Insulated Gate Bipolar Transistor Protected IGBT

BUK856-450 IX

GENERAL DESCRIPTION

Protected N-channel insulated gate bipolar power transistor in a plastic envelope, intended for automotive ignition applications. The device has built-in zener diodes providing active collector voltage clamping and ESD protection up to 2 kV.

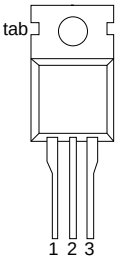
QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
$V_{(CL)CER}$	Collector-emitter clamp voltage	400	450	500	V
V_{CEsat}	Collector-emitter on-state voltage			1.8	V
I_C	Collector current (DC)			15	A
P_{tot}	Total power dissipation			125	W
E_{CERS}	Clamped energy dissipation			300	mJ

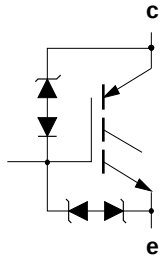
PINNING - TO220AB

PIN	DESCRIPTION
1	gate
2	collector
3	emitter
tab	collector

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CE}	Collecter-emitter voltage	$t_p \leq 500$ µs	-	500	V
V_{CE}	Collector-emitter voltage	Continuous	-20	50	V
$\pm V_{GE}$	Gate-emitter voltage	-	-	12	V
I_C	Collector current (DC)	T_{mb} = 100 ˚C	-	8	A
I_C	Collector current (DC)	T_{mb} = 25 ˚C	-	15	A
I_{CM}	Collector current (pulsed peak value, on-state)	-	-	25	A
I_{CLM}	Collector current (clamped inductive load)	1 kΩ ≤ R_G ≤ 10kΩ; see Figs. 20,21			
		$T_j \leq 150$˚C	-	15	A
		$T_j \leq 175$˚C	-	10	A
E_{CERS}	Clamped turn-off energy (non-repetitive)	T_{mb} = 25 ˚C; I_C = 10 A; see Figs.23,24	-	300	mJ
E_{ECR}	Reverse avalanche energy (repetitive)	I_E = 1 A	-	5	mJ
P_{tot}	Total power dissipation	T_{mb} = 25 ˚C	-	125	W
T_{stg}	Storage temperature	-	-55	175	˚C
T_j	Operating Junction Temperature	-	-40	175	˚C

ESD LIMITING VALUE

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (100 pF, 1.5 kΩ)	-	-	2	kV

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base	-	-	1.2	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	In free air	60	-	K/W

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CG}$	Collector-gate zener breakdown voltage	2 mA ≤ -I_G ≤ 5 mA; -40 ≤ T_j ≤175˚C	400	450	500	V
$V_{(BR)EC}$	Reverse collector-emitter breakdown voltage	I_E = 50 mA -40 ≤ T_j ≤175˚C	20	30	50	V
±$V_{(BR)GES}$	Gate-emitter breakdown voltage	I_G = ± 1 mA	12	15	20	V
$V_{GE(TO)}$	Gate threshold voltage	V_{CE} = V_{GE}; I_C = 1 mA;	2.0	3.5	4.5	V
$V_{GE(TO)}$		T_j = 175 ˚C	1.1	-	-	
I_{CER}	Collector current	V_{CE} = 50 V; R_{GE} = 1 kΩ	-	0.2	10	µA
I_{CER}		T_j = 125 ˚C	-	0.05	1	mA
I_{EC}	Reverse collector current	V_{CE} = -20 V	-	0.2	5	mA
I_{EC}		T_j = 125˚C	-	2	10	mA
I_{GES}	Gate emitter leakage current	V_{GE} = 8.5 V	-	-	1	µA
I_{GES}		T_j =175˚C	-	-	15	µA
V_{CEsat}	Collector-emitter on-state voltage	V_{GE} = 8.5 V; I_C = 8 A -40 ≤ T_j ≤175˚C	-	1.3	1.8	V
V_{CEsat}		V_{GE} = 8.5 V; I_C = 2 A; T_j = 175˚C	-	0.8	1.2	V
V_{CEsat}		V_{GE} = 8.5 V; I_C = 2 A; T_j = -40˚C	-	1.0	1.4	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(CL)CER}$	Collector-emitter clamp voltage	4 A≤ I_C ≤ 8 A; R_G = 1 kΩ; -40 ≤ T_j ≤ 175˚C; Inductive load; see figs. 23,24	400	450	500	V
g_{fe}	Forward transconductance	V_{CE} = 15 V; I_C = 4 A	-	6.5	-	S
C_{ies}	Input capacitance	V_{GE} = 0 V; V_{CE} = 25 V; f = 1 MHz	-	720	900	pF
C_{oes}	Output capacitance		-	90	110	pF
C_{res}	Feedback capacitance		-	22	35	pF
$t_{d\ off}$	Turn-off delay time	I_C = 8 A; V_{CL} = 300 V; R_G = 1 kΩ;	-	5.5	8	µs
t_f	Fall time	V_{GE} = 10 V; T_j = 125˚C;	-	5	8	µs
t_c	Crossover Time	Inductive load (externally clamped)	-	6	-	µs
E_{off}	Turn-off Energy loss	See Figs. 20,21.	-	7	-	mJ

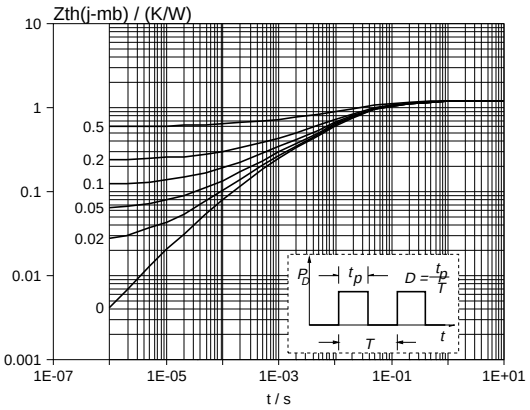


Fig.1. Transient thermal impedance
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

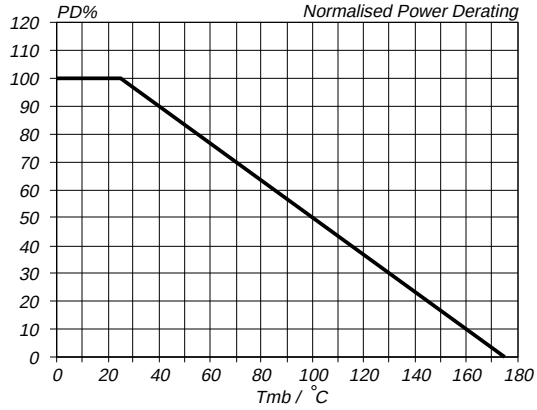


Fig.4. Normalised power dissipation.
PD% = 100.$P_D/P_{D\ 25˚C}$ = f(T_{mb})

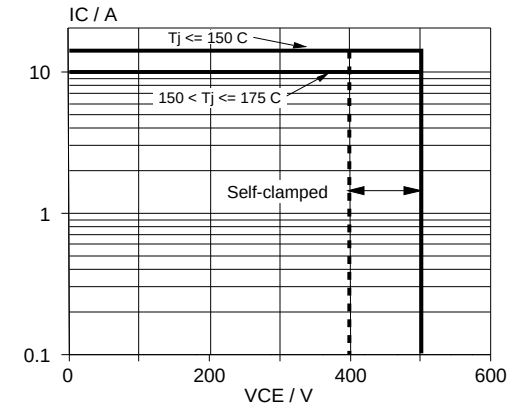


Fig.2. Turn-off safe operating area
conditions: $R_G \geq 1\ k\Omega$

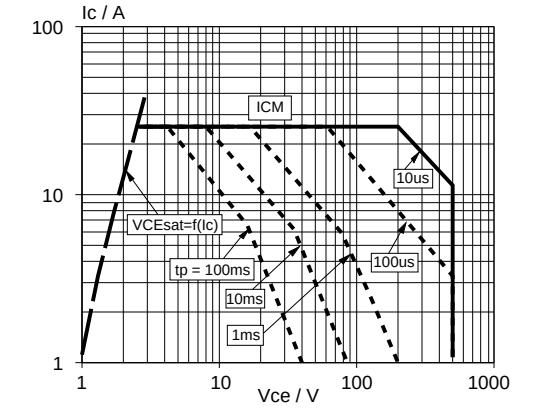


Fig.5. Pulsed on-state safe operating area
(non-repetitive). conditions : $T_{mb} = 125˚C$

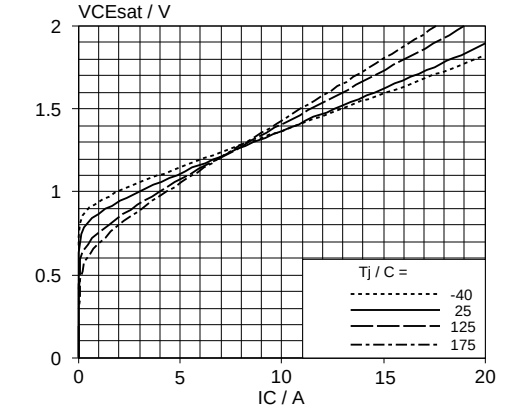


Fig.3. Typical on-state voltage
$V_{CEsat} = f(I_C)$; parameter T_j; conditions: $V_{GE} = 8.5$ V

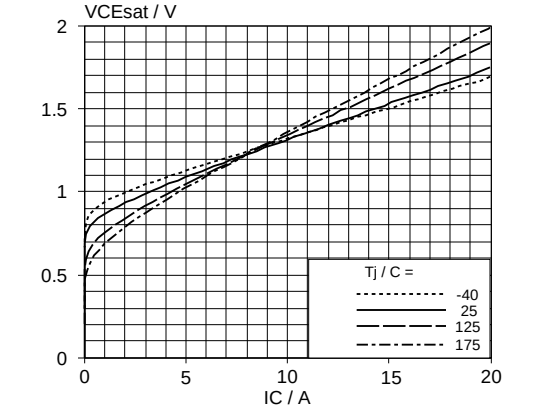


Fig.6. Typical on-state voltage
$V_{CEsat} = f(I_C)$; parameter T_j; conditions: $V_{GE} = 10$ V

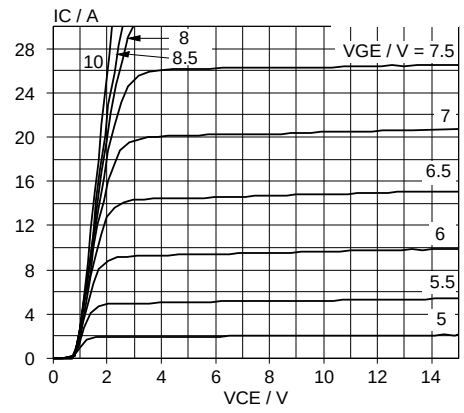


Fig.7. Typical output characteristics
I_C=f(V_{CE}); parameter V_{GE}; conditions: T_j=25˚C

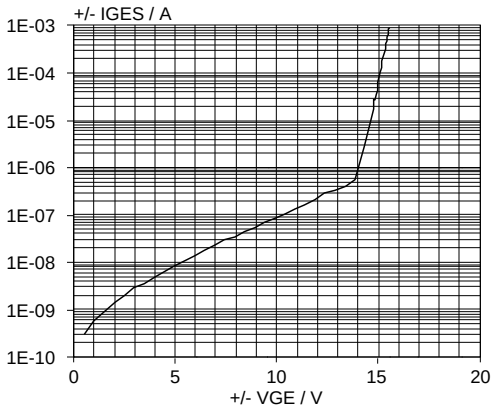


Fig.10. Typical gate-emitter charcteristics
I_{GES} = f(V_{GE}); conditions: V_{CE} = 0 V; T_j = 25˚C

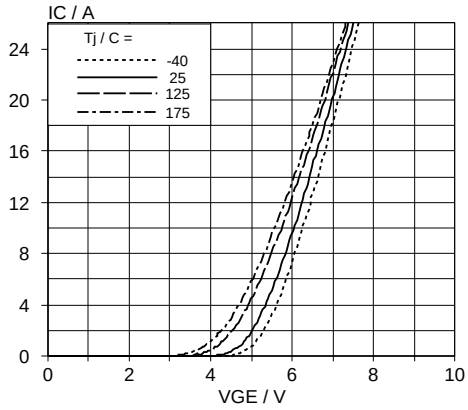


Fig.8. Typical transfer characteristics
I_C = f(V_{GE}), parameter T_j; conditions: V_{CE} = 15 V

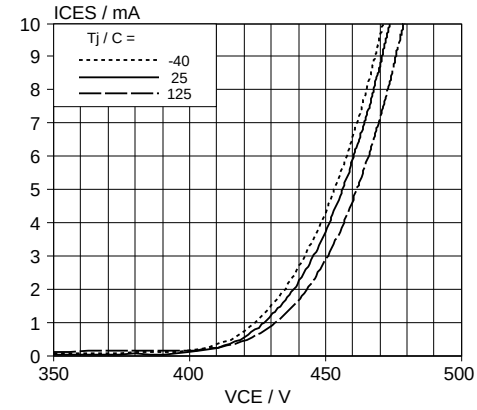


Fig.11. Typical collector clamp characteristics
I_{CES} = f(V_{CE}); parameter T_j; conditions: V_{GE} = 0 V

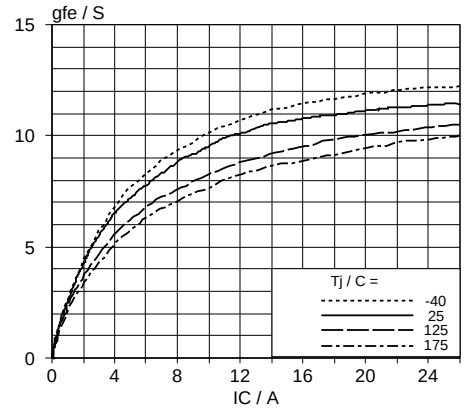


Fig.9. Typical forward transconductance
g_{fe} = f(I_C); parameter T_j; conditions: V_{CE} = 15 V

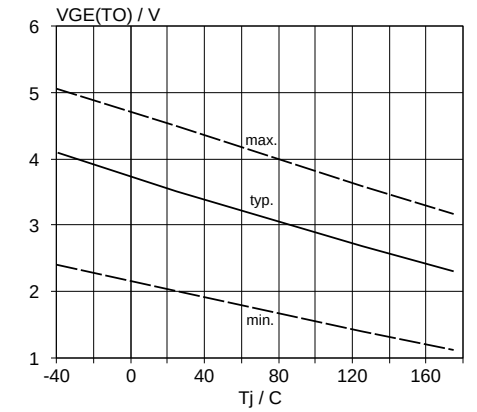


Fig.12. Gate threshold voltage
$V_{GE(TO)}$ = f(T_j); conditions: I_C = 1 mA; V_{CE} = V_{GE}

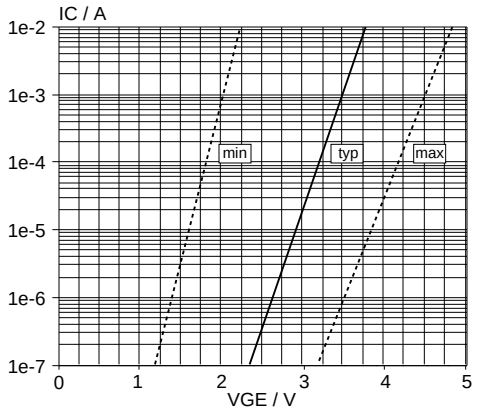


Fig.13. Sub-threshold collector current $I_C = f(V_{GE})$; T_j = 25˚C; $V_{CE} = V_{GE}$

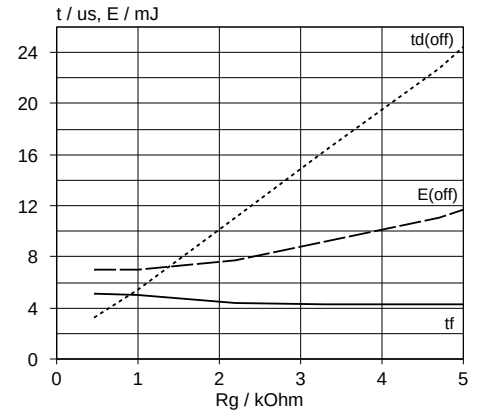


Fig.16. Typical switching characteristics vs. R_G conditions: T_j=125 ˚C; I_C=8 A; V_{CL}=300 V; L_C=5 mH.

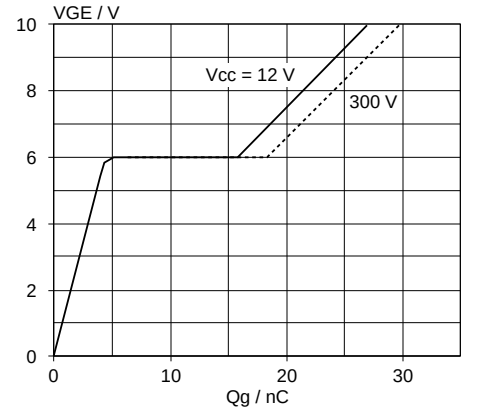


Fig.14. Typical turn-on gate charge characteristics $V_{GE} = f(Q_G)$; conditions: I_C = 8 A.

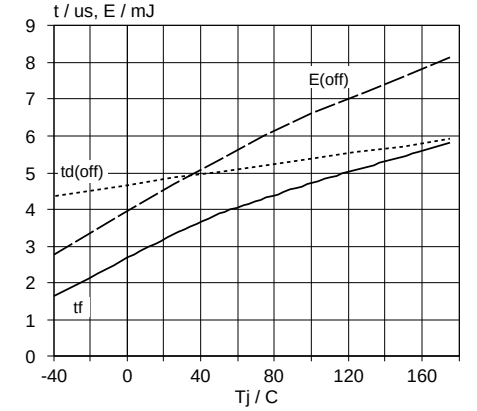


Fig.17. Typical switching characteristics vs. T_j conditions: I_C=8 A; V_{CL}=300 V; R_G=1 kΩ; L_C=5 mH.

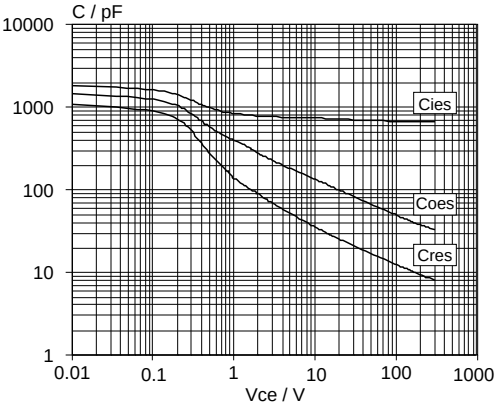


Fig.15. Typical capacitances C_{ies}, C_{oes}, C_{res} C = $f(V_{CE})$; conditions: V_{GE} = 0 V; f = 1 MHz

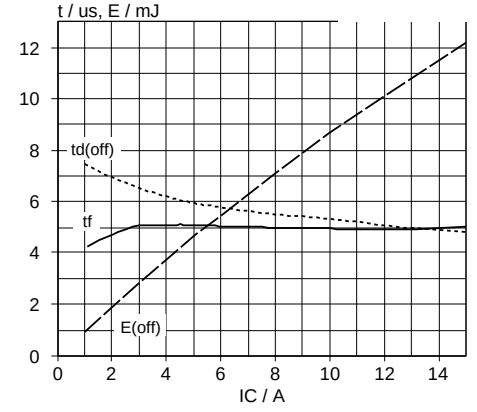


Fig.18. Typical switching characteristics vs. I_C conditions: T_j=125 ˚C V_{CL}=300 V; R_G=1 kΩ; L_C=5 mH.

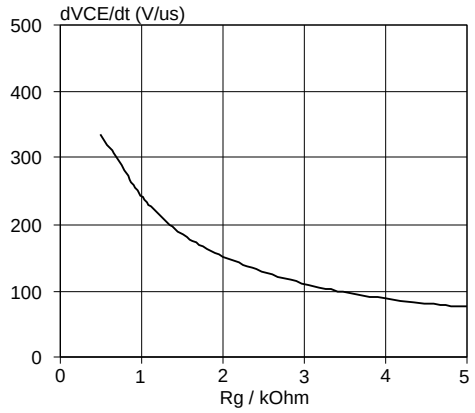


Fig.19. Typical turn-off dV_{CE}/dt vs. R_G. conditions: T_j = 125˚C; I_C = 8 A; V_{CL} = 300 V.

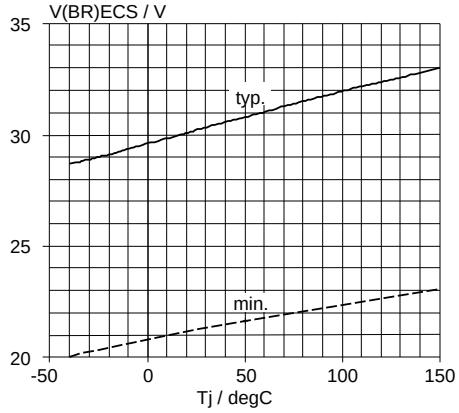


Fig.22. Reverse breakdown voltage $V_{(BR)ECS} = f(T_j)$; conditions: I_{EC} = 50 mA

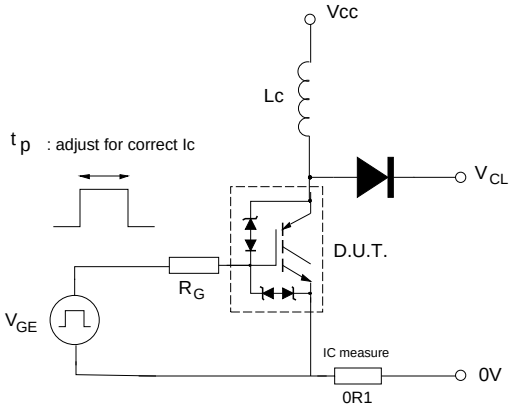


Fig.20. Test circuit for inductive load switching times.

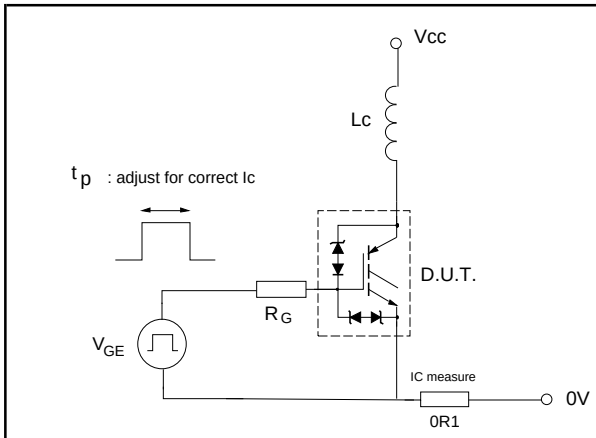


Fig.23. Test circuit for clamped inductive turn-off.

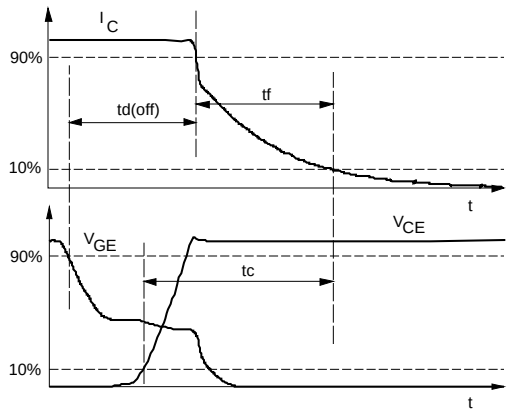


Fig.21. Definitions of inductive load switching times.

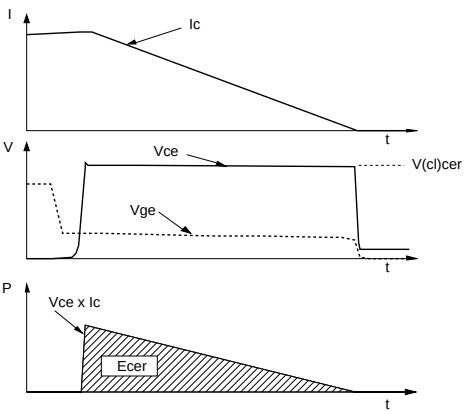


Fig.24. Definition of clamped turn-off energy E_{CER}

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

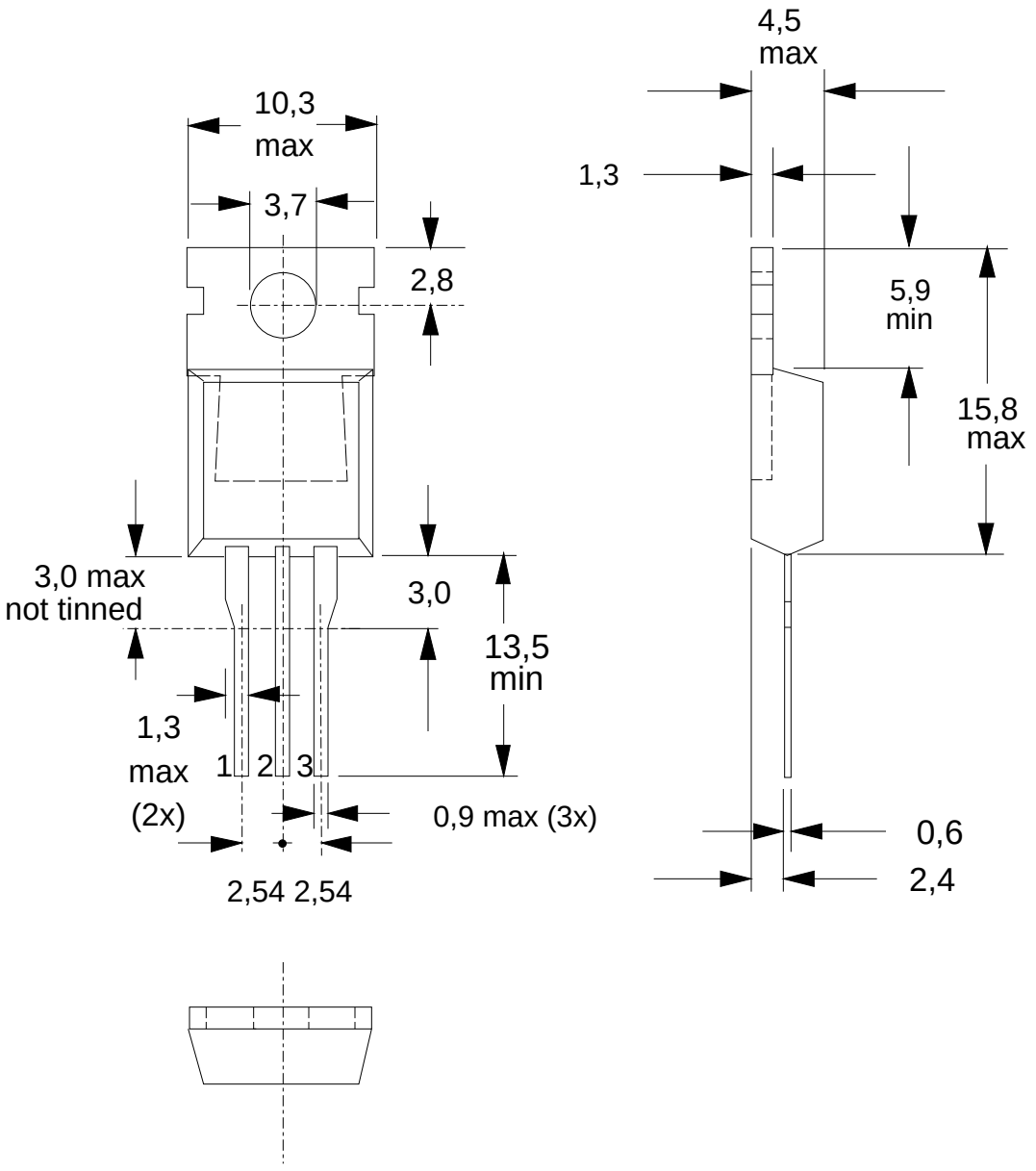


Fig.25. TO220AB; pin 2 connected to mounting base.

Notes

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

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

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