



# BUK6212-40C

N-channel TrenchMOS intermediate level FET

Rev. 2 — 21 September 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 TrenchMOS technology. This product has been designed and qualified to the appropriate AEC standard for use in automotive critical 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 solenoids
- 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	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	-	40	V
$I_D$	drain current	$V_{GS} = 10\text{ V}; T_{mb} = 25\text{ °C};$ see <a href="#">Figure 1</a>	<a href="#">[1]</a>	-	50	A
$P_{tot}$	total power dissipation	see <a href="#">Figure 2</a>	-	-	80	W
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}; I_D = 12\text{ A};$ $T_{mb} = 25\text{ °C};$ see <a href="#">Figure 11</a>	-	9.5	11.2	mΩ

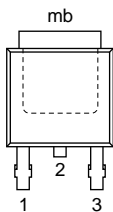
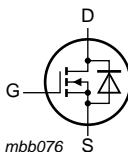
Table 1. Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 50\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$ ; unclamped	-	-	55	mJ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$I_D = 25\text{ A}$ ; $V_{DS} = 32\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	10.1	-	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		Version
	Name	Description	
BUK6212-40C	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	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	40	V
$V_{GS}$	gate-source voltage	Pulsed <a href="#">[1]</a>	-20	20	V
		DC <a href="#">[2]</a>	-16	16	V
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a> <a href="#">[3]</a>	-	50	A
		$T_{mb} = 100\text{ °C}$ ; $V_{GS} = 10\text{ V}$ ; see <a href="#">Figure 1</a>	-	41	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}$ ; $t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; see <a href="#">Figure 3</a>	-	233	A
$P_{tot}$	total power dissipation	see <a href="#">Figure 2</a>	-	80	W
$T_{stg}$	storage temperature		-55	175	°C
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$ <a href="#">[3]</a>	-	50	A
$I_{SM}$	peak source current	$t_p \leq 10\text{ }\mu\text{s}$ ; pulsed; $T_{mb} = 25\text{ °C}$	-	233	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 50\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(init)} = 25\text{ °C}$ ; unclamped	-	55	mJ
$E_{DS(AL)R}$	repetitive drain-source avalanche energy	<a href="#">[4]</a> <a href="#">[5]</a> <a href="#">[6]</a>	-	-	J

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

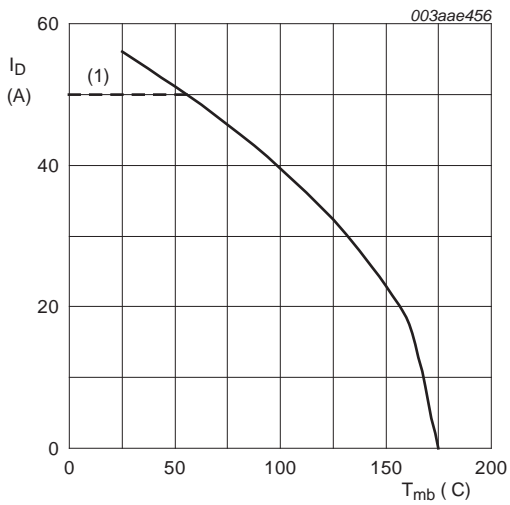
[2] -16V accumulated duration not to exceed 168 hrs.

[3] Continuous current is limited by package.

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

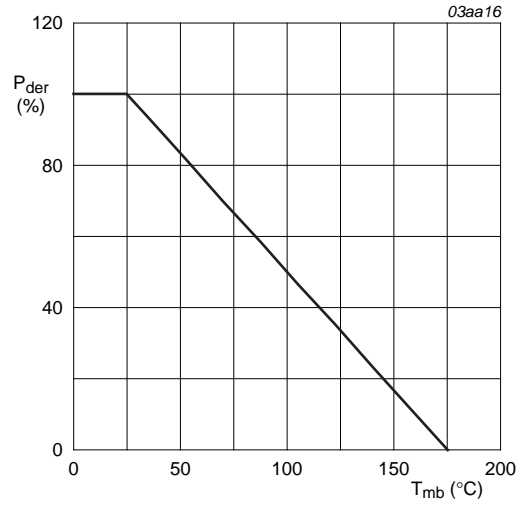
[5] Repetitive avalanche rating limited by an average junction temperature of 170 °C.

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



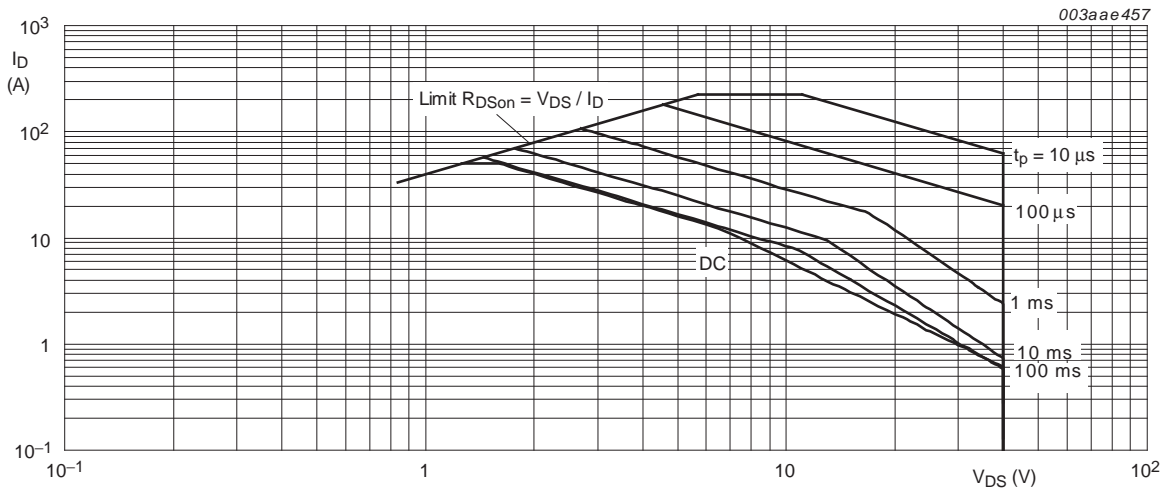
(1) Capped at 50 A due to package

**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**



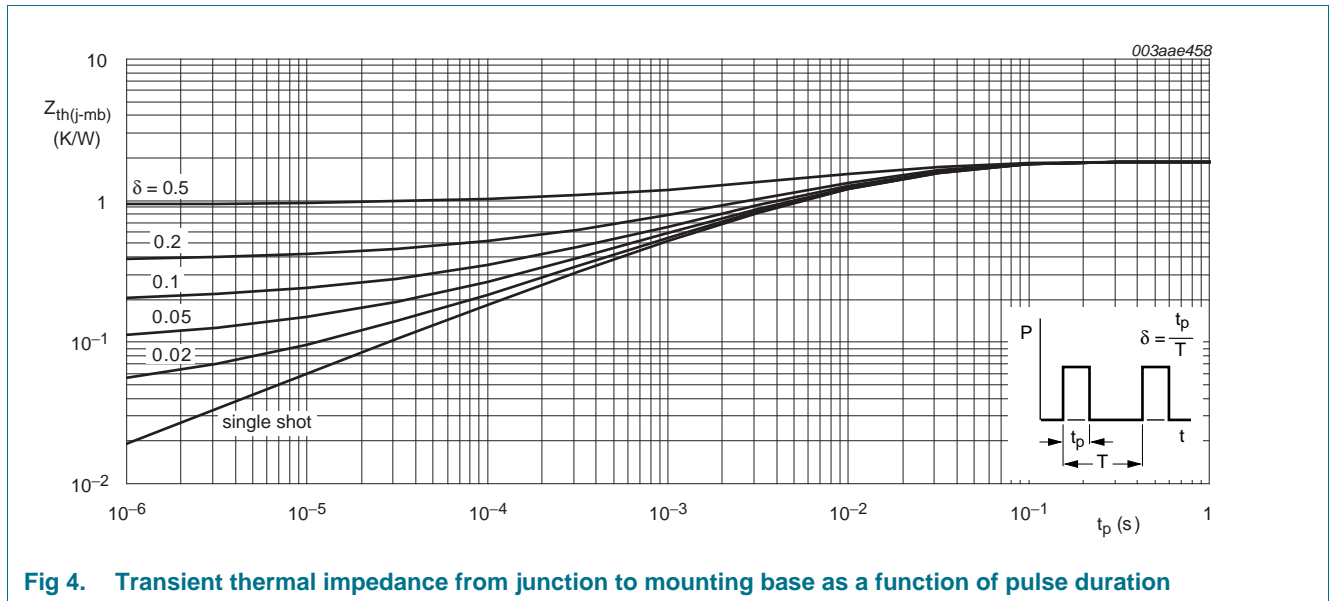
$T_{mb} = 25^{\circ}\text{C}; I_{DM}$  is a single pulse

**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 <a href="#">Figure 4</a>	-	-	1.87	K/W



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

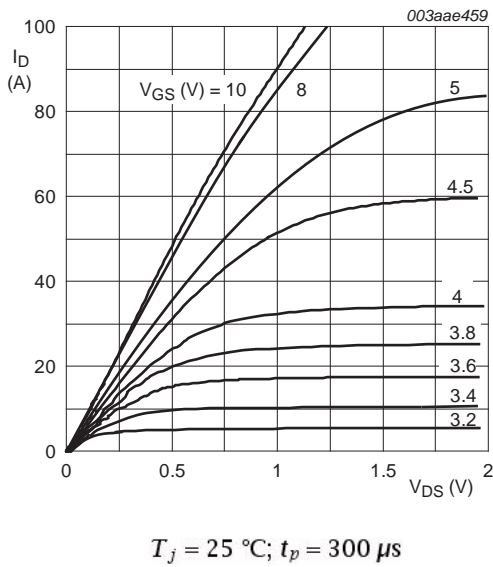
## 6. Characteristics

Table 6. Characteristics

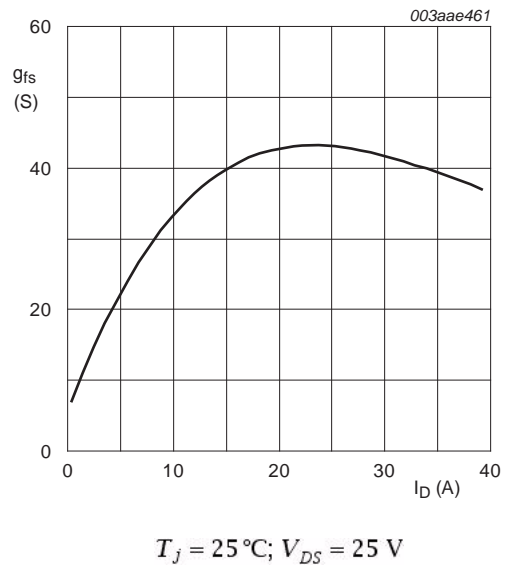
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	40	-	-	V
		$I_D = 250 \mu\text{A}; V_{GS} = 0 \text{ V}; T_j = -55 \text{ }^\circ\text{C}$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	1.8	2.3	2.8	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ\text{C};$ see <a href="#">Figure 9</a> ; see <a href="#">Figure 10</a>	-	-	3.3	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ\text{C}$	0.8	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	0.02	1	$\mu\text{A}$
		$V_{DS} = 40 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ\text{C}$	-	-	500	$\mu\text{A}$
$I_{GSS}$	gate leakage current	$V_{DS} = 0 \text{ V}; V_{GS} = 20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
		$V_{DS} = 0 \text{ V}; V_{GS} = -20 \text{ V}; T_j = 25 \text{ }^\circ\text{C}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 12 \text{ A}; T_{mb} = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 11</a>	-	9.5	11.2	m $\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 12 \text{ A}; T_j = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 11</a>	-	13	16.3	m $\Omega$
		$V_{GS} = 4.5 \text{ V}; I_D = 12 \text{ A}; T_{mb} = 25 \text{ }^\circ\text{C};$ see <a href="#">Figure 11</a>	-	15	20	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 12 \text{ A}; T_j = 175 \text{ }^\circ\text{C};$ see <a href="#">Figure 12</a> ; see <a href="#">Figure 11</a>	-	-	23.5	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V};$ see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	33.9	-	nC
		$I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 5 \text{ V};$ see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	19.5	-	nC
$Q_{GS}$	gate-source charge	$I_D = 25 \text{ A}; V_{DS} = 32 \text{ V}; V_{GS} = 10 \text{ V};$ see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	5.4	-	nC
$Q_{GD}$	gate-drain charge	see <a href="#">Figure 13</a> ; see <a href="#">Figure 14</a>	-	10.1	-	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>	-	1422	1900	pF
$C_{oss}$	output capacitance		-	205	250	pF
$C_{rss}$	reverse transfer capacitance		-	143	200	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; R_L = 1.2 \text{ } \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 10 \text{ } \Omega$	-	9.7	-	ns
$t_r$	rise time		-	21	-	ns
$t_{d(off)}$	turn-off delay time		-	54	-	ns
$t_f$	fall time		-	32	-	ns
$L_D$	internal drain inductance	measured from source lead to source bond pad; ; $T_j = 25 \text{ }^\circ\text{C}$	-	3.5	-	nH
$L_S$	internal source inductance	$T_j = 25 \text{ }^\circ\text{C};$ measured from drain to centre of die;	-	2.5	-	nH

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

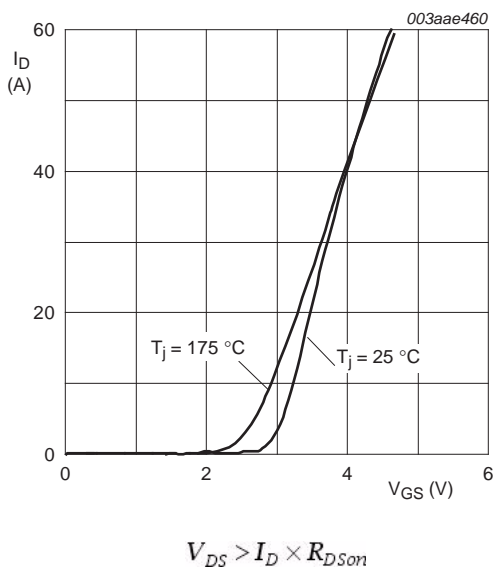
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; see <a href="#">Figure 16</a>	-	0.9	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20\text{ A}$ ; $di_S/dt = -100\text{ A}/\mu\text{s}$ ; $V_{GS} = 0\text{ V}$ ;	-	35.6	-	ns
$Q_r$	recovered charge	$V_{DS} = 25\text{ V}$	-	38	-	nC



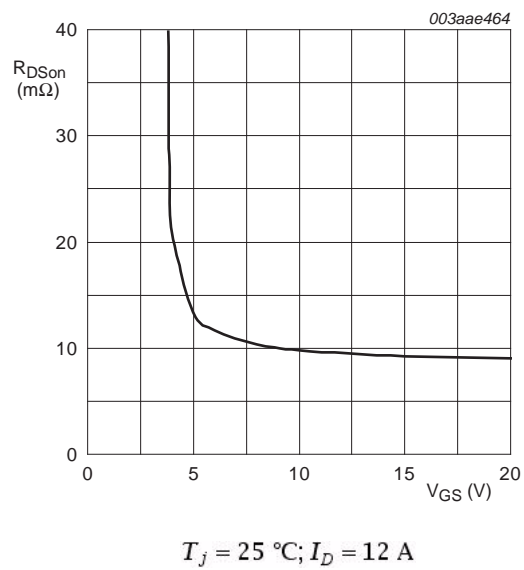
**Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values**



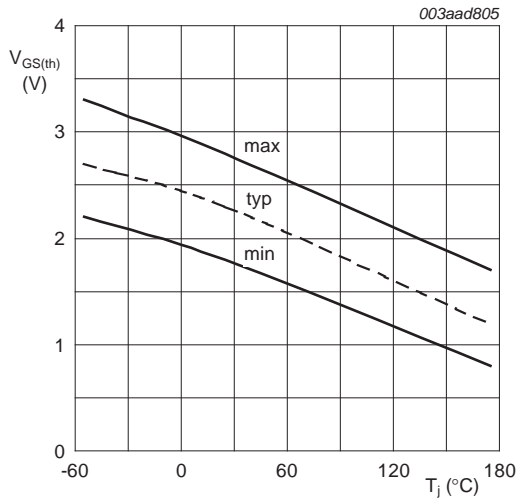
**Fig 6. Forward transconductance as a function of drain current; typical values**



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

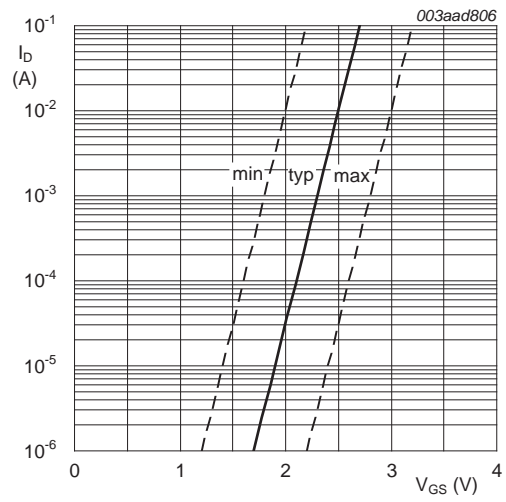


**Fig 8. Drain-source on-state resistance as a function of gate-source voltage; typical values**



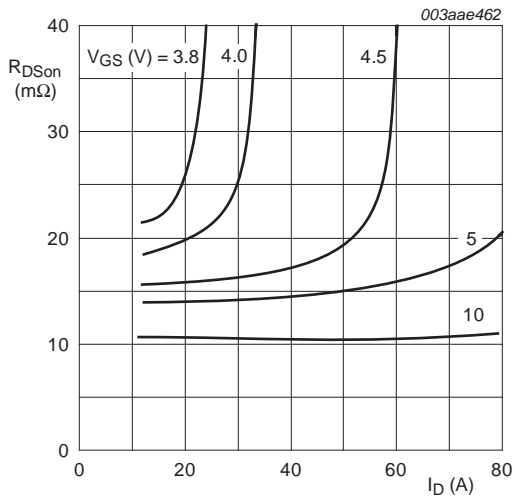
$I_D = 1\text{ mA}; V_{DS} = V_{GS}$

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



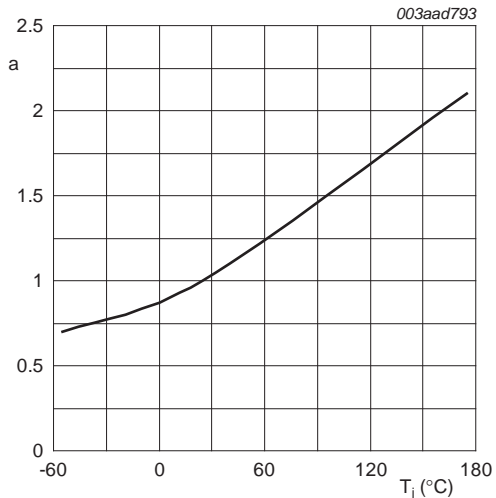
$T_j = 25\text{ °C}; V_{DS} = 5\text{ V}$

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



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

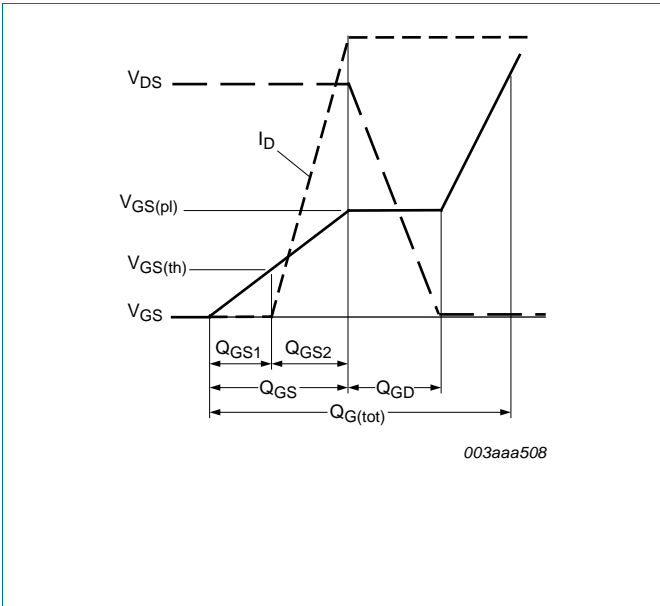
Fig 11. Drain-source on-state resistance as a function of drain current; typical values



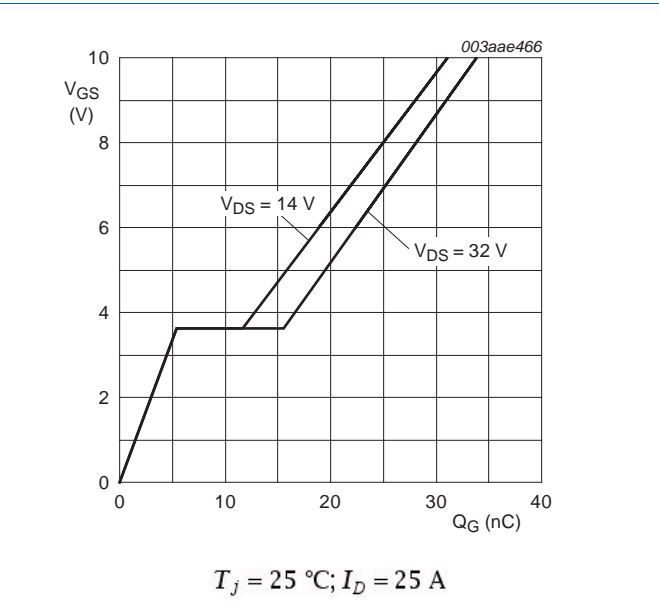
$$a = \frac{R_{DS(on)}}{R_{DS(on)25\text{ °C}}}$$

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

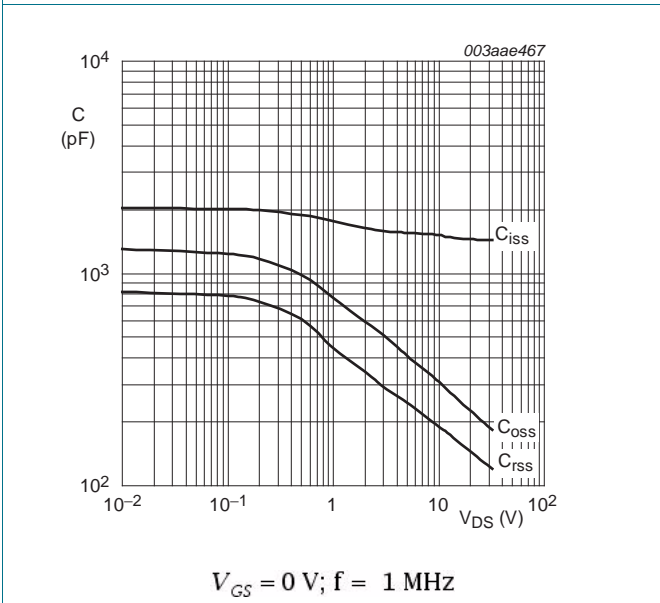




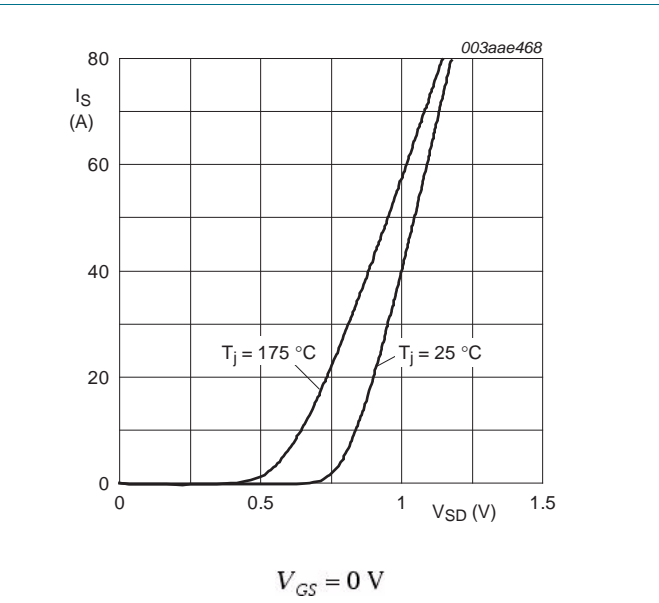
**Fig 13. Gate charge waveform definitions**



**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

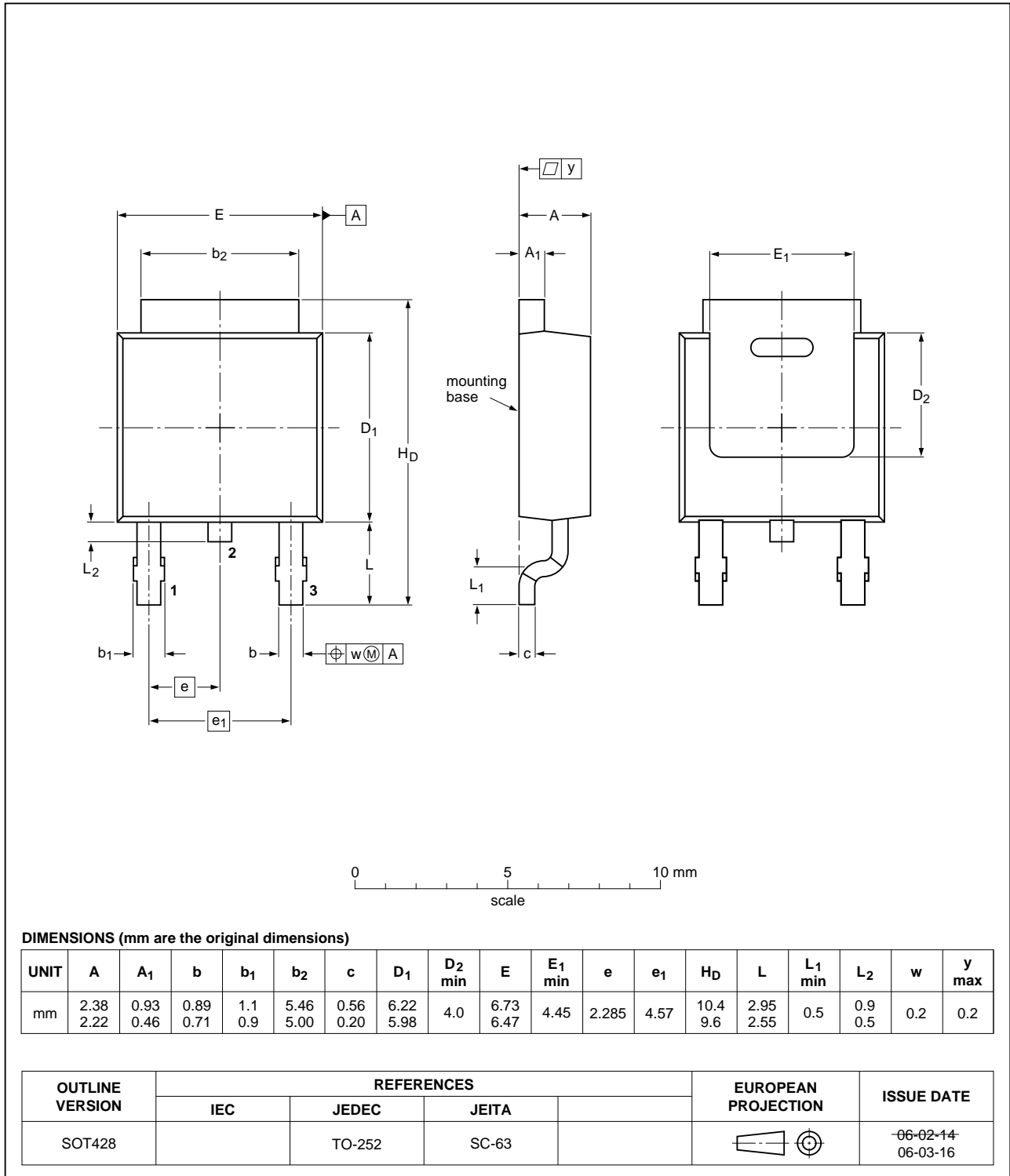


Fig 17. Package outline SOT428 (DPAK)

## 8. Revision history

Table 7. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK6212-40C v.2	20100921	Product data sheet	-	BUK6212-40C v.1
Modifications:	<ul style="list-style-type: none"><li>• Status changed from Objective to Product.</li><li>• Various changes to content.</li></ul>			
BUK6212-40C v.1	20100512	Objective 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".

[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.nexperia.com>.

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