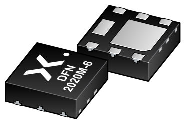


PSMN047-100NSE

N-channel 100 V, 53 mOhm standard level ASFET with enhanced SOA in DFN2020 package. Recommended for fault tolerant applications including high power PoE, inrush management, eFuse and relay replacement

2 October 2023 **Product data sheet**

1. General description

New standards and proprietary approaches are enabling Power-over-Ethernet (PoE) systems capable of delivering up to 90 W to each powered device (PD). Such solutions place increased demands on the power sourcing equipment (PSE) in terms of "soft-start", thermal management and power density requirements. These ASFETs combine enhanced SOA in a compact 2 mm x 2 mm footprint making them ideally placed for a variety of applications including PoE, eFuse and relay replacement.

2. Features and benefits

- Enhanced safe operating area (SOA) for superior linear mode operation
- Low R_{DSon} for low I^2R conduction losses
- 2 mm x 2 mm space-saving DFN2020 package, 60% smaller than LFPAK33
- Very low I_{DSS} leakage

3. Applications

- High power PoE applications (60 W and higher)
- IEEE802.3at and proprietary PoE solutions
- Fault tolerant load switch - Inrush management and eFuse applications
- Battery management applications
- Relay replacement
- WIFI hotspots
- 5G picocells
- CCTV

4. Quick reference data

Table 1. Quick reference data

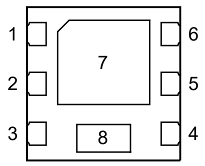
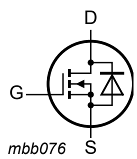
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	25 °C ≤ T_j ≤ 175 °C		-	-	100	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	-	18.4	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	42	W
T_j	junction temperature			-55	-	175	°C
Static characteristics							
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 5 A; T_j = 25 °C; Fig. 11		-	42	53.4	mΩ
		V_{GS} = 10 V; I_D = 5 A; T_j = 100 °C; Fig. 12		-	66	85	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	I_D = 5 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 13; Fig. 14		0.5	1.5	3.5	nC
$Q_{G(tot)}$	total gate charge			4.5	9	13.5	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 10.6 A; V_{sup} ≤ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 20 µs; Fig. 4	[1]	-	-	13.8	mJ
Source-drain diode							
Q_r	recovered charge	I_S = 5 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 50 V; T_j = 25 °C; Fig. 17		-	22.3	-	nC

[1] Protected by 100% test

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	D	drain	 Transparent top view **DFN2020M-6 (SOT1220-2)**	
2	D	drain		
3	G	gate		
4	S	souce		
5	D	drain		
6	D	drain		
7	D	drain		
8	S	souce		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN047-100NSE	DFN2020M-6	plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm	SOT1220-2

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN047-100NSE	ZT

8. Limiting values

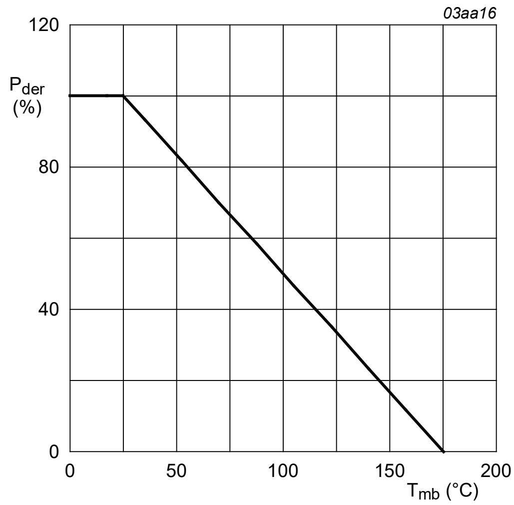
Table 5. Limiting values

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	-	42	W

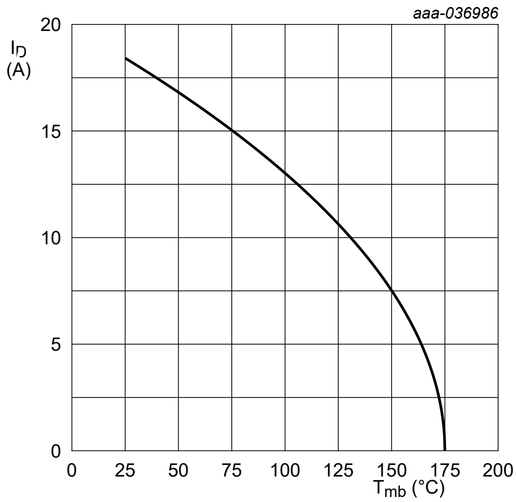
Symbol	Parameter	Conditions		Min	Max	Unit
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	18.4	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	13	A
I_{DM}	peak drain current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C; Fig. 3		-	74	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C		-	18.4	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	74	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 10.6 A; V_{sup} ≤ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 20 µs; Fig. 4	[1]	-	13.8	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]	-	10.6	A

[1] Protected by 100% test



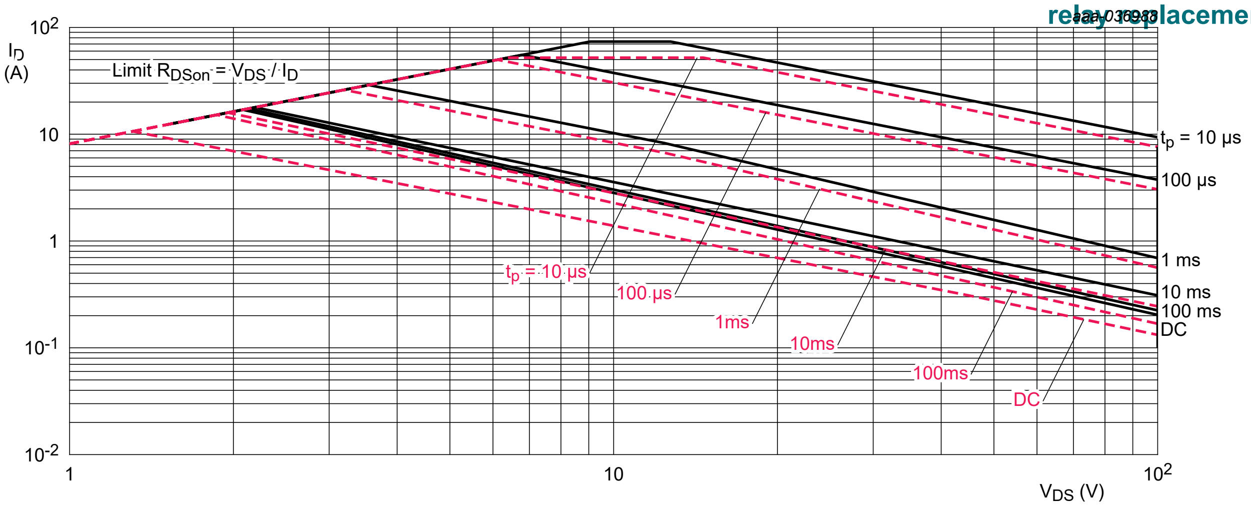
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



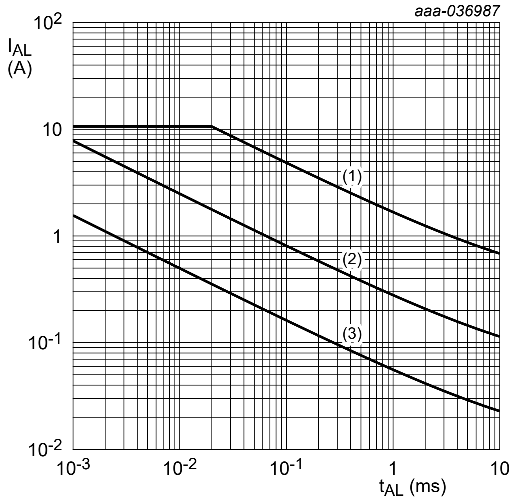
VGS ≥ 10 V
18.4 A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

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



T_{mb} = 25 °C (solid black 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
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 5		-	3.2	3.6	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 6		-	63	-	K/W
		Fig. 7		-	239	-	K/W

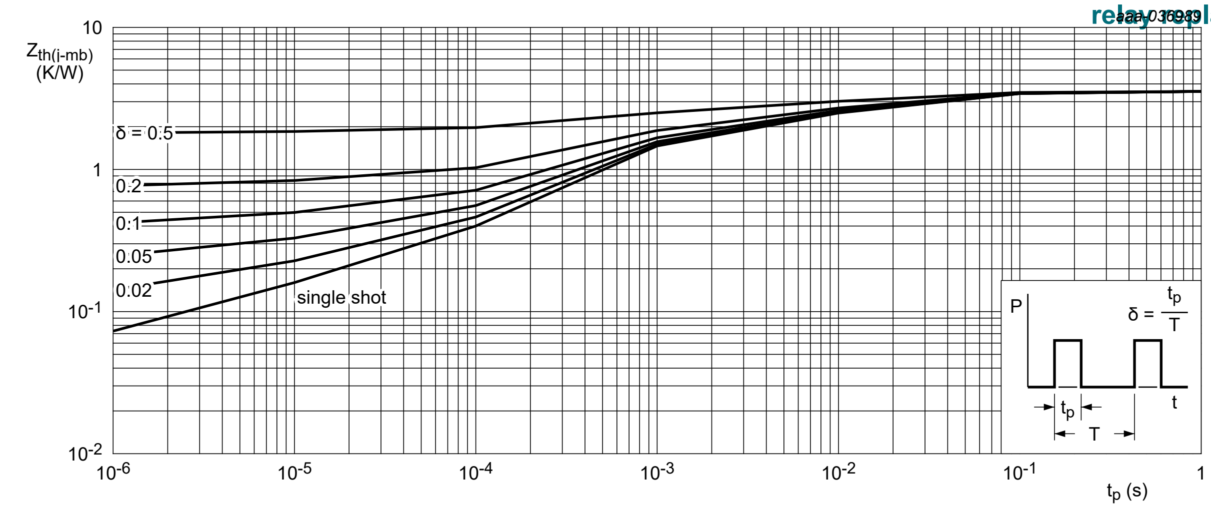
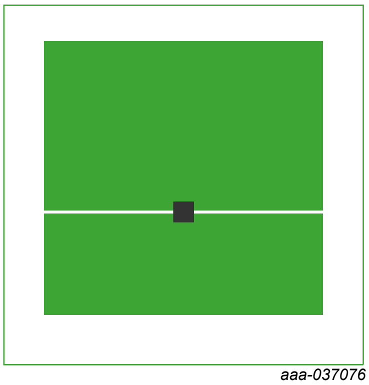
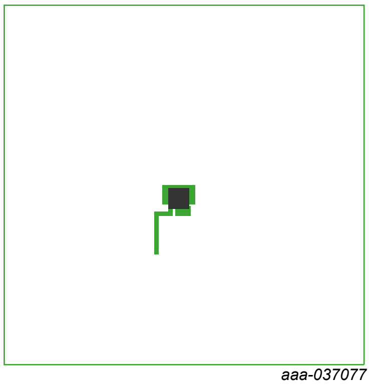


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration



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

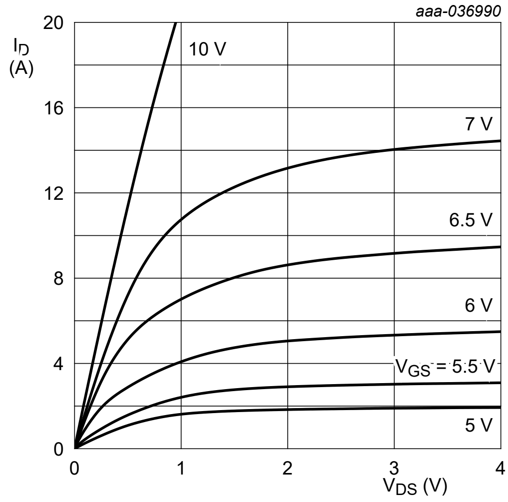
Fig. 7. PCB layout with minimum footprint for thermal resistance from junction to ambient

10. Characteristics

Table 7. Characteristics

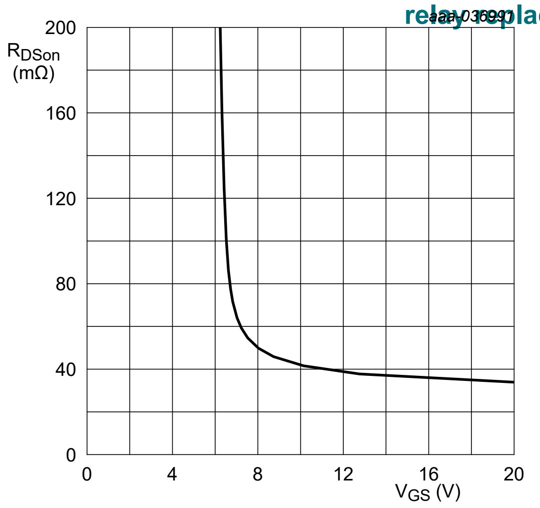
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		100	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C		2	2.8	3.6	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = 175 °C		-	1.9	-	V
		I_D = 1 mA; V_{DS}=V_{GS}; T_j = -55 °C		-	3.1	-	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	25 °C ≤ T_j ≤ 150 °C		-	-5.2	-	mV/K
I_{DSS}	drain leakage current	V_{DS} = 100 V; V_{GS} = 0 V; T_j = 25 °C		-	0.01	1	µA
		V_{DS} = 100 V; V_{GS} = 0 V; T_j = 125 °C		-	1.3	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

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 5 A; T_j = 25 °C; Fig. 11		-	42	53.4	mΩ
		V_{GS} = 10 V; I_D = 5 A; T_j = 100 °C; Fig. 12		-	66	85	mΩ
		V_{GS} = 10 V; I_D = 5 A; T_j = 175 °C; Fig. 12		-	93	121	mΩ
R_G	gate resistance	f = 1 MHz; T_j = 25 °C		0.5	1	2	Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 5 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 13; Fig. 14		4.5	9	13.5	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V; T_j = 25 °C		-	8	-	nC
Q_{GS}	gate-source charge	I_D = 5 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 13; Fig. 14		2.4	4	5.6	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	2	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	2	-	nC
Q_{GD}	gate-drain charge			0.5	1.5	3.5	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 5 A; V_{DS} = 50 V; T_j = 25 °C; Fig. 13; Fig. 14		-	5.9	-	V
C_{iss}	input capacitance	V_{DS} = 50 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 15		363	605	847	pF
C_{oss}	output capacitance			91.2	152	243	pF
C_{rss}	reverse transfer capacitance			0.6	5.7	15	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 50 V; R_L = 10 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 5 Ω; T_j = 25 °C		-	4.4	-	ns
t_r	rise time			-	3.3	-	ns
$t_{d(off)}$	turn-off delay time			-	6.2	-	ns
t_f	fall time			-	6.1	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 5 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 16		-	0.85	1	V
t_{rr}	reverse recovery time	I_S = 5 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 50 V; T_j = 25 °C; Fig. 17		-	28.5	-	ns
Q_r	recovered charge			-	22.3	-	nC



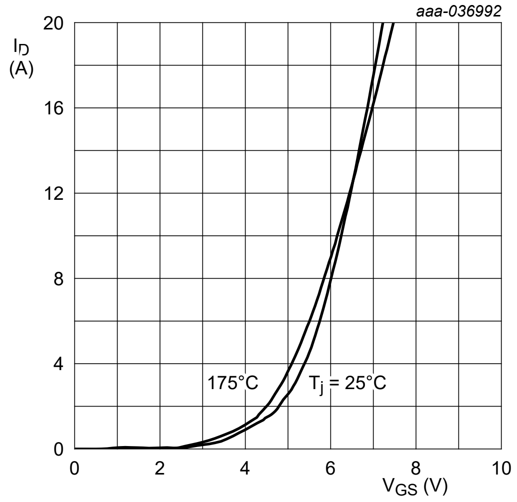
T_j = 25 °C

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



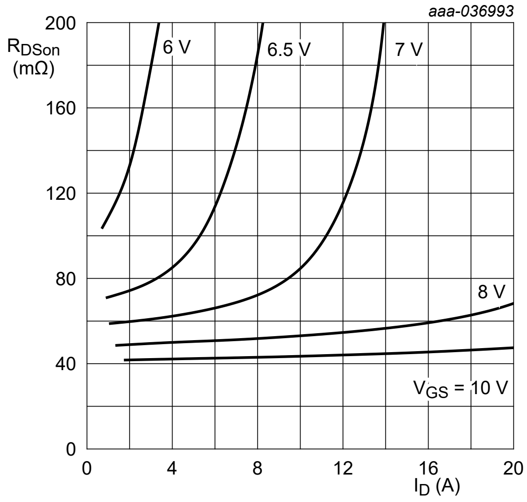
T_j = 25 °C; I_D = 5 A

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



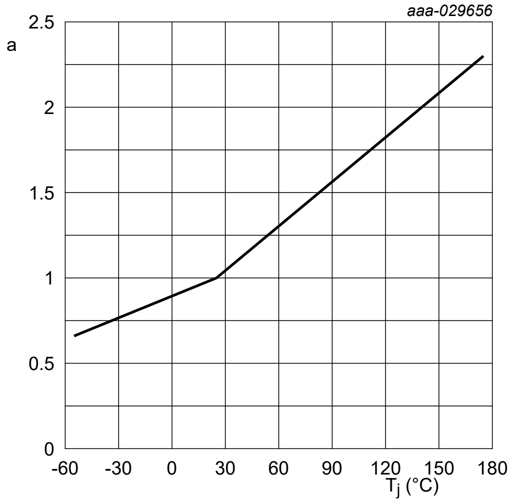
V_{DS} = 8 V

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



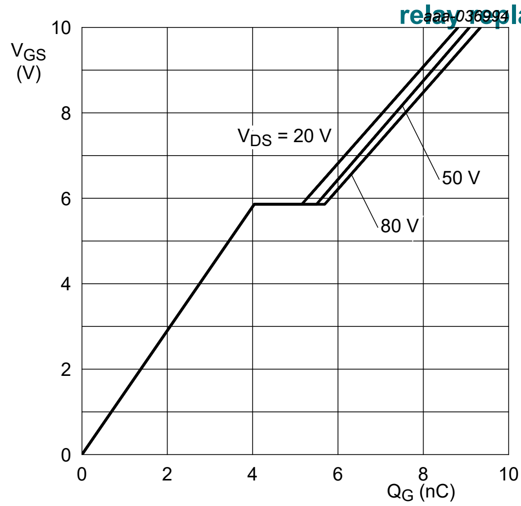
T_j = 25 °C

Fig. 11. Drain-source on-state resistance as a function of drain current; typical values



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

Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature



T_j = 25 °C; I_D = 5 A

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

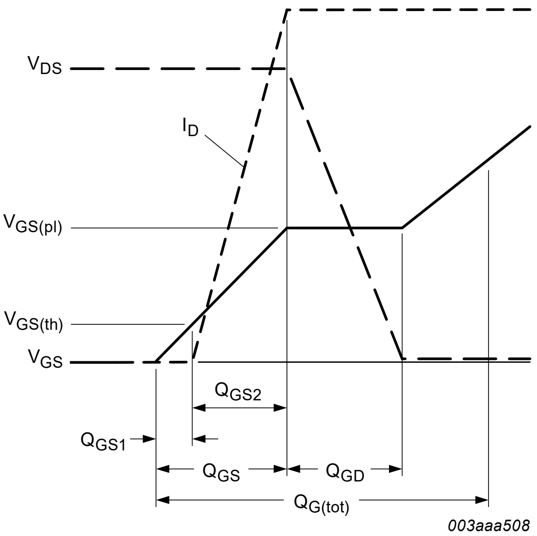
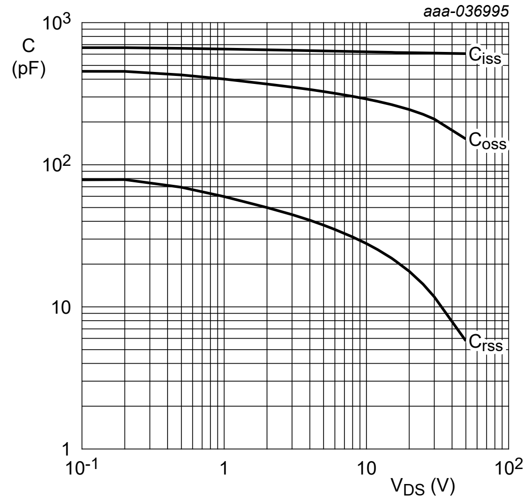


Fig. 14. Gate charge waveform definitions



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

Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

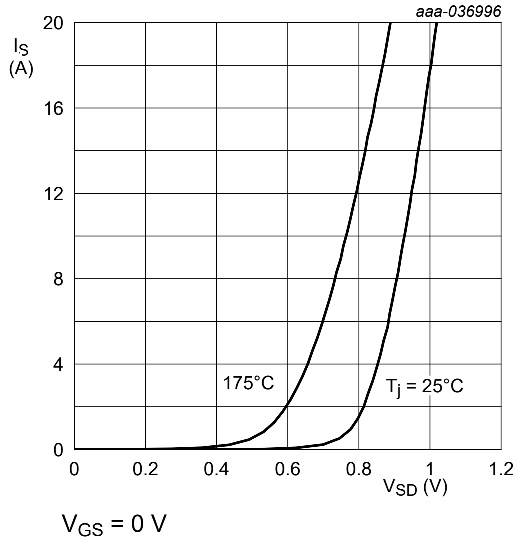


Fig. 16. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

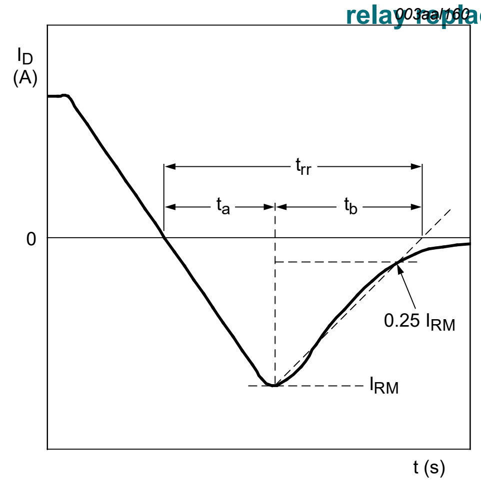
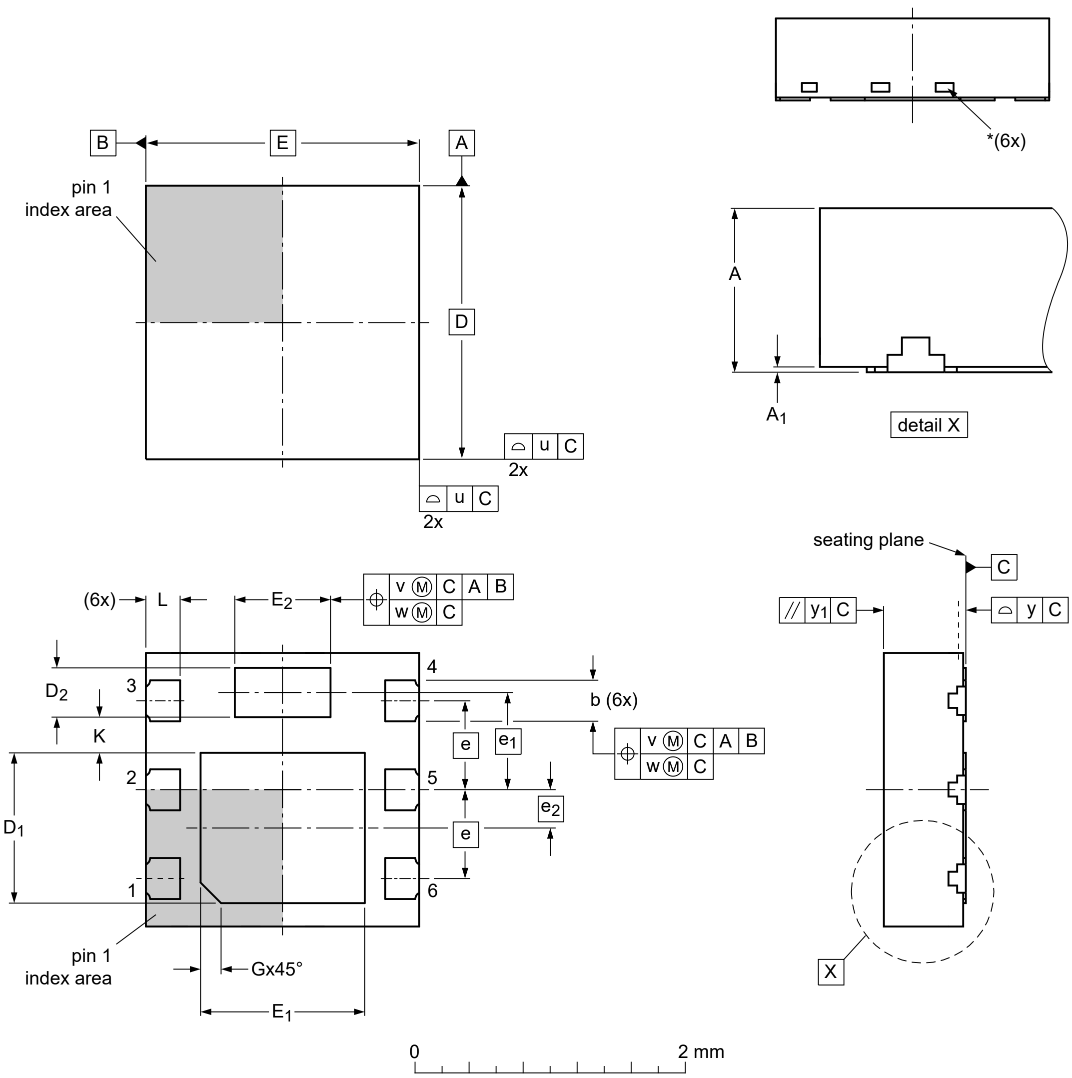


Fig. 17. Reverse recovery timing definition

11. Package outline

DFN2020M-6: plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm **SOT1220-2**



Dimensions (mm are the original dimensions)

Unit		A	A_1	b	D	D_1	D_2	E	E_1	E_2	e	e_1	e_2	G	K	L	u	v	w	y	y_1
	min	0.55	0	0.25		1.0	0.31		1.1	0.6					0.2	0.20					
mm	nom	0.60	0.02	0.30	2	1.1	0.36	2	1.2	0.7	0.65	0.71	0.28	0.15 (ref)		0.25	0.05	0.1	0.05	0.05	0.05
	max	0.65	0.04	0.35		1.2	0.41		1.3	0.8						0.30					

Note
1. Dimension A is including plating thickness.
2. * Visible depend upon used manufacturing technology.

sot1220-2_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1220-2		- - -				~~20-03-31~~ 20-04-01

Fig. 18. Package outline DFN2020M-6 (SOT1220-2)

12. Soldering

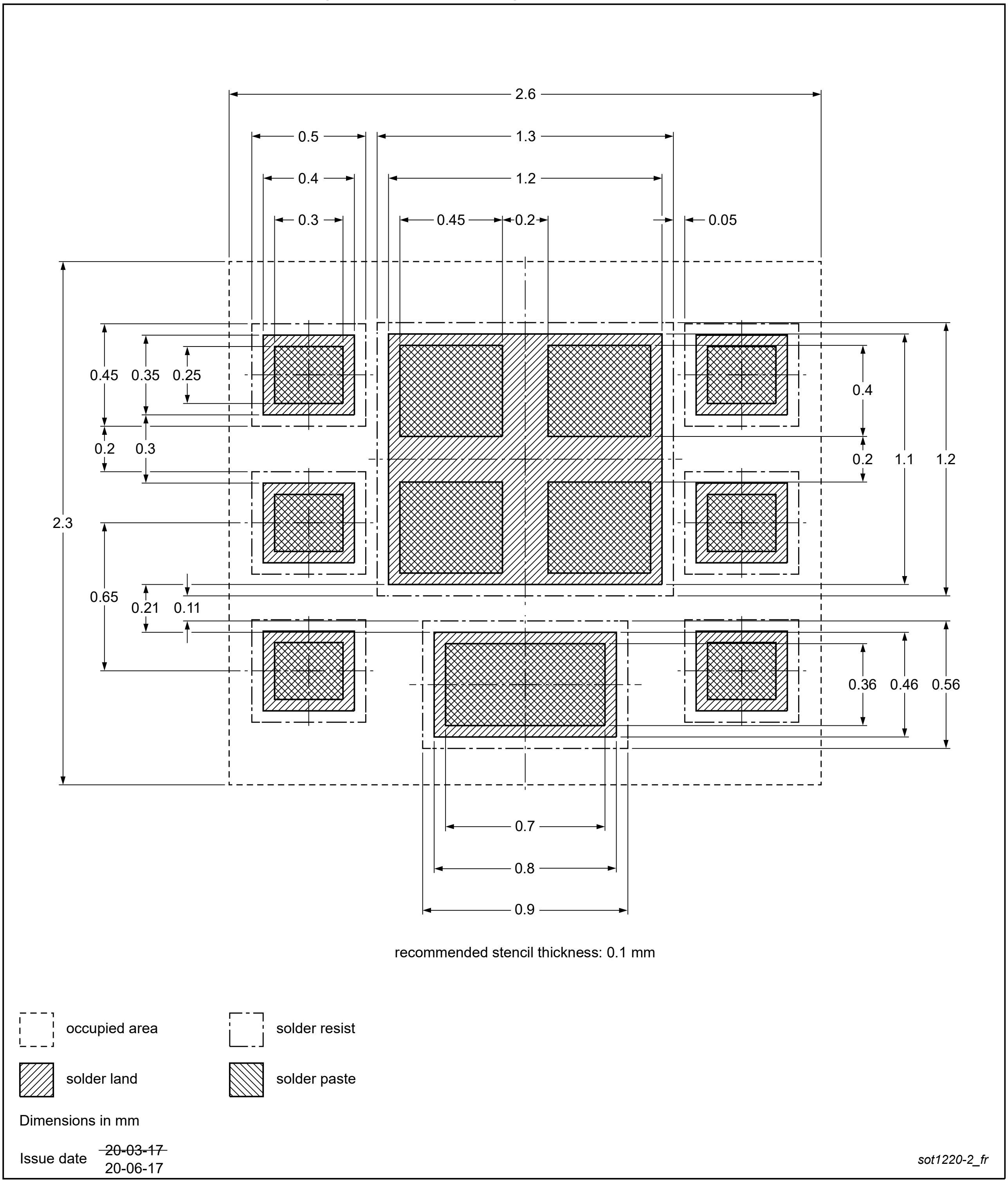


Fig. 19. Reflow soldering footprint for DFN2020M-6 (SOT1220-2)

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".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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