



# PSMN5R6-60YL

N-channel 60 V, 5.6 mΩ logic level MOSFET in LPAK56

3 June 2016

Product data sheet

## 1. General description

Logic level N-channel MOSFET in an LPAK56 (Power SO8) package using TrenchMOS technology. This product is designed and qualified for use in a wide range of power supply & motor control equipment.

## 2. Features and benefits

- Advanced TrenchMOS provides low  $R_{DSon}$  and low gate charge
- Logic level gate operation
- Avalanche rated, 100% tested
- LPAK provides maximum power density in a Power SO8 package

## 3. Applications

- Synchronous rectifier in LLC topology
- Chargers & adaptors with  $V_{out} < 10\text{ V}$
- Fast charge & USB-PD applications
- Battery powered motor control
- LED lighting & TV backlight

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	-	60	V
$I_D$	drain current	$V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	-	100	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	-	167	W
<b>Static characteristics</b>							
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 11</a>		-	5.4	7.2	mΩ
<b>Dynamic characteristics</b>							
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}$ ; $V_{DS} = 48\text{ V}$ ; $V_{GS} = 5\text{ V}$ ; $T_j = 25\text{ °C}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	12	-	nC

[1] Continuous current is limited by package.

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source	 <p><b>LPAK56; Power-SO8 (SOT669)</b></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
PSMN5R6-60YL	LPAK56; Power-SO8	Plastic single-ended surface-mounted package (LPAK56; Power-SO8); 4 leads	SOT669

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PSMN5R6-60YL	5R6L60

## 8. Limiting values

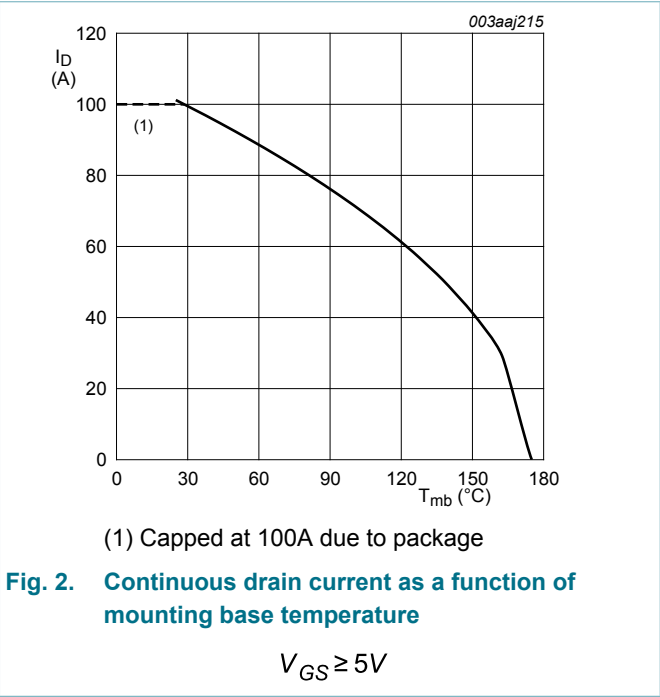
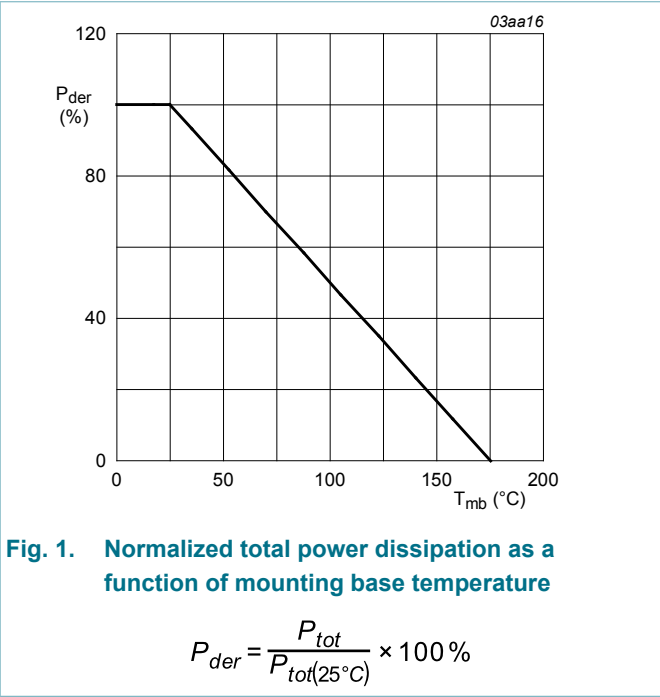
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	60	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	60	V
$V_{GS}$	gate-source voltage			-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; Fig. 1		-	167	W
$I_D$	drain current	$V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; Fig. 2	[1]	-	100	A
		$V_{GS} = 5\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; Fig. 2		-	72	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; Fig. 3		-	405	A
$T_{stg}$	storage temperature			-55	175	°C

Symbol	Parameter	Conditions		Min	Max	Unit
T <sub>j</sub>	junction temperature			-55	175	°C
Source-drain diode						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	[1]	-	100	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C		-	405	A
Avalanche ruggedness						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 100 A; V <sub>sup</sub> ≤ 60 V; R <sub>GS</sub> = 50 Ω; V <sub>GS</sub> = 5 V; T <sub>j(init)</sub> = 25 °C; unclamped; Fig. 4	[2][3]	-	88.2	mJ

- [1] Continuous current is limited by package.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.



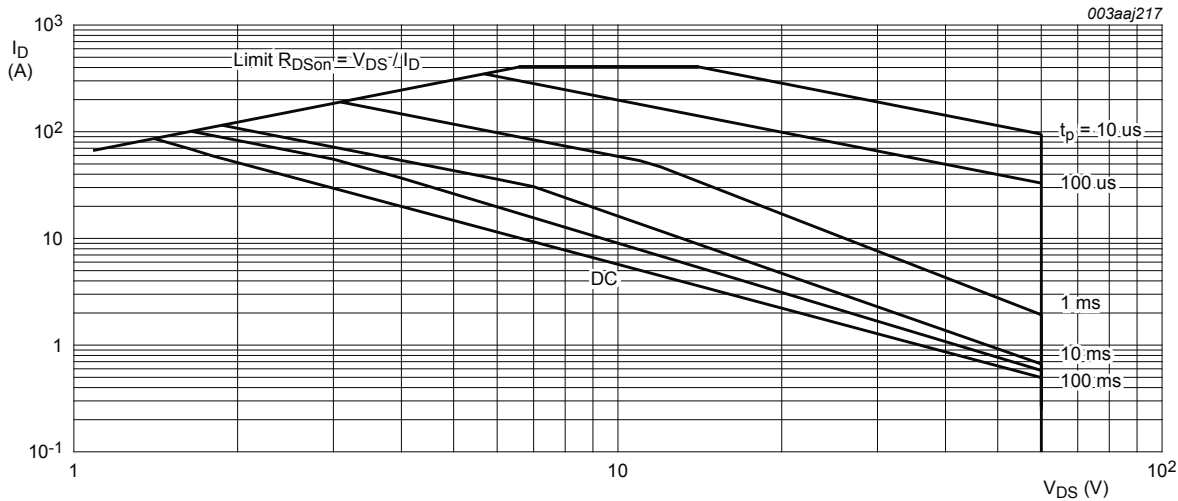


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^{\circ}\text{C}$ ;  $I_{DM}$  is a single pulse

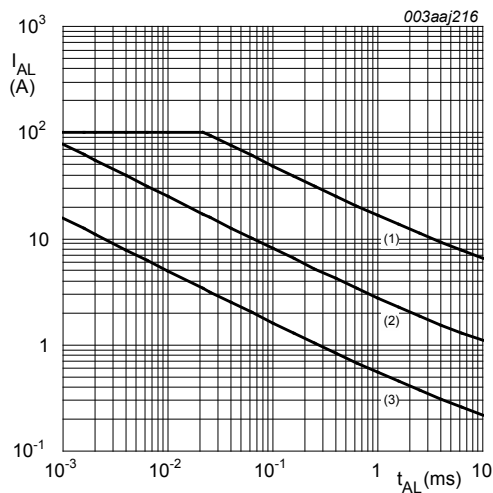


Fig. 4. Avalanche rating; avalanche current as a function of avalanche time

(1)  $T_{j(init)} = 25^{\circ}\text{C}$ ; (2)  $T_{j(init)} = 150^{\circ}\text{C}$ ; (3) Repetitive Avalanche

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. 5	-	-	0.9	K/W

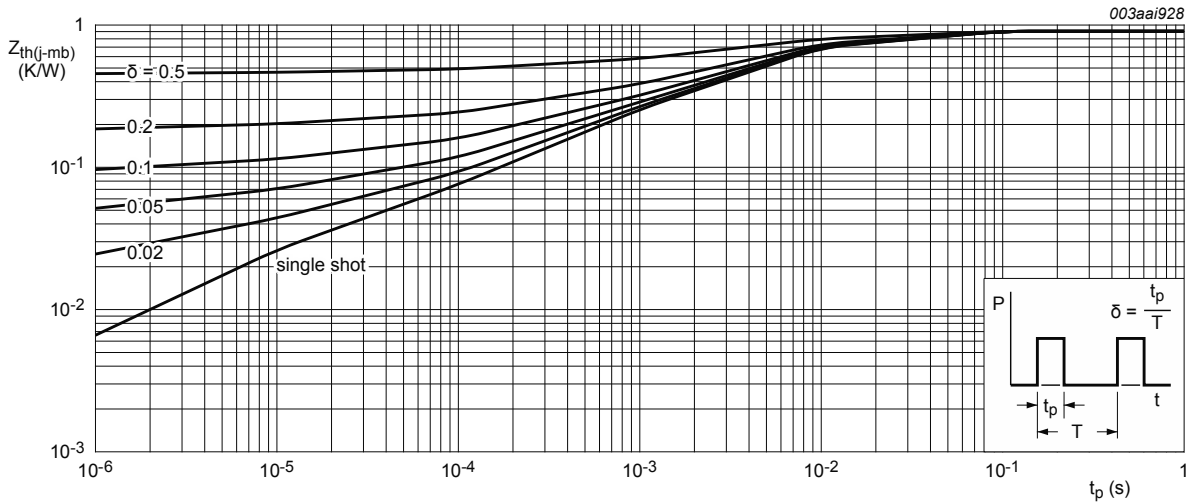


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C		60	-	-	V
		I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V; T <sub>j</sub> = -55 °C		54	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 1 mA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>j</sub> = 25 °C; <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a>		1.4	1.7	2.1	V
		I <sub>D</sub> = 1 mA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>j</sub> = -55 °C; <a href="#">Fig. 9</a>		-	-	2.45	V
		I <sub>D</sub> = 1 mA; V <sub>DS</sub> =V <sub>GS</sub> ; T <sub>j</sub> = 175 °C; <a href="#">Fig. 9</a>		0.5	-	-	V
I <sub>DSS</sub>	drain leakage current	V <sub>DS</sub> = 60 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C		-	0.05	10	μA
		V <sub>DS</sub> = 60 V; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 175 °C		-	-	500	μA
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = 16 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C		-	2	100	nA
		V <sub>GS</sub> = -16 V; V <sub>DS</sub> = 0 V; T <sub>j</sub> = 25 °C		-	2	100	nA
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 5 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>		-	5.4	7.2	mΩ
		V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>		-	4.7	5.6	mΩ
		V <sub>GS</sub> = 5 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 175 °C; <a href="#">Fig. 11</a> ; <a href="#">Fig. 12</a>		-	-	16.3	mΩ
Dynamic characteristics							
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 10 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	66.8	-	nC
		I <sub>D</sub> = 25 A; V <sub>DS</sub> = 48 V; V <sub>GS</sub> = 5 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	35	-	nC
Q <sub>GS</sub>	gate-source charge	T <sub>j</sub> = 25 °C; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	9.5	-	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Q <sub>GD</sub>	gate-drain charge			-	12	-	nC
C <sub>iss</sub>	input capacitance	V <sub>DS</sub> = 25 V; V <sub>GS</sub> = 0 V; f = 1 MHz; T <sub>j</sub> = 25 °C; <a href="#">Fig. 15</a>		-	3769	5026	pF
C <sub>oss</sub>	output capacitance			-	341	409	pF
C <sub>rss</sub>	reverse transfer capacitance			-	185	253	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 45 V; R <sub>L</sub> = 1.8 Ω; V <sub>GS</sub> = 5 V; R <sub>G(ext)</sub> = 5 Ω; T <sub>j</sub> = 25 °C		-	19.3	-	ns
t <sub>r</sub>	rise time			-	36.4	-	ns
t <sub>d(off)</sub>	turn-off delay time			-	49.4	-	ns
t <sub>f</sub>	fall time			-	32.1	-	ns
Source-drain diode							
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 25 A; V <sub>GS</sub> = 0 V; T <sub>j</sub> = 25 °C; <a href="#">Fig. 16</a>		-	0.81	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs; V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; T <sub>j</sub> = 25 °C		-	23.1	-	ns
Q <sub>r</sub>	recovered charge			-	18.1	-	nC

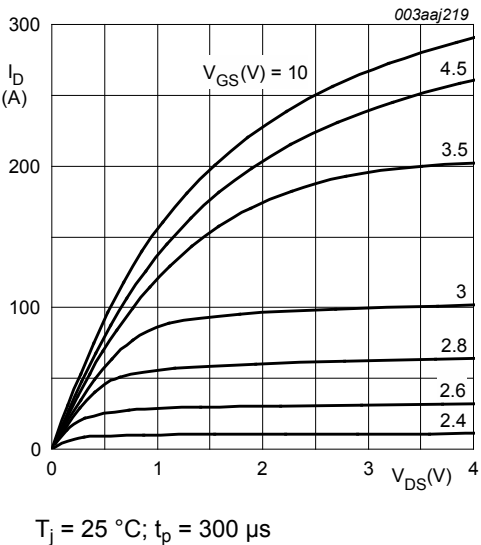


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

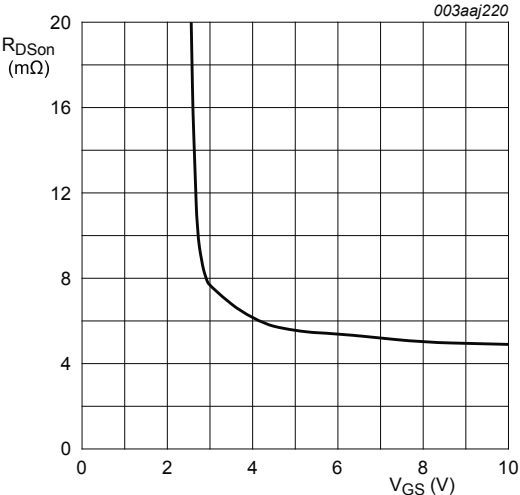


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25\text{ }^{\circ}\text{C}; I_D = 25\text{ A}$

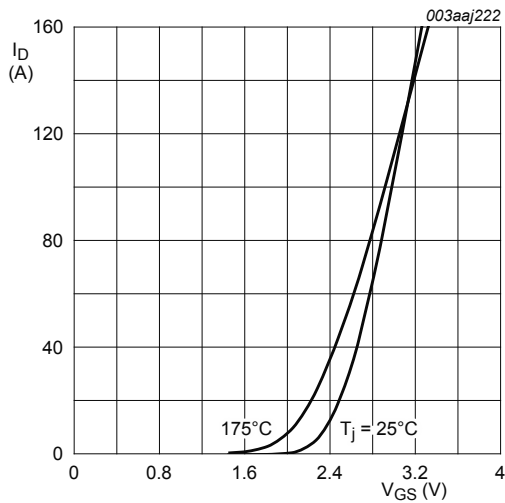


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\text{V}$

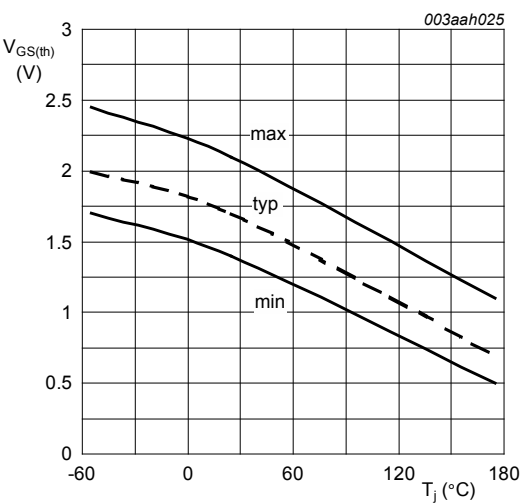


Fig. 9. Gate-source threshold voltage as a function of junction temperature

$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

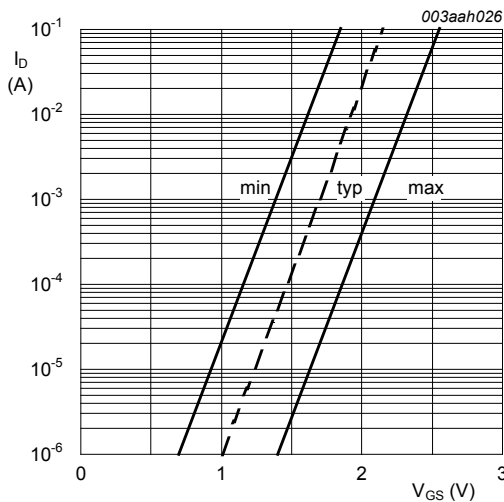
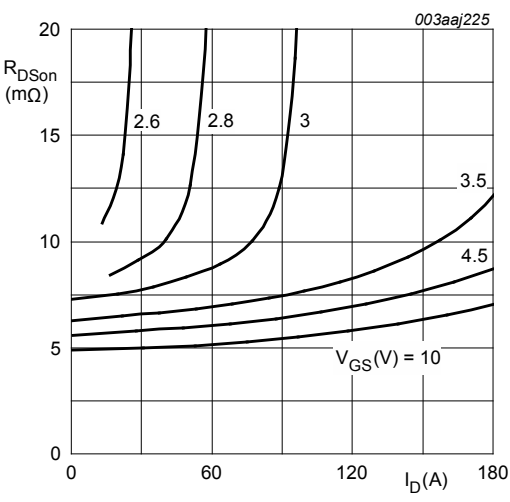


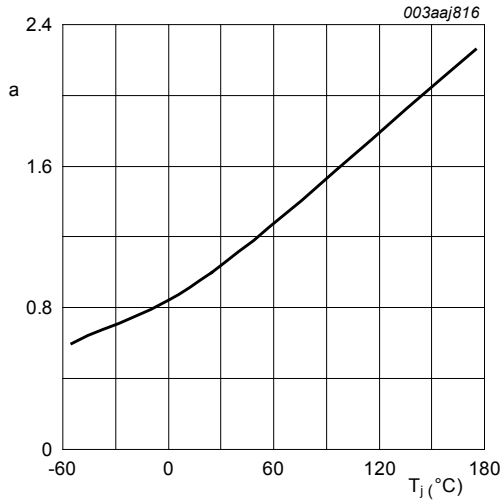
Fig. 10. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$



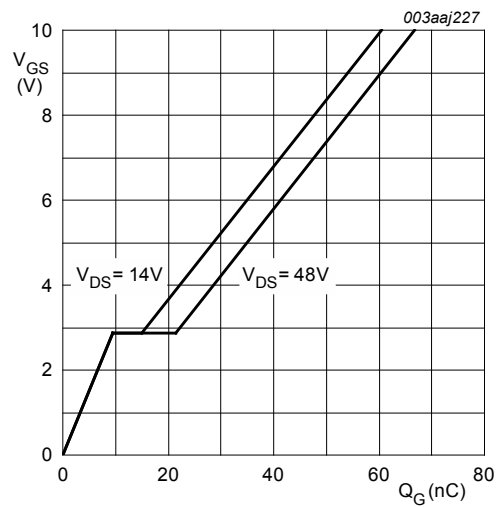
$T_j = 25^\circ\text{C}; t_p = 300\text{ }\mu\text{s}$

Fig. 11. Drain-source on-state resistance as a function of drain current; typical values



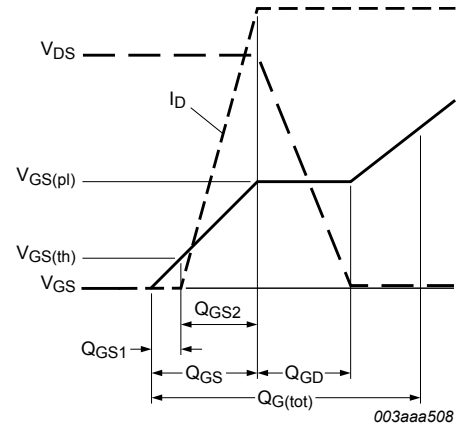
**Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature**

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

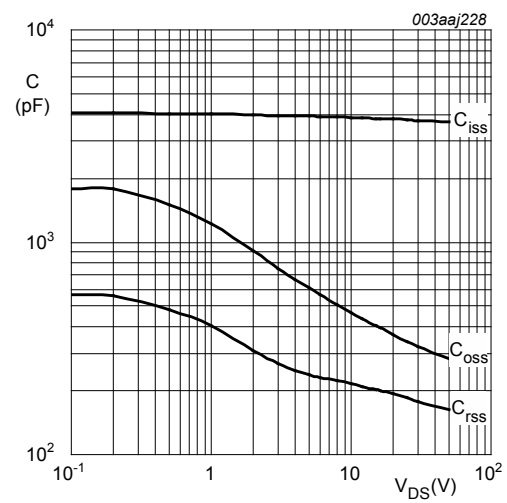


**Fig. 14. Gate-source voltage as a function of gate charge; typical values**

$$T_j = 25^{\circ}\text{C}; I_D = 25\text{A}$$



**Fig. 13. Gate charge waveform definitions**



**Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**

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



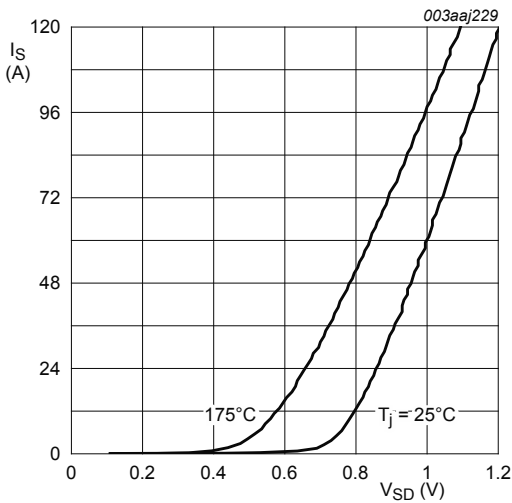


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values  
 $V_{GS} = 0V$

11. Package outline



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

## 12. Legal information

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**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

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