

# BUK724R5-30C

## N-channel TrenchMOS standard level FET

Rev. 01 — 1 July 2010

Product data sheet

## 1. Product profile

### 1.1 General description

Standard 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 standard for use in high performance automotive applications.

### 1.2 Features and benefits

- AEC Q101 compliant
- Avalanche robust
- Suitable for standard level gate drive
- Suitable for thermally demanding environment up to 175°C rating

### 1.3 Applications

- 12V Motor, lamp and solenoid loads
- High performance automotive power systems
- High performance Pulse Width Modulation (PWM) applications

### 1.4 Quick reference data

Table 1. Quick reference data

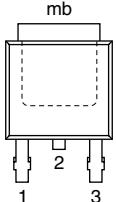
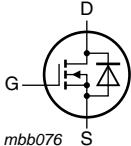
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25^\circ\text{C}; T_j \leq 175^\circ\text{C}$	-	-	30	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 1</a>	[1]	-	-	75 A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	-	157	W
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	3.8	4.5	$\text{m}\Omega$
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}; V_{sup} \leq 30\text{ V}; R_{GS} = 50\text{ }\Omega; V_{GS} = 10\text{ V}; T_{j(init)} = 25^\circ\text{C}$ ; unclamped	-	-	329	$\text{mJ}$
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 10\text{ V}; I_D = 25\text{ A}; V_{DS} = 24\text{ V}; T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 14</a>	-	21	-	$\text{nC}$



[1] Continuous current is limited by package.

## 2. Pinning information

**Table 2. Pinning information**

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate		
2	D	drain[1]		
3	S	source		
mb	D	mounting base; connected to drain		
SOT428 (DPAK)				

[1] It is not possible to make connection to pin 2.

## 3. Ordering information

**Table 3. Ordering information**

Type number	Package			Version
	Name	Description		
BUK724R5-30C	DPAK	plastic single-ended surface-mounted package (DPAK); 3 leads (one lead cropped)		SOT428

## 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	$T_j \geq 25^\circ\text{C}; T_j \leq 175^\circ\text{C}$	-	-	30	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	-	30	V
$V_{GS}$	gate-source voltage		-20	-	20	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 1</a> ; <a href="#">[1]</a> $T_{mb} = 100^\circ\text{C}; V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a> <a href="#">[2]</a> $V_{GS} = 10\text{ V}; T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 1</a> <a href="#">[2]</a>	-	-	136	A
$I_{DM}$	peak drain current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 4</a>	-	-	543	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	-	157	W
$T_{stg}$	storage temperature		-55	-	175	$^\circ\text{C}$
$T_j$	junction temperature		-55	-	175	$^\circ\text{C}$
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25^\circ\text{C}$	<a href="#">[2]</a>	-	75	A
			<a href="#">[1]</a>	-	136	A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25^\circ\text{C}$	-	-	543	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}; V_{sup} \leq 30\text{ V}; R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}; T_{j(init)} = 25^\circ\text{C}$ ; unclamped	-	-	329	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	see <a href="#">Figure 3</a>	<a href="#">[3]</a> <a href="#">[4]</a> <a href="#">[5]</a>	-	-	J

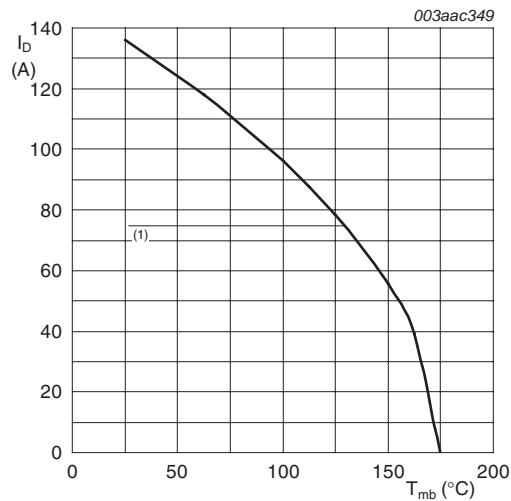
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.

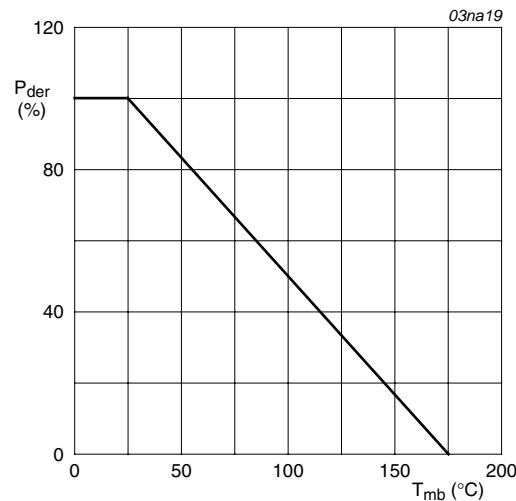
[3] Single-pulse avalanche rating limited by maximum junction temperature of  $175^\circ\text{C}$ .

[4] Repetitive avalanche rating limited by average junction temperature of  $170^\circ\text{C}$ .

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

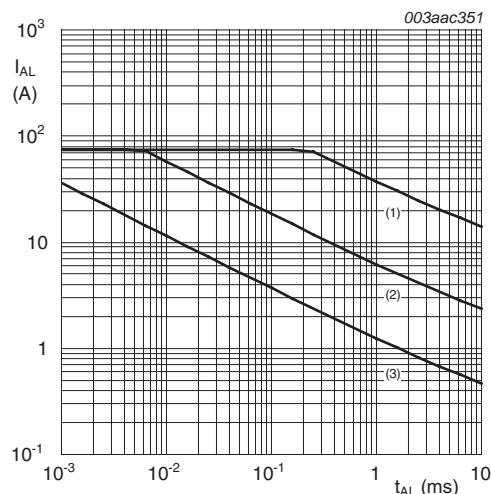


**Fig 1. Continuous drain current as a function of mounting base temperature**



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

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



- (1) Single-pulse;  $T_j = 25^{\circ}\text{C}$ .
- (2) Single-pulse;  $T_j = 150^{\circ}\text{C}$ .
- (3) Repetitive.

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

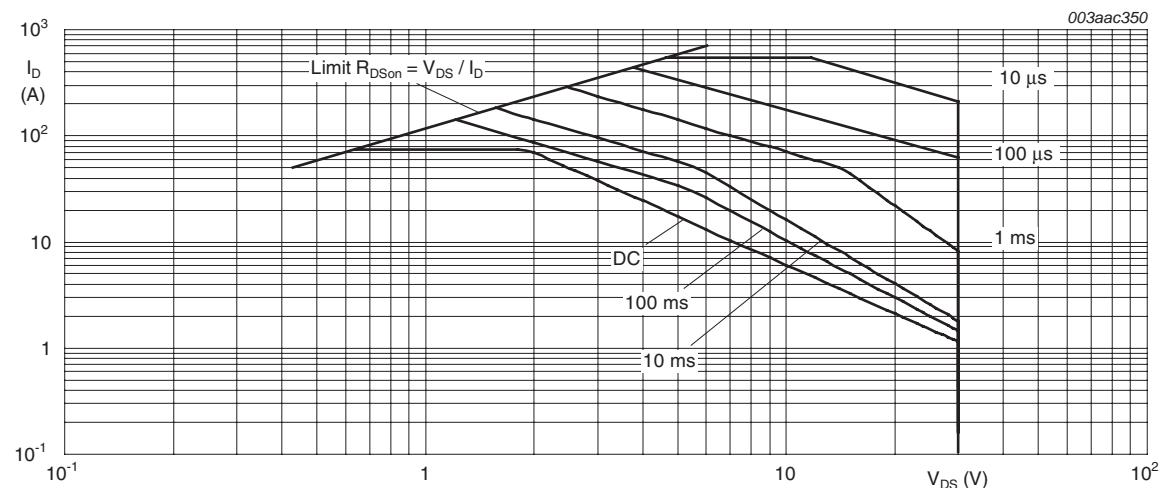


Fig 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

## 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>	-	0.65	0.95	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		-	70	-	K/W

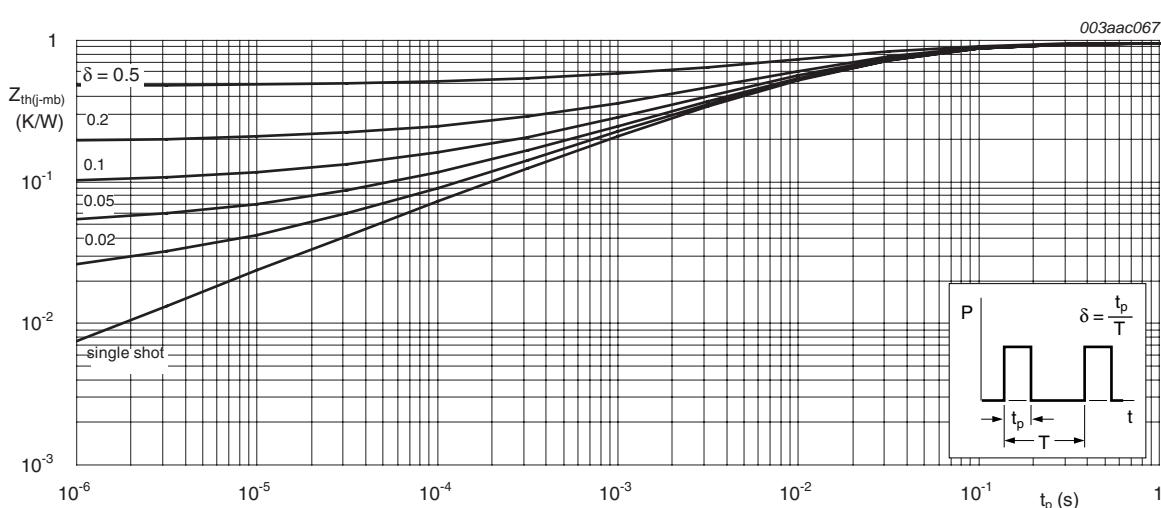


Fig 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

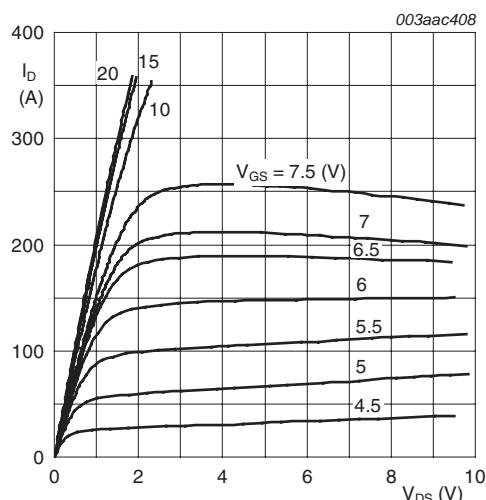
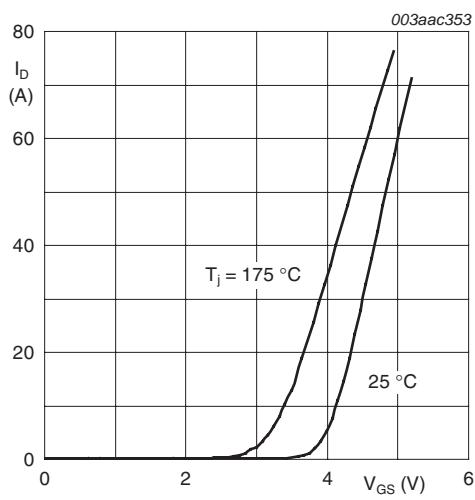
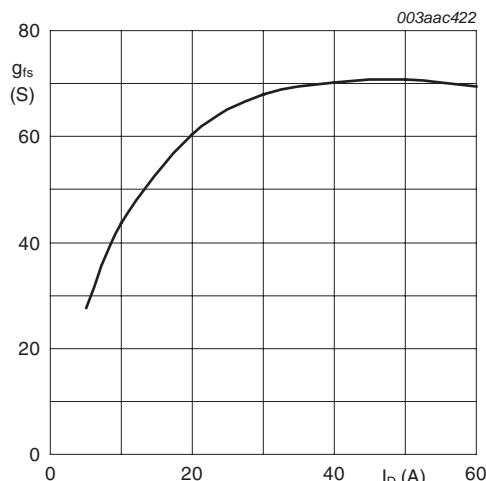
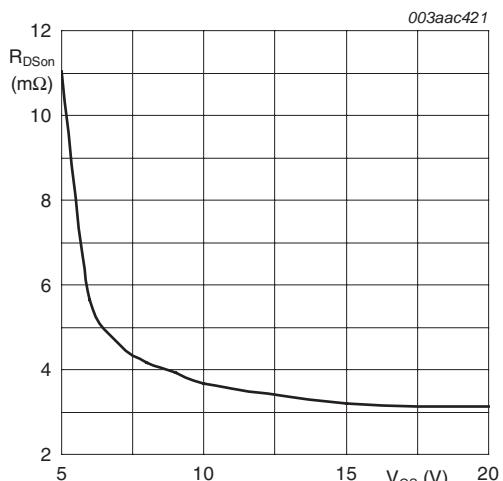
## 6. Characteristics

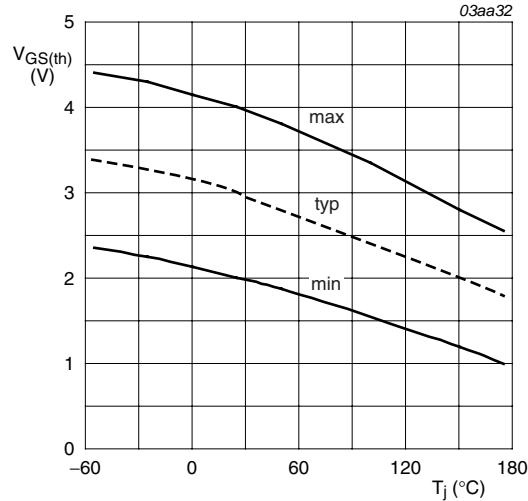
**Table 6. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ $I_D = 0.25 \text{ mA}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	30	-	-	V
$V_{GS(\text{th})}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 10</a> ; see <a href="#">Figure 11</a> $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C};$ see <a href="#">Figure 10</a> $I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see <a href="#">Figure 10</a>	2	3	4	V
$I_{DSS}$	drain leakage current	$V_{DS} = 30 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$ $V_{DS} = 30 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{DS} = 0 \text{ V}; V_{GS} = 20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$ $V_{DS} = 0 \text{ V}; V_{GS} = -20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see <a href="#">Figure 12</a> $V_{GS} = 10 \text{ V}; I_D = 25 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 12</a> ; see <a href="#">Figure 13</a>	-	-	8.5	$\text{m}\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(\text{tot})}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 24 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 14</a>	-	62	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 \text{ A}; V_{DS} = 24 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 14</a>	-	14	-	nC
$Q_{GD}$	gate-drain charge	$I_D = 25 \text{ A}; V_{DS} = 24 \text{ V}; V_{GS} = 10 \text{ V};$ $T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 14</a>	-	21	-	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>	-	2820	3760	pF
$C_{oss}$	output 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>	-	670	804	pF
$C_{rss}$	reverse transfer capacitance		-	422	580	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 25 \text{ V}; R_L = 1 \Omega; V_{GS} = 10 \text{ V};$ $R_{G(\text{ext})} = 10 \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	24	-	ns
$t_r$	rise time	$V_{DS} = 25 \text{ V}; R_L = 1 \Omega; V_{GS} = 10 \text{ V};$ $R_{G(\text{ext})} = 10 \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	51	-	ns
$t_{d(off)}$	turn-off delay time	$V_{DS} = 25 \text{ V}; R_L = 1 \Omega; V_{GS} = 10 \text{ V};$ $R_{G(\text{ext})} = 10 \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	85	-	ns
$t_f$	fall time	$V_{DS} = 25 \text{ V}; R_L = 1 \Omega; V_{GS} = 10 \text{ V};$ $R_{G(\text{ext})} = 10 \Omega; T_j = 25 \text{ }^\circ\text{C}$	-	62	-	ns
$L_D$	internal drain inductance	measured from drain to centre of die ; $T_j = 25 \text{ }^\circ\text{C}$	-	2.5	-	nH
$L_S$	internal source inductance	measured from source lead to source bond pad ; $T_j = 25 \text{ }^\circ\text{C}$	-	7.5	-	nH

**Table 6. Characteristics ...continued**

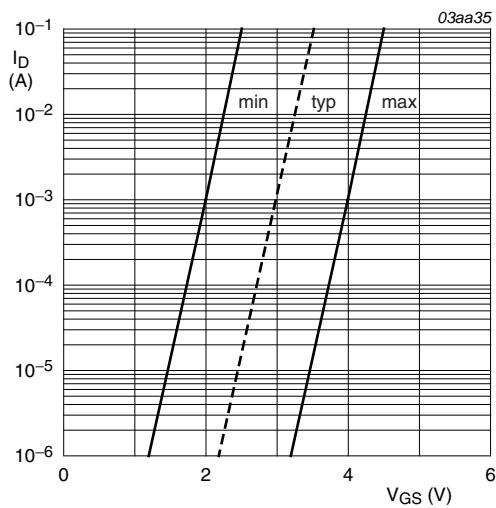
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 20 \text{ A}$ ; $V_{GS} = 0 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$ ; see <a href="#">Figure 16</a>	-	0.85	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}$ ; $dI_S/dt = -100 \text{ A}/\mu\text{s}$	-	40	-	ns
$Q_r$	recovered charge	$V_{GS} = -10 \text{ V}$ ; $V_{DS} = 25 \text{ V}$ ; $T_j = 25 \text{ }^\circ\text{C}$	-	44	-	nC

 $T_j = 25 \text{ }^\circ\text{C}$ **Fig 6. Output characteristics: drain current as a function of drain-source voltage; typical values** $V_{DS} = 25 \text{ V}$ **Fig 7. Transfer characteristics: drain current as a function of gate-source voltage; 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** $T_j = 25 \text{ }^\circ\text{C}; I_D = 15 \text{ A}$ **Fig 9. Drain-source on-state resistance as a function of gate-source voltage; typical values**



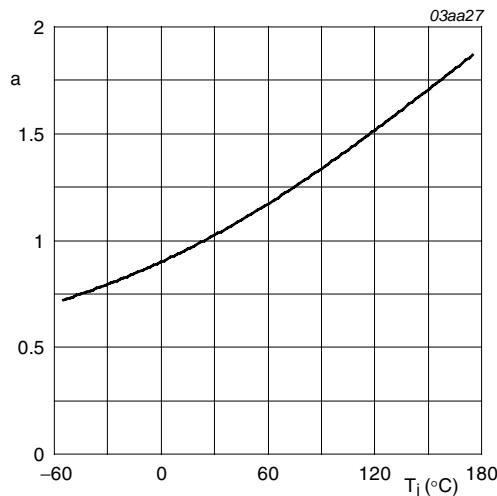
$$I_D = 1\text{mA}; V_{DS} = V_{GS}$$

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



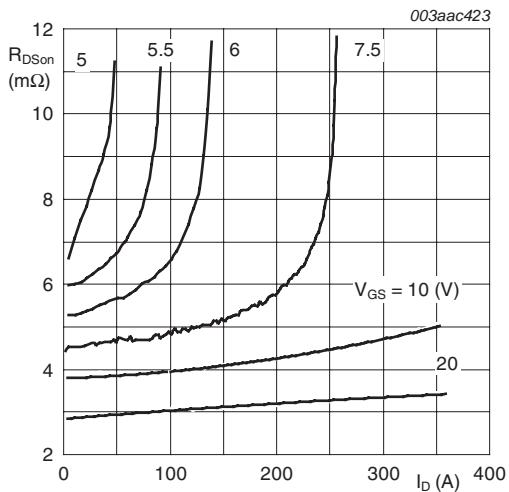
$$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$$

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



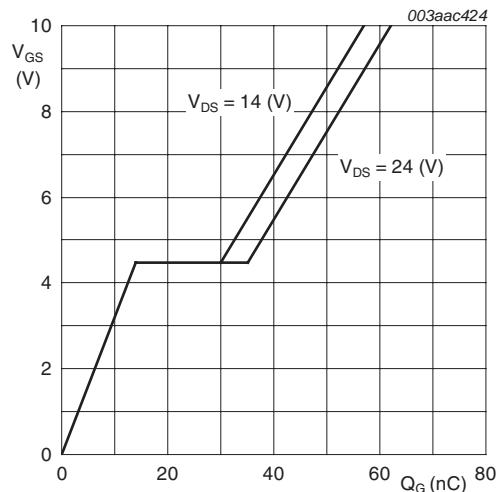
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

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



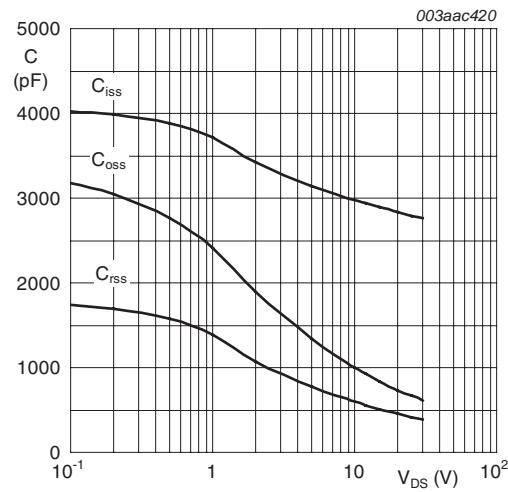
$$T_j = 25^\circ\text{C}$$

**Fig 13. Drain-source on-state resistance as a function of drain current; typical values**



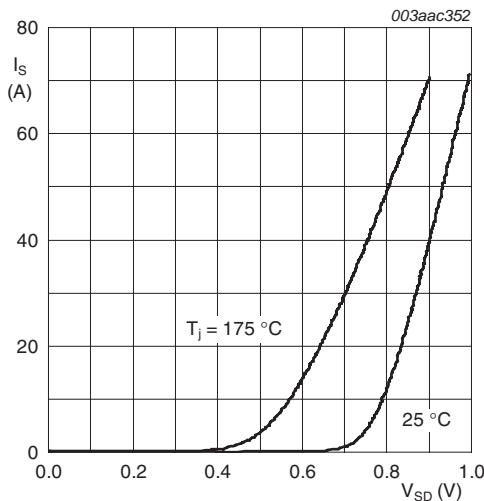
$T_j = 25^\circ\text{C}; I_D = 25\text{A}$

**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**



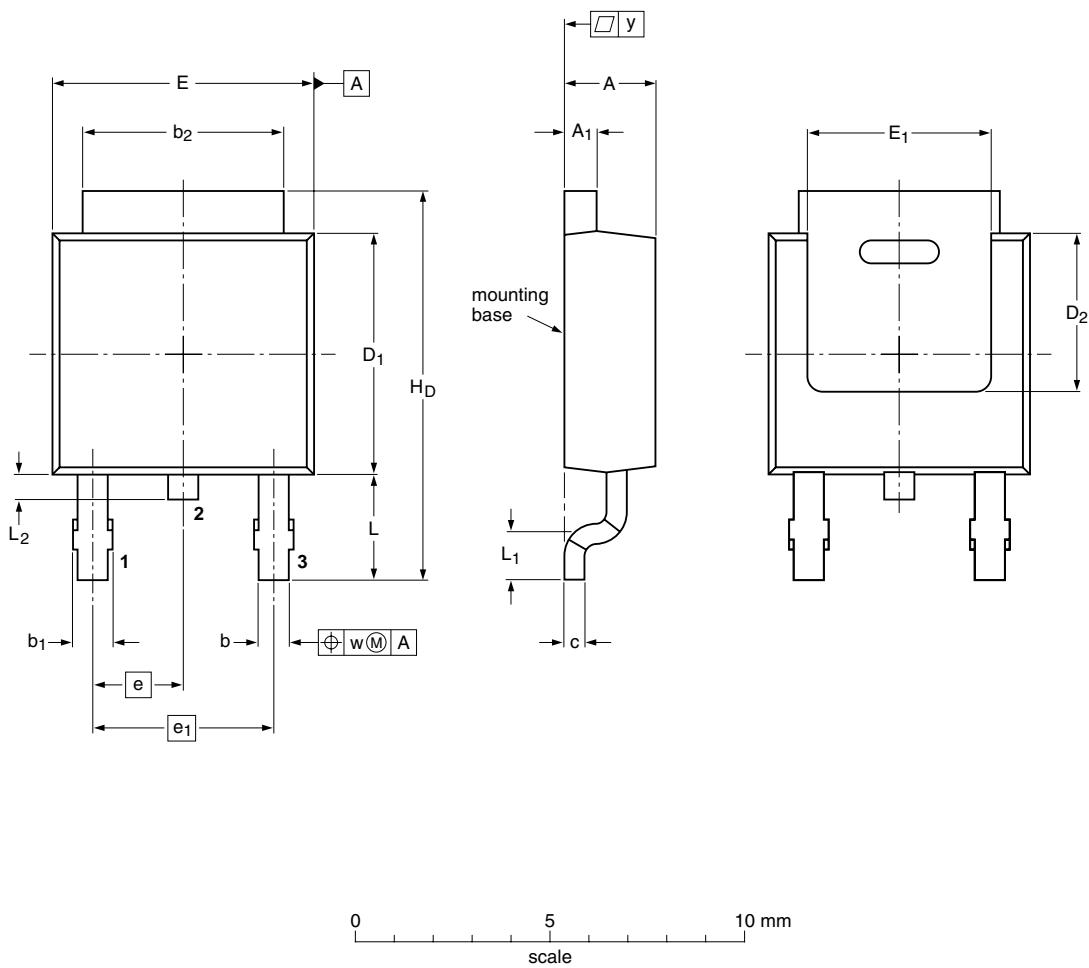
$V_{GS} = 0\text{V}$

**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 (DPAK); 3 leads (one lead cropped)

SOT428



### DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub>	b	b <sub>1</sub>	b <sub>2</sub>	c	D <sub>1</sub>	D <sub>2</sub> min	E	E <sub>1</sub> min	e	e <sub>1</sub>	H <sub>D</sub>	L	L <sub>1</sub> min	L <sub>2</sub>	w	y max
mm	2.38 2.22	0.93 0.46	0.89 0.71	1.1 0.9	5.46 5.00	0.56 0.20	6.22 5.98	4.0	6.73 6.47	4.45	2.285 4.57	4.57	10.4 9.6	2.95 2.55	0.5	0.9 0.5	0.2	0.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT428		TO-252	SC-63			06-02-14 06-03-16

Fig 17. Package outline SOT428 (DPAK)

## 8. Revision history

**Table 7. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK724R5-30C v.1	20100701	Product data sheet	-	-

## 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

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