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Kind regards,

Team Nexperia

# BUK951R6-30E

## 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

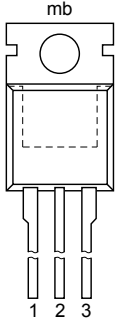
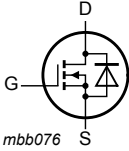
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>DS</sub>	drain-source voltage	T <sub>j</sub> ≥ 25 °C; T <sub>j</sub> ≤ 175 °C	-	-	30	V
I <sub>D</sub>	drain current	V <sub>GS</sub> = 5 V; T <sub>mb</sub> = 25 °C; <a href="#">Fig. 1</a>	[1]	-	120	A
P <sub>tot</sub>	total power dissipation	T <sub>mb</sub> = 25 °C; <a href="#">Fig. 2</a>	-	-	349	W
<b>Static characteristics</b>						
R <sub>DSon</sub>	drain-source on-state resistance	V <sub>GS</sub> = 5 V; I <sub>D</sub> = 25 A; T <sub>j</sub> = 25 °C; <a href="#">Fig. 11</a>	-	1.3	1.6	mΩ
<b>Dynamic characteristics</b>						
Q <sub>GD</sub>	gate-drain charge	V <sub>GS</sub> = 5 V; I <sub>D</sub> = 25 A; V <sub>DS</sub> = 24 V; <a href="#">Fig. 13</a> ; <a href="#">Fig. 14</a>	-	39.2	-	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 style="text-align: center;"><b>TO-220AB (SOT78A)</b></p>	 <p style="text-align: center;"><i>mbb076</i></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
BUK951R6-30E	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78A

## 4. Marking

**Table 4. Marking codes**

Type number	Marking code
BUK951R6-30E	BUK951R6-30E

## 5. Limiting values

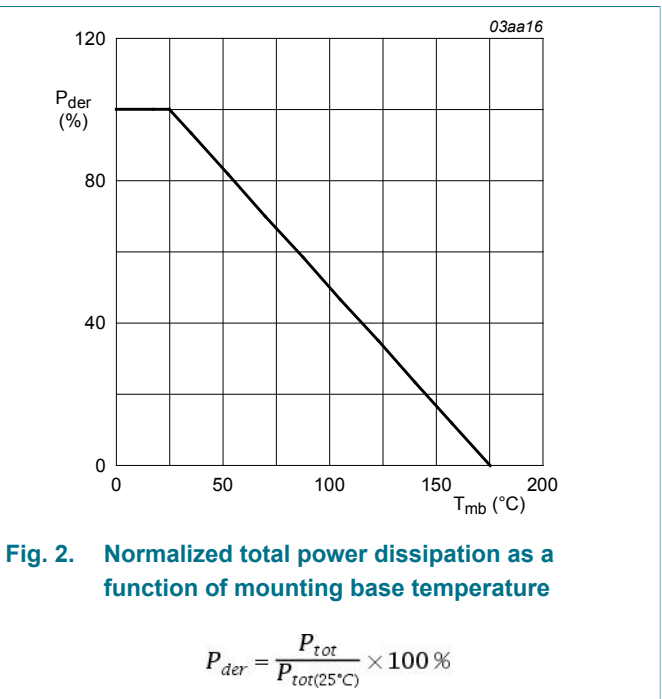
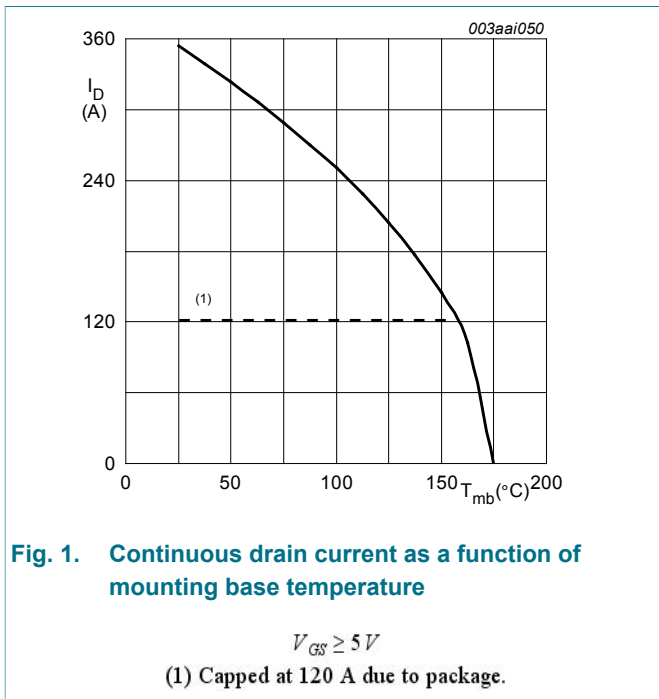
**Table 5. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{DS}$	drain-source voltage	$T_j \geq 25\text{ }^\circ\text{C}$ ; $T_j \leq 175\text{ }^\circ\text{C}$	-	30	V	
$V_{DGR}$	drain-gate voltage	$R_{GS} = 20\text{ k}\Omega$	-	30	V	
$V_{GS}$	gate-source voltage	$T_j \leq 175\text{ }^\circ\text{C}$ ; Pulsed	[1][2]	-15	15	V
		$T_j \leq 175\text{ }^\circ\text{C}$ ; DC		-10	10	V
$I_D$	drain current	$T_{mb} = 25\text{ }^\circ\text{C}$ ; $V_{GS} = 5\text{ V}$ ; Fig. 1	[3]	-	120	A
		$T_{mb} = 100\text{ }^\circ\text{C}$ ; $V_{GS} = 5\text{ V}$ ; Fig. 1	[3]	-	120	A

Symbol	Parameter	Conditions	Min	Max	Unit
$I_{DM}$	peak drain current	$T_{mb} = 25\text{ }^{\circ}\text{C}$ ; pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; <a href="#">Fig. 4</a>	-	1400	A
$P_{tot}$	total power dissipation	$T_{mb} = 25\text{ }^{\circ}\text{C}$ ; <a href="#">Fig. 2</a>	-	349	W
$T_{stg}$	storage temperature		-55	175	$^{\circ}\text{C}$
$T_j$	junction temperature		-55	175	$^{\circ}\text{C}$
<b>Source-drain diode</b>					
$I_S$	source current	$T_{mb} = 25\text{ }^{\circ}\text{C}$ <a href="#">[3]</a>	-	120	A
$I_{SM}$	peak source current	pulsed; $t_p \leq 10\text{ }\mu\text{s}$ ; $T_{mb} = 25\text{ }^{\circ}\text{C}$	-	1400	A
<b>Avalanche ruggedness</b>					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	$I_D = 120\text{ A}$ ; $V_{sup} \leq 30\text{ V}$ ; $R_{GS} = 50\text{ }\Omega$ ; $V_{GS} = 5\text{ V}$ ; $T_{j(\text{init})} = 25\text{ }^{\circ}\text{C}$ ; unclamped; <a href="#">Fig. 3</a>	<a href="#">[4][5]</a>	-	1405 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  $^{\circ}\text{C}$ .
- [5] Refer to application note AN10273 for further information.



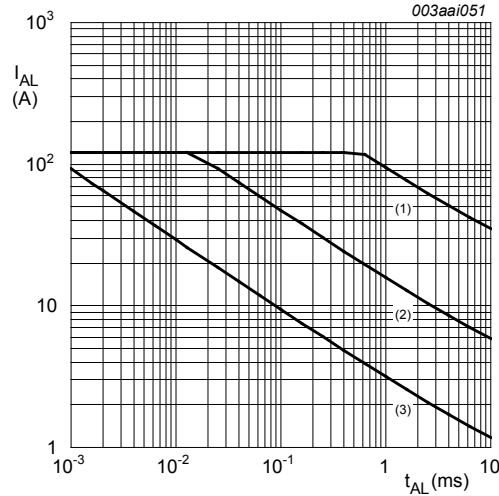


Fig. 3. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time

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

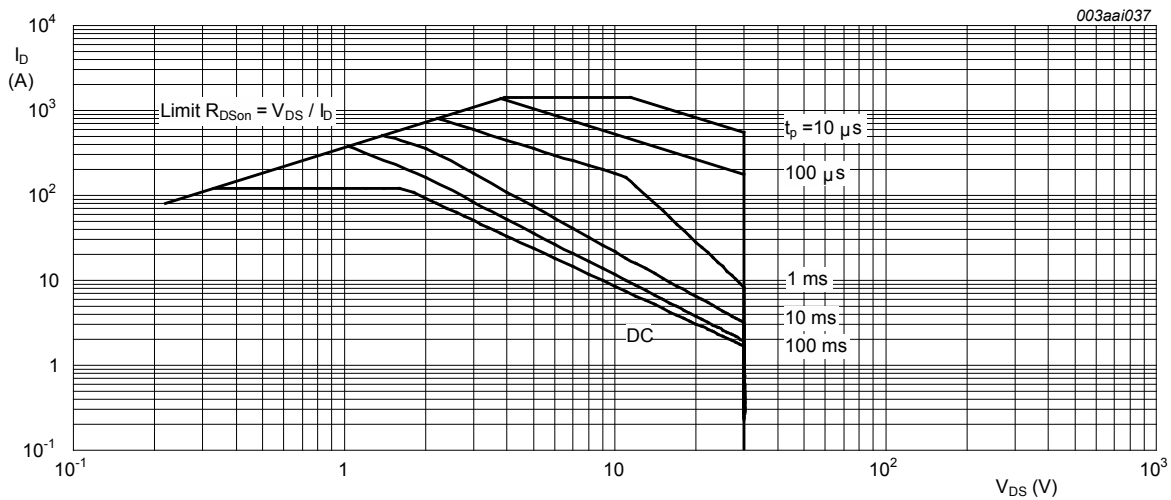


Fig. 4. Safe operating area; continuous and peak drain currents as a function of drain-source voltage

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

## 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	-	-	0.43	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	vertical in still air	-	60	-	K/W

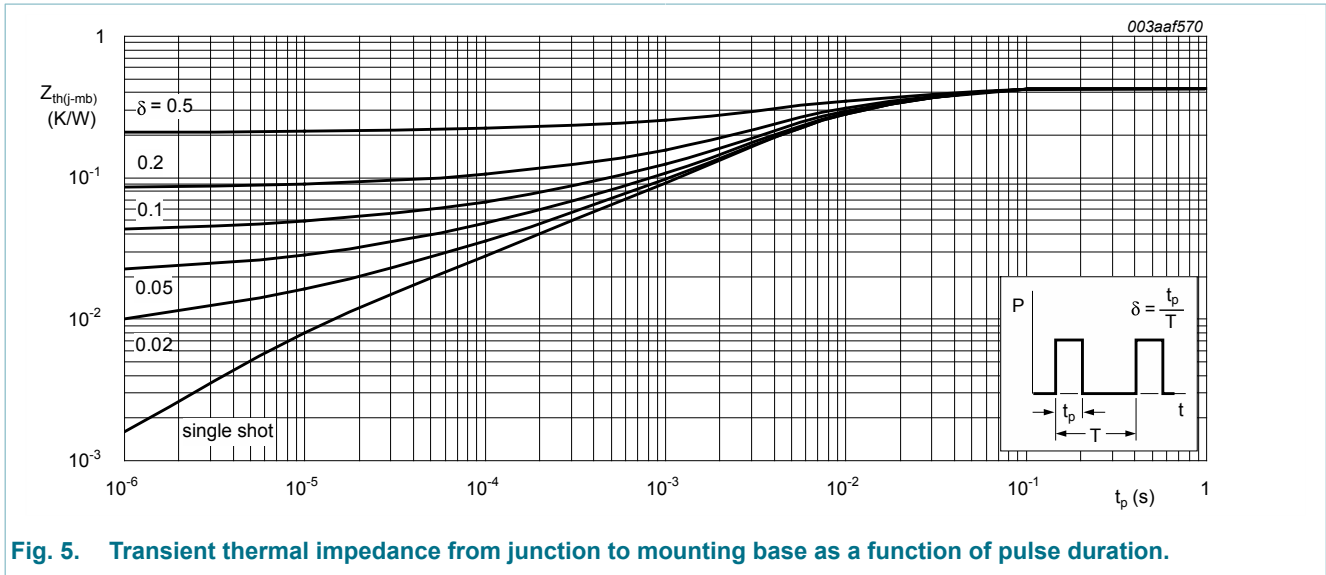


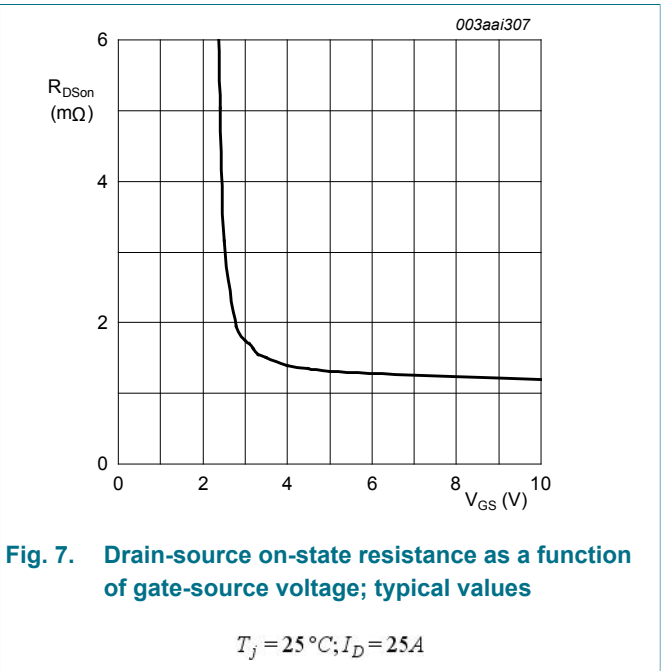
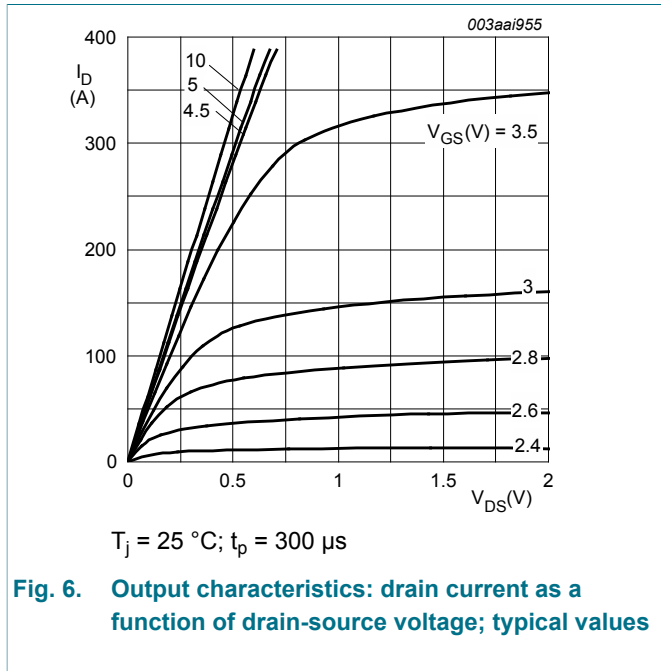
Fig. 5. Transient thermal impedance from junction to mounting base as a function of pulse duration.

## 7. Characteristics

Table 7. Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 250 \mu A; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	30	-	-	V
		$I_D = 250 \mu A; V_{GS} = 0 V; T_j = -55 \text{ }^\circ C$	27	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 9; Fig. 10</a>	1.4	1.7	2.1	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = -55 \text{ }^\circ C;$ <a href="#">Fig. 9</a>	-	-	2.45	V
		$I_D = 1 \text{ mA}; V_{DS} = V_{GS}; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 9</a>	0.5	-	-	V
$I_{DSS}$	drain leakage current	$V_{DS} = 30 V; V_{GS} = 0 V; T_j = 25 \text{ }^\circ C$	-	0.1	1	$\mu A$
		$V_{DS} = 30 V; V_{GS} = 0 V; T_j = 175 \text{ }^\circ C$	-	-	500	$\mu A$
$I_{GSS}$	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
$R_{DSon}$	drain-source on-state resistance	$V_{GS} = 5 V; I_D = 25 A; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	1.3	1.6	m $\Omega$
		$V_{GS} = 10 V; I_D = 25 A; T_j = 25 \text{ }^\circ C;$ <a href="#">Fig. 11</a>	-	1.15	1.4	m $\Omega$
		$V_{GS} = 5 V; I_D = 25 A; T_j = 175 \text{ }^\circ C;$ <a href="#">Fig. 12; Fig. 11</a>	-	-	2.85	m $\Omega$
<b>Dynamic characteristics</b>						
$Q_{G(tot)}$	total gate charge	$I_D = 25 A; V_{DS} = 24 V; V_{GS} = 5 V;$ <a href="#">Fig. 13; Fig. 14</a>	-	113	-	nC
$Q_{GS}$	gate-source charge		-	29	-	nC

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Q_{GD}$	gate-drain charge		-	39.2	-	nC
$C_{iss}$	input capacitance	$V_{GS} = 0\text{ V}; V_{DS} = 25\text{ V}; f = 1\text{ MHz};$	-	12100	16150	pF
$C_{oss}$	output capacitance	$T_j = 25\text{ }^\circ\text{C}; \text{Fig. 15}$	-	1840	2210	pF
$C_{rss}$	reverse transfer capacitance		-	898	1240	pF
$t_{d(on)}$	turn-on delay time	$V_{DS} = 25\text{ V}; R_L = 1\text{ }\Omega; V_{GS} = 5\text{ V};$	-	71	-	ns
$t_r$	rise time	$R_{G(ext)} = 5\text{ }\Omega$	-	127	-	ns
$t_{d(off)}$	turn-off delay time		-	184	-	ns
$t_f$	fall time		-	111	-	ns
$L_D$	internal drain inductance	from upper edge of drain mounting base to center of die	-	2.5	-	nH
		from drain lead 6mm from package to centre of die	-	4.5	-	nH
$L_S$	internal source inductance	from source lead to source bonding pad	-	7.5	-	nH
<b>Source-drain diode</b>						
$V_{SD}$	source-drain voltage	$I_S = 25\text{ A}; V_{GS} = 0\text{ V}; T_j = 25\text{ }^\circ\text{C}; \text{Fig. 16}$	-	0.76	1.2	V
$t_{rr}$	reverse recovery time	$I_S = 20\text{ A}; di_S/dt = -100\text{ A}/\mu\text{s}; V_{GS} = 0\text{ V};$	-	62	-	ns
$Q_r$	recovered charge	$V_{DS} = 25\text{ V}$	-	112	-	nC



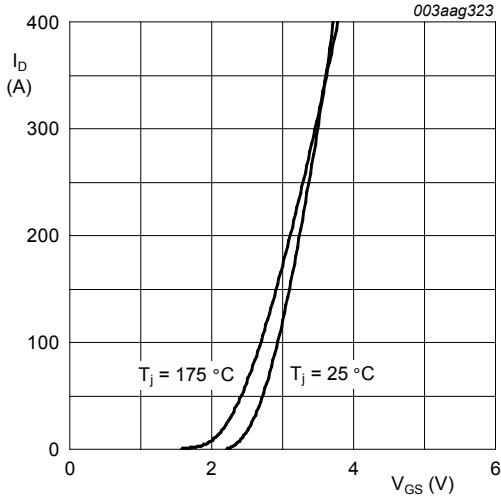


Fig. 8. Transfer characteristics: drain current as a function of gate-source voltage; typical values

$V_{DS} = 12\text{ V}$

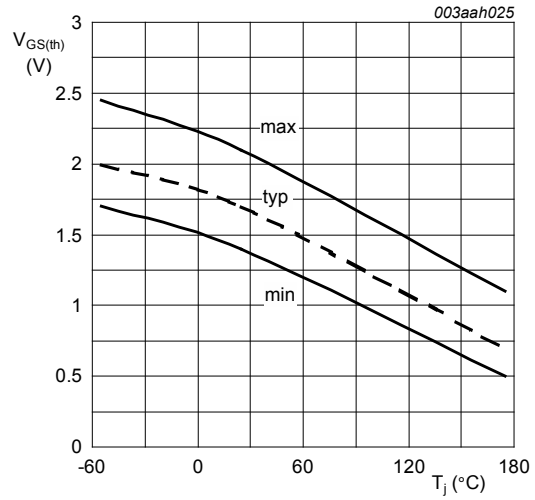


Fig. 9. Gate-source threshold voltage as a function of junction temperature

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

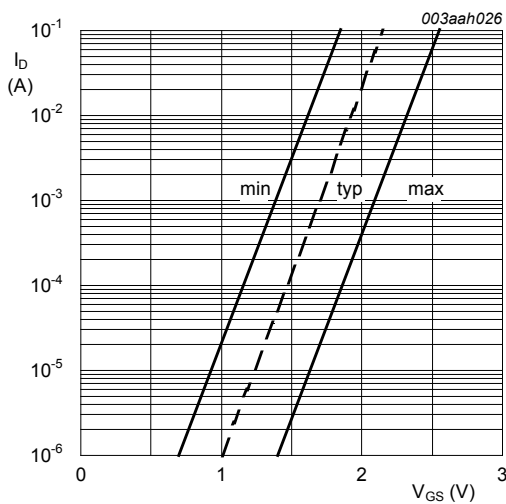
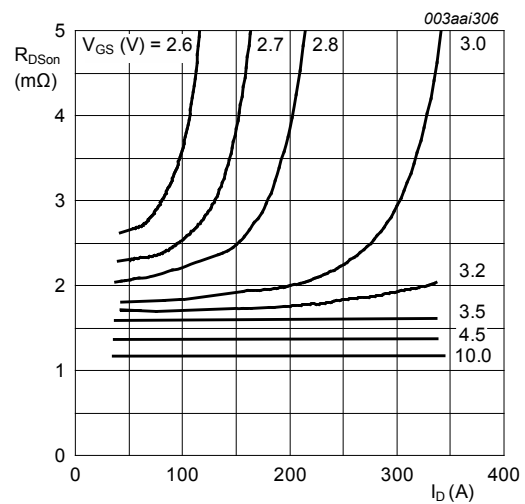


Fig. 10. Sub-threshold drain current as a function of gate-source voltage

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



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

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



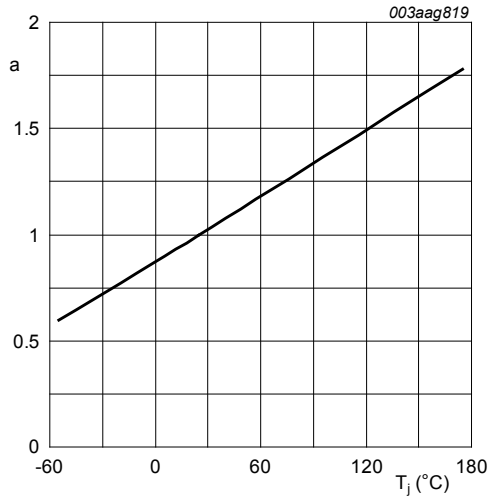


Fig. 12. Normalized drain-source on-state resistance factor as a function of junction temperature

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

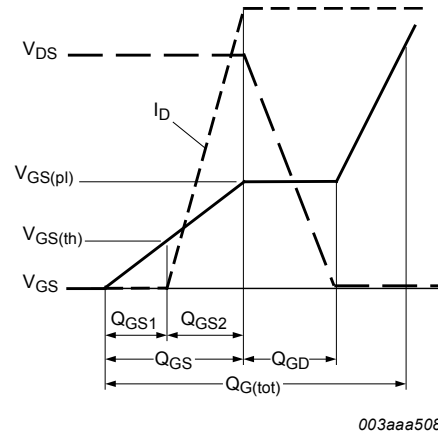
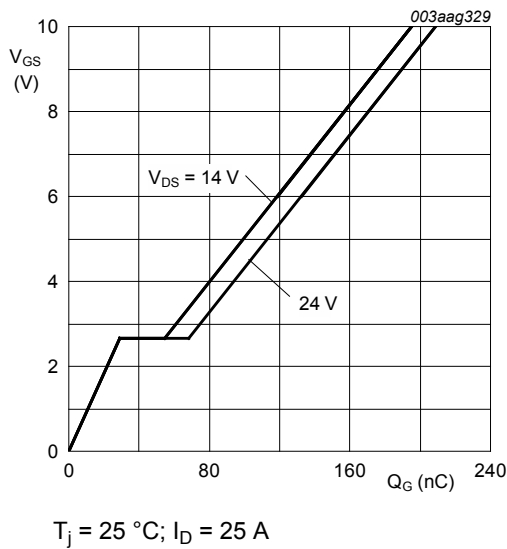
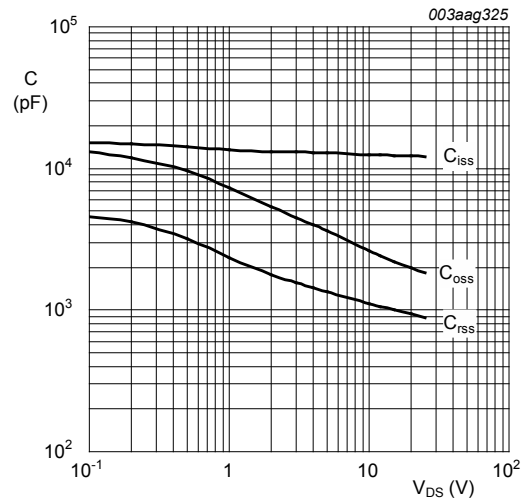


Fig. 13. Gate charge waveform definitions



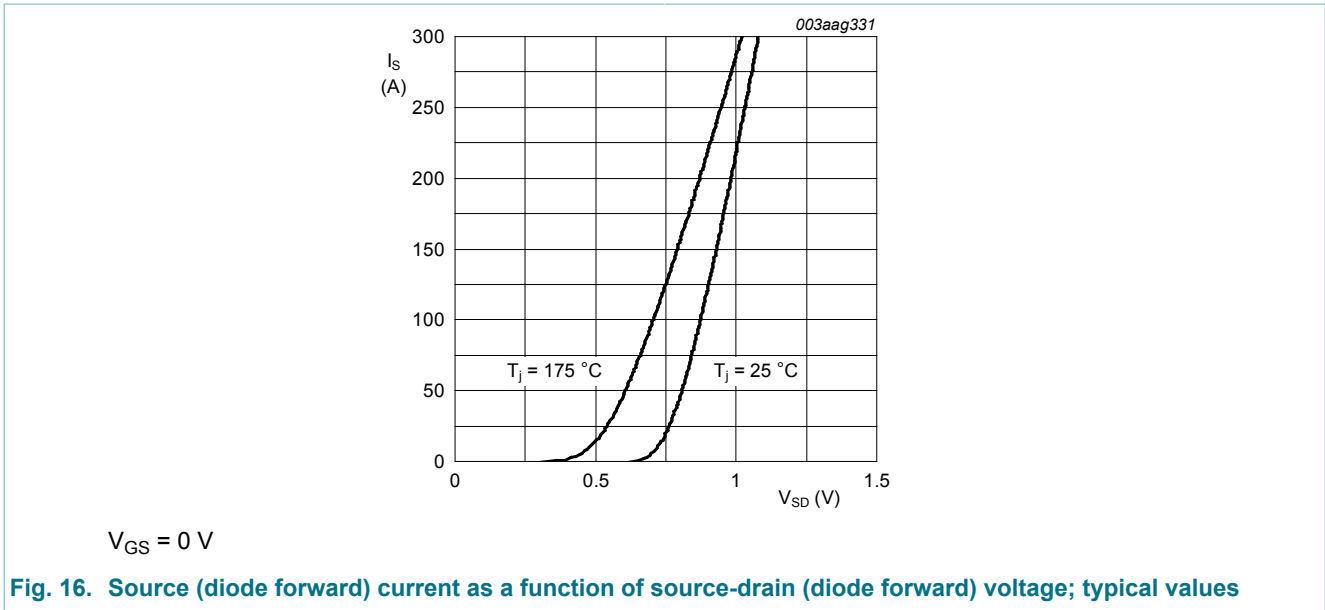
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

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

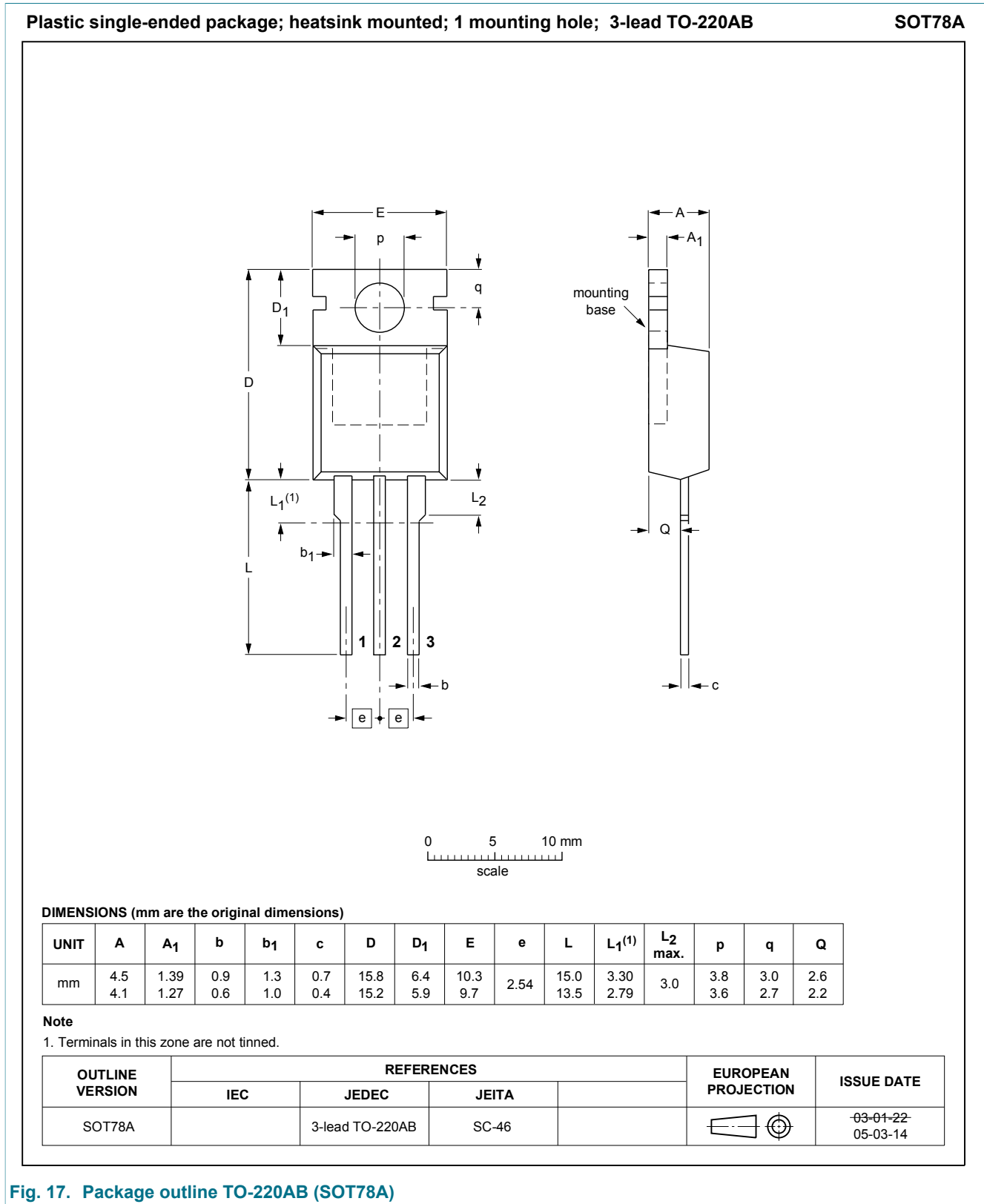


$V_{GS} = 0\text{ V}; f = 1\text{ MHz}$

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



### 8. Package outline



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

## 9. Legal information

### 9.1 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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