



# PSMN4R8-100PSE

N-channel 100 V 5 m $\Omega$  standard level MOSFET with improved SOA in TO220 package

11 July 2014

Product data sheet

## 1. General description

Standard level N-channel MOSFET with improved SOA in a TO220 package. Part of NXP's "NextPower Live" portfolio, the PSMN4R8-100PSE is robust enough to withstand substantial in-rush and fault condition currents during turn on/off, whilst offering a low  $R_{DS(on)}$  characteristic to keep temperatures down and efficiency up in continued use. Ideal for telecommunication systems based on 48 V backplanes / supply rails.

## 2. Features and benefits

- Enhanced safe operating area (SOA) for superior protection during linear mode operation
- Very low  $R_{DS(on)}$  for low conduction losses

## 3. Applications

- Electronic fuse
- Hot-swap / Soft-start
- Uninterruptible power supplies
- Motor control

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ }^\circ\text{C}$ ; $T_j \leq 175\text{ }^\circ\text{C}$	-	-	100	V
$I_{DM}$	peak drain current	pulsed; $T_{mb} = 25\text{ }^\circ\text{C}$ ; $t_p \leq 10\text{ }\mu\text{s}$ ; <a href="#">Fig. 3</a>	-	-	693	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a>	-	-	405	W
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 12</a>	-	4.3	5	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 50\text{ V}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	59	83	nC
$Q_{G(tot)}$	total gate charge		-	196	278	nC

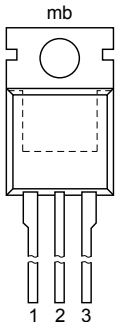
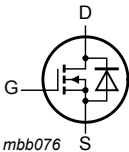


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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 120\text{ A}$ ; $V_{\text{sup}} \leq 100\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; unclamped; <a href="#">Fig. 4</a>	-	-	542	mJ

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>TO-220AB (SOT78)</p>	 <p>mbb076</p>
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN4R8-100PSE	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN4R8-100PSE	PSMN4R8-100PSE

## 8. Limiting values

Table 5. Limiting values

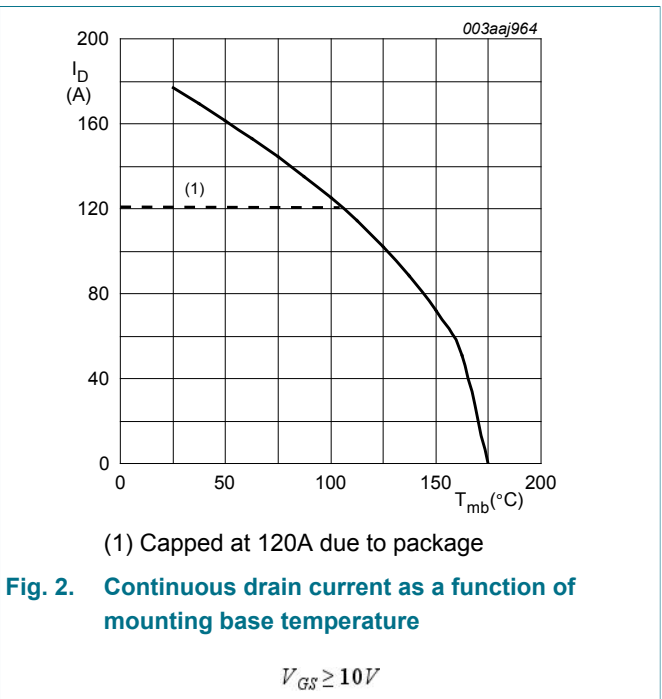
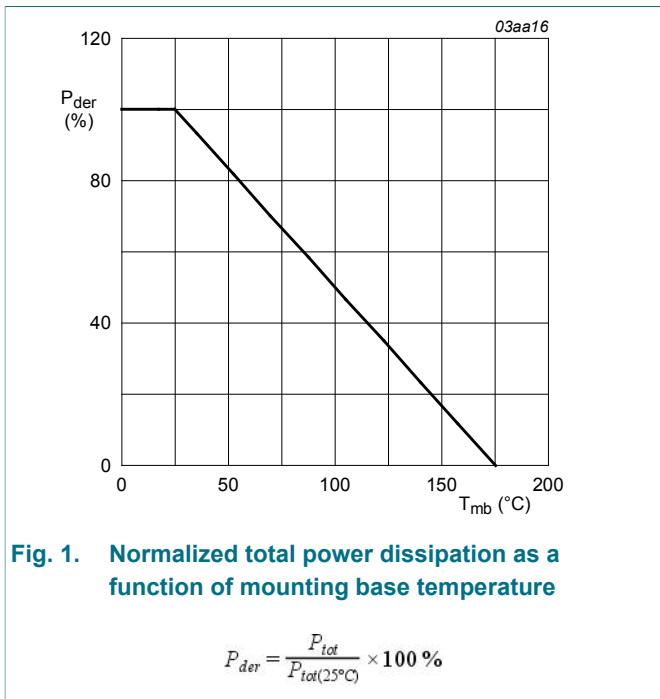
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	100	V

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Symbol	Parameter	Conditions		Min	Max	Unit
V <sub>DGR</sub>	drain-gate voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C; R <sub>GS</sub> = 20 kΩ		-	100	V
V <sub>GS</sub>	gate-source voltage			-20	20	V
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>		-	405	W
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 2</a>	[1]	-	120	A
		V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 100 °C; <a href="#">Fig. 2</a>	[1]	-	120	A
I <sub>DM</sub>	peak drain current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 3</a>		-	693	A
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
T <sub>slid(M)</sub>	peak soldering temperature			-	260	°C
<b>Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	[1]	-	120	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C		-	693	A
<b>Avalanche ruggedness</b>						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	V <sub>GS</sub> = 10 V; T <sub>j(initial)</sub> = 25 °C; I <sub>D</sub> = 120 A; V <sub>sup</sub> ≤ 100 V; R <sub>GS</sub> = 50 Ω; unclamped; <a href="#">Fig. 4</a>		-	542	mJ

[1] Continuous current limited by package.



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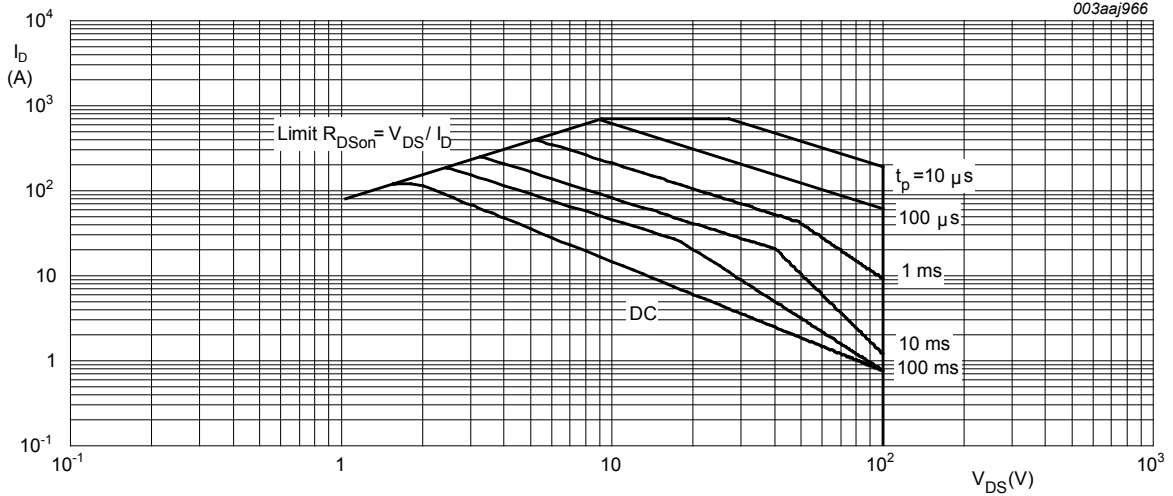


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25\text{ }^{\circ}\text{C}$ ;  $I_{DM}$  is a single pulse; Capped at 120 A due to package

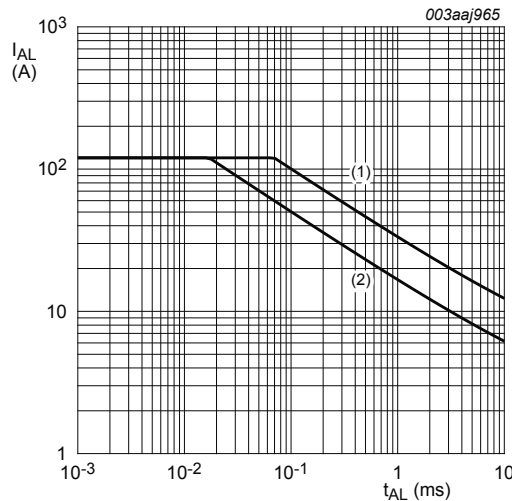


Fig. 4. Single pulse avalanche rating; avalanche current as a function of avalanche time

(1)  $T_{j (init)} = 25\text{ }^{\circ}\text{C}$ ; (2)  $T_{j (init)} = 100\text{ }^{\circ}\text{C}$

### 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 5	-	0.3	0.37	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Minimum footprint; mounted on a printed circuit board	-	60	-	K/W

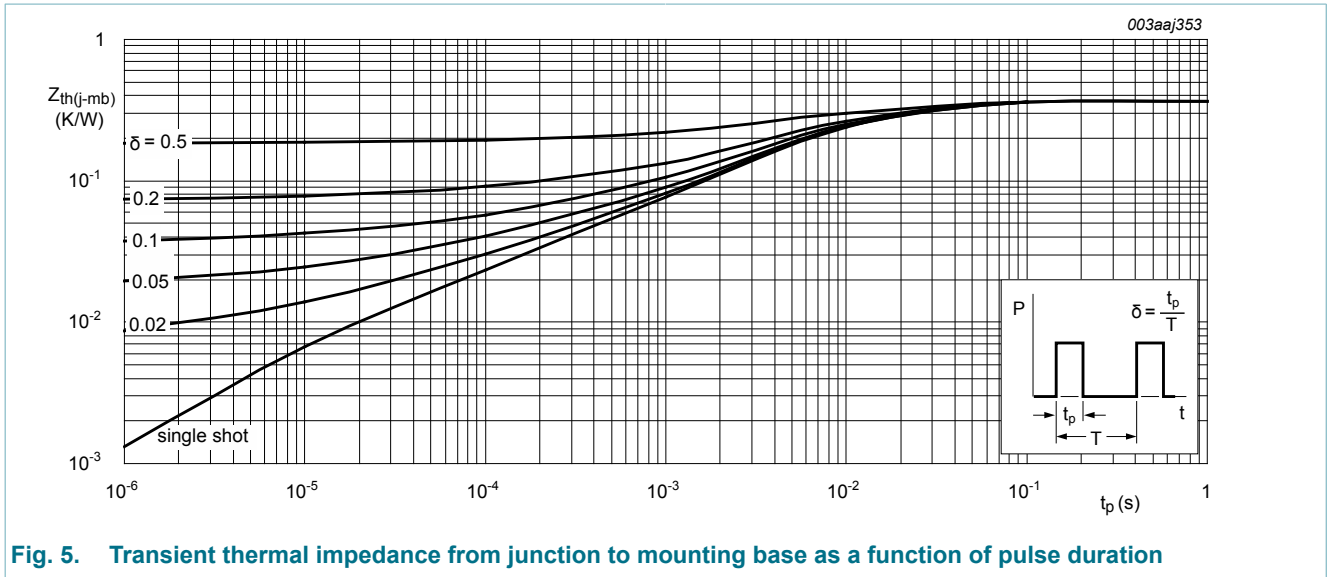


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	100	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 10; Fig. 11</a>	2	3	4	V
$V_{GSth}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	-	4.6	V
$I_{DSS}$	drain leakage current	$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.16	10	$\mu A$
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$	-	-	500	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	10	100	nA
		$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	10	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 12</a>	-	4.3	5	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 100 \text{ }^\circ C;$ <a href="#">Fig. 13; Fig. 12</a>	-	-	9	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 12; Fig. 13</a>	-	-	13.5	mΩ
$R_G$	gate resistance	$f = 1 \text{ MHz}$	0.43	0.85	1.7	Ω

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Dynamic characteristics</b>						
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 50 V; V <sub>GS</sub> = 10 V; Fig. 14; Fig. 15	-	196	278	nC
		I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V	-	166.9	234	nC
Q <sub>GS</sub>	gate-source charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 50 V; V <sub>GS</sub> = 10 V; Fig. 14; Fig. 15	-	40	56	nC
Q <sub>GD</sub>	gate-drain charge		-	59	83	nC
V <sub>GS(pl)</sub>	gate-source plateau voltage	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 50 V; Fig. 14; Fig. 15	-	4.3	-	V
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 50 V; V <sub>GS</sub> = 0 V; f = 1 MHz;	-	10665	14400	pF
C <sub>oss</sub>	output capacitance	T <sub>j</sub> = 25 °C; Fig. 16	-	674	910	pF
C <sub>rss</sub>	reverse transfer capacitance		-	459	643	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 50 V; R <sub>L</sub> = 2 Ω; V <sub>GS</sub> = 10 V;	-	41	61.5	ns
t <sub>r</sub>	rise time	R <sub>G(ext)</sub> = 4.7 Ω	-	65	97.5	ns
t <sub>d(off)</sub>	turn-off delay time		-	127	190.5	ns
t <sub>f</sub>	fall time		-	69	103.5	ns
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; Fig. 17	-	0.79	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 25 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V;	-	72	94	ns
Q <sub>r</sub>	recovered charge	V <sub>DS</sub> = 50 V	-	227	296	nC

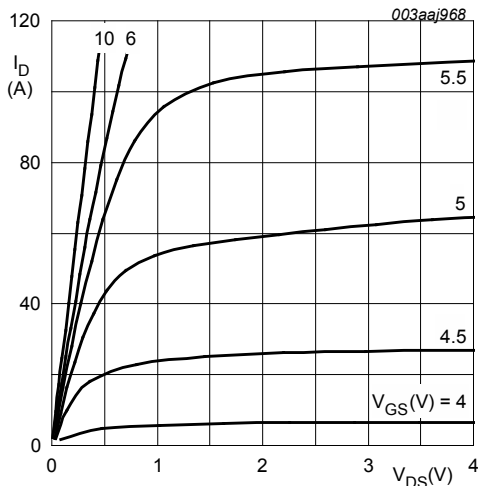


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

T<sub>j</sub> = 25 °C

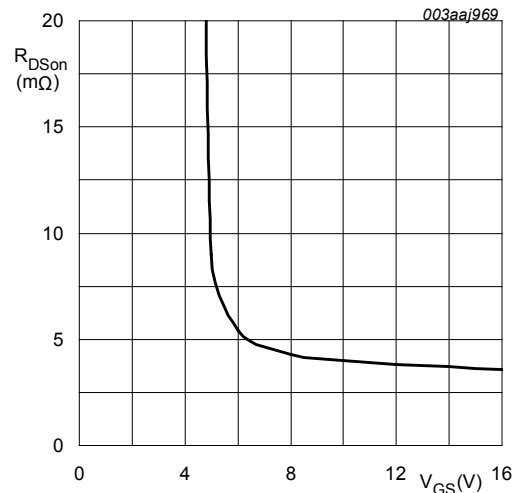


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

T<sub>j</sub> = 25 °C; I<sub>D</sub> = 25 A

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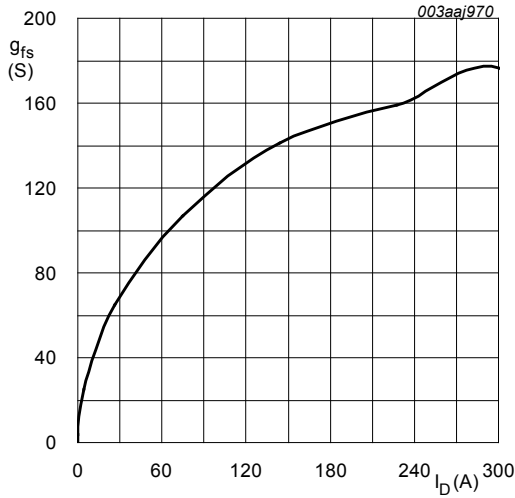


Fig. 8. Forward transconductance as a function of drain current; typical values

$T_j = 25^\circ\text{C}; V_{DS} = 10\text{V}$

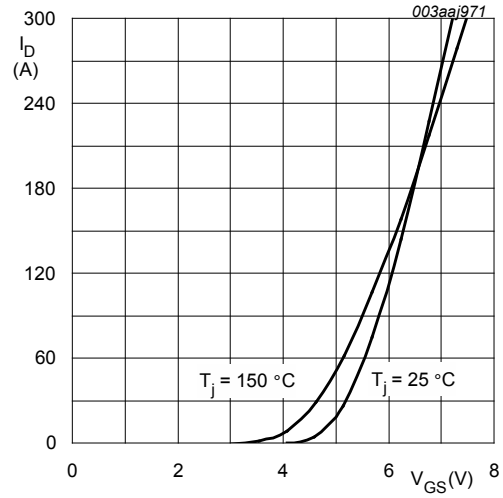


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\text{V}$

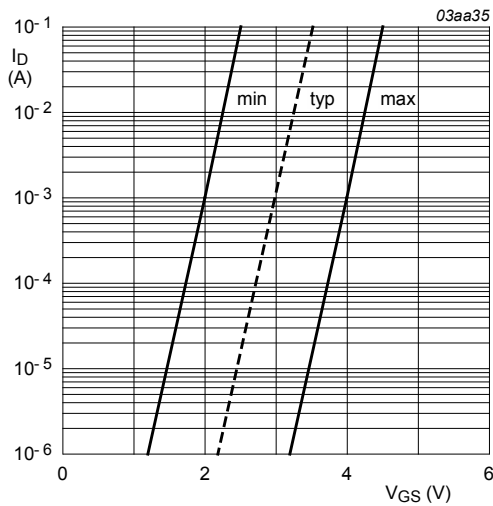


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

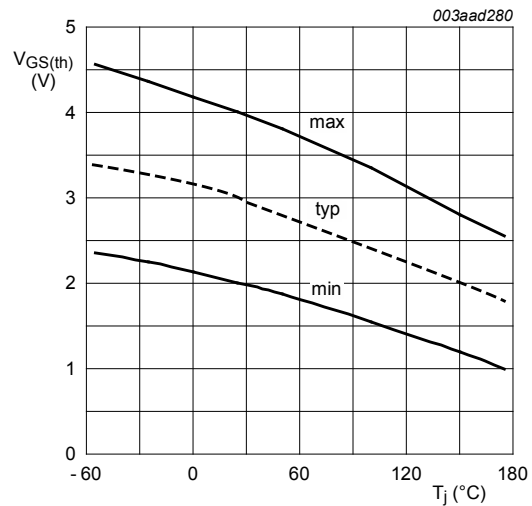


Fig. 11. Gate-source threshold voltage as a function of junction temperature

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

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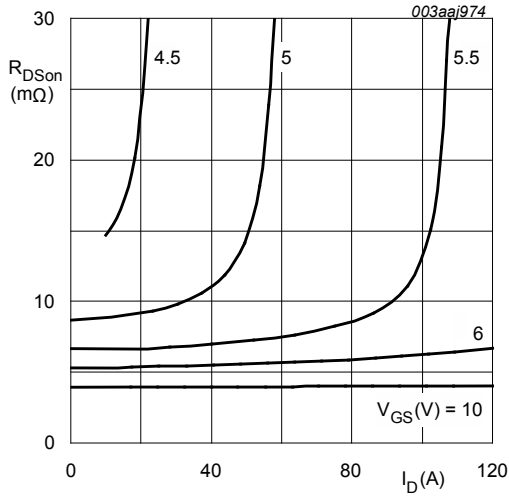


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25^\circ C$

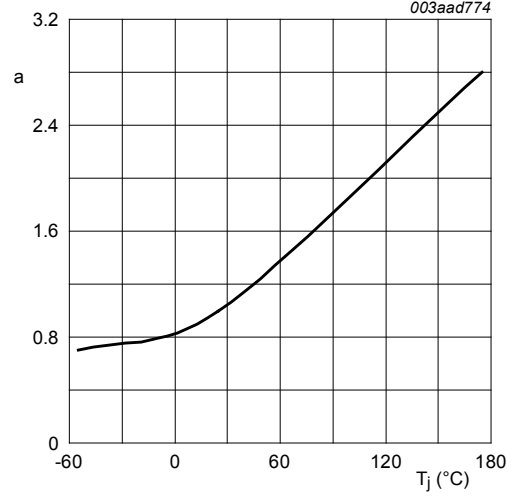


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

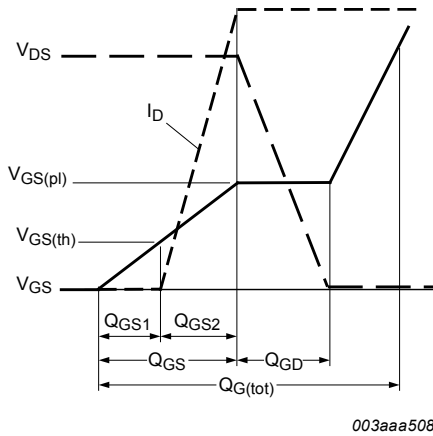


Fig. 14. Gate charge waveform definitions

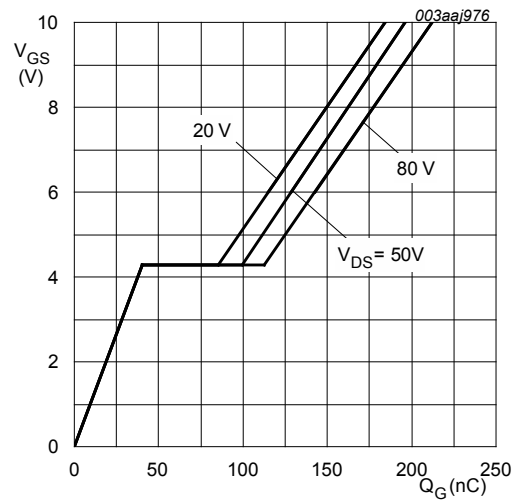
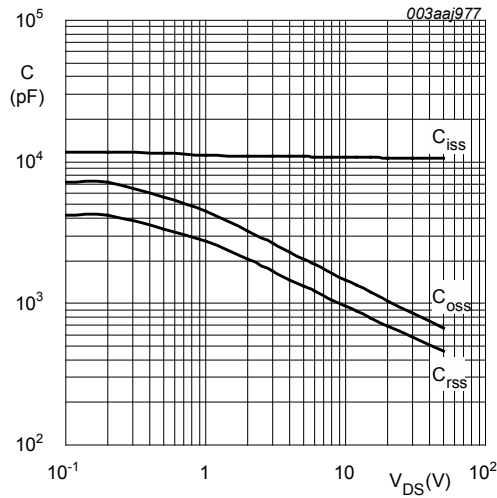


Fig. 15. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ C; I_D = 25A$

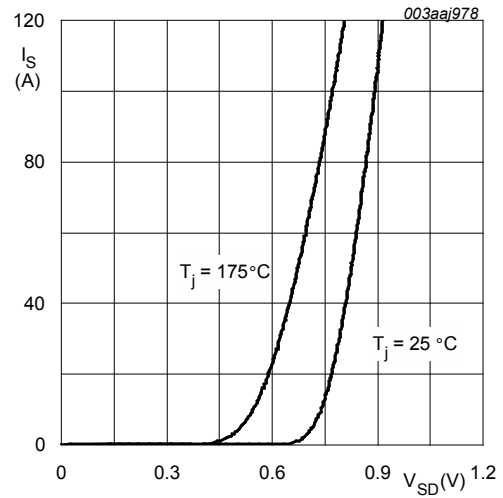


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**Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

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



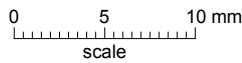
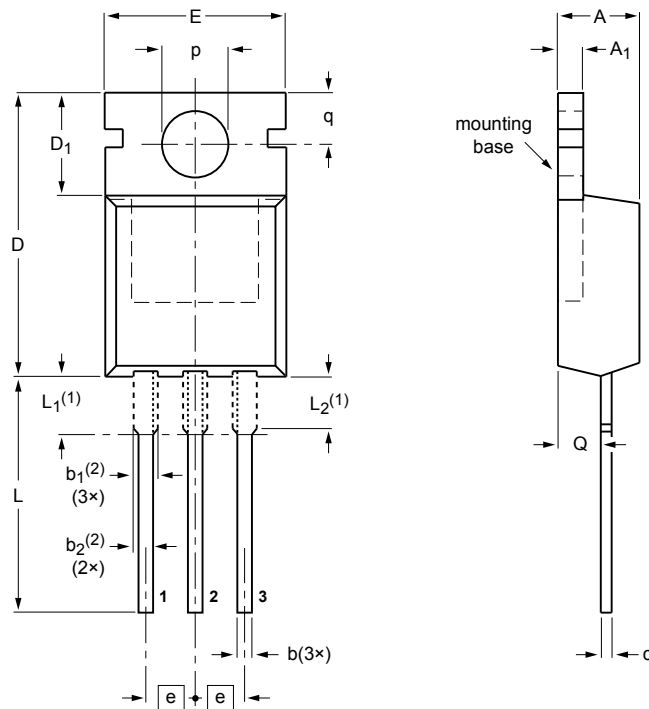
**Fig. 17. Source current as a function of source-drain voltage; typical values**

$$V_{GS} = 0V$$

11. Package outline

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

SOT78



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub> (2)	b <sub>2</sub> (2)	c	D	D <sub>1</sub>	E	e	L	L <sub>1</sub> (1)	L <sub>2</sub> (1) max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

Notes

- Lead shoulder designs may vary.
- Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT78		3-lead TO-220AB	SC-46		08-04-23 08-06-13

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

## 12. Legal information

### 12.1 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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