



# PSMN3R9-25MLC

N-channel 25 V 4.15 mΩ logic level MOSFET in LPAK33 using NextPower Technology

Rev. 4 — 15 June 2012

Product data sheet

## 1. Product profile

### 1.1 General description

Logic level enhancement mode N-channel MOSFET in LPAK33 package. This product is designed and qualified for use in a wide range of industrial, communications and domestic equipment.

### 1.2 Features and benefits

- Low parasitic inductance and resistance
- Optimised for 4.5V Gate drive utilising NextPower Superjunction technology
- Ultra low QG, QGD, & QOSS for high system efficiencies at low and high loads

### 1.3 Applications

- DC-to-DC converters
- Load switching
- Synchronous buck regulator

### 1.4 Quick reference data

Table 1. Quick reference data

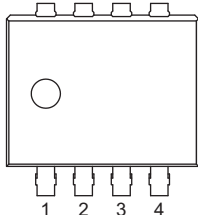
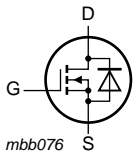
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25^\circ\text{C}$	-	-	25	V
$I_D$	drain current	$T_{mb} = 25^\circ\text{C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a>	[1]	-	70	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	-	69	W
$T_j$	junction temperature		-55	-	175	$^\circ\text{C}$
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 10</a>	-	4.85	5.55	mΩ
		$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 10</a>	-	3.65	4.15	mΩ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 4.5\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 12.5\text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	2.3	-	nC
$Q_{G(tot)}$	total gate charge	$V_{GS} = 4.5\text{ V}$ ; $I_D = 25\text{ A}$ ; $V_{DS} = 12.5\text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	9.7	-	nC

[1] Continuous current is limited by package.



## 2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source		
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain		

**SOT1210 (LFAK33)**

## 3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
PSMN3R9-25MLC	LFAK33	Plastic single ended surface mounted package (LFAK33); 4 leads	SOT1210

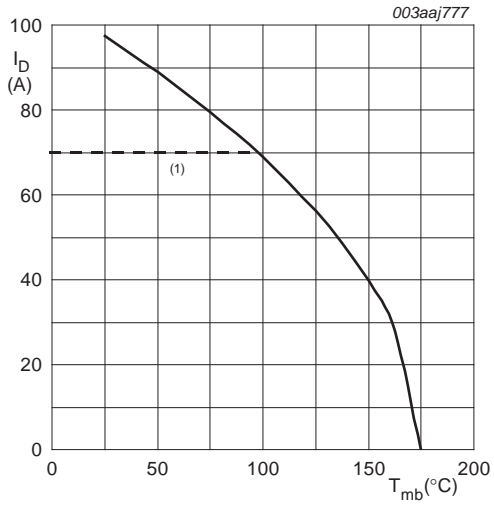
## 4. Limiting values

Table 4. Limiting values

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

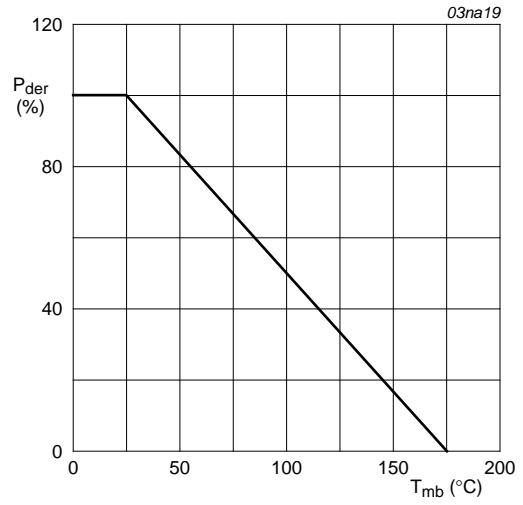
Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j = 25\text{ }^\circ\text{C}$	-	25	V
$V_{GS}$	gate-source voltage		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ }^\circ\text{C}$ ; see <a href="#">Figure 1</a>	[1]	70	A
		$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ }^\circ\text{C}$ ; see <a href="#">Figure 1</a>	-	69	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^\circ\text{C}$ ; see <a href="#">Figure 4</a>	-	390	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ }^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	69	W
$T_{stg}$	storage temperature		-55	175	$^\circ\text{C}$
$T_j$	junction temperature		-55	175	$^\circ\text{C}$
$T_{sld(M)}$	peak soldering temperature		-	260	$^\circ\text{C}$
$V_{ESD}$	electrostatic discharge voltage	MM (JEDEC JESD22-A115)	230	-	V
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ }^\circ\text{C}$	-	63	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^\circ\text{C}$	-	390	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$V_{GS} = 10\text{ V}; T_{j(\text{init})} = 25\text{ }^\circ\text{C}; I_D = 70\text{ A}; V_{sup} \leq 25\text{ V}; R_{GS} = 50\text{ }\Omega$ ; unclamped; see <a href="#">Figure 3</a>	-	34.5	mJ

[1] Continuous current is limited by package.



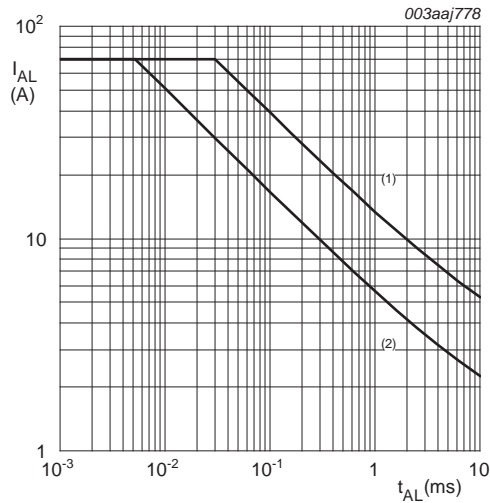
$V_{GS} \geq 10V$   
 (1) Capped at 70 A due to package.

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



(1)  $T_{j(jmb)} = 25^{\circ}C$ ; (2)  $T_{j(jmb)} = 100^{\circ}C$

Fig 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

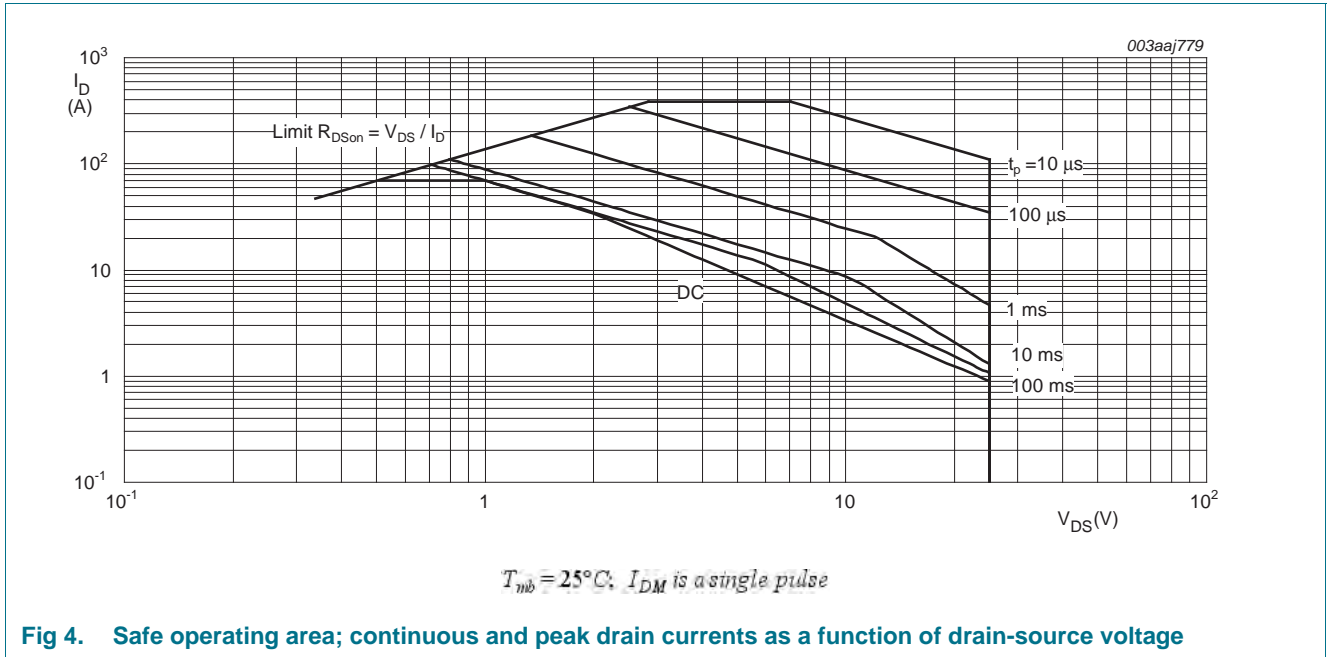


Fig 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

### 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 5</a>	-	1.95	2.18	K/W

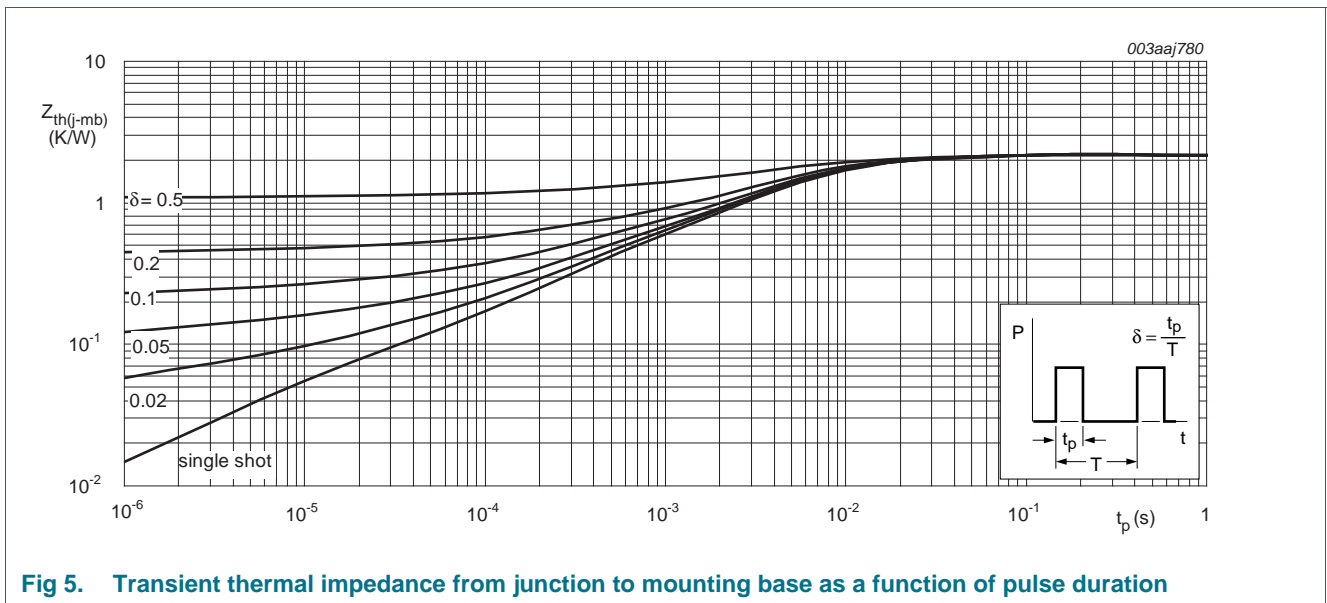


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 6. Characteristics

**Table 6. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	25	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	22.5	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	1.45	1.81	2.15	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature		-	-4.1	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ C$	-	-	100	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	100	nA
		$V_{GS} = -16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 10</a>	-	4.85	5.55	mΩ
		$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ C$ ; see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	-	-	8.9	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 10</a>	-	3.65	4.15	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ C$ ; see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	-	-	6.65	mΩ
$R_G$	gate resistance	$f = 1 \text{ MHz}$	0.9	1.8	3.6	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 12.5 \text{ V}; V_{GS} = 10 \text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	21.5	-	nC
		$I_D = 25 \text{ A}; V_{DS} = 12.5 \text{ V}; V_{GS} = 4.5 \text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	9.7	-	nC
		$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	20.9	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 \text{ A}; V_{DS} = 12.5 \text{ V}; V_{GS} = 4.5 \text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	3.9	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	2.4	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	1.5	-	nC
$Q_{GD}$	gate-drain charge		-	2.3	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 \text{ A}; V_{DS} = 12.5 \text{ V}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	2.9	-	V
$C_{iss}$	input capacitance	$V_{DS} = 12.5 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$ ; $T_j = 25 \text{ }^\circ C$ ; see <a href="#">Figure 14</a>	-	1524	-	pF
$C_{oss}$	output capacitance		-	376	-	pF
$C_{rss}$	reverse transfer capacitance		-	128	-	pF

Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{d(on)}$	turn-on delay time	$V_{DS} = 12.5\text{ V}; R_L = 0.5\ \Omega; V_{GS} = 4.5\text{ V};$	-	13	-	ns
$t_r$	rise time	$R_{G(ext)} = 5\ \Omega$	-	23.2	-	ns
$t_{d(off)}$	turn-off delay time		-	15.6	-	ns
$t_f$	fall time		-	9.8	-	ns
$Q_{oss}$	output charge	$V_{GS} = 0\text{ V}; V_{DS} = 12.5\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C}$	-	9.9	-	nC
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ see <a href="#">Figure 15</a>	-	0.82	1.1	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$	-	17.6	-	ns
$Q_r$	recovered charge	$V_{DS} = 12.5\text{ V}$	-	9.2	-	nC
$t_a$	reverse recovery rise time	$V_{GS} = 0\text{ V}; I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s};$ $V_{DS} = 12.5\text{ V};$ see <a href="#">Figure 16</a>	-	9.8	-	ns
$t_b$	reverse recovery fall time		-	7.8	-	ns

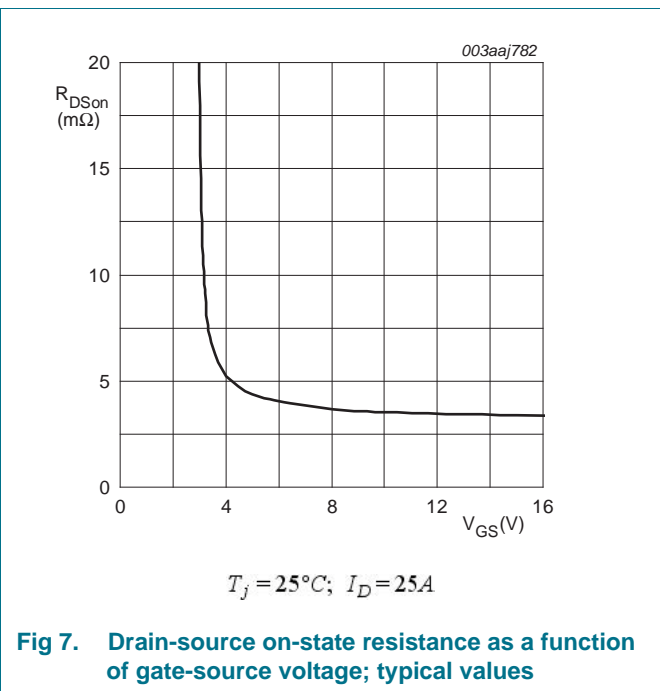
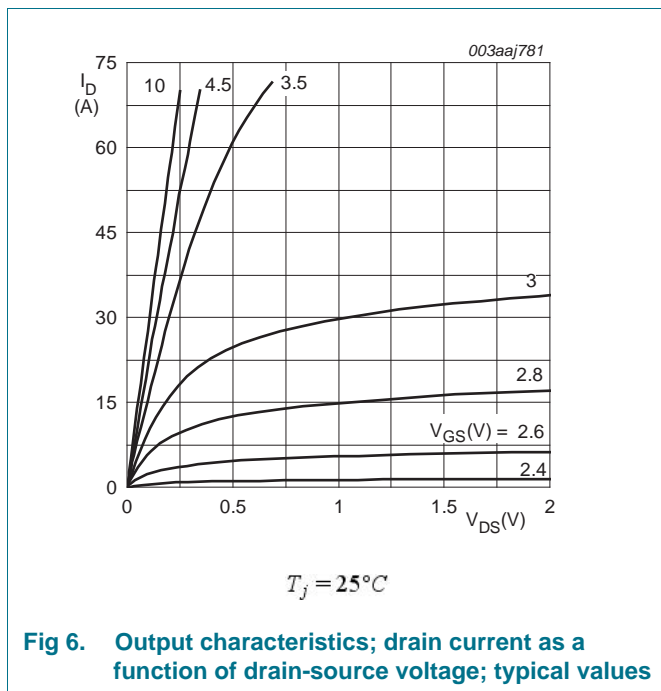


Fig 6. Output characteristics; drain current as a function of drain-source voltage; typical values

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

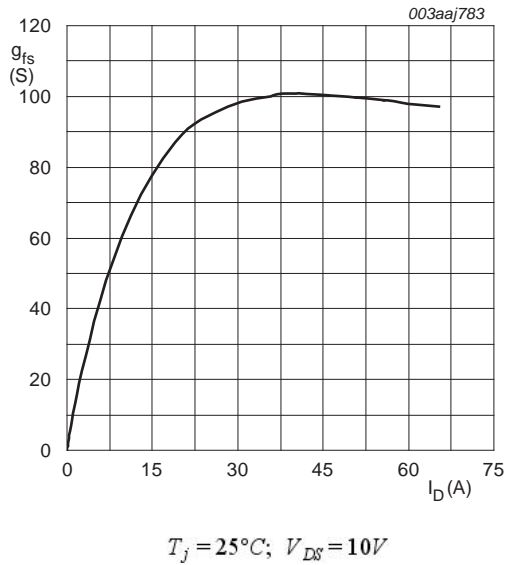


Fig 8. Forward transconductance as a function of drain current; typical values

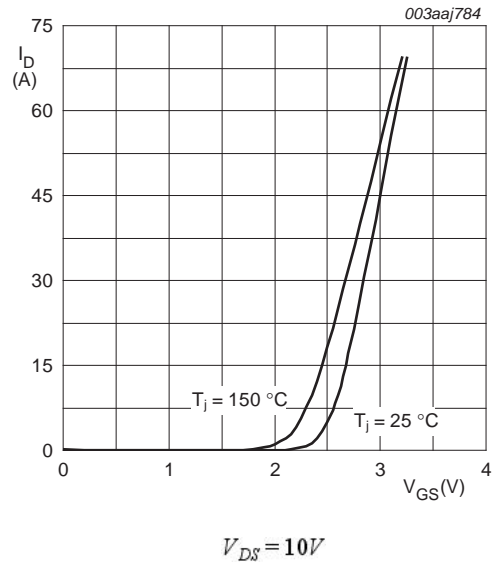


Fig 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

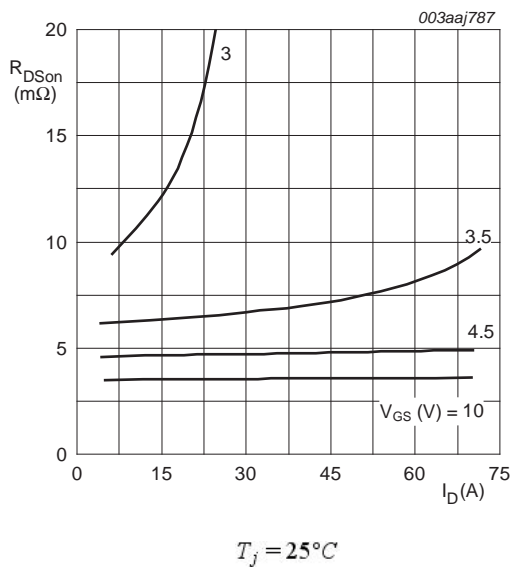


Fig 10. Drain-source on-state resistance as a function of drain current; typical values

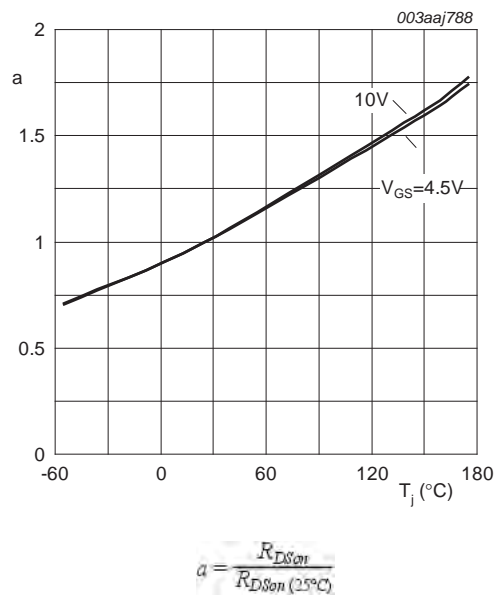


Fig 11. Normalized drain-source on-state resistance factor as a function of junction temperature

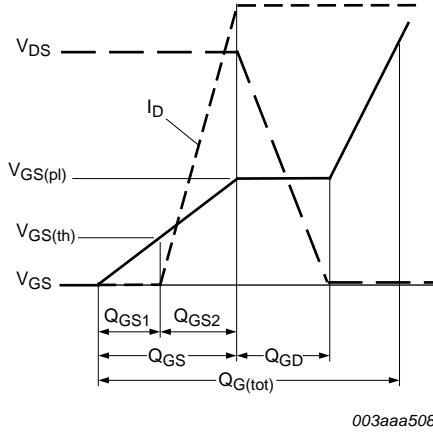
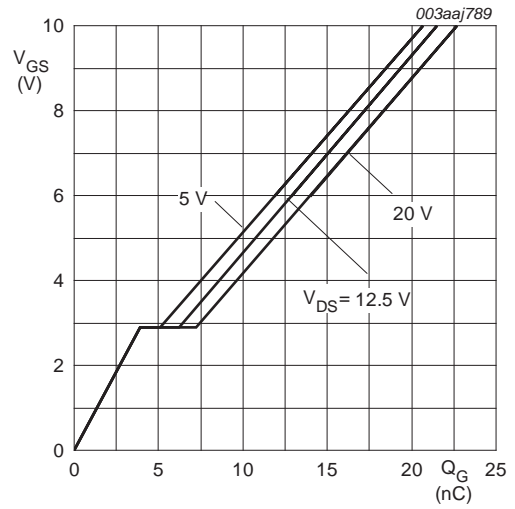
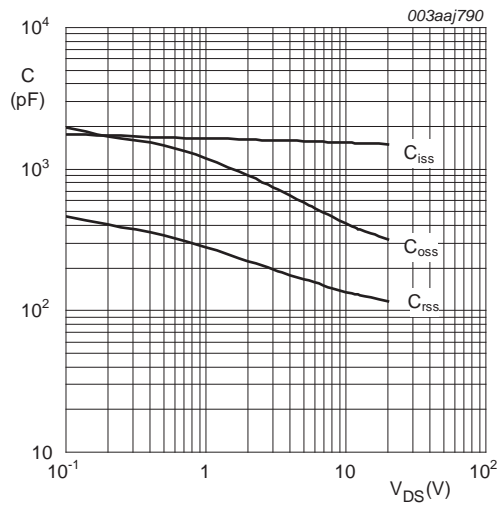


Fig 12. Gate charge waveform definitions



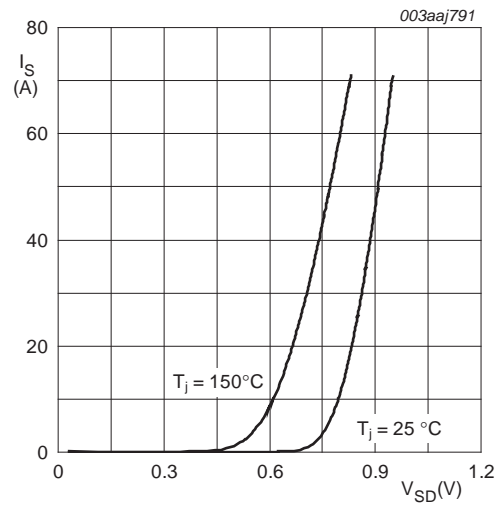
$T_j = 25^\circ C; I_D = 25 A$

Fig 13. Gate-source voltage as a function of gate charge; typical values



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

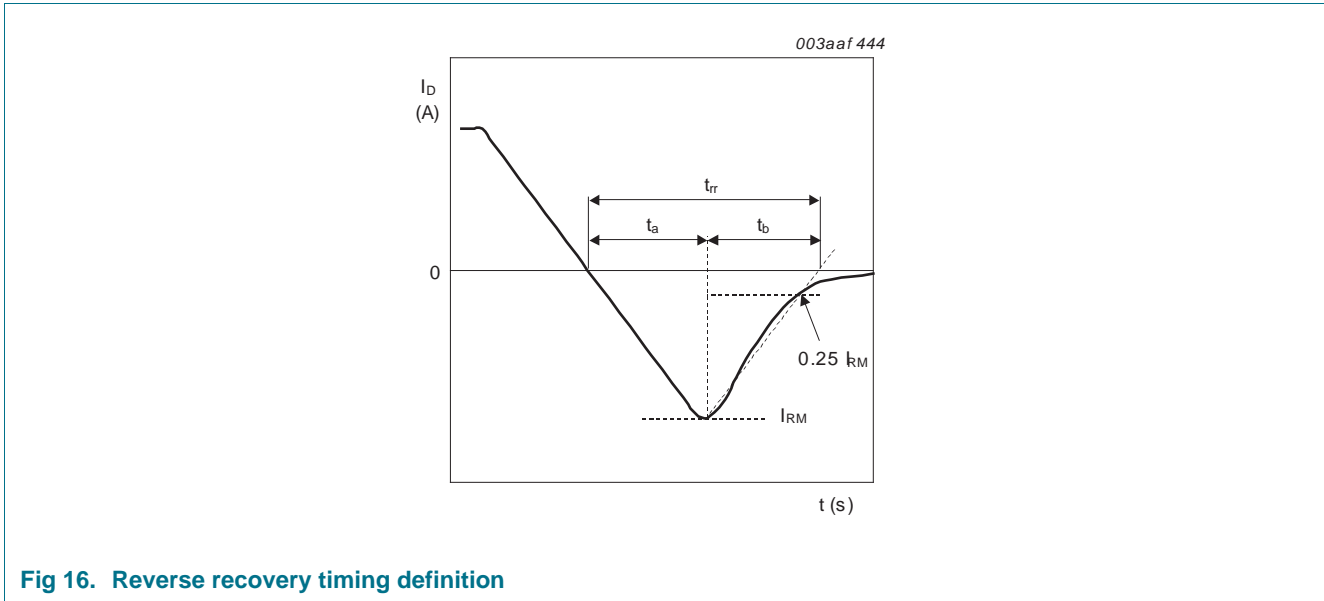
Fig 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



$V_{GS} = 0 V$

Fig 15. Source current as a function of source-drain voltage; typical values





7. Package outline

Plastic single ended surface mounted package (LFAK33); 8 leads

SOT1210

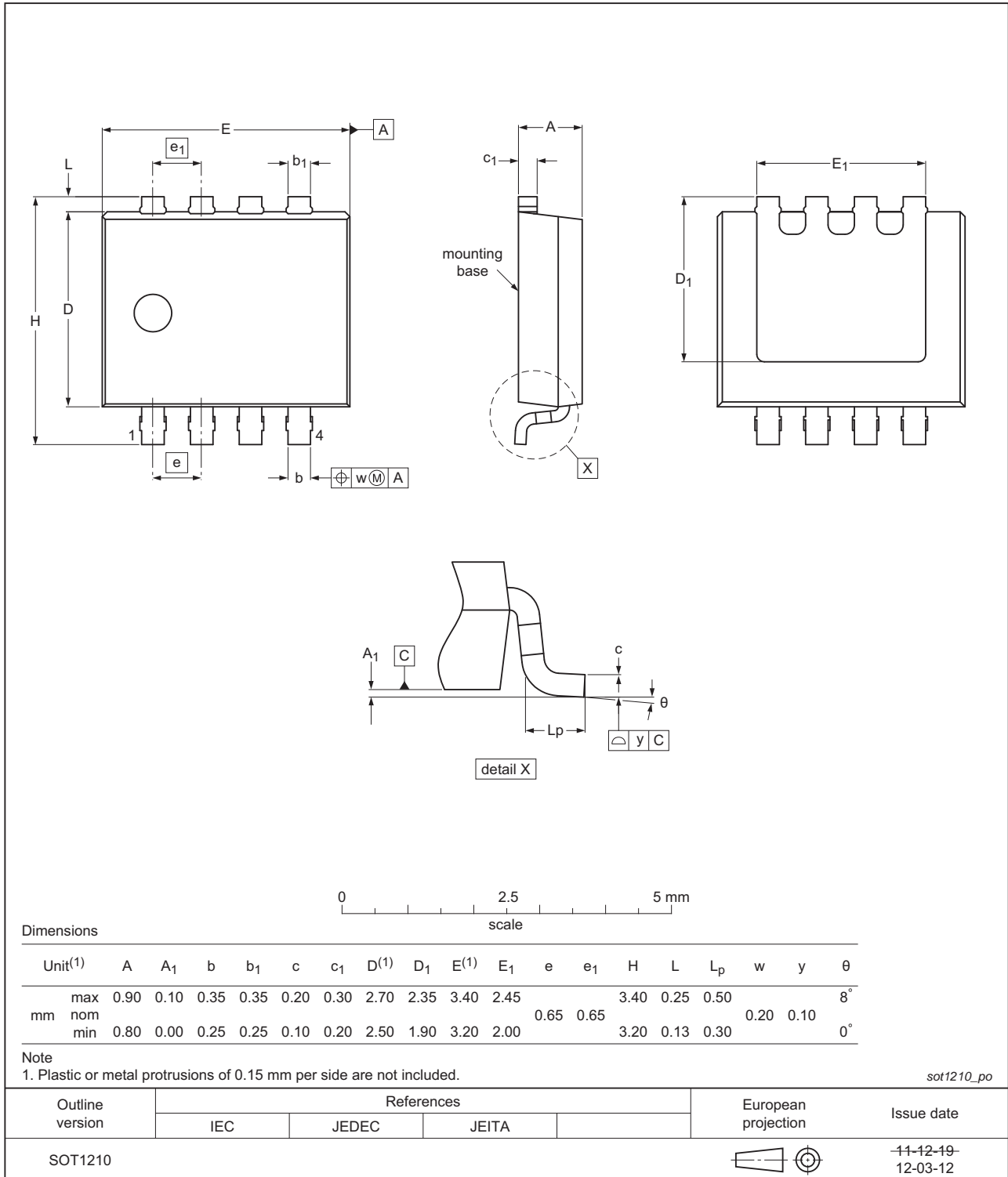


Fig 17. Package outline SOT1210 (LFAK33)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PSMN3R9-25MLC v.4	20120615	Product data sheet	-	PSMN3R9-25MLC v.3
Modifications:	• Various changes to content.			
PSMN3R9-25MLC v.3	20120607	Product data sheet	-	PSMN3R9-25MLC v.2

## 9. Legal information

### 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.

[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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