



PSMN4R6-60BS

N-channel 60 V, 4.4 mΩ standard level MOSFET in D2PAK

Rev. 1 — 22 March 2012

Product data sheet

1. Product profile

1.1 General description

Standard level N-channel MOSFET in a D2PAK 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

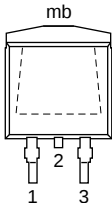
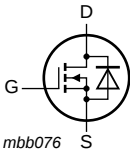
Table 1. Quick reference data

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	[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
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 100\text{ °C}$; see Figure 12 ; see Figure 13	-	5.98	7	mΩ
		$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C}$; see Figure 13	-	3.74	4.4	mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; V_{DS} = 30\text{ V}$; 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	$V_{GS} = 10\text{ V}; T_{j(init)} = 25\text{ °C}; I_D = 100\text{ A}; V_{sup} \leq 60\text{ V}; R_{GS} = 50\text{ Ω}$; 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 ^[1]		
3	S	source		
mb	D	mounting base; connected to drain		

SOT404 (D2PAK)

[1] It is not possible to make connection to pin 2

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN4R6-60BS	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

4. Marking

Table 4. Marking codes

Type number	Marking code
PSMN4R6-60BS	PSMN4R6-60BS

5. 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	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	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	pulsed; $t_p = 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; 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
$T_{sld(M)}$	peak soldering temperature		-	260	°C

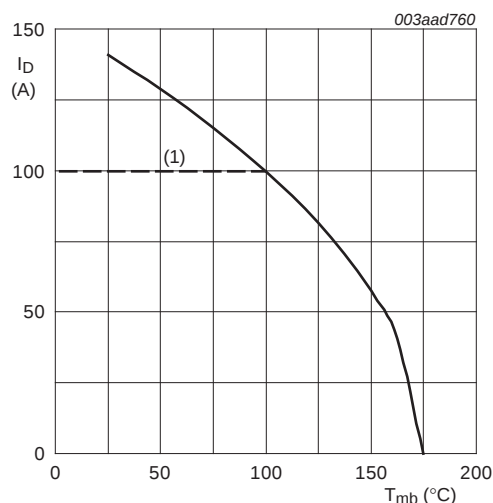
Source-drain diode

I_S	source current	$T_{mb} = 25\text{ °C}$	[1]	-	100	A
I_{SM}	peak source current	pulsed; $t_p = 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$	-	-	565	A

Avalanche ruggedness

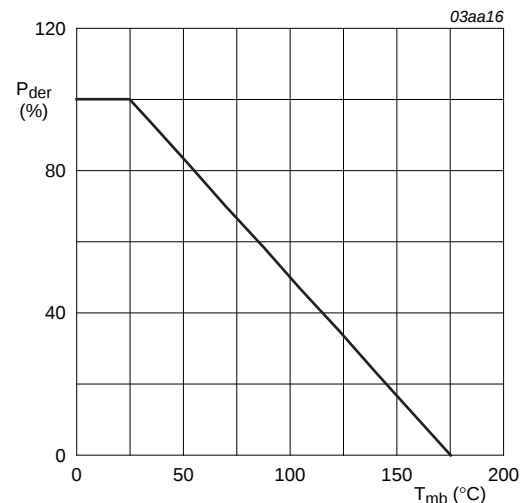
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ °C}$; $I_D = 100\text{ A}$; $V_{sup} \leq 60\text{ V}$; $R_{GS} = 50\text{ }\Omega$; unclamped	-	-	266	mJ
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[1] Continuous current is limited by package.



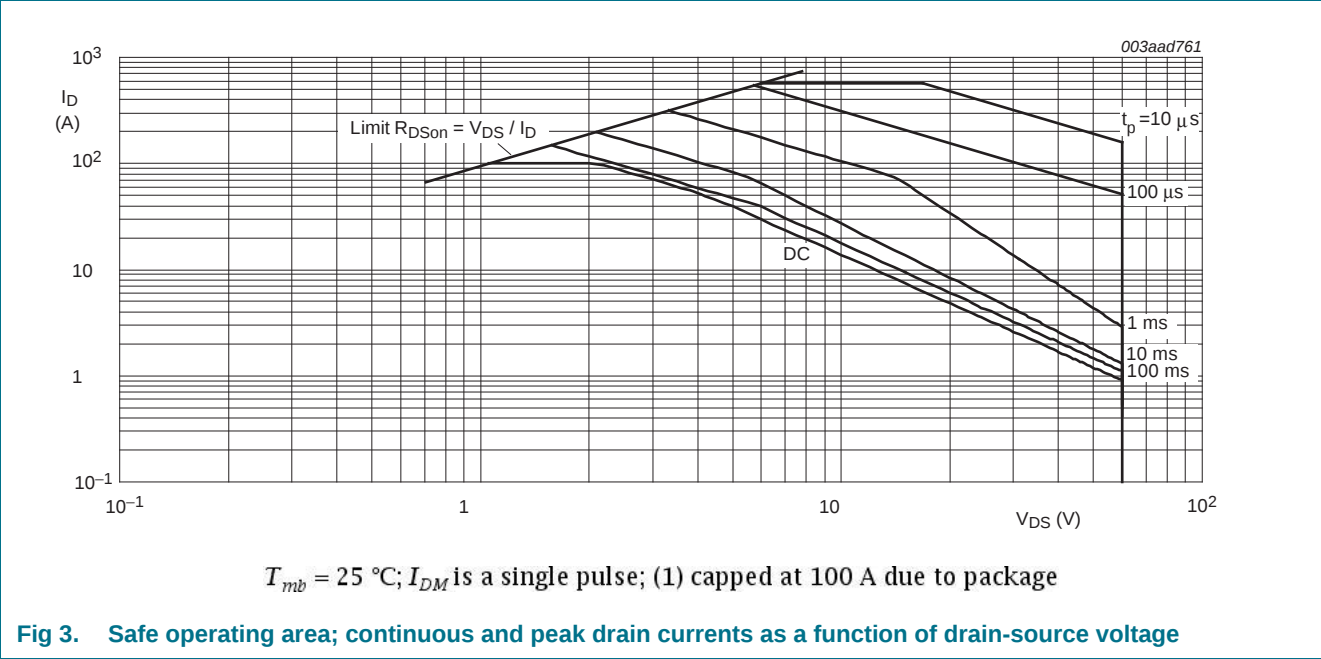
$V_{GS} \geq 10\text{ V}$; (1) capped at 100 A due to package.

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



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

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



6. Thermal characteristics

Table 6. 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	0.71	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint; mounted on a printed circuit board	-	50	-	K/W

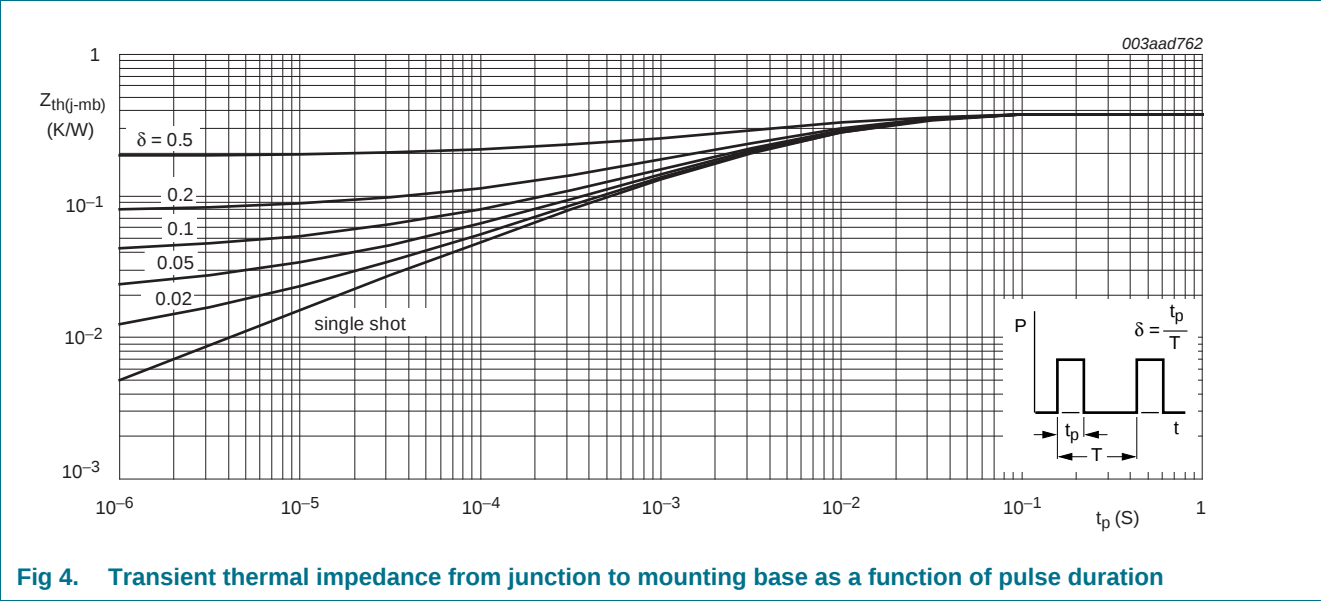


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$; $V_{GS} = 0\ \text{V}$; $T_j = -55\ ^\circ\text{C}$	54	-	-	V
		$I_D = 250\ \mu\text{A}$; $V_{GS} = 0\ \text{V}$; $T_j = 25\ ^\circ\text{C}$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ \text{mA}$; $V_{DS} = V_{GS}$; $T_j = 25\ ^\circ\text{C}$; see Figure 10 ; see Figure 11	2	3	4	V
V_{GSth}	gate-source threshold voltage	$I_D = 1\ \text{mA}$; $V_{DS} = V_{GS}$; $T_j = -55\ ^\circ\text{C}$; see Figure 11	-	-	4.8	V
		$I_D = 1\ \text{mA}$; $V_{DS} = V_{GS}$; $T_j = 175\ ^\circ\text{C}$; see Figure 11	1	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 60\ \text{V}$; $V_{GS} = 0\ \text{V}$; $T_j = 25\ ^\circ\text{C}$	-	0.05	10	μA
		$V_{DS} = 60\ \text{V}$; $V_{GS} = 0\ \text{V}$; $T_j = 125\ ^\circ\text{C}$	-	-	200	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_{DSon}	drain-source on-state resistance	$V_{GS} = 10\ \text{V}$; $I_D = 25\ \text{A}$; $T_j = 175\ ^\circ\text{C}$; see Figure 12 ; see Figure 13	-	8.6	10.1	mΩ
		$V_{GS} = 10\ \text{V}$; $I_D = 25\ \text{A}$; $T_j = 100\ ^\circ\text{C}$; see Figure 12 ; see Figure 13	-	5.98	7	mΩ
		$V_{GS} = 10\ \text{V}$; $I_D = 25\ \text{A}$; $T_j = 25\ ^\circ\text{C}$; see Figure 13	-	3.74	4.4	mΩ
R_G	gate resistance	$f = 1\ \text{MHz}$	-	0.79	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 0\ \text{A}$; $V_{DS} = 0\ \text{V}$; $V_{GS} = 10\ \text{V}$	-	63	-	nC
		$I_D = 25\ \text{A}$; $V_{DS} = 30\ \text{V}$; $V_{GS} = 10\ \text{V}$; 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		-	13.5	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	6	-	nC
Q_{GD}	gate-drain charge		-	14.8	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\ \text{A}$; $V_{DS} = 30\ \text{V}$; see Figure 14 ; see Figure 15	-	4.3	-	V
C_{iss}	input capacitance	$V_{DS} = 30\ \text{V}$; $V_{GS} = 0\ \text{V}$; $f = 1\ \text{MHz}$; $T_j = 25\ ^\circ\text{C}$; 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	$V_{DS} = 30\ \text{V}$; $R_L = 1.2\ \Omega$; $V_{GS} = 10\ \text{V}$; $R_{G(ext)} = 4.7\ \Omega$	-	26	-	ns
t_r	rise time		-	24	-	ns
$t_{d(off)}$	turn-off delay time		-	58	-	ns
t_f	fall time		-	22	-	ns

Table 7. Characteristics ...continued

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

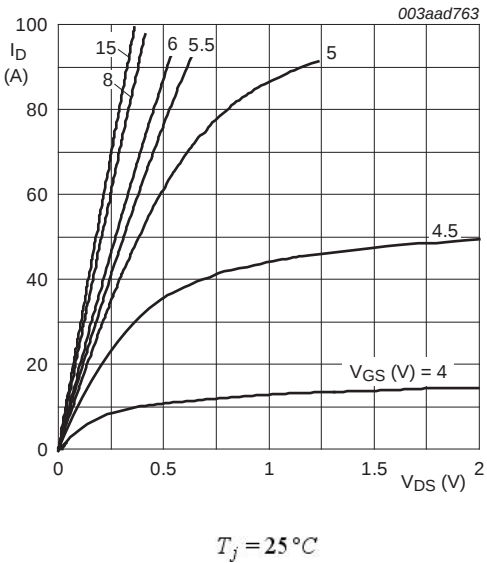


Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

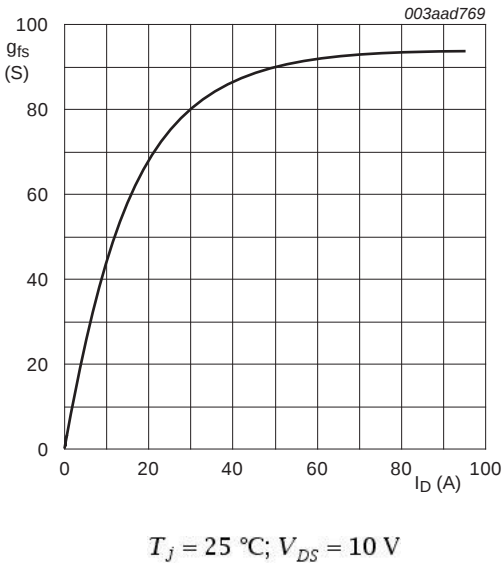


Fig 6. Forward transconductance as a function of drain current; typical values

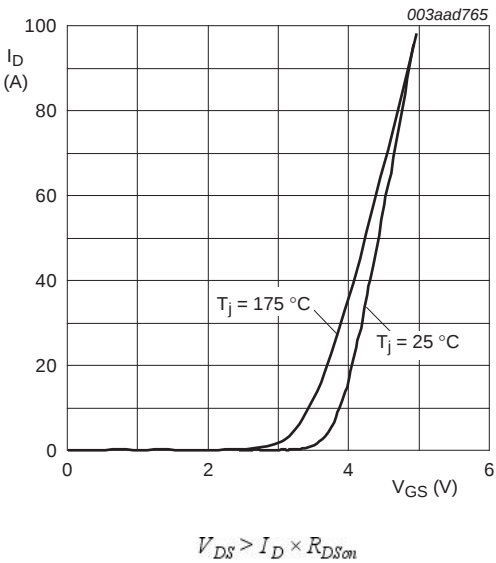


Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

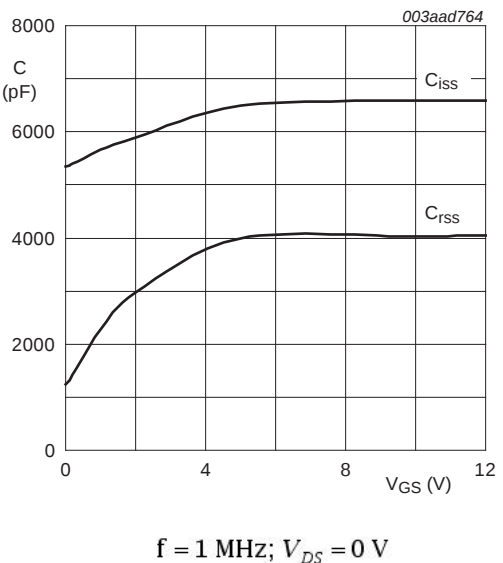
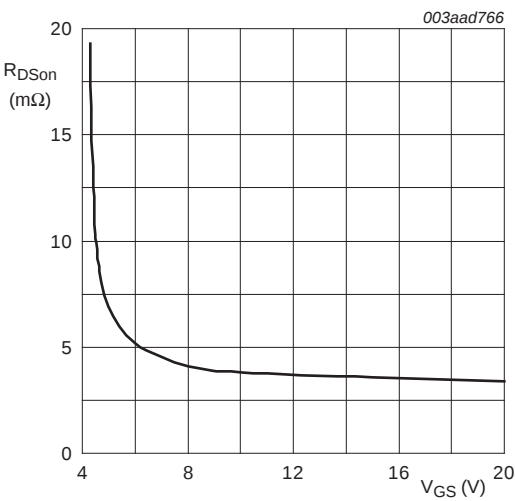
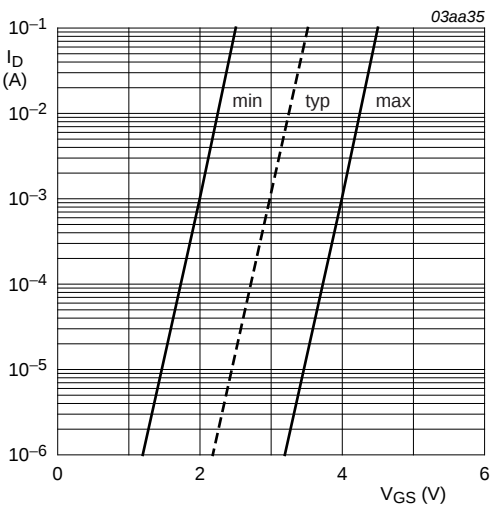


Fig 8. Input and reverse transfer capacitances as a function of gate-source voltage, typical values



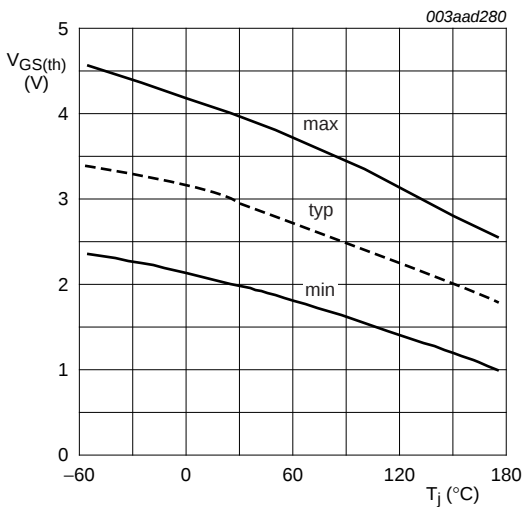
$T_j = 25\text{ }^{\circ}\text{C}; I_D = 25\text{ A}$

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



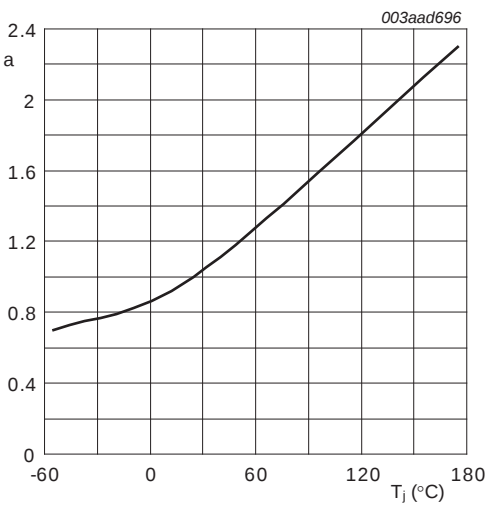
$T_j = 25\text{ }^{\circ}\text{C}; V_{DS} = 5\text{ V}$

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



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

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

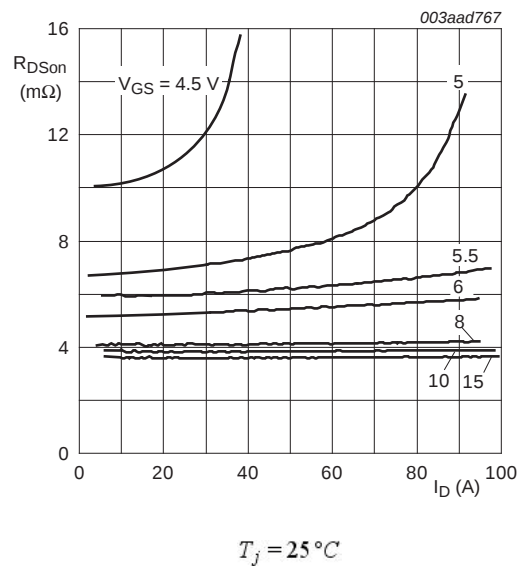


Fig 13. Drain-source on-state resistance as a function of drain current; typical values

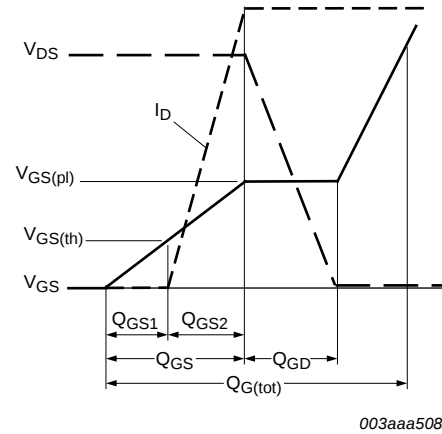


Fig 14. Gate charge waveform definitions

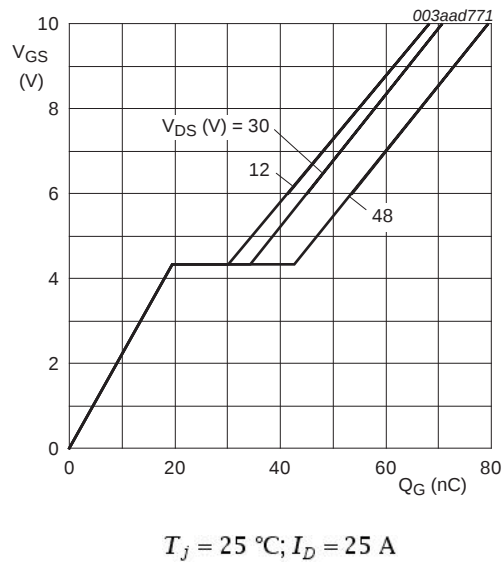


Fig 15. Gate-source voltage as a function of gate charge; typical values

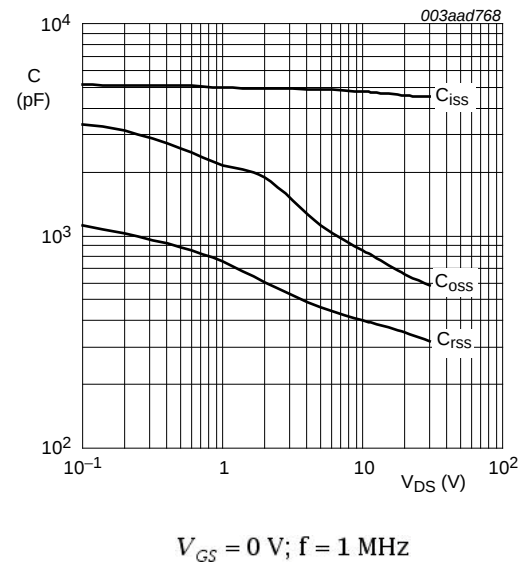


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

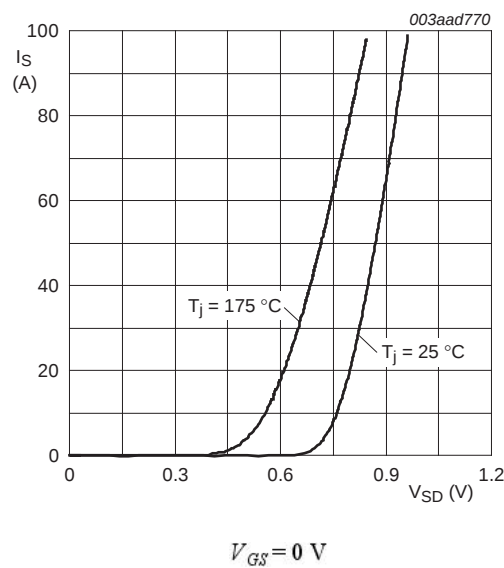
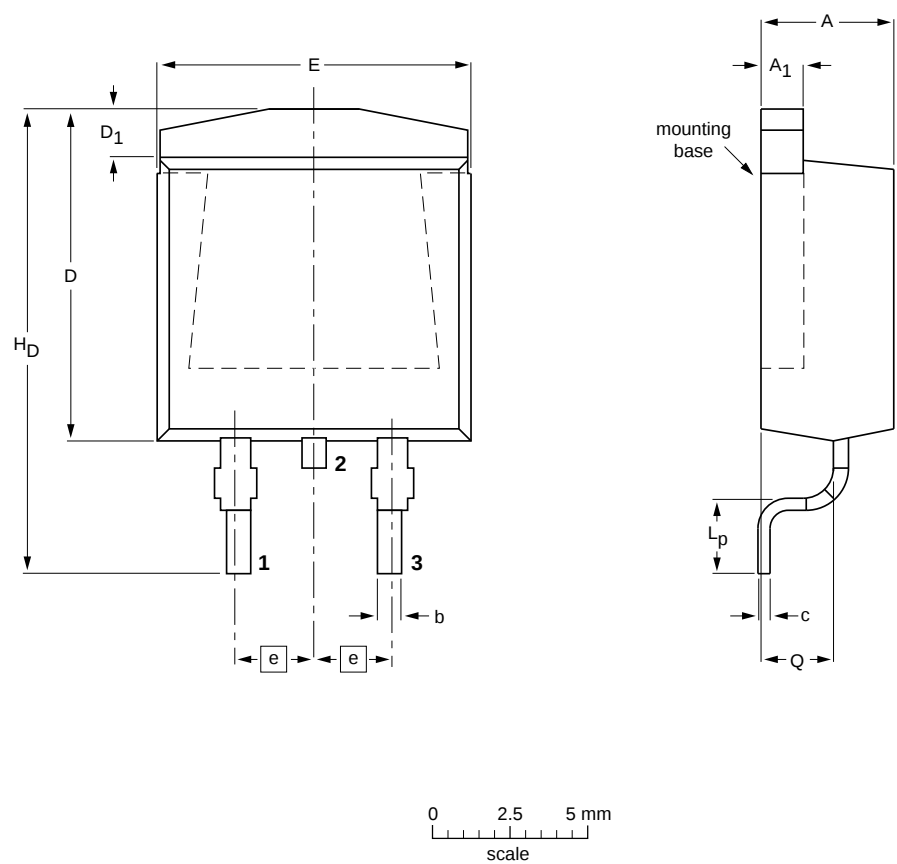


Fig 17. Source current as a function of source-drain voltage; typical values

8. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)

SOT404



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	b	c	D _{max.}	D ₁	E	e	L _p	H _D	Q
mm	4.50 4.10	1.40 1.27	0.85 0.60	0.64 0.46	11	1.60 1.20	10.30 9.70	2.54	2.90 2.10	15.80 14.80	2.60 2.20

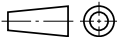
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT404						05-02-11 06-03-16

Fig 18. Package outline SOT404 (D2PAK)

9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN4R6-60BS v.1	20120322	Product data sheet	-	-

10. Legal information

10.1 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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