

PSMN1R5-40ES

N-channel 40 V 1.6 mΩ standard level MOSFET in I2PAK.

Rev. 01 — 19 April 2011

Product data sheet

1. Product profile

1.1 General description

Standard level N-channel MOSFET in I2PAK (SOT226) 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 Figure 1	[1]	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; see Figure 2	-	-	338	W
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; see Figure 13	[2]	-	1.3	1.6 mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}$; $I_D = 75\text{ A}$;	-	32	-	nC
$Q_{G(tot)}$	total gate charge	$V_{DS} = 20\text{ V}$; see Figure 14 ; see Figure 15	-	136	-	nC

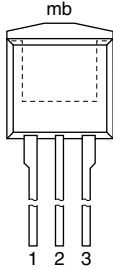
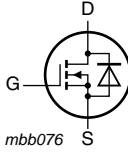
[1] Continuous current is limited by package

[2] Measured 3 mm from 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	drain		

SOT226 (I2PAK)

3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PSMN1R5-40ES	I2PAK	plastic single-ended package (I2PAK); TO-262	SOT226

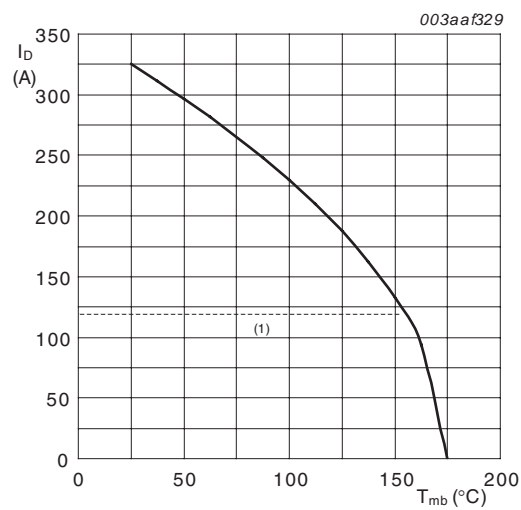
4. Limiting values

Table 4. Limiting values

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

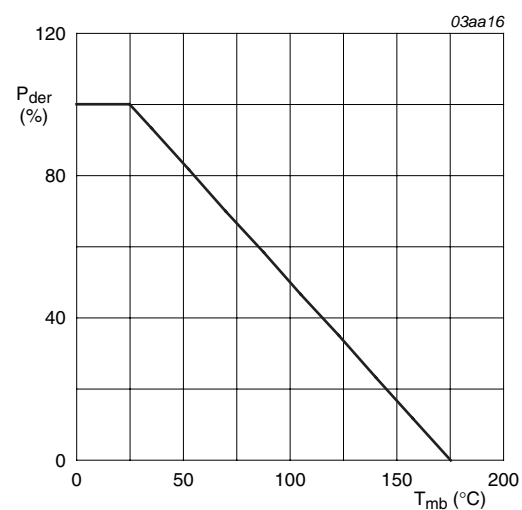
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	40	V
V_{DGR}	drain-gate voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$	-	40	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$	[1]	120	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; see Figure 1	[1]	120	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; see Figure 3	-	1301	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; see Figure 2	-	338	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]	120	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$	-	1301	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

[1] Continuous current is limited by package.



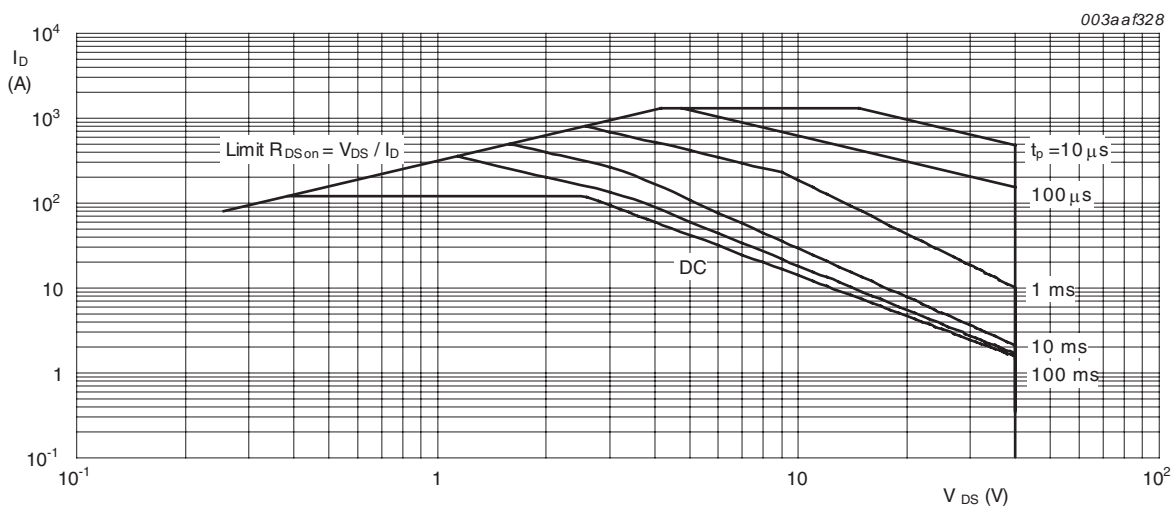
$V_{GS} \geq 10$ V(1) Capped at 120 A due to package

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



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

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 Figure 4	-	0.22	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Vertical in free air	-	60	-	K/W

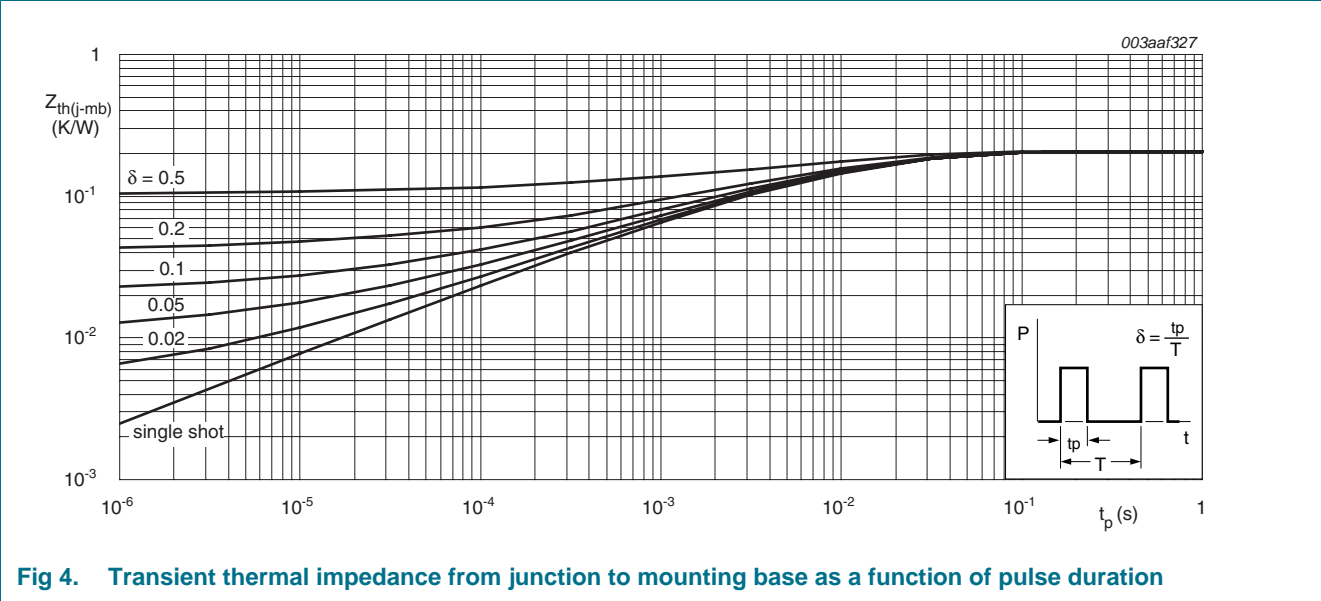


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

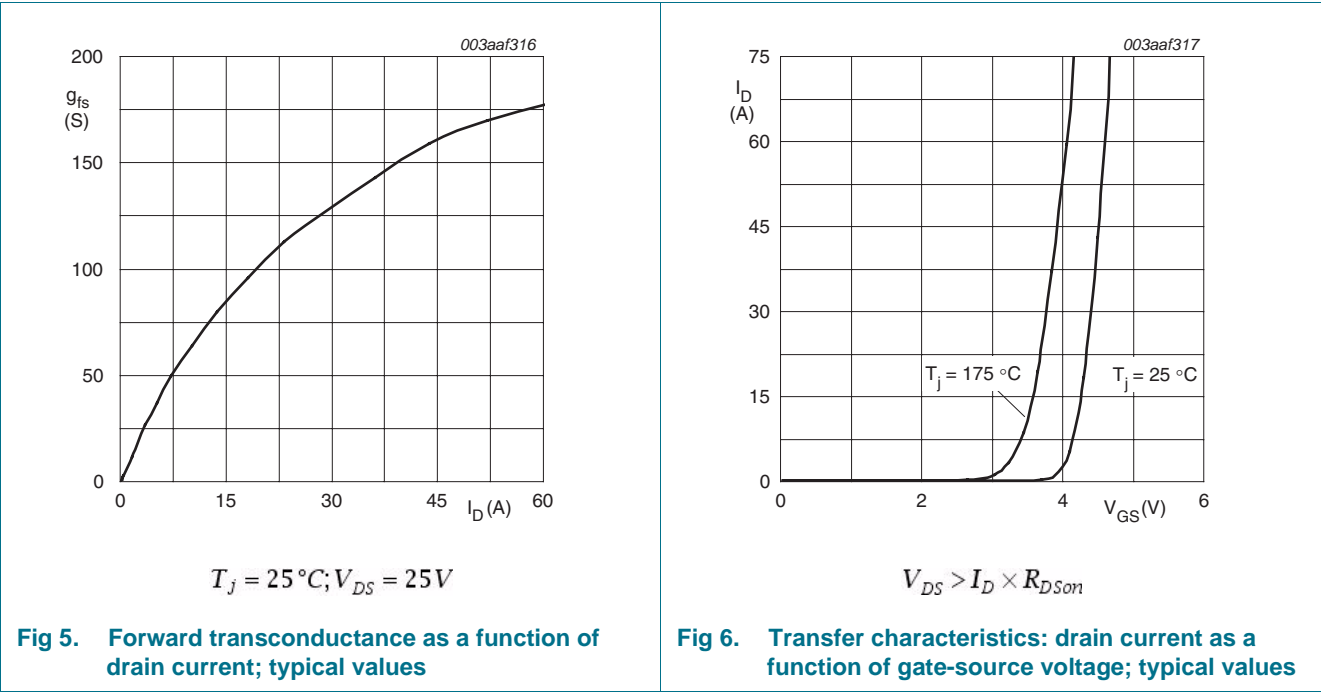
Table 6. Characteristics

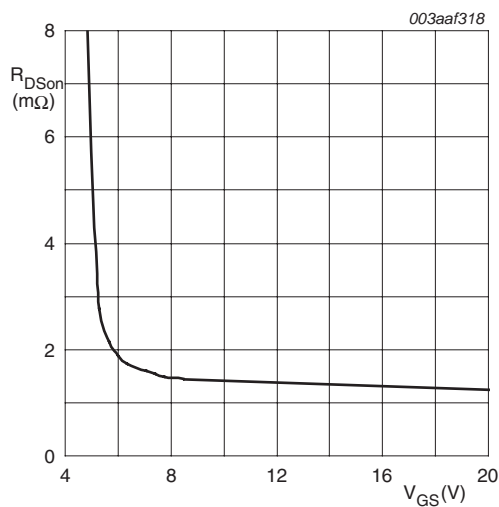
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\ \mu A$; $V_{GS} = 0\ V$; $T_j = -55\ ^\circ C$	36	-	-	V
		$I_D = 250\ \mu A$; $V_{GS} = 0\ V$; $T_j = 25\ ^\circ C$	40	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = -55\ ^\circ C$; see Figure 10	-	-	4.6	V
		$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = 175\ ^\circ C$; see Figure 10	1	-	-	V
		$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_j = 25\ ^\circ C$; see Figure 11 ; see Figure 10	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	μA
		$V_{DS} = 40\ V$; $V_{GS} = 0\ V$; $T_j = 175\ ^\circ C$	-	250	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 20\ V$; $V_{DS} = 0\ V$; $T_j = 25\ ^\circ C$	-	2	100	nA
		$V_{GS} = -20\ V$; $V_{DS} = 0\ V$; $T_j = 25\ ^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_j = 100\ ^\circ C$; see Figure 12	-	1.9	2.3	mΩ
		$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_j = 175\ ^\circ C$; see Figure 12	-	2.6	3.2	mΩ
		$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_j = 25\ ^\circ C$; see Figure 13	[1] -	1.3	1.6	mΩ
R_G	internal gate resistance (AC)	$f = 1\ MHz$	-	1.1	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 0\ A$; $V_{DS} = 0\ V$; $V_{GS} = 10\ V$; see Figure 14 ; see Figure 15	-	133	-	nC
		$I_D = 75\ A$; $V_{DS} = 20\ V$; $V_{GS} = 10\ V$; see Figure 14 ; see Figure 15	-	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	$V_{DS} = 20\ V$; see Figure 14 ; see Figure 15	-	6.1	-	V
C_{iss}	input capacitance	$V_{DS} = 20\ V$; $V_{GS} = 0\ V$; $f = 1\ MHz$; $T_j = 25\ ^\circ C$; see Figure 16	-	9710	-	pF
C_{oss}	output capacitance		-	2042	-	pF
C_{rss}	reverse transfer capacitance		-	994	-	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\ V$; $R_L = 0.8\ \Omega$; $V_{GS} = 10\ V$; $R_{G(ext)} = 4.7\ \Omega$	-	45	-	ns
t_r	rise time		-	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	$I_S = 25\text{ A}$; $di_S/dt = -100\text{ A/}\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$	-	64	-	ns
Q_r	recovered charge	$I_S = 25\text{ A}$; $di_S/dt = -100\text{ A/}\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $T_j = 25\text{ °C}$	-	117	-	nC

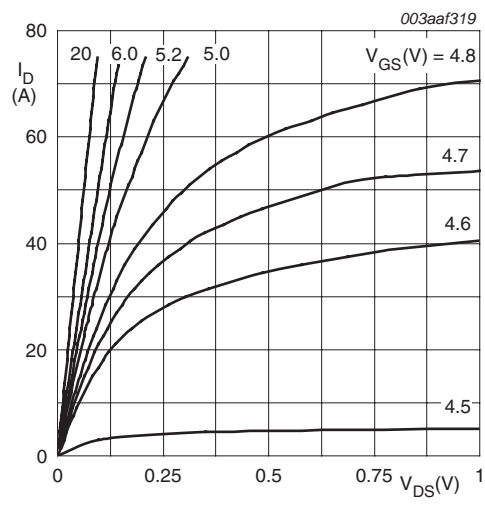
[1] Measured 3 mm from package.





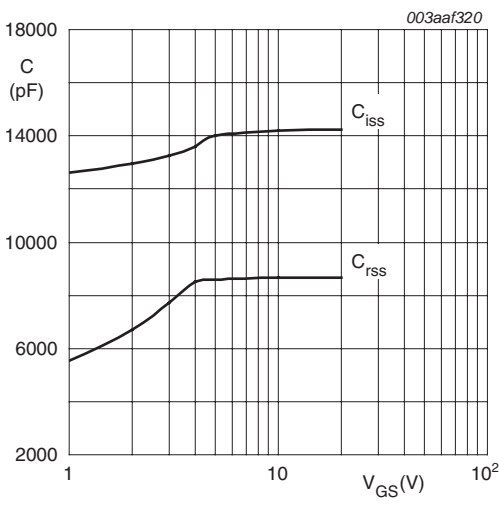
$T_j = 25^\circ\text{C}; V_{DS} = 25\text{ V}$

Fig 7. Drain-source on-state resistance as a function of gate-source voltage; typical values.



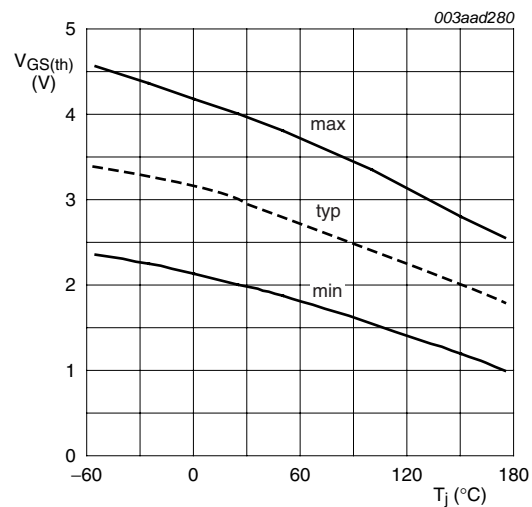
$T_j = 25^\circ\text{C}$

Fig 8. Output characteristics: drain current as a function of drain-source voltage; typical values



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

Fig 9. Input and reverse transfer capacitances as a function of gate-source voltage; typical values



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

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

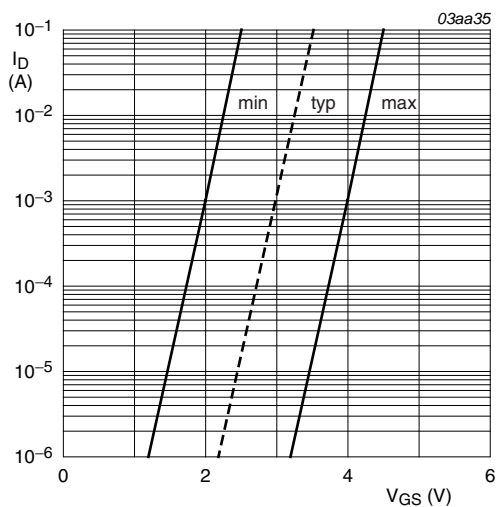
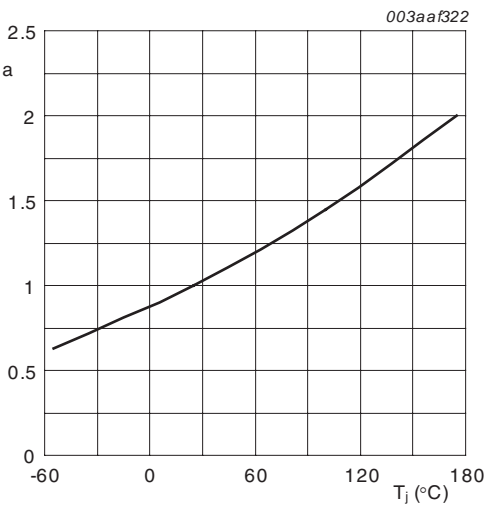


Fig 11. Sub-threshold drain current as a function of gate-source voltage



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

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

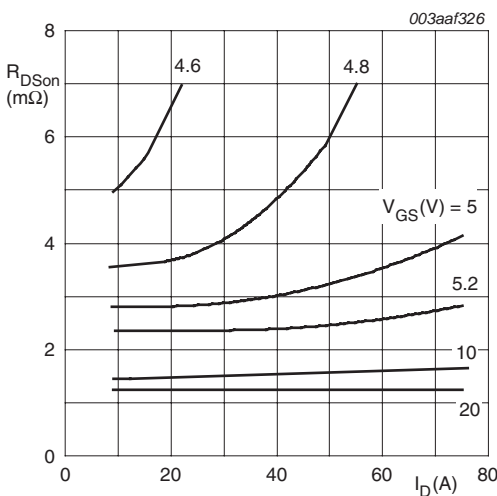


Fig 13. Drain-source on-state resistance as a function of drain current; typical values

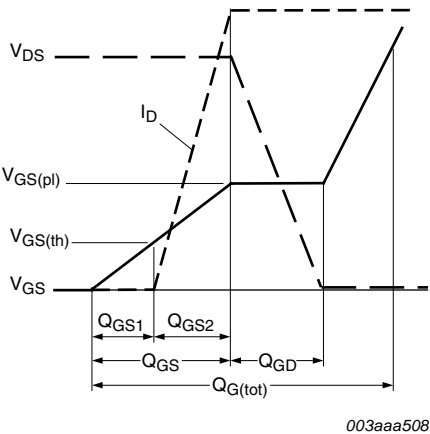


Fig 14. Gate charge waveform definitions

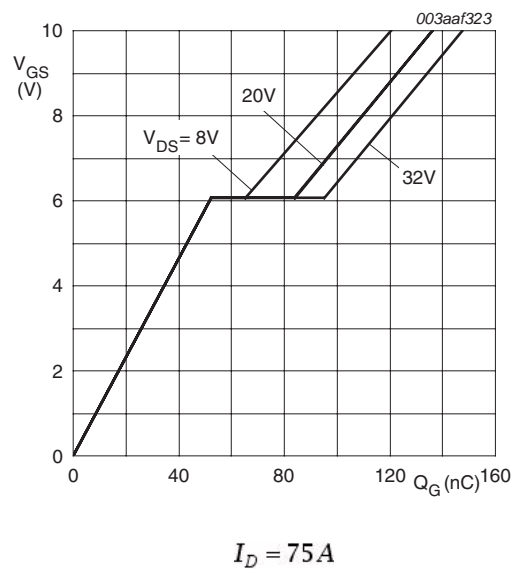


Fig 15. Gate-source voltage as a function of gate charge; typical values

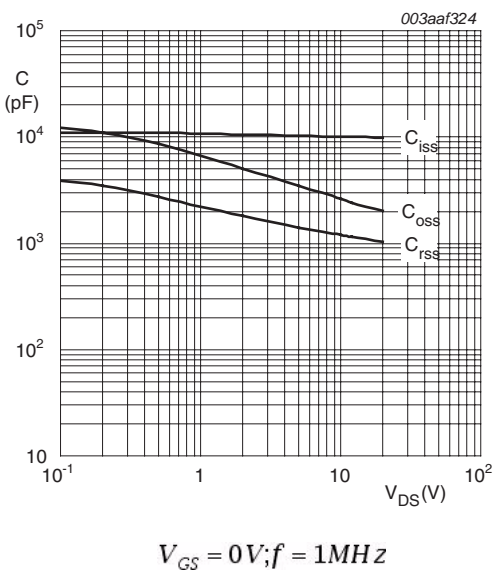


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

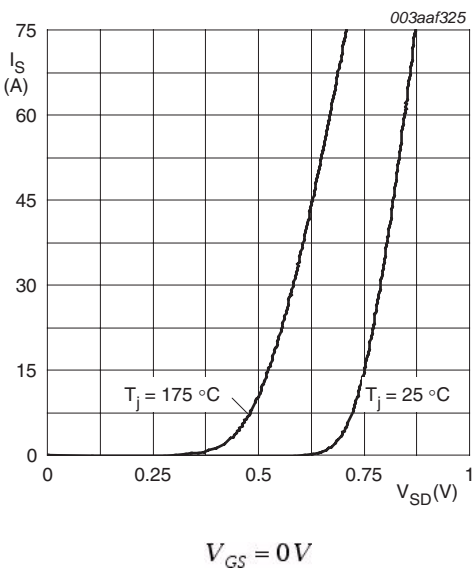


Fig 17. Source current as a function of source-drain voltage; typical values

7. Package outline

Plastic single-ended package (I2PAK); low-profile 3-lead TO-262

SOT226

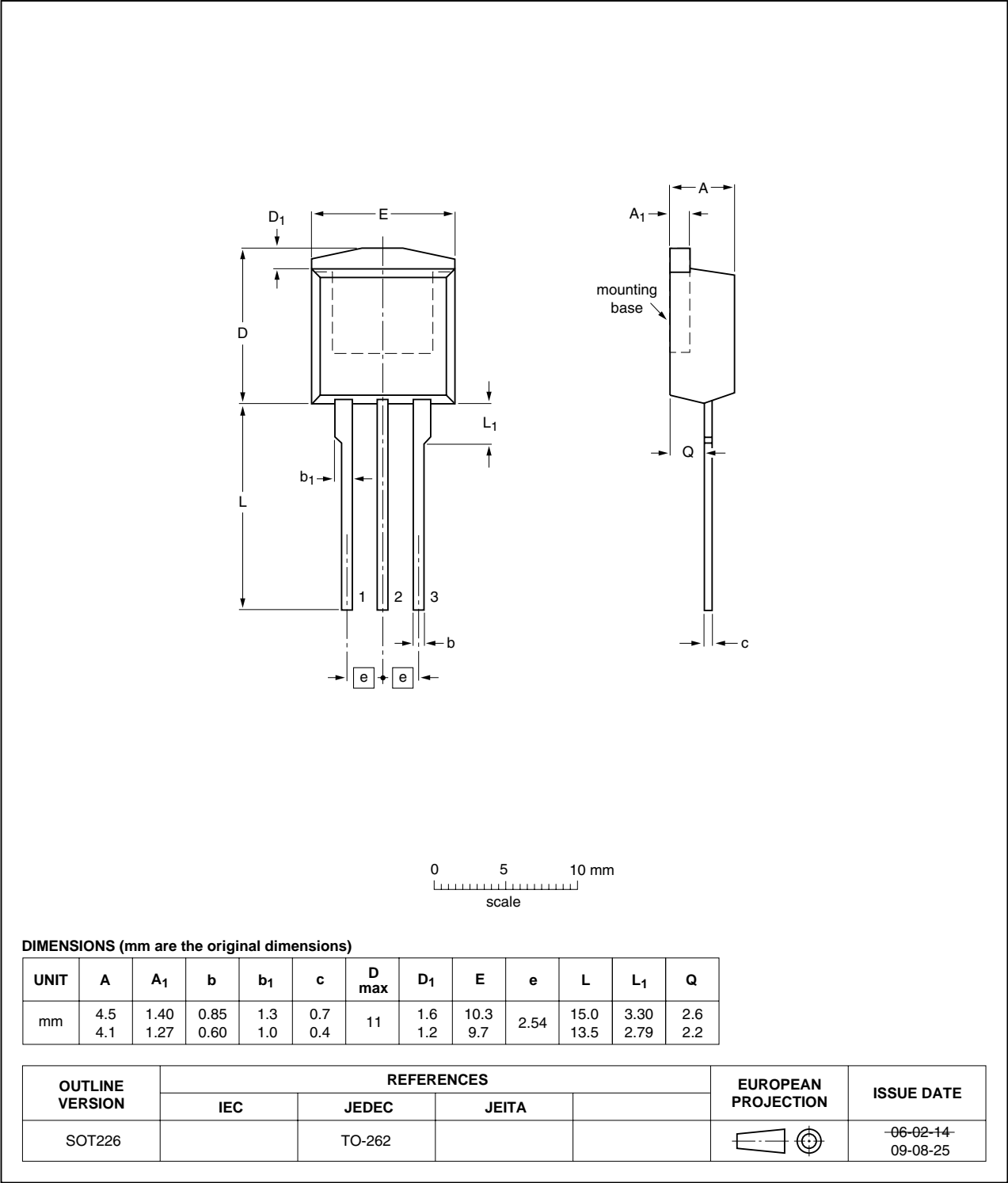


Fig 18. Package outline SOT226 (I2PAK)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN1R5-40ES v.1	20110419	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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