

# BUK754R0-55B; BUK764R0-55B

N-channel TrenchMOS standard level FET

Rev. 04 — 4 October 2007

Product data sheet

## 1. Product profile

### 1.1 General description

N-channel enhancement mode power Field-Effect Transistor (FET) in a plastic package using NXP High-Performance Automotive (HPA) TrenchMOS technology.

### 1.2 Features

- Very low on-state resistance
- 175 °C rated
- Q101 compliant
- Standard level compatible

### 1.3 Applications

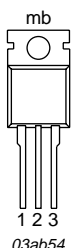
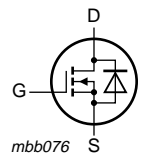
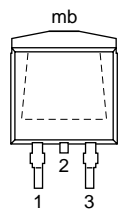
- Automotive systems
- Motors, lamps and solenoids
- General purpose power switching
- 12 V and 24 V loads

### 1.4 Quick reference data

- $E_{DS(AL)S} \leq 1.2 \text{ J}$
- $I_D \leq 75 \text{ A}$
- $R_{DSon} = 3.4 \text{ m}\Omega$  (typ)
- $P_{tot} \leq 300 \text{ W}$

## 2. Pinning information

Table 1. Pinning

Pin	Description	Simplified outline	Symbol
1	gate (G)	 03ab54 SOT78A (TO-220AB)	 mbb076
2	drain (D)		
3	source (S)		
mb	mounting base; connected to drain (D)	 SOT404 (D2PAK)	

### 3. Ordering information

**Table 2. Ordering information**

Type number	Package		Version
	Name	Description	
BUK754R0-55B	SC-46	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78A
BUK764R0-55B	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

### 4. Limiting values

**Table 3. Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{DS}$	drain-source voltage		-	55	V	
$V_{DGR}$	drain-gate voltage (DC)	$R_{GS} = 20 \text{ k}\Omega$	-	55	V	
$V_{GS}$	gate-source voltage		-	$\pm 20$	V	
$I_D$	drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$ ; $V_{GS} = 10 \text{ V}$ ; see <a href="#">Figure 2</a> and <a href="#">3</a>	[1][3]	-	193	A
			[2]	-	75	A
		$T_{mb} = 100 \text{ }^\circ\text{C}$ ; $V_{GS} = 10 \text{ V}$ ; see <a href="#">Figure 2</a>	[2]	-	75	A
$I_{DM}$	peak drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$ ; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$ ; see <a href="#">Figure 3</a>	-	774	A	
$P_{tot}$	total power dissipation	$T_{mb} = 25 \text{ }^\circ\text{C}$ ; see <a href="#">Figure 1</a>	-	300	W	
$T_{stg}$	storage temperature		-55	+175	$^\circ\text{C}$	
$T_j$	junction temperature		-55	+175	$^\circ\text{C}$	
<b>Source-drain diode</b>						
$I_{DR}$	reverse drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$	[1][2]	-	193	A
			[2]	-	75	A
$I_{DRM}$	peak reverse drain current	$T_{mb} = 25 \text{ }^\circ\text{C}$ ; pulsed; $t_p \leq 10 \text{ }\mu\text{s}$	-	774	A	
<b>Avalanche ruggedness</b>						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 75 \text{ A}$ ; $V_{DS} \leq 55 \text{ V}$ ; $R_{GS} = 50 \text{ }\Omega$ ; $V_{GS} = 10 \text{ V}$ ; starting at $T_j = 25 \text{ }^\circ\text{C}$	-	1.2	J	
$E_{DS(AL)R}$	repetitive drain-source avalanche energy		[4]	-	-	J

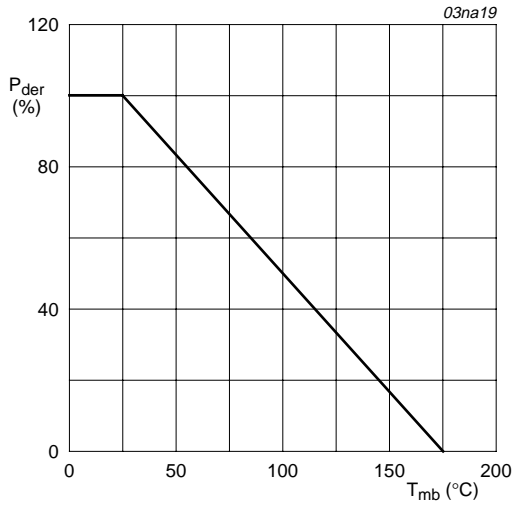
[1] Current is limited by chip power dissipation rating.

[2] Continuous current is limited by package.

[3] Refer to document *9397 750 12572* for further information.

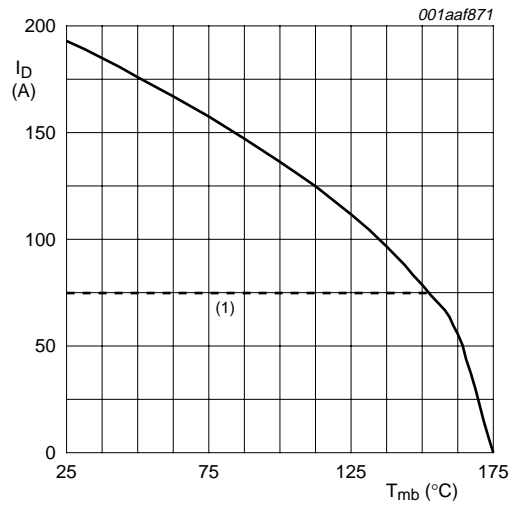
[4] Conditions:

- Maximum value not quoted. Repetitive rating defined in [Figure 16](#).
- Single-pulse avalanche rating limited by  $T_{j(max)}$  of  $175 \text{ }^\circ\text{C}$ .
- Repetitive avalanche rating limited by an average junction temperature of  $170 \text{ }^\circ\text{C}$ .
- Refer to application note *AN10273* for further information.



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

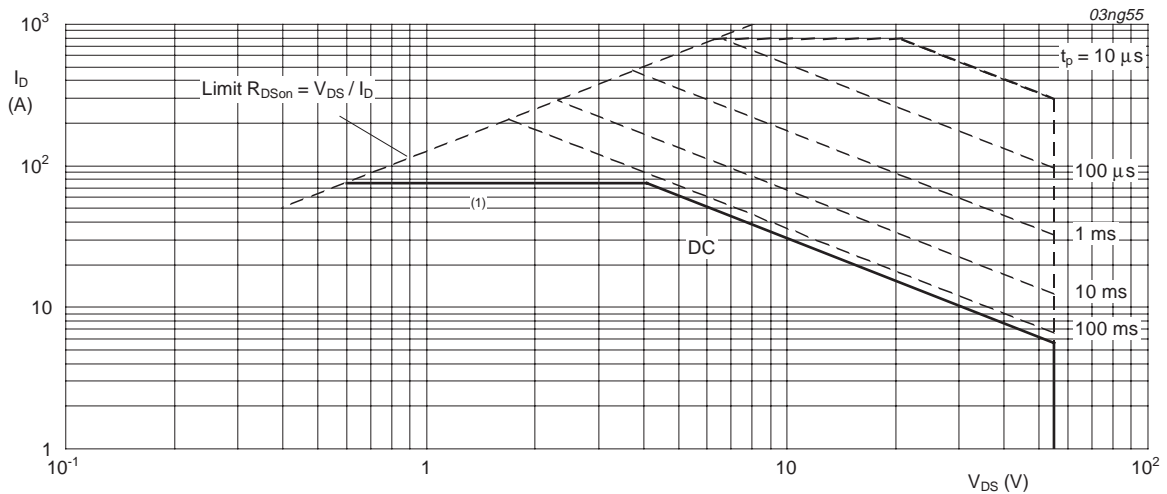
**Fig 1. Normalized total power dissipation as a function of mounting base temperature**



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

(1) Capped at 75 A due to package.

**Fig 2. Continuous drain current as a function of mounting base temperature**



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

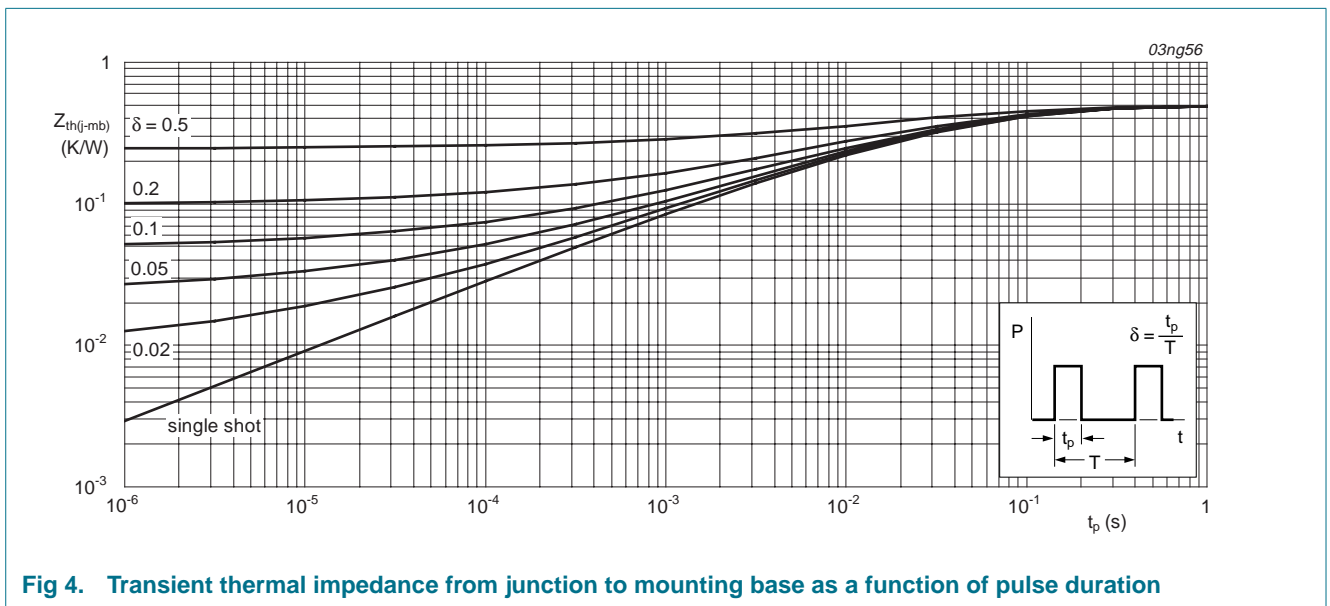
(1) Capped at 75 A due to package.

**Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage**

**5. Thermal characteristics**

**Table 4. Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base		-	-	0.5	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient					
	SOT78A (TO-220AB)	vertical in free air	-	60	-	K/W
	SOT404 (D2PAK)	mounted on a printed-circuit board; minimum footprint	-	50	-	K/W

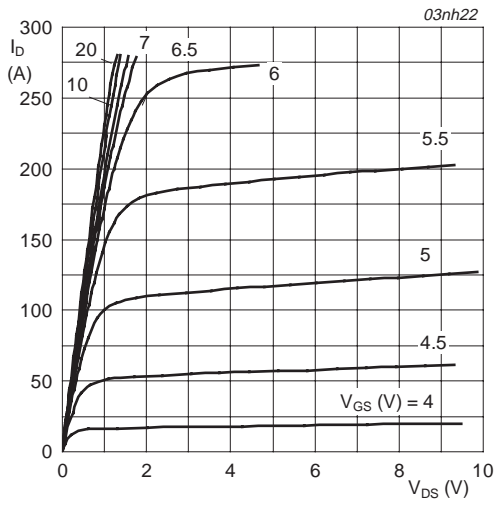


**Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration**

## 6. Characteristics

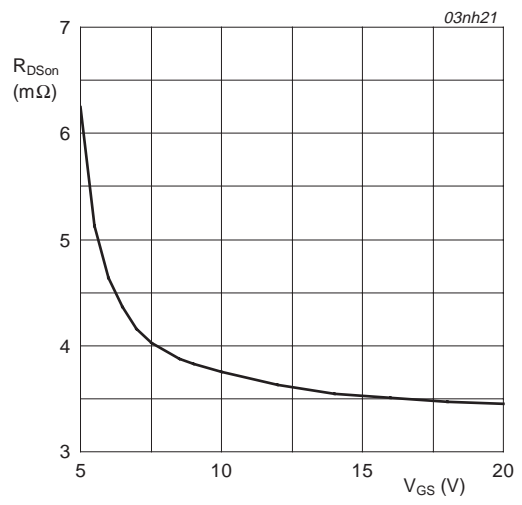
**Table 5. Characteristics**
*T<sub>j</sub> = 25 °C unless otherwise specified.*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Static characteristics</b>						
V <sub>(BR)DSS</sub>	drain-source breakdown voltage	I <sub>D</sub> = 250 μA; V <sub>GS</sub> = 0 V				
		T <sub>j</sub> = 25 °C	55	-	-	V
		T <sub>j</sub> = -55 °C	50	-	-	V
V <sub>GS(th)</sub>	gate-source threshold voltage	I <sub>D</sub> = 1 mA; V <sub>DS</sub> = V <sub>GS</sub> ; see <a href="#">Figure 9</a>				
		T <sub>j</sub> = 25 °C	2	3	4	V
		T <sub>j</sub> = 175 °C	1	-	-	V
		T <sub>j</sub> = -55 °C	-	-	4.4	V
I <sub>DSS</sub>	drain leakage current	V <sub>DS</sub> = 55 V; V <sub>GS</sub> = 0 V				
		T <sub>j</sub> = 25 °C	-	0.02	1	μA
		T <sub>j</sub> = 175 °C	-	-	500	μA
I <sub>GSS</sub>	gate leakage current	V <sub>GS</sub> = ±20 V; V <sub>DS</sub> = 0 V	-	2	100	nA
R <sub>DS(on)</sub>	drain-source on-state resistance	V <sub>GS</sub> = 10 V; I <sub>D</sub> = 25 A; see <a href="#">Figure 6</a> and <a href="#">8</a>				
		T <sub>j</sub> = 25 °C	-	3.4	4.0	mΩ
		T <sub>j</sub> = 175 °C	-	-	8	mΩ
<b>Dynamic characteristics</b>						
Q <sub>G(tot)</sub>	total gate charge	I <sub>D</sub> = 25 A; V <sub>DD</sub> = 44 V; V <sub>GS</sub> = 10 V; see <a href="#">Figure 14</a>	-	86	-	nC
Q <sub>GS</sub>	gate-source charge		-	18	-	nC
Q <sub>GD</sub>	gate-drain charge		-	25	-	nC
C <sub>iss</sub>	input capacitance	V <sub>GS</sub> = 0 V; V <sub>DS</sub> = 25 V; f = 1 MHz; see <a href="#">Figure 12</a>	-	5082	6776	pF
C <sub>oss</sub>	output capacitance		-	1054	1265	pF
C <sub>rss</sub>	reverse transfer capacitance		-	450	617	pF
t <sub>d(on)</sub>	turn-on delay time	V <sub>DS</sub> = 30 V; R <sub>L</sub> = 1.2 Ω;	-	23	-	ns
t <sub>r</sub>	rise time	V <sub>GS</sub> = 10 V; R <sub>G</sub> = 10 Ω	-	51	-	ns
t <sub>d(off)</sub>	turn-off delay time		-	71	-	ns
t <sub>f</sub>	fall time		-	41	-	ns
L <sub>D</sub>	internal drain inductance	from drain lead 6 mm from package to center of die	-	4.5	-	nH
		from contact screw on mounting base to center of die SOT78A	-	3.5	-	nH
		from upper edge of drain mounting base to center of die SOT404	-	2.5	-	nH
L <sub>S</sub>	internal source inductance	from source lead to source bonding pad	-	7.5	-	nH
<b>Source-drain diode</b>						
V <sub>SD</sub>	source-drain voltage	I <sub>S</sub> = 40 A; V <sub>GS</sub> = 0 V; see <a href="#">Figure 15</a>	-	0.85	1.2	V
t <sub>rr</sub>	reverse recovery time	I <sub>S</sub> = 20 A; dI <sub>S</sub> /dt = -100 A/μs;	-	95	-	ns
Q <sub>r</sub>	recovered charge	V <sub>GS</sub> = -10 V; V <sub>R</sub> = 30 V	-	251	-	nC



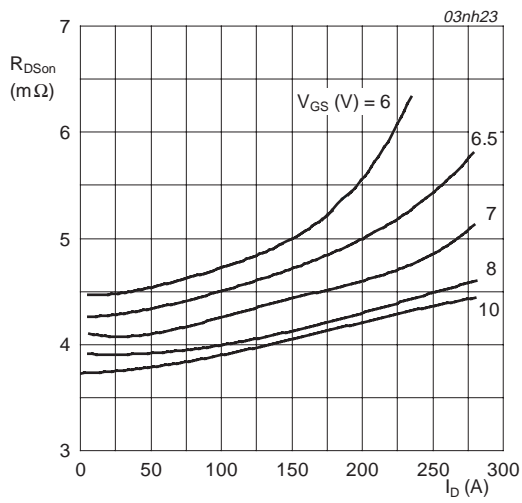
$T_j = 25\text{ }^\circ\text{C}$

**Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values**



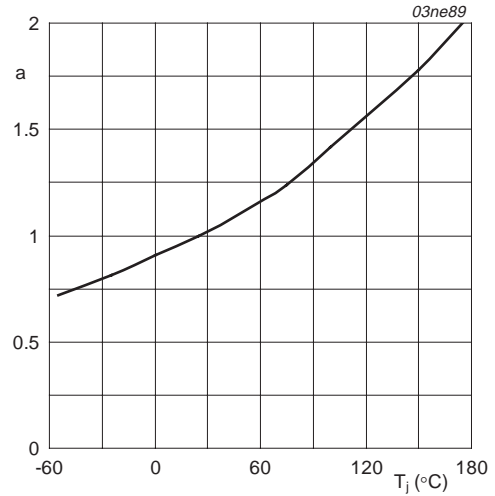
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

**Fig 6. Drain-source on-state resistance as a function of gate-source voltage; typical values**



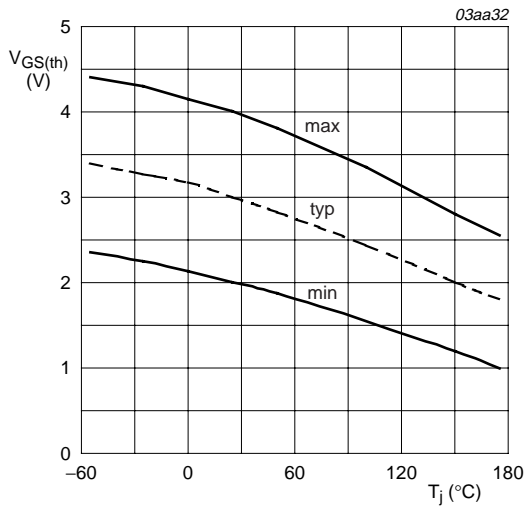
$T_j = 25\text{ }^\circ\text{C}$

**Fig 7. Drain-source on-state resistance as a function of drain current; typical values**



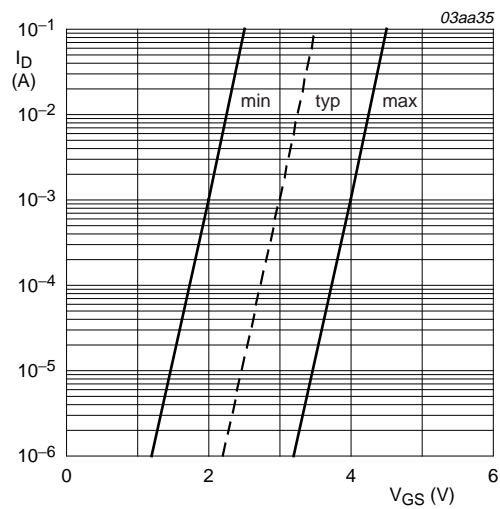
$$a = \frac{R_{DS(on)}}{R_{DS(on)(25^\circ\text{C})}}$$

**Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature**



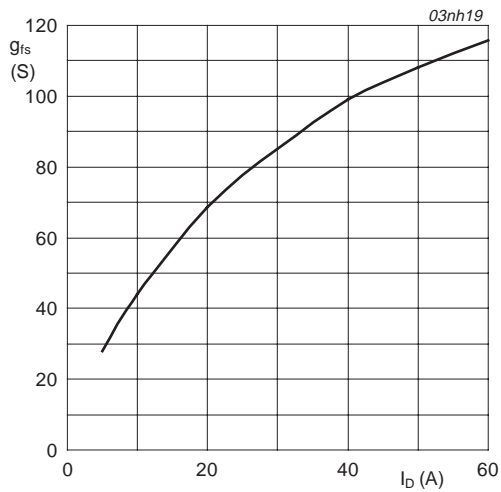
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$

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



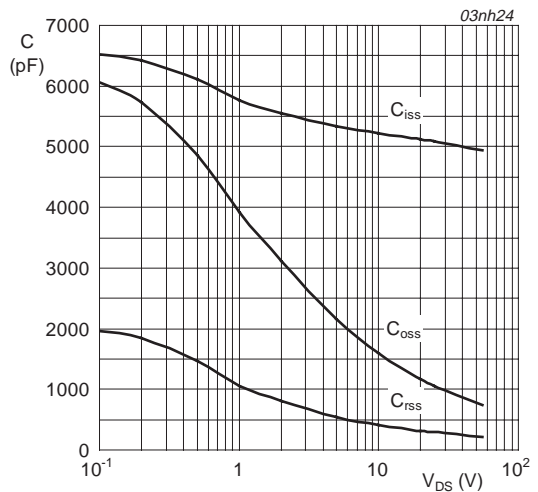
$T_j = 25 \text{ °C}; V_{DS} = V_{GS}$

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



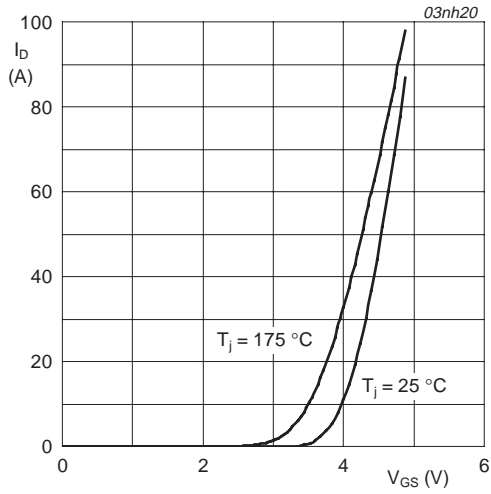
$T_j = 25 \text{ °C}; V_{DS} = 25 \text{ V}$

**Fig 11. Forward transconductance as a function of drain current; typical values**



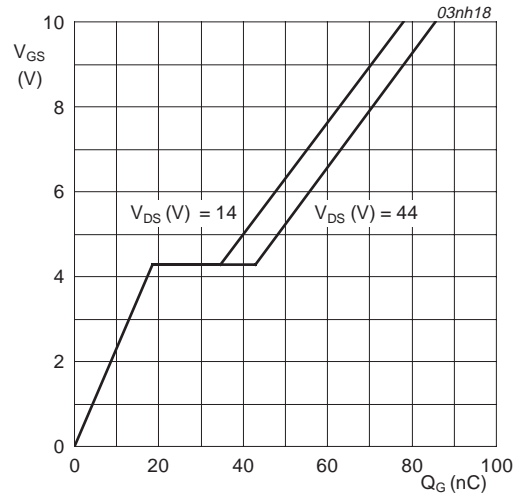
$V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$

**Fig 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values**



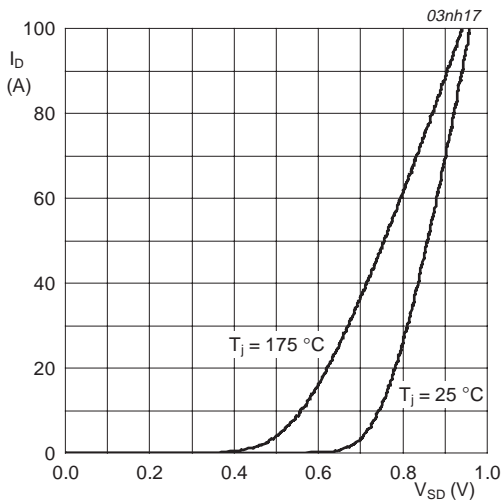
$V_{DS} = 25 \text{ V}$

**Fig 13. Transfer characteristics: drain current as a function of gate-source voltage; typical values**



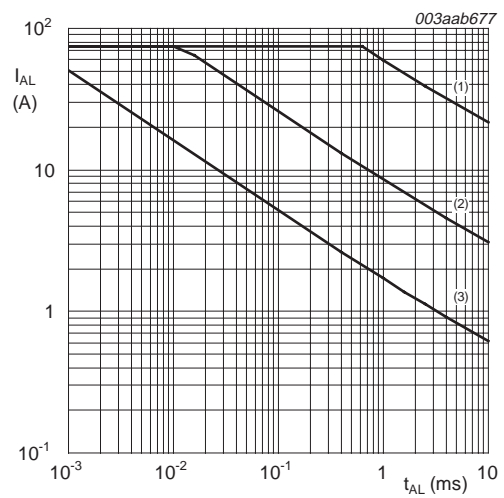
$T_j = 25 \text{ }^\circ\text{C}; I_D = 25 \text{ A}$

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



$V_{GS} = 0 \text{ V}$

**Fig 15. Source (diode forward) current as a function of source-drain (diode forward) voltage; typical values**



See [Table note 4](#) of [Table 3](#) Limiting values.

- (1) Single-pulse;  $T_j = 25 \text{ }^\circ\text{C}$ .
- (2) Single-pulse;  $T_j = 150 \text{ }^\circ\text{C}$ .
- (3) Repetitive.

**Fig 16. Single-pulse and repetitive avalanche rating; avalanche current as a function of avalanche time**



**7. Package outline**

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

SOT78A

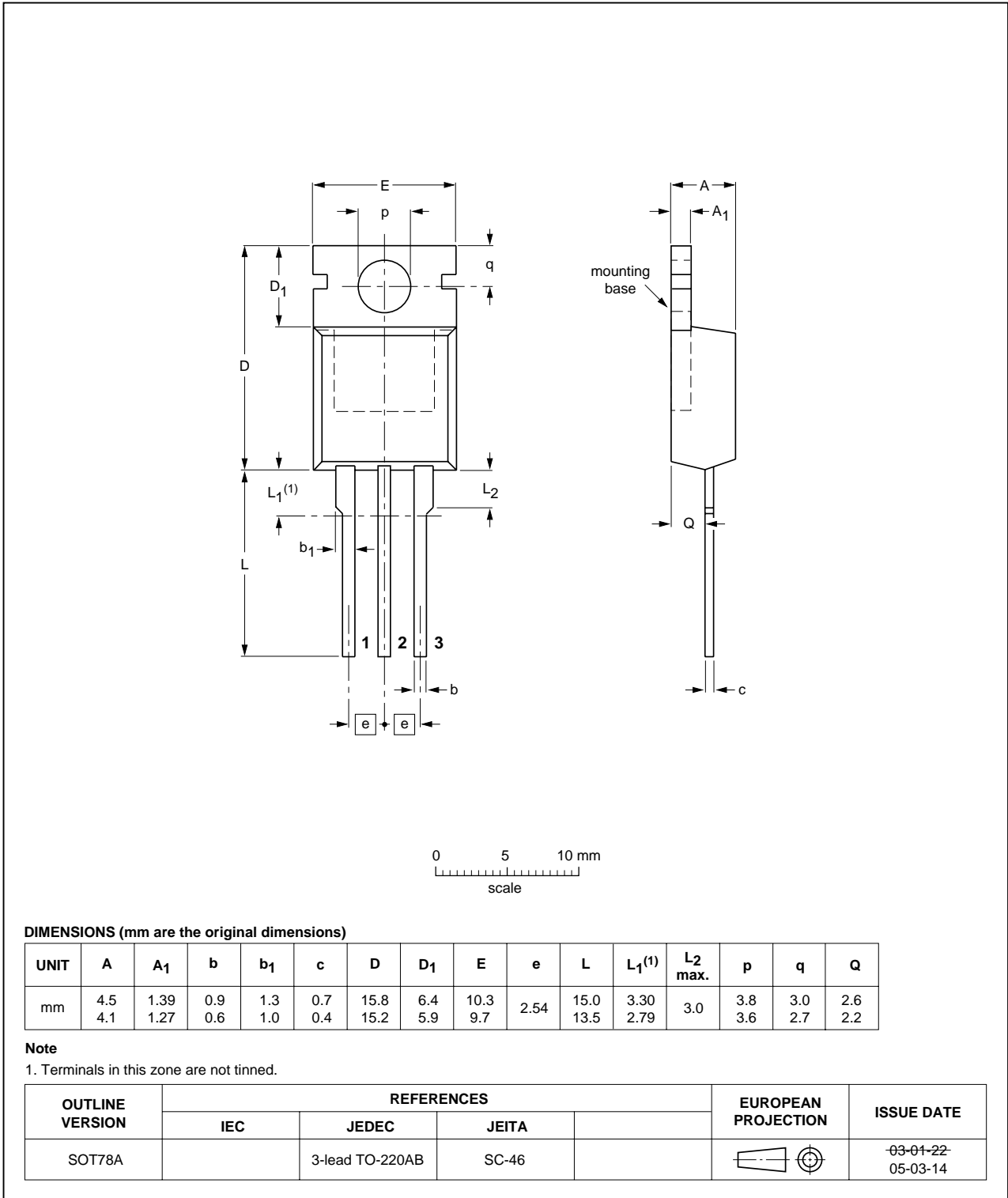


Fig 17. Package outline SOT78A (TO-220AB)

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)

SOT404

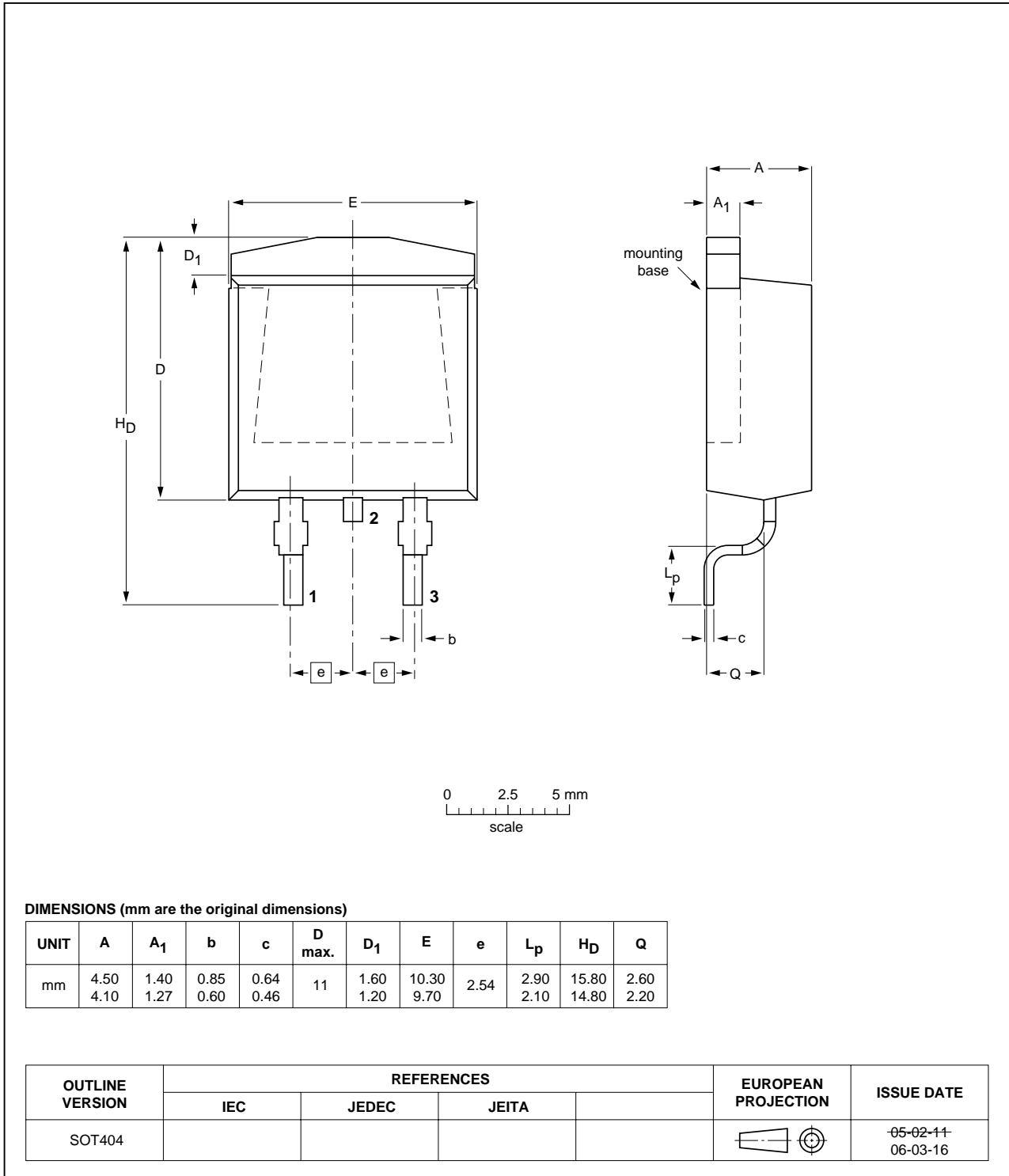
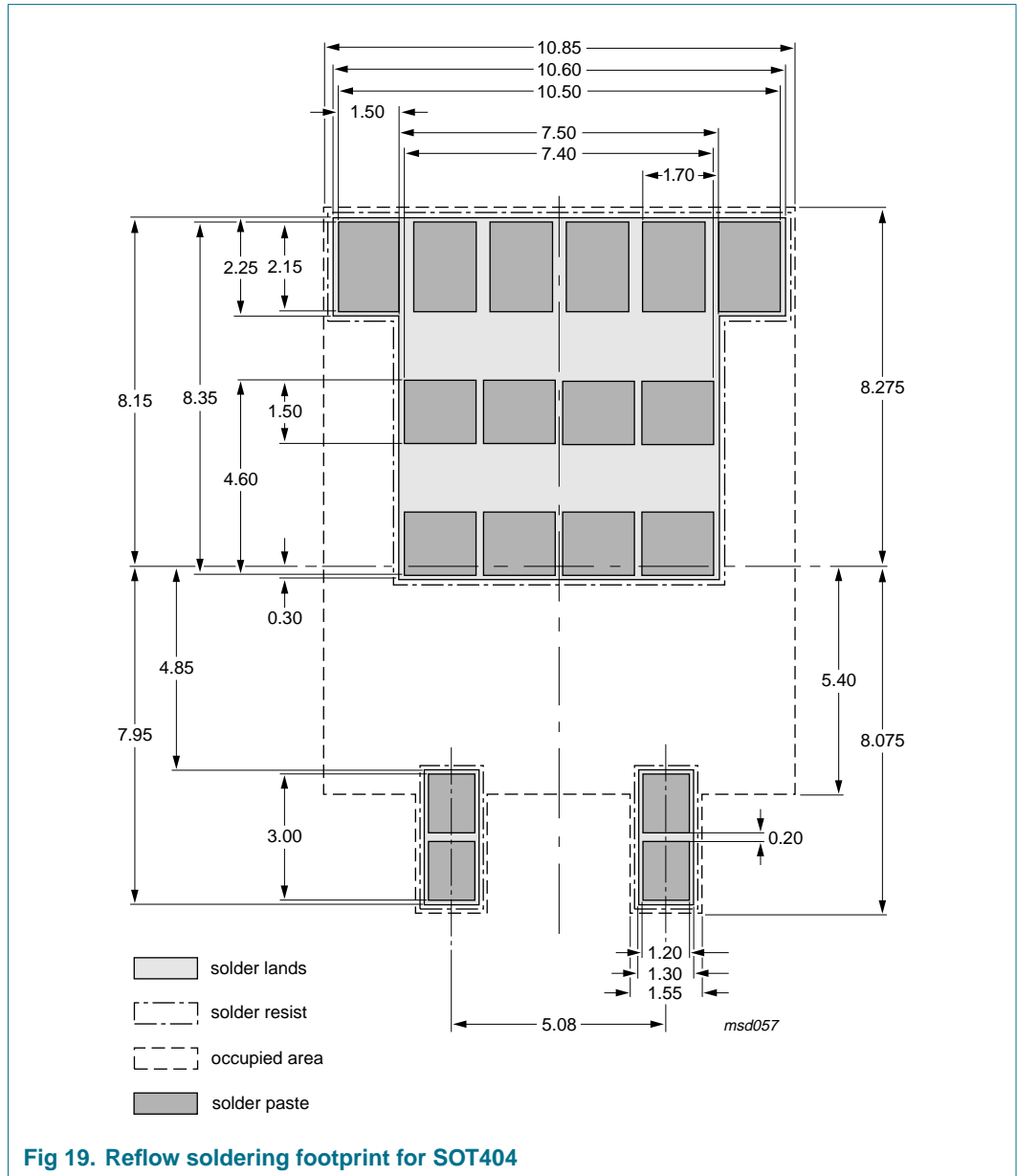


Fig 18. Package outline SOT404 (D2PAK)

## 8. Soldering



## 9. Revision history

**Table 6. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK75_764R0-55B_4	20071004	Product data sheet	-	BUK75_764R0-55B_3
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">Figure 7</a> updated.</li></ul>			
BUK75_764R0-55B_3	20070124	Product data sheet	-	BUK75_764R0_55B-02
Modifications:	<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• <math>C_{rss}</math> (typ) and (max) value in Section 6 "Characteristics" changed from 289 (typ) and 396 (max) to 450 (typ) and 617 (max).</li></ul>			
BUK75_764R0_55B-02	20020930	Product data sheet	-	BUK75_764R0_55B-01
BUK75_764R0_55B-01	20020328	Product data sheet	-	-

## 10. Legal information

### 10.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

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

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