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BUK954R8-60E

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 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]	-	-	100	A
P _{tot}	total power dissipation	T _{mb} = 25 °C; Fig. 2		-	-	234	W
Static characteristics							
R _{DS(on)}	drain-source on-state resistance	V _{GS} = 5 V; I _D = 25 A; T _j = 25 °C; Fig. 11		-	4	4.9	mΩ
Dynamic characteristics							
Q _{GD}	gate-drain charge	V _{GS} = 5 V; I _D = 25 A; V _{DS} = 48 V; Fig. 13 ; Fig. 14		-	20.3	-	nC

[1] Continuous current is limited by package.



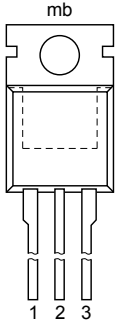
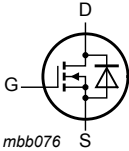
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2. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	G	gate	 <p>TO-220AB (SOT78A)</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
BUK954R8-60E	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	$T_j \leq 175\text{ °C}$; 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	[3]	-	100	A
		$T_{mb} = 100\text{ °C}$; $V_{GS} = 5\text{ V}$; Fig. 1	[3]	-	100	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ °C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Fig. 4	-	590	A	
P_{tot}	total power dissipation	$T_{mb} = 25\text{ °C}$; Fig. 2	-	234	W	
T_{stg}	storage temperature		-55	175	°C	
T_j	junction temperature		-55	175	°C	
Source-drain diode						
I_S	source current	$T_{mb} = 25\text{ °C}$	[3]	-	100	A

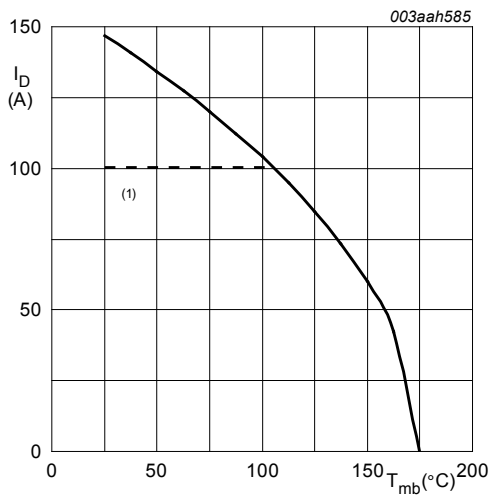
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Symbol	Parameter	Conditions	Min	Max	Unit
I_{SM}	peak source current	pulsed; $t_p \leq 10 \mu s$; $T_{mb} = 25^\circ C$	-	590	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 100 A$; $V_{sup} \leq 60 V$; $R_{GS} = 50 \Omega$; $V_{GS} = 5 V$; $T_{j(init)} = 25^\circ C$; unclamped; Fig. 3	[4][5]	-	273 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 $175^\circ C$.
- [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

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

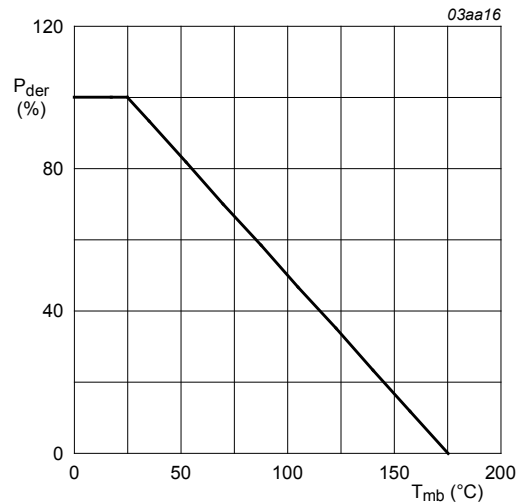


Fig. 2. Normalized total power dissipation as a function of mounting base temperature

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

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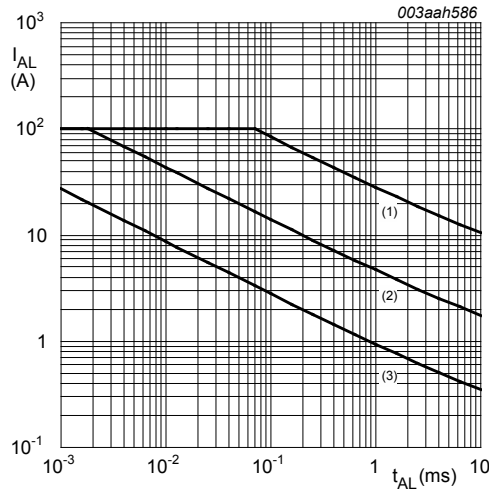


Fig. 3. Single pulse avalanche rating; avalanche current as a function of avalanche time

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

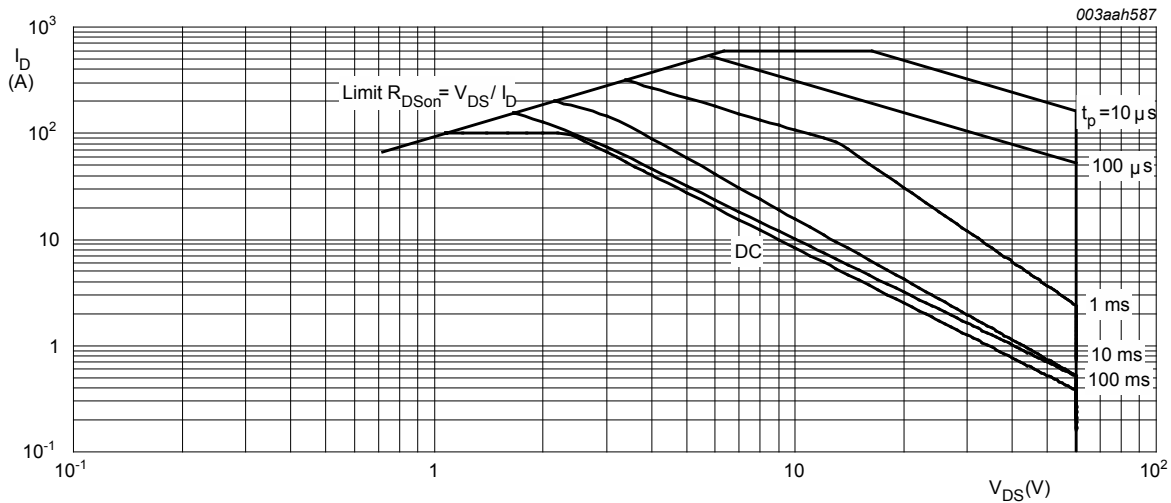


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

$T_{mb} = 25^{\circ}C$; 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	-	-	0.64	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	60	-	K/W

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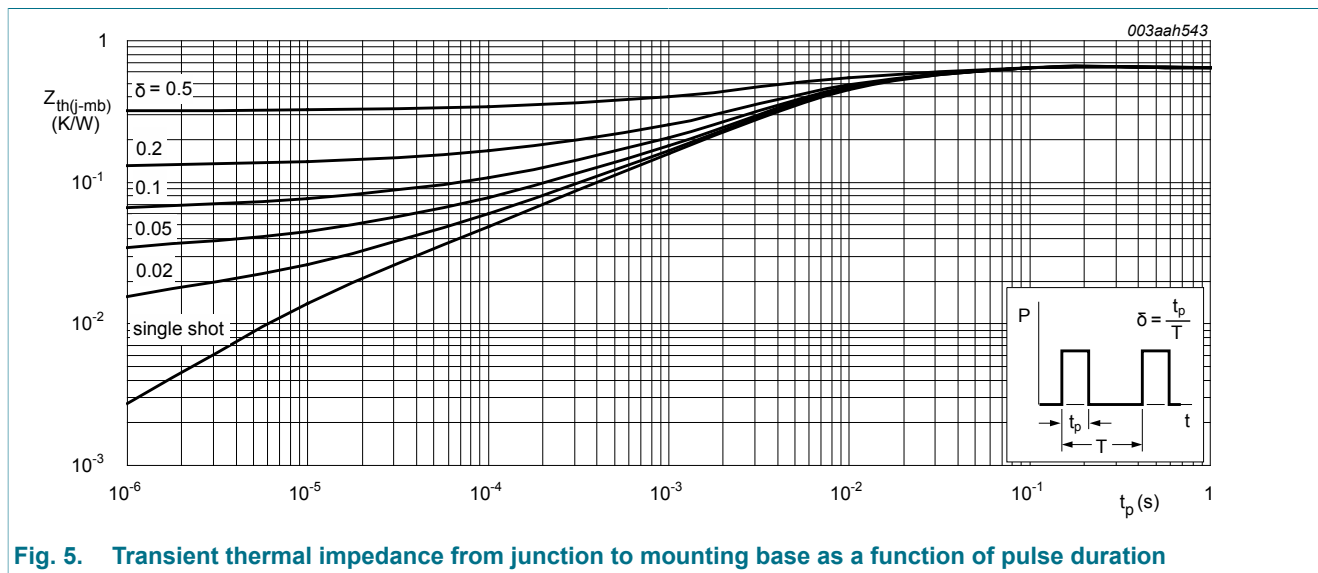


Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration

6. Characteristics

Table 6. Characteristics

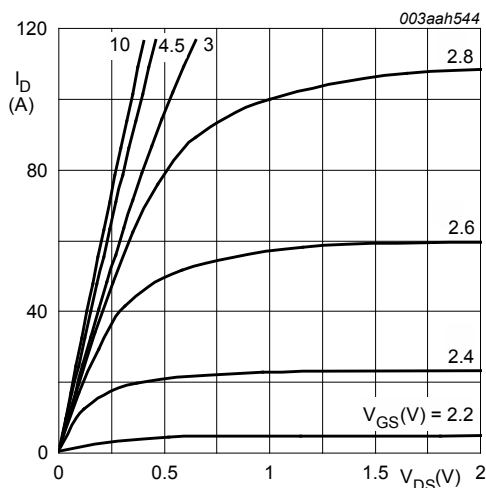
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_J = 25 \text{ }^\circ C$	60	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_J = -55 \text{ }^\circ C$	54	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_J = 25 \text{ }^\circ C;$ 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	$V_{DS} = 60 V; V_{GS} = 0 V; T_J = 25 \text{ }^\circ C$	-	0.05	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	$V_{GS} = 5 V; I_D = 25 A; T_J = 25 \text{ }^\circ C;$ Fig. 11	-	4	4.9	m Ω
		$V_{GS} = 10 V; I_D = 25 A; T_J = 25 \text{ }^\circ C;$ Fig. 11	-	3.6	4.5	m Ω
		$V_{GS} = 5 V; I_D = 25 A; T_J = 175 \text{ }^\circ C;$ Fig. 12; Fig. 11	-	-	10.8	m Ω
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	$I_D = 25 A; V_{DS} = 48 V; V_{GS} = 5 V;$ Fig. 13; Fig. 14	-	65	-	nC
Q_{GS}	gate-source charge		-	17.5	-	nC

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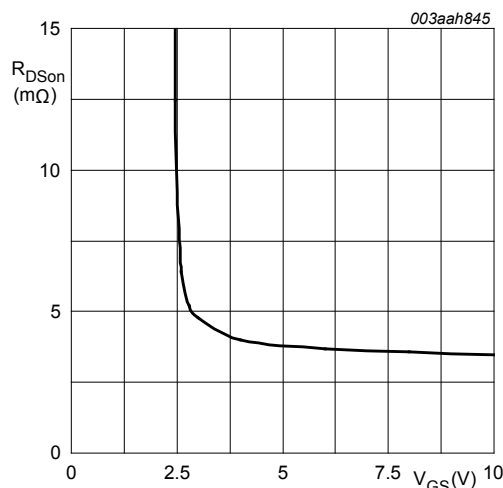
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Q_{GD}	gate-drain charge		-	20.3	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz}; T_j = 25\text{ }^\circ\text{C};$ Fig. 15	-	7282	9710	pF
C_{oss}	output capacitance		-	607	729	pF
C_{rss}	reverse transfer capacitance		-	313	429	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 45\text{ V}; R_L = 1.8\text{ }\Omega; V_{GS} = 5\text{ V}; R_{G(ext)} = 5\text{ }\Omega$	-	36	-	ns
t_r	rise time		-	73	-	ns
$t_{d(off)}$	turn-off delay time		-	78	-	ns
t_f	fall time		-	68	-	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	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C};$ Fig. 16	-	0.8	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}$	-	39	-	ns
Q_r	recovered charge		-	56	-	nC



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

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



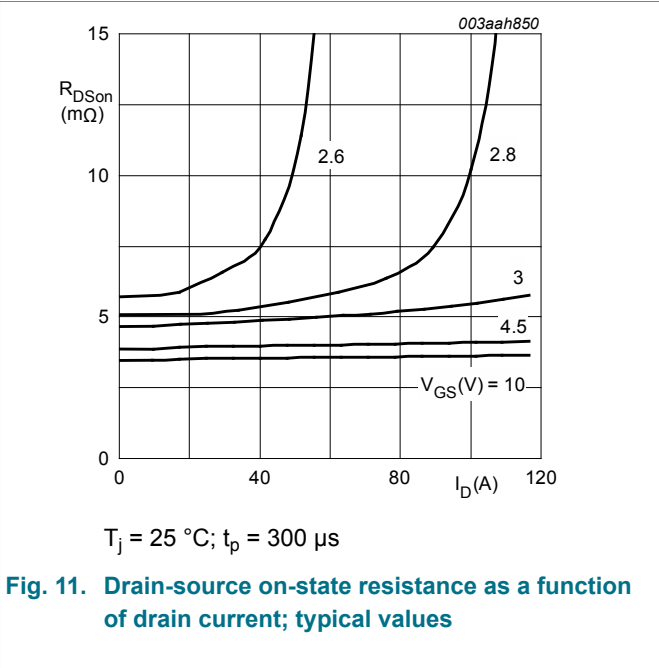
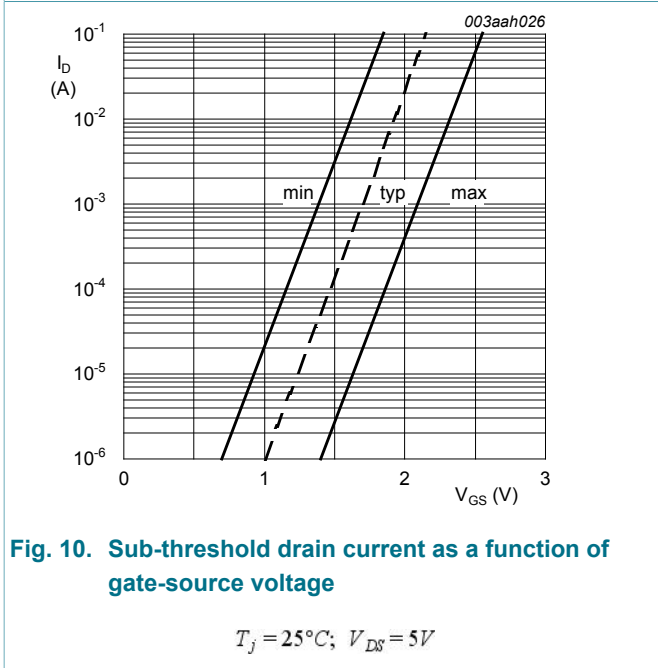
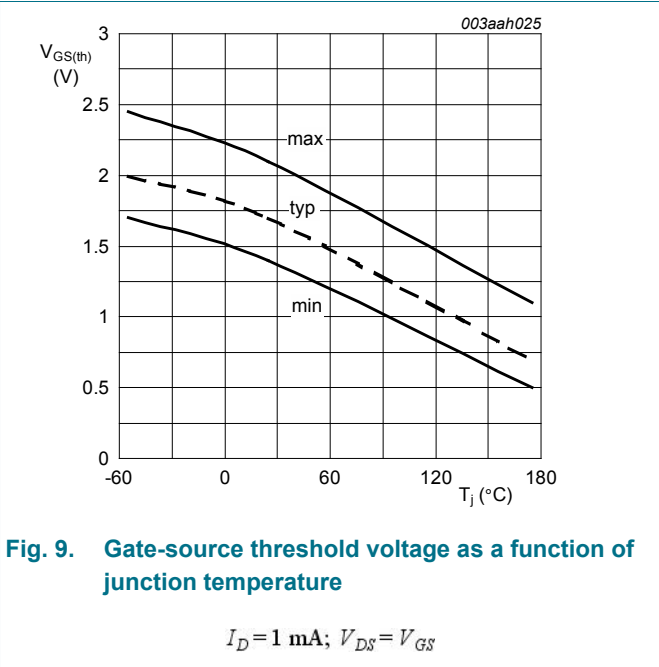
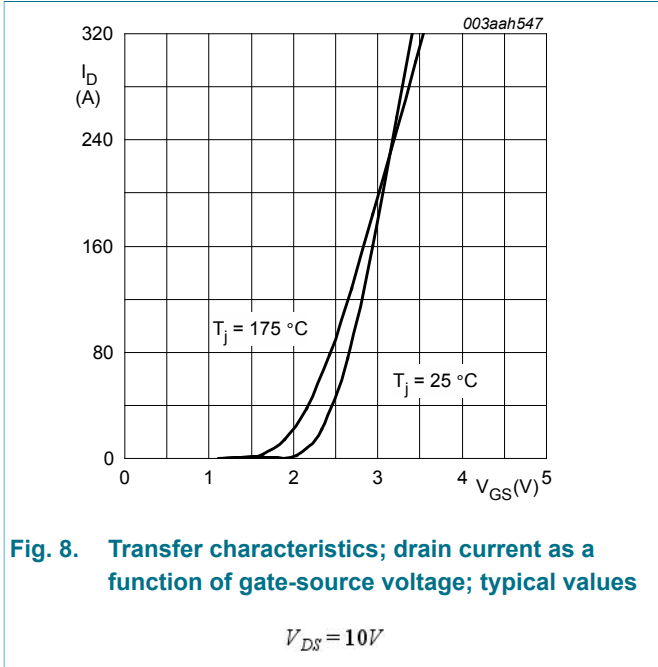
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

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

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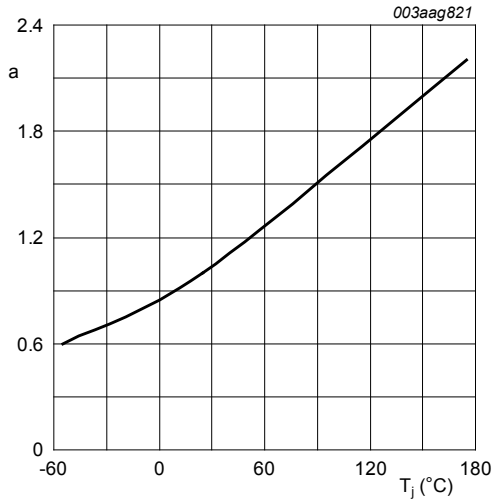


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

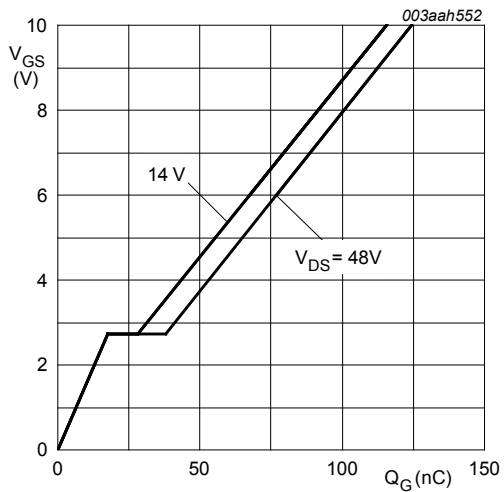


Fig. 14. Gate-source voltage as a function of gate charge; typical values

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

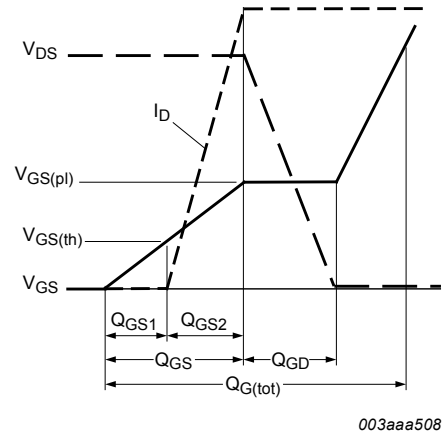


Fig. 13. Gate charge waveform definitions

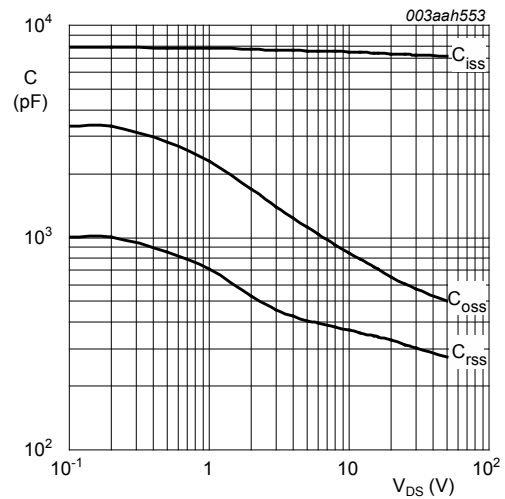


Fig. 15. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

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

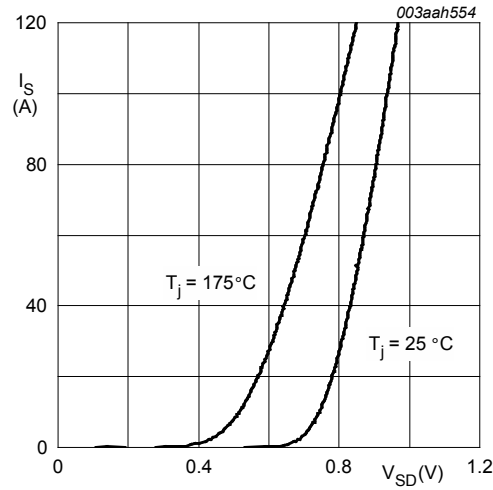


Fig. 16. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values

$$V_{GS} = 0V$$

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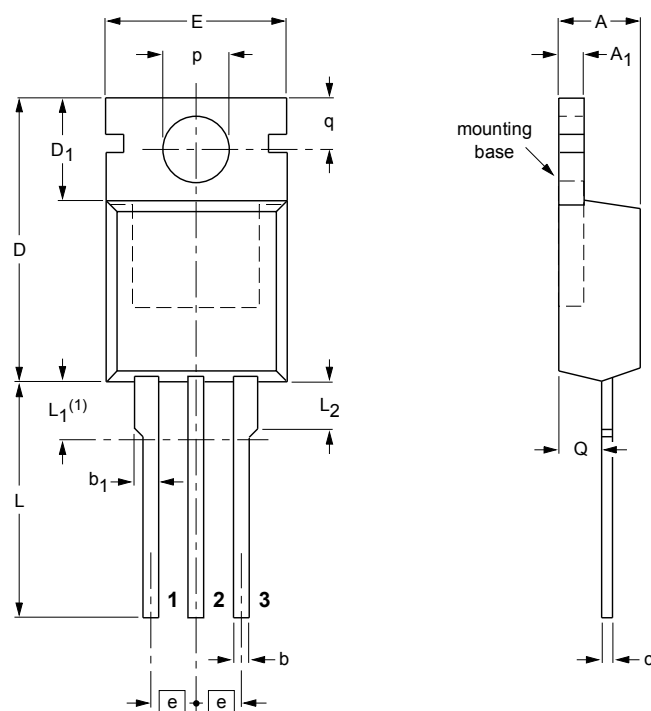
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7. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78A



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	b	b ₁	c	D	D ₁	E	e	L	L ₁ (¹)	L ₂ max.	p	q	Q
mm	4.5 4.1	1.39 1.27	0.9 0.6	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

Note

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT78A		3-lead TO-220AB	SC-46			03-01-22- 05-03-14

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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- [2] The term 'short data sheet' is explained in section "Definitions".
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