

# BUK9Y12-55B

## N-channel TrenchMOS logic level FET

Rev. 04 — 7 April 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Logic level N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical applications.

### 1.2 Features and benefits

- Low conduction losses due to low on-state resistance
- Q101 compliant
- Suitable for logic level gate drive sources
- Suitable for thermally demanding environments due to 175 °C rating

### 1.3 Applications

- 12 V and 24 V loads
- Advanced braking systems (ABS)
- Automotive systems
- General purpose power switching
- Motors, lamps and solenoids

### 1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	-	55	V
$I_D$	drain current	$V_{GS} = 5\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 1</a> ; see <a href="#">Figure 4</a>	-	-	61.8	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; see <a href="#">Figure 2</a>	-	-	106	W
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 20\text{ A}$ ; $T_j = 25\text{ °C}$	-	8.1	11	mΩ
		$V_{GS} = 5\text{ V}$ ; $I_D = 20\text{ A}$ ; $T_j = 25\text{ °C}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	9.1	12	mΩ

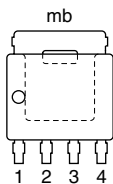
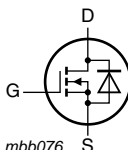


**Table 1. Quick reference data ...continued**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 61.8\text{ A}$ ; $V_{sup} \leq 55\text{ V}$ ; $R_{GS} = 50\ \Omega$ ; $V_{GS} = 5\text{ V}$ ; $T_{j(init)} = 25\text{ }^\circ\text{C}$ ; unclamped	-	-	129	mJ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 5\text{ V}$ ; $I_D = 20\text{ A}$ ; $V_{DS} = 44\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; see <a href="#">Figure 14</a>	-	13	-	nC

## 2. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	S	source		
2	S	source		
3	S	source		
4	G	gate		
mb	D	mounting base; connected to drain		

**SOT669 (LFAK)**

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package		Version
	Name	Description	
BUK9Y12-55B	LFAK	plastic single-ended surface-mounted package (LFAK); 4 leads	SOT669

## 4. Limiting values

**Table 4. Limiting values**

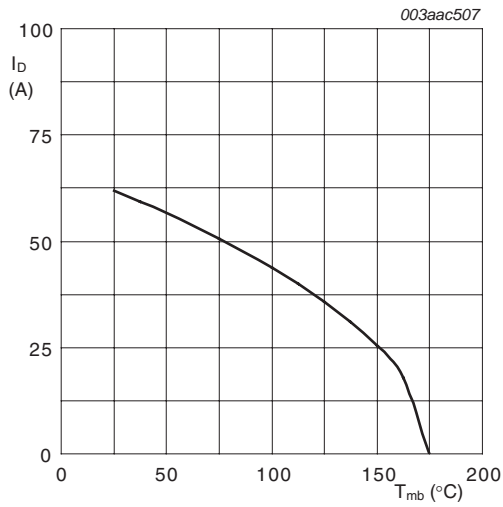
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	-	55	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	-	55	V
$V_{GS}$	gate-source voltage		-15	-	15	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}; V_{GS} = 5\text{ V};$ see <a href="#">Figure 1</a> ; see <a href="#">Figure 4</a>	-	-	61.8	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 5\text{ V};$ see <a href="#">Figure 1</a>	-	-	43.8	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}; t_p \leq 10\text{ }\mu\text{s};$ pulsed; see <a href="#">Figure 4</a>	-	-	247	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C};$ see <a href="#">Figure 2</a>	-	-	106	W
$T_{stg}$	storage temperature		-55	-	175	°C
$T_j$	junction temperature		-55	-	175	°C
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25\text{ °C}$	-	-	61.8	A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s};$ pulsed; $T_{mb} = 25\text{ °C}$	-	-	247	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 61.8\text{ A}; V_{sup} \leq 55\text{ V}; R_{GS} = 50\text{ }\Omega;$ $V_{GS} = 5\text{ V}; T_{j(init)} = 25\text{ °C};$ unclamped	-	-	129	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	see <a href="#">Figure 3</a>	<a href="#">[1]</a> <a href="#">[2]</a> <a href="#">[3]</a>	-	-	J

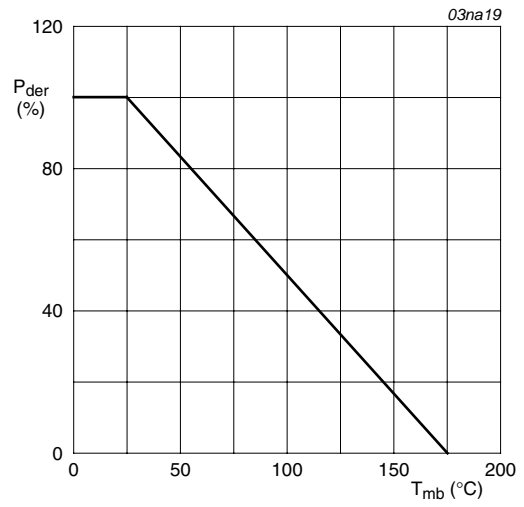
[1] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.

[2] Repetitive avalanche rating limited by average junction temperature of 170 °C.

[3] Refer to application note AN10273 for further information.

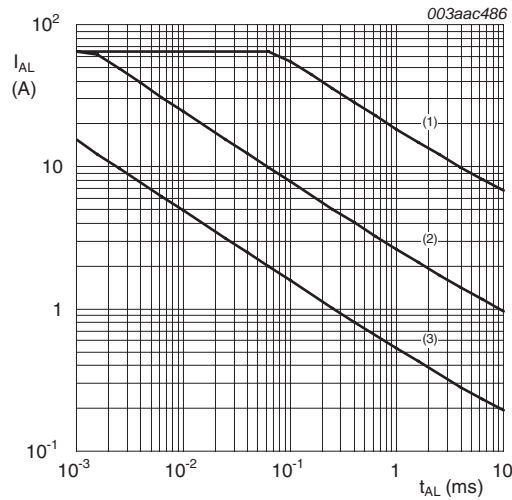


**Fig 1. Continuous drain current as a function of mounting base temperature**



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

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



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

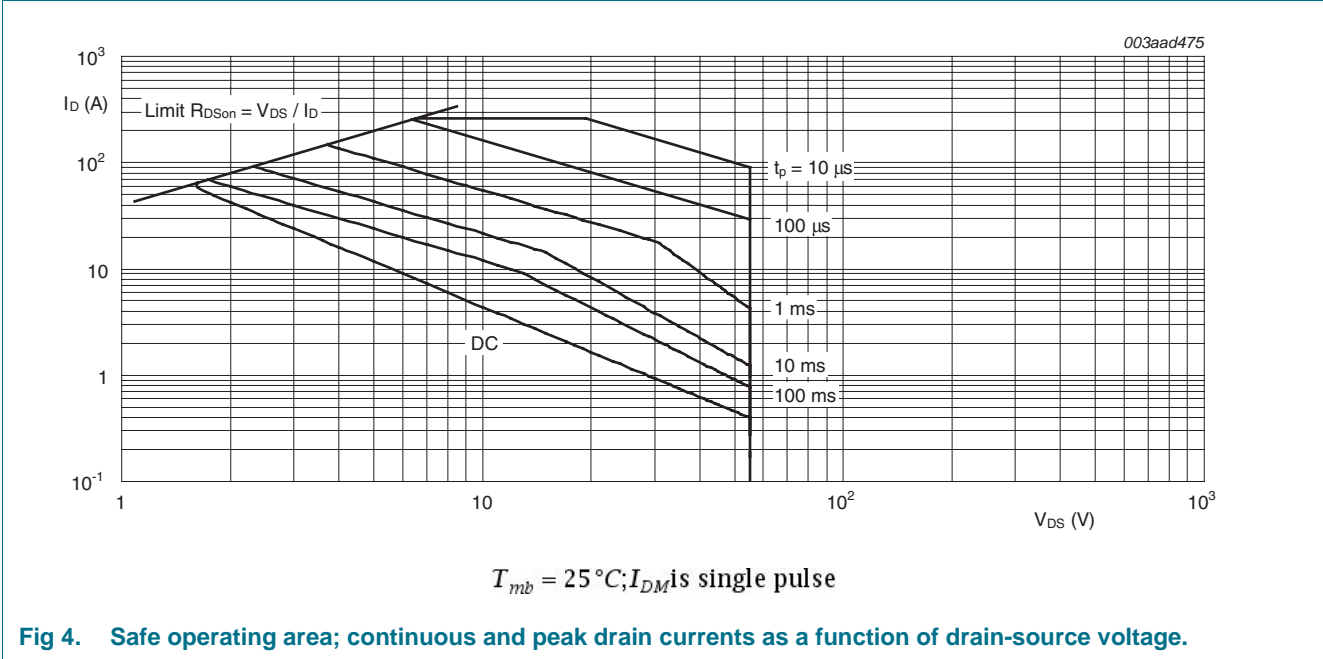


Fig 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

## 5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see <a href="#">Figure 5</a>	-	-	1.42	K/W

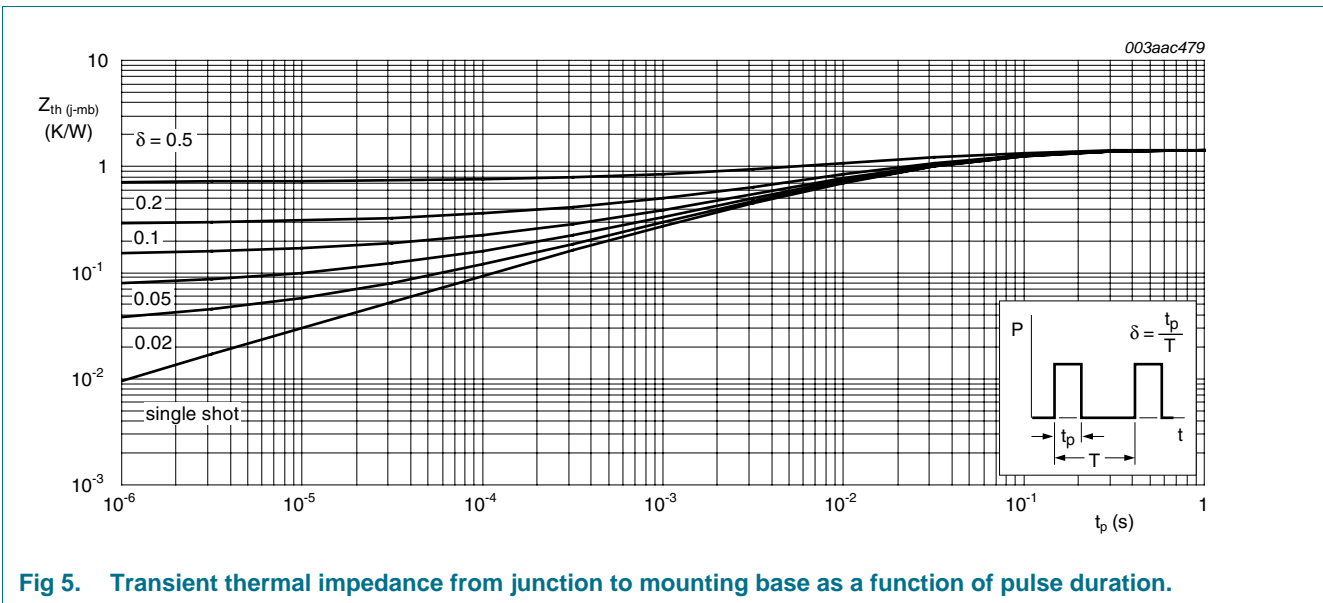
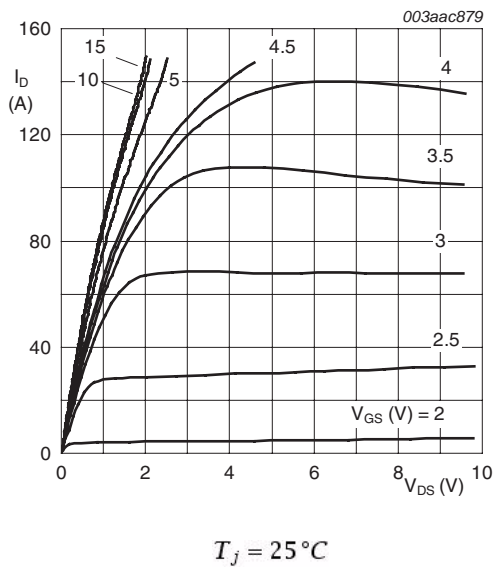


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

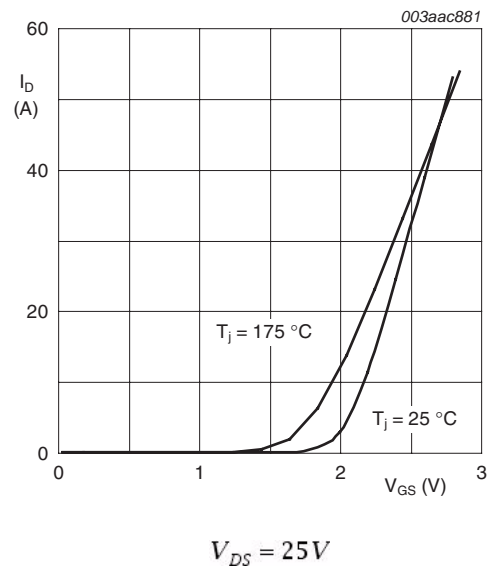
## 6. Characteristics

Table 6. Characteristics

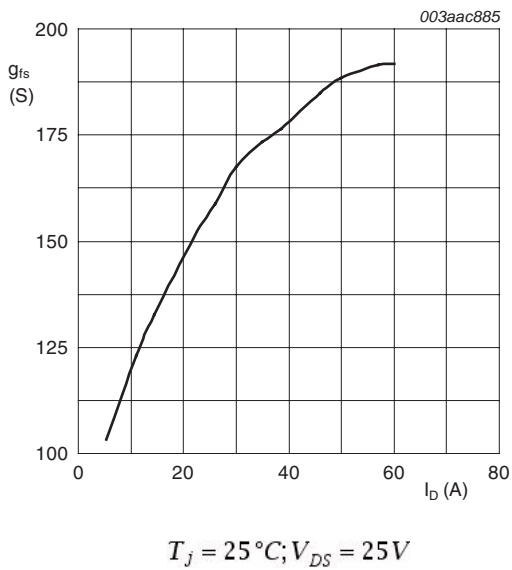
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	55	-	-	V
		$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	50	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	-	-	2.45	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	1.25	1.65	2.15	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a>	0.5	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	-	500	$\mu\text{A}$
		$V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	1	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{DS} = 0 \text{ V}; V_{GS} = 15 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{DS} = 0 \text{ V}; V_{GS} = -15 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 4.5 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	-	13	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$	-	8.1	11	m $\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 20 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	9.1	12	m $\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 20 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see <a href="#">Figure 13</a>	-	-	27.6	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 20 \text{ A}; V_{DS} = 44 \text{ V}; V_{GS} = 5 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 14</a>	-	32	-	nC
$Q_{GS}$	gate-source charge		-	6	-	nC
$Q_{GD}$	gate-drain charge		-	13	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 15</a>	-	2160	2880	pF
$C_{oss}$	output capacitance		-	315	378	pF
$C_{rss}$	reverse transfer capacitance		-	175	240	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; R_L = 1.5 \text{ } \Omega; V_{GS} = 5 \text{ V};$ $R_{G(ext)} = 10 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	29	-	ns
$t_r$	rise time		-	78	-	ns
$t_{d(off)}$	turn-off delay time		-	100	-	ns
$t_f$	fall time		-	63	-	ns
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 20 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 16</a>	-	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}; di_S/dt = -100 \text{ A}/\mu\text{s};$ $V_{GS} = -10 \text{ V}; V_{DS} = 30 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	44	-	ns
$Q_r$	recovered charge		-	83	-	nC



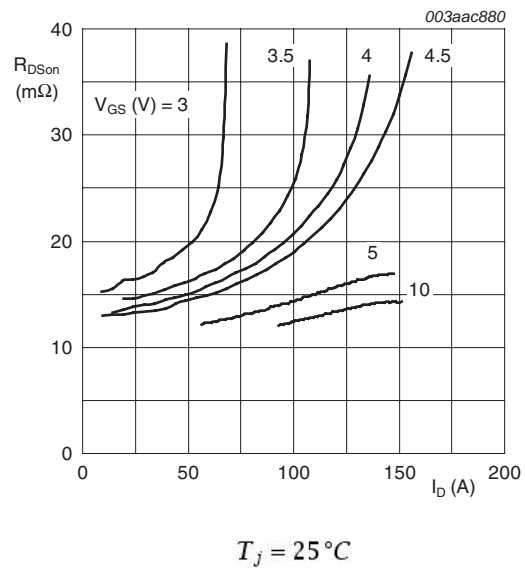
**Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values.**



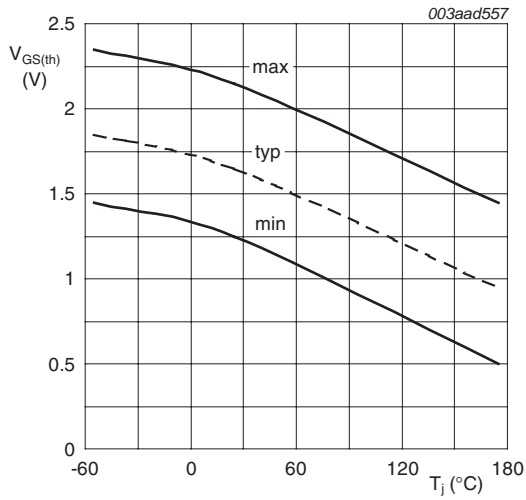
**Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; typical values.**



**Fig 8. Forward transconductance as a function of drain current; typical values.**

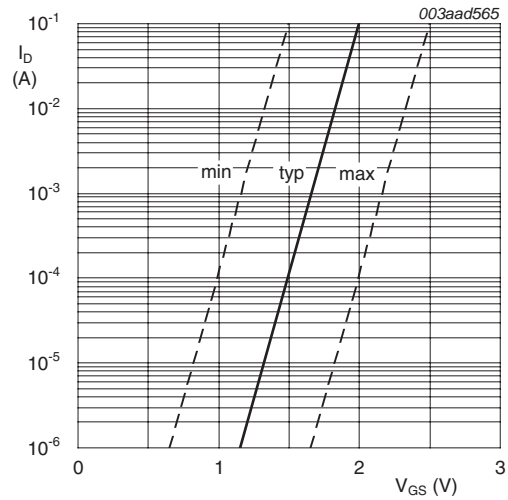


**Fig 9. Drain-source on-state resistance as a function of drain current; typical values.**



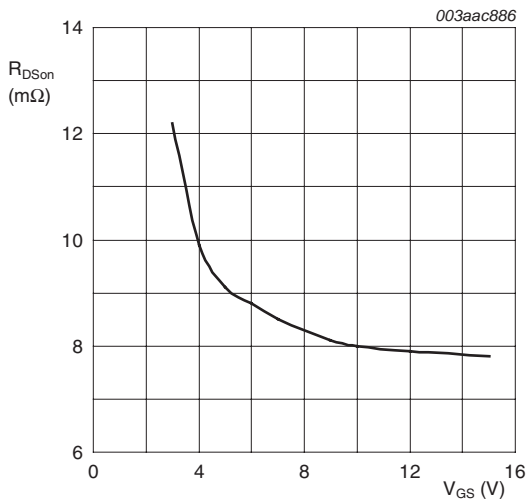
$$I_D = 1\text{mA}; V_{DS} = V_{GS}$$

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



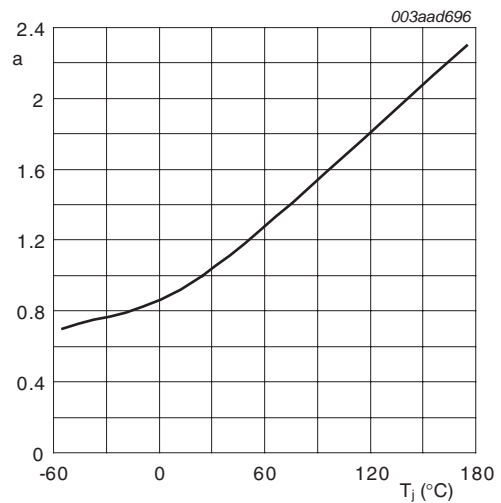
$$T_j = 25^\circ\text{C}; V_{DS} = V_{GS}$$

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



$$T_j = 25^\circ\text{C}; I_D = 20\text{A}$$

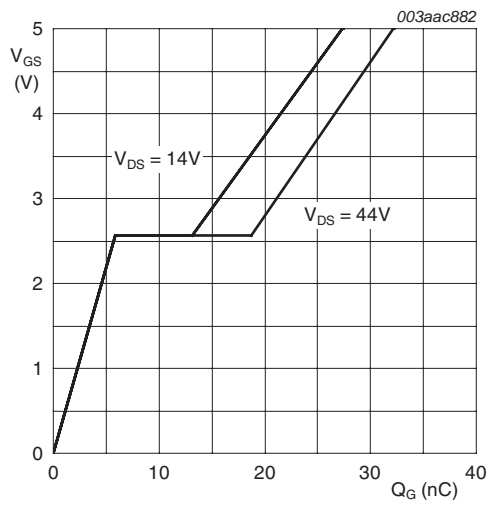
**Fig 12. Drain-source on-state resistance as a function of gate-source voltage; typical values.**



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

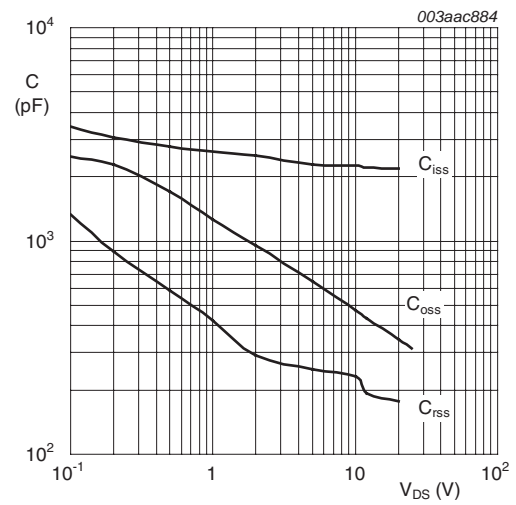
**Fig 13. Normalized drain-source on-state resistance factor as a function of junction temperature.**





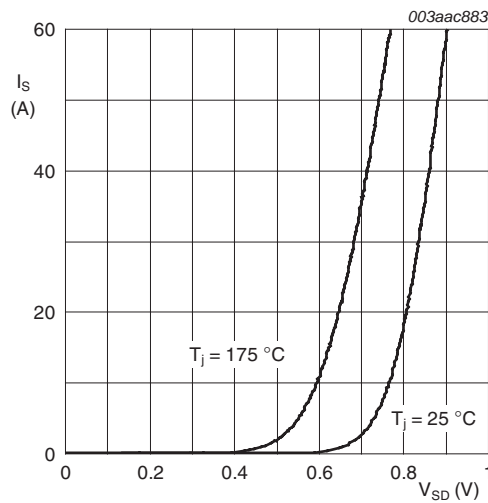
$T_j = 25^\circ\text{C}; I_D = 20\text{A}$

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



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

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



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

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

**7. Package outline**

Plastic single-ended surface-mounted package (LFPAK); 4 leads

SOT669

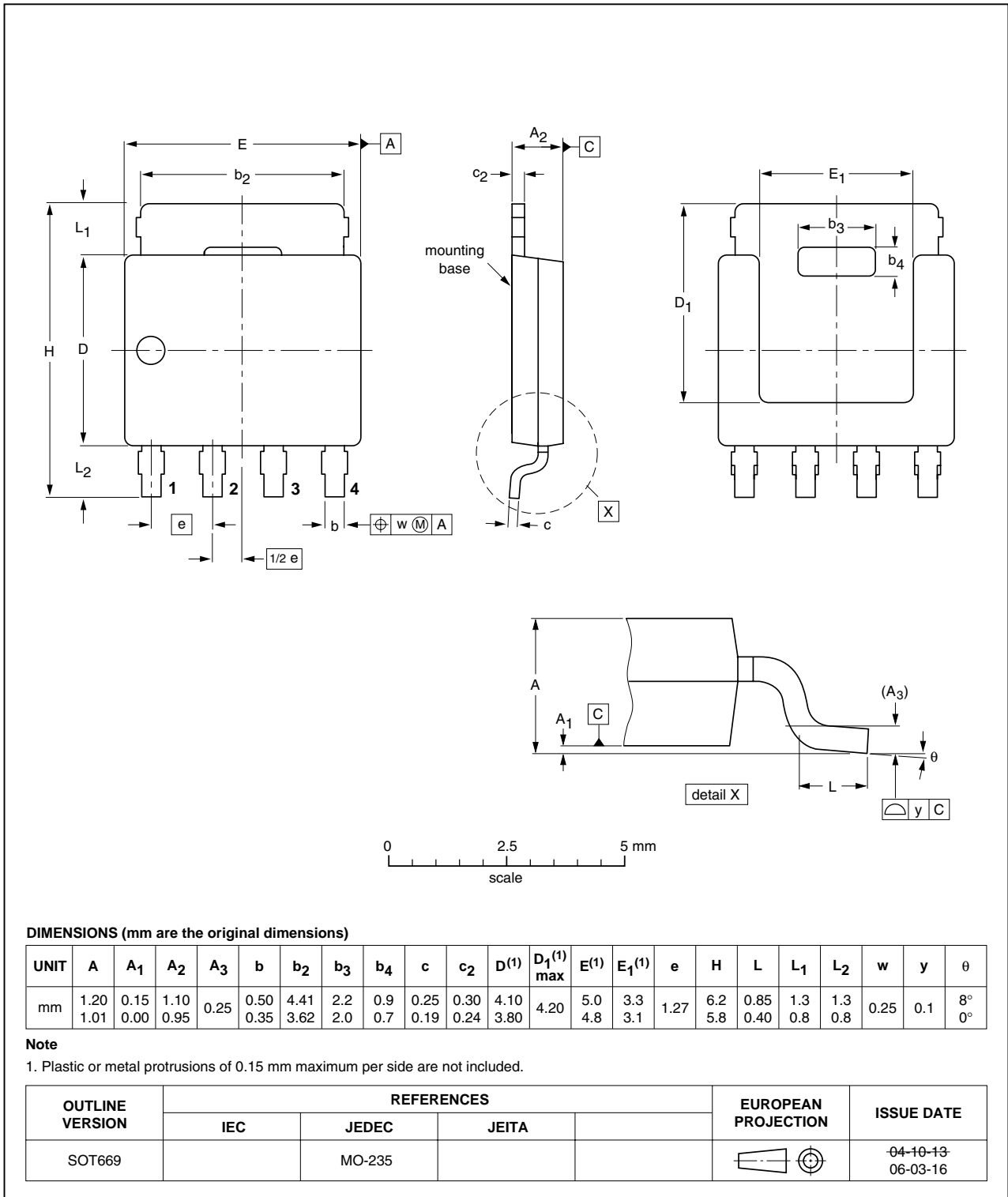


Fig 17. Package outline SOT669 (LFPAK)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK9Y12-55B_4	20100407	Product data sheet	-	BUK9Y12-55B_3
Modifications:	• Status changed from objective to product.			
BUK9Y12-55B_3	20100216	Objective data sheet	-	BUK9Y12-55B_2

## 9. Legal information

### 9.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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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**11. Contents**

**1 Product profile . . . . .1**

1.1 General description . . . . .1

1.2 Features and benefits . . . . .1

1.3 Applications . . . . .1

1.4 Quick reference data . . . . .1

**2 Pinning information . . . . .2**

**3 Ordering information . . . . .2**

**4 Limiting values . . . . .3**

**5 Thermal characteristics . . . . .5**

**6 Characteristics . . . . .6**

**7 Package outline . . . . .10**

**8 Revision history . . . . .11**

**9 Legal information . . . . .12**

9.1 Data sheet status . . . . .12

9.2 Definitions . . . . .12

9.3 Disclaimers . . . . .12

9.4 Trademarks . . . . .13

**10 Contact information . . . . .13**

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