

## Silicon Diffused Power Transistor

BUT11F

## GENERAL DESCRIPTION

High-voltage, high-speed glass-passivated npn power transistor in a SOT186 envelope with electrically insulated mounting base, intended for use in converters, inverters, switching regulators, motor control systems, etc.

## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$V_{CESM}$	Collector-emitter voltage peak value	$V_{BE} = 0 \text{ V}$	-	850	V
$V_{CEO}$	Collector-emitter voltage (open base)		-	400	V
$I_C$	Collector current (DC)	$T_{hs} \leq 25 \text{ }^\circ\text{C}$	-	5	A
$I_{CM}$	Collector current peak value		-	10	A
$P_{tot}$	Total power dissipation		-	20	W
$V_{CESat}$	Collector-emitter saturation voltage		-	1.5	V
$I_{Csat}$	Collector saturation current		-	3	A
$t_f$	Fall time		-	800	ns

## [INCLUDE]

## LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CESM}$	Collector-emitter voltage peak value	$V_{BE} = 0 \text{ V}$	-	850	V
$V_{CEO}$	Collector-emitter voltage (open base)		-	450	V
$I_C$	Collector current (DC)	$T_{hs} \leq 25 \text{ }^\circ\text{C}$	-	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		-	20	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

## ISOLATION LIMITING VALUE &amp; CHARACTERISTIC

$T_{hs} = 25 \text{ }^\circ\text{C}$  unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{isol}$	Repetitive peak voltage from all three terminals to external heatsink	R.H. $\leq 65\%$ ; clean and dustfree	-		1500	V
$C_{isol}$	Capacitance from T2 to external heatsink	$f = 1 \text{ MHz}$	-	12	-	pF

Silicon Diffused Power Transistor

BUT11F

**STATIC CHARACTERISTICS**

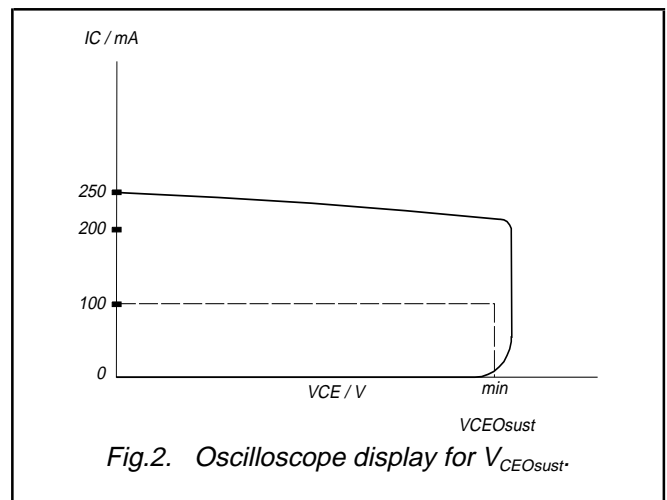
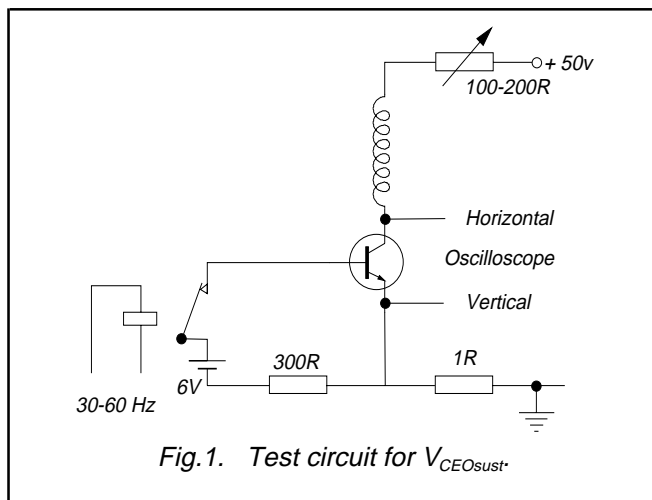
$T_{hs} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified

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
$I_{CES}$		$V_{BE} = 0\text{ V}; V_{CE} = V_{CESMmax}$ $T_j = 125\text{ }^{\circ}\text{C}$	-	-	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	$I_C = 3.0\text{ A}; I_B = 0.6\text{ A}$	-	-	1.5	V
$V_{BEsat}$	Base-emitter saturation voltage	$I_C = 3.0\text{ A}; I_B = 0.6\text{ A}$	-	-	1.3	V
$h_{FE}$	DC current gain	$I_C = 5\text{ mA}; V_{CE} = 5\text{ V}$	10	18	35	
$h_{FE}$		$I_C = 500\text{ mA}; V_{CE} = 5\text{ V}$	10	20	35	

**DYNAMIC CHARACTERISTICS**

$T_{hs} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified

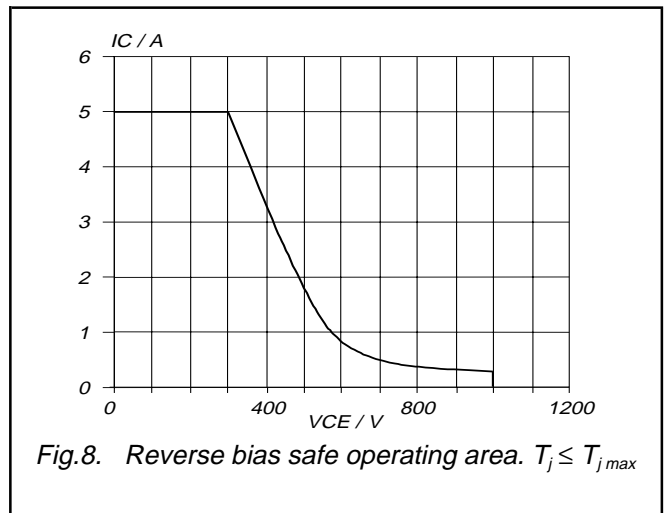
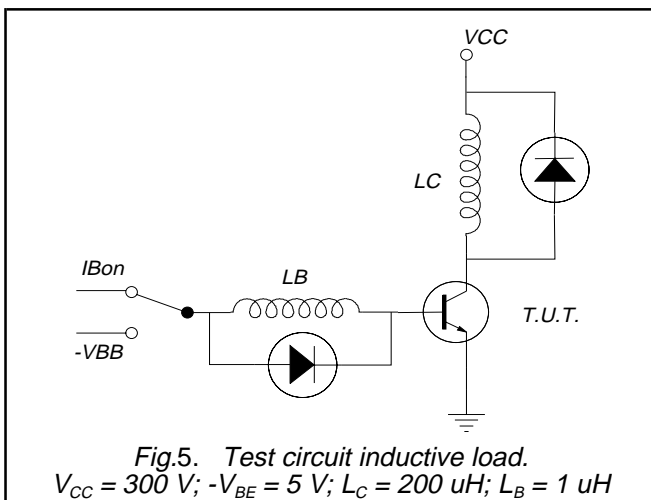
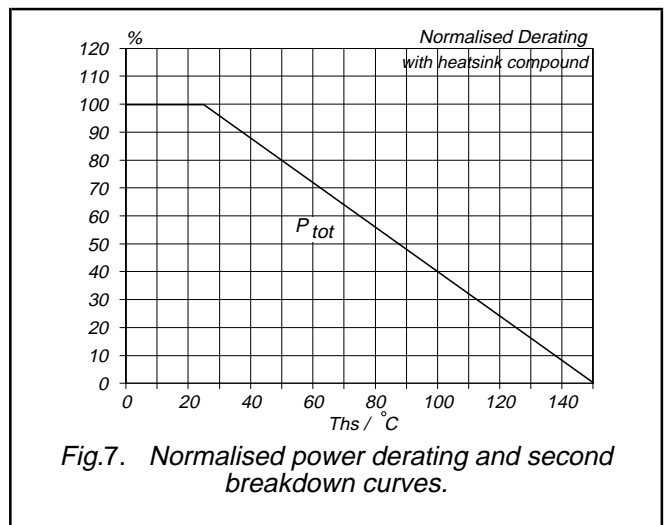
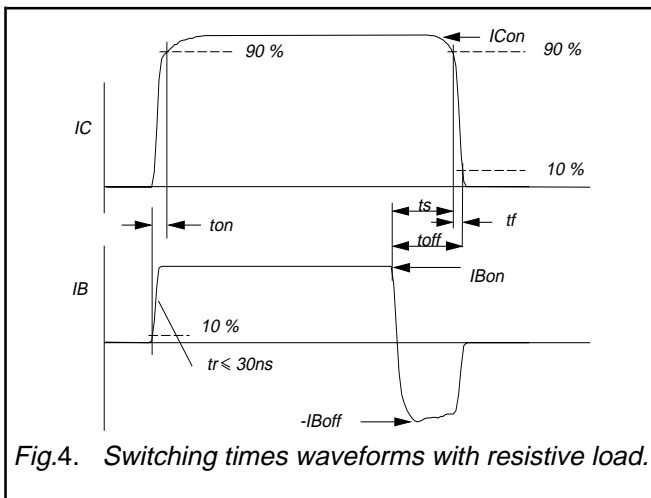
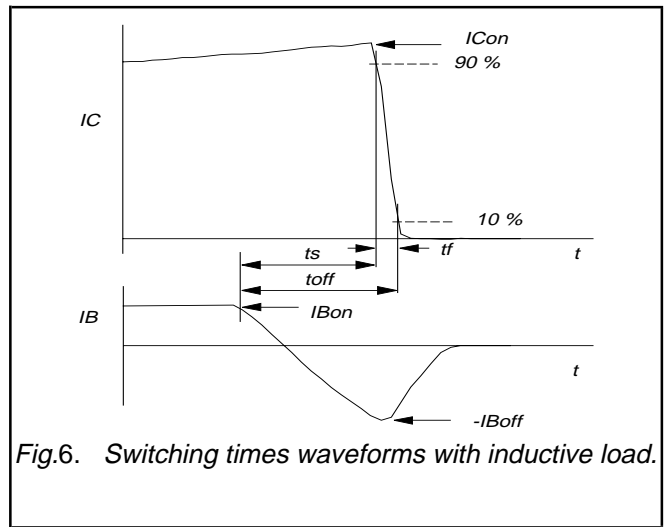
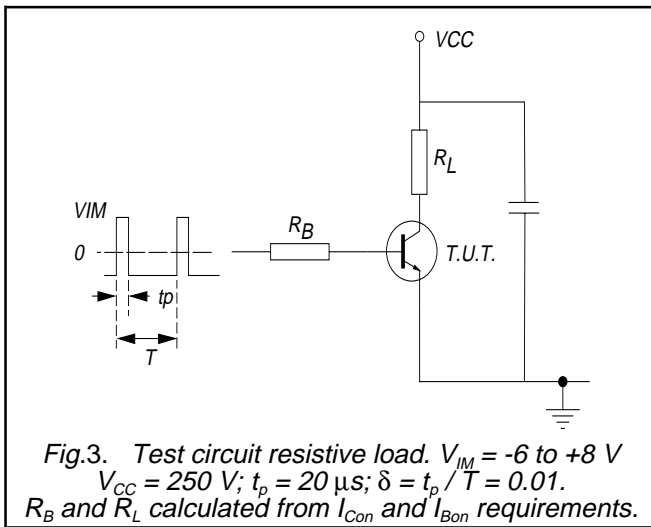
SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$t_{on}$	Switching times (resistive load)	$I_{Con} = 2.5\text{ A}; I_{Bon} = -I_{Boff} = 0.5\text{ A}$	-	1	$\mu\text{s}$
$t_s$	Turn-on time		-	4	$\mu\text{s}$
$t_s$	Turn-off storage time		-	0.8	$\mu\text{s}$
$t_f$	Turn-off fall time		-		$\mu\text{s}$
$t_s$	Switching times (inductive load)	$I_{Con} = 2.5\text{ A}; I_{Bon} = 0.5\text{ A}; L_B = 1\text{ }\mu\text{H};$ $-V_{BB} = 5\text{ V}$	1.1	1.4	$\mu\text{s}$
$t_s$	Turn-off storage time		80	150	ns
$t_s$	Switching times (inductive load)	$I_{Con} = 2.5\text{ A}; I_{Bon} = 0.5\text{ A}; L_B = 1\text{ }\mu\text{H};$ $-V_{BB} = 5\text{ V}; T_j = 100\text{ }^{\circ}\text{C}$	1.2	1.5	$\mu\text{s}$
$t_s$	Turn-off storage time		140	300	ns
$t_f$	Turn-off fall time				ns



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

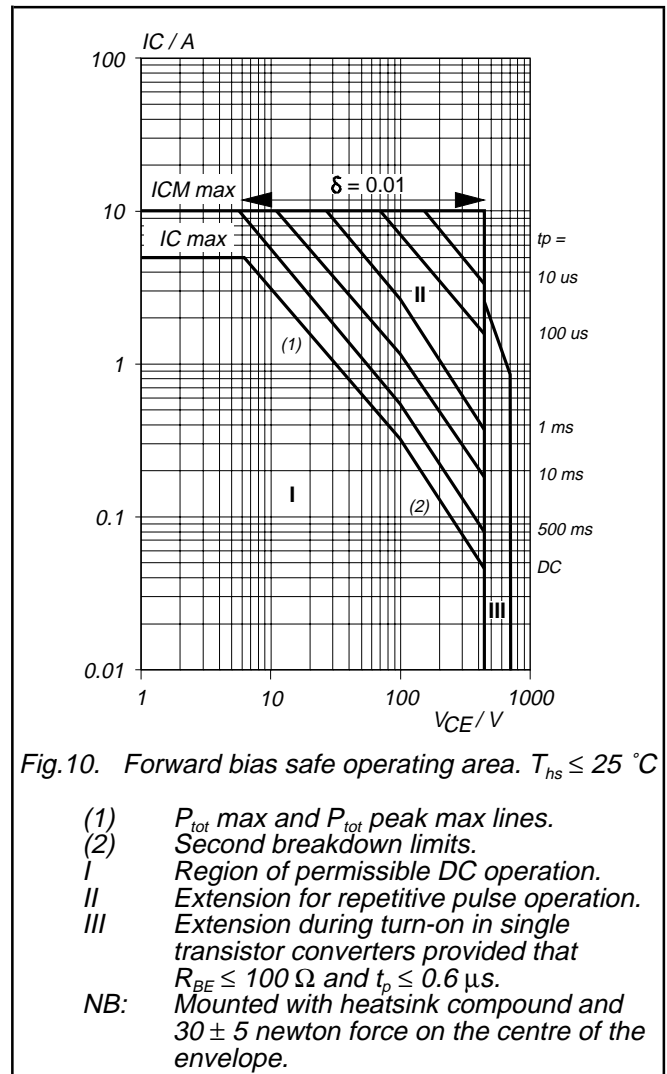
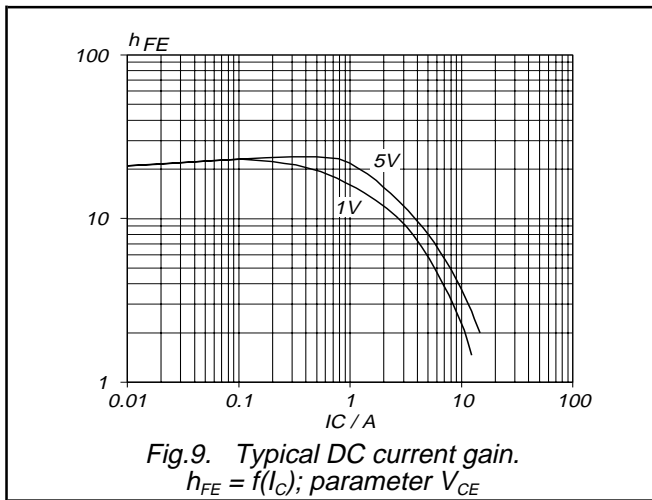
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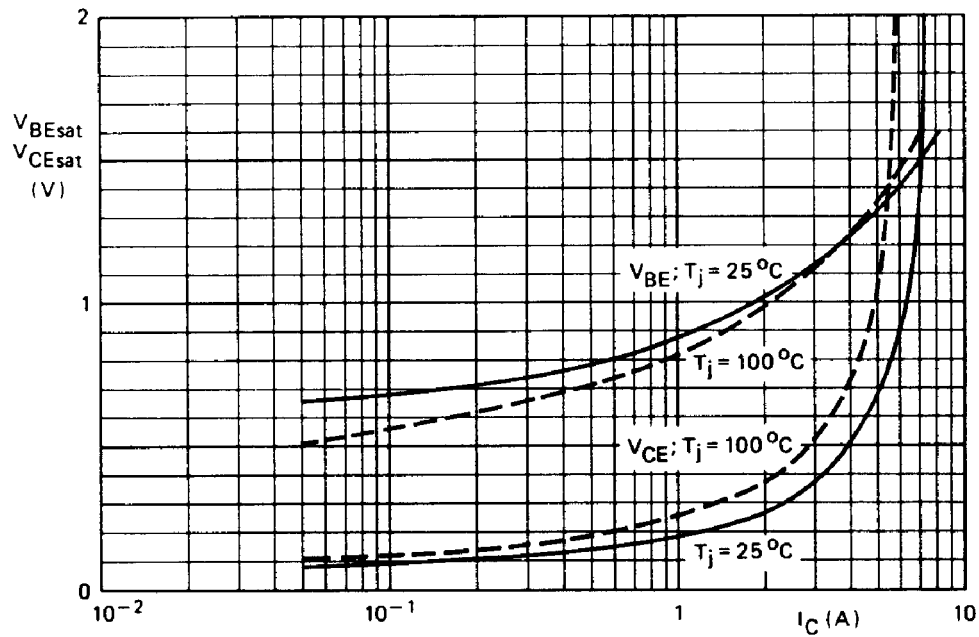


Fig.11. Typical base-emitter and collector-emitter saturation voltages.  
 $V_{BEsat} = f(I_C)$ ;  $V_{CEsat} = f(I_C)$ ;  $I_C/I_B = 5$

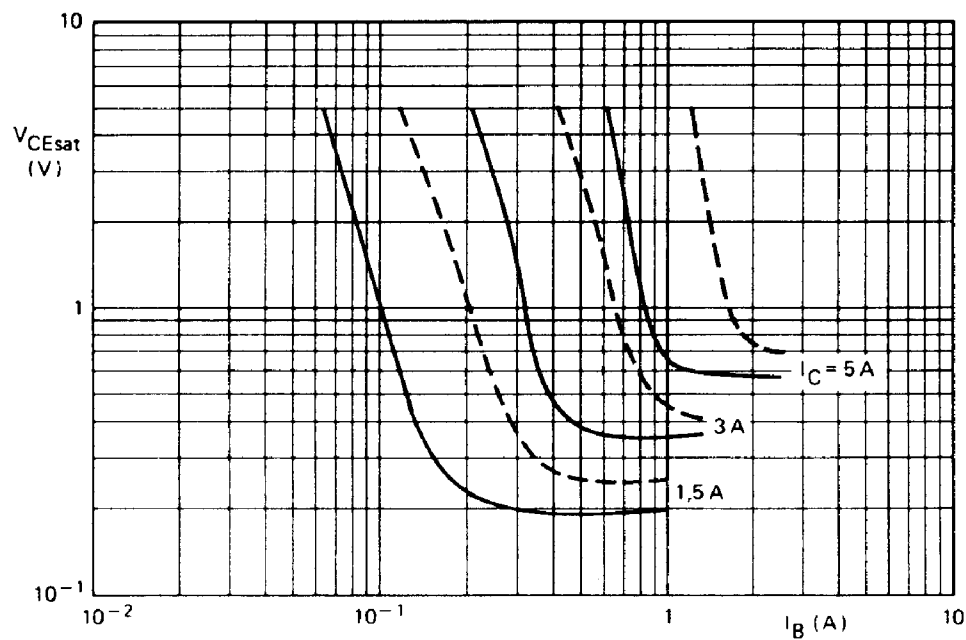


Fig.12. Collector-emitter saturation voltage. Solid lines = typ values, dotted lines = max values.  $V_{CEsat} = f(I_B)$ ; parameter  $I_C$

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BUT11F

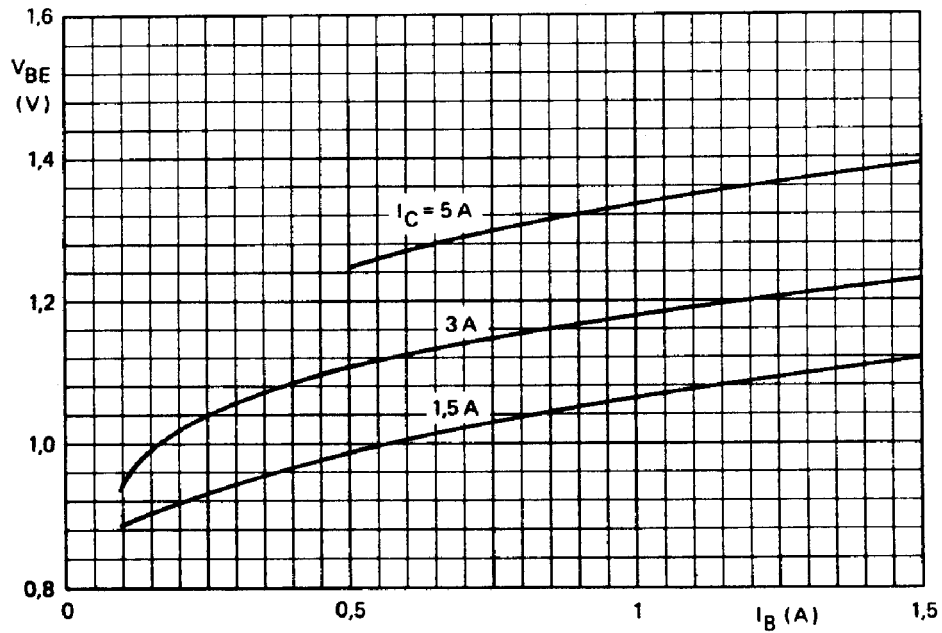


Fig.13. Typical base-emitter saturation voltage.  
 $V_{BEsat} = f(I_B)$ ; parameter  $I_C$

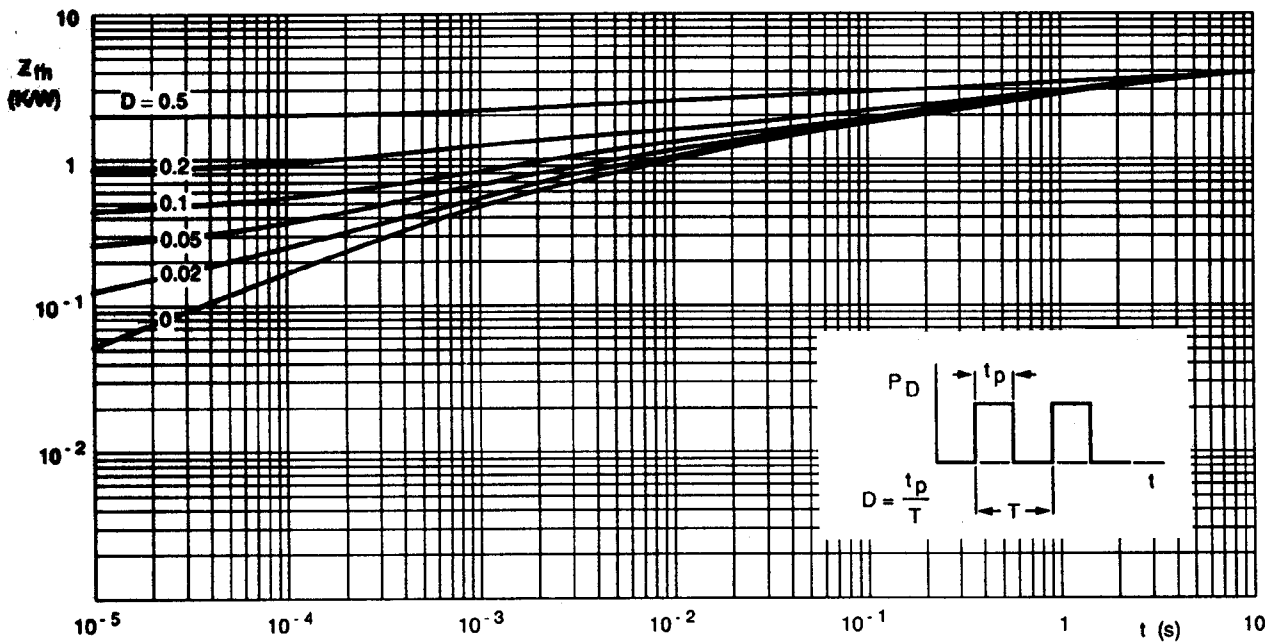
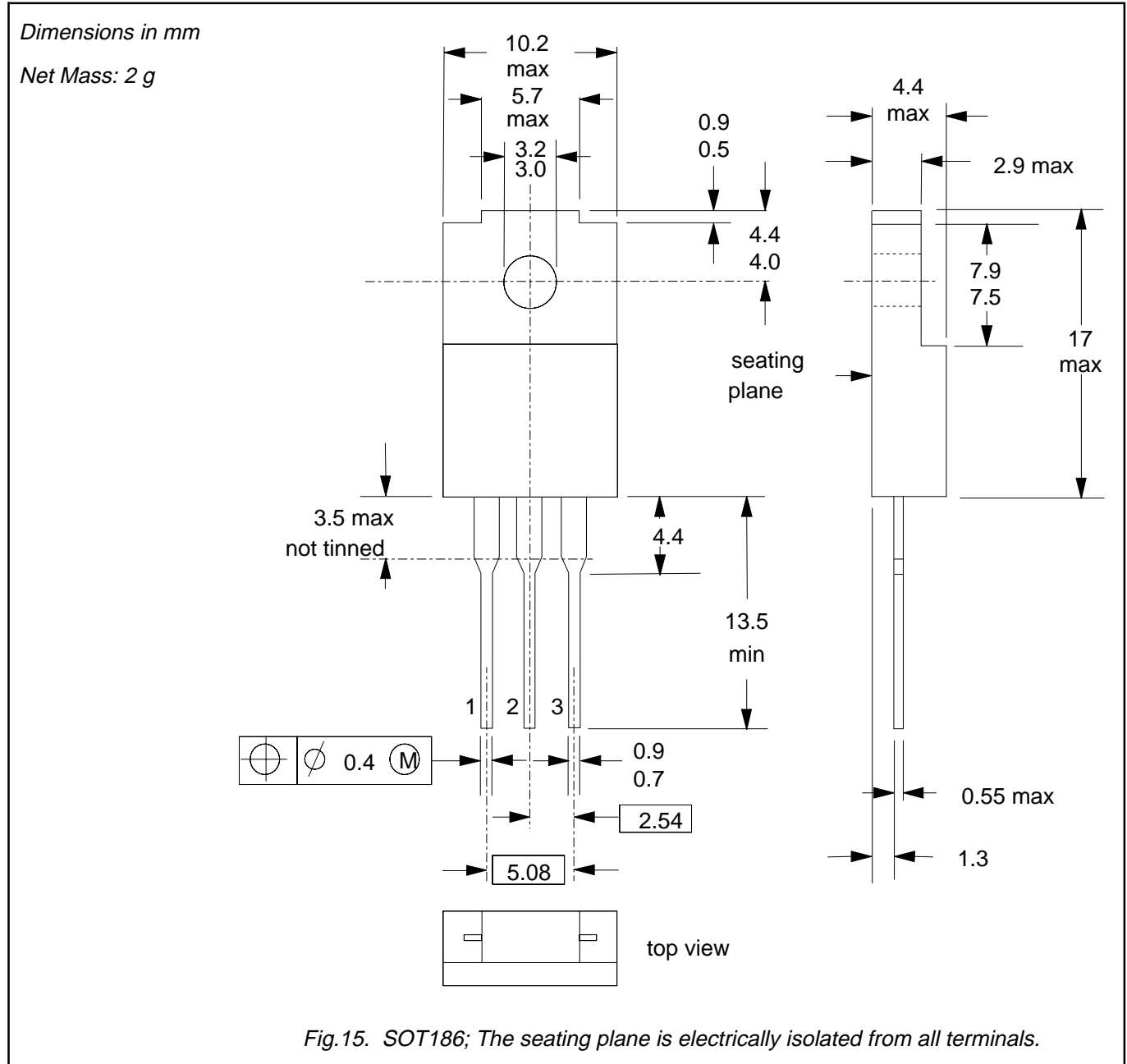


Fig.14. Transient thermal impedance.  
 $Z_{thj-hs} = f(t)$ ; parameter  $D = t_p/T$

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BUT11F

**MECHANICAL DATA**



**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 F-pack envelopes.
3. 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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