

BUK6209-30C

N-channel TrenchMOS intermediate level FET

Rev. 2 — 1 October 2010

Product 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 standard and logic 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	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	-	30	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{mb} = 25\text{ °C}$; see Figure 1	-	-	50	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; see Figure 2	-	-	80	W
Static characteristics						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 12\text{ A}$; $T_j = 25\text{ °C}$; see Figure 11	-	8.3	9.8	mΩ

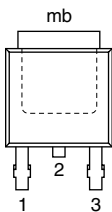
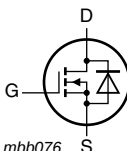
Table 1. Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 50\text{ A}$; $V_{sup} \leq 30\text{ V}$; $R_{GS} = 50\ \Omega$; $V_{GS} = 10\text{ V}$; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; unclamped	-	-	74	mJ
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 25\text{ A}$; $V_{DS} = 24\text{ V}$; $V_{GS} = 10\text{ V}$; see Figure 13 ; see Figure 14	-	7.9	-	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		
3	S	source		
mb	D	mounting base; connected to drain		

SOT428 (DPAK)

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK6209-30C	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	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$	-	30	V
V_{GS}	gate-source voltage	Pulsed [1]	-20	20	V
		DC [2]	-16	16	V
I_D	drain current	$T_{mb} = 25\text{ °C}$; $V_{GS} = 10\text{ V}$; see Figure 1 [3]	-	50	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 10\text{ V}$; see Figure 1	-	46	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; $t_p \leq 10\text{ }\mu\text{s}$; pulsed; see Figure 3	-	262	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; see Figure 2	-	80	W
T_{stg}	storage temperature		-55	175	°C
T_j	junction temperature		-55	175	°C
Source-drain diode					
I_S	source current	$T_{mb} = 25\text{ °C}$ [3]	-	50	A
I_{SM}	peak source current	$t_p \leq 10\text{ }\mu\text{s}$; pulsed; $T_{mb} = 25\text{ °C}$	-	262	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 50\text{ A}$; $V_{sup} \leq 30\text{ V}$; $R_{GS} = 50\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $T_{j(init)} = 25\text{ °C}$; unclamped	-	74	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	[4] [5] [6]	-	-	mJ

[1] Accumulated pulse duration not to exceed 5mins.

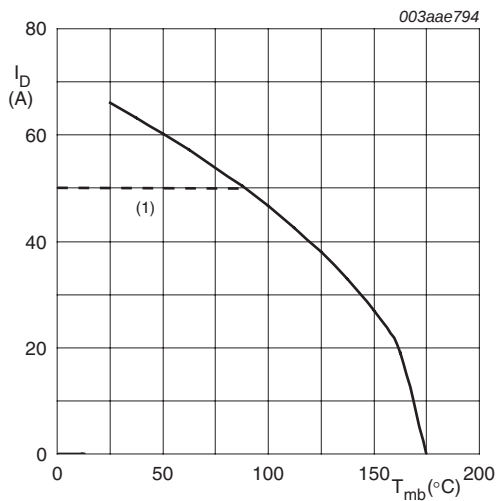
[2] -16V accumulated duration not to exceed 168hrs.

[3] Continuous current is limited by package.

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

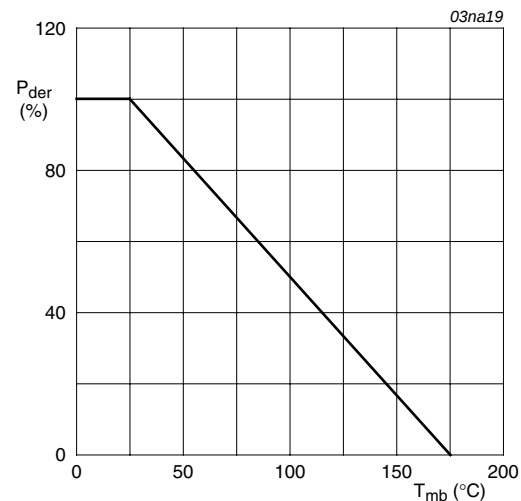
[5] Repetitive avalanche rating limited by an average junction temperature of 170 °C.

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



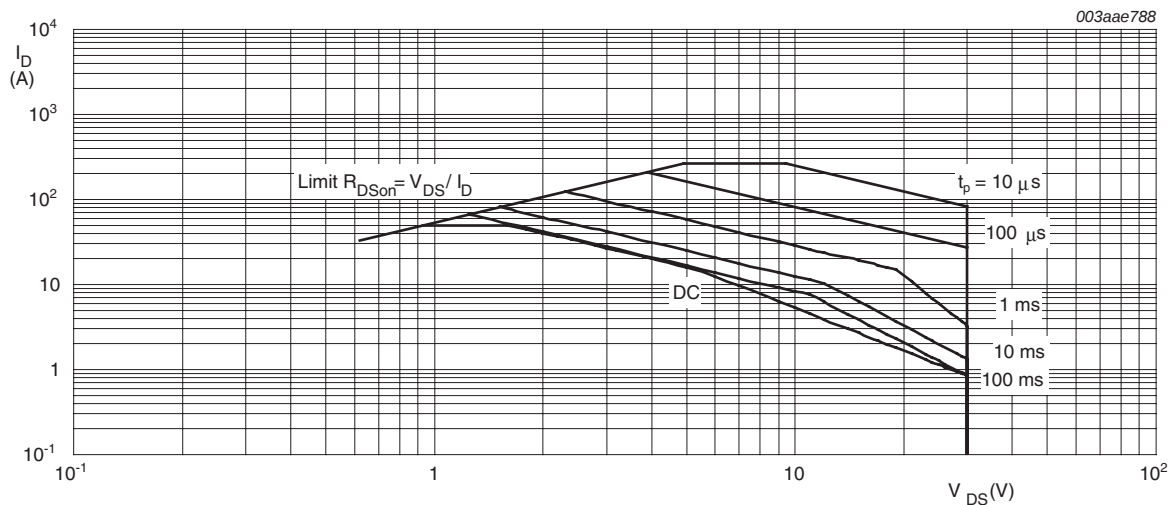
(1) Capped at 50 A due to package

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



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

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



$T_{mb} = 25^{\circ}\text{C}$; I_{DM} is a 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 Figure 4	-	-	1.87	K/W

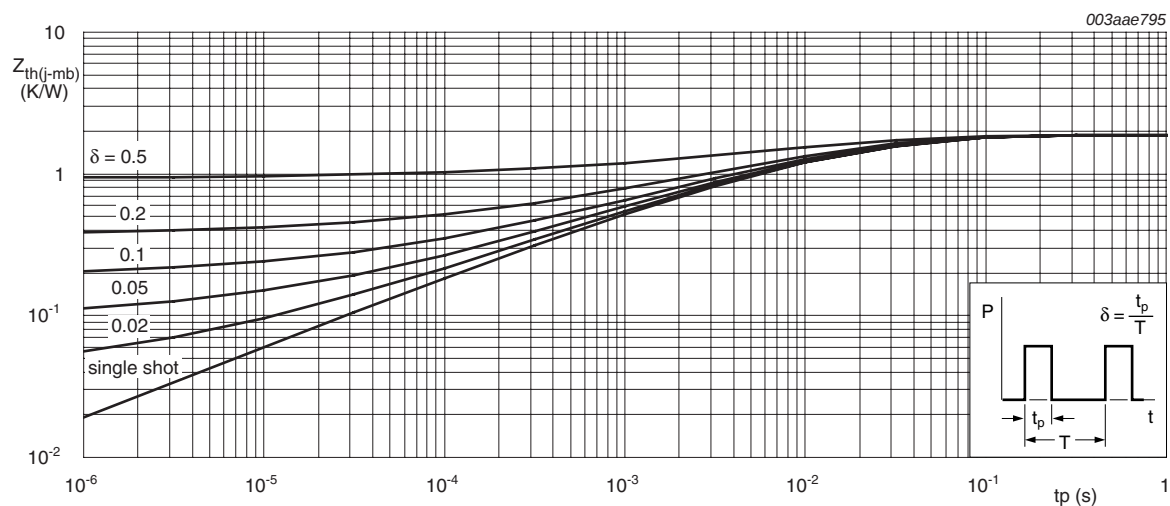


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

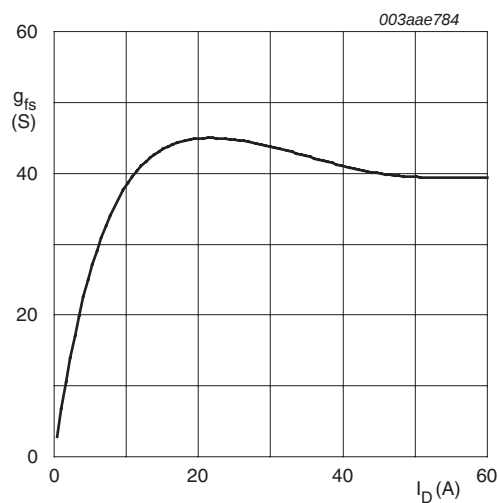
6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
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 9 ; see Figure 10	1.8	2.3	2.8	V
		I _D = 1 mA; V _{DS} = V _{GS} ; T _j = -55 °C; see Figure 9	-	-	3.3	V
		I _D = 1 mA; V _{DS} = V _{GS} ; T _j = 175 °C; see Figure 9	0.8	-	-	V
I _{DSS}	drain leakage current	V _{DS} = 30 V; V _{GS} = 0 V; T _j = 175 °C	-	-	500	μA
		V _{DS} = 30 V; V _{GS} = 0 V; T _j = 25 °C	-	0.02	1	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 = 12 A; T _j = 25 °C; see Figure 11	-	8.3	9.8	mΩ
		V _{GS} = 5 V; I _D = 12 A; T _j = 25 °C; see Figure 11	-	12	15	mΩ
		V _{GS} = 4.5 V; I _D = 12 A; T _j = 25 °C; see Figure 11	-	14.4	19.2	mΩ
		V _{GS} = 10 V; I _D = 12 A; T _j = 175 °C; see Figure 12	-	-	18.6	mΩ
Dynamic characteristics						
Q _{G(tot)}	total gate charge	I _D = 25 A; V _{DS} = 24 V; V _{GS} = 10 V; see Figure 13 ; see Figure 14	-	30.5	-	nC
		I _D = 25 A; V _{DS} = 24 V; V _{GS} = 5 V; see Figure 13 ; see Figure 14	-	17.4	-	nC
Q _{GS}	gate-source charge	I _D = 25 A; V _{DS} = 24 V; V _{GS} = 10 V; see Figure 13 ; see Figure 14	-	6.7	-	nC
Q _{GD}	gate-drain charge		-	7.9	-	nC
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 25 V; f = 1 MHz; T _j = 25 °C; see Figure 15	-	1315	1760	pF
C _{oss}	output capacitance		-	249	300	pF
C _{rss}	reverse transfer capacitance	V _{GS} = 0 V; V _{DS} = 30 V; f = 1 MHz; T _j = 25 °C; see Figure 15	-	157	220	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	-	9.2	-	ns
t _r	rise time		-	23	-	ns
t _{d(off)}	turn-off delay time		-	45.5	-	ns
t _f	fall time		-	31.3	-	ns
L _D	internal drain inductance	from upper edge of drain mounting base to centre of die; T _j = 25 °C	-	3.5	-	nH
L _S	internal source inductance	from source lead to source bond pad; T _i = 25 °C	-	7.5	-	nH

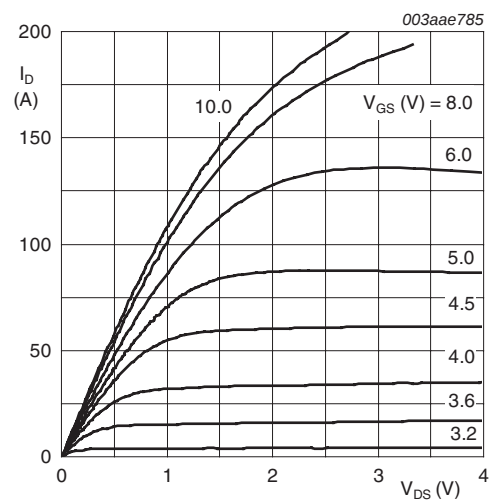
Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$; see Figure 16	-	0.8	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$;	-	34	-	ns
Q_r	recovered charge	$V_{DS} = 25\text{ V}$	-	32	-	nC



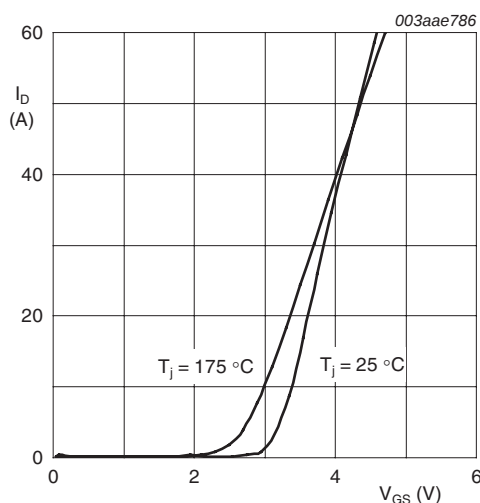
$T_j = 25\text{ }^{\circ}\text{C}$; $V_{DS} = 25\text{ V}$

Fig 5. Forward transconductance as a function of drain current; typical values



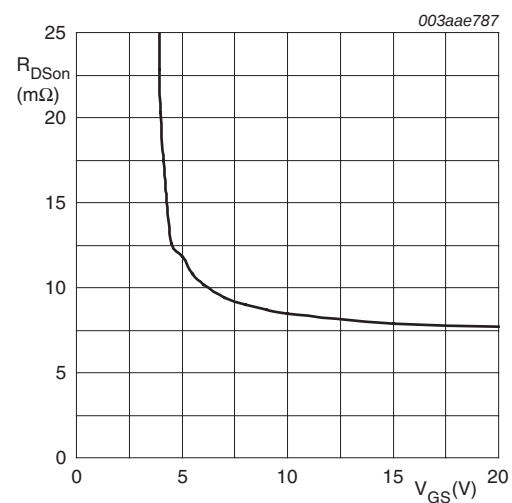
$T_j = 25\text{ }^{\circ}\text{C}$; $t_p = 300\text{ }\mu\text{s}$

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



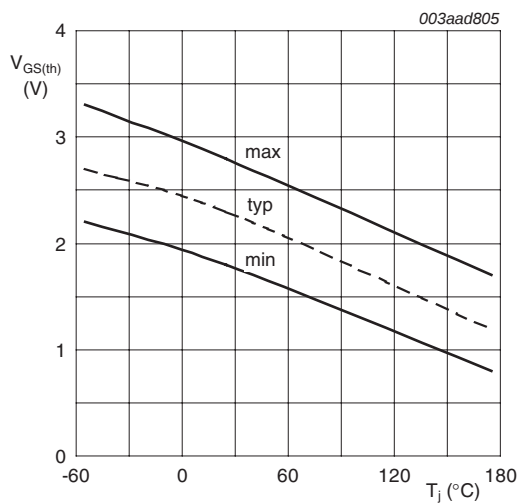
$V_{DS} > I_D \times R_{DS(on)}$

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



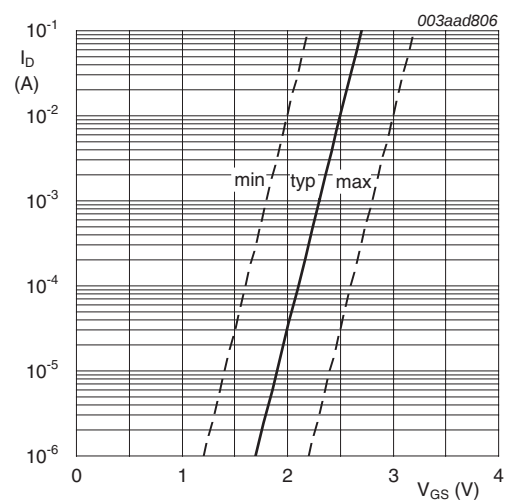
$T_j = 25\text{ }^{\circ}\text{C}$; $I_D = 12\text{ A}$

Fig 8. Drain-source on-state resistance as a function of gate-source voltage; typical values



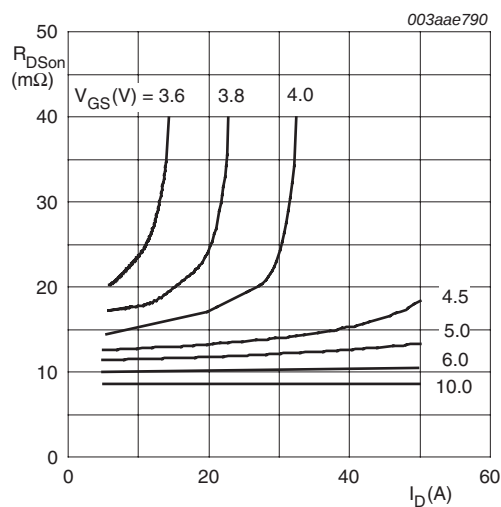
$$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$$

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



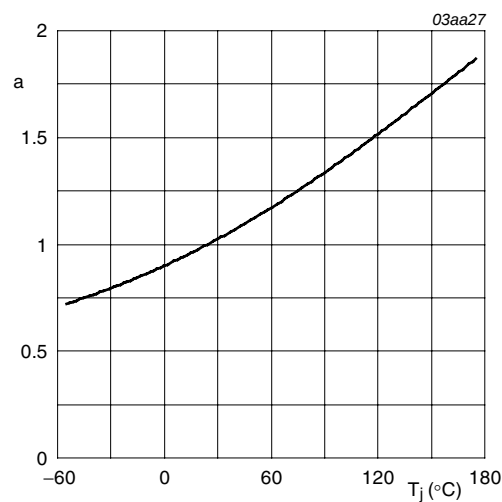
$$T_j = 25 \text{ °C}; V_{DS} = 5 \text{ V}$$

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



$$T_j = 25 \text{ °C}; t_p = 300 \text{ } \mu\text{s}$$

Fig 11. Drain-source on-state resistance as a function of drain current; typical values



$$a = \frac{R_{DS(on)}}{R_{DS(on)(25\text{°C})}}$$

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

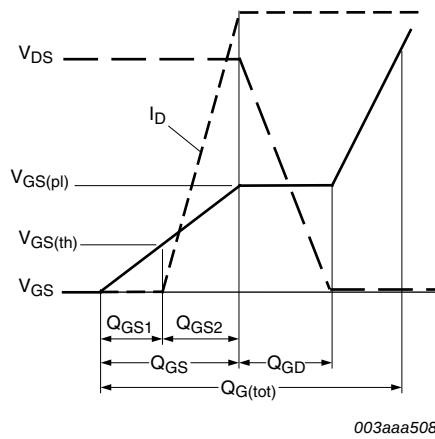


Fig 13. Gate charge waveform definitions

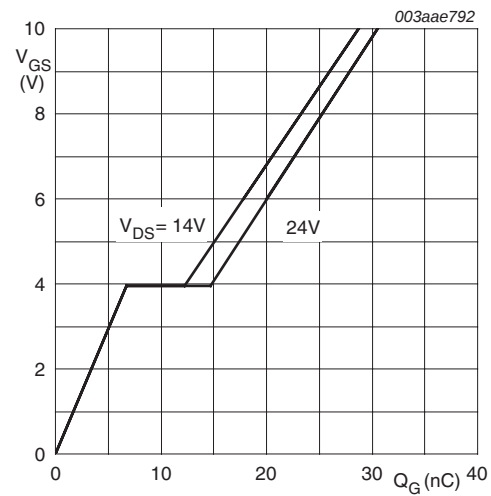


Fig 14. Gate-source voltage as a function of gate charge; typical values

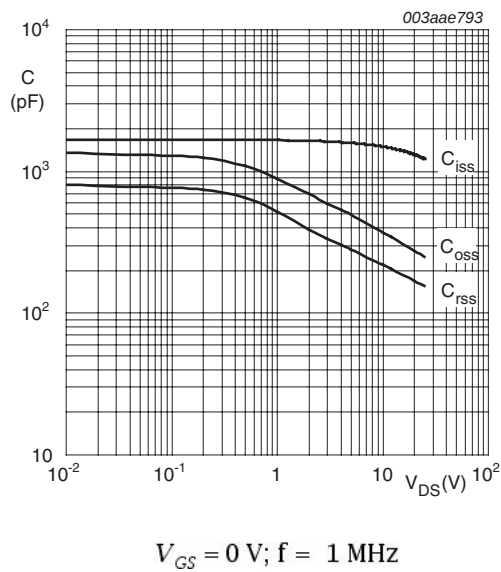


Fig 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

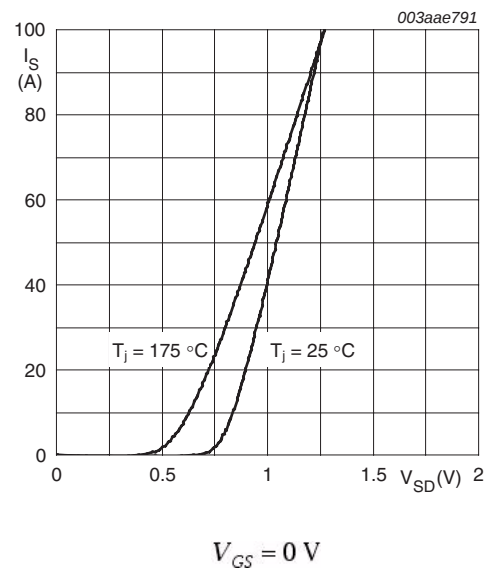
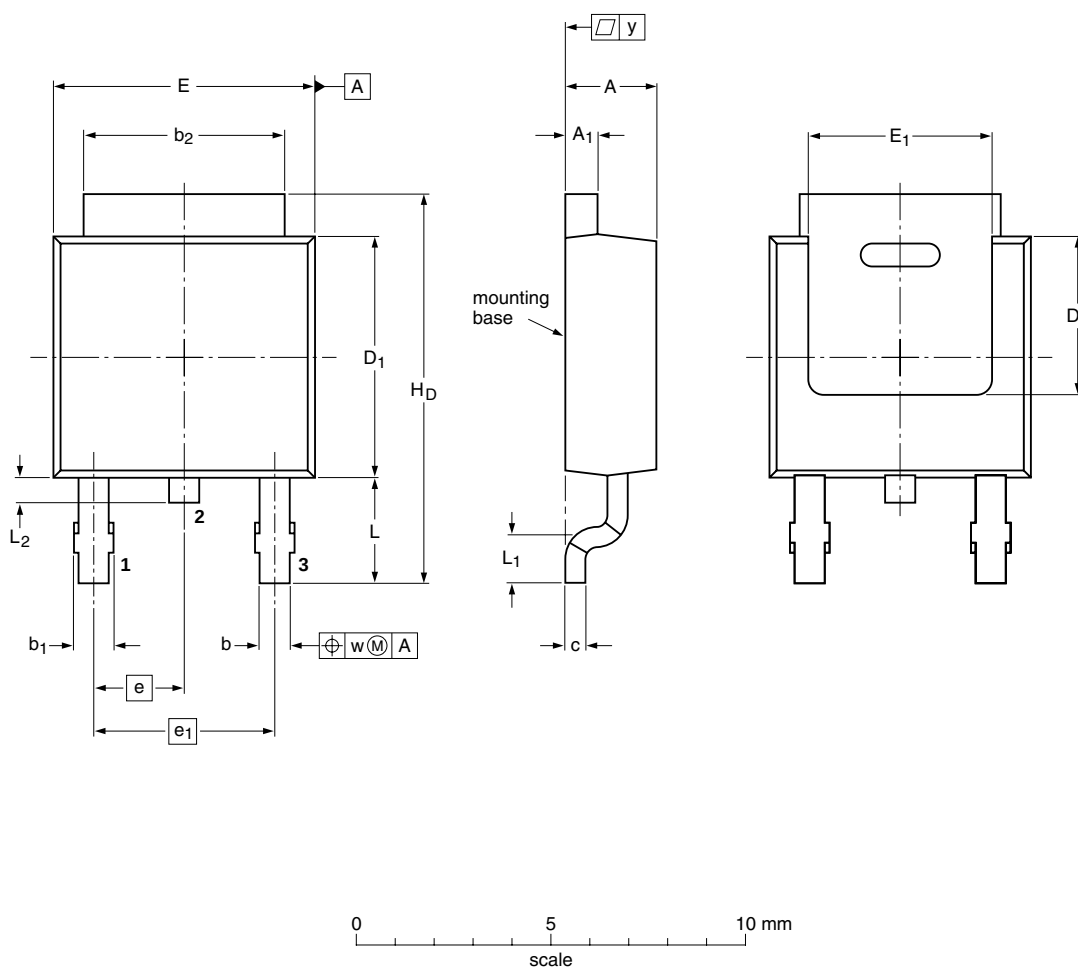


Fig 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

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 ₁	b	b ₁	b ₂	c	D ₁	D ₂ min	E	E ₁ min	e	e ₁	H _D	L	L ₁ min	L ₂	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	10.4 9.6	2.95 2.55	0.5	0.9 0.5	0.2	0.2

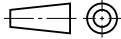
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT428		TO-252	SC-63			06-02-14 06-03-16

Fig 17. Package outline SOT428 (DPAK)

8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK6209-30C v.2	20101001	Product data sheet	-	BUK6209-30C v.1
Modifications:	• Status changed from objective to product.			
BUK6209-30C v.1	20100908	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".

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