



PSMN6R3-120PS

N-channel 120 V 6.7 mΩ standard level MOSFET in TO-220

7 June 2013

Product data sheet

1. General description

Standard level N-channel MOSFET in TO-220 package qualified to 175 °C. This product is designed and qualified for use in a wide range of industrial, communications and domestic power supply equipment.

2. Features and benefits

- High efficiency due to low switching and conduction losses
- Improved dynamic avalanche performance
- Suitable for standard level gate drive
- TO-220 package can be mounted to heatsink

3. Applications

- AC-to-DC power supply
- Synchronous rectification
- Motor control

4. Quick reference data

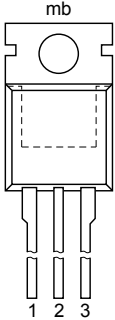
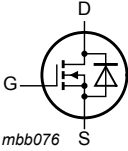
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V _{DS}	drain-source voltage	T _j ≥ 25 °C; T _j ≤ 175 °C		-	-	120	V
I _D	drain current	T _{mb} = 25 °C; V _{GS} = 10 V; Fig. 1		-	-	70	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2		-	-	405	W
Static characteristics							
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 25 A; T _j = 25 °C; Fig. 12		4	5.7	6.7	mΩ
Dynamic characteristics							
Q _{GD}	gate-drain charge	V _{GS} = 10 V; I _D = 25 A; V _{DS} = 60 V; Fig. 14 ; Fig. 15		-	61.9	-	nC
Q _{G(tot)}	total gate charge			-	207.1	-	nC
Avalanche ruggedness							
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	V _{GS} = 10 V; T _{j(init)} = 25 °C; I _D = 70 A; V _{sup} ≤ 120 V; unclamped; R _{GS} = 50 Ω; Fig. 3		-	-	532	mJ

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5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN6R3-120PS	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

7. Limiting values

Table 4. 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 ≥ 25 °C; T _j ≤ 175 °C	-	120	V
V _{DGR}	drain-gate voltage	T _j ≥ 25 °C; T _j ≤ 175 °C; R _{GS} = 20 kΩ	-	120	V
V _{GS}	gate-source voltage		-20	20	V
I _D	drain current	V _{GS} = 10 V; T _{mb} = 25 °C; Fig. 1	-	70	A
		V _{GS} = 10 V; T _{mb} = 100 °C; Fig. 1	-	70	A
I _{DM}	peak drain current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C; Fig. 4	-	280	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2	-	405	W
T _{stg}	storage temperature		-55	175	°C
T _j	junction temperature		-55	175	°C
T _{slid(M)}	peak soldering temperature		-	260	°C
Source-drain diode					
I _S	source current	T _{mb} = 25 °C	-	70	A

Symbol	Parameter	Conditions		Min	Max	Unit
I _{SM}	peak source current	pulsed; t _p ≤ 10 μs; T _{mb} = 25 °C		-	280	A
Avalanche ruggedness						
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	V _{GS} = 10 V; T _{j(init)} = 25 °C; I _D = 70 A; V _{sup} ≤ 120 V; unclamped; R _{GS} = 50 Ω; Fig. 3		-	532	mJ

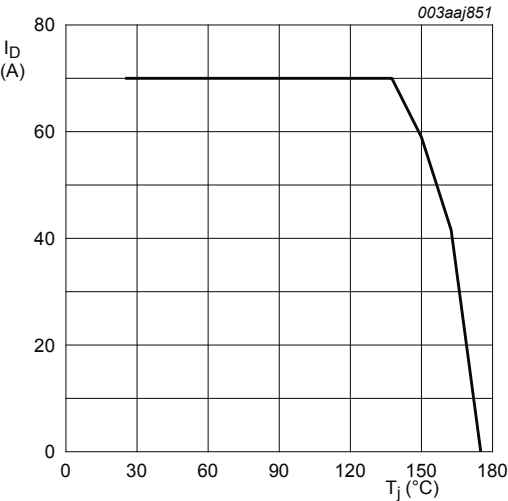


Fig. 1. Continuous drain current as a function of mounting base temperature

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

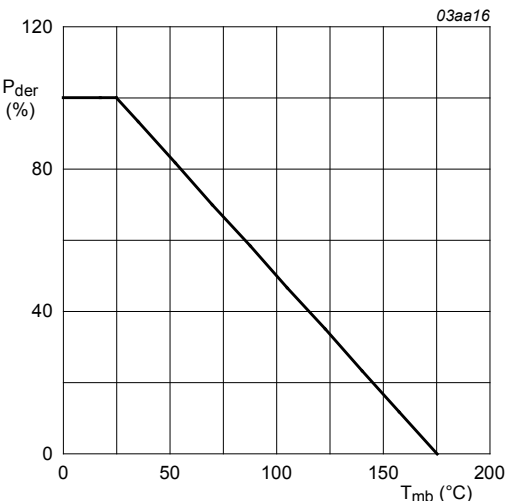


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

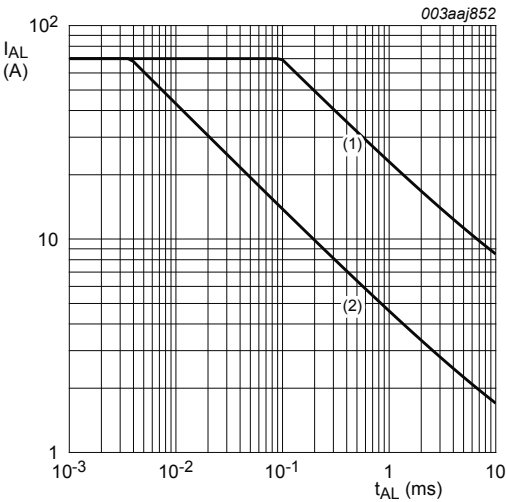


Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

- (1) Single-pulse; T_j = 25 °C.
- (2) Single-pulse; T_j = 125 °C.

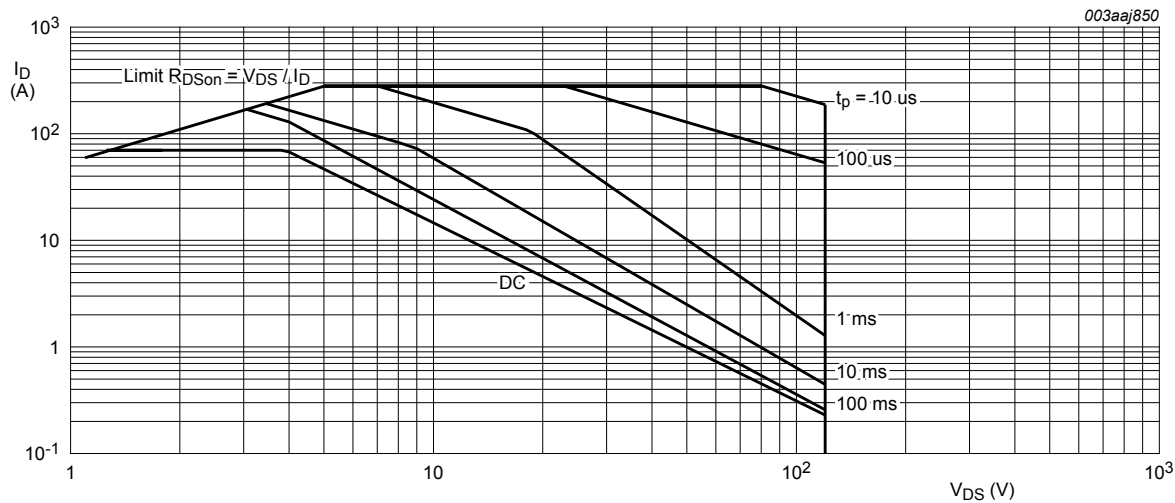


Fig. 4. Safe operating area; continuous and peak drain current as a function of drain-source voltage

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

8. Thermal characteristics

Table 5. 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	vertical in free air	-	60	-	K/W

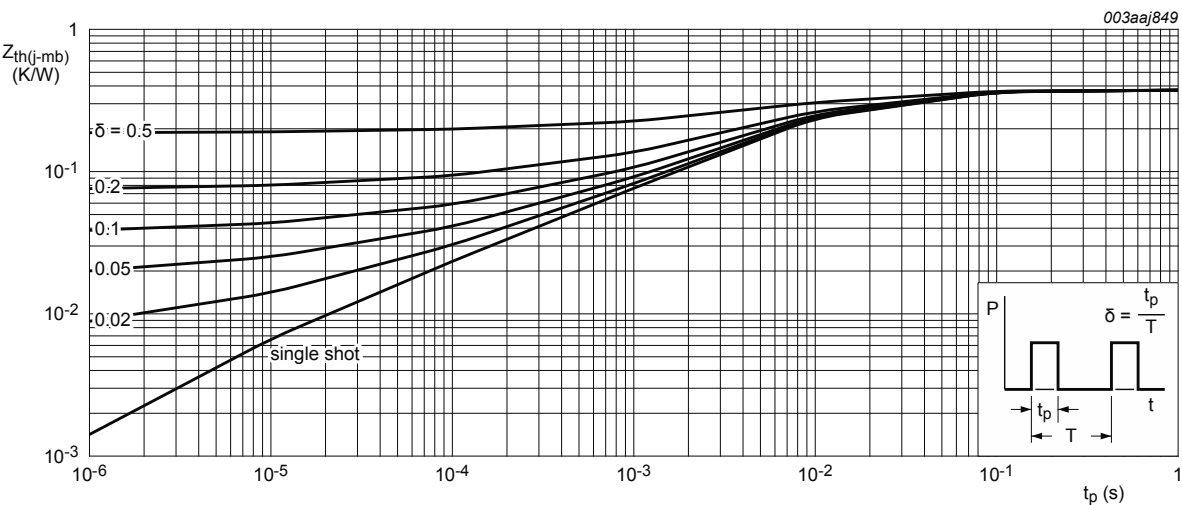


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu A$; $V_{GS} = 0\ V$; $T_j = 25\ ^\circ C$	120	-	-	V
		$I_D = 250\ \mu A$; $V_{GS} = 0\ V$; $T_j = -55\ ^\circ C$	108	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = 25\ ^\circ C$; Fig. 10 ; Fig. 11	2	3	4	V
		$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = 175\ ^\circ C$; Fig. 10 ; Fig. 11	1	-	-	V
		$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = -55\ ^\circ C$; Fig. 10 ; Fig. 11	-	-	4.6	V
I_{DSS}	drain leakage current	$V_{DS} = 120\ V$; $V_{GS} = 0\ V$; $T_j = 25\ ^\circ C$	-	0.1	1	μA
		$V_{DS} = 120\ V$; $V_{GS} = 0\ V$; $T_j = 175\ ^\circ C$	-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 20\ V$; $V_{DS} = 0\ V$; $T_j = 25\ ^\circ C$	-	10	100	nA
		$V_{GS} = -20\ V$; $V_{DS} = 0\ V$; $T_j = 25\ ^\circ C$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_j = 25\ ^\circ C$; Fig. 12	4	5.7	6.7	mΩ
		$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_j = 175\ ^\circ C$; Fig. 13 ; Fig. 12	-	16.5	19.4	mΩ
R_G	internal gate resistance (AC)	$f = 1\ MHz$	0.44	0.88	1.76	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25\ A$; $V_{DS} = 60\ V$; $V_{GS} = 10\ V$; Fig. 14 ; Fig. 15	-	207.1	-	nC
Q_{GS}	gate-source charge		-	43.2	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	29.8	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	13.4	-	nC
Q_{GD}	gate-drain charge		-	61.9	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\ A$; $V_{DS} = 60\ V$; Fig. 14 ; Fig. 15	-	4.3	-	V
C_{iss}	input capacitance	$V_{DS} = 60\ V$; $V_{GS} = 0\ V$; $f = 1\ MHz$; $T_j = 25\ ^\circ C$; Fig. 16	-	11384	-	pF
C_{oss}	output capacitance		-	534	-	pF
C_{rss}	reverse transfer capacitance		-	358	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 60\ V$; $R_L = 2.4\ \Omega$; $V_{GS} = 10\ V$; $R_{G(ext)} = 5\ \Omega$; $T_j = 25\ ^\circ C$	-	42.1	-	ns
t_r	rise time		-	58.2	-	ns

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t _{d(off)}	turn-off delay time			-	142.1	-	ns
t _f	fall time			-	67.7	-	ns
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 17		-	0.79	1.2	V
t _{rr}	reverse recovery time	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 60 V		-	76.1	-	ns
Q _r	recovered charge			-	264.2	-	nC

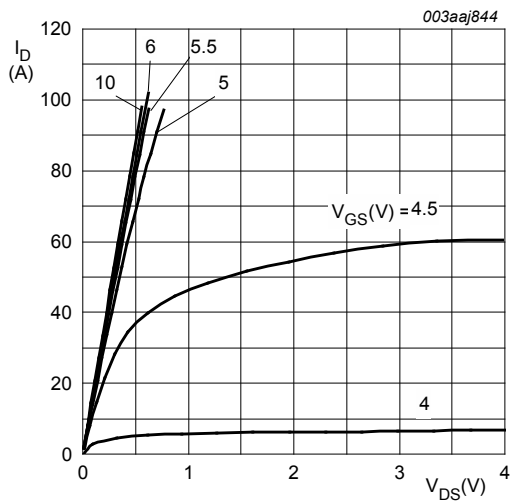


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\text{ °C}$

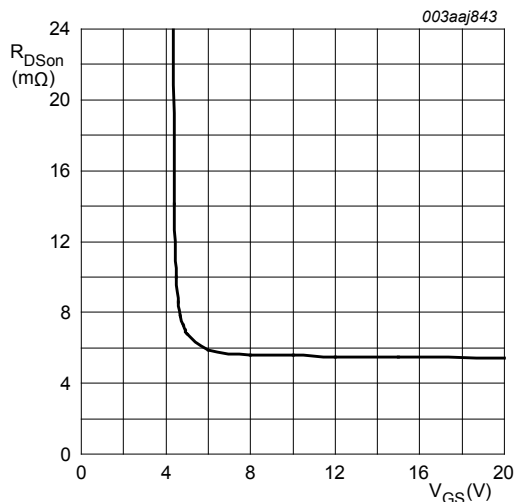


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25\text{ °C}$

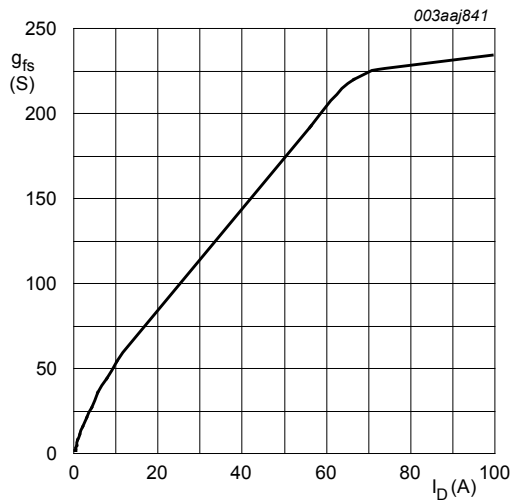


Fig. 8. Forward transconductance as a function of drain current; typical values

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

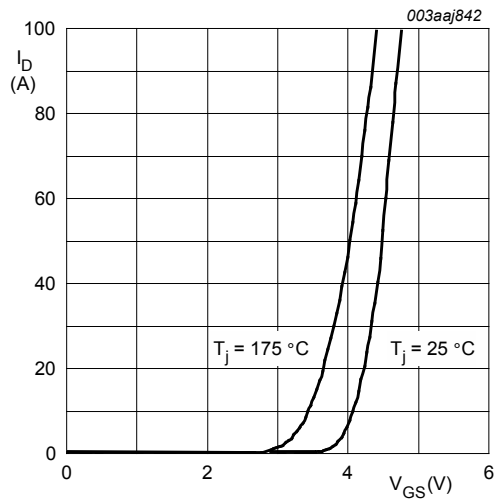


Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} > I_D \times R_{DS(on)}$

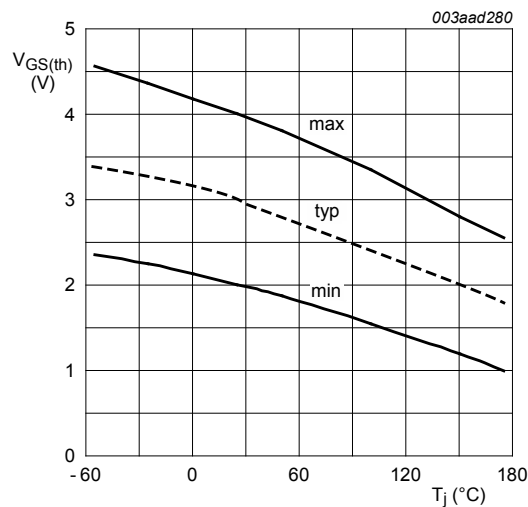


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

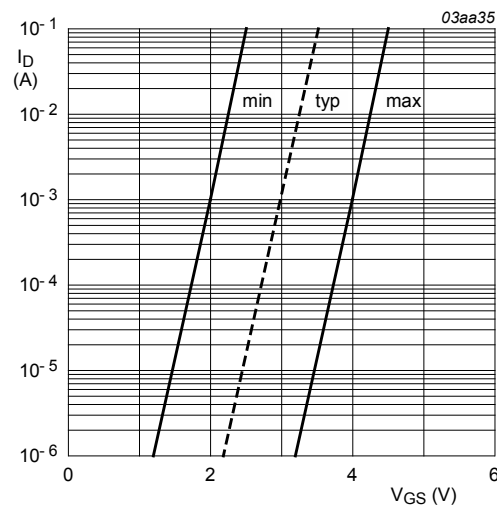


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

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

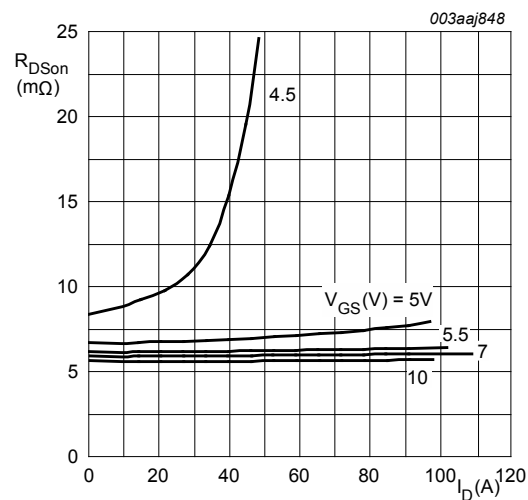


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25\text{ °C}$

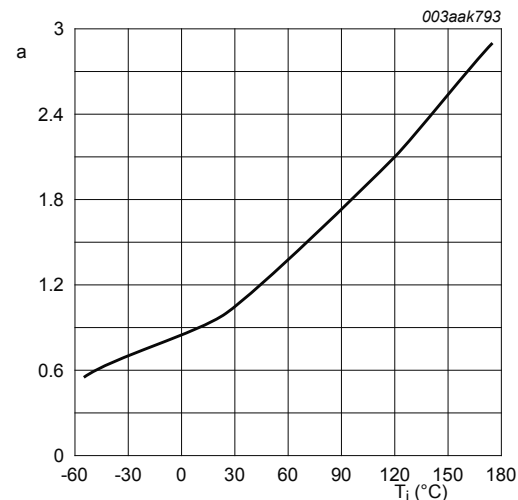


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

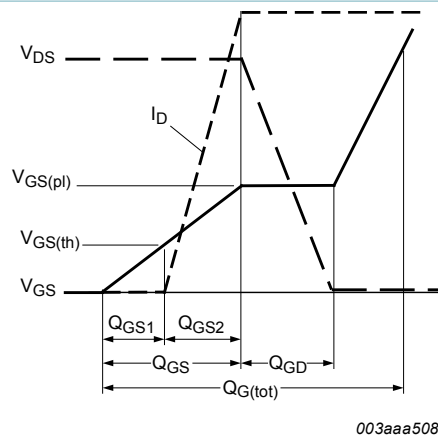


Fig. 14. Gate charge waveform definitions

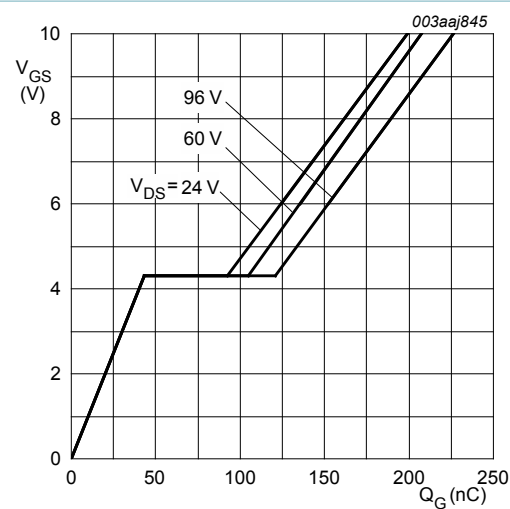


Fig. 15. Gate-source voltage as a function of gate charge; typical values

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

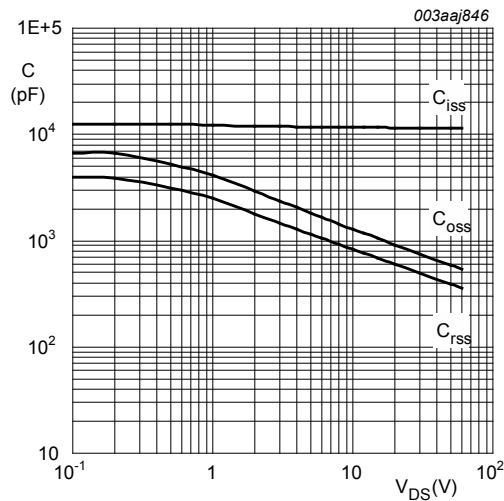


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

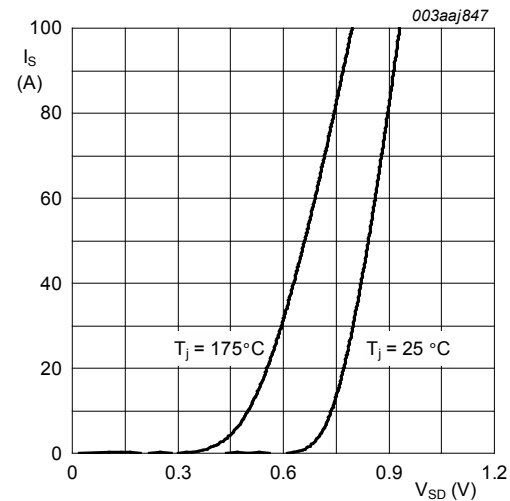


Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

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

10. Package outline

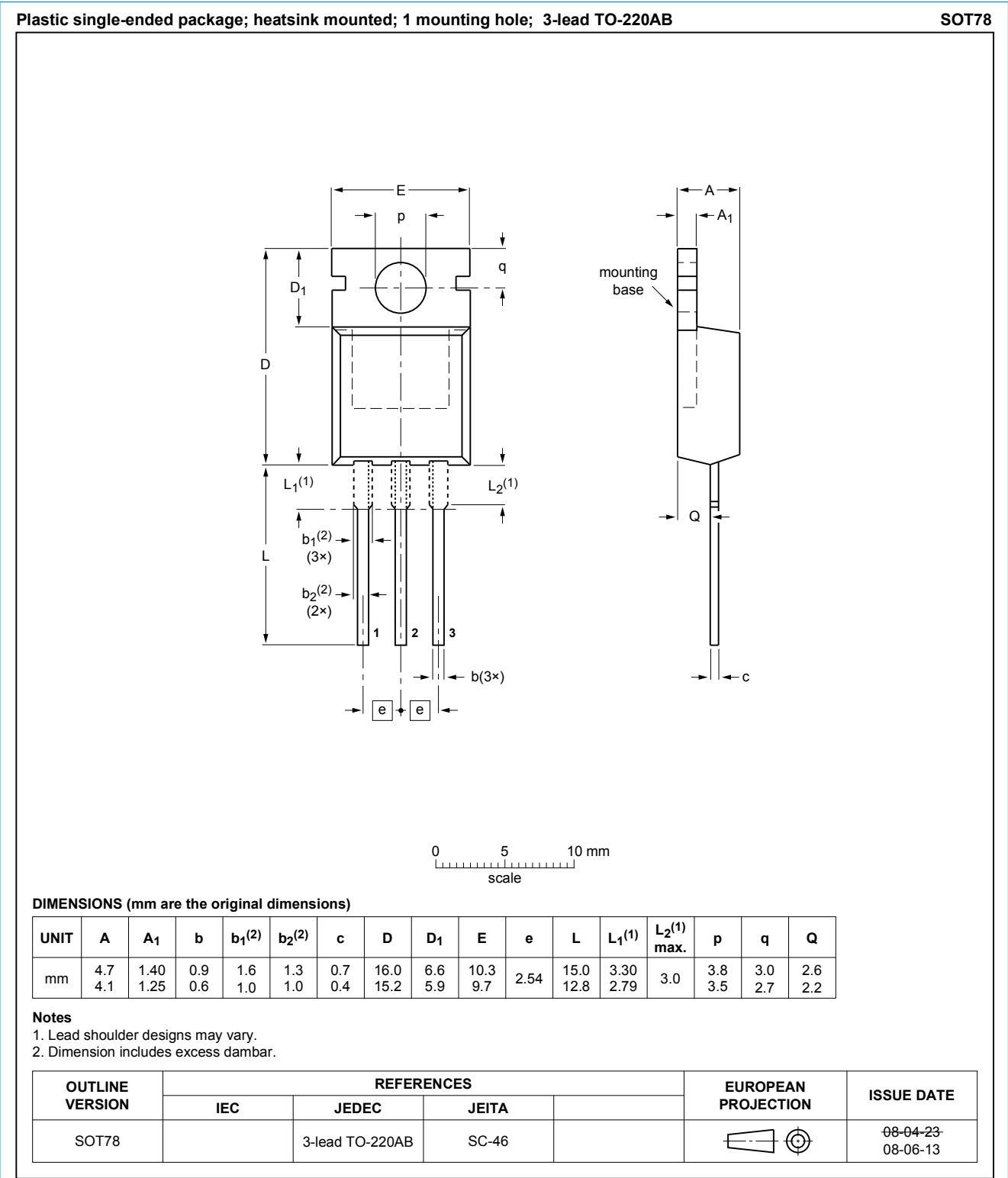


Fig. 18. Package outline TO-220AB (SOT78)

11. 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.
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