

# PSMN8R0-40PS



N-channel 40 V 7.6 mΩ standard level MOSFET

Rev. 02 — 25 June 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel MOSFET in TO220 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 convertors
- 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             | $T_j \geq 25 \text{ }^\circ\text{C}; T_j \leq 175 \text{ }^\circ\text{C}$                                                                 | -   | -   | 40  | V    |    |
| $I_D$                          | drain current                    | $T_{mb} = 25 \text{ }^\circ\text{C}; V_{GS} = 10 \text{ V};$<br>see <a href="#">Figure 1</a>                                              | -   | -   | 77  | A    |    |
| $P_{tot}$                      | total power dissipation          | $T_{mb} = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 2</a>                                                                        | -   | -   | 86  | W    |    |
| <b>Dynamic characteristics</b> |                                  |                                                                                                                                           |     |     |     |      |    |
| $Q_{GD}$                       | gate-drain charge                | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A};$<br>$V_{DS} = 20 \text{ V};$ see <a href="#">Figure 14</a> ;<br>see <a href="#">Figure 15</a> | -   | 3.8 | -   | nC   |    |
| <b>Static characteristics</b>  |                                  |                                                                                                                                           |     |     |     |      |    |
| $R_{DSon}$                     | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A};$<br>$T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 13</a>                          | [1] | -   | 6.2 | 7.6  | mΩ |

[1] Measured 3 mm from package.

**nexperia**

## 2. Pinning information

Table 2. Pinning information

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

**SOT78  
(TO-220AB)**

## 3. Ordering information

Table 3. Ordering information

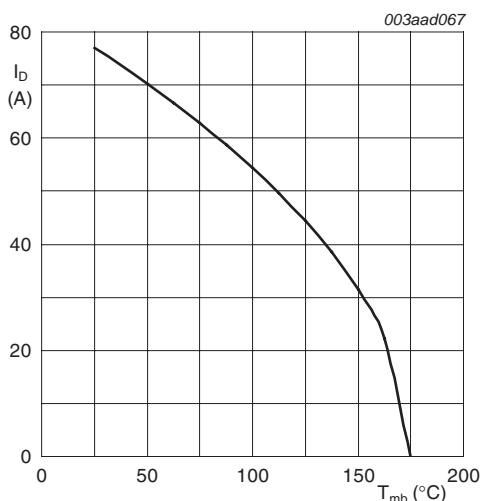
| Type number  | Package  |                                                                                  |  | Version |
|--------------|----------|----------------------------------------------------------------------------------|--|---------|
|              | Name     | Description                                                                      |  |         |
| PSMN8R0-40PS | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB |  | SOT78   |

## 4. Limiting values

**Table 4. Limiting values**

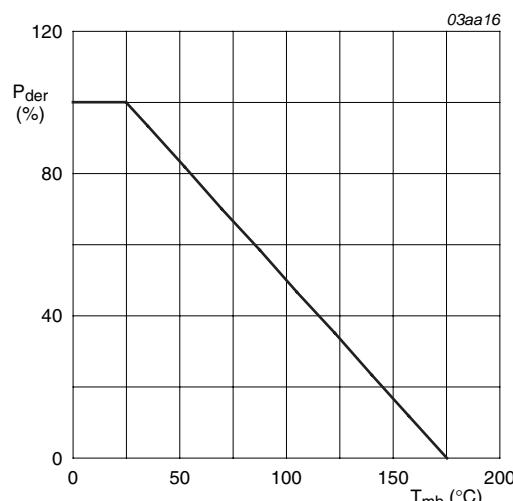
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol                      | Parameter                                    | Conditions                                                                                                                                   | Min | Max | Unit |
|-----------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|------|
| $V_{DS}$                    | drain-source voltage                         | $T_j \geq 25^\circ\text{C}; T_{mb} \leq 175^\circ\text{C}$                                                                                   | -   | 40  | V    |
| $V_{DGR}$                   | drain-gate voltage                           | $T_j \geq 25^\circ\text{C}; T_{mb} \leq 175^\circ\text{C}; R_{GS} = 20\text{ k}\Omega$                                                       | -   | 40  | V    |
| $V_{GS}$                    | gate-source voltage                          |                                                                                                                                              | -20 | 20  | V    |
| $I_D$                       | drain current                                | $V_{GS} = 10\text{ V}; T_{mb} = 100^\circ\text{C}$ ; see <a href="#">Figure 1</a>                                                            | -   | 55  | A    |
|                             |                                              | $V_{GS} = 10\text{ V}; T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 1</a>                                                             | -   | 77  | A    |
| $I_{DM}$                    | peak drain current                           | $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 3</a>                                        | -   | 309 | A    |
| $P_{tot}$                   | total power dissipation                      | $T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>                                                                                   | -   | 86  | W    |
| $T_{stg}$                   | storage temperature                          |                                                                                                                                              | -55 | 175 | °C   |
| $T_j$                       | junction temperature                         |                                                                                                                                              | -55 | 175 | °C   |
| <b>Source-drain diode</b>   |                                              |                                                                                                                                              |     |     |      |
| $I_S$                       | source current                               | $T_{mb} = 25^\circ\text{C}$                                                                                                                  | -   | 77  | A    |
| $I_{SM}$                    | peak source current                          | $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25^\circ\text{C}$                                                                       | -   | 309 | A    |
| <b>Avalanche ruggedness</b> |                                              |                                                                                                                                              |     |     |      |
| $E_{DS(AL)S}$               | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}; T_{j(init)} = 25^\circ\text{C}; I_D = 77\text{ A}; V_{sup} \leq 40\text{ V}$ ; unclamped; $R_{GS} = 50\text{ }\Omega$ | -   | 43  | mJ   |



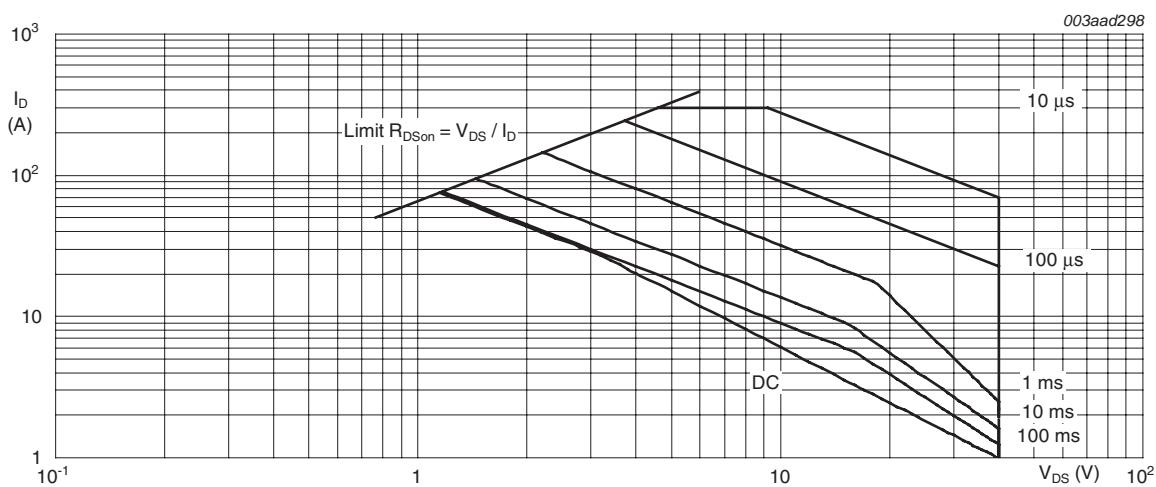
$V_{GS} \geq 10\text{ V}$

**Fig 1. 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**



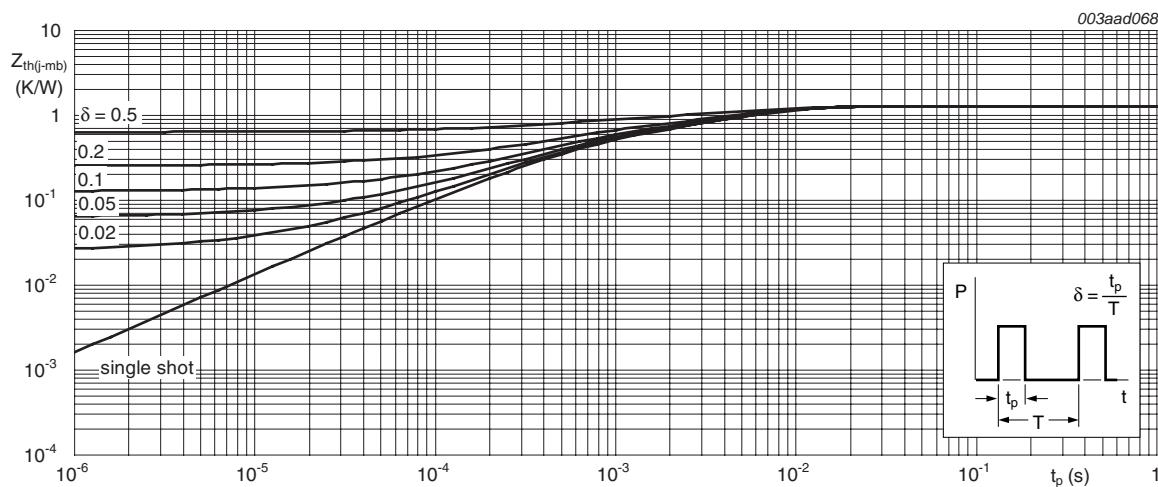
$T_{mb} = 25^\circ C$ ;  $I_{DM}$  is single pulse  
 (1) Capped at 100 A due to package.

**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 <a href="#">Figure 4</a> | -   | 1.2 | 1.74 | 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**

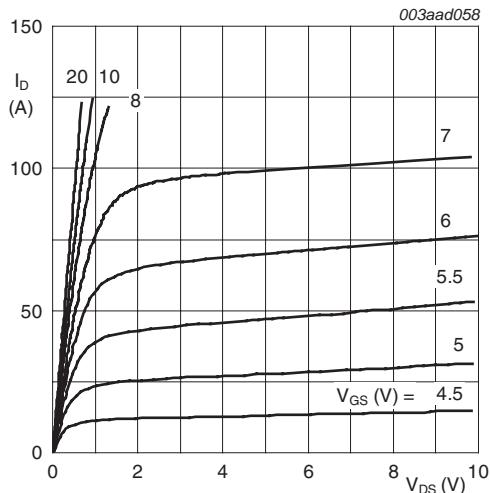
| Symbol                         | Parameter                         | Conditions                                                                                                         | Min | Typ  | Max | Unit      |
|--------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------|-----|------|-----|-----------|
| <b>Static characteristics</b>  |                                   |                                                                                                                    |     |      |     |           |
| $V_{(BR)DSS}$                  | drain-source breakdown voltage    | $I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55^\circ C$<br>$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25^\circ C$            | 36  | -    | -   | V         |
| $V_{GS(th)}$                   | gate-source threshold voltage     | $I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55^\circ C;$<br>see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a> | -   | -    | 4.6 | V         |
|                                |                                   | $I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175^\circ C;$<br>see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a> | 1   | -    | -   | V         |
|                                |                                   | $I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25^\circ C;$<br>see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>  | 2   | 3    | 4   | V         |
| $I_{DSS}$                      | drain leakage current             | $V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25^\circ C$                                                                    | -   | -    | 1.5 | $\mu A$   |
|                                |                                   | $V_{DS} = 40 V; V_{GS} = 0 V; T_j = 125^\circ C$                                                                   | -   | -    | 30  | $\mu A$   |
| $I_{GSS}$                      | gate leakage current              | $V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25^\circ C$                                                                    | -   | -    | 100 | nA        |
|                                |                                   | $V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25^\circ C$                                                                   | -   | -    | 100 | nA        |
| $R_{DSon}$                     | drain-source on-state resistance  | $V_{GS} = 10 V; I_D = 25 A; T_j = 100^\circ C;$<br>see <a href="#">Figure 13</a>                                   | -   | -    | 11  | $m\Omega$ |
|                                |                                   | $V_{GS} = 10 V; I_D = 25 A; T_j = 25^\circ C;$<br>see <a href="#">Figure 13</a>                                    | [2] | -    | 6.2 | 7.6       |
| $R_G$                          | internal gate resistance (AC)     | $f = 1 MHz$                                                                                                        | -   | 1.1  | -   | $\Omega$  |
| <b>Dynamic characteristics</b> |                                   |                                                                                                                    |     |      |     |           |
| $Q_{G(tot)}$                   | total gate charge                 | $I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V$                                                                           | -   | 17   | -   | nC        |
|                                |                                   | $I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V;$<br>see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>       | -   | 21   | -   | nC        |
| $Q_{GS}$                       | gate-source charge                | $I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V;$<br>see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>       | -   | 7.2  | -   | nC        |
| $Q_{GS(th)}$                   | pre-threshold gate-source charge  | $I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V;$<br>see <a href="#">Figure 14</a>                                       | -   | 3.6  | -   | nC        |
| $Q_{GS(th-pl)}$                | post-threshold gate-source charge |                                                                                                                    | -   | 3.6  | -   | nC        |
| $Q_{GD}$                       | gate-drain charge                 | $I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V;$<br>see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>       | -   | 3.8  | -   | nC        |
| $V_{GS(pl)}$                   | gate-source plateau voltage       | $I_D = 25 A; V_{DS} = 20 V;$ see <a href="#">Figure 14</a>                                                         | -   | 4.8  | -   | V         |
| $C_{iss}$                      | input capacitance                 | $V_{DS} = 12 V; V_{GS} = 0 V; f = 1 MHz;$                                                                          | -   | 1262 | -   | pF        |
| $C_{oss}$                      | output capacitance                | $T_j = 25^\circ C;$ see <a href="#">Figure 16</a>                                                                  | -   | 327  | -   | pF        |
| $C_{rss}$                      | reverse transfer capacitance      |                                                                                                                    | -   | 160  | -   | pF        |
| $t_{d(on)}$                    | turn-on delay time                | $V_{DS} = 12 V; R_L = 0.5 \Omega; V_{GS} = 10 V;$                                                                  | -   | 12   | -   | ns        |
| $t_r$                          | rise time                         | $R_{G(ext)} = 4.7 \Omega$                                                                                          | -   | 4.7  | -   | ns        |
| $t_{d(off)}$                   | turn-off delay time               |                                                                                                                    | -   | 21   | -   | ns        |
| $t_f$                          | fall time                         |                                                                                                                    | -   | 4.7  | -   | ns        |

Table 6. Characteristics ...continued

| Symbol                    | Parameter             | Conditions                                                                                                                       | Min | Typ  | Max | Unit |
|---------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| <b>Source-drain diode</b> |                       |                                                                                                                                  |     |      |     |      |
| 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;<br>see Figure 17                                           | -   | 0.85 | 1.2 | V    |
| t <sub>rr</sub>           | reverse recovery time | I <sub>S</sub> = 50 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V;<br>V <sub>DS</sub> = 20 V                         | -   | 30   | -   | ns   |
| Q <sub>r</sub>            | recovered charge      | I <sub>S</sub> = 50 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V;<br>V <sub>DS</sub> = 20 V; T <sub>j</sub> = 25 °C | -   | 18   | -   | nC   |

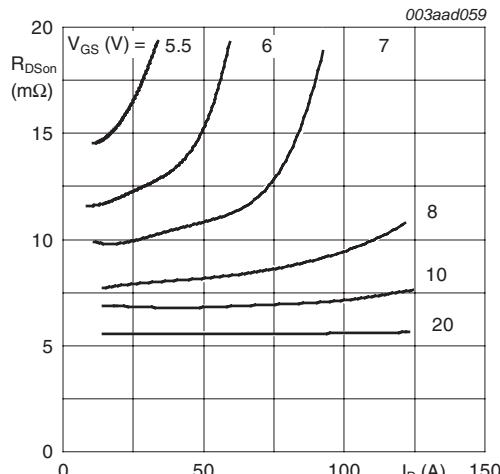
[1] Tested to JEDEC standards where applicable.

[2] Measured 3 mm from package.



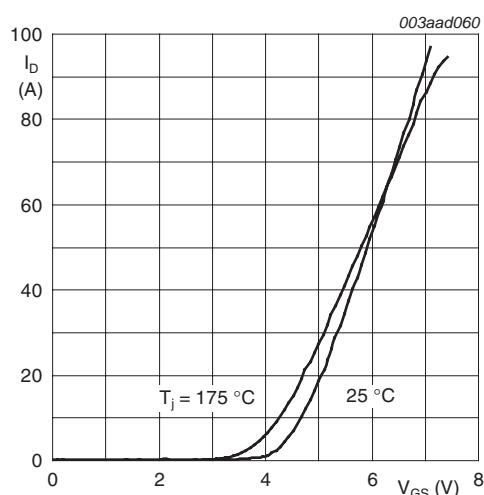
T<sub>j</sub> = 25 °C; t<sub>p</sub> = 300 μs

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



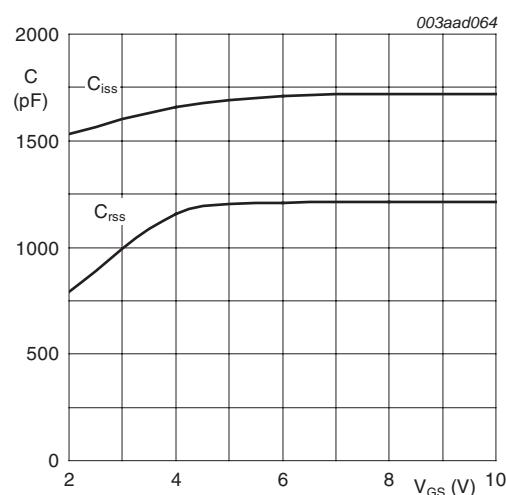
T<sub>j</sub> = 25 °C; t<sub>p</sub> = 300 μs

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



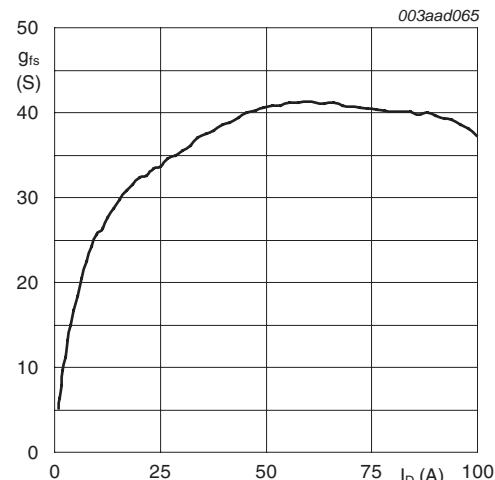
$V_{DS} = 15\text{ V}$

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



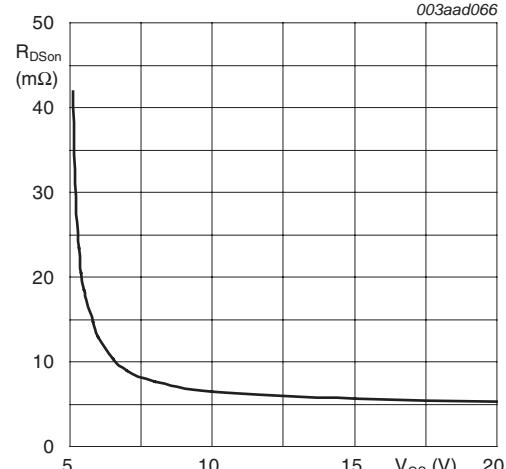
$V_{DS} = 0\text{ V}; f = 1\text{ MHz}$

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



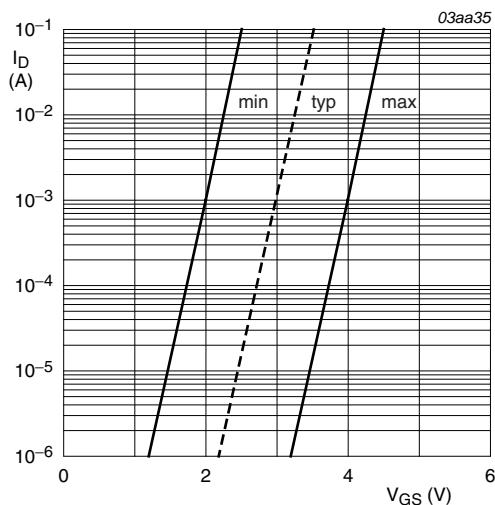
$T_j = 25^\circ\text{C}; V_{DS} = 15\text{ V}$

**Fig 9. Forward transconductance as a function of drain current; typical values**



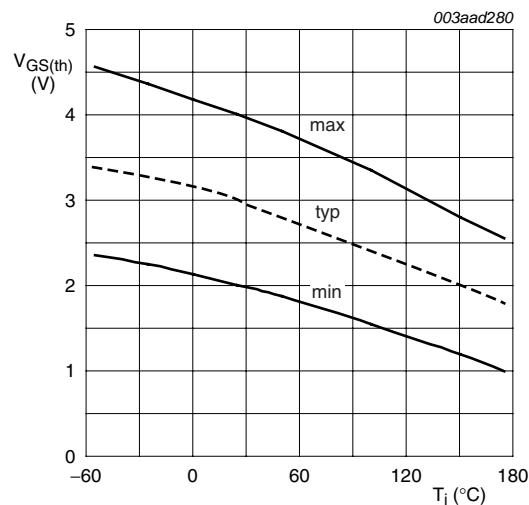
$T_j = 25^\circ\text{C}; I_D = 25\text{ A}$

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



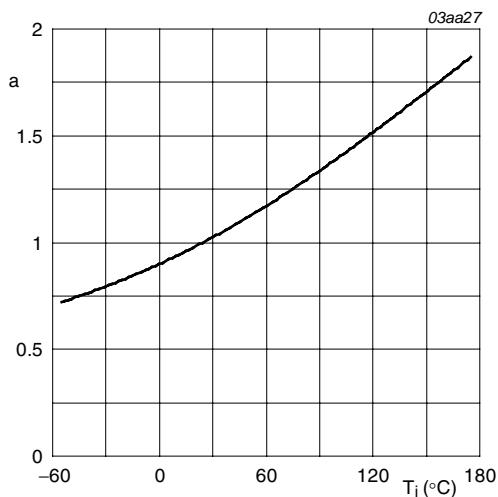
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$

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



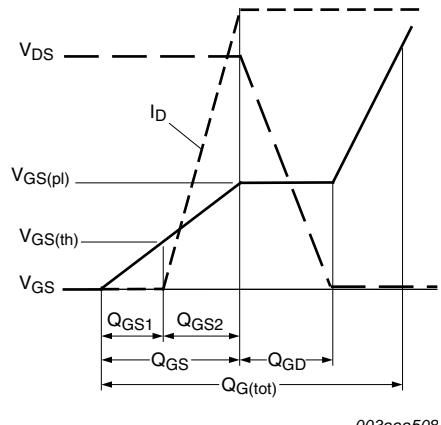
$I_D = 1\text{mA}; V_{DS} = V_{GS}$

**Fig 12. Gate-source threshold voltage as a function of junction temperature**

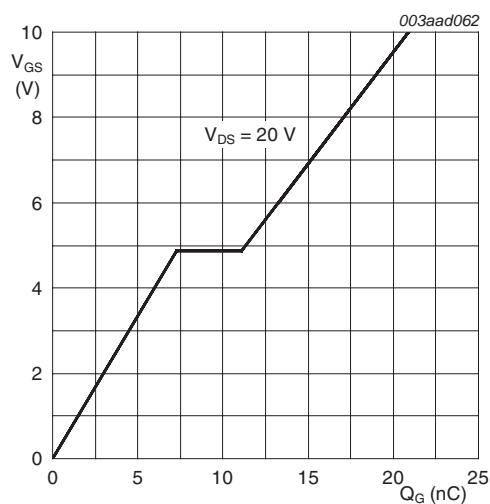


$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

**Fig 13. Normalized drain-source on-state resistance factor as a function of junction temperature**

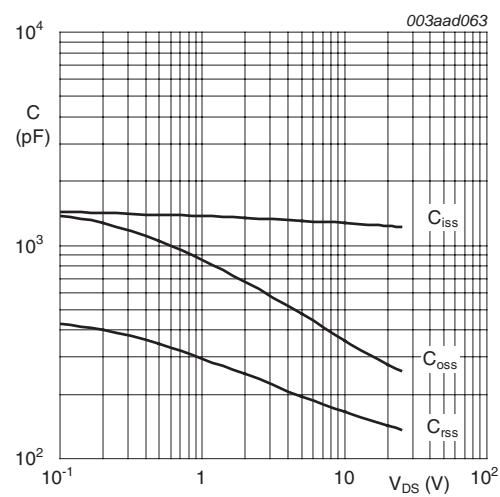


**Fig 14. Gate charge waveform definitions**



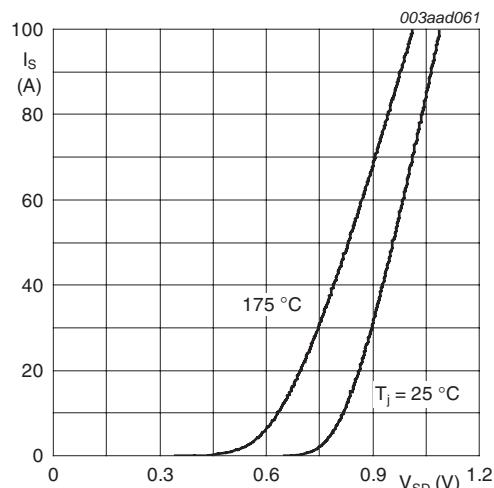
$T_j = 25^\circ\text{C}$ ;  $I_D = 25\text{A}$

**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**



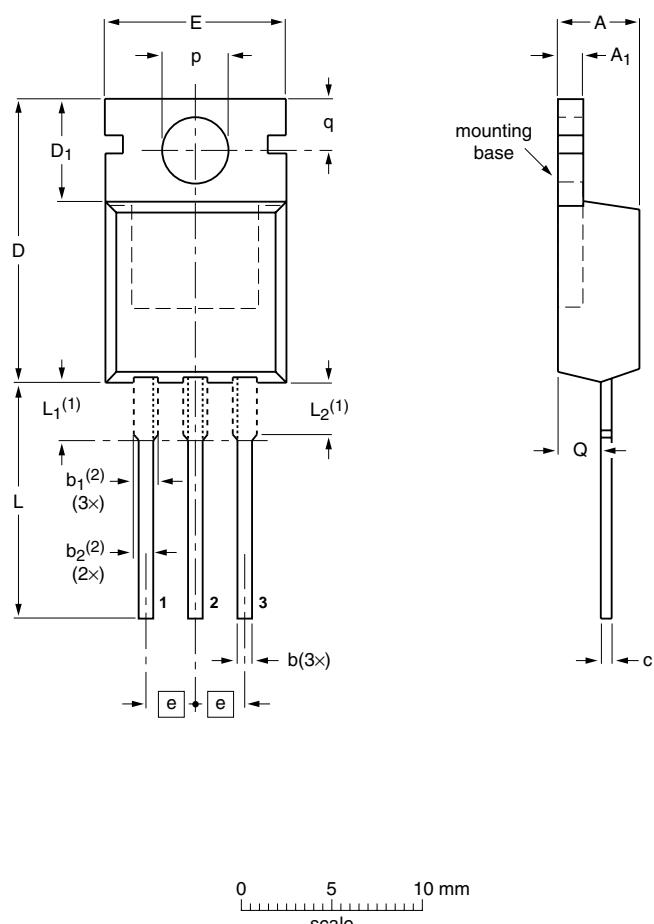
$V_{GS} = 0$  V

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

## 7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78



### DIMENSIONS (mm are the original dimensions)

| UNIT | A   | A <sub>1</sub> | b   | b <sub>1</sub> (2) | b <sub>2</sub> (2) | c   | D    | D <sub>1</sub> | E    | e    | L    | L <sub>1</sub> (1) | L <sub>2</sub> (1)<br>max. | p   | q   | Q   |
|------|-----|----------------|-----|--------------------|--------------------|-----|------|----------------|------|------|------|--------------------|----------------------------|-----|-----|-----|
| mm   | 4.7 | 1.40           | 0.9 | 1.6                | 1.3                | 0.7 | 16.0 | 6.6            | 10.3 | 2.54 | 15.0 | 3.30               | 3.0                        | 3.8 | 3.0 | 2.6 |
|      | 4.1 | 1.25           | 0.6 | 1.0                | 1.0                | 0.4 | 15.2 | 5.9            | 9.7  |      | 12.8 | 2.79               |                            | 3.5 | 2.7 | 2.2 |

### Notes

1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

| OUTLINE<br>VERSION | REFERENCES |                 |       |  |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|-----------------|-------|--|--|------------------------|----------------------|
|                    | IEC        | JEDEC           | JEITA |  |  |                        |                      |
| SOT78              |            | 3-lead TO-220AB | SC-46 |  |  |                        | 08-04-29<br>08-06-13 |

Fig 18. Package outline SOT78 (TO-220AB)

## 8. Revision history

**Table 7. Revision history**

| Document ID    | Release date                                                                               | Data sheet status    | Change notice | Supersedes     |
|----------------|--------------------------------------------------------------------------------------------|----------------------|---------------|----------------|
| PSMN8R0-40PS_2 | 20090625                                                                                   | Product data sheet   | -             | PSMN8R0-40PS_1 |
| Modifications: | <ul style="list-style-type: none"><li>• Status changed from objective to product</li></ul> |                      |               |                |
| PSMN8R0-40PS_1 | 20090511                                                                                   | 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.nexperia.com>.

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## 11. Contents

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