



# PSMN2R2-40PS

N-channel 40 V 2.1 m $\Omega$  standard level MOSFET

22 February 2013

Product data sheet

## 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.

## 2. Features and benefits

- High efficiency due to low switching and conduction losses
- Suitable for standard level gate drive sources

## 3. Applications

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

## 4. Quick reference data

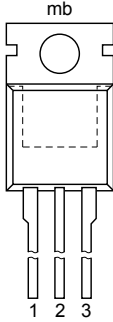
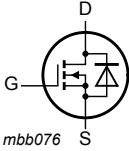
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C		-	-	40	V
I <sub>D</sub>	drain current	T <sub>mb</sub> = 25 °C; V <sub>GS</sub> = 10 V; <a href="#">Fig. 3</a> ; <a href="#">Fig. 1</a>		-	-	100	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>		-	-	306	W
<b>Static characteristics</b>							
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 12</a>	[1]	-	1.75	2.1	m $\Omega$
<b>Dynamic characteristics</b>							
Q <sub>GD</sub>	gate-drain charge	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 80 A; V <sub>DS</sub> = 20 V; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	25	-	nC

[1] Measured 3 mm from package.

## 5. Pinning information

Table 2. Pinning information

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

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN2R2-40PS	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
PSMN2R2-40PS	PSMN2R2-40PS

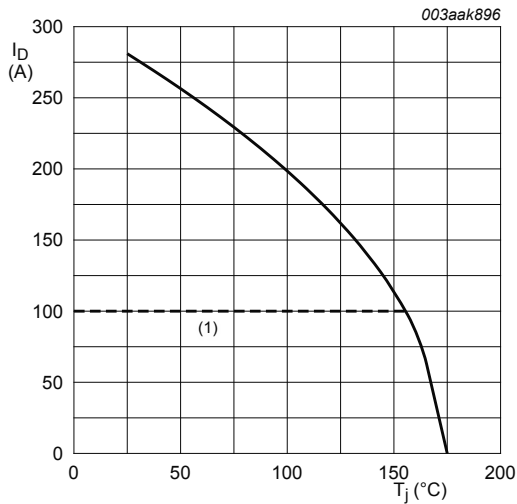
## 8. Limiting values

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	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	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	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 1</a>	-	100	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a> ; <a href="#">Fig. 1</a>	-	100	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>	-	1122	A

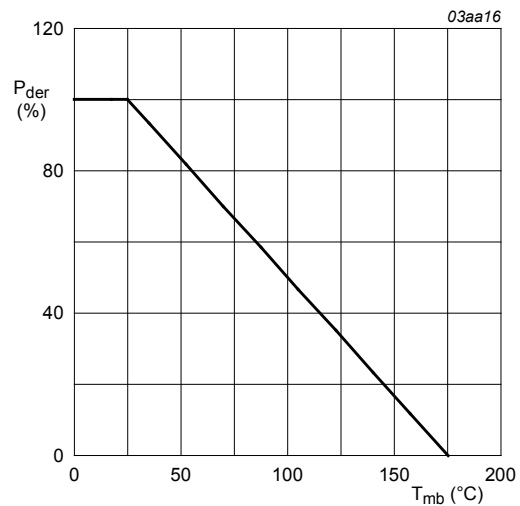
Symbol	Parameter	Conditions	Min	Max	Unit
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	-	306	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$	-	100	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$	-	1122	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; $I_D = 100\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; unclamped; $R_{GS} = 50\text{ }\Omega$	-	1.24	J



(1) Capped at 100 A due to package

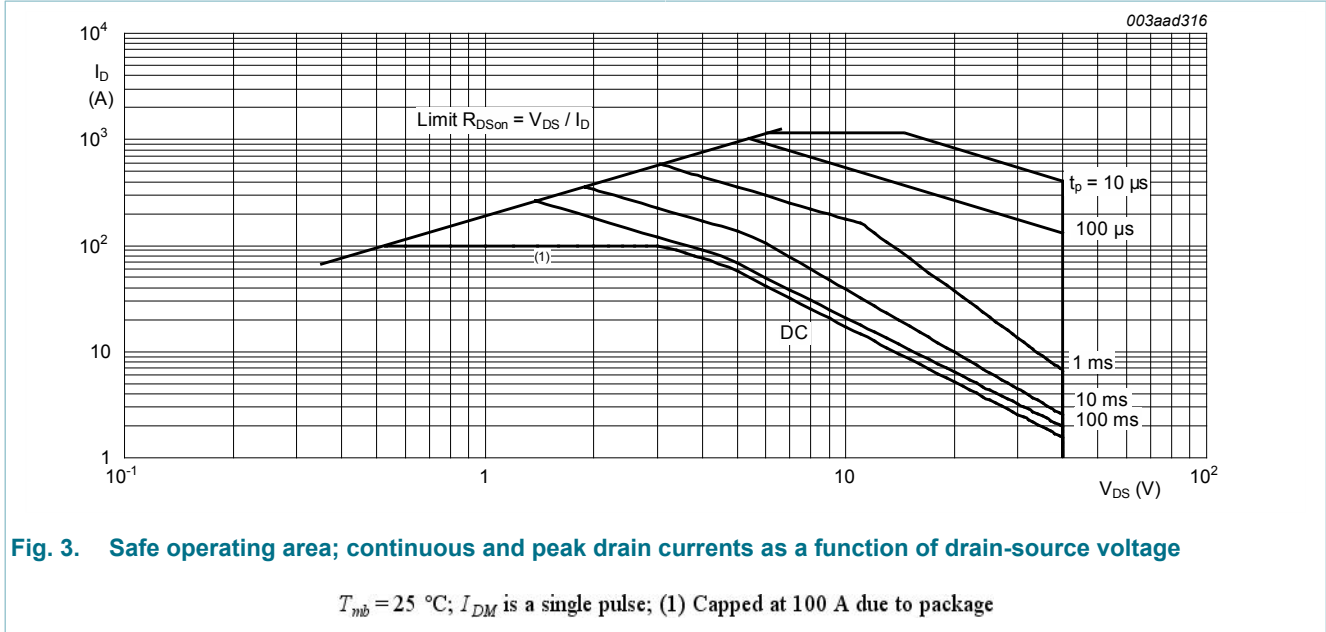
**Fig. 1. Continuous drain current as a function of mounting base temperature**

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



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

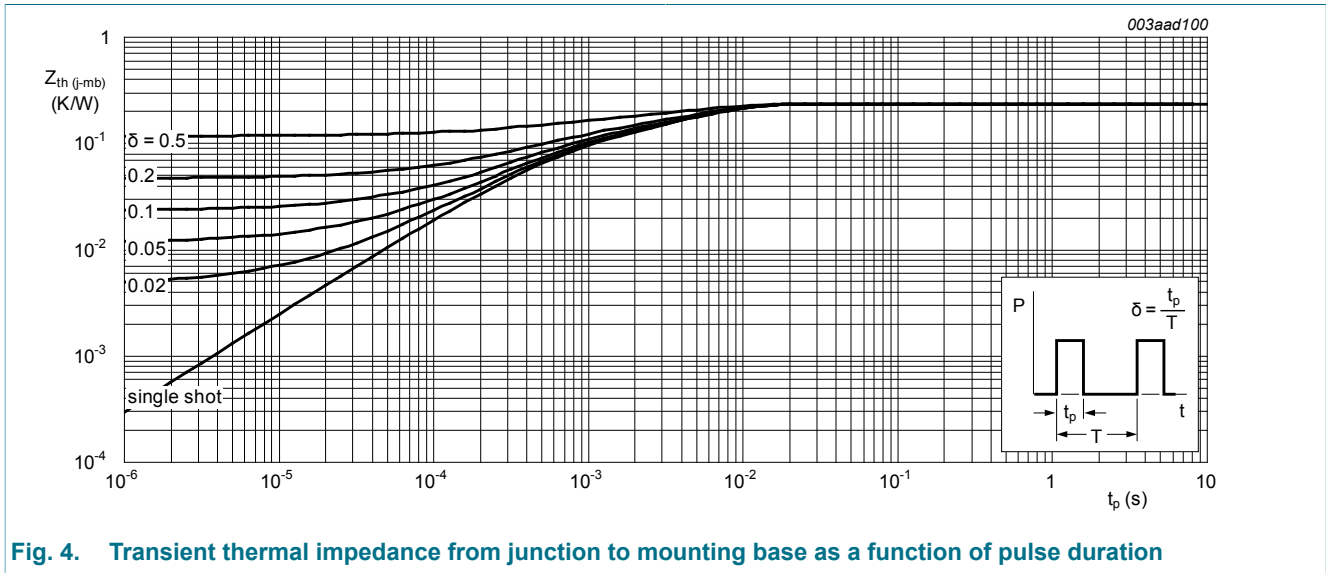
$$P_{der} = \frac{P_{tot}}{P_{tot(25\text{°C})}} \times 100\%$$



## 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. 4	-	0.25	0.5	K/W



## 10. Characteristics

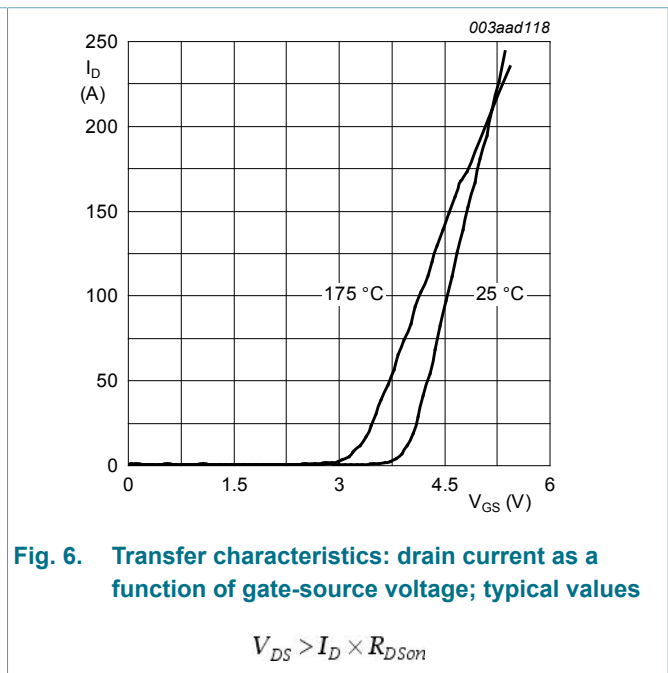
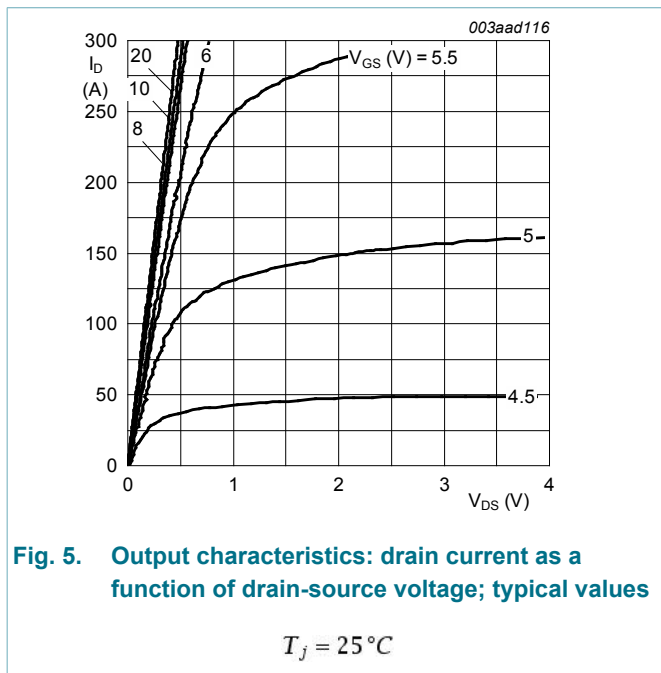
**Table 7. Characteristics**

Tested to JEDEC standards where applicable.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	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	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	-	-	4.6	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 11; Fig. 10</a>	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	$\mu\text{A}$
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$	-	-	200	$\mu\text{A}$
$I_{GSS}$	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	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 100 \text{ }^\circ\text{C};$ <a href="#">Fig. 12; Fig. 13</a>	-	2.4	2.85	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ <a href="#">Fig. 12; Fig. 13</a>	-	3.25	3.9	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 12</a>	[1]	-	1.75	2.1
$R_G$	internal gate resistance (AC)	$f = 1 \text{ MHz}$	-	1	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	110	-	nC
		$I_D = 80 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 10 \text{ V};$ <a href="#">Fig. 14; Fig. 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	$I_D = 80 \text{ A}; V_{DS} = 20 \text{ V};$ <a href="#">Fig. 14; Fig. 15</a>	-	4.95	-	V
$C_{iss}$	input capacitance	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 16</a>	-	8423	-	pF
$C_{oss}$	output capacitance		-	1671	-	pF

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{rSS}$	reverse transfer capacitance		-	814	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\text{ V}; R_L = 0.25\ \Omega; V_{GS} = 10\text{ V}; R_{G(ext)} = 1.5\ \Omega$	-	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
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}; \text{Fig. 17}$	-	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	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 20\text{ V}; T_j = 25\text{ }^\circ\text{C}$	-	80.75	-	nC

[1] Measured 3 mm from package.



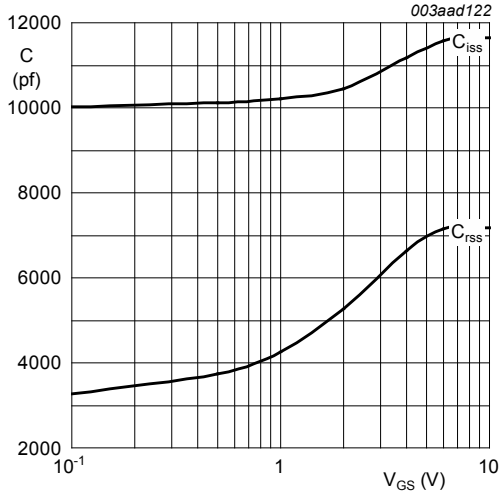


Fig. 7. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

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

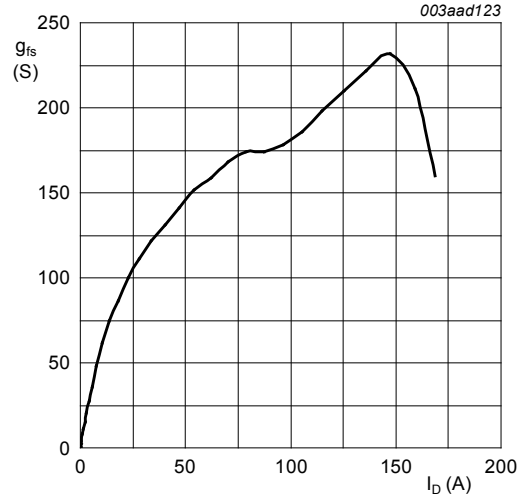


Fig. 8. Forward transconductance as a function of drain current; typical values

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

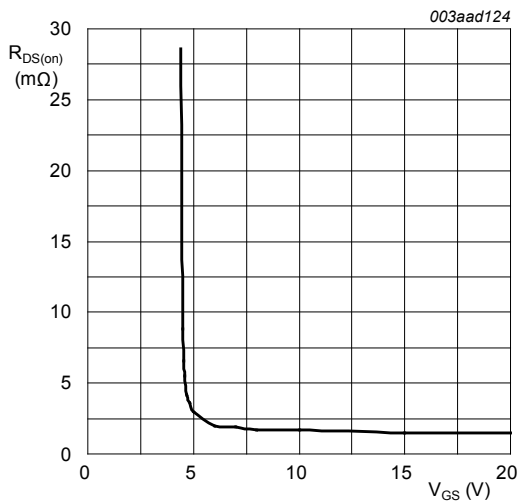


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

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

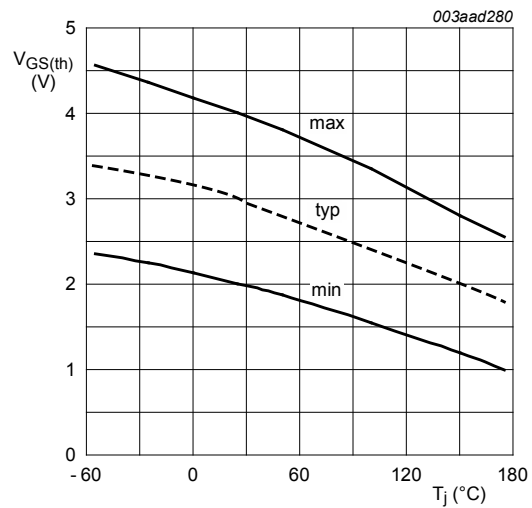


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

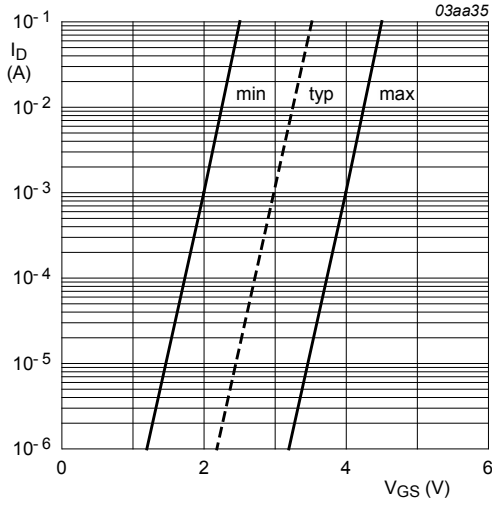


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

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

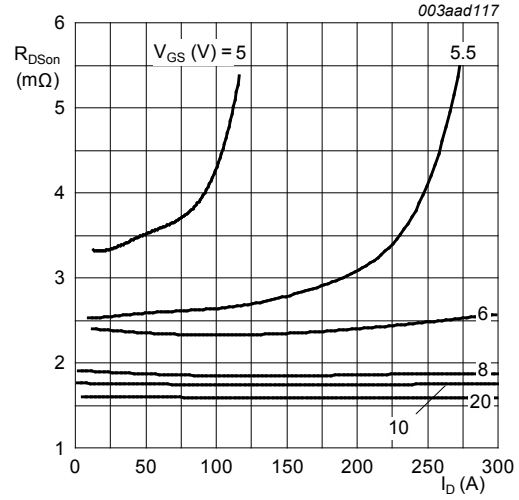


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

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

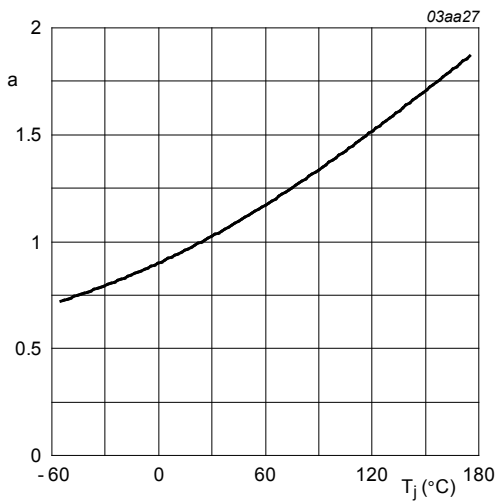


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

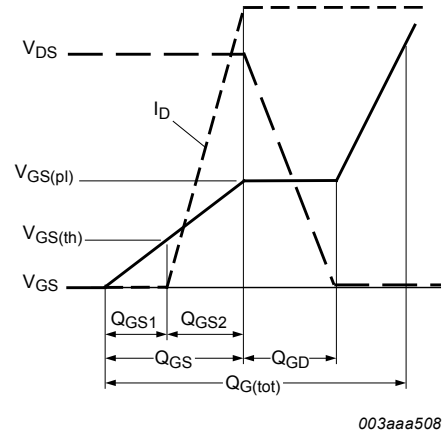


Fig. 14. Gate charge waveform definitions



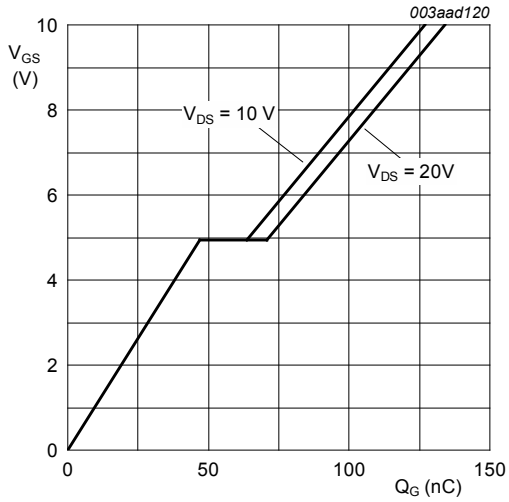


Fig. 15. Gate-source voltage as a function of gate charge; typical values

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

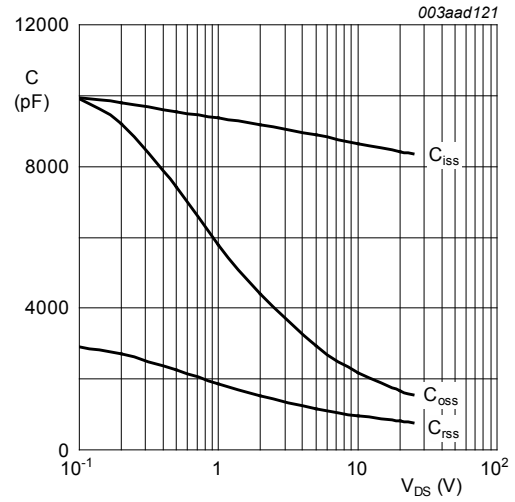


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

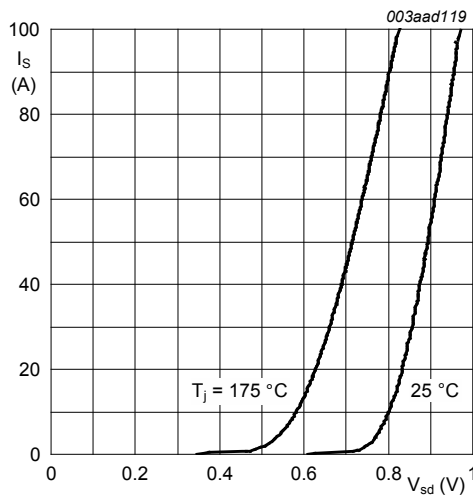


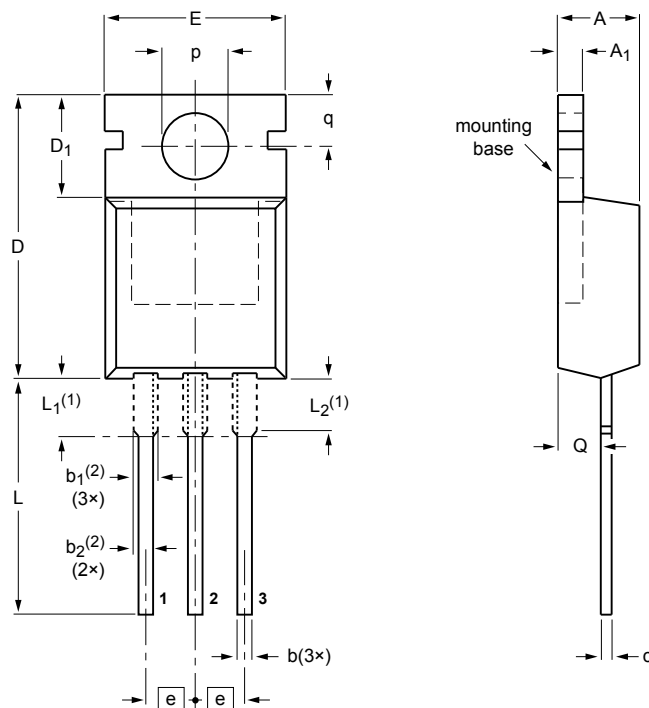
Fig. 17. Source current as a function of source-drain voltage; typical values

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

### 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

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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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## 13. Contents

1	General description .....	1
2	Features and benefits .....	1
3	Applications .....	1
4	Quick reference data .....	1
5	Pinning information .....	2
6	Ordering information .....	2
7	Marking .....	2
8	Limiting values .....	2
9	Thermal characteristics .....	4
10	Characteristics .....	5
11	Package outline .....	10
12	Legal information .....	11
12.1	Data sheet status .....	11
12.2	Definitions .....	11
12.3	Disclaimers .....	11
12.4	Trademarks .....	12

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Date of release: 22 February 2013