



PSMN2R0-40YLD

N-channel 40 V, 2.1 mΩ, 180 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology

25 September 2019

Product data sheet

1. General description

180 A, logic level gate drive N-channel enhancement mode MOSFET in 175 °C LPAK56 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
- Optimised for 4.5 V gate drive utilising NextPower-S3 Superjunction technology
- High reliability LPAK (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	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	-	180	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	166	W
T_J	junction temperature			-55	-	175	°C
Static characteristics							
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_J = 25\text{ °C}$; Fig. 10		-	1.8	2.1	mΩ
		$V_{GS} = 4.5\text{ V}$; $I_D = 25\text{ A}$; $T_J = 25\text{ °C}$; Fig. 10		-	2.3	2.7	mΩ

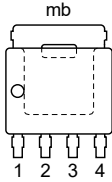
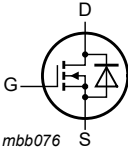
N-channel 40 V, 2.1 mΩ, 180 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; $V_{GS} = 4.5\text{ V}$; Fig. 12 ; Fig. 13	2.2	7.3	15	nC
$Q_{G(tot)}$	total gate charge		20	30	42	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	 LPAK56; Power-SO8 (SOT669)	 mbb076
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
PSMN2R0-40YLD	LPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN2R0-40YLD	2D0L40Y

8. Limiting values

Table 5. Limiting values

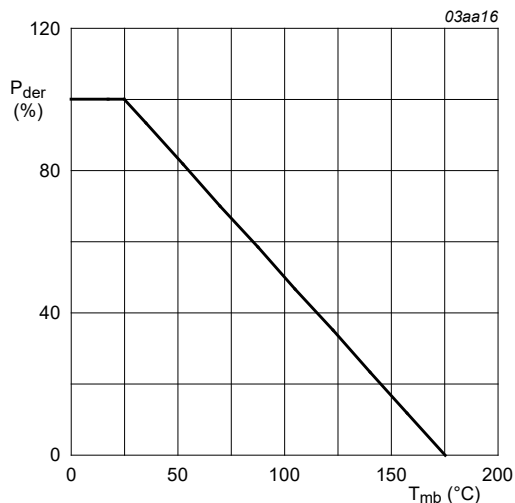
In accordance with the Absolute Maximum Rating System (IEC 60134).

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	$t_p \leq 20\text{ ns}$; $f \leq 500\text{ kHz}$; $E_{DS(AL)} \leq 200\text{ nJ}$; 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_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1	-	166	W
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	180	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2	-	143	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3	-	807	A

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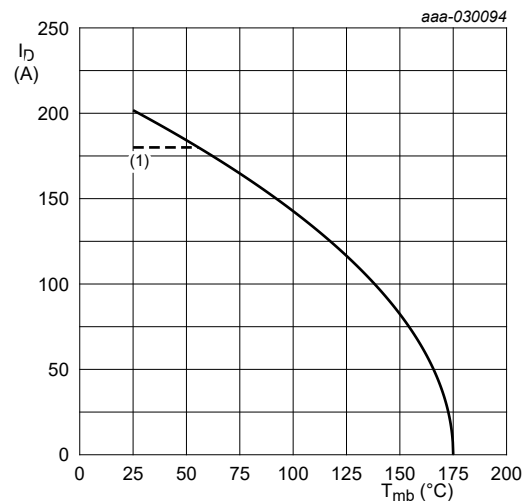
Symbol	Parameter	Conditions		Min	Max	Unit
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
$T_{slid(M)}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$		-	166	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$		-	807	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 53.5\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 182\text{ }\mu\text{s}$	[2]	-	253	mJ
		$I_D = 25\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 937\text{ }\mu\text{s}$	[2]	-	609	mJ
I_{AS}	non-repetitive avalanche current	$V_{sup} \leq 40\text{ V}$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; $R_{GS} = 50\text{ }\Omega$	[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



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

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

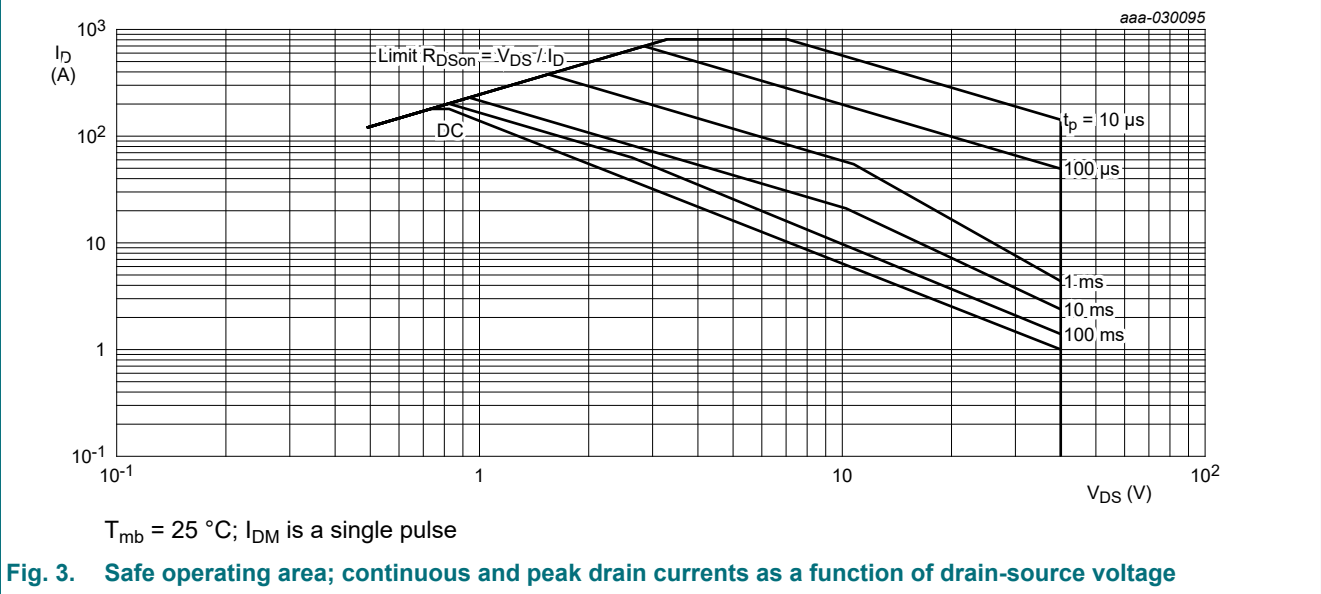


$V_{GS} \geq 10\text{ V}$

(1) 180A 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

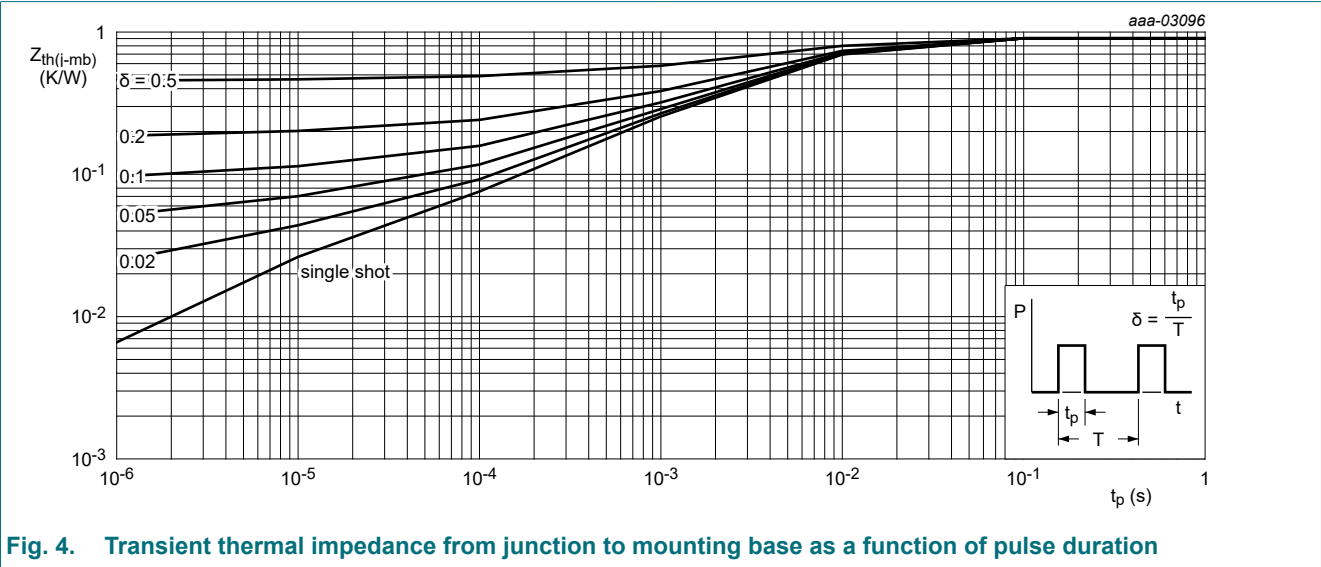
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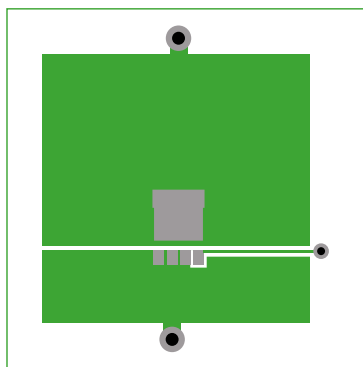
9. Thermal characteristics

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

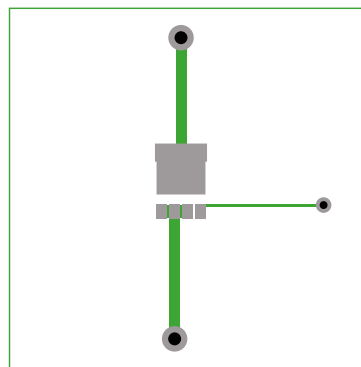


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Copper area 25.4 mm x 25.4 mm; 70 μm thick on FR4 board

Fig. 5. PCB layout for thermal resistance from junction to ambient



70 μm thick copper on FR4 board

Fig. 6. 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	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25^\circ C$	40	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55^\circ C$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25^\circ C$	1.35	1.73	2.05	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25^\circ C \leq T_j \leq 150^\circ C$	-	-4.3	-	mV/K
I_{DSS}	drain leakage current	$V_{DS} = 32 V; V_{GS} = 0 V; T_j = 25^\circ C$	-	0.007	1	μA
		$V_{DS} = 32 V; V_{GS} = 0 V; T_j = 125^\circ C$	-	2	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 16 V; V_{DS} = 0 V; T_j = 25^\circ C$	-	2	100	nA
		$V_{GS} = -16 V; V_{DS} = 0 V; T_j = 25^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 25 A; T_j = 25^\circ C$; Fig. 10	-	1.8	2.1	mΩ
		$V_{GS} = 10 V; I_D = 25 A; T_j = 175^\circ C$; Fig. 11	-	-	4.1	mΩ
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 25^\circ C$; Fig. 10	-	2.3	2.7	mΩ
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 175^\circ C$; Fig. 11	-	-	5.2	mΩ
R_G	gate resistance	$f = 1 MHz; T_j = 25^\circ C$	0.3	0.8	2	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 4.5 V$; Fig. 12 ; Fig. 13	20	30	42	nC
		$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V$; Fig. 12 ; Fig. 13	43	66	92	nC
		$I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V$	-	35	-	nC

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Q_{GS}	gate-source charge	$I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; $V_{GS} = 4.5\text{ V}$; Fig. 12; Fig. 13	6.6	11	17	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		4.1	6.9	10.4	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		2.5	4.1	6	nC
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; Fig. 12; Fig. 13	2.2	7.3	15	nC
$V_{GS(pl)}$	gate-source plateau voltage		-	2.7	-	V
C_{iss}	input capacitance		3056	4701	6581	pF
C_{oss}	output capacitance	$V_{DS} = 20\text{ V}$; $V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 14	680	1047	1466	pF
C_{rss}	reverse transfer capacitance		54	181	398	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\text{ V}$; $R_L = 0.8\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $R_{G(ext)} = 5\text{ }\Omega$	-	26	-	ns
t_r	rise time		-	29	-	ns
$t_{d(off)}$	turn-off delay time		-	29	-	ns
t_f	fall time		-	18	-	ns
Q_{oss}	output charge	$V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $f = 1\text{ MHz}$; $T_j = 25\text{ }^\circ\text{C}$	-	33	-	nC
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 15	-	0.8	1	V
t_{rr}	reverse recovery time	$I_S = 25\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; Fig. 16	-	32	-	ns
Q_r	recovered charge		[1]	27	-	nC
t_a	reverse recovery rise time		-	17	-	ns
t_b	reverse recovery fall time		-	15	-	ns

[1] includes capacitive recovery

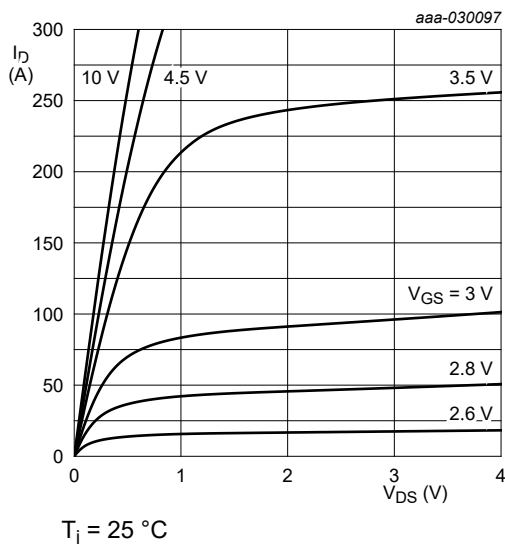


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

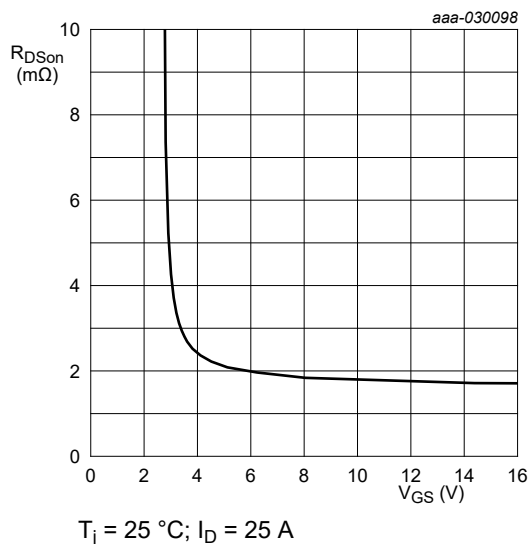


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

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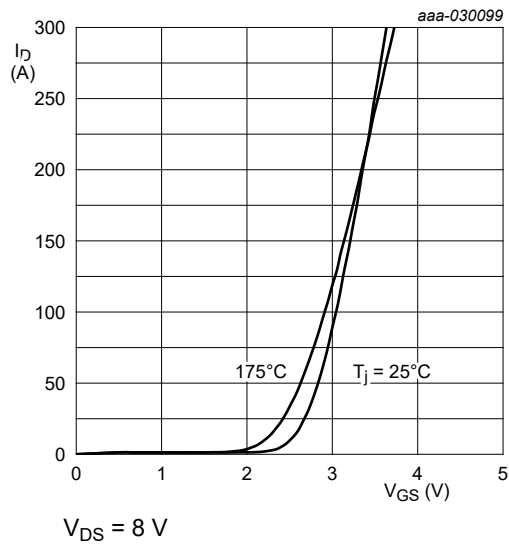


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

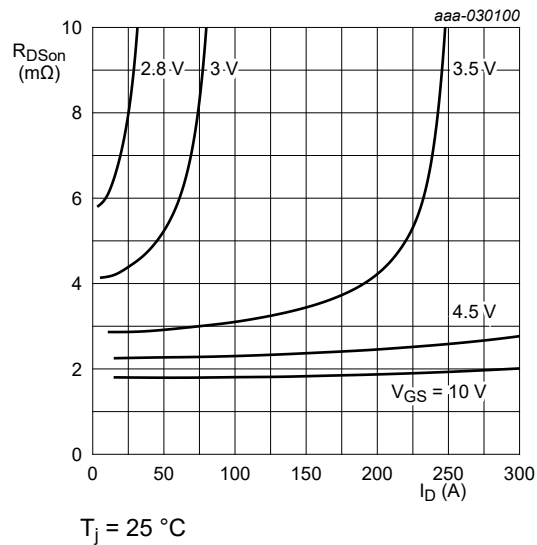


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

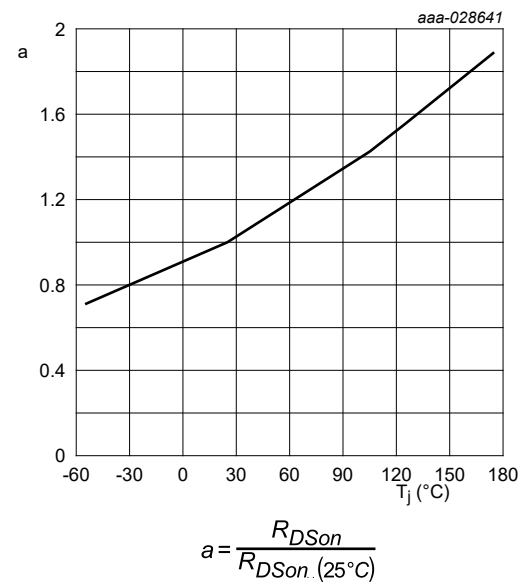


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

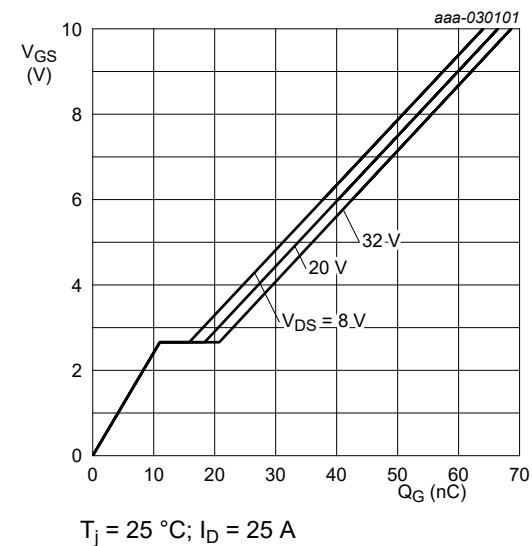
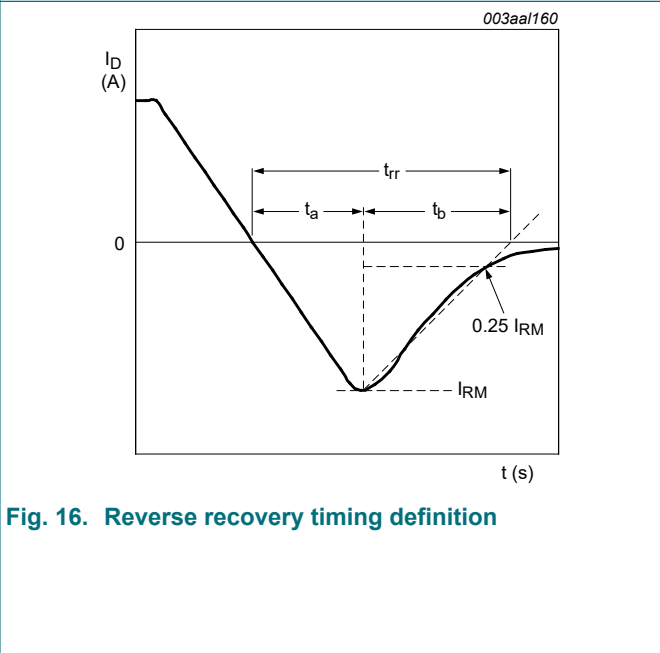
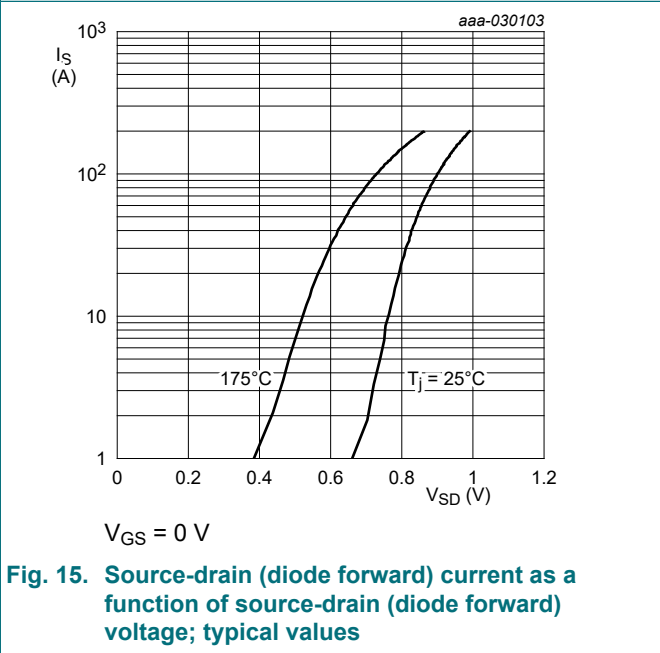
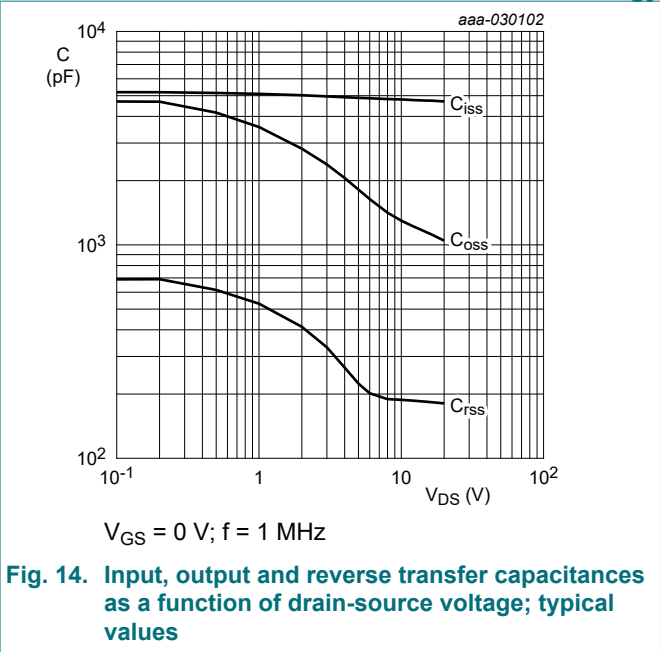
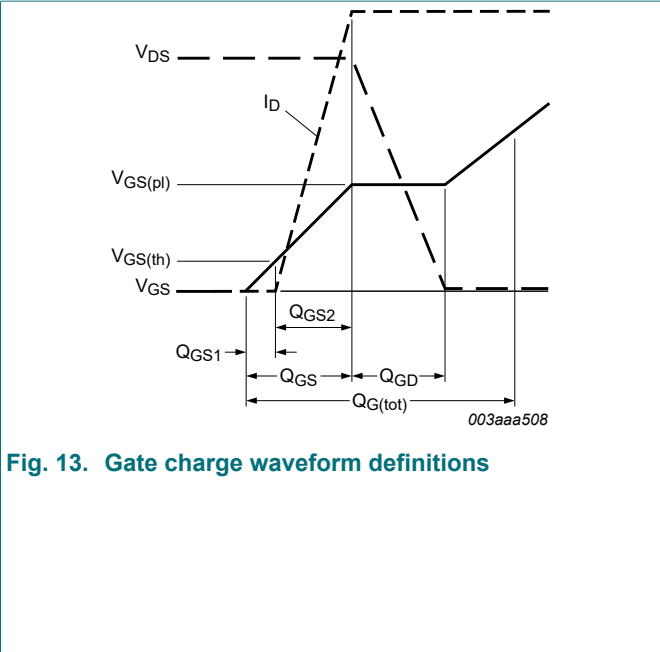


Fig. 12. Gate-source voltage as a function of gate charge; typical values

N-channel 40 V, 2.1 mΩ, 180 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology



11. Package outline

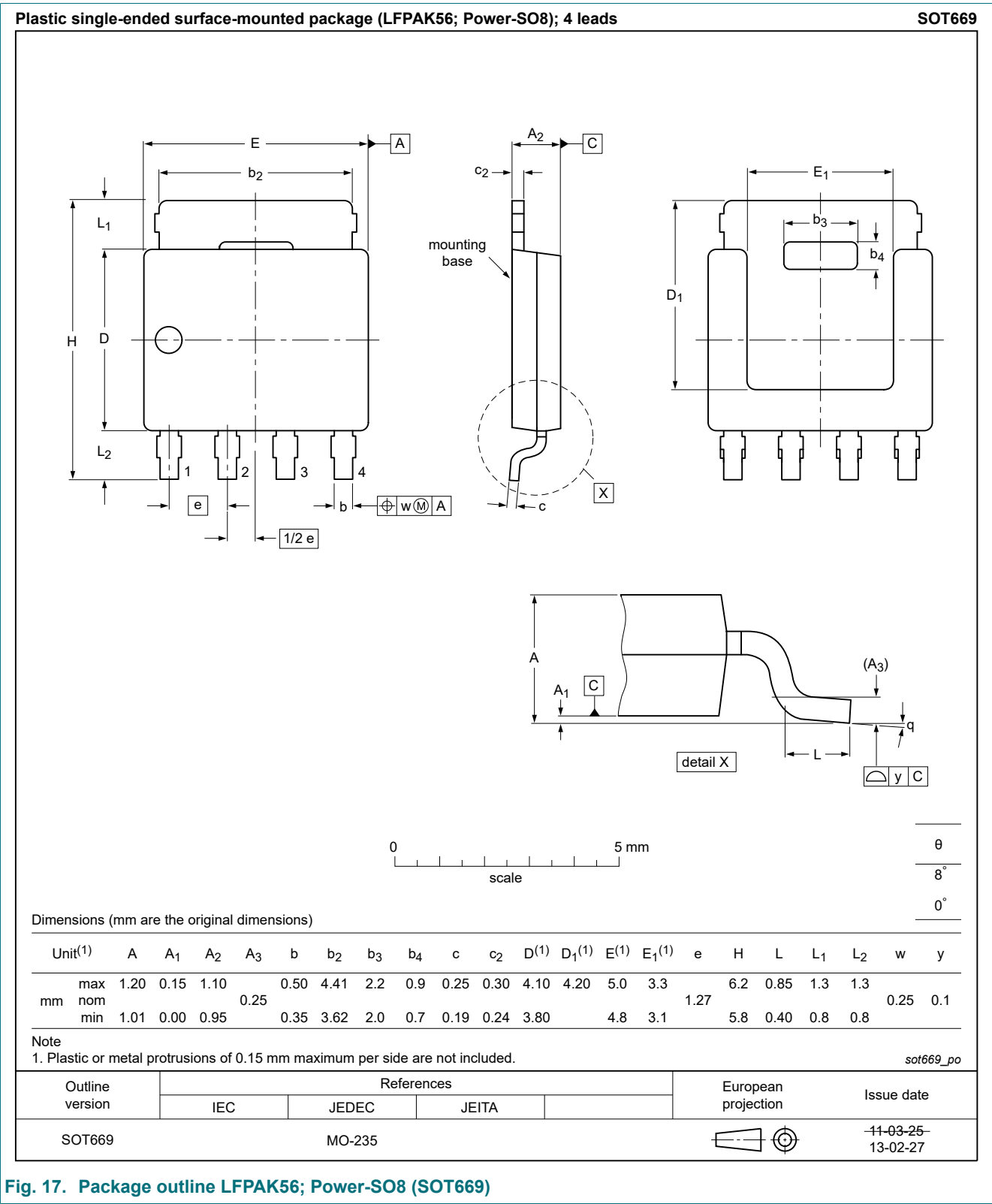


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

12. Soldering

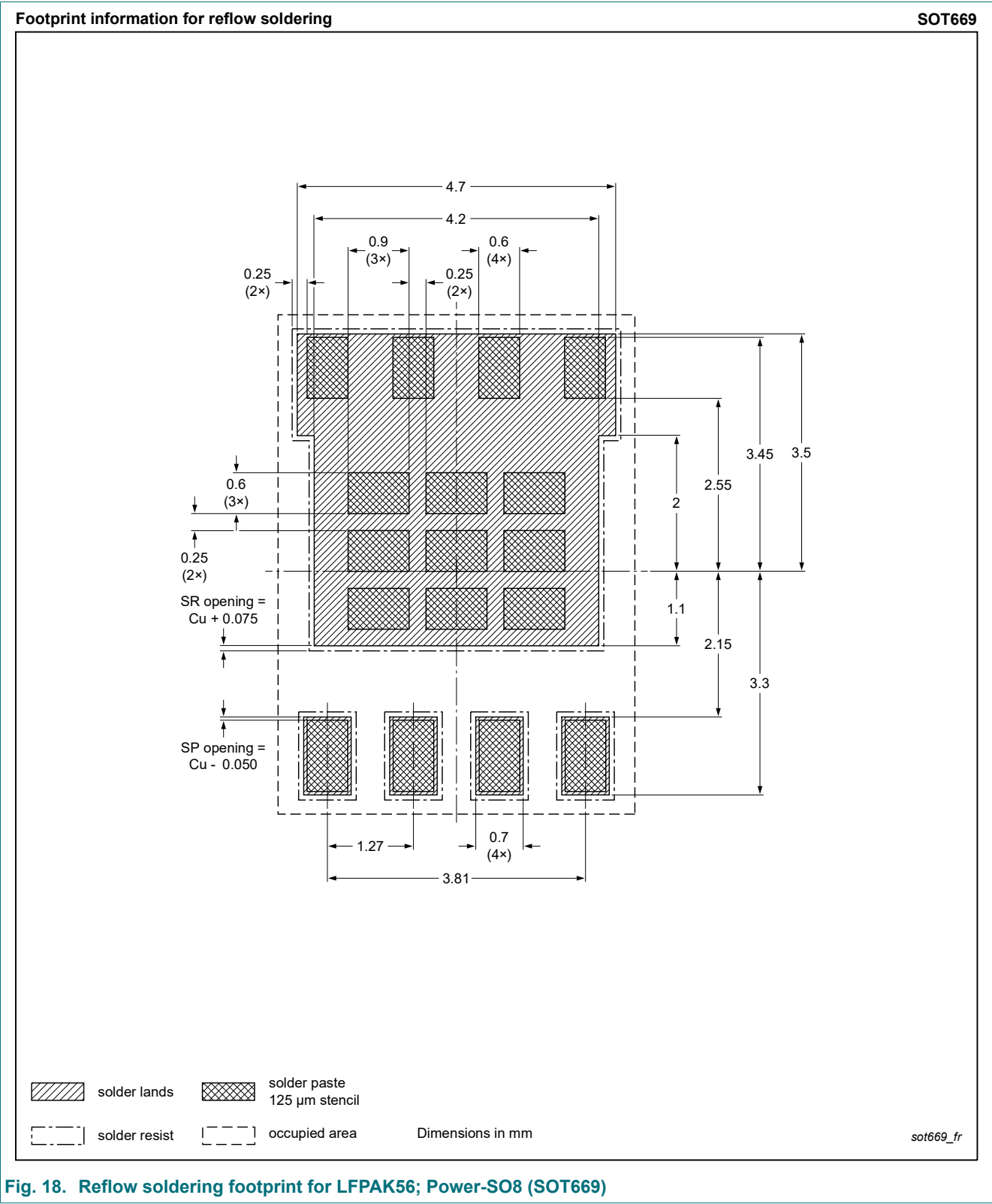


Fig. 18. Reflow soldering footprint for LPAK56; Power-SO8 (SOT669)

Wave soldering footprint information for LPAK56 package

SOT669

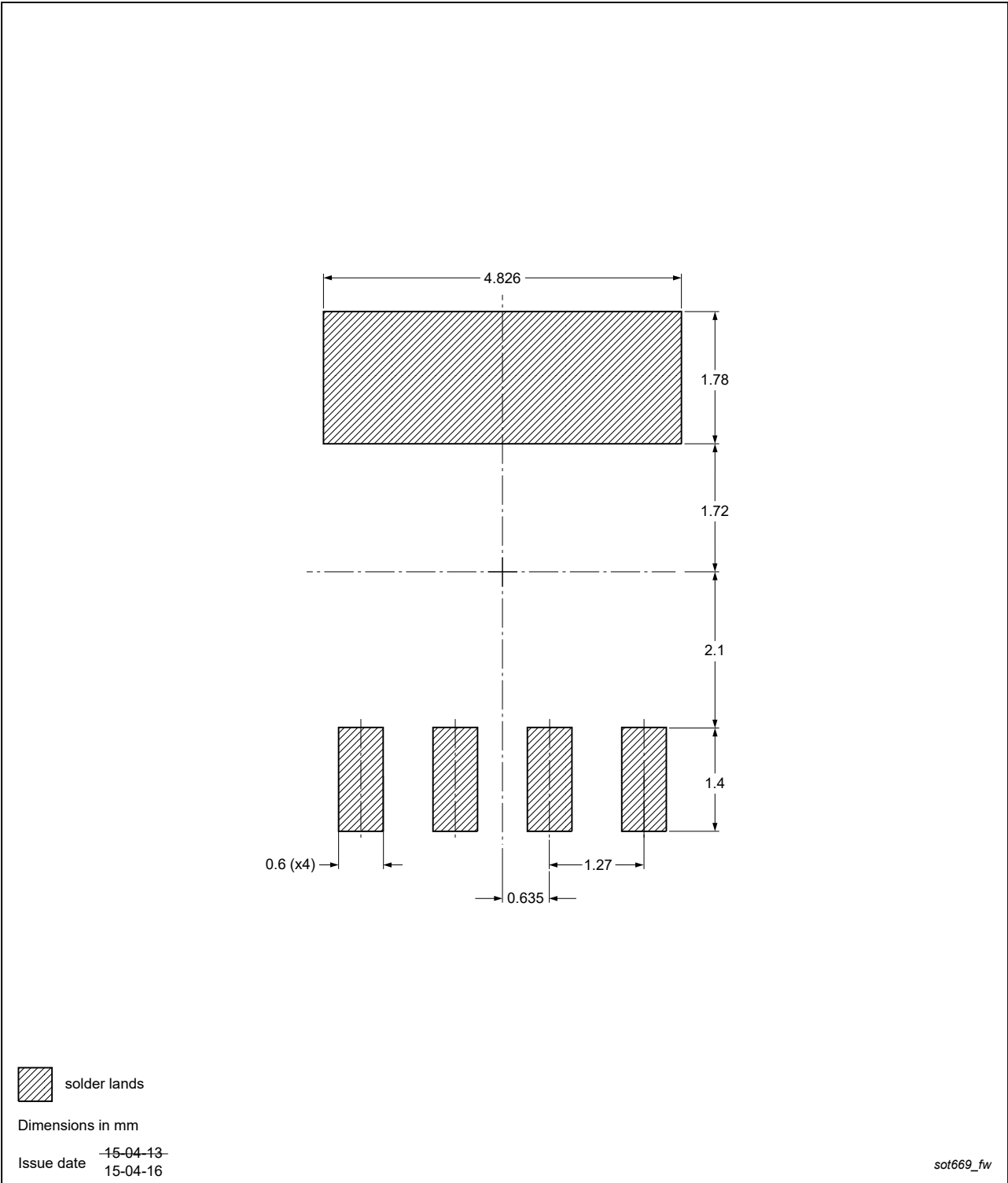


Fig. 19. Wave soldering footprint for LPAK56; Power-SO8 (SOT669)

N-channel 40 V, 2.1 mΩ, 180 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology

13. Legal information

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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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