



# PSMN4R5-40BS

N-channel 40 V 4.5 m $\Omega$  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 SOT404 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 convertors
- Motor control
- Load switching
- Server power supplies

### 1.4 Quick reference data

Table 1. Quick reference data

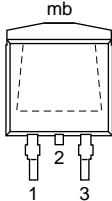
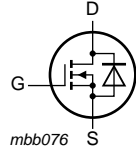
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C	-	-	40	V
I <sub>D</sub>	drain current	T <sub>mb</sub> = 25 °C; V <sub>GS</sub> = 10 V; see <a href="#">Figure 1</a>	[1]	-	100	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; see <a href="#">Figure 2</a>	-	-	148	W
T <sub>j</sub>	junction temperature		-55	-	175	°C
<b>Static characteristics</b>						
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> = 100 °C; see <a href="#">Figure 13</a> ; see <a href="#">Figure 5</a>	-	5.5	6.5	m $\Omega$
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; see <a href="#">Figure 5</a>	-	3.79	4.5	m $\Omega$
<b>Dynamic characteristics</b>						
Q <sub>GD</sub>	gate-drain charge	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; V <sub>DS</sub> = 20 V; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	8.8	-	nC
Q <sub>G(tot)</sub>	total gate charge	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V	-	35	-	nC
<b>Avalanche ruggedness</b>						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; I <sub>D</sub> = 100 A; V <sub>sup</sub> ≤ 40 V; unclamped; R <sub>GS</sub> = 50 $\Omega$	-	-	152	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	 <p>SOT404 (D2PAK)</p>	
2	D	drain <sup>[1]</sup>		
3	S	source		
mb	D	mounting base; connected to drain		

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

## 3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN4R5-40BS	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

## 4. Marking

Table 4. Marking codes

Type number	Marking code
PSMN4R5-40BS	PSMN4R5-40BS

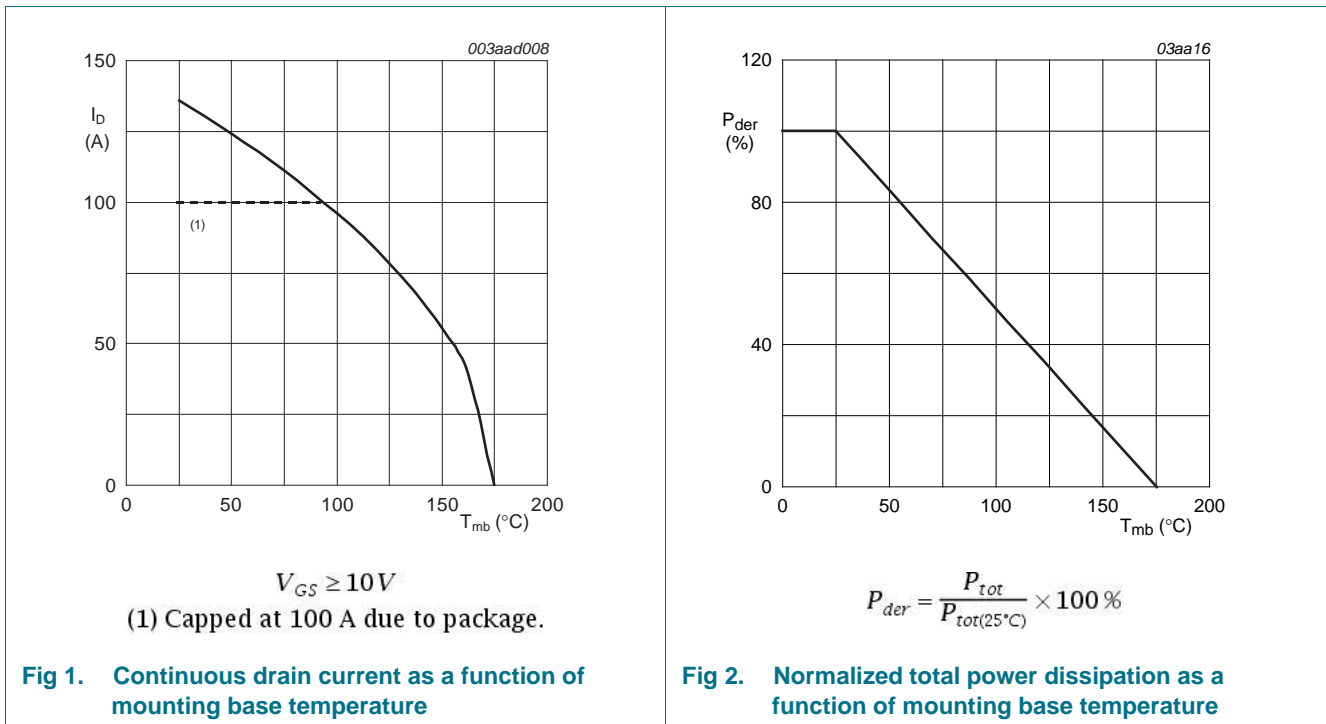
## 5. Limiting values

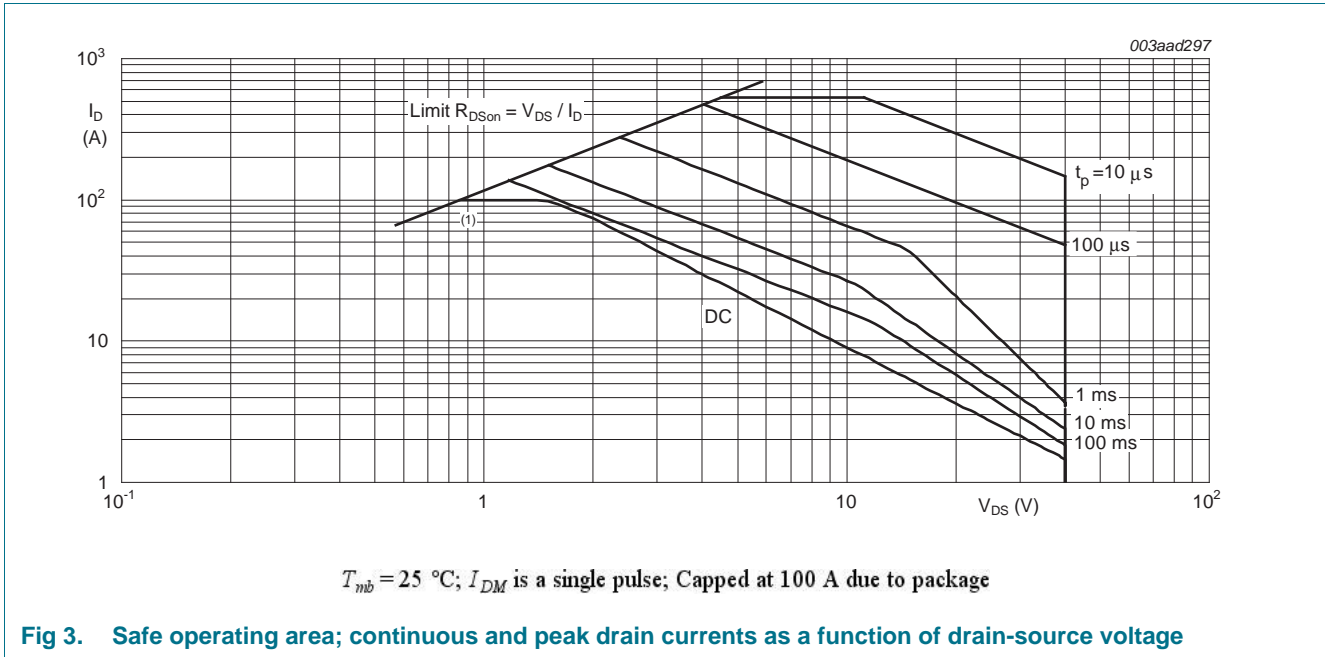
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	40	V
$V_{DGR}$	drain-gate voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}; R_{GS} = 20\text{ k}\Omega$	-	40	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ °C}$ ; see <a href="#">Figure 1</a>	[1]	96	A
		$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a>	[1]	100	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 3</a>	-	545	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	148	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
$T_{slid(M)}$	peak soldering temperature		-	260	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$	[1]	100	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$	-	545	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}; T_{j(init)} = 25\text{ °C}; I_D = 100\text{ A}; V_{sup} \leq 40\text{ V};$ unclamped; $R_{GS} = 50\text{ }\Omega$	-	152	mJ

[1] Continuous current is limited by package





## 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 <a href="#">Figure 4</a>	-	0.65	1	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Minimum footprint; mounted on a printed circuit board	-	50	-	K/W

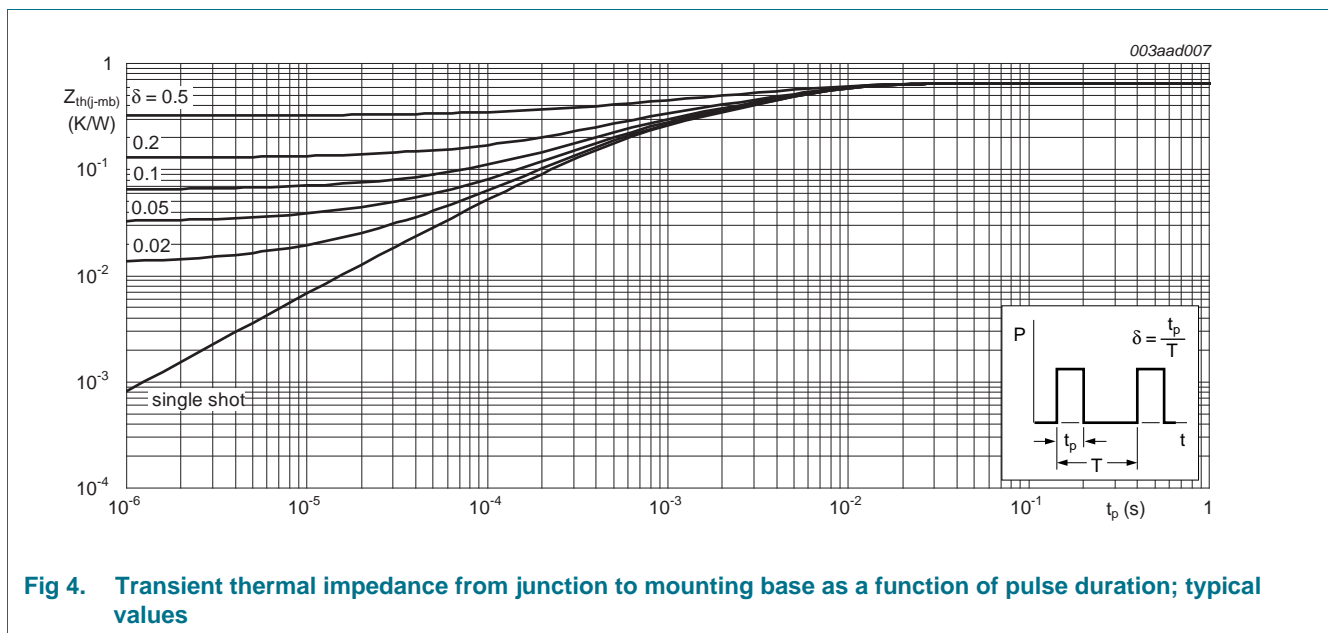


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration; typical values

## 7. Characteristics

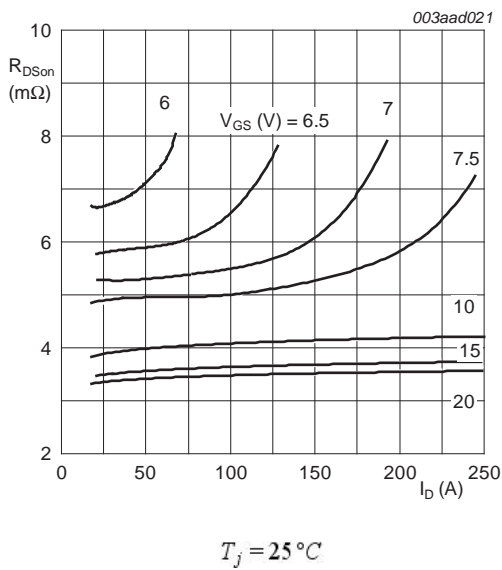
**Table 7. Characteristics**

Tested to JEDEC standards where applicable.

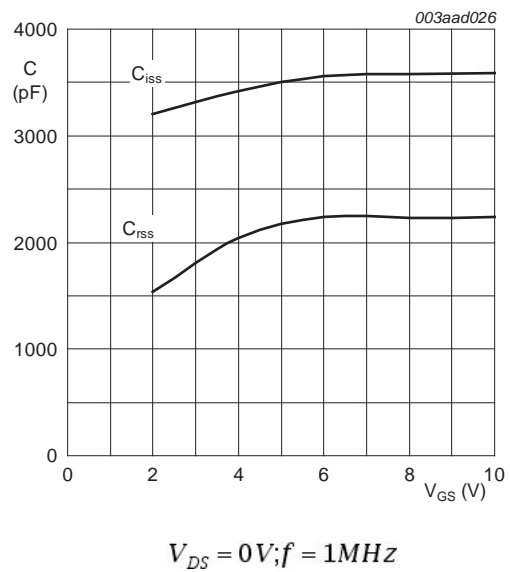
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	36	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C$ ; see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>	-	-	4.6	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C$ ; see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 11</a> ; see <a href="#">Figure 12</a>	2	3	4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.02	3	$\mu A$
		$V_{DS} = 40 V; V_{GS} = 0 V; T_j = 125 \text{ }^\circ C$	-	-	60	$\mu A$
$I_{GSS}$	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 <a href="#">Figure 13</a> ; see <a href="#">Figure 5</a>	-	7.41	8.7	$\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 100 \text{ }^\circ C$ ; see <a href="#">Figure 13</a> ; see <a href="#">Figure 5</a>	-	5.5	6.5	m $\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 5</a>	-	3.79	4.5	m $\Omega$
$R_G$	internal gate resistance (AC)	$f = 1 \text{ MHz}$	-	0.97	-	$\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V$	-	35	-	nC
		$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	42.3	-	nC
$Q_{GS}$	gate-source charge		-	13.8	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	7.9	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	5.9	-	nC
$Q_{GD}$	gate-drain charge		-	8.8	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 A; V_{DS} = 20 V$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	4.8	-	V
$C_{iss}$	input capacitance	$V_{DS} = 20 V; V_{GS} = 0 V; f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 16</a>	-	2683	-	pF
$C_{oss}$	output capacitance		-	660	-	pF
$C_{rss}$	reverse transfer capacitance		-	290	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20 V; R_L = 0.5 \text{ } \Omega; V_{GS} = 10 V; R_{G(ext)} = 4.7 \text{ } \Omega$	-	19	-	ns
$t_r$	rise time		-	23	-	ns
$t_{d(off)}$	turn-off delay time		-	30	-	ns
$t_f$	fall time		-	9	-	ns

**Table 7. Characteristics ...continued**  
 Tested to JEDEC standards where applicable.

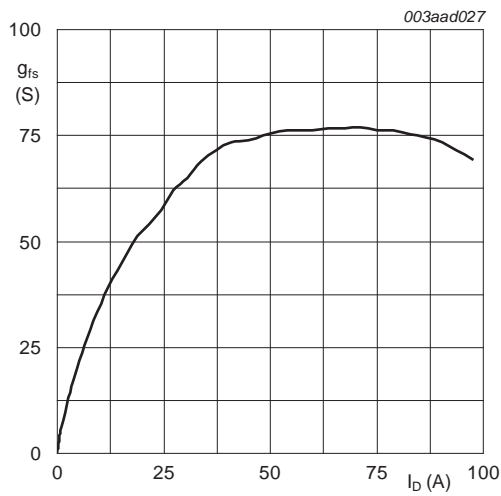
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 17</a>	-	0.75	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 20\text{ V}$	-	40	-	ns
$Q_r$	recovered charge	$I_S = 25\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 20\text{ V}$ ; $T_j = 25\text{ °C}$	-	33	-	nC



**Fig 5. Drain-source on-state resistance as a function of drain current; typical values**

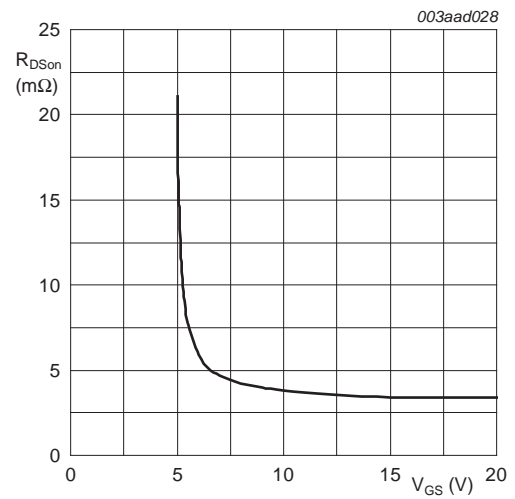


**Fig 6. Input and reverse transfer capacitances as a function of gate-source voltage; typical values**



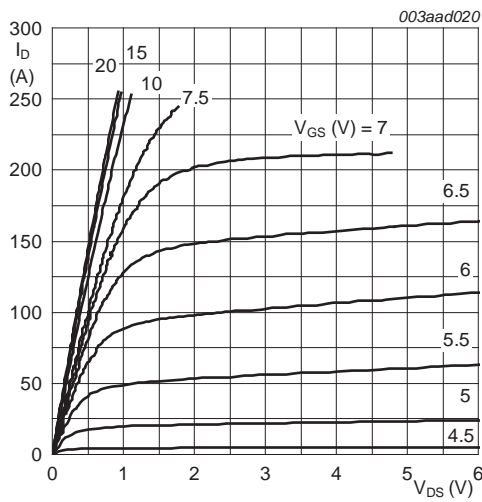
$T_j = 25^\circ\text{C}; V_{DS} = 15\text{V}$

Fig 7. Forward transconductance as a function of drain current; typical values



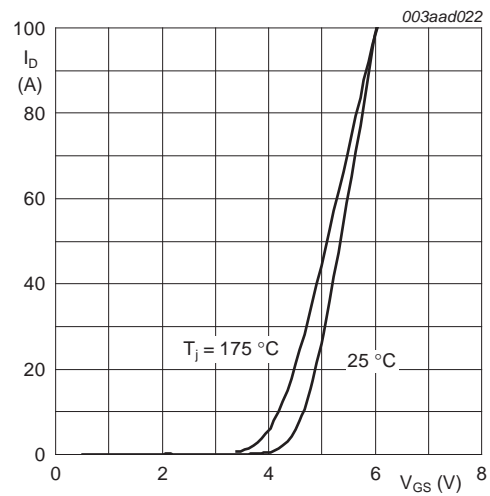
$T_j = 25^\circ\text{C}; I_D = 25\text{A}$

Fig 8. Drain-source on-state resistance as a function of gate-source voltage; typical values



$T_j = 25^\circ\text{C}$

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



$V_{DS} > I_D \times R_{DS(on)}$

Fig 10. Transfer characteristics: drain current as a function of gate-source voltage; typical values



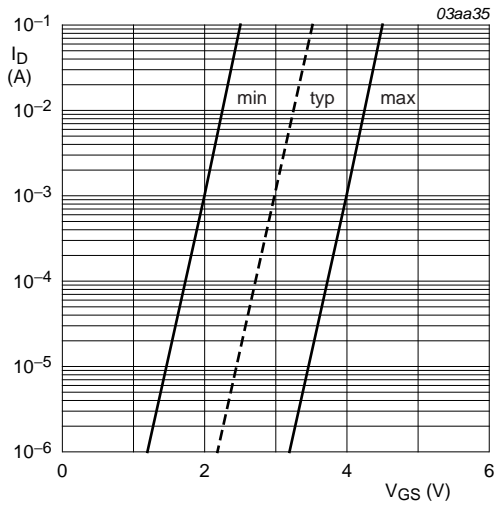


Fig 11. Sub-threshold drain current as a function of gate-source voltage

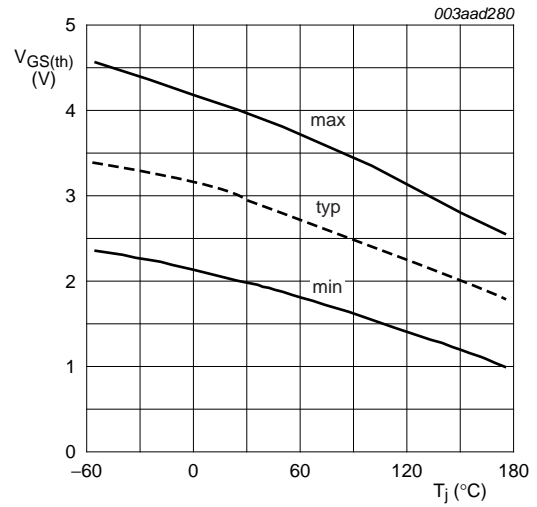


Fig 12. Gate-source threshold voltage as a function of junction temperature

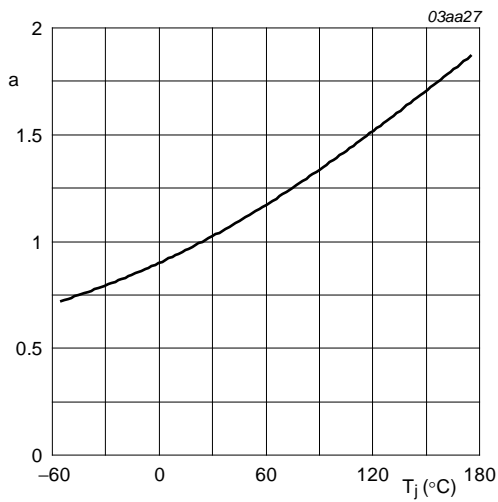


Fig 13. Normalized drain-source on-state resistance factor as a function of junction temperature

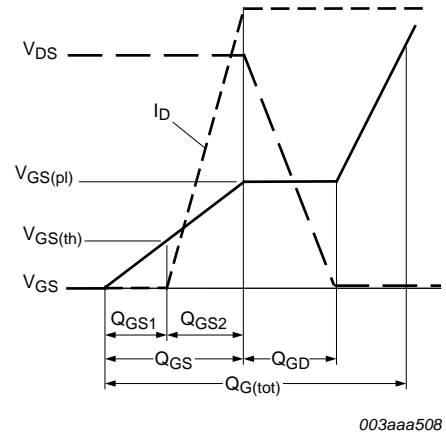
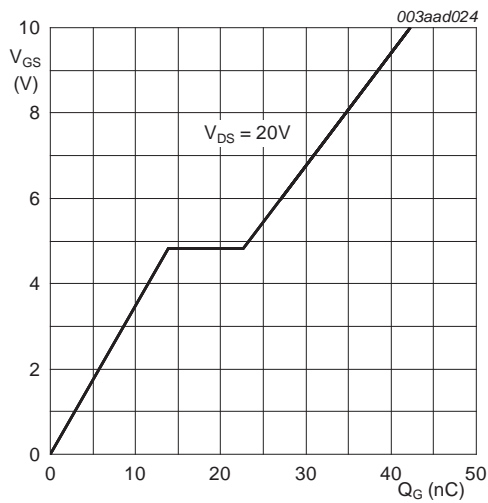
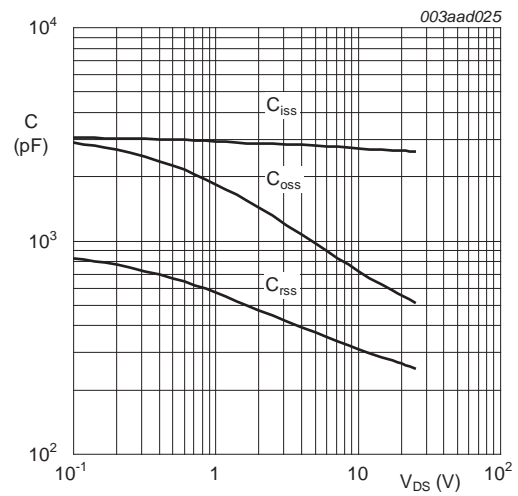


Fig 14. Gate charge waveform definitions



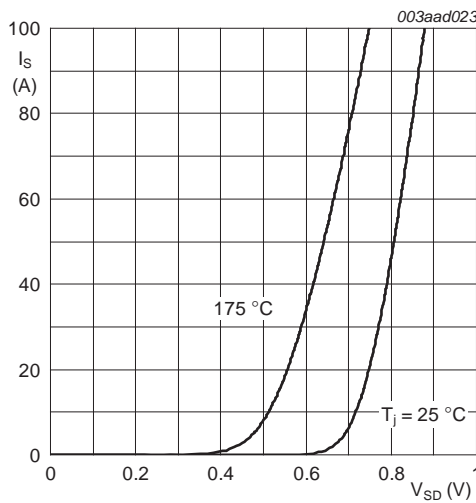
$T_j = 25^\circ C; I_D = 25A$

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



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

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



$V_{GS} = 0V$

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

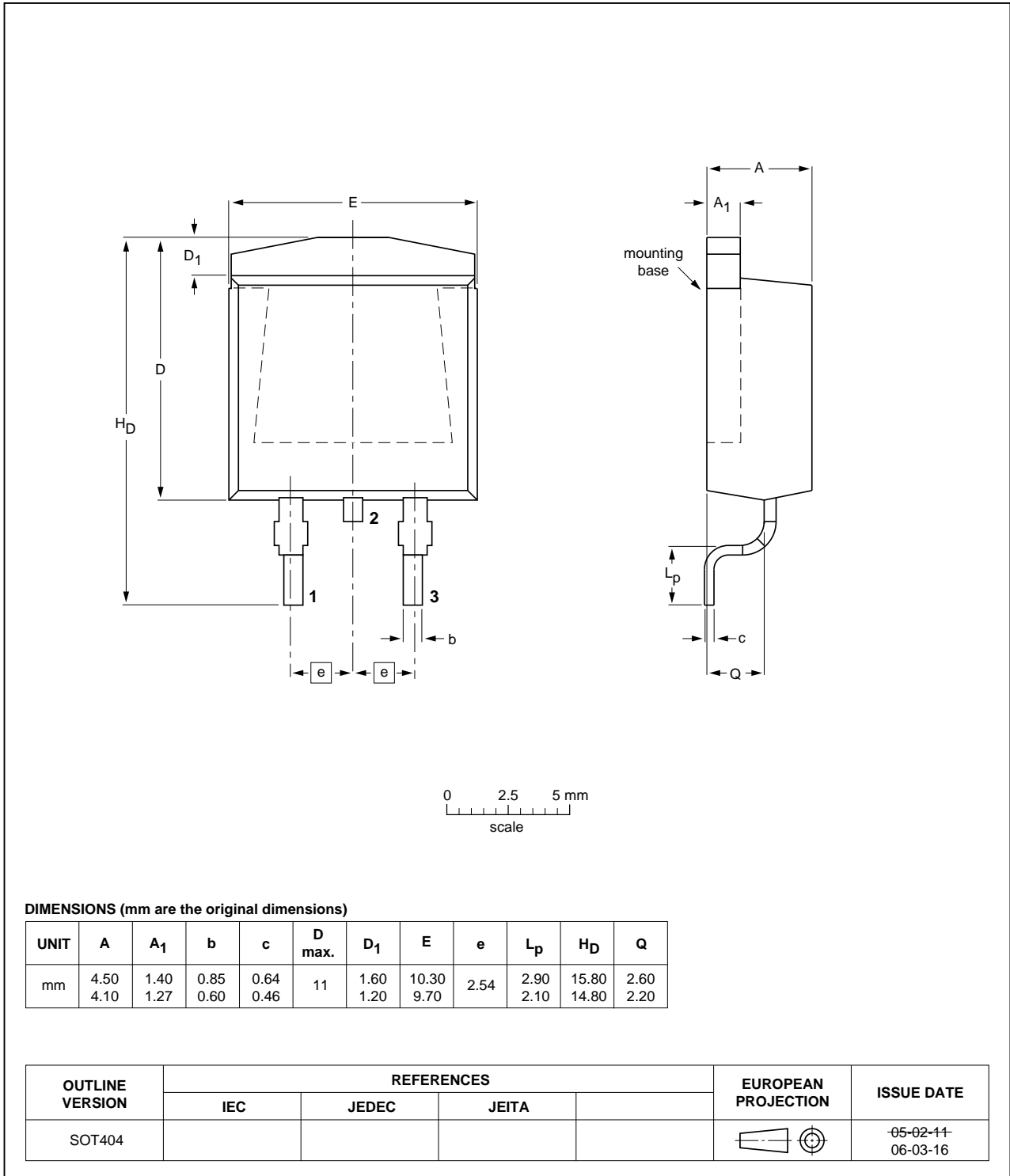


Fig 18. Package outline SOT404 (D2PAK)

## 9. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN4R5-40BS v.1	20120322	Product data sheet	-	-

## 10. Legal information

### 10.1 Data sheet status

Document status <sup>[1]</sup> [2]	Product status <sup>[3]</sup>	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.

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