PSMN4R2-30MLD

N-channel 30 V, 4.2 mΩ logic level MOSFET in LFPAK33 using NextPowerS3 Technology

11 August 2015 Product data sheet

1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LFPAK33 package. NextPowerS3 portfolio utilising Nexperia's unique "SchottkyPlus" technology delivers high efficiency, low spiking performance usually associated with MOSFETs with an integrated Schottky or Schottky-like diode but without problematic high leakage current. NextPowerS3 is particularly suited to high efficiency applications at high switching frequencies.

2. Features and benefits

- Ultra low Q_G, Q_{GD} and Q_{OSS} for high system efficiency, especially at higher switching frequencies
- Superfast switching with soft-recovery; s-factor > 1
- Low spiking and ringing for low EMI designs
- Unique "SchottkyPlus" technology; Schottky-like performance with < 1 µA leakage at 25 °C
- Optimised for 4.5 V gate drive
- Low parasitic inductance and resistance
- High reliability clip bonded and solder die attach Mini Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Exposed leads for optimal visual solder inspection

3. Applications

- On-board DC-to-DC solutions for server and telecommunications
- Secondary-side synchronous rectification in telecommunication applications
- Voltage regulator modules (VRM)
- Point-of-Load (POL) modules
- Power delivery for V-core, ASIC, DDR, GPU, VGA and system components
- Brushed and brushless motor control

4. Quick reference data

Table 1. Quick reference data

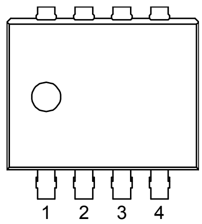
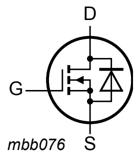
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	-	30	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; Fig. 2	[1]	-	-	70	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	65	W

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
T_j	junction temperature			-55	-	175	°C
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 20 A; T_j = 25 °C; Fig. 10		-	4.5	5.7	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 10		-	3.45	4.3	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	V_{GS} = 4.5 V; I_D = 25 A; V_{DS} = 15 V; Fig. 12; Fig. 13		-	3.1	4.6	nC
$Q_{G(tot)}$	total gate charge	V_{GS} = 4.5 V; I_D = 25 A; V_{DS} = 15 V; Fig. 12; Fig. 13		-	9.2	13.8	nC
Source-drain diode							
S	softness factor	I_S = 25 A; V_{GS} = 0 V; dI_S/dt = -100 A/µs; V_{DS} = 15 V; Fig. 16		-	1.05	-	

[1] Continuous current is limited by package

5. 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	LFPAK33 (SOT1210)	

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN4R2-30MLD	LFPAK33	Plastic single ended surface mounted package (LFPAK33); 8 leads	SOT1210

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN4R2-30MLD	4D230L

8. 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	25 °C ≤ T_j ≤ 175 °C		-	30	V
V_{DGR}	drain-gate voltage	25 °C ≤ T_j ≤ 175 °C; R_{GS} = 20 kΩ		-	30	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	65	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2	[1]	-	70	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	65	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3		-	366	A
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 °C		-	54	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	366	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; I_D = 25 A; V_{sup} ≤ 30 V; R_{GS} = 50 Ω; unclamped; t_p = 122 µs	[2]	-	59	mJ

[1] Continuous current is limited by package
[2] Protected by 100% test

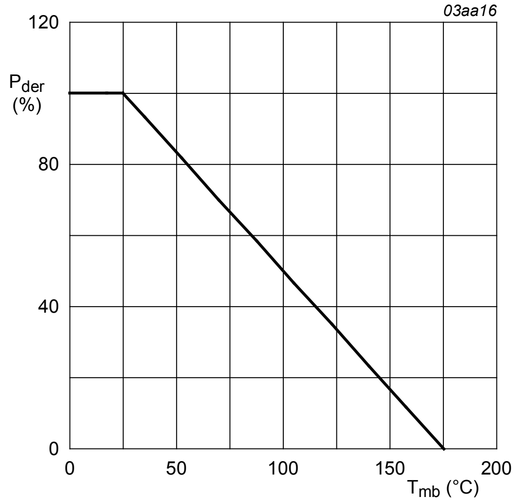
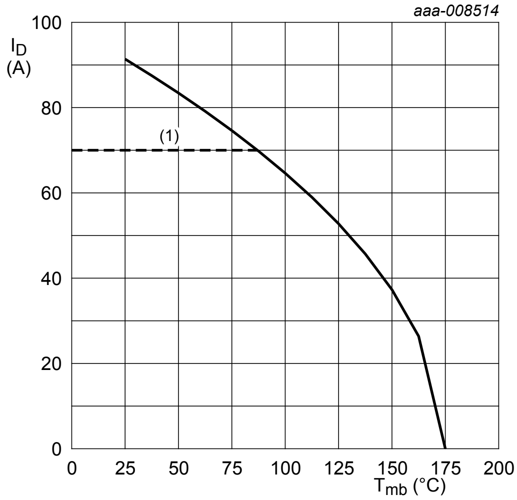


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

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



(1) Capped at 70A due to package

Fig. 2. Continuous drain current as a function of mounting base temperature

$$V_{GS} \geq 10\,V$$

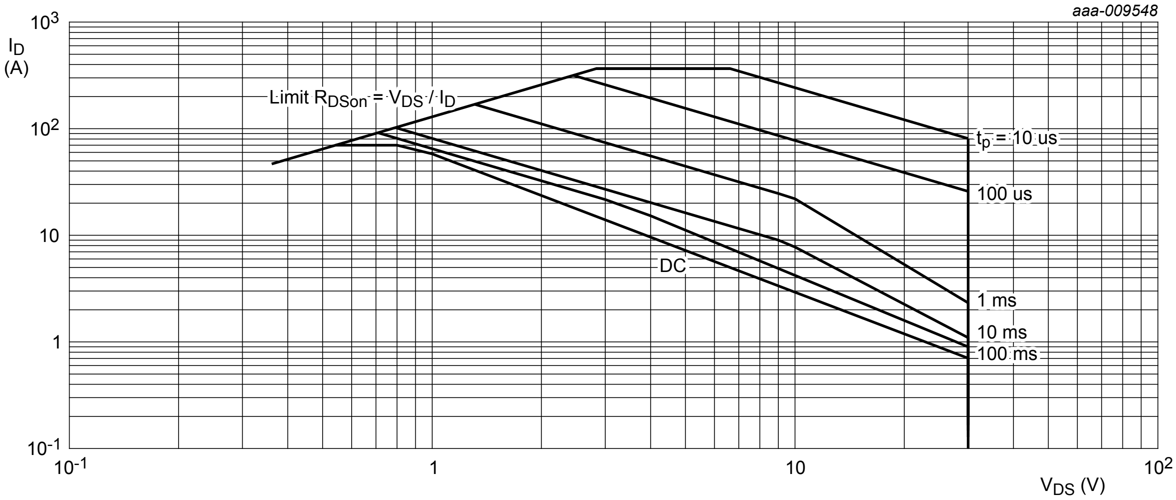


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$$T_{mb} = 25\,°C;\ I_{DM}\ is\ a\ single\ pulse$$

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 4		-	2.09	2.32	K/W

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5		-	57	-	K/W
		Fig. 6		-	178	-	K/W

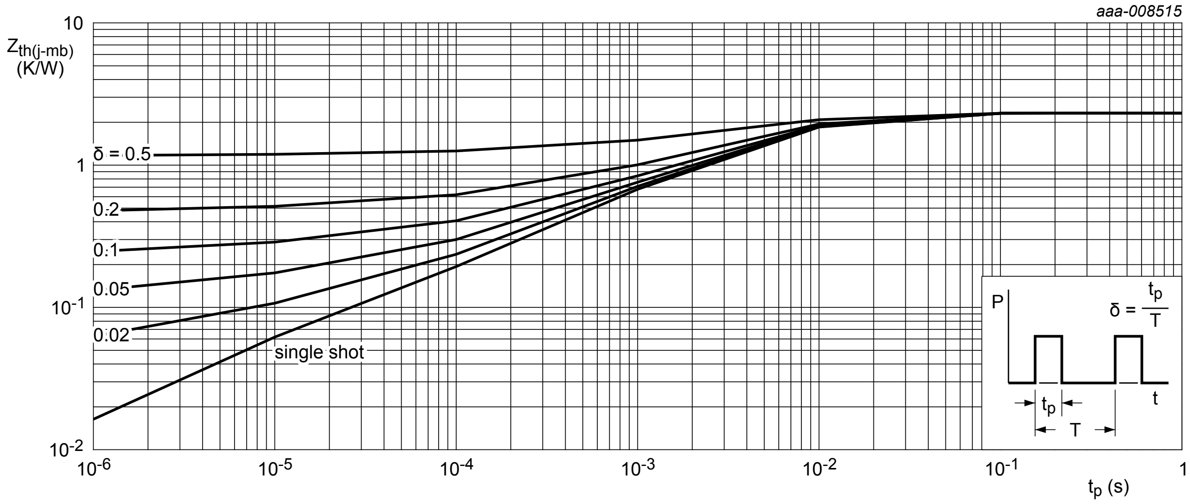


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

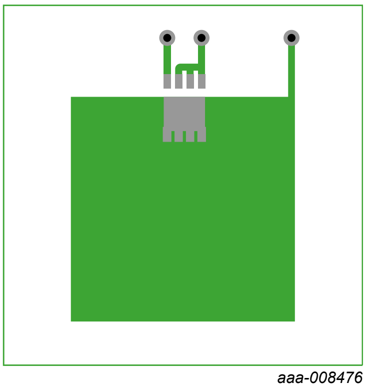


Fig. 5. PCB layout for thermal resistance junction to ambient 1" square pad; FR4 Board; 2oz copper

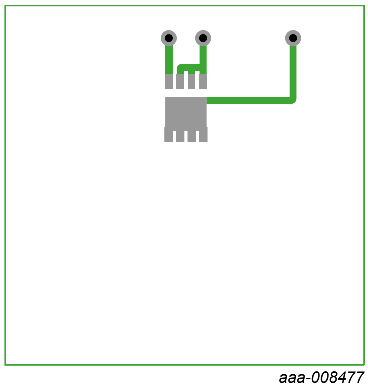


Fig. 6. PCB layout for thermal resistance junction to ambient minimum footprint; FR4 Board; 2oz copper

10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		30	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C		1.2	1.7	2.2	V

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	25 °C ≤ T_j ≤ 150 °C		-	-4.1	-	mV/K
I_{DSS}	drain leakage current	V_{DS} = 24 V; V_{GS} = 0 V; T_j = 25 °C		-	-	1	μA
		V_{DS} = 24 V; V_{GS} = 0 V; T_j = 125 °C		-	0.67	-	μA
I_{GSS}	gate leakage current	V_{GS} = 16 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
		V_{GS} = -16 V; V_{DS} = 0 V; T_j = 25 °C		-	-	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 4.5 V; I_D = 20 A; T_j = 25 °C; Fig. 10		-	4.5	5.7	mΩ
		V_{GS} = 4.5 V; I_D = 20 A; T_j = 150 °C; Fig. 11; Fig. 10		-	-	9.4	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 10		-	3.45	4.3	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 150 °C; Fig. 11; Fig. 10		-	-	7.1	mΩ
R_G	gate resistance	f = 1 MHz		-	0.48	0.95	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 15 V; V_{GS} = 10 V; Fig. 12; Fig. 13		-	19.6	29.3	nC
		I_D = 25 A; V_{DS} = 15 V; V_{GS} = 4.5 V; Fig. 12; Fig. 13		-	9.2	13.8	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V		-	16.8	-	nC
Q_{GS}	gate-source charge	I_D = 25 A; V_{DS} = 15 V; V_{GS} = 4.5 V; Fig. 12; Fig. 13		-	3.1	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	1.7	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	1.4	-	nC
Q_{GD}	gate-drain charge			-	3.1	4.6	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 25 A; V_{DS} = 15 V; Fig. 12; Fig. 13		-	2.9	-	V
C_{iss}	input capacitance	V_{DS} = 15 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 14		-	1197	1795	pF
C_{oss}	output capacitance			-	848	1272	pF
C_{rss}	reverse transfer capacitance			-	87	130	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 15 V; R_L = 0.6 Ω; V_{GS} = 4.5 V; $R_{G(ext)}$ = 5 Ω		-	10.1	-	ns
t_r	rise time			-	18.5	-	ns
$t_{d(off)}$	turn-off delay time			-	12	-	ns
t_f	fall time			-	8.7	-	ns

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Q_{oss}	output charge	V_{GS} = 0 V; V_{DS} = 15 V; f = 1 MHz; T_j = 25 °C		-	16.8	-	nC
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 15 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 15		-	0.81	1.2	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 15 V; Fig. 16		-	26	52	ns
Q_r	recovered charge		[1]	-	15	30	nC
t_a	reverse recovery rise time			-	12.7	-	ns
t_b	reverse recovery fall time			-	13.3	-	ns
S	softness factor			-	1.05	-	

[1] includes capacitive recovery

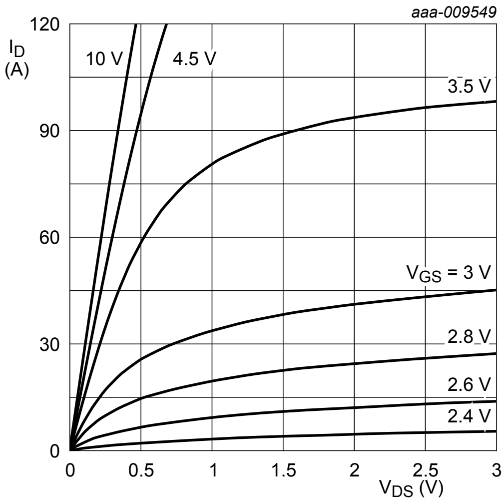


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

$T_j = 25°C$

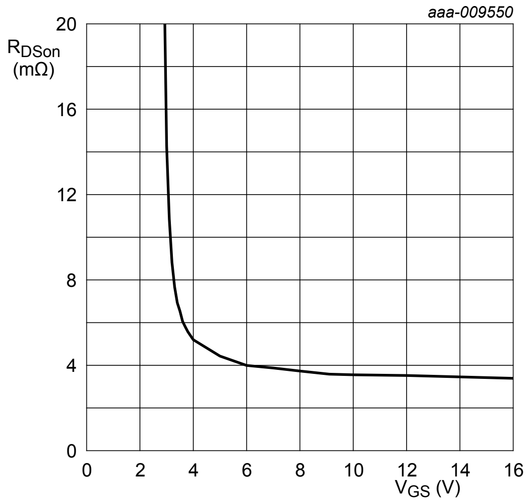


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25°C; I_D = 25A$

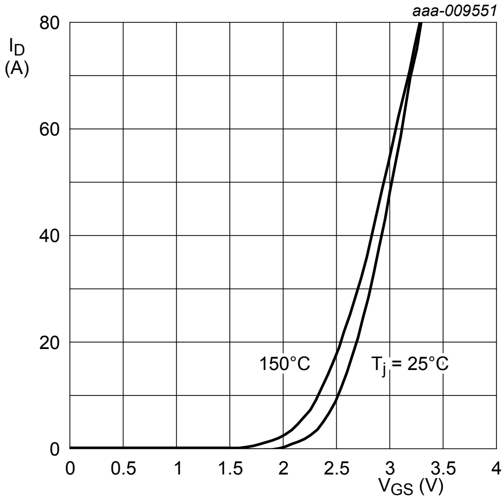


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10 V$

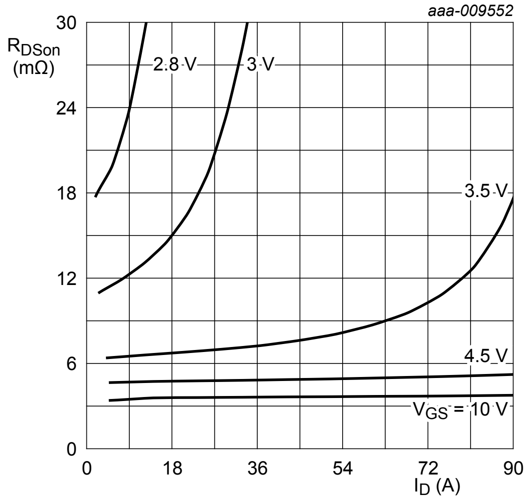


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

$T_j = 25°C$

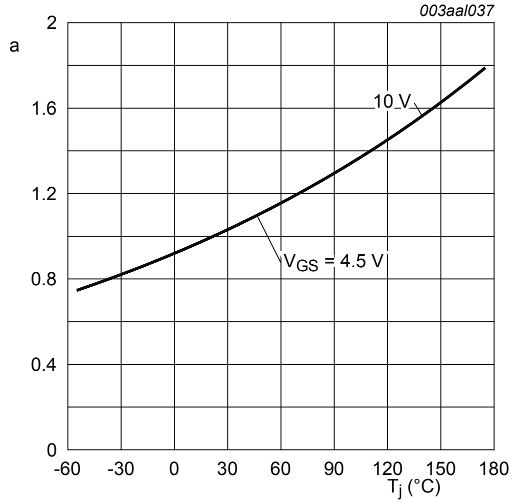


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

$$a = \frac{R_{DSon}}{R_{DSon\,(25°C)}}$$

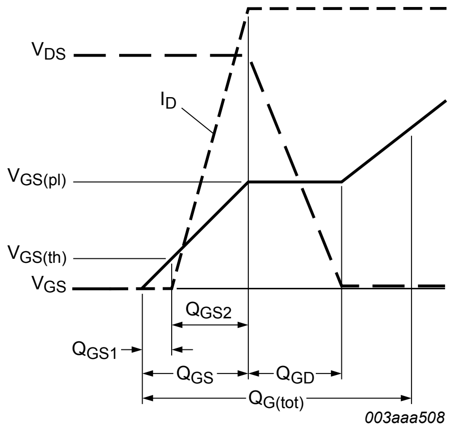


Fig. 12. Gate charge waveform definitions

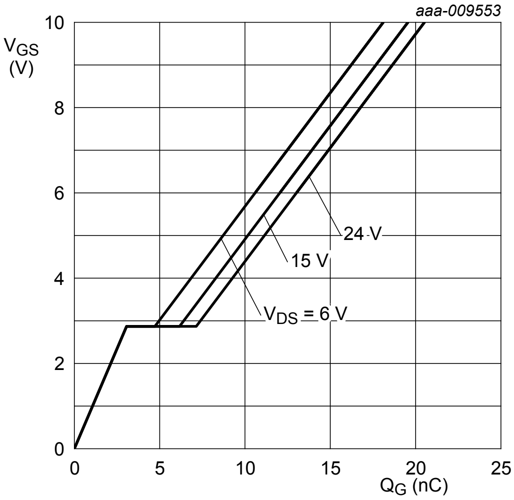


Fig. 13. Gate-source voltage as a function of gate charge; typical values

$T_j = 25°C;\ I_D = 25A$

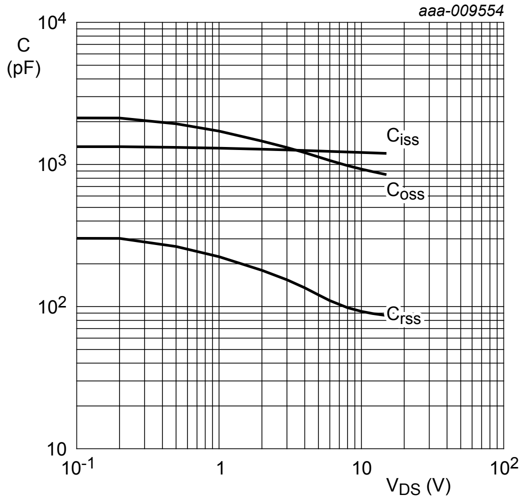


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

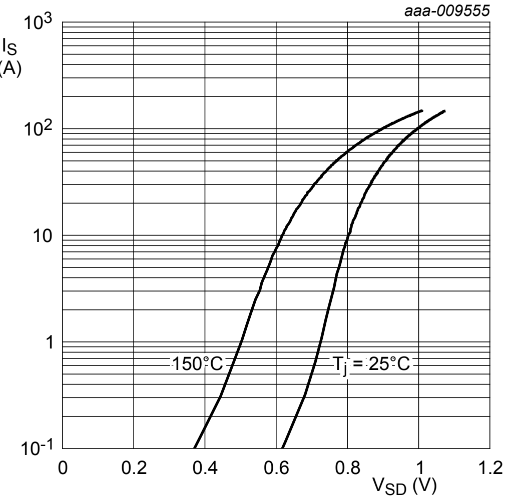


Fig. 15. Source current as a function of source-drain voltage; typical values

$V_{GS} = 0V$

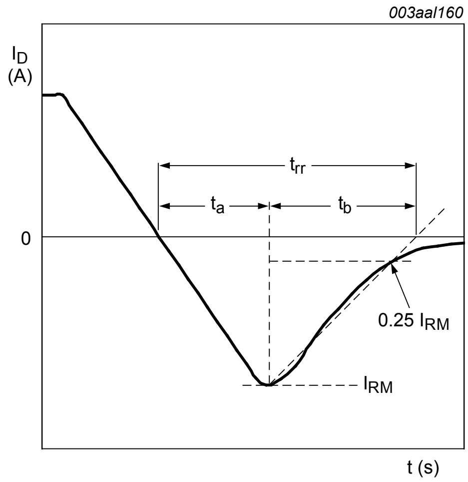
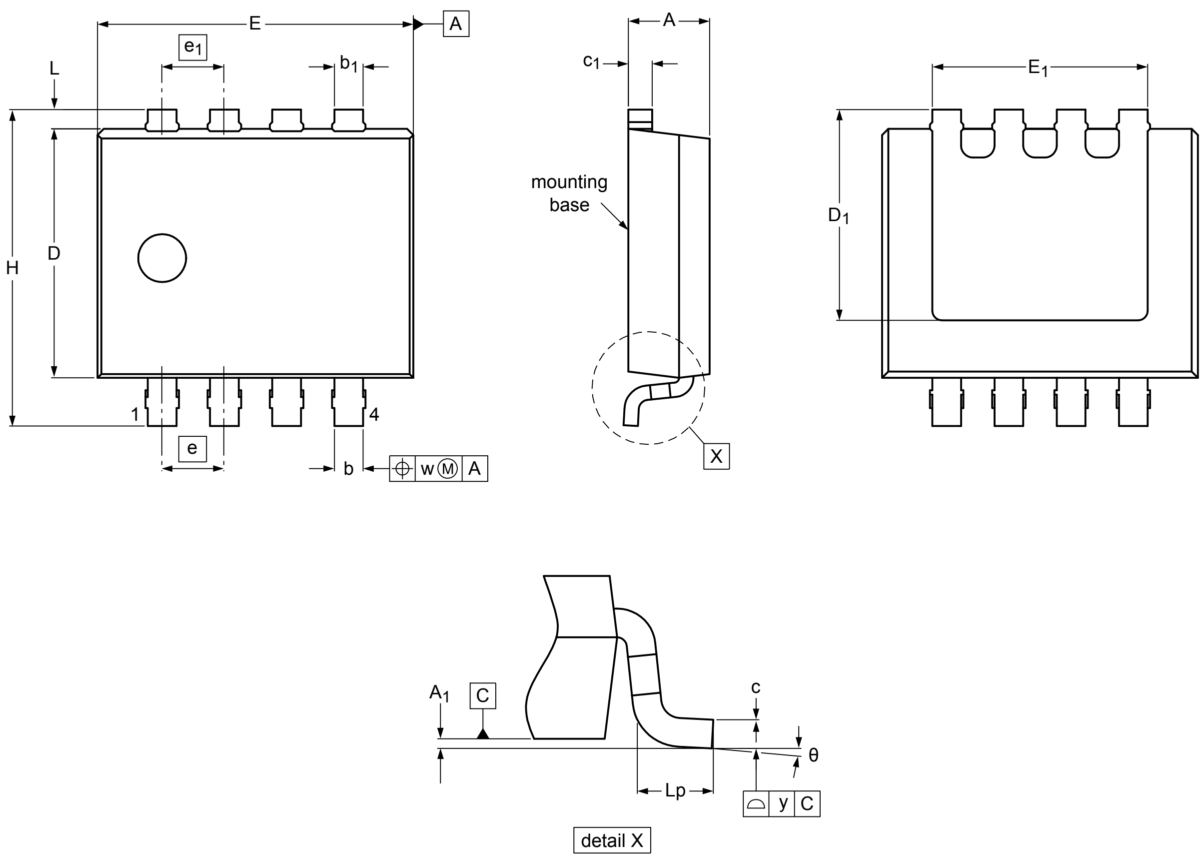


Fig. 16. Reverse recovery timing definition

11. Package outline

Plastic single ended surface mounted package (LFPAK33); 8 leads **SOT1210**



0 2.5 5 mm
scale

Dimensions

Unit(1)		A	A_1	b	b_1	c	c_1	D(1)	D_1	E(1)	E_1	e	e_1	H	L	L_p	w	y	θ
mm	max	0.90	0.10	0.35	0.35	0.20	0.30	2.70	2.35	3.40	2.45			3.40	0.25	0.50			8°
	nom											0.65	0.65				0.20	0.10	
	min	0.80	0.00	0.25	0.25	0.10	0.20	2.50	1.90	3.20	2.00			3.20	0.13	0.30			0°

Note
1. Plastic or metal protrusions of 0.15 mm per side are not included.

sot1210_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1210						~~11-12-19~~ 12-03-12

Fig. 17. Package outline LFPAK33 (SOT1210)

12. Legal information

12.1 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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13. Contents

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Date of release: 11 August 2015