



# BUK765R3-40E

N-channel TrenchMOS standard level FET

28 July 2016

Product data sheet

## 1. General description

Standard 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 standard level gate with VGS(th) rating of greater than 1V at 175 °C

## 3. Applications

- 12 V 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 <sub>DS</sub>	drain-source voltage	25 °C ≤ T <sub>j</sub> ≤ 175 °C		-	-	40	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 10 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>	[1]	-	-	75	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>		-	-	137	W
<b>Static characteristics</b>							
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>		-	4.2	4.9	mΩ
<b>Dynamic characteristics</b>							
Q <sub>GD</sub>	gate-drain charge	I <sub>D</sub> = 25 A; V <sub>DS</sub> = 32 V; V <sub>GS</sub> = 10 V; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	14.8	-	nC

[1] Continuous current is limited by package.

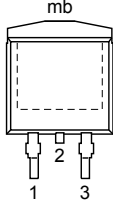
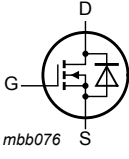


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## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 D2PAK (SOT404)	
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
BUK765R3-40E	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

## 7. Marking

Table 4. Marking codes

Type number	Marking code
BUK765R3-40E	BUK765R3-40E

## 8. Limiting values

Table 5. Limiting values

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

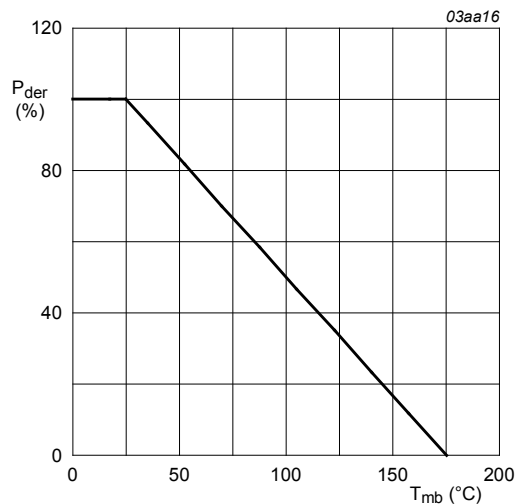
Symbol	Parameter	Conditions		Min	Max	Unit
$V_{DS}$	drain-source voltage	$25\text{ °C} \leq T_j \leq 175\text{ °C}$		-	40	V
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	40	V
$V_{GS}$	gate-source voltage	DC; $T_j \leq 175\text{ °C}$		-20	20	V
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 1</a>		-	137	W
$I_D$	drain current	$V_{GS} = 10\text{ V}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	75	A
		$V_{GS} = 10\text{ V}$ ; $T_{mb} = 100\text{ °C}$ ; <a href="#">Fig. 2</a>	[1]	-	75	A
$I_{DM}$	peak drain current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ °C}$ ; <a href="#">Fig. 3</a>		-	485	A
$T_{stg}$	storage temperature			-55	175	°C
$T_j$	junction temperature			-55	175	°C

Symbol	Parameter	Conditions		Min	Max	Unit
<b>Source-drain diode</b>						
$I_S$	source current	$T_{mb} = 25\text{ }^{\circ}\text{C}$	[1]	-	75	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^{\circ}\text{C}$		-	485	A
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}$ ; $V_{sup} \leq 40\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 10\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; unclamped; <a href="#">Fig. 4</a>	[2][3]	-	131	mJ

[1] Continuous current is limited by package.

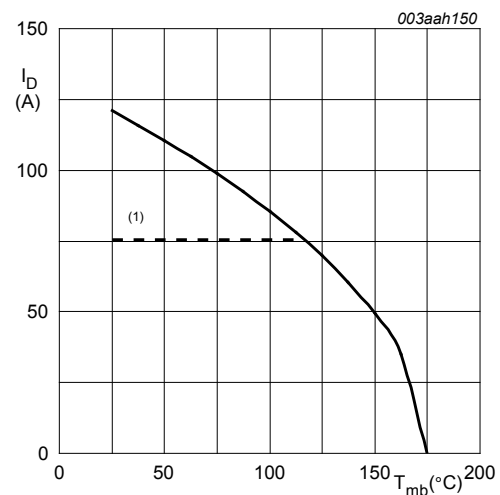
[2] Single-pulse avalanche rating limited by maximum junction temperature of  $175\text{ }^{\circ}\text{C}$ .

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



**Fig. 1. Normalized total power dissipation as a function of mounting base temperature**

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



(1) Capped at 75A due to package

**Fig. 2. Continuous drain current as a function of mounting base temperature**

$$V_{GS} \geq 10\text{ V}$$

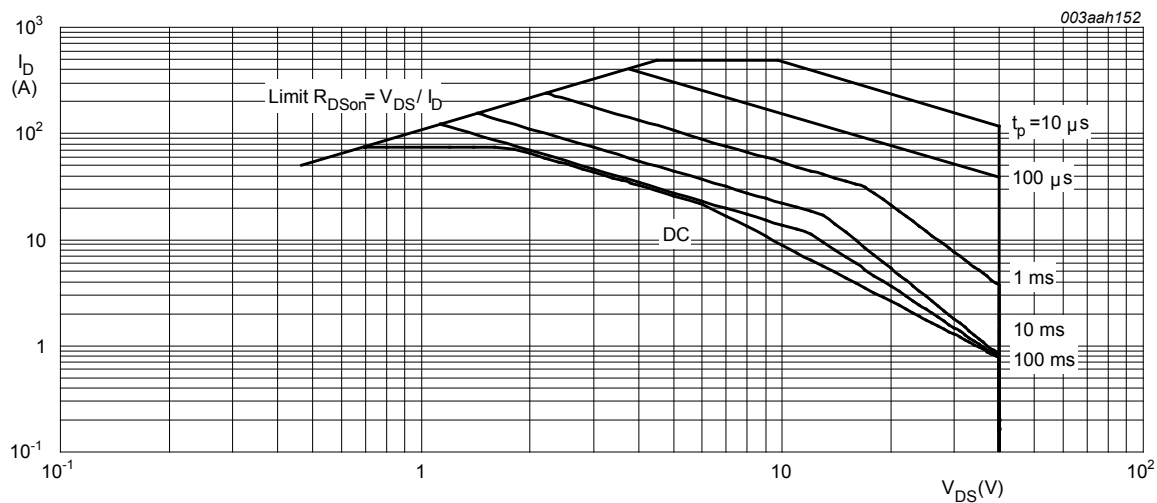


Fig. 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

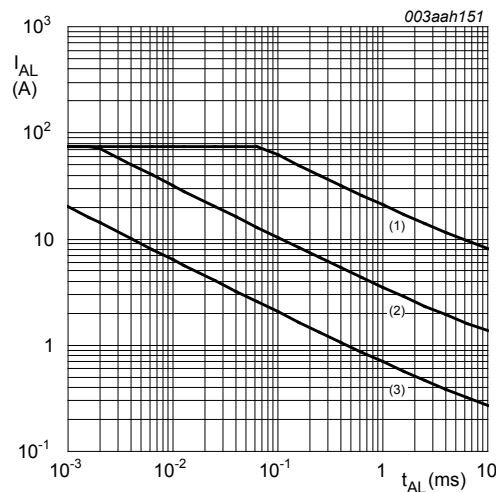


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

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>	-	-	1.09	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	minimum footprint; mounted on a printed-circuit board	-	50	-	K/W

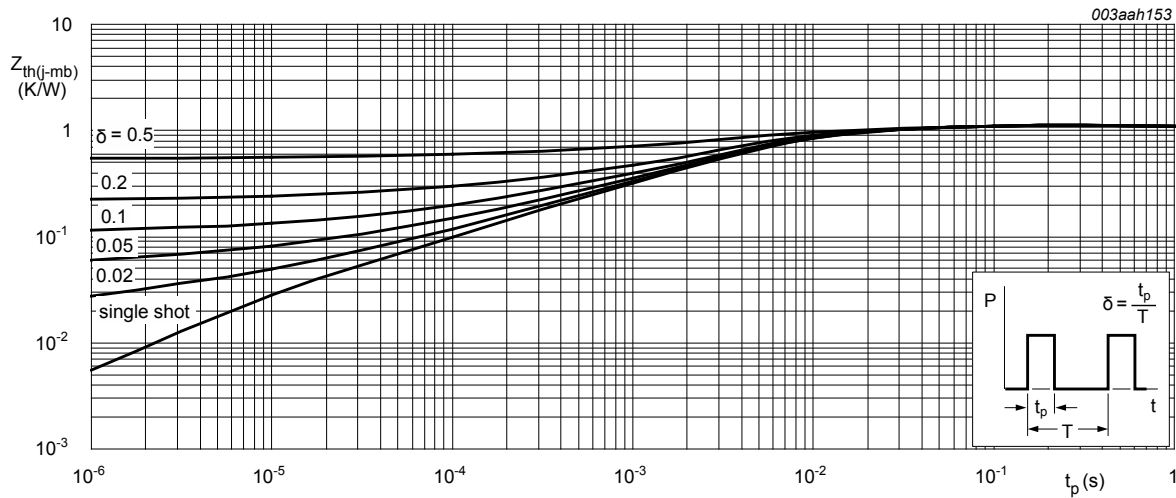


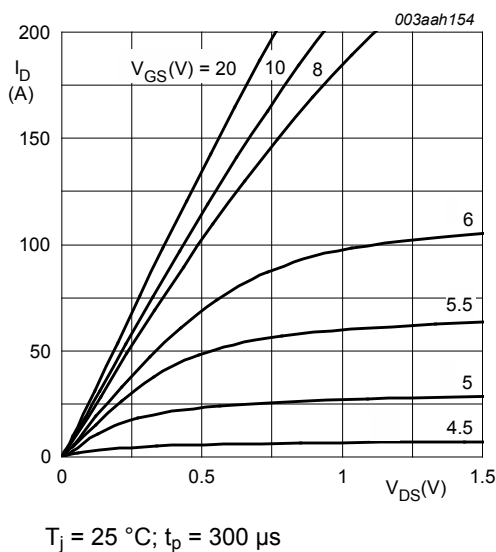
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

## 10. Characteristics

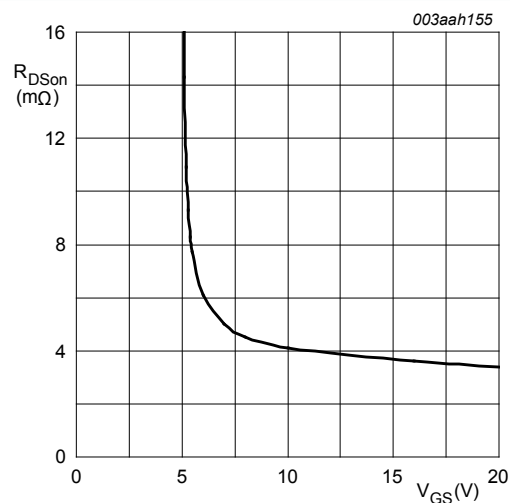
Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$		40	-	-	V
		$I_D = 250\text{ }\mu\text{A}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = -55\text{ }^\circ\text{C}$		36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$ ; $V_{DS}=V_{GS}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 9</a> ; <a href="#">Fig. 10</a>		2.4	3	4	V
		$I_D = 1\text{ mA}$ ; $V_{DS}=V_{GS}$ ; $T_j = -55\text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>		-	-	4.5	V
		$I_D = 1\text{ mA}$ ; $V_{DS}=V_{GS}$ ; $T_j = 175\text{ }^\circ\text{C}$ ; <a href="#">Fig. 10</a>		1	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 40\text{ V}$ ; $V_{GS} = 0\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$		-	0.08	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	$V_{GS} = 20\text{ V}$ ; $V_{DS} = 0\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$		-	2	100	nA
		$V_{GS} = -20\text{ V}$ ; $V_{DS} = 0\text{ V}$ ; $T_j = 25\text{ }^\circ\text{C}$		-	2	100	nA
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 25\text{ }^\circ\text{C}$ ; <a href="#">Fig. 11</a>		-	4.2	4.9	m $\Omega$
		$V_{GS} = 10\text{ V}$ ; $I_D = 25\text{ A}$ ; $T_j = 175\text{ }^\circ\text{C}$ ; <a href="#">Fig. 12</a> ; <a href="#">Fig. 11</a>		-	-	9.3	m $\Omega$
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 25\text{ A}$ ; $V_{DS} = 32\text{ V}$ ; $V_{GS} = 10\text{ V}$ ; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>		-	43.6	-	nC
$Q_{GS}$	gate-source charge			-	9.3	-	nC
$Q_{GD}$	gate-drain charge			-	14.8	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$C_{iss}$	input capacitance	$V_{DS} = 25 \text{ V}; V_{GS} = 0 \text{ V}; f = 1 \text{ MHz};$ $T_j = 25^\circ\text{C};$ <a href="#">Fig. 15</a>	-	2080	2772	pF
$C_{oss}$	output capacitance		-	422	507	pF
$C_{rss}$	reverse transfer capacitance		-	257	352	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 30 \text{ V}; R_L = 1.2 \Omega; V_{GS} = 10 \text{ V};$ $R_{G(ext)} = 5 \Omega$	-	15	-	ns
$t_r$	rise time		-	15	-	ns
$t_{d(off)}$	turn-off delay time		-	28	-	ns
$t_f$	fall time		-	13	-	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	$I_S = 25 \text{ A}; V_{GS} = 0 \text{ V}; T_j = 25^\circ\text{C};$ <a href="#">Fig. 16</a>	-	0.86	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20 \text{ A}; dI_S/dt = -100 \text{ A}/\mu\text{s}; V_{GS} = 0 \text{ V};$ $V_{DS} = 25 \text{ V}$	-	25.3	-	ns
$Q_r$	recovered charge		-	19	-	nC



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



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

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

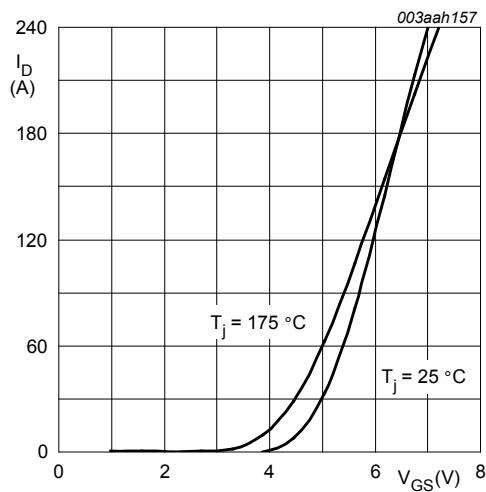


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10\text{ V}$

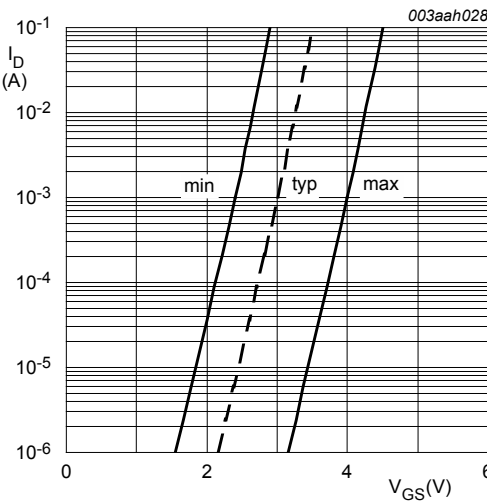


Fig. 9. Sub-threshold drain current as a function of gate-source voltage

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

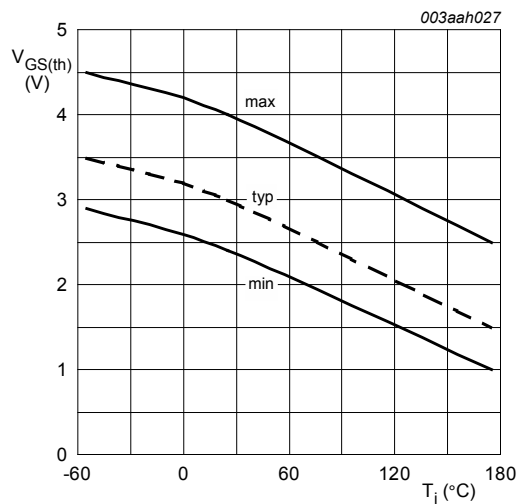


Fig. 10. Gate-source threshold voltage as a function of junction temperature

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

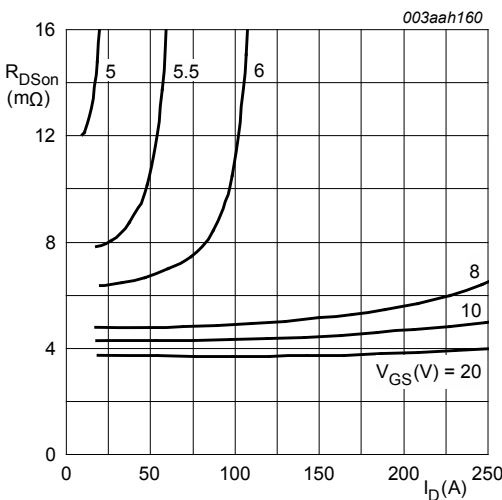


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

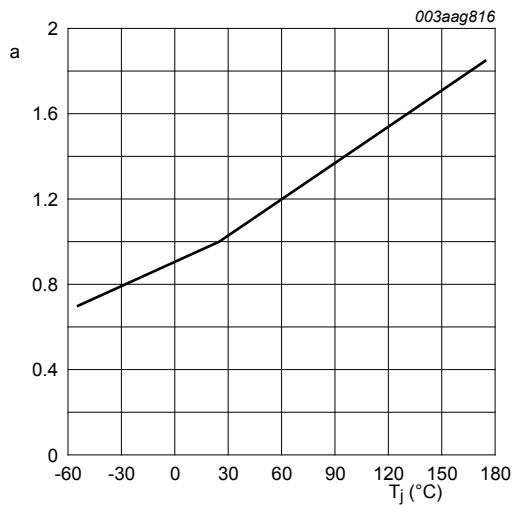


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

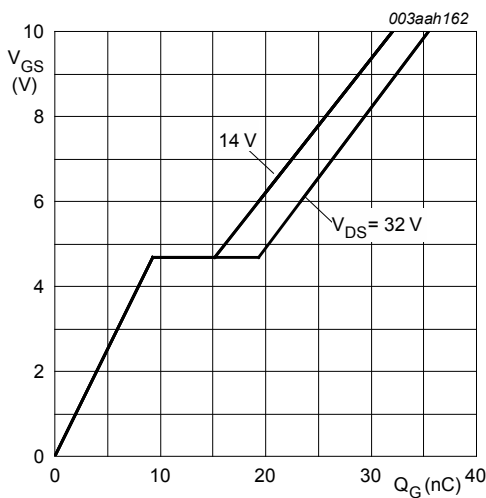


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

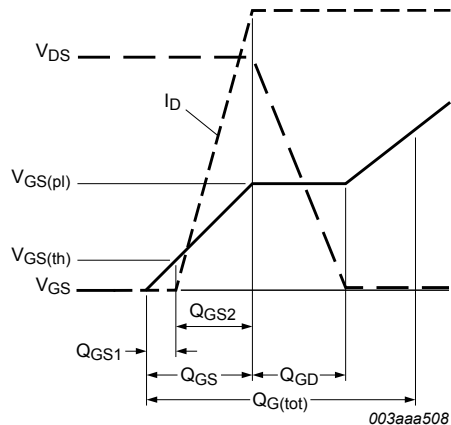


Fig. 13. Gate charge waveform definitions

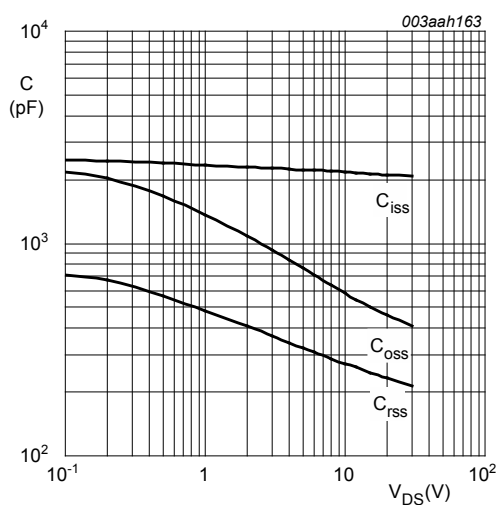


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

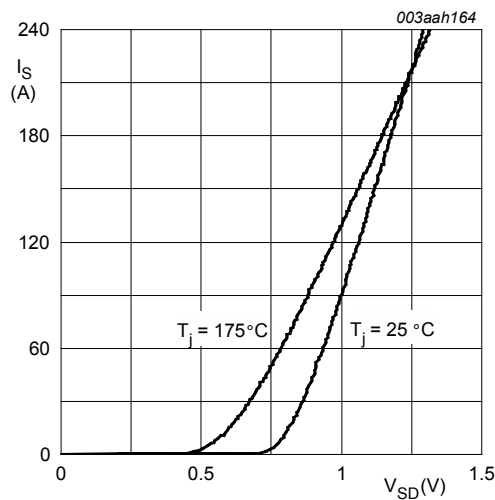


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values  
 $V_{GS} = 0V$

11. Package outline

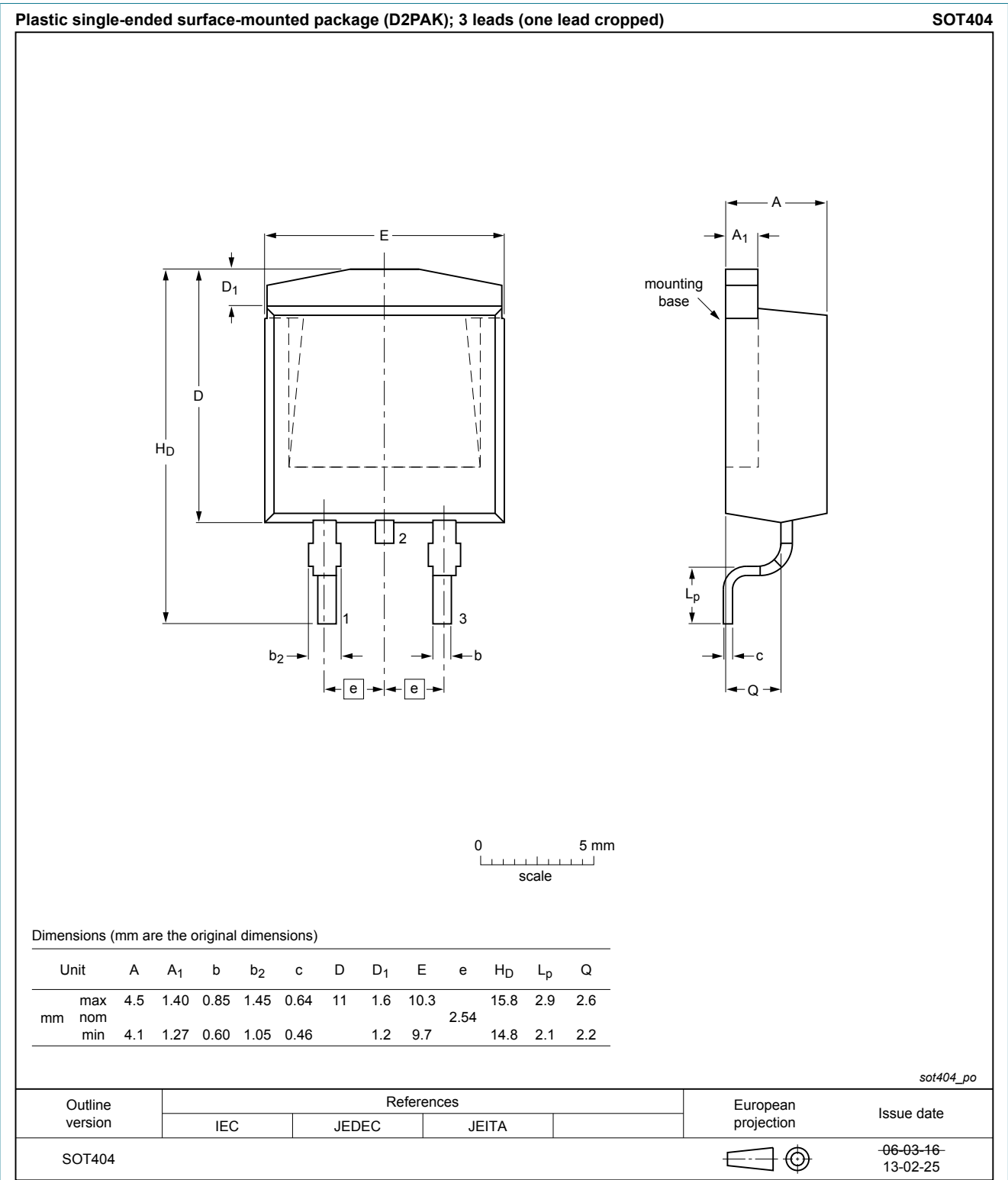


Fig. 17. Package outline D2PAK (SOT404)

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### 12.1 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.

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