

## Silicon Diffused Power Transistor

## BUT11APX

## GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of colour television receivers. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

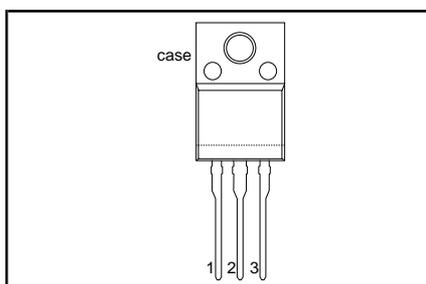
## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$V_{CESM}$	Collector-emitter voltage peak value	$V_{BE} = 0 \text{ V}$	-	1000	V
$V_{CBO}$	Collector-Base voltage (open emitter)		-	1000	V
$V_{CEO}$	Collector-emitter voltage (open base)		-	450	V
$I_C$	Collector current (DC)		-	5	A
$I_{CM}$	Collector current peak value		-	10	A
$P_{tot}$	Total power dissipation	$T_{hs} \leq 25 \text{ }^\circ\text{C}$	-	32	W
$V_{CEsat}$	Collector-emitter saturation voltage		-	1.5	V
$I_{Csat}$	Collector saturation current		3.5	-	A
$t_f$	Fall time	$I_{Csat}=2.5\text{A}, I_{B1}=0.5\text{A}, I_{B2}=0.8\text{A}$	145	160	ns

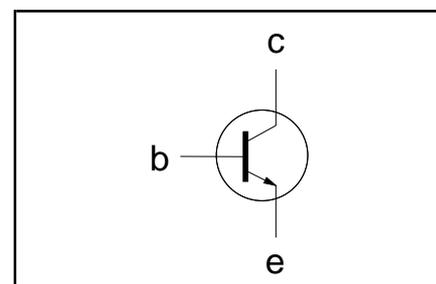
## PINNING - SOT186A

PIN	DESCRIPTION
1	base
2	collector
3	emitter
case	isolated

## PIN CONFIGURATION



## SYMBOL



## LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CESM}$	Collector to emitter voltage	$V_{BE} = 0 \text{ V}$	-	1000	V
$V_{CEO}$	Collector to emitter voltage (open base)		-	450	V
$V_{CBO}$	Collector to base voltage (open emitter)		-	1000	V
$I_C$	Collector current (DC)		-	5	A
$I_{CM}$	Collector current peak value		-	10	A
$I_B$	Base current (DC)		-	2	A
$I_{BM}$	Base current peak value		-	4	A
$P_{tot}$	Total power dissipation	$T_{hs} \leq 25 \text{ }^\circ\text{C}$	-	32	W
$T_{stg}$	Storage temperature		-65	150	$^\circ\text{C}$
$T_j$	Junction temperature		-	150	$^\circ\text{C}$

## THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	3.95	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	55	-	K/W

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**ISOLATION LIMITING VALUE & CHARACTERISTIC** $T_{hs} = 25\text{ °C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{isol}$	R.M.S. isolation voltage from all three terminals to external heatsink	$f = 50\text{-}60\text{ Hz}$ ; sinusoidal waveform; $R.H. \leq 65\%$ ; clean and dustfree	-		2500	V
$C_{isol}$	Capacitance from T2 to external heatsink	$f = 1\text{ MHz}$	-	10	-	pF

**STATIC CHARACTERISTICS** $T_{hs} = 25\text{ °C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$I_{CES}$	Collector cut-off current <sup>1</sup>	$V_{BE} = 0\text{ V}$ ; $V_{CE} = V_{CESMmax}$	-	-	1.0	mA
$I_{CES}$		$V_{BE} = 0\text{ V}$ ; $V_{CE} = V_{CESMmax}$ $T_j = 125\text{ °C}$	-	-	2.0	mA
$I_{EBO}$	Emitter cut-off current	$V_{EB} = 9\text{ V}$ ; $I_C = 0\text{ A}$	-	-	10	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	$I_B = 0\text{ A}$ ; $I_C = 100\text{ mA}$ ; $L = 25\text{ mH}$	450	-	-	V
$V_{CEsat}$	Collector-emitter saturation voltages	$I_C = 3.0\text{ A}$ ; $I_B = 0.6\text{ A}$	-	0.25	1.5	V
$V_{BEsat}$	Base-emitter saturation voltage	$I_C = 2.5\text{ A}$ ; $I_B = 0.33\text{ A}$	-	-	1.3	V
$h_{FE}$	DC current gain	$I_C = 5\text{ mA}$ ; $V_{CE} = 5\text{ V}$	10	22	35	
$h_{FE}$		$I_C = 500\text{ mA}$ ; $V_{CE} = 5\text{ V}$	14	25	35	
$h_{FEsat}$		$I_C = 2.5\text{ A}$ ; $V_{CE} = 5\text{ V}$	10	13.5	17	
$h_{FEsat}$		$I_C = 3.5\text{ A}$ ; $V_{CE} = 5\text{ V}$	8	10	12	

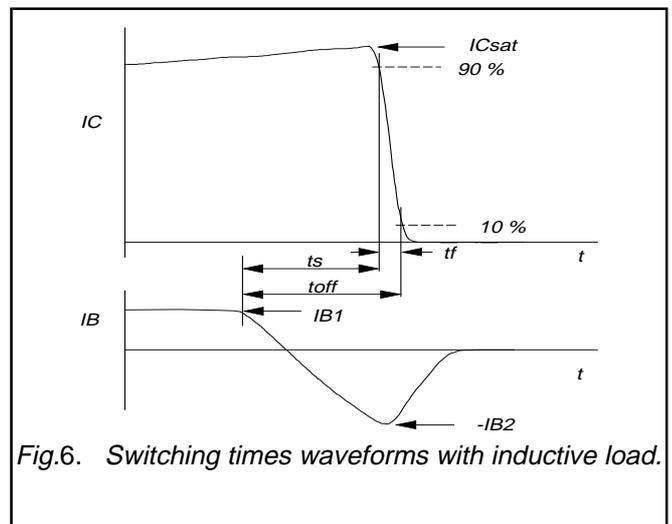
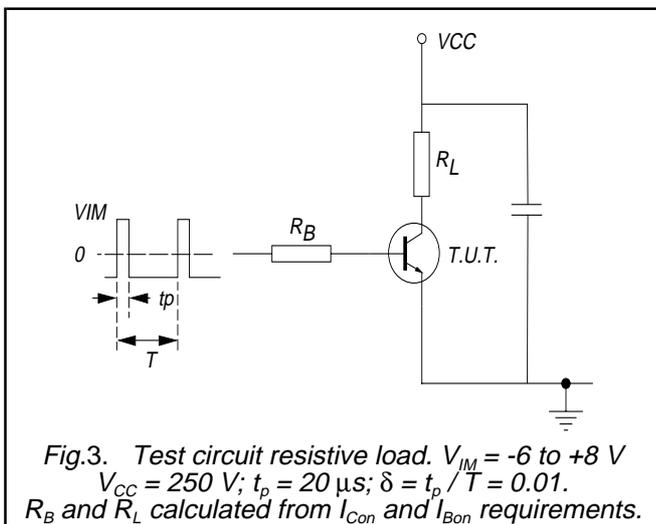
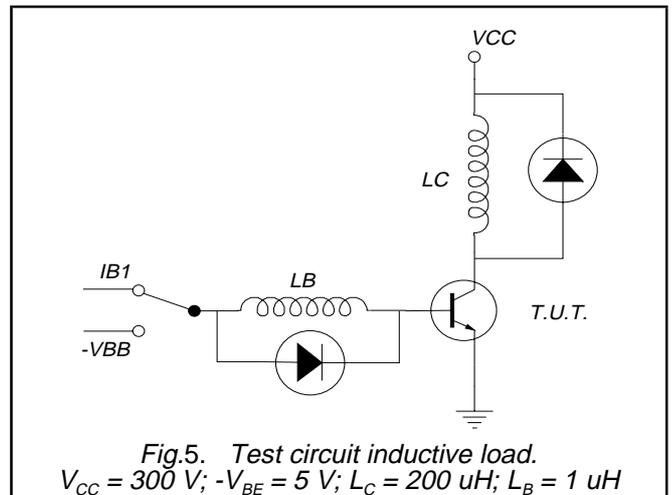
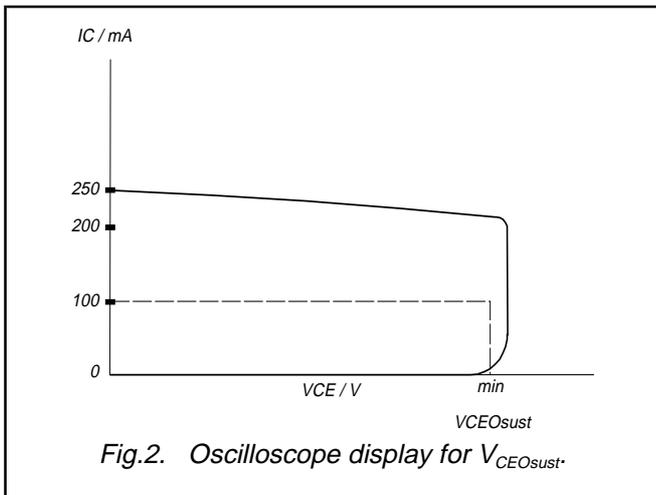
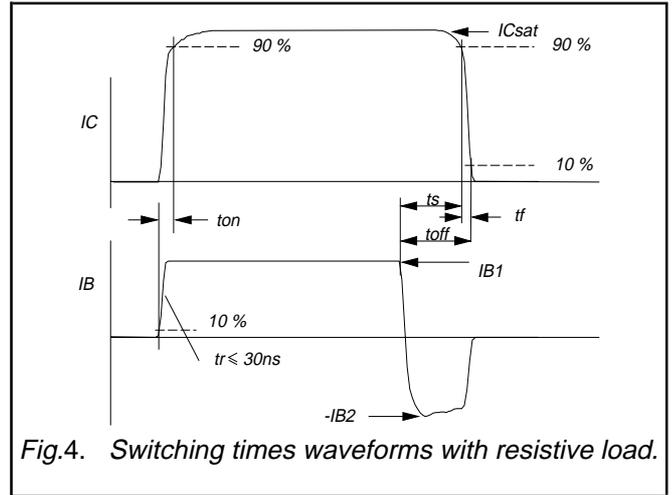
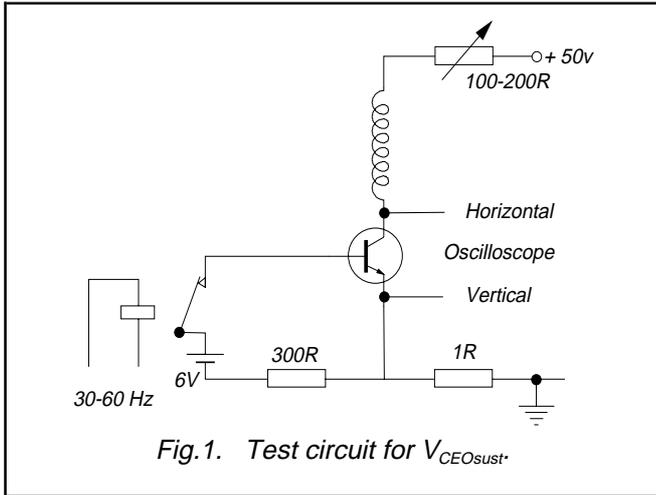
**DYNAMIC CHARACTERISTICS** $T_{hs} = 25\text{ °C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$t_{on}$	Switching times (resistive load)	$I_{Csat} = 2.5\text{ A}$ ; $I_{B1} = -I_{B2} = 0.5\text{ A}$ ; $R_L = 75\text{ ohms}$ ; $V_{BB2} = 4\text{ V}$ ;			
$t_s$	Turn-on time		0.5	0.7	$\mu\text{s}$
$t_s$	Turn-off storage time		3.3	4	$\mu\text{s}$
$t_f$	Turn-off fall time		0.33	0.45	$\mu\text{s}$
$t_s$	Switching times (inductive load)	$I_{Csat} = 2.5\text{ A}$ ; $I_{B1} = 0.5\text{ A}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $-V_{BB} = 5\text{ V}$			
$t_s$	Turn-off storage time		1.4	1.6	$\mu\text{s}$
$t_f$	Turn-off fall time		145	160	ns
$t_s$	Switching times (inductive load)	$I_{Csat} = 2.5\text{ A}$ ; $I_{B1} = 0.5\text{ A}$ ; $L_B = 1\text{ }\mu\text{H}$ ; $-V_{BB} = 5\text{ V}$ ; $T_j = 100\text{ °C}$			
$t_s$	Turn-off storage time		1.7	1.9	$\mu\text{s}$
$t_f$	Turn-off fall time		160	200	ns

<sup>1</sup> Measured with half sine-wave voltage (curve tracer).

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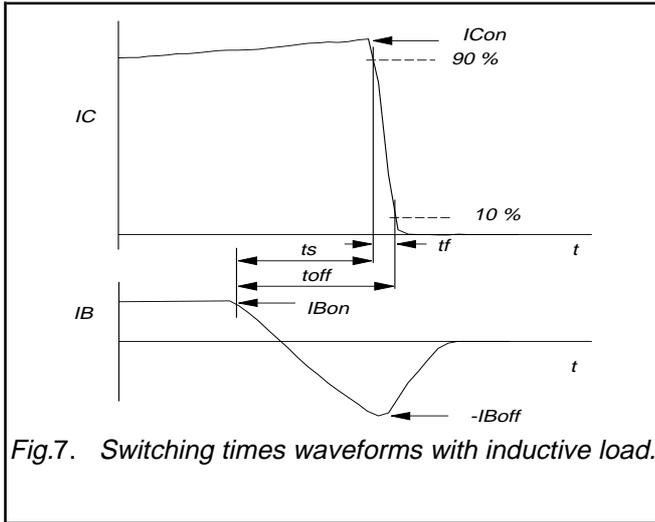


Fig.7. Switching times waveforms with inductive load.

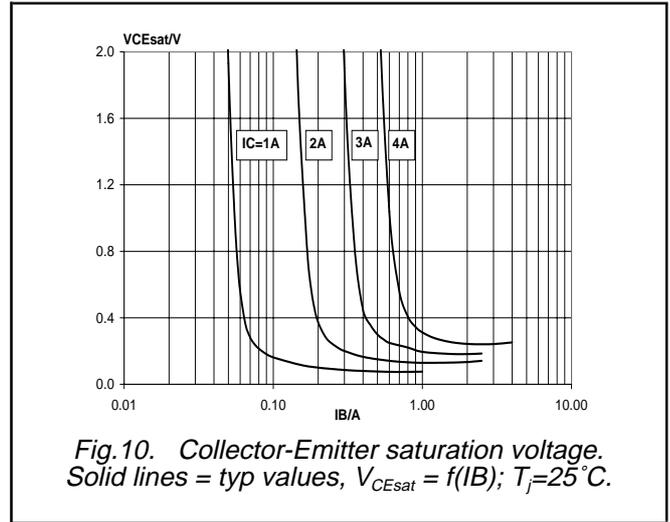


Fig.10. Collector-Emitter saturation voltage. Solid lines = typ values,  $V_{CEsat} = f(I_B)$ ;  $T_j=25^\circ\text{C}$ .

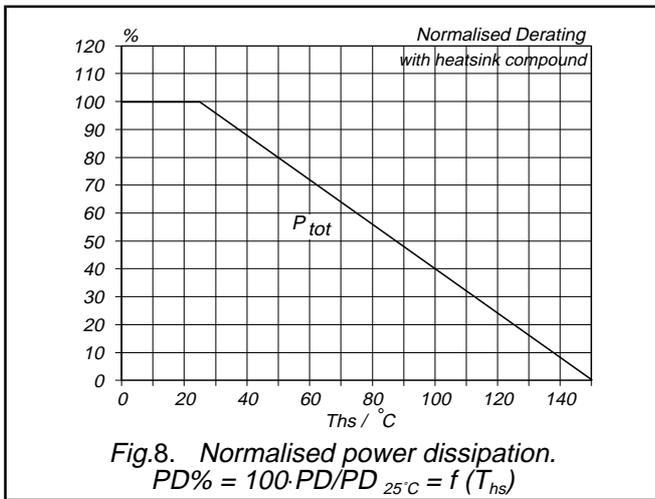


Fig.8. Normalised power dissipation.  $PD\% = 100 - PD/PD_{25^\circ\text{C}} = f(T_{hs})$

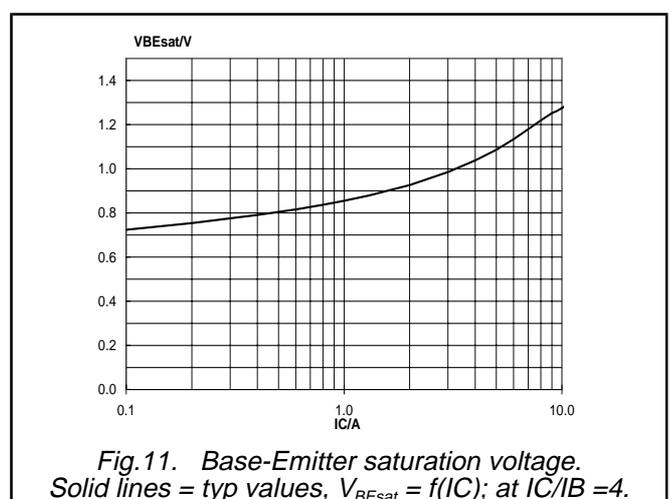


Fig.11. Base-Emitter saturation voltage. Solid lines = typ values,  $V_{BEsat} = f(I_C)$ ; at  $I_C/I_B = 4$ .

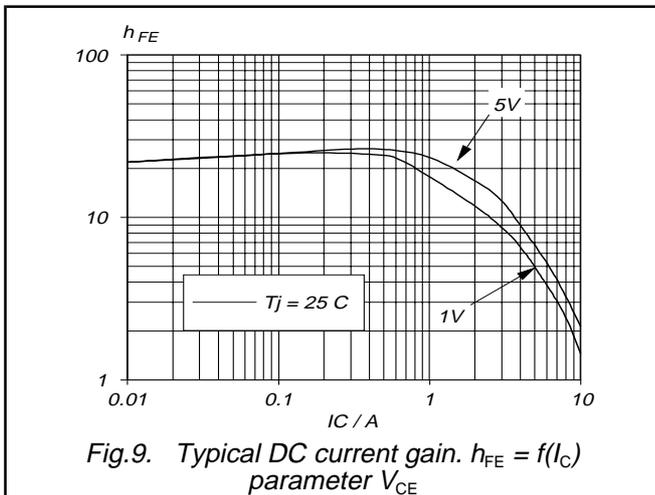


Fig.9. Typical DC current gain.  $h_{FE} = f(I_C)$  parameter  $V_{CE}$

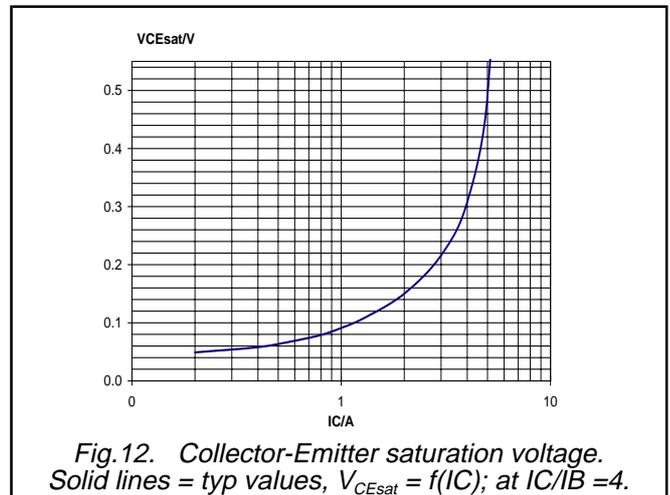
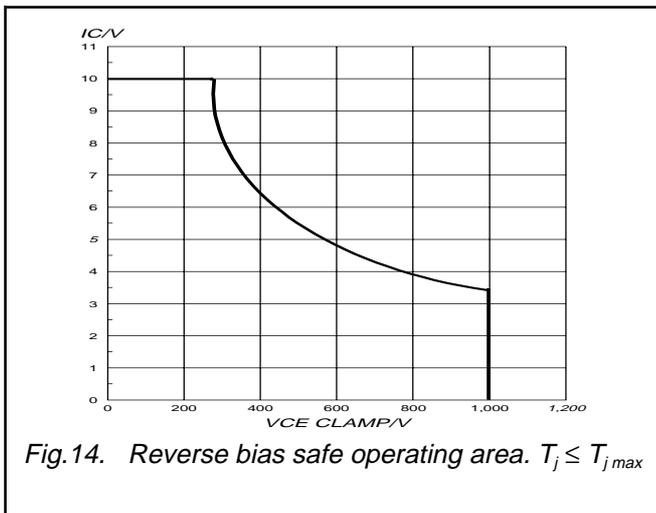
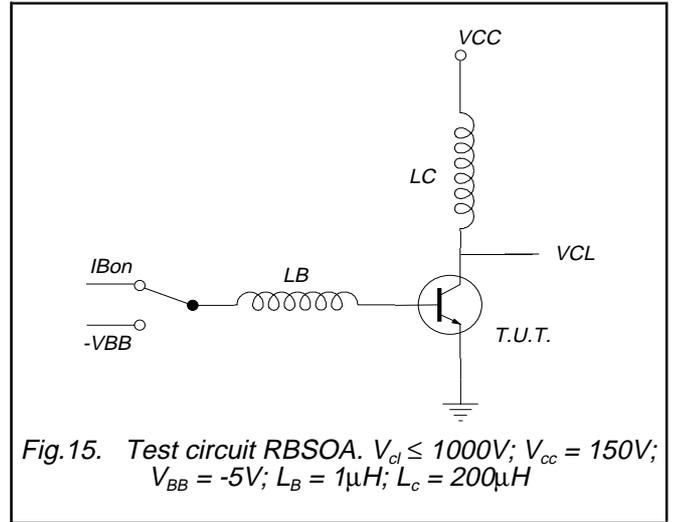
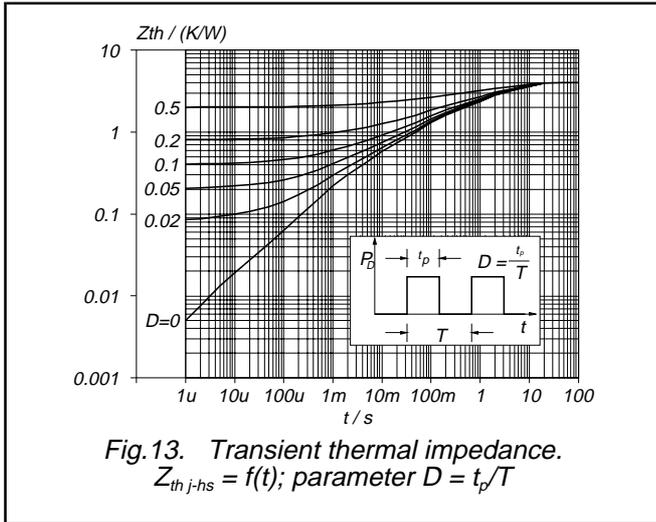


Fig.12. Collector-Emitter saturation voltage. Solid lines = typ values,  $V_{CEsat} = f(I_C)$ ; at  $I_C/I_B = 4$ .

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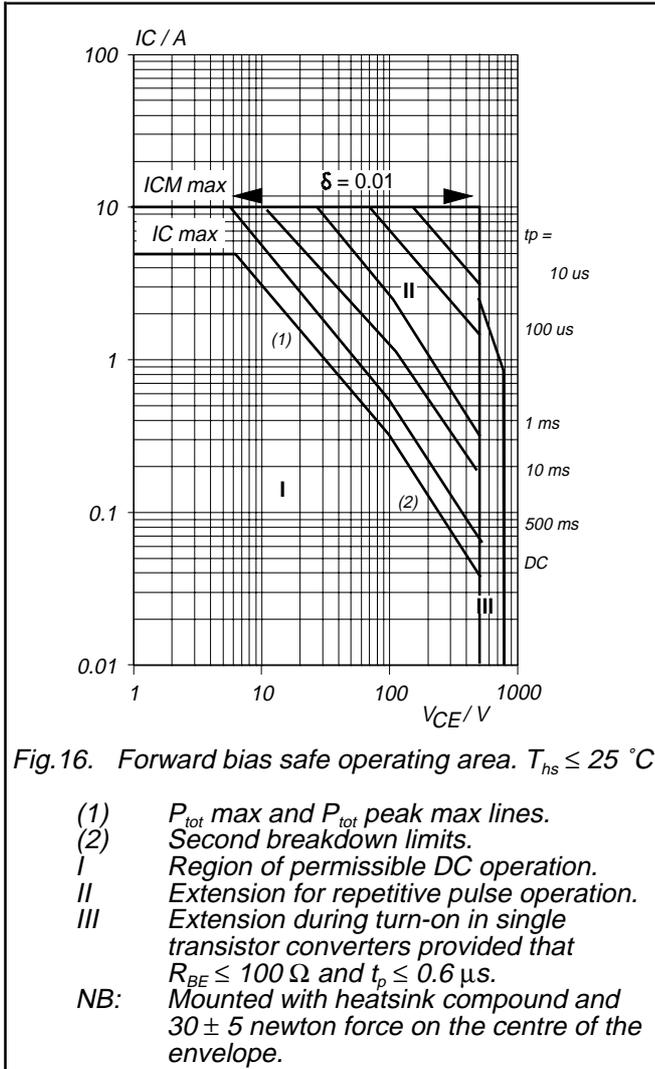


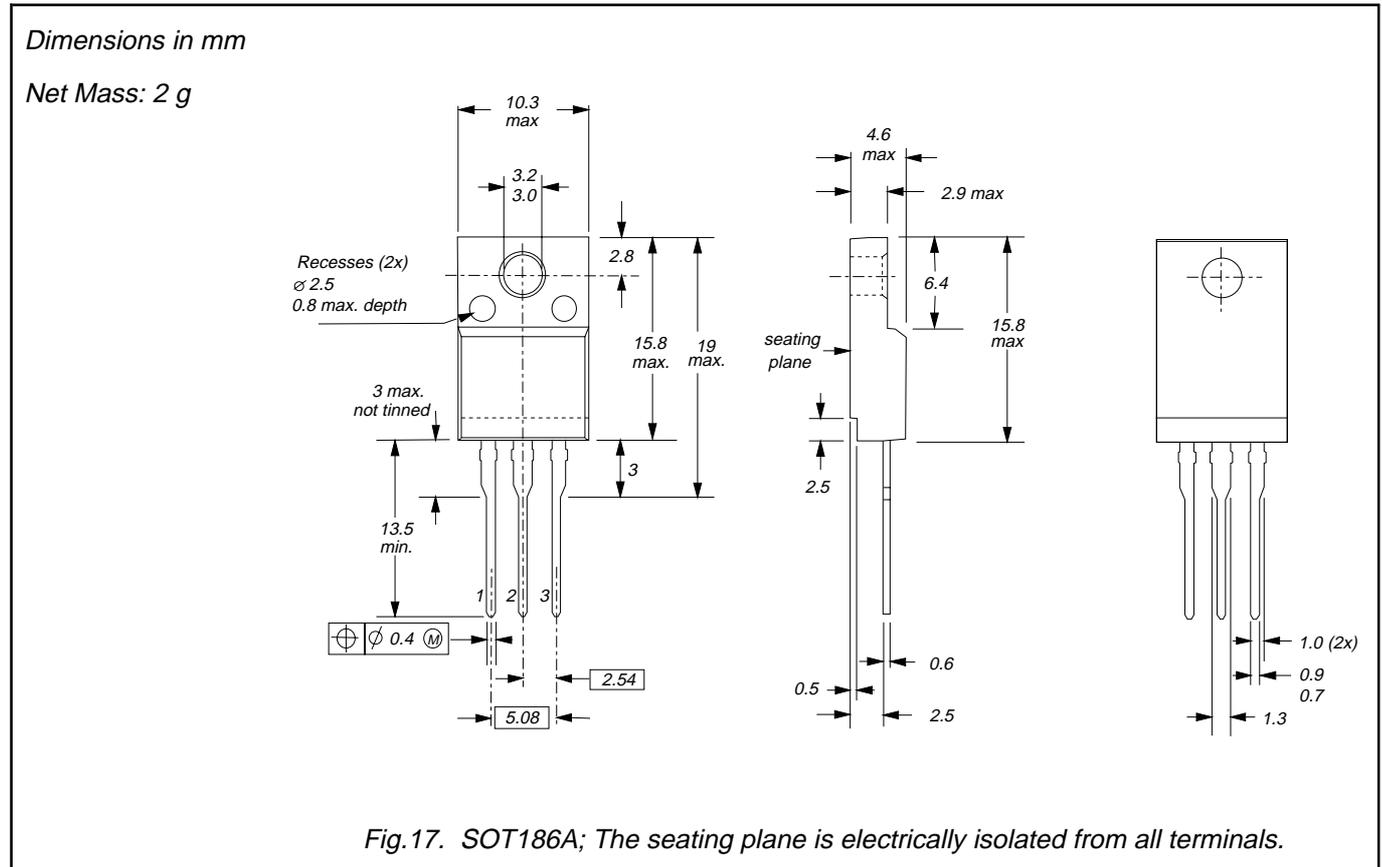
Fig. 16. Forward bias safe operating area.  $T_{hs} \leq 25\ ^\circ C$

- (1)  $P_{tot\ max}$  and  $P_{tot\ peak\ max}$  lines.
  - (2) Second breakdown limits.
  - I Region of permissible DC operation.
  - II Extension for repetitive pulse operation.
  - III Extension during turn-on in single transistor converters provided that  $R_{BE} \leq 100\ \Omega$  and  $t_p \leq 0.6\ \mu s$ .
- NB: Mounted with heatsink compound and  $30 \pm 5$  newton force on the centre of the envelope.

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**MECHANICAL DATA**



**Notes**

1. Refer to mounting instructions for F-pack envelopes.
2. Epoxy meets UL94 V0 at 1/8".

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**DEFINITIONS**

<b>Data sheet status</b>	
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.
<b>Limiting values</b>	
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.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	
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