

BUK969R0-60E

N-channel TrenchMOS logic level FET

13 July 2012

Product data sheet

1. Product profile

1.1 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.

1.2 Features and benefits

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

1.3 Applications

- 12 V Automotive systems
- 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 ≥ 25 °C; T _j ≤ 175 °C	-	-	60	V
I _D	drain current	V _{GS} = 5 V; T _{mb} = 25 °C; Fig. 1	[1]	-	75	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2	-	-	137	W
Static characteristics						
R _{DSon}	drain-source on-state resistance	V _{GS} = 5 V; I _D = 20 A; T _j = 25 °C; Fig. 11	-	7.53	9	mΩ
Dynamic characteristics						
Q _{GD}	gate-drain charge	V _{GS} = 5 V; I _D = 20 A; V _{DS} = 48 V; Fig. 13 ; Fig. 14	-	9.7	-	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	 <p>D2PAK (SOT404)</p>	
2	D	drain		
3	S	source		
mb	D	mounting base; connected to drain		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BUK969R0-60E	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

4. Limiting values

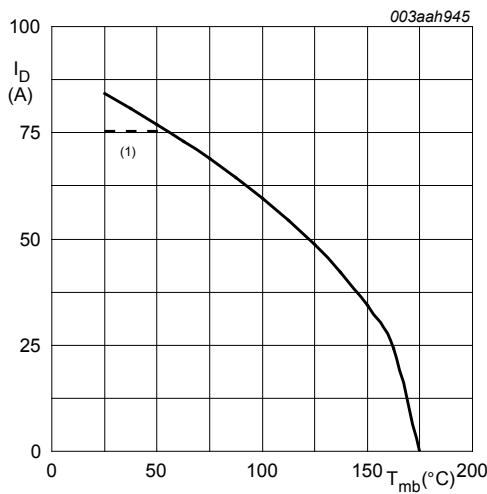
Table 4. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25\text{ °C}$; $T_j \leq 175\text{ °C}$		-	60	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$		-	60	V
V_{GS}	gate-source voltage	$T_j = 25\text{ °C}$; lifetime = 100 hours		-15	15	V
		$T_j = 25\text{ °C}$		-10	10	V
I_D	drain current	$T_{mb} = 25\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1	[1]	-	75	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1		-	59	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4		-	333	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 2		-	137	W
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$	[1]	-	75	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25\text{ °C}$		-	333	A

Symbol	Parameter	Conditions	Min	Max	Unit
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 75\text{ A}$; $V_{sup} \leq 60\text{ V}$; $R_{GS} = 50\ \Omega$; $V_{GS} = 5\text{ V}$; $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; unclamped; Fig. 3	[2][3]	-	86 mJ

- [1] Continuous current is limited by package.
- [2] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
- [3] Refer to application note AN10273 for further information.



(1) Capped at 75A due to package

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

$$V_{GS} \geq 5V$$

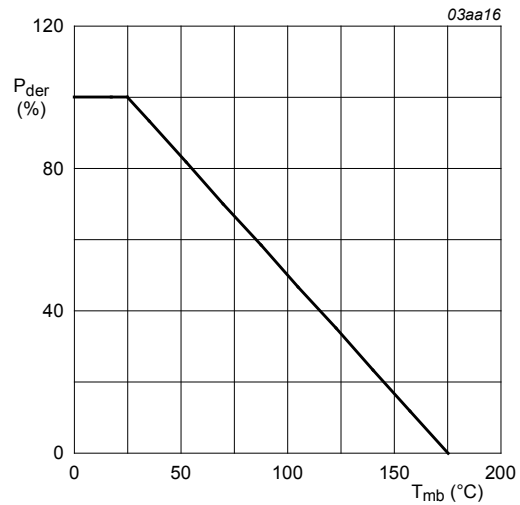


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

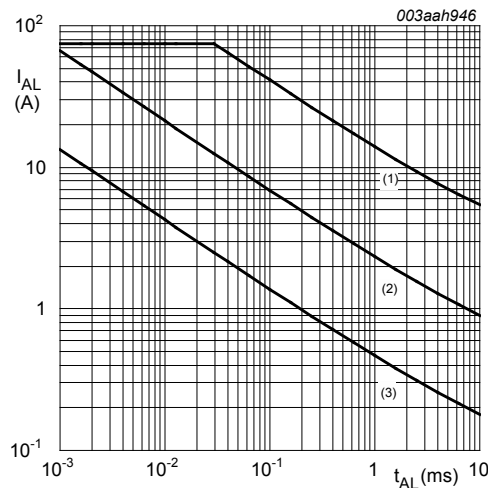
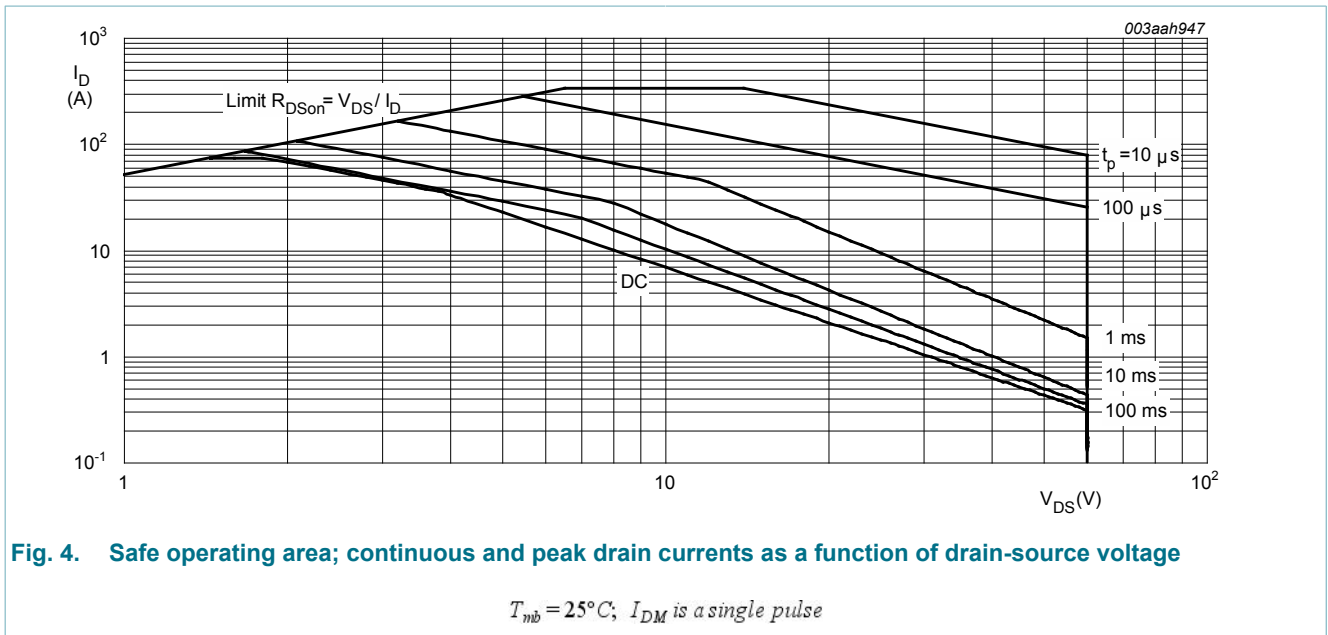


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

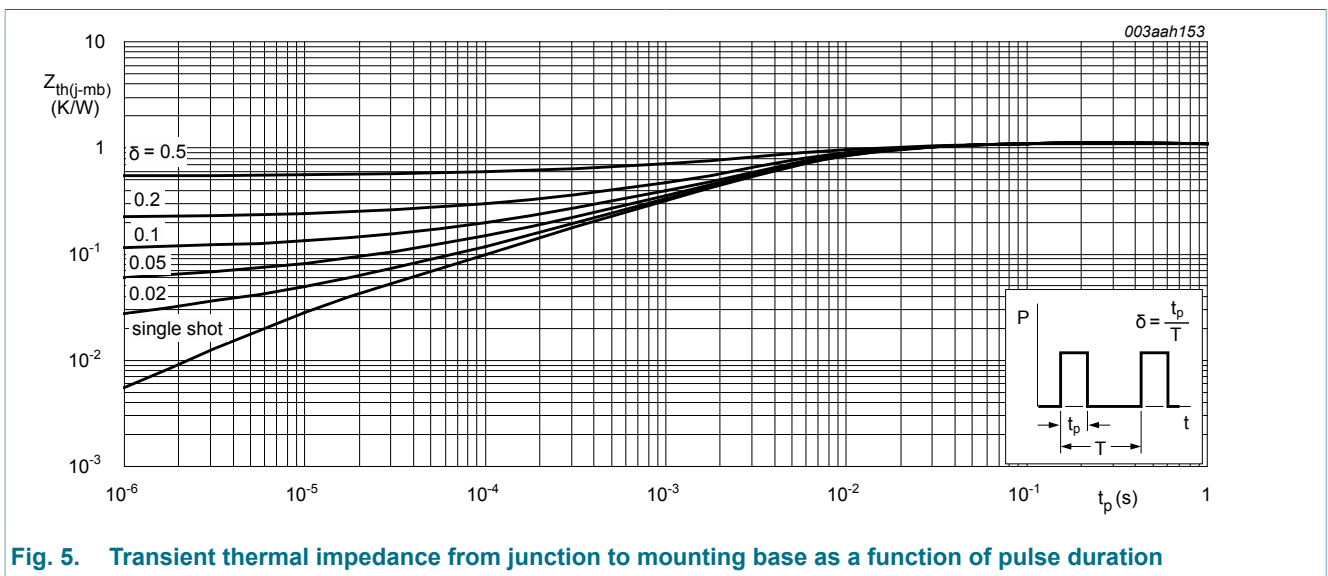
- (1) $T_{j(\text{init})} = 25\text{ }^\circ\text{C}$; (2) $T_{j(\text{init})} = 150\text{ }^\circ\text{C}$; (3) Repetitive Avalanche



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	Fig. 5	-	-	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



6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	60	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ Fig. 9; Fig. 10	1.4	1.7	2.1	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ Fig. 9	-	-	2.45	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ Fig. 9	0.5	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.04	1	μA
		$V_{DS} = 60 V; V_{GS} = 0 V; T_j = 175 \text{ }^\circ C$	-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	2	100	nA
		$V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 \text{ }^\circ C$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 5 V; I_D = 20 A; T_j = 25 \text{ }^\circ C;$ Fig. 11	-	7.53	9	m Ω
		$V_{GS} = 10 V; I_D = 20 A; T_j = 25 \text{ }^\circ C;$ Fig. 11	-	6.74	8	m Ω
		$V_{GS} = 5 V; I_D = 20 A; T_j = 175 \text{ }^\circ C;$ Fig. 12; Fig. 11	-	-	19.8	m Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 20 A; V_{DS} = 48 V; V_{GS} = 5 V;$ Fig. 13; Fig. 14	-	29.8	-	nC
Q_{GS}	gate-source charge		-	7.9	-	nC
Q_{GD}	gate-drain charge		-	9.7	-	nC
C_{iss}	input capacitance	$V_{GS} = 0 V; V_{DS} = 25 V; f = 1 \text{ MHz};$ $T_j = 25 \text{ }^\circ C;$ Fig. 15	-	3263	4350	pF
C_{oss}	output capacitance		-	305	366	pF
C_{rss}	reverse transfer capacitance		-	160	219	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 45 V; R_L = 2 \Omega; V_{GS} = 5 V;$ $R_{G(ext)} = 5 \Omega$	-	21	-	ns
t_r	rise time		-	56	-	ns
$t_{d(off)}$	turn-off delay time		-	32	-	ns
t_f	fall time		-	46	-	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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain voltage	$I_S = 20\text{ A}$; $V_{GS} = 0\text{ V}$; $T_j = 25\text{ }^\circ\text{C}$; Fig. 16	-	0.83	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$; $V_{GS} = 0\text{ V}$;	-	27	-	ns
Q_r	recovered charge	$V_{DS} = 25\text{ V}$	-	28	-	nC

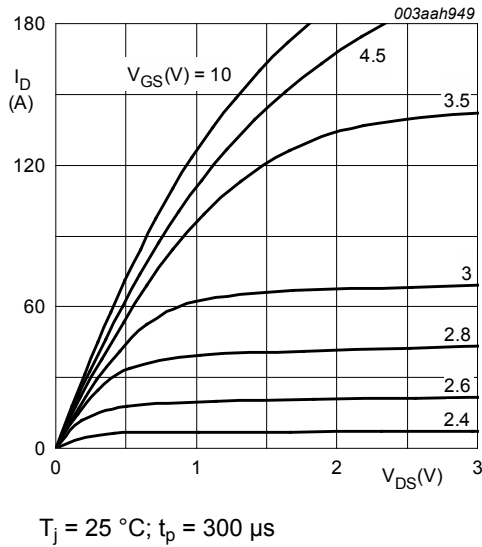


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

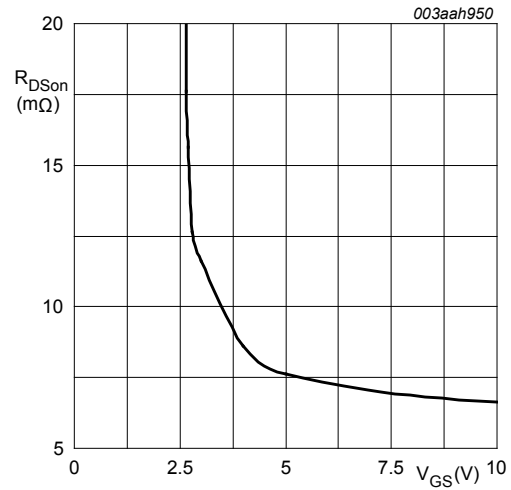


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

$T_j = 25\text{ }^\circ\text{C}$; $I_D = 20\text{ A}$

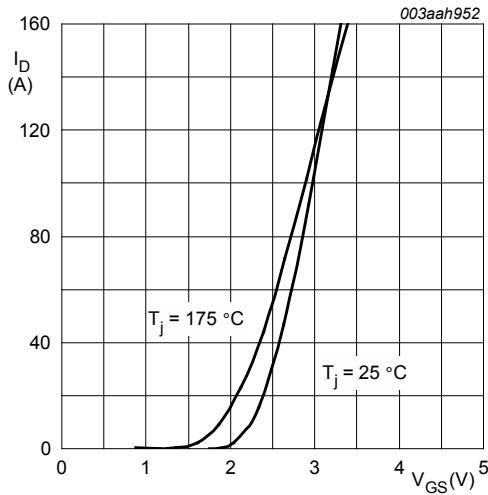


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

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

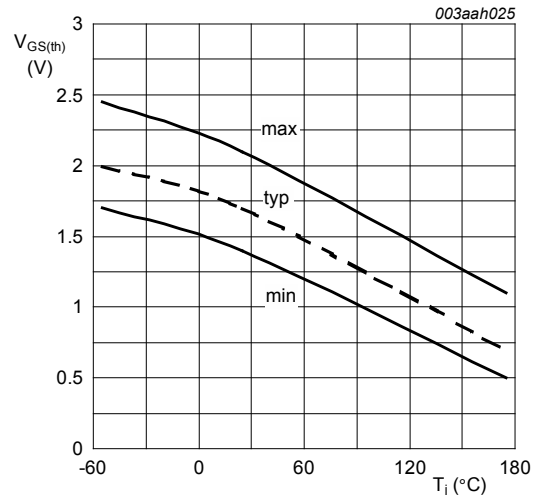


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

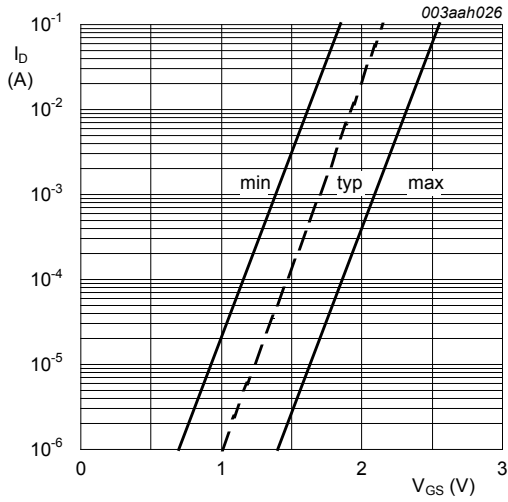


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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

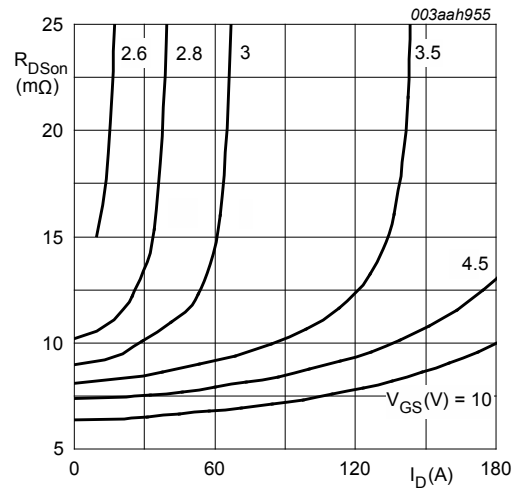


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

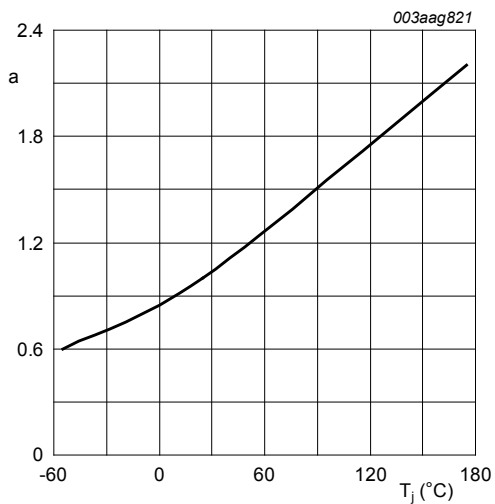


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

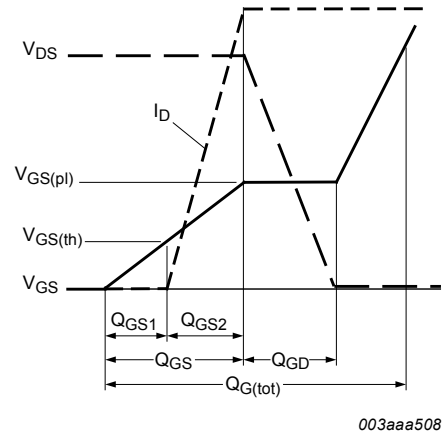


Fig. 13. Gate charge waveform definitions

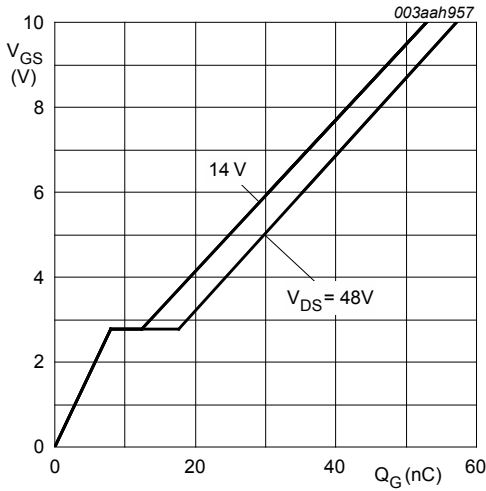


Fig. 14. Gate-source voltage as a function of gate charge; typical values

$T_j = 25^\circ\text{C}; I_D = 20\text{A}$

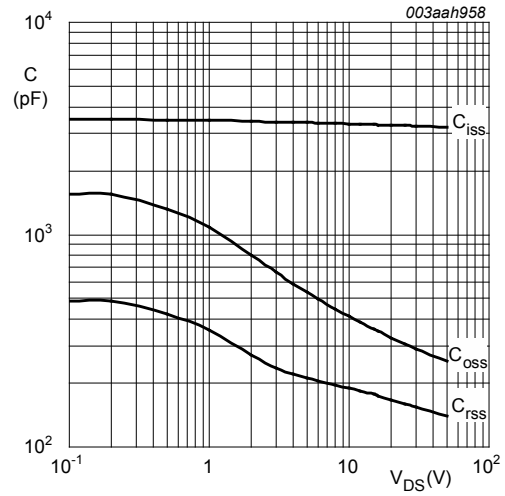


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

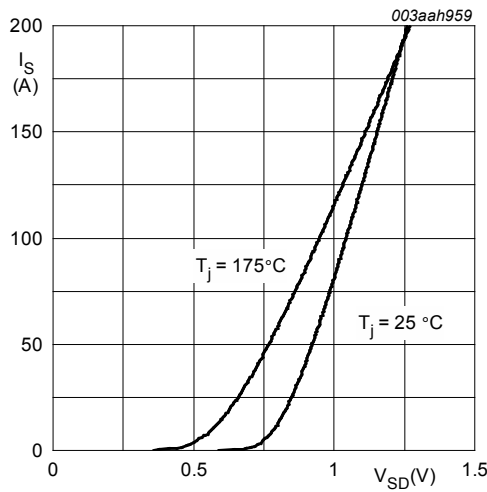


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

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

7. Package outline

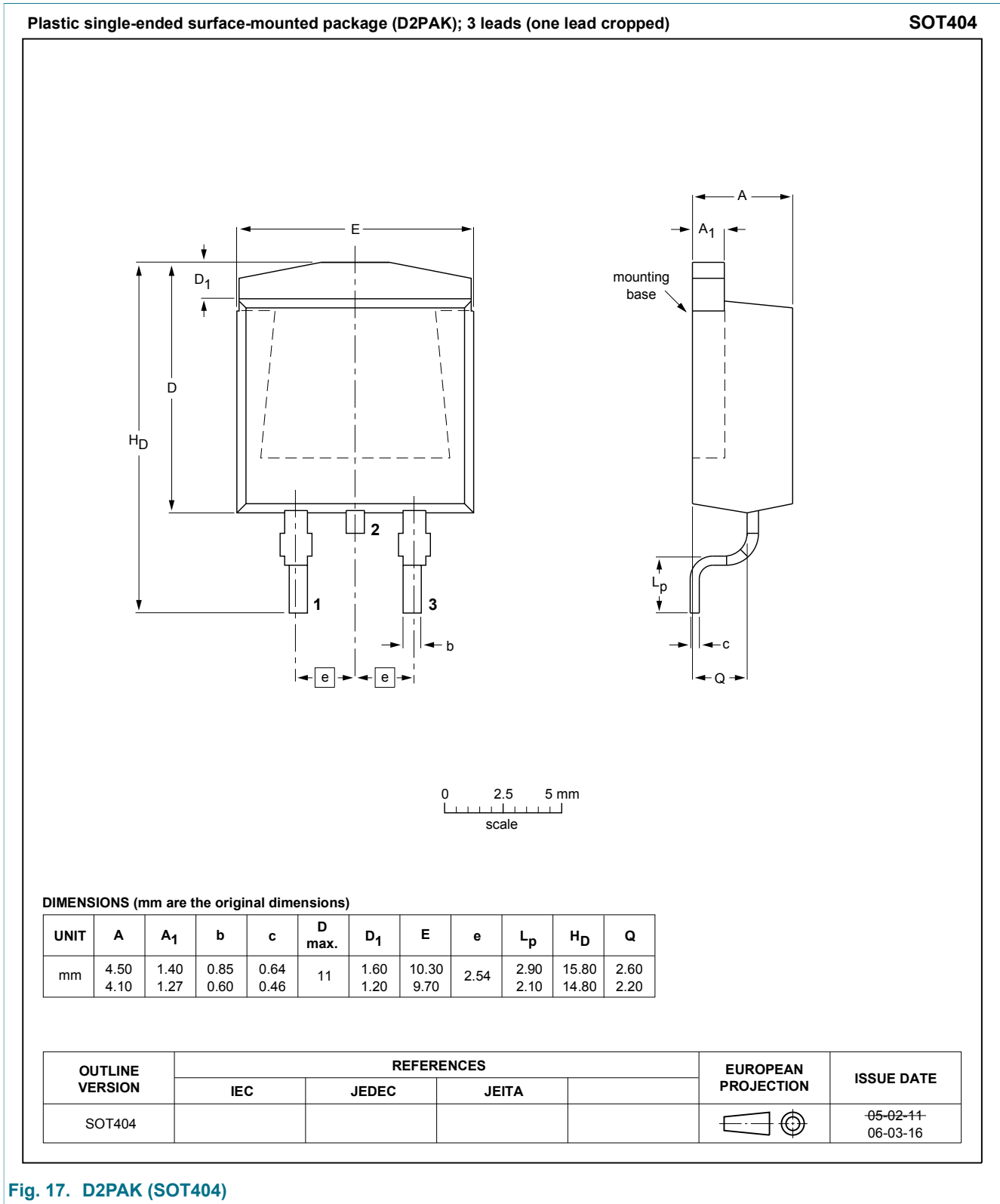


Fig. 17. D2PAK (SOT404)

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8.1 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.
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9. Contents

1	Product profile	1
1.1	General description	1
1.2	Features and benefits	1
1.3	Applications	1
1.4	Quick reference data	1
2	Pinning information	2
3	Ordering information	2
4	Limiting values	2
5	Thermal characteristics	4
6	Characteristics	5
7	Package outline	9
8	Legal information	10
8.1	Data sheet status	10
8.2	Definitions	10
8.3	Disclaimers	10
8.4	Trademarks	11

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