



# PSMN5R5-100YSF

NextPower 100 V, 5.6 mOhm N-channel MOSFET in LFAK56 package

11 October 2022

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
- Low  $Q_G \times R_{DSon}$  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 LFAK56 package
- Wave-solderable LFAK56 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

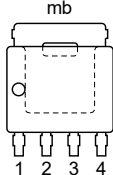
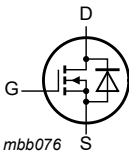
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	-	100	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	-	-	115	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	-	238	W
$T_j$	junction temperature		-55	-	175	°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. 12</a>	-	4.5	5.6	mΩ
		$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 100\text{ °C}$ ; <a href="#">Fig. 13</a>	-	6.9	8.9	mΩ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}$ ; $V_{DS} = 50\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	3.5	11.8	27.1	nC
$Q_{G(tot)}$	total gate charge		32	64	95	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 44.1\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $R_{GS} = 50\ \Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; unclamped; $t_p = 80\ \mu\text{s}$ ; <a href="#">Fig. 4</a>	[1]	-	231	mJ
<b>Source-drain diode</b>						
$Q_r$	recovered charge	$I_S = 25\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ; $V_{DS} = 50\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 18</a>	-	30	-	nC

[1] Protected by 100% test

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p>LFPAK56; Power-SO8 (SOT669)</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
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

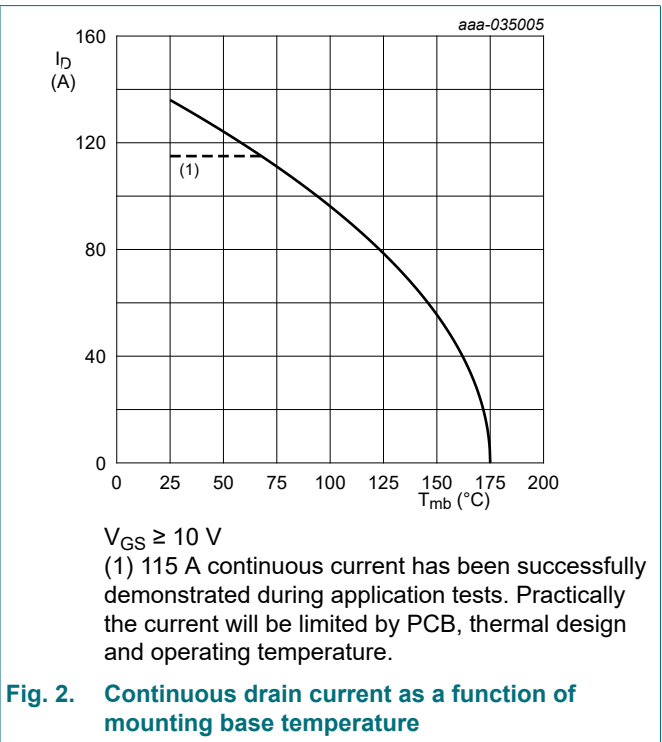
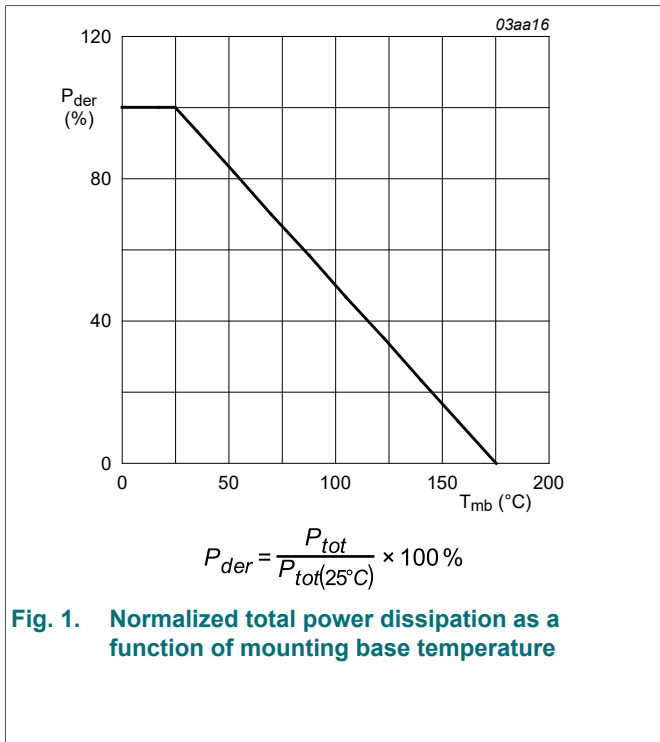
Table 5. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ }^\circ\text{C} \leq T_j \leq 175\text{ }^\circ\text{C}$	-	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	$T_{mb} = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 1</a>	-	238	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 2</a>	-	115	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ }^\circ\text{C}$ ; <a href="#">Fig. 2</a>	-	96	A

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

[1] Protected by 100% test



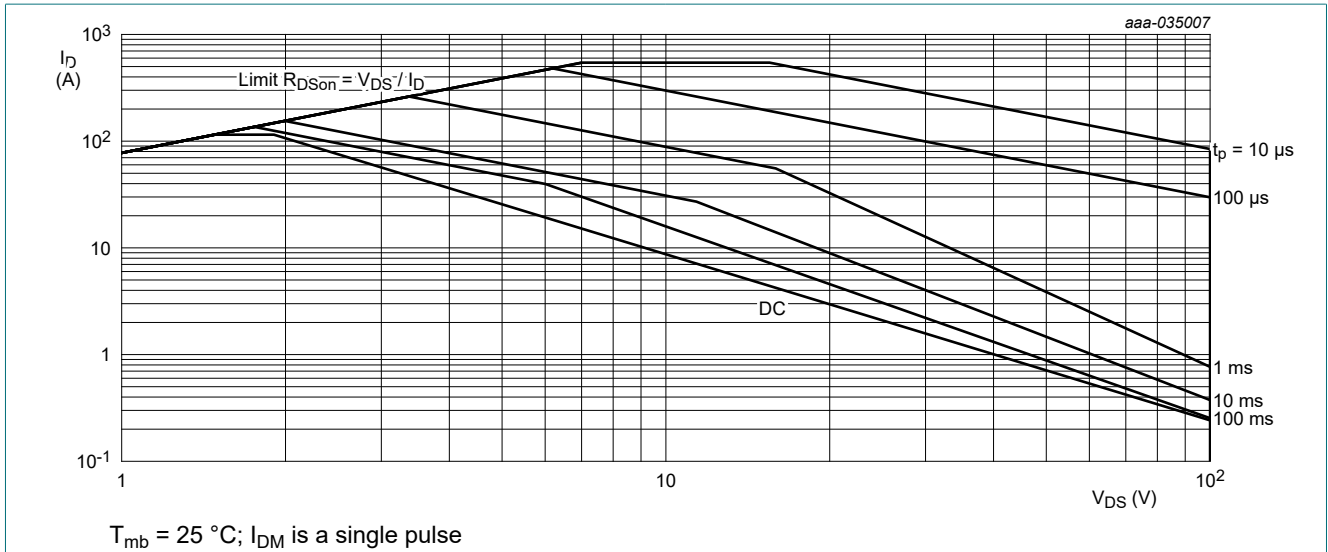


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

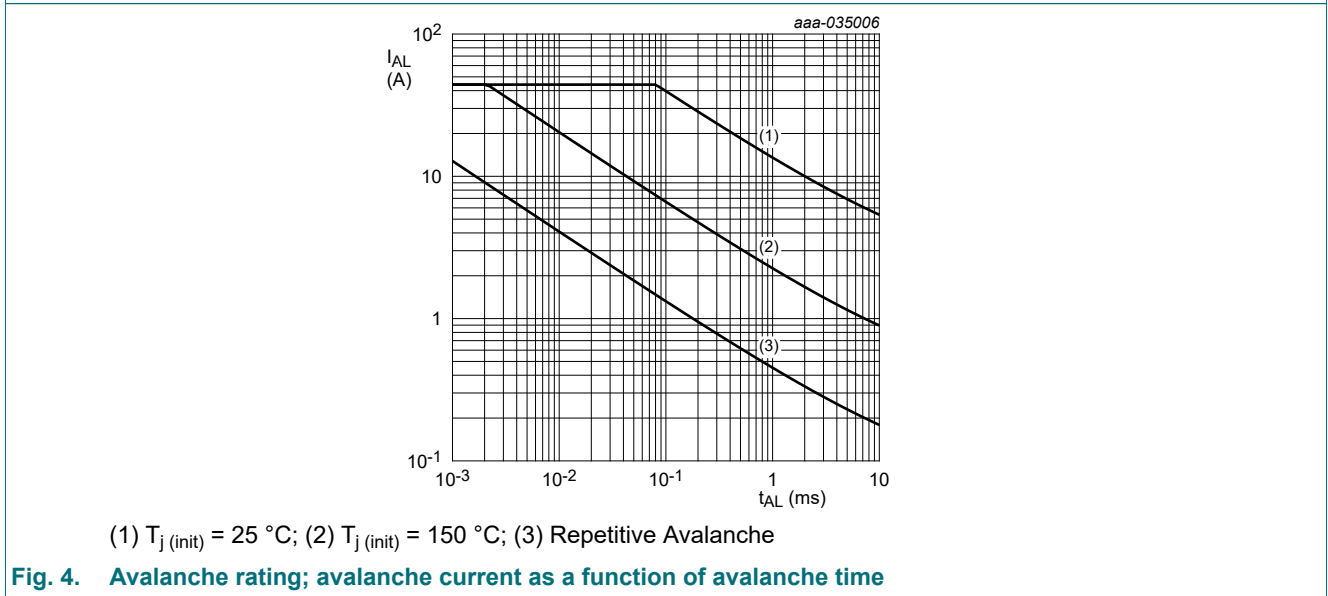


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

## 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	<a href="#">Fig. 5</a>	-	0.56	0.63	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	<a href="#">Fig. 6</a>	-	42	-	K/W
		<a href="#">Fig. 7</a>	-	85	-	K/W

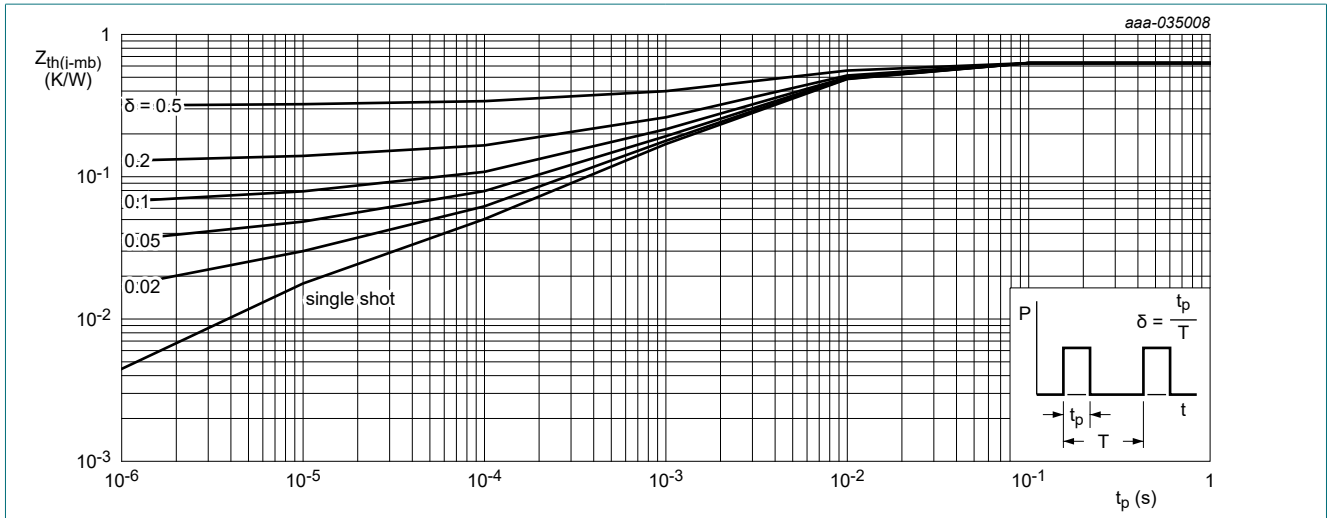


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

aaa-027933

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

aaa-027935

70 μm thick copper on FR4 board

Fig. 6. PCB layout for thermal 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
<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	$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 25 \text{ }^\circ C; \text{ Fig. 11}$	2	2.7	4	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = 175 \text{ }^\circ C$	-	1.6	-	V
		$I_D = 1 \text{ mA}; V_{DS}=V_{GS}; T_j = -55 \text{ }^\circ C$	-	3	-	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ C \leq T_j \leq 150 \text{ }^\circ C$	-	-6.8	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.04	1	μA
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	13	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, 5.6 mOhm N-channel MOSFET in LPAK56 package

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 12</a>	-	4.5	5.6	mΩ
		V <sub>GS</sub> = 7 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 12</a>	-	5	8.4	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 100 °C; <a href="#">Fig. 13</a>	-	6.9	8.9	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 175 °C; <a href="#">Fig. 13</a>	-	9.8	12.7	mΩ
R <sub>G</sub>	gate resistance	f = 1 MHz; T <sub>j</sub> = 25 °C	0.5	1	2	Ω
<b>Dynamic characteristics</b>						
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 50 V; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	32	64	95	nC
		I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C	-	32	-	nC
Q <sub>GS</sub>	gate-source charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 50 V; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	10.3	17.1	24	nC
Q <sub>GS(th)</sub>	pre-threshold gate-source charge		-	12	-	nC
Q <sub>GS(th-pl)</sub>	post-threshold gate-source charge		-	4.8	-	nC
Q <sub>GD</sub>	gate-drain charge		3.5	11.8	27.1	nC
V <sub>GS(pl)</sub>	gate-source plateau voltage	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 50 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 14</a> ; <a href="#">Fig. 15</a>	-	4.1	-	V
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 50 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>j</sub> = 25 °C; <a href="#">Fig. 16</a>	2674	4456	6238	pF
C <sub>oss</sub>	output capacitance		548	914	1462	pF
C <sub>rss</sub>	reverse transfer capacitance		2	19	49	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 50 V; R <sub>L</sub> = 2 Ω; V <sub>GS</sub> = 10 V; R <sub>G(ext)</sub> = 5 Ω; T <sub>j</sub> = 25 °C	-	16	-	ns
t <sub>r</sub>	rise time		-	14	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	42	-	ns
t <sub>f</sub>	fall time		-	21	-	ns
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 17</a>	-	0.82	1	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 25 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 50 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 18</a>	-	37	-	ns
Q <sub>r</sub>	recovered charge		-	30	-	nC

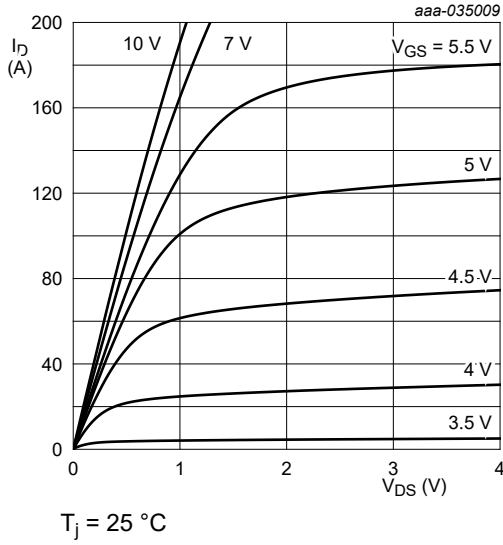


Fig. 8. Output characteristics; drain current as a function of drain-source voltage; typical values

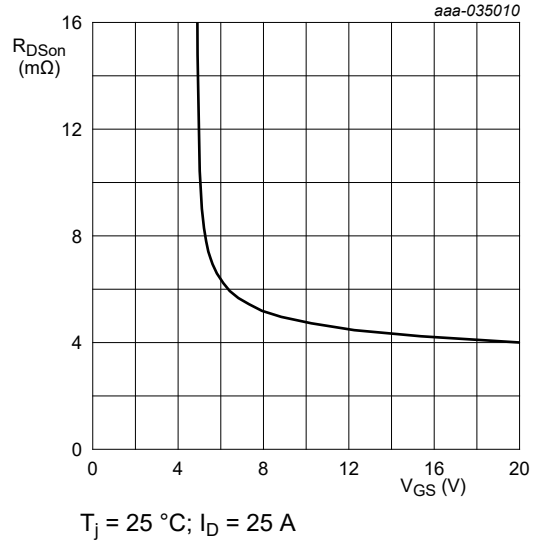


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

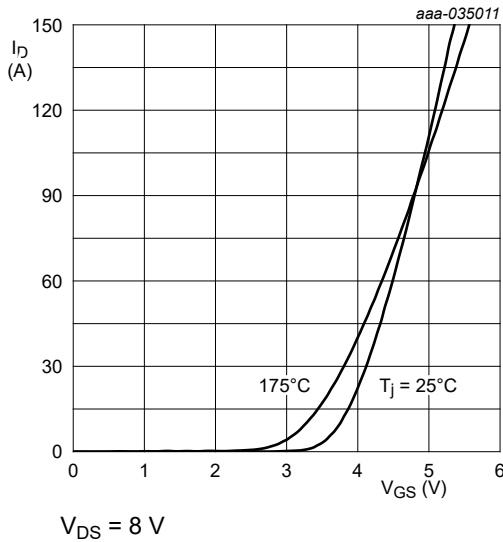


Fig. 10. Transfer characteristics; drain current as a function of gate-source voltage; typical values

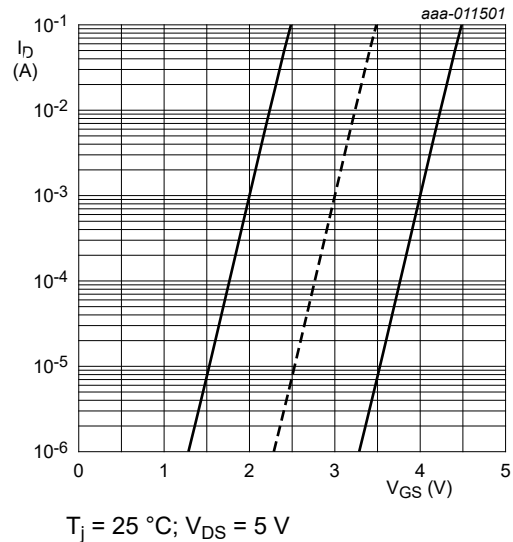


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

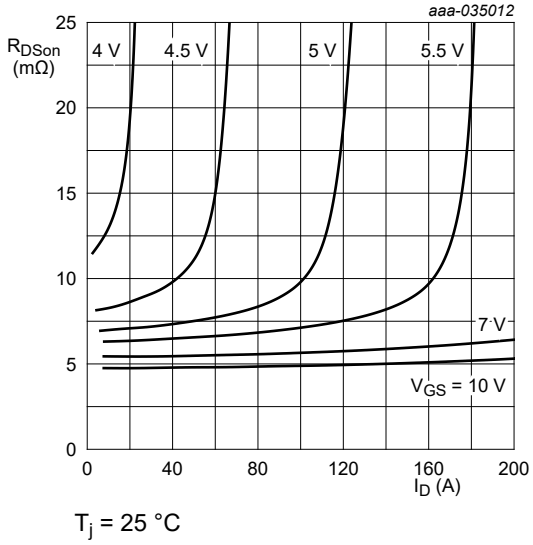
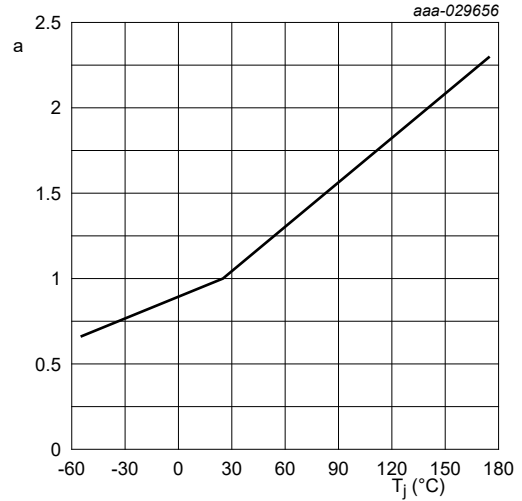


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values



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

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

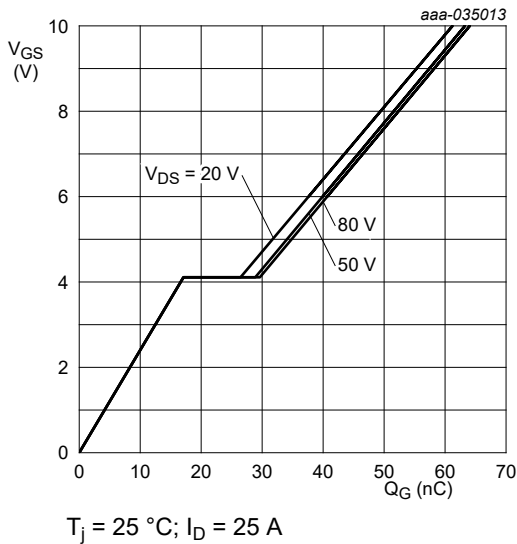


Fig. 14. Gate-source voltage as a function of gate charge; typical values

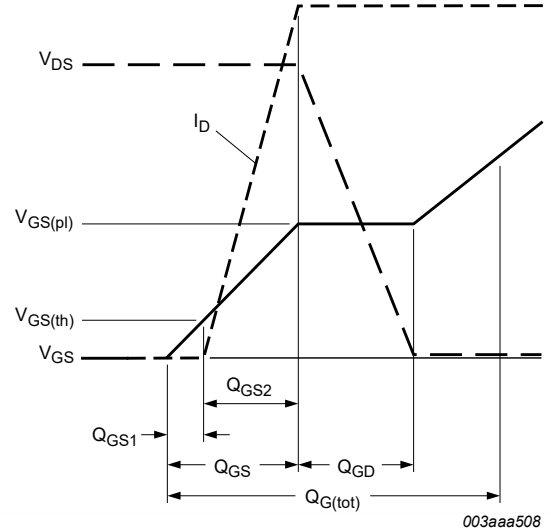


Fig. 15. Gate charge waveform definitions



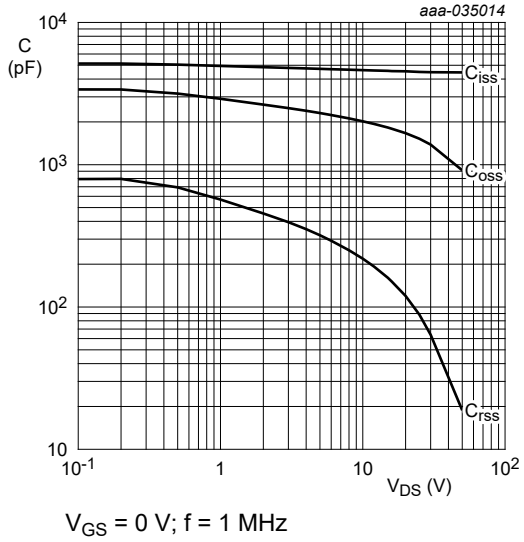


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

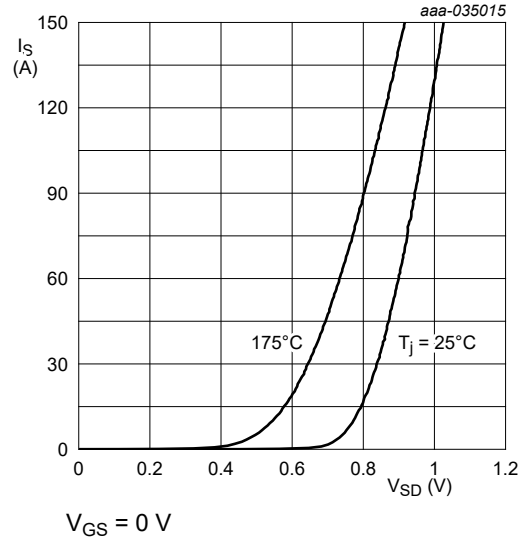


Fig. 17. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

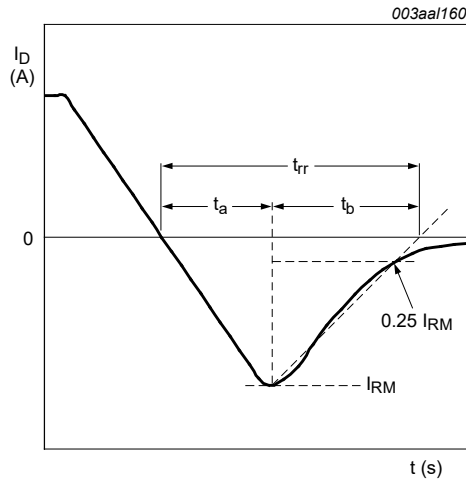


Fig. 18. Reverse recovery timing definition

### 11. Package outline

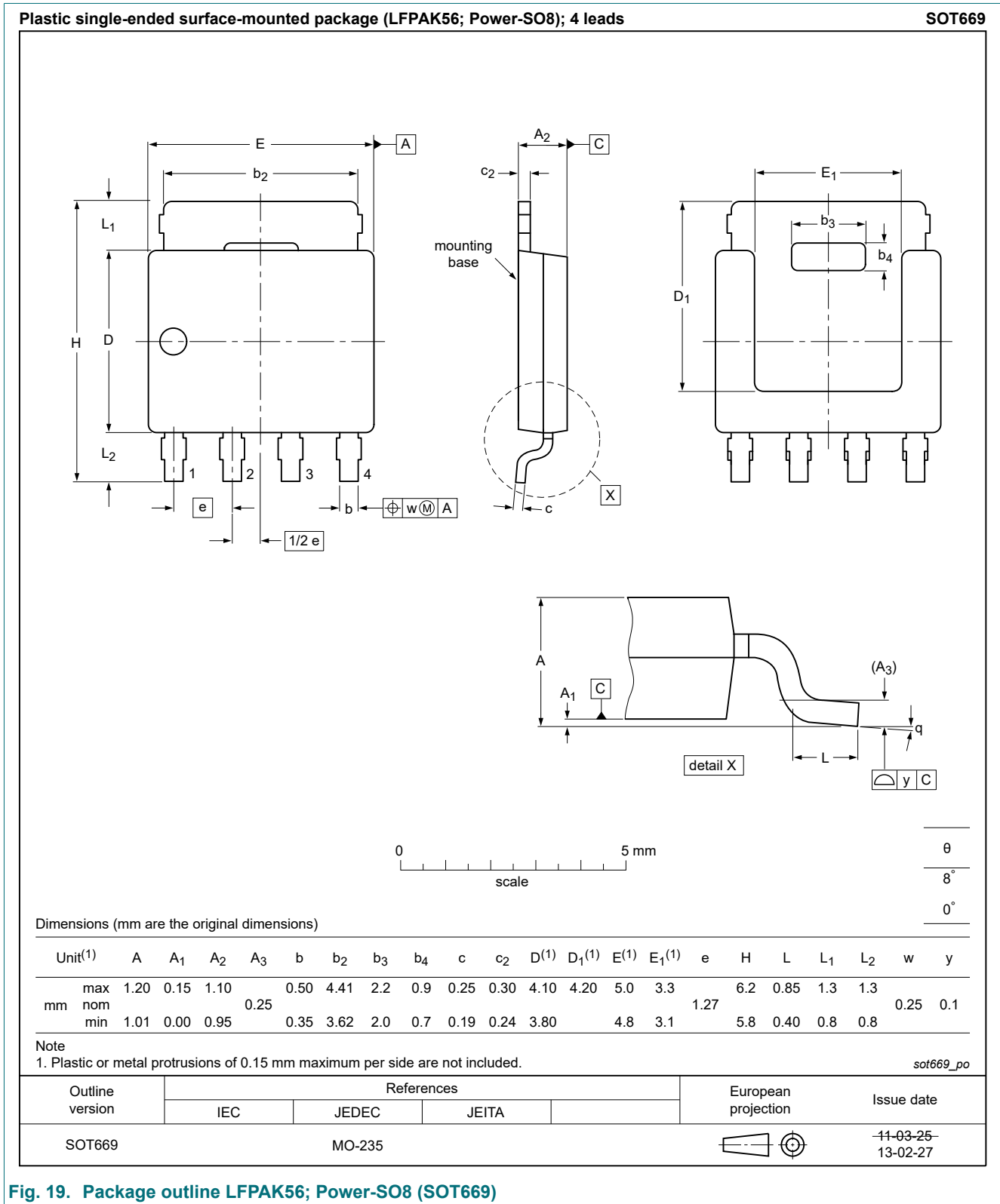


Fig. 19. Package outline LPAK56; Power-SO8 (SOT669)

## 12. Soldering

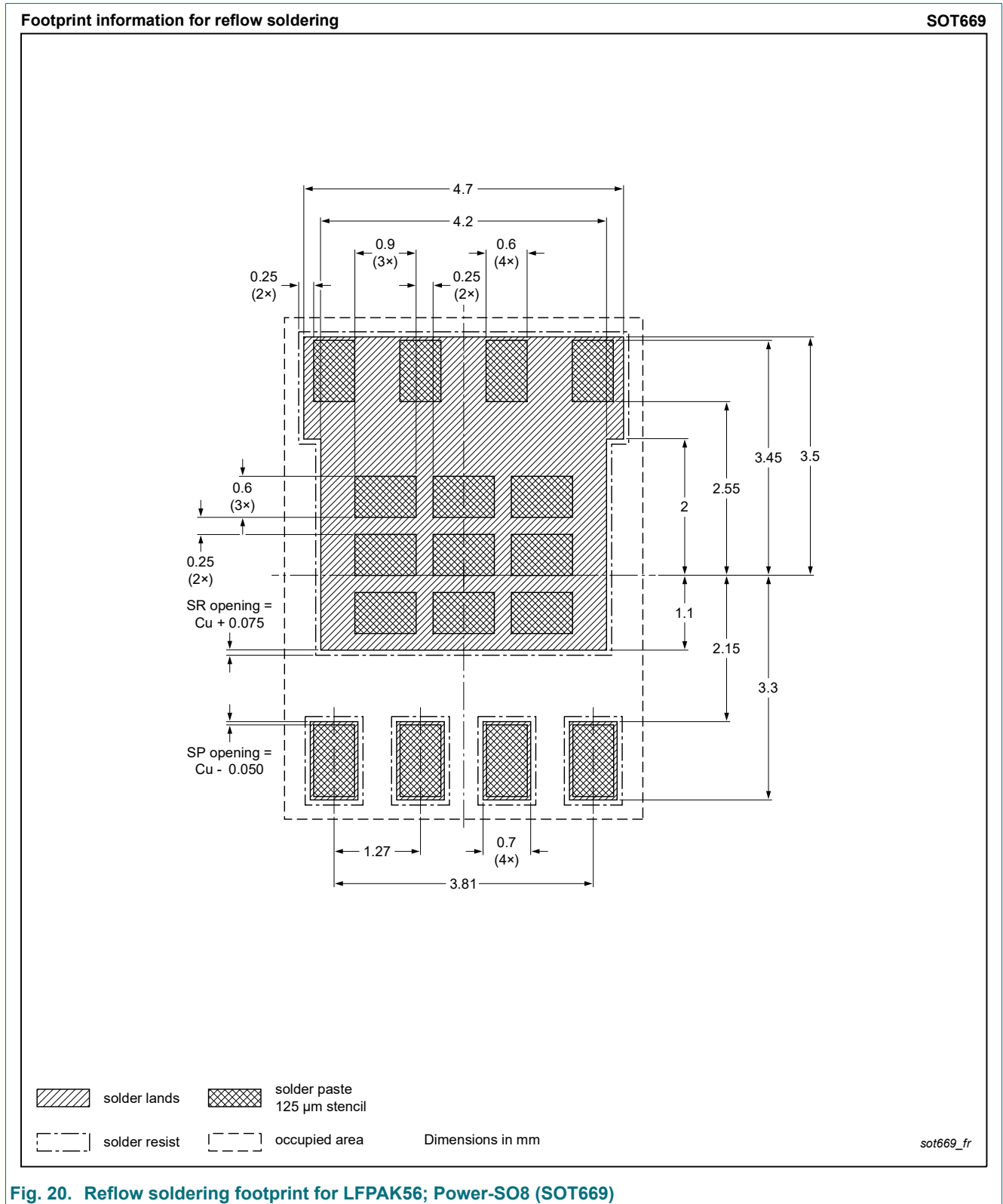
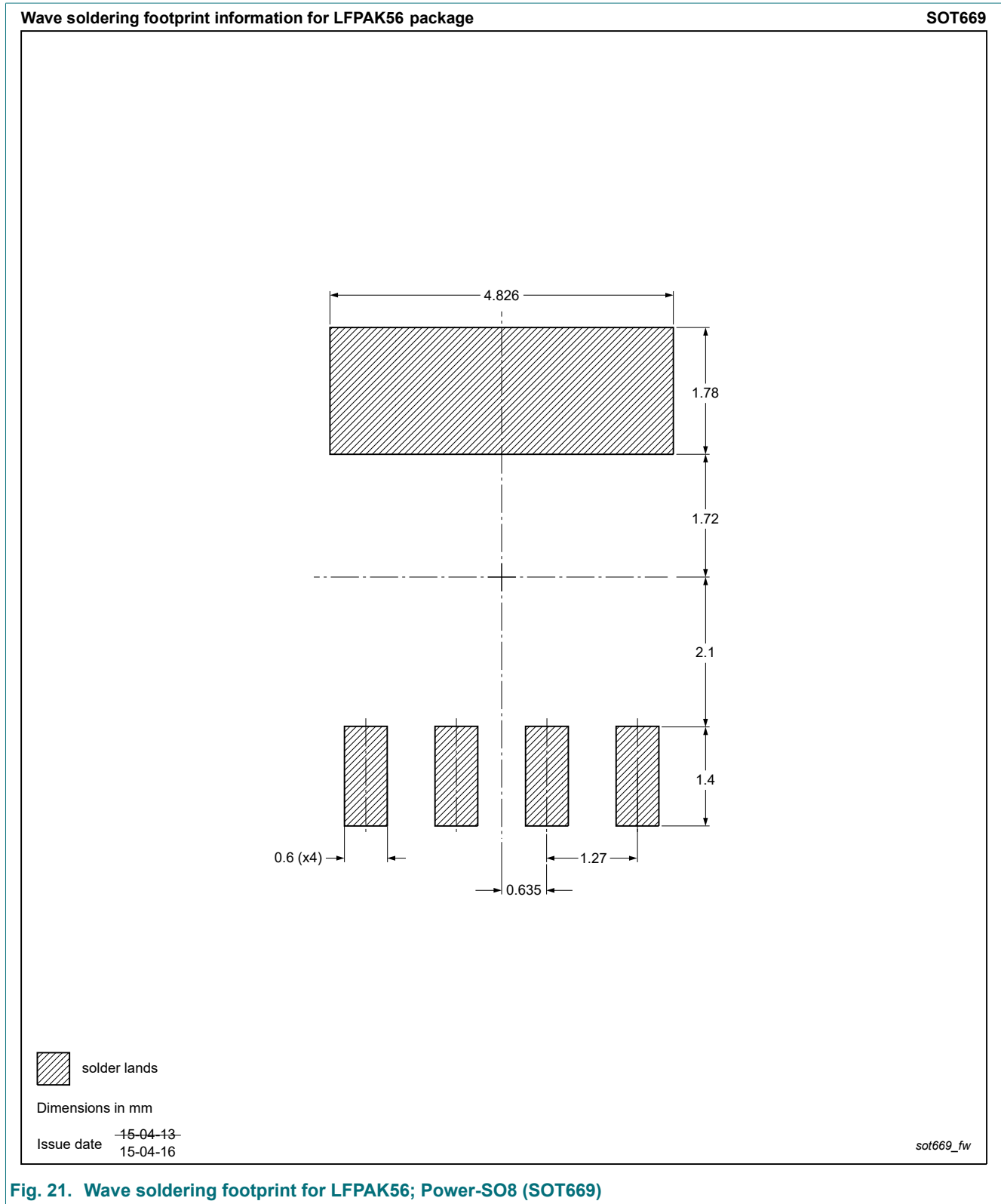


Fig. 20. Reflow soldering footprint for LPAK56; Power-SO8 (SOT669)



## 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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