



# PSMN3R9-100YSF

NextPower 100 V, 4.3 mΩ N-channel MOSFET in LFPAK56 package

17 February 2020

Preliminary data sheet

## 1. General description

NextPower 100 V, standard level gate drive MOSFET. Qualified to 150 °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 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 adapters
- Full-bridge and half-bridge applications
- Flyback and resonant topologies

## 4. Quick reference data

Table 1. Quick reference data

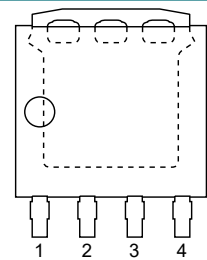
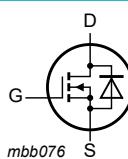
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 150\text{ °C}$	-	-	100	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C};$ <a href="#">Fig. 2</a>	-	-	120	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C};$ <a href="#">Fig. 1</a>	-	-	245	W
$T_j$	junction temperature		-55	-	150	°C
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25\text{ °C};$ <a href="#">Fig. 10</a>	-	3.3	4.3	mΩ
		$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 100\text{ °C};$ <a href="#">Fig. 11</a>	-	5.1	6.9	mΩ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}; V_{DS} = 50\text{ V}; V_{GS} = 10\text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	-	15.8	35.6	nC
$Q_{G(tot)}$	total gate charge		-	79	111	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Avalanche ruggedness</b>							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 55\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $R_{GS} = 50\ \Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; unclamped; <a href="#">Fig. 4</a>	[1]	-	-	310	mJ
<b>Source-drain diode</b>							
$Q_r$	recovered charge	$I_S = 25\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; <a href="#">Fig. 16</a>		-	44	66	nC

[1] Protected by 100% test

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p>LPAK56E; Power-SO8 (SOT1023)</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	LPAK56E; Power-SO8	plastic, single-ended surface-mounted package (LPAK56); 4 leads; 1.27 mm pitch	SOT1023

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN3R9-100YSF	3F9S10J

## 8. Limiting values

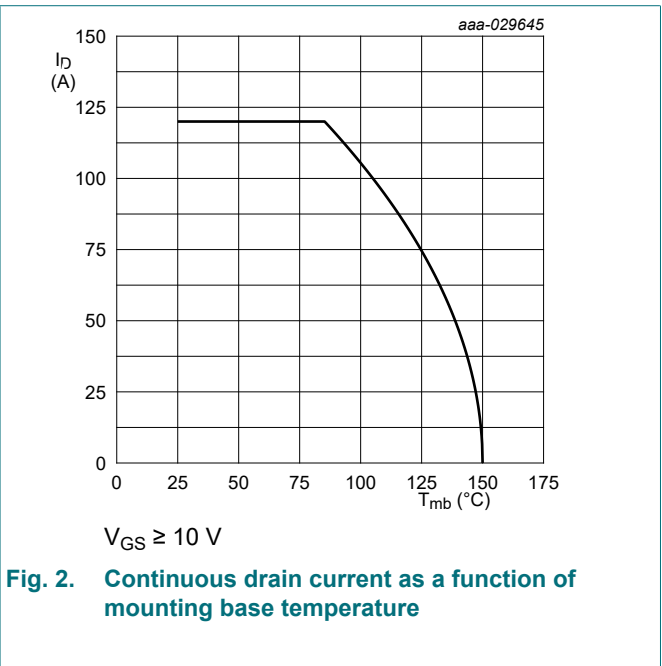
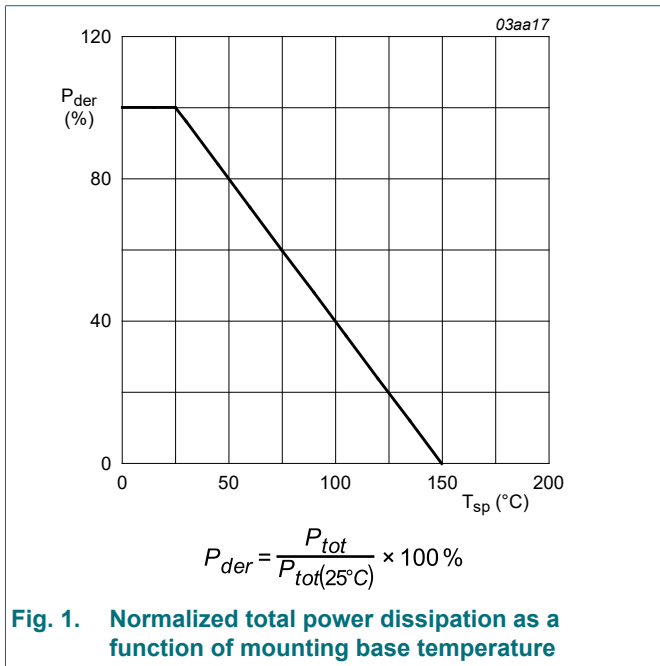
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ }^\circ\text{C} \leq T_j \leq 150\text{ }^\circ\text{C}$		-	100	V
$V_{DGR}$	drain-gate voltage	$25\text{ }^\circ\text{C} \leq T_j \leq 150\text{ }^\circ\text{C}$ ; $R_{GS} = 20\text{ k}\Omega$		-	100	V
$V_{GS}$	gate-source voltage			-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a>		-	245	W

Symbol	Parameter	Conditions	Min	Max	Unit
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>	-	120	A
		V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 100 °C; <a href="#">Fig. 2</a>	-	105	A
I <sub>DM</sub>	peak drain current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 3</a>	-	667	A
T <sub>stg</sub>	storage temperature		-55	150	°C
T <sub>j</sub>	junction temperature		-55	150	°C
T <sub>slid(M)</sub>	peak soldering temperature		-	260	°C
<b>Source-drain diode</b>					
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	-	120	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C	-	667	A
<b>Avalanche ruggedness</b>					
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 55 A; V <sub>sup</sub> ≤ 100 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; <a href="#">Fig. 4</a>	[1]	-	310 mJ
I <sub>AS</sub>	non-repetitive avalanche current	V <sub>sup</sub> = 100 V; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; R <sub>GS</sub> = 50 Ω; <a href="#">Fig. 4</a>	[1]	-	55 A

[1] Protected by 100% test



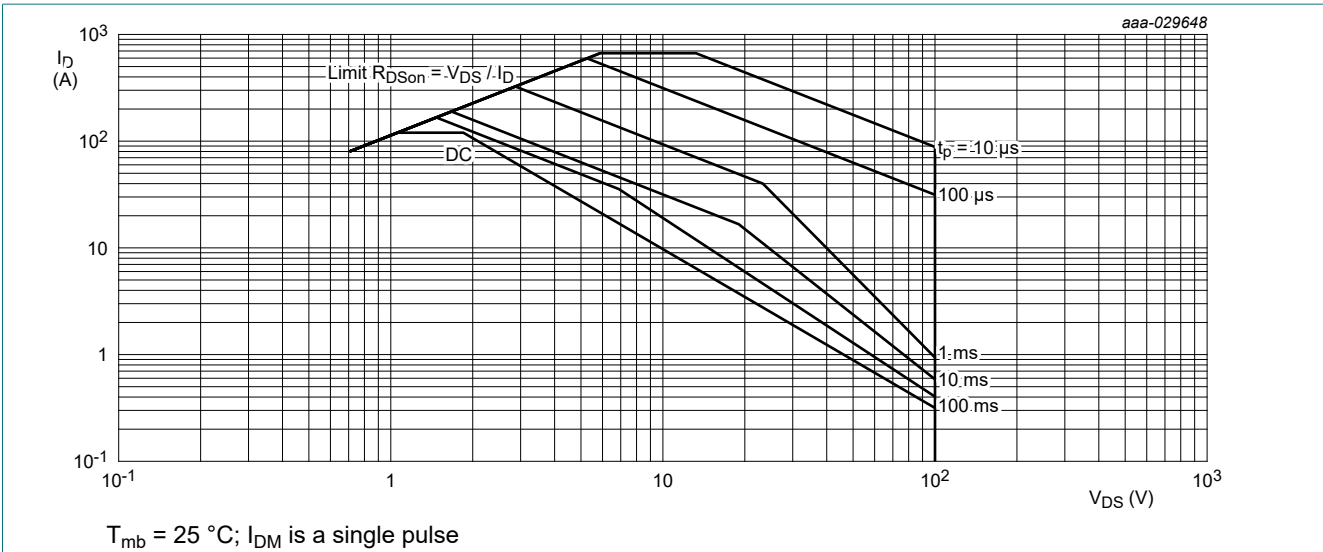


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

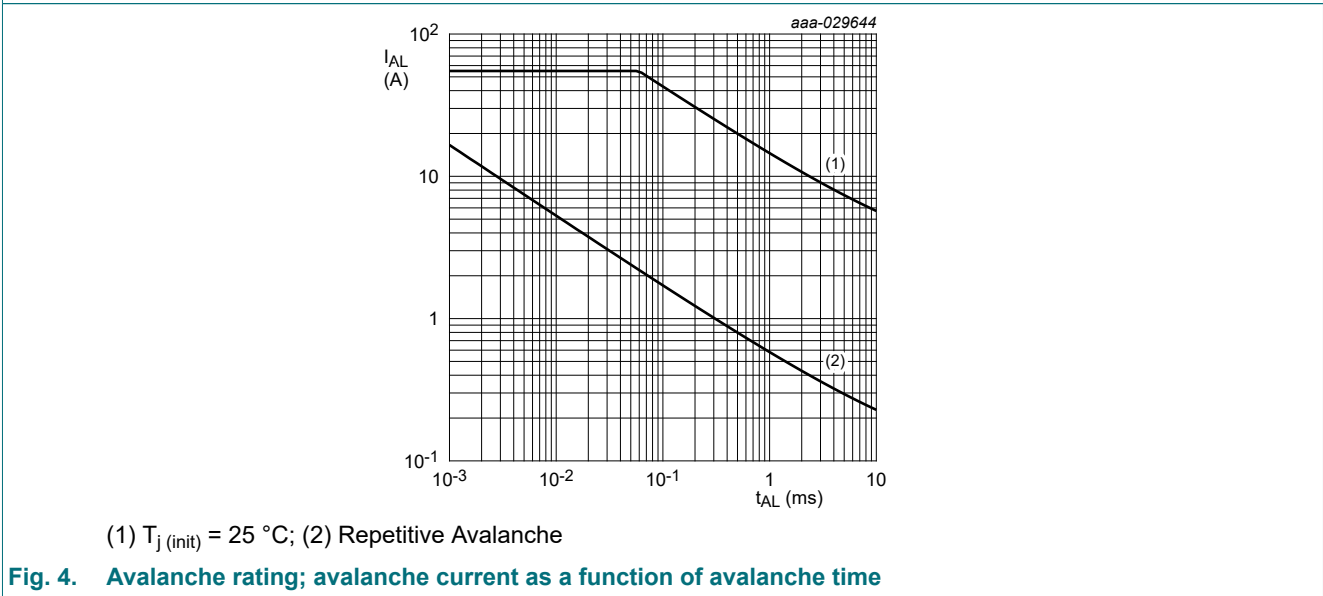


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

## 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

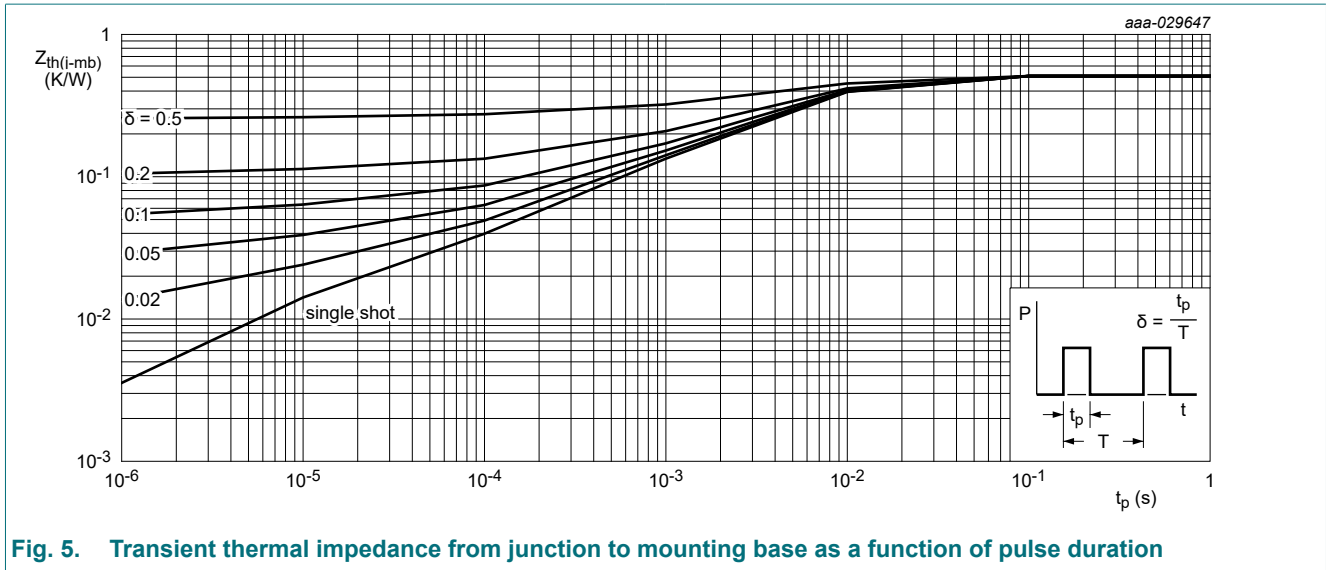


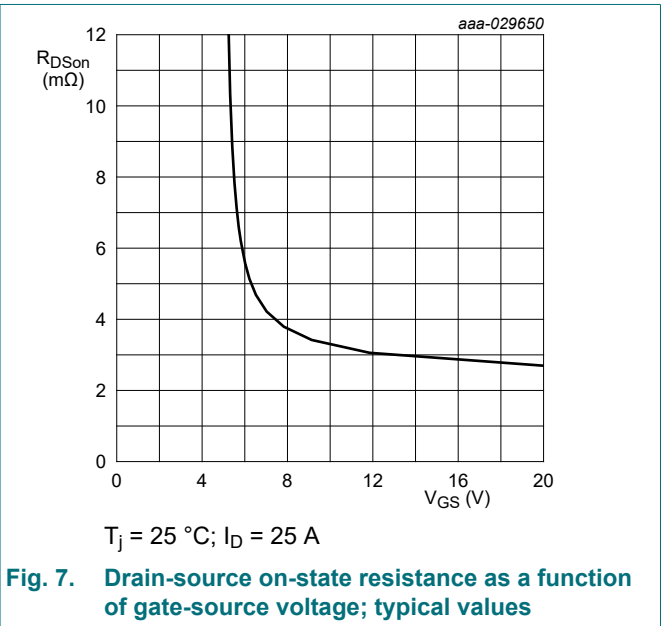
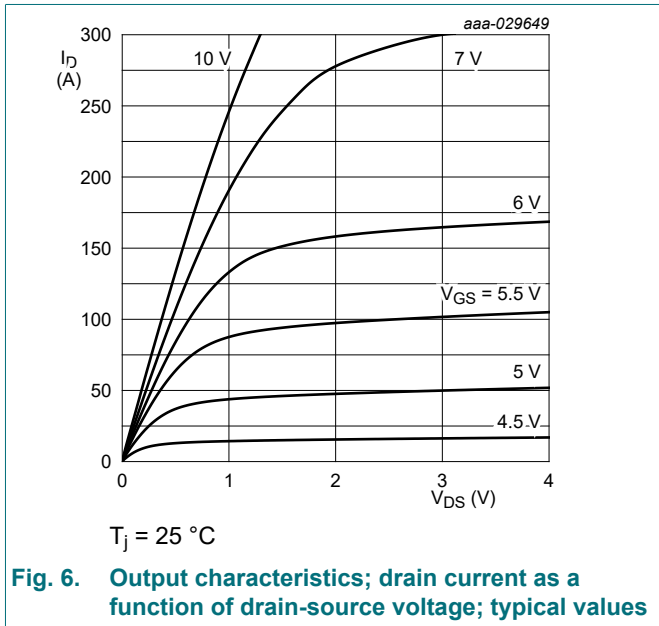
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	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	$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ C; \text{ Fig. 9}$	2	3	4	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 150 \text{ }^\circ C$	-	1.9	-	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	25	$\mu A$
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	-	100	$\mu A$
$I_{GSS}$	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
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C; \text{ Fig. 10}$	-	3.3	4.3	mΩ
		$V_{GS} = 7 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C; \text{ Fig. 10}$	-	3.9	6.1	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 100 \text{ }^\circ C; \text{ Fig. 11}$	-	5.1	6.9	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ C; \text{ Fig. 11}$	-	6.5	8.8	mΩ
$R_G$	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$	-	0.8	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 50 \text{ V}; V_{GS} = 10 \text{ V}; \text{ Fig. 12}; \text{ Fig. 13}$	-	79	111	nC
		$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	42.4	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Q_{GS}$	gate-source charge	$I_D = 25\text{ A}; V_{DS} = 50\text{ V}; V_{GS} = 10\text{ V};$ <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	23.6	33.1	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		-	15.8	35.6	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\text{ A}; V_{DS} = 50\text{ V};$ <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	4.5	-	V
$C_{iss}$	input capacitance	$V_{DS} = 50\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 14</a>	3963	5662	7360	pF
$C_{oss}$	output capacitance		656	1313	1969	pF
$C_{rss}$	reverse transfer capacitance		0	23	52.3	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 50\text{ V}; R_L = 2\text{ }\Omega; V_{GS} = 10\text{ V};$ $R_{G(ext)} = 5\text{ }\Omega$	-	22	33	ns
$t_r$	rise time		-	18	25	ns
$t_{d(off)}$	turn-off delay time		-	45	63	ns
$t_f$	fall time		-	23	37	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ <a href="#">Fig. 15</a>	-	0.82	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 50\text{ V};$ <a href="#">Fig. 16</a>	-	43	51	ns
$Q_r$	recovered charge		-	44	66	nC



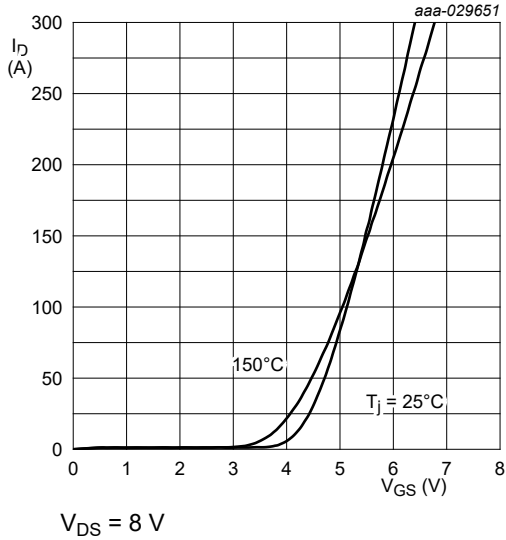


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

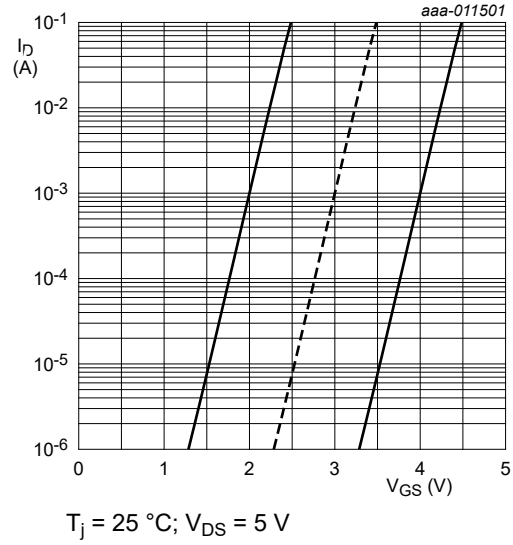


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

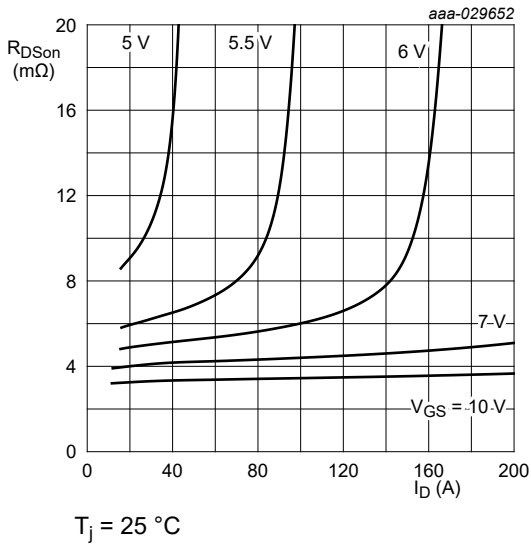


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

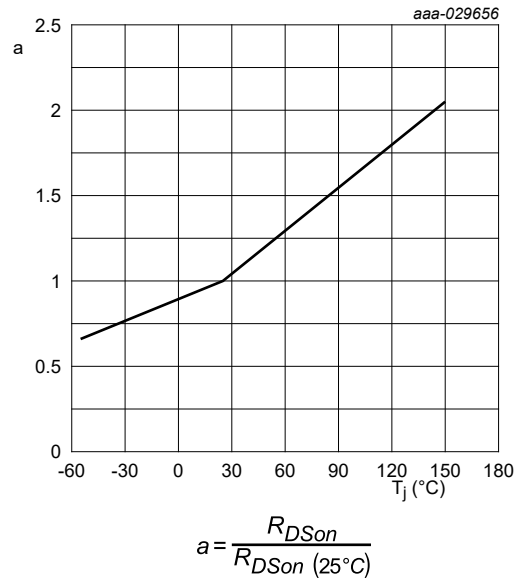
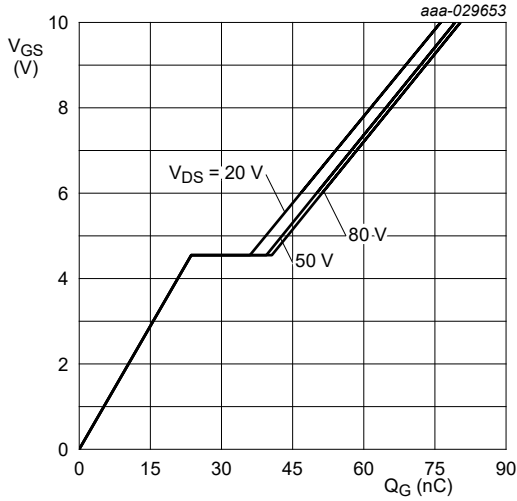


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

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



$T_j = 25\text{ }^\circ\text{C}$ ;  $I_D = 25\text{ A}$

Fig. 12. Gate-source voltage as a function of gate charge; typical values

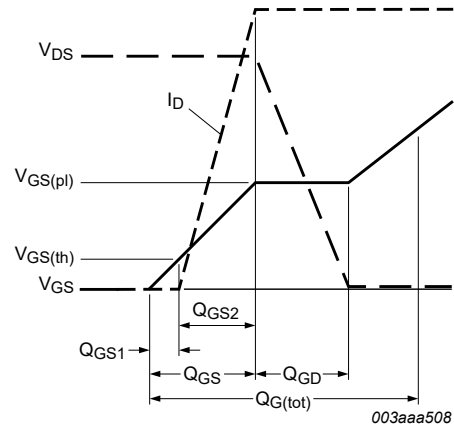
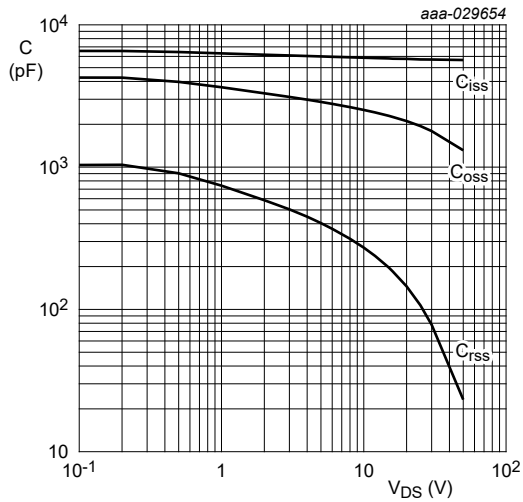
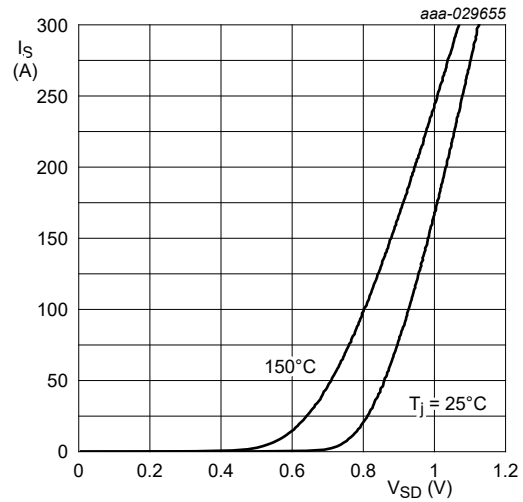


Fig. 13. Gate charge waveform definitions



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

Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values



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

Fig. 15. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

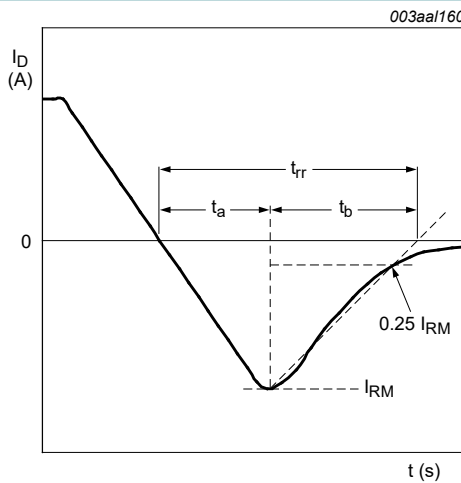


Fig. 16. Reverse recovery timing definition



### 11. Package outline

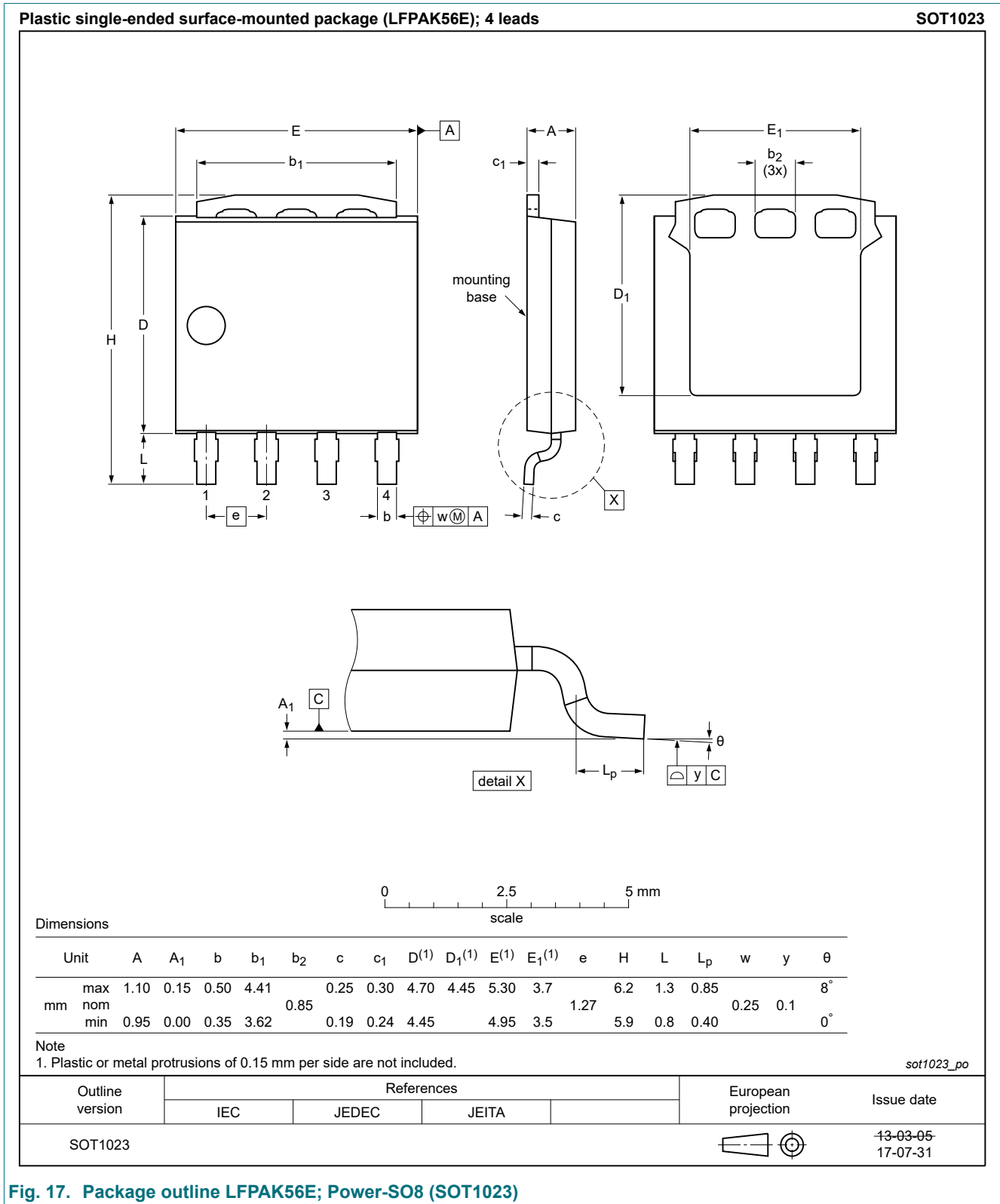


Fig. 17. Package outline LPAK56E; Power-SO8 (SOT1023)

### 12. Soldering

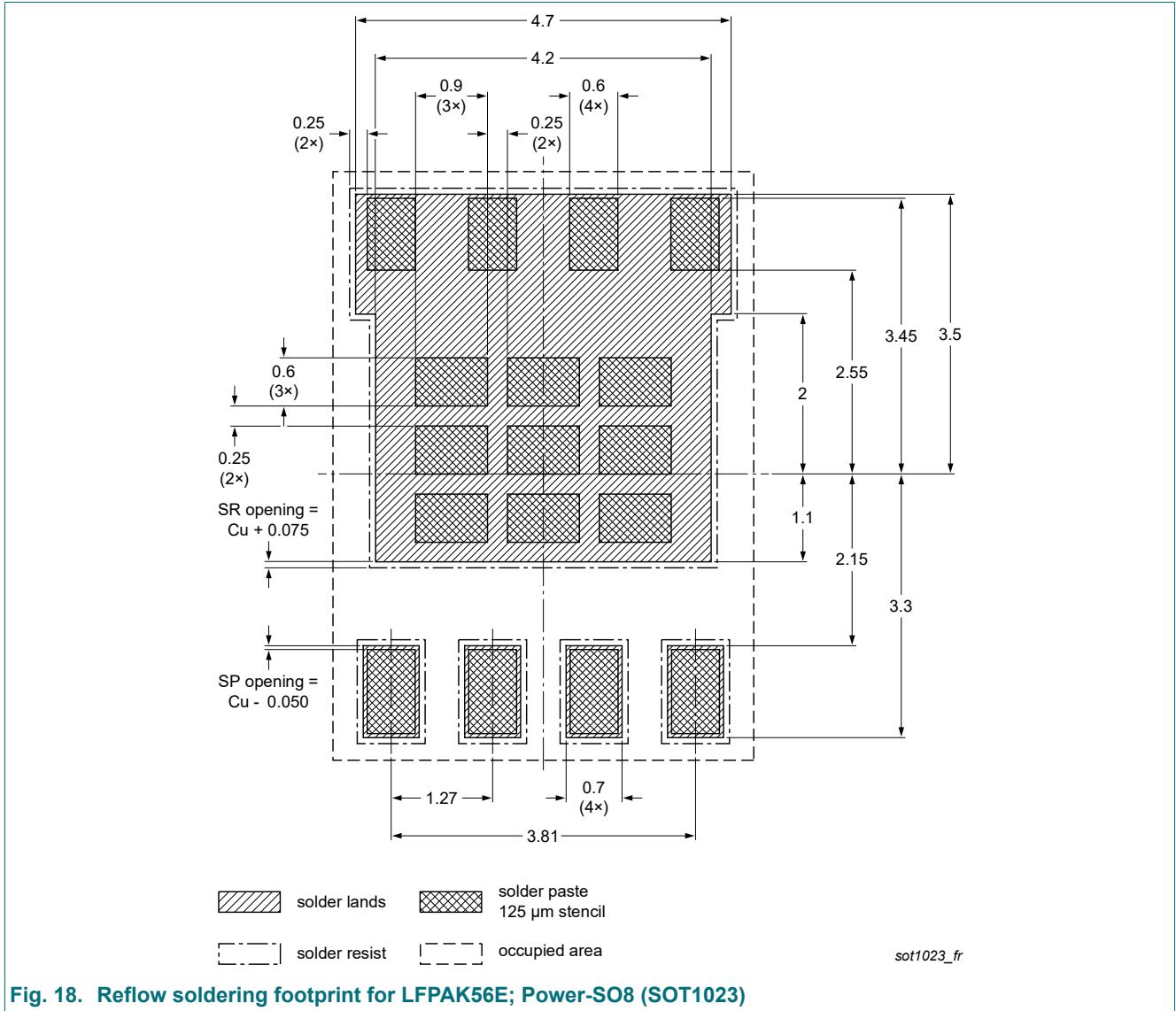


Fig. 18. Reflow soldering footprint for LPAK56E; Power-SO8 (SOT1023)

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### 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.
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Date of release: 17 February 2020

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