



PSMN1R0-40YLD

N-channel 40 V, 1.1 mΩ, 280 A logic level MOSFET in LPAK56 using NextPower-S3 Schottky-Plus technology

30 November 2017

Product data sheet

1. General description

280 Amp, logic level gate drive N-channel enhancement mode MOSFET in 150 °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

- 280 A capability
- Avalanche rated, 100% tested at $I_{AS} = 190$ A
- NextPower-S3 technology delivers 'superfast switching with soft recovery'
- Low Q_{RR} , Q_G and Q_{GD} for high system efficiency and low EMI designs
- Schottky-Plus body-diode, gives soft switching without the associated high I_{DSS} leakage
- Optimised for 4.5 V gate drive utilising NextPower-S3 Superjunction technology
- High reliability LPAK (Power SO8) package, copper-clip, solder die attach and qualified to 150 °C
- Exposed leads can be wave soldered, visual solder joint inspection and high quality solder joints
- Low parasitic inductance and resistance

3. Applications

- Synchronous rectification
- DC-to-DC converters
- High performance & high efficiency server power supply
- Motor control
- Power ORing

4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 150\text{ °C}$		-	-	40	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	-	280	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	-	198	W
T_j	junction temperature			-55	-	150	°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 ; Fig. 11		-	1.1	1.4	mΩ
		$V_{GS} = 10\text{ V}$; $I_D = 25\text{ A}$; $T_j = 25\text{ °C}$; Fig. 10 ; Fig. 11		-	0.93	1.1	mΩ

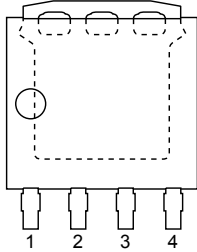
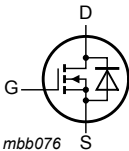
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 20\text{ V}$; $V_{GS} = 4.5\text{ V}$; Fig. 12 ; Fig. 13	-	17	-	nC
$Q_{G(tot)}$	total gate charge		-	59	-	nC

[1] 280A continuous current has been successfully demonstrated during application tests. Practically, the current will be limited by PCB, thermal design and operation temperature.

5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 LPAK56; Power-SO8 (SOT1023)	 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
PSMN1R0-40YLD	LPAK56; Power-SO8	Plastic single-ended surface-mounted package (LPAK56); 4 leads	SOT1023

7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN1R0-40YLD	1D040L

8. Limiting values

Table 5. Limiting values

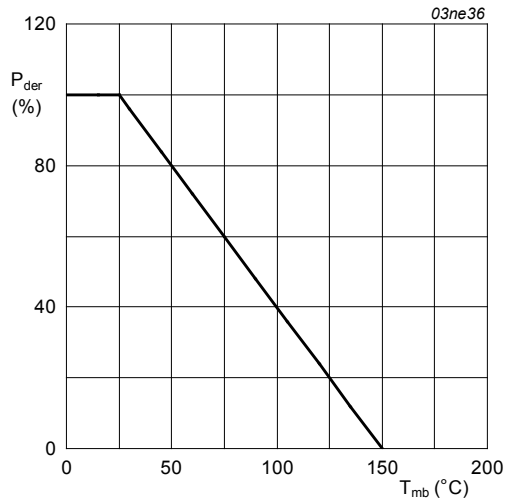
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$25\text{ °C} \leq T_j \leq 150\text{ °C}$		-	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	$25\text{ °C} \leq T_j \leq 150\text{ °C}$; $R_{GS} = 20\text{ k}\Omega$		-	40	V
V_{GS}	gate-source voltage			-20	20	V
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 1		-	198	W
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; Fig. 2	[1]	-	280	A
		$V_{GS} = 10\text{ V}$; $T_{mb} = 100\text{ °C}$; Fig. 2		-	198	A
I_{DM}	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$; Fig. 3		-	1284	A
T_{stg}	storage temperature			-55	150	°C
T_j	junction temperature			-55	150	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
V_{ESD}	electrostatic discharge voltage	HBM		2	-	kV
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$		-	165	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$		-	1284	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 85\text{ A}$; $V_{sup} \leq 40\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped; $t_p = 0.26\text{ ms}$	[2]	-	578	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; $t_p = 3.8\text{ ms}$	[2]	-	2472	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]	-	190	A

[1] 280A continuous current has been successfully demonstrated during application tests. Practically, the current will be limited by PCB, thermal design and operation temperature.

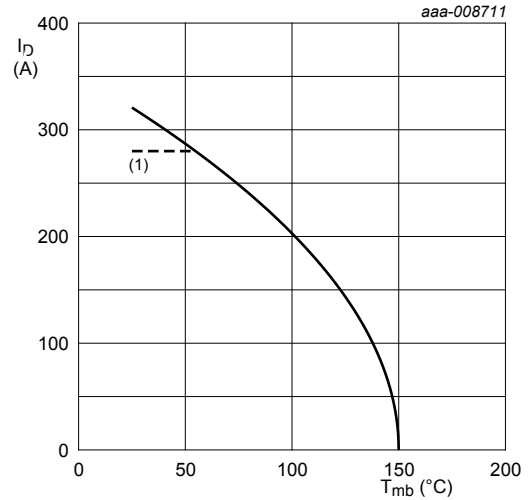
[2] Protected by 100% test

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

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



(1) 280A continuous current has been successfully demonstrated during applications tests. Practically, the current will be limited by PCB, thermal design and operating temperature.

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

Fig. 2. Continuous drain current as a function of mounting base temperature

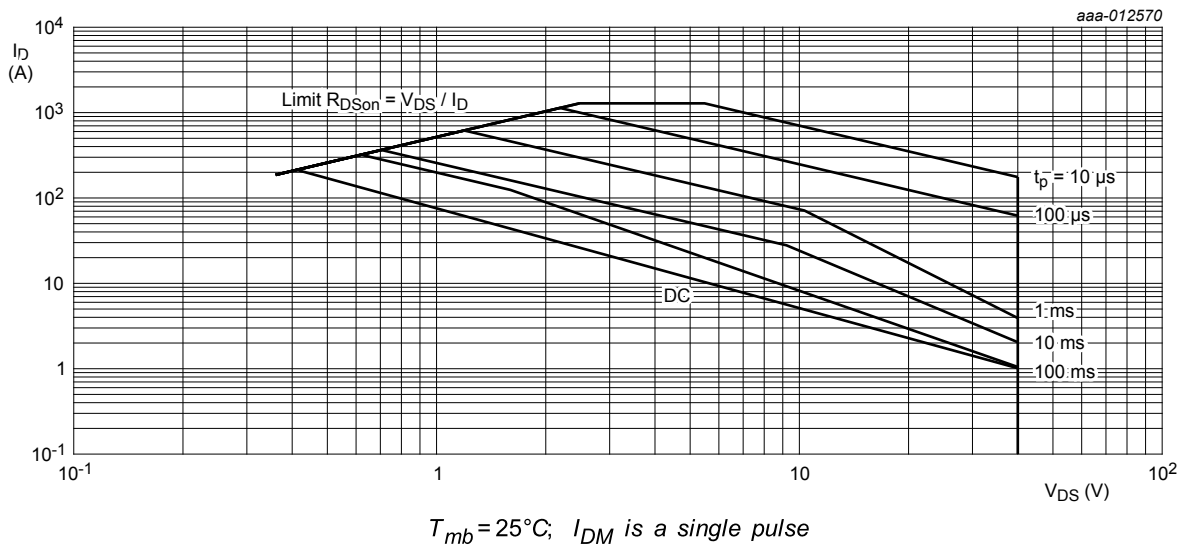


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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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		-	0.56	0.63	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Fig. 5		-	50	-	K/W
		Fig. 6		-	125	-	K/W

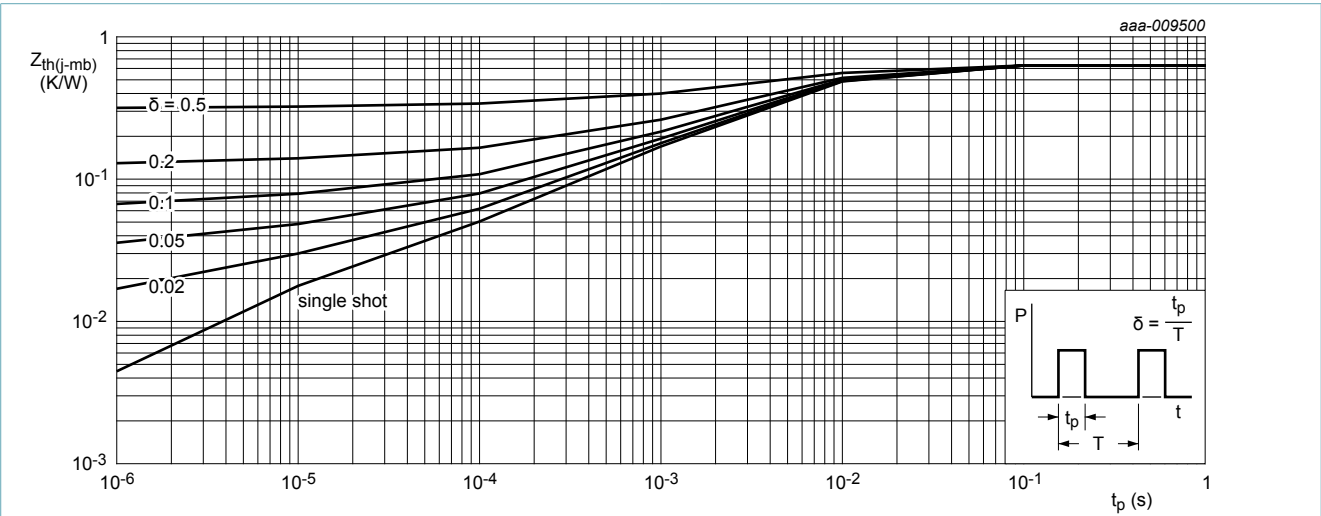


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

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
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	$I_D = 1\ mA$; $V_{DS} = V_{GS}$; $T_J = 25\ ^\circ C$	1.05	1.7	2.2	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25\ ^\circ C \leq T_J \leq 150\ ^\circ C$	-	-5.1	-	mV/K
I_{DSS}	drain leakage current	$V_{DS} = 32\ V$; $V_{GS} = 0\ V$; $T_J = 25\ ^\circ C$	-	-	1	μA
		$V_{DS} = 32\ V$; $V_{GS} = 0\ V$; $T_J = 125\ ^\circ C$	-	9	-	μA
I_{GSS}	gate leakage current	$V_{GS} = 16\ V$; $V_{DS} = 0\ V$; $T_J = 25\ ^\circ C$	-	-	100	nA
		$V_{GS} = -16\ V$; $V_{DS} = 0\ V$; $T_J = 25\ ^\circ C$	-	-	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 ; Fig. 11	-	0.93	1.1	mΩ
		$V_{GS} = 10\ V$; $I_D = 25\ A$; $T_J = 150\ ^\circ C$; Fig. 10 ; Fig. 11	-	-	1.93	mΩ
		$V_{GS} = 4.5\ V$; $I_D = 25\ A$; $T_J = 25\ ^\circ C$; Fig. 10 ; Fig. 11	-	1.1	1.4	mΩ
		$V_{GS} = 4.5\ V$; $I_D = 25\ A$; $T_J = 150\ ^\circ C$; Fig. 10 ; Fig. 11	-	-	2.45	mΩ
R_G	gate resistance	$f = 1\ MHz$	-	1.3	-	Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25\ A$; $V_{DS} = 20\ V$; $V_{GS} = 10\ V$; Fig. 12 ; Fig. 13	-	127	-	nC
		$I_D = 25\ A$; $V_{DS} = 20\ V$; $V_{GS} = 4.5\ V$; Fig. 12 ; Fig. 13	-	59	-	nC
		$I_D = 0\ A$; $V_{DS} = 0\ V$; $V_{GS} = 10\ V$	-	115	-	nC
Q_{GS}	gate-source charge	$I_D = 25\ A$; $V_{DS} = 20\ V$; $V_{GS} = 4.5\ V$; Fig. 12 ; Fig. 13	-	19	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	12	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	8	-	nC
Q_{GD}	gate-drain charge		-	17	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25\ A$; $V_{DS} = 20\ V$; Fig. 12 ; Fig. 13	-	2.7	-	V
C_{iss}	input capacitance	$V_{DS} = 20\ V$; $V_{GS} = 0\ V$; $f = 1\ MHz$; $T_J = 25\ ^\circ C$; Fig. 14	-	8845	-	pF
C_{oss}	output capacitance		-	1878	-	pF
C_{rss}	reverse transfer capacitance		-	382	-	pF

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Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t _{d(on)}	turn-on delay time	V _{DS} = 20 V; R _L = 0.8 Ω; V _{GS} = 4.5 V; R _{G(ext)} = 5 Ω		-	52	-	ns
t _r	rise time			-	62	-	ns
t _{d(off)}	turn-off delay time			-	65	-	ns
t _f	fall time			-	38	-	ns
Q _{oss}	output charge	V _{GS} = 0 V; V _{DS} = 20 V; f = 1 MHz; T _j = 25 °C		-	51	-	nC
Source-drain diode							
V _{SD}	source-drain voltage	I _S = 25 A; V _{GS} = 0 V; T _j = 25 °C; Fig. 15		-	0.78	1.2	V
t _{rr}	reverse recovery time	I _S = 25 A; dI _S /dt = -100 A/μs; V _{GS} = 0 V; V _{DS} = 20 V; Fig. 16		-	48	-	ns
Q _r	recovered charge		[1]	-	67	-	nC
t _a	reverse recovery rise time			-	28.6	-	ns
t _b	reverse recovery fall time			-	23.8	-	ns

[1] includes capacitive recovery

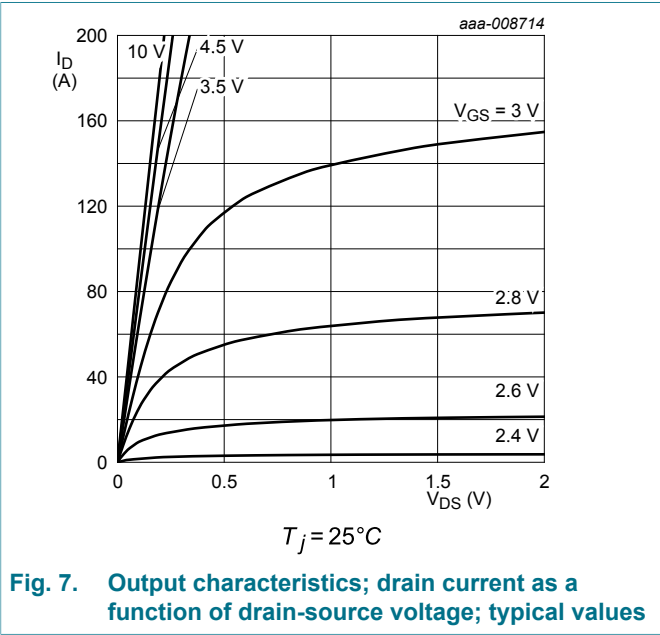


Fig. 7. Output characteristics; drain current as a function of drain-source voltage; typical values

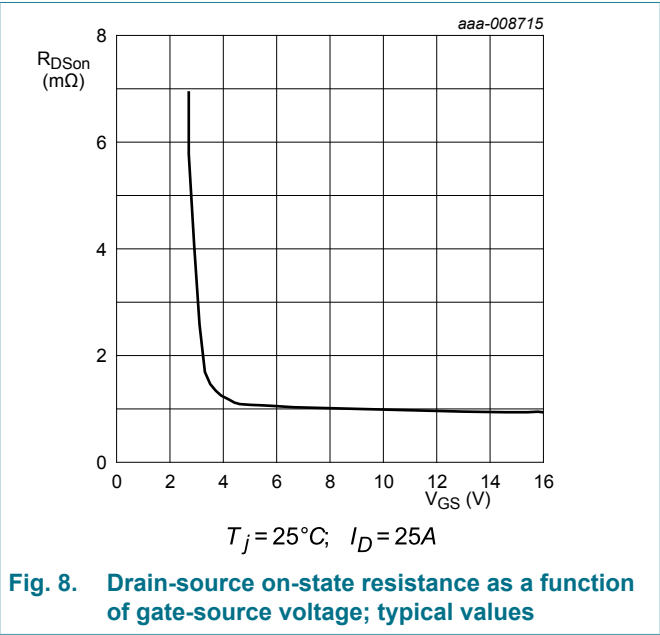


Fig. 8. Drain-source on-state resistance as a function of gate-source voltage; typical values

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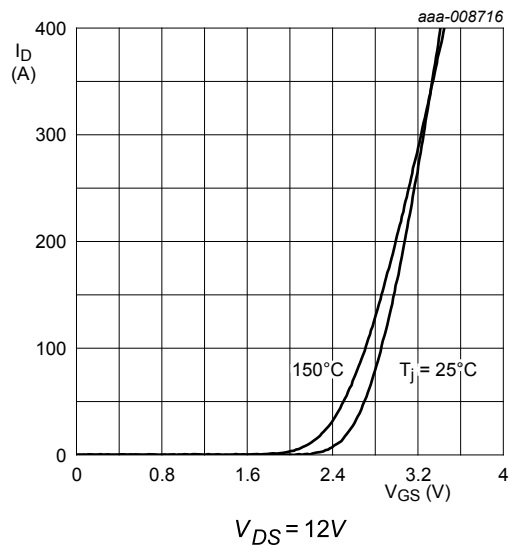


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

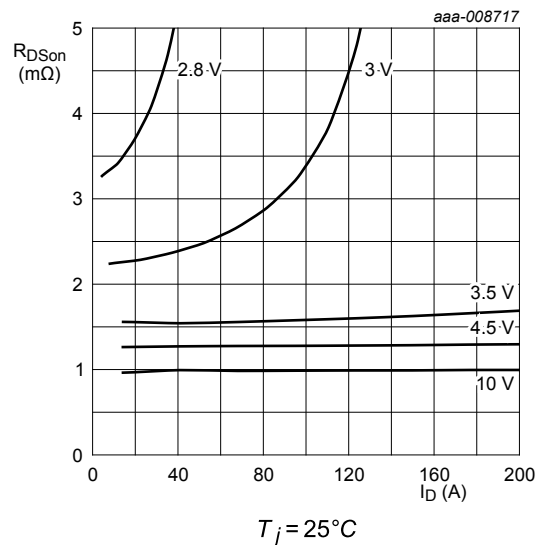


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

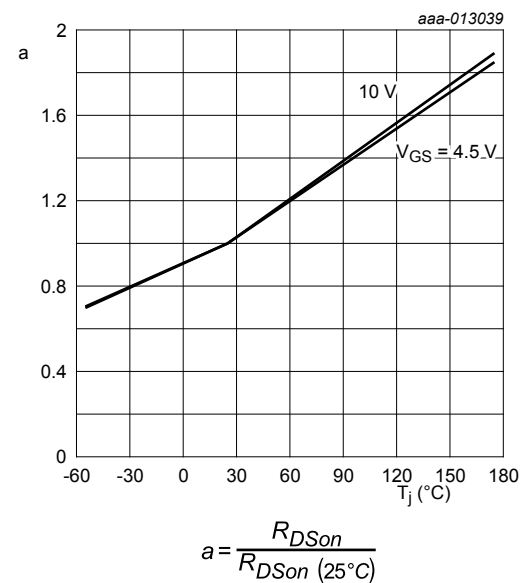


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

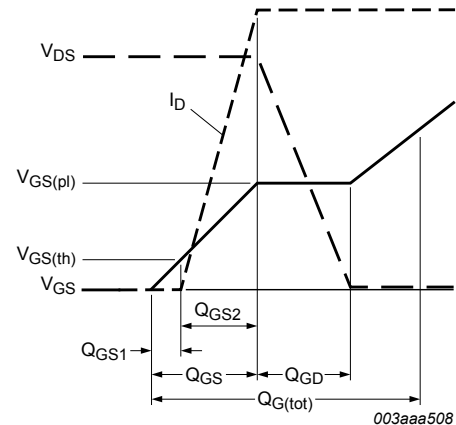


Fig. 12. Gate charge waveform definitions

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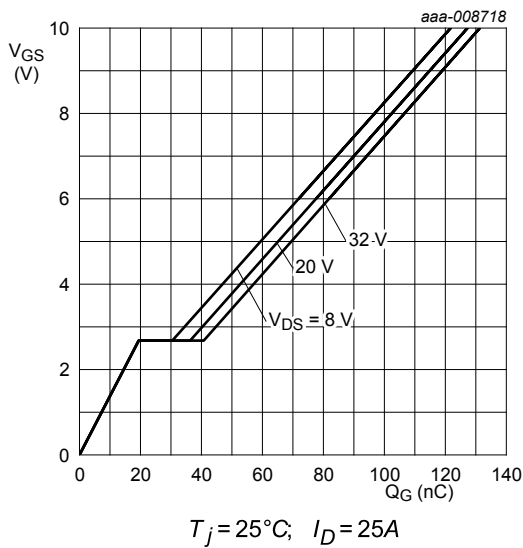


Fig. 13. Gate-source voltage as a function of gate charge; typical values

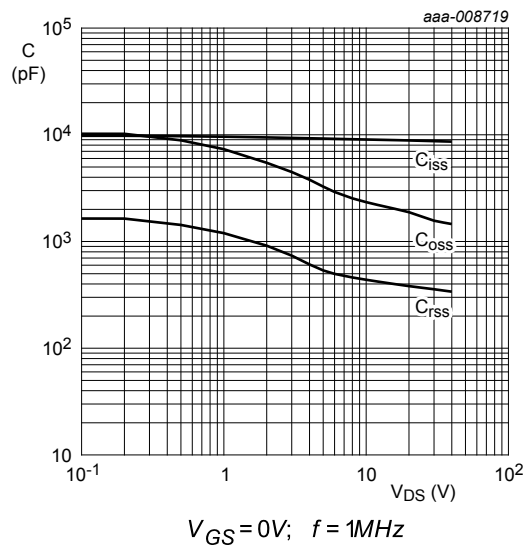


Fig. 14. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

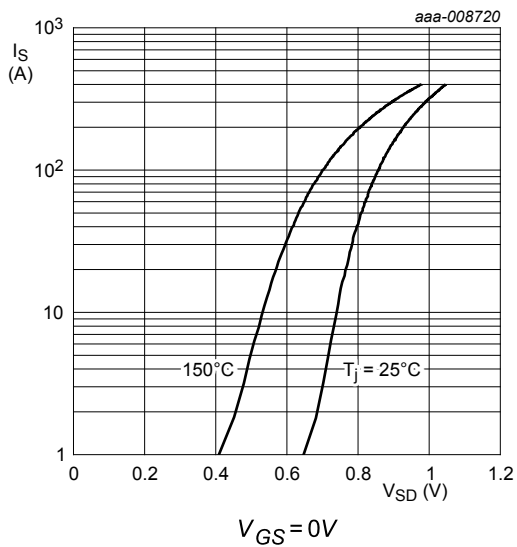


Fig. 15. Source current as a function of source-drain voltage; typical values

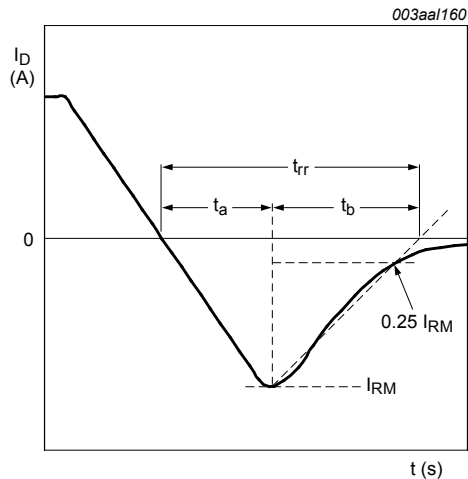


Fig. 16. Reverse recovery timing definition

11. Package outline

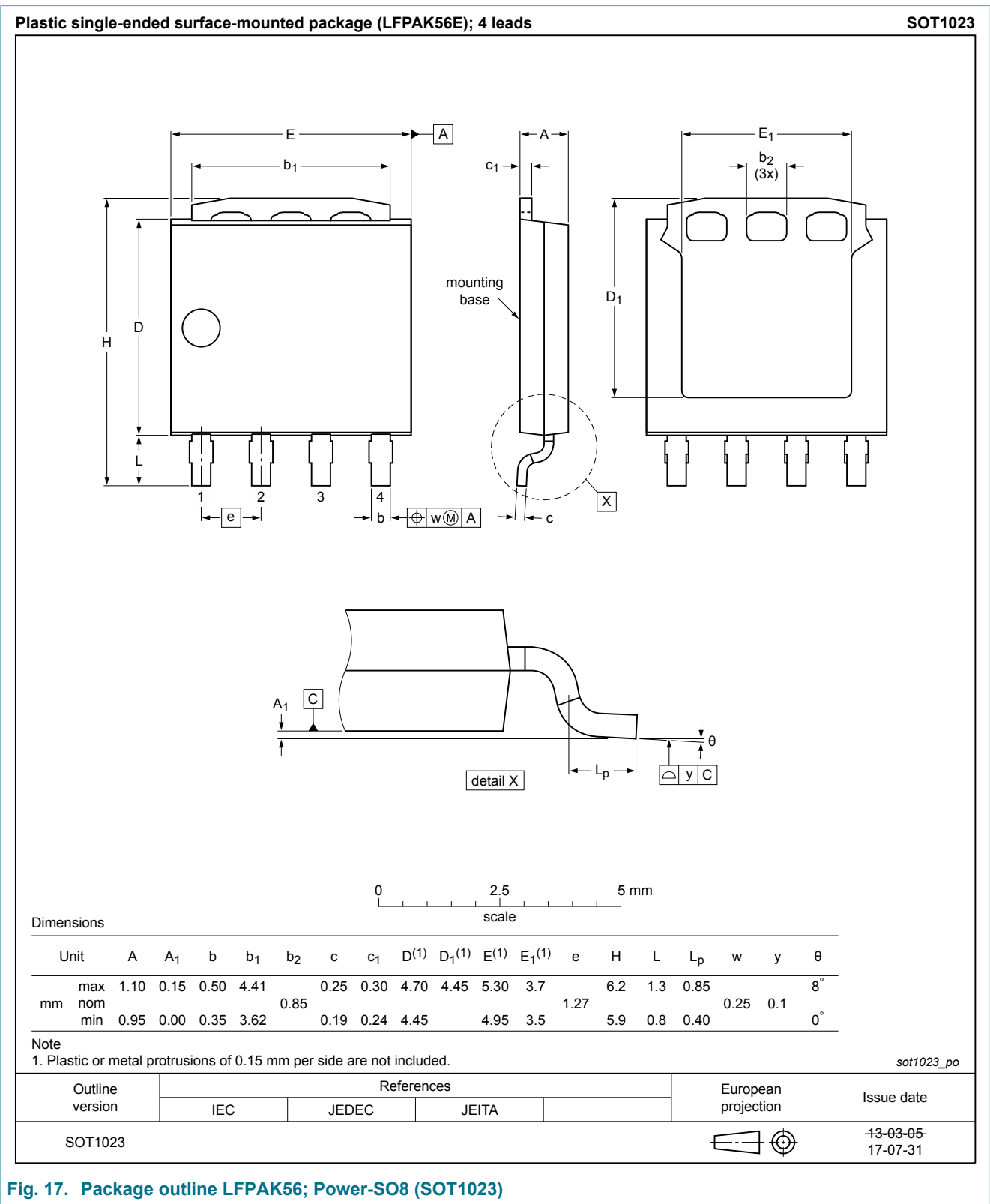


Fig. 17. Package outline LPAK56; Power-SO8 (SOT1023)

12. Soldering

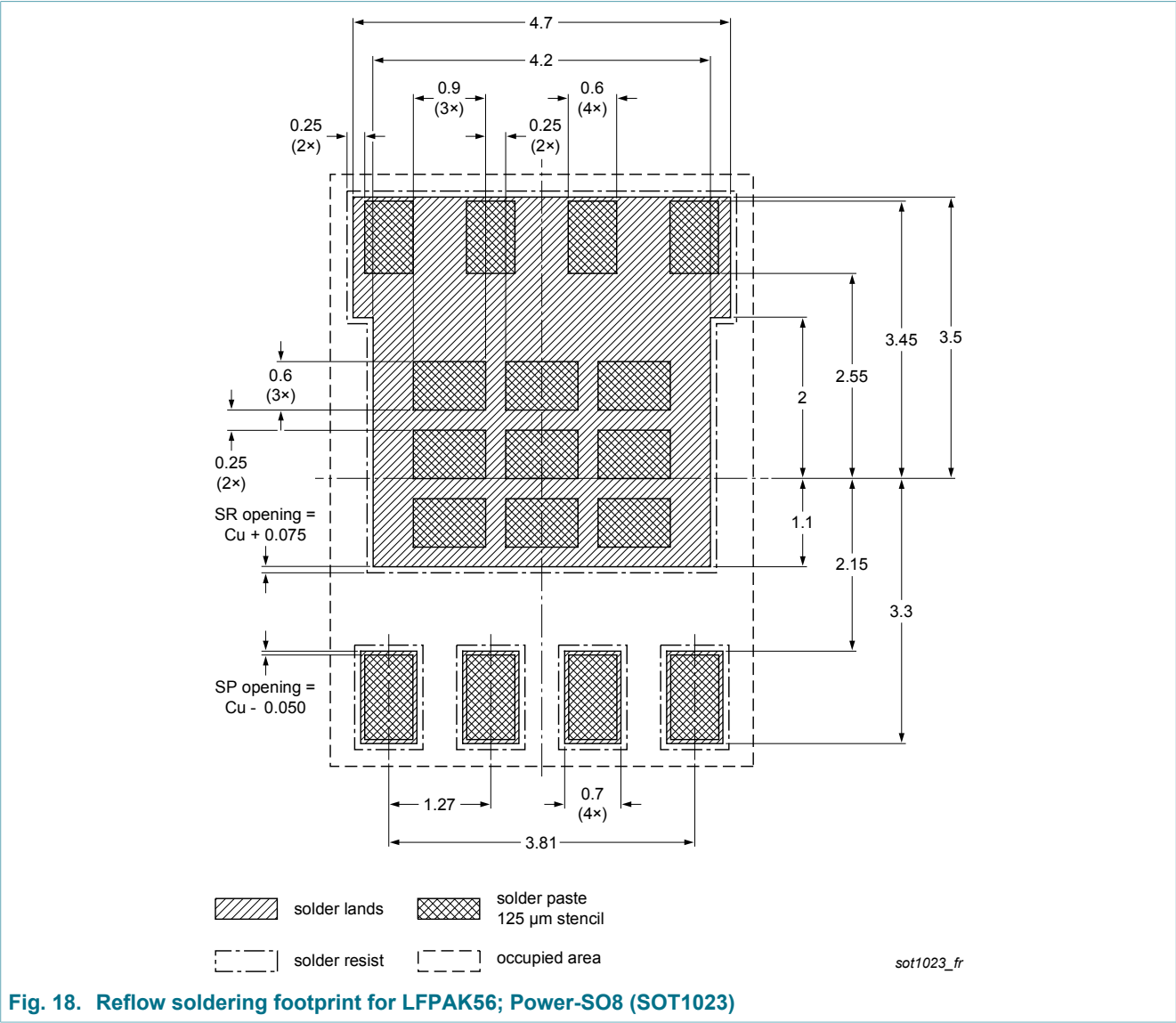


Fig. 18. Reflow soldering footprint for LPAK56; Power-SO8 (SOT1023)

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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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