



# PSMN3R3-60PL

N-channel 60 V, 3.4 mΩ logic level MOSFET in SOT78

7 February 2013

Product data sheet

## 1. General description

Logic level N-channel MOSFET in SOT78 using TrenchMOS technology. Product design and manufacture has been optimized for use in battery operated power tools.

## 2. Features and benefits

- High efficiency due to low switching & conduction losses
- Robust construction for demanding applications
- Logic level gate

## 3. Applications

- Battery-powered tools
- Load switching
- Motor control
- Uninterruptible power supplies

## 4. Quick reference data

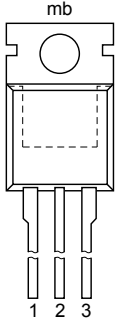
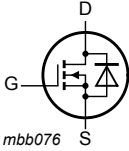
Table 1. Quick reference data

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		-	-	60	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>	[1]	-	-	130	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>		-	-	293	W
Static characteristics							
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. 11</a>		-	2.7	3.4	mΩ
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; V <sub>DS</sub> = 48 V;		-	175	-	nC
Q <sub>GD</sub>	gate-drain charge	<a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	31	-	nC
Avalanche ruggedness							
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 130 A; V <sub>sup</sub> ≤ 60 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>J(init)</sub> = 25 °C; unclamped; <a href="#">Fig. 3</a>		-	-	372	mJ

[1] Continuous current is limited by package.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 TO-220AB (SOT78)	 mbb076
2	D	drain		
3	S	source		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN3R3-60PL	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
PSMN3R3-60PL	PSMN3R3-60PL

8. Limiting values

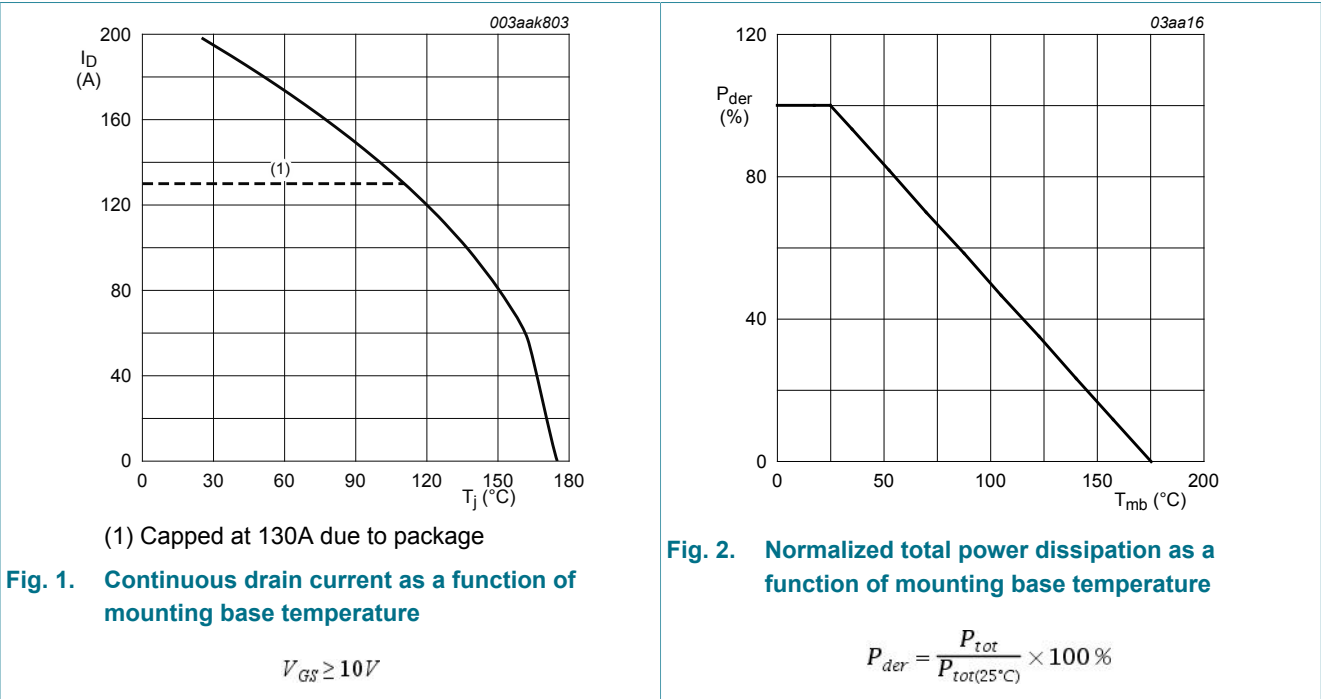
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C		-	60	V
V <sub>DGR</sub>	drain-gate voltage	R <sub>GS</sub> = 20 kΩ		-	60	V
V <sub>GS</sub>	gate-source voltage			-20	20	V
I <sub>D</sub>	drain current	T <sub>mb</sub> = 25 °C; V <sub>GS</sub> = 10 V; Fig. 1	[1]	-	130	A
		T <sub>mb</sub> = 100 °C; V <sub>GS</sub> = 10 V; Fig. 1	[1]	-	130	A
I <sub>DM</sub>	peak drain current	T <sub>mb</sub> = 25 °C; pulsed; t <sub>p</sub> ≤ 10 μs; Fig. 4		-	793	A

Symbol	Parameter	Conditions		Min	Max	Unit
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>		-	293	W
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
Source-drain diode						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	<a href="#">[1]</a>	-	130	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C		-	793	A
Avalanche ruggedness						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 130 A; V <sub>sup</sub> ≤ 60 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; <a href="#">Fig. 3</a>		-	372	mJ

[1] Continuous current is limited by package.



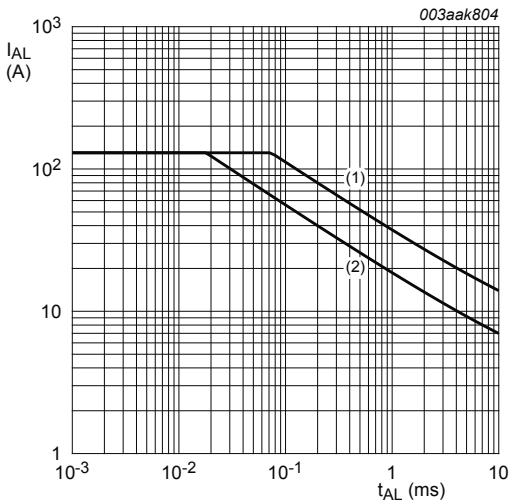


Fig. 3. Avalanche rating; avalanche current as a function of avalanche time

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

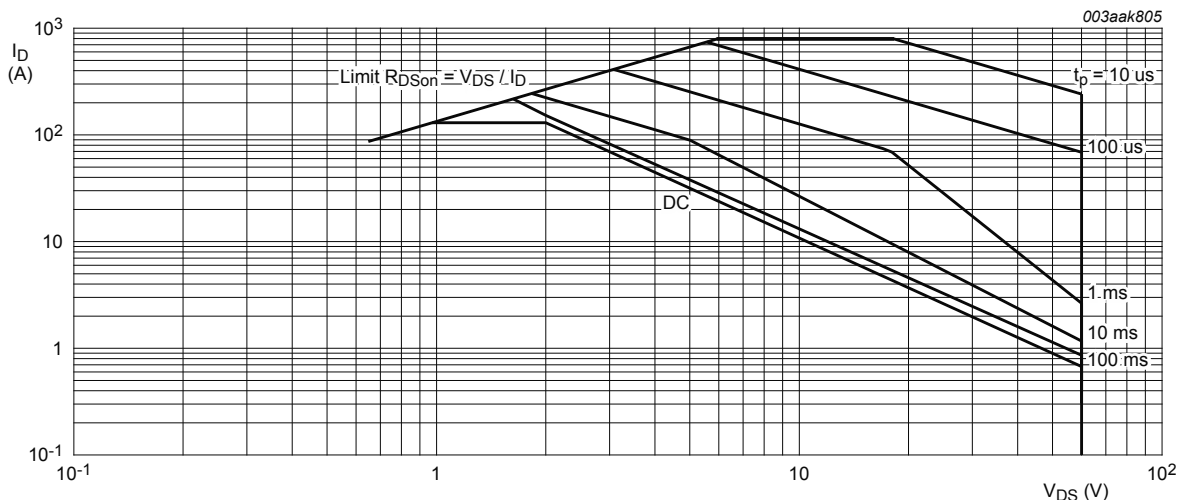


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

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	-	0.4	0.51	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	60	-	K/W

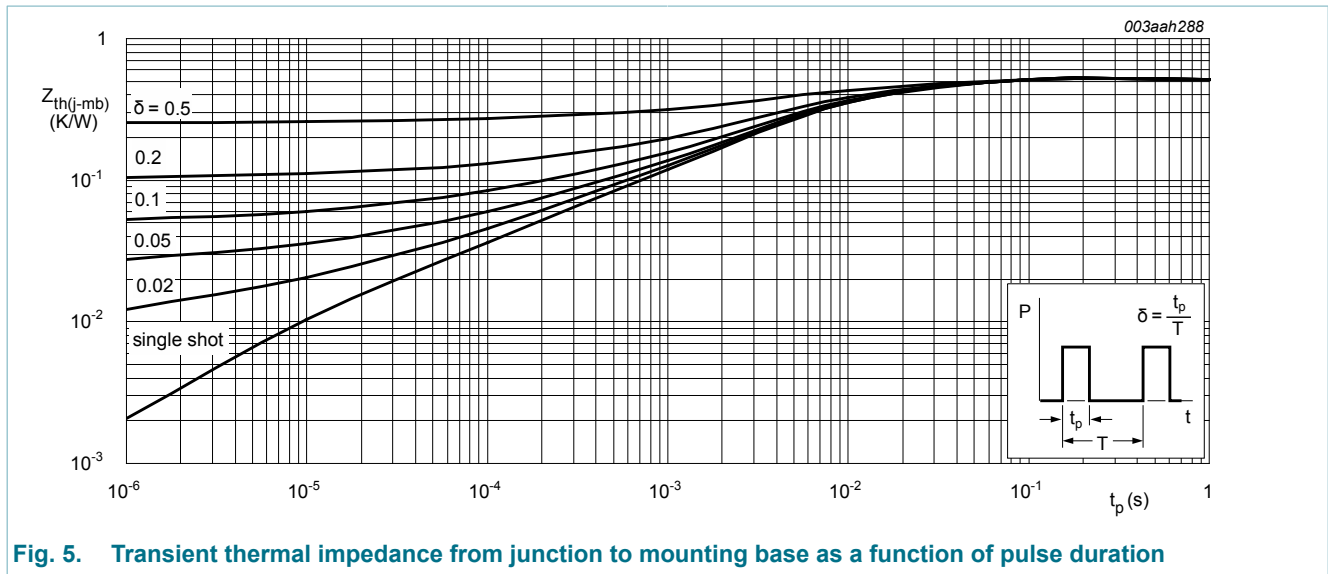


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_J = 25 ^\circ C$	60	-	-	V
		$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_J = -55 ^\circ C$	54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_J = 25 ^\circ C$ ; <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a>	1.4	1.7	2.1	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_J = -55 ^\circ C$ ; <a href="#">Fig. 9</a>	-	-	2.45	V
		$I_D = 1 mA$ ; $V_{DS} = V_{GS}$ ; $T_J = 175 ^\circ C$ ; <a href="#">Fig. 9</a>	0.5	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_J = 175 ^\circ C$	-	-	500	$\mu A$
		$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_J = 25 ^\circ C$	-	0.09	1	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 16 V$ ; $V_{DS} = 0 V$ ; $T_J = 25 ^\circ C$	-	2	100	nA
		$V_{GS} = -16 V$ ; $V_{DS} = 0 V$ ; $T_J = 25 ^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5 V$ ; $I_D = 25 A$ ; $T_J = 25 ^\circ C$ ; <a href="#">Fig. 11</a>	-	3	3.8	mΩ
		$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_J = 25 ^\circ C$ ; <a href="#">Fig. 11</a>	-	2.7	3.4	mΩ
		$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_J = 175 ^\circ C$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 11</a>	-	-	7.5	mΩ
$R_G$	gate resistance	$f = 1 MHz$	0.5	1	2	Ω

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 5 V; Fig. 13; Fig. 14		-	95	-	nC
		I <sub>D</sub> = 25 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 10 V; Fig. 13; Fig. 14		-	175	-	nC
Q <sub>GS</sub>	gate-source charge			-	20	-	nC
Q <sub>GD</sub>	gate-drain charge			-	31	-	nC
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz;		-	10115	-	pF
C <sub>oss</sub>	output capacitance	T <sub>j</sub> = 25 °C; Fig. 15		-	822	-	pF
C <sub>rss</sub>	reverse transfer capacitance			-	427	-	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 45 V; R <sub>L</sub> = 1.8 Ω; V <sub>GS</sub> = 5 V;		-	54.2	-	ns
t <sub>r</sub>	rise time	R <sub>G(ext)</sub> = 5 Ω		-	100	-	ns
t <sub>d(off)</sub>	turn-off delay time			-	158	-	ns
t <sub>f</sub>	fall time			-	109	-	ns
Source-drain diode							
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. 16		-	0.78	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V;		-	43	-	ns
Q <sub>r</sub>	recovered charge	V <sub>DS</sub> = 25 V		-	67	-	nC

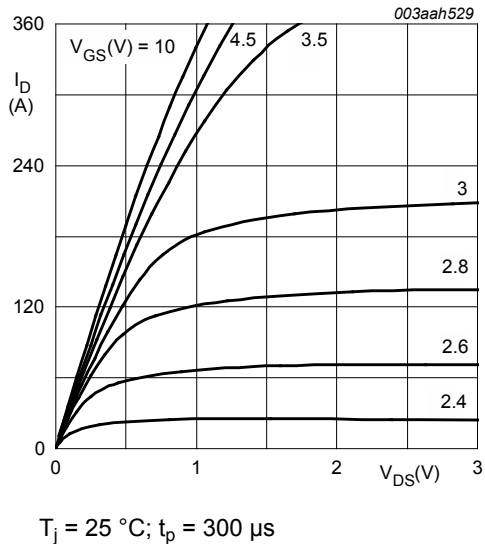


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

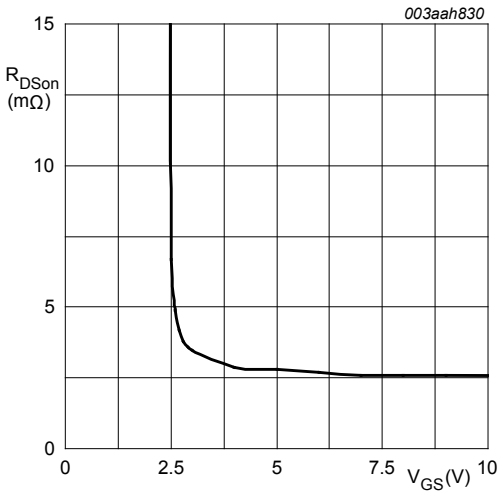


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

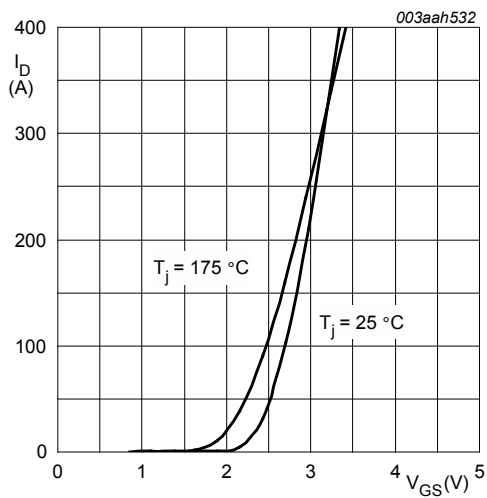


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10V$

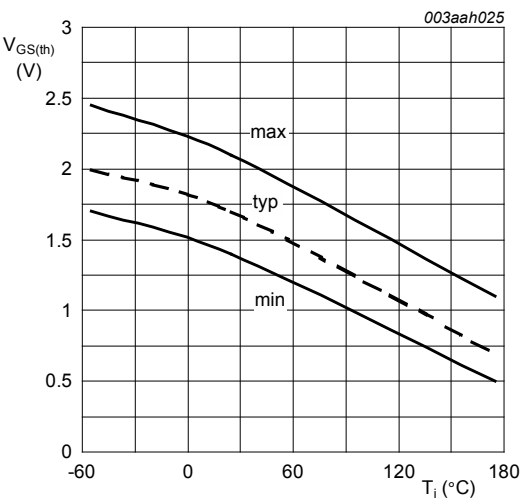


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

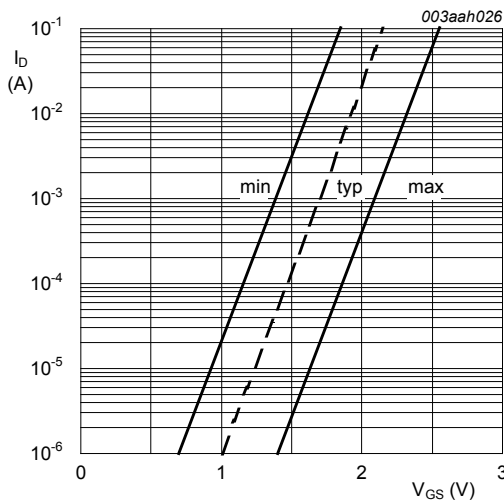


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

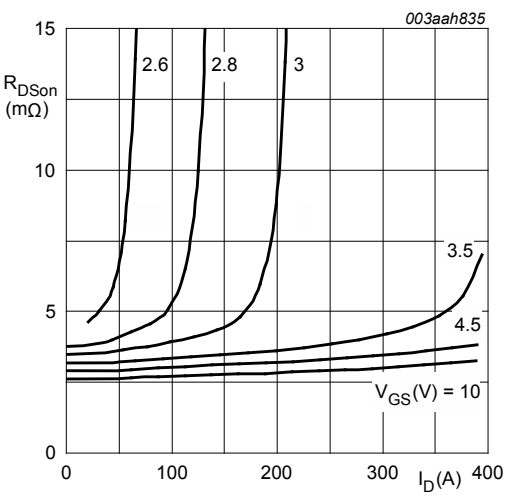


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

$T_J = 25^\circ\text{C}; t_p = 300\text{ }\mu\text{s}$

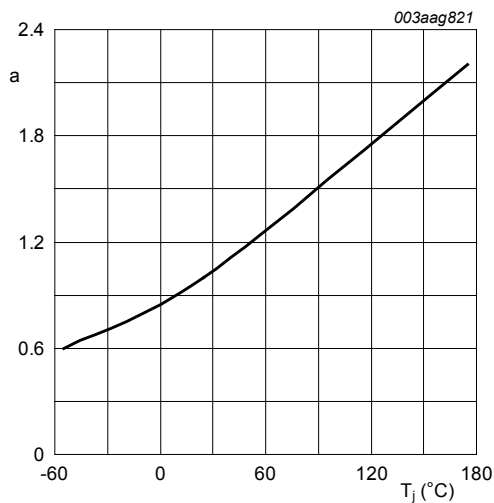


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

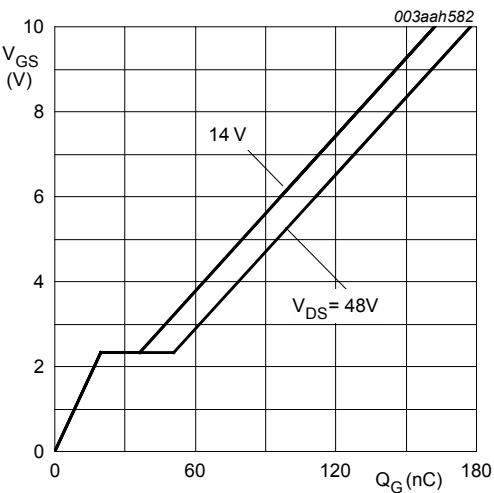


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

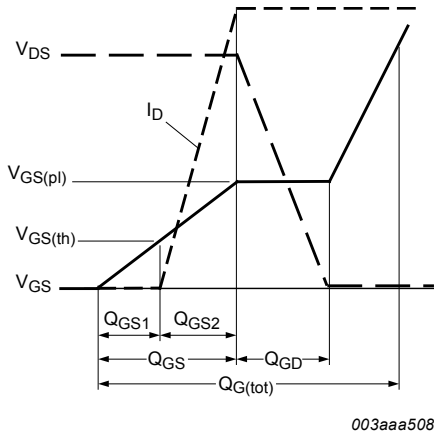


Fig. 13. Gate charge waveform definitions

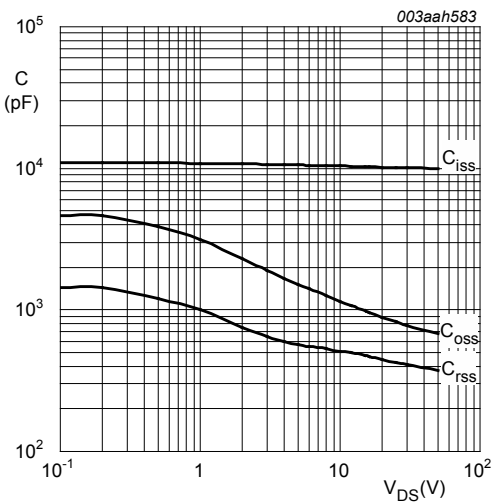


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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



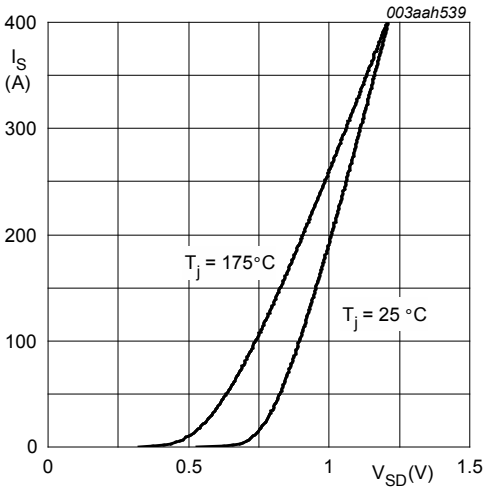


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

11. Package outline

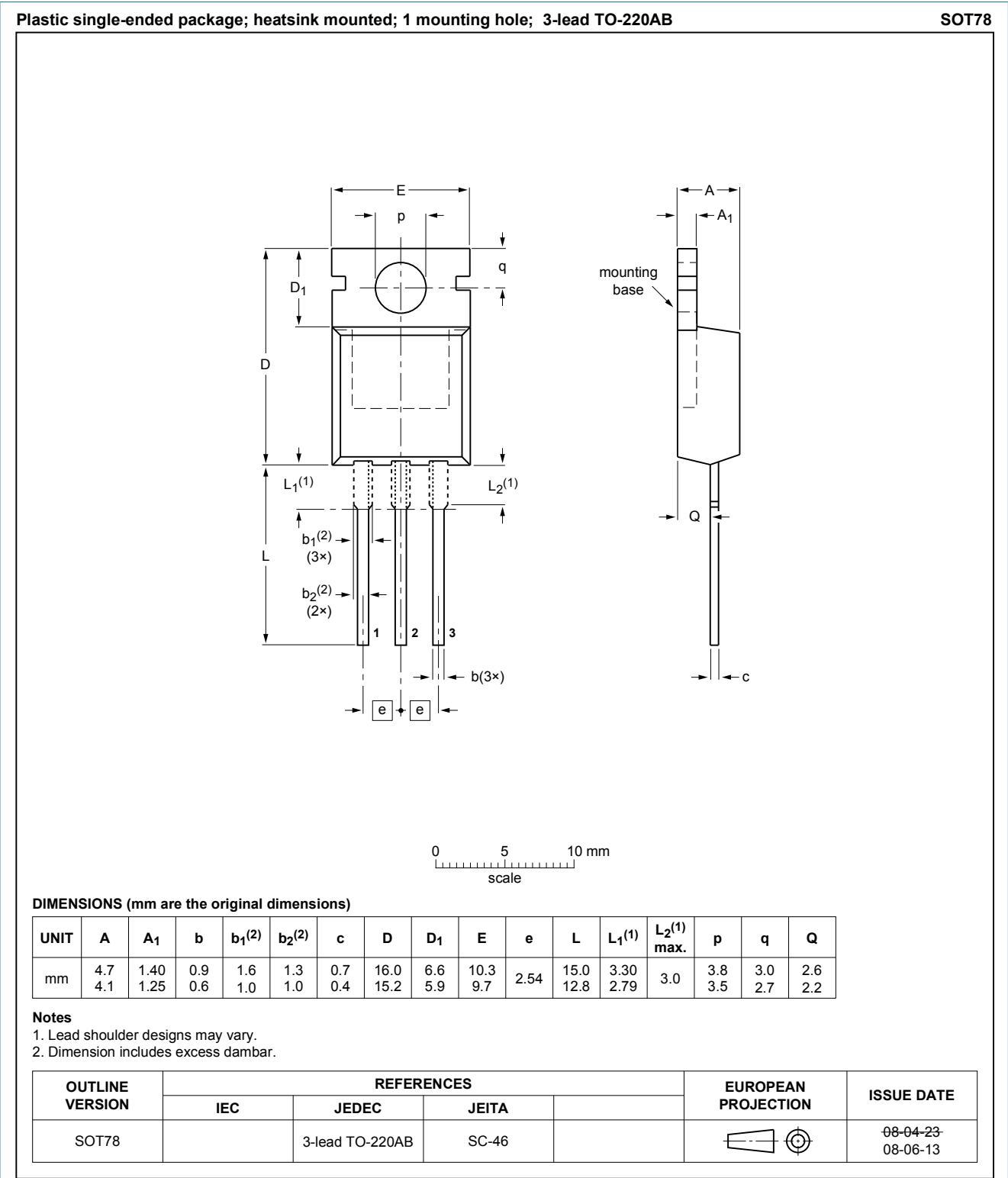


Fig. 17. Package outline TO-220AB (SOT78)

## 12. Legal information

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