# PSMN2R0-30PL

## N-channel 30 V 2.1 mΩ logic level MOSFET

Rev. 01 — 24 June 2009 **Product data sheet**

## 1. Product profile

### 1.1 General description

Logic 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 logic level gate drive sources

### 1.3 Applications

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

### 1.4 Quick reference data
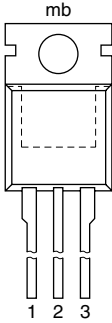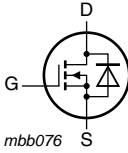
**Table 1.  Quick reference**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | - | 30 | V |
| $I_D$ | drain current | $T_{mb} = 25$ °C; $V_{GS} = 10$ V; see Figure 1 | [1] | - | - | 100 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ °C; see Figure 2 | | - | - | 211 | W |
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS} = 4.5$ V; $I_D = 25$ A; | | - | 16 | - | nC |
| $Q_{G(tot)}$ | total gate charge | $V_{DS} = 12$ V; see Figure 13; see Figure 14 | | - | 55 | - | nC |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS} = 4.5$ V; $I_D = 15$ A; $T_j = 25$ °C | | - | 2 | 2.8 | mΩ |
| | | $V_{GS} = 10$ V; $I_D = 15$ A; $T_j = 25$ °C; see Figure 12 | [2] | - | 1.7 | 2.1 | mΩ |

[1]    Continuous current is limited by package.

[2]    Measured 3 mm from package.

founded by Philips

## 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 | | |

mb

1 2 3

**SOT78**
**(TO-220AB)**

D

G

mbb076    S

## 3. Ordering information

**Table 3.    Ordering information**

| Type number | Package | | Version |
|-------------|---------|--|---------|
| | **Name** | **Description** | |
| PSMN2R0-30PL | 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 | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | 30 | V |
| $V_{DGR}$ | drain-gate voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C; $R_{GS} = 20$ kΩ | | - | 30 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS} = 10$ V; $T_{mb} = 100$ °C; see Figure 1 | [1] | - | 100 | A |
| | | $V_{GS} = 10$ V; $T_{mb} = 25$ °C; see Figure 1 | [1] | - | 100 | A |
| $I_{DM}$ | peak drain current | $t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C; see Figure 3 | | - | 943 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ °C; see Figure 2 | | - | 211 | 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 | [1] | - | 100 | A |
| $I_{SM}$ | peak source current | $t_p \leq 10$ µs; pulsed; $T_{mb} = 25$ °C | | - | 943 | 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; $V_{sup} \leq 30$ V; $R_{GS} = 50$ Ω; unclamped | | - | 555 | mJ |

[1]   Continuous current is limited by package.
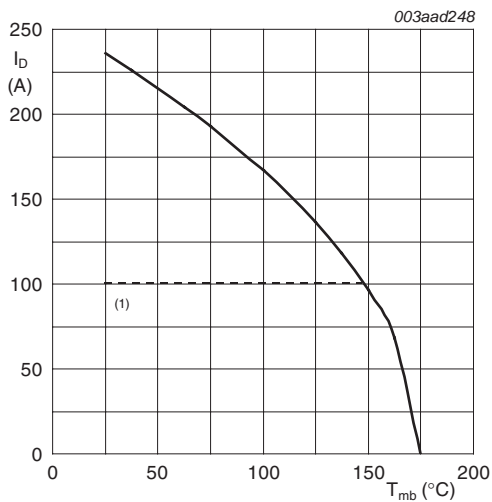


$$V_{GS} \geq 10\,V$$
(1) Capped at 100 A due to package.

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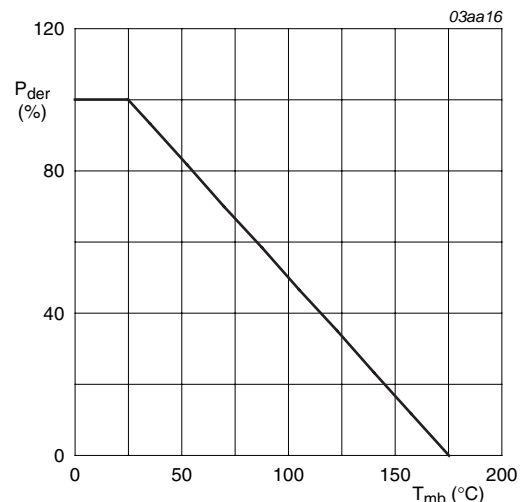


$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

**Fig 2.    Normalized total power dissipation as a function of mounting base temperature**
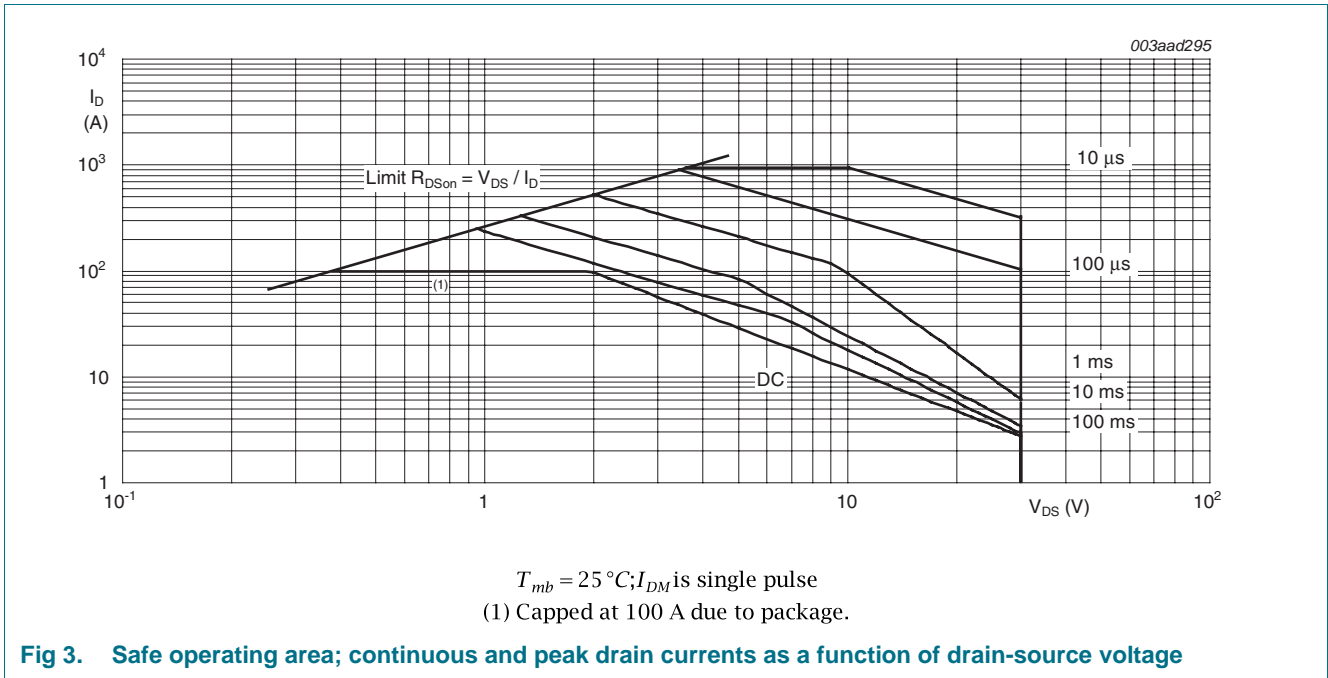
$T_{mb} = 25\,°C; I_{DM}$ is single pulse
(1) Capped at 100 A due to package.

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

## 5. Thermal characteristics

**Table 5.** **Thermal characteristics**

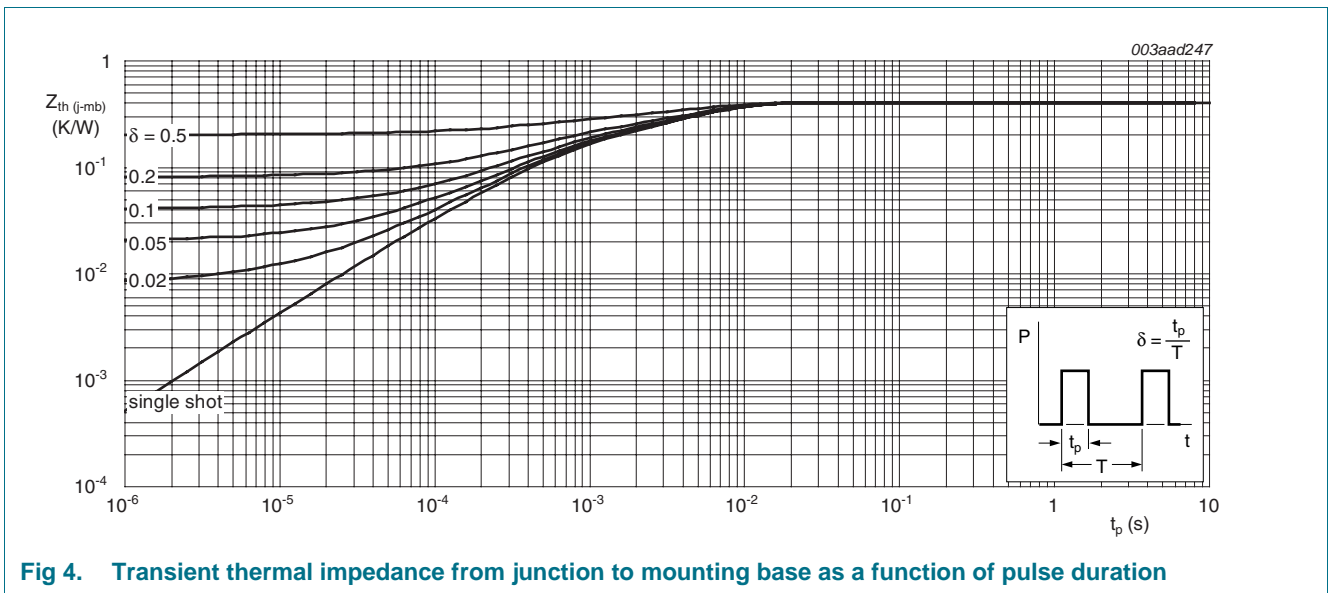| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | see Figure 4 | - | 0.41 | 0.71 | K/W |



**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; $T_j$ = 25 °C | 30 | - | - | V |
| | | $I_D$ = 250 μA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | 27 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; see Figure 9; see Figure 10 | 1.3 | 1.7 | 2.15 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; see Figure 10 | 0.5 | - | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; see Figure 10 | - | - | 2.45 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | - | - | 3 | μA |
| | | $V_{DS}$ = 30 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | - | - | 70 | μA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 16 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | - | - | 100 | nA |
| | | $V_{GS}$ = -16 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | - | - | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 4.5 V; $I_D$ = 15 A; $T_j$ = 25 °C | - | 2 | 2.8 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 100 °C; see Figure 11 | - | - | 3 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 15 A; $T_j$ = 25 °C; see Figure 12 [2] | - | 1.7 | 2.1 | mΩ |
| $R_G$ | gate resistance | f = 1 MHz | - | 0.78 | - | Ω |
| **Dynamic characteristics** | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 25 A; $V_{DS}$ = 12 V; $V_{GS}$ = 10 V; see Figure 13; see Figure 14 | - | 117 | - | nC |
| | | $I_D$ = 25 A; $V_{DS}$ = 12 V; $V_{GS}$ = 4.5 V; see Figure 13; see Figure 14 | - | 55 | - | nC |
| $Q_{GS}$ | gate-source charge | $I_D$ = 25 A; $V_{DS}$ = 12 V; $V_{GS}$ = 4.5 V; see Figure 13; see Figure 14 | - | 17 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | - | 11 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | - | 6 | - | nC |
| $Q_{GD}$ | gate-drain charge | | - | 16 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $V_{DS}$ = 12 V; see Figure 13; see Figure 14 | - | 2.6 | - | V |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 12 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; see Figure 15 | - | 6810 | - | pF |
| $C_{oss}$ | output capacitance | | - | 1410 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | - | 650 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 12 V; $R_L$ = 0.5 Ω; $V_{GS}$ = 4.5 V; $R_{G(ext)}$ = 4.7 Ω | - | 63 | - | ns |
| $t_r$ | rise time | | - | 125 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 111 | - | ns |
| $t_f$ | fall time | | - | 59 | - | 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 16 | - | 0.76 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 20 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = 30 V | - | 49 | - | ns |
| $Q_r$ | recovered charge | | - | 66 | - | nC |

[1] Tested to JEDEC standards where applicable.

[2] Measured 3 mm from package.



$$T_j = 25\,°C$$
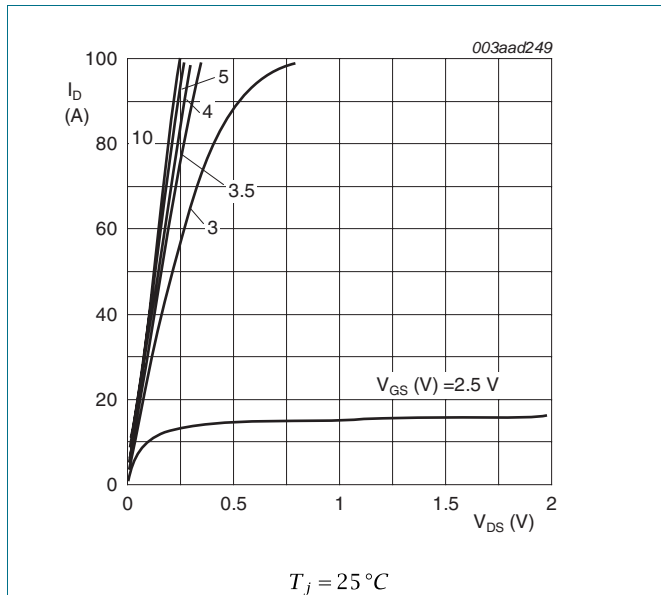
**Fig 5.** **Output characteristics: drain current as a function of drain-source voltage; typical values**



$$V_{DS} > I_D \times R_{DSon}$$
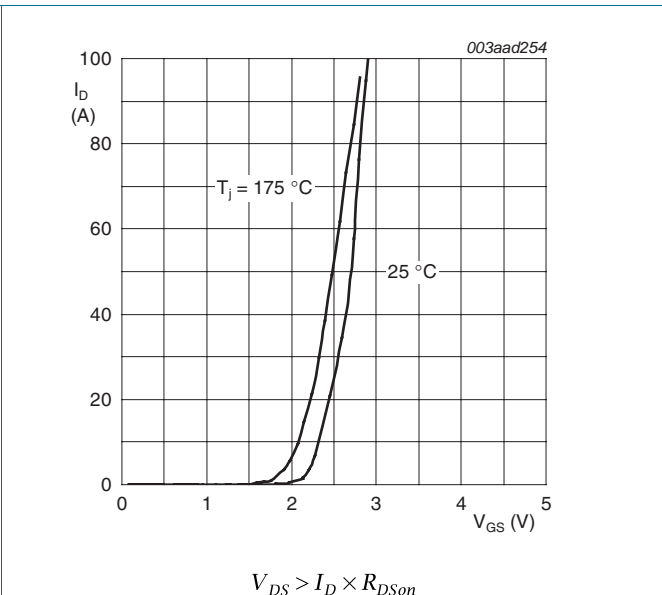
**Fig 6.** **Transfer characteristics: drain current as a function of gate-source voltage; typical values**
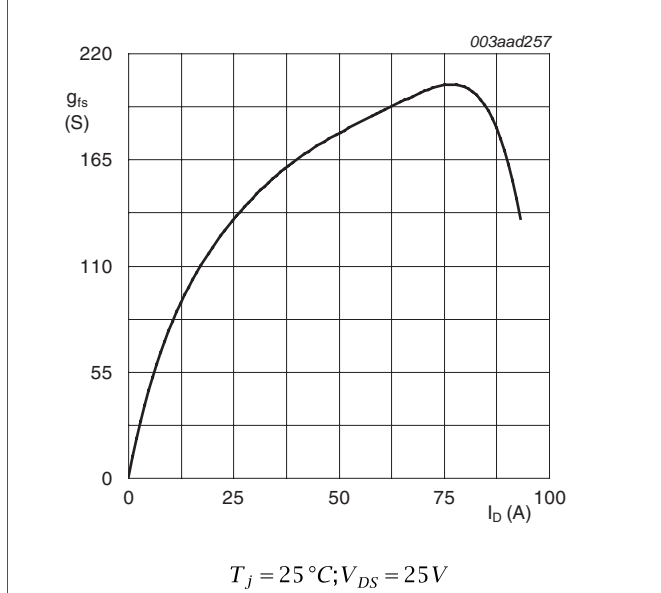


$$T_j = 25\,°C; V_{DS} = 25\,V$$

**Fig 7.** **Forward transconductance as a function of drain current; typical values**
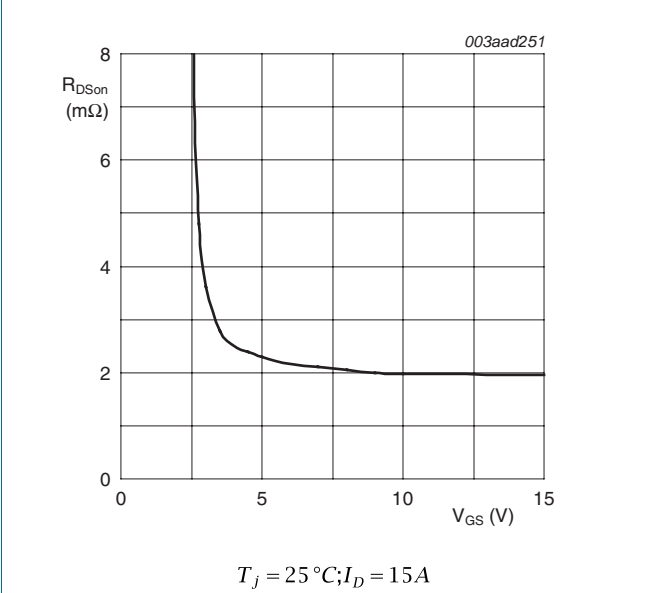


$$T_j = 25\,°C; I_D = 15A$$

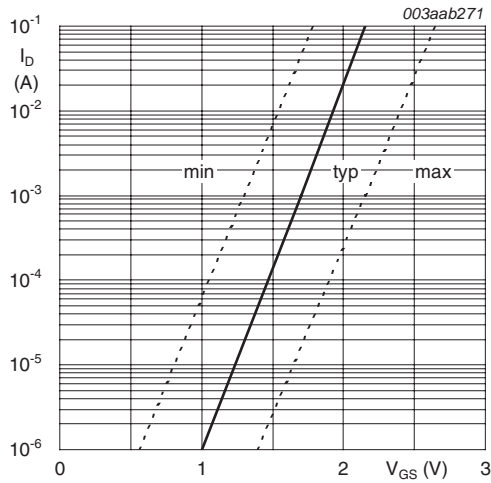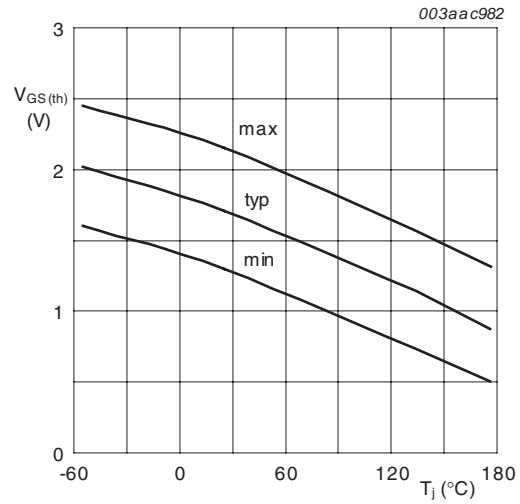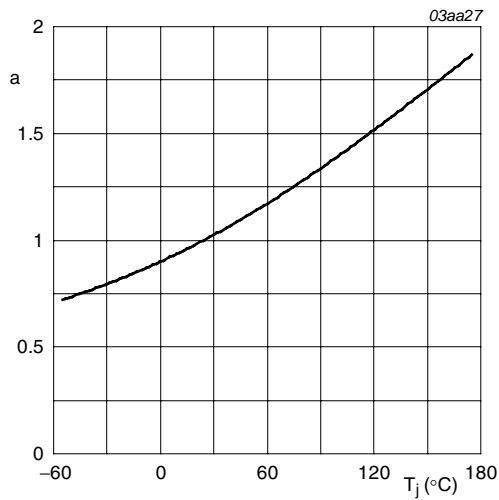**Fig 8.** **Drain source on-state resistance as a function of gate-source voltage; typical values**

$$T_j = 25\,°C; V_{DS} = 5\,V$$

**Fig 9.** Sub-threshold drain current as a function of gate-source voltage



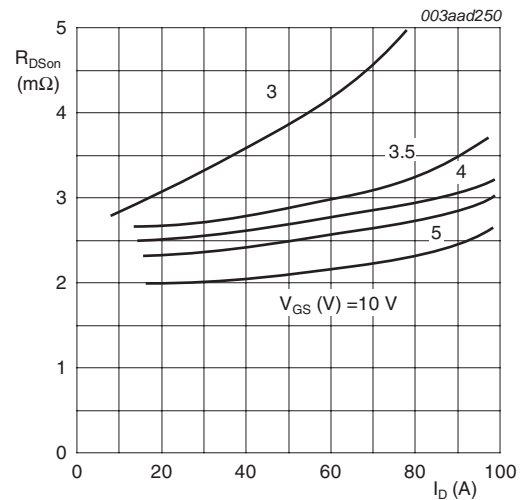$$I_D = 1\,mA; V_{DS} = V_{GS}$$

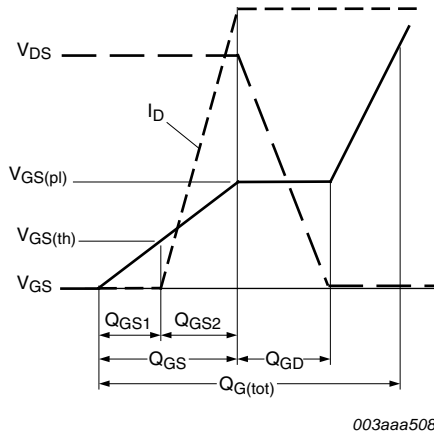**Fig 10.** Gate-source threshold voltage as a function of junction temperature



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

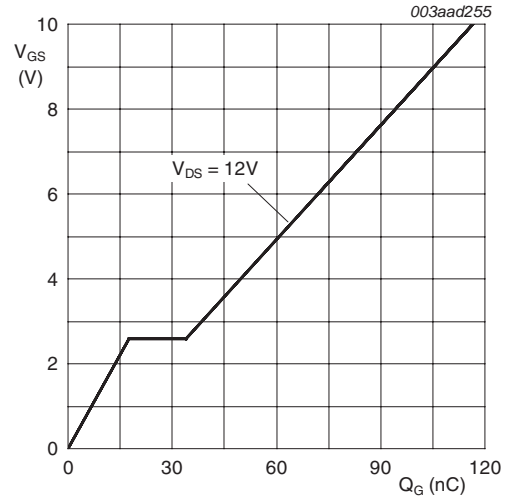**Fig 11.** Normalized drain-source on-state resistance factor as a function of junction temperature



$$T_j = 25\,°C$$

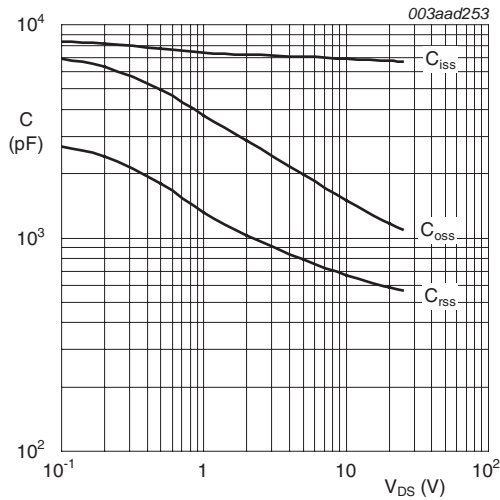**Fig 12.** Drain-source on-state resistance as a function of drain current; typical values

**Fig 13.  Gate charge waveform definitions**



$$T_j = 25\,°C; I_D = 25A$$

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



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

**Fig 15.  Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**
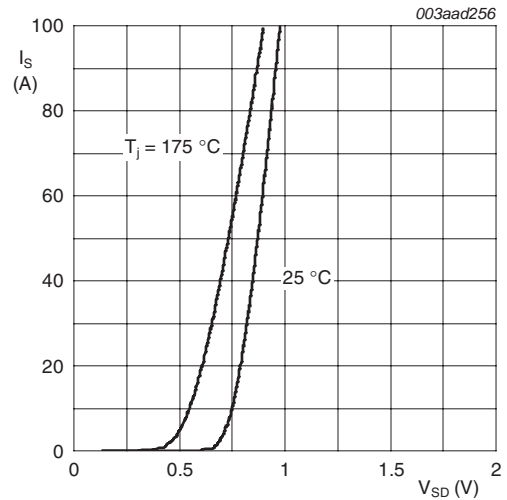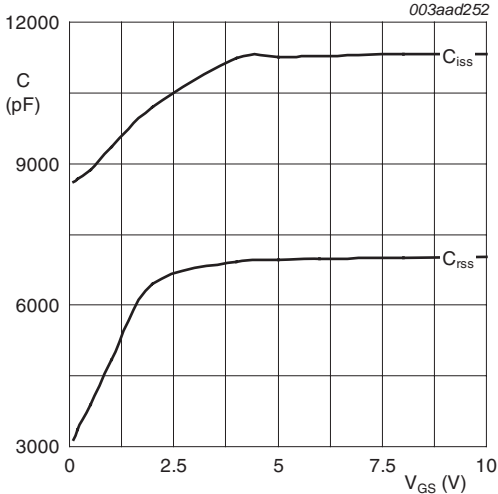


$$V_{GS} = 0\,V$$

**Fig 16.  Source current as a function of source-drain voltage; typical values**

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

**Fig 17. Input and reverse transfer capacitances as a function of gate-source voltage; typical values**

# 7. Package outline

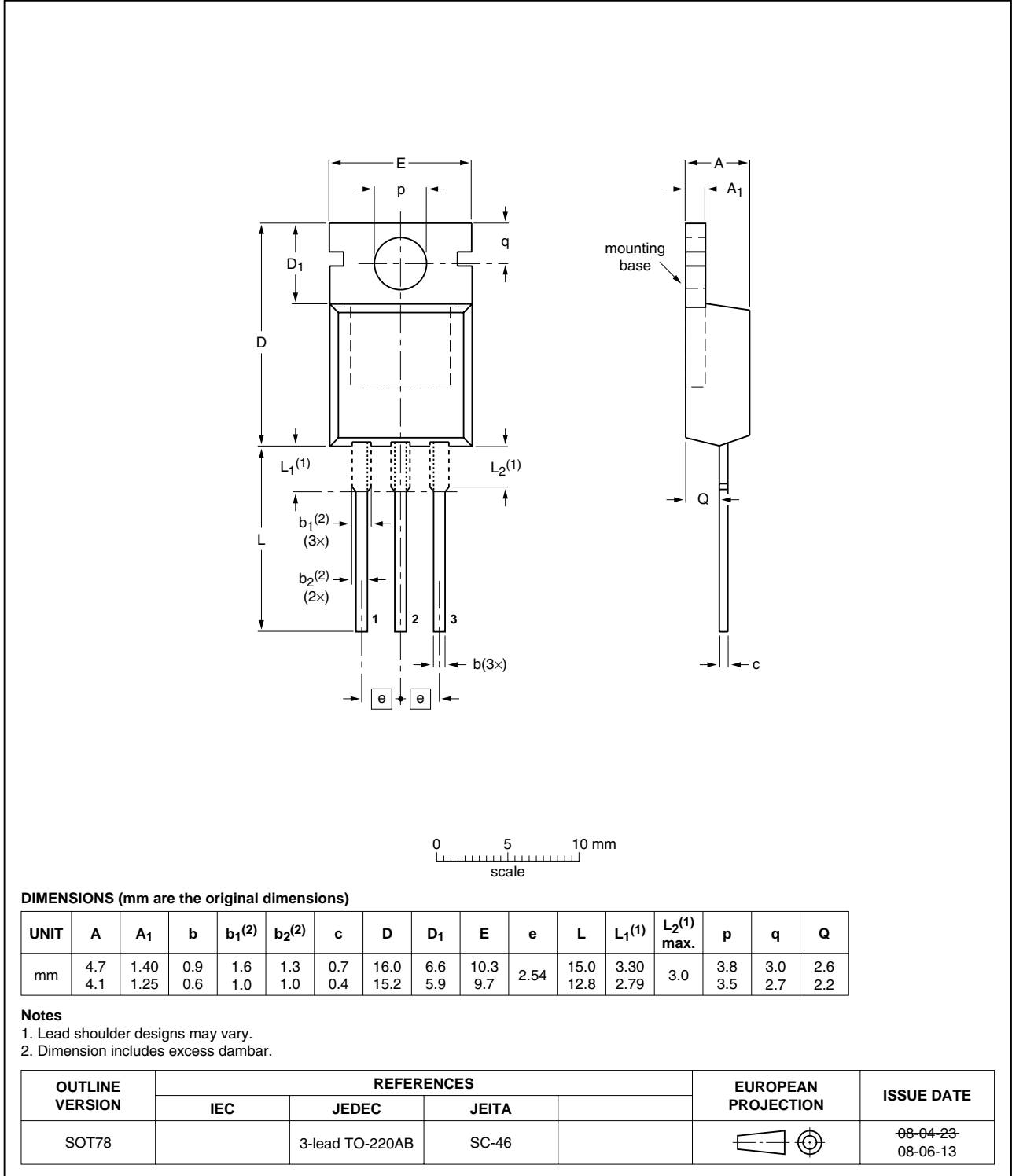Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB    **SOT78**

**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 4.1 | 1.40 1.25 | 0.9 0.6 | 1.6 1.0 | 1.3 1.0 | 0.7 0.4 | 16.0 15.2 | 6.6 5.9 | 10.3 9.7 | 2.54 | 15.0 12.8 | 3.30 2.79 | 3.0 | 3.8 3.5 | 3.0 2.7 | 2.6 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~~ 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 |
|---|---|---|---|---|
| PSMN2R0-30PL_1 | 20090624 | 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. |
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| 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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