



BUK7E13-60E

N-channel TrenchMOS standard level FET

11 September 2012

Product data sheet

1. Product profile

1.1 General description

Standard 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 standard level gate with VGS(th) rating of greater than 1V 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

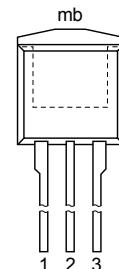
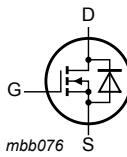
Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_j \geq 25 \text{ }^\circ\text{C}; T_j \leq 175 \text{ }^\circ\text{C}$	-	-	60	V
I_D	drain current	$V_{GS} = 10 \text{ V}; T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 1	-	-	58	A
P_{tot}	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$; Fig. 2	-	-	96	W
Static characteristics						
R_{DSon}	drain-source on-state resistance	$V_{GS} = 10 \text{ V}; I_D = 15 \text{ A}; T_j = 25 \text{ }^\circ\text{C}$; Fig. 11	-	9.6	13	$\text{m}\Omega$
Dynamic characteristics						
Q_{GD}	gate-drain charge	$I_D = 15 \text{ A}; V_{DS} = 48 \text{ V}; V_{GS} = 10 \text{ V}$; Fig. 13 ; Fig. 14	-	6.9	-	nC

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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	 I2PAK (SOT226)	

3. Ordering information

Table 3. Ordering information

Type number	Package			Version
	Name	Description	Version	
BUK7E13-60E	I2PAK	plastic single-ended package (I2PAK); TO-262		SOT226

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	$T_j \geq 25^\circ\text{C}$; $T_j \leq 175^\circ\text{C}$	-	60	V
V_{DGR}	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	60	V
V_{GS}	gate-source voltage	$T_j \leq 175^\circ\text{C}$; DC	-20	20	V
I_D	drain current	$T_{mb} = 25^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Fig. 1	-	58	A
		$T_{mb} = 100^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Fig. 1	-	41	A
I_{DM}	peak drain current	$T_{mb} = 25^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4	-	234	A
P_{tot}	total power dissipation	$T_{mb} = 25^\circ\text{C}$; Fig. 2	-	96	W
T_{stg}	storage temperature		-55	175	°C
T_j	junction temperature		-55	175	°C
Source-drain diode					
I_S	source current	$T_{mb} = 25^\circ\text{C}$	[1]	-	A
I_{SM}	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$; $T_{mb} = 25^\circ\text{C}$	-	234	A

Symbol	Parameter	Conditions		Min	Max	Unit
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 58 \text{ A}$; $V_{sup} \leq 60 \text{ V}$; $R_{GS} = 50 \Omega$; $V_{GS} = 60 \text{ V}$; $T_{j(init)} = 25^\circ\text{C}$; unclamped; Fig. 3	[2][3]	-	37	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.

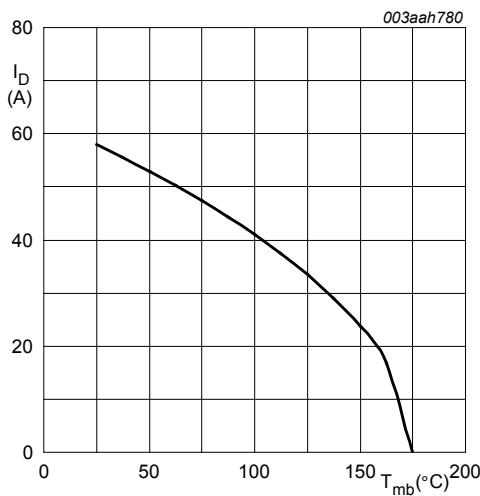


Fig. 1. Continuous drain current as a function of mounting base temperature

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

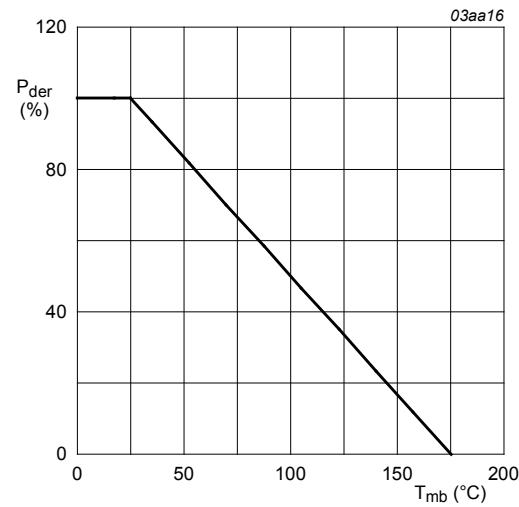


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

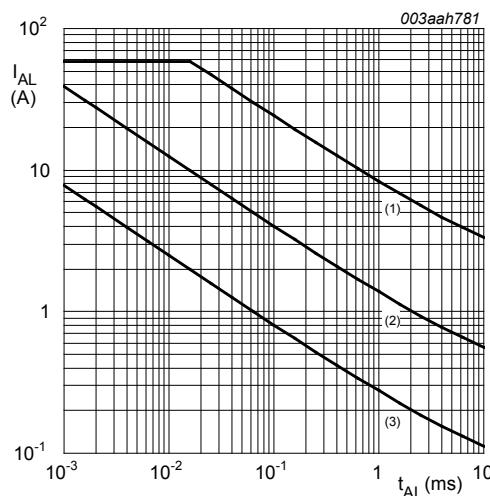


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

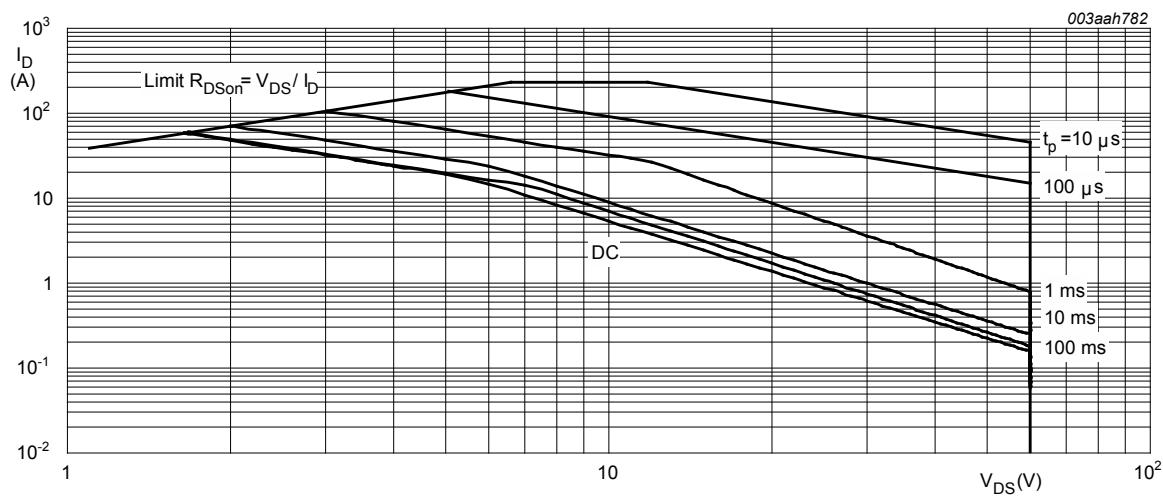


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

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	-	-	1.56	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	65	-	K/W

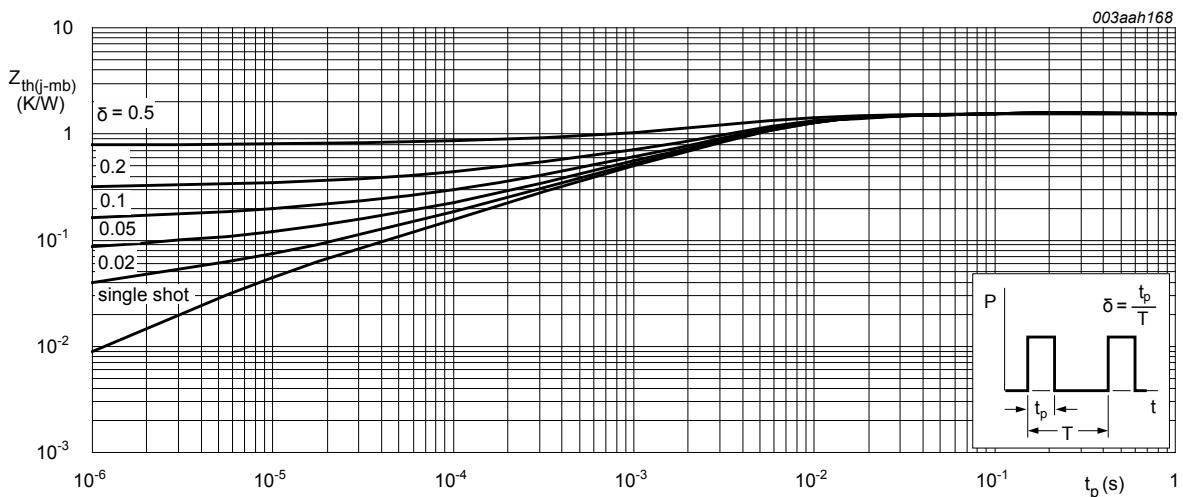


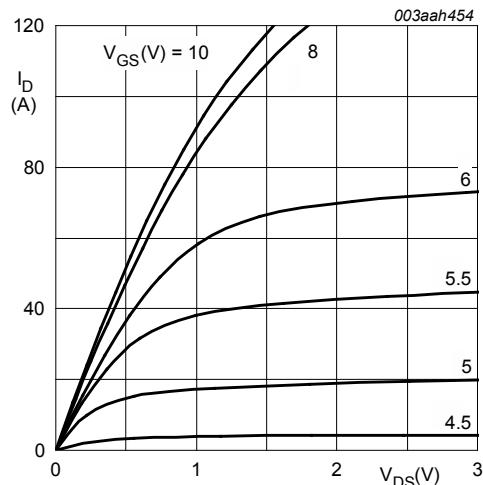
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
V _{(BR)DSS}	drain-source breakdown voltage	I _D = 250 μ A; V _{GS} = 0 V; T _j = 25 °C		60	-	-	V
		I _D = 250 μ A; V _{GS} = 0 V; T _j = -55 °C		54	-	-	V
V _{GS(th)}	gate-source threshold voltage	I _D = 1 mA; V _{DS} = V _{GS} ; T _j = 25 °C; Fig. 9 ; Fig. 10		2.4	3	4	V
		I _D = 1 mA; V _{DS} = V _{GS} ; T _j = 175 °C; Fig. 9		1	-	-	V
		I _D = 1 mA; V _{DS} = V _{GS} ; T _j = -55 °C; Fig. 9		-	-	4.5	V
I _{DSS}	drain leakage current	V _{DS} = 60 V; V _{GS} = 0 V; T _j = 25 °C		-	0.025	1	μ A
		V _{DS} = 60 V; V _{GS} = 0 V; T _j = 175 °C		-	-	500	μ A
I _{GSS}	gate leakage current	V _{GS} = 20 V; V _{DS} = 0 V; T _j = 25 °C		-	2	100	nA
		V _{GS} = -20 V; V _{DS} = 0 V; T _j = 25 °C		-	2	100	nA
R _{DSon}	drain-source on-state resistance	V _{GS} = 10 V; I _D = 15 A; T _j = 25 °C; Fig. 11		-	9.6	13	$m\Omega$
		V _{GS} = 10 V; I _D = 15 A; T _j = 175 °C; Fig. 11 ; Fig. 12		-	-	28.2	$m\Omega$
Dynamic characteristics							
Q _{G(tot)}	total gate charge	I _D = 15 A; V _{DS} = 48 V; V _{GS} = 10 V; Fig. 13 ; Fig. 14		-	22.9	-	nC
Q _{GS}	gate-source charge			-	5	-	nC
Q _{GD}	gate-drain charge			-	6.9	-	nC
C _{iss}	input capacitance	V _{GS} = 0 V; V _{DS} = 25 V; f = 1 MHz; T _j = 25 °C; Fig. 15		-	1298	1730	pF
C _{oss}	output capacitance			-	197	237	pF
C _{rss}	reverse transfer capacitance			-	122	162	pF
t _{d(on)}	turn-on delay time	V _{DS} = 45 V; R _L = 3 Ω ; V _{GS} = 10 V; R _{G(ext)} = 5 Ω		-	10.8	-	ns
t _r	rise time			-	9.2	-	ns
t _{d(off)}	turn-off delay time			-	21.9	-	ns
t _f	fall time			-	9.8	-	ns
L _D	internal drain inductance	from upper edge of mounting base to centre of die ; T _j = 25 °C		-	2.5	-	nH
		T _j = 25 °C; from drain lead 6mm from package to centre of die		-	4.5	-	nH
L _S	internal source inductance	measured from source lead to source bond pad ; T _j = 25 °C		-	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		-	0.84	1.2	V
t_{rr}	reverse recovery time	$I_S = 15 \text{ A}$; $dI_S/dt = -100 \text{ A}/\mu\text{s}$; $V_{GS} = 0 \text{ V}$		-	21.3	-	ns
Q_r	recovered charge	$V_{DS} = 25 \text{ V}$		-	18.1	-	nC



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

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

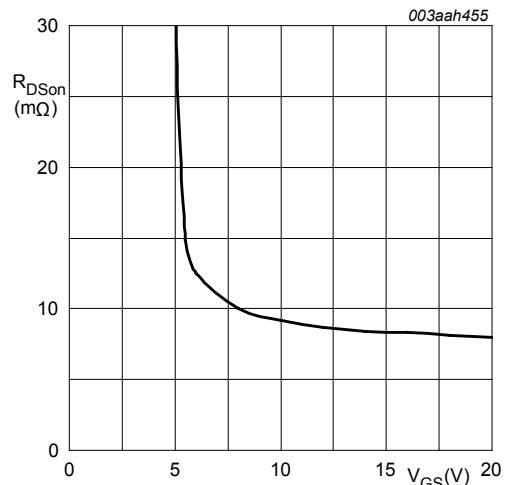
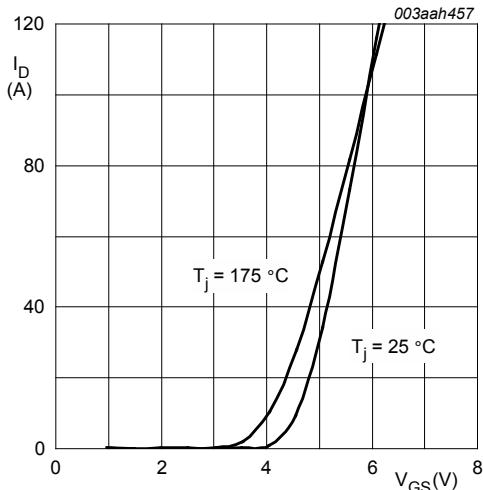


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

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



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

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

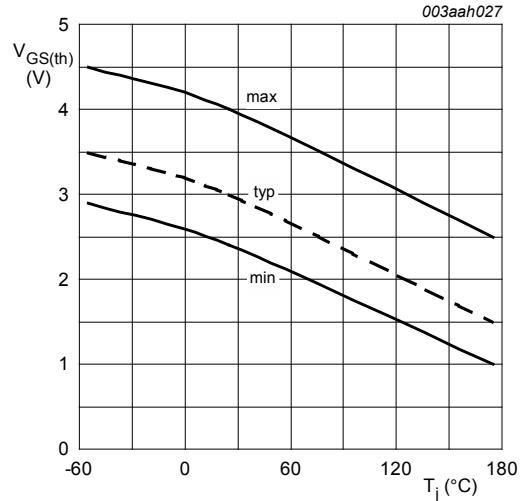


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

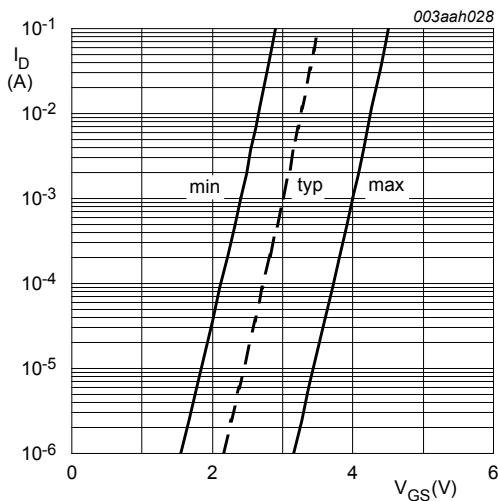
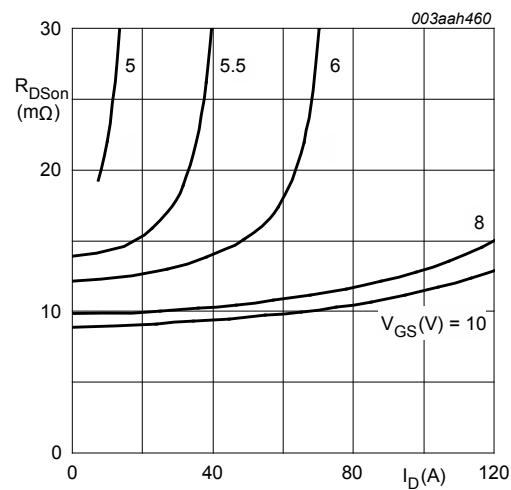


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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



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

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

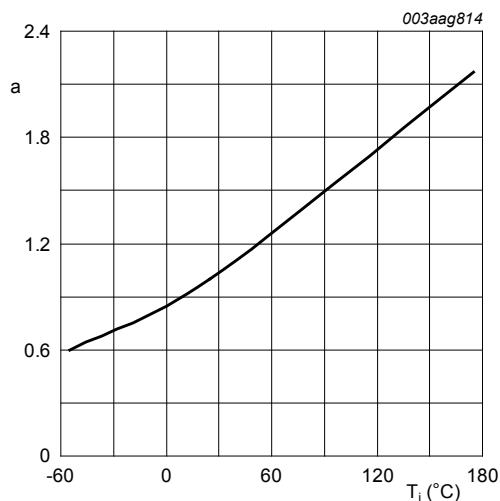


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

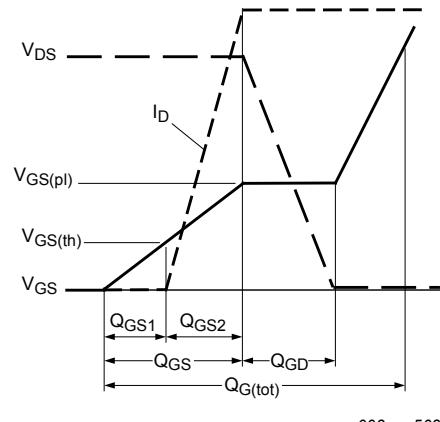


Fig. 13. Gate charge waveform definitions

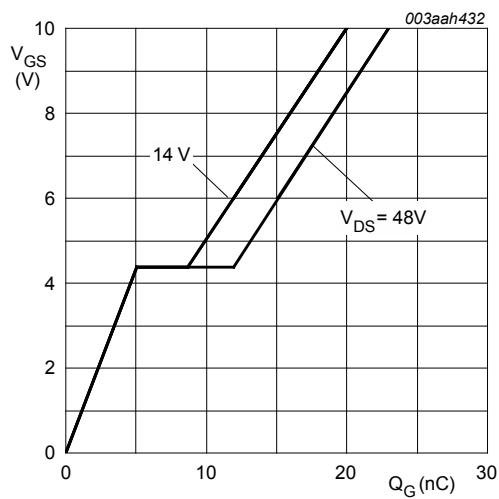


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

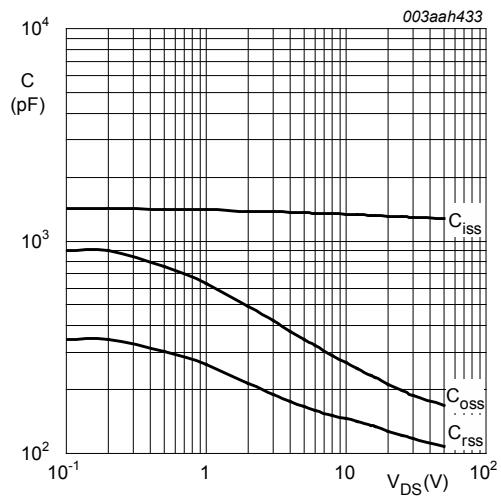


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

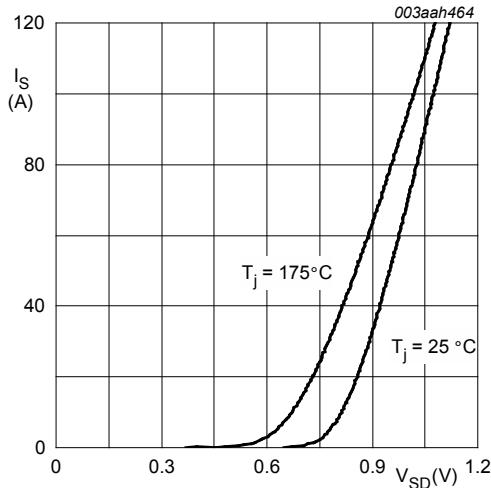


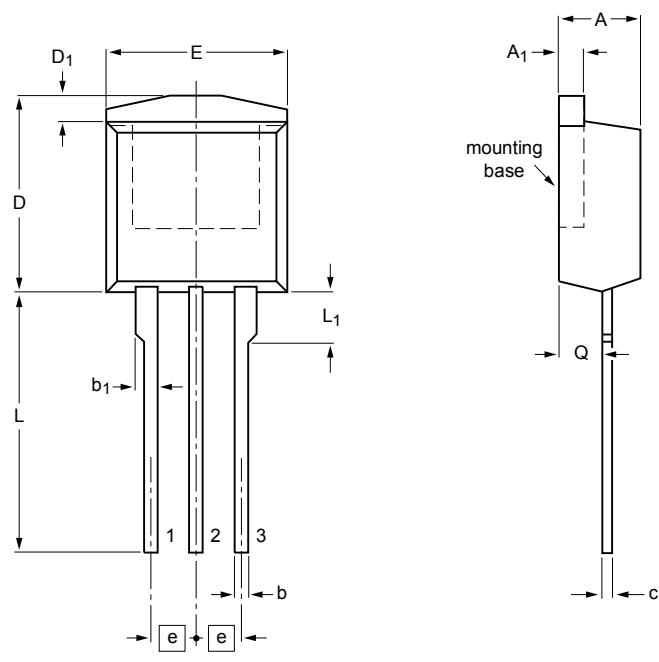
Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

7. 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)

8. Legal information

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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