

PSMN4R6-60PS

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

Rev. 01 — 11 March 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
- Motor control
- Load switching
- Server power supplies

1.4 Quick reference data

Table 1. Quick reference

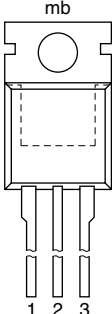
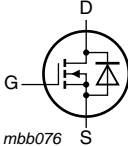
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	-	60	V
I_D	drain current	$T_{mb} = 25\text{ °C}$; see Figure 1	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; see Figure 2	-	-	211	W
T_j	junction temperature		-55	-	175	°C
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$;	-	14.8	-	nC
$Q_{G(tot)}$	total gate charge	$V_{DS} = 30\text{ V}$; see Figure 14 and 15	-	70.8	-	nC
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$;	-	8.4	11.5	mΩ
		$T_j = 175\text{ °C}$; see Figure 12				
		$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$;	-	3.5	4.6	mΩ
		$T_j = 25\text{ °C}$; see Figure 13				

[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

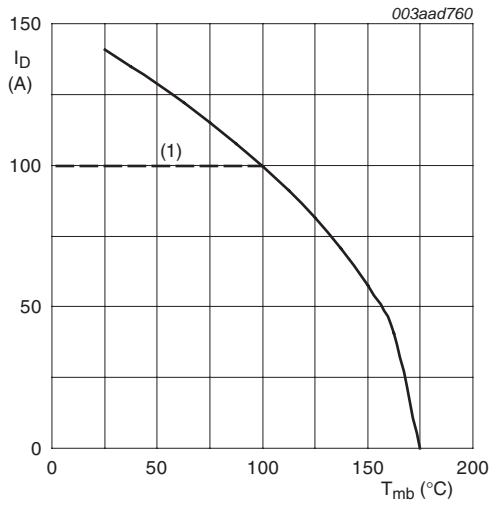
4. Limiting values

Table 4. Limiting values

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

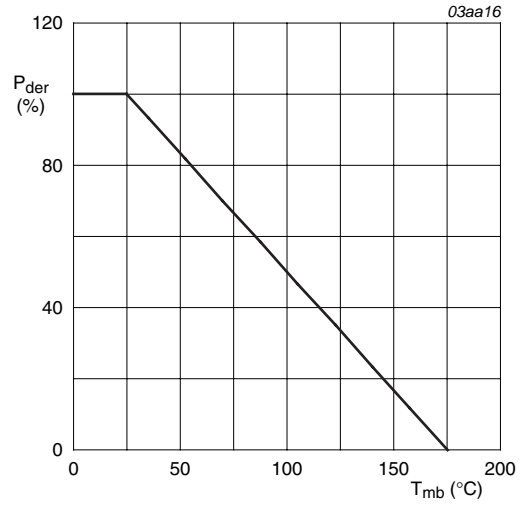
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	60	V
V_{DGR}	drain-gate voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	60	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$T_{mb} = 100\text{ °C}$; see Figure 1	[1]	99.7	A
		$T_{mb} = 25\text{ °C}$; see Figure 1	[1]	100	A
I_{DM}	peak drain current	$t_p = 10\text{ }\mu\text{s}$; pulsed; $T_{mb} = 25\text{ °C}$; see Figure 3	-	565	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; 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	$T_{mb} = 25\text{ °C}$;	[1]	100	A
I_{SM}	peak source current	$t_p = 10\text{ }\mu\text{s}$; pulsed; $T_{mb} = 25\text{ °C}$	-	565	A

[1] Continuous current is limited by package.



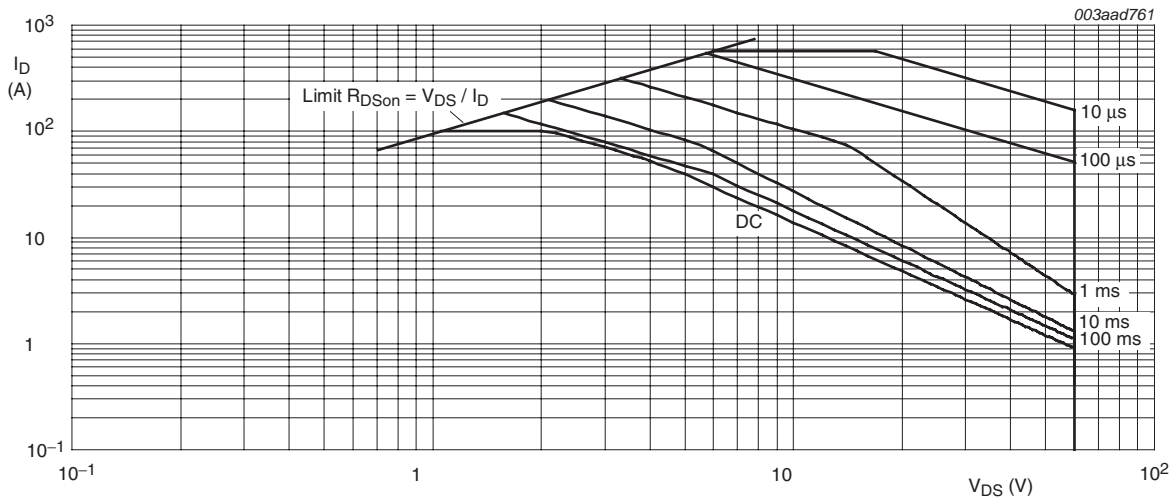
$V_{GS} \geq 10$ V; (1) capped at 100 A due to package.

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

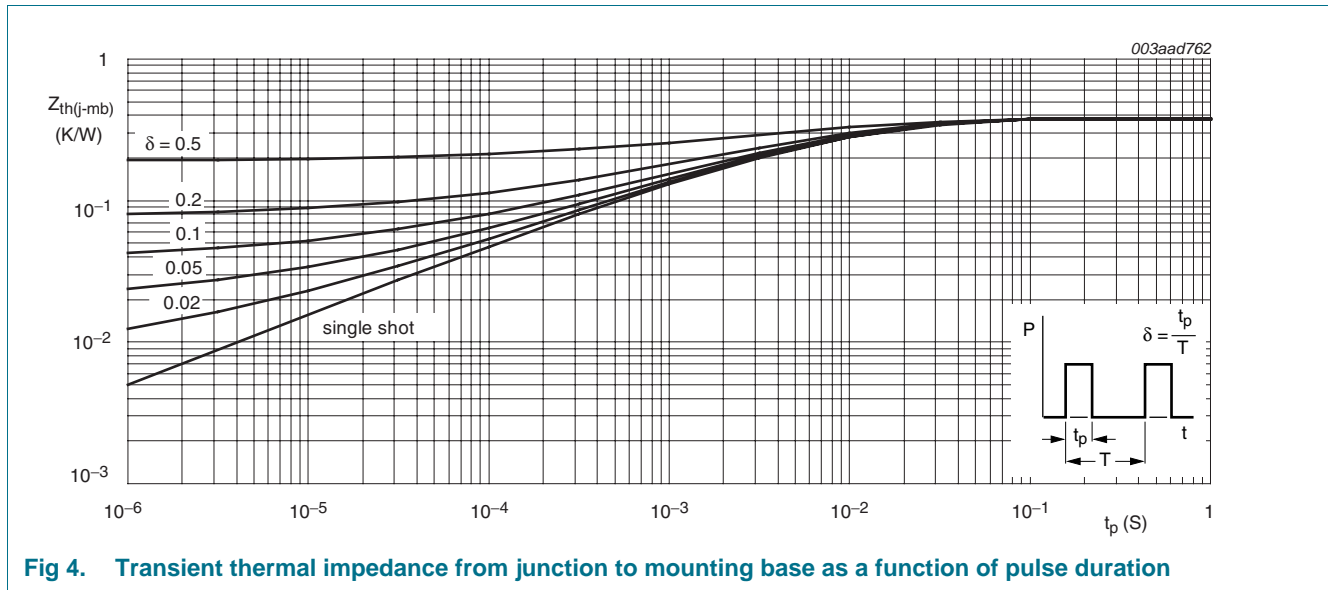
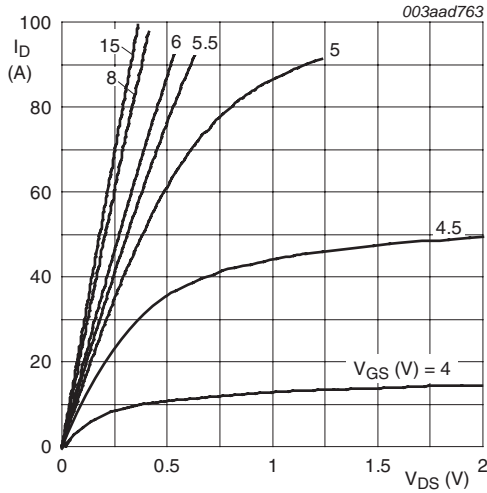


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

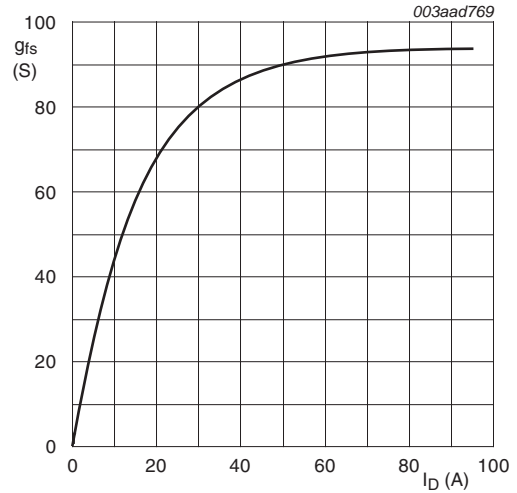
Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	54	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$; see Figure 10 and 11	2	3	4	V
$V_{GS(th)}$		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C$; see Figure 11	-	-	4.8	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C$; see Figure 11	1	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.05	10	μA
		$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 125 \text{ }^\circ C$	-	-	200	μA
I_{GSS}	gate leakage current	$V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	10	100	nA
		$V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 25 A; T_j = 175 \text{ }^\circ C$; see Figure 12	-	8.4	11.5	mΩ
		$V_{GS} = 10 V; I_D = 25 A; T_j = 100 \text{ }^\circ C$; see Figure 12	-	-	7.4	mΩ
		$V_{GS} = 10 V; I_D = 25 A; T_j = 25 \text{ }^\circ C$; see Figure 13	-	3.5	4.6	mΩ
R_G	gate resistance	$f = 1 \text{ MHz}$	-	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 and 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 and 15	-	14.8	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$V_{DS} = 30 V$; see Figure 14 and 15	-	4.3	-	V
C_{iss}	input capacitance	$V_{DS} = 30 V; V_{GS} = 0 V; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$; 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	$V_{DS} = 30 V; R_L = 1.2 \text{ } \Omega; V_{GS} = 10 V$; $R_{G(ext)} = 4.7 \text{ } \Omega$	-	26	-	ns
t_r	rise time		-	24	-	ns
$t_{d(off)}$	turn-off delay time		-	58	-	ns
t_f	fall time		-	22	-	ns
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25 A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$; see Figure 17	-	0.81	1.1	V
t_{rr}	reverse recovery time	$I_S = 25 A; di/dt = -100 \text{ A}/\mu s; V_{GS} = 0 V$;	-	45	-	ns
Q_r	recovered charge	$V_{DS} = 30 V$	-	64	-	nC



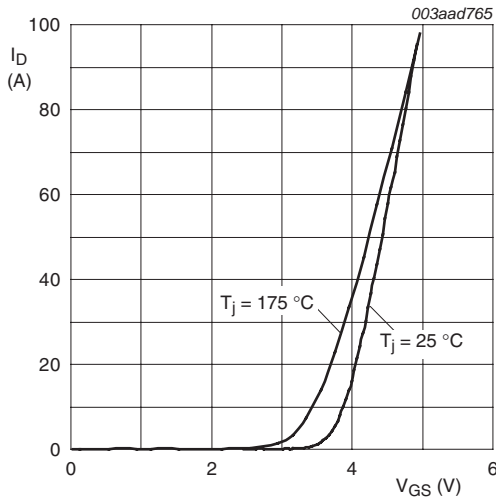
$T_j = 25\text{ }^\circ\text{C}; t_p = 300\text{ }\mu\text{s}$

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



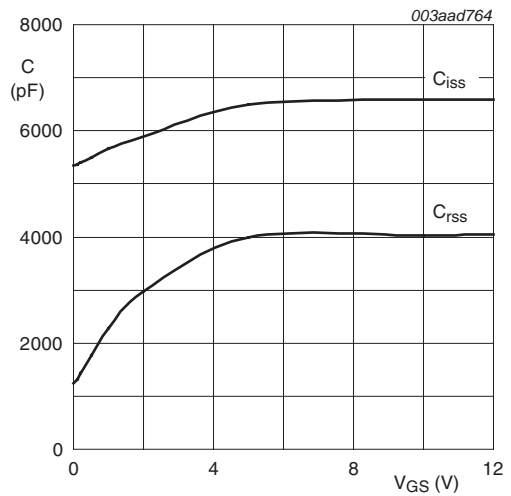
$T_j = 25\text{ }^\circ\text{C}; V_{DS} = 10\text{ V}$

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



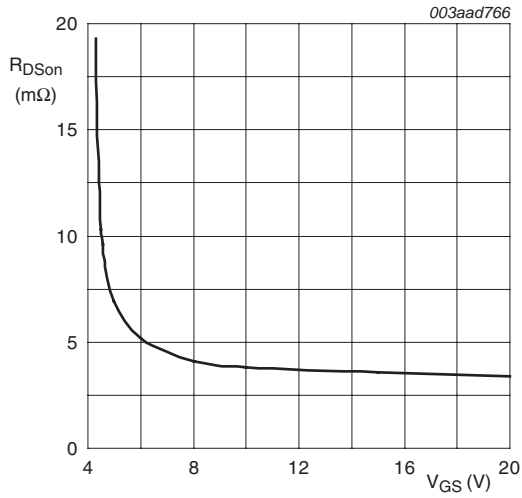
$V_{DS} = 15\text{ V}$

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



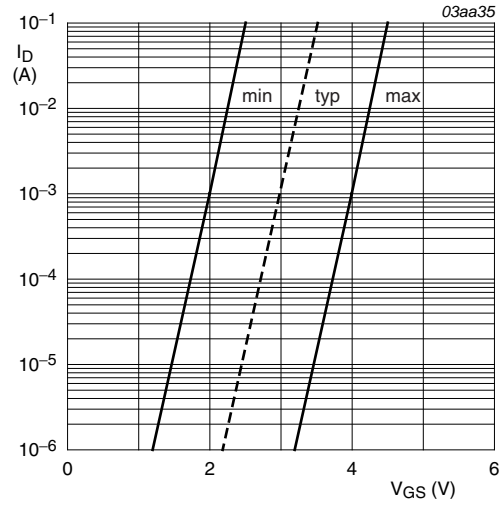
$f = 1\text{ MHz}; V_{DS} = 0\text{ V}$

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



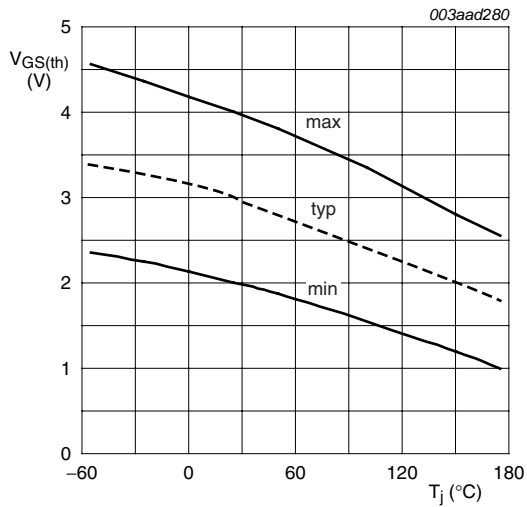
$T_j = 25\text{ °C}; I_D = 25\text{ A}$

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



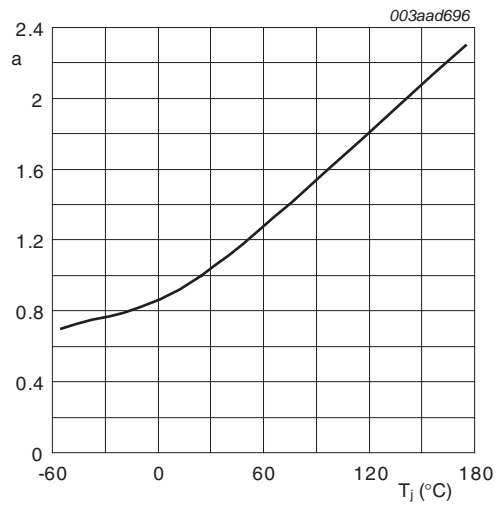
$T_j = 25\text{ °C}; V_{DS} = 5\text{ V}$

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



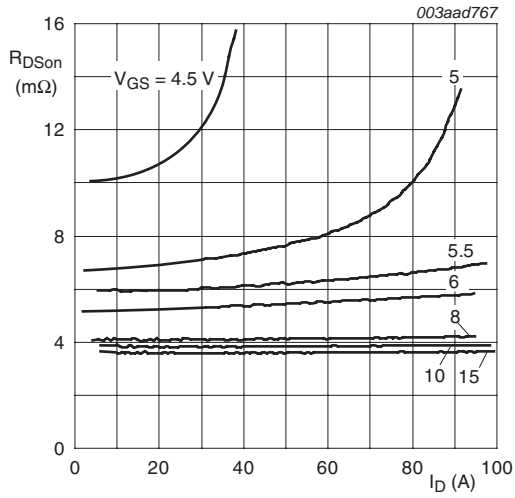
$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

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



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

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



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

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

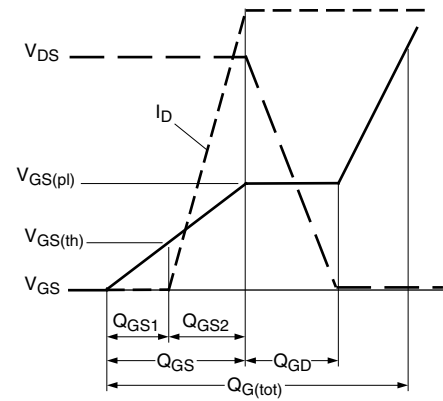
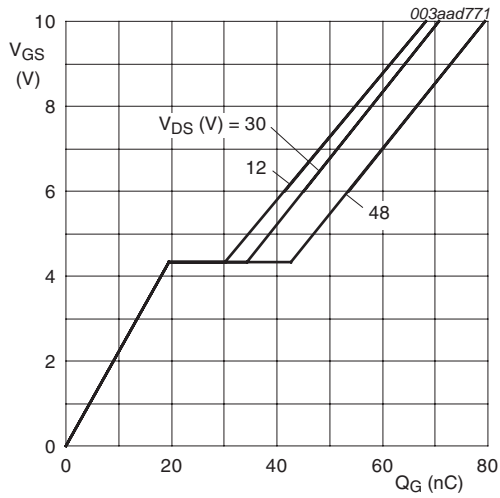
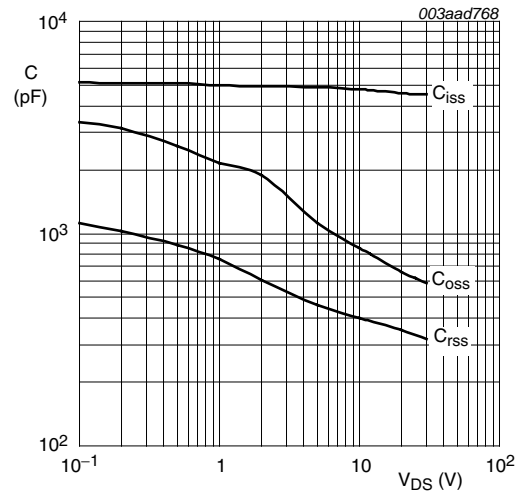


Fig 14. Gate charge waveform definitions



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

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



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

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

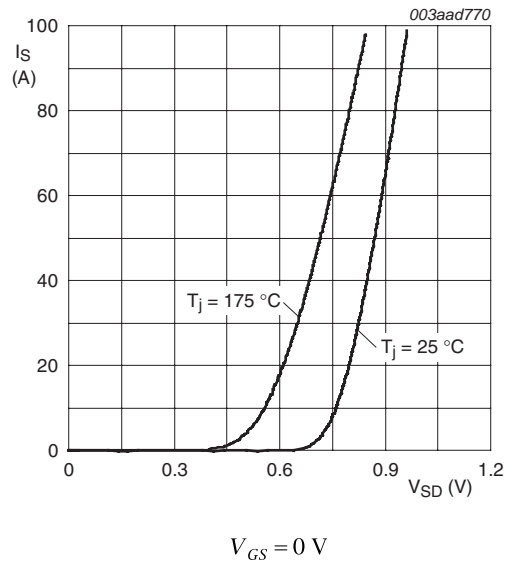


Fig 17. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

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

SOT78

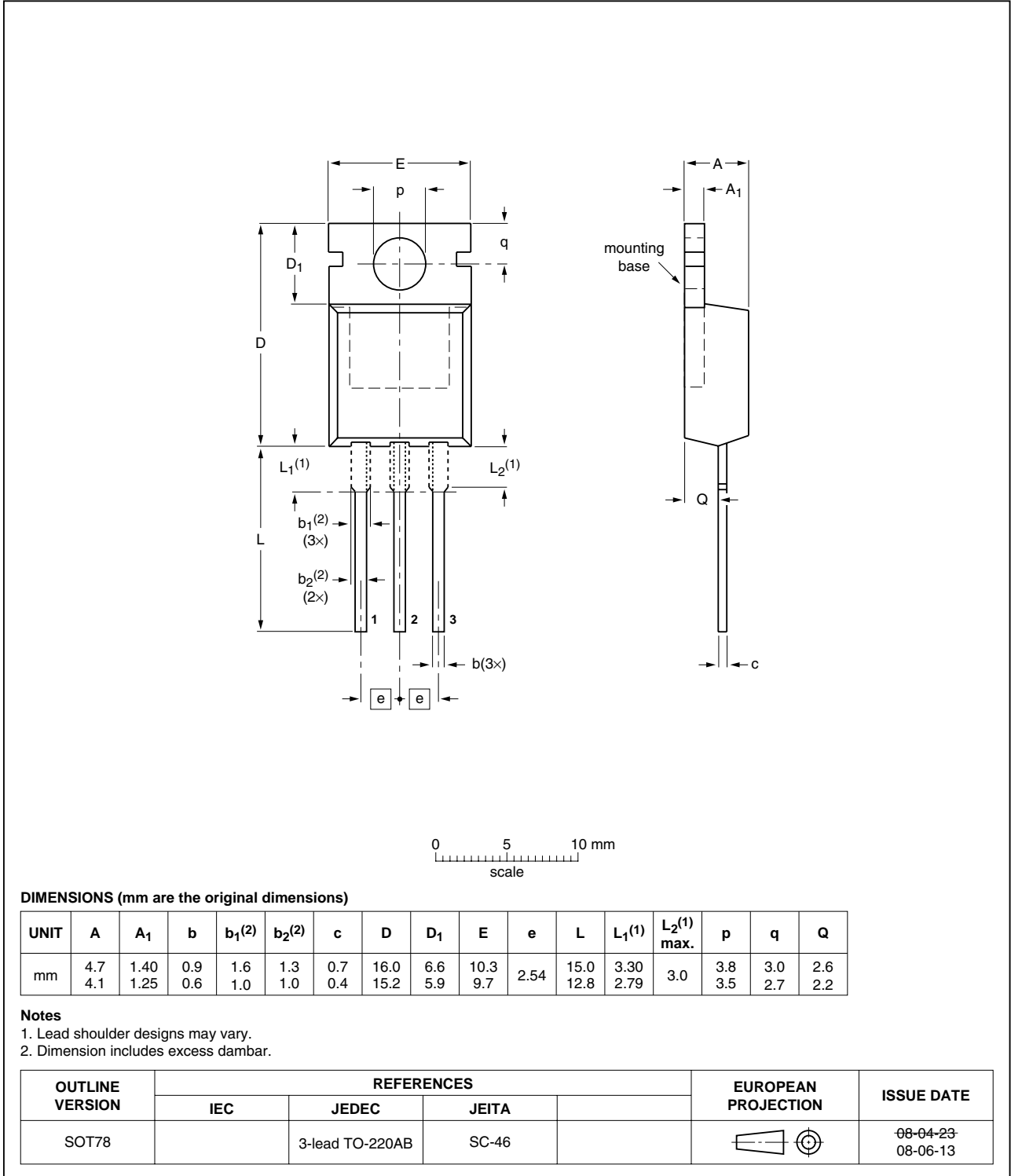


Fig 18. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN4R6-60PS_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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