# PSMN3R3-60PL

## N-channel 60 V, 3.4 mΩ logic level MOSFET in SOT78

7 February 2013 Product data sheet

## 1. General description

Logic level N-channel MOSFET in SOT78 using TrenchMOS technology. Product design and manufacture has been optimized for use in battery operated power tools.

## 2. Features and benefits

- High efficiency due to low switching & conduction losses
- Robust construction for demanding applications
- Logic level gate

## 3. Applications

- Battery-powered tools
- Load switching
- Motor control
- Uninterruptible power supplies

## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | - | 60 | V |
| $I_D$ | drain current | $V_{GS}$ = 10 V; $T_{mb}$ = 25 °C; Fig. 1 | [1] | - | - | 130 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 2 | | - | - | 293 | W |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; Fig. 11 | | - | 2.7 | 3.4 | mΩ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $V_{GS}$ = 10 V; $I_D$ = 25 A; $V_{DS}$ = 48 V; Fig. 13; Fig. 14 | | - | 175 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 31 | - | nC |
| **Avalanche ruggedness** | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D$ = 130 A; $V_{sup} \leq 60$ V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 3 | | - | - | 372 | mJ |

[1] Continuous current is limited by package.

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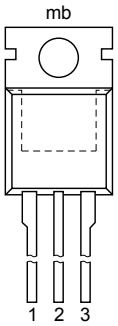
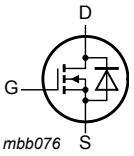
## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate |  TO-220AB (SOT78) |  |
| 2 | D | drain | | |
| 3 | S | source | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PSMN3R3-60PL | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking code |
|---|---|
| PSMN3R3-60PL | PSMN3R3-60PL |

## 8. Limiting values

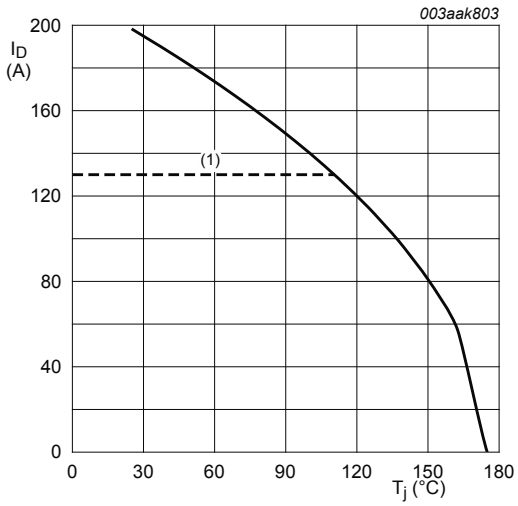
**Table 5. Limiting values**

*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 | | - | 60 | V |
| $V_{DGR}$ | drain-gate voltage | $R_{GS}$ = 20 kΩ | | - | 60 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $I_D$ | drain current | $T_{mb}$ = 25 °C; $V_{GS}$ = 10 V; Fig. 1 | [1] | - | 130 | A |
| | | $T_{mb}$ = 100 °C; $V_{GS}$ = 10 V; Fig. 1 | [1] | - | 130 | A |
| $I_{DM}$ | peak drain current | $T_{mb}$ = 25 °C; pulsed; $t_p \leq 10$ µs; Fig. 4 | | - | 793 | A |

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 2 | | - | 293 | 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] | - | 130 | A |
| $I_{SM}$ | peak source current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C | | - | 793 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $I_D$ = 130 A; $V_{sup} \leq 60$ V; $R_{GS}$ = 50 Ω; $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 3 | | - | 372 | mJ |

[1] Continuous current is limited by package.




(1) Capped at 130A due to package

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

$V_{GS} \geq 10V$

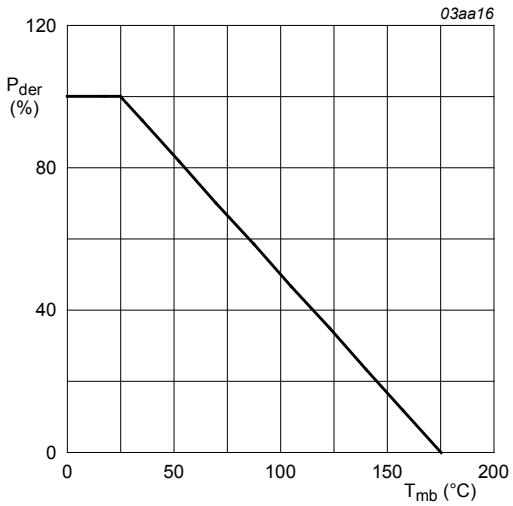



**Fig. 2. Normalized total power dissipation as a function of mounting base temperature**

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

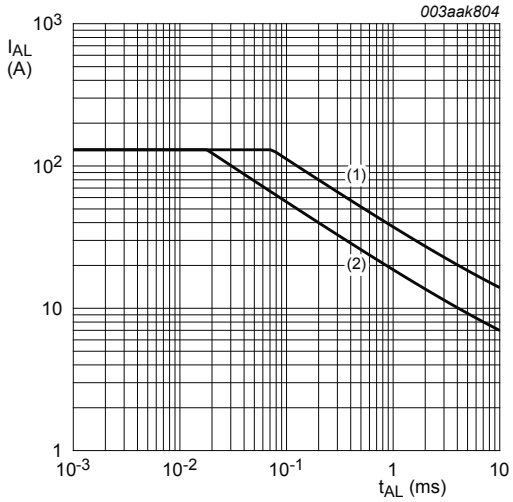



**Fig. 3. Avalanche rating; avalanche current as a function of avalanche time**

(1) $T_{j\ (init)} = 25°C$; (2) $T_{j\ (init)} = 100°C$

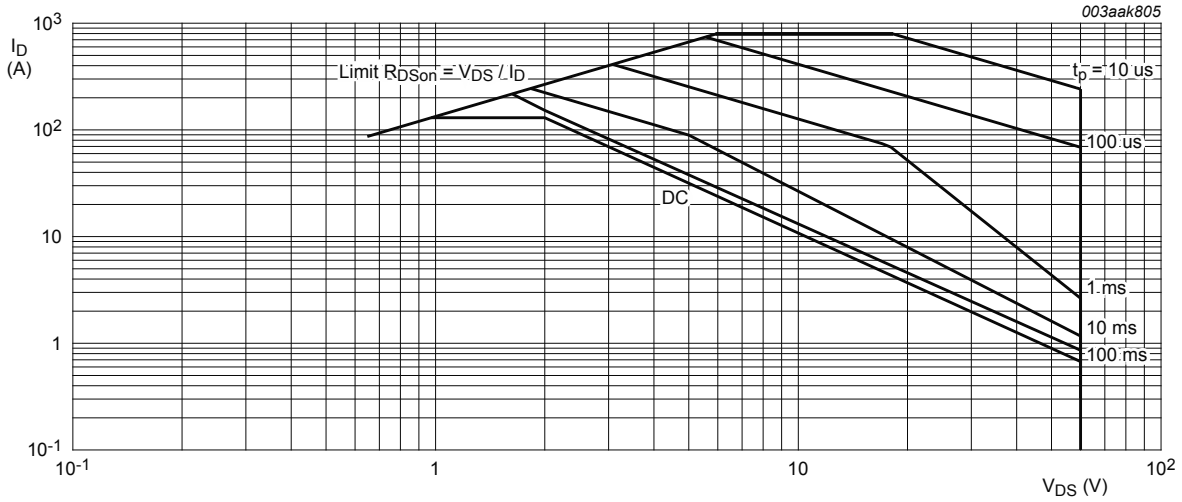



**Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

$T_{mb} = 25°C$; $I_{DM}$ *is a single pulse*

# 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 5 | | - | 0.4 | 0.51 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | vertical in still air | | - | 60 | - | K/W |

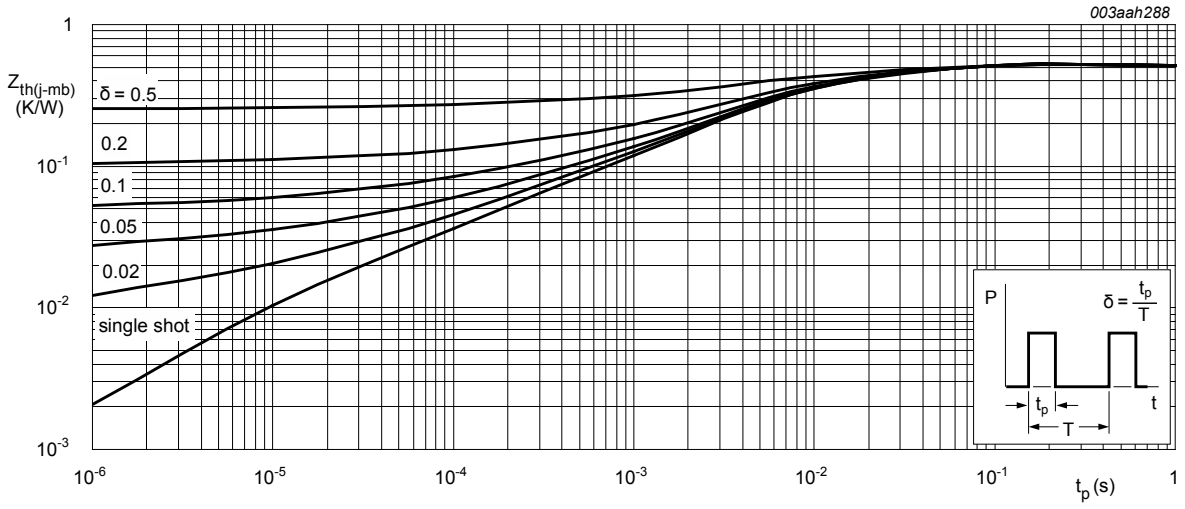


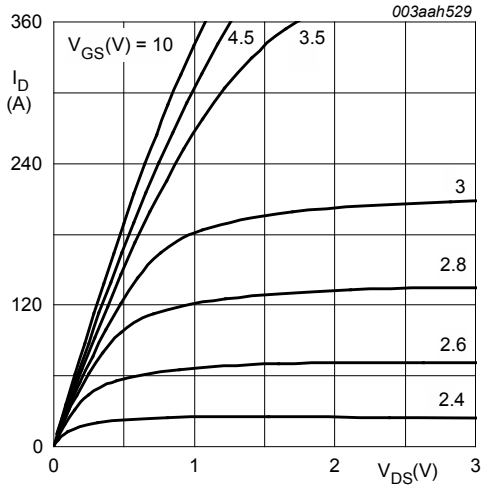

**Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration**

# 10. Characteristics

**Table 7. Characteristics**

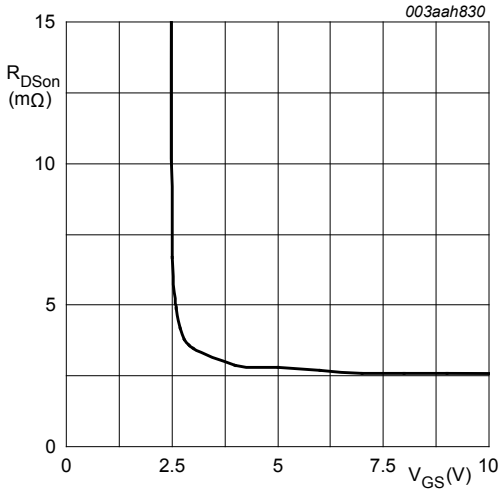
| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | 60 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | | 54 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; Fig. 9; Fig. 10 | | 1.4 | 1.7 | 2.1 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; Fig. 9 | | - | - | 2.45 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; Fig. 9 | | 0.5 | - | - | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | | - | - | 500 | µA |
| | | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.09 | 1 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 16 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 2 | 100 | nA |
| | | $V_{GS}$ = -16 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 2 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 4.5 V; $I_D$ = 25 A; $T_j$ = 25 °C; Fig. 11 | | - | 3 | 3.8 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; Fig. 11 | | - | 2.7 | 3.4 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 175 °C; Fig. 12; Fig. 11 | | - | - | 7.5 | mΩ |
| $R_G$ | gate resistance | f = 1 MHz | | 0.5 | 1 | 2 | Ω |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 25 A; $V_{DS}$ = 48 V; $V_{GS}$ = 5 V; Fig. 13; Fig. 14 | | - | 95 | - | nC |
| | | $I_D$ = 25 A; $V_{DS}$ = 48 V; $V_{GS}$ = 10 V; Fig. 13; Fig. 14 | | - | 175 | - | nC |
| $Q_{GS}$ | gate-source charge | | | - | 20 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 31 | - | nC |
| $C_{iss}$ | input capacitance | $V_{GS}$ = 0 V; $V_{DS}$ = 25 V; f = 1 MHz; $T_j$ = 25 °C; Fig. 15 | | - | 10115 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 822 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 427 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 45 V; $R_L$ = 1.8 Ω; $V_{GS}$ = 5 V; $R_{G(ext)}$ = 5 Ω | | - | 54.2 | - | ns |
| $t_r$ | rise time | | | - | 100 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 158 | - | ns |
| $t_f$ | fall time | | | - | 109 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 25 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; Fig. 16 | | - | 0.78 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 20 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = 25 V | | - | 43 | - | ns |
| $Q_r$ | recovered charge | | | - | 67 | - | nC |




$T_j$ = 25 °C; $t_p$ = 300 µs

**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**




$T_j = 25°C;\ I_D = 25A$

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

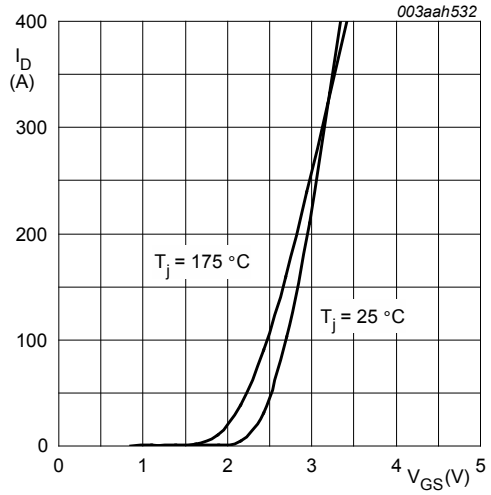



**Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values**

$V_{DS} = 10V$

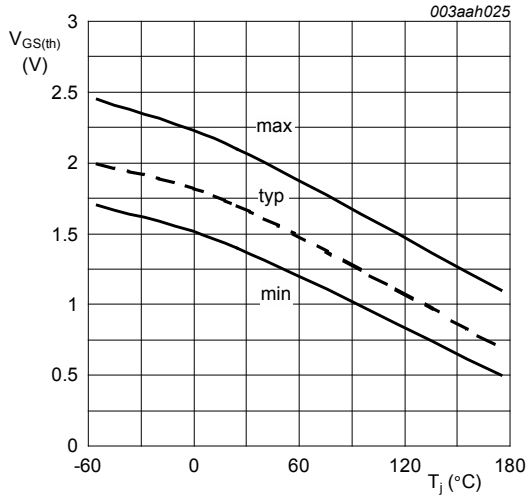



**Fig. 9. Gate-source threshold voltage as a function of junction temperature**

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

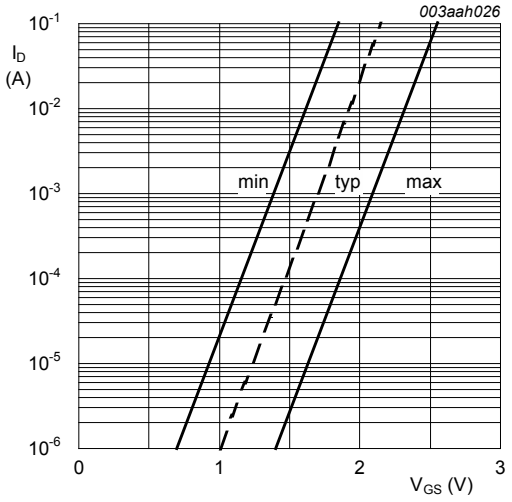
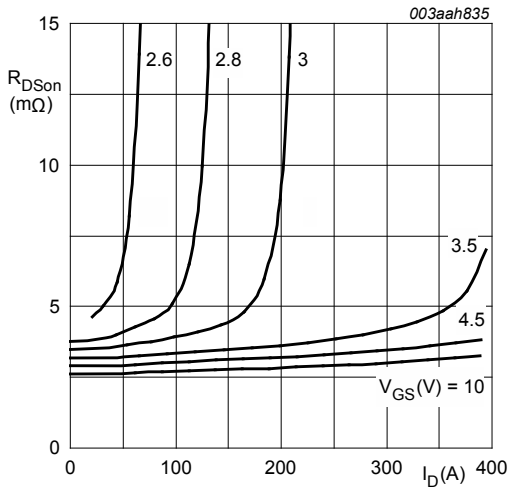



**Fig. 10. Sub-threshold drain current as a function of gate-source voltage**

$T_j = 25°C$; $V_{DS} = 5V$




$T_j$ = 25 °C; $t_p$ = 300 µs

**Fig. 11. Drain-source on-state resistance as a function of drain current; typical values**

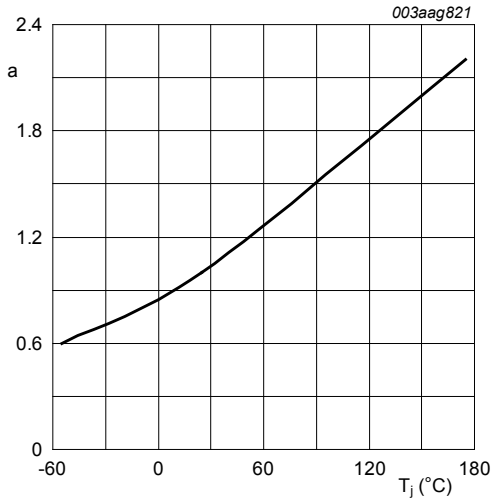



**Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature**

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

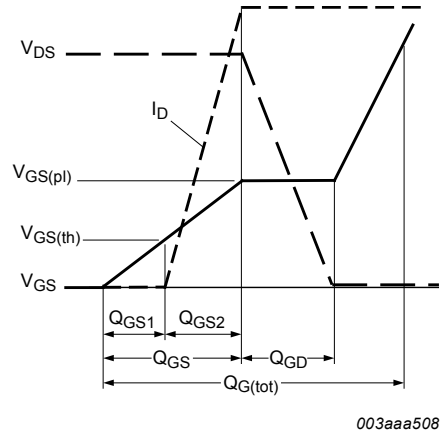



**Fig. 13. Gate charge waveform definitions**

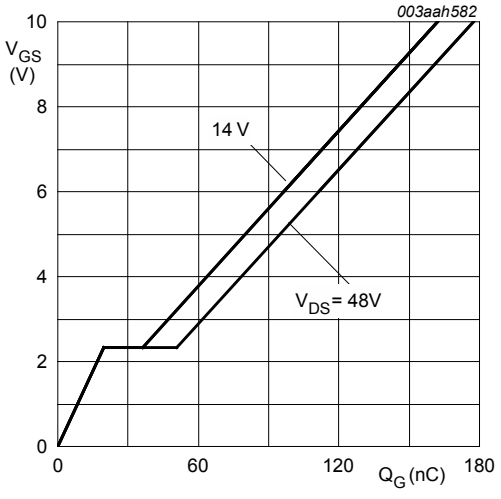



**Fig. 14. Gate-source voltage as a function of gate charge; typical values**

$T_j = 25°C;\ I_D = 25A$

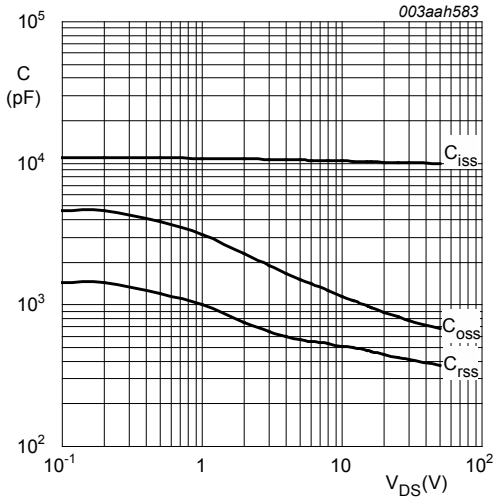



**Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

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

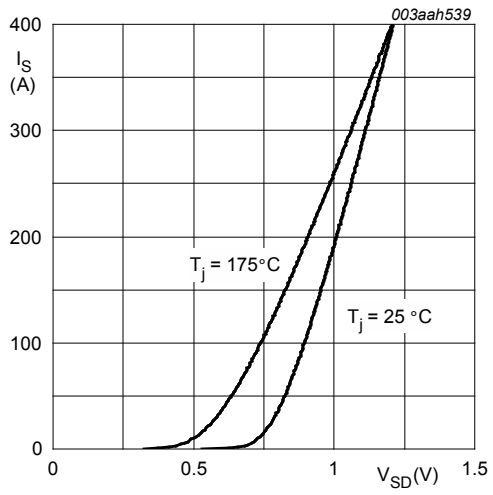
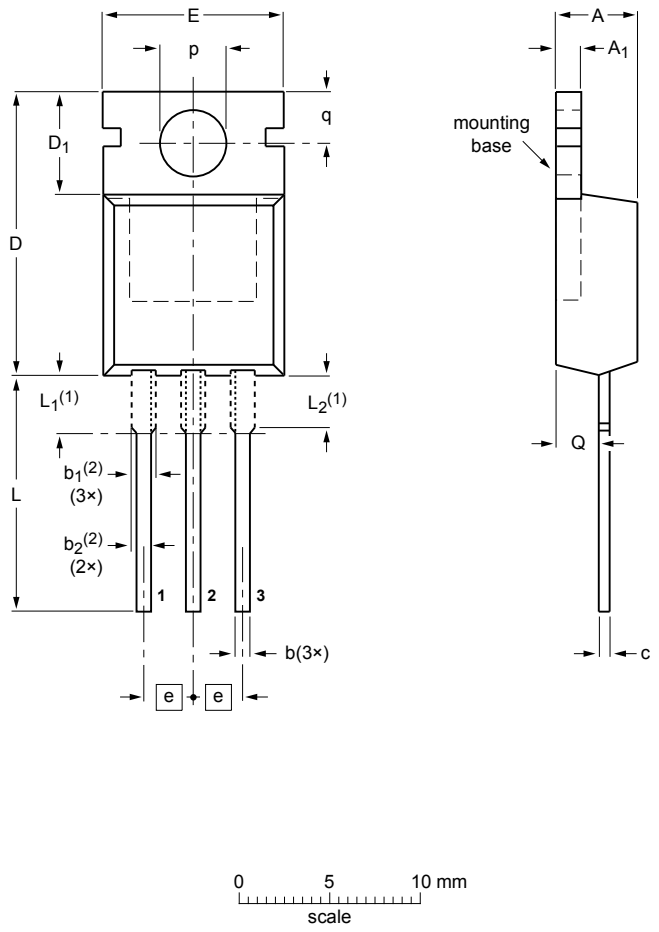



**Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values**

$V_{GS} = 0\,V$

# 11. 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. 17. Package outline TO-220AB (SOT78)**

# 12. Legal information

## 12.1 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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