



# PSMN2R0-60PS

N-channel 60 V 2.2 mΩ standard level MOSFET in TO-220

26 October 2020

Product data sheet

## 1. General description

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

## 2. Features and benefits

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

## 3. Applications

- DC-to-DC converters
- Load switching
- Motor control
- Server power supplies

## 4. Quick reference data

Table 1. Quick reference data

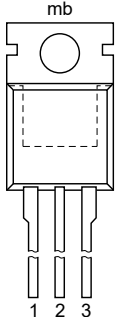
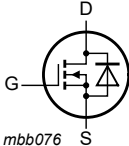
Table 1. Quick reference data							
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C		-	-	60	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 100 °C; <a href="#">Fig. 2</a>	[1]	-	-	120	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>		-	-	338	W
T <sub>j</sub>	junction temperature			-55	-	175	°C
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. 12</a>	[2]	-	1.8	2.2	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 100 °C; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>		-	3	3.5	mΩ
Dynamic characteristics							
Q <sub>GD</sub>	gate-drain charge	I <sub>D</sub> = 75 A; V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	32	45	nC
Q <sub>G(tot)</sub>	total gate charge			-	137	192	nC
Avalanche ruggedness							
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 120 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		-	-	913	mJ

[1] Continuous current limited by package

[2] Measured 3 mm from package.

## 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	mounting base; connected to drain		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN2R0-60PS	TO-220AB	plastic, single-ended package (heatsink mounted, 1 mounting hole); 3 leads; 2.54 mm pitch; 15.6 mm x 10 mm x 4.4 mm body	SOT78

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN2R0-60PS	PSMN2R0 60PS

## 8. Limiting values

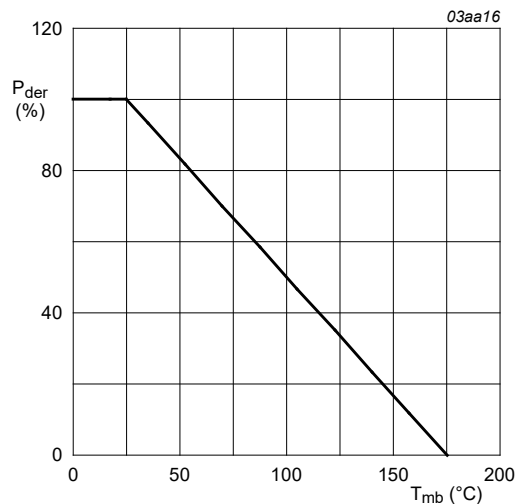
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	60	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$		-	60	V
$V_{GS}$	gate-source voltage			-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	338	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	120	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	120	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>		-	1135	A
$T_{stg}$	storage temperature			-55	175	°C
$T_j$	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C

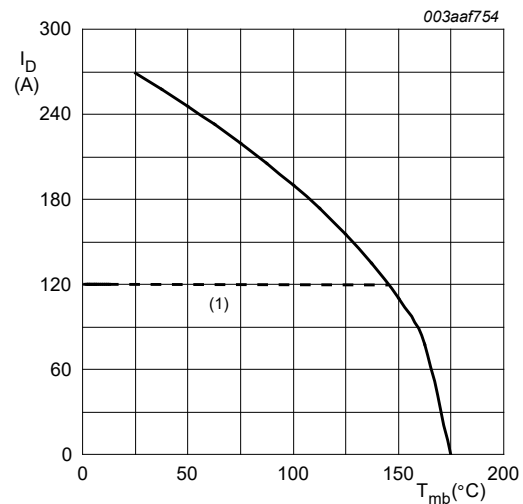
Symbol	Parameter	Conditions		Min	Max	Unit
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$	[1]	-	120	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$		-	1135	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 120\text{ A}$ ; $V_{sup} \leq 60\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; Unclamped		-	913	mJ

[1] Continuous current limited by package



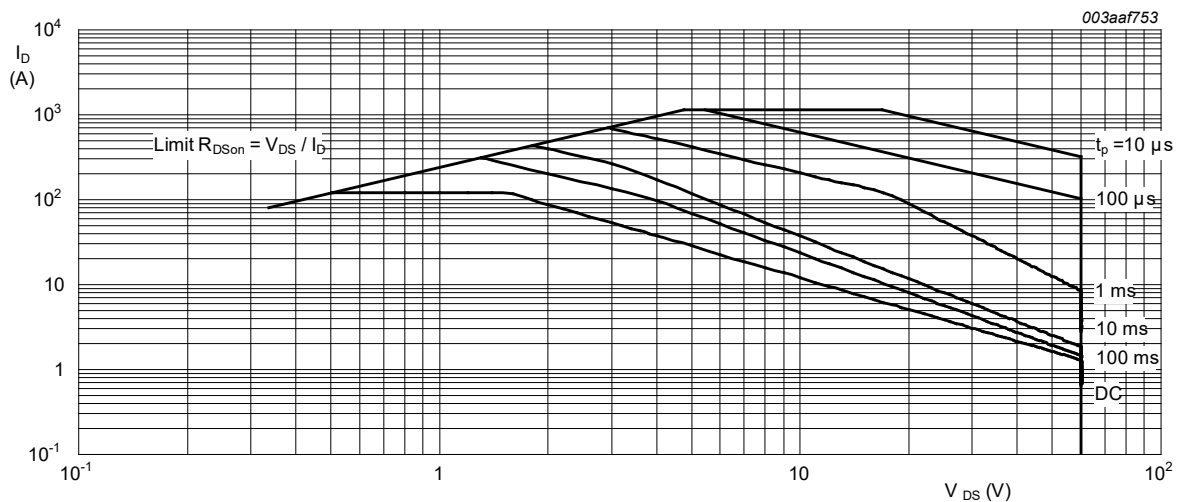
$$P_{der} = \frac{P_{tot}}{P_{tot(25^\circ\text{C})}} \times 100\%$$

**Fig. 1. Normalized total power dissipation as a function of mounting base temperature**



$V_{GS} \geq 10\text{ V}$ ; (1) Capped at 120 A due to package

**Fig. 2. Continuous drain current as a function of mounting base temperature.**



$T_{mb} = 25\text{ °C}$ ;  $I_{DM}$  is a single pulse; Capped at 120 A due to package

**Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

## 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. 4	-	0.22	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Vertical in free air	-	60	-	K/W

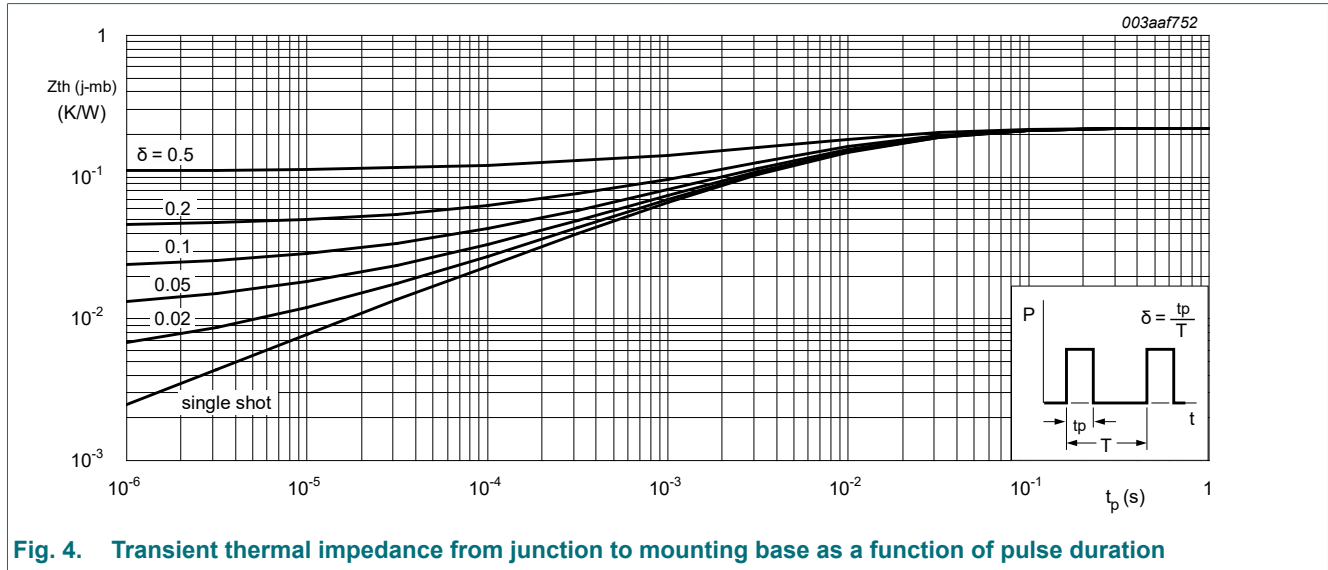


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

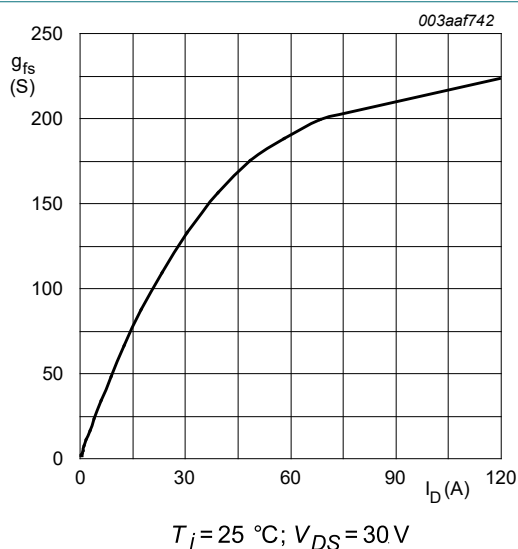
## 10. Characteristics

Table 7. Characteristics

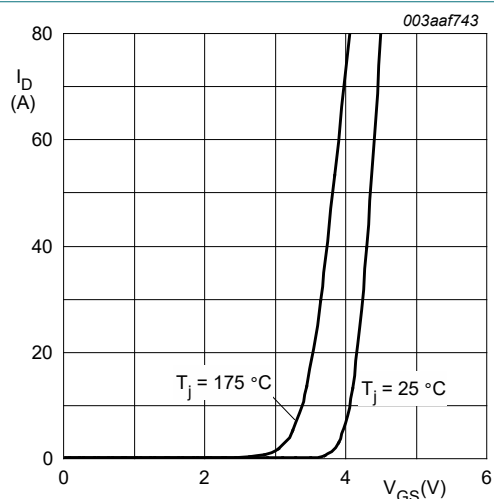
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_J = -55 ^\circ C$	54	-	-	V
		$I_D = 250 \mu A$ ; $V_{GS} = 0 V$ ; $T_J = 25 ^\circ C$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA$ ; $V_{DS}=V_{GS}$ ; $T_J = 175 ^\circ C$ ; Fig. 10	1	-	-	V
		$I_D = 1 mA$ ; $V_{DS}=V_{GS}$ ; $T_J = 25 ^\circ C$ ; Fig. 10; Fig. 11	2	3	4	V
		$I_D = 1 mA$ ; $V_{DS}=V_{GS}$ ; $T_J = -55 ^\circ C$ ; Fig. 10	-	-	4.6	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_J = 25 ^\circ C$	-	0.03	10	$\mu A$
		$V_{DS} = 60 V$ ; $V_{GS} = 0 V$ ; $T_J = 175 ^\circ C$	-	-	1000	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = -20 V$ ; $V_{DS} = 0 V$ ; $T_J = 25 ^\circ C$	-	-	100	nA
		$V_{GS} = 20 V$ ; $V_{DS} = 0 V$ ; $T_J = 25 ^\circ C$	-	-	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_J = 25 ^\circ C$ ; Fig. 12	[1]	1.8	2.2	mΩ
		$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_J = 175 ^\circ C$ ; Fig. 12; Fig. 13	-	4.3	5.1	mΩ
		$V_{GS} = 10 V$ ; $I_D = 25 A$ ; $T_J = 100 ^\circ C$ ; Fig. 12; Fig. 13	-	3	3.5	mΩ

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R <sub>G</sub>	gate resistance	f = 1 MHz		0.45	0.9	1.8	Ω
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 75 A; V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	137	192	nC
		I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	129	181	nC
Q <sub>GS</sub>	gate-source charge	I <sub>D</sub> = 75 A; V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	48	68	nC
Q <sub>GS(th)</sub>	pre-threshold gate-source charge			-	29	-	nC
Q <sub>GS(th-pl)</sub>	post-threshold gate-source charge			-	19	-	nC
Q <sub>GD</sub>	gate-drain charge			-	32	45	nC
V <sub>GS(pl)</sub>	gate-source plateau voltage	V <sub>DS</sub> = 30 V; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>		-	5.7	-	V
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 30 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>j</sub> = 25 °C; <a href="#">Fig. 16</a>		-	9997	13500	pF
C <sub>oss</sub>	output capacitance			-	1210	1640	pF
C <sub>rss</sub>	reverse transfer capacitance			-	594	835	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 30 V; R <sub>L</sub> = 0.4 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 4.7 Ω		-	42	63	ns
t <sub>r</sub>	rise time			-	56	84	ns
t <sub>d(off)</sub>	turn-off delay time			-	115	173	ns
t <sub>f</sub>	fall time			-	49	74	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; <a href="#">Fig. 17</a>		-	0.8	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 25 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 30 V		-	57	75	ns
Q <sub>r</sub>	recovered charge			-	80	104	nC

[1] Measured 3 mm from package.



**Fig. 5. Forward transconductance as a function of drain current; typical values**



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

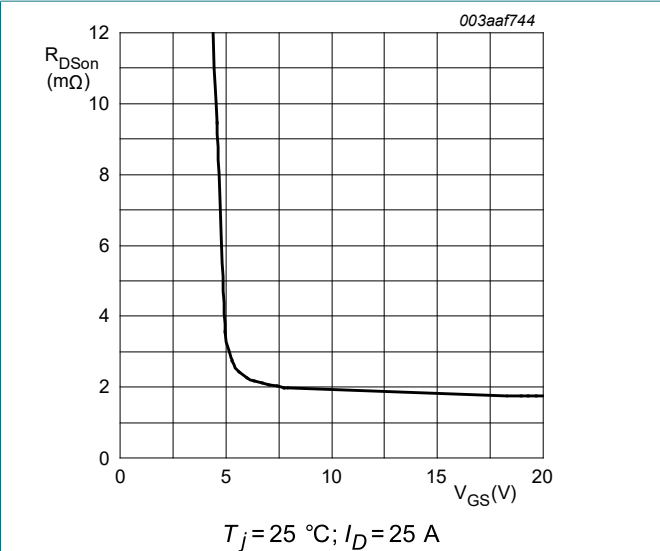


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

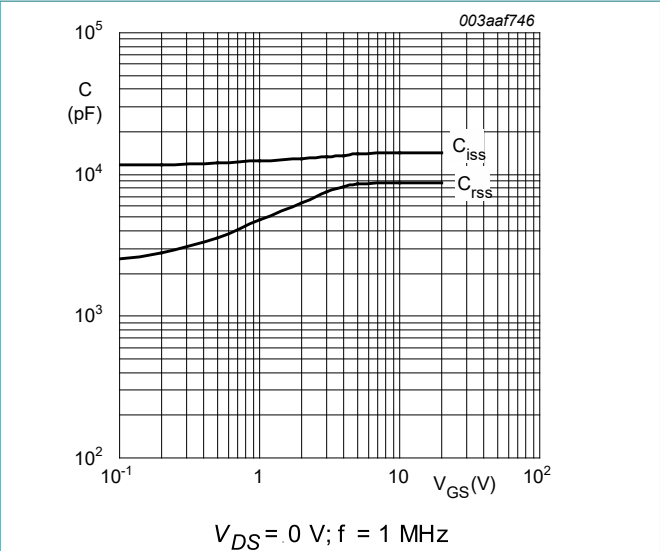


Fig. 8. Input and reverse transfer capacitances as a function of gate-source voltage, typical values

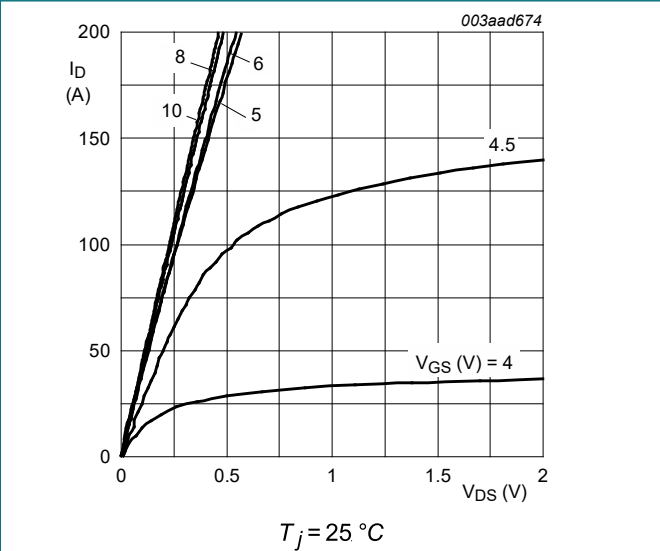


Fig. 9. Output characteristics: drain current as a function of drain-source voltage; typical values

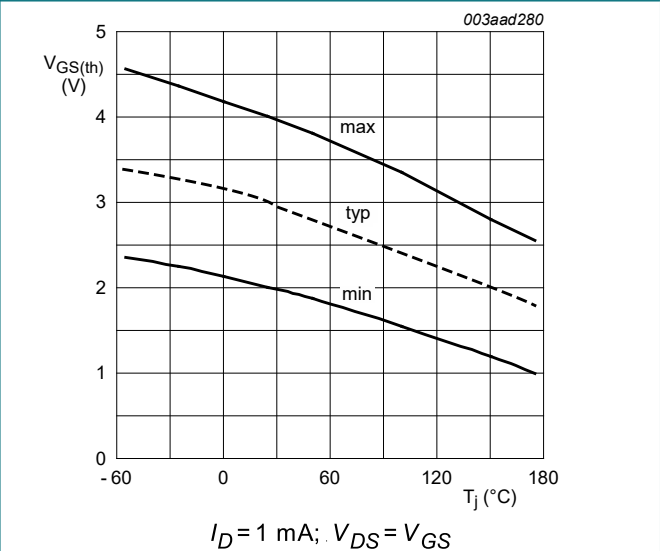


Fig. 10. Gate-source threshold voltage as a function of junction temperature

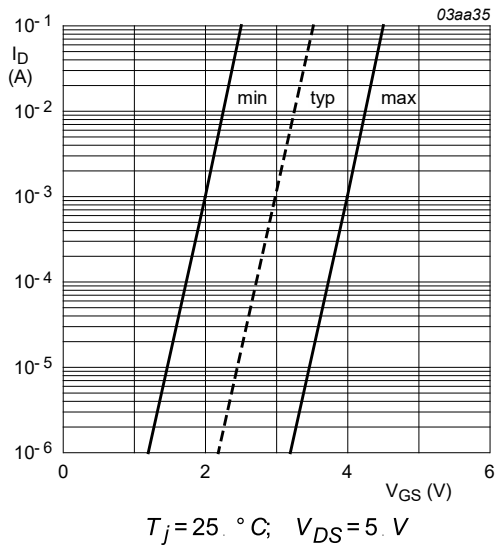


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

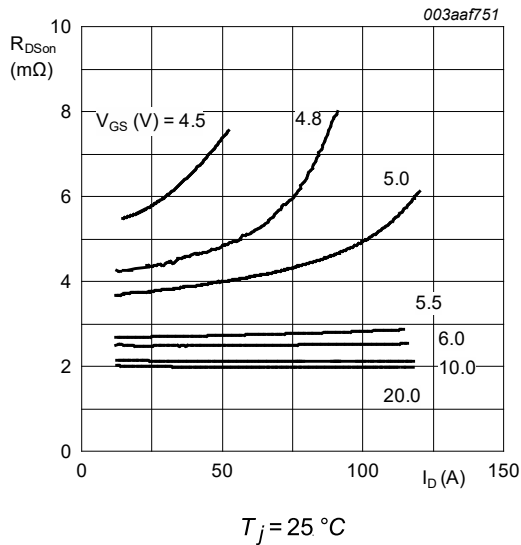


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

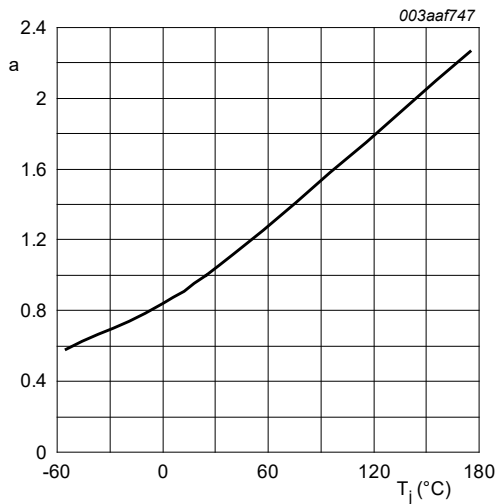


Fig. 13. Drain-source on-state resistance as a function of gate-source voltage; typical values

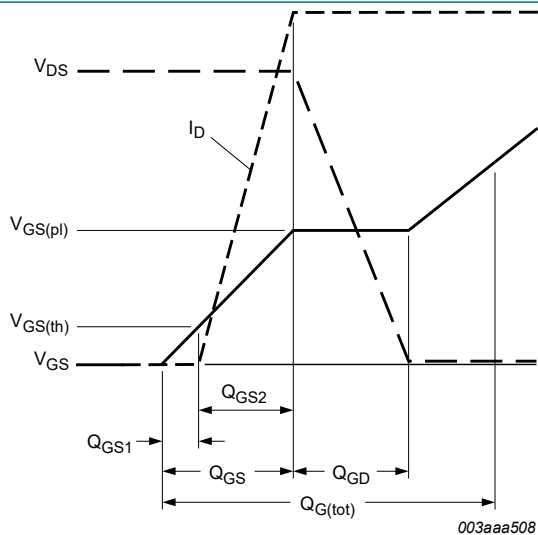


Fig. 14. Gate charge waveform definitions

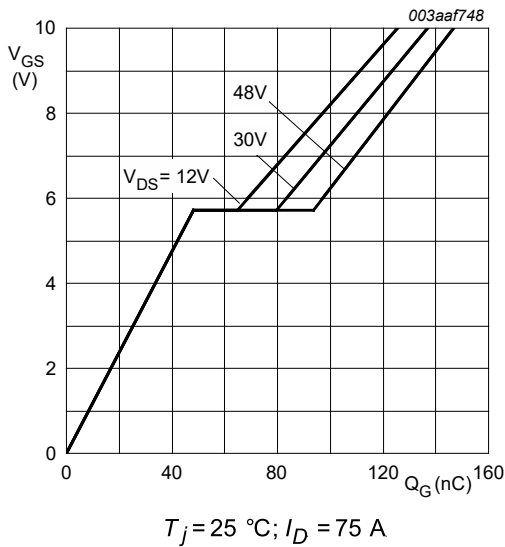


Fig. 15. Gate-source voltage as a function of gate charge; typical values

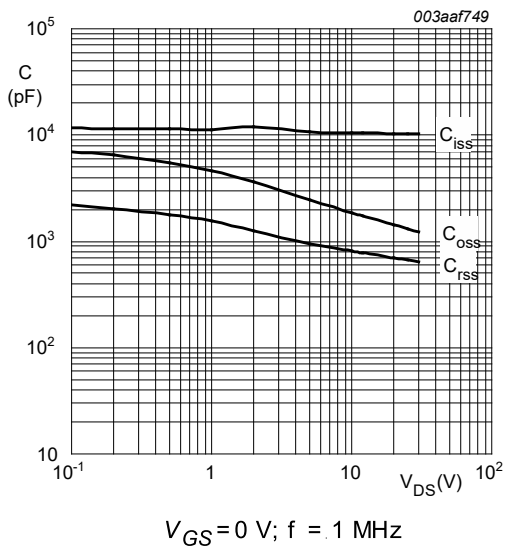


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

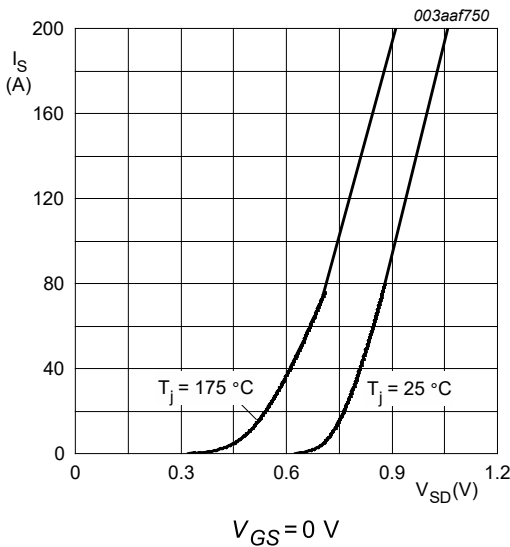


Fig. 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values



11. Package outline

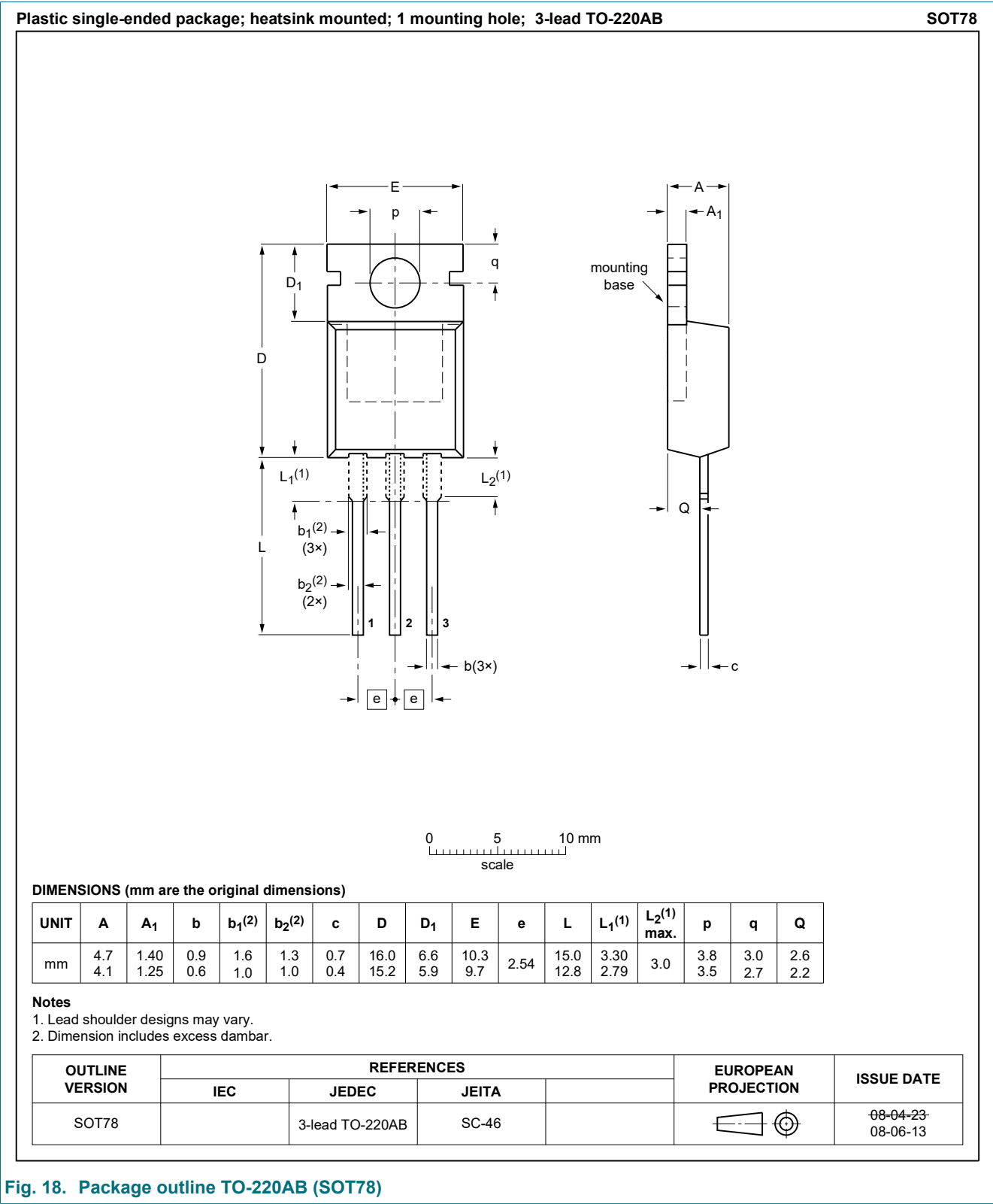


Fig. 18. Package outline TO-220AB (SOT78)

## 12. 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.
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Product [short] data sheet	Production	This document contains the product specification.

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