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Team Nexperia

BUK9E3R2-40E

N-channel TrenchMOS logic level FET

11 September 2012 — Product data sheet

1. Product profile

1.1 General description

Logic level N-channel MOSFET in a SOT226 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 Vgst(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

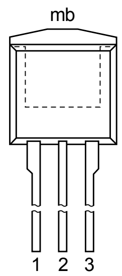
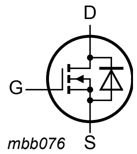
Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	-	40	V
I_D	drain current	$V_{GS} = 5$ V; $T_{mb} = 25$ °C; Fig. 1	[1]	-	-	100	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Fig. 2		-	-	234	W
Static characteristics							
R_{DSon}	drain-source on-state resistance	$V_{GS} = 5$ V; $I_D = 25$ A; $T_j = 25$ °C; Fig. 11		-	2.7	3.2	mΩ
Dynamic characteristics							
Q_{GD}	gate-drain charge	$V_{GS} = 5$ V; $I_D = 25$ A; $V_{DS} = 32$ V; Fig. 13; Fig. 14		-	25.8	-	nC

[1] Continuous current is limited by package.

Scan or click this QR code to view the latest information for this product

2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 **I2PAK (SOT226)**	
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
BUK9E3R2-40E	I2PAK	plastic single-ended package (I2PAK); TO-262	SOT226

4. Marking

Table 4. Marking codes

Type number	Marking code
BUK9E3R2-40E	BUK9E3R2-40E

5. Limiting values

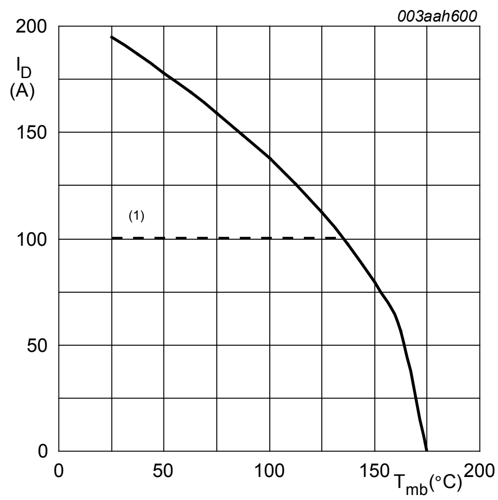
Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25$ °C; $T_j \leq 175$ °C		-	40	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20$ kΩ		-	40	V
V_{GS}	gate-source voltage	$T_j \leq 175$ °C; Pulsed	[1][2]	-15	15	V
		$T_j \leq 175$ °C; DC		-10	10	V
I_D	drain current	$T_{mb} = 25$ °C; $V_{GS} = 5$ V; Fig. 1	[3]	-	100	A
		$T_{mb} = 100$ °C; $V_{GS} = 5$ V; Fig. 1	[3]	-	100	A
I_{DM}	peak drain current	$T_{mb} = 25$ °C; pulsed; $t_p \leq 10$ μs; Fig. 4		-	781	A
P_{tot}	total power dissipation	$T_{mb} = 25$ °C; Fig. 2		-	234	W

Symbol	Parameter	Conditions		Min	Max	Unit
T_{stg}	storage temperature			-55	175	°C
T_j	junction temperature			-55	175	°C
Source-drain diode						
I_S	source current	T_{mb} = 25 °C	[3]	-	100	A
I_{SM}	peak source current	pulsed; t_p ≤ 10 µs; T_{mb} = 25 °C		-	781	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	I_D = 100 A; V_{sup} ≤ 40 V; R_{GS} = 50 Ω; V_{GS} = 5 V; $T_{j(init)}$ = 25 °C; unclamped; Fig. 3	[4][5]	-	419	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] Continuous current is limited by package.
[4] Single-pulse avalanche rating limited by maximum junction temperature of 175 °C.
[5] Refer to application note AN10273 for further information.



(1) Capped at 100A due to package

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

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

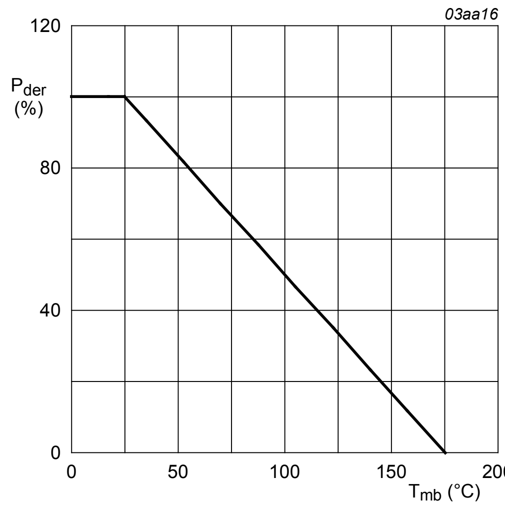


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

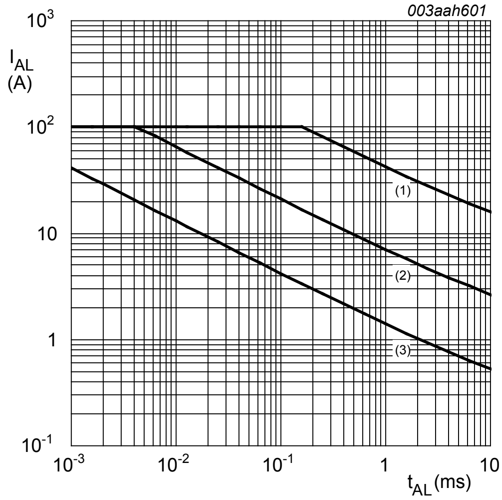


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

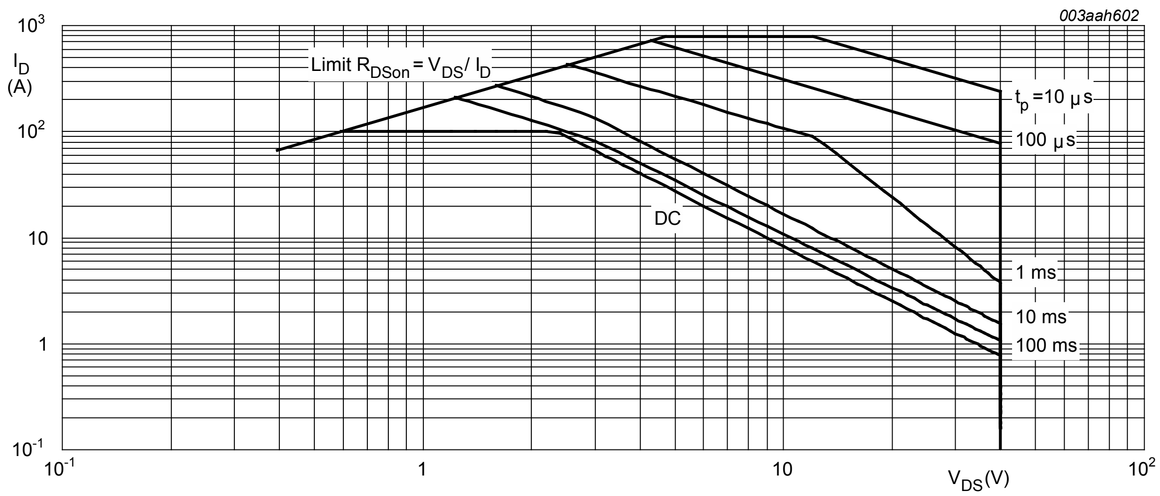


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25°C$; I_{DM} *is a single pulse*

6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Fig. 5		-	-	0.64	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air		-	65	-	K/W

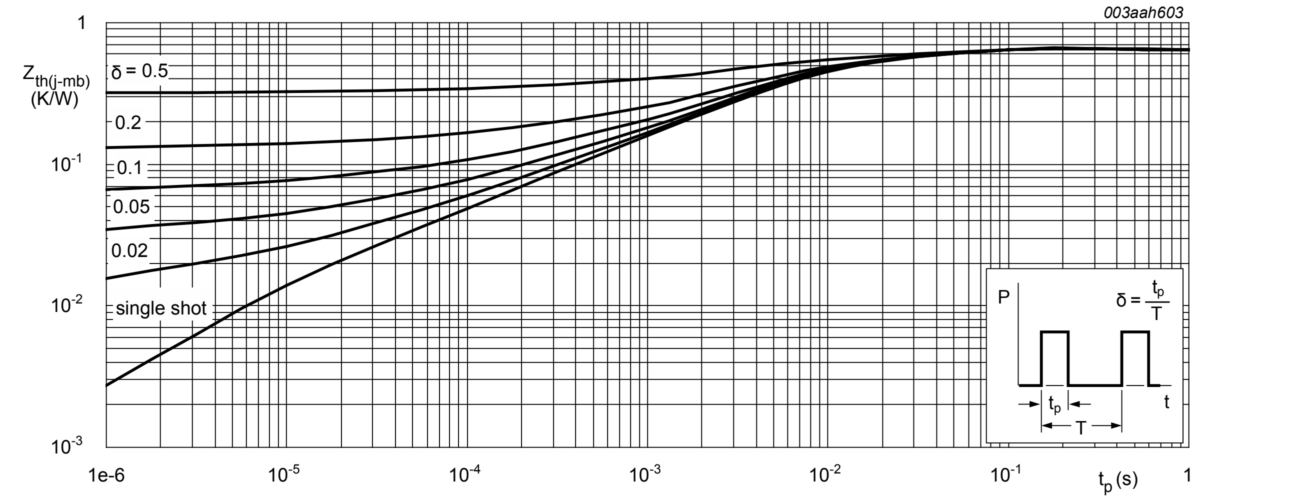


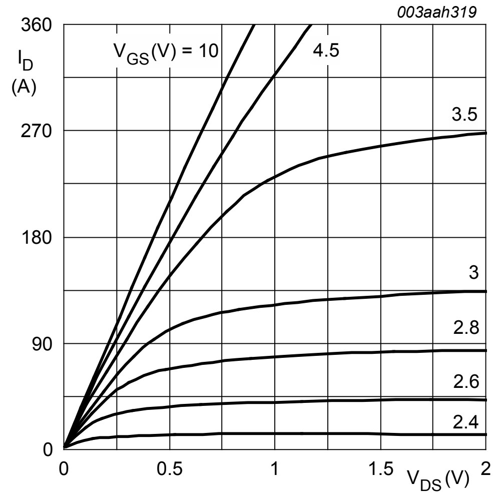
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V; T_j = 25 °C		40	-	-	V
		I_D = 250 µA; V_{GS} = 0 V; T_j = -55 °C		36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; T_j = 25 °C; Fig. 9; Fig. 10		1.4	1.7	2.1	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = -55 °C; Fig. 9		-	-	2.45	V
		I_D = 1 mA; V_{DS} = V_{GS}; T_j = 175 °C; Fig. 9		0.5	-	-	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V; T_j = 25 °C		-	0.06	1	µA
		V_{DS} = 40 V; V_{GS} = 0 V; T_j = 175 °C		-	-	500	µA
I_{GSS}	gate leakage current	V_{GS} = 10 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
		V_{GS} = -10 V; V_{DS} = 0 V; T_j = 25 °C		-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 5 V; I_D = 25 A; T_j = 25 °C; Fig. 11		-	2.7	3.2	mΩ
		V_{GS} = 10 V; I_D = 25 A; T_j = 25 °C; Fig. 11		-	2.4	2.8	mΩ
		V_{GS} = 5 V; I_D = 25 A; T_j = 175 °C; Fig. 12; Fig. 11		-	-	6.1	mΩ
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DS} = 32 V; V_{GS} = 5 V; Fig. 13; Fig. 14		-	69.5	-	nC
Q_{GS}	gate-source charge			-	16.1	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Q_{GD}	gate-drain charge		-	25.8	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; T_j = 25 °C; Fig. 15	-	6870	9150	pF
C_{oss}	output capacitance		-	875	1050	pF
C_{rss}	reverse transfer capacitance		-	450	620	pF
$t_{d(on)}$	turn-on delay time	V_{DS} = 30 V; R_L = 1.2 Ω; V_{GS} = 5 V; $R_{G(ext)}$ = 5 Ω	-	42	-	ns
t_r	rise time		-	73	-	ns
$t_{d(off)}$	turn-off delay time		-	114	-	ns
t_f	fall time		-	76	-	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
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; T_j = 25 °C; Fig. 16	-	0.8	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = -100 A/µs; V_{GS} = 0 V; V_{DS} = 25 V	-	40	-	ns
Q_r	recovered charge		-	47	-	nC



T_j = 25 °C; t_p = 300 µs

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

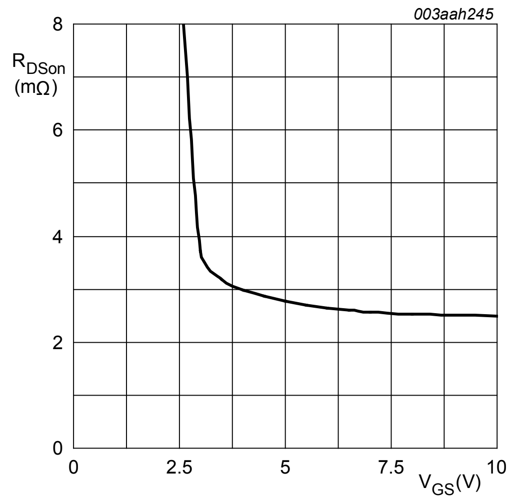


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

T_j = 25°C; I_D = 25A

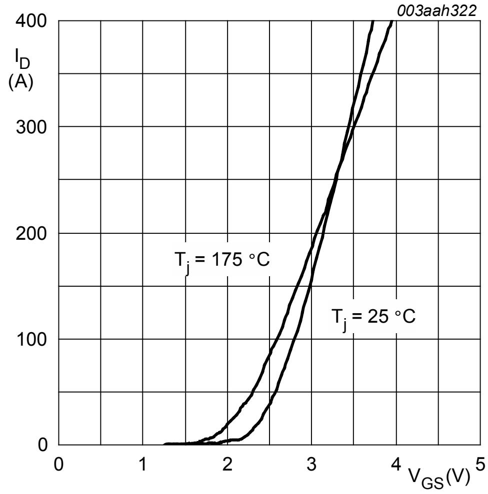


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10 V$

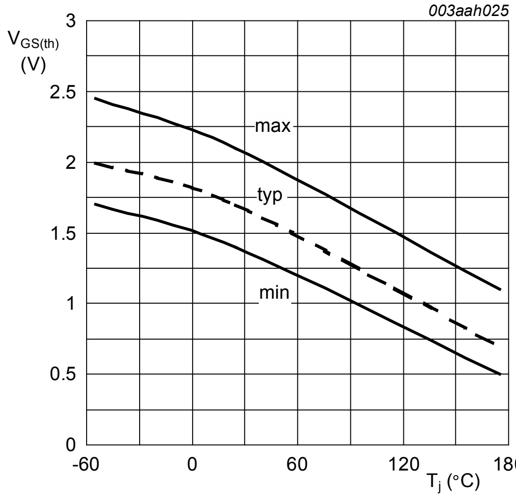


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

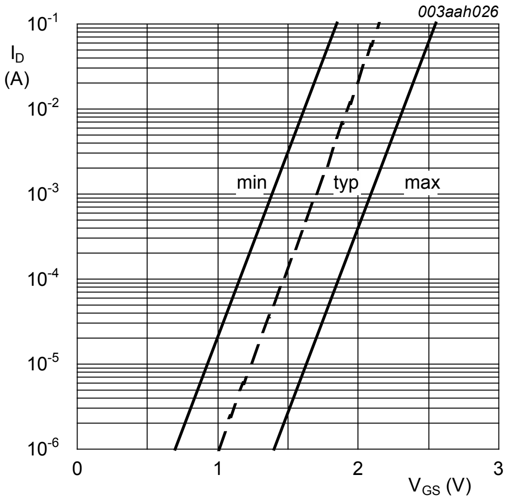
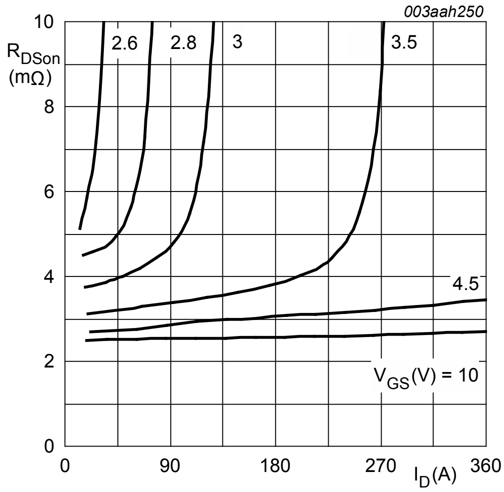


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25°C$; $V_{DS} = 5V$



T_j = 25 °C; t_p = 300 μs

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

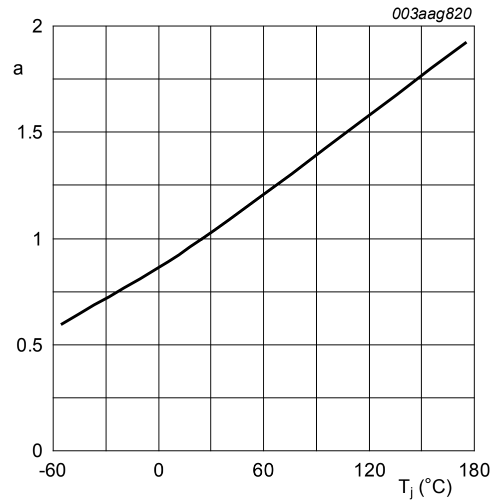


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

$$a = \frac{R_{DSon}}{R_{DSon(25\,°C)}}$$

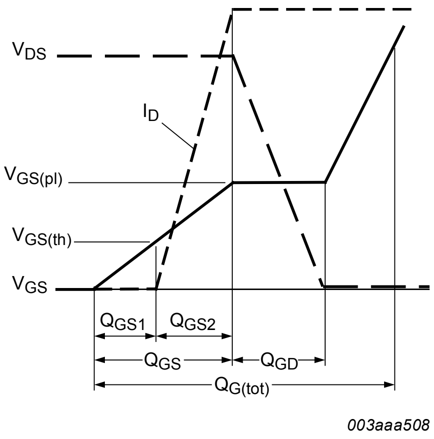


Fig. 13. Gate charge waveform definitions

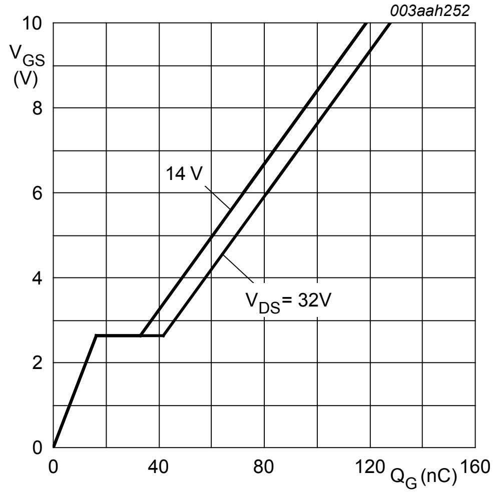


Fig. 14. Gate-source voltage as a function of gate charge; typical values

$T_j = 25°C;\ I_D = 25A$

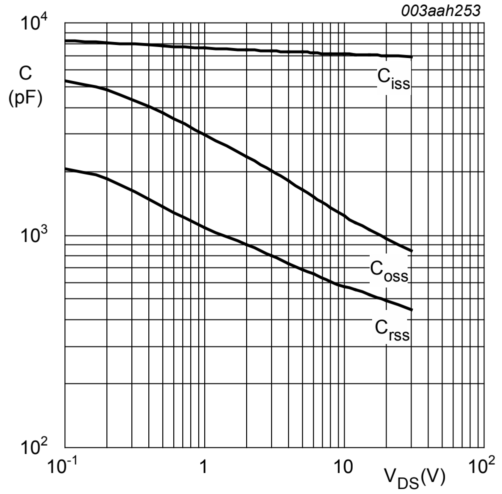


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

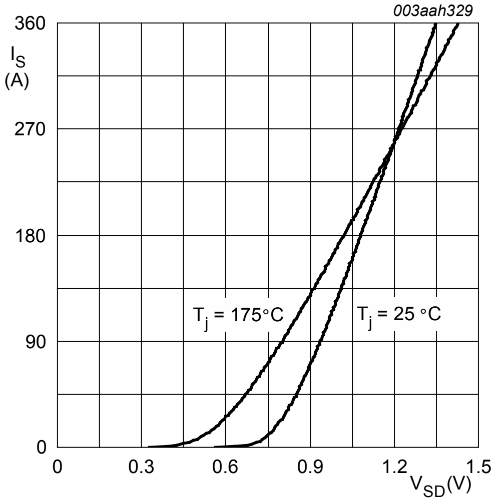
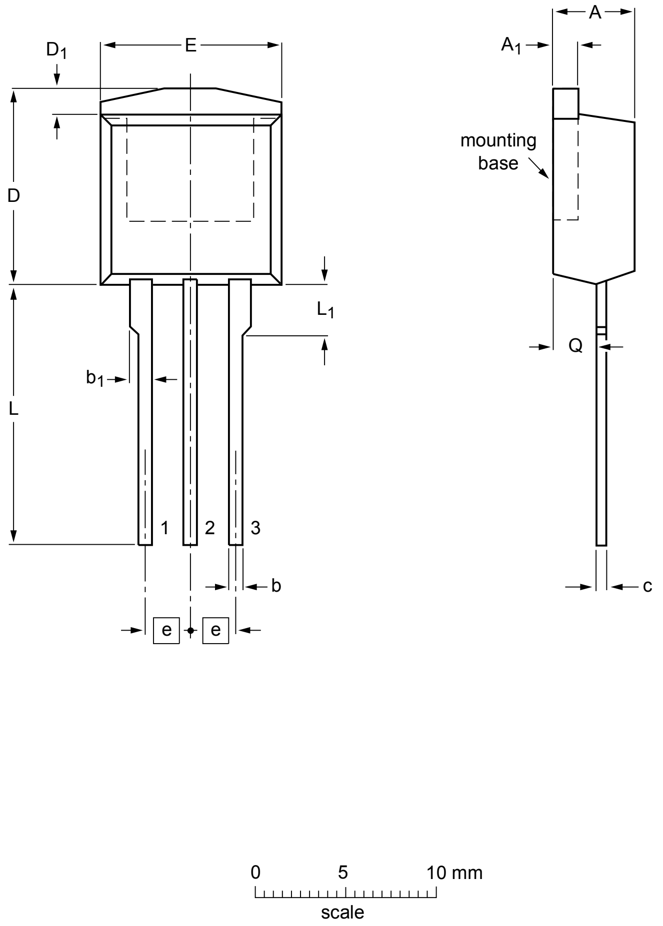


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

8. Package outline

Plastic single-ended package (I2PAK); low-profile 3-lead TO-262 **SOT226**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D max	D_1	E	e	L	L_1	Q
mm	4.5 4.1	1.40 1.27	0.85 0.60	1.3 1.0	0.7 0.4	11	1.6 1.2	10.3 9.7	2.54	15.0 13.5	3.30 2.79	2.6 2.2

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT226		TO-262				~~06-02-14~~ 09-08-25

Fig. 17. Package outline I2PAK (SOT226)

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Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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