



PSMN3R9-100YSF

NextPower 100 V, 4.3 mOhm, 120 A, N-channel MOSFET in LFPAK56E package

11 June 2021

Product 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
- 120 A I_D (max) – demonstrated continuous current rating
- Low $Q_G \times R_{DSon}$ FOM for high efficiency switching applications
- Strong avalanche energy rating (E_{as})
- Avalanche rated and 100% tested
- Ha-free and RoHS compliant LFPAK56E package

3. Applications

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

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	100	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	-	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1	-	-	294	W
T_j	junction temperature		-55	-	175	°C
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 12	-	3.3	4.3	mΩ
		$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 100\text{ °C}$; Fig. 13	-	5.1	6.9	mΩ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 50\text{ V}$; $V_{GS} = 10\text{ V}$; Fig. 14 ; Fig. 15	5	18	41	nC
$Q_{G(tot)}$	total gate charge		40	80	120	nC
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 52.6\text{ A}$; $V_{sup} \leq 100\text{ V}$; $R_{GS} = 50\text{ Ω}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 95\text{ μs}$; Fig. 4	[1]	-	325	mJ

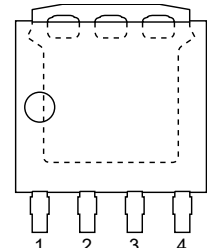
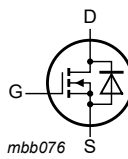
NextPower 100 V, 4.3 mOhm, 120 A, N-channel MOSFET in LFAK56E package

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
Q_r	recovered charge	$I_S = 25 \text{ A}$; $di_S/dt = -100 \text{ A}/\mu\text{s}$; $V_{GS} = 0 \text{ V}$; $V_{DS} = 50 \text{ V}$; Fig. 18	-	44	-	nC

[1] Protected by 100% test

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p>LFAK56E; Power-SO8 (SOT1023)</p>	 <p>mbb076</p>
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
PSMN3R9-100YSF	LFAK56E; Power-SO8	plastic, single-ended surface-mounted package (LFAK56); 4 leads; 1.27 mm pitch	SOT1023

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN3R9-100YSF	3F9S10J

8. Limiting values

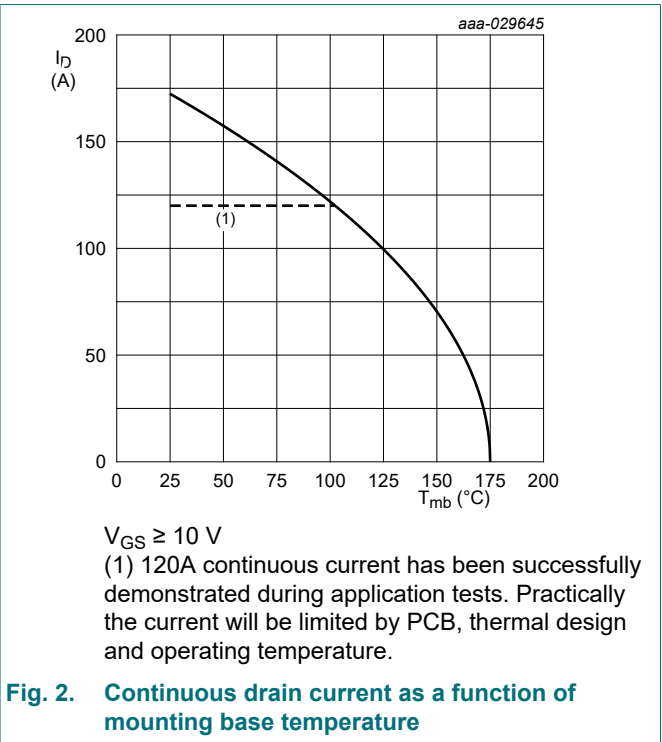
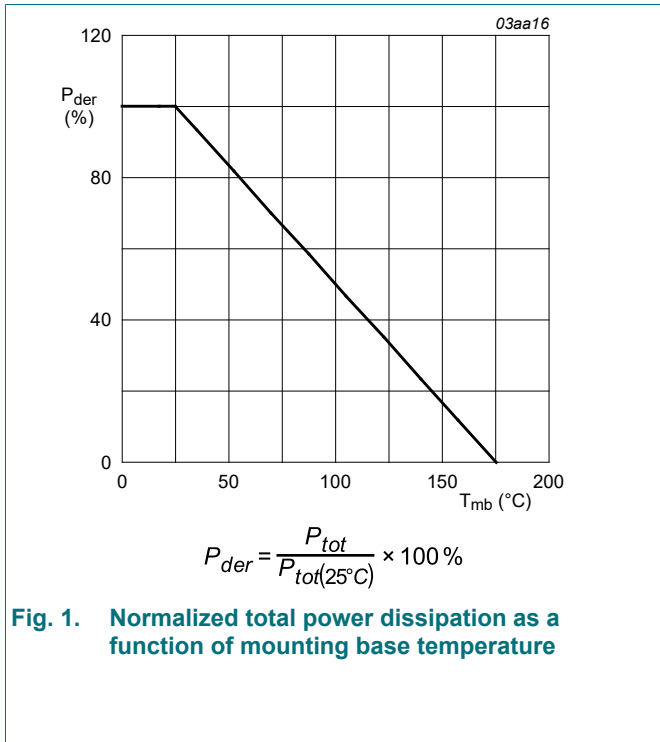
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage	$25 \text{ }^\circ\text{C} \leq T_j \leq 175 \text{ }^\circ\text{C}$	-	100	V
V_{DGR}	drain-gate voltage	$25 \text{ }^\circ\text{C} \leq T_j \leq 175 \text{ }^\circ\text{C}$; $R_{GS} = 20 \text{ k}\Omega$	-	100	V
V_{GS}	gate-source voltage		-20	20	V
P_{tot}	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 1	-	294	W
I_D	drain current	$V_{GS} = 10 \text{ V}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 2	-	120	A
		$V_{GS} = 10 \text{ V}$; $T_{mb} = 100 \text{ }^\circ\text{C}$; Fig. 2	-	120	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10 \text{ }\mu\text{s}$; $T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 3	-	690	A
T_{stg}	storage temperature		-55	175	$^\circ\text{C}$

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	$T_{mb} = 25\text{ °C}$	-	120	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$	-	690	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 52.6\text{ A}$; $V_{sup} \leq 100\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 95\text{ }\mu\text{s}$; Fig. 4	[1]	-	325 mJ
I_{AS}	non-repetitive avalanche current	$V_{sup} = 100\text{ V}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; $R_{GS} = 50\text{ }\Omega$; Fig. 4	[1]	-	52.6 A

[1] Protected by 100% test



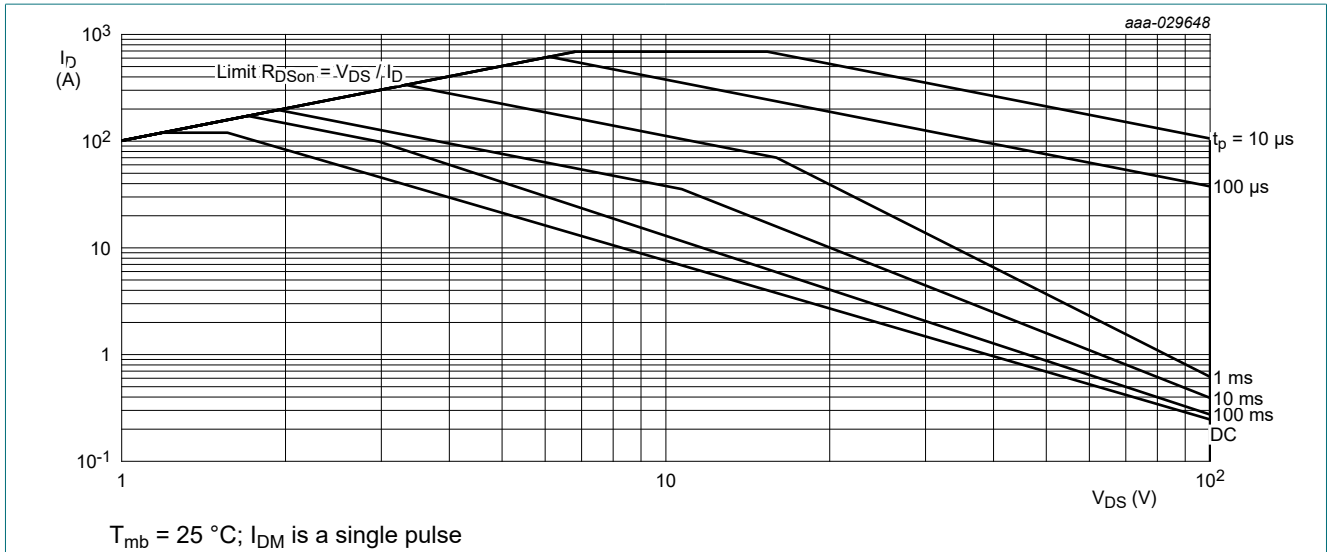


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

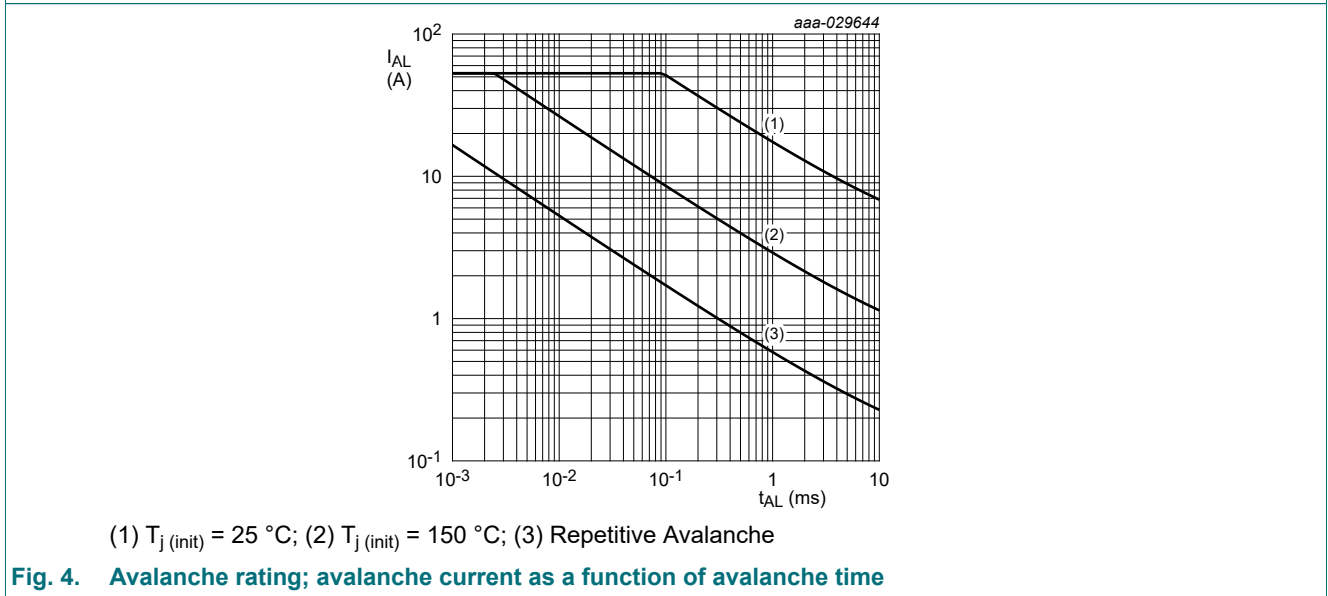


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

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	-	0.45	0.51	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 6	-	42	-	K/W
		Fig. 7	-	85	-	K/W

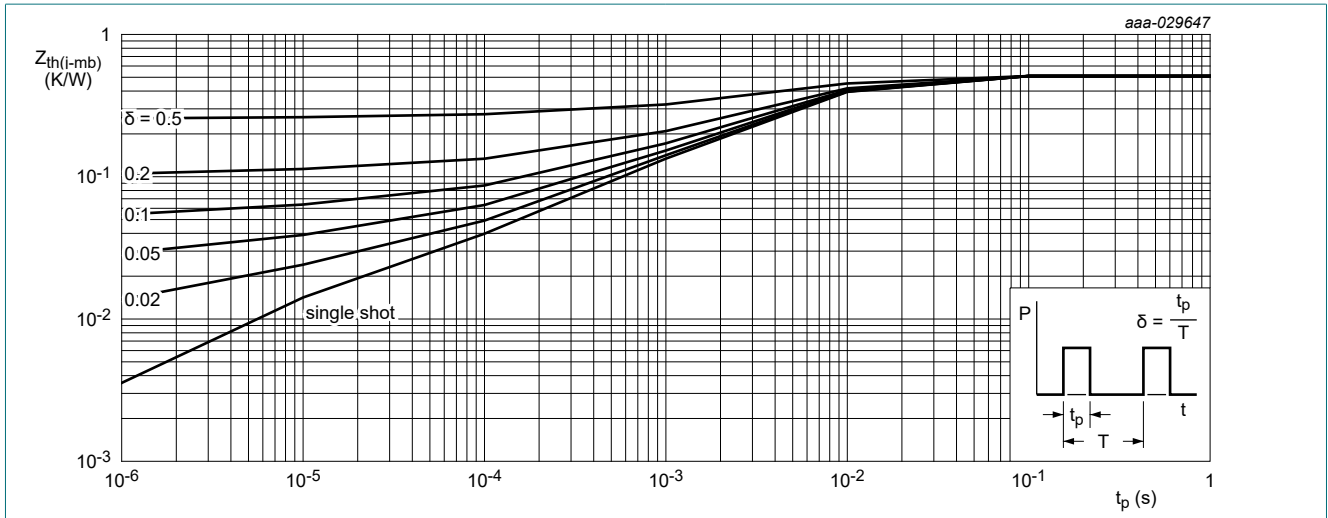


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

aaa-027933

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

aaa-027935

70 μm thick copper on FR4 board

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

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	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	100	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ C; \text{ Fig. 11}$	2	3	4	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ C$	-	1.65	-	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ C$	-	3.5	-	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ C \leq T_j \leq 150 \text{ }^\circ C$	-	-8.4	-	mV/K
I_{DSS}	drain leakage current	$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.03	1	μA
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	10	100	μA
I_{GSS}	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA

NextPower 100 V, 4.3 mOhm, 120 A, N-channel MOSFET in LPAK56E package

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	-	3.3	4.3	mΩ
		V _{GS} = 7 V; I _D = 25 A; T _J = 25 °C; Fig. 12	-	3.9	6.1	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _J = 100 °C; Fig. 13	-	5.1	6.9	mΩ
		V _{GS} = 10 V; I _D = 25 A; T _J = 175 °C; Fig. 13	-	7.3	9.9	mΩ
R _G	gate resistance	f = 1 MHz; T _J = 25 °C	0.4	0.83	1.7	Ω
Dynamic characteristics						
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 50 V; V _{GS} = 10 V; Fig. 14 ; Fig. 15	40	80	120	nC
		I _D = 0 A; V _{DS} = 0 V; V _{GS} = 10 V	-	42	-	nC
Q _{GS}	gate-source charge	I _D = 25 A; V _{DS} = 50 V; V _{GS} = 10 V; Fig. 14 ; Fig. 15	14	23.6	33	nC
Q _{GS(th)}	pre-threshold gate-source charge		-	15.3	-	nC
Q _{GS(th-pl)}	post-threshold gate-source charge		-	8.3	-	nC
Q _{GD}	gate-drain charge		5	18	41	nC
V _{GS(pl)}	gate-source plateau voltage	I _D = 25 A; V _{DS} = 50 V; Fig. 14 ; Fig. 15	-	4.5	-	V
C _{iss}	input capacitance	V _{DS} = 50 V; V _{GS} = 0 V; f = 1 MHz; T _J = 25 °C; Fig. 16	3300	5520	7730	pF
C _{oss}	output capacitance		800	1335	2140	pF
C _{rss}	reverse transfer capacitance		3	29	75	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	-	22	-	ns
t _r	rise time		-	18	-	ns
t _{d(off)}	turn-off delay time		-	46	-	ns
t _f	fall time		-	26	-	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; Fig. 18	-	43	-	ns
Q _r	recovered charge		-	44	-	nC

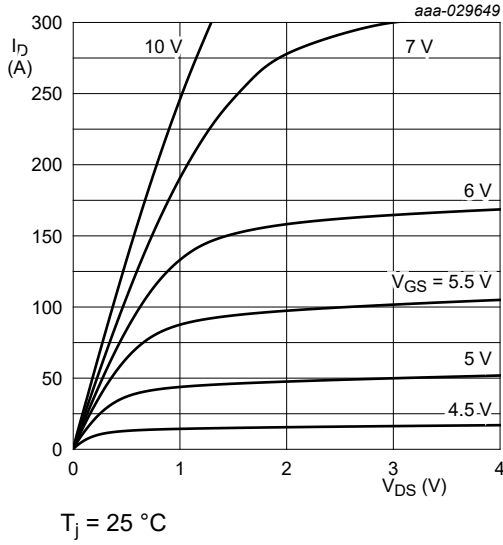


Fig. 8. Output characteristics; drain current as a function of drain-source voltage; typical values

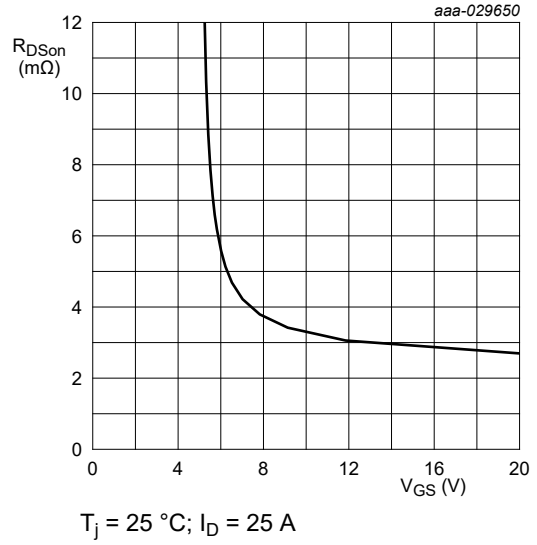


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

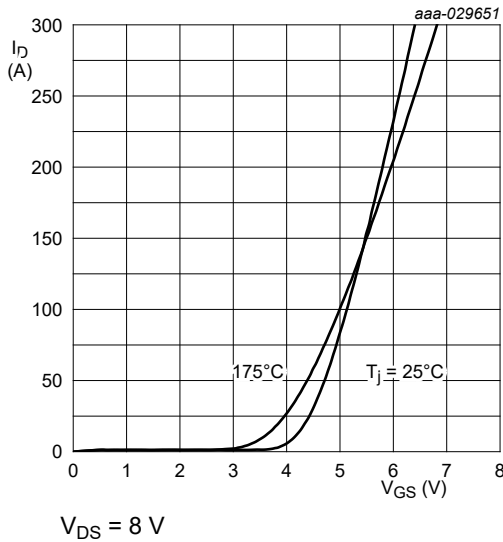


Fig. 10. Transfer characteristics; drain current as a function of gate-source voltage; typical values

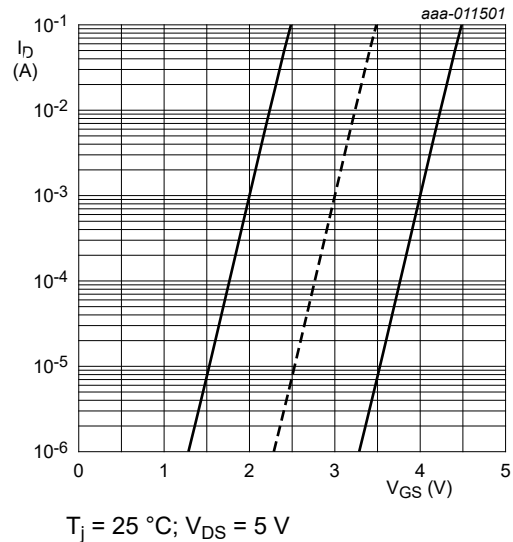


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

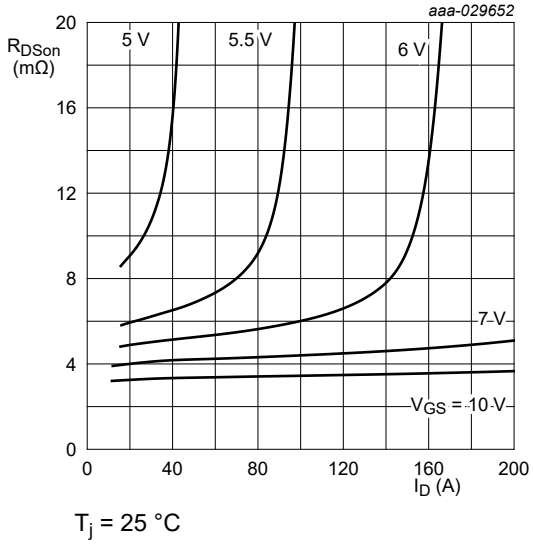
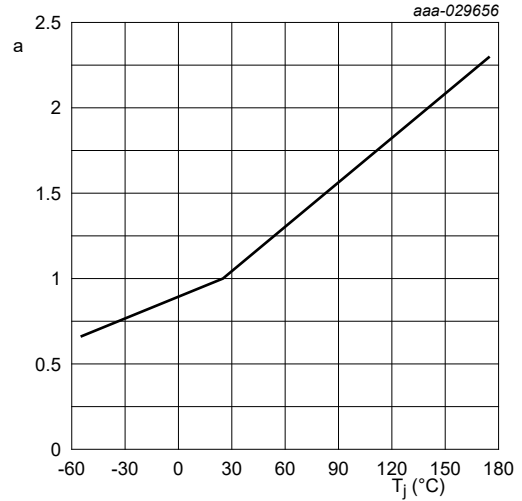


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values



$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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

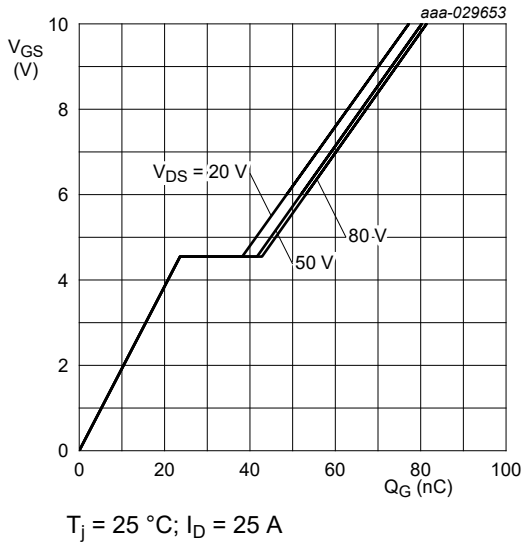


Fig. 14. Gate-source voltage as a function of gate charge; typical values

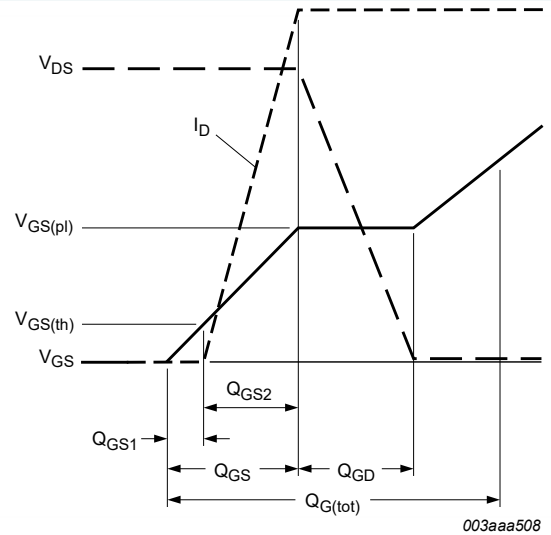
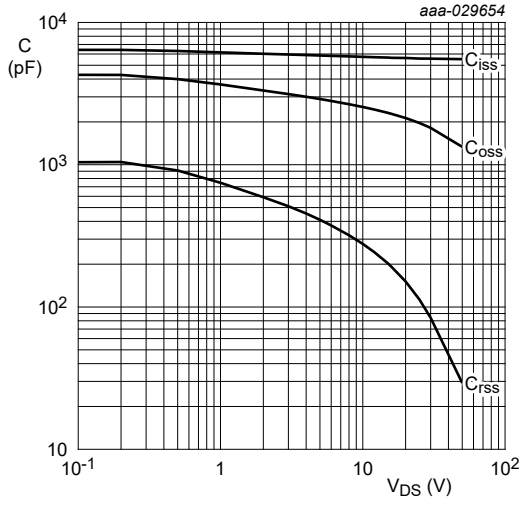
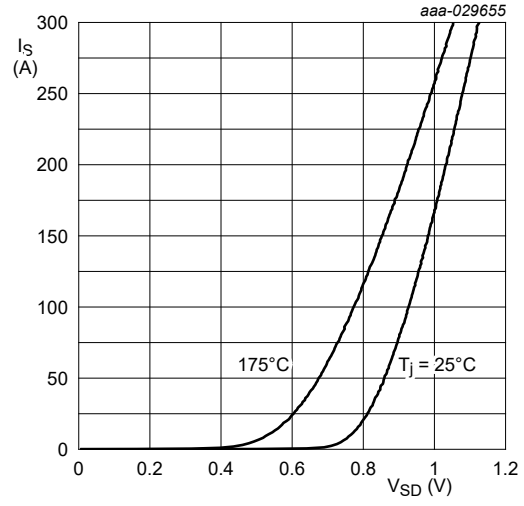


Fig. 15. Gate charge waveform definitions



$V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$

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



$V_{GS} = 0\text{ V}$

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

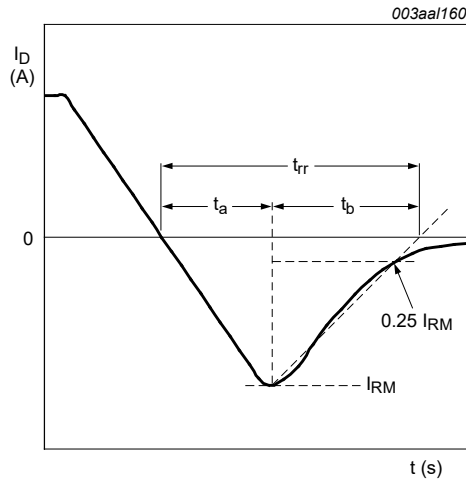


Fig. 18. Reverse recovery timing definition

11. Package outline

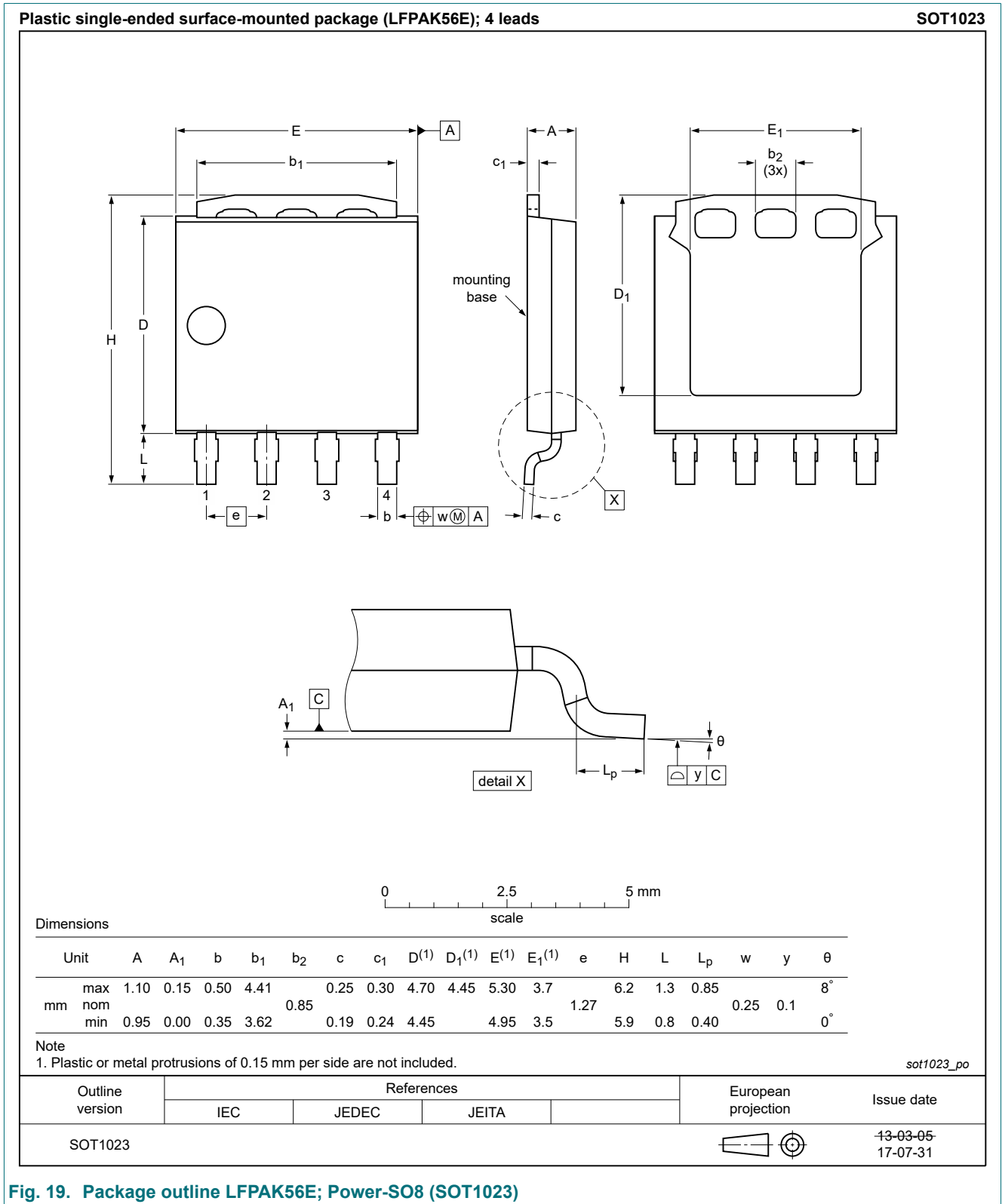


Fig. 19. Package outline LPAK56E; Power-SO8 (SOT1023)

12. Soldering

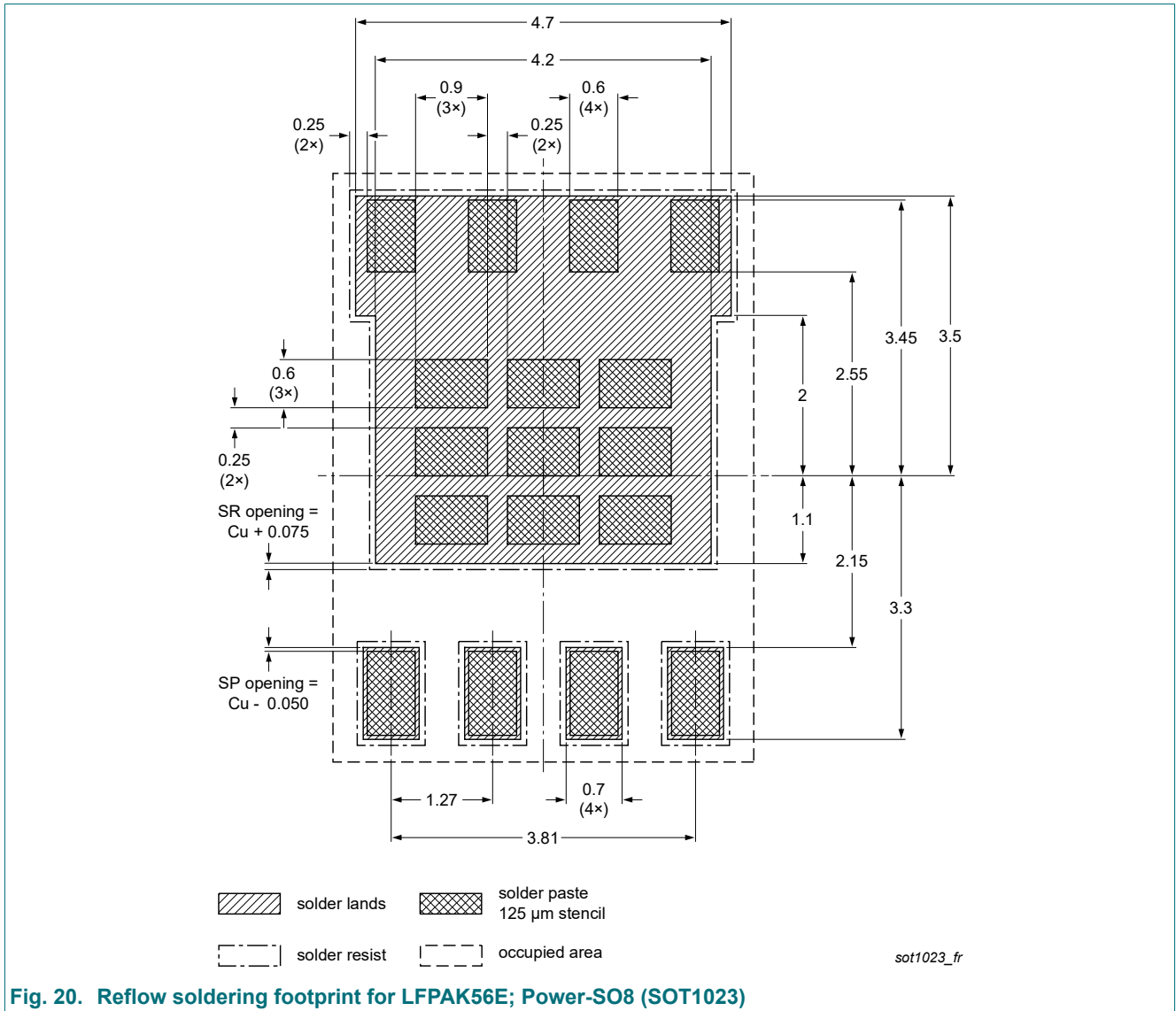


Fig. 20. Reflow soldering footprint for LPAK56E; Power-SO8 (SOT1023)

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.

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