BUK75/7608-40B

N-channel TrenchMOS standard level FET

Rev. 03 — 28 November 2007 **Product data sheet**

1. Product profile

1.1 General description

N-channel enhancement mode field-effect power transistor 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 loads

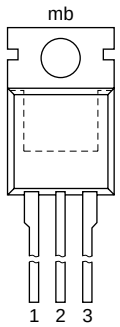
1.4 Quick reference data

- $E_{DS(AL)S} \leq 241$ mJ
- $I_D \leq 75$ A
- $R_{DSon} = 6.6$ mΩ (typ)
- $P_{tot} \leq 157$ W

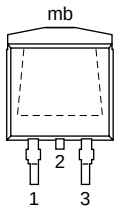
2. Pinning information

Table 1. Pinning - SOT78 and SOT404, simplified outlines and symbol

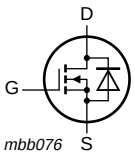
Pin	Description	Simplified outline	Symbol
1	Gate (G)		
2	Drain (D) [1]		
3	Source (S)		
mb	mounting base, connected to drain (D)		



SOT78 (TO-220AB)



SOT404 (D2PAK)



[1] It is not possible to make connection to pin 2 of the SOT404 package.

3. Ordering information

Table 2. Ordering information

Type number	Package		
	Name	Description	Version
BUK7508-40B	TO-220AB	plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB	SOT78A
BUK7608-40B	D2PAK	plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped)	SOT404

4. Limiting values

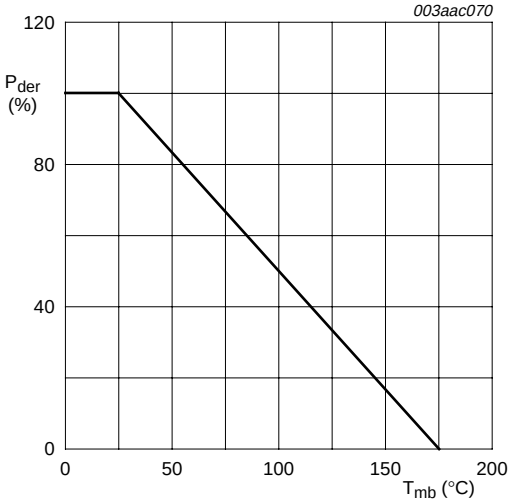
Table 3. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DS}	drain-source voltage			-	40	V
V_{DGR}	drain-gate voltage (DC)	R_{GS} = 20 kΩ		-	40	V
V_{GS}	gate-source voltage			-	±20	V
I_D	drain current	T_{mb} = 25 °C; V_{GS} = 10 V; see Figure 2 and 3	[1]	-	101	A
			[2]	-	75	A
		T_{mb} = 100 °C; V_{GS} = 10 V; see Figure 2	[1]	-	71	A
I_{DM}	peak drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs; see Figure 3		-	407	A
P_{tot}	total power dissipation	T_{mb} = 25 °C; see Figure 1		-	157	W
T_{stg}	storage temperature			–55	+175	°C
T_j	junction temperature			–55	+175	°C
Source-drain diode						
I_{DR}	reverse drain current	T_{mb} = 25 °C	[1]	-	101	A
			[2]	-	75	A
I_{DRM}	peak reverse drain current	T_{mb} = 25 °C; pulsed; $t_p \leq 10$ µs		-	407	A
Avalanche ruggedness						
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; I_D = 75 A; $V_{DS} \leq 40$ V; V_{GS} = 10 V; R_{GS} = 50 Ω; starting at T_{mb} = 25 °C		-	241	mJ

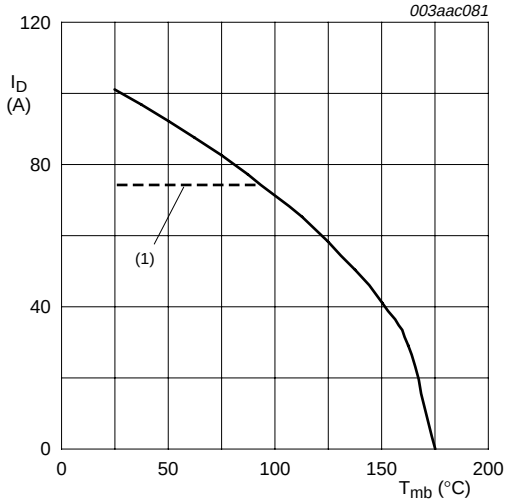
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



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

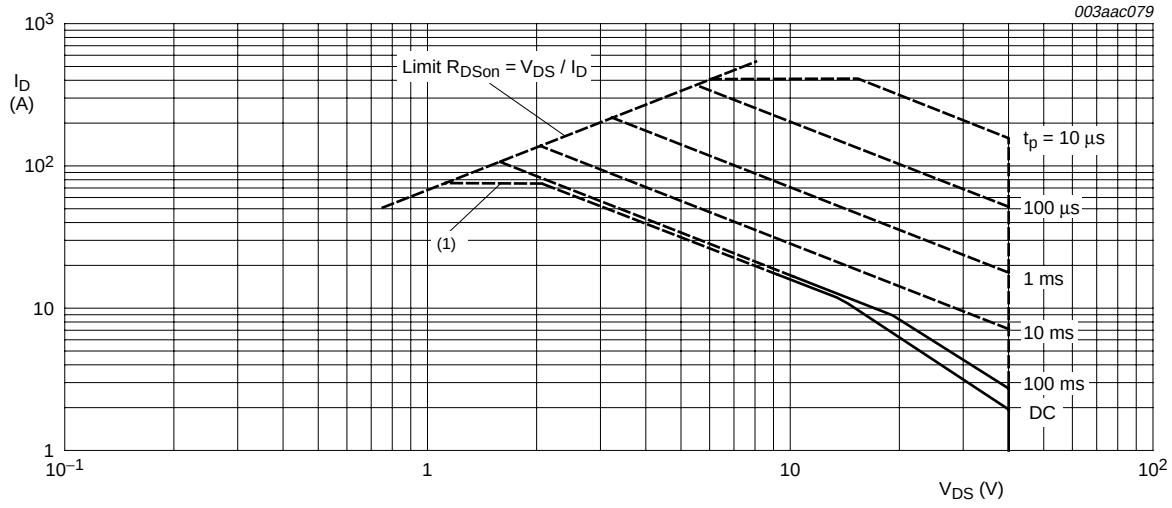
Fig 1. Normalized total power dissipation as a function of solder point temperature



$V_{GS} \geq 10$ V

[1] Capped at 75 A due to package.

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



T_{mb} = 25 °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	see Figure 4		-	-	0.95	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient		[1]	-	60	-	K/W
			[2]	-	50	-	K/W

[1] Vertical in still air; SOT78 package.

[2] mounted on a printed circuit board; minimum footprint; SOT404 package

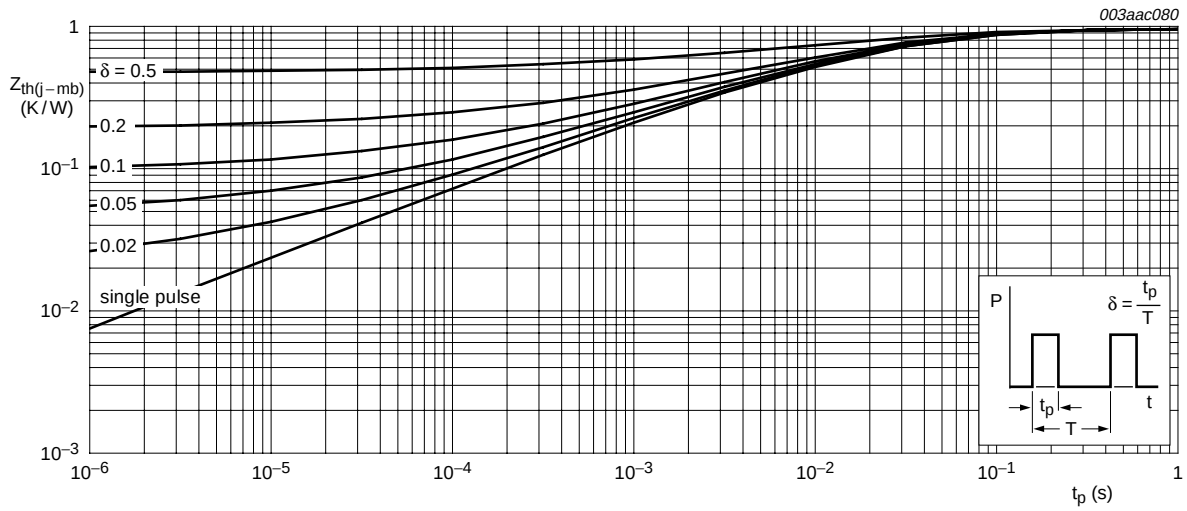


Fig 4. Transient thermal impedance from junction to mounting bast as a function of pulse duration

6. Characteristics

Table 5. Characteristics

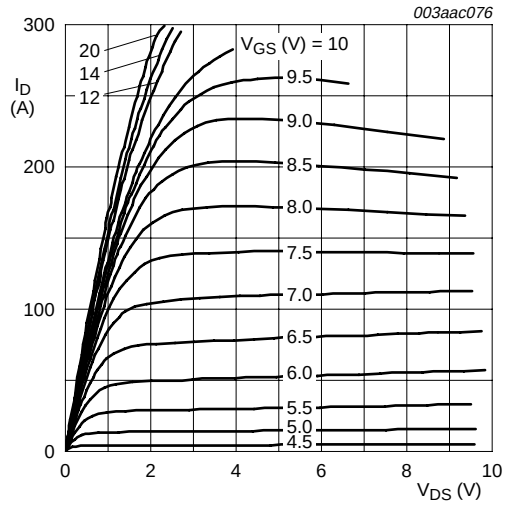
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	I_D = 250 µA; V_{GS} = 0 V				
		T_j = 25 °C	40	-	-	V
		T_j = −55 °C	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	I_D = 1 mA; V_{DS} = V_{GS}; see Figure 9 and 10				
		T_j = 25 °C	2	3	4	V
		T_j = 175 °C	1	-	-	V
		T_j = −55 °C	-	-	4.4	V
I_{DSS}	drain leakage current	V_{DS} = 40 V; V_{GS} = 0 V				
		T_j = 25 °C	-	0.02	1	µA
		T_j = 175 °C	-	-	500	µA
I_{GSS}	gate leakage current	V_{GS} = ±20 V; V_{DS} = 0 V	-	2	100	nA
R_{DSon}	drain-source on-state resistance	V_{GS} = 10 V; I_D =25 A; see Figure 6 and 8				
		T_j = 25 °C	-	6.6	8	mΩ
		T_j = 175 °C	-	-	15.2	mΩ
Dynamic characteristics						
$Q_{G(tot)}$	total gate charge	I_D = 25 A; V_{DD} = 32 V; V_{GS} = 10 V; see Figure 14	-	36	-	nC
Q_{GS}	gate-source charge		-	9	-	nC
Q_{GD}	gate-drain charge		-	12	-	nC
C_{iss}	input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz; see Figure 12	-	2017	2689	pF
C_{oss}	output capacitance		-	486	583	pF
C_{rss}	reverse transfer capacitance		-	213	291	pF
$t_{d(on)}$	turn-on delay time	V_{DD} = 30 V; R_L = 1.2 Ω; V_{GS} = 10 V; R_G = 10 Ω	-	20	-	ns
t_r	rise time		-	51	-	ns
$t_{d(off)}$	turn-off delay time		-	20	-	ns
t_f	fall time		-	33	-	ns
L_D	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 SOT78	-	3.5		nH
		from upper edge of drain mounting base to center of die SOT404	-	2.5	-	nH
L_S	internal source inductance	from source lead 6 mm from package to source bond pad	-	7.5	-	nH

Table 5. Characteristics *...continued*

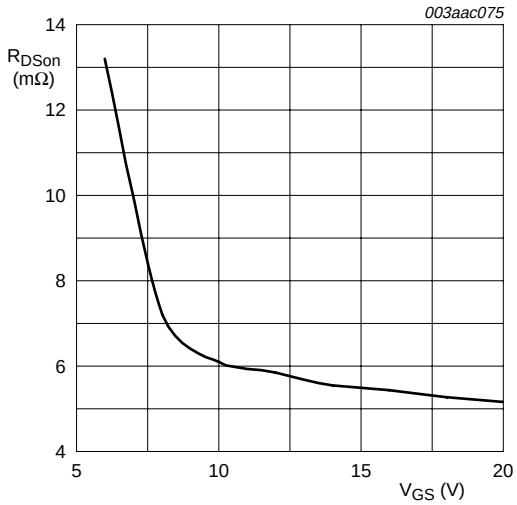
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Source-drain diode						
V_{SD}	source-drain voltage	I_S = 25 A; V_{GS} = 0 V; see Figure 15	-	0.85	1.2	V
t_{rr}	reverse recovery time	I_S = 20 A; dI_S/dt = –100 A/µs; V_{GS} = –10 V; V_{DS} = 20 V	-	53	-	ns
Q_r	recovered charge		-	44	-	nC



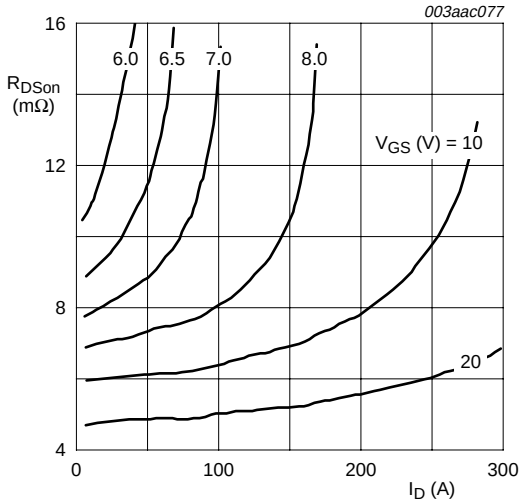
T_j = 25 °C; t_p = 300 µs

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



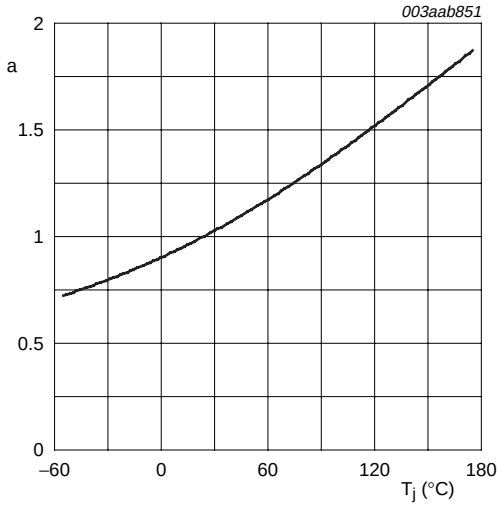
T_j = 25 °C; I_D = 25 A

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



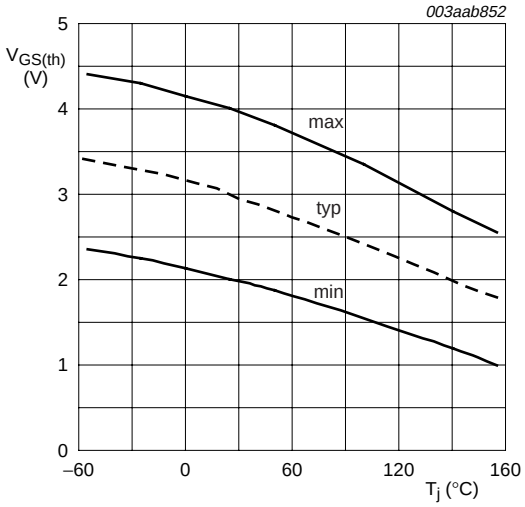
T_j = 25 °C

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



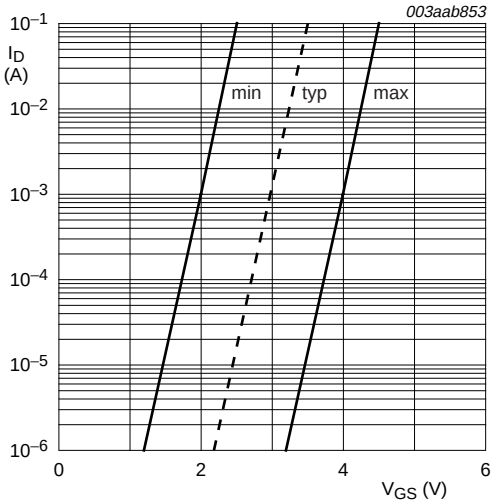
$$a = \frac{R_{DSon}}{R_{DSon(25°C)}}$$

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



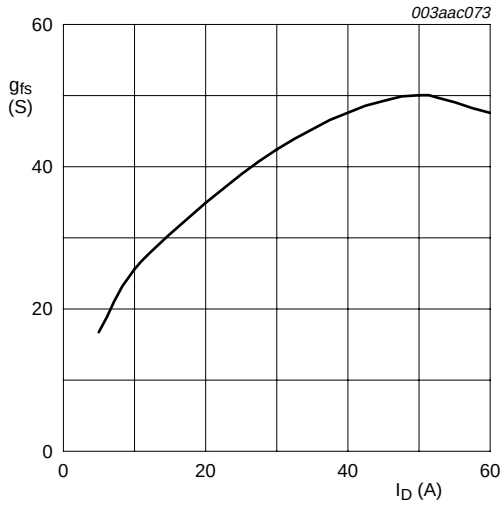
I_D = 1 mA; V_{DS} = V_{GS}

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



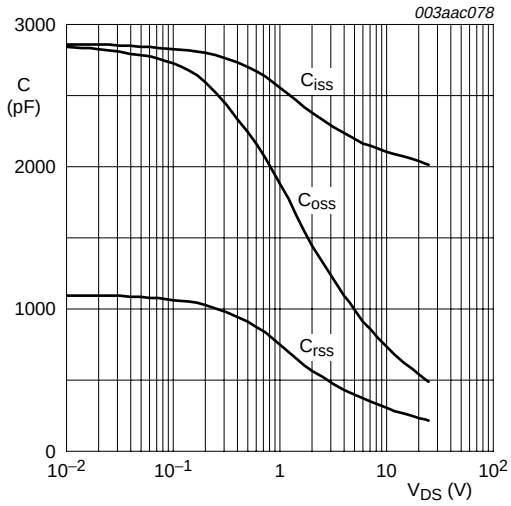
T_j = 25 °C; V_{DS} = V_{GS}

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



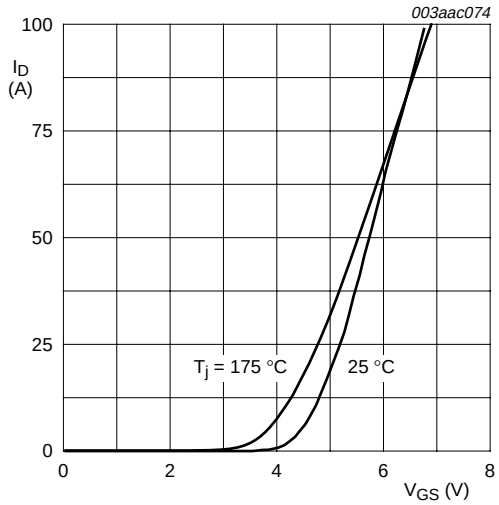
T_j = 25 °C; V_{DS} = 25 V

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



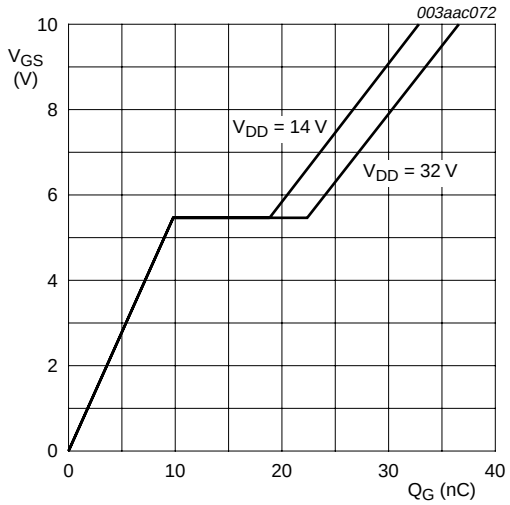
V_{GS} = 0 V; f = 1 MHz

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



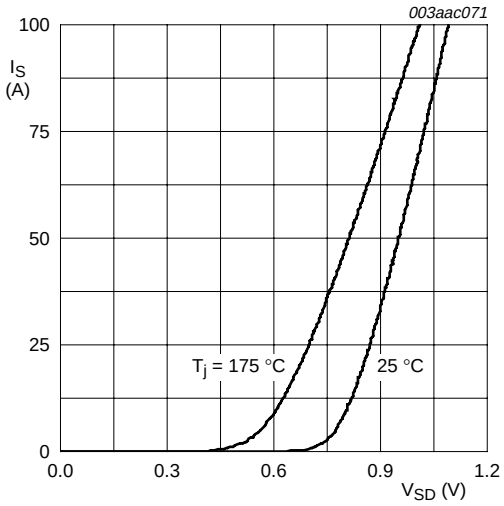
V_{DS} = 25 V

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



T_j = 25 °C; I_D = 25 A

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

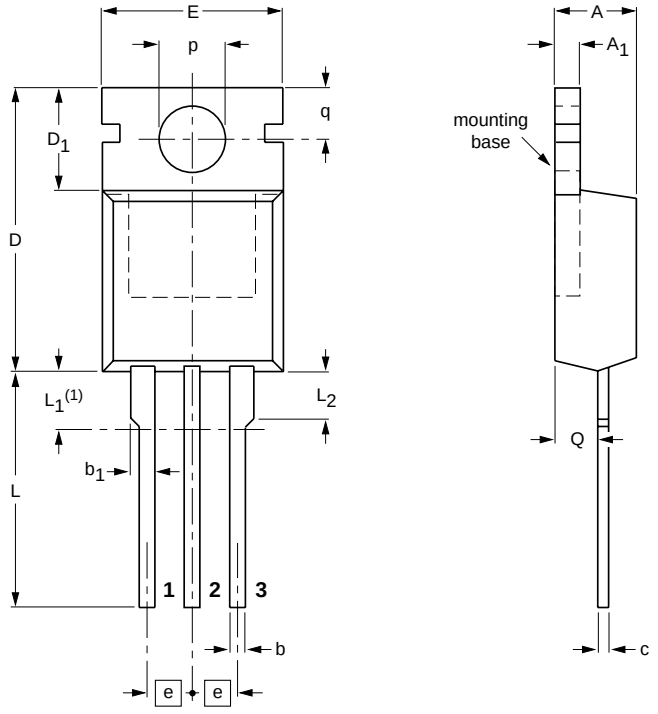


V_{GS} = 0 V

Fig 15. Reverse diode current as a function of reverse diode voltage; typical values

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

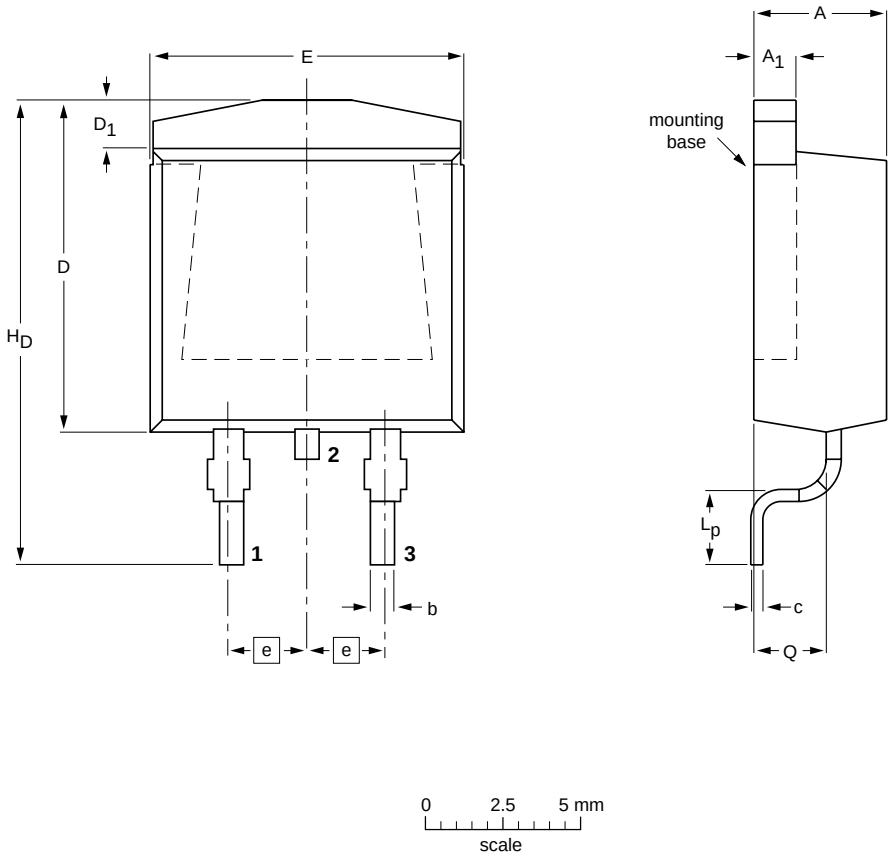
Note

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 16. Package outline SOT78A (TO-220AB)

Plastic single-ended surface-mounted package (D2PAK); 3 leads (one lead cropped) **SOT404**



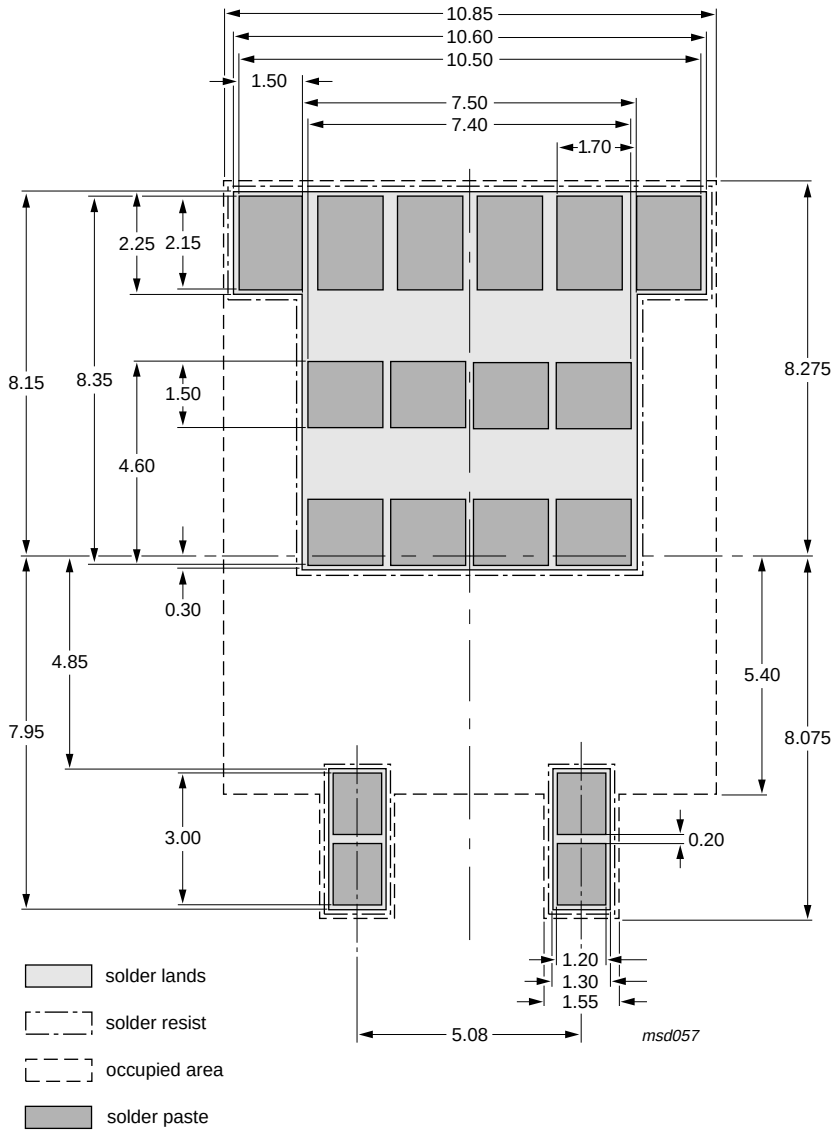
DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	c	D max.	D_1	E	e	L_p	H_D	Q
mm	4.50 4.10	1.40 1.27	0.85 0.60	0.64 0.46	11	1.60 1.20	10.30 9.70	2.54	2.90 2.10	15.80 14.80	2.60 2.20

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT404						~~05-02-11~~ 06-03-16

Fig 17. Package outline SOT404 (D2PAK)

8. Soldering



Dimensions in mm.

Fig 18. Reflow soldering footprint for SOT404

9. Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BUK75_7608-40B_3	20071128	Product data sheet	-	BUK75_7608-40B_2
Modifications:	• The format of this data sheet has been redesigned to correct a layout error.			
BUK75_7608-40B_2	20071116	Product data sheet	-	BUK75_7608_40B-01
Modifications:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate.			
BUK75_7608_40B-01	20030319	Product data sheet	-	-

10. Legal information

10.1 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.
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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

10.2 Definitions

Draft — The document is a draft version only. The content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included herein and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

10.3 Disclaimers

General — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors accepts no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) may cause permanent damage to the device. Limiting values are stress ratings only and operation of the device at these or any other conditions above those given in the Characteristics sections of this document is not implied. Exposure to limiting values for extended periods may affect device reliability.

Terms and conditions of sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at http://www.nxp.com/profile/terms, including those pertaining to warranty, intellectual property rights infringement and limitation of liability, unless explicitly otherwise agreed to in writing by NXP Semiconductors. In case of any inconsistency or conflict between information in this document and such terms and conditions, the latter will prevail.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

10.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

TrenchMOS — is a trademark of NXP B.V.

11. Contact information

For additional information, please visit: **http://www.nxp.com**

For sales office addresses, send an email to: **salesaddresses@nxp.com**

12. Contents

1	**Product profile**	**1**
1.1	General description	1
1.2	Features	1
1.3	Applications	1
1.4	Quick reference data	1
2	**Pinning information**	**1**
3	**Ordering information**	**2**
4	**Limiting values**	**2**
5	**Thermal characteristics**	**4**
6	**Characteristics**	**5**
7	**Package outline**	**9**
8	**Soldering**	**11**
9	**Revision history**	**12**
10	**Legal information**	**13**
10.1	Data sheet status	13
10.2	Definitions	13
10.3	Disclaimers	13
10.4	Trademarks	13
11	**Contact information**	**13**
12	**Contents**	**14**

For more information, please visit: http://www.nxp.com
For sales office addresses, please send an email to: salesaddresses@nxp.com

Date of release: 28 November 2007

Document identifier: BUK75_7608-40B_3