



# PSMN1R1-40BS

N-channel 40 V 1.3 mΩ standard level MOSFET in D2PAK

Rev. 2 — 29 February 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Standard level N-channel MOSFET in D2PAK (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

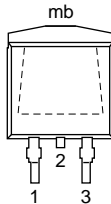
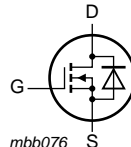
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	-	40	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ see <a href="#">Figure 1</a>	[1]	-	120	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C};$ see <a href="#">Figure 2</a>	-	-	306	W
$T_j$	junction temperature		-55	-	175	°C
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 100\text{ °C};$ see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	1.68	2	mΩ
		$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C};$ see <a href="#">Figure 13</a>	-	1.16	1.3	mΩ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 75\text{ A}; V_{DS} = 20\text{ V};$ see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	32	-	nC
$Q_{G(tot)}$	total gate charge		-	136	-	nC
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}; T_{j(init)} = 25\text{ °C}; I_D = 120\text{ A}; V_{sup} \leq 40\text{ V};$ unclamped; $R_{GS} = 50\text{ Ω}; t_p = 0.1\text{ ms}$	-	-	1.4	J

[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 <sup>[1]</sup>		
3	S	source		
mb	D	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
PSMN1R1-40BS	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

## 4. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit	
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C	-	40	V	
V <sub>DGR</sub>	drain-gate voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C; R <sub>GS</sub> = 20 kΩ	-	40	V	
V <sub>GS</sub>	gate-source voltage		-20	20	V	
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 100 °C	[1]	-	120	A
		V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; see <a href="#">Figure 1</a>	[1]	-	120	A
I <sub>DM</sub>	peak drain current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C; see <a href="#">Figure 3</a>	-	1320	A	
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; see <a href="#">Figure 2</a>	-	306	W	
T <sub>stg</sub>	storage temperature		-55	175	°C	
T <sub>j</sub>	junction temperature		-55	175	°C	
T <sub>sld(M)</sub>	peak soldering temperature		-	260	°C	

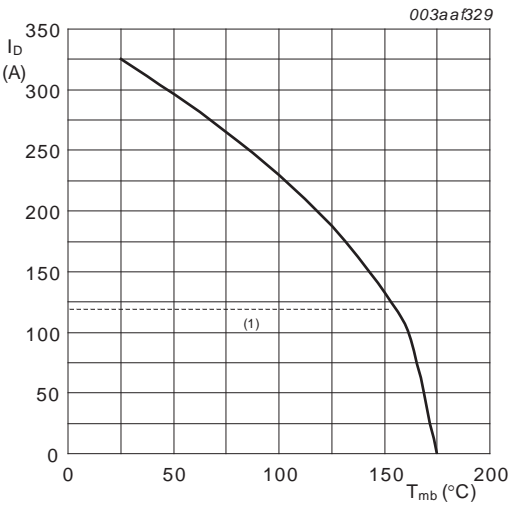
### Source-drain diode

$I_S$	source current	$T_{mb} = 25\text{ °C}$	[1]	-	120	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$	-	-	1320	A

### Avalanche ruggedness

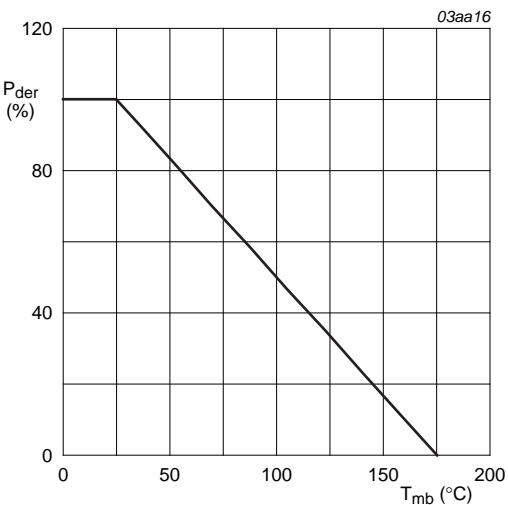
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; $I_D = 120\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; unclamped; $R_{GS} = 50\text{ }\Omega$ ; $t_p = 0.1\text{ ms}$	-	-	1.4	J
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[1] Continuous current is limited by package.



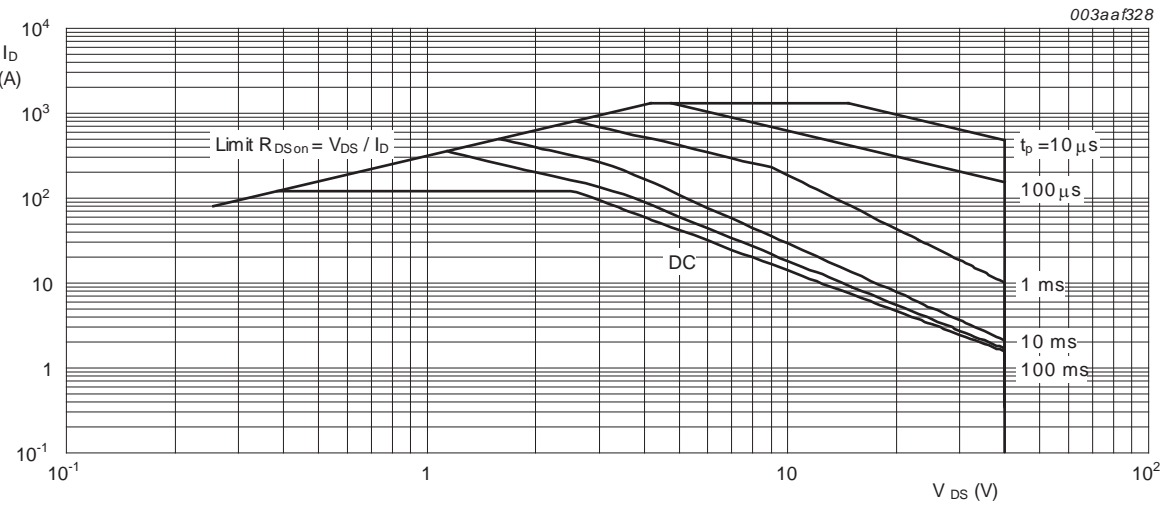
$V_{GS} \geq 10$  V; (1) Capped at 120 A due to package

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



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

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



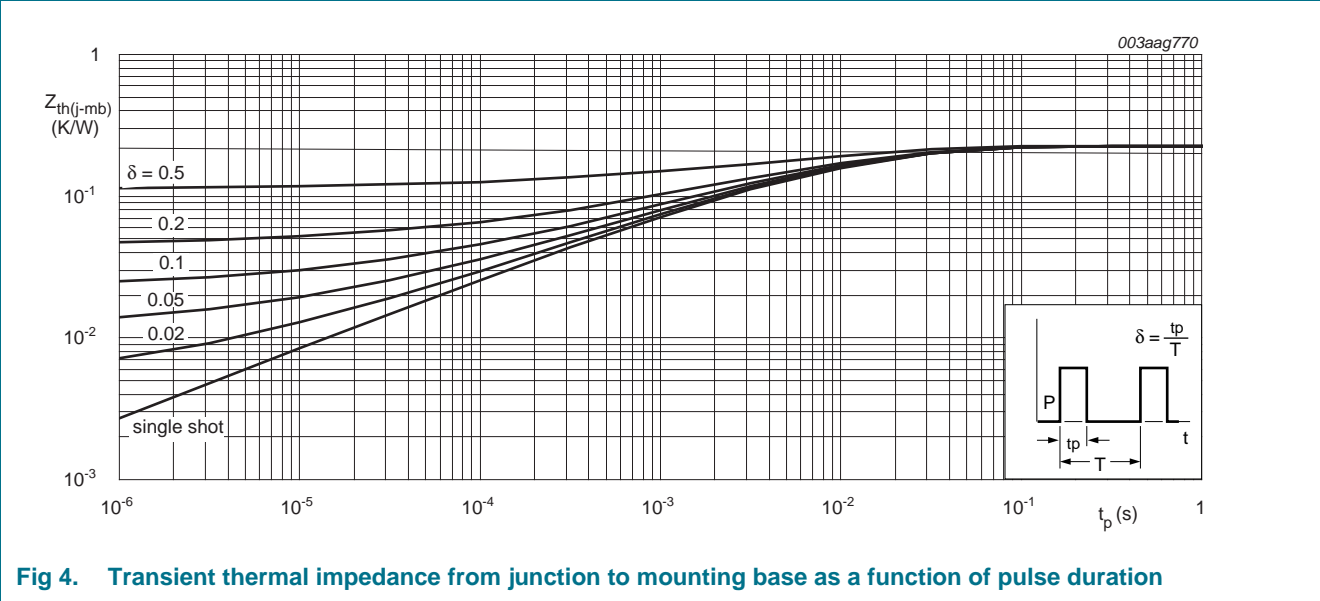
$T_{mb} = 25$  °C;  $I_{DM}$  is a single pulse; Capped at 120 A due to package

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 <a href="#">Figure 4</a>	-	0.22	0.49	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint; mounted on a printed-circuit board	-	50	-	K/W



## 6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = -55\ ^\circ C$	36	-	-	V
		$I_D = 250\ \mu A$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = -55\ ^\circ C$ ; see <a href="#">Figure 10</a>	-	-	4.6	V
		$I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 175\ ^\circ C$ ; see <a href="#">Figure 10</a>	1	-	-	V
		$I_D = 1\ mA$ ; $V_{DS} = V_{GS}$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 11</a> ; see <a href="#">Figure 10</a>	2	3	4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 40\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 25\ ^\circ C$	-	0.02	10	$\mu A$
		$V_{DS} = 40\ V$ ; $V_{GS} = 0\ V$ ; $T_j = 175\ ^\circ C$	-	-	500	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$	-	10	100	nA
		$V_{GS} = -20\ V$ ; $V_{DS} = 0\ V$ ; $T_j = 25\ ^\circ C$	-	10	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 100\ ^\circ C$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	1.68	2	mΩ
		$V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 175\ ^\circ C$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	2.3	2.8	mΩ
		$V_{GS} = 10\ V$ ; $I_D = 25\ A$ ; $T_j = 25\ ^\circ C$ ; see <a href="#">Figure 13</a>	-	1.16	1.3	mΩ
$R_G$	internal gate resistance (AC)	$f = 1\ MHz$	-	1.1	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 0\ A$ ; $V_{DS} = 0\ V$ ; $V_{GS} = 10\ V$	-	133	-	nC
		$I_D = 75\ A$ ; $V_{DS} = 20\ V$ ; $V_{GS} = 10\ V$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	136	-	nC
$Q_{GS}$	gate-source charge		-	52	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	30	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	22	-	nC
$Q_{GD}$	gate-drain charge		-	32	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 75\ A$ ; $V_{DS} = 20\ V$ ; see <a href="#">Figure 14</a> ; see <a href="#">Figure 15</a>	-	6.1	-	V
$C_{iss}$	input capacitance	$V_{DS} = 20\ V$ ; $V_{GS} = 0\ V$ ; $f = 1\ MHz$ ;	-	9710	-	pF
$C_{oss}$	output capacitance	$T_j = 25\ ^\circ C$ ; see <a href="#">Figure 16</a>	-	2042	-	pF
$C_{rss}$	reverse transfer capacitance		-	994	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\ V$ ; $R_L = 0.8\ \Omega$ ; $V_{GS} = 5\ V$ ;	-	45	-	ns
$t_r$	rise time	$R_{G(ext)} = 4.7\ \Omega$	-	66	-	ns
$t_{d(off)}$	turn-off delay time		-	111	-	ns
$t_f$	fall time		-	53	-	ns

Table 6. 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	-	0.8	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}$ ; $dI_S/dt = -100\text{ A/}\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ;	-	64	-	ns
$Q_r$	recovered charge	$V_{DS} = 20\text{ V}$	-	117	-	nC

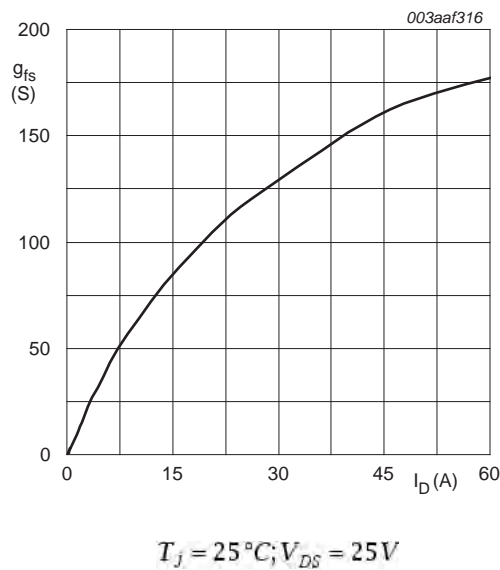


Fig 5. Forward transconductance as a function of drain current; typical values

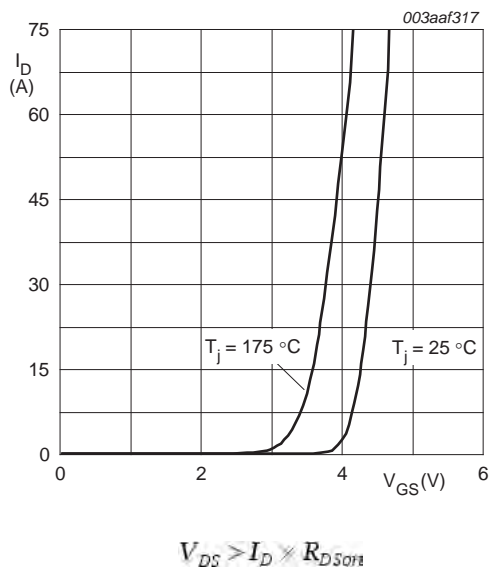


Fig 6. Transfer characteristics: drain current as a function of gate-source voltage; typical values

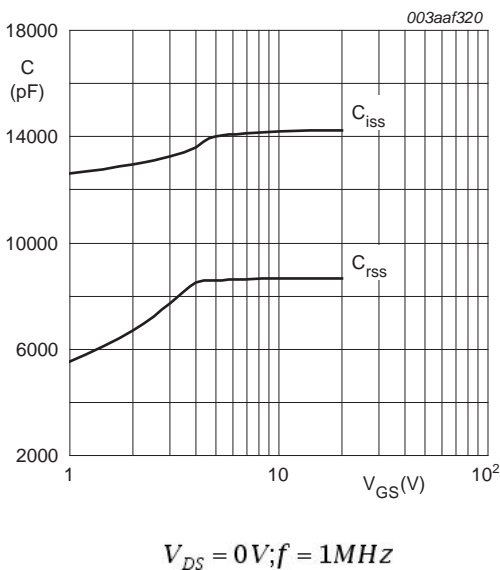


Fig 7. Input and reverse transfer capacitances as a function of gate-source voltage; typical values

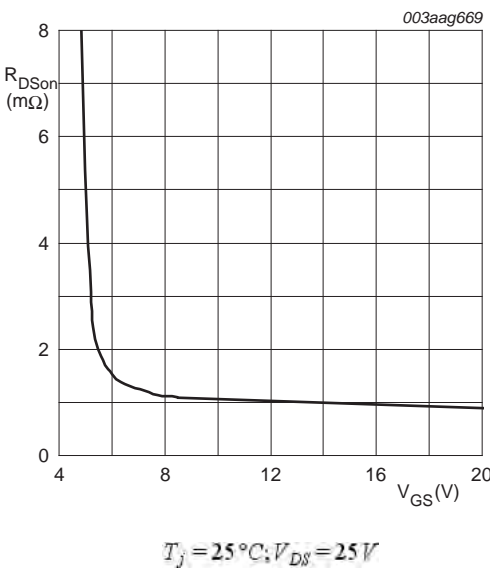


Fig 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

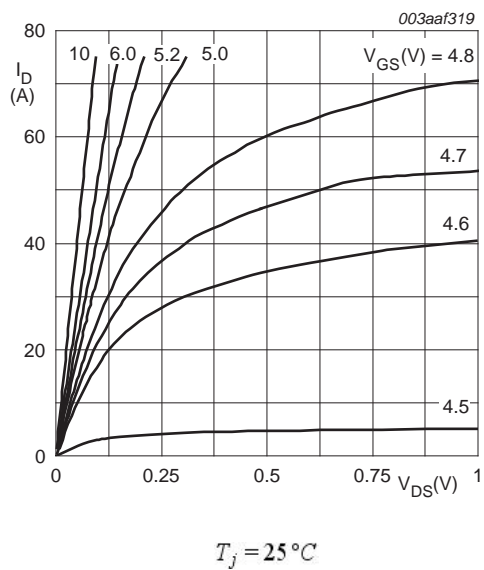


Fig 9. Output characteristics: drain current as a function of drain-source voltage; typical values

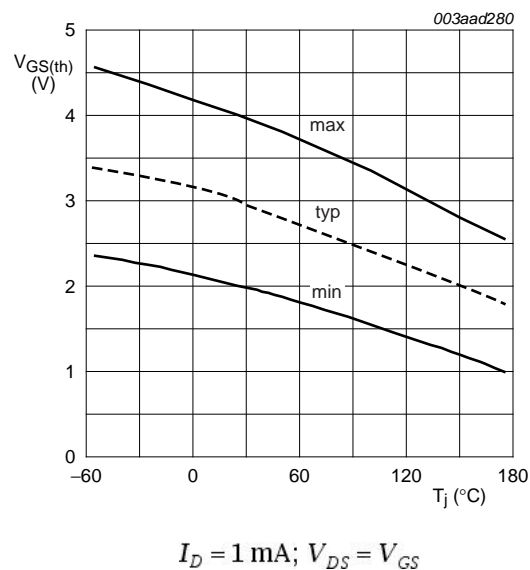


Fig 10. Gate-source threshold voltage as a function of junction temperature

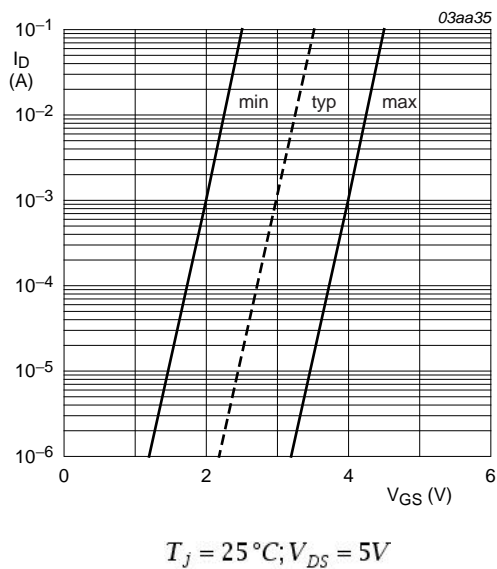


Fig 11. Sub-threshold drain current as a function of gate-source voltage

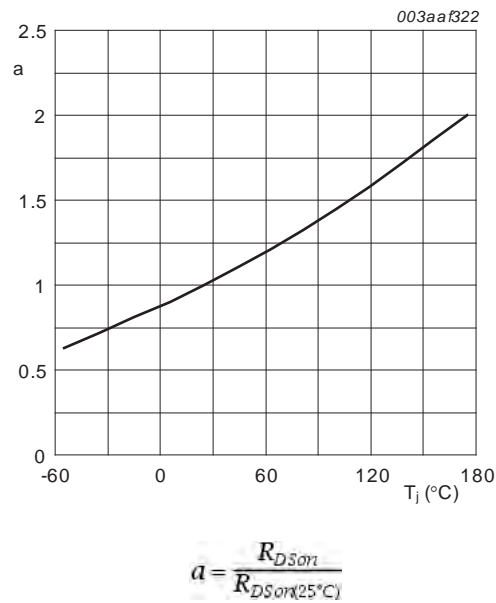


Fig 12. Normalized drain-source on state resistance factor as a function of junction temperature

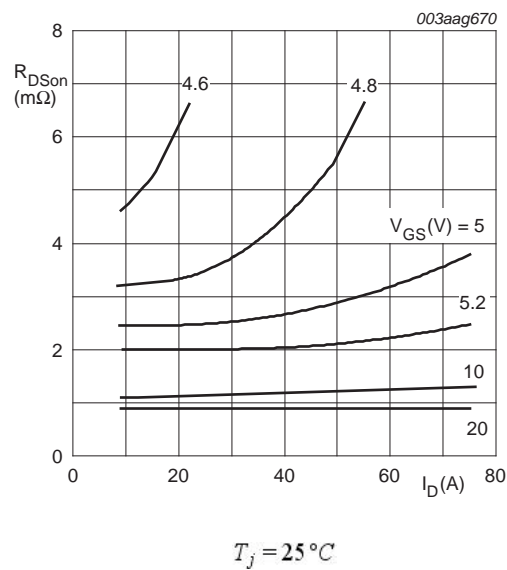


Fig 13. Drain-source on-state resistance as a function of drain current; typical values

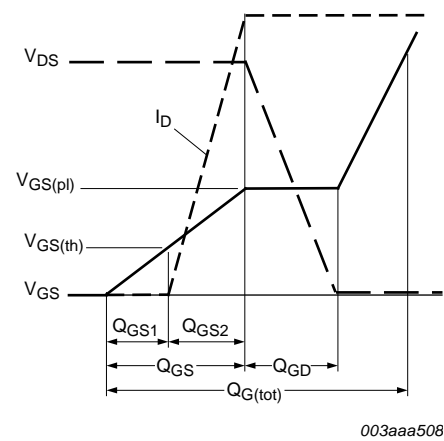


Fig 14. Gate charge waveform definitions

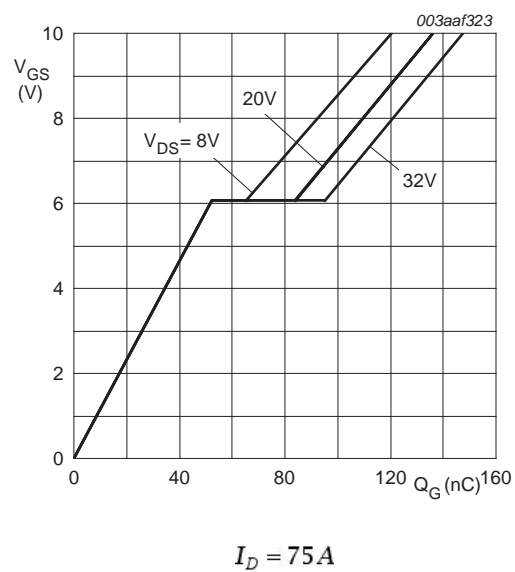


Fig 15. Gate-source voltage as a function of gate charge; typical values

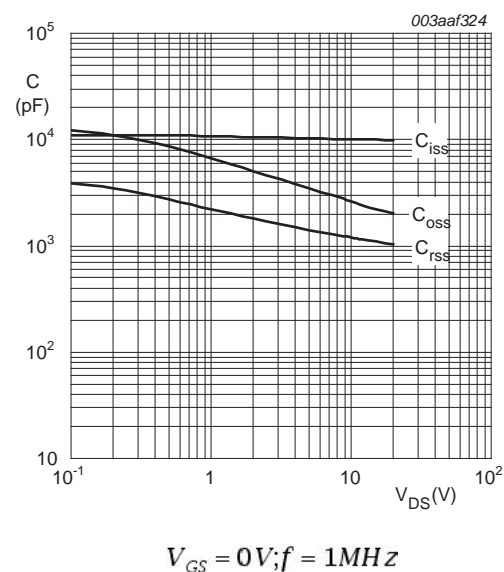


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



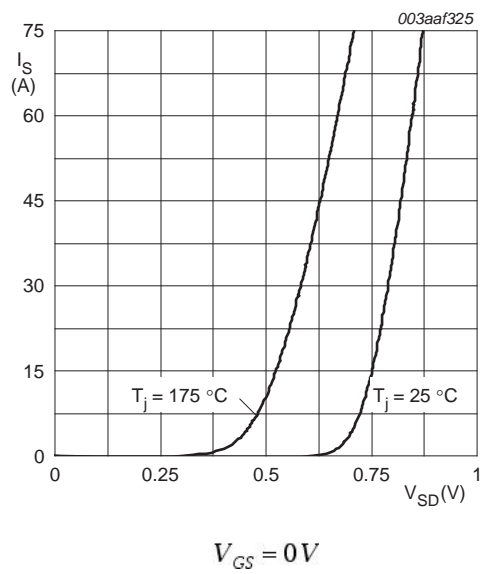


Fig 17. Source current as a function of source-drain voltage; typical values

7. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) SOT404

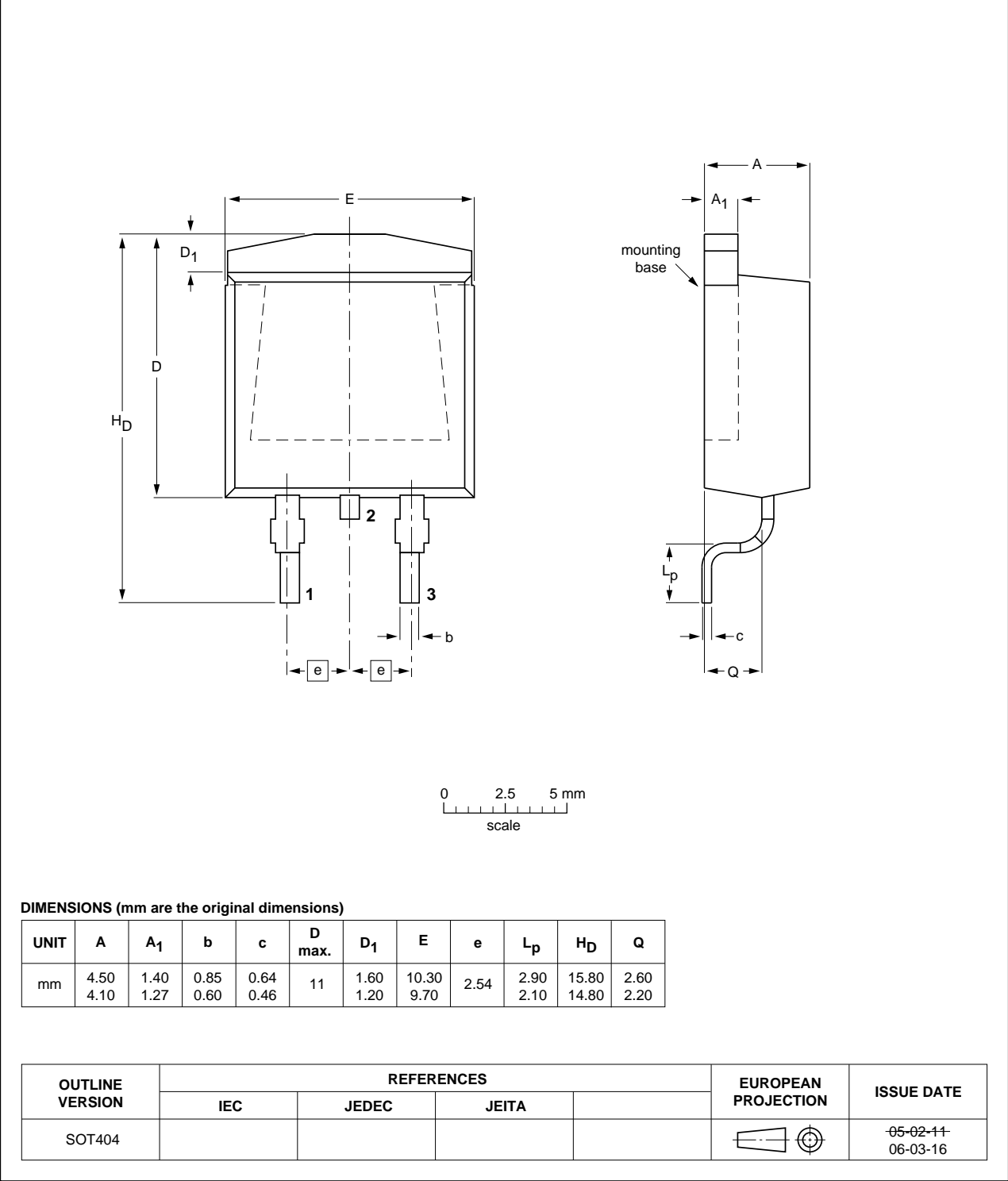


Fig 18. Package outline SOT404 (D2PAK)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN1R1-40BS v.2	20120229	Product data sheet	-	PSMN1R1-40BS v.1
Modifications:	<ul style="list-style-type: none"><li>• Status changed from objective to product.</li><li>• Various changes to content.</li></ul>			
PSMN1R1-40BS v.1	20110929	Objective data sheet	-	-

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### 9.1 Data sheet status

Document status <sup>[1][2]</sup>	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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[2] The term 'short data sheet' is explained in section "Definitions".

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