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Kind regards,

Team Nexperia

PSMN4R5-40PS

N-channel 40 V 4.6 mΩ standard level MOSFET

Rev. 02 — 25 June 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

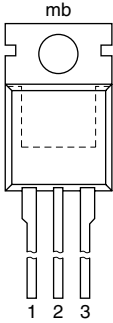
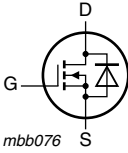
Table 1. Quick reference

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	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; see Figure 2	-	-	148	W
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; see Figure 14 ; see Figure 15	-	8.8	-	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 13 ;	[1]	-	3.9	4.6 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	mounting base; connected to drain		
			SOT78 (TO-220AB; SC-46)	

3. Ordering information

Table 3. Ordering information

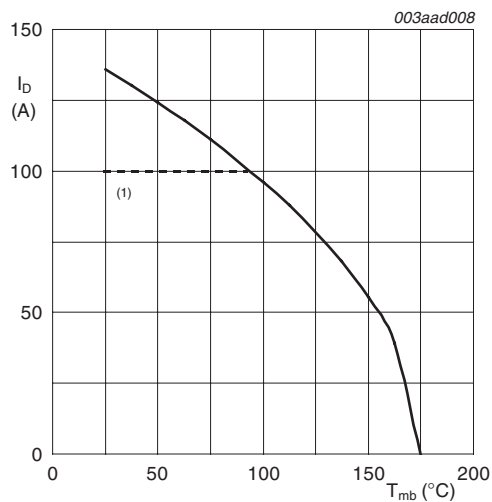
Type number	Package		Version
	Name	Description	
PSMN4R5-40PS	TO-220AB; SC-46	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

4. Limiting values

Table 4. Limiting values

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

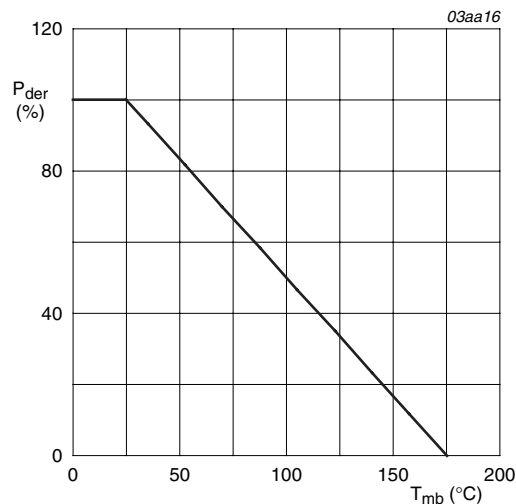
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ }^{\circ}\text{C}$; $T_j \leq 175\text{ }^{\circ}\text{C}$	-	40	V
V_{DGR}	drain-gate voltage	$T_j \geq 25\text{ }^{\circ}\text{C}$; $T_j \leq 175\text{ }^{\circ}\text{C}$; $R_{GS} = 20\text{ k}\Omega$	-	40	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ }^{\circ}\text{C}$; see Figure 1	-	96	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ }^{\circ}\text{C}$; see Figure 1	-	100	A
I_{DM}	peak drain current	$t_p \leq 10\text{ }\mu\text{s}$; pulsed; $T_{mb} = 25\text{ }^{\circ}\text{C}$; see Figure 3	-	545	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ }^{\circ}\text{C}$; see Figure 2	-	148	W
T_{stg}	storage temperature		-55	175	$^{\circ}\text{C}$
T_j	junction temperature		-55	175	$^{\circ}\text{C}$
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ }^{\circ}\text{C}$	-	100	A
I_{SM}	peak source current	$t_p \leq 10\text{ }\mu\text{s}$; pulsed; $T_{mb} = 25\text{ }^{\circ}\text{C}$	-	545	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$; $I_D = 100\text{ A}$; $V_{sup} \leq 40\text{ V}$; unclamped; $R_{GS} = 50\text{ }\Omega$	-	152	mJ



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

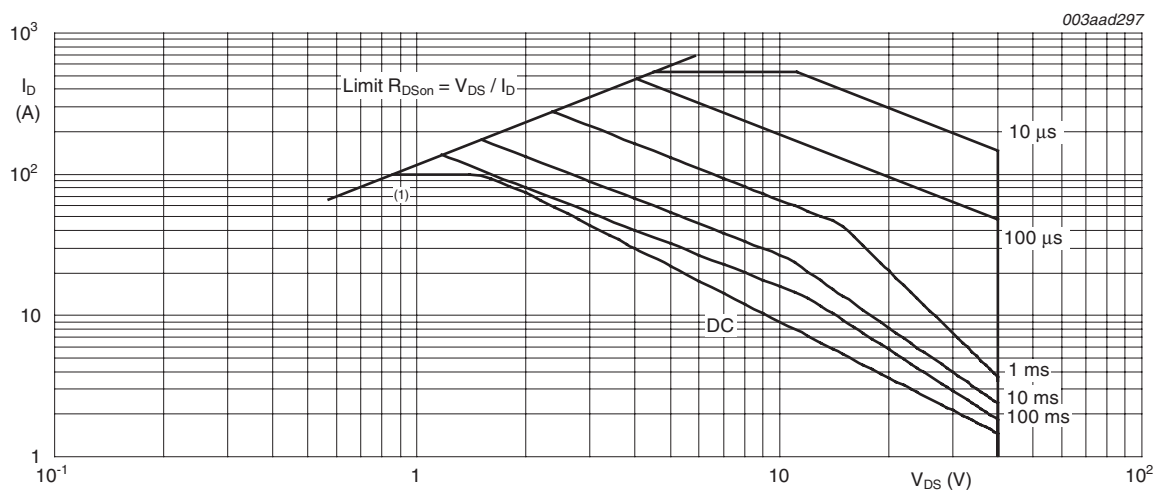
(1) Capped at 100 A due to package.

Fig 1. 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



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

(1) Capped at 100 A due to package.

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	-	0.65	1	K/W

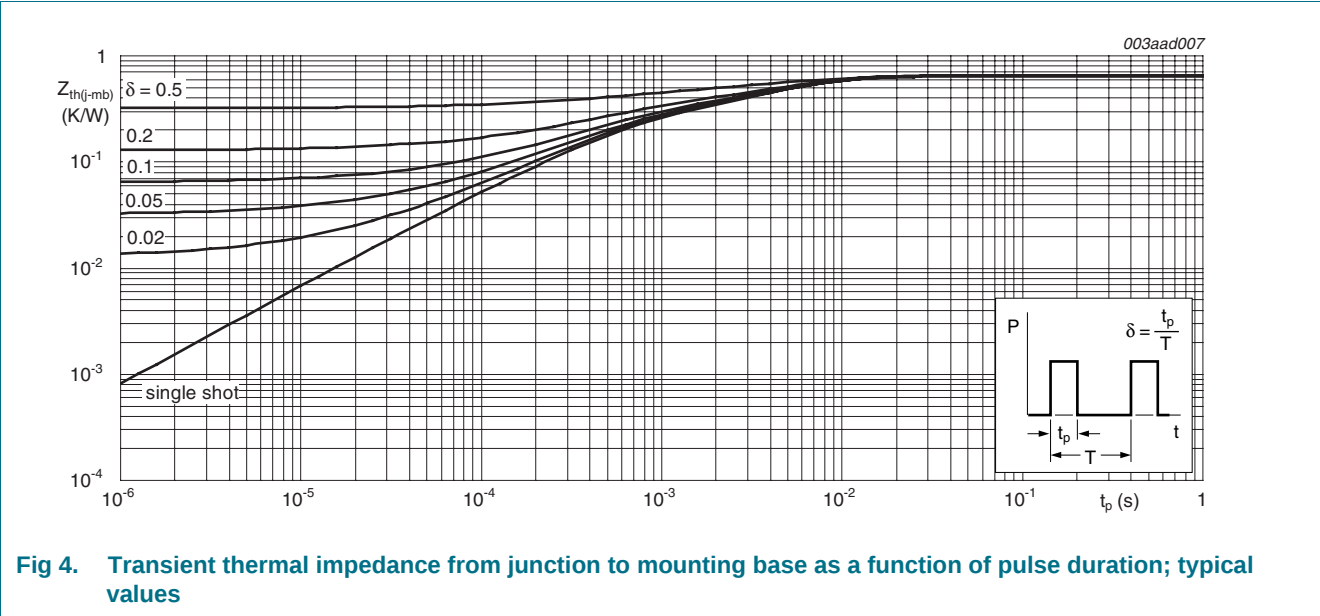


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values

6. Characteristics

Table 6. Characteristics

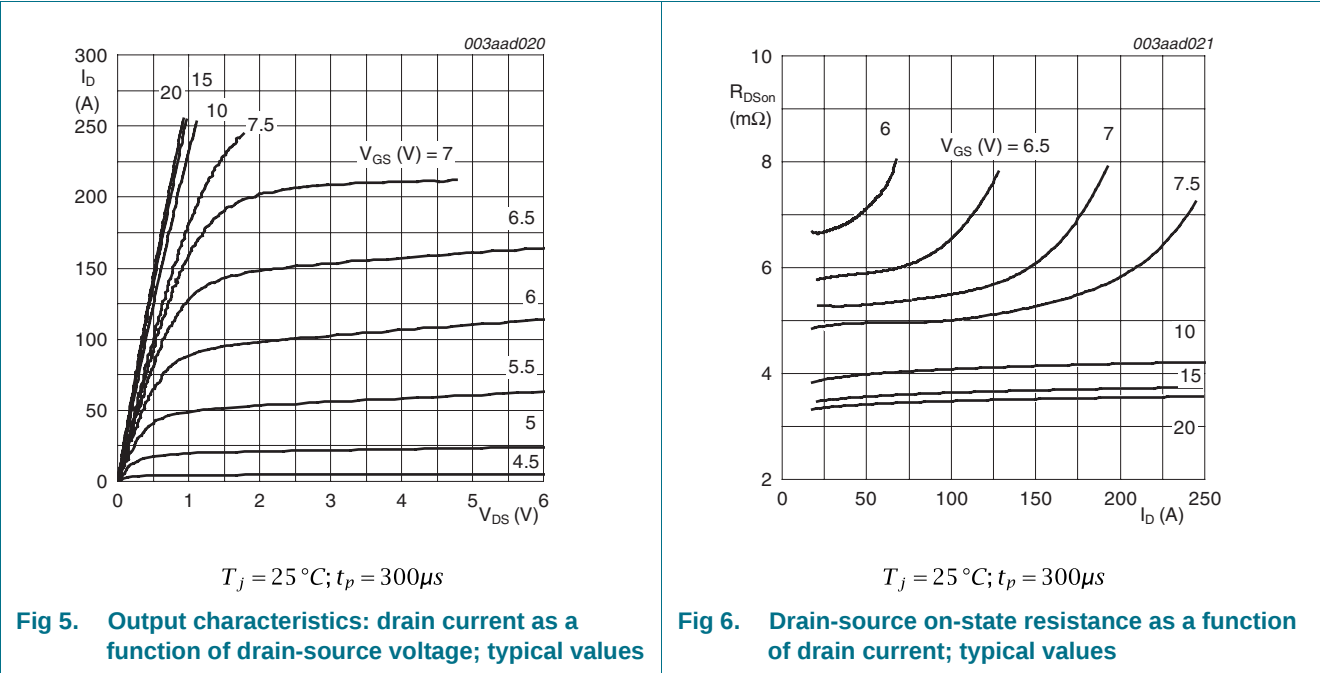
Tested to JEDEC standards where applicable.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$; $V_{GS} = 0\ \text{V}$; $T_j = -55\ ^\circ\text{C}$	36	-	-	V
		$I_D = 250\ \mu\text{A}$; $V_{GS} = 0\ \text{V}$; $T_j = 25\ ^\circ\text{C}$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ \text{mA}$; $V_{DS} = V_{GS}$; $T_j = -55\ ^\circ\text{C}$; see Figure 11 ; see Figure 12	-	-	4.6	V
		$I_D = 1\ \text{mA}$; $V_{DS} = V_{GS}$; $T_j = 175\ ^\circ\text{C}$; see Figure 11 ; see Figure 12	1	-	-	V
		$I_D = 1\ \text{mA}$; $V_{DS} = V_{GS}$; $T_j = 25\ ^\circ\text{C}$; see Figure 11 ; see Figure 12	2	3	4	V
I_{DSS}	drain leakage current	$V_{DS} = 40\ \text{V}$; $V_{GS} = 0\ \text{V}$; $T_j = 25\ ^\circ\text{C}$	-	-	3	μA
		$V_{DS} = 40\ \text{V}$; $V_{GS} = 0\ \text{V}$; $T_j = 125\ ^\circ\text{C}$	-	-	60	μA
I_{GSS}	gate leakage current	$V_{GS} = 20\ \text{V}$; $V_{DS} = 0\ \text{V}$; $T_j = 25\ ^\circ\text{C}$	-	-	100	nA
		$V_{GS} = -20\ \text{V}$; $V_{DS} = 0\ \text{V}$; $T_j = 25\ ^\circ\text{C}$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ \text{V}$; $I_D = 25\ \text{A}$; $T_j = 100\ ^\circ\text{C}$; see Figure 13	-	-	6.7	mΩ
		$V_{GS} = 10\ \text{V}$; $I_D = 25\ \text{A}$; $T_j = 25\ ^\circ\text{C}$; see Figure 13 ; [1]	-	3.9	4.6	mΩ
R_G	internal gate resistance (AC)	$f = 1\ \text{MHz}$	-	0.97	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 0\ \text{A}$; $V_{DS} = 0\ \text{V}$; $V_{GS} = 10\ \text{V}$	-	35	-	nC
		$I_D = 25\ \text{A}$; $V_{DS} = 20\ \text{V}$; $V_{GS} = 10\ \text{V}$; see Figure 14 ; see Figure 15	-	42.3	-	nC
Q_{GS}	gate-source charge	$I_D = 25\ \text{A}$; $V_{DS} = 20\ \text{V}$; $V_{GS} = 10\ \text{V}$; see Figure 14 ; see Figure 15	-	13.8	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	7.9	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	5.9	-	nC
Q_{GD}	gate-drain charge		-	8.8	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\ \text{A}$; $V_{DS} = 20\ \text{V}$; see Figure 14	-	4.8	-	V
C_{iss}	input capacitance	$V_{DS} = 12\ \text{V}$; $V_{GS} = 0\ \text{V}$; $f = 1\ \text{MHz}$;	-	2683	-	pF
C_{oss}	output capacitance	$T_j = 25\ ^\circ\text{C}$; see Figure 16	-	660	-	pF
C_{rss}	reverse transfer capacitance		-	290	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 12\ \text{V}$; $R_L = 0.5\ \Omega$; $V_{GS} = 10\ \text{V}$;	-	19	-	ns
t_r	rise time	$R_{G(ext)} = 4.7\ \Omega$	-	23	-	ns
$t_{d(off)}$	turn-off delay time		-	30	-	ns
t_f	fall time		-	9	-	ns

Table 6. Characteristics ...continued
Tested to JEDEC standards where applicable.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; see Figure 17	-	0.75	1.2	V
t _{rr}	reverse recovery time	I _S = 50 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V	-	40	-	ns
Q _r	recovered charge	I _S = 50 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V; T _j = 25 °C	-	33	-	nC

[1] Measured 3 mm from package.



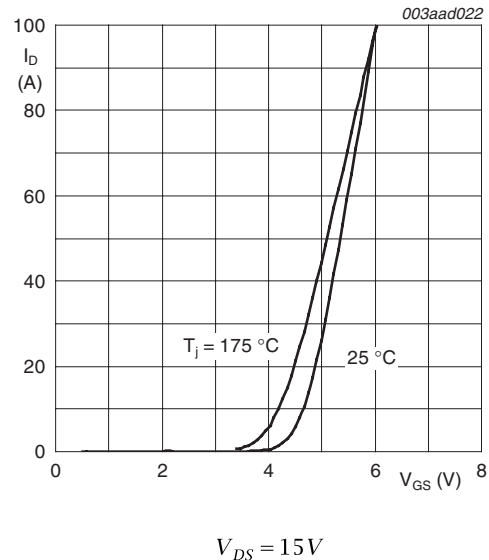


Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

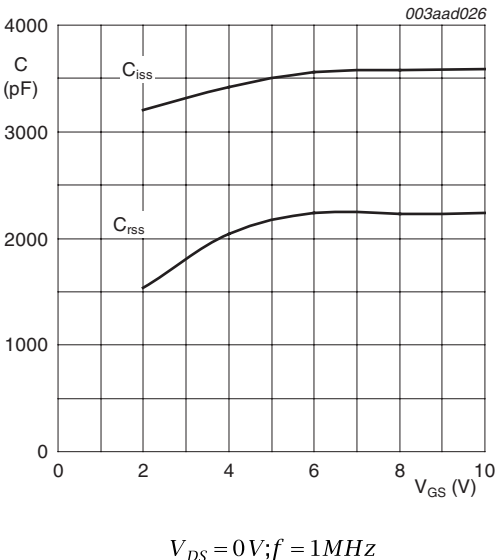


Fig 8. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

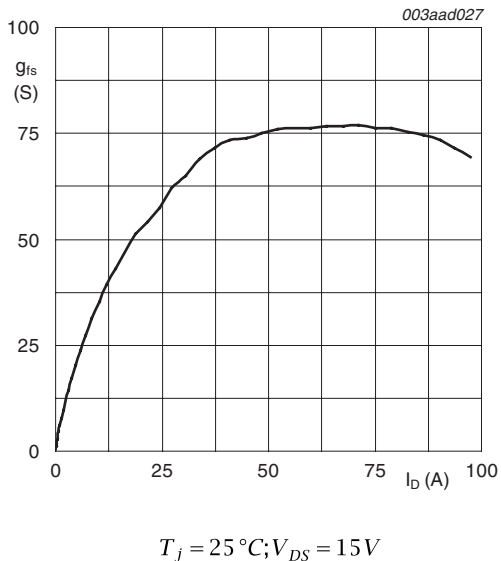


Fig 9. Forward transconductance as a function of drain current; typical values

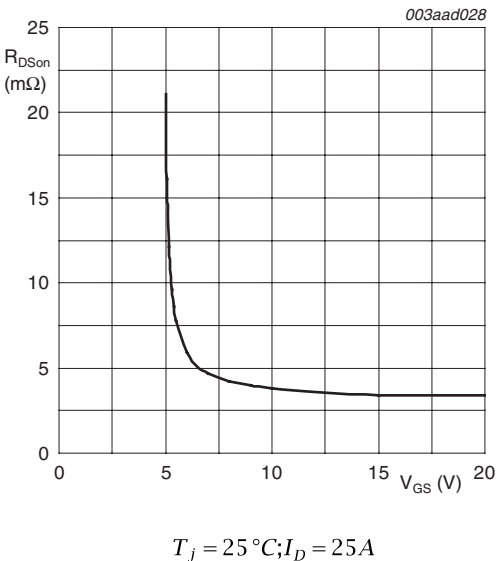
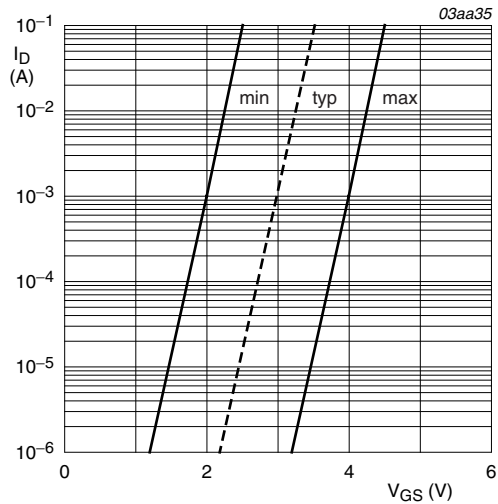
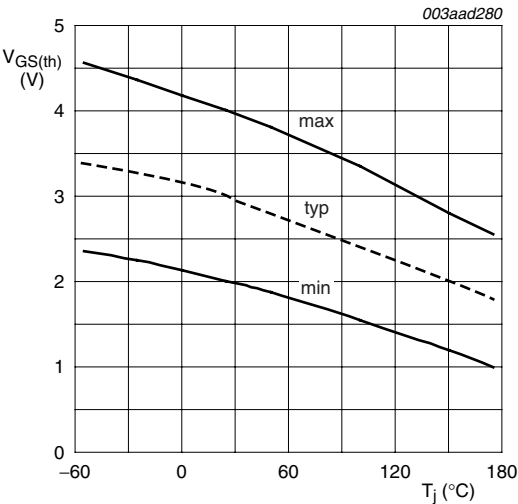


Fig 10. Drain-source on-state resistance as a function of gate-source voltage; typical values



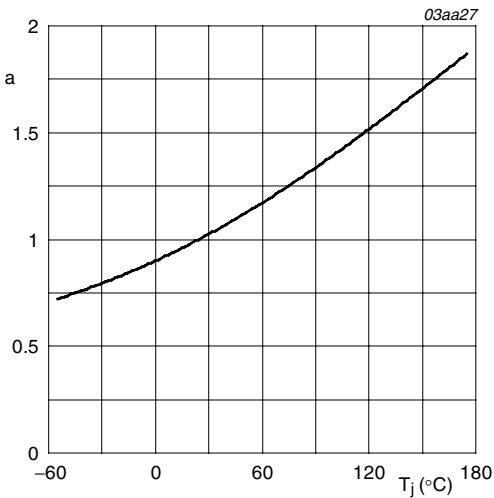
$T_j = 25\text{ °C}; V_{DS} = 5V$

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



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

Fig 12. Gate-source threshold voltage as a function of junction temperature



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

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

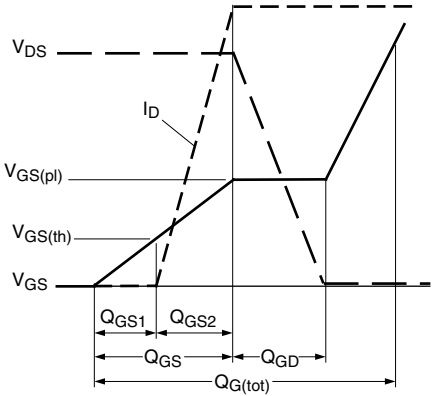
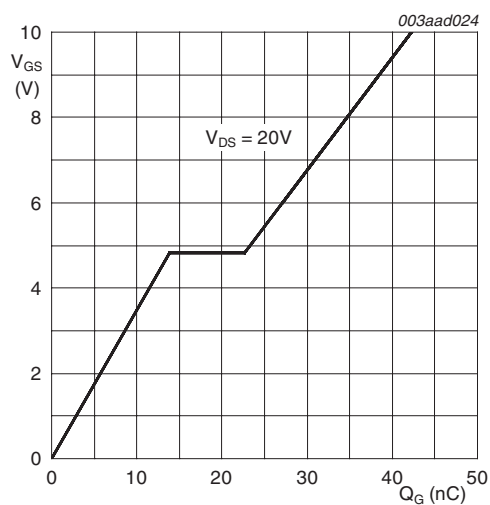
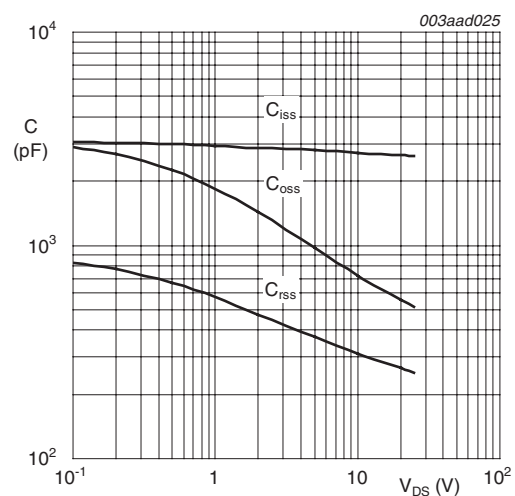


Fig 14. Gate charge waveform definitions



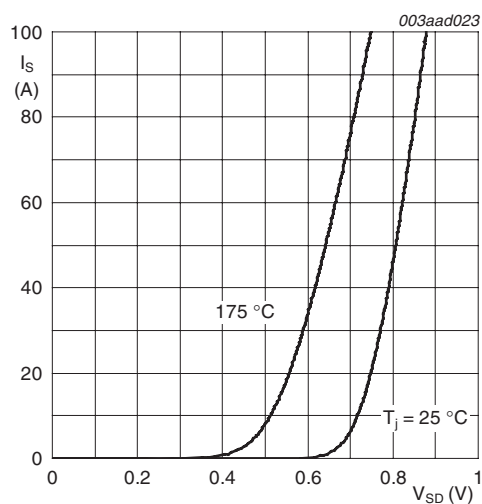
$T_j = 25^\circ\text{C}; I_D = 25\text{A}$

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 (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

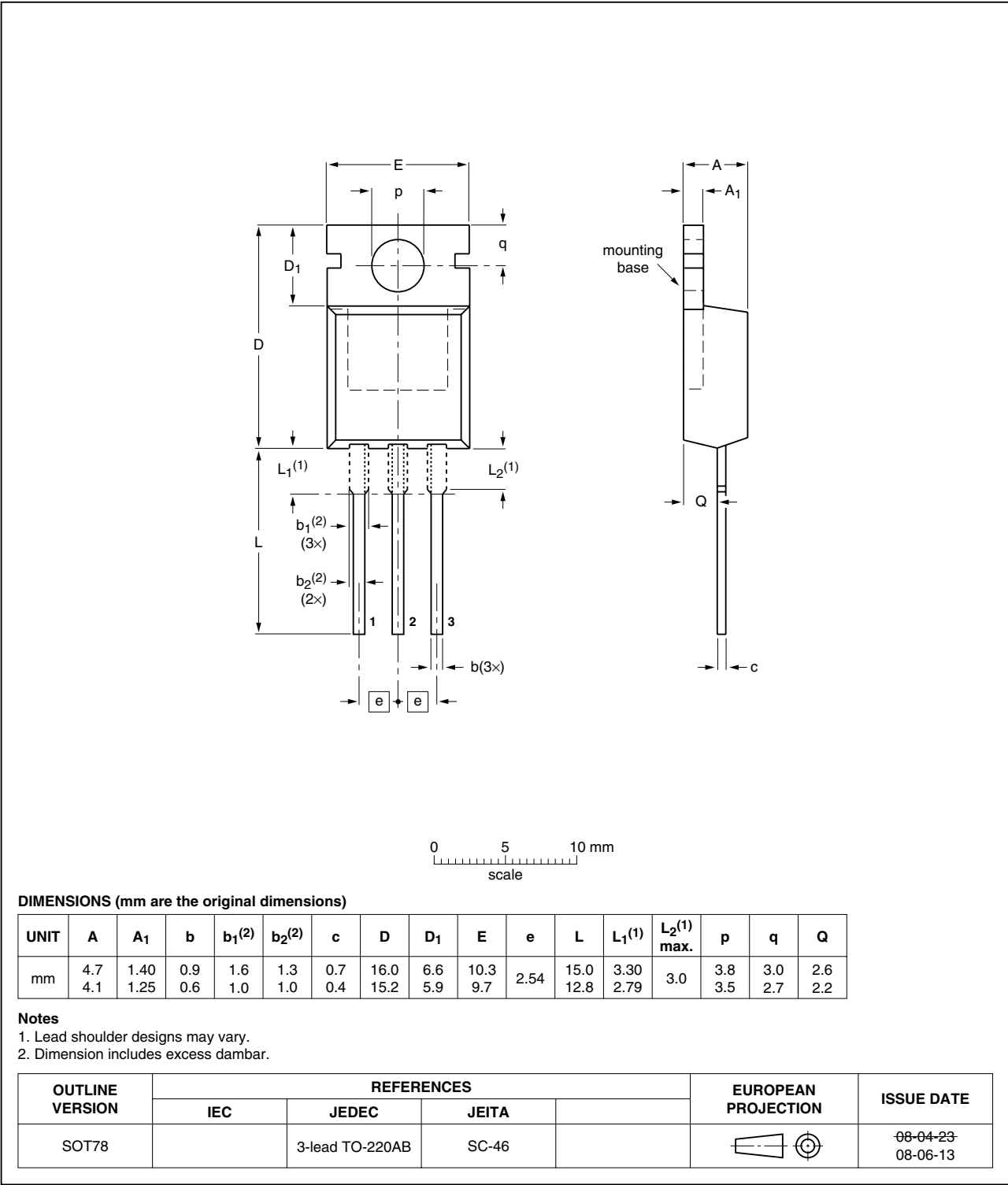


Fig 18. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN4R5-40PS_2	20090625	Product data sheet	-	PSMN4R5-40PS_1
Modifications:	• Data sheet status changed from objective to product. • Various changes to content.			
PSMN4R5-40PS_1	20090507	Objective 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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