



**THE DATASHEET OF  
BUK9K29-100E,115**





# BUK9K29-100E

Dual N-channel TrenchMOS logic level FET

28 March 2013

Product data sheet

## 1. General description

Dual logic level N-channel MOSFET in a LFAK56D package using TrenchMOS technology. This product has been designed and qualified to AEC Q101 standard for use in high performance automotive applications.

## 2. Features and benefits

- Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True logic level gate with  $V_{GS(th)} > 0.5 \text{ V @ } 175 \text{ °C}$

## 3. Applications

- 12 V Automotive systems
- Motors, lamps and solenoid control
- Start-stop micro-hybrid applications
- Transmission control
- Ultra high performance power switching

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25 \text{ °C}; T_j \leq 175 \text{ °C}$	-	-	100	V
$I_D$	drain current	$V_{GS} = 5 \text{ V}; T_{mb} = 25 \text{ °C}; \text{Fig. 1}$	-	-	30	A
$P_{tot}$	total power dissipation	$T_{mb} = 25 \text{ °C}; \text{Fig. 2}$	-	-	68	W
$T_j$	junction temperature		-55	-	175	°C
<b>Static characteristics FET1 and FET2</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5 \text{ V}; I_D = 5 \text{ A}; T_j = 25 \text{ °C}; \text{Fig. 12}$	-	25.1	29	mΩ
<b>Dynamic characteristics FET1 and FET2</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 10 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 10 \text{ V};$	-	54	-	nC
$Q_{GD}$	gate-drain charge	$T_j = 25 \text{ °C}; \text{Fig. 14}; \text{Fig. 15}$	-	10.9	-	nC

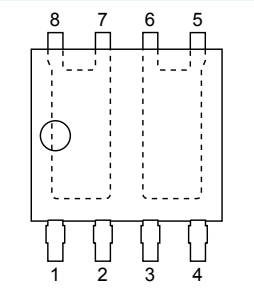
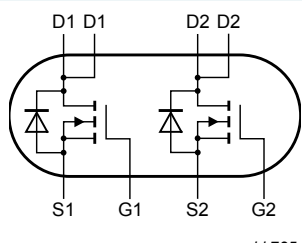
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>Avalanche Ruggedness FET1 and FET2</b>							
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 30\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $V_{GS} = 5\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; Fig. 3	[1][2]	-	-	83	mJ

[1] Refer to application note AN10273 for further information

[2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source1	 <p><b>LFPAK56D (SOT1205)</b></p>	 <p>mbk725</p>
2	G1	gate1		
3	S2	source2		
4	G2	gate2		
5	D2	drain2		
6	D2	drain2		
7	D1	drain1		
8	D1	drain1		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BUK9K29-100E	LFPAK56D	Plastic single ended surface mounted package (LFPAK56D); 8 leads	SOT1205

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BUK9K29-100E	9291E

## 8. Limiting values

**Table 5. Limiting values**

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

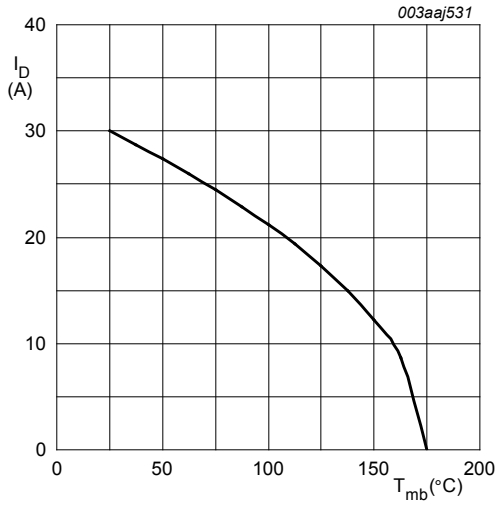
Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$		-	100	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega; T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$		-	100	V
$V_{GS}$	gate-source voltage	$T_j \leq 175\text{ °C}; \text{DC}$		-10	10	V
		$T_j \leq 175\text{ °C}; \text{Pulsed}$	[1][2]	-15	15	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V}; \text{Fig. 1}$		-	30	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 5\text{ V}; \text{Fig. 1}$		-	21	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}; \text{pulsed}; t_p \leq 10\text{ }\mu\text{s}; \text{Fig. 4}$		-	118	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}; \text{Fig. 2}$		-	68	W
$T_{stg}$	storage temperature			-55	175	°C
$T_j$	junction temperature			-55	175	°C
$T_{sld(M)}$	peak soldering temperature			-	260	°C
<b>Source-drain diode FET1 and FET2</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$		-	30	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}; T_{mb} = 25\text{ °C}$		-	118	A
<b>Avalanche Ruggedness FET1 and FET2</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 30\text{ A}; V_{sup} \leq 100\text{ V}; V_{GS} = 5\text{ V}; T_{j(\text{init})} = 25\text{ °C}; \text{Fig. 3}$	[3][4]	-	83	mJ

[1] Accumulated Pulse duration up to 50 hours delivers zero defect ppm

[2] Significantly longer life times are achieved by lowering  $T_j$  and or  $V_{GS}$ .

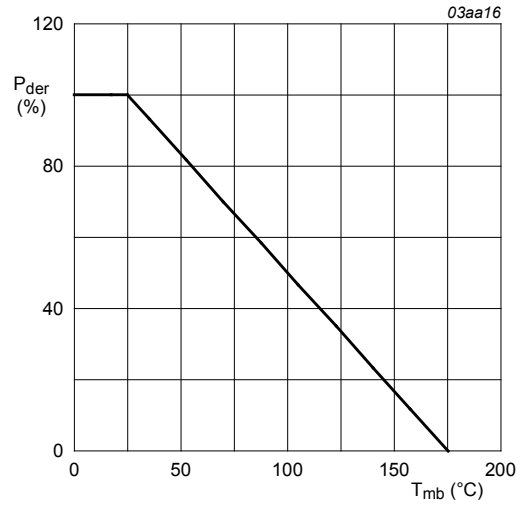
[3] Refer to application note AN10273 for further information

[4] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C



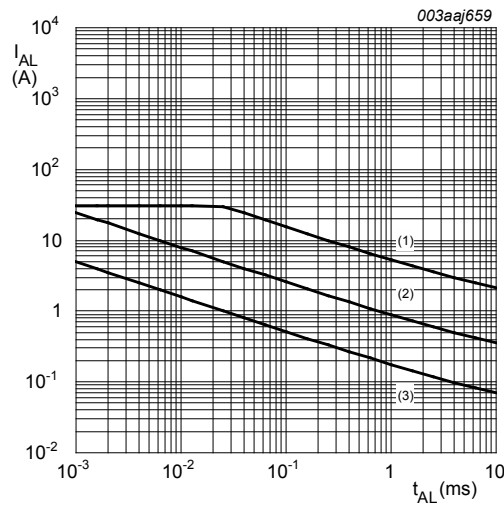
**Fig. 1. Continuous drain current as a function of mounting base temperature**

$$V_{GS} \geq 5V$$



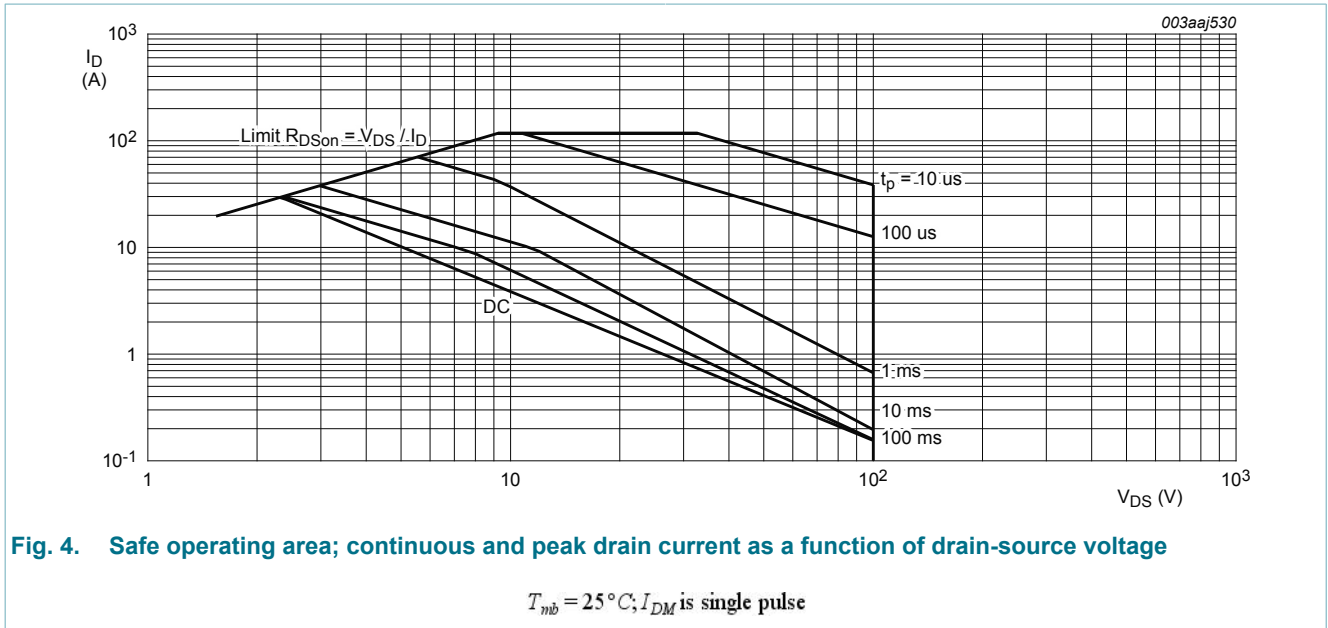
**Fig. 2. Normalized total power dissipation as a function of mounting base temperature**

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



**Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time, FET1 and FET2**

- (1) Single-pulse;  $T_j = 25^{\circ}C$ .
- (2) Single-pulse;  $T_j = 150^{\circ}C$ .
- (3) Repetitive.



## 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	-	-	2.21	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	Minimum footprint; mounted on a printed circuit board	-	95	-	K/W

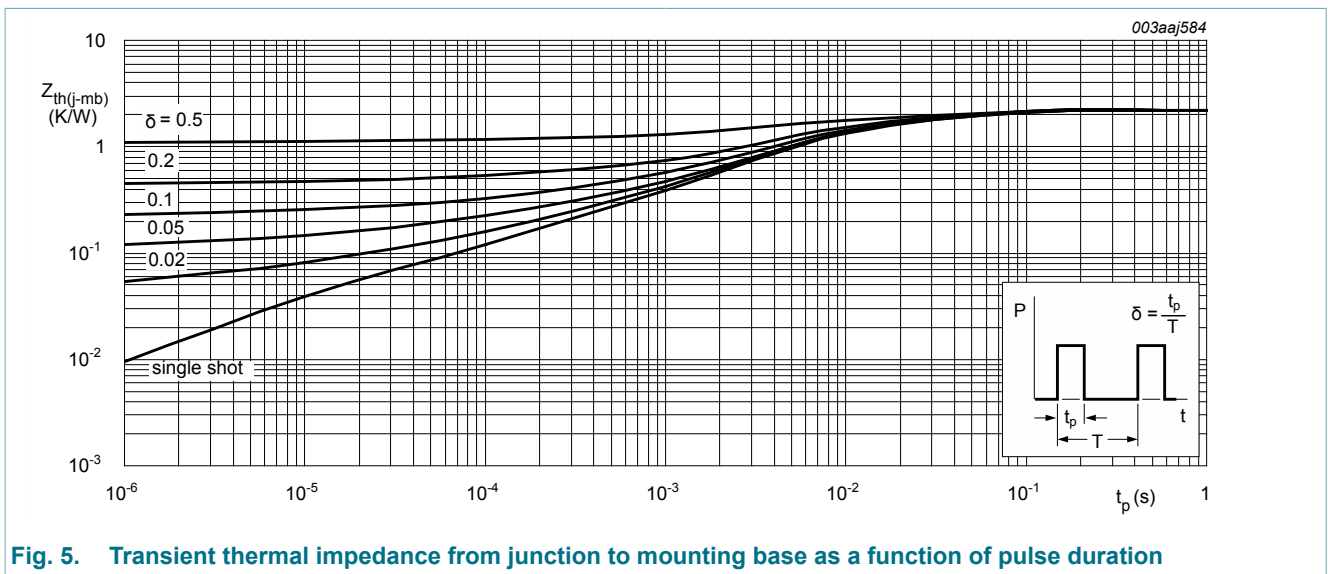


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics FET1 and FET2</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	90	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	100	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 10; Fig. 11</a>	1.4	1.7	2.1	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ <a href="#">Fig. 10; Fig. 11</a>	0.5	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ <a href="#">Fig. 10; Fig. 11</a>	-	-	2.45	V
$I_{DSS}$	drain leakage current	$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	1	$\mu\text{A}$
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5 \text{ V}; I_D = 5 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 12</a>	-	25.1	29	m $\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 5 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ <a href="#">Fig. 12; Fig. 13</a>	-	68.02	80	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 5 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 12</a>	-	22.7	27	m $\Omega$
<b>Dynamic characteristics FET1 and FET2</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 10 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 14; Fig. 15</a>	-	54	-	nC
$Q_{GS}$	gate-source charge	$I_D = 10 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 15; Fig. 14</a>	-	5.6	-	nC
$Q_{GD}$	gate-drain charge	$I_D = 10 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 14; Fig. 15</a>	-	10.9	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 16</a>	-	2727	3637	pF
$C_{oss}$	output capacitance		-	169	203	pF
$C_{rss}$	reverse transfer capacitance		-	106	145	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 80 \text{ V}; R_L = 8 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 5 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}; I_D = 10 \text{ A}$	-	6.1	-	ns
$t_r$	rise time		-	6.4	-	ns
$t_{d(off)}$	turn-off delay time		-	67.3	-	ns
$t_f$	fall time		-	35.1	-	ns
<b>Source-drain diode FET1 and FET2</b>						
$V_{SD}$	source-drain voltage	$I_S = 15 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ <a href="#">Fig. 17</a>	-	0.78	1.2	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{rr}$	reverse recovery time	$I_S = 10\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ;	-	32.7	-	ns
$Q_r$	recovered charge	$V_{DS} = 50\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$	-	50.1	-	nC

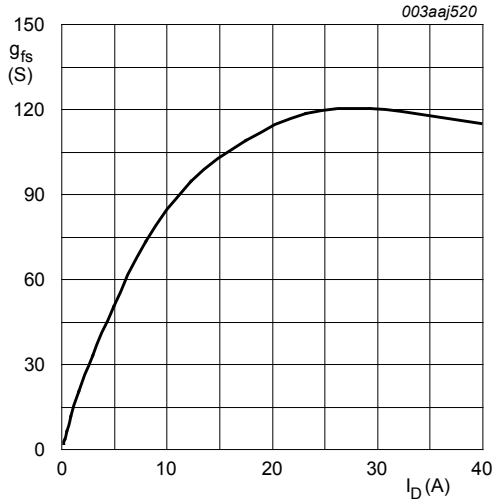


Fig. 6. Forward transconductance as a function of drain current; typical values

$T_j = 25\text{ }^\circ\text{C}$ ;  $V_{DS} = 15\text{ V}$

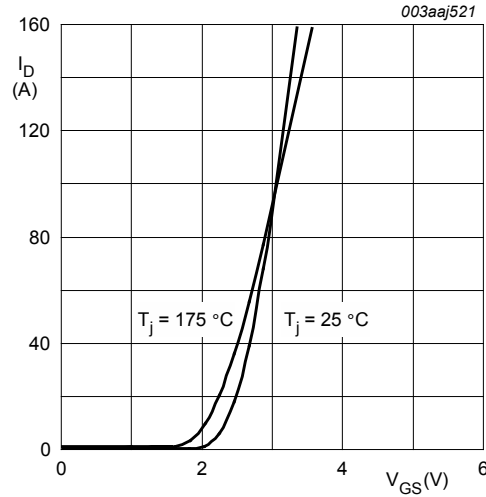


Fig. 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values

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

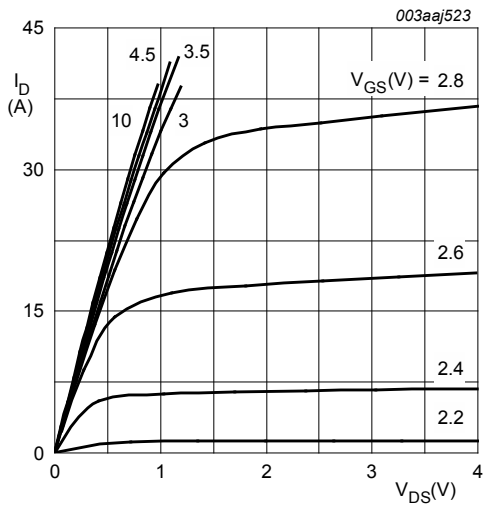


Fig. 8. Output characteristics: drain current as a function of drain-source voltage; typical values

$T_j = 25\text{ }^\circ\text{C}$

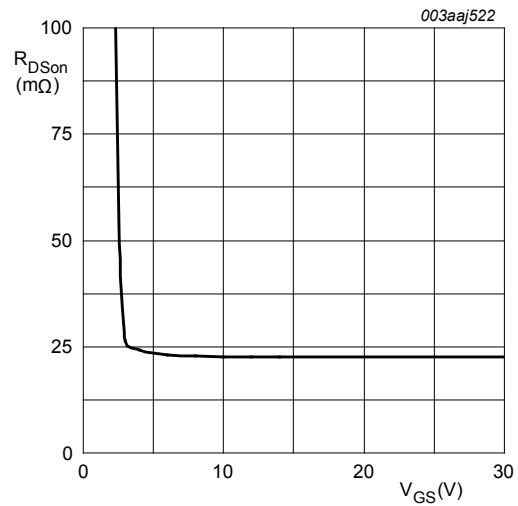


Fig. 9. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25\text{ }^\circ\text{C}$ ;  $I_D = 5\text{ A}$

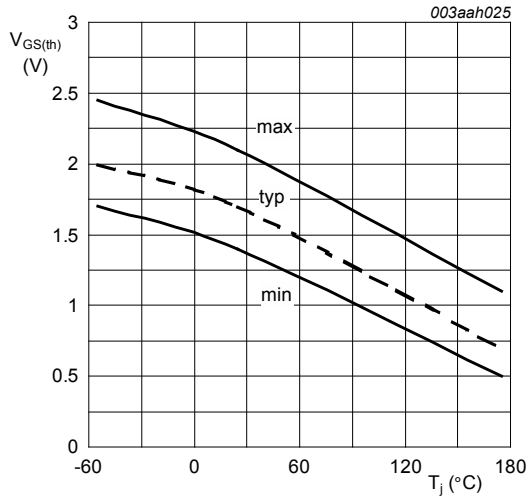


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

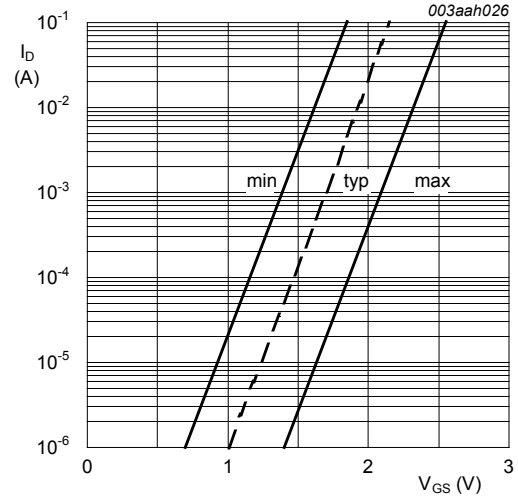


Fig. 11. Sub-threshold drain current as a function of gate-source voltage

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

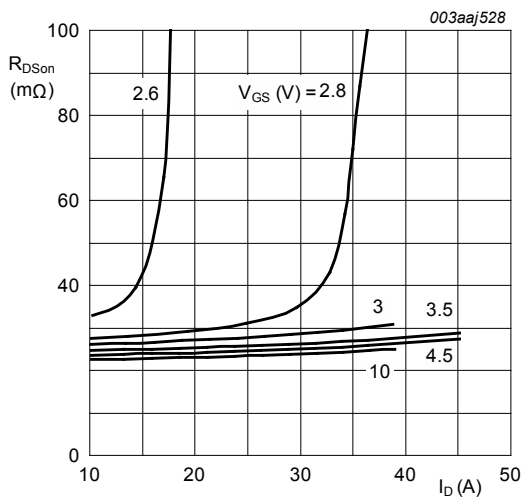


Fig. 12. Drain-source on-state resistance as a function of drain current; typical values

$$T_j = 25^\circ\text{C}$$

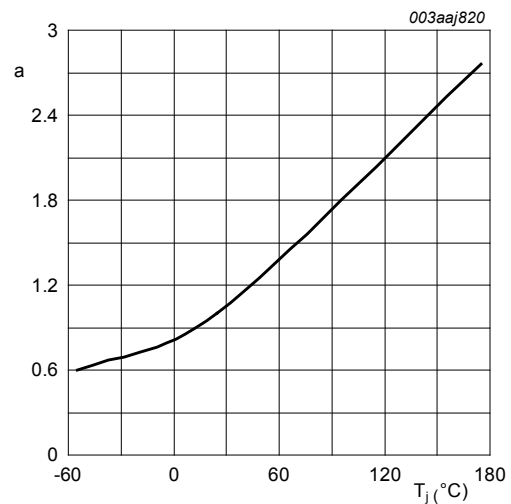


Fig. 13. Normalized drain-source on-state resistance factor as a function of junction temperature

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

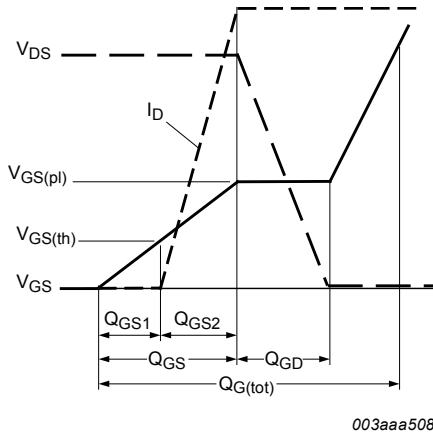


Fig. 14. Gate charge waveform definitions

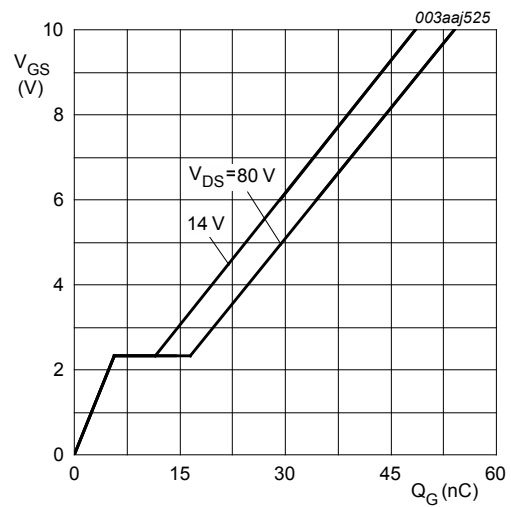


Fig. 15. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ\text{C}; I_D = 10\text{A}$

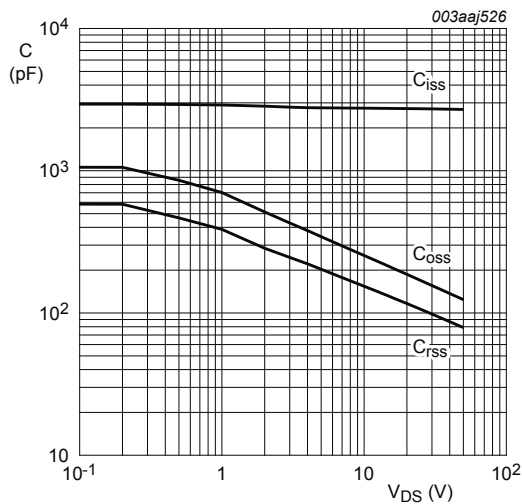


Fig. 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

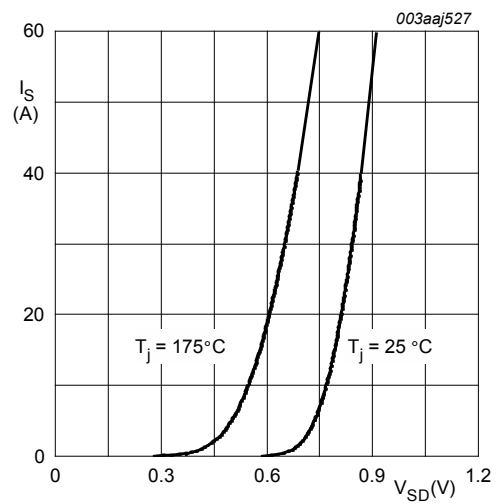
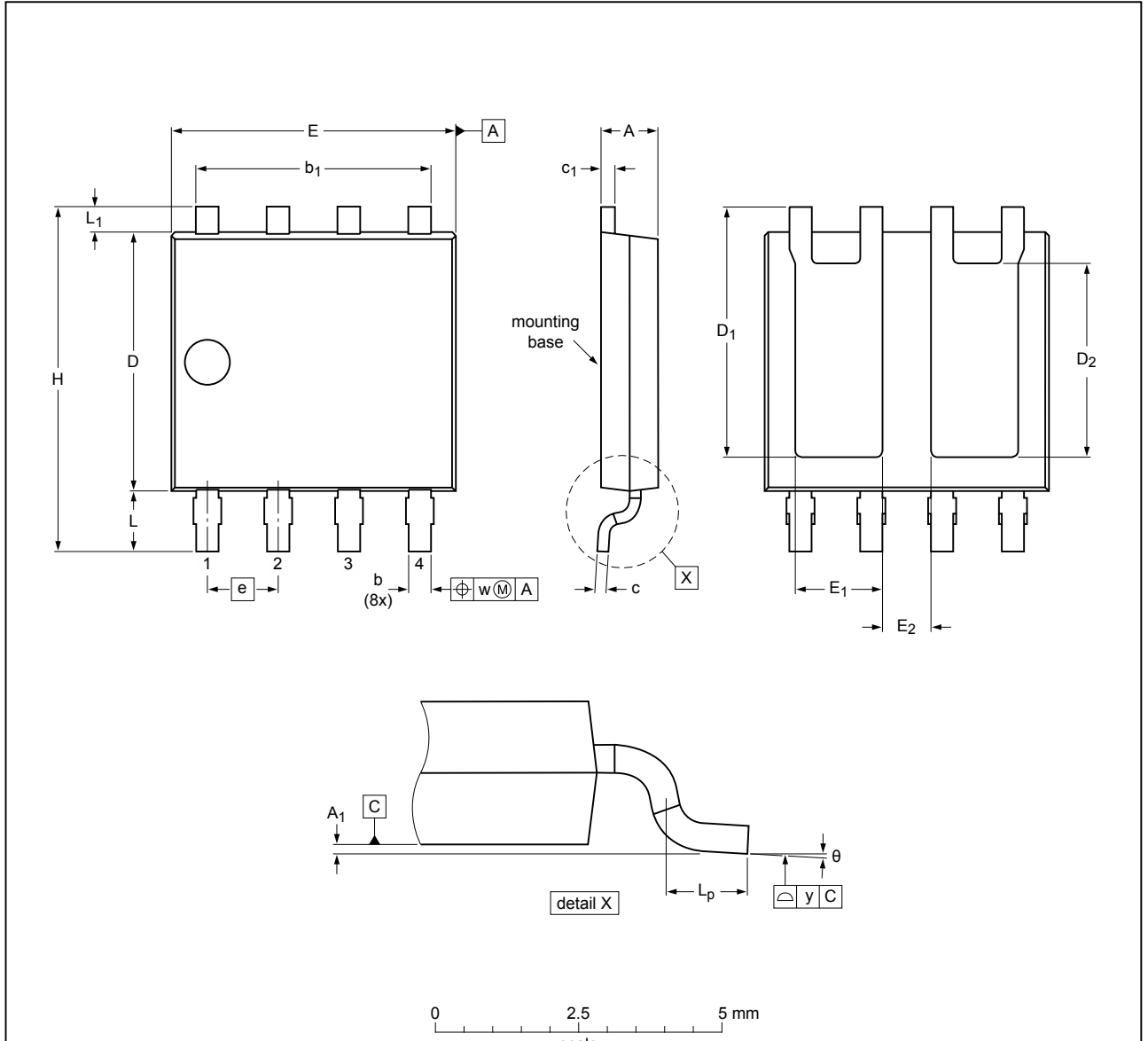


Fig. 17. Source current as a function of source-drain voltage; typical values

$V_{GS} = 0\text{V}$

### 11. Package outline

Plastic single ended surface mounted package (LPAK56D); 8 leads SOT1205



**Dimensions**

Unit	A	A <sub>1</sub>	b	b <sub>1</sub>	c	c <sub>1</sub>	D <sup>(1)</sup>	D <sub>1</sub> <sup>(1)</sup>	D <sub>2</sub> <sup>(ref)</sup>	E <sup>(1)</sup>	E <sub>1</sub> <sup>(1)</sup>	E <sub>2</sub>	e	H	L	L <sub>1</sub>	L <sub>p</sub>	w	y	θ	
max	1.05	0.1	0.50	4.4	0.25	0.30	4.70	4.8	3.5	5.30	1.8	0.85	6.2	1.3	0.55	0.85		0.25	0.1	8°	
nom													1.27								
min		0.0	0.35	4.1	0.19	0.24	4.45			4.95	1.6		5.9	0.8	0.30	0.40				0°	

**Note**

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

sot1205\_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	JEITA			
SOT1205						13-02-19 13-02-21

**Fig. 18. Package outline LPAK56D (SOT1205)**

## 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.

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## 13. Contents



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