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.

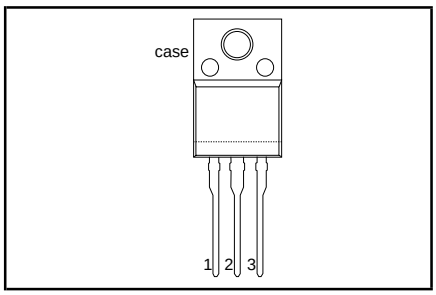
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 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	$T_{hs} \leq 25$ ˚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}=2.5A,I_{B1}=0.5A,I_{B2}=0.8A	145	160	ns

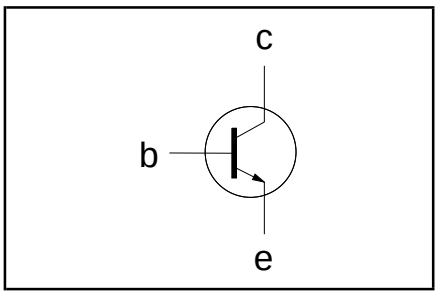
PINNING - SOT186A

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 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	$T_{hs} \leq 25$ ˚C	-	32	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

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

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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 = 50-60 Hz; sinusoidal waveform; R.H. ≤ 65% ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	10	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

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

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

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

1 Measured with half sine-wave voltage (curve tracer).

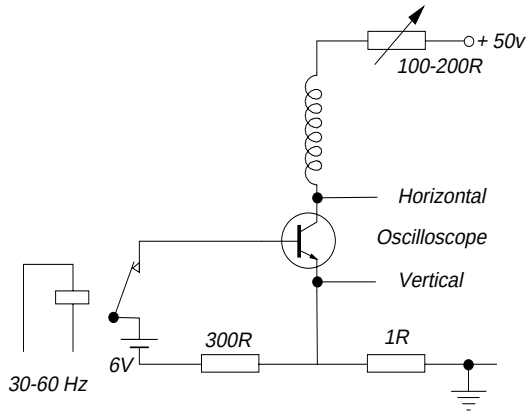


Fig.1. Test circuit for $V_{CEOsust}$.

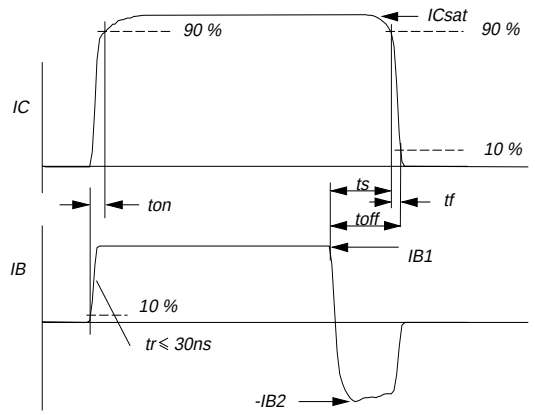


Fig.4. Switching times waveforms with resistive load.

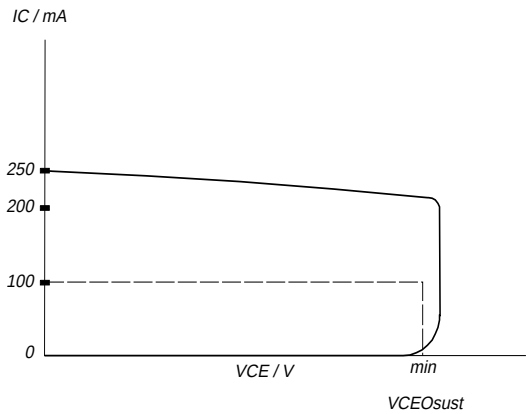


Fig.2. Oscilloscope display for $V_{CEOsust}$.

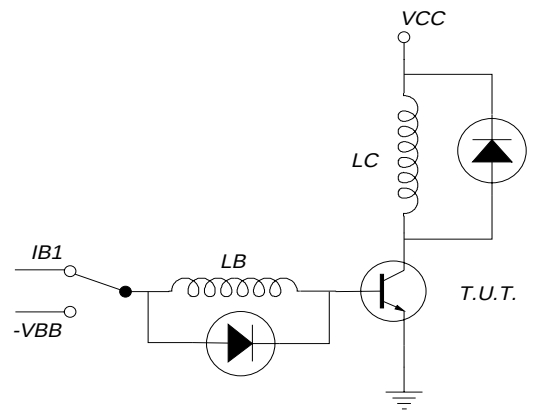


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_C = 200 uH; L_B = 1 uH

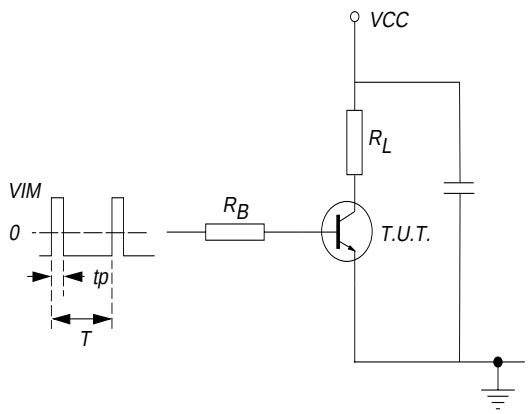


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 μs; δ = t_p / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

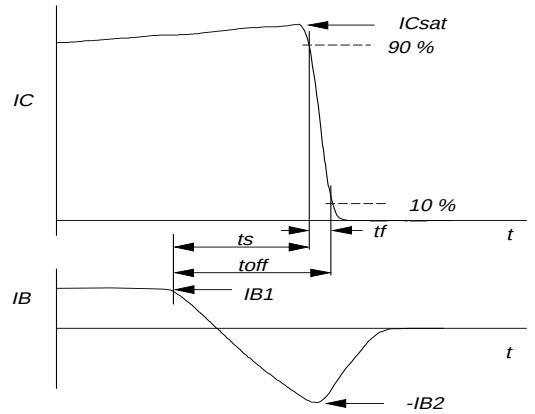


Fig.6. Switching times waveforms with inductive load.

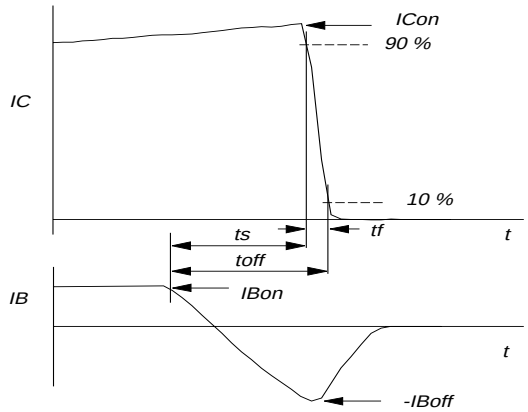


Fig.7. Switching times waveforms with inductive load.

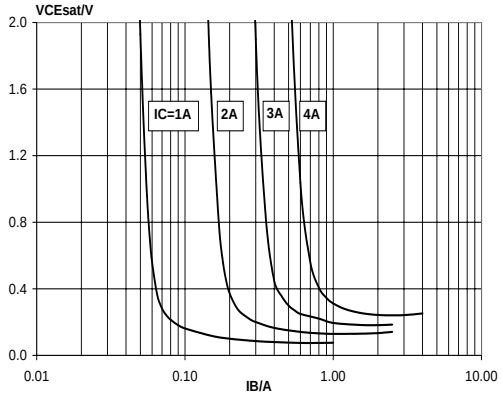


Fig.10. Collector-Emitter saturation voltage. Solid lines = typ values, V_{CEsat} = f(IB); T_j=25˚C.

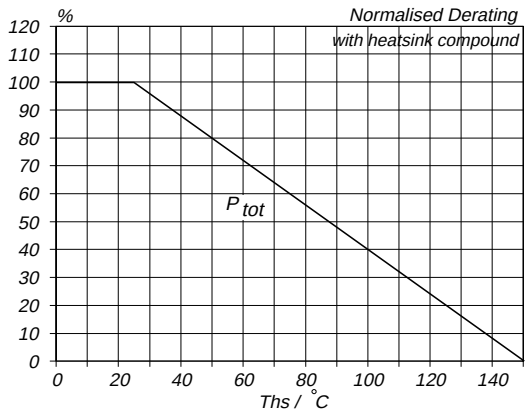


Fig.8. Normalised power dissipation. PD% = 100·PD/PD $_{25˚C}$ = f (T_{hs})

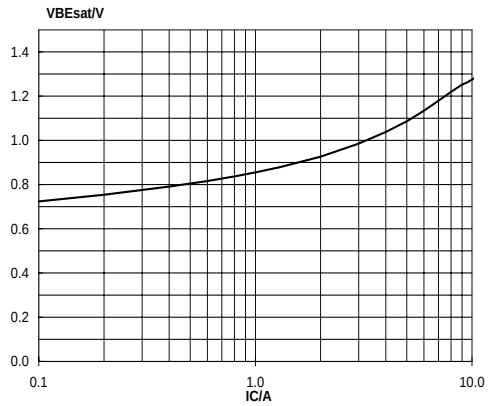


Fig.11. Base-Emitter saturation voltage. Solid lines = typ values, V_{BEsat} = f(IC); at IC/IB =4.

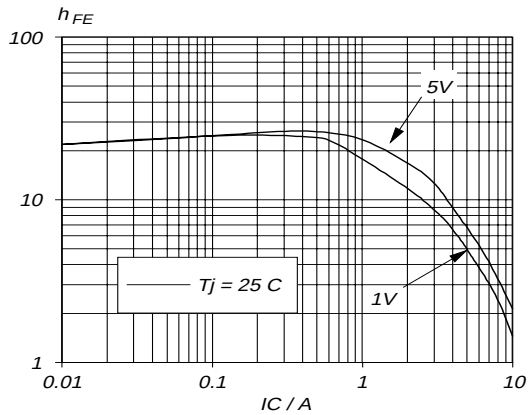


Fig.9. Typical DC current gain. h_{FE} = f(I_C) parameter V_{CE}

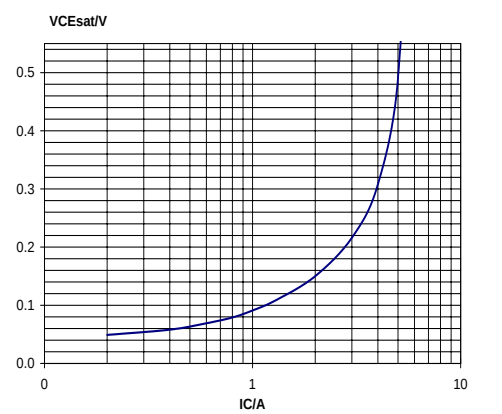


Fig.12. Collector-Emitter saturation voltage. Solid lines = typ values, V_{CEsat} = f(IC); at IC/IB =4.

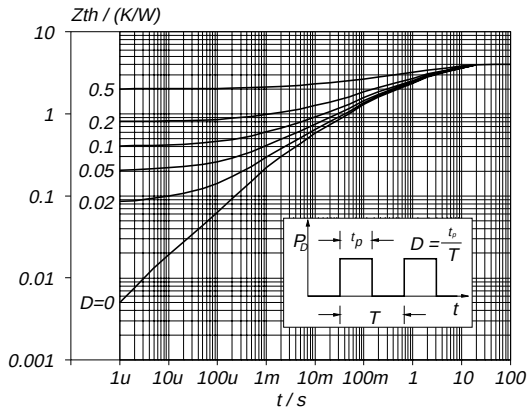


Fig.13. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

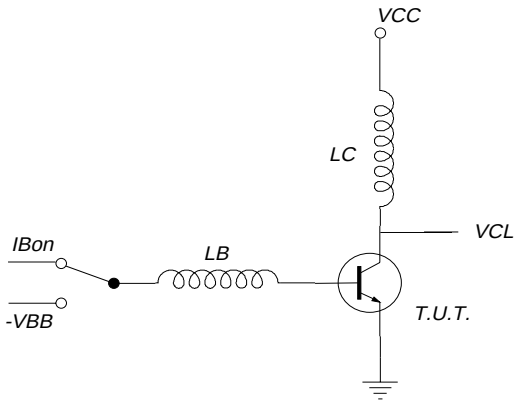


Fig.15. Test circuit RBSOA. $V_{cl} \leq 1000V$; $V_{cc} = 150V$; $V_{BB} = -5V$; $L_B = 1\mu H$; $L_c = 200\mu H$

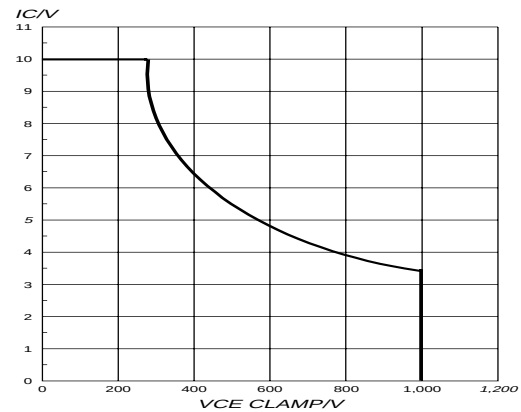


Fig.14. Reverse bias safe operating area. $T_j \leq T_{j\ max}$

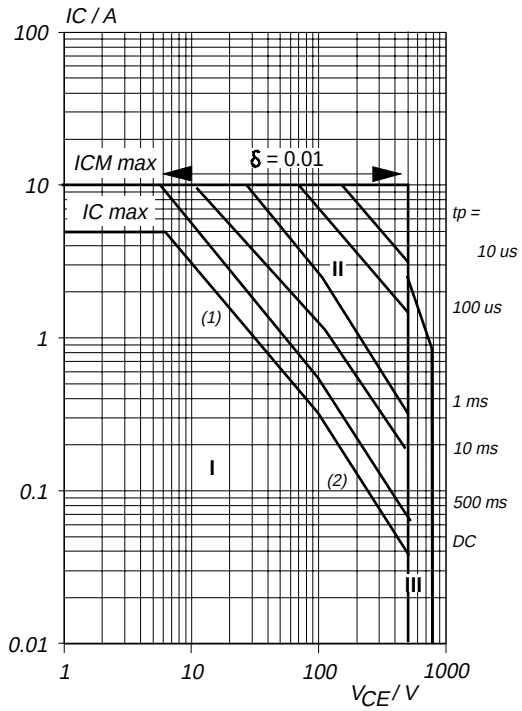


Fig.16. Forward bias safe operating area. $T_{hs} \leq 25$ ˚C

(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 ± 5 *newton force on the centre of the envelope.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

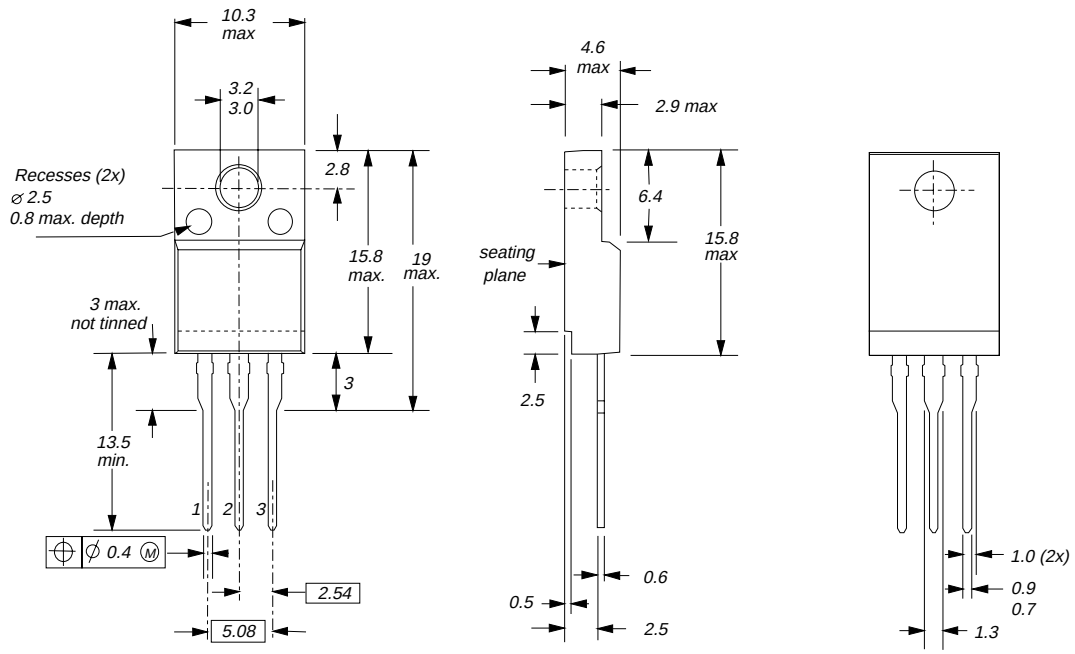


Fig.17. SOT186A; The seating plane is electrically isolated from all terminals.

Notes
1. Refer to mounting instructions for F-pack envelopes.
2. 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

These products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.