



# PSMN2R2-40YSD

N-channel 40 V, 2.2 m $\Omega$ , 180 A standard level MOSFET in LFPAK56 using NextPower-S3 Schottky-Plus technology

25 September 2019

Product data sheet

## 1. General description

180 A, standard level gate drive N-channel enhancement mode MOSFET in 175 °C LFPAK56 package using advanced TrenchMOS Superjunction technology. This product has been designed and qualified for high performance power switching applications.

## 2. Features and benefits

- 180 A continuous  $I_{D(max)}$  rating
- Avalanche rated, 100% tested at  $I_{AS} = 160$  A
- Strong SOA (linear-mode) rating
- NextPower-S3 technology delivers 'superfast switching with soft body-diode recovery'
- Low  $Q_{rr}$ ,  $Q_G$  and  $Q_{GD}$  for high system efficiency and low EMI designs
- Schottky-Plus body-diode with low  $V_{SD}$ , low  $Q_{rr}$ , soft recovery and low  $I_{DSS}$  leakage
- High reliability LFPAK (Power SO8) package, with copper-clip and solder die attach, qualified to 175 °C
- Exposed leads can be wave soldered, visual solder joint inspection and high quality solder joints
- Low parasitic inductance and resistance

## 3. Applications

- High-performance synchronous rectification
- DC-to-DC converters
- Brushless DC motor control
- Battery protection
- Load-switch and eFuse
- Inrush management, hotswap

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	-	40	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	-	180	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	-	166	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. 10</a>		-	1.9	2.2	m $\Omega$

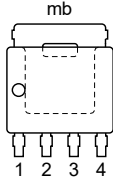
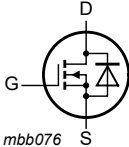
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}$ ; $V_{DS} = 20\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 13</a>	1.8	6.1	12	nC
$Q_{G(\text{tot})}$	total gate charge		29	45	63	nC

[1] 180A 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>LPAK56; Power-SO8 (SOT669)</p>	 <p>mbb076 S</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
PSMN2R2-40YSD	LPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN2R2-40YSD	2D2S40Y

## 8. Limiting values

Table 5. Limiting values

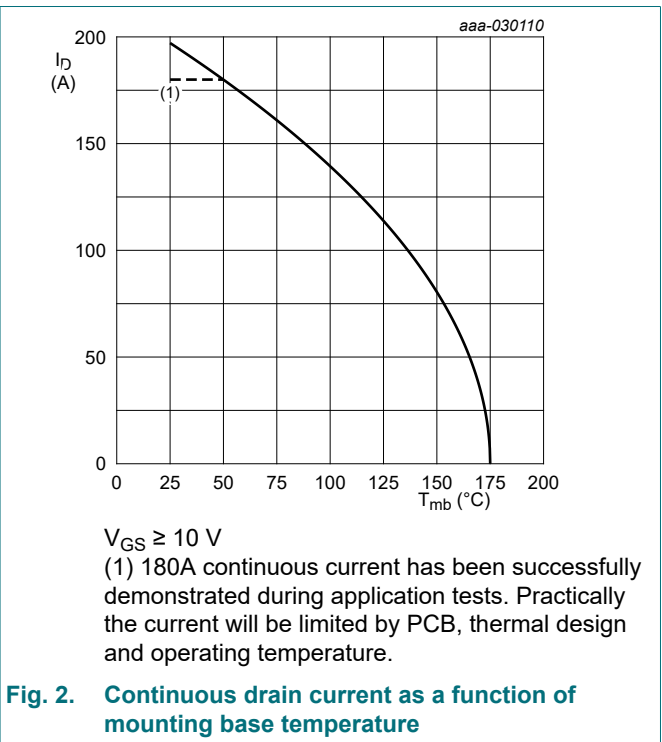
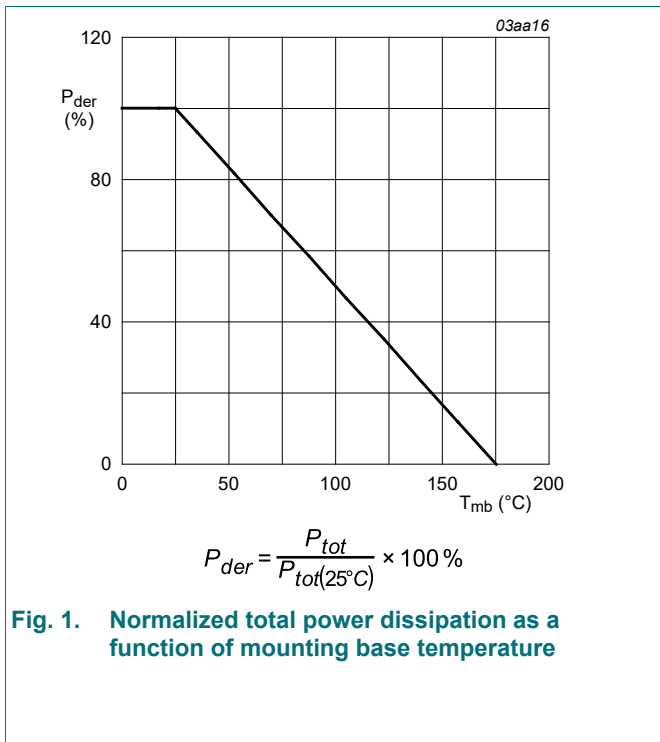
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$	-	40	V
$V_{DSM}$	peak drain-source voltage	$t_p \leq 20\text{ ns}$ ; $f \leq 500\text{ kHz}$ ; $E_{DS(\text{AL})} \leq 200\text{ nJ}$ ; pulsed	-	45	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$	-	40	V
$V_{GS}$	gate-source voltage		-20	20	V
$P_{\text{tot}}$	total power dissipation	$T_{\text{mb}} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	-	166	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{\text{mb}} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	180	A
		$V_{GS} = 10\text{ V}$ ; $T_{\text{mb}} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>	-	140	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{\text{mb}} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>	-	789	A

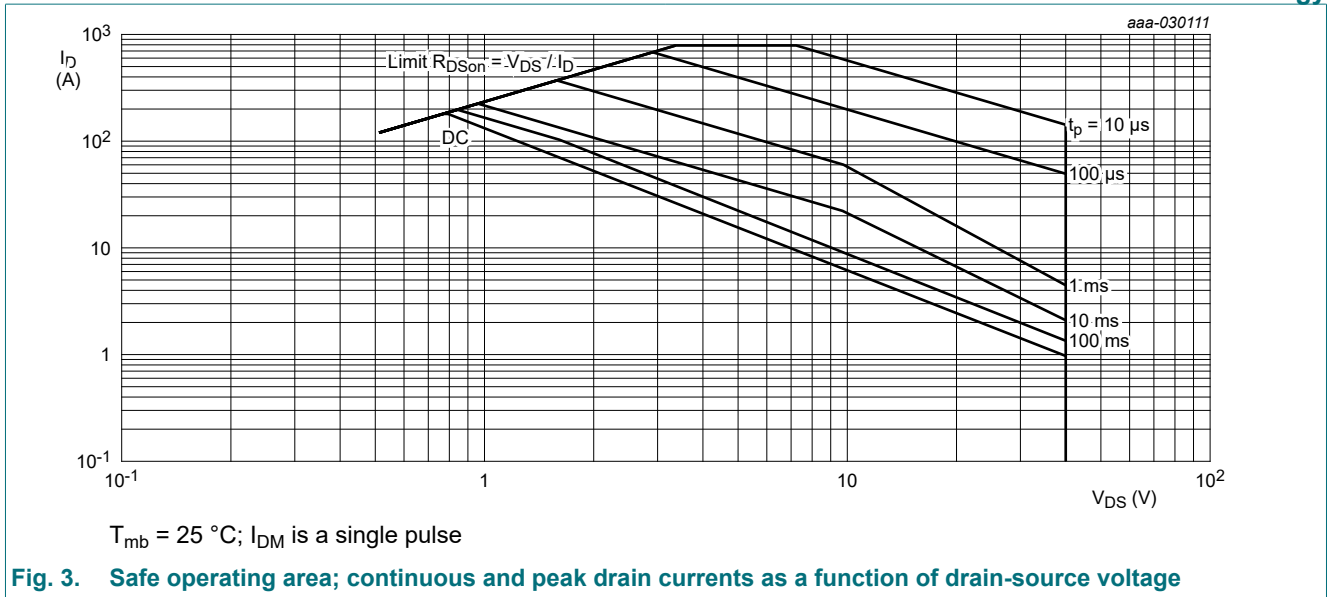
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Symbol	Parameter	Conditions		Min	Max	Unit
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
T <sub>slid(M)</sub>	peak soldering temperature			-	260	°C
<b>Source-drain diode</b>						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C		-	166	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C		-	789	A
<b>Avalanche ruggedness</b>						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 53.5 A; V <sub>sup</sub> ≤ 40 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; t <sub>p</sub> = 182 μs	[2]	-	253	mJ
		I <sub>D</sub> = 25 A; V <sub>sup</sub> ≤ 40 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; unclamped; t <sub>p</sub> = 937 μs	[2]	-	609	mJ
I <sub>AS</sub>	non-repetitive avalanche current	V <sub>sup</sub> ≤ 40 V; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; R <sub>GS</sub> = 50 Ω	[2]	-	160	A

- [1] 180A 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



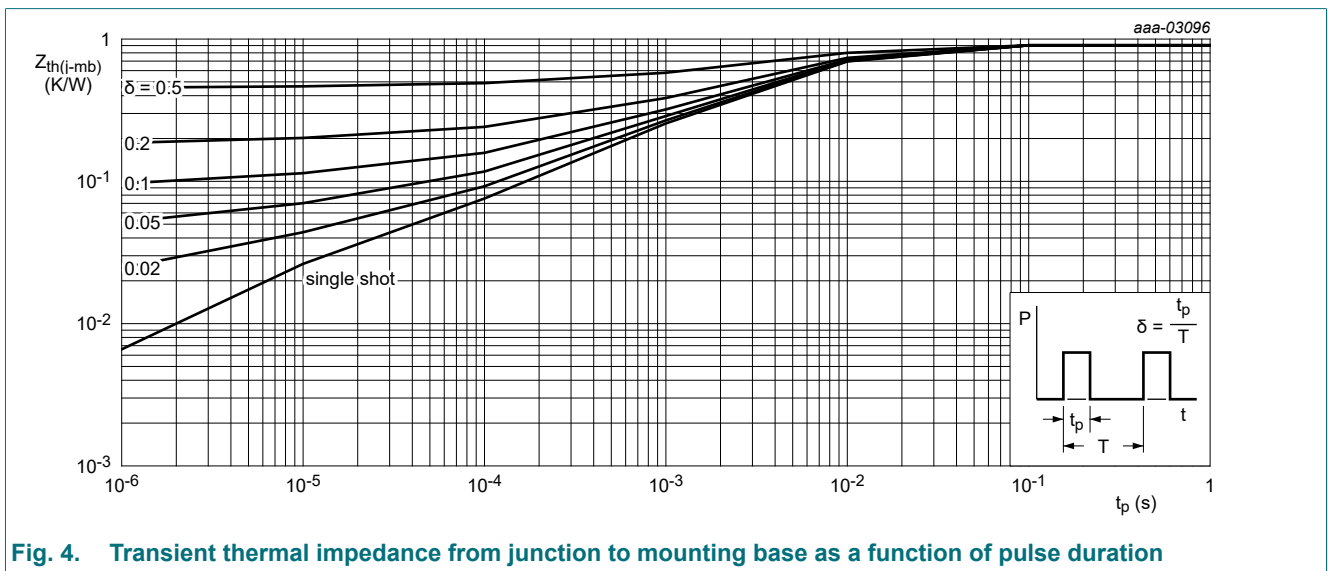
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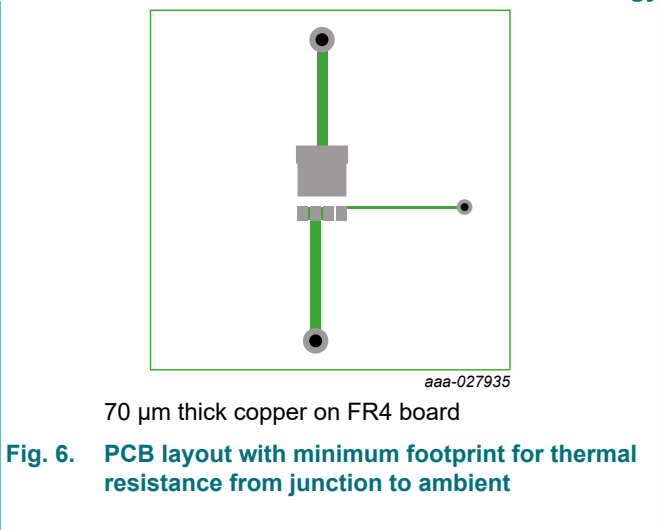
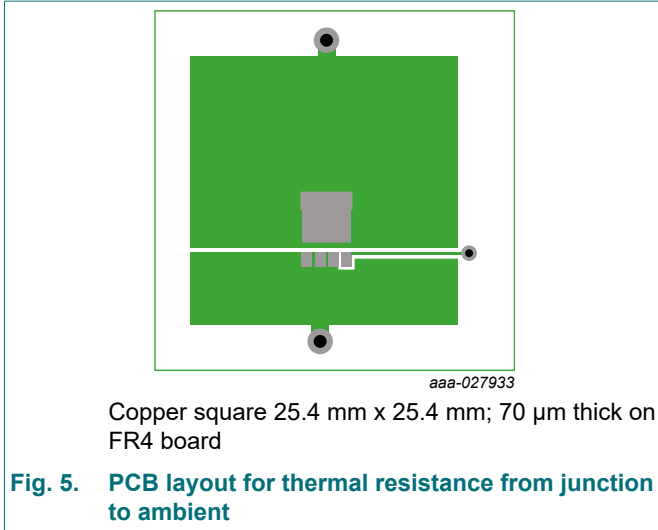
### 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 4	-	0.8	0.9	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5	-	42	-	K/W
		Fig. 6	-	85	-	K/W



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## 10. Characteristics

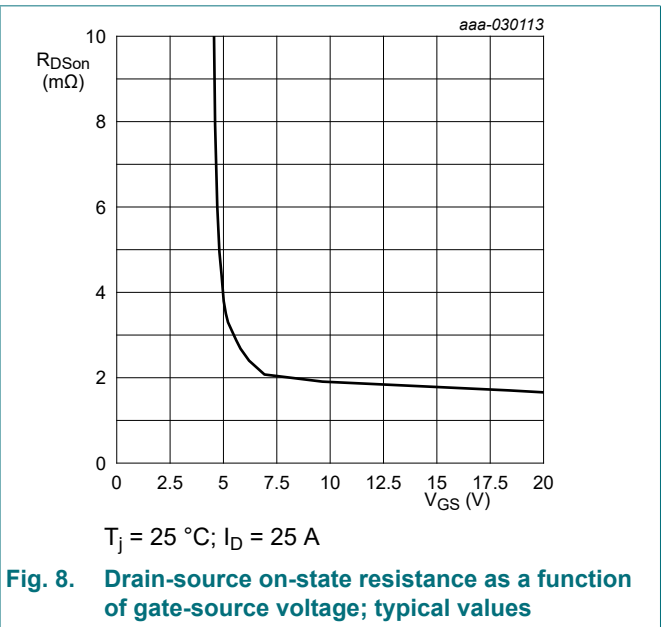
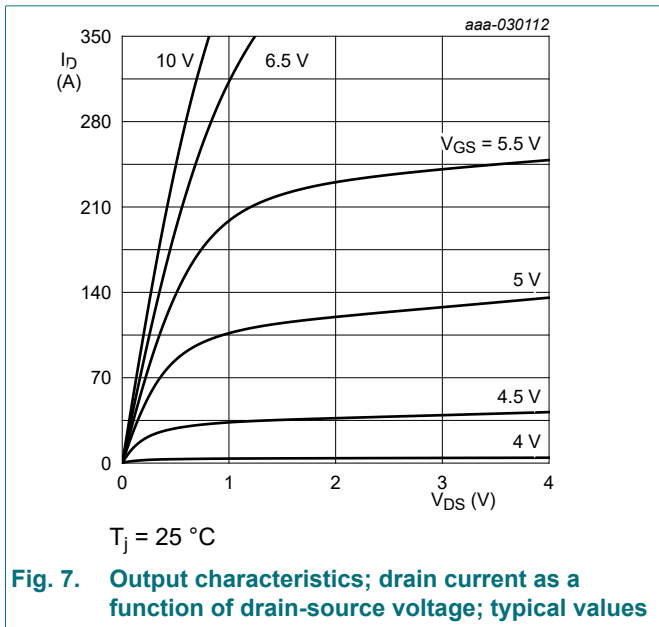
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	40	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C$	2.4	3	3.6	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ C \leq T_j \leq 150 \text{ }^\circ C$	-	-6.3	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 32 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.009	1	μA
		$V_{DS} = 32 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ C$	-	2	-	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
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 10</a>	-	1.9	2.2	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	-	4.3	mΩ
$R_G$	gate resistance	$f = 1 \text{ MHz}; T_j = 25 \text{ }^\circ C$	0.4	0.9	2.3	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 10 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	29	45	63	nC
		$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	40	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 \text{ A}; V_{DS} = 20 \text{ V}; V_{GS} = 10 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	8.4	14	21	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		6	10	15	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		2.9	4.8	7.2	nC
$Q_{GD}$	gate-drain charge		1.8	6.1	12	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 \text{ A}; V_{DS} = 20 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	-	4.4	-	V

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{iss}$	input capacitance	$V_{DS} = 20\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C};$ <a href="#">Fig. 14</a>	2382	3664	5130	pF
$C_{oss}$	output capacitance		694	1068	1495	pF
$C_{rss}$	reverse transfer capacitance		58	193	425	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\text{ V}; R_L = 0.8\text{ }\Omega; V_{GS} = 10\text{ V}; R_{G(ext)} = 5\text{ }\Omega$	-	13	-	ns
$t_r$	rise time		-	9	-	ns
$t_{d(off)}$	turn-off delay time		-	26	-	ns
$t_f$	fall time		-	10	-	ns
$Q_{oss}$	output charge	$V_{GS} = 0\text{ V}; V_{DS} = 20\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C}$	-	33	-	nC
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C};$ <a href="#">Fig. 15</a>	-	0.8	1	V
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 20\text{ V};$ <a href="#">Fig. 16</a>	-	29	-	ns
$Q_r$	recovered charge		[1]	21	-	nC
$t_a$	reverse recovery rise time		-	16	-	ns
$t_b$	reverse recovery fall time		-	13	-	ns

[1] includes capacitive recovery



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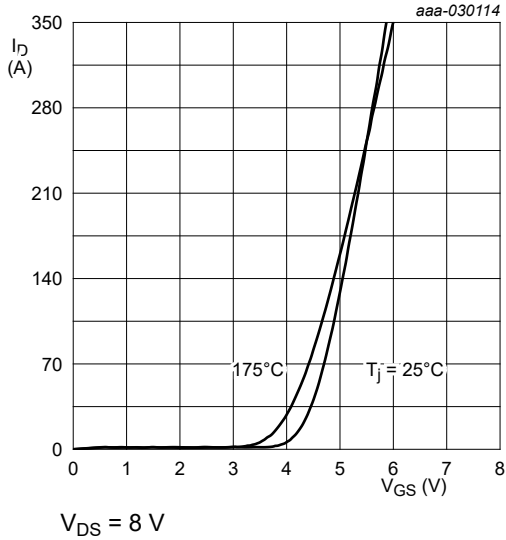


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

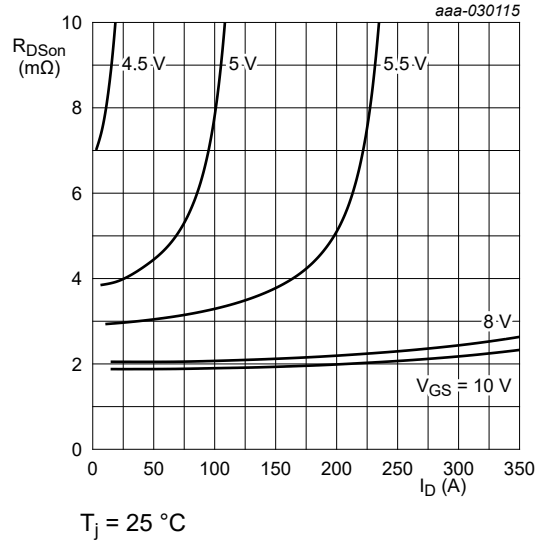


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

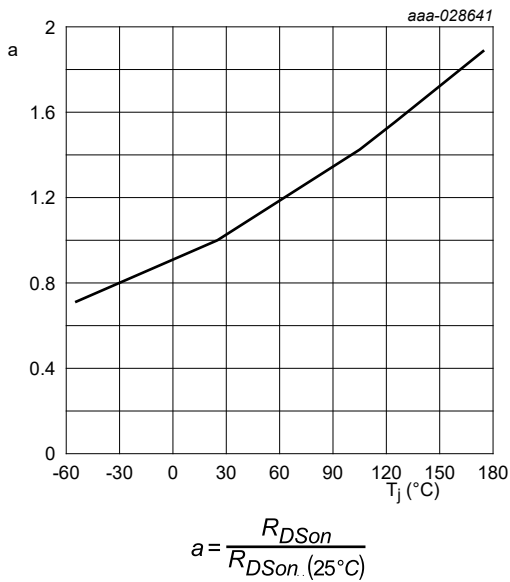


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

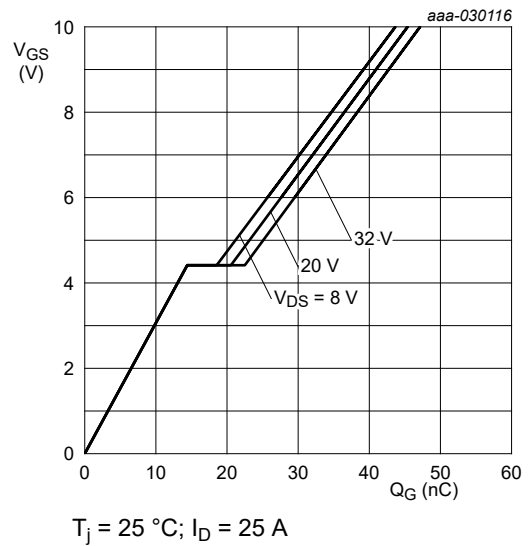


Fig. 12. Gate-source voltage as a function of gate charge; typical values

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Fig. 13. Gate charge waveform definitions

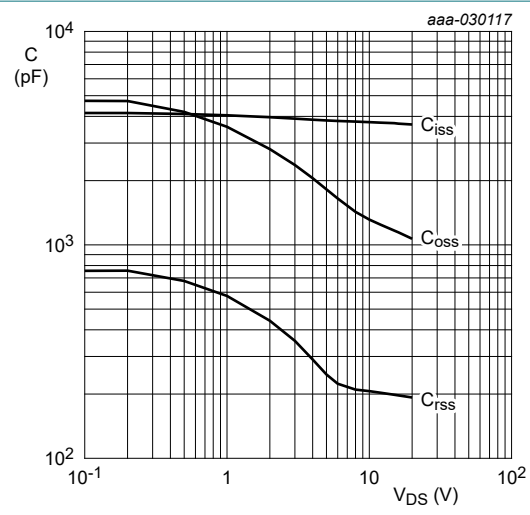


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

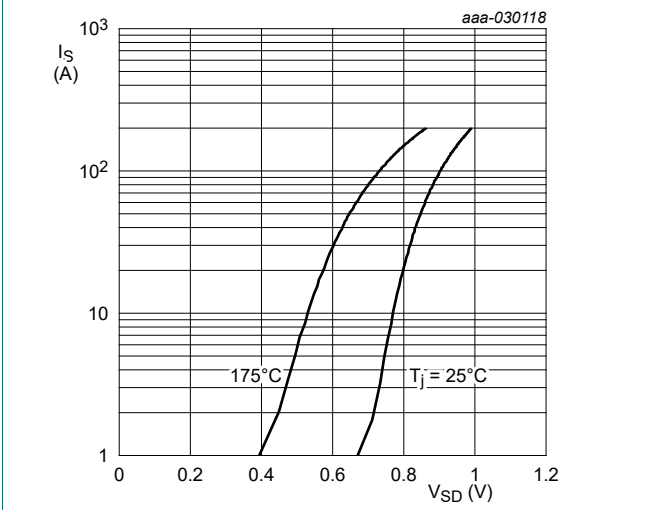


Fig. 15. Source-drain (diode forward) current as a function of source-drain (diode forward) voltage; typical values

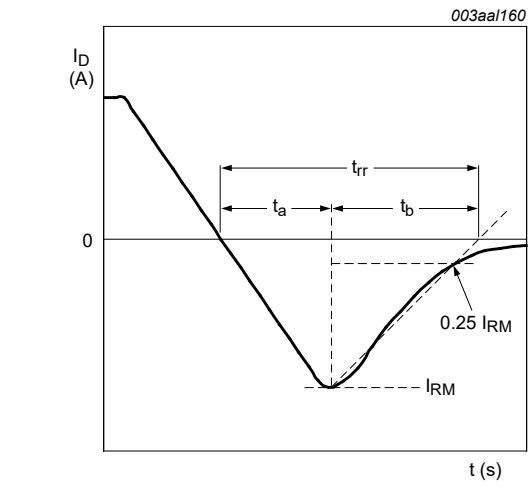


Fig. 16. Reverse recovery timing definition



11. Package outline

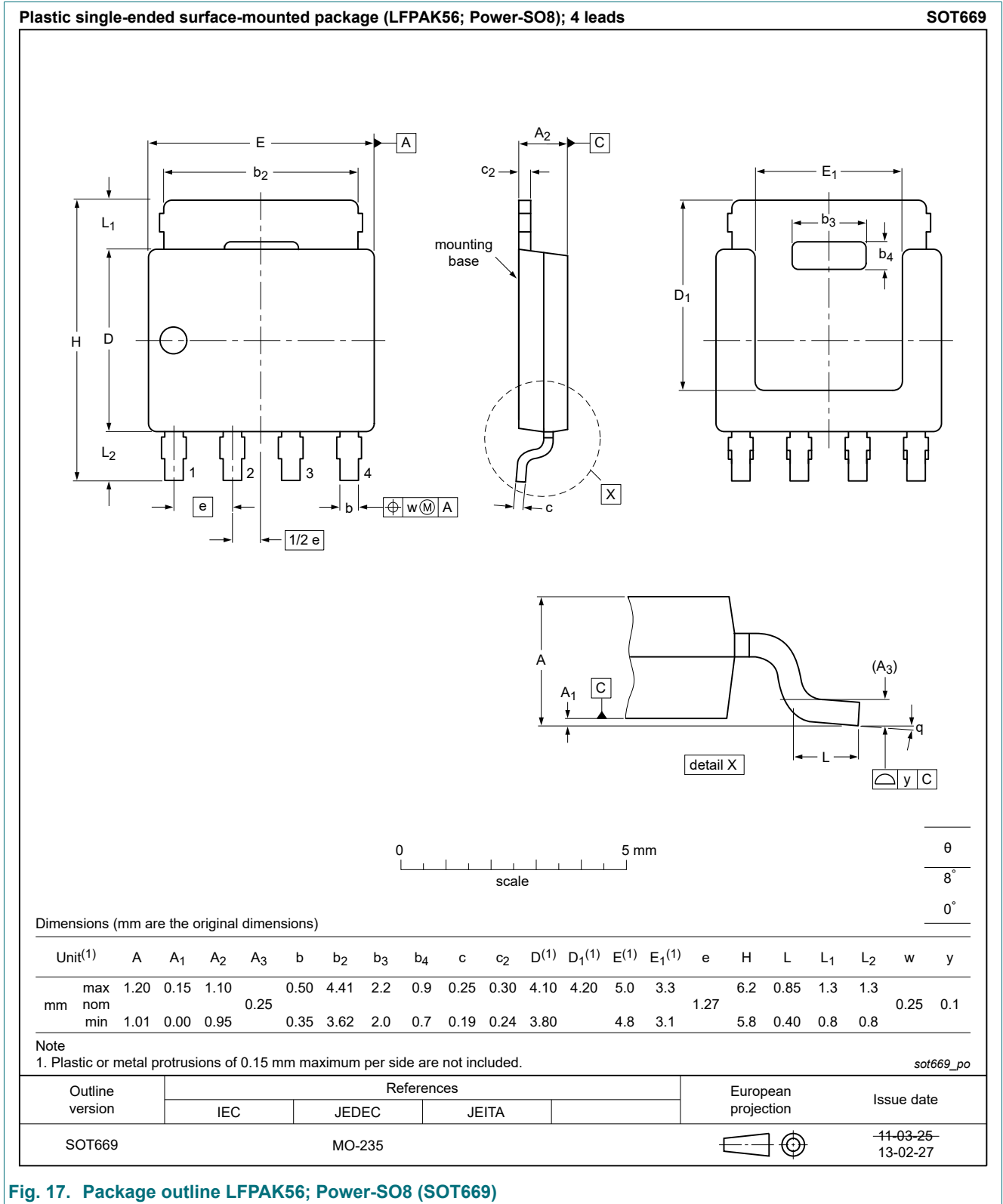


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

## 12. Soldering

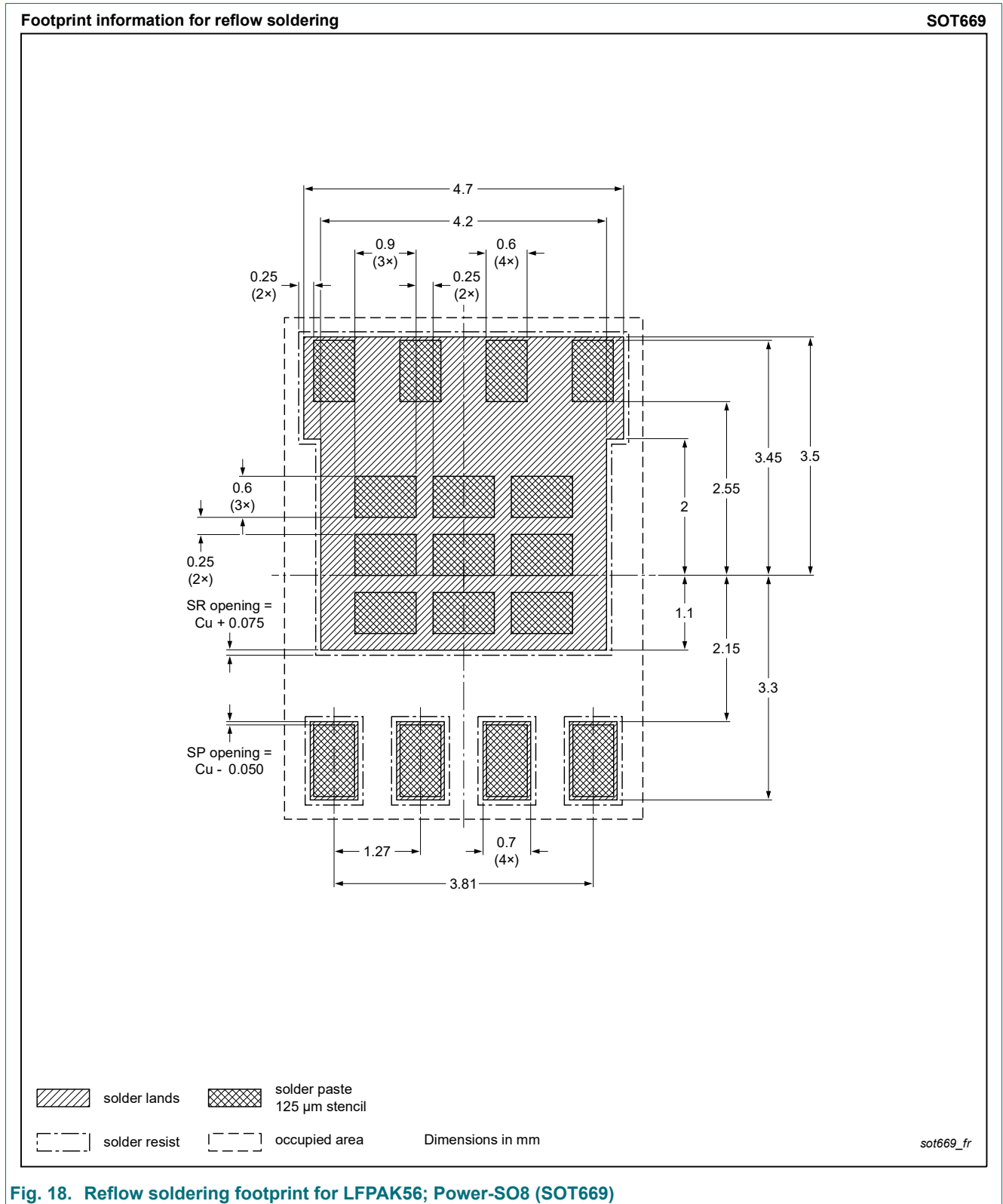
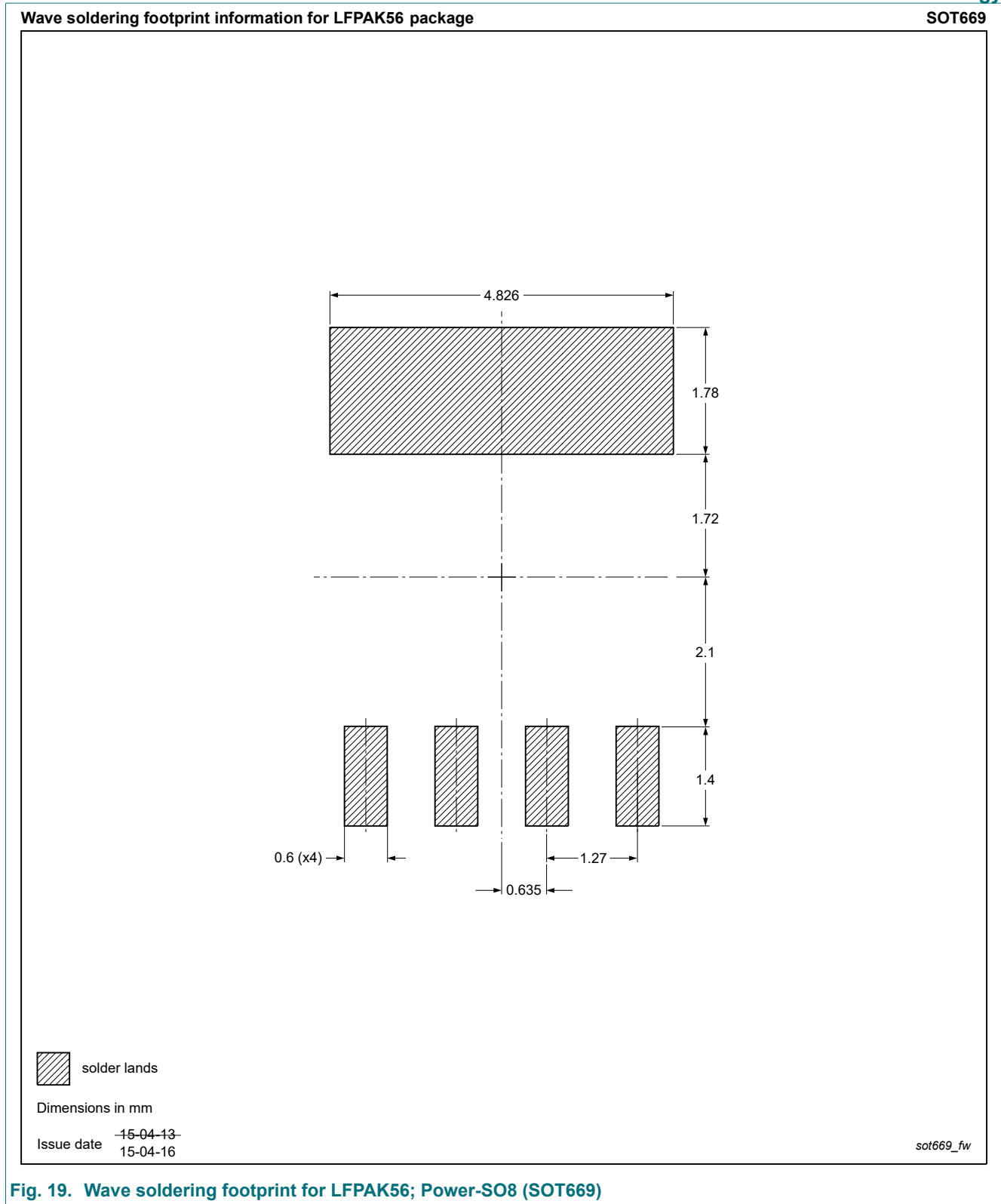


Fig. 18. Reflow soldering footprint for LPAK56; Power-SO8 (SOT669)



## N-channel 40 V, 2.2 mΩ, 180 A standard level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology

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Document status [1][2]	Product status [3]	Definition
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