



# BUK9615-100E

N-channel TrenchMOS logic level FET

26 May 2016

Product data sheet

## 1. General description

Logic level N-channel MOSFET in a SOT404 package using TrenchMOS technology. This product has been designed and qualified to AEC Q101 standard for use in high performance automotive applications.

## 2. Features and benefits

- AEC Q101 compliant
- Repetitive avalanche rated
- Suitable for thermally demanding environments due to 175 °C rating
- True logic level gate with  $V_{gst(th)}$  rating of greater than 0.5V at 175 °C

## 3. Applications

- 12V, 24V and 48V Automotive systems
- Motors, lamps and solenoid control
- Start-Stop micro-hybrid applications
- Transmission control
- Ultra high performance power switching

## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}; T_j \leq 175\text{ °C}$	-	-	100	V
$I_D$	drain current	$V_{GS} = 5\text{ V}; T_{mb} = 25\text{ °C}; \text{Fig. 2}$	-	-	66	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}; \text{Fig. 1}$	-	-	182	W
<b>Static characteristics</b>						
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ °C}; \text{Fig. 11}$	-	12.5	15	mΩ
<b>Dynamic characteristics</b>						
$Q_{GD}$	gate-drain charge	$V_{GS} = 5\text{ V}; I_D = 15\text{ A}; V_{DS} = 80\text{ V}; \text{Fig. 13}; \text{Fig. 14}$	-	23	-	nC

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>D2PAK (SOT404)</p>	
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK9615-100E	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BUK9615-100E	BUK9615-100E

## 8. Limiting values

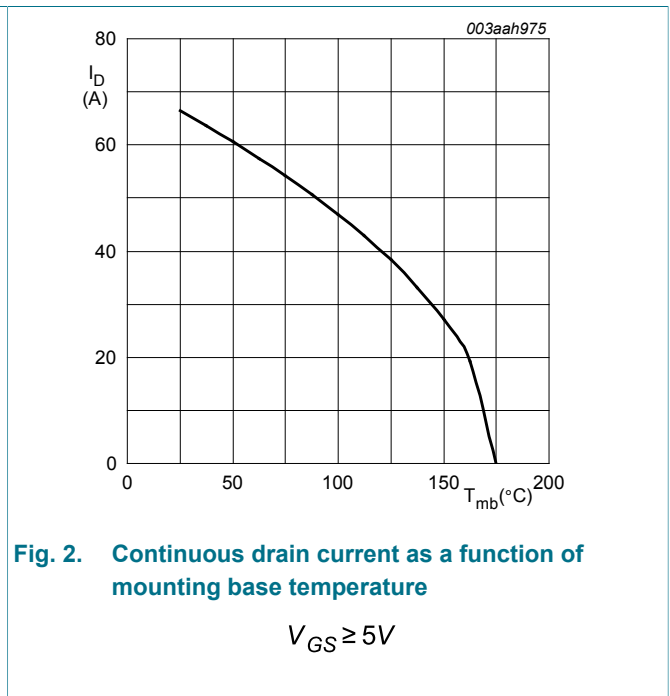
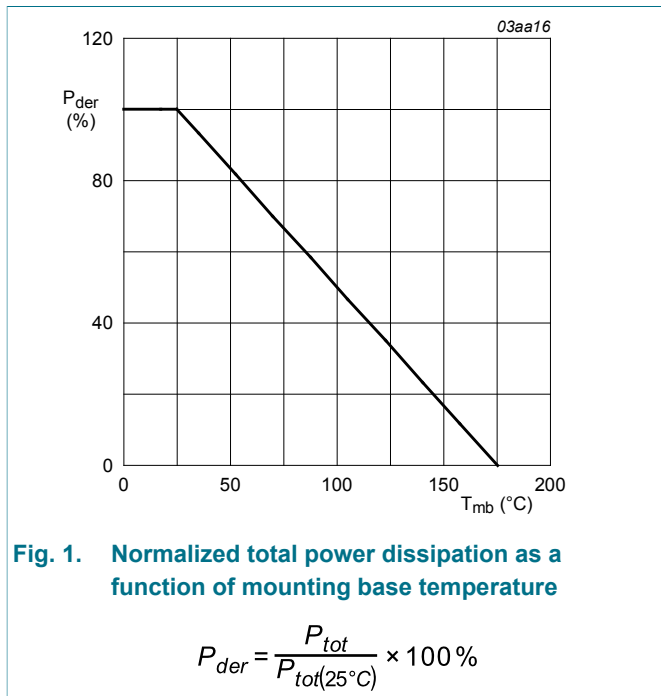
Table 5. Limiting values

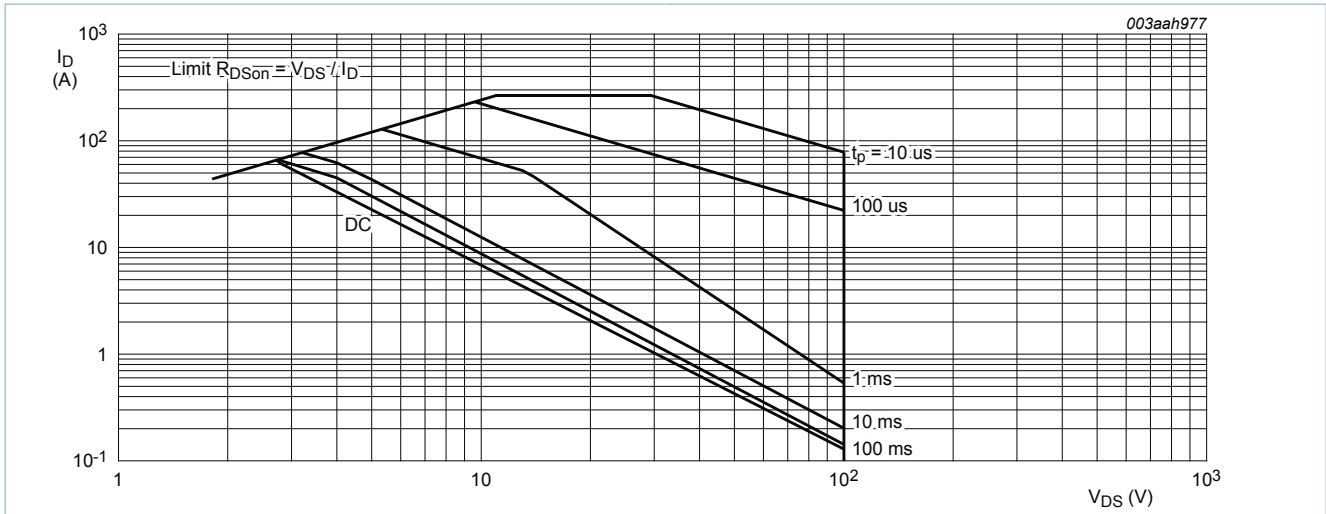
In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ °C}$ ; $T_j \leq 175\text{ °C}$	-	100	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	100	V
$V_{GS}$	gate-source voltage	$T_j \leq 175\text{ °C}$ ; DC	-10	10	V
		$T_j \leq 175\text{ °C}$ ; Pulsed	[1][2]	15	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; Fig. 1	-	182	W
$I_D$	drain current	$T_{mb} = 25\text{ °C}$ ; $V_{GS} = 5\text{ V}$ ; Fig. 2	-	66	A
		$T_{mb} = 100\text{ °C}$ ; $V_{GS} = 5\text{ V}$ ; Fig. 2	-	47	A
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ °C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; Fig. 3	-	266	A
$T_{stg}$	storage temperature		-55	175	°C

Symbol	Parameter	Conditions	Min	Max	Unit
$T_j$	junction temperature		-55	175	°C
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ °C}$	-	66	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\ \mu\text{s}$ ; $T_{mb} = 25\text{ °C}$	-	266	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 66\text{ A}$ ; $V_{sup} \leq 100\text{ V}$ ; $R_{GS} = 50\ \Omega$ ; $V_{GS} = 5\text{ V}$ ; $T_{j(\text{init})} = 25\text{ °C}$ ; unclamped; <a href="#">Fig. 4</a>	[3][4]	-	132 mJ

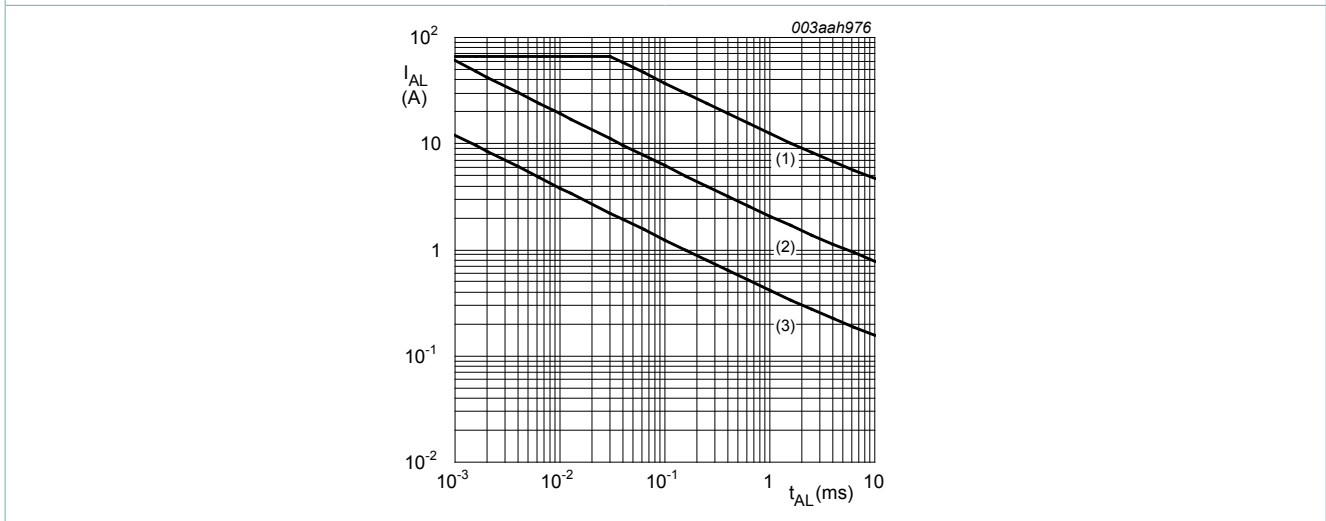
- [1] Accumulated pulse duration up to 50 hours delivers zero defect ppm
- [2] Significantly longer life times are achieved by lowering  $T_j$  and or  $V_{GS}$
- [3] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [4] Refer to application note AN10273 for further information.





**Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

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



**Fig. 4. Avalanche rating; avalanche current as a function of avalanche time**

(1)  $T_{j(init)} = 25^{\circ}\text{C}$ ; (2)  $T_{j(init)} = 150^{\circ}\text{C}$ ; (3) Repetitive Avalanche

## 9. Thermal characteristics

**Table 6. Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	<a href="#">Fig. 5</a>	-	-	0.82	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint ; mounted on a printed-circuit board	-	50	-	K/W

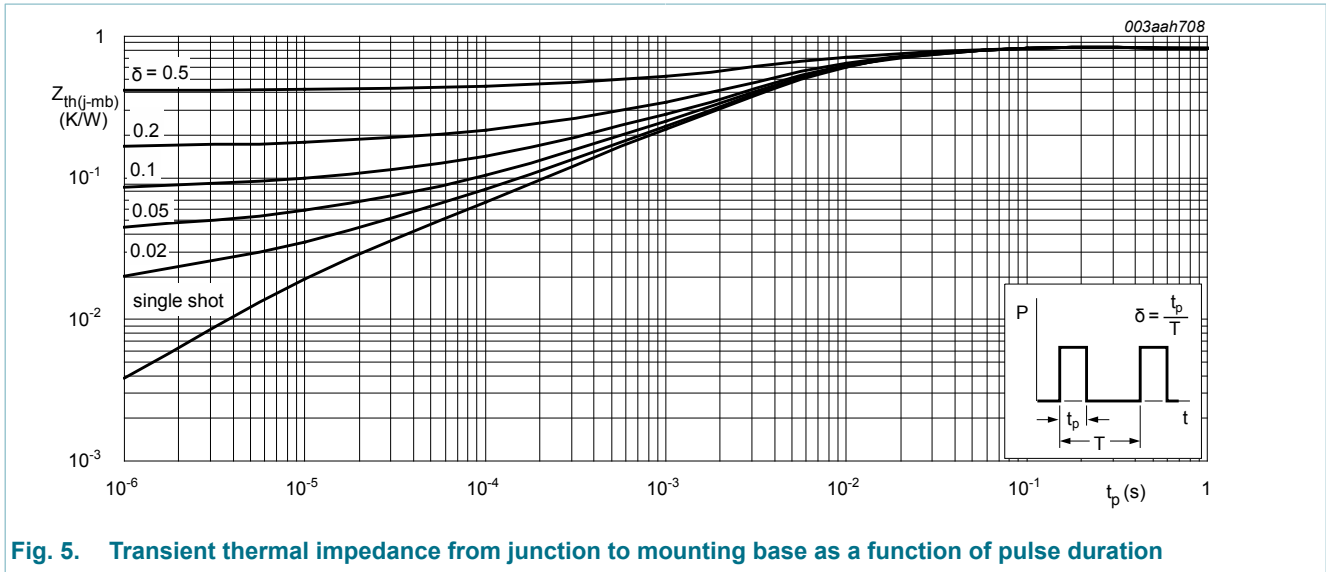


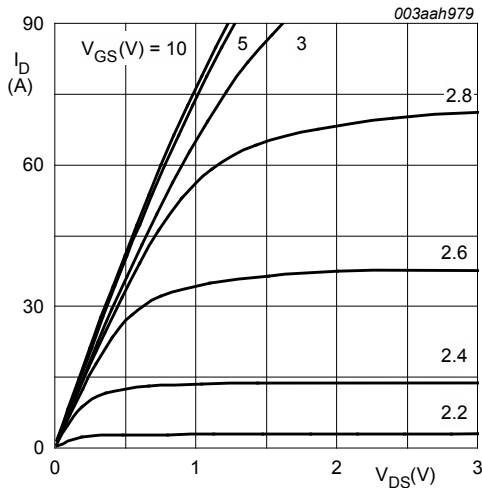
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

Table 7. Characteristics

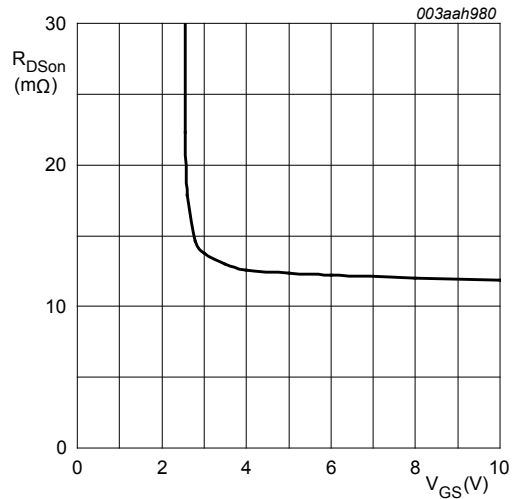
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	100	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	90	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 9; Fig. 10</a>	1.4	1.7	2.1	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ <a href="#">Fig. 9</a>	-	-	2.45	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 9</a>	0.5	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	0.04	1	$\mu A$
		$V_{DS} = 100 \text{ V}; V_{GS} = 0 \text{ V}; T_j = 175 \text{ }^\circ C$	-	-	500	$\mu A$
$I_{GSS}$	gate leakage current	$V_{GS} = 10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
		$V_{GS} = -10 \text{ V}; V_{DS} = 0 \text{ V}; T_j = 25 \text{ }^\circ C$	-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5 \text{ V}; I_D = 15 \text{ A}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	12.5	15	m $\Omega$
		$V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	12	14	m $\Omega$
		$V_{GS} = 5 \text{ V}; I_D = 15 \text{ A}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 12; Fig. 11</a>	-	-	41	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 15 \text{ A}; V_{DS} = 80 \text{ V}; V_{GS} = 5 \text{ V};$ <a href="#">Fig. 13; Fig. 14</a>	-	60	-	nC
$Q_{GS}$	gate-source charge		-	11	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Q_{GD}$	gate-drain charge		-	23	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ }^\circ\text{C}; \text{Fig. 15}$	-	5110	6813	pF
$C_{oss}$	output capacitance		-	307	368	pF
$C_{rss}$	reverse transfer capacitance		-	202	277	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 80\text{ V}; R_L = 5\text{ }\Omega; V_{GS} = 5\text{ V}; R_{G(ext)} = 5\text{ }\Omega$	-	26.6	-	ns
$t_r$	rise time		-	62.2	-	ns
$t_{d(off)}$	turn-off delay time		-	77.6	-	ns
$t_f$	fall time		-	59.1	-	ns
$L_D$	internal drain inductance	from upper edge of drain mounting base to center of die	-	2.5	-	nH
$L_S$	internal source inductance	from source lead to source bonding pad	-	7.5	-	nH
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 15\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}; \text{Fig. 16}$	-	0.8	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 15\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}$	-	51	-	ns
$Q_r$	recovered charge		-	115	-	nC



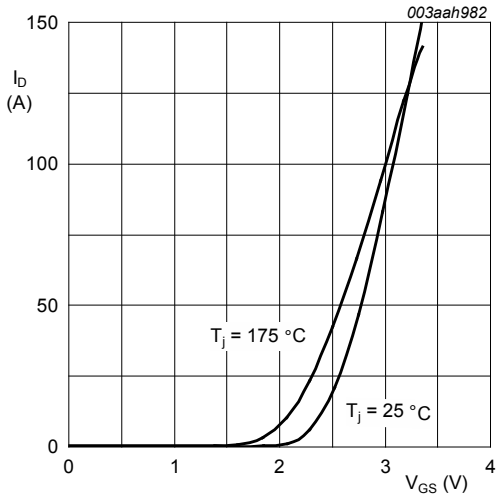
**Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values**

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



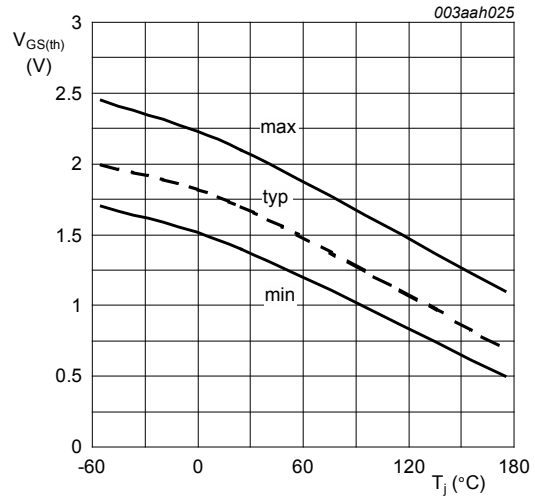
**Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values**

$T_j = 25\text{ }^\circ\text{C}; I_D = 15\text{ A}$



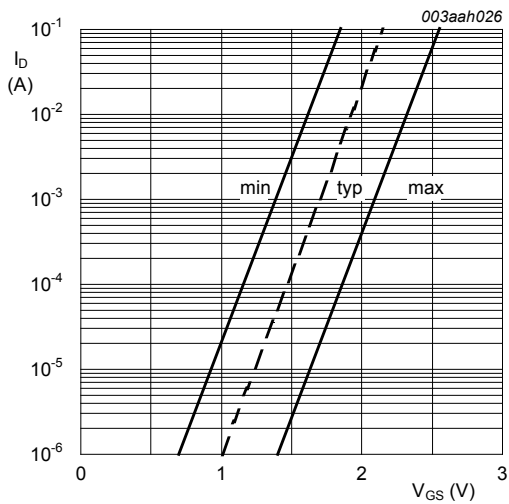
**Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values**

$V_{DS} = 10V$



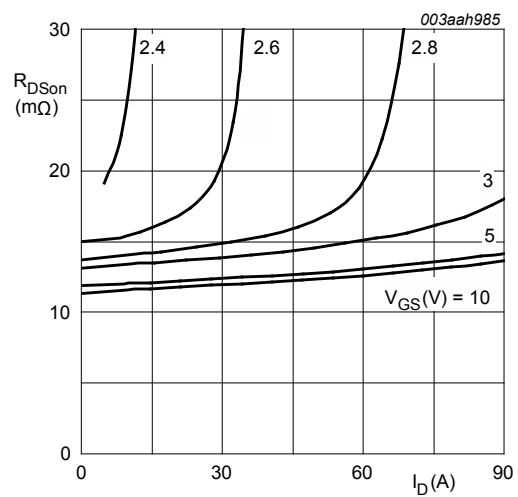
**Fig. 9. Gate-source threshold voltage as a function of junction temperature**

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



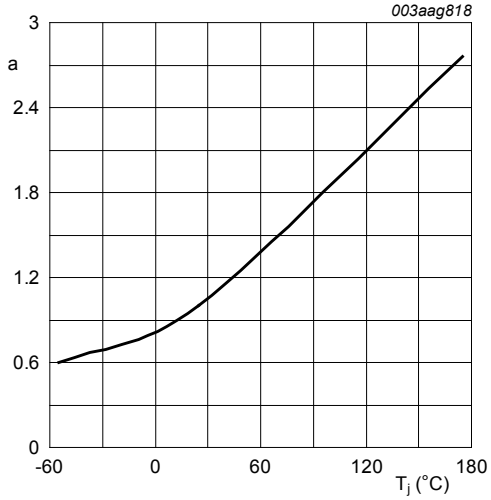
**Fig. 10. Sub-threshold drain current as a function of gate-source voltage**

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



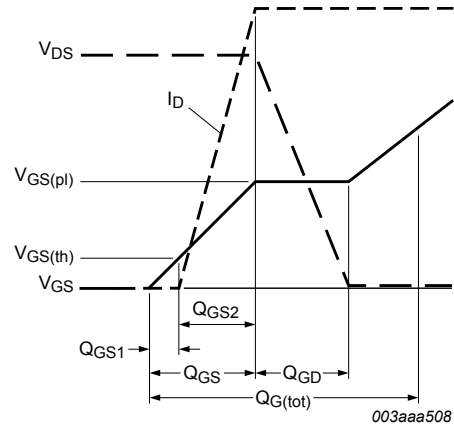
$T_j = 25^\circ\text{C}; t_p = 300 \mu\text{s}$

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

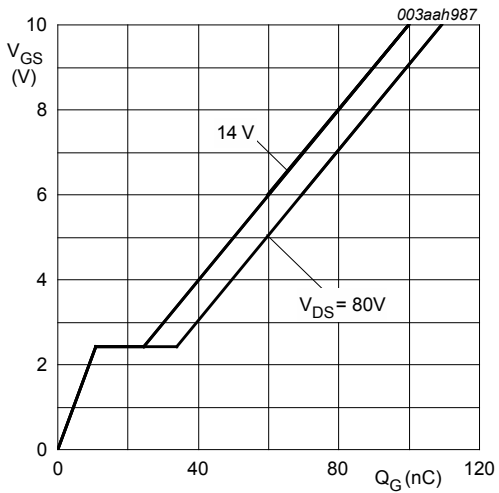


**Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature**

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

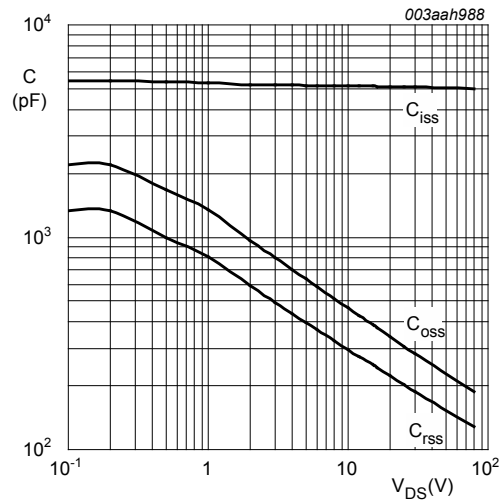


**Fig. 13. Gate charge waveform definitions**



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

$$T_j = 25^\circ\text{C}; I_D = 15\text{A}$$



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

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



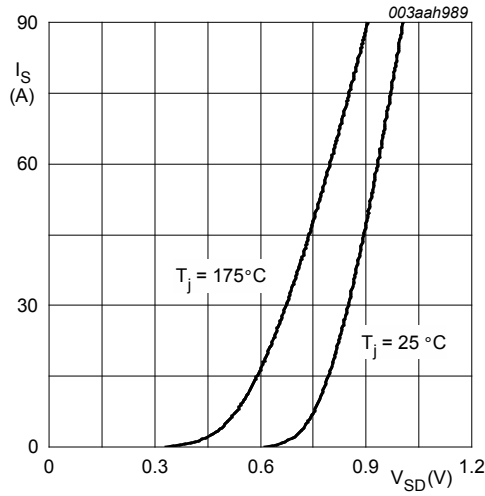
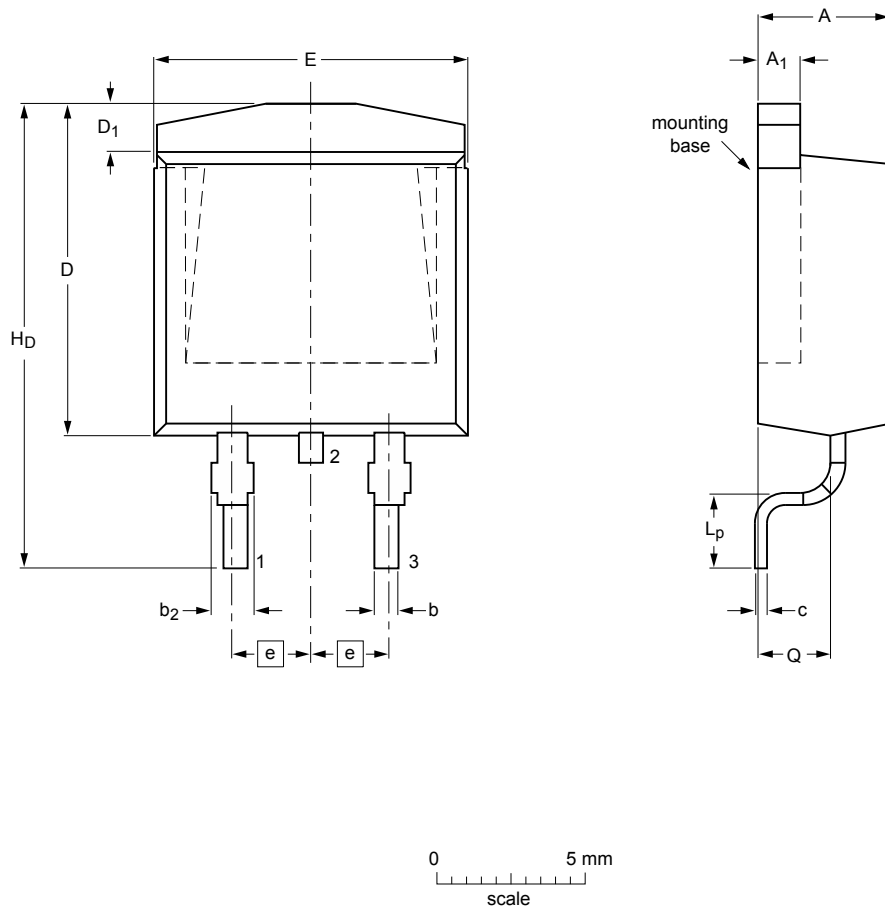


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

### 11. Package outline

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) SOT404



Dimensions (mm are the original dimensions)

Unit	A	A <sub>1</sub>	b	b <sub>2</sub>	c	D	D <sub>1</sub>	E	e	H <sub>D</sub>	L <sub>p</sub>	Q
max	4.5	1.40	0.85	1.45	0.64	11	1.6	10.3		15.8	2.9	2.6
nom									2.54			
min	4.1	1.27	0.60	1.05	0.46		1.2	9.7		14.8	2.1	2.2

sot404\_po

Outline version	References			European projection	Issue date
	IEC	JEDEC	JEITA		
SOT404					-06-03-16- 13-02-25

Fig. 17. Package outline D2PAK (SOT404)

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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.
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