



PSMN3R2-40YLD

N-channel 40 V, 3.3 mΩ, 120 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology

26 August 2019

Product data sheet

1. General description

120 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

- 120 A continuous $I_{D(max)}$ rating
- Avalanche rated, 100% tested at $I_{AS} = 120$ 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

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]	-	-	120	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	115	W
T_j	junction temperature			-55	-	175	°C
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 4.5\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10		-	3.6	4.2	mΩ
		$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10		-	2.9	3.3	mΩ

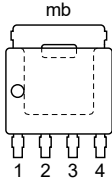
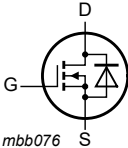
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; $V_{GS} = 4.5\text{ V}$; Fig. 12 ; Fig. 13	12	18	26	nC
Q_{GD}	gate-drain charge		1.3	4.3	8.6	nC

[1] 120A 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
PSMN3R2-40YLD	LPAK56; Power-SO8	plastic, single-ended surface-mounted package; 4 terminals	SOT669

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN3R2-40YLD	3D2L40Y

8. Limiting values

Table 5. Limiting values

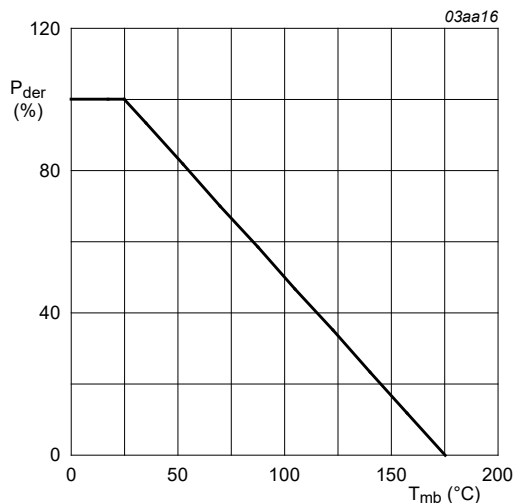
In accordance with the Absolute Maximum Rating System (IEC 60134).

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	-	115	W
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	120	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2	-	95	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3	-	537	A

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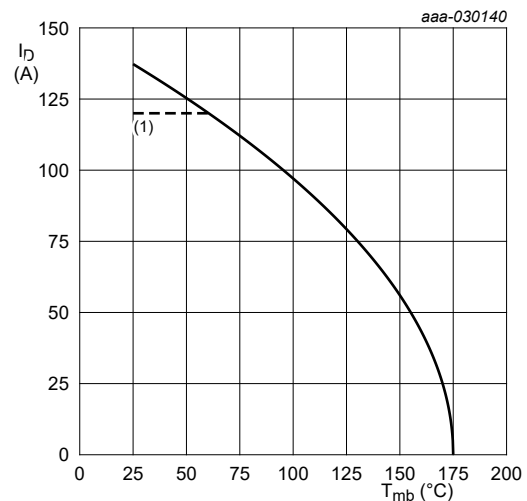
Symbol	Parameter	Conditions		Min	Max	Unit
T_{stg}	storage temperature			-55	175	°C
T_{j}	junction temperature			-55	175	°C
$T_{\text{slid(M)}}$	peak soldering temperature			-	260	°C
Source-drain diode						
I_{S}	source current	$T_{\text{mb}} = 25\text{ °C}$		-	115	A
I_{SM}	peak source current	pulsed; $t_{\text{p}} \leq 10\text{ }\mu\text{s}$; $T_{\text{mb}} = 25\text{ °C}$		-	537	A
Avalanche ruggedness						
$E_{\text{DS(AL)S}}$	non-repetitive drain-source avalanche energy	$I_{\text{D}} = 39\text{ A}$; $V_{\text{sup}} \leq 40\text{ V}$; $R_{\text{GS}} = 50\text{ }\Omega$; $V_{\text{GS}} = 10\text{ V}$; $T_{\text{j(init)}} = 25\text{ °C}$; unclamped; $t_{\text{p}} = 146\text{ }\mu\text{s}$	[2]	-	148	mJ
		$I_{\text{D}} = 25\text{ A}$; $V_{\text{sup}} \leq 40\text{ V}$; $R_{\text{GS}} = 50\text{ }\Omega$; $V_{\text{GS}} = 10\text{ V}$; $T_{\text{j(init)}} = 25\text{ °C}$; unclamped; $t_{\text{p}} = 374\text{ }\mu\text{s}$	[2]	-	243	mJ
I_{AS}	non-repetitive avalanche current	$V_{\text{sup}} = 40\text{ V}$; $V_{\text{GS}} = 10\text{ V}$; $T_{\text{j(init)}} = 25\text{ °C}$; $R_{\text{GS}} = 50\text{ }\Omega$	[2]	-	120	A

- [1] 120A 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



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

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

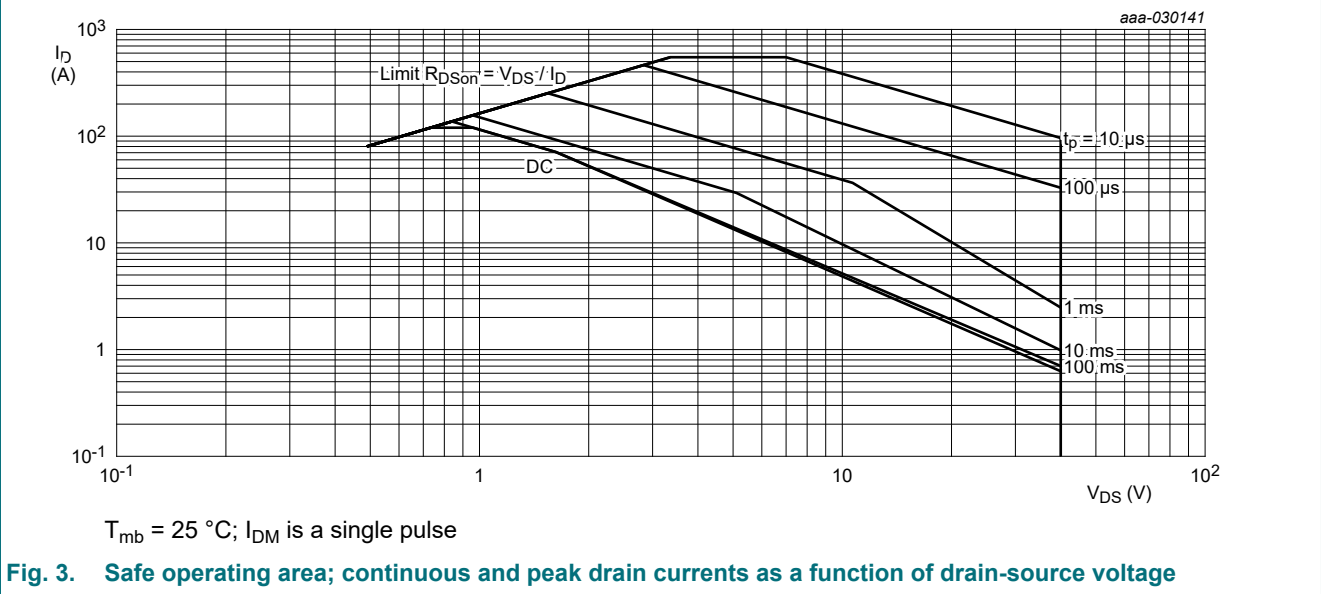


$V_{\text{GS}} \geq 10\text{ V}$

(1) 120A 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

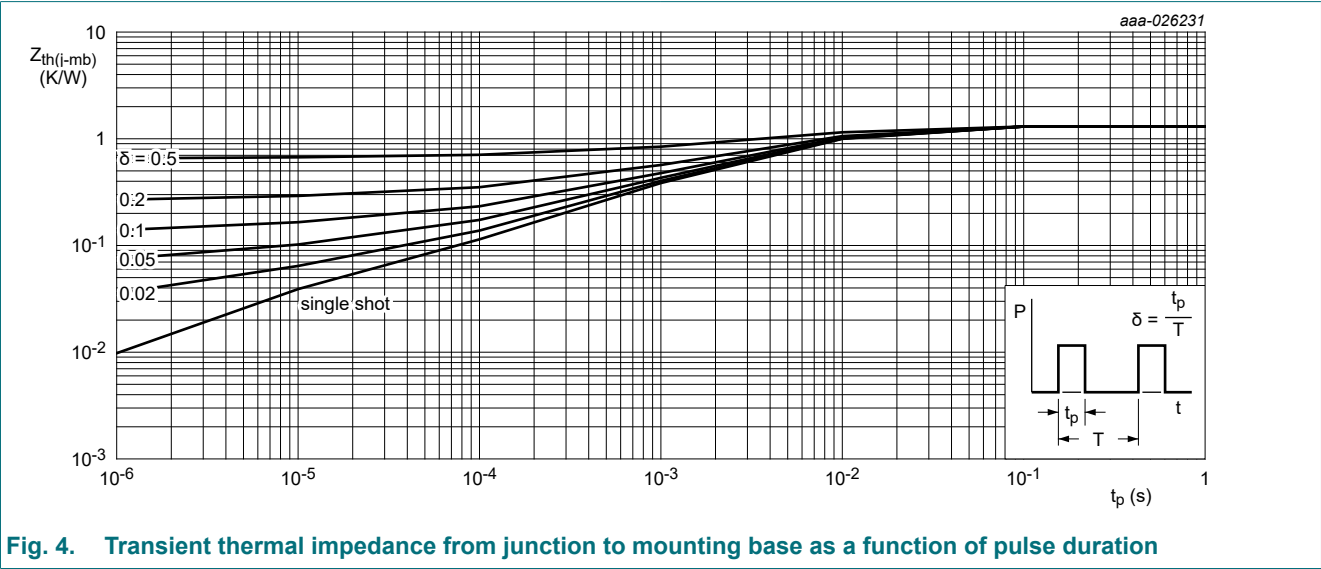
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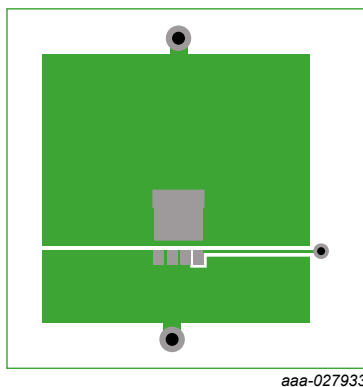
9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 4	-	1.18	1.3	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5	-	42	-	K/W
		Fig. 6	-	85	-	K/W

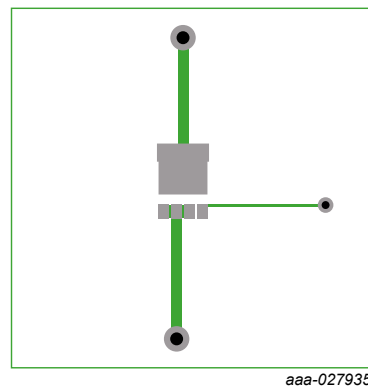


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Copper area 25.4 mm square; 70 μm thick on FR4 board

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	1.8	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	$V_{DS} = 32 V; V_{GS} = 0 V; T_j = 25^\circ C$	-	0.005	1	μA
		$V_{DS} = 32 V; V_{GS} = 0 V; T_j = 125^\circ C$	-	1.2	-	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	$V_{GS} = 10 V; I_D = 25 A; T_j = 25^\circ C; \text{Fig. 10}$	-	2.9	3.3	mΩ
		$V_{GS} = 10 V; I_D = 25 A; T_j = 175^\circ C; \text{Fig. 11}$	-	-	6.4	mΩ
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 25^\circ C; \text{Fig. 10}$	-	3.6	4.2	mΩ
		$V_{GS} = 4.5 V; I_D = 25 A; T_j = 175^\circ C; \text{Fig. 11}$	-	-	8.1	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	$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 4.5 V; \text{Fig. 12; Fig. 13}$	12	18	26	nC
		$I_D = 25 A; V_{DS} = 20 V; V_{GS} = 10 V; \text{Fig. 12; Fig. 13}$	26	41	57	nC
		$I_D = 0 A; V_{DS} = 0 V; V_{GS} = 10 V$	-	23	-	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	4.4	7.4	11.1	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		2.6	4.3	6.5	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		1.8	3.1	4.7	nC
Q_{GD}	gate-drain charge		1.3	4.3	8.6	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; Fig. 12 ; Fig. 13	-	2.9	-	V
C_{iss}	input capacitance	$V_{DS} = 20\text{ V}$; $V_{GS} = 0\text{ V}$; $f = 1\text{ MHz}$; $T_j = 25\text{ °C}$; Fig. 14	1905	2931	4103	pF
C_{oss}	output capacitance		458	704	986	pF
C_{rss}	reverse transfer capacitance		32	108	238	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 20\text{ V}$; $R_L = 0.8\text{ }\Omega$; $V_{GS} = 4.5\text{ V}$; $R_{G(ext)} = 5\text{ }\Omega$	-	18	-	ns
t_r	rise time		-	20	-	ns
$t_{d(off)}$	turn-off delay time		-	18	-	ns
t_f	fall time		-	11	-	ns
Q_{oss}	output charge	$V_{GS} = 0\text{ V}$; $V_{DS} = 20\text{ V}$; $f = 1\text{ MHz}$; $T_j = 25\text{ °C}$	-	22	-	nC
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ °C}$; 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	-	25	-	ns
Q_r	recovered charge		[1]	16	-	nC
t_a	reverse recovery rise time		-	14	-	ns
t_b	reverse recovery fall time		-	11	-	ns

[1] includes capacitive recovery

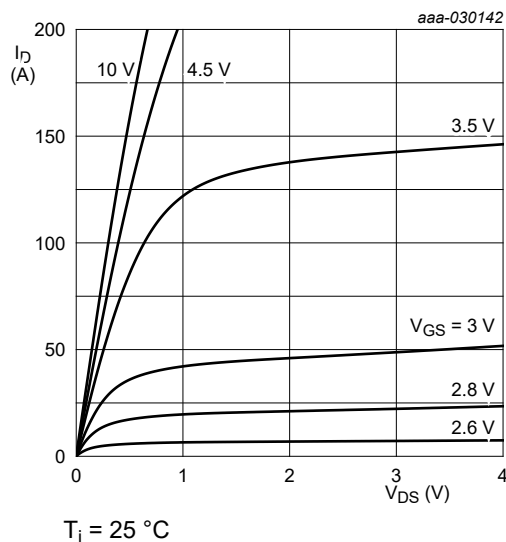


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

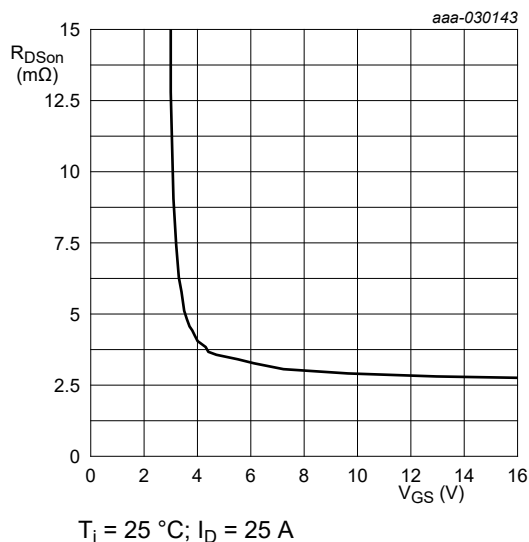


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

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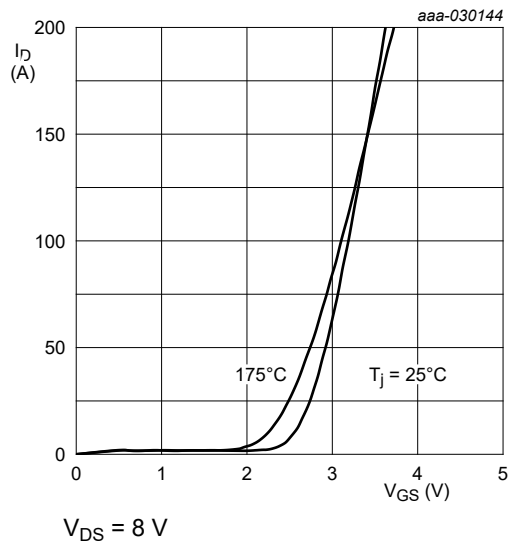


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

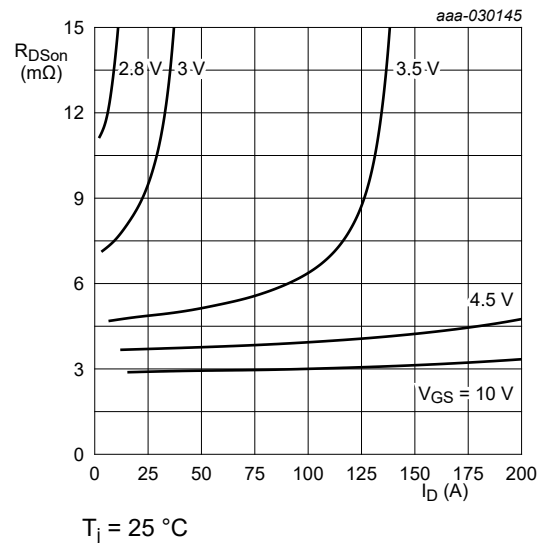


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

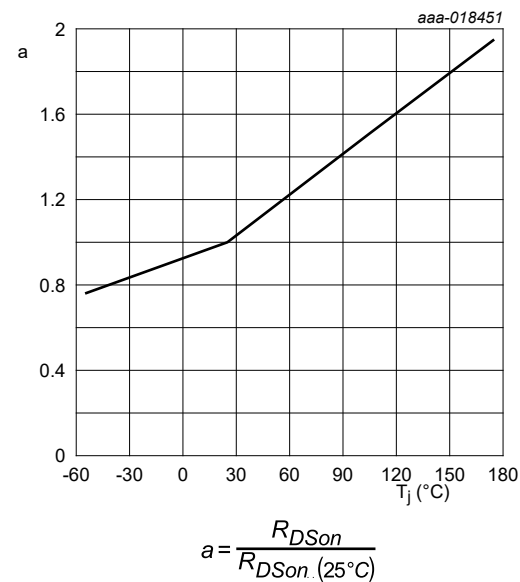


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

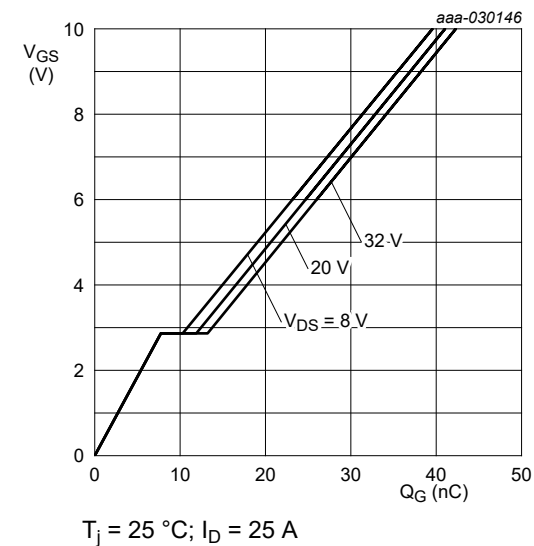
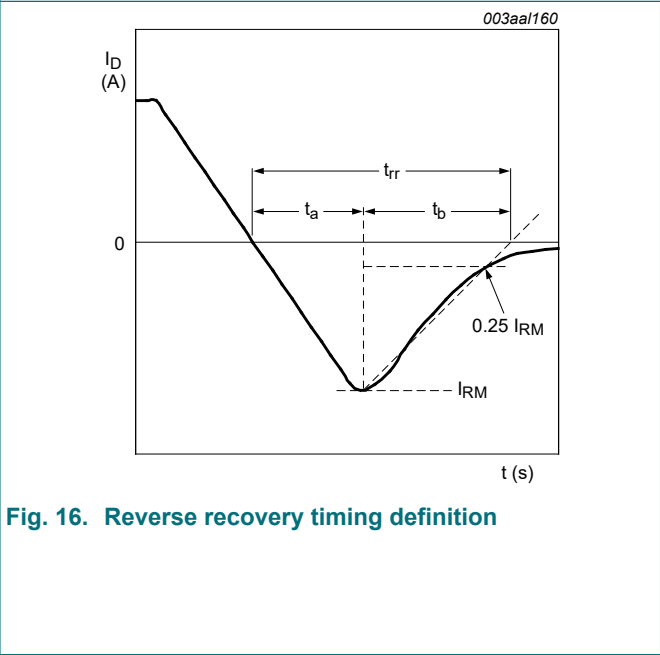
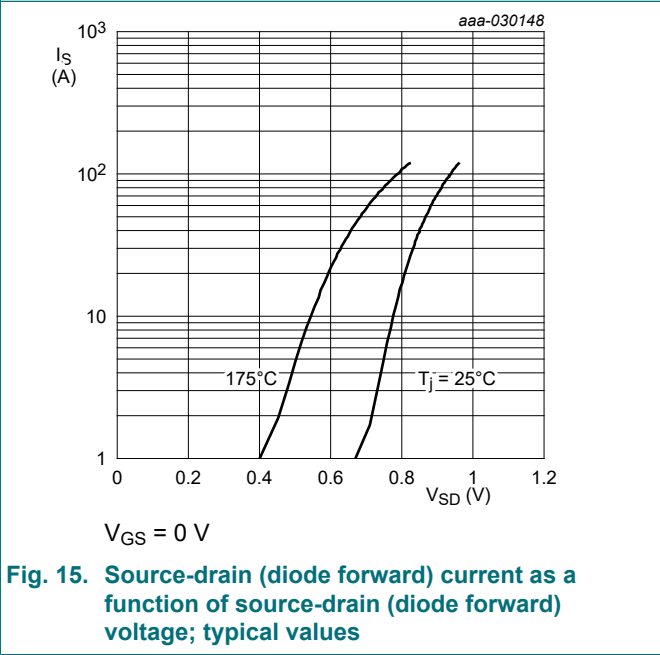
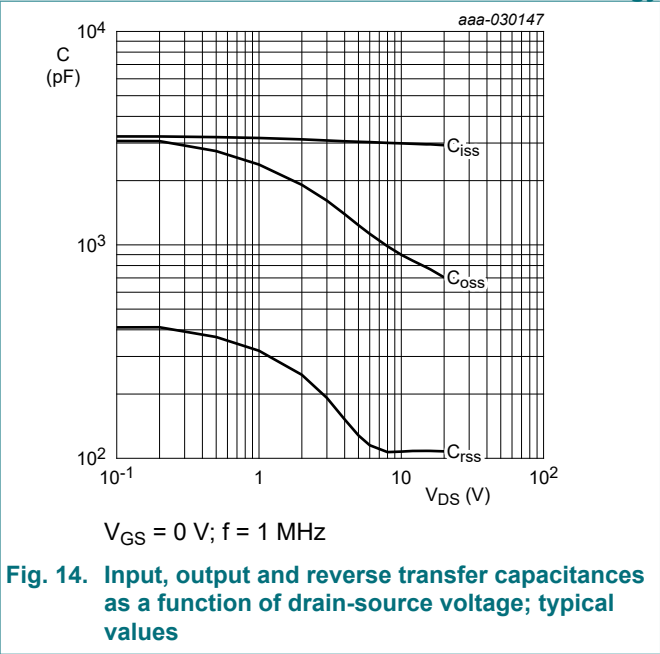
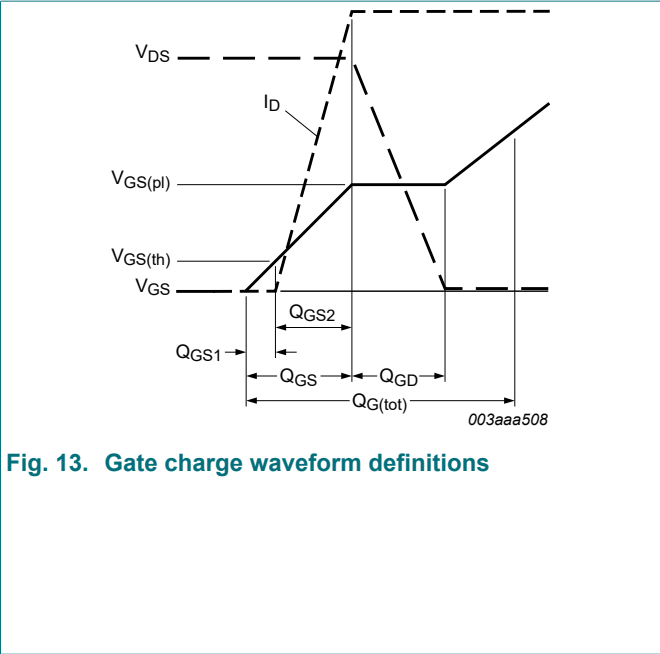


Fig. 12. Gate-source voltage as a function of gate charge; typical values

N-channel 40 V, 3.3 mΩ, 120 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology



11. Package outline

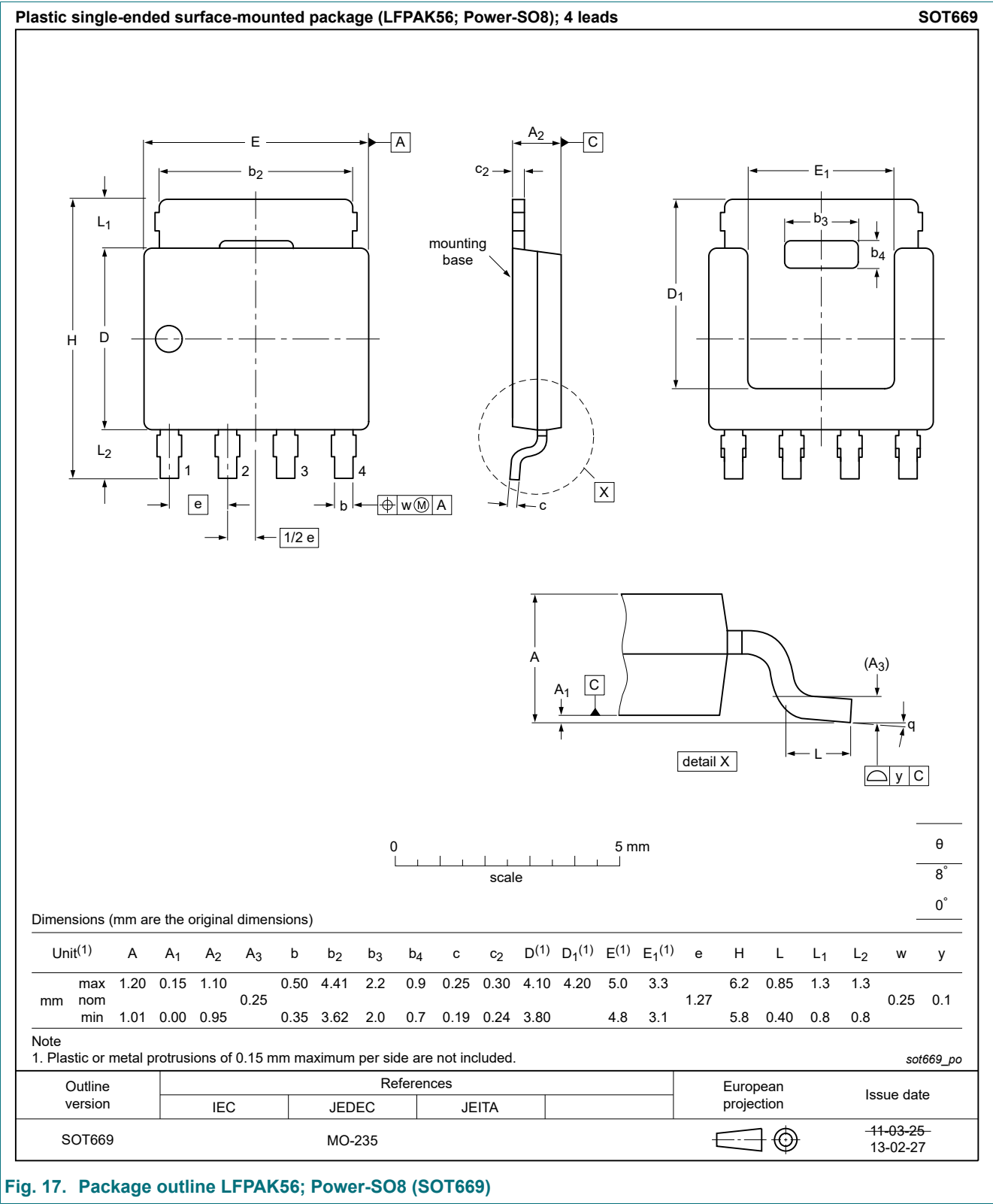
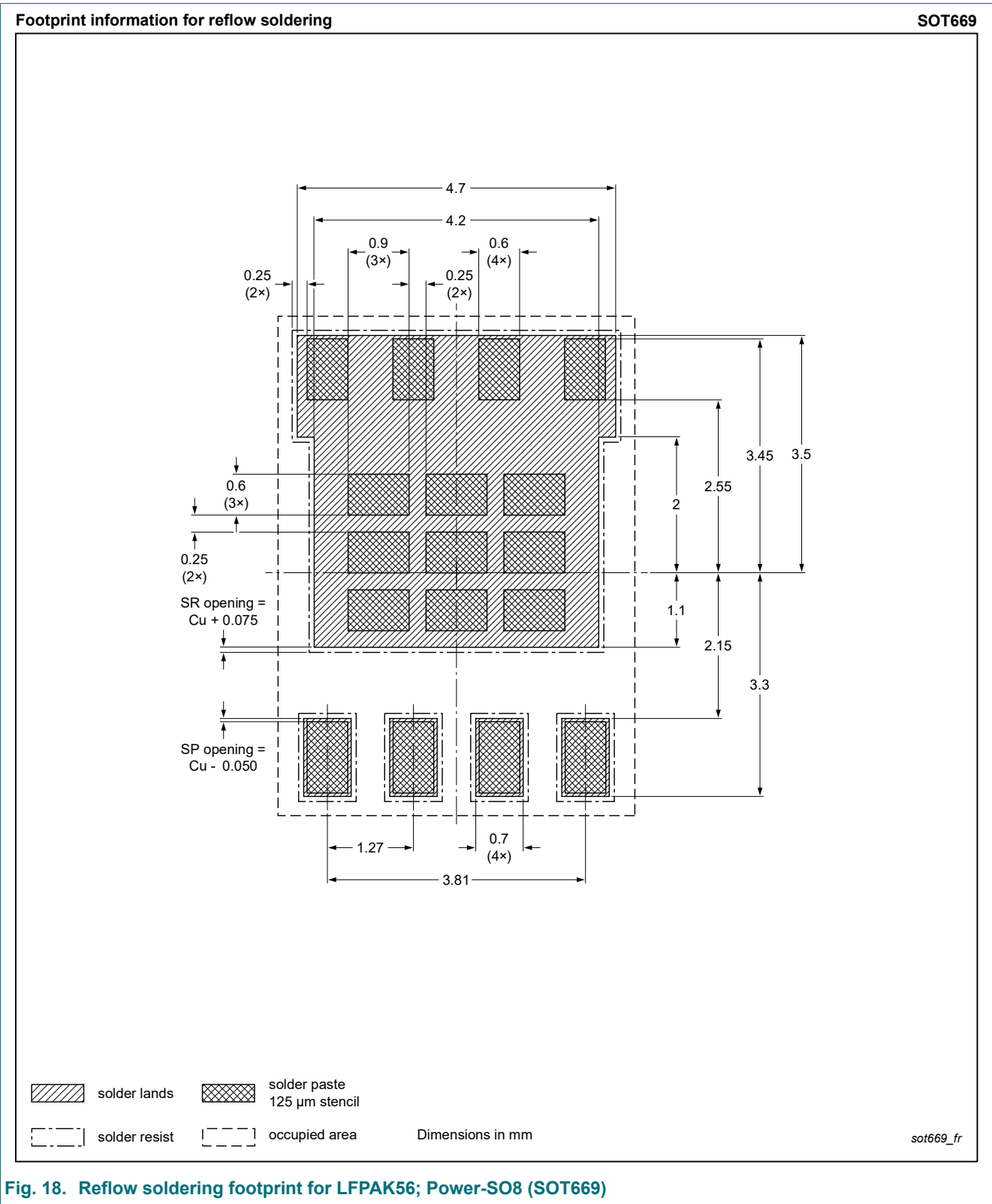


Fig. 17. Package outline LPAK56; Power-SO8 (SOT669)

12. Soldering



Wave soldering footprint information for LPAK56 package

SOT669

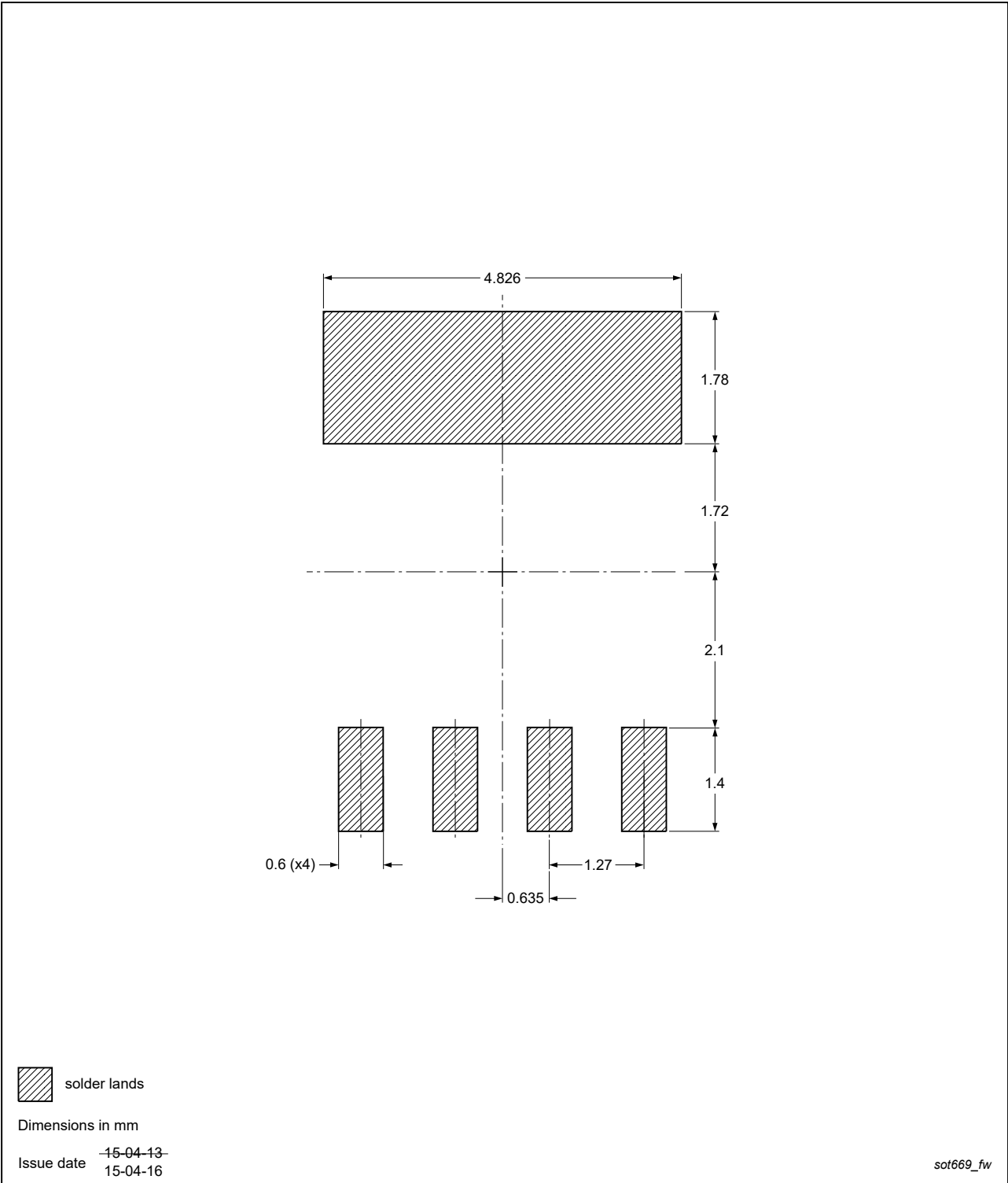


Fig. 19. Wave soldering footprint for LPAK56; Power-SO8 (SOT669)

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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.
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Product [short] data sheet	Production	This document contains the product specification.

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