

# PSMN2R2-40PS

## N-channel 40 V 2.1 mΩ standard level MOSFET

Rev. 02 — 28 September 2009

Product data sheet

## 1. Product profile

### 1.1 General description

Standard 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 standard level gate drive sources

### 1.3 Applications

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

### 1.4 Quick reference data

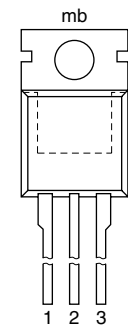
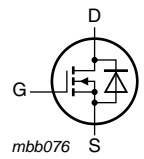
Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	-	40	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a> and <a href="#">3</a>	-	-	100	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	-	306	W
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}$ ; $I_D = 80\text{ A}$ ; $V_{DS} = 20\text{ V}$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	25	-	nC
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 6</a> and <a href="#">13</a>	<a href="#">[1]</a>	-	1.75	2.1 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		
			<b>SOT78</b> <b>(TO-220AB)</b>	

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PSMN2R2-40PS	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 4. Limiting values

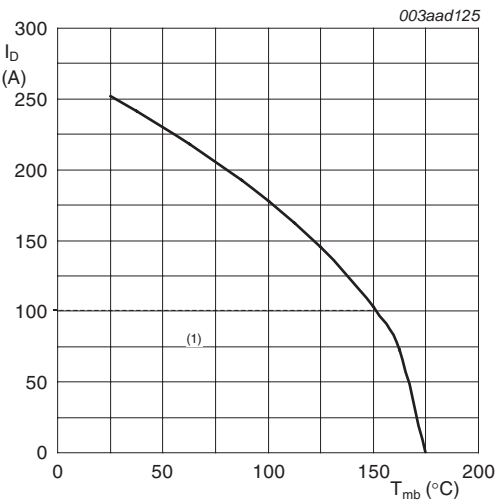
Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ }^{\circ}\text{C}$ ; $T_j \leq 175\text{ }^{\circ}\text{C}$	-	40	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25\text{ }^{\circ}\text{C}$ ; $T_j \leq 175\text{ }^{\circ}\text{C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	40	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 1</a>	-	100	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 1</a> and <a href="#">3</a>	-	100	A
$I_{DM}$	peak drain current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 3</a>	-	962	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 2</a>	-	306	W
$T_{stg}$	storage temperature		-55	175	$^{\circ}\text{C}$
$T_j$	junction temperature		-55	175	$^{\circ}\text{C}$

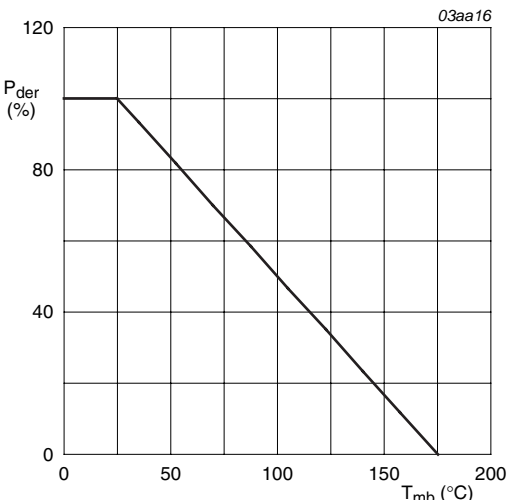
Table 4. Limiting values ...continued  
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
Source-drain diode					
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	-	100	A
I <sub>SM</sub>	peak source current	t <sub>p</sub> ≤ 10 μs; pulsed; T <sub>mb</sub> = 25 °C	-	962	A
Avalanche ruggedness					
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; I <sub>D</sub> = 100 A; V <sub>sup</sub> ≤ 40 V; unclamped; R <sub>GS</sub> = 50 Ω	-	1.24	J



$$I_{der} = \frac{I_D}{I_{D(25^{\circ}\text{C})}} \times 100\%$$

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



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

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

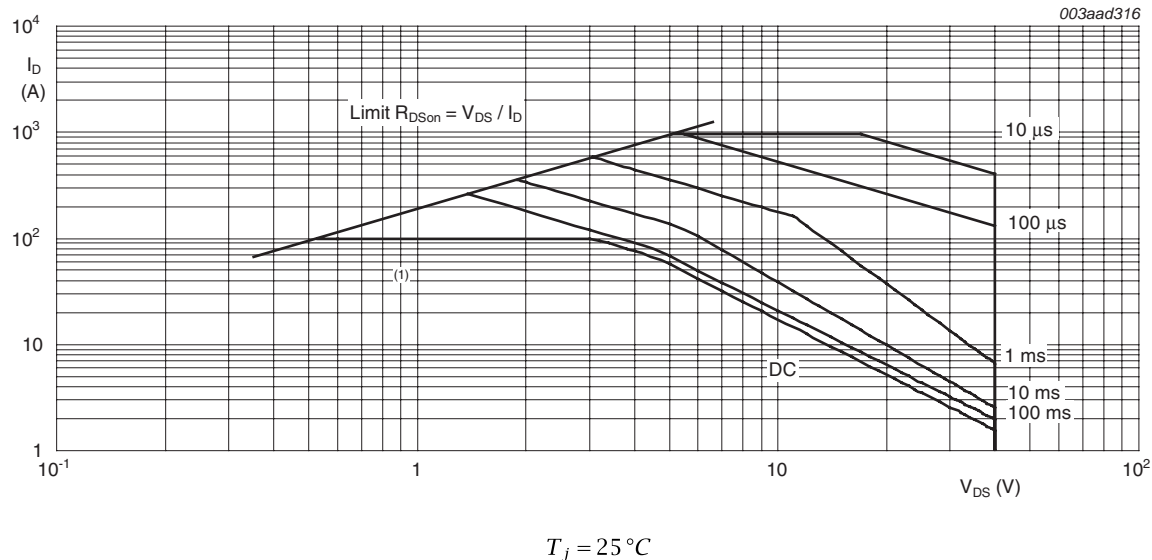


Fig 3. Safe operating area; continuouse and peak drain currents as a function of drain-source voltage

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 <a href="#">Figure 4</a>	-	0.25	0.5	K/W

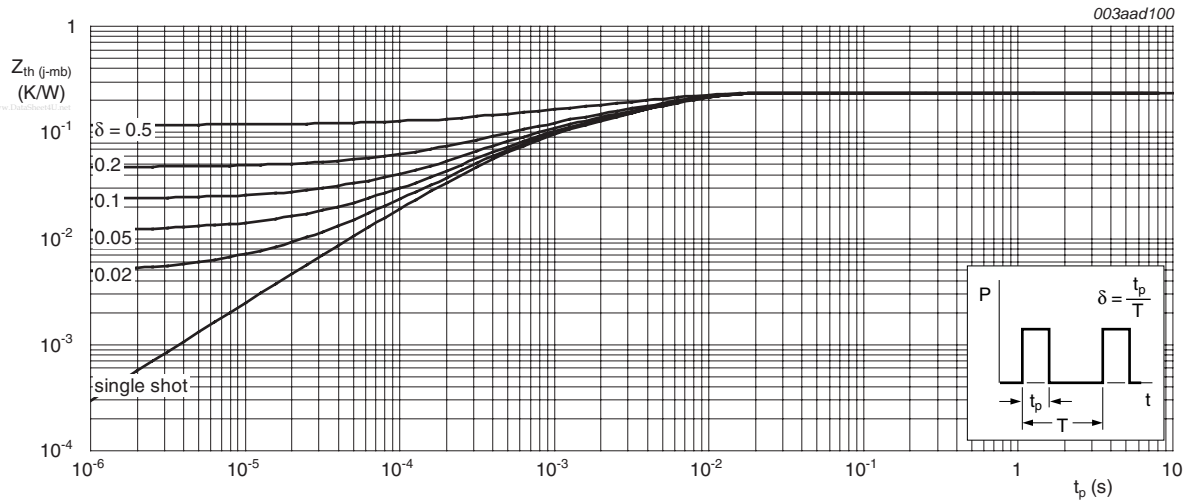


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 6. Characteristics

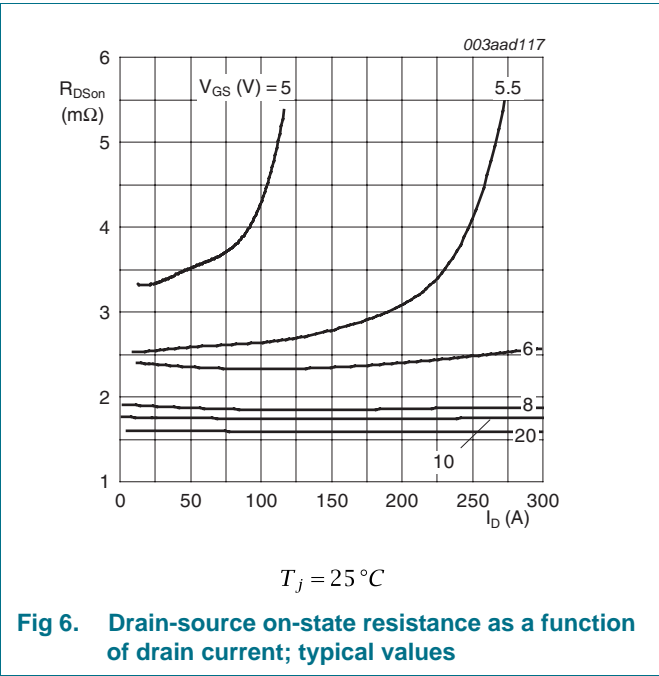
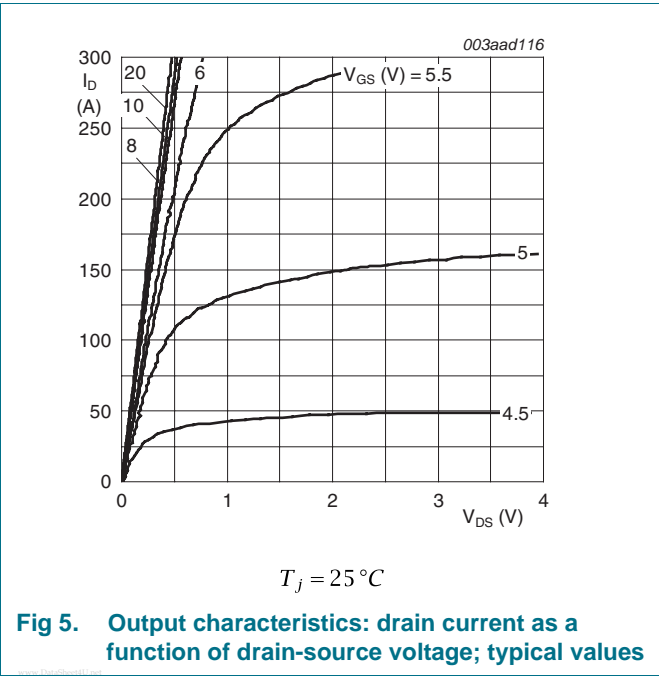
**Table 6. Characteristics**

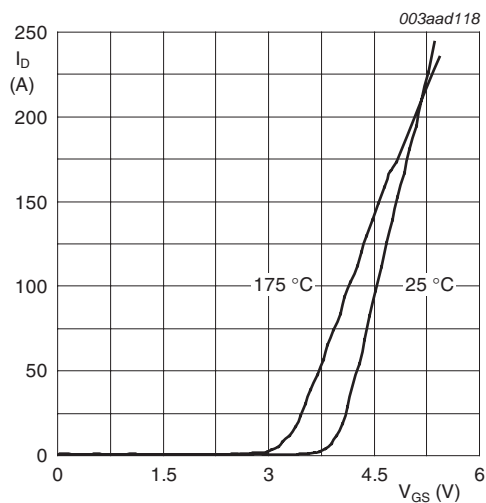
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = -55\ ^\circ C$	36	-	-	V
		$I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55\ ^\circ C$ ; see <a href="#">Figure 11</a>	-	-	4.6	V
		$I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 175\ ^\circ C$ ; see <a href="#">Figure 11</a>	1	-	-	V
		$I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 12</a> and <a href="#">11</a>	2	3	4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 40\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$	-	-	10	$\mu A$
		$V_{DS} = 40\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 125\ ^\circ C$	-	-	200	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$	-	-	100	nA
		$V_{GS} = -20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 100\ ^\circ C$ ; see <a href="#">Figure 13</a>	-	2.75	3.3	mΩ
		$V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 175\ ^\circ C$ ; see <a href="#">Figure 13</a>	-	3.8	4.6	mΩ
		$V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 6</a> and <a href="#">13</a>	<a href="#">[2]</a>	1.75	2.1	mΩ
$R_G$	internal gate resistance (AC)		-	1	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 0\ A$ ; $V_{DS} = 0\ V$ ; $V_{GS} = 10\ V$	-	110	-	nC
		$I_D = 80\ A$ ; $V_{DS} = 20\ V$ ; $V_{GS} = 10\ V$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	130	-	nC
$Q_{GS}$	gate-source charge		-	42	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	24	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	18	-	nC
$Q_{GD}$	gate-drain charge		-	25	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 80\ A$ ; $V_{DS} = 20\ V$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	4.95	-	V
$C_{iss}$	input capacitance	$V_{DS} = 20\ V$ ; $V_{GS} = 0\ V$ ; $f = 1\ MHz$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 16</a>	-	8423	-	pF
$C_{oss}$	output capacitance		-	1671	-	pF
$C_{rss}$	reverse transfer capacitance		-	814	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\ V$ ; $R_L = 0.25\ \Omega$ ; $V_{GS} = 10\ V$ ; $R_{G(ext)} = 1.5\ \Omega$	-	33.2	-	ns
$t_r$	rise time		-	40.4	-	ns
$t_{d(off)}$	turn-off delay time		-	66.6	-	ns
$t_f$	fall time		-	25.2	-	ns

Table 6. Characteristics ...continued

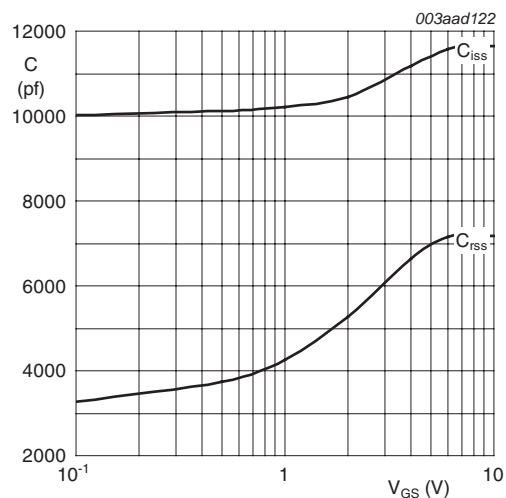
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$ ; see <a href="#">Figure 17</a>	-	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}$ ; $dI_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 20\text{ V}$	-	53.7	-	ns
$Q_r$	recovered charge	$I_S = 25\text{ A}$ ; $dI_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 20\text{ V}$ ; $T_j = 25\text{ }^{\circ}\text{C}$	-	80.75	-	nC

- [1] Tested to JEDEC standards where applicable.  
[2] Measured 3 mm from package.

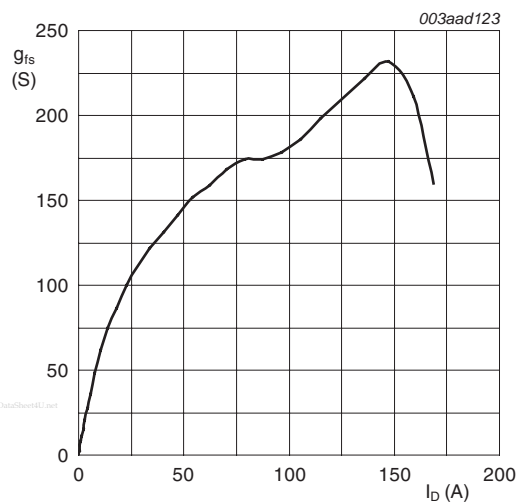




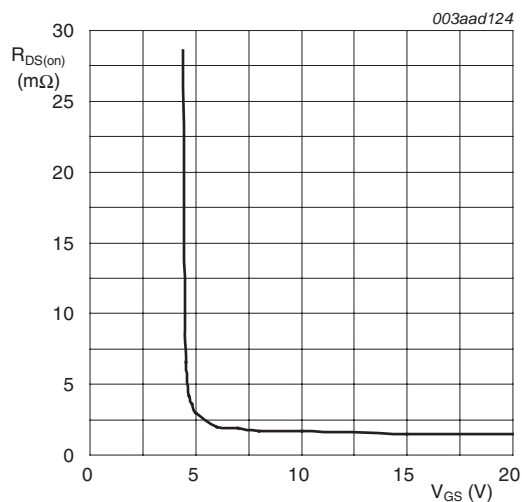
**Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



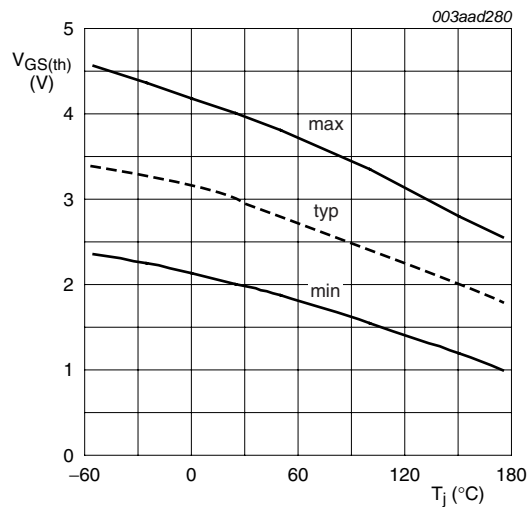
**Fig 8. Input and reverse transfer capacitances as a function of gate-source voltage; typical values**



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

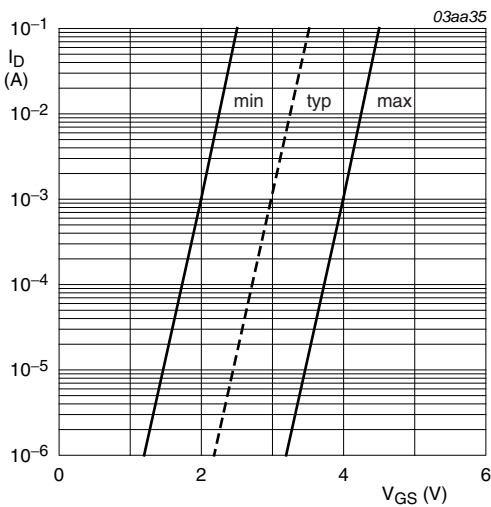


**Fig 10. Drain-source on-state resistance as a function of gate-source voltage; typical values**



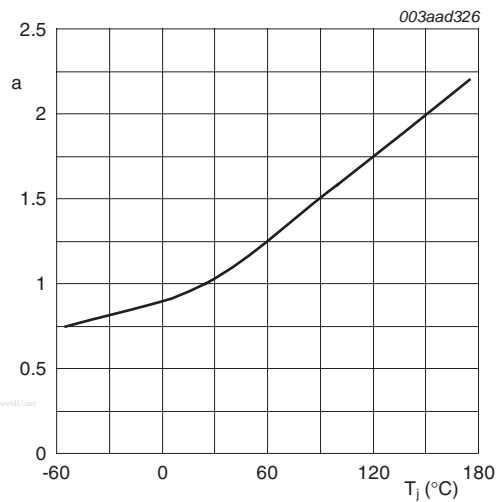
$$I_D = 1\text{ mA}; V_{DS} = V_{GS}$$

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



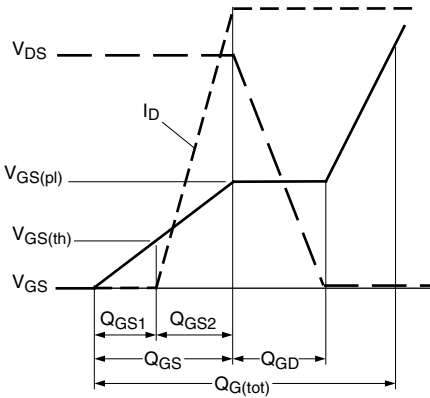
$$T_j = 25\text{ °C}; V_{DS} = 5\text{ V}$$

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



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

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



003aaa508

Fig 14. Gate charge waveform definitions



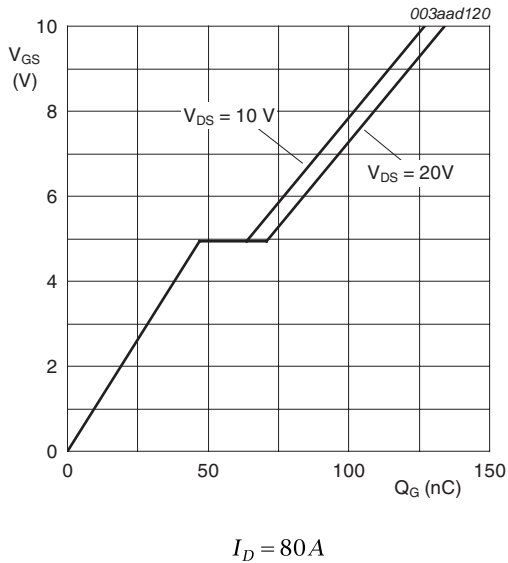


Fig 15. Gate-source voltage as a function of gate charge; typical values

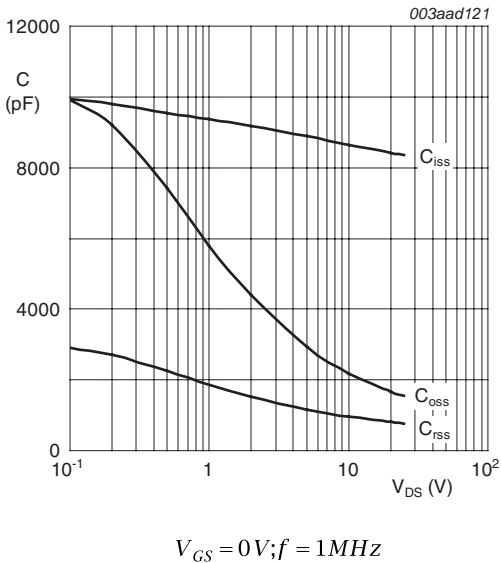


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

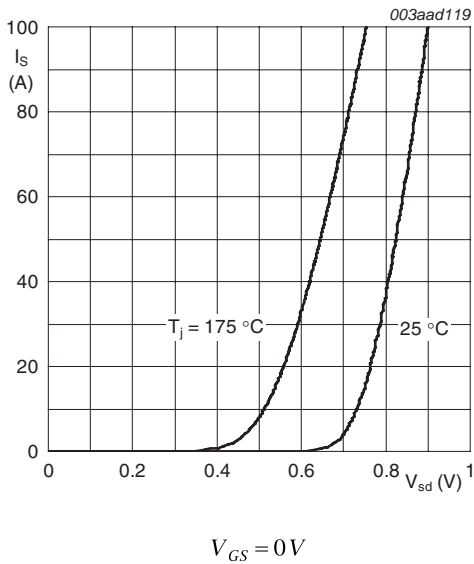


Fig 17. Source current as a function of source-drain voltage; typical values

7. Package outline

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

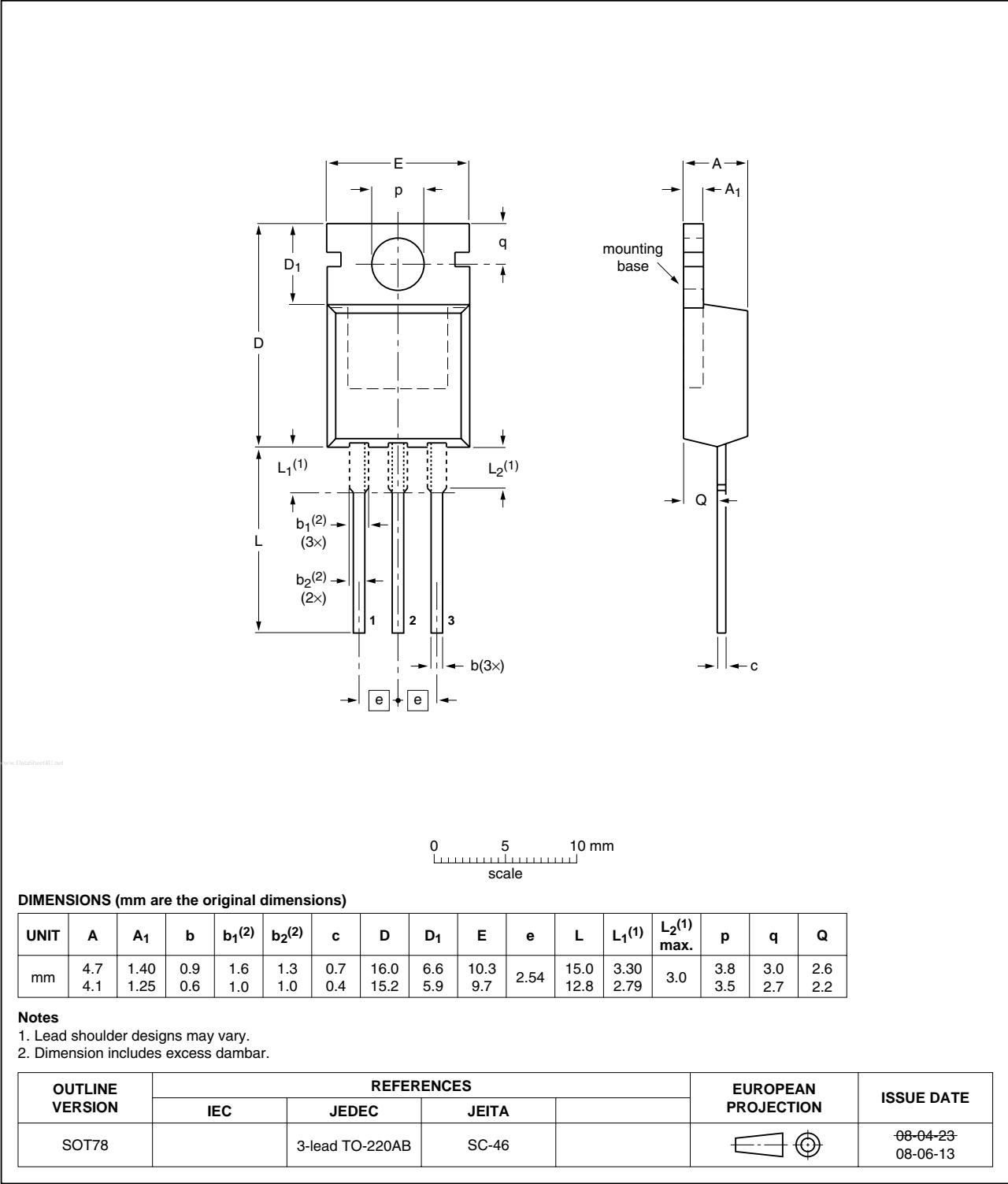


Fig 18. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN2R2-40PS_2	20090928	Product data sheet	-	PSMN2R2-40PS_1
Modifications:	• Various changes to content.			
PSMN2R2-40PS_1	20090624	Product data sheet	-	-

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## 9. Legal information

### 9.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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