Insulated Gate Bipolar Transistor Protected Logic-Level IGBT

BUK856-400 IZ

GENERAL DESCRIPTION

Protected N-channel logic-level 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.

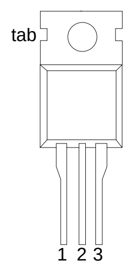
QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
$V_{(CL)CER}$	Collector-emitter clamp voltage	350	400	500	V
V_{CEsat}	Collector-emitter on-state voltage			2.2	V
I_C	Collector current (DC)			20	A
P_{tot}	Total power dissipation			100	W
E_{CERS}	Clamped energy dissipation			300	mJ

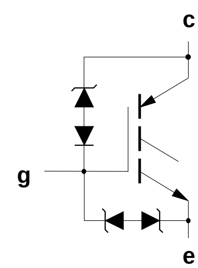
PINNING - TO220AB

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	$t_p \leq 500\ \mu s$	-	500	V
V_{CE}	Collector-emitter voltage	Continuous	-20	50	V
$\pm V_{GE}$	Gate-emitter voltage	-	-	12	V
I_C	Collector current (DC)	$T_{mb} = 100\ ^{\circ}C$	-	10	A
I_C	Collector current (DC)	$T_{mb} = 25\ ^{\circ}C$	-	20	A
I_{CM}	Collector current (pulsed peak value, on-state)	$T_{mb} = 25\ ^{\circ}C$; $t_p \leq 10$ ms; $V_{CE} \leq 15$ V	-	25	A
I_{CLM}	Collector current (clamped inductive load)	$1\ k\Omega \leq R_G \leq 10\ k\Omega$	-	10	A
E_{CERS}	Clamped turn-off energy (non-repetitive)	$T_{mb} = 25\ ^{\circ}C$; $I_C = 10$ A; $R_G = 1\ k\Omega$; see Figs. 23,24	-	300	mJ
E_{CERR}[1]	Clamped turn-off energy (repetitive)	$T_{mb} = 100\ ^{\circ}C$; $I_C = 8$ A; $R_G = 1\ k\Omega$; f = 50 Hz	-	125	mJ
E_{ECR}[1]	Reverse avalanche energy (repetitive)	$I_E = 1$ A; f = 50 Hz	-	5	mJ
P_{tot}	Total power dissipation	$T_{mb} = 25\ ^{\circ}C$	-	125	W
T_{stg}	Storage temperature	-	-55	150	˚C
T_j	Operating Junction Temperature	-	-40	150	˚C

ESD LIMITING VALUE

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

1 This applies to short-term operation in ignition circuits with open-secondary ignition coil.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base		-	1.0	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 ≤150˚C	350	400	500	V
$V_{(BR)EC}$	Reverse collector-emitter breakdown voltage	I_E = 10 mA	20	30	50	V
$\pm V_{(BR)GES}$	Gate-emitter breakdown voltage	I_G = ± 1 mA	12	16	20	V
$V_{GE(TO)}$	Gate threshold voltage	V_{CE} = V_{GE}; I_C = 1 mA	1	1.5	2	V
$V_{GE(TO)}$	Gate threshold voltage	V_{CE} = V_{GE}; I_C = 1 mA; -40 ≤ T_j ≤150˚C	0.6	-	2.4	V
I_{CES}	Zero gate voltage collector current	V_{CE} = 50 V; V_{GE} = 0 V; T_j = 25 ˚C	-	0.01	10	µA
I_{CES}	Zero gate voltage collector current	T_j = 125 ˚C	-	0.01	1	mA
I_{EC}	Reverse collector current	V_{CE} = -20 V	-	0.2	5	mA
I_{EC}	Reverse collector current	V_{CE} = -20 V; T_j = 125˚C	-	2	20	mA
I_{GES}	Gate emitter leakage current	V_{GE} = ±6 V	-	0.1	1	µA
		T_j = 150˚C	-	5	100	µA
V_{CEsat}	Collector-emitter on-state voltage	V_{GE} = 4.5 V; I_C = 8 A	-	1.2	2.2	V
		V_{GE} = 3.5 V; I_C = 6 A; -40 ≤ T_j ≤150˚C	-	1.2	2.2	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(CL)CER}$	Collector-emitter clamp voltage (peak value)	R_G = 1 kΩ; I_C = 10 A; -40 ≤ T_j ≤150˚C; Inductive load; see Figs. 23,24	350	400	500	V
g_{fe}	Forward transconductance	V_{CE} = 15 V; I_C = 4 A	5.5	15	20	S
C_{ies}	Input capacitance	V_{GE} = 0 V; V_{CE} = 25 V; f = 1 MHz	-	940	1200	pF
C_{oes}	Output capacitance		-	95	130	pF
C_{res}	Feedback capacitance		-	30	50	pF
$t_{d\ off}$	Turn-off delay time	I_C = 8 A; V_{CL} = 300 V; R_G = 1 kΩ;	-	13	18	µs
t_f	Fall time	V_{GE} = 5 V; T_j = 125˚C;	-	6	10	µs
t_c	Crossover Time	Inductive load; see Figs. 20,21	-	12	-	µs
E_{off}	Turn-off Energy loss		-	13	-	mJ

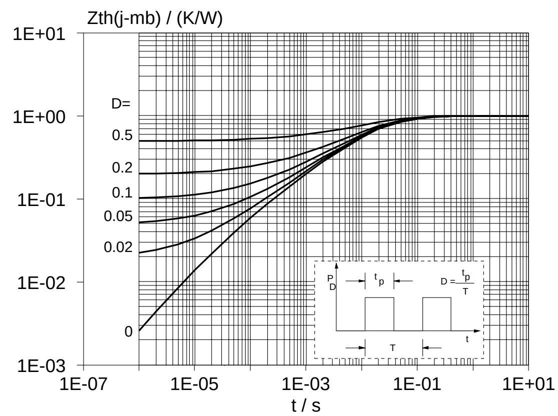


Fig.1. Transient thermal impedance
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

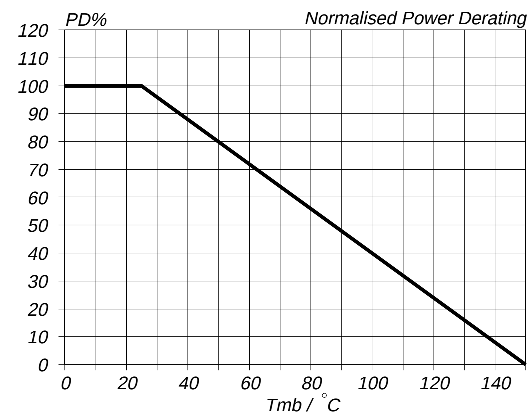


Fig.4. Normalised power dissipation.
$PD\% = 100.P_D/P_{D\ 25^\circ C} = f(T_{mb})$

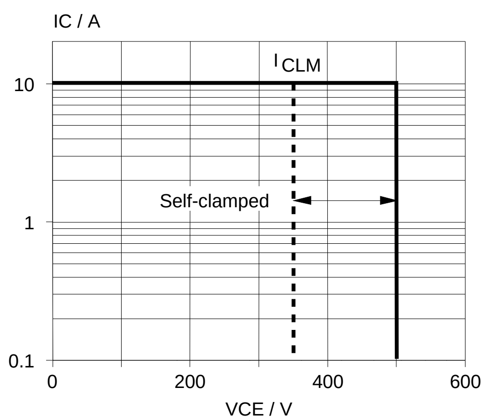


Fig.2. Turn-off Safe Operating Area
conditions: $T_j \leq T_{jmax.}$; $R_G \geq 1$ kΩ

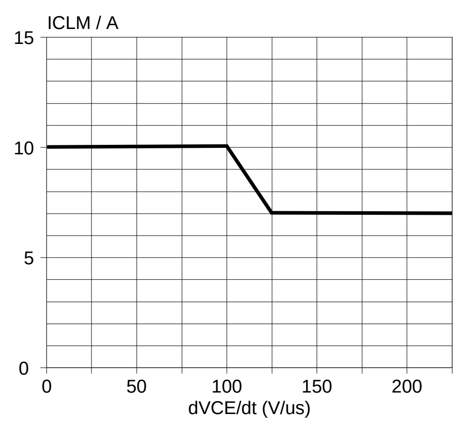


Fig.5. Derating of I_{CLM} with turn-off dV_{CE}/dt
conditions: $V_{CE} \leq 500$ V; $T_j \leq T_{jmax.}$

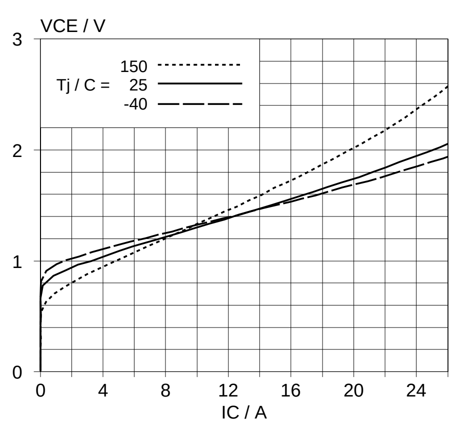


Fig.3. Typical On-state Voltage
$V_{CEsat} = f(I_C)$; parameter T_j; conditions: $V_{GE} = 3.5$ V

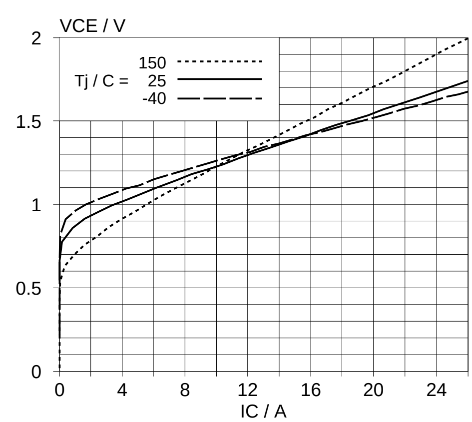


Fig.6. Typical On-state Voltage
$V_{CEsat} = f(I_C)$; parameter T_j; conditions: $V_{GE} = 5$ V

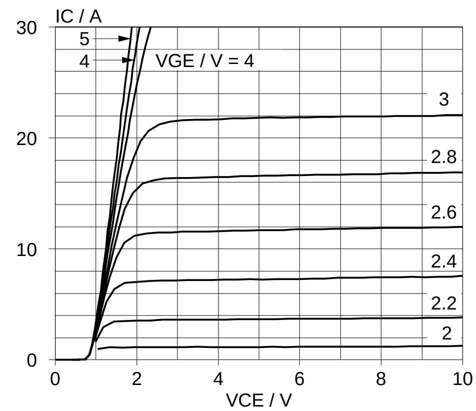


Fig.7. Typical Output Characteristics
$I_C = f(V_{CE})$; parameter V_{GE}; conditions: $T_j = 25˚C$

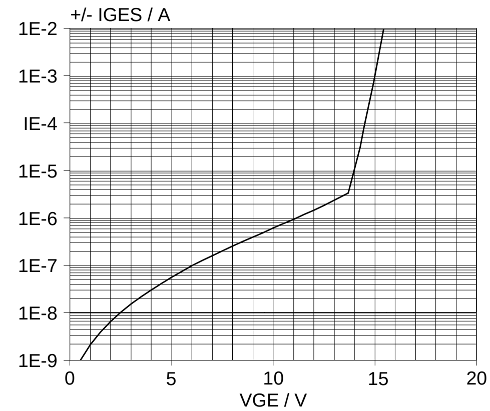


Fig.10. Typical gate-emitter charcteristics
$I_{GES} = f(V_{GE})$; conditions: $V_{CE} = 0\ V$; $T_j = 25˚C$

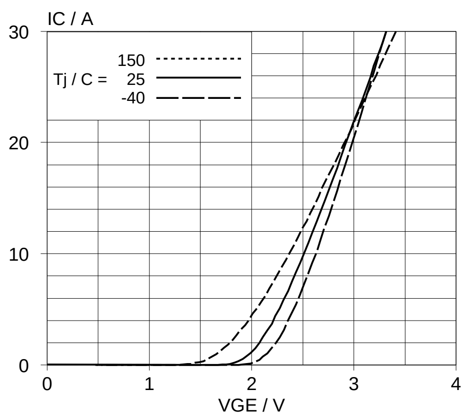


Fig.8. Typical Transfer Characteristics
$I_C = f(V_{GE})$, parameter T_j; conditions: $V_{CE} = 10\ V$

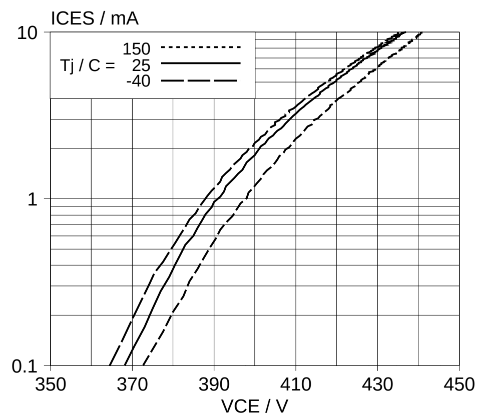


Fig.11. Typical collector clamp characteristics
$I_{CES} = f(V_{CE})$; parameter T_j; conditions: $V_{GE} = 0\ V$

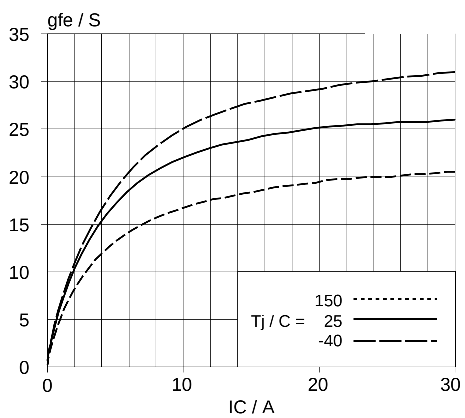


Fig.9. Typical Forward Transconductance
$g_{fe} = f(I_C)$; parameter T_j; conditions: $V_{CE} = 10\ V$

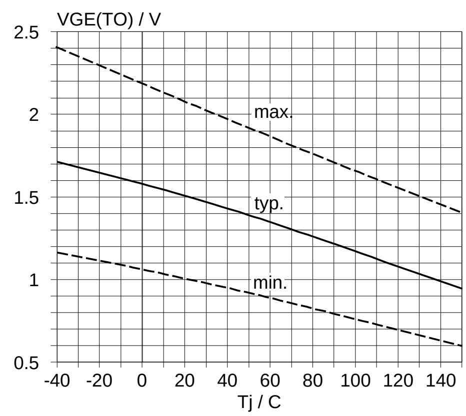


Fig.12. Gate Threshold Voltage
$V_{GE(TO)} = f(T_j)$; conditions: $I_C = 1\ mA$; $V_{CE} = V_{GE}$

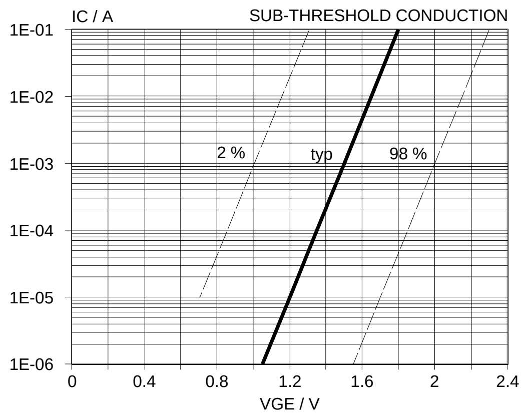


Fig.13. Sub-threshold collector current
$I_C = f(V_{GE})$; $T_j = 25^\circ C$; $V_{CE} = V_{GE}$

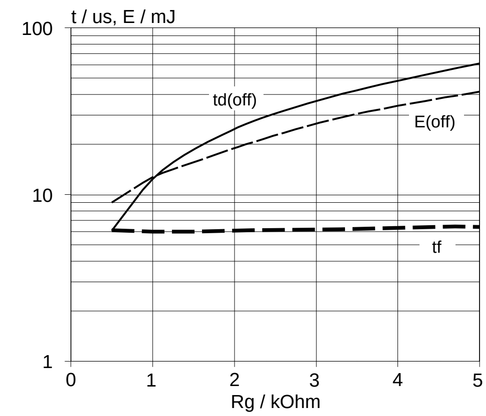


Fig.16. Typical Switching Characteristics vs. R_G
conditions: T_j=125 ˚C; I_C=8 A; V_{CL}=300 V; L_C=5 mH.

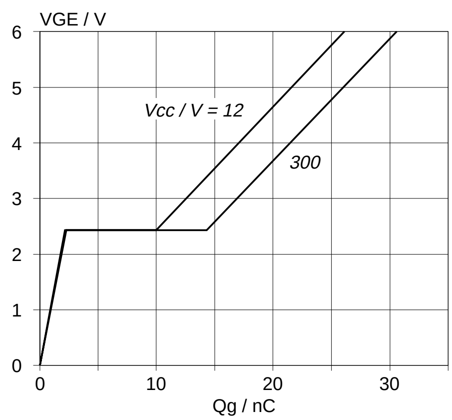


Fig.14. Typical Turn-on Gate Charge Characteristics
$V_{GE} = f(Q_G)$; conditions: I_C = 8 A.

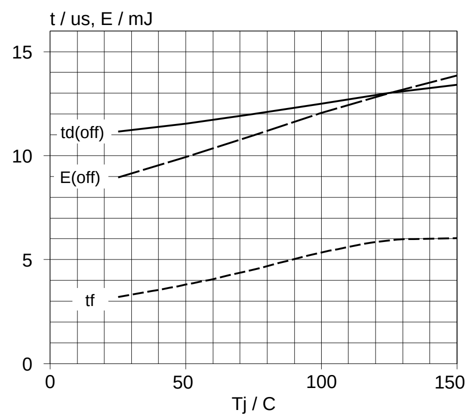


Fig.17. Typical Switching Characteristics vs. T_j
conditions: I_C=8 A; V_{CL}=300 V; R_G=1 kΩ; L_C=5 mH.

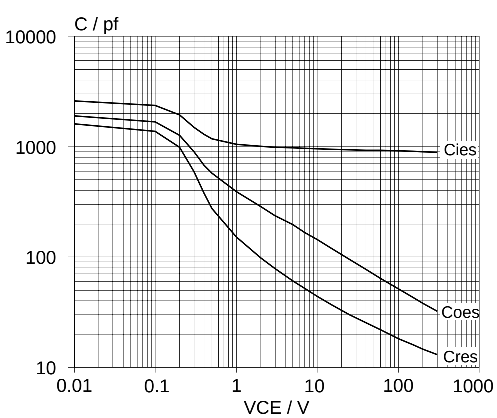


Fig.15. Typical Capacitances C_{ies}, C_{oes}, C_{res}
$C = f(V_{CE})$; conditions: V_{GE} = 0 V; f = 1 MHz

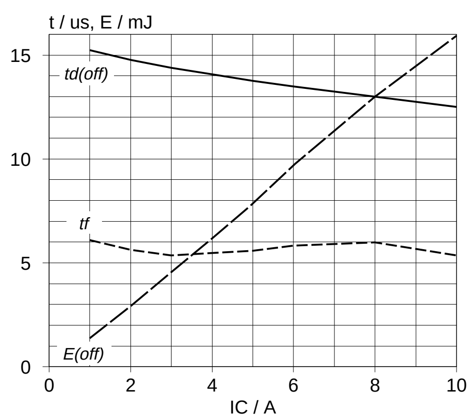


Fig.18. Typical Switching Characteristics vs. I_C
conditions: T_j=125 ˚C V_{CL}=300 V; R_G=1 kΩ; L_C=5 mH.

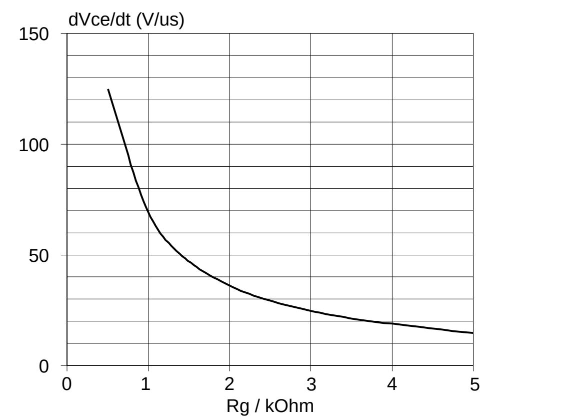


Fig.19. Typical Turn-off dV_{CE}/dt vs. R_G conditions: T_j=125 ˚C; I_C=8 A; V_{CL}=300 V; L_C=5 mH.

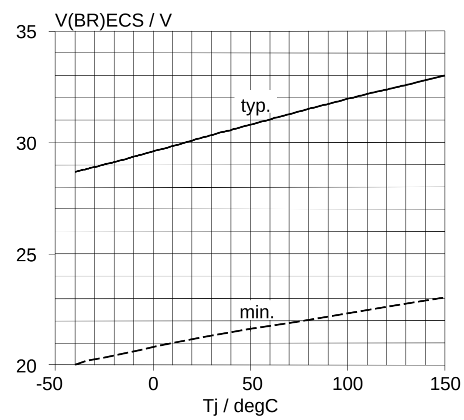


Fig.22. Reverse Breakdown Voltage $V_{(BR)ECS} = f(T_j)$; conditions: I_{EC} = 50 mA

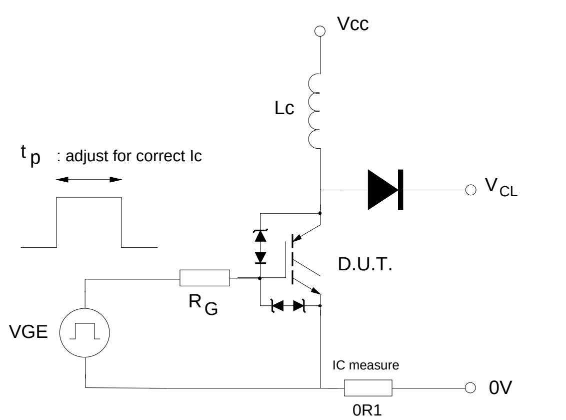


Fig.20. Test circuit for inductive load switching times.

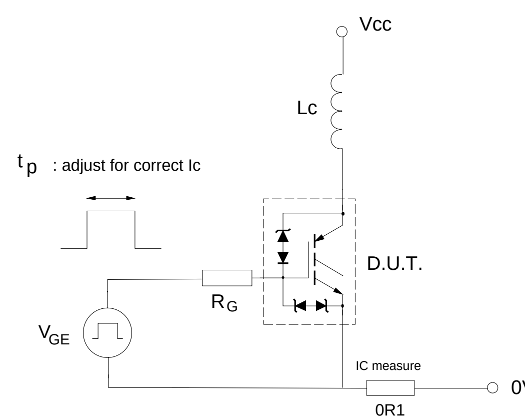


Fig.23. Test circuit for clamped turn-off energy test

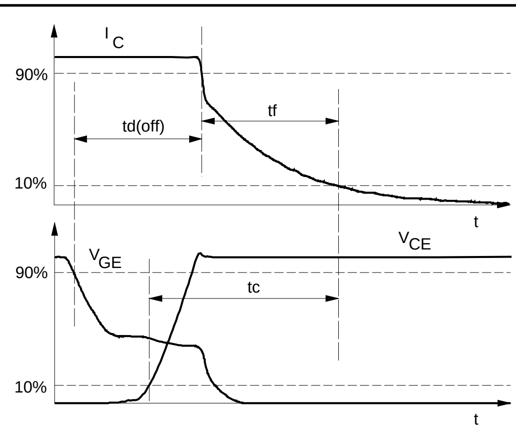


Fig.21. Definitions of inductive load switching times.

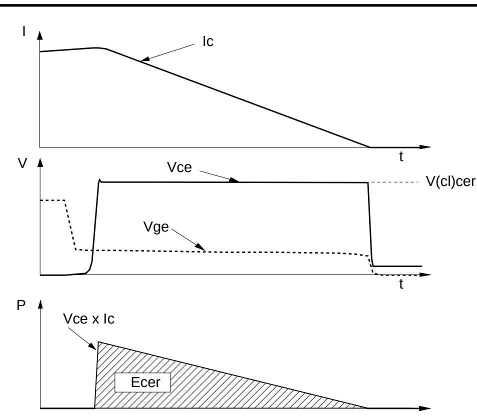


Fig.24. Definition of clamping energy E_{CER}

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

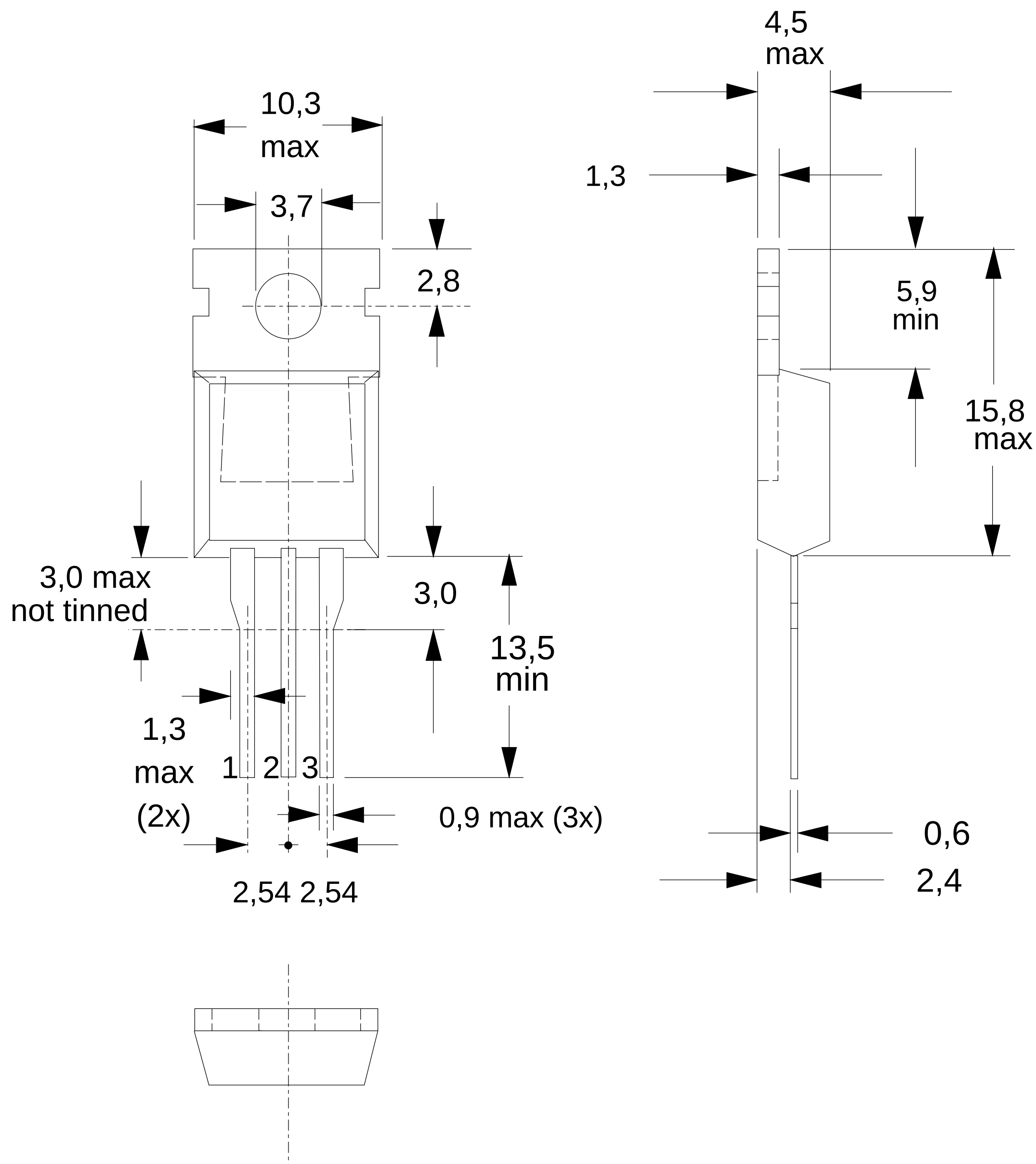


Fig.25. TO220AB; pin 2 connected to mounting base.

Notes
1. Observe the general handling precautions for electrostatic-discharge sensitive devices (ESDs) to prevent damage to MOS gate oxide.
2. 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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