



PSMN1R5-40PS

N-channel 40 V 1.6 mΩ standard level MOSFET in TO220.

Rev. 02 — 19 April 2011

Product data sheet

1. Product profile

1.1 General description

Standard level N-channel MOSFET in TO220 (SOT78) 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 data

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	[1]	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ see Figure 2	-	-	338	W

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	[2]	-	1.3	1.6	mΩ
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Dynamic characteristics

Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 75\text{ A};$	-	32	-	nC
$Q_{G(tot)}$	total gate charge	$V_{DS} = 20\text{ V};$ see Figure 14 ; see Figure 15	-	136	-	nC

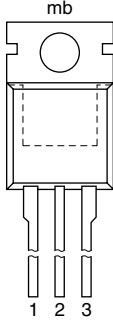
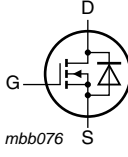
[1] Continuous current is limited by package.

[2] 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		

SOT78 (TO-220AB)

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN1R5-40PS	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

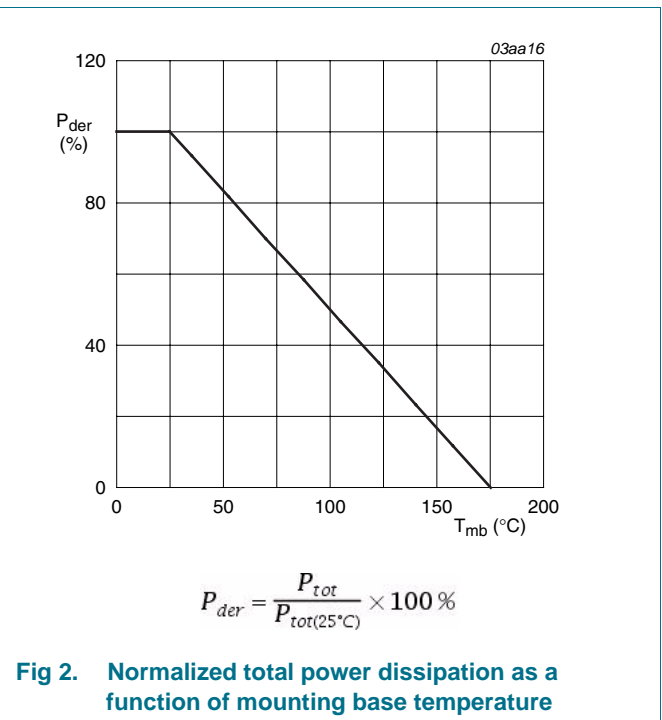
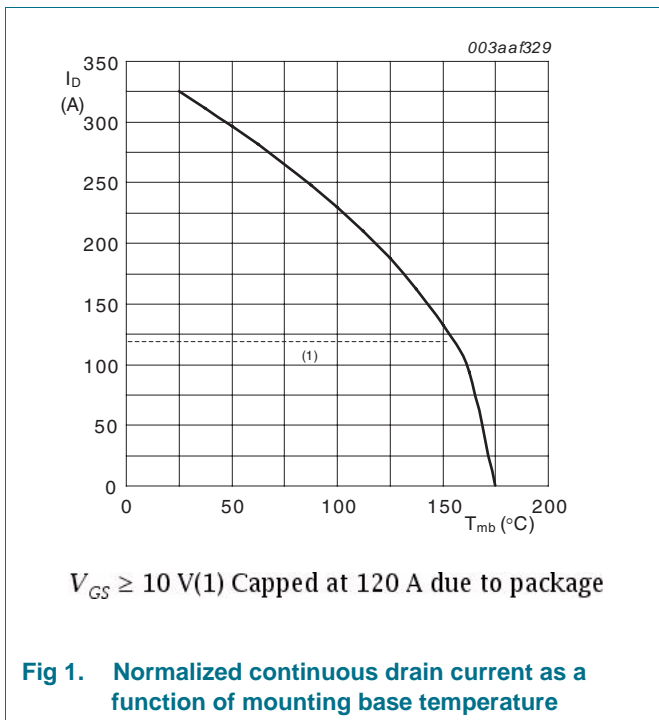
4. Limiting values

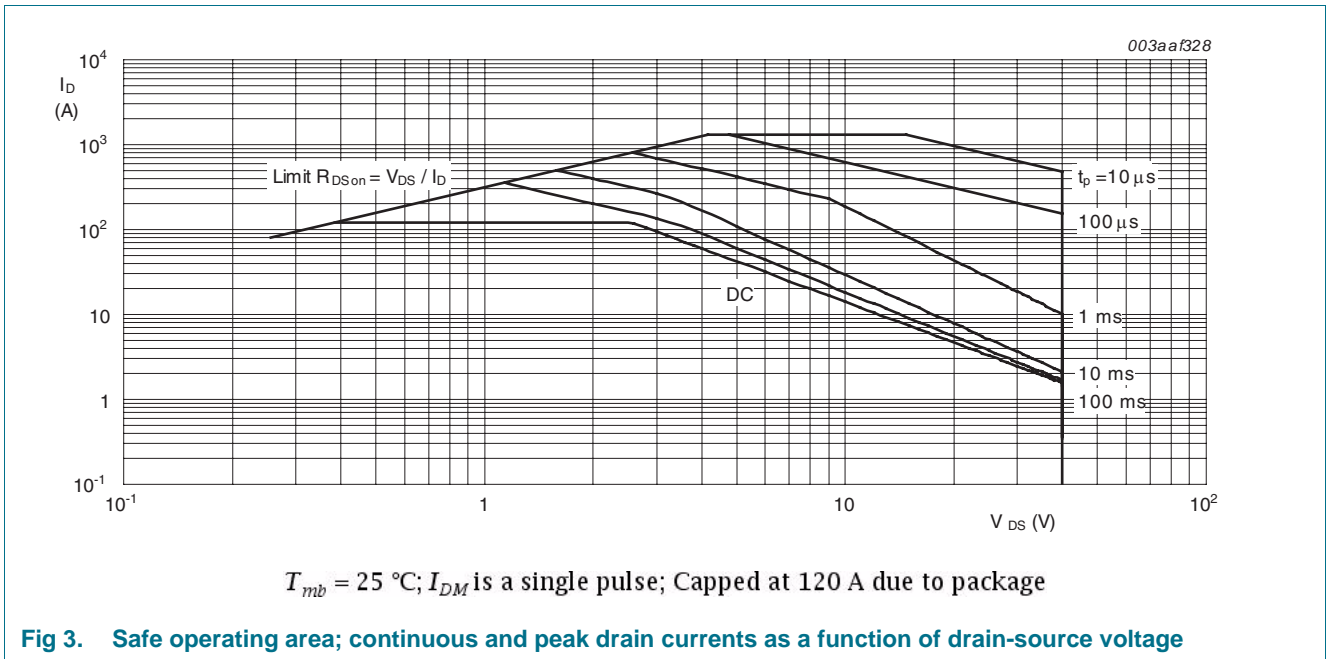
Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit	
V _{DS}	drain-source voltage	T _j ≥ 25 °C; T _j ≤ 175 °C	-	40	V	
V _{DGR}	drain-gate voltage	T _j ≥ 25 °C; T _j ≤ 175 °C; R _{GS} = 20 kΩ	-	40	V	
V _{GS}	gate-source voltage		-20	20	V	
I _D	drain current	V _{GS} = 10 V; T _{mb} = 100 °C	[1]	-	120	A
		V _{GS} = 10 V; T _{mb} = 25 °C; see Figure 1	[1]	-	120	A
I _{DM}	peak drain current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C; see Figure 3	-	1301	A	
P _{tot}	total power dissipation	T _{mb} = 25 °C; see Figure 2	-	338	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	[1]	-	120	A
I _{SM}	peak source current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C	-	1301	A	
Avalanche ruggedness						
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	V _{GS} = 10 V; T _{j(initial)} = 25 °C; I _D = 120 A; V _{sup} ≤ 40 V; unclamped; R _{GS} = 50 Ω; t _p = 0.1 ms	-	1.4	J	

[1] Continuous current is limited by package





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	-	0.22	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Vertical in free air	-	60	-	K/W

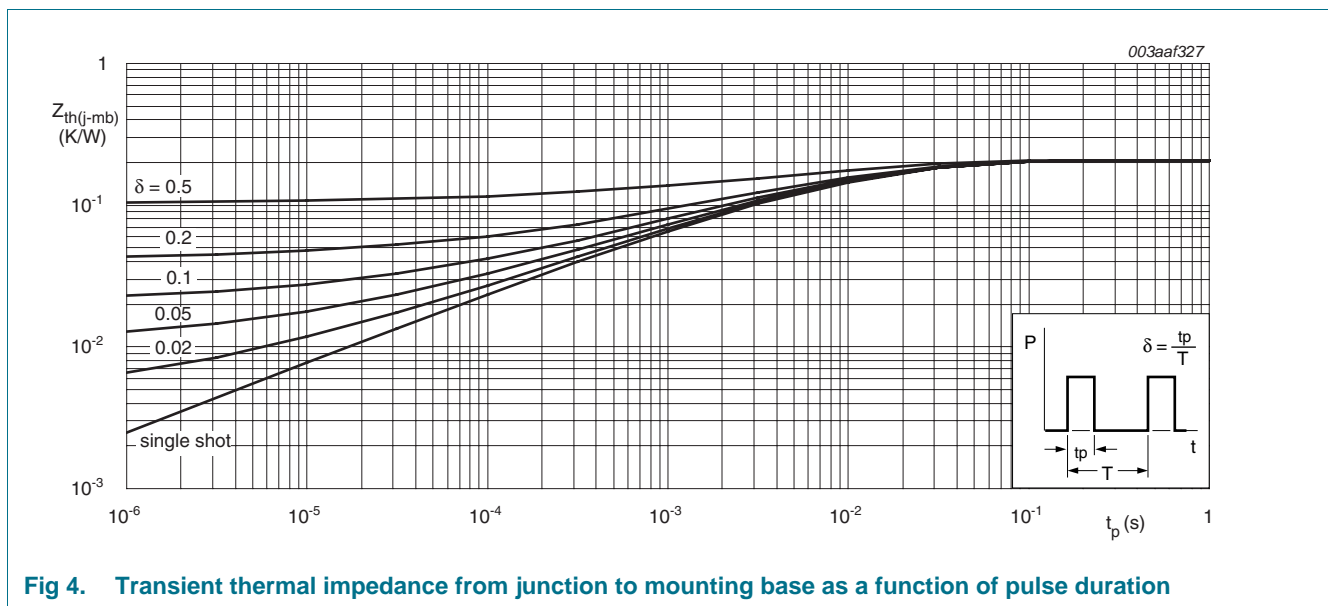


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

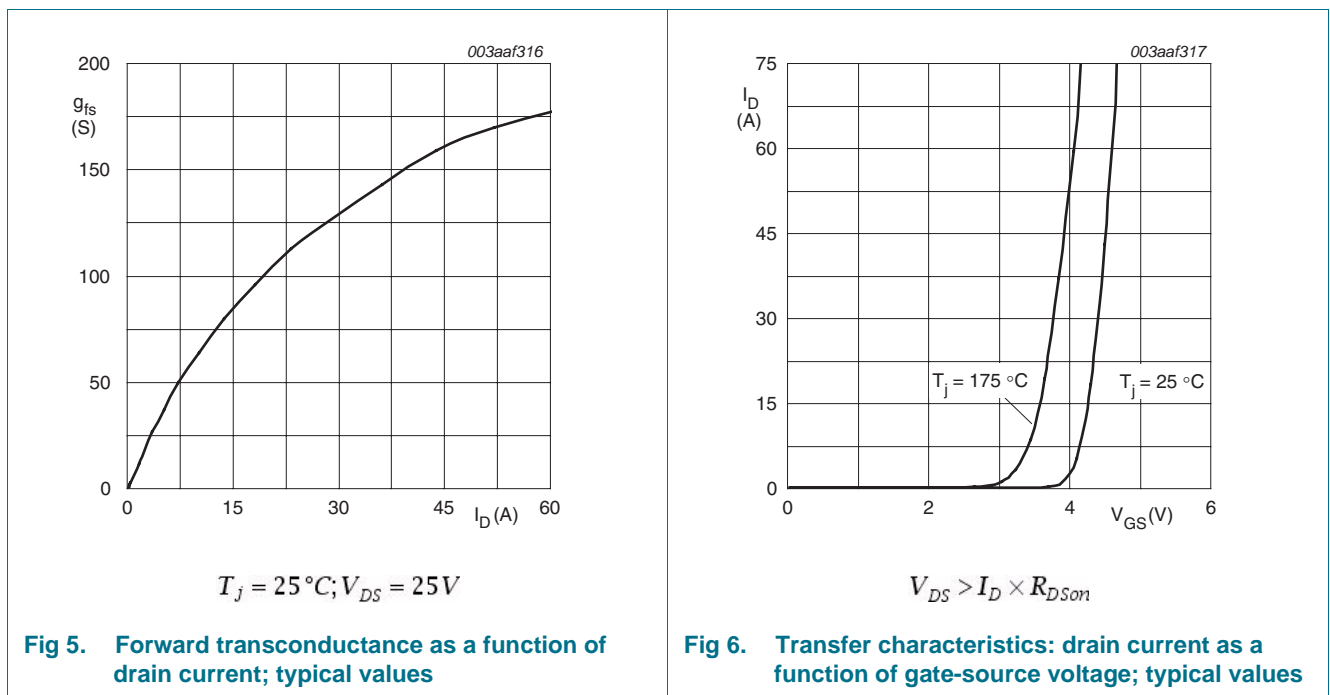
Table 6. Characteristics

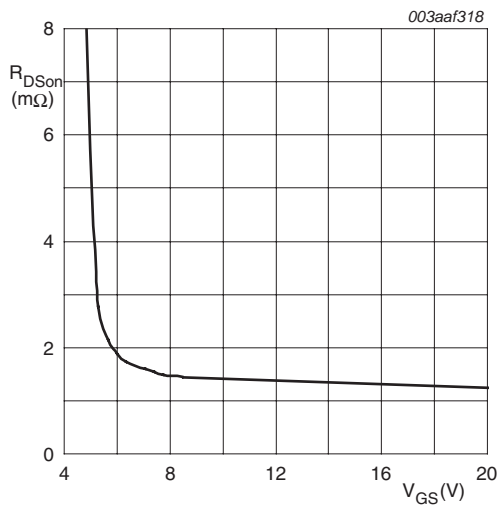
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	36	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see Figure 10	-	-	4.6	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 10	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 11 ; see Figure 10	2	3	4	V
I_{DSS}	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	10	μA
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	250	500	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
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 100 \text{ }^\circ\text{C};$ see Figure 12	-	1.9	2.3	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 12	-	2.6	3.2	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 13	11	-	1.3	1.6
R_G	internal gate resistance (AC)	$f = 1 \text{ MHz}$	-	1.1	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V};$ see Figure 14 ; see Figure 15	-	133	-	nC
		$I_D = 75 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 10 \text{ V};$ see Figure 14 ; see Figure 15	-	136	-	nC
Q_{GS}	gate-source charge		-	52	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	30	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	22.5	-	nC
Q_{GD}	gate-drain charge		-	32	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$V_{DS} = 20 \text{ V};$ see Figure 14 ; see Figure 15	-	6.1	-	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	-	9710	-	pF
C_{oss}	output capacitance		-	2042	-	pF
C_{riss}	reverse transfer capacitance		-	994	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 \text{ V}; R_L = 0.8 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 4.7 \text{ } \Omega$	-	45	-	ns
t_r	rise time		-	66	-	ns
$t_{d(off)}$	turn-off delay time		-	111	-	ns
t_f	fall time		-	53	-	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	-	0.8	1.2	V
t_{rr}	reverse recovery time	$I_S = 25\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$	-	64	-	ns
Q_r	recovered charge	$I_S = 25\text{ A}$; $di_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_j = 25\text{ °C}$	-	117	-	nC

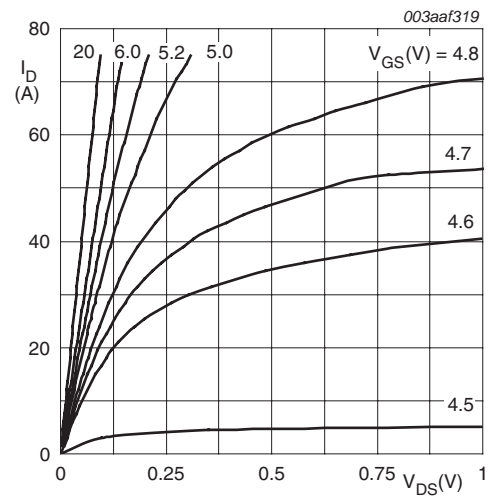
[1] Measured 3 mm from package.





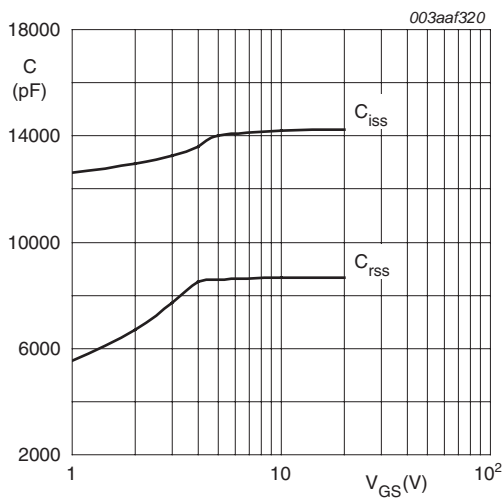
$T_j = 25^\circ\text{C}; V_{DS} = 25\text{V}$

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



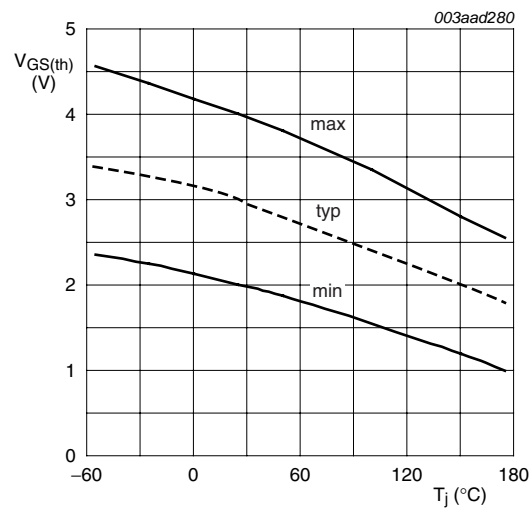
$T_j = 25^\circ\text{C}$

Fig 8. Output characteristics: drain current as a function of drain-source voltage; typical values



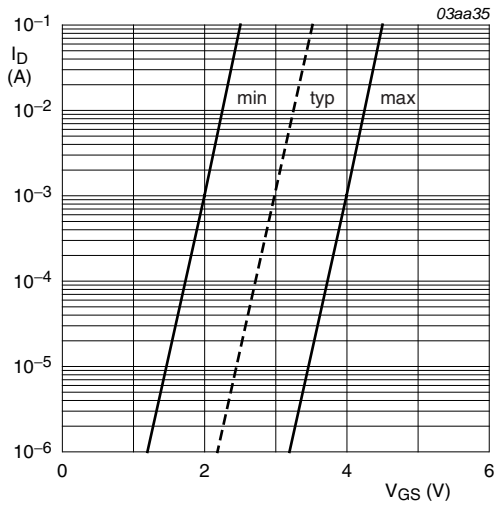
$V_{DS} = 0\text{V}; f = 1\text{MHz}$

Fig 9. Input and reverse transfer capacitances as a function of gate-source voltage; typical values



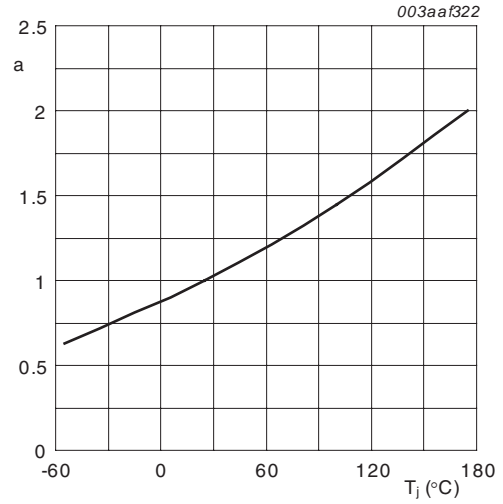
$I_D = 1\text{mA}; V_{DS} = V_{GS}$

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



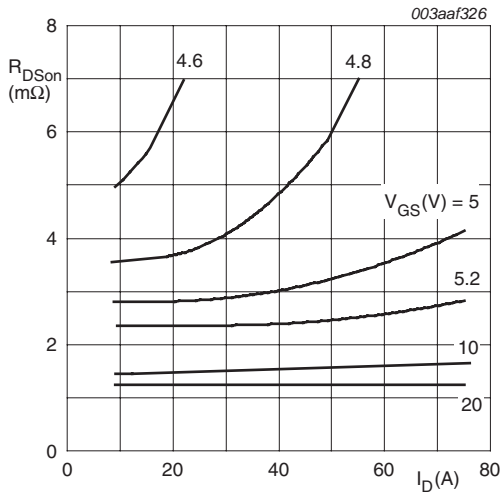
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$

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



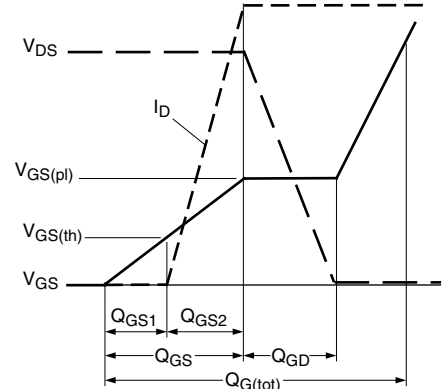
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



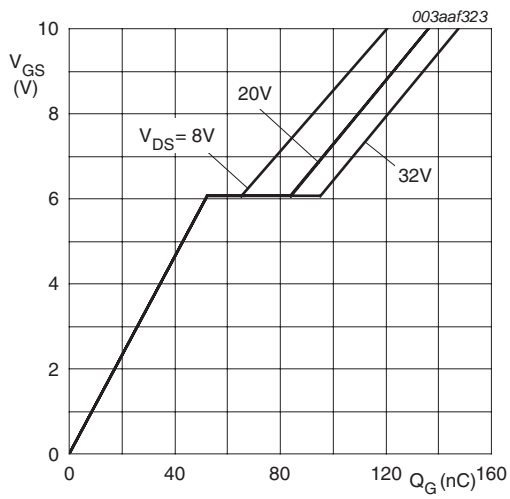
$T_j = 25^\circ\text{C}$

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



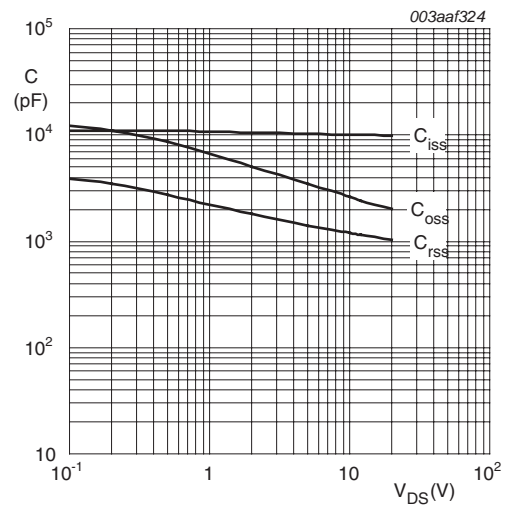
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Fig 14. Gate charge waveform definitions



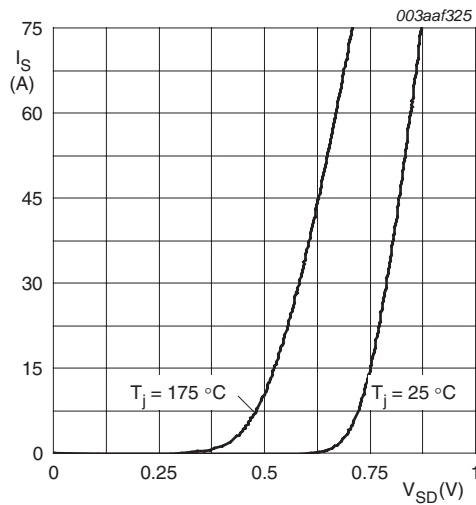
$I_D = 75 A$

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



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

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



$V_{GS} = 0V$

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

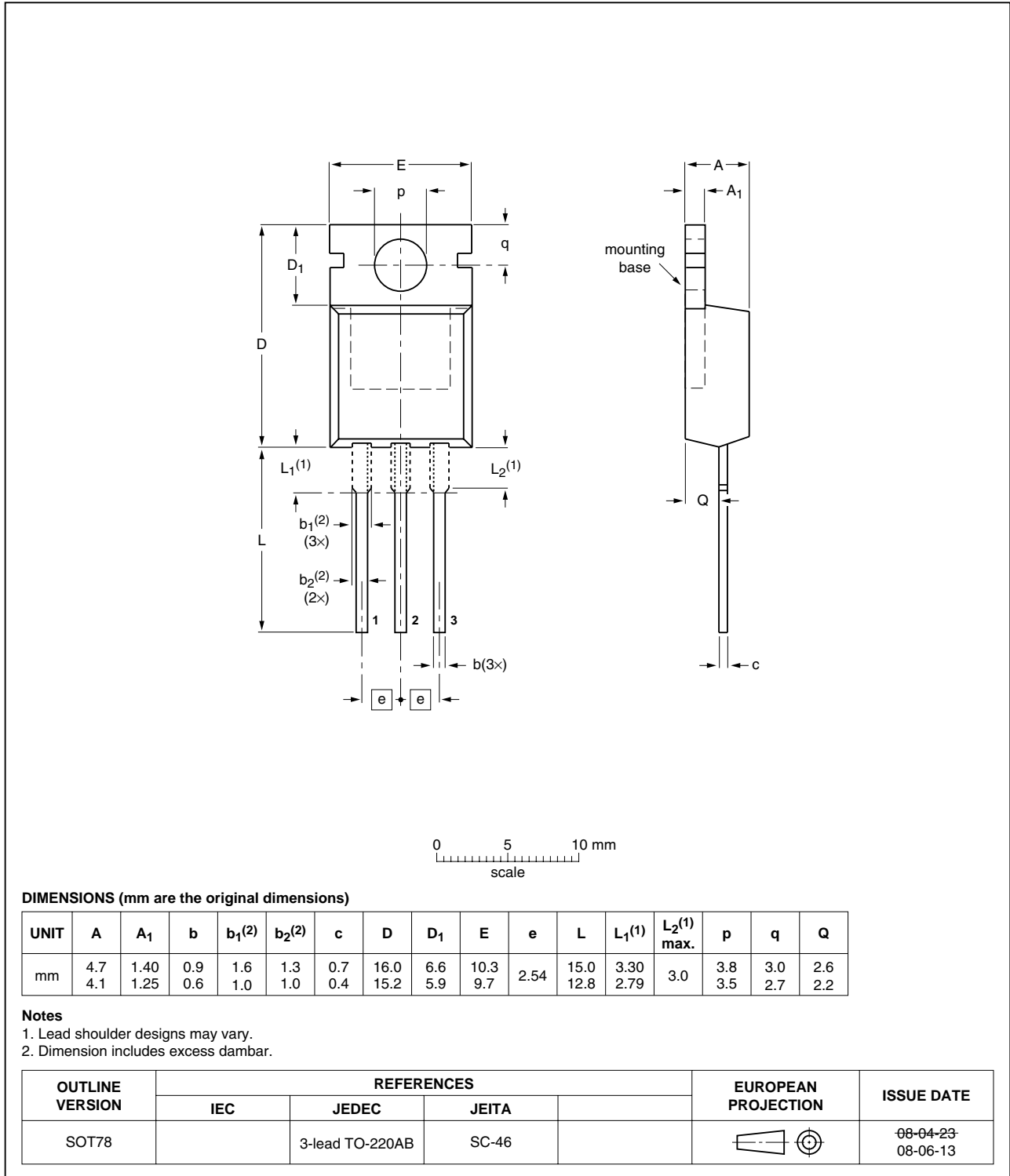


Fig 18. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN1R5-40PS v.2	20110419	Product data sheet	-	PSMN1R5-40PS v.1
Modifications:	<ul style="list-style-type: none">• Status changed from objective to product.• Various changes to content.			
PSMN1R5-40PS v.1	20110203	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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