



# PSMN0R7-25YLD

N-channel 25 V, 0.72 m $\Omega$ , 300 A logic level MOSFET in LFPAK56 using NextPowerS3 Technology

21 April 2016

Product data sheet

## 1. General description

Logic level gate drive N-channel enhancement mode MOSFET in LFPAK56 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  $I_{(AS)} = 190$  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 150 °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
- Power OR-ing

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 150\text{ °C}$		-	-	25	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	-	300	A

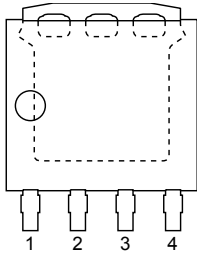
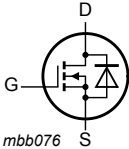
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>	-	-	158	W
T <sub>j</sub>	junction temperature		-55	-	150	°C
<b>Static characteristics</b>						
R <sub>DSon</sub>	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>	-	0.76	0.92	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 10</a>	-	0.57	0.72	mΩ
<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>	-	110.2	-	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>	-	50.9	-	nC
		I <sub>D</sub> = 0 A; V <sub>DS</sub> = 0 V; V <sub>GS</sub> = 10 V	-	45.8	-	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>	-	11.9	-	nC
<b>Source-drain diode</b>						
S	softness factor	I <sub>S</sub> = 25 A; di <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 12 V; <a href="#">Fig. 16</a>	-	0.9	-	

[1] 300A 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>LFPAK56; Power-SO8 (SOT1023)</p>	 <p>mbb076</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
PSMN0R7-25YLD	LFAK56; Power-SO8	Plastic single-ended surface-mounted package (LFAK56); 4 leads	SOT1023

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN0R7-25YLD	0D725L

## 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	$25\text{ °C} \leq T_j \leq 150\text{ °C}$		-	25	V
$V_{DGR}$	drain-gate voltage	$25\text{ °C} \leq T_j \leq 150\text{ °C}$ ; $R_{GS} = 20\text{ k}\Omega$		-	25	V
$V_{GS}$	gate-source voltage			-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; Fig. 1		-	158	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; Fig. 2	[1]	-	300	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; Fig. 2	[1]	-	235	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; Fig. 3		-	1482	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
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$		-	132	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$		-	1482	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 300\text{ A}$ ; $V_{sup} \leq 25\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; unclamped; $t_p = 36\text{ }\mu\text{s}$		-	174	mJ

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Symbol	Parameter	Conditions	Min	Max	Unit
I <sub>AS</sub>	non-repetitive avalanche current	V <sub>sup</sub> ≤ 25 V; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; [2] R <sub>GS</sub> = 50 Ω	-	190	A

- [1] 300A 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

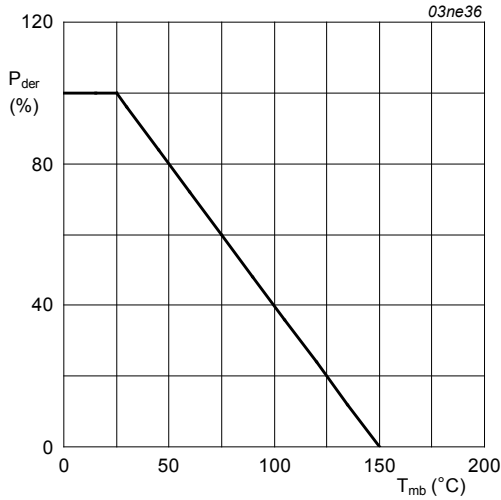
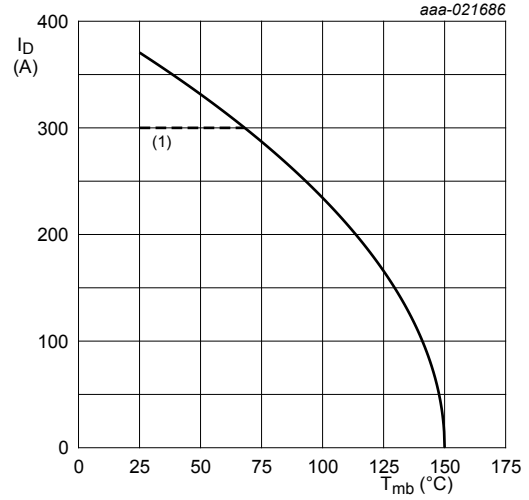


Fig. 1. Normalized total power dissipation as a function of mounting base temperature

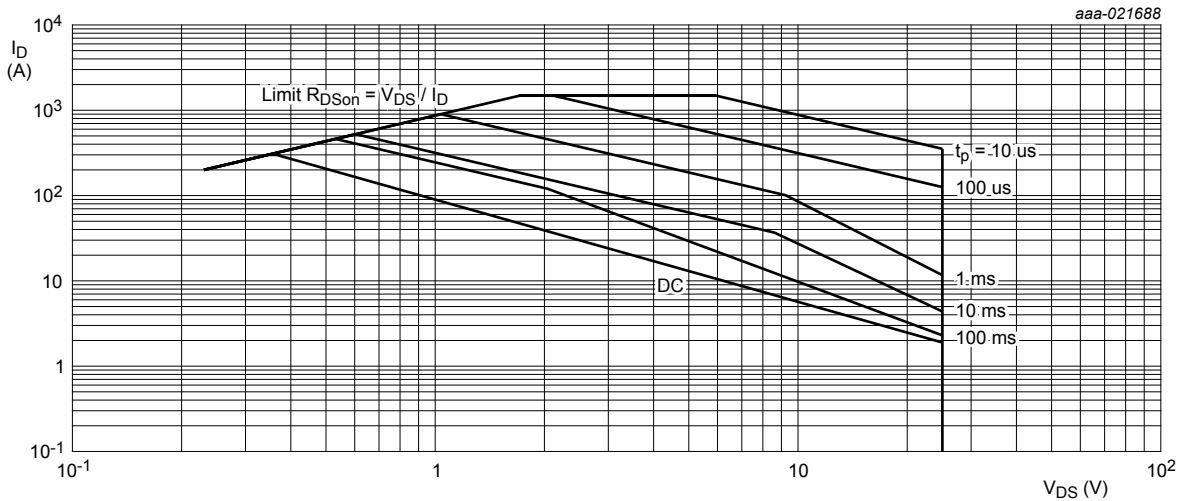
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$



V<sub>GS</sub> ≥ 10 V

(1) 300A 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<sub>mb</sub> = 25 °C; I<sub>DM</sub> 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	<a href="#">Fig. 4</a>	-	0.59	0.79	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	<a href="#">Fig. 5</a>	-	50	-	K/W
		<a href="#">Fig. 6</a>	-	125	-	K/W

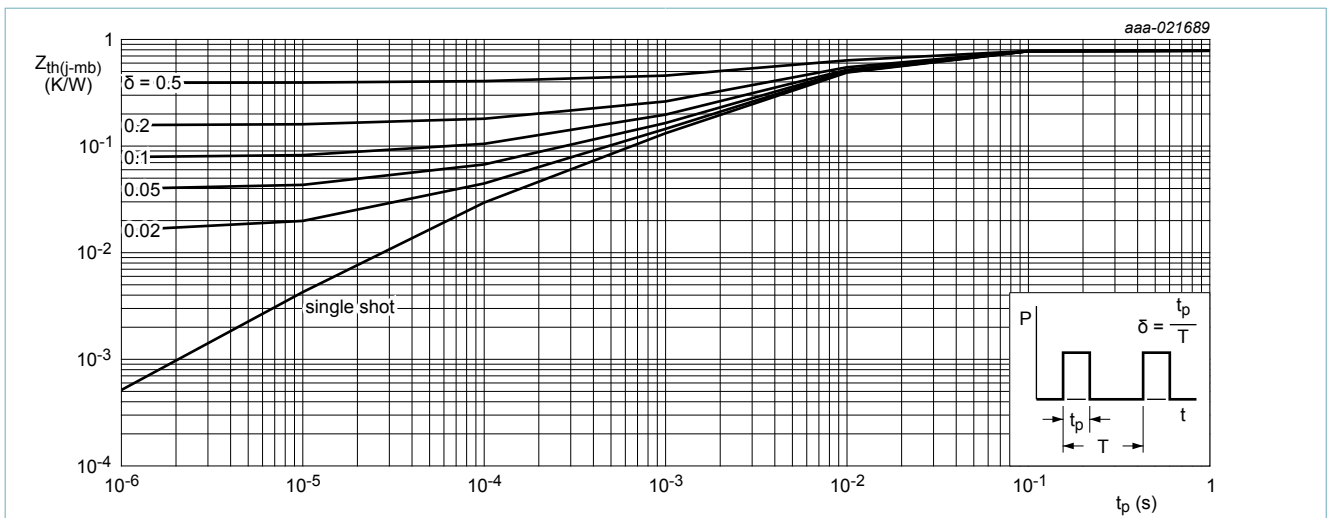


Fig. 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

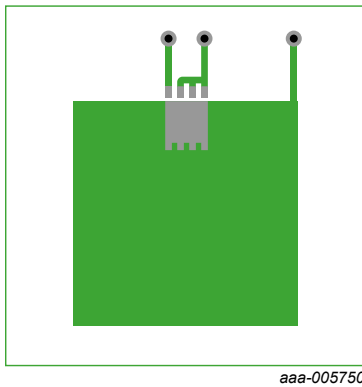


Fig. 5. PCB layout for thermal impedance junction to ambient 1" square pad; FR4 Board; 2oz copper

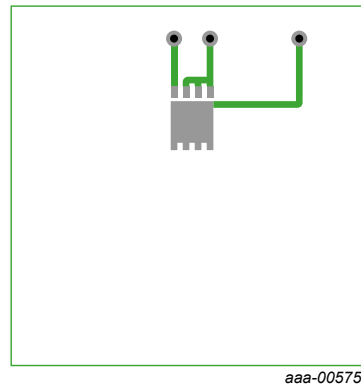


Fig. 6. PCB layout for thermal resistance junction to ambient minimum footprint; FR4 Board; 2oz copper

## 10. Characteristics

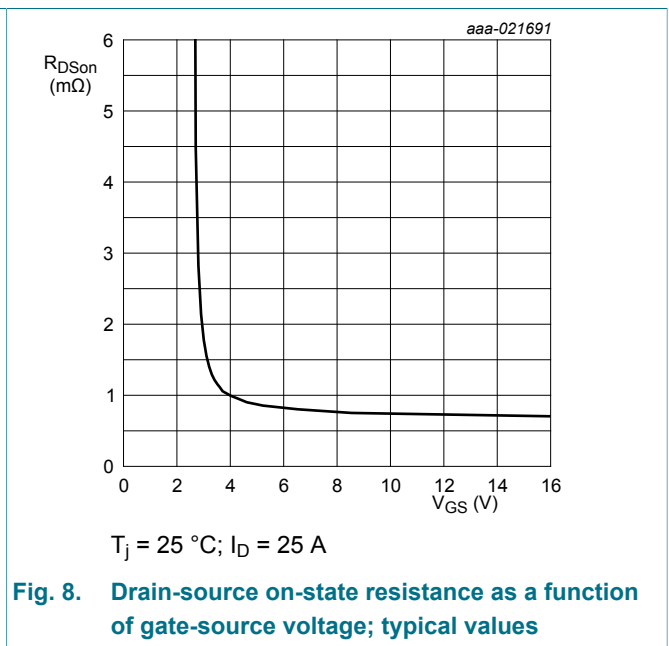
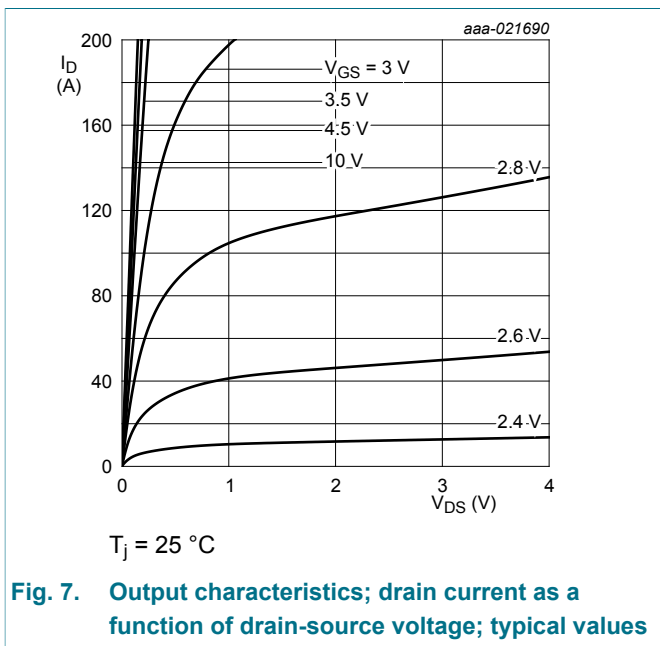
Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	25	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	22.5	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C}$	1.2	1.66	2.2	V
$\Delta V_{GS(th)}/\Delta T$	gate-source threshold voltage variation with temperature	$25 \text{ }^\circ\text{C} \leq T_j \leq 150 \text{ }^\circ\text{C}$	-	-5.1	-	mV/K
$I_{DSS}$	drain leakage current	$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 20 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 125 \text{ }^\circ\text{C}$	-	68.5	-	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = 20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
		$V_{GS} = -20 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	-	0.76	0.92	mΩ
		$V_{GS} = 4.5 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$ <a href="#">Fig. 10; Fig. 11</a>	-	-	1.47	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 10</a>	-	0.57	0.72	mΩ
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 150 \text{ }^\circ\text{C};$ <a href="#">Fig. 10; Fig. 11</a>	-	-	1.15	mΩ
$R_G$	gate resistance	$f = 1 \text{ MHz}$	-	1.35	-	Ω
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 12 \text{ V}; V_{GS} = 10 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	-	110.2	-	nC
		$I_D = 25 \text{ A}; V_{DS} = 12 \text{ V}; V_{GS} = 4.5 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	-	50.9	-	nC
		$I_D = 0 \text{ A}; V_{DS} = 0 \text{ V}; V_{GS} = 10 \text{ V}$	-	45.8	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 \text{ A}; V_{DS} = 12 \text{ V}; V_{GS} = 4.5 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	-	18.8	-	nC
$Q_{GS(th)}$	pre-threshold gate-source charge		-	11.9	-	nC
$Q_{GS(th-pl)}$	post-threshold gate-source charge		-	6.9	-	nC
$Q_{GD}$	gate-drain charge		-	11.9	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 \text{ A}; V_{DS} = 12 \text{ V};$ <a href="#">Fig. 12; Fig. 13</a>	-	2.6	-	V

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$C_{iss}$	input capacitance	$V_{DS} = 12\text{ V}; V_{GS} = 0\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C};$ <a href="#">Fig. 14</a>	-	8320	-	pF	
$C_{oss}$	output capacitance		-	2982	-	pF	
$C_{rss}$	reverse transfer capacitance		-	522	-	pF	
$t_{d(on)}$	turn-on delay time		$V_{DS} = 12\text{ V}; R_L = 0.6\text{ }\Omega; V_{GS} = 4.5\text{ V}; R_{G(ext)} = 5\text{ }\Omega$	-	42.2	-	ns
$t_r$	rise time		-	48.3	-	ns	
$t_{d(off)}$	turn-off delay time		-	53.1	-	ns	
$t_f$	fall time		-	38.2	-	ns	
$Q_{oss}$	output charge	$V_{GS} = 0\text{ V}; V_{DS} = 12\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ °C}$	-	54	-	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>	-	0.77	1.2	V	
$t_{rr}$	reverse recovery time	$I_S = 25\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 12\text{ V};$ <a href="#">Fig. 16</a>	-	57.7	-	ns	
$Q_r$	recovered charge		[1]	-	83.2	-	nC
$t_a$	reverse recovery rise time		-	-	30.5	-	ns
$t_b$	reverse recovery fall time		-	-	27.2	-	ns
S	softness factor		-	-	0.9	-	

[1] includes capacitive recovery



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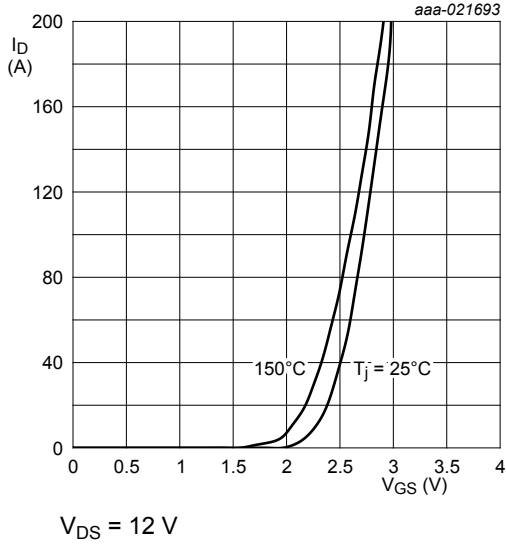


Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

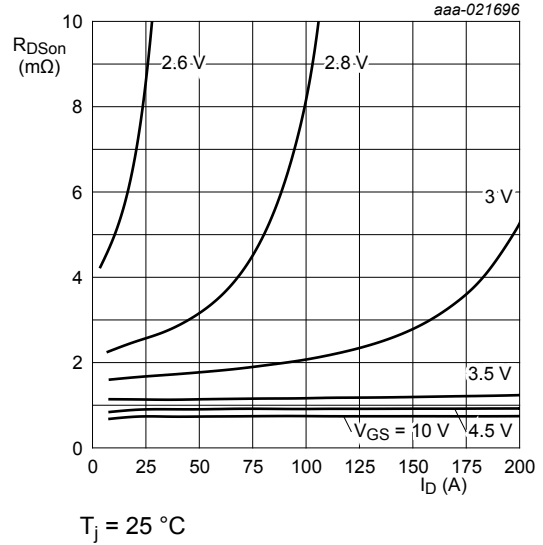


Fig. 10. Drain-source on-state resistance as a function of drain current; typical values

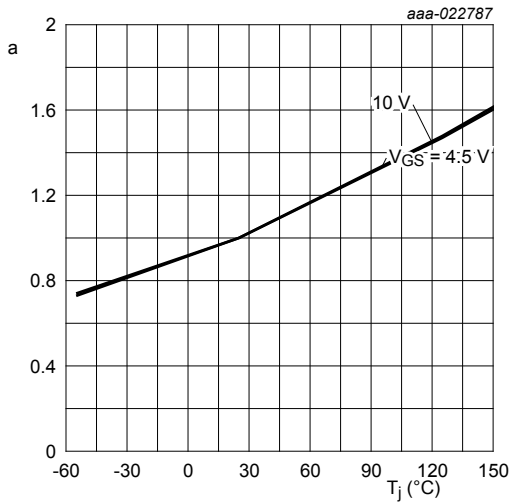


Fig. 11. Normalized drain-source on-state resistance factor as a function of junction temperature

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

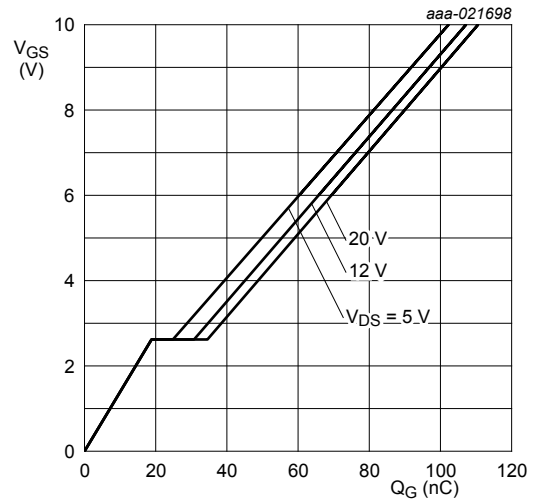


Fig. 12. Gate-source voltage as a function of gate charge; typical values



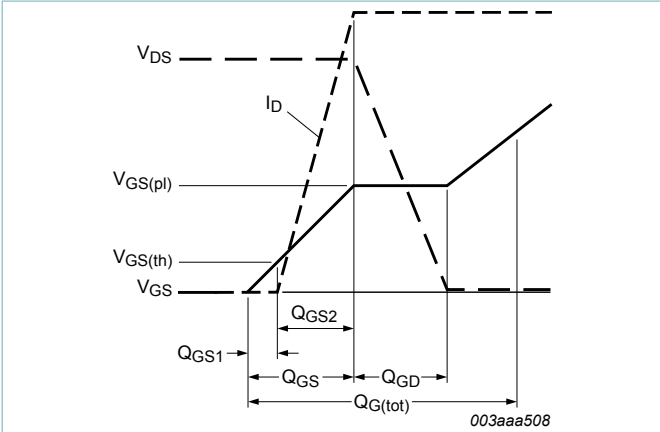
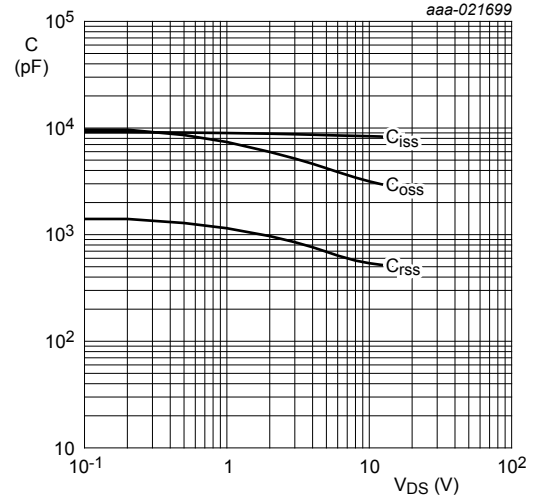
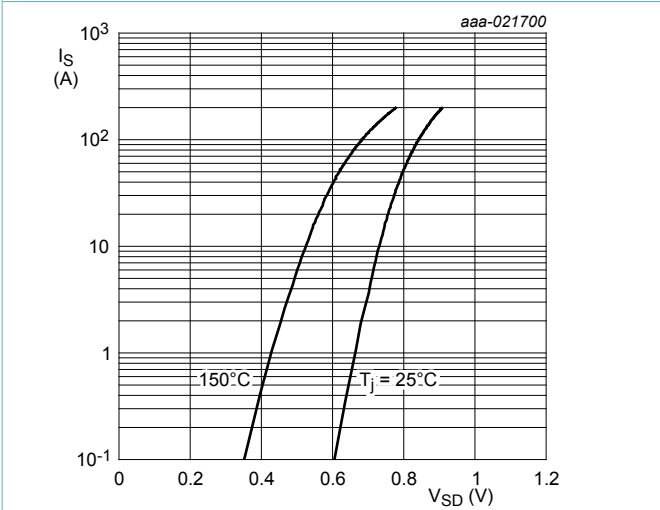


Fig. 13. Gate charge waveform definitions



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

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

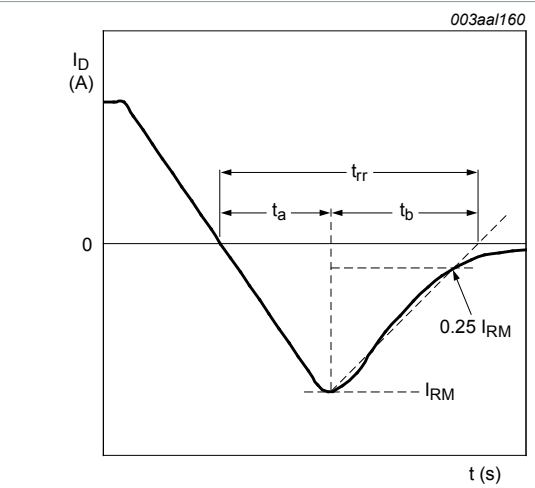


Fig. 16. Reverse recovery timing definition

### 11. Package outline

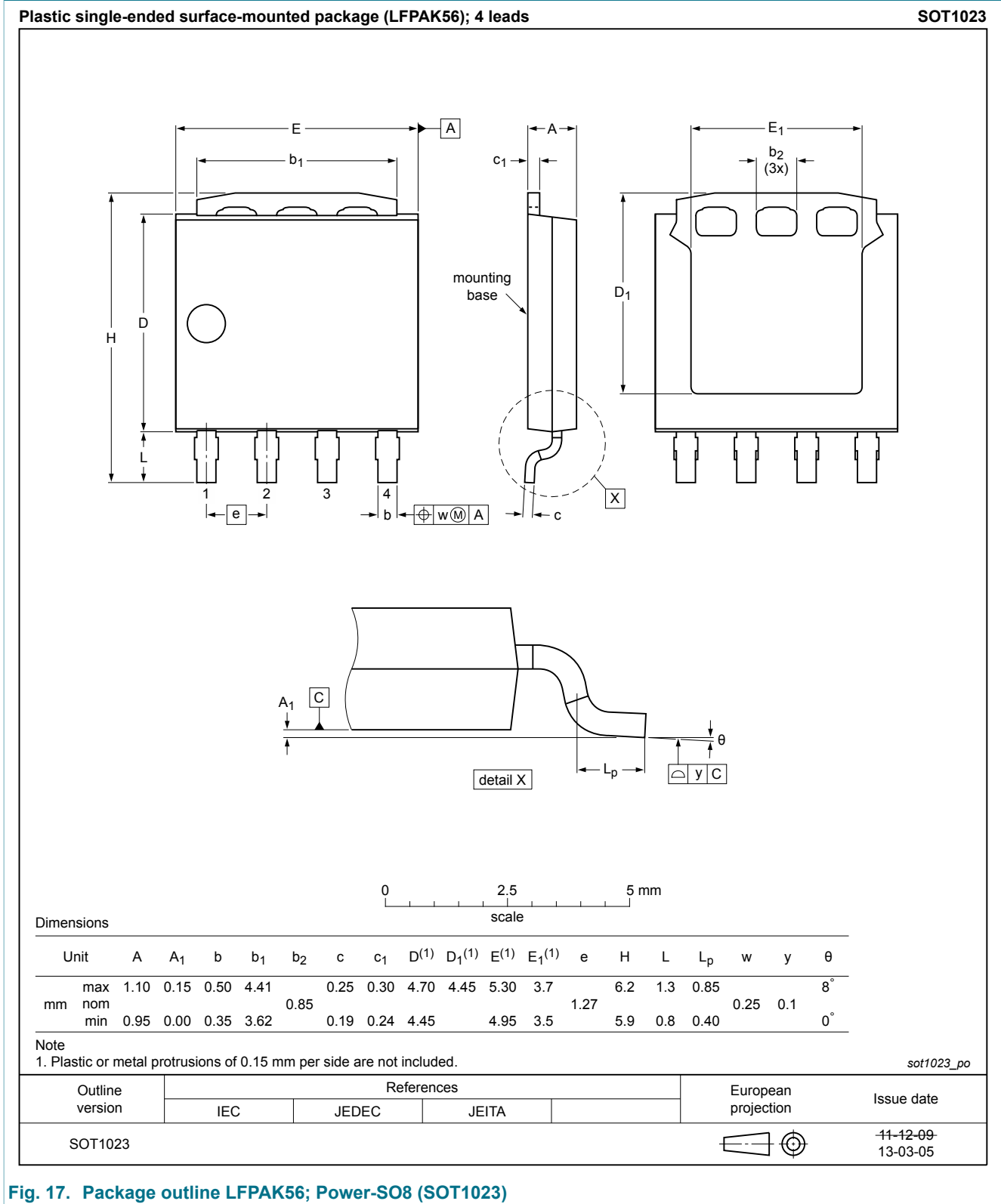


Fig. 17. Package outline LPAK56; Power-SO8 (SOT1023)

## 12. Legal information

### 12.1 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.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions".
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