

# BUK7K12-60E

Dual N-channel 60 V, 9.3 mΩ standard level MOSFET

11 December 2013

Product data sheet

## 1. General description

Dual standard level N-channel MOSFET in an LFAK56D (Dual Power-SO8) 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

- Dual MOSFET
- Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True standard level gate with  $V_{GS(th)}$  of greater than 1 V at 175 °C

## 3. Applications

- 12 V Automotive systems
- Motors, lamps and solenoid control
- 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	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	-	60	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C}; \text{Fig. 1}$	[1]	-	40	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}; \text{Fig. 2}$	-	-	68	W
<b>Static characteristics FET1 and FET2</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 10\text{ A}; T_j = 25\text{ °C}; \text{Fig. 11}$	-	7.64	9.3	mΩ
<b>Dynamic characteristics FET1 and FET2</b>						
$Q_{GD}$	gate-drain charge	$I_D = 10\text{ A}; V_{DS} = 48\text{ V}; V_{GS} = 10\text{ V}; T_j = 25\text{ °C}; \text{Fig. 13}; \text{Fig. 14}$	-	11	-	nC

[1] Continuous current is limited by package.

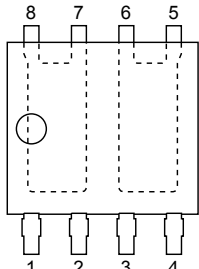
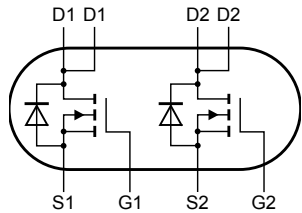


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## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S1	source1	 <p><b>LFPAK56D (SOT1205)</b></p>	 <p><i>mbk725</i></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		
	Name	Description	Version
BUK7K12-60E	LFPAK56D	Plastic single ended surface mounted package (LFPAK56D); 8 leads	SOT1205

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BUK7K12-60E	71260E

## 8. Limiting values

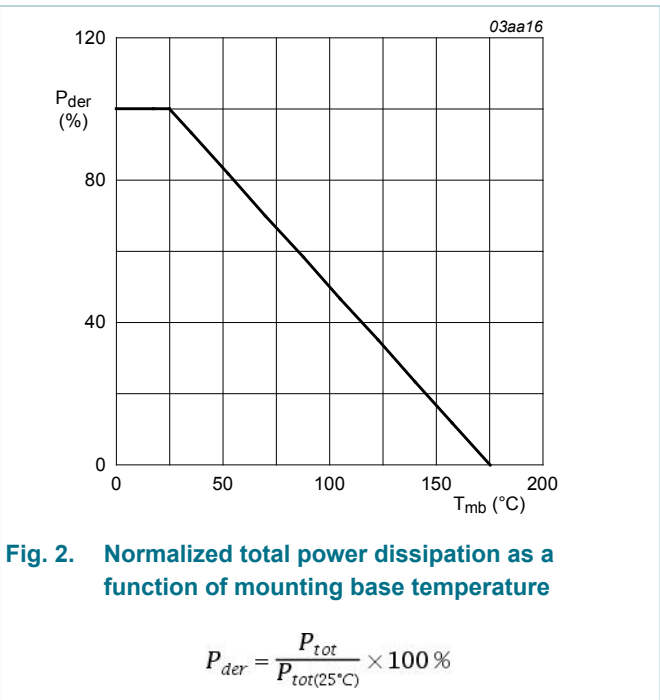
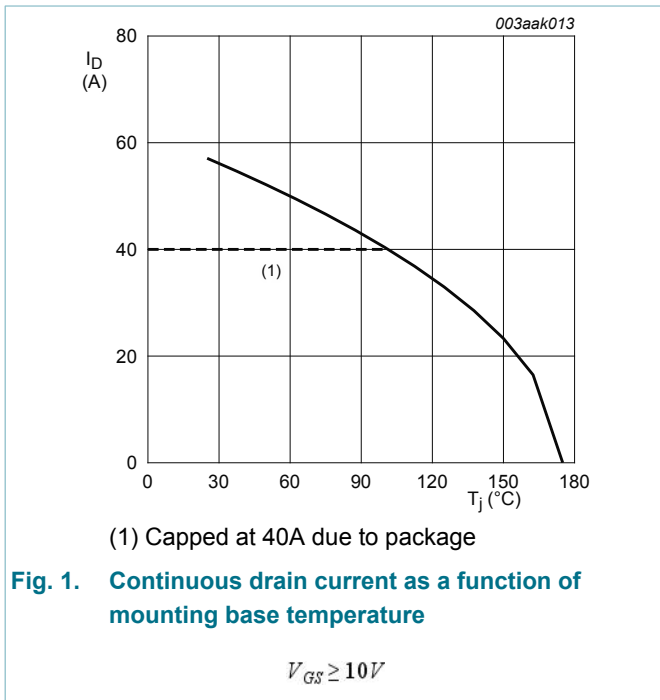
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$		-	60	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	60	V
$V_{GS}$	gate-source voltage	$T_j \leq 175\text{ °C}$ ; DC		-20	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>	[1]	-	40	A
		$T_{mb} = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 1</a>	[1]	-	40	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <a href="#">Fig. 4</a>		-	228	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>		-	68	W

Symbol	Parameter	Conditions		Min	Max	Unit
T <sub>stg</sub>	storage temperature			-55	175	°C
T <sub>j</sub>	junction temperature			-55	175	°C
<b>Source-drain diode FET1 and FET2</b>						
I <sub>S</sub>	source current	T <sub>mb</sub> = 25 °C	[1]	-	40	A
I <sub>SM</sub>	peak source current	pulsed; t <sub>p</sub> ≤ 10 μs; T <sub>mb</sub> = 25 °C		-	228	A
<b>Avalanche Ruggedness FET1 and FET2</b>						
E <sub>DS(AL)S</sub>	non-repetitive drain-source avalanche energy	I <sub>D</sub> = 40 A; V <sub>sup</sub> ≤ 60 V; V <sub>GS</sub> = 10 V; T <sub>j(init)</sub> = 25 °C; Fig. 3	[2][3]	-	103	mJ

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



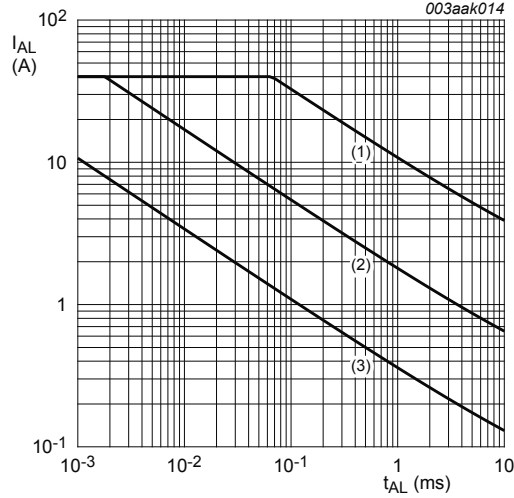


Fig. 3. Avalanche rating; avalanche current as a function of avalanche time

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

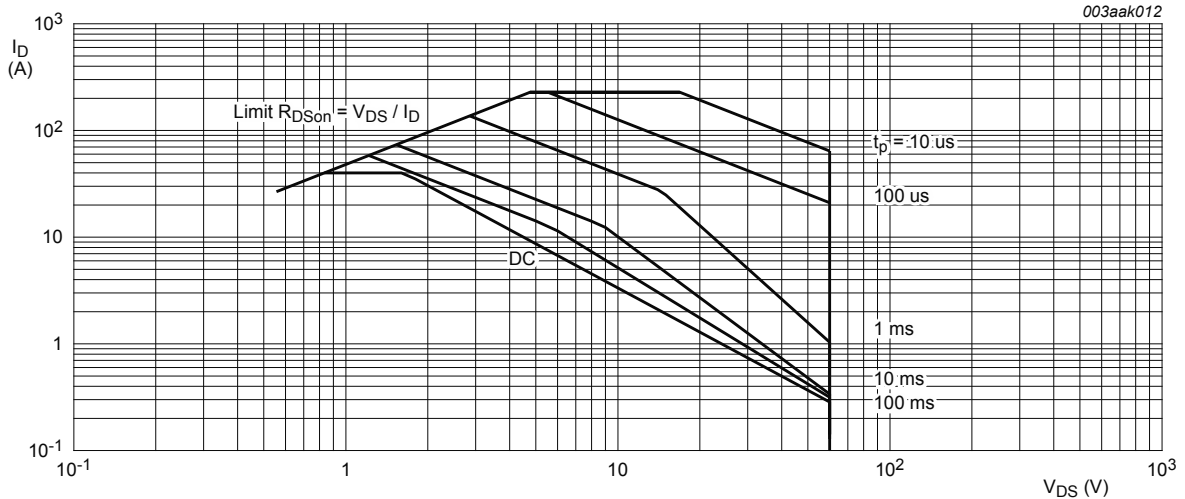


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

## 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. 5</a>	-	-	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

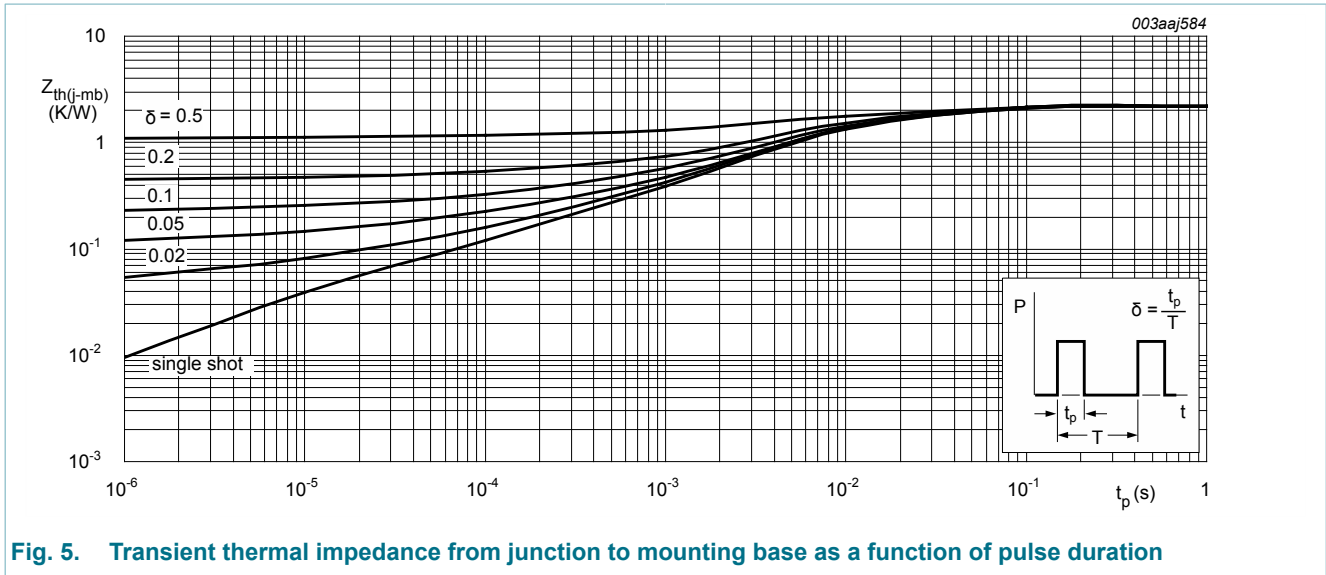


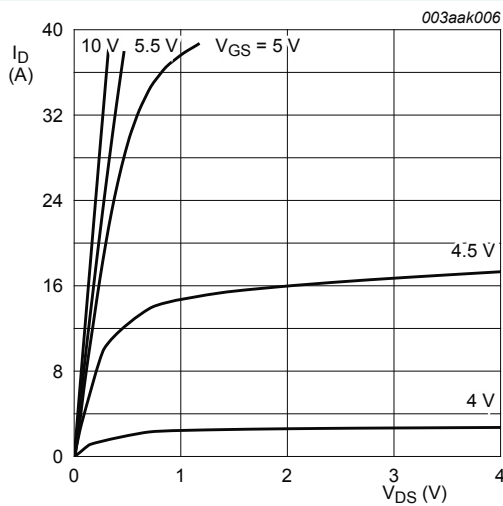
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

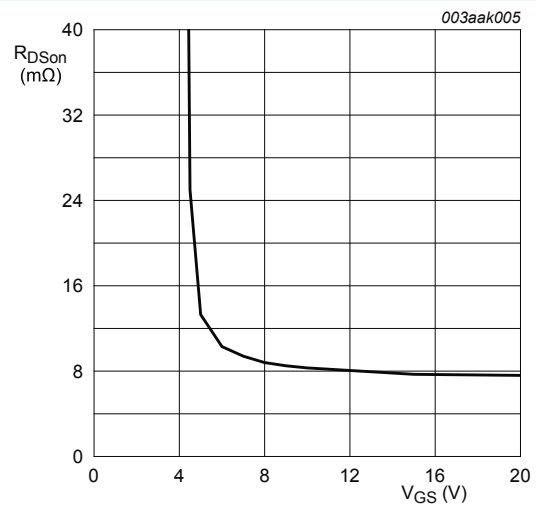
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics FET1 and FET2</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	54	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	60	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 9; Fig. 10</a>	2.4	3	4	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 9; Fig. 10</a>	1	-	-	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ <a href="#">Fig. 9; Fig. 10</a>	-	-	4.5	V
$I_{DSS}$	drain leakage current	$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.02	1	$\mu A$
		$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 \text{ }^\circ C$	-	-	500	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = -20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	2	100	nA
		$V_{GS} = 20 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 10 A; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	7.64	9.3	mΩ
		$V_{GS} = 10 V; I_D = 10 A; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 11; Fig. 12</a>	-	17.1	20.8	mΩ
<b>Dynamic characteristics FET1 and FET2</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 10 A; V_{DS} = 48 V; V_{GS} = 10 V;$ $T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 13; Fig. 14</a>	-	34.2	-	nC
$Q_{GS}$	gate-source charge		-	6.7	-	nC
$Q_{GD}$	gate-drain charge		-	11	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$	-	1761	2348	pF
$C_{oss}$	output capacitance	$T_j = 25\text{ °C};$ <a href="#">Fig. 15</a>	-	247	297	pF
$C_{rss}$	reverse transfer capacitance		-	155	213	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 48\text{ V}; R_L = 5\text{ }\Omega; V_{GS} = 10\text{ V};$	-	9.1	-	ns
$t_r$	rise time	$R_{G(ext)} = 5\text{ }\Omega; T_j = 25\text{ °C}; I_D = 10\text{ A}$	-	12.5	-	ns
$t_{d(off)}$	turn-off delay time		-	23	-	ns
$t_f$	fall time		-	15	-	ns
<b>Source-drain diode FET1 and FET2</b>						
$V_{SD}$	source-drain voltage	$I_S = 10\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ °C};$ <a href="#">Fig. 16</a>	-	0.78	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 10\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$	-	25	-	ns
$Q_r$	recovered charge	$V_{DS} = 30\text{ V}; T_j = 25\text{ °C}$	-	24	-	nC



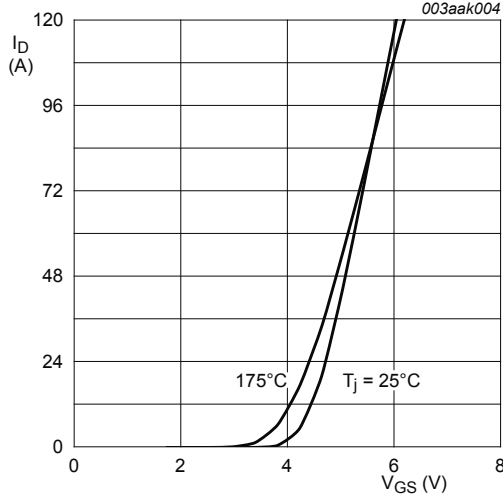
$T_j = 25\text{ °C}; t_p = 300\text{ }\mu\text{s}$

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



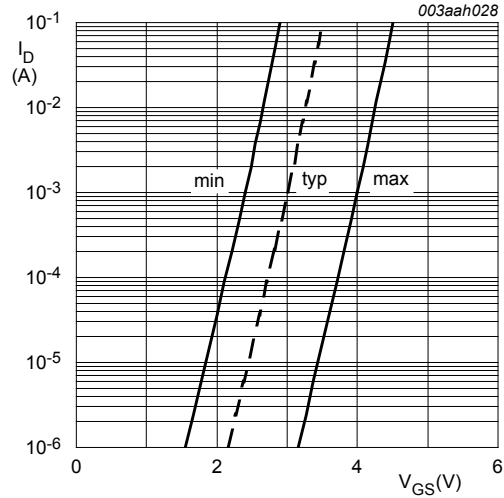
**Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**

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



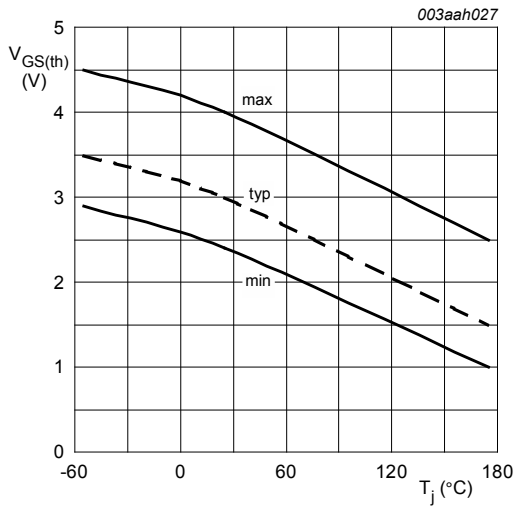
**Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values**

$V_{DS} = 10V$



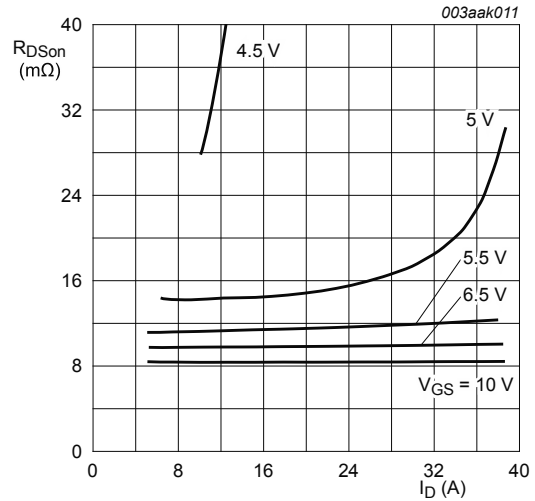
**Fig. 9. Sub-threshold drain current as a function of gate-source voltage**

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



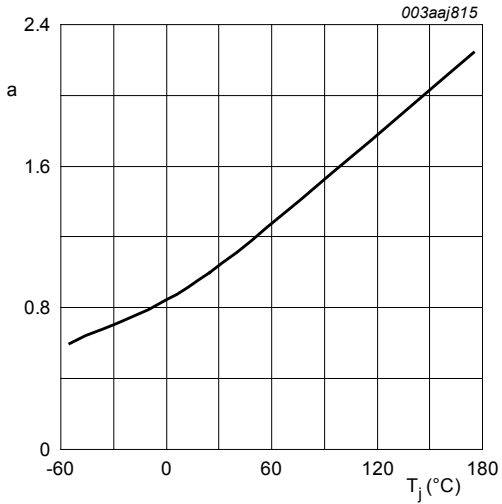
**Fig. 10. Gate-source threshold voltage as a function of junction temperature**

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



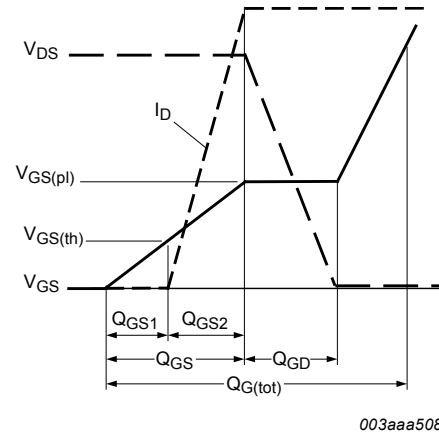
$T_j = 25^\circ C; t_p = 300 \mu s$

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

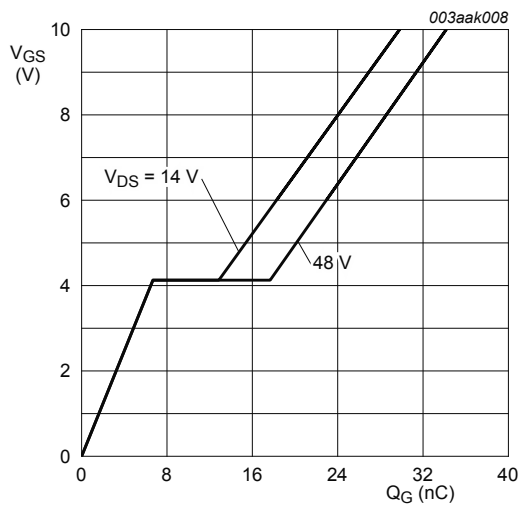


**Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature**

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

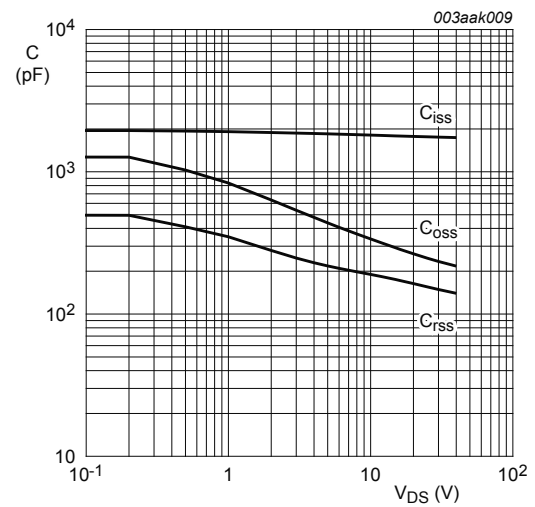


**Fig. 13. Gate charge waveform definitions**



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

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



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

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



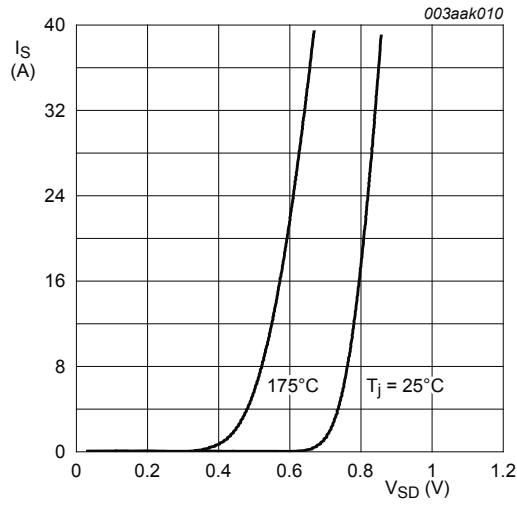
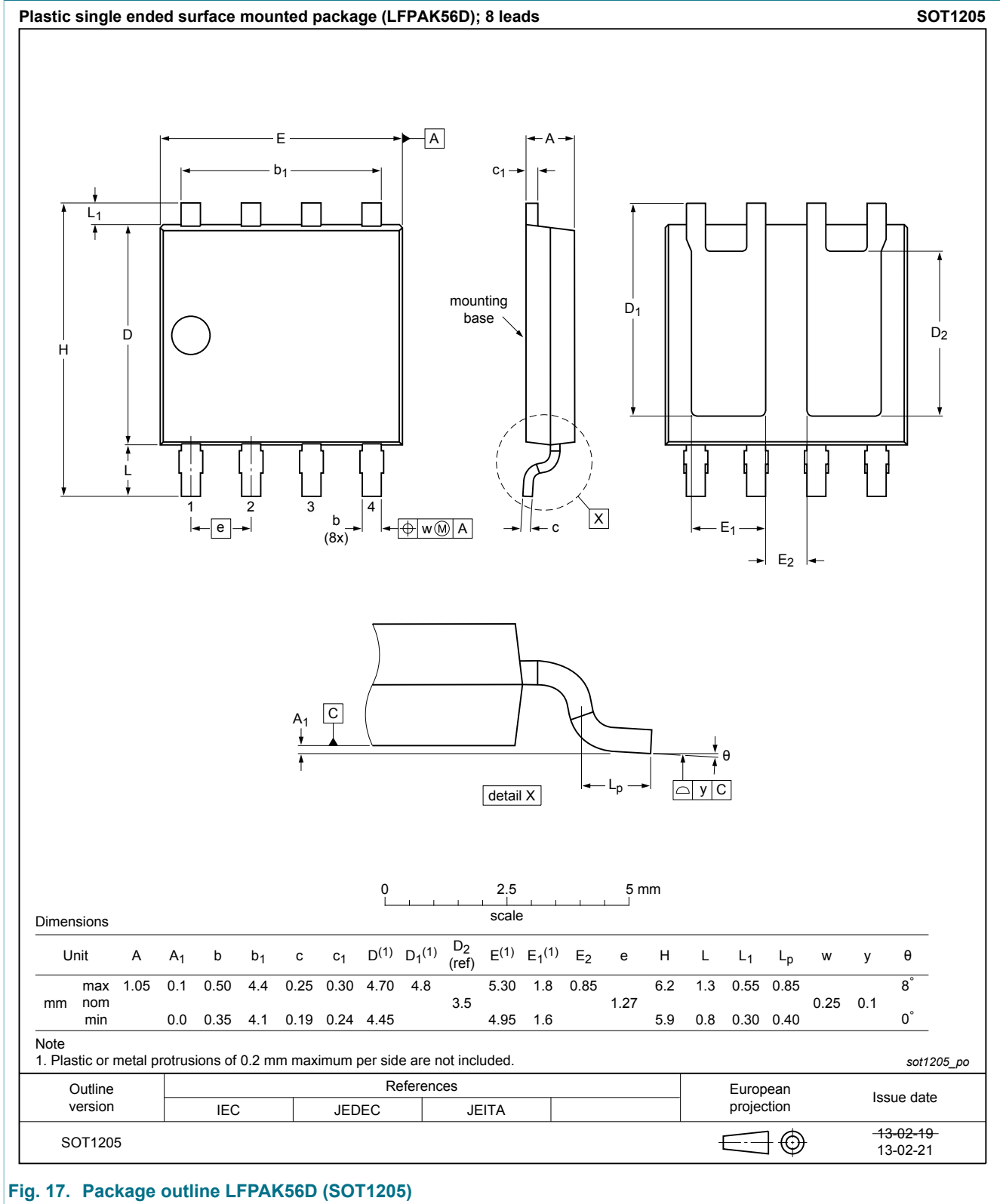


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

**11. Package outline**



**Fig. 17. Package outline 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.
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- [2] The term 'short data sheet' is explained in section "Definitions".
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