PSMN1R9-80SSE

N-channel 80 V, 1.9 mOhm MOSFET with enhanced SOA in LFPAK88

16 December 2022 Product data sheet

1. General description

N-channel enhancement mode MOSFET in a LFPAK88 package qualified to 175 °C. Part of Nexperia's "ASFETs for hotswap" portfolio, the PSMN1R9-80SSE delivers very low R_{DSon} and a very strong linear-mode (SOA) performance in a high-reliability copper-clip LFPAK88 package.

PSMN1R9-80SSE 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 and computing 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		-	-	80	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	-	286	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	340	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		-	1.6	1.9	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	2.6	3	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	I_D = 25 A; V_{DS} = 40 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		7	23	53	nC
$Q_{G(tot)}$	total gate charge			77	155	232	nC
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 90 A; V_{sup} ≤ 80 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 179 µs; Fig. 4	[1]	-	-	840	mJ

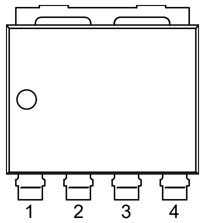
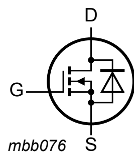
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Source-drain diode							
Q_r	recovered charge	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 40 V; T_j = 25 °C; Fig. 18	[2]	-	60	-	nC

[1] Protected by 100% test

[2] includes capacitive recovery

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
PSMN1R9-80SSE	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
PSMN1R9-80SSE	X1E9S80S

8. Limiting values

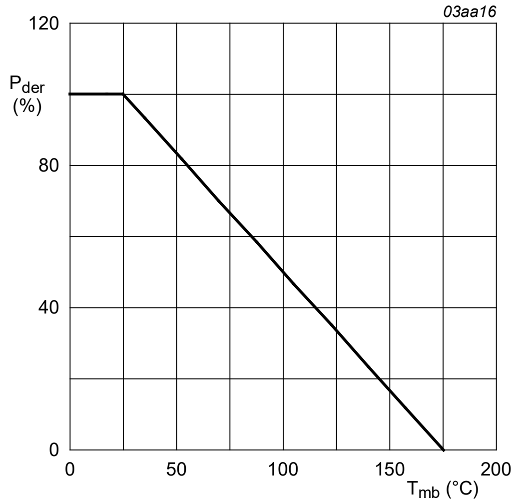
Table 5. Limiting values

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		-	80	V
V_{DGR}	drain-gate voltage	25 °C ≤ T_j ≤ 175 °C; R_{GS} = 20 kΩ		-	80	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	340	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	286	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	202	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3		-	1142	A
T_{stg}	storage temperature			-55	175	°C

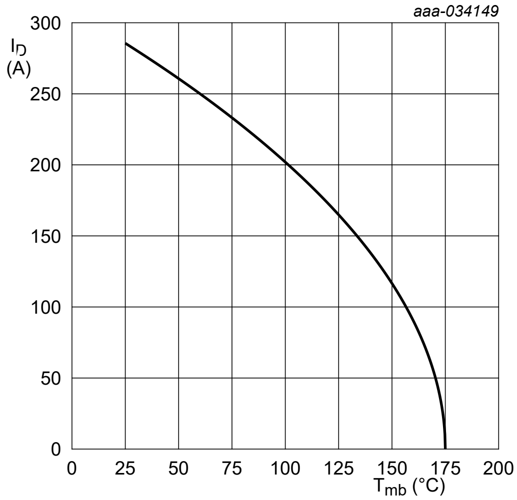
Symbol	Parameter	Conditions		Min	Max	Unit
T_j	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C		-	286	A
I_{SM}	peak source current	pulsed; $t_p \leq$ 10 µs; T_{mb} = 25 °C		-	1142	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 90 A; $V_{sup} \leq$ 80 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 179 µs; Fig. 4	[1]	-	840	mJ
I_{AS}	non-repetitive avalanche current	V_{sup} = 80 V; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; R_{GS} = 50 Ω; Fig. 4	[1]	-	90	A

[1] Protected by 100% test



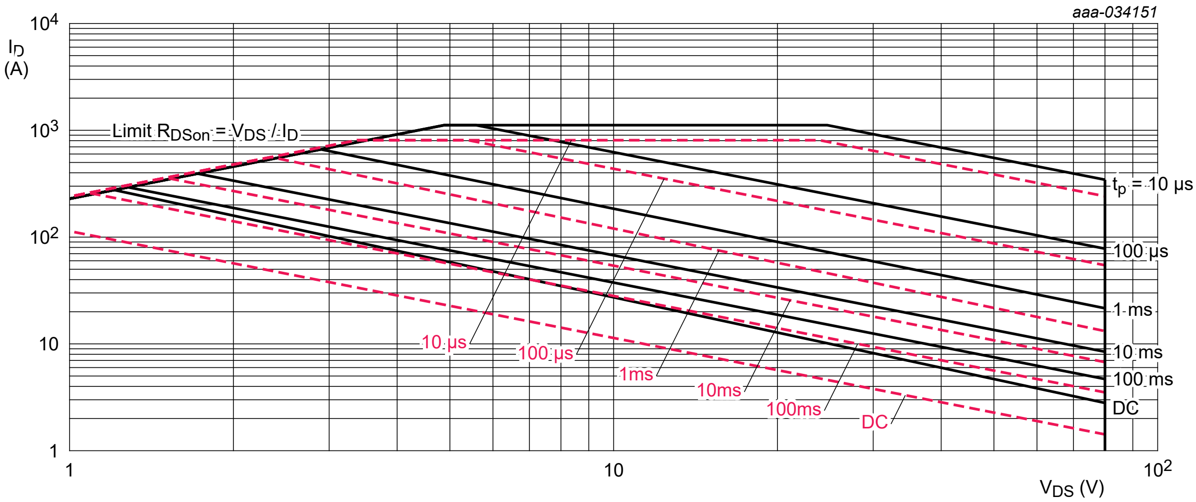
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



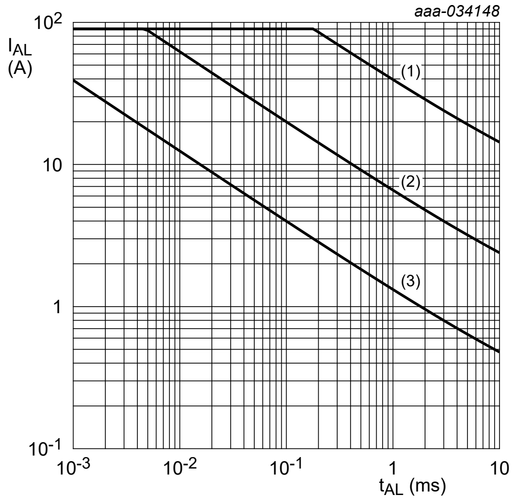
$V_{GS} \geq$ 10 V

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



T_{mb} = 25 °C; 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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 5		-	0.2	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 6		-	35	-	K/W
		Fig. 7		-	70	-	K/W

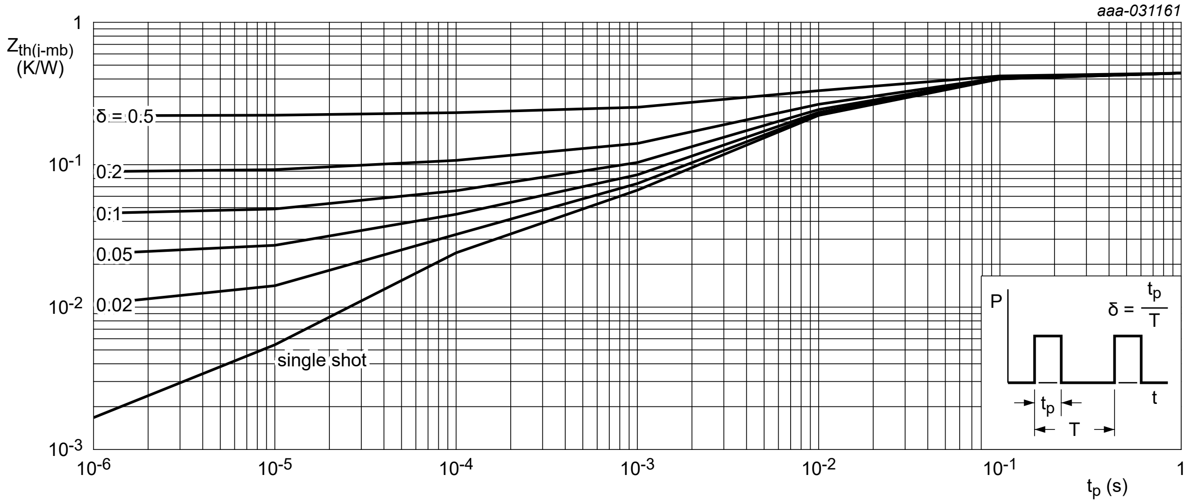
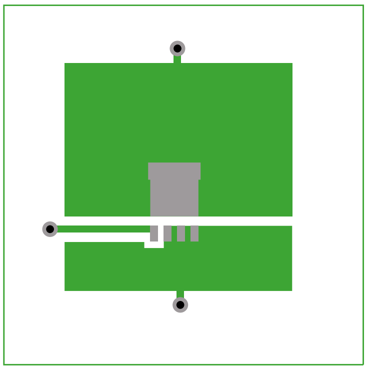


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration



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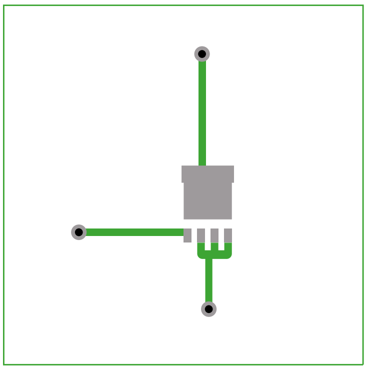
Copper square 25.4 mm x 25.4 mm; 70 µm thick on FR4 board

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



aaa-029384

70 µm thick copper on FR4 board

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

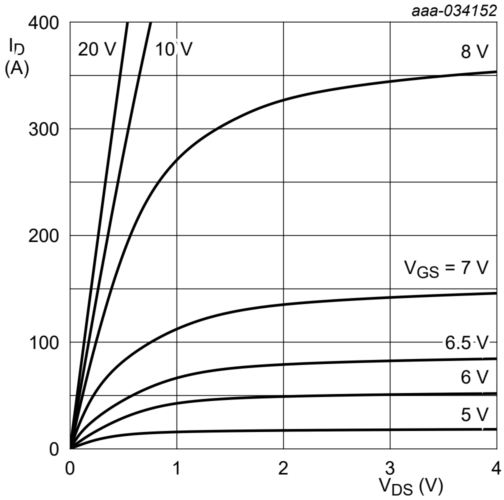
10. Characteristics

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		80	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		72	-	-	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		-	-6.4	-	mV/K
I_{DSS}	drain leakage current	V_{DS} = 80 V; V_{GS} = 0 V; T_j = 25 °C		-	0.02	1	µA
		V_{DS} = 16 V; V_{GS} = 0 V; T_j = 125 °C		-	3	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		-	1.6	1.9	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	2.6	3	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 13		-	-	4.2	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		0.8	1.6	3.2	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 40 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		77	155	232	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		-	83	-	nC

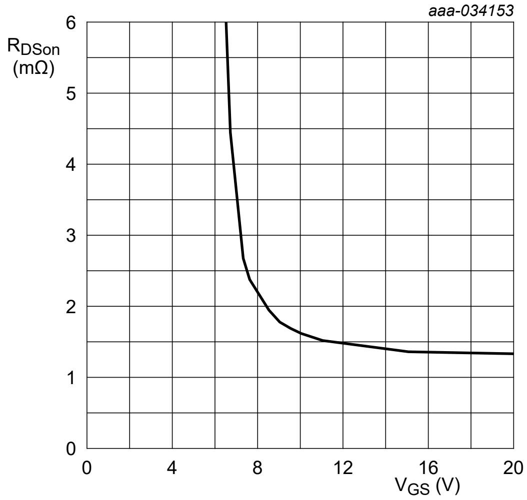
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Q_{GS}	gate-source charge	I_D = 25 A; V_{DS} = 40 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		36	60	84	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	34	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	26	-	nC
Q_{GD}	gate-drain charge			7	23	53	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 25 A; V_{DS} = 40 V; T_j = 25 °C; Fig. 14; Fig. 15		-	5.2	-	V
C_{iss}	input capacitance	V_{DS} = 40 V; V_{GS} = 0 V; f = 0.5 MHz; T_j = 25 °C; Fig. 16		7340	12235	17140	pF
C_{oss}	output capacitance			1710	2843	4560	pF
C_{rss}	reverse transfer capacitance			7	64	169	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 40 V; R_L = 1.6 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 5 Ω; T_j = 25 °C		-	46	-	ns
t_r	rise time			-	42	-	ns
$t_{d(off)}$	turn-off delay time			-	79	-	ns
t_f	fall time			-	46	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 17		-	0.78	1	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 40 V; T_j = 25 °C; Fig. 18		-	54	-	ns
Q_r	recovered charge		[1]	-	60	-	nC

[1] includes capacitive recovery



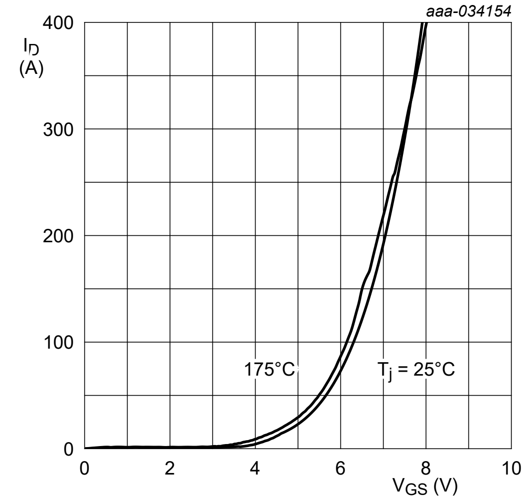
T_j = 25 °C

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



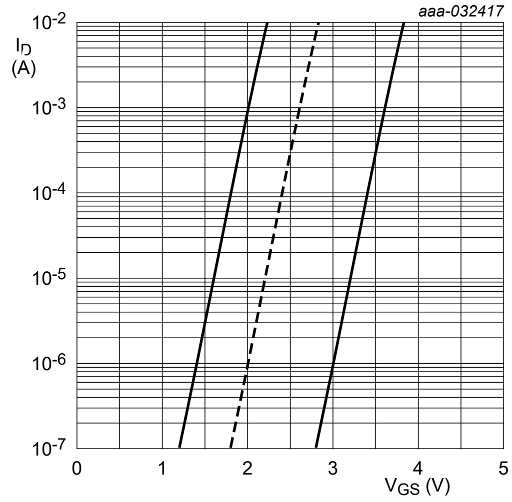
T_j = 25 °C; I_D = 25 A

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



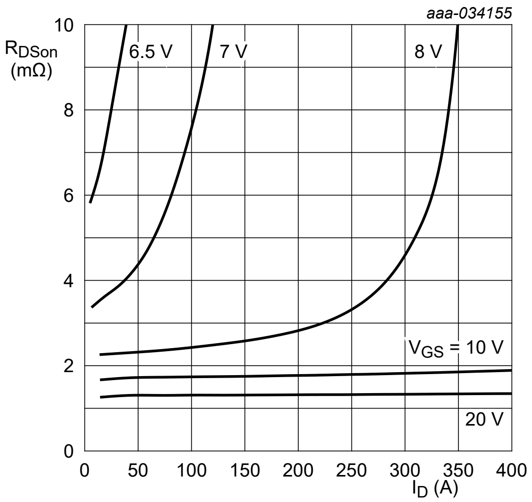
V_{DS} = 8 V

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



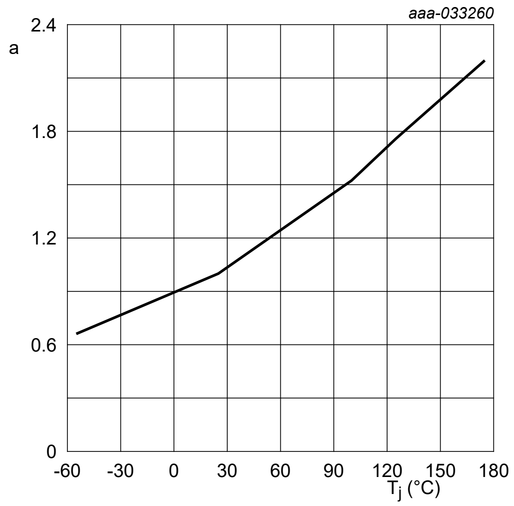
T_j = 25 °C; V_{DS} = 5 V

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



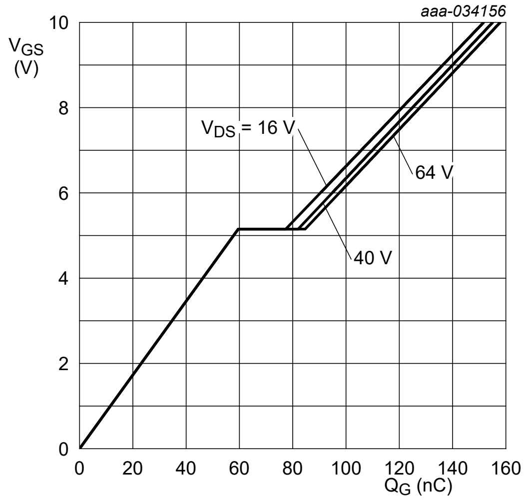
T_j = 25 °C

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



T_j = 25 °C; I_D = 25 A

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

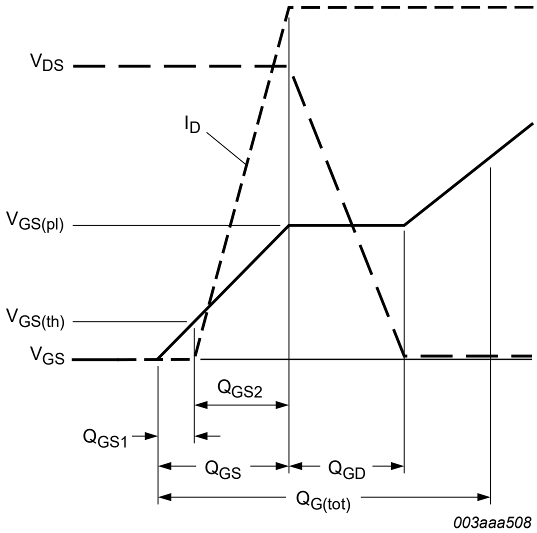
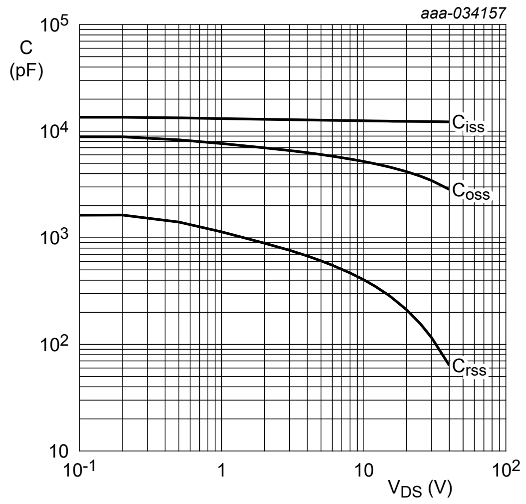
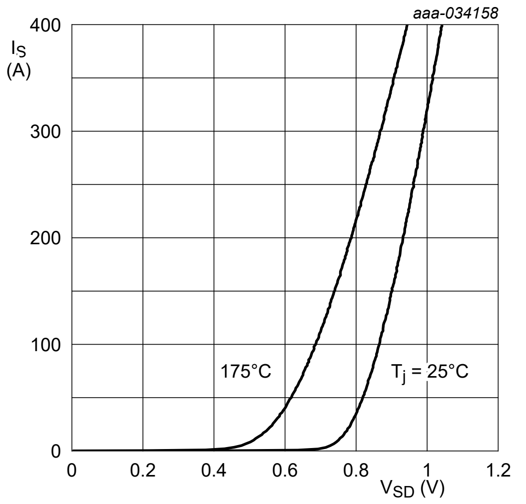


Fig. 15. Gate charge waveform definitions



V_{GS} = 0 V; f = 1 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

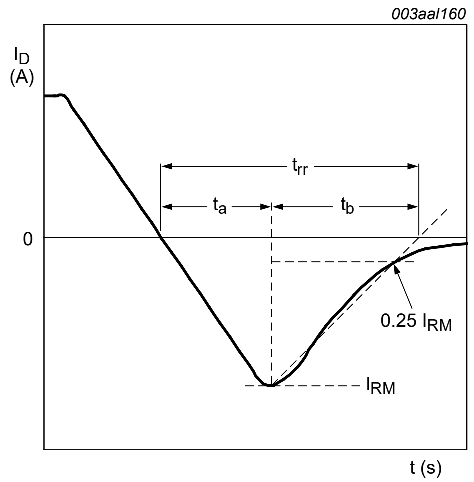
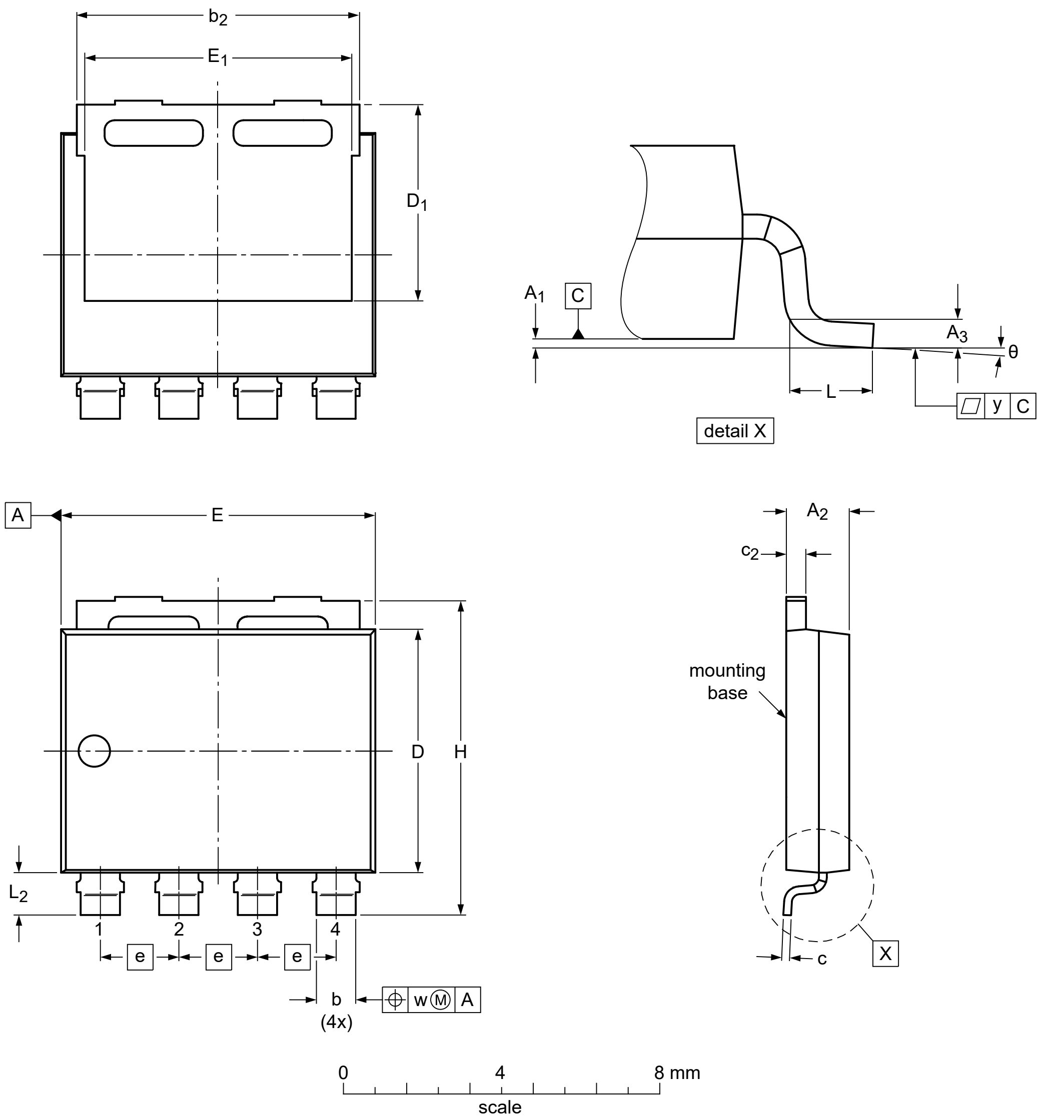


Fig. 18. Reverse recovery timing definition

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)

12. Soldering

Footprint information for reflow soldering of LFPAK88 package **SOT1235**

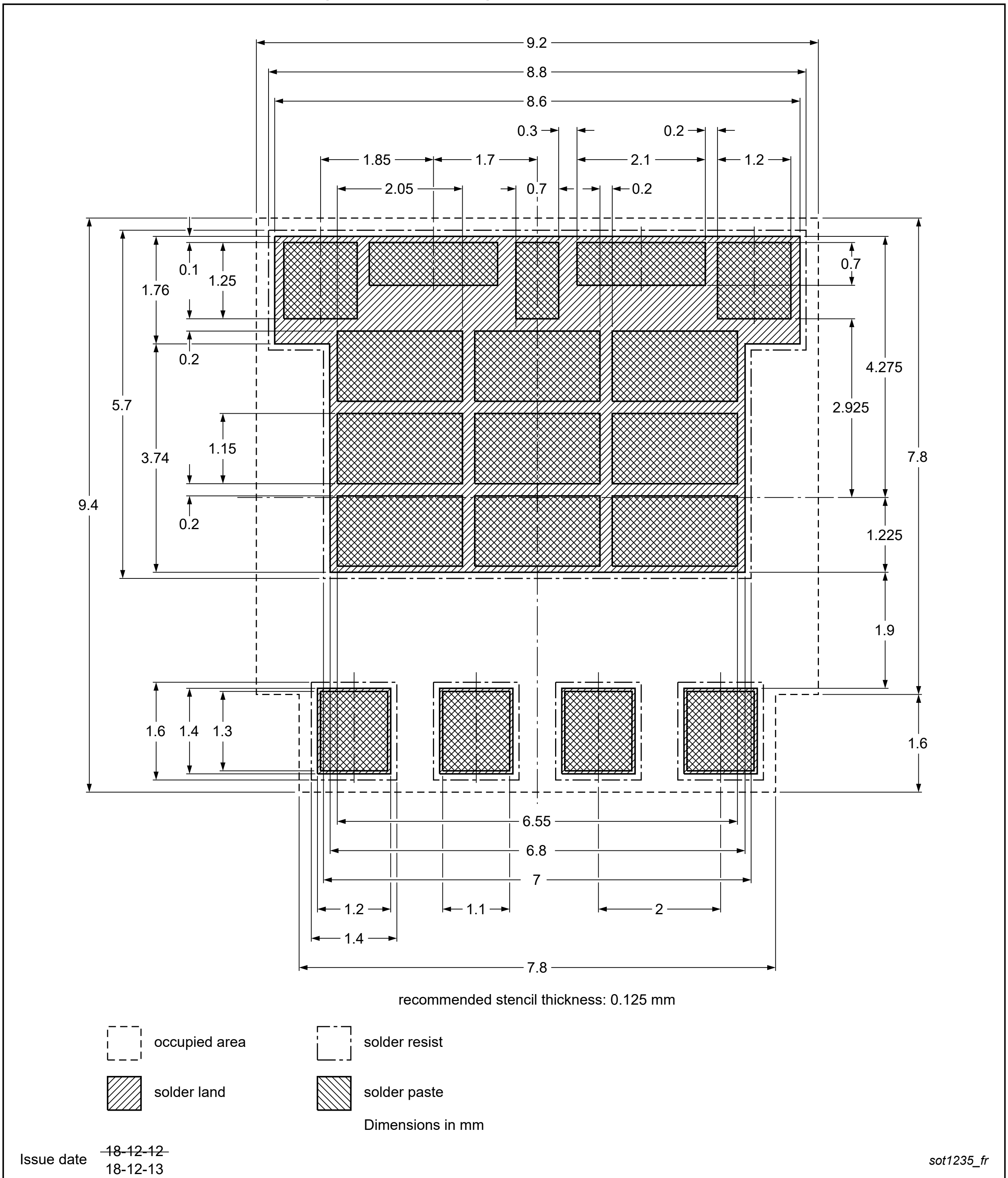


Fig. 20. Reflow soldering footprint for LFPAK88 (SOT1235)

13. Legal information

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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