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PSMN2R9-100SSE

N-channel 100 V, 2.9 mOhm MOSFET with enhanced SOA in LFPAK88

3 July 2024 **Product data sheet**

1. General description

N-channel enhancement mode MOSFET in a LFPAK88 package qualified to 175 °C. Part of Nexperia's Application Specific MOSFETs (ASFETs) for Hotswap and Soft Start. The PSMN2R9-100SSE delivers very low R_{DSon} and enhanced safe operating area performance in a high-reliability copper-clip LFPAK88 package.

PSMN2R9-100SSE complements the latest "hot-swap" controllers - robust enough to withstand substantial inrush currents during turn-on, low R_{DSon} to minimize I^2R losses and deliver optimum efficiency when turned fully ON.

2. Features and benefits

- Fully optimized Safe Operating Area (SOA) for superior linear mode operation
- Low R_{DSon} for low I^2R conduction losses
- LFPAK88 package for applications that demand the highest performance and reliability

3. Applications

- Hot swap
- Load switch
- Soft start
- E-fuse
- Telecommunication systems based on a 48 V backplane/supply rail

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		-	-	100	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	-	210	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	341	W
T_j	junction temperature			-55	-	175	°C
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 12		-	2.3	2.9	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	3.4	4.6	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	I_D = 25 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		6.4	21.3	49	nC
$Q_{G(tot)}$	total gate charge			63	125	188	nC

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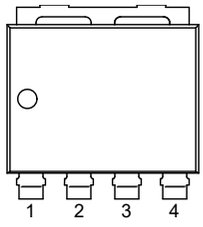
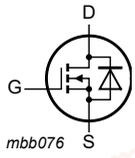
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Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 71 A; V_{sup} ≤ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 124 µs; Fig. 4	[1]	-	-	575	mJ
Source-drain diode							
Q_r	recovered charge	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 50 V; T_j = 25 °C; Fig. 18		-	57	-	nC

[1] Protected by 100% test

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 LFPAK88 (SOT1235)	
2	S	source		
3	S	source		
4	S	source		
mb	D	mounting base; connected to drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN2R9-100SSE	LFPAK88	plastic, single-ended surface-mounted package (LFPAK88); 4 leads; 2 mm pitch; 8 mm x 8 mm x 1.6 mm body	SOT1235

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN2R9-100SSE	X2E9S10S

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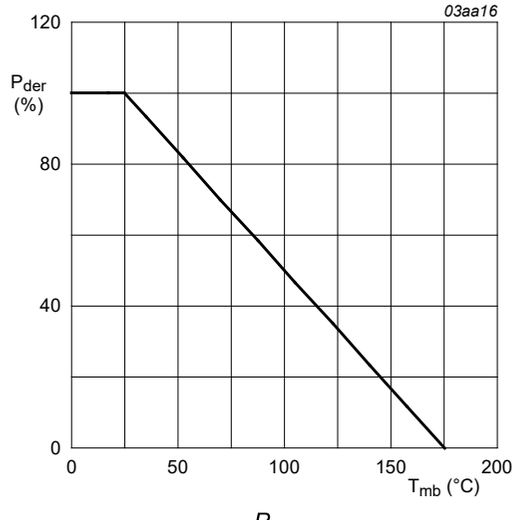
8. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Tj = 25 °C unless otherwise stated.

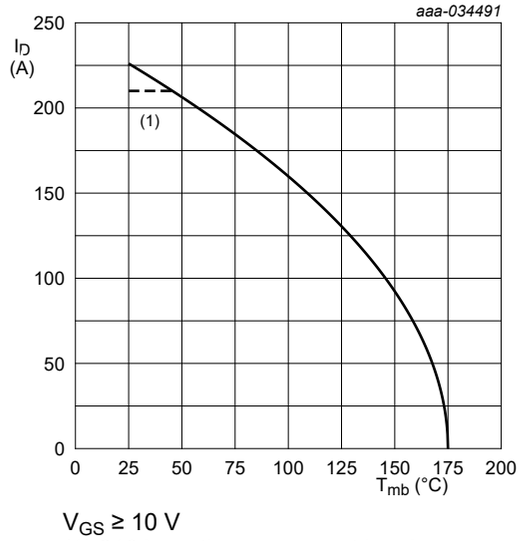
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	100	V
V_{DGR}	drain-gate voltage	25 °C ≤ T_j ≤ 175 °C; R_{GS} = 20 kΩ		-	100	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	341	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	210	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	160	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3		-	904	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		-	210	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	904	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 71 A; V_{sup} ≤ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 124 µs; Fig. 4	[1]	-	575	mJ
I_{AS}	non-repetitive avalanche current	V_{sup} ≤ 100 V; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; R_{GS} = 50 Ω; Fig. 4	[1]	-	71	A

[1] Protected by 100% test



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

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



$V_{GS} \geq 10$ V

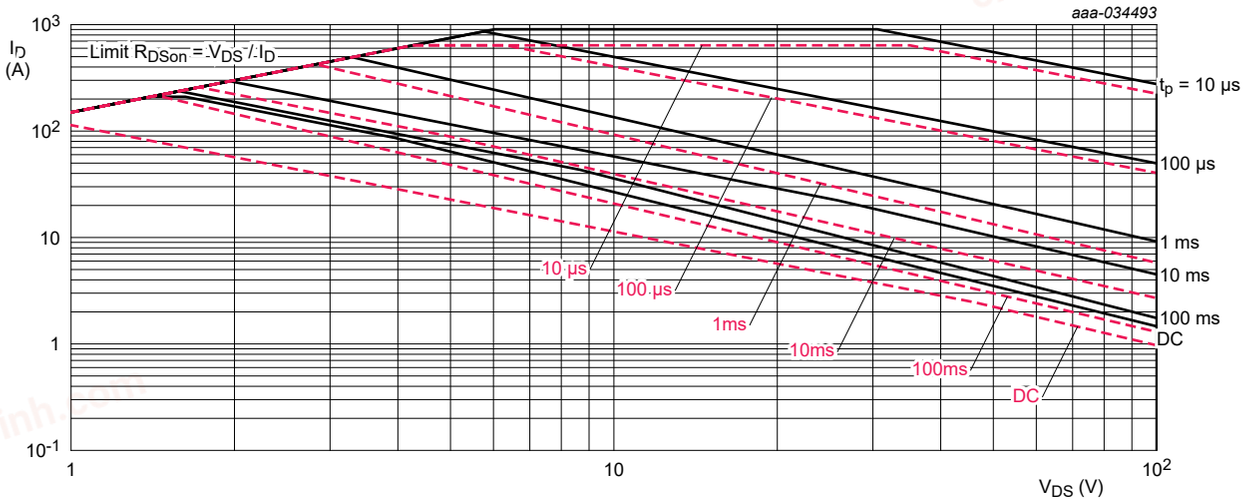
(1) 210A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

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

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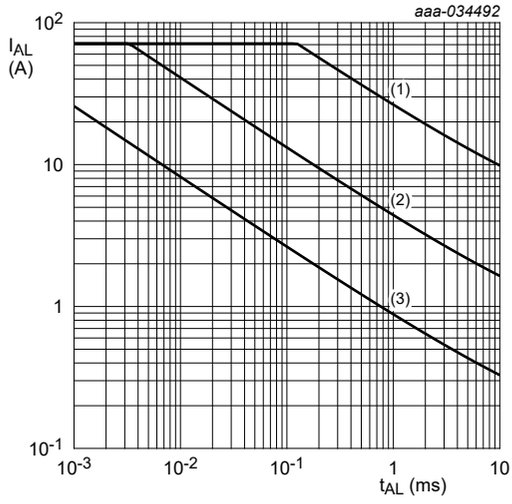
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T_{mb} = 25 °C (black solid line); T_{mb} = 125 °C (red dashed line); I_{DM} is a single pulse

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



(1) $T_{j\ (init)}$ = 25 °C; (2) $T_{j\ (init)}$ = 150 °C; (3) Repetitive Avalanche

Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j\text{-}mb)}$	thermal resistance from junction to mounting base	Fig. 5		-	0.24	0.44	K/W
$R_{th(j\text{-}a)}$	thermal resistance from junction to ambient	Fig. 6		-	35	-	K/W
		Fig. 7		-	70	-	K/W

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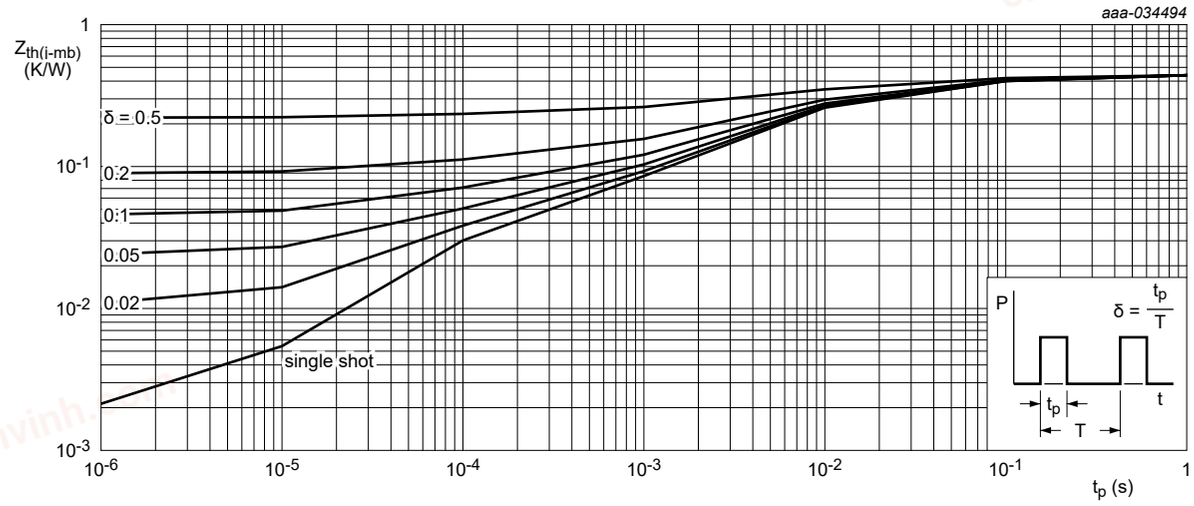
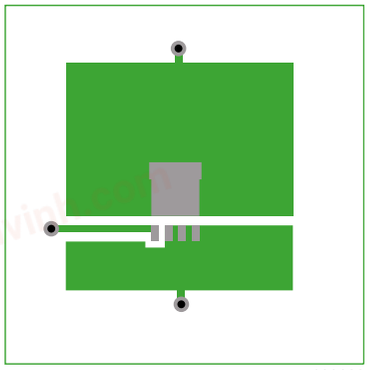
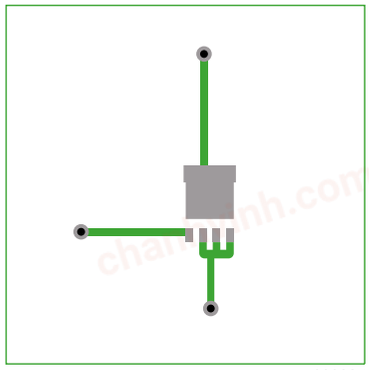


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration



Copper square 25.4 mm square; 70 µm thick on FR4 board

Fig. 6. PCB layout for thermal resistance from junction to ambient



70 µm thick copper on FR4 board

Fig. 7. PCB layout with minimum footprint for thermal resistance from junction to ambient

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10. Characteristics

Table 7. Characteristics

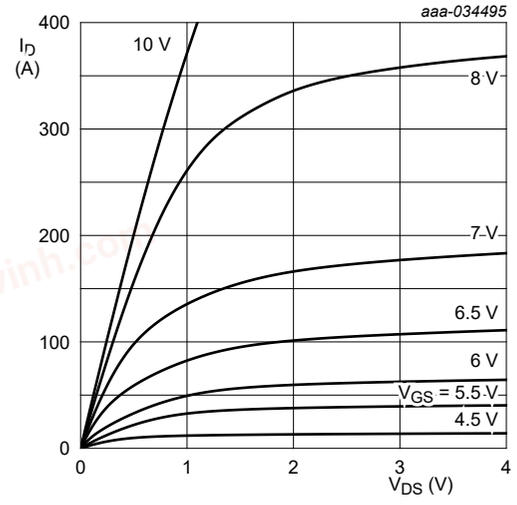
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		100	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C; Fig. 11		2	2.6	3.6	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = 175 °C		-	1.6	-	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55 °C		-	3	-	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	25 °C ≤ T_j ≤ 150 °C		-	-6.6	-	mV/K
I_{DSS}	drain leakage current	V_{DS} = 100 V; V_{GS} = 0 V; T_j = 25 °C		-	0.13	1	µA
		V_{DS} = 100 V; V_{GS} = 0 V; T_j = 125 °C		-	50	100	µA
I_{GSS}	gate leakage current	V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
		V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 12		-	2.3	2.9	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	3.4	4.6	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 13		-	4.8	6.7	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		0.55	1.1	2.2	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		63	125	188	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V; T_j = 25 °C		-	65	-	nC
Q_{GS}	gate-source charge	I_D = 25 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		26	44	61	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	26.4	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	17.4	-	nC
Q_{GD}	gate-drain charge			6.4	21.3	49	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 25 A; V_{DS} = 50 V; T_j = 25 °C; Fig. 14; Fig. 15		-	4.9	-	V
C_{iss}	input capacitance	V_{DS} = 50 V; V_{GS} = 0 V; f = 0.5 MHz; T_j = 25 °C; Fig. 16		5679	9465	13250	pF
C_{oss}	output capacitance			1427	2380	3806	pF
C_{rss}	reverse transfer capacitance			8	78	203	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 50 V; R_L = 2 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 5 Ω; T_j = 25 °C		-	31	-	ns
t_r	rise time			-	35	-	ns
$t_{d(off)}$	turn-off delay time			-	61	-	ns
t_f	fall time			-	43	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 17		-	0.79	1	V

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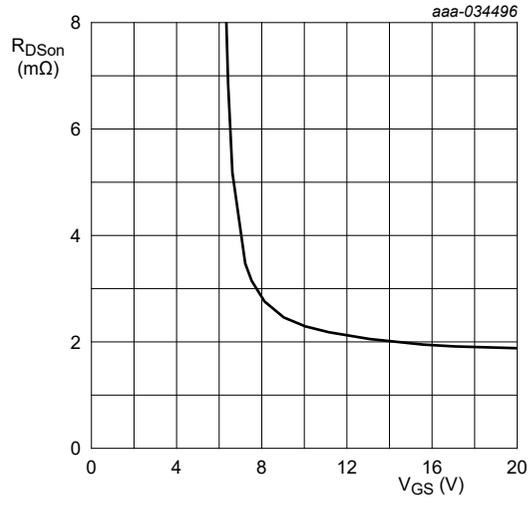
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Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 50 V; T_j = 25 °C; Fig. 18		-	52	-	ns
Q_r	recovered charge			-	57	-	nC



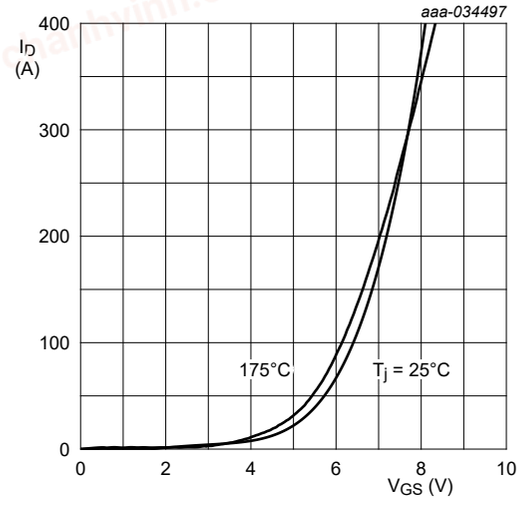
T_j = 25 °C

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



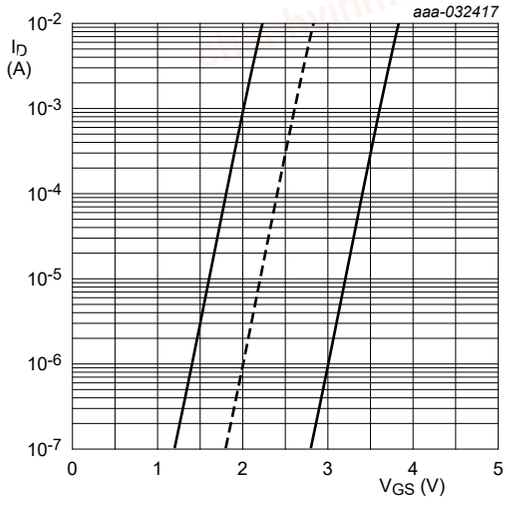
T_j = 25 °C; I_D = 25 A

Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values



V_{DS} = 8 V

Fig. 10. Transfer characteristics; drain current as a function of gate-source voltage; typical values



T_j = 25 °C; V_{DS} = 5 V

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

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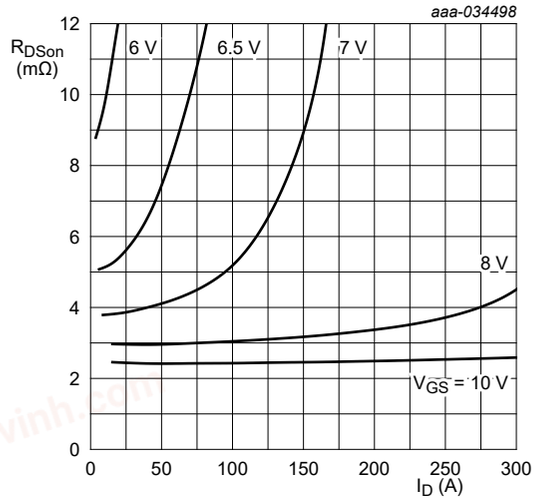
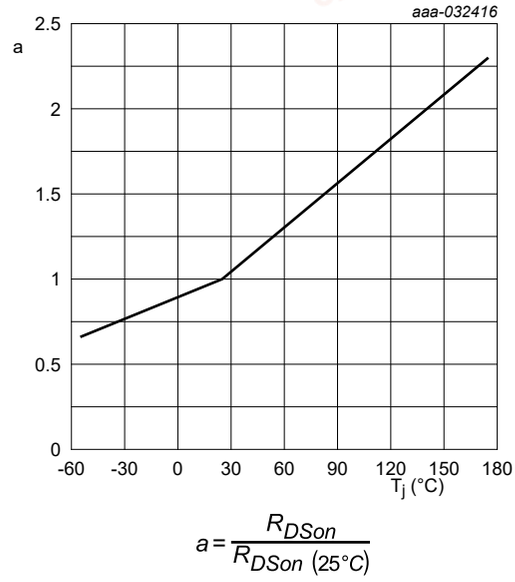


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values



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

Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

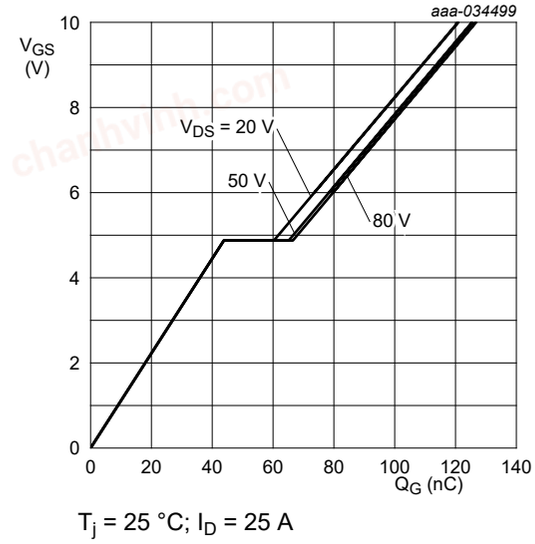


Fig. 14. Gate-source voltage as a function of gate charge; typical values

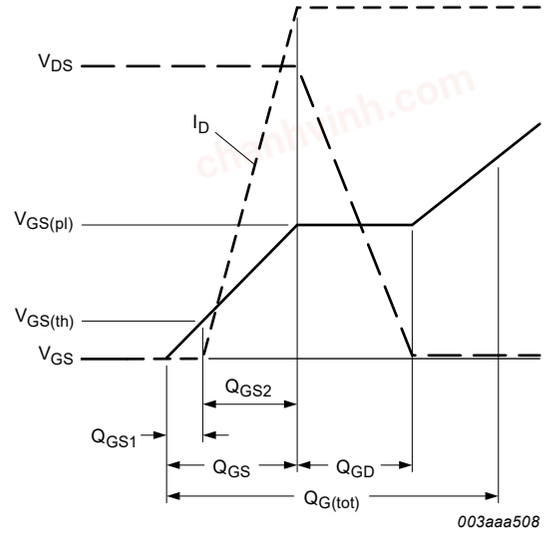
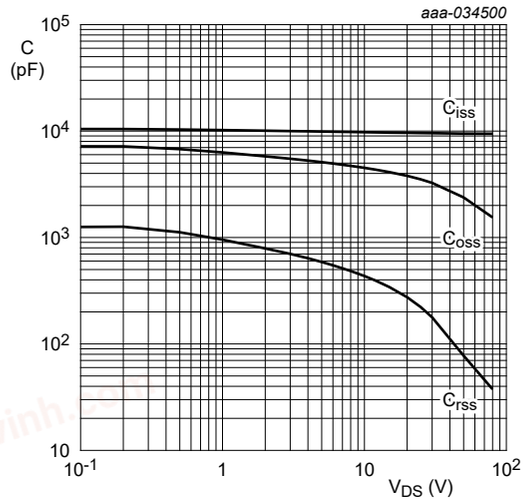


Fig. 15. Gate charge waveform definitions

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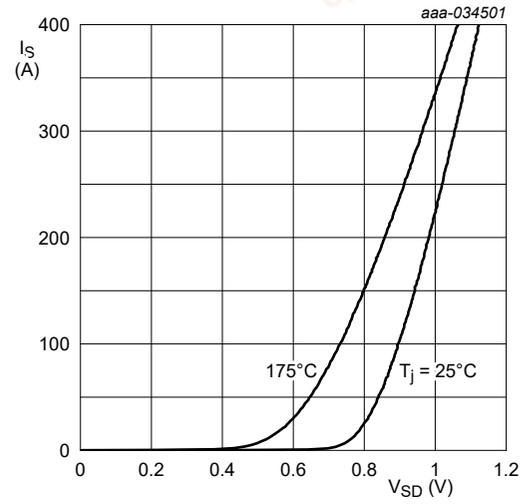
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V_{GS} = 0 V; f = 0.5 MHz

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



V_{GS} = 0 V

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

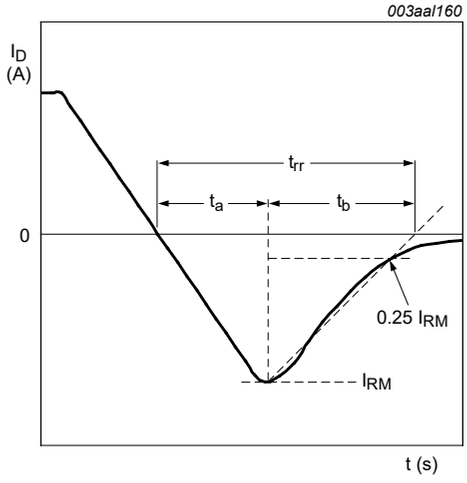


Fig. 18. Reverse recovery timing definition

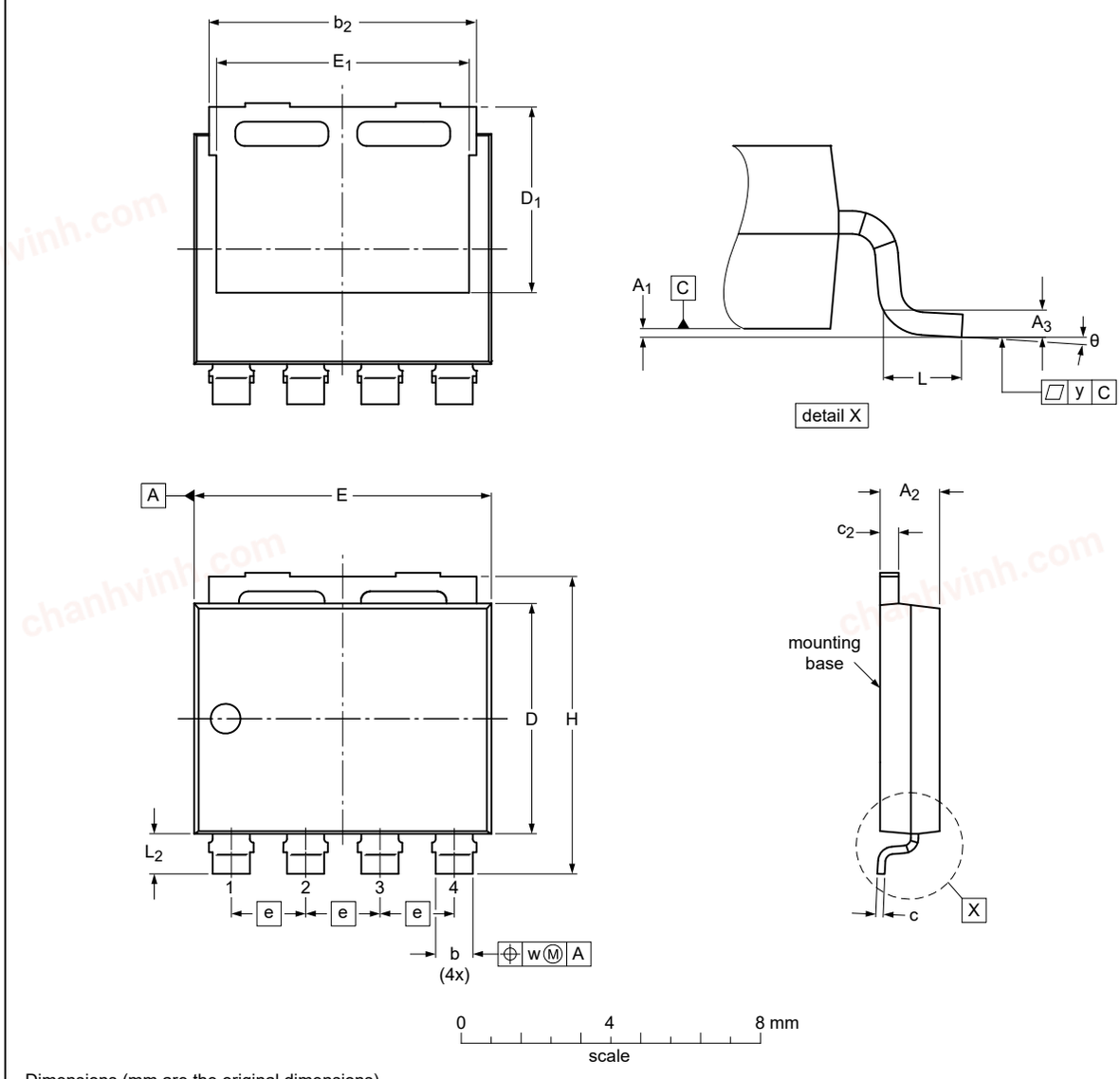
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11. Package outline

Plastic single-ended surface-mounted package (LFPAK88); 4 leads **SOT1235**



Dimensions (mm are the original dimensions)

Unit		A_1	A_2	A_3	b	b_2	c	c_2	$D^{(1)}$	$D_1^{(1)}$	$E^{(1)}$	$E_1^{(1)}$	e	$H^{(1)}$	L	L_2	w	y	θ
mm	max	0.15	1.7		1.1	7.3	0.24	0.55	6.3	5.1	8.1	6.9		8.1	0.8	1.3			8°
	nom			0.25									2.0				0.25	0.10	
	min	0.00	1.5		0.9	7.1	0.18	0.45	6.1	4.9	7.9	6.7		7.8	0.6	0.9			0°

Note
1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

sot1235_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1235						~~17-08-02~~ 17-08-07

Fig. 19. Package outline LFPAK88 (SOT1235)

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12. Soldering

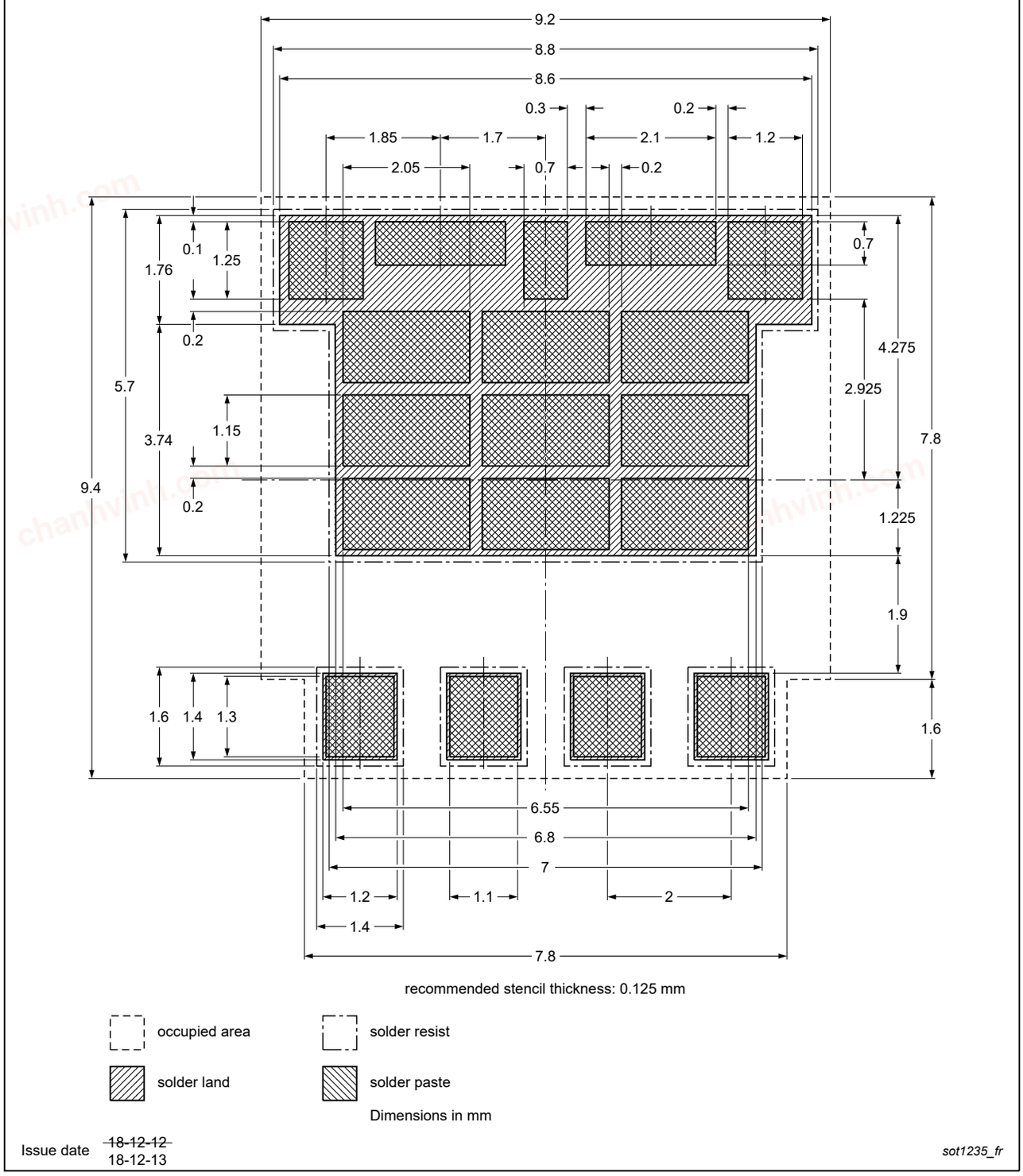


Fig. 20. Reflow soldering footprint for LFPAK88 (SOT1235)

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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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