PSMN5R5-100YSF

NextPower 100 V, 5.6 mOhm N-channel MOSFET in LFPAK56 package

29 April 2022 | Preliminary data sheet

1. General description

NextPower 100 V, standard level gate drive MOSFET. Qualified to 175 °C and recommended for industrial and consumer applications.

2. Features and benefits

- Low Q_{rr} for higher efficiency and lower spiking
- Low Q_G × R_{DSon} FOM for high efficiency switching applications
- 115 A $I_{D(max)}$ – demonstrated continuous current rating
- Strong avalanche energy rating (E_{AS})
- Avalanche rated and 100% tested
- Ha-free and RoHS compliant LFPAK56 package
- Wave-solderable LFPAK56 package

3. Applications

- Synchronous rectifier in AC-DC and DC-DC
- Primary side switch – 48 V DC-DC
- BLDC motor control
- USB-PD and mobile fast-charge adapters
- Flyback and resonant topologies
- Full-bridge and half-bridge applications

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		-	-	115	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; Fig. 1		-	-	238	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		-	4.5	5.6	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	6.9	8.9	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		3.5	11.8	27.1	nC
$Q_{G(tot)}$	total gate charge			32	64	95	nC

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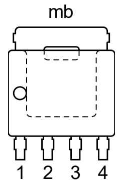
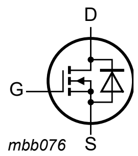
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Avalanche ruggedness							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 44.1 A; V_{sup} ≤ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 80 µs; Fig. 4	[1]	-	-	231	mJ
Source-drain diode							
Q_r	recovered 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		-	30	-	nC

[1] Protected by 100% test

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 **LFPAK56; Power-SO8 (SOT669)**	
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain		

6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PSMN5R5-100YSF	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN5R5-100YSF	5F5S10Y

8. Limiting values

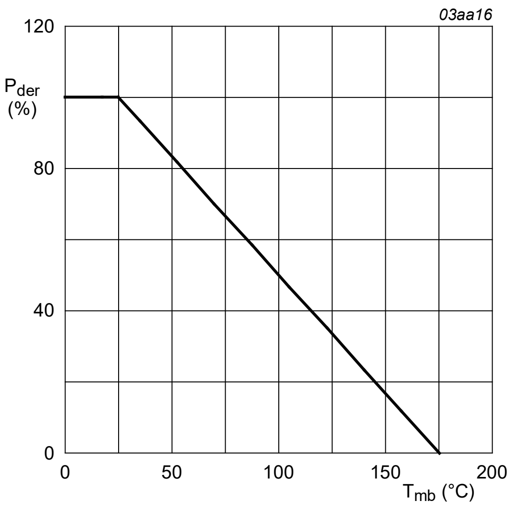
Table 5. Limiting values

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		-	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		-	238	W
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; Fig. 2		-	115	A
		V_{GS} = 10 V; T_{mb} = 100 °C; Fig. 2		-	96	A

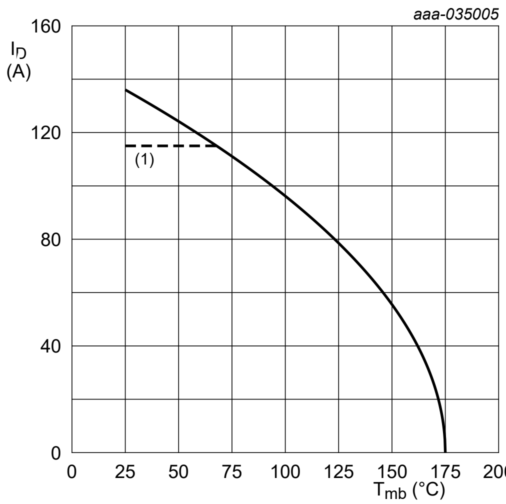
Symbol	Parameter	Conditions		Min	Max	Unit
I_{DM}	peak drain current	pulsed; $t_p \le$ 10 µs; T_{mb} = 25 °C; Fig. 3		-	544	A
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C		-	115	A
I_{SM}	peak source current	pulsed; $t_p \le$ 10 µs; T_{mb} = 25 °C		-	544	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 44.1 A; $V_{sup} \le$ 100 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped; t_p = 80 µs; Fig. 4	[1]	-	231	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]	-	44.1	A

[1] Protected by 100% test



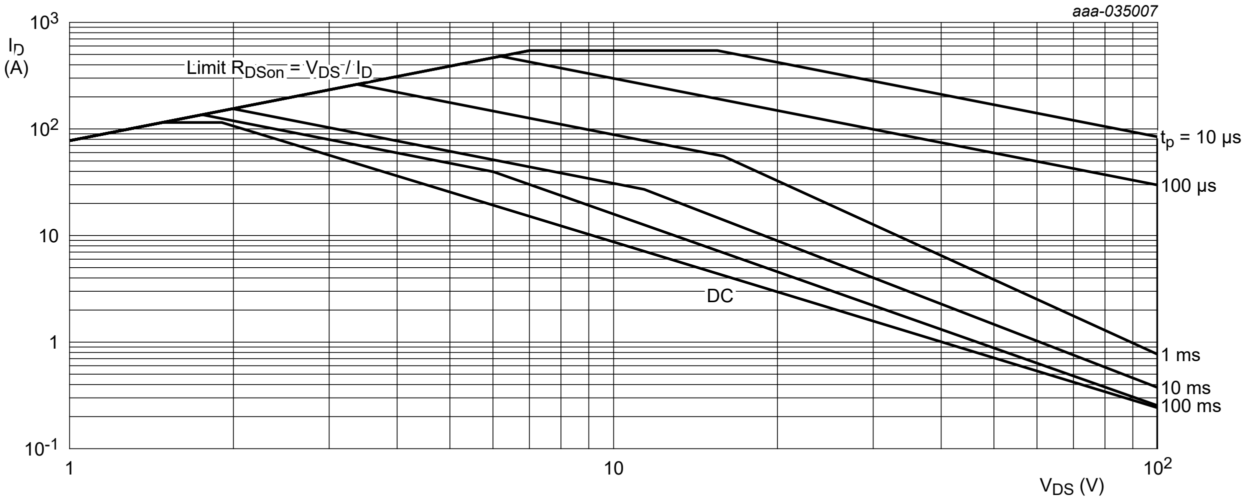
$$P_{der} = \frac{P_{tot}}{P_{tot(25°C)}} \times 100\,\%$$

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



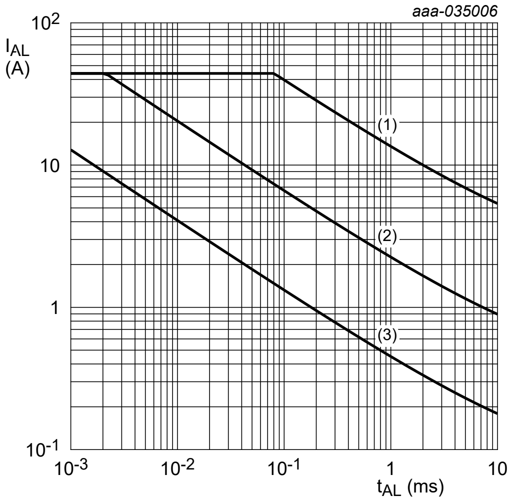
$V_{GS} \ge$ 10 V
(1) 115A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

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



T_{mb} = 25 °C; 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		-	0.56	0.63	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 6		-	42	-	K/W
		Fig. 7		-	85	-	K/W

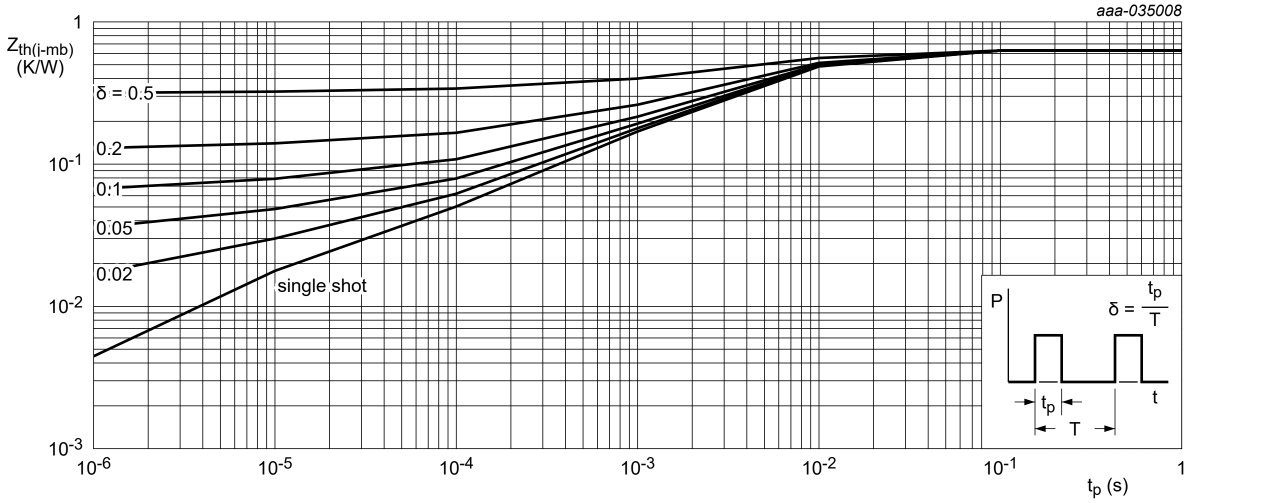
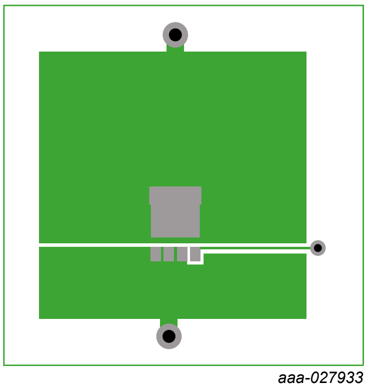
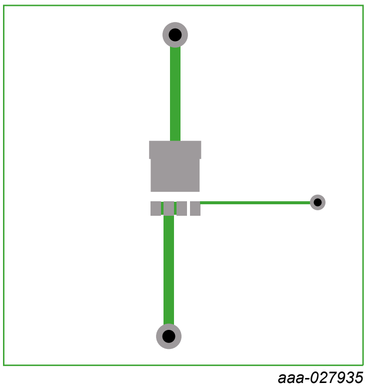


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration



Copper area 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

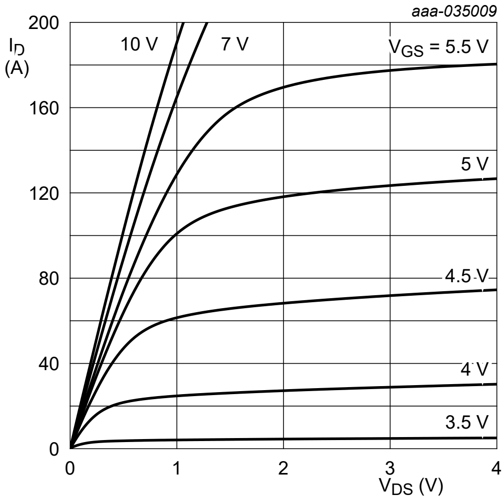
Fig. 7. PCB layout with minimum footprint for thermal resistance from junction to ambient

10. Characteristics

Table 7. Characteristics

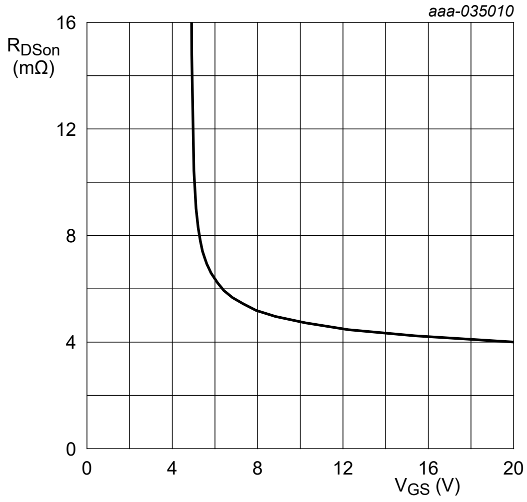
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		100	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS}=V_{GS}; T_j = 25 °C; Fig. 11		2	2.7	4	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		-	-6.8	-	mV/K
I_{DSS}	drain leakage current	V_{DS} = 100 V; V_{GS} = 0 V; T_j = 25 °C		-	0.04	1	µA
		V_{DS} = 100 V; V_{GS} = 0 V; T_j = 125 °C		-	13	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 = 25 A; T_j = 25 °C; Fig. 12		-	4.5	5.6	mΩ
		V_{GS} = 7 V; I_D = 25 A; T_j = 25 °C; Fig. 12		-	5	8.4	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 100 °C; Fig. 13		-	6.9	8.9	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; Fig. 13		-	9.8	12.7	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 = 25 A; V_{DS} = 50 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		32	64	95	nC
		I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V; T_j = 25 °C; Fig. 14; Fig. 15		-	32	-	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		10.3	17.1	24	nC
$Q_{GS(th)}$	pre-threshold gate-source charge			-	12	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge			-	4.8	-	nC
Q_{GD}	gate-drain charge			3.5	11.8	27.1	nC
$V_{GS(pl)}$	gate-source plateau voltage	I_D = 25 A; V_{DS} = 50 V; T_j = 25 °C; Fig. 14; Fig. 15		-	4.1	-	V
C_{iss}	input capacitance	V_{DS} = 50 V; V_{GS} = 0 V; f = 1 MHz; T_j = 25 °C; Fig. 16		2674	4456	6238	pF
C_{oss}	output capacitance			548	914	1462	pF
C_{rss}	reverse transfer capacitance			2	19	49	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		-	16	-	ns
t_r	rise time			-	14	-	ns
$t_{d(off)}$	turn-off delay time			-	42	-	ns
t_f	fall time			-	21	-	ns
Source-drain diode							
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 17		-	0.82	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; T_j = 25 °C; Fig. 18		-	37	-	ns
Q_r	recovered charge			-	30	-	nC



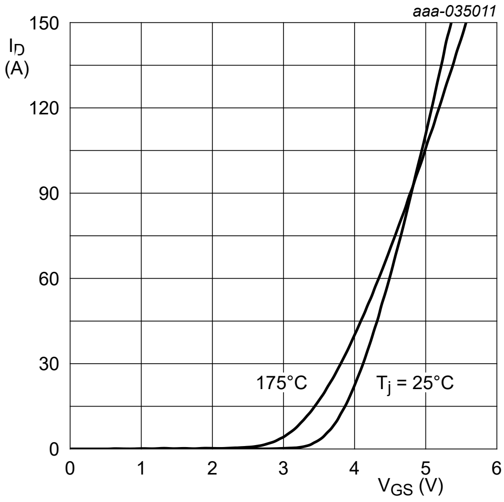
T_j = 25 °C

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



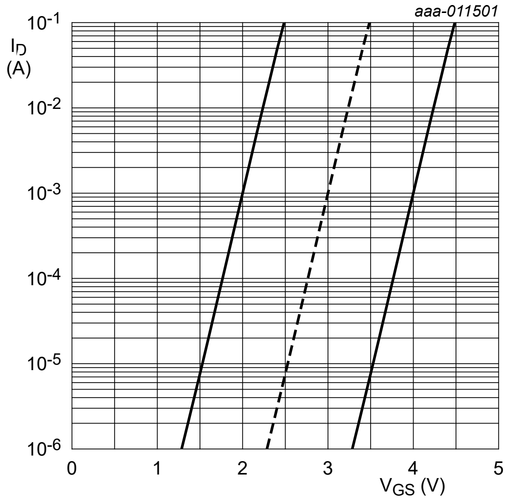
T_j = 25 °C; I_D = 100 A

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

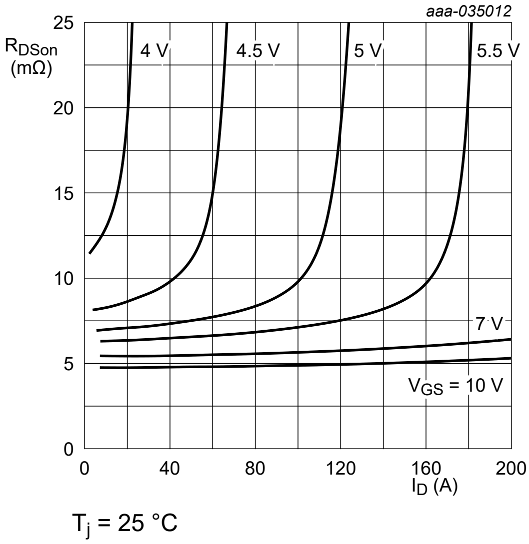
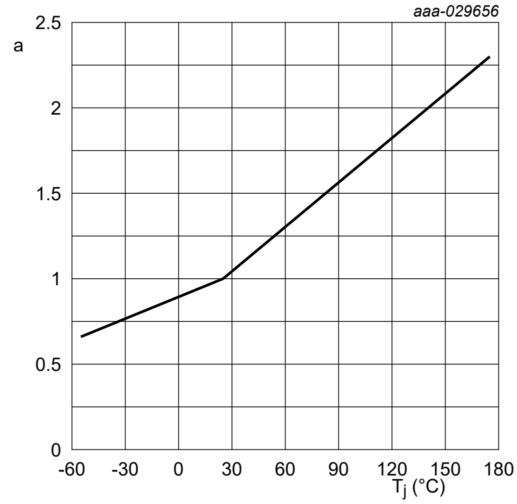


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values



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

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

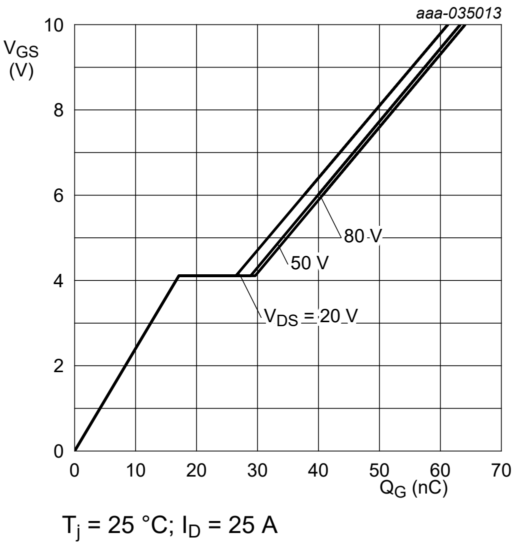


Fig. 14. Gate-source voltage as a function of gate charge; typical values

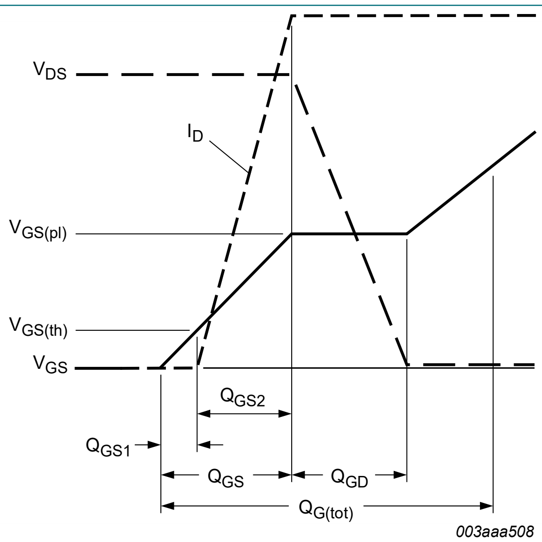
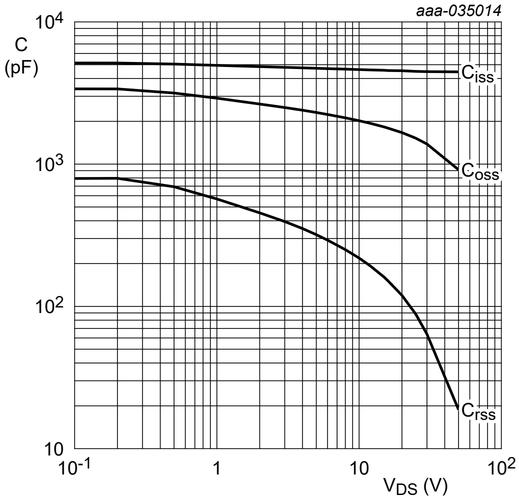
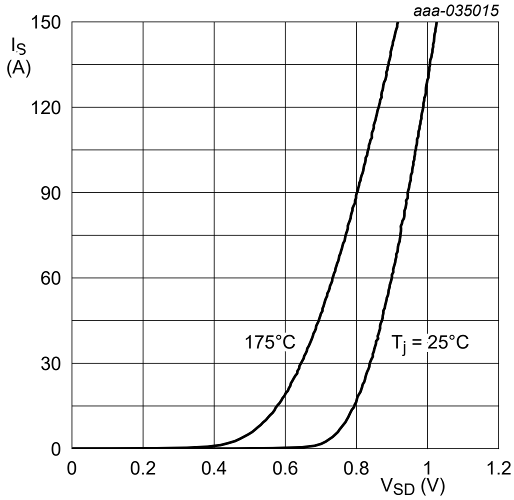


Fig. 15. Gate charge waveform definitions



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

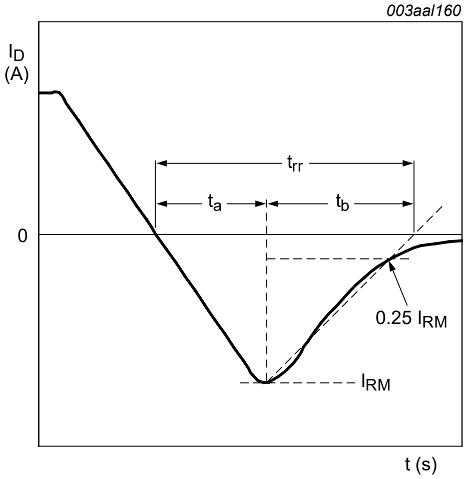
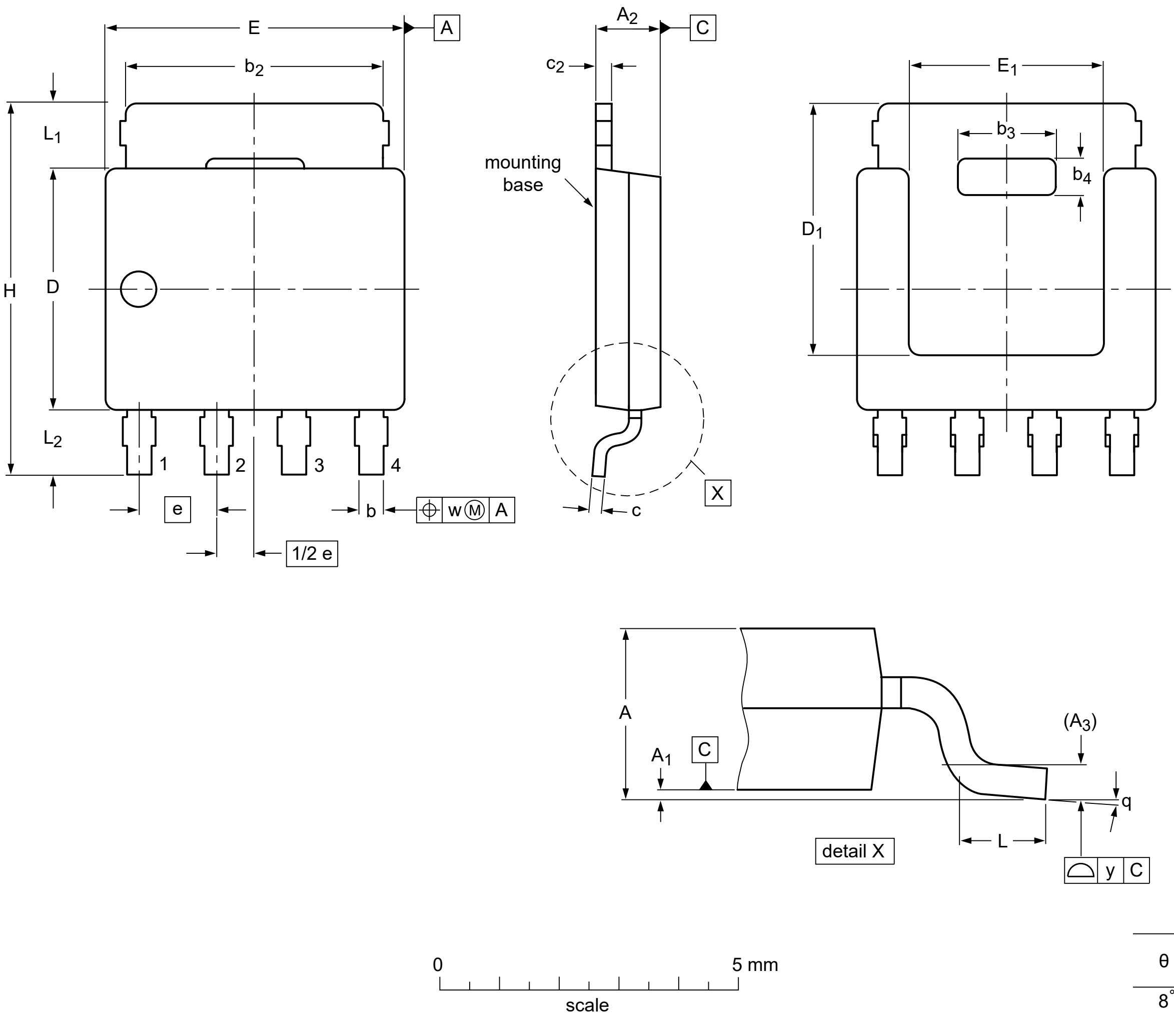


Fig. 18. Reverse recovery timing definition

11. Package outline

Plastic single-ended surface-mounted package (LFPAK56; Power-SO8); 4 leads **SOT669**



Dimensions (mm are the original dimensions)

Unit(1)		A	A_1	A_2	A_3	b	b_2	b_3	b_4	c	c_2	D(1)	D_1(1)	E(1)	E_1(1)	e	H	L	L_1	L_2	w	y	θ
mm	max	1.20	0.15	1.10		0.50	4.41	2.2	0.9	0.25	0.30	4.10	4.20	5.0	3.3		6.2	0.85	1.3	1.3			8°
	nom				0.25											1.27					0.25	0.1	
	min	1.01	0.00	0.95		0.35	3.62	2.0	0.7	0.19	0.24	3.80		4.8	3.1		5.8	0.40	0.8	0.8			0°

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

sot669_po

Outline version	References IEC	References JEDEC	References JEITA		European projection	Issue date
SOT669		MO-235				~~11-03-25~~ 13-02-27

Fig. 19. Package outline LFPAK56; Power-SO8 (SOT669)

12. Soldering

Footprint information for reflow soldering **SOT669**

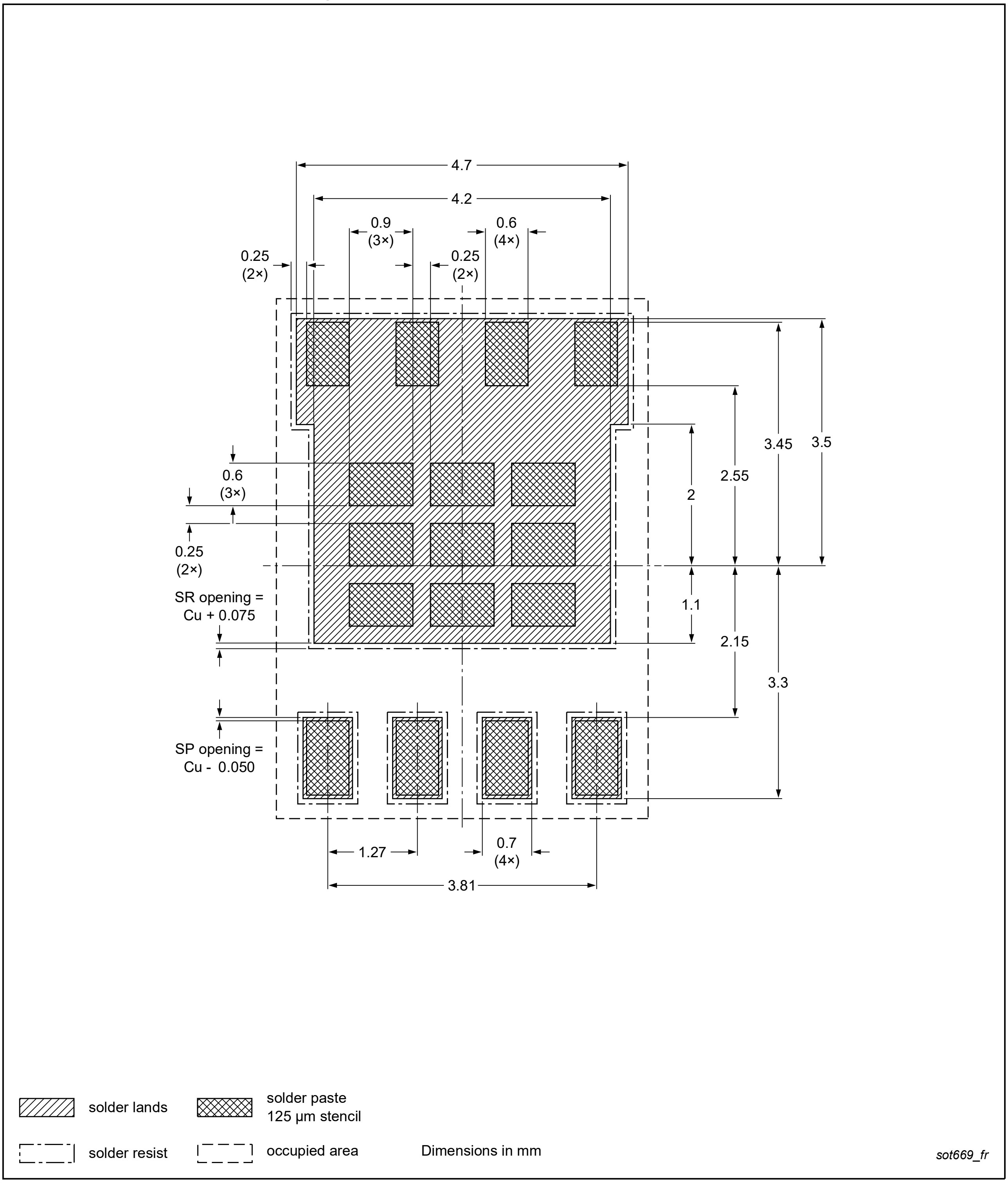


Fig. 20. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)

Wave soldering footprint information for LFPAK56 package **SOT669**

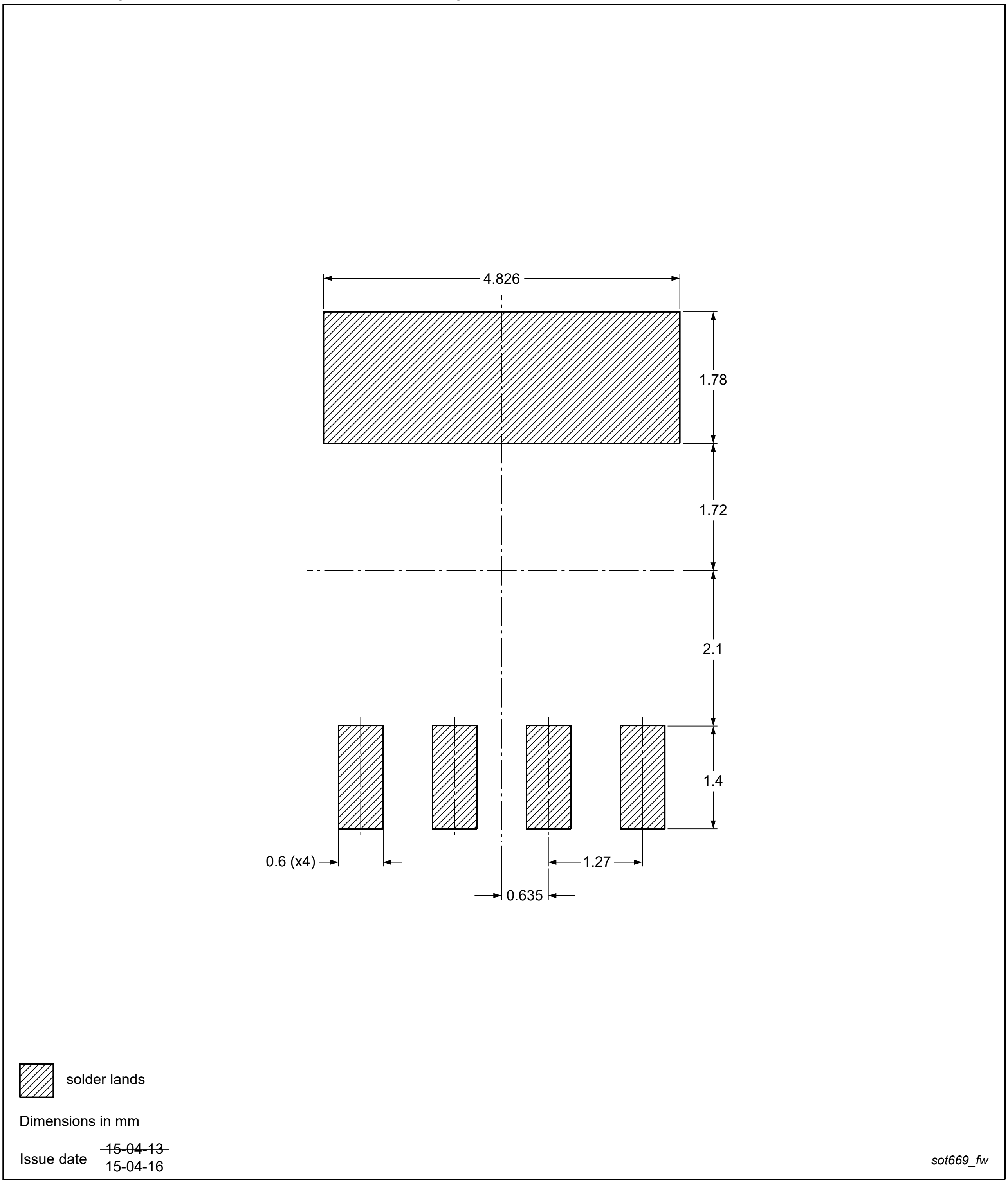


Fig. 21. Wave soldering footprint for LFPAK56; Power-SO8 (SOT669)

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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