

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

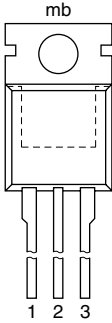
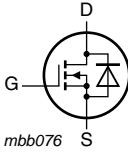
Table 1. Quick reference

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 Figure 1 and 3	-	-	100	A	
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ see Figure 2	-	-	306	W	
Dynamic characteristics							
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 80\text{ A};$ $V_{DS} = 20\text{ V};$ see Figure 14 and 15	-	25	-	nC	
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A};$ $T_j = 25\text{ °C};$ see Figure 6 and 13	[1]	-	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	 <p>SOT78 (TO-220AB)</p>	
2	D	drain		
3	S	source		
mb	D	drain		

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

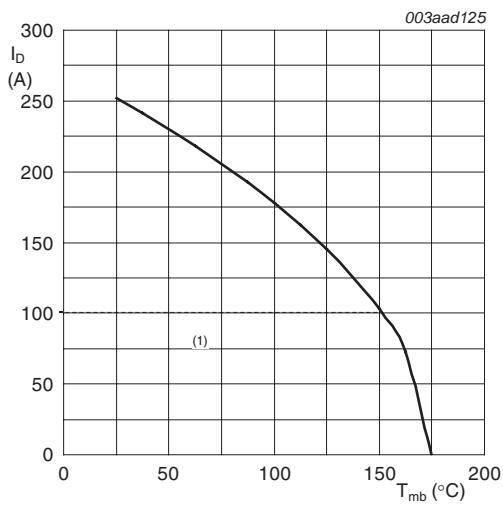
In accordance with the Absolute Maximum Rating System (IEC 60134).

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

Table 4. Limiting values ...continued

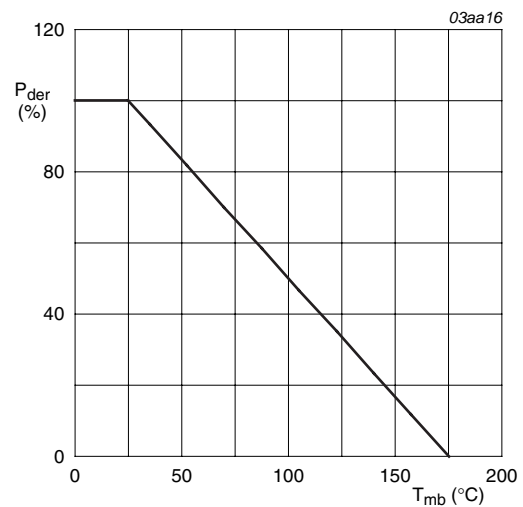
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$	-	100	A
I_{SM}	peak source current	$t_p \leq 10\text{ }\mu\text{s}$; pulsed; $T_{mb} = 25\text{ °C}$	-	962	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $I_D = 100\text{ A}$; $V_{sup} \leq 40\text{ V}$; unclamped; $R_{GS} = 50\text{ }\Omega$	-	1.24	J



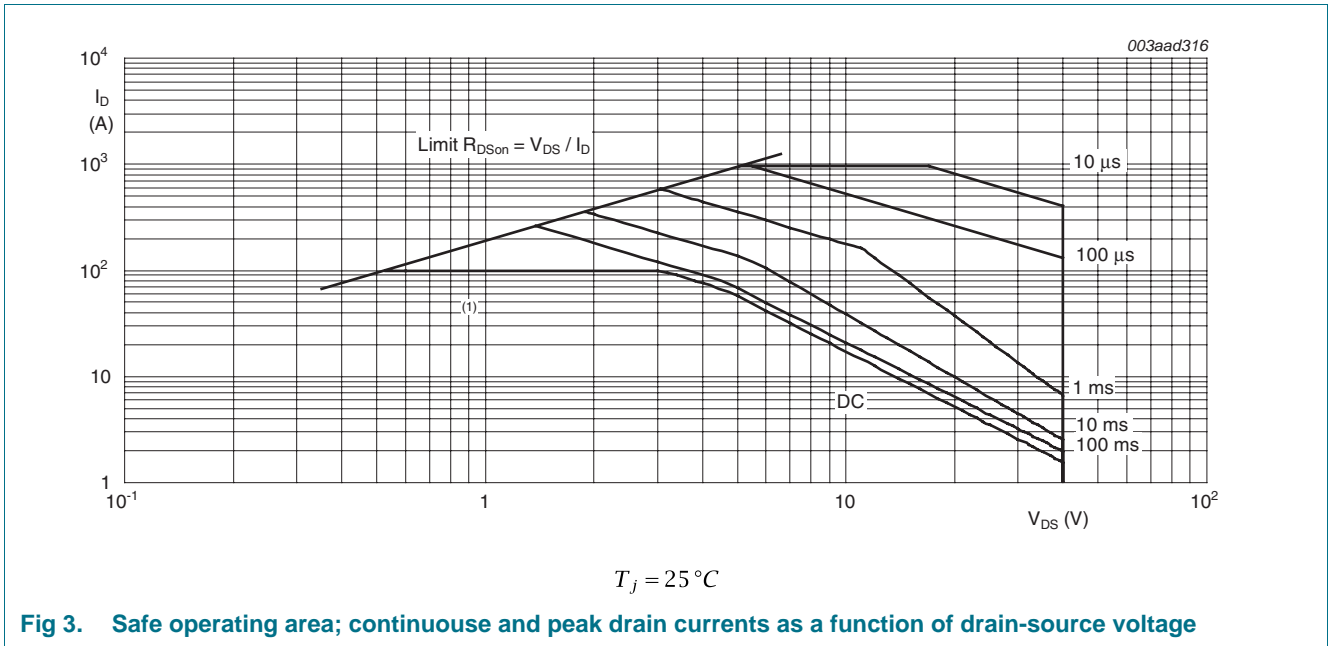
$$I_{der} = \frac{I_D}{I_{D(25^\circ\text{C})}} \times 100\%$$

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



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

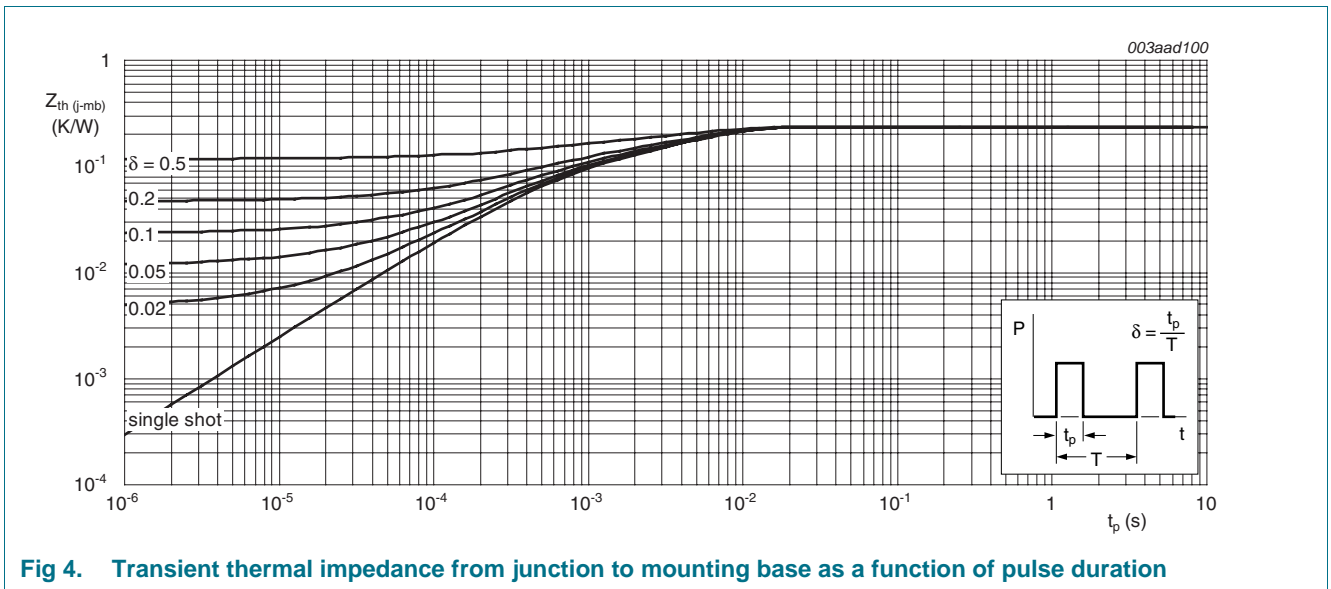
Fig 2. Normalized total power dissipation as a function of mounting base temperature



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	-	0.25	0.5	K/W



6. Characteristics

Table 6. Characteristics

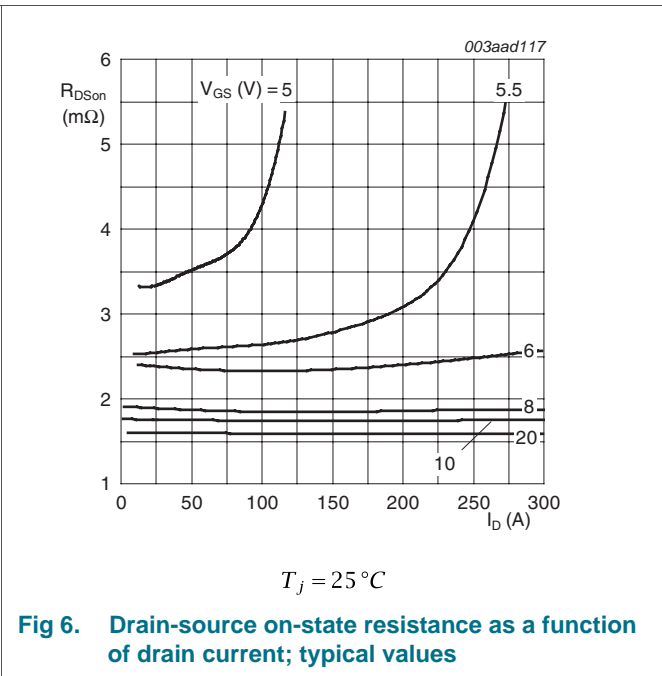
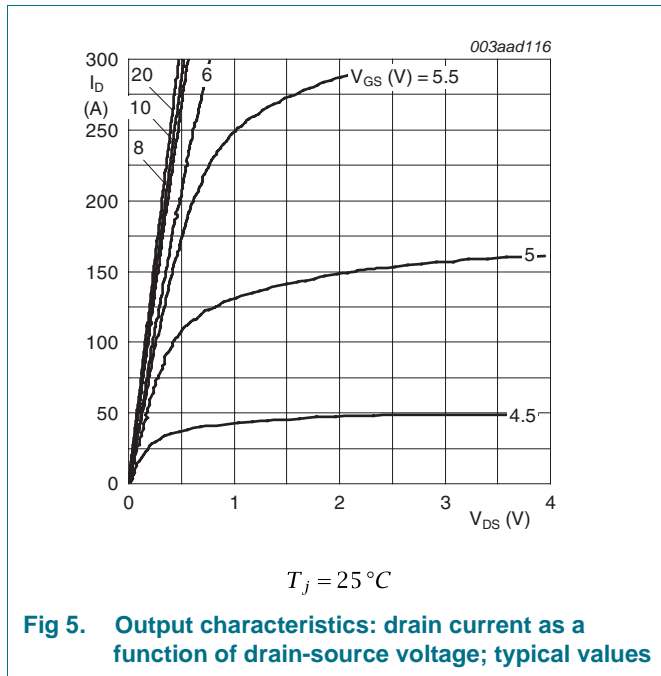
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	36	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see Figure 11	-	-	4.6	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 11	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 12 and 11	2	3	4	V
I_{DSS}	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	10	μA
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$	-	-	200	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 100 \text{ }^\circ\text{C};$ see Figure 13	-	2.75	3.3	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 13	-	3.8	4.6	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 6 and 13	[2]	-	1.75	2.1
R_G	internal gate resistance (AC)		-	1	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	110	-	nC
		$I_D = 80 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 10 \text{ V};$ see Figure 14 and 15	-	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	$I_D = 80 \text{ A}; V_{DS} = 20 \text{ V};$ see Figure 14 and 15	-	4.95	-	V
C_{iss}	input capacitance	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 16	-	8423	-	pF
C_{oss}	output capacitance		-	1671	-	pF
C_{riss}	reverse transfer capacitance		-	814	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 \text{ V}; R_L = 0.25 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 1.5 \text{ } \Omega$	-	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

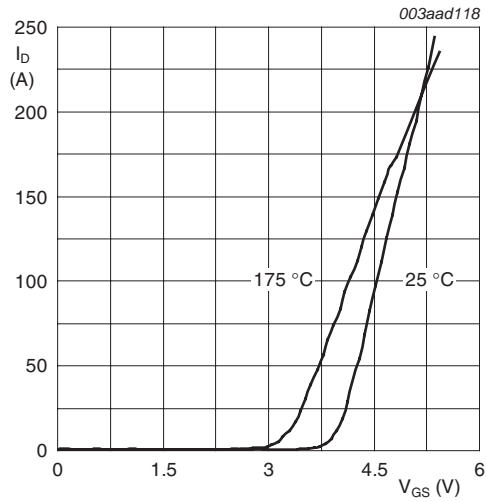
Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ °C}$; see Figure 17	-	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	$I_S = 25\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_j = 25\text{ °C}$	-	80.75	-	nC

[1] Tested to JEDEC standards where applicable.

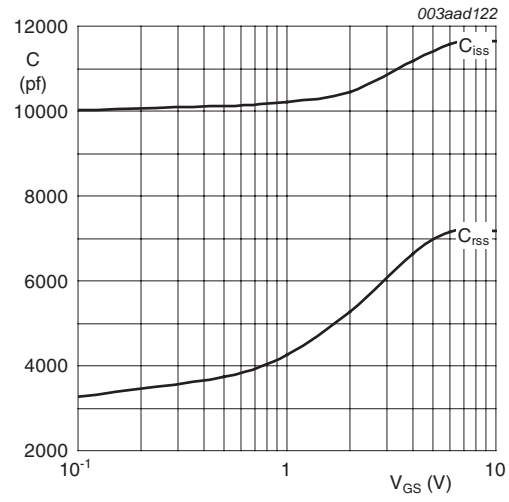
[2] Measured 3 mm from package.





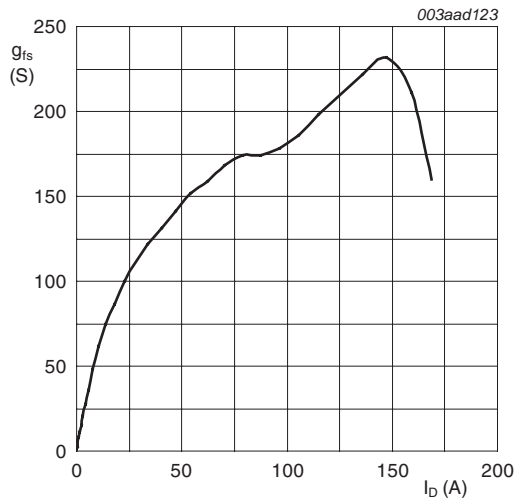
$$V_{DS} > I_D \times R_{DS(on)}$$

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



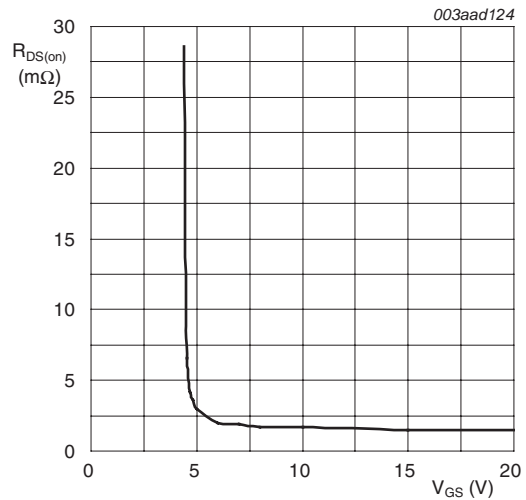
$$V_{DS} = 0V; f = 1MHz$$

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



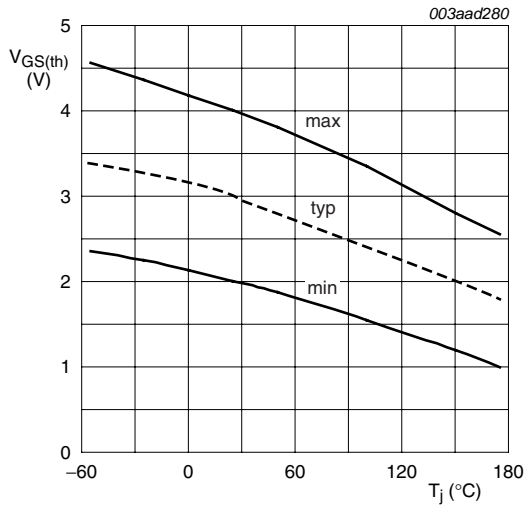
$$T_j = 25\text{ °C}; V_{DS} = 25V$$

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



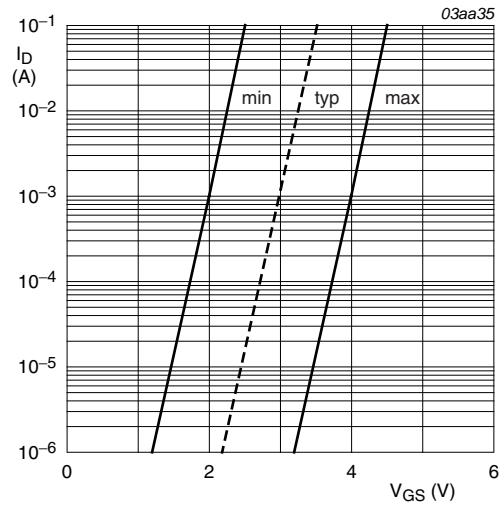
$$T_j = 25\text{ °C}; V_{DS} = 25V$$

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



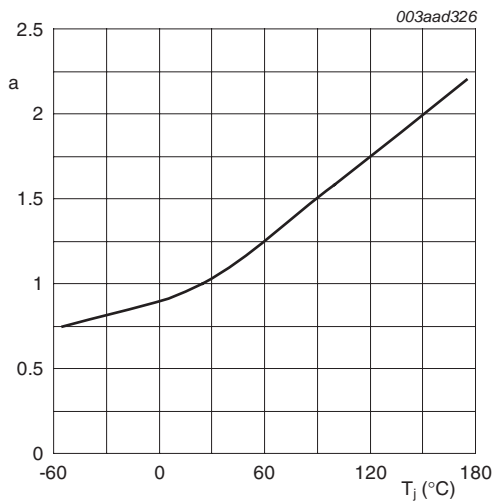
$$I_D = 1\text{ mA}; V_{DS} = V_{GS}$$

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



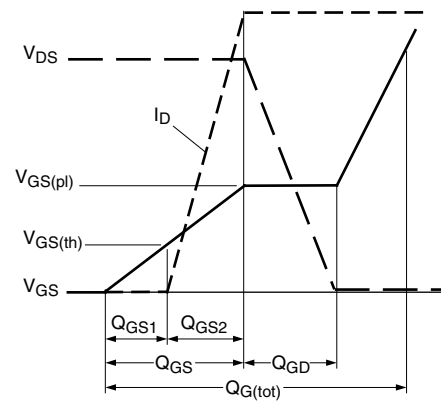
$$T_j = 25\text{ °C}; V_{DS} = 5\text{ V}$$

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



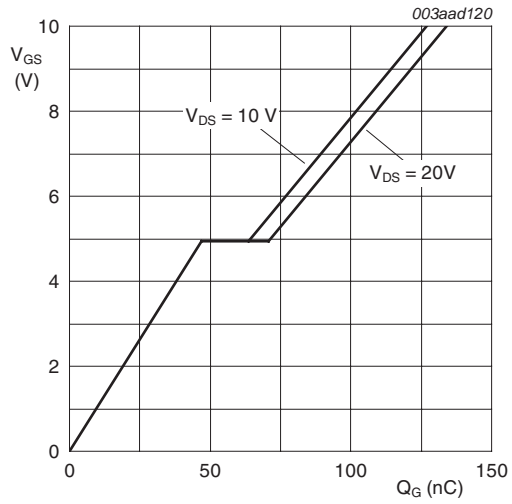
$$a = \frac{R_{DSon}}{R_{DSon(25\text{ °C})}}$$

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



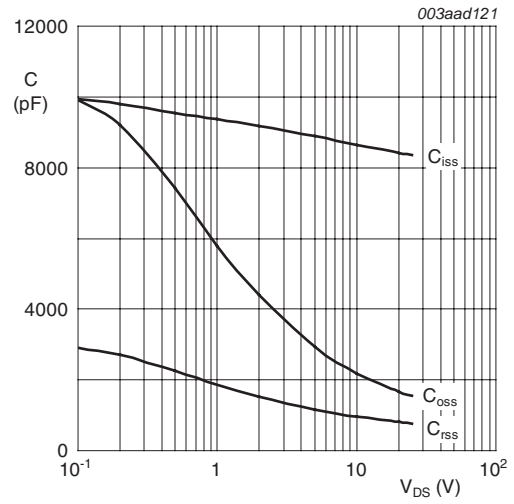
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Fig 14. Gate charge waveform definitions



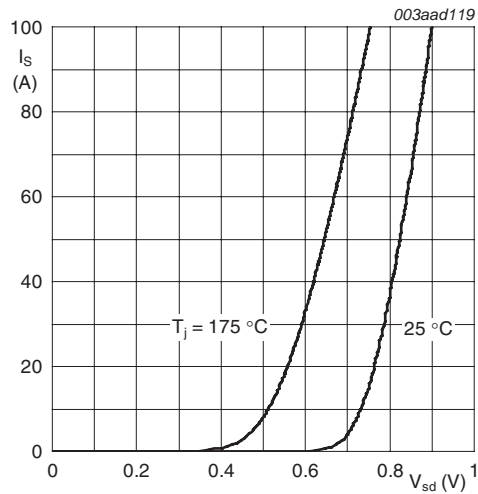
$I_D = 80\text{ A}$

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



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

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



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

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

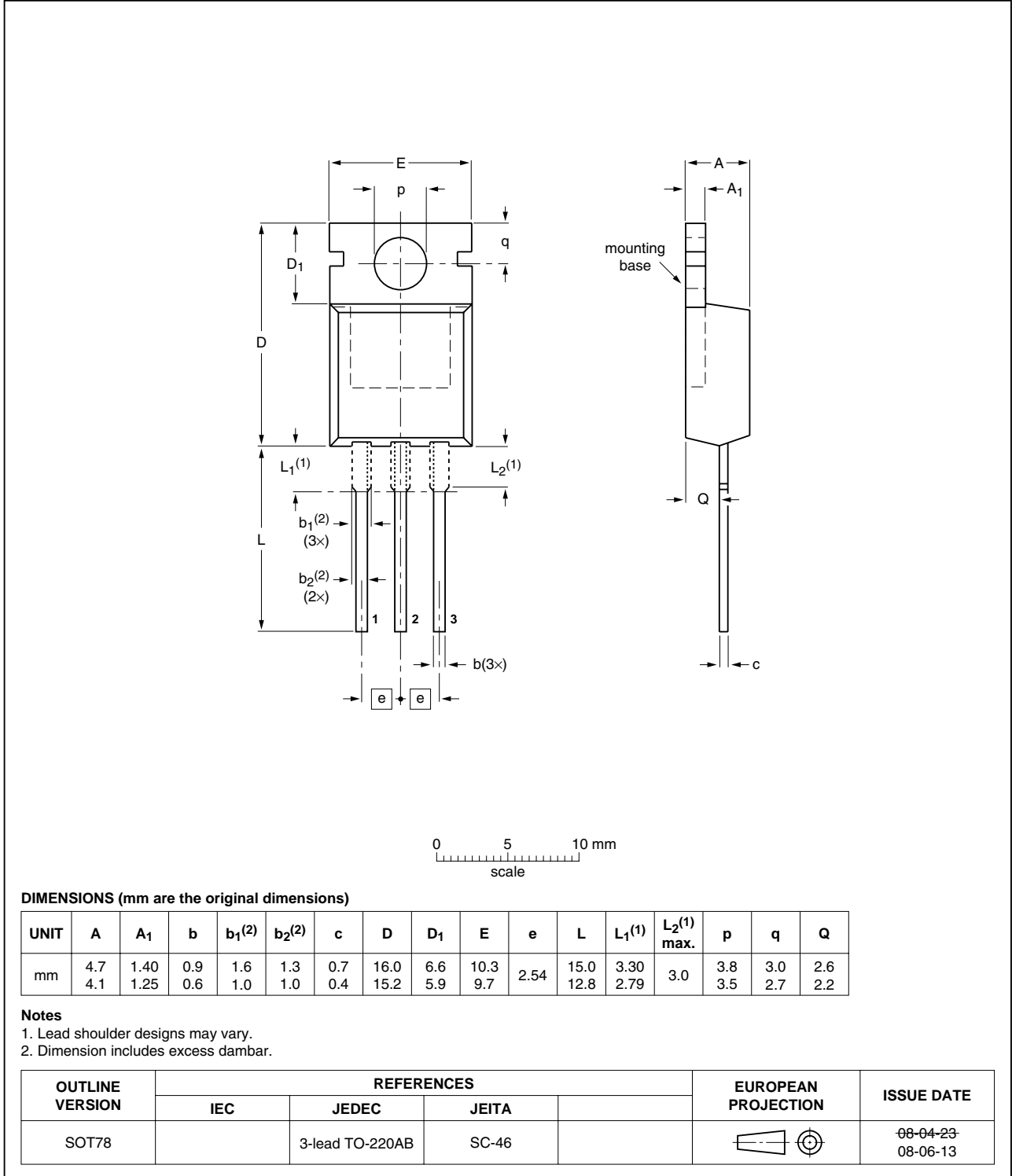


Fig 18. Package outline SOT78 (TO-220AB)

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	-	-

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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