PSMN4R6-60PS

N-channel 60 V, 4.6 mΩ standard level MOSFET in TO220

Rev. 02 — 1 November 2010 **Product data sheet**

1. Product profile

1.1 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.

1.2 Features and benefits

- High efficiency due to low switching and conduction losses
- Suitable for standard level gate drive sources

1.3 Applications

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

1.4 Quick reference data

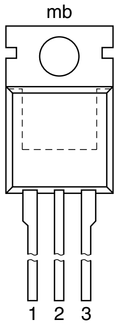
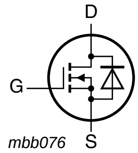
Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	-	60	V
I_D	drain current	$T_{mb} = 25$ °C; see Figure 1	[1]	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; see Figure 2		-	-	211	W
T_j	junction temperature			-55	-	175	°C
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 175$ °C; see Figure 12		-	8.4	11.5	mΩ
		$V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ °C; see Figure 13		-	3.5	4.6	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	$V_{GS} = 10$ V; $I_D = 25$ A; $V_{DS} = 30$ V; see Figure 14; see Figure 15		-	14.8	-	nC
$Q_{G(tot)}$	total gate charge			-	70.8	-	nC
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10$ V; $T_{j(init)} = 25$ °C; $I_D = 100$ A; $V_{sup} \leq 60$ V; $R_{GS} = 50$ Ω; unclamped		-	-	266	mJ

[1] Continuous current is limited by package.

2. 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		

SOT78 (TO-220AB)

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN4R6-60PS	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

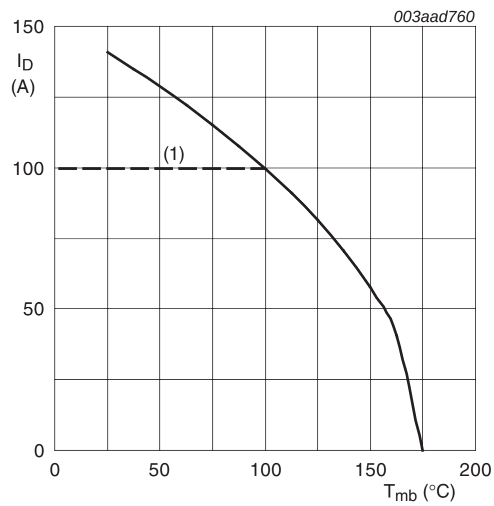
4. Limiting values

Table 4. Limiting values

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

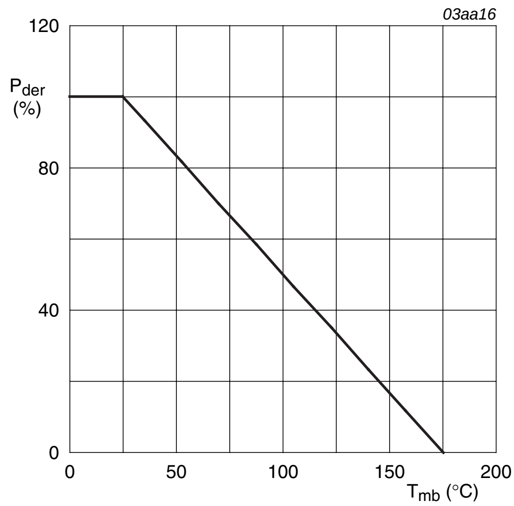
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	60	V
V_{DGR}	drain-gate voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C; R_{GS} = 20 kΩ		-	60	V
V_{GS}	gate-source voltage			-20	20	V
I_D	drain current	T_{mb} = 100 °C; see Figure 1	[1]	-	99.7	A
		T_{mb} = 25 °C; see Figure 1	[1]	-	100	A
I_{DM}	peak drain current	pulsed; t_p = 10 µs; T_{mb} = 25 °C; see Figure 3		-	565	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 2		-	211	W
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C	[1]	-	100	A
I_{SM}	peak source current	pulsed; t_p = 10 µs; T_{mb} = 25 °C		-	565	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; I_D = 100 A; $V_{sup} \leq 60$ V; R_{GS} = 50 Ω; unclamped		-	266	mJ

[1] Continuous current is limited by package.



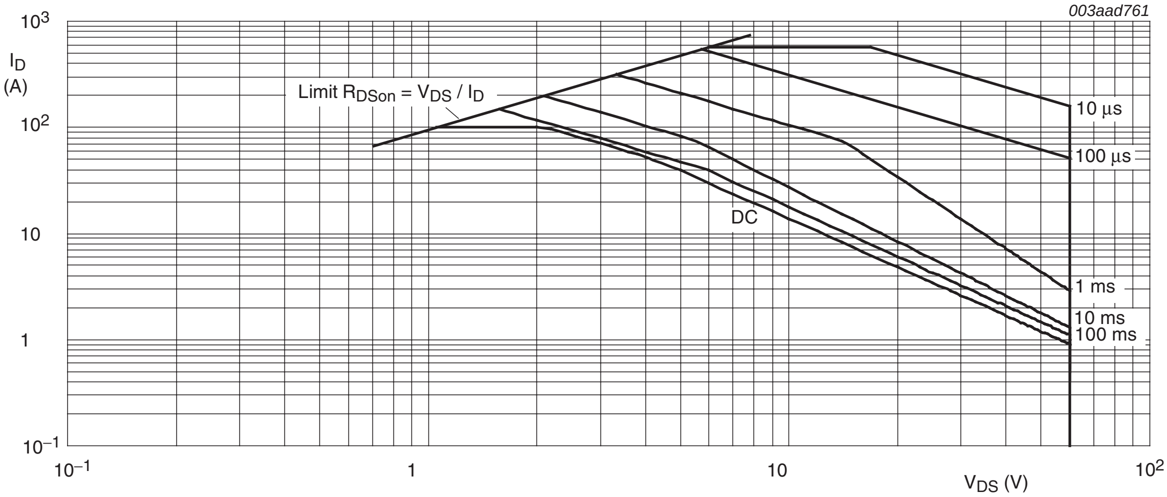
$V_{GS} \geq 10$ V; (1) capped at 100 A due to package.

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



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

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



T_{mb} = 25 °C; I_{DM} is a single pulse; (1) capped at 100 A due to package

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

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 4	-	0.38	1.04	K/W

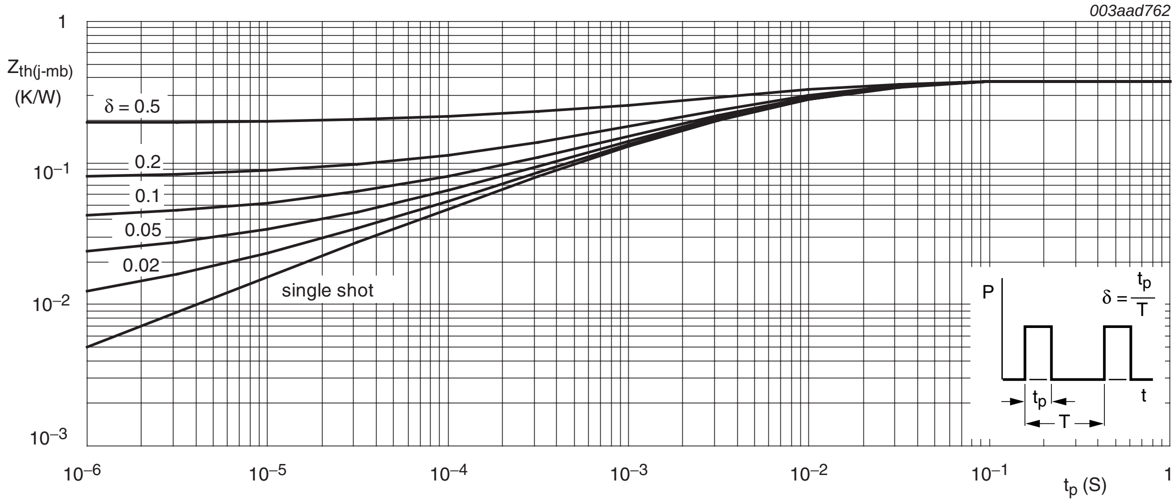


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

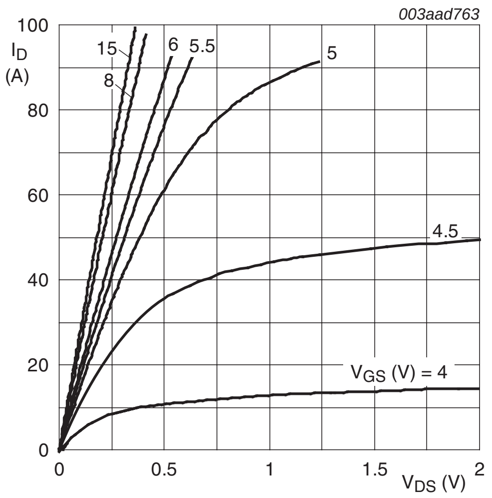
6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C	54	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; see Figure 10; see Figure 11	2	3	4	V
V_{GSth}	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; see Figure 11	-	-	4.8	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; see Figure 11	1	-	-	V
I_{DSS}	drain leakage current	V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 °C	-	0.05	10	µA
		V_{DS} = 60 V; V_{GS} = 0 V; T_j = 125 °C	-	-	200	µA
I_{GSS}	gate leakage current	V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C	-	10	100	nA
		V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C	-	10	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; see Figure 12	-	8.4	11.5	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; see Figure 12	-	-	7.4	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; see Figure 13	-	3.5	4.6	mΩ
R_G	gate resistance	f = 1 MHz	-	0.79	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 0 A; V_{DS} = 30 V; V_{GS} = 10 V; see Figure 14	-	63	-	nC
		I_D = 25 A; V_{DS} = 30 V; V_{GS} = 10 V; see Figure 14; see Figure 15	-	70.8	-	nC
Q_{GS}	gate-source charge		-	19.5	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge	I_D = 25 A; V_{DS} = 30 V; V_{GS} = 10 V; see Figure 14	-	13.5	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	6	-	nC
Q_{GD}	gate-drain charge	I_D = 25 A; V_{DS} = 30 V; V_{GS} = 10 V; see Figure 14; see Figure 15	-	14.8	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	V_{DS} = 30 V; see Figure 14; see Figure 15	-	4.3	-	V
C_{iss}	input capacitance	V_{DS} = 30 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; see Figure 16	-	4426	-	pF
C_{oss}	output capacitance		-	567	-	pF
C_{rss}	reverse transfer capacitance		-	293	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 4.7 Ω	-	26	-	ns
t_r	rise time		-	24	-	ns
$t_{d(off)}$	turn-off delay time		-	58	-	ns
t_f	fall time		-	22	-	ns

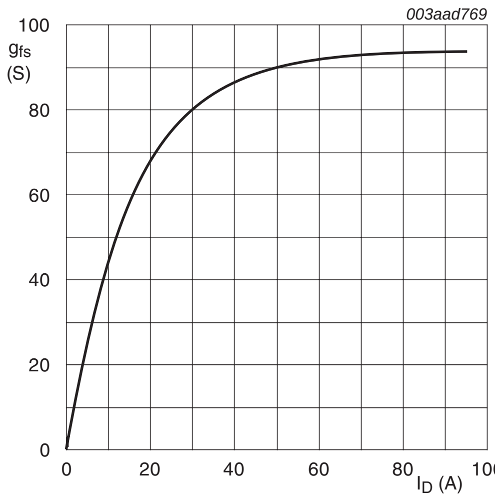
Table 6. Characteristics *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; see Figure 17	-	0.81	1.1	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 30 V	-	45	-	ns
Q_r	recovered charge		-	64	-	nC



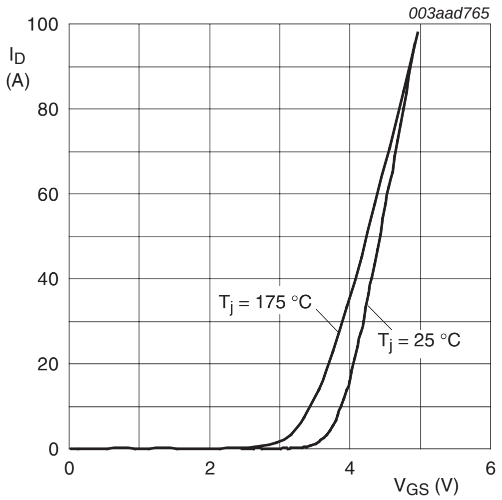
T_j = 25 °C; t_p = 300 µs

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values



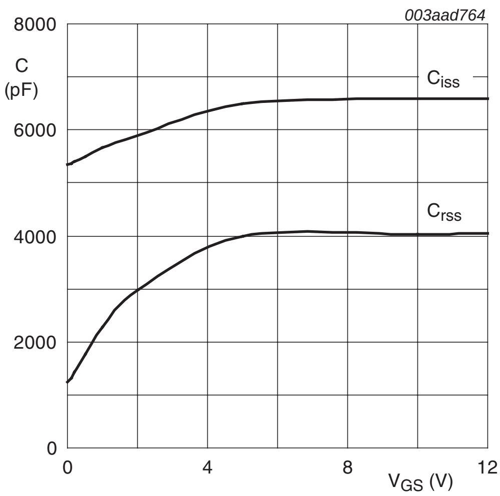
T_j = 25 °C; V_{DS} = 10 V

Fig 6. Forward transconductance as a function of drain current; typical values



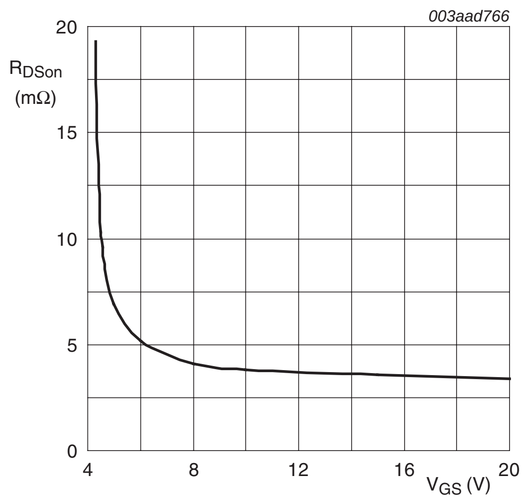
V_{DS} = 15 V

Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values



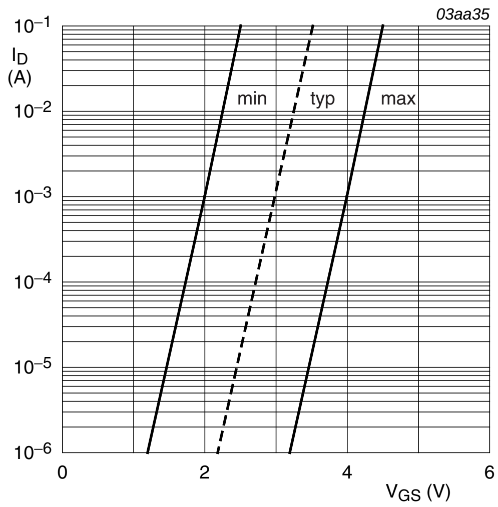
f = 1 MHz; V_{DS} = 0 V

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



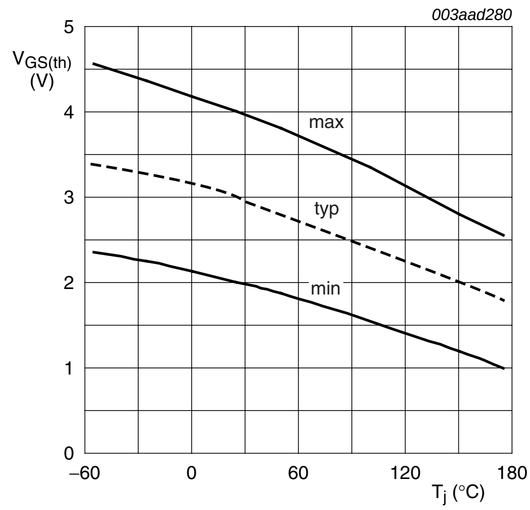
$T_j = 25$ °C; $I_D = 25$ A

Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



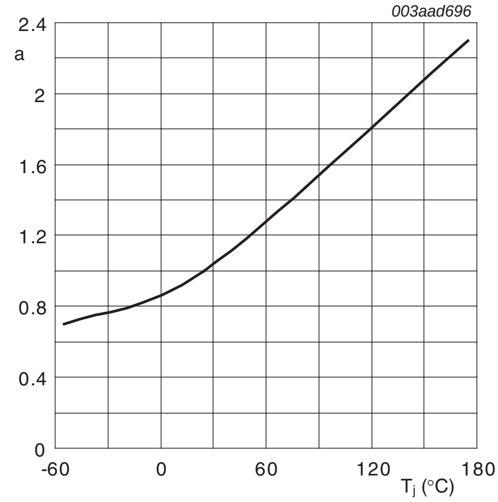
$T_j = 25°C; V_{DS} = 5V$

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



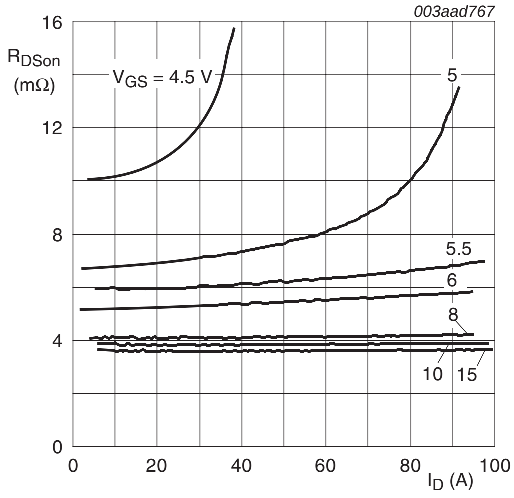
$I_D = 1$ mA; $V_{DS} = V_{GS}$

Fig 11. Gate-source threshold voltage as a function of junction temperature



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

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



$T_j = 25\ °C; t_p = 300\ \mu s$

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

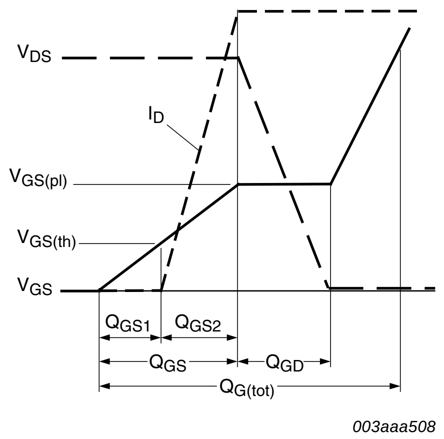
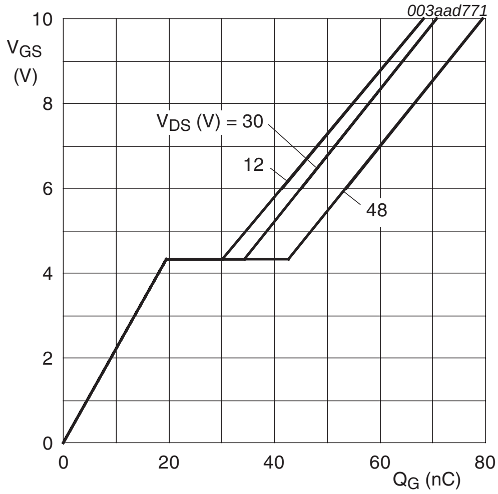
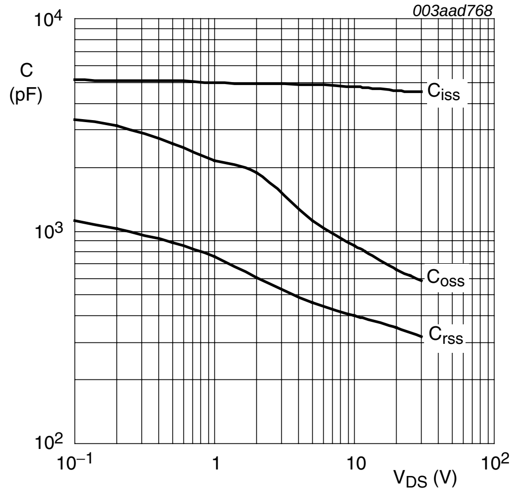


Fig 14. Gate charge waveform definitions



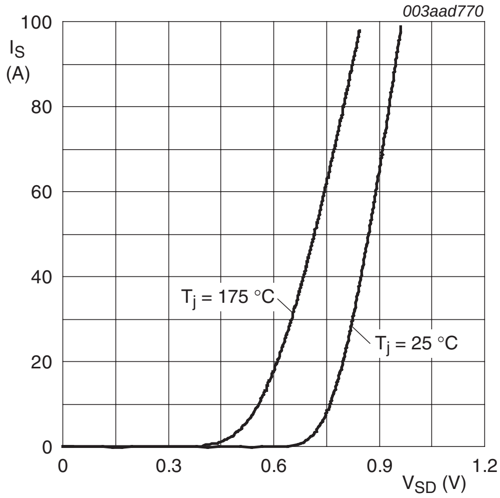
$T_j = 25\ °C; I_D = 25\ A$

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



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

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

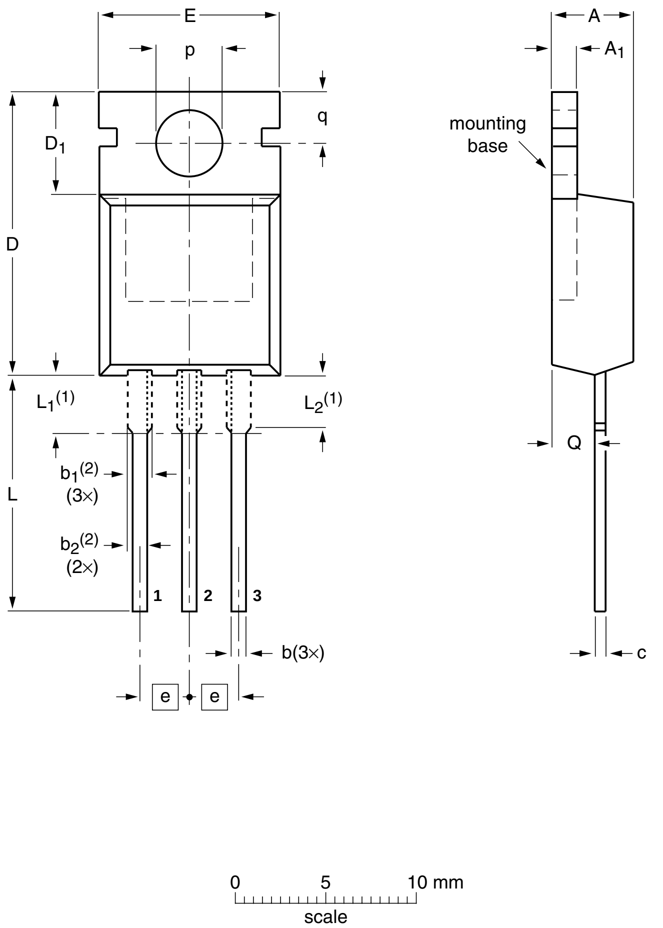


$V_{GS} = 0$ V

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

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB **SOT78**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	$b_1^{(2)}$	$b_2^{(2)}$	c	D	D_1	E	e	L	$L_1^{(1)}$	$L_2^{(1)}$ max.	p	q	Q
mm	4.7 4.1	1.40 1.25	0.9 0.6	1.6 1.0	1.3 1.0	0.7 0.4	16.0 15.2	6.6 5.9	10.3 9.7	2.54	15.0 12.8	3.30 2.79	3.0	3.8 3.5	3.0 2.7	2.6 2.2

Notes

1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78		3-lead TO-220AB	SC-46			~~08-04-23~~ 08-06-13

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

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN4R6-60PS v.2	20101101	Product data sheet	-	PSMN4R6-60PS v.1
Modifications:	• Various changes to content.			
PSMN4R6-60PS v.1	20100311	Product data sheet	-	-

9. Legal information

9.1 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.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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11. Contents

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