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Kind regards,

Team Nexperia



PSMN3R9-60PS

N-channel 60 V, 3.9 mΩ standard level MOSFET in SOT78

1 February 2013

Product data sheet

1. General description

Standard 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
- Standard 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	$T_j \geq 25^\circ\text{C}$; $T_j \leq 175^\circ\text{C}$		-	-	60	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25^\circ\text{C}$; Fig. 1	[1]	-	-	130	A
P_{tot}	total power dissipation	$T_{mb} = 25^\circ\text{C}$; Fig. 2		-	-	263	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25^\circ\text{C}$; Fig. 11		-	2.94	3.9	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 25\text{ A}$; $V_{DS} = 48\text{ V}$; $V_{GS} = 10\text{ V}$; Fig. 13 ; Fig. 14		-	103	-	nC
Q_{GD}	gate-drain charge			-	33	-	nC
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 130\text{ A}$; $V_{sup} \leq 60\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25^\circ\text{C}$; unclamped; Fig. 3		-	-	283	mJ

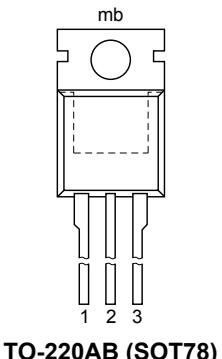
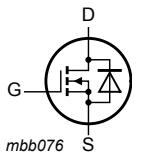
[1] Continuous current is limited by package.



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5. Pinning information

Table 2. Pinning information

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

6. Ordering information

Table 3. Ordering information

Type number	Package			Version
	Name	Description		
PSMN3R9-60PS	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
PSMN3R9-60PS	PSMN3R9-60PS

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	$T_j \geq 25^\circ\text{C}$; $T_j \leq 175^\circ\text{C}$	-	60	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	60	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$T_{mb} = 25^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Fig. 1	[1]	130	A
		$T_{mb} = 100^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Fig. 1	-	127	A
I_{DM}	peak drain current	$T_{mb} = 25^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4	-	705	A

Symbol	Parameter	Conditions	Min	Max	Unit
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2	-	263	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 °C	[1]	-	130 A
I _{SM}	peak source current	pulsed; t _p ≤ 10 µs; T _{mb} = 25 °C	-	705	A
Avalanche ruggedness					
E _{DS(AL)S}	non-repetitive drain-source avalanche energy	I _D = 130 A; V _{sup} ≤ 60 V; R _{GS} = 50 Ω; V _{GS} = 10 V; T _{j(init)} = 25 °C; unclamped; Fig. 3	-	283	mJ

[1] Continuous current is limited by package.

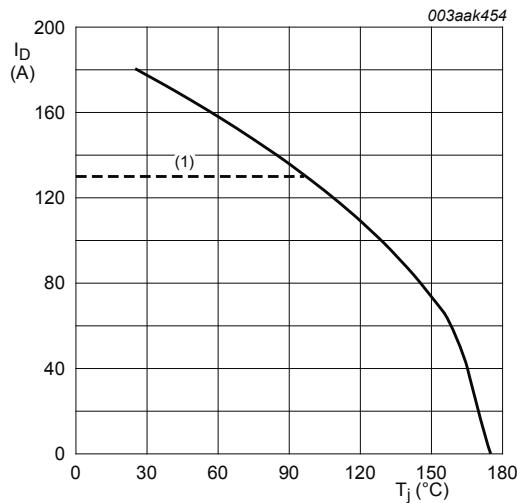


Fig. 1. Continuous drain current as a function of mounting base temperature

$V_{GS} \geq 10 \text{ V}$
(1) Capped at 130 A due to package.

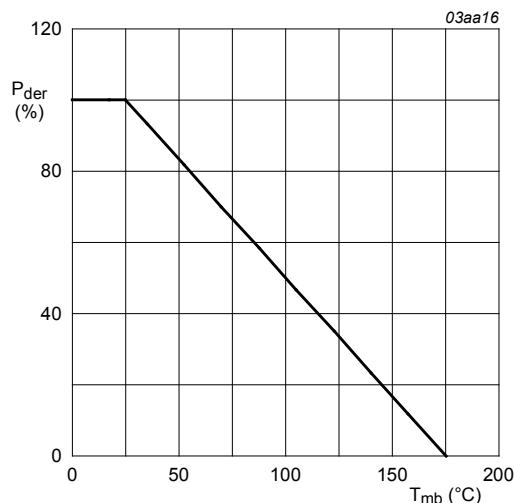


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

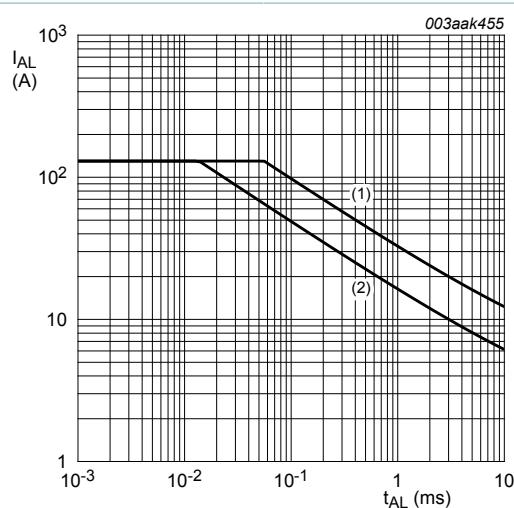


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

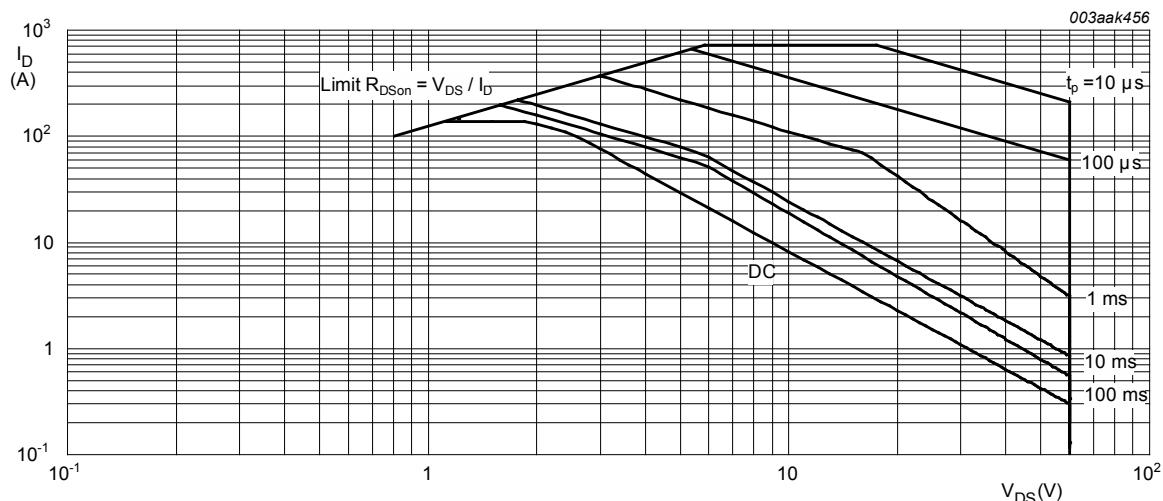
(1) $T_J (int) = 25^\circ C$; (2) $T_J (int) = 100^\circ C$ 

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		-	0.49	0.57	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air		-	60	-	K/W

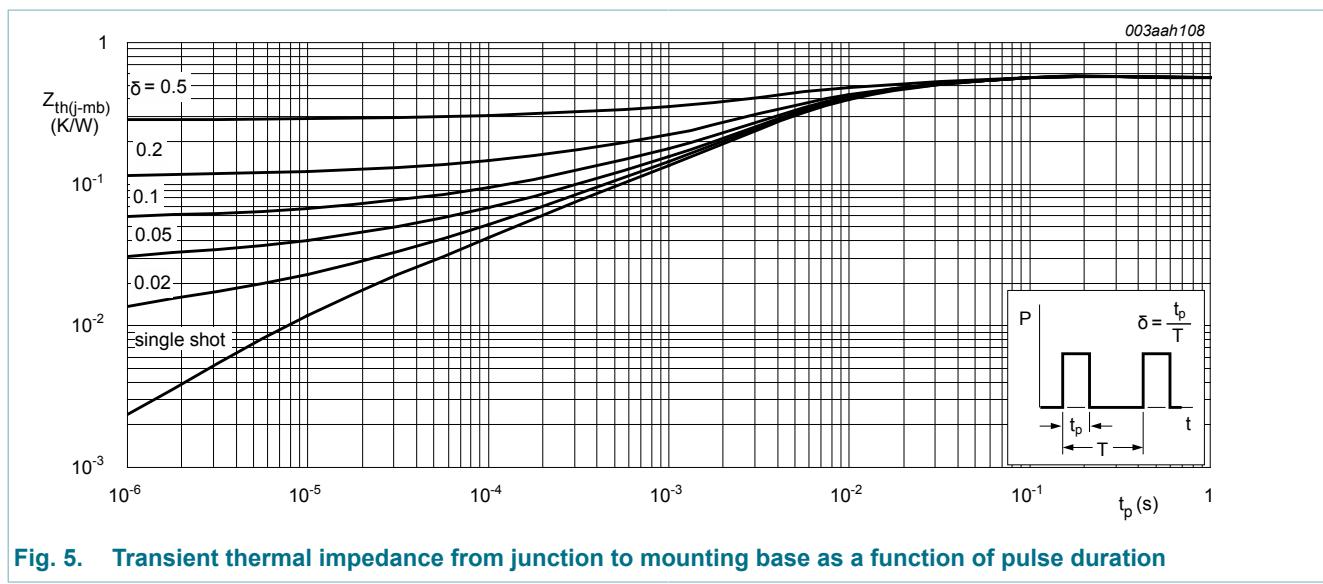


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25^\circ C$		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	$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25^\circ C;$ Fig. 9 ; Fig. 10		2.4	3	4	V
		$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175^\circ C;$ Fig. 9		1	-	-	V
		$I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55^\circ C;$ Fig. 9		-	-	4.5	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175^\circ C$		-	-	500	μA
		$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25^\circ C$		-	0.07	1	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25^\circ C$		-	2	100	nA
		$V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25^\circ C$		-	2	100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 25 A; T_j = 25^\circ C;$ Fig. 11		-	2.94	3.9	$m\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 175^\circ C;$ Fig. 11 ; Fig. 12		-	-	8.5	$m\Omega$
R_G	gate resistance	$f = 1 MHz$		0.35	0.7	1.4	Ω
Dynamic characteristics							
$Q_{G(\text{tot})}$	total gate charge	$I_D = 25 A; V_{DS} = 48 V; V_{GS} = 10 V;$ Fig. 13 ; Fig. 14		-	103	-	nC
Q_{GS}	gate-source charge			-	25.1	-	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Q_{GD}	gate-drain charge			-	33	-	nC
C_{iss}	input capacitance	$V_{GS} = 0 \text{ V}$; $V_{DS} = 25 \text{ V}$; $f = 1 \text{ MHz}$;		-	5600	-	pF
C_{oss}	output capacitance	$T_j = 25 \text{ }^\circ\text{C}$; Fig. 15		-	740	-	pF
C_{rss}	reverse transfer capacitance			-	460	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 45 \text{ V}$; $R_L = 1.8 \Omega$; $V_{GS} = 10 \text{ V}$;		-	25.3	-	ns
t_r	rise time	$R_{G(ext)} = 5 \Omega$		-	41.4	-	ns
$t_{d(off)}$	turn-off delay time			-	62.7	-	ns
t_f	fall time			-	45	-	ns

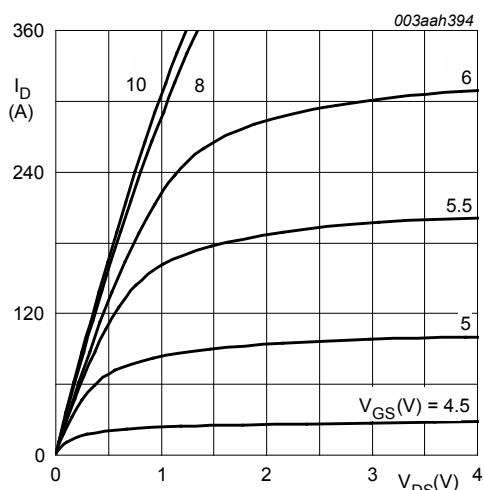


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

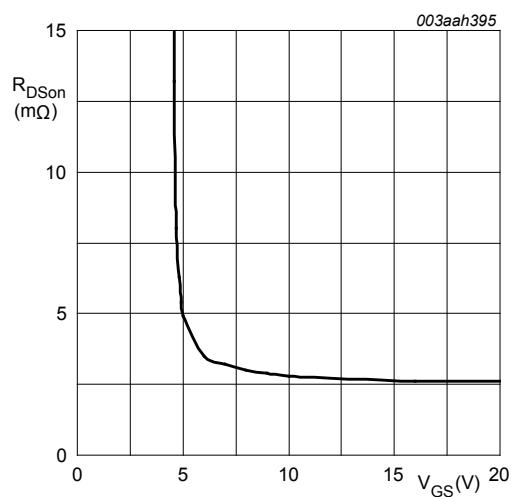


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

$$T_j = 25^\circ C; \quad I_D = 25A$$

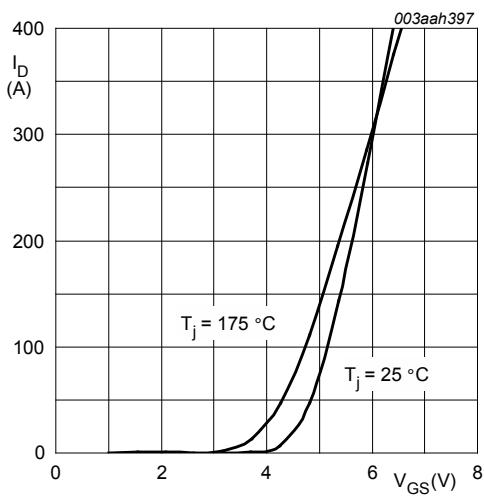


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10V$

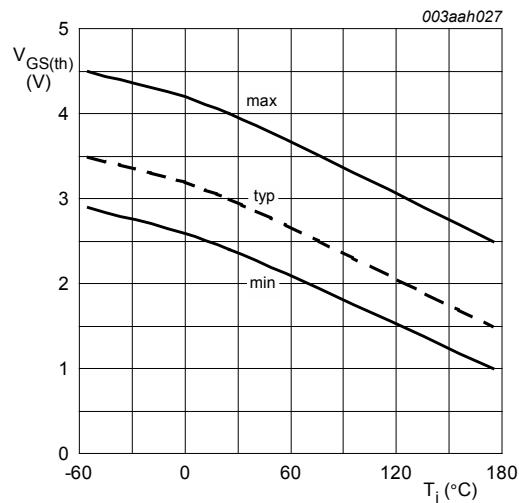


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

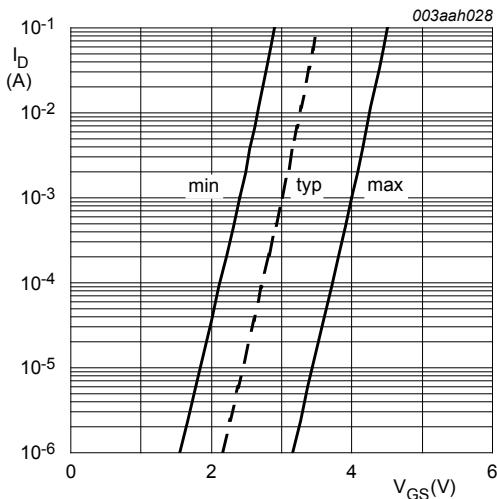
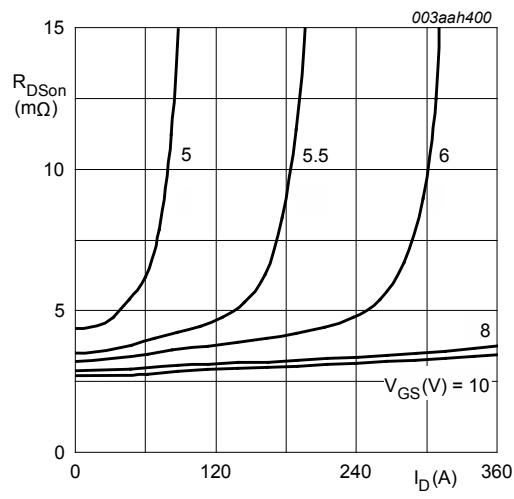


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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



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

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

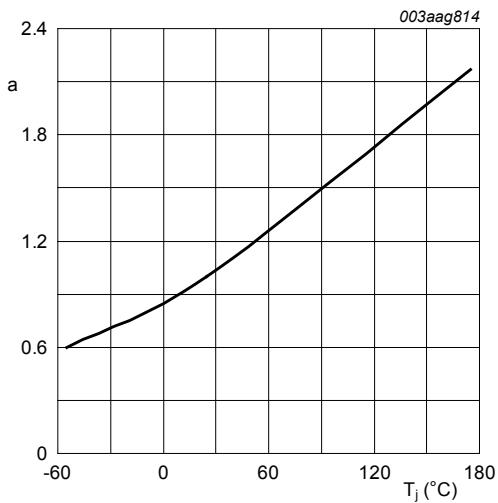


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

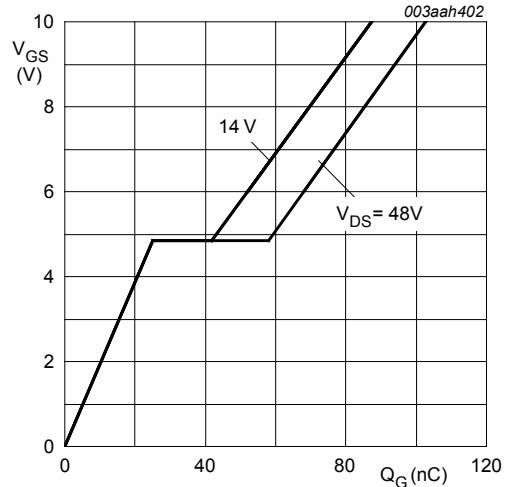


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

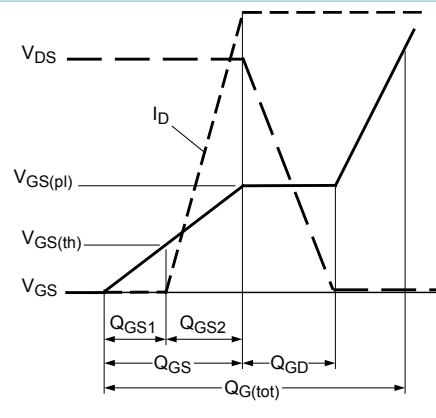


Fig. 13. Gate charge waveform definitions

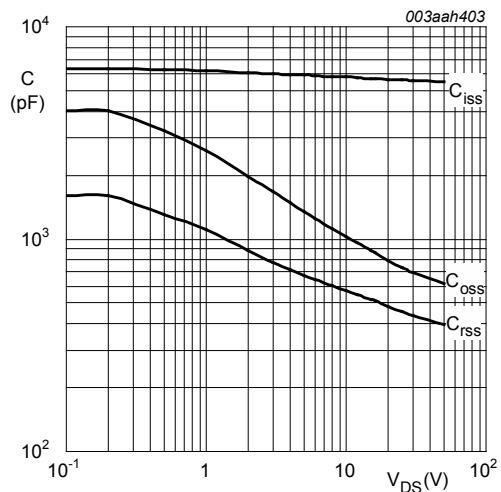


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

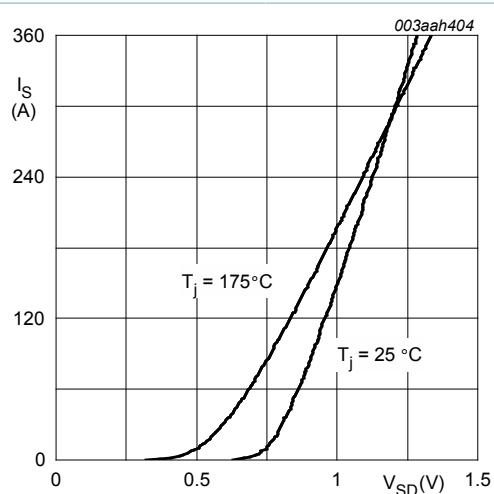
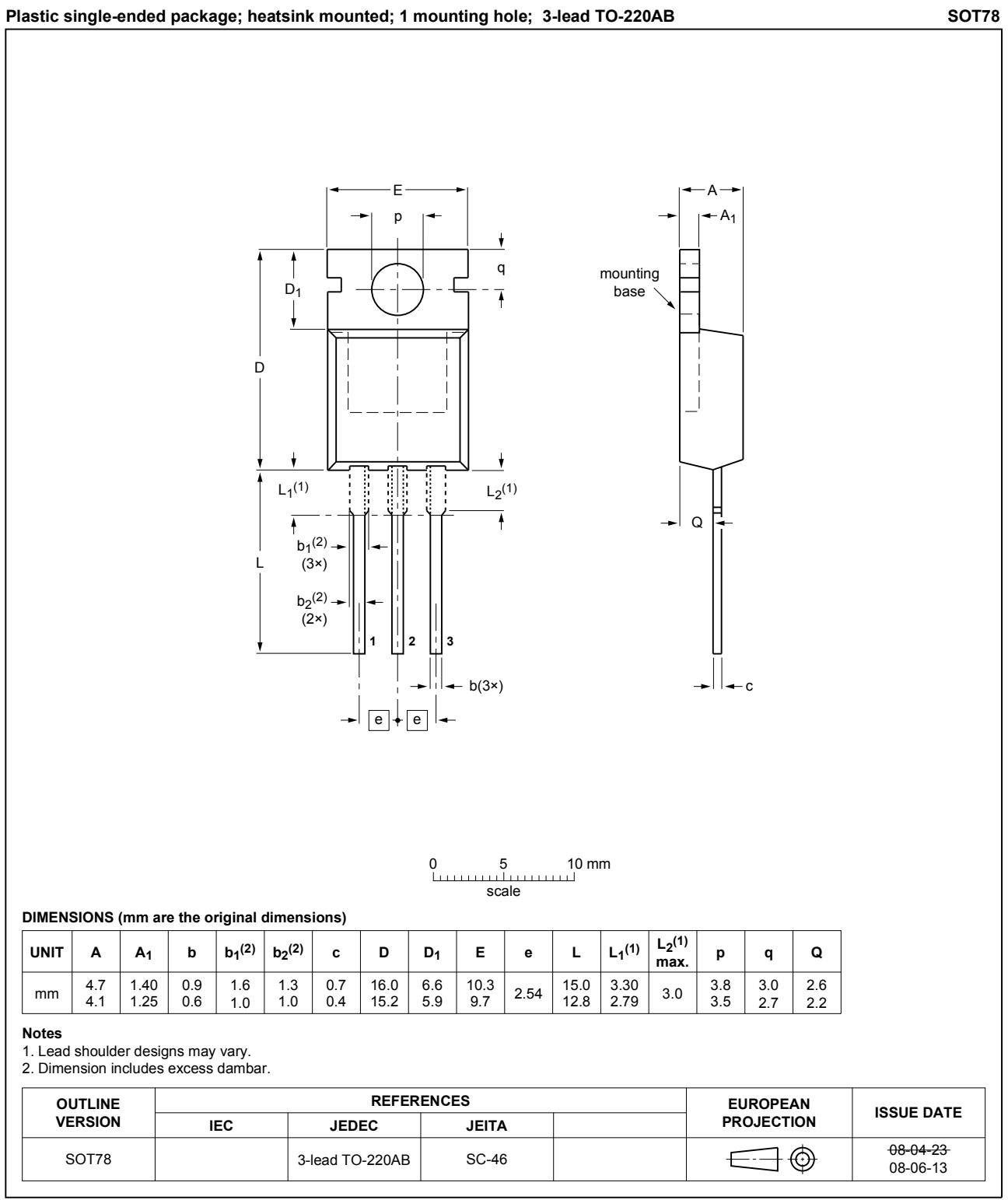


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

11. Package outline



12. Legal information

12.1 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.
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13. Contents

1	General description	1
2	Features and benefits	1
3	Applications	1
4	Quick reference data	1
5	Pinning information	2
6	Ordering information	2
7	Marking	2
8	Limiting values	2
9	Thermal characteristics	4
10	Characteristics	5
11	Package outline	10
12	Legal information	11
12.1	Data sheet status	11
12.2	Definitions	11
12.3	Disclaimers	11
12.4	Trademarks	12

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