



# BUK6228-55C

N-channel TrenchMOS intermediate level FET

Rev. 01 — 4 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 and 24 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

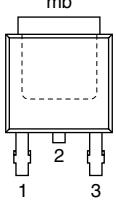
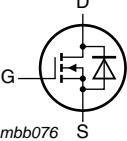
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25^\circ\text{C}$ ; $T_j \leq 175^\circ\text{C}$	-	-	55	V
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 1</a>	-	-	31	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	-	60	W
<b>Static characteristics</b>						
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 10\text{ A}$ ; $T_j = 25^\circ\text{C}$ ; see <a href="#">Figure 11</a>	-	24.8	29	$\text{m}\Omega$
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 31\text{ A}$ ; $V_{sup} \leq 55\text{ V}$ ; $R_{GS} = 50\ \Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25^\circ\text{C}$ ; unclamped	-	-	25	$\text{mJ}$
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}$ ; $V_{DS} = 44\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	5.76	-	$\text{nC}$

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## 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		Version
	Name	Description	
BUK6228-55C	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	$T_j \geq 25^\circ\text{C}; T_j \leq 175^\circ\text{C}$	-	55	V
$V_{GS}$	gate-source voltage	DC	[1]	-16	V
		Pulsed		-20	V
$I_D$	drain current	$T_{mb} = 25^\circ\text{C}; V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a>	-	31	A
		$T_{mb} = 100^\circ\text{C}; V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a>	-	22	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>	-	122	A
$P_{tot}$	total power dissipation	$T_{mb} = 25^\circ\text{C}$ ; see <a href="#">Figure 2</a>	-	60	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25^\circ\text{C}$	-	31	A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25^\circ\text{C}$	-	122	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 31\text{ A}; V_{sup} \leq 55\text{ V}; R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}; T_{j(init)} = 25^\circ\text{C}$ ; unclamped	-	25	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy		[3][4][5]	-	J

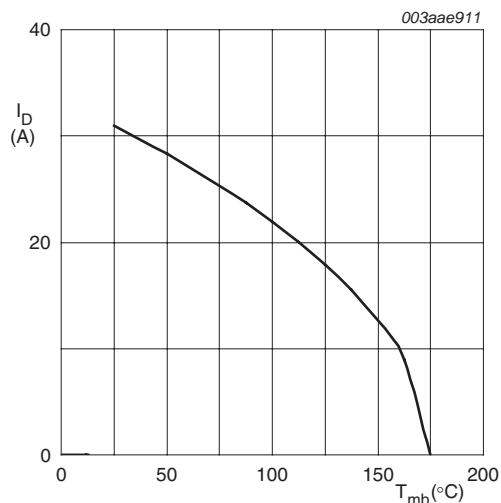
[1] -16V accumulated duration not to exceed 168 hrs

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

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

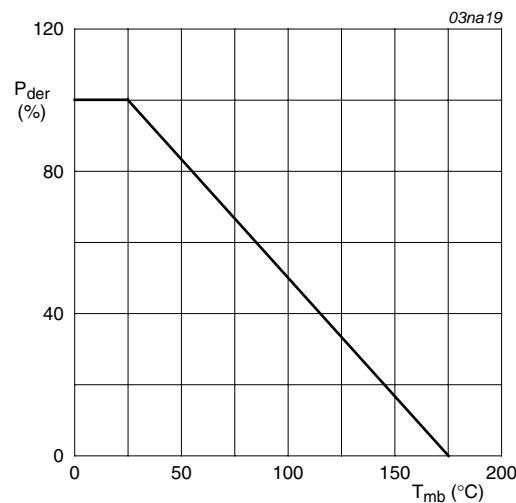
[4] Repetitive avalanche rating limited by an average junction temperature of 170 °C.

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



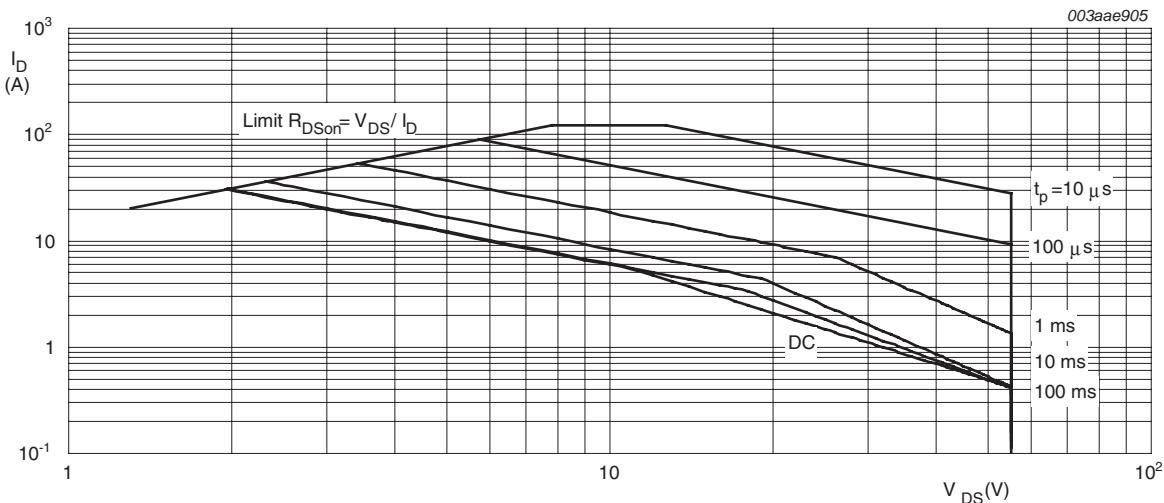
$V_{GS} \geq 10V$

**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
$R_{th(j\text{-mb})}$	thermal resistance from junction to mounting base	see <a href="#">Figure 4</a>	-	-	2.52	K/W

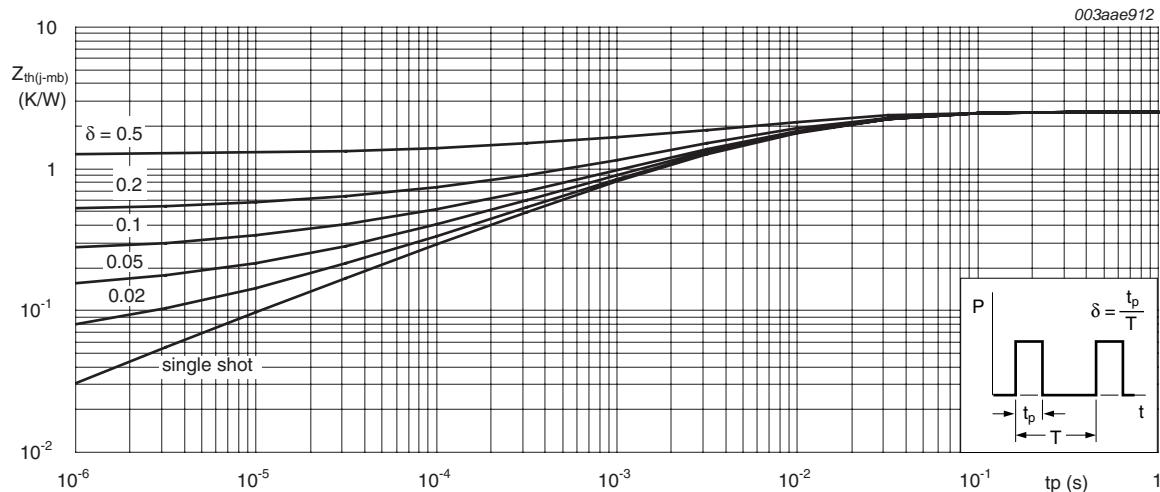


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration

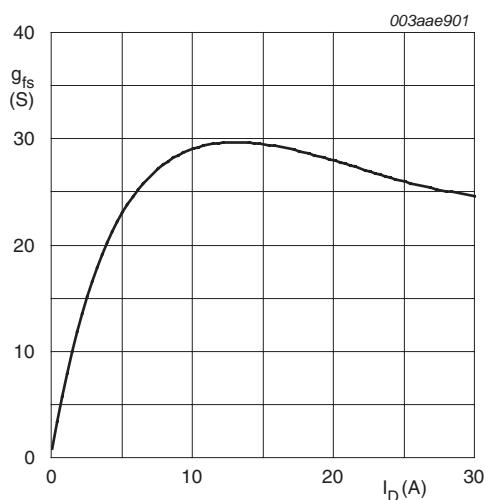
## 6. Characteristics

**Table 6. Characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25^\circ C$	55	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55^\circ C$	50	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25^\circ C$ ; see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	1.8	2.3	2.8	V
		$I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55^\circ C$ ; see <a href="#">Figure 10</a>	-	-	3.3	V
		$I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175^\circ C$ ; see <a href="#">Figure 10</a>	0.8	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 55 V; V_{GS} = 0 V; T_j = 175^\circ C$	-	-	500	$\mu A$
		$V_{DS} = 55 V; V_{GS} = 0 V; T_j = 25^\circ C$	-	0.02	1	$\mu A$
$I_{GSS}$	gate leakage current	$V_{DS} = 0 V; V_{GS} = 20 V; T_j = 25^\circ C$	-	2	100	nA
		$V_{DS} = 0 V; V_{GS} = -20 V; T_j = 25^\circ C$	-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10 V; I_D = 10 A; T_j = 25^\circ C$ ; see <a href="#">Figure 11</a>	-	24.8	29	$m\Omega$
		$V_{GS} = 5 V; I_D = 10 A; T_j = 25^\circ C$ ; see <a href="#">Figure 11</a>	-	30.3	38	$m\Omega$
		$V_{GS} = 4.5 V; I_D = 10 A; T_j = 25^\circ C$ ; see <a href="#">Figure 11</a>	-	32.9	44	$m\Omega$
		$V_{GS} = 10 V; I_D = 10 A; T_j = 175^\circ C$ ; see <a href="#">Figure 12</a> ; see <a href="#">Figure 11</a>	-	-	64	$m\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 A; V_{DS} = 44 V; V_{GS} = 5 V$ ; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	11	-	nC
		$I_D = 25 A; V_{DS} = 44 V; V_{GS} = 10 V$ ; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	20.2	-	nC
$Q_{GS}$	gate-source charge		-	3.73	-	nC
$Q_{GD}$	gate-drain charge		-	5.76	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz$	-	1003	1340	pF
$C_{oss}$	output capacitance	$T_j = 25^\circ C$ ; see <a href="#">Figure 15</a>	-	102	123	pF
$C_{rss}$	reverse transfer capacitance		-	70	96	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 45 V; R_L = 1.8 \Omega; V_{GS} = 10 V$	-	6.6	-	ns
$t_r$	rise time	$R_{G(ext)} = 10 \Omega$	-	21.9	-	ns
$t_{d(off)}$	turn-off delay time		-	22.5	-	ns
$t_f$	fall time		-	10.6	-	ns
$L_D$	internal drain inductance	from upper edge of drain mounting base to centre of die ; $T_j = 25^\circ C$	-	3.5	-	nH
$L_S$	internal source inductance	from source lead to source bond pad ; $T_j = 25^\circ C$	-	7.5	-	nH

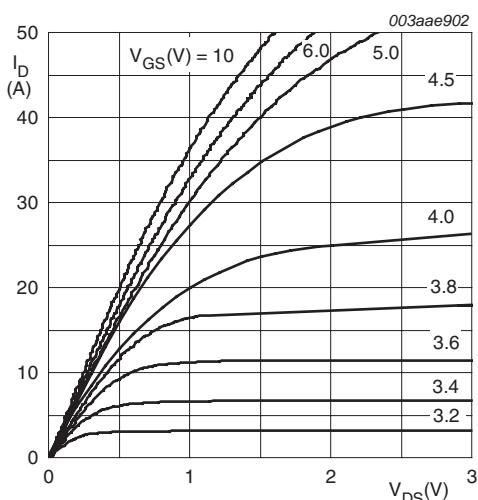
Table 6. Characteristics ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 16</a>	-	0.9	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s};$ $V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}$	-	39.9	-	ns
$Q_r$	recovered charge	$V_{GS} = 0 \text{ V}; V_{DS} = 25 \text{ V}$	-	58.4	-	nC



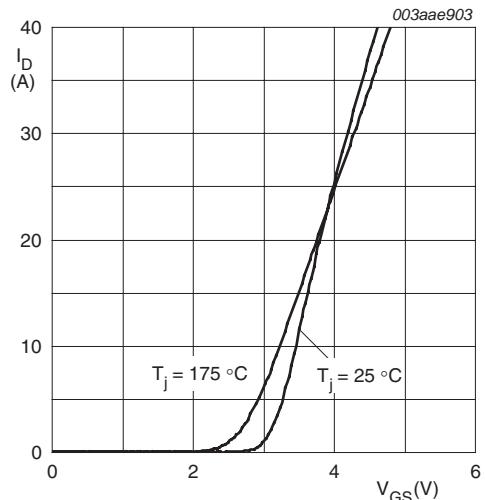
$T_j = 25 \text{ }^\circ\text{C}; V_{DS} = 25 \text{ V}$

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



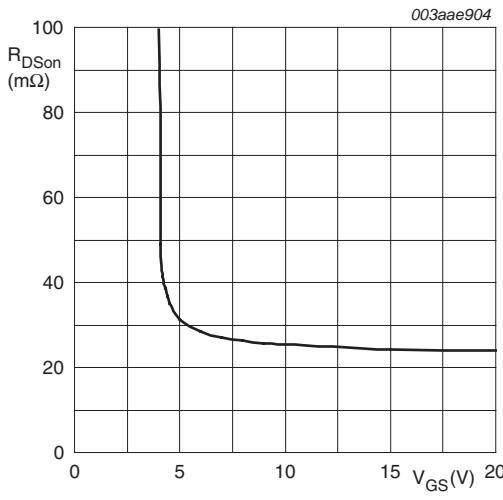
$T_j = 25 \text{ }^\circ\text{C}; t_p = 300 \mu\text{s}$

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



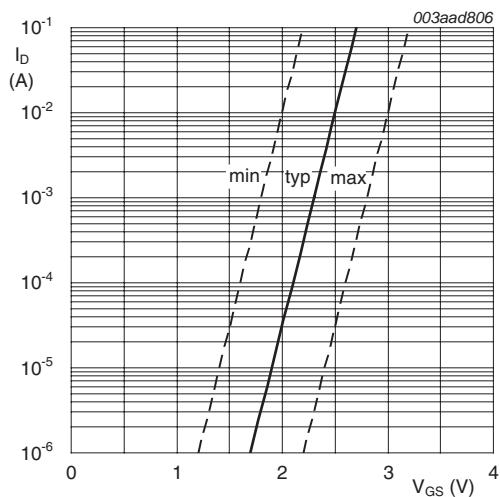
$V_{DS} > I_D \times R_{DSon}$

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



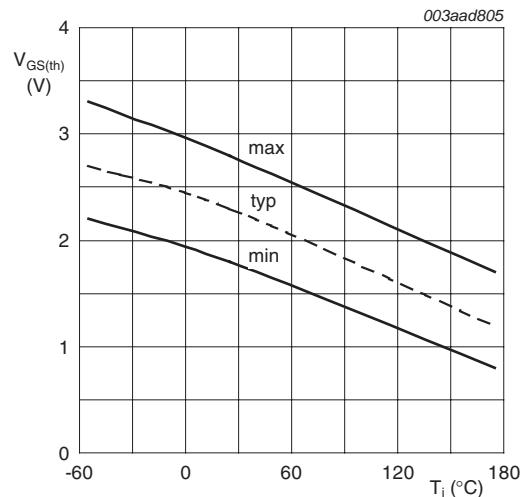
$T_j = 25 \text{ }^\circ\text{C}; I_D = 10 \text{ A}$

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



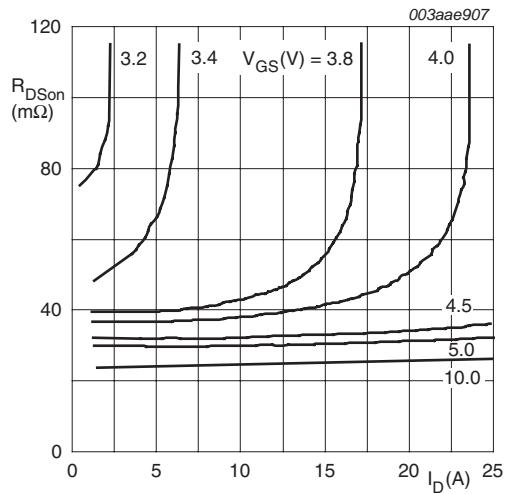
$T_j = 25^\circ\text{C}; V_{DS} = 5\text{V}$

**Fig 9. Sub-threshold drain current as a function of gate-source voltage**



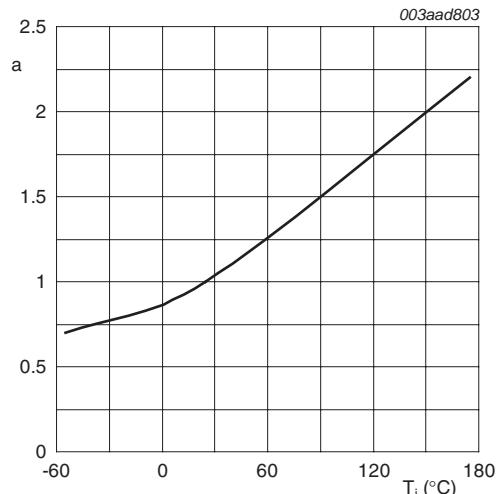
$I_D = 1\text{mA}; V_{DS} = V_{GS}$

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



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

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

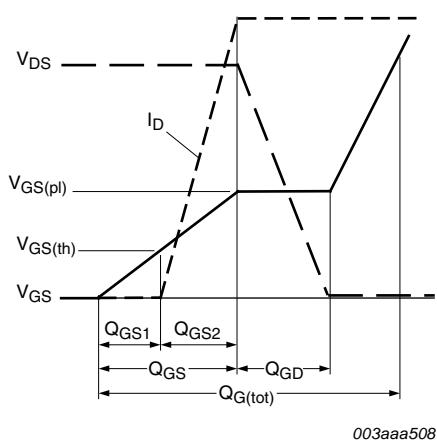


Fig 13. Gate charge waveform definitions

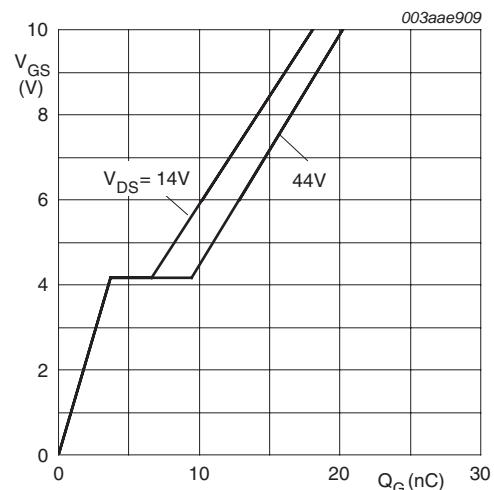

 $T_j = 25^\circ\text{C}; I_D = 25 \text{ A}$ 

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

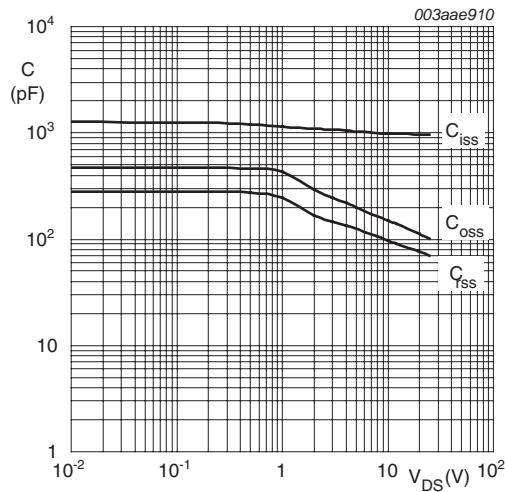

 $V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$ 

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

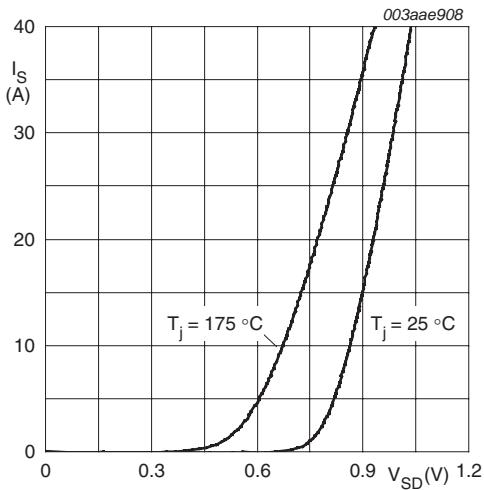

 $V_{GS} = 0 \text{ V}$ 

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

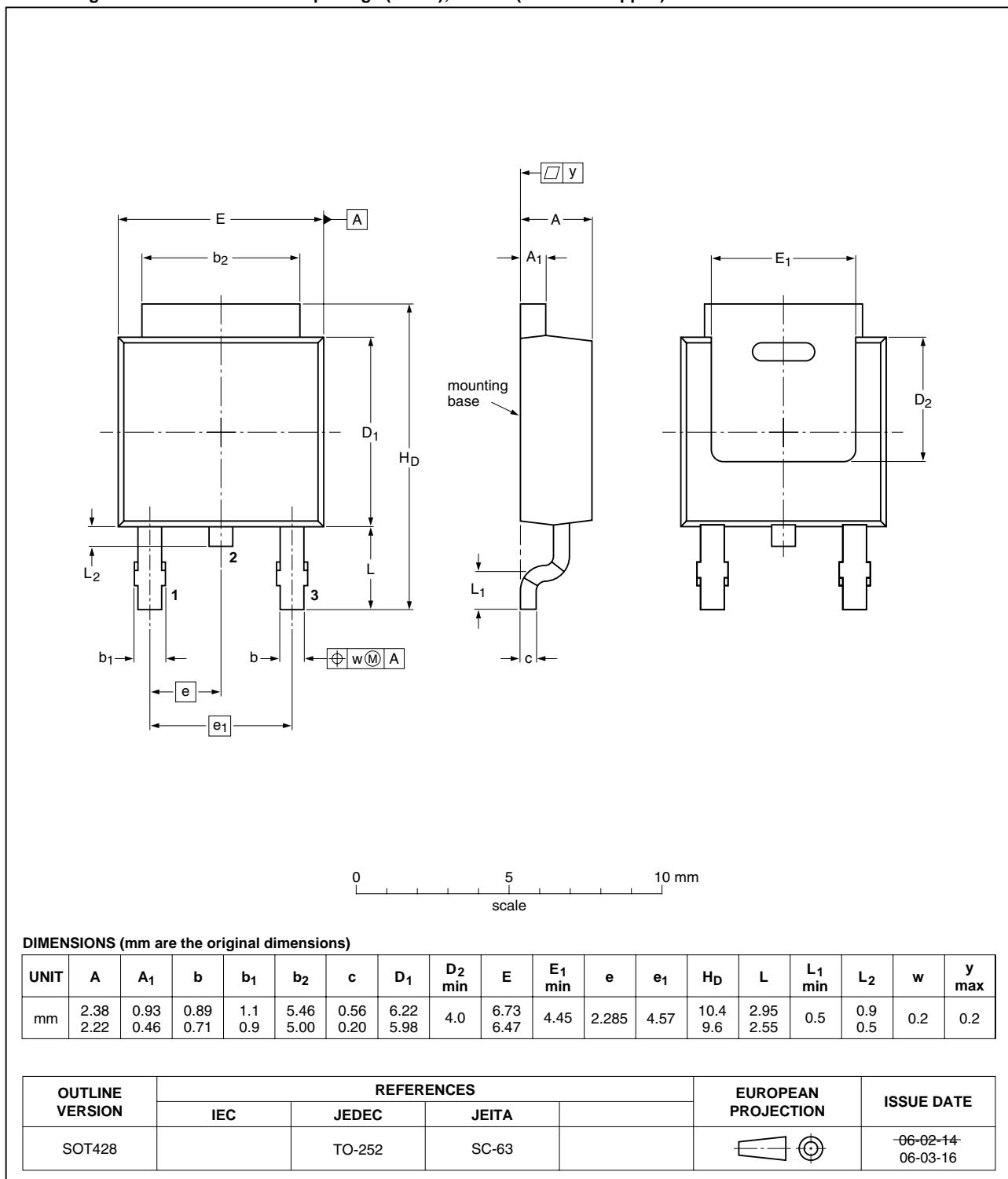


Fig 17. Package outline SOT428 (DPAK)

## 8. Revision history

**Table 7. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK6228-55C v.1	20101004	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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<b>1</b>	<b>Product profile</b>	<b>1</b>
1.1	General description	1
1.2	Features and benefits	1
1.3	Applications	1
1.4	Quick reference data	1
<b>2</b>	<b>Pinning information</b>	<b>2</b>
<b>3</b>	<b>Ordering information</b>	<b>2</b>
<b>4</b>	<b>Limiting values</b>	<b>3</b>
<b>5</b>	<b>Thermal characteristics</b>	<b>5</b>
<b>6</b>	<b>Characteristics</b>	<b>6</b>
<b>7</b>	<b>Package outline</b>	<b>10</b>
<b>8</b>	<b>Revision history</b>	<b>11</b>
<b>9</b>	<b>Legal information</b>	<b>12</b>
9.1	Data sheet status	12
9.2	Definitions	12
9.3	Disclaimers	12
9.4	Trademarks	13
<b>10</b>	<b>Contact information</b>	<b>13</b>

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