

## 1. Product profile

### 1.1 General description

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
- Automotive systems
- General purpose power switching
- Motors, lamps and solenoids

### 1.4 Quick reference data

Table 1. Quick reference

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25^\circ\text{C}; T_j \leq 175^\circ\text{C}$	-	-	55	V
$I_D$	drain current	$V_{GS} = 5\text{ V}; T_{mb} = 25^\circ\text{C};$ see <a href="#">Figure 1</a> and <a href="#">3</a>	[1]	-	75	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	-	258	W
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}; V_{sup} \leq 55\text{ V};$ $R_{GS} = 50\ \Omega; V_{GS} = 5\text{ V};$ $T_{j(init)} = 25^\circ\text{C}$ ; unclamped	-	-	679	mJ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 5\text{ V}; I_D = 25\text{ A};$ $V_{DS} = 44\text{ V}; T_j = 25^\circ\text{C};$ see <a href="#">Figure 14</a> and <a href="#">15</a>	-	22	-	nC

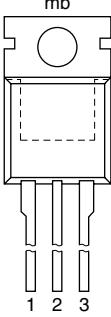
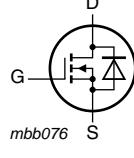
Table 1. Quick reference ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10$ V; $I_D = 25$ A; $T_j = 25$ °C; see <a href="#">Figure 11</a> and <a href="#">12</a>	-	4.8	5.4	$\text{m}\Omega$
		$V_{GS} = 5$ V; $I_D = 25$ A; $T_j = 25$ °C; see <a href="#">Figure 11</a> and <a href="#">12</a>	-	5.1	6	$\text{m}\Omega$

[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	 <b>SOT78</b> <b>(TO-220AB)</b>	

## 3. Ordering information

Table 3. Ordering information

Type number	Package	Version	
	Name	Description	Version
BUK9506-55B	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78

## 4. Limiting values

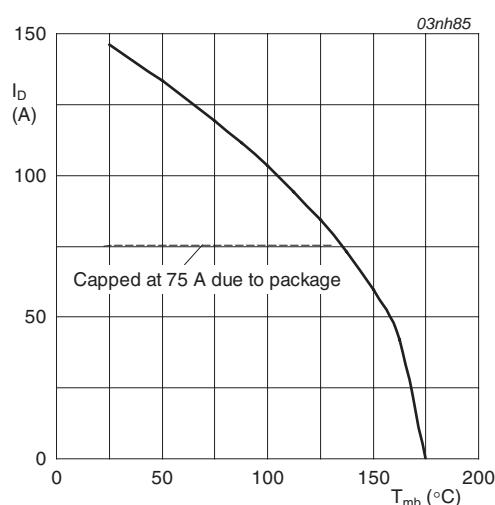
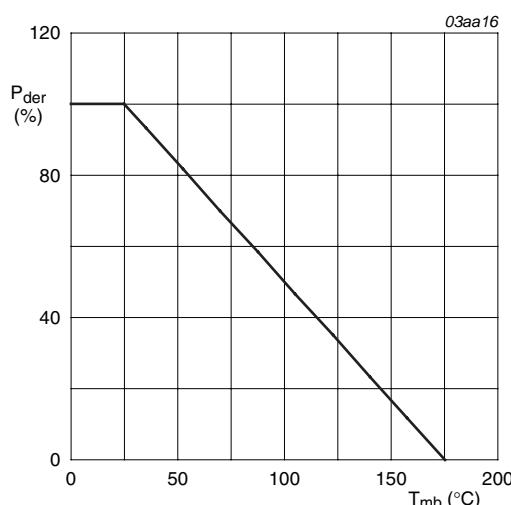
**Table 4. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25^\circ\text{C}; T_j \leq 175^\circ\text{C}$	-	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	$T_{mb} = 25^\circ\text{C}; V_{GS} = 5\text{ V}$ ; see <a href="#">Figure 1</a> and <a href="#">3</a>	[1]	-	146 A
			[2]	-	75 A
		$T_{mb} = 100^\circ\text{C}; V_{GS} = 5\text{ V}$ ; see <a href="#">Figure 1</a>	[2]	-	75 A
$I_{DM}$	peak drain current	$T_{mb} = 25^\circ\text{C}; t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; see <a href="#">Figure 3</a>	-	587	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	258	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25^\circ\text{C}$ ;	[1]	-	146 A
			[2]	-	75 A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25^\circ\text{C}$	-	587	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}; V_{sup} \leq 55\text{ V}; R_{GS} = 50\text{ }\Omega; V_{GS} = 5\text{ V}; T_{j(init)} = 25^\circ\text{C}$ ; unclamped	-	679	mJ

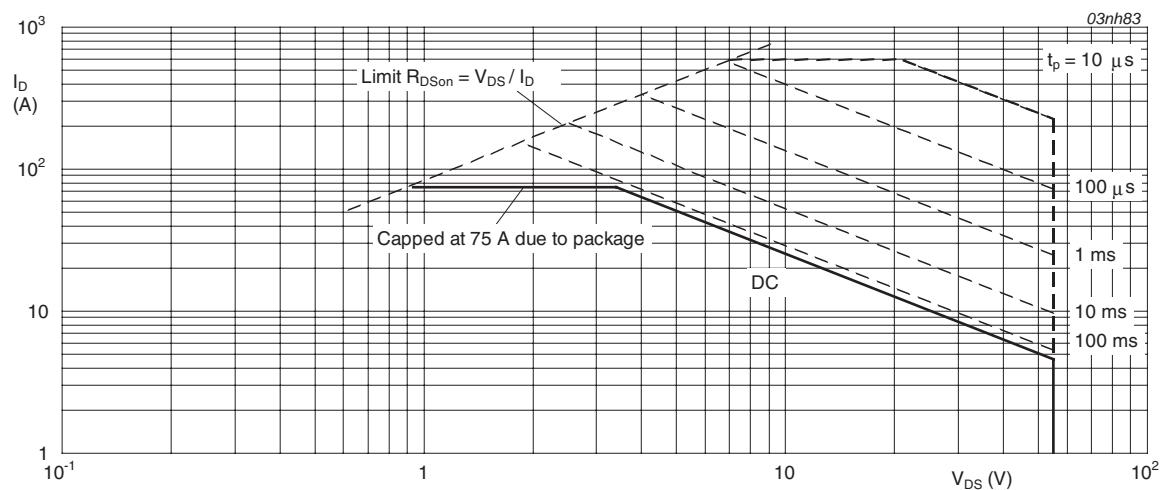
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.

 $V_{GS} \geq 5\text{ V}$ **Fig 1. Continuous drain current as a function of mounting base temperature**

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

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



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

Fig 3. 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 4</a>	-	-	0.58	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		-	60	-	K/W

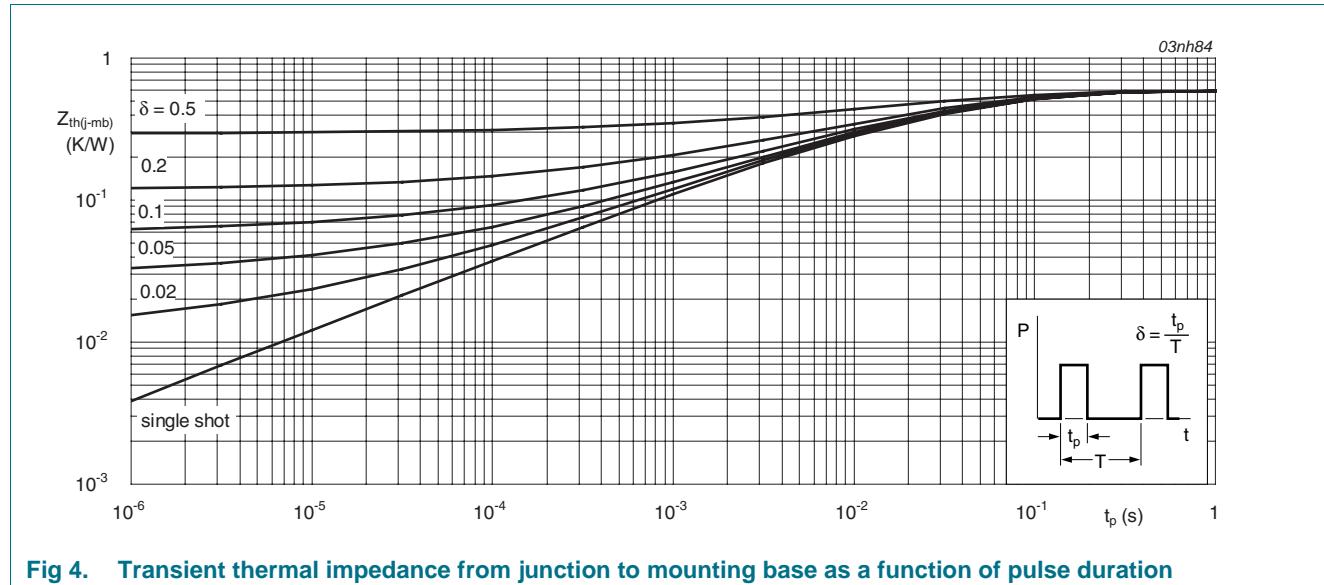


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55^\circ C$	50	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25^\circ C$	55	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55^\circ C$ see <a href="#">Figure 9</a> and <a href="#">10</a>	-	-	2.3	V
		$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25^\circ C$ see <a href="#">Figure 9</a> and <a href="#">10</a>	1.1	1.5	2	V
		$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175^\circ C$ see <a href="#">Figure 9</a> and <a href="#">10</a>	0.5	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 55 V; V_{GS} = 0 V; T_j = 25^\circ C$	-	0.02	1	$\mu A$
		$V_{DS} = 55 V; V_{GS} = 0 V; T_j = 175^\circ C$	-	-	500	$\mu A$
$I_{GSS}$	gate leakage current	$V_{DS} = 0 V; V_{GS} = 15 V; T_j = 25^\circ C$	-	2	100	nA
		$V_{DS} = 0 V; V_{GS} = -15 V; T_j = 25^\circ C$	-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 4.5 V; I_D = 25 A; T_j = 25^\circ C$ see <a href="#">Figure 11</a> and <a href="#">12</a>	-	-	6.4	$m\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 25^\circ C$ see <a href="#">Figure 11</a> and <a href="#">12</a>	-	4.8	5.4	$m\Omega$
		$V_{GS} = 5 V; I_D = 25 A; T_j = 175^\circ C$ see <a href="#">Figure 11</a> and <a href="#">12</a>	-	-	12	$m\Omega$
		$V_{GS} = 5 V; I_D = 25 A; T_j = 25^\circ C$ see <a href="#">Figure 11</a> and <a href="#">12</a>	-	5.1	6	$m\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 A; V_{DS} = 44 V; V_{GS} = 5 V$	-	60	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 A; V_{DS} = 44 V; V_{GS} = 5 V$ $T_j = 25^\circ C$ ; see <a href="#">Figure 14</a> and <a href="#">15</a>	-	11	-	nC
$Q_{GD}$	gate-drain charge		-	22	-	nC
$V_{GS(pl)}$	gate-source plateau voltage	$I_D = 25 A; V_{DS} = 44 V; T_j = 25^\circ C$ see <a href="#">Figure 14</a> and <a href="#">15</a>	-	2.4	-	V
$C_{iss}$	input capacitance	$V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz$	-	5674	7565	pF
$C_{oss}$	output capacitance	$V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz$ $T_j = 25^\circ C$ ; see <a href="#">Figure 16</a>	-	755	906	pF
$C_{rss}$	reverse transfer capacitance		-	255	350	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 V; R_L = 1.2 \Omega; V_{GS} = 5 V$	-	37	-	ns
$t_r$	rise time	$R_{G(ext)} = 10 \Omega; T_j = 25^\circ C$	-	95	-	ns
$t_{d(off)}$	turn-off delay time		-	117	-	ns
$t_f$	fall time		-	106	-	ns
$L_D$	internal drain inductance	from drain lead 6 mm from package to center of die; $T_j = 25^\circ C$	-	4.5	-	nH
		from contact screw on mounting base to center of die; $T_j = 25^\circ C$	-	3.5	-	nH
$L_S$	internal source inductance	from source lead to source bonding pad; $T_j = 25^\circ C$	-	7.5	-	nH

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Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25 \text{ A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; see Figure 13	-	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}$ ; $dI_S/dt = -100 \text{ A}/\mu\text{s}$ ; $V_{GS} = 0 \text{ V}$	-	64	-	ns
$Q_r$	recovered charge	$V_{DS} = 30 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	79	-	nC

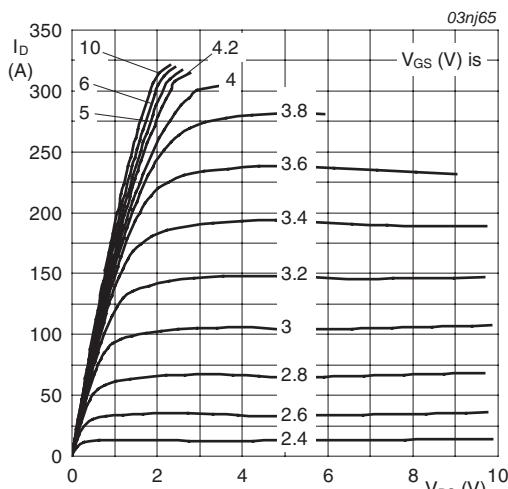
 $T_j = 25 \text{ }^\circ\text{C}$ 

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values

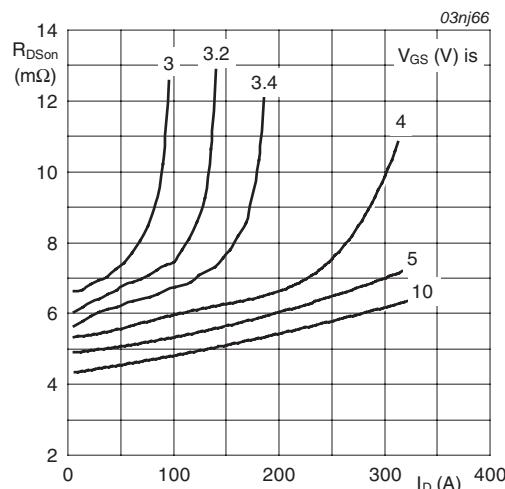
 $T_j = 25 \text{ }^\circ\text{C}$ 

Fig 6. Drain-source on-state resistance as a function of drain current; typical values

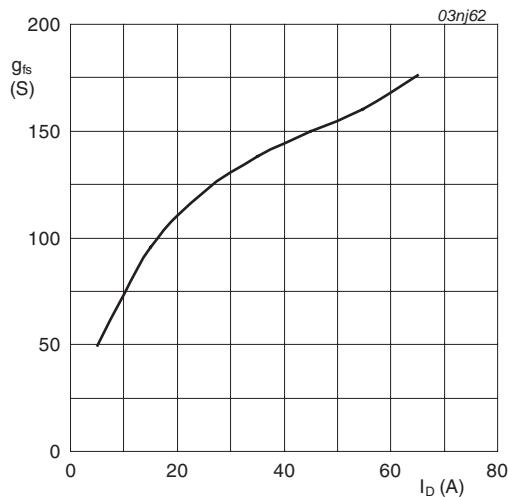
 $T_j = 25 \text{ }^\circ\text{C}; V_{DS} = 25 \text{ V}$ 

Fig 7. Forward transconductance as a function of drain current; typical values

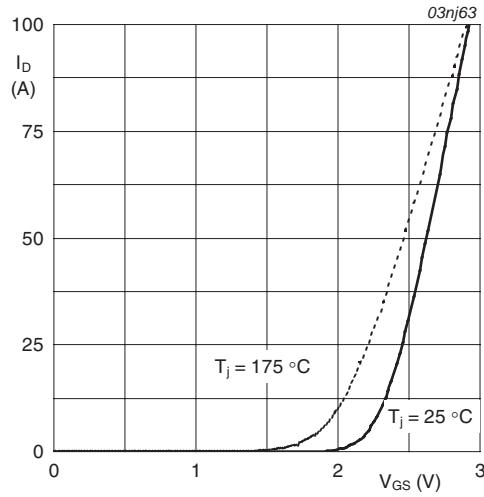
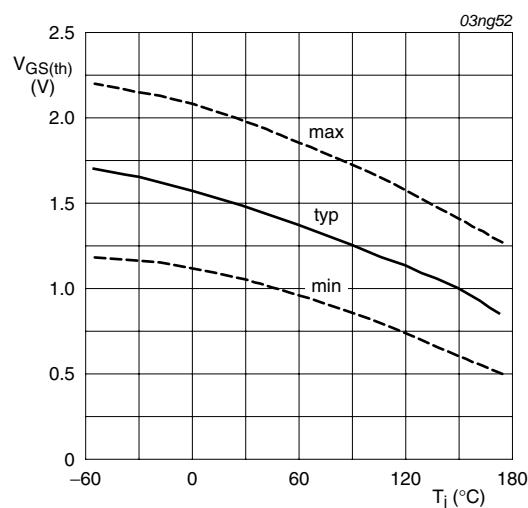
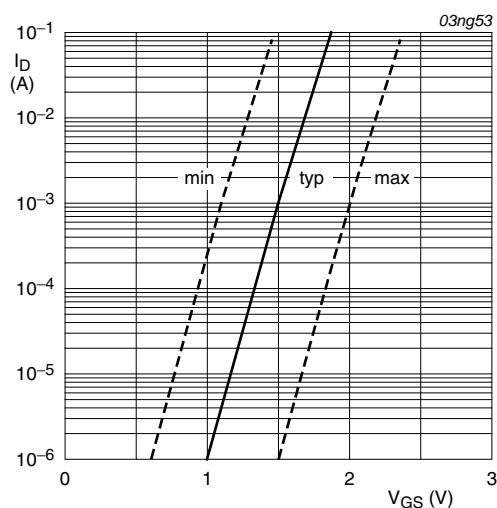
 $V_{DS} = 25 \text{ V}$ 

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



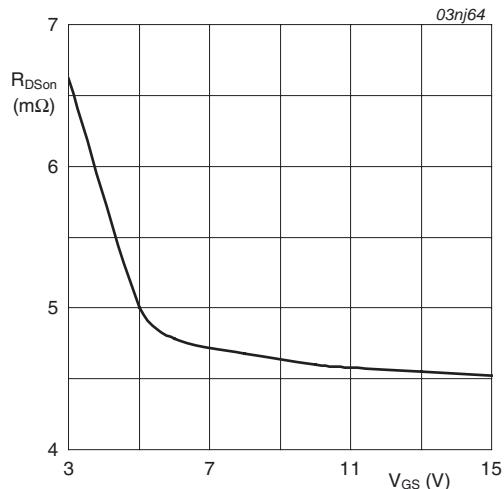
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



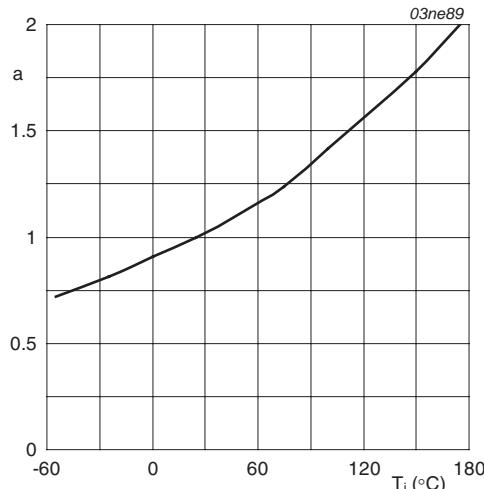
$T_j = 25^\circ\text{C}; V_{DS} = V_{GS}$

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



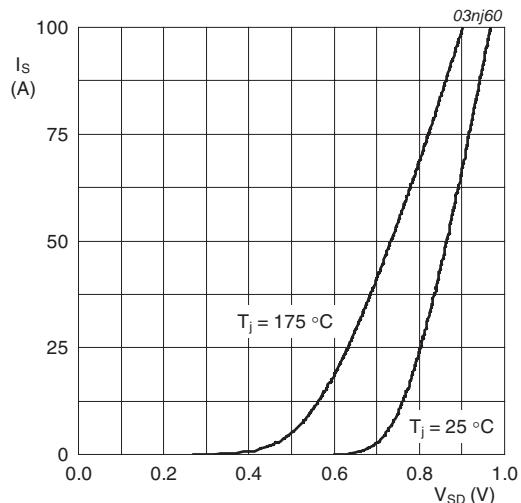
$T_j = 25^\circ\text{C}; I_D = 25\text{A}$

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



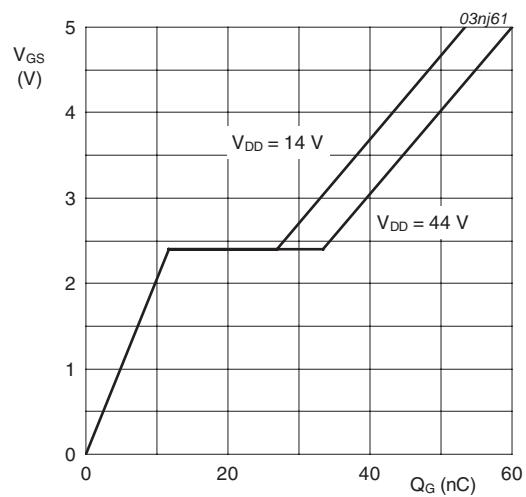
$$a = \frac{R_{DSon}}{R_{DSon}(25^\circ\text{C})}$$

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



$V_{GS} = 0V$

Fig 13. Source current as a function of source-drain voltage; typical values



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

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

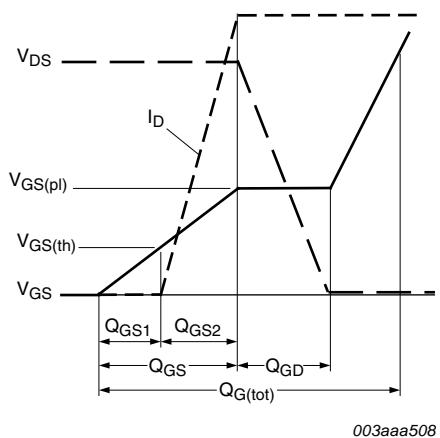
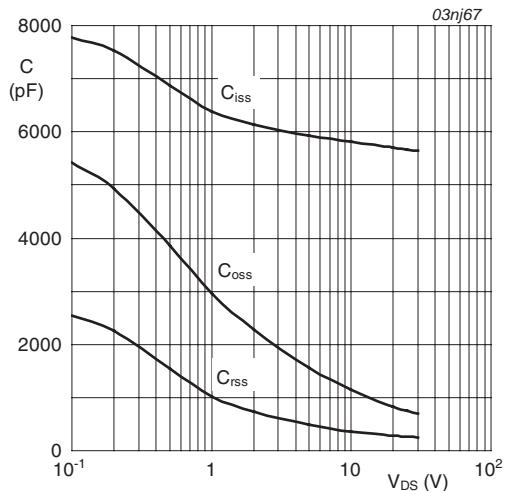


Fig 15. Gate charge waveform definitions



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

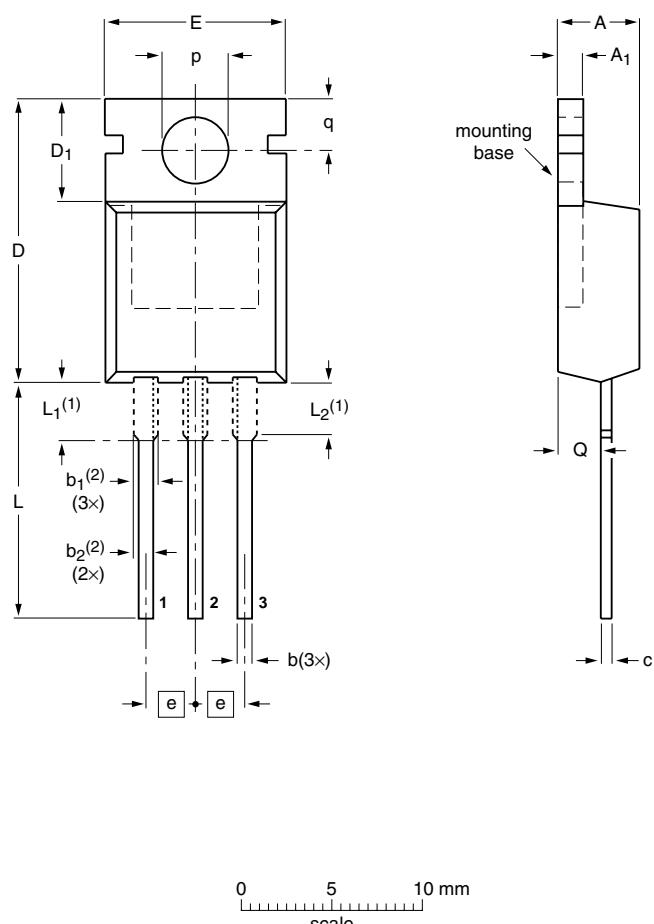
Fig 16. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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## 7. Package outline

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

SOT78



### DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1(2)</sub>	b <sub>2(2)</sub>	c	D	D <sub>1</sub>	E	e	L	L <sub>1(1)</sub>	L <sub>2(1)</sub> max.	p	q	Q
mm	4.7	1.40	0.9	1.6	1.3	0.7	16.0	6.6	10.3	2.54	15.0	3.30	3.0	3.8	3.0	2.6
	4.1	1.25	0.6	1.0	1.0	0.4	15.2	5.9	9.7		12.8	2.79		3.5	2.7	2.2

### Notes

1. Lead shoulder designs may vary.
2. Dimension includes excess dambar.

OUTLINE VERSION	REFERENCES					EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA				
SOT78		3-lead TO-220AB	SC-46				08-04-29 08-06-13

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

## 8. Revision history

**Table 7. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK9506-55B_4	20090723	Product data sheet	-	BUK95_96_9E06_55B_3
Modifications:	<ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>Legal texts have been adapted to the new company name where appropriate.</li><li>Type number BUK9506-55B separated from data sheet BUK95_96_9E06_55B_3.</li></ul>			
BUK95_96_9E06_55B_3 (9397 750 13519)	20041130	Product data sheet	-	BUK95_96_9E06_55B-02
BUK95_96_9E06_55B-02 (9397 750 10474)	20021010	Product data	-	BUK95_96_9E06_55B-01
BUK95_96_9E06_55B-01 (9397 750 09946)	20020813	Product data	-	-

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## 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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## 10. Contact information

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For sales office addresses, please send an email to: [salesaddresses@nxp.com](mailto:salesaddresses@nxp.com)

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