



# PSMN013-100PS

N-channel 100V 13.9mΩ standard level MOSFET in TO220.

10 August 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel MOSFET in TO220 package qualified to 175C. 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
- Improved dynamic avalanche performance
- Suitable for standard level gate drive

### 1.3 Applications

- DC-to-DC converters
- Load switching
- Motor control
- 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	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$		-	-	100	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ <a href="#">Fig. 1</a>	[1]	-	-	68	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C};$ <a href="#">Fig. 2</a>		-	-	170	W
$T_j$	junction temperature			-55	-	175	°C
<b>Static characteristics</b>							
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 100\text{ °C};$ <a href="#">Fig. 12</a>		-	19.4	25	mΩ
		$V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ °C};$ <a href="#">Fig. 13</a>	[2]	-	10.8	13.9	mΩ
<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. 15; Fig. 14</a>		-	17	-	nC

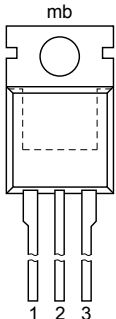
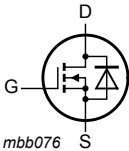
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Q_{G(\text{tot})}$	total gate charge	$V_{GS} = 10 \text{ V}$ ; $I_D = 25 \text{ A}$ ; $V_{DS} = 50 \text{ V}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	59	-	nC
<b>Avalanche ruggedness</b>						
$E_{DS(\text{AL})S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10 \text{ V}$ ; $T_{j(\text{init})} = 25 \text{ °C}$ ; $I_D = 68 \text{ A}$ ; $V_{\text{sup}} \leq 100 \text{ V}$ ; unclamped; $R_{GS} = 50 \text{ } \Omega$	-	-	128	mJ

[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	 <p style="text-align: center;"><b>TO-220AB (SOT78)</b></p>	 <p style="text-align: center;"><i>mbb076</i></p>
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN013-100PS	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 4. Marking

Table 4. Marking codes

Type number	Marking code
PSMN013-100PS	PSMN013-100PS

## 5. 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
$V_{DGR}$	drain-gate voltage	$T_j \leq 175\text{ °C}; T_j \geq 25\text{ °C}; R_{GS} = 20\text{ k}\Omega$		-	100	V
$V_{GS}$	gate-source voltage			-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ °C}; \text{Fig. 1}$	[1]	-	47	A
		$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}; \text{Fig. 1}$	[1]	-	68	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}; T_{mb} = 25\text{ °C}; \text{Fig. 3}$		-	272	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}; \text{Fig. 2}$		-	170	W
$T_{stg}$	storage temperature			-55	175	°C
$T_j$	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$	[1]	-	68	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}; T_{mb} = 25\text{ °C}$		-	272	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}; T_{j(\text{init})} = 25\text{ °C}; I_D = 68\text{ A}; V_{sup} \leq 100\text{ V}; \text{unclamped}; R_{GS} = 50\text{ }\Omega$		-	128	mJ

[1] Continuous current is limited by package

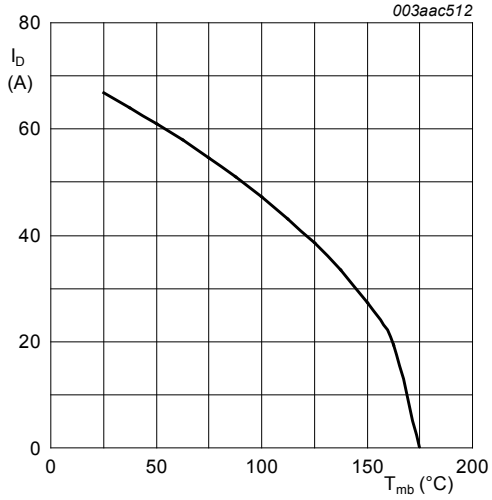


Fig. 1. Continuous drain current as a function of mounting base temperature

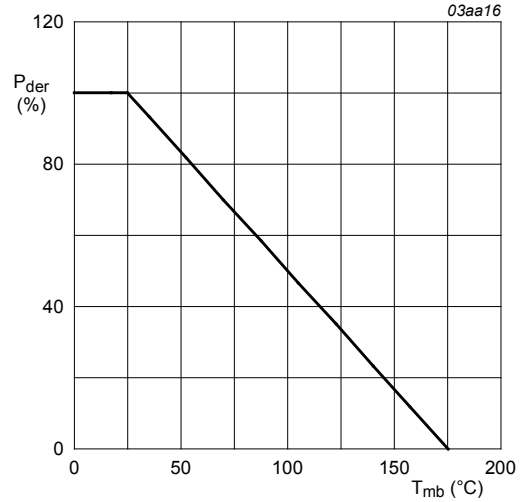


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

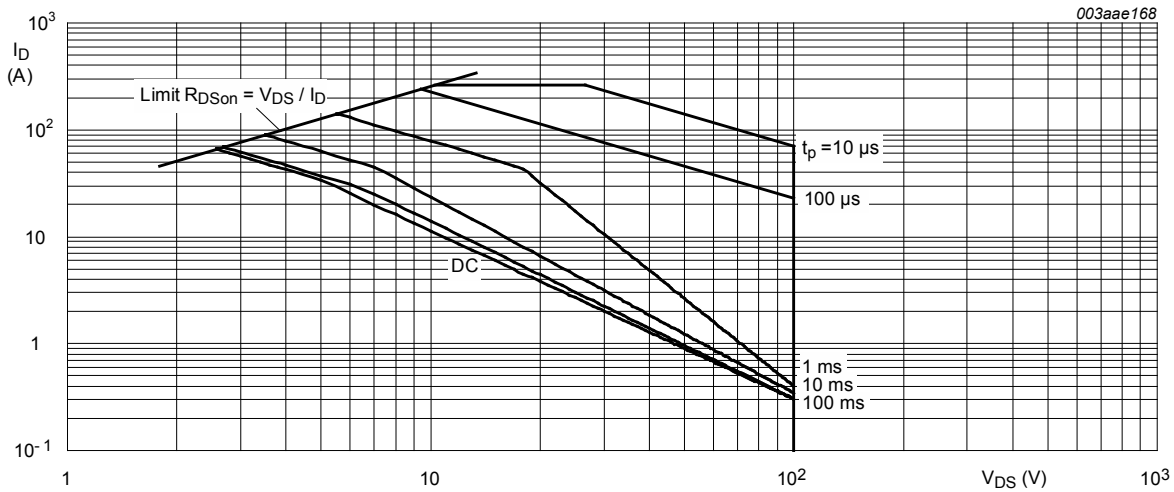


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

## 6. 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	-	0.5	0.9	K/W

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in free air	-	60	-	K/W

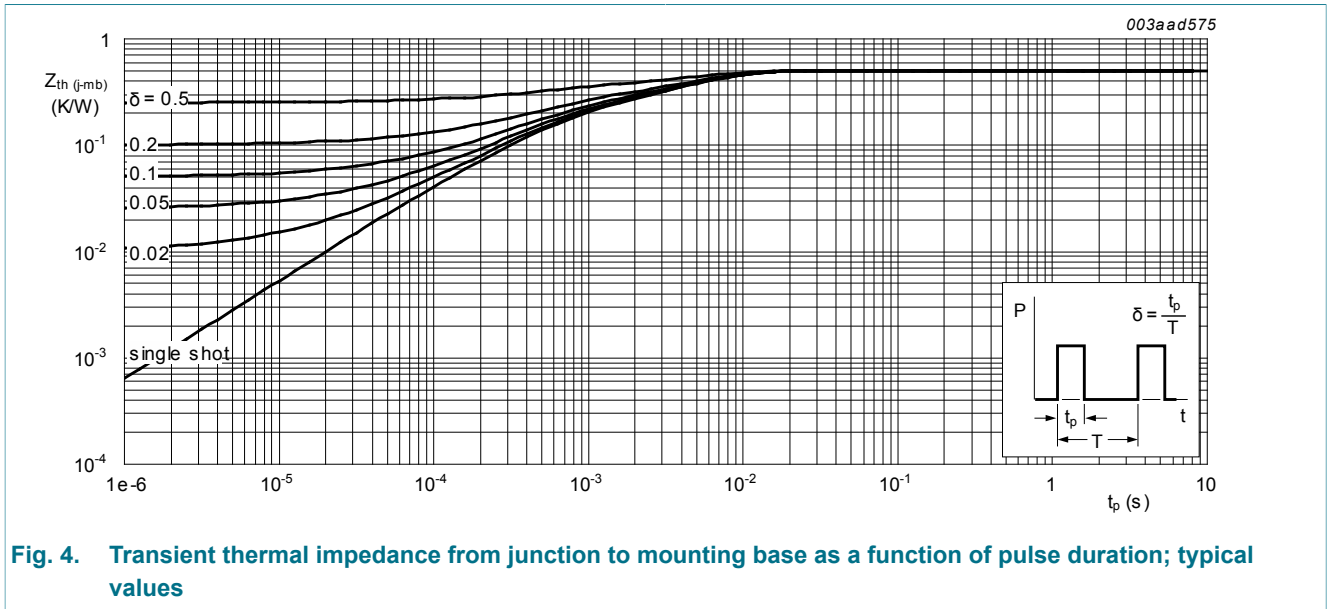


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values

## 7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	90	-	-	V
		$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	100	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ <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. 10; Fig. 11</a>	2	3	4	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	-	-	4.6	V
$I_{DSS}$	drain leakage current	$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$	-	-	100	$\mu\text{A}$
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.06	2	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	10	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	10	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_j = 100 \text{ }^\circ\text{C};$ <a href="#">Fig. 12</a>	-	19.4	25	mΩ

## N-channel 100V 13.9mΩ standard level MOSFET in TO220.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
		$V_{GS} = 10\text{ V}$ ; $I_D = 15\text{ A}$ ; $T_j = 175\text{ °C}$ ; <a href="#">Fig. 12</a>	-	29.5	38.9	mΩ
		$V_{GS} = 10\text{ V}$ ; $I_D = 15\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 13</a>	[1]	10.8	13.9	mΩ
$R_G$	internal gate resistance (AC)	$f = 1\text{ MHz}$	-	1	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(\text{tot})}$	total gate charge	$I_D = 25\text{ A}$ ; $V_{DS} = 50\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	59	-	nC
		$I_D = 0\text{ A}$ ; $V_{DS} = 0\text{ V}$ ; $V_{GS} = 10\text{ V}$	-	47.6	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25\text{ A}$ ; $V_{DS} = 50\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	13.8	-	nC
$Q_{GS(\text{th})}$	pre-threshold gate-source charge	$I_D = 25\text{ A}$ ; $V_{DS} = 50\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 15</a>	-	9.2	-	nC
$Q_{GS(\text{th-pl})}$	post-threshold gate-source charge		-	4.6	-	nC
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}$ ; $V_{DS} = 50\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 15</a> ; <a href="#">Fig. 14</a>	-	17	-	nC
$V_{GS(\text{pl})}$	gate-source plateau voltage	$V_{DS} = 50\text{ V}$ ; <a href="#">Fig. 15</a> ; <a href="#">Fig. 14</a>	-	4.4	-	V
$C_{iss}$	input capacitance	$V_{DS} = 50\text{ V}$ ; $V_{GS} = 0\text{ V}$ ; $f = 1\text{ MHz}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 16</a>	-	3195	-	pF
$C_{oss}$	output capacitance		-	221	-	pF
$C_{rss}$	reverse transfer capacitance		-	136	-	pF
$t_{d(\text{on})}$	turn-on delay time	$V_{DS} = 50\text{ V}$ ; $R_L = 2\text{ Ω}$ ; $V_{GS} = 10\text{ V}$ ; $R_{G(\text{ext})} = 4.7\text{ Ω}$ ; $T_j = 25\text{ °C}$	-	20.7	-	ns
$t_r$	rise time		-	25	-	ns
$t_{d(\text{off})}$	turn-off delay time		-	52.5	-	ns
$t_f$	fall time		-	24	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 15\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 17</a>	-	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}$ ; $di_S/dt = 100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$	-	52	-	ns
$Q_r$	recovered charge		-	109	-	nC

[1] Measured 3 mm from package.

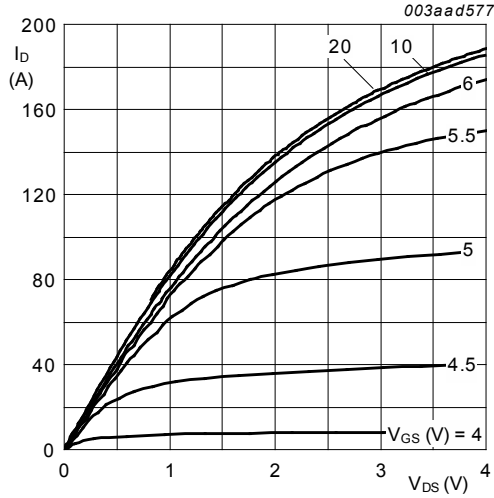


Fig. 5. Output characteristics: drain current as a function of drain-source voltage; typical values

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

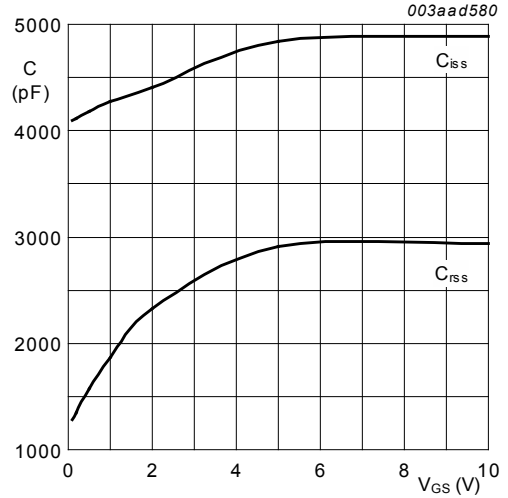


Fig. 6. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

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

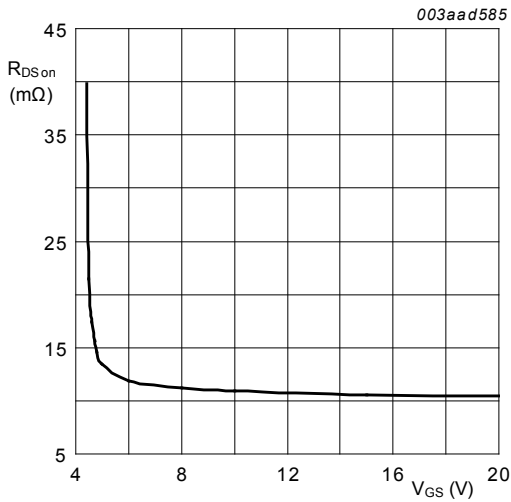


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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

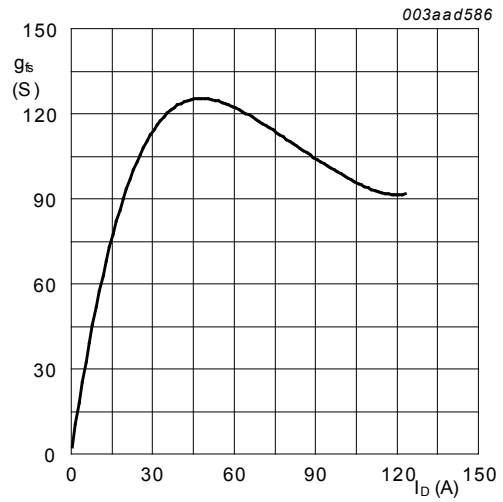


Fig. 8. Forward transconductance as a function of drain current; typical values

$T_j = 25^\circ\text{C}; V_{DS} = 15\text{V}$

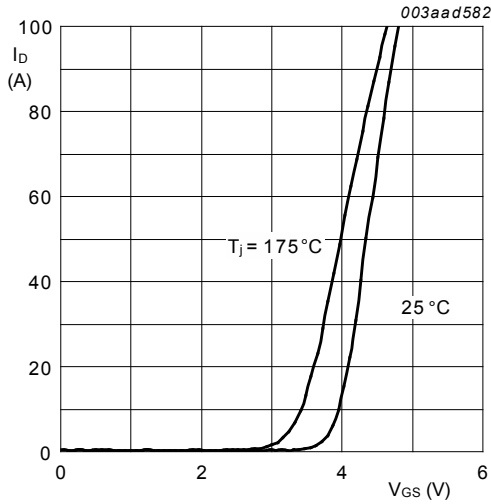


Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$$V_{DS} > I_D \times R_{DSon}$$

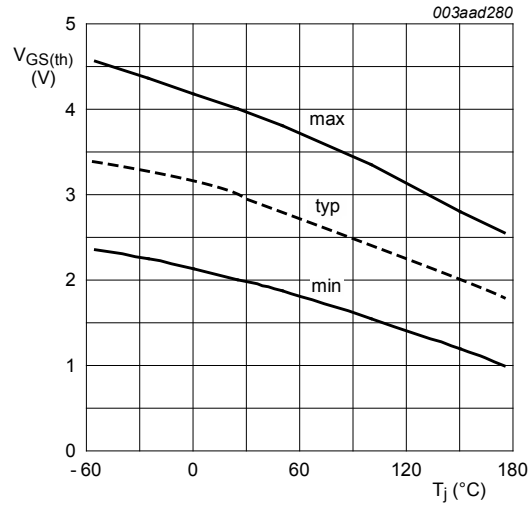


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

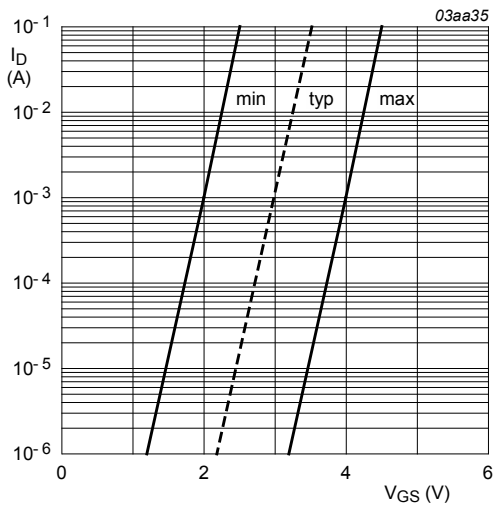


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

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

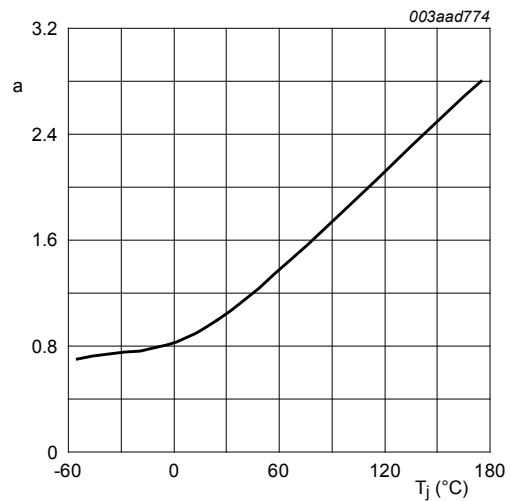


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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



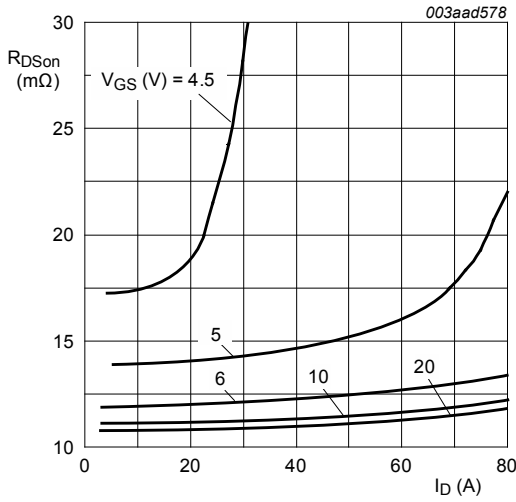


Fig. 13. Drain-source on-state resistance as a function of drain current; typical values

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

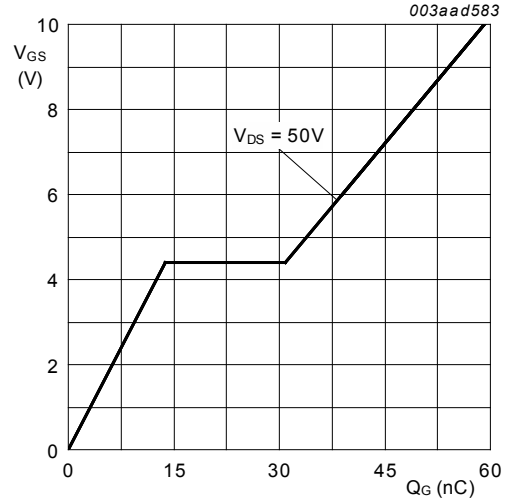


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

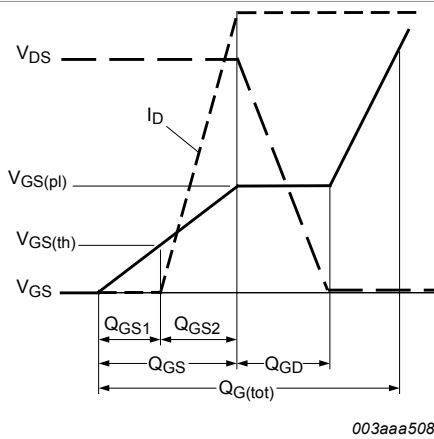


Fig. 15. Gate charge waveform definitions

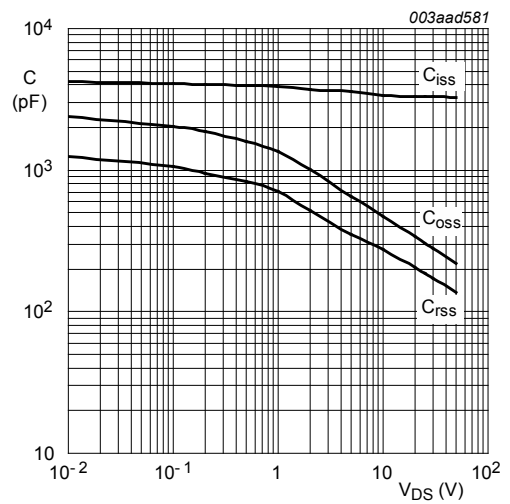


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

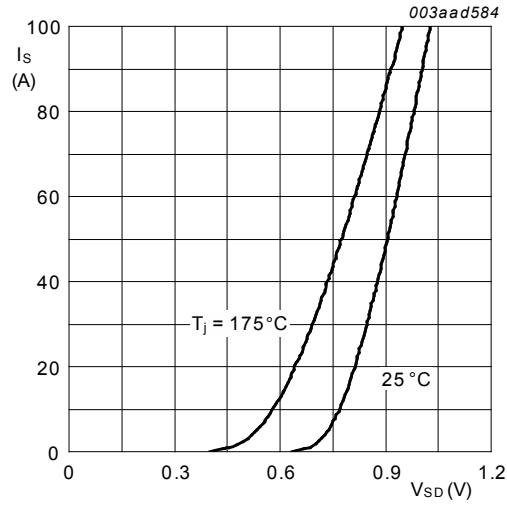


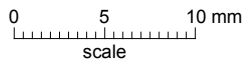
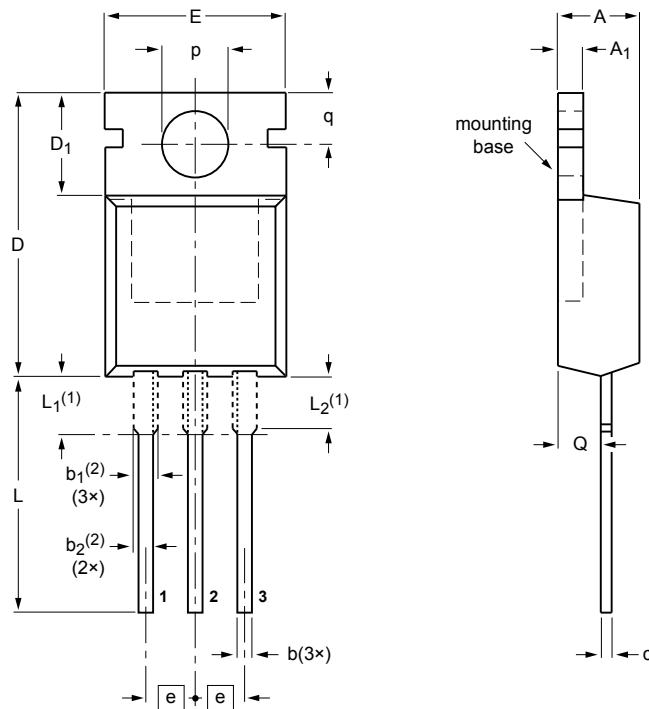
Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

### 8. 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**

- 1. Lead shoulder designs may vary.
- 2. 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. TO-220AB (SOT78)

## 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.

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