



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

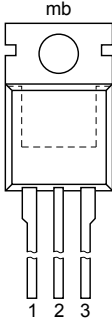
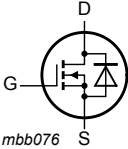
4. Quick reference data

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

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	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	120	V
V_{DGR}	drain-gate voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	120	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 1	-	70	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 1	-	70	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 4	-	280	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 2	-	405	W
T_{stg}	storage temperature		-55	175	°C
T_j	junction temperature		-55	175	°C
$T_{sld(M)}$	peak soldering temperature		-	260	°C
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$	-	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

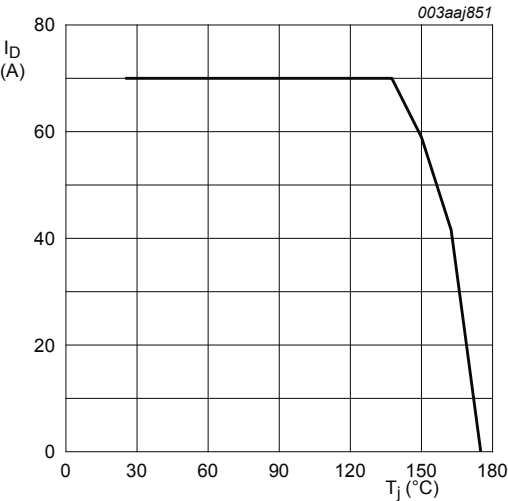


Fig. 1. Continuous drain current as a function of mounting base temperature

$V_{GS} \geq 10V$

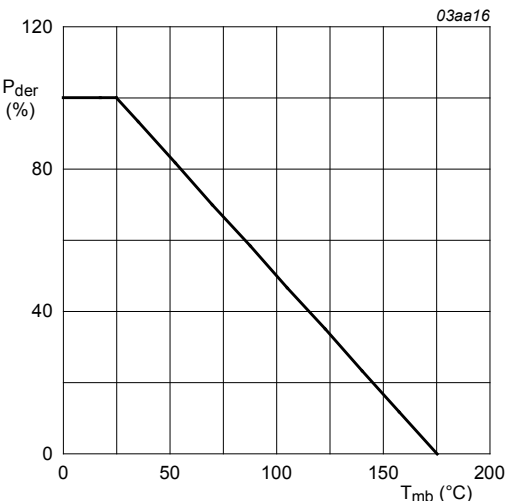


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

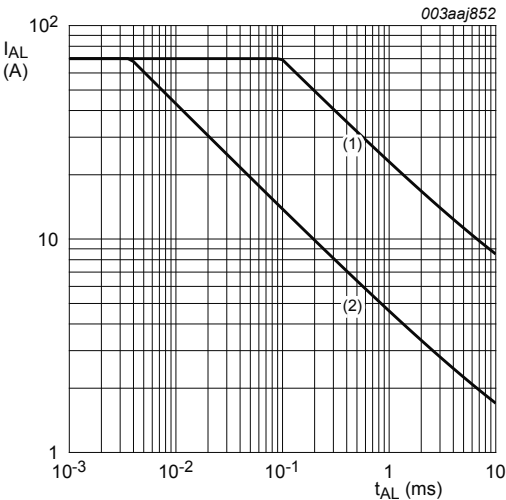


Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

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

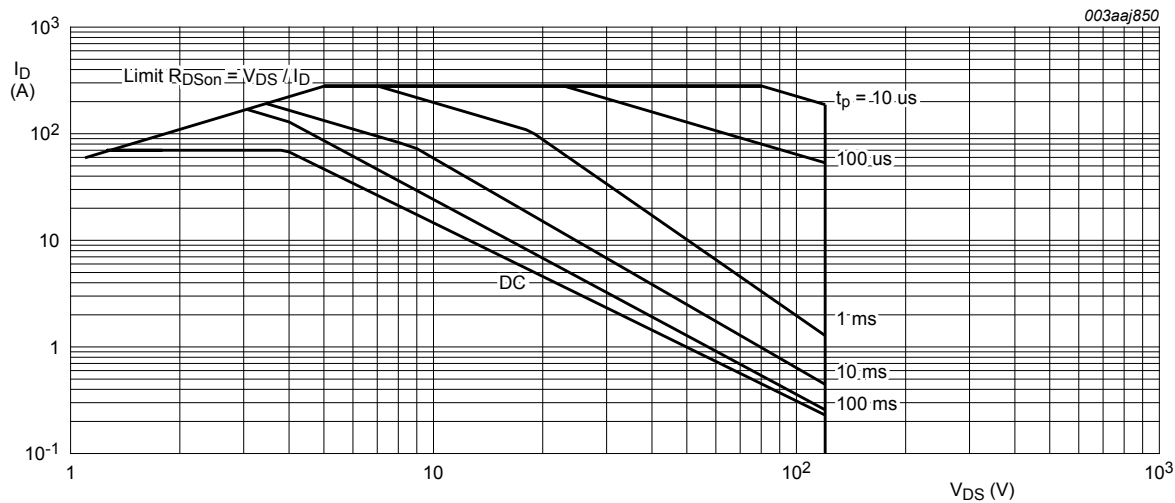


Fig. 4. Safe operating area; continuous and peak drain current as a function of drain-source voltage

$T_{mb} = 25^{\circ}C$; 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

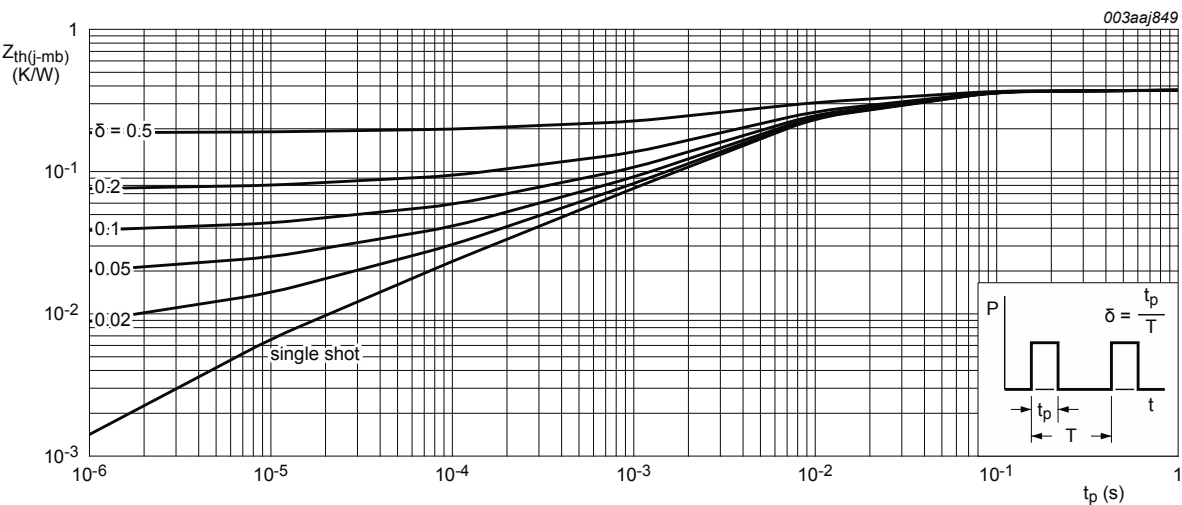


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

9. Characteristics

Table 6. Characteristics

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

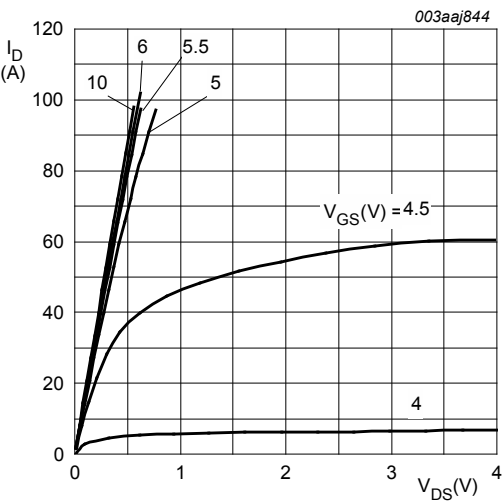


Fig. 6. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\text{ °C}$

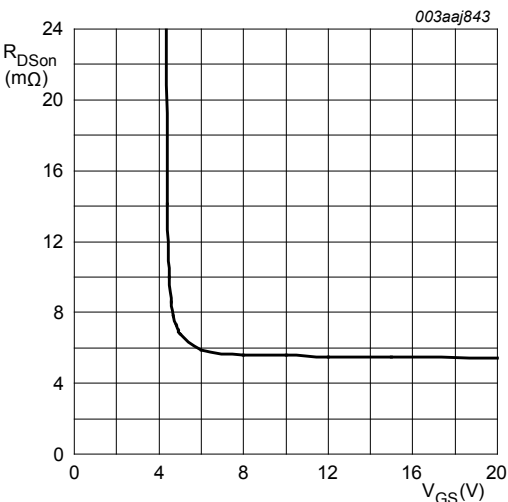


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25\text{ °C}$

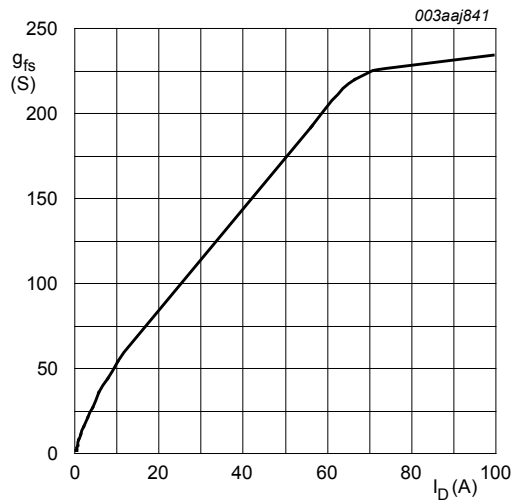


Fig. 8. Forward transconductance as a function of drain current; typical values

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

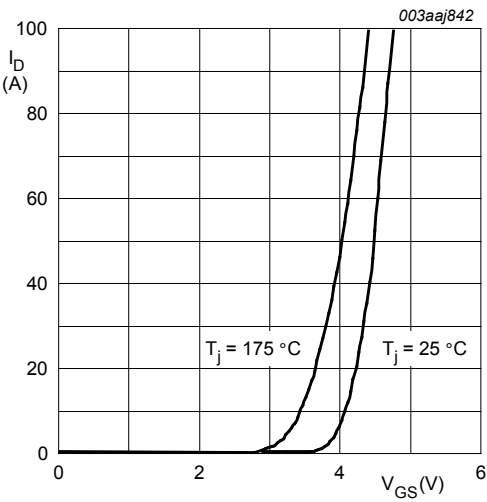


Fig. 9. Transfer characteristics: drain current as a function of gate-source voltage; typical values

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

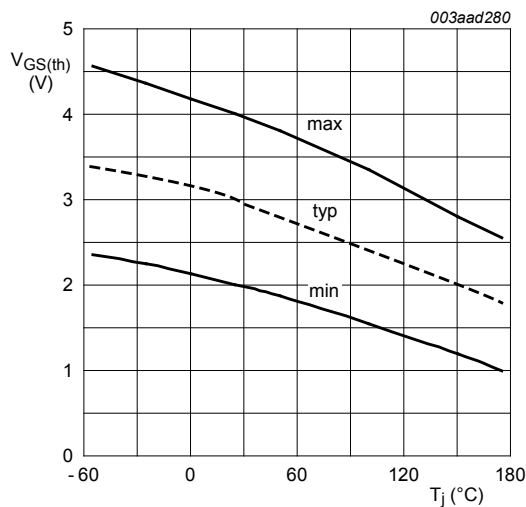


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

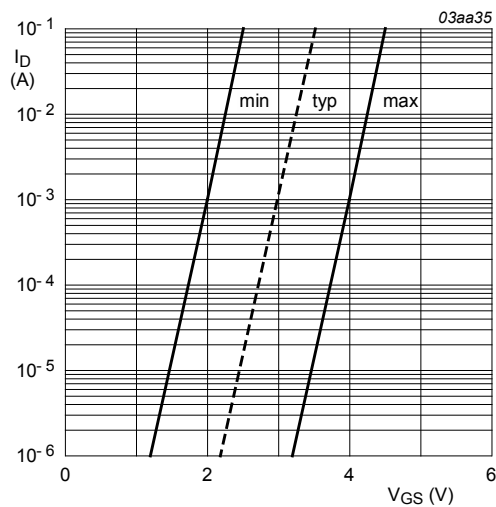


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

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

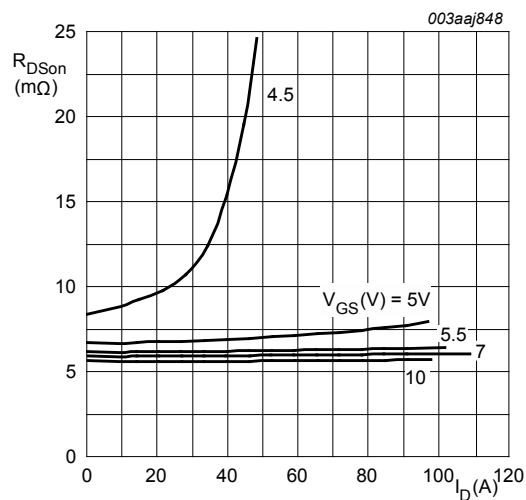


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

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

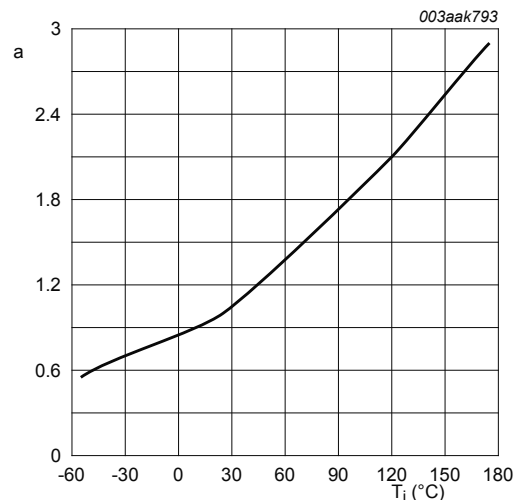


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

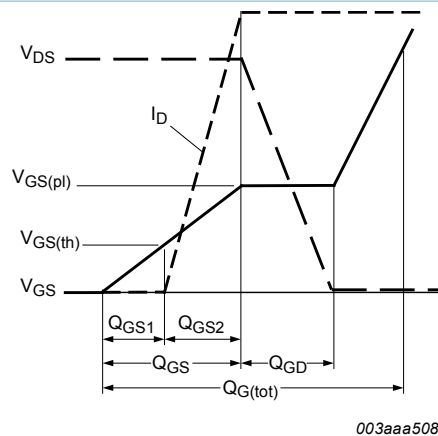


Fig. 14. Gate charge waveform definitions

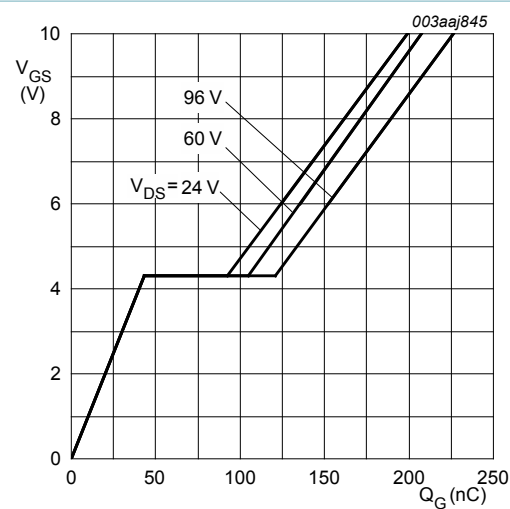


Fig. 15. Gate-source voltage as a function of gate charge; typical values

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

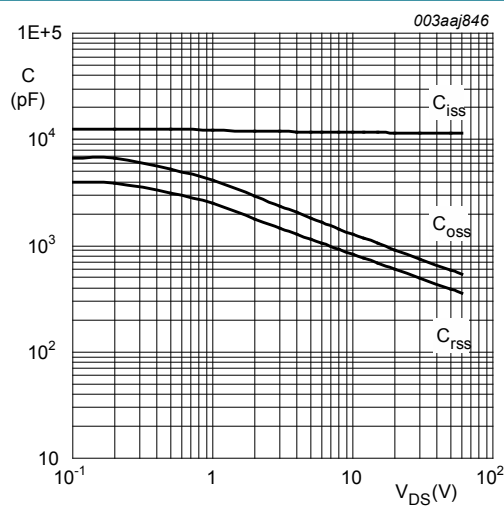


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

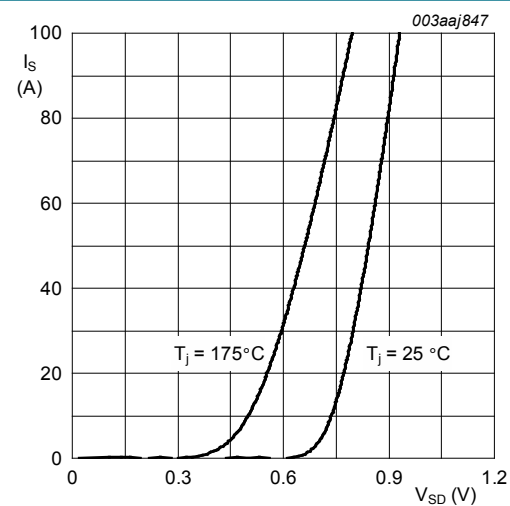


Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

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

10. Package outline

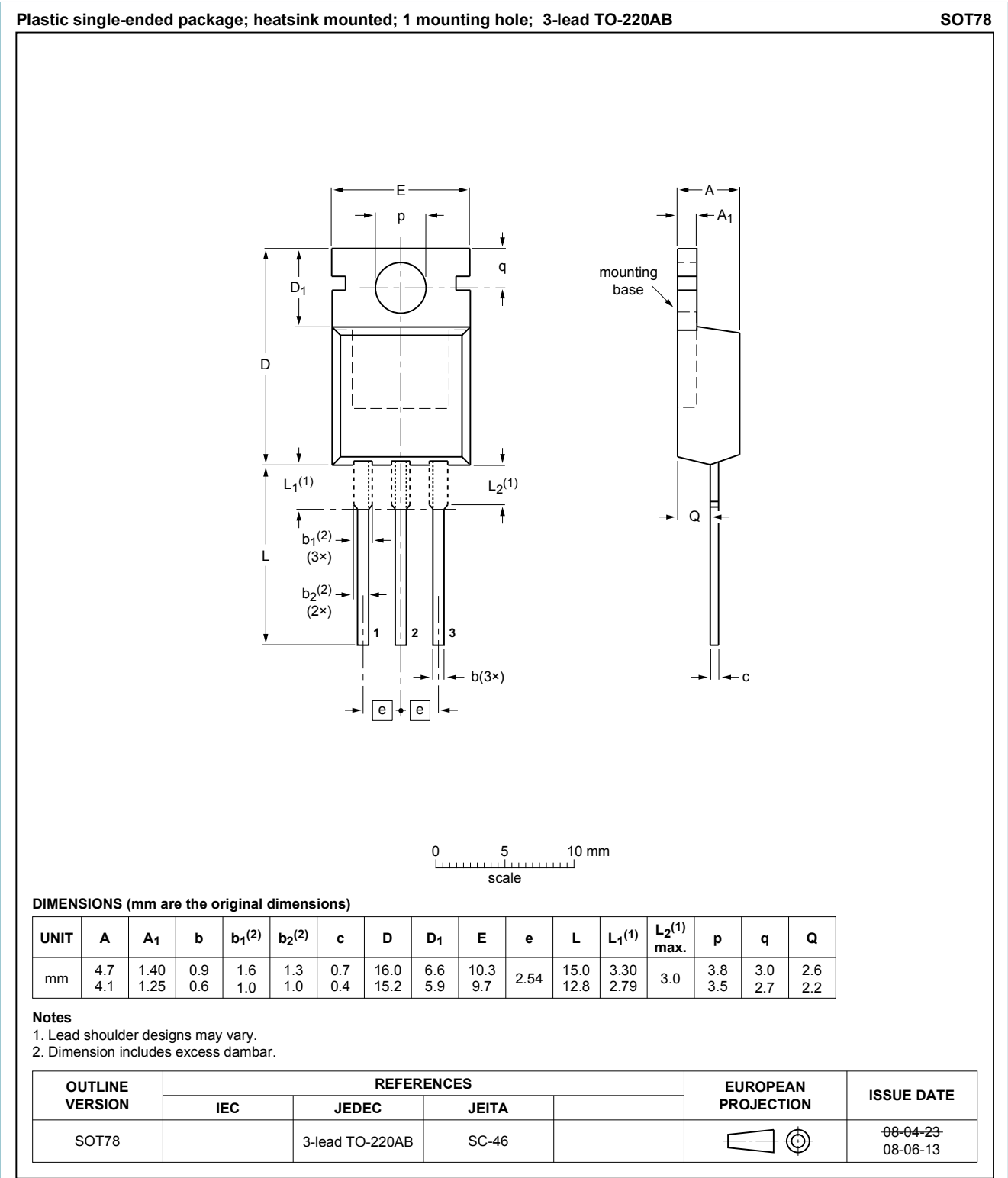


Fig. 18. Package outline TO-220AB (SOT78)

11. Legal information

11.1 Data sheet status

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Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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