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Team Nexperia

BUK9515-60E

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 SOT78 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 V_{GS(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	-	-	54	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2	-	-	96	W
Static characteristics						
R _{DS(on)}	drain-source on-state resistance	V _{GS} = 5 V; I _D = 15 A; T _j = 25 °C; Fig. 11	-	11.6	15	mΩ
Dynamic characteristics						
Q _{GD}	gate-drain charge	V _{GS} = 5 V; I _D = 15 A; V _{DS} = 48 V; Fig. 13 ; Fig. 14	-	6.7	-	nC

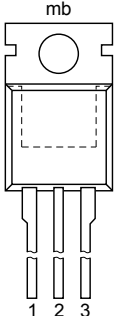
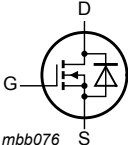


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2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 TO-220AB (SOT78A)	
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
BUK9515-60E	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78A

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	$T_j > 175\text{ °C}$; Pulsed	[1][2]	-15	15	V
		$T_j \leq 175\text{ °C}$; DC		-10	10	V
I_D	drain current	$T_{mb} = 25\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1		-	54	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1		-	38	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4		-	216	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; 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	$T_{mb} = 25\text{ °C}$		-	54	A

Symbol	Parameter	Conditions		Min	Max	Unit
I_{SM}	peak source current	pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25 \text{ }^{\circ}C$		-	216	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 54 \text{ A}$; $V_{sup} \leq 60 \text{ V}$; $R_{GS} = 50 \text{ }\Omega$; $V_{GS} = 5 \text{ V}$; $T_{j(init)} = 25 \text{ }^{\circ}C$; unclamped; Fig. 3	[3][4]	-	39	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 $^{\circ}C$.
- [4] Refer to application note AN10273 for further information.

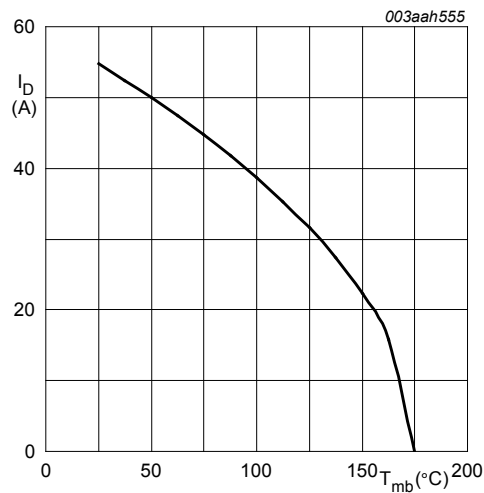


Fig. 1. Continuous drain current as a function of mounting base temperature

$V_{GS} \geq 5V$

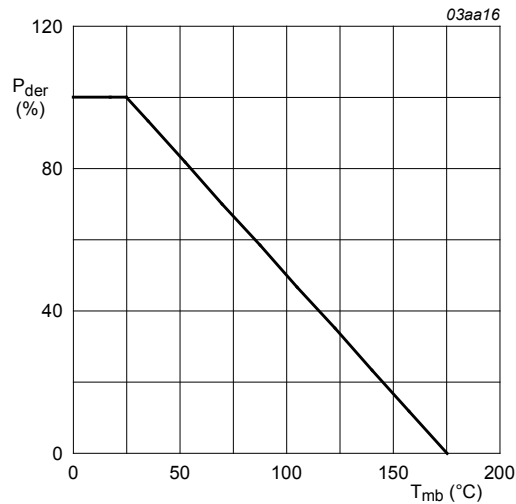


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

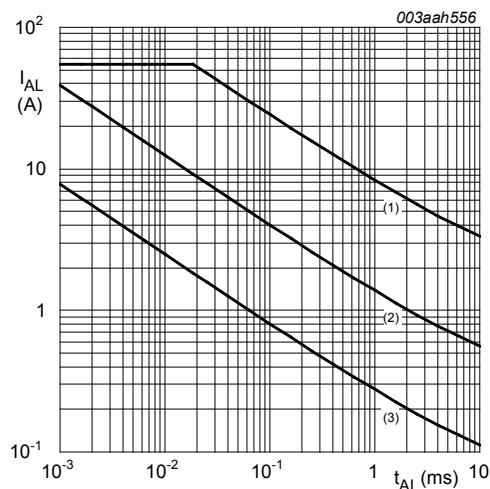


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

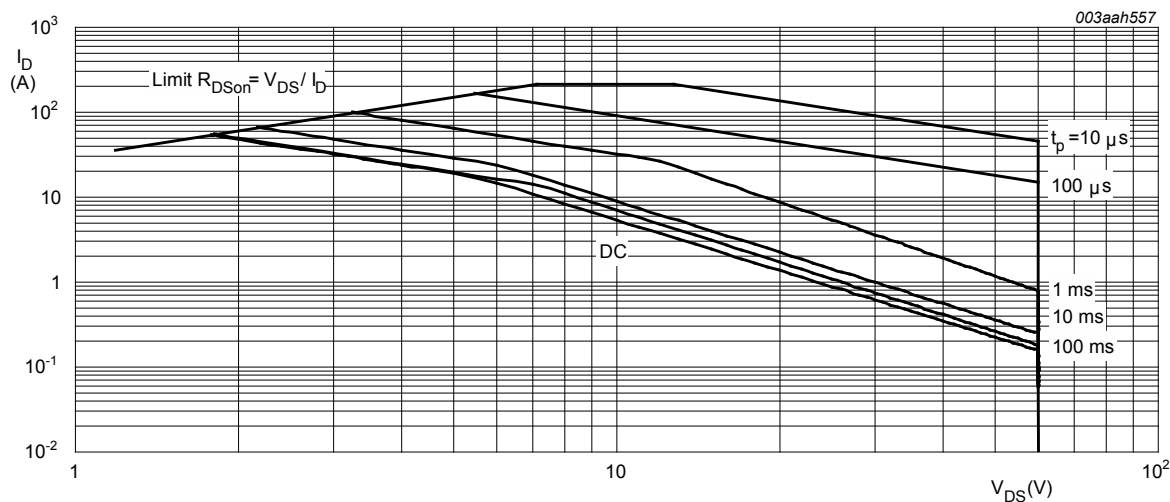


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^{\circ}C$; 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	-	60	-	K/W

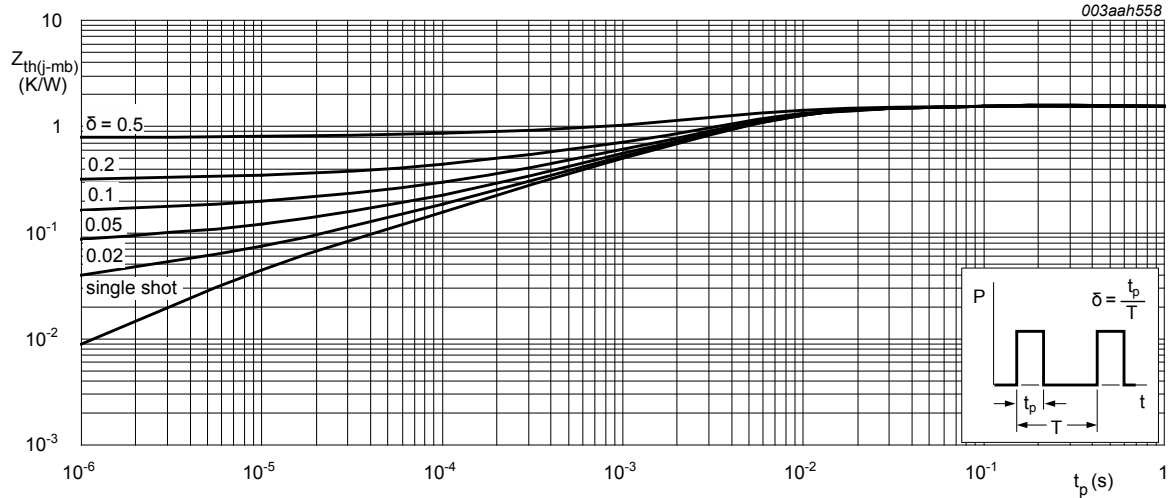


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Static characteristics							
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$		60	-	-	V
		$I_D = 250\text{ }\mu\text{A}; V_{GS} = 0\text{ V}; T_j = -55\text{ }^\circ\text{C}$		54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}; V_{DS} = V_{GS}; T_j = 25\text{ }^\circ\text{C};$ Fig. 9; Fig. 10		1.4	1.7	2.1	V
		$I_D = 1\text{ mA}; V_{DS} = V_{GS}; T_j = -55\text{ }^\circ\text{C};$ Fig. 9		-	-	2.45	V
		$I_D = 1\text{ mA}; V_{DS} = V_{GS}; T_j = 175\text{ }^\circ\text{C};$ Fig. 9		0.5	-	-	V
I_{DSS}	drain leakage current	$V_{DS} = 60\text{ V}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$		-	0.02	1	μA
		$V_{DS} = 60\text{ V}; V_{GS} = 0\text{ V}; T_j = 175\text{ }^\circ\text{C}$		-	-	500	μA
I_{GSS}	gate leakage current	$V_{GS} = 10\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$		-	2	100	nA
		$V_{GS} = -10\text{ V}; V_{DS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}$		-	2	100	nA
R_{DSon}	drain-source on-state resistance	$V_{GS} = 5\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ }^\circ\text{C};$ Fig. 11		-	11.6	15	m Ω
		$V_{GS} = 10\text{ V}; I_D = 15\text{ A}; T_j = 25\text{ }^\circ\text{C};$ Fig. 11		-	10.3	13	m Ω
		$V_{GS} = 5\text{ V}; I_D = 15\text{ A}; T_j = 175\text{ }^\circ\text{C};$ Fig. 12; Fig. 11		-	-	33	m Ω
Dynamic characteristics							
$Q_{G(tot)}$	total gate charge	$I_D = 15\text{ A}; V_{DS} = 48\text{ V}; V_{GS} = 5\text{ V};$ Fig. 13; Fig. 14		-	20.5	-	nC
Q_{GS}	gate-source charge			-	4	-	nC

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Q_{GD}	gate-drain charge			-	6.7	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$ $T_j = 25\text{ }^{\circ}\text{C};$ Fig. 15		-	1988	2651	pF
C_{oss}	output capacitance			-	196	235	pF
C_{rss}	reverse transfer capacitance			-	114	156	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 45\text{ V}; R_L = 3\text{ }\Omega; V_{GS} = 5\text{ V};$ $R_{G(ext)} = 5\text{ }\Omega$		-	16.9	-	ns
t_r	rise time			-	22.4	-	ns
$t_{d(off)}$	turn-off delay time			-	35.7	-	ns
t_f	fall time			-	22.9	-	ns
L_D	internal drain inductance	from upper edge of drain mounting base to center of die ; $T_j = 25\text{ }^{\circ}\text{C}$		-	2.5	-	nH
		from drain lead 6mm from package to centre of die ; $T_j = 25\text{ }^{\circ}\text{C}$		-	4.5	-	nH
L_S	internal source inductance	from source lead to source bonding pad ; $T_j = 25\text{ }^{\circ}\text{C}$		-	7.5	-	nH
Source-drain diode							
V_{SD}	source-drain voltage	$I_S = 15\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^{\circ}\text{C};$ Fig. 16		-	0.83	1.2	V
t_{rr}	reverse recovery time	$I_S = 15\text{ A}; dI_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$ $V_{DS} = 25\text{ V}$		-	22.3	-	ns
Q_r	recovered charge			-	20.9	-	nC

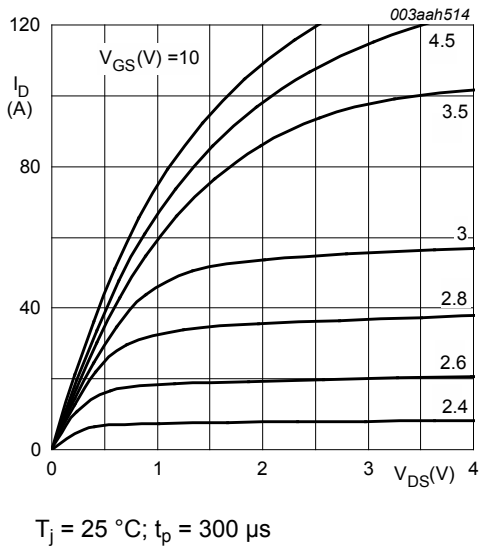


Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

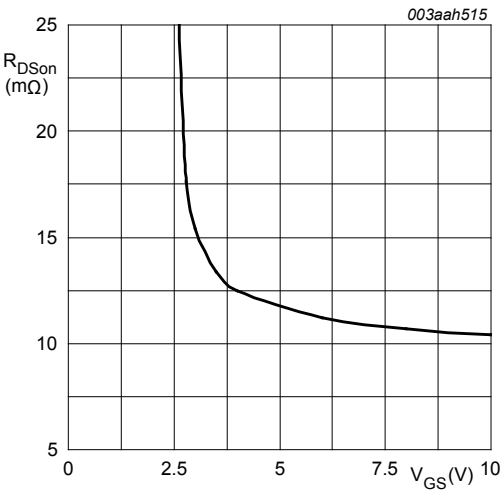


Fig. 7. Drain-source on-state resistance as a function of gate-source voltage; typical values

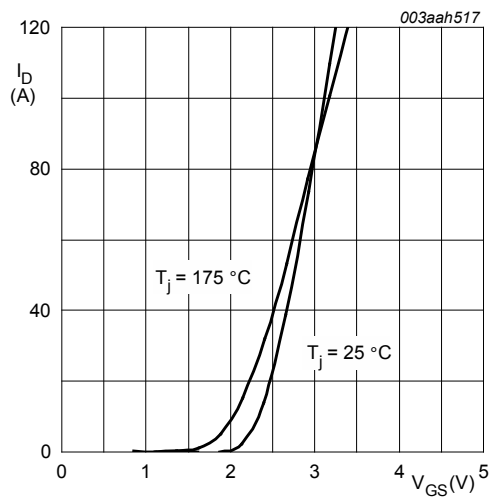


Fig. 8. Transfer characteristics; drain current as a function of gate-source voltage; typical values

$V_{DS} = 10V$

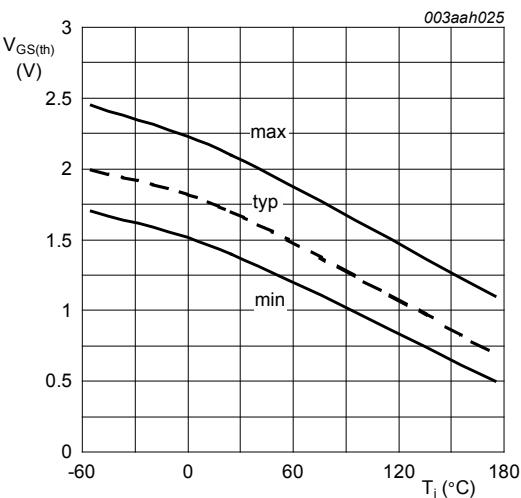


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

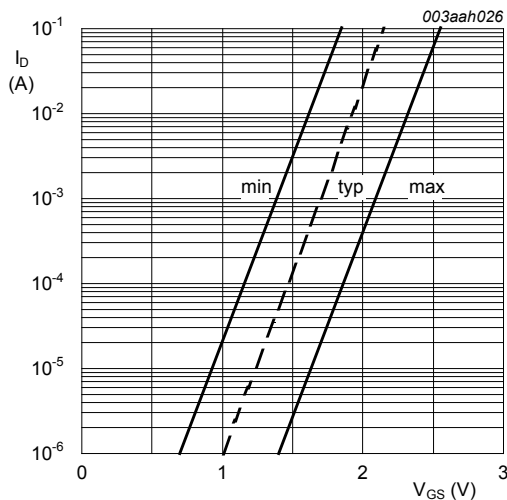


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

$T_j = 25\text{ °C}; V_{DS} = 5V$

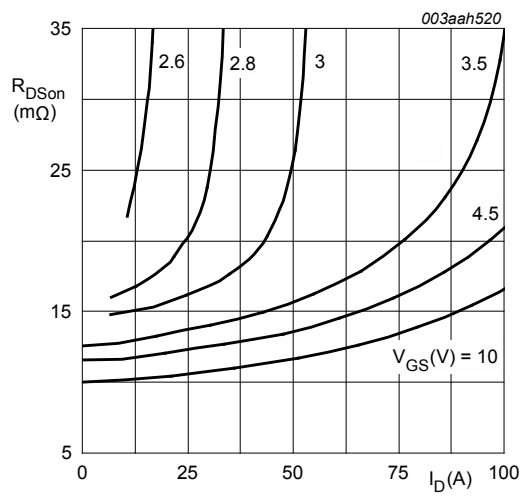


Fig. 11. Drain-source on-state resistance as a function of drain current; typical values

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

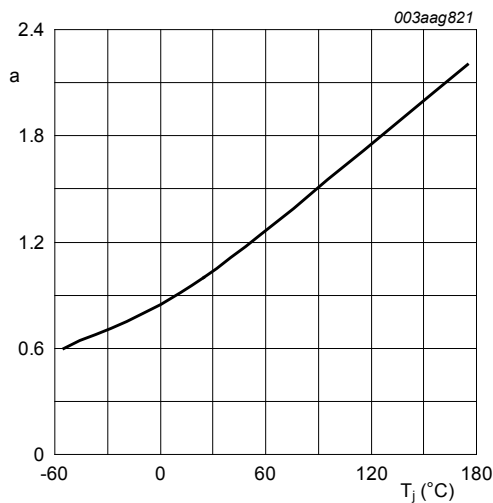


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

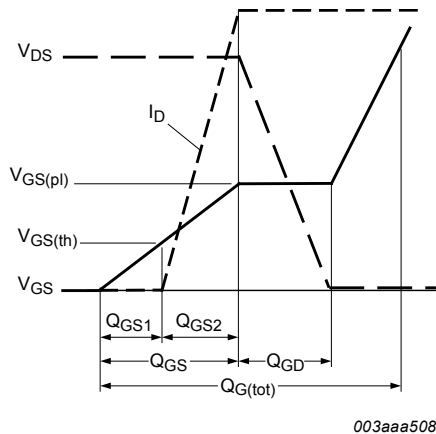


Fig. 13. Gate charge waveform definitions

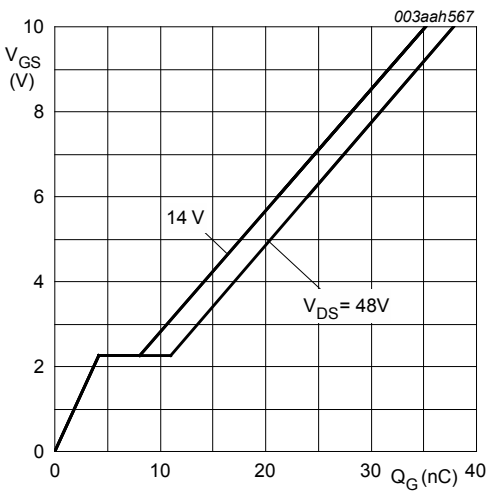


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

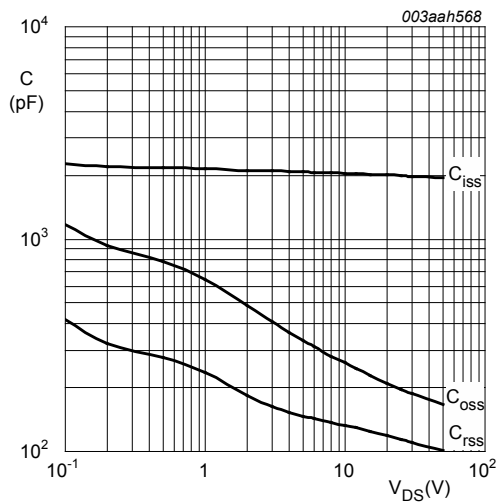


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

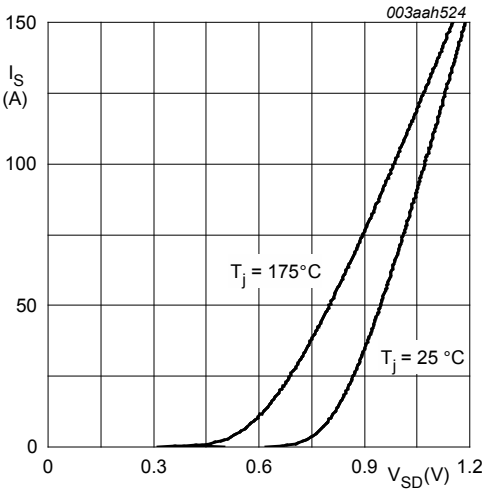


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$V_{GS} = 0V$

7. Package outline

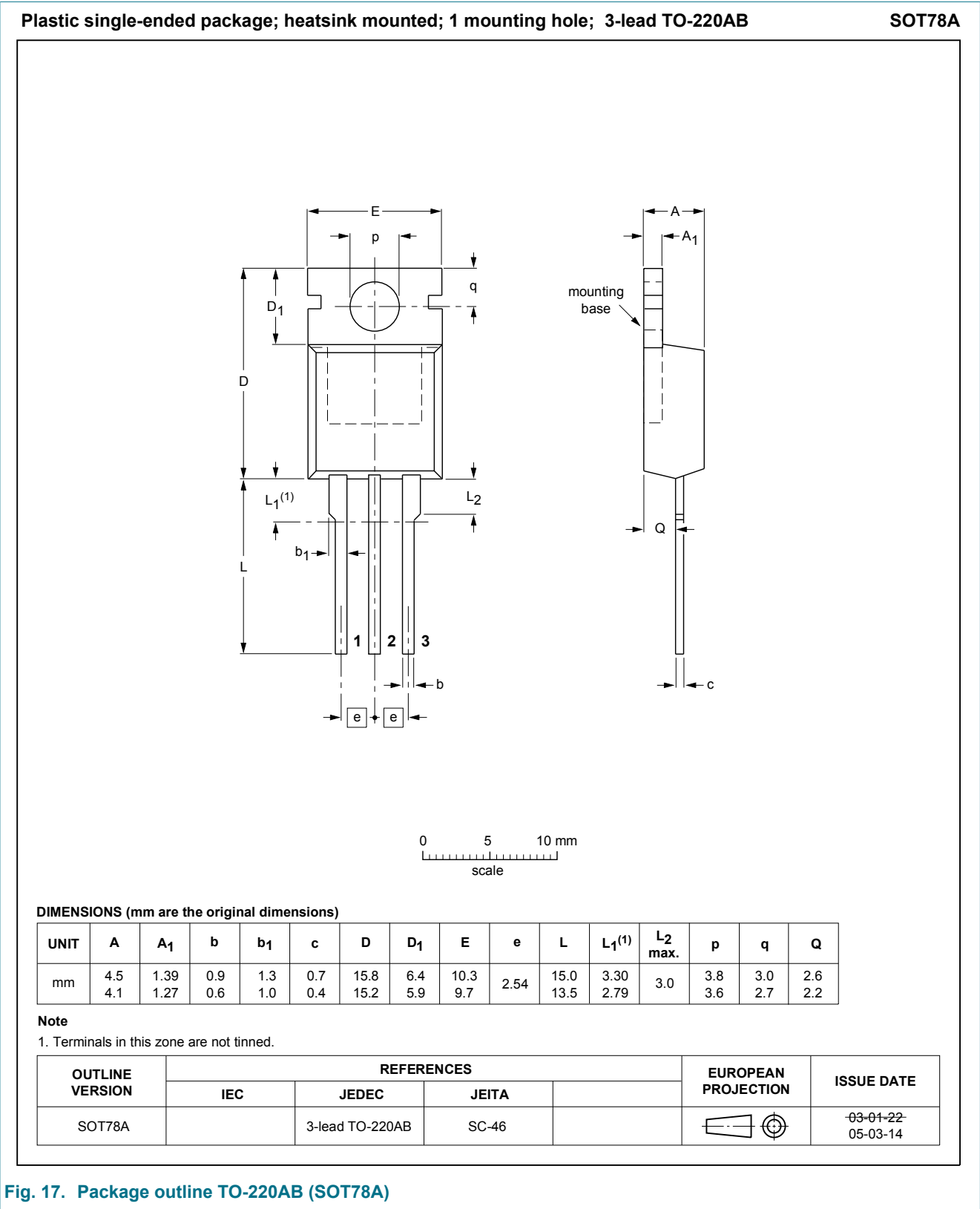


Fig. 17. Package outline TO-220AB (SOT78A)

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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