



# PSMN7R6-60BS

N-channel 60 V 7.8 mΩ standard level MOSFET in D2PAK

Rev. 2 — 2 March 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel MOSFET in a D2PAK 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

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

### 1.3 Applications

- DC-to-DC converters
- Motor control
- Load switching
- Server power supplies

### 1.4 Quick reference data

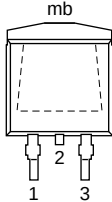
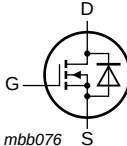
Table 1. Quick reference data

| 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                                | $T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a>                                                                | -   | -    | 92  | A    |
| $P_{tot}$                      | total power dissipation                      | $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>                                                                                         | -   | -    | 149 | W    |
| $T_j$                          | junction temperature                         |                                                                                                                                                | -55 | -    | 175 | °C   |
| <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 13</a> ; see <a href="#">Figure 9</a>             | -   | 5.9  | 7.8 | mΩ   |
| <b>Dynamic characteristics</b> |                                              |                                                                                                                                                |     |      |     |      |
| $Q_{GD}$                       | gate-drain charge                            | $V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 30\text{ V}$ ; see <a href="#">Figure 15</a> ; see <a href="#">Figure 14</a>          | -   | 10.6 | -   | nC   |
| $Q_{G(tot)}$                   | total gate charge                            | $V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 30\text{ V}$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>          | -   | 38.7 | -   | nC   |
| <b>Avalanche ruggedness</b>    |                                              |                                                                                                                                                |     |      |     |      |
| $E_{DS(AL)S}$                  | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; $I_D = 92\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $R_{GS} = 50\text{ Ω}$ ; unclamped | -   | -    | 110 | mJ   |



## 2. Pinning information

Table 2. Pinning information

| Pin | Symbol | Description                       | Simplified outline                                                                | Graphic symbol                                                                      |
|-----|--------|-----------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1   | G      | gate                              |  |  |
| 2   | D      | drain <sup>[1]</sup>              |                                                                                   |                                                                                     |
| 3   | S      | source                            |                                                                                   |                                                                                     |
| mb  | D      | mounting base; connected to drain |                                                                                   |                                                                                     |

SOT404 (D2PAK)

[1] It is not possible to make connection to pin 2.

## 3. Ordering information

Table 3. Ordering information

| Type number  | Package |                                                                                  |         |
|--------------|---------|----------------------------------------------------------------------------------|---------|
|              | Name    | Description                                                                      | Version |
| PSMN7R6-60BS | D2PAK   | plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) | SOT404  |

## 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                           | $R_{GS} = 20\text{ k}\Omega$                                                                                                                               | -   | 60  | V    |
| $V_{GS}$                    | gate-source voltage                          |                                                                                                                                                            | -20 | 20  | V    |
| $I_D$                       | drain current                                | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>                                                                           | -   | 65  | A    |
|                             |                                              | $V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a>                                                                            | -   | 92  | A    |
| $I_{DM}$                    | peak drain current                           | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 3</a>                                                          | -   | 389 | A    |
| $P_{tot}$                   | total power dissipation                      | $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>                                                                                                     | -   | 149 | W    |
| $T_{stg}$                   | storage temperature                          |                                                                                                                                                            | -55 | 175 | °C   |
| $T_j$                       | junction temperature                         |                                                                                                                                                            | -55 | 175 | °C   |
| $T_{sld(M)}$                | peak soldering temperature                   |                                                                                                                                                            | -   | 260 | °C   |
| <b>Source-drain diode</b>   |                                              |                                                                                                                                                            |     |     |      |
| $I_S$                       | source current                               | $T_{mb} = 25\text{ °C}$                                                                                                                                    | -   | 92  | A    |
| $I_{SM}$                    | peak source current                          | pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$                                                                                         | -   | 389 | A    |
| <b>Avalanche ruggedness</b> |                                              |                                                                                                                                                            |     |     |      |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 92\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped | -   | 110 | mJ   |

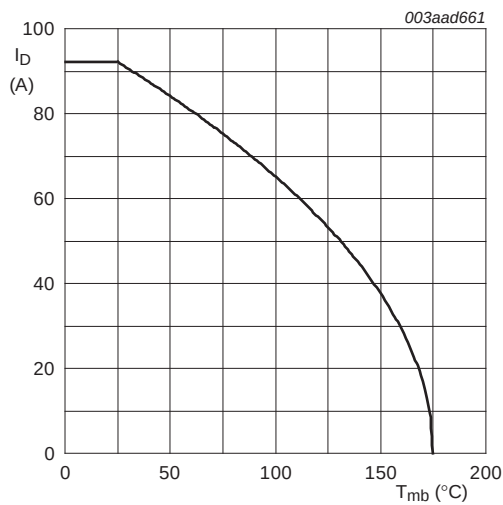
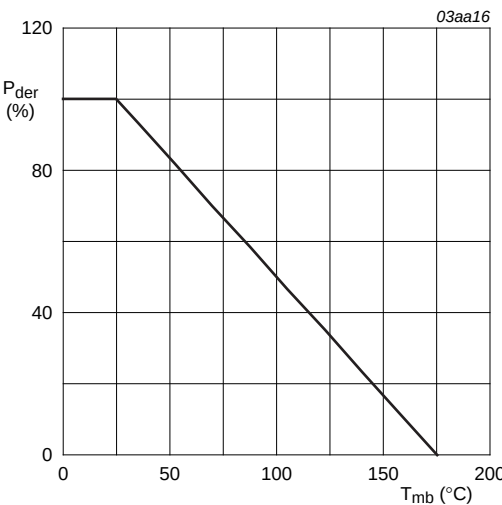
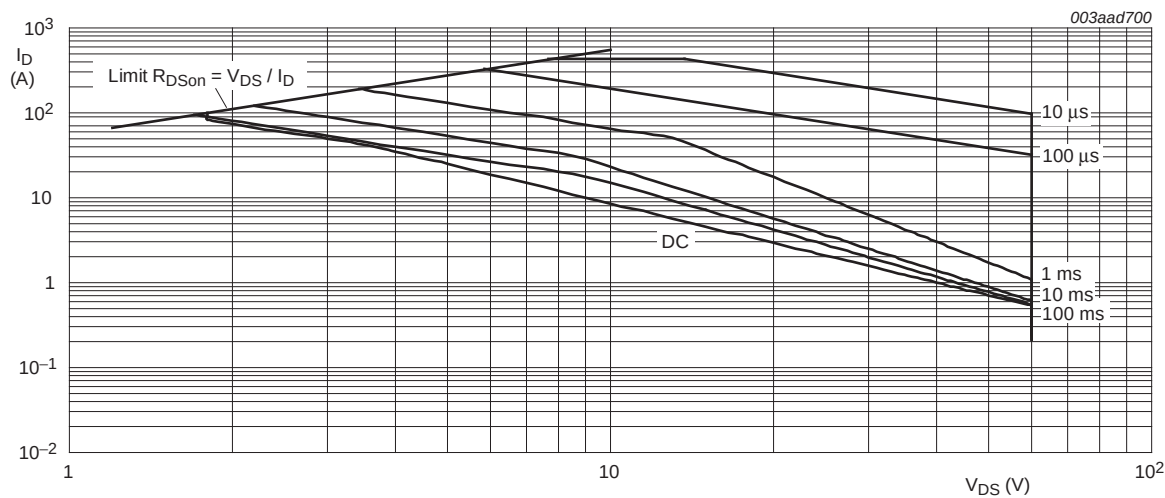


Fig 1. Continuous drain current as a function of mounting base temperature



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

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



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

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 |
|----------------|---------------------------------------------------|-------------------------------------------------------|-----|------|------|------|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | see <a href="#">Figure 4</a>                          | -   | 0.49 | 1.01 | K/W  |
| $R_{th(j-a)}$  | thermal resistance from junction to ambient       | Minimum footprint; mounted on a printed circuit board | -   | 50   | -    | K/W  |

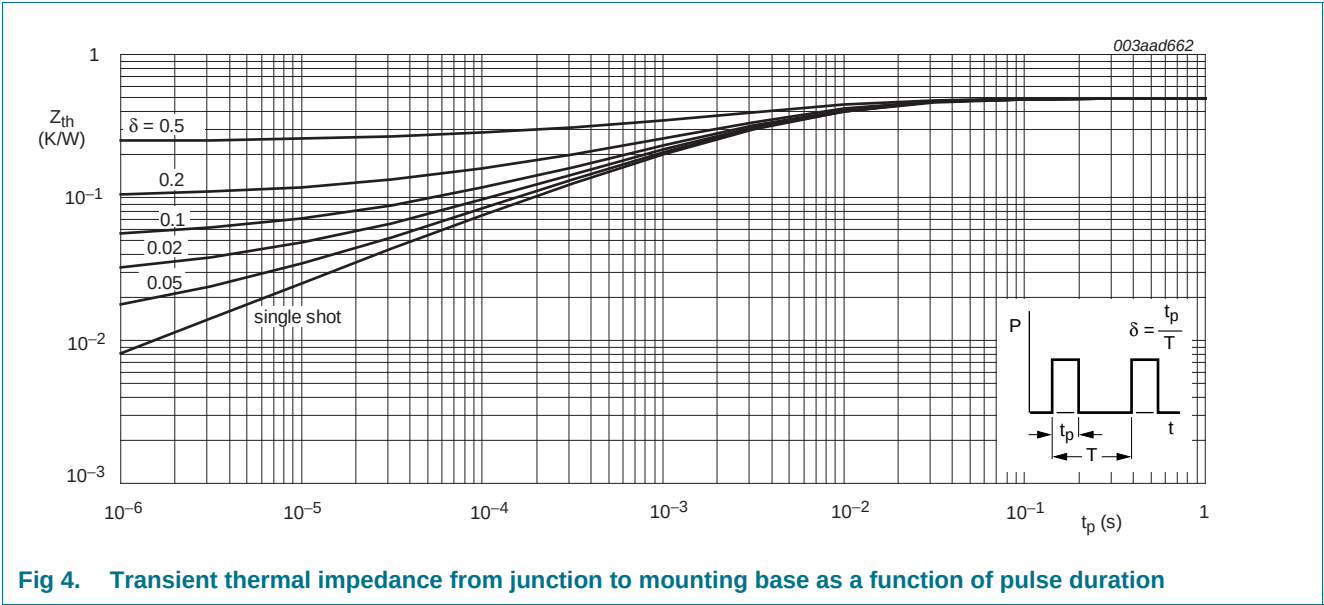


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 6. Characteristics

Table 6. Characteristics

| Symbol                         | Parameter                         | Conditions                                                                                                                              | Min | Typ  | Max | Unit    |
|--------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|---------|
| <b>Static characteristics</b>  |                                   |                                                                                                                                         |     |      |     |         |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage    | $I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = -55\ ^\circ C$                                                                            | 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> ; see <a href="#">Figure 11</a>                | 2   | 3    | 4   | V       |
| $V_{GSth}$                     | gate-source threshold voltage     | $I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 175\ ^\circ C$ ; see <a href="#">Figure 11</a>                                               | 1   | -    | -   | V       |
|                                |                                   | $I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55\ ^\circ C$ ; see <a href="#">Figure 11</a>                                               | -   | -    | 4.6 | V       |
| $I_{DSS}$                      | drain leakage current             | $V_{DS} = 60\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$                                                                               | -   | 0.05 | 10  | $\mu A$ |
|                                |                                   | $V_{DS} = 60\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 125\ ^\circ C$                                                                              | -   | -    | 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  | $V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 175\ ^\circ C$ ; see <a href="#">Figure 12</a>                                                | -   | 13.3 | 18  | mΩ      |
|                                |                                   | $V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 13</a> ; see <a href="#">Figure 9</a>                  | -   | 5.9  | 7.8 | mΩ      |
| $R_G$                          | gate resistance                   | $f = 1\ MHz$                                                                                                                            | -   | 0.98 | -   | Ω       |
| <b>Dynamic characteristics</b> |                                   |                                                                                                                                         |     |      |     |         |
| $Q_{G(tot)}$                   | total gate charge                 | $I_D = 25\ A$ ; $V_{DS} = 30\ V$ ; $V_{GS} = 10\ V$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>                     | -   | 38.7 | -   | nC      |
| $Q_{GS}$                       | gate-source charge                |                                                                                                                                         | -   | 12.9 | -   | nC      |
| $Q_{GS(th)}$                   | pre-threshold gate-source charge  |                                                                                                                                         | -   | 6.9  | -   | nC      |
| $Q_{GS(th-pl)}$                | post-threshold gate-source charge |                                                                                                                                         | -   | 6    | -   | nC      |
| $Q_{GD}$                       | gate-drain charge                 | $I_D = 25\ A$ ; $V_{DS} = 30\ V$ ; $V_{GS} = 10\ V$ ; see <a href="#">Figure 15</a> ; see <a href="#">Figure 14</a>                     | -   | 10.6 | -   | nC      |
| $V_{GS(pl)}$                   | gate-source plateau voltage       | $I_D = 25\ A$ ; $V_{DS} = 30\ V$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>                                        | -   | 5.6  | -   | 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> ; see <a href="#">Figure 8</a> | -   | 2651 | -   | pF      |
| $C_{oss}$                      | output capacitance                | $V_{DS} = 30\ V$ ; $V_{GS} = 0\ V$ ; $f = 1\ MHz$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 16</a>                                | -   | 342  | -   | pF      |
| $C_{rss}$                      | reverse transfer capacitance      | $V_{DS} = 30\ V$ ; $V_{GS} = 0\ V$ ; $f = 1\ MHz$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 16</a> ; see <a href="#">Figure 8</a> | -   | 183  | -   | pF      |
| $t_{d(on)}$                    | turn-on delay time                | $V_{DS} = 30\ V$ ; $R_L = 1.2\ \Omega$ ; $V_{GS} = 10\ V$ ; $R_{G(ext)} = 4.7\ \Omega$                                                  | -   | 19   | -   | ns      |
| $t_r$                          | rise time                         |                                                                                                                                         | -   | 21   | -   | ns      |
| $t_{d(off)}$                   | turn-off delay time               |                                                                                                                                         | -   | 37   | -   | ns      |
| $t_f$                          | fall time                         |                                                                                                                                         | -   | 13   | -   | ns      |

Table 6. Characteristics ...continued

| Symbol             | Parameter             | Conditions                                                                           | Min | Typ  | Max | Unit |
|--------------------|-----------------------|--------------------------------------------------------------------------------------|-----|------|-----|------|
| Source-drain diode |                       |                                                                                      |     |      |     |      |
| $V_{SD}$           | source-drain voltage  | $I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_J = 25\text{ °C}$ ; see Figure 17   | -   | 0.86 | 1.2 | V    |
| $t_{rr}$           | reverse recovery time | $I_S = 25\text{ A}$ ; $dI_S/dt = 100\text{ A/}\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; | -   | 40.4 | -   | ns   |
| $Q_r$              | recovered charge      | $V_{DS} = 30\text{ V}$                                                               | -   | 56   | -   | nC   |

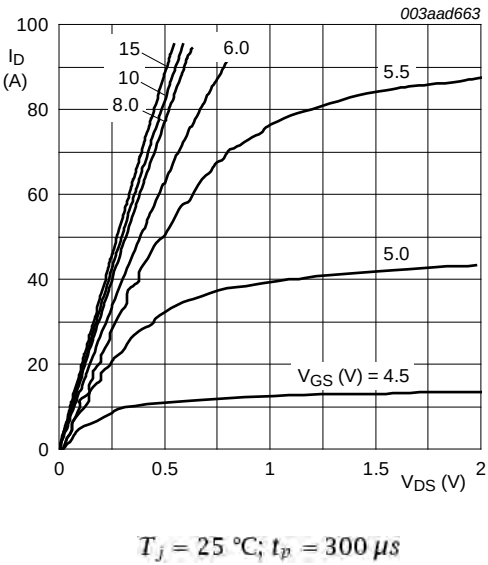


Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

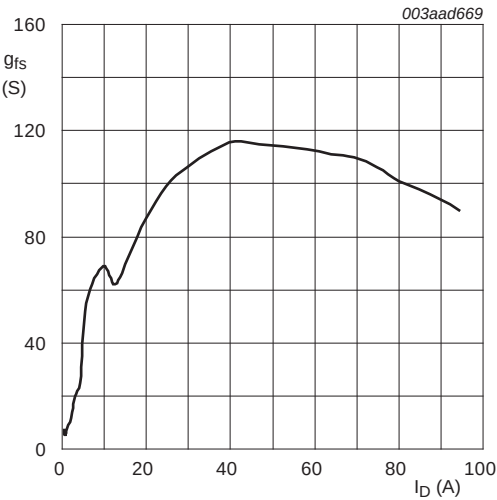


Fig 6. Forward transconductance as a function of drain current; typical values

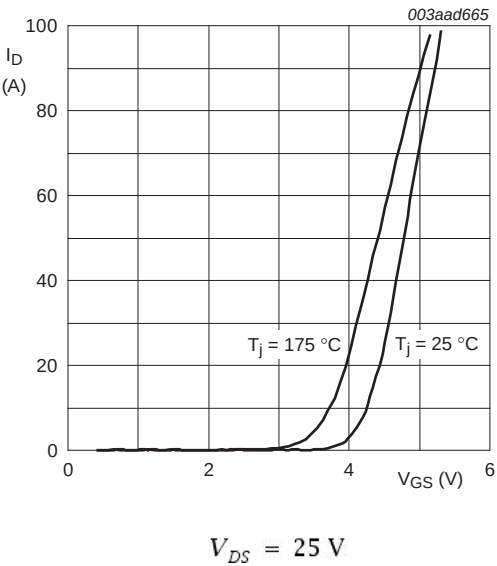


Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

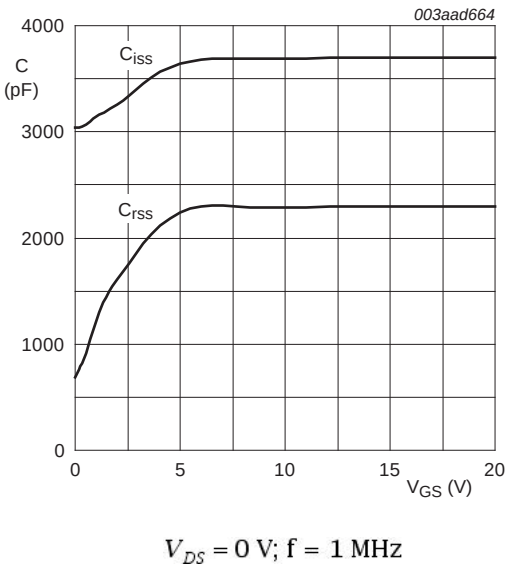
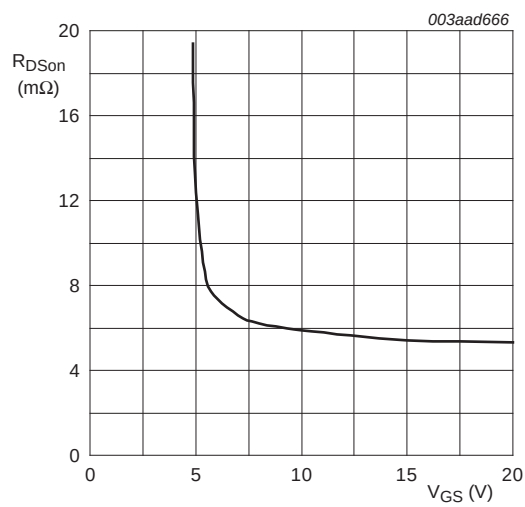
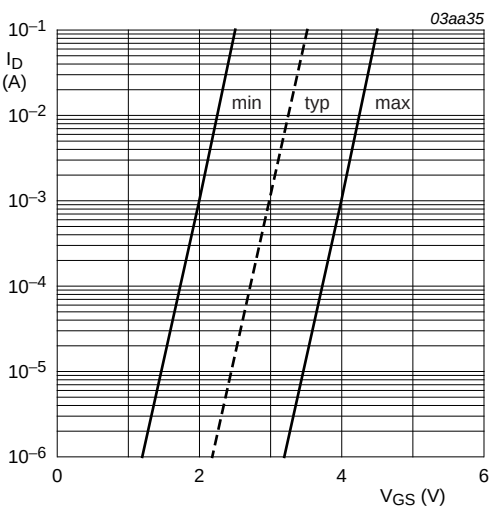


Fig 8. Input and reverse transfer capacitances as a function of gate-source voltage; typical values



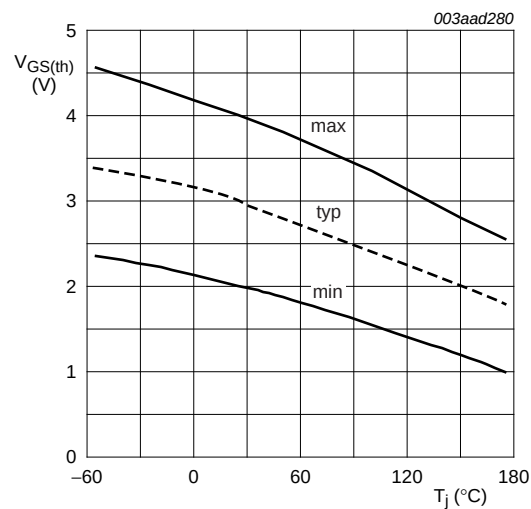
$T_j = 25^\circ\text{C}$

Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



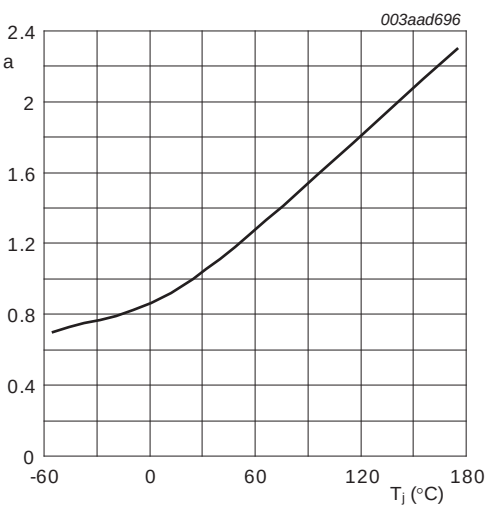
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$

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



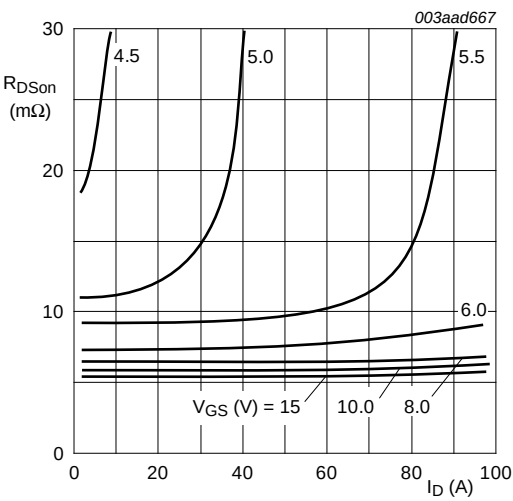
$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

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



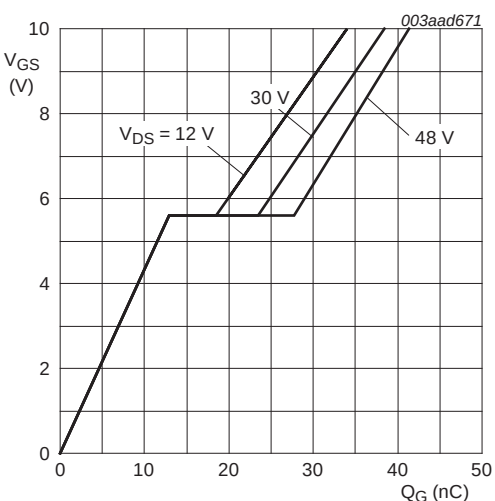
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ\text{C})}}$$

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



$T_j = 25^{\circ}\text{C}; t_p = 300\mu\text{s}$

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



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

Fig 14. Gate-source voltage as a function of gate charge; typical values

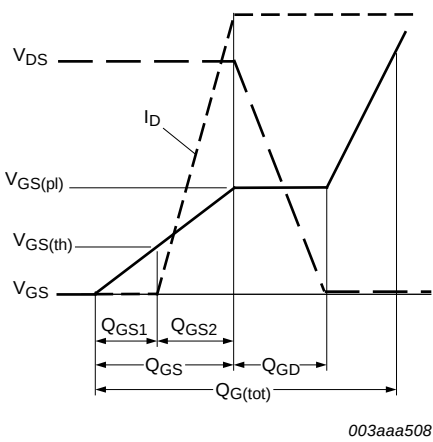
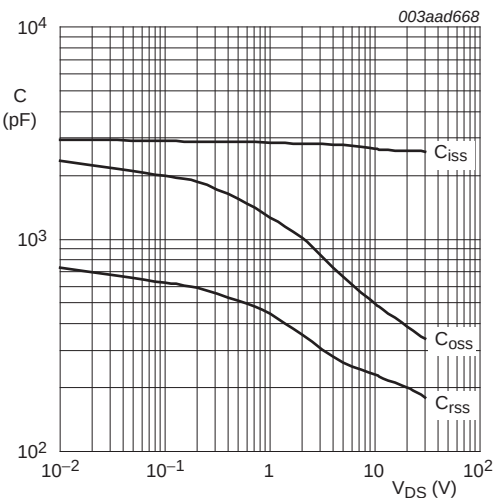


Fig 15. Gate charge waveform definitions



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

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



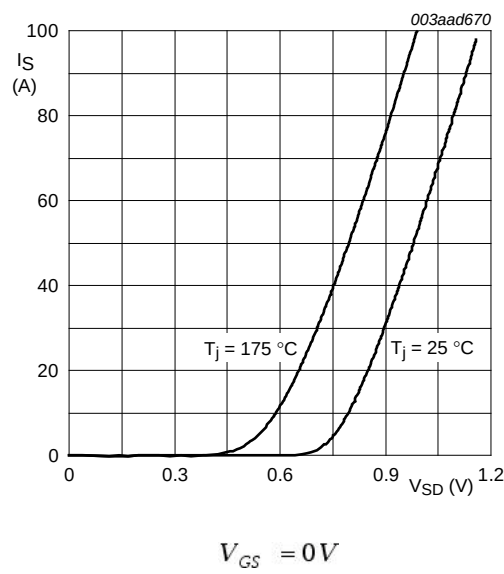


Fig 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) SOT404

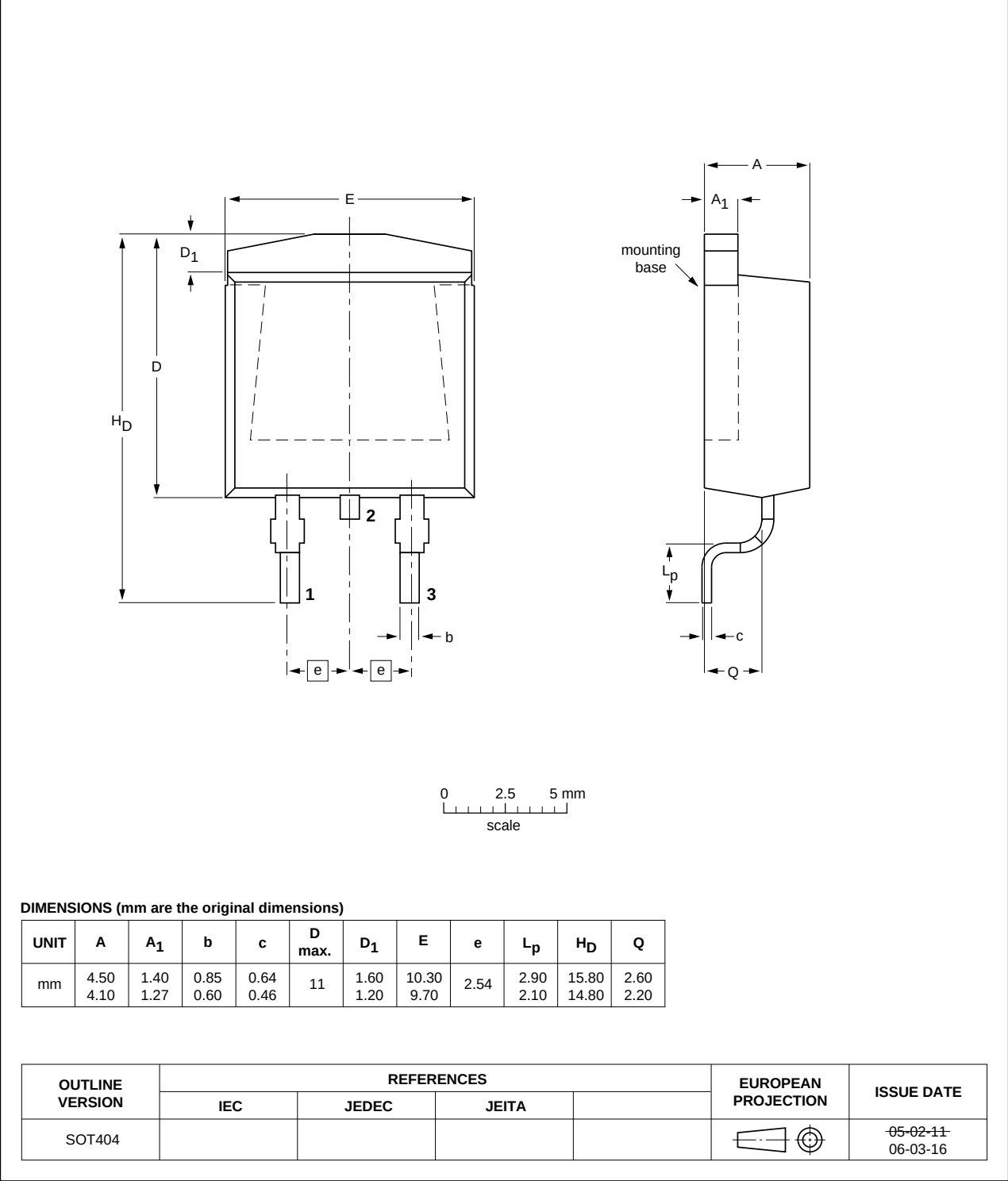


Fig 18. Package outline SOT404 (D2PAK)

## 8. Revision history

Table 7. Revision history

| Document ID      | Release date                                                                                                                      | Data sheet status    | Change notice | Supersedes       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------|------------------|
| PSMN7R6-60BS v.2 | 20120302                                                                                                                          | Product data sheet   | -             | PSMN7R6-60BS v.1 |
| Modifications:   | <ul style="list-style-type: none"><li>• Status changed from objective to product.</li><li>• Various changes to content.</li></ul> |                      |               |                  |
| PSMN7R6-60BS v.1 | 20111020                                                                                                                          | 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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## 10. Contact information

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