# PSMN4R4-80PS

## N-channel 80 V, 4.1 mΩ standard level FET

Rev. 01 — 18 June 2009 Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product is designed and qualified for use in computing, communications, consumer and industrial applications only.

### 1.2 Features and benefits

- Low conduction losses due to low on-state resistance
- Suitable for standard level gate drive sources

### 1.3 Applications

- DC - DC converters
- Load switch
- Motor control
- Server power supplies

### 1.4 Quick reference data

Table 1. Quick reference

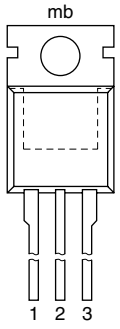
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_D$ | drain current | $T_{mb}$ = 25 °C; $V_{GS}$ = 10 V; see Figure 1; see Figure 3 | | - | - | 100 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | | - | - | 306 | W |
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS}$ = 10 V; $I_D$ = 80 A; $V_{DS}$ = 40 V; see Figure 14; see Figure 15 | | - | 25 | - | nC |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; see Figure 6; see Figure 13 | [1] | - | 3.3 | 4.1 | mΩ |

[1] Measured 3 mm from package.

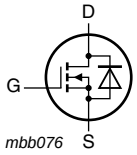
## 2. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate | | |
| 2 | D | drain | | |
| 3 | S | source | | |
| mb | D | drain | | |




**SOT78**
**(TO-220AB; SC-46)**




## 3. Ordering information

**Table 3. Ordering information**

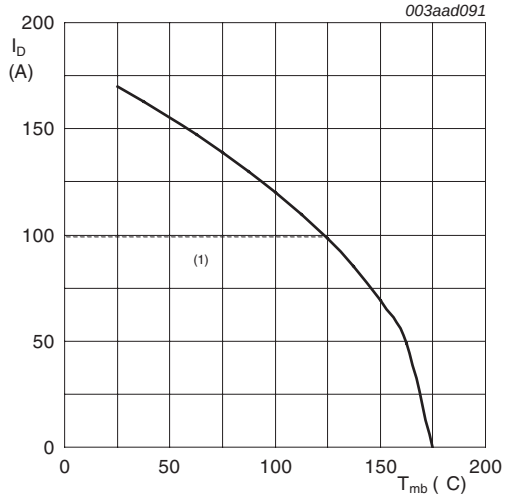
| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PSMN4R4-80PS | TO-220AB; SC-46 | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78 |

# 4. Limiting values

**Table 4. Limiting values**

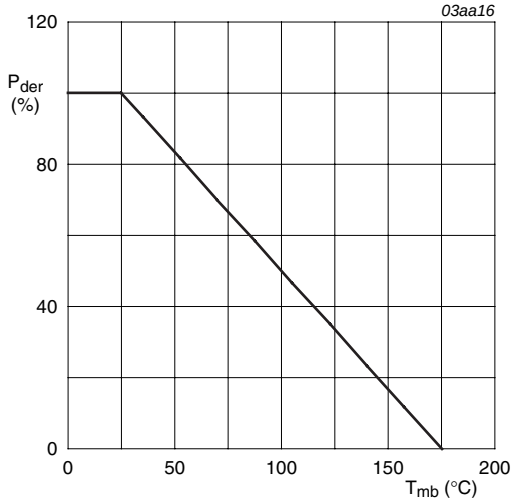
*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | - | 80 | V |
| $V_{DGR}$ | drain-gate voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C; $R_{GS}$ = 20 kΩ | - | 80 | V |
| $V_{GS}$ | gate-source voltage | | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = 10 V; $T_{mb}$ = 100 °C; see Figure 1; see Figure 3 | - | 100 | A |
| | | $V_{GS}$ = 10 V; $T_{mb}$ = 25 °C; see Figure 1; see Figure 3 | - | 100 | A |
| $I_{DM}$ | peak drain current | $t_p \leq 10$ µs; pulsed; $T_{mb}$ = 25 °C; see Figure 3 | - | 680 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; see Figure 2 | - | 306 | W |
| $T_{stg}$ | storage temperature | | -55 | 175 | °C |
| $T_j$ | junction temperature | | -55 | 175 | °C |
| **Source-drain diode** | | | | | |
| $I_S$ | source current | $T_{mb}$ = 25 °C | - | 100 | A |
| $I_{SM}$ | peak source current | $t_p \leq 10$ µs; pulsed; $T_{mb}$ = 25 °C | - | 680 | 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; $V_{sup} \leq 80$ V; $R_{GS}$ = 50 Ω; unclamped | - | 591 | mJ |



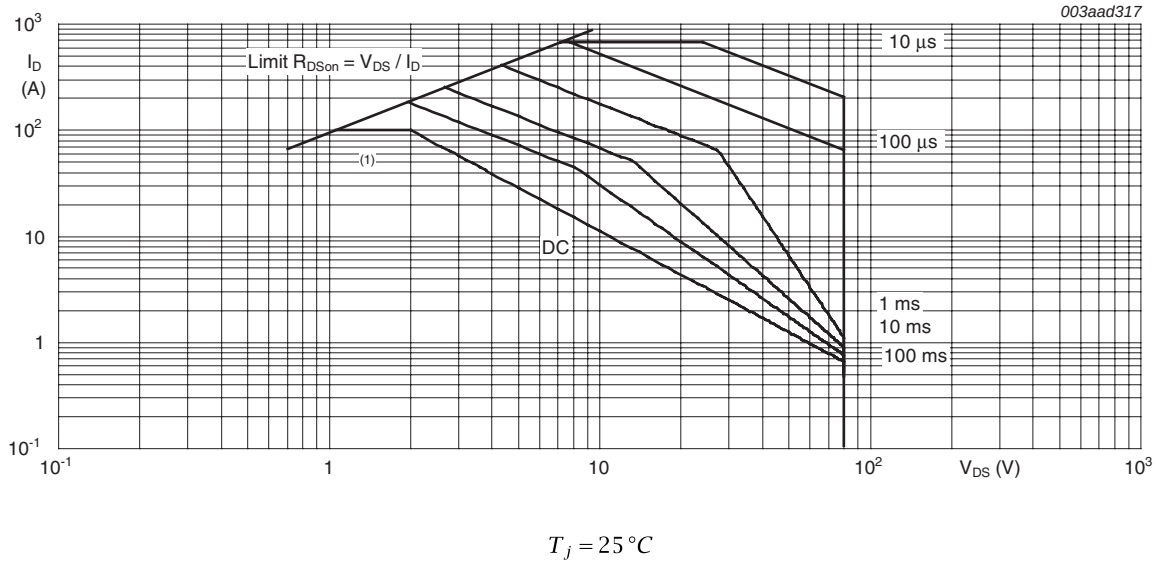

$$I_{der} = \frac{I_D}{I_{D(25°C)}} \times 100\,\%$$

**Fig 1. Normalized 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**




$T_j = 25\,°C$

**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 | - | 0.23 | 0.49 | K/W |

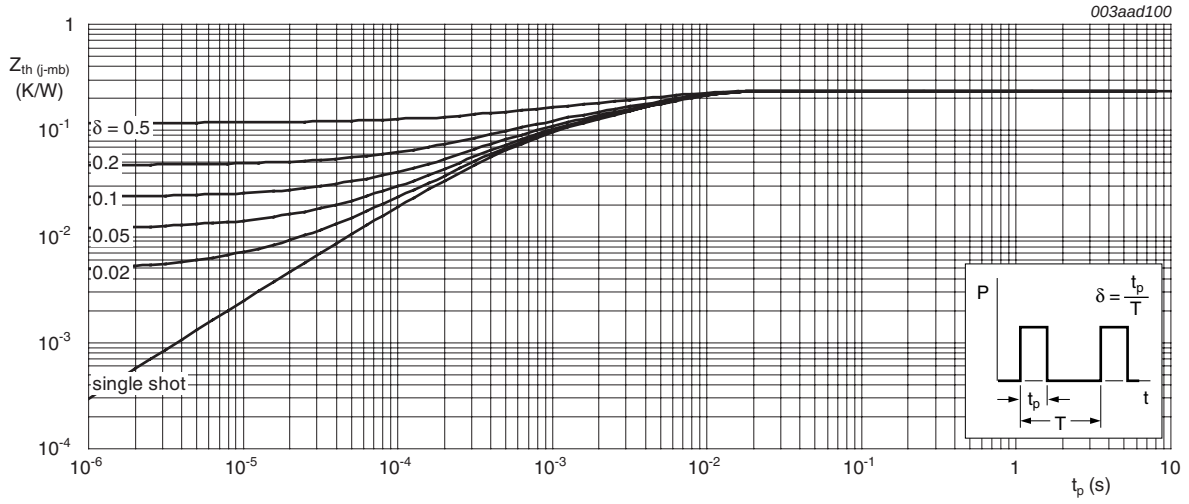



**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

**Table 6. Characteristics**

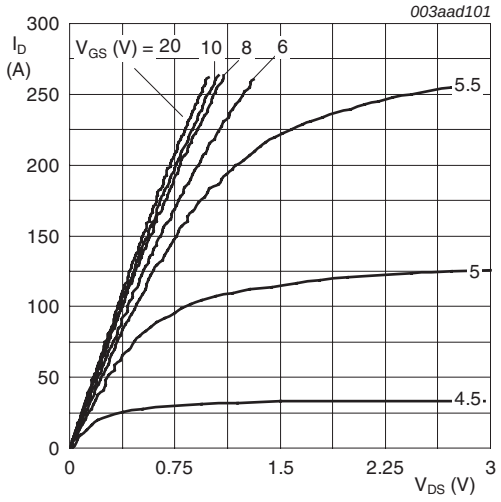
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | | 73 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 80 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; see Figure 11 | | 1 | - | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; see Figure 11 | | - | - | 4.6 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; see Figure 11; see Figure 12 | | 2 | 3 | 4 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 80 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | - | 10 | µA |
| | | $V_{DS}$ = 80 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | | - | - | 200 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = -20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 100 | nA |
| | | $V_{GS}$ = 20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | - | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 175 °C; see Figure 13 | [2] | - | 7.6 | 9.47 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 100 °C; see Figure 13 | | - | 5.5 | 6.8 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; see Figure 6; see Figure 13 | [2] | - | 3.3 | 4.1 | mΩ |
| $R_G$ | internal gate resistance (AC) | f = 1 MHz | | - | 1 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 0 A; $V_{DS}$ = 0 V; $V_{GS}$ = 10 V | | - | 112 | - | nC |
| | | $I_D$ = 80 A; $V_{DS}$ = 40 V; $V_{GS}$ = 10 V; see Figure 14; see Figure 15 | | - | 125 | - | nC |
| $Q_{GS}$ | gate-source charge | $I_D$ = 80 A; $V_{DS}$ = 40 V; $V_{GS}$ = 10 V; see Figure 14; see Figure 15 | | - | 39 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | | - | 24 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | | - | 15 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 25 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D$ = 25 A; $V_{DS}$ = 40 V; see Figure 14; see Figure 15 | | - | 4.65 | - | V |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 40 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; see Figure 16 | | - | 8400 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 700 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 336 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 40 V; $R_L$ = 0.5 Ω; $V_{GS}$ = 10 V; $R_{G(ext)}$ = 1.5 Ω | | - | 34.7 | - | ns |
| $t_r$ | rise time | | | - | 38.1 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 66 | - | ns |
| $t_f$ | fall time | | | - | 18.4 | - | ns |

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Source-drain diode** | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 25 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; $V_{DS}$ = 20 V | - | 59 | - | ns |
| $Q_r$ | recovered charge | | - | 130 | - | nC |

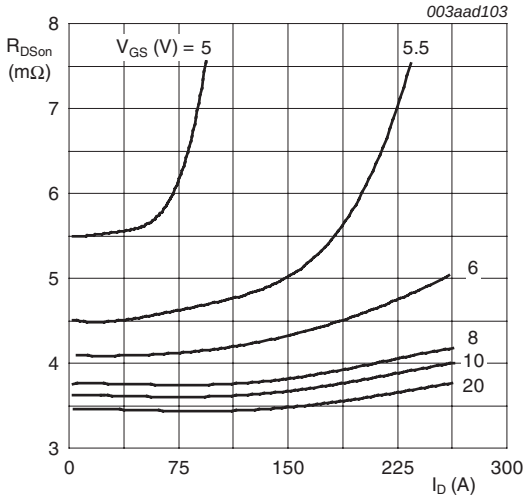
[1] Tested to JEDEC standards where applicable.

[2] Measured 3 mm from package.



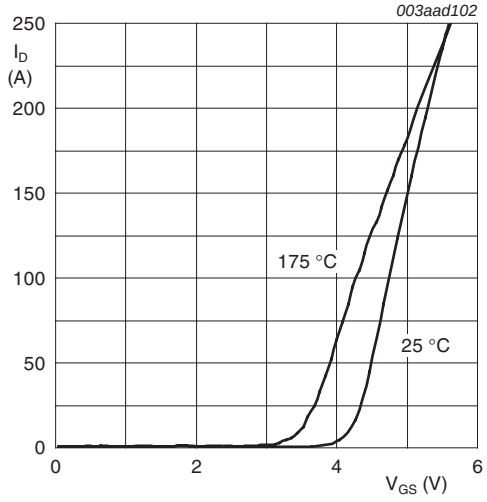

$T_j = 25\,°C$

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



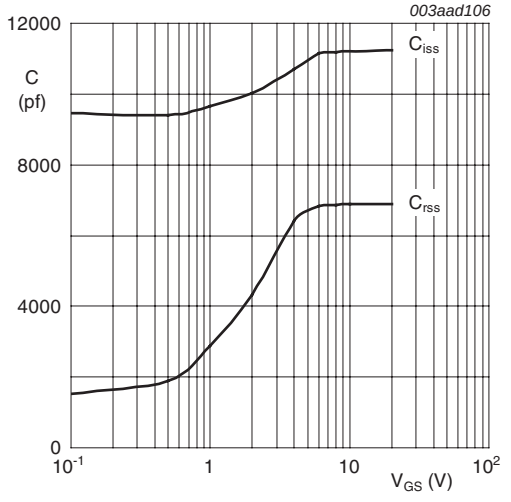

$T_j = 25\,°C; I_D = 15A$

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



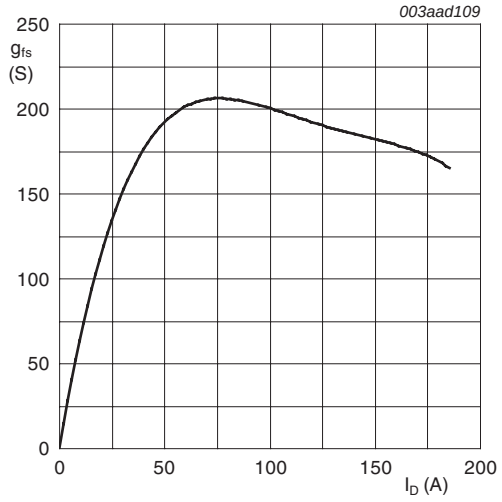

$V_{DS} > I_D \times R_{DSon}$

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



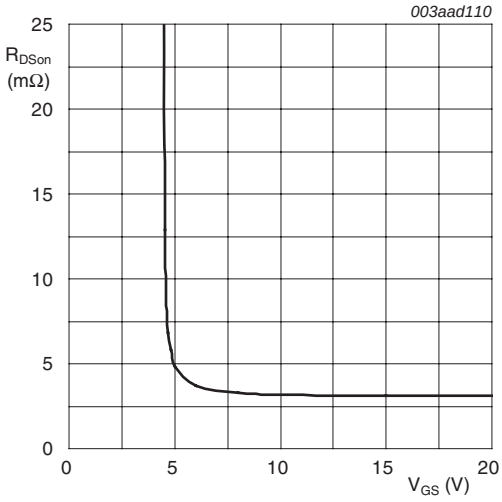

$V_{DS} = 0V; f = 1MHz$

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



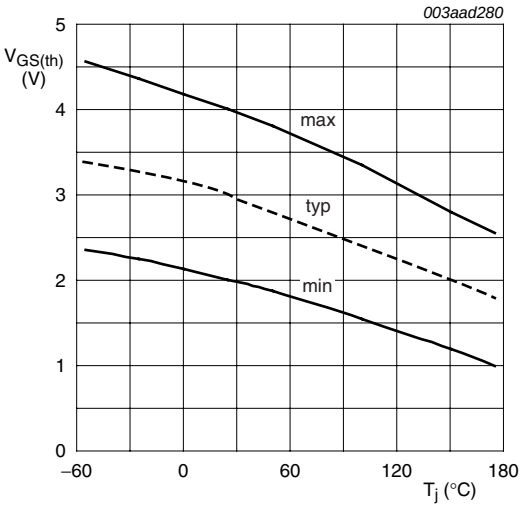

$T_j = 25\,°C; V_{DS} = 25\,V$

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



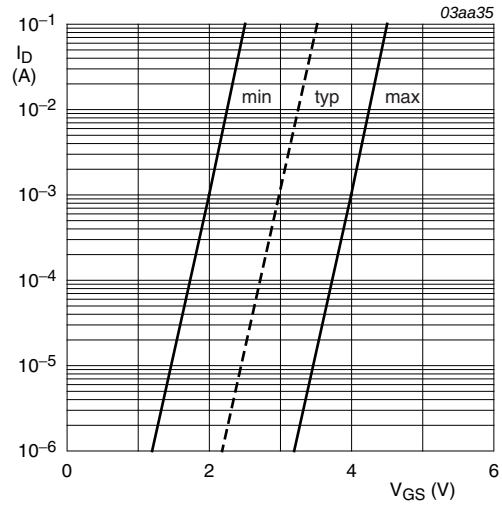

$T_j = 25\,°C; I_D = 15\,A$

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



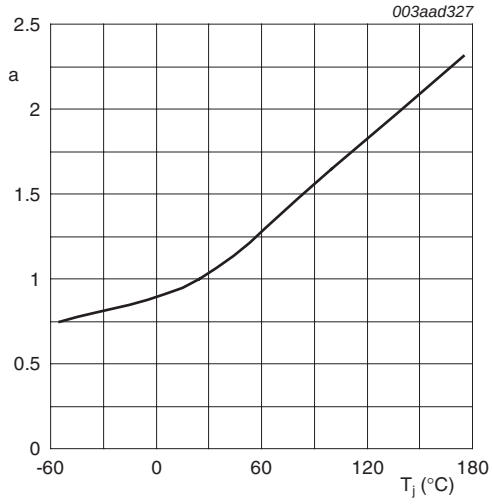

$I_D = 1\,mA; V_{DS} = V_{GS}$

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




$T_j = 25\,°C; V_{DS} = 5\,V$

**Fig 12. Sub-threshold drain current as a function of gate-source voltage**




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

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

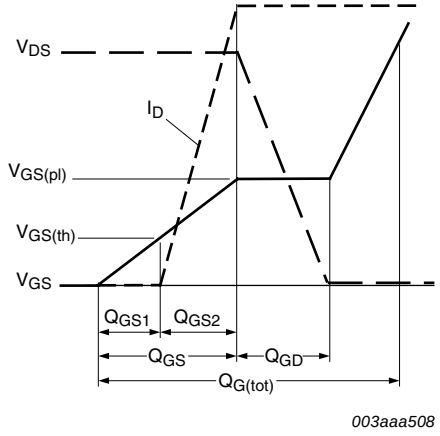
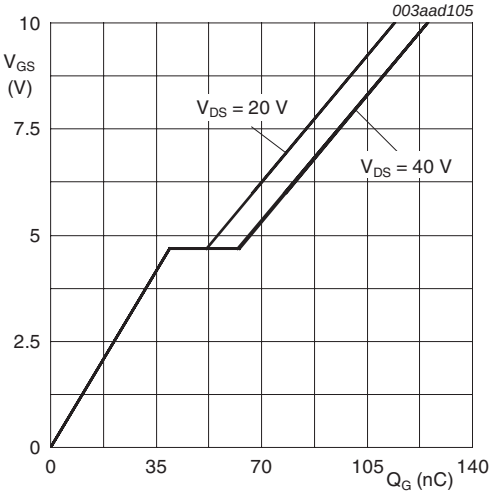
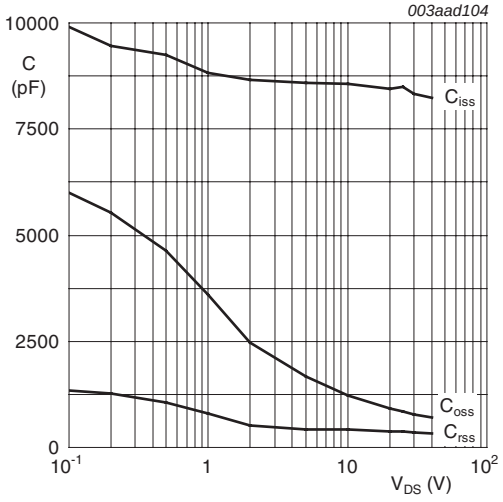



**Fig 14. Gate charge waveform definitions**



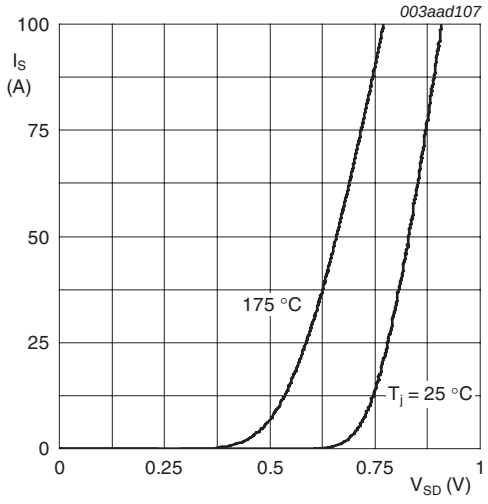

$$I_D = 80A$$

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




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

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

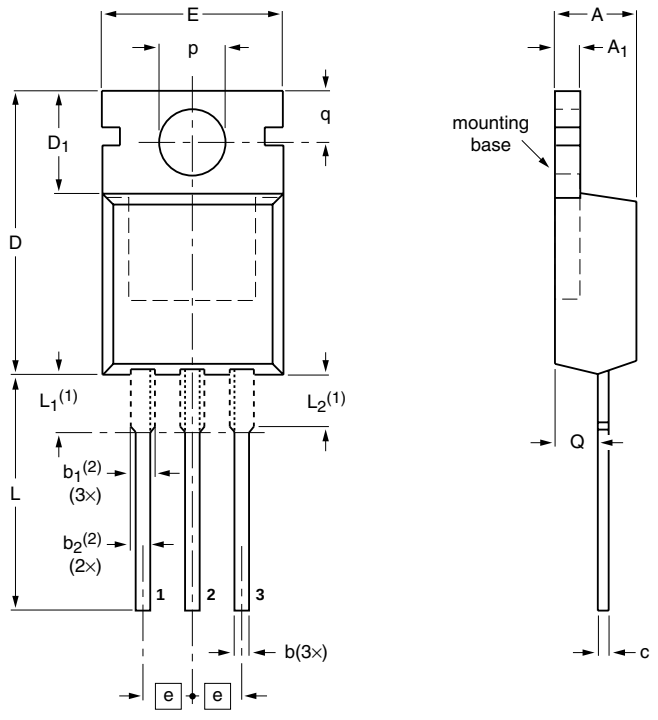



$V_{GS} = 0\,V$

**Fig 17. Source current as a function of source-drain 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 | $A_1$ | b | $b_1$(2) | $b_2$(2) | c | D | $D_1$ | E | e | L | $L_1$(1) | $L_2$(1) max. | p | q | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.7<br>4.1 | 1.40<br>1.25 | 0.9<br>0.6 | 1.6<br>1.0 | 1.3<br>1.0 | 0.7<br>0.4 | 16.0<br>15.2 | 6.6<br>5.9 | 10.3<br>9.7 | 2.54 | 15.0<br>12.8 | 3.30<br>2.79 | 3.0 | 3.8<br>3.5 | 3.0<br>2.7 | 2.6<br>2.2 |

**Notes**

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

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT78 | | 3-lead TO-220AB | SC-46 | | | ~~08-04-23~~<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 |
|---|---|---|---|---|
| PSMN4R4-80PS_1 | 20090618 | Product 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".

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