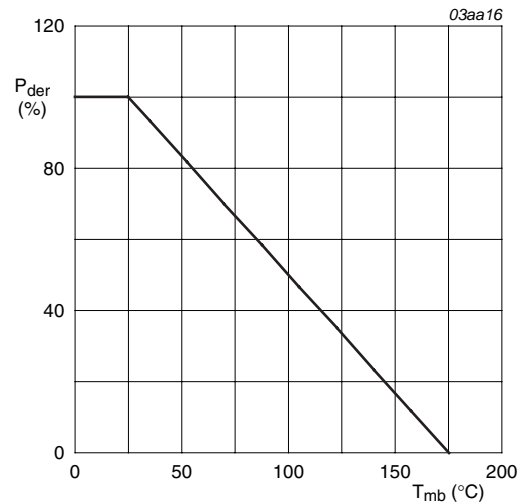
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 100\text{ A}$ ; $V_{sup} \leq 60\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped	-	170	mJ
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[1] Continuous current is limited by package.



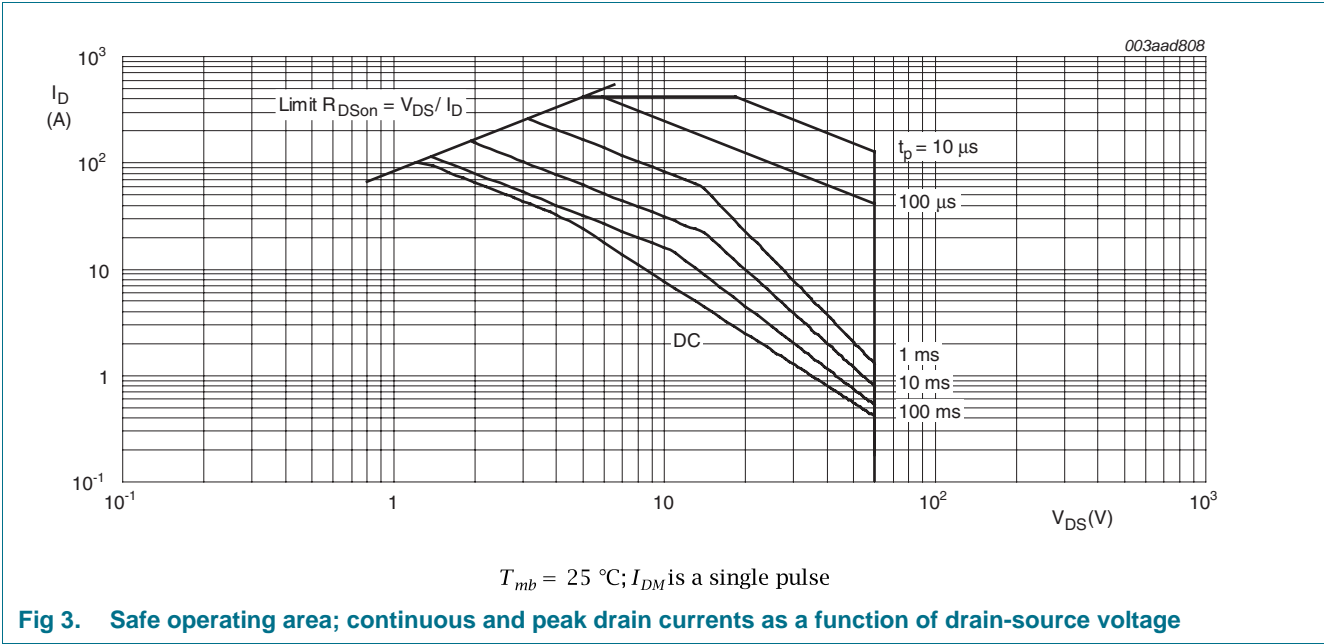
$V_{GS} \geq 10\text{ V}$ ; (1) capped at 100 A due to package

**Fig 1. Continuous drain current as a function of mounting base temperature**



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

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



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>	-	0.5	1.1	K/W

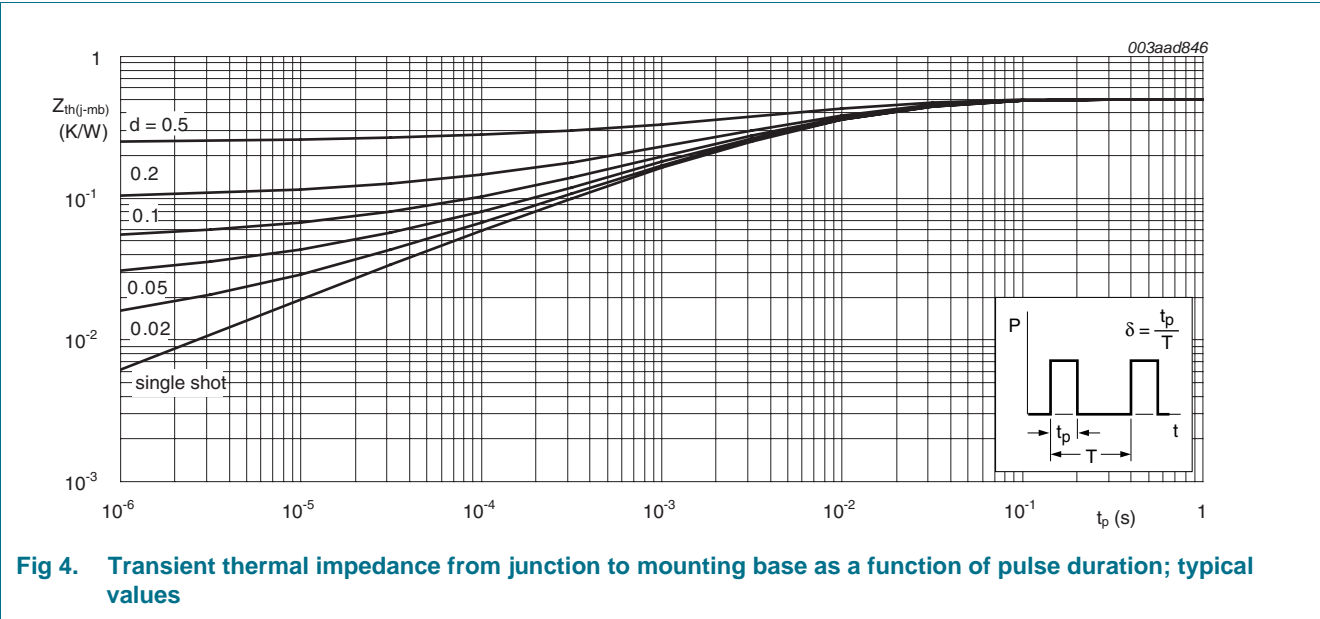


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values

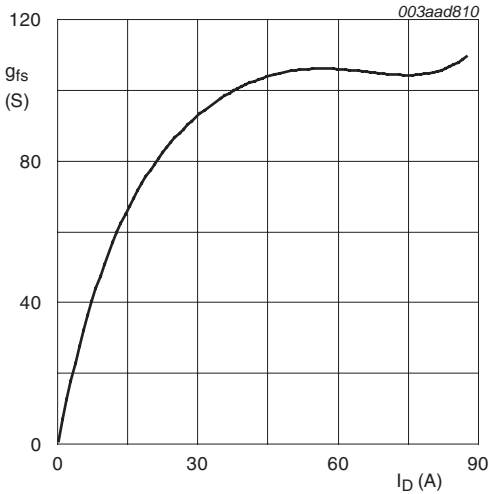
## 6. Characteristics

**Table 6. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = -55 ^\circ C$	54	-	-	V
		$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_j = 25 ^\circ C$	60	-	-	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 10</a> and <a href="#">11</a>	2	3	4	V
$V_{GSth}$		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55 ^\circ C$ ; see <a href="#">Figure 11</a>	-	-	4.6	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 175 ^\circ C$ ; see <a href="#">Figure 11</a>	0.95	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 25 ^\circ C$	-	0.05	5	$\mu A$
		$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_j = 125 ^\circ C$	-	-	100	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 ^\circ C$	-	2	100	nA
		$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_j = 25 ^\circ C$	-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 15 A$ ; $T_j = 175 ^\circ C$ ; see <a href="#">Figure 12</a>	-	7.6	12	mΩ
		$V_{GS} = 10 V$ ; $I_D = 15 A$ ; $T_j = 100 ^\circ C$ ; see <a href="#">Figure 12</a>	-	-	8.3	mΩ
		$V_{GS} = 10 V$ ; $I_D = 15 A$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 13</a>	-	3.6	5.2	mΩ
$R_G$	gate resistance	$f = 1 MHz$	-	0.7	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 75 A$ ; $V_{DS} = 30 V$ ; $V_{GS} = 10 V$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	56	-	nC
		$I_D = 0 A$ ; $V_{DS} = 0 V$ ; $V_{GS} = 10 V$	-	47.5	-	nC
$Q_{GS}$	gate-source charge	$I_D = 75 A$ ; $V_{DS} = 30 V$ ; $V_{GS} = 10 V$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	18.7	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge	$I_D = 75 A$ ; $V_{DS} = 30 V$ ; $V_{GS} = 10 V$ ; see <a href="#">Figure 14</a>	-	10.3	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	8.4	-	nC
$Q_{GD}$	gate-drain charge	$I_D = 75 A$ ; $V_{DS} = 30 V$ ; $V_{GS} = 10 V$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	11.2	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$V_{DS} = 30 V$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	4.9	-	V
$C_{iss}$	input capacitance	$V_{DS} = 30 V$ ; $V_{GS} = 0 V$ ; $f = 1 MHz$ ; $T_j = 25 ^\circ C$ ; see <a href="#">Figure 16</a>	-	3501	-	pF
$C_{oss}$	output capacitance		-	457	-	pF
$C_{rss}$	reverse transfer capacitance		-	240	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 V$ ; $R_L = 0.4 \Omega$ ; $V_{GS} = 10 V$ ; $R_{G(ext)} = 4.7 \Omega$	-	23	-	ns
$t_r$	rise time		-	24	-	ns
$t_{d(off)}$	turn-off delay time		-	44	-	ns
$t_f$	fall time		-	14	-	ns

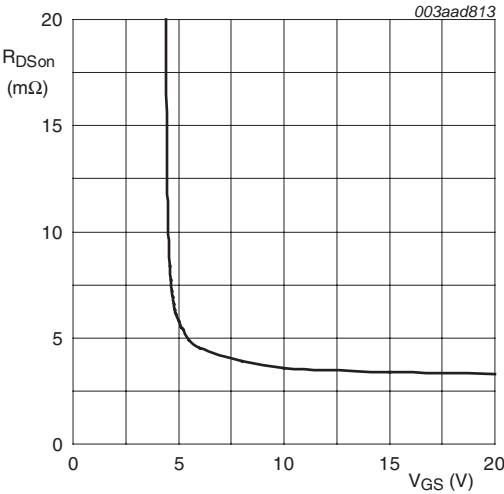
Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
$V_{SD}$	source-drain voltage	$I_S = 15\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 17</a>	-	0.8	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}$ ; $dI_S/dt = -100\text{ A/}\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ;	-	43	-	ns
$Q_r$	recovered charge	$V_{DS} = 30\text{ V}$	-	58	-	nC



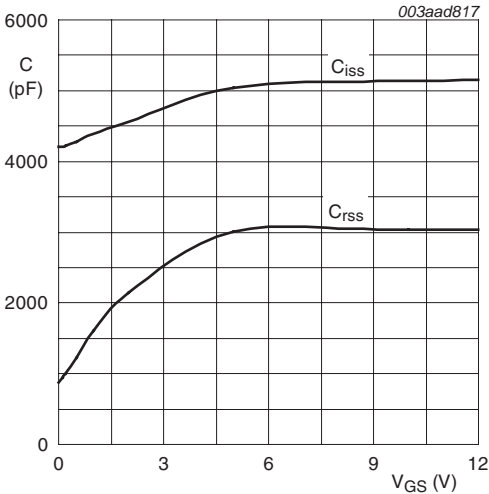
$T_j = 25\text{ °C}$ ;  $V_{DS} = 15\text{ V}$

Fig 5. Forward transconductance as a function of drain current; typical values



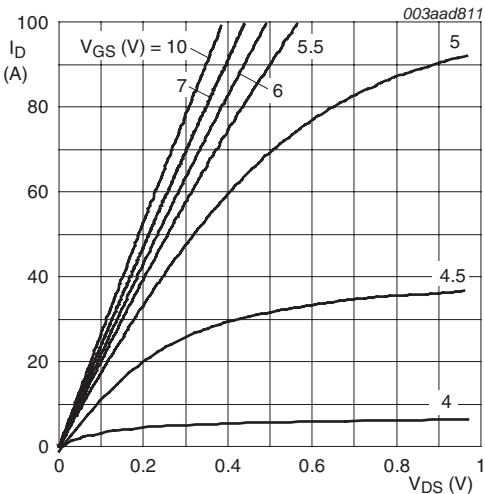
$T_j = 25\text{ °C}$ ;  $I_D = 25\text{ A}$

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



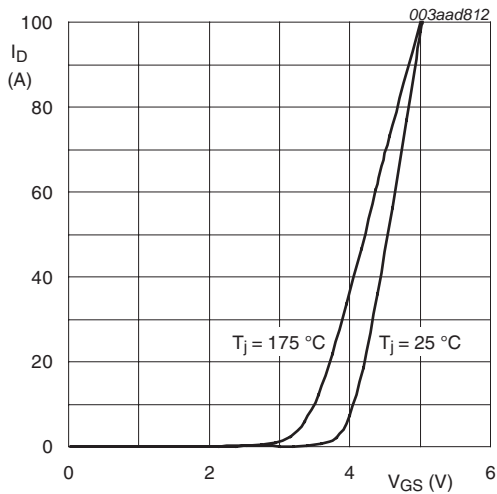
$V_{DS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

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



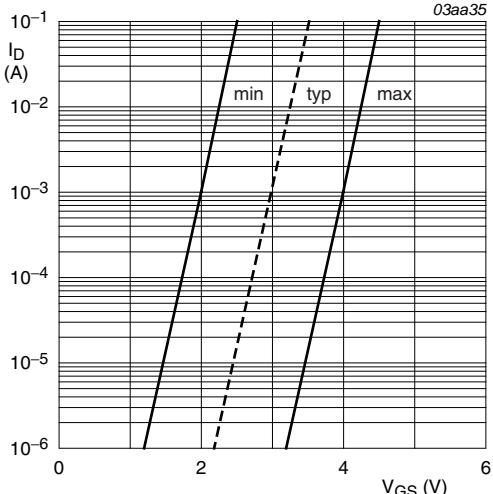
$T_j = 25\text{ °C}$

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



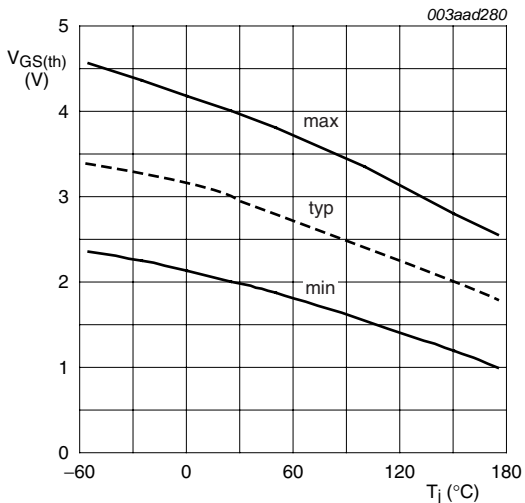
$V_{DS} > I_D \times R_{DSon}$

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



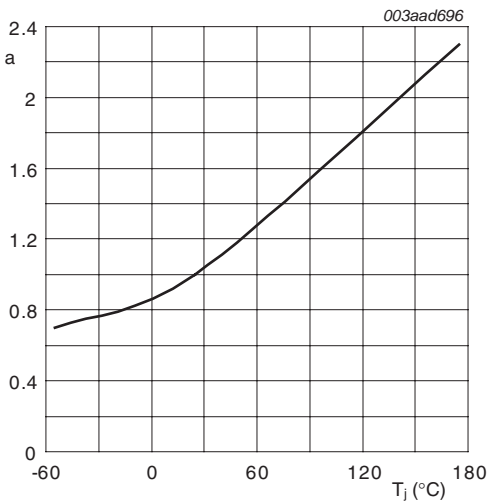
$T_j = 25\text{ °C}; V_{DS} = 5V$

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



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

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



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

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



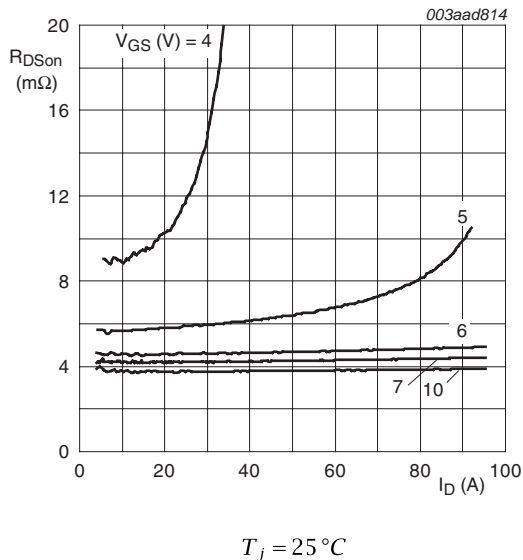


Fig 13. Drain-source on-state resistance as a function of drain current; typical values

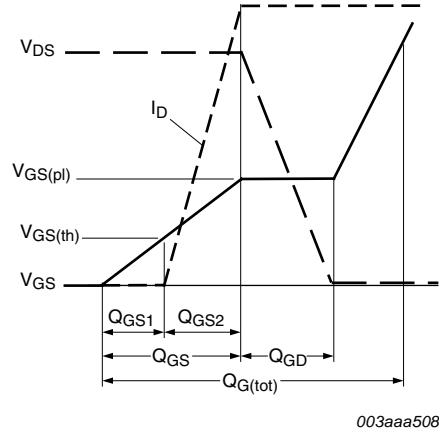


Fig 14. Gate charge waveform definitions

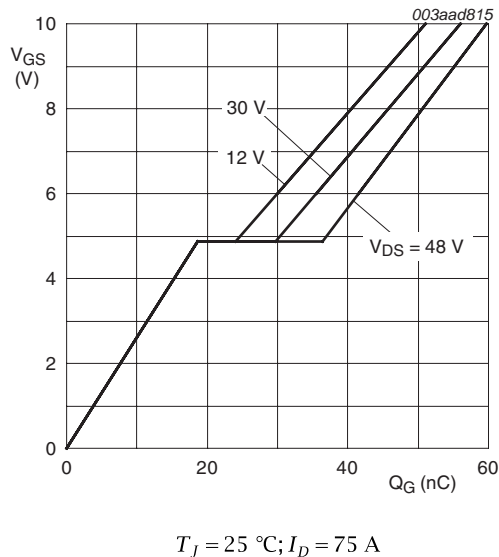


Fig 15. Gate-source voltage as a function of gate charge; typical values

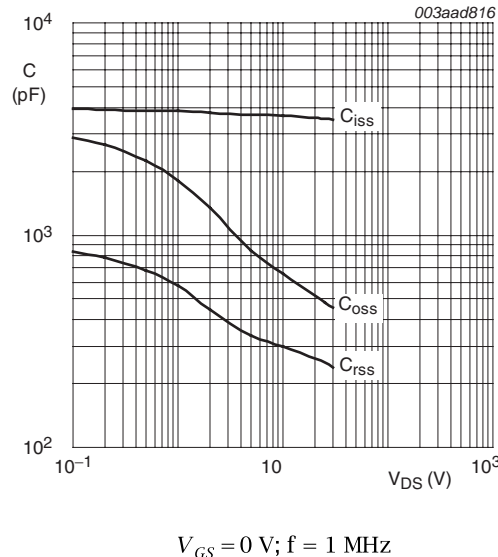
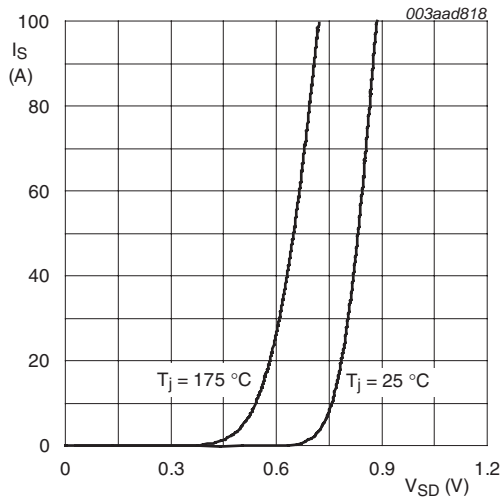


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$V_{GS} = 0\text{ V}$

Fig 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

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

SOT669

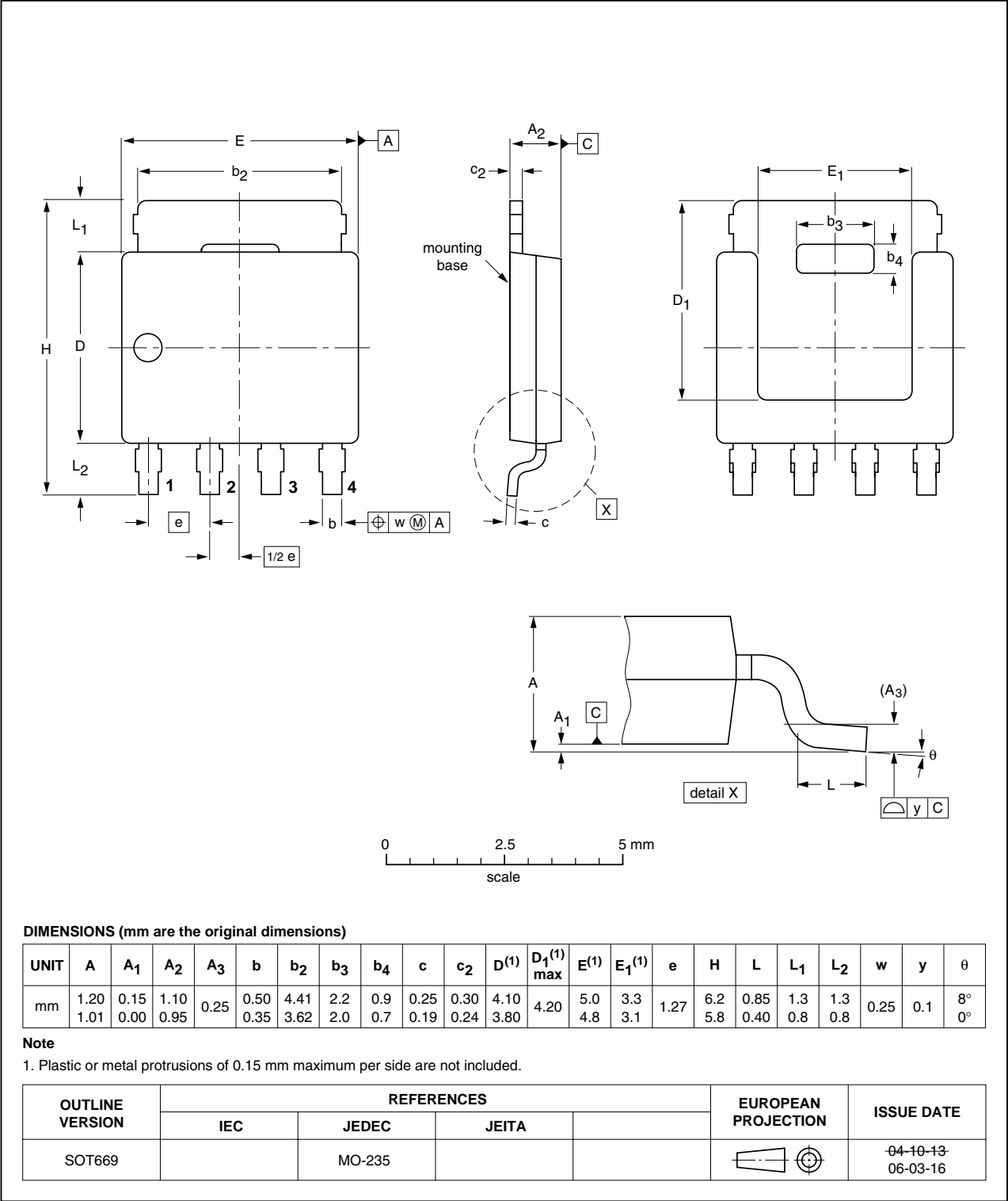


Fig 18. Package outline SOT669 (LPAK)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN5R5-60YS_2	20091224	Product data sheet	-	PSMN5R5-60YS_1
Modifications:				
• Status changed from objective to product.				
PSMN5R5-60YS_1	20091201	Objective 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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