



# PSMN2R0-25YLD

N-channel 25 V, 2.09 mΩ, 179 A logic level MOSFET in LPAK56 using NextPowerS3 Technology

23 April 2021

Product data sheet

## 1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LPAK56 package. NextPowerS3 portfolio utilising Nexperia's unique "SchottkyPlus" technology delivers high efficiency, low spiking performance usually associated with MOSFETS with an integrated Schottky or Schottky-like diode but without problematic high leakage current. NextPowerS3 is particularly suited to high efficiency applications at high switching frequencies.

## 2. Features and benefits

- 100% Avalanche tested at  $I_{(AS)} = 118$  A
- Ultra low  $Q_G$ ,  $Q_{GD}$  and  $Q_{OSS}$  for high system efficiency, especially at higher switching frequencies
- Superfast switching with soft-recovery
- Low spiking and ringing for low EMI designs
- Unique "SchottkyPlus" technology; Schottky-like performance with  $< 1$   $\mu$ A leakage at 25 °C
- Optimised for 4.5 V gate drive
- Low parasitic inductance and resistance
- High reliability clip bonded and solder die attach Power SO8 package; no glue, no wire bonds, qualified to 175 °C
- Wave solderable; exposed leads for optimal visual solder inspection

## 3. Applications

- On-board DC:DC solutions for server and telecommunications
- Secondary-side synchronous rectification in telecommunication applications
- Voltage regulator modules (VRM)
- Point-of-Load (POL) modules
- Power delivery for V-core, ASIC, DDR, GPU, VGA and system components
- Brushed and brushless motor control

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	-	25	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	-	179	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	-	115	W
$T_j$	junction temperature			-55	-	175	°C
<b>Static characteristics</b>							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>		-	2.41	2.91	mΩ
		$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 10</a>		-	1.82	2.09	mΩ

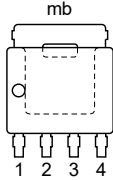
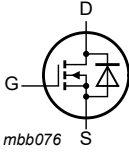
N-channel 25 V, 2.09 mΩ, 179 A logic level MOSFET in LFPAK56 using NextPowerS3 Technology

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Dynamic characteristics</b>						
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	34.1	-	nC
		I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 4.5 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	15.7	-	nC
		I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V	-	15.2	-	nC
Q <sub>GD</sub>	gate-drain charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 4.5 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	3.6	-	nC
<b>Source-drain diode</b>						
S	softness factor	I <sub>S</sub> = 25 A; di <sub>S</sub> /dt = -100 A/s; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 12 V; <a href="#">Fig. 16</a>	-	1	-	

[1] 179A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

### 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p><b>LFPAK56; Power-SO8 (SOT669)</b></p>	 <p><i>mbb076</i></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
PSMN2R0-25YLD	LFPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

### 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN2R0-25YLD	2D025L

## 8. Limiting values

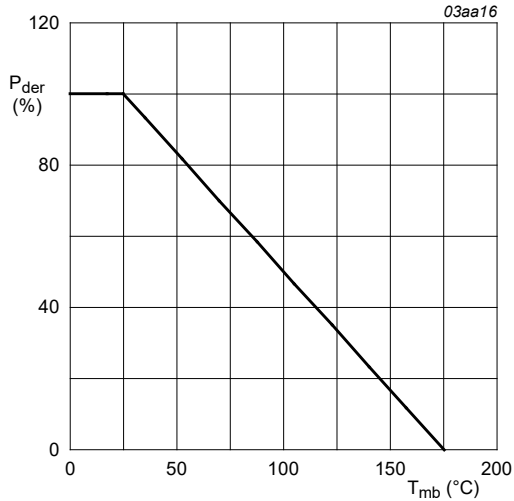
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	25	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}; R_{GS} = 20\text{ k}\Omega$		-	25	V
$V_{GS}$	gate-source voltage			-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	115	W
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	179	A
		$V_{GS} = 10\text{ V}; T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>		-	127	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>		-	722	A
$T_{stg}$	storage temperature			-55	175	°C
$T_j$	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
$V_{ESD}$	electrostatic discharge voltage	HBM (JEDEC)		600	-	V
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$		-	95	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$		-	722	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 25\text{ A}; V_{sup} \leq 25\text{ V}; R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}; T_{j(init)} = 25\text{ °C}$ ; unclamped; $t_p = 1.01\text{ ms}$		-	410	mJ
$I_{AS}$	non-repetitive avalanche current	$V_{sup} = 25\text{ V}; V_{GS} = 10\text{ V}; T_{j(init)} = 25\text{ °C}$ ; $R_{GS} = 50\text{ }\Omega$	[2]	-	118	A

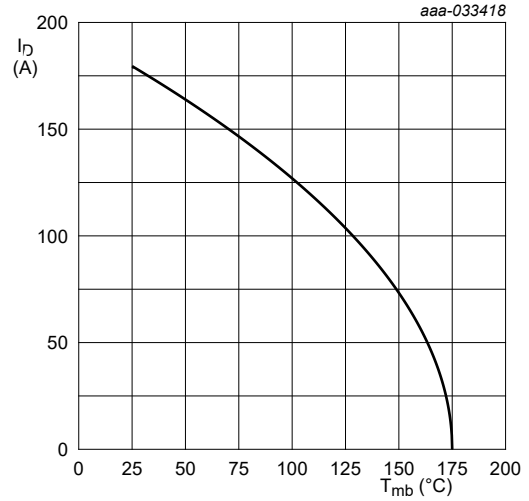
[1] 179A continuous current has been successfully demonstrated during application tests. Practically the current will be limited by PCB, thermal design and operating temperature.

[2] Protected by 100% test



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

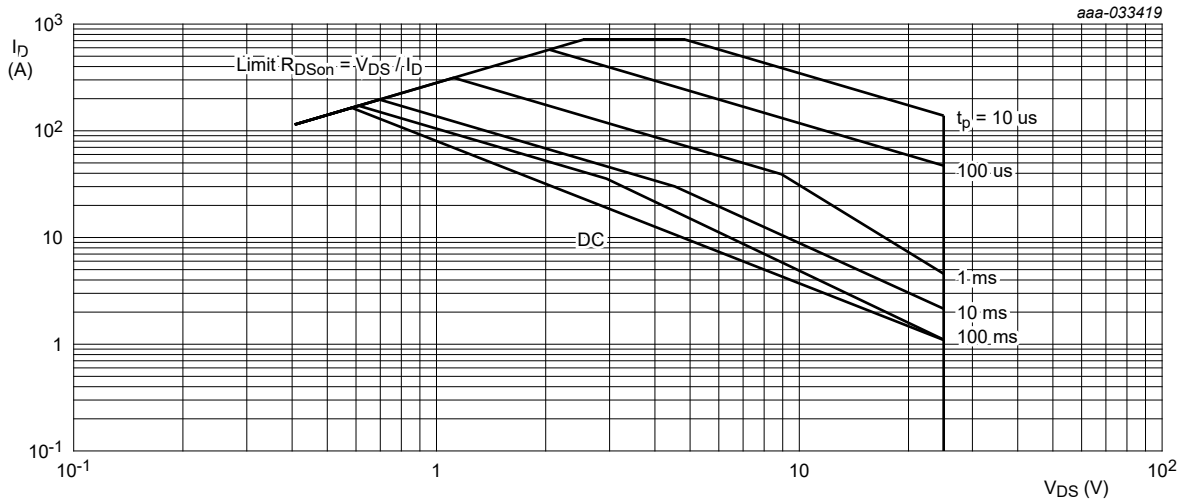
Fig. 1. Normalized total power dissipation as a function of mounting base temperature



$V_{GS} \geq 10\text{ V}$

(1) 179A 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



$T_{mb} = 25^{\circ}C$ ;  $I_{DM}$  is a single pulse

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

## 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. 4	-	1.09	1.31	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5	-	50	-	K/W
		Fig. 6	-	125	-	K/W

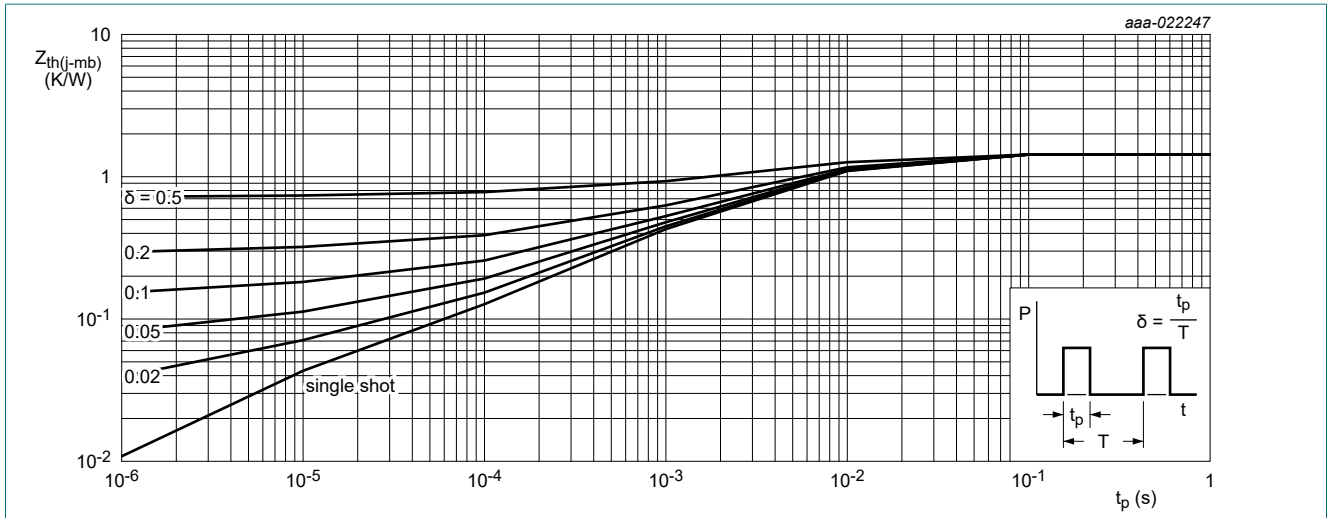


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

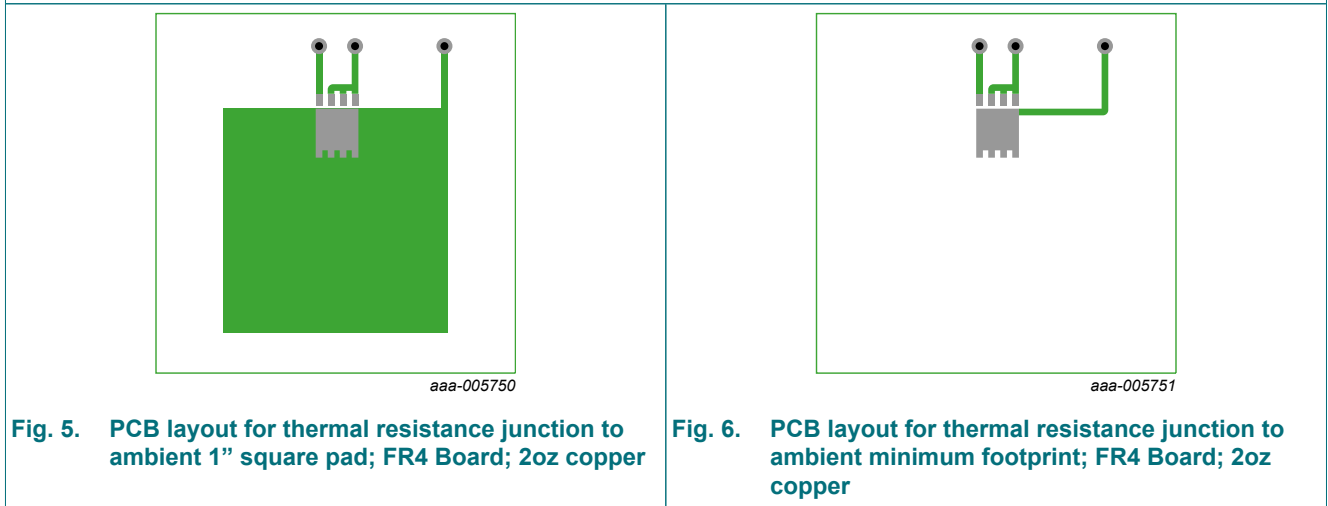


Fig. 5. PCB layout for thermal resistance junction to ambient 1” square pad; FR4 Board; 2oz copper

Fig. 6. PCB layout for thermal resistance junction to ambient minimum footprint; FR4 Board; 2oz copper

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	25	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	22.5	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	1.2	1.68	2.2	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ C \leq T_j \leq 175 \text{ }^\circ C$	-	-4.5	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	1	$\mu A$
		$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	3.9	-	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	-	100	nA

## N-channel 25 V, 2.09 mΩ, 179 A logic level MOSFET in LPAK56 using NextPowerS3 Technology

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>	-	2.41	2.91	mΩ	
		V <sub>GS</sub> = 4.5 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 175 °C; <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	-	-	4.95	mΩ	
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>	-	1.82	2.09	mΩ	
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 175 °C; <a href="#">Fig. 10</a> ; <a href="#">Fig. 11</a>	-	-	3.52	mΩ	
R <sub>G</sub>	gate resistance	f = 1 MHz	-	0.849	-	Ω	
<b>Dynamic characteristics</b>							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	34.1	-	nC	
		I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 4.5 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	15.7	-	nC	
		I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V	-	15.2	-	nC	
Q <sub>GS</sub>	gate-source charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 4.5 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	6.4	-	nC	
Q <sub>GS(th)</sub>	pre-threshold gate-source charge		-	3.8	-	nC	
Q <sub>GS(th-pl)</sub>	post-threshold gate-source charge		-	2.6	-	nC	
Q <sub>GD</sub>	gate-drain charge		-	3.6	-	nC	
V <sub>GS(pl)</sub>	gate-source plateau voltage	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 12 V; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	-	2.8	-	V	
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 12 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>j</sub> = 25 °C; <a href="#">Fig. 14</a>	-	2485	-	pF	
C <sub>oss</sub>	output capacitance		-	1142	-	pF	
C <sub>rss</sub>	reverse transfer capacitance		-	152	-	pF	
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 12 V; R <sub>L</sub> = 0.6 Ω; V <sub>GS</sub> = 4.5 V; R <sub>G(ext)</sub> = 5 Ω	-	15.7	-	ns	
t <sub>r</sub>	rise time		-	18.7	-	ns	
t <sub>d(off)</sub>	turn-off delay time		-	18.7	-	ns	
t <sub>f</sub>	fall time		-	12.4	-	ns	
Q <sub>oss</sub>	output charge	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 12 V; f = 1 MHz; T <sub>j</sub> = 25 °C	-	23	-	nC	
<b>Source-drain diode</b>							
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 20 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 15</a>	-	0.8	1.2	V	
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 25 A; dI <sub>S</sub> /dt = -100 A/s; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 12 V; <a href="#">Fig. 16</a>	-	26	-	ns	
Q <sub>r</sub>	recovered charge		[1]	-	16.8	-	nC
t <sub>a</sub>	reverse recovery rise time		-	-	13	-	ns
t <sub>b</sub>	reverse recovery fall time		-	-	13	-	ns
S	softness factor		-	-	1	-	

[1] Includes capacitive recovery

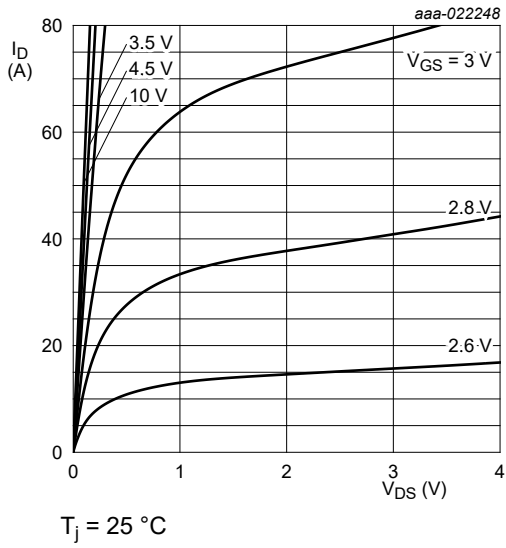


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

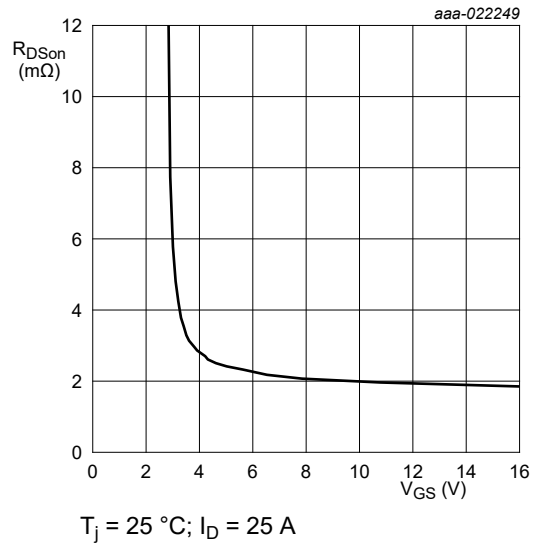


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

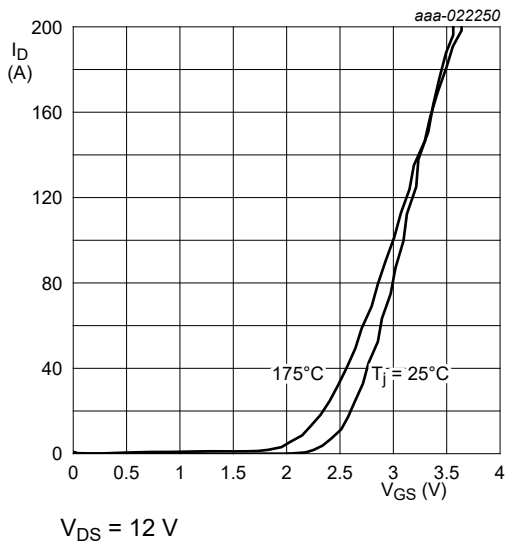


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

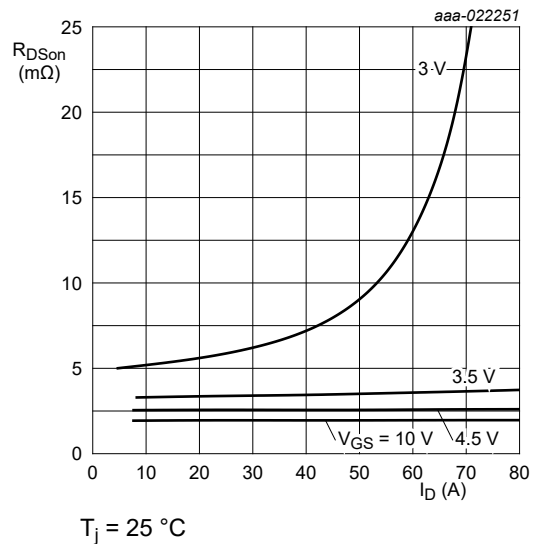
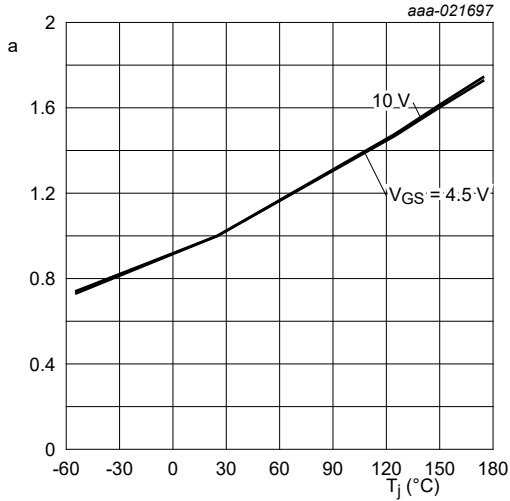
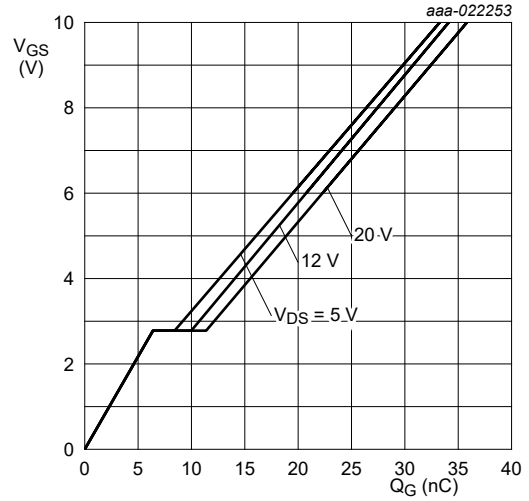


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values



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

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



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

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

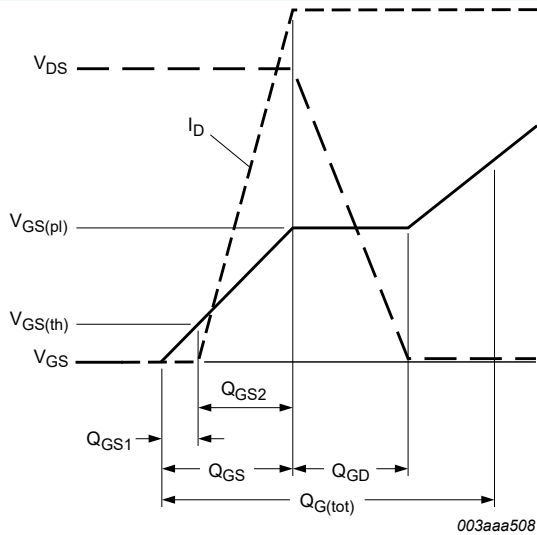
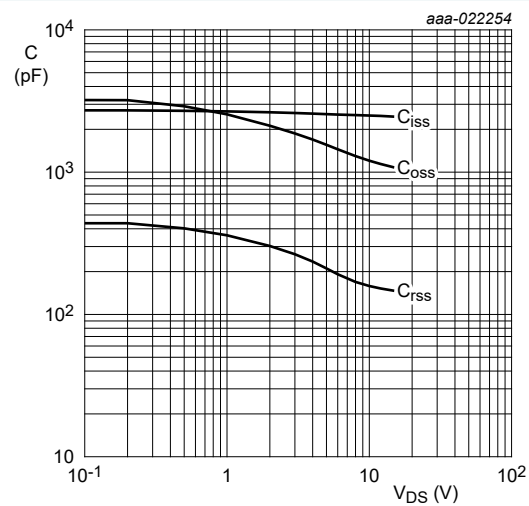
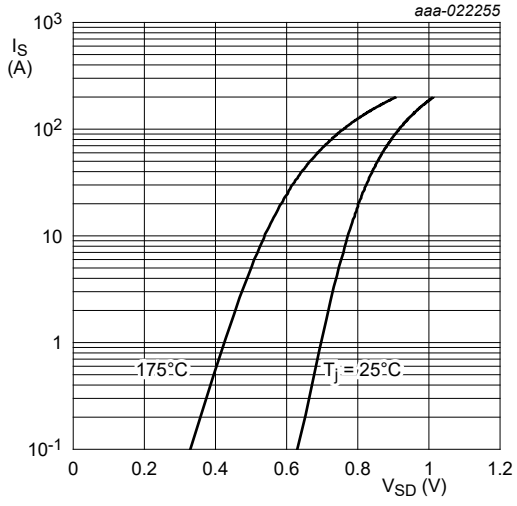


Fig. 13. Gate charge waveform definitions



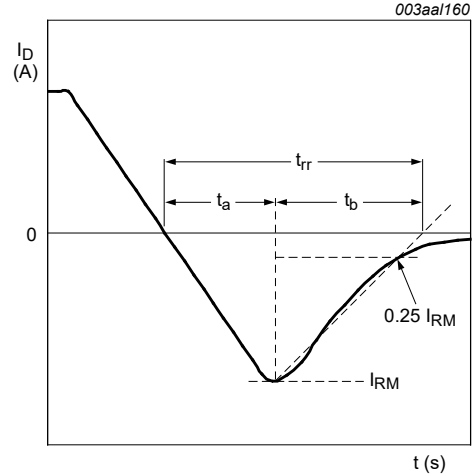
$V_{GS} = 0\text{ V}; f = 1\text{ MHz}$

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

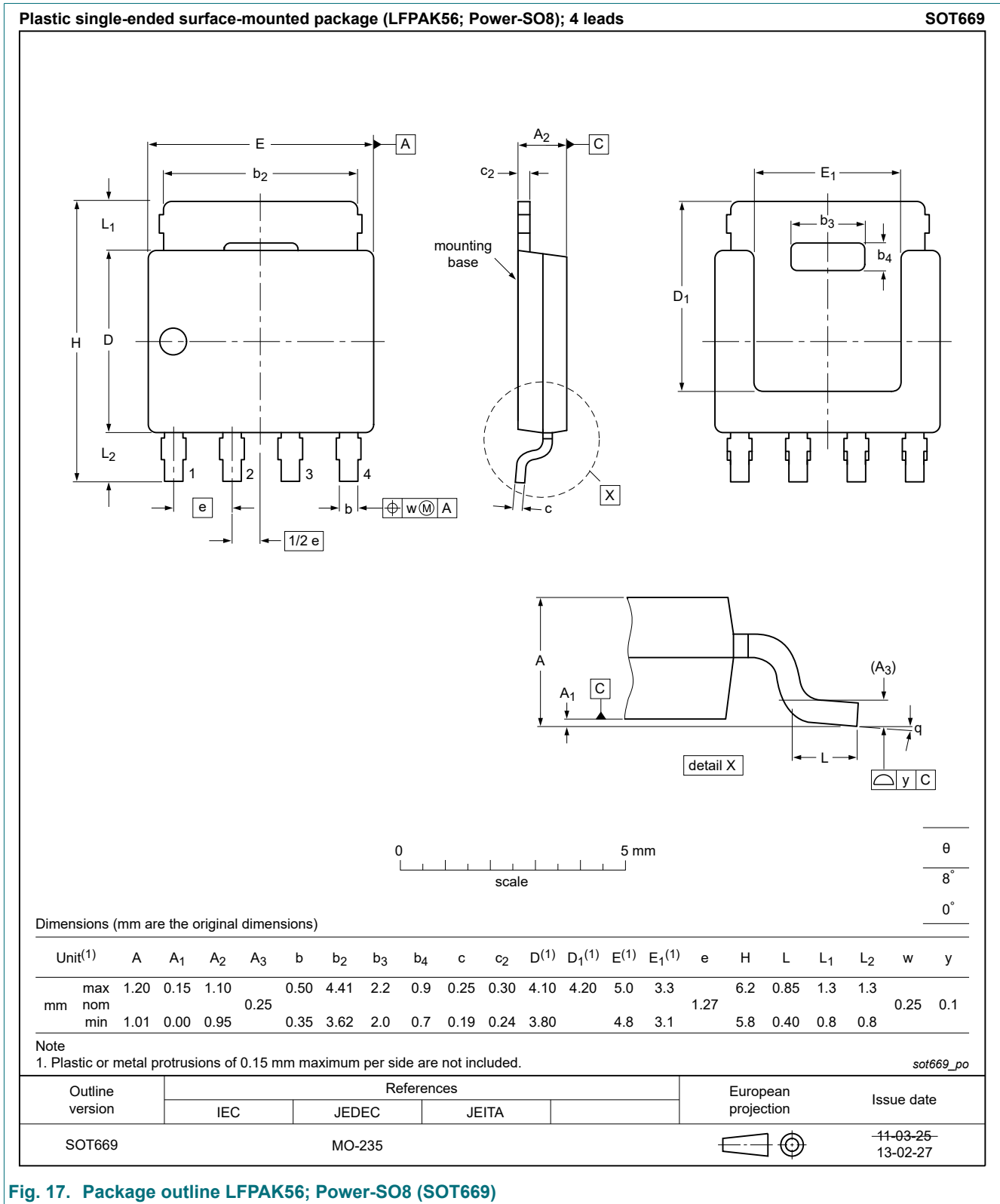


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

## 12. Soldering

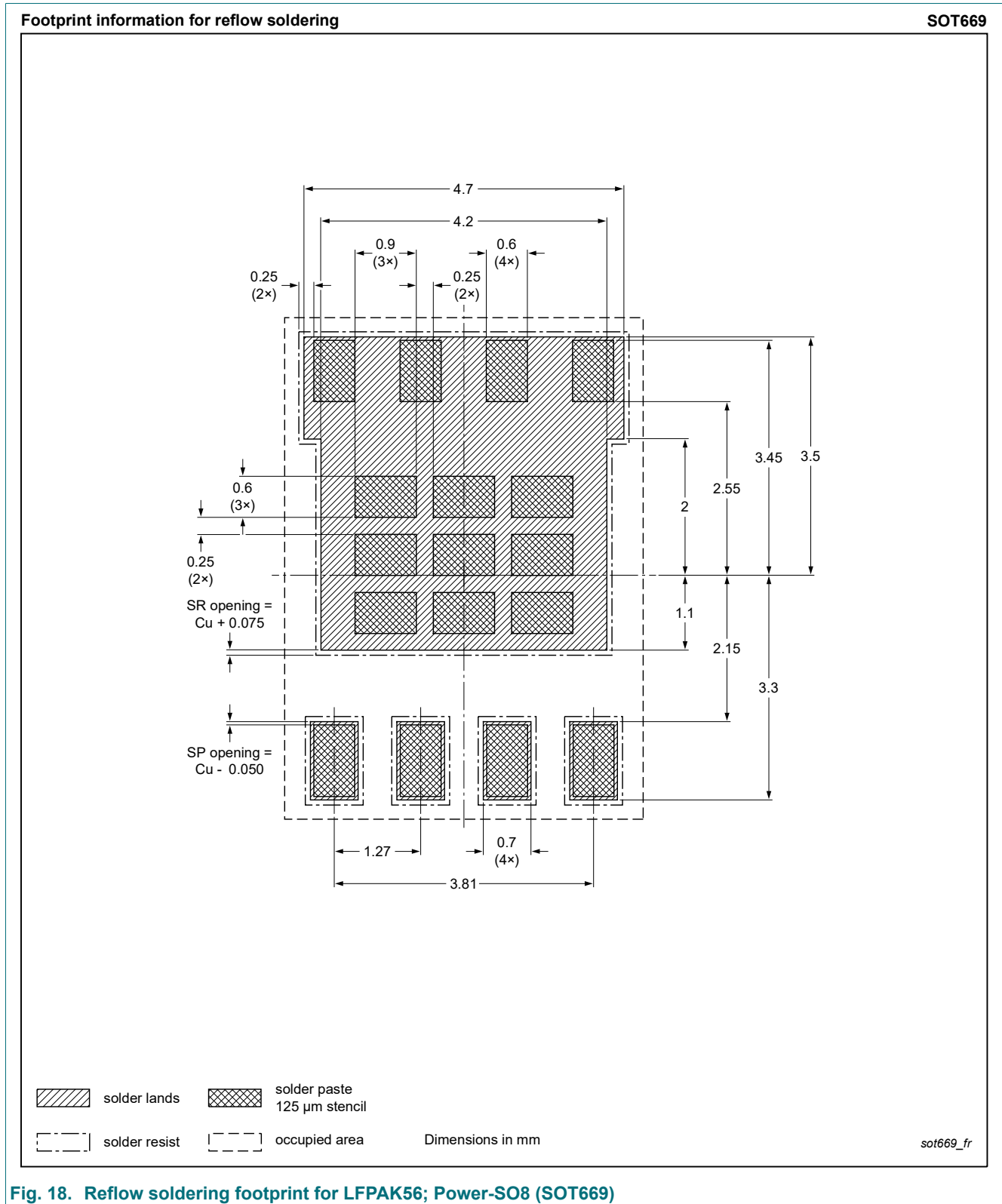
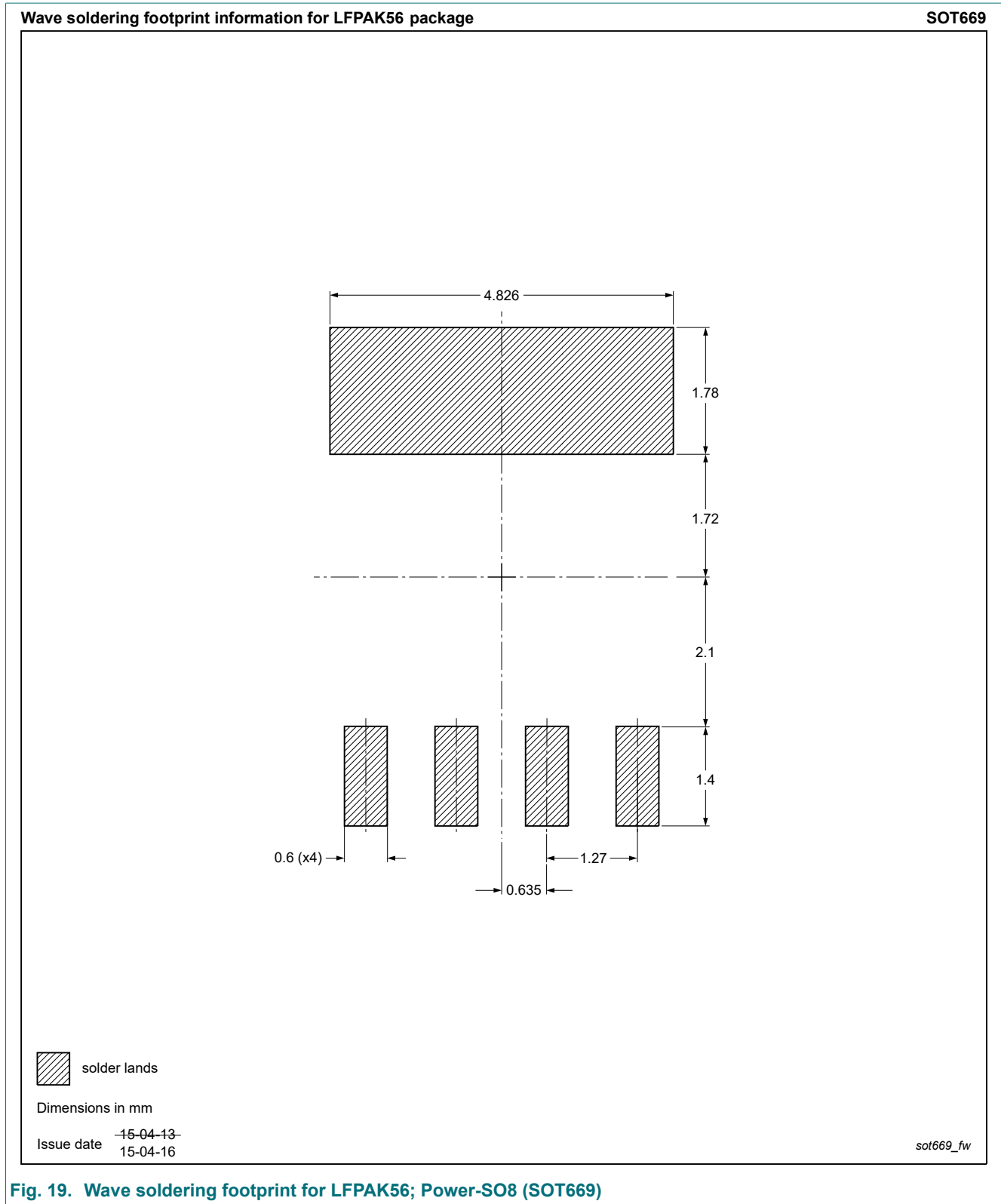


Fig. 18. Reflow soldering footprint for LFPAK56; Power-SO8 (SOT669)



## 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.

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## Contents

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1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values.....	3
9. Thermal characteristics.....	4
10. Characteristics.....	5
11. Package outline.....	10
12. Soldering.....	11
13. Legal information.....	13

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