

# PSMN012-100YS

## N-channel 100V 12mΩ standard level MOSFET in LPAK

Rev. 04 — 23 February 2010

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 RDSon and low gate charge
- High efficiency gains 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 <sub>DS</sub>                | drain-source voltage                         | T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C                                                                                          | -   | -   | 100 | V    |
| I <sub>D</sub>                 | drain current                                | T <sub>mb</sub> = 25 °C; see <a href="#">Figure 1</a>                                                                                    | -   | -   | 60  | A    |
| P <sub>tot</sub>               | total power dissipation                      | T <sub>mb</sub> = 25 °C; see <a href="#">Figure 2</a>                                                                                    | -   | -   | 130 | W    |
| T <sub>j</sub>                 | junction temperature                         |                                                                                                                                          | -55 | -   | 175 | °C   |
| <b>Avalanche ruggedness</b>    |                                              |                                                                                                                                          |     |     |     |      |
| E <sub>DS(AL)S</sub>           | non-repetitive drain-source avalanche energy | V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; I <sub>D</sub> = 60 A; V <sub>sup</sub> ≤ 100 V; R <sub>GS</sub> = 50 Ω; unclamped | -   | -   | 170 | mJ   |
| <b>Dynamic characteristics</b> |                                              |                                                                                                                                          |     |     |     |      |
| Q <sub>GD</sub>                | gate-drain charge                            | V <sub>GS</sub> = 10 V; I <sub>D</sub> = 45 A;                                                                                           | -   | 19  | -   | nC   |
| Q <sub>G(tot)</sub>            | total gate charge                            | V <sub>DS</sub> = 50 V; see <a href="#">Figure 14</a> and <a href="#">15</a>                                                             | -   | 64  | -   | nC   |

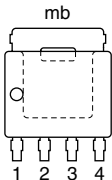
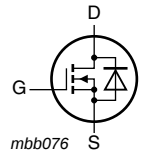


Table 1. Quick reference ...continued

| Symbol                        | Parameter                        | Conditions                                                                                                            | Min | Typ | Max | Unit |
|-------------------------------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| <b>Static characteristics</b> |                                  |                                                                                                                       |     |     |     |      |
| $R_{DS(on)}$                  | drain-source on-state resistance | $V_{GS} = 10\text{ V}$ ; $I_D = 15\text{ A}$ ;<br>$T_j = 100\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 12</a> | -   | -   | 23  | mΩ   |
|                               |                                  | $V_{GS} = 10\text{ V}$ ; $I_D = 15\text{ A}$ ;<br>$T_j = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 13</a>  | -   | 10  | 12  | mΩ   |

## 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 |                                                              |         |
|---------------|---------|--------------------------------------------------------------|---------|
|               | Name    | Description                                                  | Version |
| PSMN012-100YS | 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).

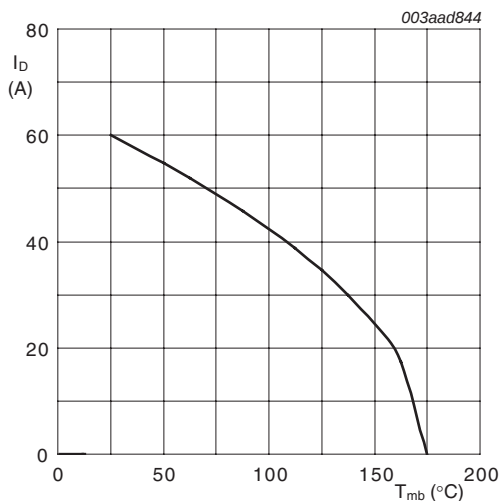
| Symbol       | Parameter                  | Conditions                                                                                        | Min | Max | Unit |
|--------------|----------------------------|---------------------------------------------------------------------------------------------------|-----|-----|------|
| $V_{DS}$     | drain-source voltage       | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$                                                | -   | 100 | V    |
| $V_{DGR}$    | drain-gate voltage         | $T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$                 | -   | 100 | V    |
| $V_{GS}$     | gate-source voltage        |                                                                                                   | -20 | 20  | V    |
| $I_D$        | drain current              | $T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>                                           | -   | 43  | A    |
|              |                            | $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a>                                            | -   | 60  | 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> | -   | 242 | 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

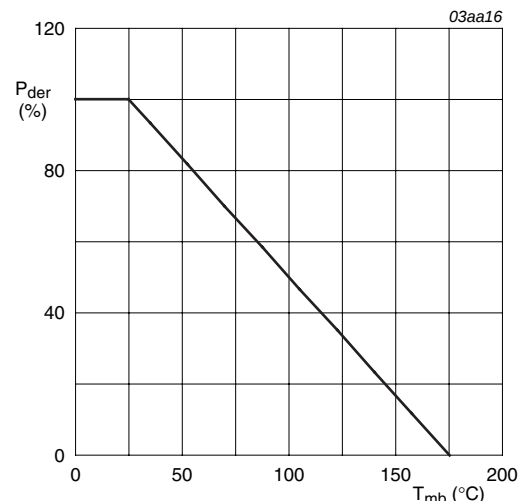
|          |                     |                                                                    |   |     |   |
|----------|---------------------|--------------------------------------------------------------------|---|-----|---|
| $I_S$    | source current      | $T_{mb} = 25\text{ °C}$                                            | - | 60  | A |
| $I_{SM}$ | peak source current | $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$ | - | 242 | A |

### Avalanche ruggedness

|               |                                              |                                                                                                                                                            |   |     |    |
|---------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|----|
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 60\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped | - | 170 | mJ |
|---------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|----|



**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**

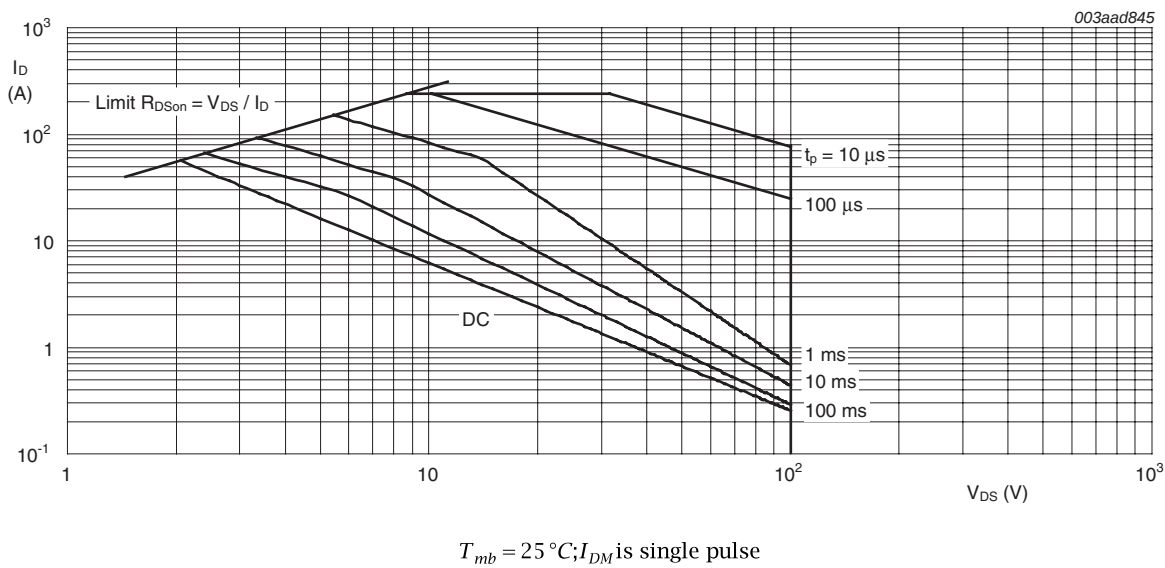
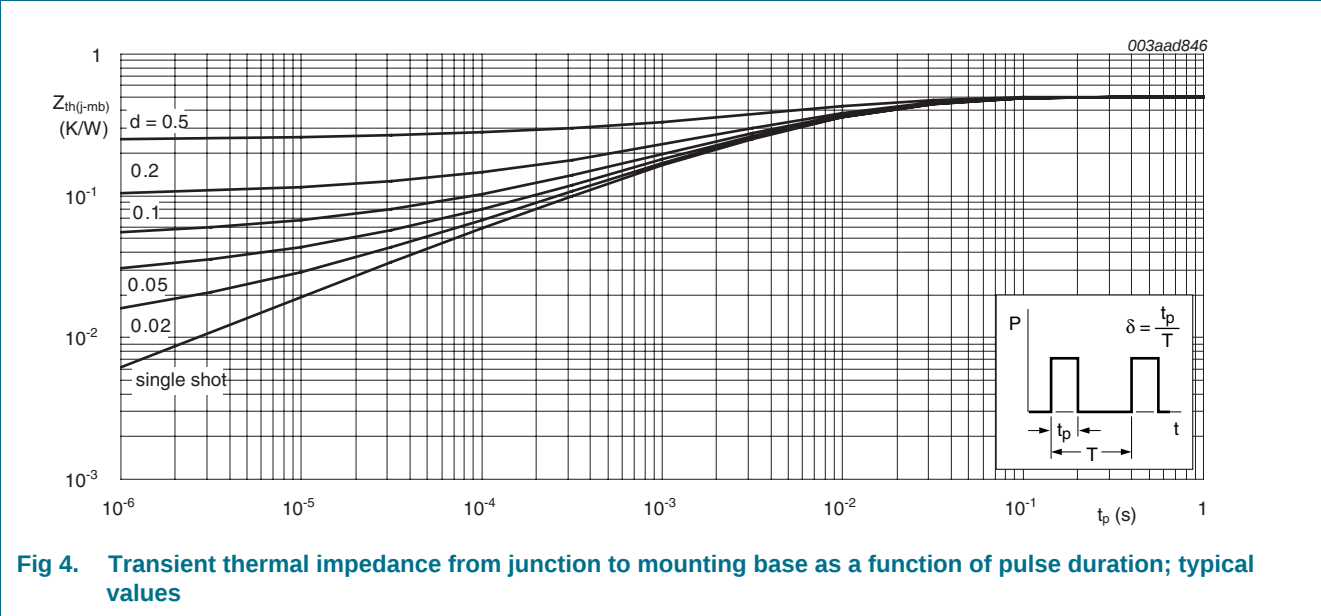


Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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> | -   | 0.5 | 1.1 | K/W  |



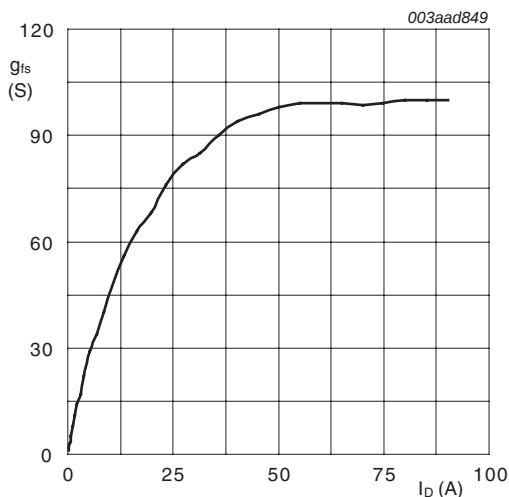
## 6. Characteristics

Table 6. Characteristics

| Symbol                         | Parameter                         | Conditions                                                                                                                                        | Min  | Typ  | Max  | Unit          |
|--------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| <b>Static characteristics</b>  |                                   |                                                                                                                                                   |      |      |      |               |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage    | $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_J = -55 \text{ }^\circ\text{C}$                                                                   | 90   | -    | -    | V             |
|                                |                                   | $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_J = 25 \text{ }^\circ\text{C}$                                                                    | 100  | -    | -    | V             |
| $V_{GS(th)}$                   | gate-source threshold voltage     | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_J = 175 \text{ }^\circ\text{C};$<br>see <a href="#">Figure 10</a>                                         | 0.95 | -    | -    | V             |
|                                |                                   | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_J = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 11</a><br>and <a href="#">10</a>                   | 2    | 3    | 4    | V             |
|                                |                                   | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_J = -55 \text{ }^\circ\text{C};$<br>see <a href="#">Figure 10</a>                                         | -    | -    | 4.6  | V             |
| $I_{DSS}$                      | drain leakage current             | $V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 125 \text{ }^\circ\text{C}$                                                                  | -    | -    | 100  | $\mu\text{A}$ |
|                                |                                   | $V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_J = 25 \text{ }^\circ\text{C}$                                                                   | -    | 0.06 | 5    | $\mu\text{A}$ |
| $I_{GSS}$                      | gate leakage current              | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_J = 25 \text{ }^\circ\text{C}$                                                                    | -    | 10   | 100  | nA            |
|                                |                                   | $V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_J = 25 \text{ }^\circ\text{C}$                                                                   | -    | 10   | 100  | nA            |
| $R_{DS(on)}$                   | drain-source on-state resistance  | $V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_J = 100 \text{ }^\circ\text{C};$<br>see <a href="#">Figure 12</a>                                   | -    | -    | 23   | mΩ            |
|                                |                                   | $V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_J = 175 \text{ }^\circ\text{C};$<br>see <a href="#">Figure 12</a>                                   | -    | 27   | 35.8 | mΩ            |
|                                |                                   | $V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_J = 25 \text{ }^\circ\text{C};$<br>see <a href="#">Figure 13</a>                                    | -    | 10   | 12   | mΩ            |
| $R_G$                          | internal gate resistance (AC)     | $f = 1 \text{ MHz}$                                                                                                                               | -    | 0.7  | -    | Ω             |
| <b>Dynamic characteristics</b> |                                   |                                                                                                                                                   |      |      |      |               |
| $Q_{G(tot)}$                   | total gate charge                 | $I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$                                                                                  | -    | 51   | -    | nC            |
|                                |                                   | $I_D = 45 \text{ A}; V_{DS} = 50 \text{ V}; V_{GS} = 10 \text{ V};$<br>see <a href="#">Figure 14</a> and <a href="#">15</a>                       | -    | 64   | -    | nC            |
| $Q_{GS}$                       | gate-source charge                |                                                                                                                                                   | -    | 14.9 | -    | nC            |
| $Q_{GS(th)}$                   | pre-threshold gate-source charge  | $I_D = 45 \text{ A}; V_{DS} = 50 \text{ V}; V_{GS} = 10 \text{ V};$<br>see <a href="#">Figure 14</a>                                              | -    | 10.2 | -    | nC            |
| $Q_{GS(th-pl)}$                | post-threshold gate-source charge |                                                                                                                                                   | -    | 4.7  | -    | nC            |
| $Q_{GD}$                       | gate-drain charge                 | $I_D = 45 \text{ A}; V_{DS} = 50 \text{ V}; V_{GS} = 10 \text{ V};$<br>see <a href="#">Figure 14</a> and <a href="#">15</a>                       | -    | 19   | -    | nC            |
| $V_{GS(pl)}$                   | gate-source plateau voltage       | $V_{DS} = 50 \text{ V};$ see <a href="#">Figure 14</a> and <a href="#">15</a>                                                                     | -    | 4.4  | -    | V             |
| $C_{iss}$                      | input capacitance                 | $V_{DS} = 50 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_J = 25 \text{ }^\circ\text{C};$<br>see <a href="#">Figure 16</a>               | -    | 3500 | -    | pF            |
| $C_{oss}$                      | output capacitance                |                                                                                                                                                   | -    | 246  | -    | pF            |
| $C_{rss}$                      | reverse transfer capacitance      |                                                                                                                                                   | -    | 149  | -    | pF            |
| $t_{d(on)}$                    | turn-on delay time                | $V_{DS} = 50 \text{ V}; R_L = 1.1 \text{ } \Omega; V_{GS} = 10 \text{ V};$<br>$R_{G(ext)} = 4.7 \text{ } \Omega; T_J = 25 \text{ }^\circ\text{C}$ | -    | 23   | -    | ns            |
| $t_r$                          | rise time                         |                                                                                                                                                   | -    | 31   | -    | ns            |
| $t_{d(off)}$                   | turn-off delay time               |                                                                                                                                                   | -    | 52.5 | -    | ns            |
| $t_f$                          | fall time                         |                                                                                                                                                   | -    | 25   | -    | ns            |

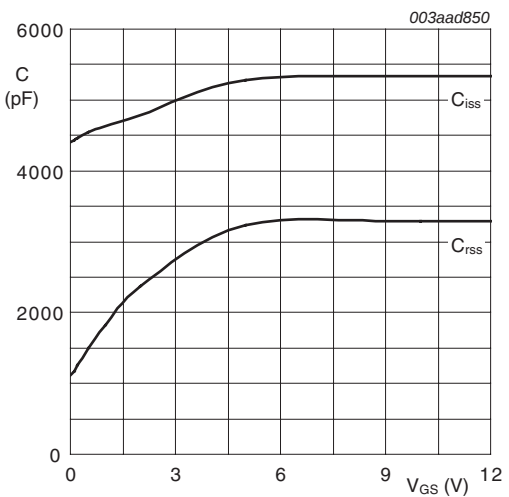
Table 6. Characteristics ...continued

| 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 | $I_S = 15\text{ A}$ ; $di_S/dt = 100\text{ A/}\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ;               | -   | 56  | -   | ns   |
| $Q_r$              | recovered charge      | $V_{DS} = 50\text{ V}$                                                                             | -   | 129 | -   | nC   |



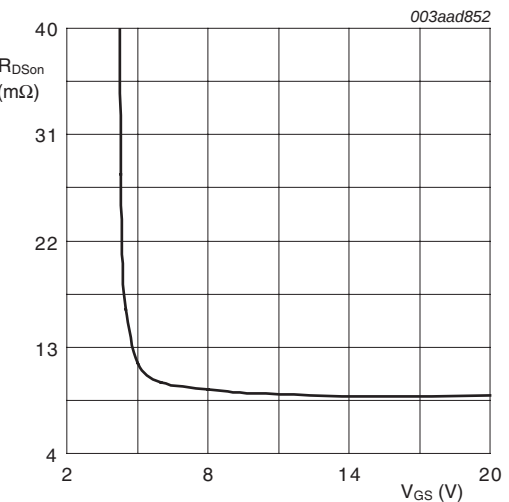
$T_j = 25\text{ °C}$ ;  $V_{DS} = 20\text{ V}$

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



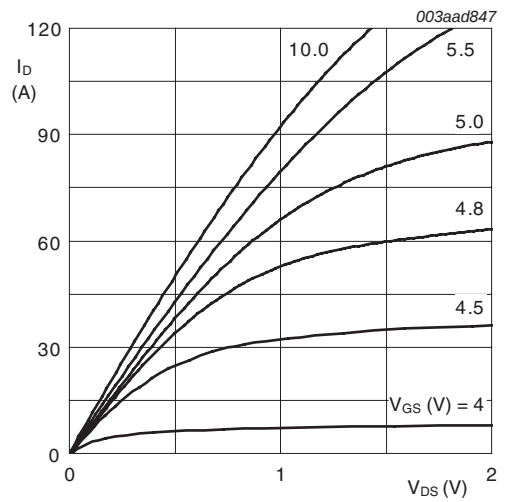
$V_{DS} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

Fig 6. Input and reverse transfer capacitances as a function of gate-source voltage; typical values



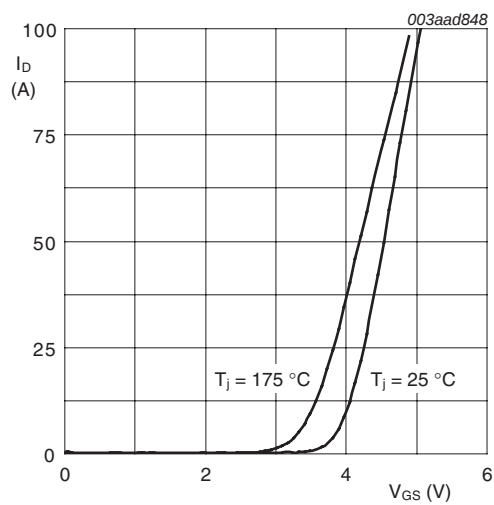
$T_j = 25\text{ °C}$ ;  $I_D = 15\text{ A}$

Fig 7. Drain-source on-state resistance as a function of gate-source voltage; typical values



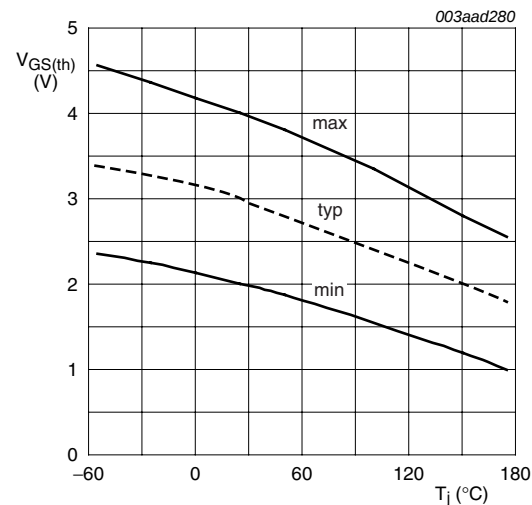
$T_j = 25\text{ °C}$

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



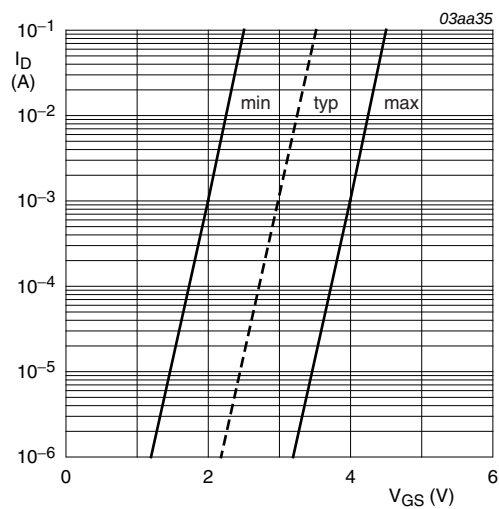
$V_{DS} > I_D \times R_{DSon}$

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



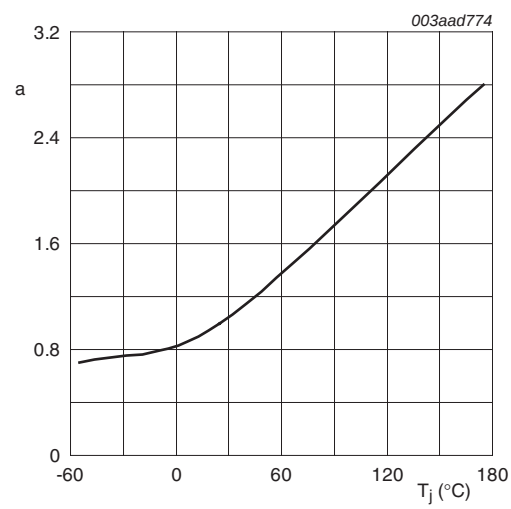
$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

Fig 10. Gate-source threshold voltage as a function of junction temperature



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

Fig 11. Sub-threshold drain current as a function of gate-source voltage



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

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

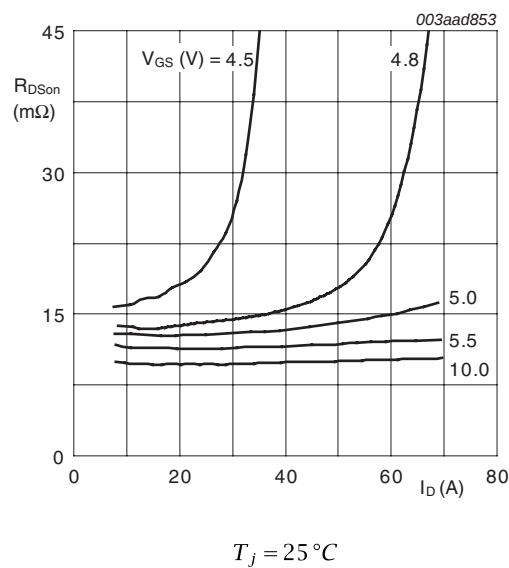


Fig 13. Drain-source on-state resistance as a function of drain current; typical values

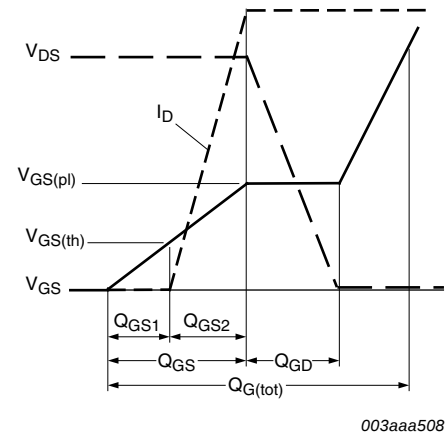


Fig 14. Gate charge waveform definitions

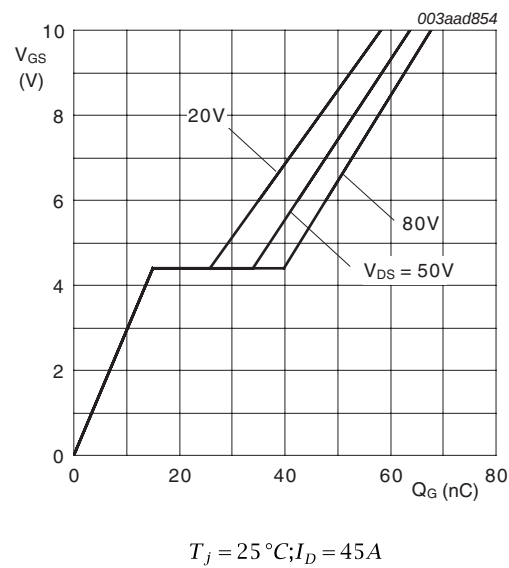


Fig 15. Gate-source voltage as a function of gate charge; typical values

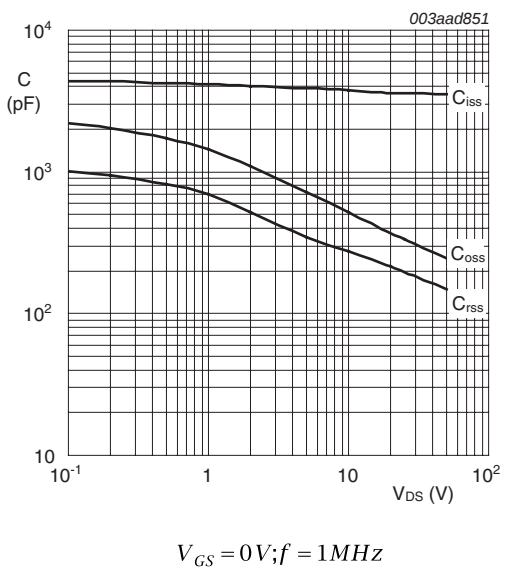


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

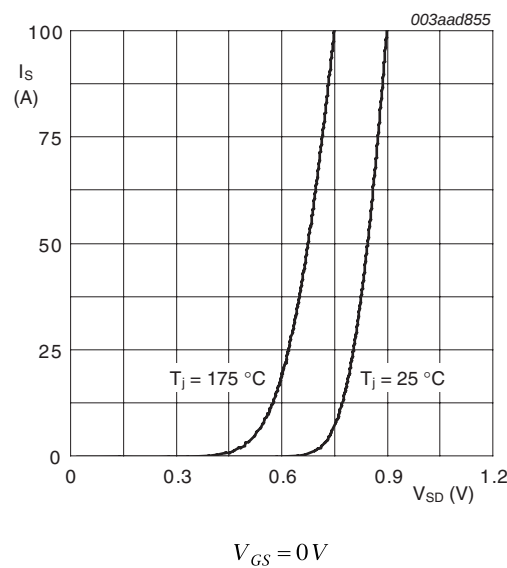


Fig 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

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

SOT669

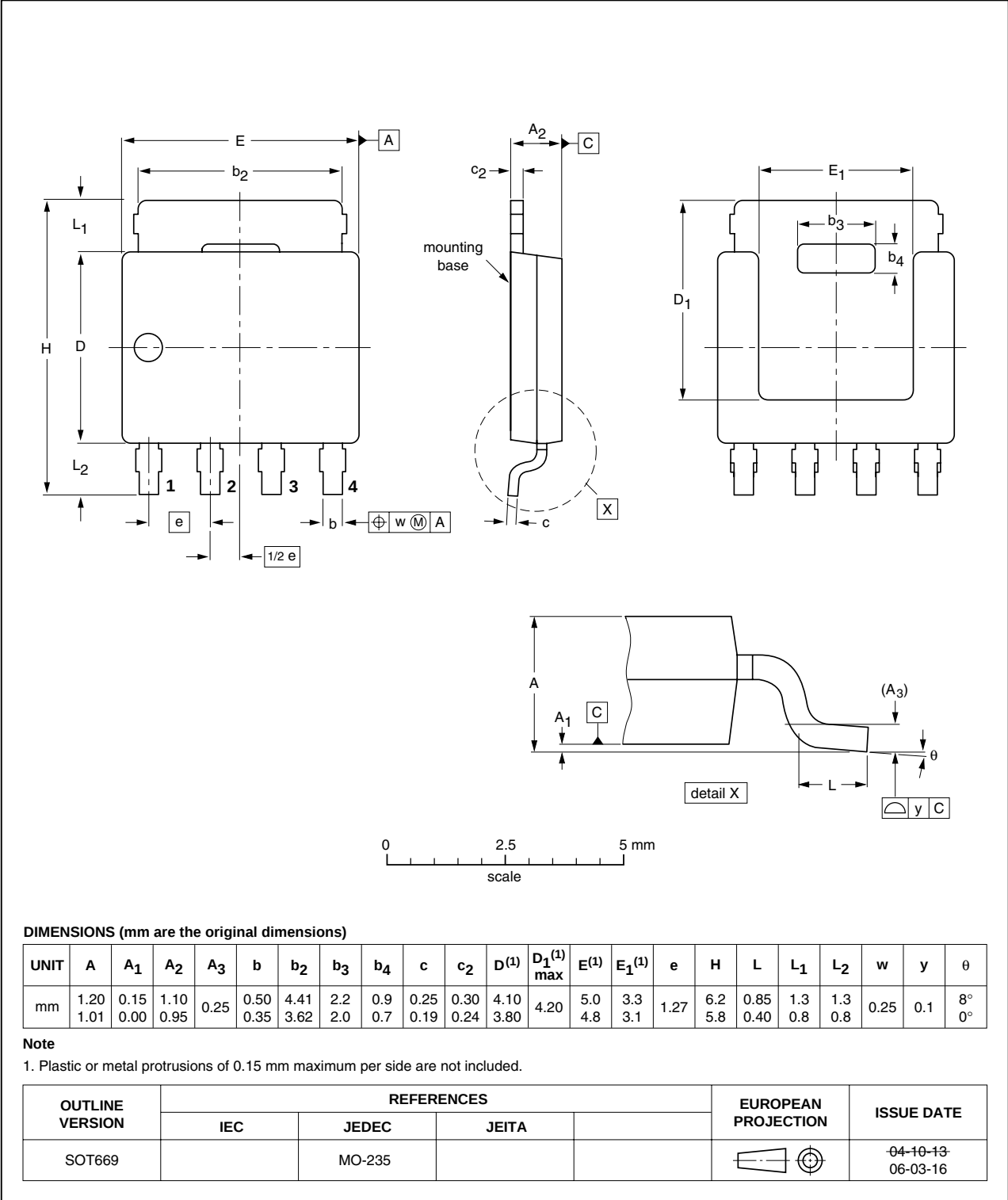


Fig 18. Package outline SOT669 (LPAK)

## 8. Revision history

Table 7. Revision history

| Document ID     | Release date | Data sheet status                           | Change notice | Supersedes      |
|-----------------|--------------|---------------------------------------------|---------------|-----------------|
| PSMN012-100YS_4 | 20100223     | Product data sheet                          | -             | PSMN012-100YS_3 |
| Modifications:  |              | • Status changed from objective to product. |               |                 |
| PSMN012-100YS_3 | 20100107     | Product data sheet                          | -             | PSMN012-100YS_2 |
| PSMN012-100YS_2 | 20091214     | Objective data sheet                        | -             | PSMN012-100YS_1 |
| PSMN012-100YS_1 | 20091022     | 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>.

### 9.2 Definitions

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**Limiting values** — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

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Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

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