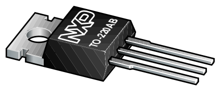


# PSMN6R3-120PS

## N-channel 120 V 6.7 mΩ standard level MOSFET in TO-220

7 June 2013 | Product data sheet

## 1. General description

Standard level N-channel MOSFET in TO-220 package qualified to 175 °C. This product is designed and qualified for use in a wide range of industrial, communications and domestic power supply equipment.

## 2. Features and benefits

- High efficiency due to low switching and conduction losses
- Improved dynamic avalanche performance
- Suitable for standard level gate drive
- TO-220 package can be mounted to heatsink

## 3. Applications

- AC-to-DC power supply
- Synchronous rectification
- Motor control

## 4. Quick reference data

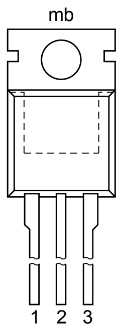
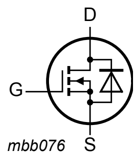
**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C | | - | - | 120 | V |
| $I_D$ | drain current | $T_{mb} = 25$ °C; $V_{GS} = 10$ V; Fig. 1 | | - | - | 70 | A |
| $P_{tot}$ | total power dissipation | $T_{mb} = 25$ °C; Fig. 2 | | - | - | 405 | W |
| **Static characteristics** | | | | | | | |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ °C; Fig. 12 | | 4 | 5.7 | 6.7 | mΩ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{GD}$ | gate-drain charge | $V_{GS} = 10$ V; $I_D = 25$ A; $V_{DS} = 60$ V; Fig. 14; Fig. 15 | | - | 61.9 | - | nC |
| $Q_{G(tot)}$ | total gate charge | | | - | 207.1 | - | nC |
| **Avalanche ruggedness** | | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; $I_D = 70$ A; $V_{sup} \leq 120$ V; unclamped; $R_{GS} = 50$ Ω; Fig. 3 | | - | - | 532 | mJ |

Scan or click this QR code to view the latest information for this product

## 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 | | |
| mb | D | drain | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| PSMN6R3-120PS | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78 |

## 7. 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 | | - | 120 | V |
| $V_{DGR}$ | drain-gate voltage | $T_j \geq 25$ °C; $T_j \leq 175$ °C; $R_{GS}$ = 20 kΩ | | - | 120 | V |
| $V_{GS}$ | gate-source voltage | | | -20 | 20 | V |
| $I_D$ | drain current | $V_{GS}$ = 10 V; $T_{mb}$ = 25 °C; Fig. 1 | | - | 70 | A |
| | | $V_{GS}$ = 10 V; $T_{mb}$ = 100 °C; Fig. 1 | | - | 70 | A |
| $I_{DM}$ | peak drain current | pulsed; $t_p \leq 10$ µs; $T_{mb}$ = 25 °C; Fig. 4 | | - | 280 | A |
| $P_{tot}$ | total power dissipation | $T_{mb}$ = 25 °C; Fig. 2 | | - | 405 | W |
| $T_{stg}$ | storage temperature | | | -55 | 175 | °C |
| $T_j$ | junction temperature | | | -55 | 175 | °C |
| $T_{sld(M)}$ | peak soldering temperature | | | - | 260 | °C |
| **Source-drain diode** | | | | | | |
| $I_S$ | source current | $T_{mb}$ = 25 °C | | - | 70 | A |

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{SM}$ | peak source current | pulsed; $t_p$ ≤ 10 µs; $T_{mb}$ = 25 °C | | - | 280 | A |
| **Avalanche ruggedness** | | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS}$ = 10 V; $T_{j(init)}$ = 25 °C; $I_D$ = 70 A; $V_{sup}$ ≤ 120 V; unclamped; $R_{GS}$ = 50 Ω; Fig. 3 | | - | 532 | mJ |

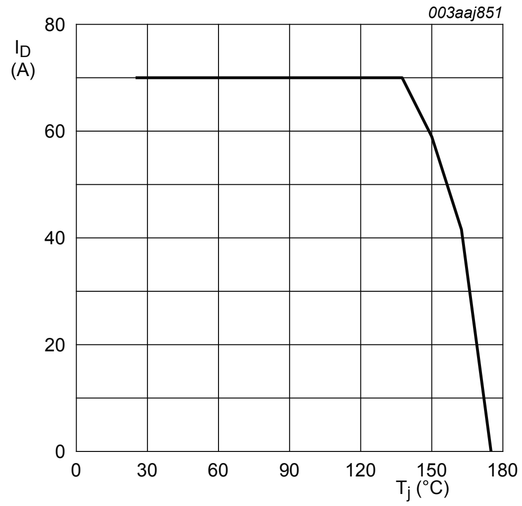



**Fig. 1. Continuous drain current as a function of mounting base temperature**

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

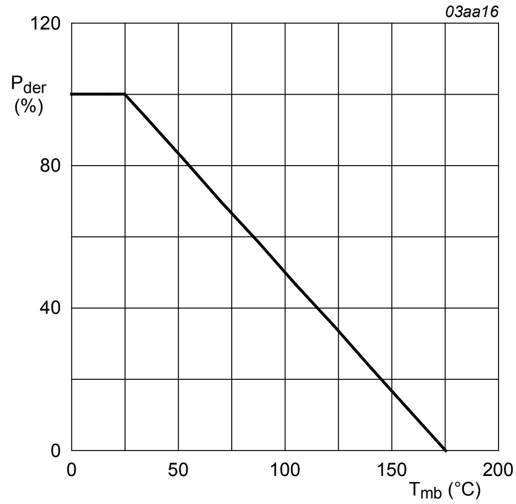



**Fig. 2. Normalized total power dissipation as a function of mounting base temperature**

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

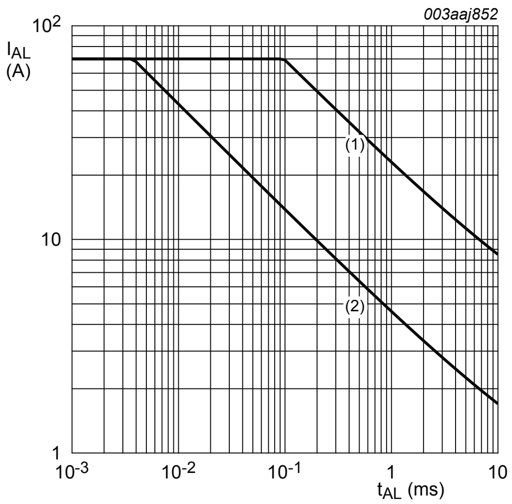



**Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time**

(1) Single-pulse; $T_j = 25\,°C$.

(2) Single-pulse; $T_j = 125\,°C$.

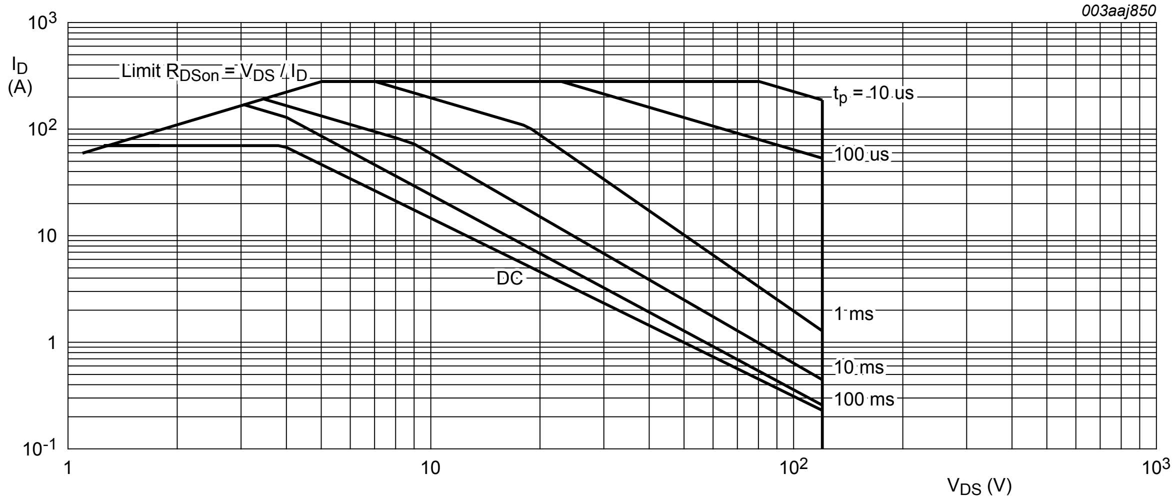



**Fig. 4. Safe operating area; continuous and peak drain current as a function of drain-source voltage**

$T_{mb} = 25\,°C$; $I_{DM}$ is single pulse

## 8. Thermal characteristics

**Table 5. Thermal characteristics**

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-mb)}$ | thermal resistance from junction to mounting base | Fig. 5 | | - | 0.3 | 0.37 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | vertical in free air | | - | 60 | - | K/W |

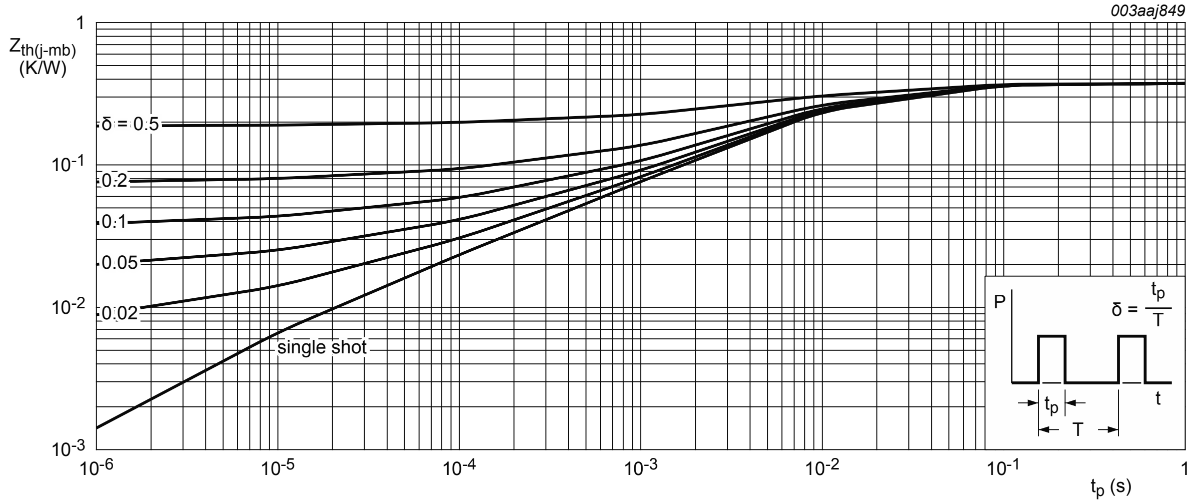



**Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration**

# 9. 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 | | 120 | - | - | V |
| | | $I_D$ = 250 µA; $V_{GS}$ = 0 V; $T_j$ = -55 °C | | 108 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C; Fig. 10; Fig. 11 | | 2 | 3 | 4 | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 175 °C; Fig. 10; Fig. 11 | | 1 | - | - | V |
| | | $I_D$ = 1 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = -55 °C; Fig. 10; Fig. 11 | | - | - | 4.6 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 120 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C | | - | 0.1 | 1 | µA |
| | | $V_{DS}$ = 120 V; $V_{GS}$ = 0 V; $T_j$ = 175 °C | | - | - | 500 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = 20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 10 | 100 | nA |
| | | $V_{GS}$ = -20 V; $V_{DS}$ = 0 V; $T_j$ = 25 °C | | - | 10 | 100 | nA |
| $R_{DSon}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 25 °C; Fig. 12 | | 4 | 5.7 | 6.7 | mΩ |
| | | $V_{GS}$ = 10 V; $I_D$ = 25 A; $T_j$ = 175 °C; Fig. 13; Fig. 12 | | - | 16.5 | 19.4 | mΩ |
| $R_G$ | internal gate resistance (AC) | f = 1 MHz | | 0.44 | 0.88 | 1.76 | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 25 A; $V_{DS}$ = 60 V; $V_{GS}$ = 10 V; Fig. 14; Fig. 15 | | - | 207.1 | - | nC |
| $Q_{GS}$ | gate-source charge | | | - | 43.2 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | | - | 29.8 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | | - | 13.4 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 61.9 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D$ = 25 A; $V_{DS}$ = 60 V; Fig. 14; Fig. 15 | | - | 4.3 | - | V |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 60 V; $V_{GS}$ = 0 V; f = 1 MHz; $T_j$ = 25 °C; Fig. 16 | | - | 11384 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 534 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 358 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 60 V; $R_L$ = 2.4 Ω; $V_{GS}$ = 10 V; $R_{G(ext)}$ = 5 Ω; $T_j$ = 25 °C | | - | 42.1 | - | ns |
| $t_r$ | rise time | | | - | 58.2 | - | ns |

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $t_{d(off)}$ | turn-off delay time | | | - | 142.1 | - | ns |
| $t_f$ | fall time | | | - | 67.7 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $I_S$ = 25 A; $V_{GS}$ = 0 V; $T_j$ = 25 °C; Fig. 17 | | - | 0.79 | 1.2 | V |
| $t_{rr}$ | reverse recovery time | $I_S$ = 25 A; $dI_S/dt$ = -100 A/µs; $V_{GS}$ = 0 V; $V_{DS}$ = 60 V | | - | 76.1 | - | ns |
| $Q_r$ | recovered charge | | | - | 264.2 | - | nC |

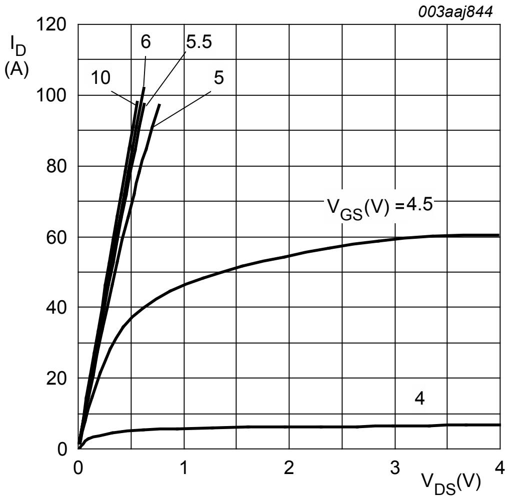



**Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values**

$T_j = 25\,°C$

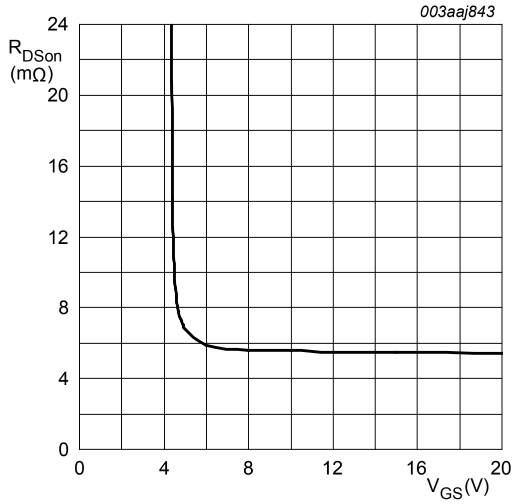



**Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**

$T_j = 25\,°C$

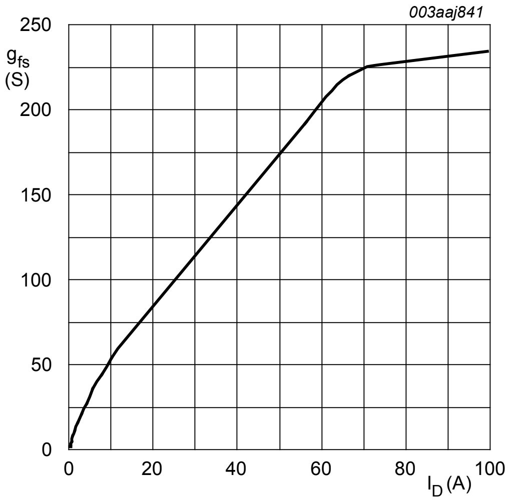



**Fig. 8. Forward transconductance as a function of drain current; typical values**

$T_j = 25\,°C; V_{DS} = 10\,V$

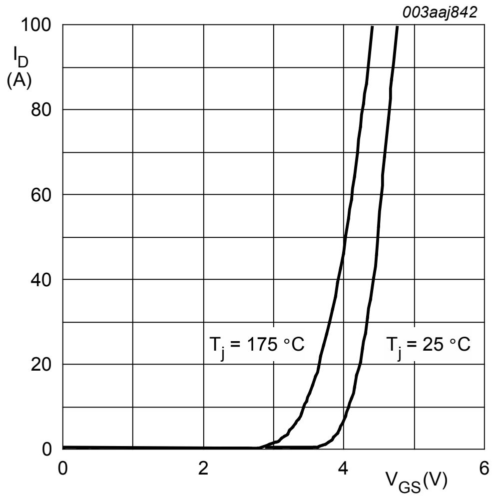



**Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values**

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

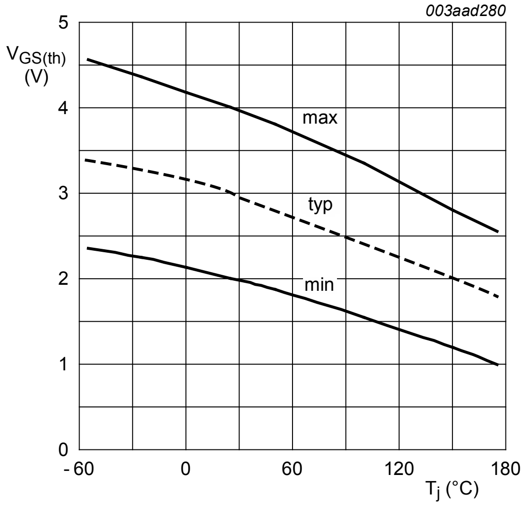



**Fig. 10. Gate-source threshold voltage as a function of junction temperature**

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

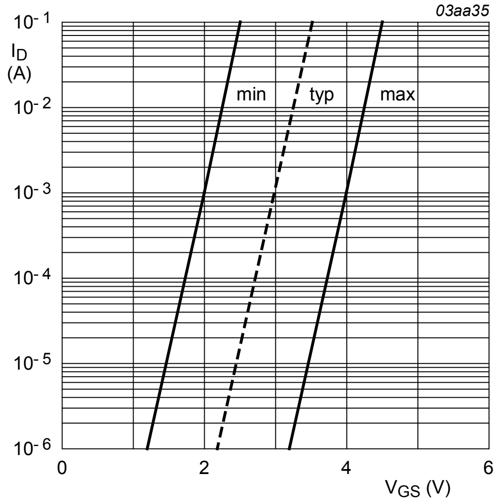



**Fig. 11. Sub-threshold drain current as a function of gate-source voltage**

$T_j = 25\ °C; V_{DS} = 5V$

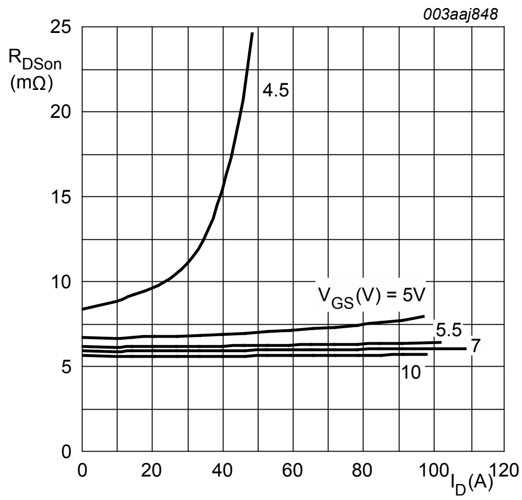



**Fig. 12. Drain-source on-state resistance as a function of drain current; typical values**

$T_j = 25\ °C$

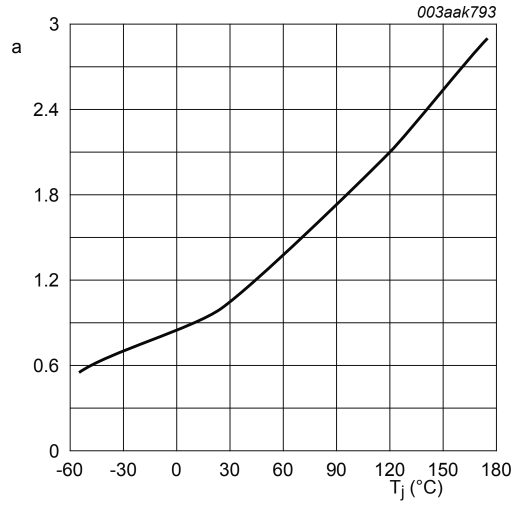



**Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature**

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

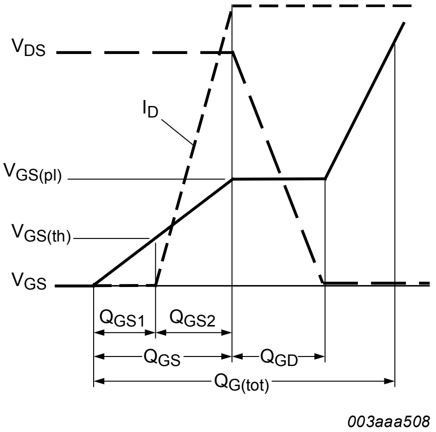



**Fig. 14. Gate charge waveform definitions**

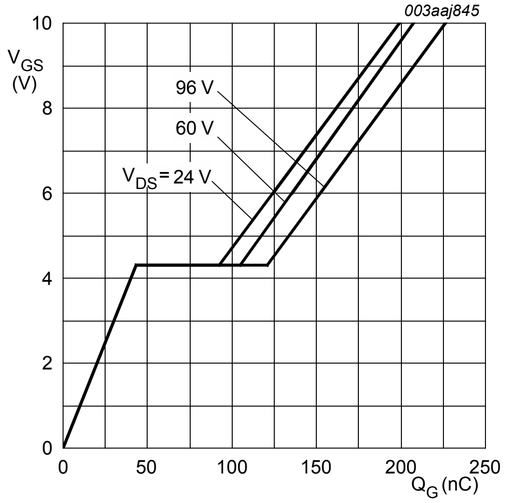



**Fig. 15. Gate-source voltage as a function of gate charge; typical values**

$T_j = 25\,°C; I_D = 25\,A$

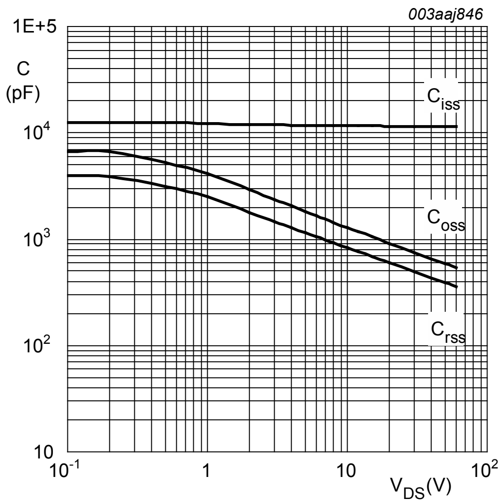



**Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

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

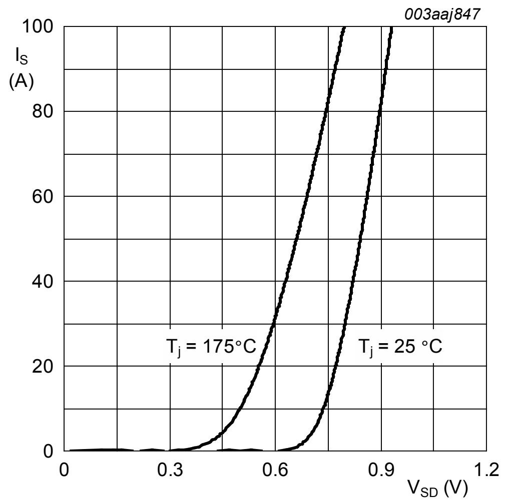
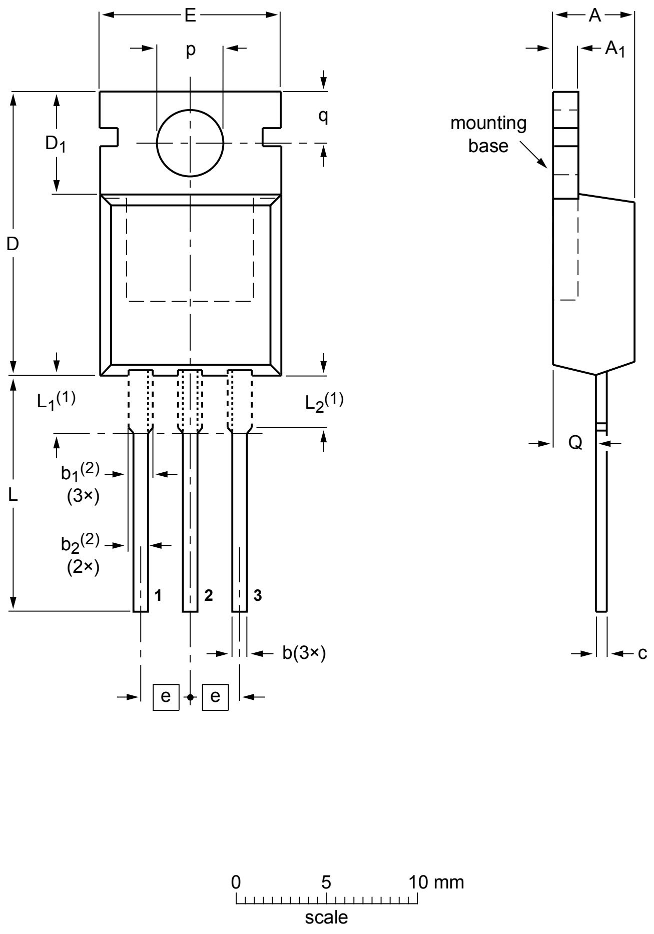



**Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values**

$V_{GS} = 0\,V$

# 10. 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 TO-220AB (SOT78)

# 11. Legal information

## 11.1 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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## 12. Contents





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