BUK7L3R3-34BRC

N-channel TrenchPLUS standard level FET

Rev. 02 — 26 September 2007 **Product data sheet**

1. Product profile

1.1 General description

N-channel enhancement mode power Field-Effect Transistor (FET) in a plastic package using NXP High-Performance Automotive (HPA) TrenchMOS technology, featuring very low on-state resistance, internal gate resistor, ElectroStatic Discharge (ESD) protection diodes and clamping diodes that are guaranteed to prevent MOSFET avalanching.

1.2 Features

- Internal gate resistor
- 175 °C rated
- Q101 compliant
- ESD and overvoltage protection

1.3 Applications

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

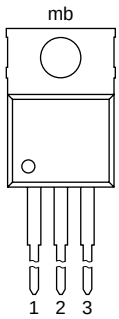
1.4 Quick reference data

- $E_{DS(AL)S} \leq 1.9$ J
- $I_D \leq 75$ A
- $R_{DSon} = 2.9$ mΩ (typ)
- $P_{tot} \leq 298$ W

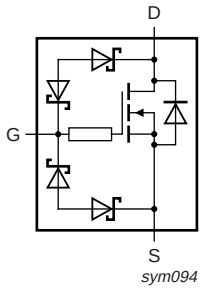
2. Pinning information

Table 1. Pinning

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



SOT78C (TO-220)



3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
BUK7L3R3-34BRC	TO-220	plastic single-ended package; heatsink mounted; 1 mounting hole; 3 leads	SOT78C

4. Limiting values

Table 3. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage		[1]	-	34	V
V_{DGR}	drain-gate voltage (DC)	R_{GS} = 20 kΩ	[1]	-	34	V
V_{GS}	gate-source voltage			-	±20	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; see Figure 2 and 3	[2]	-	218	A
			[3][4]	-	75	A
		T_{mb} = 100 °C; V_{GS} = 10 V; see Figure 2	[3]	-	75	A
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs; see Figure 3		-	872	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 1		-	298	W
$I_{DG(CL)}$	drain-gate clamping current	t_p = 5 ms; δ = 0.01		-	50	mA
$I_{GS(CL)}$	gate-source clamping current	continuous		-	10	mA
		t_p = 5 ms; δ = 0.01		-	50	mA
T_{stg}	storage temperature			–55	+175	°C
T_j	junction temperature			–55	+175	°C
Source-drain diode						
I_{DR}	reverse drain current	T_{mb} = 25 °C	[2]	-	218	A
			[3][4]	-	75	A
I_{DRM}	peak reverse drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs		-	872	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; I_D = 75 A; $V_{DS} \leq 34$ V; R_{GS} = 50 Ω; V_{GS} = 10 V; starting at T_j = 25 °C		-	1.9	J
$E_{DS(AL)R}$	repetitive drain-source avalanche energy		[5]	-	-	J
V_{esd}	electrostatic discharge voltage	all pins; human body model; R = 1.5 kΩ				
		C = 100 pF		-	8	kV
		C = 250 pF		-	8	kV

[1] Voltage is limited by clamping.

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

[3] Continuous current is limited by package.

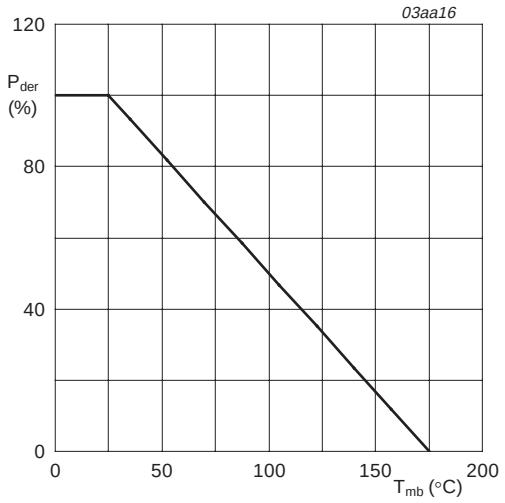
[4] Refer to literature 9397 750 12572 for further information.

[5] Maximum value not quoted. Refer to application note *AN10273* for further information.

a) Repetitive rating defined in Figure 14.

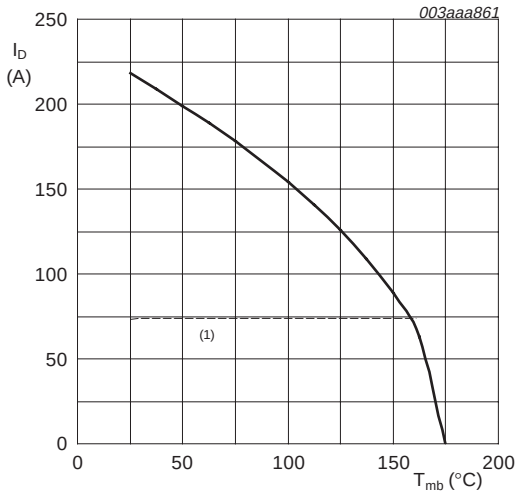
b) Single-pulse avalanche rating limited by a $T_{j(max)}$ of 175 °C.

c) Repetitive avalanche rating limited by an average junction temperature of 170 °C.



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

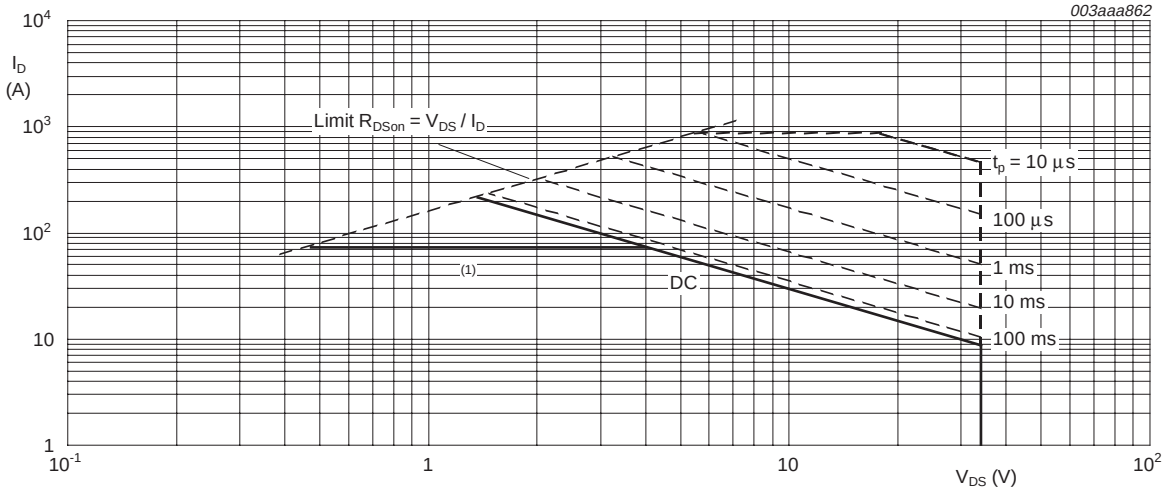
Fig 1. Normalized total power dissipation as a function of mounting base temperature



$V_{GS} \geq 10$ V

(1) Capped at 75 A due to package

Fig 2. Continuous drain current as a function of mounting base temperature



T_{mb} = 25 °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

5. Thermal characteristics

Table 4. Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-a)}$	thermal resistance from junction to ambient		-	60	-	K/W
$R_{th(j-mb)}$	thermal resistance from junction to mounting base		-	-	0.5	K/W

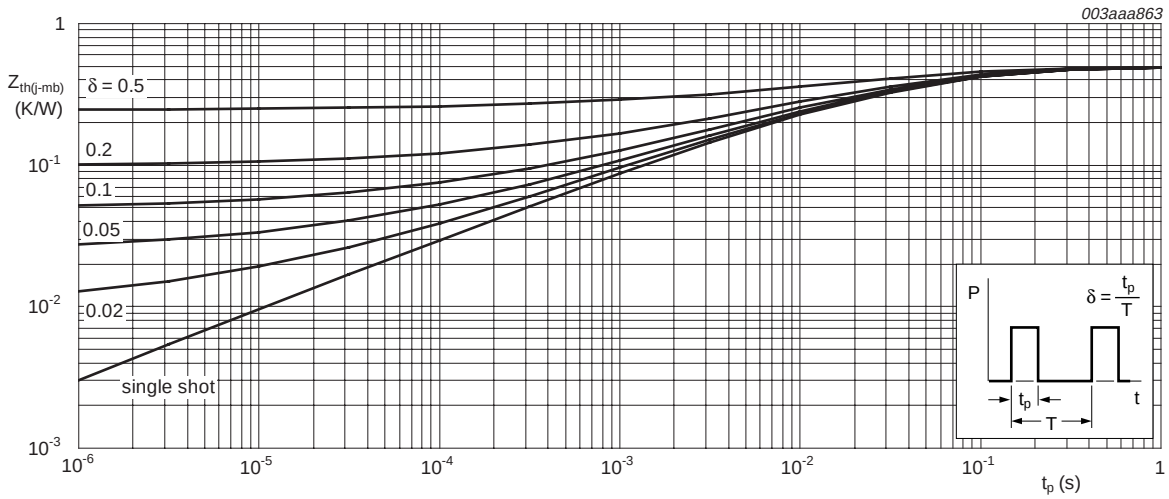


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 5. Characteristics

T_j = 25 °C unless otherwise specified.

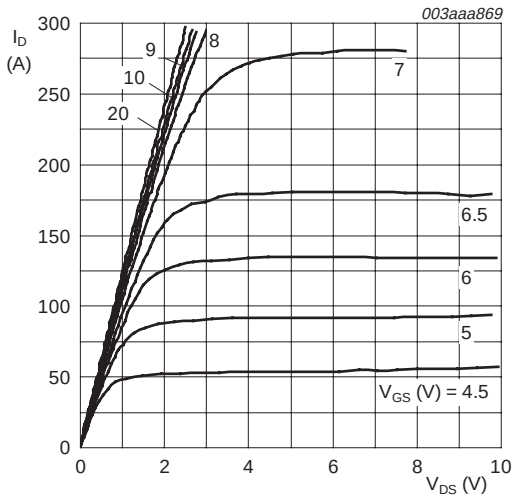
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DG}$	drain-gate breakdown voltage	I_D = 2 mA; V_{GS} = 0 V					
		T_j = 25 °C		34	-	45	V
		T_j = –55 °C		34	-	45	V
$V_{DS(CL)}$	drain-source clamping voltage	$I_{GD(CL)}$ = –2 mA; I_D = 1 A; see Figure 17 and 18		-	41	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; see Figure 9 and 10					
		T_j = 25 °C		2	3	4	V
		T_j = 175 °C		1	-	-	V
		T_j = –55 °C		-	-	4.4	V
I_{DSS}	drain leakage current	V_{DS} = 16 V; V_{GS} = 0 V					
		T_j = 25 °C		-	0.1	0.6	µA
		T_j = 150 °C		-	5	50	µA
		T_j = 175 °C		-	30	250	µA
$V_{(BR)GSS}$	gate-source breakdown voltage	I_G = ±1 mA; –55 °C < T_j < +175 °C		20	22	-	V
I_{GSS}	gate leakage current	V_{GS} = ±10 V; V_{DS} = 0 V					
		T_j = 25 °C		-	5	1000	nA
		T_j = 175 °C		-	-	50	µA
		V_{GS} = ±16 V; V_{DS} = 0 V					
		T_j = 175 °C		-	-	150	µA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D = 25 A; see Figure 7 and 8					
		T_j = 25 °C	[1]	-	2.9	3.3	mΩ
		T_j = 175 °C		-	-	6.3	mΩ
R_G	gate resistance			-	11	-	Ω

Table 5. Characteristics *...continued*

T_j = 25 °C unless otherwise specified.

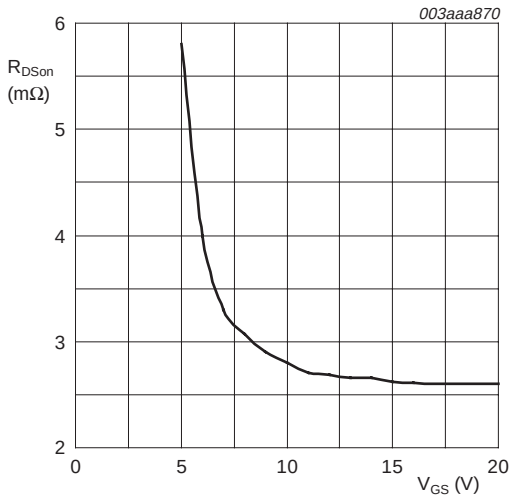
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 27 V; V_{GS} = 10 V; see Figure 12	-	109	-	nC
Q_{GS}	gate-source charge		-	22	-	nC
Q_{GD}	gate-drain charge		-	55	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; see Figure 16	-	5050	6730	pF
C_{oss}	output capacitance		-	1300	1560	pF
C_{rss}	reverse transfer capacitance		-	510	690	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; R_G = 10 Ω	-	69	-	ns
t_r	rise time		-	150	-	ns
$t_{d(off)}$	turn-off delay time		-	290	-	ns
t_f	fall time		-	210	-	ns
L_D	internal drain inductance	measure from drain lead 6 mm from package to center of die	-	4.5	-	nH
		measure from contact screw on mounting base to center of die	-	3.5	-	nH
L_S	internal source inductance	measure from source lead from package to source bonding pad	-	7.5	-	nH
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; see Figure 13	-	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = –100 A/µs; V_{GS} = 0 V; V_R = 30 V	-	93	-	ns
Q_r	recovered charge		-	65	-	nC

[1] R_{DSon} measured at 1.5 mm away from the plastic body.



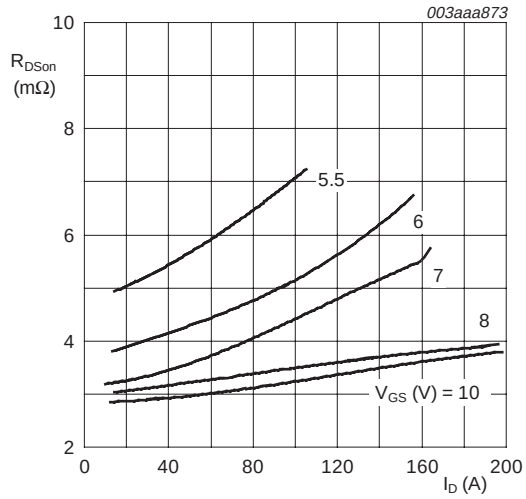
T_j = 25 °C

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



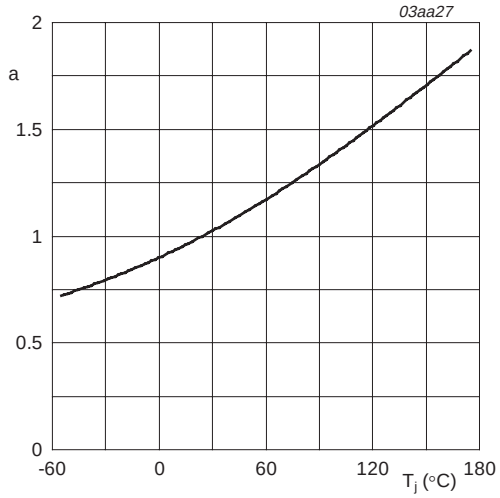
T_j = 25 °C; I_D = 25 A

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



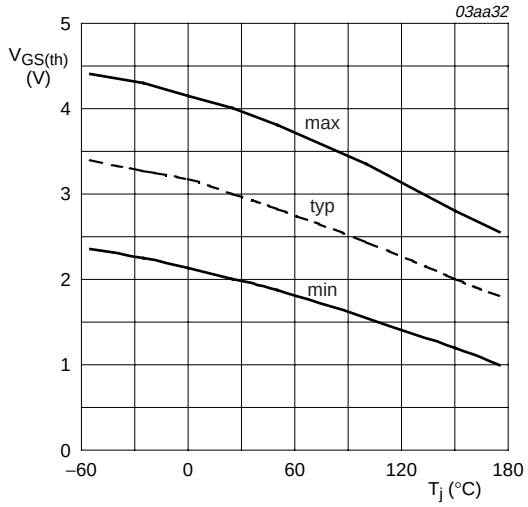
T_j = 25 °C

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



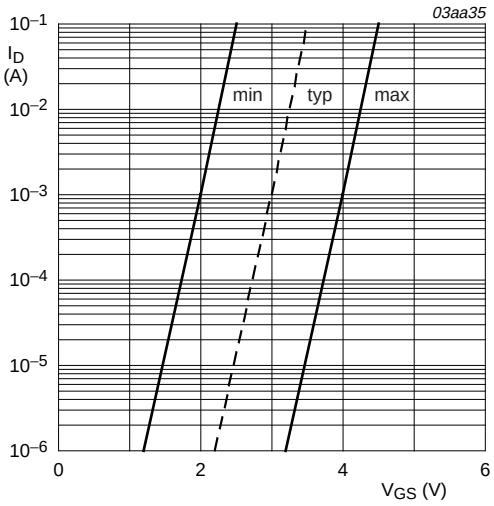
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature



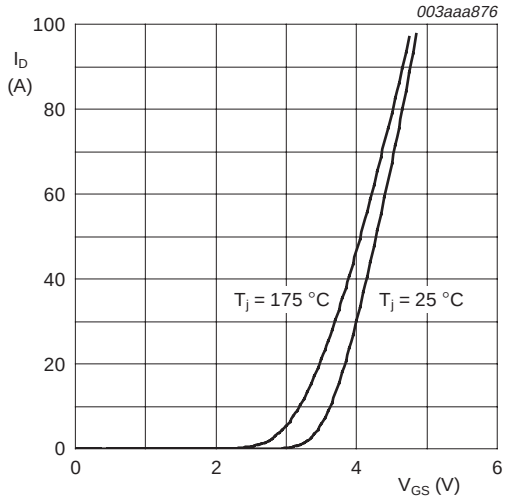
I_D = 1 mA; V_{DS} = V_{GS}

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



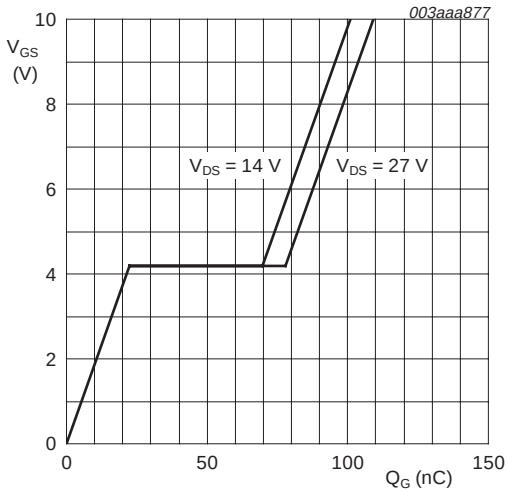
T_j = 25 °C; V_{DS} = V_{GS}

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



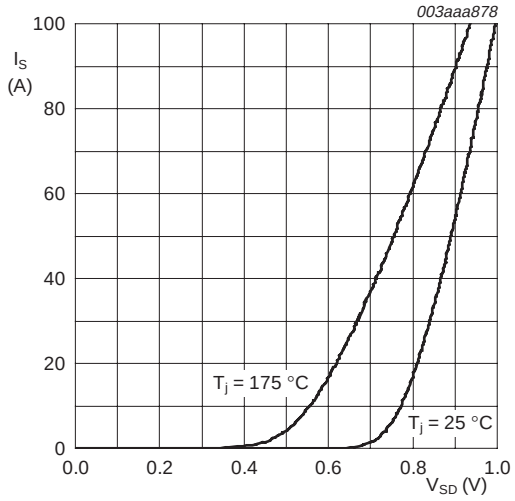
V_{DS} = 25 V

Fig 11. Transfer characteristics: drain current as a function of gate-source voltage; typical values



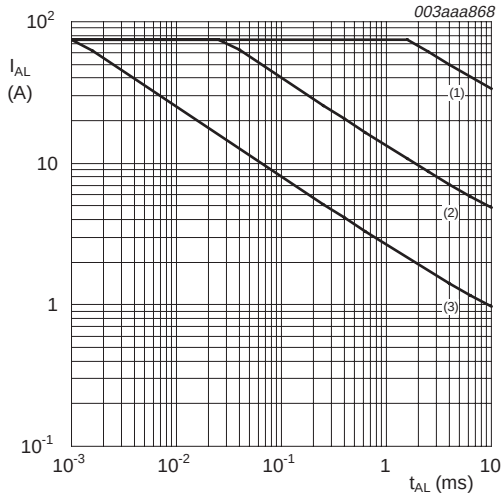
T_j = 25 °C; I_D = 25 A

Fig 12. Gate-source voltage as a function of gate charge; typical values



V_{GS} = 0 V

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



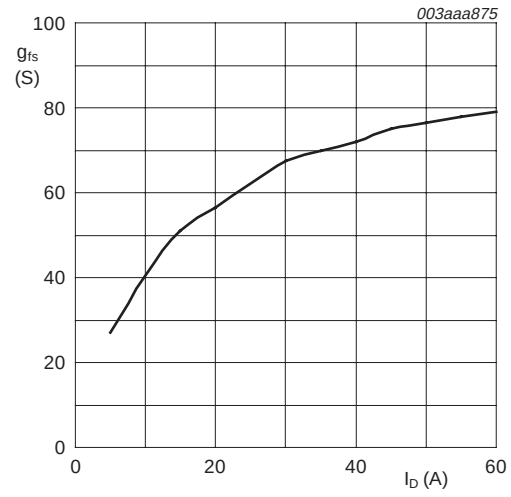
See Table note 5 of Table 3 “Limiting values”.

(1) Single-pulse; T_j = 25 °C

(2) Single-pulse; T_j = 150 °C

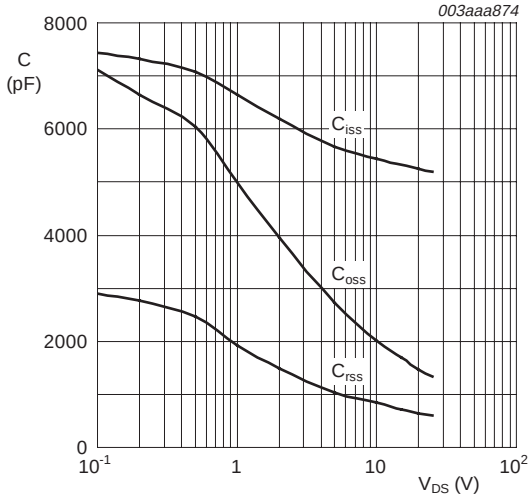
(3) Repetitive

Fig 14. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time



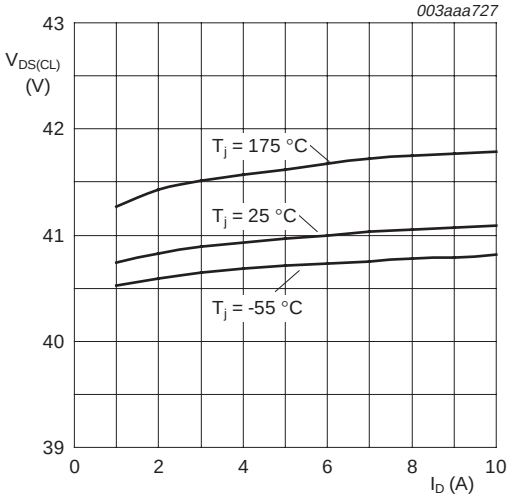
T_j = 25 °C; V_{DS} = 25 V

Fig 15. Forward transconductance as a function of drain current; typical values



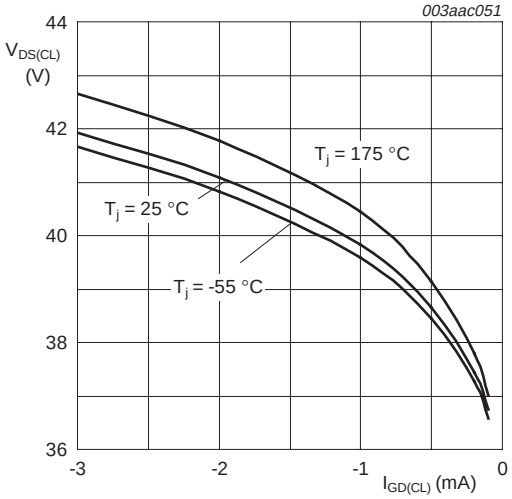
V_{GS} = 0 V; f = 1 MHz

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



$I_{GD(CL)}$ = –2 mA

Fig 17. Drain-source clamping voltage as a function of drain current; typical values

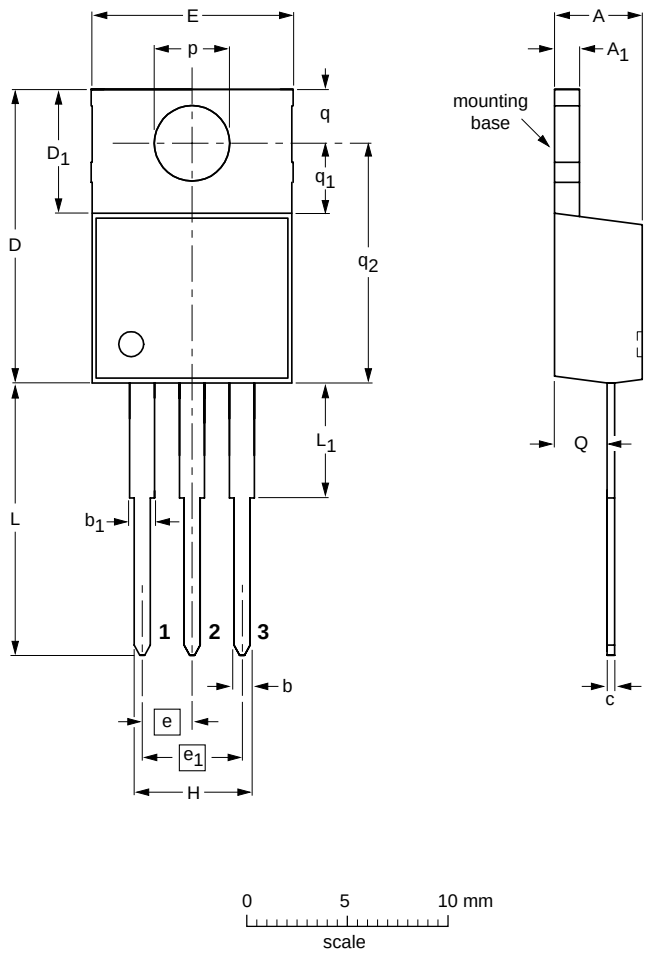


I_D = 10 A

Fig 18. Drain-source clamping voltage as a function of gate-drain clamping current; typical values

7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3 leads **SOT78C**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D	D_1	E	e	e_1	H	L	L_1	p	Q	q	q_1	q_2
mm	4.58 4.31	1.33 1.21	0.87 0.76	1.33 1.21	0.44 0.33	15.07 14.80	6.47 6.22	10.40 10.00	2.64 2.44	5.16 5.00	6.03 5.76	14.00 13.50	6.10 5.58	3.90 3.78	2.72 2.40	2.95 2.69	3.80 3.42	12.40 12.00

Notes

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78C		3-lead TO-220				~~01-12-11~~ 03-01-21

Fig 19. Package outline SOT78C (TO-220)

8. Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK7L3R3-34BRC_2	20070926	Product data sheet	-	BUK7L3R3-34BRC_1
Modifications:	• Table 5: updated maximum value of drain leakage current • Table 5: added Table note 1			
BUK7L3R3-34BRC_1	20070515	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".

[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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Date of release: 26 September 2007

Document identifier: BUK7L3R3-34BRC_2