



PSMN2R1-40PL

N-channel 40 V, 2.2 mΩ logic level MOSFET in SOT78

1 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

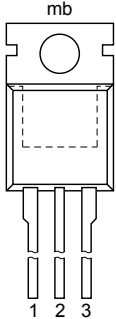
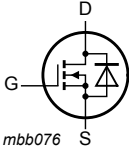
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V _{DS}	drain-source voltage	T _J ≥ 25 °C; T _J ≤ 175 °C		-	-	40	V
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C; Fig. 1	[1]	-	-	150	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2		-	-	293	W
Static characteristics							
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 25 A; T _J = 25 °C; Fig. 11		-	1.8	2.2	mΩ
Dynamic characteristics							
Q _{G(tot)}	total gate charge	V _{GS} = 10 V; I _D = 25 A; V _{DS} = 32 V; Fig. 13 ; Fig. 14		-	168.9	-	nC
Q _{GD}	gate-drain charge			-	29.6	-	nC
Avalanche ruggedness							
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	I _D = 150 A; V _{sup} ≤ 40 V; R _{GS} = 50 Ω; V _{GS} = 10 V; T _{j(init)} = 25 °C; unclamped; Fig. 3		-	-	490.3	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	 <p>TO-220AB (SOT78)</p>	
2	D	drain		
3	S	source		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN2R1-40PL	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
PSMN2R1-40PL	PSMN2R1-40PL

8. Limiting values

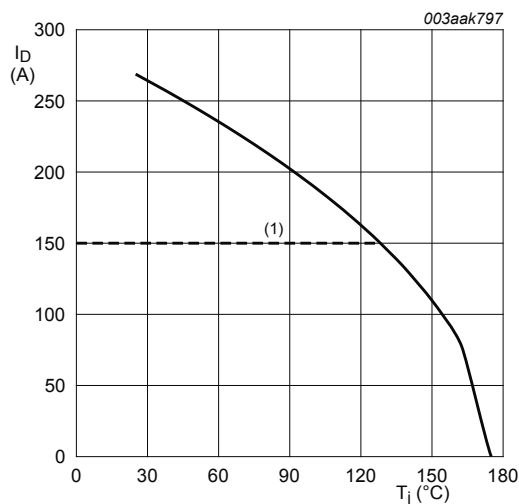
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ }^{\circ}\text{C}$; $T_j \leq 175\text{ }^{\circ}\text{C}$		-	40	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	40	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	$T_{mb} = 100\text{ }^{\circ}\text{C}$; $V_{GS} = 10\text{ V}$; Fig. 1	[1]	-	150	A
		$T_{mb} = 25\text{ }^{\circ}\text{C}$; $V_{GS} = 10\text{ V}$; Fig. 1	[1]	-	150	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ }^{\circ}\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4		-	1075	A

Symbol	Parameter	Conditions		Min	Max	Unit
P_{tot}	total power dissipation	$T_{\text{mb}} = 25\text{ °C}$; Fig. 2		-	293	W
T_{stg}	storage temperature			-55	175	°C
T_{j}	junction temperature			-55	175	°C
$T_{\text{sld(M)}}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_{S}	source current	$T_{\text{mb}} = 25\text{ °C}$	[1]	-	150	A
I_{SM}	peak source current	pulsed; $t_{\text{p}} \leq 10\text{ }\mu\text{s}$; $T_{\text{mb}} = 25\text{ °C}$		-	1075	A
Avalanche ruggedness						
$E_{\text{DS(AL)S}}$	non-repetitive drain-source avalanche energy	$I_{\text{D}} = 150\text{ A}$; $V_{\text{sup}} \leq 40\text{ V}$; $R_{\text{GS}} = 50\text{ }\Omega$; $V_{\text{GS}} = 10\text{ V}$; $T_{\text{j(init)}} = 25\text{ °C}$; unclamped; Fig. 3		-	490.3	mJ

[1] Continuous current is limited by package.



(1) Capped at 150A due to package

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

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

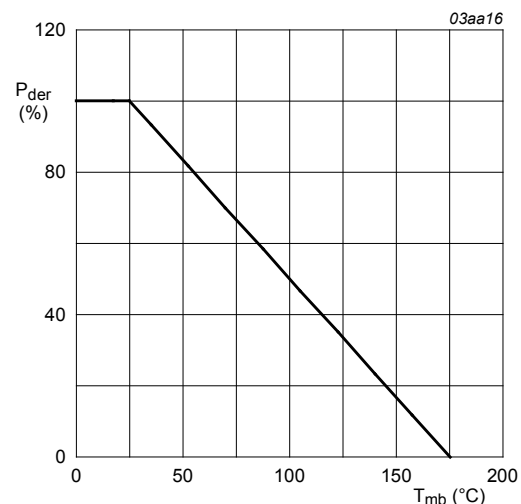


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

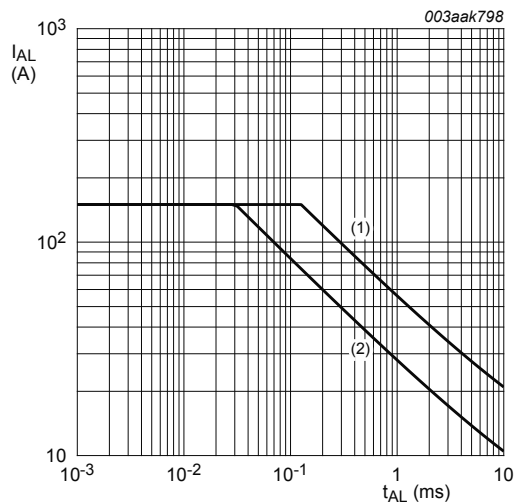


Fig. 3. Avalanche rating; avalanche current as a function of avalanche time

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

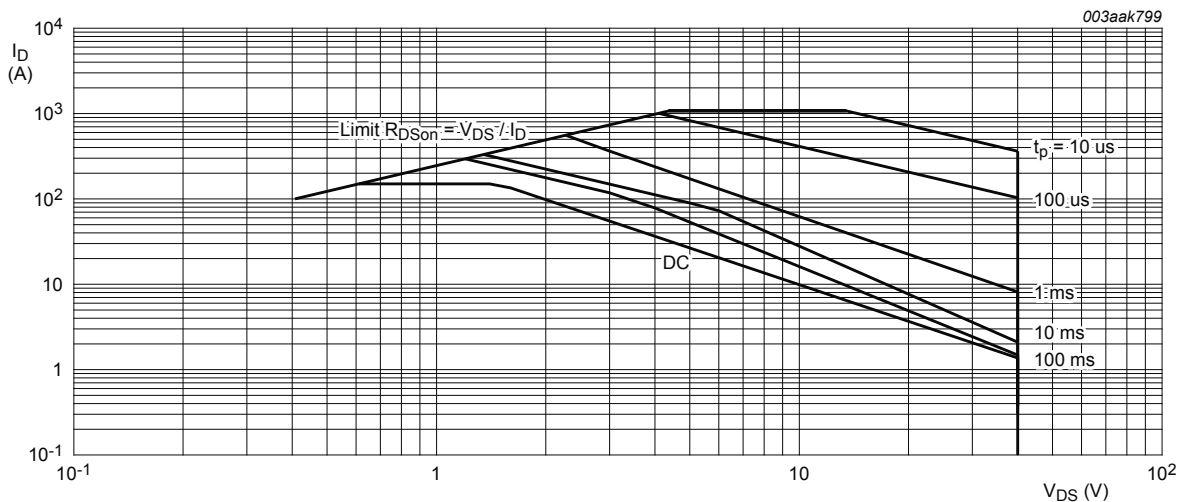


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

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	-	0.44	0.51	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	60	-	K/W

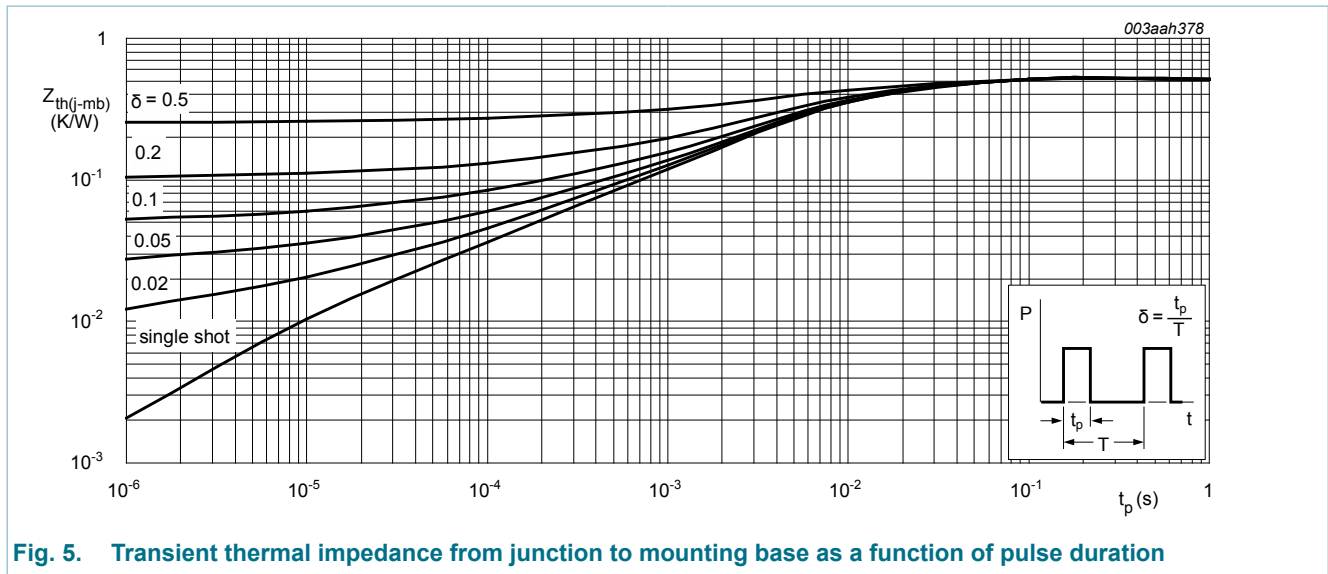


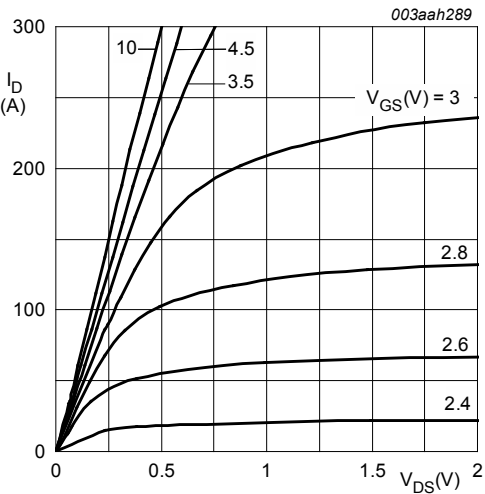
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_J = 25 ^\circ C$	40	-	-	V
		$I_D = 250 \mu A$; $V_{GS} = 0 V$; $T_J = -55 ^\circ C$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_J = 25 ^\circ C$; Fig. 9 ; Fig. 10	1.4	1.7	2.1	V
		$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_J = -55 ^\circ C$; Fig. 9	-	-	2.45	V
		$I_D = 1 mA$; $V_{DS} = V_{GS}$; $T_J = 175 ^\circ C$; Fig. 9	0.5	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 40 V$; $V_{GS} = 0 V$; $T_J = 25 ^\circ C$	-	0.15	1	μA
		$V_{DS} = 40 V$; $V_{GS} = 0 V$; $T_J = 175 ^\circ C$	-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 10 V$; $V_{DS} = 0 V$; $T_J = 25 ^\circ C$	-	2	100	nA
		$V_{GS} = -10 V$; $V_{DS} = 0 V$; $T_J = 25 ^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 V$; $I_D = 25 A$; $T_J = 25 ^\circ C$; Fig. 11	-	1.8	2.2	mΩ
		$V_{GS} = 4.5 V$; $I_D = 25 A$; $T_J = 25 ^\circ C$; Fig. 11	-	2.2	2.6	mΩ
		$V_{GS} = 10 V$; $I_D = 25 A$; $T_J = 175 ^\circ C$; Fig. 12 ; Fig. 11	-	-	4.1	mΩ
R_G	gate resistance	$f = 1 MHz$	0.41	0.82	1.64	Ω

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 32 V; V _{GS} = 5 V; Fig. 13 ; Fig. 14		-	87.8	-	nC
		I _D = 25 A; V _{DS} = 32 V; V _{GS} = 10 V; Fig. 13 ; Fig. 14		-	168.9	-	nC
Q _{GS}	gate-source charge	I _D = 25 A; V _{DS} = 32 V; V _{GS} = 10 V; Fig. 14 ; Fig. 13		-	20.8	-	nC
Q _{GD}	gate-drain charge	I _D = 25 A; V _{DS} = 32 V; V _{GS} = 10 V; Fig. 13 ; Fig. 14		-	29.6	-	nC
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 25 V; f = 1 MHz; T _j = 25 °C; Fig. 15		-	9584	-	pF
C _{oss}	output capacitance			-	1190	-	pF
C _{rss}	reverse transfer capacitance			-	585	-	pF
t _{d(on)}	turn-on delay time	V _{DS} = 30 V; R _L = 1.2 Ω; V _{GS} = 5 V; R _{G(ext)} = 5 Ω		-	56	-	ns
t _r	rise time			-	96	-	ns
t _{d(off)}	turn-off delay time			-	151	-	ns
t _f	fall time			-	93	-	ns
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 16		-	0.8	1.2	V
t _{rr}	reverse recovery time	I _S = 20 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 25 V		-	45	-	ns
Q _r	recovered charge			-	62	-	nC



T_j = 25 °C; t_p = 300 μs

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

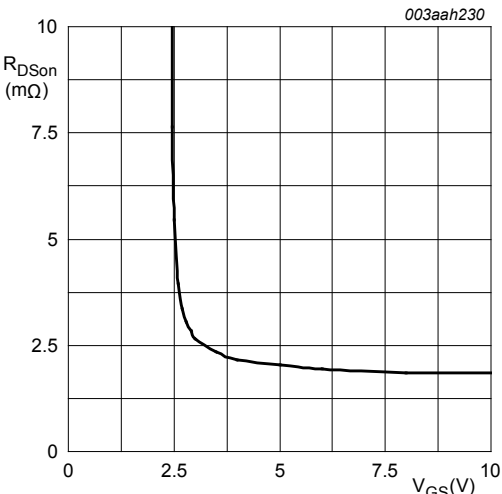


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

T_j = 25 °C; I_D = 25 A

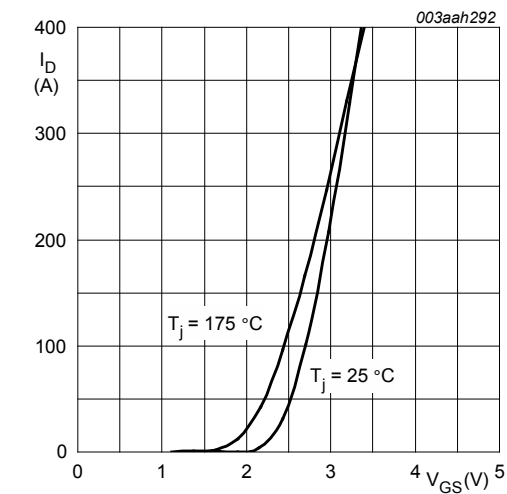


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10V$

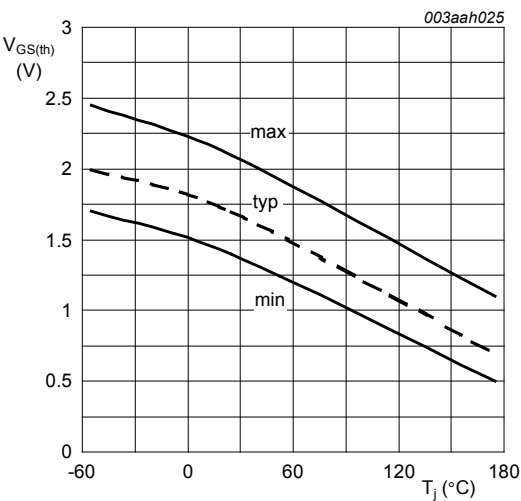


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

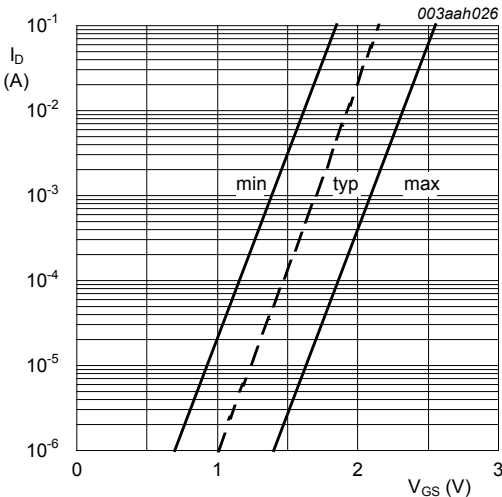
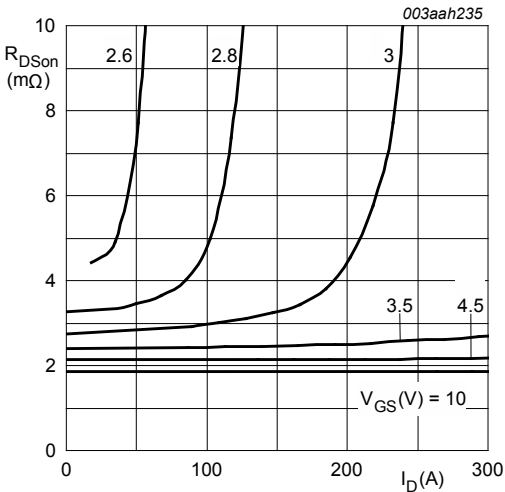


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25\text{ °C}; V_{DS} = 5V$



$T_j = 25\text{ °C}; t_p = 300\text{ }\mu\text{s}$

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

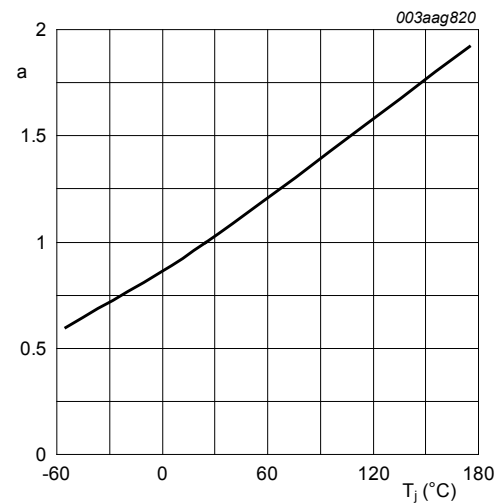


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

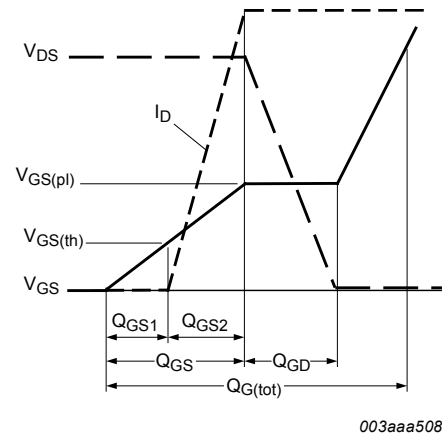


Fig. 13. Gate charge waveform definitions

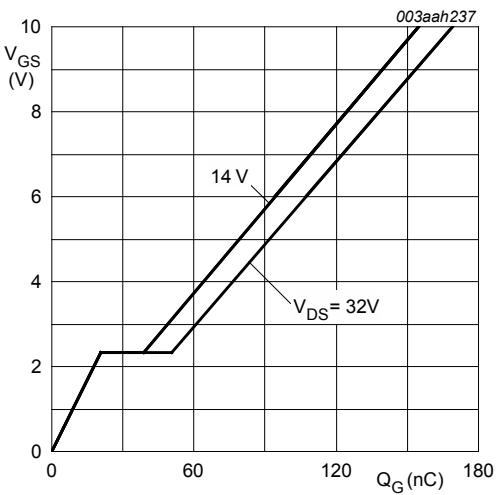


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

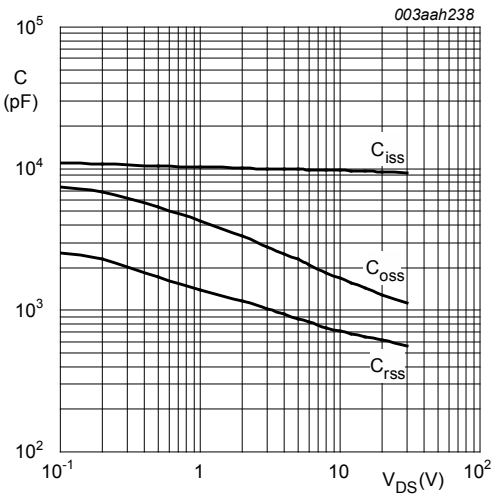


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

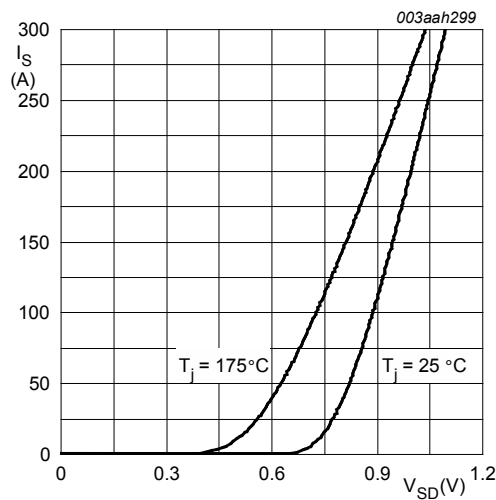


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

11. Package outline

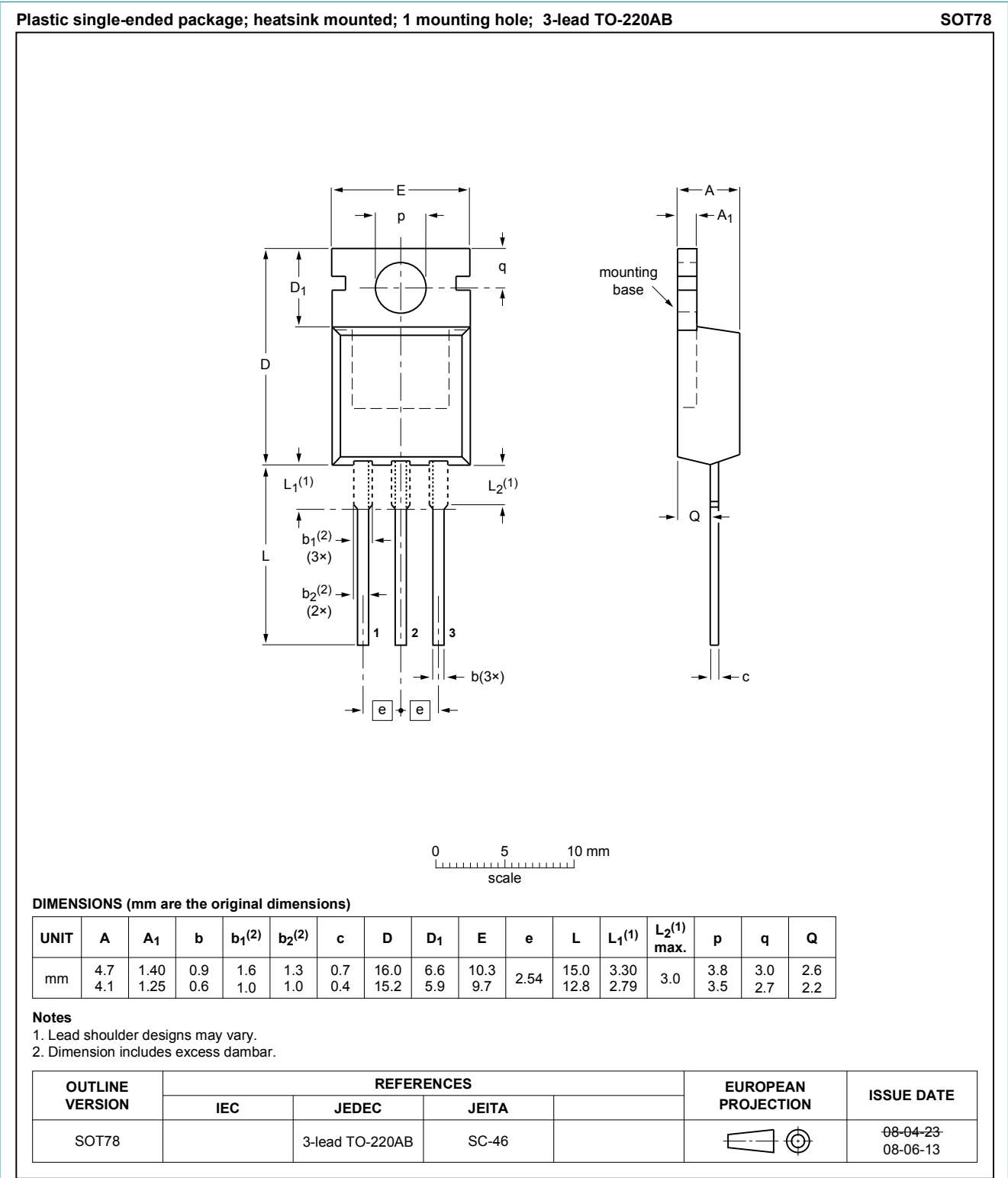


Fig. 17. Package outline TO-220AB (SOT78)

12. Legal information

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Document status [1][2]	Product status [3]	Definition
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Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
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