

BUK7510-55AL

N-channel TrenchMOS standard level FET

Rev. 03 — 4 August 2009

Product data sheet

1. Product profile

1.1 General description

Standard 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

- Q101 compliant
- Suitable for thermally demanding environments due to 175 °C rating
- Suitable for use in control systems due to stable operation in linear mode

1.3 Applications

- 12 V and 24 V loads
- Automotive systems
- DC motor control
- Repetitive clamped inductive switching

1.4 Quick reference data

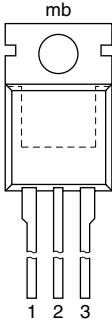
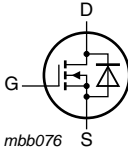
Table 1. Quick reference

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	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C};$ see Figure 1 ; see Figure 3	[1]	-	75	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ see Figure 2	-	-	300	W
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}; V_{sup} \leq 55\text{ V};$ $R_{GS} = 50\ \Omega; V_{GS} = 10\text{ V};$ $T_{j(init)} = 25\text{ °C};$ unclamped	-	-	1.1	J
Dynamic characteristics						
Q_{GD}	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 25\text{ A};$ $V_{DS} = 44\text{ V}; T_j = 25\text{ °C};$ see Figure 15	-	50	-	nC
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A};$ $T_j = 25\text{ °C};$ see Figure 12 ; see Figure 13	-	8.5	10	m Ω

[1] Continuous current is limited by package.

2. Pinning information

Table 2. Pinning information

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

SOT78
(TO-220AB; SC-46)

3. Ordering information

Table 3. Ordering information

Type number	Package		Version
	Name	Description	
BUK7510-55AL	TO-220AB; SC-46	Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

4. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit	
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	55	V	
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	55	V	
V_{GS}	gate-source voltage		-20	20	V	
I_D	drain current	$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ see Figure 1 ; see Figure 3	[1][2]	-	122	A
		$T_{mb} = 25\text{ °C}; V_{GS} = 10\text{ V};$ see Figure 1 ; see Figure 3	[3]	-	75	A
		$T_{mb} = 100\text{ °C}; V_{GS} = 10\text{ V};$ see Figure 1	[3]	-	75	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}; t_p \leq 10\text{ }\mu\text{s};$ pulsed; see Figure 3	-	490	A	
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C};$ see Figure 2	-	300	W	
T_{stg}	storage temperature		-55	175	°C	
T_j	junction temperature		-55	175	°C	
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C};$	[1][2]	-	122	A
		$T_{mb} = 25\text{ °C};$	[3]	-	75	A
I_{SM}	peak source current	$t_p \leq 10\text{ }\mu\text{s};$ pulsed; $T_{mb} = 25\text{ °C}$	-	490	A	
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}; V_{sup} \leq 55\text{ V}; R_{GS} = 50\text{ }\Omega; V_{GS} = 10\text{ V};$ $T_{j(init)} = 25\text{ °C};$ unclamped	-	1.1	J	
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	see Figure 4	[4][5] [6]	-	-	J

[1] Current is limited by power dissipation chip rating.

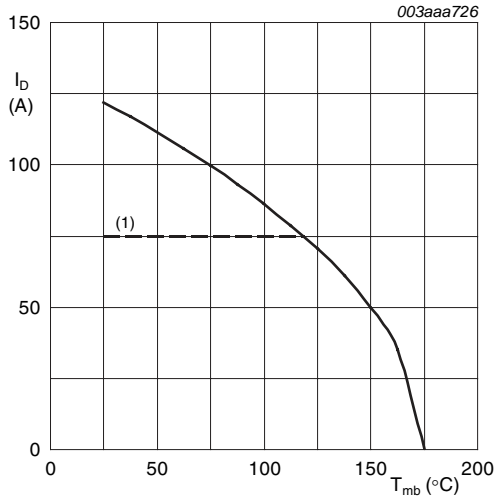
[2] Refer to document 9397 750 12572 for further information.

[3] Continuous current is limited by package.

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

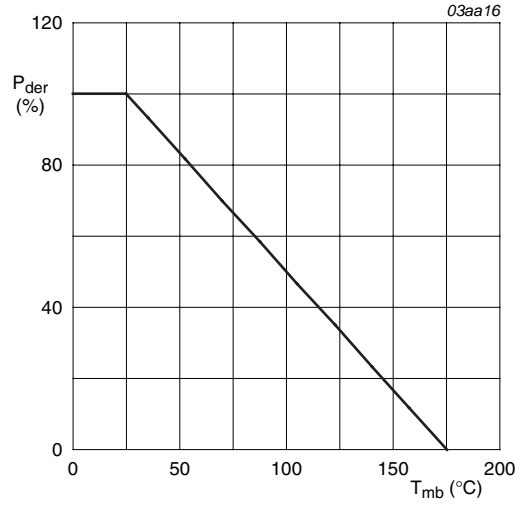
[5] Repetitive avalanche rating limited by average junction temperature of 170 °C.

[6] Refer to AN10273 for further information.



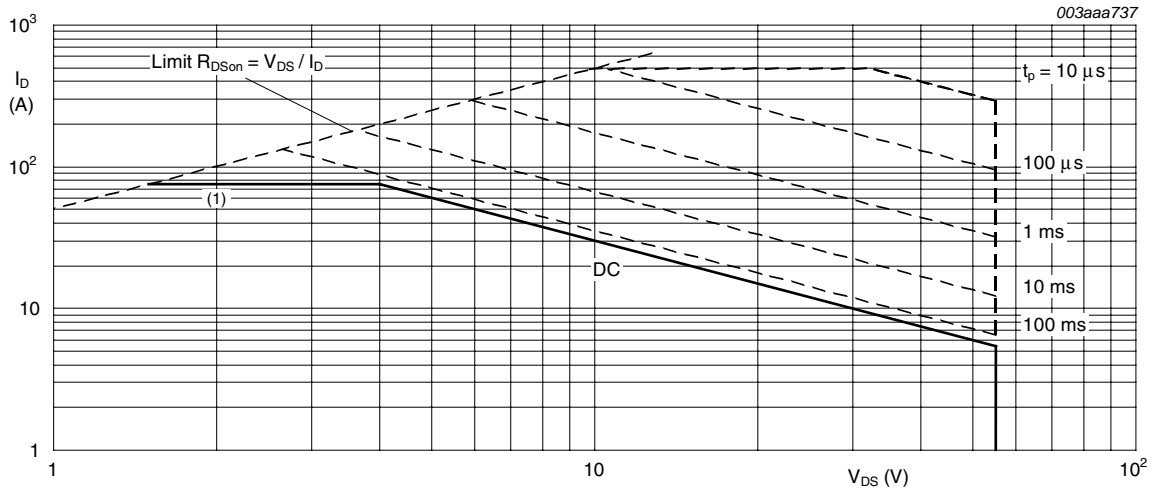
$V_{GS} \geq 10V$
 (1) Capped at 75 A due to package.

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



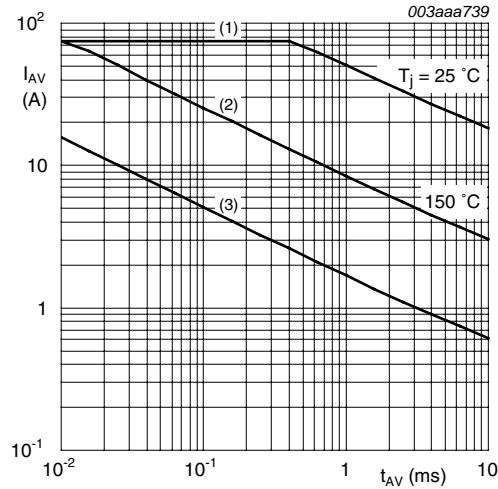
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

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



$T_{mb} = 25^{\circ}C$; I_{DM} is single pulse
 (1) Capped at 75 A due to package.

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



- (1) Single-shot.
- (2) Single-shot.
- (3) Repetitive.

Fig 4. Single-shot and repetitive avalanche rating; avalanche current as a function of avalanche period

5. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	60	-	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	see Figure 5	-	0.25	0.5	K/W

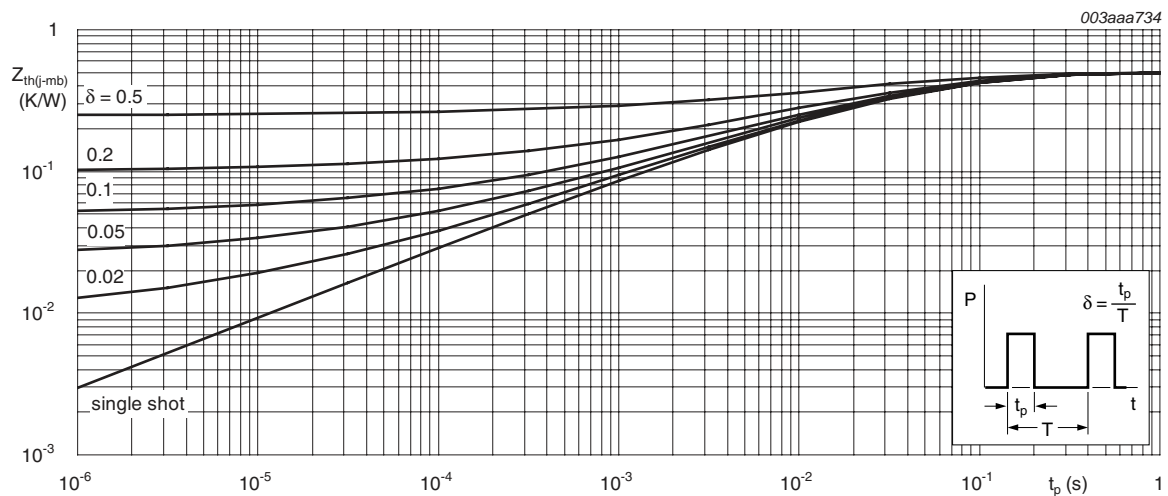
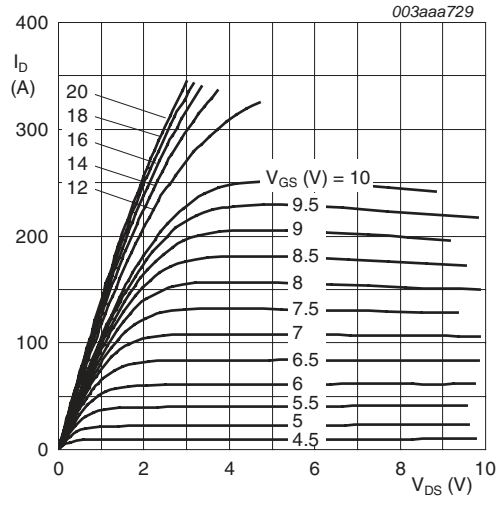


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

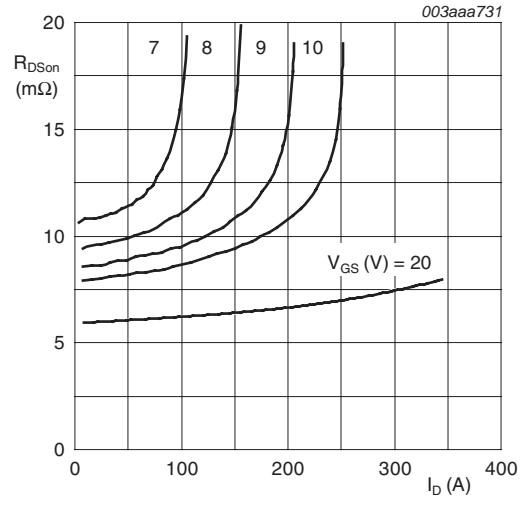
Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	50	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	55	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11	2	3	4	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11	-	-	4.4	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 10 ; see Figure 11	1	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	-	500	μA
		$V_{DS} = 55 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.05	10	μA
I_{GSS}	gate leakage current	$V_{DS} = 0 \text{ V}; V_{GS} = +20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{DS} = 0 \text{ V}; V_{GS} = -20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see Figure 12 ; see Figure 13	-	-	20	m Ω
		$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 12 ; see Figure 13	-	8.5	10	m Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 44 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see Figure 15	-	124	-	nC
Q_{GS}	gate-source charge		-	22	-	nC
Q_{GD}	gate-drain charge		-	50	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 \text{ A}; V_{DS} = 44 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 15	-	5	-	V
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 Figure 16	-	4710	6280	pF
C_{oss}	output capacitance		-	980	1180	pF
C_{rss}	reverse transfer capacitance		-	560	770	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; R_L = 1.2 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 10 \text{ } \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	33	-	ns
t_r	rise time		-	117	-	ns
$t_{d(off)}$	turn-off delay time		-	132	-	ns
t_f	fall time		-	95	-	ns
L_D	internal drain inductance	from contact screw on package to centre of die; $T_j = 25 \text{ }^\circ\text{C}$	-	3.5	-	nH
		from drain lead 6mm from package to centre of die; $T_j = 25 \text{ }^\circ\text{C}$	-	4.5	-	H
L_S	internal source inductance	from source lead to source bond pad; $T_j = 25 \text{ }^\circ\text{C}$	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see Figure 14	-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20 \text{ A}; di_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V};$ $V_{DS} = 30 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	73	-	ns
Q_r	recovered charge		-	430	-	nC



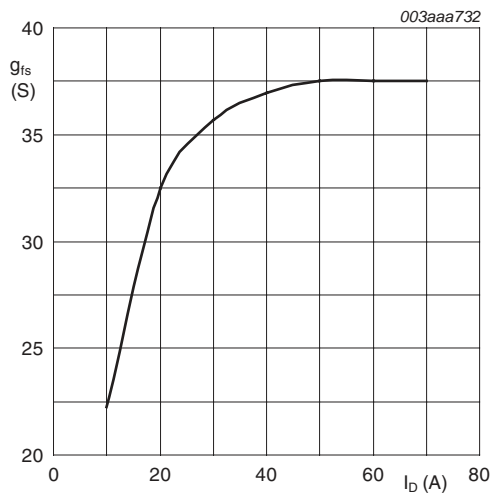
$T_j = 25\text{ }^\circ\text{C}$

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



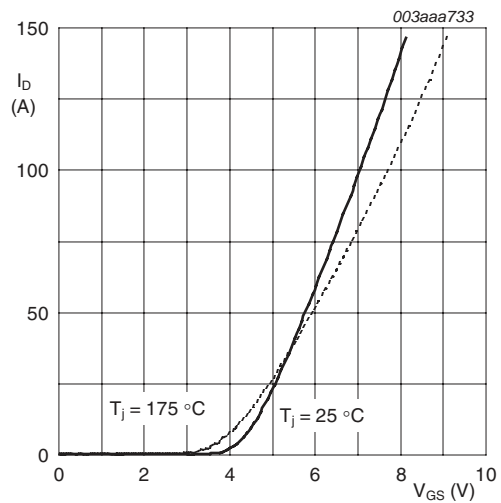
$T_j = 25\text{ }^\circ\text{C}$

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



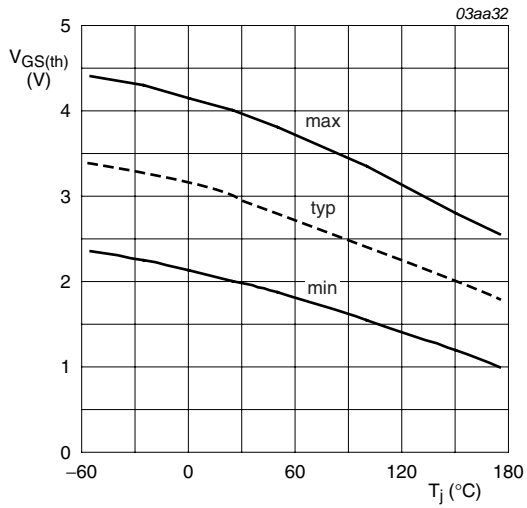
$T_j = 25\text{ }^\circ\text{C}; V_{DS} = 25\text{ V}$

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



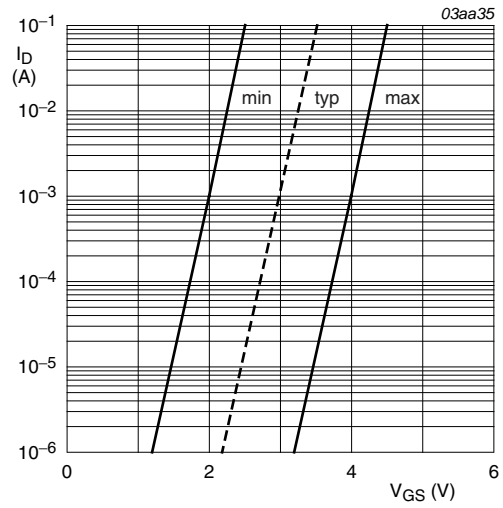
$V_{DS} = 25\text{ V}$

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



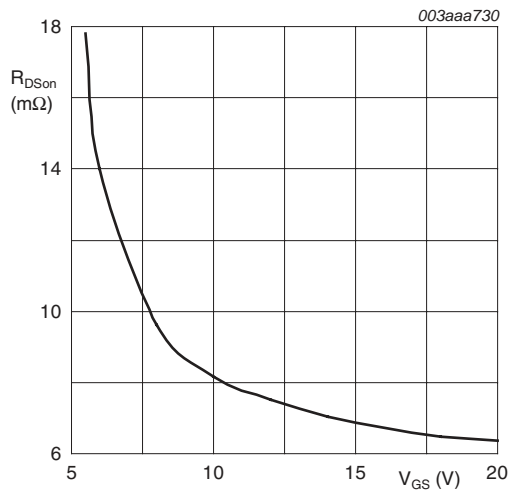
$$I_D = 1\text{ mA}; V_{DS} = V_{GS}$$

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



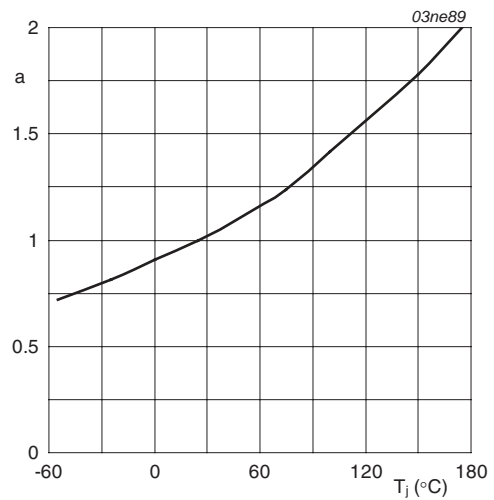
$$T_j = 25^\circ\text{C}; V_{DS} = 5\text{ V}$$

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



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

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



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

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

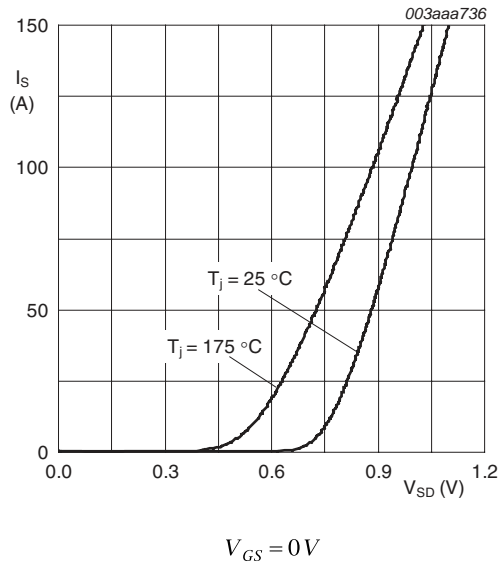


Fig 14. Source current as a function of source-drain voltage; typical values

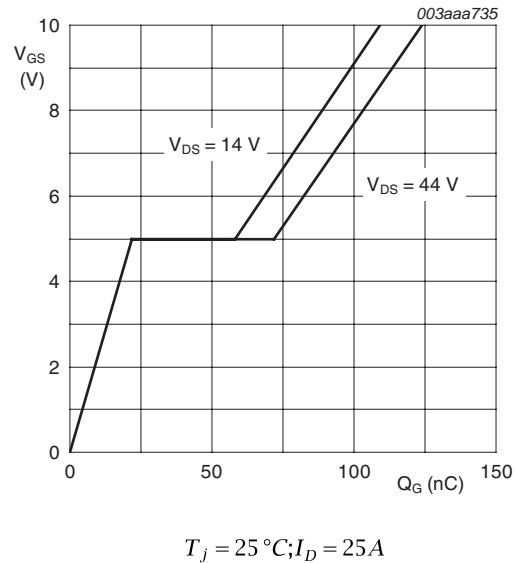


Fig 15. Gate-source voltage as a function of gate charge; typical values

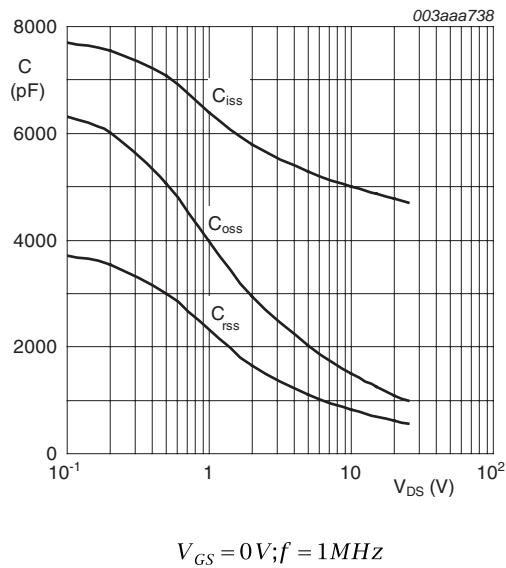


Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78

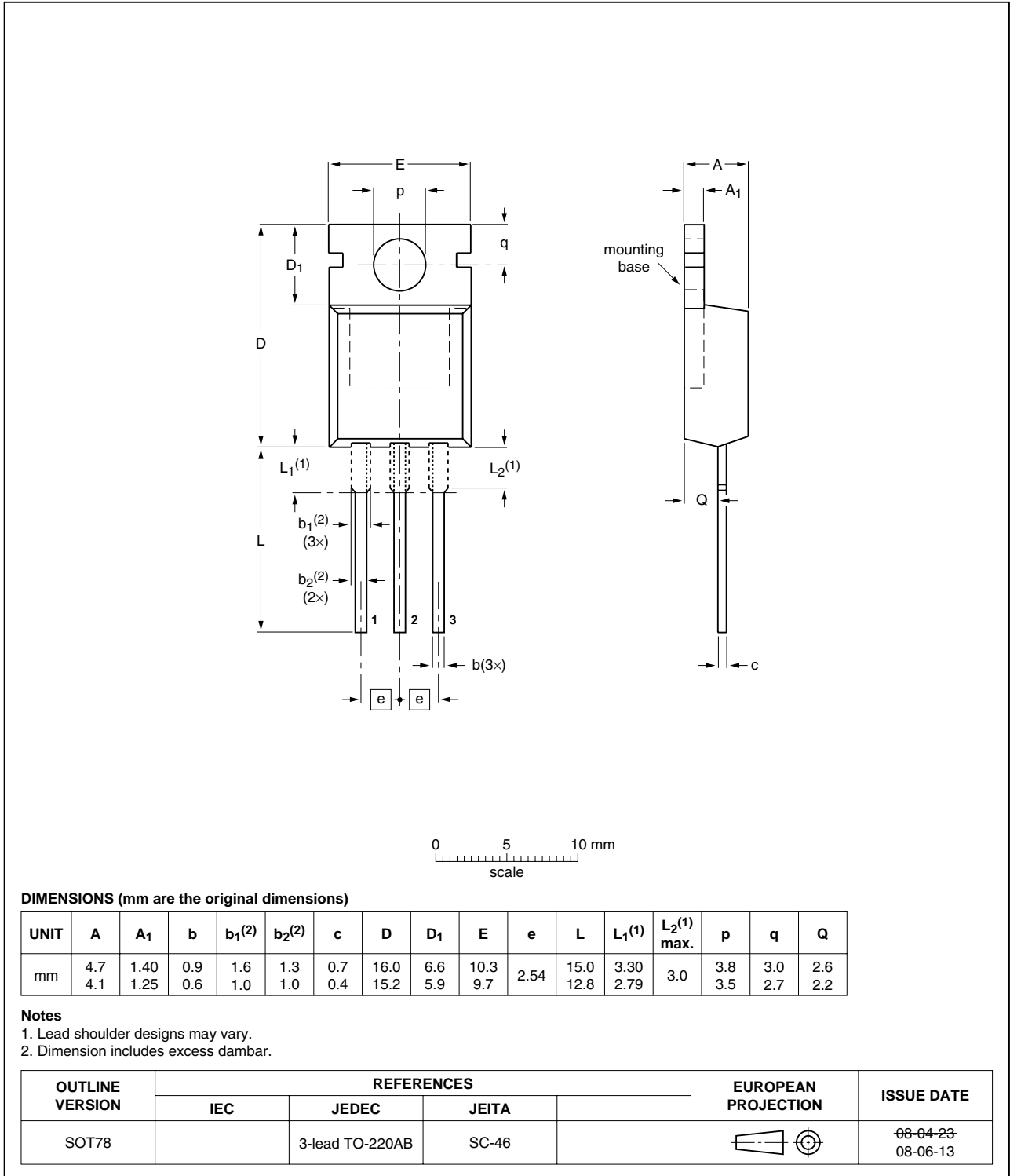


Fig 17. Package outline SOT78 (TO-220AB)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK7510-55AL_3	20090804	Product data sheet	-	BUK7510-55AL_2
Modifications:	• Package outline updated.			
BUK7510-55AL_2	20080103	Product data sheet	-	BUK75_7610_55AL_1
BUK75_7610_55AL_1	20050331	Product data sheet	-	-

9. Legal information

9.1 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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