PowerMOS transistor
Voltage clamped logic level FET

BUK553-48C

GENERAL DESCRIPTION

Protected N-channel enhancement mode logic level field-effect power transistor in a plastic envelope. The device is intended for use in automotive applications. It has built-in zener diodes providing active drain voltage clamping.
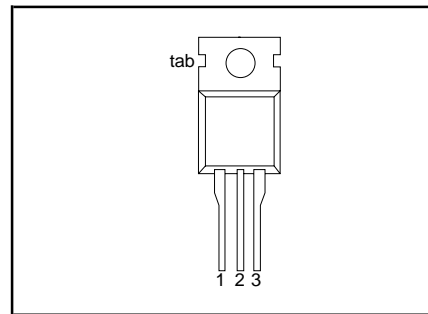
QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
$V_{(CL)DSR}$	Drain-source clamp voltage	40	48	58	V
I_D	Drain current (DC)			21	A
P_{tot}	Total power dissipation			75	W
T_j	Junction temperature			175	˚C
W_{DSRR}	Repetitive clamped turn off energy; $T_j = 150$˚C			50	mJ
$R_{DS(ON)}$	Drain-source on-state resistance; $V_{GS} = 5$ V			85	mΩ

PINNING - TO220AB

PIN	DESCRIPTION
1	gate
2	drain
3	source
tab	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	continuous	-	30	V
V_{DG}	Drain-gate voltage	continuous	-	30	V
$\pm V_{GS}$	Gate-source voltage	-	-	15	V
I_D	Drain current (DC)	$T_{mb} = 25$ ˚C	-	21	A
I_D	Drain current (DC)	$T_{mb} = 100$ ˚C	-	15	A
I_{DM}	Drain current (pulse peak value)	$T_{mb} = 25$ ˚C	-	84	A
P_{tot}	Total power dissipation	$T_{mb} = 25$ ˚C	-	75	W
T_{stg}	Storage temperature	-	- 55	175	˚C
T_j	Junction Temperature	-	- 55	175	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$R_{th\ j-mb}$	Thermal resistance junction to heatsink	with heatsink compound	-	-	2	K/W
$R_{th\ j-a}$	Thermal resistance junction to ambient		-	60	-	K/W

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STATIC CHARACTERISTICS

T_j = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)DG}$	Drain-gate zener voltage	$0.2 \le -I_G \le 0.4$ mA; $-55˚C \le T_j \le 150˚C$	38	45	54	V
$V_{GS(TO)}$	Gate threshold voltage	$V_{DS} = V_{GS}$; $I_D = 1$ mA	1.0	1.5	2.0	V
$V_{GS(ON)}$	Gate voltage	$V_{DS} = 10$ V; $I_D = 10$ A; $-55˚C \le T_j \le 150˚C$	2.0	3.1	4.0	V
I_{DSS}	Zero gate voltage drain current	$V_{DS} = 30$ V; $V_{GS} = 0$ V; $T_j = 150$ ˚C	-	0.01	1.0	mA
I_{GSS}	Gate source leakage current	$V_{GS} = \pm15$ V; $V_{DS} = 0$ V; $T_j = 150$ ˚C	-	0.1	10	μA
$R_{DS(ON)}$	Drain-source on-state resistance	$V_{GS} = 5$ V; $I_D = 10$ A	-	65	85	mΩ

DYNAMIC CHARACTERISTICS

T_j = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(CL)DSR}$	Drain source clamp voltage (peak value)	$R_G = 10$ kΩ; $I_D = 10$ A; $-55 \le T_j \le 150˚C$; Inductive load.	40	48	58	V
g_{fs}	Forward transconductance	$V_{DS} = 25$ V; $I_D = 10$ A	7	12	-	S
C_{iss}	Input capacitance	$V_{GS} = 0$ V; $V_{DS} = 25$ V; $f = 1$ MHz	-	550	825	pF
C_{oss}	Output capacitance		-	240	350	pF
C_{rss}	Feedback capacitance		-	100	160	pF
$t_{d on}$	Turn-on delay time	$V_{DD} = 12$ V; $I_D = 5$ A; $V_{GS} = 5$ V; $R_G = 10$ kΩ;	-	3.5	-	μs
t_r	Turn-on rise time		-	22	-	μs
$t_{d off}$	Turn-off delay time		-	16	-	μs
t_f	Turn-off fall time		-	18	-	μs
L_d	Internal drain inductance	Measured from drain lead 6 mm from package to centre of die	-	4.5	-	nH
L_s	Internal source inductance	Measured from source lead 6 mm from package to source bond pad	-	7.5	-	nH

REVERSE DIODE LIMITING VALUES AND CHARACTERISTICS
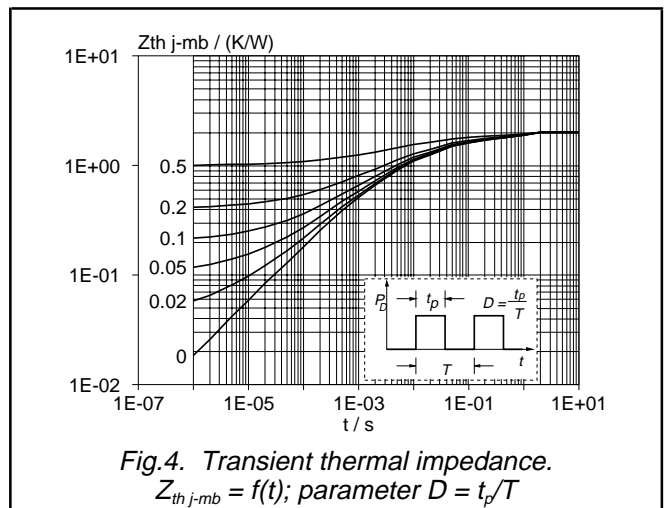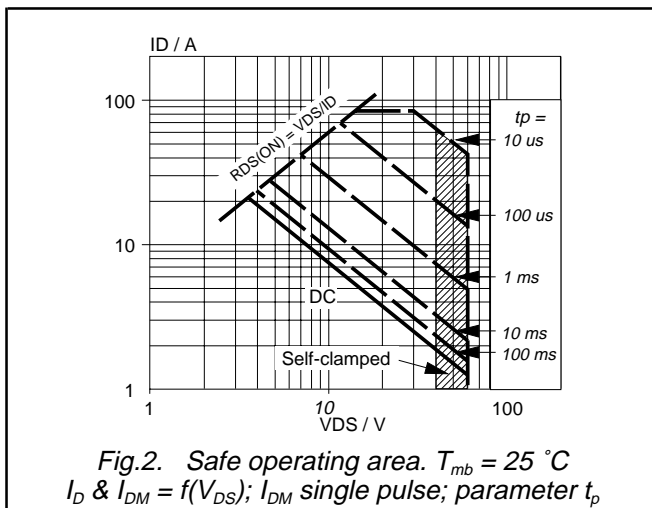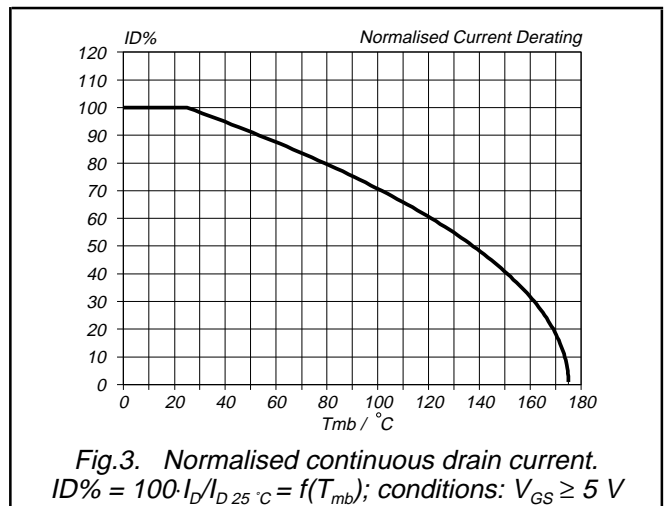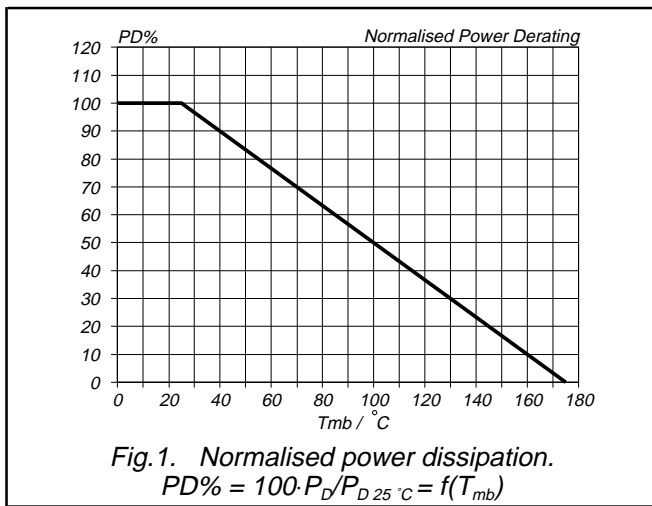
T_j = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{DR}	Continuous reverse drain current	-	-	-	21	A
I_{DRM}	Pulsed reverse drain current	-	-	-	84	A
V_{SD}	Diode forward voltage	$I_F = 21$ A ; $V_{GS} = 0$ V	-	1.3	1.7	V

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BUK553-48C

CLAMPED ENERGY LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
W_{DSRS}	Non-repetitive drain-source clamped inductive turn off energy	T_j = 25°C prior to clamping; I_D = 10 A; $V_{DD} \leq$ 16 V; V_{GS} = 5 V; R_G = 10 kΩ; inductive load	-	200	mJ
W_{DSRR}	Drain-source repetitive clamped inductive turn off energy	T_j = 150°C prior to clamping; I_D = 10 A; $V_{DD} \leq$ 16 V; V_{GS} = 5 V; R_G = 10 kΩ; inductive load	-	50	mJ

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

Fig.3. Normalised continuous drain current.
$ID\% = 100 \cdot I_D/I_{D\,25\,°C} = f(T_{mb})$; conditions: $V_{GS} \geq 5$ V

Fig.2. Safe operating area. T_{mb} = 25 °C
I_D & $I_{DM} = f(V_{DS})$; I_{DM} single pulse; parameter t_p

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

PowerMOS transistor
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BUK553-48C

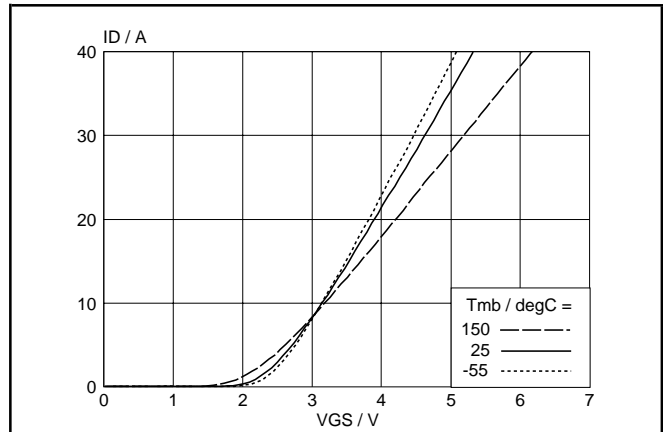Fig.5. Typical output characteristics, $T_j = 25$ °C.
$I_D = f(V_{DS})$; parameter V_{GS}

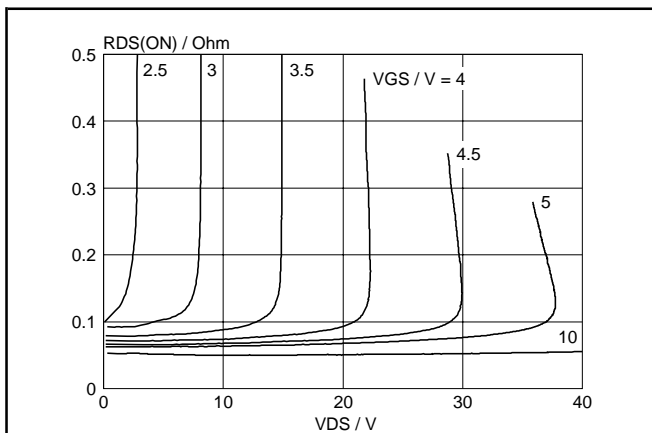Fig.8. Typical transfer characteristics.
$I_D = f(V_{GS})$; conditions: $V_{DS} = 25$ V.

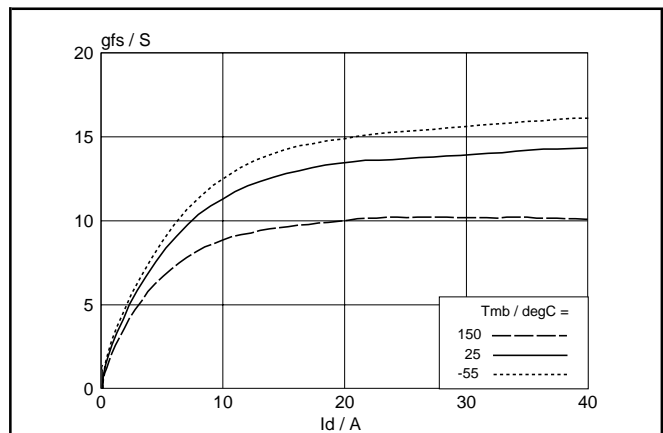Fig.6. Typical on-state resistance, $T_j = 25$ °C.
$R_{DS(ON)} = f(I_D)$; parameter V_{GS}

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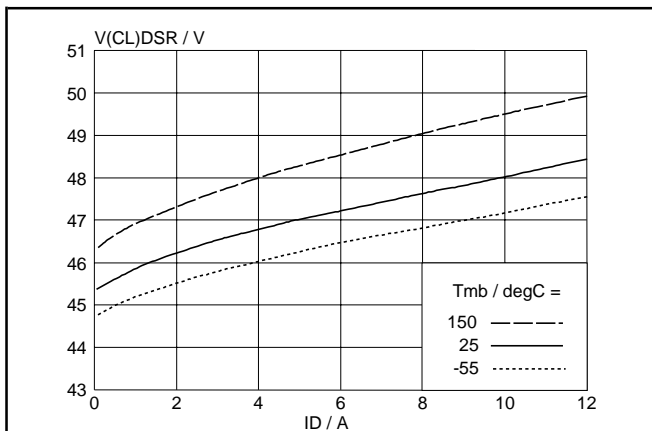$g_{fs} = f(I_D)$; conditions: $V_{DS} = 25$ V

Fig.7. Typical clamping voltage
$V_{(CL)DSR} = f(I_D)$; conditions: $R_G = 10$ kΩ

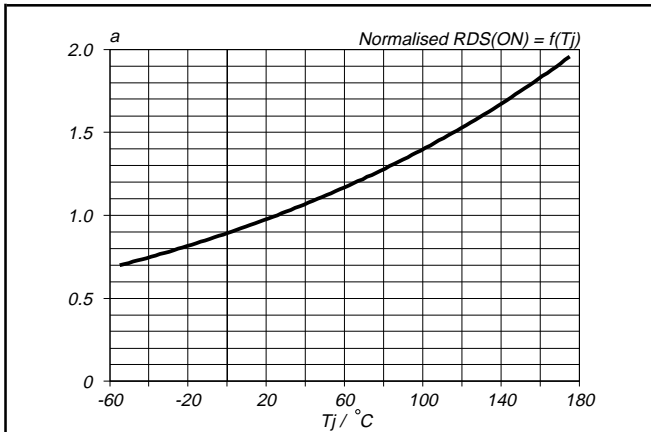Fig.10. Typical clamping voltgage
$V_{(CL)DSR} = f(R_G)$; conditions: $I_D = 10$ A.

Fig.11.   Normalised drain-source on-state resistance.
$a = R_{DS(ON)}/R_{DS(ON)25\,°C} = f(T_j)$; $I_D = 10$ A; $V_{GS} = 5$ V
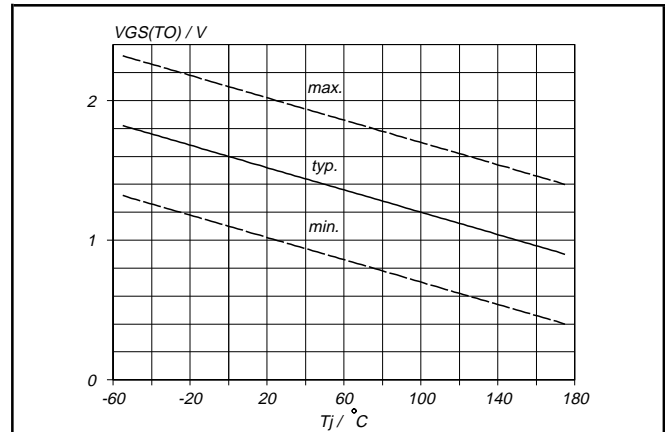

Fig.14.   Gate threshold voltage.
$V_{GS(TO)} = f(T_j)$; conditions: $I_D = 1$ mA; $V_{DS} = V_{GS}$
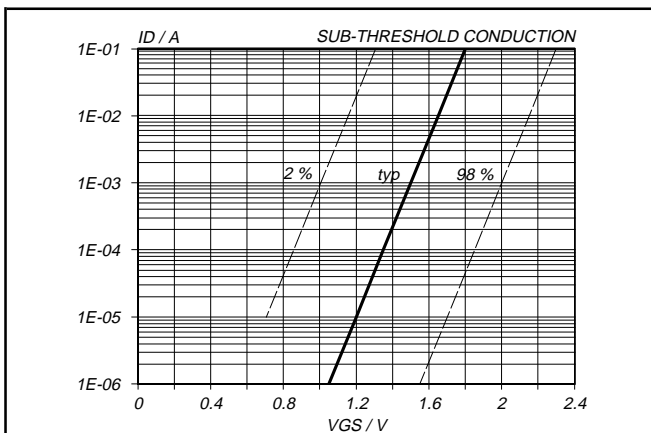

Fig.12.   Sub-threshold drain current.
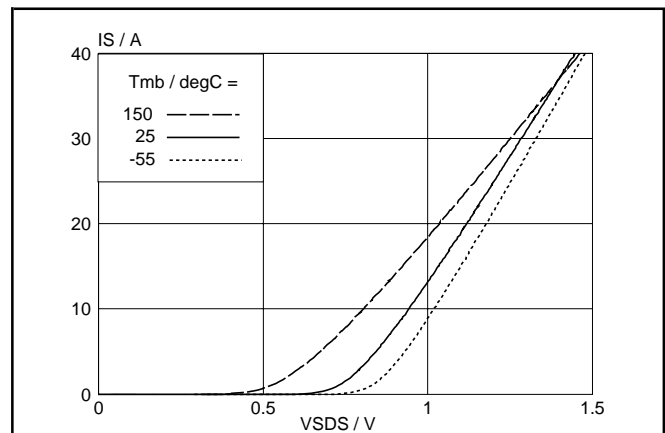$I_D = f(V_{GS})$; conditions: $T_j = 25$ °C; $V_{DS} = V_{GS}$

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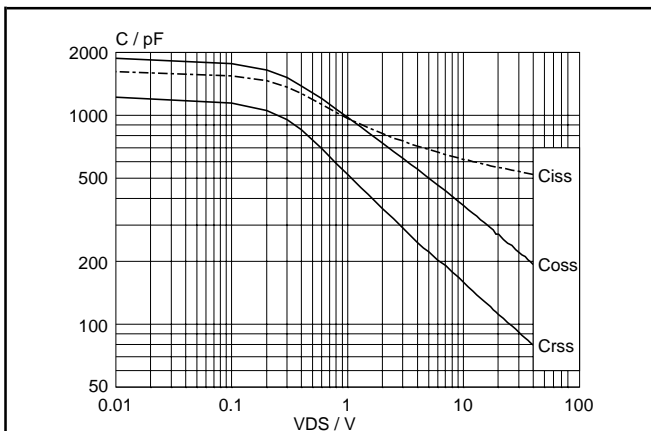$I_F = f(V_{SDS})$; conditions: $V_{GS} = 0$ V; parameter T_j

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

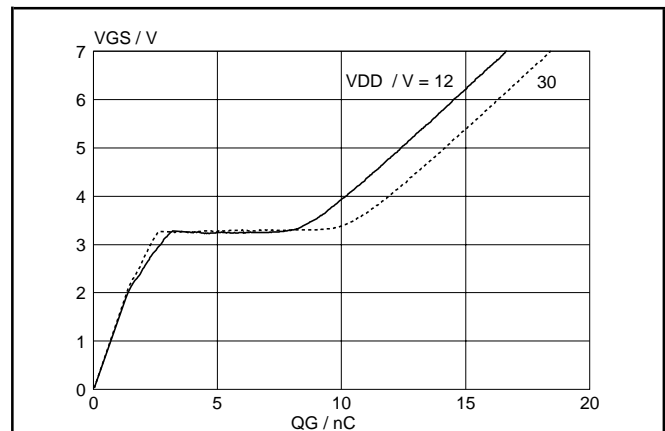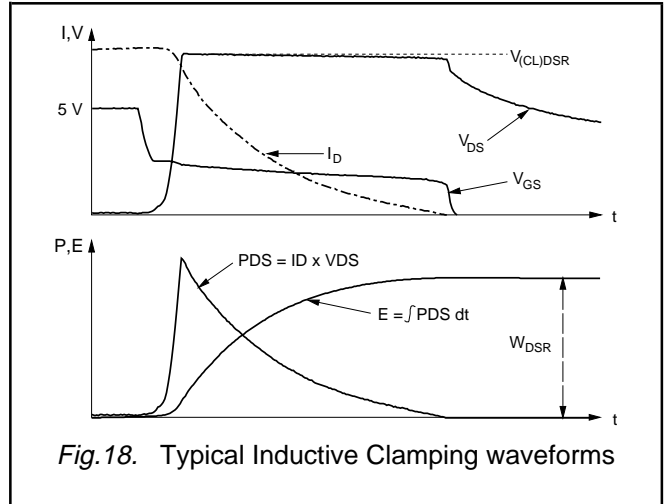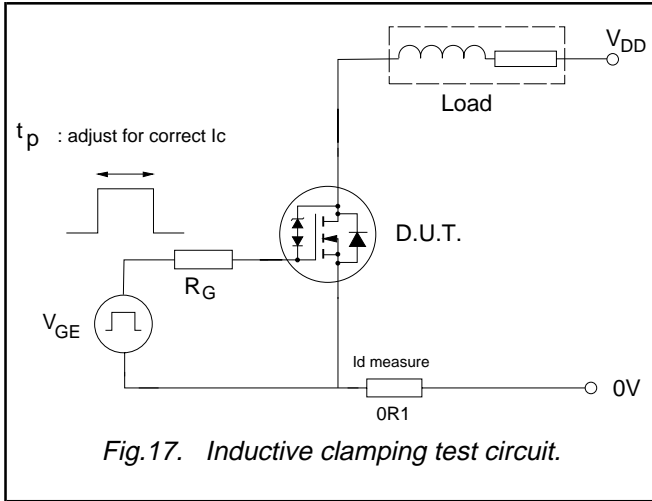Fig.16.   Typical turn-on gate-charge characteristics.
$V_{GS} = f(Q_G)$; conditions: $I_D = 10$ A; parameter V_{DS}

Fig.17.   Inductive clamping test circuit.

Fig.18.   Typical Inductive Clamping waveforms

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

10,3 max

3,7

2,8

4,5 max

1,3

5,9 min

15,8 max

3,0 max not tinned

3,0

13,5 min

1,3 max (2x)
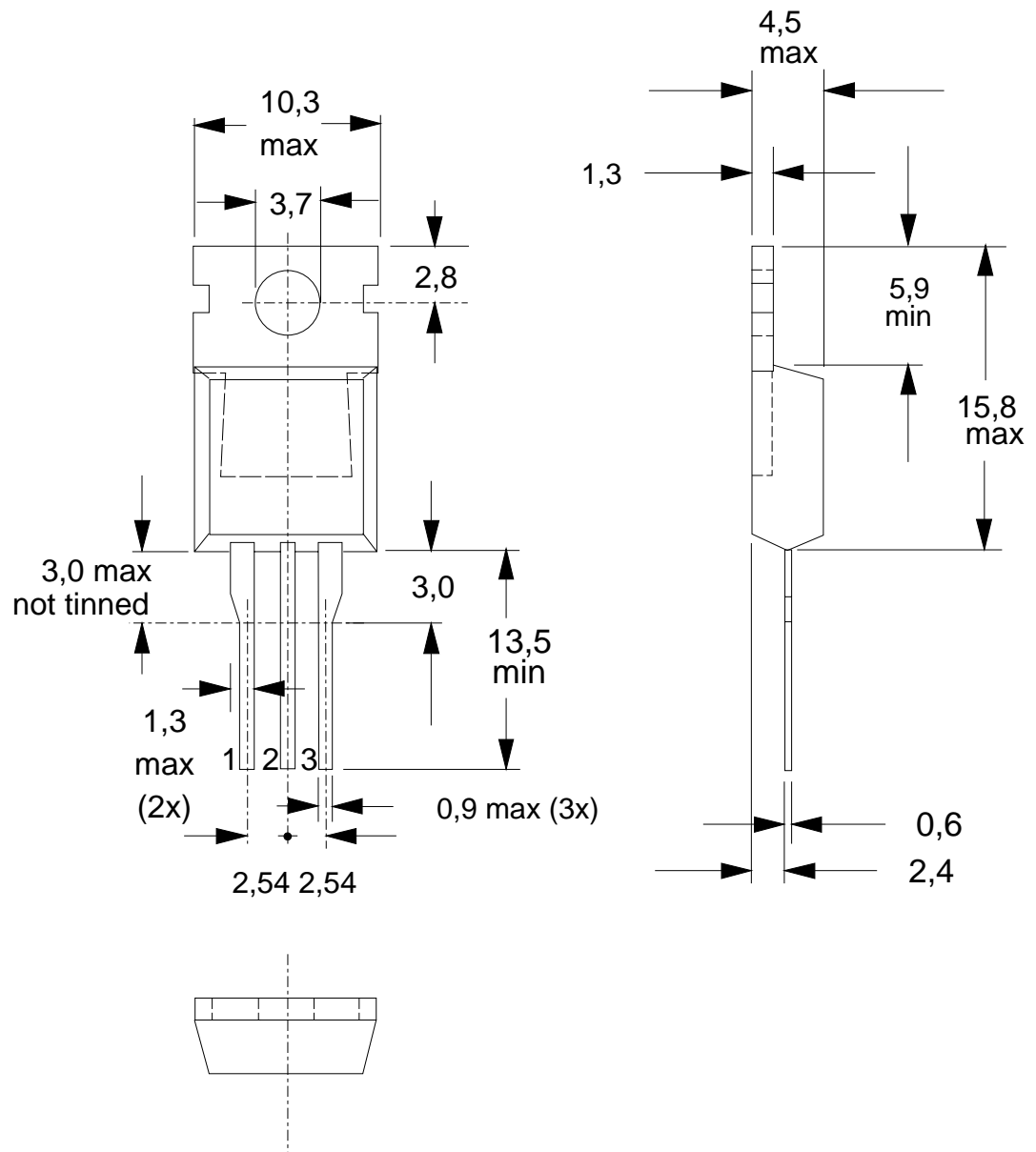
1   2   3

0,9 max (3x)

2,54 2,54

0,6

2,4

Fig.19. 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 TO220 envelopes.
3. Epoxy meets UL94 V0 at 1/8".

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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.	
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