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Team Nexperia

PSMN7R6-60PS

N-channel 60 V 7.8 m Ω standard level MOSFET

Rev. 03 — 28 October 2010

Product data sheet

1. Product profile

1.1 General description

Standard level N-channel MOSFET in a TO-220 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 converters
- Motor control
- Load switching
- Server power supplies

1.4 Quick reference data

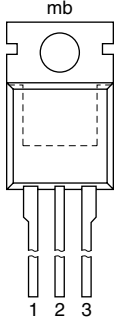
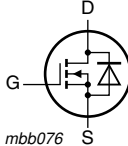
Table 1. Quick reference data

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--|---|-----|------|-----|------------|
| V _{DS} | drain-source voltage | T _j ≥ 25 °C; T _j ≤ 175 °C | - | - | 60 | V |
| I _D | drain current | T _{mb} = 25 °C; V _{GS} = 10 V; see Figure 1 | - | - | 92 | A |
| P _{tot} | total power dissipation | T _{mb} = 25 °C; see Figure 2 | - | - | 149 | W |
| Static characteristics | | | | | | |
| R _{DS(on)} | drain-source on-state resistance | V _{GS} = 10 V; I _D = 25 A; T _j = 25 °C; see Figure 13 ; see Figure 9 | - | 5.9 | 7.8 | m Ω |
| Dynamic characteristics | | | | | | |
| Q _{GD} | gate-drain charge | V _{GS} = 10 V; I _D = 25 A; V _{DS} = 30 V; see Figure 15 ; see Figure 14 | - | 10.6 | - | nC |
| Avalanche ruggedness | | | | | | |
| E _{DS(AL)S} | non-repetitive drain-source avalanche energy | V _{GS} = 10 V; T _{j(initial)} = 25 °C; I _D = 92 A; V _{sup} ≤ 100 V; R _{GS} = 50 Ω ; unclamped | - | - | 110 | mJ |



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

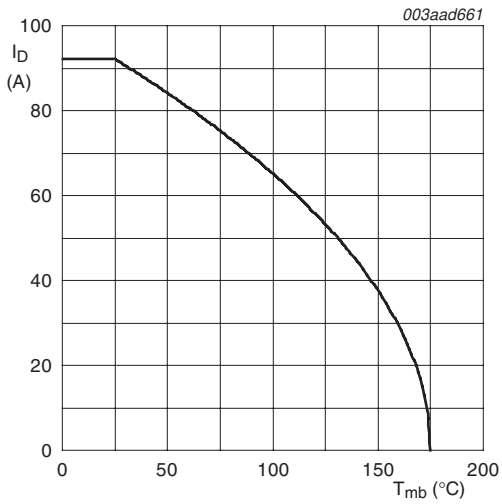
| Type number | Package | | |
|--------------|----------|--|---------|
| | Name | Description | Version |
| PSMN7R6-60PS | TO-220AB | plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB | SOT78 |

4. Limiting values

Table 4. Limiting values

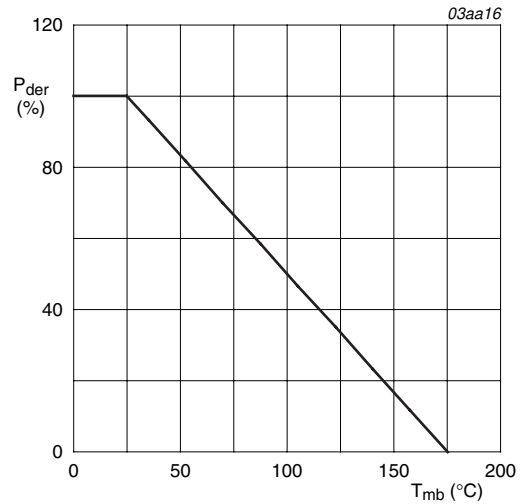
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------------------------|--|--|-----|-----|------|
| V_{DS} | drain-source voltage | $T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$ | - | 60 | V |
| V_{DGR} | drain-gate voltage | $R_{GS} = 20\text{ k}\Omega$ | - | 60 | V |
| V_{GS} | gate-source voltage | | -20 | 20 | V |
| I_D | drain current | $V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; see Figure 1 | - | 65 | A |
| | | $V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; see Figure 1 | - | 92 | A |
| I_{DM} | peak drain current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; see Figure 3 | - | 389 | A |
| P_{tot} | total power dissipation | $T_{mb} = 25\text{ °C}$; see Figure 2 | - | 149 | W |
| T_{stg} | storage temperature | | -55 | 175 | °C |
| T_j | junction temperature | | -55 | 175 | °C |
| Source-drain diode | | | | | |
| I_S | source current | $T_{mb} = 25\text{ °C}$ | - | 92 | A |
| I_{SM} | peak source current | pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$ | - | 389 | A |
| Avalanche ruggedness | | | | | |
| $E_{DS(AL)S}$ | non-repetitive drain-source avalanche energy | $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $I_D = 92\text{ A}$; $V_{sup} \leq 100\text{ V}$; $R_{GS} = 50\text{ }\Omega$; unclamped | - | 110 | mJ |



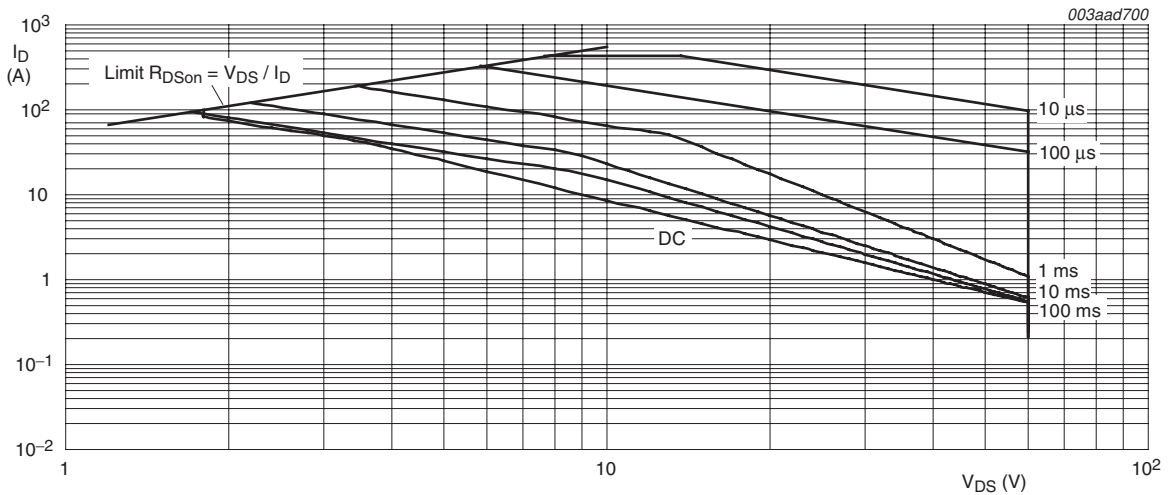
$$V_{GS} \geq 10V$$

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



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

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



$$T_{mb} = 25^{\circ}C; I_{DM} \text{ is a single pulse}$$

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 | - | 0.49 | 1.01 | K/W |

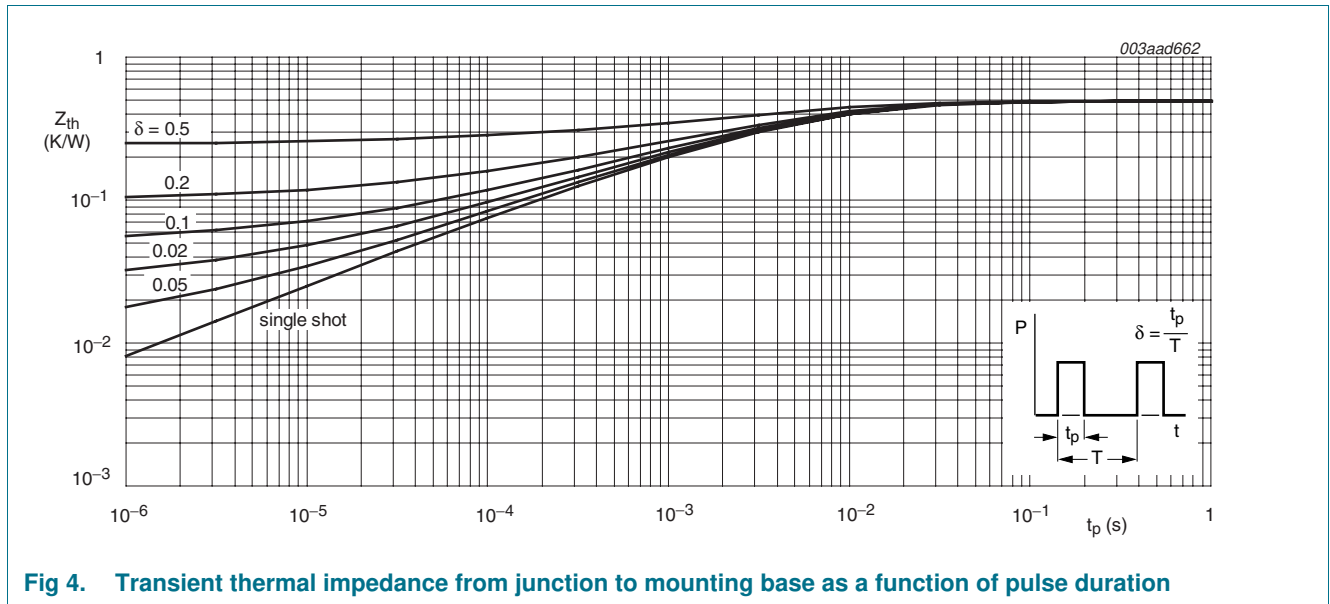


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

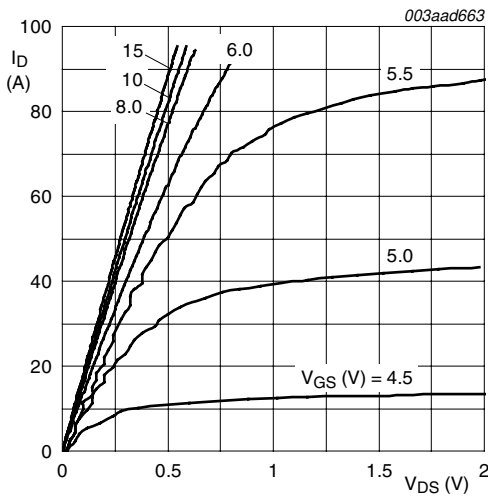
6. Characteristics

Table 6. Characteristics

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|-----------------------------------|--|-----|------|-----|---------------|
| Static characteristics | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$ | 54 | - | - | V |
| | | $I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | 60 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11 | 2 | 3 | 4 | V |
| V_{GSth} | gate-source threshold voltage | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 11 | 1 | - | - | V |
| | | $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see Figure 11 | - | - | 4.6 | V |
| I_{DSS} | drain leakage current | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 0.05 | 10 | μA |
| | | $V_{DS} = 60 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$ | - | - | 100 | μA |
| I_{GSS} | gate leakage current | $V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 2 | 100 | nA |
| | | $V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ | - | 2 | 100 | nA |
| R_{DSon} | drain-source on-state resistance | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 12 | - | 13.3 | 18 | mΩ |
| | | $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 13 ; see Figure 9 | - | 5.9 | 7.8 | mΩ |
| R_G | gate resistance | $f = 1 \text{ MHz}$ | - | 0.98 | - | Ω |
| Dynamic characteristics | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D = 25 \text{ A}; V_{DS} = 30 \text{ V}; V_{GS} = 10 \text{ V};$ see Figure 14 ; see Figure 15 | - | 38.7 | - | nC |
| Q_{GS} | gate-source charge | | - | 12.9 | - | nC |
| $Q_{GS(th)}$ | pre-threshold gate-source charge | | - | 6.9 | - | nC |
| $Q_{GS(th-pl)}$ | post-threshold gate-source charge | | - | 6 | - | nC |
| Q_{GD} | gate-drain charge | $I_D = 25 \text{ A}; V_{DS} = 30 \text{ V}; V_{GS} = 10 \text{ V};$ see Figure 15 ; see Figure 14 | - | 10.6 | - | nC |
| $V_{GS(pl)}$ | gate-source plateau voltage | $I_D = 25 \text{ A}; V_{DS} = 30 \text{ V};$ see Figure 14 ; see Figure 15 | - | 5.6 | - | V |
| C_{iss} | input capacitance | $V_{DS} = 30 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 16 ; see Figure 8 | - | 2651 | - | pF |
| C_{oss} | output capacitance | $V_{DS} = 30 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 16 | - | 342 | - | pF |
| C_{rss} | reverse transfer capacitance | $V_{DS} = 30 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 16 ; see Figure 8 | - | 183 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS} = 30 \text{ V}; R_L = 1.2 \text{ }^\circ\Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 4.7 \text{ }^\circ\Omega$ | - | 19 | - | ns |
| t_r | rise time | | - | 21 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | - | 37 | - | ns |
| t_f | fall time | | - | 13 | - | ns |

Table 6. Characteristics ...continued

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------------|-----------------------|---|-----|------|-----|------|
| Source-drain diode | | | | | | |
| V_{SD} | source-drain voltage | $I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ °C}$; see Figure 17 | - | 0.86 | 1.2 | V |
| t_{rr} | reverse recovery time | $I_S = 25\text{ A}$; $dI_S/dt = 100\text{ A}/\mu\text{s}$; | - | 40.4 | - | ns |
| Q_r | recovered charge | $V_{GS} = 0\text{ V}$; $V_{DS} = 30\text{ V}$ | - | 56 | - | nC |



$T_j = 25\text{ °C}$; $t_p = 300\text{ }\mu\text{s}$

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

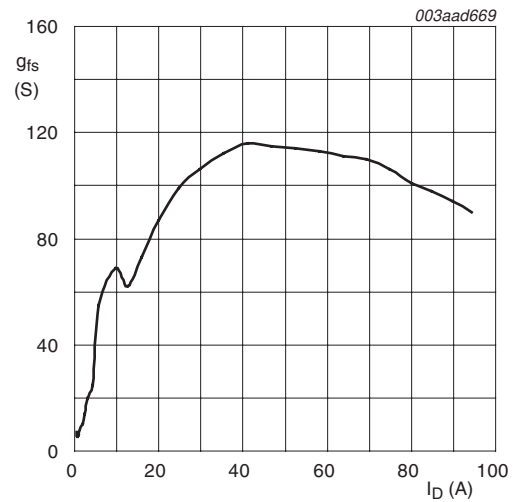
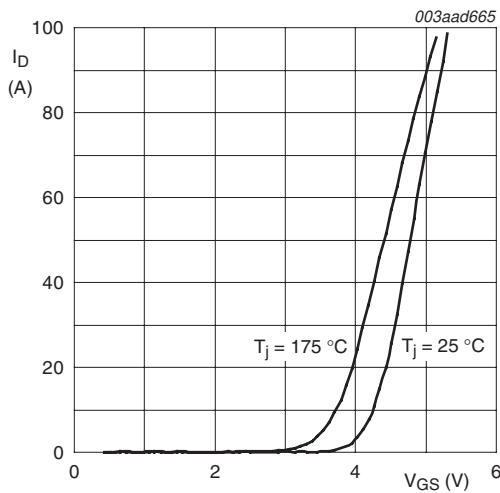
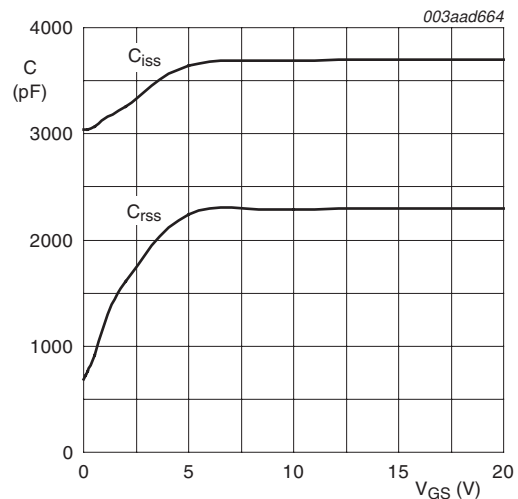


Fig 6. Forward transconductance as a function of drain current; typical values



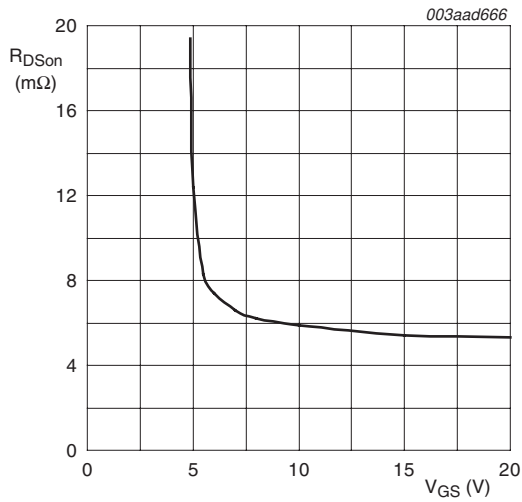
$V_{DS} = 25\text{ V}$

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



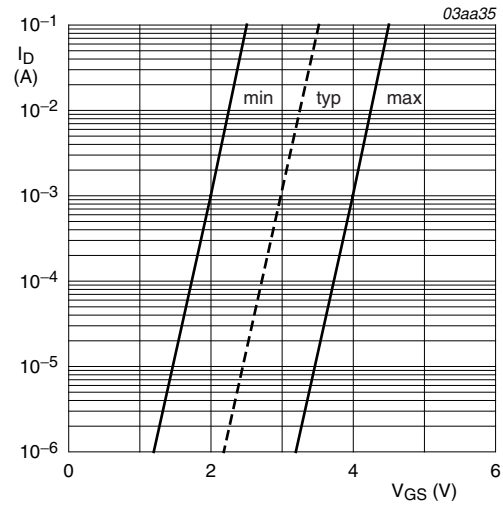
$V_{DS} = 0\text{ V}$; $f = 1\text{ MHz}$

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



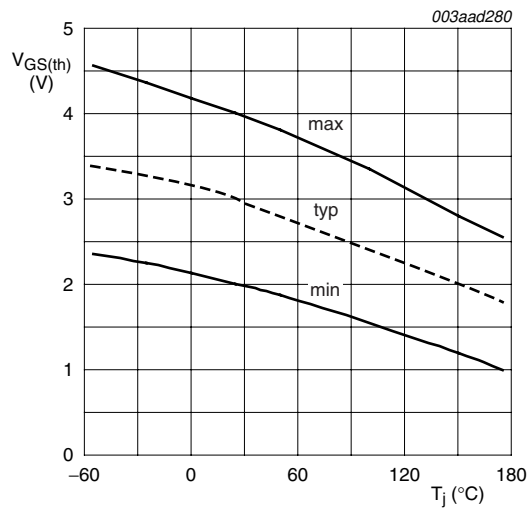
$T_j = 25^\circ\text{C}$

Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



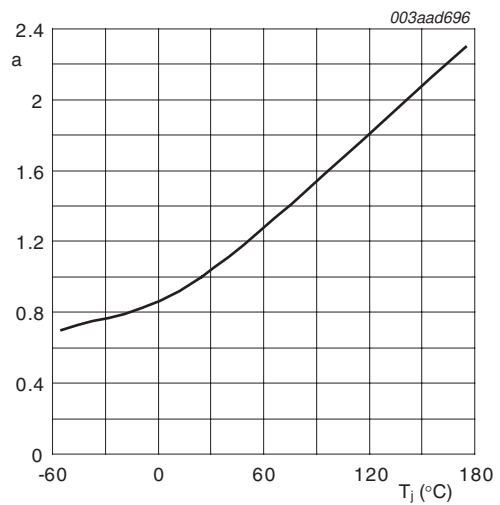
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$

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



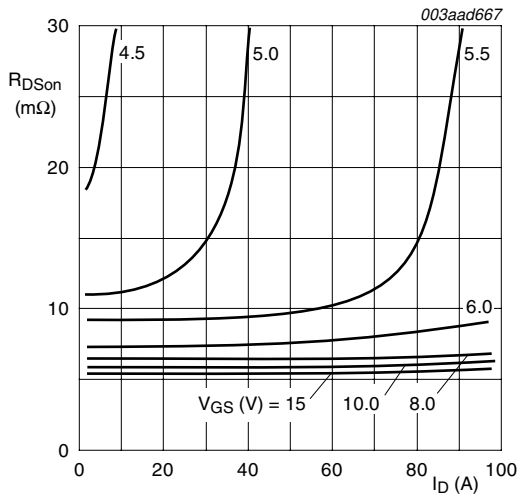
$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

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



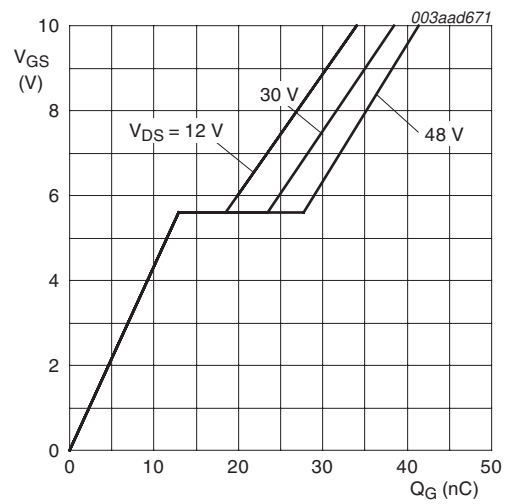
$$a = \frac{R_{DS(on)}}{R_{DS(on)@25^\circ\text{C}}}$$

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



$T_j = 25^\circ\text{C}; t_p = 300\mu\text{s}$

Fig 13. Drain-source on-state resistance as a function of drain current; typical values



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

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

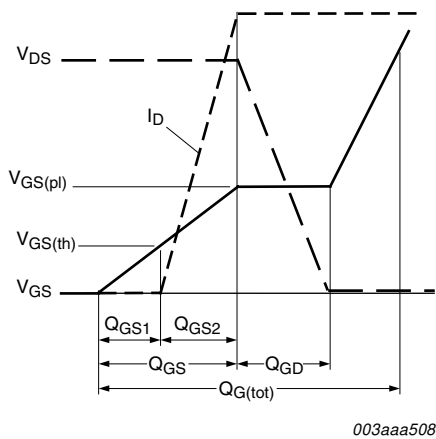
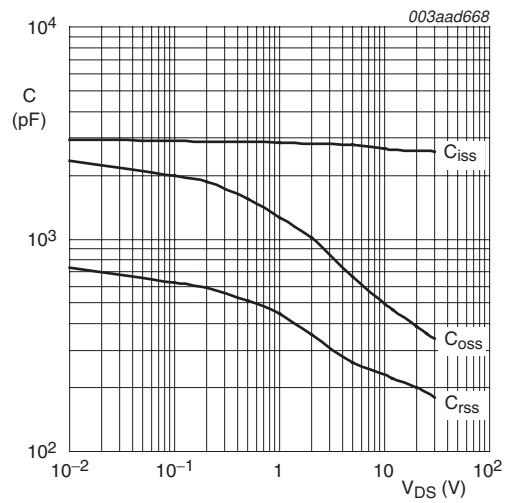


Fig 15. Gate charge waveform definitions



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

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

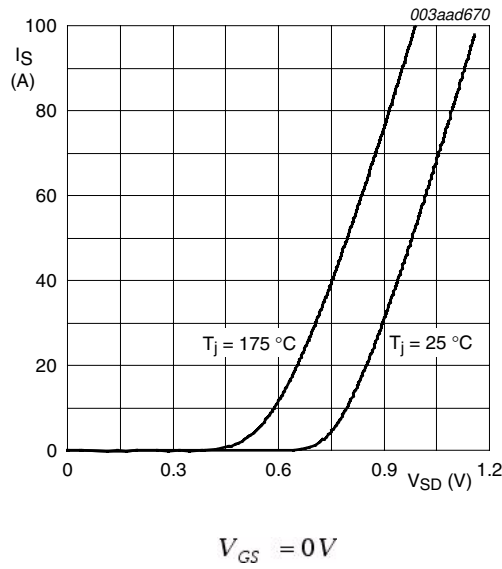


Fig 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

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

SOT78

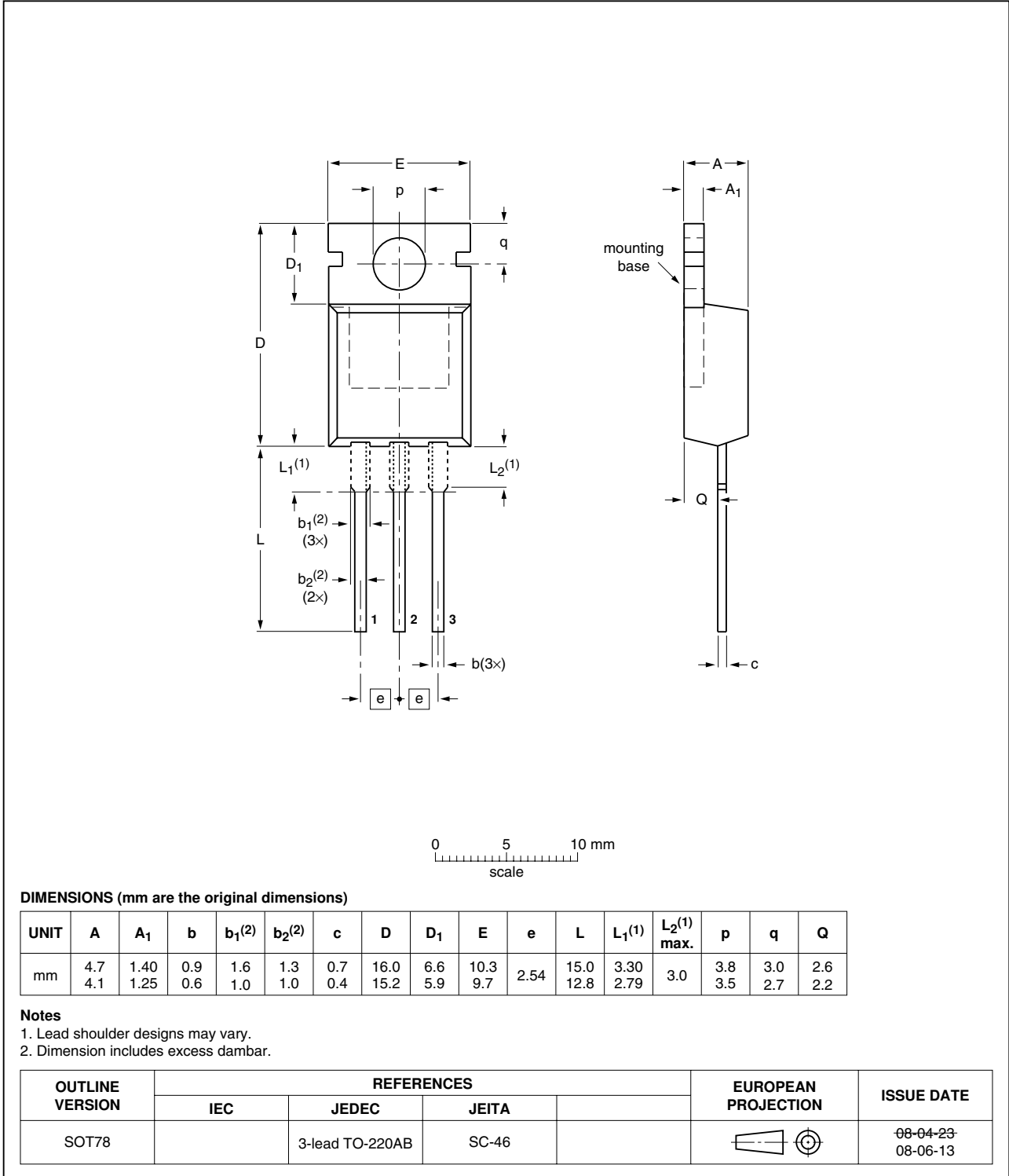


Fig 18. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|-------------------------------|--------------------|---------------|------------------|
| PSMN7R6-60PS v.3 | 20101028 | Product data sheet | - | PSMN7R6-60PS v.2 |
| Modifications: | • Various changes to content. | | | |
| PSMN7R6-60PS v.2 | 20100122 | 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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11. Contents

| | | |
|-----------|--|-----------|
| 1 | Product profile | 1 |
| 1.1 | General description | 1 |
| 1.2 | Features and benefits | 1 |
| 1.3 | Applications | 1 |
| 1.4 | Quick reference data | 1 |
| 2 | Pinning information | 2 |
| 3 | Ordering information | 2 |
| 4 | Limiting values | 2 |
| 5 | Thermal characteristics | 4 |
| 6 | Characteristics | 5 |
| 7 | Package outline | 10 |
| 8 | Revision history | 11 |
| 9 | Legal information | 12 |
| 9.1 | Data sheet status | 12 |
| 9.2 | Definitions | 12 |
| 9.3 | Disclaimers | 12 |
| 9.4 | Trademarks | 13 |
| 10 | Contact information | 13 |

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