BUK652R7-30C

N-channel TrenchMOS intermediate level FET

Rev. 01 — 5 July 2010 Objective data sheet

1. Product profile

1.1 General description

Intermediate level gate drive N-channel enhancement mode Field-Effect Transistor (FET) in a plastic package using advanced TrenchMOS technology. This product has been designed and qualified to the appropriate AEC Q101 standard for use in high performance automotive applications.

1.2 Features and benefits

- AEC Q101 compliant
- Suitable for intermediate level gate drive sources
- Suitable for thermally demanding environments due to 175 °C rating

1.3 Applications

- 12 V Automotive systems
- Electric and electro-hydraulic power steering
- Motors, lamps and solenoid control
- Start-Stop micro-hybrid applications
- Transmission control
- Ultra high performance power switching

1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C	-	-	30	V
I_D	drain current	V_{GS} = 10 V; T_{mb} = 25 °C; see Figure 1 [1]	-	-	100	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 2	-	-	204	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; see Figure 13; see Figure 14	-	2.72	3.2	mΩ

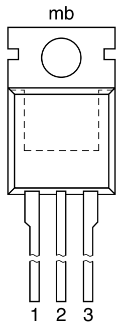
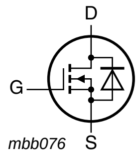
Table 1. Quick reference data *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 100 A; V_{sup} ≤ 30 V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped	-	-	501	mJ
Dynamic characteristics						
Q_{GD}	gate-drain charge	I_D = 25 A; V_{DS} = 24 V; V_{GS} = 10 V; see Figure 15; see Figure 16	-	33.3	-	nC

[1] Continuous current is limited by package.

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 SOT78A (TO-220AB)	
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK652R7-30C	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78A

4. Limiting values

Table 4. Limiting values

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

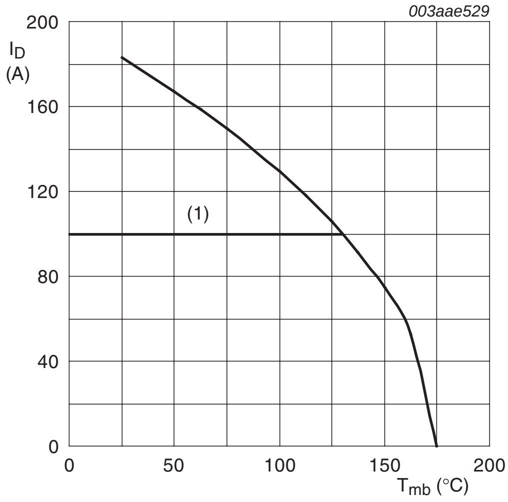
Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	30	V
V_{GS}	gate-source voltage	Pulsed; Accumulated pulse duration not to exceed 168 hours.		-20	20	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; see Figure 1	[1]	-	100	A
		T_{mb} = 100 °C; V_{GS} = 10 V; see Figure 1	[1]	-	100	A
I_{DM}	peak drain current	T_{mb} = 25 °C; $t_p \leq 10$ µs; pulsed; see Figure 4		-	733	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 2		-	204	W
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
V_{GS}	gate-source voltage	DC		-16	16	V
Source-drain diode						
I_S	source current	T_{mb} = 25 °C	[1]	-	100	A
I_{SM}	peak source current	$t_p \leq 10$ µs; pulsed; T_{mb} = 25 °C		-	733	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 100 A; $V_{sup} \leq 30$ V; R_{GS} = 50 Ω; V_{GS} = 10 V; $T_{j(init)}$ = 25 °C; unclamped		-	501	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	see Figure 3	[2][3][4]	-	-	J

[1] Continuous current is limited by package.

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

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

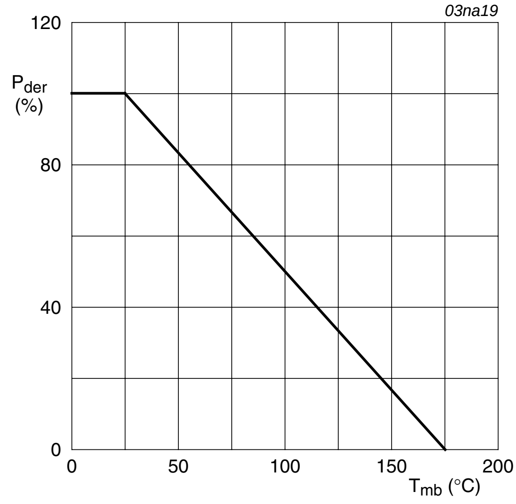
[4] Refer to application note AN10273 for further information.



$V_{GS} \geq 10$ V

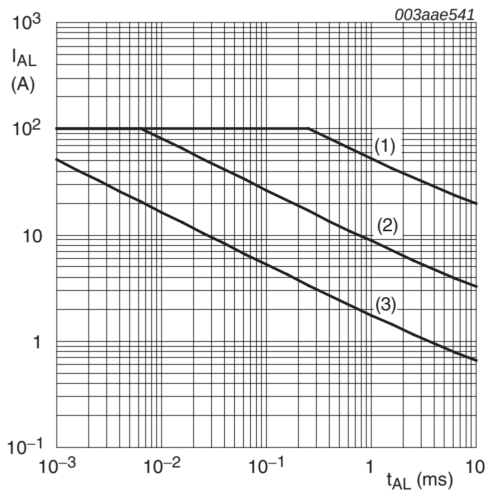
(1) capped at 100 A due to package

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



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

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

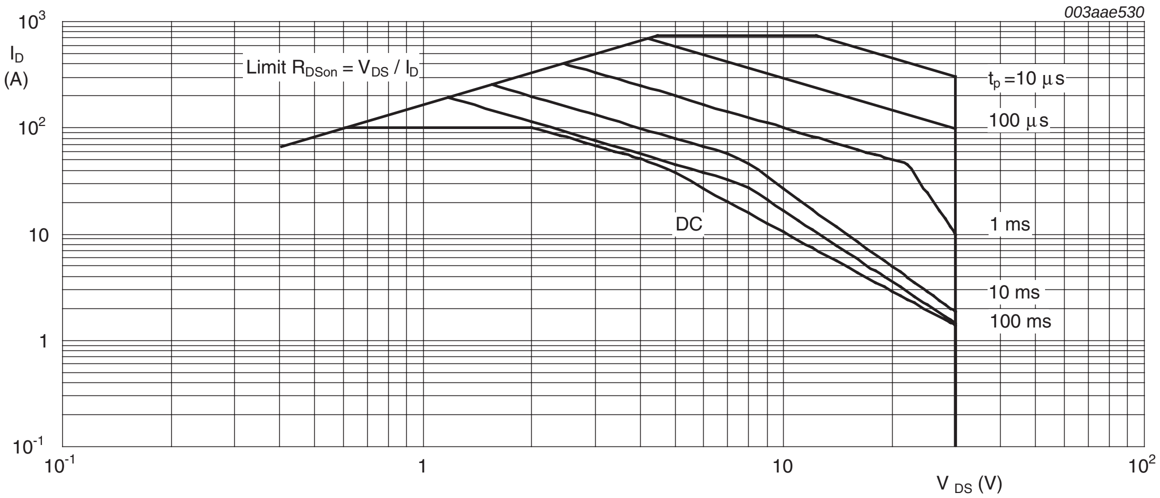


(1) Single pulse, T_j = 25 °C

(2) Single pulse, T_j = 125 °C

(3) Repetitive pulse

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



$T_{mb} = 25°C$; I_{DM} is a single pulse

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 Figure 5	-	-	0.7	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in free air	-	60	-	K/W

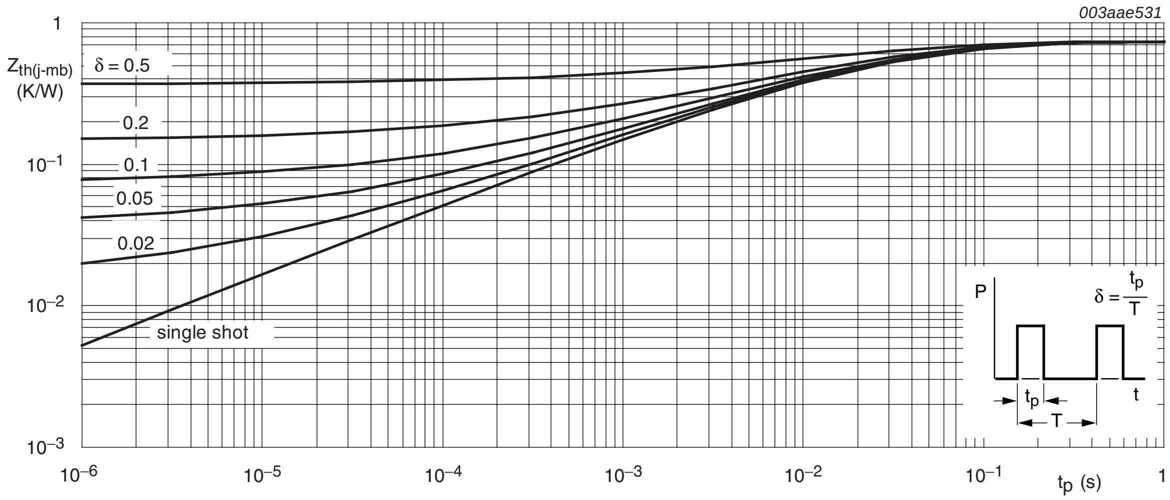


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

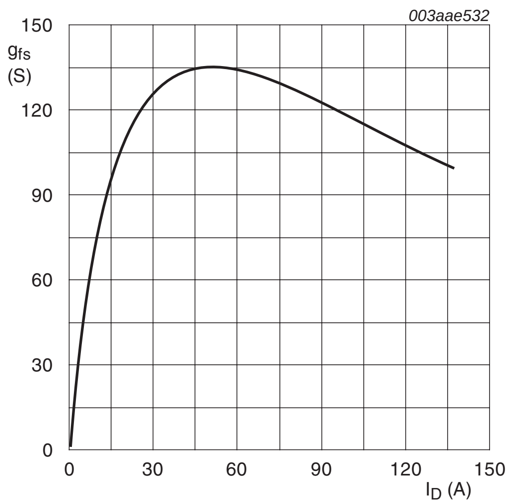
6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C	30	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C	27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; see Figure 11; see Figure 12	1.8	2.3	2.8	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; see Figure 11	-	-	3.3	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; see Figure 11	0.8	-	-	V
I_{DSS}	drain leakage current	V_{DS} = 30 V; V_{GS} = 0 V; T_j = 25 °C	-	0.02	1	µA
		V_{DS} = 30 V; V_{GS} = 0 V; T_j = 175 °C	-	-	500	µA
I_{GSS}	gate leakage current	V_{DS} = 0 V; V_{GS} = 20 V; T_j = 25 °C	-	2	100	nA
		V_{DS} = 0 V; V_{GS} = -20 V; T_j = 25 °C	-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; see Figure 13; see Figure 14	-	2.72	3.2	mΩ
		V_{GS} = 4.5 V; I_D = 25 A; T_j = 25 °C; see Figure 13; see Figure 14	-	3.9	5.1	mΩ
		V_{GS} = 5 V; I_D = 25 A; T_j = 25 °C; see Figure 13	-	3.45	4.4	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 175 °C; see Figure 13	-	5.2	6.1	mΩ
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 24 V; V_{GS} = 10 V; see Figure 15; see Figure 16	-	115	-	nC
		I_D = 25 A; V_{DS} = 24 V; V_{GS} = 5 V; see Figure 15; see Figure 16	-	66	-	nC
Q_{GS}	gate-source charge	I_D = 25 A; V_{DS} = 24 V; V_{GS} = 10 V; see Figure 15; see Figure 16	-	18	-	nC
Q_{GD}	gate-drain charge		-	33.3	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; see Figure 17	-	5216	-	pF
C_{oss}	output capacitance		-	896	-	pF
C_{rss}	reverse transfer capacitance		-	537	-	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 25 V; R_L = 1 Ω; V_{GS} = 10 V; $R_{G(ext)}$ = 10 Ω	-	118	-	ns
t_r	rise time		-	484	-	ns
$t_{d(off)}$	turn-off delay time		-	244	-	ns
t_f	fall time		-	269	-	ns
L_D	internal drain inductance	from drain lead 6 mm from package to centre of die ; T_j = 25 °C	-	4.5	-	nH
L_S	internal source inductance	from source lead to source bond pad ; T_j = 25 °C	-	7.5	-	nH

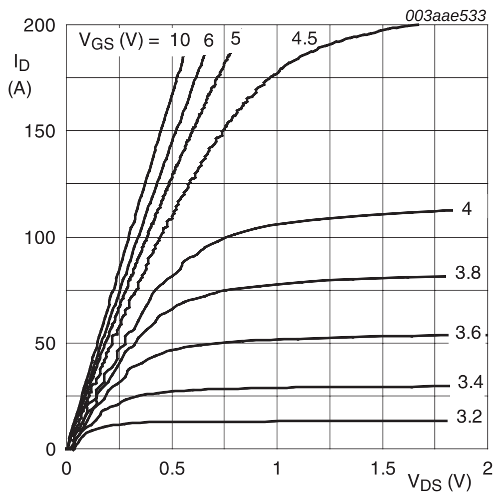
Table 6. Characteristics *...continued*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; see Figure 18	-	0.8	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 25 V	-	[tbd]	-	ns
Q_r	recovered charge		-	[tbd]	-	nC



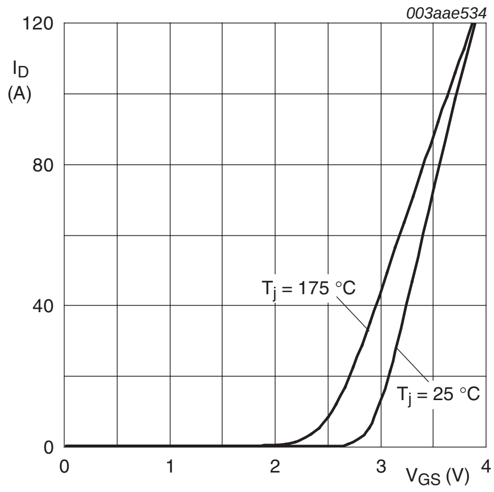
T_j = 25°C; V_{DS} = 25 V

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



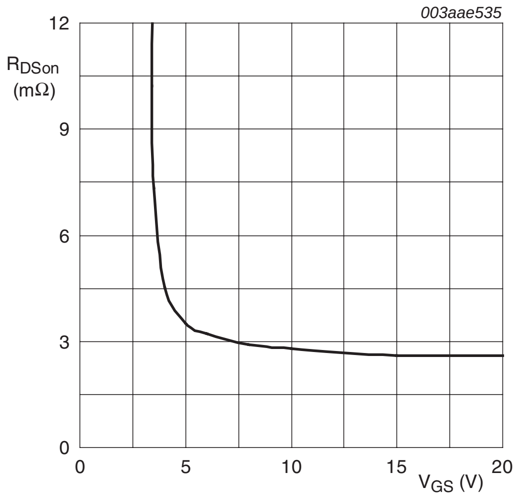
T_j = 25°C and t_p = 300 us

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



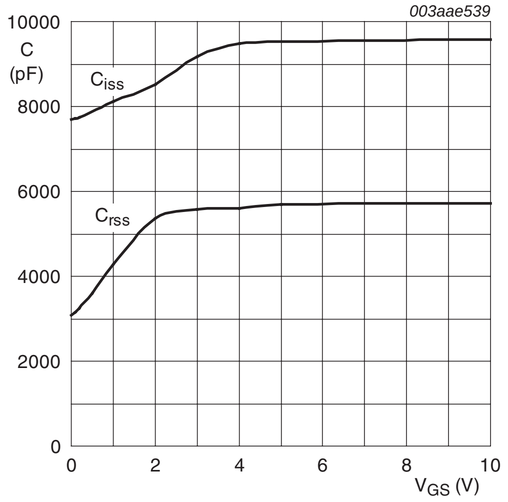
V_{DS} = 25 V

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



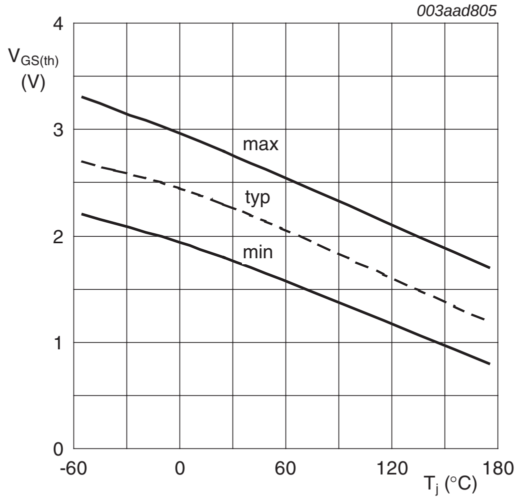
T_j = 25°C; I_D 25 A

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



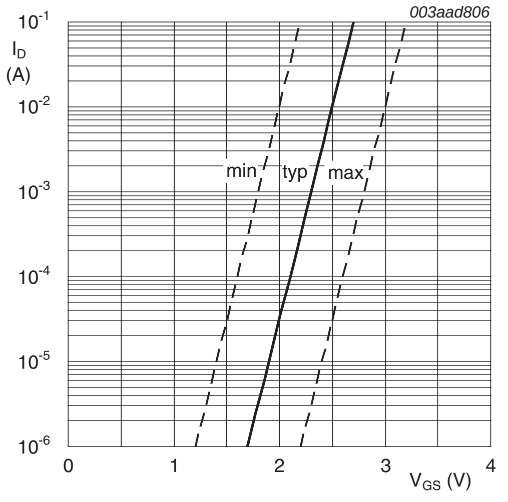
V_{DS} = 0 V; f = 1 MHz

Fig 10. Input and reverse transfer capacitances as a function of gate-source voltage, typical values



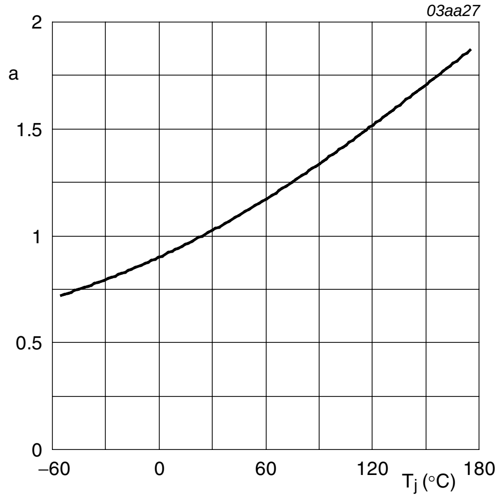
$I_D = 1mA; V_{DS} = V_{GS}$

Fig 11. Gate-source threshold voltage as a function of junction temperature



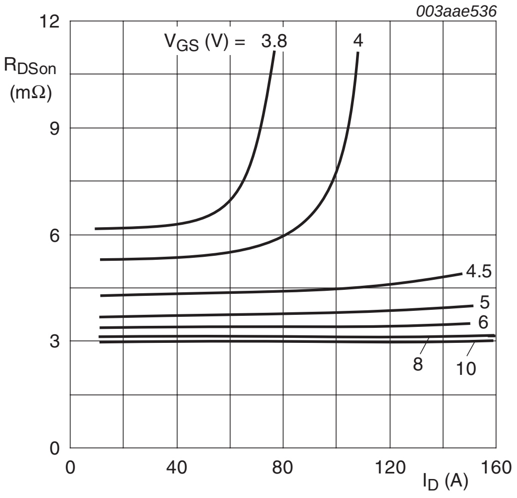
$T_j = 25\,°C; V_{DS} = 5V$

Fig 12. Sub-threshold drain current as a function of gate-source voltage



$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



T_j = 25°C; t_p = 300 µs

Fig 14. Drain-source on-state resistance as a function of drain current; typical values

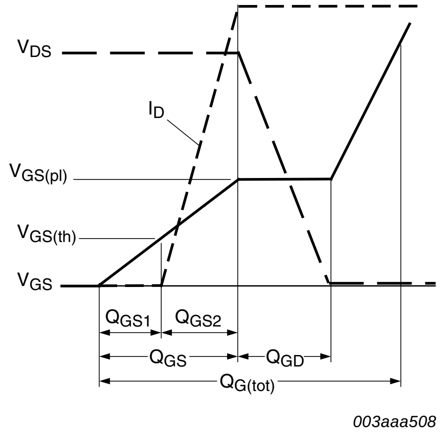
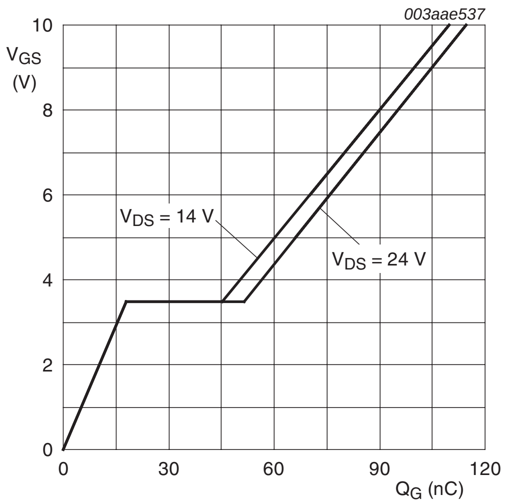
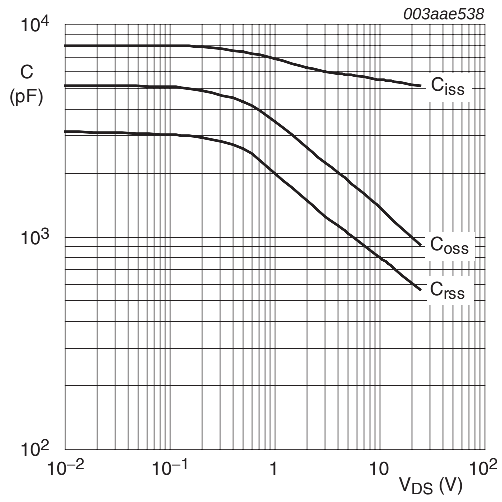


Fig 15. Gate charge waveform definitions



T_j = 25°C and I_D = 25 A

Fig 16. Gate-source voltage as a function of gate charge; typical values



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

Fig 17. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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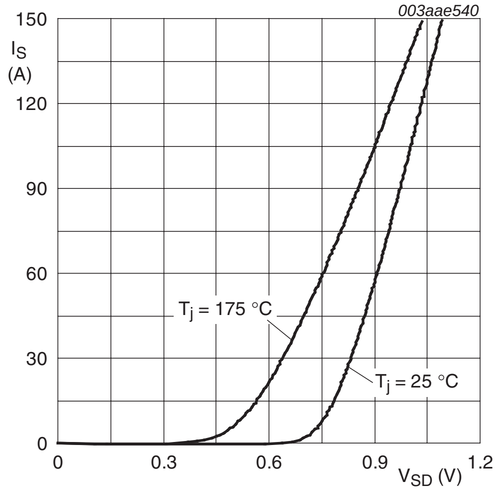
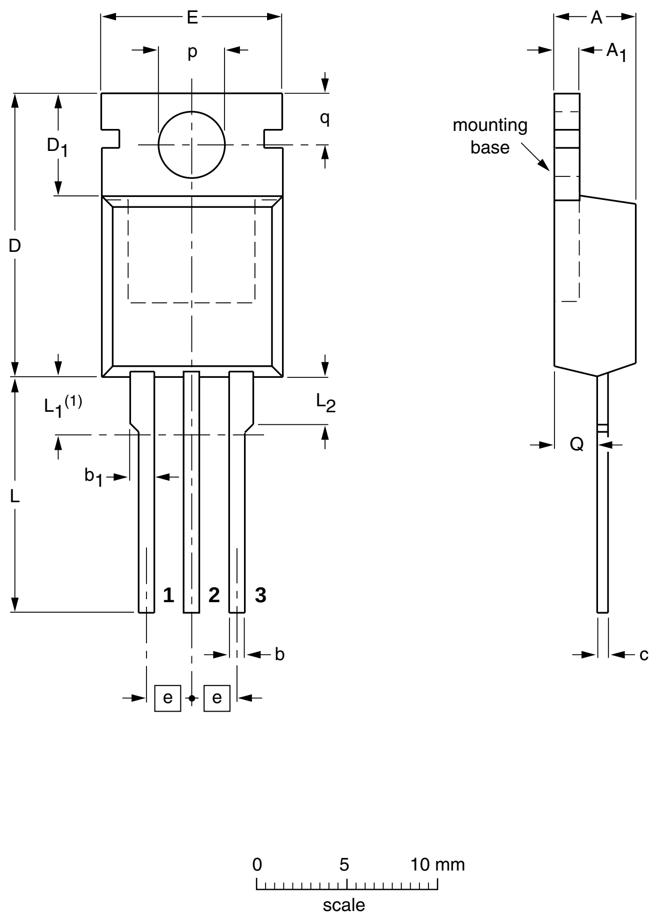


V_{GS} = 0 V

Fig 18. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB **SOT78A**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D	D_1	E	e	L	$L_1^{(1)}$	L_2 max.	p	q	Q
mm	4.5 4.1	1.39 1.27	0.9 0.6	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

Note

1. Terminals in this zone are not tinned.

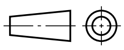
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78A		3-lead TO-220AB	SC-46			~~03-01-22~~ 05-03-14

Fig 19. Package outline SOT78A (TO-220AB)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK652R7-30C v.1	20100705	Objective 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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11. Contents

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