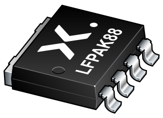

PSMN2R3-100SSJ

N-channel 100 V, 2.3 mOhm ASFET with enhanced dynamic current sharing in LFPAK88

24 October 2024 Objective data sheet

1. General description

In high-power applications, it is common practice to connect two or more MOSFETs in parallel to provide high current capability. Even when the gates are driven from the same gate driver, it can be challenging to ensure that MOSFETs share the load current equally.

Small differences in $V_{GS(th)}$ for individual devices cause the MOSFET with the lowest $V_{GS(th)}$ to turn-on first, taking a larger share of the load current during the dynamic switching phase.

The difference in load current between individual MOSFETs ΔI_D can be significant often leading to differential heating and potential accelerated failure.

One method to reduce the ΔI between MOSFETs is to select devices with matched $V_{GS(th)}$, but testing & sorting MOSFETs with matched $V_{GS(th)}$ can be a difficult process. $V_{GS(th)}$ is typically measured at ΔI_D < 1 mA and is influenced by temperature also.

ASFETs with enhanced dynamic current sharing are designed to show significantly improved current sharing with low ΔI_D when connected in parallel applications, they also deliver improved temperature stability showing lower ΔI_D due to temperature differences across the PCB.

2. Features and benefits

- Removes the need for $V_{GS(th)}$ matching
- Low ΔI_D enhances current sharing in parallel applications
- Less sensitive to temperature differences across the PCB
- Reduced $V_{GS(th)}$ spread
- Low R_{DSon}
- 255 A continuous I_D Max
- Avalanche rated, 100% tested
- Compact and Reliable 8x8 LFPAK88 package, qualified to 175 °C

3. Applications

- Applications using MOSFETs in parallel
- Applications utilizing MOSFETs with matched $V_{GS(th)}$
- High-power 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		-	-	100	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	-	255	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	341	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C		-	1.8	2.3	mΩ

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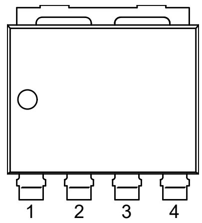
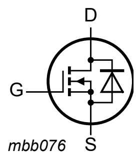
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Dynamic characteristics							
Q_{GD}	gate-drain charge	I_D = 25 A; V_{DS} = 50 V; V_{GS} = 10 V		5	17	39	nC
Source-drain diode							
Q_r	recovered charge	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 50 V; Fig. 10	[1]	-	121	-	nC

[1] 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
PSMN2R3-100SSJ	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. Limiting values

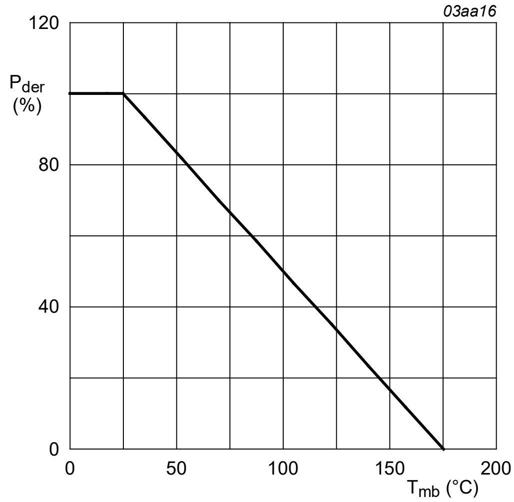
Table 4. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	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		-	255	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	180	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	1020	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		-	255	A

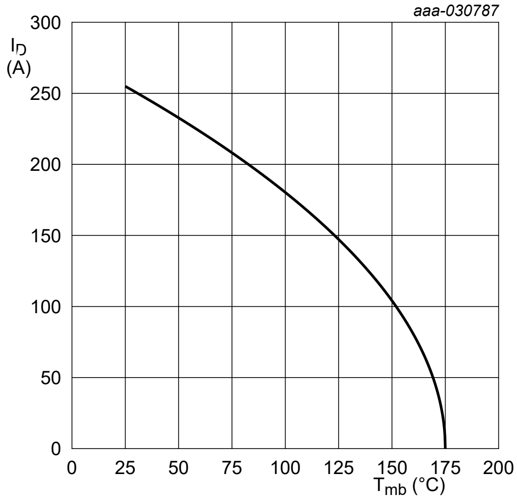
Symbol	Parameter	Conditions		Min	Max	Unit
I_{SM}	peak source current	pulsed; $t_p \leq$ 10 µs; T_{mb} = 25 °C		-	1020	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 82 A; $V_{sup} \leq$ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 137 µs; Fig. 3	[1]	-	732	mJ
I_{AS}	non-repetitive avalanche current	$V_{sup} \leq$ 100 V; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; R_{GS} = 50 Ω; Fig. 3	[1]	-	82	A

[1] Protected by 100% test



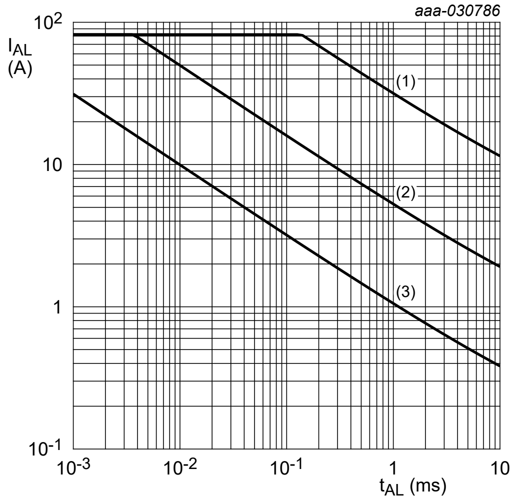
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



$V_{GS} \geq$ 10 V
(1) 255A 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



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

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

8. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 4		-	0.2	0.44	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5		-	35	-	K/W
		Fig. 6		-	70	-	K/W

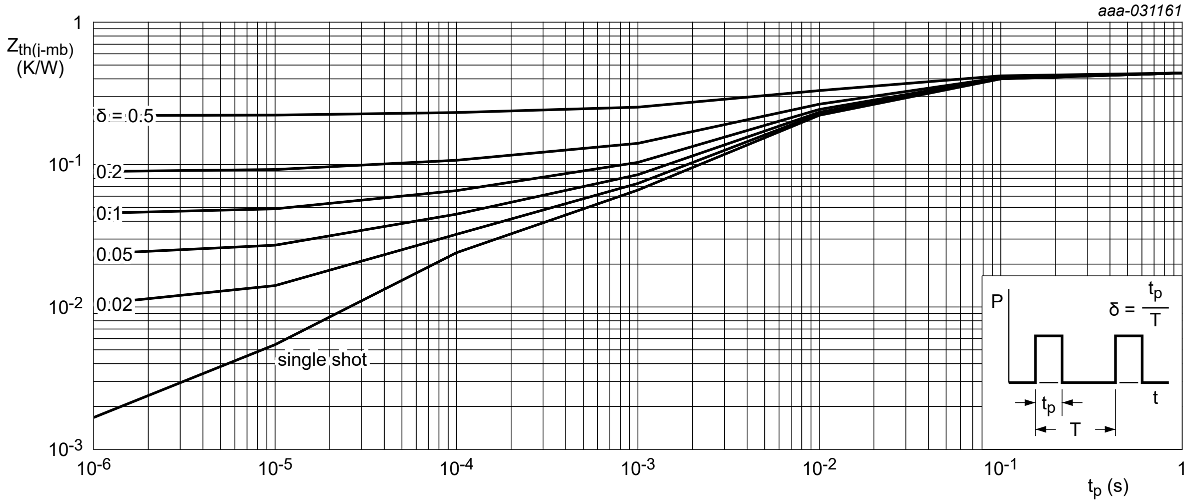
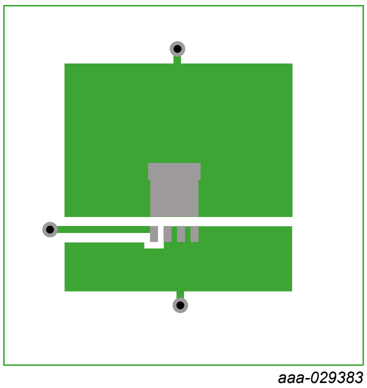
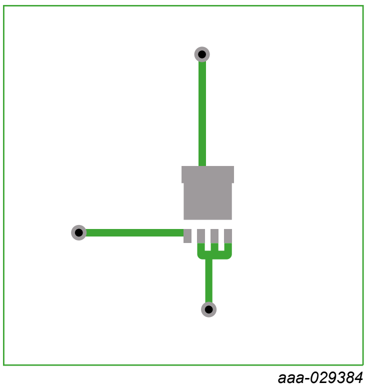


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration



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

Fig. 5. PCB layout for resistance from junction to ambient



70 µm thick copper on FR4 board

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

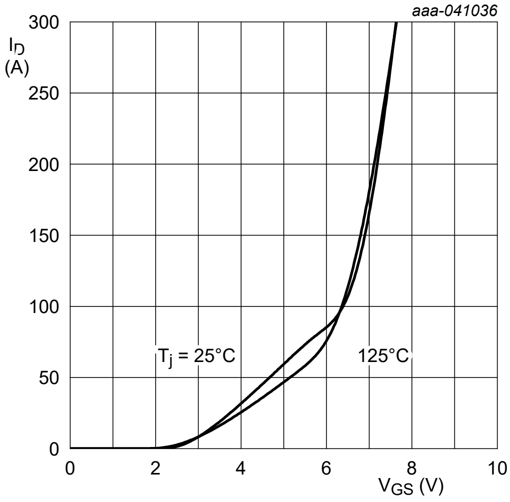
9. Characteristics

Table 6. 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

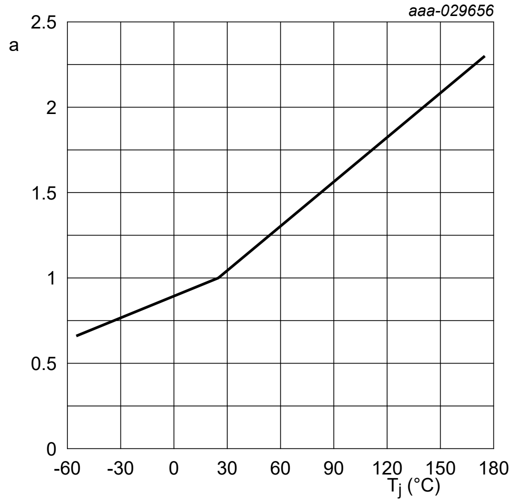
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C		1	1.8	3	V
		I_D = 100 mA; V_{DS}=V_{GS}; T_j = 25 °C		-	2.2	-	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55 °C		-	2.1	-	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = 175 °C		-	1.1	-	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	25 °C ≤ T_j ≤ 150 °C		-	-4.5	-	mV/K
I_{DSS}	drain leakage current	V_{DS} = 100 V; V_{GS} = 0 V; T_j = 25 °C		-	0.1	1	µA
		V_{DS} = 100 V; V_{GS} = 0 V; T_j = 125 °C		-	66	200	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		-	1.8	2.3	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 8		-	2.9	3.6	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 8		-	3.7	5.2	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		0.7	1.4	2.8	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 50 V; V_{GS} = 10 V		131	263	395	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V		-	[tbd]	-	nC
Q_{GS}	gate-source charge	I_D = 25 A; V_{DS} = 50 V; V_{GS} = 10 V		49	81	113	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	58	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	23	-	nC
Q_{GD}	gate-drain charge			5	17	39	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 25 A; V_{DS} = 50 V		-	4	-	V
C_{iss}	input capacitance	V_{DS} = 50 V; V_{GS} = 0 V; f = 0.5 MHz; T_j = 25 °C		12840	21400	29960	pF
C_{oss}	output capacitance			1600	2670	4300	pF
C_{rss}	reverse transfer capacitance			4	36	94	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		-	53	-	ns
t_r	rise time			-	56	-	ns
$t_{d(off)}$	turn-off delay time			-	180	-	ns
t_f	fall time			-	83	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 9		-	0.8	1	V
t_{rr}	reverse recovery time	I_S = 25 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 50 V; Fig. 10		-	67	-	ns
Q_r	recovered charge		[1]	-	121	-	nC

[1] includes capacitive recovery



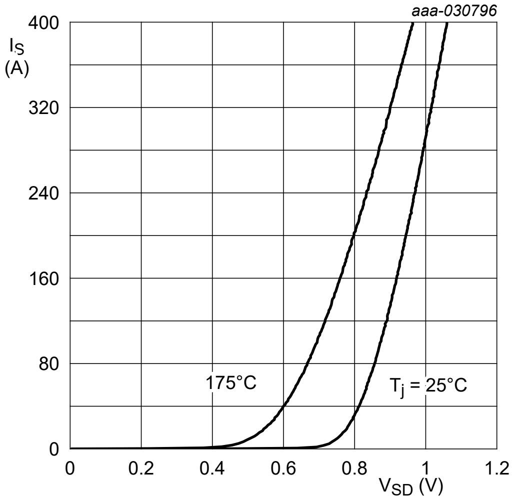
V_{DS} = 8 V

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



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

Fig. 8. Normalized drain-source on-state resistance factor as a function of junction temperature



V_{GS} = 0 V

Fig. 9. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

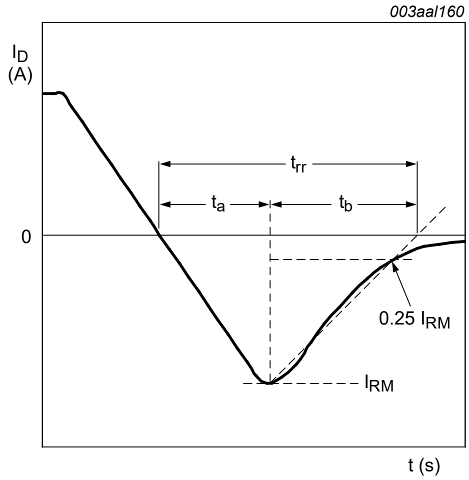
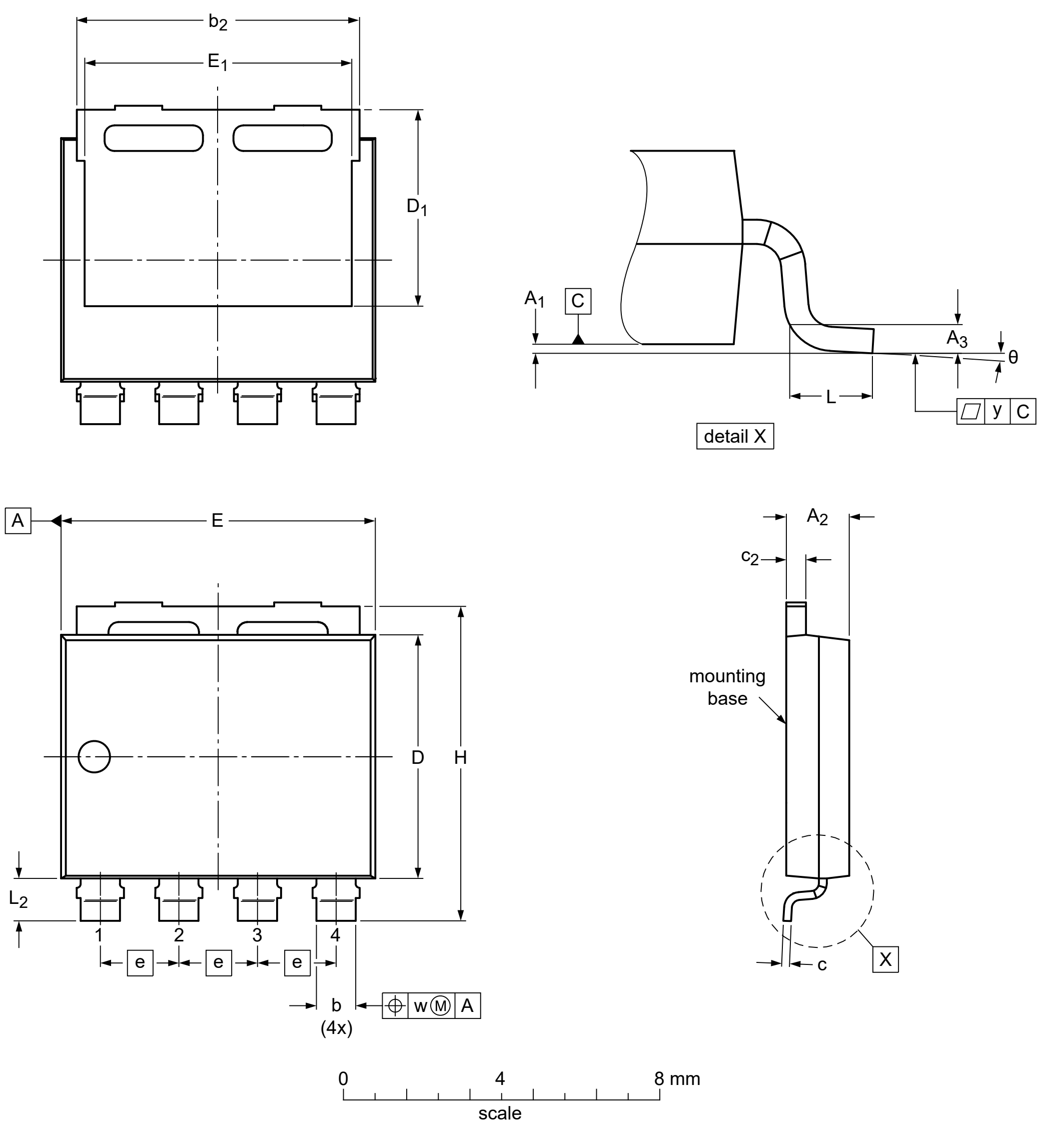


Fig. 10. Reverse recovery timing definition

10. 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

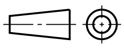
Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1235						~~17-08-02~~ 17-08-07

Fig. 11. Package outline LFPAK88 (SOT1235)

11. Soldering

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

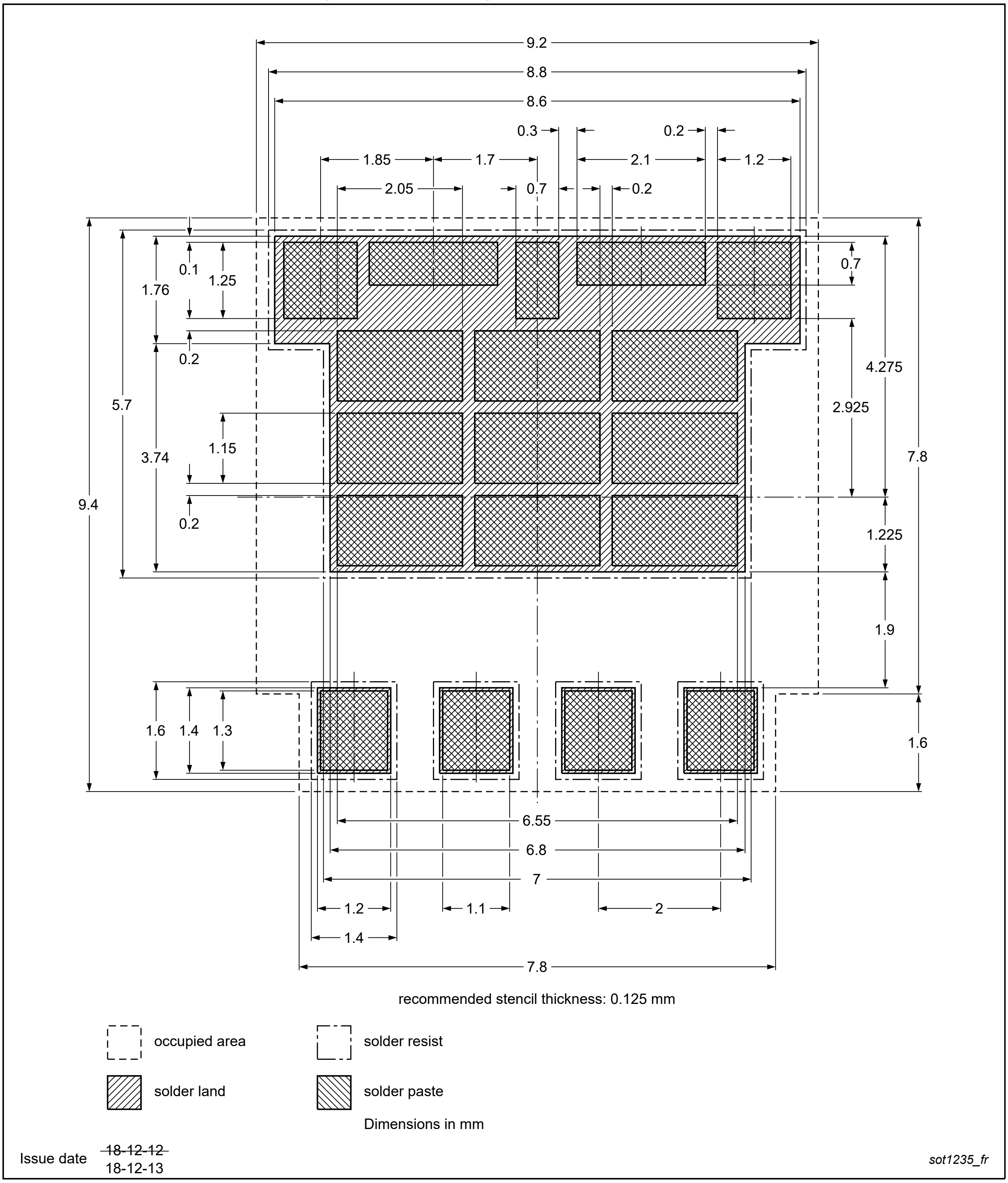


Fig. 12. Reflow soldering footprint for LFPAK88 (SOT1235)

12. 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.

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Date of release: 24 October 2024