
# PSMN5R5-60YS

## N-channel LFPAK 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 LFPAK 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 RDSon and low gate charge
- High efficiency in switching power converters
- Improved mechanical and thermal characteristics
- LFPAK 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 | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | - | 60 | V |
| $I_D$ | drain current | $T_{mb}$ = 25 °C; see Figure 1 | [1] | - | - | 100 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | | - | - | 130 | W |
| $T_j$ | junction temperature | | | -55 | - | 175 | °C |
| **Avalanche ruggedness** | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; $I_D$ = 100 A; $V_{sup} \leq 60$ V; $R_{GS}$ = 50 Ω; unclamped | | - | - | 170 | mJ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS}$ = 10 V; $I_D$ = 75 A; $V_{DS}$ = 30 V; see Figure 14 and 15 | | - | 11.2 | - | nC |
| $Q_{G(tot)}$ | total gate charge | | | - | 56 | - | nC |

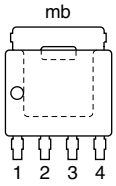
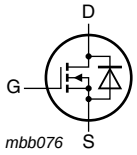
**Table 1. Quick reference** *…continued*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 100 °C; see Figure 12 | - | - | 8.3 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; see Figure 13 | - | 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 |   SOT669 (LFPAK) |   |
| 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 | | |
|---|---|---|---|
| | Name | Description | Version |
| PSMN5R5-60YS | LFPAK | plastic single-ended surface-mounted package (LFPAK); 4 leads | SOT669 |

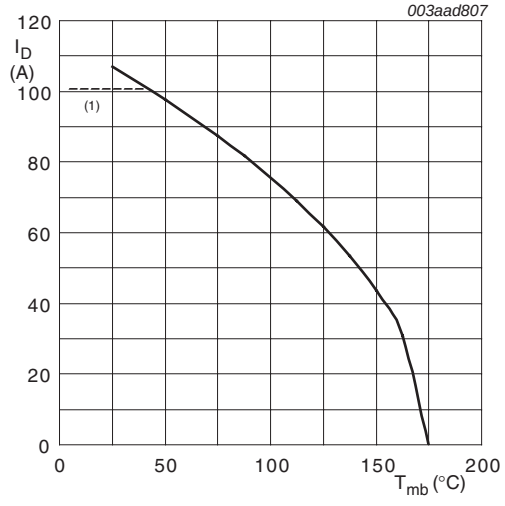
# 4. Limiting values

**Table 4. Limiting values**

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

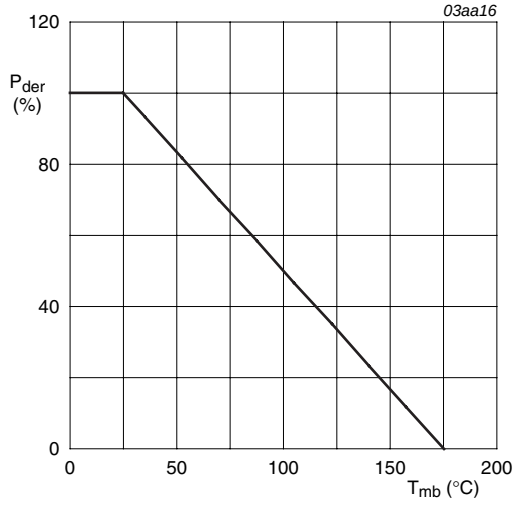
| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | 60 | V |
| $V_{DGR}$ | drain-gate voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C; $R_{GS}$ = 20 kΩ | | - | 60 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $I_D$ | drain current | $T_{mb}$ = 100 °C; see Figure 1 | | - | 74 | A |
| | | $T_{mb}$ = 25 °C; see Figure 1 | [1] | - | 100 | A |
| $I_{DM}$ | peak drain current | $t_p \leq 10$ µs; pulsed; $T_{mb}$ = 25 °C; see Figure 3 | | - | 418 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | | - | 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 °C; | [1] | - | 100 | A |
| $I_{SM}$ | peak source current | $t_p \leq 10$ µs; pulsed; $T_{mb}$ = 25 °C | | - | 418 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; $I_D$ = 100 A; $V_{sup} \leq 60$ V; $R_{GS}$ = 50 Ω; unclamped | | - | 170 | mJ |

[1] Continuous current is limited by package.



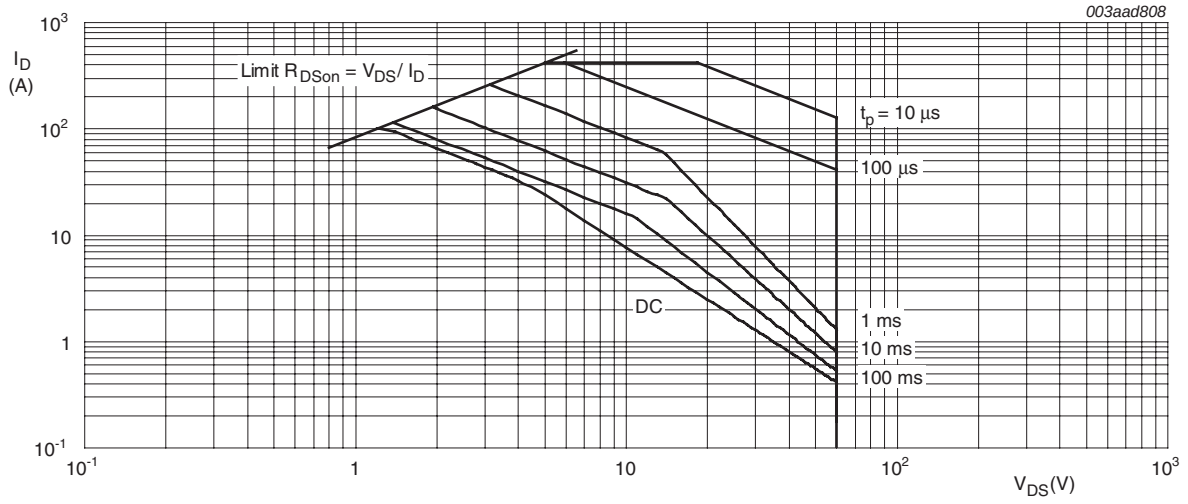

$V_{GS} \geq$ 10 V; (1) capped at 100 A due to package

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




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

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




$T_{mb} = 25$ °C; $I_{DM}$ is a 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 |
|---|---|---|---|---|---|---|
| $R_{th(j\text{-}mb)}$ | thermal resistance from junction to mounting base | see Figure 4 | - | 0.5 | 1.1 | K/W |

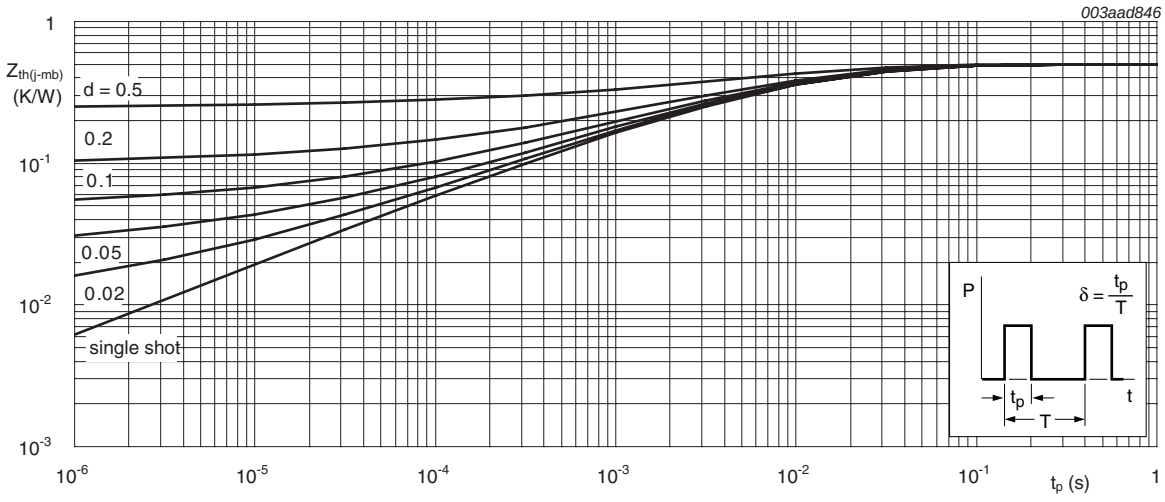



**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values**

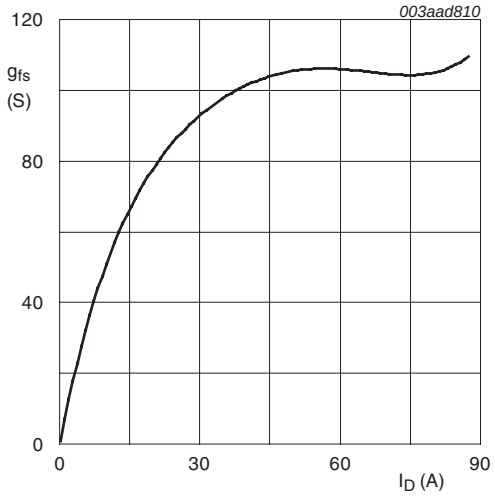
# 6. Characteristics

**Table 6. Characteristics**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | 54 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | 60 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$= $V_{GS}$; $T_j$ = 25 °C; see Figure 10 and 11 | 2 | 3 | 4 | V |
| $V_{GSth}$ | | $I_D$ = 1 mA; $V_{DS}$= $V_{GS}$; $T_j$ = -55 °C; see Figure 11 | - | - | 4.6 | V |
| | | $I_D$ = 1 mA; $V_{DS}$= $V_{GS}$; $T_j$ = 175 °C; see Figure 11 | 0.95 | - | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | 0.05 | 5 | µA |
| | | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | - | - | 100 | 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; $I_D$ = 15 A; $T_j$ = 175 °C; see Figure 12 | - | 7.6 | 12 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 100 °C; see Figure 12 | - | - | 8.3 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; see Figure 13 | - | 3.6 | 5.2 | mΩ |
| $R_G$ | gate resistance | f = 1 MHz | - | 0.7 | - | Ω |
| **Dynamic characteristics** | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 75 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; see Figure 14 and 15 | - | 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 Figure 14 and 15 | - | 18.7 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | $I_D$ = 75 A; $V_{DS}$ = 30 V; $V_{GS}$ = 10 V; see Figure 14 | - | 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 Figure 14 and 15 | - | 11.2 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $V_{DS}$ = 30 V; see Figure 14 and 15 | - | 4.9 | - | V |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; see Figure 16 | - | 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 Ω; $V_{GS}$ = 10 V; $R_{G(ext)}$ = 4.7 Ω | - | 23 | - | ns |
| $t_r$ | rise time | | - | 24 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 44 | - | ns |
| $t_f$ | fall time | | - | 14 | - | ns |

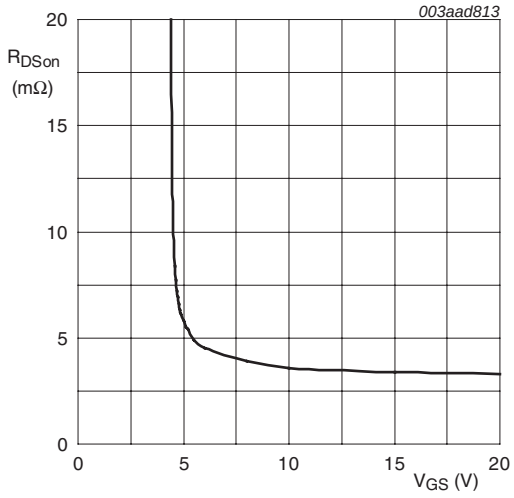
**Table 6. Characteristics** *…continued*

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



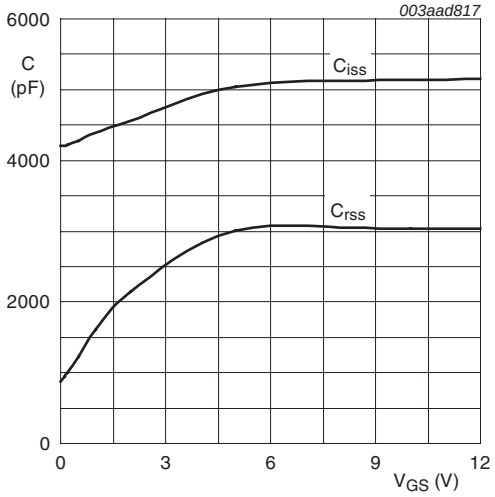

$T_j = 25\ °C; V_{DS} = 15\ V$

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



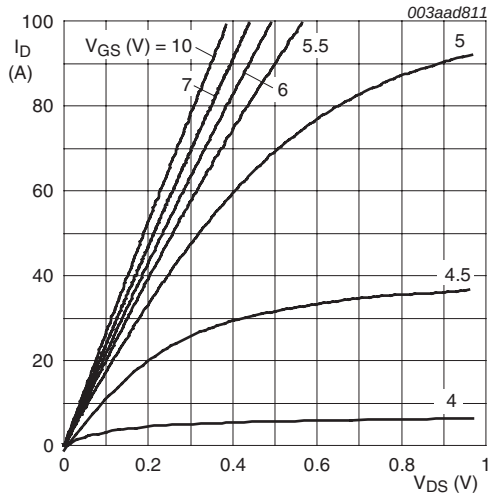

$T_j = 25\ °C; I_D = 25\ A$

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



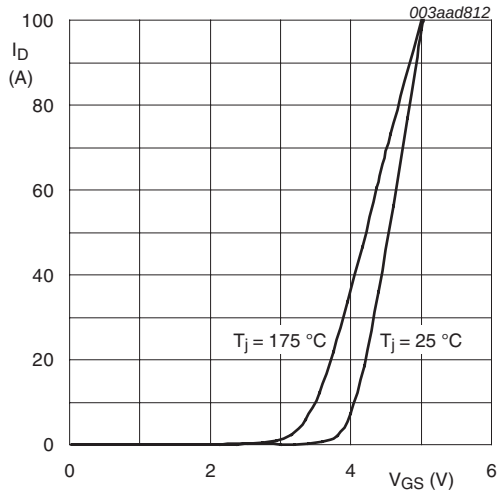

$V_{DS} = 0\ V; f = 1\ MHz$

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



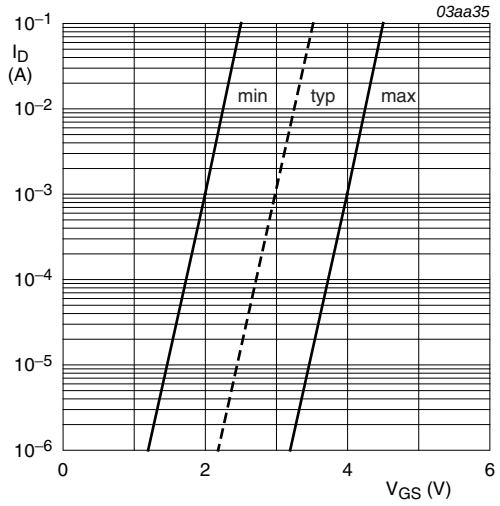

$T_j = 25\ °C$

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



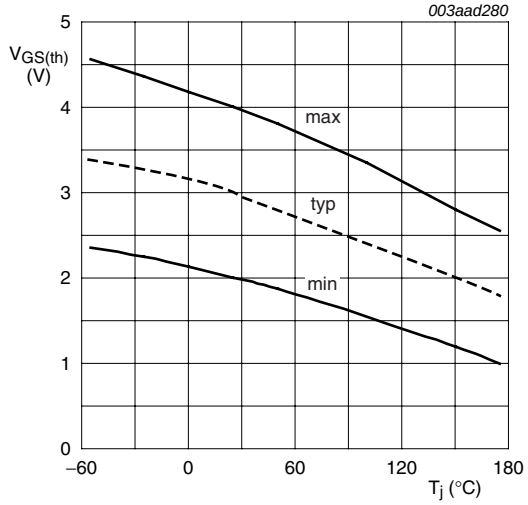

$$V_{DS} > I_D \times R_{DSon}$$

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



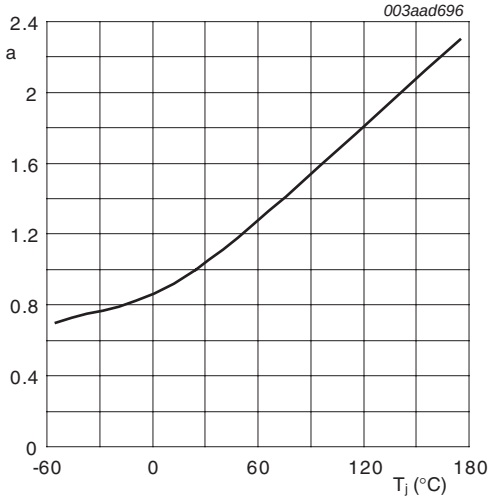

$$T_j = 25\,°C; V_{DS} = 5V$$

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



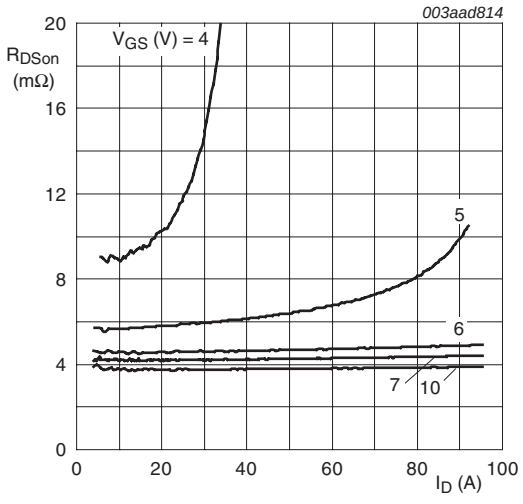

$$I_D = 1\,mA; V_{DS} = V_{GS}$$

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




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

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




$T_j = 25\,°C$

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

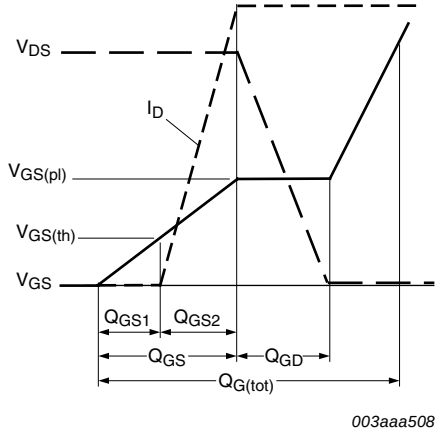
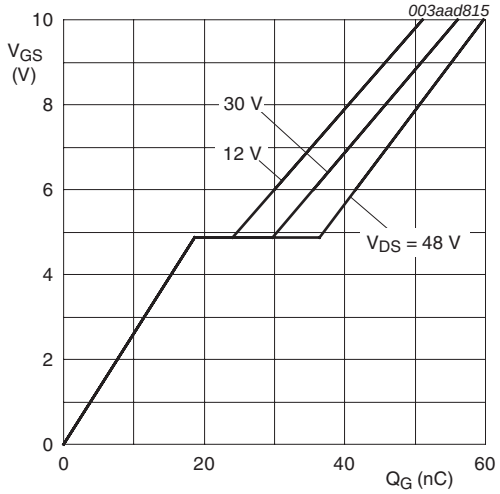
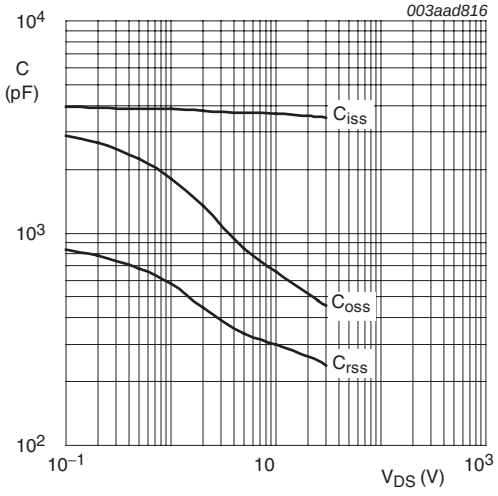



**Fig 14. Gate charge waveform definitions**



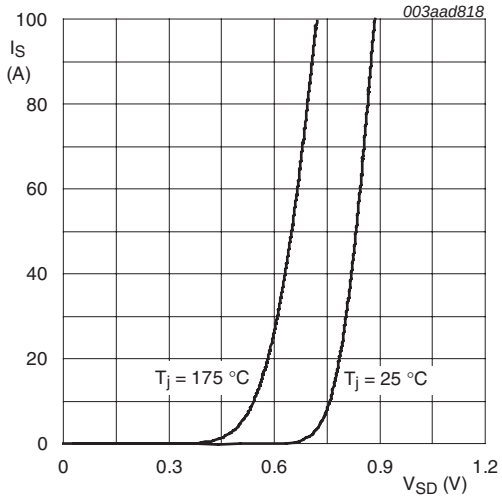

$T_J = 25\ °C; I_D = 75\ A$

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




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

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

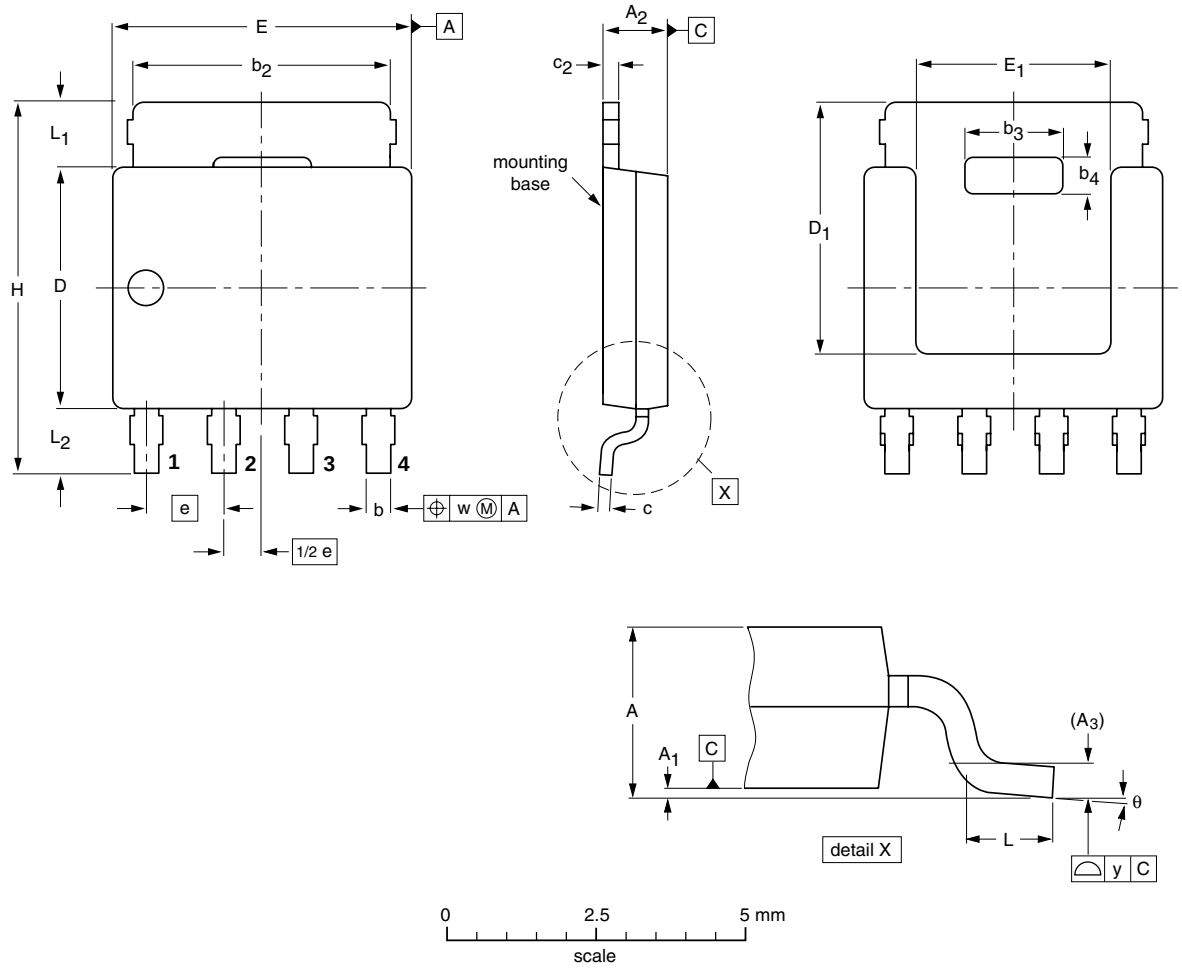



$V_{GS} = 0$ V

**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 (LFPAK); 4 leads** **SOT669**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | $A_2$ | $A_3$ | b | $b_2$ | $b_3$ | $b_4$ | c | $c_2$ | $D^{(1)}$ | $D_1^{(1)}$ max | $E^{(1)}$ | $E_1^{(1)}$ | e | H | L | $L_1$ | $L_2$ | w | y | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.20<br>1.01 | 0.15<br>0.00 | 1.10<br>0.95 | 0.25 | 0.50<br>0.35 | 4.41<br>3.62 | 2.2<br>2.0 | 0.9<br>0.7 | 0.25<br>0.19 | 0.30<br>0.24 | 4.10<br>3.80 | 4.20 | 5.0<br>4.8 | 3.3<br>3.1 | 1.27 | 6.2<br>5.8 | 0.85<br>0.40 | 1.3<br>0.8 | 1.3<br>0.8 | 0.25 | 0.1 | 8°<br>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~~<br>06-03-16 |

**Fig 18. Package outline SOT669 (LFPAK)**

# 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[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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# 10. Contact information

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