



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

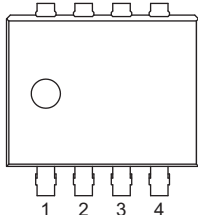
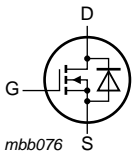
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25^\circ\text{C}$	-	-	25	V
I_D	drain current	$T_{mb} = 25^\circ\text{C}$; $V_{GS} = 10\text{ V}$; see Figure 1	[1]	-	70	A
P_{tot}	total power dissipation	$T_{mb} = 25^\circ\text{C}$; see Figure 2	-	-	69	W
T_j	junction temperature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

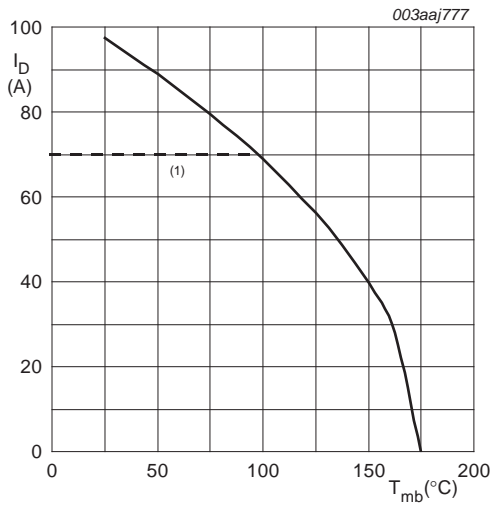
4. Limiting values

Table 4. Limiting values

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

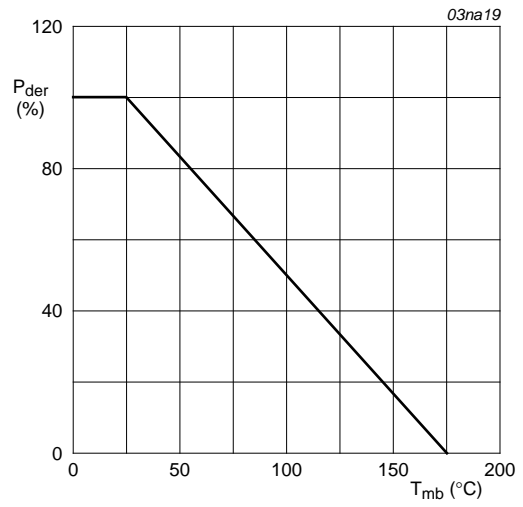
Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$T_j = 25\text{ }^\circ\text{C}$	-	25	V
V_{GS}	gate-source voltage		-20	20	V
I_D	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ }^\circ\text{C}$; see Figure 1	[1]	70	A
		$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ }^\circ\text{C}$; see Figure 1	-	69	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ }^\circ\text{C}$; see Figure 4	-	390	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ }^\circ\text{C}$; see Figure 2	-	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
Source-drain diode					
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
Avalanche ruggedness					
$E_{DS(AL)S}$	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 Figure 3	-	34.5	mJ

[1] Continuous current is limited by package.



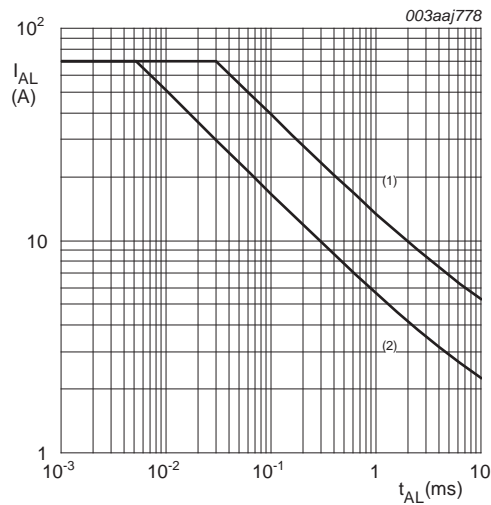
$V_{GS} \geq 10V$
 (1) Capped at 70 A due to package.

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

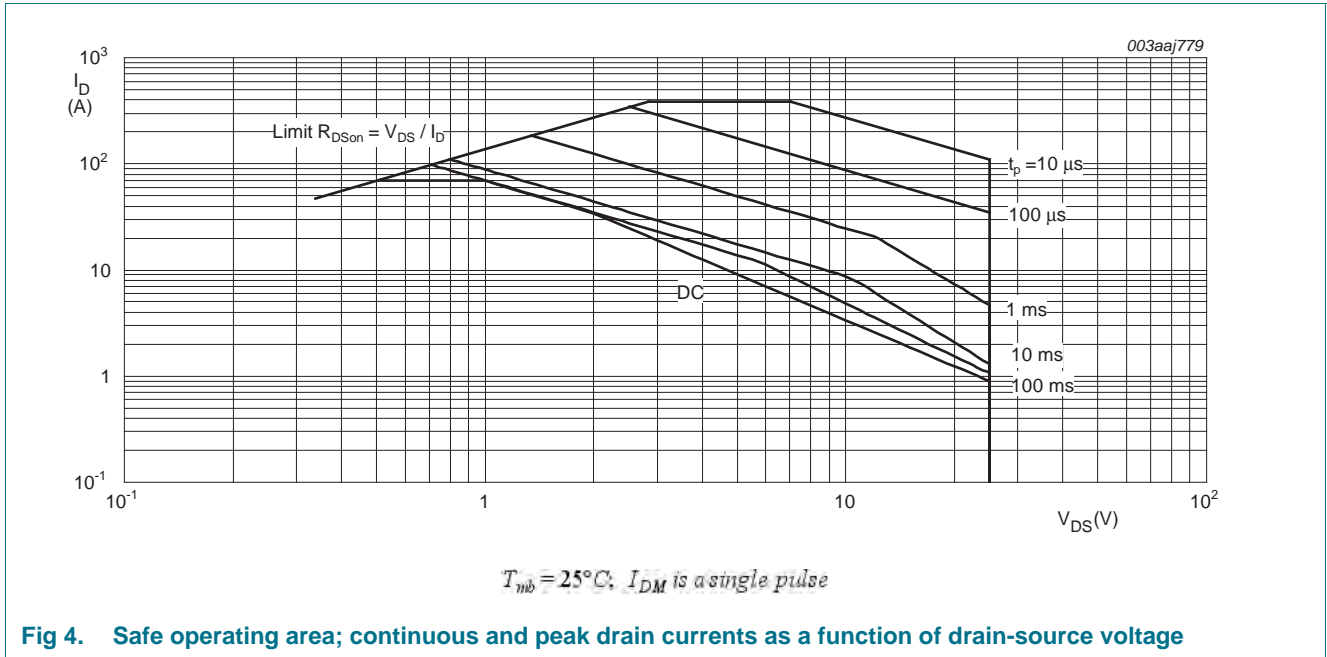


Fig 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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 Figure 5	-	1.95	2.18	K/W

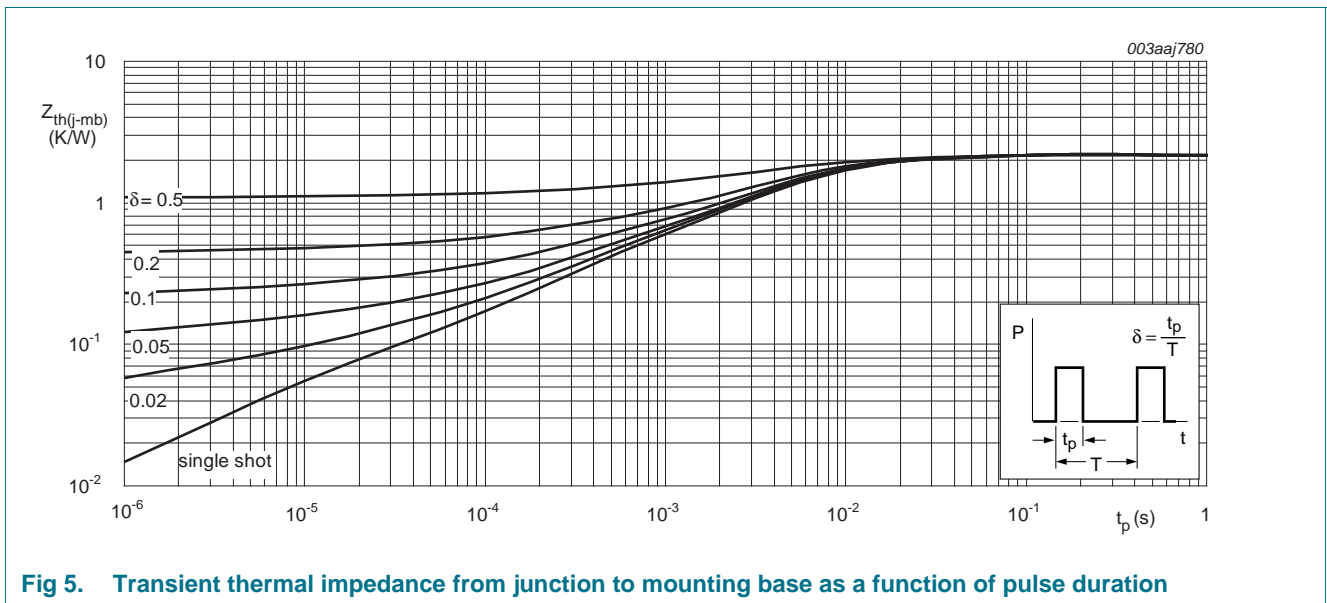


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	25	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	22.5	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	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	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	1	μA
		$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 150 \text{ }^\circ\text{C}$	-	-	100	μA
I_{GSS}	gate leakage current	$V_{GS} = 16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
		$V_{GS} = -16 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 10	-	4.85	5.55	mΩ
		$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11	-	-	8.9	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 10	-	3.65	4.15	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11	-	-	6.65	mΩ
R_G	gate resistance	$f = 1 \text{ MHz}$	0.9	1.8	3.6	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 12.5 \text{ V}; V_{GS} = 10 \text{ V};$ see Figure 12 ; see Figure 13	-	21.5	-	nC
		$I_D = 25 \text{ A}; V_{DS} = 12.5 \text{ V}; V_{GS} = 4.5 \text{ V};$ see Figure 12 ; see Figure 13	-	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 Figure 12 ; see Figure 13	-	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 Figure 12 ; see Figure 13	-	2.9	-	V
C_{iss}	input capacitance	$V_{DS} = 12.5 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 14	-	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
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ see Figure 15	-	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 Figure 16	-	9.8	-	ns
t_b	reverse recovery fall time		-	7.8	-	ns

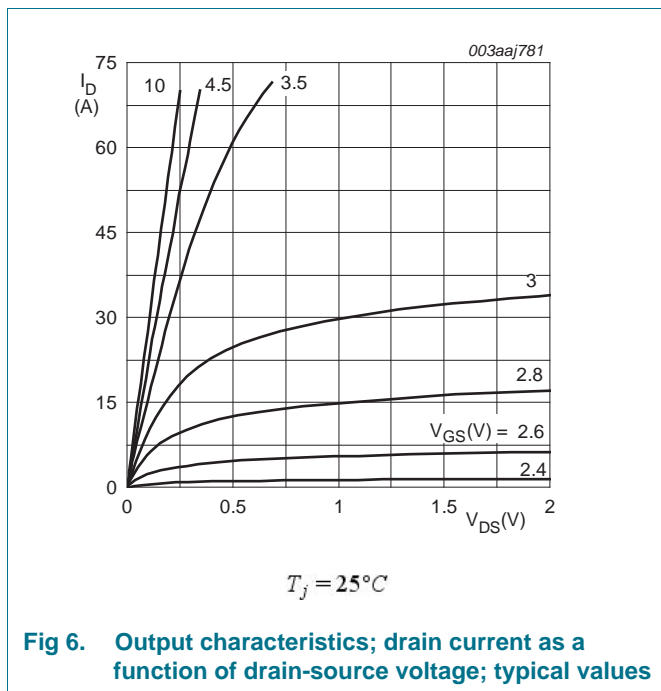


Fig 6. Output characteristics; drain current as a function of drain-source voltage; typical values

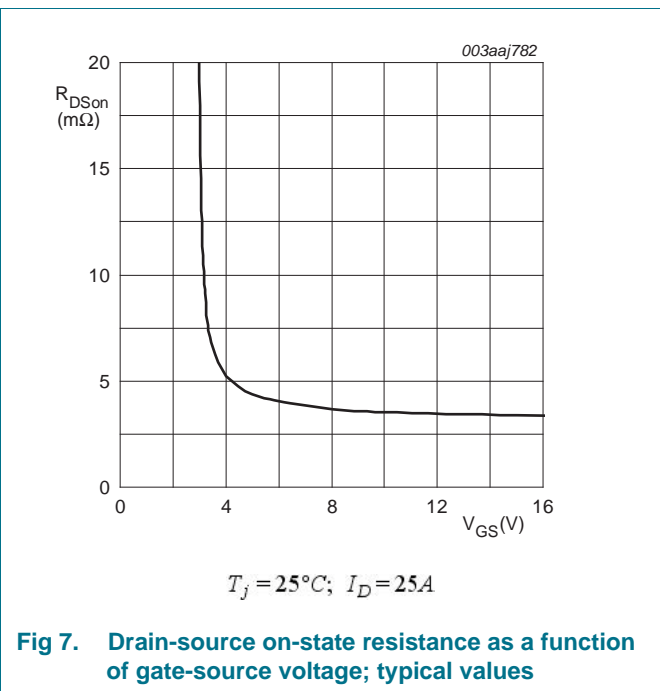


Fig 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

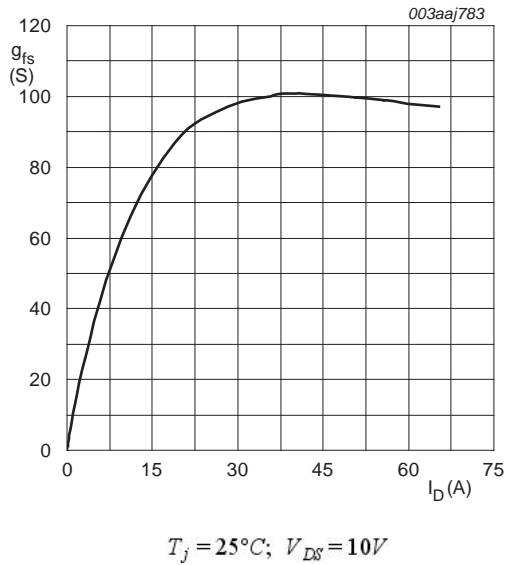


Fig 8. Forward transconductance as a function of drain current; typical values

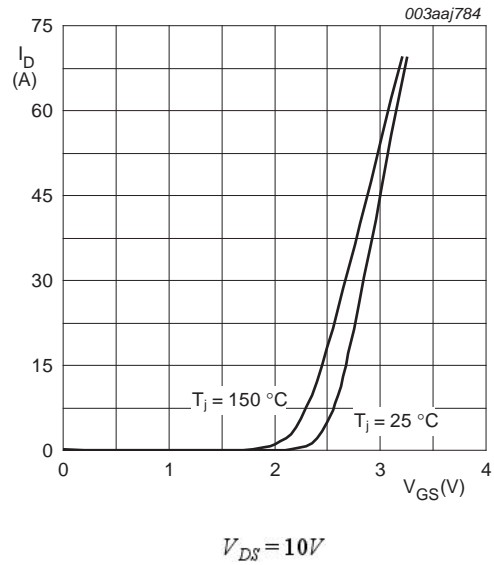


Fig 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

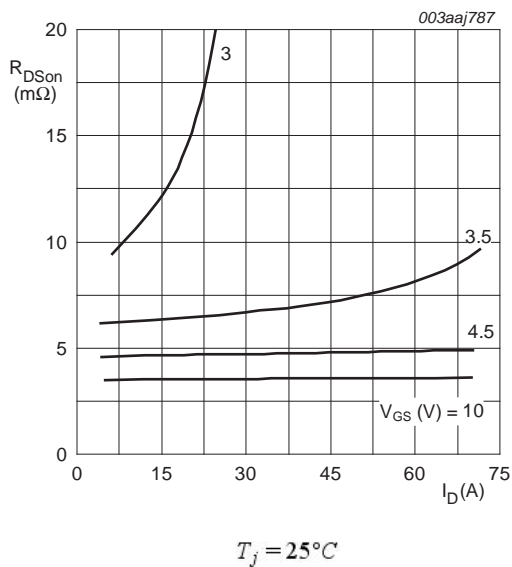


Fig 10. Drain-source on-state resistance as a function of drain current; typical values

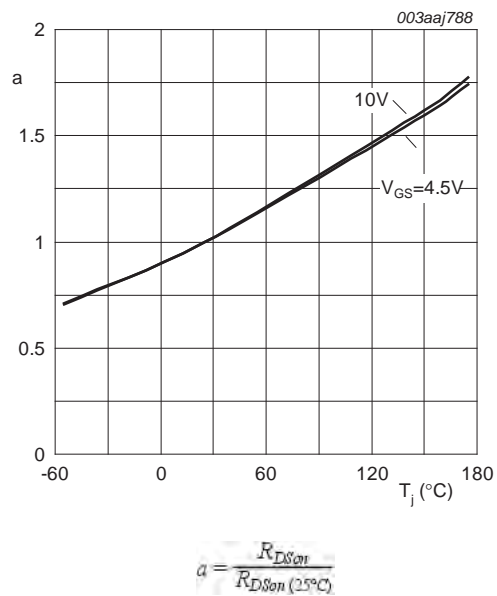
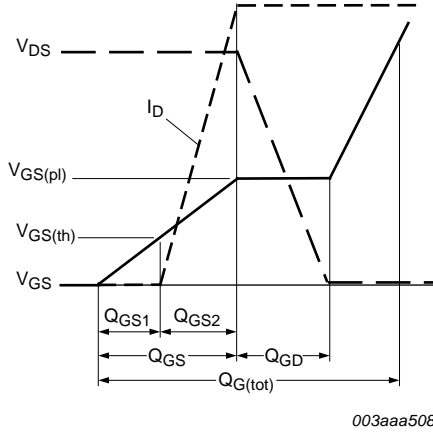
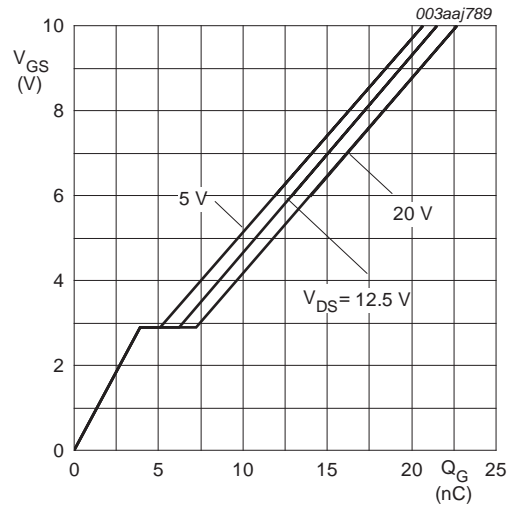


Fig 11. Normalized drain-source on-state resistance factor as a function of junction temperature



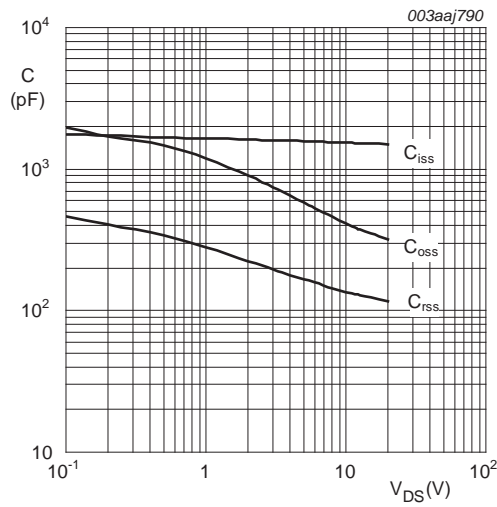
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Fig 12. Gate charge waveform definitions



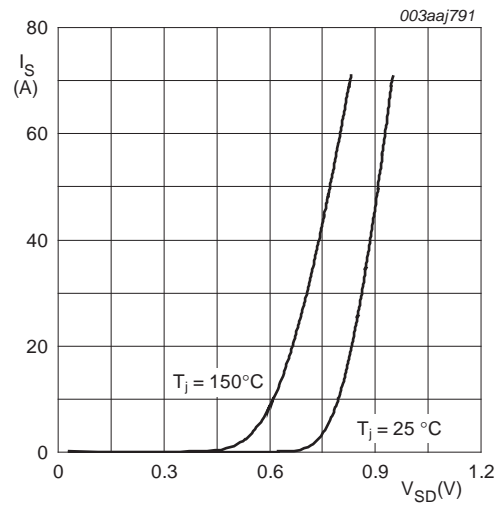
$T_j = 25^\circ C; I_D = 25 A$

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

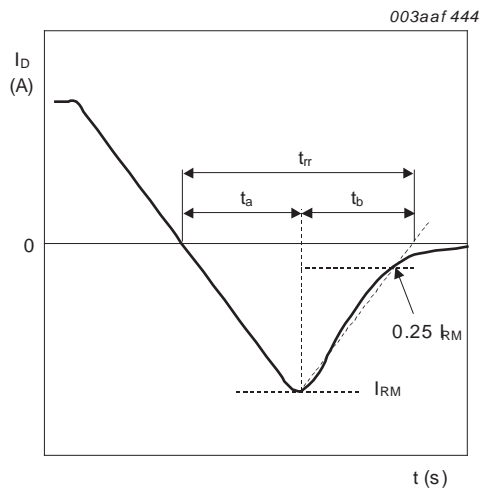


Fig 16. Reverse recovery timing definition

7. Package outline

Plastic single ended surface mounted package (LPAK33); 8 leads

SOT1210



Fig 17. Package outline SOT1210 (LPAK33)

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 ^{[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.

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