TrenchMOS™ transistor
Logic level FET

BUK9516-55A
BUK9616-55A

GENERAL DESCRIPTION

N-channel enhancement mode logic level field-effect power transistor in a plastic envelope available in TO220AB and SOT404 . Using '**trench**' technology which features very low on-state resistance. It is intended for use in automotive and general purpose switching applications.

QUICK REFERENCE DATA

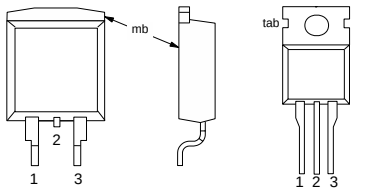
SYMBOL	PARAMETER	MAX.	UNIT
V_{DS}	Drain-source voltage	55	V
I_D	Drain current (DC)	66	A
P_{tot}	Total power dissipation	138	W
T_j	Junction temperature	175	˚C
$R_{DS(ON)}$	Drain-source on-state resistance V_{GS} = 5 V	16	mΩ
	V_{GS} = 10 V	15	mΩ

PINNING

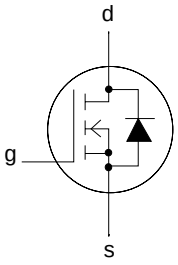
TO220AB & SOT404

PIN	DESCRIPTION
1	gate
2	drain
3	source
tab/mb	drain

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

Limiting values in accordance with the Absolute Maximum System (IEC 134)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DS}	Drain-source voltage	-	-	55	V
V_{DGR}	Drain-gate voltage	R_{GS} = 20 kΩ	-	55	V
$\pm V_{GS}$	Gate-source voltage	-	-	10	V
$\pm V_{GSM}$	Non-repetitive gate-source voltage	$t_p \leq 50\mu S$	-	15	V
I_D	Drain current (DC)	T_{mb} = 25 ˚C	-	66	A
I_D	Drain current (DC)	T_{mb} = 100 ˚C	-	46	A
I_{DM}	Drain current (pulse peak value)	T_{mb} = 25 ˚C	-	263	A
P_{tot}	Total power dissipation	T_{mb} = 25 ˚C	-	138	W
T_{stg}, T_j	Storage & operating temperature	-	- 55	175	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Thermal resistance junction to mounting base	-	-	1.1	K/W
$R_{th\ j\text{-}a}$	Thermal resistance junction to ambient(TO220AB)	in free air	60	-	K/W
$R_{th\ j\text{-}a}$	Thermal resistance junction to ambient(SOT404)	Minimum footprint, FR4 board	50	-	K/W

STATIC CHARACTERISTICS

T_j= 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V; I_D = 0.25 mA;	55	-	-	V
		T_j = -55˚C	50	-	-	V
$V_{GS(TO)}$	Gate threshold voltage	V_{DS} = V_{GS}; I_D = 1 mA	1	1.5	2.0	V
		T_j = 175˚C	0.5	-	-	V
		T_j = -55˚C	-	-	2.3	V
I_{DSS}	Zero gate voltage drain current	V_{DS} = 55 V; V_{GS} = 0 V;	-	0.05	10	μA
		T_j = 175˚C	-	-	500	μA
I_{GSS}	Gate source leakage current	V_{GS} = ±10 V; V_{DS} = 0 V	-	2	100	nA
$R_{DS(ON)}$	Drain-source on-state resistance	V_{GS} = 5 V; I_D = 25 A	-	12.5	16	mΩ
		T_j = 175˚C	-	-	32	mΩ
		V_{GS} = 10 V; I_D = 25 A	-	10	15	mΩ
		V_{GS} = 4.5 V; I_D = 25 A	-	-	17	mΩ

DYNAMIC CHARACTERISTICS

T_{mb} = 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
C_{iss}	Input capacitance	V_{GS} = 0 V; V_{DS} = 25 V; f = 1 MHz	-	2314	3085	pF
C_{oss}	Output capacitance		-	347	416	pF
C_{rss}	Feedback capacitance		-	243	333	pF
$t_{d\,on}$	Turn-on delay time	V_{DD} = 30 V; R_{load} =1.2Ω;	-	45	68	ns
t_r	Turn-on rise time	V_{GS} = 5 V; R_G = 10 Ω	-	130	195	ns
$t_{d\,off}$	Turn-off delay time		-	400	560	ns
t_f	Turn-off fall time		-	130	182	ns
L_d	Internal drain inductance	Measured from drain lead 6 mm from package to centre of die	-	4.5	-	nH
L_d	Internal drain inductance	Measured from contact screw on tab to centre of die(TO220AB)	-	3.5	-	nH
L_d	Internal drain inductance	Measured from upper edge of drain tab to centre of die(SOT404)	-	2.5	-	nH
L_s	Internal source inductance	Measured from source lead to source bond pad	-	7.5	-	nH

REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS

T_j = 25˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current		-	-	66	A
I_{DRM}	Pulsed reverse drain current		-	-	263	A
V_{SD}	Diode forward voltage	I_F = 25 A; V_{GS} = 0 V	-	0.85	1.2	V
		I_F = 66 A; V_{GS} = 0 V	-	1.1	-	V
t_{rr}	Reverse recovery time	I_F = 20 A; -dI_F/dt = 100 A/μs;	-	51	164	ns
Q_{rr}	Reverse recovery charge	V_{GS} = -10 V; V_R = 30 V	-	102	126	nC

AVALANCHE LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
W_{DSS}	Drain-source non-repetitive unclamped inductive turn-off energy	I_D = 49 A; $V_{DD} \leq$ 25 V; V_{GS} = 5 V; R_{GS} = 50 Ω; T_{mb} = 25 ˚C	-	-	120	mJ

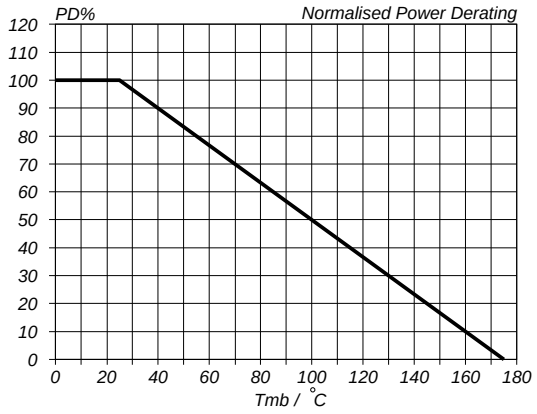


Fig.1. Normalised power dissipation.
PD% = 100·P_D/$P_{D\ 25\ ˚C}$ = f(T_{mb})

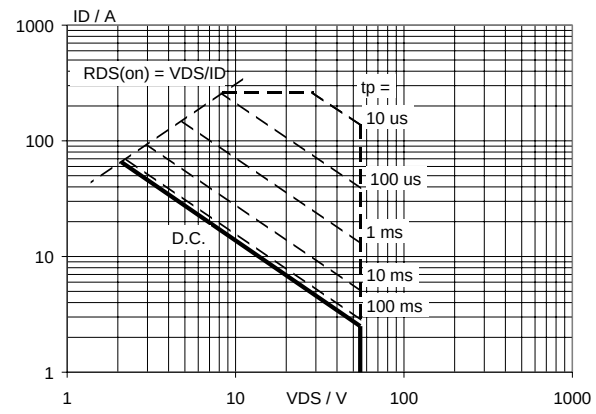


Fig.3. Safe operating area. T_{mb} = 25 ˚C
I_D & I_{DM} = f(V_{DS}); I_{DM} single pulse; parameter t_p

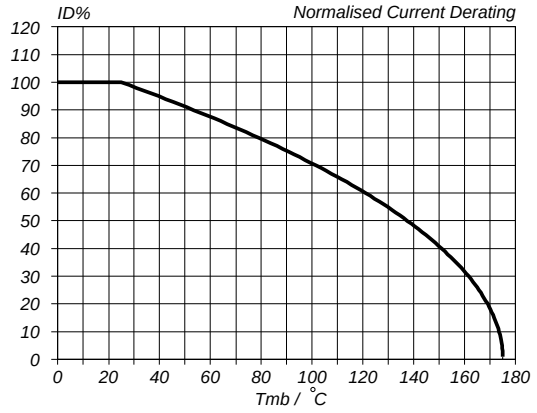


Fig.2. Normalised continuous drain current.
ID% = 100·I_D/$I_{D\ 25\ ˚C}$ = f(T_{mb}); conditions: $V_{GS} \geq$ 5 V

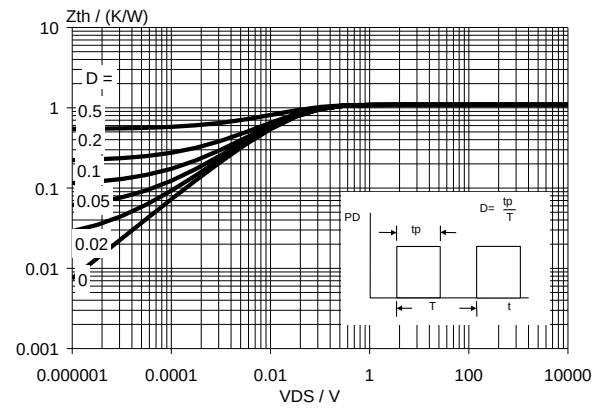


Fig.4. Transient thermal impedance.
$Z_{th\ j\text{-}mb}$ = f(t); parameter D = t_p/T

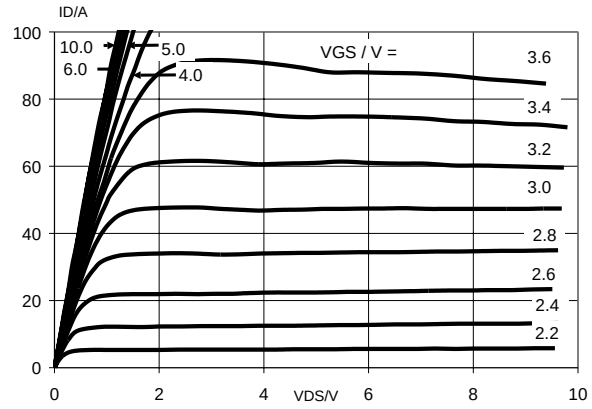


Fig.5. Typical output characteristics, T_j = 25 ˚C. $I_D = f(V_{DS})$; parameter V_{GS}

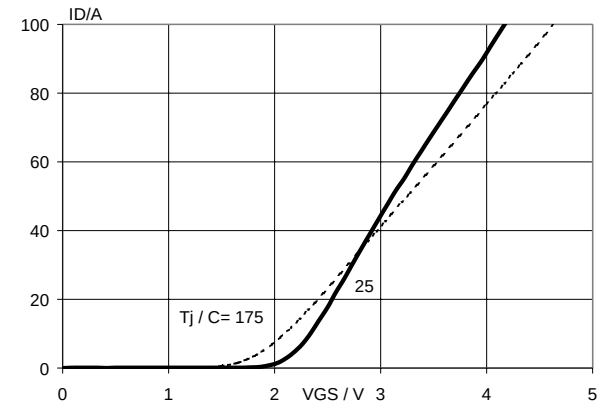


Fig.8. Typical transfer characteristics. $I_D = f(V_{GS})$; conditions: V_{DS} = 25 V; parameter T_j

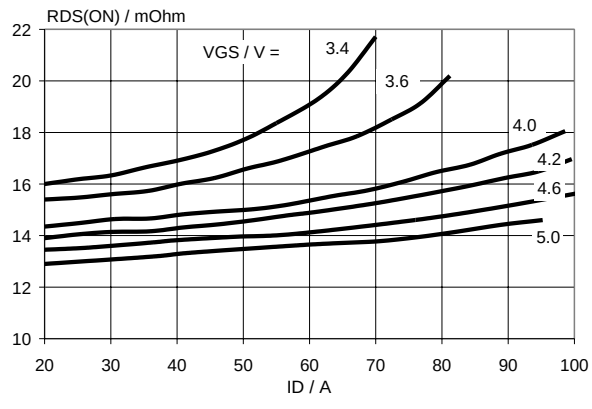


Fig.6. Typical on-state resistance, T_j = 25 ˚C. $R_{DS(ON)} = f(I_D)$; parameter V_{GS}

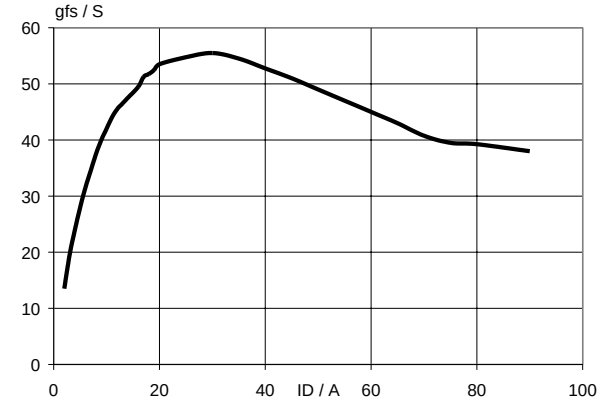


Fig.9. Typical transconductance, T_j = 25 ˚C. $g_{fs} = f(I_D)$; conditions: V_{DS} = 25 V

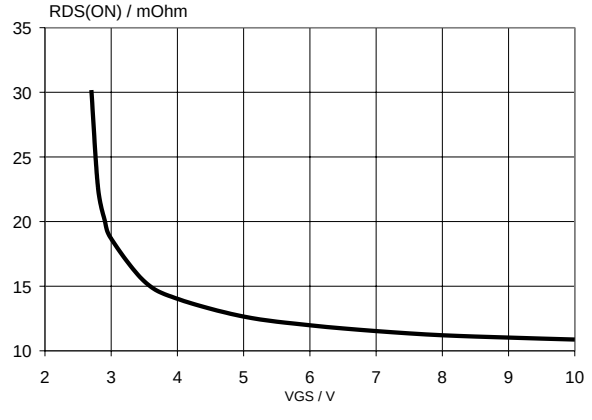


Fig.7. Typical on-state resistance, T_j = 25 ˚C. $R_{DS(ON)} = f(V_{GS})$; conditions I_D = 25 A;

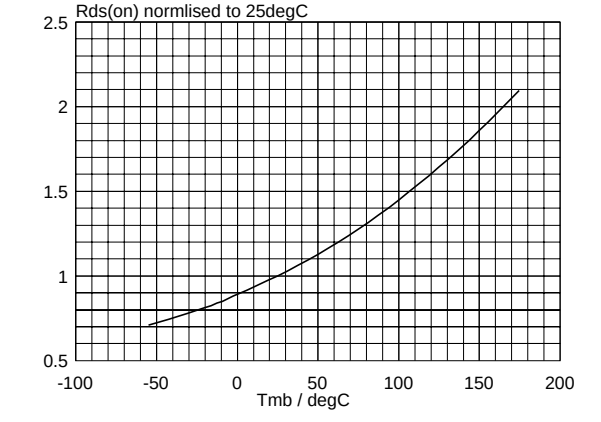


Fig.10. Normalised drain-source on-state resistance. $a = R_{DS(ON)}/R_{DS(ON)25\,°C} = f(T_j)$; I_D = 25 A; V_{GS} = 5 V

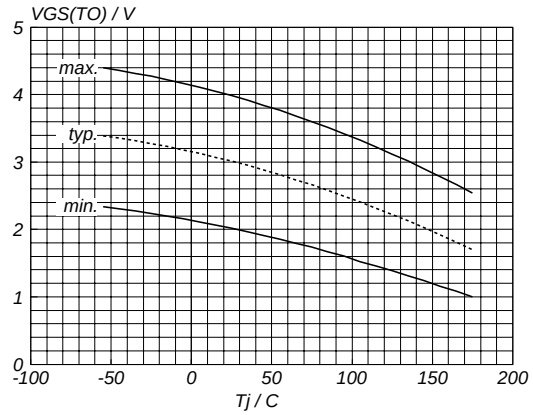


Fig.11. Gate threshold voltage.
$V_{GS(TO)} = f(T_j)$; conditions: I_D = 1 mA; $V_{DS} = V_{GS}$

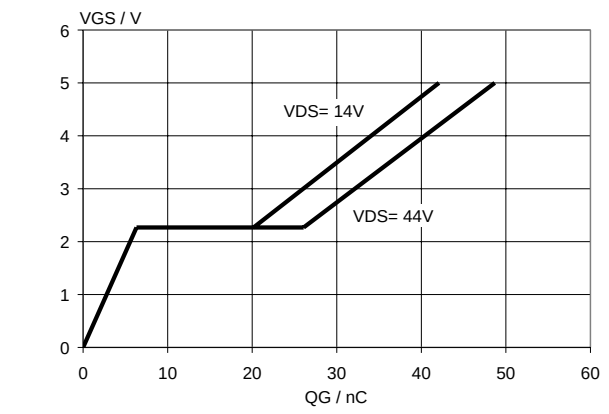


Fig.14. Typical turn-on gate-charge characteristics.
$V_{GS} = f(Q_G)$; conditions: I_D = 50 A; parameter V_{DS}

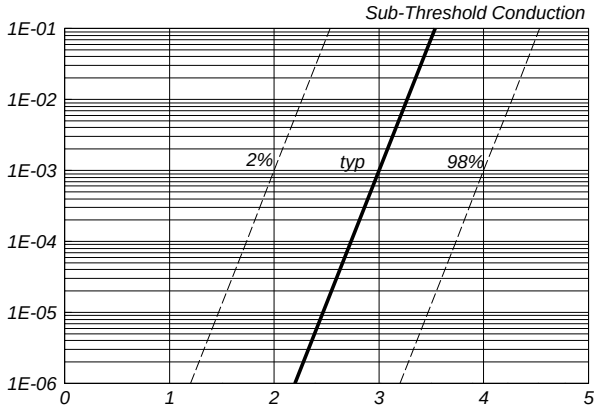


Fig.12. Sub-threshold drain current.
$I_D = f(V_{GS})$; conditions: T_j = 25 ˚C; $V_{DS} = V_{GS}$

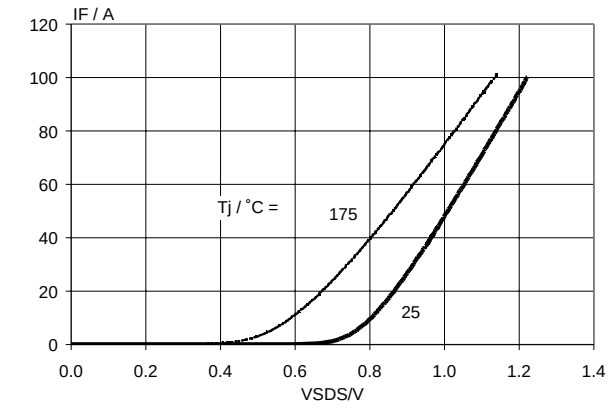


Fig.15. Typical reverse diode current.
$I_F = f(V_{SDS})$; conditions: V_{GS} = 0 V; parameter T_j

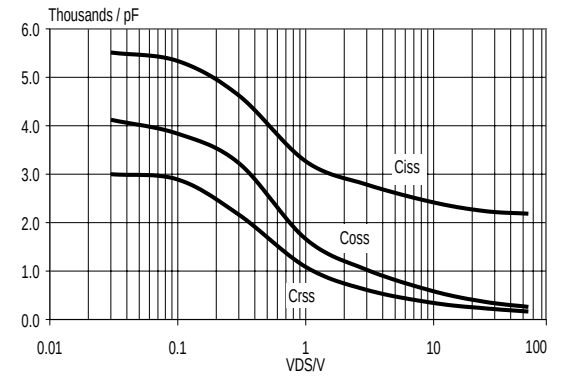


Fig.13. Typical capacitances, C_{iss}, C_{oss}, C_{rss}.
C = $f(V_{DS})$; conditions: V_{GS} = 0 V; f = 1 MHz

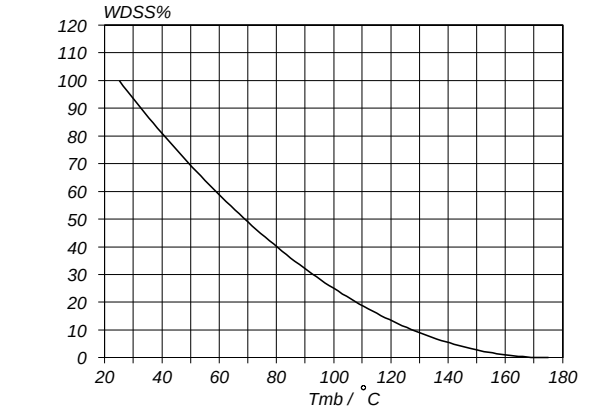


Fig.16. Normalised avalanche energy rating.
W_{DSS}% = $f(T_{mb})$; conditions: I_D = 75 A

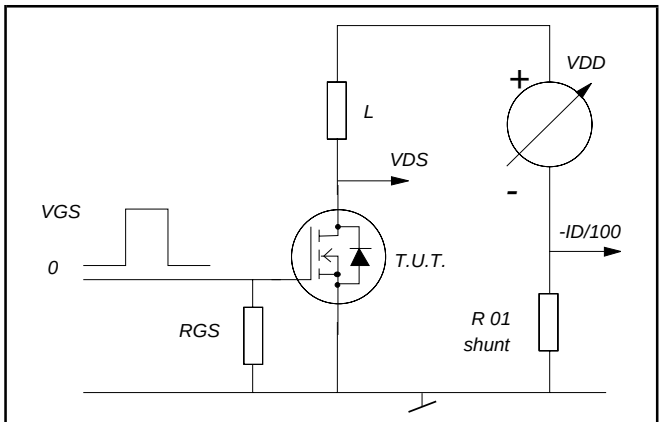


Fig.17. Avalanche energy test circuit.

$$W_{DSS} = 0.5 \cdot LI_D^2 \cdot BV_{DSS}/(BV_{DSS} - V_{DD})$$

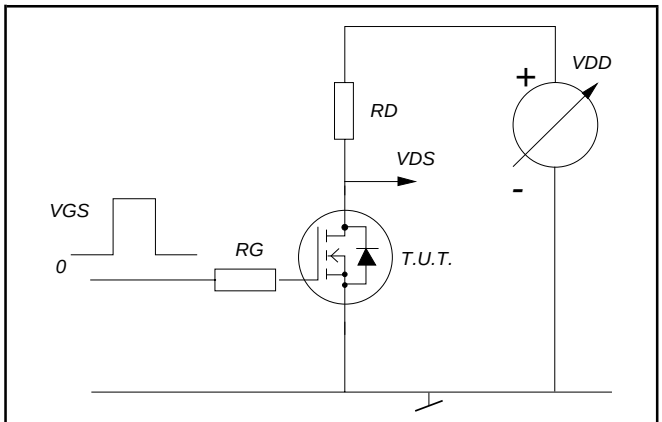


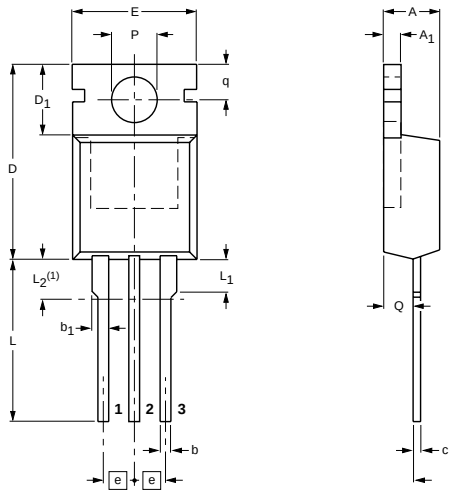
Fig.18. Switching test circuit.

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220 **SOT78**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D	D_1	E	e	L	L_1	$L_2^{(1)}$ max.	P	q	Q
mm	4.5 4.1	1.39 1.27	0.9 0.7	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	EIAJ			
SOT78		TO-220				97-06-11

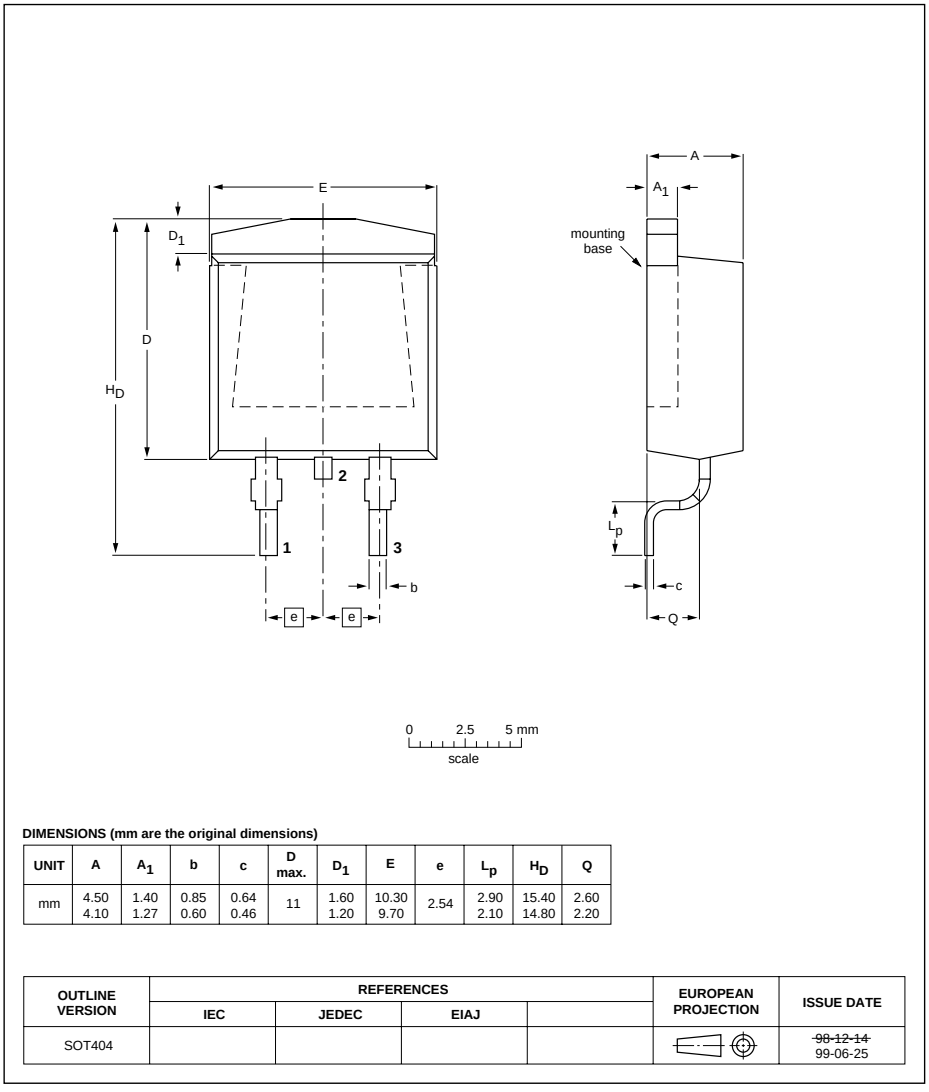
Fig.19. SOT78 (TO220AB); pin 2 connected to mounting base.

Notes

1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. Refer to mounting instructions for SOT78 (TO220) envelopes.
3. Epoxy meets UL94 V0 at 1/8".

MECHANICAL DATA

Plastic single-ended surface mounted package (Philips version of D²-PAK); 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	15.40 14.80	2.60 2.20

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT404						~~98-12-14~~ 99-06-25

Fig.20. SOT404 surface mounting package. Centre pin connected to mounting base.

Notes

1. This product is supplied in anti-static packaging. The gate-source input must be protected against static discharge during transport or handling.
2. Refer to SMD Footprint Design and Soldering Guidelines, Data Handbook SC18.
3. Epoxy meets UL94 V0 at 1/8".

MOUNTING INSTRUCTIONS

Dimensions in mm

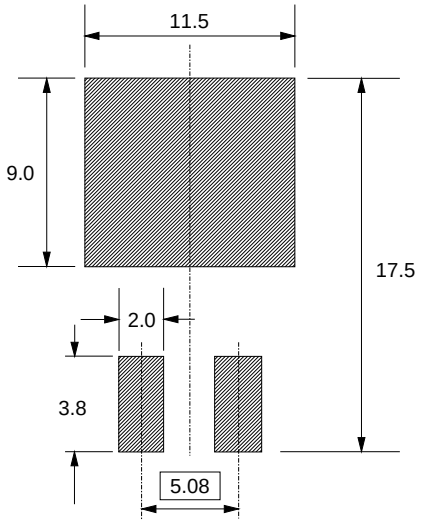


Fig.21. SOT404 : soldering pattern for surface mounting.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values are given in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of this specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.