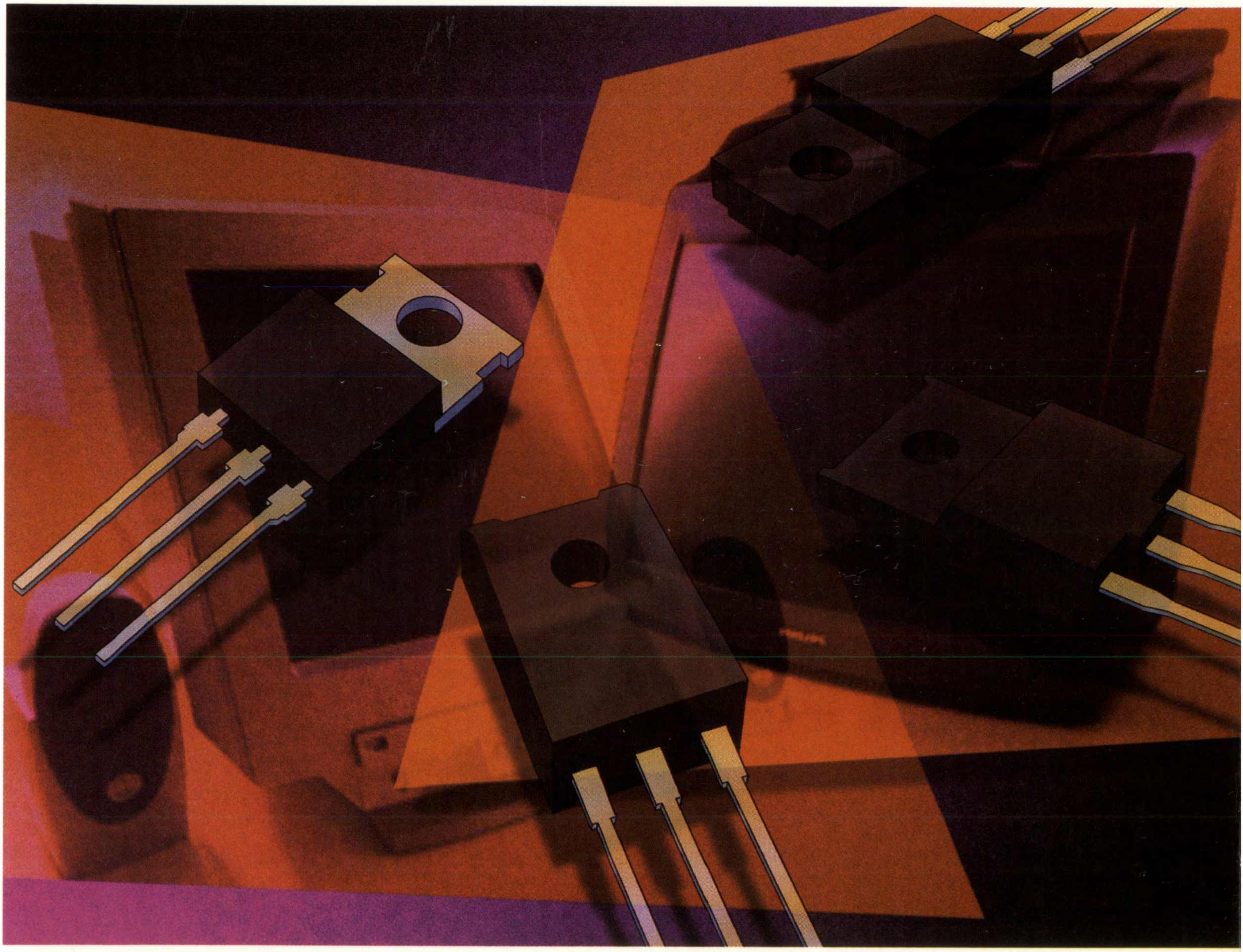
DISCRETE SEMICONDUCTORS

High-voltage and Switching NPN Power Transistors



1996

DATA HANDBOOK SC06

Philips Semiconductors

PHILIPS

QUALITY ASSURED

Our quality system focuses on the continuing high quality of our components and the best possible service for our customers. We have a three-sided quality strategy: we apply a system of total quality control and assurance; we operate customer-oriented dynamic improvement programmes; and we promote a partnering relationship with our customers and suppliers.

PRODUCT SAFETY

In striving for state-of-the-art perfection, we continuously improve components and processes with respect to environmental demands. Our components offer no hazard to the environment in normal use when operated or stored within the limits specified in the data sheet.

Some components unavoidably contain substances that, if exposed by accident or misuse, are potentially hazardous to health. Users of these components are informed of the danger by warning notices in the data sheets supporting the components. Where necessary the warning notices also indicate safety precautions to be taken and disposal instructions to be followed. Obviously users of these components, in general the set-making industry, assume responsibility towards the consumer with respect to safety matters and environmental demands.

All used or obsolete components should be disposed of according to the regulations applying at the disposal location. Depending on the location, electronic components are considered to be ‘chemical’, ‘special’ or sometimes ‘industrial’ waste. Disposal as domestic waste is usually not permitted.

High-voltage and Switching NPN Power Transistors

CONTENTS

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 given are 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 the 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 reasonably be 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.

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REPLACED/WITHDRAWN TYPES

The following type numbers were in the previous issue of this data handbook, but not in the current version:

TYPE NUMBER	REPLACED BY	REASON FOR DELETION
BU1708AX		Pruned
BUV47	BUW12	Pruned
BUV47A	BUW12A	Pruned
BUV48	BUW13	Pruned
BUV48A	BUW13A	Pruned
BUV89		Pruned
BUV90		Pruned
BUV90F		Pruned
BUX86	BUX86P	Pruned
BUX87	BUX87P	Pruned
BUX100		Pruned
TIP49	BUX84	Non preferred
TIP50	BUX85	Non preferred

SELECTION GUIDE

This selection guide lists the devices in the book, grouped in accordance with the collector-emitter voltage (V_{CESM}) parameter and in order of the collector current (I_C) parameter. Types added to the range since the last issue of the handbook are shown in bold print. For an alphanumeric listing of all devices included, refer to the index preceding this guide.

TYPE	ENVELOPE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BUX86P	SOT82	800	400	0.5	42	459
BUX84F	SOT186	800	400	2	18	457
BUX84	TO-220AB	800	400	2	40	447
BUW84	SOT82	800	400	2	50	437
BUT11F	SOT186	850	400	5	32	334
BUT211	TO220AB	850	400	5	100	376
BUT211X	SOT186A	850	400	5	20	382
BUW11	SOT93	850	400	5	100	385
BUT11	TO-220AB	850	400	5	100	319
BUT18	TO-220AB	850	400	6	110	361
BUT12F	SOT186	850	400	8	23	353
BUW12F	SOT199	850	400	8	34	407
BUT12	TO-220AB	850	400	8	125	345
BUW13F	SOT199	850	400	15	37	423
BUW11F	SOT199	850	450	5	32	393
BUT18F	SOT186	850	450	6	33	369
BUW12	SOT93	850	450	8	125	399
BUW13	SOT93	850	450	15	175	415
BUW14	SOT82	1000	450	0.5	20	431
BUX85	TO-220AB	1000	450	2	40	447
BUX85F	SOT186	1000	450	2	18	457
BUX87P	SOT82	1000	450	0.5	42	459
BUW85	SOT82	1000	450	3	50	437
BUT18AF	SOT186	1000	450	4	33	369
BUT11AF	SOT186	1000	450	5	20	334
BUT11AX	SOT186A	1000	450	5	20	327
BUW11AF	SOT199	1000	450	5	32	393
BUT11A	TO-220AB	1000	450	5	100	319
BUW11A	SOT93	1000	450	5	100	385
BUT18A	TO-220AB	1000	450	6	110	361
BUT12AF	SOT186	1000	450	8	23	353
BUW12AF	SOT199	1000	450	8	34	407
BUT12A	TO-220AB	1000	450	8	125	345
BUW12A	SOT93	1000	450	8	125	399
BUW13AF	SOT199	1000	450	15	37	423

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Selection Guide

TYPE	ENVELOPE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BUW13A	SOT93	1000	450	15	175	415
BU505DF	SOT186	1500	700	2.5	20	41
BU505F	SOT186	1500	700	2.5	20	41
BU705DF	SOT199	1500	700	2.5	29	83
BU705F	SOT199	1500	700	2.5	29	83
BU505	TO-220AB	1500	700	2.5	75	35
BU705	SOT93A	1500	700	2.5	75	77
BU505D	TO-220AB	1500	700	2.5	75	35
BU506DF	SOT186	1500	700	5	20	55
BU706DF	SOT199	1500	700	5	32	97
BU706F	SOT199	1500	700	5	32	97
BU2506DX	TOP3D	1500	700	5	45	139
BU2506DF	SOT199	1500	700	5	45	133
BU506	TO-220AB	1500	700	5	100	49
BU506D	TO-220AB	1500	700	5	100	49
BU706D	SOT93A	1500	700	5	100	91
BU706	SOT93A	1500	700	5	100	91
BU508AF	SOT199	1500	700	8	34	69
BU508DF	SOT199	1500	700	8	34	69
BU1508AX	SOT186A	1500	700	8	35	109
BU1506DX	SOT186A	1500	–	5	32	104
BU1508DX	SOT186A	1500	700	8	35	115
BU1508AX	TOP3D	1500	700	8	45	109
BU2508DF	SOT199	1500	700	8	45	169
BU2508AF	SOT199	1500	700	8	45	151
BU2508DX	TOP3D	1500	700	8	45	175
BU508D	SOT93A	1500	700	8	125	63
BU2508A	SOT93	1500	700	8	125	145
BU2508D	SOT93	1500	700	8	125	163
BU508A	SOT93A	1500	700	8	125	63
BU2522AX	TOP3D	1500	800	10	45	231
BU2520AF	SOT199	1500	800	10	45	187
BU2520AX	TOP3D	1500	800	10	45	194
BU2520DF	SOT93	1500	800	10	45	206
BU2520AF	SOT93	1500	800	10	45	187
BU2520DX	TOP3D	1500	800	10	45	212
BU2520A	SOT93	1500	800	10	125	181
BU2520D	SOT93	1500	800	10	125	201
BU2525AF	SOT199	1500	800	12	45	244
BU2525AX	TOP3D	1500	800	12	45	250

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Selection Guide

TYPE	ENVELOPE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BU2527AX	TOP3D	1500	800	12	45	268
BU2527A	SOT93	1500	800	12	125	256
BU2527AF	SOT199	1500	800	12	45	267
BU2525A	SOT93	1500	800	12	125	238
BU2530AL	TOP3L	1500	800	40	125	274
BU2708AF	SOT199	1700	825	8	45	277
BU2708DF	SOT199	1700	825	8	45	283
BU2720AF	SOT199	1700	825	10	45	289
BU2720DF	SOT199	1700	825	10	45	295
BU2722AF	SOT199A	1700	825	10	45	301
BU2727A	SOT93	1700	825	12	125	307
BU2727AF	SOT199	1700	825	12	45	313
BU1706AX	SOT186A	1750	850	5	32	127
BU1706A	TO220AB	1750	850	5	100	121

GENERAL

TOTAL QUALITY MANAGEMENT

Philips Semiconductors is a Quality Company, renowned for the high quality of our products and service. We keep alive this tradition by constantly aiming towards one ultimate standard, that of zero defects. This aim is guided by our Total Quality Management (TQM) system, the basis of which is described in the following paragraphs.

Quality assurance

Based on ISO 9000 standards, customer standards such as Ford TQE and IBM MDQ, and the CECC system of conformity. Our factories are certified to ISO 9000 and CECC by external inspectorates.

Partnerships with customers

PPM co-operations, design-in agreements, ship-to-stock, just-in-time and self-qualification programmes, and application support.

Partnerships with suppliers

Ship-to-stock, statistical process control and ISO 9000 audits.

Quality improvement programme

Continuous process and system improvement, design improvement, complete use of statistical process control, realization of our final objective of zero defects, and logistics improvement by ship-to-stock and just-in-time agreements.

ADVANCED QUALITY PLANNING

During the design and development of new products and processes, quality is built-in by advanced quality planning. Through failure-mode-and-effect analysis the critical parameters are detected and measures taken to ensure good performance on these parameters. The capability of process steps is also planned in this phase.

PRODUCT CONFORMANCE

The assurance of product conformance is an integral part of our quality assurance (QA) practice. This is achieved by:

- Incoming material management through partnerships with suppliers.
- In-line quality assurance to monitor process reproducibility during manufacture and initiate any necessary corrective action. Critical process steps are 100% under statistical process control.
- Acceptance tests on finished products to verify conformance with the device specification. The test results are used for quality feedback and corrective actions. The inspection and test requirements are detailed in the general quality specifications.
- Periodic inspections to monitor and measure the conformance of products.

PRODUCT RELIABILITY

With the increasing complexity of Original Equipment Manufacturer (OEM) equipment, component reliability must be extremely high. Our research laboratories and development departments study the failure mechanisms of semiconductors. Their studies result in design rules and process optimization for the highest built-in product reliability. Highly accelerated tests are applied to the products reliability evaluation. Rejects from reliability tests and from customer complaints are submitted to failure analysis, to result in corrective action.

CUSTOMER RESPONSES

Our quality improvement depends on joint action with our customer. We need our customer's inputs and we invite constructive comments on all aspects of our performance. Please contact our local sales representative.

RECOGNITION

The high quality of our products and services is demonstrated by many Quality Awards granted by major customers and international organizations.

PRO ELECTRON TYPE NUMBERING SYSTEM

Basic type number

This type designation code applies to discrete semiconductor devices (not integrated circuits), multiples of such devices, semiconductor chips and darlington transistors.

First letter

The first letter gives information about the material for the active part of the device.

- A germanium or other material with a band gap of 0.6 to 1 eV
- B silicon or other material with a band gap of 1 to 1.3 eV
- C gallium arsenide (GaAs) or other material with a band gap of 1.3 eV or more
- R compound materials, e.g. cadmium sulphide.

Second letter

The second letter indicates the function for which the device is primarily designed. The same letter can be used for multi-chip devices with similar elements.
In the following list low power types are defined by $R_{th\ j\text{-}mb}$ > 15 K/W and power types by $R_{th\ j\text{-}mb} \leq 15$ K/W.

- A diode; signal, low power
- B diode; variable capacitance
- C transistor; low power, audio frequency
- D transistor; power, audio frequency
- E diode; tunnel
- F transistor; low power, high frequency
- G multiple of dissimilar devices/miscellaneous devices; e.g. oscillators. Also with special third letter, see under 'Serial number'
- H diode; magnetic sensitive
- L transistor; power, high frequency
- N photocoupler
- P radiation detector; e.g. high sensitivity photo-transistor; with special third letter
- Q radiation generator; e.g. LED, laser; with special third letter
- R control and switching device; e.g. thyristor, low power; with special third letter
- S transistor; low power, switching
- T control and switching device; e.g. thyristor, power; with special third letter
- U transistor; power, switching
- W surface acoustic wave device
- X diode; multiplier, e.g. varactor, step recovery
- Y diode; rectifying, booster
- Z diode; voltage reference or regulator, transient suppressor diode; with special third letter

Serial number/special third letter

The number comprises three figures running from 100 to 999 for devices primarily intended for consumer equipment, or one letter (Z, Y, X, etc.) and two figures running from 10 to 99 for devices primarily intended for industrial or professional equipment.[1] The letter has no fixed meaning, except in the following cases:

- A for triacs, after second letter 'R' or 'T'
- F for emitters and receivers in fibre-optic communication, after second letter 'G', 'P' or 'Q'. When the second letter is 'G', the first letter should be defined in accordance with the material of the main optical device.
- L for lasers in non-fibre-optic applications, after second letter 'G' or 'Q'. When the second letter is 'G', the first letter should be defined in accordance with the material of the main optical device.
- O for opto-triacs, after second letter 'R'
- T for 3-state bicolour LEDs, after second letter 'Q'
- W for transient voltage suppressor diodes, after second letter 'Z'.

(1) When the supply of these serial numbers is exhausted, the serial number may be expanded to three figures for industrial types and four figures for consumer types.

EXAMPLES OF BASIC TYPE NUMBERS

AA112: germanium, low-power signal diode (consumer type)

ACY32: germanium, low-power AF transistor (industrial type)

BD232: silicon, power AF transistor (consumer type)

CQY17: GaAs, light-emitting diode (industrial type)

RPY84: CdS, photo-conductive cell (industrial type).

Version letter(s)

One or two letters may be added to the basic type number to indicate minor electrical or mechanical variants of the basic type. The letters never have a fixed meaning, except that the letter 'R' indicates reverse polarity and the letter 'W' indicates a surface mounted device (SMD).

Suffix

Sub-classification can be used for devices supplied in a wide range of variants, called associated types. The following sub-coding suffixes are in use:

VOLTAGE REFERENCE AND VOLTAGE REGULATOR DIODES

One letter and one number, preceded by a hyphen (-). The letter, if required, indicates the nominal tolerance of the Zener voltage.

A 1% (in accordance with IEC 63, series E96)

B 2% (in accordance with IEC 63, series E48)

C 5% (in accordance with IEC 63, series E24)

D 10% (in accordance with IEC 63, series E12)

E 20% (in accordance with IEC 63, series E6).

In the case of a 3% tolerance, the letter 'F' is used.

The number denotes the typical operating (Zener) voltage, related to the nominal current rating for the entire range. The letter 'V' is used in place of the decimal point.

Example: BZY74-C6V3 or -C10.

TRANSIENT VOLTAGE SUPPRESSOR DIODES

One number, preceded by a hyphen (-). The number indicates the maximum recommended continuous reversed (stand-off) voltage, V_R. The letter 'V' is used in place of the decimal point.

Example: BZW70-9V1 or –39.

The letter 'B' may be used immediately after the last number, to indicate a bidirectional suppressor diode.

Example: BZW10-15B.

CONVENTIONAL AND CONTROLLED AVALANCHE RECTIFIER DIODES AND THYRISTORS

One number, preceded by a hyphen (-). The number indicates the rated maximum repetitive peak reverse voltage, V_{RRM}, or the rated repetitive peak off-state voltage, V_{DRM}, whichever is the lower. Reversed polarity with respect to the case is indicated by the letter 'R' immediately after the number.

Example: BYT-100 or -100R.

RADIATION DETECTORS

One number, preceded by a hyphen (-). The number indicates the depletion layer in micrometres (µm). The resolution is indicated by a version letter.

Example: BPX10-2A.

ARRAY OF RADIATION DETECTORS AND GENERATORS

One number, preceded by a hyphen (-). The number indicates the number of basic devices assembled into the array.

Examples: BPW50-6, BPW50-9, BPW50-12.

HIGH FREQUENCY POWER TRANSISTORS

One number, preceded by a hyphen (-). The number indicates the supply voltage.

Example: BLU80-24.

RATING SYSTEMS

The rating systems described herein are those recommended by the International Electrotechnical Commission (IEC) in its publication number 134.

Definition of terms used

ELECTRONIC DEVICE

An electronic tube or valve, transistor or other semiconductor device. This definition excludes inductors, capacitors, resistors and similar components.

CHARACTERISTIC

A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

BOGEY ELECTRONIC DEVICE

An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics that are directly related to the application.

RATING

A value that establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms. Limiting conditions may be either maxima or minima.

RATING SYSTEM

The set of principles upon which ratings are established and which determine their interpretation. The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

Absolute maximum rating system

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type, as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout the life of the device, no absolute maximum value for the intended service is exceeded with any device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

Design maximum rating system

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout the life of the device, no design maximum value for the intended service is exceeded with a bogey electronic device, under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

Design centre rating system

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

LETTER SYMBOLS

The letter symbols for transistors and signal diodes detailed in this section are based on IEC publication number 148.

Letter symbols for currents, voltages and powers

BASIC LETTERS

I, i	Current
V, v	Voltage
P, p	Power.

Upper-case letter symbols are used to represent all values except instantaneous values that vary with time, these are represented by lower-case letters.

SUBSCRIPTS

A, a	Anode terminal
(AV), (av)	Average value
B, b	Base terminal (for MOS devices: Substrate)
C, c	Collector terminal
D, d	Drain terminal
E, e	Emitter terminal
F, f	Forward
G, g	Gate terminal
K, k	Cathode terminal
M, m	Peak value
O, o	As third subscript: the terminal not mentioned is open-circuit
R, r	As first subscript: reverse. As second subscript: repetitive. As third subscript: with a specified resistance between the terminal not mentioned and the reference terminal
(RMS), (rms)	Root-mean-square value
S, s	As first or second subscript: source terminal (FETs only). As second subscript: non-repetitive (not FETs). As third subscript: short circuit between the terminal not mentioned and the reference terminal
X, x	Specified circuit
Z, z	Replaces R to indicate the actual working voltage, current or power of voltage reference and voltage regulator diodes.

No additional subscript is used for DC values.

Upper-case subscripts are used for the indication of:

1. Continuous (DC) values (without signal), e.g. I_B
2. Instantaneous total values, e.g. i_B
3. Average total values, e.g. $I_{B(AV)}$
4. Peak total values, e.g. I_{BM}
5. Root-mean-square total values, e.g. $I_{B(RMS)}$.

Lower-case subscripts are used for the indication of values applying to the varying component alone:

1. Instantaneous values, e.g. i_b
2. Root-mean-square values, e.g. $I_{b(rms)}$
3. Peak values, e.g. I_{bm}
4. Average values, e.g. $I_{b(av)}$.

If more than one subscript is used, the subscript for which both styles exist are either all upper-case or all lower-case.

ADDITIONAL RULES FOR SUBSCRIPTS

Transistor currents

If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

Examples: I_B, i_B, i_b, I_{bm}.

Diode currents

To indicate a forward current (conventional current flow into the anode terminal), the subscript F or f should be used. For a reverse current (conventional current flow out of the anode terminal), the subscript R or r should be used.

Examples: I_F, I_R, i_F, $I_{f(rms)}$.

Transistor voltages

If it is necessary to indicate the points between which a voltage is measured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion, the second subscript may be omitted.

Examples: V_{BE}, v_{BE}, v_{be}, V_{bem}.

Diode voltages

To indicate a forward voltage (anode positive with respect to cathode), the subscript F or f should be used. For a reverse voltage (anode negative with respect to cathode), the subscript R or r should be used.

Examples: V_F, V_R, v_F, V_{rm}.

Supply voltages or currents

Supply voltages or supply currents are indicated by repeating the appropriate terminal subscript.

Examples: V_{CC}, I_{EE}.

If it is necessary to indicate a reference terminal, this should be done by a third subscript.

Example: V_{CCE}.

Subscripts for devices with more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal, followed by a number. In the case of multiple subscripts, hyphens may be necessary to avoid confusion.

Examples:

I_{B2} continuous (DC) current flowing into the second base terminal

$V_{B2\text{-}E}$ continuous (DC) voltage between the terminals of second base and emitter.

Subscripts for multiple devices

For multiple unit devices, the subscripts are modified by a number preceding the letter subscript. In the case of multiple subscripts, hyphens may necessary to avoid confusion.

Examples:

I_{2C} continuous (DC) current flowing into the collector terminal of the second unit

$V_{1C\text{-}2C}$ continuous (DC) voltage between the collector terminals of the first and second units.

Application of the rules

Fig.1 represents a transistor collector current as a function of time. It comprises a continuous (DC) current and a varying component.

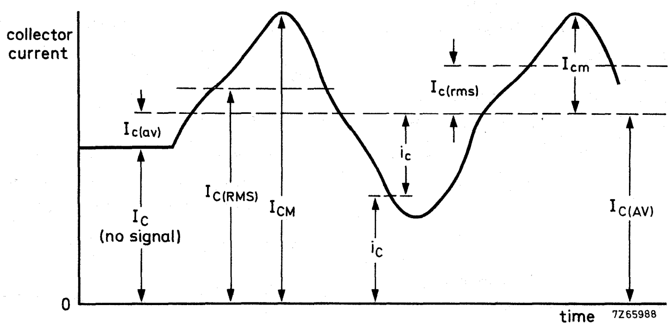


Fig.1 Collector current as a function of time.

Letter symbols for electrical parameters

DEFINITION

For the purpose of this publication, the term 'electrical parameter' applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

BASIC LETTERS

The following list comprises the most important basic letters used for electrical parameters of semiconductor devices.

B, b	Susceptance (imaginary part of an admittance)
C	Capacitance
G, g	Conductance (real part of an admittance)
H, h	Hybrid parameter
L	Inductance
R, r	Resistance (real part of an impedance)
X, x	Reactance (imaginary part of an impedance)
Y, y	Admittance
Z, z	Impedance.

Upper-case letters are used for the representation of:

1. Electrical parameters of external circuits and of circuits in which the device forms only a part
2. All inductances and capacitances.

Lower-case letters are used for the representation of electrical parameters inherent in the device, with the exception of inductances and capacitances.

SUBSCRIPTS

General subscripts

The following list comprises the most important general subscripts used for electrical parameters of semiconductor devices.

F, f	Forward (forward transfer)
I, i (or 1)	Input
L, l	Load
O, o (or 2)	Output
R, r	Reverse (reverse transfer)
S, s	Source.

Examples: Z_S, h_f, h_F.

The upper-case variant of a subscript is used for the designation of static (DC) values.

Examples:

h_{FE}	static value of forward current transfer ratio in common-emitter configuration (DC current gain)
R_E	DC value of the external emitter resistance.

The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript is used for the designation of small-signal values.

Examples:

h_{fe}	small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration
$Z_e = R_e + jX_e$	small-signal value of the external impedance.

If more than one subscript is used, subscripts for which both styles exist are either all upper-case or all lower-case.

Example: h_{FE}, y_{RE}, h_{fe}.

Subscripts for four-pole matrix parameters

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer.

Examples: h_i (or h_{11}), h_o (or h_{22}), h_f (or h_{21}), h_r (or h_{12}).

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: h_{fe} (or h_{21e}), h_{FE} (or h_{21E}).

DISTINCTION BETWEEN REAL AND IMAGINARY PARTS

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts should be used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples: $Z_i = R_i + jX_i$, $y_{fe} = g_{fe} + jb_{fe}$.

If such symbols do not exist, or if they are not suitable, the following notation is used:

Examples:

Re (h_{ib}) etc. for the real part of h_{ib}
Im (h_{ib}) etc. for the imaginary part of h_{ib}.

TRANSISTOR RATINGS

Voltage ratings

COLLECTOR TO BASE

V_{CBmax} The maximum permissible instantaneous voltage between collector and base terminals. The collector voltage is negative with respect to base in pnp transistors and positive with respect to base in npn types.

V_{CBmax} ($I_E = 0$) The maximum permissible instantaneous voltage between collector and base terminals when the emitter terminal is open-circuit.

EMITTER TO BASE

V_{EBmax} The maximum permissible instantaneous voltage between emitter and base terminals. The emitter voltage is negative with respect to base in pnp transistors and positive with respect to base in npn types.

V_{EBmax} ($I_C = 0$) The maximum permissible instantaneous voltage between emitter and base terminals when the collector terminal is open-circuit.

COLLECTOR TO EMITTER

V_{CEmax} The maximum permissible instantaneous voltage between collector and emitter terminals. The collector voltage is negative with respect to emitter in pnp transistors and positive with respect to emitter in npn types. This rating is very dependent on circuit conditions and collector current, and it is necessary to refer to the curve of V_{CE} versus I_C for the appropriate circuit condition in order to obtain the correct rating.

V_{CEmax} (Cut-off) The maximum permissible instantaneous voltage between collector and emitter terminals when the emitter current is reduced to zero by means of a reverse emitter base voltage, i.e. the base voltage is normally positive with respect to emitter for pnp transistors and negative with respect to emitter for npn types.

The term '(Cut-off)' is sometimes replaced by $V_{BE} > x$ V, or $R_B/R_E \leq y$, which are equivalent conditions under which the transistor may be cut off.

V_{CEmax} ($I_C = x$ mA) The maximum permissible instantaneous voltage between collector and emitter terminals when the collector current is at a high value, often the maximum rated value.

V_{CEmax} ($I_B = 0$) The maximum permissible instantaneous voltage between collector and emitter terminals when the base terminal is open-circuit or when a very high resistance is in series with the base terminal. Special care must be taken to ensure that thermal runaway due to excessive collector leakage current does not occur in this condition.

Due to the current dependency of V_{CE} it is usual to present this information as a voltage rating chart, a curve of collector current as a function of collector-to-emitter voltage (see Fig.2). The permissible area of operation under all conditions of base drive (provided the dissipation rating is not exceeded) is shown as area 1 and operation under certain specified conditions is shown as area 2. To assist in determining the rating in area 2, further curves can relate the voltage rating to external circuit conditions, for example: R_B/R_E, R_B, Z_{Bg}, V_{BE}, I_B or V_{BB}/R_B. An example of this type of curve is given in Fig.3 with V_{CE} as a function of R_B/R_E for two values of collector current.

It should be noted that when R_E is shunted by a capacitor, during switching, the collector voltage V_{CE} must be restricted to a value that does not rely on the effect of R_E.
In the case of an inductive load, when an energy rating is given, it may be safe to operate outside the rated area provided the specified energy rating is not exceeded.

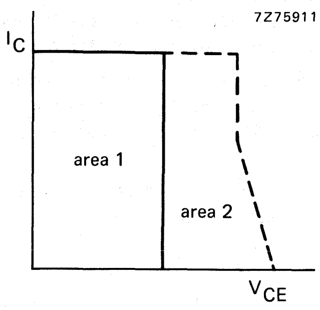


Fig.2 Graph of permissible operating areas.

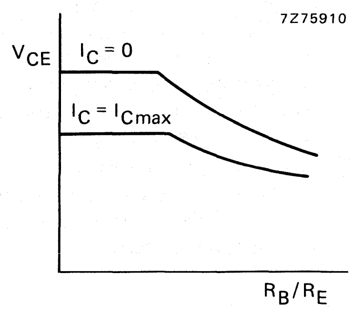


Fig.3 Graph showing effect of collector current on permissible operating areas.

Current ratings

COLLECTOR

I_{Cmax}	The maximum permissible collector current. Without further qualification, the DC value is implied.
$I_{C(AV)max}$	The maximum permissible average value of the total collector current.
I_{CM}	The maximum permissible instantaneous value of the total collector current.

EMITTER

I_{Emax}	The maximum permissible emitter current. Without further qualification, the DC value is implied.
$I_{E(AV)max}$	The maximum permissible average value of the total emitter current.
$I_{ER(AV)max}$	The maximum permissible average value of the total emitter current when operating in the reverse emitter-base breakdown region.
I_{EM}	The maximum permissible instantaneous value of the total emitter current.
I_{ERM}	The maximum permissible instantaneous value of the total emitter current when operating in the reverse breakdown region.

BASE

I_{Bmax}	The maximum permissible base current. Without further qualification, the DC value is implied.
$I_{B(AV)max}$	The maximum permissible average value of the total base current.
$I_{BR(AV)max}$	The maximum permissible average value of the total base current when operating in the reverse breakdown region.
I_{BM}	The maximum permissible instantaneous value of the total base current. The rating also includes the switch-off current.
I_{BRM}	The maximum permissible instantaneous value of the total reverse current allowable in the reverse breakdown region.

Power ratings

The total maximum permissible continuous power dissipation in the transistor, $P_{tot\ max}$, includes collector-base dissipation and emitter-base dissipation. Under steady state conditions, the total power is given as:

$P_{tot} = V_{CE} \times I_C + V_{BE} \times I_B$.

In order to distinguish between 'steady state' and 'pulse' conditions, the terms 'steady state power (P_S)' and 'pulse power (P_P)' can be used. The permissible total power dissipation is dependent on temperature; this relationship is shown in Fig.4.

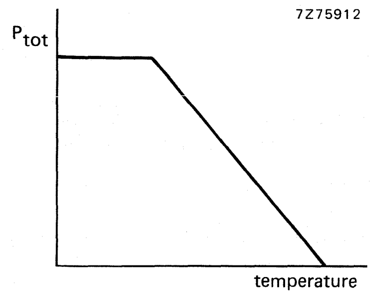


Fig.4 Permissible total power dissipation.

The temperature may be the ambient, the case or the mounting base temperature. Where a cooling clip or heatsink is attached to the device, the allowable power dissipation is also dependent on the efficiency of the heatsink.

The efficiency of this clip or heatsink is measured in terms of its thermal resistance ($R_{th\ h}$) normally expressed in degrees kelvin per watt (K/W). For mounting-base rated devices, the added effect of the contact resistance ($R_{th\ i}$) must be taken into account.

The effect of heatsinks of various thermal and contact resistance is often included in the graph of permissible total power dissipation.

The relationship between maximum power dissipation, ambient temperature and thermal heatsink resistance is given by:

$$P_{tot} = \frac{T_j - T_{amb}}{R_{th\ j\text{-}a}}$$

where $R_{th\ j\text{-}a}$ is the thermal resistance from the transistor junction to the ambient. For case rated or mounting-base rated devices, the thermal resistance $R_{th\ j}$ is made up of the thermal resistance junction to case or mounting-base ($R_{th\ j\text{-}mb}$), the contact thermal resistance ($R_{th\ i}$) and the heatsink thermal resistance ($R_{th\ h}$).

For the calculation of pulse power operation, the maximum pulse power is obtained using a graph as shown in Fig.5.

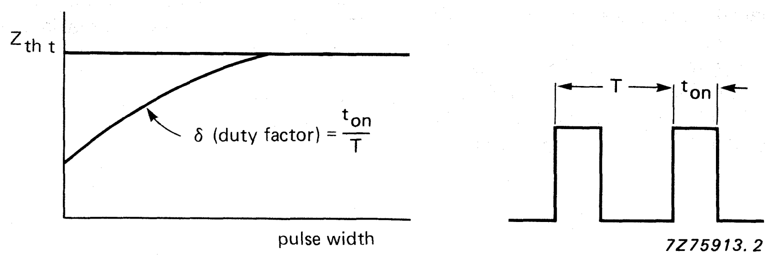


Fig.5 Pulse power operation.

The general expression from which the maximum pulse power dissipation can be calculated is:

$$P_P = \frac{T_j - T_{amb} - P_S \times R_{th\,j\text{-}a}}{Z_{th\,t} + d\,(R_{th\,c\text{-}a})}.$$

where $Z_{th\,t}$ and δ are given in Fig.5 and $R_{th\,c\text{-}a}$ is the thermal resistance between case and ambient for a case rated device. For a mounting-base rated device, it is equal to $R_{th\,h} + R_{th\,i}$ and is zero for a free-air rated device because the effect of the temperature rise of the case over the ambient for a pulse train is already included in $Z_{th\,t}$.

Temperature ratings

$T_{j\,max}$ The maximum permissible junction temperature which is used as the basis for the calculation of power ratings. Unless otherwise stated, the continuous value is implied.

$T_{j\,max}$ (continuous operation): indicates the maximum permissible continuous value.

$T_{j\,max}$ (intermittent operation): indicates the maximum permissible instantaneous junction temperature usually allowed for a total duration of 200 hours.

T_{mb} The temperature of the surface in contact with the heatsink. This is confined to devices where a flange or stud for fixing onto a heatsink forms an integral part of the envelope.

T_{case} The temperature of the envelope. This is confined to devices that may have a clip-on cooling fin attachment.

TRANSISTOR SAFE OPERATING AREA (SOAR)

There are two main limiting factors which affect the power handling ability of a transistor; the average junction temperature and the second breakdown. To indicate these limitations, the data sheets contain safe operating area curves specific to the type and, for reliable operation of the transistor, the I_C/V_{CE} limits shown by these curves must never be exceeded. The following advice on SOAR will enable design engineers to make optimum use of the information in the data sheets.

Average junction temperature

Heat dissipation in the collector-base junction flows through the thermal resistance $R_{th\,j\text{-}mb}$ between junction and mounting base, see Fig.6.

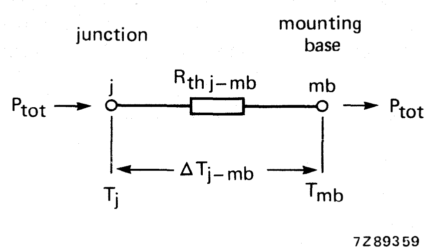


Fig.6 Heat transport in a transistor with power dissipation constant with time.

For steady-state (DC) operation the junction temperature will increase to:

$T_j = T_{mb} + P_{tot}\,R_{th\,j\text{-}mb}$

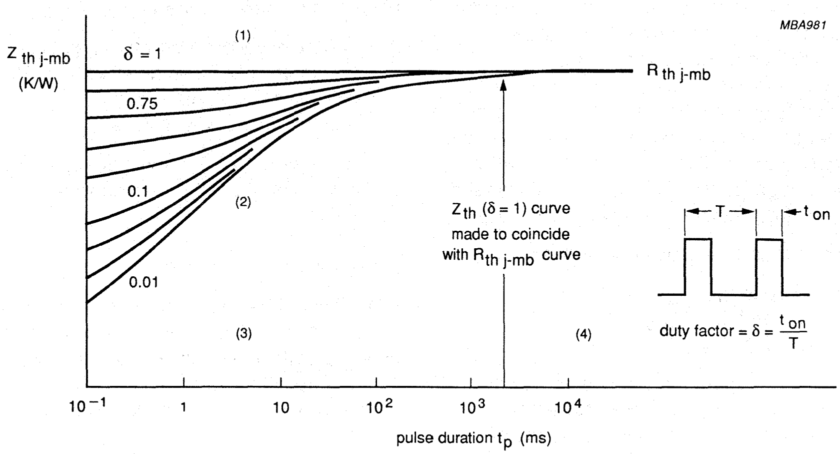
and for pulse operation the junction temperature will be:

$T_j = T_{mb} + P_{tot}\,Z_{th\,j\text{-}mb}$.

During pulse operation the junction has no time to be fully heated and will wholly or partly cool during the interval between pulses. For this reason a higher dissipation is permitted, see Fig.7.

This curve may be represented by absolute values ($Z_{th\,j\text{-}mb}$) or as normalized thermal impedance (NTI), where:

$$NTI = \frac{Z_{th\,j\text{-}mb}}{R_{th\,j\text{-}mb}}$$



(1) DC line.
(2) Single pulse line.
(3) Pulse conditions.
(4) Steady-state conditions.

Fig.7 A typical family of $Z_{th\ j\text{-}mb}$ curves for a power transistor.

Maximum allowable dissipation

Total power dissipation in a transistor is given by:

$P_{tot} = I_C V_{CE} + I_B V_{BE}$

The second term can usually be disregarded, so

$P_{tot} \approx I_C V_{CE}$.

The maximum allowable power dissipation is limited to the maximum allowable junction temperature for the constant power curves (P_{tot}) and by second breakdown curves, see Fig.8.

Constant power curves

Calculation of P_{tot} can be as follows:

for steady-state (DC) conditions

$$P_{tot} = \frac{T_{j\ max} - T_{mb}}{R_{th\ j\text{-}mb}};$$

for pulsed conditions

$$P_{tot} = \frac{T_{j\ max} - T_{mb}}{Z_{th\ j\text{-}mb}}.$$

The maximum power dissipation ($P_{tot\ max}$ DC) mostly specified in a data sheet is for a given mounting base temperature, this is usually T_{mb} = 25 °C but may be much higher.

The maximum power dissipation cannot be referred to the mounting base for transistors in fully isolated envelopes (SOT186, SOT199 and SOT227 (ISOTOP)). For these, the data sheets specify a given heatsink temperature (T_h) which may be calculated as follows:

for steady-state (DC) conditions

$$P_{tot} = \frac{T_{j\ max} - T_h}{R_{th\ j\text{-}mb}};$$

for pulsed conditions

$$P_{tot} = \frac{T_{j\ max} - T_h}{Z_{th\ j\text{-}mb}}.$$

The temperature specified in a data sheet is usually T_h = 25 °C but may be much higher. The total thermal resistance/impedance includes the transfer resistance from the case to heatsink under specific mounting conditions.

Second breakdown curves

In the forward biased condition, second breakdown is a thermally-triggered avalanche effect which, once started, will destroy the transistor. The mechanism can be understood by considering the device as a large number of elemental transistors in parallel, some of which will have a lower forward voltage drop than others. Current will tend to gather in these, raising their temperature and further lowering their forward voltage drop. Current will concentrate still further, leading to local overheating and eventually a short circuit between emitter and collector.

This effect can occur under various conditions:

forward biased up to V_{CEOmax}
forward biased with $V_{CE} > V_{CEOmax}$
reverse biased up to V_{CESmax}.

In the data sheets, safe operating area curves for the first condition are given for every power transistor; curves showing extensions for the safe operating area for the other two conditions are specified only for power switching transistors.

Forward biased safe operation area up to V_{CEOmax}

Four operating limits form the boundaries of the forward biased safe operating area up to V_{CEOmax}:

maximum collector current, I_C or I_{CM}
maximum collector-emitter voltage, V_{CEOmax}
maximum power dissipation, P_{tot}
second breakdown limit, S/B_{sat}.

Forward biased SOAR curves are specified for both DC and pulse operation to cover the widest range of applications.

IN STEADY STATE CONDITIONS

A DC forward biased SOAR curve plotted on a log-log grid is shown in Fig.8. The right-hand boundary is formed by V_{CEOmax} which extends up to a collector current of 300 mA, above this point as I_{Cmax} is increased V_{CE} must be reduced to prevent second breakdown.

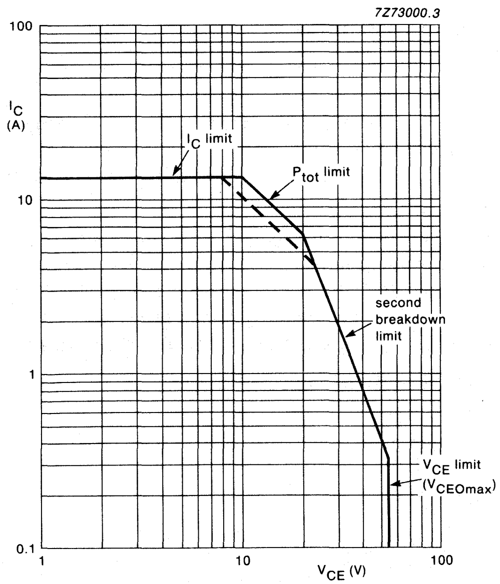


Fig.8 A typical DC SOAR graph with boundaries defined.

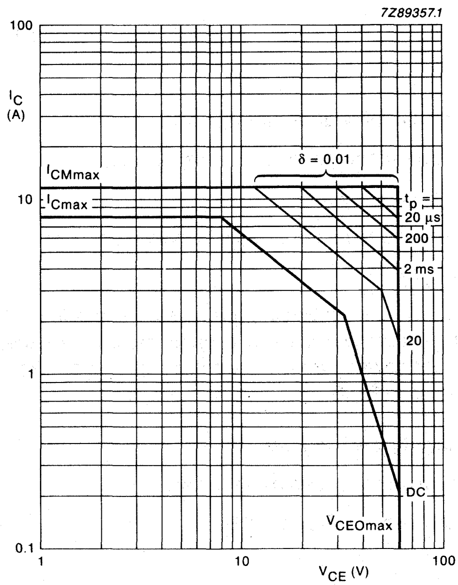


Fig.9 Graph showing maximum collector current and collector-emitter voltage for DC and pulsed conditions.

The upper boundary is formed by I_{Cmax}, which extends to where the product of I_{Cmax} and V_{CE} equals the maximum power dissipation. From this point I_C must be reduced as V_{CE} is increased, thus forming the constant power curve of the maximum power dissipation boundary.

This maximum power dissipation boundary will normally intersect the second breakdown boundary at some point. However, for values of T_{mb} above the T_{mb} specified, $P_{tot\ max}$ must be reduced (as shown by the broken line in Fig.8), so that the boundary of maximum power dissipation intersects the second breakdown boundary at a lower point.

IN PULSED CONDITIONS

With the exception of DC forward biased SOAR, data sheets for power transistors contain a set of curves that apply under specific pulse conditions, normally at a duty factor of δ = 0.01 and at pulse lengths of 20 ms or less. An example of the forward biased SOAR extension for single-shot and repetitive pulsed operation is shown in Fig.9.

The curves for pulsed conditions shown in Fig.9 are derived from the DC curve with the aid of the thermal impedance curves shown in Fig.7.

All curves apply to the temperature stated in the data sheet (T_{mb} or T_h). Derating must be applied for the allowable P_{tot} at any T_{mb} or T_h up to $T_{j\ max}$, an example of a power derating curve is shown in Fig.10. The second breakdown curve is valid for all temperatures up to $T_{j\ max}$ unless an I_{SB} (second breakdown current) derating curve is specified, in which case derating has to be applied.

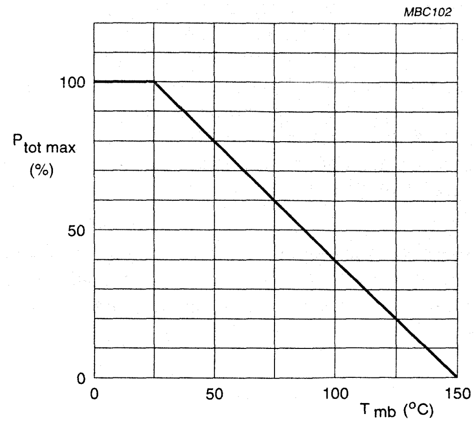
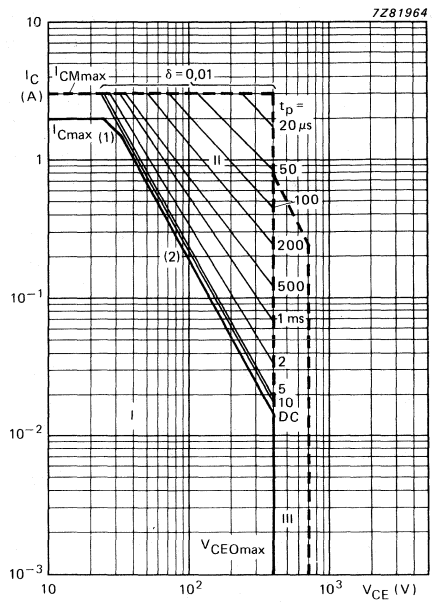


Fig.10 Power derating curve: maximum allowable power dissipation as a function of mounting base temperature.

Forward biased safe operating area with $V_{CE} > V_{CEOmax}$

For switching power transistors in inductive load applications such as flyback converters, the collector-emitter voltage normally exceeds the rated V_{CEOmax} limit in the non-inductive stage. The collector current will rise steeply at turn-on while the collector-emitter voltage is still greater than V_{CEOmax}. Under these conditions the collector current must be held at a safe level by means of load line shaping or similar circuits.

Figure 11 shows forward biased SOAR with an extension for turn-on (area III); this is not temperature dependent and therefore derating at higher temperatures is not necessary.



I — Region of permissible DC operation.

II — Permissible extension for repetitive pulse operation.

III — Area of permissible operation during turn-on in single-transistor converters, provided $R_{BE} \leq 100\ \Omega$ and $t_p \leq 6.0\ \mu s$.

(1) — $P_{tot\ max}$ and $P_{tot\ peak}$ maximum lines.

(2) — Second breakdown limits.

Fig.11 Safe operating area at $T_{amb} \leq 25$ °C.

Reversed biased safe operating area up to V_{CESmax}

Most inductively loaded transistors operate with their base to emitter junction reverse biased. At turn-off, the inductive loading causes the collector to emitter voltage to rise steeply to a high level while the collector continues to conduct. Under these conditions the collector voltage must be held to a safe level by means of a clamping, snubbing or similar circuit.

The SOAR extension for this reverse biased operation is shown in the relevant data sheets in a graph as in Fig.12. This turn-off extension is not temperature dependent and so derating at higher temperatures is not necessary.

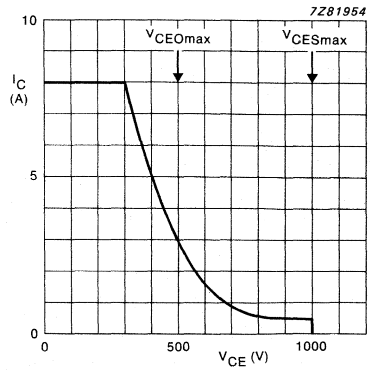


Fig.12 Reversed biased area of permissible operation during turn-off, providing that $T_{mb} \leq 100$ °C; $V_{BEoff} = 5$ V; $I_C/I_B \geq 5$.

Using data sheet SOAR information

Select a power transistor for a particular function or application using the following criteria from QUICK REFERENCE DATA:

collector current, I_C or I_{CM}
collector voltage, V_{CEO} or V_{CES}
maximum allowable dissipation, P_{tot}
maximum allowable junction temperature, T_j
required gain, h_{FE}
required speed, t_f or f_T.

Determine the following parameters for the intended application:

duty factor, δ
maximum operating ambient temperature, T_{amb}
maximum operational, worst-case average dissipation, P_{WC}.

Calculate the thermal resistance of the heatsink, $R_{th\ h\text{-}a}$:

for directly mounted devices

$$R_{th\ h\text{-}a} = \frac{T_j - T_{mb}}{P_{WC}} - \left(R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}\right)$$

or for fully isolated devices

$$R_{th\ h\text{-}a} = \frac{T_j - T_{mb}}{P_{WC}} - R_{th\ j\text{-}mb}.$$

Calculate the mounting base temperature, T_{mb} or T_h:

for directly mounted devices

$$T_{mb} = T_{amb} + P_{WC}(R_{th\ h\text{-}a} + R_{th\ mb\text{-}h})$$

or for fully isolated devices

$$T_h = T_{amb} + P_{WC} \times R_{th\ h\text{-}a}.$$

Use the data sheet SOAR curves, thermal impedance and derating to construct a safe operating area for the device (this can be adapted to the conditions for the application, e.g. T_{mb}, pulse time, duty factor).

Measure the I_C/V_{CE} locus in the application and check that it does not exceed the previously-constructed SOAR graph. In switching applications check also the extensions for turn-on and turn-off.

If the SOAR of the preferred transistor does not fit the requirements, select the nearest suitable device or modify the application circuit.

APPLICATION INFORMATION

APPLICATION INFORMATION

Application information for high voltage and switching npn power transistors, and other Philips Semiconductors power products, is published in the Power Semiconductors Applications Handbook. The order code for this publication is: 9398 652 85011.

The Applications Handbook contains information-processing the theory of power transistors in typical applications such as SMPS and TV deflection circuits. Examples are included to support the theory.

DEVICE DATA

in alphanumeric sequence

SILICON DIFFUSED POWER TRANSISTOR

High-voltage, high-speed switching npn power transistor in a TO-220 envelope intended for use in horizontal deflection circuits of colour television receivers. The BU505D has an integrated efficiency diode.

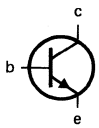
QUICK REFERENCE DATA

Collector-emitter voltage			
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
open base	V_{CEO}	max.	700 V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.0 V
Collector current			
saturation	I_{Csat}	max.	2.0 A
DC	I_C	max.	2.5 A
peak value	I_{CM}	max.	4.0 A
Diode forward voltage (BU505D)	V_F	max.	1.8 V
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	75 W
Fall time; inductive load	t_f	typ.	0.9 μs

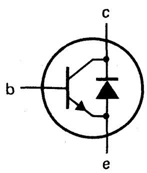
MECHANICAL DATA

Dimensions in mm

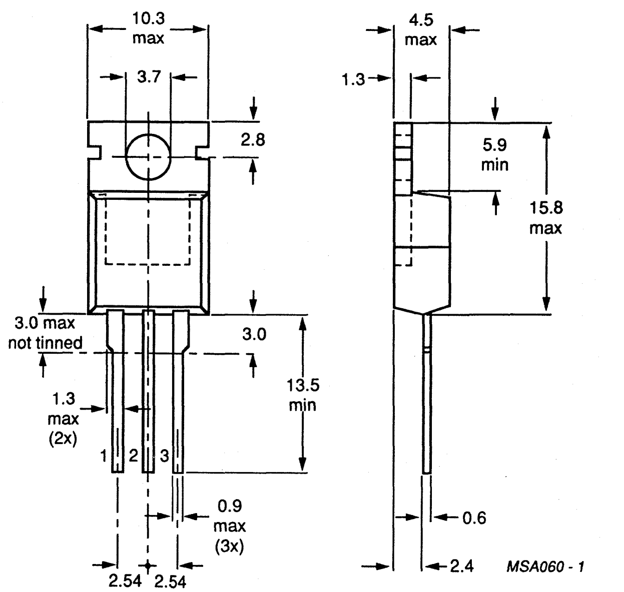
Fig. 1 TO-220AB.



BU505



BU505D



Pinning:

1 = base
2 = collector
3 = emitter

Collector connected to mounting base.

RATINGS

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

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CES}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector current				
saturation	I_{Csat}	max.	2.0	A
DC	I_C	max.	2.5	A
peak	I_{CM}	max.	4.0	A
Base current				
DC	I_B	max.	2.0	A
peak	I_{BM}	max.	4.0	A
Total power dissipation				
up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	75	W
Storage temperature range	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.67	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current*			
$V_{BE} = 0$; $V_{CE} = V_{CESmax}$	I_{CES}	max.	0.15 mA
$V_{BE} = 0$; $V_{CE} = V_{CESmax}$; T_j = 125 °C	I_{CES}	max.	1.0 mA
Emitter cut-off current			
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	max.	1.0 mA
Emitter-base voltage			
I_E = 10 mA; I_C = 0 A	V_{EBO}		6.0 V
Collector-emitter sustaining voltage (Figs 2 and 3)	$V_{CEOsust}$	min.	700 V
Saturation voltage			
I_C = 2.0 A; I_B = 0.9 A	V_{CEsat}	max.	1.0 V
	V_{BEsat}	max.	1.3 V
DC current gain			
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Diode forward voltage (BU505D)			
I_F = 2 A	V_F	max.	1.8 V
Transition frequency at f = 5 MHz			
I_C = 0.1 A; V_{CE} = 5 V	f_T	typ.	7.0 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	65 pF
Switching times (in horizontal deflection circuit) (Fig. 4)			
I_{CM} = 2 A; $I_{B(end)}$ = 0.9 A; V_{dr} = −4 V			
L_B = 10 μH	t_s	typ.	6.5 μs
	t_f	typ.	0.9 μs
L_B = 15 μH	t_s	typ.	7.5 μs
	t_f	typ.	0.9 μs
L_B = 25 μH	t_s	typ.	9.5 μs
	t_f	typ.	0.85 μs

* Measured with a half-sinewave voltage (curve tracer).

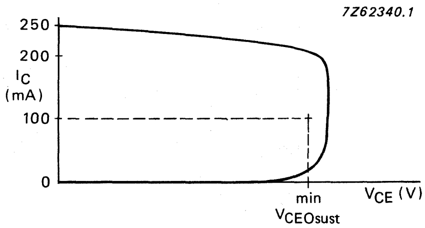


Fig. 2 Oscilloscope display for sustaining voltage.

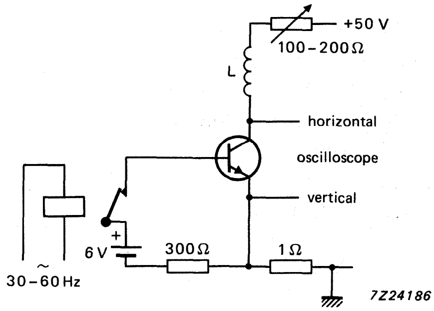


Fig. 3 Test circuit for V_{CEOsat}.

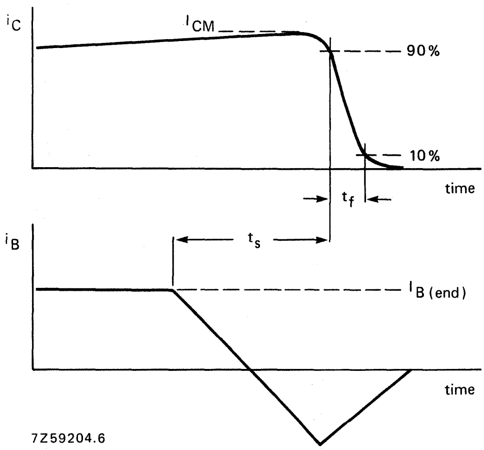


Fig. 4 Switching times waveforms.

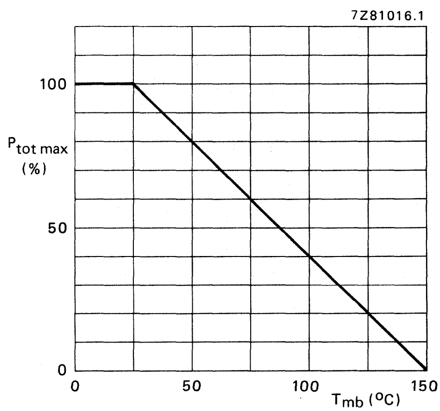
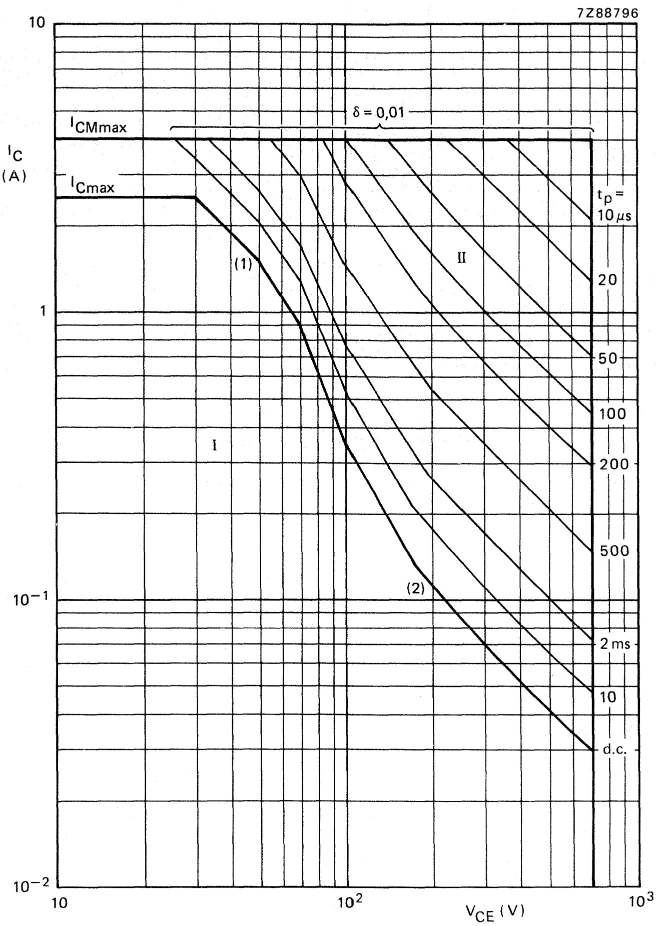


Fig. 5 Power derating curve.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

(1) $P_{tot\ max}$ and $P_{tot\ peak\ max}$ lines.
(2) Second breakdown limits.

Fig. 6 Safe operating area at T_m = 25 °C.

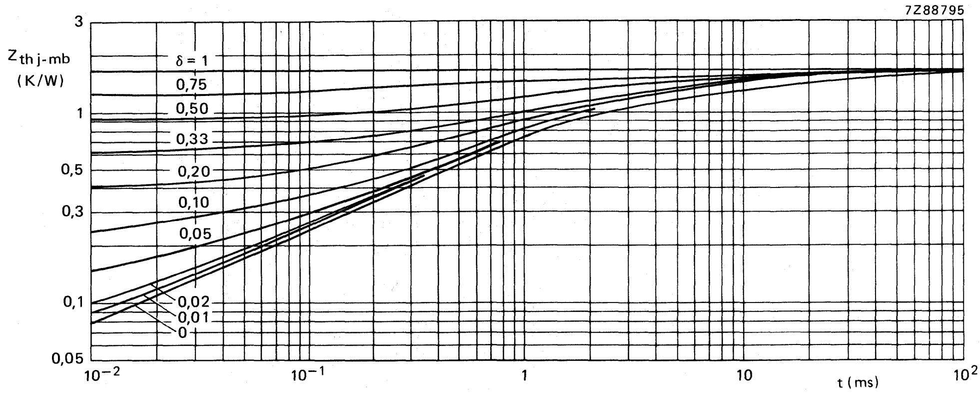


Fig. 7 Pulse power rating chart.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistor in a SOT186 envelope with electrically isolated mounting base, intended for use in horizontal deflection circuits of colour television receivers. The BU505DF has an integrated efficiency diode.

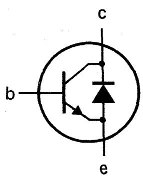
QUICK REFERENCE DATA

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.0	V
Collector current				
saturation	I_{Csat}	max.	2.0	A
DC	I_C	max.	2.5	A
peak value	I_{CM}	max.	4.0	A
Diode forward voltage (BU505DF)	V_F	max.	1.8	V
Total power dissipation up to $T_h = 25\ ^oC$	P_{tot}	max.	20	W
Fall time inductive load	t_f	typ.	0.7	μs

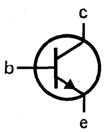
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT186.



BU505DF

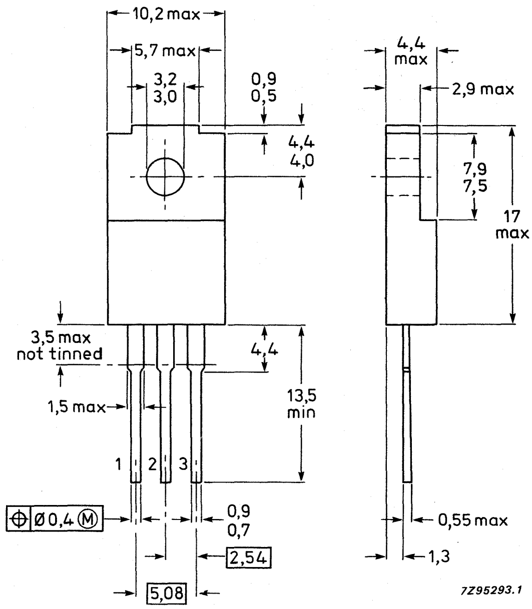


BU505F

Pinning:

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated from all terminals.



RATINGS

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

Collector-emitter voltage			
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
open base	V_{CEO}	max.	700 V
Collector current			
saturation	I_{Csat}		2.0 A
DC	I_C	max.	2.5 A
peak	I_{CM}	max.	4.0 A
Base current			
DC	I_B	max.	2.0 A
peak	I_{BM}	max.	4.0 A
Total power dissipation			
up to $T_h = 25\ ^oC$	P_{tot}	max.	20 W
Storage temperature range	T_{stg}		−65 to + 150 ^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	max.	6.35 K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	max.	3.85 K/W
From junction to ambient	$R_{th\ j\text{-}a}$	max.	55 K/W

ISOLATION

Isolation voltage from all terminals to external heatsink; peak value	V_{isol}	max.	1500 V
Isolation capacitance from collector to external heatsink	C_{isol}	typ.	12 pF

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current*				
V_{BE} = 0; V_{CE} = V_{CESmax}	I_{CES}	max.	0.15	mA
V_{BE} = 0; V_{CE} = V_{CESmax}; T_j = 125 °C	I_{CES}	max.	1.0	mA
Emitter cut-off current				
V_{EB} = 5 V; I_C = 0	I_{EBO}	max.	1.0	mA
Second-breakdown current				
V_{CE} = 120 V; t_p = 200 μs	I_{SB}	min.	2.0	A
Collector-emitter sustaining voltage				
I_C = 0.1 A; I_B = 0; L = 25 mH; (Figs 2 and 3)	$V_{CEOsust}$	min.	700	V
Saturation voltage				
I_C = 2.0 A; I_B = 0.9 A	V_{CEsat}	max.	1.0	V
	V_{BEsat}	max.	1.3	V
Diode forward voltage (BU505DF)				
I_F = 2 A	V_F	max.	1.8	V
DC current gain				
I_C = 2.0 A; V_{CE} = 5 V	h_{FE}	min.	2.22	
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	6	
	h_{FE}	typ.	13	
	h_{FE}	max.	30	
Transition frequency at f = 1 MHz				
I_C = 0.1 A; V_{CE} = 5 V	f_T	typ.	7.0	MHz
Collector capacitance at f = 1 MHz				
I_E = I_e = 0; V_{CB} = 10 V	C_c	typ.	65	pF
Switching times (in horizontal deflection circuit) (Fig. 4)				
I_{CM} = 2 A; $I_{B(end)}$ = 0.9 A; V_{dr} = −4 V				
L_B = 10 μH	t_s	typ.	6.5	μs
	t_f	typ.	0.9	μs
L_B = 15 μH	t_s	typ.	7.5	μs
	t_f	typ.	0.9	μs
L_B = 25 μH	t_s	typ.	9.5	μs
	t_f	typ.	0.85	μs

* Measured with a half-sinewave voltage (curve tracer).

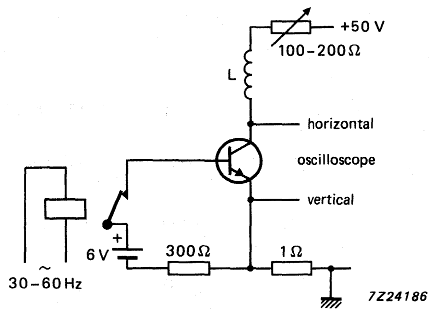


Fig. 2 Test circuit for $V_{CEOsust}$.

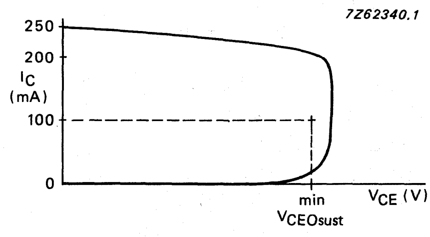


Fig. 3 Oscilloscope display for sustaining voltage.

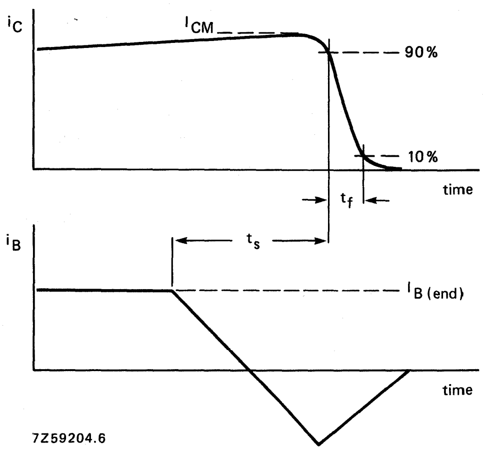


Fig. 4 Switching times waveforms.

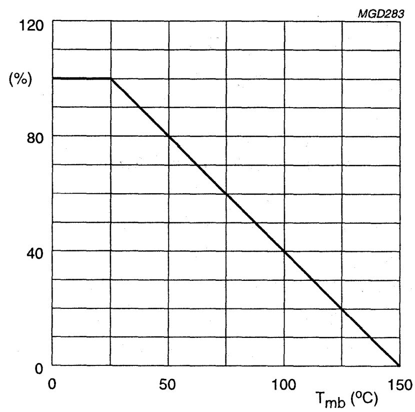
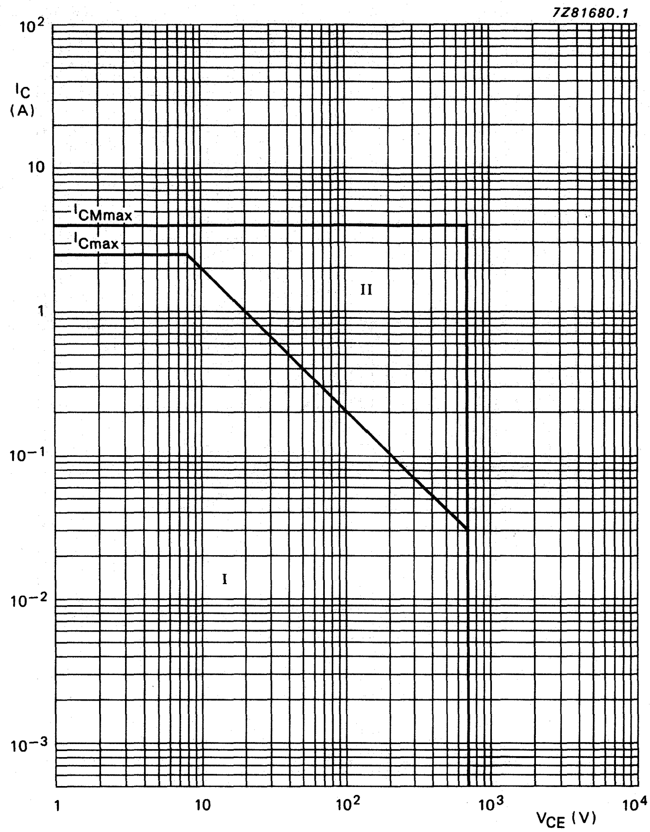
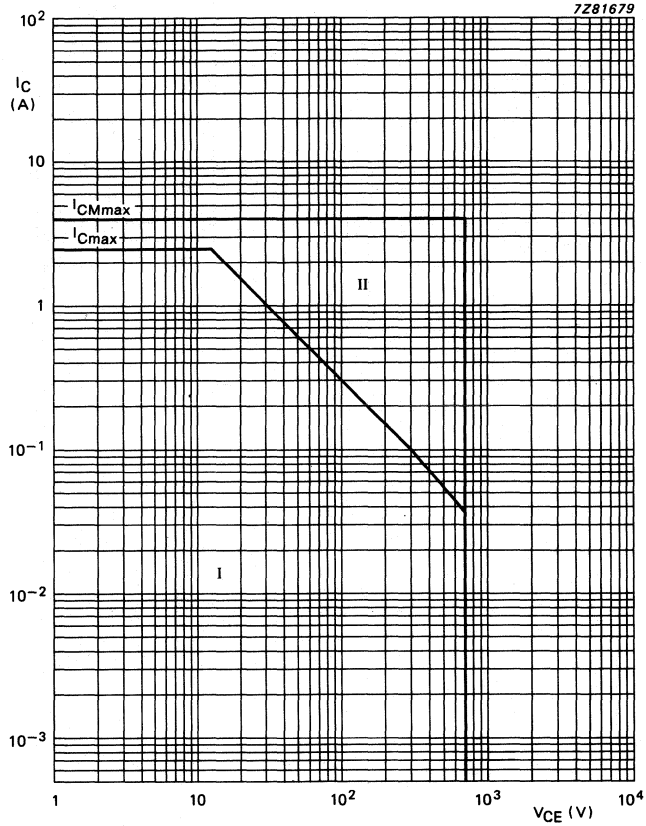


Fig. 5 Total power dissipation.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 6 Safe operating area; T_h = 25 °C; mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 7 Safe operating area; T_h = 25 °C; mounted with heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

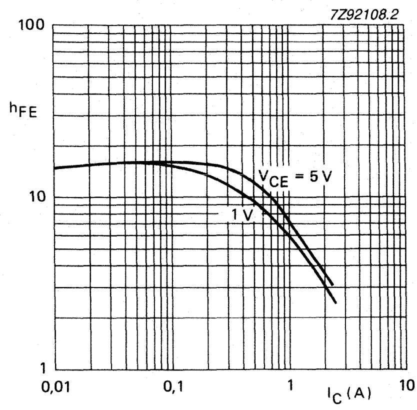


Fig. 8 Typical DC current gain; T_j = 25 °C.

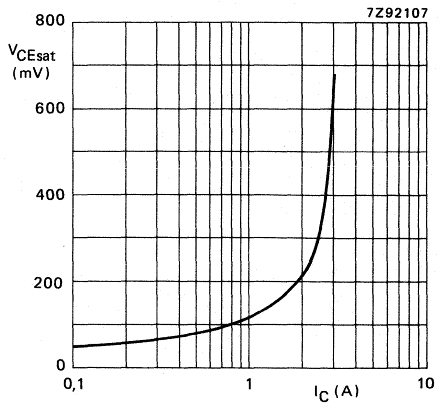


Fig. 9 Collector-emitter saturation voltage; I_C/I_B = 2; T_j = 25 °C.

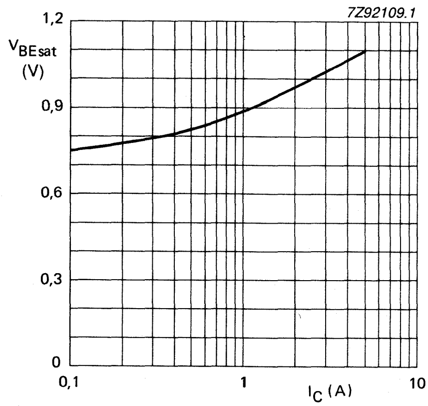


Fig. 10 Base-emitter saturation voltage; I_C/I_B = 2; T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of colour television receivers and for line operated switch-mode applications.
The BU506D has an integrated efficiency diode.

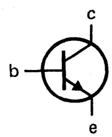
QUICK REFERENCE DATA

Collector-emitter voltage				
peak value; V_{BE} = 0	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.0	V
Collector current				
saturation	I_{Csat}		3.0	A
DC	I_C	max.	5.0	A
peak value	I_{CM}	max.	8.0	A
Total power dissipation				
up to T_{mb} = 25 °C	P_{tot}	max.	100	W
Diode forward voltage (BU506D)				
I_F = 3 A	V_F	typ.	1.5	V
Fall time inductive load	t_f	typ.	0.7	μs

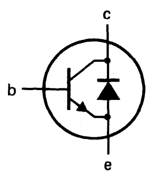
MECHANICAL DATA

Dimensions in mm

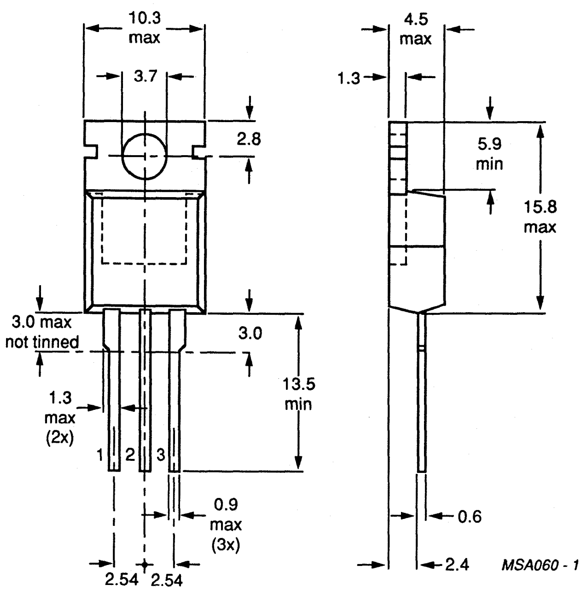
Fig. 1 TO-220AB.



BU506



BU506D



Pinning:

1 = base
2 = collector
3 = emitter

Collector connected to case.

RATINGS

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

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector current				
saturation	I_{Csat}		3.0	A
DC	I_C	max.	5.0	A
peak	I_{CM}	max.	8.0	A
Base current				
DC	I_B	max.	3.0	A
peak	I_{BM}	max.	5.0	A
Total power dissipation				
up to T_{mb} = 25 °C	P_{tot}	max.	100	W
Storage temperature range	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	1.25	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current*			
V_{BE} = 0; V_{CE} = $V_{CESMmax}$	I_{CES}	max.	0.5 mA
V_{BE} = 0; V_{CE} = $V_{CESMmax}$; T_j = 125 °C	I_{CES}	max.	1.0 mA
Emitter cut-off current			
I_C = 0; V_{EB} = 6 V	I_{EBO}	max.	10 mA
Collector-emitter sustaining voltage (Figs 2 and 3)	$V_{CEOsust}$	min.	700 V
Saturation voltage			
I_C = 3 A; I_B = 1.33 A	V_{CEsat}	max.	1.0 V
	V_{BEsat}	max.	1.3 V
DC current gain			
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Diode forward voltage (BU506D)			
I_F = 3 A	V_F	typ.	1.5 V
	V_F	max.	2.2 V
Switching times (in line deflection circuit) (Fig. 4)			
I_{CM} = 3 A; $I_{B(end)}$ = 1 A; L_B = 12 μH	t_f	typ.	0.7 μs
	t_s	typ.	6.5 μs

* Measured with a half-sinewave voltage (curve tracer).

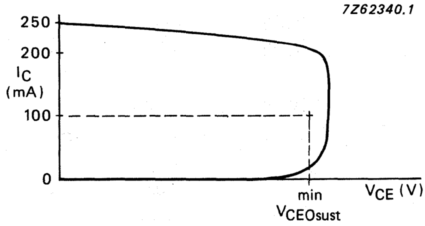


Fig. 2 Oscilloscope display for $V_{CEOsust}$.

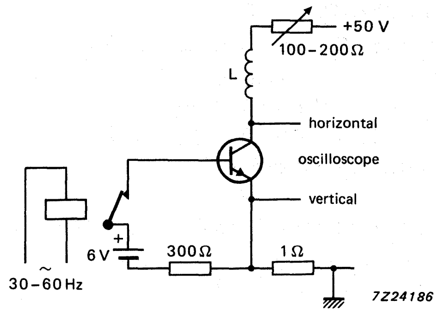


Fig. 3 Test circuit for $V_{CEOsust}$.

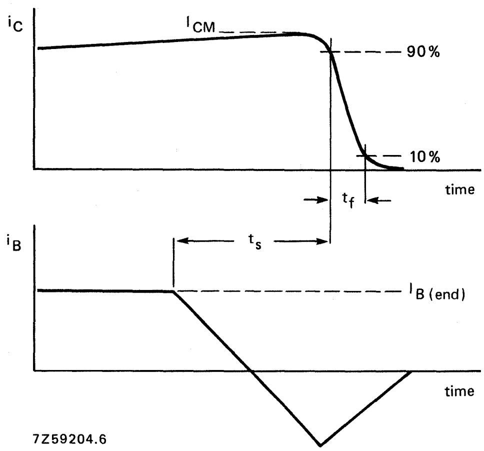


Fig. 4 Switching times waveforms.

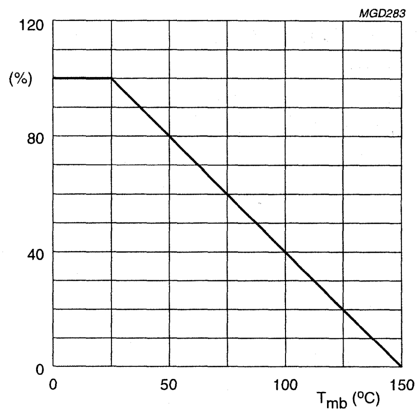
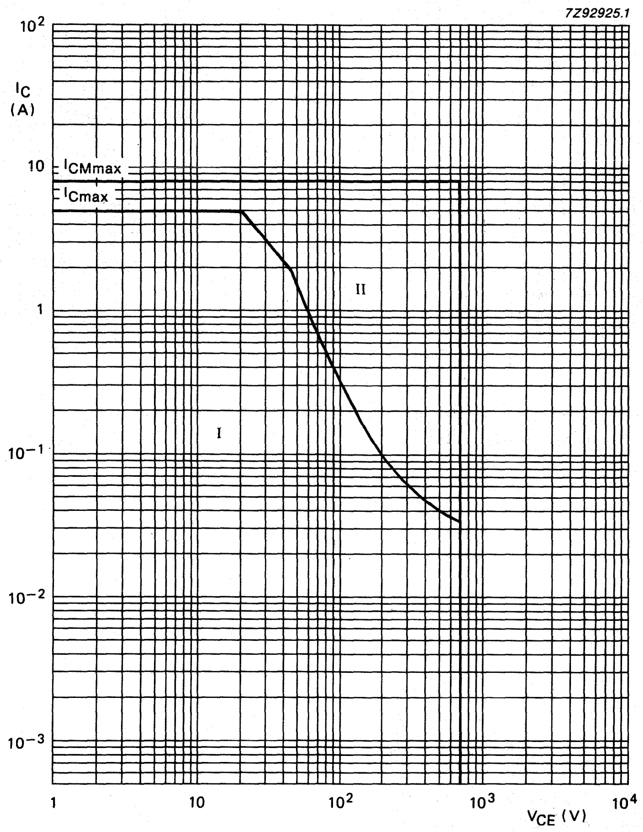


Fig. 5 Total power dissipation.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 6 Safe operating area at $T_{mb} = 25\ ^oC$.

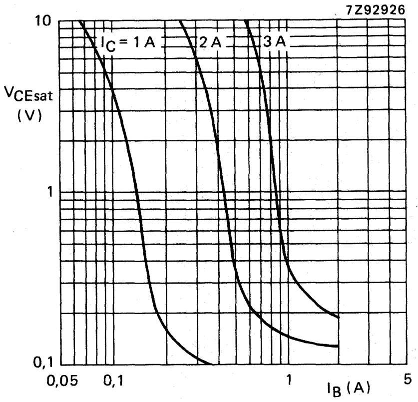


Fig. 7 Typical collector-emitter saturation voltage; T_{mb} = 25 °C.

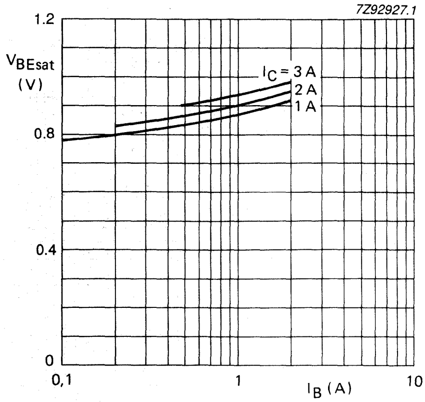


Fig. 8 Typical base-emitter saturation voltage; T_{mb} = 25 °C.

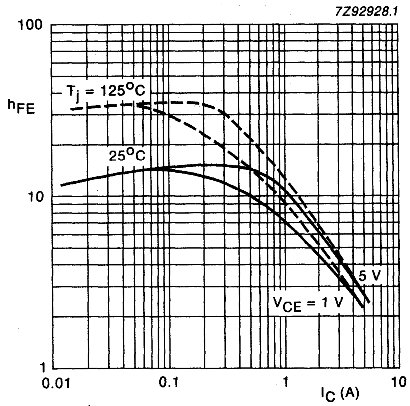


Fig. 9 Typical DC current gain.

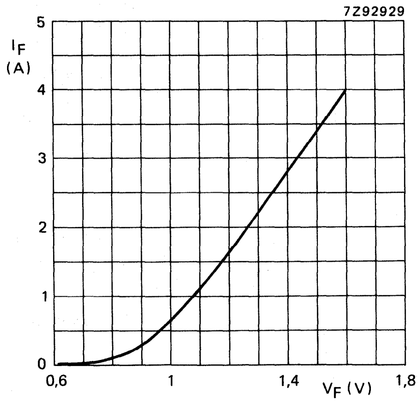


Fig. 10 Diode forward voltage; T_{mb} = 25 °C.

SILICON DIFFUSED POWER TRANSISTOR

High-voltage, high-speed switching npn transistor in a SOT186 envelope, intended for use in horizontal deflection circuits of colour television receivers and in line-operated switch-mode applications.
The product has an integrated efficiency diode.

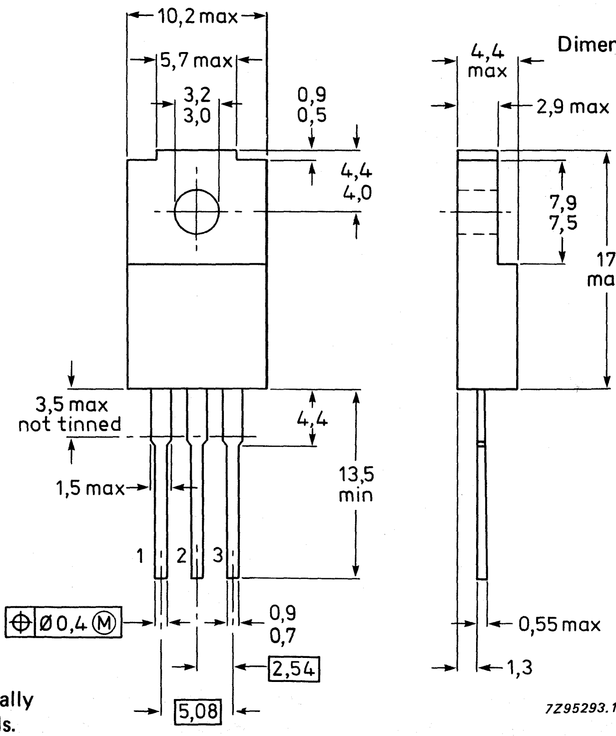
QUICK REFERENCE DATA

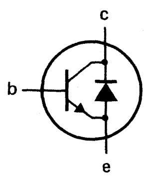
Collector-emitter voltage			
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
open base	V_{CEO}	max.	700 V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.0 V
Collector current			
saturation	I_{Csat}	max.	3.0 A
DC	I_C	max.	5.0 A
peak value	I_{CM}	max.	8.0 A
Total power dissipation			
up to $T_h = 25\ ^oC$	P_{tot}	max.	20 W
Diode forward voltage			
at $I_F = 3$ A	V_F	typ.	1.5 V
Fall time; inductive load	t_f	typ.	0.7 μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT186.





BU506DF

Pinning:

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated from all terminals.

RATINGS

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

Collector-emitter voltage			
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
open base	V_{CEO}	max.	700 V
Collector current			
saturation	I_{Csat}	max.	3.0 A
DC	I_C	max.	5.0 A
peak value	I_{CM}	max.	8.0 A
Base current			
DC	I_B	max.	3.0 A
peak value	I_{BM}	max.	5.0 A
Total power dissipation			
up to $T_h = 25\ ^oC$	P_{tot}	max.	20 W
Storage temperature range	T_{stg}		–65 to + 150 ^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	6.35 K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	3.85 K/W
From junction to ambient	$R_{th\text{-}a}$	=	55 K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500 V
Isolation capacitance from collector to external heatsink	C_{isol}	typ.	12 pF

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	0.5 mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125$ °C	I_{CES}	max.	1.0 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 6$ V	I_{EBO}	max.	10 mA
Saturation voltage			
$I_C = 3$ A; $I_B = 1.33$ A	V_{CEsat}	max.	1.0 V
	V_{BEsat}	max.	1.3 V
Collector saturation current			
$V_{CE} = 5$ V	I_C	typ.	3.0 A
DC current gain			
$I_C = 3$ A; $V_{CE} = 5$ V	h_{FE}	min.	2.25
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Collector emitter sustaining voltage (Figs 2 and 3)			
$I_C = 100$ mA; $I_B = 0$; $L = 25$ mH	$V_{CEOsust}$	min.	700 V
Diode forward voltage			
$I_F = 3$ A	V_F	typ.	1.5 V
	V_F	max.	2.2 V
Switching times in horizontal deflection circuit (Fig. 4)			
$I_{CM} = 3$ A; $L_B = 12$ μH;			
$I_{B\,(end)} = 1$ A;			
$\frac{-d\,I_B}{dt} = 0.33$ A/μs	t_f	typ.	0.7 μs
	t_s	typ.	6.5 μs

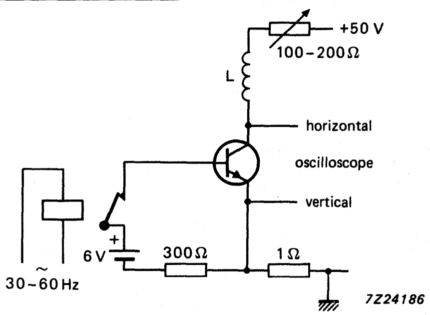


Fig. 2 Test circuit for $V_{CEOsust}$.

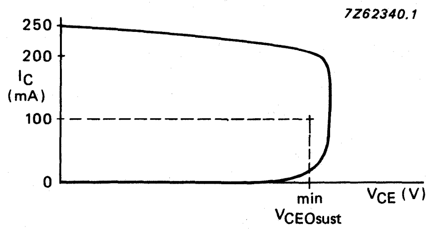


Fig. 3 Oscilloscope display for sustaining voltage.

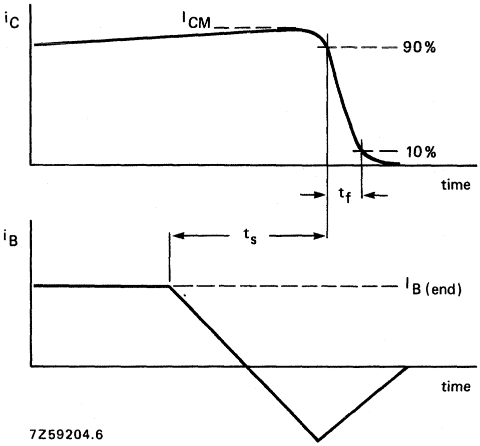


Fig. 4 Switching times waveforms.

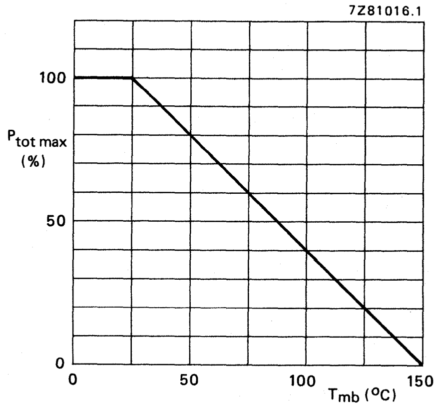


Fig. 5 Power derating curve.

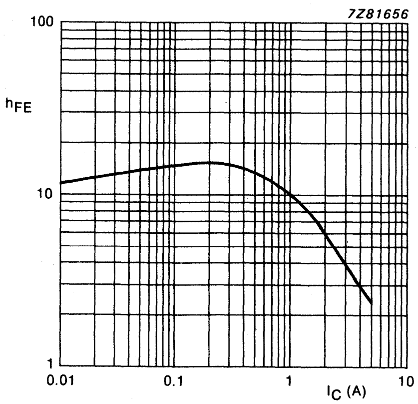
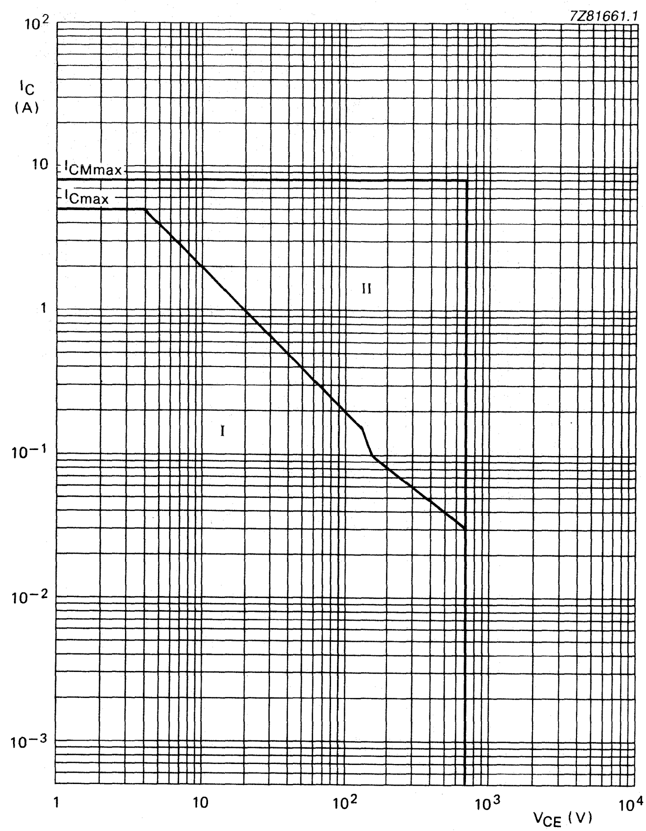
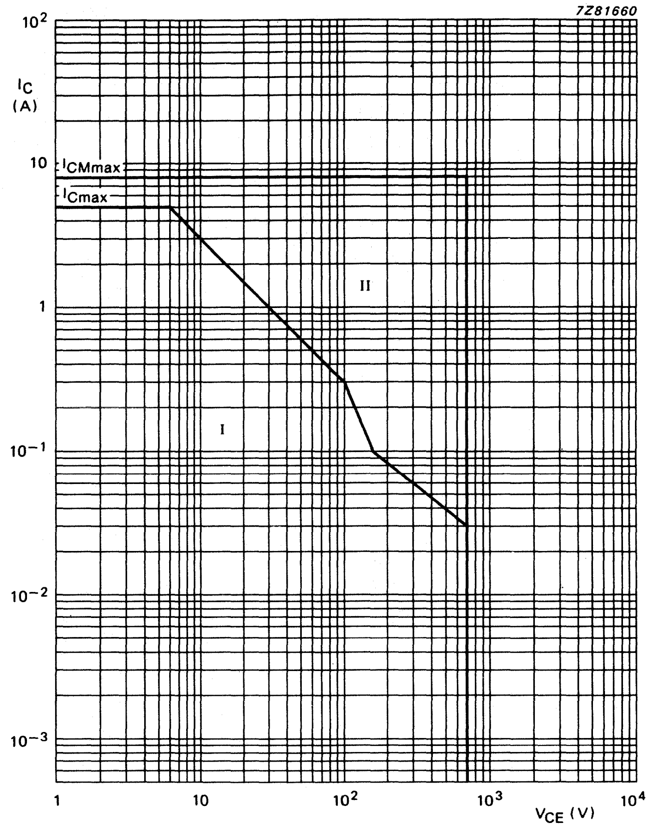


Fig. 6 Typical DC current gain; V_{CE} = 5 V; T_j = 25 °C.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 7 Safe operating area at T_{mb} = 25 °C; mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at T_{mb} = 25 °C; mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

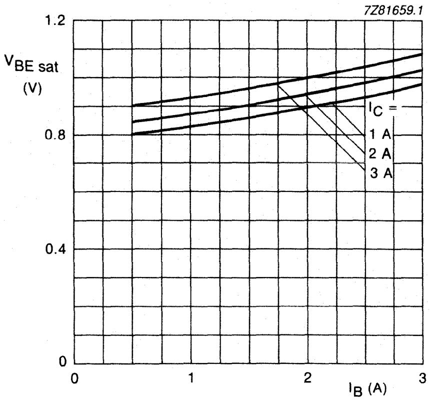


Fig. 9 Typical values V_{BEsat}; T_j = 25 °C.

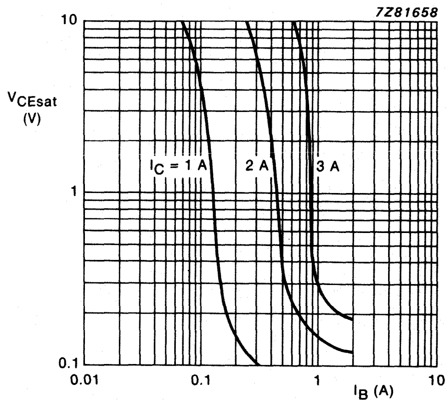


Fig. 10 Typical collector-emitter saturation voltage; T_j = 25 °C.

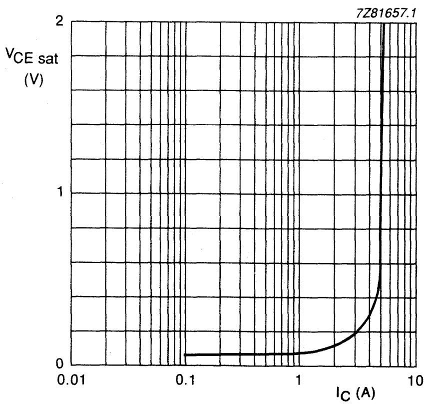


Fig.11 Typical values V_{CEsat}; I_C/I_B = 2; T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTOR

High-voltage, high-speed switching npn transistor in SOT93 envelope intended for use in horizontal deflection circuits of colour television receivers. The BU508D has an integrated efficiency diode.

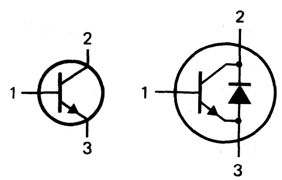
QUICK REFERENCE DATA

Collector-emitter voltage peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
Collector-emitter voltage (open base)	V_{CEO}	max.	700	V
Collector current (DC)	I_C	max.	8	A
Collector current peak value	I_{CM}	max.	15	A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	125	W
Collector-saturation voltage $I_C = 4.5$ A; $I_B = 2$ A	V_{CEsat}	max.	1	V
Saturation collector current	I_{Csat}	typ.	4.5	A
Diode forward voltage (BU508D) $I_F = 4.5$ A	V_F	typ.	1.6	V
Fall time $I_{CM} = 4.5$ A; $I_{B(on)} = 1.4$ A	t_f	typ.	0.7	μs

MECHANICAL DATA

Fig. 1 SOT93.

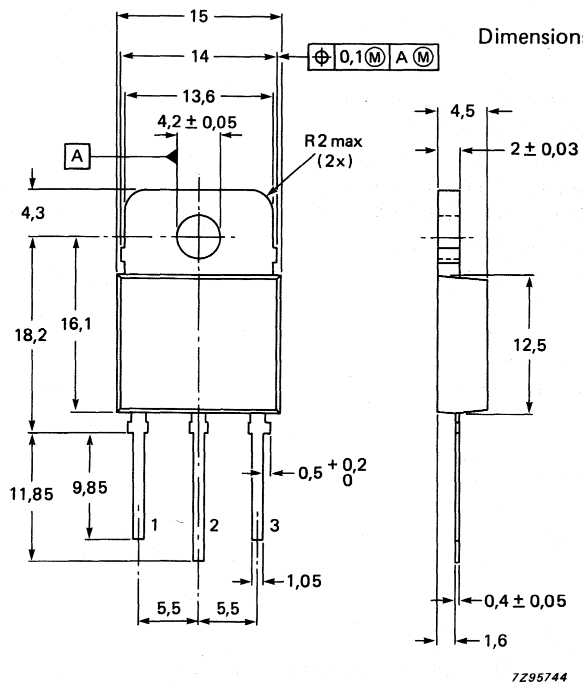
Dimensions in mm



BU508A BU508D

1 = base
2 = collector
3 = emitter

Collector connected to mounting base.



RATINGS

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

Collector-emitter voltage peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
Collector-emitter voltage (open base)	V_{CEO}	max.	700 V
Collector current (DC)	I_C	max.	8 A
Collector current peak value	I_{CM}	max.	15 A
Base current (DC)	I_B	max.	4 A
Base current (peak value)	I_{BM}	max.	6 A
Reverse base current (DC or average over any 20 ms period)	$-I_{B(AV)}$	max.	100 mA
Reverse base current* (peak value)	$-I_{BM}$	max.	5 A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	125 W
Storage temperature range	T_{stg}		−65 to + 150 ^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1 K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off current**			
$V_{BE} = 0$; $V_{CE} = V_{CESMmax}$	I_{CES}	max.	1 mA
$V_{BE} = 0$; $V_{CE} = V_{CESMmax}$; $T_j = 125\ ^oC$	I_{CES}	max.	2 mA
Emitter cut-off current $V_{EB} = 6$ V; $I_C = 0$	I_{EBO}	max.	10 mA
Collector-emitter sustaining voltage $I_B = 0$; $I_C = 100$ mA; L = 25 mH	$V_{CEOsust}$	min.	700 V
Saturation voltages $I_C = 4.5$ A; $I_B = 2$ A	V_{CEsat}	max.	1 V
	V_{BEsat}	max.	1.3 V
DC current gain $I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Transition frequency at f = 5 MHz $I_C = 0.1$ A; $V_{CE} = 5$ V	f_T	typ.	7 MHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	125 pF

* Turn-off current.
** Measured with half-sinewave voltage (curve tracer).

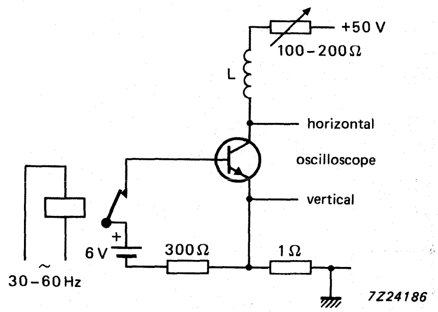


Fig. 2 Test circuit for $V_{CEOsust}$.

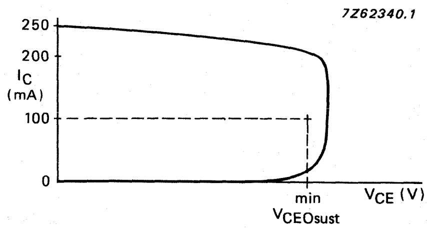


Fig. 3 Oscilloscope display for $V_{CEOsust}$.

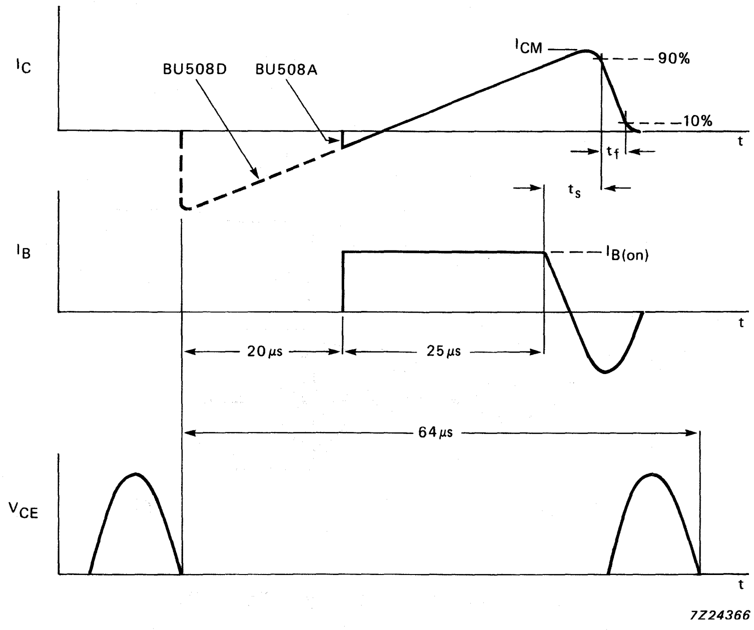


Fig. 4 Switching times waveforms; I_{CM} = 4.5 A; $I_{B(on)}$ = 1.4 A; L_B = 6 μH; $-V_{BB}$ = 4 V; $-dI_B/dt$ = 0.6 A/μs; typical value of t_s = 6.5 μs; typical value of t_f = 0.7 μs.

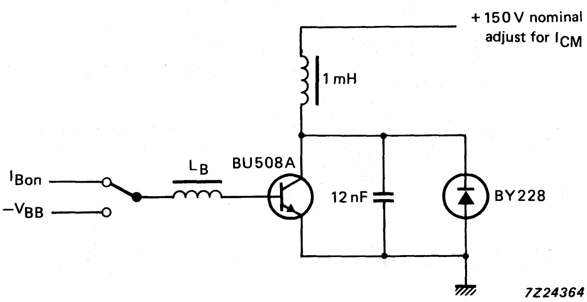


Fig. 5 Switching times test circuit (BU508A).

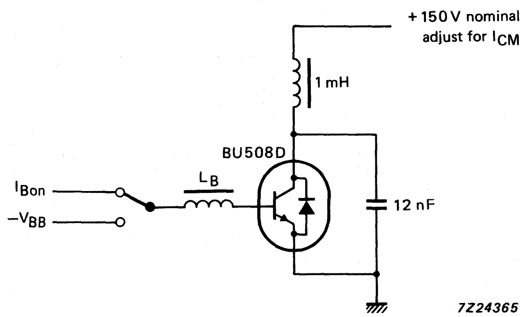
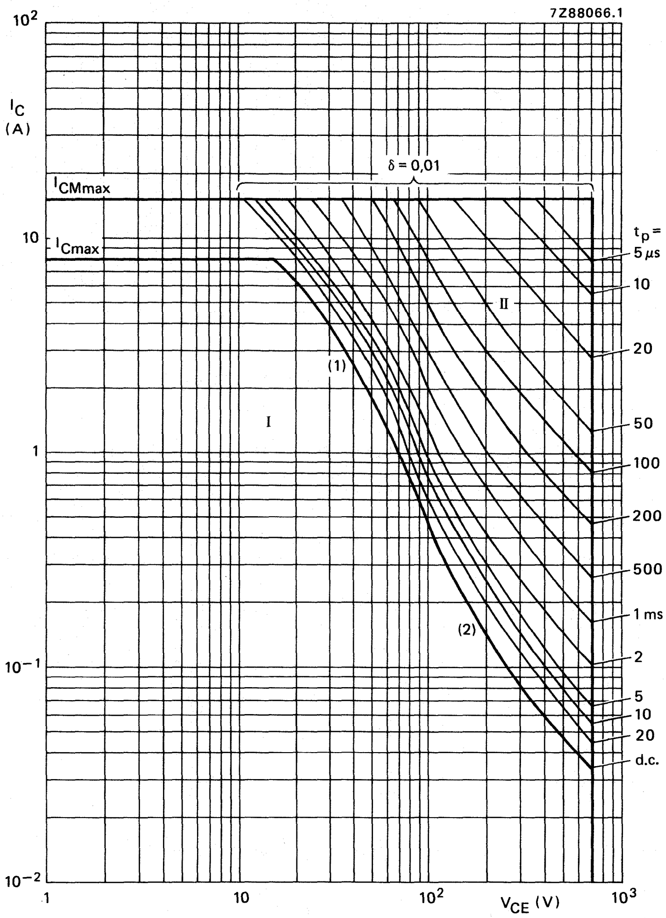


Fig. 6 Switching times test circuit (BU508D).



(1) $P_{tot\ max}$ line.
(2) Second-breakdown limits (independent of temperature).
I   Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 7 Safe operating area; $T_{mb} < 25\ ^{o}C$.

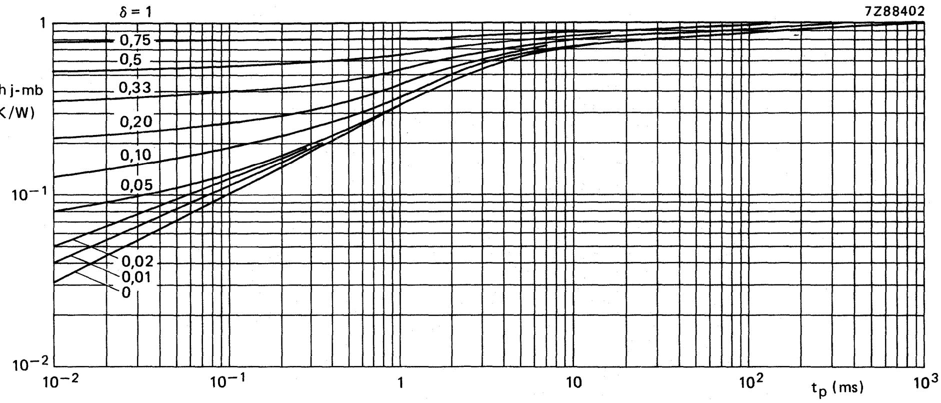


Fig. 8 Pulse power rating chart.

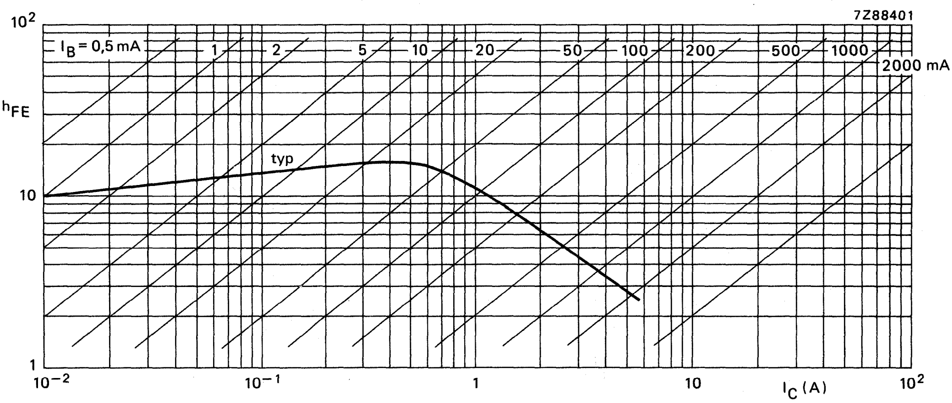


Fig. 9 Typical values DC current gain at V_{CE} = 5 V; T_{mb} = 25 °C.

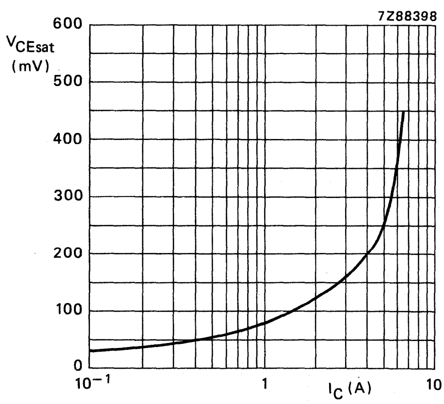


Fig. 10 Typical values I_C/I_B = 2; T_j = 25 °C.

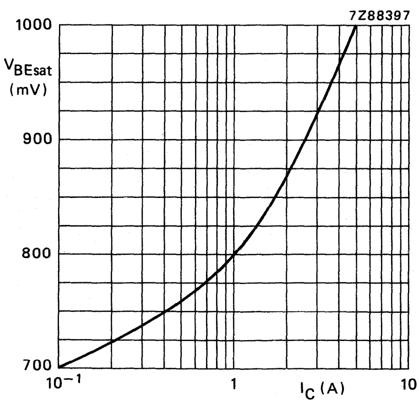


Fig. 11 Typical values I_C/I_B = 2; T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed switching npn transistors in a fully isolated SOT199 envelope (with integrated efficiency diode for the BU508DF), primarily intended for use in horizontal deflection circuits of colour television receivers.

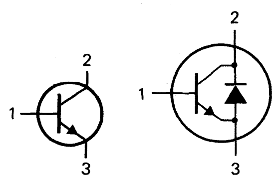
QUICK REFERENCE DATA

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector saturation current	I_{Csat}	max.	4,5	A
Collector current (DC)	I_C	max.	8	A
Collector current (peak value)	I_{CM}	max.	15	A
Total power dissipation up to $T_h = 25\ ^oC$	P_{tot}	max.	34	W
Collector-emitter saturation voltage	V_{CEsat}	max.	1	V
Diode forward voltage				
$I_F = 4{,}5$ A (BU508DF)	V_F	typ.	1,6	V
Fall time	t_f	typ.	0,7	μs

MECHANICAL DATA

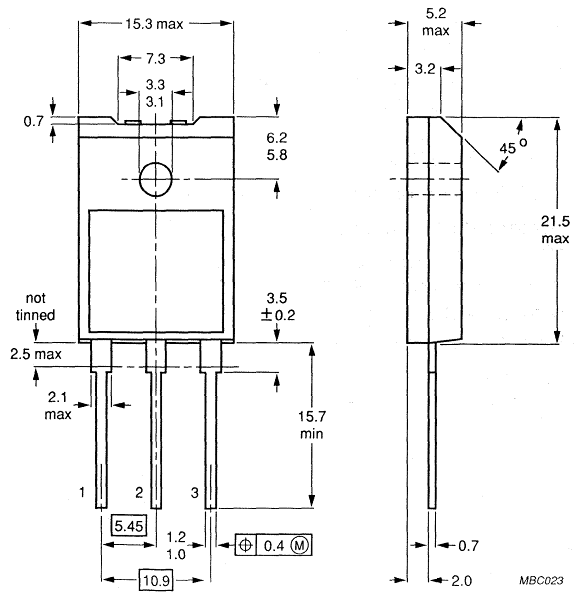
Dimensions in mm

Fig. 1 SOT199.



BU508AF BU508DF

1 = base
2 = collector
3 = emitter
Mounting base is electrically isolated from all terminals.



RATINGS

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

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector current				
DC	I_C	max.	8	A
peak value	I_{CM}	max.	15	A
saturation	I_{Csat}	max.	4,5	A
Base current				
DC	I_B	max.	4	A
peak value	I_{BM}	max.	6	A
Total power dissipation				
up to $T_h = 25\ ^{o}C$*	P_{tot}	max.	34	W
Storage temperature	T_{stg}	−65 to + 150		^{o}C
Junction temperature	T_j	max.	150	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	K/W
From junction to external heatsink*	$R_{th\ j\text{-}h}$	=	3,7	K/W
From junction to external heatsink**	$R_{th\ j\text{-}h}$	=	2,8	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	35	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500	V
Isolation capacitance from collector to external heatsink	C_{isol}	typ.	21	pF

CHARACTERISTICS

$T_j = 25\ ^{o}C$ unless otherwise specified

Collector cut-off current				
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	1	mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125\ ^{o}C$	I_{CES}	max.	2	mA
Emitter cut-off current				
$V_{EB} = 6$ V; $I_C = 0$	I_{EBO}	max.	10	mA
DC current gain				
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	6	
	h_{FE}	typ.	13	
	h_{FE}	max.	30	

* Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
** Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

Saturation voltages $I_C = I_{Csat}$; $I_B = 2$ A	V_{CEsat} V_{BEsat}	max. max.	1 V 1,3 V
Diode forward voltage $I_F = 4,5$ A (BU508DF)	V_F V_F	max. typ.	2 V 1,6 V
Collector-emitter sustaining voltage $I_C = 0,1$ A; $I_B = 0$; L = 25 mH	V_{CEOsus}	min.	700 V

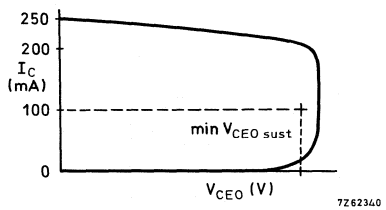


Fig. 2 Oscilloscope display for $V_{CEOsust}$.

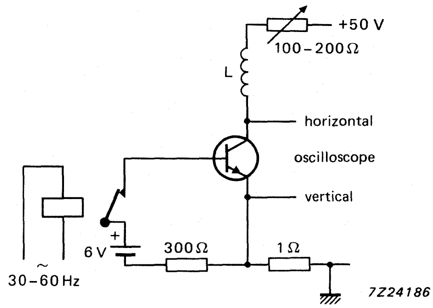


Fig. 3 Test circuit for $V_{CEOsust}$.

Transition frequency at f = 5 MHz $I_C = 0,1$ A; $V_{CE} = 5$ V	f_T	typ.	7 MHz
Collector capacitance at f = 1 MHz $I_E = i_e = 0$; $V_{CB} = 10$ V	C_c	typ.	125 pF
Switching times in horizontal deflection circuit $-V_{IM} = 4$ V; $L_B = 6$ μH $I_C = I_{Csat}$; $I_{B(end)} = 1,4$ A ($-dI_B/dt = 0,6$ A/μs)	t_f t_s	typ. typ.	0,7 μs 6,5 μs

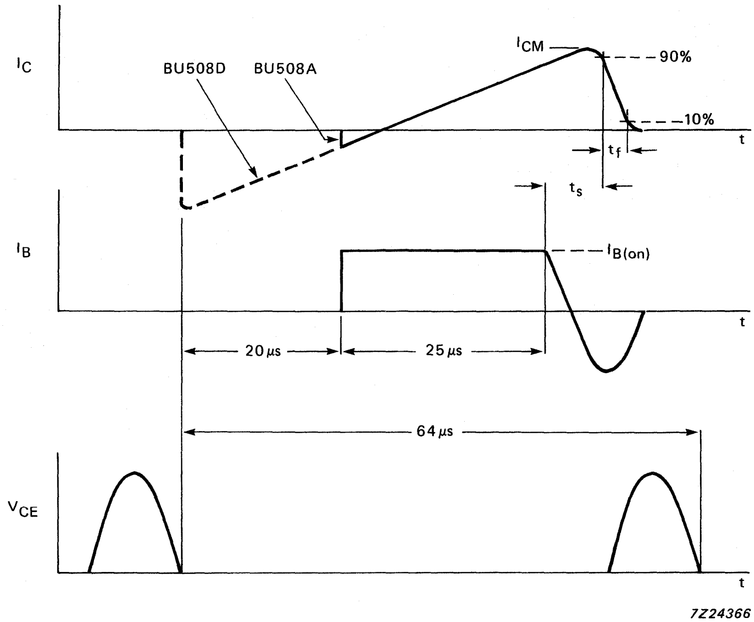


Fig. 4 Switching times waveforms.

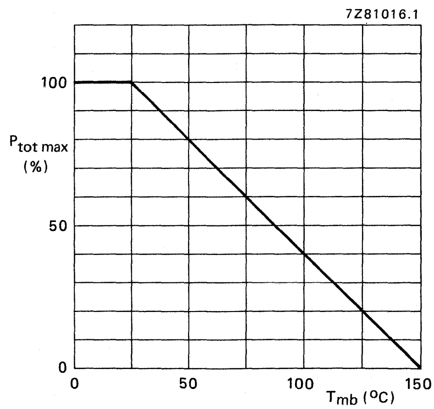


Fig. 5 Power derating curve.

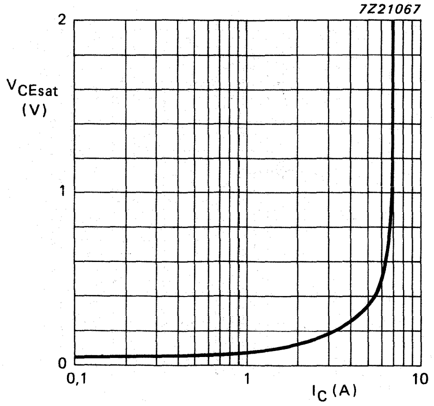


Fig. 6 Typical values $I_C/I_B = 2$; $T_j = 25\ ^oC$.

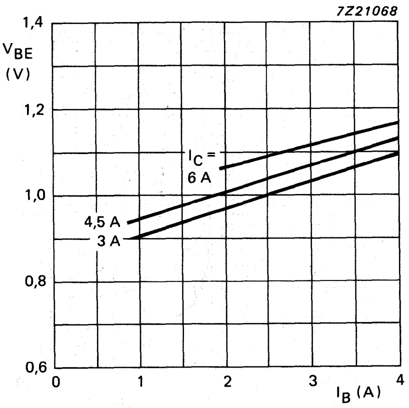


Fig. 7 Typical values base-emitter voltage at $T_j = 25\ ^oC$.

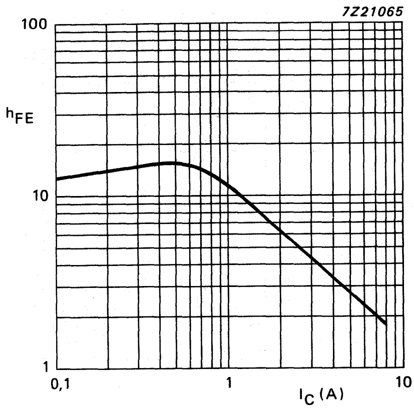


Fig. 8 Typical values DC current gain at V_{CE} = 5 V; T_j = 25 °C.

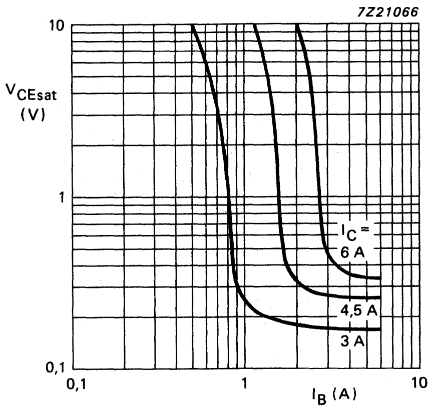
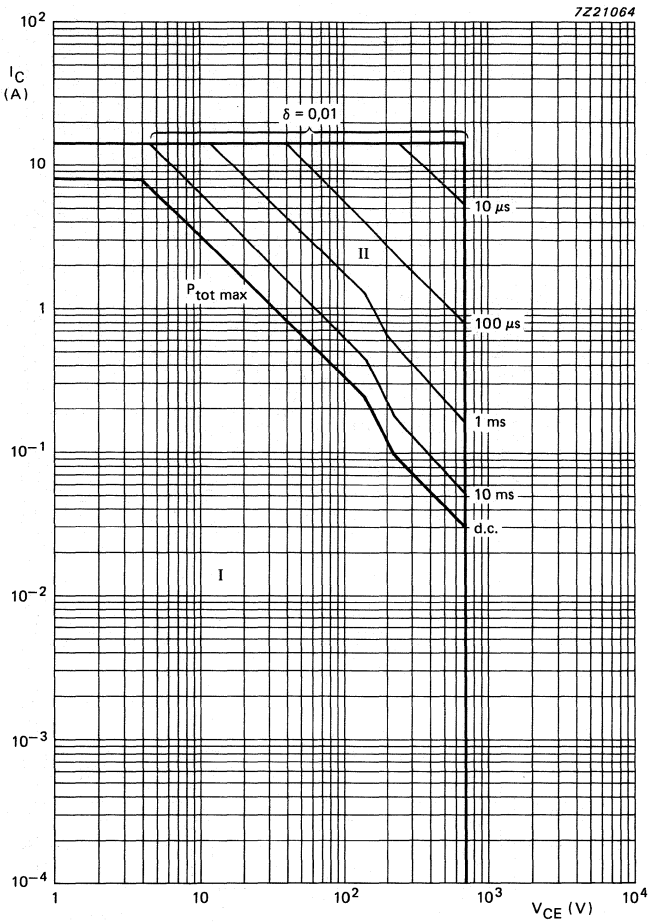
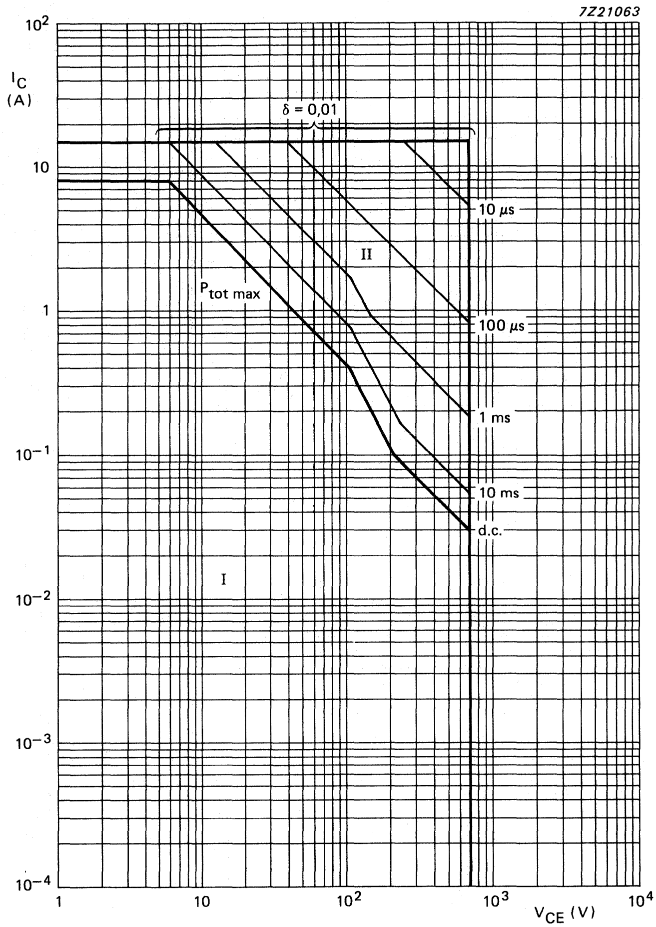


Fig. 9 Typical values collector-emitter voltage at T_j = 25 °C.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.
Note: Mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

Fig. 10 Safe Operating Area; $T_h = 25\,^oC$.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.
Note: Mounted with heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

Fig. 11 Safe Operating Area; $T_h = 25\ ^oC$.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed switching, glass passivated npn power transistor in a SOT93 envelope, intended for use in horizontal deflection circuits of television receivers.

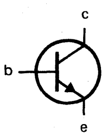
QUICK REFERENCE DATA

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1	V
Collector current				
saturation	I_{Csat}	max.	2	A
DC	I_C	max.	2.5	A
peak value	I_{CM}	max.	4	A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	75	W
Fall time inductive load	t_f	typ.	0.9	μs

MECHANICAL DATA

Dimensions in mm

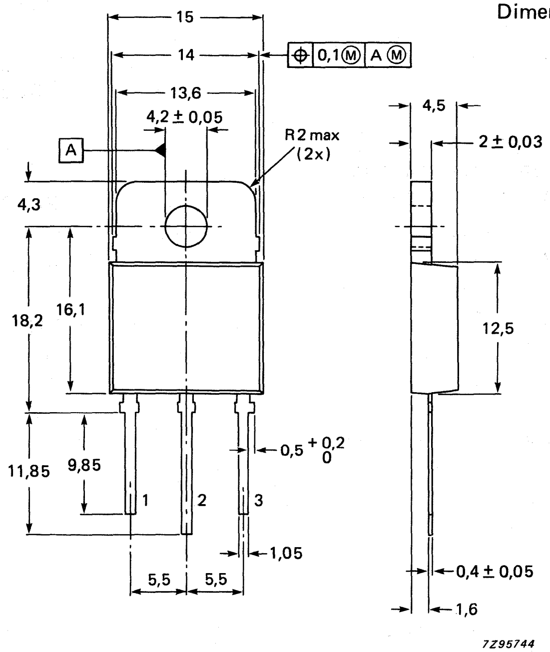
Fig. 1 SOT93.



BU705

Pinning
1 = base
2 = collector
3 = emitter

Collector connected to tab.



RATINGS

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

Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	1500	V
Collector-emitter voltage (open base)	V_{CEO}	max.	700	V
Collector current (DC)	I_C	max.	2,5	A
Collector current (peak value; $t_p < 2$ ms)	I_{CM}	max.	4	A
Base current	I_B	max.	2	A
Base current (peak value; $t_p < 2$ ms)	I_{BM}	max.	4	A
Total power dissipation up to $T_{mb} = 25$ °C	P_{tot}	max.	75	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	1,67	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Collector cut-off current*				
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	0,15	mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C	I_{CES}	max.	1	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	max.	1	mA
Emitter-base voltage				
$I_C = 0$; $I_E = 10$ mA	V_{EBO}	min.	6	V
Saturation voltage				
$I_C = 2$ A; $I_B = 0,9$ A	V_{CEsat}	max.	1	V
	V_{BEsat}	max.	1,3	V
Collector-emitter sustaining voltage				
$I_C = 100$ mA; $I_B = 0$; $L = 25$ mH	$V_{CEOsust}$	min.	700	V
Collector saturation current				
$V_{CE} = 5$ V	I_{Csat}	typ.	2	A
DC current gain				
$I_C = 2$ A; $V_{CE} = 5$ V	h_{FE}	min.	2,2	
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	6	
	h_{FE}	typ.	13	
	h_{FE}	max.	30	
Transition frequency at f = 5 MHz				
$I_C = 0,1$ A; $V_{CE} = 5$ V	f_T	typ.	7	MHz

* Measured with a half-sinewave voltage (curve tracer).

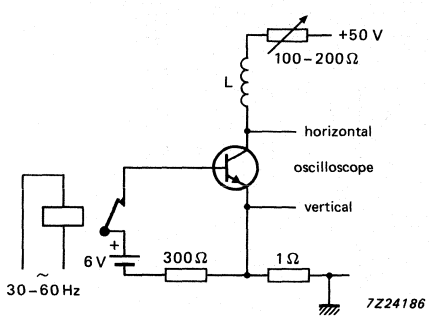


Fig. 2 Test circuit for sustaining voltage.

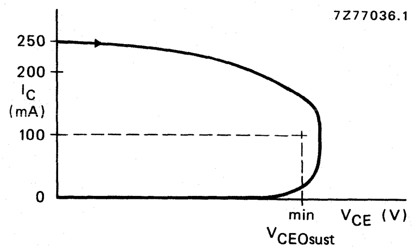


Fig. 3 Oscilloscope display for sustaining voltage.

Switching times (in horizontal deflection circuit)
$-V_{dr}$ = 4 V; L_B = 15 μH; I_{CM} = 2 A
$I_{B(end)}$ = 0,9 A;

fall time	t_f	typ.	0,9	μs
storage time	t_s	typ.	7,5	μs

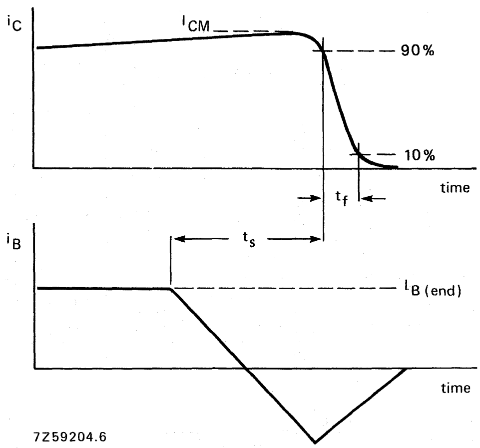
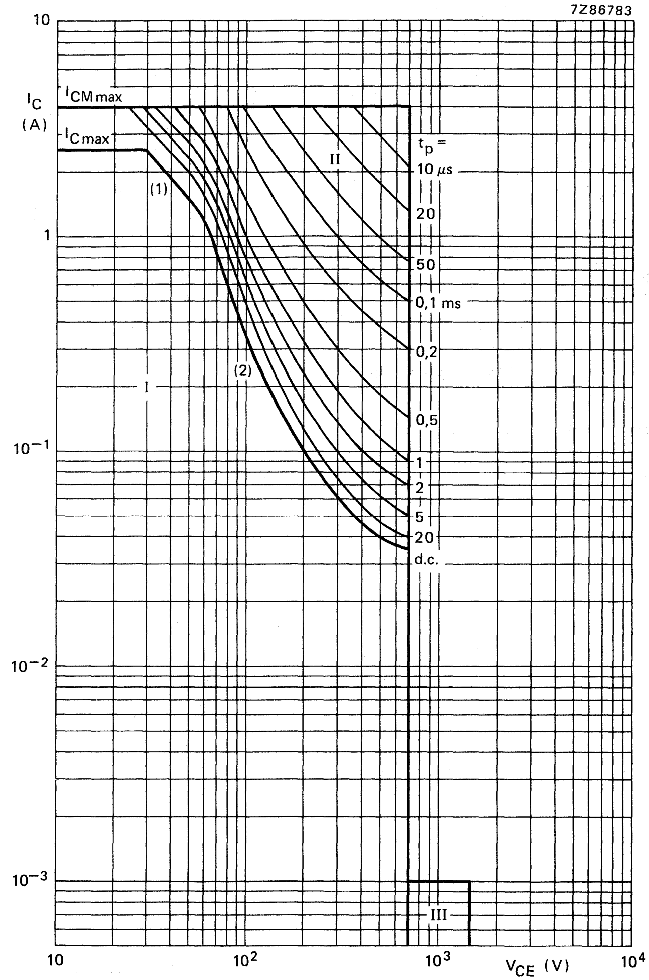


Fig. 4 Switching times waveform.



(1) $P_{tot\,max}$ and $P_{peak\,max}$ lines.
(2) Second breakdown limits.
I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.
III Repetitive pulse operation in this region is allowable, provided $R_{BE} < 100\ \Omega$, $t_p = 20\ \mu s$, d = 0,25.

Fig. 5 Safe operating area; $T_{mb} = 25\ ^oC$.

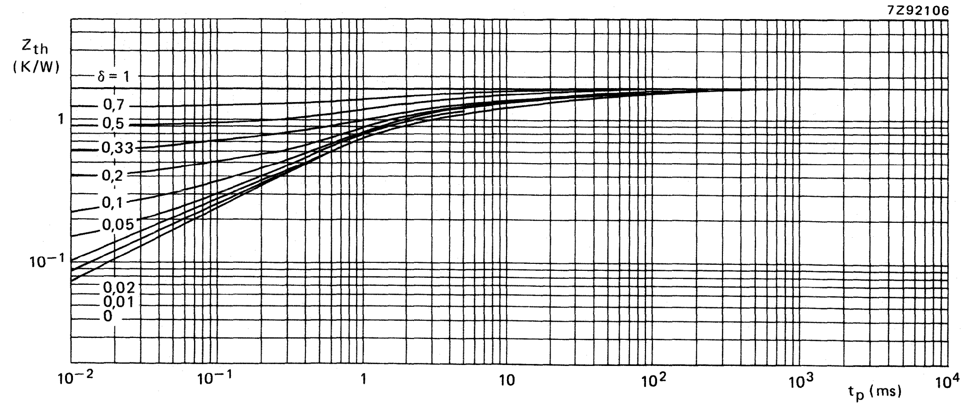


Fig. 6 Pulse power rating chart.

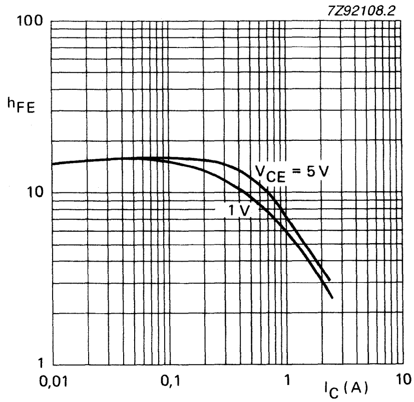


Fig. 7 Typical DC current gain; T_j = 25 °C.

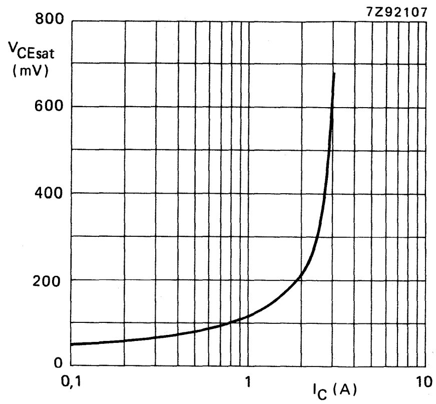


Fig. 8 Typical values V_{CEsat}
I_C/I_B = 2; T_j = 25 °C.

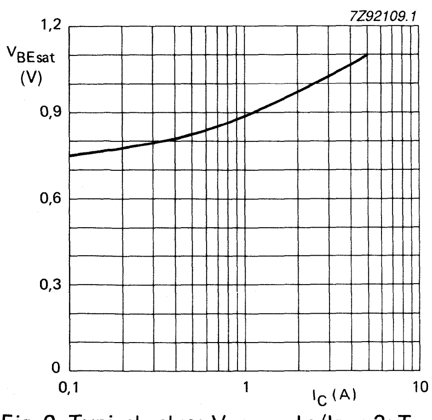


Fig. 9 Typical values V_{BEsat}; I_C/I_B = 2; T_j = 25 °C.

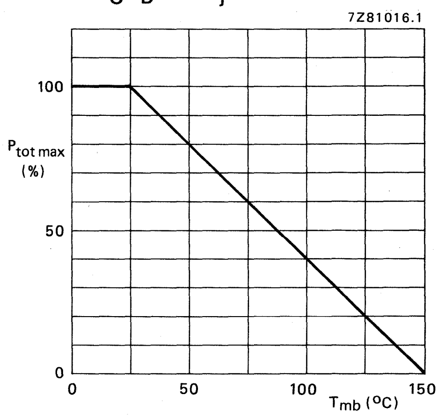


Fig. 10 Power derating curve.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed switching npn power transistors in a SOT199 envelope intended for use in horizontal deflection circuits of television receivers. The BU705DF has an integrated efficiency diode.

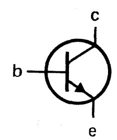
QUICK REFERENCE DATA

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.0	V
Collector current				
saturation	I_{Csat}	max.	2.0	A
DC	I_C	max.	2.5	A
peak value	I_{CM}	max.	4.0	A
Diode Forward voltage (BU705DF)	V_F	max.	1.8	V
Total power dissipation				
up to $T_{mb} = 25\ °C$	P_{tot}	max.	29	W
Fall time; inductive load	t_f	typ.	0.9	μs

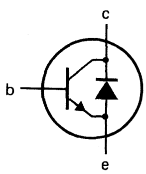
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT199.



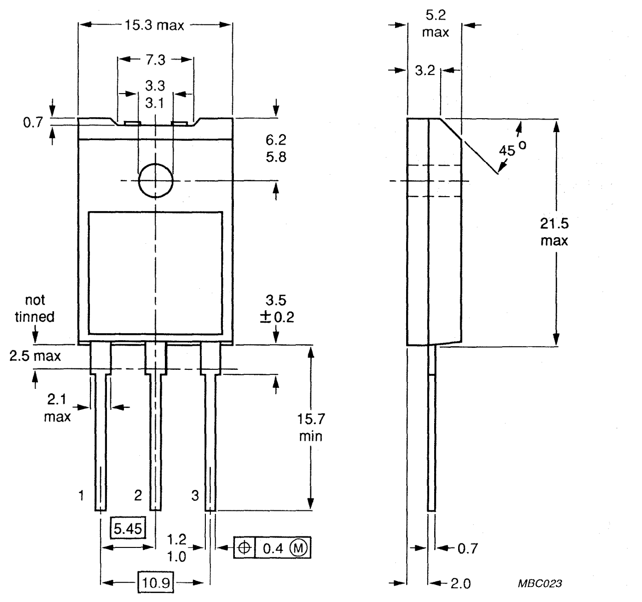
BU705F



BU705DF

Pinning:
1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated from all terminals



RATINGS

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

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector current				
saturation	I_{Csat}		2.0	A
DC	I_C	max.	2.5	A
peak	I_{CM}	max.	4.0	A
Base current				
DC	I_B	max.	2.0	A
peak	I_{BM}	max.	4.0	A
Total power dissipation				
up to $T_h = 25$ °C	P_{tot}	max.	29	W
Storage temperature range	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	4.37	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	3.47	K/W
From junction to ambient	$R_{th\text{-}a}$	=	35	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value) (note 3)	V_{isol}	max.	2000	V
Isolation capacitance from collector to external heatsink	C_{isol}	typ.	21	pF

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre envelope.
3. Repetitive peak operation with RH ⩽ 65% under clean and dust-free conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	0.15 mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	1.0 mA
Emitter cut-off current			
$I_C = 0$; V_{EB} = 5 V	I_{EBO}	max.	1.0 mA
Saturation voltage			
I_C = 2 A; I_B = 0.9 A	V_{CEsat}	max.	1.0 V
	V_{BEsat}	max.	1.3 V
Diode forward voltage			
I_F = 2.0 A	V_F	max.	1.8 V
Collector saturation current			
V_{CE} = 5 V	I_{Csat}	typ.	2.0 A
DC current gain			
I_C = 2 A; V_{CE} = 5 V	h_{FE}	min.	2.2
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Transition frequency at f = 5 MHz			
I_C = 0.1 A; V_{CE} = 5 V	f_T	typ.	7.0 MHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	65 pF
Collector emitter sustaining voltage (Figs 2 and 3)			
I_C = 100 mA; I_B = 0; L = 25 mH	$V_{CEOsust}$	min.	700 V
Switching times in horizontal deflection circuit (Fig. 4)			
I_{CM} = 2 A; L_B = 15 μH			
$I_{B(end)}$ = 0.9 A; $-V_{dr}$ = 4 V			
	t_f	typ.	0.9 μs
	t_s	typ.	7.5 μs

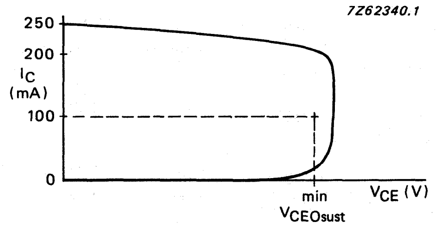


Fig. 2 Oscilloscope display for sustaining voltage.

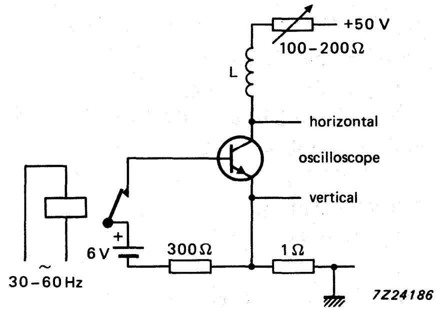


Fig. 3 Test circuit for $V_{CEOsust}$.

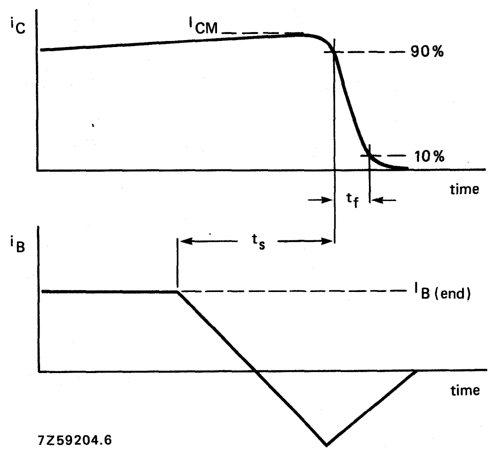


Fig. 4 Switching times waveforms.

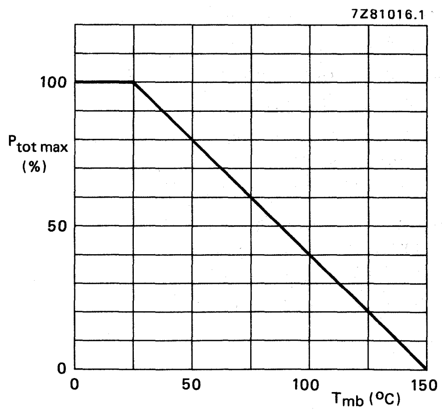
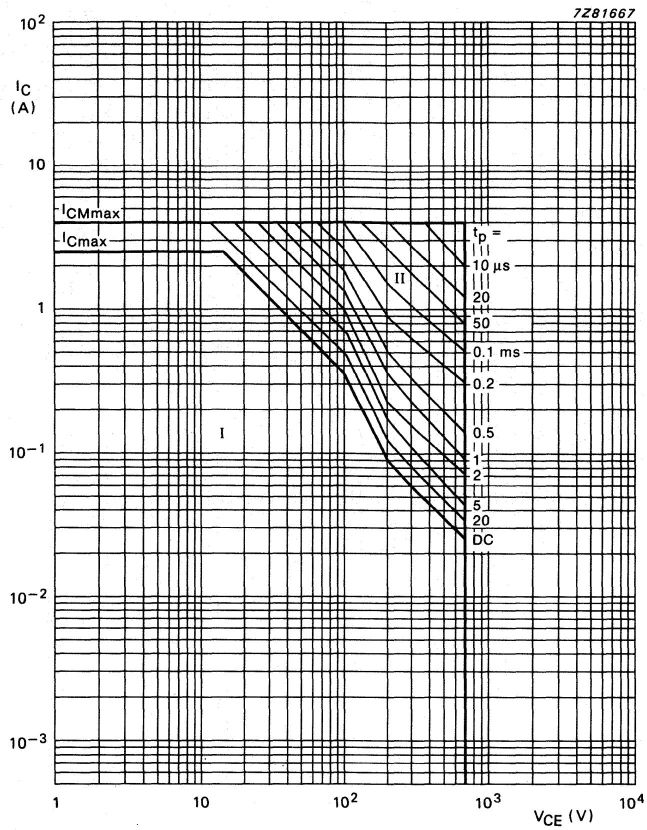


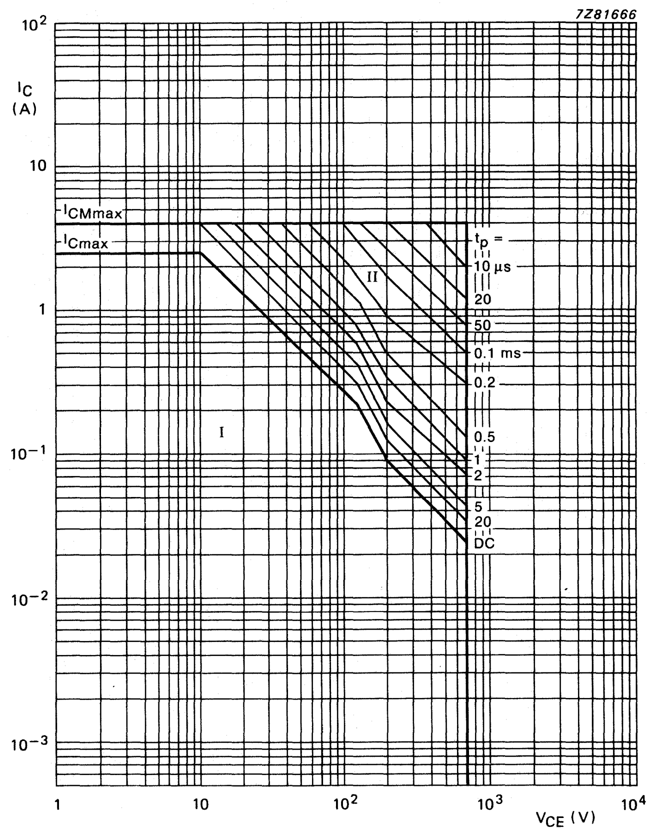
Fig. 5 Power derating curve.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Note: mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

Fig. 6 Safe operating area at T_{mb} = 25 ^oC.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Note: mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

Fig. 7 Safe operating area at T_{mb} = 25 °C.

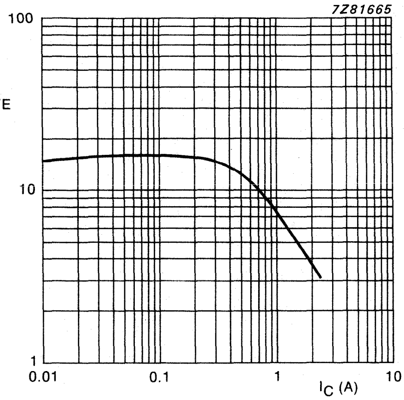


Fig. 8 Typical DC current gain; V_{CE} = 5 V; T_j = 25 °C.

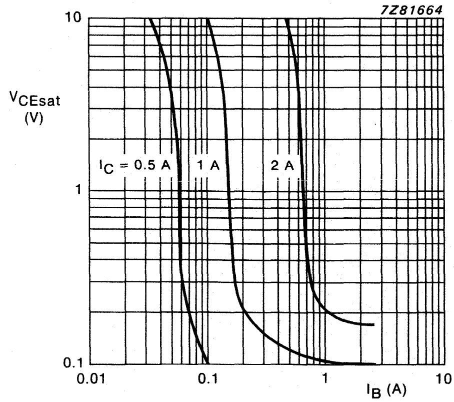


Fig. 9 Typical collector-emitter saturation voltage; T_j = 25 °C.

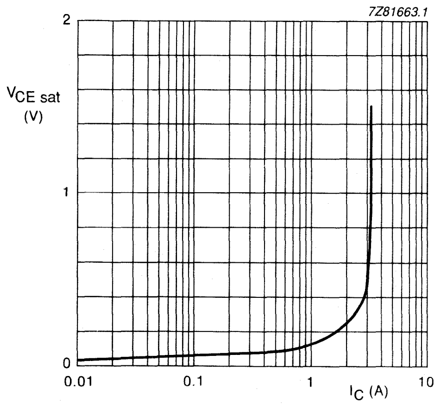


Fig. 10 Typical values V_{CEsat}; I_C/I_B = 2; T_j = 25 °C.

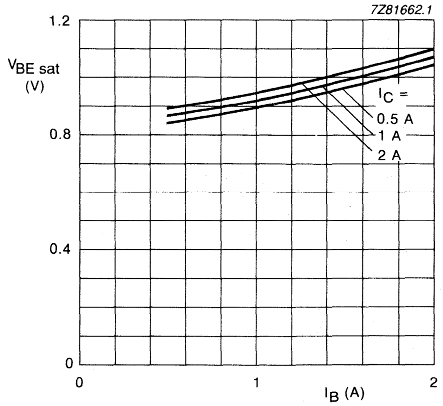


Fig. 11 Typical values V_{BEsat}; T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed switching npn transistors in a plastic envelope intended for use in horizontal deflection circuits of colour television receivers and line operated switch-mode applications. The BU706D has an integrated efficiency diode.

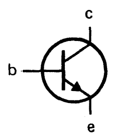
QUICK REFERENCE DATA

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector-emitter saturation				
voltage	V_{CEsat}	max.	1.0	V
Collector current				
saturation	I_{Csat}	max.	3.0	A
DC	I_C	max.	5.0	A
peak value	I_{CM}	max.	8.0	A
Diode forward voltage (BU706D)	V_F	typ.	1.5	V
Total power dissipation				
up to T_{mb} = 25 °C	P_{tot}	max.	100	W
Fall time; inductive load	t_f	typ.	0.7	μs

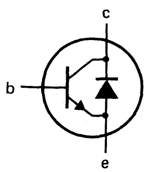
MECHANICAL DATA

Dimensions in mm

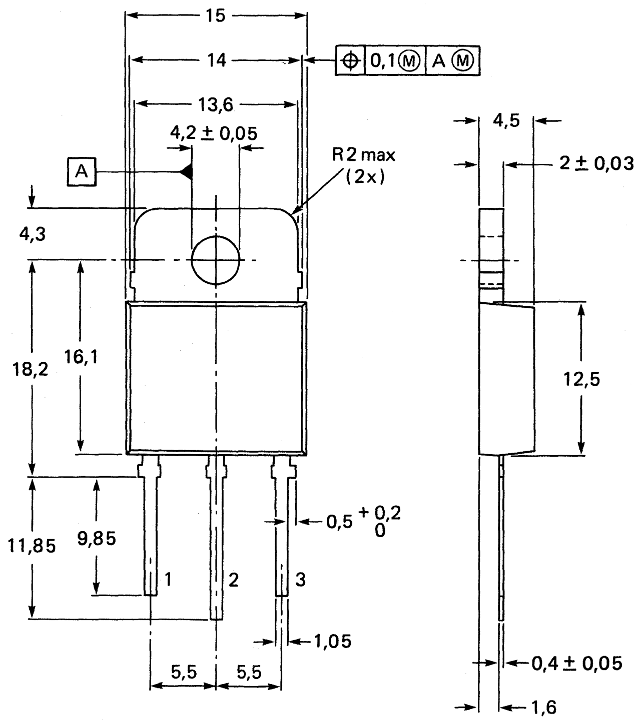
Fig. 1 SOT93.



BU706



BU706D



Pinning:
1 = base
2 = collector
3 = emitter

Collector connected to mounting base.

7Z95744

RATINGS

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

Collector-emitter voltage				
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500	V
open base	V_{CEO}	max.	700	V
Collector current				
saturation	I_{Csat}		3.0	A
DC	I_C	max.	5.0	A
peak	I_{CM}	max.	8.0	A
Base current				
DC	I_B	max.	3.0	A
peak	I_{BM}	max.	5.0	A
Total power dissipation				
up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	100	W
Storage temperature range	T_{stg}	−65 to + 150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.25	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current*			
V_{BE} = 0; V_{CE} = $V_{CESMmax}$	I_{CES}	max.	0.5 mA
V_{BE} = 0; V_{CE} = $V_{CESMmax}$; T_j = 125 °C	I_{CES}	max.	1.0 mA
Emitter cut-off current			
V_{EB} = 6 V; I_C = 0	I_{EBO}	max.	10 mA
Collector-emitter sustaining voltage			
I_C = 0.1 A; I_B = 0; L = 25 mH (Figs 2 and 3)	$V_{CEOsust}$	min.	700 V
Saturation voltage			
I_C = 3.0 A; I_B = 1.33 mA	V_{CEsat}	max.	1.0 V
	V_{BEsat}	max.	1.3 V
DC current gain			
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Diode forward voltage (BU706D)	V_F	typ.	1.5 V
I_F = 3 A	V_F	max.	2.2 V
Switching times (in line deflection circuit) (Fig. 4)			
I_{CM} = 3.0 A; $I_{B(end)}$ = 1.0 A; L_B = 12 μH; $-dI_B/dt$ = 0.33 A/μs	t_f	typ.	0.7 μs
	t_s	typ.	6.5 μs

* Measured with a half-sinewave voltage (curve tracer).

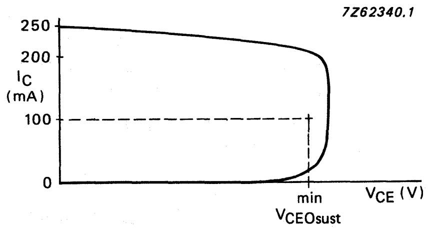


Fig. 2 Oscilloscope display for sustaining voltage.

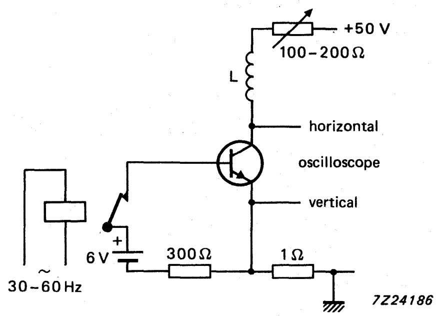


Fig. 3 Test circuit for $V_{CEOsust}$.

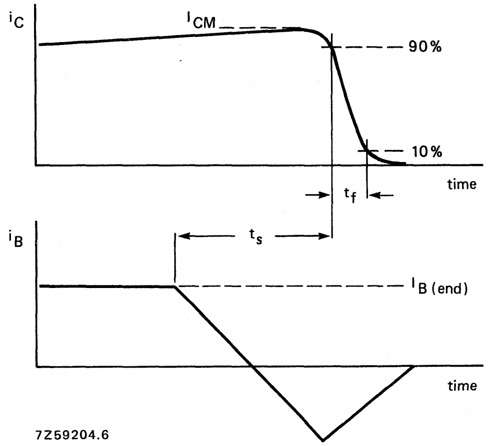


Fig. 4 Switching times waveforms.

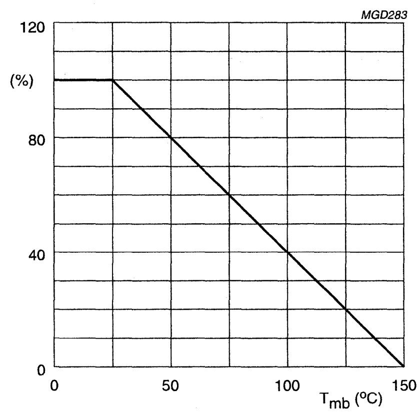
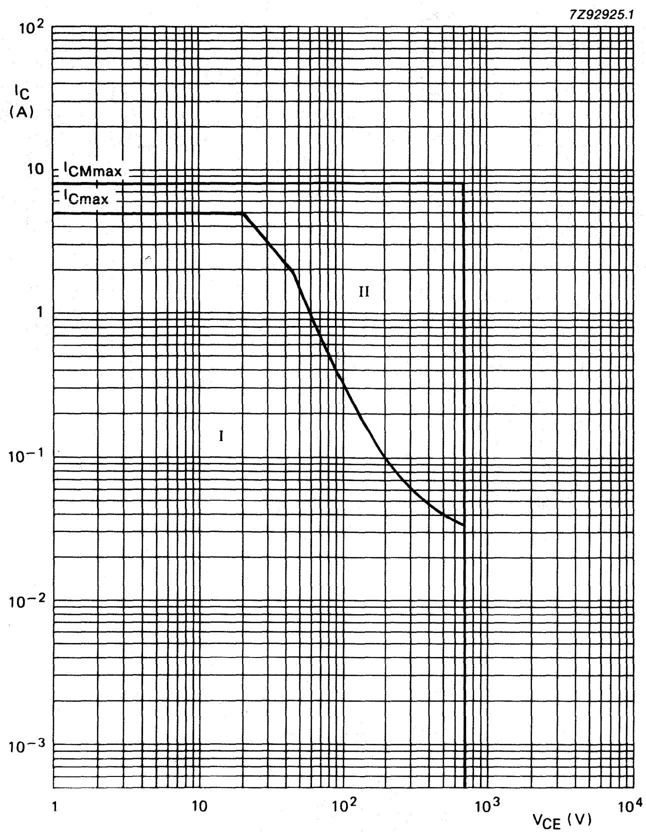


Fig. 5 Total power dissipation.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 6 Safe operating area.

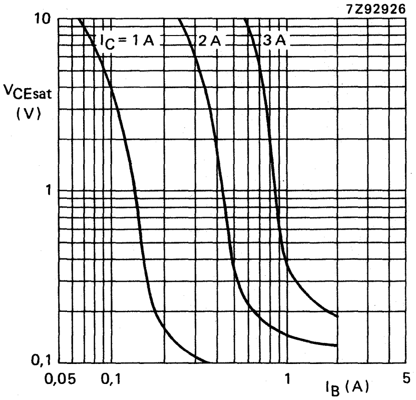


Fig. 7 Typical collector emitter saturation voltage; T_{mb} = 25 °C.

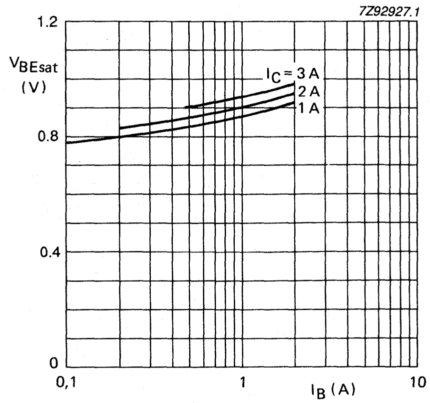


Fig. 8 Typical base-emitter saturation voltage; T_{mb} = 25 °C.

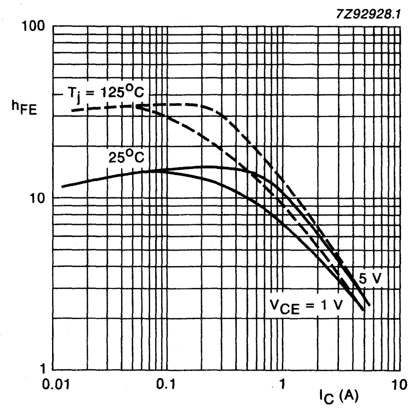


Fig. 9 Typical DC current gain.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed switching npn transistor in a SOT199 envelope, intended for use in horizontal deflection circuits of colour television receivers and in line-operated switch-mode applications.
The BU706DF has an integrated efficiency diode.

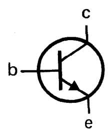
QUICK REFERENCE DATA

Collector-emitter voltage			
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
open base	V_{CEO}	max.	700 V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.0 V
Collector current			
saturation	I_{Csat}	max.	3.0 A
DC	I_C	max.	5.0 A
peak value	I_{CM}	max.	8.0 A
Total power dissipation			
up to $T_h = 25\ ^oC$	P_{tot}	max.	32 W
Diode forward voltage			
at $I_F = 3$ A (BU706DF)	V_F	typ.	1.0 V
Fall time; inductive load	t_f	typ.	0.7 μs

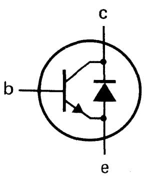
MECHANICAL DATA

Dimensions in mm

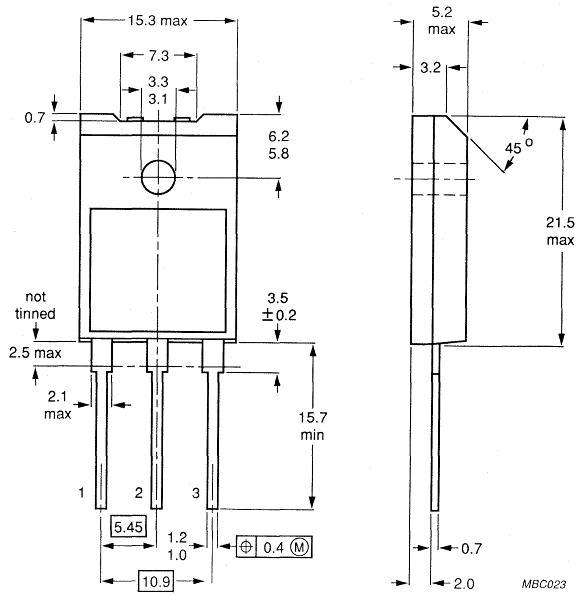
Fig. 1 SOT199.



BU706F



BU706DF



Pinning:

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated from all terminals.

RATINGS

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

Collector-emitter voltage			
peak value; $V_{BE} = 0$	V_{CESM}	max.	1500 V
open base	V_{CEO}	max.	700 V
Collector current			
saturation	I_{Csat}		3.0 A
DC	I_C	max.	5.0 A
peak value	I_{CM}	max.	8.0 A
Base current			
DC	I_B	max.	3.0 A
peak value	I_{BM}	max.	5.0 A
Total power dissipation			
up to $T_h = 25\ ^oC$	P_{tot}	max.	32 W
Storage temperature range	T_{stg}		−65 to + 150 ^oC
Junction temperature	T_j	max.	150 ^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	3.95 K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	3.05 K/W
From junction to ambient	$R_{th\text{-}a}$	=	35 K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500 V
Isolation capacitance from collector to external heatsink	C_{isol}	typ.	21 pF

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	0.5 mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	1.0 mA
Emitter cut-off current			
$I_C = 0$; V_{EB} = 6 V	I_{EBO}	max.	10 mA
Saturation voltage			
I_C = 3 A; I_B = 1.33 A	V_{CEsat}	max.	1.0 V
	V_{BEsat}	max.	1.3 V
Collector saturation current			
V_{CE} = 5 V	I_C	typ.	3.0 A
DC current gain			
I_C = 3 A; V_{CE} = 5 V	h_{FE}	min.	2.25
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	6
	h_{FE}	typ.	13
	h_{FE}	max.	30
Collector emitter sustaining voltage (Figs 2 and 3)			
I_C = 100 mA; I_B = 0; L = 25 mH	$V_{CEOsust}$	min.	700 V
Diode forward voltage			
I_F = 3 A (BU706DF)	V_F	typ.	1.5 V
	V_F	max.	2.2 V
Switching times in horizontal deflection circuit (Fig. 4)			
I_{CM} = 3 A; L_B = 12 μH;			
$I_{B\,(end)}$ = 1 A;			
$\frac{-d\,I_B}{dt}$ = 0.33 A/μs	t_f	typ.	0.7 μs
	t_s	typ.	6.5 μs

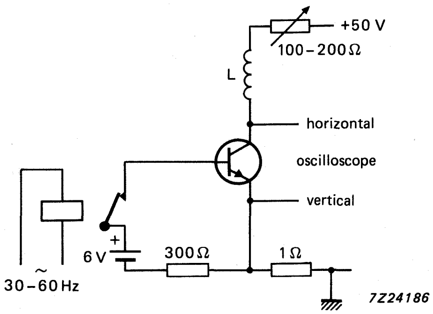


Fig. 2 Test circuit for $V_{CEOsust}$.

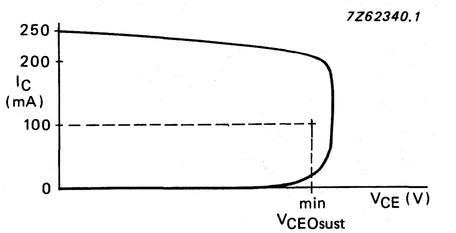


Fig. 3 Oscilloscope display for sustaining voltage.

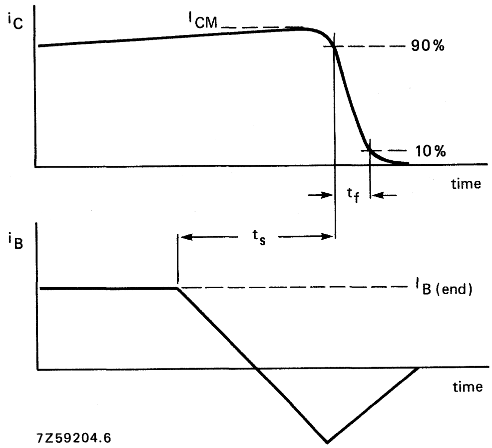


Fig. 4 Switching times waveforms.

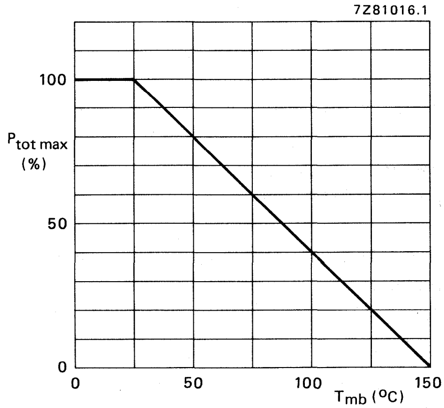


Fig. 5 Power derating curve.

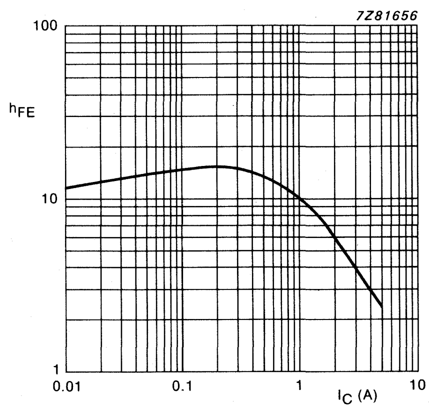
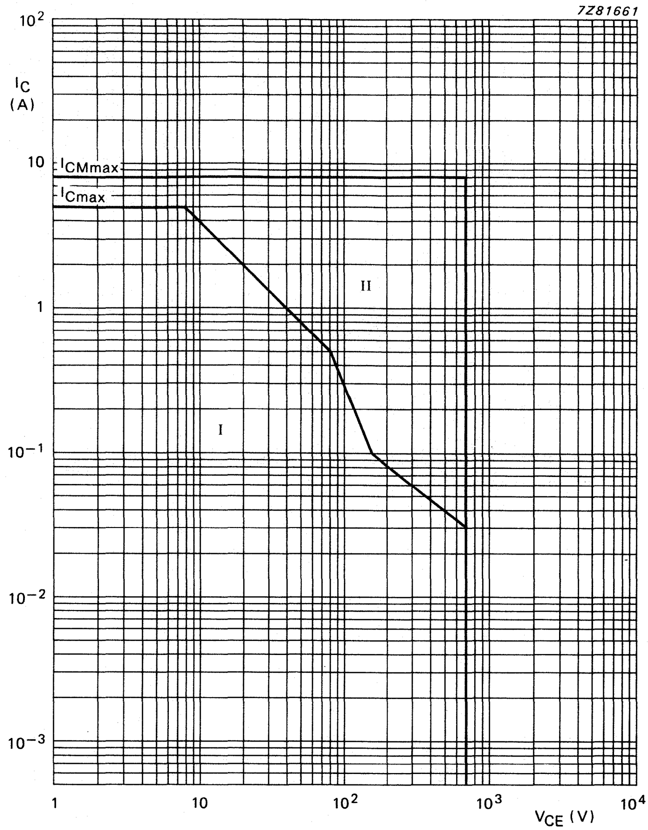
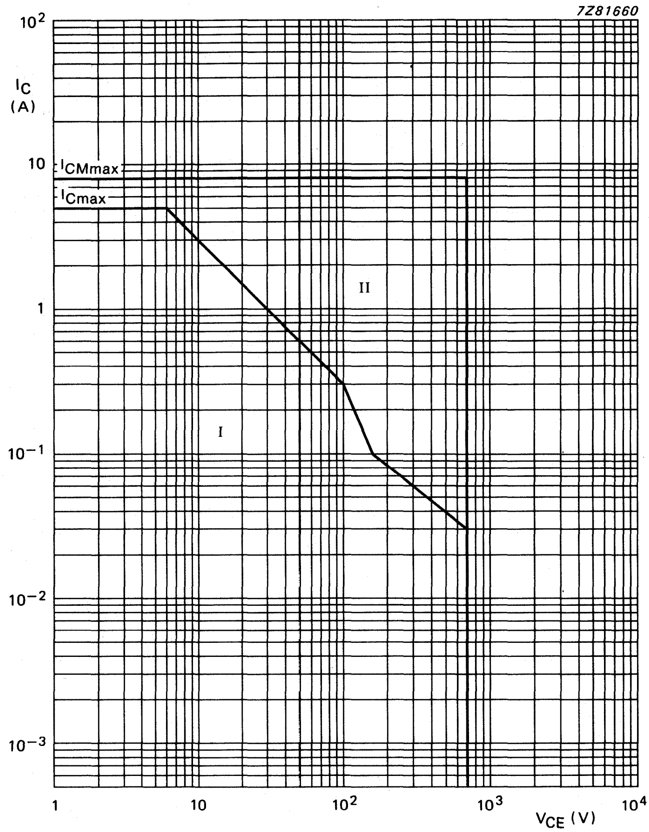


Fig. 6 Typical DC current gain; V_{CE} = 5 V; T_j = 25 °C.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 7 Safe operating area at $T_{mb} = 25\ ^{o}C$; mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at T_{mb} = 25 °C; mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

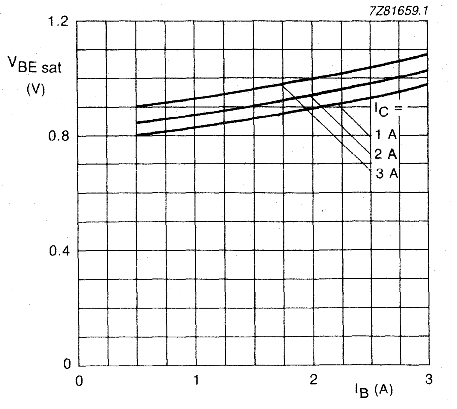


Fig. 9 Typical values V_{BEsat}; T_j = 25 °C.

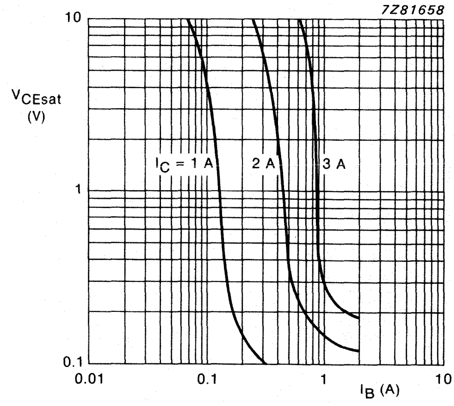


Fig. 10 Typical collector-emitter saturation voltage; T_j = 25 °C.

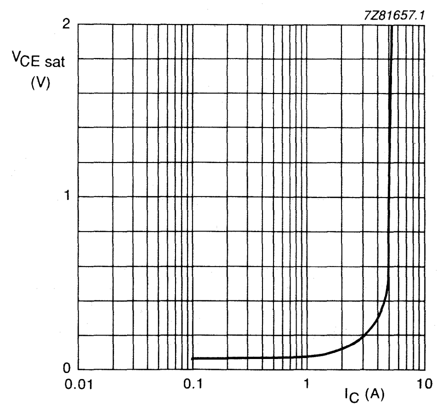


Fig. 11 Typical values V_{CEsat}; I_C/I_B = 2; T_j = 25 °C.

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode 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.

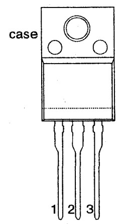
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	32	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 3.0$ A; $I_B = 1.0$ A	-	1.0	V
I_{Csat}	Collector saturation current		3.0	-	A
V_F	Diode forward voltage	$I_F = 3.0$ A	1.6	2.0	V
t_f	Fall time	$I_{CM} = 3.0$ A; $I_{B(end)} = 0.67$ A	0.25	0.5	µs

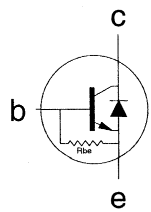
PINNING - SOT186A

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	8	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	8	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	32	W
T_{stg}	Storage temperature		-40	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	4.0	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	55	-	K/W

1 Turn-off current.

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 [2]	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} = 7.5 V; I_C = 0 A	90	-	180	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	40	60	80	Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 1.0 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 1.1 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 0.3 A; V_{CE} = 5 V	7	12	19	
h_{FE}		I_C = 3.0 A; V_{CE} = 5 V	3.8	5.5	7.5	
V_F	Diode forward voltage	I_F = 3.0 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	47	-	pF
	Switching times (line deflection circuit)	I_{CM} = 3.0 A; L_C = 1.35 mH; C_{FB} = 9.4 nF; $I_{B(end)}$ = 0.67 A; L_B = 8 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.45 A/µs)			
t_s	Turn-off storage time		4.5	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

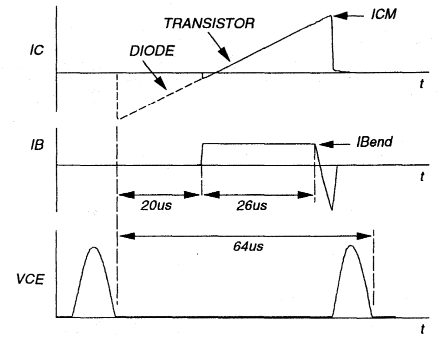


Fig.1. Switching times waveforms.

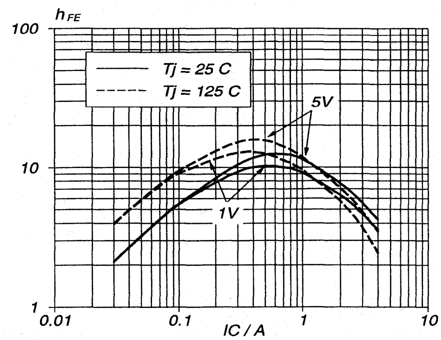


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

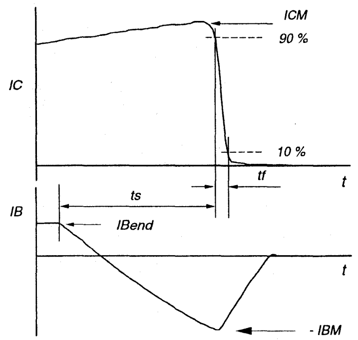


Fig.2. Switching times definitions.

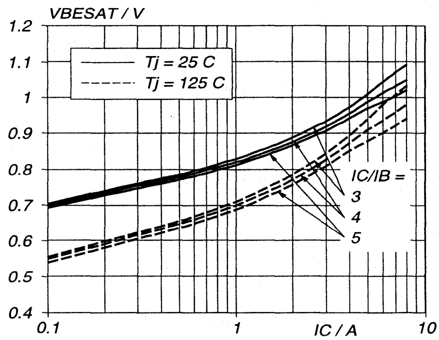


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

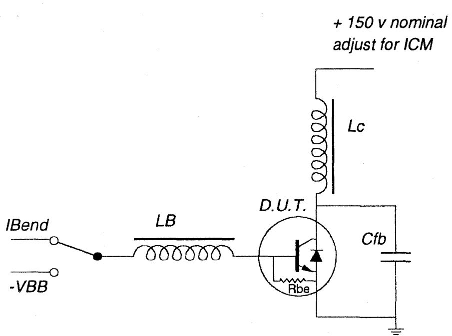


Fig.3. Switching times test circuit.

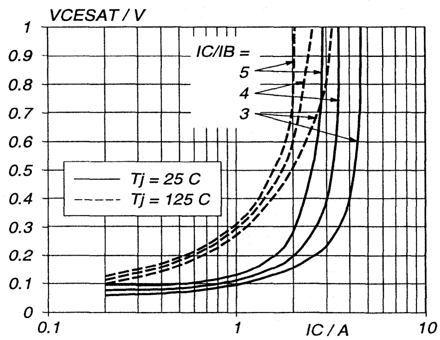


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

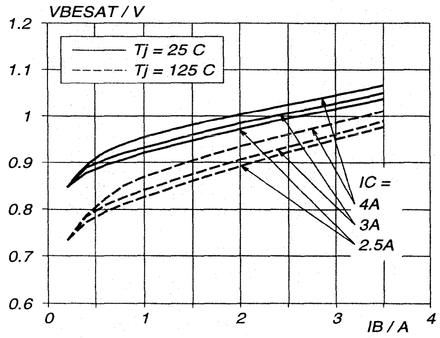


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

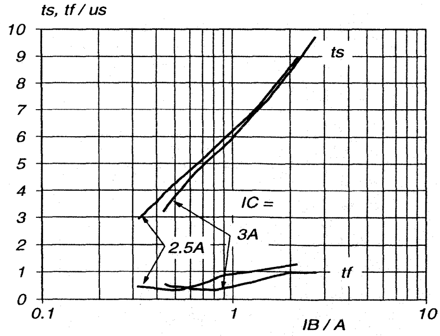


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$

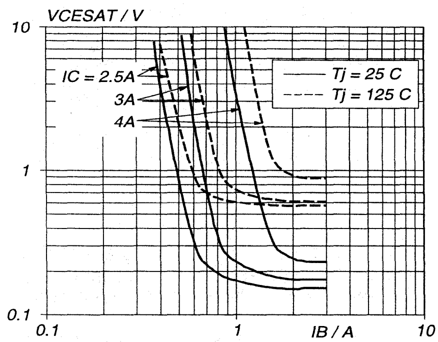


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

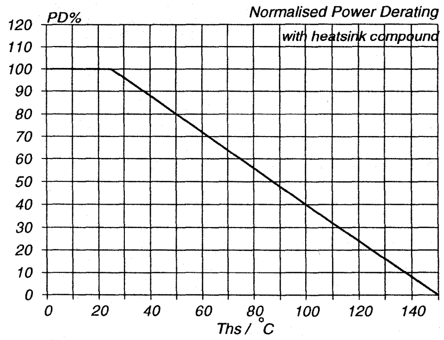


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

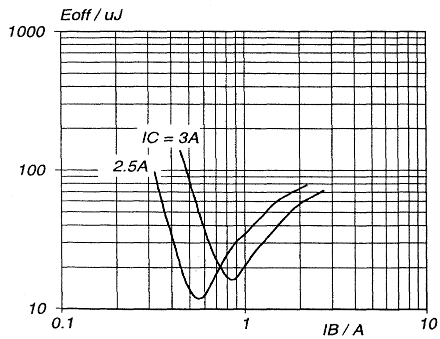


Fig.9. Typical turn-off losses. $T_j = 85^\circ C$
$Eoff = f(I_B)$; parameter I_C

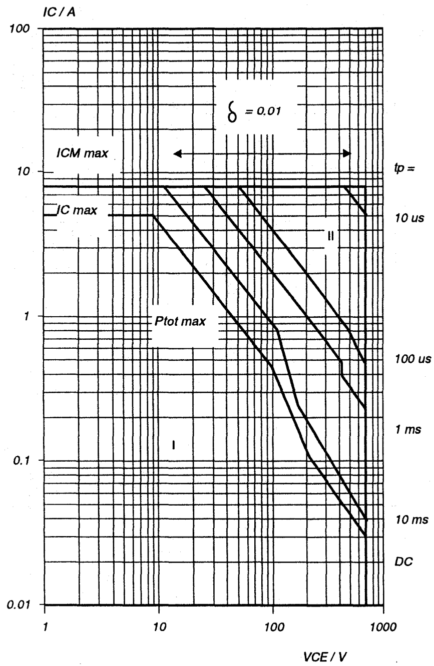


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

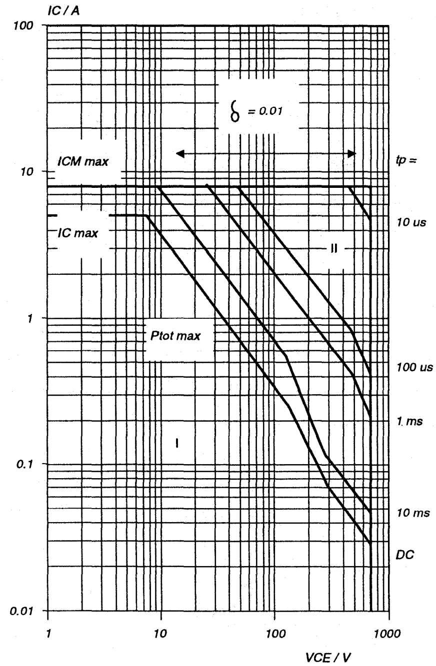


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

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.

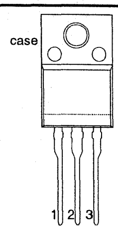
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	35	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

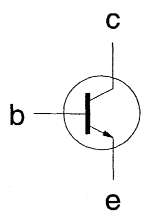
PINNING - SOT186A

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	35	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	-	3.6	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	55	-	K/W

1 Turn-off current.

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 [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	3.5	5.5	7.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.4	0.6	µs

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

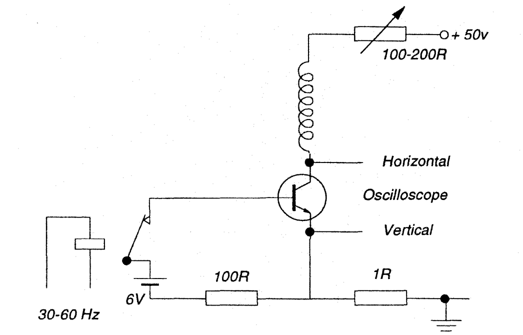


Fig.1. Test circuit for $V_{CEOsust}$.

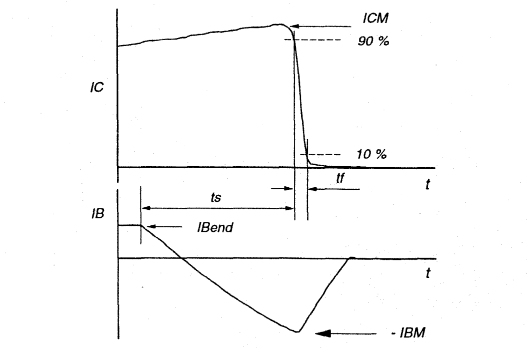


Fig.4. Switching times definitions.

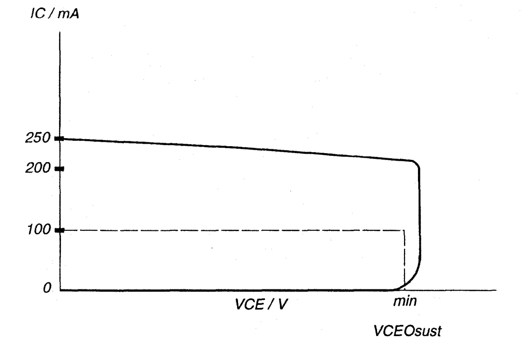


Fig.2. Oscilloscope display for $V_{CEOsust}$.

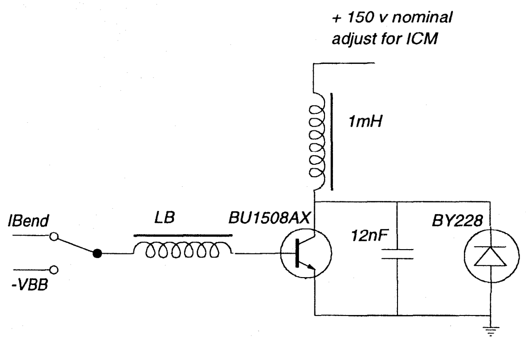


Fig.5. Switching times test circuit (BU1508AX).

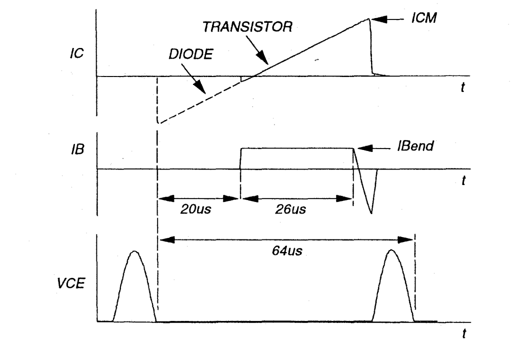


Fig.3. Switching times waveforms.

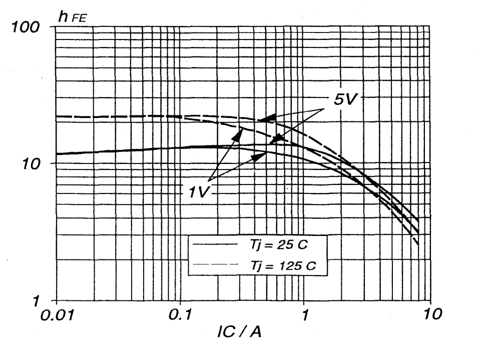


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

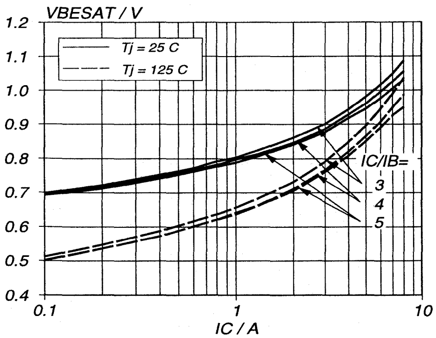


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

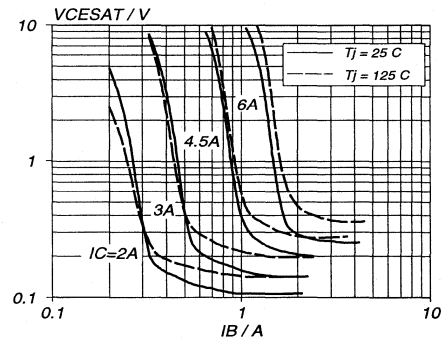


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

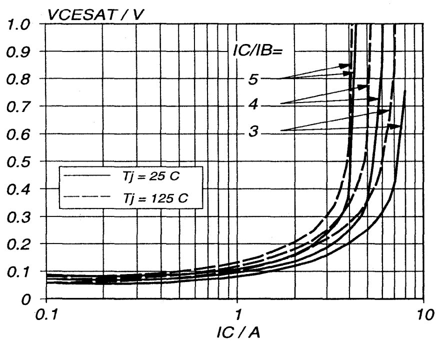


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

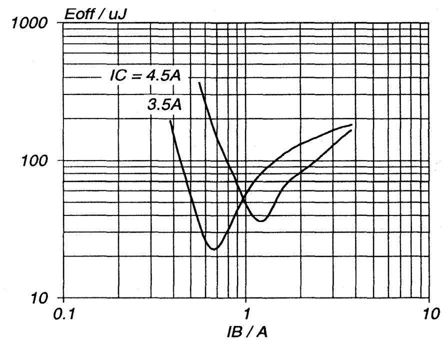


Fig.11. Typical turn-off losses. $T_j = 85˚C$ $Eoff = f(I_B)$; parameter I_C

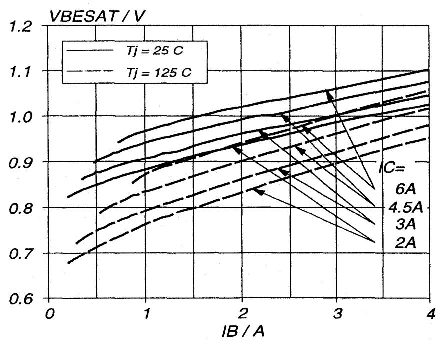


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

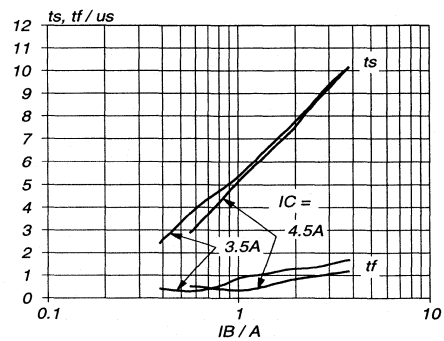


Fig.12. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$

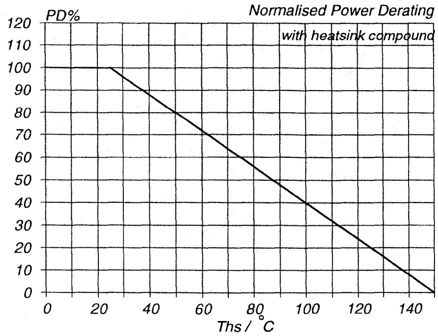


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f\,(T_{hs})$

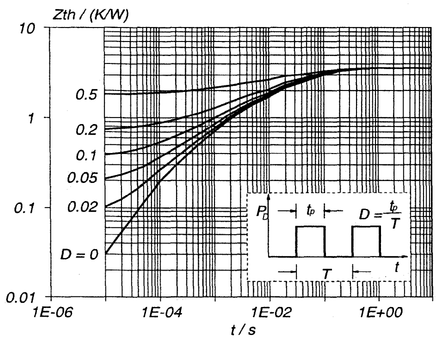


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

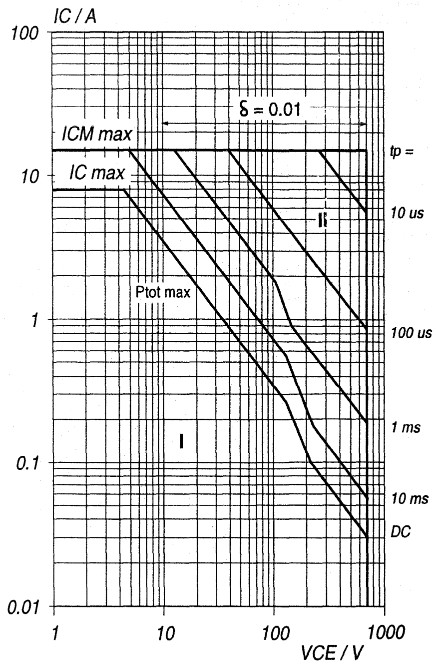


Fig.15. Forward bias safe operating area. $T_{hs} = 25^{\circ}C$
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

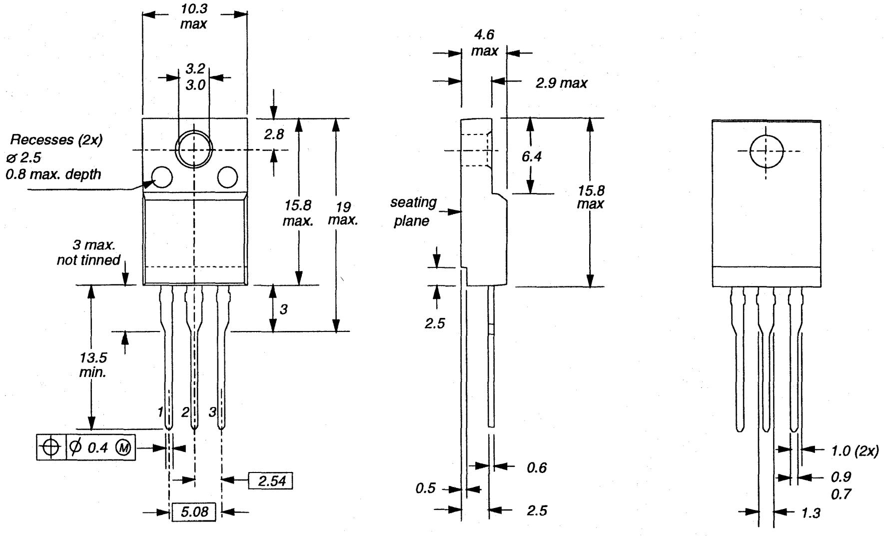


Fig.16. SOT186A; The seating plane is electrically isolated from all terminals.

Notes

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

Silicon Diffused Power Transistor — BU1508DX

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode 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.

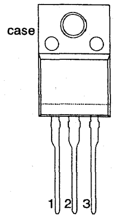
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	35	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	-	V
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

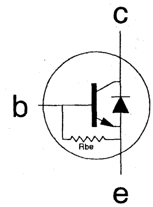
PINNING - SOT186A

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	35	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	3.6	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 [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	1.0	mA
I_{CES}		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$; Tj = 125˚C	-	-	2.0	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 7.5 V; I_C = 0 A	140	-	390	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	33	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	7	13	23	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.5	
V_F	Diode forward voltage	I_F = 4.5 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (line deflection circuit). Fig.1, Fig.2 and Fig.3.	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.4	0.6	µs

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

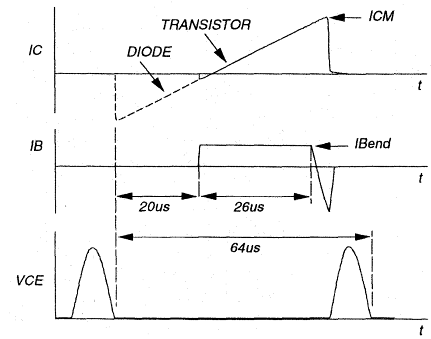


Fig.1. Switching times waveforms.

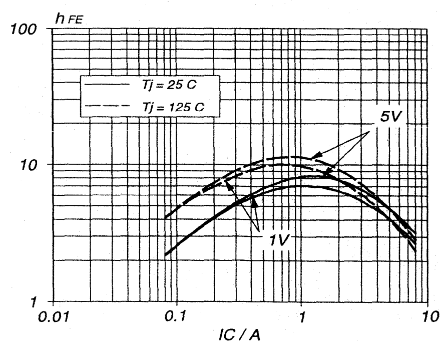


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

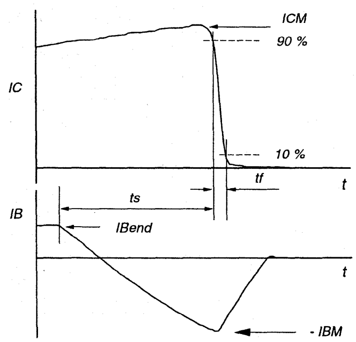


Fig.2. Switching times definitions.

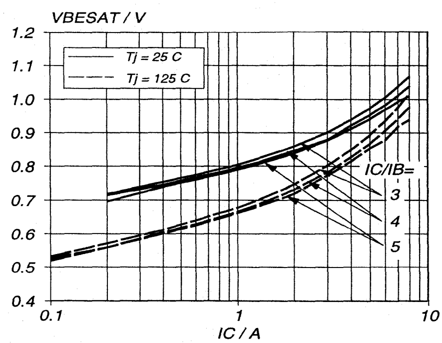


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

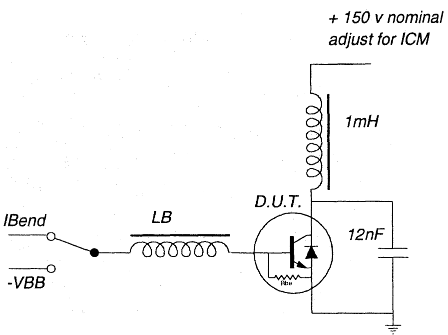


Fig.3. Switching times test circuit.

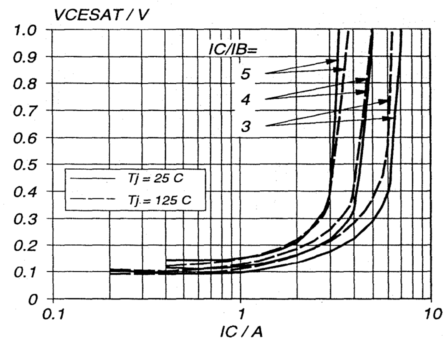


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

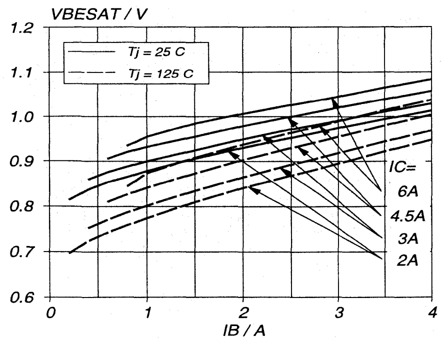


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

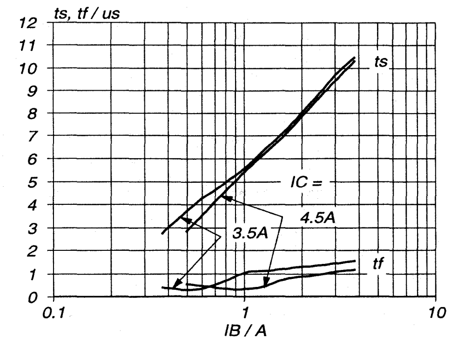


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$

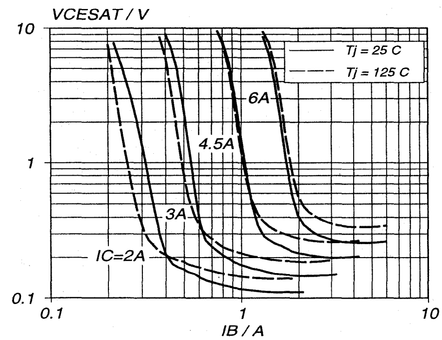


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

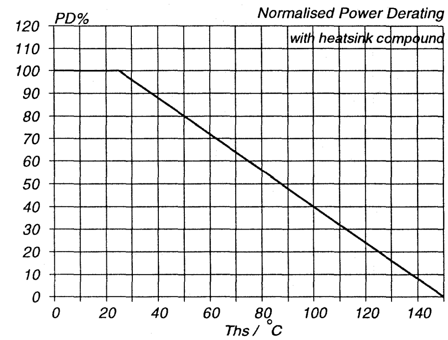


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

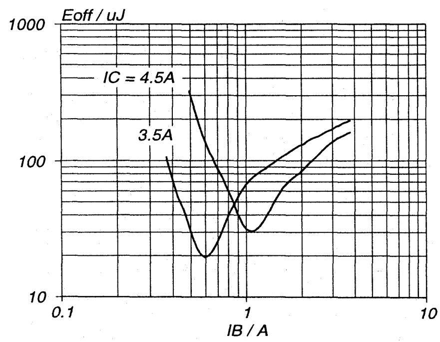


Fig.9. Typical turn-off losses. $T_j = 85^\circ C$
$Eoff = f(I_B)$; parameter I_C

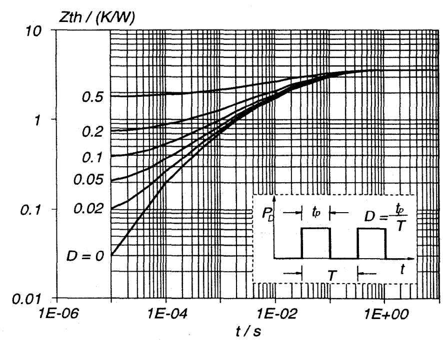


Fig.12. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

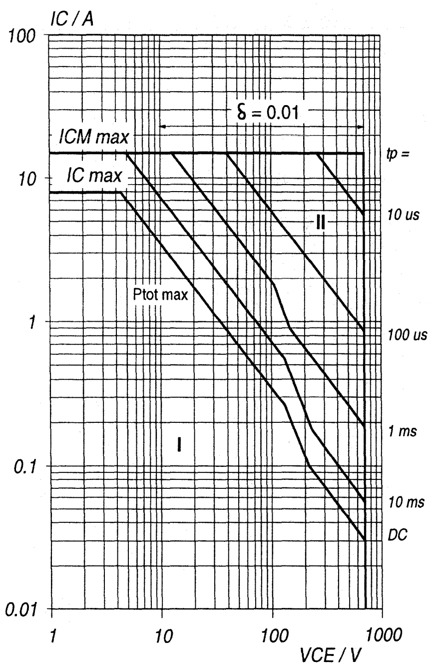


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

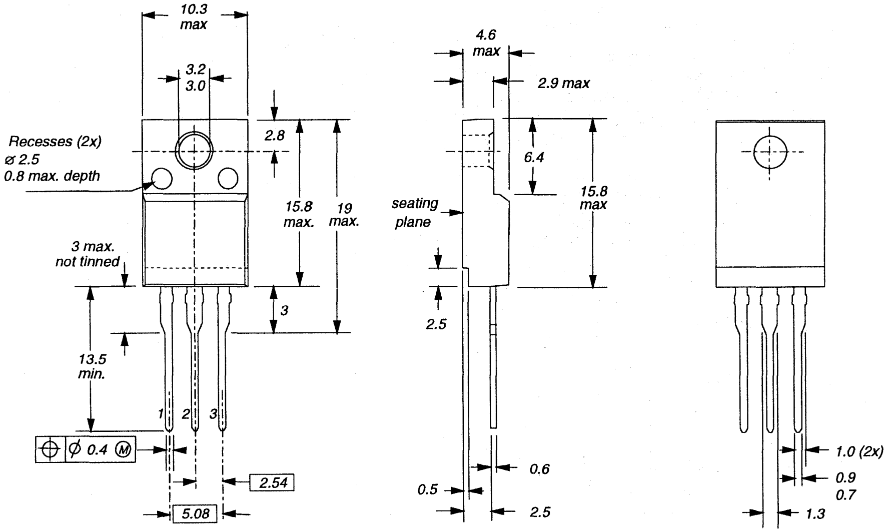


Fig.14. SOT186A; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor BU1706A

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor in a plastic envelope intended for use in high frequency electronic lighting ballast applications.

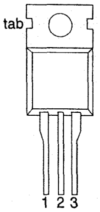
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1750	V
V_{CEO}	Collector-emitter voltage (open base)		-	850	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	100	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 1.5$ A; $I_B = 0.3$ A	-	1.0	V
I_{Csat}	Collector saturation current		1.5	-	A
t_f	Fall time	$I_{CM} = 1.5$ A; $I_{B(on)} = 0.3$ A	0.25	0.6	µs

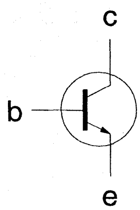
PINNING - TO220AB

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1750	V
V_{CEO}	Collector-emitter voltage (open base)		-	850	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	5	A
$-I_{B(AV)}$	Reverse base current	average over any 20ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value		-	4	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	100	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base		-	1.25	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
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} = 1500 V	-	-	20	µA
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} = 12 V; I_C = 0 A	-	-	1	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	750	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1.5 A; I_B = 0.3 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 1.5 A; I_B = 0.3 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 10 V	8	-	-	
h_{FE}		I_C = 400 mA; V_{CE} = 3 V	12	18	35	
h_{FE}		I_C = 1.5 A; V_{CE} = 1 V	5	7	-	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 1.5 A; I_{Bon} = -I_{Boff} = 0.3 A			
t_{on}	Turn-on time		1.1	1.5	µs
t_s	Turn-off storage time		5	6.5	µs
t_f	Turn-off fall time		0.75	1.0	µs
	Switching times (inductive load)	I_{Con} = 1.5 A; I_{Bon} = 0.3 A; L_B = 1 µH; -V_{BB} = 5 V			
t_s	Turn-off storage time		2.0	3.0	µs
t_f	Turn-off fall time		0.25	0.6	µs
	Switching times (inductive load)	I_{Con} = 1.5 A; I_{Bon} = 0.3 A; L_B = 1 µH; -V_{BB} = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		2.2	3.3	µs
t_f	Turn-off fall time		0.2	0.7	µs

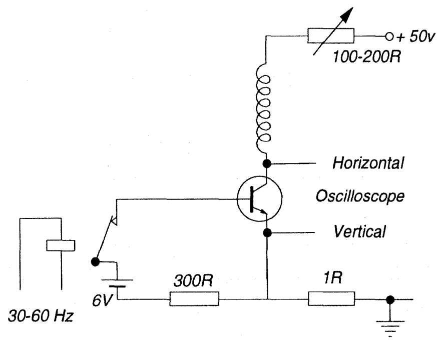


Fig.1. Test circuit for $V_{CEOsust}$.

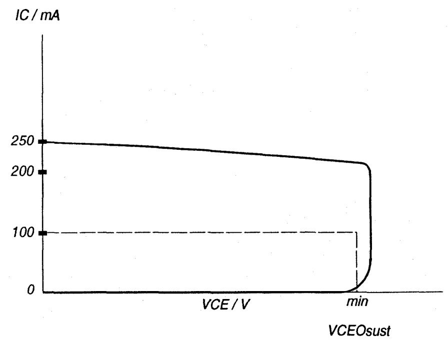


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

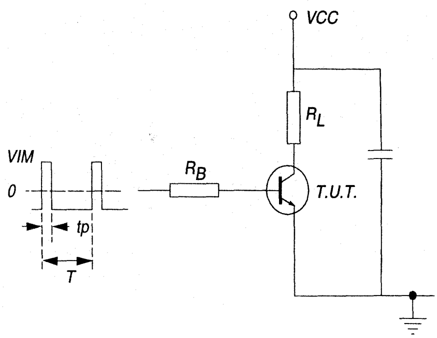


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; tp = 20 μs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

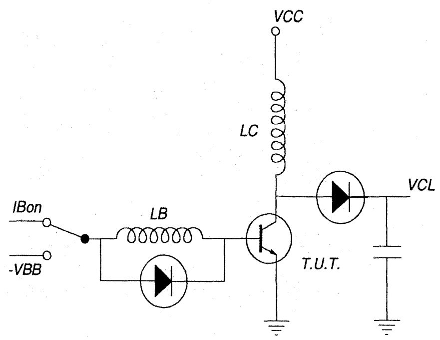


Fig.6. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 5 V; L_C = 2 mH; $V_{CL} \leq$ 1500 V;
L_B = 1 μH

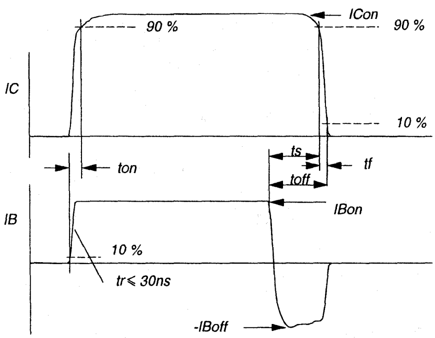


Fig.4. Switching times waveforms with resistive load.

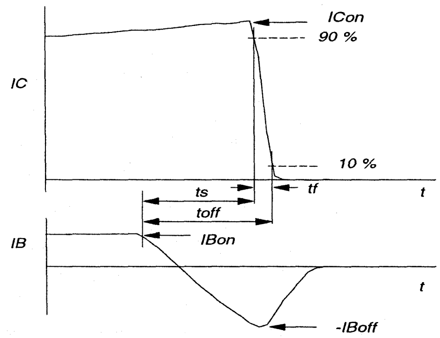


Fig.7. Switching times waveforms with inductive load.

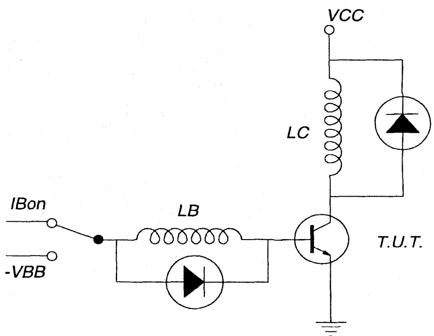


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_B = 1 uH

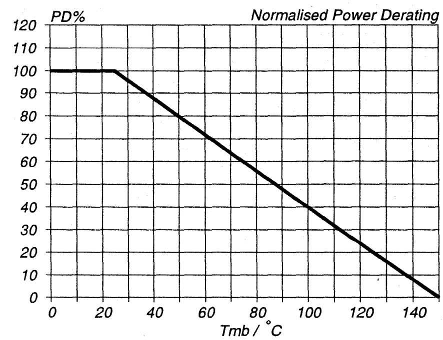


Fig.8. Normalised power dissipation.
PD% = 100·PD/PD $_{25\,^{\circ}C}$ = f (T_{mb})

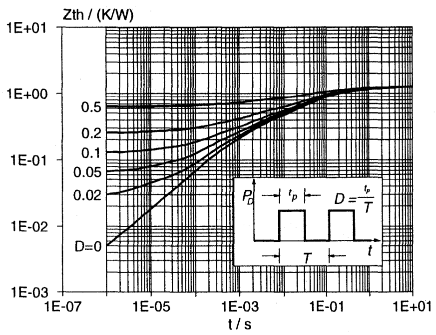


Fig.9. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

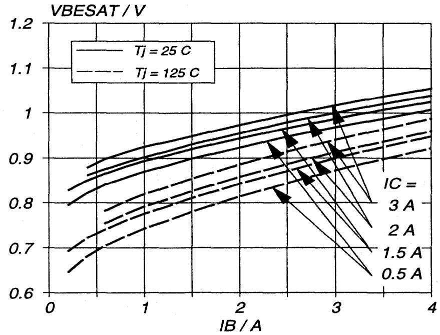


Fig.12. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

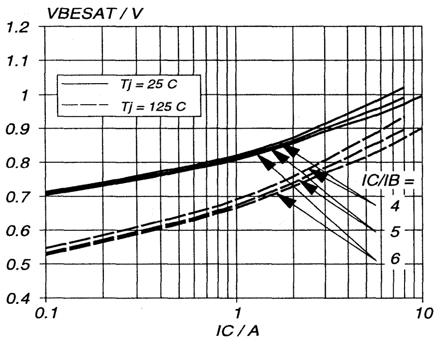


Fig.10. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_C)$; parameter I_C/I_B

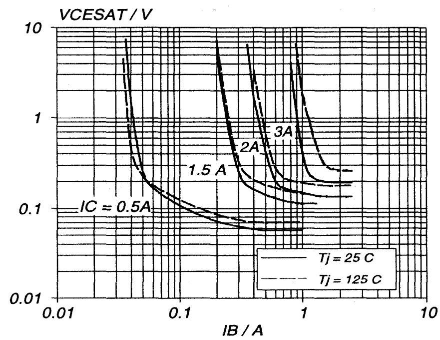


Fig.13. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

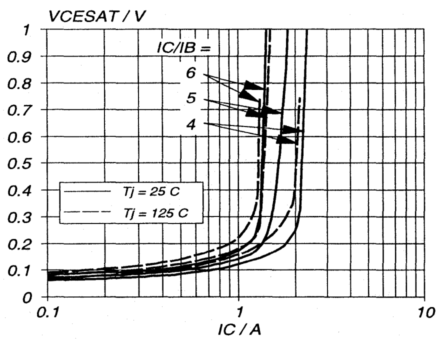


Fig.11. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

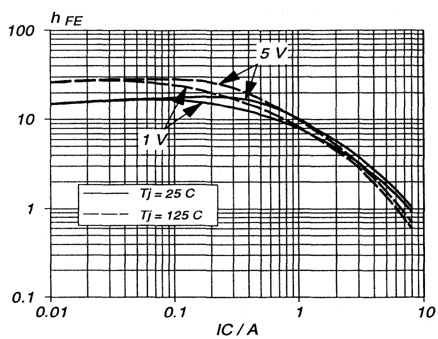


Fig.14. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

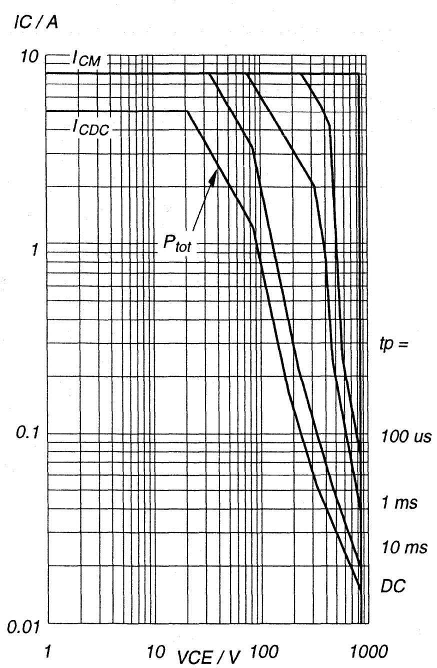


Fig.15. Forward bias safe operating area. T_{mb} = 25 ˚C

I	Region of permissible DC operation.
II	Extension for repetitive pulse operation.
NB:	Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

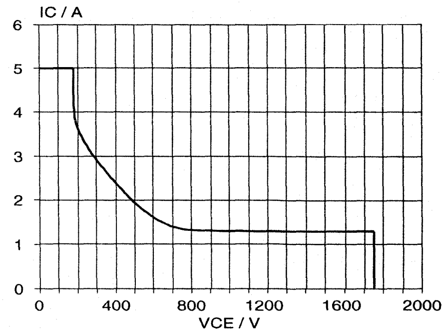


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

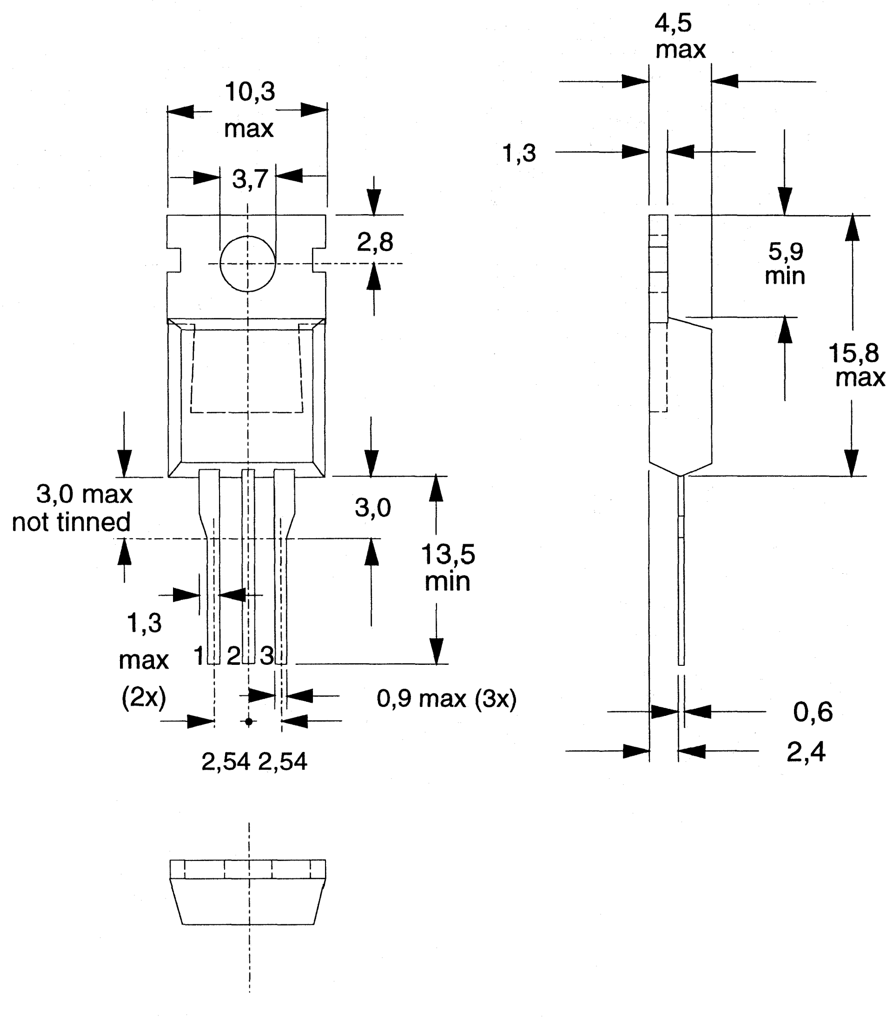


Fig.17. TO220AB; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for TO220 envelopes.
2. Epoxy meets UL94 V0 at 1/8".

Silicon Diffused Power Transistor | BU1706AX

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in high frequency electronic lighting ballast applications.

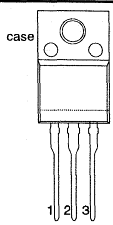
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1750	V
V_{CEO}	Collector-emitter voltage (open base)		-	850	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	32	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 1.5$ A; $I_B = 0.3$ A	-	1.0	V
I_{Csat}	Collector saturation current		1.5	-	A
t_f	Fall time	$I_{CM} = 1.5$ A; $I_{B(on)} = 0.3$ A	0.25	0.6	µs

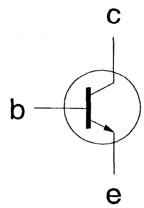
PINNING - SOT186A

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1750	V
V_{CEO}	Collector-emitter voltage (open base)		-	850	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	5	A
$-I_{B(AV)}$	Reverse base current	average over any 20ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value		-	4	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	32	W
T_{stg}	Storage temperature		-40	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	-	4.0	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} = 1500 V	-	-	20	µA
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} = 12 V; I_C = 0 A	-	-	1	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	750	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1.5 A; I_B = 0.3 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 1.5 A; I_B = 0.3 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 10 V	8	-	-	
h_{FE}		I_C = 400 mA; V_{CE} = 3 V	12	18	35	
h_{FE}		I_C = 1.5 A; V_{CE} = 1 V	5	7	-	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 1.5 A; I_{Bon} = $-I_{Boff}$ = 0.3 A			
t_{on}	Turn-on time		1.1	1.5	µs
t_s	Turn-off storage time		5	6.5	µs
t_f	Turn-off fall time		0.75	1.0	µs
	Switching times (inductive load)	I_{Con} = 1.5 A; I_{Bon} = 0.3 A; L_B = 1 µH; $-V_{BB}$ = 5 V			
t_s	Turn-off storage time		2.0	3.0	µs
t_f	Turn-off fall time		0.25	0.6	µs
	Switching times (inductive load)	I_{Con} = 1.5 A; I_{Bon} = 0.3 A; L_B = 1 µH; $-V_{BB}$ = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		2.2	3.3	µs
t_f	Turn-off fall time		0.2	0.7	µs

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

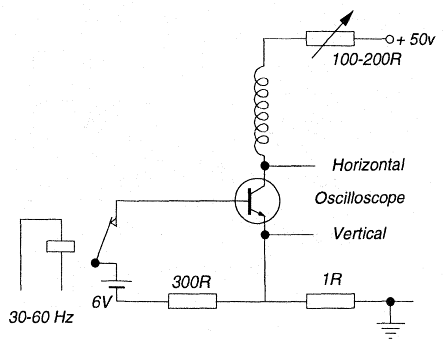


Fig.1. Test circuit for $V_{CEOsust}$.

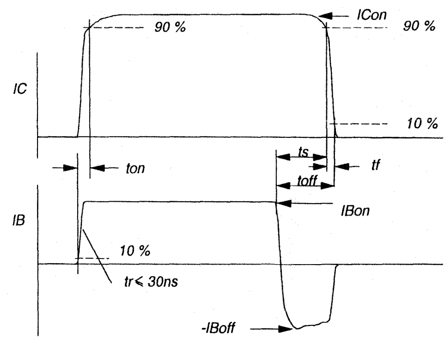


Fig.4. Switching times waveforms with resistive load.

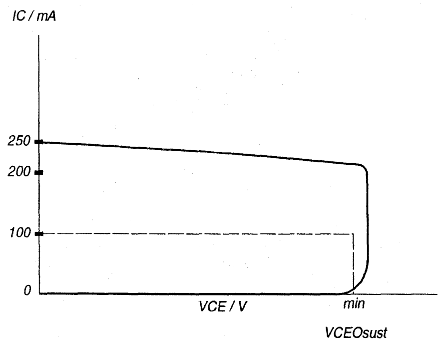


Fig.2. Oscilloscope display for $V_{CEOsust}$.

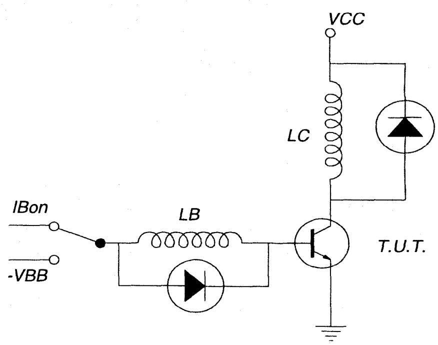


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_B = 1 uH

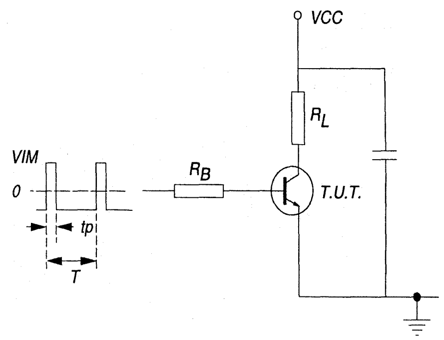


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

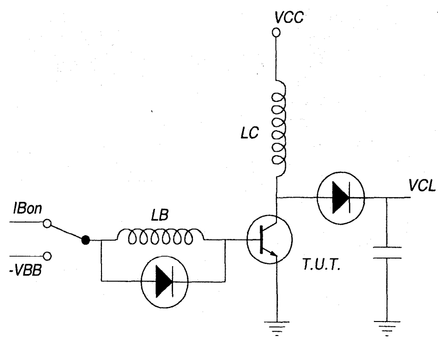


Fig.6. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 5 V; L_C = 2 mH; $V_{CL} \leq$ 1500 V;
L_B = 1 µH

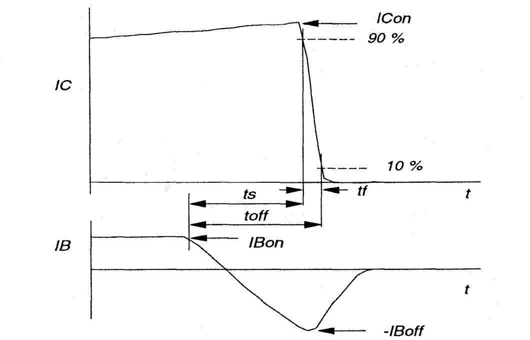


Fig.7. Switching times waveforms with inductive load.

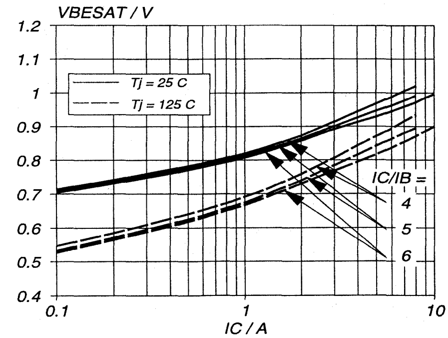


Fig.10. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_C)$; parameter I_C/I_B

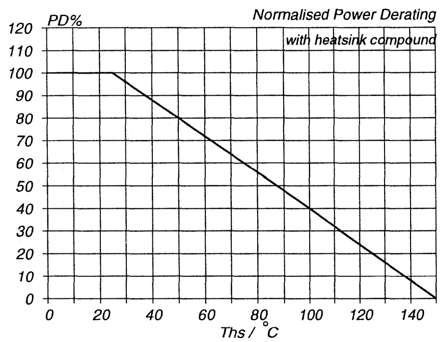


Fig.8. Normalised power dissipation. $PD\% = 100 \cdot PD/PD_{25\,^\circ C} = f\,(T_{hs})$

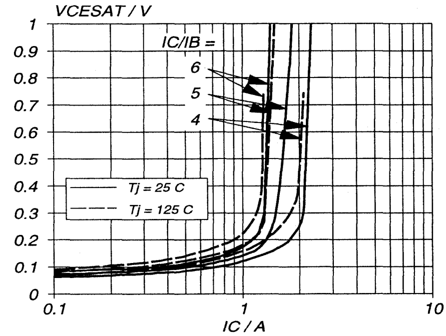


Fig.11. Typical collector-emitter saturation voltage. $V_{CEsat} = f(I_C)$; parameter I_C/I_B

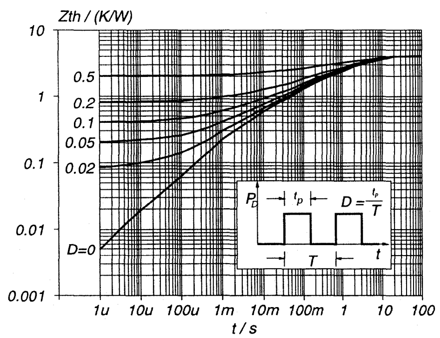


Fig.9. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

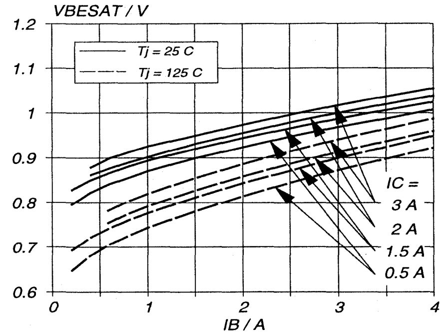


Fig.12. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_B)$; parameter I_C

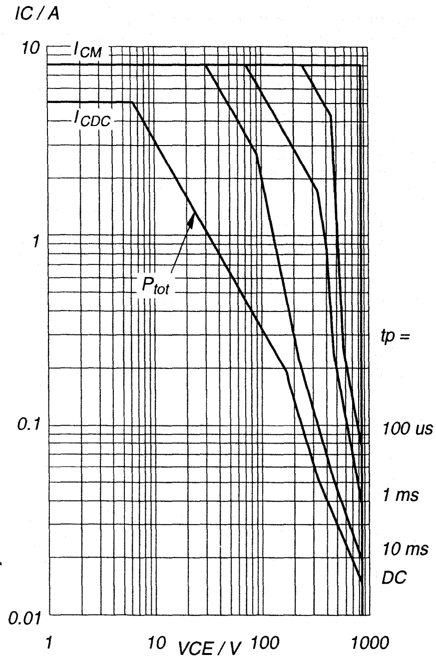


Fig.13. Forward bias safe operating area. T_{hs} = 25 ˚C

I	Region of permissible DC operation.
II	Extension for repetitive pulse operation.
NB:	Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

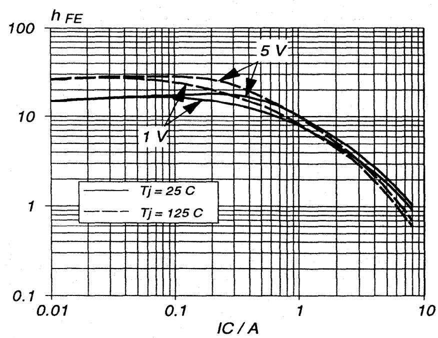


Fig.15. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

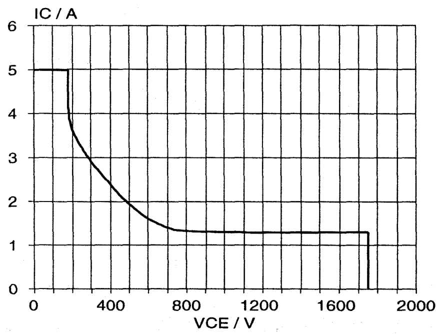


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

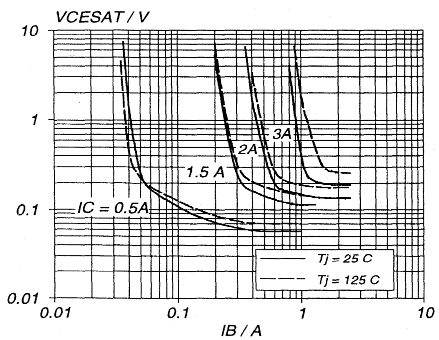


Fig.14. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

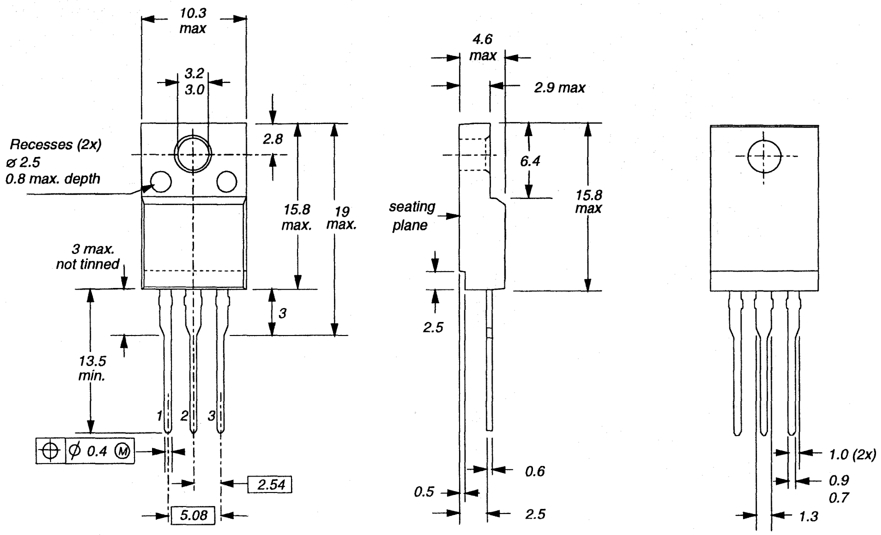


Fig.17. SOT186A; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode 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.

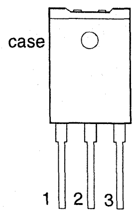
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 3.0$ A; $I_B = 1.0$ A	-	1.0	V
I_{Csat}	Collector saturation current		3.0	-	A
V_F	Diode forward voltage	$I_F = 3.0$ A	1.6	2.0	V
t_f	Fall time	$I_{CM} = 3.0$ A; $I_{B(end)} = 0.67$ A	0.25	0.5	µs

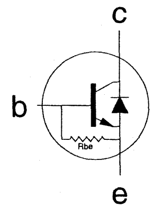
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	5	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	4	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	32	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	90	-	180	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	40	60	80	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 1.0 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 1.1 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 0.3 A; V_{CE} = 5 V	7	12	19	
h_{FE}		I_C = 3.0 A; V_{CE} = 5 V	3.8	5.5	7.5	
V_F	Diode forward voltage	I_F = 3.0 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	47	-	pF
	Switching times (line deflection circuit)	I_{CM} = 3.0 A; L_C = 1.35 mH; C_{FB} = 9.4 nF; $I_{B(end)}$ = 0.67 A; L_B = 8 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.45 A/μs)			
t_s	Turn-off storage time		4.5	6.0	μs
t_f	Turn-off fall time		0.25	0.5	μs

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

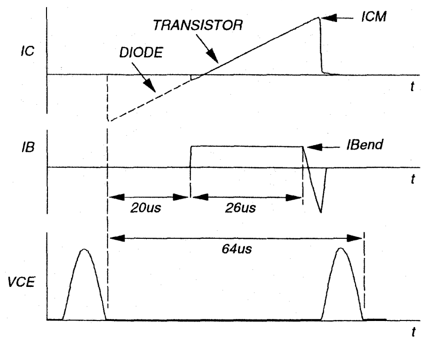


Fig.1. Switching times waveforms.

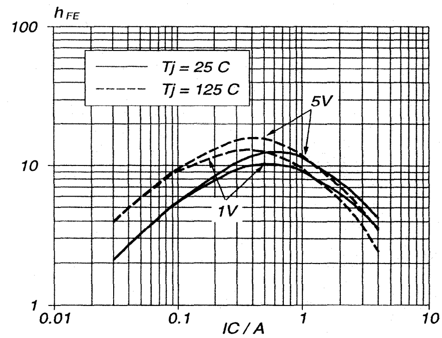


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

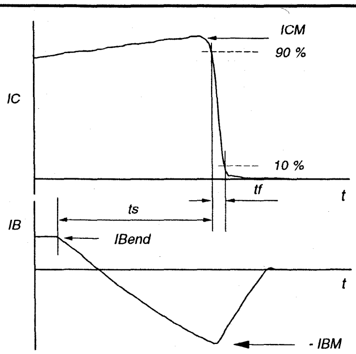


Fig.2. Switching times definitions.

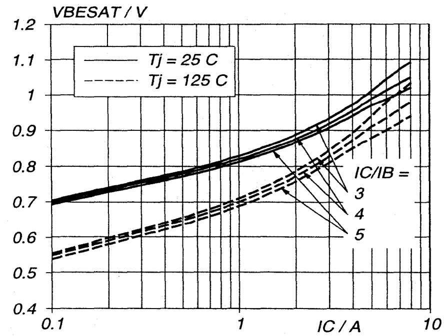


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

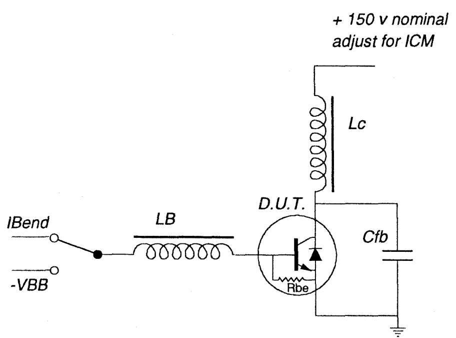


Fig.3. Switching times test circuit.

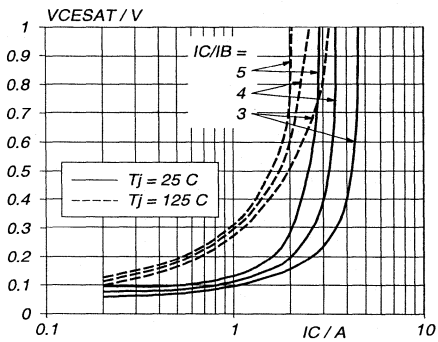


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

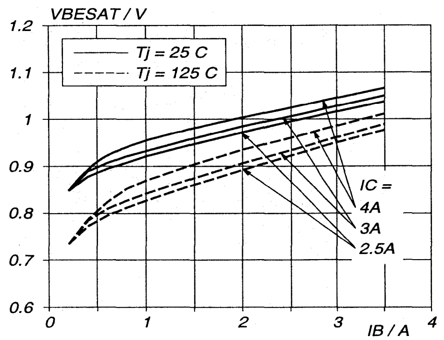


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

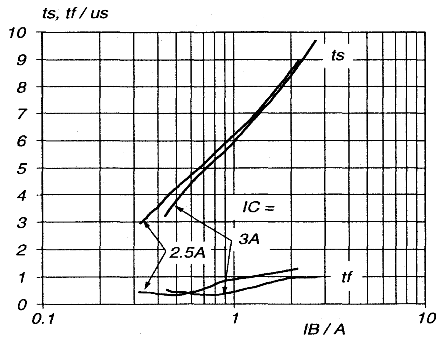


Fig.10. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85˚C$

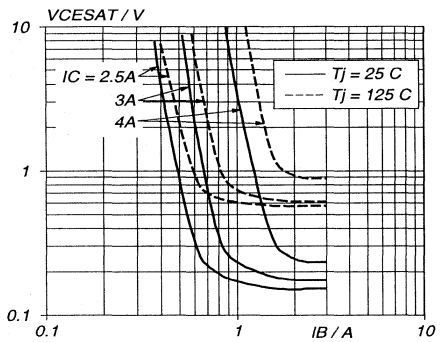


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

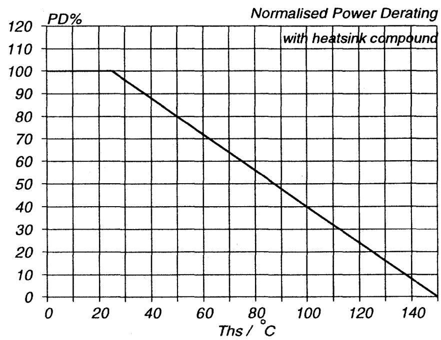


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25˚C} = f\ (T_{hs})$

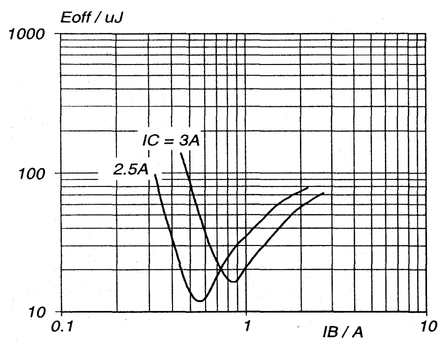


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f\ (I_B)$; parameter I_C

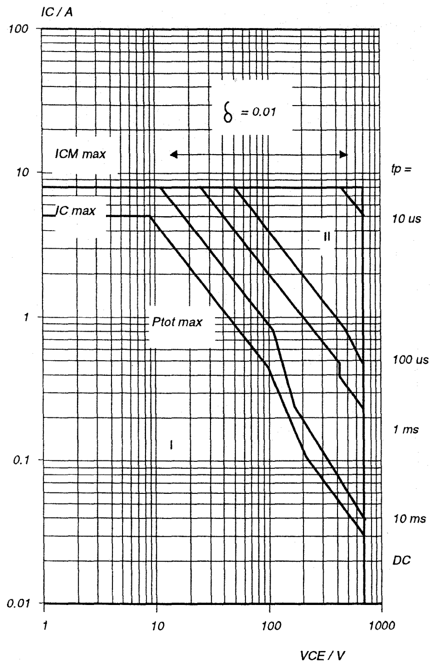


Fig.12. Forward bias safe operating area. $T_{hs} = 25^{\circ}C$
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

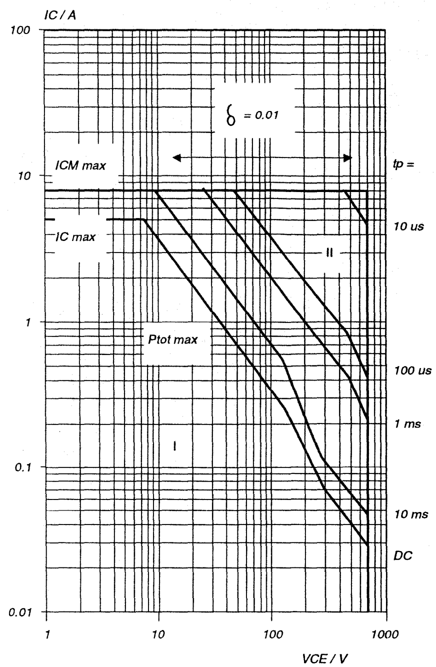


Fig.13. Forward bias safe operating area. $T_{hs} = 25^{\circ}C$
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

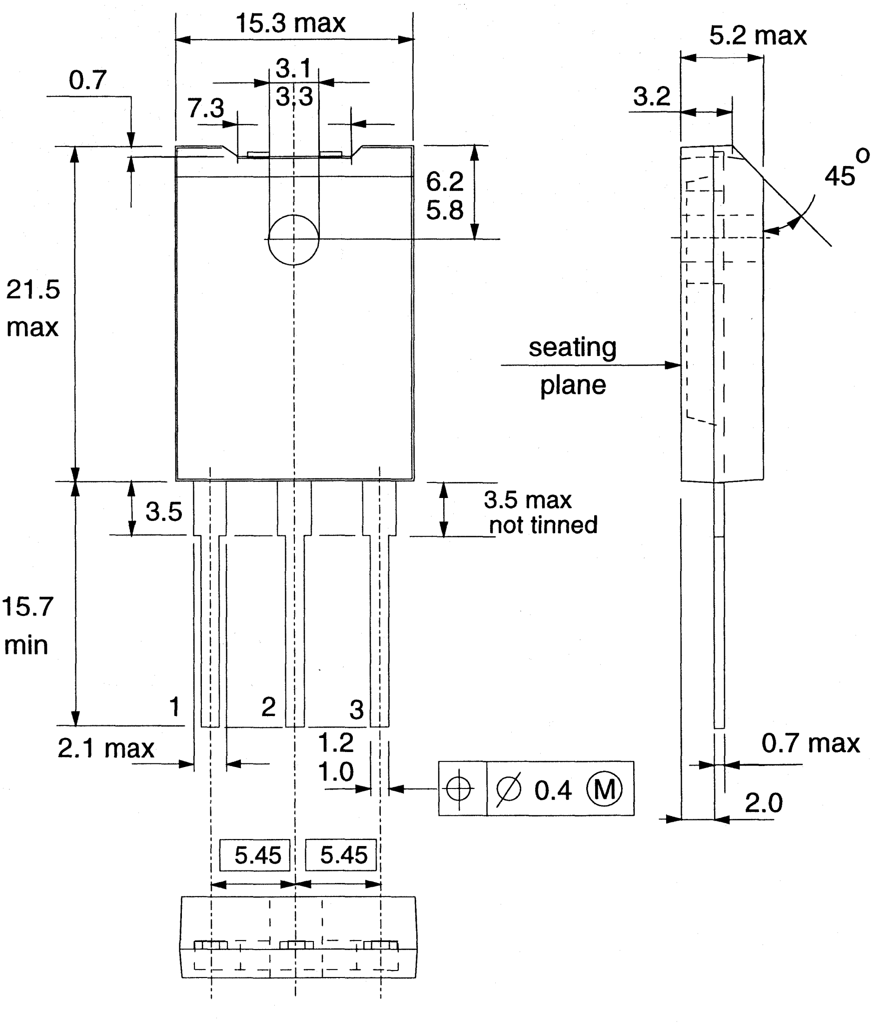


Fig.14. SOT199; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor BU2506DX

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode 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.

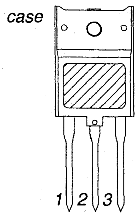
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 3.0$ A; $I_B = 1.0$ A	-	1.0	V
I_{Csat}	Collector saturation current		3.0	-	A
V_F	Diode forward voltage	$I_F = 3.0$ A	1.6	2.0	V
t_f	Fall time	$I_{CM} = 3.0$ A; $I_{B(end)} = 0.67$ A	0.25	0.5	µs

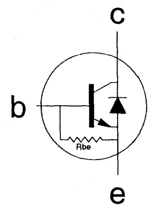
PINNING - SOT399

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	8	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	5	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	4	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	32	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	90	-	180	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	40	60	80	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 1.0 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 1.1 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 0.3 A; V_{CE} = 5 V	7	12	19	
h_{FE}		I_C = 3.0 A; V_{CE} = 5 V	3.8	5.5	7.5	
V_F	Diode forward voltage	I_F = 3.0 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	47	-	pF
	Switching times (line deflection circuit)	I_{CM} = 3.0 A; L_C = 1.35 mH; C_{FB} = 9.4 nF; $I_{B(end)}$ = 0.67 A; L_B = 8 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.45 A/µs)			
t_s	Turn-off storage time		4.5	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

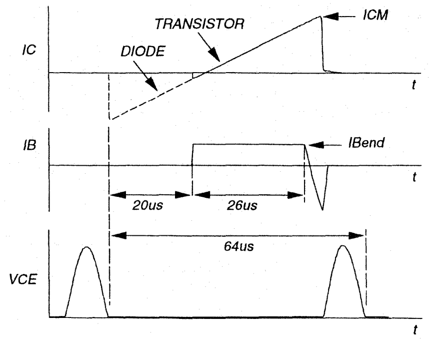


Fig.1. Switching times waveforms.

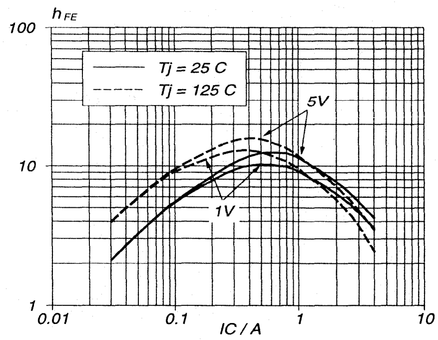


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

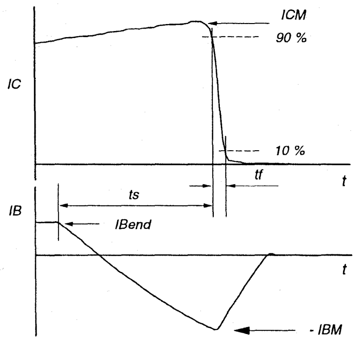


Fig.2. Switching times definitions.

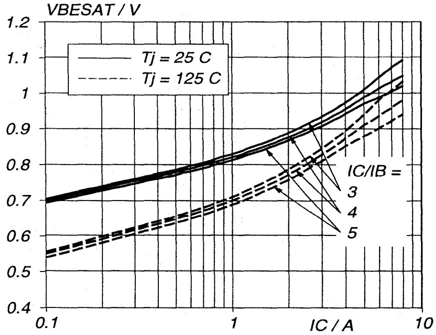


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

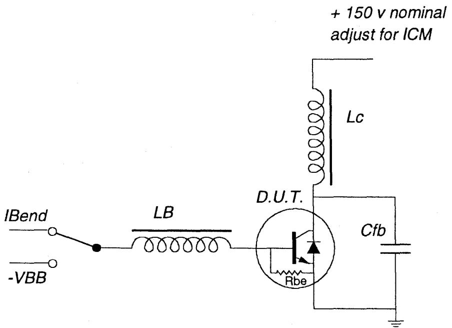


Fig.3. Switching times test circuit.

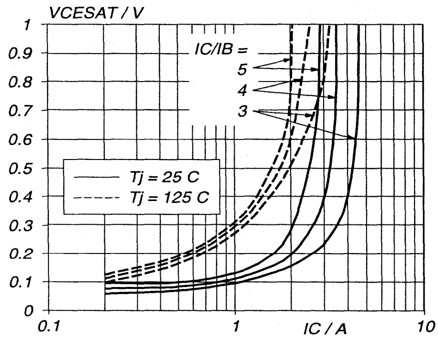


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

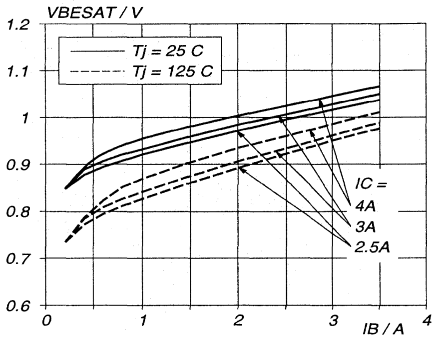


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f (I_B)$; parameter I_C

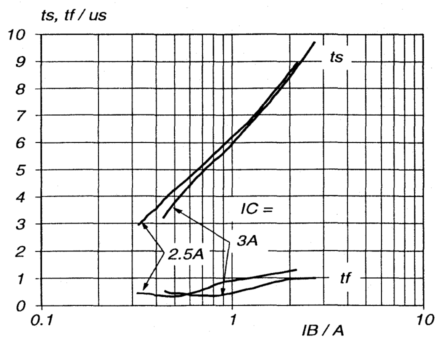


Fig.10. Typical collector storage and fall time.
$ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85˚C$

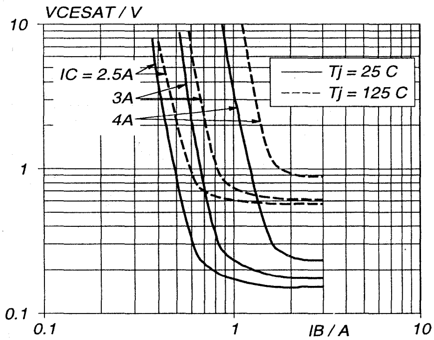


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f (I_B)$; parameter I_C

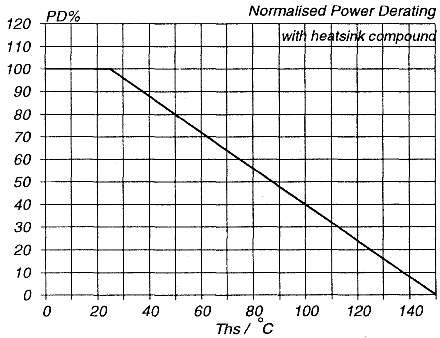


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f (T_{hs})$

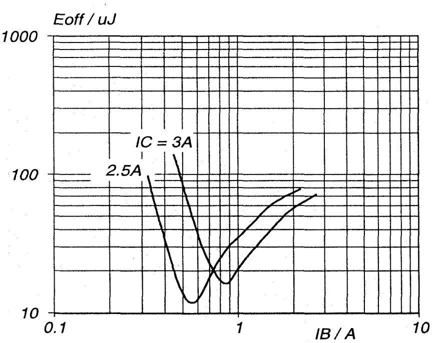


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f (I_B)$; parameter I_C

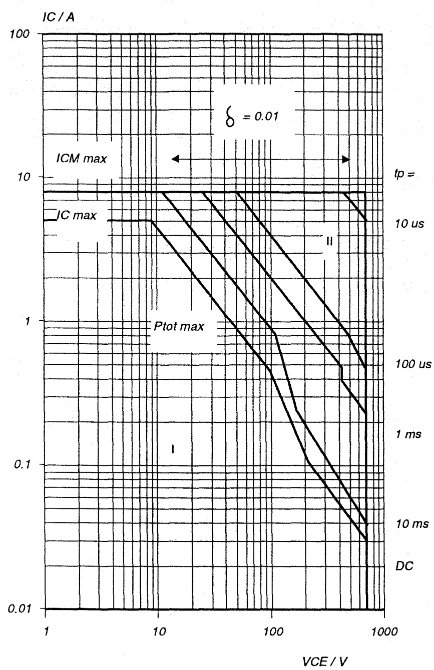


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

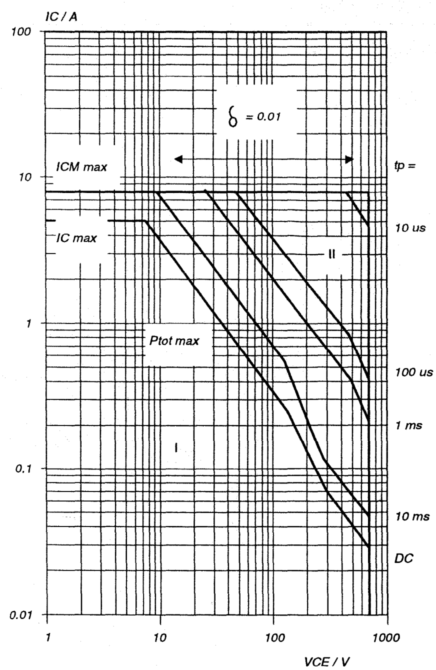


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

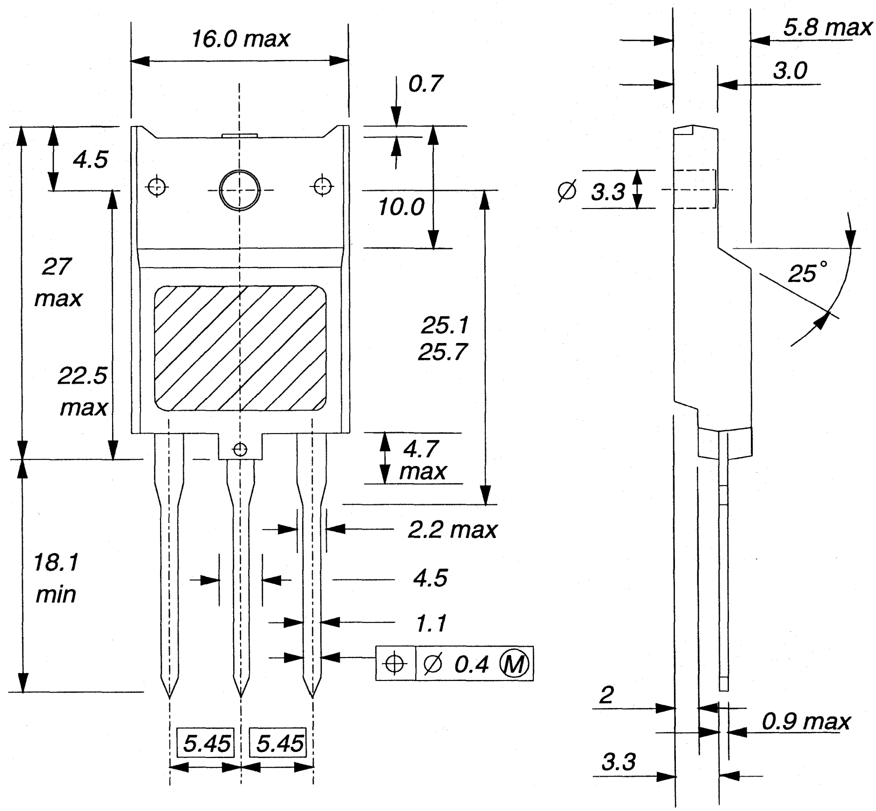


Fig.14. SOT399; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor in a plastic 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.

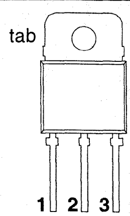
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

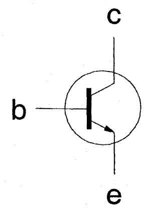
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base	-	-	1.0	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.5	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.4	0.6	µs
	Switching times (38 kHz line deflection circuit)	I_{CM} = 4.0 A; $I_{B(end)}$ = 0.9 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		4.7	5.7	µs
t_f	Turn-off fall time		0.25	0.35	µs

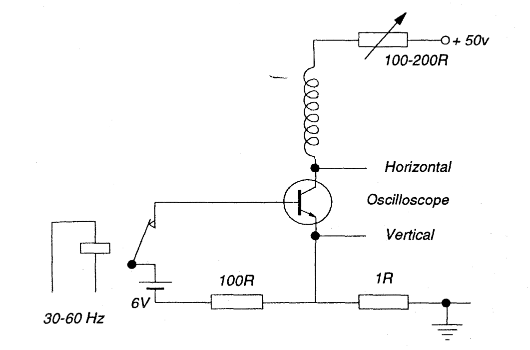


Fig.1. Test circuit for V_{CEO}sust.

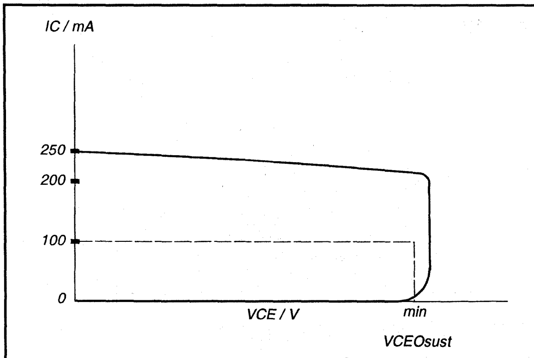


Fig.2. Oscilloscope display for V_{CEO}sust.

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

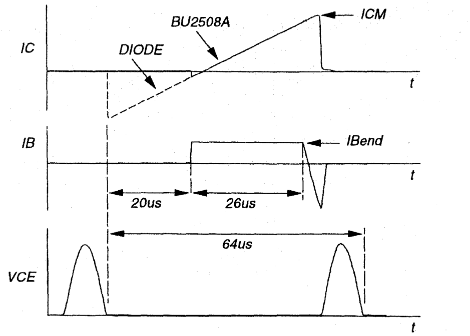


Fig.3. Switching times waveforms.

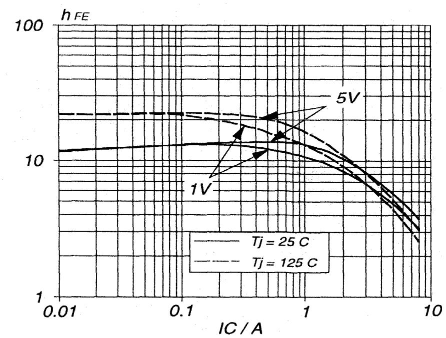


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

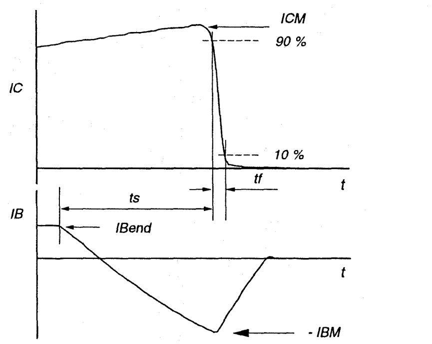


Fig.4. Switching times definitions.

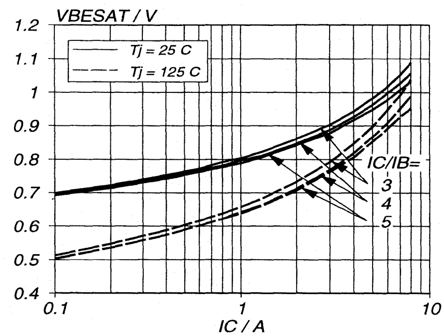


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

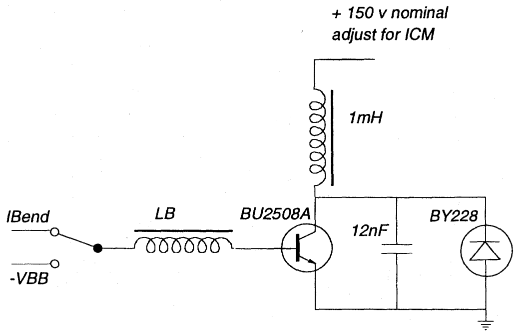


Fig.5. Switching times test circuit (BU2508A).

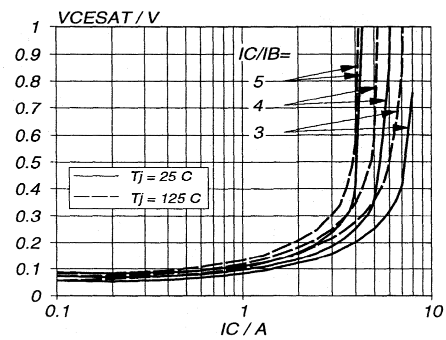


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

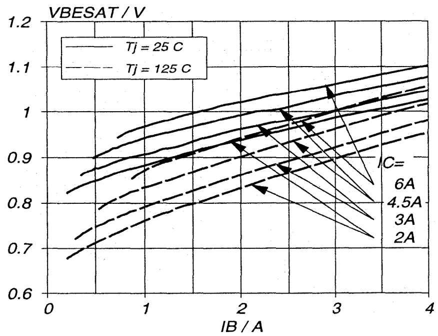


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

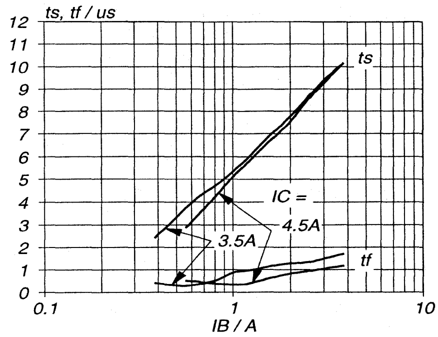


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16\ kHz$

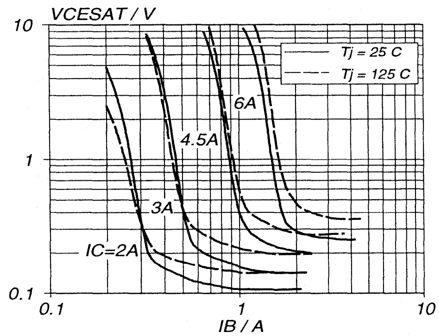


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

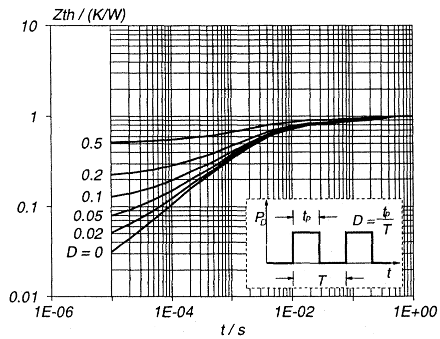


Fig.13. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

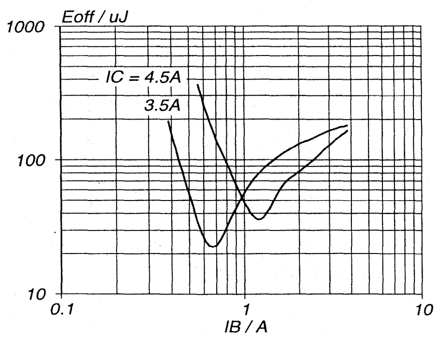


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f\ (I_B)$; parameter I_C; $f = 16\ kHz$

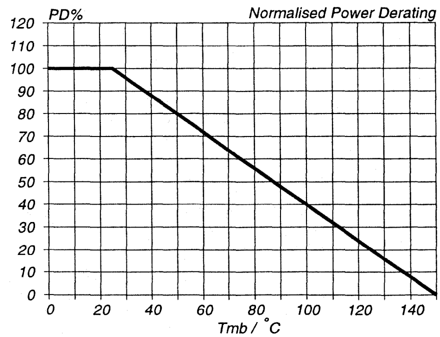


Fig.14. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25^{\circ}C} = f\ (T_{mb})$

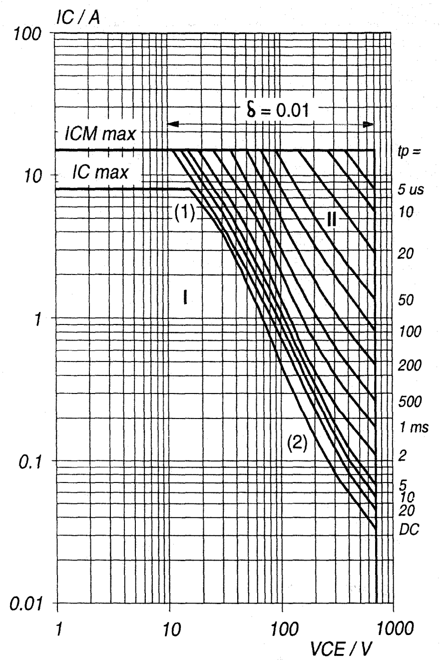


Fig.15. Forward bias safe operating area. T_{mb} = 25˚C
(1) *P_{tot} max line.*
(2) *Second-breakdown limits (independent of temperature).*
I *Region of DC operation.*
II *Extension for repetitive pulse operation.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

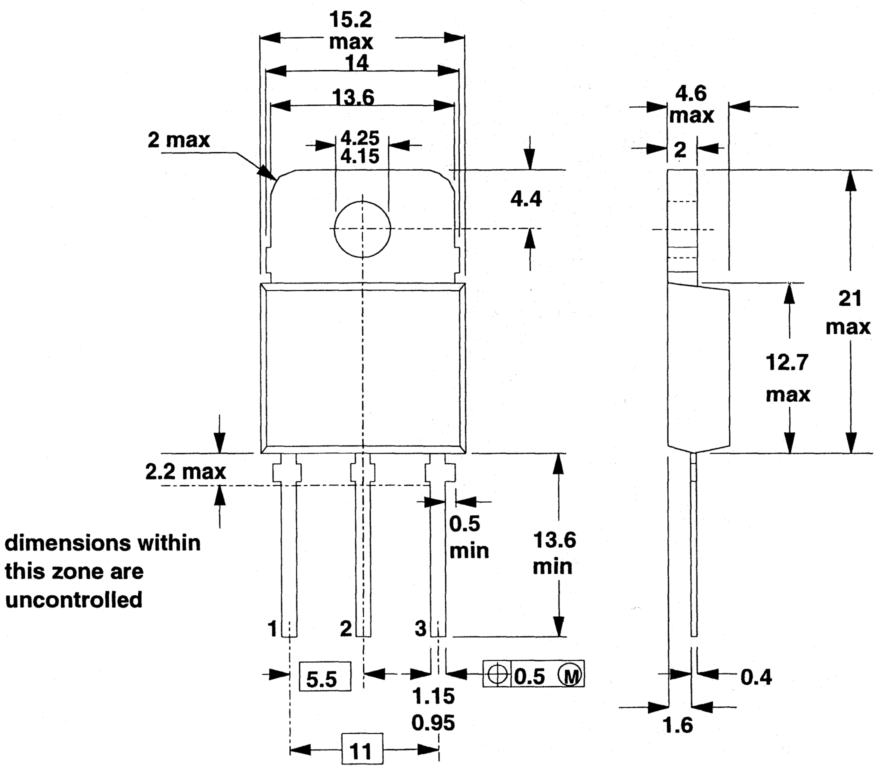


Fig.16. SOT93; pin 2 connected to mounting base.

Notes

1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

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.

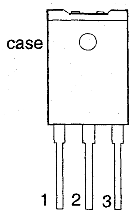
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

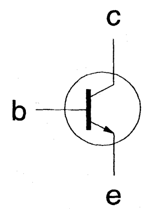
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	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	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.4	0.6	µs
	Switching times (38 kHz line deflection circuit)	I_{CM} = 4.0 A; $I_{B(end)}$ = 0.9 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		4.7	5.7	µs
t_f	Turn-off fall time		0.25	0.35	µs

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

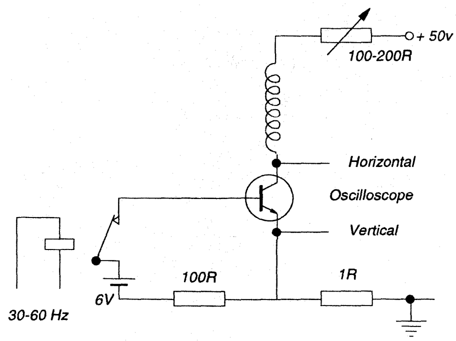


Fig.1. Test circuit for $V_{CEOsust}$.

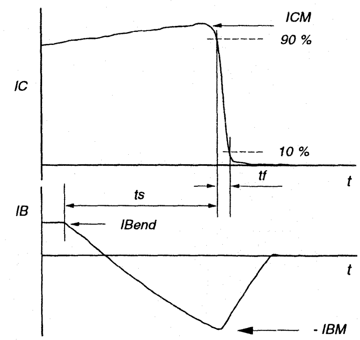


Fig.4. Switching times definitions.

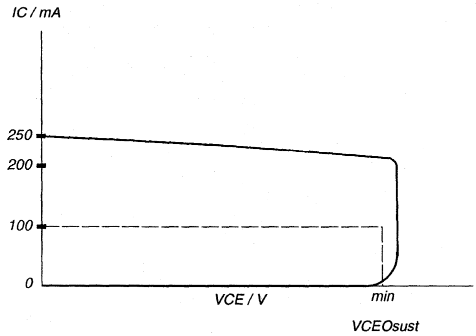


Fig.2. Oscilloscope display for $V_{CEOsust}$.

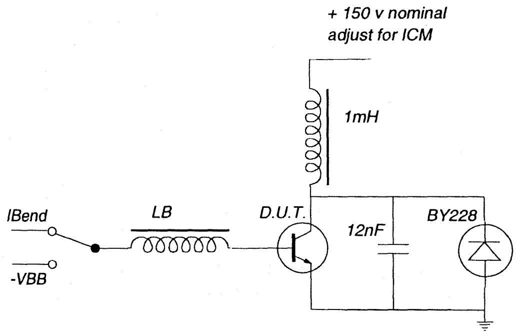


Fig.5. Switching times test circuit.

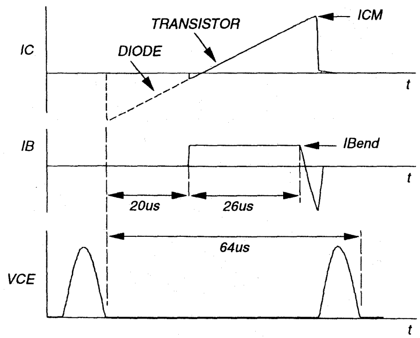


Fig.3. Switching times waveforms.

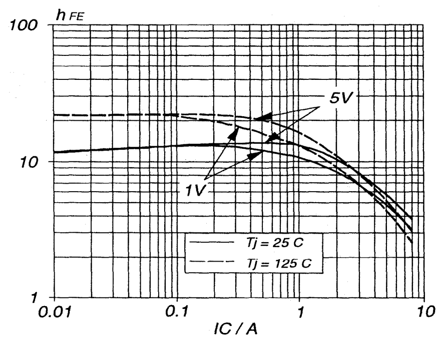


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

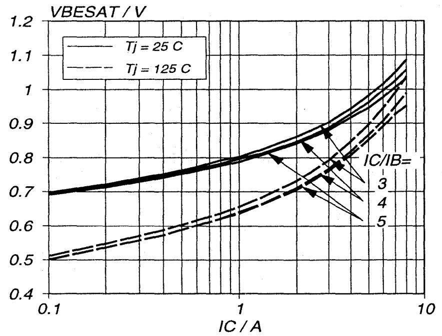


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

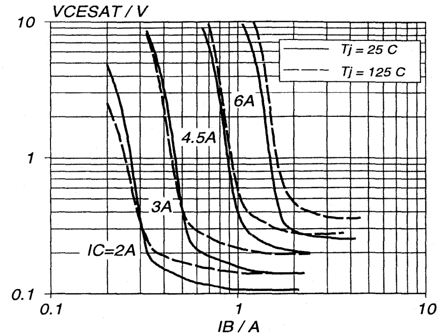


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

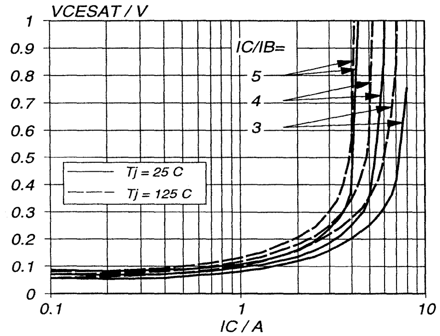


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

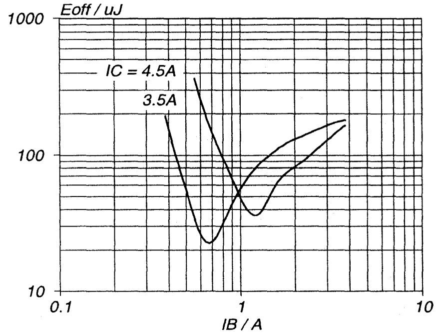


Fig.11. Typical turn-off losses. $T_j = 85^\circ C$ $Eoff = f(I_B)$; parameter I_C; $f = 16$ kHz

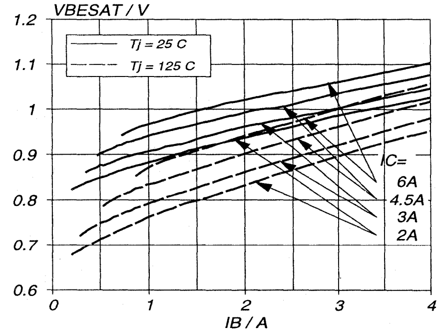


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

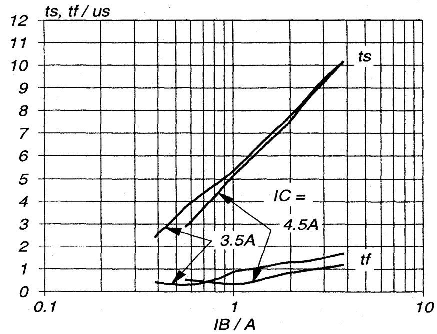


Fig.12. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 16$ kHz

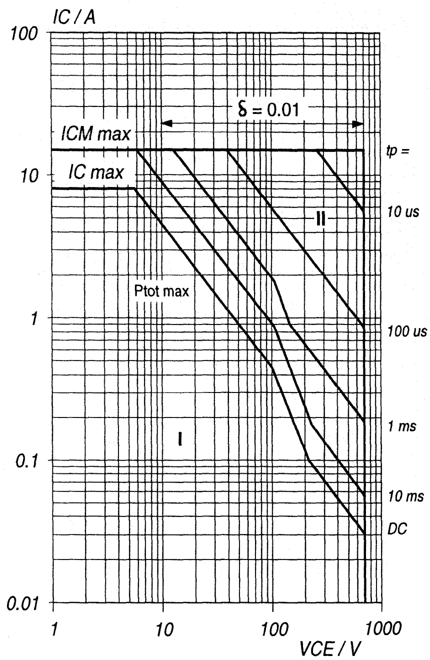


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

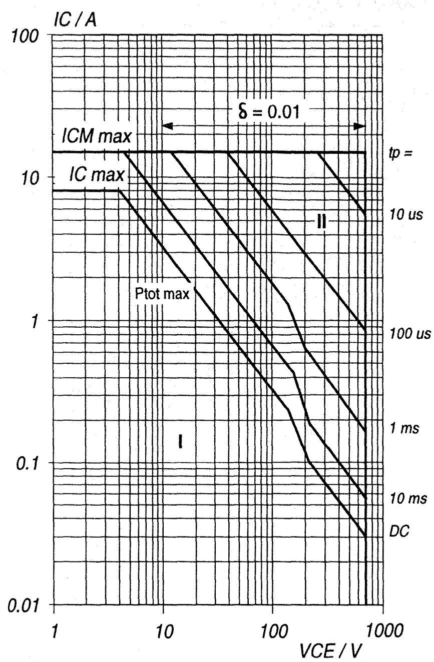


Fig.15. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

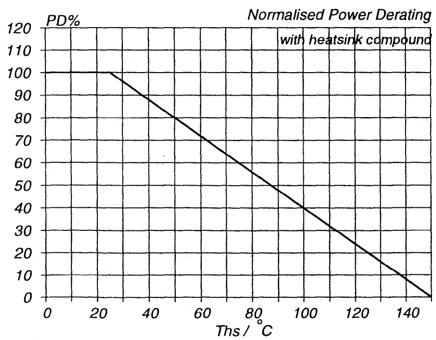


Fig.14. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f\,(T_{hs})$

MECHANICAL DATA

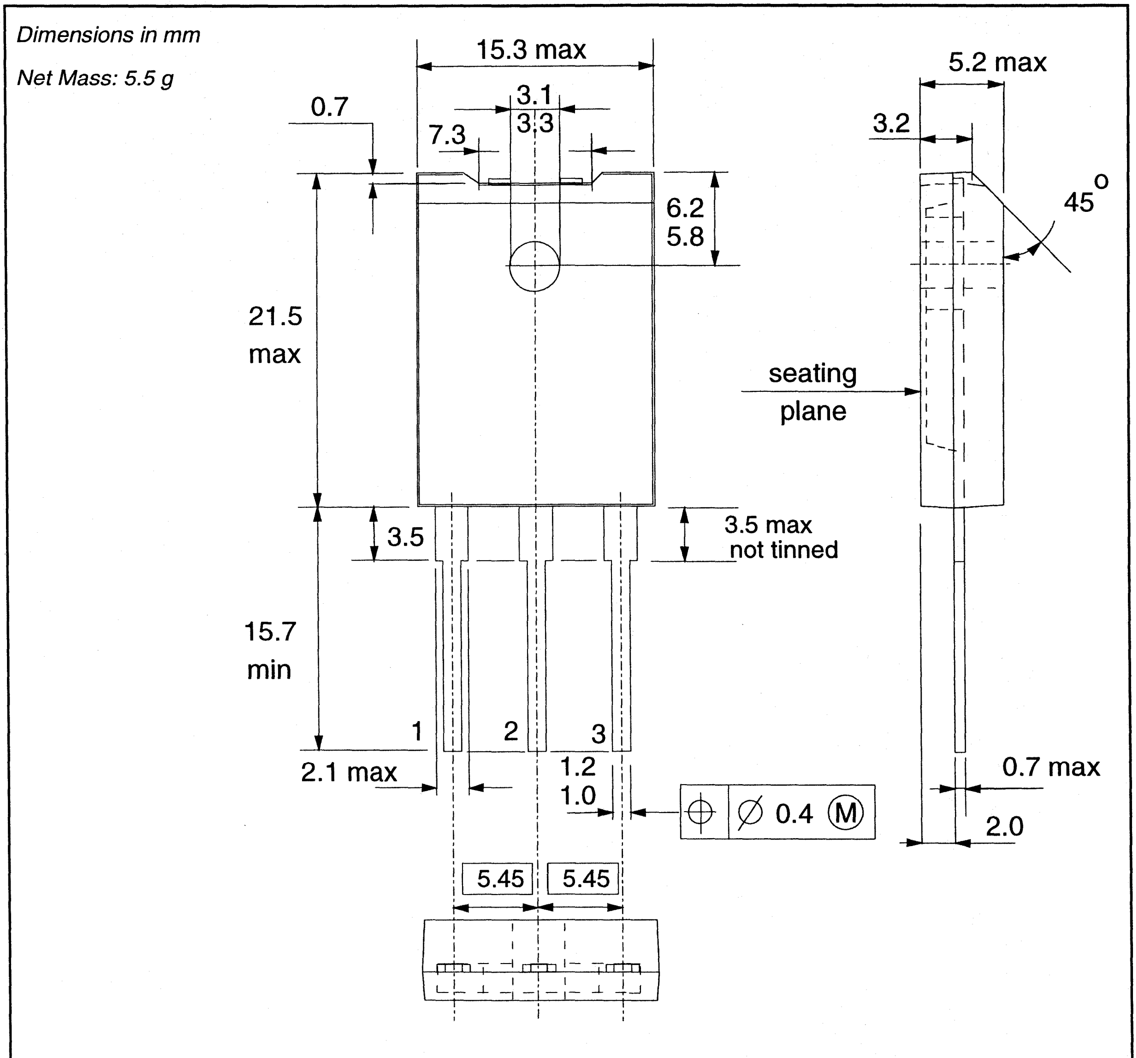


Fig.16. SOT199; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor — BU2508AX

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.

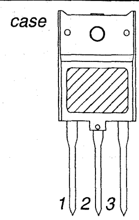
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

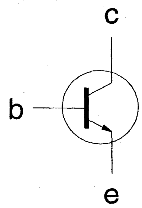
PINNING - SOT399

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA;V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 4.5 A;V_{CE} = 1 V	4	5.5	7.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/μs)			
t_s	Turn-off storage time		5.0	6.0	μs
t_f	Turn-off fall time		0.4	0.6	μs
	Switching times (38 kHz line deflection circuit)	I_{CM} = 4.0 A; $I_{B(end)}$ = 0.9 A; L_B = 6 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/μs)			
t_s	Turn-off storage time		4.7	5.7	μs
t_f	Turn-off fall time		0.25	0.35	μs

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

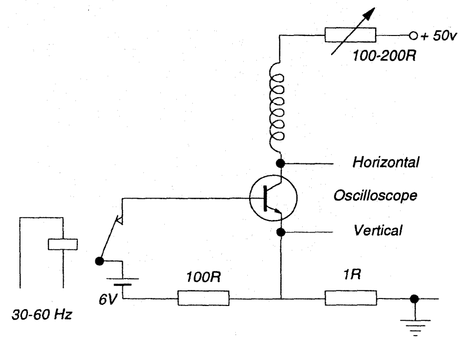


Fig.1. Test circuit for $V_{CEOsust}$.

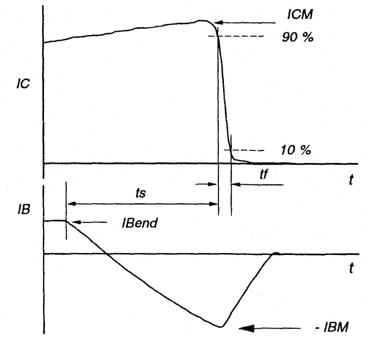


Fig.4. Switching times definitions.

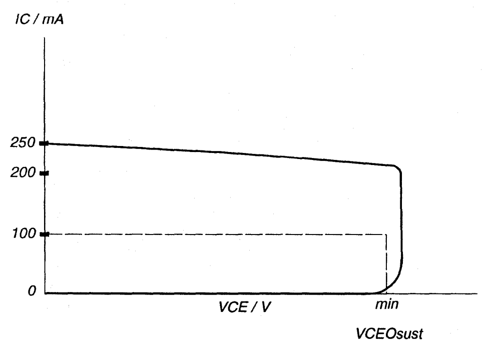


Fig.2. Oscilloscope display for $V_{CEOsust}$.

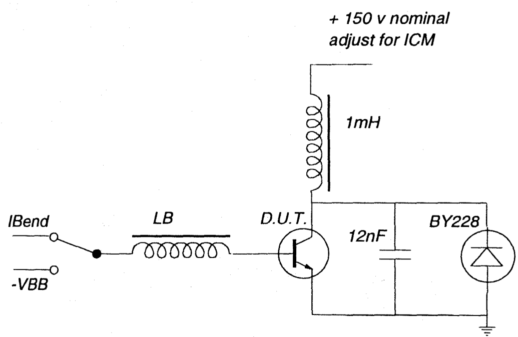


Fig.5. Switching times test circuit.

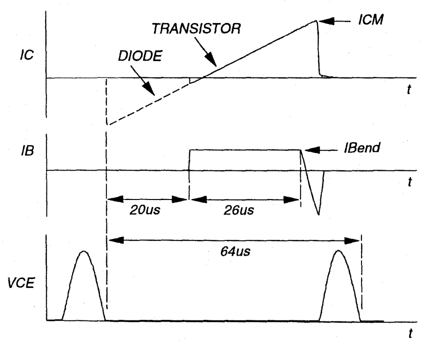


Fig.3. Switching times waveforms.

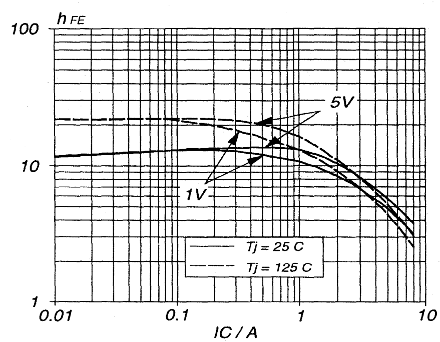


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

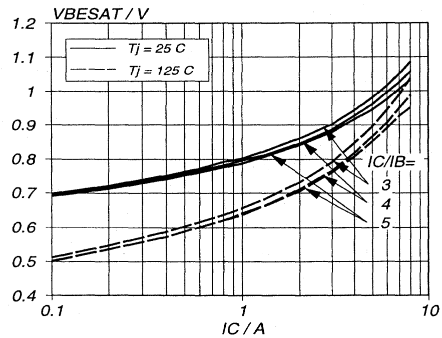


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

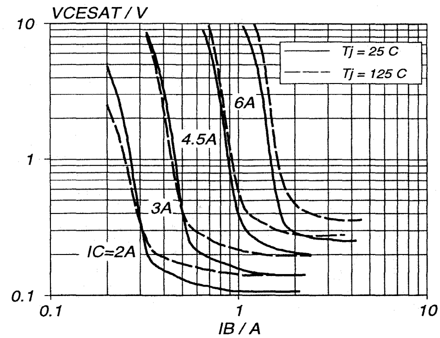


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

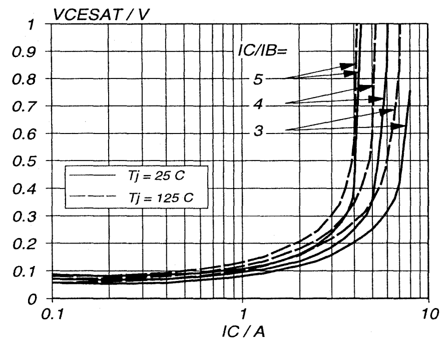


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

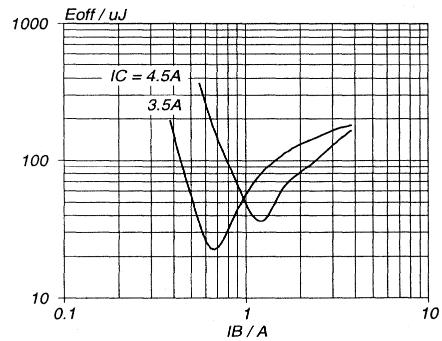


Fig.11. Typical turn-off losses. $T_j = 85˚C$ $E_{off} = f\ (I_B)$; parameter I_C; $f = 16$ kHz

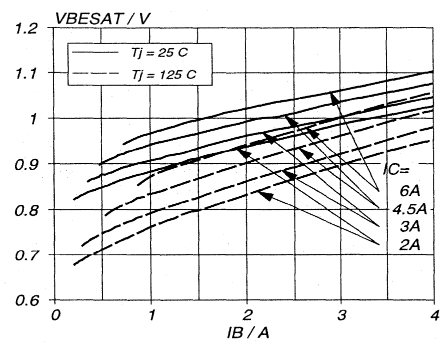


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

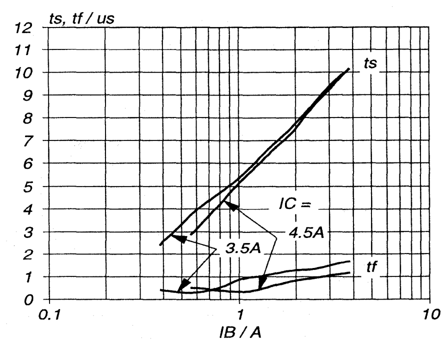


Fig.12. Typical collector storage and fall time. $t_s = f\ (I_B)$; $t_f = f\ (I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

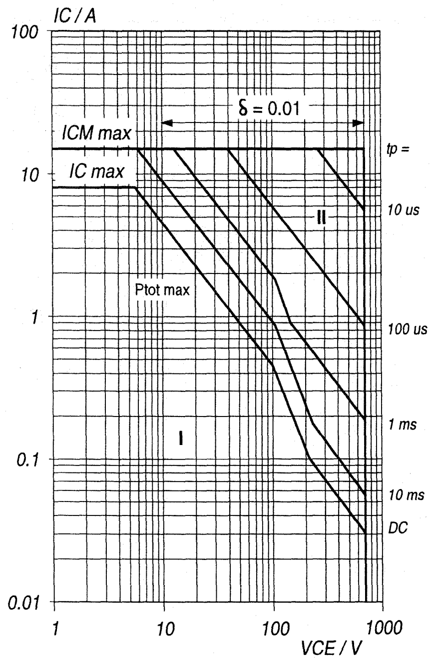


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

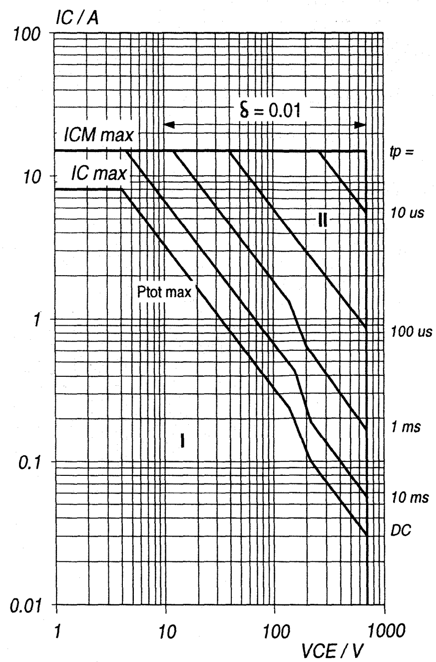


Fig.15. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

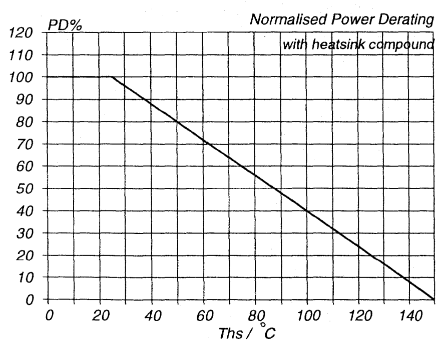


Fig.14. Normalised power dissipation.
$PD\% = 100 \cdot P_D / P_{D\,25^\circ C} = f\,(T_{hs})$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

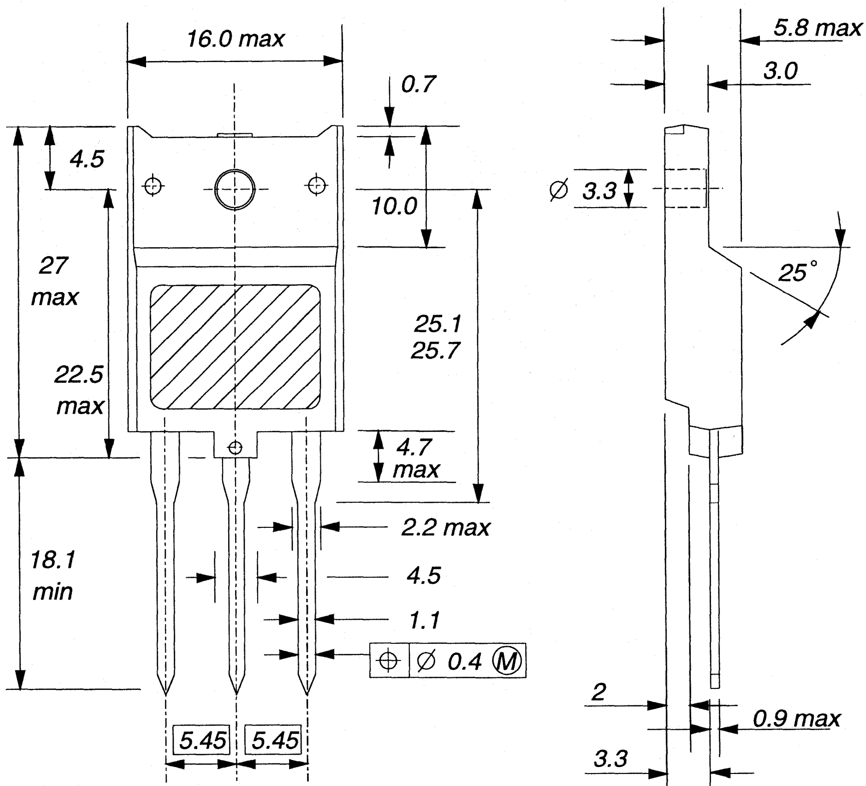


Fig.16. SOT399; The seating plane is electrically isolated from all terminals.

Notes

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

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode in a plastic 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.

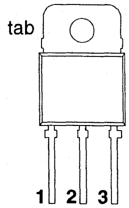
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	2.0	V
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	μs

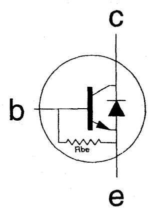
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

1 Turn-off current.

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	45	-	K/W

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	140	-	390	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	33	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	7	13	23	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.5	
V_F	Diode forward voltage	I_F = 4.5 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.4	0.6	µs
	Switching times (38 kHz line deflection circuit)	I_{CM} = 4.0 A; $I_{B(end)}$ = 0.9 A; L_B = 6 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/µs)			
t_s	Turn-off storage time		4.7	5.7	µs
t_f	Turn-off fall time		0.25	0.35	µs

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

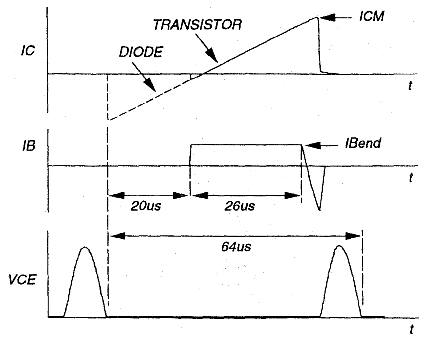


Fig.1. Switching times waveforms.

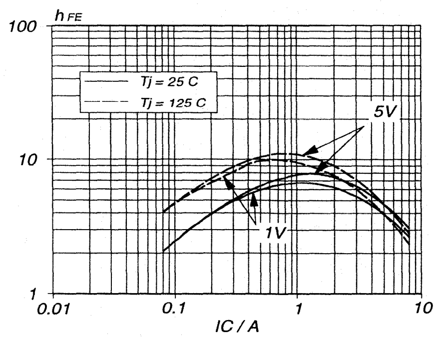


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

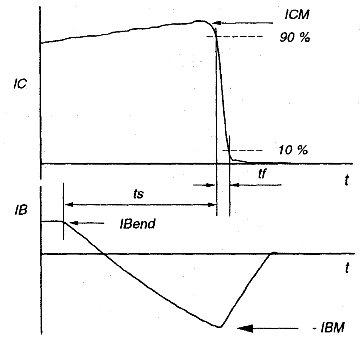


Fig.2. Switching times definitions.

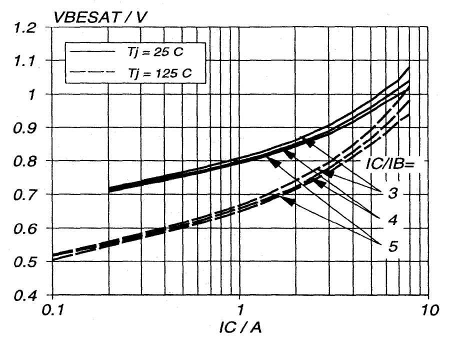


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

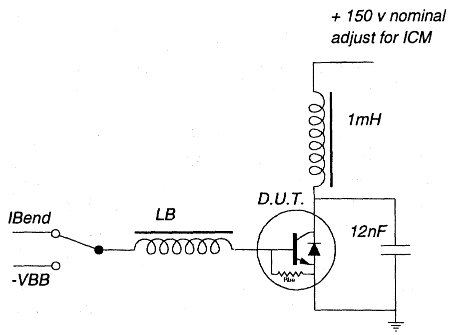


Fig.3. Switching times test circuit.

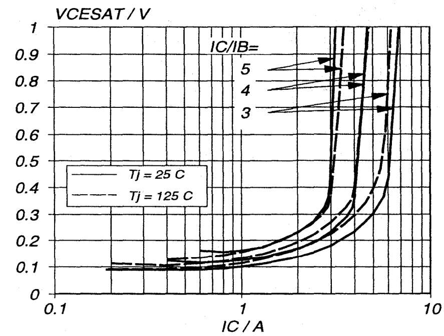


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

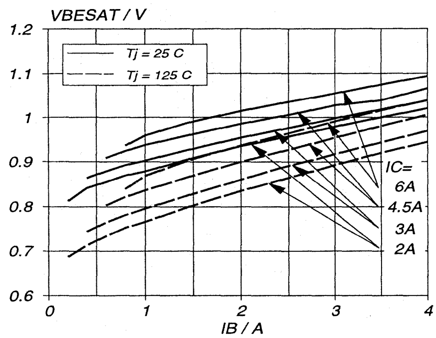


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

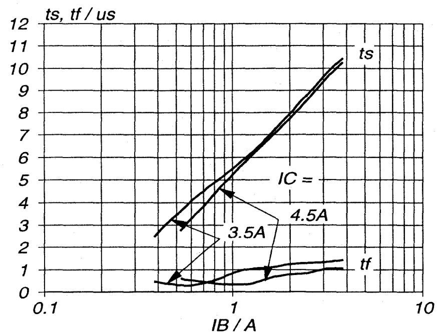


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

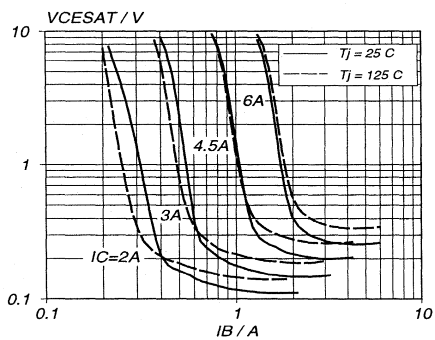


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

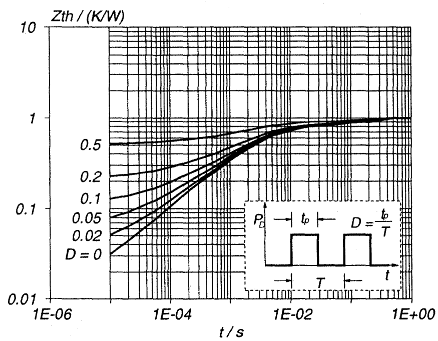


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

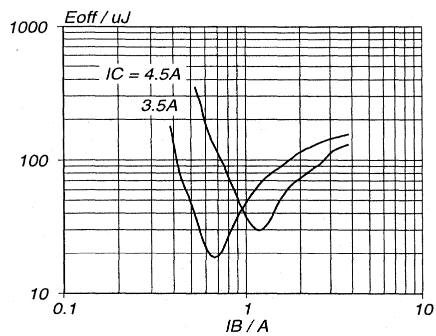


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f(I_B)$; parameter I_C; $f = 16$ kHz

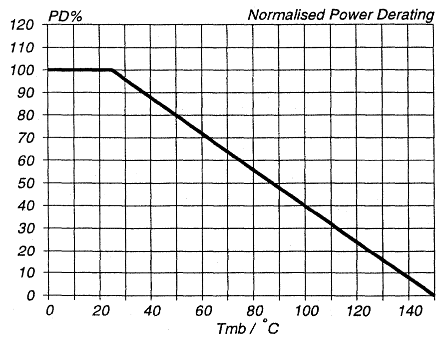


Fig.12. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25˚C} = f(T_{mb})$

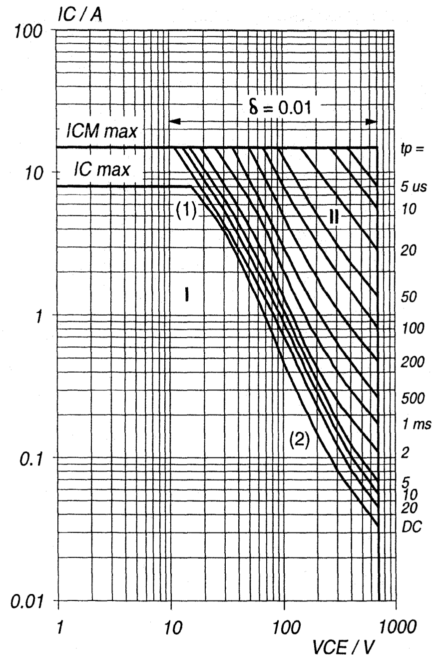


Fig.13. Forward bias safe operating area. $T_{mb} = 25˚C$
(1) P_{tot} *max line.*
(2) *Second-breakdown limits (independent of temperature).*
I *Region of DC operation.*
II *Extension for repetitive pulse operation.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

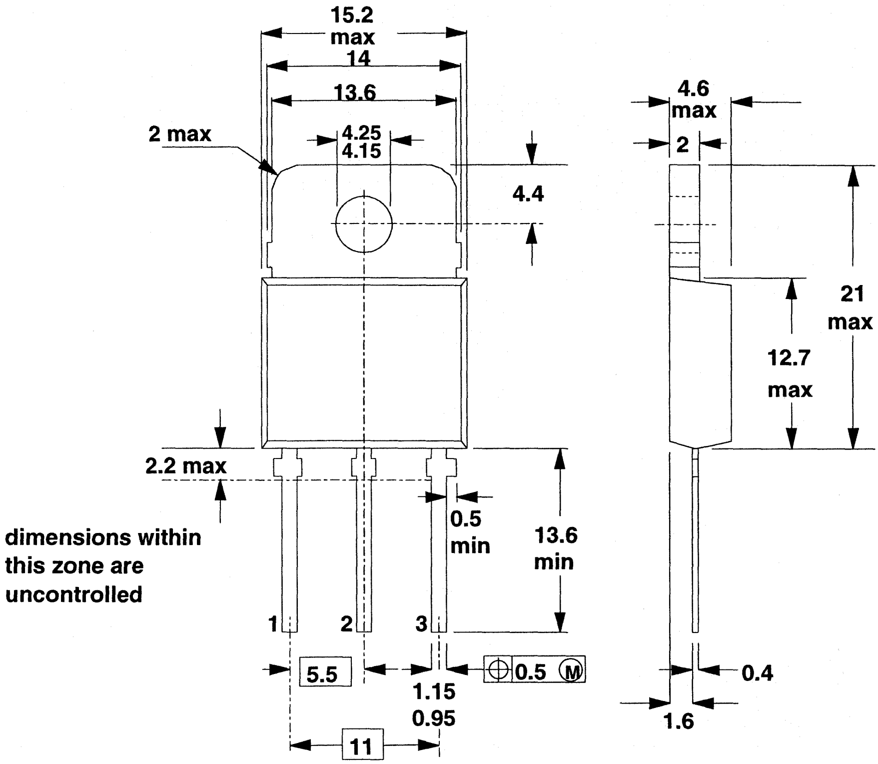


Fig.14. SOT93; pin 2 connected to mounting base.

Notes

1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode 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.

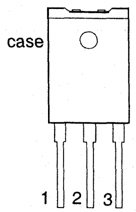
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	2.0	V
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

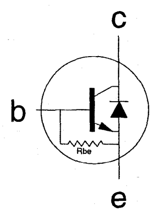
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	140	-	390	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	33	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	7	13	23	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.5	
V_F	Diode forward voltage	I_F = 4.5 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/μs)			
t_s	Turn-off storage time		5.0	6.0	μs
t_f	Turn-off fall time		0.4	0.6	μs
	Switching times (38 kHz line deflectioin circuit)	I_{CM} = 4.0 A; $I_{B(end)}$ = 0.9 A; L_B = 6 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/μs)			
t_s	Turn-off storage time		4.7	5.7	μs
t_f	Turn-off fall time		0.25	0.35	μs

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

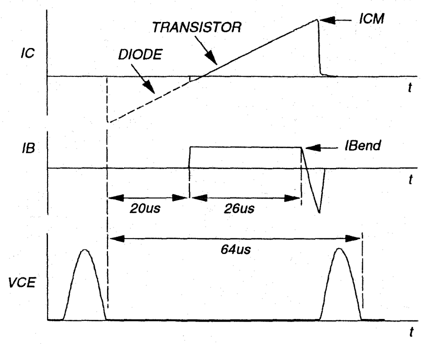


Fig.1. Switching times waveforms.

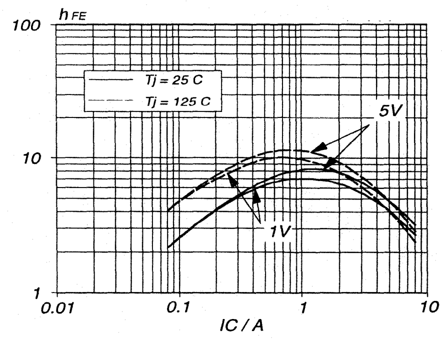


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

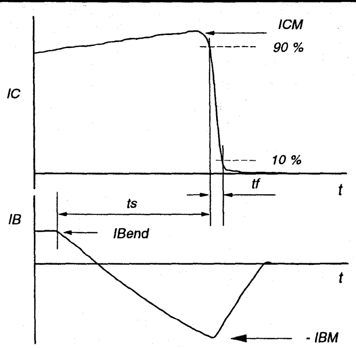


Fig.2. Switching times definitions.

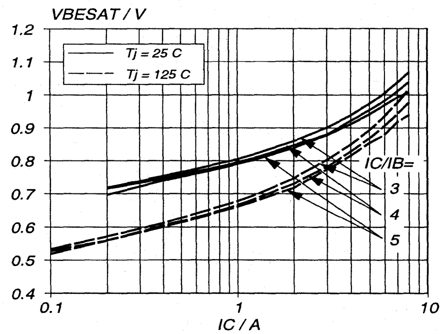


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

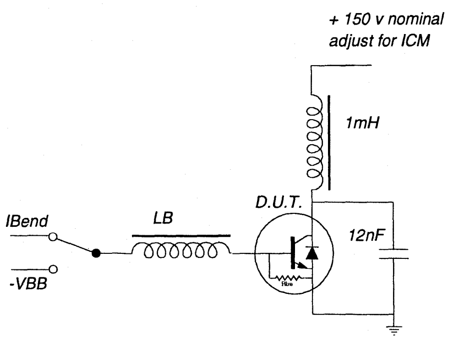


Fig.3. Switching times test circuit.

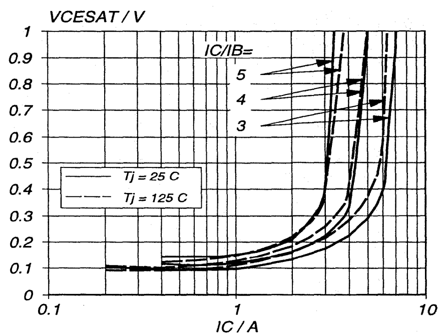


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

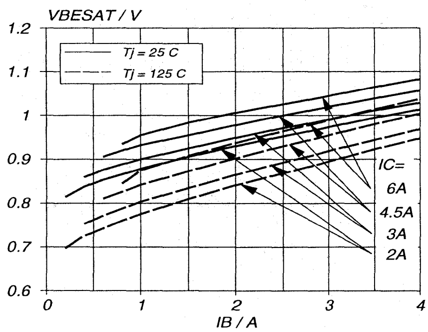


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

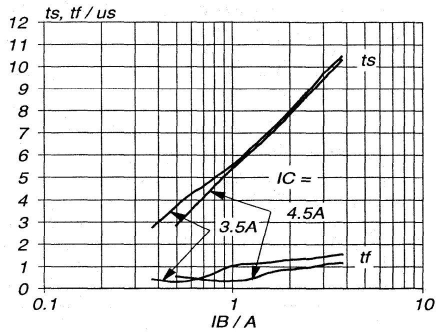


Fig.10. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16$ kHz

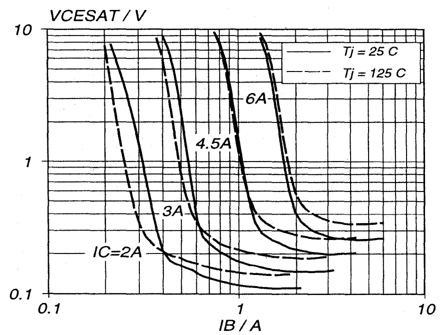


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

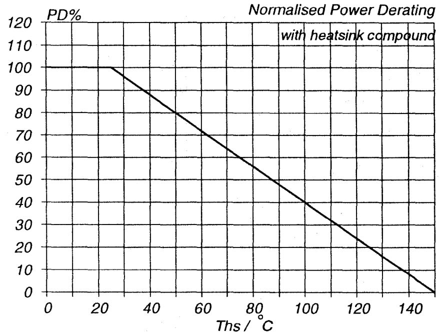


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25^{\circ}C} = f\ (T_{hs})$

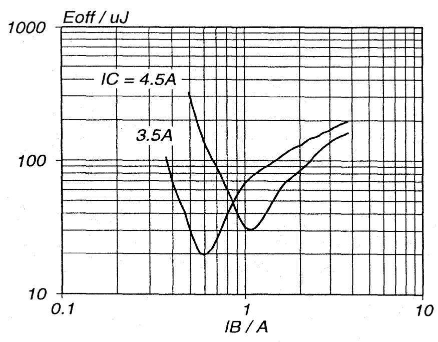


Fig.9. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f\ (I_B)$; parameter I_C; $f = 16$ kHz

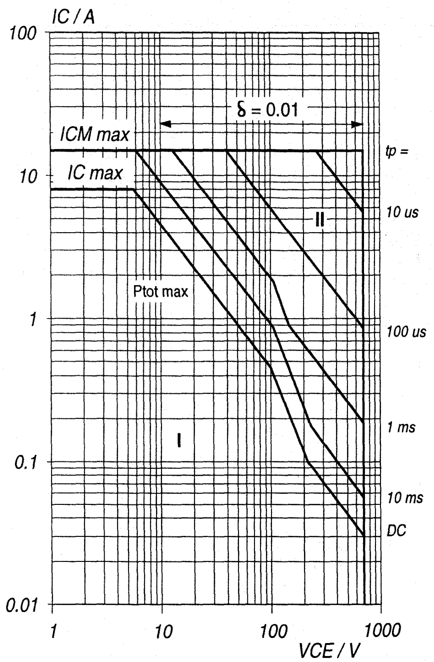


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

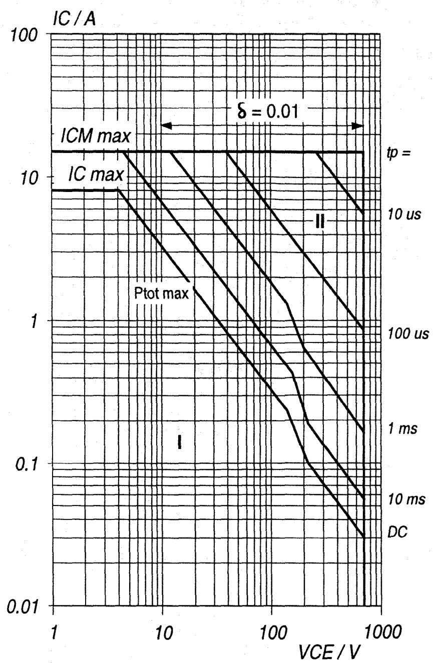


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

MECHANICAL DATA

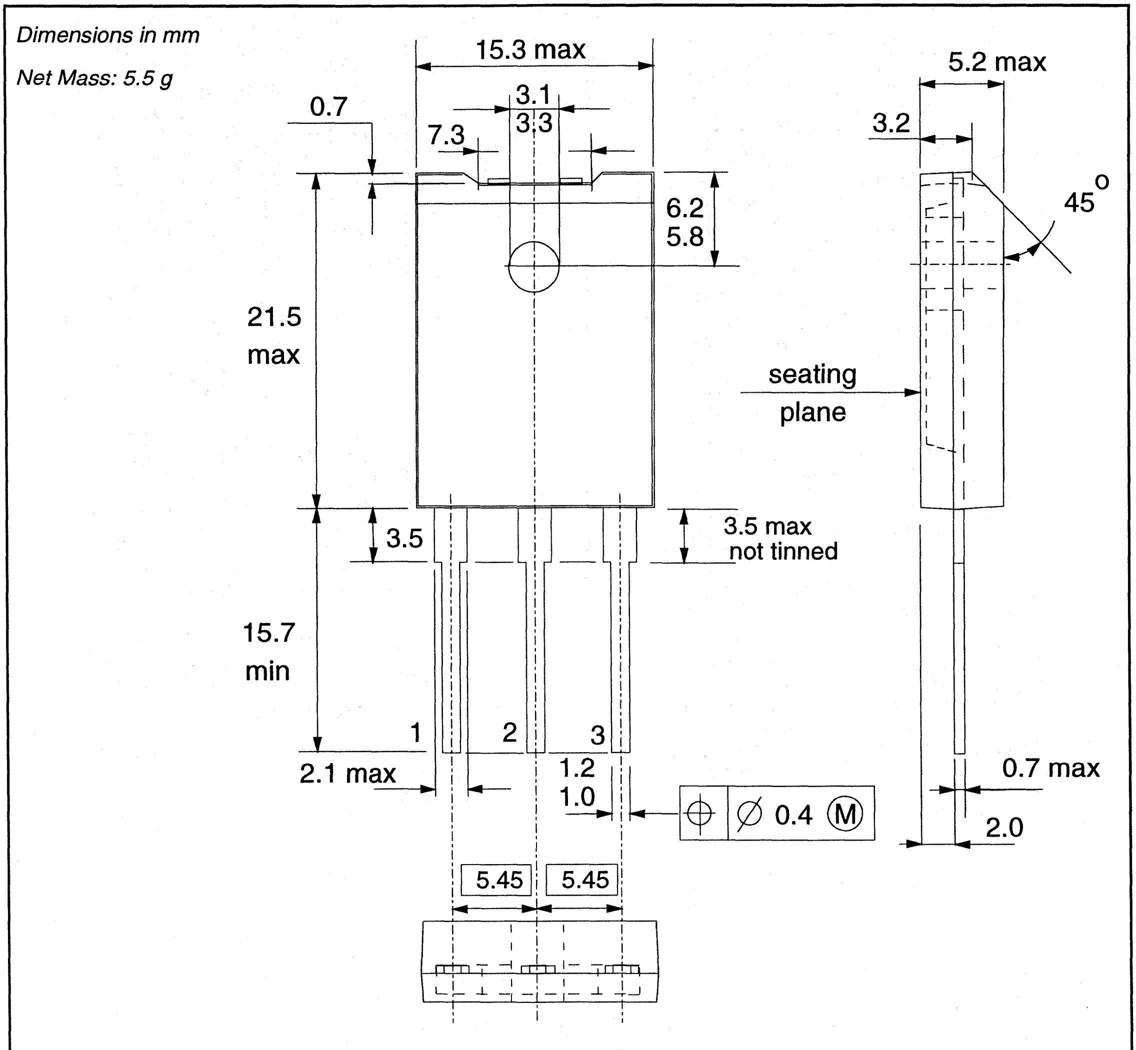


Fig.14. SOT199; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

Enhanced performance, new generation, high-voltage, high-speed switching npn transistor with an integrated damper diode 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.

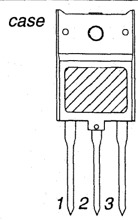
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ °C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.29$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current		4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	2.0	V
t_f	Fall time	$I_{CM} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

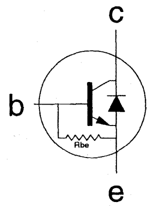
PINNING - SOT399

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	700	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	100	mA
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ °C	-	45	W
T_{stg}	Storage temperature		-55	150	°C
T_j	Junction temperature		-	150	°C

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	140	-	390	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	33	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	5.0	V
V_{CEsat}		I_C = 4.5 A; I_B = 1.29 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	7	13	23	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.5	
V_F	Diode forward voltage	I_F = 4.5 A	-	1.6	2.0	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	80	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 4.5 A; $I_{B(end)}$ = 1.1 A; L_B = 6 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/μs)			
t_s	Turn-off storage time		5.0	6.0	μs
t_f	Turn-off fall time		0.4	0.6	μs
	Switching times (38 kHz line deflection circuit)	I_{CM} = 4.0 A; $I_{B(end)}$ = 0.9 A; L_B = 6 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.6 A/μs)			
t_s	Turn-off storage time		4.7	5.7	μs
t_f	Turn-off fall time		0.25	0.35	μs

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

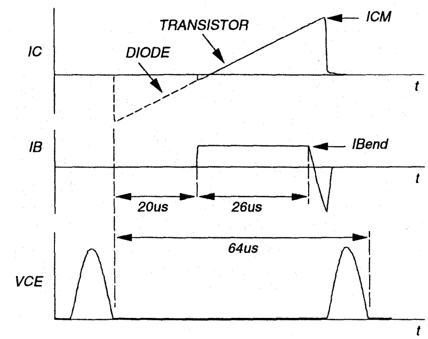


Fig.1. Switching times waveforms.

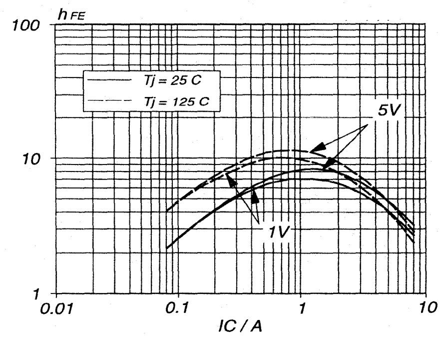


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

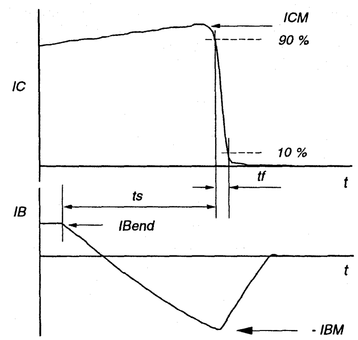


Fig.2. Switching times definitions.

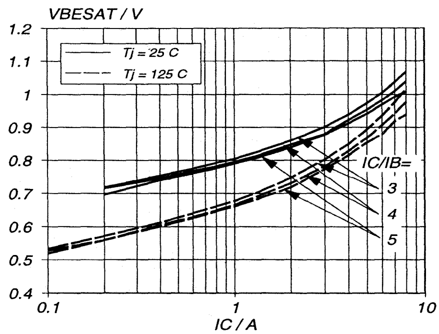


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

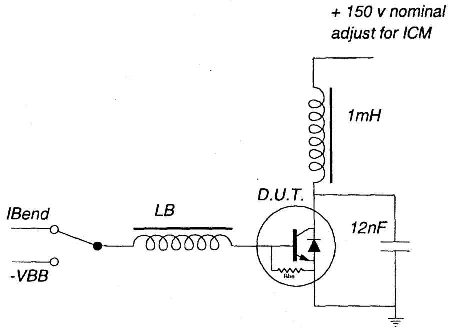


Fig.3. Switching times test circuit.

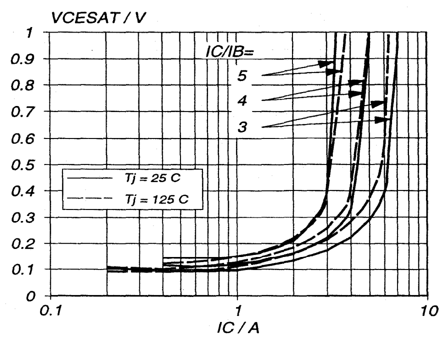


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

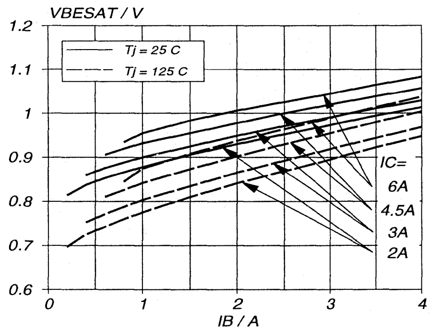


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

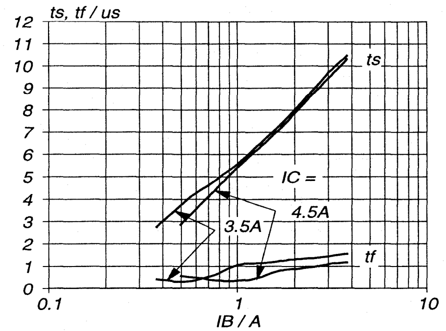


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; f = 16 kHz

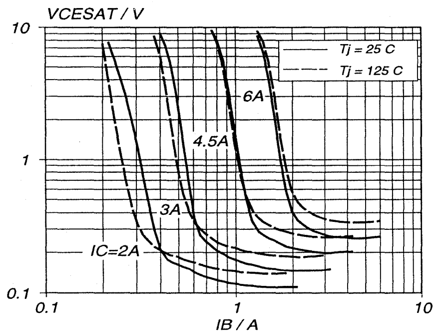


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

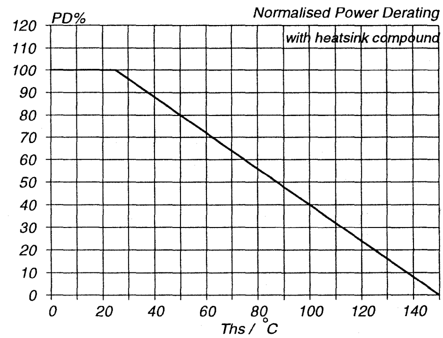


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

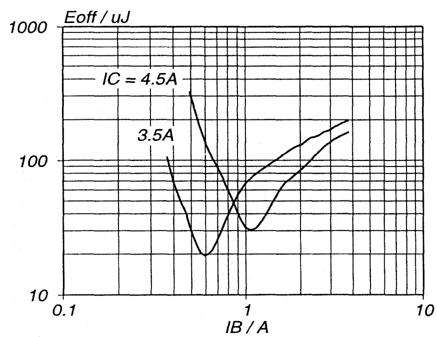


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f(I_B)$; parameter I_C; f = 16 kHz

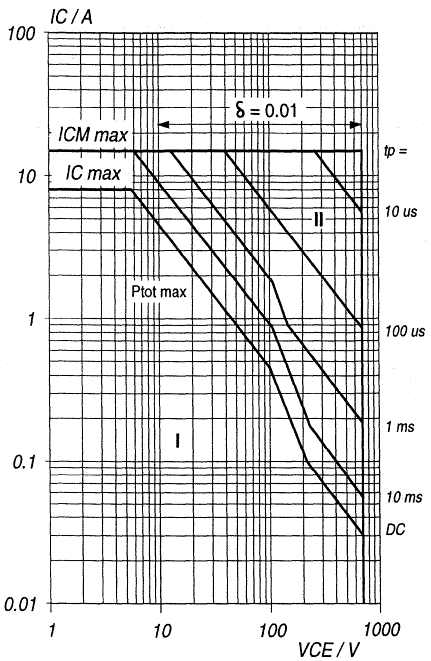


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

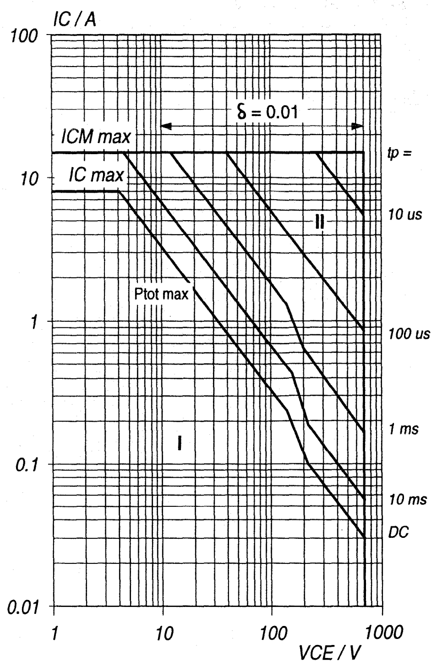


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

NB: *Mounted without heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

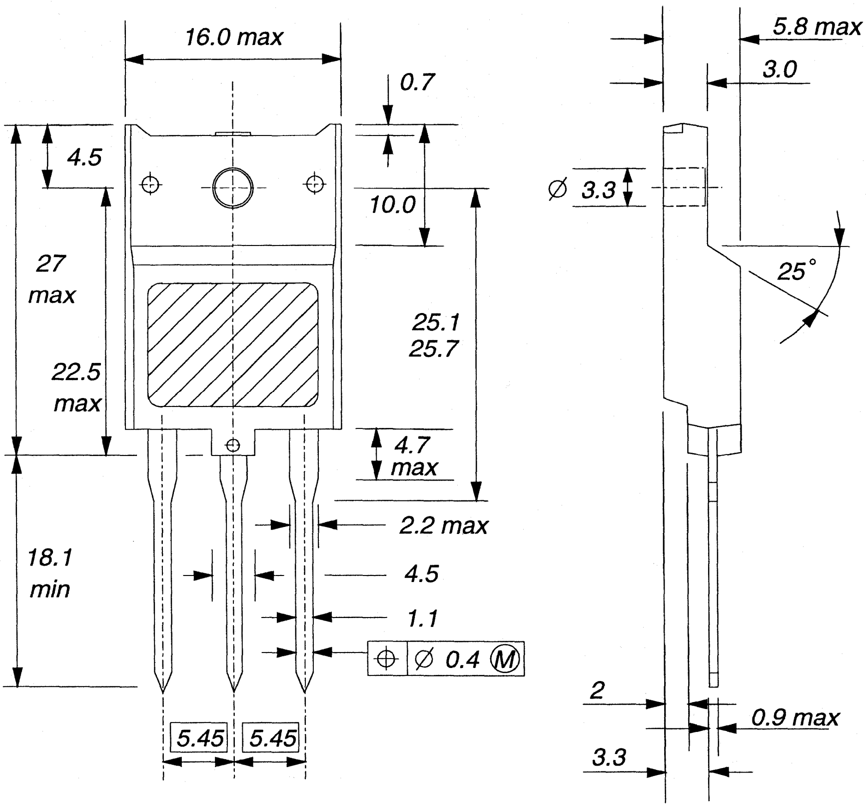


Fig.14. SOT399; The seating plane is electrically isolated from all terminals.

Notes

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

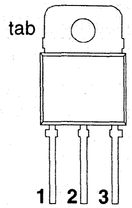
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6	-	A
t_f	Fall time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.85$ A	0.2	0.35	µs

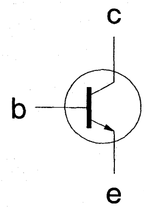
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base	-	-	1.0	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	10	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (32 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 330 µH; C_{fb} = 9 nF; $I_{B(end)}$ = 0.85 A; L_B = 3.45 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 1.2 A/µs)			
t_s	Turn-off storage time		3.0	4.0	µs
t_f	Turn-off fall time		0.2	0.35	µs
	Switching times (16 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 650 µH; C_{fb} = 19 nF; $I_{B(end)}$ = 1.0 A; L_B = 5.3 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.8 A / µs)			
t_s	Turn-off storage time		4.5	5.5	µs
t_f	Turn-off fall time		0.35	0.5	µs

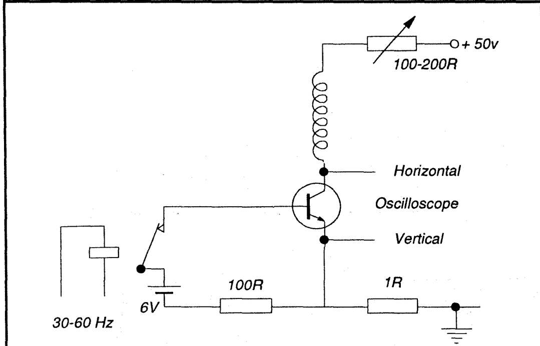


Fig.1. Test circuit for V_{CEO}sust.

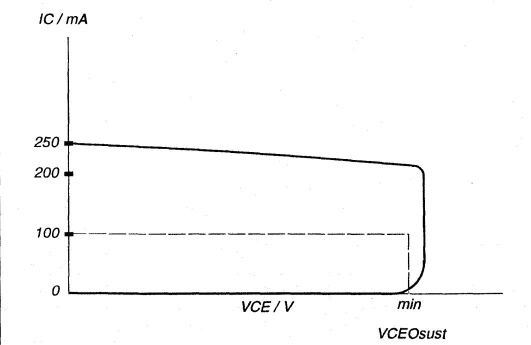


Fig.2. Oscilloscope display for V_{CEO}sust.

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

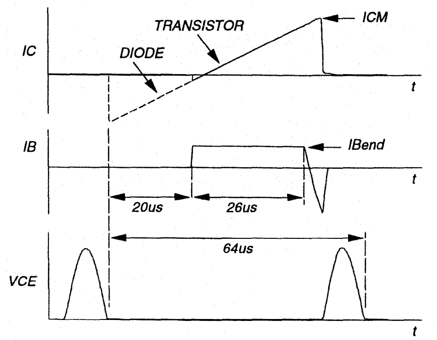


Fig.3. Switching times waveforms (16 kHz).

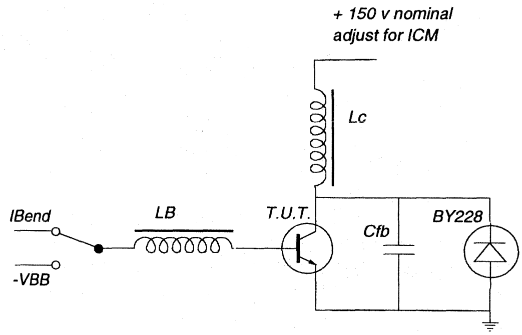


Fig.6. Switching times test circuit (BU2520A).

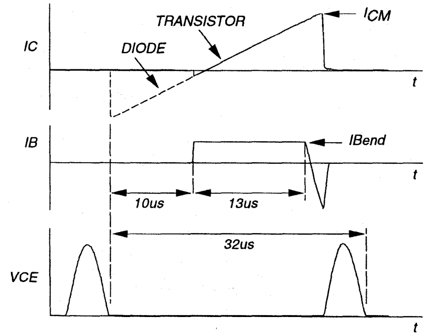


Fig.4. Switching times waveforms (32 kHz).

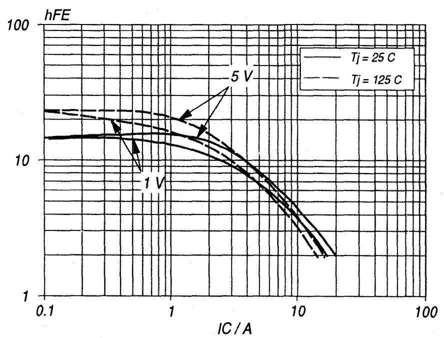


Fig.7. Typical DC current gain. $h_{FE} = f (I_C)$ parameter V_{CE}

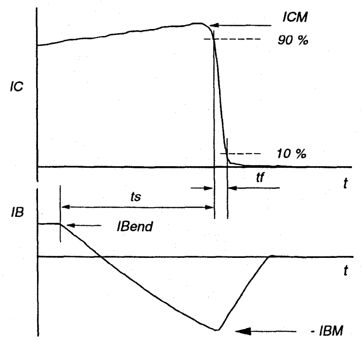


Fig.5. Switching times definitions.

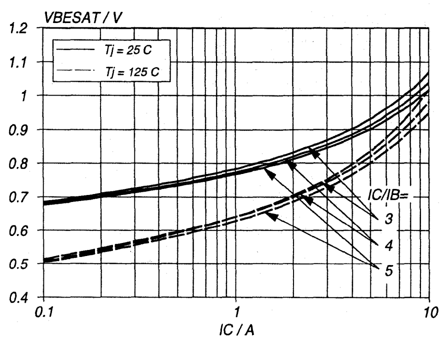


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_C)$; parameter I_C/I_B

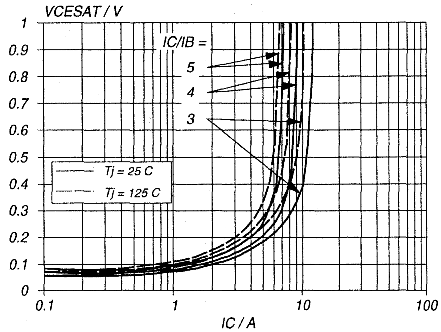


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

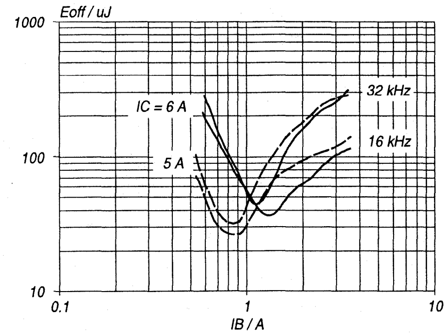


Fig.12. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f(I_B)$; parameter I_C; parameter frequency

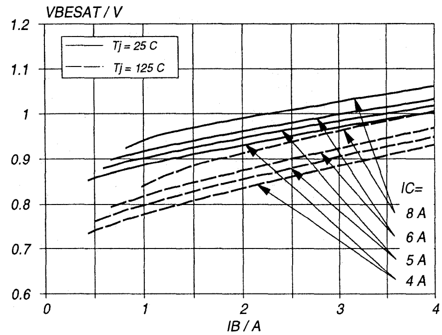


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

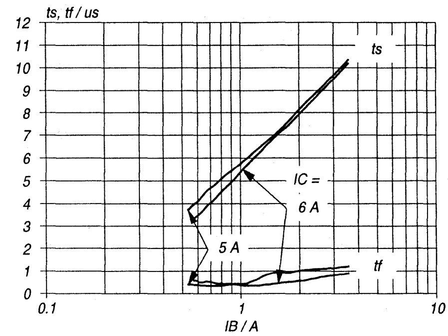


Fig.13. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16$ kHz

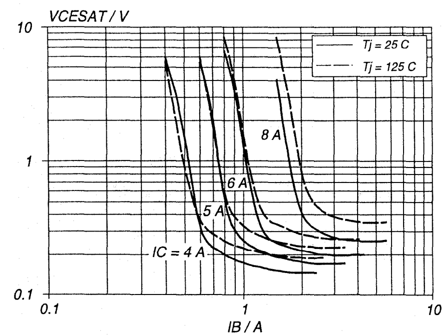


Fig.11. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

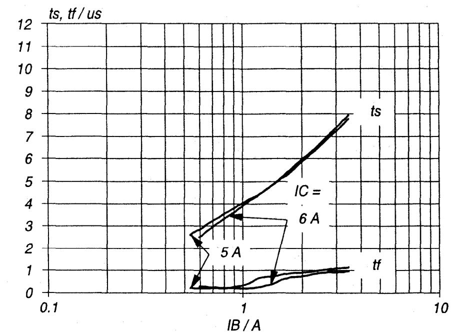


Fig.14. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 32$ kHz

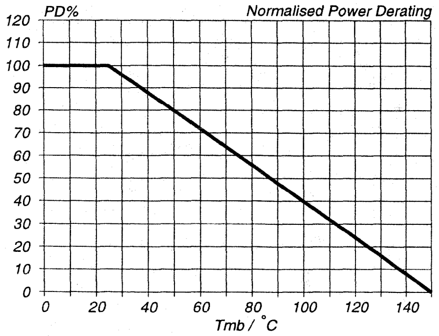


Fig.15. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{mb})$

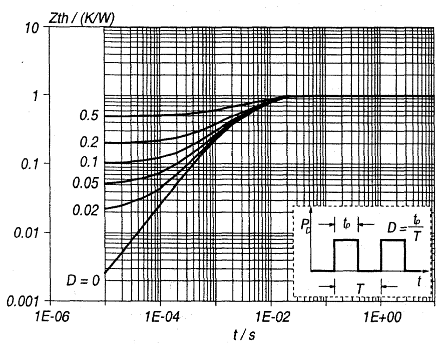


Fig.16. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

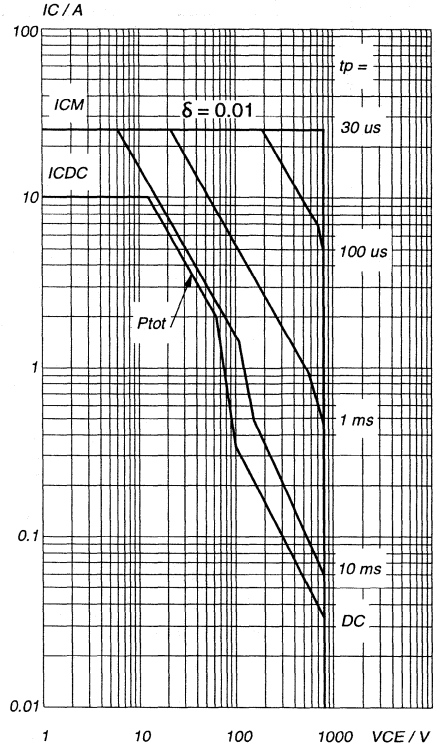


Fig.17. Forward bias safe operating area. T_{mb} = 25 ˚C I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p Second-breakdown limits independant of temperature.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

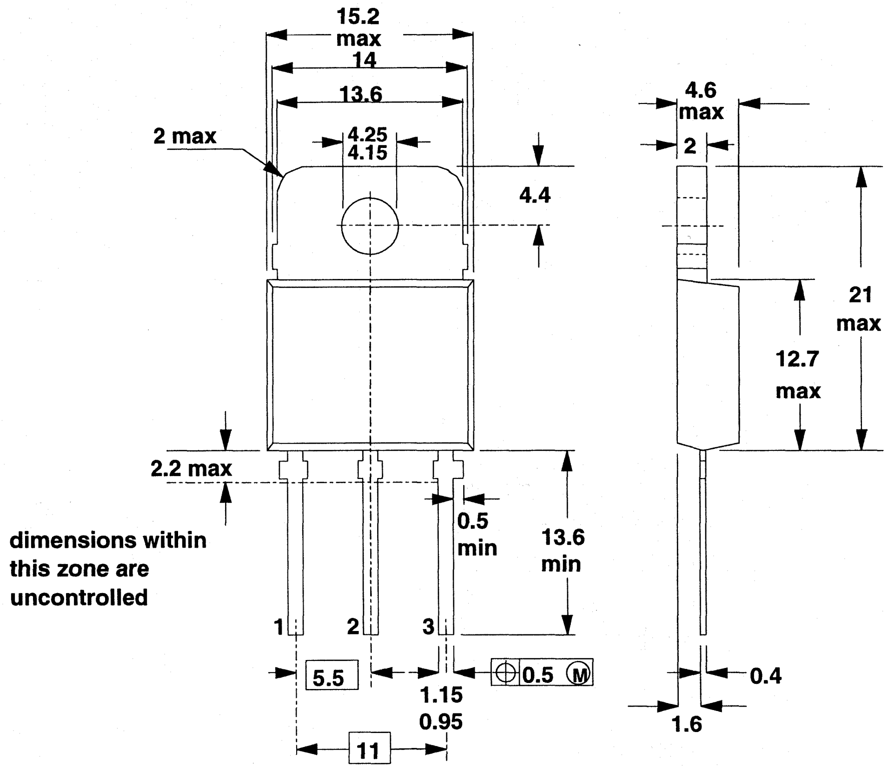


Fig.18. SOT93; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

Silicon Diffused Power Transistor — BU2520AF

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

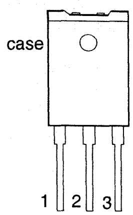
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_f	Fall time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.85$ A	0.2	0.35	µs

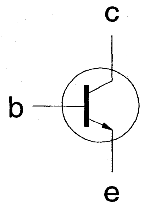
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	10	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (32 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 330 µH; C_{fb} = 9 nF; $I_{B(end)}$ = 0.85 A; L_B = 3.45 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 1.2 A / µs)			
t_s	Turn-off storage time		3.0	4.0	µs
t_f	Turn-off fall time		0.2	0.35	µs
	Switching times (16 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 650 µH; C_{fb} = 19 nF; $I_{B(end)}$ = 1.0 A; L_B = 5.3 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.8 A / µs)			
t_s	Turn-off storage time		4.5	5.5	µs
t_f	Turn-off fall time		0.35	0.5	µs

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

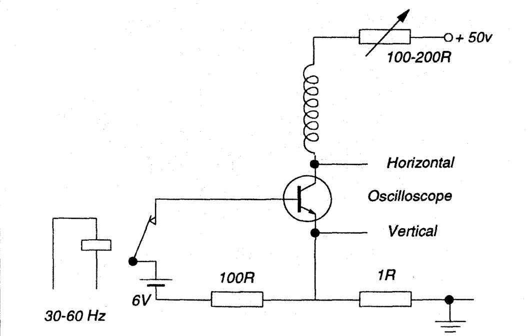


Fig.1. Test circuit for $V_{CEOsust}$.

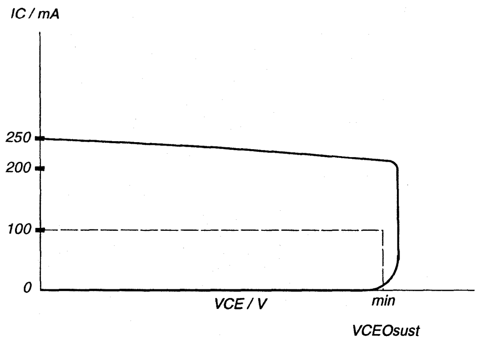


Fig.2. Oscilloscope display for $V_{CEOsust}$.

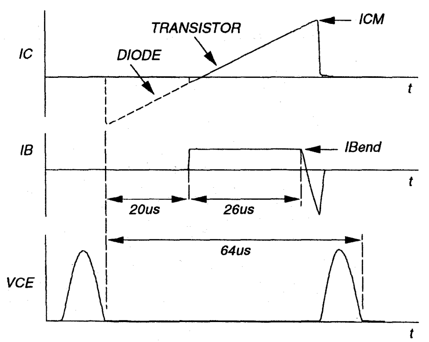


Fig.3. Switching times waveforms (16 kHz).

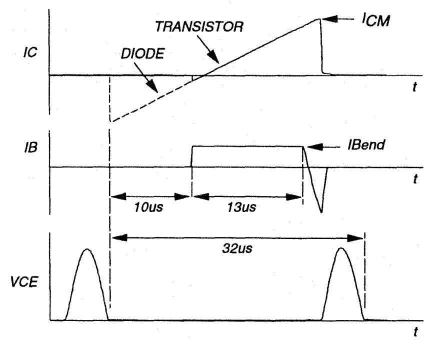


Fig.4. Switching times waveforms (32 kHz).

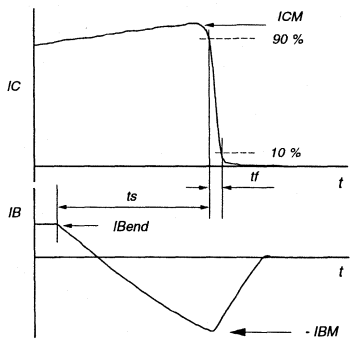


Fig.5. Switching times definitions.

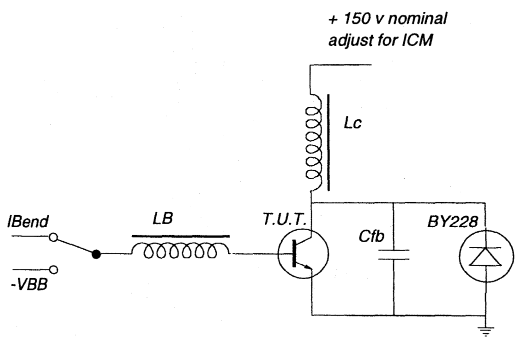


Fig.6. Switching times test circuit.

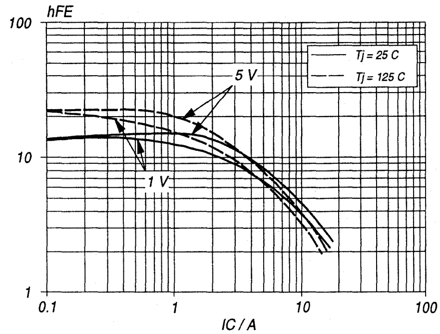


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

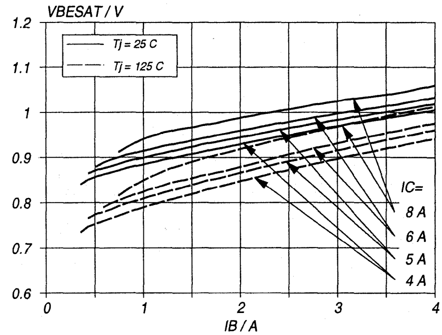


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

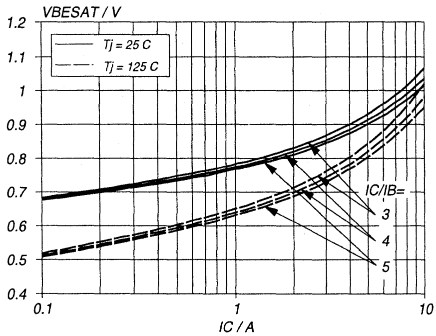


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

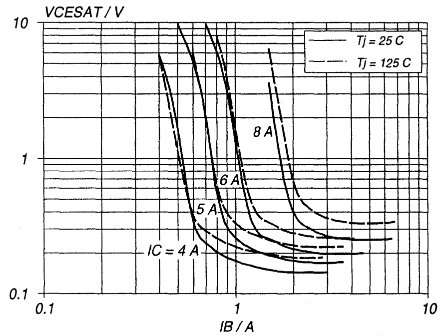


Fig.11. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

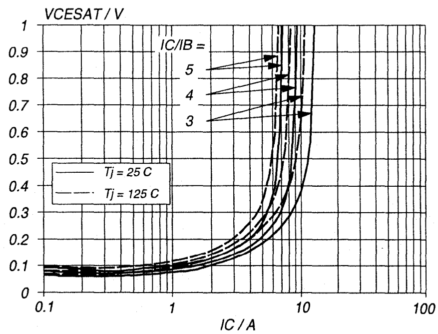


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

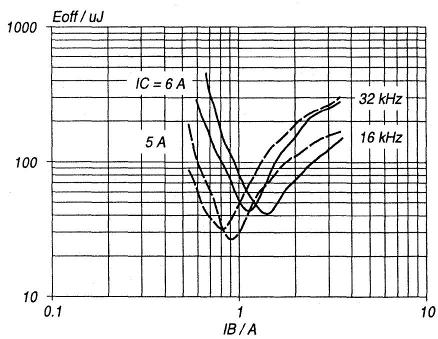


Fig.12. Typical turn-off losses. $T_j = 85^{\circ}C$ $E_{off} = f\ (I_B)$; parameter I_C; parameter frequency

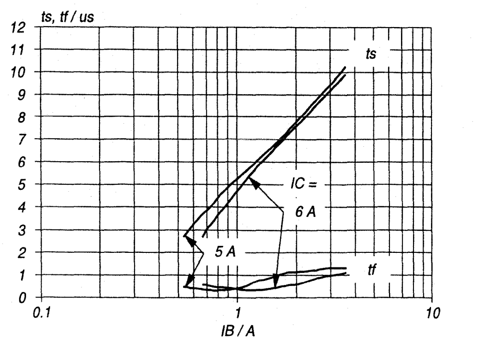


Fig.13. Typical collector storage and fall time.
ts = f (I_B); tf = f (I_B); parameter I_C; T_j = 85˚C; f = 16 kHz

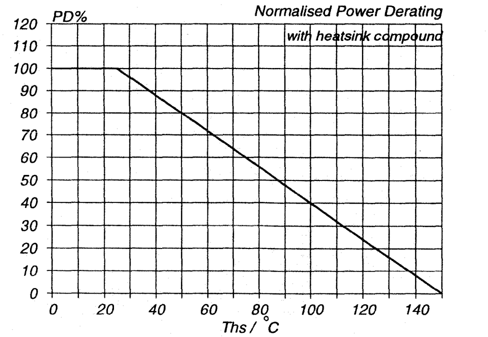


Fig.15. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

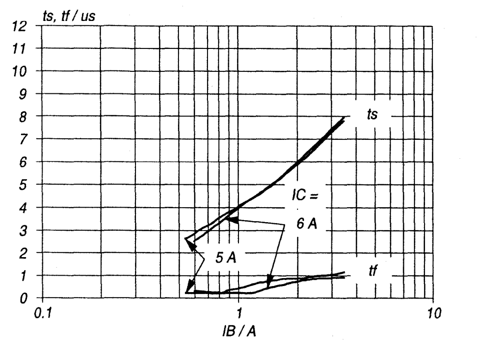


Fig.14. Typical collector storage and fall time.
ts = f (I_B); tf = f (I_B); parameter I_C; T_j = 85˚C; f = 32 kHz

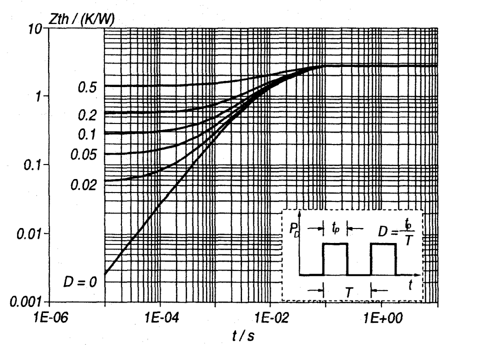


Fig.16. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

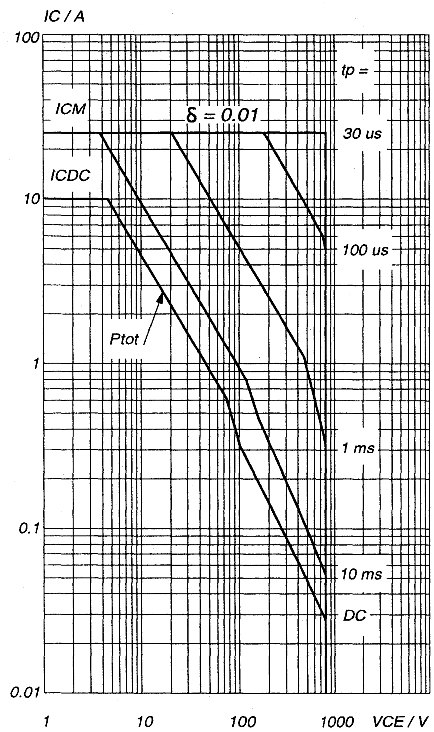


Fig.17. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = $f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

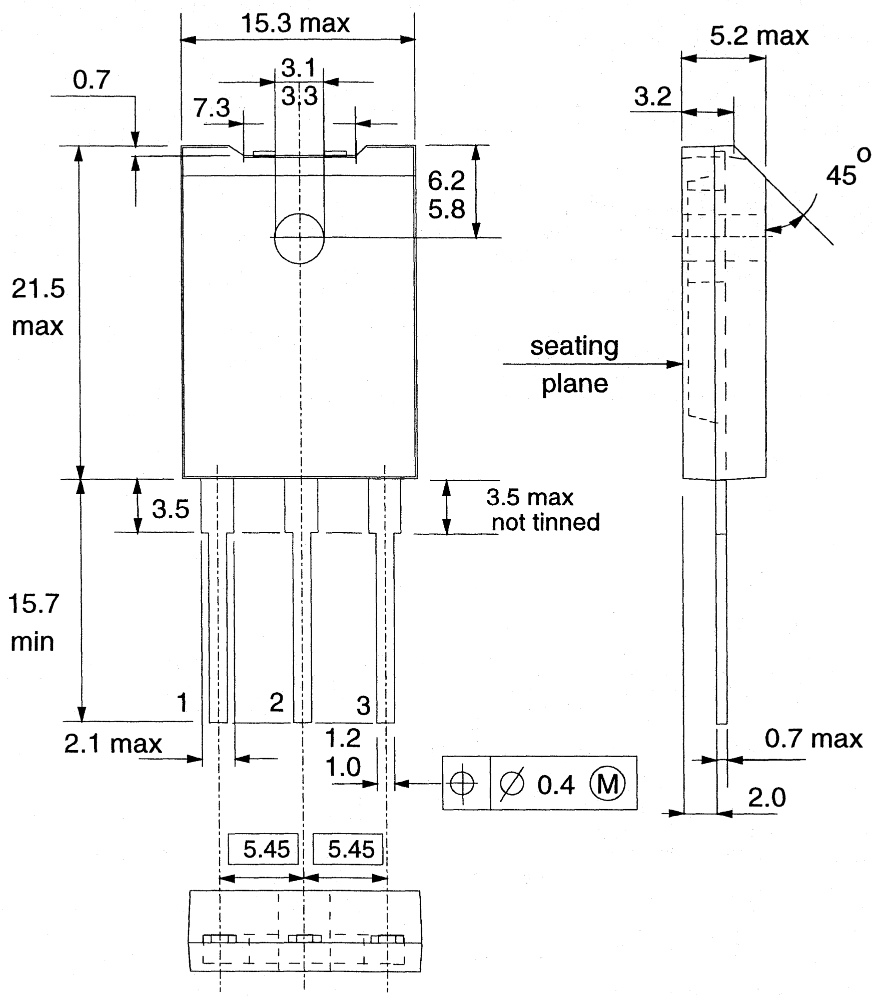


Fig.18. SOT199; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

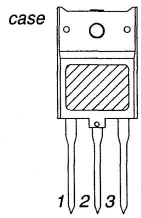
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_f	Fall time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.85$ A	0.2	0.35	µs

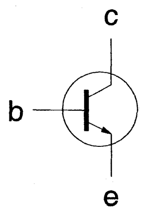
PINNING - SOT399

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	10	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (32 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 330 µH; C_{fb} = 9 nF; $I_{B(end)}$ = 0.85 A; L_B = 3.45 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 1.2 A / µs)			
t_s	Turn-off storage time		3.0	4.0	µs
t_f	Turn-off fall time		0.2	0.35	µs
	Switching times (16 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 650 µH; C_{fb} = 19 nF; $I_{B(end)}$ = 1.0 A; L_B = 5.3 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.8 A / µs)			
t_s	Turn-off storage time		4.5	5.5	µs
t_f	Turn-off fall time		0.35	0.5	µs

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

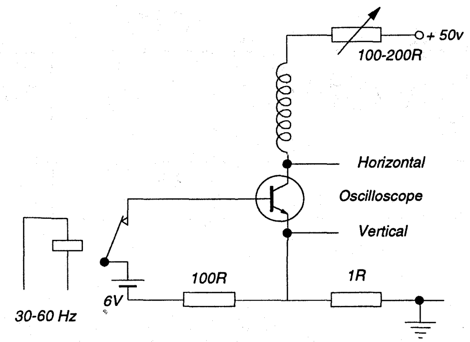


Fig.1. Test circuit for $V_{CEOsust}$.

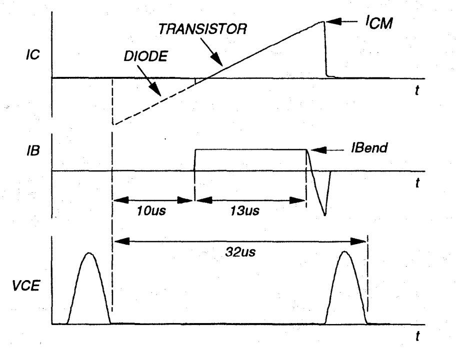


Fig.4. Switching times waveforms (32 kHz).

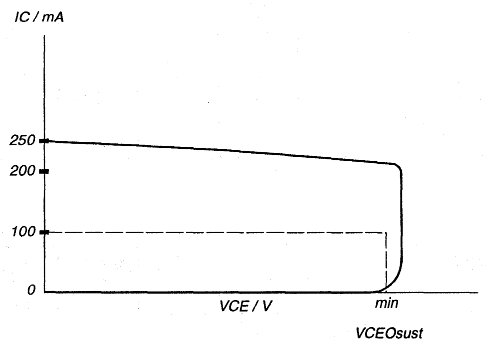


Fig.2. Oscilloscope display for $V_{CEOsust}$.

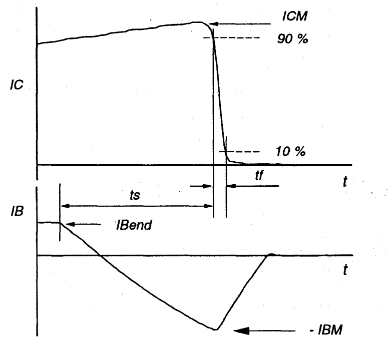


Fig.5. Switching times definitions.

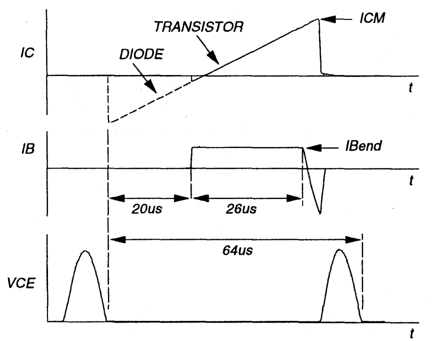


Fig.3. Switching times waveforms (16 kHz).

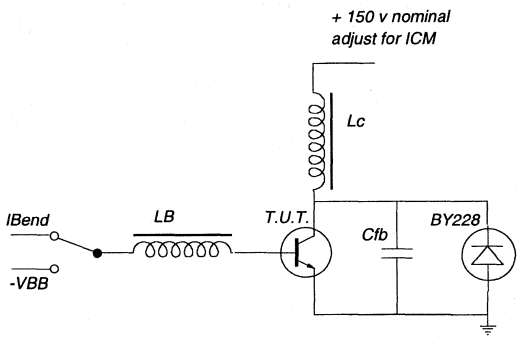


Fig.6. Switching times test circuit.

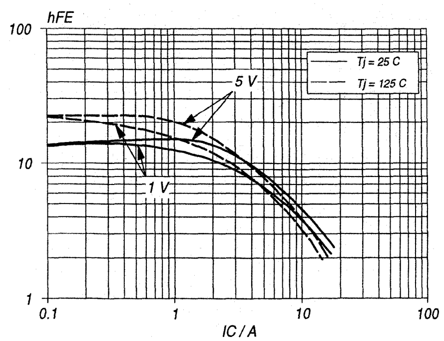


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$
parameter V_{CE}

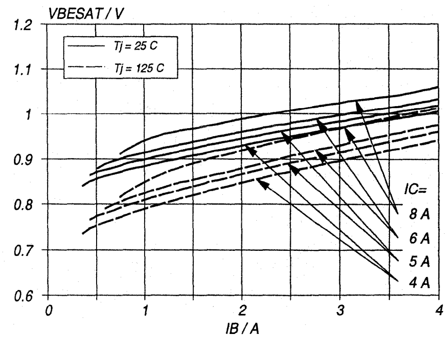


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

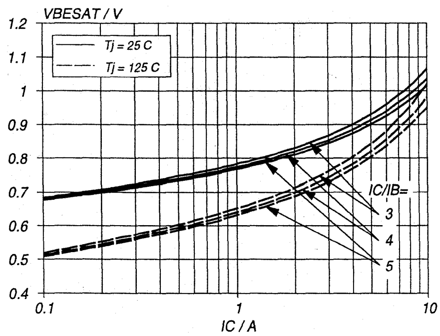


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

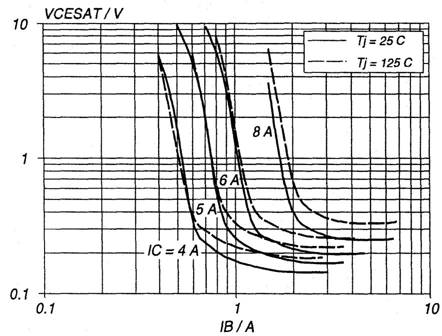


Fig.11. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

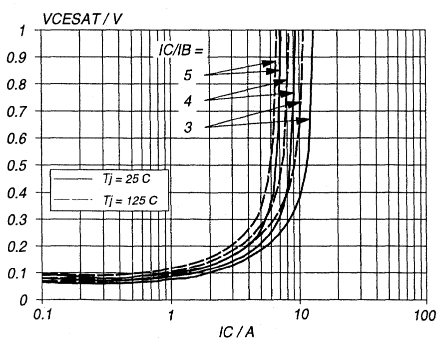


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

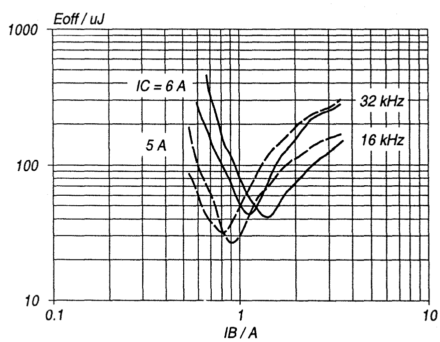


Fig.12. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f\ (I_B)$; parameter I_C; parameter frequency

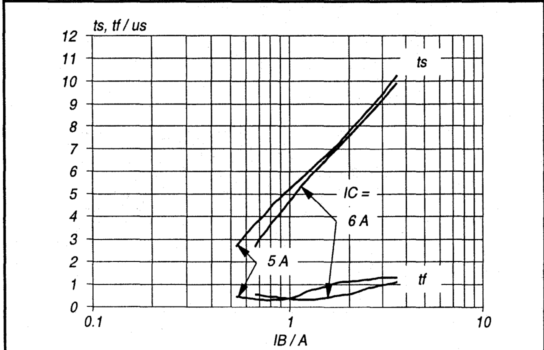


Fig.13. Typical collector storage and fall time.
ts = f (I_B); tf = f (I_B); parameter I_C; T_j = 85˚C; f = 16 kHz

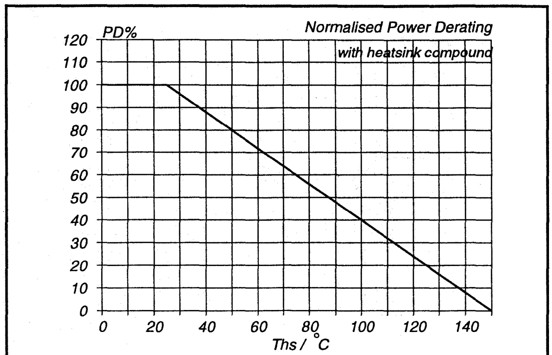


Fig.15. Normalised power dissipation.
PD% = 100·P_D/$P_{D\,25˚C}$ = f (T_{hs})

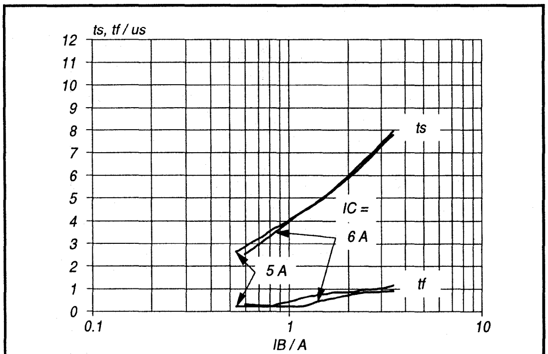


Fig.14. Typical collector storage and fall time.
ts = f (I_B); tf = f (I_B); parameter I_C; T_j = 85˚C; f = 32 kHz

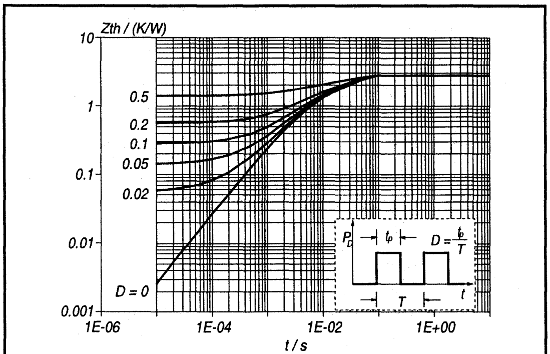


Fig.16. Transient thermal impedance.
$Z_{th\,j\text{-}hs}$ = f(t); parameter D = t_p/T

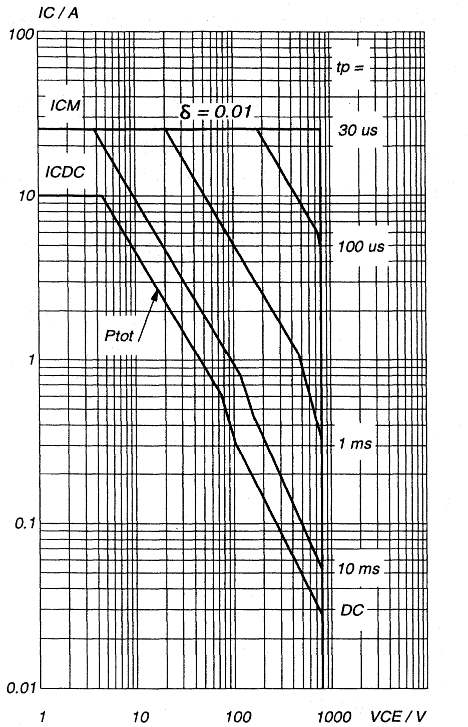


Fig.17. Forward bias safe operating area. $T_{hs} = 25$ ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

MECHANICAL DATA

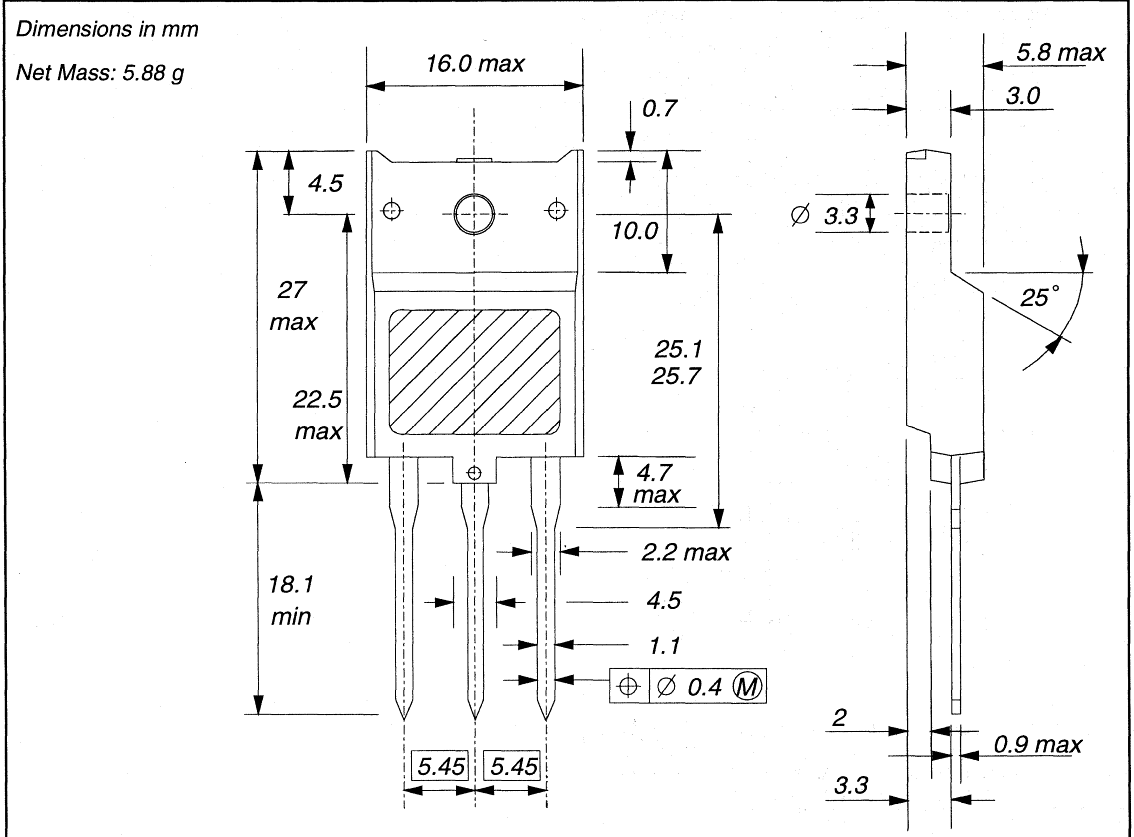


Fig.18. SOT399; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor with an integrated damper diode in a plastic envelope intended for use in horizontal deflection circuits of large screen colour television receivers.

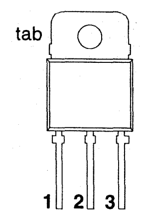
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6	-	A
V_F	Diode forward voltage	$I_F = 6.0$ A	-	2.2	V
t_f	Fall time	$I_{CM} = 6.0$ A; $I_{B(end)} = 1.0$ A	0.35	0.5	µs

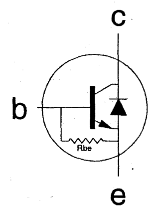
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\,j-mb}$	Junction to mounting base	-	-	1.0	K/W
$R_{th\,j-a}$	Junction to ambient	in free air	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	100	-	300	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	50	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	-	23	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	10	
V_F	Diode forward voltage	I_F = 6 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 650 µH; C_{fb} = 19 nF; $I_{B(end)}$ = 1.0 A; L_B = 5.3 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.8 A / µs)			
t_s	Turn-off storage time		4.5	5.5	µs
t_f	Turn-off fall time		0.35	0.5	µs

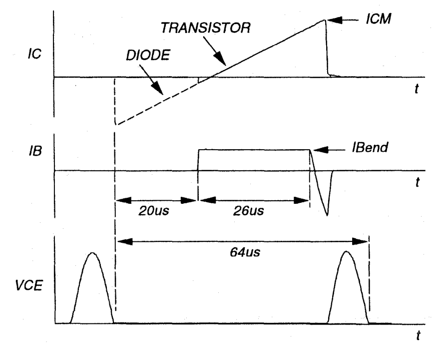


Fig.1. Switching times waveforms (16 kHz).

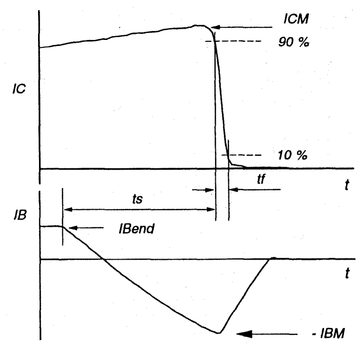


Fig.2. Switching times definitions.

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

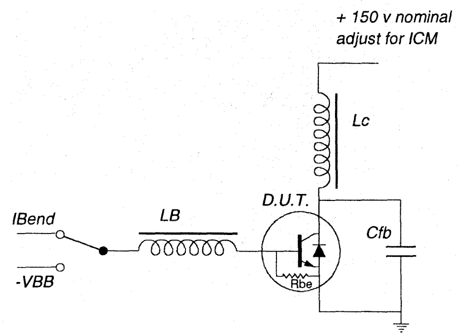


Fig.3. Switching times test circuit.

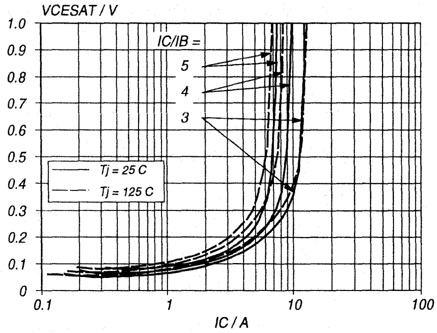


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

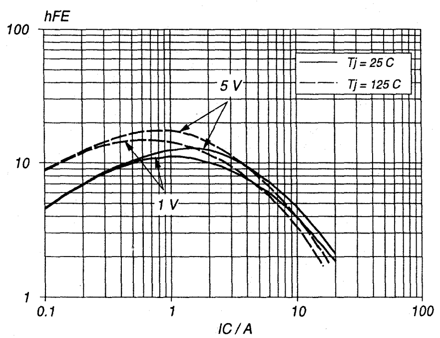


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

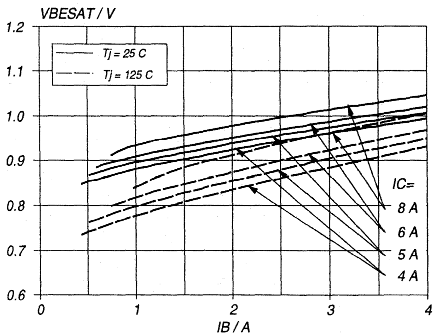


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

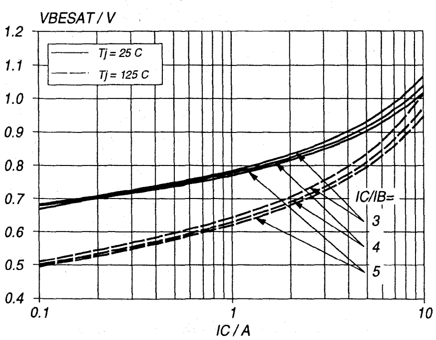


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

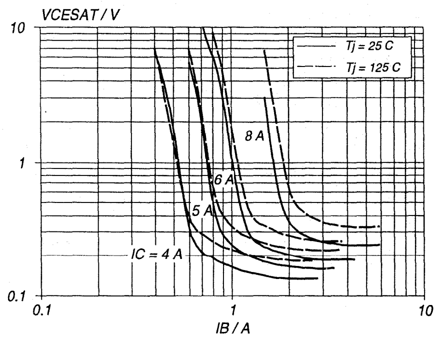


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

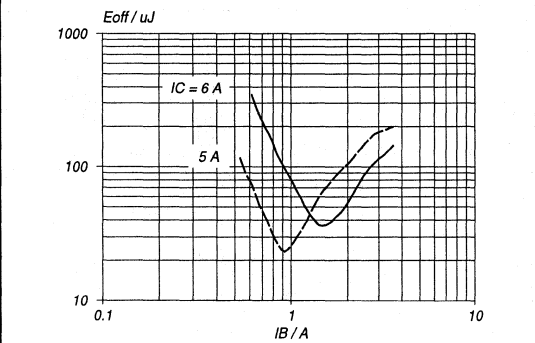


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f(I_B)$; parameter I_C; parameter frequency

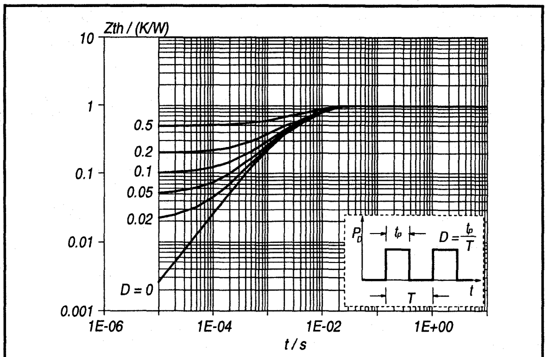


Fig.12. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

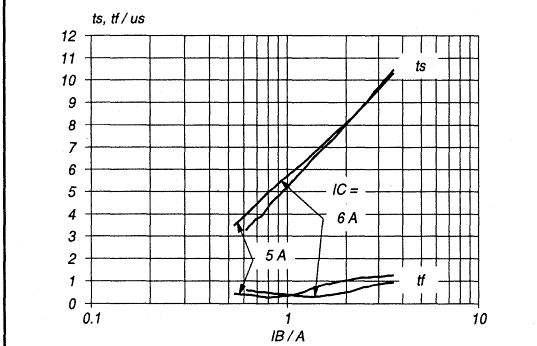


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

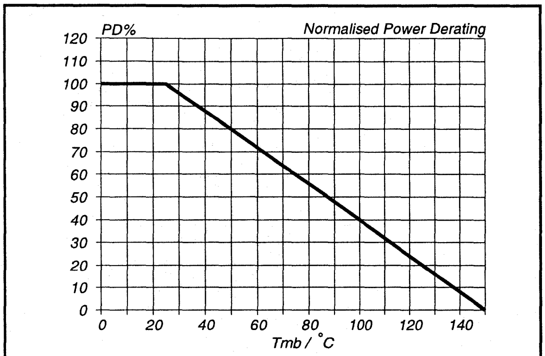


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{mb})$

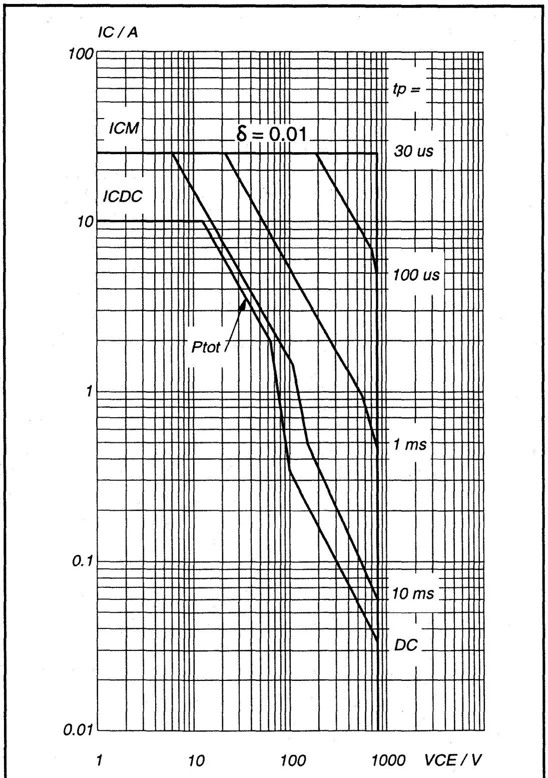


Fig.13. Forward bias safe operating area. $T_{mb} = 25$ ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

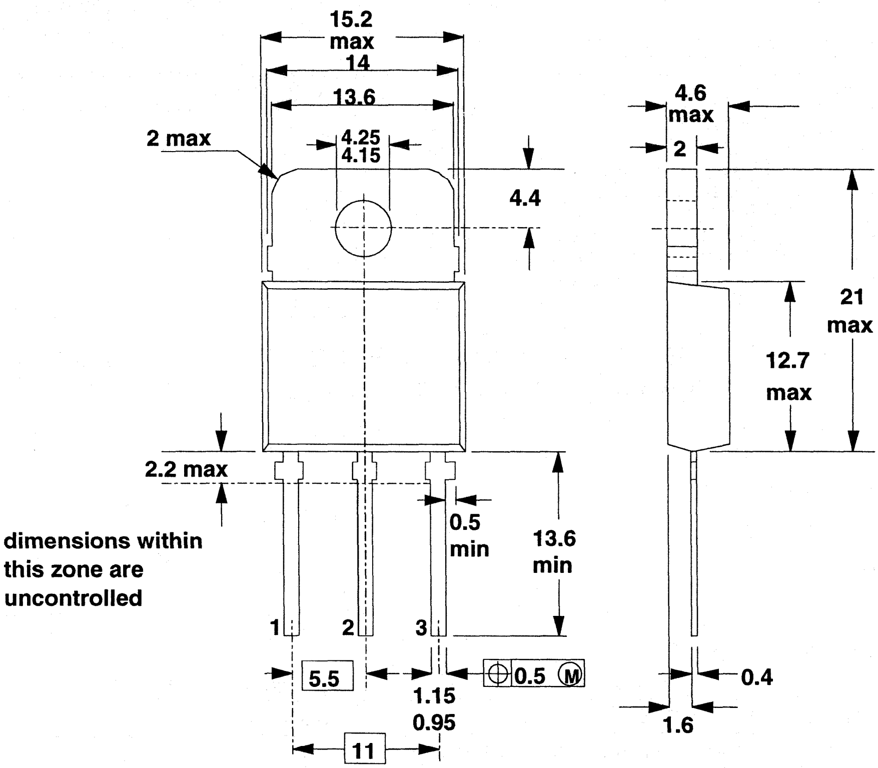


Fig.14. SOT93; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor with an integrated damper diode in a full plastic envelope intended for use in horizontal deflection circuits of large screen colour television receivers.

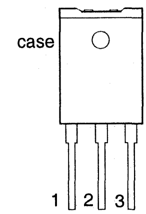
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6	-	A
V_F	Diode forward voltage	$I_F = 6.0$ A	-	2.2	V
t_f	Fall time	$I_{CM} = 6.0$ A; $I_{B(end)} = 1.0$ A	0.35	0.5	µs

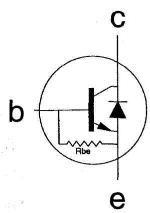
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	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	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	100	-	300	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	50	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	-	23	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	10	
V_F	Diode forward voltage	I_F = 6 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 650 µH; C_{fb} = 19 nF; $I_{B(end)}$ = 1.0 A; L_B = 5.3 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.8 A / µs)			
t_s	Turn-off storage time		4.5	5.5	µs
t_f	Turn-off fall time		0.35	0.5	µs

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

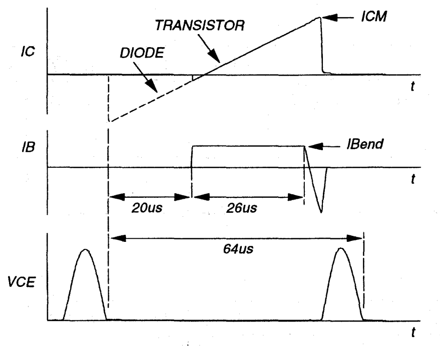


Fig.1. Switching times waveforms (16 kHz).

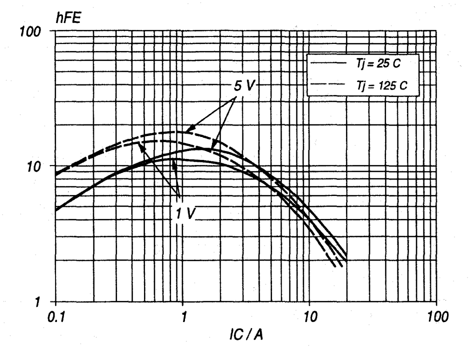


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

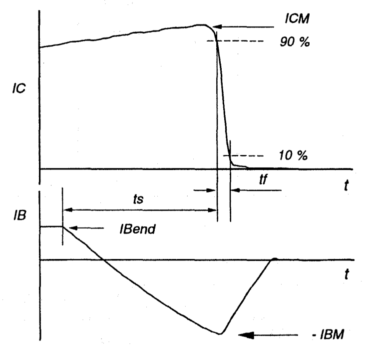


Fig.2. Switching times definitions.

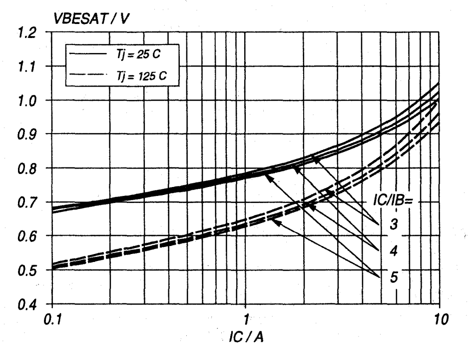


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

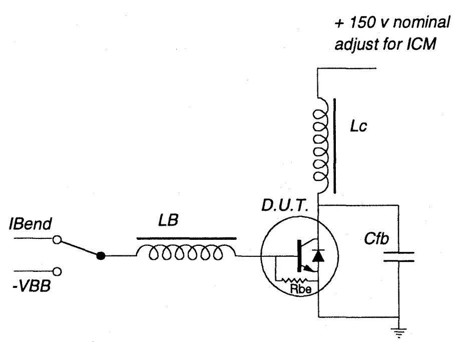


Fig.3. Switching times test circuit.

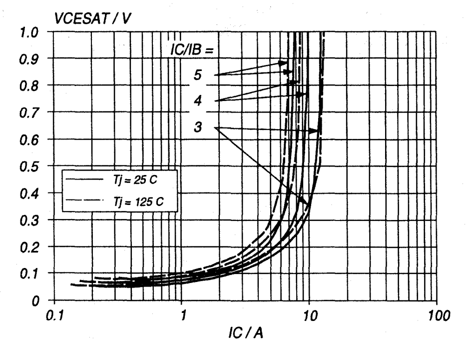


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

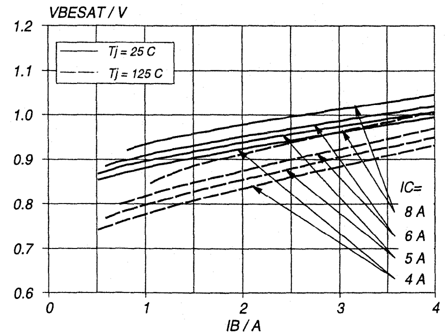


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

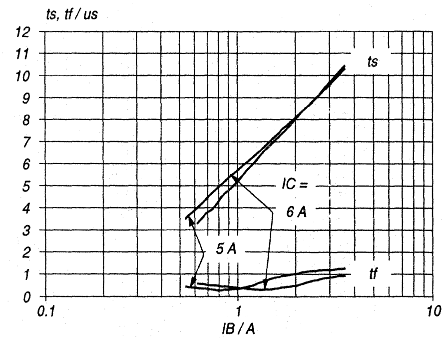


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

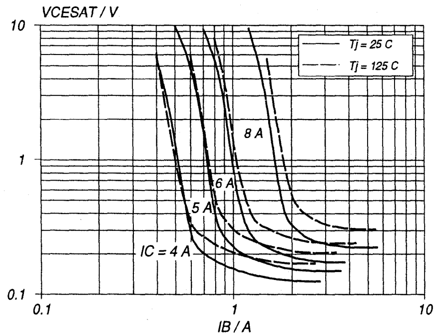


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

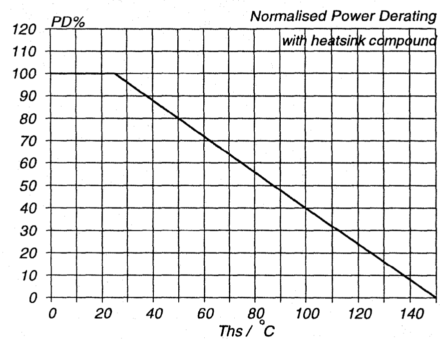


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

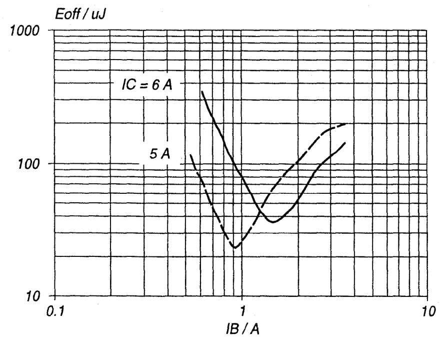


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f(I_B)$; parameter I_C; parameter frequency

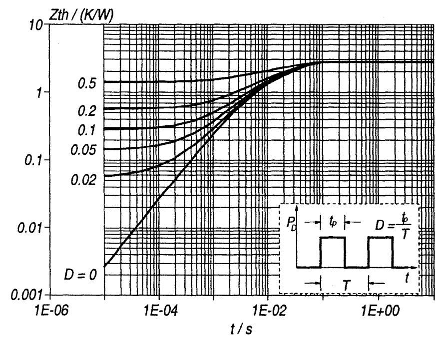


Fig.12. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

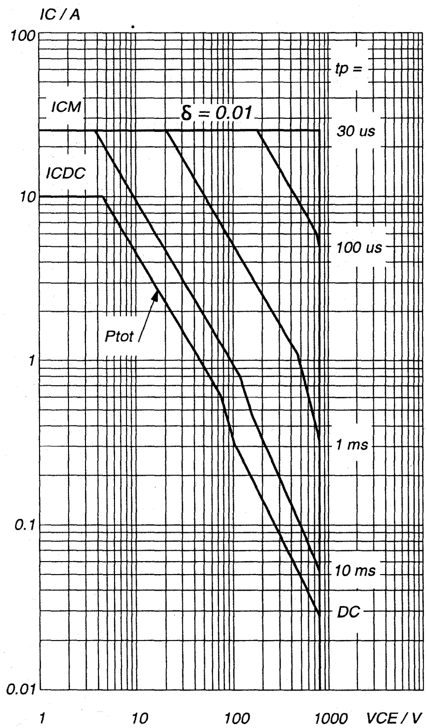


Fig.13. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

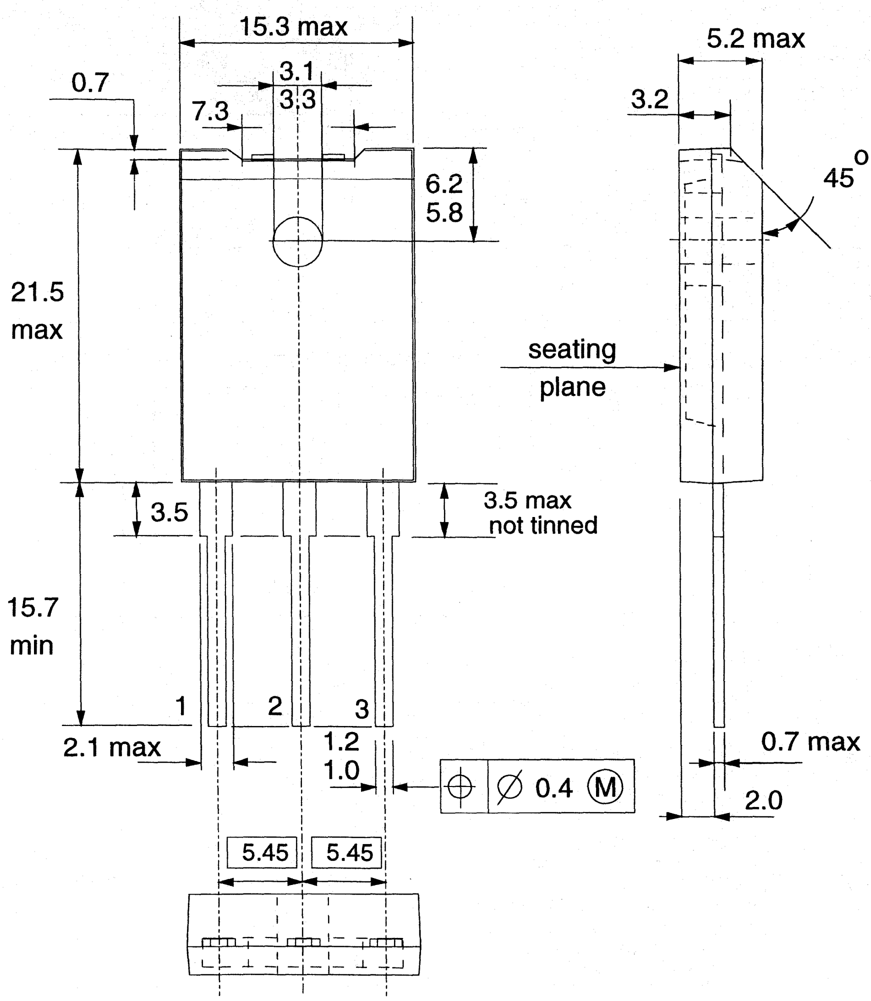


Fig.14. SOT199; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor with an integrated damper diode in a full plastic envelope intended for use in horizontal deflection circuits of large screen colour television receivers.

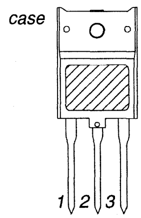
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	5.0	V
I_{Csat}	Collector saturation current		6	-	A
V_F	Diode forward voltage	I_F = 6.0 A	-	2.2	V
t_f	Fall time	I_{CM} = 6.0 A; $I_{B(end)}$ = 1.0 A	0.35	0.5	µs

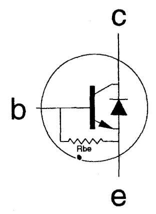
PINNING - SOT399

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-emitter voltage peak value	V_{BE} = 0 V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-55	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	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	100	-	300	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	50	-	Ω
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	-	23	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	10	
V_F	Diode forward voltage	I_F = 6 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (16 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 650 μH; C_{fb} = 19 nF; $I_{B(end)}$ = 1.0 A; L_B = 5.3 μH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 0.8 A / μs)			
t_s	Turn-off storage time		4.5	5.5	μs
t_f	Turn-off fall time		0.35	0.5	μs

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

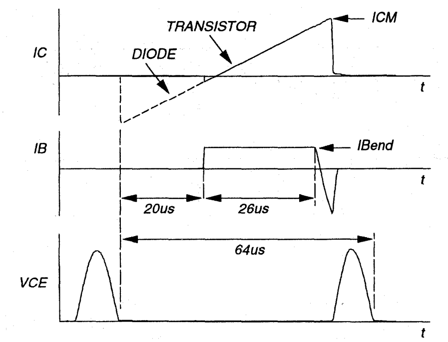


Fig.1. Switching times waveforms (16 kHz).

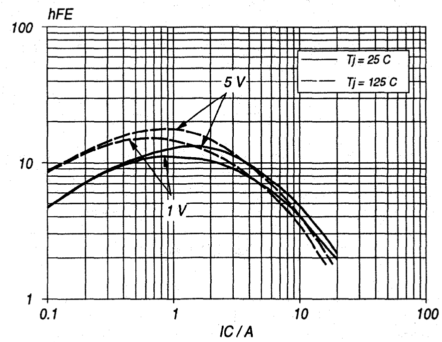


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

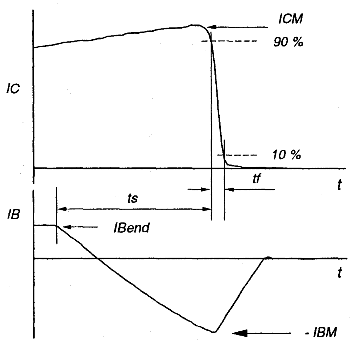


Fig.2. Switching times definitions.

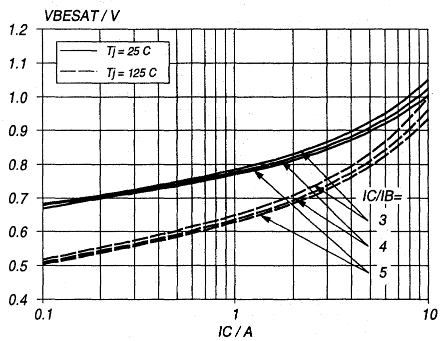


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

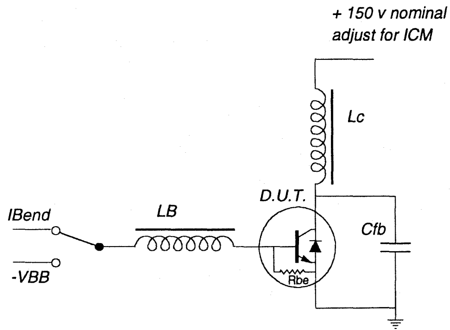


Fig.3. Switching times test circuit.

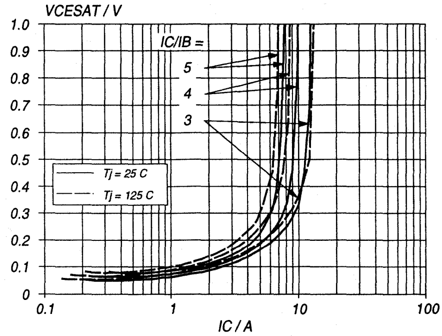


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

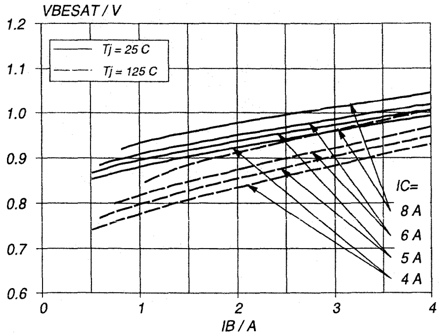


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

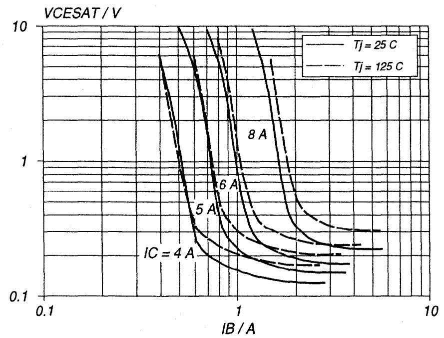


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

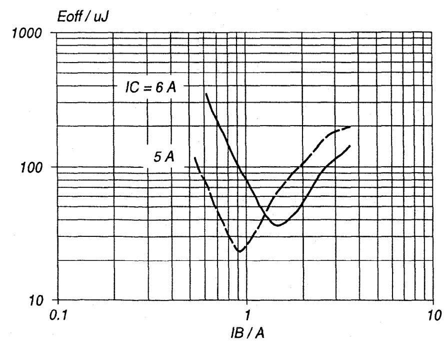


Fig.9. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f\ (I_B)$; parameter I_C; parameter frequency

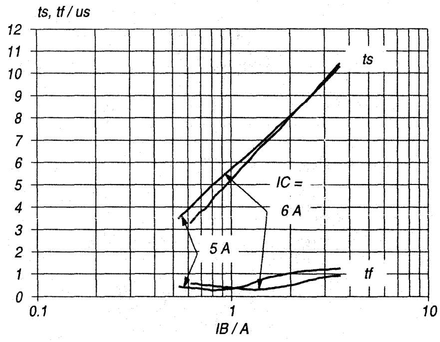


Fig.10. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16\ kHz$

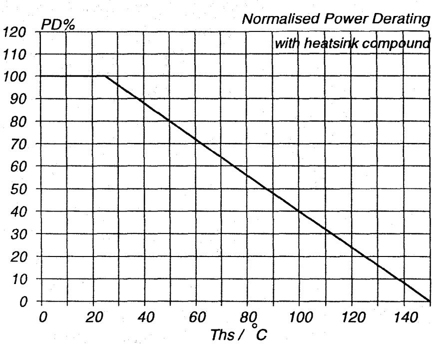


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25^{\circ}C} = f\ (T_{hs})$

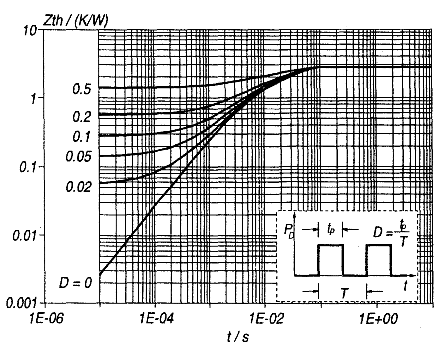


Fig.12. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

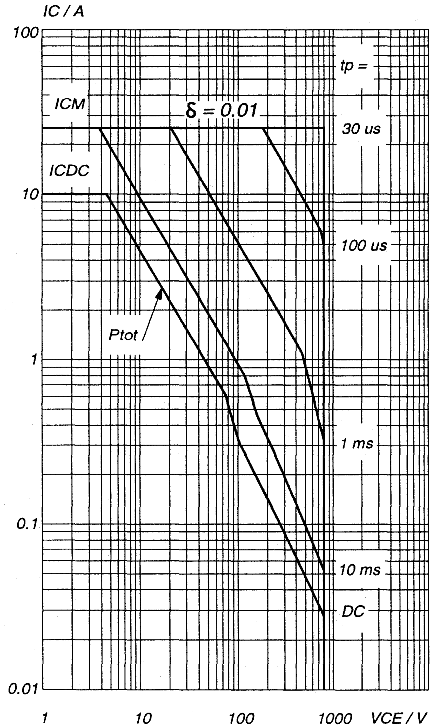


Fig.13. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

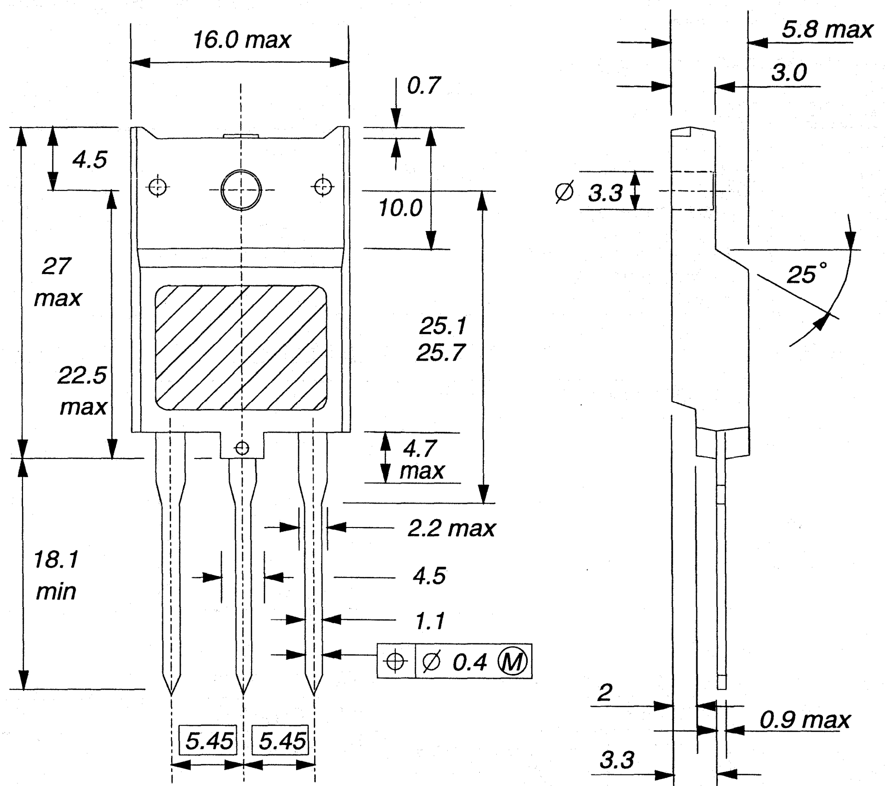


Fig.14. SOT399; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor BU2522A

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of high resolution monitors. Features improved RBSOA performance and is suitable for operation up to 64 kHz.

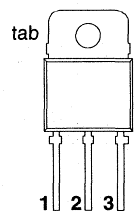
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.76$ A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_s	Storage time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.7$ A	1.7	2.0	µs

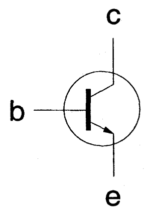
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base		-	1.0	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	0.25	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} = 7.5 V; I_C = 0 A	-	-	0.25	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	8	10	21	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	8	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (64 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.7 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A / µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.12	0.25	µs

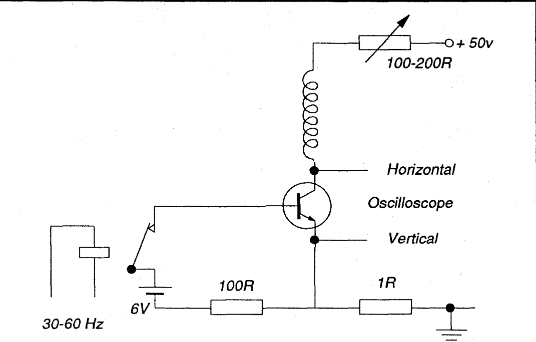


Fig.1. Test circuit for $V_{CEOsust}$.

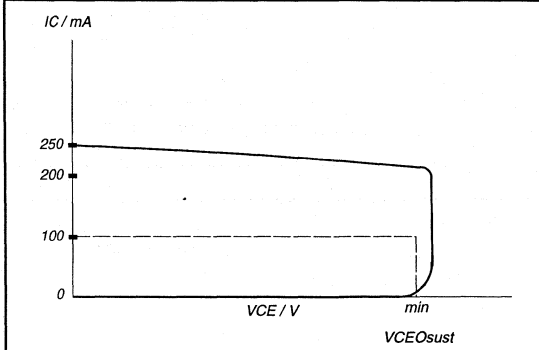


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

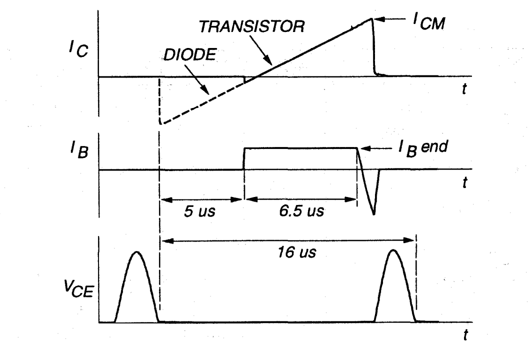


Fig.3. Switching times waveforms (64 kHz).

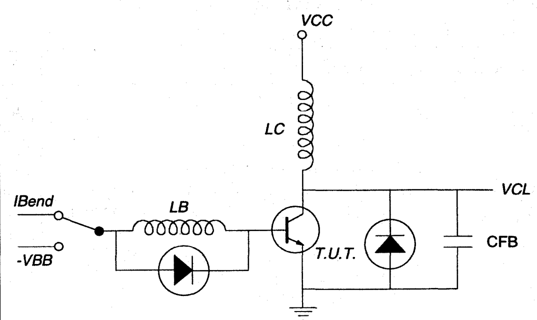


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 400 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1.6 - 2 A

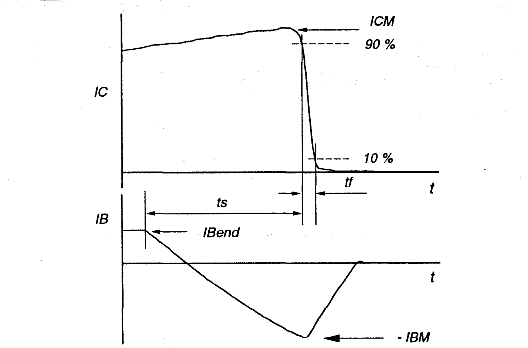


Fig.4. Switching times definitions.

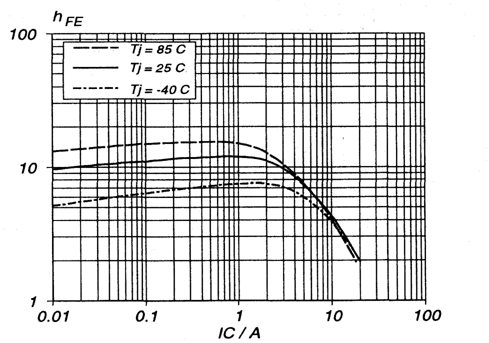


Fig.7. Typical DC current gain. $h_{FE} = f(I_C)$ V_{CE} = 5 V

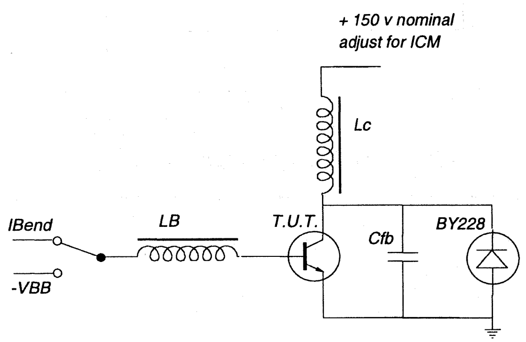


Fig.5. Switching times test circuit.

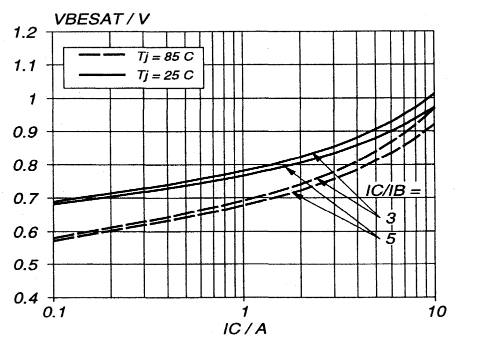


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

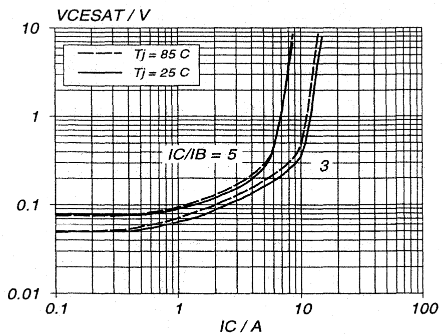


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

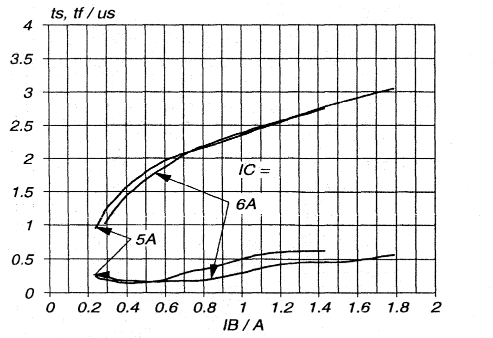


Fig.12. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 64 kHz

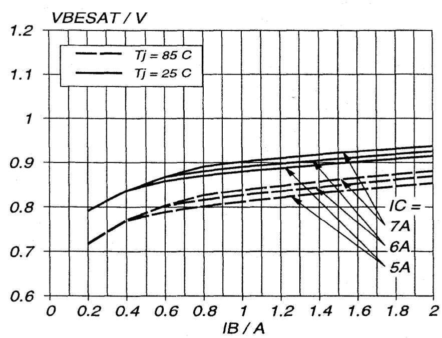


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

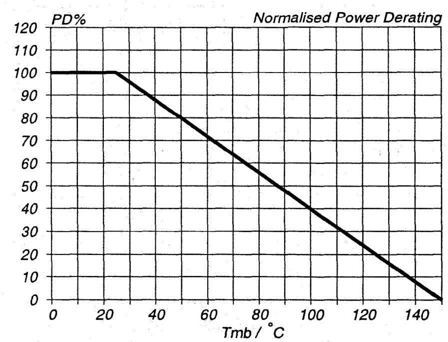


Fig.13. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f(T_{mb})$

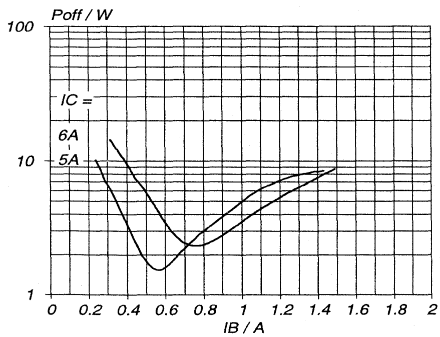


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$ $Poff = f(I_B)$; parameter I_C; f = 64 kHz

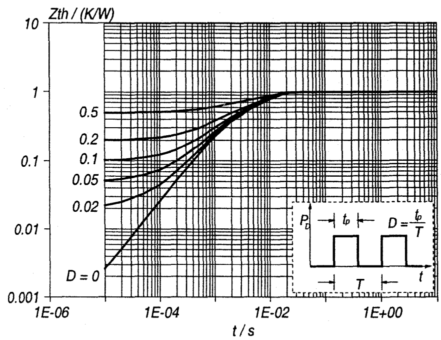


Fig.14. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

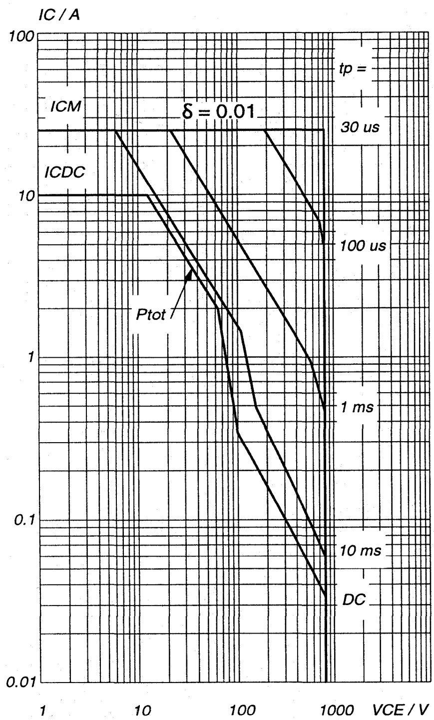


Fig.15. Forward bias safe operating area. T_{mb} = 25 ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.

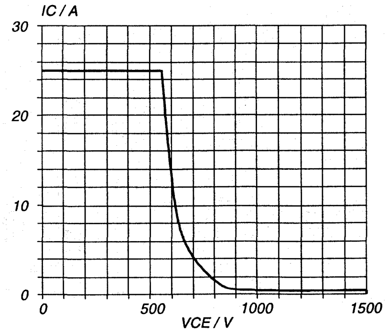


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

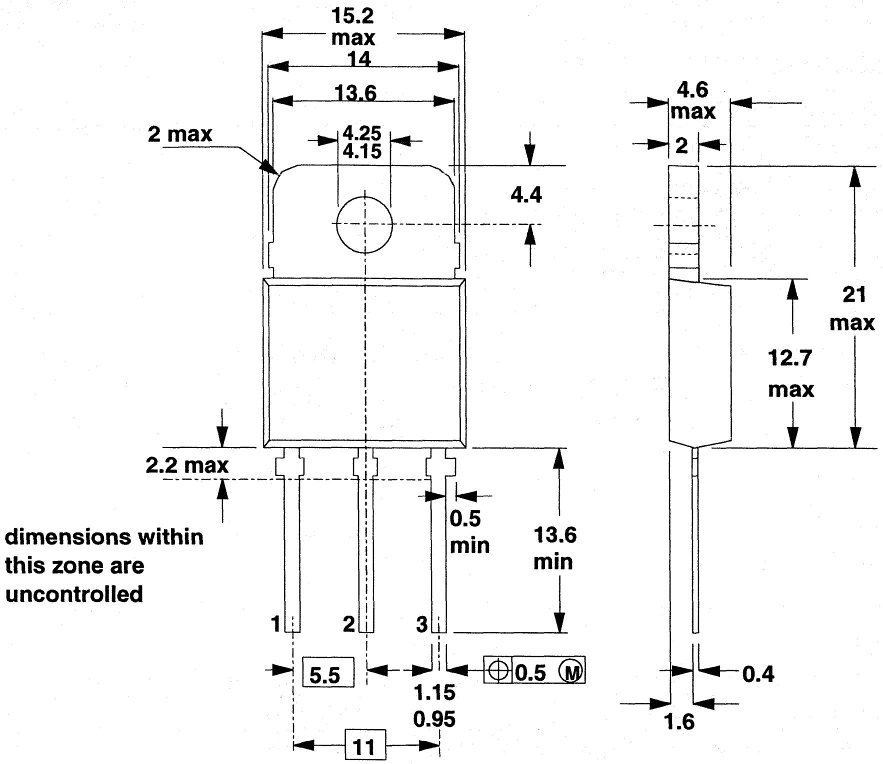


Fig.17. SOT93; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of high resolution monitors. Features improved RBSOA performance and is suitable for operation up to 64 kHz.

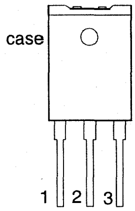
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.76$ A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_s	Storage time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.7$ A	1.7	2.0	µs

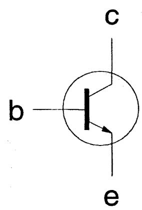
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	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	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	0.25	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} = 7.5 V; I_C = 0 A	-	-	0.25	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	8	10	21	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	8	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (64 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.7 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A / µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.12	0.25	µs

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

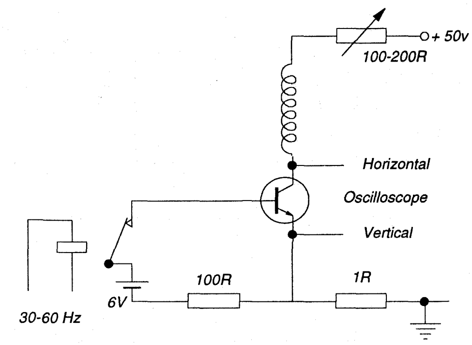


Fig.1. Test circuit for $V_{CEOsust}$.

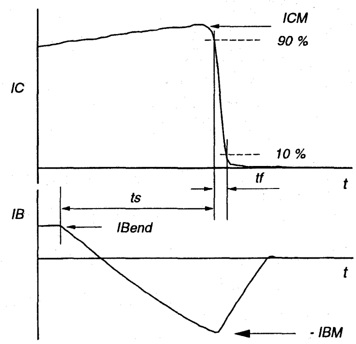


Fig.4. Switching times definitions.

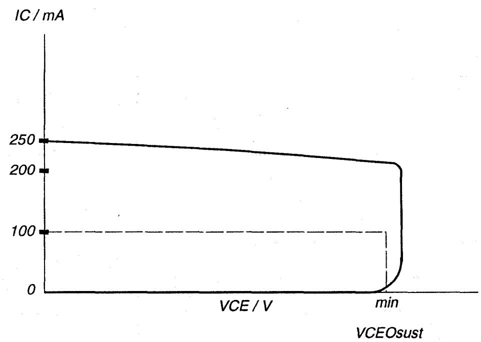


Fig.2. Oscilloscope display for $V_{CEOsust}$.

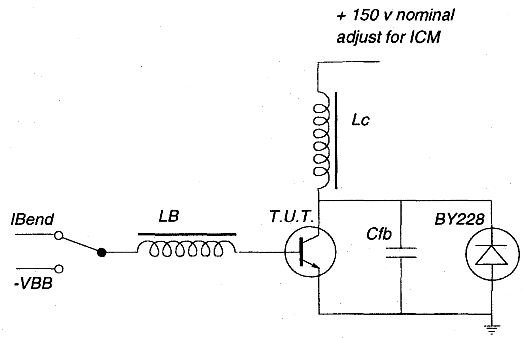


Fig.5. Switching times test circuit.

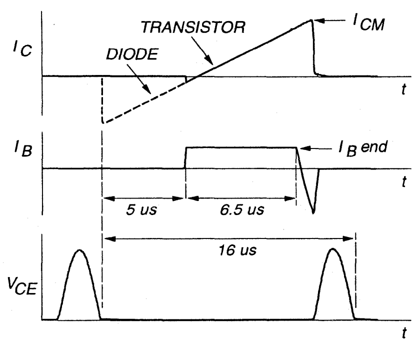


Fig.3. Switching times waveforms (64 kHz).

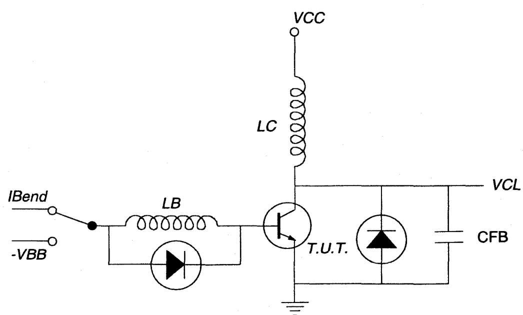


Fig.6. Test Circuit RBSOA. $V_{CC} = 140$ V; $-V_{BB} = 4$ V; $L_C = 100 - 400$ µH; $V_{CL} \leq 1500$ V; $L_B = 3$ µH; $C_{FB} = 1 - 2.2$ nF; $I_B(end) = 1.6 - 2$ A

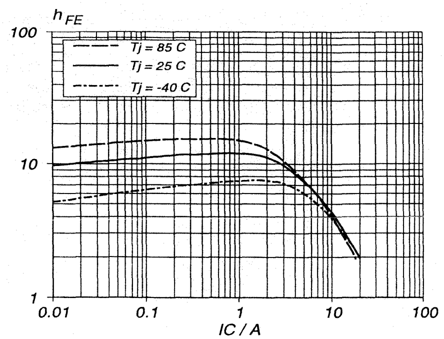


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

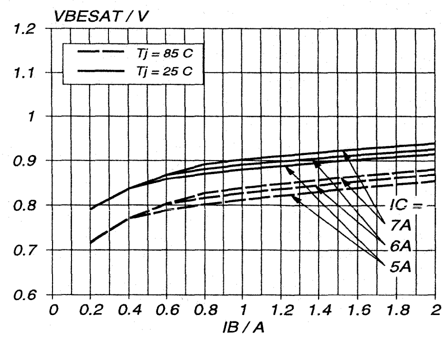


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

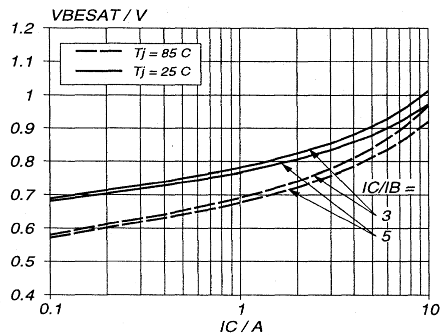


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

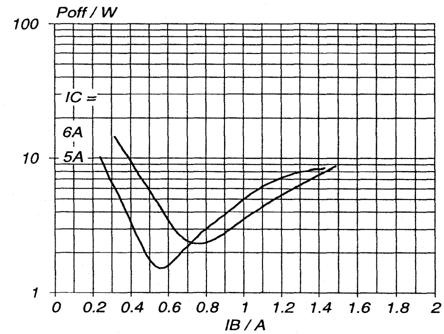


Fig.11. Typical turn-off losses. $T_j = 85^\circ C$
Poff = $f\ (I_B)$; parameter I_C; $f = 64\ kHz$

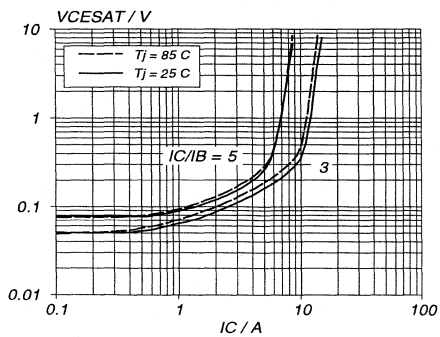


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

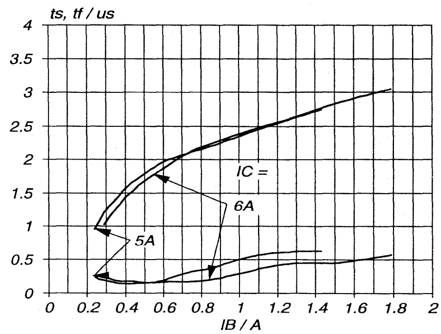


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 64\ kHz$

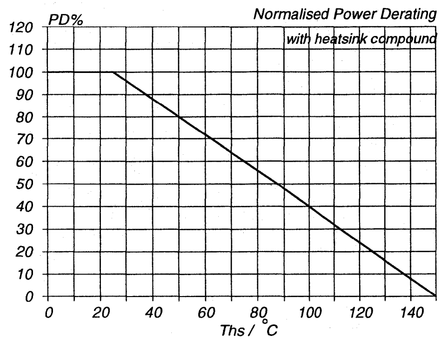


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

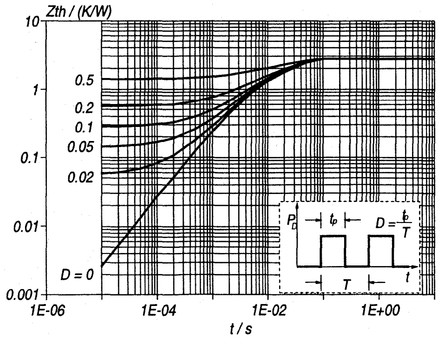


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

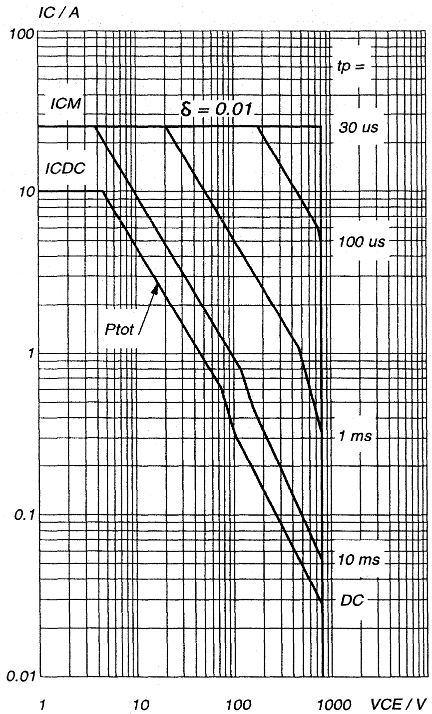


Fig.15. Forward bias safe operating area. $T_{hs} = 25$ ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

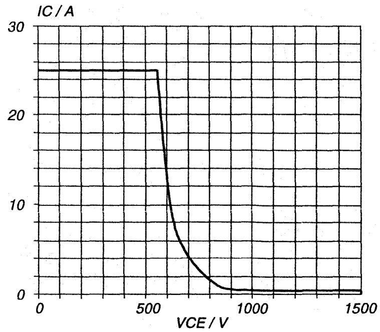


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

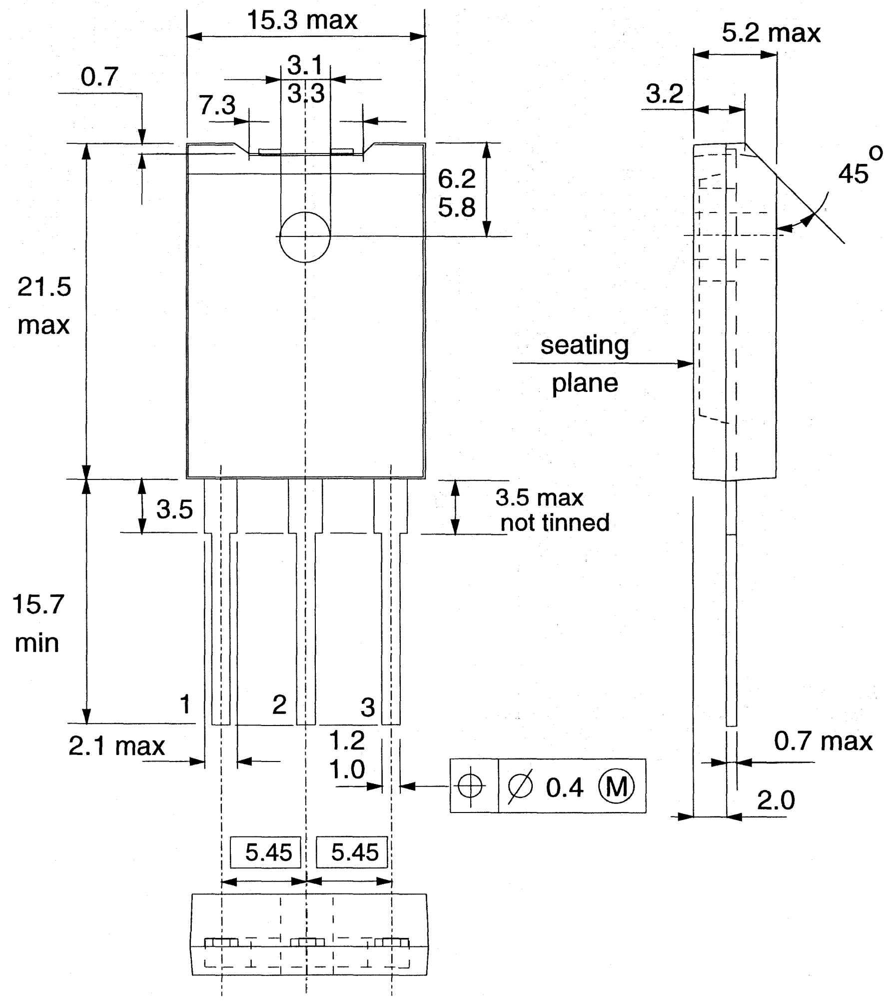


Fig.17. SOT199; The seating plane is electrically isolated from all terminals.

Notes

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

Silicon Diffused Power Transistor | BU2522AX

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of high resolution monitors. Features improved RBSOA performance and is suitable for operation up to 64 kHz.

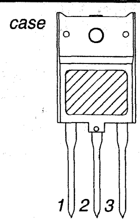
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_s	Storage time	I_{CM} = 6.0 A; $I_{B(end)}$ = 0.7 A	1.7	2.0	µs

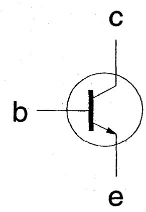
PINNING - SOT399

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-emitter voltage peak value	V_{BE} = 0 V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	6	A
I_{BM}	Base current peak value		-	9	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	45	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	0.25	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} = 7.5 V; I_C = 0 A	-	-	0.25	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.76 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	8	10	21	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	8	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	115	-	pF
	Switching times (64 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.7 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A / µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.12	0.25	µs

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

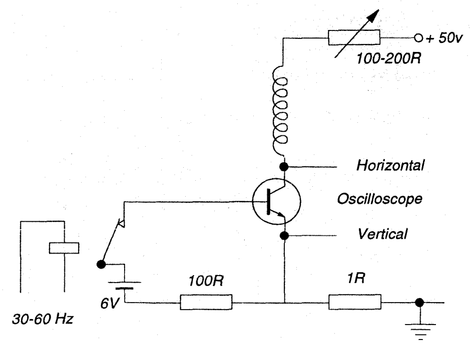


Fig.1. Test circuit for $V_{CEOsust}$.

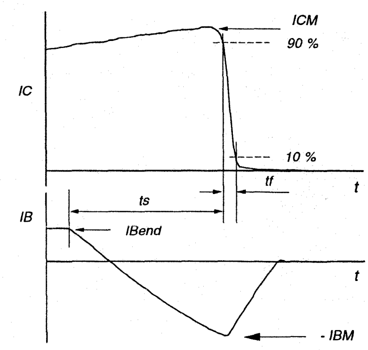


Fig.4. Switching times definitions.

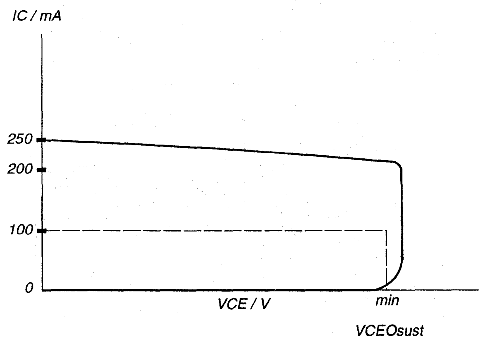


Fig.2. Oscilloscope display for $V_{CEOsust}$.

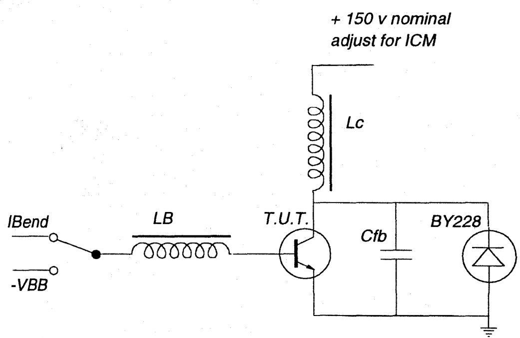


Fig.5. Switching times test circuit.

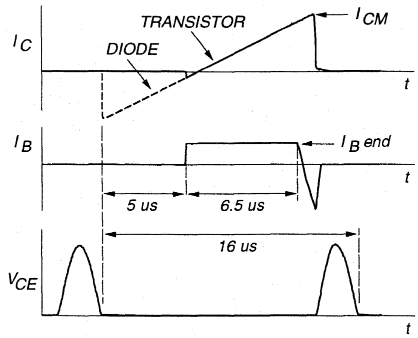


Fig.3. Switching times waveforms (64 kHz).

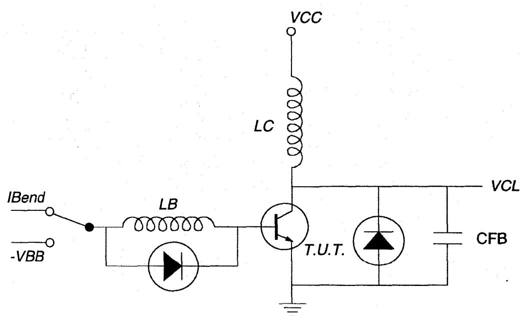


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 400 μH; $V_{CL} \leq$ 1500 V; L_B = 3 μH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1.6 - 2 A

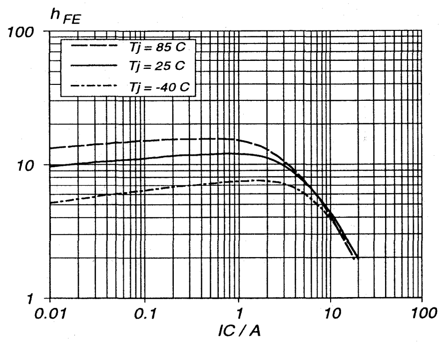


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5$ V

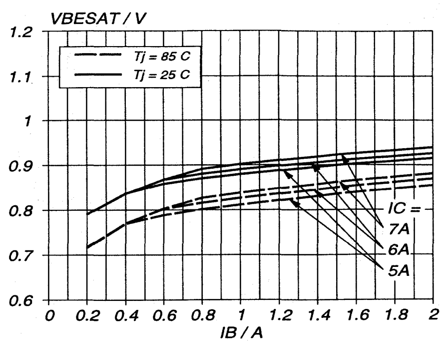


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

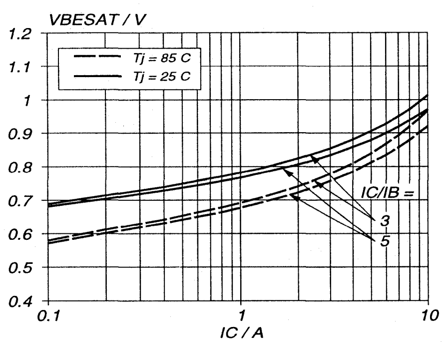


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

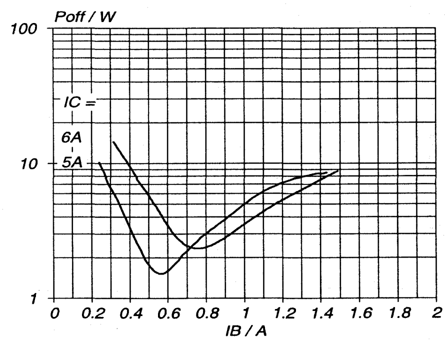


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$
$Poff = f\ (I_B)$; parameter I_C; f = 64 kHz

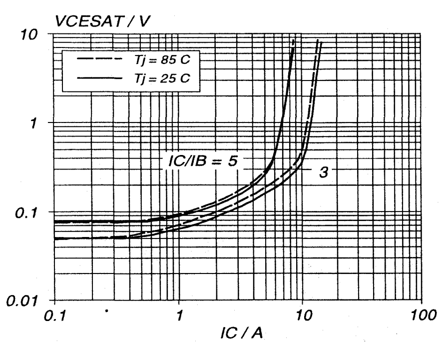


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

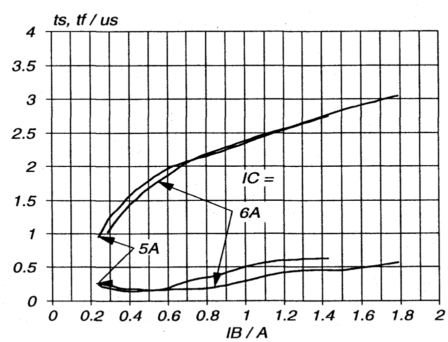


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 64 kHz

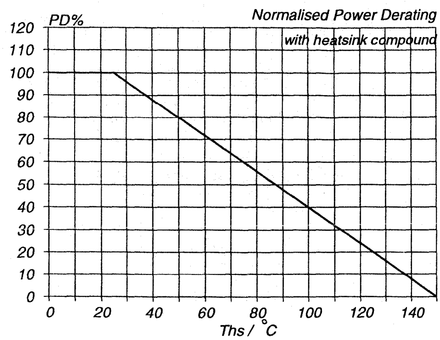


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f\,(T_{hs})$

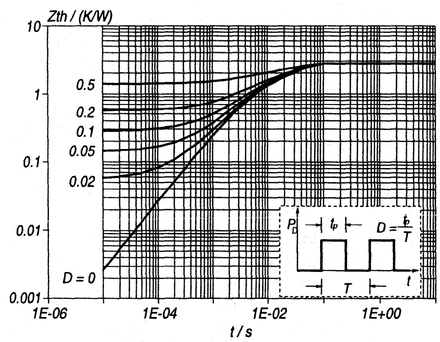


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

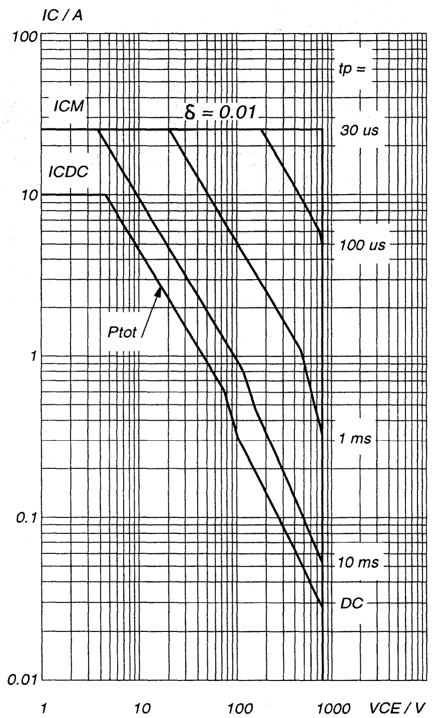


Fig.15. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

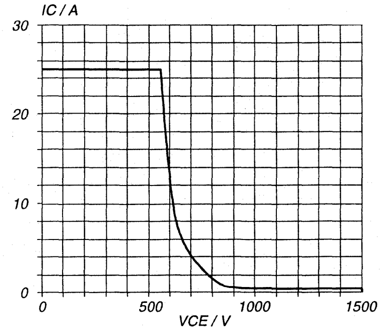


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

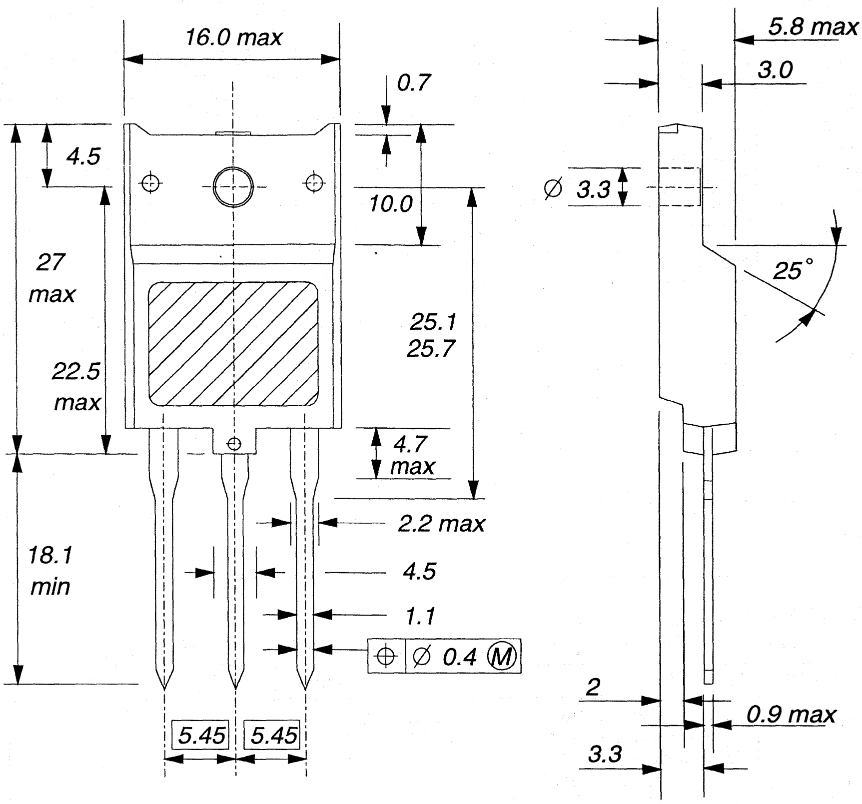


Fig.17. SOT399; The seating plane is electrically isolated from all terminals.

Notes

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

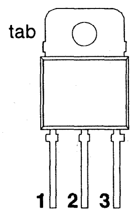
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 8.0$ A; $I_B = 1.6$ A	-	5.0	V
I_{Csat}	Collector saturation current		8	-	A
t_f	Fall time	$I_{CM} = 8.0$ A; $I_{B(end)} = 1.1$ A	0.2	0.35	µs

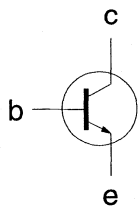
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	8	A
I_{BM}	Base current peak value		-	12	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{mb} \leq$ 25 ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base	-	-	1.0	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 8.0 A; I_B = 1.6 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 8.0 A; I_B = 1.6 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	10	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{CM} = 8.0 A; L_C = 260 µH; C_{fb} = 13 nF; $I_{B(end)}$ = 1.1 A; L_B = 2.5 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 1.6 A/µs)			
t_s	Turn-off storage time		3.0	4.0	µs
t_f	Turn-off fall time		0.2	0.35	µs

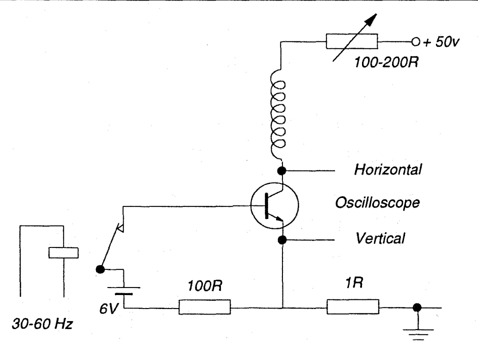


Fig.1. Test circuit for V_{CEO}sust.

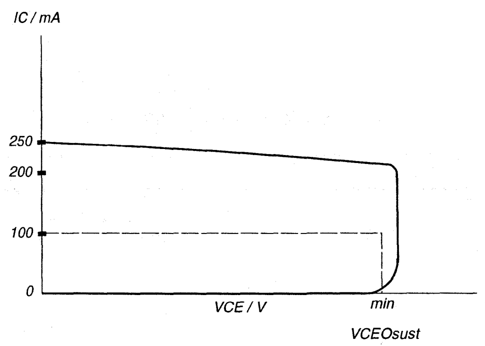


Fig.2. Oscilloscope display for V_{CEO}sust.

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

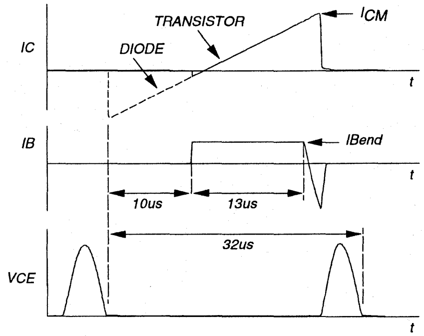


Fig.3. Switching times waveforms.

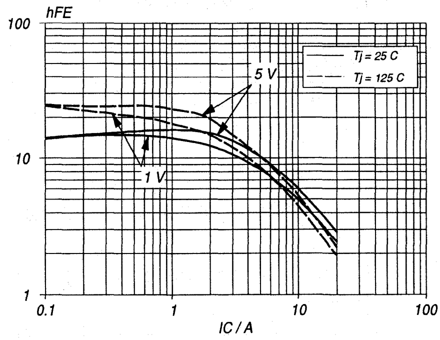


Fig.6. Typical DC current gain. $h_{FE} = f\,(I_C)$
parameter V_{CE}

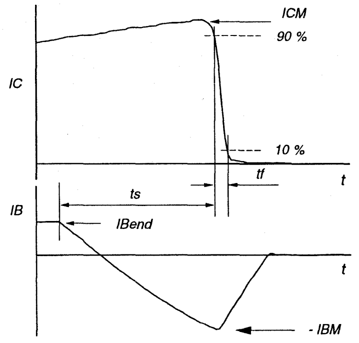


Fig.4. Switching times definitions.

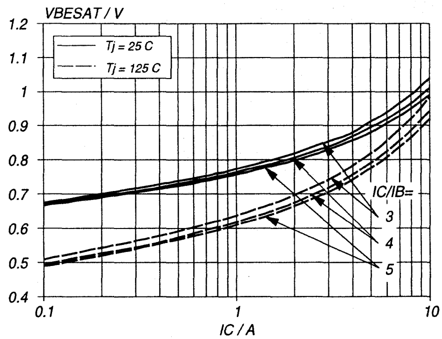


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\,(I_C)$; parameter I_C/I_B

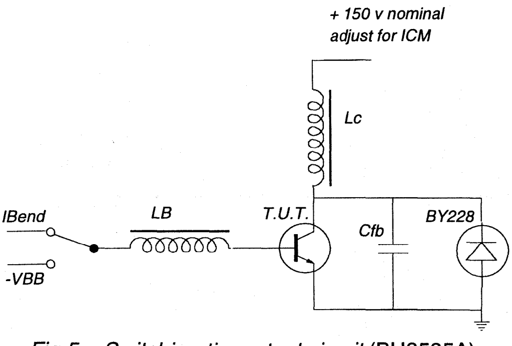


Fig.5. Switching times test circuit (BU2525A).

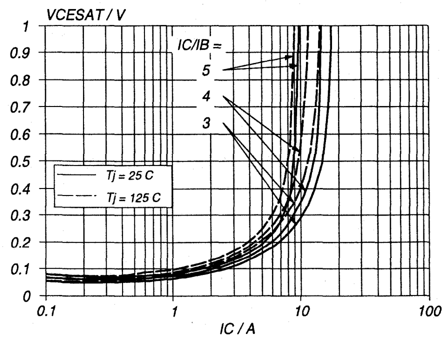


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\,(I_C)$; parameter I_C/I_B

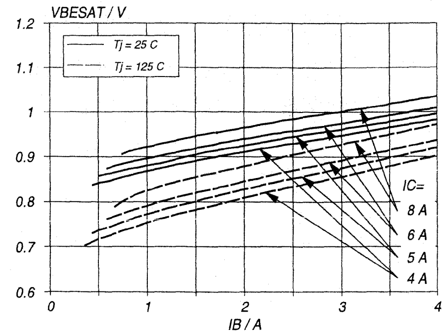


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

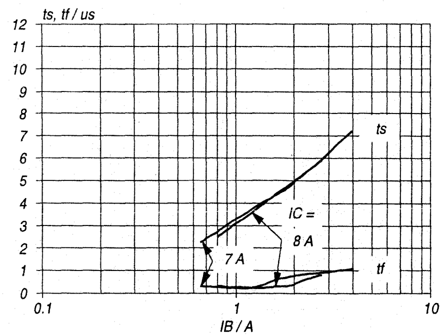


Fig.12. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 32$ kHz

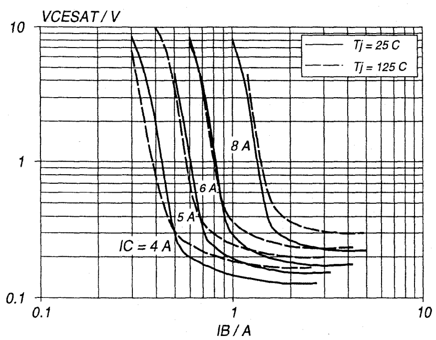


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

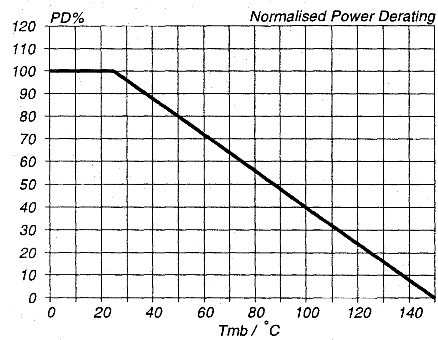


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

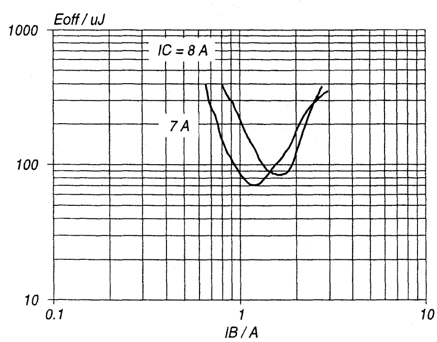


Fig.11. Typical turn-off losses. $T_j = 85^\circ C$
$Eoff = f(I_B)$; parameter I_C; $f = 32$ kHz

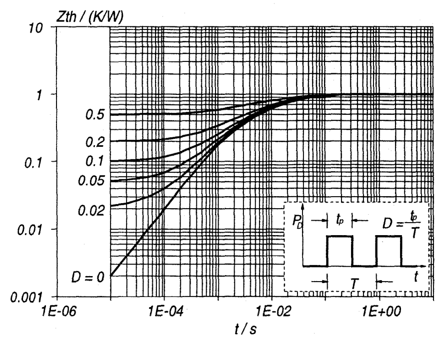


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

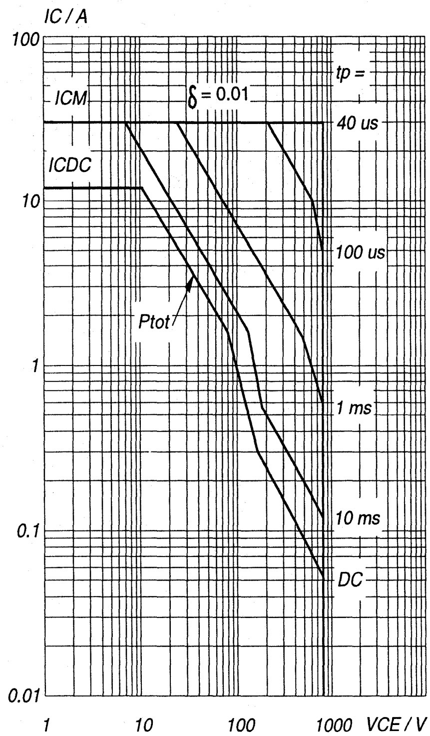


Fig.15. Forward bias safe operating area. T_{mb} = 25 ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p;
Second-breakdown limits independant of temperature.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

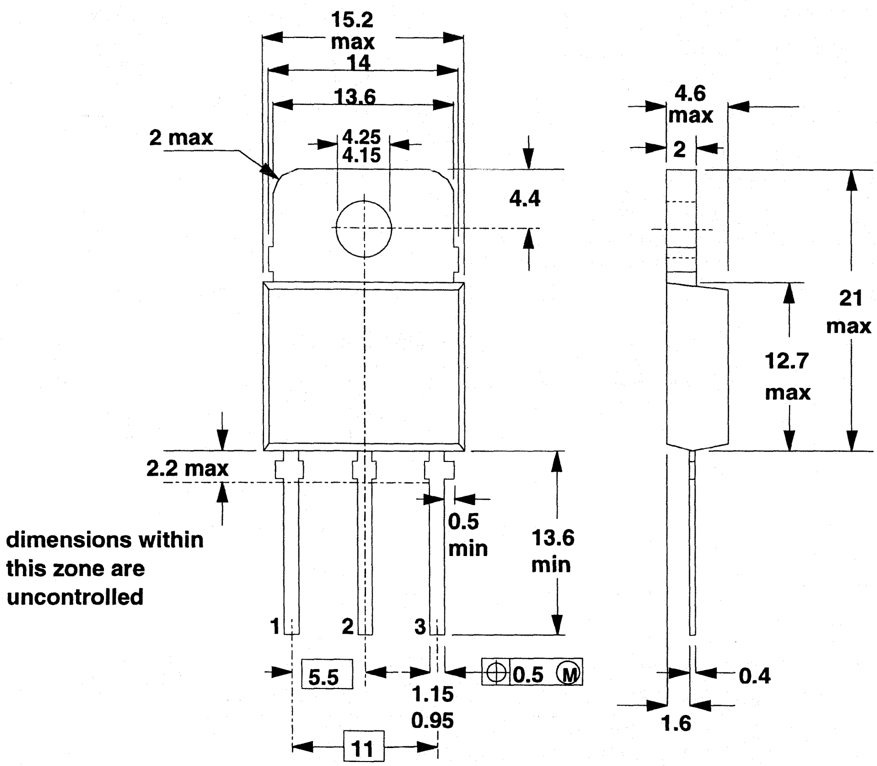


Fig.16. SOT93; pin 2 connected to mounting base.

Notes

1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

Silicon Diffused Power Transistor BU2525AF

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

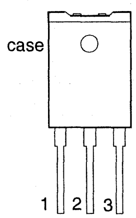
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ °C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 8.0$ A; $I_B = 1.6$ A	-	5.0	V
I_{Csat}	Collector saturation current		8.0	-	A
t_f	Fall time	$I_{CM} = 8.0$ A; $I_{B(end)} = 1.1$ A	0.2	0.35	µs

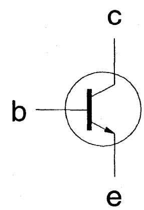
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	8	A
I_{BM}	Base current peak value		-	12	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ °C	-	45	W
T_{stg}	Storage temperature		-65	150	°C
T_j	Junction temperature		-	150	°C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 8.0 A; I_B = 1.6 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 8.0 A; I_B = 1.6 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	10	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{CM} = 8.0 A; L_C = 260 µH; C_{fb} = 13 nF; $I_{B(end)}$ = 1.1 A; L_B = 2.5 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 1.6 A/µs)			
t_s	Turn-off storage time		3.0	4.0	µs
t_f	Turn-off fall time		0.2	0.35	µs

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

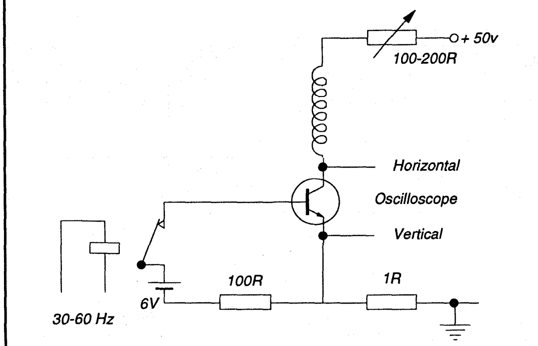


Fig.1. Test circuit for $V_{CEOsust}$.

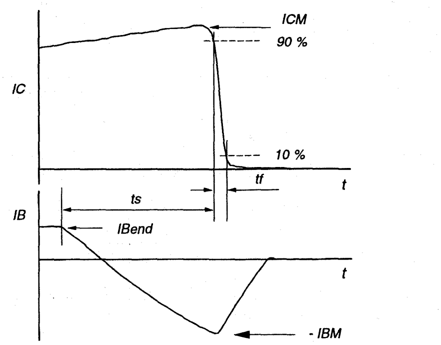


Fig.4. Switching times definitions.

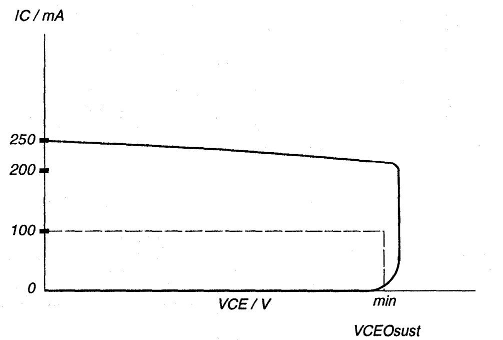


Fig.2. Oscilloscope display for $V_{CEOsust}$.

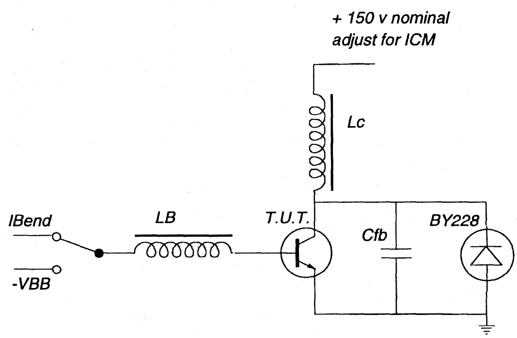


Fig.5. Switching times test circuit.

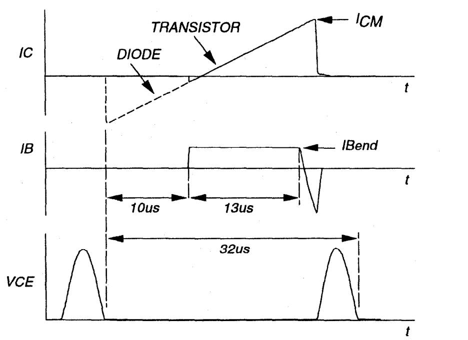


Fig.3. Switching times waveforms.

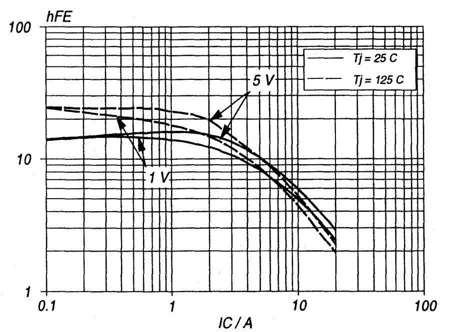


Fig.6. Typical DC current gain. $h_{FE} = f\,(I_C)$ parameter V_{CE}

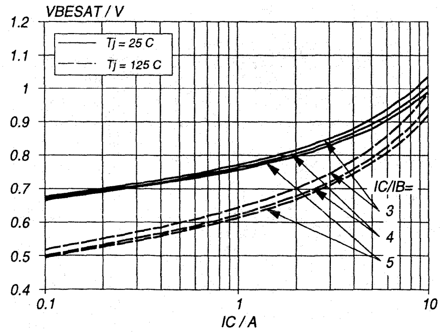


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

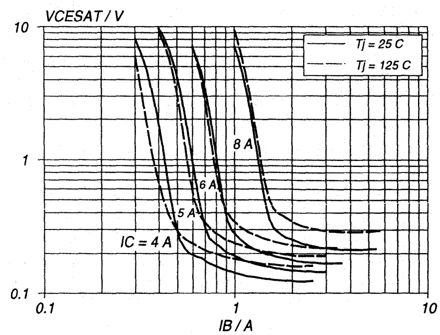


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

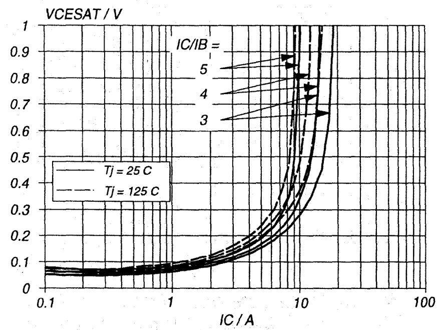


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

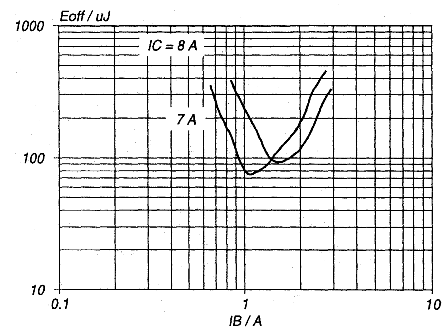


Fig.11. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f\ (I_B)$; parameter I_C; f = 32 kHz

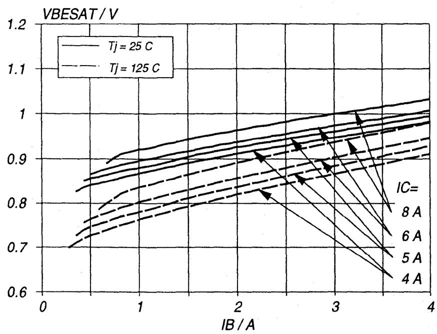


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

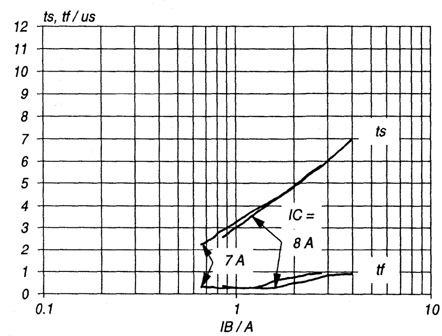


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85˚C$; f = 32 kHz

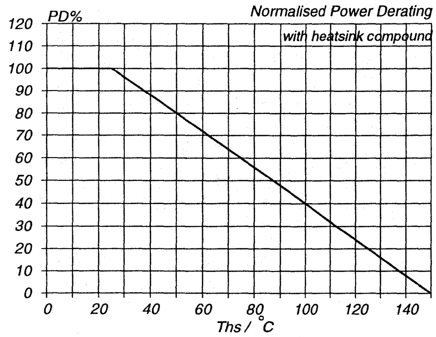


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

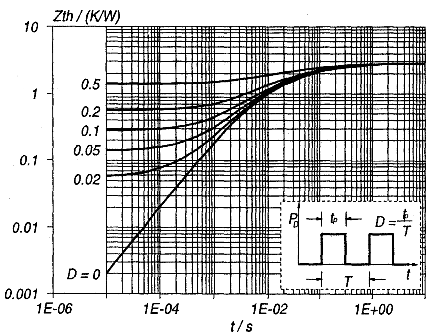


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

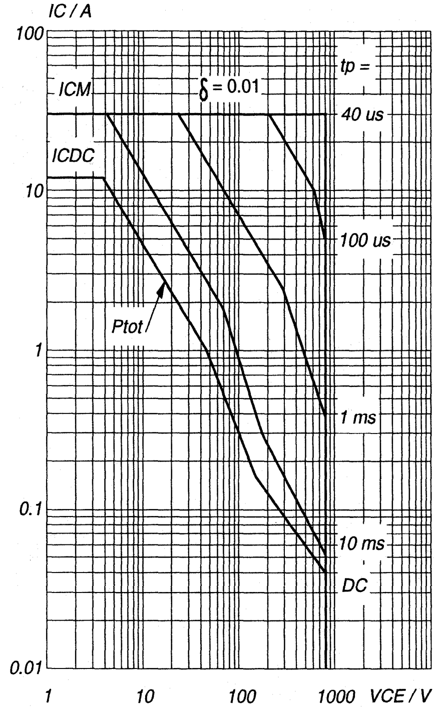


Fig.15. Forward bias safe operating area. $T_{hs} = 25$ ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

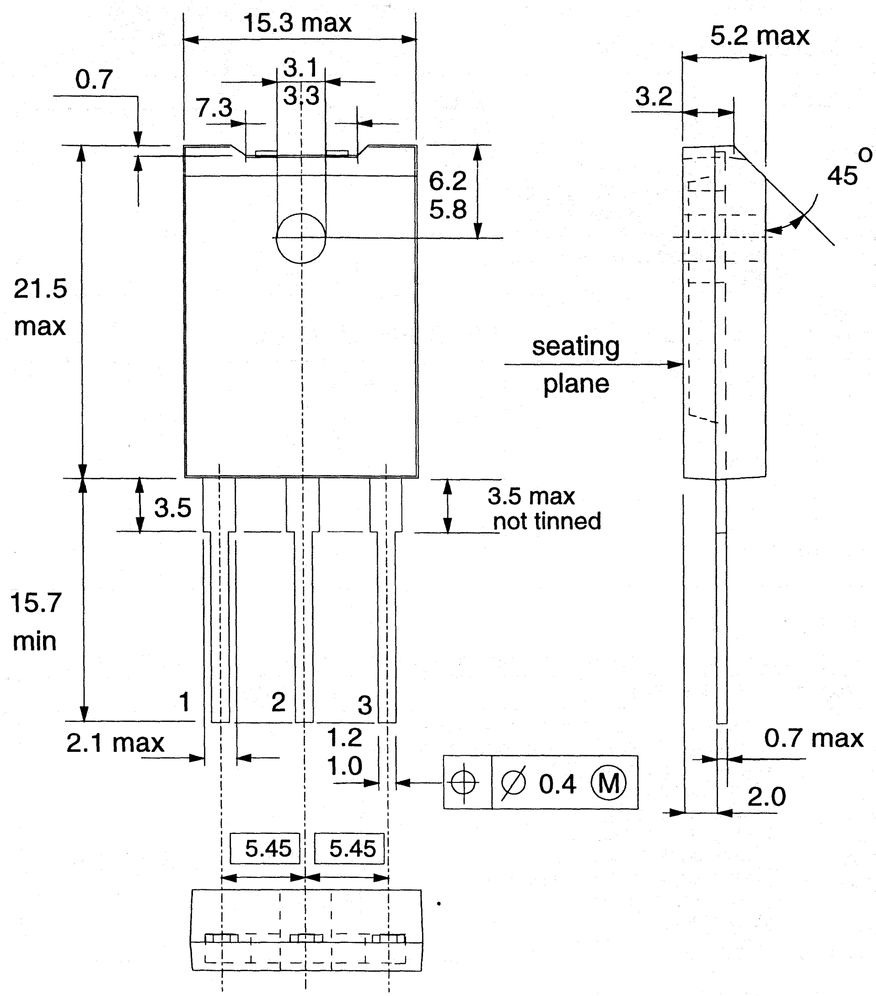


Fig.16. SOT199; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor — BU2525AX

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

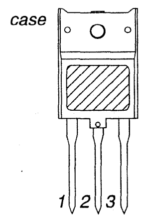
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 8.0$ A; $I_B = 1.6$ A	-	5.0	V
I_{Csat}	Collector saturation current		8.0	-	A
t_f	Fall time	$I_{CM} = 8.0$ A; $I_{B(end)} = 1.1$ A	0.2	0.35	µs

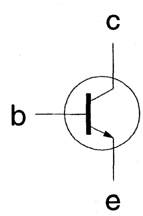
PINNING - SOT399

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	8	A
I_{BM}	Base current peak value		-	12	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 8.0 A; I_B = 1.6 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 8.0 A; I_B = 1.6 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	26	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	10	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{CM} = 8.0 A; L_C = 260 µH; C_{fb} = 13 nF; $I_{B(end)}$ = 1.1 A; L_B = 2.5 µH; $-V_{BB}$ = 4 V; ($-dI_B/dt$ = 1.6 A/µs)			
t_s	Turn-off storage time		3.0	4.0	µs
t_f	Turn-off fall time		0.2	0.35	µs

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

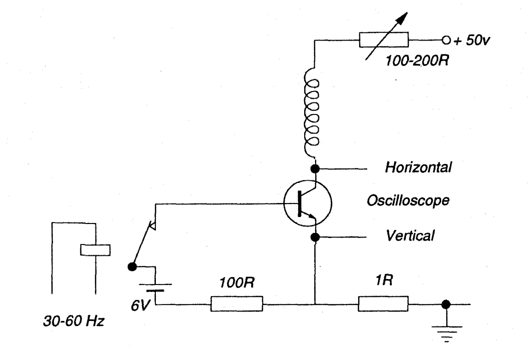


Fig.1. Test circuit for $V_{CEOsust}$.

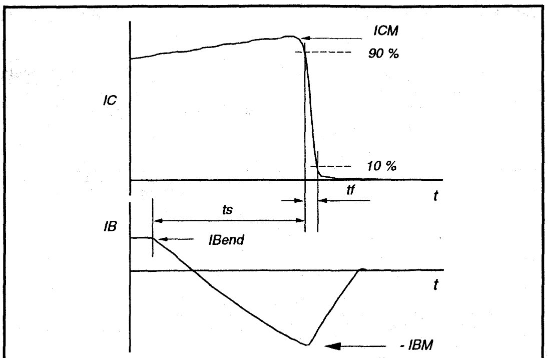


Fig.4. Switching times definitions.

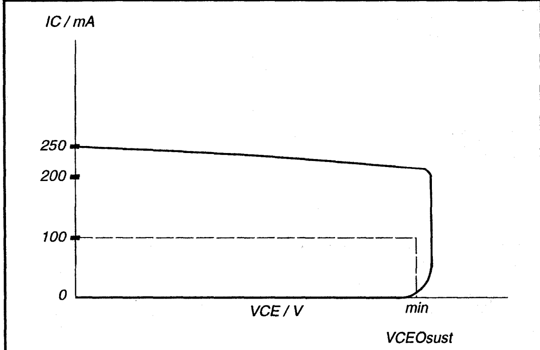


Fig.2. Oscilloscope display for $V_{CEOsust}$.

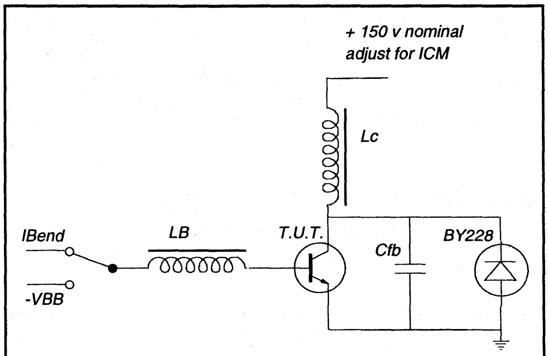


Fig.5. Switching times test circuit.

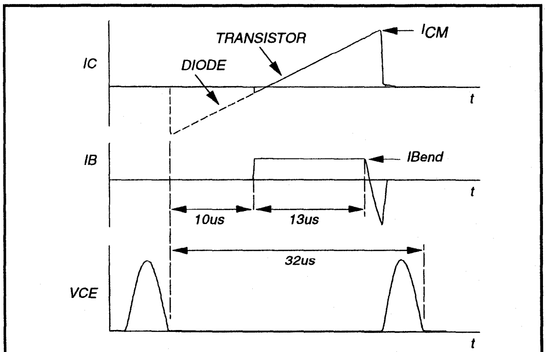


Fig.3. Switching times waveforms.

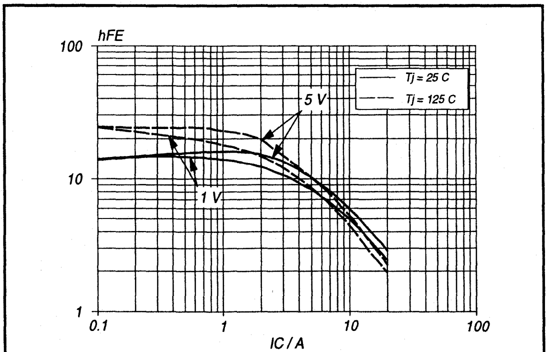


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

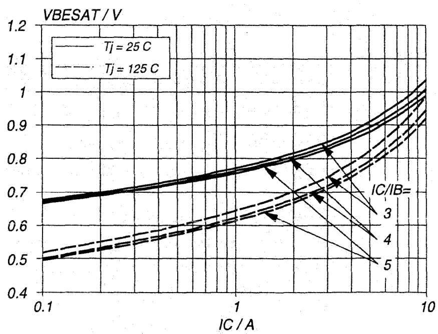


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

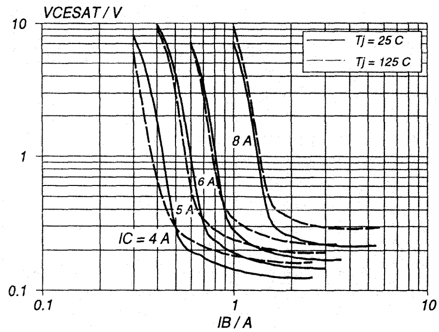


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

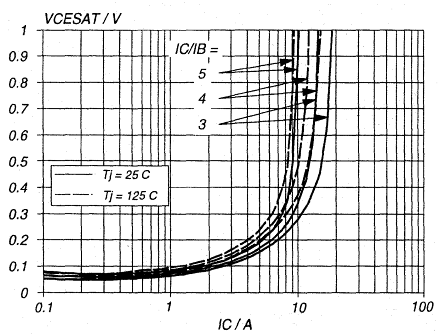


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

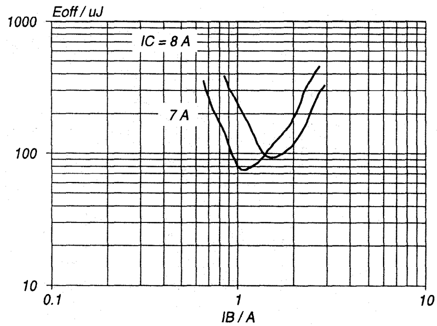


Fig.11. Typical turn-off losses. T_j = 85˚C
Eoff = f (I_B); parameter I_C; f = 32 kHz

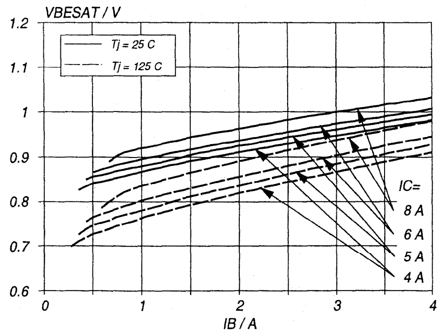


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

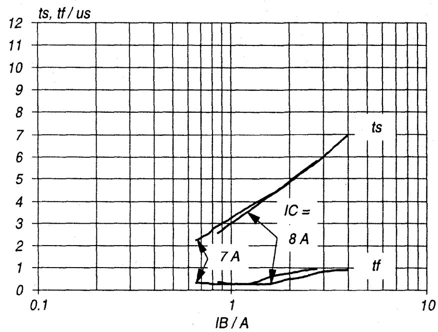


Fig.12. Typical collector storage and fall time.
ts = f (I_B); tf = f (I_B); parameter I_C; T_j = 85˚C; f = 32 kHz

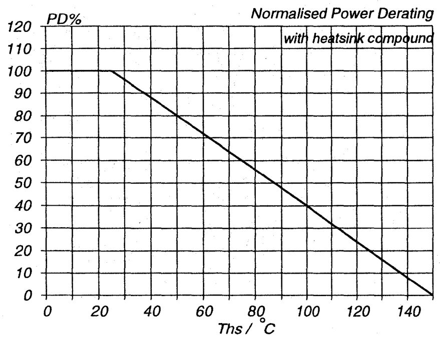


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

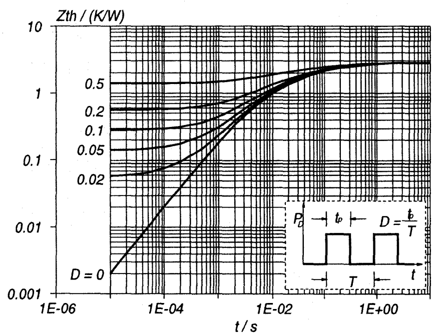


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

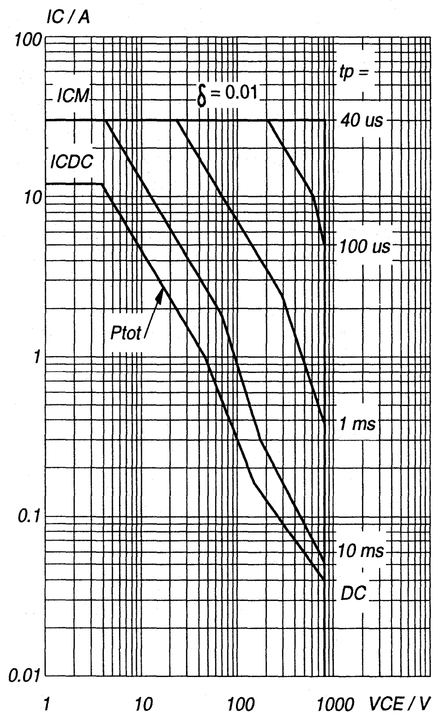


Fig.15. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

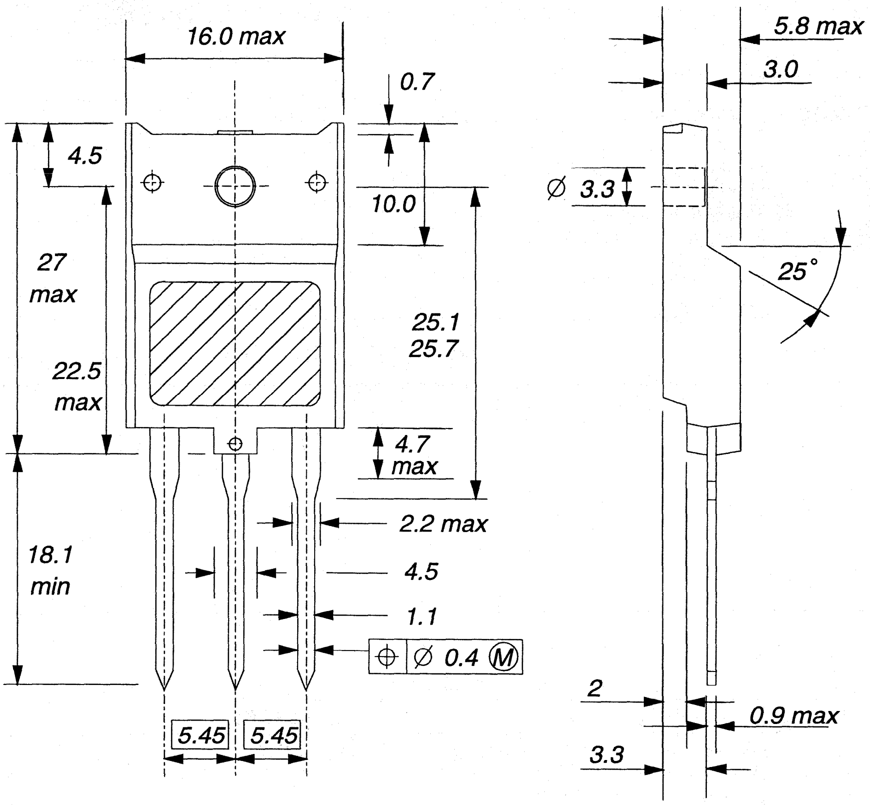


Fig.16. SOT399; The seating plane is electrically isolated from all terminals.

Notes

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

Silicon Diffused Power Transistor | BU2527A

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of high resolution monitors. Features improved RBSOA performance and is suitable for operation up to 64 kHz.

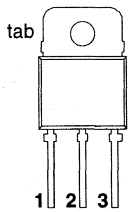
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_s	Storage time	I_{CM} = 6.0 A; $I_{B(end)}$ = 0.55 A	1.7	2.0	µs

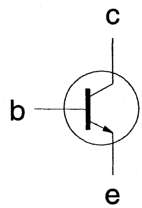
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	V_{BE} = 0 V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	8	A
I_{BM}	Base current peak value		-	12	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{mb} \leq$ 25 ˚C	-	125	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-mb}$	Junction to mounting base		-	1.0	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	0.25	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} = 7.5 V; I_C = 0 A	-	-	0.25	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	6	10	21	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	145	-	pF
	Switching times (64 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.55 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A/µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.1	0.2	µs

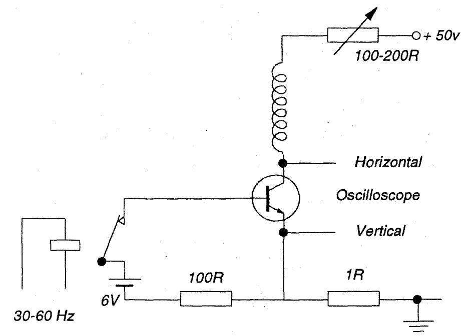


Fig.1. Test circuit for $V_{CEOsust}$.

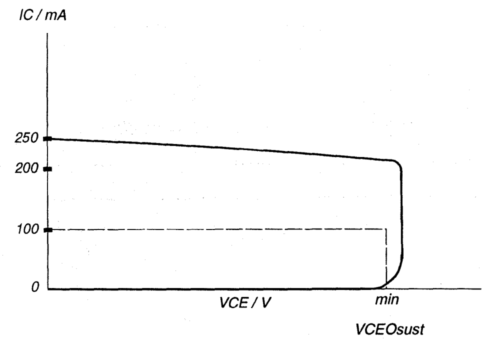


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

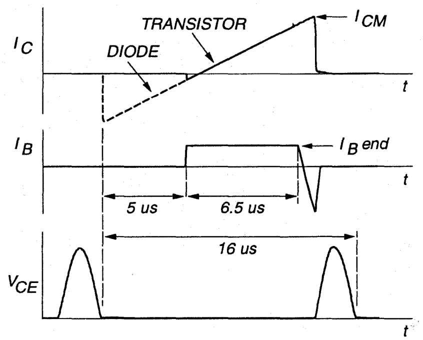


Fig.3. Switching times waveforms.

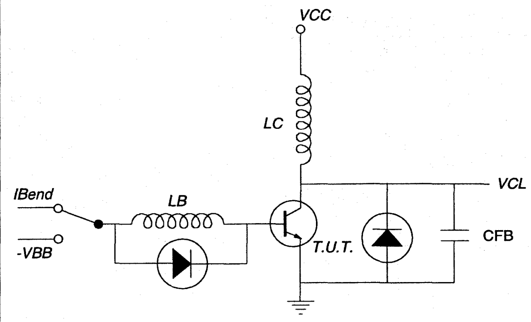


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1 - 2 A

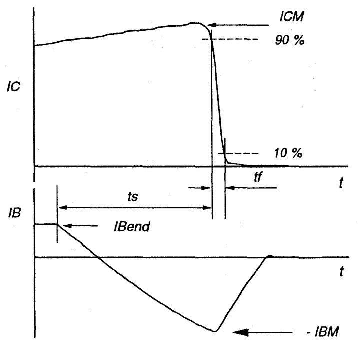


Fig.4. Switching times definitions.

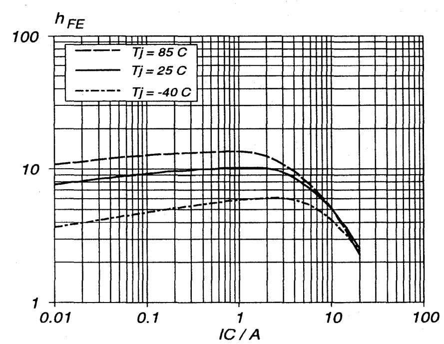


Fig.7. Typical DC current gain. $h_{FE} = f(I_C)$ V_{CE} = 5 V

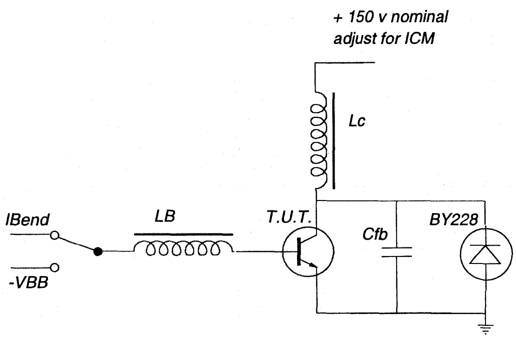


Fig.5. Switching times test circuit.

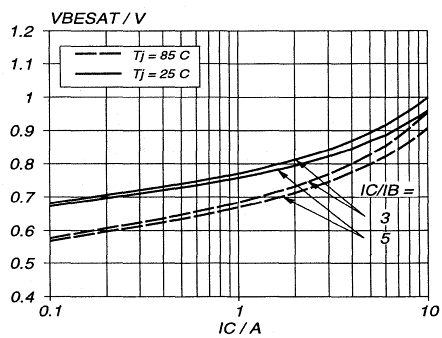


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

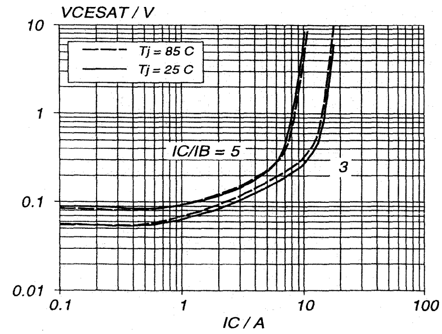


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

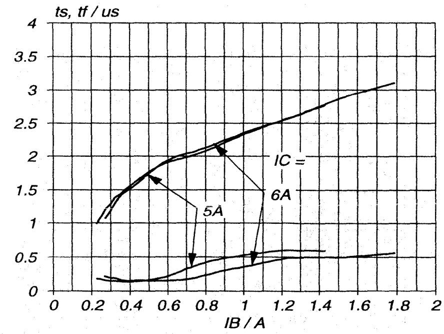


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85˚C$; f = 64 kHz

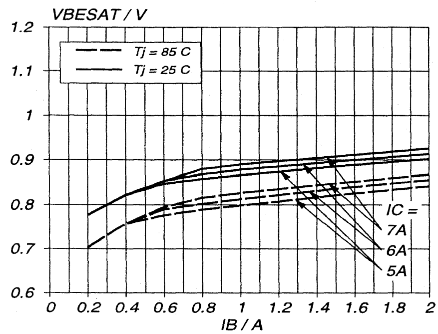


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

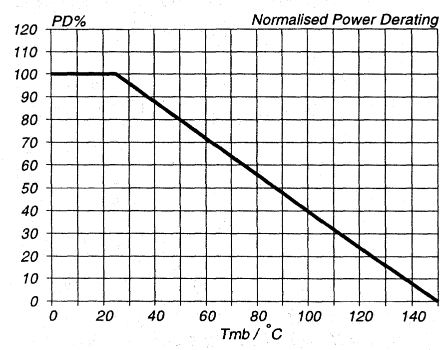


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f\ (T_{mb})$

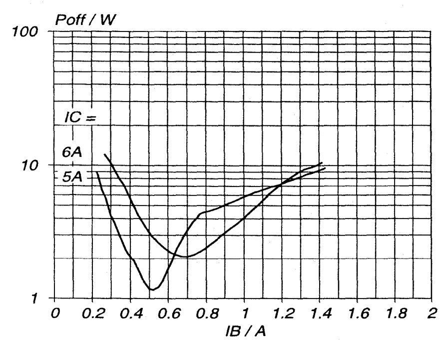


Fig.11. Typical turn-off losses. $T_j = 85˚C$
$Poff = f\ (I_B)$; parameter I_C; f = 64 kHz

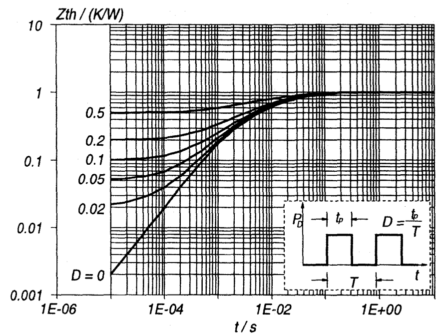


Fig.14. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

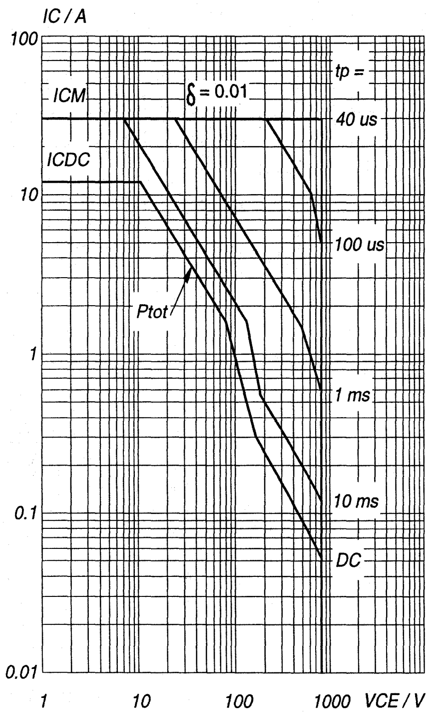


Fig. 15. Forward bias safe operating area. T_{mb} = 25 ˚C
I_{CDC} & I_{CM} = $f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.

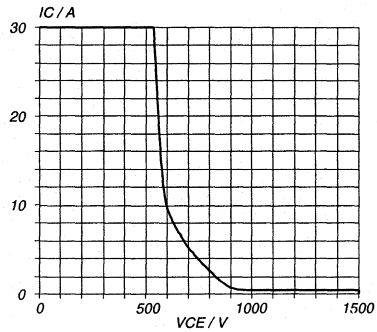


Fig. 16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

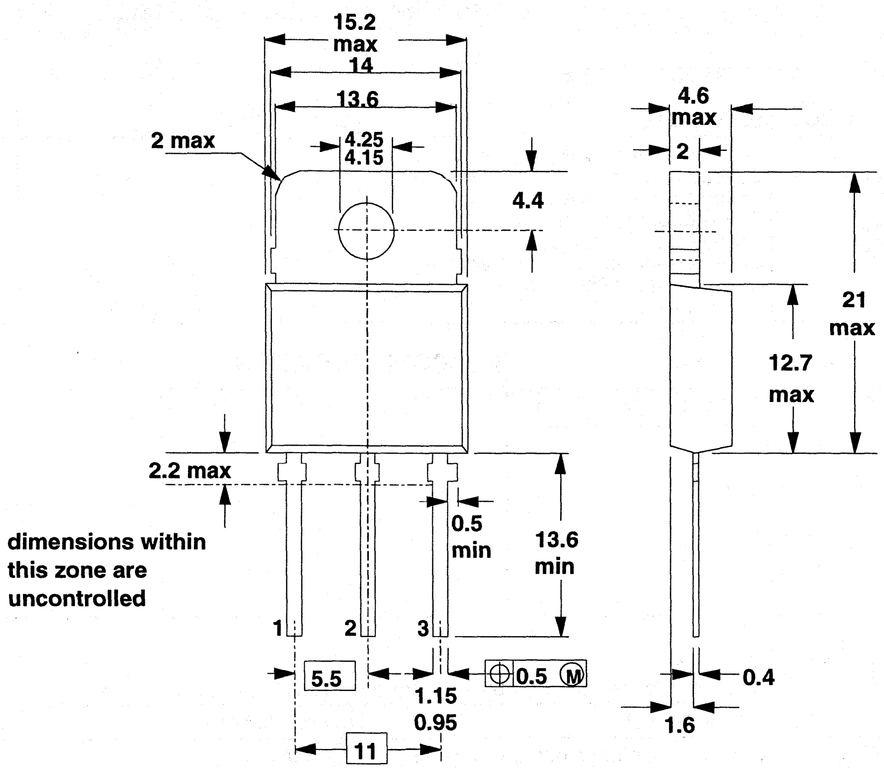


Fig.17. SOT93; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of high resolution monitors. Features improved RBSOA performance and is suitable for operation up to 64 kHz.

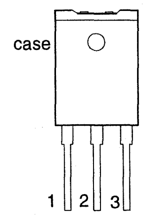
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_s	Storage time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.55$ A	1.7	2.0	µs

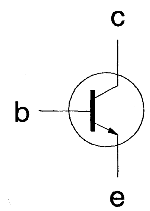
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	8	A
I_{BM}	Base current peak value		-	12	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	0.25	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} = 7.5 V; I_C = 0 A	-	-	0.25	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	6	10	21	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	145	-	pF
	Switching times (64 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.55 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A/µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.1	0.2	µs

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

Silicon Diffused Power Transistor BU2527AF

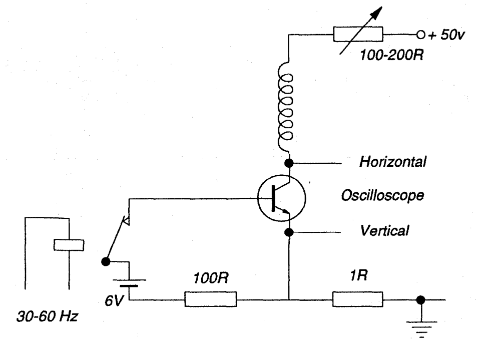


Fig.1. Test circuit for $V_{CEOsust}$.

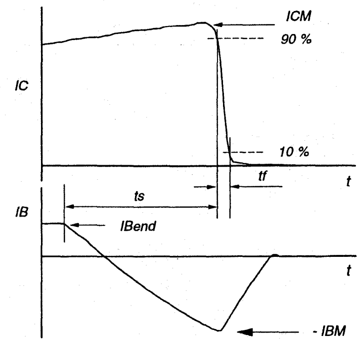


Fig.4. Switching times definitions.

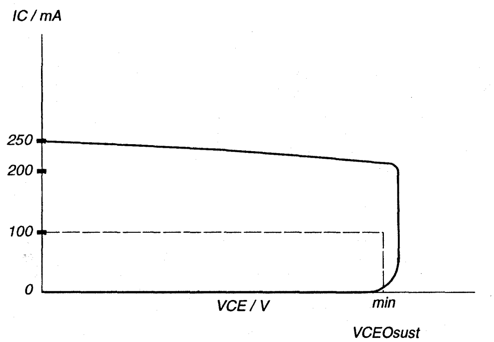


Fig.2. Oscilloscope display for $V_{CEOsust}$.

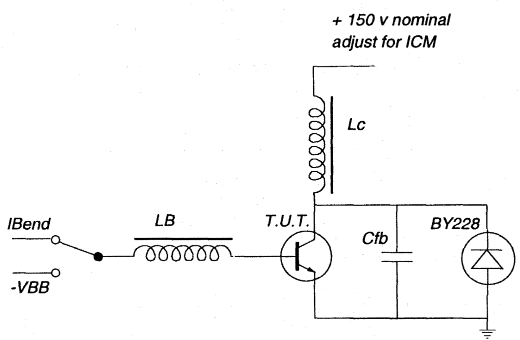


Fig.5. Switching times test circuit.

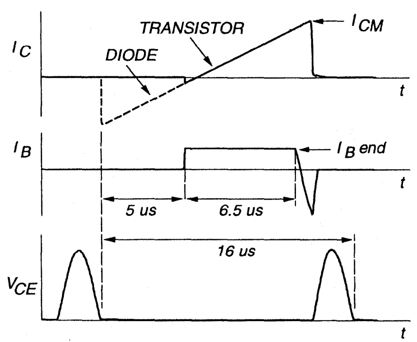


Fig.3. Switching times waveforms.

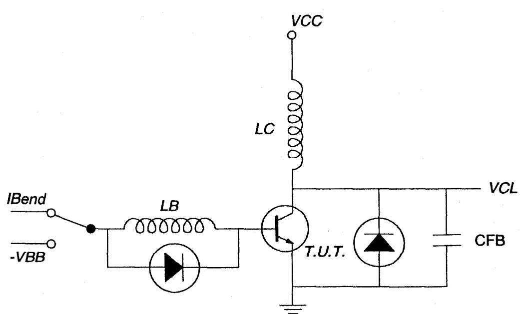


Fig.6. Test Circuit RBSOA. $V_{CC} = 140$ V; $-V_{BB} = 4$ V; $L_C = 100 - 200\ \mu H$; $V_{CL} \leq 1500$ V; $L_B = 3\ \mu H$; $C_{FB} = 1 - 2.2$ nF; $I_B(end) = 1 - 2$ A

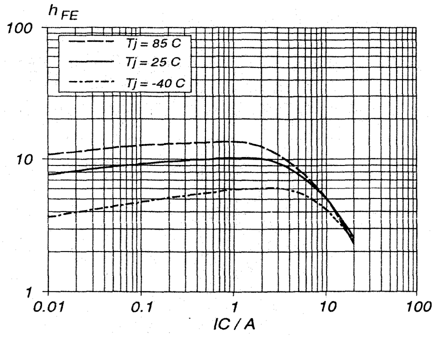


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

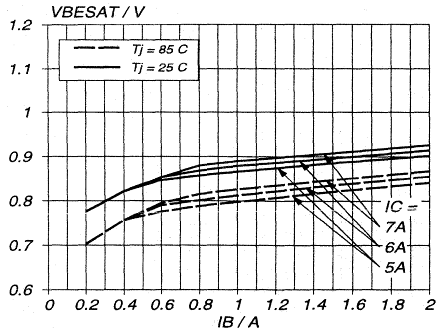


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

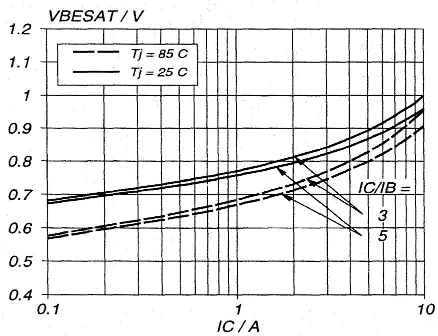


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

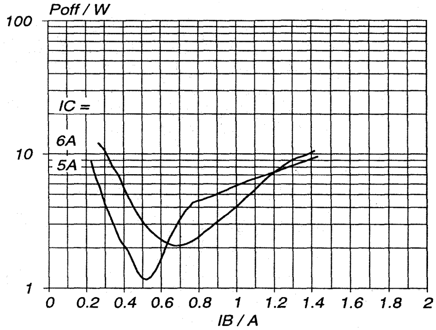


Fig.11. Typical turn-off losses. $T_j = 85°C$
$Poff = f\ (I_B)$; parameter I_C; $f = 64\ kHz$

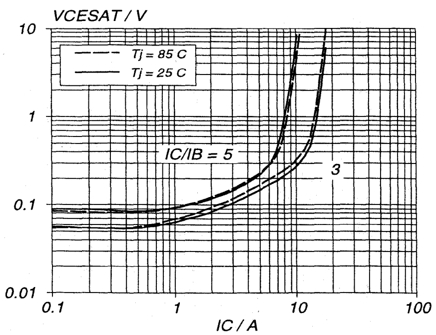


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

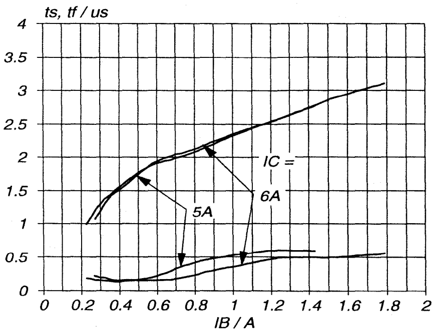


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85°C$; $f = 64\ kHz$

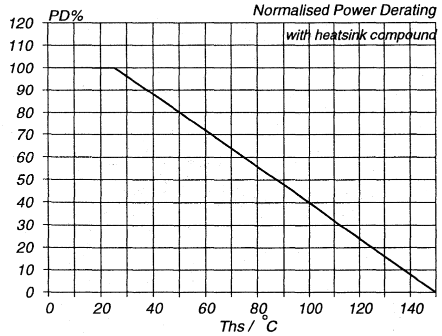


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

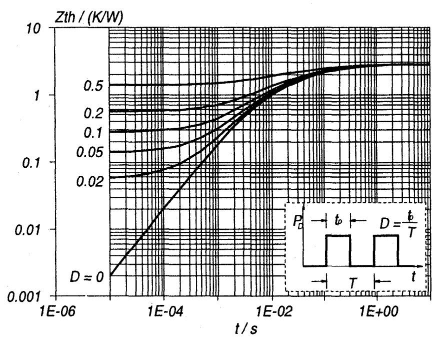


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

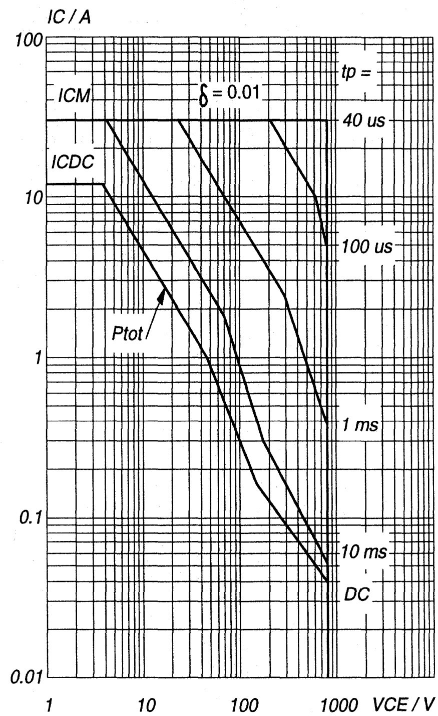


Fig.15. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

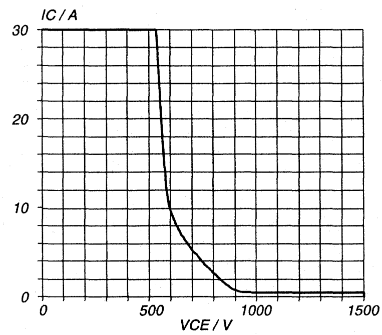


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

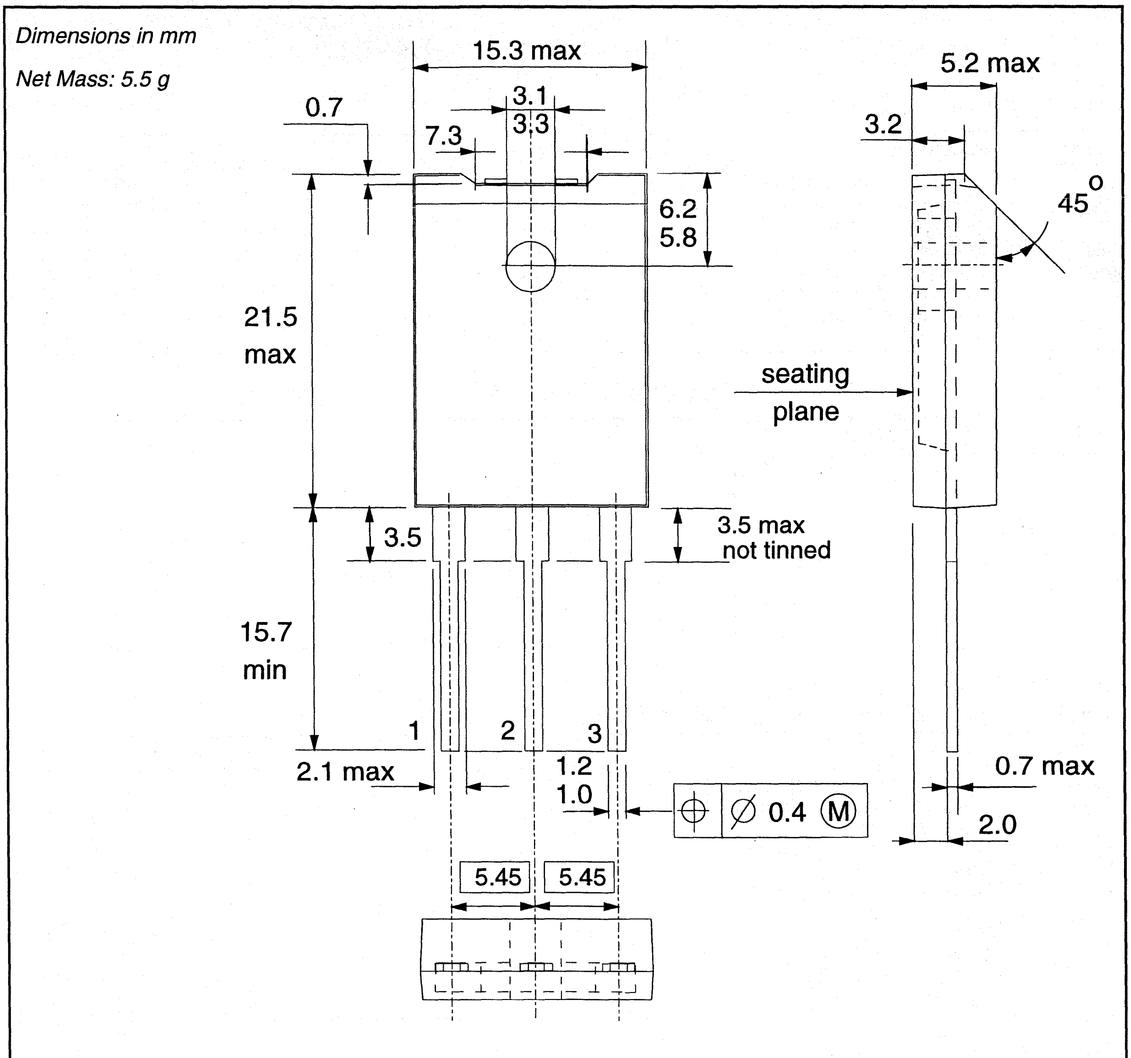


Fig.17. SOT199; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of high resolution monitors. Features improved RBSOA performance and is suitable for operation up to 64 kHz.

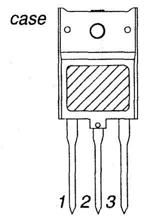
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 6.0$ A; $I_B = 1.2$ A	-	5.0	V
I_{Csat}	Collector saturation current		6.0	-	A
t_s	Storage time	$I_{CM} = 6.0$ A; $I_{B(end)} = 0.55$ A	1.7	2.0	µs

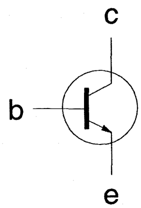
PINNING - SOT399

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	8	A
I_{BM}	Base current peak value		-	12	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

1 Turn-off current.

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	0.25	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} = 7.5 V; I_C = 0 A	-	-	0.25	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 6.0 A; I_B = 1.2 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	6	10	21	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
C_c	Collector capacitance	I_E = 0 A; V_{CB} = 10 V; f = 1 MHz	145	-	pF
	Switching times (64 kHz line deflection circuit)	I_{CM} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.55 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A/µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.1	0.2	µs

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

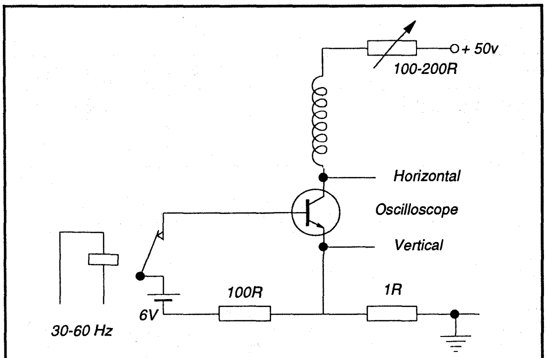


Fig.1. Test circuit for $V_{CEOsust}$.

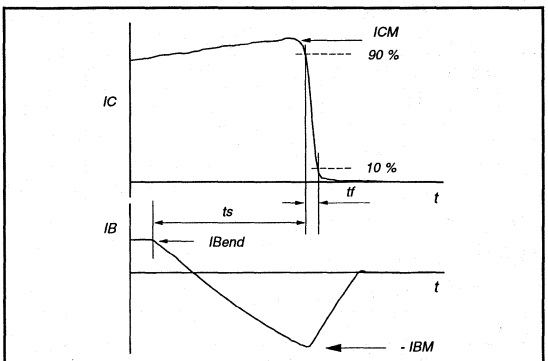


Fig.4. Switching times definitions.

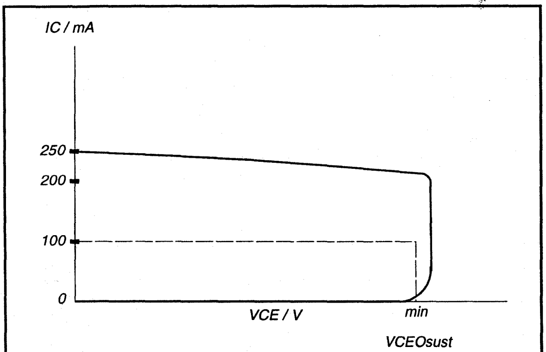


Fig.2. Oscilloscope display for $V_{CEOsust}$.

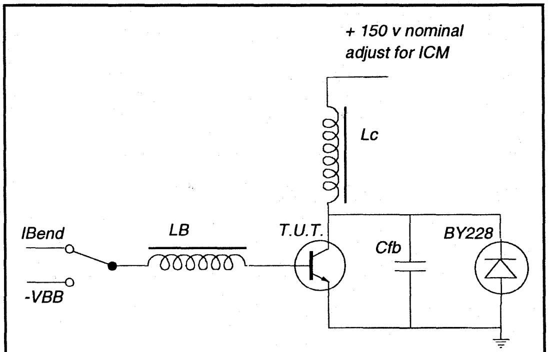


Fig.5. Switching times test circuit.

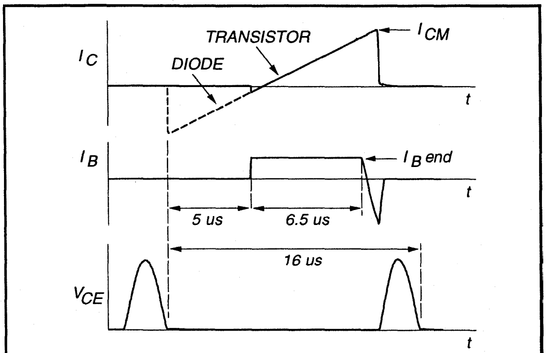


Fig.3. Switching times waveforms.

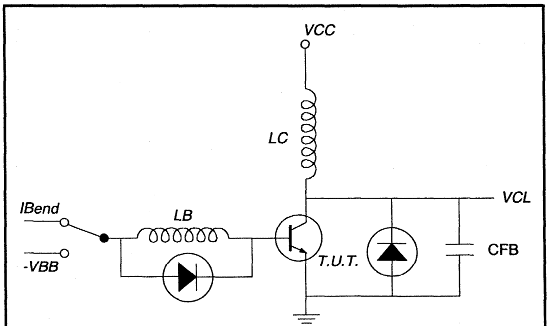


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1 - 2 A

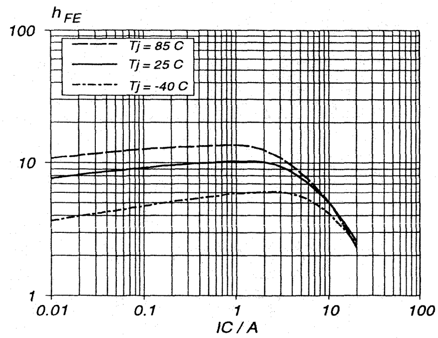


Fig.7. Typical DC current gain. $h_{FE} = f(I_C)$
$V_{CE} = 5$ V

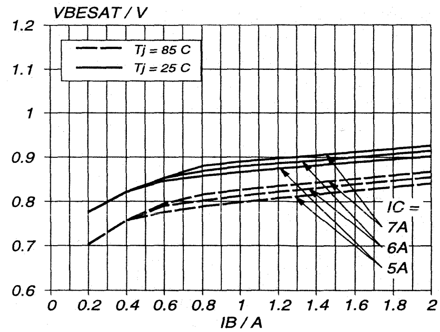


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

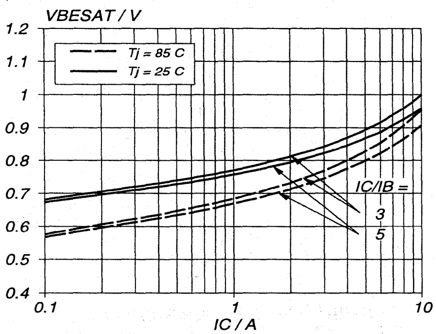


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_C)$; parameter I_C/I_B

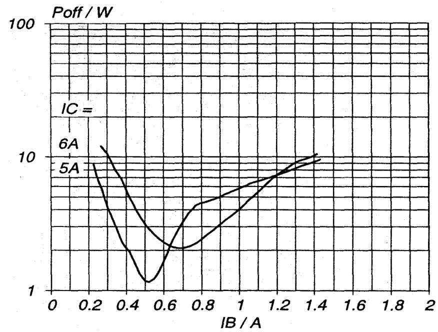


Fig.11. Typical turn-off losses. $T_j = 85$˚C
$Poff = f(I_B)$; parameter I_C; f = 64 kHz

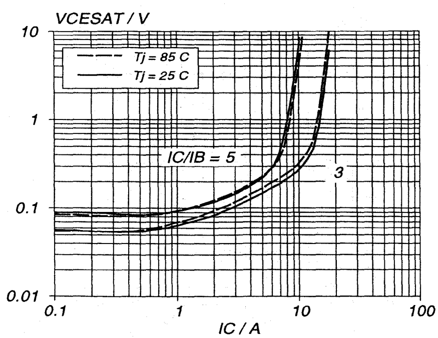


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

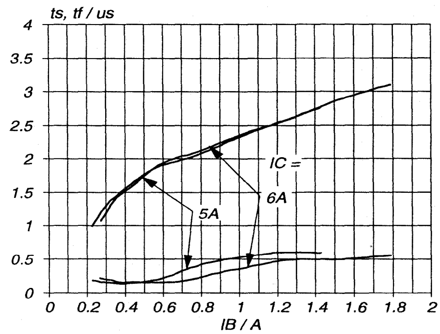


Fig.12. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85$˚C; f = 64 kHz

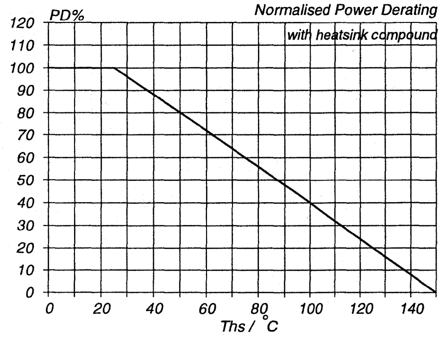


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f\,(T_{hs})$

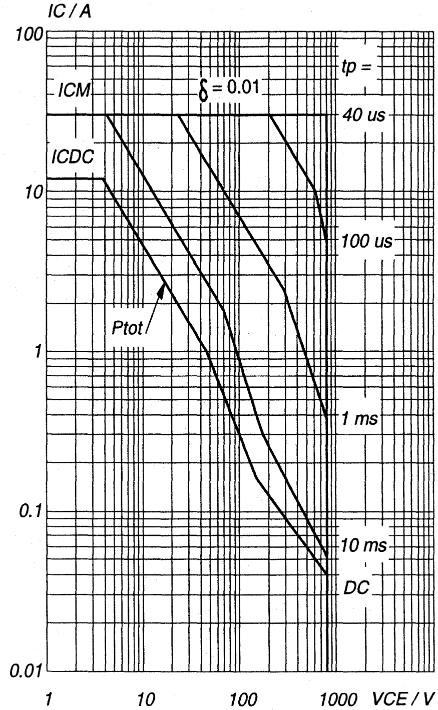


Fig.15. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

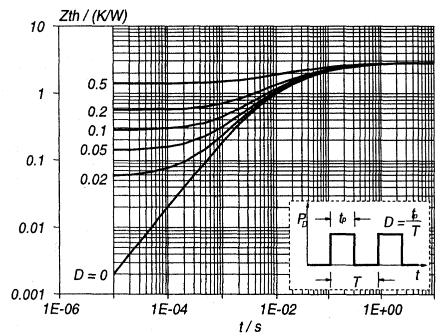


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

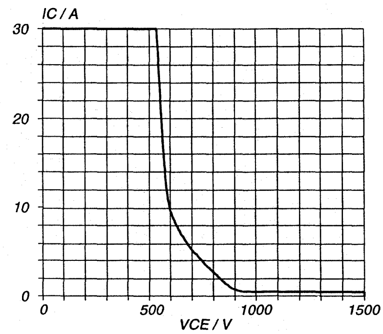


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.88 g

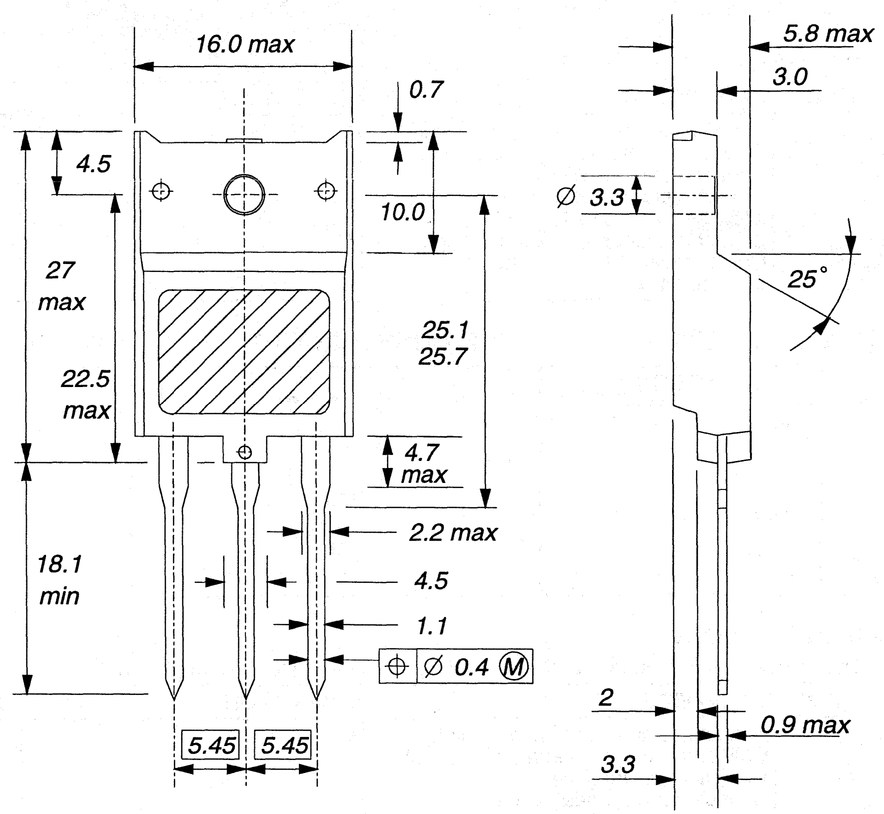


Fig.17. SOT399; The seating plane is electrically isolated from all terminals.

Notes

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of large screen colour television receivers up to 32 kHz.

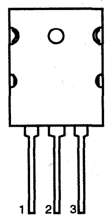
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	16	A
I_{CM}	Collector current peak value		-	40	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 9.0$ A; I_B = tbf	-	5.0	V
I_{Csat}	Collector saturation current		9	-	A
t_s	Storage time	$I_{CM} = 9.0$ A; $I_{B(end)}$ = tbf	-	4.5	µs

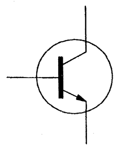
PINNING - SOT430

PIN	DESCRIPTION
1	base
2	collector
3	emitter
heat sink	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_C	Collector current (DC)		-	16	A
I_{CM}	Collector current peak value		-	40	A
I_B	Base current (DC)		-	16	A
I_{BM}	Base current peak value		-	30	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	30	A
P_{tot}	Total power dissipation	$T_{mb} \leq$ 25 ˚C	-	125	W
T_{stg}	Storage temperature		-55	150	˚C
T_j	Junction temperature		-	150	˚C

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	45	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Base-emitter breakdown voltage	I_B = 1 mA	7.5	14	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 9.0 A; I_B = tbf	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage [3]	I_C = 9.0 A; I_B = tbf	tbf	tbf	tbf	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	10	-	30	
h_{FE}		I_C = 9 A; V_{CE} = 5 V	tbf	tbf	tbf	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (32 kHz line deflection test circuit).	I_{CM} = 9.0 A; L_C = 250 µH; C_{fb} = 13 nF; $I_{B(end)}$ = tbf			
t_s	Turn-off storage time		-	4.5	µs
t_f	Turn-off fall time		-	0.35	µs

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

3 V_{BEsat} limits are targetted at ± 5% of the 50% value of the distribution of measured values.

MECHANICAL DATA

Dimensions in mm

Net Mass: 9 g

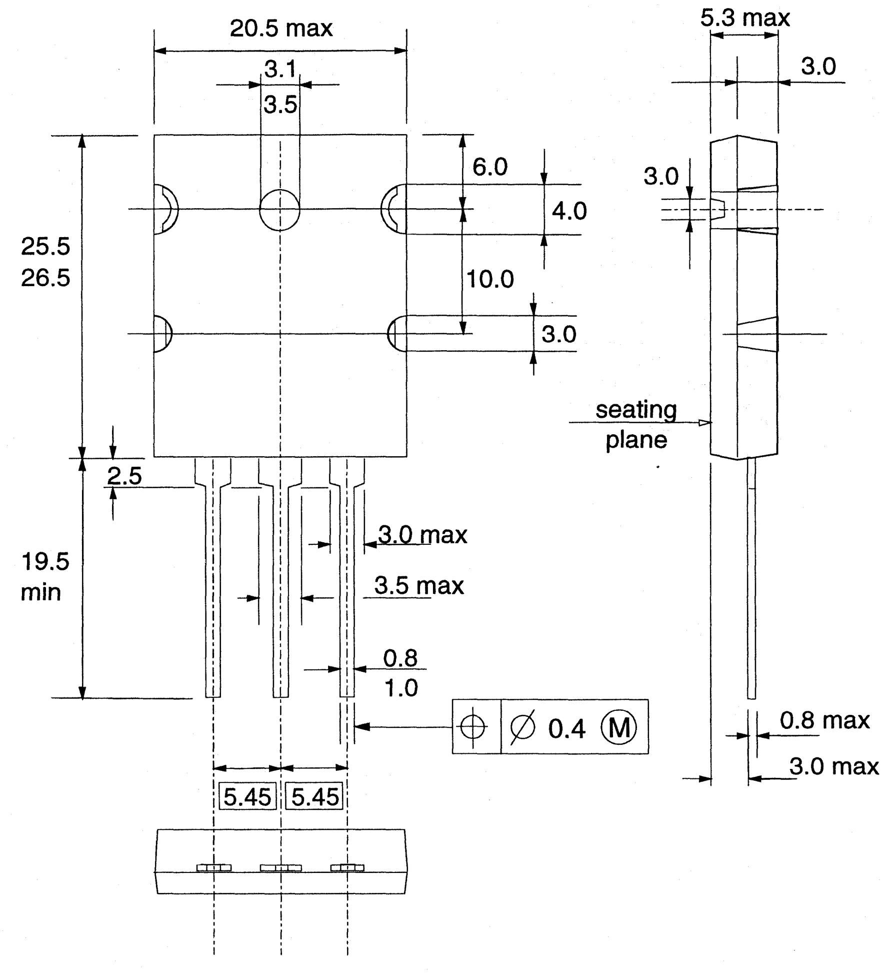


Fig.1. SOT430; pin 2 connected to mounting base.

GENERAL DESCRIPTION

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 low worst-case dissipation. Designed to withstand V_{CES} pulses up to 1700 V.

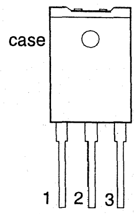
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4 A; I_B = 1.33 A	-	1.0	V
I_{Csat}	Collector saturation current		4	-	A
t_s	Storage time	I_{CM} = 4 A; $I_{B(end)}$ = 0.8 A	4.8	5.5	µs

PINNING - SOT199

PIN	DESCRIPTION
1	base
2	collector
3	emitter
case	isolated

PIN CONFIGURATION



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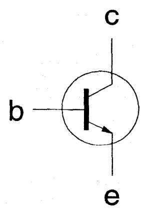


LIMITING VALUES

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 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 6 V; I_C = 0 A	-	-	70	µA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	825	900	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4 A; I_B = 1.33 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 1.33 A	0.83	0.91	1.00	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	12	21	35	
h_{FE}		I_C = 4 A; V_{CE} = 1 V	3	6	7.3	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (line deflection circuit 16 kHz)	I_{CM} = 4 A; $I_{B(end)}$ = 0.8 A; $-I_{BM}$ = I_{CM}/2; L_B = 6 µH; $-V_{BB}$ = 4 V; L_C = 1 mH; C_{FB} = 12.2 nF			
t_s	Turn-off storage time		4.8	5.5	µs
t_f	Turn-off fall time		0.4	0.52	µs

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

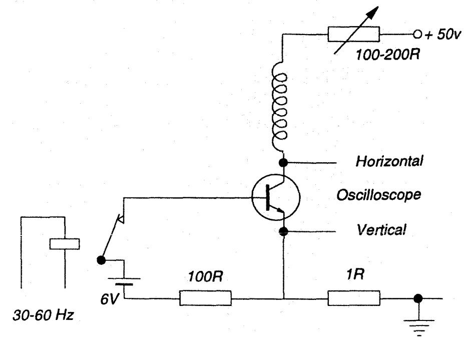


Fig.1. Test circuit for $V_{CEOsust}$.

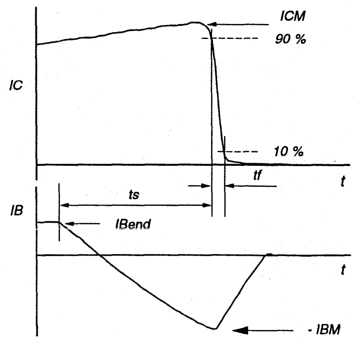


Fig.4. Switching times definitions.

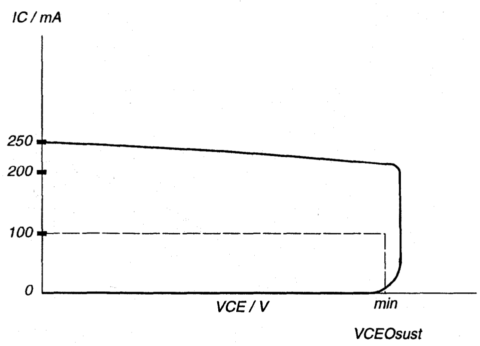


Fig.2. Oscilloscope display for $V_{CEOsust}$.

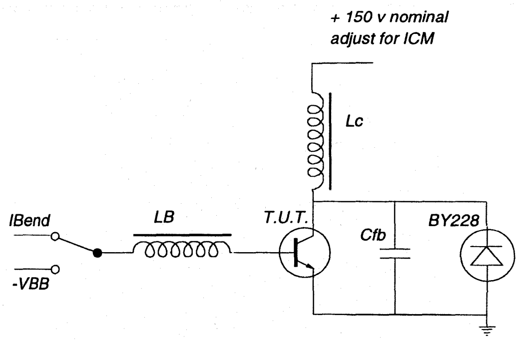


Fig.5. Switching times test circuit.

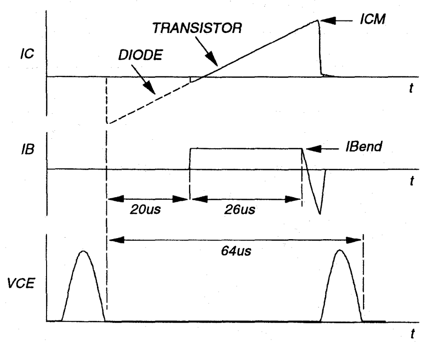


Fig.3. Switching times waveforms.

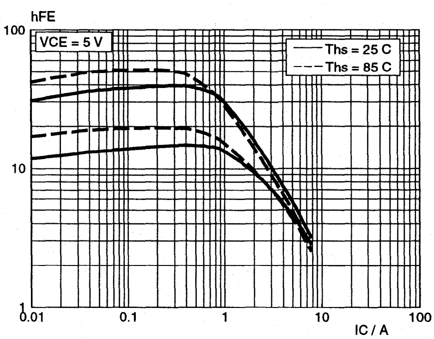


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

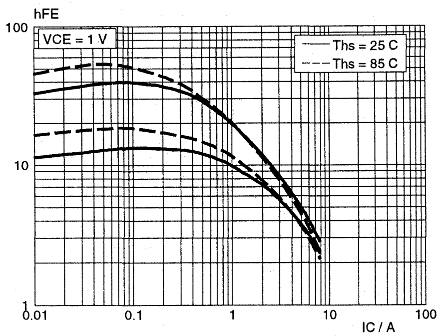


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

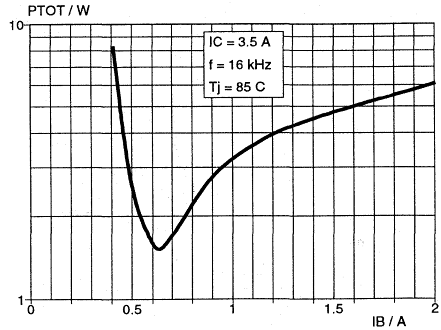


Fig.10. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 3.5$ A; f = 16 kHz

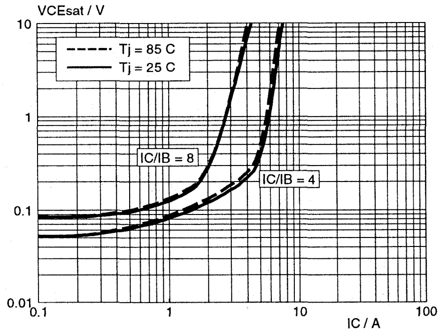


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

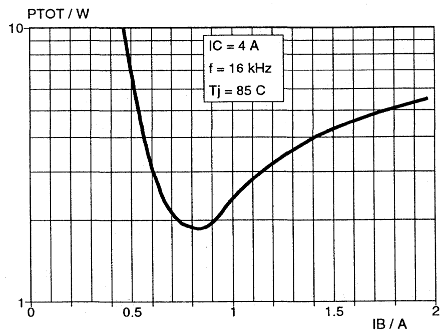


Fig.11. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.0$ A; f = 16 kHz

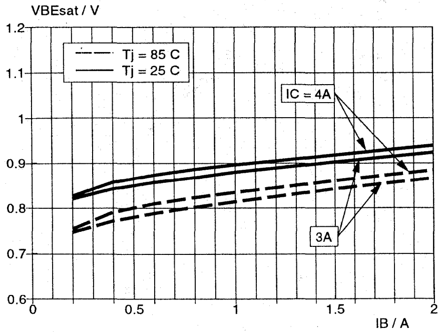


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

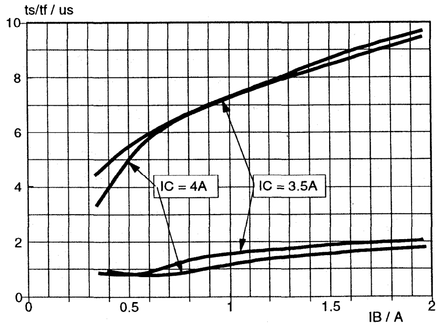


Fig.12. Limit storage and fall time.
$t_s = f\ (I_B)$; tf = f (I_B); paramete[illegible]; $T_j = 85^\circ C$; f = 16 kHz

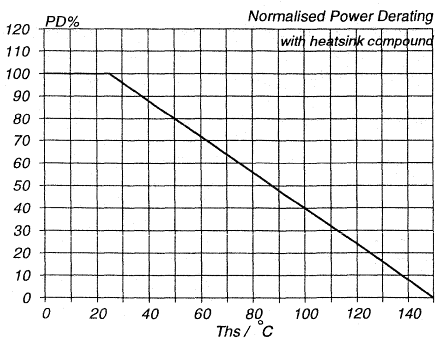


Fig.13. Normalised power dissipation. PD% = 100·PD/PD 25˚C = f (T_{hs})

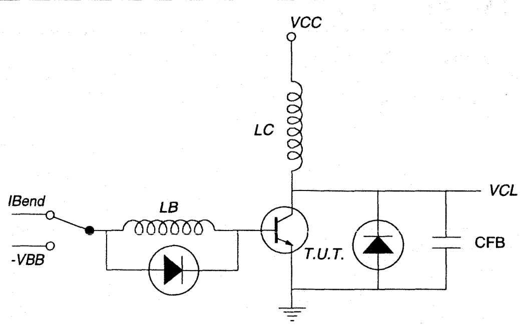


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

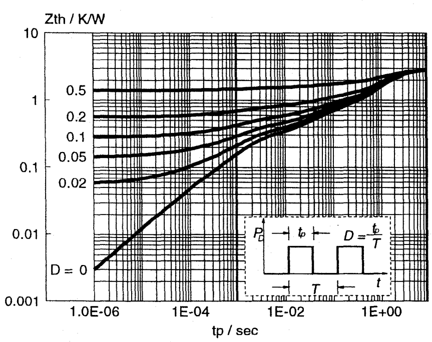


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

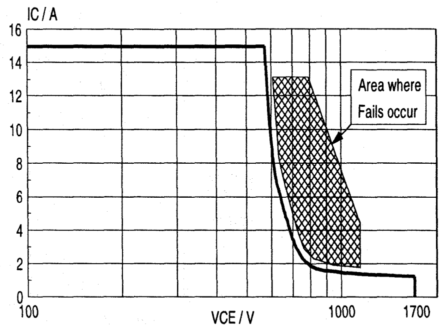


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

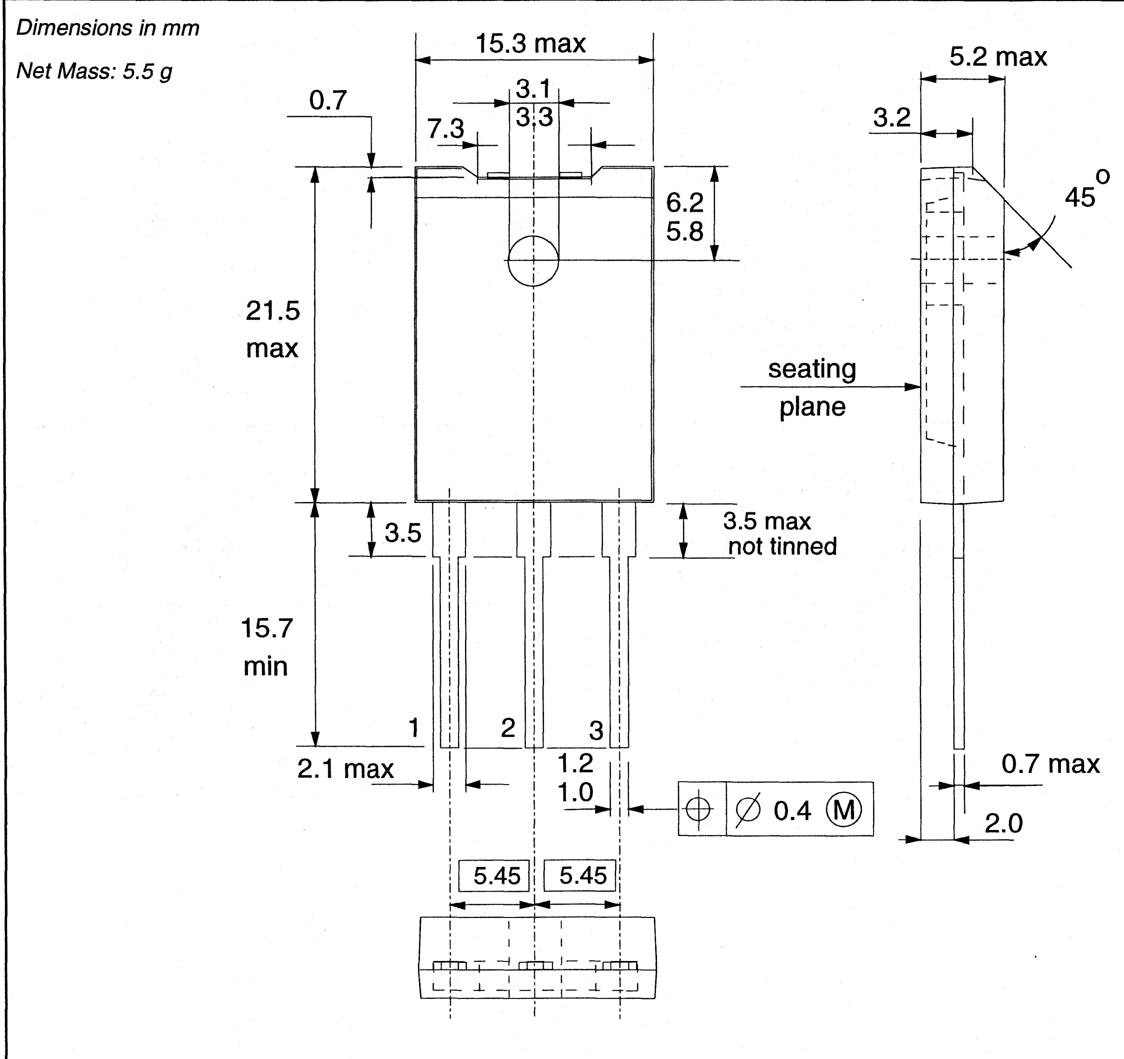


Fig.17. SOT199; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor BU2708DF

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistor with integrated damper diode 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 low worst case dissipation. Designed to withstand V_{CES} pulses up to 1700V.

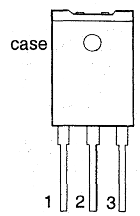
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4 A; I_B = 1.33 A	-	1.0	V
I_{Csat}	Collector saturation current		4.0	-	A
V_F	Diode forward voltage	I_F = 4.0 A	1.6	-	V
t_s	Storage time	I_{CM} = 4 A; $I_{B(end)}$ = 0.8 A	4.8	5.5	µs

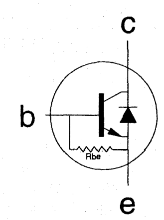
PINNING - SOT199

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-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	15	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
$-I_{BM}$	Reverse base current peak value [1]		-	5	A
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	132	-	268	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{BE}	Base-emitter resistance	V_{EB} = 7.5 V		45		Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4 A; I_B = 1.33 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 1.33 A	0.83	0.91	1.00	V
V_F	Diode forward voltage	I_F = 4 A		1.6		V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	9.5	15	21	
h_{FE}		I_C = 4 A; V_{CE} = 1 V	3	6	7.3	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (line deflection circuit 16 kHz)	I_{CM} = 4 A; L_C = 1 mH; C_{FB} = 12.2 nF; V_{CC} = 120 V; $I_{B(end)}$ = 0.8 A; L_B = 6 µH; $-V_{BB}$ = 4 V; $-I_{BM}$ = $I_{CM}/2$			
t_s	Turn-off storage time		4.8	5.5	µs
t_f	Turn-off fall time		0.4	0.52	µs

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

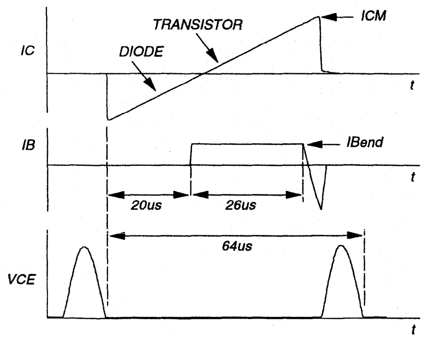


Fig.1. Switching times waveforms.

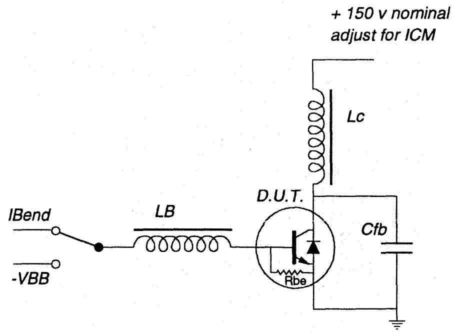


Fig.3. Switching times test circuit.

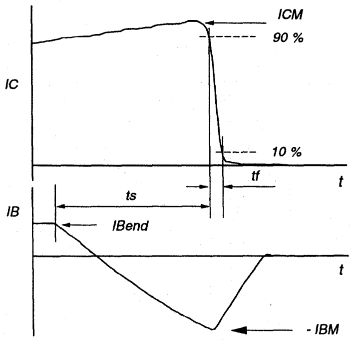


Fig.2. Switching times definitions.

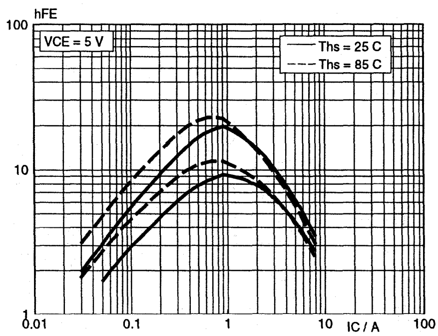


Fig.4. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

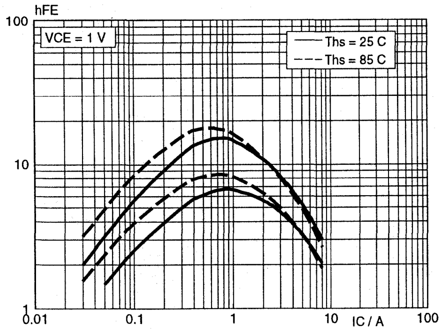


Fig.5. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

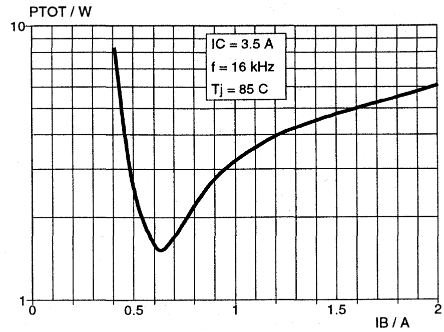


Fig.8. Limit P_{tot}; $T_j = 85˚C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 3.5$ A; f = 16 kHz

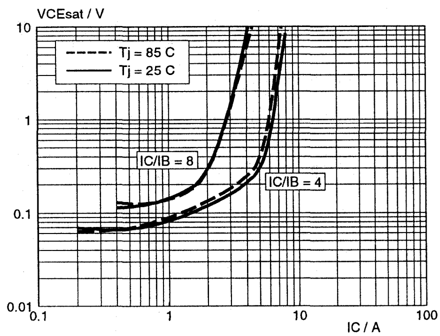


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

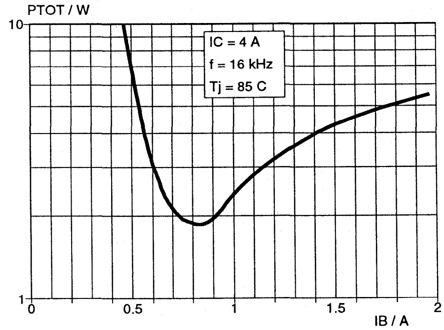


Fig.9. Limit P_{tot}; $T_j = 85˚C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.0$ A; f = 16 kHz

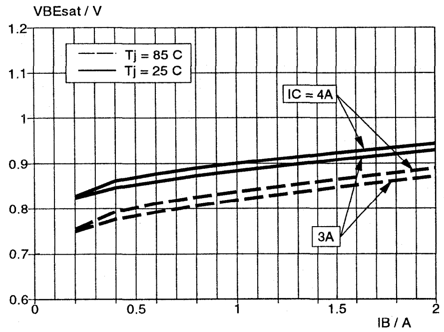


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

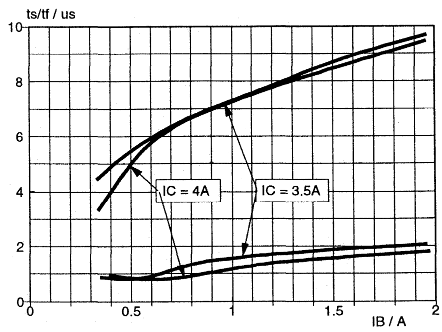


Fig.10. Limit storage and fall time.
$t_s = f\ (I_B)$; tf = f (I_B); parameter I_C; $T_j = 85˚C$; f = 16 kHz

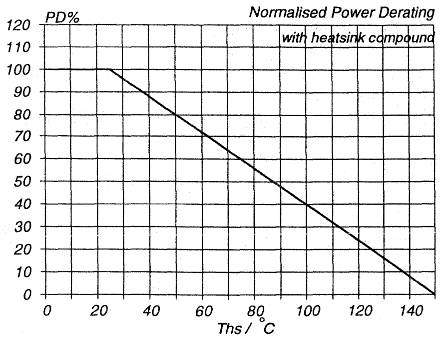


Fig.11. Normalised power dissipation. PD% = 100·PD/PD 25˚C = f (T_{hs})

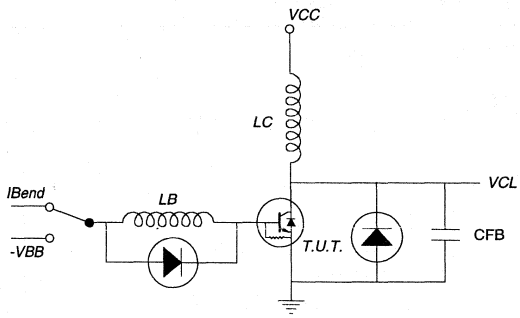


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

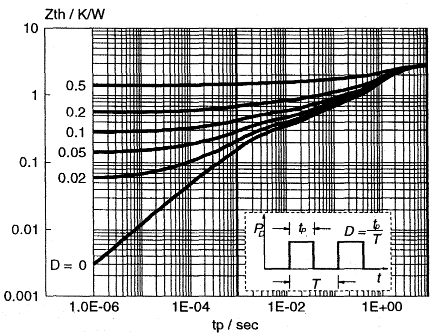


Fig.12. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

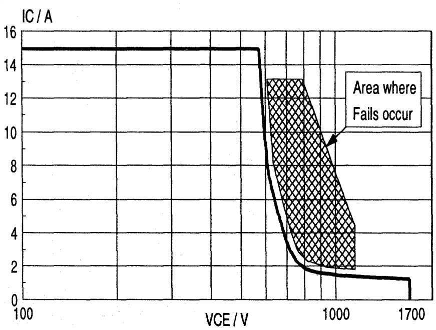


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

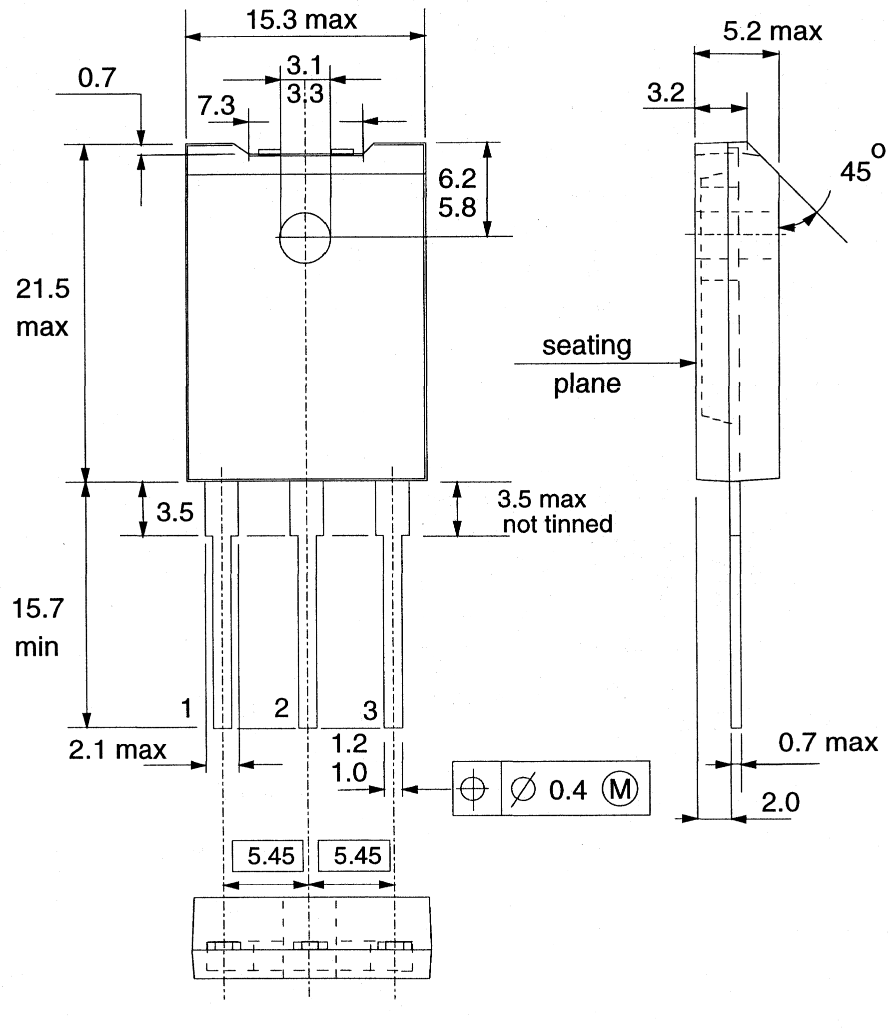


Fig.15. SOT199; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor BU2720AF

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of colour television receivers up to 16 kHz. Designed to withstand V_{CES} pulses up to 1700V.

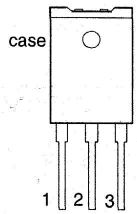
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.38 A	-	1.0	V
I_{Csat}	Collector saturation current		5.5	-	A
t_s	Storage time	I_{CM} = 5.5 A; $I_{B(end)}$ = 1.2 A	7.4	8.5	µs

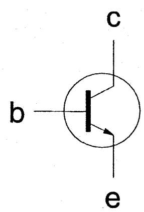
PINNING - SOT199

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-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	10	A
I_{BM}	Base current peak value		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	825	900	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.38 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.5 A; I_B = 1.38 A	0.82	0.9	1.0	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	12	22	35	
h_{FE}		I_C = 5.5 A; V_{CE} = 1 V	4	5.5	7.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (16 kHz line deflection circuit)	I_{CM} = 5.5 A; L_C = 750 µH; C_{fb} = 15.5 nF; V_{CC} = 125 V; $I_{B(end)}$ = 1.2 A; L_B = 6 µH; $-V_{BB}$ = 4 V; $-I_{BM}$ = I_{CM}/2;			
t_s	Turn-off storage time		7.4	8.5	µs
t_f	Turn-off fall time		0.7	0.9	µs

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

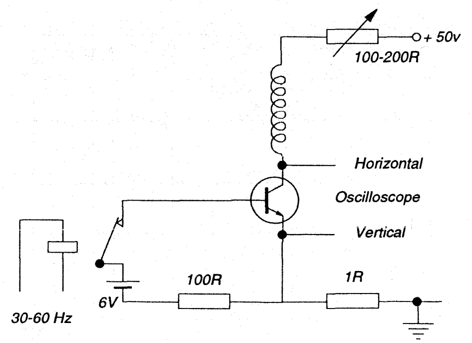


Fig.1. Test circuit for $V_{CEOsust}$.

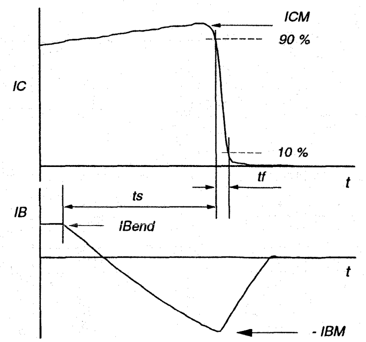


Fig.4. Switching times definitions.

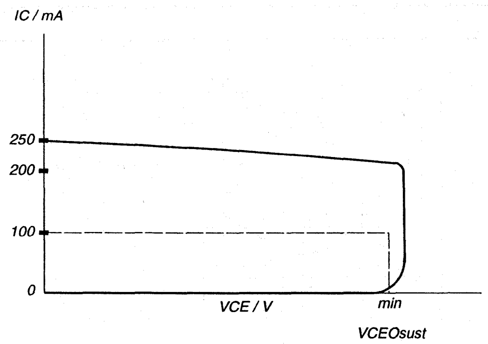


Fig.2. Oscilloscope display for $V_{CEOsust}$.

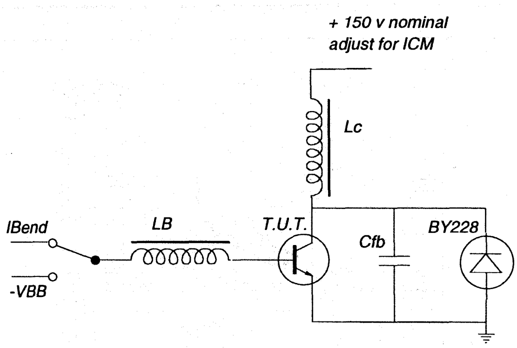


Fig.5. Switching times test circuit.

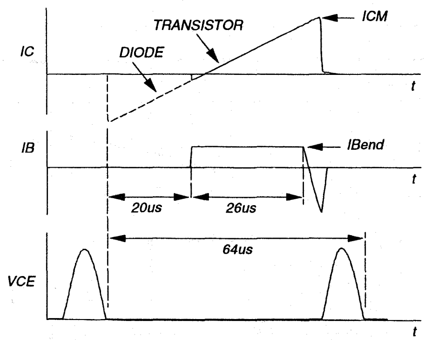


Fig.3. Switching times waveforms.

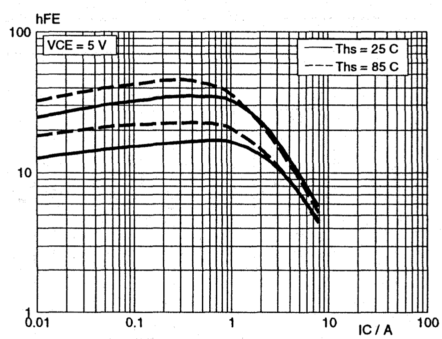


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

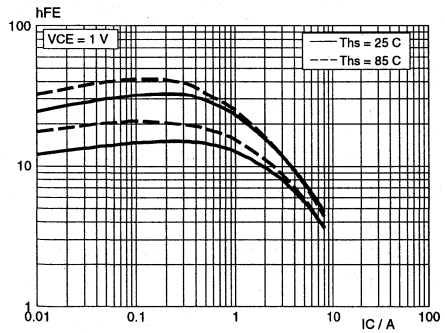


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

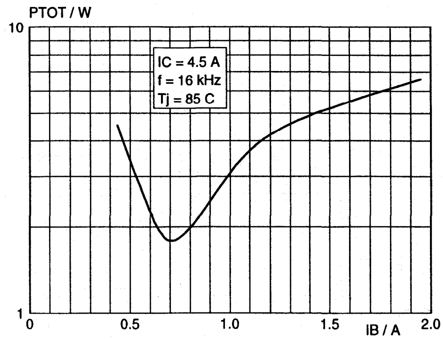


Fig.10. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.5\ A$; $f = 16\ kHz$

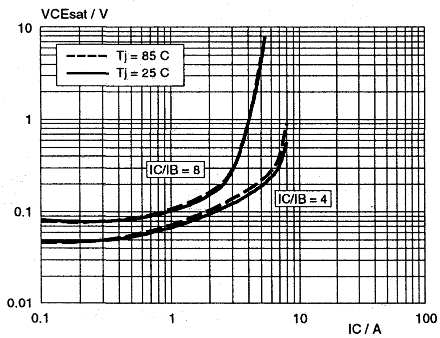


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

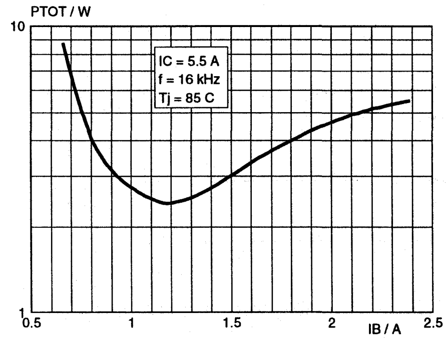


Fig.11. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 5.5\ A$; $f = 16\ kHz$

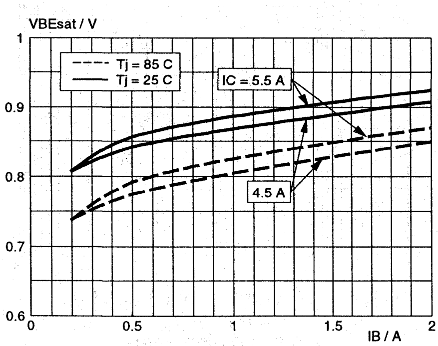


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

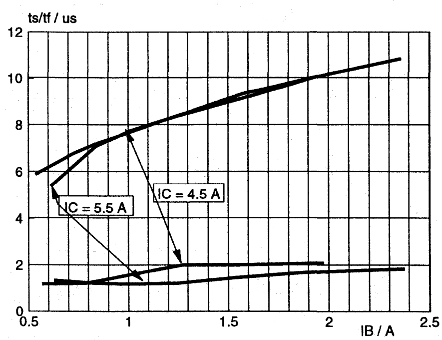


Fig.12. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; Parameter I_C; $T_j = 85^\circ C$; $f = 16\ kHz$

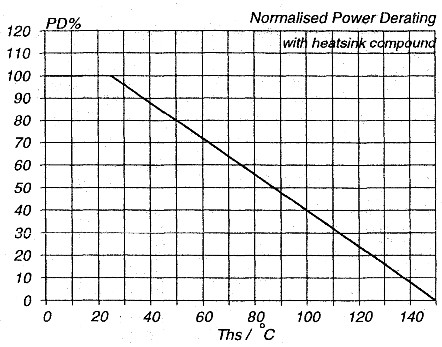


Fig.13. Normalised power dissipation. PD% = 100·PD/PD 25°C = f (T_{hs})

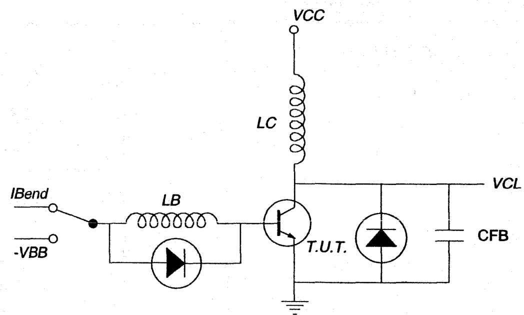


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

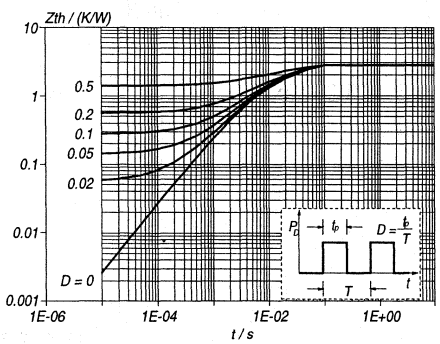


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

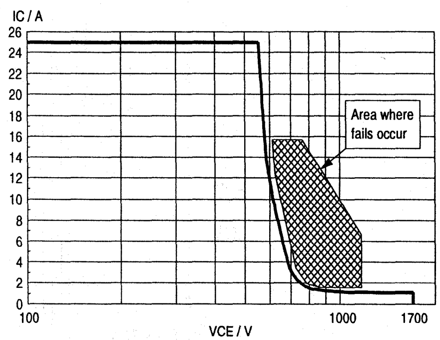


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

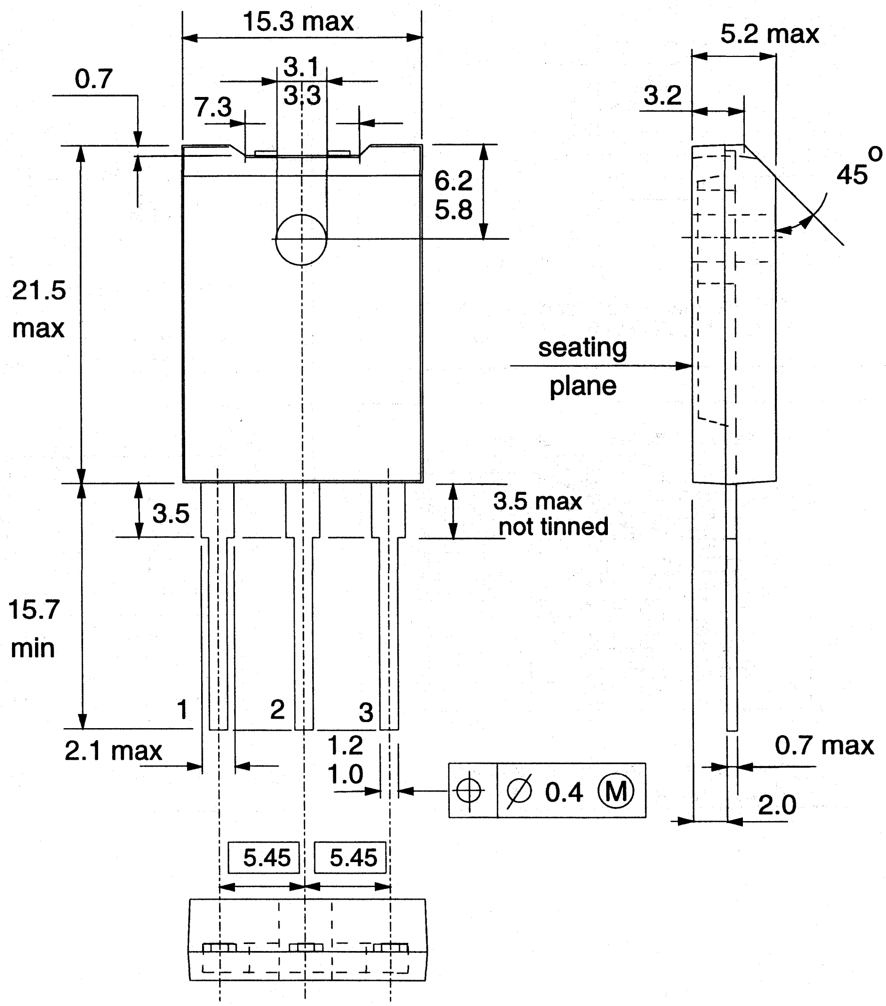


Fig.17. SOT199; The seating plane is electrically isolated from all terminals.

Notes

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

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistor with integrated damper diode in a plastic full-pack envelope. Intended for use in horizontal deflection circuits of colour television receivers up to 16 kHz. Designed to withstand V_{CES} pulses up to 1700V.

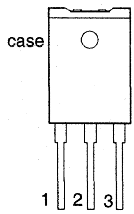
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.5$ A; $I_B = 1.38$ A	-	1.0	V
I_{Csat}	Collector saturation current		5.5	-	A
t_s	Storage time	$I_{CM} = 5.5$ A; $I_{B(end)} = 1.2$ A	7.4	8.5	µs

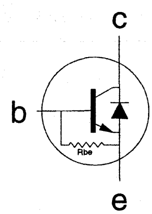
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	10	A
I_{BM}	Base current peak value		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	85	-	150	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{BE}	Base-emitter resistance	V_{EB} = 7.5 V		65		Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.38 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.5 A; I_B = 1.38 A	0.82	0.9	1.0	V
V_F	Diode forward voltage	I_F = 5.5 A		1.6		V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	14	19	26	
h_{FE}		I_C = 5.5 A; V_{CE} = 1 V	4	5.5	7.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (16 kHz line deflection circuit)	I_{CM} = 5.5 A; L_C = 750 µH; C_{fb} = 15.5 nF; V_{CC} = 125 V; $I_{B(end)}$ = 1.2 A; L_B = 6 µH; $-V_{BB}$ = 4 V; $-I_{BM}$ = I_{CM}/2			
t_s	Turn-off storage time		7.4	8.5	µs
t_f	Turn-off fall time		0.7	0.9	µs

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

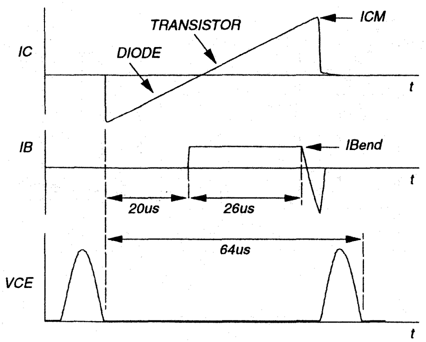


Fig.1. Switching times waveforms.

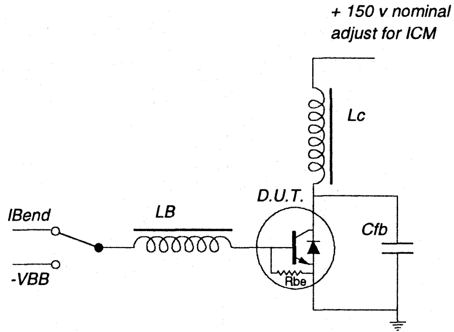


Fig.3. Switching times test circuit.

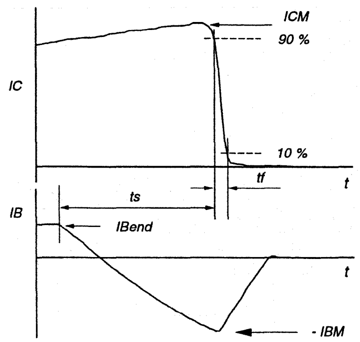


Fig.2. Switching times definitions.

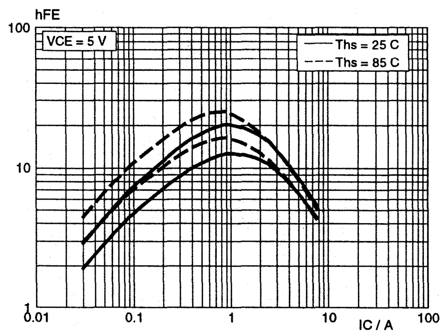


Fig.4. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

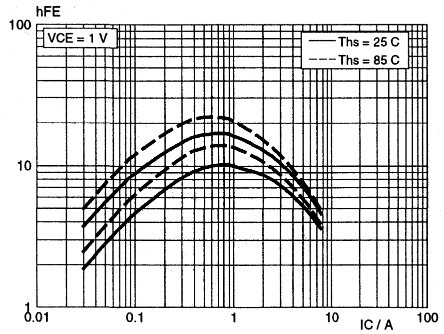


Fig.5. DC current gain. $h_{FE} = f (I_C)$
Parameter T_{hs}
(Low and high gain)

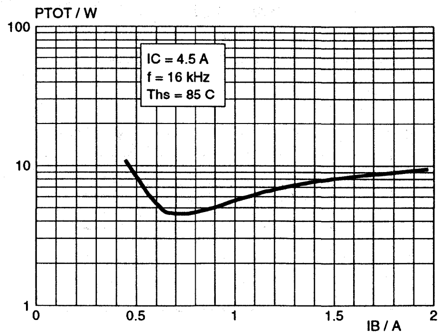


Fig.8. Limit P_{tot}; T_{hs} = 85˚C
$P_{tot} = f (I_{B(end)})$; I_C = 4.5 A; f = 16 kHz

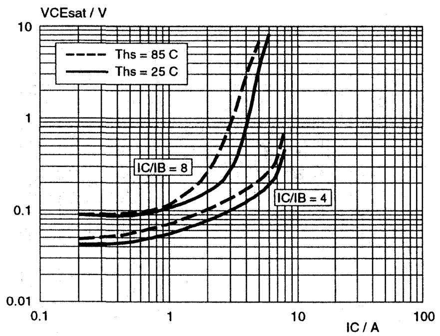


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f (I_C)$; parameter I_C/I_B

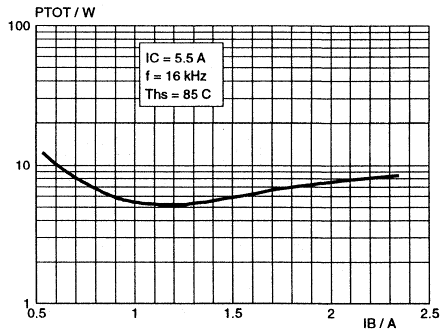


Fig.9. Limit P_{tot}; T_{hs} = 85˚C
$P_{tot} = f (I_{B(end)})$; I_C = 5.5 A; f = 16 kHz

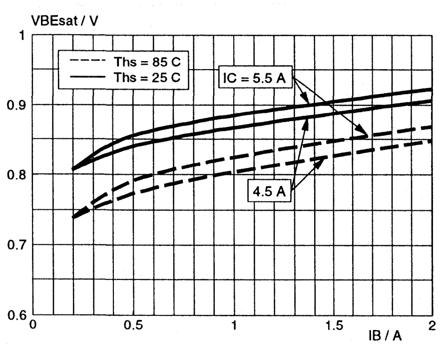


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f (I_B)$; parameter I_C

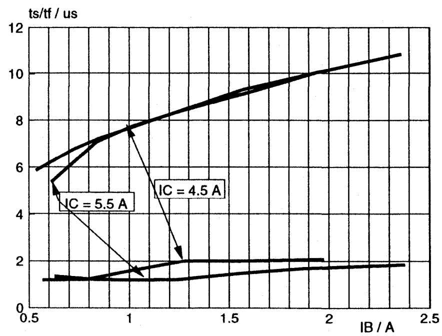


Fig.10. Limit storage and fall time.
$t_s = f (I_B)$; $tf = f (I_B)$; parameter I_C; T_{hs} = 85˚C; f = 16 kHz

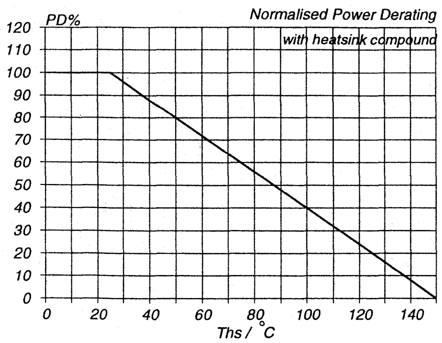


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{hs})$

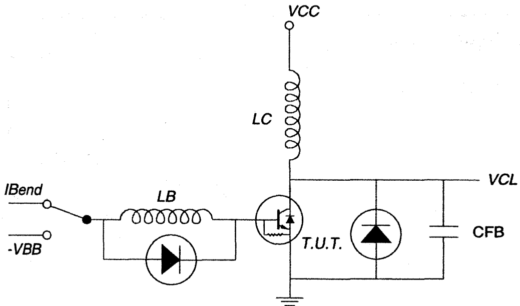


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 1.2 - 4 A

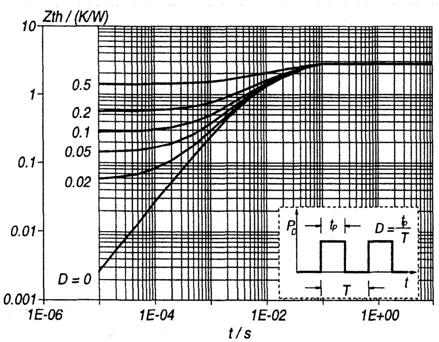


Fig.12. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

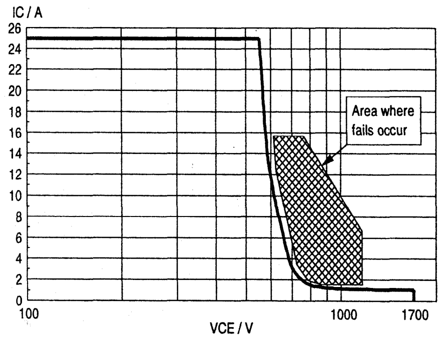


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

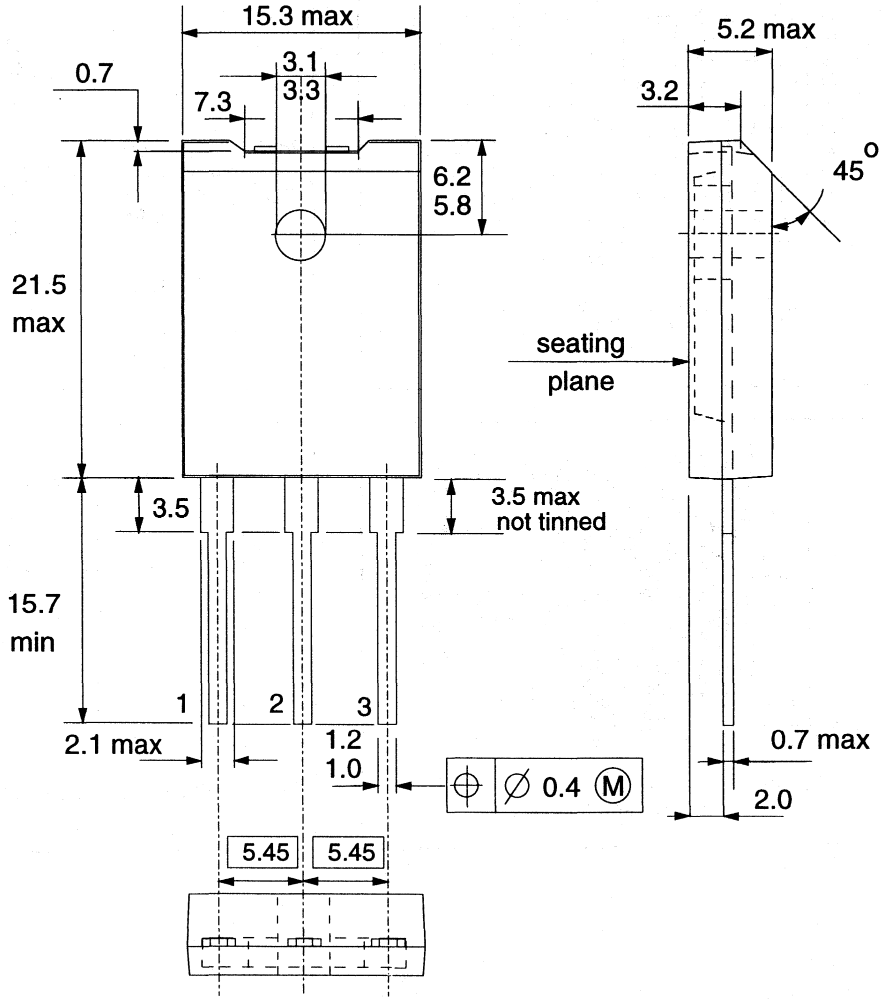


Fig.15. SOT199; The seating plane is electrically isolated from all terminals.

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

GENERAL DESCRIPTION

New generation, high-voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of high resolution monitors. Suitable for operation up to 64 kHz, designed to withstand V_{CES} pulses up to 1700 V.

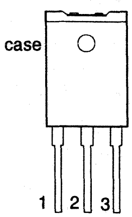
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 1.0 A	-	1.0	V
I_{Csat}	Collector saturation current		4.5	-	A
t_s	Storage time	I_{CM} = 4.5 A; $I_{B(end)}$ = 0.7 A	1.9	tbf	µs

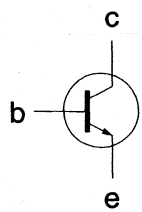
PINNING - SOT199

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-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	10	A
I_{CM}	Collector current peak value		-	25	A
I_B	Base current (DC)		-	10	A
I_{BM}	Base current peak value		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	150	mA
$-I_{BM}$	Reverse base current peak value [1]		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	825	900	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 1.0 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.0 A	0.79	0.87	0.96	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	12	22	35	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4.5	7	10	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{CM} = 4.5 A; L_C = 260 µH; C_{fb} = 4.8 nF; V_{CC} = 160 V; $I_{B(end)}$ = 0.7 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V;			
t_s	Turn-off storage time		1.9	tbf	µs
t_f	Turn-off fall time		tbf	tbf	µs

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

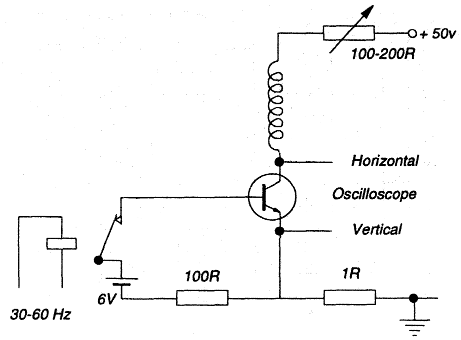


Fig.1. Test circuit for $V_{CEOsust}$.

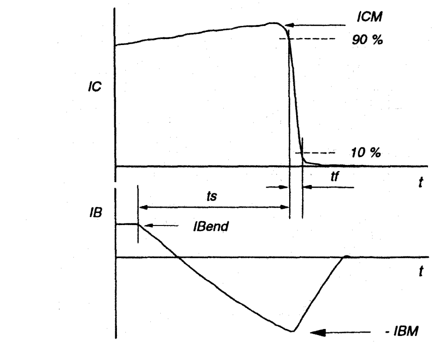


Fig.4. Switching times definitions.

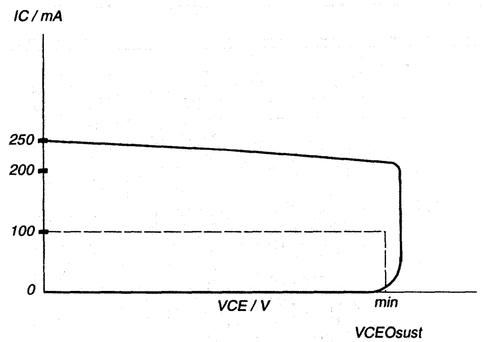


Fig.2. Oscilloscope display for $V_{CEOsust}$.

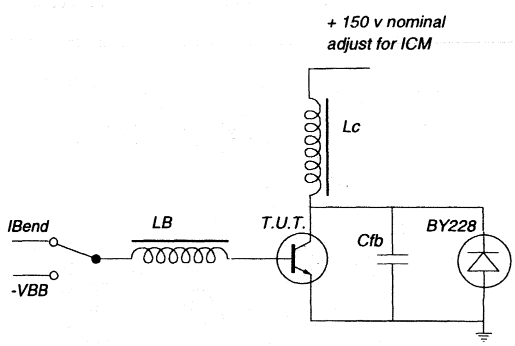


Fig.5. Switching times test circuit.

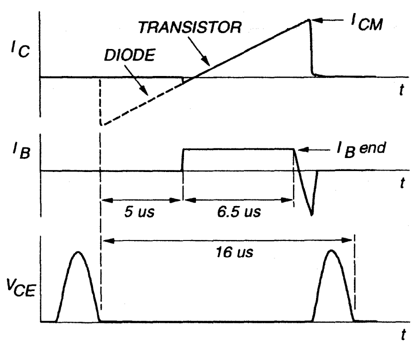


Fig.3. Switching times waveforms (64 kHz).

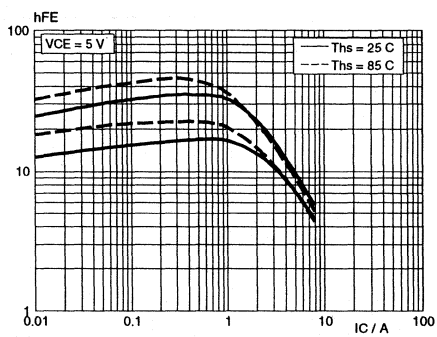


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

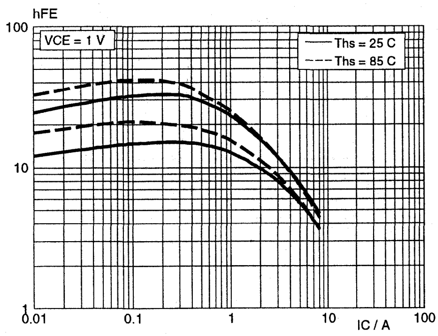


Fig.7. DC current gain. $h_{FE} = f\,(I_C)$
Parameter T_{hs}
(Low and high gain)

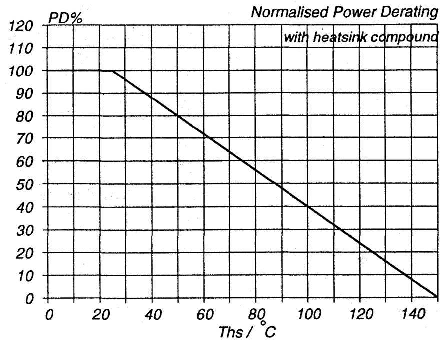


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f\,(T_{hs})$

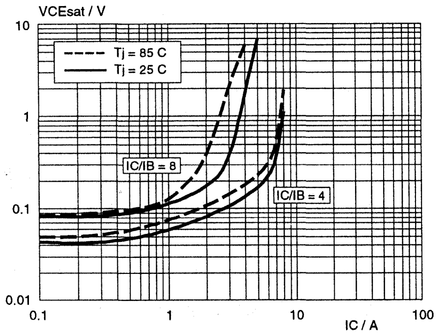


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\,(I_C)$; parameter I_C/I_B

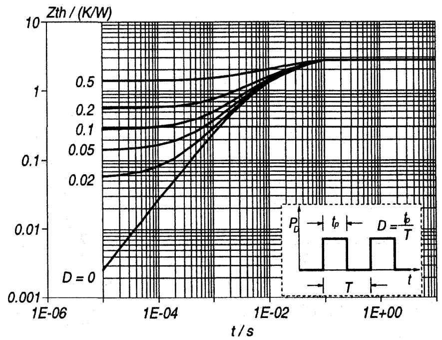


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

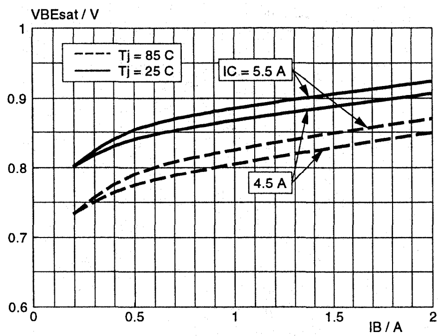


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\,(I_B)$; parameter I_C

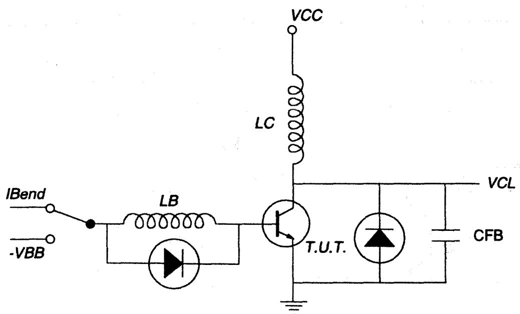


Fig.12. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 μH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

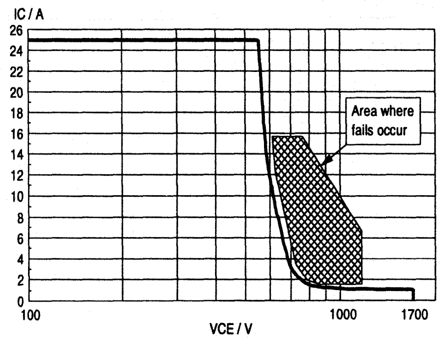


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

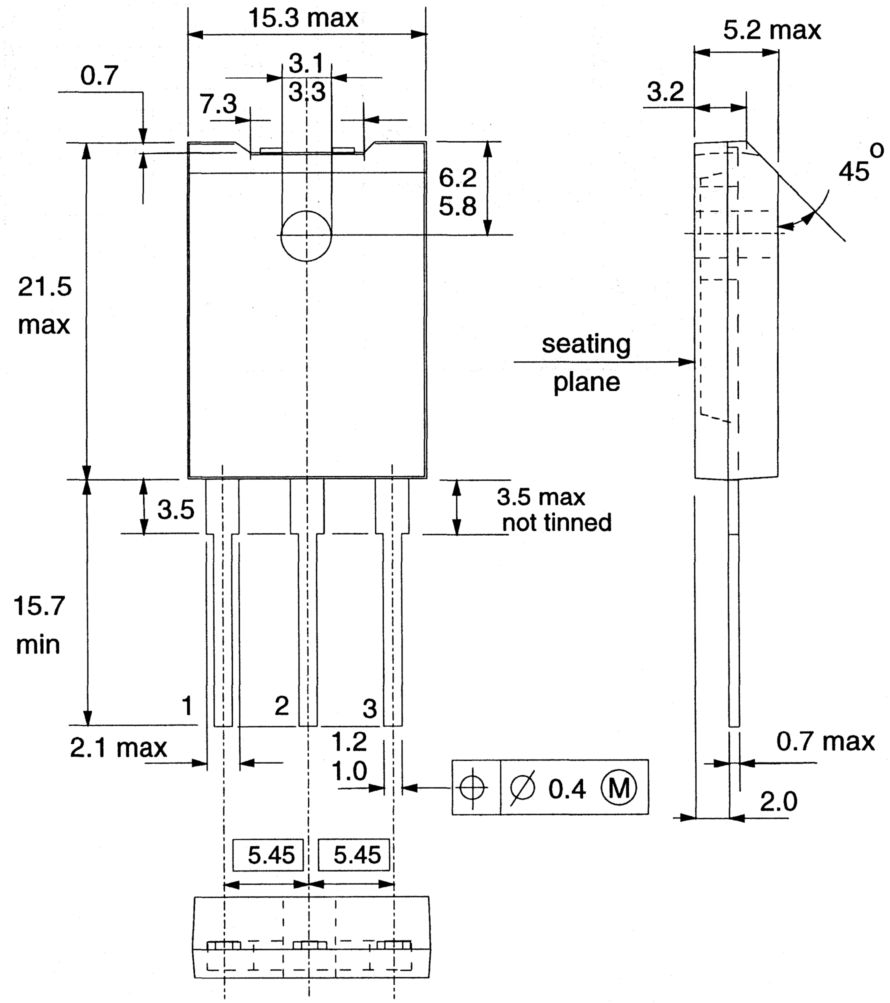


Fig.14. SOT199; The seating plane is electrically isolated from all terminals.

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

Silicon Diffused Power Transistor | BU2727A

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistor in a plastic envelope intended for use in horizontal deflection circuits of high resolution monitors, suitable for operation up to 64 kHz. Designed to withstand V_{CES} pulses up to 1700V.

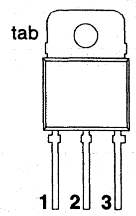
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ °C	-	125	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.0$ A; $I_B = 0.91$ A	-	1.0	V
I_{Csat}	Collector saturation current		5.0	-	A
t_s	Storage time	$I_{CM} = 5.0$ A; $I_{B(end)} = 0.9$ A	2.2	tbf	µs

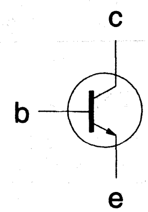
PINNING - SOT93

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	12	A
I_{BM}	Base current peak value		-	25	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	25	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ °C	-	125	W
T_{stg}	Storage temperature		-65	150	°C
T_j	Junction temperature		-	150	°C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

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	45	-	K/W

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	825	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.0 A; I_B = 0.91 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.0 A; I_B = 0.91 A	0.78	0.86	0.95	V
h_{FE}	DC current gain	I_C = 0.1 A; V_{CE} = 5 V	12	22	35	
h_{FE}		I_C = 5 A; V_{CE} = 1 V	5.5	8	11	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{CM} = 5.0 A; L_C = 260 µH; C_{fb} = 4.8 nF; V_{CC} = 180 V; $I_{B(end)}$ = 0.9 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A/µs)			
t_s	Turn-off storage time		2.2	tbf	µs
t_f	Turn-off fall time		tbf	tbf	µs

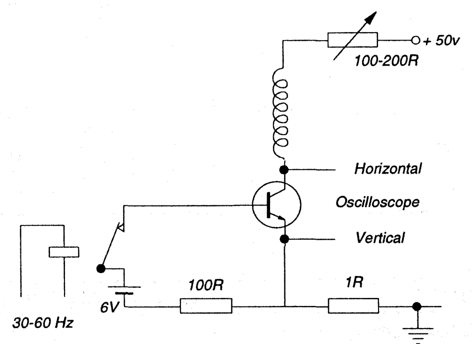


Fig.1. Test circuit for $V_{CEOsust}$.

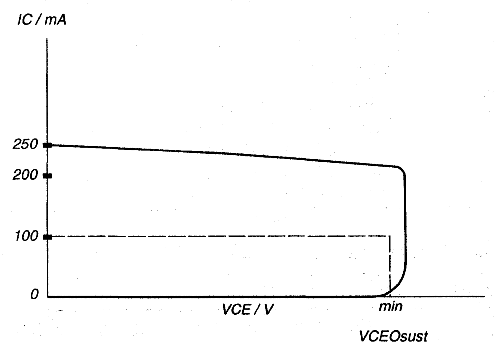


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

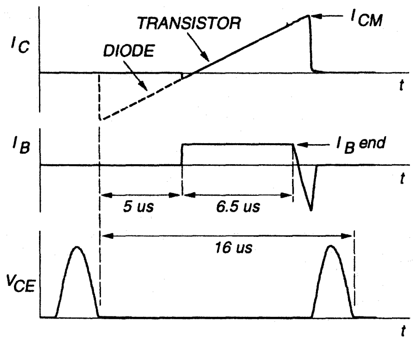


Fig.3. Switching times waveforms (64 kHz).

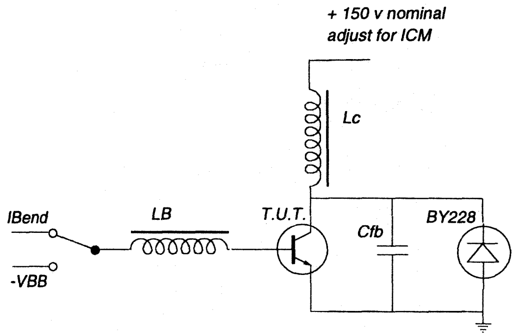


Fig.5. Switching times test circuit.

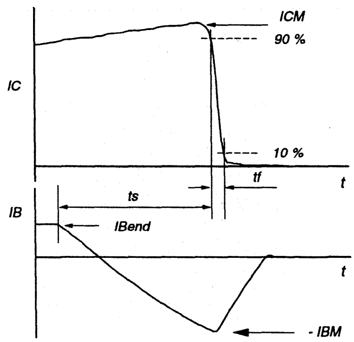


Fig.4. Switching times definitions.

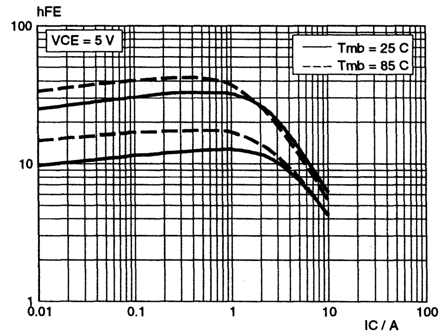


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{mb}
(Low and high gain)

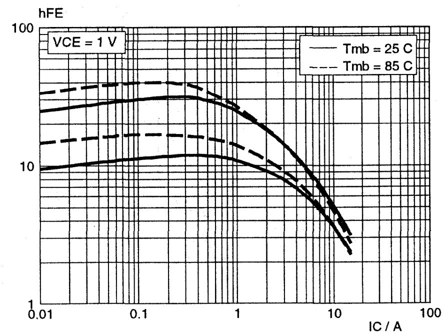


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{mb}
(Low and high gain)

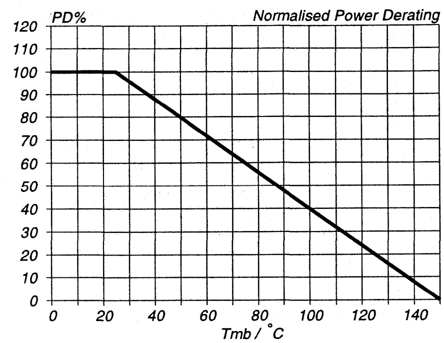


Fig.10. Normalised power dissipation.
PD% = 100·PD/PD 25˚C = f (T_{mb})

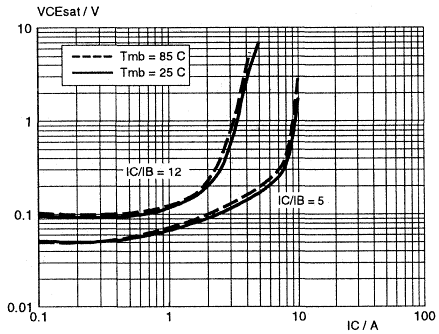


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

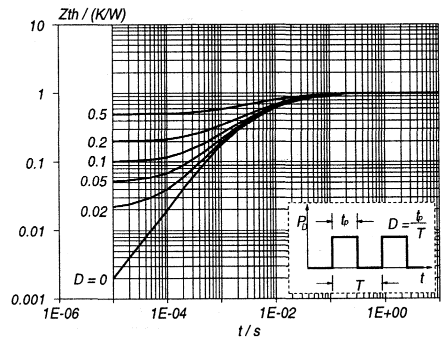


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

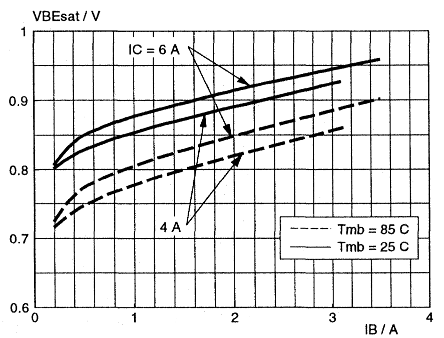


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

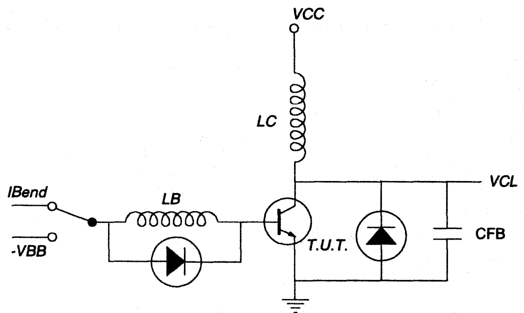


Fig.12. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 µH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

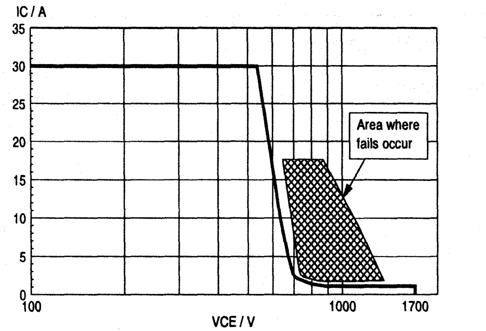


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5 g

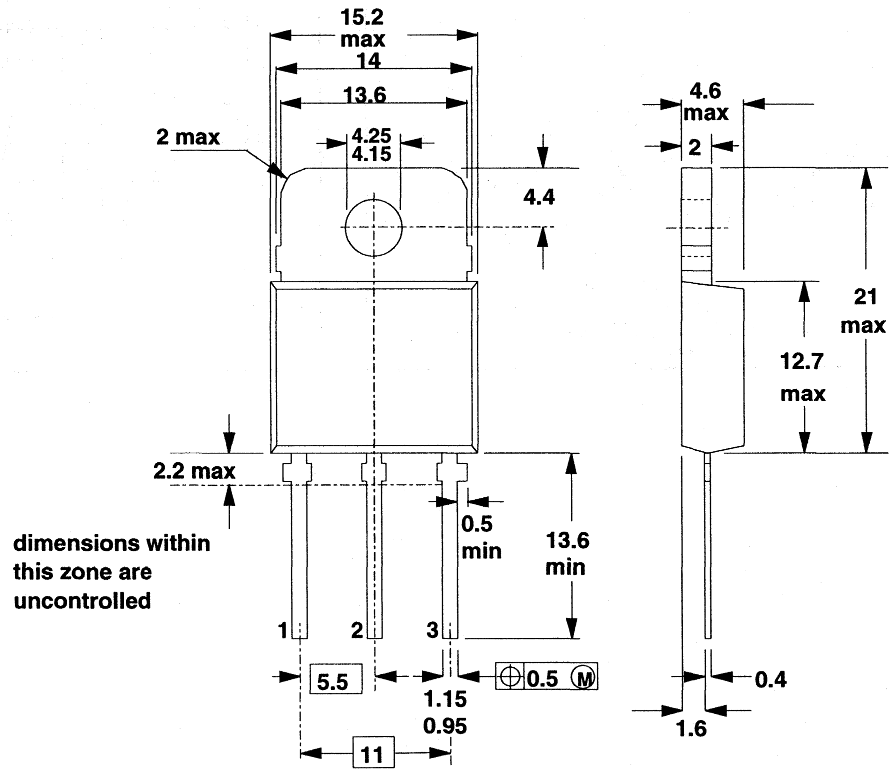


Fig.14. SOT93; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT93 envelope.
2. Epoxy meets UL94 V0 at 1/8".

Silicon Diffused Power Transistor BU2727AF

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistor in a plastic full-pack envelope intended for use in horizontal deflection circuits of high resolution monitors, suitable for operation up to 64 kHz. Designed to withstand V_{CES} pulses up to 1700V.

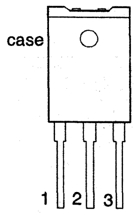
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.0$ A; $I_B = 0.91$ A	-	1.0	V
I_{Csat}	Collector saturation current		5.0	-	A
t_s	Storage time	$I_{CM} = 5.0$ A; $I_{B(end)} = 0.9$ A	2.2	tbf	µs

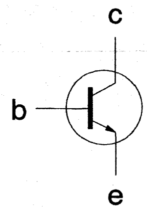
PINNING - SOT199

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	12	A
I_{BM}	Base current peak value		-	25	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	25	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

ESD LIMITING VALUES

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_C	Electrostatic discharge capacitor voltage	Human body model (250 pF, 1.5 kΩ)	-	10	kV

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-hs}$	Junction to heatsink	without heatsink compound	-	3.7	K/W
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	2.8	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	35	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚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. ≤ 65 % ; clean and dustfree	-		2500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	22	-	pF

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	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} = 7.5 V; I_C = 0 A	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	825	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.0 A; I_B = 0.91 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.0 A; I_B = 0.91 A	0.78	0.86	0.95	V
h_{FE}	DC current gain	I_C = 0.1 A; V_{CE} = 5 V	12	22	35	
h_{FE}		I_C = 5 A; V_{CE} = 1 V	5.5	8	11	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{CM} = 5.0 A; L_C = 260 µH; C_{fb} = 4.8 nF; V_{CC} = 180 V; $I_{B(end)}$ = 0.9 A; L_B = 0.6 µH; $-V_{BB}$ = 2 V; ($-dI_B/dt$ = 3.33 A/µs)			
t_s	Turn-off storage time		2.2	tbf	µs
t_f	Turn-off fall time		tbf	tbf	µs

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

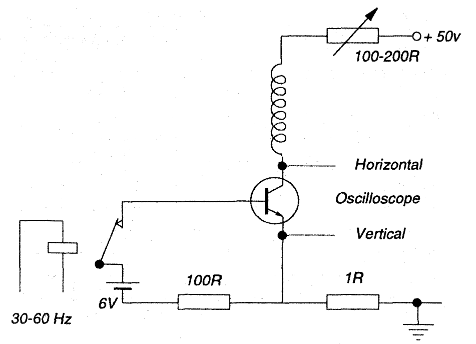


Fig.1. Test circuit for $V_{CEOsust}$.

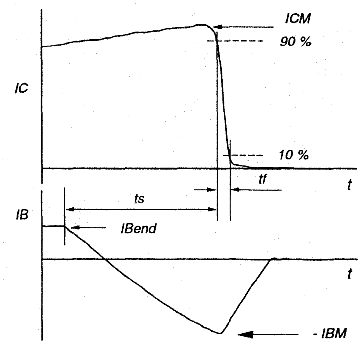


Fig.4. Switching times definitions.

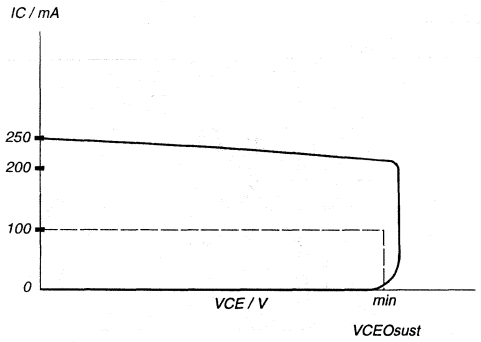


Fig.2. Oscilloscope display for $V_{CEOsust}$.

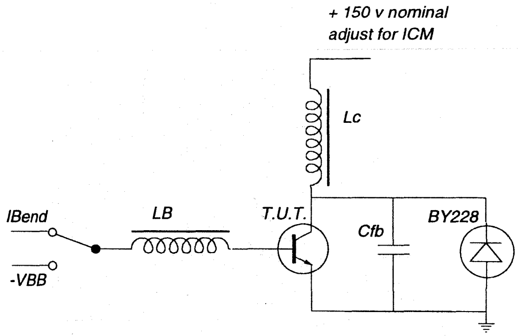


Fig.5. Switching times test circuit.

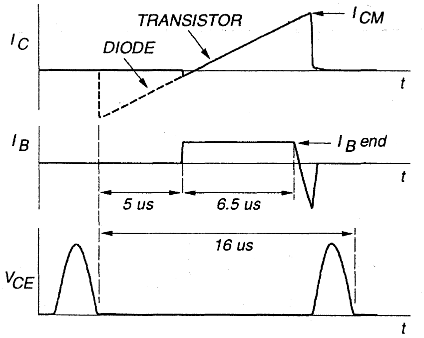


Fig.3. Switching times waveforms (64 kHz).

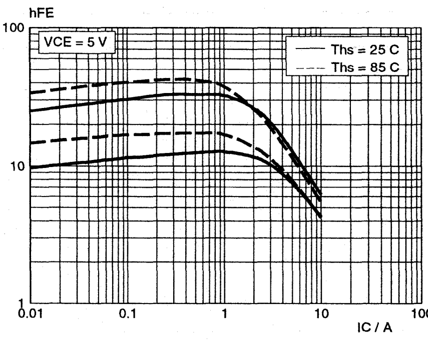


Fig.6. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

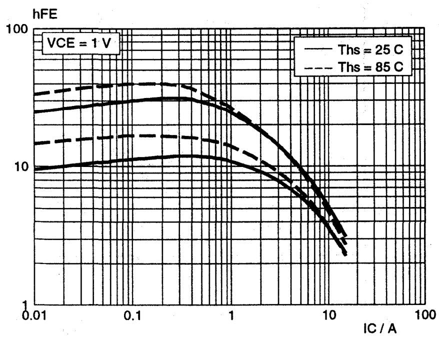


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

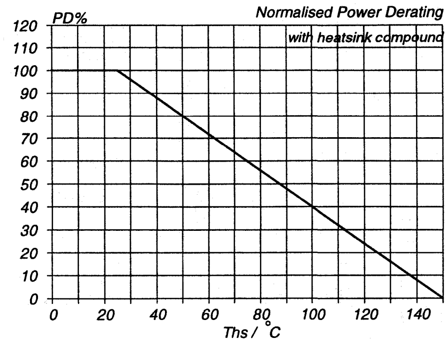


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f\ (T_{hs})$

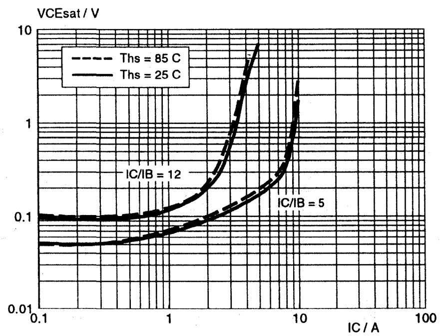


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

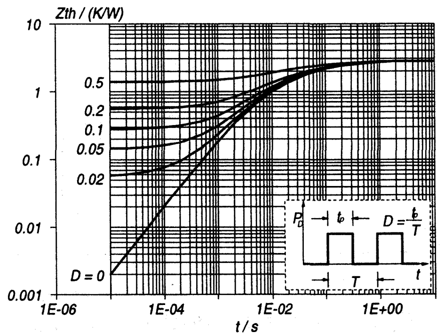


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

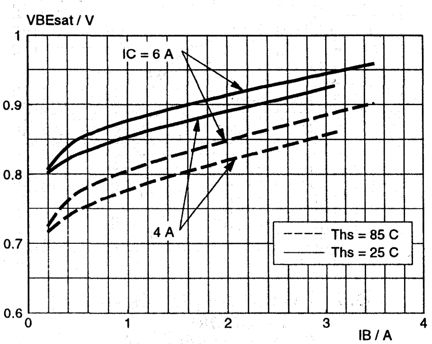


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

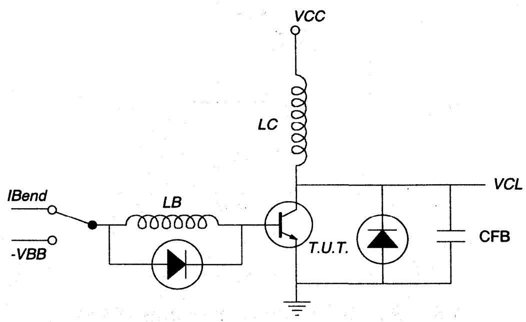


Fig.12. Test Circuit RBSOA.
$V_{CC} = 150$ V; $-V_{BB} = 1 - 4$ V;
$L_C = 1$ mH; $V_{CL} = 1500$ V; $L_B = 0.5 - 2\ \mu$H;
$C_{FB} = 1 - 3$ nF; $I_{B(end)} = 0.8 - 4$ A

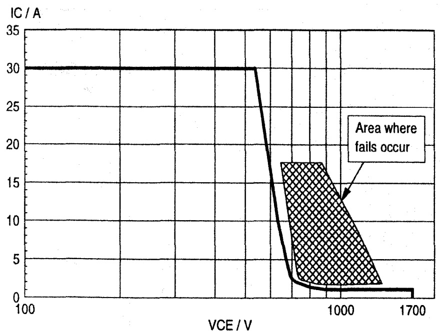


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

MECHANICAL DATA

Dimensions in mm

Net Mass: 5.5 g

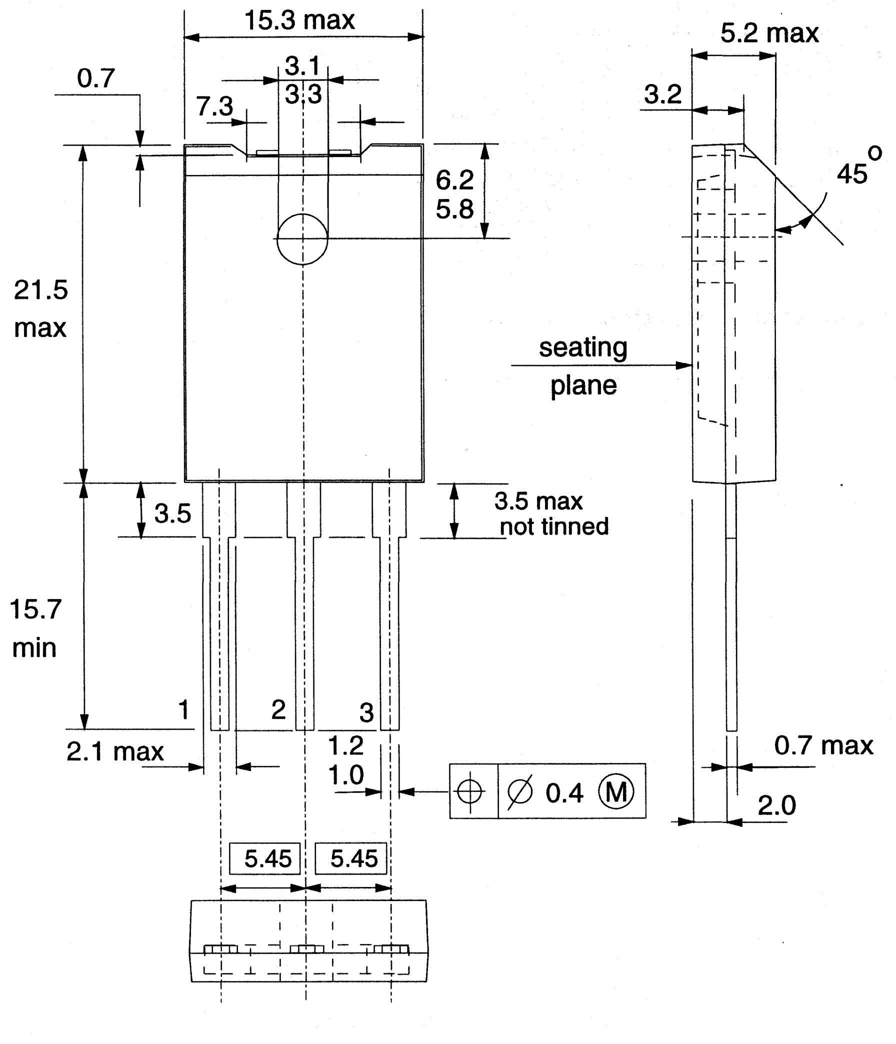


Fig.14. SOT199; The seating plane is electrically isolated from all terminals.

Notes

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

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in a TO-220 envelope, intended for use in converters, inverters, switching regulators, motor control systems etc.

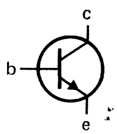
QUICK REFERENCE DATA

			BUT11	BUT11A	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1,5		V
Collector current (DC)	I_C	max.	5		A
Collector current (peak value)	I_{CM}	max.	10		A
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	100		W
Fall time	t_f	max.	0,8		μs

MECHANICAL DATA

Dimensions in mm

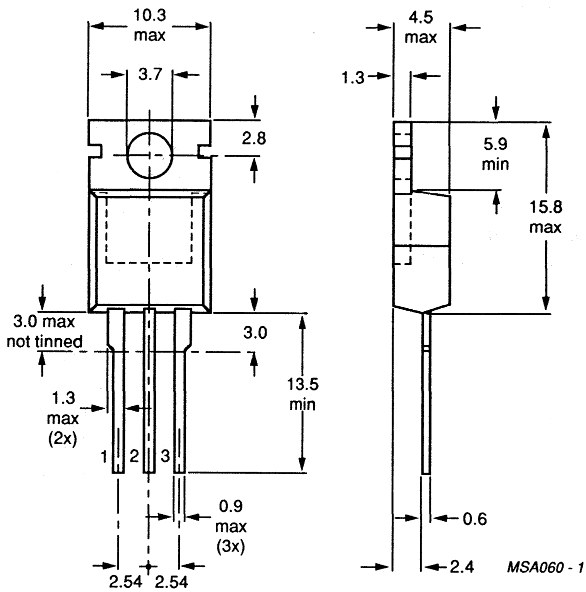
Fig. 1 TO-220AB.



Pinning;

1 = base
2 = collector
3 = emitter

Collector mounted to mounting base.



RATINGS

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

			BUT11	BUT11A	
Collector-emitter voltage (peak value, $V_{BE} = 0$)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector current (DC)	I_C	max.	5		A
Collector current (peak value) $t_p < 2$ ms	I_{CM}	max.	10		A
Base current (DC)	I_B	max.	2		A
Base current (peak value); $t_p < 2$ ms	I_{BM}	max.	4		A
Total power dissipation up to $T_{mb} = 25$ °C	P_{tot}	max.	100		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,25	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

			BUT11	BUT11A	
Collector cut-off current *					
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1		mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C	I_{CES}	max.	2		mA
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 9$ V	I_{EBO}	max.	10		mA
Saturation voltages					
$I_C = 3$ A; $I_B = 0,6$ A	V_{CEsat}	max.	1,5	–	V
	V_{BEsat}	max.	1,3	–	V
$I_C = 2,5$ A; $I_B = 0,5$ A	V_{CEsat}	max.	–	1,5	V
	V_{BEsat}	max.	–	1,3	V
Collector-emitter sustaining voltage					
$I_C = 100$ mA; $I_{Boff} = 0$; $L = 25$ mH	$V_{CEOsust}$	min.	400	450	V
DC current gain					
$I_C = 5$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
$I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		

* Measured with a half-sinewave voltage (curve tracer).

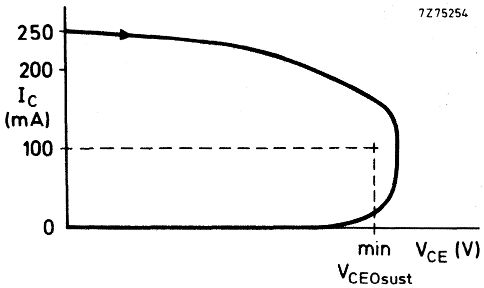


Fig. 2 Oscilloscope display for sustaining voltage.

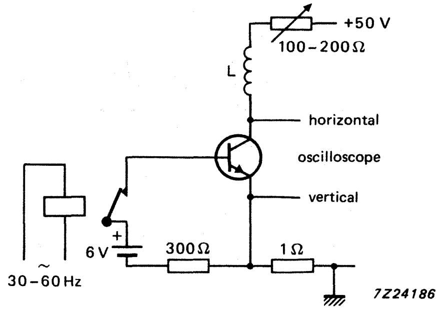
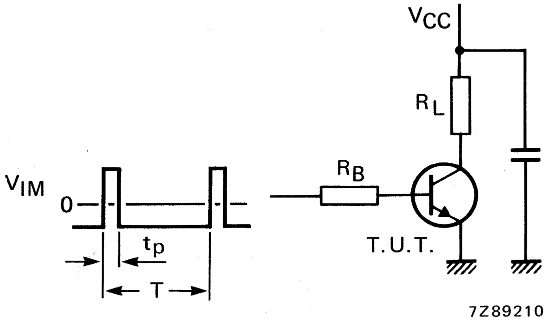


Fig. 3 Test circuit for $V_{CEOsust}$.

			BUT11	BUT11A	
Switching times resistive load (Figs 4 and 5)					
I_{Con} = 3 A; I_{Bon} = $-I_{Boff}$ = 0,6 A					
Turn-on time	t_{on}	max.	1	—	μs
Turn-off: Storage time	t_s	max.	4	—	μs
Fall time	t_f	max.	0,8	—	μs
I_{Con} = 2,5 A; I_{Bon} = $-I_{Boff}$ = 0,5 A					
Turn-on time	t_{on}	max.	—	1	μs
Turn-off: Storage time	t_s	max.	—	4	μs
Fall time	t_f	max.	—	0,8	μs
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 3 A; I_B = 0,6 A					
Turn-off: Storage time	t_s	typ.	1,1	—	μs
		max.	1,4	—	μs
Fall time	t_f	typ.	80	—	ns
		max.	150	—	ns
I_{Con} = 3 A; I_B = 0,6 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	1,2	—	μs
		max.	1,5	—	μs
Fall time	t_f	typ.	140	—	ns
		max.	300	—	ns
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 2,5 A; I_B = 0,5 A					
Turn-off: Storage time	t_s	typ.	—	1,1	μs
		max.	—	1,4	μs
Fall time	t_f	typ.	—	80	ns
		max.	—	150	ns
I_{Con} = 2,5 A; I_B = 0,5 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	—	1,2	μs
		max.	—	1,5	μs
Fall time	t_f	typ.	—	140	ns
		max.	—	300	ns



V_{CC} = 250 V
V_{IM} = −6 to +8 V
$\frac{t_p}{T}$ = 0,01
t_p = 20 μs

The values of R_B and R_L are selected in accordance with I_{Con} and I_B requirements.

Fig. 4 Test circuit resistive load.

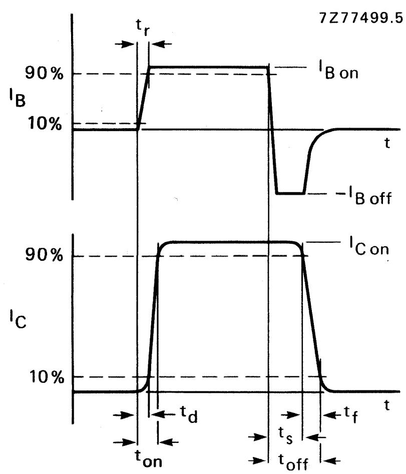


Fig. 5 Switching times waveforms with resistive load.

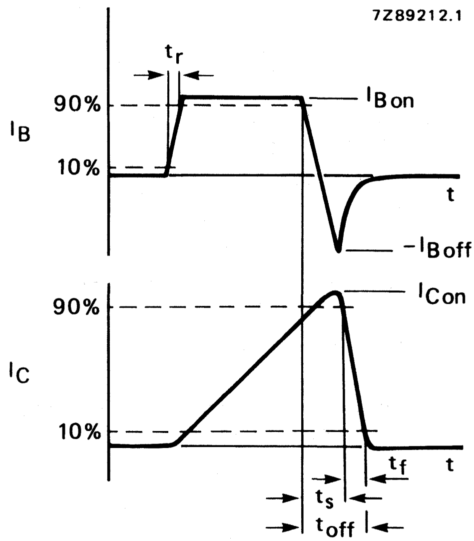
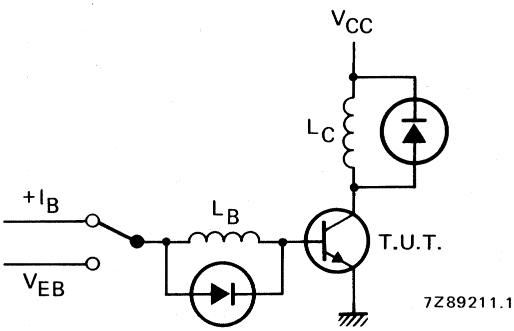
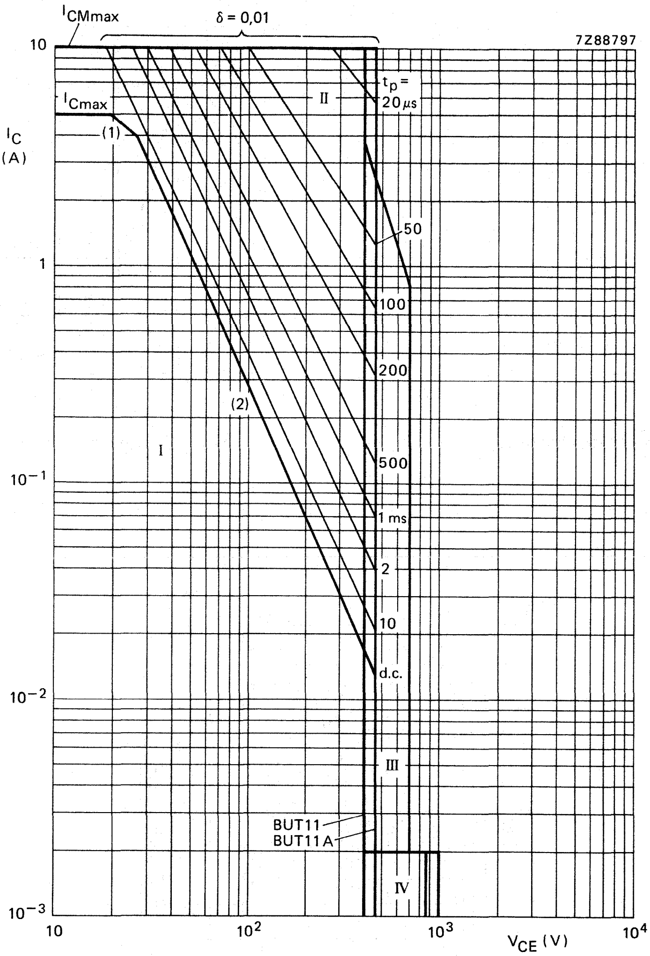


Fig. 6 Switching times waveforms with inductive load.



V_{CC} = 300 V
V_{EB} = 5 V
L_B = 1 μH

Fig. 7 Test circuit inductive load.



(1) $P_{tot\,max}$ and $P_{tot\,peak}$ max. lines.
(2) Second-breakdown limits

I Region of permissible DC operation
II Permissible extension for repetitive pulse operation
III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$.
IV Repetitive pulse operation in this region is permissible provided $V_{BE} \leqslant 0$ and $t_p \leqslant 5$ ms.

Fig. 8 Safe operating area at $T_{mb} \leqslant 25\ ^oC$.

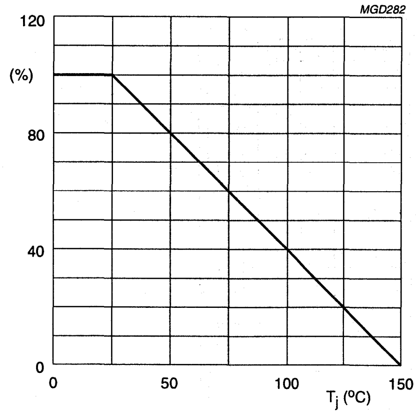


Fig. 9 Total power dissipation.

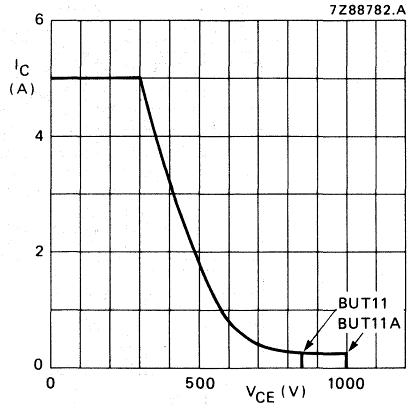


Fig. 10 Reverse bias SOAR.

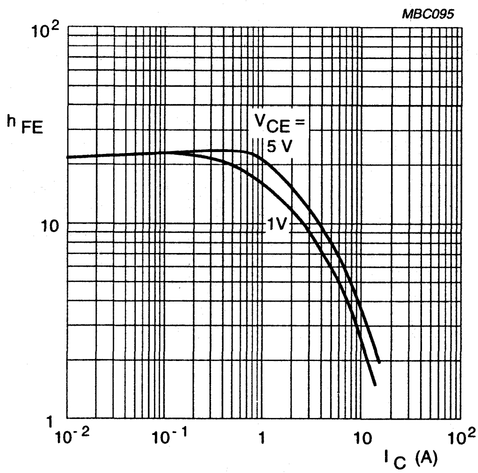


Fig.11 Typical DC current gain.

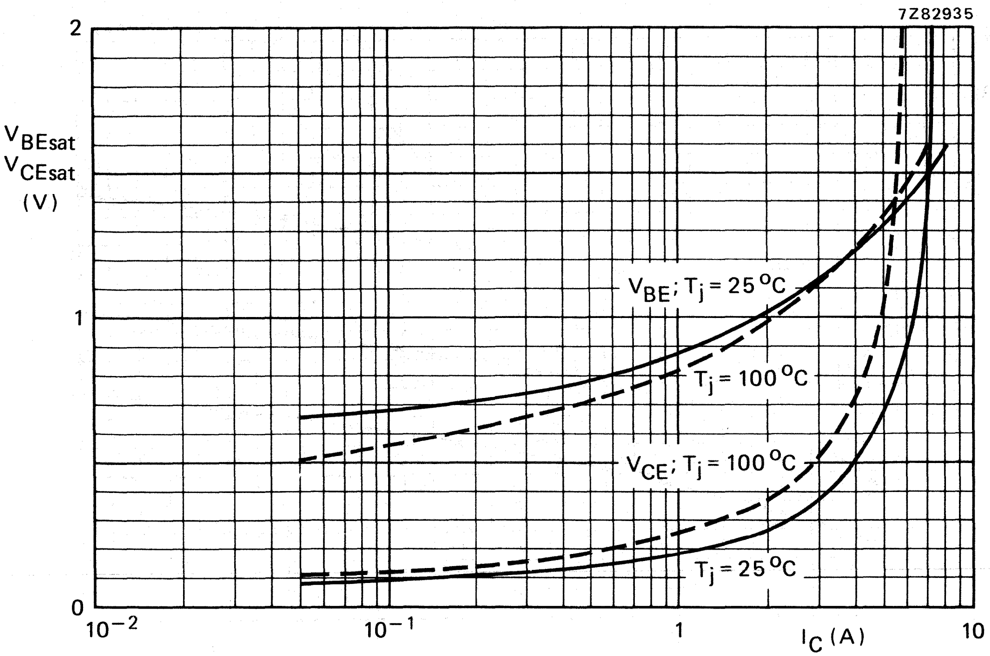


Fig. 12 Typical values base-emitter and collector-emitter voltage, $I_C/I_B = 5$.

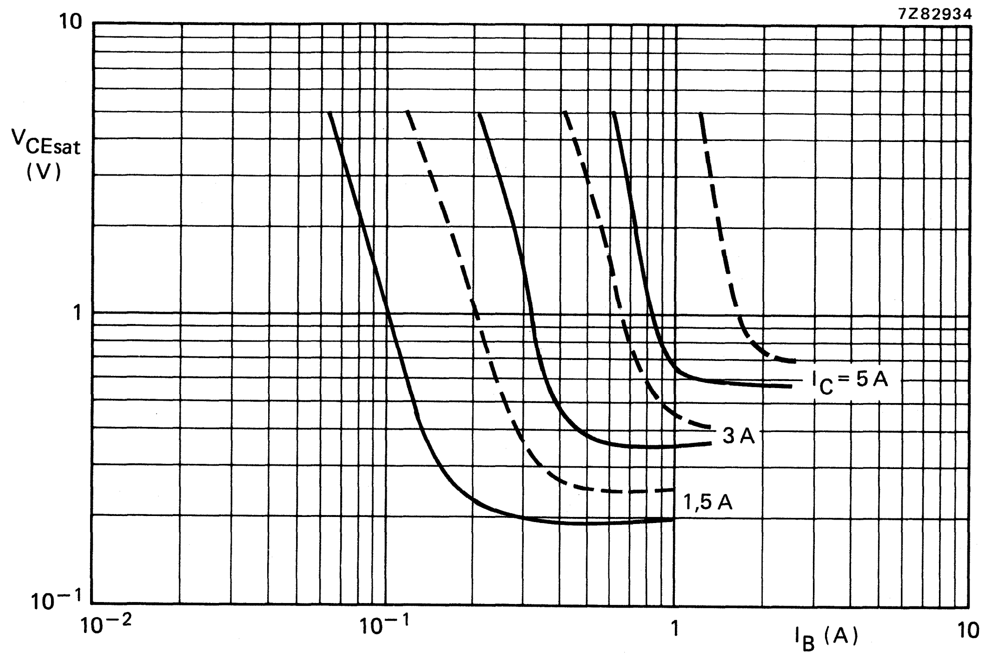


Fig. 13 Typ. (——) and max. (– – –) values collector-emitter saturation voltage at T_j = 25 °C.

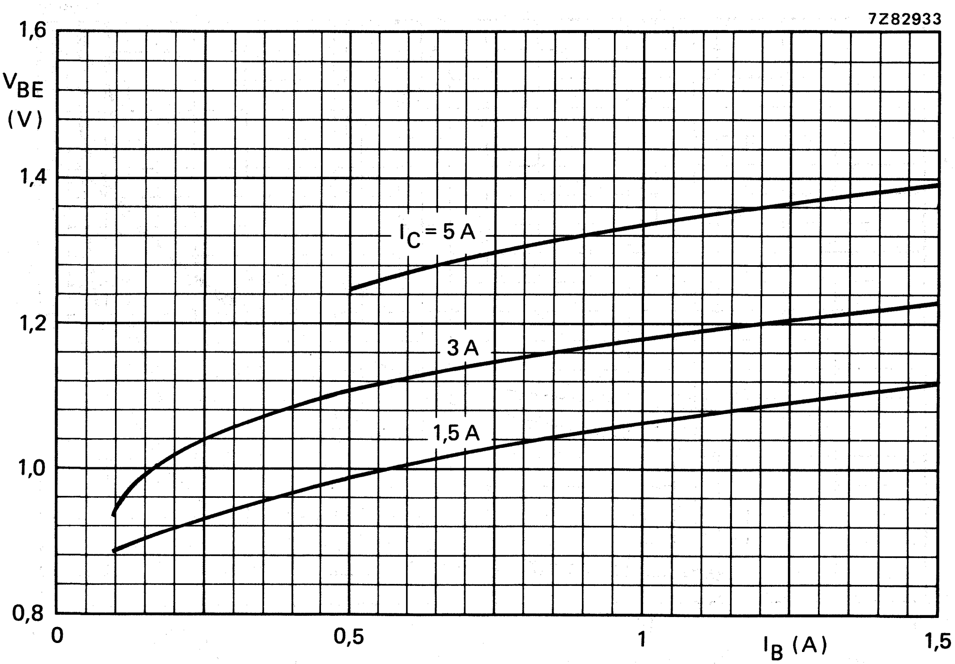


Fig. 14 Typical values at T_j = 25 °C.

Silicon Diffused Power Transistor BUT11AX

GENERAL DESCRIPTION

High-voltage, high-speed glass-passivated npn power transistor in a plastic full-pack envelope intended for use in converters, inverters, switching regulators, motor control systems, etc.

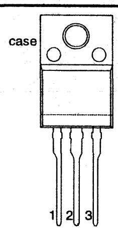
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	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		2.5	-	A
t_f	Fall time		150	-	ns

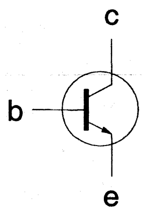
PINNING - SOT186A

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-emitter voltage peak value	V_{BE} = 0 V	-	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
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
$R_{th\ j-hs}$	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 & 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 = 2.5 A; I_B = 0.5 A	-	-	1.5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 2.5 A; I_B = 0.5 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 5 V	10	18	35	
h_{FE}		I_C = 500 mA; V_{CE} = 5 V	10	20	35	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 2.5 A; I_{Bon} = -I_{Boff} = 0.5 A			
t_{on}	Turn-on time		0.6	-	µs
t_s	Turn-off storage time		3.5	-	µs
t_f	Turn-off fall time		0.6	-	µs
	Switching times (inductive load)	I_{Con} = 2.5 A; I_{Bon} = 0.5 A; L_B = 1 µH; -V_{BB} = 5 V			
t_s	Turn-off storage time		1.5	-	µs
t_f	Turn-off fall time		150	-	ns
	Switching times (inductive load)	I_{Con} = 2.5 A; I_{Bon} = 0.5 A; L_B = 1 µH; -V_{BB} = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		1.8	-	µs
t_f	Turn-off fall time		170	-	ns

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

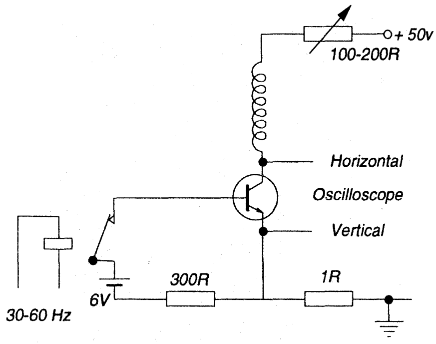


Fig.1. Test circuit for $V_{CEOsust}$.

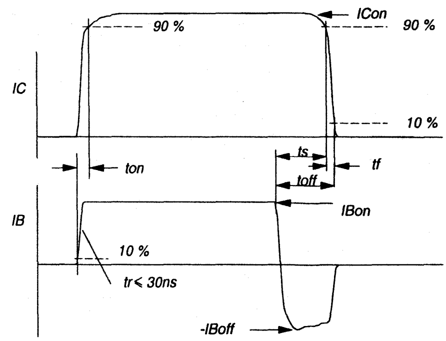


Fig.4. Switching times waveforms with resistive load.

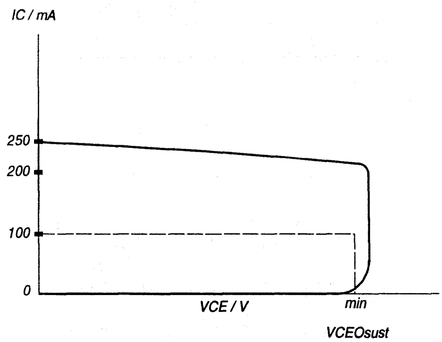


Fig.2. Oscilloscope display for $V_{CEOsust}$.

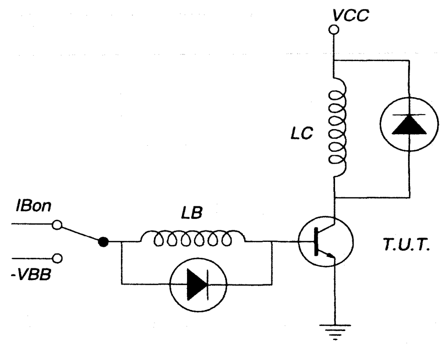


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V; L_C = 200 uH; L_B = 1 uH

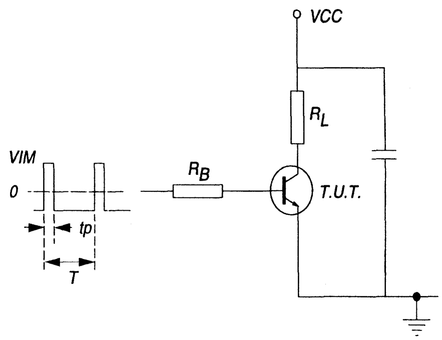


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; $\delta = t_p / T = 0.01$.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

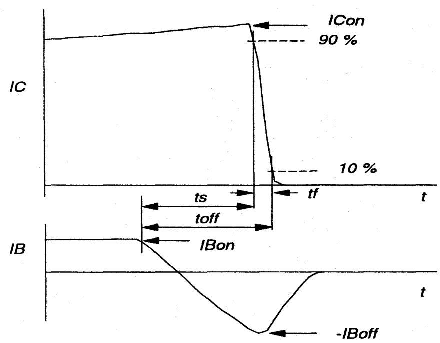


Fig.6. Switching times waveforms with inductive load.

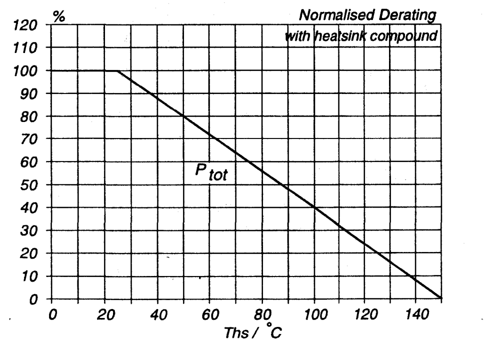


Fig.7. Normalised power derating and second breakdown curves.

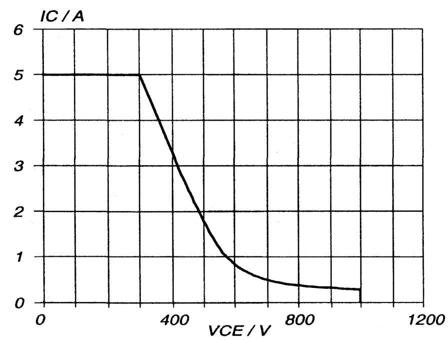


Fig.8. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

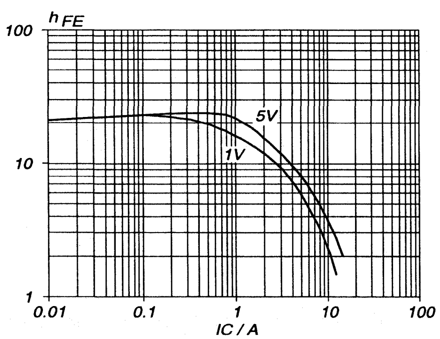


Fig.9. Typical DC current gain. $h_{FE} = f(I_C)$; parameter V_{CE}

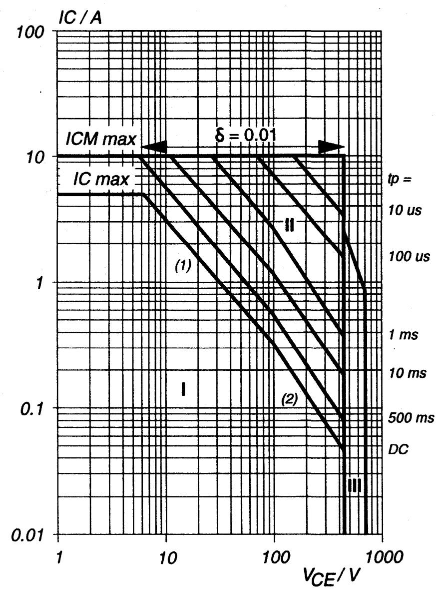


Fig.10. Forward bias safe operating area. $T_{hs} \leq 25$ ˚C

- (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.

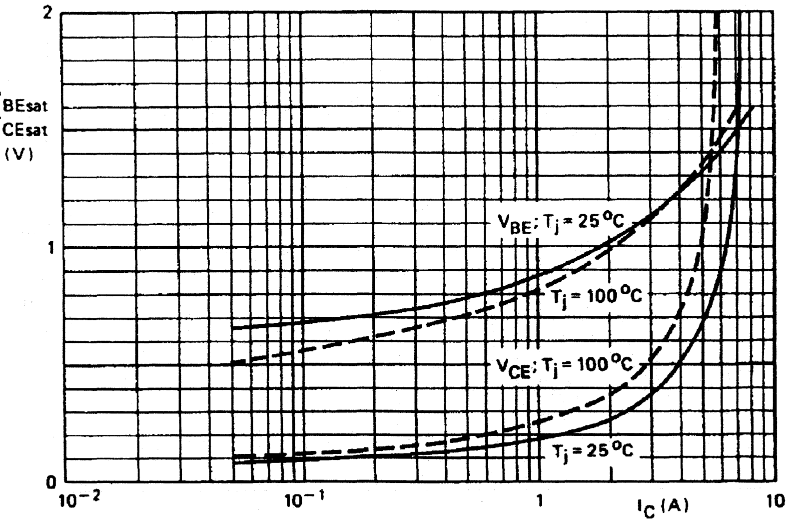


Fig.11. Typical base-emitter and collector-emitter saturation voltages.
$V_{BEsat} = f(I_C)$; $V_{CEsat} = f(I_C)$; $I_C/I_B = 5$

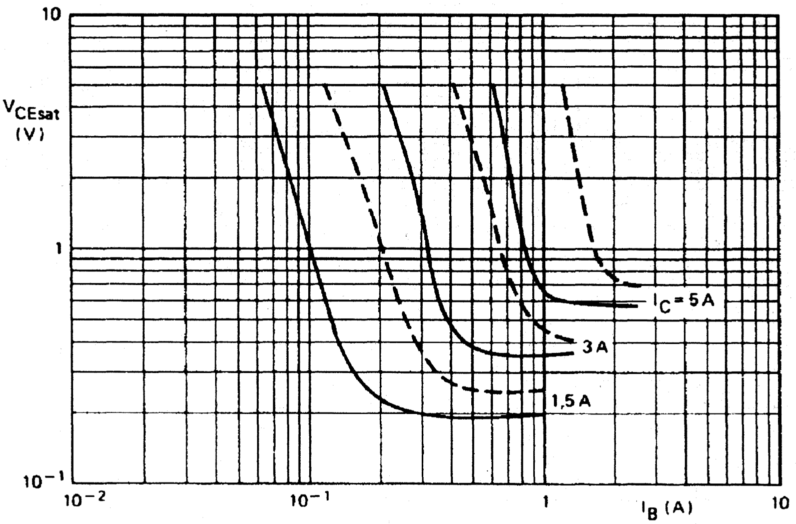


Fig.12. Collector-emitter saturation voltage. Solid lines = typ values, dotted lines = max values. $V_{CEsat} = f(I_B)$; parameter I_C

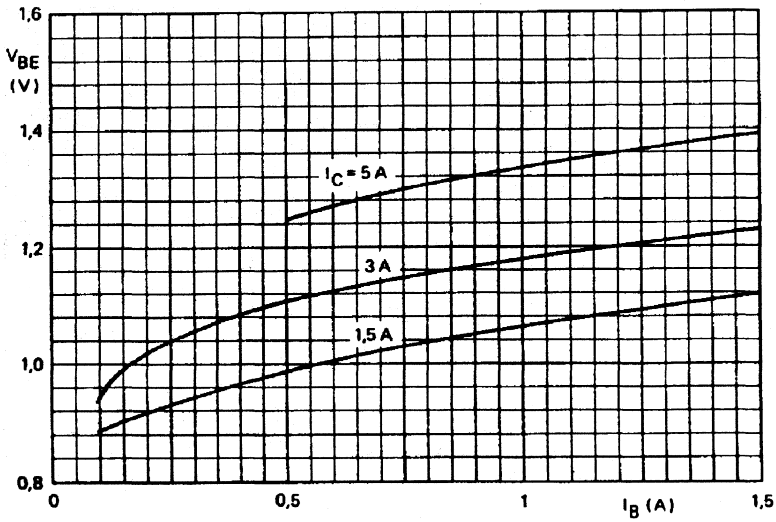


Fig.13. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

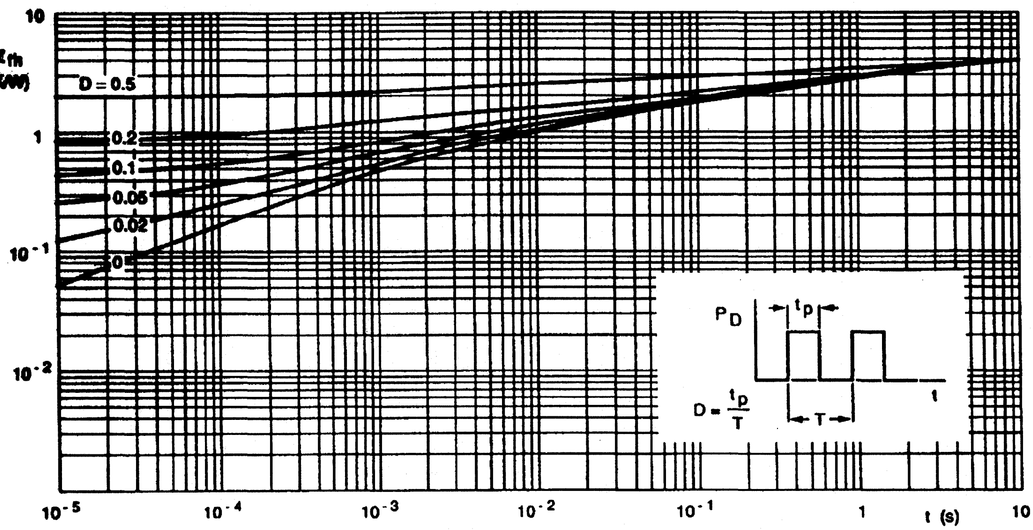


Fig.14. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

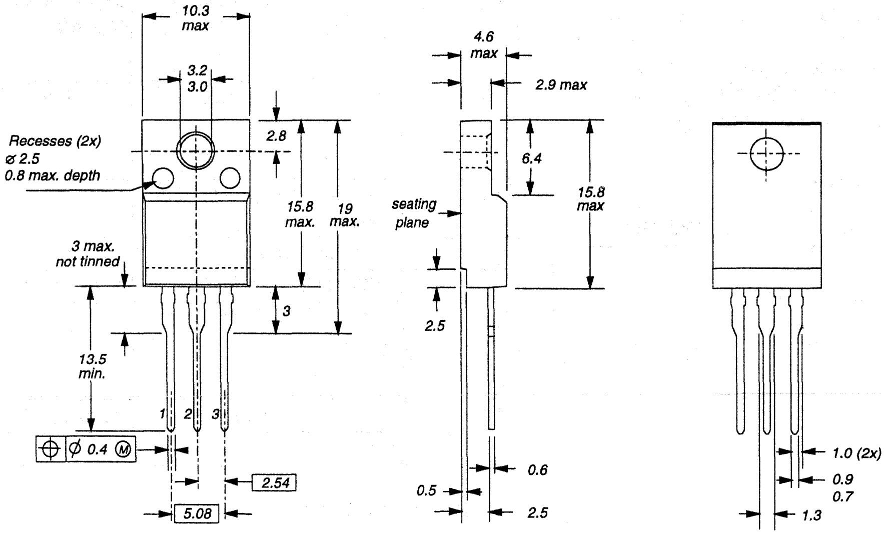


Fig.15. SOT186A; The seating plane is electrically isolated from all terminals.

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

Silicon diffused power transistors — BUT11F/BUT11AF

DESCRIPTION

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

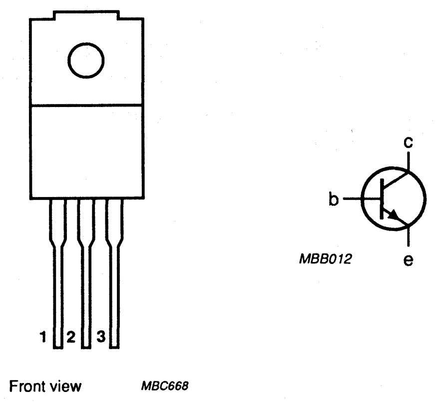
PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter voltage	peak value; $V_{BE} = 0$		
	BUT11F		850	V
	BUT11AF		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT11F		400	V
	BUT11AF		450	V
$V_{CE\ sat}$	collector-emitter saturation voltage		1.5	V
I_C	collector current	DC value	5	A
I_{CM}	collector current	peak value	10	A
$I_{C\ sat}$	collector saturation current			
	BUT11F		3	A
	BUT11AF		2.5	A
P_{tot}	total power dissipation	up to $T_h = 25$ °C	20	W
t_f	fall time		0.8	µs

PIN CONFIGURATION



The mounting base is electrically insulated from all terminals.

Fig.1 Simplified outline and symbol.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter voltage	peak value; $V_{BE} = 0$			
	BUT11F		–	850	V
	BUT11AF		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT11F		–	400	V
	BUT11AF		–	450	V
I_C	collector current	DC value	–	5	A
I_{CM}	collector current	peak value	–	10	A
I_B	base current	DC value	–	2	A
I_{BM}	base current	peak value	–	4	A
P_{tot}	total power dissipation	up to T_h = 25 °C (note 1)	–	20	W
T_{stg}	storage temperature range		–65	150	°C
T_j	junction temperature		–	150	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	from junction to mounting base	1.45	K/W
$R_{th\ j\text{-}h}$	from junction to external heatsink (note 1)	6.45	K/W
$R_{th\ j\text{-}h}$	from junction to external heatsink (note 2)	3.95	K/W
$R_{th\ j\text{-}a}$	from junction to ambient	55	K/W

Notes

1. Mounted without heatsink compound and 30 ±5 N pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ±5 N pressure on centre of envelope.

ISOLATION

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isol}	isolation voltage from all terminals to external heatsink (peak value)	–	1500	V
C_{isol}	isolation capacitance from collector to external heatsink	12	–	pF

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	collector cut-off current	$V_{CE} = V_{CES\,max}$; $V_{BE} = 0$	–	–	1	mA
		$V_{CE} = V_{CES\,max}$; $V_{BE} = 0$; T_j = 125 °C	–	–	2	mA
I_{EBO}	emitter cut-off current	V_{EB} = 9 V; $I_C = 0$	–	–	10	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 5 mA	10	18	35	
		V_{CE} = 5 V; I_C = 500 mA	10	20	35	
$V_{CE\,sat}$	collector-emitter saturation voltage BUT11F	I_C = 3 A; I_B = 0.6 A	–	–	1.5	V
	BUT11AF	I_C = 2.5 A; I_B = 0.5 A	–	–	1.5	V
$V_{BE\,sat}$	base-emitter saturation voltage BUT11F	I_C = 3 A; I_B = 0.6 A	–	–	1.3	V
	BUT11AF	I_C = 2.5 A; I_B = 0.5 A	–	–	1.3	V
$V_{CEO\,sust}$	collector-emitter sustaining voltage BUT11F BUT11AF	I_C = 100 mA; I_B = 0; L = 25 mH; (See Figs 2 and 3)	 400 450	 – –	 – –	 V V
Switching times resistive load (See Figs 4 and 5)						
t_{on}	turn-on time BUT11F	$I_{C\,on}$ = 3 A; $I_{B\,on} = I_{B\,off}$ = 0.6 A	–	–	1	µs
	BUT11AF	$I_{C\,on}$ = 2.5 A; $I_{B\,on} = I_{B\,off}$ = 0.5 A	–	–	1	µs
t_s	storage time BUT11F	$I_{C\,on}$ = 3 A; $I_{B\,on} = I_{B\,off}$ = 0.6 A	–	–	4	µs
	BUT11AF	$I_{C\,on}$ = 2.5 A; $I_{B\,on} = I_{B\,off}$ = 0.5 A	–	–	4	µs
t_f	fall time BUT11F	$I_{C\,on}$ = 3 A; $I_{B\,on} = I_{B\,off}$ = 0.6 A	–	–	0.8	µs
	BUT11AF	$I_{C\,on}$ = 2.5 A; $I_{B\,on} = I_{B\,off}$ = 0.5 A	–	–	0.8	µs

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times inductive load (See Figs 6 and 7)						
t_s	storage time, BUT11F	$I_{C\,on}$ = 3 A; I_B = 0.6 A	–	1.1	1.4	µs
		$I_{C\,on}$ = 3 A; I_B = 0.6 A; T_j = 100 °C	–	1.2	1.5	µs
t_s	storage time, BUT11AF	$I_{C\,on}$ = 2.5 A; I_B = 0.5 A	–	1.1	1.4	µs
		$I_{C\,on}$ = 2.5 A; I_B = 0.5 A; T_j = 100 °C	–	1.2	1.5	µs
t_f	fall time, BUT11F	$I_{C\,on}$ = 3 A; I_B = 0.6 A	–	80	150	ns
		$I_{C\,on}$ = 3 A; I_B = 0.6 A; T_j = 100 °C	–	140	300	ns
t_f	fall time, BUT11AF	$I_{C\,on}$ = 2.5 A; I_B = 0.5 A	–	80	150	ns
		$I_{C\,on}$ = 2.5 A; I_B = 0.5 A; T_j = 100 °C	–	140	300	ns

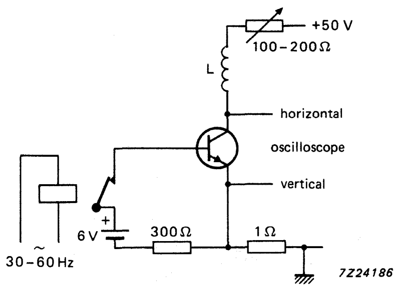


Fig.2 Test circuit for collector-emitter sustaining voltage.

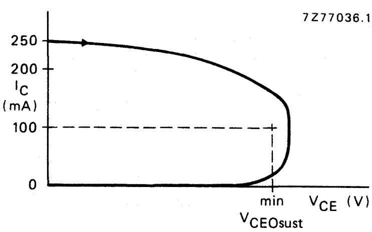
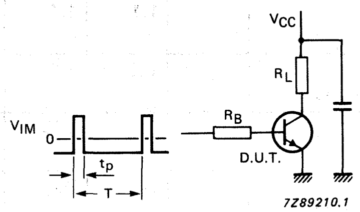


Fig.3 Oscilloscope display for sustaining voltage.



V_{CC} = 250 V; V_{IM} = –6 to +8 V; t_p = 20 μs; $\frac{t_p}{T}$ = 0.01.

Fig.4 Test circuit resistive load.

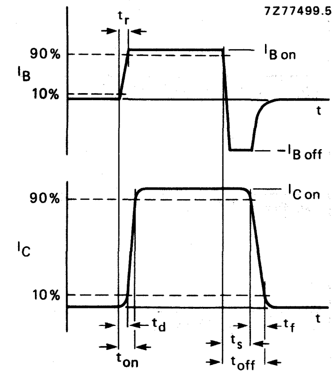


Fig.5 Switching times waveforms with resistive load.

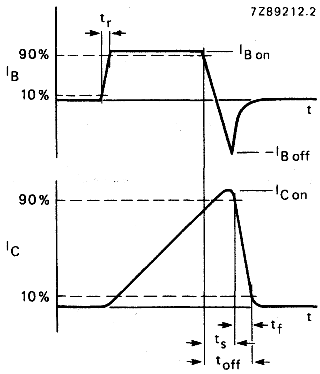
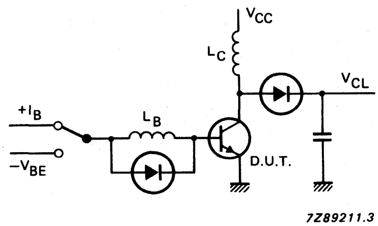
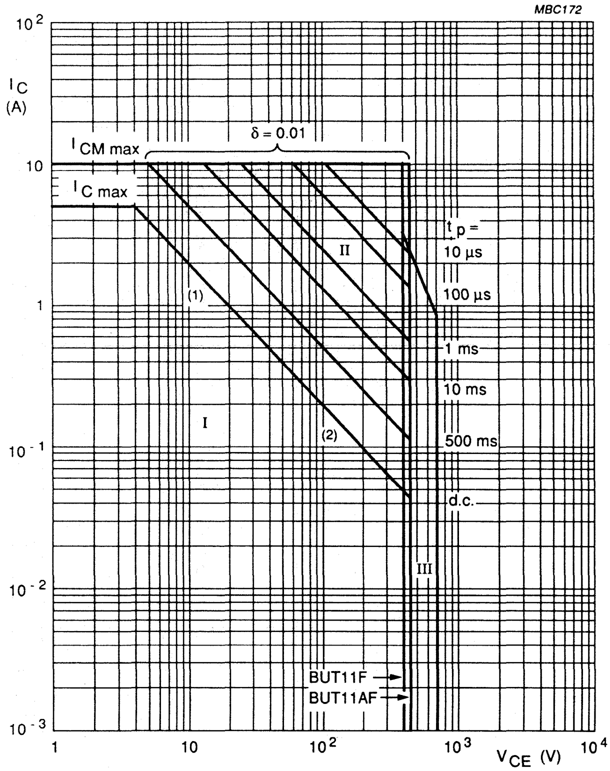


Fig.6 Switching times waveforms with inductive load.



V_{CL} = 300 V; V_{CC} = 30 V; V_{EB} = 5 V; L_B = 1 μH; L_C = 200 μH.

Fig.7 Test circuit inductive load.



Mounted without heatsink compound and 30 ±5 N force on centre of envelope.

$T_h \leq 25$ °C.

(1) $P_{tot\ max}$ and $P_{tot\ peak\ max}$ lines.

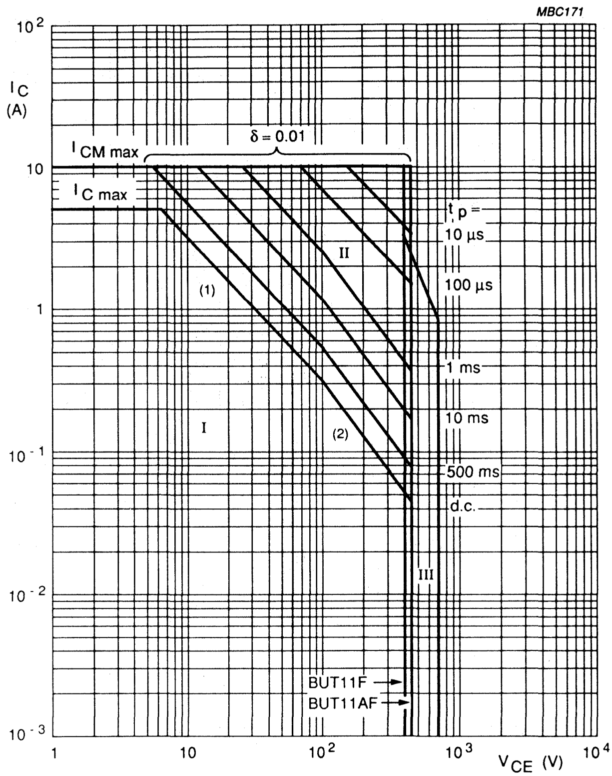
(2) Second breakdown limits.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

III - Area of permissible operation during turn-on in single transistor converters provided that $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6$ μs.

Fig.8 Forward bias safe operating area.



Mounted with heatsink compound and 30 ±5 N force on centre of envelope.

$T_h \leq 25$ °C.

(1) $P_{tot\,max}$ and $P_{tot\,peak\,max}$ lines.

(2) Second breakdown limits.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

III - Area of permissible operation during turn-on in single transistor converters provided that $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6$ µs.

Fig.9 Forward bias safe operating area.

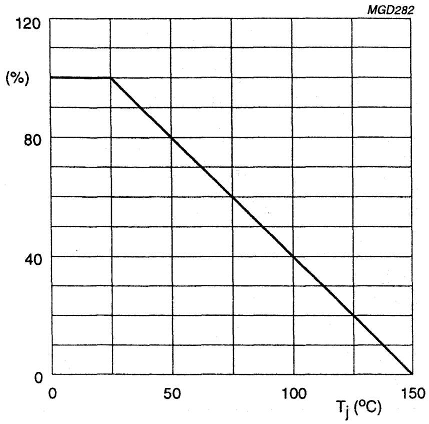


Fig.10 Total power dissipation.

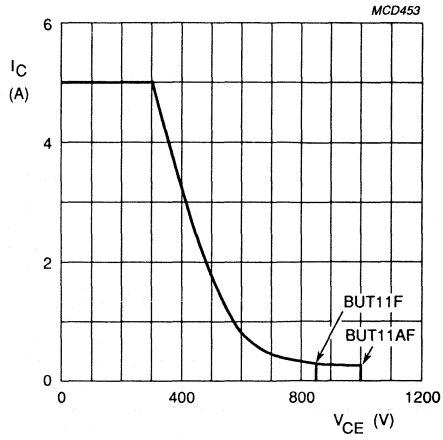


Fig.11 Reverse bias SOAR.

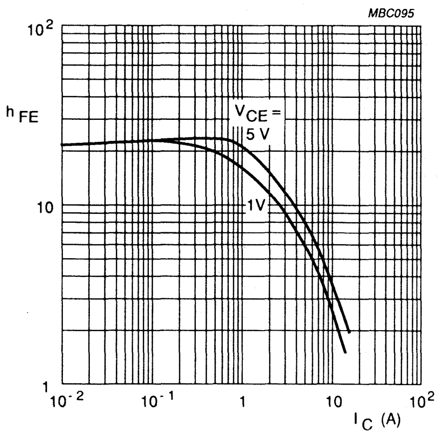
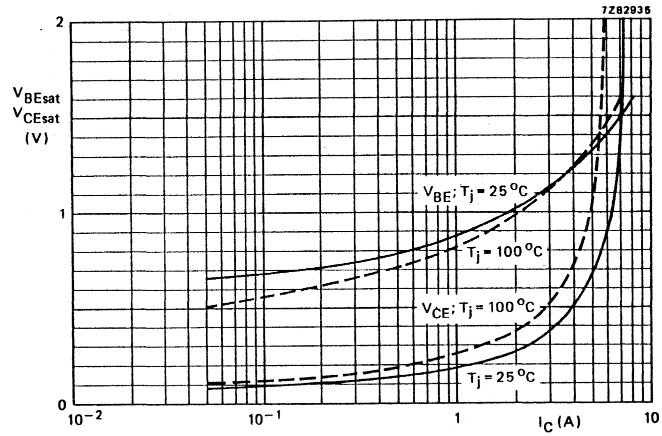
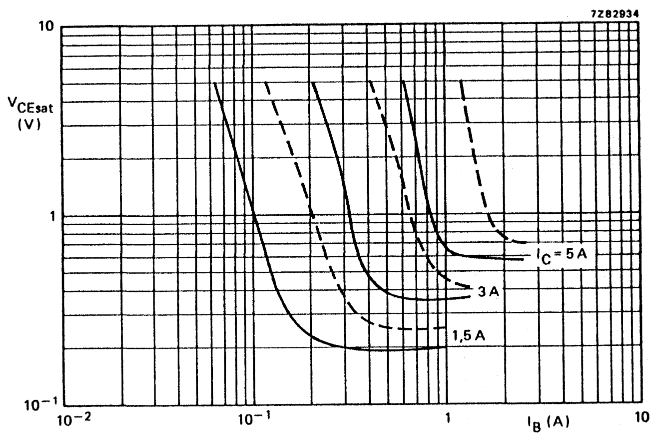


Fig.12 DC current gain, typical values.



$I_C/I_B = 5$.

Fig.13 Base-emitter and collector-emitter saturation voltages as functions of collector current, typical values.

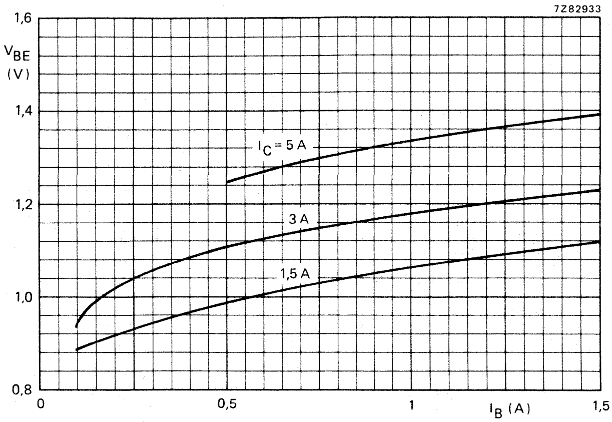


T_j = 25 °C.

Solid line = typical values.

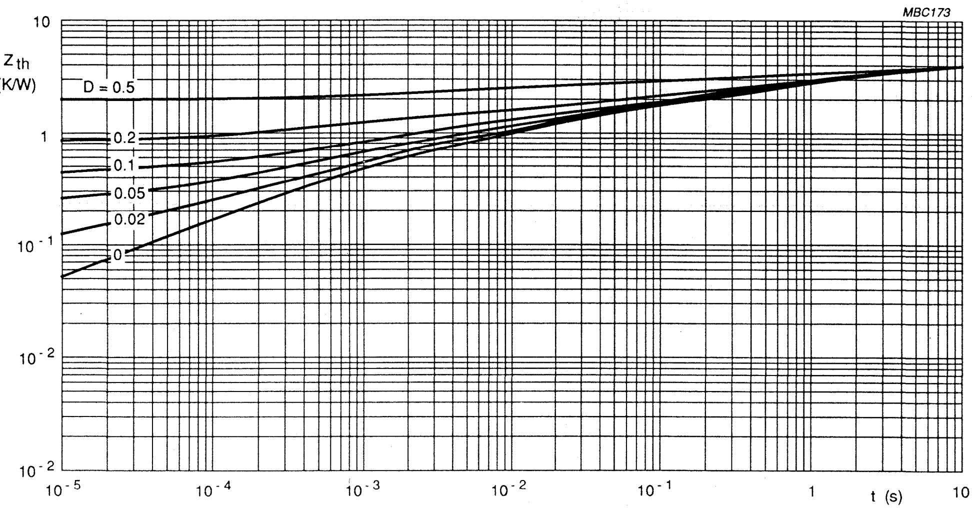
Dotted line = maximum values.

Fig.14 Collector-emitter saturation voltage as a function of base current.



T_j = 25 °C.

Fig.15 Base-emitter voltage as a function of base current.



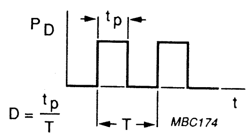
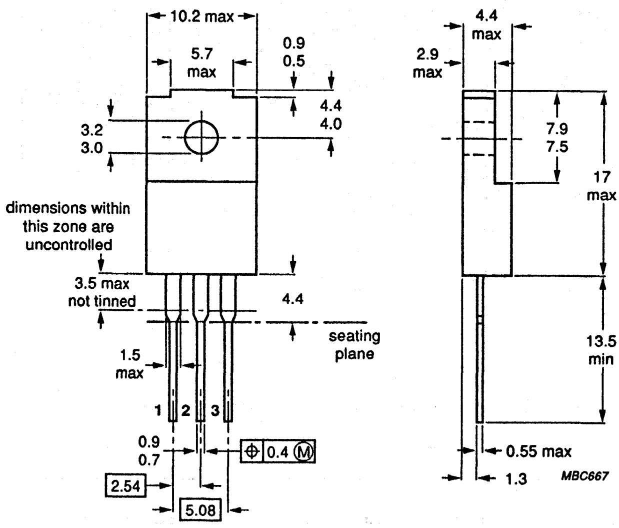


Fig.16 Transient thermal impedance.

PACKAGE OUTLINE



Dimensions in mm.

Fig.17 SOT186.

Silicon diffused power transistors — BUT12; BUT12A

High-voltage, high-speed, glass-passivated npn power transistors in a TO220 envelope intended for use in converters, inverters, switching regulators, motor control systems, etc.

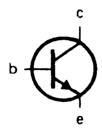
QUICK REFERENCE DATA

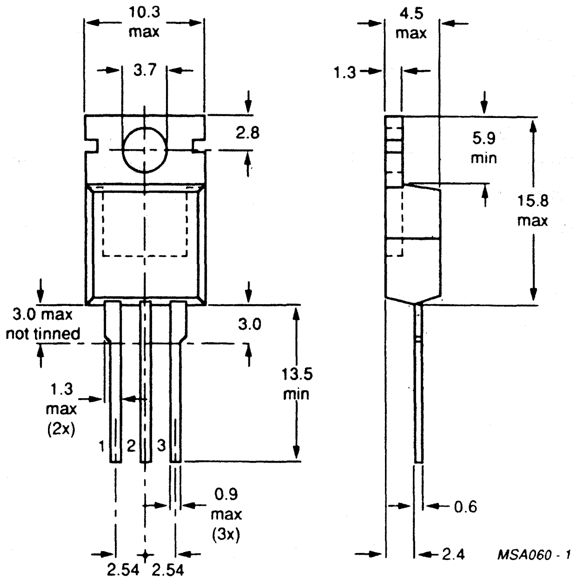
			BUT12	BUT12A	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5	1.5	V
Collector current					
saturation	I_{Csat}	max.	6.0	5.0	A
DC	I_C	max.	8		A
peak value	I_{CM}	max.	20		A
Total power dissipation					
up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	125		W
Fall time	t_f	max.	0.8		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO220AB.





Pinning:

1 = base
2 = collector
3 = emitter

Collector connected to mounting base.

RATINGS

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

			BUT12	BUT12A	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		6.0	5.0	A
DC	I_C	max.	8		A
peak value	I_{CM}	max.	20		A
Base current					
DC	I_B	max.	4.0		A
peak value	I_{BM}	max.	6.0		A
Total power dissipation					
up to $T_{mb} = 25\ ^{o}C$	P_{tot}	max.	125		W
Storage temperature range	T_{stg}		−65 to +150		^{o}C
Junction temperature	T_j	max.	150		^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	K/W

CHARACTERISTICS

$T_j = 25\ ^{o}C$ unless otherwise specified

Collector cut-off currents*				
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0	mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125\ ^{o}C$	I_{CES}	max.	3.0	mA
Emitter cut-off current				
$V_{EB} = 9$ V; $I_C = 0$	I_{EBO}	max.	10	mA

* Measured with a half-sinewave voltage (curve tracer).

			BUT12	BUT12A	
Saturation voltages					
$I_C = 6$ A; $I_B = 1.2$ A	V_{CEsat}	max.	1.5	–	V
	V_{BEsat}	max.	1.5	–	V
$I_C = 5$ A; $I_B = 1.0$ A	V_{CEsat}	max.	–	1.5	V
	V_{BEsat}	max.	–	1.5	V
DC current gain					
$I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
$I_C = 1$ A; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Collector-emitter sustaining voltage (Figs 2 and 3)					
$I_C = 100$ mA; $I_{B\,off} = 0$; L = 25 mH	$V_{CEOsust}$	min.	400	450	V
Switching times resistive load (Figs 4 and 5)					
$I_{C\,on} = 6$ A; $I_{B\,on} = -I_{B\,off} = 1.2$ A					
Turn-on time	t_{on}	max.	1.0	—	μs
Turn-off;					
storage time	t_s	max.	4.0	–	μs
fall time	t_f	max.	0.8	–	μs
$I_{C\,on} = 5$ A; $I_{B\,on} = -I_{B\,off} = 1.0$ A					
Turn-on time	t_{on}	max.	–	1.0	μs
Turn-off;					
storage time	t_s	max.	–	4.0	μs
fall time	t_f	max.	–	0.8	μs
Switching times inductive load (Figs 5 and 6)					
$I_{C\,on} = 6$ A; $I_{B\,on} = 1.2$ A; $V_{CL} = 250$ V; $T_c = 100$ °C					
Turn-off;					
storage time	t_s	typ.	1.9	–	μs
	t_s	max.	2.5	–	μs
fall time	t_f	typ.	200	–	ns
	t_f	max.	300	–	ns
$I_{C\,on} = 5$ A; $I_{B\,on} = 1.0$ A; $V_{CL} = 300$ V; $T_c = 100$ °C					
Turn-off;					
storage time	t_s	typ.	–	1.9	μs
	t_s	max.	–	2.5	μs
fall time	t_f	typ.	–	200	ns
	t_f	max.	–	300	ns

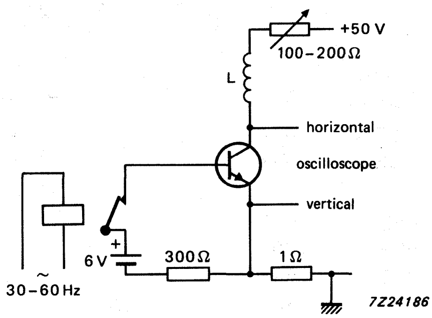


Fig. 2 Test circuit for $V_{CEOsust}$.

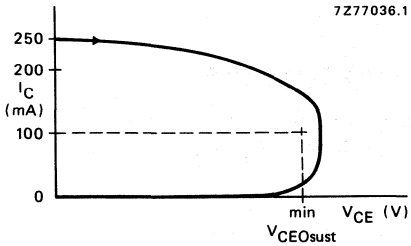
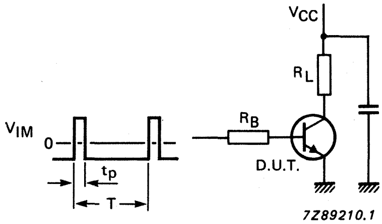


Fig. 3 Oscilloscope display for sustaining voltage.



V_{CC} = 250 V
t_p = 20 μs
V_{IM} = –6 to +8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\,on}$ and I_B requirements.

Fig. 4 Test circuit resistive load.

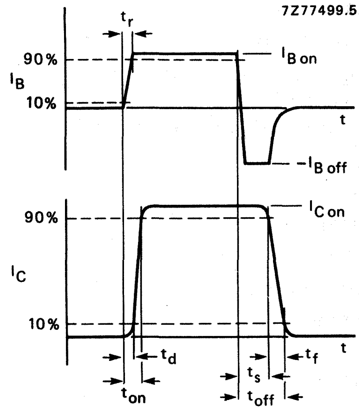
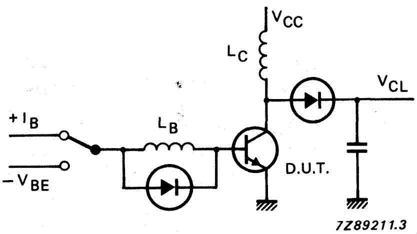


Fig. 5 Switching times waveforms with resistive load; $t_r \leqslant$ 20 ns.



V_{CL} = up to 1000 V
V_{CC} = 30 V
$-V_{BE}$ = 1 to 5 V
L_B = 1.0 μH
L_C = 200 μH

Fig. 6 Test circuit inductive load and reverse bias SOAR.

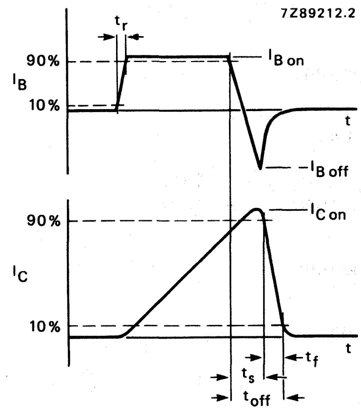
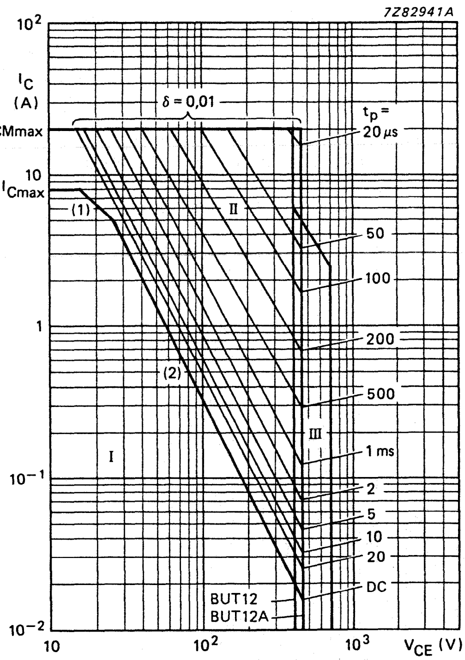
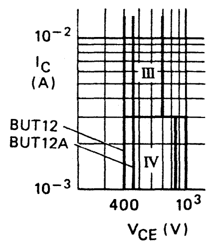


Fig. 7 Switching times waveforms with inductive load.





(1) $P_{tot\ max}$ and $P_{tot\ max\ peak}$ lines.

(2) Second-breakdown limits.

I Region of permissible DC operation.

II Permissible extension for repetitive pulse operation.

III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leq 100\ \Omega$ and $t_p \leq 6\ \mu s$.

IV Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2$ ms.

Fig.8 Safe operating area at $T_{mb} \leq 25$ °C.

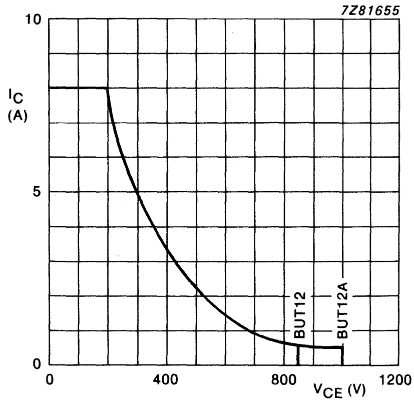


Fig. 9 Reverse bias SOAR; T_c = 100 °C; V_{BE} = −1 V to −5 V.

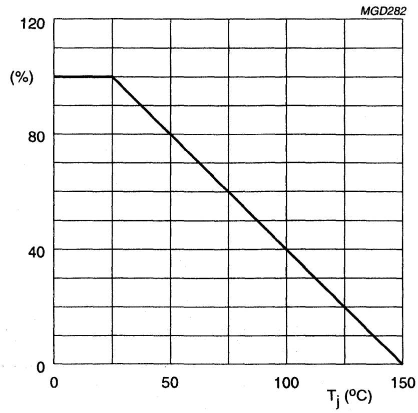


Fig. 10 Total power dissipation.

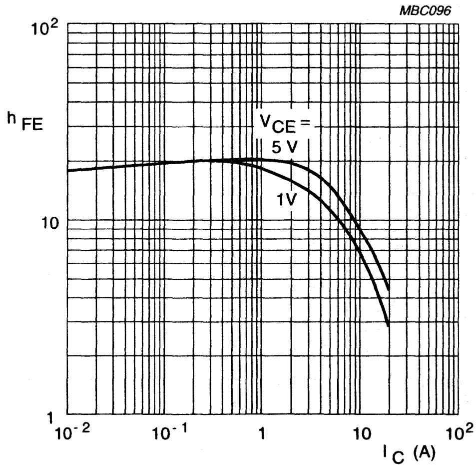


Fig. 11 Typical values DC current gain.

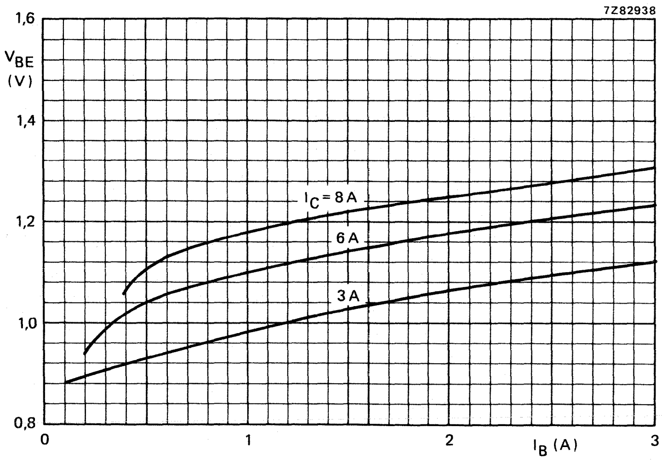


Fig. 12 Base-emitter voltage as a function of base current at T_j = 25 °C.

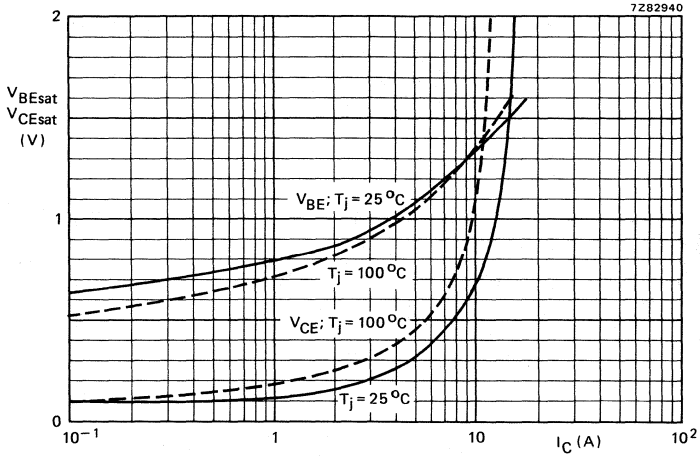


Fig. 13 Typical values base and collector voltage at I_C/I_B = 5.

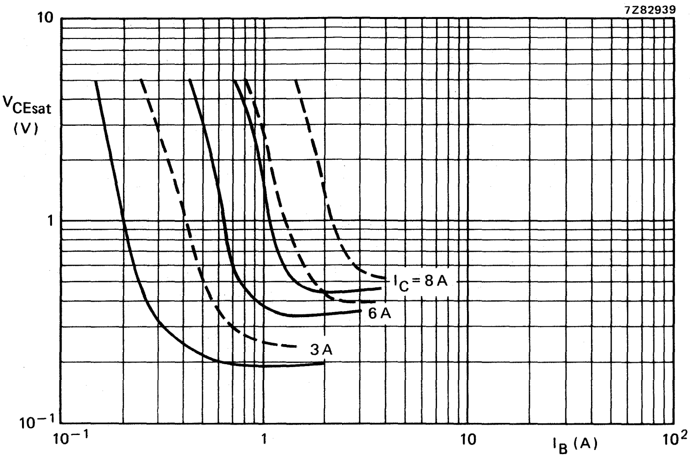


Fig. 14 Typical (——) and max. (– – –) values collector emitter saturation voltage at T_j = 25 °C.

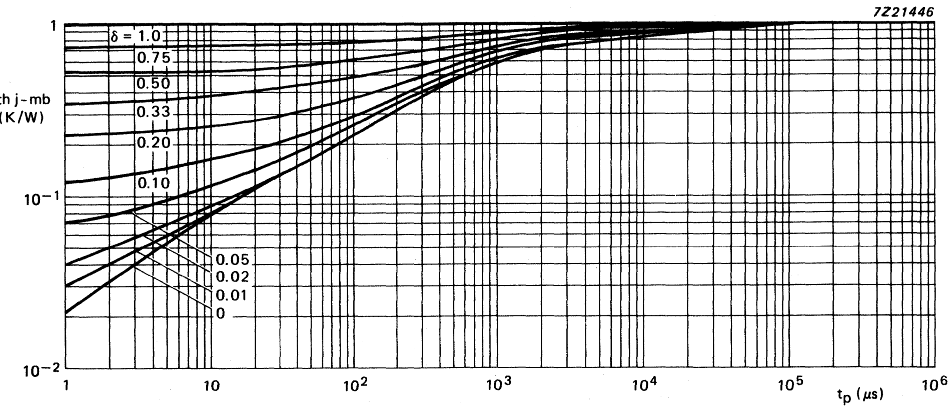


Fig. 15 Thermal response at pulse power conditions.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in a SOT186 envelope intended for use in converters, inverters, switching regulators, motor control systems, etc.

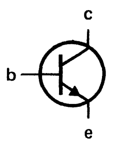
QUICK REFERENCE DATA

			BUT12F	BUT12AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5	1.5	V
Collector current					
saturation	I_{Csat}	max.	6.0	5.0	A
DC	I_C	max.	8		A
peak value	I_{CM}	max.	20		A
Total power dissipation					
up to $T_h = 25$ °C	P_{tot}	max.	23		W
Fall time	t_f	max.	0.8		μs

MECHANICAL DATA

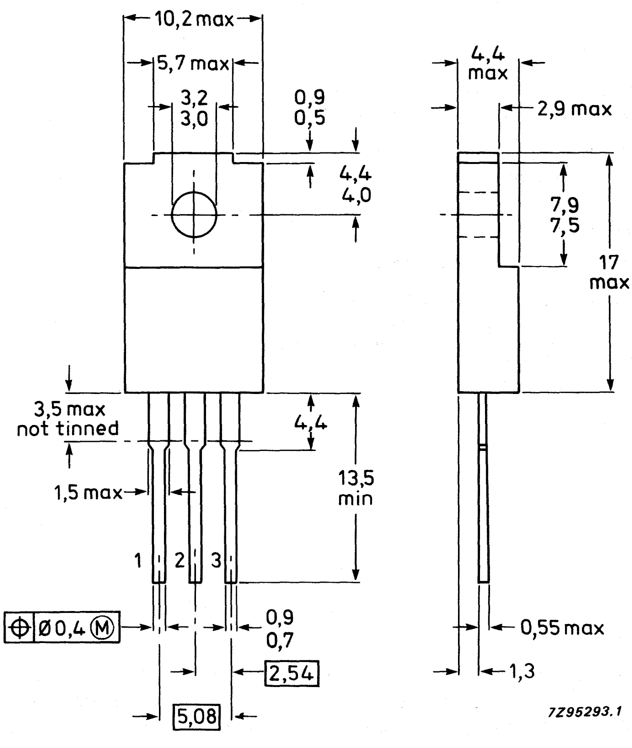
Dimensions in mm

Fig. 1 SOT186.



Pinning:

1 = base
2 = collector
3 = emitter



Mounting base is electrically isolated from all terminals.

RATINGS

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

			BUT12F	BUT12AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		6.0	5.0	A
DC	I_C	max.	8		A
peak value	I_{CM}	max.	20		A
Base current					
DC	I_B	max.	4.0		A
peak value	I_{BM}	max.	6.0		A
Total power dissipation					
up to $T_h = 25\ ^oC$ (note 1)	P_{tot}	max.	23		W
Storage temperature range	T_{stg}		−65 to +150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	5.5	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	3.9	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	55	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500	V
Isolation capacitance from collector to external heatsink	C_{isol}	max.	12	pF

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off currents* (note 3)				
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0	mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125\ ^oC$	I_{CES}	max.	3.0	mA
Emitter cut-off current				
$V_{EB} = 9$ V; $I_C = 0$	I_{EBO}	max.	10	mA

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of the envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of the envelope.
3. Measured with a half-sinewave voltage (curve tracer).

			BUT12F	BUT12AF	
Saturation voltages					
I_C = 6 A; I_B = 1.2 A	V_{CEsat}	max.	1.5	–	V
	V_{BEsat}	max.	1.5	–	V
I_C = 5 A; I_B = 1.0 A	V_{CEsat}	max.	–	1.5	V
	V_{BEsat}	max.	–	1.5	V
DC current gain					
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
I_C = 1 A; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Collector-emitter sustaining voltage (Figs 2 and 3) I_C = 100 mA; $I_{B\ off}$ = 0; L = 25 mH	$V_{CEOsust}$	min.	400	450	V
Switching times resistive load (Figs 4 and 5) $I_{C\ on}$ = 6 A; $I_{B\ on}$ = $-I_{B\ off}$ = 1.2 A					
Turn-on time	t_{on}	max.	1.0	—	μs
Turn-off; storage time	t_s	max.	4.0	–	μs
fall time	t_f	max.	0.8	–	μs
$I_{C\ on}$ = 5 A; $I_{B\ on}$ = $-I_{B\ off}$ = 1.0 A					
Turn-on time	t_{on}	max.	–	1.0	μs
Turn-off; storage time	t_s	max.	–	4.0	μs
fall time	t_f	max.	–	0.8	μs
Switching times inductive load (Figs 6 and 7) $I_{C\ on}$ = 6 A; $I_{B\ on}$ = 1.2 A; V_{CL} = 250 V; T_c = 100 °C					
Turn-off; storage time	t_s	typ.	1.9	–	μs
	t_s	max.	2.5	–	μs
fall time	t_f	typ.	200	–	ns
	t_f	max.	300	–	ns
$I_{C\ on}$ = 5 A; $I_{B\ on}$ = 1.0 A; V_{CL} = 300 V; T_c = 100 °C					
Turn-off; storage time	t_s	typ.	–	1.9	μs
	t_s	max.	–	2.5	μs
fall time	t_f	typ.	–	200	ns
	t_f	max.	–	300	ns

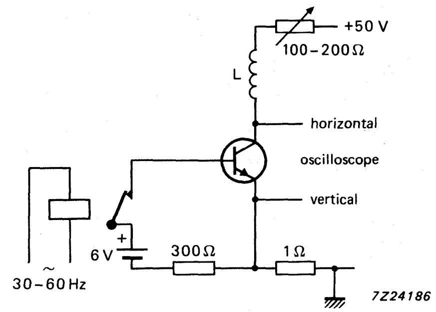


Fig. 2 Test circuit for $V_{CEOsust}$.

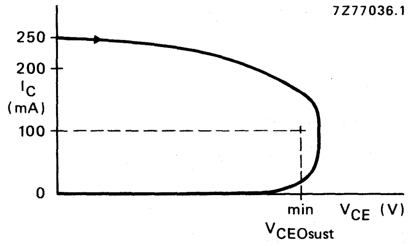
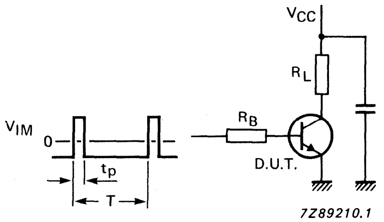


Fig. 3 Oscilloscope display for sustaining voltage.



V_{CC} = 250 V
t_p = 20 μs
V_{IM} = –6 to +8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\ on}$ and I_B requirements.

Fig. 4 Test circuit resistive load.

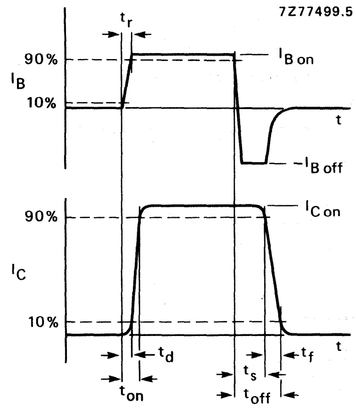
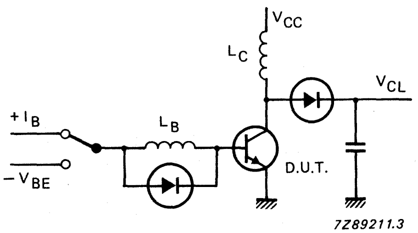


Fig. 5 Switching times waveforms with resistive load; $t_r \leqslant 20$ ns.



V_{CL} = up to 1000 V
V_{CC} = 30 V
$-V_{BE}$ = 1 to 5 V
L_B = 1.0 μH
L_C = 200 μH

Fig. 6 Test circuit inductive load and reverse bias SOAR.

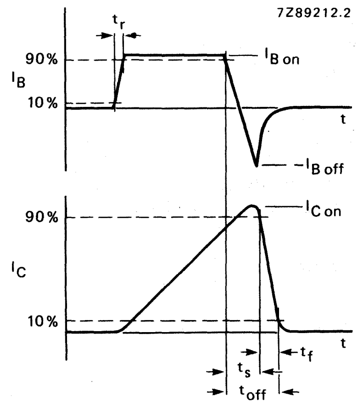
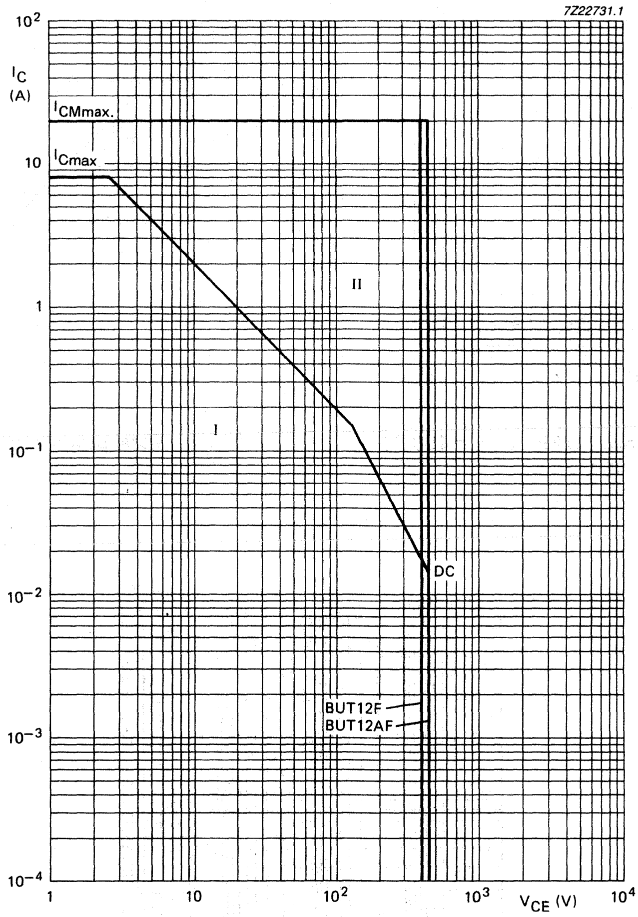


Fig. 7 Switching times waveforms with inductive load.



I Region of permissible DC operation
II Permissible extension for repetitive pulse operation

Fig. 8 Safe operating area at $T_{mb} < 25$ °C.

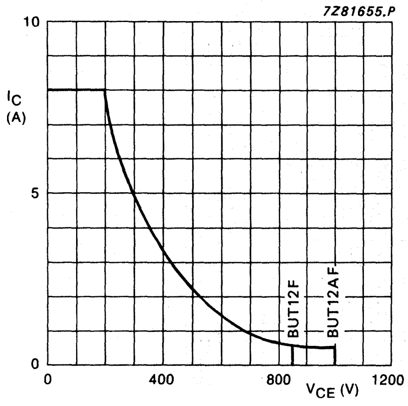


Fig. 9 Reverse bias SOAR; T_{mb} = 100 °C; V_{BE} = −1 V to −5 V.

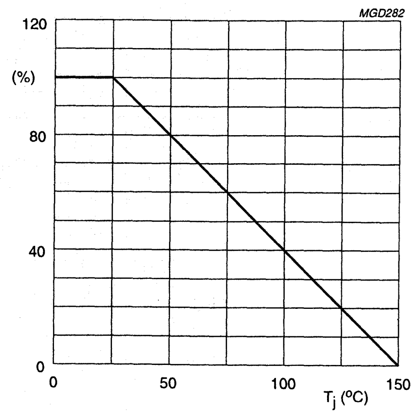


Fig. 10 Total power dissipation.

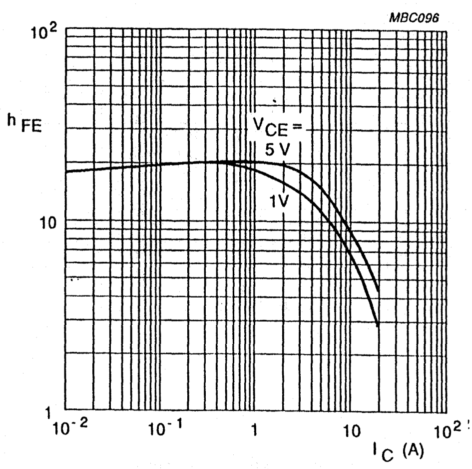


Fig. 11 Typical values DC current gain.

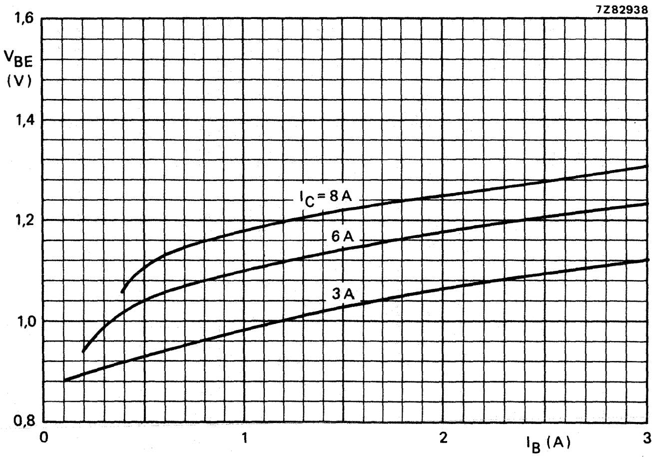


Fig. 12 Base-emitter voltage as a function of base current at T_j = 25 °C.

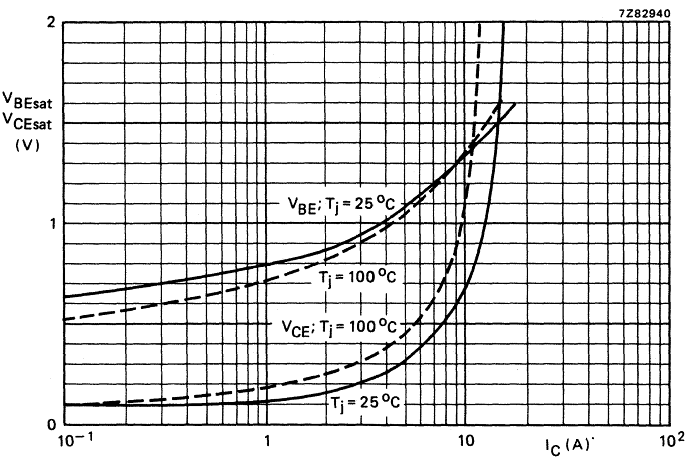


Fig. 13 Typical values base and collector voltage at I_C/I_B = 5.

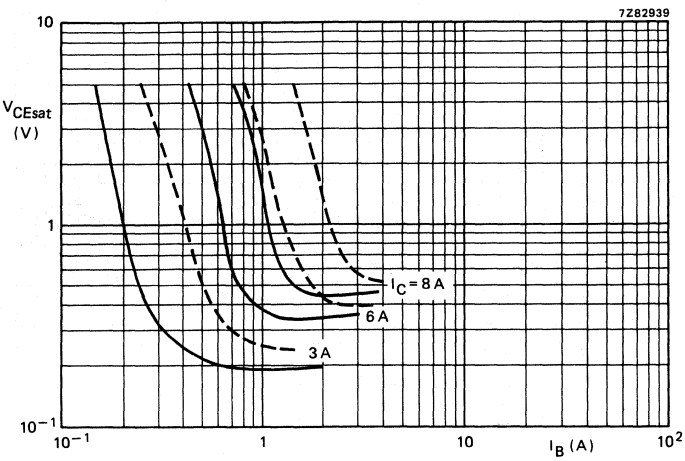


Fig. 14 Typical (——) and max. (– – –) values collector emitter saturation voltage at T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in a TO-220 envelope, intended for use in converters, inverters, switching regulators, motor control systems, etc.

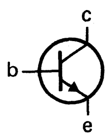
QUICK REFERENCE DATA

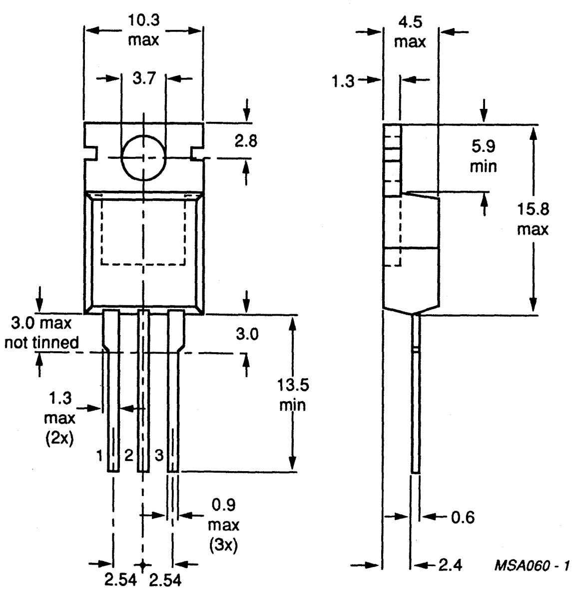
			BUT18	BUT18A	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5		V
Collector current					
saturation	I_{Csat}		4.0		A
DC	I_C	max.	6.0		A
peak value	I_{CM}	max.	12		A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	110		W
Fall time	t_f	max.	0.8		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-220AB.





Pinning:

1 = base
2 = collector
3 = emitter

Collector connected to mounting base.

RATINGS

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

			BUT18	BUT18A	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		4.0		A
DC	I_C	max.	6.0		A
peak value	I_{CM}	max.	12		A
Base current					
DC	I_B	max.	3.0		A
peak value	I_{BM}	max.	6.0		A
Total power dissipation					
up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	110		W
Storage temperature range	T_{stg}		−65 to + 150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.15	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off currents*					
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0		mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	2.0		mA
Emitter cut-off current					
V_{EB} = 9 V; $I_C = 0$	I_{EBO}	max.	10		mA
			BUT18	BUT18A	
Collector-emitter sustaining voltage					
I_C = 0.1 A; $I_{B\ off} = 0$; L = 25 mH (Figs 2 and 3)	$V_{CEOsust}$	min.	400	450	V
Saturation voltages					
I_C = 4 A; I_B = 0.8 A	V_{CEsat}	max.	1.5		V
	V_{BEsat}	max.	1.3		V
DC current gain					
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
I_C = 1 A; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Switching times resistive load (Figs 4 and 5)					
$I_{C\ on}$ = 4 A; $I_{B\ on} = -I_{B\ off}$ = 0.8 A					
Turn-on time	t_{on}	max.	1.0		μs
Turn-off; storage time	t_s	max.	4.0		μs
fall time	t_f	max.	0.8		μs
Switching times inductive load (Figs 6 and 7)					
$I_{C\ on}$ = 4 A; $I_{B\ on}$ = 0.8 A; V_{CL} = 250 V					
Turn-off; storage time	t_s	typ.	1.6		μs
	t_s	max.	2.5		μs
fall time	t_f	typ.	150		ns
	t_f	max.	400		ns

* Measured with a half-sinewave voltage (curve tracer).

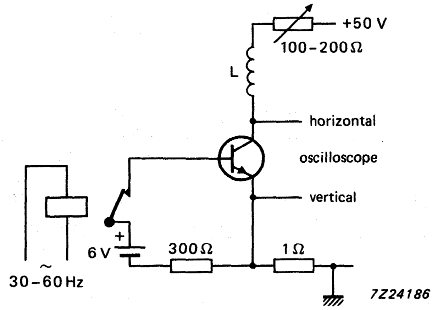


Fig. 2 Test circuit for $V_{CEOsust}$.

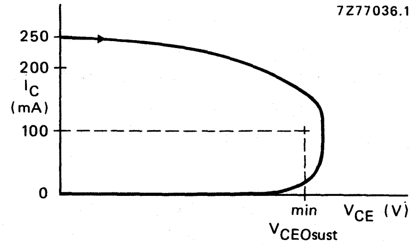
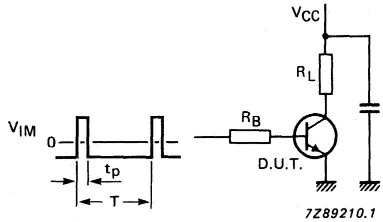


Fig. 3 Oscilloscope display for sustaining voltage.



V_{CC} = 250 V
t_p = 20 μs
V_{IN} = −6 to + 8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\ on}$ and I_B requirements.

Fig. 4 Test circuit resistive load.

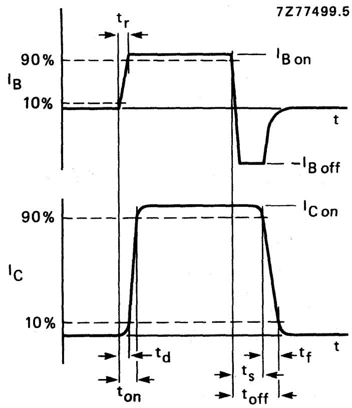
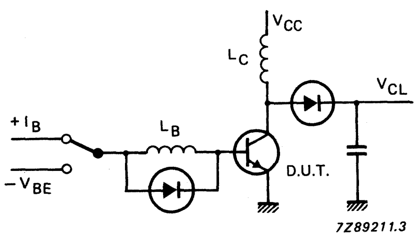


Fig. 5 Switching times waveforms with resistive load; $t_r \leqslant 30$ ns.



V_{CL} = up to 1000 V
V_{CC} = 30 V
$-V_{BE}$ = 5 V
L_B = 1 μH (0 for RB SOAR)
L_C = 200 μH

Fig. 6 Test circuit inductive load and RB SOAR.

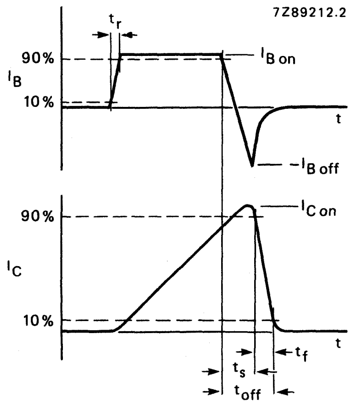
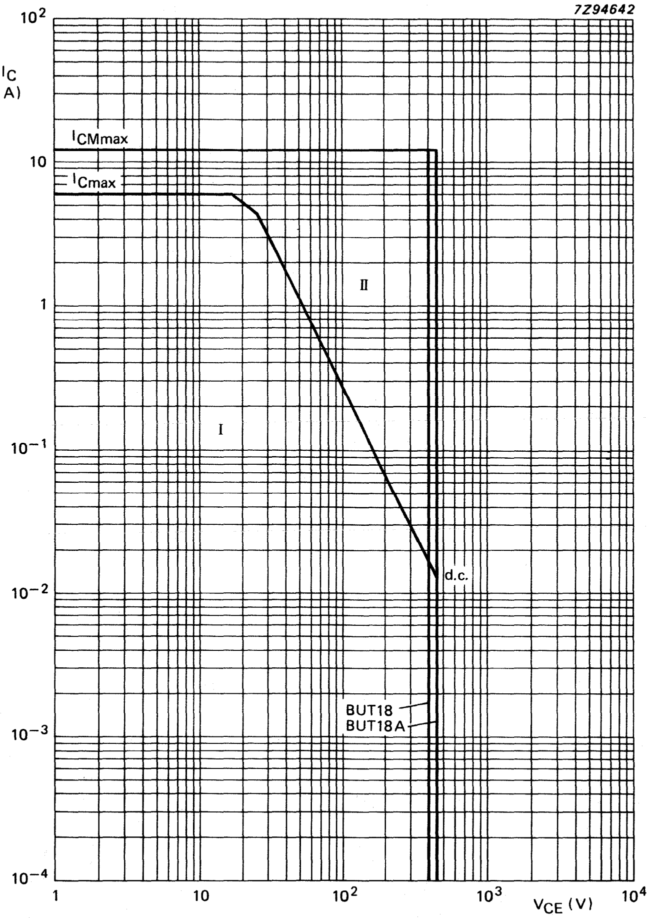


Fig. 7 Switching times waveforms with inductive load.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at T_{mb} = 25 °C.

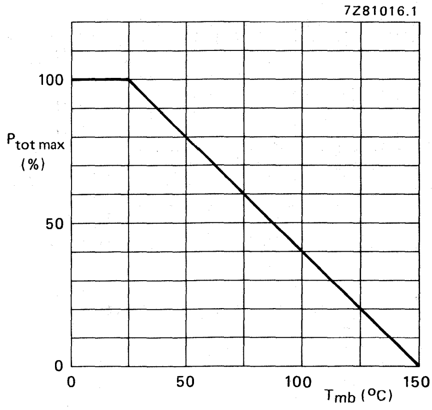


Fig. 9 Power derating curve.

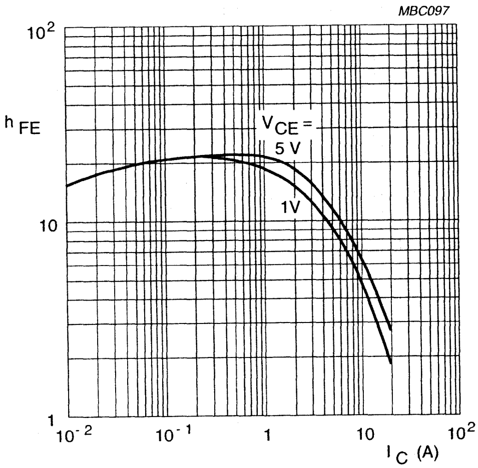


Fig.10 Typical values DC current gain; V_{CE} = 5 V; T_j = 25 °C.

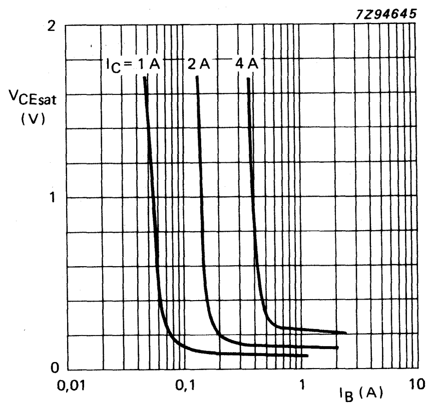


Fig.11 Collector-emitter saturation voltage as a function of base current; T_j = 25 °C.

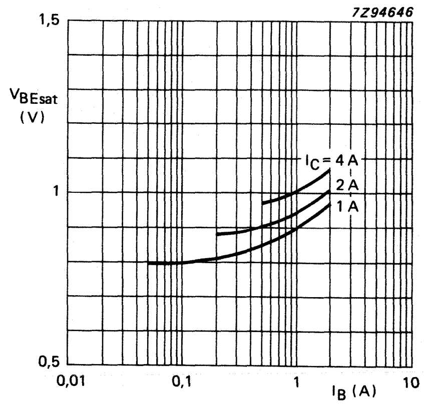


Fig. 12 Base-emitter saturation voltage as a function of base current; T_j = 25 °C.

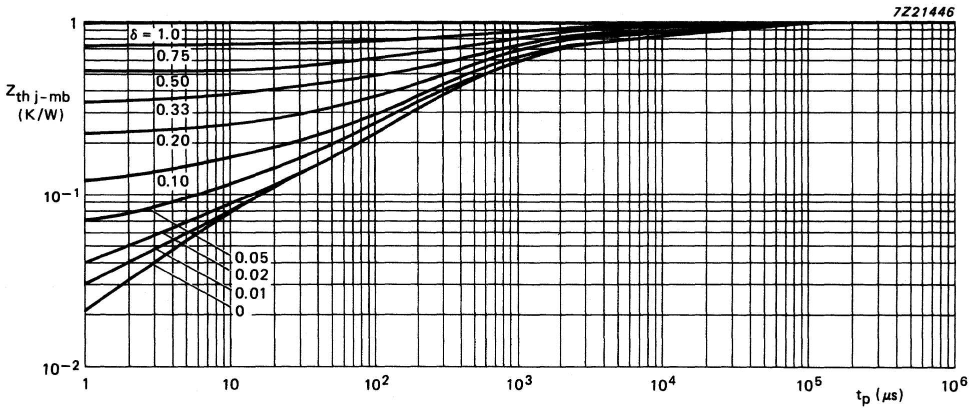


Fig. 13 Thermal response at pulse power conditions.

SILICON DIFFUSED POWER TRANSISTORS

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

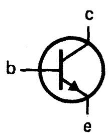
QUICK REFERENCE DATA

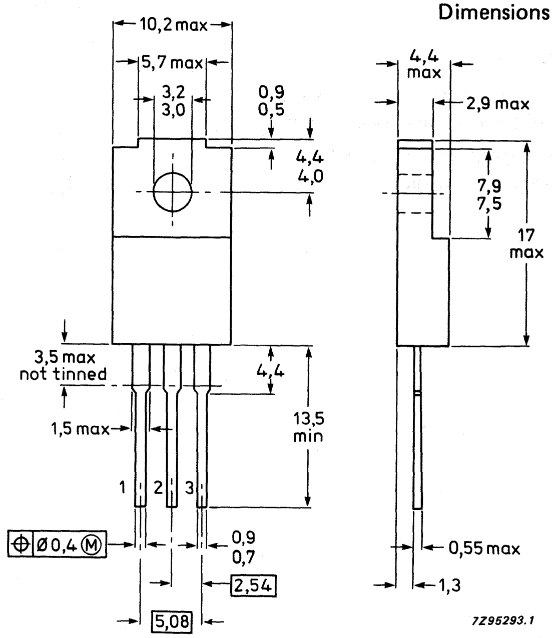
			BUT18F	18AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5		V
Collector current					
saturation	I_{Csat}	max.	4.0		A
DC	I_C	max.	6.0		A
peak value	I_{CM}	max.	12		A
Total power dissipation					
up to T_{mb} = 25 °C	P_{tot}	max.	33		W
Fall time; resistive load	t_f	max.	0.8		µs

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT186.





Pinning:

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated from all terminals.

RATINGS

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

			BUT18F	18AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		4.0		A
DC	I_C	max.	6.0		A
peak value	I_{CM}	max.	12		A
Base current					
DC	I_B	max.	3.0		A
peak value	I_{BM}	max.	6.0		A
Total power dissipation					
up to $T_{mb} = 25\ ^oC$					
without heatsink compound	P_{tot}	max.	20		W
with heatsink compound	P_{tot}	max.	33		W
Storage temperature range	T_{stg}		−65 to + 150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)				
without heatsink compound	$R_{th\ j\text{-}h}$	=	6.15	K/W
with heatsink compound	$R_{th\ j\text{-}h}$	=	3.65	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500	V
Isolation capacitance from collector to external heatsink	C_{isol}	typ.	12	pF

Note

1. 30 ± 5 newtons pressure on the centre of the envelope.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off currents*					
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0		mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	2.0		mA
Emitter cut-off current					
V_{EB} = 9 V; $I_C = 0$	I_{EBO}	max.	10		mA
			BUT18F	**18AF**	
Collector-emitter sustaining voltage (Figs 2 and 3)					
I_C = 100 mA; $I_{B\,off} = 0$; L = 25 mH	$V_{CEOsust}$	min.	400	450	V
Saturation voltages					
I_C = 4 A; I_B = 0.8 A	V_{CEsat}	max.	1.5		V
	V_{BEsat}	max.	1.3		V
DC current gain					
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
I_C = 1 A; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Switching times resistive load (Figs 4 and 5)					
$I_{C\,on}$ = 4 A; $I_{B\,on} = -B_{off}$ = 0.8 A					
turn-on time	t_{on}	max.	1.0		μs
turn-off; storage time	t_s	max.	4.0		μs
fall time	t_f	max.	0.8		μs
Switching times inductive load (Figs 6 and 7)					
$I_{C\,on}$ = 4 A; $I_{B\,on}$ = 0.8 A					
turn-off; storage time	t_s	typ.	1.6		μs
	t_s	max.	2.5		μs
fall time	t_f	typ.	150		ns
	t_f	max.	400		ns

* Measured with a half-sinewave voltage (curve tracer).

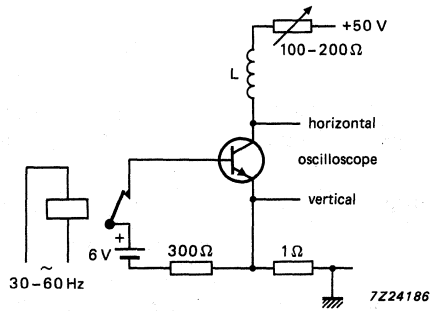


Fig. 2 Test circuit for $V_{CEOsust}$.

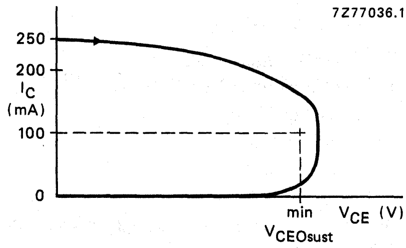
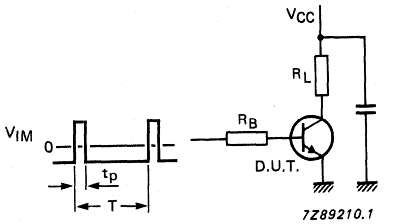


Fig. 3 Oscilloscope display for sustaining voltage.



V_{CC} = 250 V
t_p = 20 μs
V_{IN} = –6 to +8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\ on}$ and I_B requirements.

Fig. 4 Test circuit resistive load.

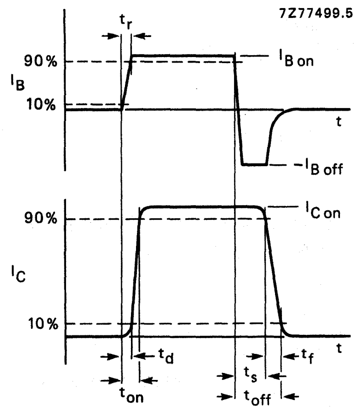
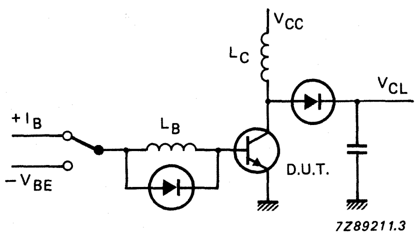


Fig. 5 Switching times waveforms with resistive load; $t_r \leq 20$ ns.



V_{CL} = 300 V
V_{CC} = 30 V
$-V_{BE}$ = 5 V
L_B = 1 μH
L_C = 200 μH

Fig. 6 Test circuit inductive load.

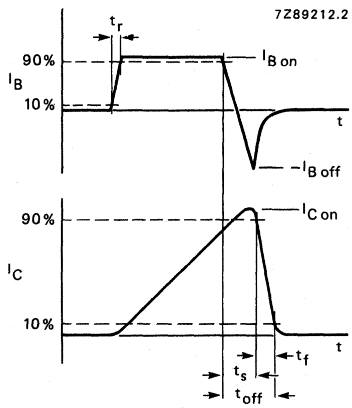
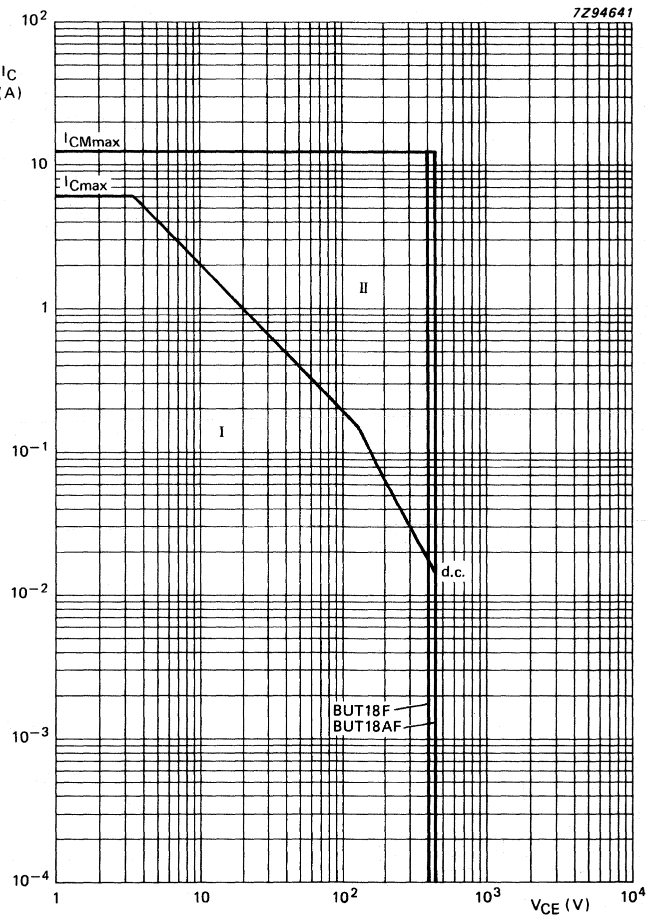


Fig. 7 Switching times waveforms with inductive load.



I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at $T_{mb} < 25$ °C; mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

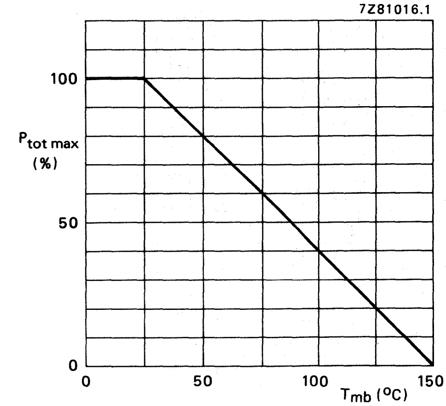


Fig. 9 Power derating curve.

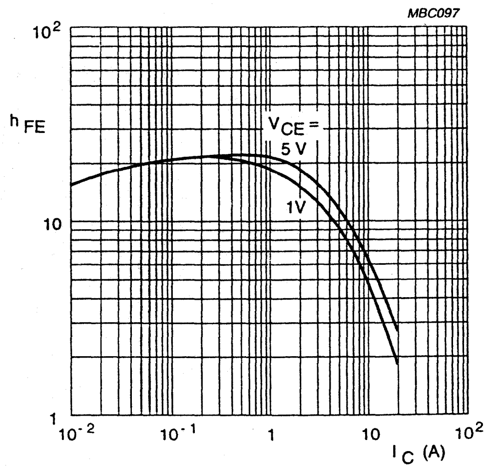


Fig. 10 Typical values DC current gain; $V_C = 5$ V; $T_j = 25$ °C.

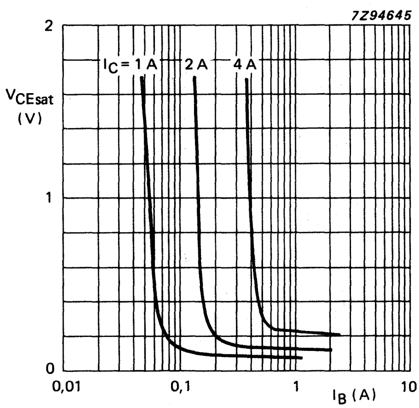


Fig. 11 Collector-emitter saturation voltage as a function of base current; $T_j = 25$ °C.

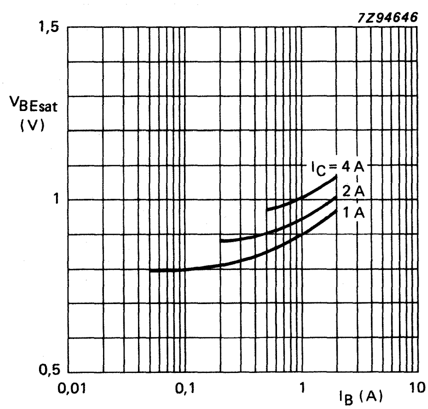


Fig. 12 Base-emitter saturation voltage as a function of base current; $T_j = 25$ °C

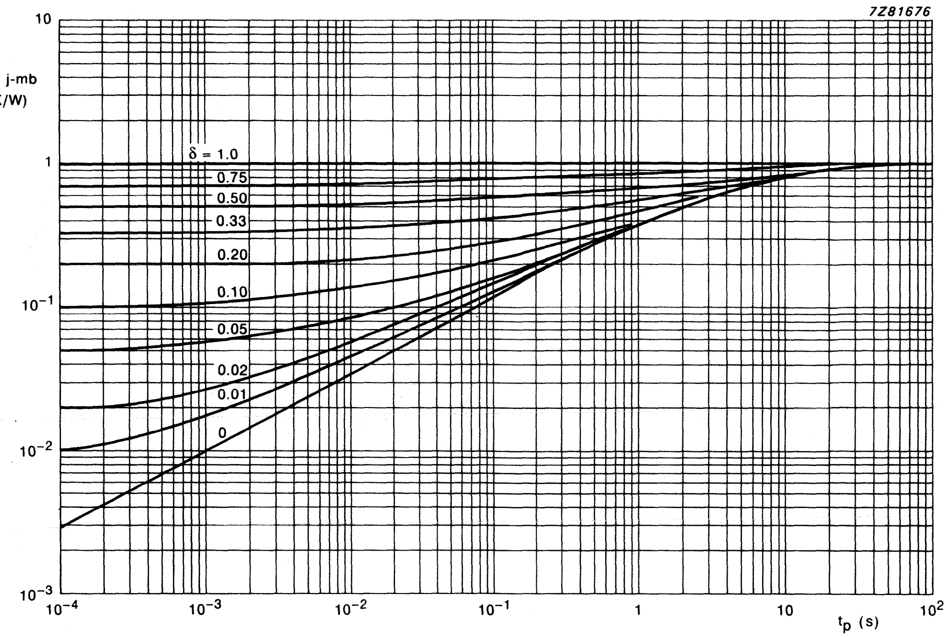


Fig. 13 Normalized thermal resistance.

GENERAL DESCRIPTION

Enhanced performance, new generation, high speed switching npn transistor in TO220AB envelope specially suited for high frequency electronic lighting ballast applications.

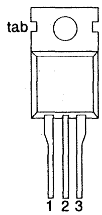
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	850	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	V
I_C	Collector current (DC)		-	5	A
I_{CM}	Collector current peak value		-	10	A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	100	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 3.0$ A; $I_B = 0.3$ A	-	2.0	V
t_f	Inductive fall time	$I_{Con} = 3.0$ A; $I_{Bon} = 0.3$ A	-	0.1	µs

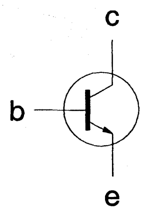
PINNING - TO220AB

PIN	DESCRIPTION
1	base
2	collector
3	emitter
tab	collector

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-emitter voltage peak value	$V_{BE} = 0$ V	-	850	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	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	$T_{mb} \leq 25$ ˚C	-	100	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base		-	1.25	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
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} = 9.0 V; I_C = 0 A	-	-	10.0	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	400	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 0.3 A	-	0.8	2.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.0 A; I_B = 0.6 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 2 V	13	23	30	
h_{FE}		I_C = 4.0 A; V_{CE} = 2 V	6	10.5	-	
h_{FE}		I_C = 3.0 A; V_{CE} = 2 V	10	13	-	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times resistive load	I_{Con} = 3.0 A; I_{Bon} = 0.3 A; $-I_{Boff}$ = 0.6 A			
t_s	Turn-off storage time		1.5	2.0	µs
t_f	Turn-off fall time		0.5	0.8	µs
	Switching times inductive load	I_{Con} = 3.0 A; I_{Bon} = 0.3 A; L_B = 1 µH; $-V_{BB}$ = 5 V			
t_s	Turn-off storage time		1.0	1.2	µs
t_f	Turn-off fall time		60	100	ns
		I_{Con} = 3.0 A; I_{Bon} = 0.3 A; L_B = 1 µH; $-V_{BB}$ = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		1.1	1.4	µs
t_f	Turn-off fall time		120	250	ns

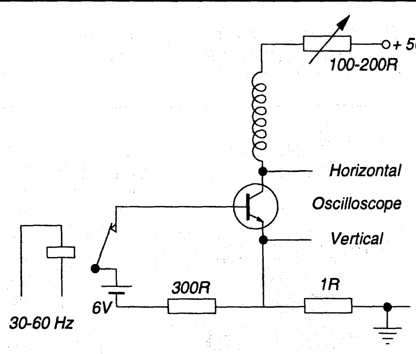


Fig.1. Test circuit for $VCEO_{sust}$.

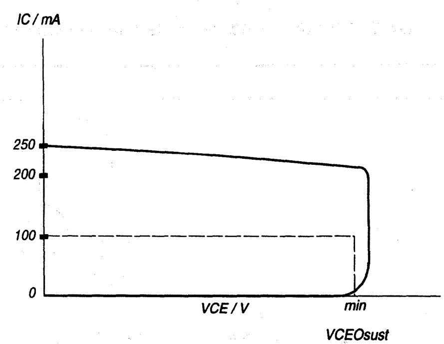


Fig.2. Oscilloscope display for $VCEO_{sust}$.

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

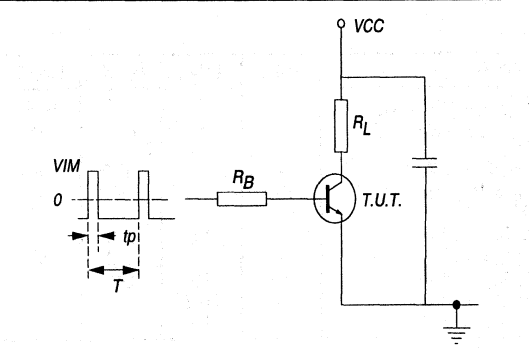


Fig.3. Test circuit resistive load. VIM = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

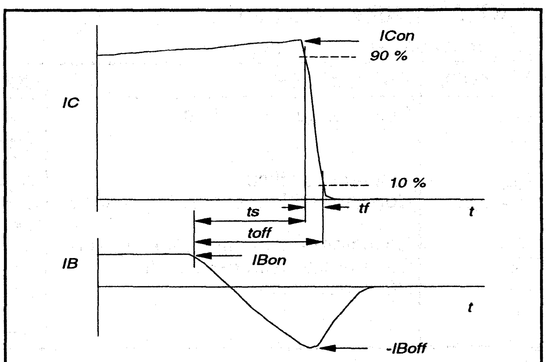


Fig.6. Switching times waveforms with inductive load.

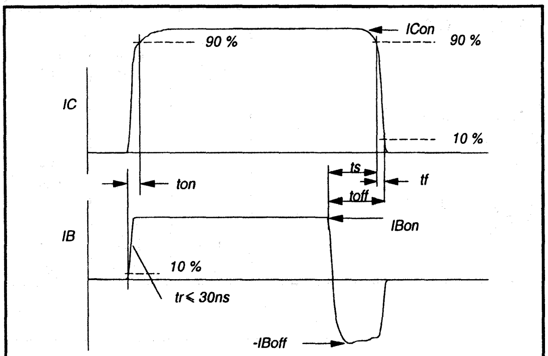


Fig.4. Switching times waveforms with resistive load.

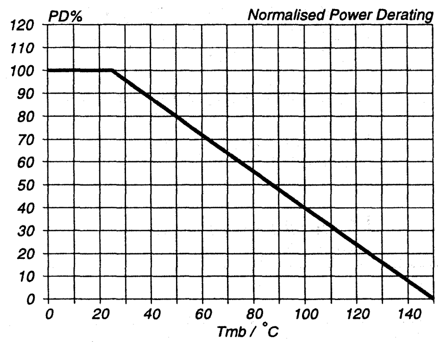


Fig.7. Normalised power dissipation.
PD% = 100·PD/PD $_{25°C}$ = f (T_{mb})

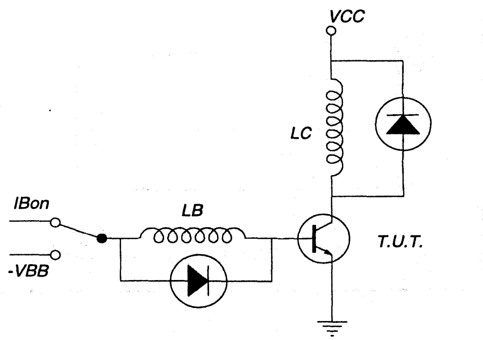


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V;L_B = 1 uH

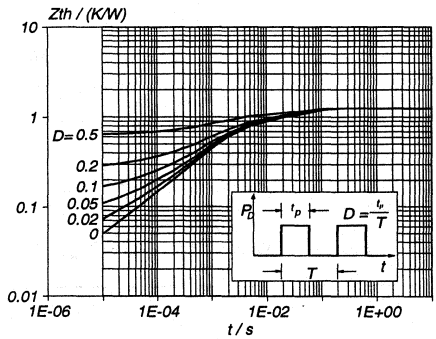


Fig.8. Transient thermal impedance.
$Z_{th\ j\text{-}mb}$ = f(t); parameter D = t_p/T

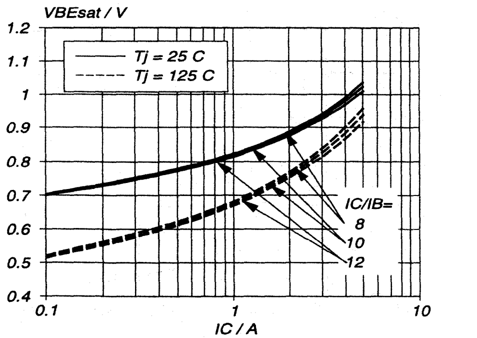


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_C)$; parameter I_C/I_B

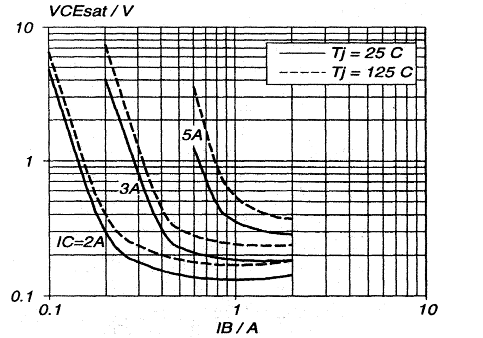


Fig.12. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

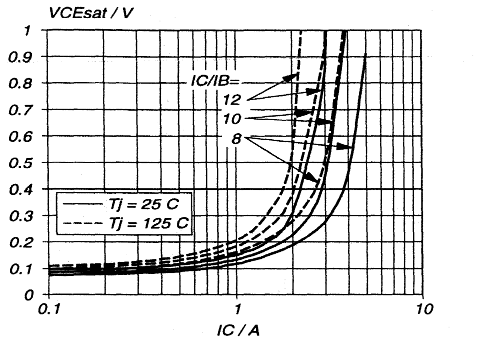


Fig.10. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

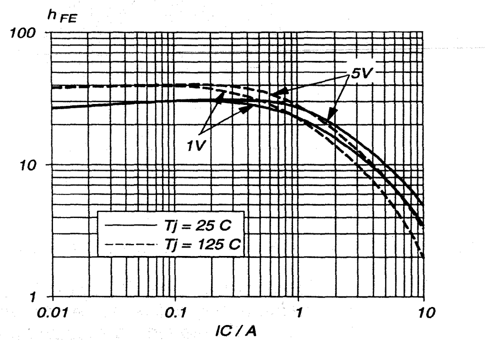


Fig.13. Typical DC current gain. $h_{FE} = f(I_C)$
parameter V_{CE}

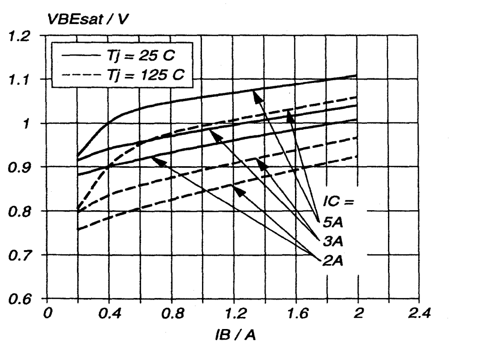


Fig.11. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

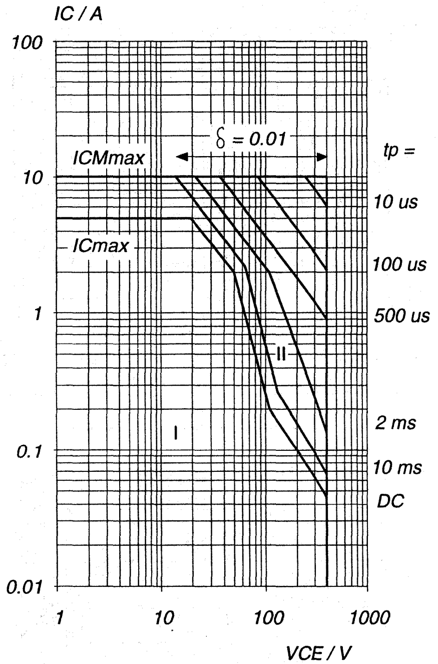


Fig.14. Forward bias safe operating area. $T_{mb} = 25^{\circ}C$

I Region of permissible DC operation.
II Extension for repetitive pulse operation.
NB: Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

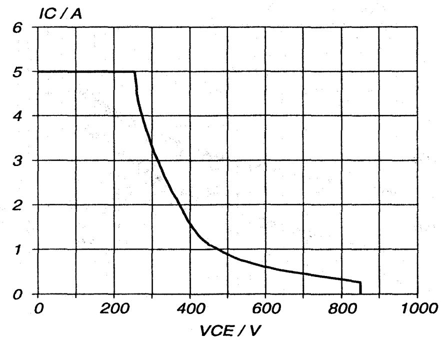


Fig.15. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

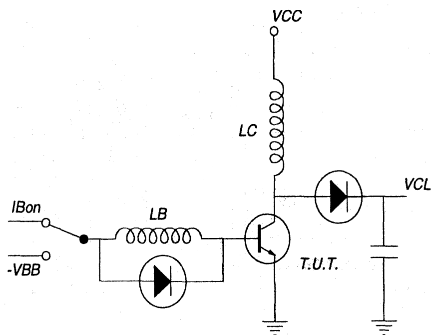


Fig.16. Test circuit RBSOAR. V_{CC} = 150 V; $-V_{BB}$ = 5 V L_C = 200 µH; $V_{CL} \leq$ 850 V; L_B = 1 µH

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

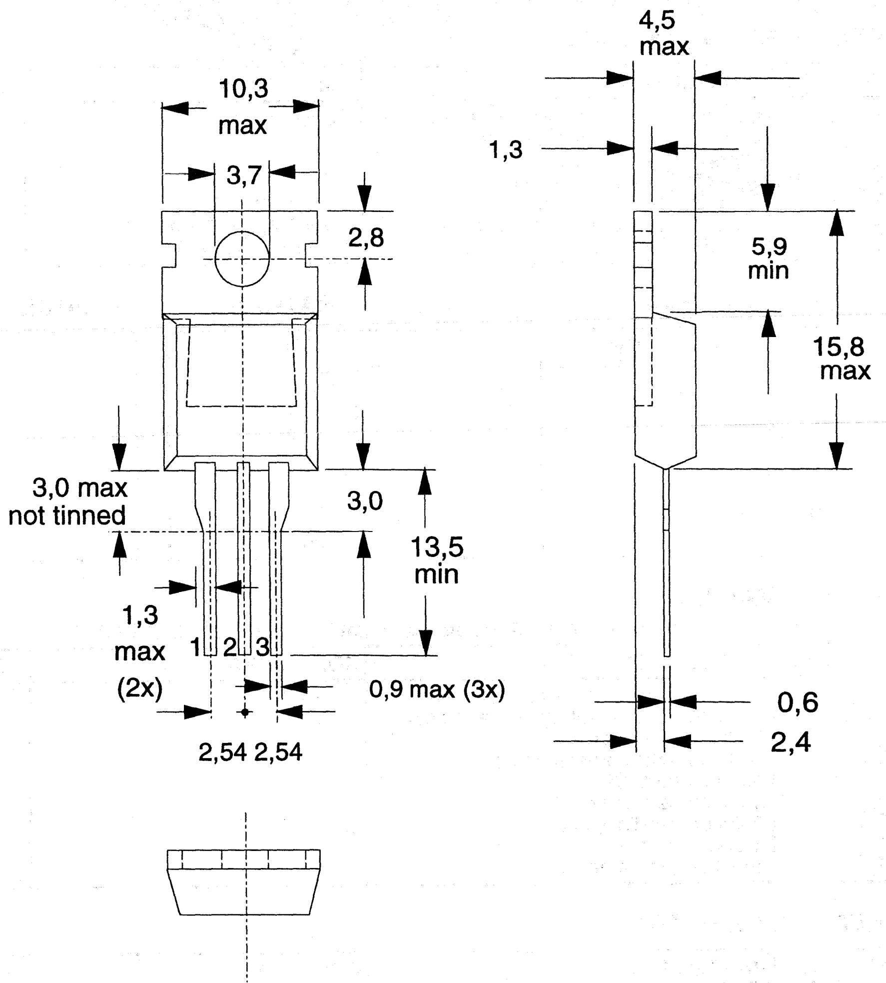


Fig.17. TO220AB; pin 2 connected to mounting base.

Notes

1. Refer to mounting instructions for TO220 envelopes.
2. Epoxy meets UL94 V0 at 1/8".

GENERAL DESCRIPTION

Enhanced performance, new generation, high speed switching npn transistor in a plastic full-pack envelope specially suited for high frequency electronic lighting ballast applications.

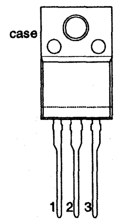
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	850	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	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	$I_C = 3.0$ A; $I_B = 0.3$ A	-	2.0	V
t_f	Inductive fall time	$I_{Con} = 3.0$ A; $I_{Bon} = 0.3$ A	-	0.1	µs

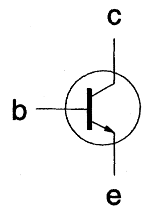
PINNING - SOT186A

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-emitter voltage peak value	$V_{BE} = 0$ V	-	850	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	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 heat sink		-	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} = 9.0 V; I_C = 0 A	-	-	10.0	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	400	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 0.3 A	-	0.8	2.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.0 A; I_B = 0.6 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 2 V	13	23	30	
h_{FE}		I_C = 4.0 A; V_{CE} = 2 V	6	10.5	-	
h_{FE}		I_C = 3.0 A; V_{CE} = 2 V	10	13	-	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times resistive load	I_{Con} = 3.0 A; I_{Bon} = 0.3 A; $-I_{Boff}$ = 0.6 A			
t_s	Turn-off storage time		1.5	2.0	µs
t_f	Turn-off fall time		0.5	0.8	µs
	Switching times inductive load	I_{Con} = 3.0 A; I_{Bon} = 0.3 A; L_B = 1 µH; $-V_{BB}$ = 5 V			
t_s	Turn-off storage time		1.0	1.2	µs
t_f	Turn-off fall time		60	100	ns
		I_{Con} = 3.0 A; I_{Bon} = 0.3 A; L_B = 1 µH; $-V_{BB}$ = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		1.1	1.4	µs
t_f	Turn-off fall time		120	250	ns

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

MECHANICAL DATA

Dimensions in mm

Net Mass: 2 g

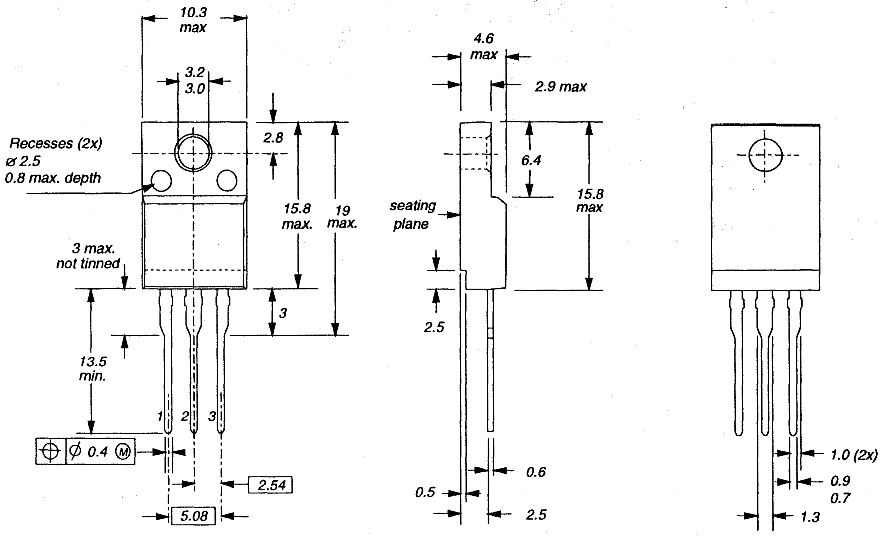


Fig.1. SOT186A; The seating plane is electrically isolated from all terminals.

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

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in a SOT93 envelope, intended for use in converters, inverters, switching regulators, motor control systems etc.

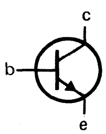
QUICK REFERENCE DATA

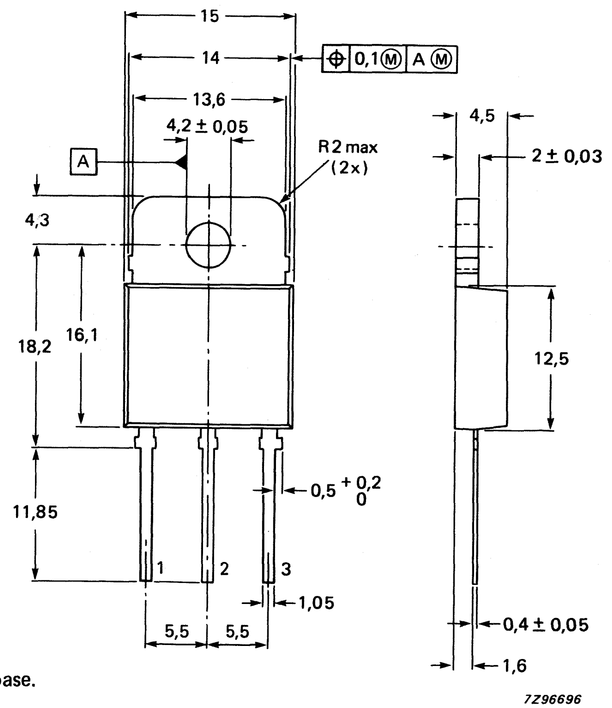
			BUW11	BUW11A	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5		V
Collector current (DC)	I_C	max.	5		A
Collector current (peak value)	I_{CM}	max.	10		A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	100		W
Fall time (resistive load)	t_f	max.	0.8		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT93.





Pinning:
1 = base
2 = collector
3 = emitter

Collector connected to mounting base.

RATINGS

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

			BUW11	BUW11A	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector current (DC)	I_C	max.	5		A
Collector current (peak value) $t_p < 2$ ms	I_{CM}	max.	10		A
Base current (DC)	I_B	max.	2		A
Base current (peak value); $t_p < 2$ ms	I_{BM}	max.	4		A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	100		W
Storage temperature range	T_{stg}		−65 to + 150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,25	K/W

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

			BUW11	BUW11A	
Collector cut-off current*					
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1		mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125\ ^oC$	I_{CES}	max.	2		mA
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 9$ V	I_{EBO}	max.	10		mA
Saturation voltages					
$I_C = 3$ A; $I_B = 0,6$ A	V_{CEsat}	max.	1,5	–	V
	V_{BEsat}	max.	1,4	–	V
$I_C = 2,5$ A; $I_B = 0,5$ A	V_{CEsat}	max.	–	1,5	V
	V_{BEsat}	max.	–	1,4	V
Collector-emitter sustaining voltage					
$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH	$V_{CEOsust}$	min.	400	450	V
Collector saturation current					
$V_{CE} = 1,5$ V	I_{Csat}	max.	3	2,5	A
DC current gain					
$I_C = 5$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
$I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		

* Measured with a half sinewave voltage (curve tracer).

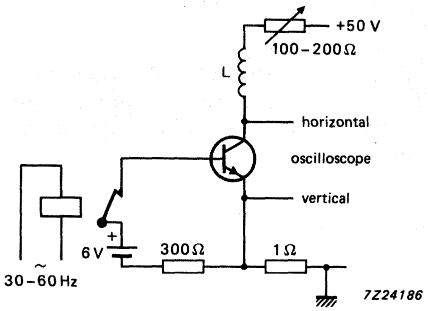


Fig. 2 Test circuit for $V_{CEOsust}$.

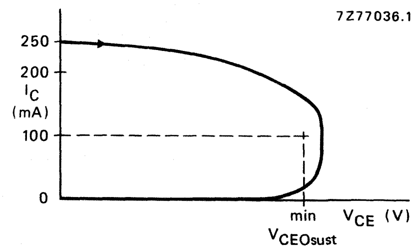
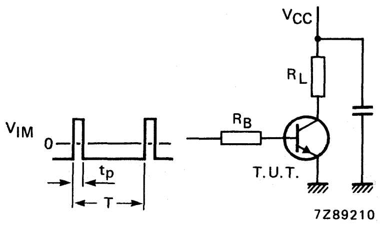


Fig. 3 Oscilloscope display for sustaining voltage.

			BUW11	BUW11A	
Switching times resistive load (Figs 4 and 5)					
I_{Con} = 3 A; I_{Bon} = I_{Boff} = 0,6 A					
Turn-on time	t_{on}	max.	1	–	μs
Turn-off: Storage time	t_s	max.	4	–	μs
Fall time	t_f	max.	0,8	–	μs
I_{Con} = 2,5 A; I_{Bon} = $-I_{Boff}$ = 0,5 A					
Turn-on time	t_{on}	max.	–	1	μs
Turn-off: Storage time	t_s	max.	–	4	μs
Fall time	t_f	max.	–	0,8	μs
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 3 A; I_B = 0,6 A					
Turn-off: Storage time	t_s	typ.	1,1	–	μs
		max.	1,4	–	μs
Fall time	t_f	typ.	80	–	ns
		max.	150	–	ns
I_{Con} = 3 A; I_B = 0,6 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	1,2	–	μs
		max.	1,5	–	μs
Fall time	t_f	typ.	140	–	ns
		max.	300	–	ns
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 2,5 A; I_B = 0,5 A					
Turn-off: Storage time	t_s	typ.	–	1,1	μs
		max.	–	1,4	μs
Fall time	t_f	typ.	–	80	ns
		max.	–	150	ns
I_{Con} = 2,5 A; I_B = 0,5 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	–	1,2	μs
		max.	–	1,5	μs
Fall time		typ.	–	140	ns
		max.	–	300	ns



V_{CC} = 250 V
V_{IM} = −6 to + 8 V
$\frac{t_p}{T}$ = 0,01
t_p = 20 μs
The values of R_B and R_L are selected in accordance with I_{Con} and I_B requirements.

Fig. 4 Test circuit resistive load.

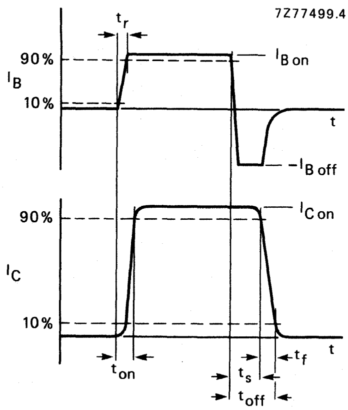


Fig. 5 Switching times waveforms with resistive load.

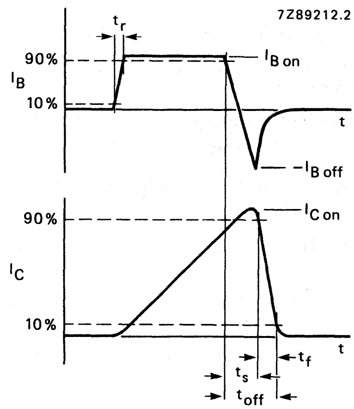
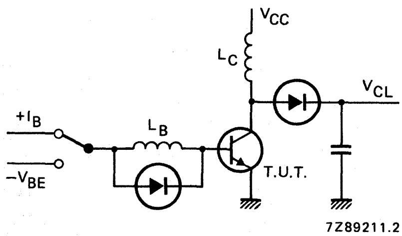
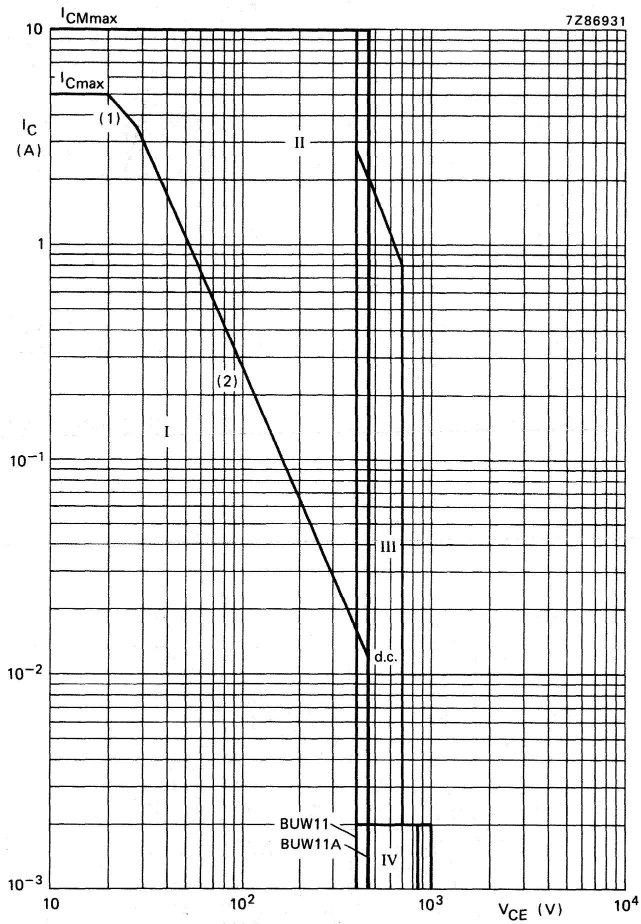


Fig. 6 Switching times waveforms with inductive load.



V_{CL} = 300 V
V_{CC} = 30 V
$-V_{BE}$ = 5 V
L_B = 1 μH
L_C = 200 μH

Fig. 7 Test circuit inductive load.



(1) $P_{tot\ max}$ line.
(2) Second-breakdown limits.

I Region of permissible DC operation
II Permissible extension for repetitive pulse operation
III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$.
IV Repetitive pulse operation in this region is permissible provided $V_{BE} \leqslant 0$ and $t_p \leqslant 5$ ms.

Fig. 8 Safe operating area at $T_{mb} \leqslant 25\ ^{o}C$.

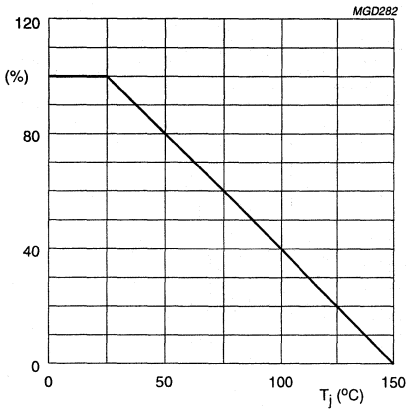


Fig. 9 Total power dissipation.

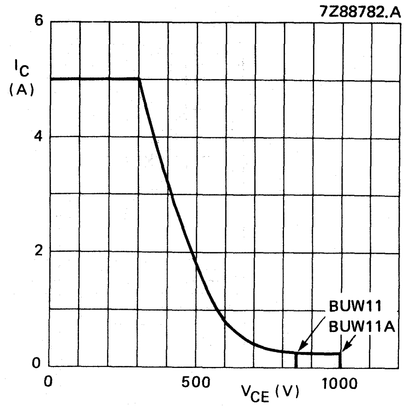


Fig. 10 Reverse bias SOAR.

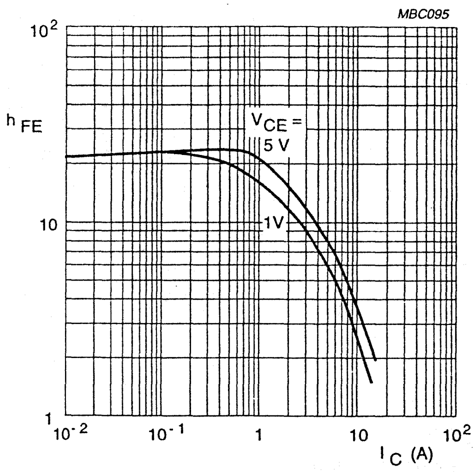


Fig.11 Typical values DC current gain.

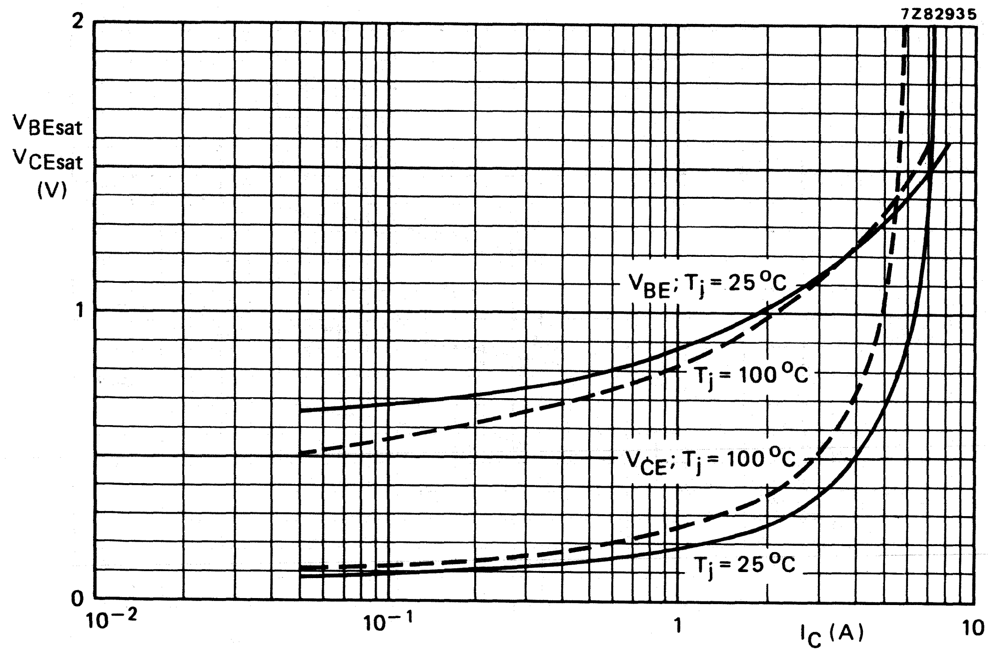


Fig. 12 Typical values base-emitter and collector-emitter voltage, $I_C/I_B = 5$.

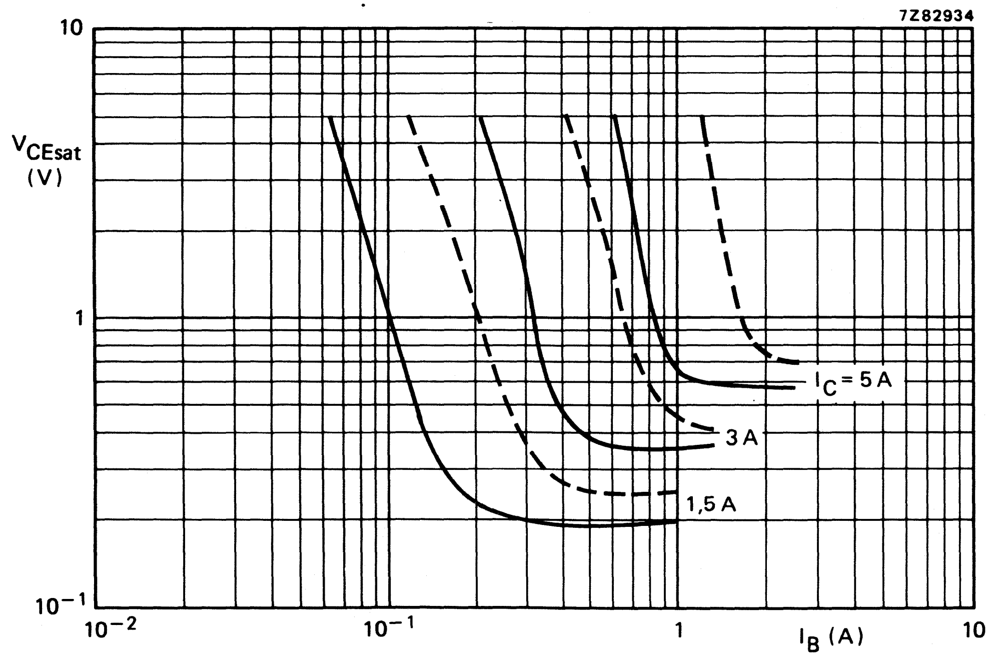


Fig. 13 Typ. (———) and max. (– – –) values collector-emitter saturation voltage at $T_j = 25\ ^oC$.

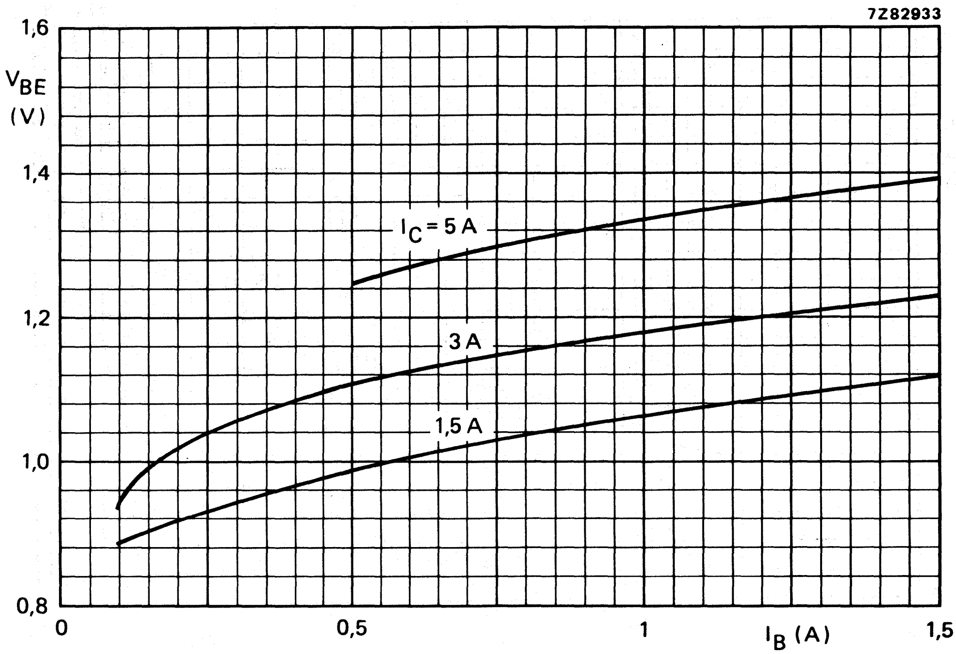


Fig. 14 Typical values at T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistor in a SOT199 envelope intended for use in converters, inverters, switching regulators, motor control systems, etc.

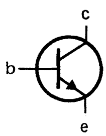
QUICK REFERENCE DATA

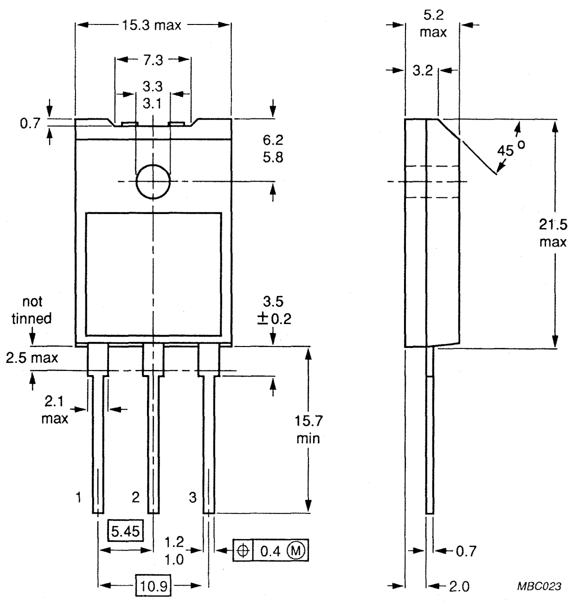
			BUW11F	BUW11AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5	1.5	V
Collector current					
saturation	I_{Csat}	max.	3.0	2.5	A
DC	I_C	max.	5.0	5.0	A
peak value; $t_p < 20$ ms	I_{CM}	max.	10	10	A
Total power dissipation					
up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	32	32	W
Fall time	t_f	max.	0.8	0.8	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT199.





Pinning:

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated.

RATINGS

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

			BUW11F	BUW11AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		3.0	2.5	
DC	I_C	max.	5.0		A
peak value; $t_p < 20$ ms	I_{CM}	max.	10		A
Base current					
DC	I_B	max.	2.0		A
peak value; $t_p < 20$ ms	I_{BM}	max.	4.0		A
Total power dissipation up to T_{mb} = 25 °C (note 1)	P_{tot}	max.	32		W
Total power dissipation up to T_{mb} = 25 °C (note 2)	P_{tot}	max.	41		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	3.95	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	3.05	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	35	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500	V
Isolation capacitance from collector to external heatsink	C_{isol}	max.	21	pF

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off currents (note 3)				
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0	mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	2.0	mA
Emitter cut-off current				
V_{EB} = 9 V; $I_C = 0$	I_{EBO}	max.	10	mA

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
3. Measured with a half-sinewave voltage (curve tracer).

			BUW11F	BUW11AF	
Saturation voltages					
$I_C = 3$ A; $I_B = 0.6$ A	V_{CEsat}	max.	1.5	—	V
	V_{BEsat}	max.	1.4	—	V
$I_C = 2.5$ A; $I_B = 0.5$ A	V_{CEsat}	max.	—	1.5	V
	V_{BEsat}	max.	—	1.4	V
Collector-emitter sustaining voltage (Figs 2 and 3)					
$I_C = 100$ mA; $I_{B\,off} = 0$; L = 25 mH	$V_{CEOsust}$	min.	400	450	V
Collector saturation current					
$V_{CE} = 1.5$ V	I_{Csat}	max.	3.0	2.5	A
DC current gain					
$I_C = 5$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
$I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Switching times resistive load (Figs 4 and 5)					
$I_{C\,on} = 3$ A; $I_{B\,on} = I_{B\,off} = 0.6$ A					
Turn-on time	t_{on}	max.	1.0	—	μs
Turn-off; storage time	t_s	max.	4.0	—	μs
fall time	t_f	max.	0.8	—	μs
$I_{C\,on} = 2.5$ A; $I_{B\,on} = I_{B\,off} = 0.5$ A					
Turn-on time	t_{on}	max.	—	1.0	μs
Turn-off; storage time	t_s	max.	—	4.0	μs
fall time	t_f	max.	—	0.8	μs
Switching times inductive load (Figs 6 and 7)					
$I_{C\,on} = 3$ A; $I_B = 0.6$ A; $V_{CL} = 250$ V; $T_c = 100$ °C					
Turn-off; storage time	t_s	typ.	2.0	—	μs
	t_s	max.	2.5	—	μs
fall time	t_f	typ.	200	—	ns
	t_f	max.	300	—	ns
$I_{C\,on} = 2.5$ A; $I_B = 0.5$ A; $V_{CL} = 300$ V; $T_c = 100$ °C					
Turn-off; storage time	t_s	typ.	—	2.0	μs
	t_s	max.	—	2.5	μs
fall time	t_f	typ.	—	200	ns
	t_f	max.	—	300	ns

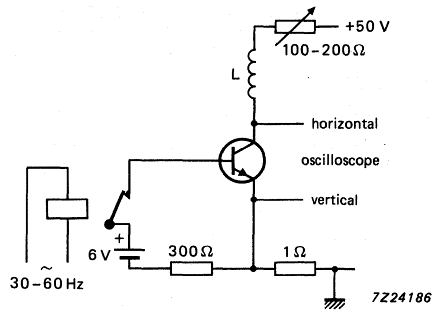


Fig. 2 Test circuit for $V_{CEOsust}$.

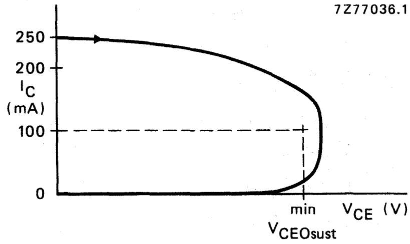


Fig. 3 Oscilloscope display for sustaining voltage.

V_{CC} = 250 V
t_p = 20 µs
V_{IM} = –6 to + 8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\ on}$ and I_B requirements.

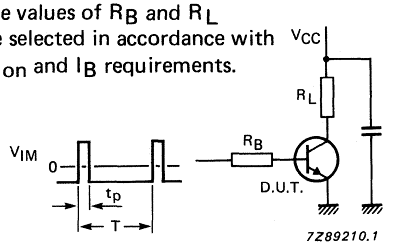


Fig. 4 Test circuit resistive load.

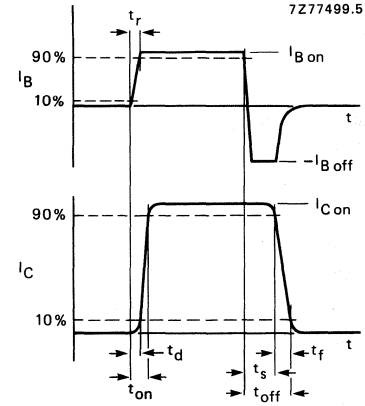


Fig. 5 Switching times waveforms with resistive load; $t_r \leqslant 20$ ns.

V_{CL} = up to 1000 V
V_{CC} = 30 V
$-V_{BE}$= 1 V to 5 V
L_B = 1.0 µH
L_C = 200 µH

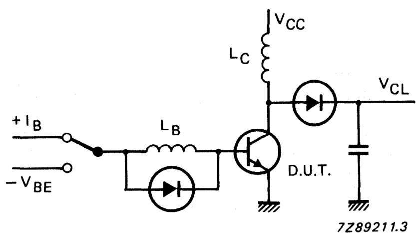


Fig. 6 Test circuit inductive load and reverse bias SOAR.

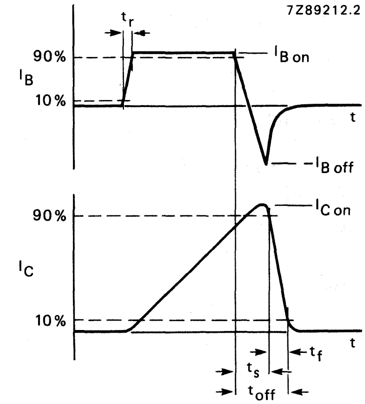
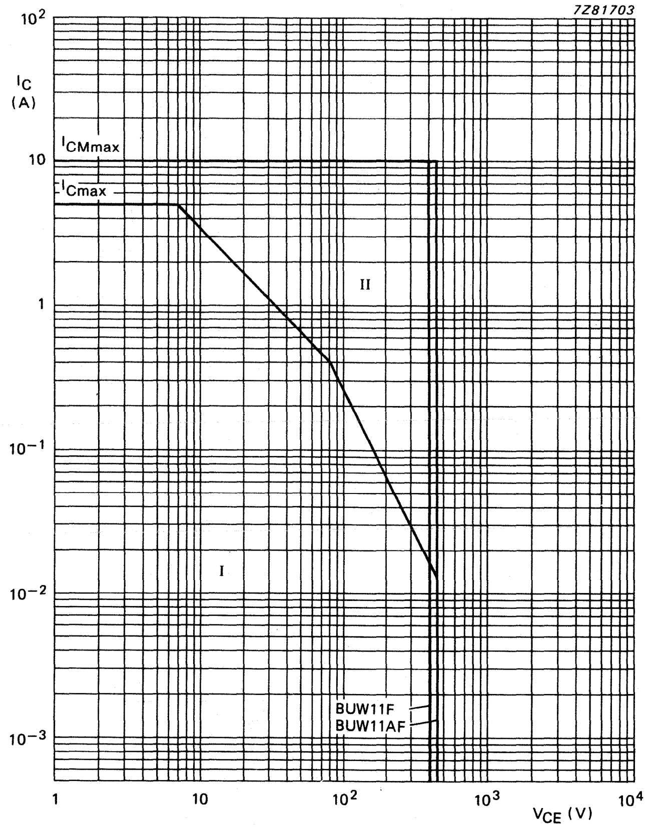


Fig. 7 Switching times waveforms with inductive load.



Mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at $T_{mb} < 25\ ^oC$.

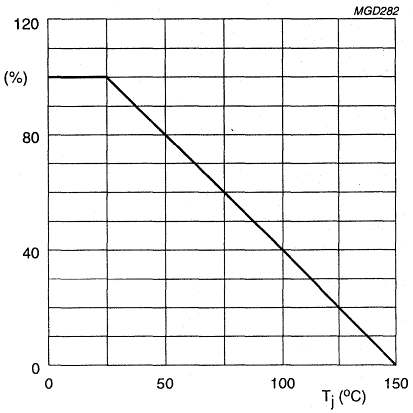


Fig. 9 Total power dissipation.

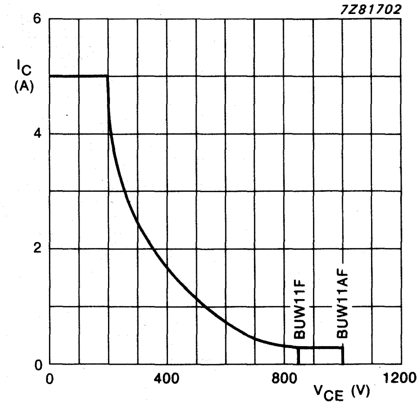


Fig. 10 RB SOAR; $T_c \leqslant 100\ ^oC$; $V_{BE} = -1$ V to -5 V.

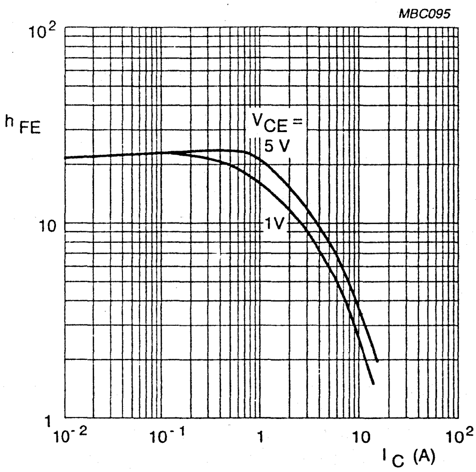


Fig. 11 Typical values DC current gain; $T_j = 125\ ^oC$.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in a SOT93 envelope, intended for use in converters, inverters, switching regulators, motor control systems etc.

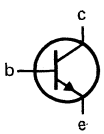
QUICK REFERENCE DATA

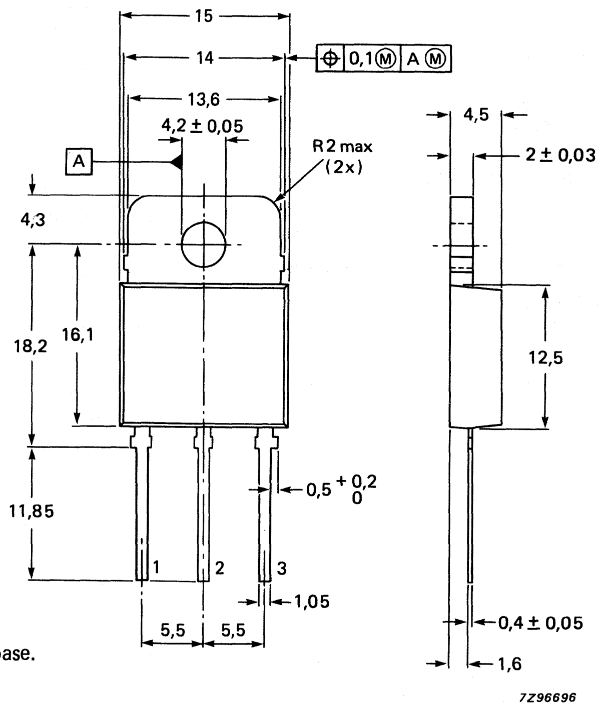
			BUW12	BUW12A	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5		V
Collector current (DC)	I_C	max.	8		A
Collector current (peak value)	I_{CM}	max.	20		A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	125		W
Fall time (resistive load)	t_f	max.	0.8		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT93.





Pinning:
1 = base
2 = collector
3 = emitter

Collector connected to mounting base.

RATINGS

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

			BUW12	BUW12A	
Collector-emitter voltage (peak value; V_{BE} = 0)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector current (DC)	I_C	max.	8		A
Collector current (peak value); $t_p < 2$ ms	I_{CM}	max.	20		A
Base current (DC)	I_B	max.	4		A
Base current (peak value); $t_p \leqslant 2$ ms	I_{BM}	max.	6		A
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	125		W
Storage temperature range	T_{stg}		−65 to + 150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,0	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current*				
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1	mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	3	mA
Emitter cut-off current				
$I_C = 0$; V_{EB} = 9 V	I_{EBO}	max.	10	mA

			BUW12	BUW12A	
Saturation voltages					
I_C = 6 A; I_B = 1,2 A	V_{CEsat}	max.	1,5	–	V
	V_{BEsat}	max.	1,5	–	V
I_C = 5 A; I_B = 1,0 A	V_{CEsat}	max.	–	1,5	V
	V_{BEsat}	max.	–	1,5	V
Collector-emitter sustaining voltage					
I_C = 100 mA; I_{Boff} = 0; L = 25 mH	$V_{CEOsust}$	min.	400	450	V

DC current gain			
I_C = 10 mA; V_{CE} = 5 V	h_{FE}	min.	10
	h_{FE}	typ.	18
	h_{FE}	max.	35
I_C = 1 A; V_{CE} = 5 V	h_{FE}	min.	10
	h_{FE}	typ.	20
	h_{FE}	max.	35

* Measured with a half-sinewave voltage (curve tracer).

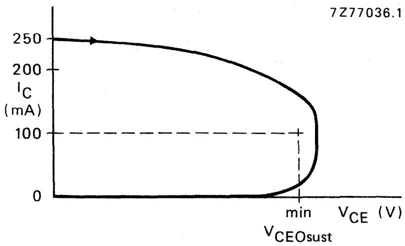


Fig. 2 Oscilloscope display for sustaining voltage.

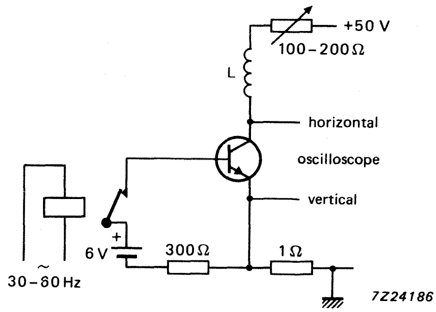
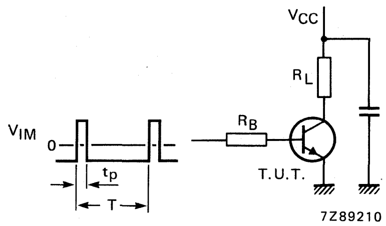


Fig. 3 Test circuit for $V_{CEOsust}$.

			BUW12	BUW12A	
Switching times resistive load (Figs 4 and 5)					
I_{Con} = 6 A; $I_{Bon} = -I_{Boff}$ = 1,2 A					
Turn-on time	t_{on}	max.	1	–	μs
Turn-off: Storage time	t_s	max.	4	–	μs
Fall time	t_f	max.	0,8	–	μs
I_{Con} = 5 A; $I_{Bon} = -I_{Boff}$ = 1 A					
Turn-on time	t_{on}	max.	–	1	μs
Turn-off: Storage time	t_s	max.	–	4	μs
Fall time	t_f	max.	–	0,8	μs
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 6 A; I_B = 1,2 A					
Turn-off: Storage time	t_s	typ.	1,6	–	μs
		max.	2,1	–	μs
Fall time	t_f	typ.	80	–	ns
		max.	150	–	ns
I_{Con} = 6 A; I_B = 1,2 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	1,8	–	μs
		max.	2,3	–	μs
Fall time	t_f	typ.	140	–	ns
		max.	300	–	ns
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 5 A; I_B = 1 A					
Turn-off: Storage time	t_s	typ.	–	1,6	μs
		max.	–	2,1	μs
Fall time	t_f	typ.	–	80	ns
		max.	–	150	ns
I_{Con} = 5 A; I_B = 1 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	–	1,8	μs
		max.	–	2,3	μs
Fall time	t_f	typ.	–	140	ns
		max.	–	300	ns



V_{CC} = 250 V
V_{IM} = −6 to + 8 V
$\frac{t_p}{T}$ = 0,01
t_p = 20 μs
The values of R_B and R_L are selected in accordance with I_{Con} and I_B requirements.

Fig. 4 Test circuit resistive load.

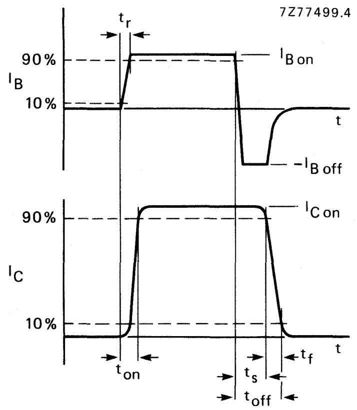


Fig. 5 Switching times waveforms. with resistive load.

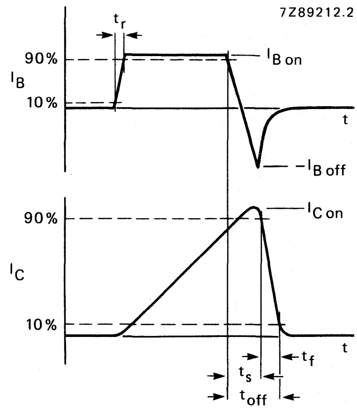
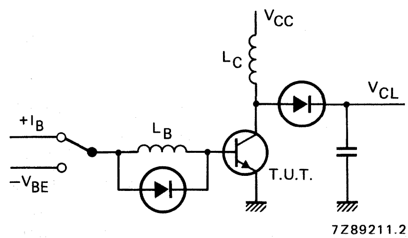
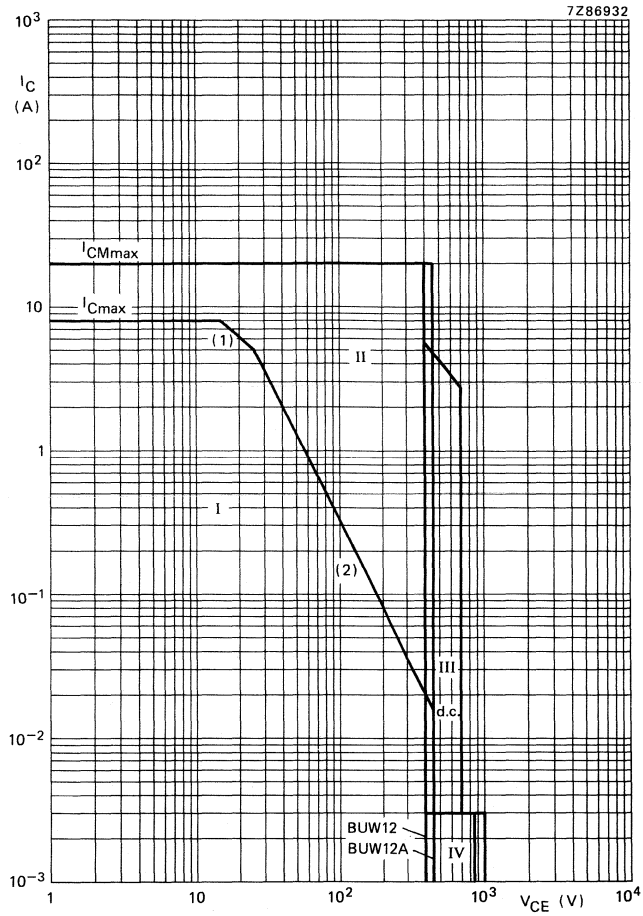


Fig. 6 Switching times waveforms with inductive load.



V_{CL} = 300 V
V_{CC} = 30 V
$-V_{BE}$ = 5 V
L_B = 1 μH
L_C = 200 μH

Fig. 7 Test circuit inductive load.



(1) $P_{tot\ max}$ line.
(2) Second-breakdown limits.

I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.
III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$.
IV Repetitive pulse operation in this region is permissible provided $V_{BE} \leqslant 0$ and $t_p \leqslant 2$ ms.

Fig. 8 Safe operating area at $T_{mb} \leqslant 25\ ^oC$.

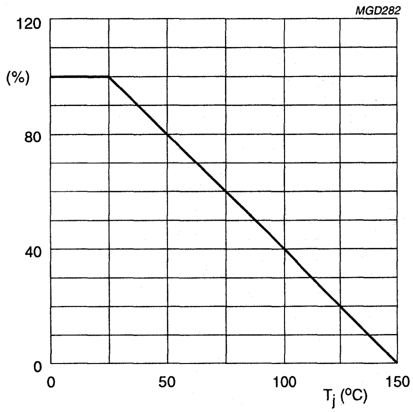


Fig. 9 Total power dissipation.

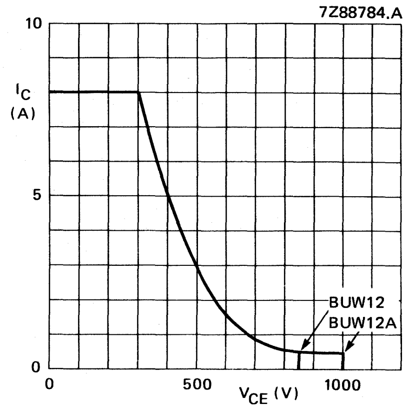


Fig. 10 Reverse bias SOAR.

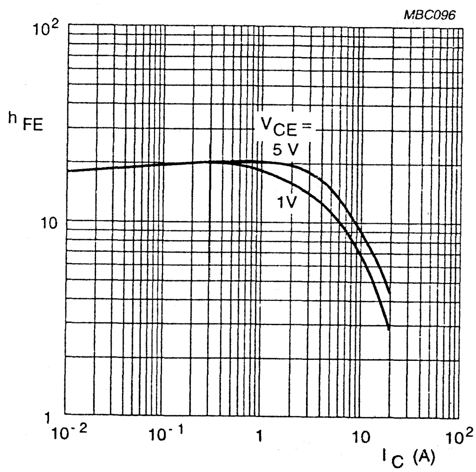


Fig.11 Typical values DC current gain.

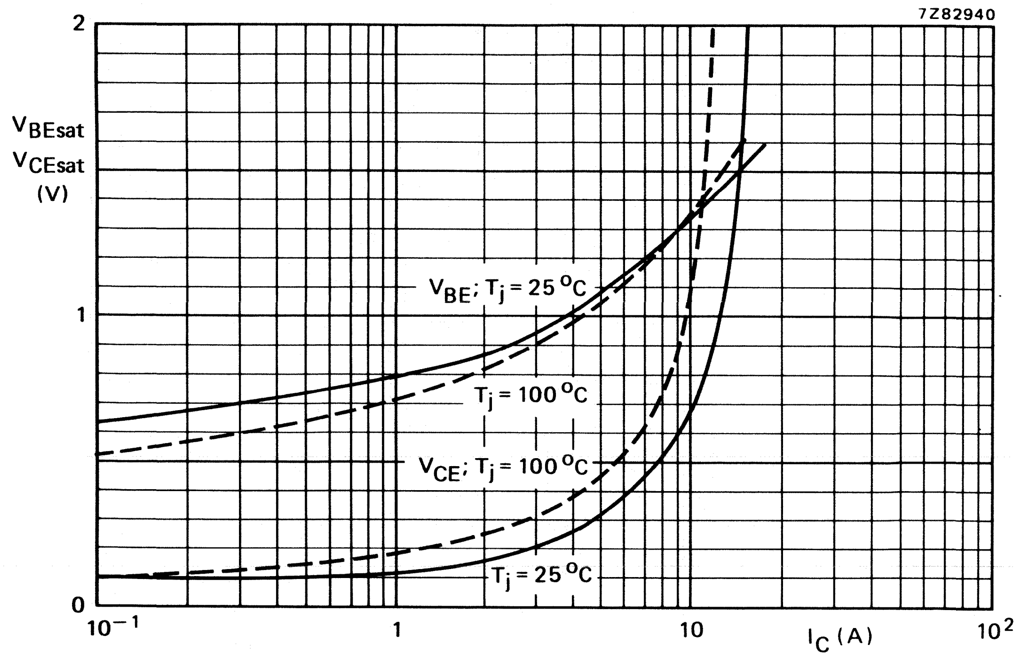


Fig. 12 Typical values base and collector voltage at $I_C/I_B = 5$.

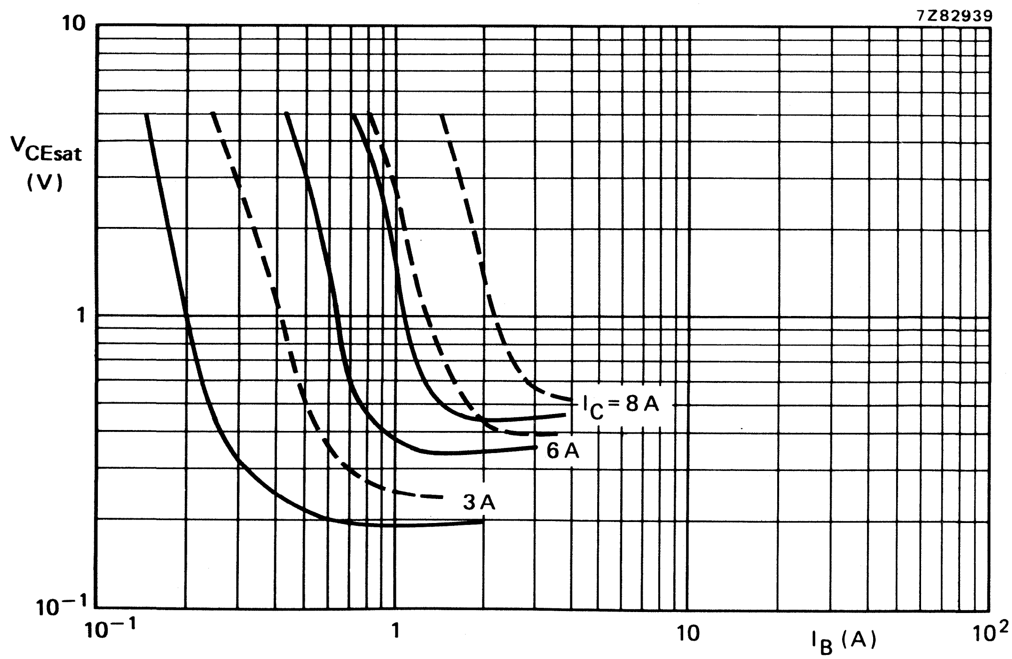


Fig. 13 Typ. (——) and max. (– – –) values collector-emitter saturation voltage at T_j = 25 °C.

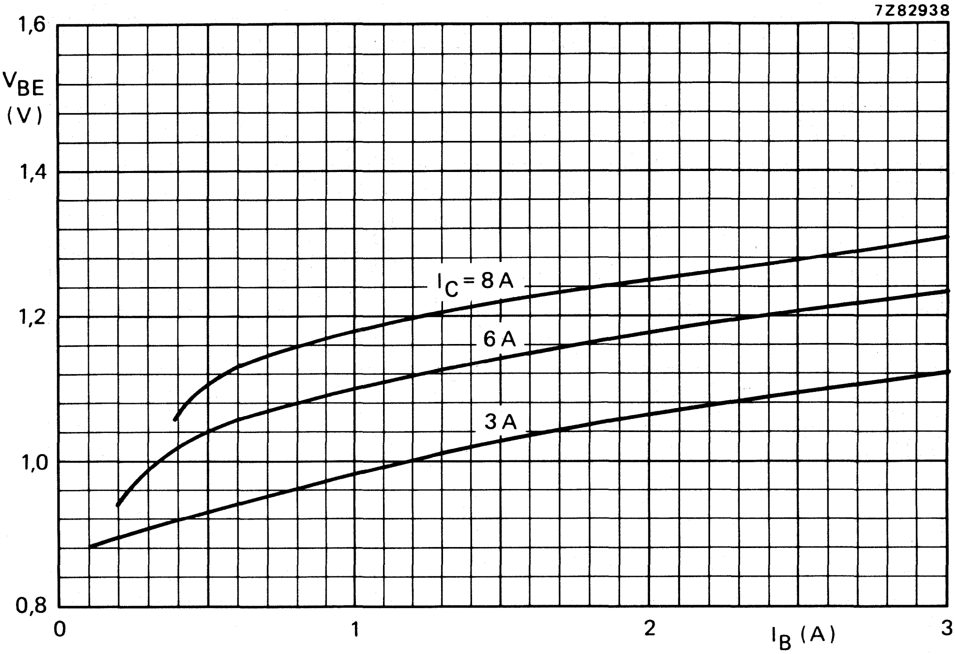


Fig. 14 Typical values base-emitter voltage at T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistor in a SOT199 envelope intended for use in converters, inverters, switching regulators, motor control systems, etc.

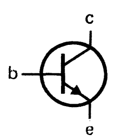
QUICK REFERENCE DATA

			BUW12F	BUW12AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5	1.5	V
Collector current					
saturation	I_{Csat}	max.	6.0	5.0	A
DC	I_C	max.	8.0		A
peak value	I_{CM}	max.	20		A
Total power dissipation					
up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	34		W
Fall time	t_f	max.	0.8		μs

MECHANICAL DATA

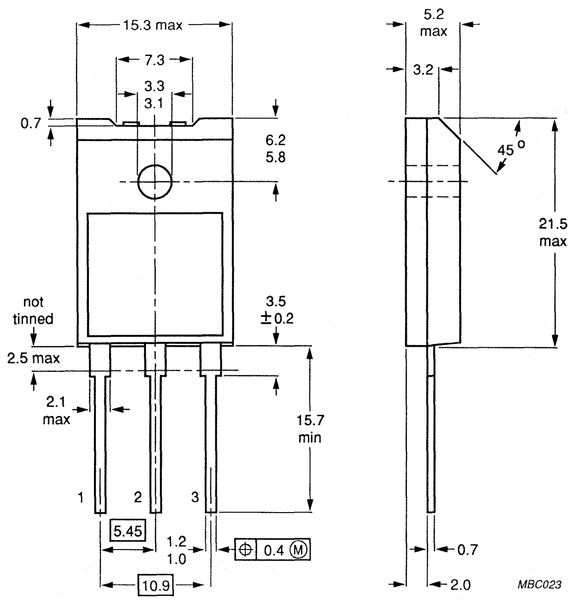
Dimensions in mm

Fig. 1 SOT199.



Pinning:

1 = base
2 = collector
3 = emitter



Mounting base is electrically isolated.

RATINGS

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

			BUW12F	BUW12AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		6.0	5.0	A
DC	I_C	max.	8.0		A
peak value	I_{CM}	max.	20		A
Base current					
DC	I_B	max.	4.0		A
peak value	I_{BM}	max.	6.0		A
Total power dissipation up to $T_h = 25\ ^oC$ (note 1)	P_{tot}	max.	34		W
Total power dissipation up to $T_h = 25\ ^oC$ (note 2)	P_{tot}	max.	45		W
Storage temperature range	T_{stg}		–65 to + 150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	3.7	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	2.8	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	35	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value)	V_{isol}	max.	1500	V
Isolation capacitance from collector to external heatsink	C_{isol}	max.	21	pF

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off currents (note 3)				
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0	mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125\ ^oC$	I_{CES}	max.	3.0	mA
Emitter cut-off current				
$V_{EB} = 9$ V; $I_C = 0$	I_{EBO}	max.	10	mA

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
3. Measured with a half-sinewave voltage (curve tracer).

			BUW12F	BUW12AF	
Saturation voltages					
$I_C = 6$ A; $I_B = 1.2$ A	V_{CEsat}	max.	1.5	—	V
	V_{BEsat}	max.	1.5	—	V
$I_C = 5$ A; $I_B = 1.0$ A	V_{CEsat}	max.	—	1.5	V
	V_{BEsat}	max.	—	1.5	V
Collector-emitter sustaining voltage (Figs 2 and 3)					
$I_C = 100$ mA; $I_{B\,off} = 0$; $L = 25$ mH	$V_{CEOsust}$	min.	400	450	V
Collector saturation current					
$V_{CE} = 1.5$ V	I_{Csat}	max.	6.0	5.0	A
DC current gain					
$I_C = 10$ mA; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
$I_C = 1$ A; $V_{CE} = 5$ V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Switching times resistive load (Figs 4 and 5)					
$I_{C\,on} = 6$ A; $I_{B\,on} = I_{B\,off} = 1.2$ A					
Turn-on time	t_{on}	max.	1.0	—	μs
Turn-off; storage time	t_s	max.	4.0	—	μs
fall time	t_f	max.	0.8	—	μs
$I_{C\,on} = 5$ A; $I_{B\,on} = I_{B\,off} = 1$ A					
Turn-on time	t_{on}	max.	—	1.0	μs
Turn-off; storage time	t_s	max.	—	4.0	μs
fall time	t_f	max.	—	0.8	μs
Switching times inductive load (Figs 6 and 7)					
$I_{C\,on} = 6$ A; $I_B = 1.2$ A; $V_{CL} = 250$ V; $T_c = 100$ °C					
Turn-off; storage time	t_s	typ.	1.9	—	μs
	t_s	max.	2.5	—	μs
fall time	t_f	typ.	200	—	ns
	t_f	max.	300	—	ns
$I_{C\,on} = 5$ A; $I_B = 1$ A; $V_{CL} = 300$ V; $T_c = 100$ °C					
Turn-off; storage time	t_s	typ.	—	1.9	μs
	t_s	max.	—	2.5	μs
fall time	t_f	typ.	—	200	ns
	t_f	max.	—	300	ns

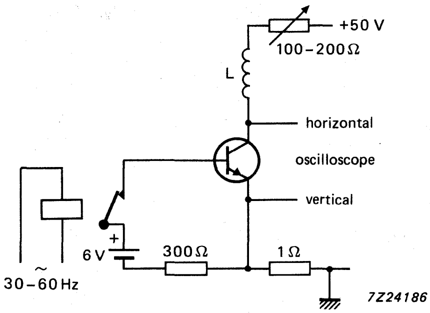


Fig. 2 Test circuit for $V_{CEOsust}$.

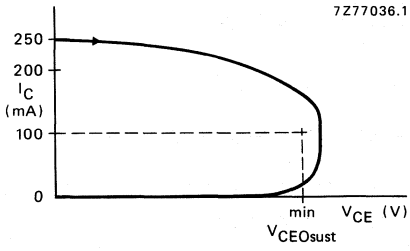


Fig. 3 Oscilloscope display for sustaining voltage.

V_{CC} = 250 V
t_p = 20 μs
V_{IM} = −6 to + 8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\ on}$ and I_B requirements

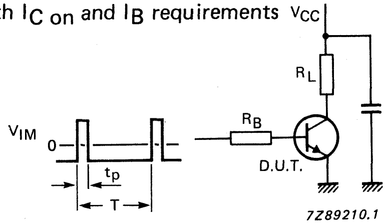


Fig. 4 Test circuit resistive load.

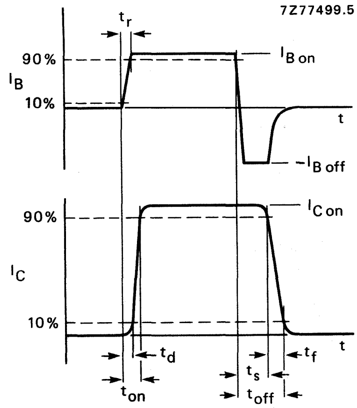


Fig. 5 Switching waveforms with resistive load; $t_r \leq 20$ ns.

V_{CL} = up to 1000 V
V_{CC} = 30 V
$-V_{BE}$= 1 V to 5 V
L_B = 1.0 μH
L_C = 200 μH

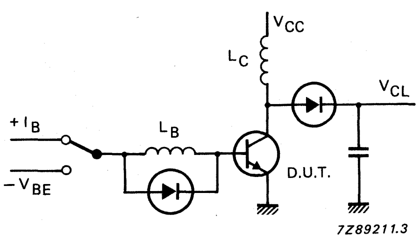


Fig. 6 Test circuit inductive load and reverse bias SOAR.

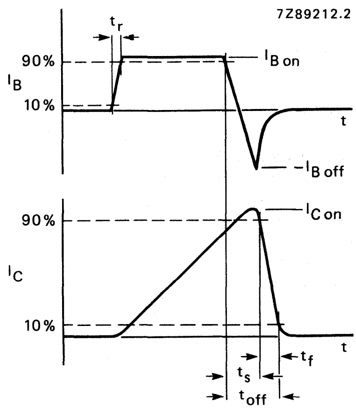
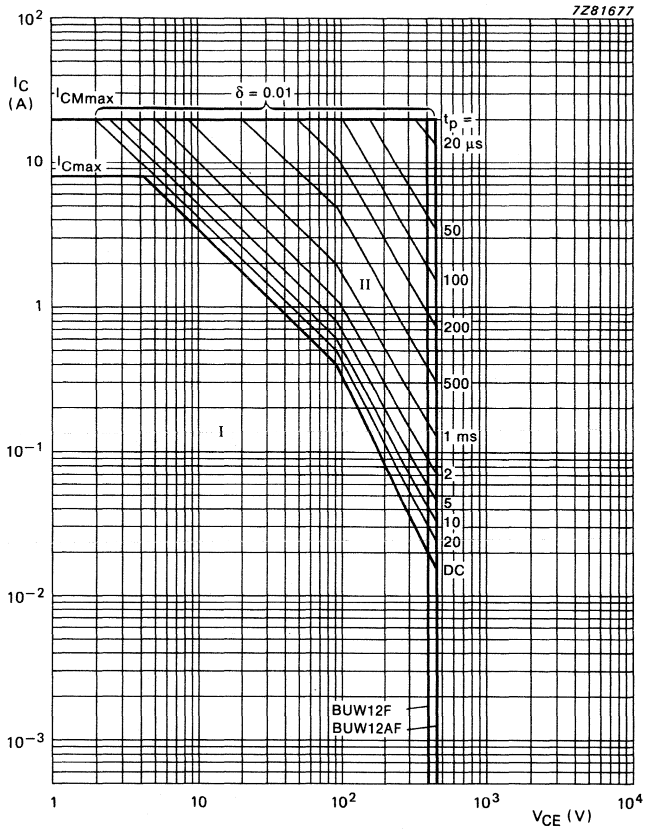


Fig. 7 Switching times waveforms with inductive load.



Mounted without heatsink compound and 30 ± 5 newtons pressure on the centre of the envelope.

I Region of permissible DC operation.

II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at $T_{mb} < 25$ °C.

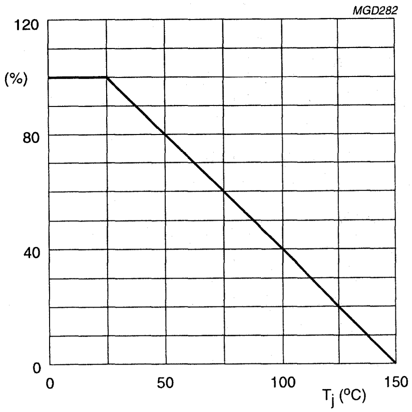


Fig. 9 Total power dissipation.

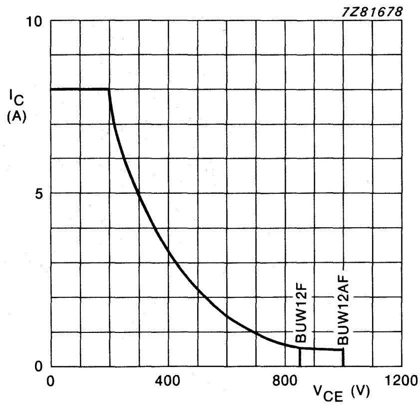


Fig. 10 RB SOAR; $T_c \leqslant 100\ ^oC$; $V_{BE} = -1$ V to -5 V.

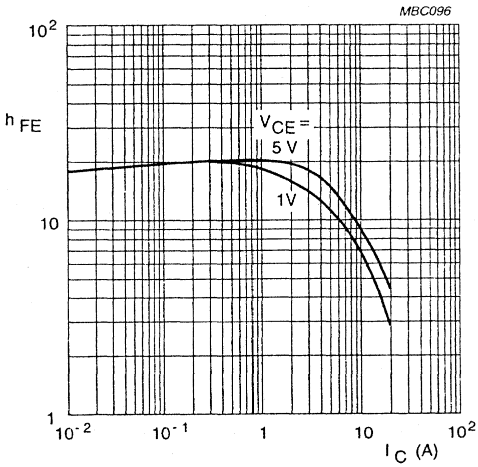


Fig. 11 Typical values DC current gain; $T_j = 125\ ^oC$.

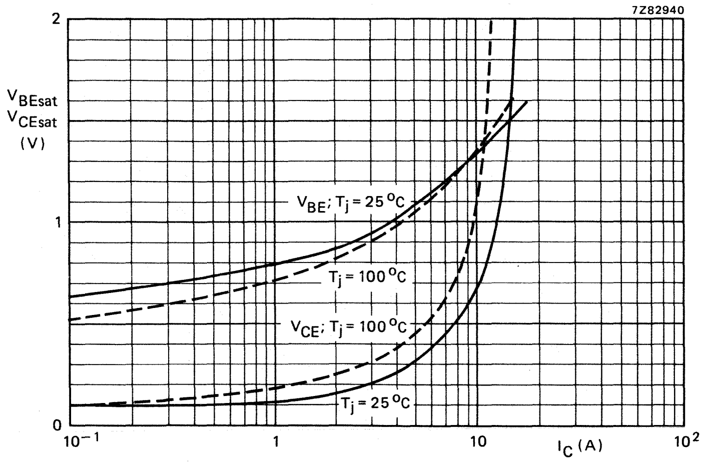


Fig. 12 Typical values base and collector voltages at $I_C/I_B = 5$.

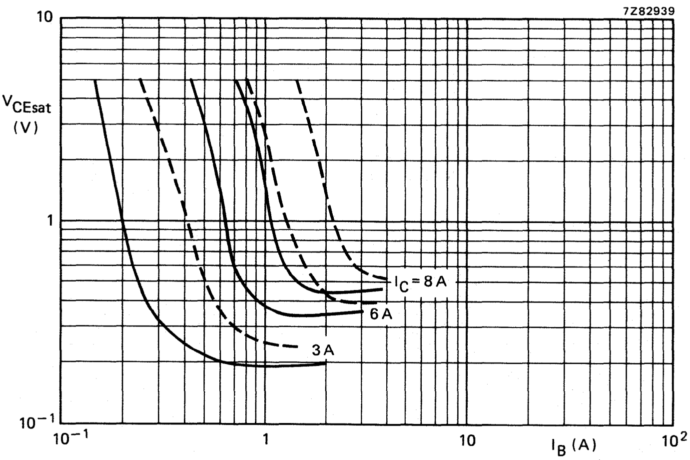


Fig. 13 Typical (——) and maximum (– – –) values saturation voltage; T_j = 25 °C.

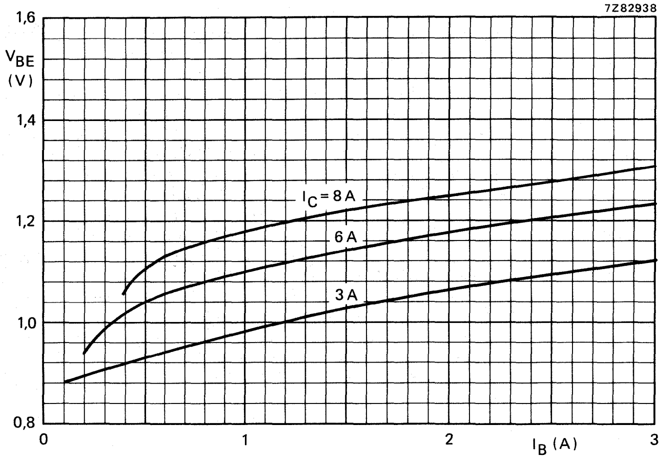


Fig. 14 Typical values base-emitter voltage at $T_j = 25$ °C.

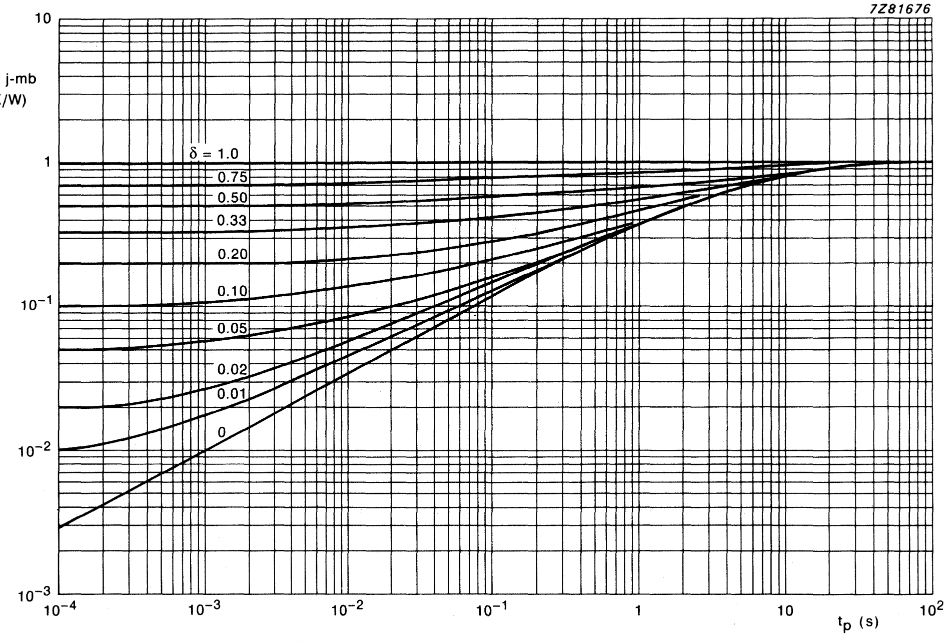


Fig. 15 Normalized thermal response at pulse power conditions.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in a SOT93 envelope, intended for use in converters, inverters, switching regulators, motor control systems etc.

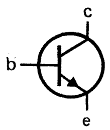
QUICK REFERENCE DATA

			BUW13	BUW13A	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5		V
Collector current (DC)	I_C	max.	15		A
Collector current (peak value)	I_{CM}	max.	30		A
Total power dissipation up to $T_{mb} = 25\ ^oC$	P_{tot}	max.	175		W
Fall time	t_f	max.	0.8		μs

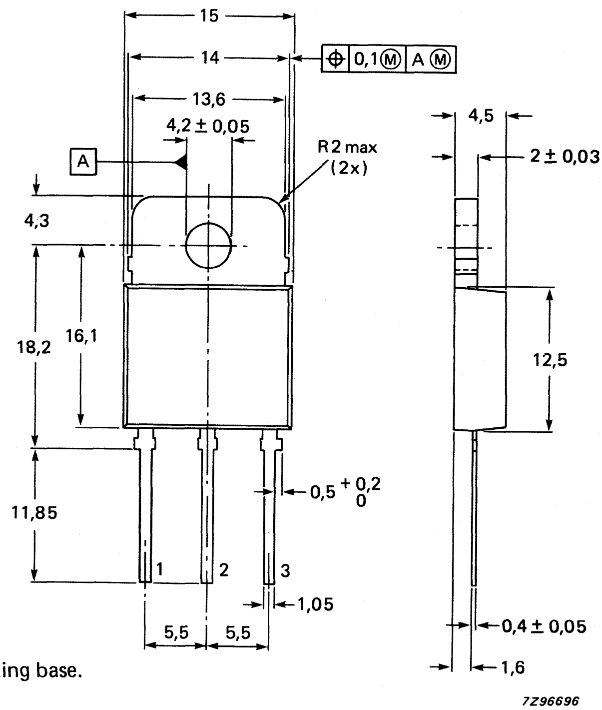
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT93.



Pinning:
1 = base
2 = collector
3 = emitter



Collector connected to mounting base.

RATINGS

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

			BUW13	BUW13A	
Collector-emitter voltage (peak value, V_{BE} = 0)	V_{CESM}	max.	850	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector current (DC)	I_C	max.	15		A
Collector current (peak value); $t_p < 2$ ms	I_{CM}	max.	30		A
Base current (DC)	I_B	max.	6		A
Base current (peak value); $t_p < 2$ ms	I_{BM}	max.	9		A
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	175		W
Storage temperature range	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,7	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current*					
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1		mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	4		mA
Emitter cut-off current					
$I_C = 0$; V_{EB} = 9 V	I_{EBO}	max.	10		mA
			BUW13	BUW13A	
Saturation voltages					
I_C = 10 A; I_B = 2 A	V_{CEsat}	max.	1,5	–	V
	V_{BEsat}	max.	1,6	–	V
I_C = 8 A; I_B = 1,6 A	V_{CEsat}	max.	–	1,5	V
	V_{BEsat}	max.	–	1,6	V
DC current gain					
I_C = 20 mA; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
I_C = 1.5 A; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Collector-emitter sustaining voltage					
I_C = 100 mA; I_{Boff} = 0; L = 25 mH	$V_{CEOsust}$	min.	400	450	V

* Measured with a half-sinewave voltage (curve tracer).

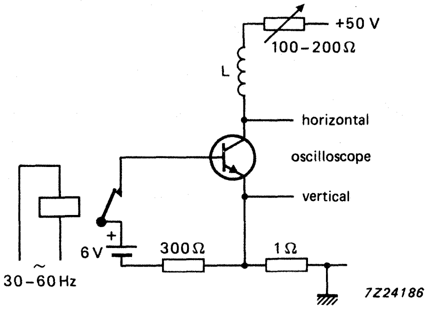


Fig. 2 Test circuit for $V_{CEOsust}$.

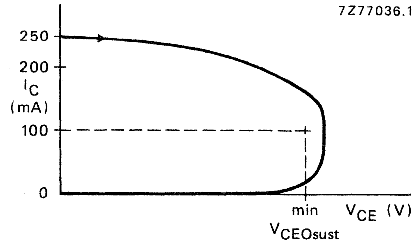
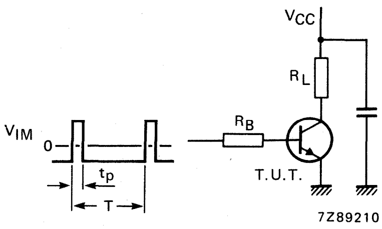


Fig. 3 Oscilloscope display for sustaining voltage.

			BUW13	BUW13A	
Switching times resistive load (Figs 4 and 5)					
I_{Con} = 10 A; $I_{Bon} = -I_{Boff}$ = 2 A					
Turn-on time	t_{on}	max.	1	–	µs
Turn-off: Storage time	t_s	max.	4	–	µs
Fall time	t_f	max.	0,8	–	µs
I_{Con} = 8 A; $I_{Bon} = -I_{Boff}$ = 1,6 A					
Turn-on time	t_{on}	max.	–	1	µs
Turn-off: Storage time	t_s	max.	–	4	µs
Fall time	t_f	max.	–	0,8	µs
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 10 A; I_B = 2 A					
Turn-off: Storage time	t_s	typ.	2,3	–	µs
		max.	3,0	–	µs
Fall time	t_f	typ.	80	–	ns
		max.	150	–	ns
I_{Con} = 10 A; I_B = 2 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	2,5	–	µs
		max.	3,2	–	µs
Fall time	t_f	typ.	140	–	ns
		max.	300	–	ns
Switching times inductive load (Figs 6 and 7)					
I_{Con} = 8 A; I_B = 1,6 A					
Turn-off: Storage time	t_s	typ.	–	2,3	µs
		max.	–	3,0	µs
Fall time	t_f	typ.	–	80	ns
		max.	–	150	ns
I_{Con} = 8 A; I_B = 1,6 A; T_j = 100 °C					
Turn-off: Storage time	t_s	typ.	–	2,5	µs
		max.	–	3,2	µs
Fall time	t_f	typ.	–	140	ns
		max.	–	300	ns



V_{CC} = 250 V
V_{IM} = −6 to + 8 V
t_p = 20 μs
$\frac{t_p}{T}$ = 0,01
The values of R_B and R_L are selected in accordance with I_{Con} and I_B requirements.

Fig. 4 Test circuit resistive load.

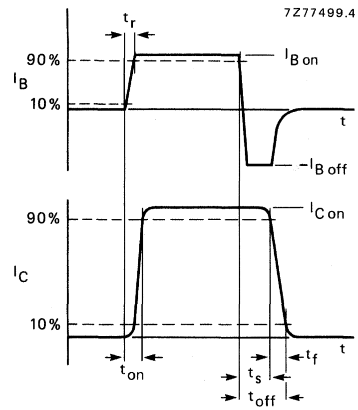


Fig. 5 Switching times waveforms with resistive load.

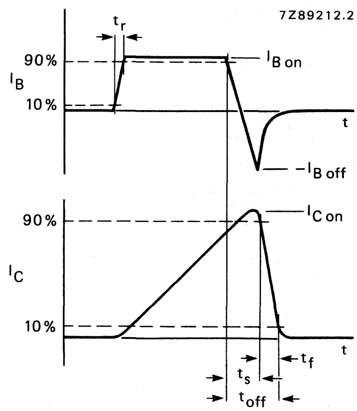
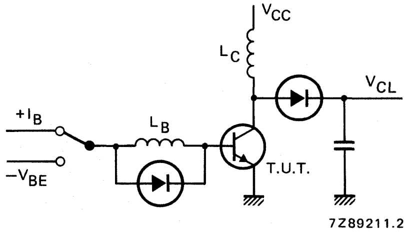
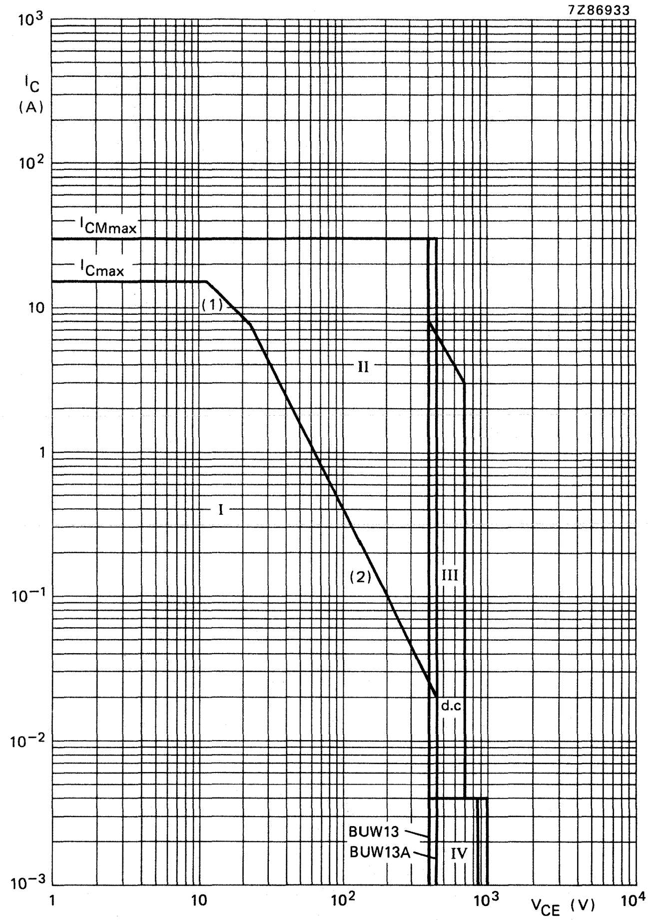


Fig. 6 Switching times waveforms with inductive load.



V_{CL} = 300 V
V_{CC} = 30 V
$-V_{BE}$ = 5 V
L_B = 1 μH
L_C = 200 μH

Fig. 7 Test circuit inductive load.



(1) $P_{tot\ max}$ line.
(2) Second-breakdown limits.

I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.
III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$.
IV Repetitive pulse operation in this region is permissible provided $V_{BE} \leqslant 0$ and $t_p \leqslant 5$ ms.

Fig. 8 Safe operating area at $T_{mb} \leqslant 25\ ^oC$.

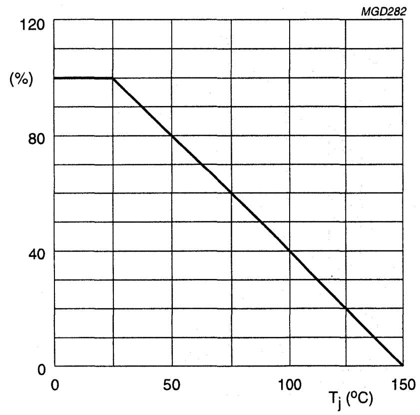


Fig. 9 Total power dissipation.

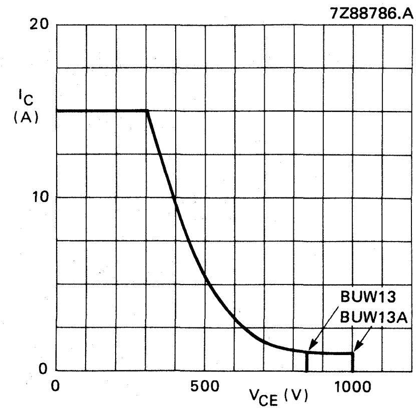


Fig. 10 Reverse bias SOAR.

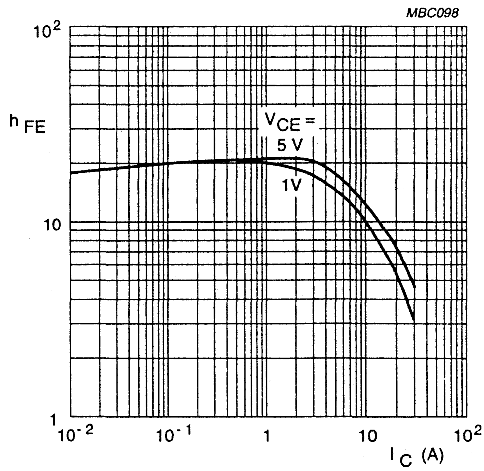


Fig.11 Typical values DC current gain.

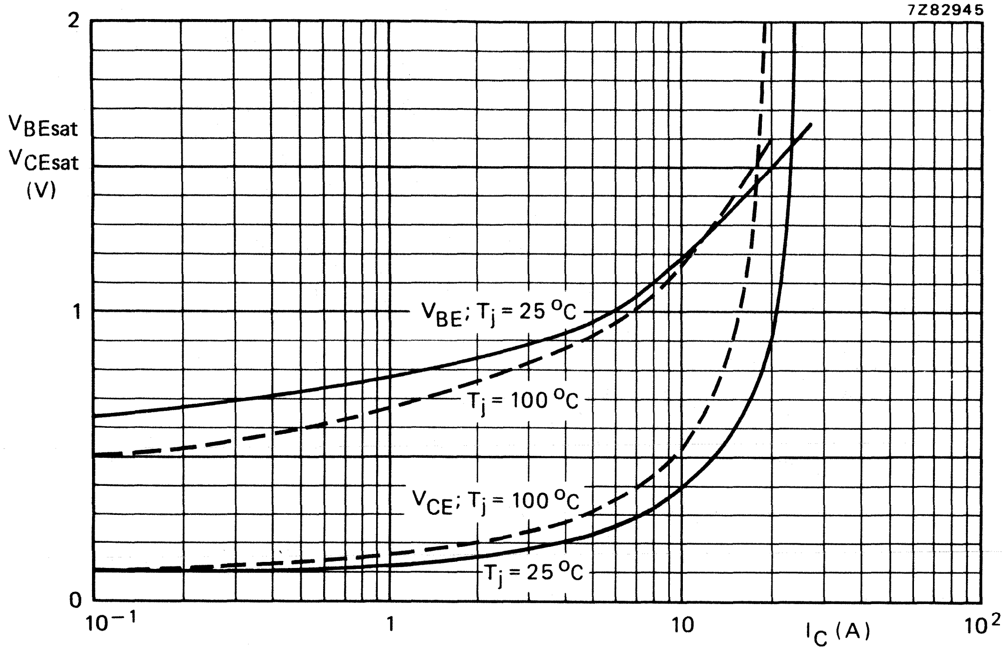


Fig. 12 Typical values base and collector voltage at $I_C/I_B = 5$.

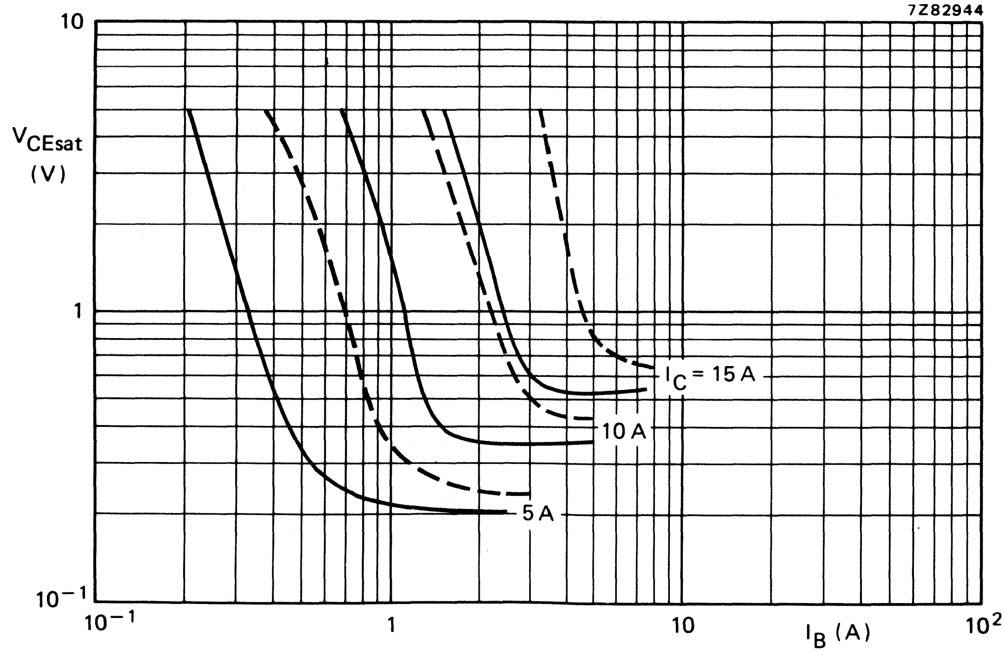


Fig. 13 Typical (——) and maximum (– – –) values saturation voltage. T_j = 25 °C.

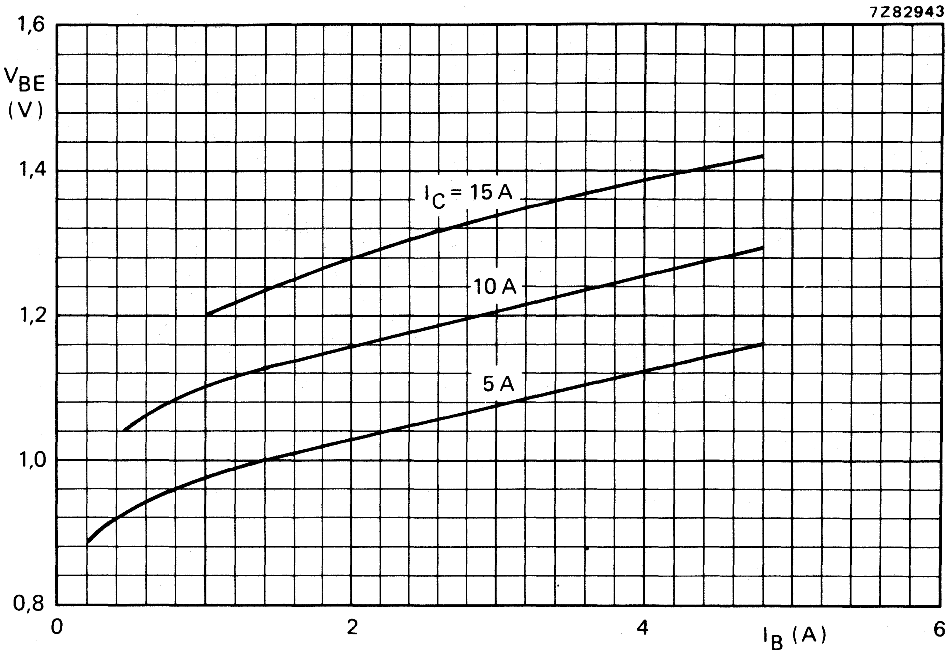


Fig. 14 Typical values base-emitter voltage at T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistor in a SOT199 envelope intended for use in converters, inverters, switching regulators, motor control systems, etc.

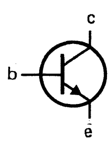
QUICK REFERENCE DATA

			BUW13F	BUW13AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1.5	1.5	V
Collector current					
saturation	I_{Csat}		10.0	8.0	A
DC	I_C	max.	15		A
peak value; $t_p < 20$ ms	I_{CM}	max.	30		A
Total power dissipation					
up to $T_h = 25\ ^oC$	P_{tot}	max.	37		W
Fall time	t_f	max.	0.8		μs

MECHANICAL DATA

Dimensions in mm

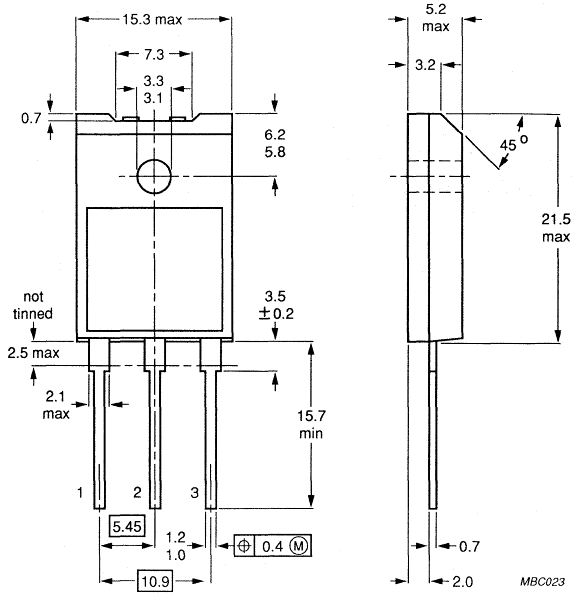
Fig. 1 SOT199.



Pinning:

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated.



RATINGS

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

			BUW13F	BUW13AF	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	850	1000	V
open base	V_{CEO}	max.	400	450	V
Collector current					
saturation	I_{Csat}		10.0	8.0	A
DC	I_C	max.	15		A
peak value; $t_p < 20$ ms	I_{CM}	max.	30		A
Base current					
DC	I_B	max.	6.0		A
peak value; $t_p = -20$ ms	I_{BM}	max.	9.0		A
Total power dissipation up to $T_h = 25\ ^oC$ (note 1)	P_{tot}	max.	37		W
Total power dissipation up to $T_h = 25\ ^oC$ (note 2)	P_{tot}	max.	50		W
Storage temperature range	T_{stg}		−65 to + 150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	3.4	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	2.5	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	35	K/W

ISOLATION

Isolation voltage from all terminals to external heatsink (peak value) (note 3)	V_{isol}	max.	2000	V
Isolation capacitance from collector to external heatsink	C_{isol}	max.	21	pF

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
3. Repetitive peak operation with RH ⩽ 65% under clean and dustfree conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Parameter	Symbol		BUW13F	BUW13AF	Unit
Collector cut-off currents*					
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	1.0		mA
$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	4.0		mA
Emitter cut-off current					
V_{EB} = 9 V; I_C = 0	I_{EBO}	max.	10		mA
Saturation voltages					
I_C = 10 A; I_B = 2 A	V_{CEsat}	max.	1.5	–	V
	V_{BEsat}	max.	1.6	–	V
I_C = 8 A; I_B = 1.6 A	V_{CEsat}	max.	–	1.5	V
	V_{BEsat}	max.	–	1.6	V
DC current gain					
I_C = 20 mA; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	18		
	h_{FE}	max.	35		
I_C = 1.5 A; V_{CE} = 5 V	h_{FE}	min.	10		
	h_{FE}	typ.	20		
	h_{FE}	max.	35		
Collector-emitter sustaining voltage (Figs 2 and 3)					
I_C = 100 mA; $I_{B\,off}$ = 0; L = 25 mH	$V_{CEOsust}$	min.	400	450	V
Collector saturation current					
V_{CE} = 1.5 V	I_{Csat}		10	8.0	A
Switching times resistive load (Figs 4 and 5)					
$I_{C\,on}$ = 10 A; $I_{B\,on} = I_{B\,off}$ = 2 A					
Turn-on time	t_{on}	max.	1.0	–	µs
Turn-off; storage time	t_s	max.	4.0	–	µs
fall time	t_f	max.	0.8	–	µs
$I_{C\,on}$ = 8 A; $I_{B\,on} = I_{B\,off}$ = 1.6 A					
Turn-on time	t_{on}	max.	–	1.0	µs
Turn-off; storage time	t_s	max.	–	4.0	µs
fall time	t_f	max.	–	0.8	µs
Switching times inductive load (Figs 6 and 7)					
$I_{C\,on}$ = 10 A; I_B = 2 A; V_{CL} = 250 V; T_c = 100 °C					
Turn-off; storage time	t_s	typ.	2.8	–	µs
	t_s	max.	3.5	–	µs
fall time	t_f	typ.	200	–	ns
	t_f	max.	300	–	ns
$I_{C\,on}$ = 8 A; I_B = 1.6 A; V_{CL} = 300 V; T_c = 100 °C					
Turn-off; storage time	t_s	typ.	–	2.8	µs
	t_s	max.	–	3.5	µs
fall time	t_f	typ.	–	200	ns
	t_f	max.	–	300	ns

* Measured with a half-sinewave voltage (curve tracer).

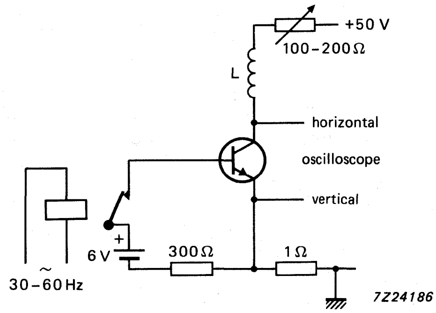


Fig. 2 Test circuit for $V_{CEOsust}$.

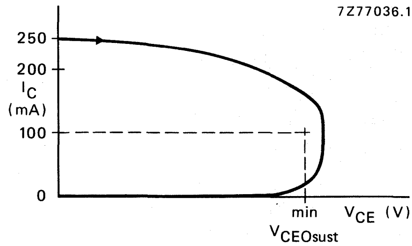
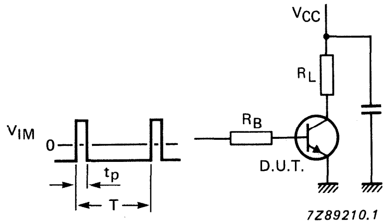


Fig. 3 Oscilloscope display for sustaining voltage.



V_{CC} = 250 V
t_p = 20 μs
V_{IM} = –6 to +8 V
$\frac{t_p}{T}$ = 0.01

The values of R_B and R_L are selected in accordance with $I_{C\ on}$ and I_B requirements.

Fig. 4 Test circuit resistive load.

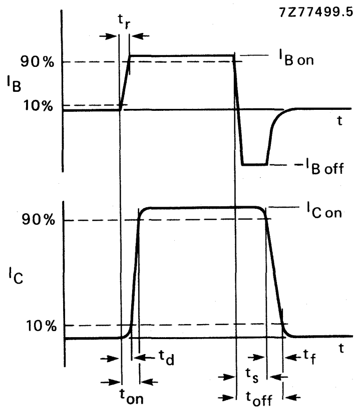
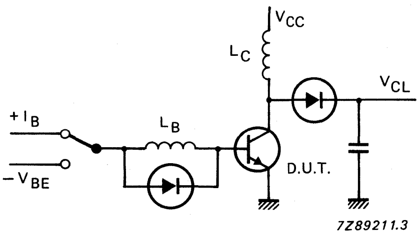


Fig. 5 Switching times waveforms with resistive load; $t_r \leqslant 20$ ns.



V_{CL} = up to 1000 V
V_{CC} = 30 V
$-V_{BE}$ = 5 V
L_B = 1.0 μH
L_C = 200 μH

Fig. 6 Test circuit inductive load and reverse bias SOAR.

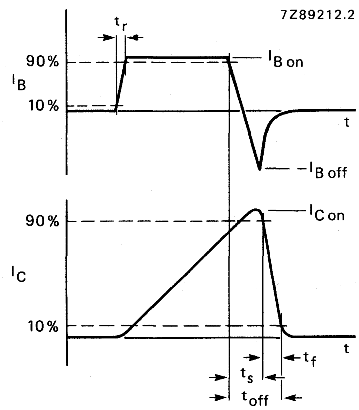
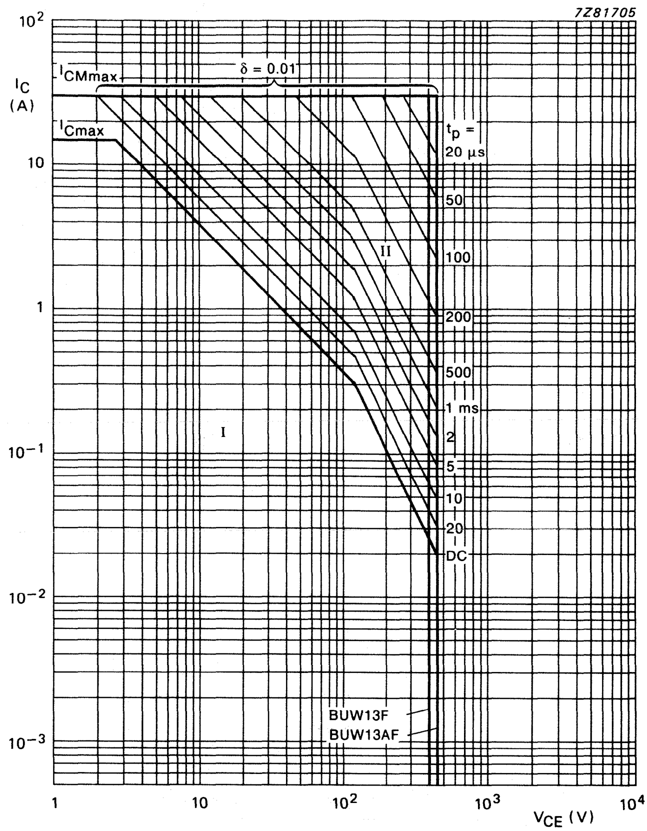


Fig. 7 Switching times waveforms with inductive load.



(1) $P_{tot\ max}$ and $P_{tot\ peak\ max}$ lines.
(2) Second-breakdown limits (independent of temperature).

I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

Fig. 8 Safe operating area at $T_{mb} < 25\ ^oC$.

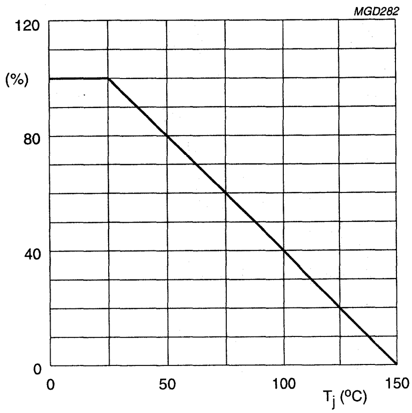


Fig. 9 Total power dissipation.

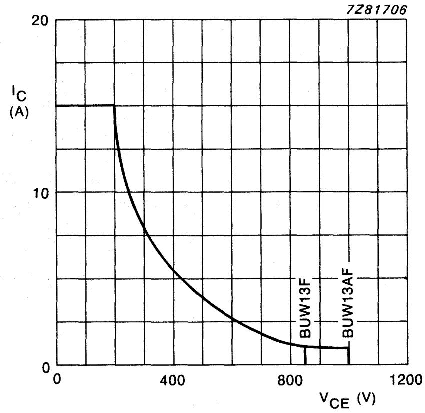


Fig. 10 RB SOAR; $T_c \leqslant 100$ °C; $V_{BE} = -1$ V to -5 V.

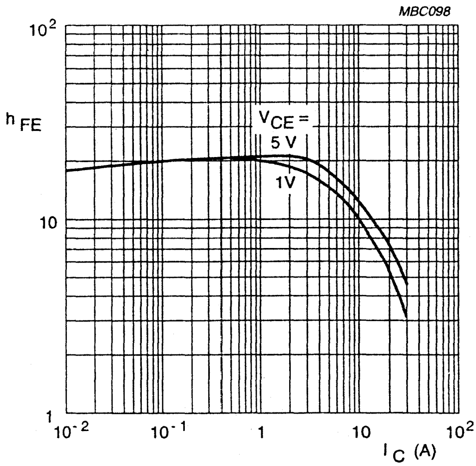


Fig. 11 Typical values DC current gain; T_j = 125 °C.

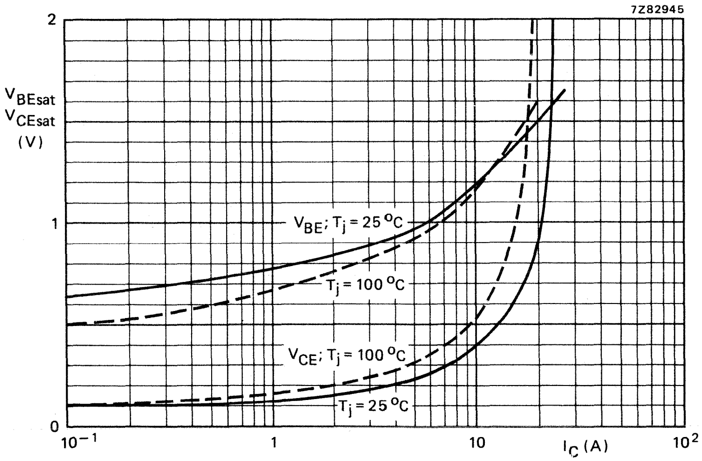


Fig. 12 Typical values base and collector voltages at $I_C/I_B = 5$.

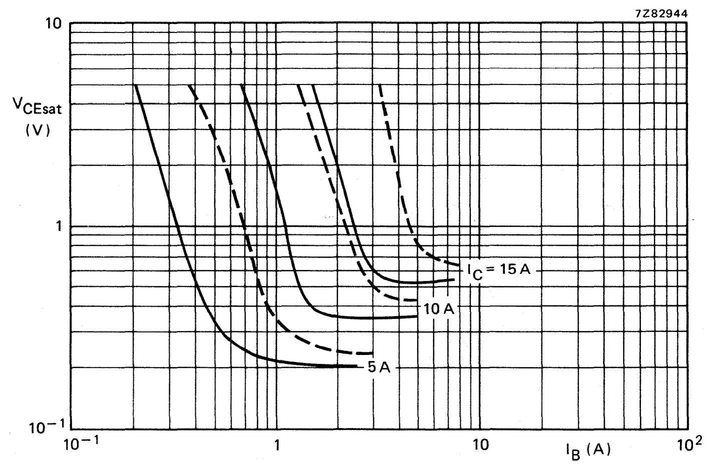


Fig. 13 Typical (——) and maximum (– – –) values saturation voltage; T_j = 25 °C.

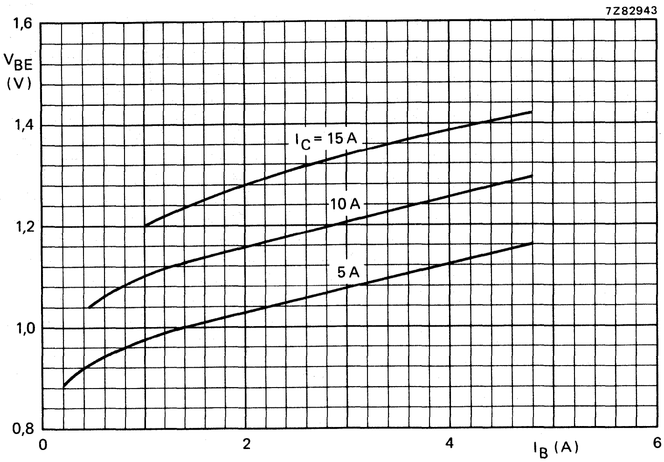


Fig. 14 Typical values base-emitter voltage at T_j = 25 °C.

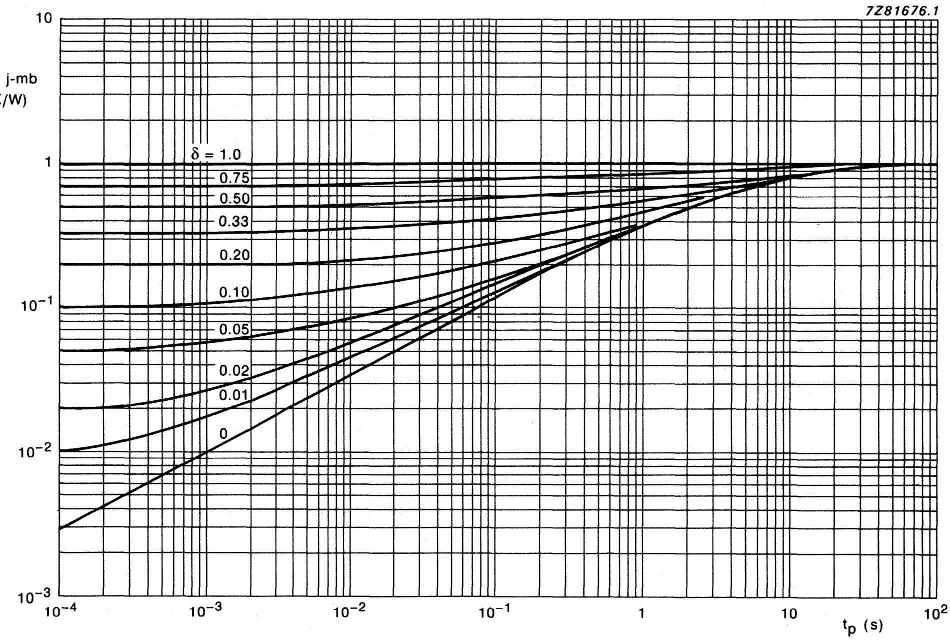


Fig. 15 Normalized thermal response at pulse power conditions.

GENERAL DESCRIPTION

High-voltage, high-speed, glass passivated npn power transistor in a SOT82 envelope intended for use in converters, inverters, switching regulators, motor control systems and switching applications.

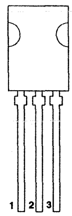
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1000	V
V_{CEO}	Collector-emitter voltage (open base)		-	450	V
I_C	Collector current (DC)		-	0.5	A
I_{CM}	Collector current peak value		-	1	A
P_{tot}	Total power dissipation	$T_{mb} \leq 60$ °C	-	20	W
t_f	Fall time		0.4	-	µs

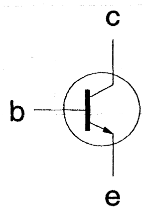
PINNING - SOT82

PIN	DESCRIPTION
1	emitter
2	collector
3	base

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-emitter voltage peak value	$V_{BE} = 0$ V	-	1000	V
V_{CEO}	Collector-emitter voltage (open base)		-	450	V
I_C	Collector current (DC)		-	0.5	A
I_{CM}	Collector current peak value		-	1	A
I_B	Base current (DC)		-	0.2	A
I_{BM}	Base current peak value		-	0.3	A
$-I_{BM}$	Reverse base current peak value [1]		-	0.3	A
P_{tot}	Total power dissipation	$T_{mb} \leq 60$ °C	-	20	W
T_{stg}	Storage temperature		-65	150	°C
T_j	Junction temperature		-	150	°C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base	-	-	4.5	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	100	-	K/W

1 Turn-off current.

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [2]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	100	µA
I_{CES}		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$; T_j = 125 ˚C	-	-	1.0	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 5 V; I_C = 0 A	-	-	1.0	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 = 0.1 A; I_B = 10 mA	-	-	0.8	V
V_{CEsat}		I_C = 0.2 A; I_B = 20 mA	-		1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 0.2 A; I_B = 20 mA	-		1.0	V
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	-	50	-	
h_{FE}		I_C = 300 mA; V_{CE} = 5 V	25	50	100	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
f_T	Transition frequency	I_C = 0.2 A; V_{CE} = 10 V; f = 1 MHz	20	-	MHz
	Switching times (resistive load circuit)	I_{Con} = 0.2 A; I_{Bon} = 20 mA; $-I_{Boff}$ = 40 mA; V_{CC} = 250 V			
t_{on}	Turn-on time		0.4	0.7	µs
t_s	Turn-off storage time		3.5	5.0	µs
t_f	Turn-off fall time		0.4	-	µs
t_f	Turn-off fall time	T_{mb} = 95 ˚C	-	1.3	µs

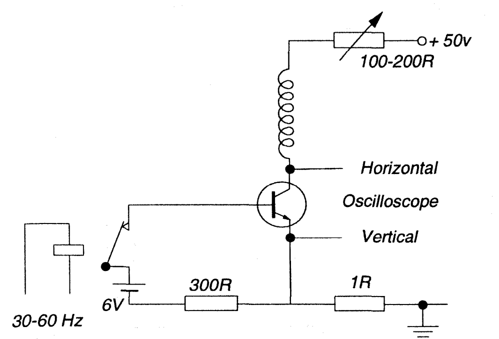


Fig.1. Test circuit for $V_{CEOsust}$.

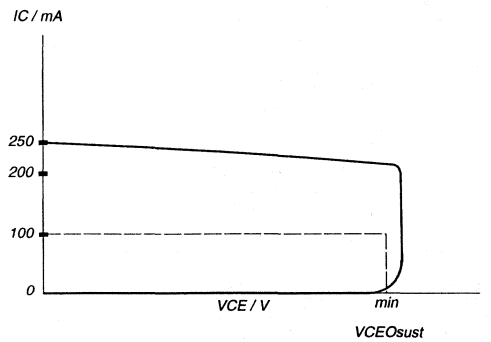


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

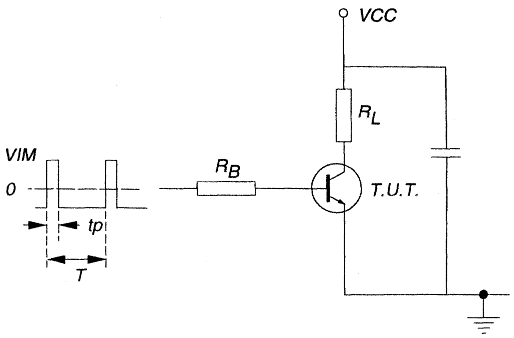


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V V_{CC} = 150 V; tp = 20 μs; δ = tp / T = 0.01. R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

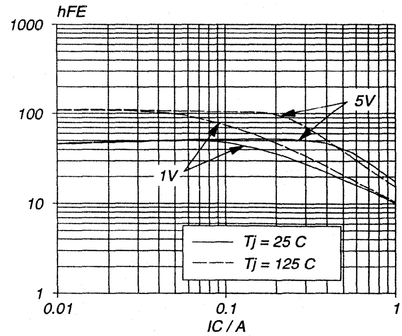


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

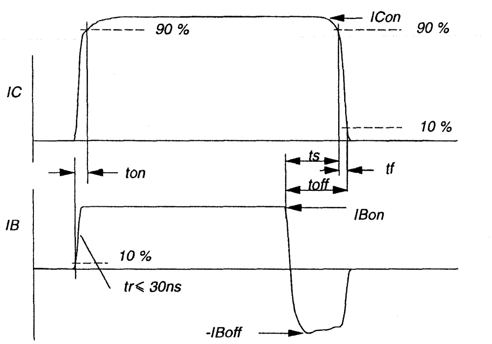


Fig.4. Switching times waveforms with resistive load.

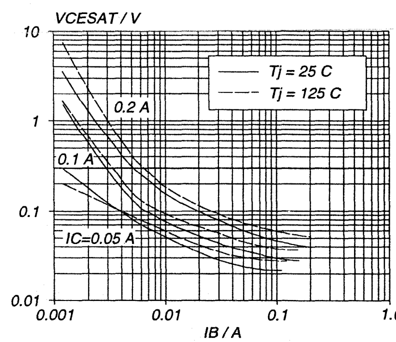


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

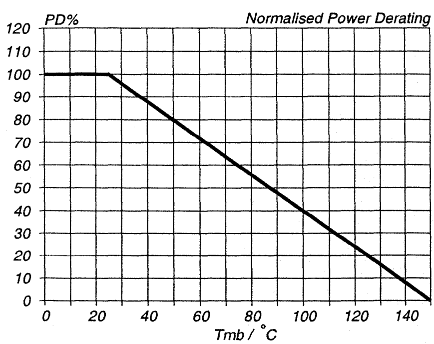


Fig.5. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{mb})$

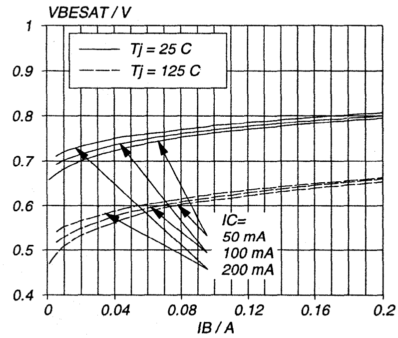


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

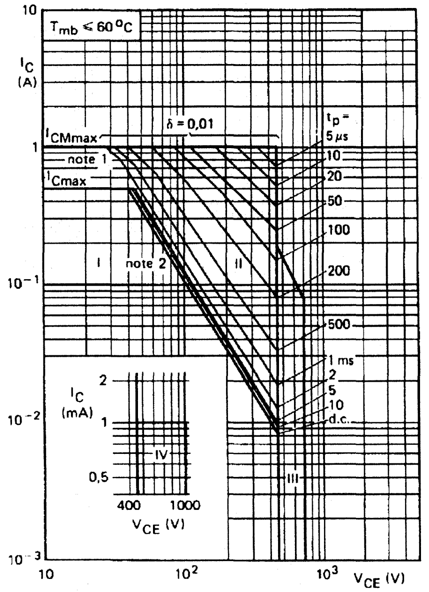


Fig.9. Forward bias safe operating area.
(1) *P_{tot} max line.*
(2) *Second-breakdown limits.*
I *Region of permissible DC operation.*
II *Permissible extension for repetitive pulse operation.*
III *Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leq 100\,\Omega$ and $tp \leq 0.6\,\mu s$.*
IV *Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $tp \leq 2$ ms.*

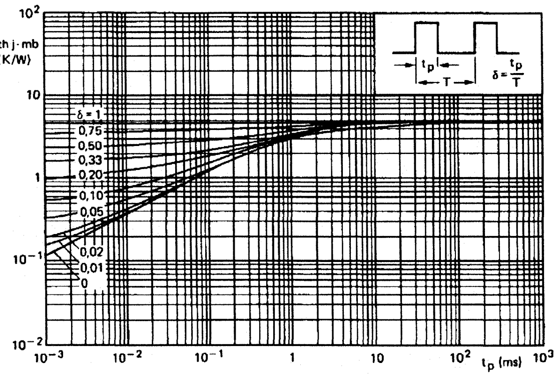


Fig.10. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter δ = duty cycle.

MECHANICAL DATA

Dimensions in mm

Net Mass: 0.8 g

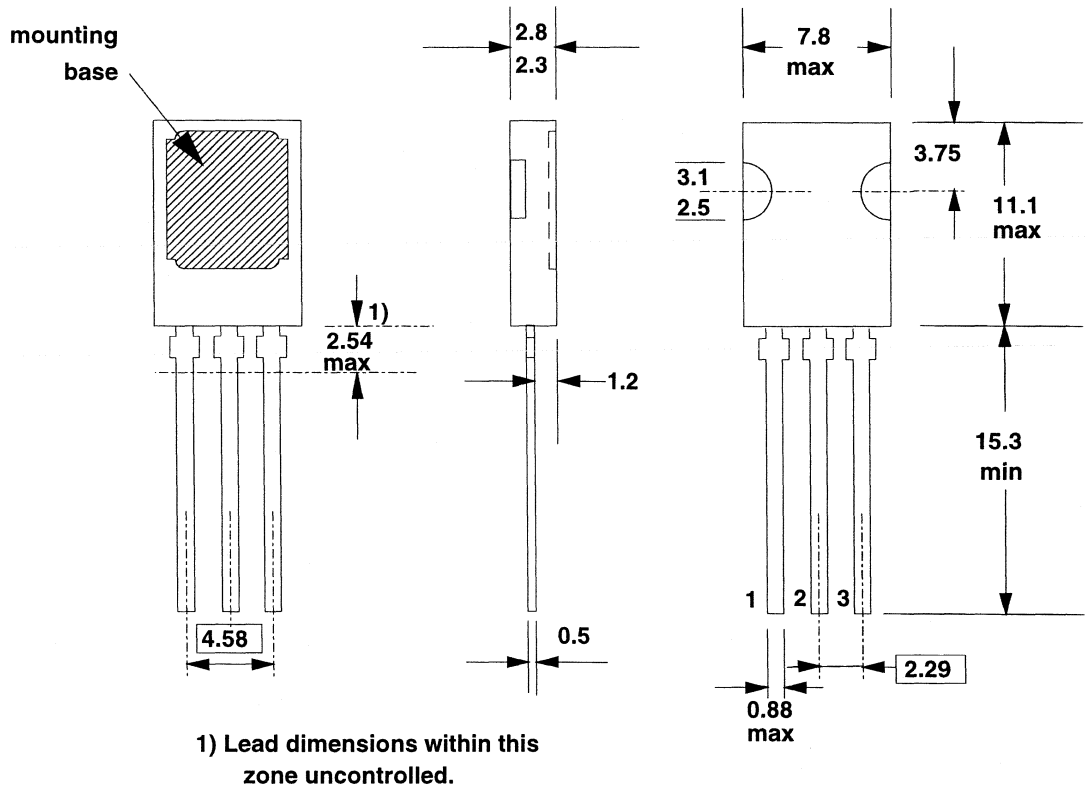


Fig.11. SOT82; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT82 envelopes.
2. Epoxy meets UL94 V0 at 1/8".

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in SOT82 envelopes, intended for use in converters, inverters, switching regulators, motor control systems and switching applications.

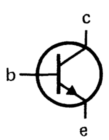
QUICK REFERENCE DATA

			BUW84	BUW85	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	800	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1		V
Collector current (DC)	I_C	max.	2		A
Collector current (peak value)	I_{CM}	max.	3		A
Total power dissipation up to $T_{mb} = 45\ ^oC$	P_{tot}	max.	50		W
Fall time	t_f	typ.	0.4		μs

MECHANICAL DATA

Dimensions in mm

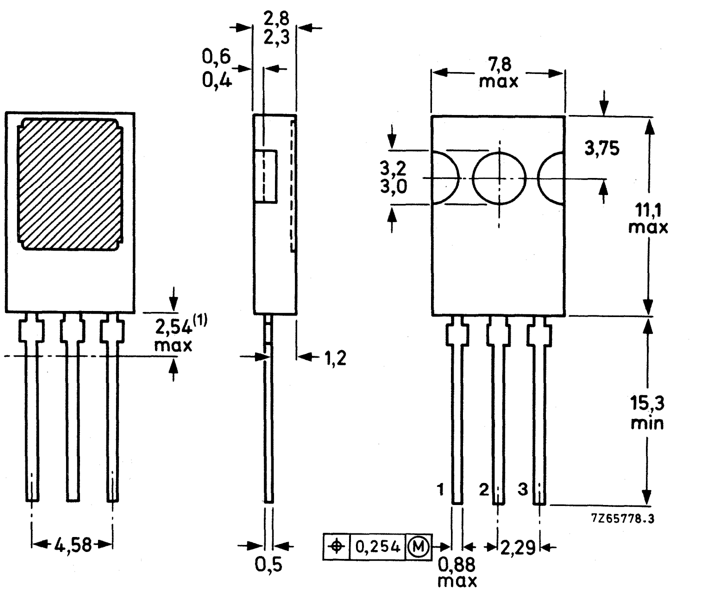
Fig. 1 SOT82.



Pinning;

1 = base
2 = collector
3 = emitter

Collector connected to mounting base.



(1) Within this region the cross-section of the leads is uncontrolled.

RATINGS

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

			BUW84	BUW85	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	800	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V

Collector current (DC)	I_C	max.	2	A
Collector current (peak value) $t_p = 2$ ms	I_{CM}	max.	3	A
Base current (DC)	I_B	max.	0.75	A
Base current (peak value)	I_{BM}	max.	1	A
Reverse base current (peak value) *	$-I_{BM}$	max.	1	A
Total power dissipation up to $T_{mb} = 45$ °C	P_{tot}	max.	50	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.1	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	100	K/W

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified

Collector cut-off current **				
$V_{CEM} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	200	μA
$V_{CEM} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C	I_{CES}	max.	1.5	mA
DC current gain				
$I_C = 5$ mA; $V_{CE} = 5$ V	h_{FE}	min.	15	
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	20	
	h_{FE}	typ.	50	
	h_{FE}	max.	100	
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	max.	1	mA
Saturation voltages				
$I_C = 0.3$ A; $I_B = 30$ mA	V_{CEsat}	max.	0.8	V
$I_C = 1$ A; $I_B = 0,2$ A	V_{CEsat}	max.	1	V
$I_C = 1$ A; $I_B = 0,2$ A	V_{BEsat}	max.	1.1	V

			BUW84	BUW85	
Collector-emitter sustaining voltage $I_C = 100$ mA; $I_{Boff} = 0$; $L = 25$ mH	$V_{CEOsust}$	min.	400	450	V

* Turn-off current.
** Measured with a half-sinewave voltage (curve tracer).

CHARACTERISTICS (continued)

T_j = 25 °C unless otherwise specified

Transition frequency at f = 1 MHz			
I_C = 0,2 A; V_{CE} = 10 V	f_T	typ.	20 MHz
Switching times			
I_{Con} = 1 A; V_{CC} = 250 V			
I_{Bon} = 0,2 A; $-I_{Boff}$ = 0,4 A			
Turn-on time	t_{on}	typ.	0.2 μs
		max.	0.5 μs
Turn-off: Storage time	t_s	typ.	2 μs
		max.	3.5 μs
Fall time	t_f	typ.	0.4 μs
Fall time, T_{mb} = 95 °C	t_f	max.	1.4 μs

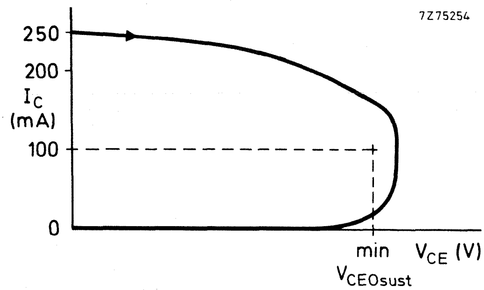


Fig. 2 Oscilloscope display for sustaining voltage.

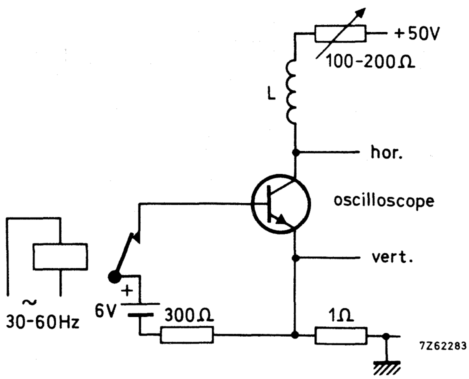


Fig. 3 Test circuit for $V_{CEOsust}$.

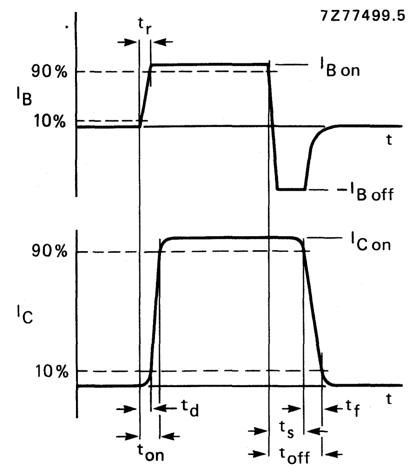


Fig. 4 Switching times waveforms with resistive load.

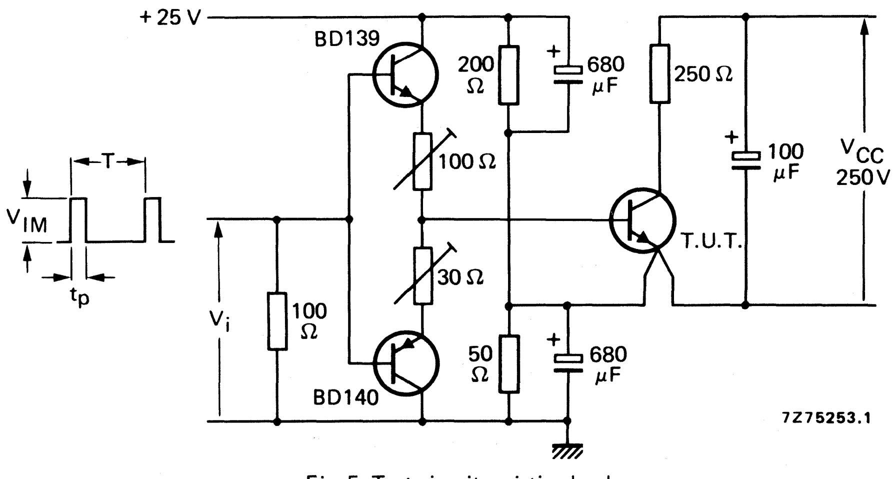
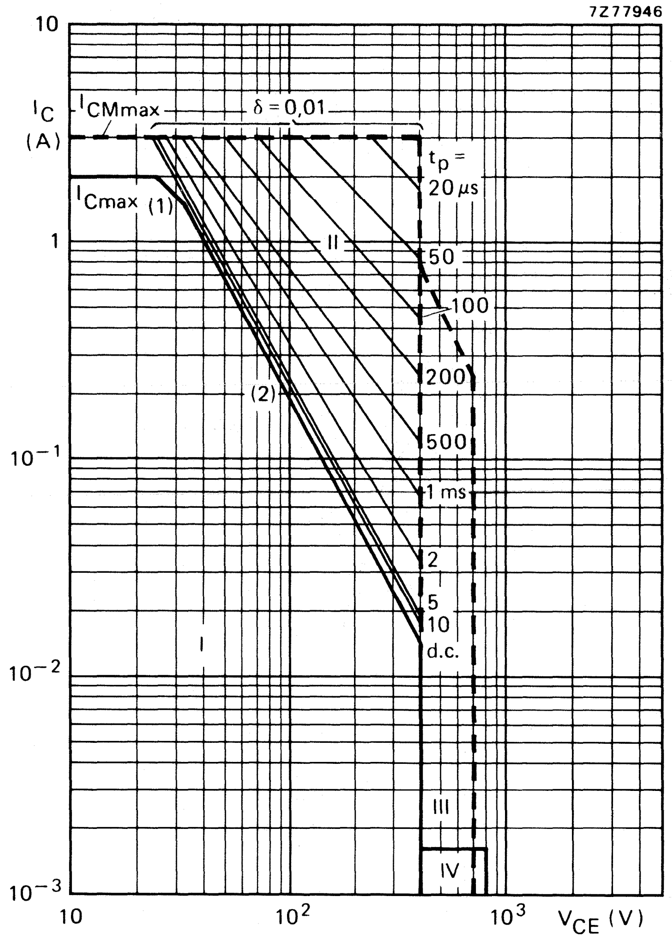
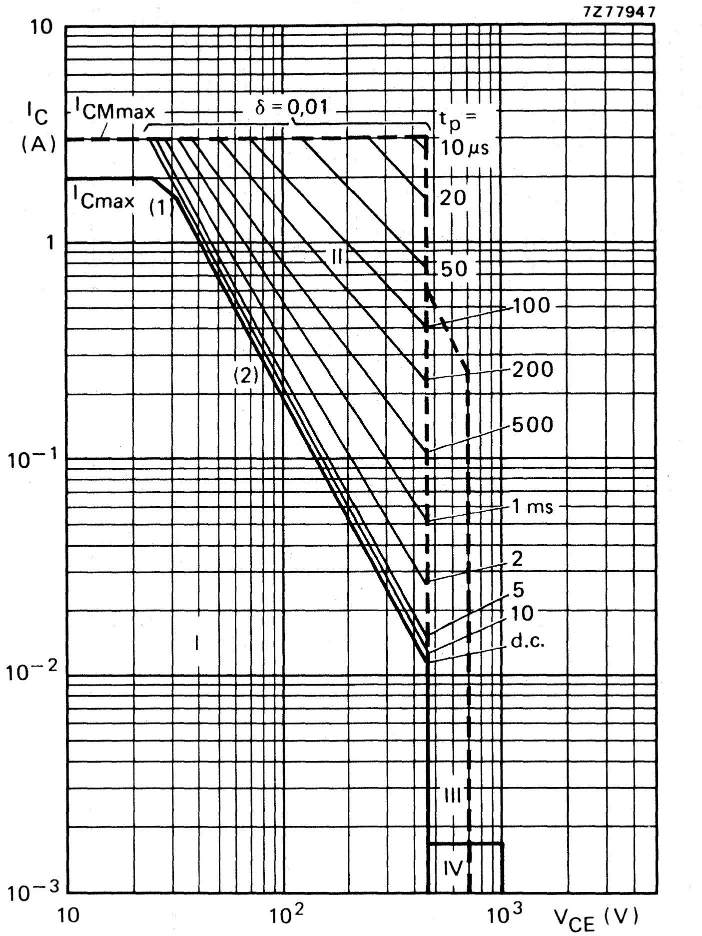


Fig. 5 Test circuit resistive load.



I Region of permissible DC operation
II Permissible extension for repetitive pulse operation
III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$
IV Repetitive pulse operation in this region is permissible, provided $V_{BE} \leqslant 0$ and $t_p \leqslant 2$ ms
(1) $P_{tot\ max}$ line.
(2) Second-breakdown limits.

Fig. 6 Safe operating area at $T_{mb} \leqslant 25\ ^{o}C$ of BUW84.



I Region of permissible DC operation
II Permissible extension for repetitive pulse operation
III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$
IV Repetitive pulse operation in this region is permissible, provided $V_{BE} \leqslant 0$ and $t_p \leqslant 2$ ms
(1) $P_{tot\ max}$ line.
(2) Second-breakdown limits.

Fig. 7 Safe operating area $T_{mb} \leqslant 25\ ^{o}C$ of BUW85.

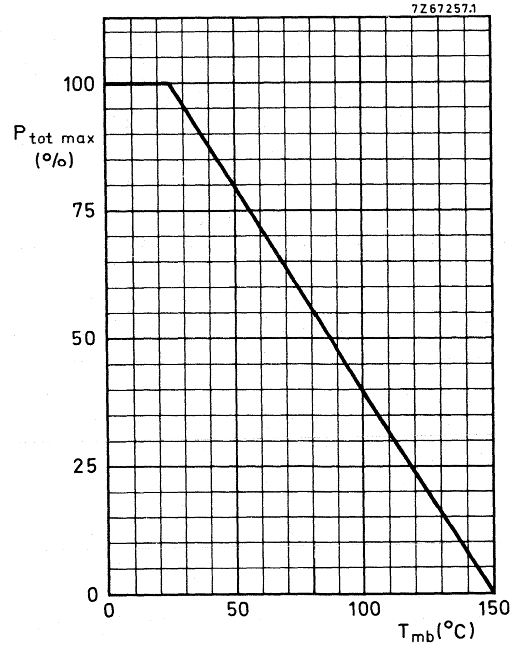


Fig. 8 Power derating curve.

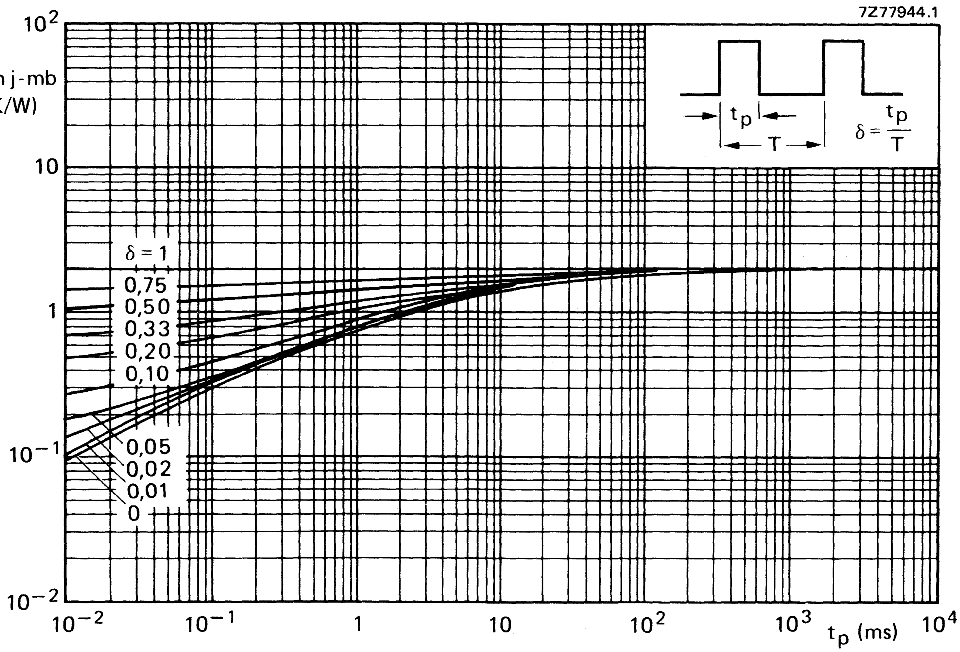


Fig. 9 Pulse power rating chart.

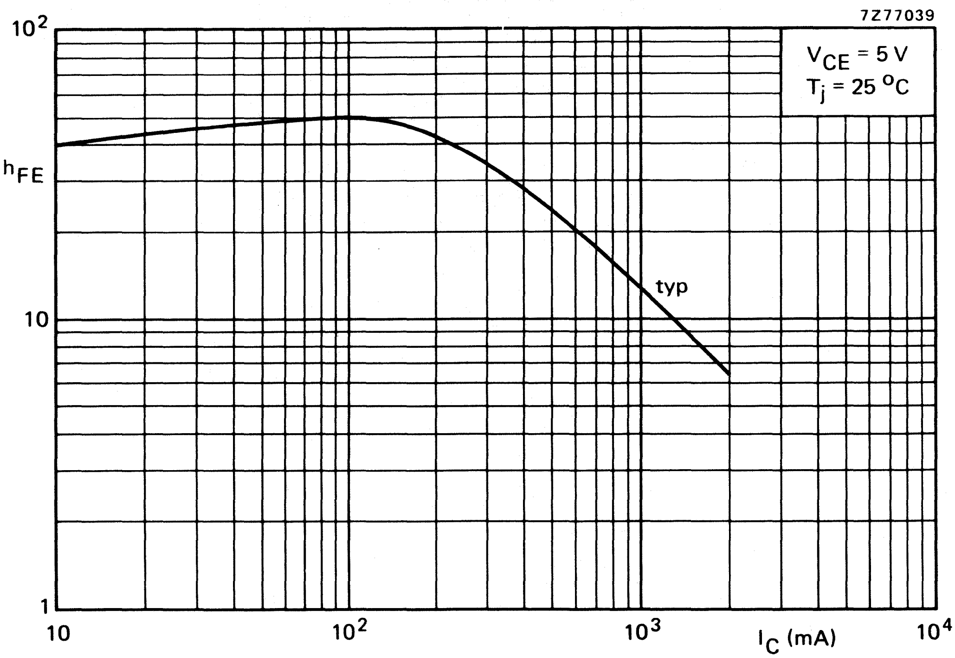


Fig. 10 Typical DC current gain.

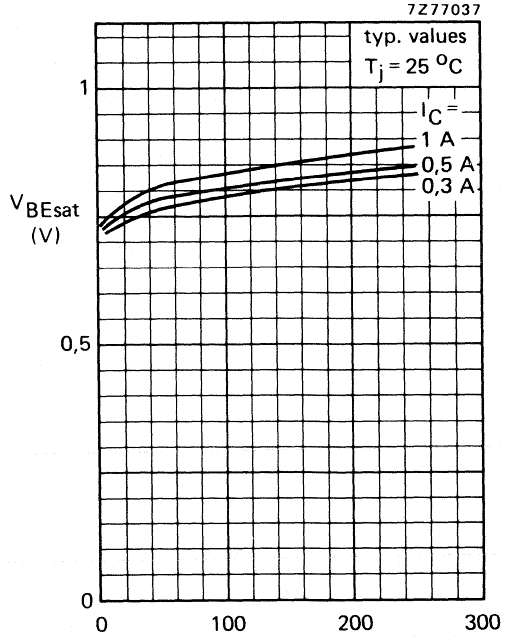


Fig. 11 Typical base-emitter saturation voltage.

Fig. 14.

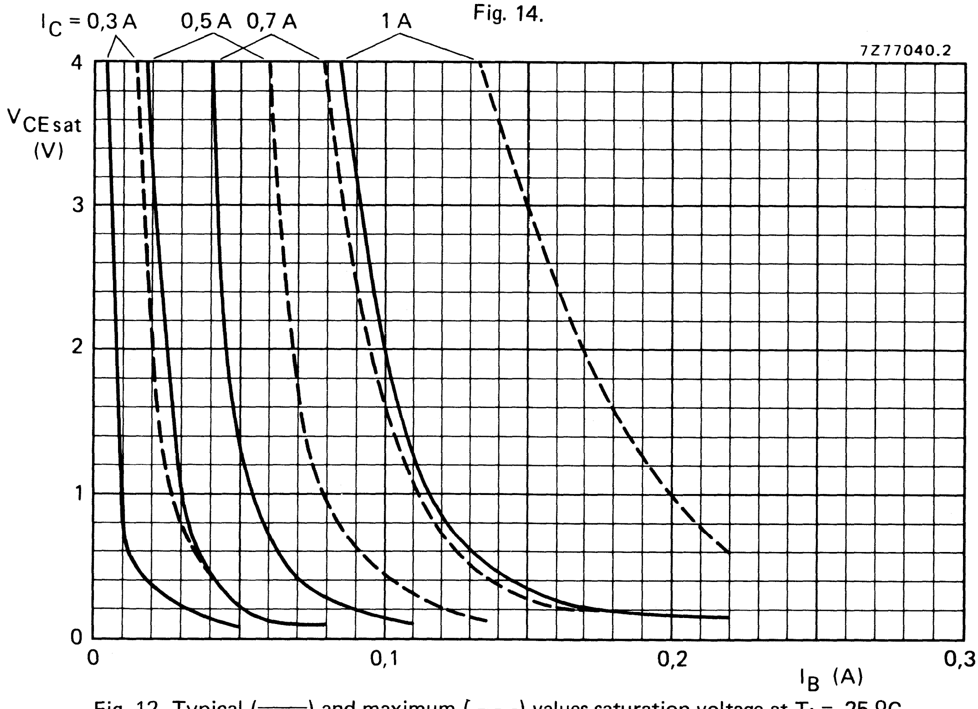


Fig. 12 Typical (——) and maximum (– – –) values saturation voltage at T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

High-voltage, high-speed, glass-passivated npn power transistors in TO-220 envelopes, intended for use in converters, inverters, switching regulators, motor control systems and switching applications.

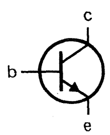
QUICK REFERENCE DATA

			BUX84	BUX85	
Collector-emitter voltage (peak value; $V_{BE} = 0$)	V_{CESM}	max.	800	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1		V
Collector current (DC)	I_C	max.	2		A
Collector current (peak value)	I_{CM}	max.	3		A
Total power dissipation up to $T_{mb} = 50\ ^oC$	P_{tot}	max.	40		W
Fall time	t_f	max.	0,4		μs

MECHANICAL DATA

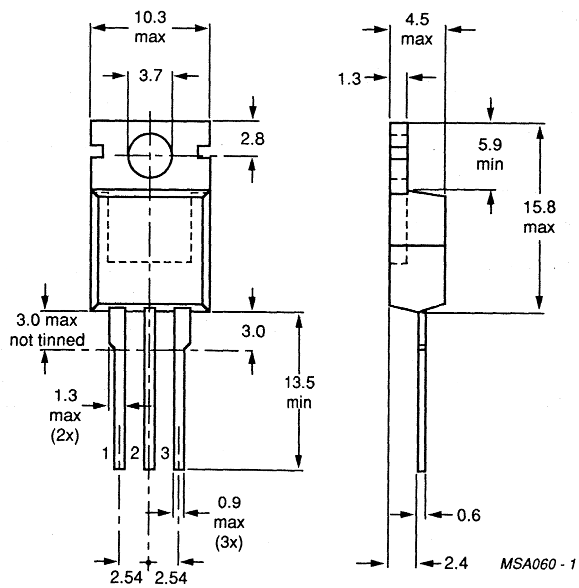
Dimensions in mm

Fig. 1 TO-220AB.



Pinning;

1 = base
2 = collector
3 = emitter



Collector connected to tab

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

			BUX84	BUX85	
Collector-emitter voltage (peak value; V_{BE} = 0)	V_{CESM}	max	800	1000	V
Collector-emitter voltage (open base)	V_{CEO}	max	400	450	V

Collector current (DC)	I_C	max	2	A
Collector current (peak value) t_p = 2 ms	I_{CM}	max	3	A
Base current (DC)	I_B	max	0,75	A
Base current (peak value)	I_{BM}	max	1	A
Reverse base current (peak value) *	$-I_{BM}$	max	1	A
Total power dissipation up to T_{mb} = 50 °C	P_{tot}	max	40	W
Storage temperature range	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,5	K/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	70	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current **

$V_{CEM} = V_{CESMmax}$; $V_{BE} = 0$	I_{CES}	max.	200	μA
$V_{CEM} = V_{CESMmax}$; $V_{BE} = 0$; T_j = 125 °C	I_{CES}	max.	1,5	mA

DC current gain

I_C = 5 mA; V_{CE} = 5 V	h_{FE}	min.	15
I_C = 100 mA; V_{CE} = 5 V	h_{FE}	min.	20
	h_{FE}	typ.	50
	h_{FE}	max.	100

* Turn-off current.
** Measured with a half-sinewave voltage (curve tracer).

Emitter cut-off current

$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	max.	1	mA

Saturation voltages

$I_C = 0{,}3$ A; $I_B = 30$ mA	V_{CEsat}	max.	0,8	V
$I_C = 1$ A; $I_B = 0{,}2$ A	V_{CEsat}	max.	1,0	V
$I_C = 1$ A; $I_B = 0{,}2$ A	V_{BEsat}	max.	1,1	V

Collector-emitter sustaining voltage

			BUX84	BUX85	
$I_C = 100$ mA; $I_{Boff} = 0$; $L = 25$ mH	$V_{CEOsust}$	min.	400	450	V

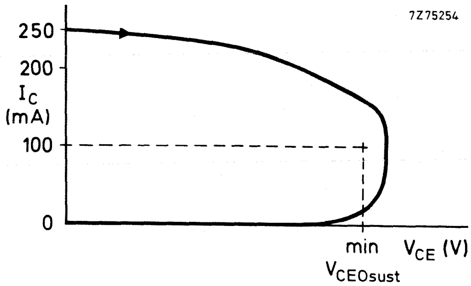


Fig. 2 Oscilloscope display for sustaining voltage.

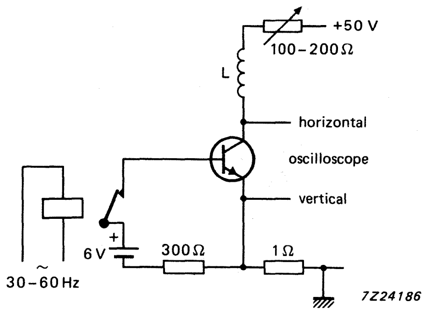


Fig. 3 Test circuit for $V_{CEOsust}$.

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Transition frequency at f = 1 MHz

I_C = 0,2 A; V_{CE} = 10 V	f_T	typ	20	MHz

Switching times

I_{Con} = 1 A; V_{CC} = 250 V
I_{Bon} = 0,2 A; $-I_{Boff}$ = 0,4 A

Turn-on time	t_{on}	typ	0,2	µs
		max.	0,5	µs
Turn-off: Storage time	t_s	typ	2	µs
		max.	3,5	µs
Fall time	t_f	typ	0,4	µs
Fall time, T_{mb} = 95 °C	t_f	max.	1,4	µs

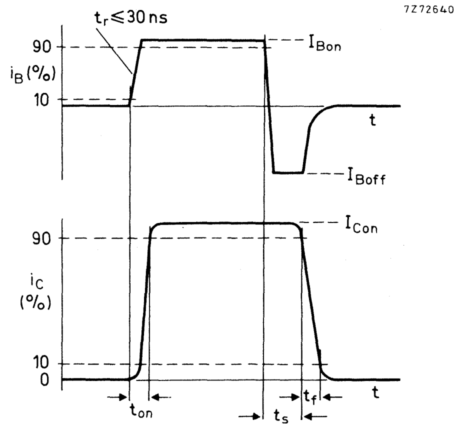


Fig. 4 Switching times waveforms with resistive load.

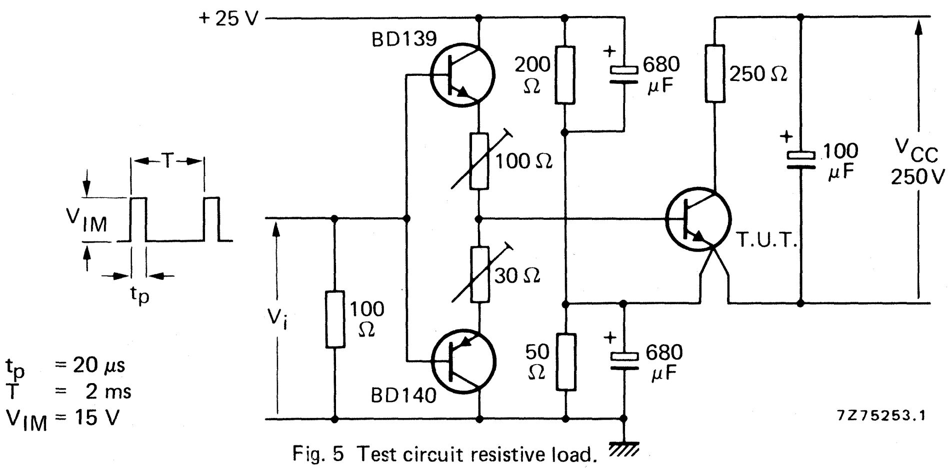
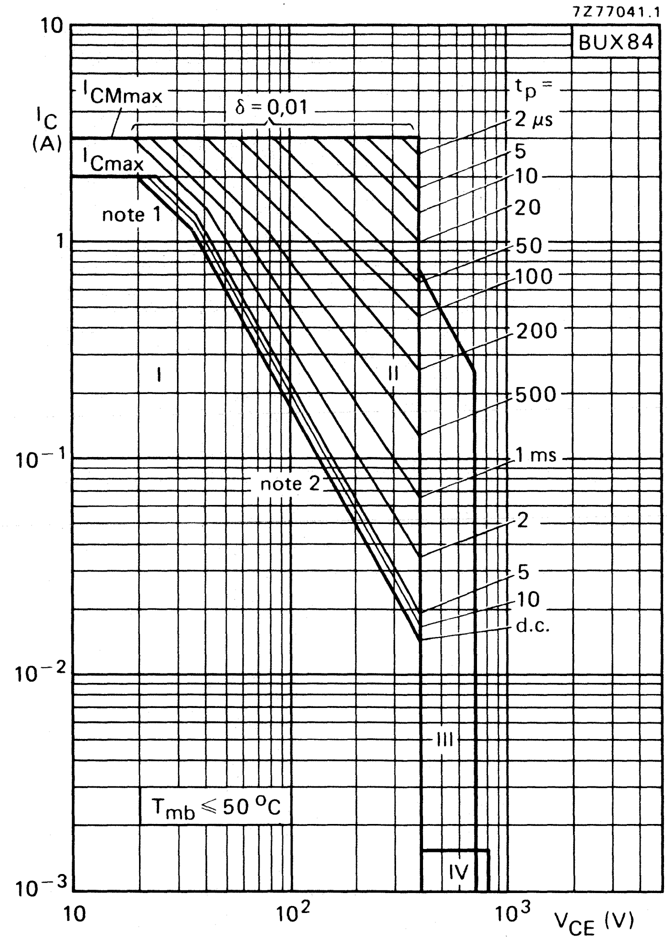


Fig. 5 Test circuit resistive load.



1. $P_{tot\ max}$ and $P_{peak\ max}$ lines.
2. Second-breakdown limits.

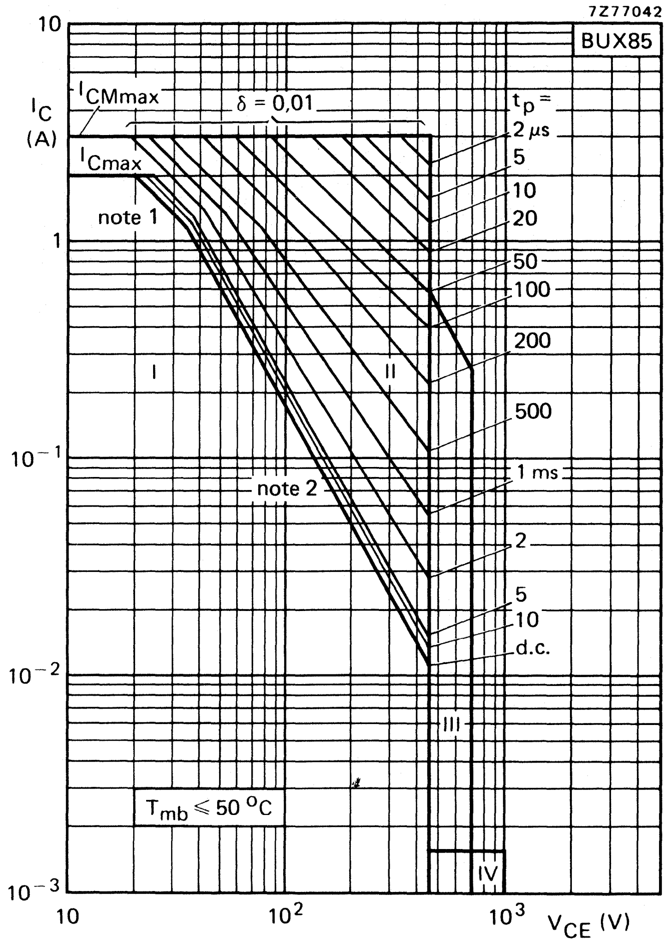
I Region of permissible DC operation

II Permissible extension for repetitive pulse operation

III Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leqslant 100\ \Omega$ and $t_p \leqslant 0{,}6\ \mu s$

IV Repetitive pulse operation in this region is permissible, provided $V_{BE} \leqslant 0$ and $t_p \leqslant 2$ ms

Fig. 6 Safe operating area.



1. $P_{tot\ max}$ and $P_{peak\ max}$ lines.
2. Second-breakdown limits.

I Region of permissible DC operation

II Permissible extension for repetitive pulse operation

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IV Repetitive pulse operation in this region is permissible, provided $V_{BE} \leqslant 0$ and $t_p \leqslant 2$ ms

Fig. 7 Safe operating area.

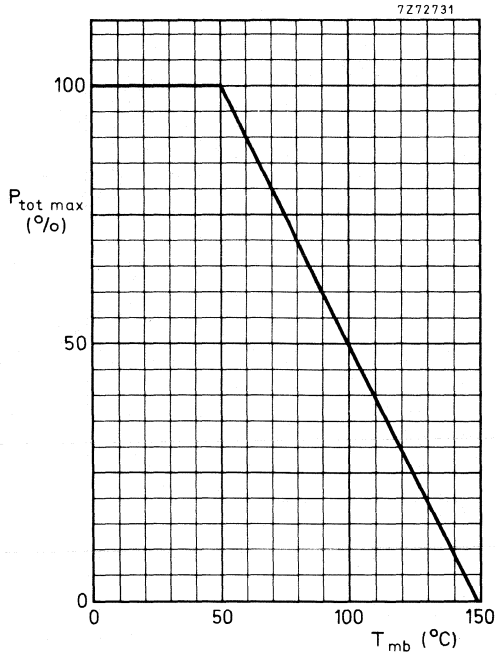


Fig. 8 Power derating curve.

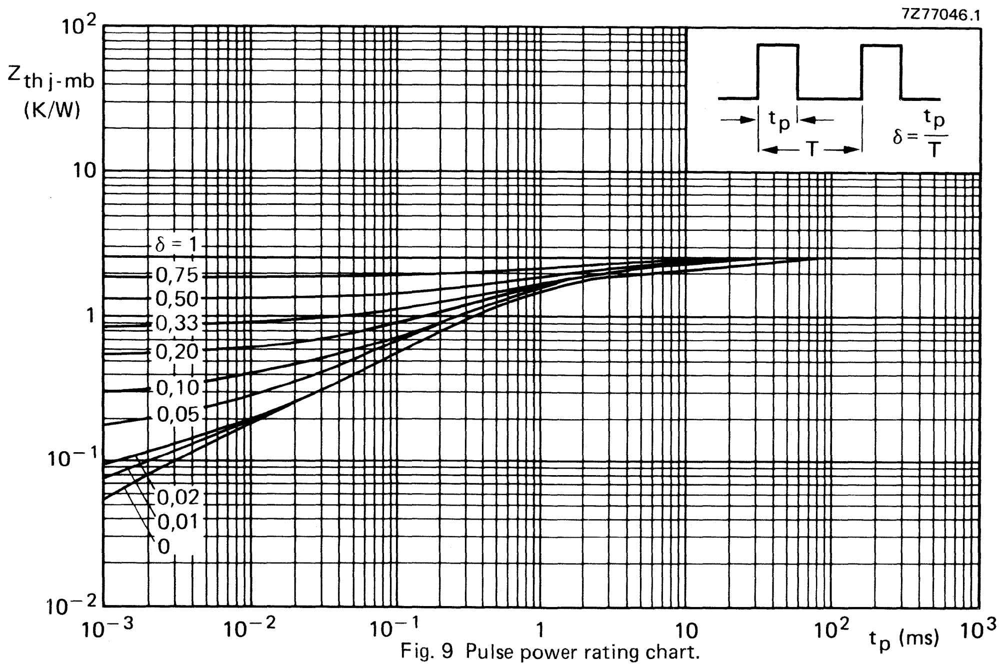


Fig. 9 Pulse power rating chart.

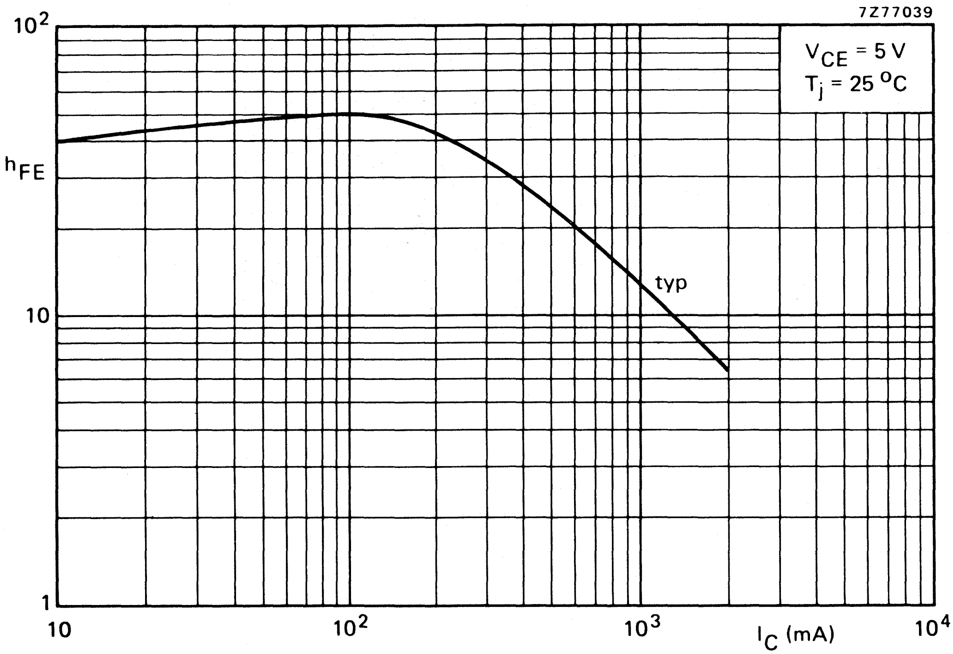


Fig. 10 Typical DC current gain.

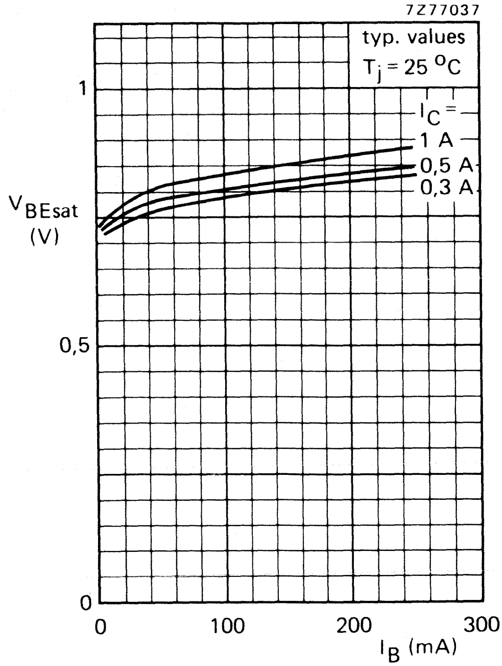


Fig. 11 Typical values saturation voltage, T_j = 25 °C.

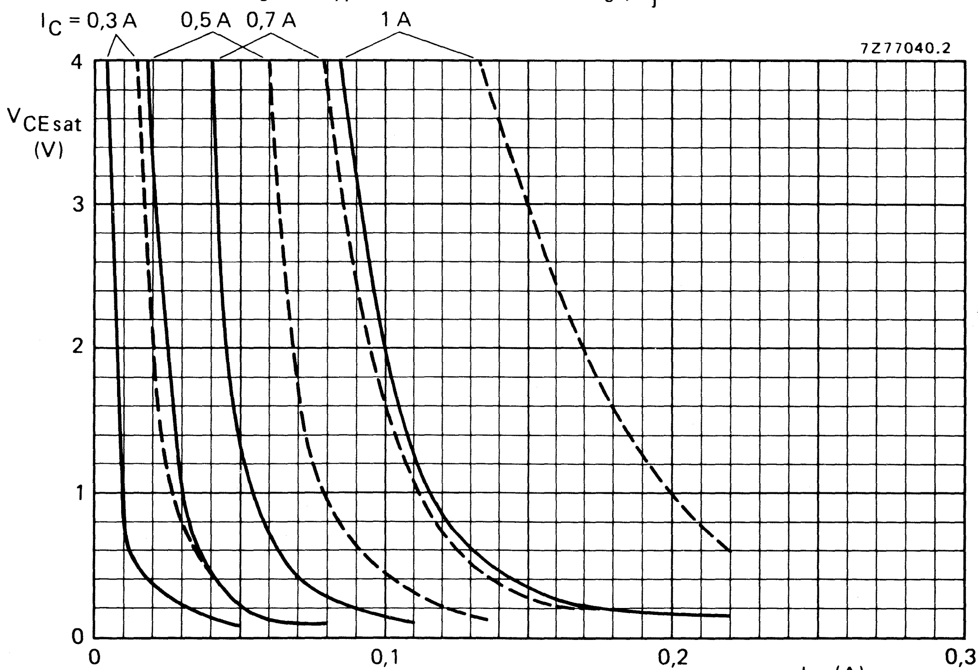


Fig. 12 Typical (——) and maximum (– – –) values saturation voltage at T_j = 25 °C.

SILICON DIFFUSED POWER TRANSISTORS

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

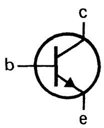
QUICK REFERENCE DATA

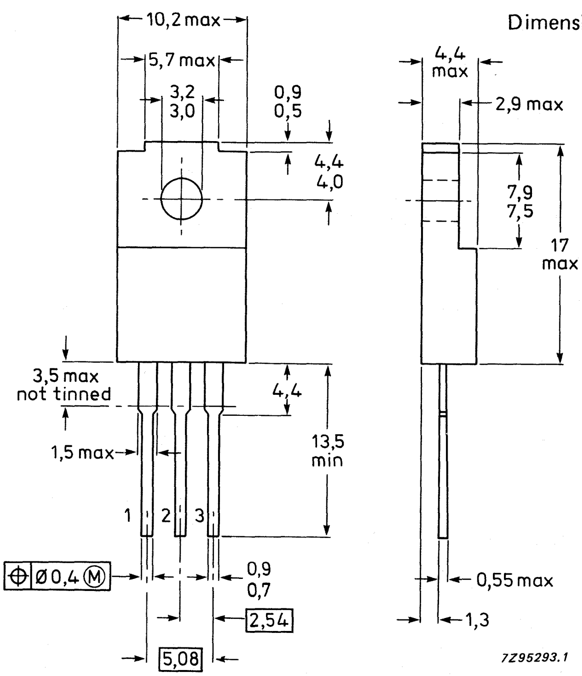
			BUX84F	BUX85F	
Collector-emitter voltage					
peak value; $V_{BE} = 0$	V_{CESM}	max.	800	1000	V
open base	V_{CEO}	max.	400	450	V
Collector-emitter saturation voltage	V_{CEsat}	max.	1,0		V
Collector saturation current	I_{Csat}	max.	1		A
Collector current					
DC	I_C	max.	2		A
peak value	I_{CM}	max.	3		A
Total power dissipation up to $T_h = 25\ ^oC$	P_{tot}	max.	18		W
Fall time	t_f	typ.	0,4		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT186.





Pinning

1 = base
2 = collector
3 = emitter

Mounting base is electrically isolated from all terminals.

RATINGS

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

			BUX84F	BUX85F	
Collector-emitter voltage					
open base	V_{CEO}	max.	400	450	V
peak value; $V_{BE} = 0$	V_{CESM}	max.	800	1000	V
Collector current, DC	I_C	max.	2		A
Collector current, peak value	I_{CM}	max.	3		A
Base current, DC	I_B	max.	0,75		A
peak value	I_{BM}	max.	1		A
Total power dissipation up to $T_h = 25\ ^oC$ (note 1)	P_{tot}	max.	18		W
Storage temperature range	T_{stg}		−65 to +150		^oC
Junction temperature	T_j	max.	150		^oC

THERMAL RESISTANCE

From junction to external heatsink (note 1)	$R_{th\ j\text{-}h}$	=	7,2	K/W
From junction to external heatsink (note 2)	$R_{th\ j\text{-}h}$	=	4,7	K/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	55	K/W

ISOLATION

Voltage allowed between all terminals and external heatsink, peak value	V_{isol}	max.	1500	V
Isolation capacitance between collector and external heatsink	C_{isol}	typ.	12	pF

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified

Collector cut-off currents				
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	I_{CES}	max.	0,2	mA
$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125\ ^oC$	I_{CES}	max.	1,5	mA
Emitter cut-off current				
$V_{EB} = 5$ V; $I_C = 0$	I_{EBO}	max.	1	mA
DC current gain				
$I_C = 5$ A; $V_{CE} = 5$ V	h_{FE}	min.	15	
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	min.	20	
	h_{FE}	typ.	50	
	h_{FE}	max.	100	
Transition frequency at f = 1 MHz				
$I_C = 0,2$ A; $V_{CE} = 10$ V	f_T	typ.	20	MHz

Notes

1. Mounted without heatsink compound and 30 ± 5 newtons pressure on centre of envelope.
2. Mounted with heatsink compound and 30 ± 5 newtons pressure on centre of envelope.

Silicon Diffused Power Transistor

BUX86P
BUX87P

GENERAL DESCRIPTION

High voltage, high speed glass passivated npn power transistors in a SOT82 envelope intended for use in converters, inverters, switching regulators, motor control systems and switching applications.

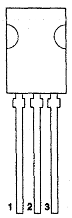
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.		UNIT
			BUX	86P	87P	
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	800	1000	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	450	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 0.2 A; I_B = 20 mA	-	1		V
I_C	Collector current (DC)		-	0.5		A
I_{CM}	Collector current peak value		-	1		A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	42		W
t_f	Fall time	I_C = 0.2 A; $I_{B(on)}$ = 20 mA	0.28	-		µs

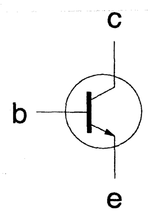
PINNING - SOT82

PIN	DESCRIPTION
1	emitter
2	collector
3	base

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.		UNIT
			BUX	86P	87P	
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	800	1000	V
V_{CEO}	Collector-emitter voltage (open base)		-	400	450	V
V_{EBO}	Emitter-base voltage (open collector)		-	5		V
I_C	Collector current (DC)		-	0.5		A
I_{CM}	Collector current (peak value) t_p = 2 ms		-	1		A
I_B	Base current (DC)		-	0.2		A
I_{BM}	Base current (peak value)		-	0.3		A
$-I_{BM}$	Reverse base current (peak value)[1]		-	0.3		A
P_{tot}	Total power dissipation	$T_{mb} \leq 25$ ˚C	-	42		W
T_{stg}	Storage temperature		-40	150		˚C
T_j	Junction temperature		-	150		˚C

1 Turn-off current.

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j\text{-}mb}$	Junction to mounting base		-	3	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	100	-	K/W

STATIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	100	µA
I_{CES}		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$; T_j = 125 ˚C	-	-	1.0	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 5 V; I_C = 0 A	-	-	1	mA
V_{CEsat}	Collector-emitter saturation voltages	I_C = 0.1 A; I_B = 10 mA	-	-	0.8	V
V_{CEsat}		I_C = 0.2 A; I_B = 20 mA	-	-	1	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 0.2 A; I_B = 20 mA	-	-	1	V
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 5 V	26	50	125	
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_C = 100 mA; **BUX86P**	400	-	-	V
		I_{Boff} = 0; L = 25 mH **BUX87P**	450	-	-	V

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load).	I_C = 0.2 A; I_{Bon} = 20 mA; $-I_{Boff}$ = 40 mA; V_{CC} = 250 V			
t_{on}	Turn-on time		0.25	0.5	µs
t_s	Turn-off storage time		2	3.5	µs
t_f	Turn-off fall time		0.28	-	µs
t_f	Turn-off fall time	T_{mb} = 95 ˚C	-	1.3	µs

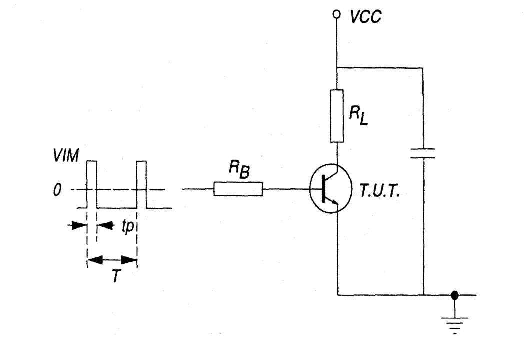


Fig.1. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; tp = 20 μs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

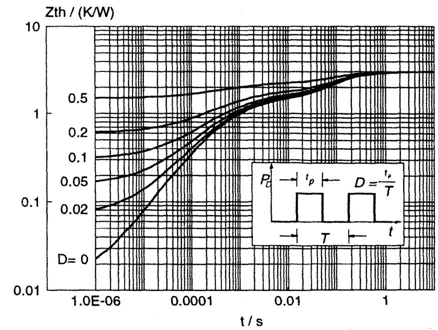


Fig.4. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

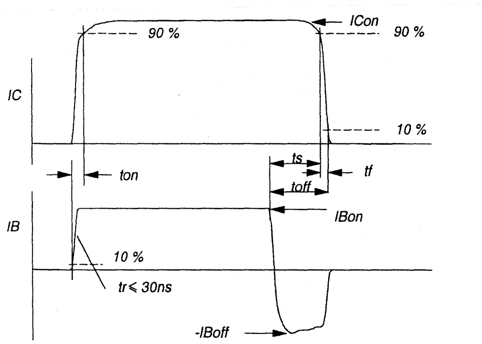


Fig.2. Switching times waveforms with resistive load.

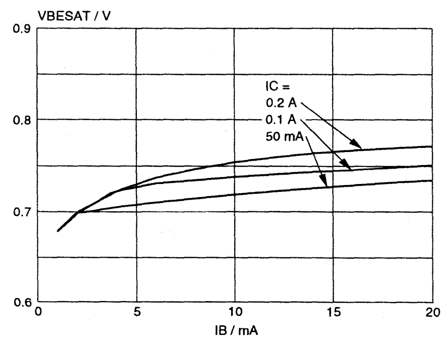


Fig.5. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

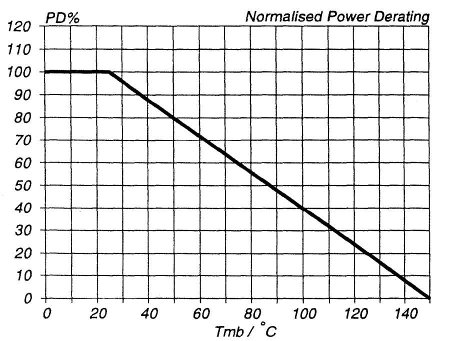


Fig.3. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25\,^\circ C} = f(T_{mb})$

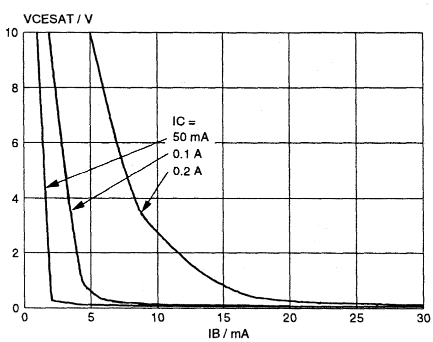


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

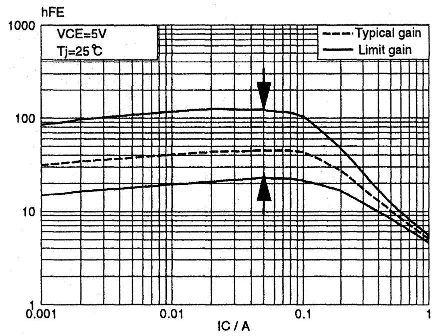


Fig.7. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}.
Arrows indicate conditions protected by 100% test.

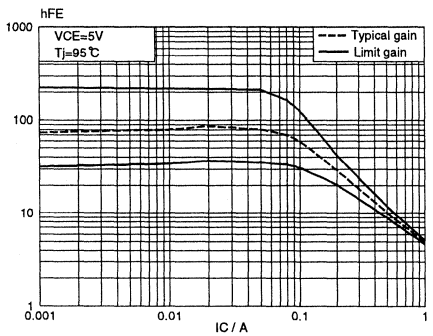


Fig.8. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

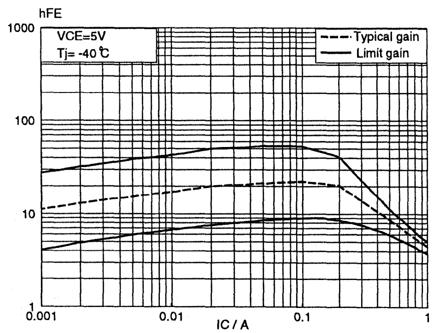


Fig.9. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

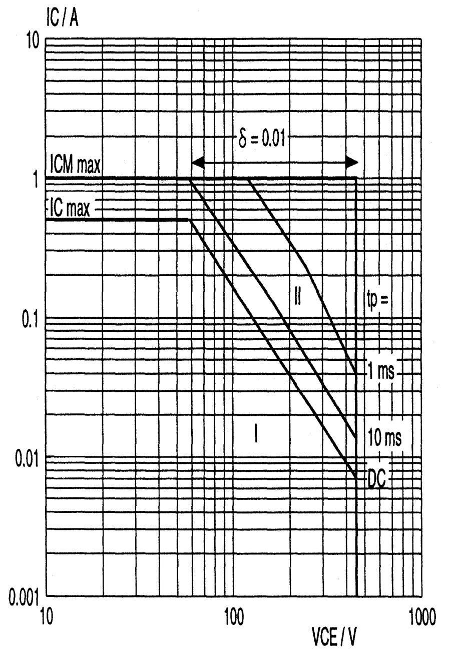


Fig.10. Forward bias safe operating area. T_{mb} = 25 ˚C

I	*Region of permissible DC operation.*
II	*Extension for repetitive pulse operation.*
NB:	*Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.*

MECHANICAL DATA

Dimensions in mm

Net Mass: 0.8 g

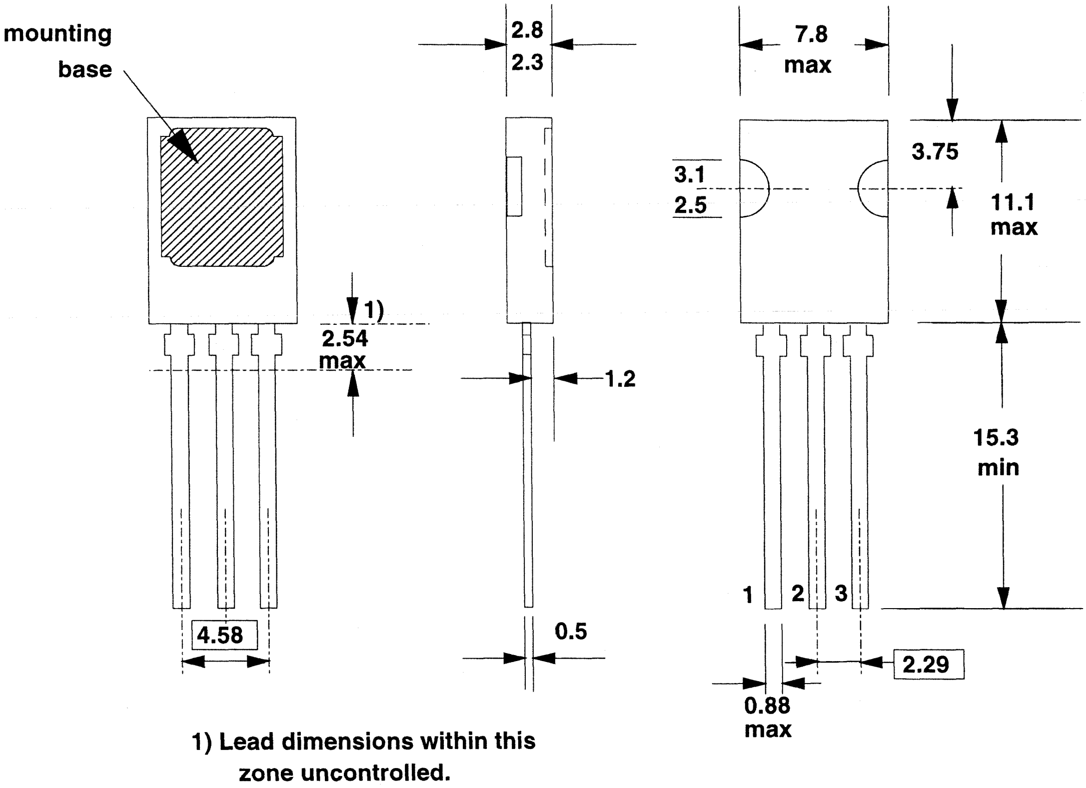


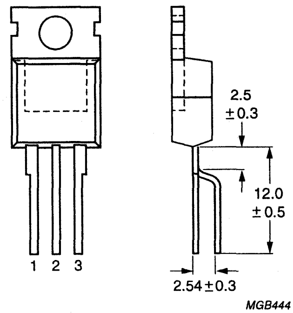
Fig.11. SOT82; pin 2 connected to mounting base.

Notes
1. Refer to mounting instructions for SOT82 envelopes.
2. Epoxy meets UL94 V0 at 1/8".

LEADFORM OPTIONS

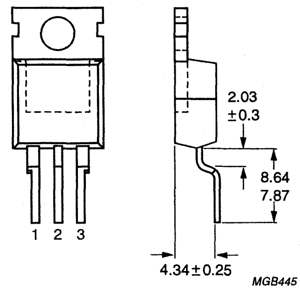
LEADFORM OPTIONS

- These options require a special part number before ordering.
- Contact your local Philips Semiconductors representative for pricing, minimum order quantities and part number.



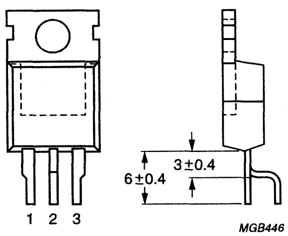
SOT78 (TO-220)

Fig.1 Leadform 78-02.



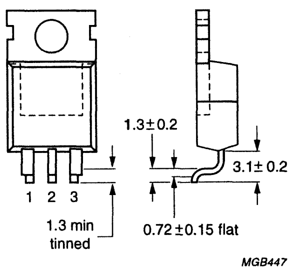
SOT78 (TO-220)

Fig.2 Leadform 78-05W.



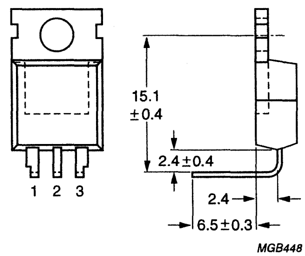
SOT78 (TO-220)

Fig.3 Leadform 78-13.



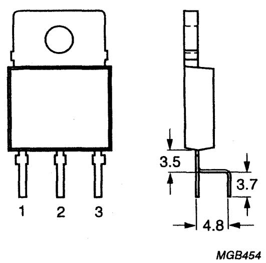
SOT78 (TO-220)

Fig.4 Leadform 78-14.



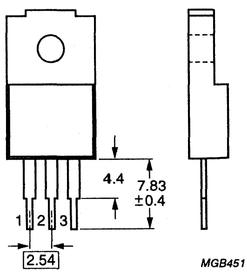
SOT78 (TO-220)

Fig.5 Leadform 78-15.



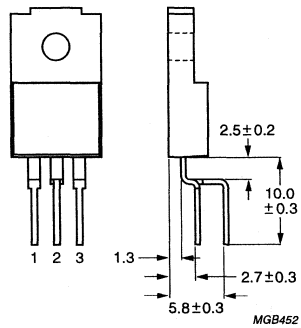
SOT93

Fig.6 Leadform 93-01.



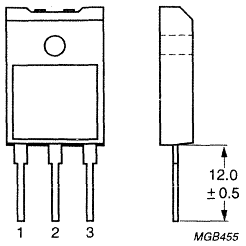
SOT186

Fig.7 Leadform 186-02.



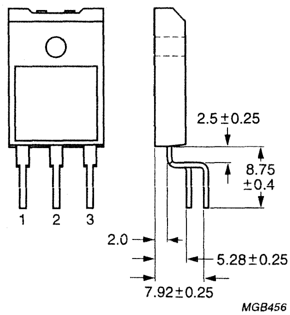
SOT186

Fig.8 Leadform 186A-02.



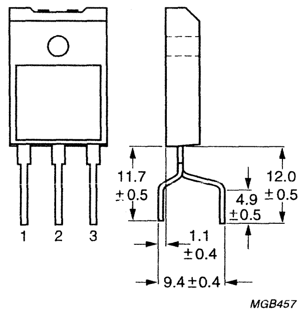
SOT199

Fig.9 Leadform 199-01.



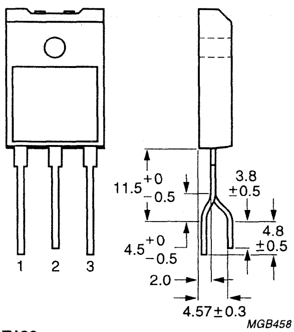
SOT199

Fig.10 Leadform 199-02.



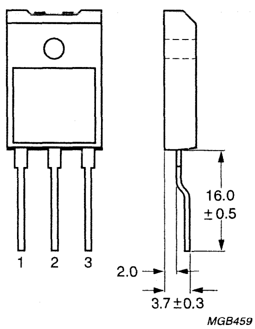
SOT199

Fig.11 Leadform 199-04.



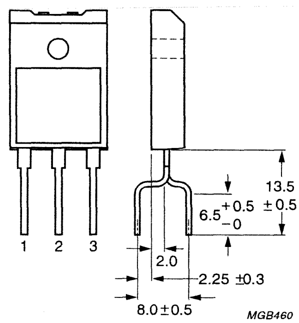
SOT199

Fig.12 Leadform 199-05.



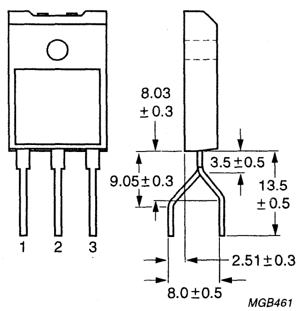
SOT199

Fig.13 Leadform 199-06.



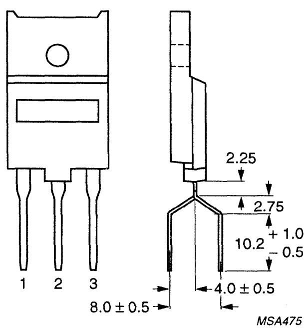
SOT199

Fig.14 Leadform 199-08.



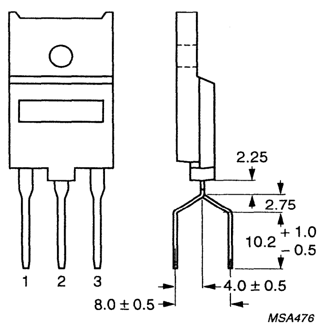
SOT199

Fig.15 Leadform 199-09.



SOT399

Fig.16 Leadform 399-01



SOT399

Fig.17 Leadform 399-02.

MOUNTING INSTRUCTIONS

GENERAL DATA AND INSTRUCTIONS

General rules

1. Fasten the device to the heatsink before soldering the leads.
2. Avoid stress to the leads.
3. Keep mounting tool (e.g. screwdriver) clear of the plastic body.

Mounting methods

CLIP MOUNTING

Mounting by means of spring clip offers:

a) A good thermal contact under the crystal area.

b) Safe insulation for mains and high voltage operation.

Minimum force for good heat transfer is 10 N.

Maximum force to avoid damaging the device is 80 N.

M2.5 AND M3 SCREW MOUNTING

TO126 only.

The spacing washer should be inserted between screw head and body.

Minimum torque for good heat transfer is 0.4 Nm.

Maximum torque to avoid damaging the device is 0.6 Nm.

When the driven nut or screw is in direct contact with a toothed lock washer the torques are as follows:

Minimum torque for good heat transfer is 0.55 Nm.

Maximum torque to avoid damaging the device is 0.8 Nm.

BODY MOUNTING

SOT82 only.

A SOT82 envelope can be adhesive mounted or soldered into a hybrid circuit.

For soldering, a copper plate or an anodised aluminium plate with copper layer is recommended.

With adhesive mounting, a ceramic substrate may be used.

RIVET MOUNTING

It is not permitted to rivet mount the TO126 outline.

Heatsink requirements

Flatness in the mounting area: 0.02 mm maximum per 10 mm.
Mounting holes must be deburred, for further information see clip and screw mounting instructions.

Heatsink compound

The thermal resistance from mounting base to heatsink ($R_{th\ mb-h}$) can be reduced by applying a metallic oxide compound between the contact surfaces. Values given are of thermal resistance using this type of compound. Dow Corning 340 Heat sink compound is recommended. For insulated mounting, the compound should be applied to the bottom of both device and insulator.

Thermal data for heatsink mounting methods

$R_{th\ mb\text{-}h}$	**Thermal resistance from mounting base to heatsink**	**K/W**			
Envelope	**Mounting Method**	**clip**		**screw**	
		direct	**insulated**	**direct**	**insulated**
TO126	with heatsink compound	1.0	3.0	0.5	3.0
	without heatsink compound	3.0	6.0	1.0	6.0
SOT82	with heatsink compound	0.4	2.0	-	-
	without heatsink compound	2.0	5.0	-	-

Soldering

LEAD SOLDERING

For devices with a maximum junction temperature < 150 ˚C.

DIP OR WAVE SOLDERING.

Maximum permissible solder temperature is 260 ˚C at a distance from the body of > 5 mm and for a total contact time with soldering bath or waves of < 7 s.

HAND SOLDERING.

Maximum permissible temperature is 275 ˚C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 5 s.

Maximum permissible temperature is 250 ˚C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 10 s.

The body of the device must not touch anything with a temperature > 200 ˚C.

Avoid any force on body and leads during or after soldering; do not correct the position of the device or of its leads after soldering.

MOUNTING BASE SOLDERING

Recommended metal-alloy of solder paste (85% metal weight)
62% Sn / 36% Pb / 2% Ag or 60% Sn / 40% Pb.

Maximum soldering temperature < 200 ˚C (mounting base temperature).
Soldering cycle duration including pre-heating < 30 sec.

For good soldering and avoiding damage to the encapsulation pre-heating is recommended to a temperature < 165 ˚C at a duration < 10 s.

Lead bending

Maximum permissible tensile force on the body for 5 seconds is 20 N.

The leads can be bent, twisted or straightened. To keep forces within the above mentioned limits the leads should always be clamped rigidly near the body during bending. This is also to prevent damage to the seal of the leads within the plastic body.

Leads can be bent as near to the body as required, but adequate length should always be allowed for clamping. This is a minimum of 1.75 mm from the body to the start of a bend radius.

The internal radius of bend should never be less than the thickness of the lead. A minimum radius of at least 1.5 x lead thickness is preferred. See figure 1. Surface cracks in the dip tin coating on the lead are common when a radius less than 1.5 x lead thickness is used. Although exposing the copper material, these cracks do not affect the mechanical strength of the lead.

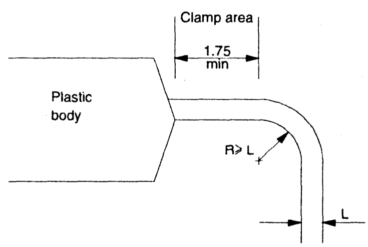


Fig 1. Minimum lead bend radius.

Additional guide-lines

It is recommended that where a device is rigidly secured to a heatsink which is in turn rigidly secured to a PCB, that a bend is put in the leads to act as an expansion loop. This will prevent differential expansion of the mounting parts transferring stress to the soldering joint, as shown in figure 2 below. This is only necessary where the device is mounted so rigidly that expansion forces are transmitted through the assembly.

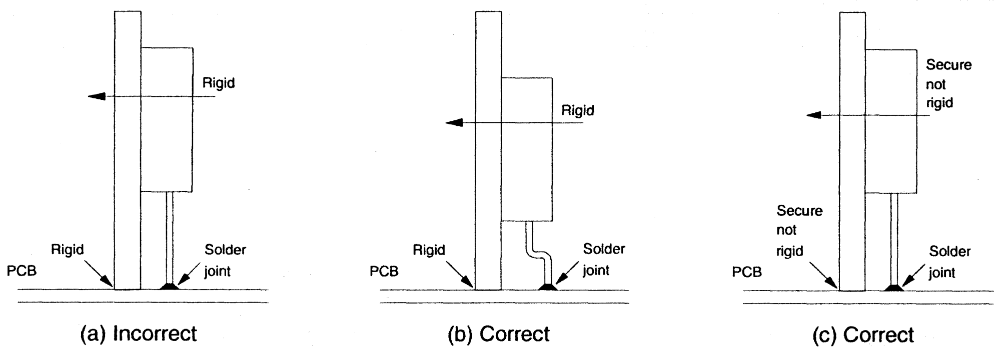


Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting with screw and spacing washer

THROUGH HEATSINK WITH NUT.

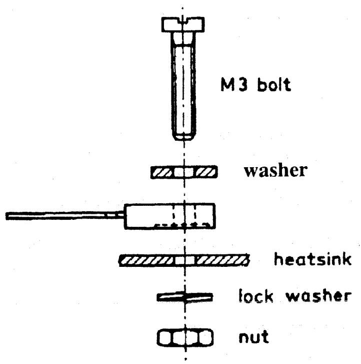


Fig 9. Assembly.

Dimensions in mm

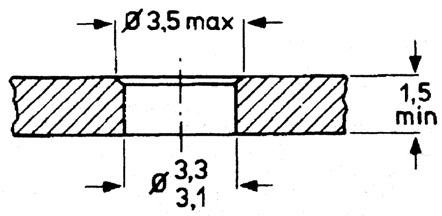


Fig 10. Heatsink requirements.

INTO TAPPED HEATSINK

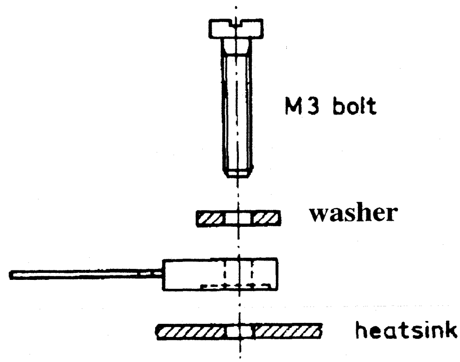


Fig 11. Assembly.

Dimensions in mm

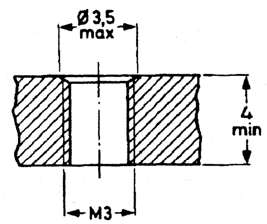


Fig 12. Heatsink requirements.

GENERAL DATA AND INSTRUCTIONS

General rules

1. Fasten the device to the heatsink before soldering the leads.
2. Avoid stress to the leads.
3. Keep mounting tool (e.g. screwdriver) clear of the plastic body.
4. The rectangular washer may only touch the plastic part of the body; it should not exert any force on that part (screw mounting).

Mounting methods

CLIP MOUNTING

Mounting with a spring clip gives:

a) A good thermal contact under the crystal area, and slightly lower thermal resistance than screw mounting.

b) Safe insulation for mains operation.

Minimum force for good heat transfer is 10 N.

Maximum force to avoid damaging the device is 80 N.

M3 SCREW MOUNTING

It is recommended that the rectangular spacing washer is inserted between screw head and mounting tab.

Do not use self-tapping screws.

Mounting torque for screw mounting:

For thread-forming screws these are final values.

Minimum torque for good heat transfer is 0.55 Nm.

Maximum torque to avoid damaging the device is 0.80 Nm.

When a nut or screw is driven directly against the tab, the torques are as follows:

Minimum torque for good heat transfer is 0.40 Nm.

Maximum torque to avoid damaging the device is 0.60 Nm.

RIVET MOUNTING NON-INSULATED.

The device should not be pop-rivetted to the heatsink. It is permissible to press-rivet the metal tab providing that eyelet rivets of soft material are used, and the press forces are slowly and carefully controlled.

This method is not permitted for full-pack envelopes because it will damage the plastic encapsulation.

Heatsink requirements

Flatness in the mounting area: 0.02 mm maximum per 10 mm.
Mounting holes must be deburred, for further information see clip and screw mounting instructions.

Heatsink compound

The thermal resistance from mounting base to heatsink ($R_{th\ mb\text{-}h}$) can be reduced by applying a metallic oxide compound between the contact surfaces. Values given are of thermal resistance using this type of compound. Dow Corning 340 Heat sink compound is recommended. For insulated mounting, the compound should be applied to the bottom of both device and insulator.

Thermal data for heatsink mounting methods (TO220 only)

Typical figures, for exact figures see data for each device type.

$R_{th\ mb\text{-}h}$	**Thermal resistance from mounting base to heatsink**	K/W	
Mounting method		**clip**	**screw**
direct with heatsink compound		0.3	0.5
direct without heatsink compound		1.4	1.4
with heatsink compound and 0.1 mm maximum mica insulator		2.2	-
with heatsink compound and 0.25 mm maximum alumina insulator		0.8	-
with heatsink compound and 0.05 mm mica insulator			
insulated up to 500 V		-	1.4
insulated up to 800 V / 1000 V		-	1.6
without heatsink compound and 0.05 mm mica insulator			
insulated up to 500 V		-	3.0
insulated up to 800 V / 1000 V		-	4.5

Additional insulators are generally not required when mounting the full-pack outlines.

Soldering

Recommendations for devices with a maximum junction temperature rating < 175 ˚C:

DIP OR WAVE SOLDERING.

Maximum permissible solder temperature is 260 ˚C at a distance from the body of > 5 mm and for a total contact time with soldering bath or waves of < 7 s.

HAND SOLDERING.

Maximum permissible temperature is 275 ˚C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 5 s.

The body of the device must not touch anything with a temperature > 200 ˚C.

It is not permitted to solder the metal tab of the device to a heatsink, otherwise the junction temperature rating will be exceeded.

Avoid any force on body and leads during or after soldering; do not correct the position of the device or of its leads after soldering.

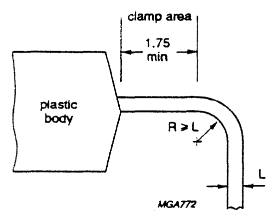
Lead bending

Maximum permissible tensile force on the body for 5 seconds is 20 N.

The leads can be bent, twisted or straightened. To keep forces within the above mentioned limits the leads should always be clamped rigidly near the body during bending. This is also to prevent damage to the seal of the leads within the plastic body.

Leads can be bent as near to the body as required, but adequate length should always be allowed for clamping. This is a minimum of 1.75 mm from the body to the start of a bend radius.

The internal radius of bend should never be less than the thickness of the lead. A minimum radius of at least 1.5 x lead thickness is preferred. See figure 1. Surface cracks in the dip tin coating on the lead are common when a radius less than 1.5 x lead thickness is used. Although exposing the copper material, these cracks do not affect the mechanical strength of the lead. Lead forming by Philips is available as an option on all products supplied in these outlines.



Dimensions in mm.

Fig 1. Minimum lead bend radius.

Additional guide-lines

It is recommended that where a device is rigidly secured to a heatsink which is in turn rigidly secured to a PCB, that a bend is put in the leads to act as an expansion loop. This will prevent differential expansion of the mounting parts transferring stress to the soldering joint, as shown in figure 2 below. This is only necessary where the device is mounted so rigidly that expansion forces are transmitted through the assembly.

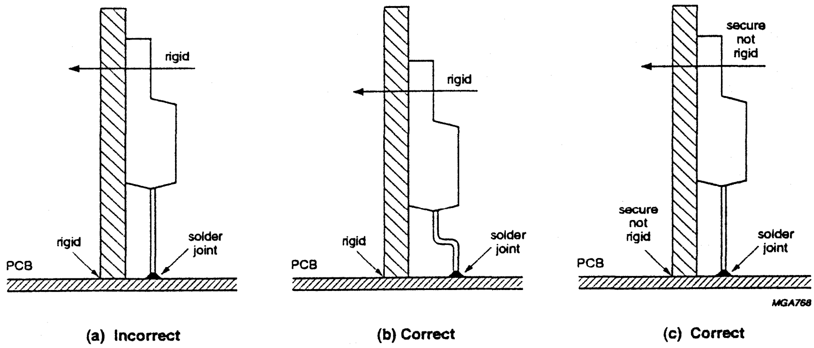


Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting with screw and spacing washer

THROUGH HEATSINK WITH NUT

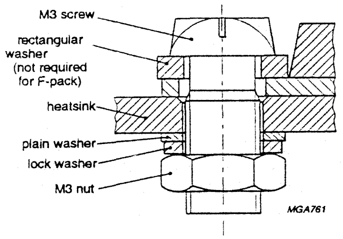
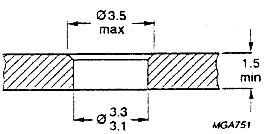


Fig 9. Assembly



Dimensions in mm.

Fig 10. Heatsink requirements.

INTO TAPPED HEATSINK

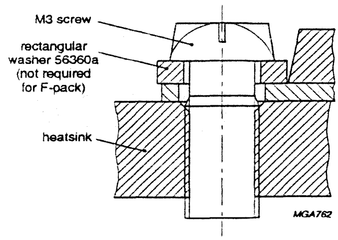
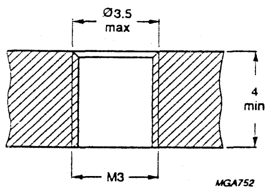


Fig 11. Assembly.



Dimensions in mm.

Fig 12. Heatsink requirements.

GENERAL DATA AND INSTRUCTIONS

General rules

1. Fasten the device to the heatsink before soldering the leads.
2. Avoid stress to the leads.
3. Keep mounting tool (e.g. screwdriver) clear of the plastic body.
4. The washer may only touch the plastic part of the body; it should not exert any force on that part (screw mounting).

Mounting methods

CLIP MOUNTING

Mounting with a spring clip gives:

a) A good thermal contact under the crystal area.

b) Safe insulation for mains operation.

Minimum force for good heat transfer is 10 N.

Maximum force to avoid damaging the device is 80 N.

MOUNTING TORQUES

For M3 screw (insulated mounting):

Minimum torque for good heat transfer is 0.4 Nm.

Maximum torque to avoid damaging the device is 0.6 Nm.

For M4 screw (direct mounting only):

Minimum torque for good heat transfer is 0.4 Nm.

Maximum torque to avoid damaging the device is 1.0 Nm.

The M4 screw head should not touch the plastic part of the envelope.

RIVET MOUNTING NON-INSULATED

The device should not be pop-rivetted to the heatsink. It is permissible to press-rivet SOT93 providing that eyelet rivets of soft material are used, and the press forces are slowly and carefully controlled.

This method is NOT recommended for F packs because it will damage the plastic encapsulation.

Heatsink requirements

Flatness in the mounting area: 0.02 mm maximum per 10 mm.
Mounting holes must be deburred, for further information see clip and screw mounting instructions.

Heatsink compound

The thermal resistance from mounting base to heatsink ($R_{th\ mb-h}$) can be reduced by applying a metallic oxide compound between the contact surfaces. Values given are of thermal resistance using this type of compound. Dow Corning 340 Heat sink compound is recommended. For insulated mounting, the compound should be applied to the bottom of both device and insulator.

Thermal data for heatsink mounting methods (SOT93 only)

Typical figures, for exact figures see data for each device type.

$R_{th\ mb-h}$	**Thermal resistance from mounting base to heatsink**	**K/W**	
Mounting method		**clip**	**screw**
direct with heatsink compound		0.3	0.3
direct without heatsink compound		1.5	0.8
with heatsink compound and 0.05 mm maximum mica insulator		0.8	0.8
without heatsink compound and 0.05 mm maximum mica insulator		3.0	2.2

Mica washers are generally not required when mounting the F-pack outlines.

Soldering

Recommendations for devices with a maximum junction temperature rating < 175 ˚C:

DIP OR WAVE SOLDERING

Maximum permissible solder temperature is 260 ˚C at a distance from the body of > 5 mm and for a total contact time with soldering bath or waves of < 7 s.

HAND SOLDERING

Maximum permissible temperature is 275 ˚C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 5 s.

The body of the device must not touch anything with a temperature > 200 ˚C.

It is not permitted to solder the metal tab of the device to a heatsink, otherwise the junction temperature rating will be exceeded.

Avoid any force on body and leads during or after soldering; do not correct the position of the device or of its leads after soldering.

Lead bending

Maximum permissible tensile force on the body for 5 seconds is 20 N.

The leads can be bent, twisted or straightened. To keep forces within the above mentioned limits the leads should always be clamped rigidly near the body during bending. This is also to prevent damage to the seal of the leads within the plastic body.

Leads can be bent as near to the body as required, but adequate length should always be allowed for clamping. This is a minimum of 1.75 mm from the body to the start of a bend radius.

The internal radius of bend should never be less than the thickness of the lead. A minimum radius of at least 1.5 x lead thickness is preferred. See figure 1 Surface cracks in the dip tin coating on the lead are common when a radius less than 1.5 x lead thickness is used. Although exposing the copper material, these cracks do not affect the mechanical strength of the lead. Lead forming by Philips is available as an option on all products supplied in these outlines.

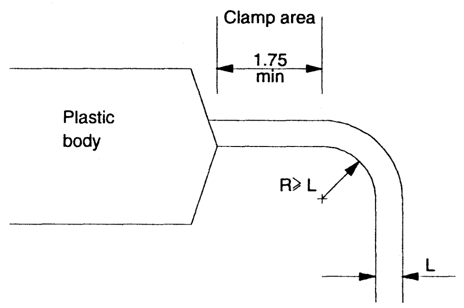


Fig 1. Minimum lead bend radius.

Additional guidelines

It is recommended that where a device is rigidly secured to a heatsink which is in turn rigidly secured to a PCB, that a bend is put in the leads to act as an expansion loop. This will prevent differential expansion of the mounting parts transferring stress to the soldering joint, as shown in figure 2 below. This is only necessary where the device is mounted so rigidly that expansion forces are transmitted through the assembly.

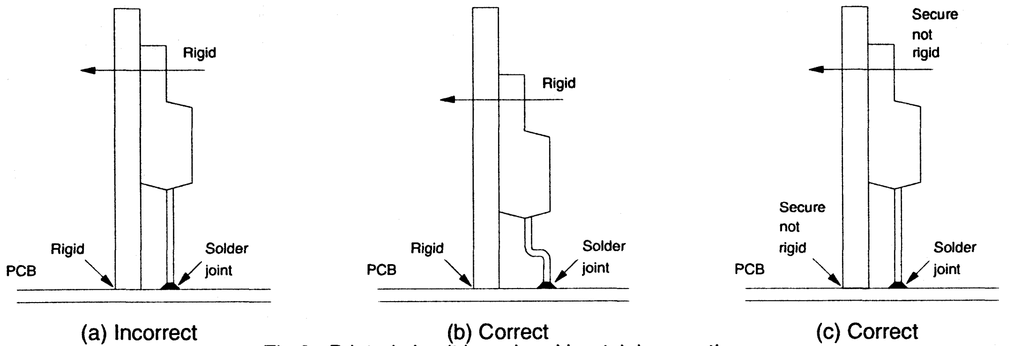


Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting through heatsink with nut

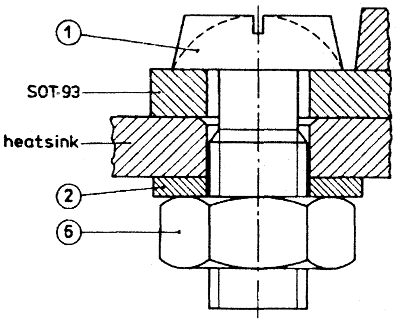


Fig 9. Assembly

(1) M4 screw
(2) plain washer
(6) M4 nut.

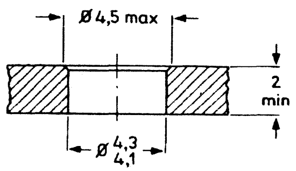


Fig 10. Heatsink requirements

When screw mounting the SOT93 envelope, it is particularly important to apply a thin, even layer of heatsink compound to the mounting base, and to apply torque to the screw slowly so that the compound has time to flow and the mounting base is not deformed. Most SOT93 envelopes contain a crystal larger than that in the other plastic envelopes, and it is more likely to crack if the mounting base is deformed.

Where vibrations are to be expected the use of a lock washer or of a curved spring washer is recommended with a plain washer between aluminium heatsink and spring washer.

Insulated screw mounting with insert nut; up to 500V

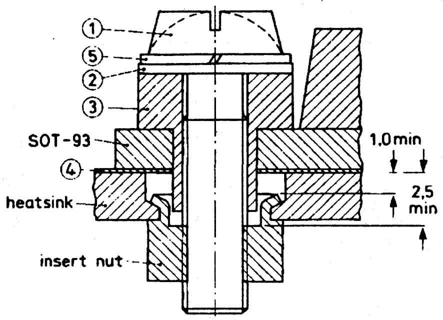


Fig 15. Assembly and heatsink requirements for 500V insulation. See also figures 9 and 10.

(1) M3 screw
(2) plain washer
(3) insulating bush (56368b)
(4) mica insulator (56368c)
(5) lock washer

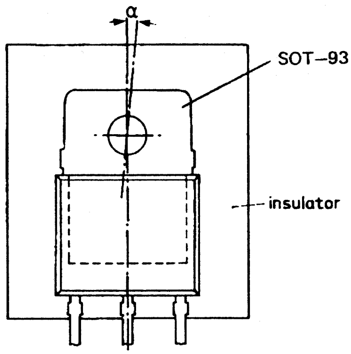


Fig 16. Mica insulator
The axial deviation (α) between package and mica should not exceed 5°

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Data handbook system

DATA HANDBOOK SYSTEM

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Data handbook system

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