DISCRETE SEMICONDUCTORS

High-voltage and Switching NPN Power Transistors

1998

Data Handbook SC06

Let's make things better.

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

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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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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 and power dissipation (P_{tot}). 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	PACKAGE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BUX86P	SOT82	800	400	0.5	42	596
BUX84F	SOT186	800	400	2	18	591
BUX84	TO-220AB	800	400	2	40	583
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BUT11F	SOT186	850	400	5	32	463
BUW11F	SOT199	850	450	5	32	523
BUT211	TO-220AB	850	400	5	100	513
BUT11	TO-220AB	850	400	5	100	442
BUW11W	SOT429	850	400	5	100	530
BUT18F	SOT186	850	450	6	33	506
BUT18	TO-220AB	850	400	6	110	500
BUT12F	SOT186	850	400	8	23	482
BUW12F	SOT199	850	400	8	34	538
BUT12	TO-220AB	850	400	8	125	474
BUW12W	SOT429	850	400	8	125	546
BUW13F	SOT199	850	400	15	37	554
BUW13W	SOT429	850	400	15	175	563
BUW14	SOT82	1000	450	0.5	20	571
BUX87P	SOT82	1000	450	0.5	42	596
BUX85F	SOT186	1000	450	2	18	591
BUX85	TO-220AB	1000	450	2	40	583
BUW85	SOT82	1000	450	3	50	575
BUT18AF	SOT186	1000	450	4	33	506
BUT11AF	SOT186	1000	450	5	20	449
BUT11AX	SOT186A	1000	450	5	20	457
BUW11AF	SOT199	1000	450	5	32	538
BUT11XI	SOT186A	1000	450	5	32	469
BUT11A	TO-220AB	1000	450	5	100	442
BUT11AI	TO-220A	1000	450	5	100	455
BUW11AW	SOT429	1000	450	5	100	530
BUT18A	TO-220AB	1000	450	6	110	500
BUT12AF	SOT186	1000	450	8	23	506
BUT12XI	SOT186A	1000	450	8	33	495
BUW12AF	SOT199	1000	450	8	34	538

TYPE	PACKAGE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BUT12AI	TO-220AB	1000	450	8	110	490
BUW12AW	SOT429	1000	450	8	125	546
BUT12A	TO-220AB	1000	450	8	125	474
BUW13AF	SOT199	1000	450	15	37	554
BUW13AW	SOT429	1000	450	15	175	563
BUJ403A	TO-220AB	1200	600	6	32	434
BUJ403AX	SOT186A	1200	550	6	32	438
BU505DF	SOT186	1500	700	2.5	20	43
BU505F	SOT186	1500	700	2.5	20	43
BU505	TO-220AB	1500	700	2.5	75	38
BU505D	TO-220AB	1500	700	2.5	75	38
BU506DF	SOT186	1500	700	5	20	55
BU506F	SOT186	1500	700	5	20	55
BU1506DX	SOT186A	1500	–	5	32	90
BU2506DX	TOP3D	1500	700	5	45	128
BU2506DF	SOT199	1500	700	5	45	123
BU506	TO-220AB	1500	700	5	100	50
BU506D	TO-220AB	1500	700	5	100	50
BU508AF	SOT199	1500	700	8	34	61
BU508DF	SOT199	1500	700	8	34	75
BU508DX	SOT199	1500	700	8	34	85
BU1508AX	SOT186A	1500	700	8	35	70
BU1507DX	SOT186A	1500	700	8	35	99
BU1508DX	SOT186A	1500	700	8	35	108
BU508AX	SOT399	1500	700	8	45	70
BU1507AX	SOT186A	1500	700	8	45	95
BU2507AF	SOT199	1500	700	8	45	133
BU2507AX	SOT399	1500	700	8	45	137
BU2507DF	SOT199	1500	700	8	45	141
BU2507DX	SOT399	1500	700	8	45	145
BU2508DF	SOT199	1500	700	8	45	164
BU2508AF	SOT199	1500	700	8	45	149
BU2508AX	SOT399	1500	700	8	45	159
BU2508DX	TOP3D	1500	700	8	45	174
BU2508AW	SOT429	1500	700	8	125	154
BU508DW	SOT429	1500	700	8	125	80
BU508AW	SOT429	1500	700	8	125	66
BU2508DW	SOT429	1500	700	8	125	169
BU2515AF	SOT199	1500	800	9	45	179
BU2515AX	SOT399	1500	800	9	45	183

TYPE	PACKAGE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BU2515DF	SOT199	1500	800	9	45	187
BU2515DX	SOT399	1500	800	9	45	192
BU2522AX	TOP3D	1500	800	10	45	238
BU2520AF	SOT199	1500	800	10	45	197
BU2520AX	TOP3D	1500	800	10	45	208
BU2520DF	SOT199	1500	800	10	45	214
BU2520DX	TOP3D	1500	800	10	45	223
BU2522AF	SOT199	1500	800	10	45	228
BU2522DF	SOT199	1500	800	10	45	243
BU2522DX	SOT399	1500	800	10	45	248
BU2522AW	SOT429	1500	800	10	125	233
BU2520AW	SOT429	1500	800	10	125	203
BU2520DW	SOT429	1500	800	10	125	219
BU2523AF	SOT199	1500	800	11	45	253
BU2523AX	SOT399	1500	800	11	45	257
BU2523DF	SOT199	1500	800	11	45	261
BU2523DX	SOT399	1500	800	11	45	266
BU2525AF	SOT199	1500	800	12	45	271
BU2525AX	TOP3D	1500	800	12	45	281
BU2525DF	SOT199	1500	800	12	45	286
BU2525DX	SOT399	1500	800	12	45	296
BU2527AX	TOP3D	1500	800	12	45	311
BU2527AF	SOT199	1500	800	12	45	301
BU2527DF	SOT199	1500	800	12	45	316
BU2527DX	SOT399	1500	800	12	45	321
BU2525AW	SOT429	1500	800	12	125	276
BU2525DW	SOT429	1500	800	12	125	291
BU2527AW	SOT429	1500	800	12	125	306
BU2530AW	SOT429	1500	800	16	125	330
BU2532AL	SOT430	1500	800	16	125	334
BU2532AW	SOT429	1500	800	16	125	338
BU2530AL	TOP3L	1500	800	16	125	326
BU2708AF	SOT199	1700	825	8	45	342
BU2708DF	SOT199	1700	825	8	45	352
BU2708AX	SOT399	1700	825	8	45	347
BU2708DX	SOT399	1700	825	8	45	357
BU2720DF	SOT199	1700	825	10	45	372
BU2720AF	SOT199	1700	825	10	45	362
BU2720AX	SOT399	1700	825	10	45	367
BU2720DX	SOT399	1700	825	10	45	377

TYPE	PACKAGE	V_{CESM} (V)	V_{CEO} (V)	I_C (A)	P_{tot} (W)	PAGE
BU2722AF	SOT199	1700	825	10	45	382
BU2722AX	SOT399	1700	825	10	45	387
BU2725AF	SOT199	1700	825	12	45	392
BU2725AX	SOT399	1700	825	12	45	397
BU2725DF	SOT199	1700	–	12	45	402
BU2725DX	SOT399	1700	–	12	45	407
BU2727AF	SOT199	1700	825	12	45	417
BU2727AX	SOT399	1700	825	12	45	427
BU2727AW	SOT429	1700	825	12	125	422
BU2727A	SOT93	1700	825	12	125	412
BU2730AL	SOT430	1700	825	16	125	432
BU1706AX	SOT186A	1750	850	5	32	118
BU1706A	TO-220AB	1750	850	5	100	113

REPLACED/WITHDRAWN TYPES

The following type numbers were included in the previous issue of this data handbook, but are not in the current edition

TYPE NUMBER	REASON FOR DELETION
BU2508A	Replaced by BU2508AW
BU2508D	Replaced by BU2508DW
BU2520A	Replaced by BU2520AW
BU2520D	Replaced by BU2520DW
BU2522A	Replaced by BU2522AW
BU2525A	Replaced by BU2525AW
BU2525D	Replaced by BU2525AW
BU2527A	Replaced by BU2527AW
BU705	Pruned
BU705D	Pruned
BU705DF	Pruned
BU705F	Pruned
BU706	Pruned
BU706D	Pruned
BU706DF	Pruned
BU706F	Pruned
BUW11	Replaced by BUW11W
BUW11A	Replaced by BUW11AW
BUW12	Replaced by BUW12W
BUW12A	Replaced by BUW12AW
BUW13	Replaced by BUW13W
BUW13A	Replaced by BUW13AW

Internet World Wide Web Home Page

WHAT IS IT?

Welcome to our place in cyberspace.

Explore our Web pages and take a look at our product offering of advance High-performance Applications and Products.

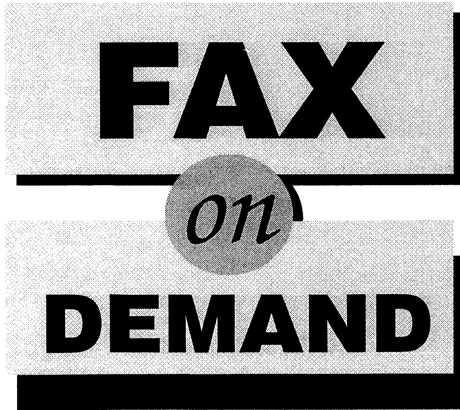
In addition, we offer you the latest information on Products, News, Support, Employment and Offices.

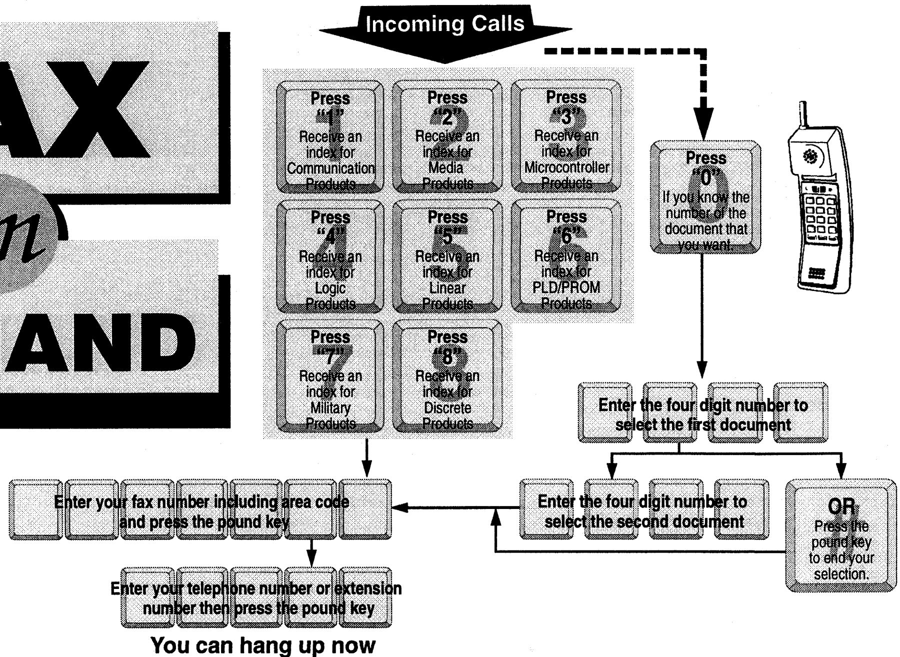
HOW TO REACH US

For access to the Philips Semiconductors Home Page go to the World Wide Web location:

http://www.semiconductors.philips.com/

FAX-on-DEMAND System





What is it?

The FAX-on-DEMAND system is a computer facsimile system that allows customers to receive selected documents by fax automatically.

How does it work?

To order a document, you simply enter the document number. This number can be obtained by asking for an index of available documents to be faxed to you the first time you call the system.

Our system has a selection of the latest product data sheets from Philips with varying page counts. As you know, it takes approximately one minute to FAX one page. This isn't bad if the number of pages is less than 10. But if the document is 37 pages long, be ready for a long transmission!

Philips Semiconductors also maintains product information on the World-Wide Web. Our home page can be located at:
http://www.semiconductors.philips.com

Who do I contact if I have a question about FAX-on-DEMAND?

Contact your local Philips sales office.

FAX-on-DEMAND phone numbers:

England (United Kingdom, Ireland)	44-181-730-5020
France	33-1-40-99-60-60
Italy	39-167-295502
North America	1-800-282-2000

Locations soon to be in operation:

Hong Kong
Japan
The Netherlands

GENERAL

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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.

DISCRETE SEMICONDUCTORS

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/special third letter"
- 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 or 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'.

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).

(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.

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%

B 2%

C 5%

D 10%

E 20%.

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 are those recommended by the IEC in its publication number 134.

Definitions 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-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-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.

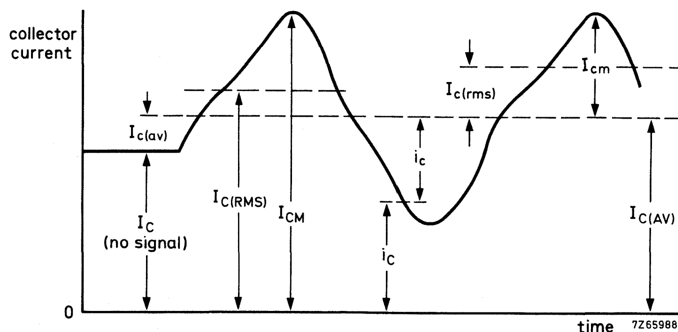


Fig.1 Collector current as a function of time.

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.

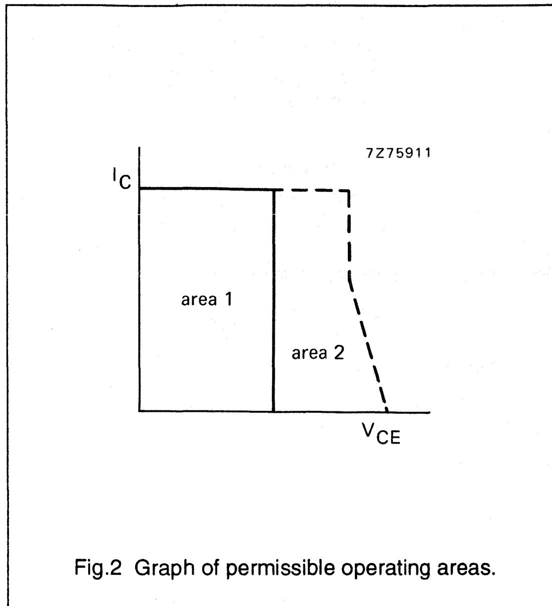


Fig.2 Graph of permissible operating areas.

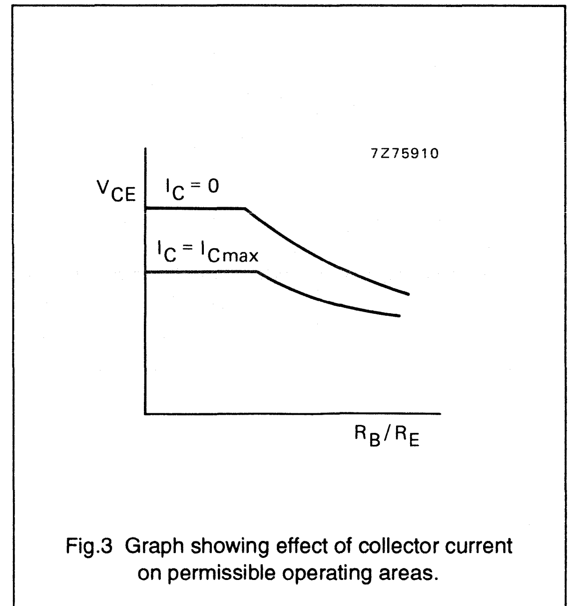


Fig.3 Graph showing effect of collector current on permissible operating areas.

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.

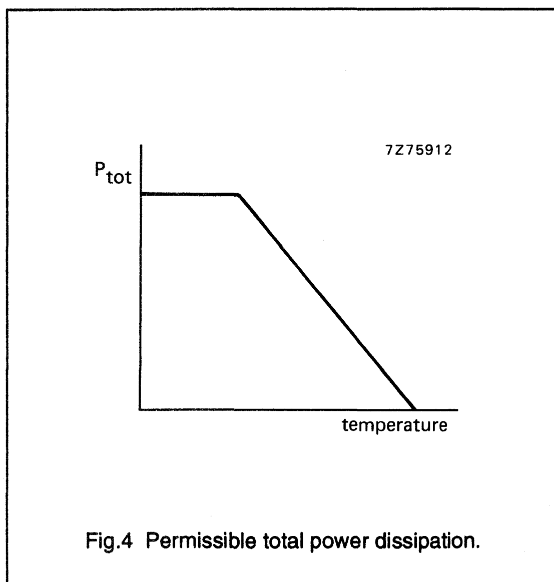


Fig.4 Permissible total power dissipation.

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.

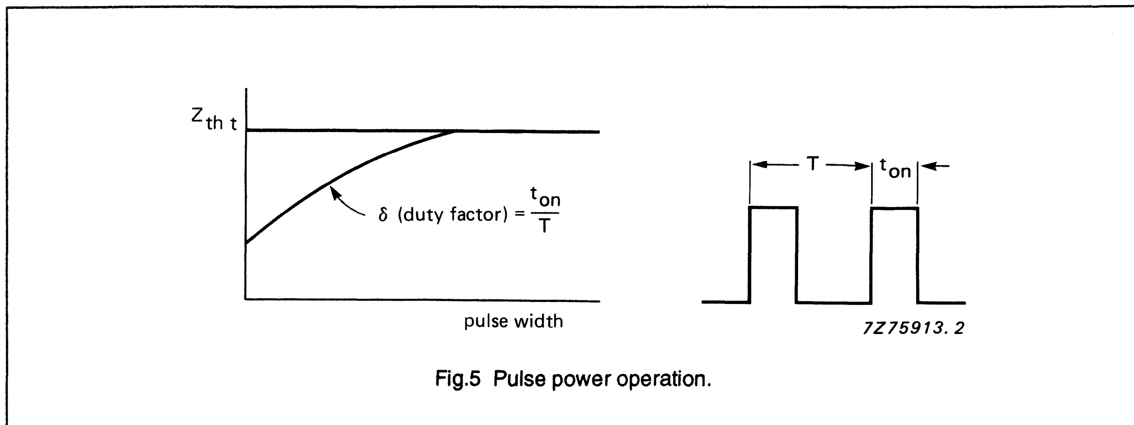


Fig.5 Pulse power operation.

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.

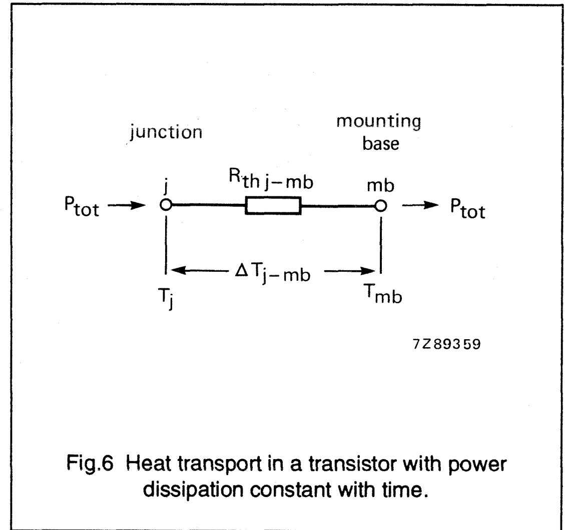


Fig.6 Heat transport in a transistor with power dissipation constant with time.

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

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

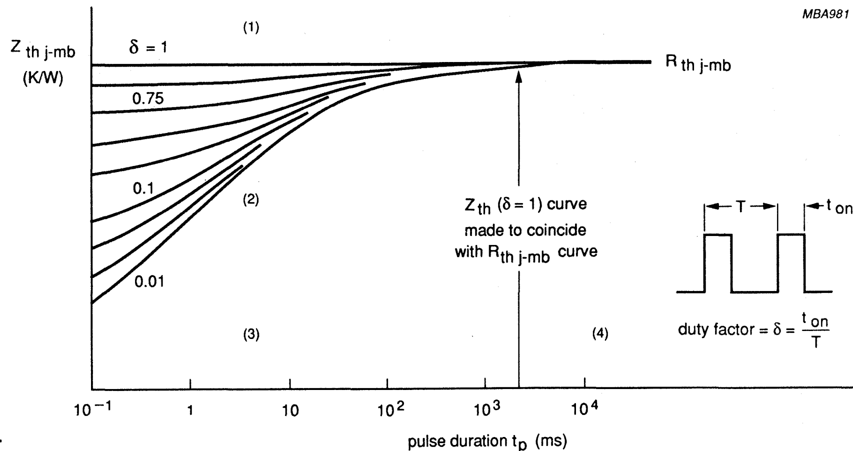
and for pulse operation the junction temperature will be:

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

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.

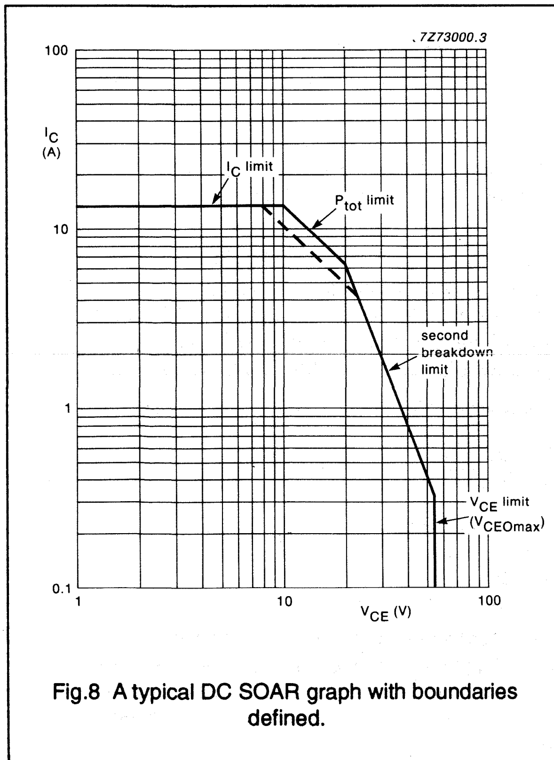


Fig.8 A typical DC SOAR graph with boundaries defined.

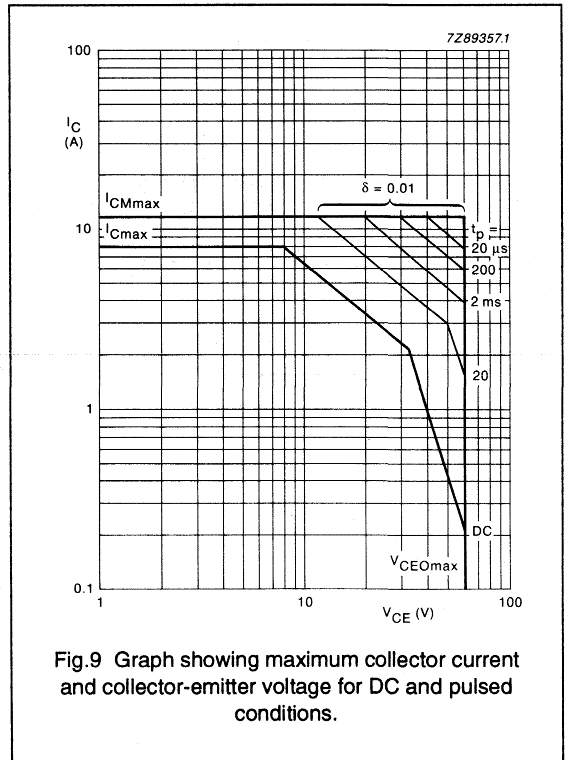


Fig.9 Graph showing maximum collector current and collector-emitter voltage for DC and pulsed conditions.

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 $\delta = 0.01$ 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.

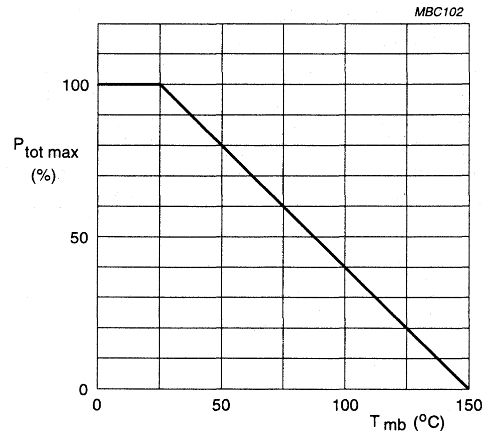
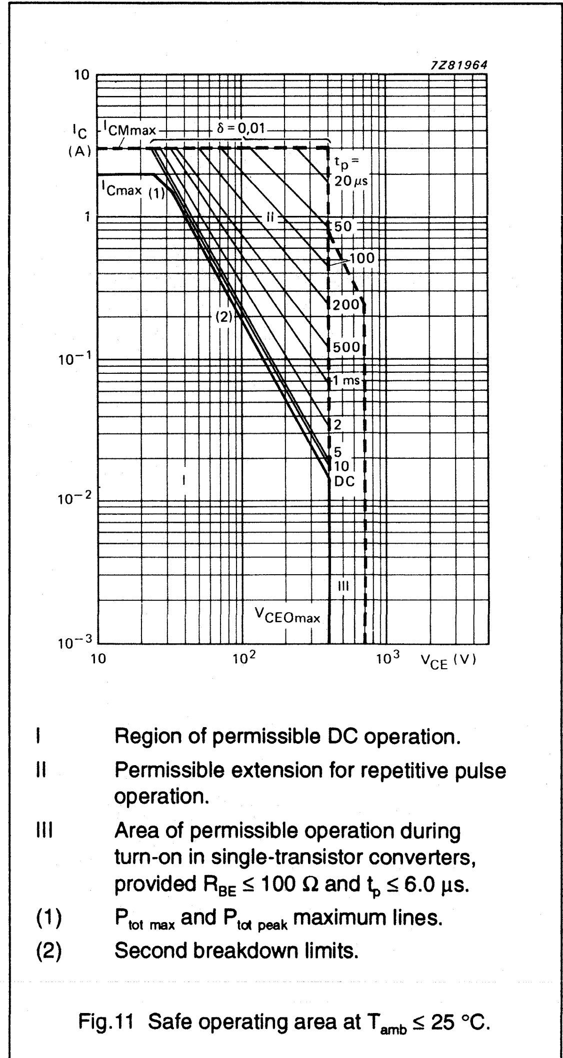


Fig.10 Power derating curve: maximum allowable power dissipation as a function of mounting base temperature.

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.

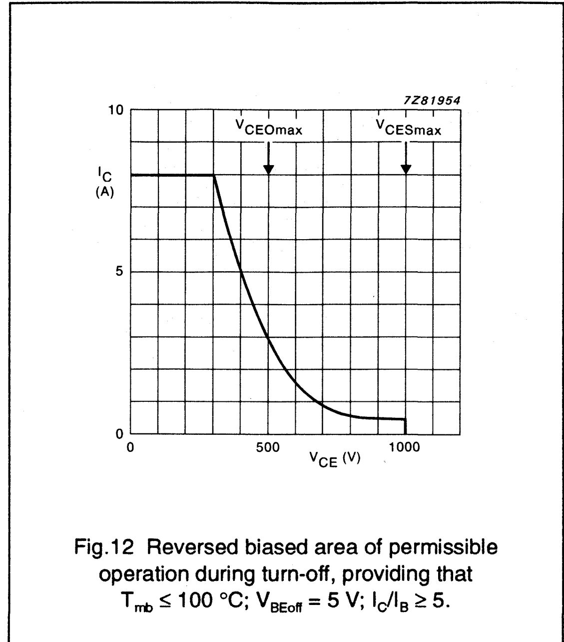


Fig.12 Reversed biased area of permissible operation during turn-off, providing that $T_{mb} \leq 100$ °C; $V_{BEoff} = 5$ V; $I_C/I_B \geq 5$.

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 NPNpower transistors, and other Philips Semiconductors power products, is published in the *Power Semiconductors Applications Handbook.* The ordering 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 transistors — BU505; BU505D

DESCRIPTION

High-voltage, high-speed switching NPN power transistor in a TO-220AB package. The BU505D has an integrated efficiency diode.

APPLICATIONS

- Horizontal deflection circuits of colour television receivers.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

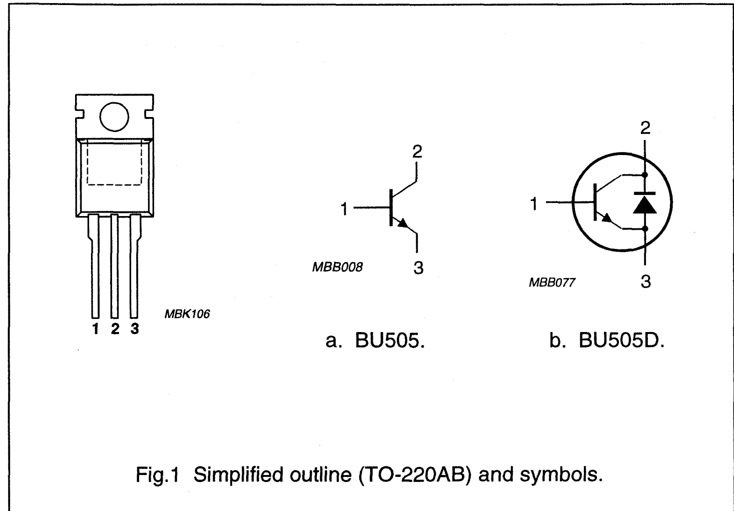


Fig.1 Simplified outline (TO-220AB) and symbols.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 2$ A; $I_B = 900$ mA	–	1	V
V_F	diode forward voltage (BU505D)	$I_F = 2$ A	–	1.8	V
I_{Csat}	collector saturation current		–	2	A
I_C	collector current (DC)	see Fig.3	–	2.5	A
I_{CM}	collector current (peak value)	see Fig.3	–	4	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.4	–	75	W
t_f	fall time	inductive load; see Fig.7	0.9	–	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1.67	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
I_{Csat}	collector saturation current		–	2	A
I_C	collector current (DC)	see Fig.3	–	2.5	A
I_{CM}	collector current (peak value)	see Fig.3	–	4	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; see Fig.4	–	75	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

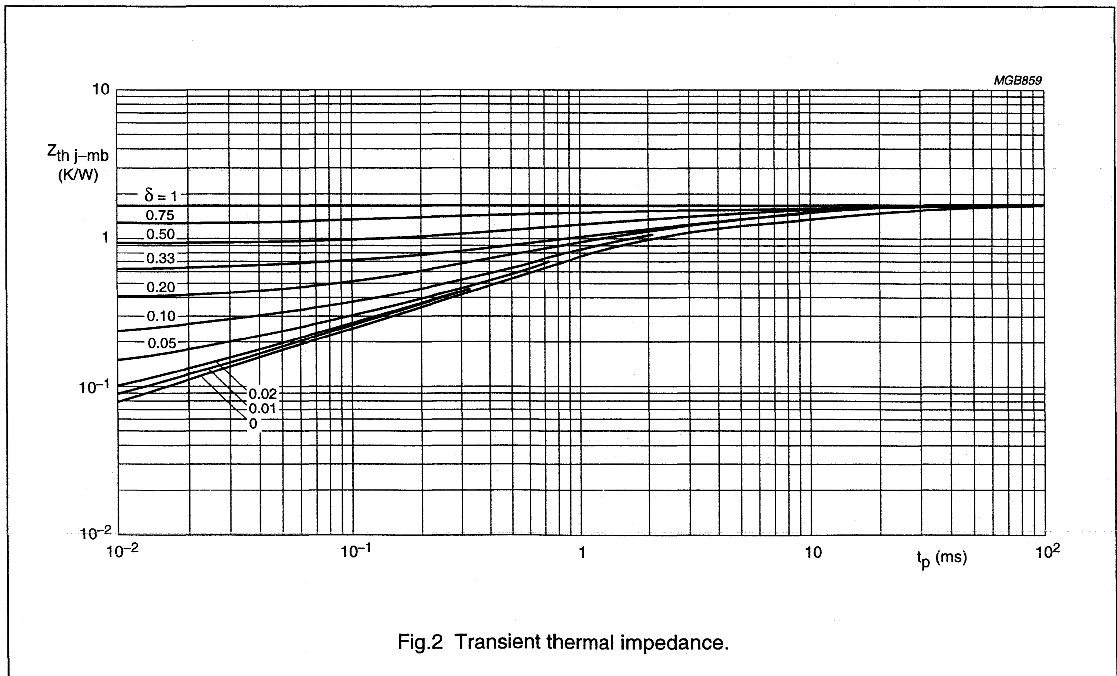


Fig.2 Transient thermal impedance.

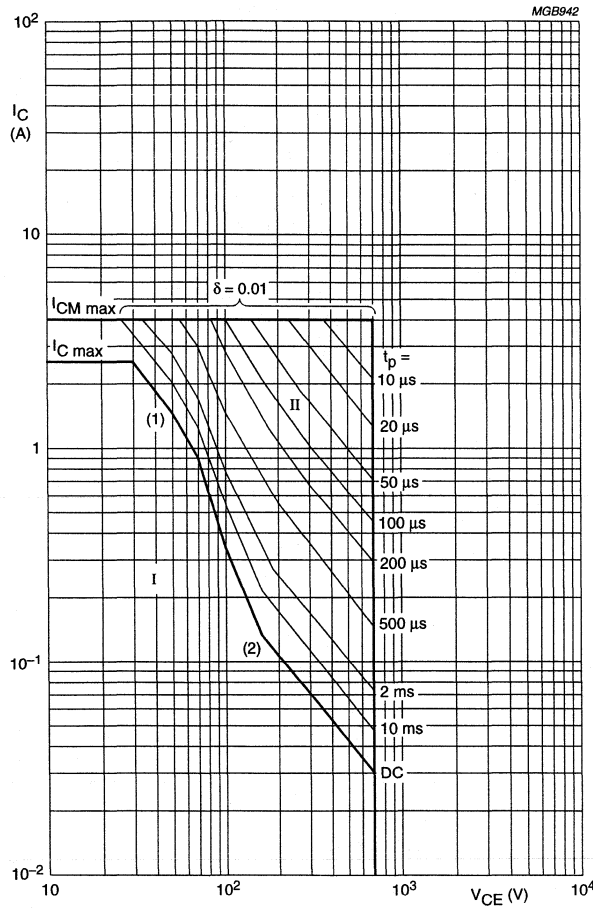
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	see Figs 5 and 6	700	–	–	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 2 A; I_B = 900 mA	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 2 A; I_B = 900 mA	–	–	1.3	V
V_{EBO}	emitter-base voltage	I_E = 10 mA; I_C = 0	–	6	–	V
V_F	diode forward voltage (BU505D)	I_F = 2 A	–	–	1.8	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$; V_{BE} = 0; note 1	–	–	0.15	mA
		$V_{CE} = V_{CESmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	1	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	1	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 100 mA	6	13	30	
f_T	transition frequency	V_{CE} = 5 V; I_C = 100 mA; f = 5 MHz	–	7	–	MHz
C_c	collector capacitance	V_{CB} = 10 V; $I_E = i_e$ = 0; f = 1 MHz	–	65	–	pF
Switching times in horizontal deflection circuit (see Fig.7)						
t_s	storage time	I_{CM} = 2 A; $I_{B(end)}$ = 900 mA; V_{dr} = –4 V				
		L_B = 10 µH	–	6.5	–	µs
		L_B = 15 µH	–	7.5	–	µs
		L_B = 25 µH	–	9.5	–	µs
t_f	fall time	I_{CM} = 2 A; $I_{B(end)}$ = 900 mA; V_{dr} = –4 V				
		L_B = 10 µH	–	0.9	–	µs
		L_B = 15 µH	–	0.9	–	µs
		L_B = 25 µH	–	0.85	–	µs

Note

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



T_{mb} = 25 °C.
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.3 Forward bias SOAR.

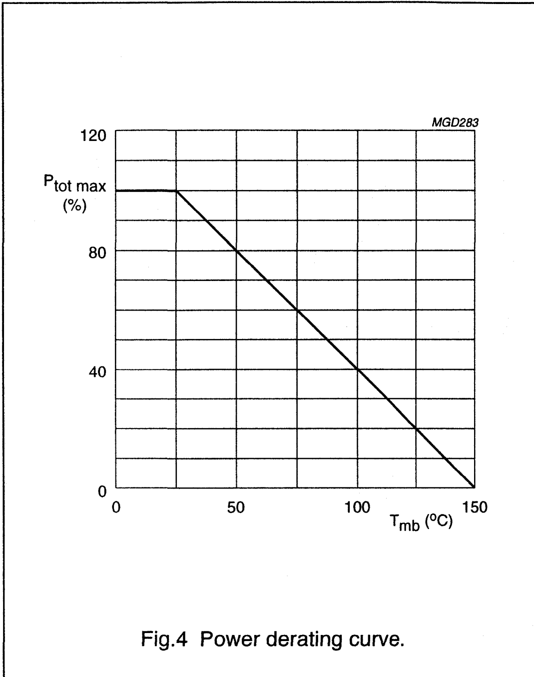


Fig.4 Power derating curve.

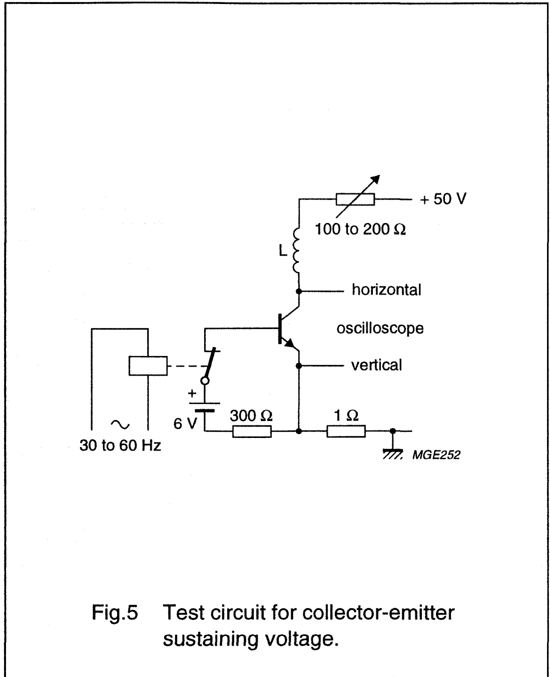


Fig.5 Test circuit for collector-emitter sustaining voltage.

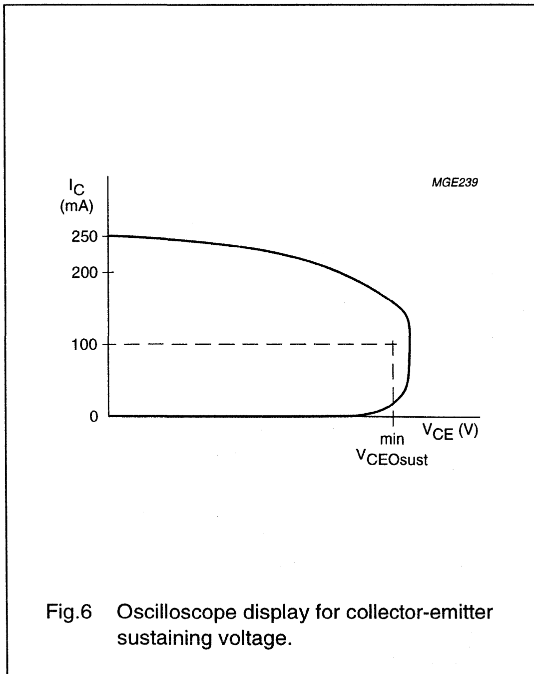


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.

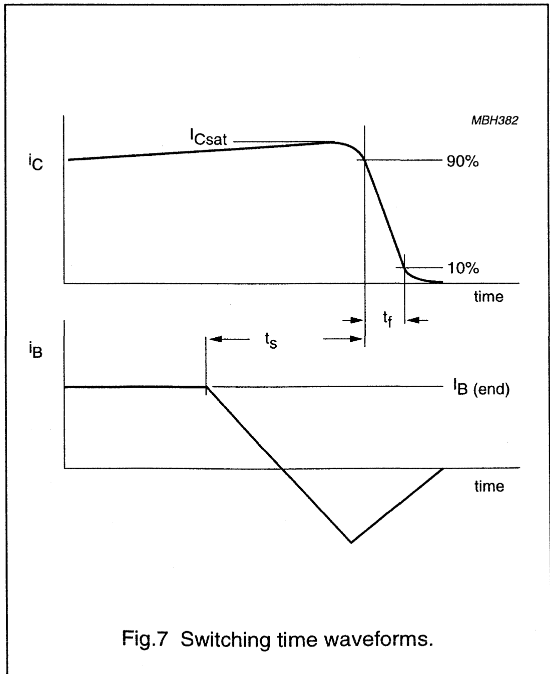


Fig.7 Switching time waveforms.

Silicon diffused power transistors BU505F; BU505DF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT186 package with electrically isolated mounting base. The BU505DF has an integrated efficiency diode.

APPLICATIONS

- Horizontal deflection circuits of colour television receivers.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated from all pins

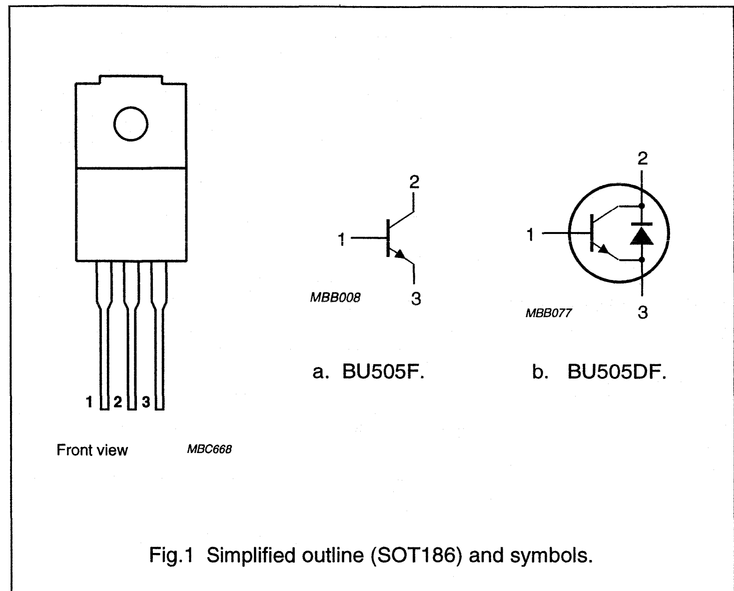


Fig.1 Simplified outline (SOT186) and symbols.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 2$ A; $I_B = 900$ mA; see Fig.8	–	1	V
V_F	diode forward voltage (BU505DF)	$I_F = 2$ A	–	1.8	V
I_{Csat}	collector saturation current		–	2	A
I_C	collector current (DC)	see Figs 4 and 5	–	2.5	A
I_{CM}	collector current (peak value)	see Figs 4 and 5	–	4	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2	–	20	W
t_f	fall time	inductive load; see Fig.10	0.7	–	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	6.35	K/W
		note 2	3.85	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		55	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isolM}	isolation voltage from all terminals to external heatsink (peak value)	–	1500	V
C_{isol}	isolation capacitance from collector to external heatsink	12	–	pF

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
I_{Csat}	collector saturation current		–	2	A
I_C	collector current (DC)	see Figs 4 and 5	–	2.5	A
I_{CM}	collector current (peak value)	see Figs 4 and 5	–	4	A
I_B	base current (DC)		–	2	A
I_{BM}	base current (peak value)		–	4	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2	–	20	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

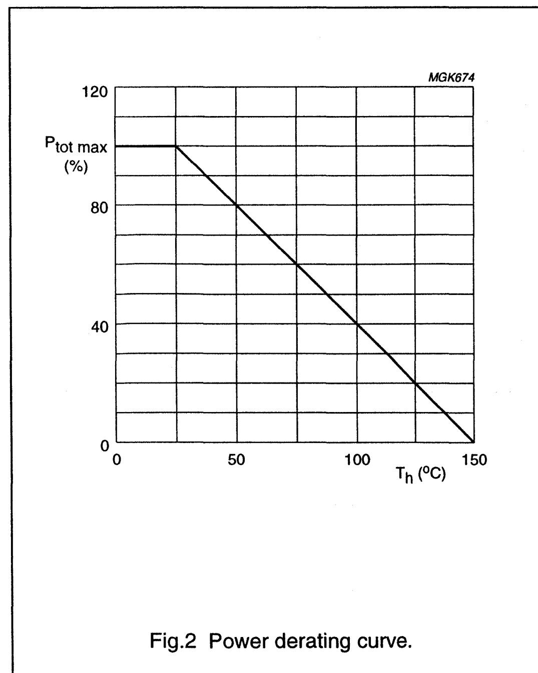
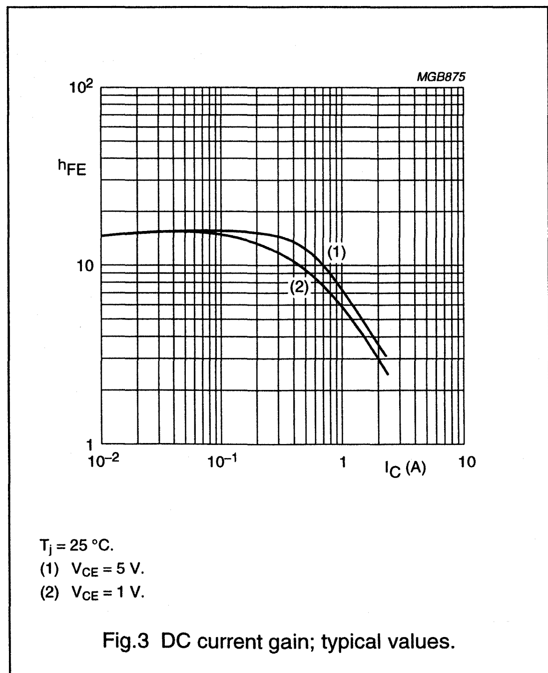


Fig.2 Power derating curve.



$T_j = 25$ °C.
(1) $V_{CE} = 5$ V.
(2) $V_{CE} = 1$ V.

Fig.3 DC current gain; typical values.

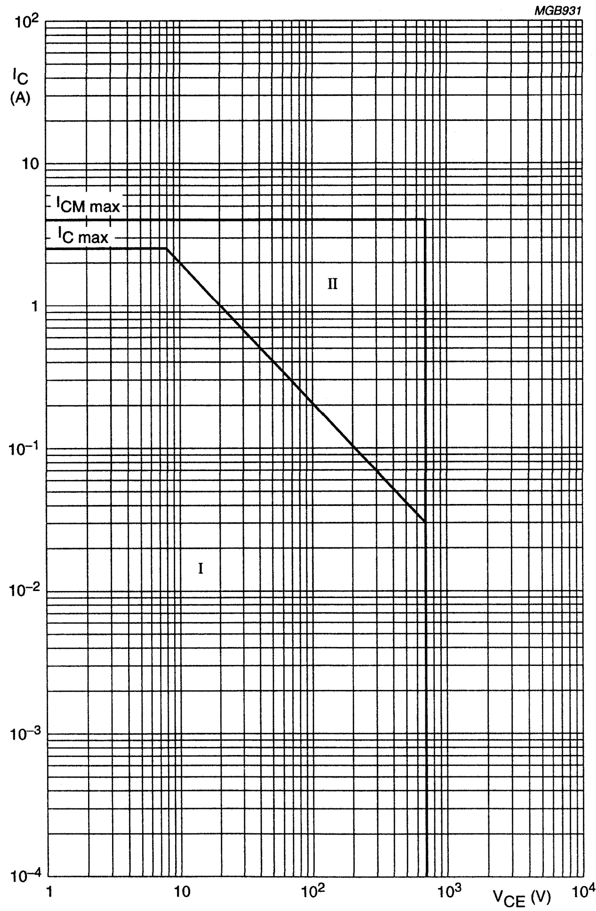
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 0.1 A; I_B = 0; L = 25 mH; see Figs 6 and 7	700	–	–	V
V_{CEsat}	collector-emitter saturation voltage	I_C = 2 A; I_B = 900 mA; see Fig.8	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	I_C = 2 A; I_B = 900 mA; see Fig.9	–	–	1.3	V
V_F	diode forward voltage (BU505DF)	I_F = 2 A	–	–	1.8	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$; V_{BE} = 0; note 1	–	–	0.15	mA
		$V_{CE} = V_{CESmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	1	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 5 V; I_C = 0	–	–	1	mA
h_{FE}	DC current gain	see Fig.3				
		V_{CE} = 5 V; I_C = 2 A	2.22	–	–	
		V_{CE} = 5 V; I_C = 100 mA	6	13	30	
f_T	transition frequency	V_{CE} = 5 V; I_C = 100 mA; f = 1 MHz	–	7	–	MHz
C_c	collector capacitance	V_{CB} = 10 V; $I_E = i_e$ = 0; f = 1 MHz	–	65	–	pF
Switching times in horizontal deflection circuit (see Fig.4)						
t_s	storage time	I_{CM} = 2 A; $I_{B(end)}$ = 900 mA; V_{dr} = –4 V				
		L_B = 10 µH	–	6.5	–	µs
		L_B = 15 µH	–	7.5	–	µs
		L_B = 25 µH	–	9.5	–	µs
t_f	fall time	I_{CM} = 2 A; $I_{B(end)}$ = 900 mA; V_{dr} = –4 V				
		L_B = 10 µH	–	0.9	–	µs
		L_B = 15 µH	–	0.9	–	µs
		L_B = 25 µH	–	0.85	–	µs

Note

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



Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

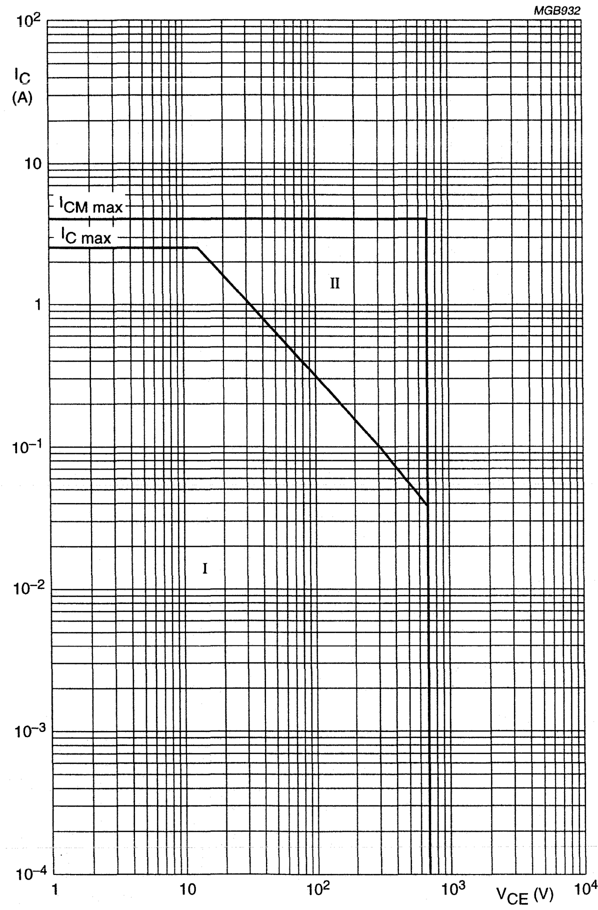
T_h = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.4 Forward bias SOAR.

Silicon diffused power transistors BU505F; BU505DF



Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

T_h = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.5 Forward bias SOAR.

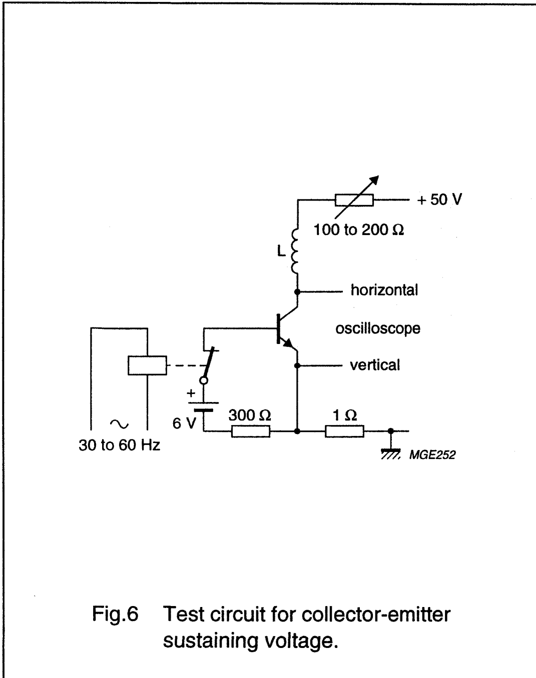


Fig.6 Test circuit for collector-emitter sustaining voltage.

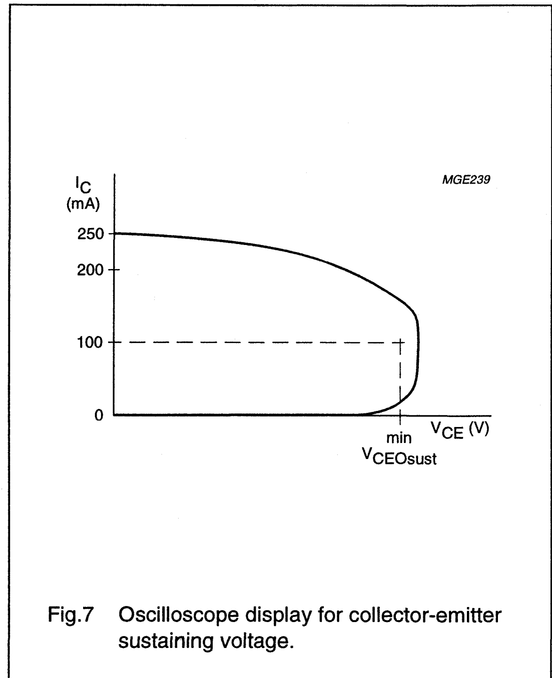
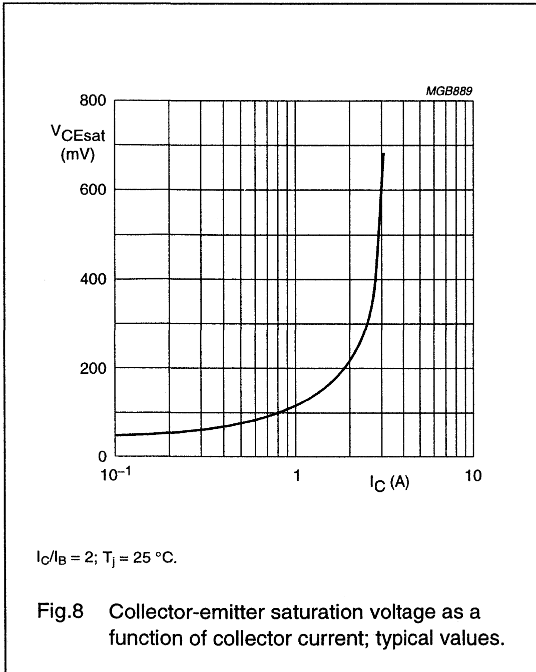
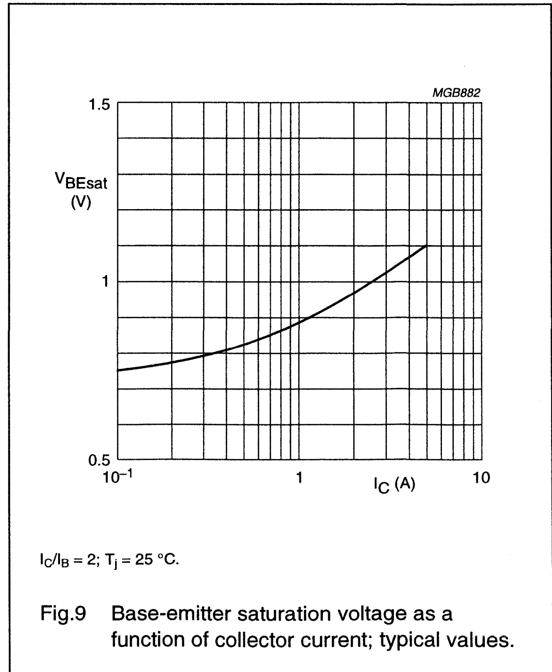


Fig.7 Oscilloscope display for collector-emitter sustaining voltage.



$I_C/I_B = 2$; $T_j = 25$ °C.

Fig.8 Collector-emitter saturation voltage as a function of collector current; typical values.



$I_C/I_B = 2$; $T_j = 25$ °C.

Fig.9 Base-emitter saturation voltage as a function of collector current; typical values.

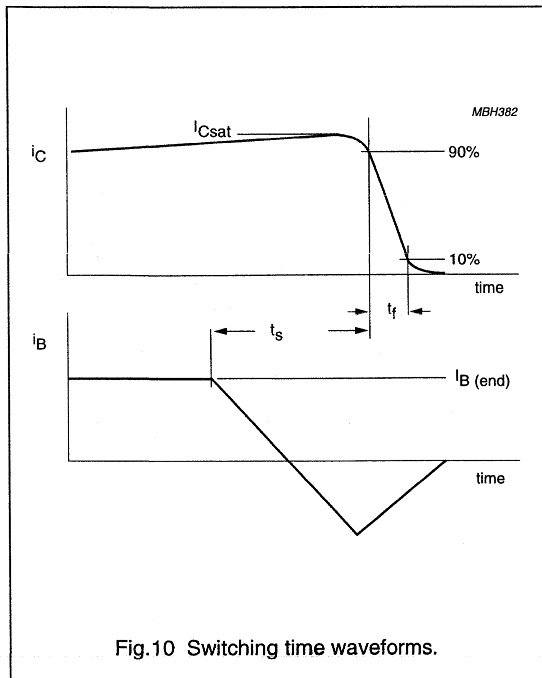


Fig.10 Switching time waveforms.

Silicon diffused power transistors — BU506; BU506D

DESCRIPTION

High-voltage, high-speed, switching NPN power transistor in a TO-220AB package. The BU506D has an integrated efficiency diode.

APPLICATIONS

- Horizontal deflection circuits of colour television receivers
- Line-operated switch-mode applications.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

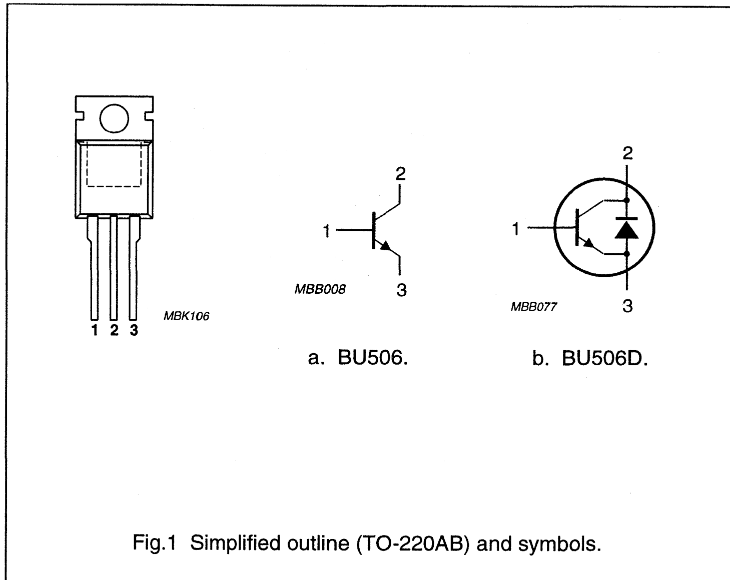


Fig.1 Simplified outline (TO-220AB) and symbols.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3$ A; $I_B = 1.33$ A; see Fig.6	–	1	V
V_F	diode forward voltage (BU506D)	$I_F = 3$ A; see Fig.10	1.5	–	V
I_{Csat}	collector saturation current		–	3	A
I_C	collector current (DC)	see Fig.2	–	5	A
I_{CM}	collector current (peak value)	see Fig.2	–	8	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	–	100	W
t_f	fall time	inductive load; see Fig.9	0.7	–	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1.25	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
I_{Csat}	collector saturation current		–	3	A
I_C	collector current (DC)	see Fig.2	–	5	A
I_{CM}	collector current (peak value)	see Fig.2	–	8	A
I_B	base current (DC)		–	3	A
I_{BM}	base current (peak value)		–	5	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	–	100	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

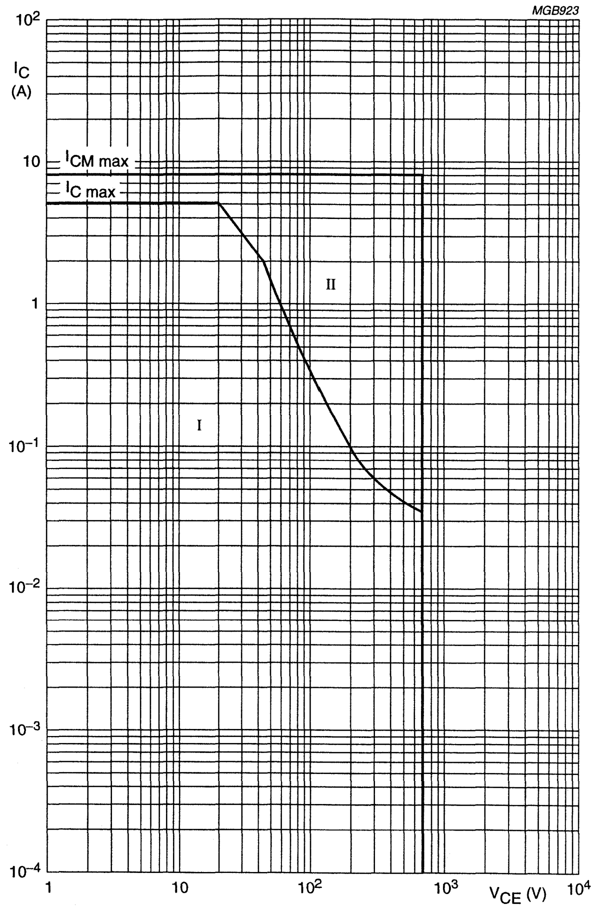
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	see Figs 4 and 5	700	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3$ A; $I_B = 1.33$ A; see Fig.6	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 3$ A; $I_B = 1.33$ A; see Fig.7	–	–	1.3	V
V_F	diode forward voltage (BU506D)	$I_F = 3$ A; see Fig.10	–	1.5	2.2	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; note 1	–	–	0.5	mA
		$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	1	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 6$ V; $I_C = 0$	–	–	10	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 100$ mA; see Fig.8	6	13	30	
Switching times in horizontal deflection circuit (see Fig.9)						
t_s	storage time	$I_{CM} = 3$ A; $I_{B(end)} = 1$A; $L_B = 12$ µH	–	6.5	–	µs
t_f	fall time	$I_{CM} = 3$ A; $I_{B(end)} = 1$A; $L_B = 12$ µH	–	0.7	–	µs

Note

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



T_{mb} = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

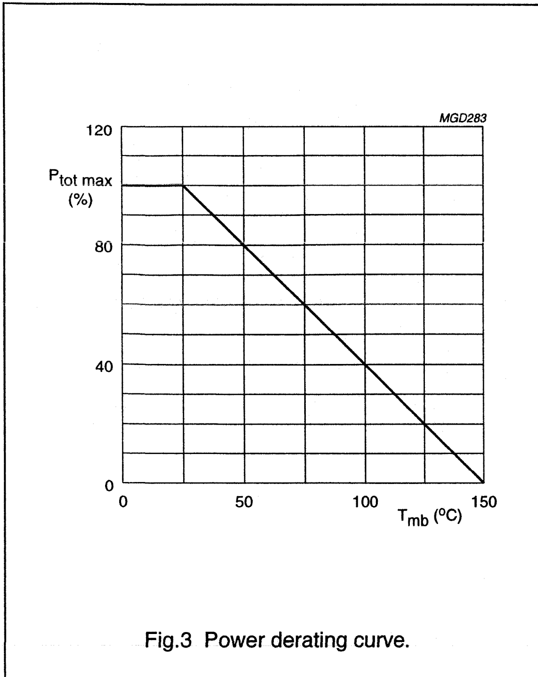


Fig.3 Power derating curve.

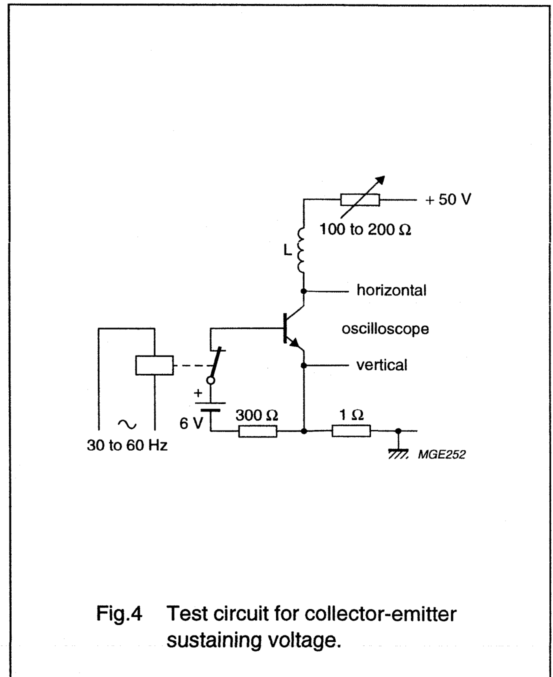


Fig.4 Test circuit for collector-emitter sustaining voltage.

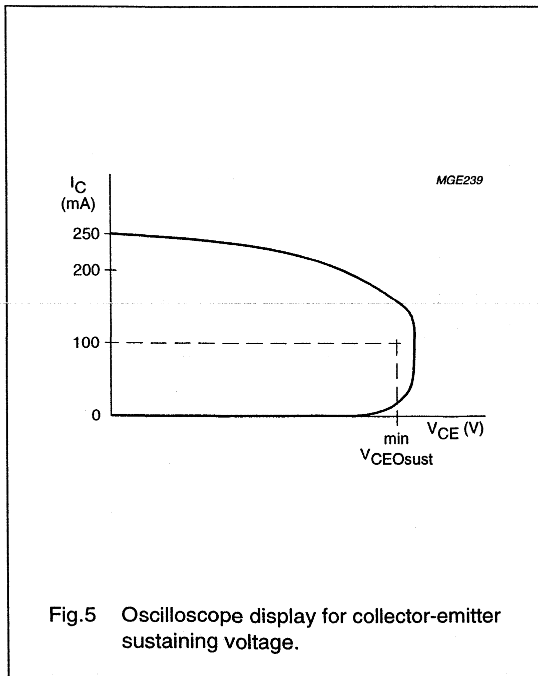
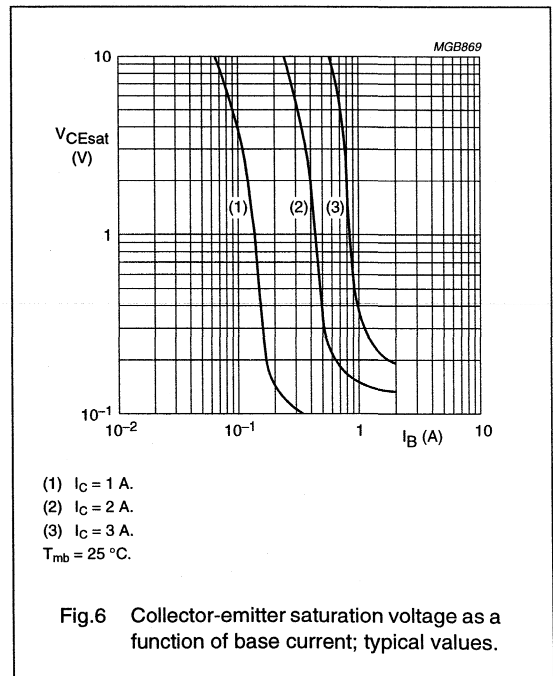
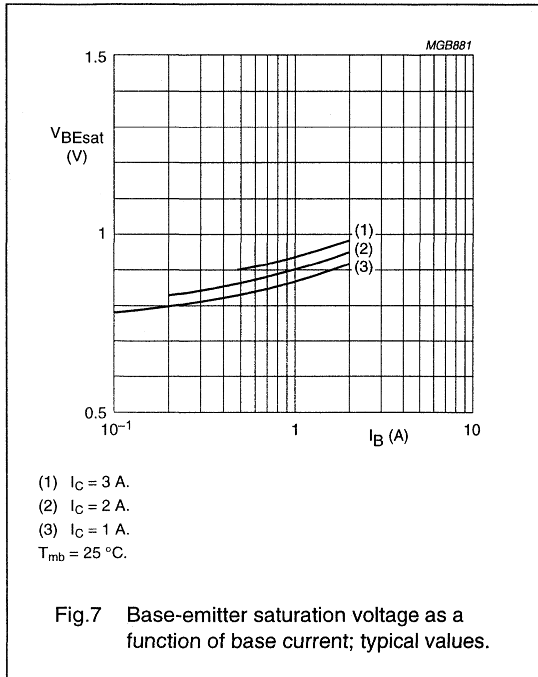


Fig.5 Oscilloscope display for collector-emitter sustaining voltage.



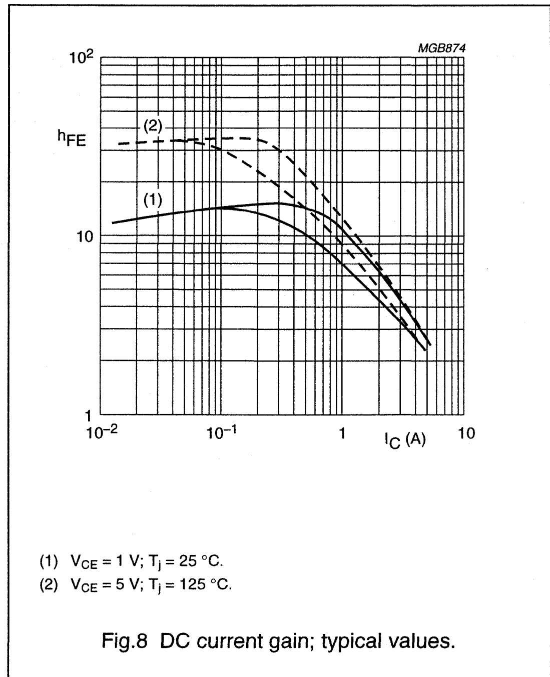
(1) $I_C = 1$ A.
(2) $I_C = 2$ A.
(3) $I_C = 3$ A.
$T_{mb} = 25$ °C.

Fig.6 Collector-emitter saturation voltage as a function of base current; typical values.



(1) $I_C = 3$ A.
(2) $I_C = 2$ A.
(3) $I_C = 1$ A.
$T_{mb} = 25$ °C.

Fig.7 Base-emitter saturation voltage as a function of base current; typical values.



(1) $V_{CE} = 1$ V; $T_j = 25$ °C.
(2) $V_{CE} = 5$ V; $T_j = 125$ °C.

Fig.8 DC current gain; typical values.

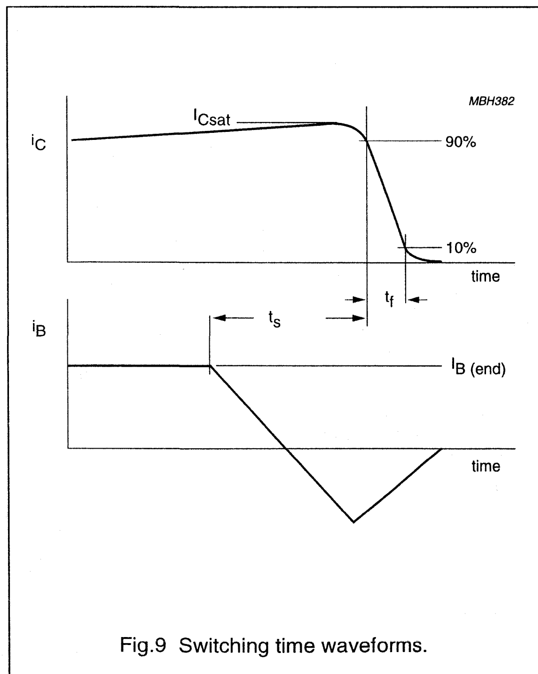
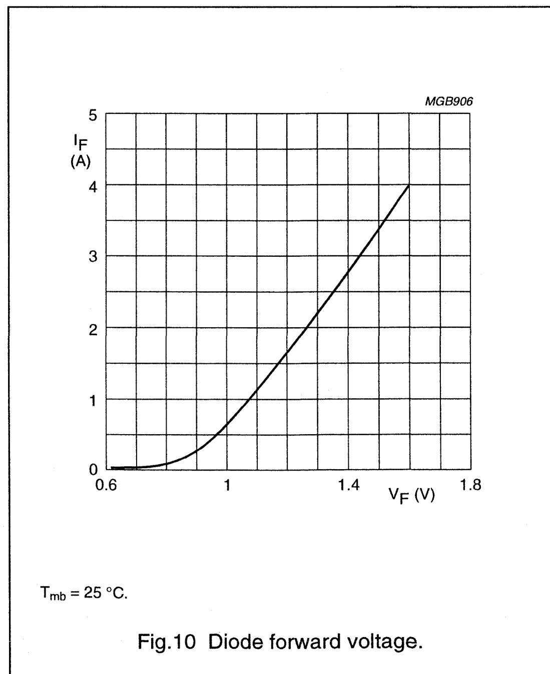


Fig.9 Switching time waveforms.



$T_{mb} = 25$ °C.

Fig.10 Diode forward voltage.

DESCRIPTION

High-voltage, high-speed switching NPN power transistor in a SOT186 package. The BU506DF has an integrated efficiency diode.

APPLICATIONS

- Horizontal deflection circuits of colour television receivers
- Line-operated switch-mode applications.

PINNING

PIN[1]	DESCRIPTION
1	base
2	collector
3	emitter

Note

1. All pins electrically isolated from mounting base.

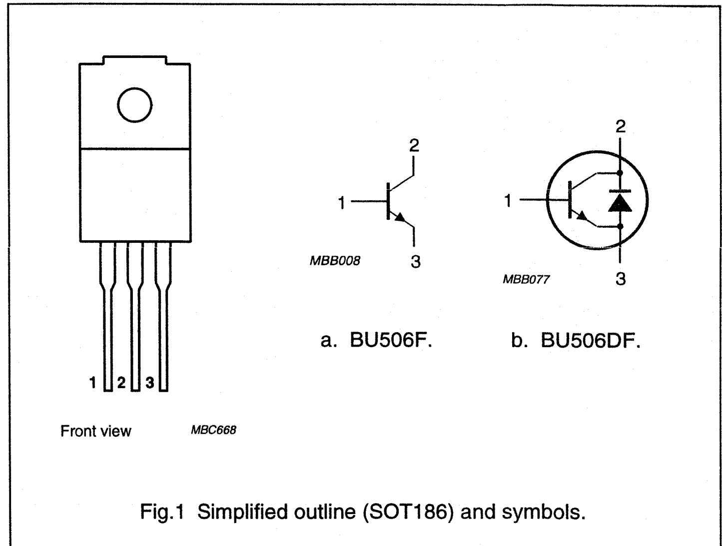


Fig.1 Simplified outline (SOT186) and symbols.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3$ A; $I_B = 1.33$ A; see Figs 7 and 8	–	1	V
V_F	diode forward voltage (BU506DF)	$I_F = 3$ A	1.5	2.2	V
I_{Csat}	collector saturation current		–	3	A
I_C	collector current (DC)	see Figs 2 and 3	–	5	A
I_{CM}	collector current (peak value)	see Figs 2 and 3	–	8	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.4	–	20	W
t_f	fall time	inductive load; see Fig.11	0.7	–	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	6.35	K/W
		note 2	3.85	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		55	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$	–	1500	V
V_{CEO}	collector-emitter voltage	open base	–	700	V
I_{Csat}	collector saturation current	$V_{CE} = 5$ V	–	3	A
I_C	collector current (DC)	see Figs 2 and 3	–	5	A
I_{CM}	collector current (peak value)	see Figs 2 and 3	–	8	A
I_B	base current (DC)		–	3	A
I_{BM}	base current (peak value)		–	5	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.4	–	20	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

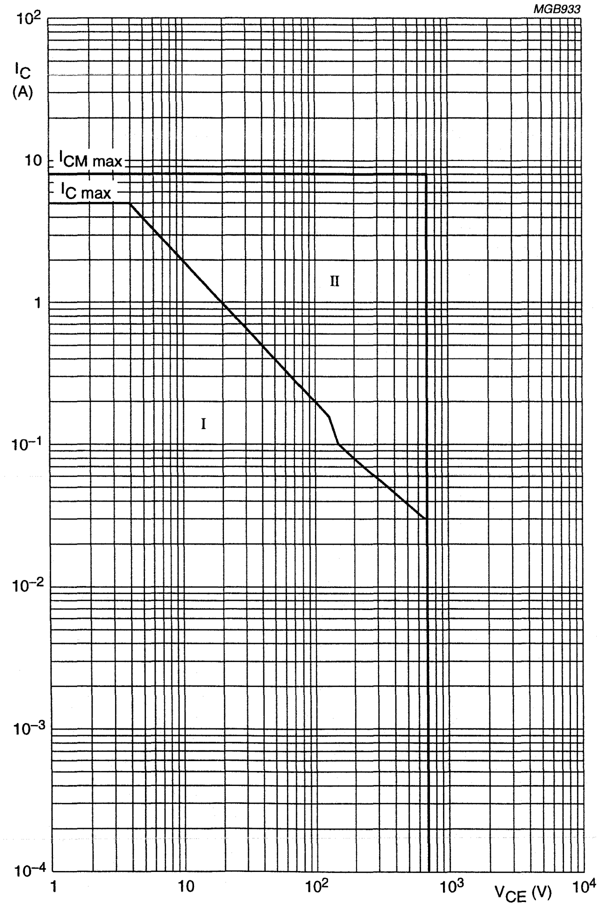
ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isolM}	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
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_B = 0$; L = 25 mH; see Figs 5 and 6	700	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 3$ A; $I_B = 1.33$ A; see Figs 7 and 8	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 3$ A; $I_B = 1.33$ A; see Fig.9	–	–	1.3	V
V_F	diode forward voltage (BU506DF)	$I_F = 3$ A	–	1.5	2.2	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	–	–	0.5	mA
		$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125$ °C	–	–	1	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 6$ V; $I_C = 0$	–	–	10	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 3$ A; see Fig.10	2.25	–	–	
		$V_{CE} = 5$ V; $I_C = 100$ mA; see Fig.10	6	13	30	
Switching times in horizontal deflection circuit (see Fig.11)						
t_s	storage time	$I_{Csat} = 3$ A; $L_B = 12$ μH; $I_{B(end)} = 1$ A; $dI_B/dt = -0.33$ A/μs	–	6.5	–	μs
t_f	fall time	$I_{Csat} = 3$ A; $L_B = 12$ μH; $I_{B(end)} = 1$ A; $dI_B/dt = -0.33$ A/μs	–	0.7	–	μs



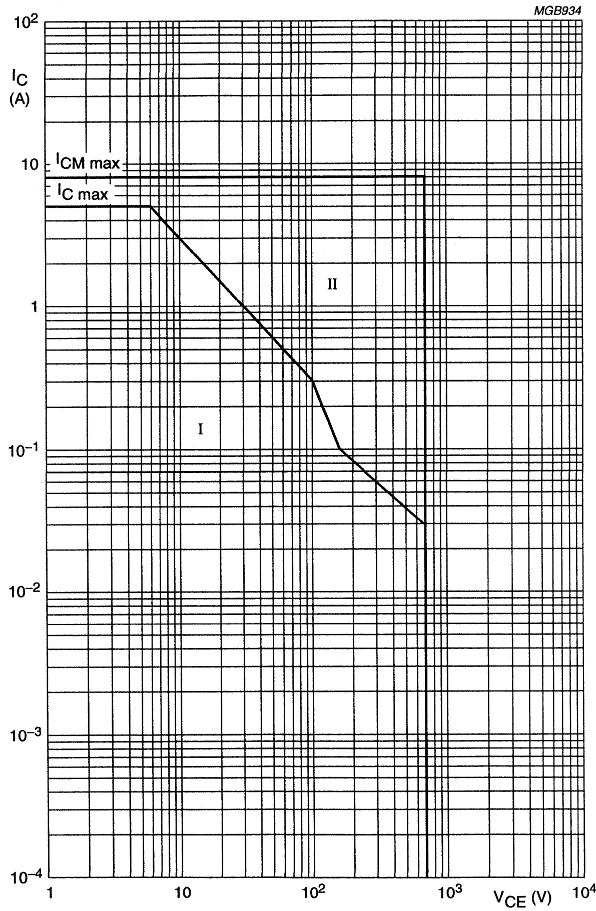
Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

T_{mb} = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR (no heatsink compound).



Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

T_{mb} = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.3 Forward bias SOAR (with heatsink compound).

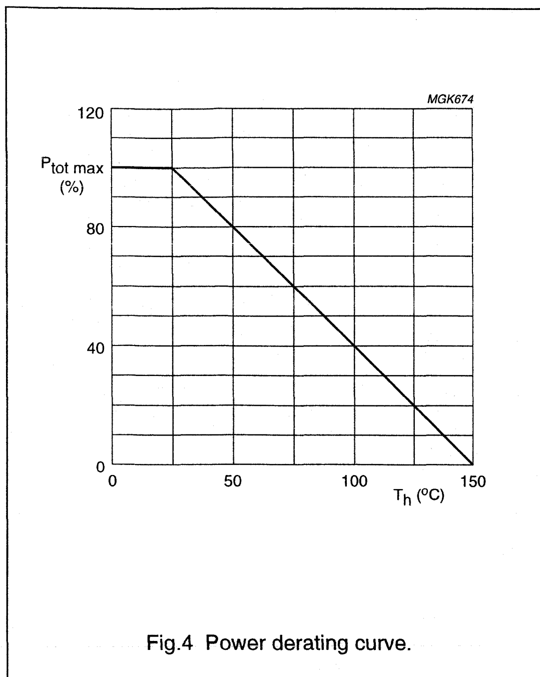


Fig.4 Power derating curve.

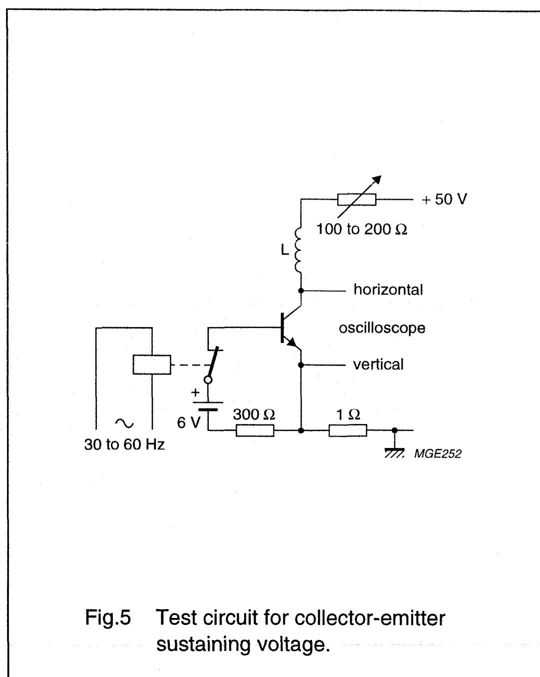


Fig.5 Test circuit for collector-emitter sustaining voltage.

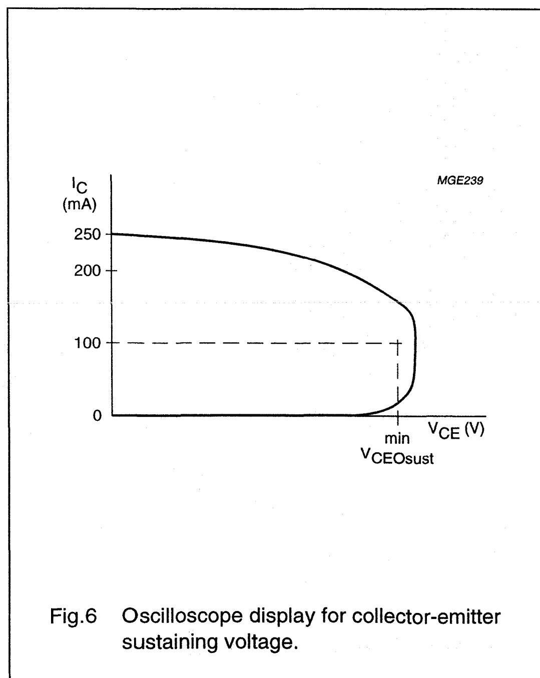
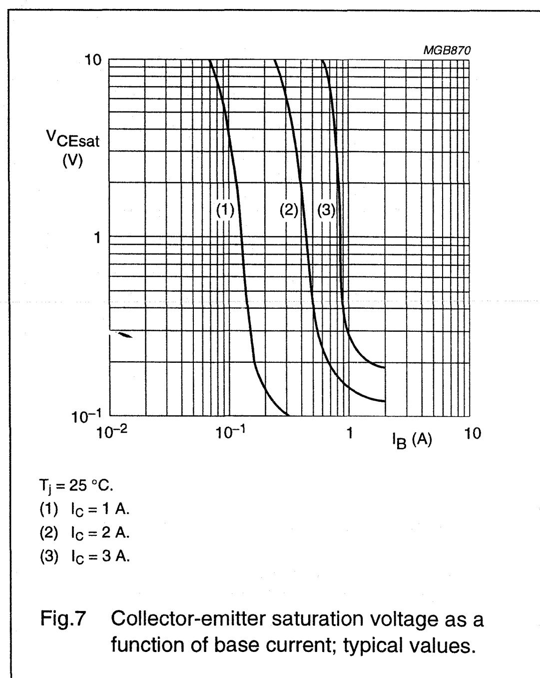
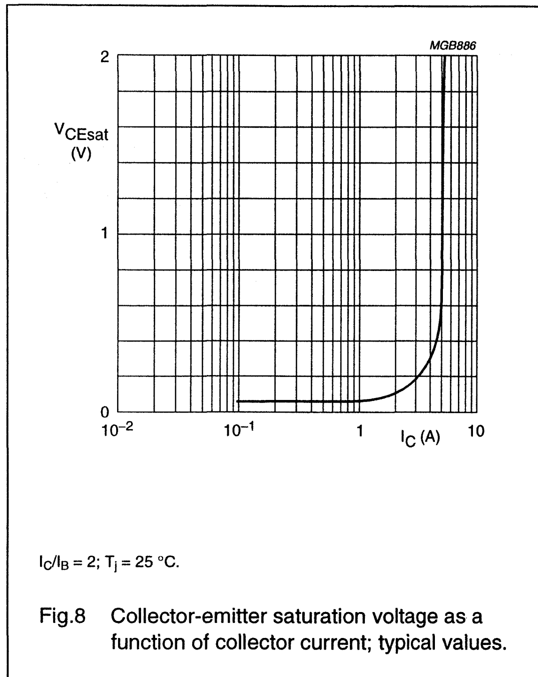


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



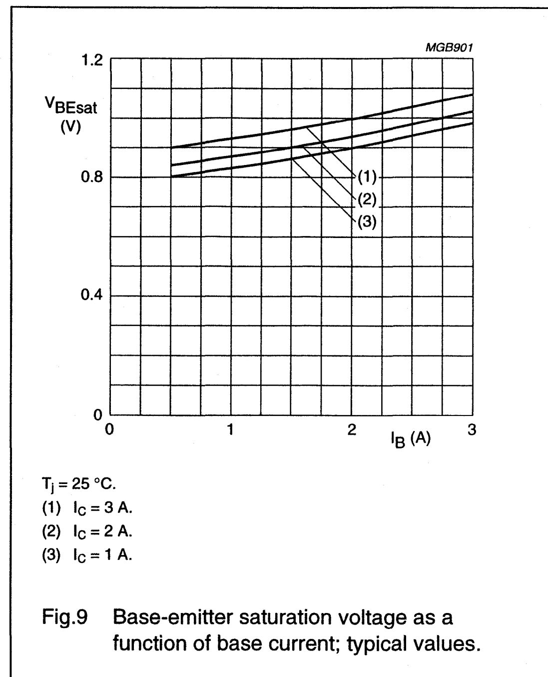
T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 2 A.
(3) I_C = 3 A.

Fig.7 Collector-emitter saturation voltage as a function of base current; typical values.



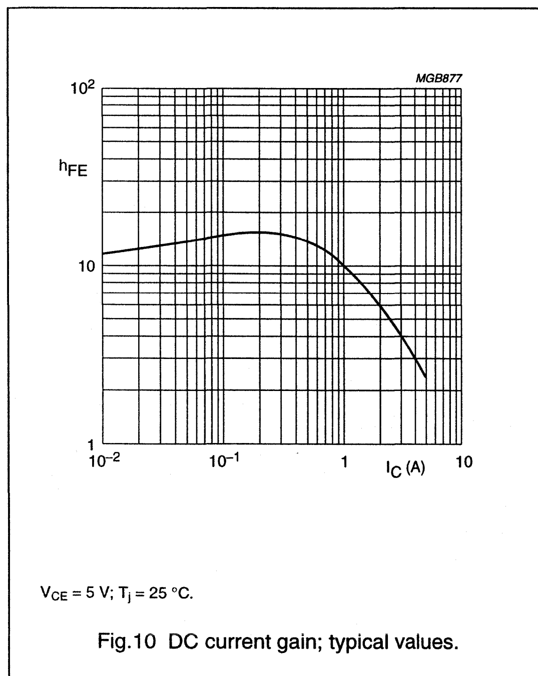
$I_C/I_B = 2$; $T_j = 25$ °C.

Fig.8 Collector-emitter saturation voltage as a function of collector current; typical values.



$T_j = 25$ °C.
(1) $I_C = 3$ A.
(2) $I_C = 2$ A.
(3) $I_C = 1$ A.

Fig.9 Base-emitter saturation voltage as a function of base current; typical values.



$V_{CE} = 5$ V; $T_j = 25$ °C.

Fig.10 DC current gain; typical values.

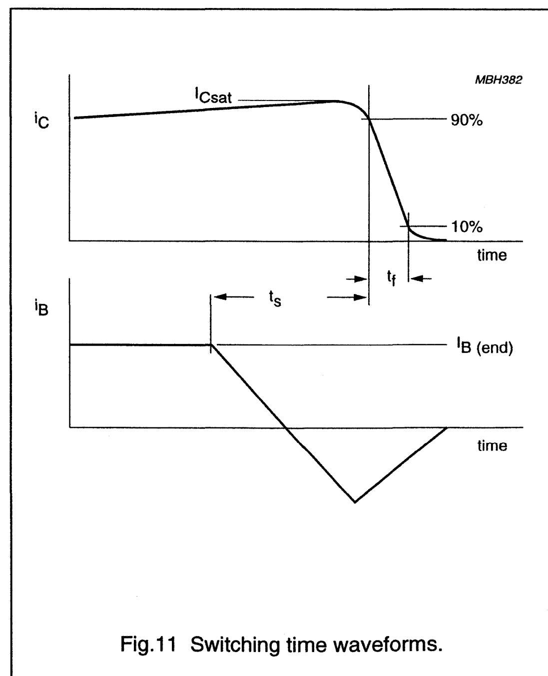


Fig.11 Switching time waveforms.

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistors in a fully isolated SOT199 envelope, primarily for use in horizontal deflection circuits of colour television receivers.

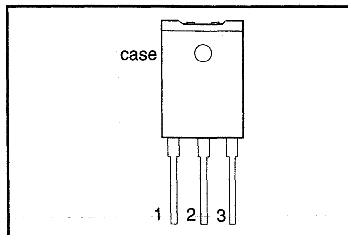
QUICK REFERENCE DATA

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)		-	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	-	34	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.6$ A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	4.5	-	A
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 16kHz	0.7	-	µs

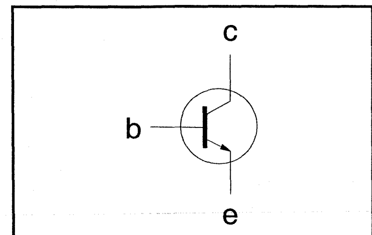
PINNING - SOT199

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
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	34	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

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 [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} = 6.0 V; I_C = 0 A	-	-	10	mA
V_{CEOsus}	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 = 1.6 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 2 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	30	-

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
f_T	Transition frequency at f = 5 MHz	I_C = 0.1 A;V_{CE} = 5 V	7	-	MHz
C_C	Collector capacitance at f = 1MHz	V_{CB} = 10 V	125	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4.5 A;L_c 1 mH;C_{fb} = 4 nF $I_{B(end)}$ = 1.4 A; L_B = 6 µH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 2.25 A			
t_s	Turn-off storage time		6.5	-	µs
t_f	Turn-off fall time		0.7	-	µs

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

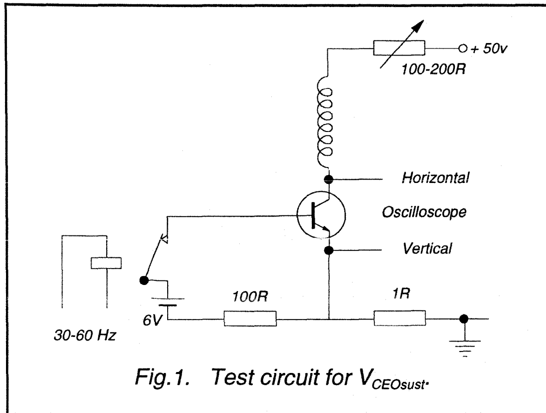


Fig.1. Test circuit for $V_{CEOsust}$.

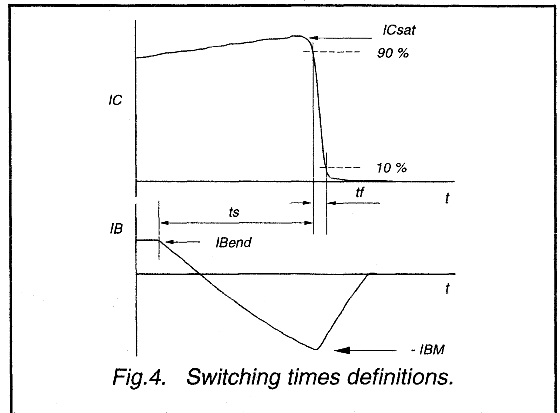


Fig.4. Switching times definitions.

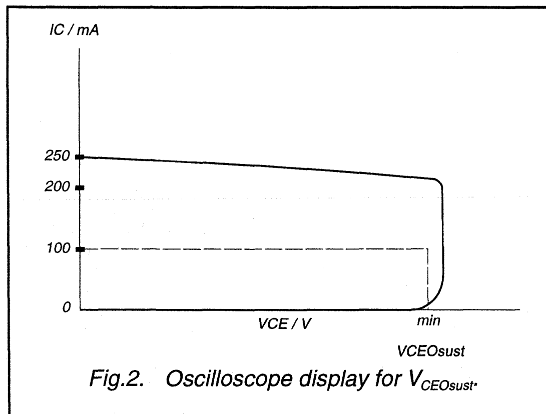


Fig.2. Oscilloscope display for $V_{CEOsust}$.

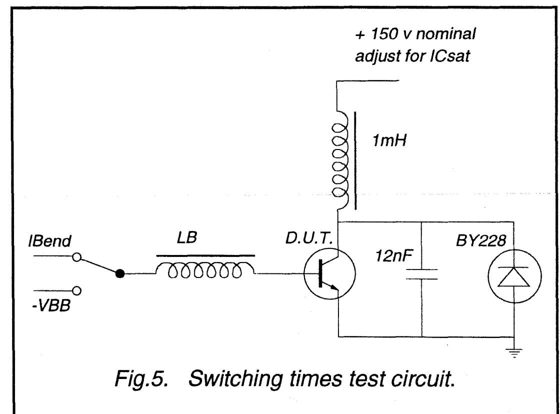


Fig.5. Switching times test circuit.

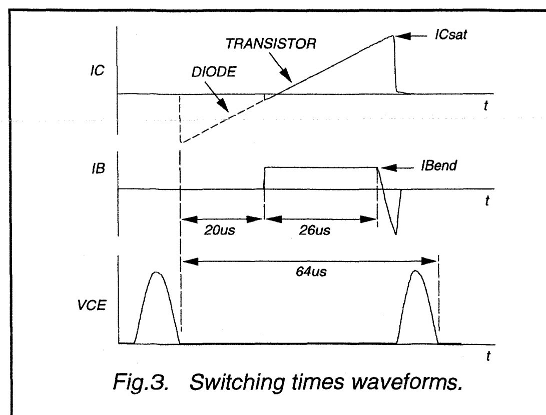


Fig.3. Switching times waveforms.

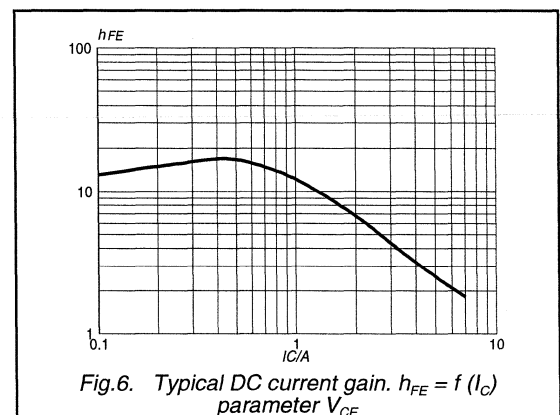


Fig.6. Typical DC current gain. $h_{FE} = f (I_C)$ parameter V_{CE}

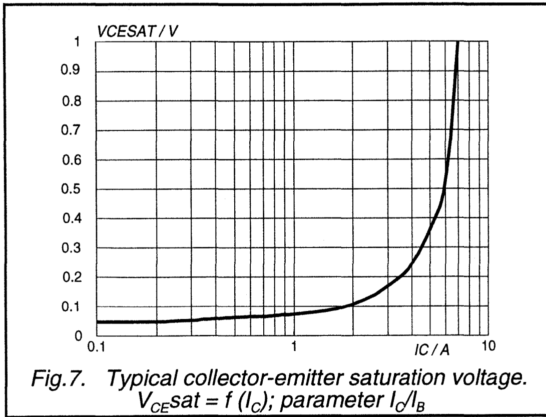


Fig.7. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

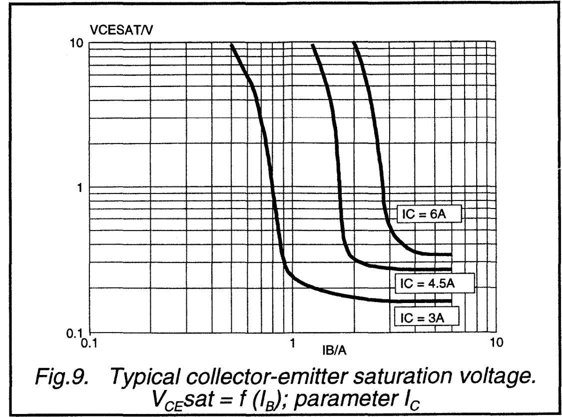


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

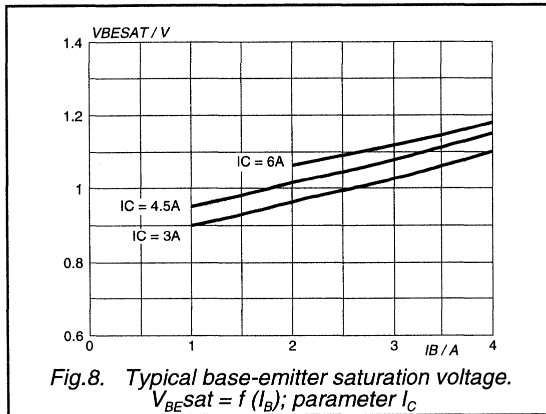


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

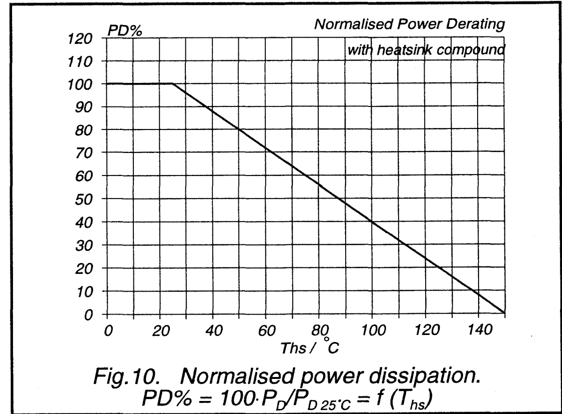


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25^{\circ}C} = f\ (T_{hs})$

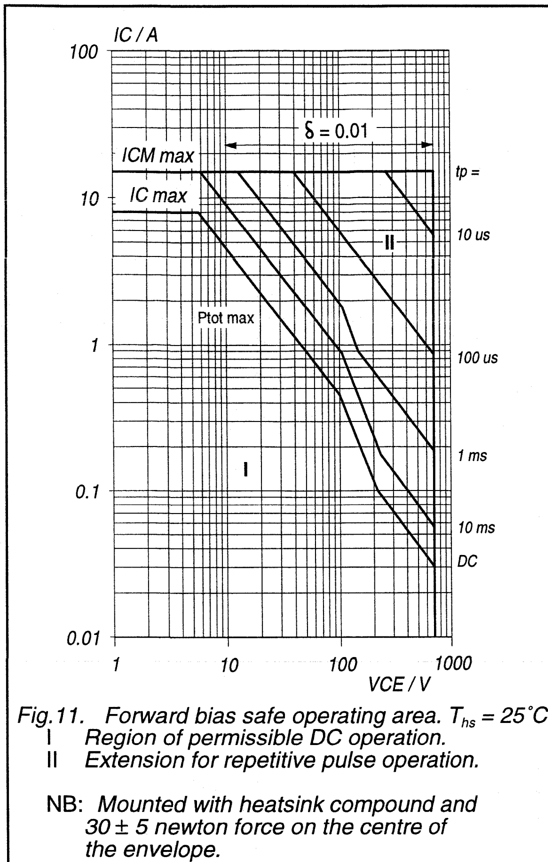


Fig.11. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

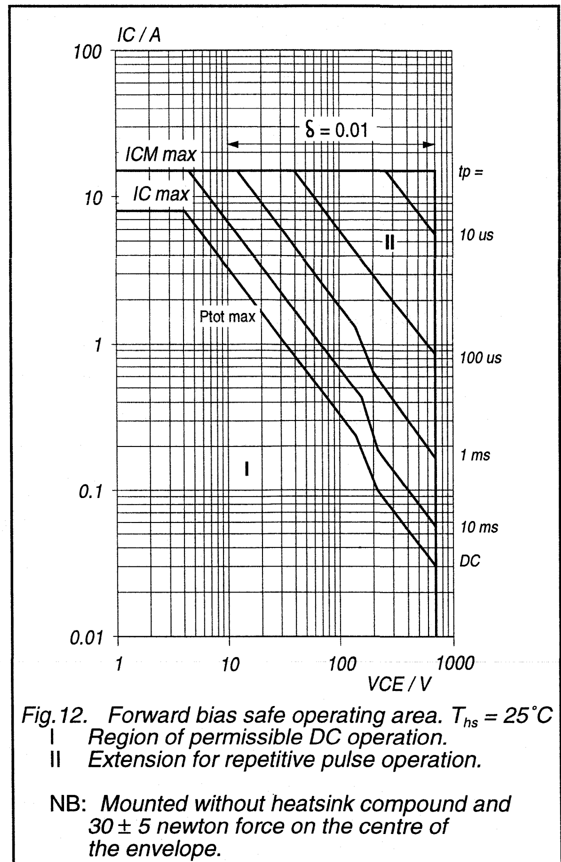


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

Silicon Diffused Power Transistor

BU508AW

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistors in a plastic envelope, primarily for use in horizontal deflection circuits of colour television receivers.

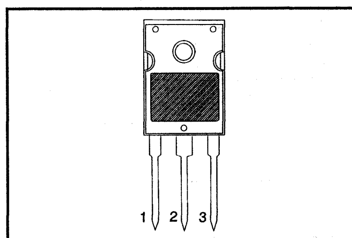
QUICK REFERENCE DATA

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)		-	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 = 1.6 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	4.5	-	A
t_f	Fall time	I_{Csat} = 4.5 A; f = 16kHz	0.7	-	µs

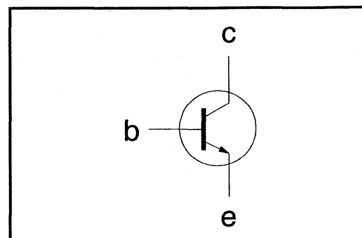
PINNING - SOT429

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
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

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} = 6.0 V; I_C = 0 A	-	-	10	mA
V_{CEOsus}	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 = 1.6 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 2.0 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	30	-

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
f_T	Transition frequency at f = 5 MHz	I_C = 0.1 A;V_{CE} = 5 V	7	-	MHz
C_C	Collector capacitance at f = 1MHz	V_{CB} = 10 V	125	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4.5 A;L_c= 1 mH;C_{fb} = 4 nF $I_{B(end)}$ = 1.4 A; L_B = 6 μH; $-V_{BB}$ = -4 V;			
t_s	Turn-off storage time		6.5	-	μs
t_f	Turn-off fall time		0.7	-	μs

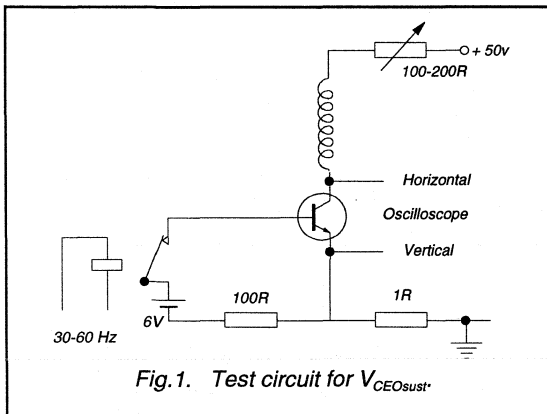


Fig.1. Test circuit for $V_{CEOsust}$.

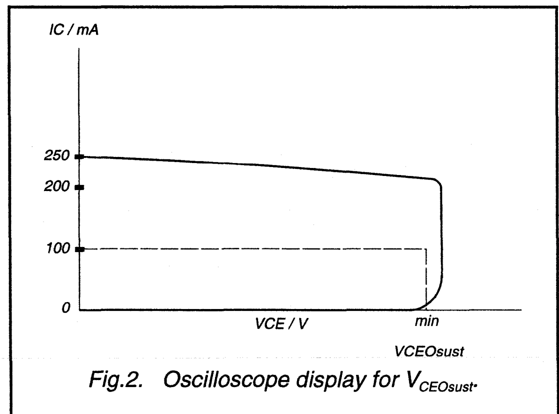


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

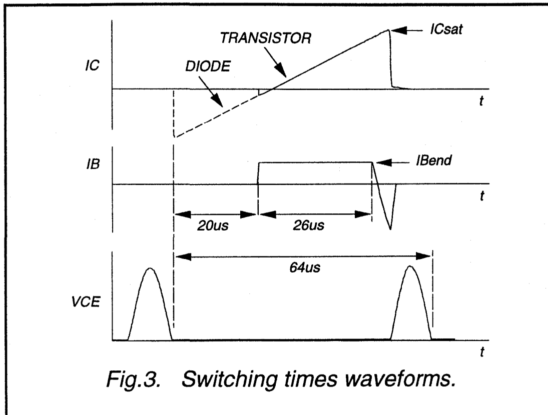


Fig.3. Switching times waveforms.

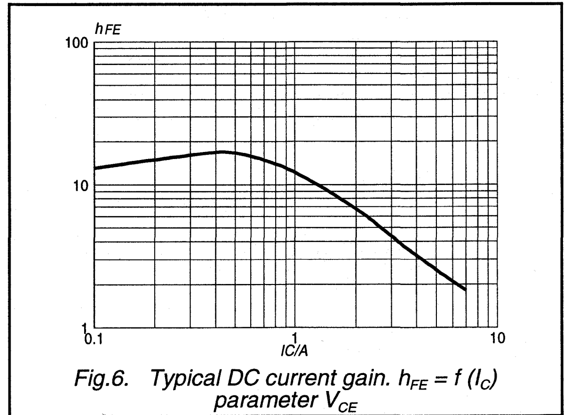


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

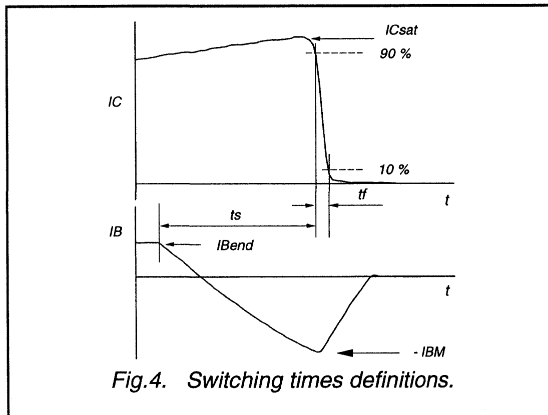


Fig.4. Switching times definitions.

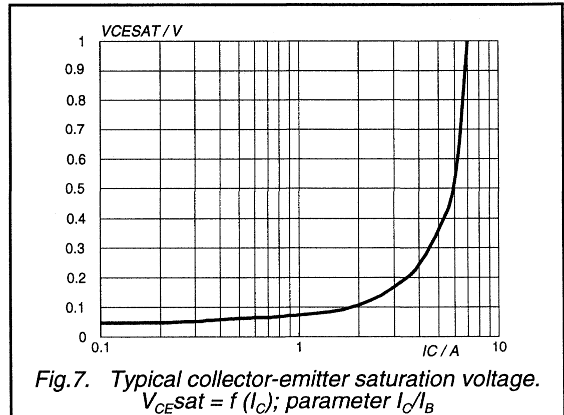


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

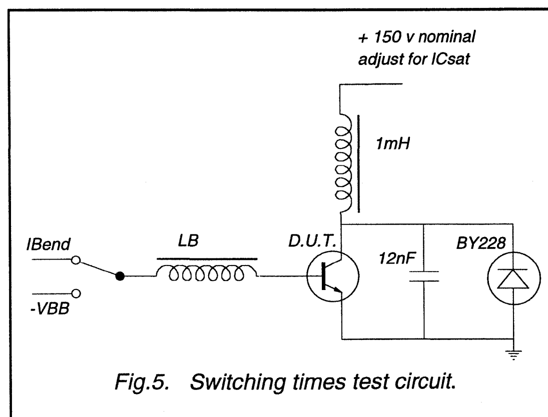


Fig.5. Switching times test circuit.

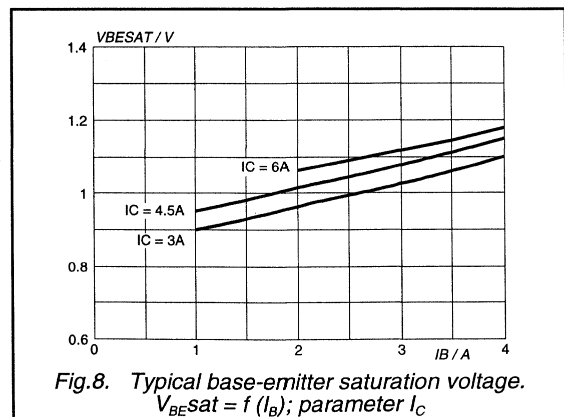


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

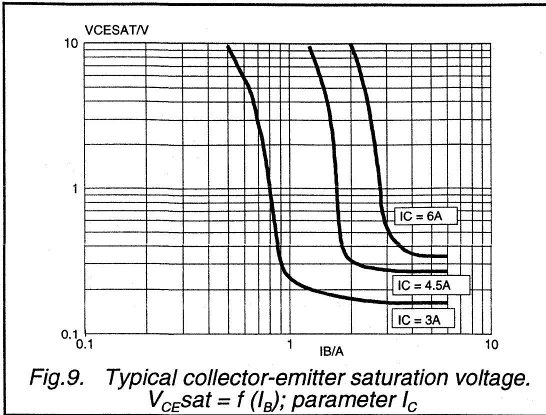


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

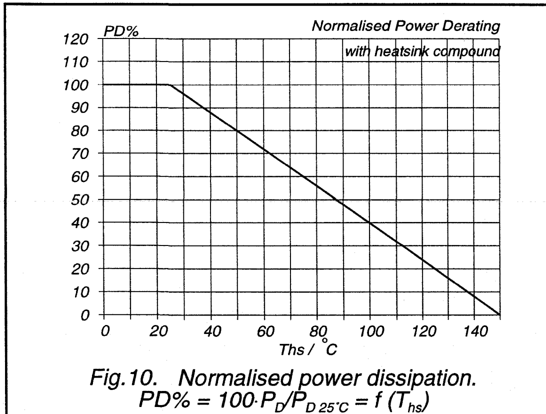


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{hs})$

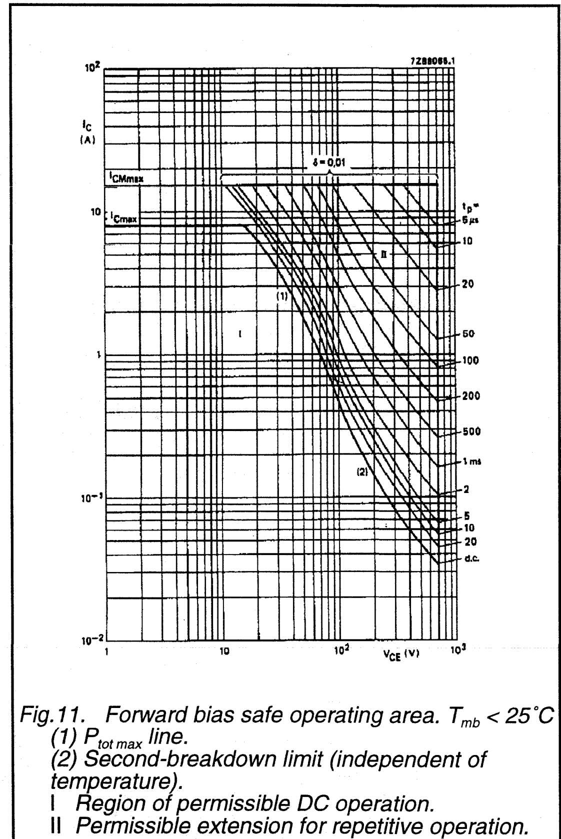


Fig.11. Forward bias safe operating area. $T_{mb} < 25^\circ C$
(1) $P_{tot\,max}$ line.
(2) Second-breakdown limit (independent of temperature).
I Region of permissible DC operation.
II Permissible extension for repetitive operation.

Silicon Diffused Power Transistor — BU508AX

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistors in a fully isolated SOT399 envelope, primarily for use in horizontal deflection circuits of colour television receivers.

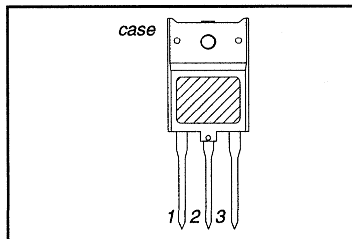
QUICK REFERENCE DATA

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)		-	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 = 1.6 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	4.5	-	A
t_f	Fall time	I_{Csat} = 4.5 A; f = 16kHz	0.7	-	µs

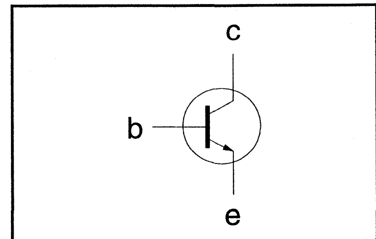
PINNING - SOT399

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
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

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 [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} = 6.0 V; I_C = 0 A	-	-	10	mA
V_{CEOsus}	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 = 1.6 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 2 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	30	-

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
f_T	Transition frequency at f = 5 MHz	I_C = 0.1 A;V_{CE} = 5 V	7	-	MHz
C_C	Collector capacitance at f = 1MHz	V_{CB} = 10 V	125	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4.5 A;L_c 1 mH;C_{fb} = 4 nF $I_{B(end)}$ = 1.4 A; L_B = 6 µH; -V_{BB} = -4 V; -I_{BM} = 2.25 A			
t_s	Turn-off storage time		6.5	-	µs
t_f	Turn-off fall time		0.7	-	µs

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

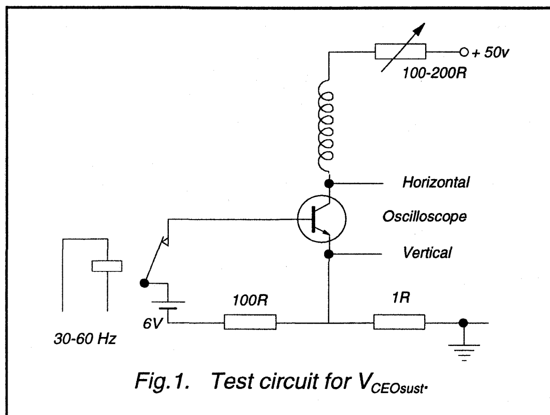


Fig.1. Test circuit for $V_{CEOsust}$.

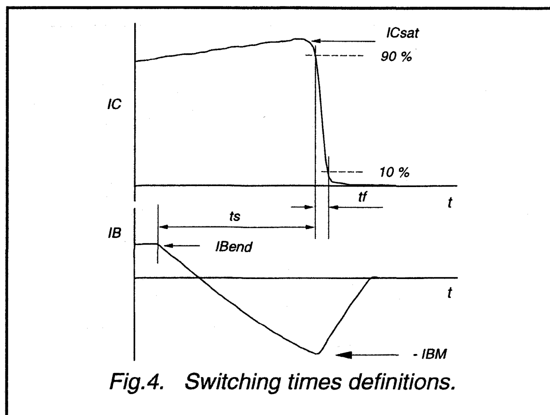


Fig.4. Switching times definitions.

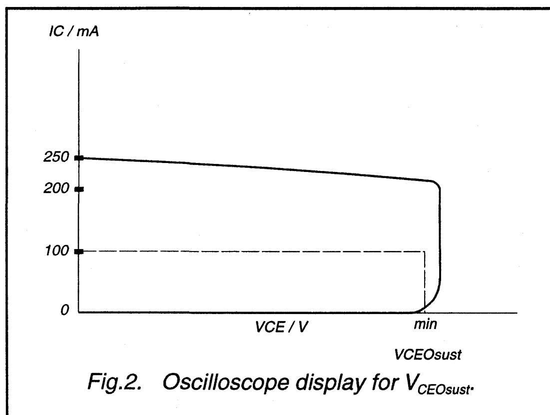


Fig.2. Oscilloscope display for $V_{CEOsust}$.

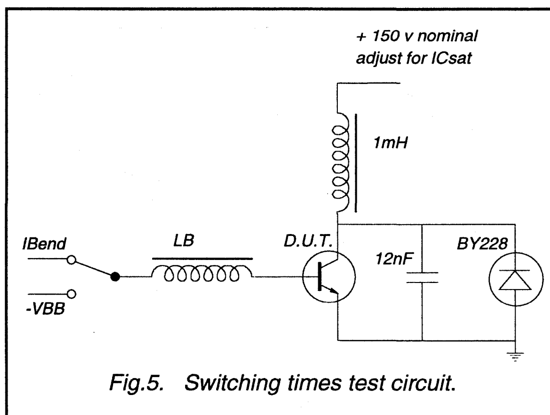


Fig.5. Switching times test circuit.

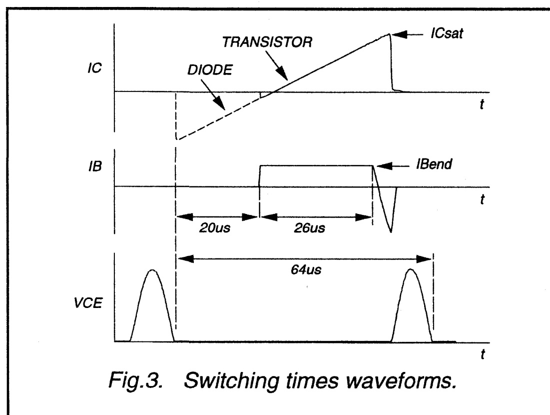


Fig.3. Switching times waveforms.

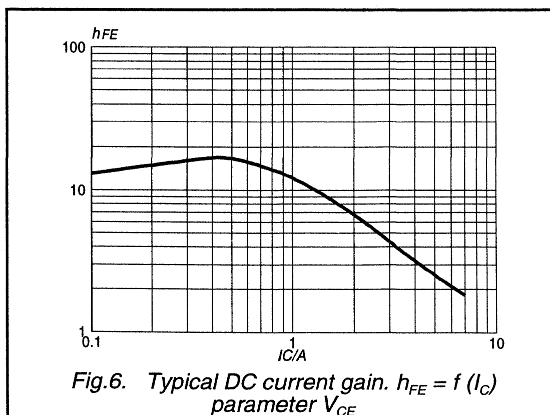


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

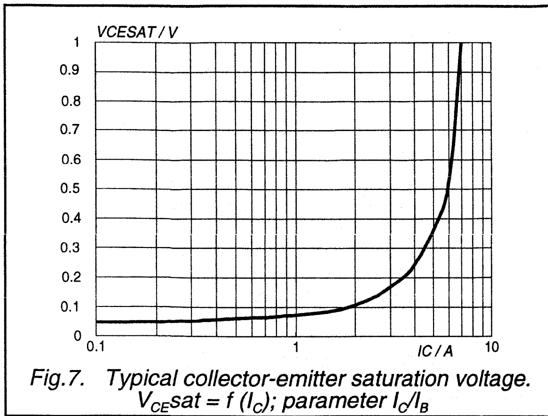


Fig.7. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

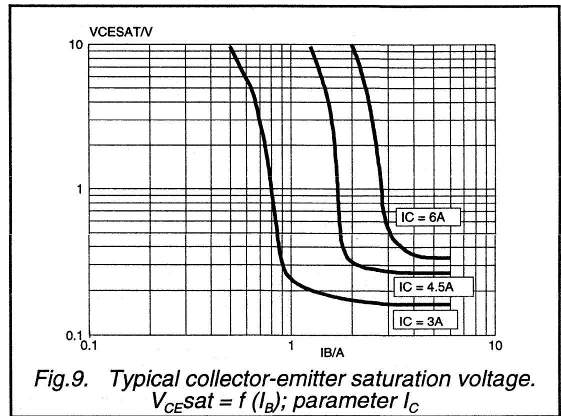


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

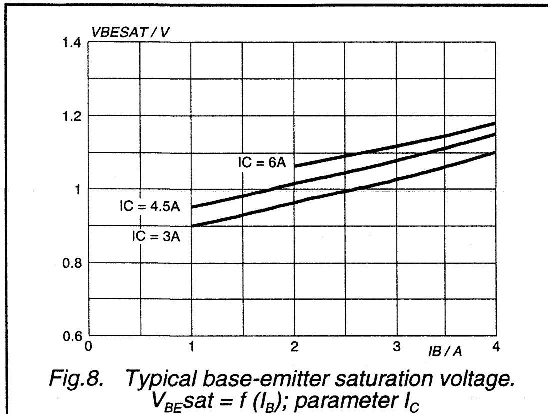


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

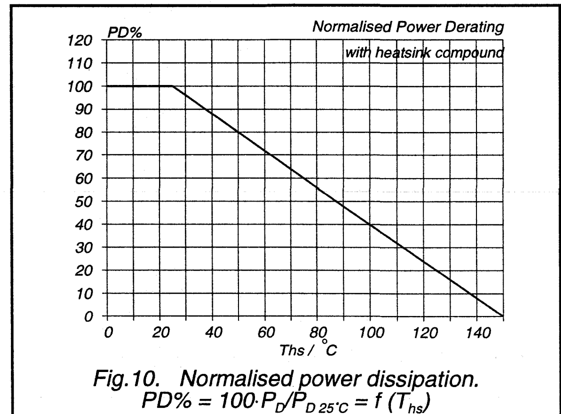


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

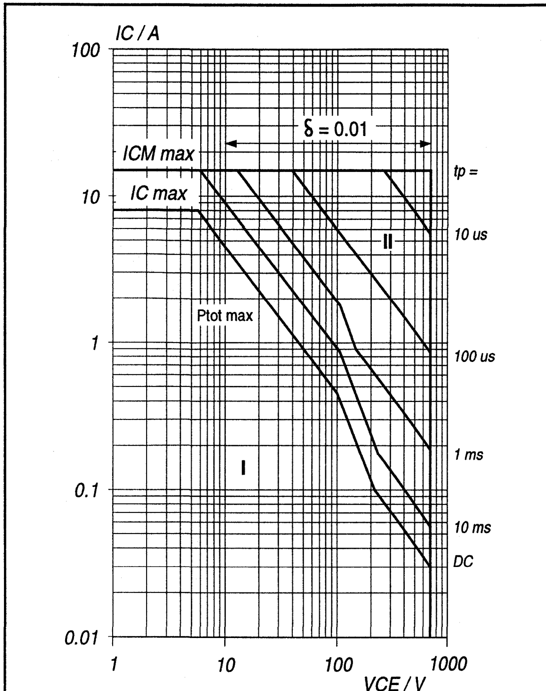


Fig.11. Forward bias safe operating area. T_{hs} *= 25˚C*
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

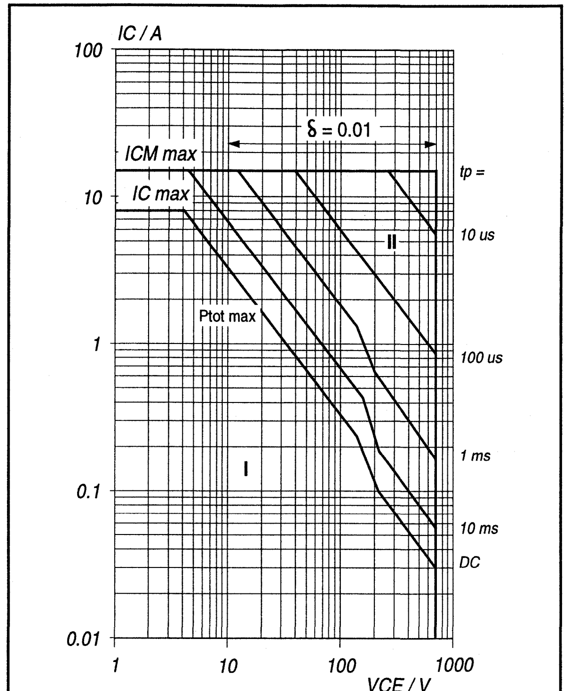


Fig.12. Forward bias safe operating area. T_{hs} *= 25˚C*
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

GENERAL DESCRIPTION

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

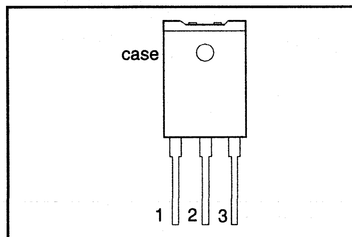
QUICK REFERENCE DATA

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)		-	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	-	34	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 1.6$ A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	2.0	V
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 16kHz	0.7	-	µs

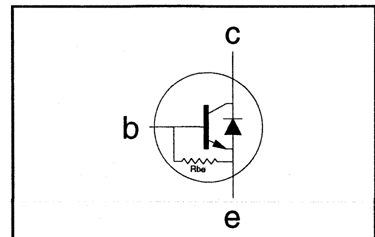
PINNING - SOT199

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
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	34	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

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 [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
$V_{CEOsust}$	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 = 1.6 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 2.0 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	30	
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
f_T	Transition frequency at f = 5 MHz	I_C = 0.1 A;V_{CE} = 5 V	7	-	MHz
C_C	Collector capacitance at f = 1MHz	V_{CB} = 10 V	125	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4.5 A;L_c 1 mH;C_{fb} = 4 nF $I_{B(end)}$ = 1.4 A; L_B = 6 µH; -V_{BB} = -4 V; -I_{BM} = 2.25 A			
t_s	Turn-off storage time		6.5	-	µs
t_f	Turn-off fall time		0.7	-	µs

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

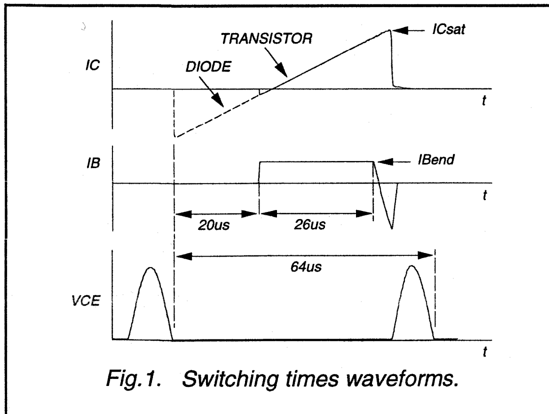


Fig.1. Switching times waveforms.

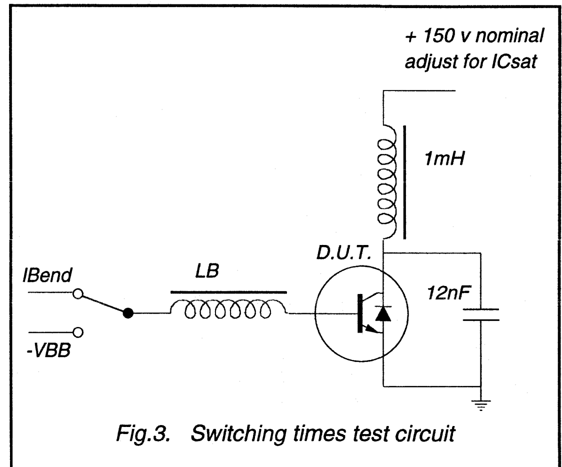


Fig.3. Switching times test circuit

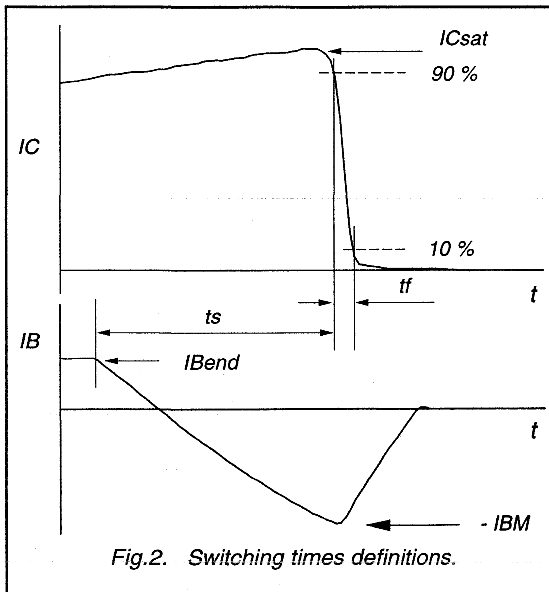


Fig.2. Switching times definitions.

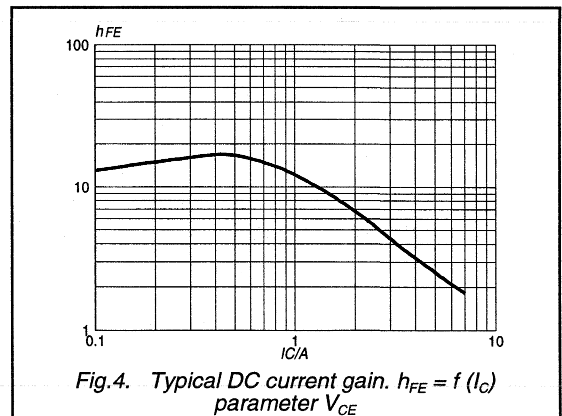


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

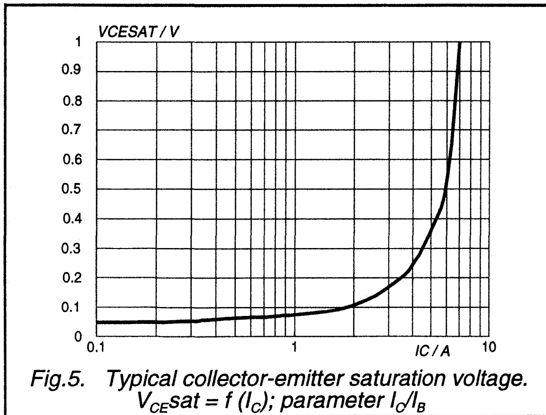


Fig.5. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

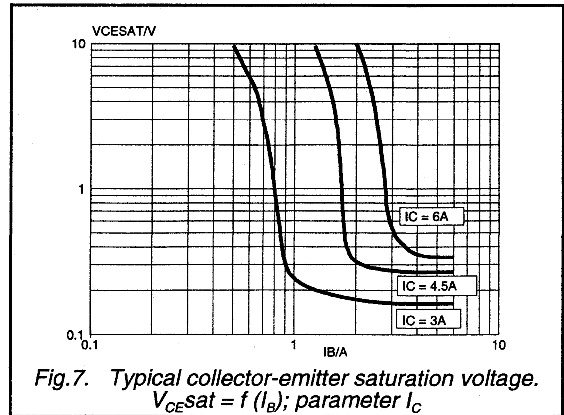


Fig.7. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

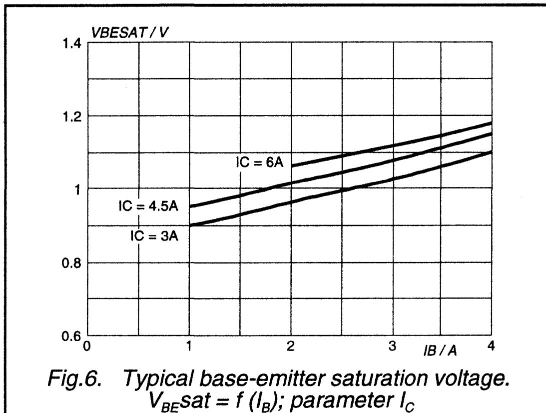


Fig.6. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

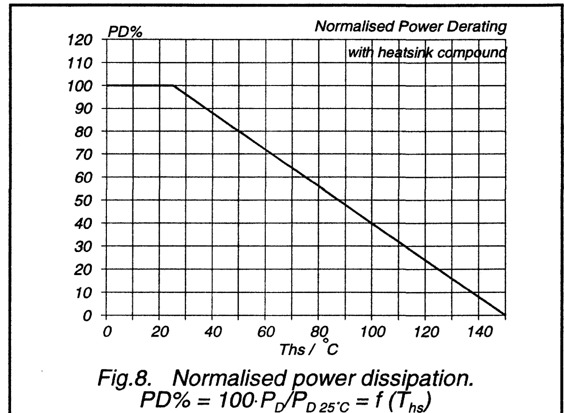


Fig.8. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{hs})$

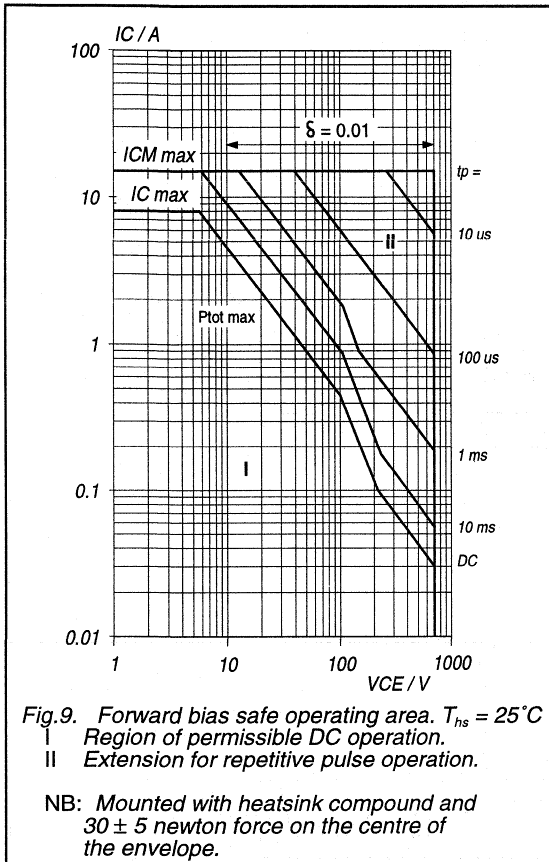


Fig.9. Forward bias safe operating area. T_{hs} *= 25˚C*
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

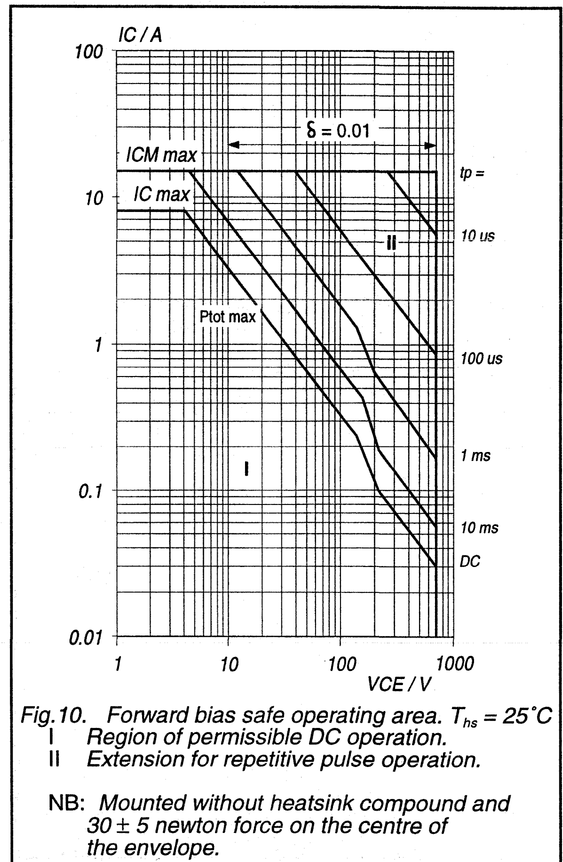


Fig.10. Forward bias safe operating area. T_{hs} *= 25˚C*
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

GENERAL DESCRIPTION

High voltage, high-speed switching npn transistors in a plastic envelope with integrated efficiency diode, primarily for use in horizontal deflection circuits of colour television receivers.

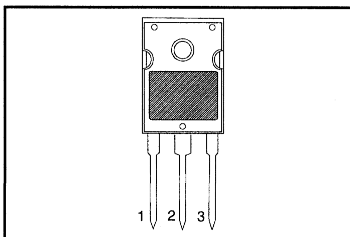
QUICK REFERENCE DATA

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)		-	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; $I_B = 1.6$ A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	2.0	V
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 16kHz	0.7	-	µs

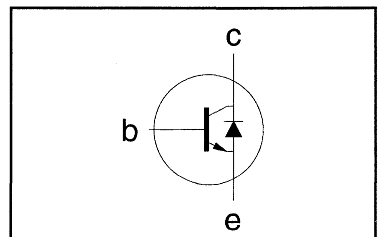
PINNING - SOT429

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
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

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
$V_{CEOsust}$	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 = 1.6 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 2 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	30	
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
f_T	Transition frequency at f = 5 MHz	I_C = 0.1 A;V_{CE} = 5 V	7	-	MHz
C_C	Collector capacitance at f = 1MHz	V_{CB} = 10 V	125	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4.5 A;L_c= 1 mH;C_{fb} = 4 nF $I_{B(end)}$ = 1.4 A; L_B = 6 µH; $-V_{BB}$ = -4 V;			
t_s	Turn-off storage time		6.5	-	µs
t_f	Turn-off fall time		0.7	-	µs

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

Silicon Diffused Power Transistor BU508DW

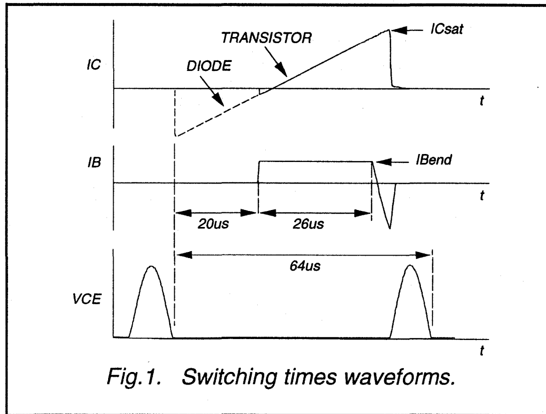


Fig.1. Switching times waveforms.

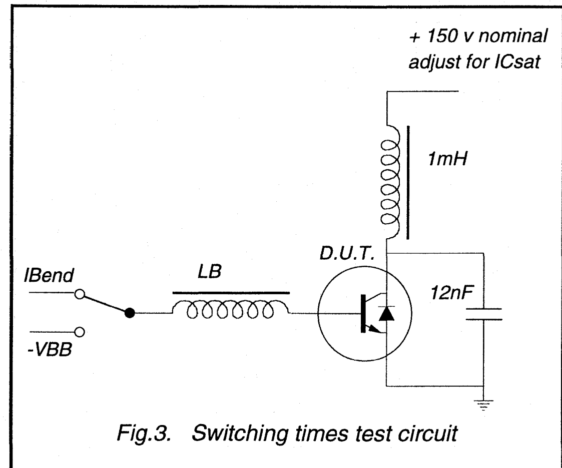


Fig.3. Switching times test circuit

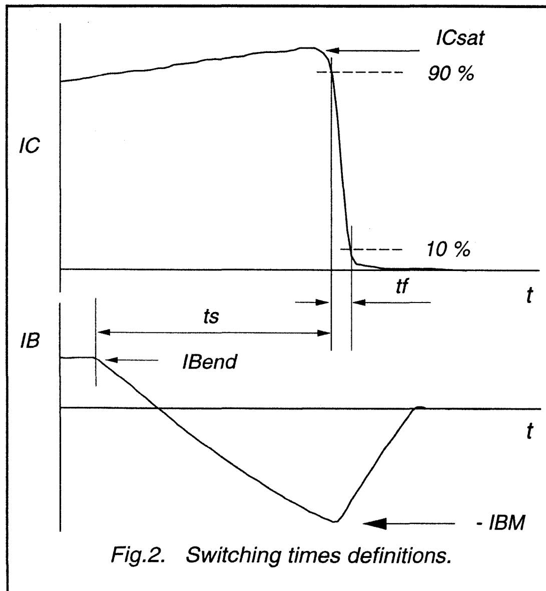


Fig.2. Switching times definitions.

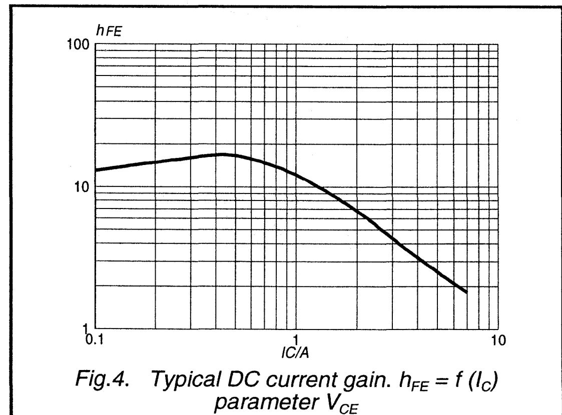


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

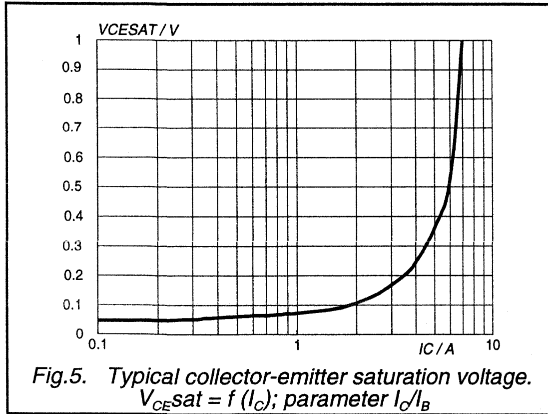


Fig.5. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

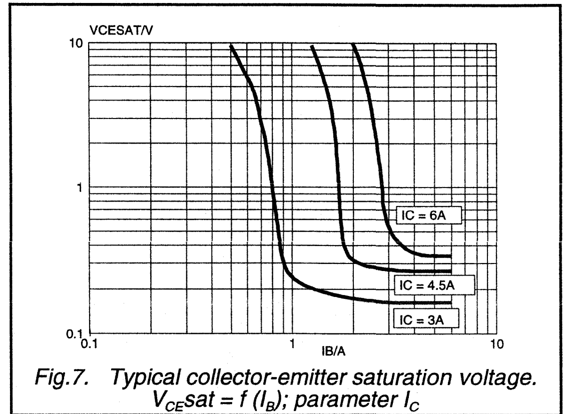


Fig.7. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

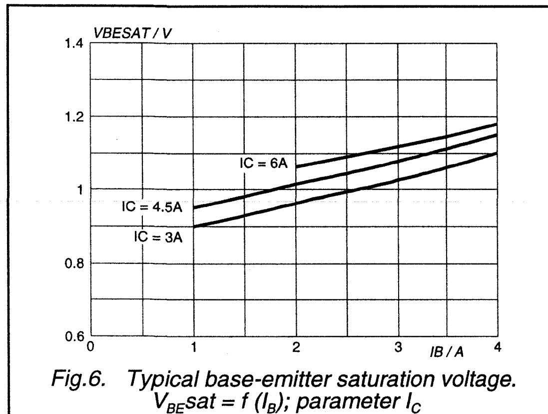


Fig.6. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

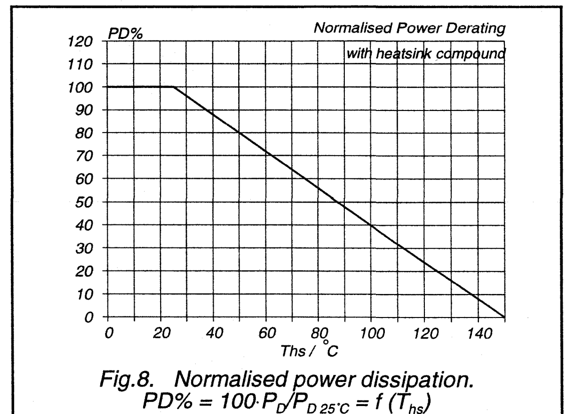


Fig.8. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{hs})$

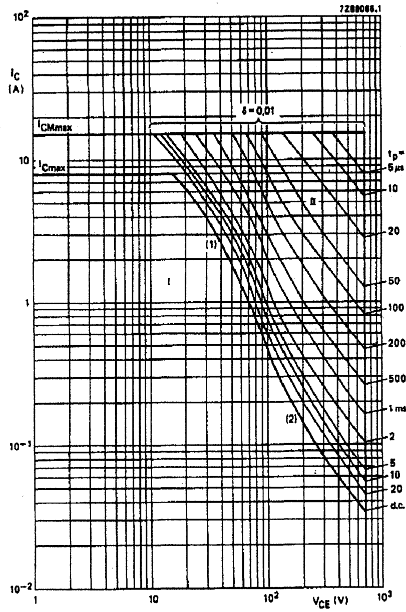


Fig.9. Forward bias safe operating area. T_{hs} < 25˚C
(1) $P_{tot\,max}$ line.
(2) Second-breakdown limits (independent of temperature).
I Region of permissible DC operation.
II Permissible extension for repetitive pulse operation.

GENERAL DESCRIPTION

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

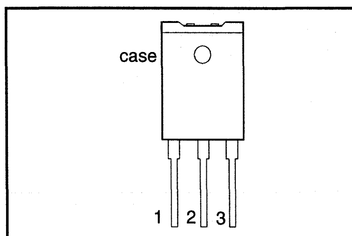
QUICK REFERENCE DATA

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)		-	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	-	34	W
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 1.6 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4.5	-	A
V_F	Diode forward voltage	I_F = 4.5 A	1.6	2.0	V
t_f	Fall time	I_{Csat} = 4.5 A; f = 16kHz	0.7	-	µs

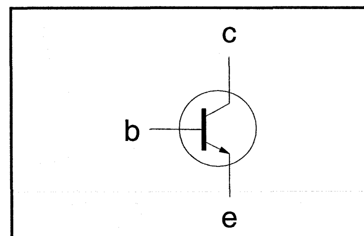
PINNING - SOT199

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
P_{tot}	Total power dissipation	$T_{hs} \leq$ 25 ˚C	-	34	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

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 [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
$V_{CEOsust}$	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 = 1.6 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 2.0 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	6	13	30	
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
f_T	Transition frequency at f = 5 MHz	I_C = 0.1 A;V_{CE} = 5 V	7	-	MHz
C_C	Collector capacitance at f = 1MHz	V_{CB} = 10 V	125	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4.5 A;L_c 1 mH;C_{fb} = 4 nF $I_{B(end)}$ = 1.4 A; L_B = 6 µH; -V_{BB} = -4 V; -I_{BM} = 2.25 A			
t_s	Turn-off storage time		6.5	-	µs
t_f	Turn-off fall time		0.7	-	µs

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

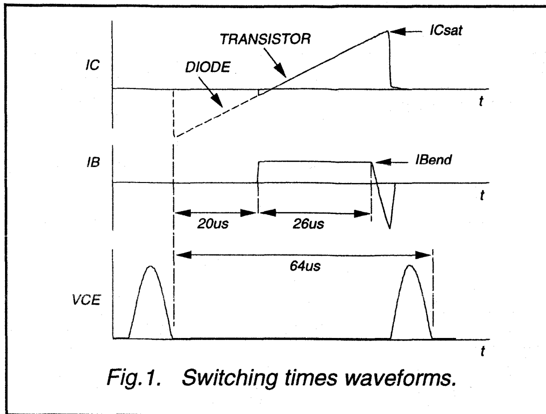


Fig.1. Switching times waveforms.

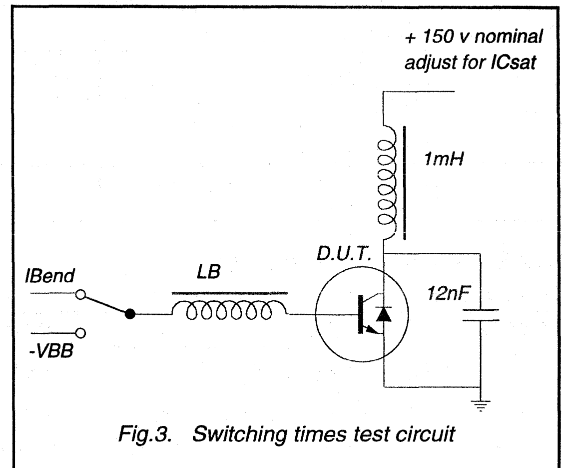


Fig.3. Switching times test circuit

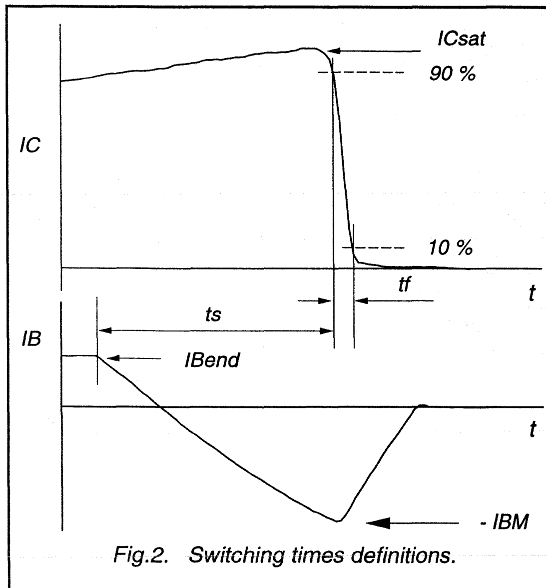


Fig.2. Switching times definitions.

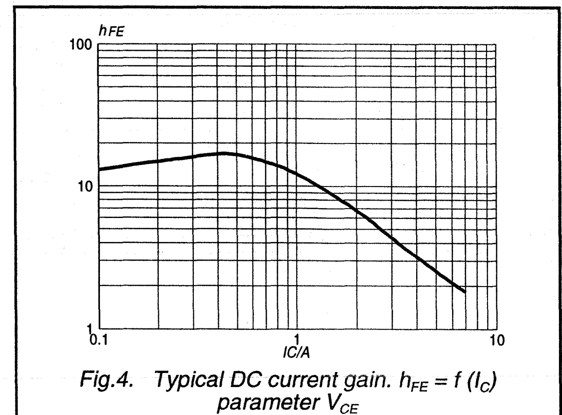


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

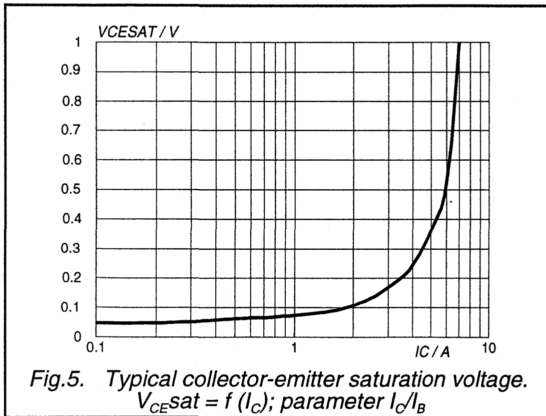


Fig.5. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

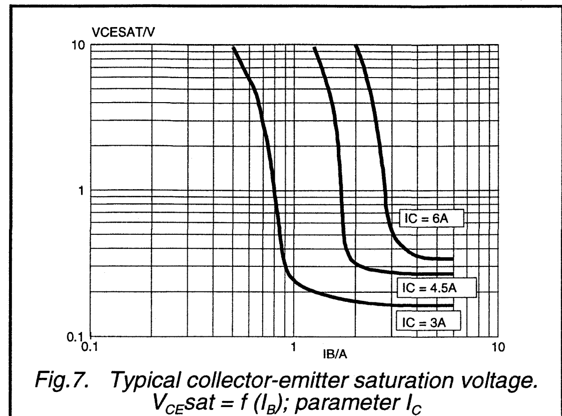


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

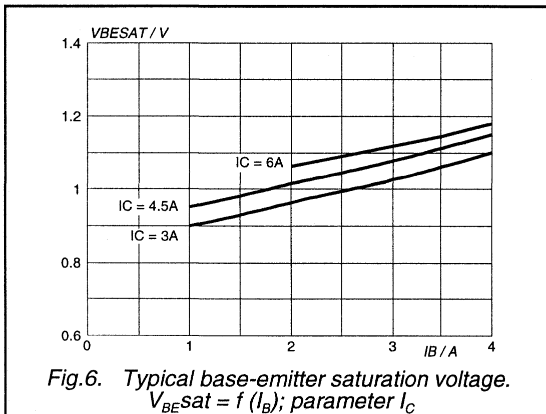


Fig.6. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

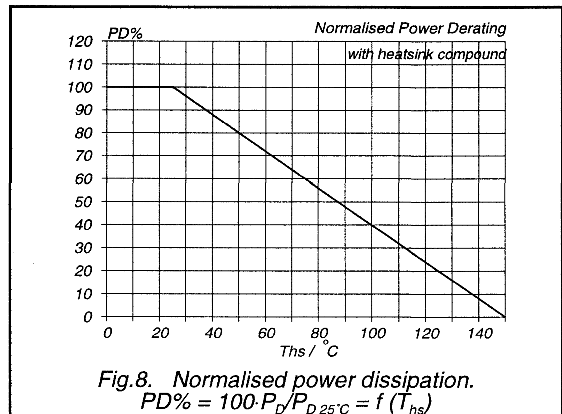


Fig.8. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

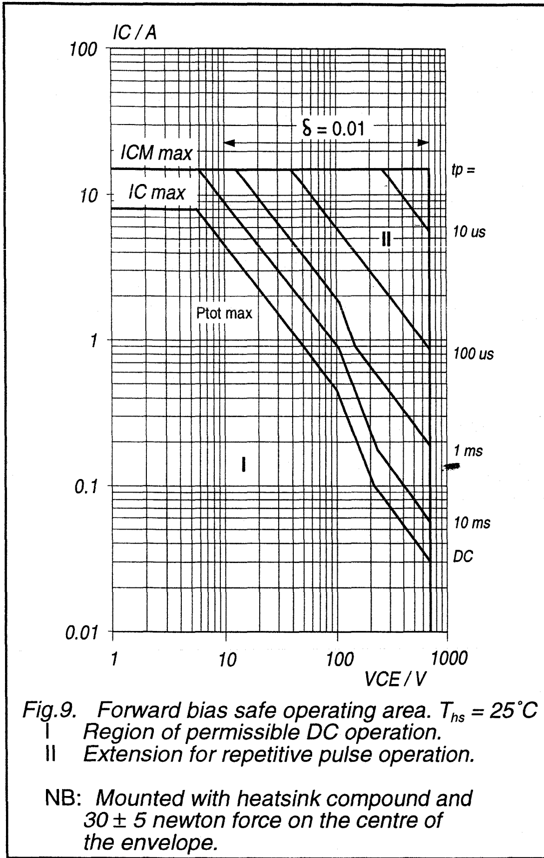


Fig.9. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

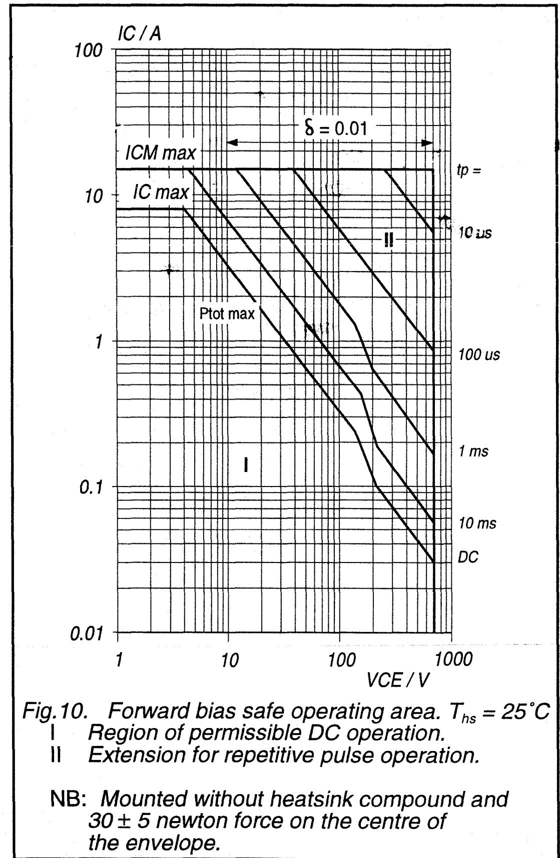


Fig.10. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

Silicon Diffused Power Transistor BU1506DX

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.

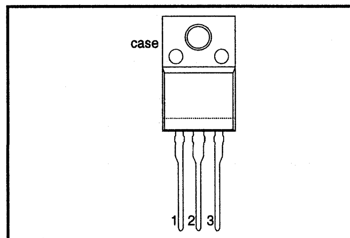
QUICK REFERENCE DATA

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	-	32	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 3.0$ A; $I_B = 0.79$ A	-	5.0	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

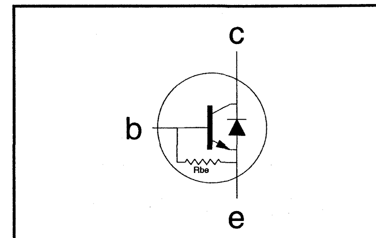
PINNING - SOT186A

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
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		-	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
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	4.0	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	55	-	K/W

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
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	55	-	Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 3.0 A; I_B = 0.79 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 0.79 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 0.3 A; V_{CE} = 5 V	-	12	-	
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).

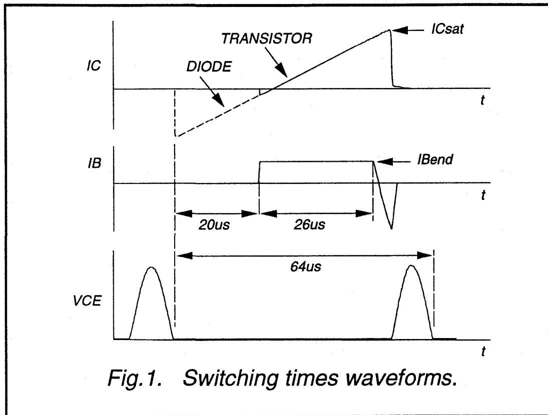


Fig.1. Switching times waveforms.

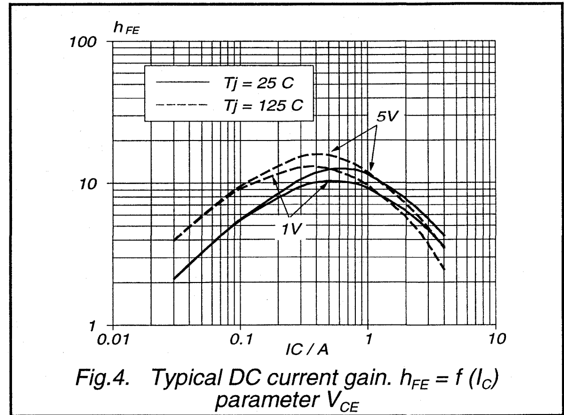


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

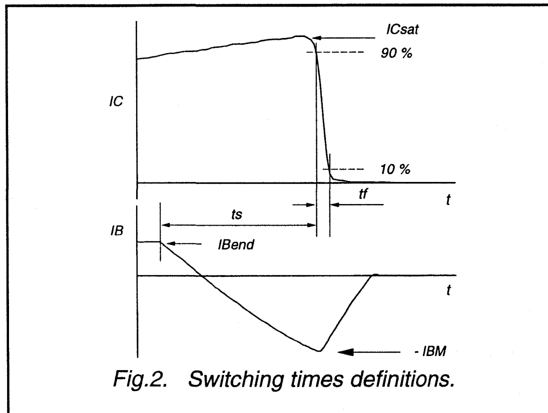


Fig.2. Switching times definitions.

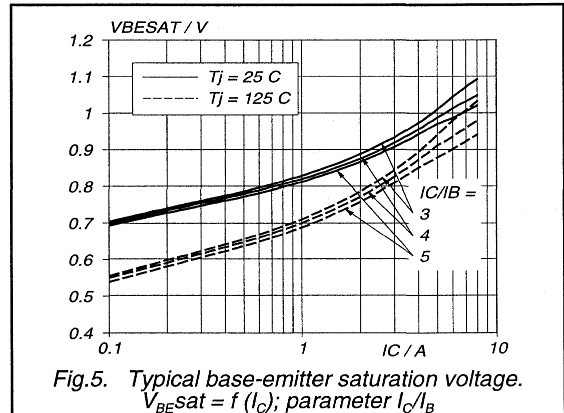


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

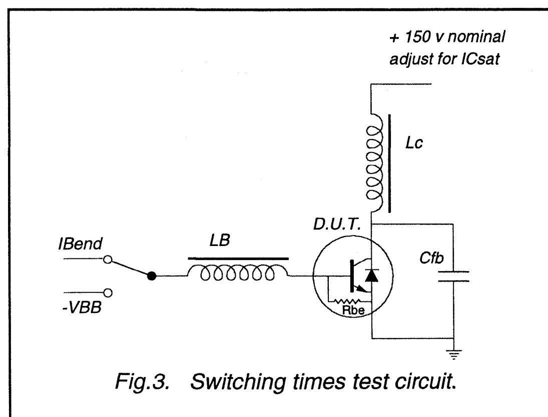


Fig.3. Switching times test circuit.

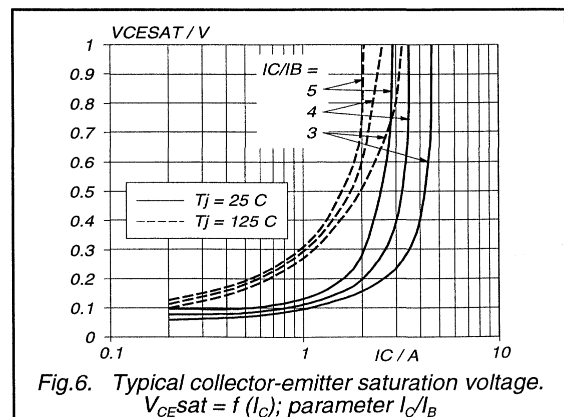


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

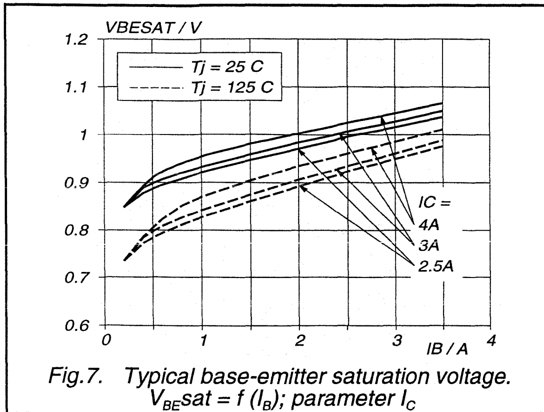


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

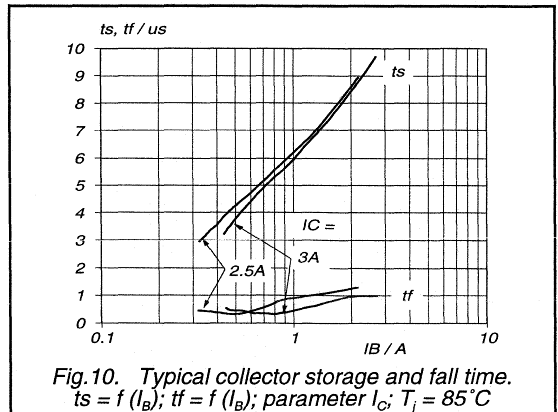


Fig.10. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85\ ^\circ C$

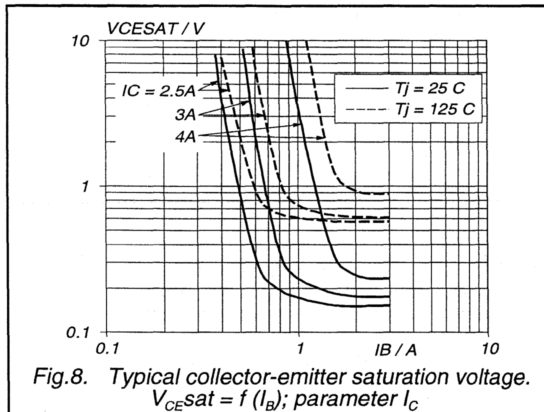


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_B)$; parameter I_C

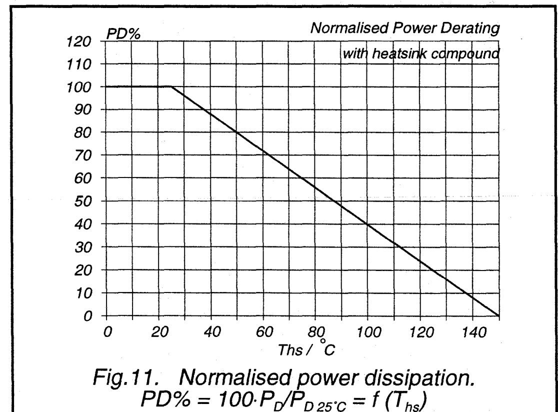


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{hs})$

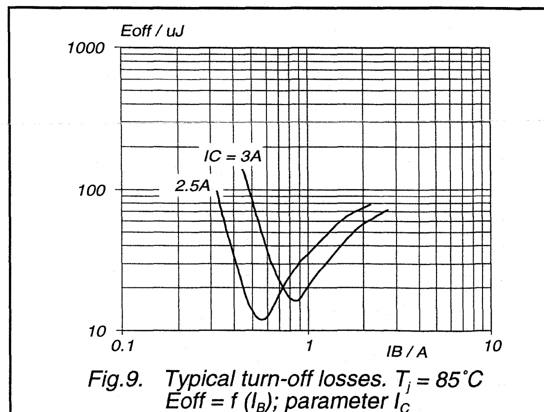


Fig.9. Typical turn-off losses. $T_j = 85\ ^\circ C$
$Eoff = f\ (I_B)$; parameter I_C

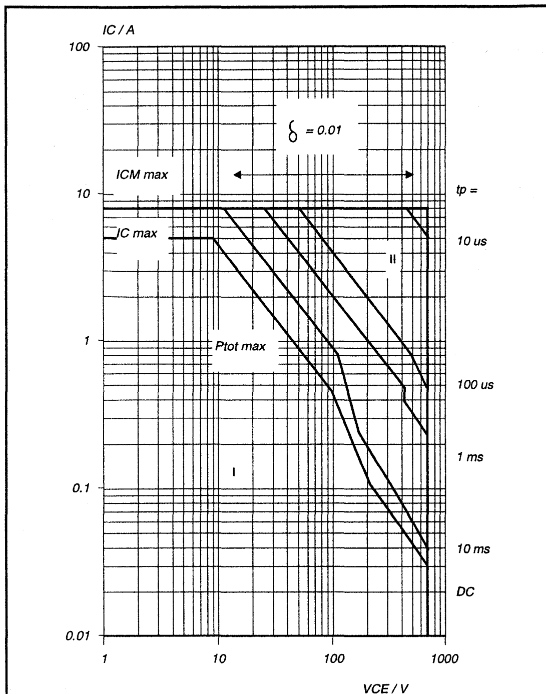


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

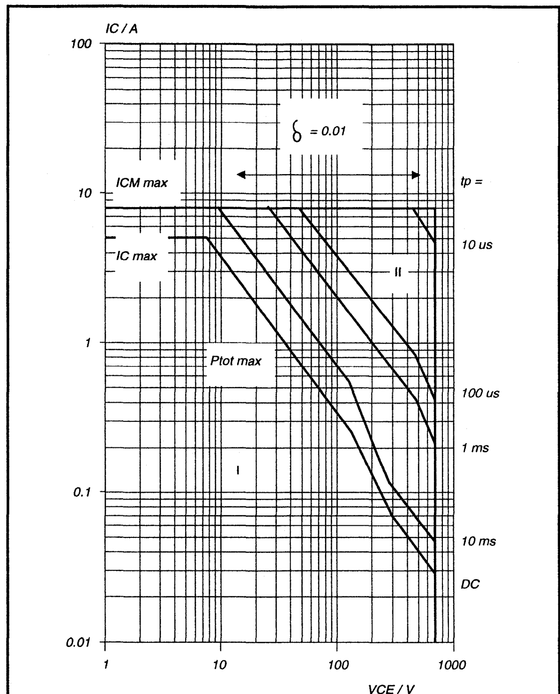


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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 and computer monitors. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

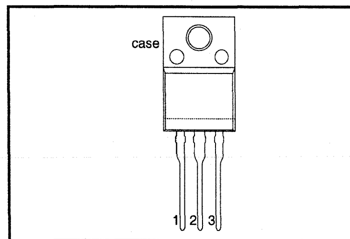
QUICK REFERENCE DATA

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	$I_C = 4$ A; $I_B = 0.95$ A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4$ A; $I_B = 0.8$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4	-	A
t_f	Fall time	$I_{Csat} = 4$ A; f = 16kHz	0.25	0.5	µs

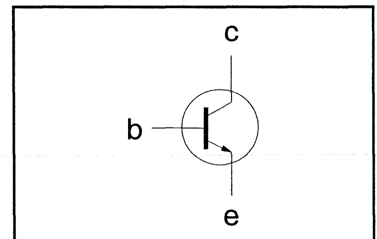
PINNING - SOT186A

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
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	with heatsink compound	-	3.7	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 A; I_B = 0.8 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	17	-	
h_{FE}		I_C = 4 A; V_{CE} = 5 V	5.0	7.0	9.0	

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	68	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4 A; $I_{B(end)}$ = 0.7 A; L_B = 6 µH; $-V_{BB}$ = 4 V			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

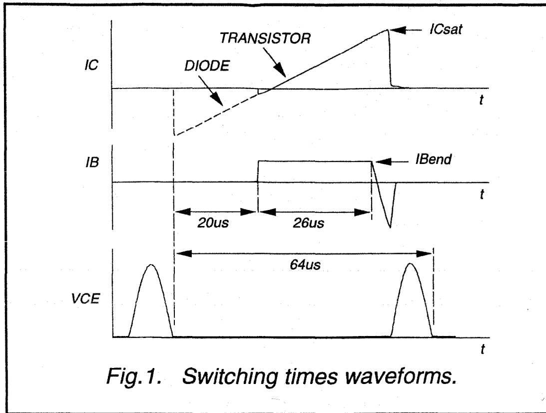


Fig.1. Switching times waveforms.

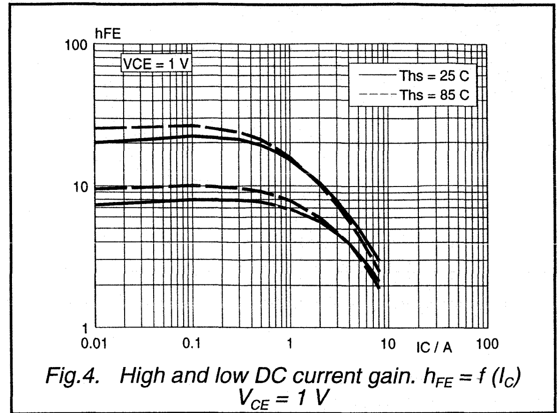


Fig.4. High and low DC current gain. $h_{FE} = f(I_C)$
$V_{CE} = 1\ V$

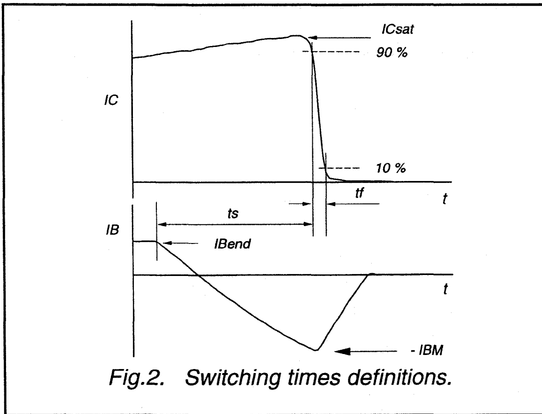


Fig.2. Switching times definitions.

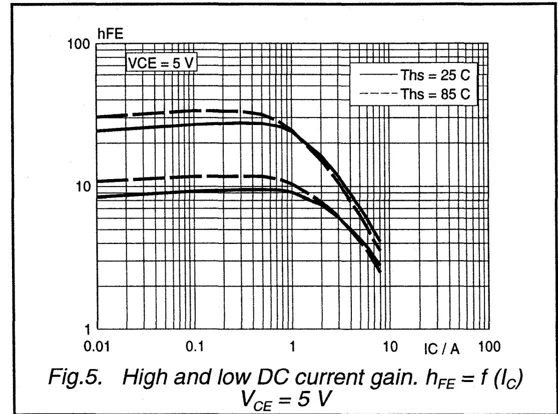


Fig.5. High and low DC current gain. $h_{FE} = f(I_C)$
$V_{CE} = 5\ V$

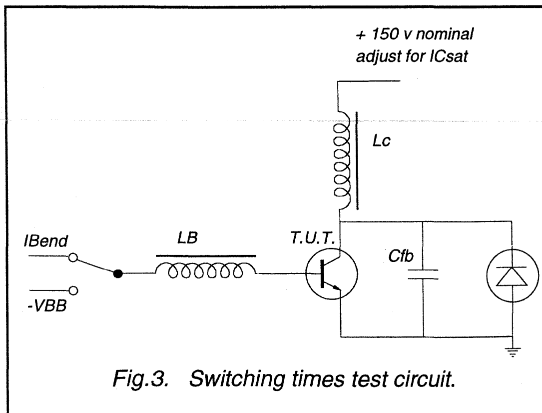


Fig.3. Switching times test circuit.

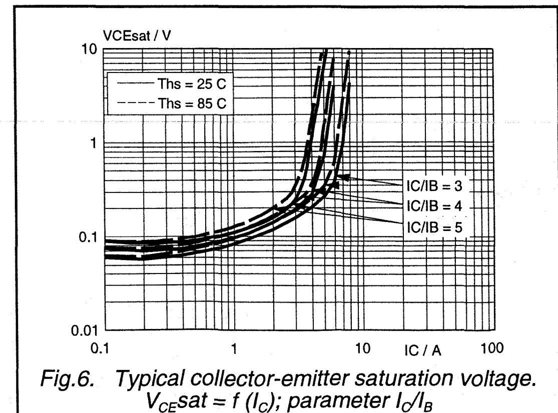


Fig.6. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

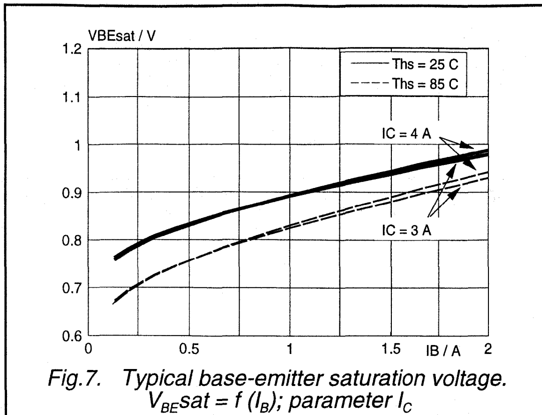


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

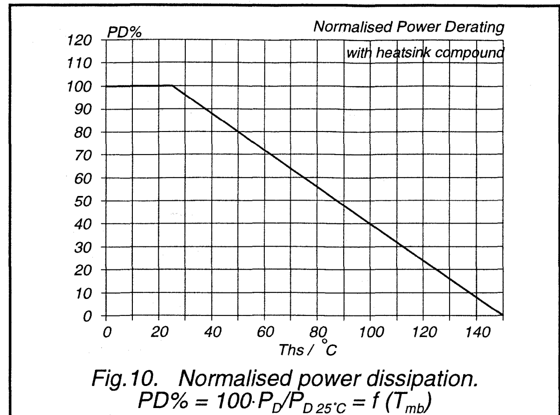


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{mb})$

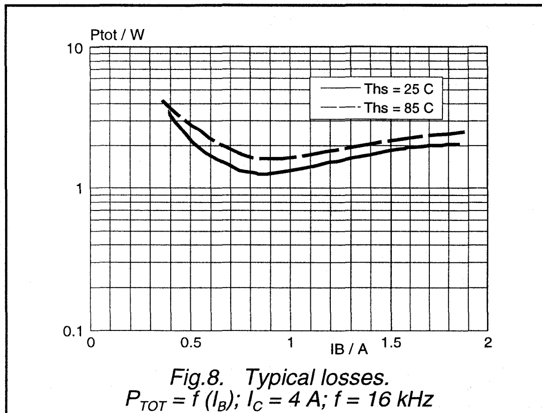


Fig.8. Typical losses.
$P_{TOT} = f\ (I_B)$; $I_C = 4$ A; f = 16 kHz

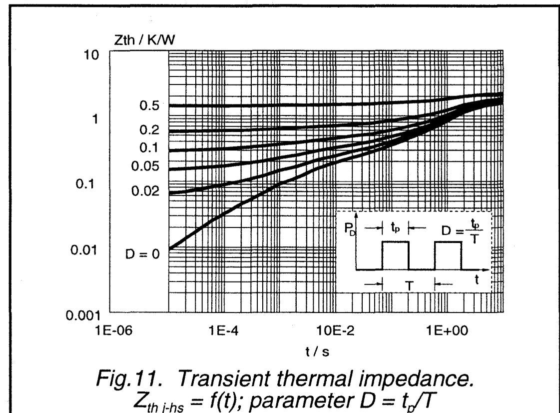


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

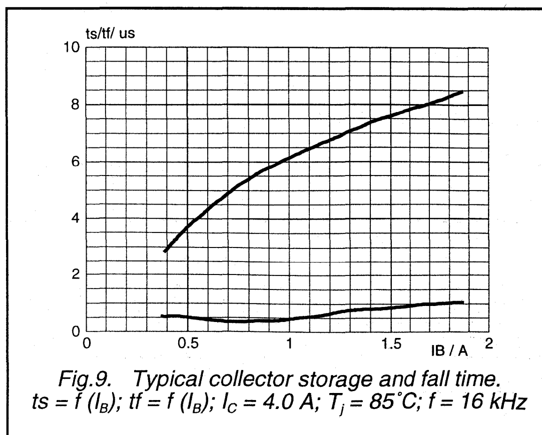


Fig.9. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; $I_C = 4.0$ A; $T_j = 85^\circ C$; f = 16 kHz

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 and computer monitors. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

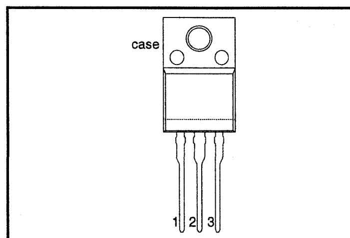
QUICK REFERENCE DATA

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	$I_C = 4$ A; $I_B = 0.8$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4	-	A
V_F	Diode forward voltage	$I_F = 4$ A	1.7	2.0	V
t_f	Fall time	$I_{Csat} = 4$ A; f = 16kHz	0.25	0.5	µs

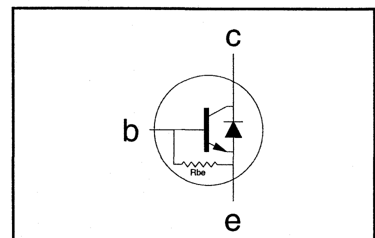
PINNING - SOT186A

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
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
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	3.7	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}	Repetitive peak voltage from all three terminals to external heatsink	R.H. ≤ 65% ; clean and dustfree	-		1500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	12	-	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	-	160	-	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
$V_{CEOsust}$	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 A; I_B = 0.8 A		-	5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	14	-	
h_{FE}		I_C = 4 A; V_{CE} = 5 V	5	7	9	
V_F	Diode forward voltage	I_F = 4 A	-	1.7	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	68	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4 A; $I_{B(end)}$ = 0.7 A; L_B = 6 µH; $-V_{BB}$ = 4 V			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

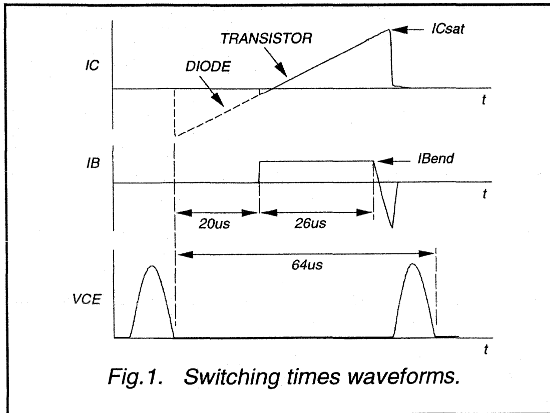


Fig.1. Switching times waveforms.

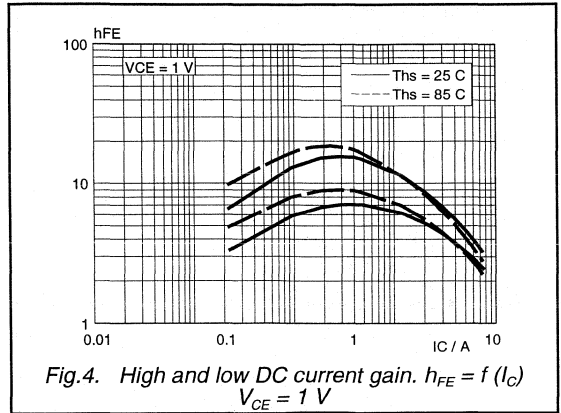


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

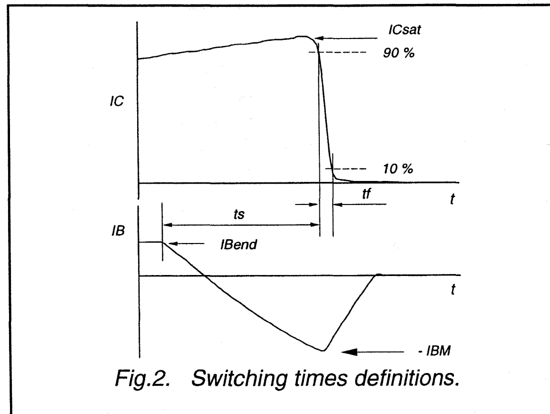


Fig.2. Switching times definitions.

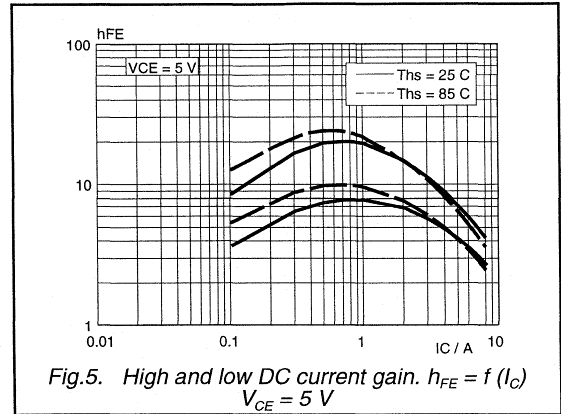


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

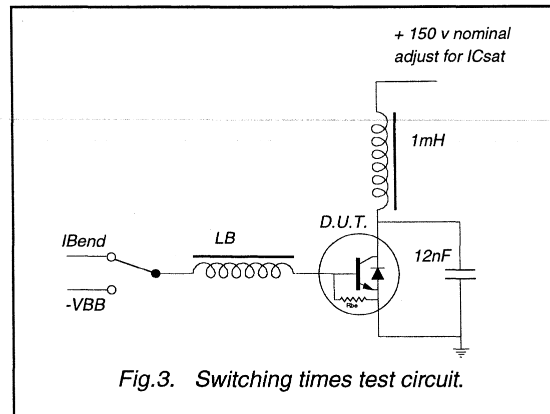


Fig.3. Switching times test circuit.

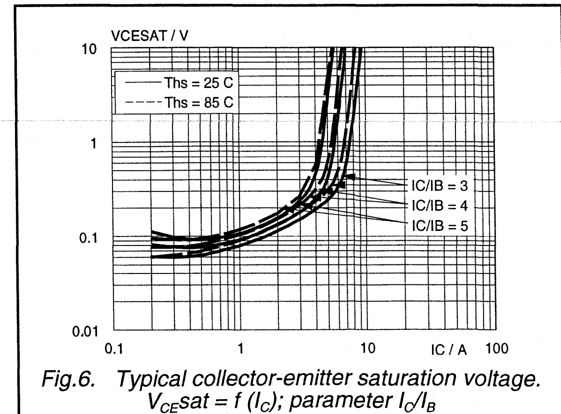


Fig.6. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

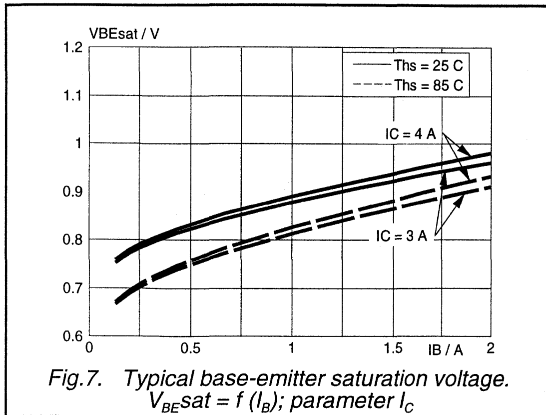


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

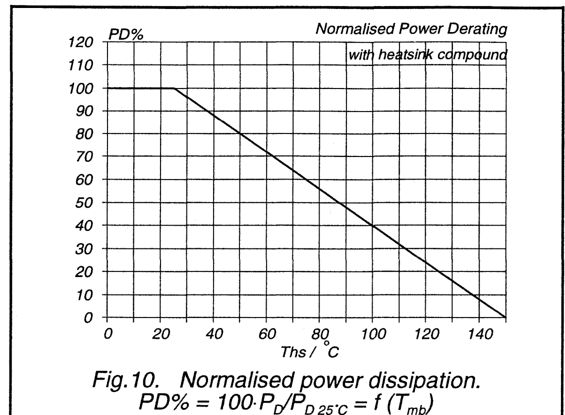


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

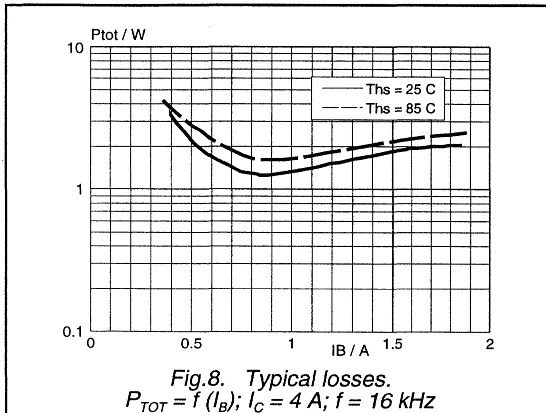


Fig.8. Typical losses. $P_{TOT} = f(I_B)$; $I_C = 4$ A; f = 16 kHz

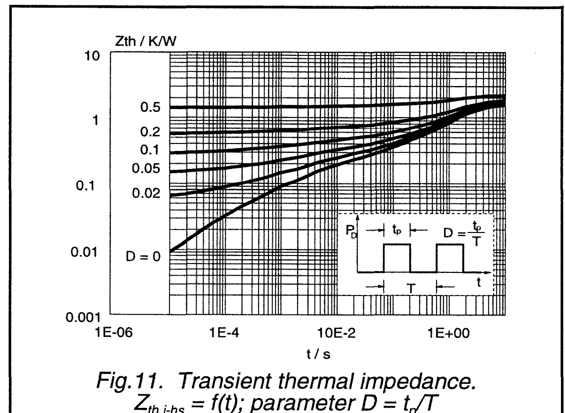


Fig.11. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

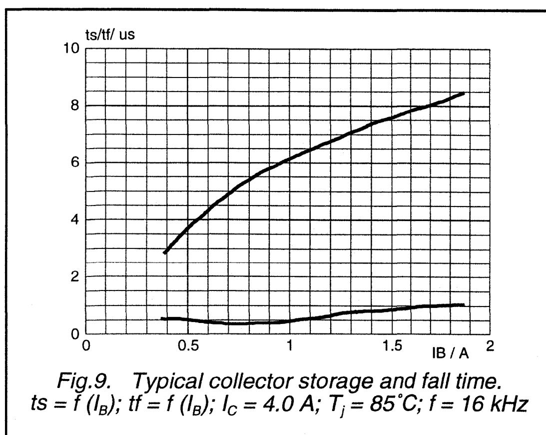


Fig.9. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; $I_C = 4.0$ A; $T_j = 85^\circ C$; f = 16 kHz

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.

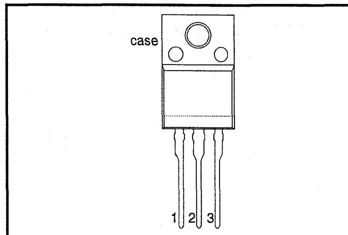
QUICK REFERENCE DATA

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 = 1.1 A	-	1.0	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

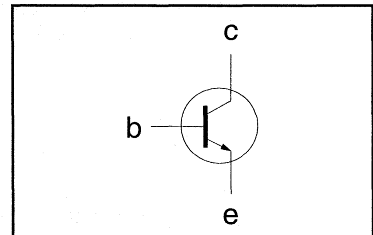
PINNING - SOT186A

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
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	3.6	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	-	-	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 voltage	I_C = 4.5 A; I_B = 1.1 A	-	-	1.0	V V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4.0	5.5	7.0	

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).

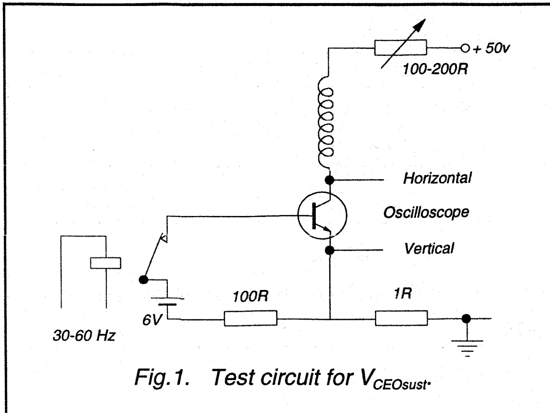


Fig.1. Test circuit for $V_{CEOsust}$.

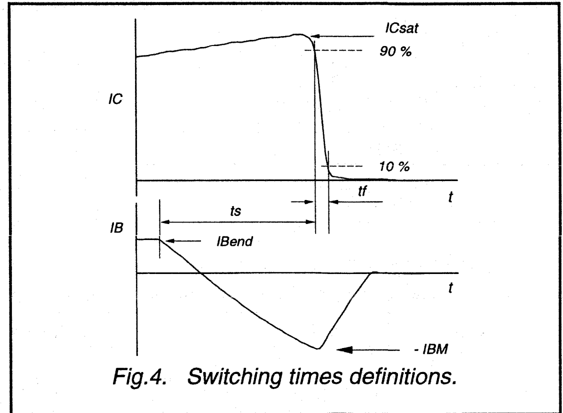


Fig.4. Switching times definitions.

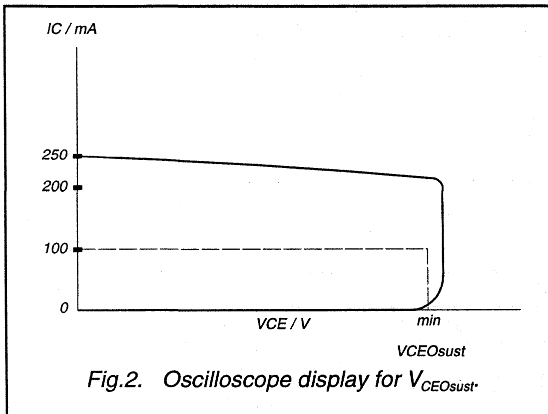


Fig.2. Oscilloscope display for $V_{CEOsust}$.

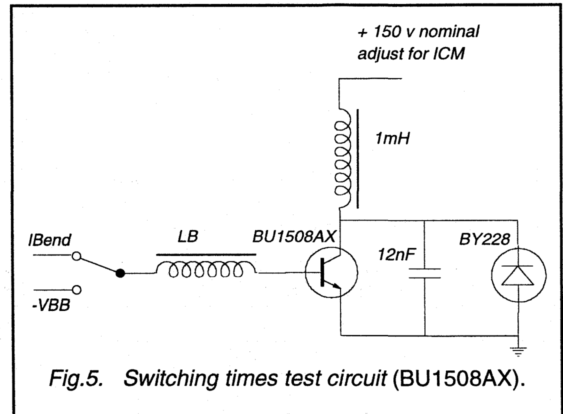


Fig.5. Switching times test circuit (BU1508AX).

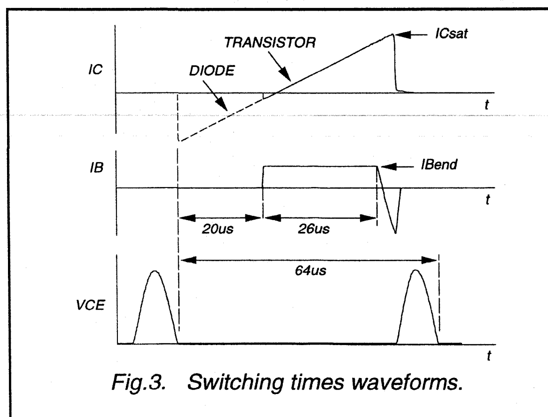


Fig.3. Switching times waveforms.

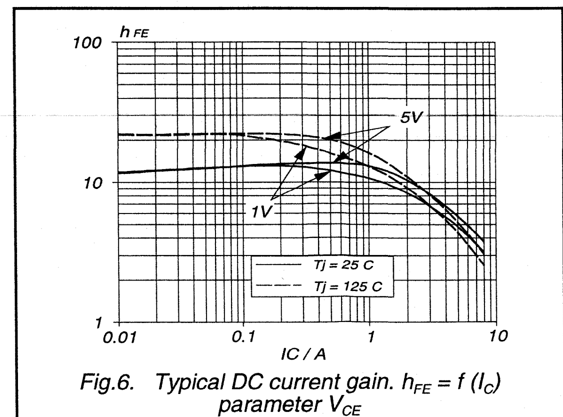


Fig.6. Typical DC current gain. $h_{FE} = f\,(I_C)$ parameter V_{CE}

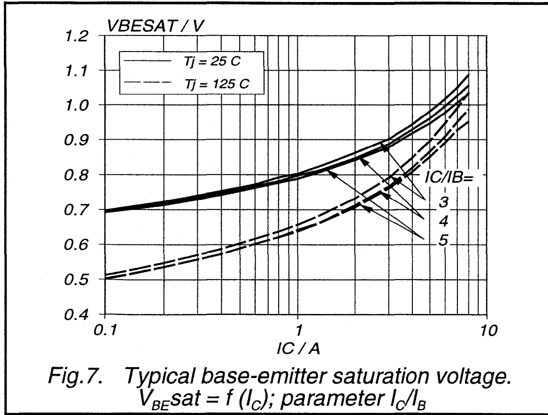


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

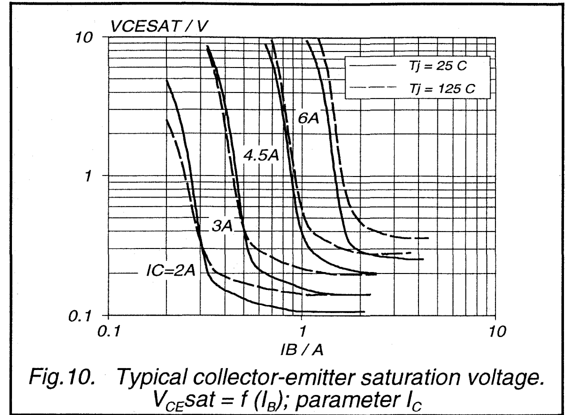


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

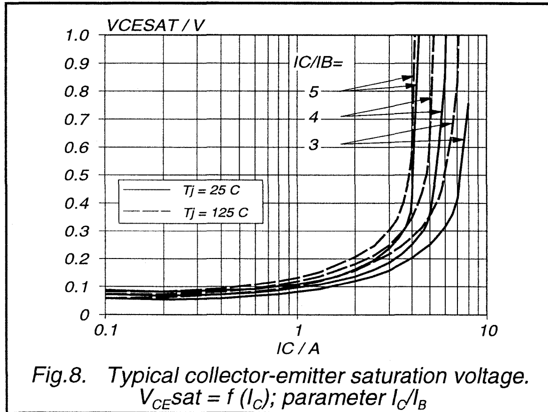


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

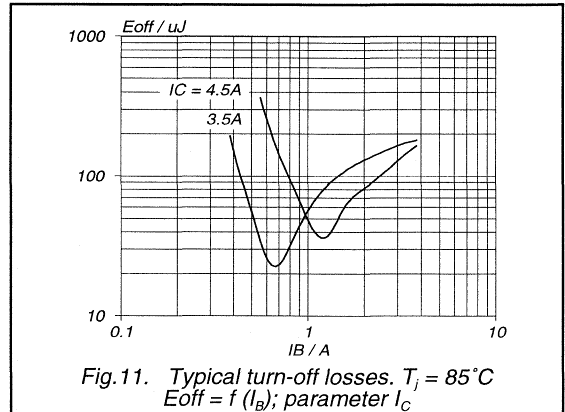


Fig.11. Typical turn-off losses. $T_j = 85^\circ C$ $Eoff = f(I_B)$; parameter I_C

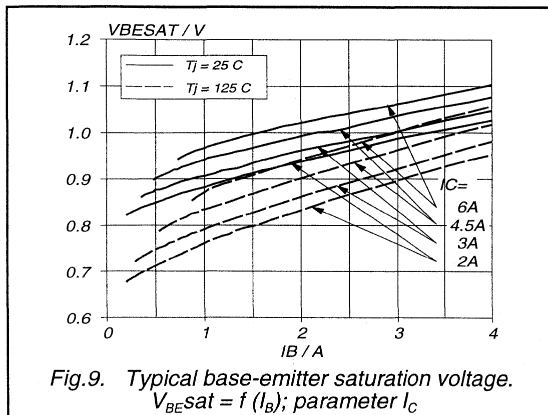


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

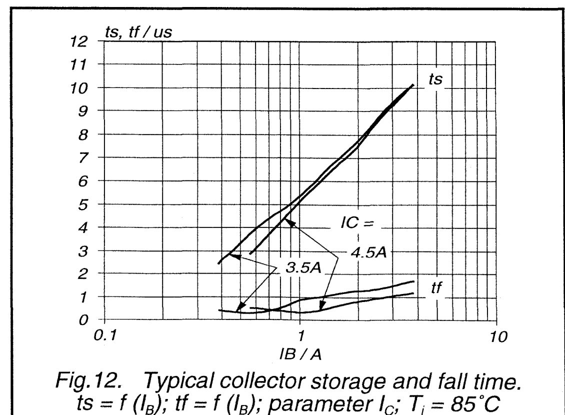


Fig.12. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$

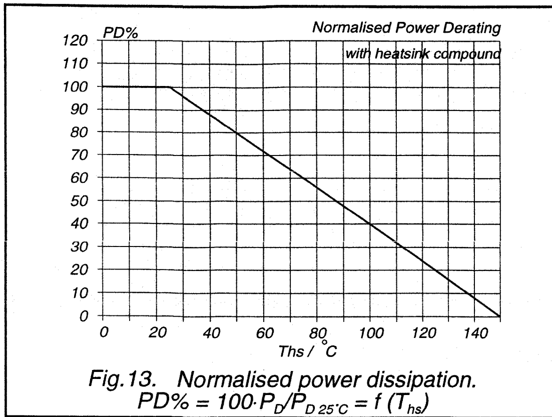


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

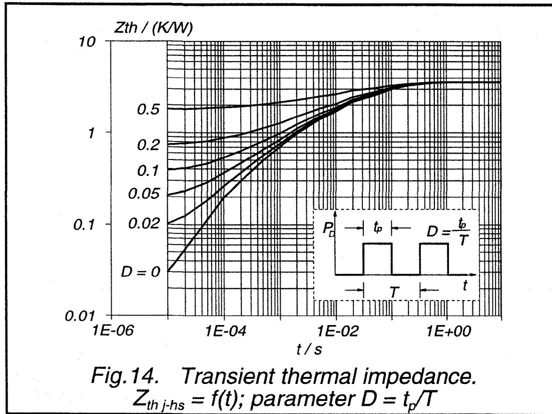


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

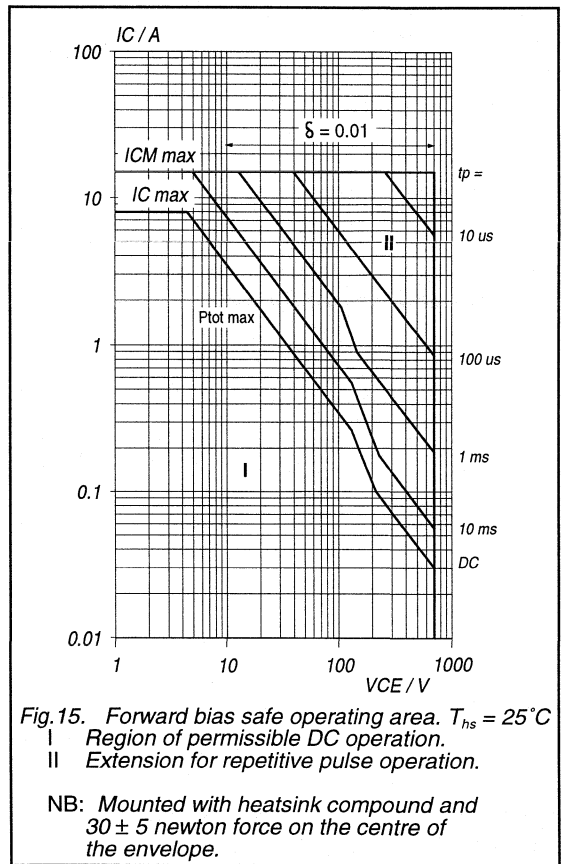


Fig.15. Forward bias safe operating area. $T_{hs} = 25^\circ C$
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

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

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.

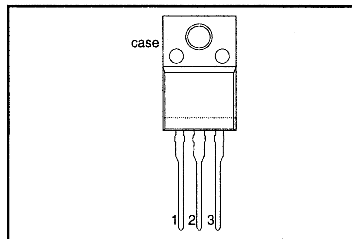
QUICK REFERENCE DATA

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; $I_B = 1.1$ A	-	1.0	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

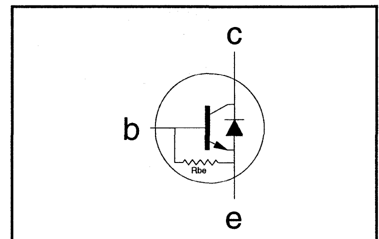
PINNING - SOT186A

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

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} = $V_{CESMmax}$; 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 voltage	I_C = 4.5 A; I_B = 1.1 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	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.0	
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).

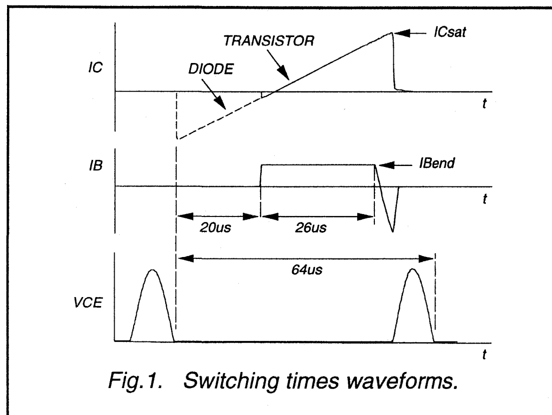


Fig.1. Switching times waveforms.

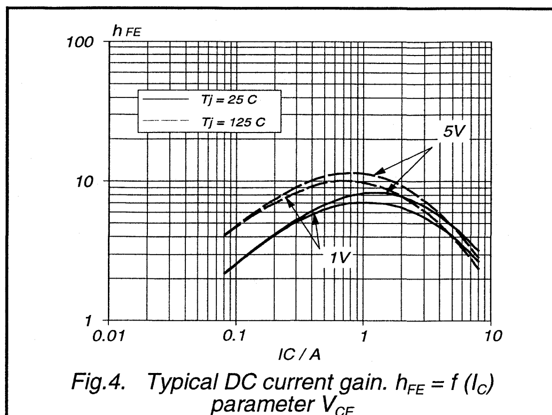


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

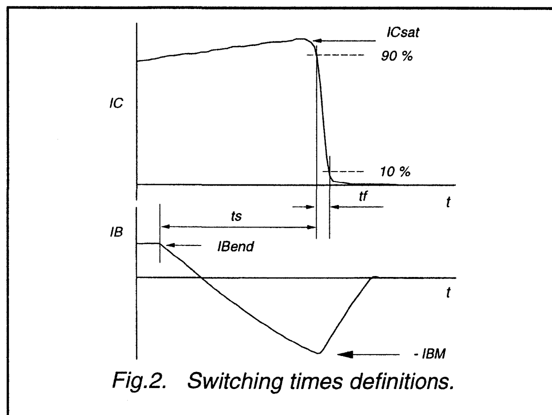


Fig.2. Switching times definitions.

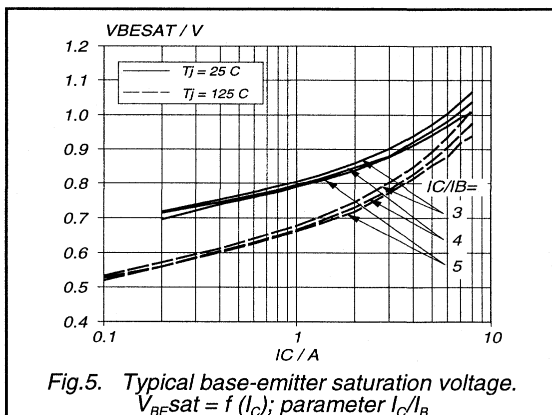


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

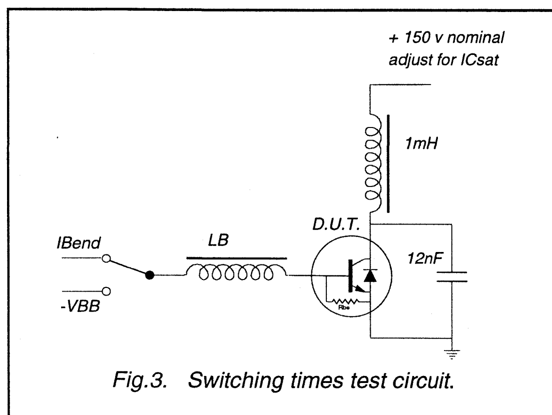


Fig.3. Switching times test circuit.

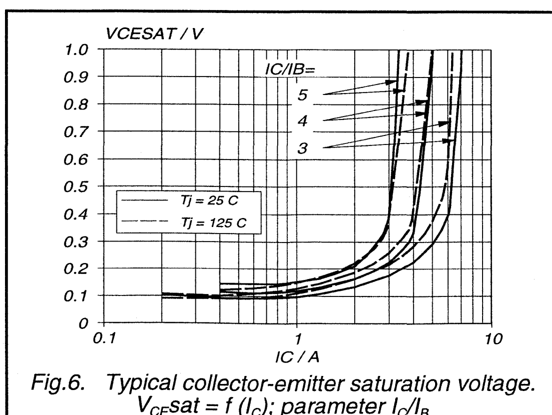


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

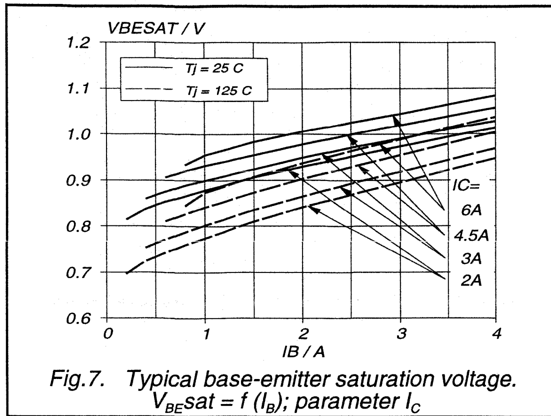


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

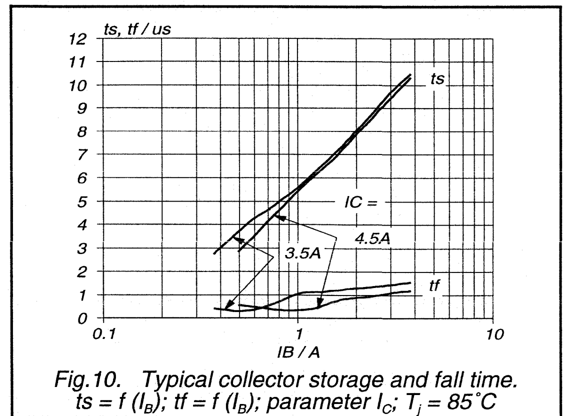


Fig.10. Typical collector storage and fall time. $ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85˚C$

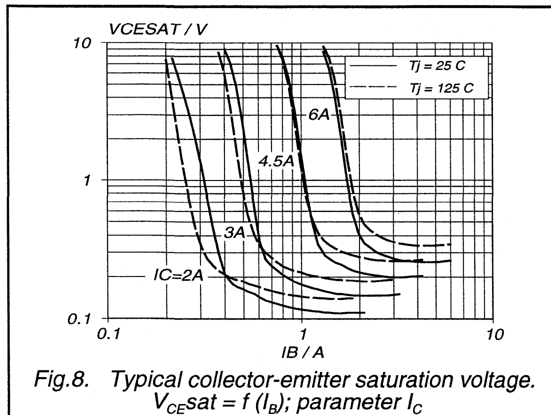


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_B)$; parameter I_C

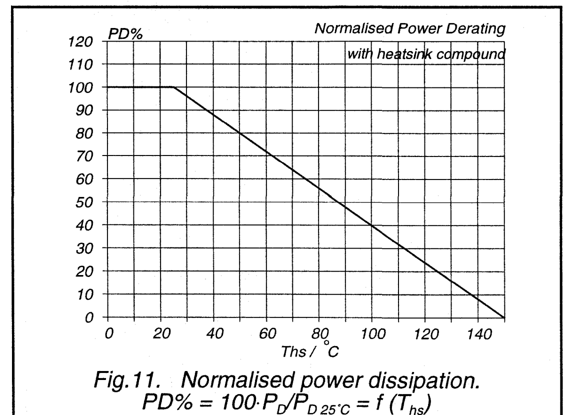


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f (T_{hs})$

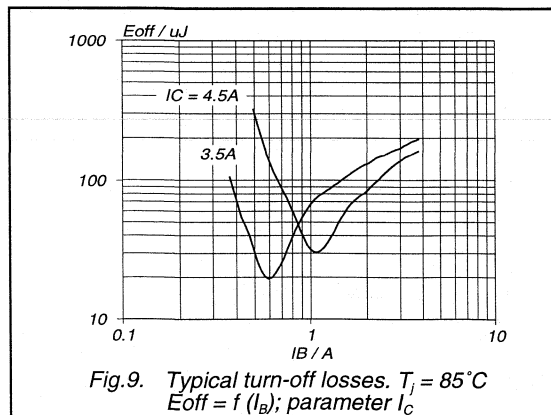


Fig.9. Typical turn-off losses. $T_j = 85˚C$ $Eoff = f (I_B)$; parameter I_C

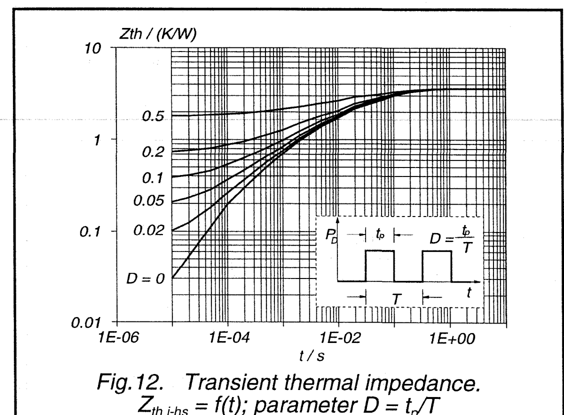


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

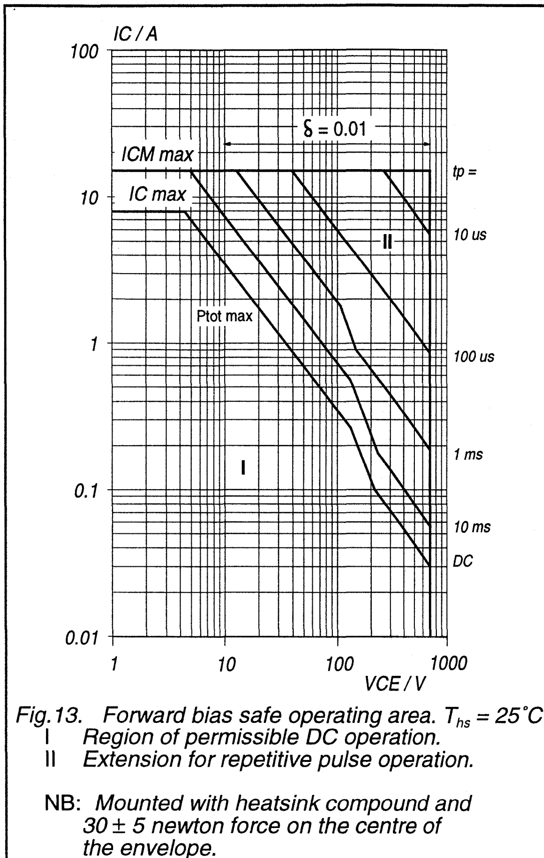


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

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.

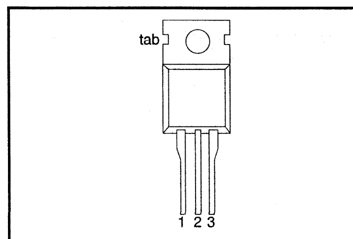
QUICK REFERENCE DATA

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

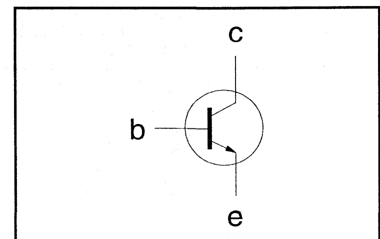
PINNING - TO220AB

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

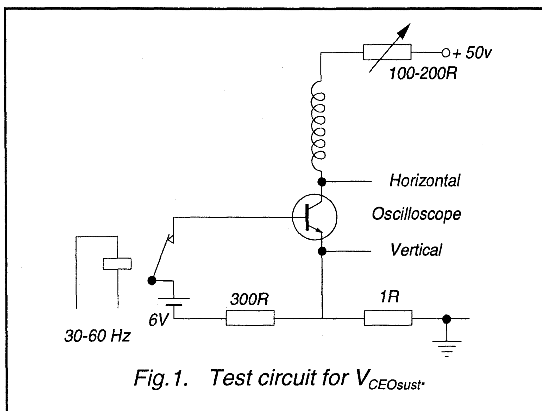


Fig.1. Test circuit for $V_{CEOsust}$.

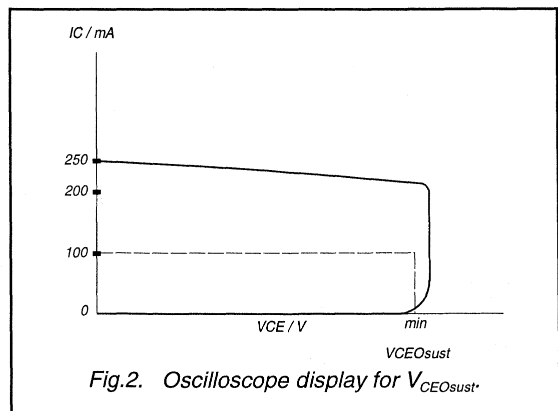


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

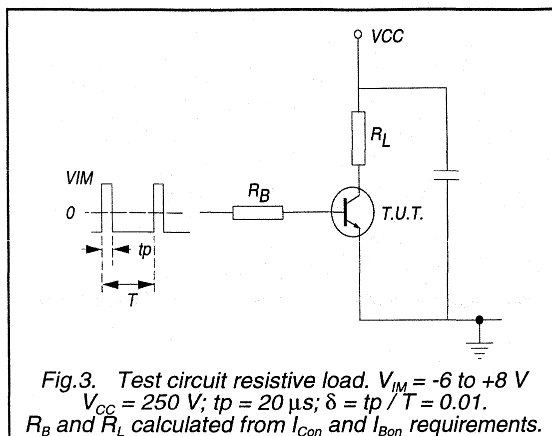


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

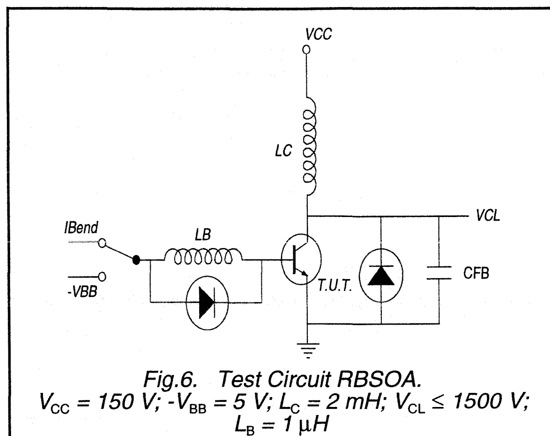


Fig.6. Test Circuit RBSOA.
V_{CC} = 150 V; -V_{BB} = 5 V; L_C = 2 mH; V_{CL} ≤ 1500 V; L_B = 1 µH

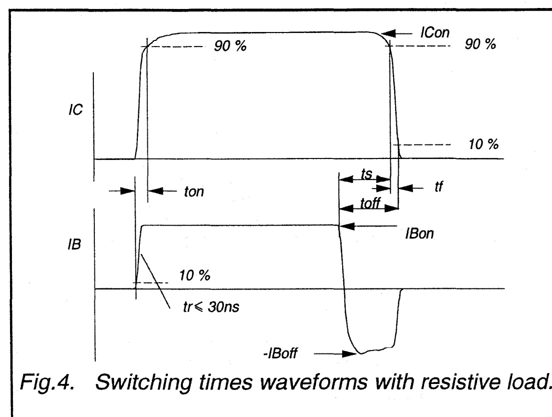


Fig.4. Switching times waveforms with resistive load.

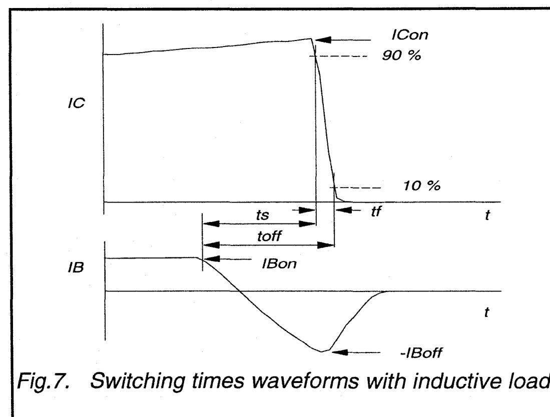


Fig.7. Switching times waveforms with inductive load.

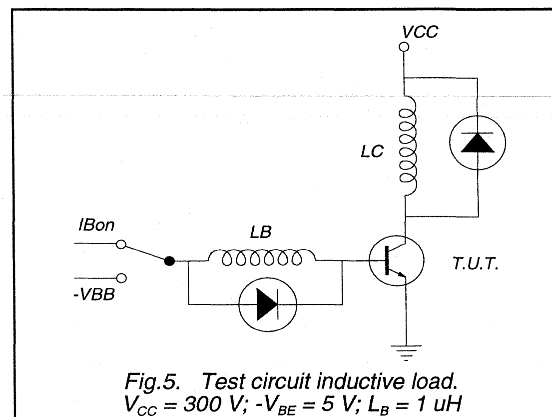


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V; L_B = 1 uH

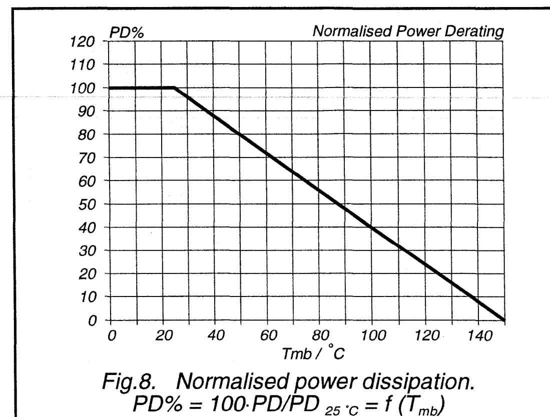


Fig.8. Normalised power dissipation.
PD% = 100·PD/PD $_{25\,^\circ C}$ = f (T_{mb})

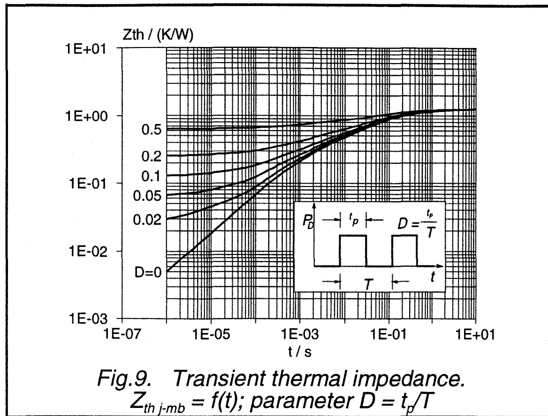


Fig.9. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

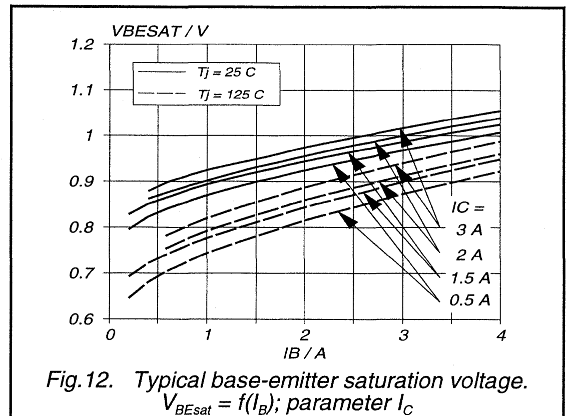


Fig.12. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

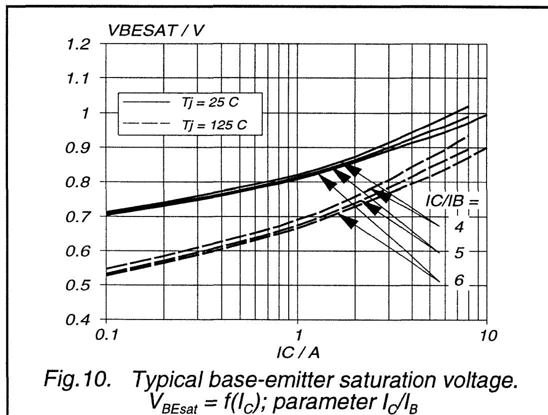


Fig.10. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_C)$; parameter I_C/I_B

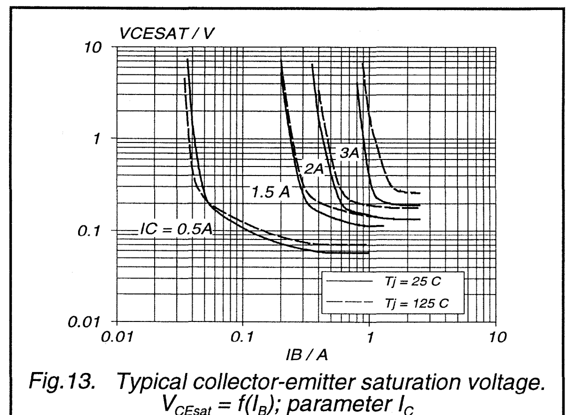


Fig.13. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

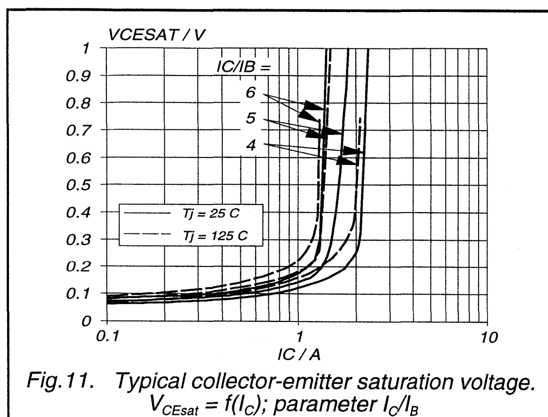


Fig.11. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

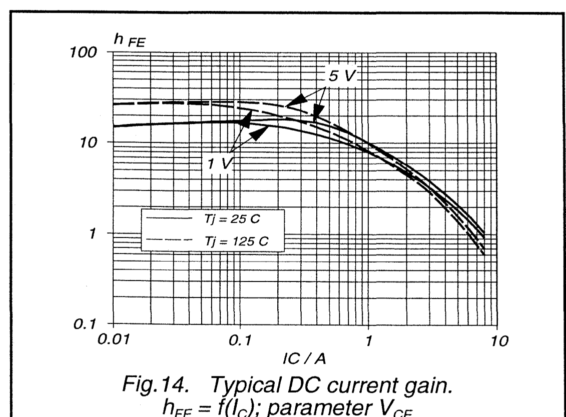


Fig.14. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

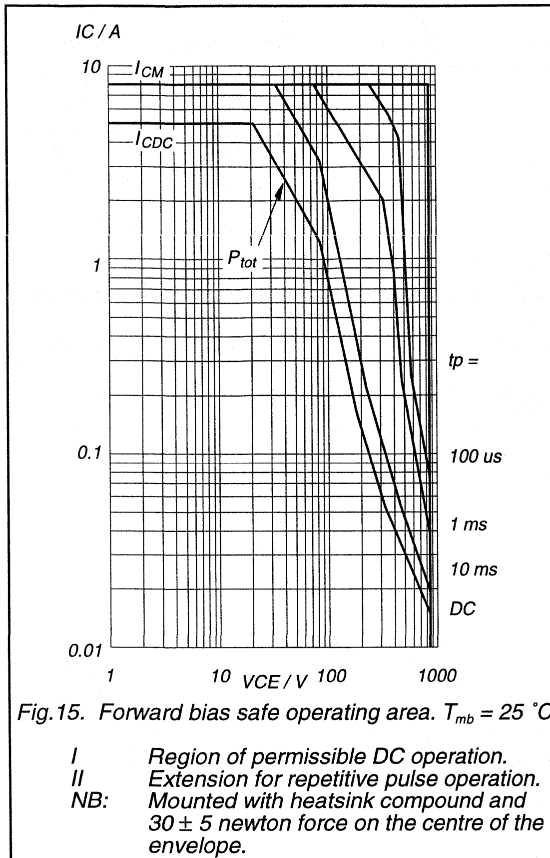


Fig.15. Forward bias safe operating area. T_{mb} = 25 ˚C

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.*

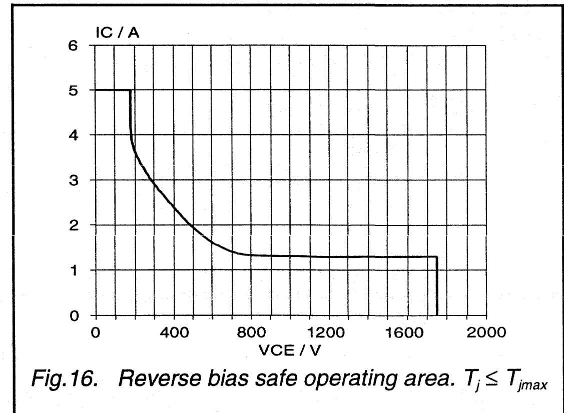


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

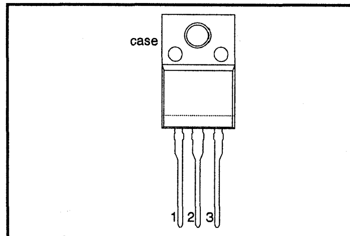
QUICK REFERENCE DATA

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

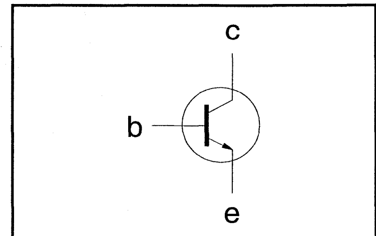
PINNING - SOT186A

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
$R_{th\ j-hs}$	Junction to heatsink	with heatsink compound	-	4.0	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} = 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).

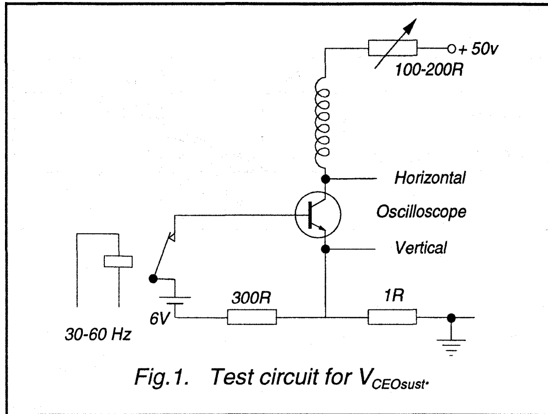


Fig.1. Test circuit for $V_{CEOsust}$.

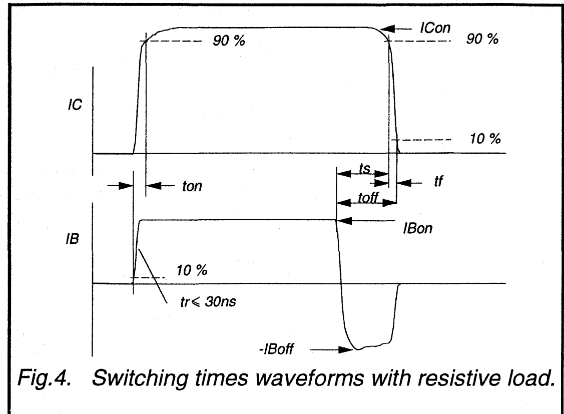


Fig.4. Switching times waveforms with resistive load.

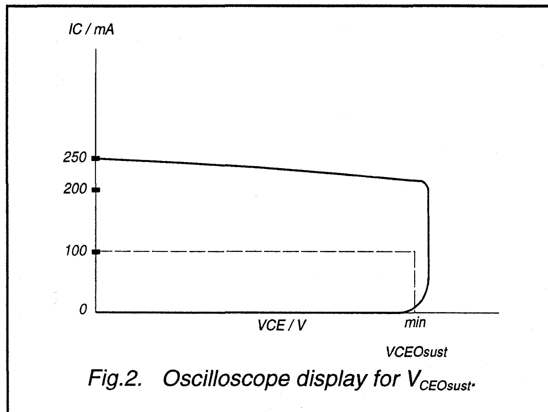


Fig.2. Oscilloscope display for $V_{CEOsust}$.

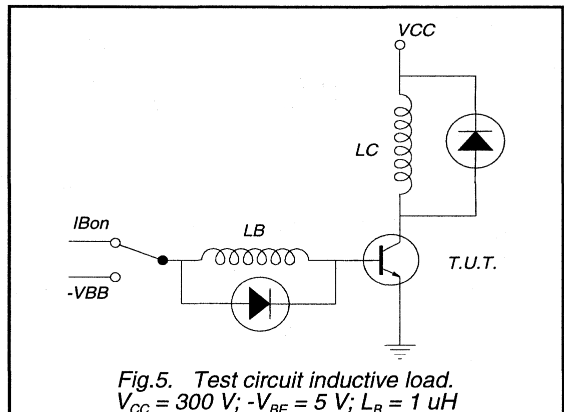


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_B = 1 uH

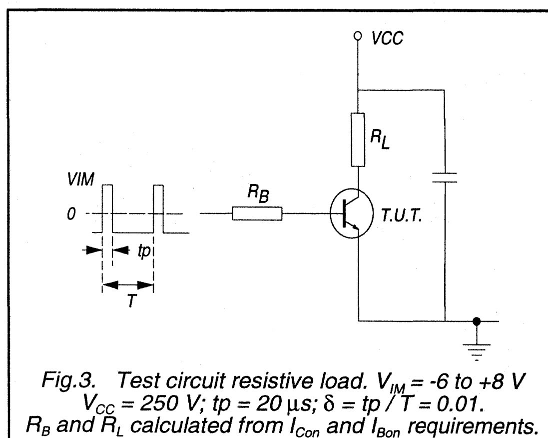


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

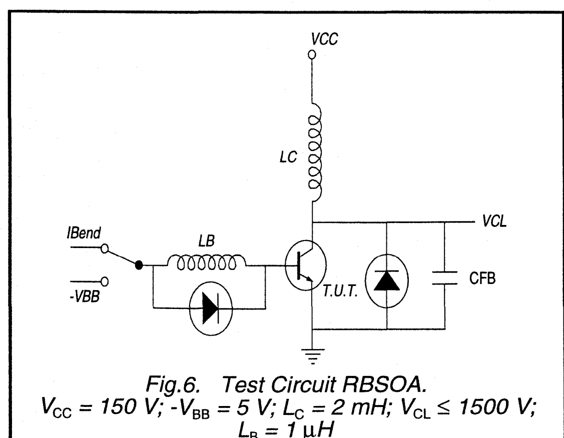


Fig.6. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 5 V; L_C = 2 mH; $V_{CL} \leq$ 1500 V;
L_B = 1 µH

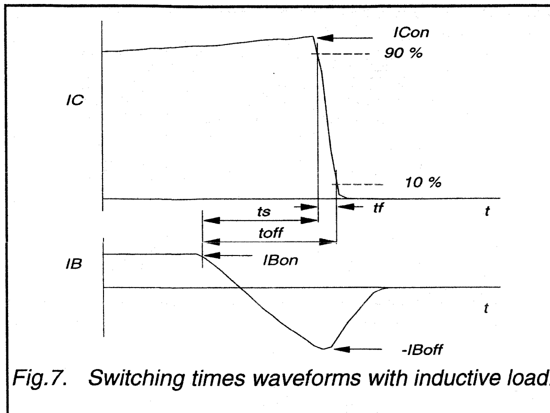


Fig.7. Switching times waveforms with inductive load.

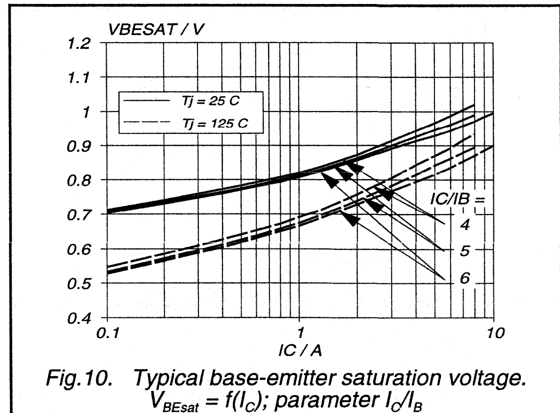


Fig.10. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_C)$; parameter I_C/I_B

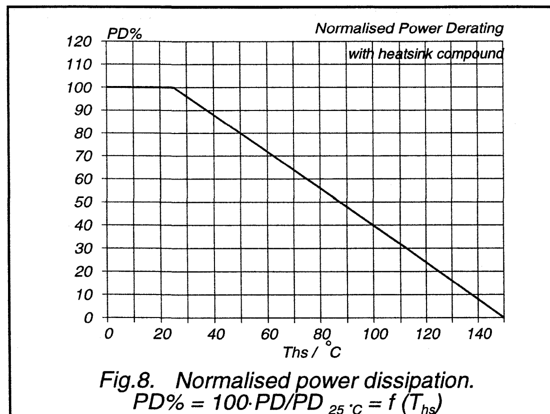


Fig.8. Normalised power dissipation. $PD\% = 100 \cdot PD/PD_{25\,^\circ C} = f(T_{hs})$

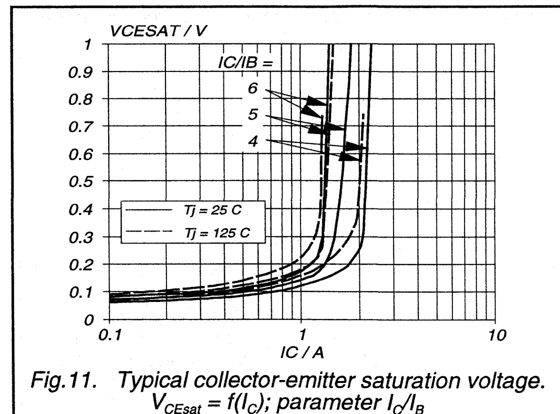


Fig.11. Typical collector-emitter saturation voltage. $V_{CEsat} = f(I_C)$; parameter I_C/I_B

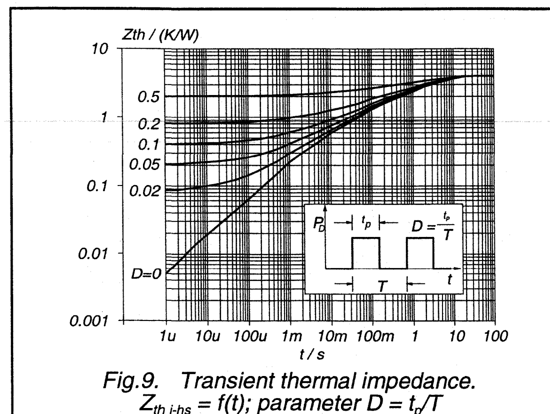


Fig.9. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

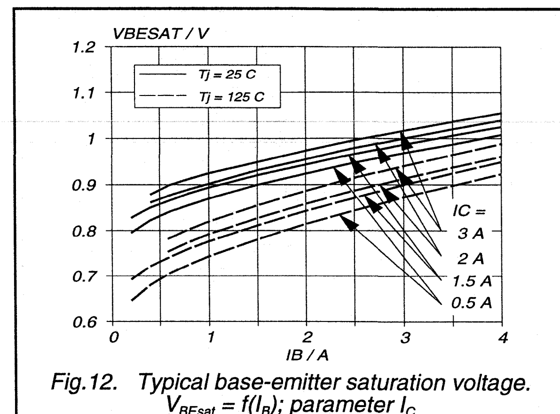


Fig.12. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_B)$; parameter I_C

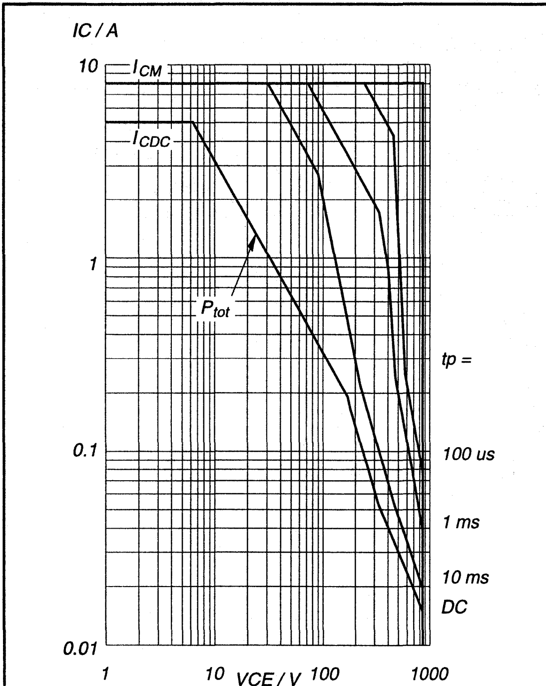


Fig.13. Forward bias safe operating area. T_{hs} = 25 ˚C

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.

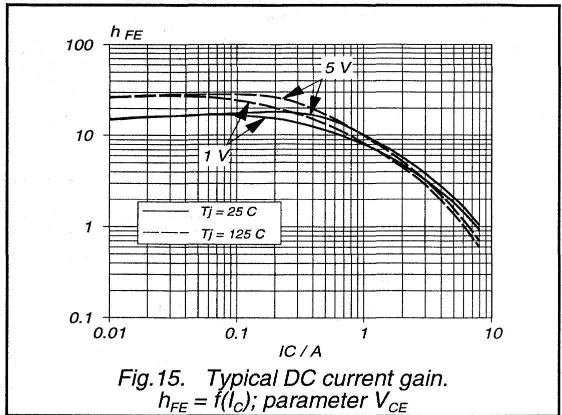


Fig.15. Typical DC current gain. $h_{FE} = f(I_C)$; parameter V_{CE}

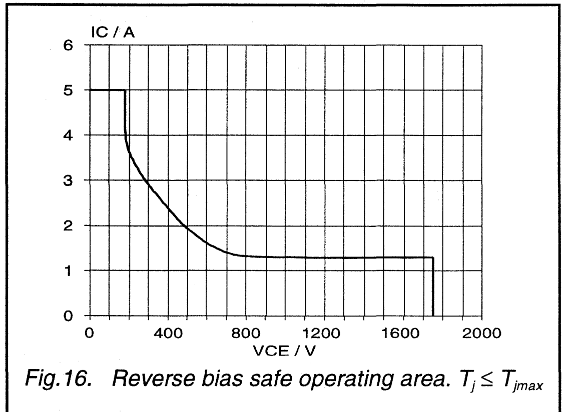


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

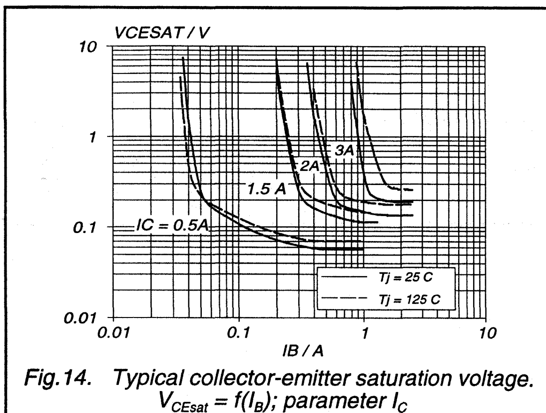


Fig.14. Typical collector-emitter saturation voltage. $V_{CEsat} = f(I_B)$; parameter I_C

Silicon Diffused Power Transistor BU2506DF

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.

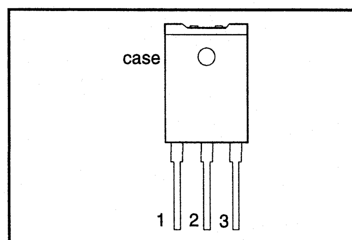
QUICK REFERENCE DATA

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; $I_B = 0.79$ A	-	5.0	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	$I_{Csat} = 3.0$ A; $I_{B(end)} = 0.67$ A	0.25	0.5	µs

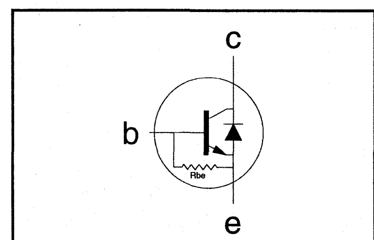
PINNING - SOT199

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	95	-	208	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	-	55	-	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 = 0.79 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 0.79 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 0.3 A; V_{CE} = 5 V	-	12	-	
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_{Csat} = 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).

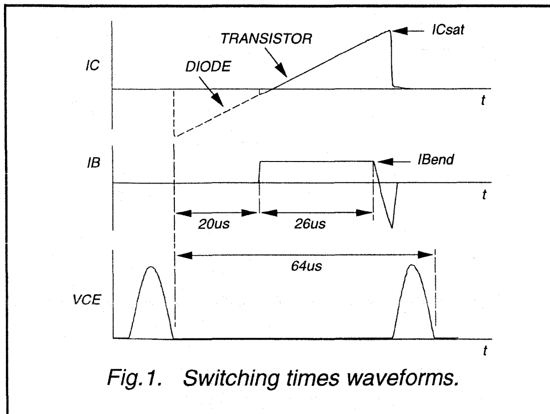


Fig.1. Switching times waveforms.

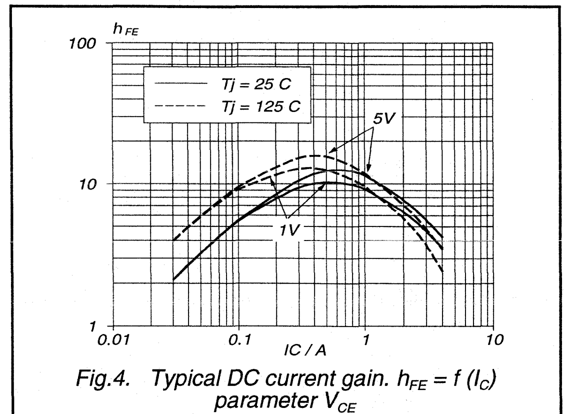


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

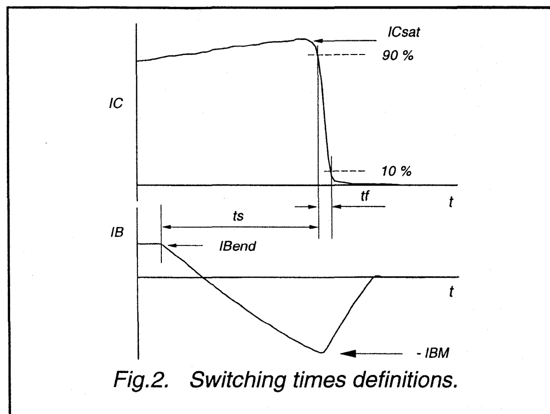


Fig.2. Switching times definitions.

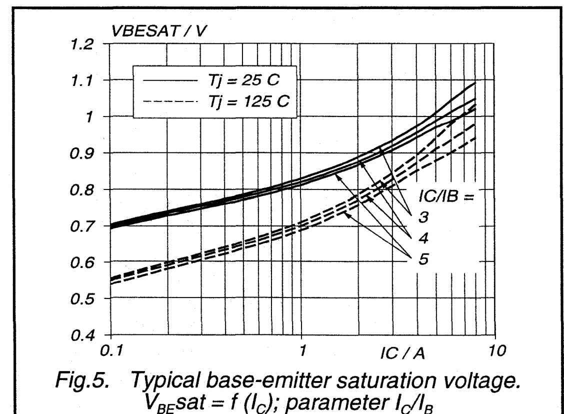


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

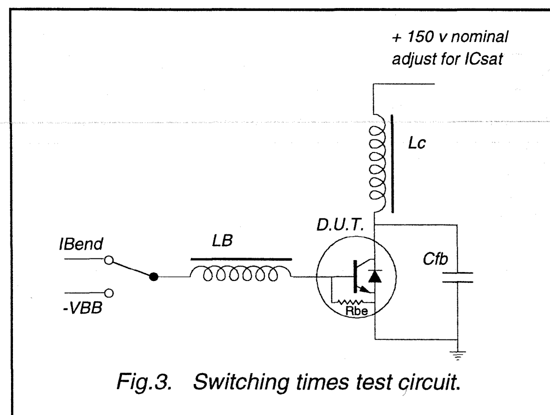


Fig.3. Switching times test circuit.

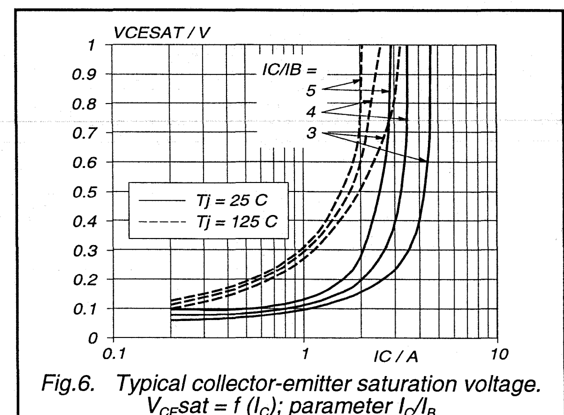


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

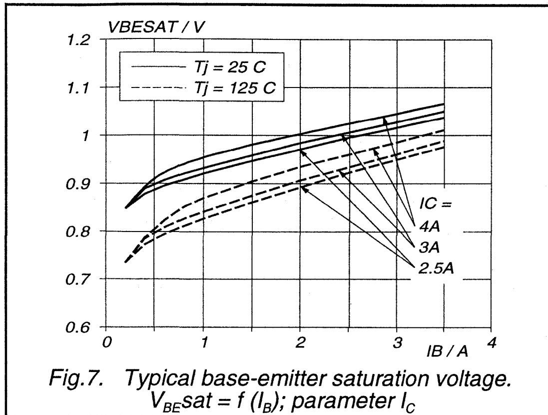


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

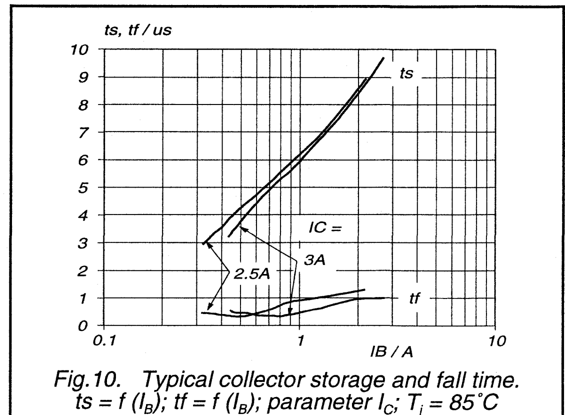


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$

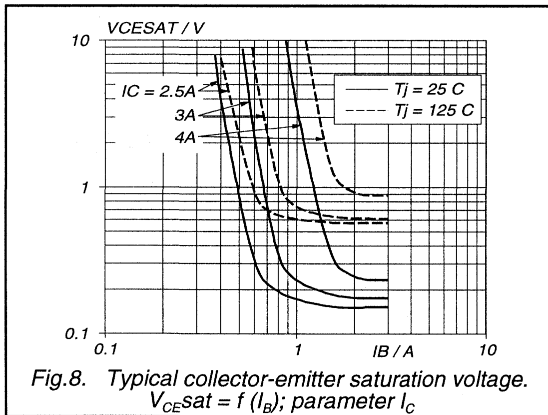


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

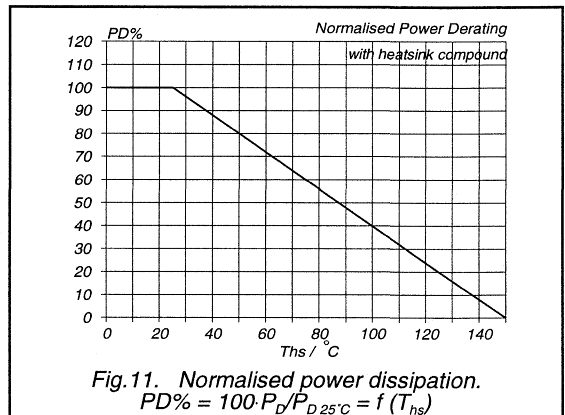


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

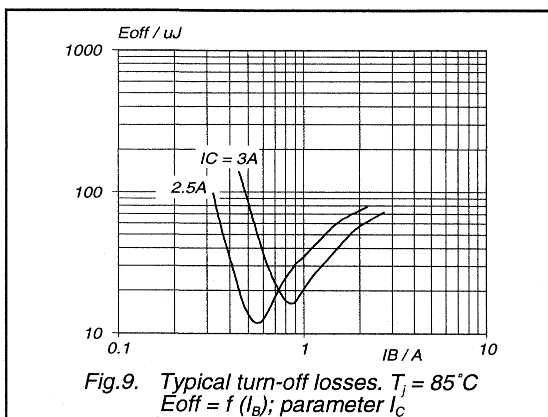


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f(I_B)$; parameter I_C

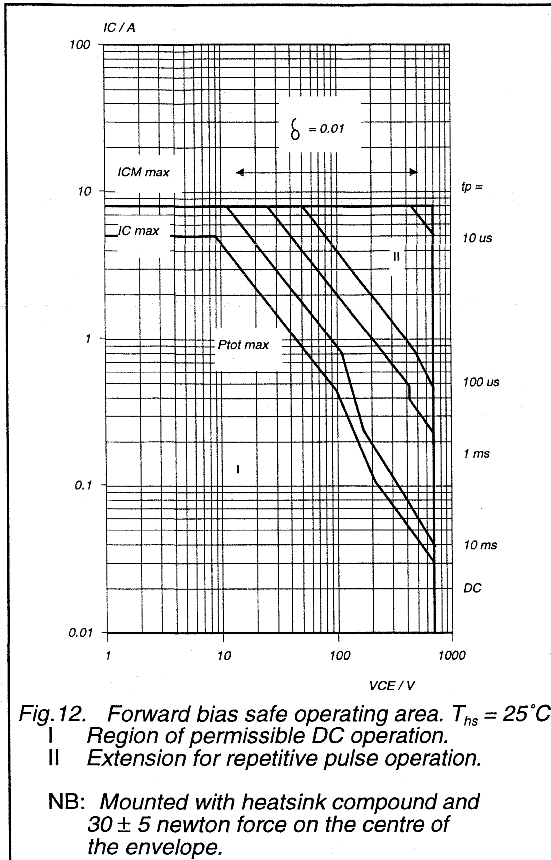


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

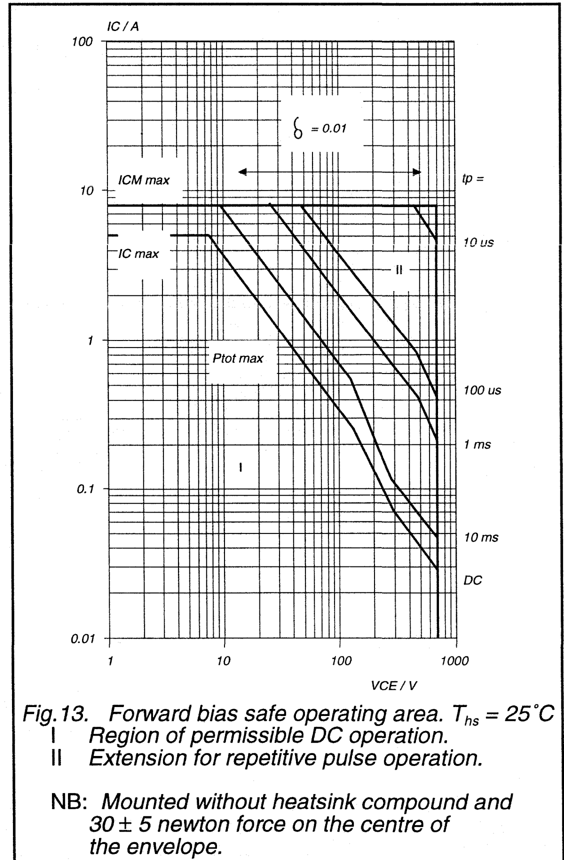


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

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.

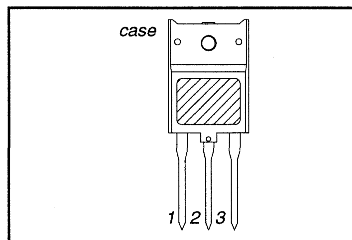
QUICK REFERENCE DATA

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; $I_B = 0.79$ A	-	5	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	$I_{Csat} = 3.0$ A; $I_{B(end)} = 0.67$ A	0.25	0.5	µs

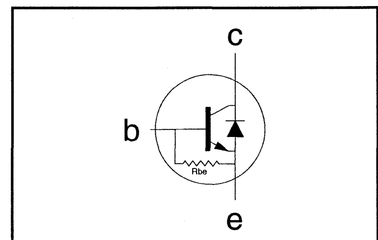
PINNING - SOT399

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
$R_{th\ j\text{-}hs}$	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	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	-	136	-	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	-	55	-	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 = 0.79 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 0.79 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 0.3 A; V_{CE} = 5 V	-	12	-	
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_{Csat} = 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).

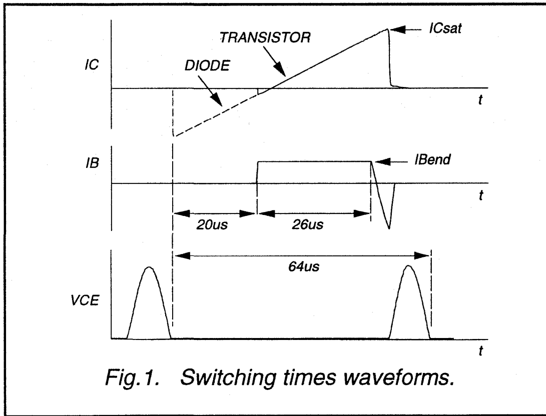


Fig.1. Switching times waveforms.

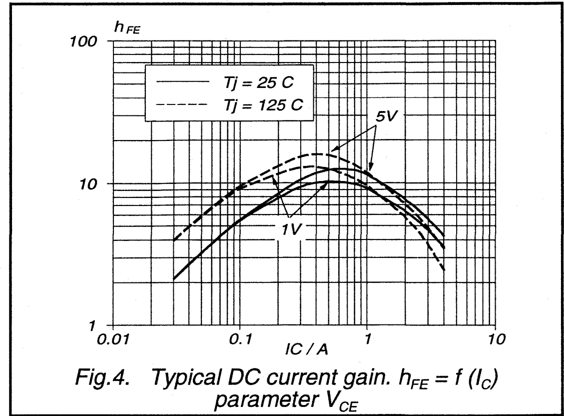


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

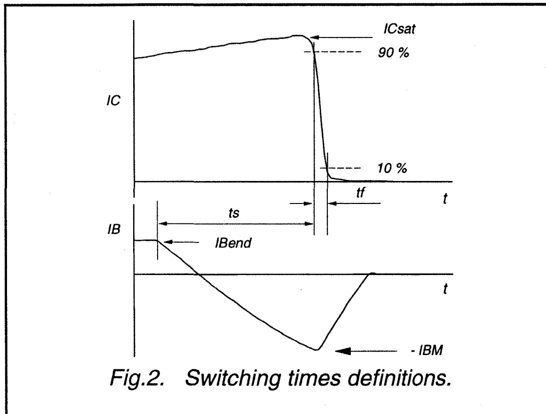


Fig.2. Switching times definitions.

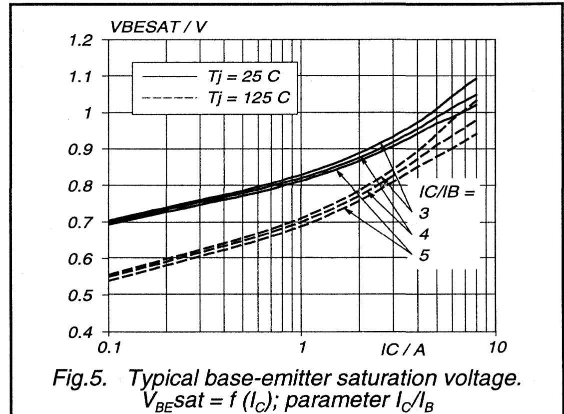


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

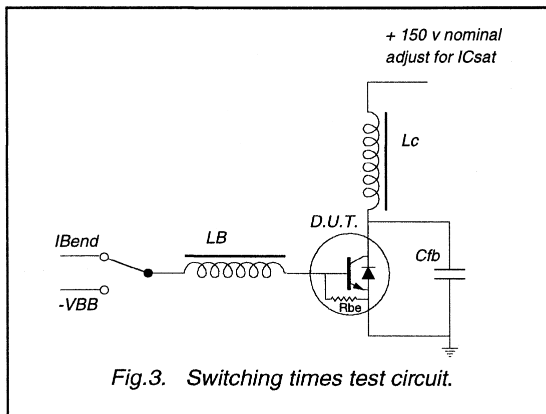


Fig.3. Switching times test circuit.

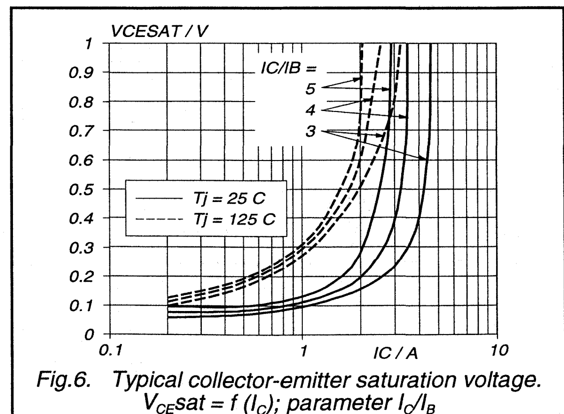


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

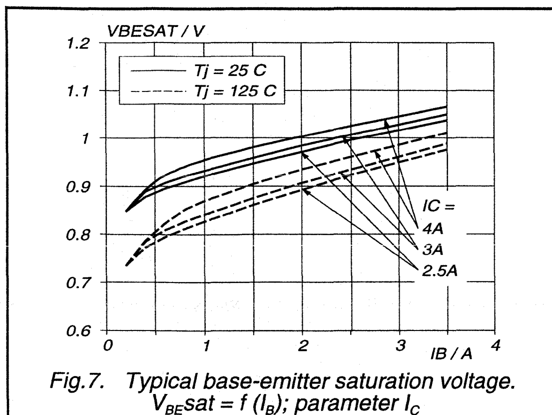


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f (I_B)$; parameter I_C

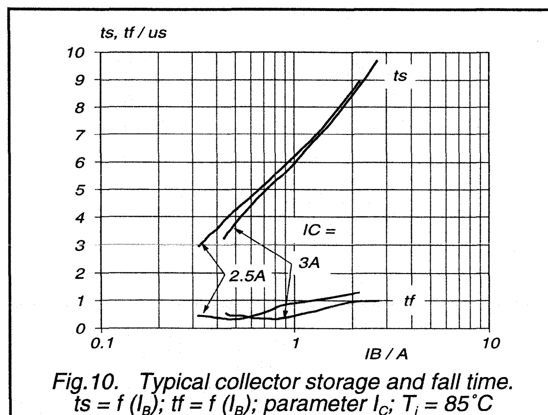


Fig.10. Typical collector storage and fall time.
$ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85˚C$

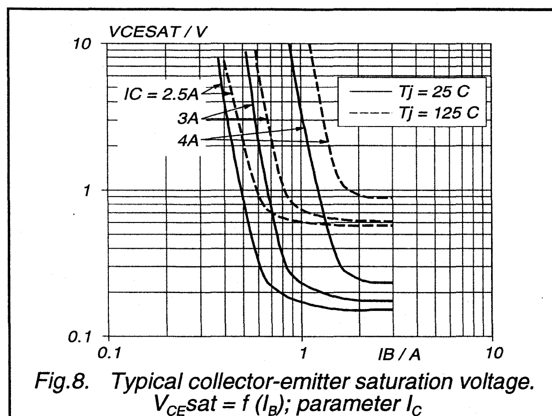


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f (I_B)$; parameter I_C

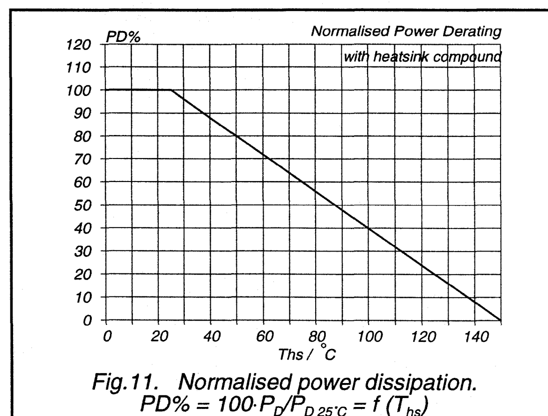


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f (T_{hs})$

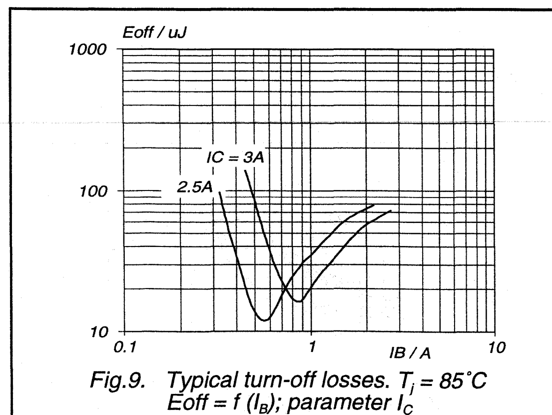


Fig.9. Typical turn-off losses. $T_j = 85˚C$
$Eoff = f (I_B)$; parameter I_C

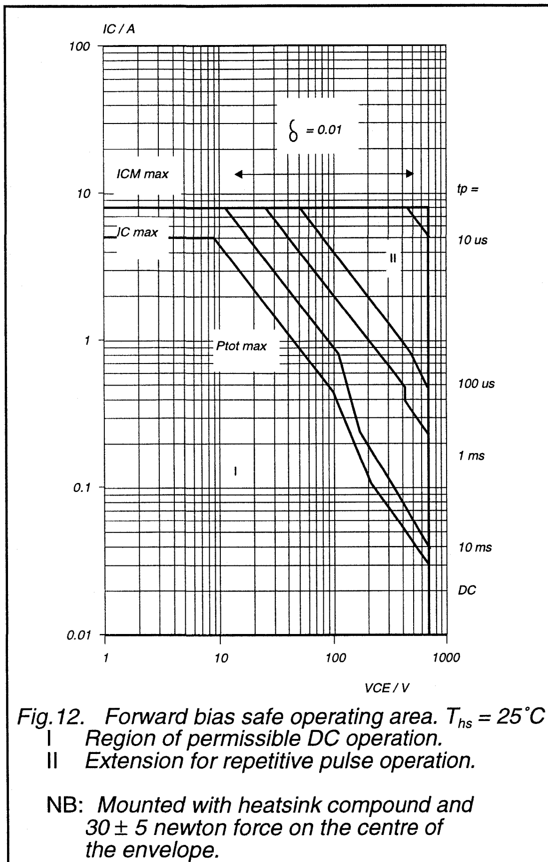


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

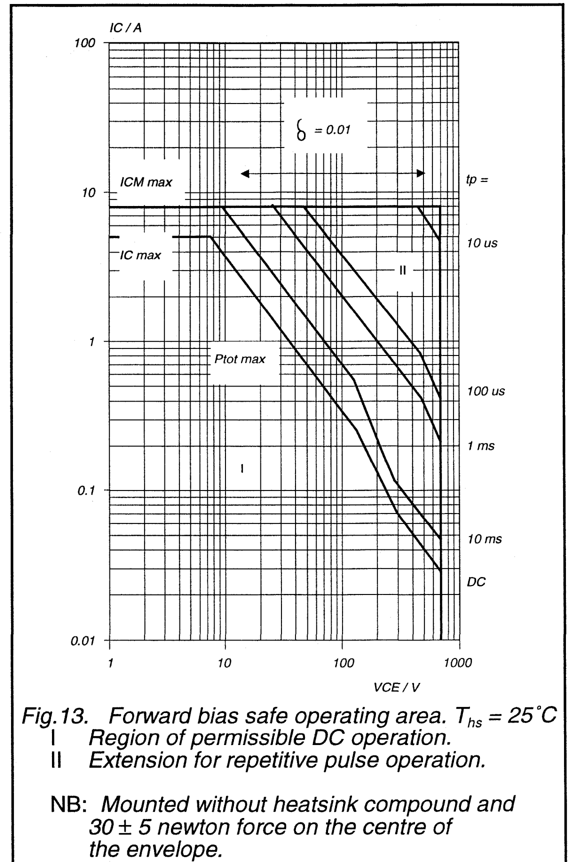


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

Silicon Diffused Power Transistor

BU2507AF

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 and computer monitors. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

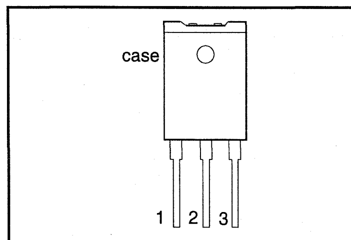
QUICK REFERENCE DATA

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 A; I_B = 0.95 A	-	1.0	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	5.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4	-	A
t_f	Fall time	I_{Csat} = 4 A; f = 16kHz	0.25	0.5	µs

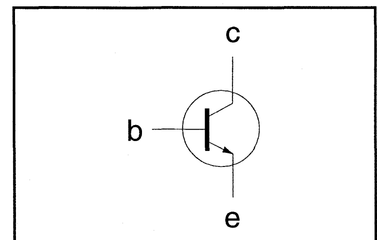
PINNING - SOT199

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)		-	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
$R_{th\ j-hs}$	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
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4 A; I_B = 0.8 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	17	-	
h_{FE}		I_C = 4 A; V_{CE} = 5 V	5.0	7.0	9.0	

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	68	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4 A; $I_{B(end)}$ = 0.7 A; L_B = 6 µH; $-V_{BB}$ = 4 V			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

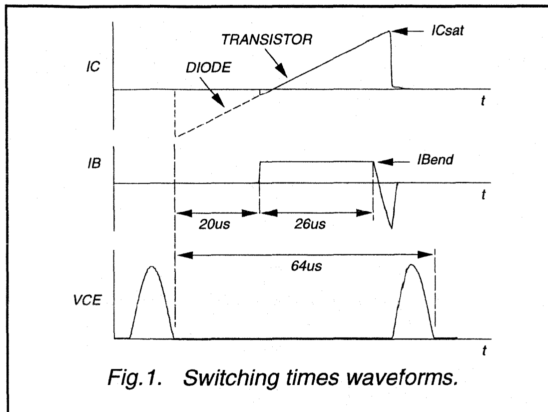


Fig.1. Switching times waveforms.

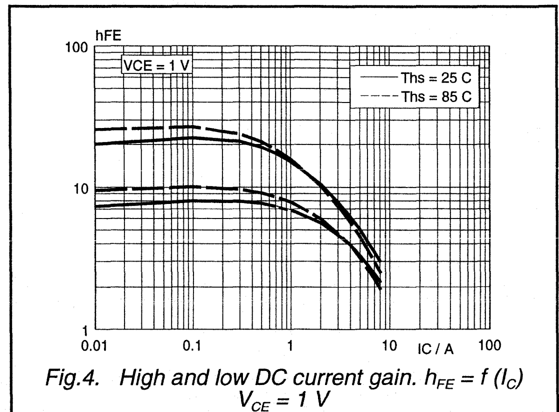


Fig.4. High and low DC current gain. $h_{FE} = f\,(I_C)$
$V_{CE} = 1\ V$

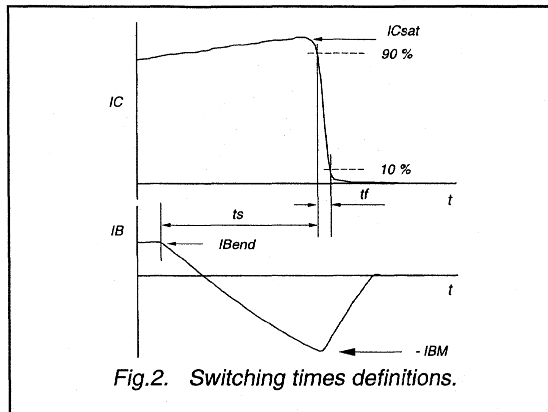


Fig.2. Switching times definitions.

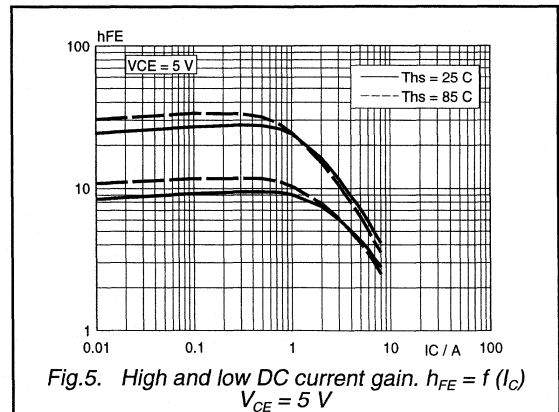


Fig.5. High and low DC current gain. $h_{FE} = f\,(I_C)$
$V_{CE} = 5\ V$

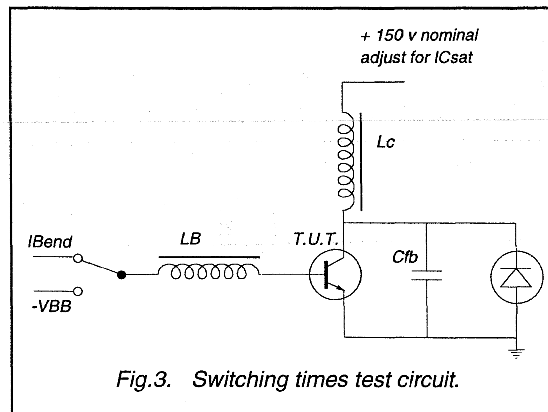


Fig.3. Switching times test circuit.

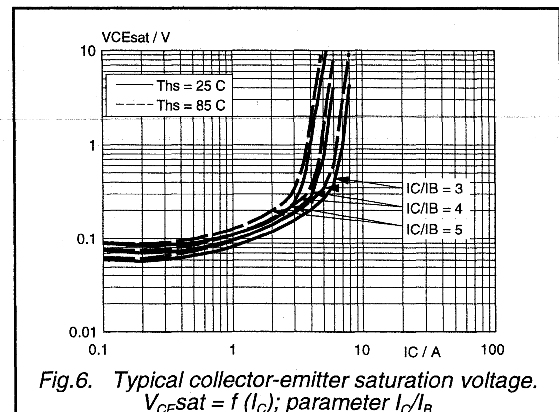


Fig.6. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\,(I_C)$; parameter I_C/I_B

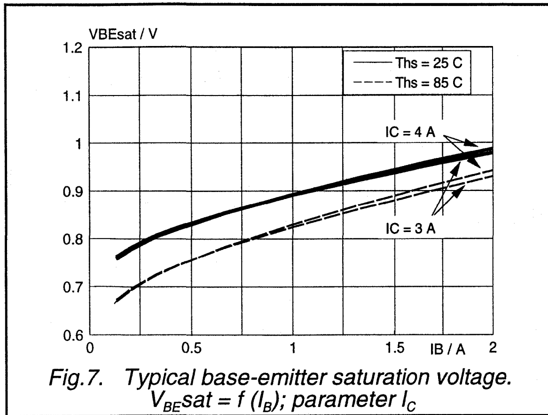


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

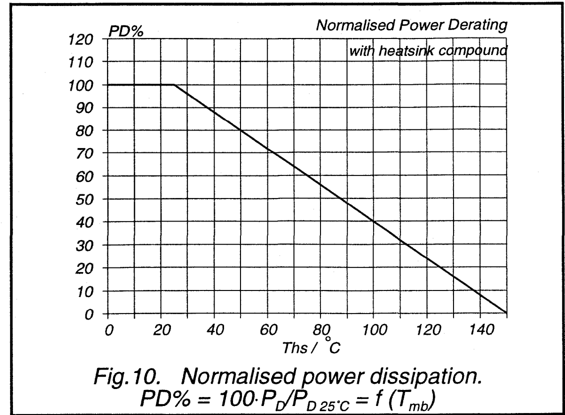


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{mb})$

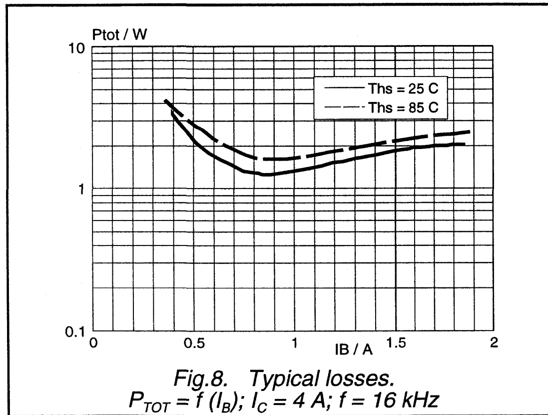


Fig.8. Typical losses. $P_{TOT} = f\ (I_B)$; $I_C = 4\ A$; $f = 16\ kHz$

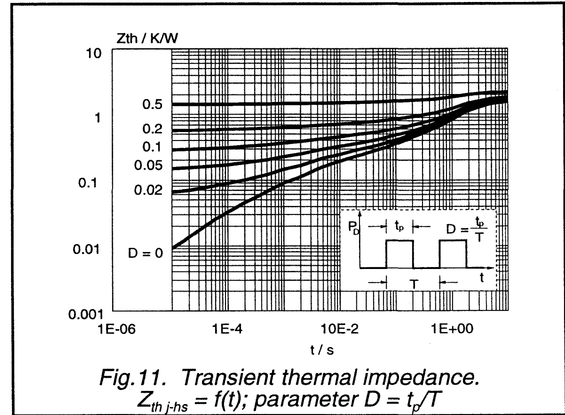


Fig.11. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

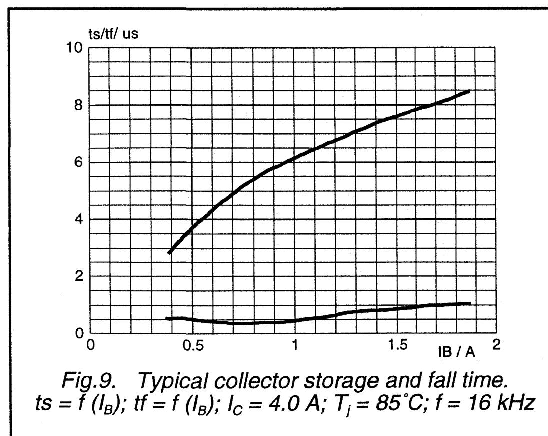


Fig.9. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; $I_C = 4.0\ A$; $T_j = 85^\circ C$; $f = 16\ kHz$

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 and computer monitors. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

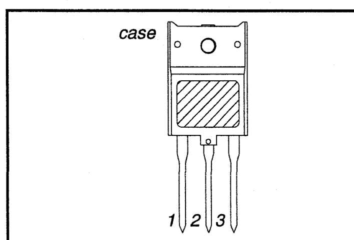
QUICK REFERENCE DATA

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	$I_C = 4$ A; $I_B = 0.8$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4	-	A
t_f	Fall time	$I_{Csat} = 4$ A; f = 16kHz	0.25	0.5	µs

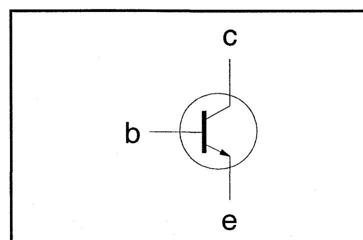
PINNING - SOT399

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)		-	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
$R_{th\ j-hs}$	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
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4 A; I_B = 0.8 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	17	-	
h_{FE}		I_C = 4 A; V_{CE} = 5 V	5.0	7.0	9.0	

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	68	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4 A; $I_{B(end)}$ = 0.7 A; L_B = 6 µH; $-V_{BB}$ = 4 V			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

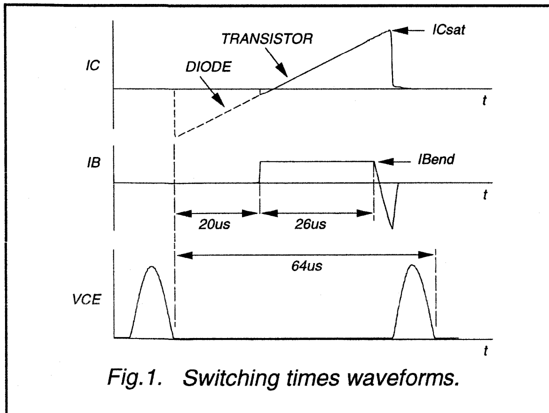


Fig.1. Switching times waveforms.

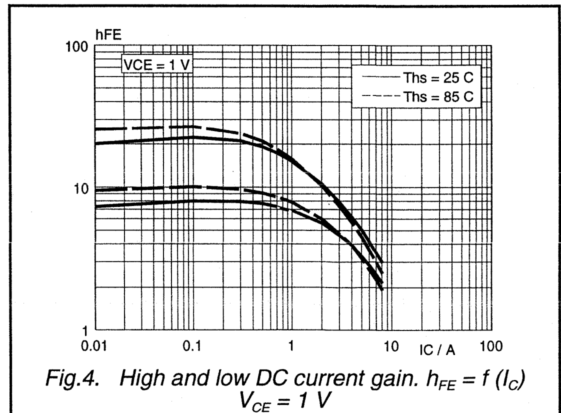


Fig.4. High and low DC current gain. $h_{FE} = f(I_C)$
$V_{CE} = 1$ V

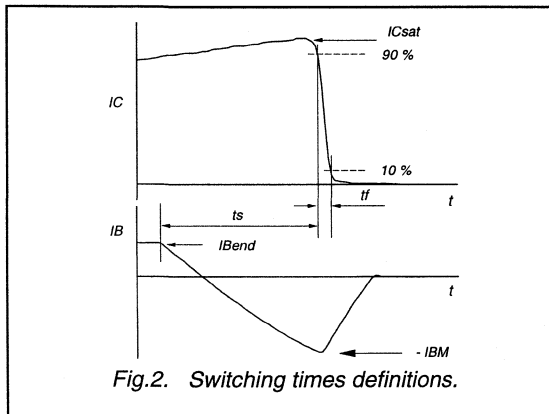


Fig.2. Switching times definitions.

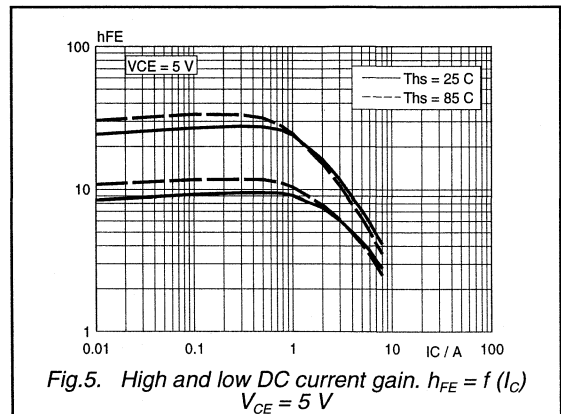


Fig.5. High and low DC current gain. $h_{FE} = f(I_C)$
$V_{CE} = 5$ V

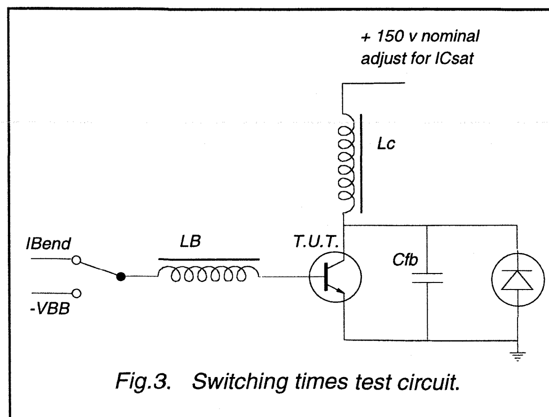


Fig.3. Switching times test circuit.

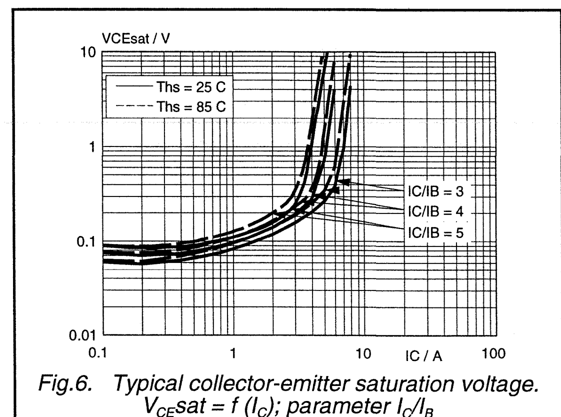


Fig.6. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

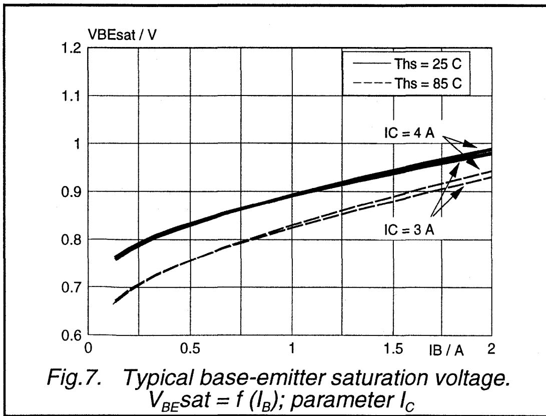


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

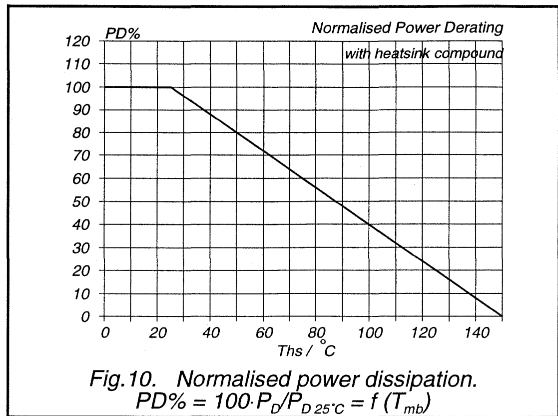


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\ 25^\circ C} = f\ (T_{mb})$

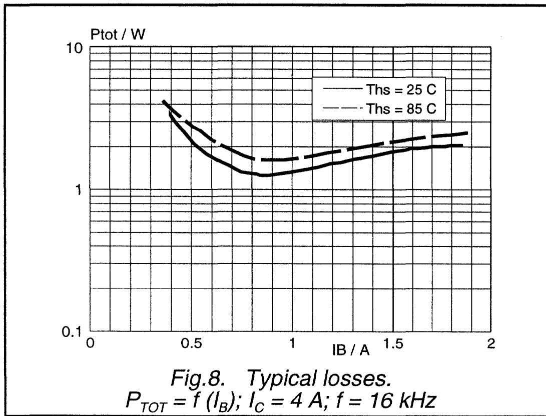


Fig.8. Typical losses.
$P_{TOT} = f\ (I_B)$; $I_C = 4\ A$; $f = 16\ kHz$

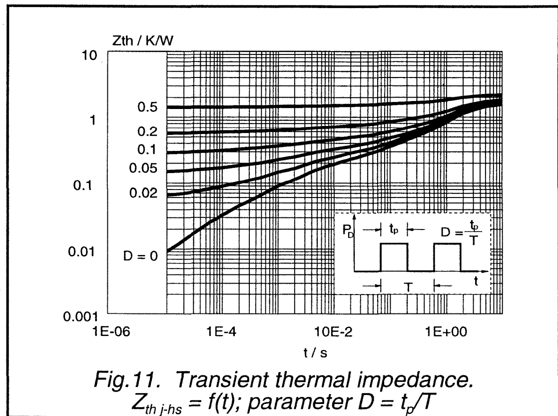


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

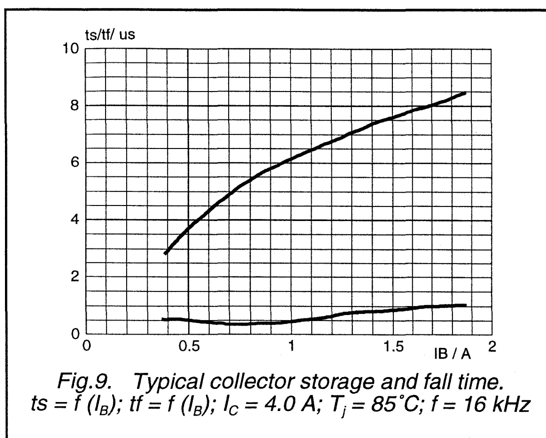


Fig.9. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; $I_C = 4.0\ A$; $T_j = 85^\circ C$; $f = 16\ kHz$

Silicon Diffused Power Transistor — BU2507DF

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 and computer monitors. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

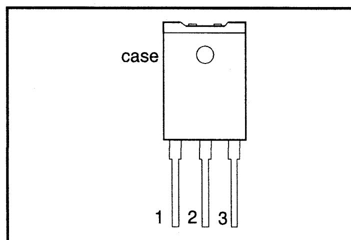
QUICK REFERENCE DATA

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	$I_C = 4$ A; $I_B = 0.8$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4	-	A
V_F	Diode forward voltage	$I_F = 4$ A	1.7	2.0	V
t_f	Fall time	$I_{Csat} = 4$ A; f = 16kHz	0.25	0.5	µs

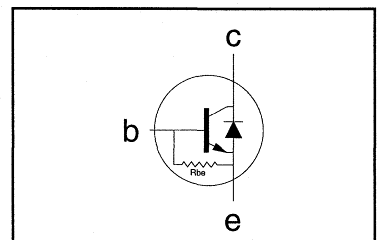
PINNING - SOT199

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)		-	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
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	700	-	-	V
I_{EBO}	Emitter cut-off current	V_{EB} = 7.5 V; I_C = 0 A	-	160	-	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 voltages	I_C = 4 A; I_B = 0.8 A	-	-	5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	14	-	
h_{FE}		I_C = 4 A; V_{CE} = 5 V	5	7	9	
V_F	Diode forward voltage	I_F = 4 A	-	1.7	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	68	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4 A; $I_{B(end)}$ = 0.7 A; L_B = 6 μH; $-V_{BB}$ = 4 V			
t_s	Turn-off storage time		5.0	6.0	μs
t_f	Turn-off fall time		0.25	0.5	μs

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

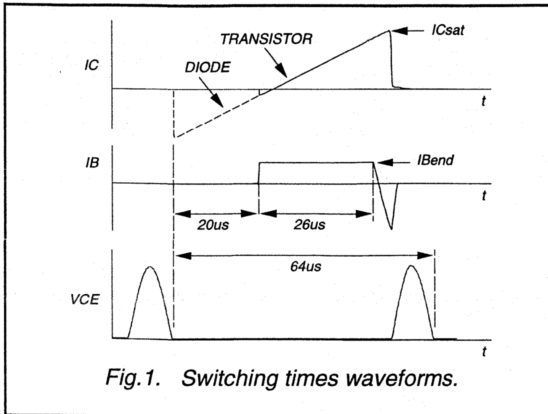


Fig.1. Switching times waveforms.

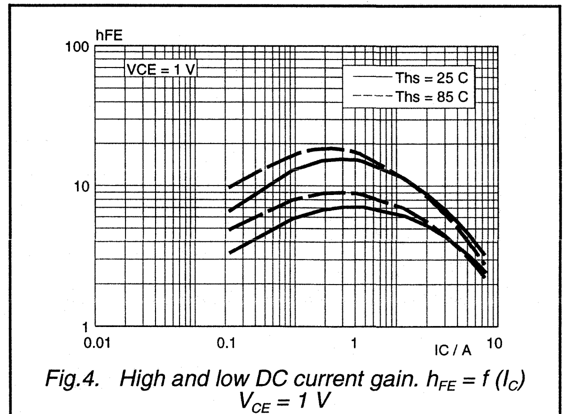


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

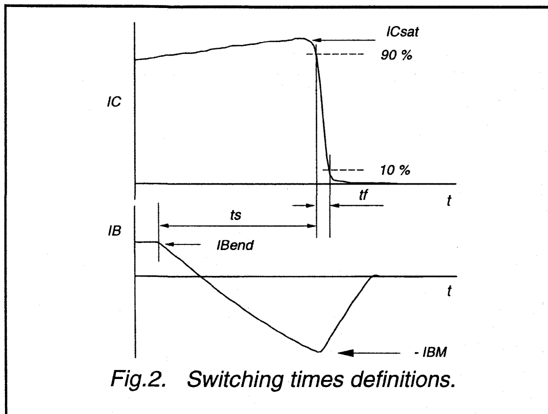


Fig.2. Switching times definitions.

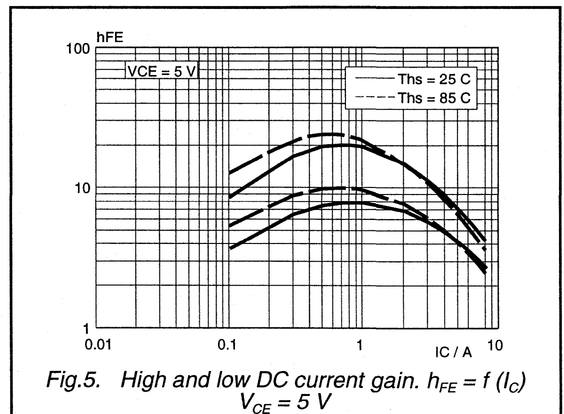


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

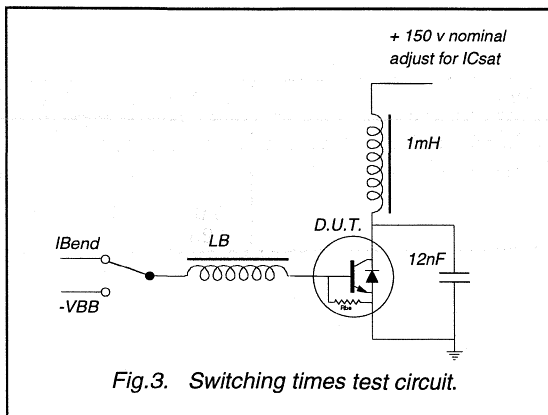


Fig.3. Switching times test circuit.

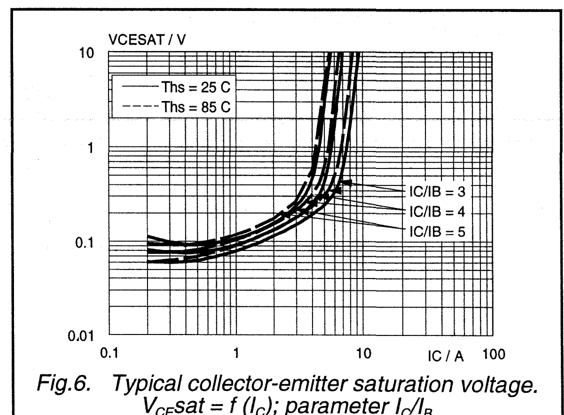


Fig.6. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

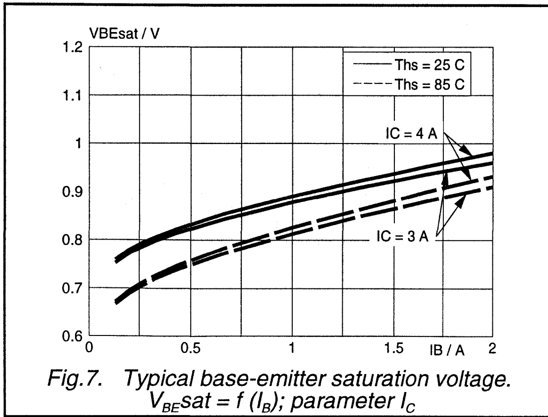


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

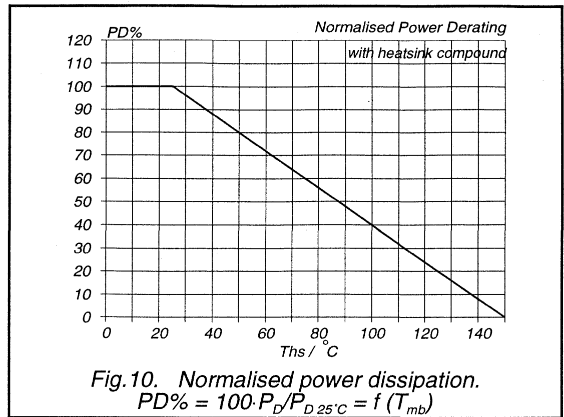


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

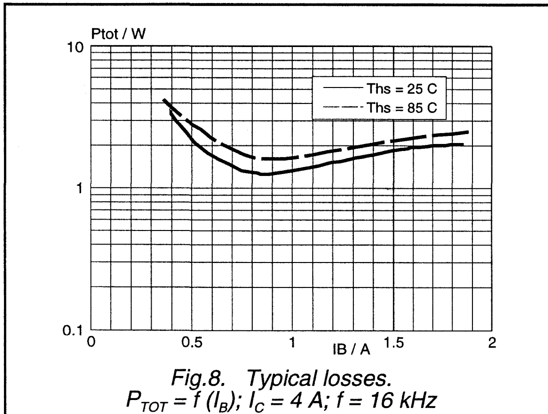


Fig.8. Typical losses. $P_{TOT} = f(I_B)$; $I_C = 4$ A; $f = 16$ kHz

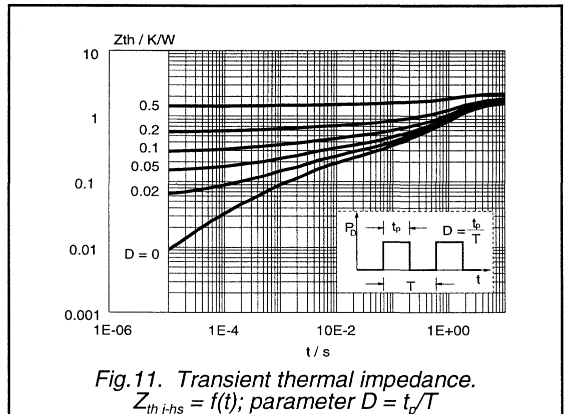


Fig.11. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

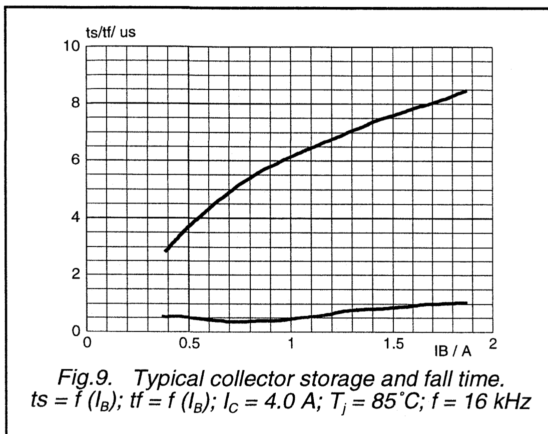


Fig.9. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; $I_C = 4.0$ A; $T_j = 85^\circ C$; $f = 16$ kHz

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 and computer monitors. Features exceptional tolerance to base drive and collector current load variations resulting in a very low worst case dissipation.

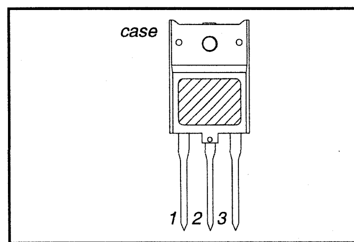
QUICK REFERENCE DATA

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	$I_C = 4$ A; $I_B = 0.8$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 16kHz	4	-	A
V_F	Diode forward voltage	$I_F = 4$ A	1.7	2.0	V
t_f	Fall time	$I_{Csat} = 4$ A; f = 16kHz	0.25	0.5	µs

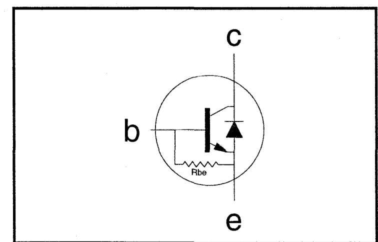
PINNING - SOT399

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)		-	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	-	160	-	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 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
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	45	-	Ω
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4 A; I_B = 0.8 A		-	5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4 A; I_B = 0.8 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	14	-	
h_{FE}		I_C = 4 A; V_{CE} = 5 V	5	7	9	
V_F	Diode forward voltage	I_F = 4 A	-	1.7	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	68	-	pF
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 4 A; $I_{B(end)}$ = 0.7 A; L_B = 6 µH; $-V_{BB}$ = 4 V			
t_s	Turn-off storage time		5.0	6.0	µs
t_f	Turn-off fall time		0.25	0.5	µs

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

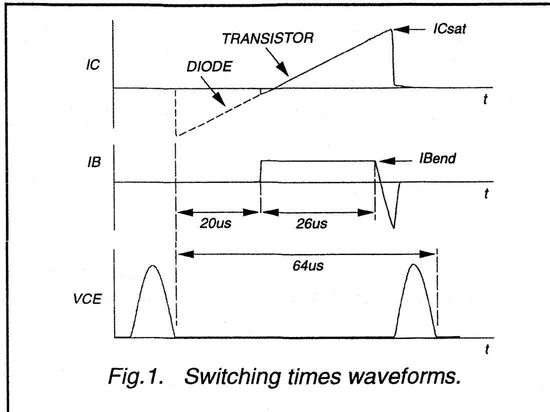


Fig.1. Switching times waveforms.

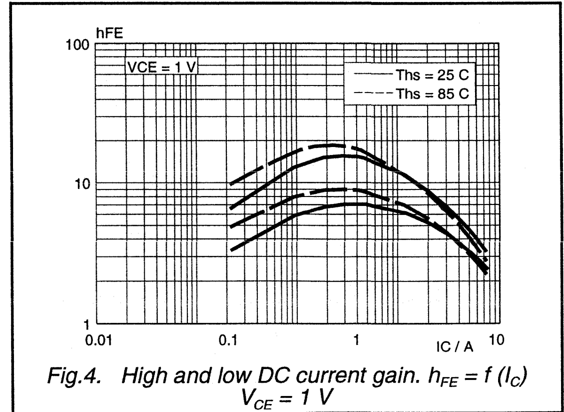


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

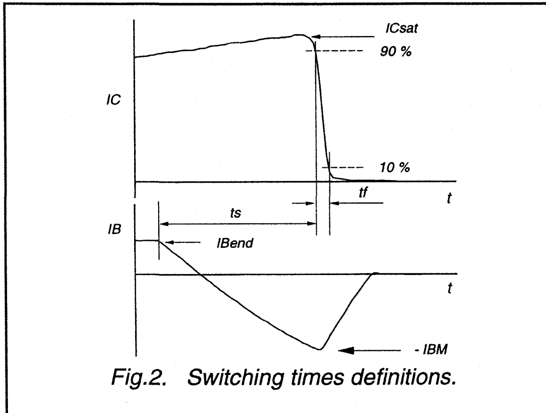


Fig.2. Switching times definitions.

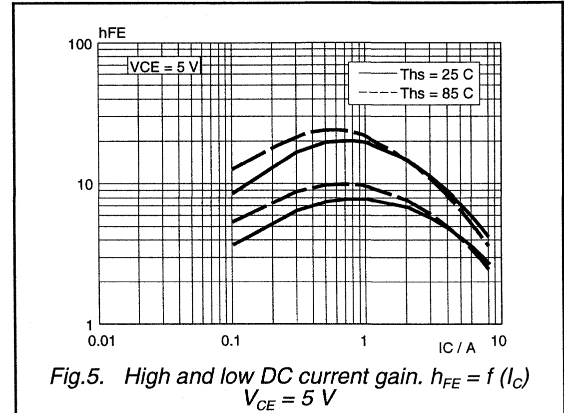


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

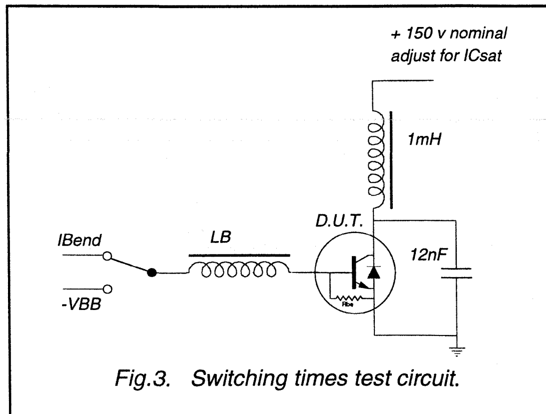


Fig.3. Switching times test circuit.

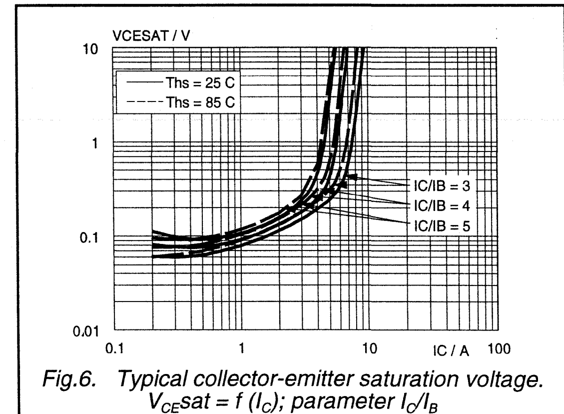


Fig.6. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

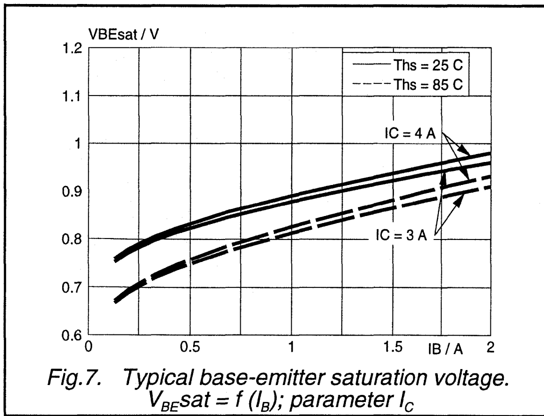


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

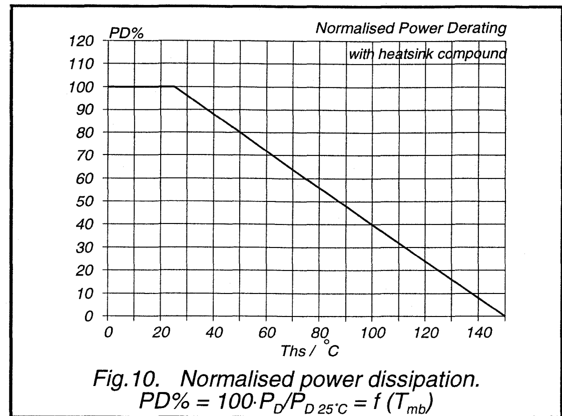


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\ (T_{mb})$

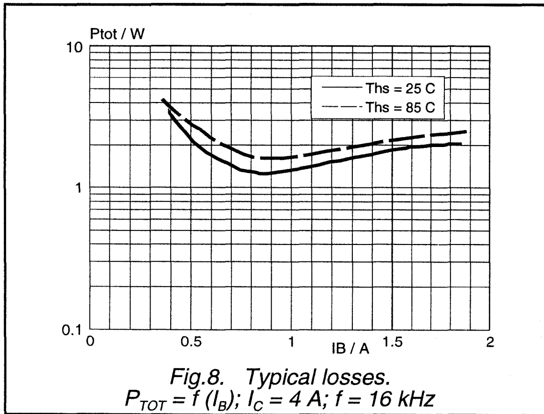


Fig.8. Typical losses. $P_{TOT} = f\ (I_B)$; $I_C = 4\ A$; $f = 16\ kHz$

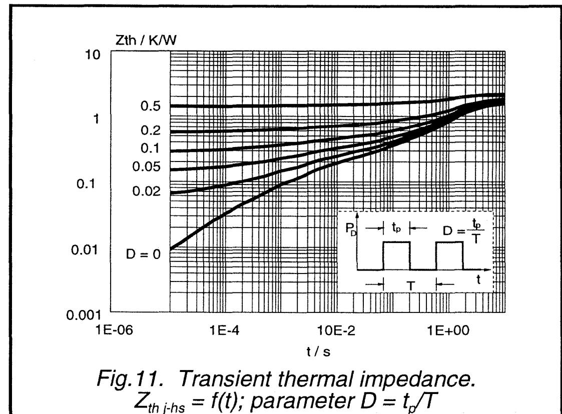


Fig.11. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

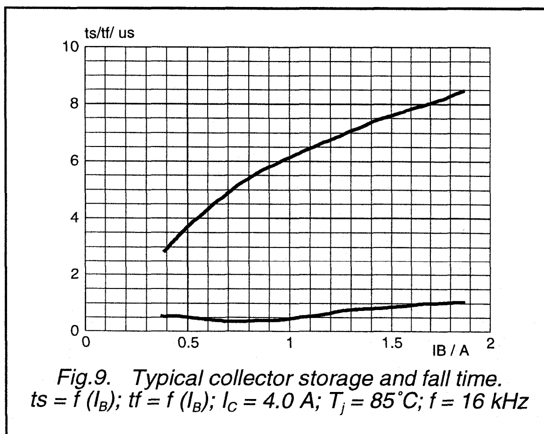


Fig.9. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; $I_C = 4.0\ A$; $T_j = 85^\circ C$; $f = 16\ kHz$

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.

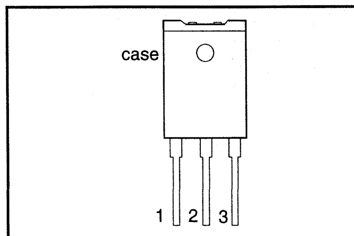
QUICK REFERENCE DATA

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; $I_B = 1.1$ A	-	1	V
I_{Csat}	Collector saturation current		4.5	-	A
t_f	Fall time	$I_{Csat} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

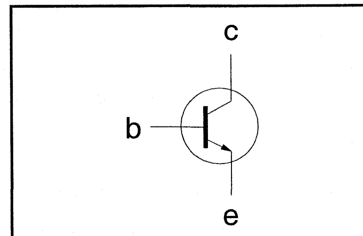
PINNING - SOT199

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
$R_{th\ j-hs}$	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	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 4.5 A; I_B = 1.1 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.0	

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_{Csat} = 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_{Csat} = 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).

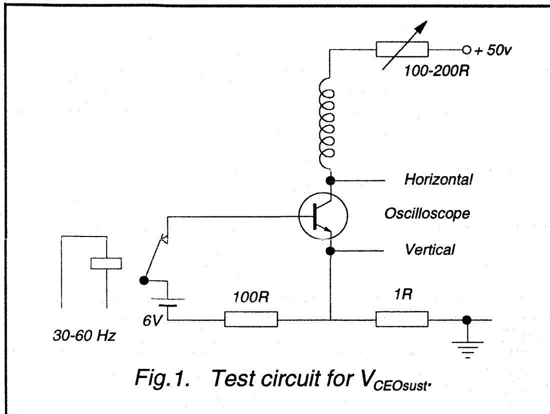


Fig.1. Test circuit for $V_{CEOsust}$.

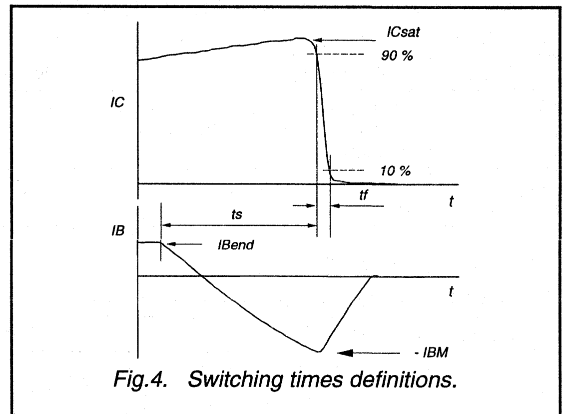


Fig.4. Switching times definitions.

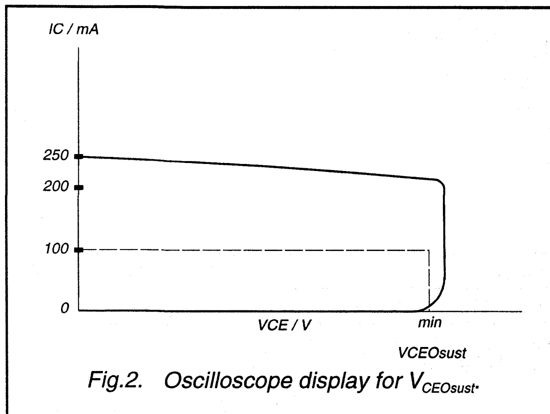


Fig.2. Oscilloscope display for $V_{CEOsust}$.

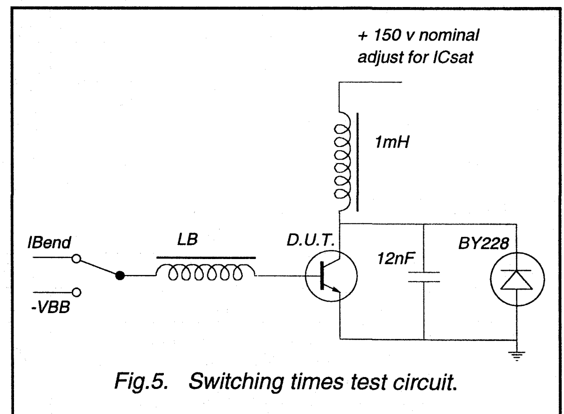


Fig.5. Switching times test circuit.

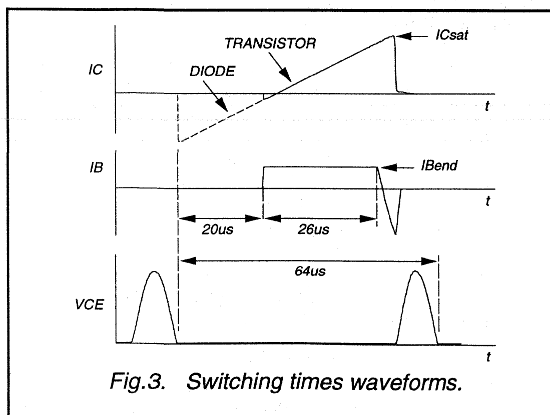


Fig.3. Switching times waveforms.

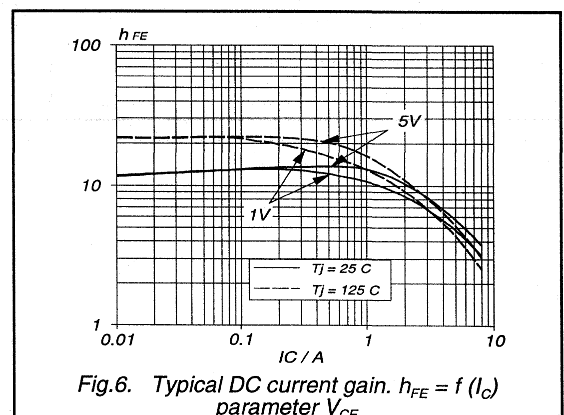


Fig.6. Typical DC current gain. $h_{FE} = f (I_C)$ parameter V_{CE}

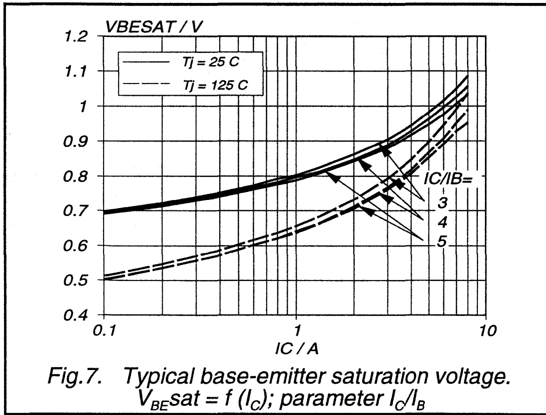


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_C)$; parameter I_C/I_B

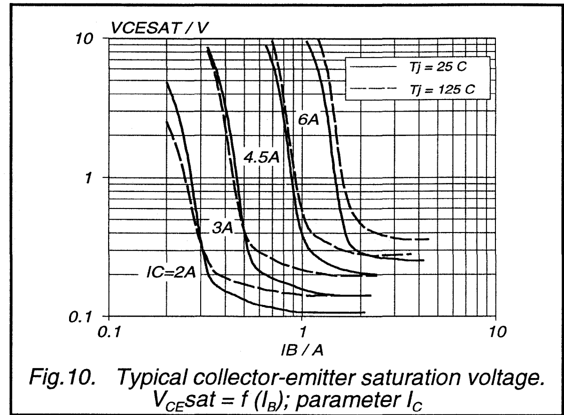


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_B)$; parameter I_C

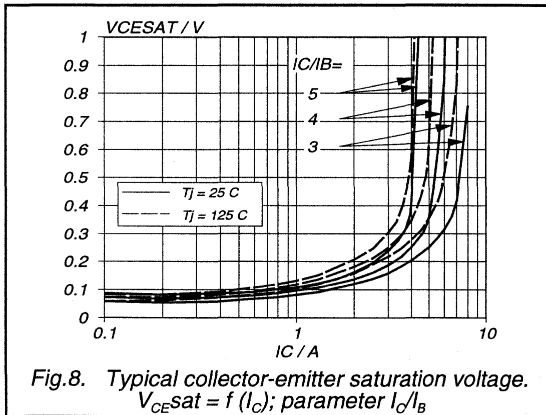


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

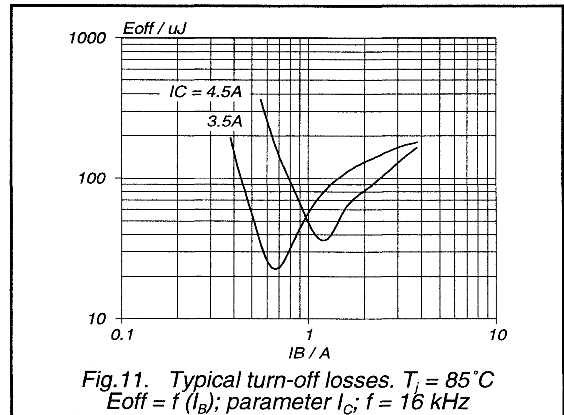


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$ Eoff = f (I_B); parameter I_C; f = 16 kHz

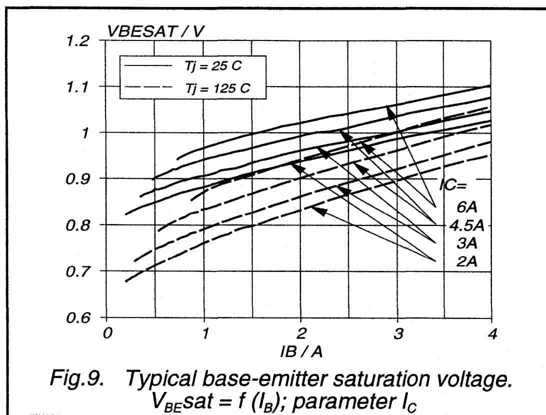


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

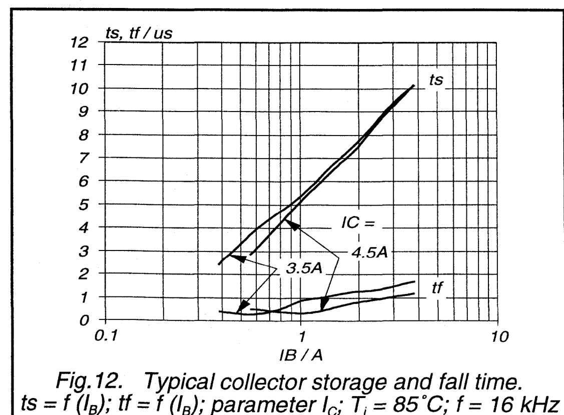


Fig.12. Typical collector storage and fall time. ts = f (I_B); tf = f (I_B); parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

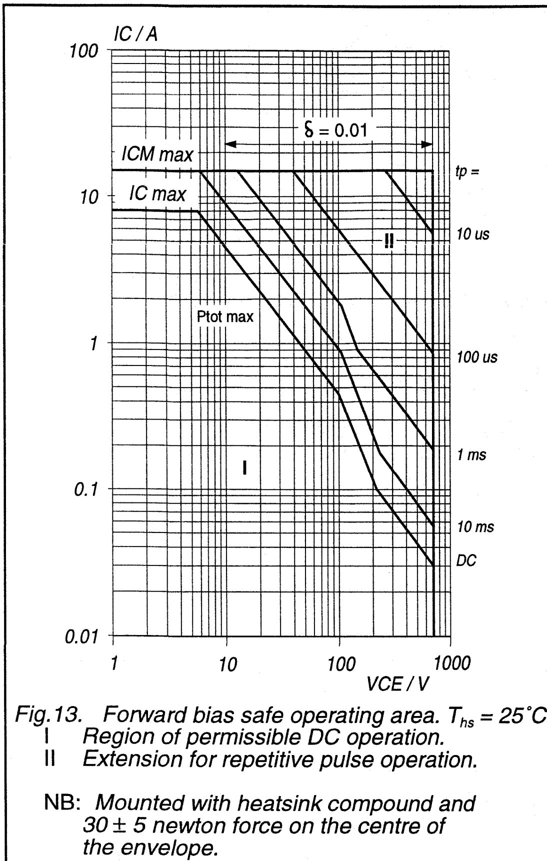


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

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

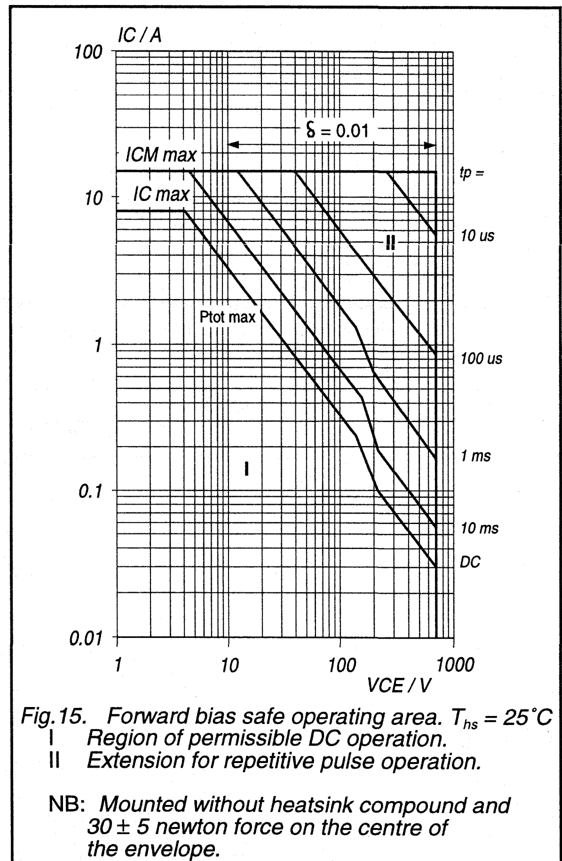


Fig.15. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

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

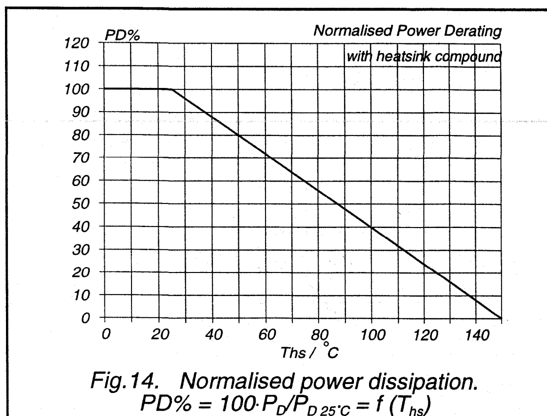


Fig.14. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25˚C} = f\,(T_{hs})$

Silicon Diffused Power Transistor BU2508AW

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.

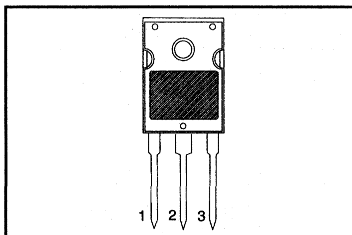
QUICK REFERENCE DATA

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; $I_B = 1.12$ A	-	1.0	V
I_{Csat}	Collector saturation current	f=16kHz	4.5	-	A
t_f	Fall time	$I_{Csat} = 4.5$ A;f=16kHz	0.4	0.6	µs

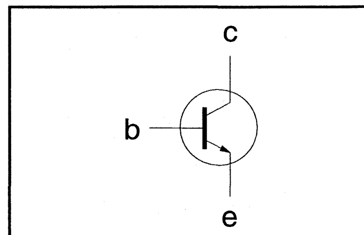
PINNING - SOT429

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		-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}	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 voltage	I_C = 4.5 A; I_B = 1.12 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA;V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A;V_{CE} = 1 V	4	5.5	7.0	

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_{Csat} = 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_{Csat} = 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

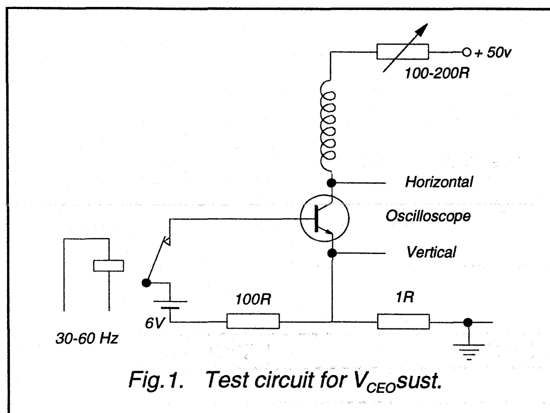


Fig.1. Test circuit for V_{CEO}sust.

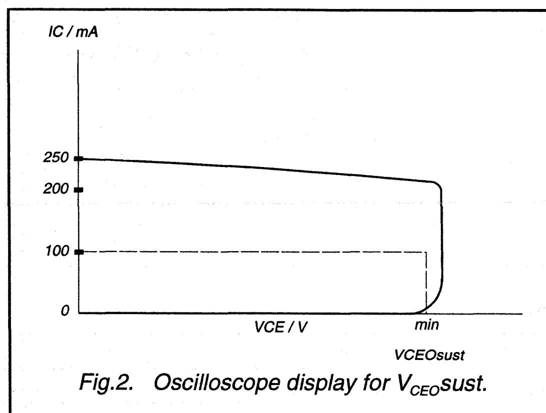


Fig.2. Oscilloscope display for V_{CEO}sust.

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

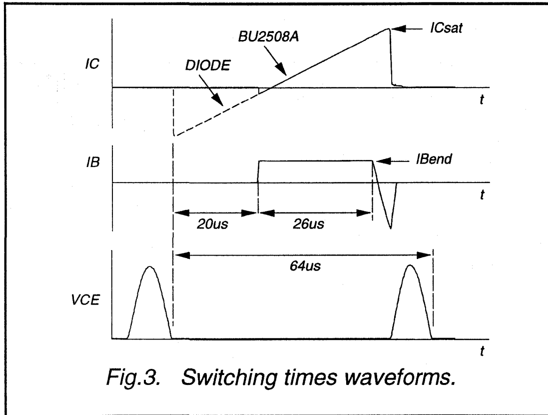


Fig.3. Switching times waveforms.

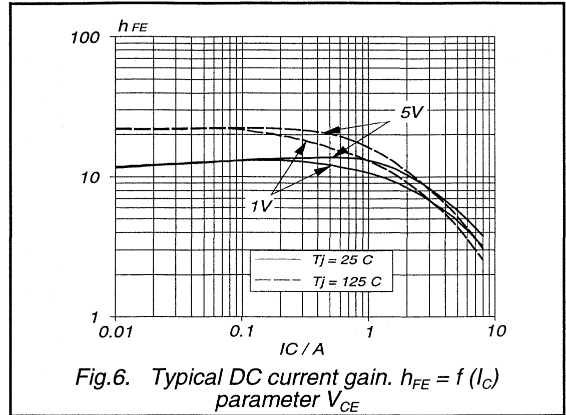


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

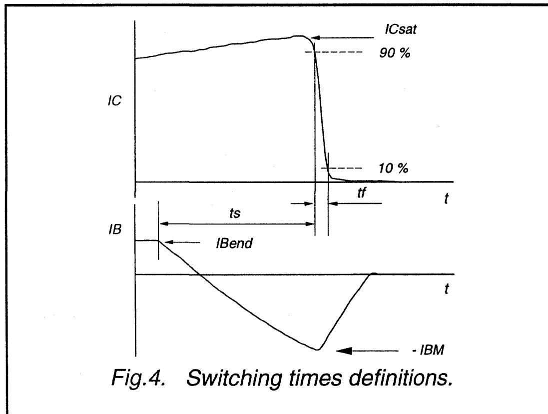


Fig.4. Switching times definitions.

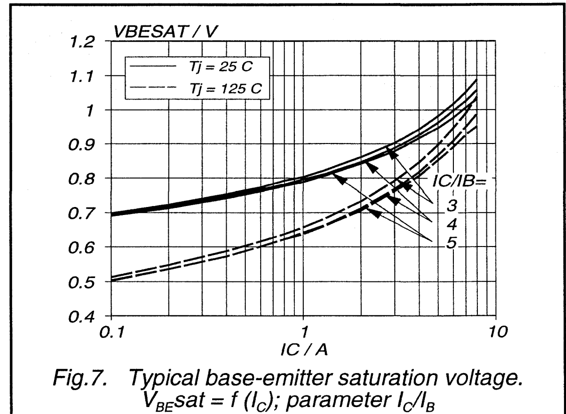


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

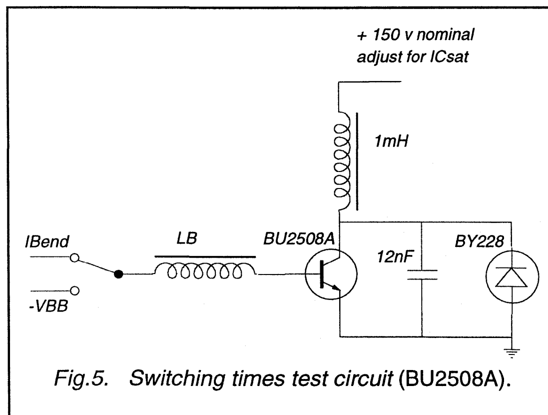


Fig.5. Switching times test circuit (BU2508A).

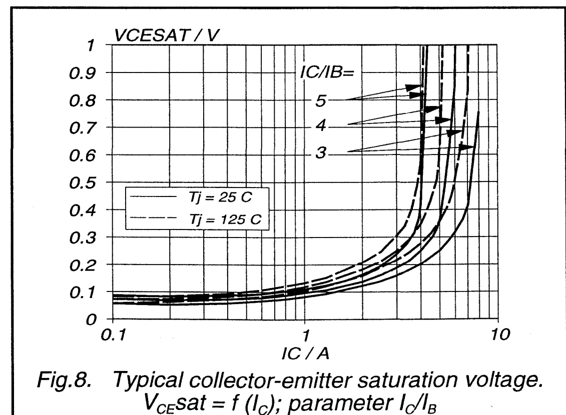


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

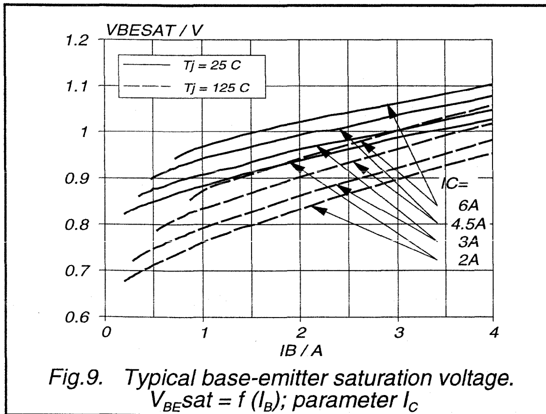


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f (I_B)$; parameter I_C

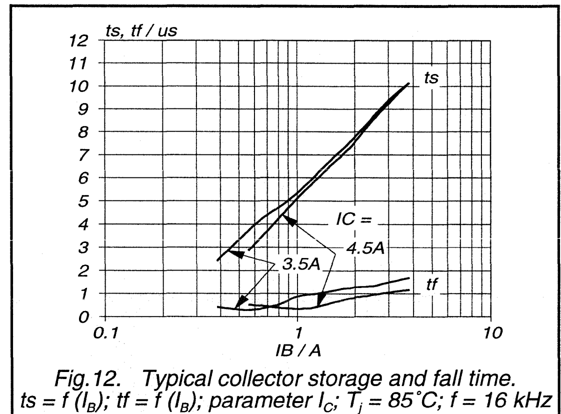


Fig.12. Typical collector storage and fall time.
$ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16$ kHz

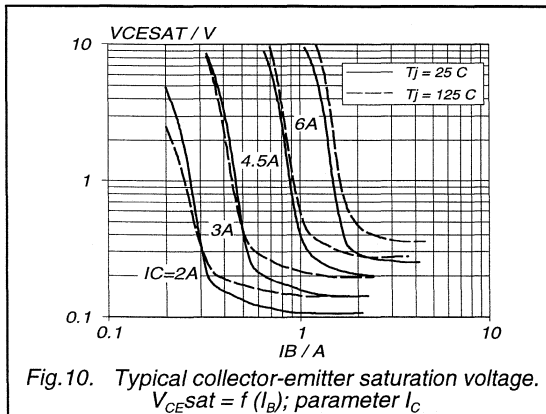


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f (I_B)$; parameter I_C

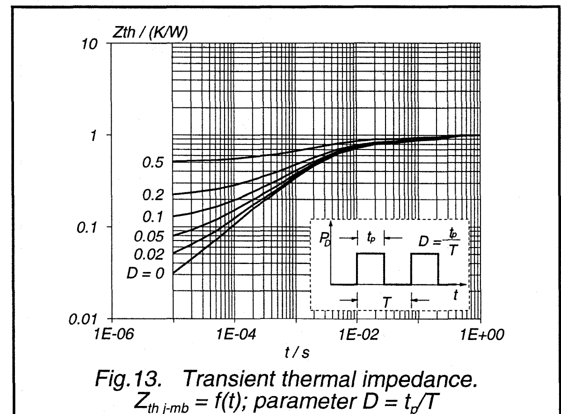


Fig.13. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

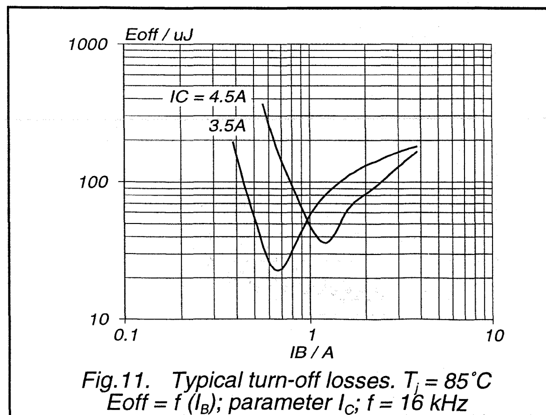


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f (I_B)$; parameter I_C; $f = 16$ kHz

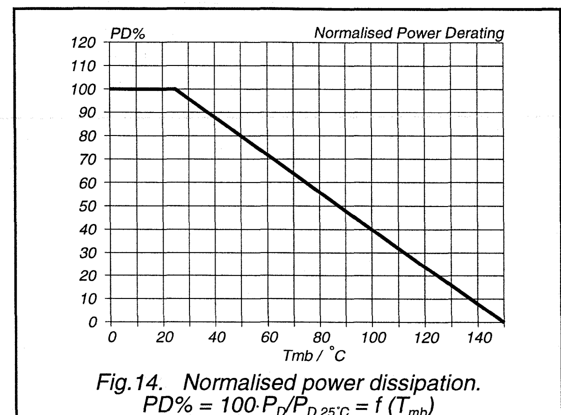


Fig.14. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f (T_{mb})$

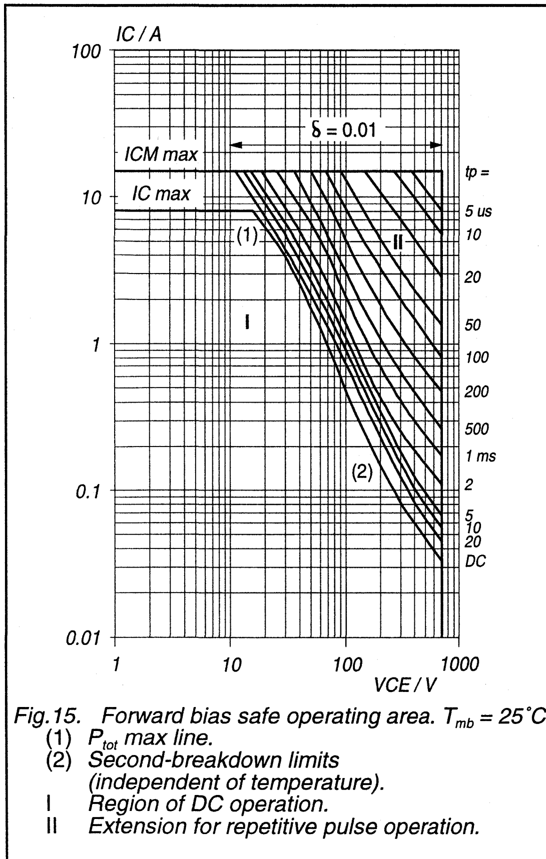


Fig.15. Forward bias safe operating area. T_{mb} = 25˚C
(1) P_{tot} max line.
(2) Second-breakdown limits (independent of temperature).
I Region of DC operation.
II Extension for repetitive pulse operation.

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.

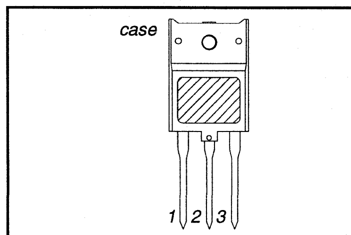
QUICK REFERENCE DATA

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; $I_B = 1.1$ A	-	1.0	V
I_{Csat}	Collector saturation current		4.5	-	A
t_f	Fall time	$I_{Csat} = 4.5$ A; $I_{B(end)} = 1.1$ A	0.4	0.6	µs

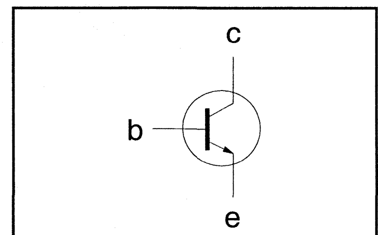
PINNING - SOT399

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
$R_{th\ j-hs}$	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	700	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 1.1 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.0	

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_{Csat} = 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_{Csat} = 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).

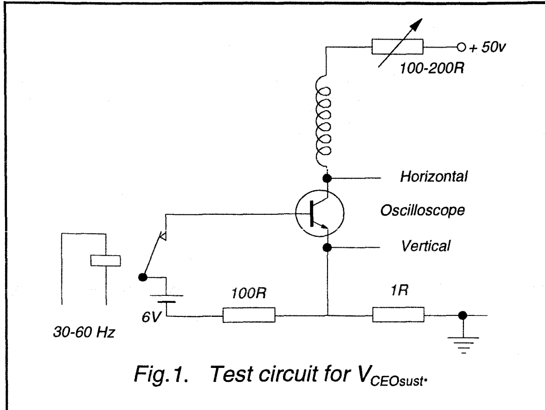


Fig.1. Test circuit for $V_{CEOsust}$.

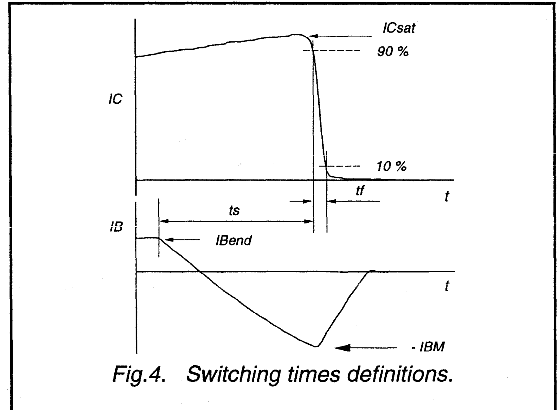


Fig.4. Switching times definitions.

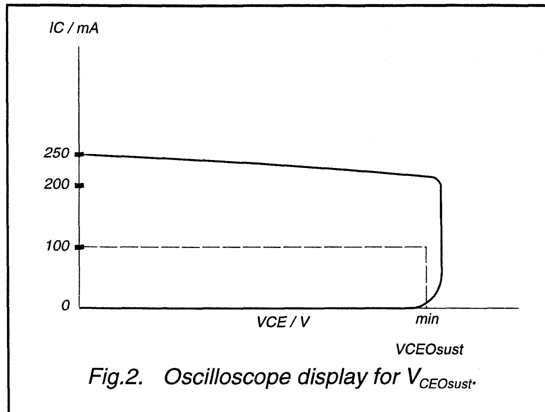


Fig.2. Oscilloscope display for $V_{CEOsust}$.

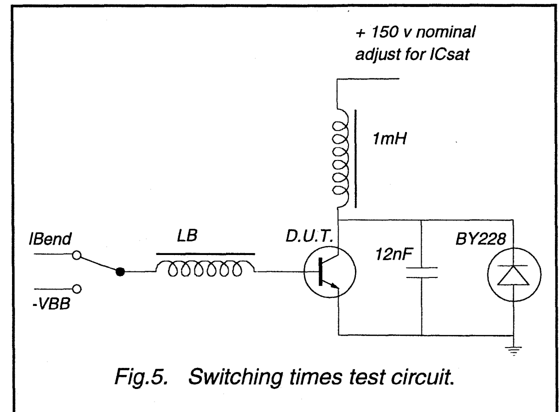


Fig.5. Switching times test circuit.

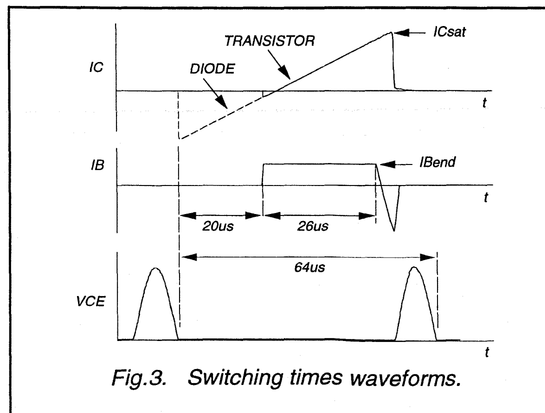


Fig.3. Switching times waveforms.

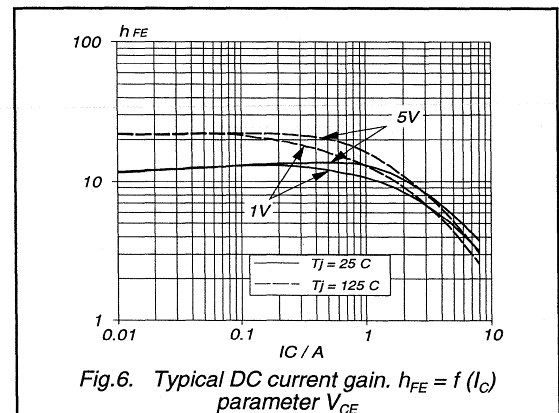


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

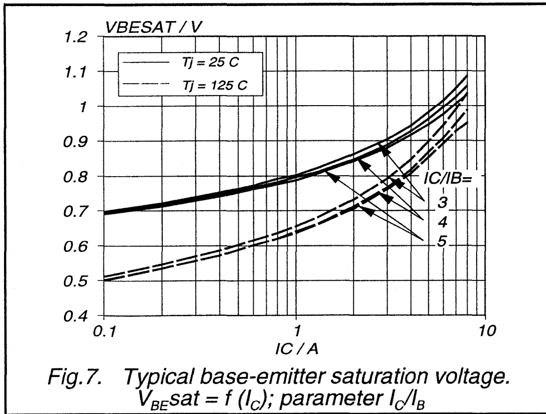


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_C)$; parameter I_C/I_B

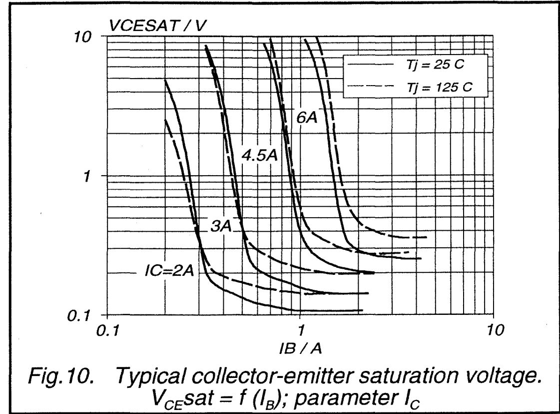


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

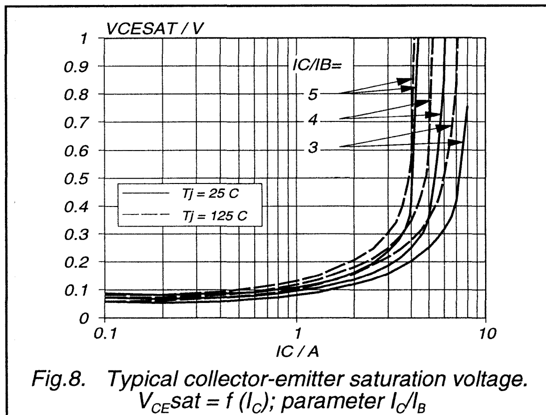


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

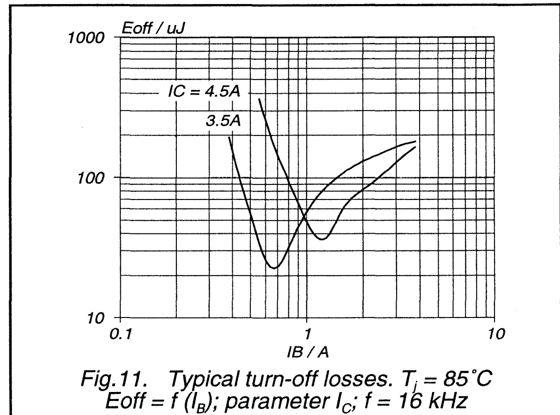


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$
Eoff = $f(I_B)$; parameter I_C; f = 16 kHz

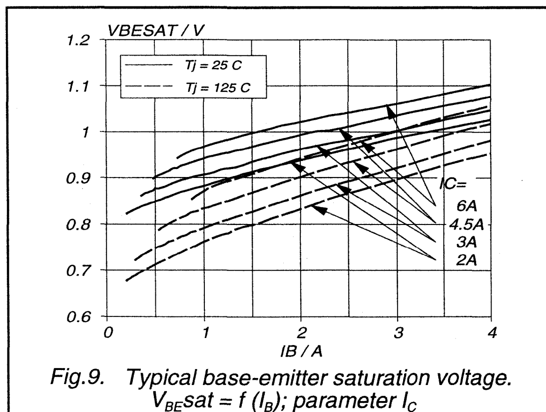


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

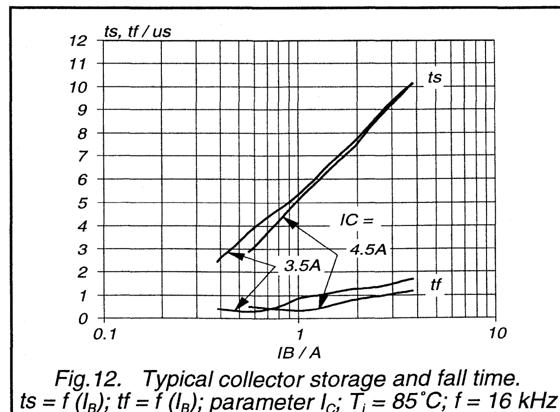


Fig.12. Typical collector storage and fall time.
ts = $f(I_B)$; tf = $f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

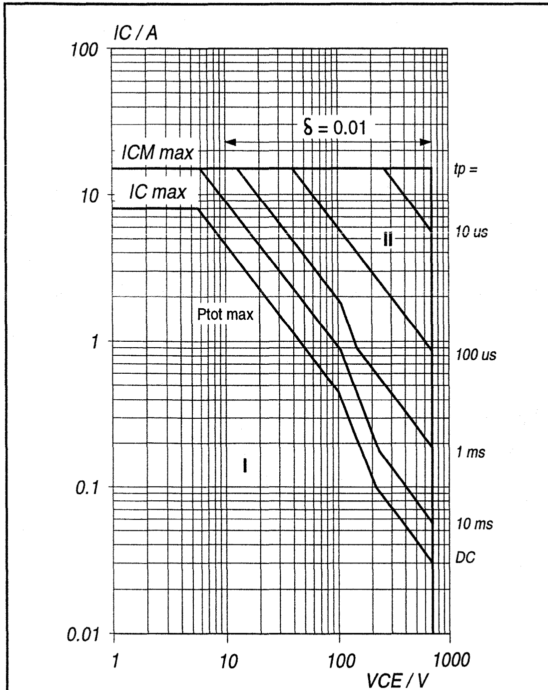


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

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

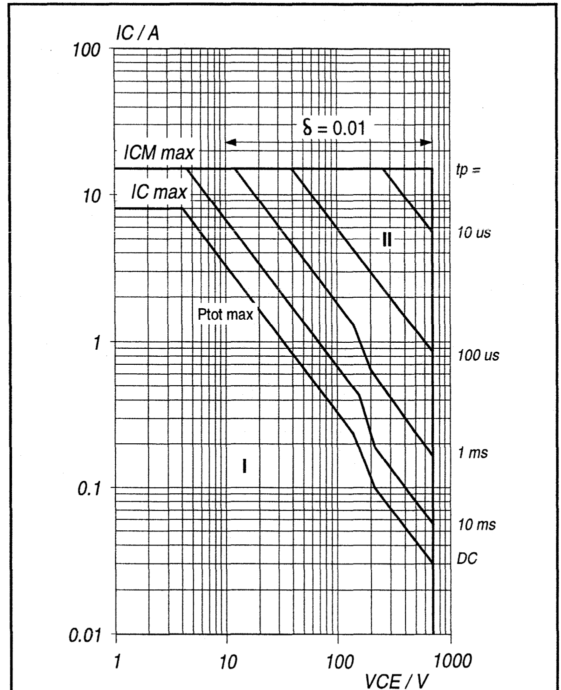


Fig.15. Forward bias safe operating area. T_{hs} = 25˚C
I Region of permissible DC operation.
II Extension for repetitive pulse operation.

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

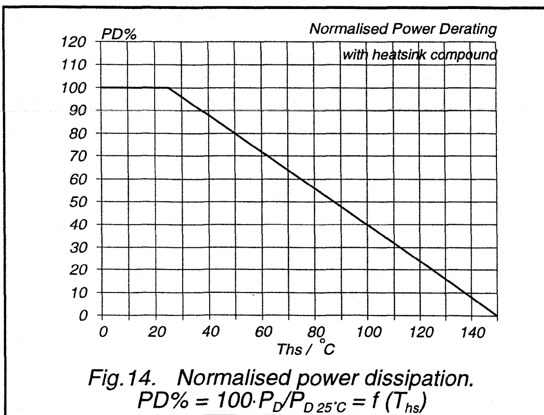


Fig.14. Normalised power dissipation.
$PD\% = 100 \cdot P_D / P_{D\,25^\circ C} = f\,(T_{hs})$

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.

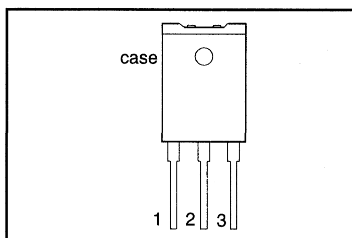
QUICK REFERENCE DATA

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 = 1.1 A	-	1.0	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_{Csat} = 4.5 A; $I_{B(end)}$ = 1.1 A	0.4	0.6	µs

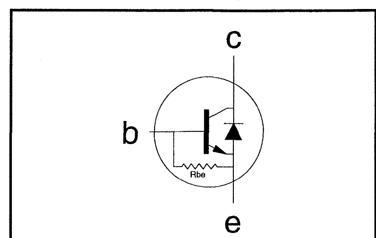
PINNING - SOT199

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
$R_{th\ j-hs}$	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	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 voltage	I_C = 4.5 A; I_B = 1.12 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.0	
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_{Csat} = 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_{Csat} = 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).

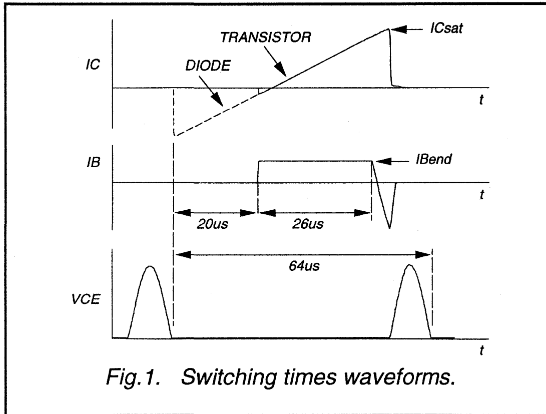


Fig.1. Switching times waveforms.

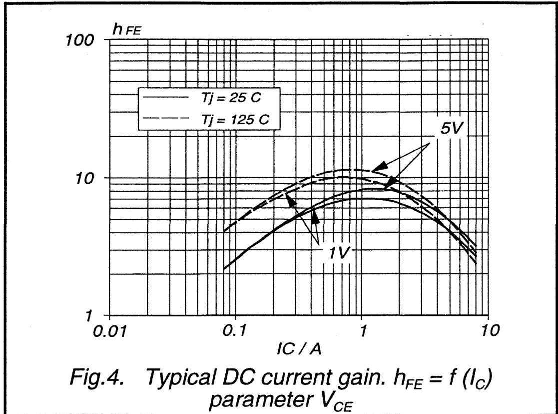


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

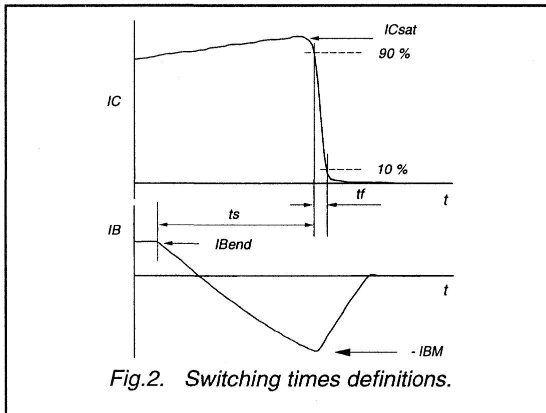


Fig.2. Switching times definitions.

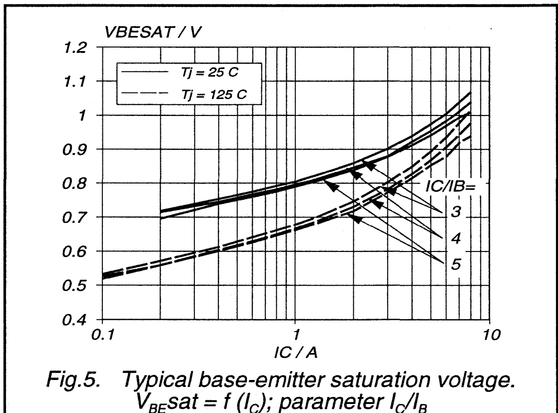


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

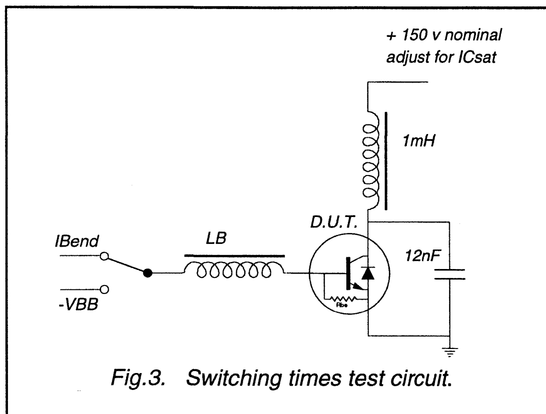


Fig.3. Switching times test circuit.

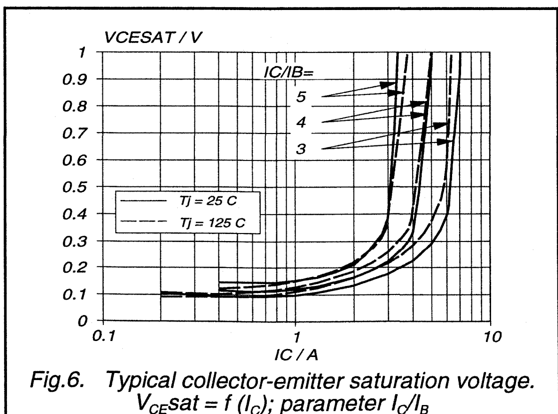


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

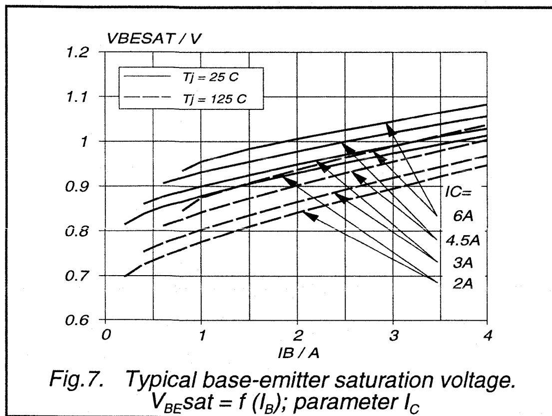


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

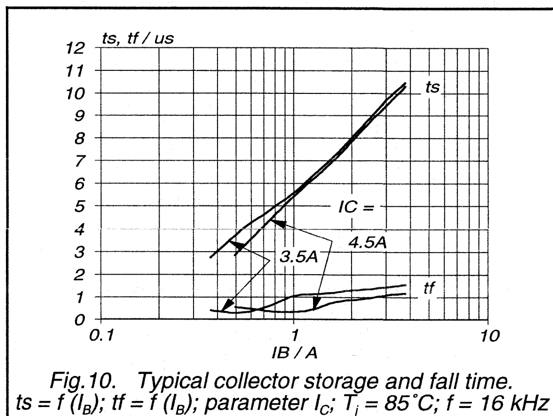


Fig.10. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; f = 16 kHz

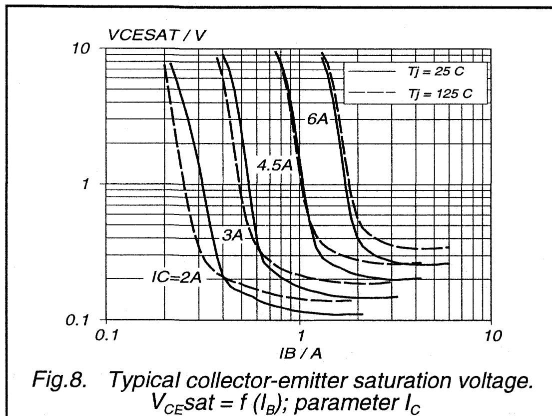


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

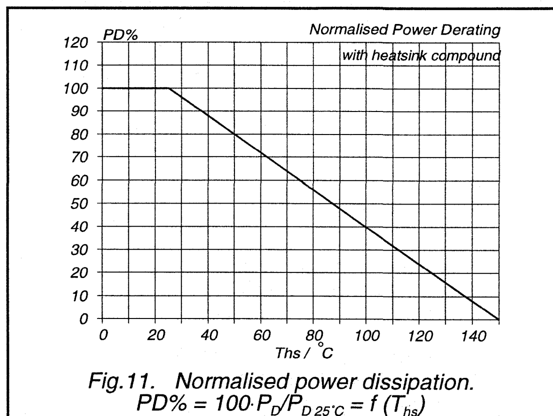


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

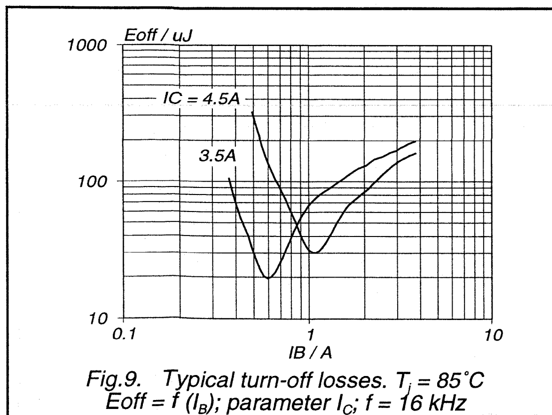


Fig.9. Typical turn-off losses. $T_j = 85˚C$ $Eoff = f(I_B)$; parameter I_C; f = 16 kHz

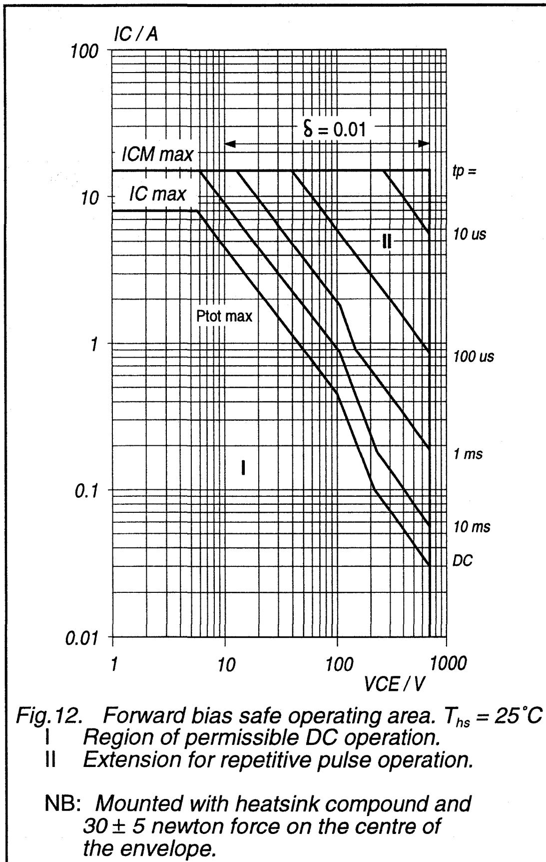


Fig.12. Forward bias safe operating area. $T_{hs} = 25˚C$
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

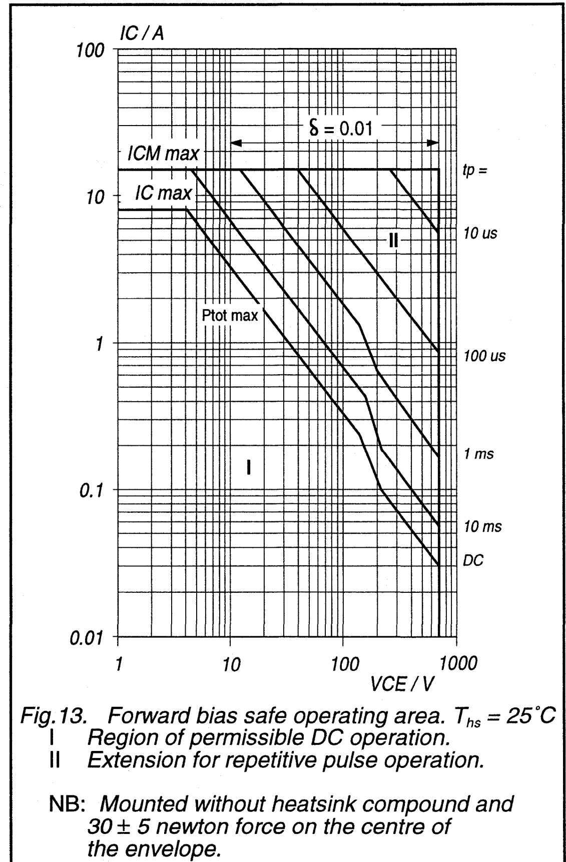


Fig.13. Forward bias safe operating area. $T_{hs} = 25˚C$
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

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.

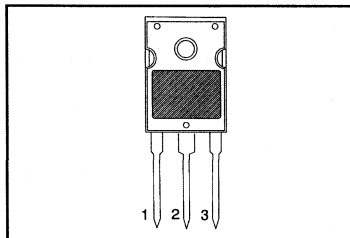
QUICK REFERENCE DATA

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; $I_B = 1.12$ A	-	1.0	V
I_{Csat}	Collector saturation current	f=16kHz	4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	1.6	2.0	V
t_f	Fall time	$I_{Csat} = 4.5$ A; f=16kHz	0.4	0.6	µs

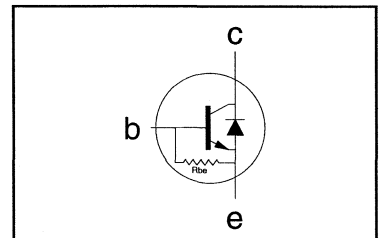
PINNING - SOT429

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
$R_{th\ j-mb}$	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	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 voltage	I_C = 4.5 A; I_B = 1.12 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.0	
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_{Csat} = 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_{Csat} = 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

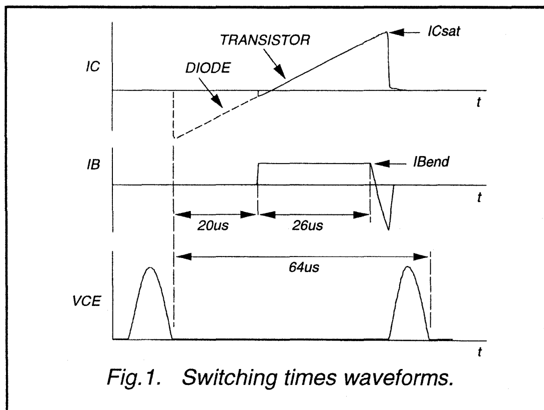


Fig.1. Switching times waveforms.

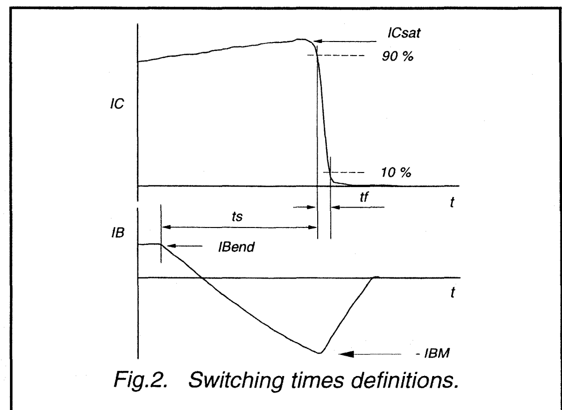


Fig.2. Switching times definitions.

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

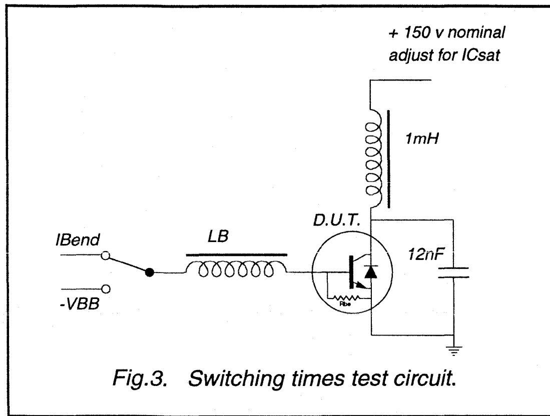


Fig.3. Switching times test circuit.

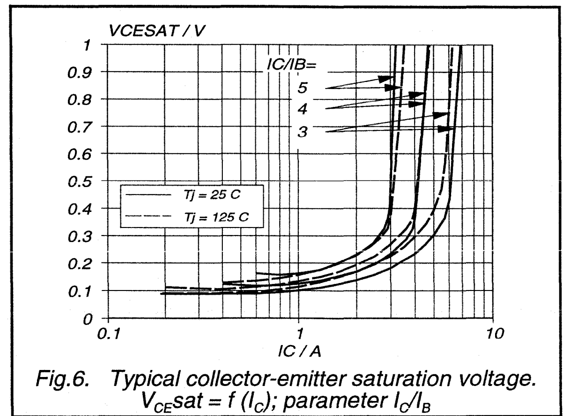


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

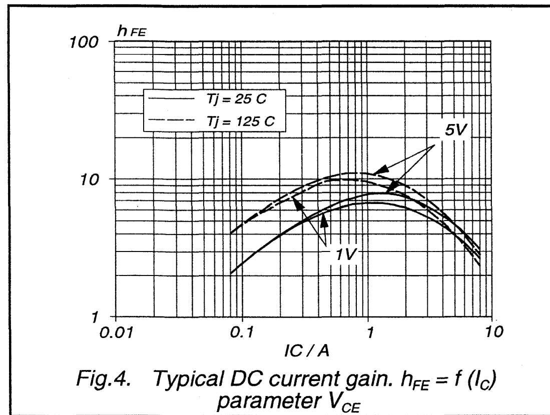


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

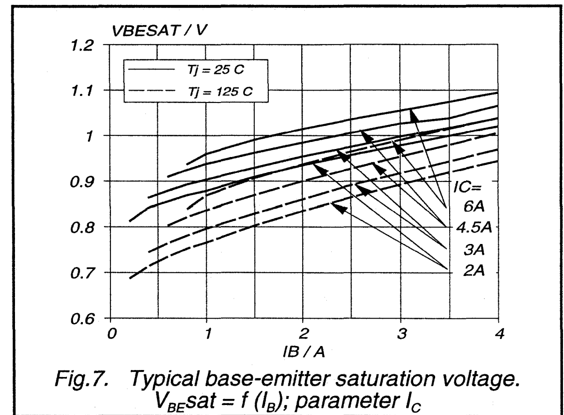


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

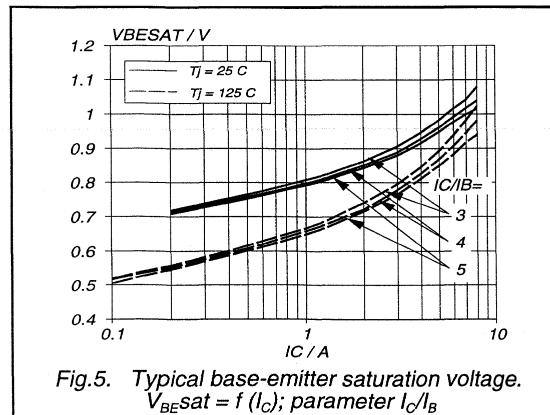


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

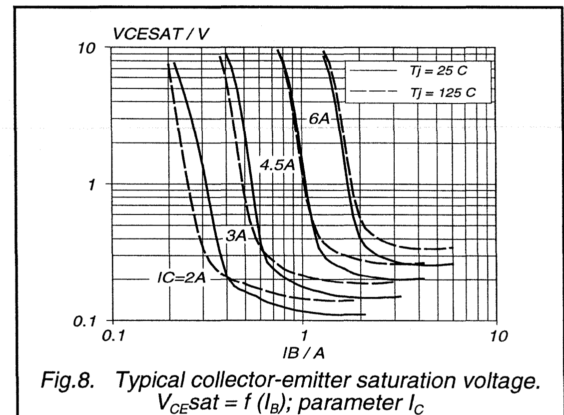


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

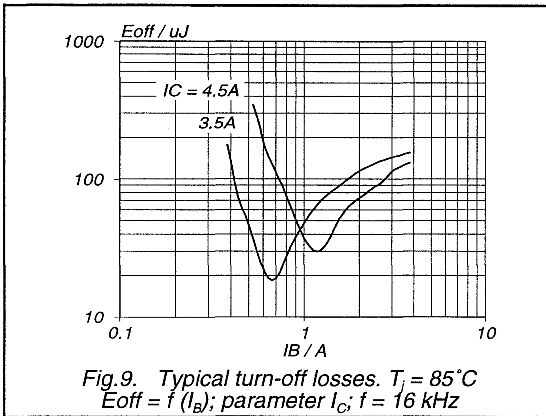


Fig.9. Typical turn-off losses. $T_j = 85^{\circ}C$
$Eoff = f(I_B)$; parameter I_C; f = 16 kHz

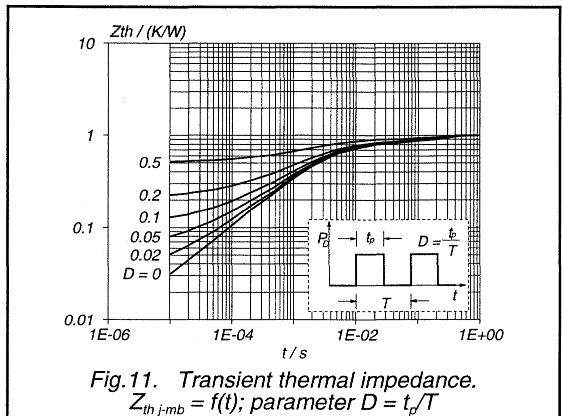


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

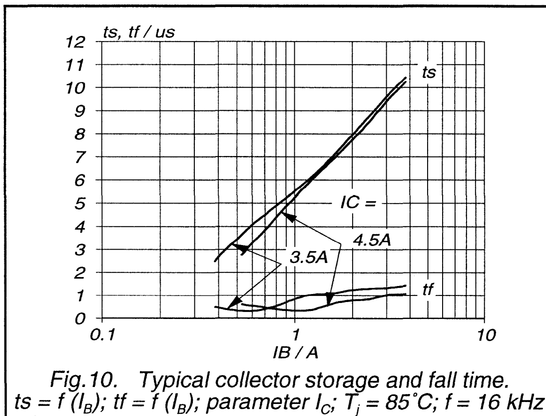


Fig.10. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

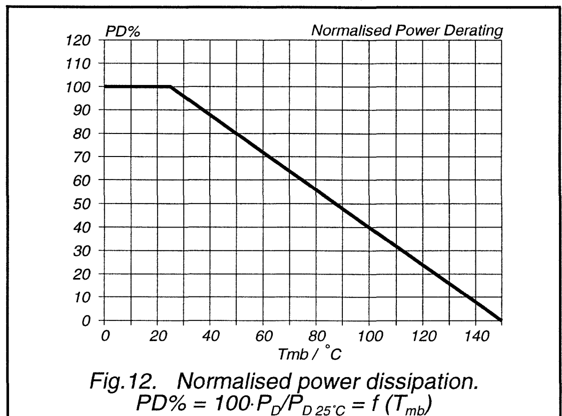


Fig.12. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f(T_{mb})$

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.

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.

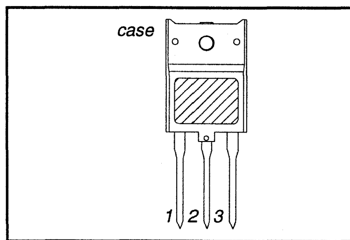
QUICK REFERENCE DATA

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 = 1.1 A	-	1.0	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_{Csat} = 4.5 A; $I_{B(end)}$ = 1.1 A	0.4	0.6	µs

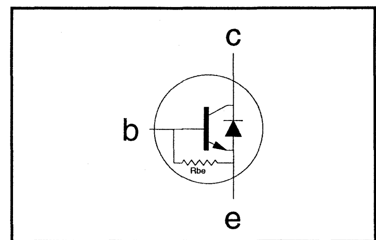
PINNING - SOT399

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
$R_{th\ j-hs}$	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	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 = 1.12 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 1.7 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 1 V	4	5.5	7.0	
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_{Csat} = 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_{Csat} = 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).

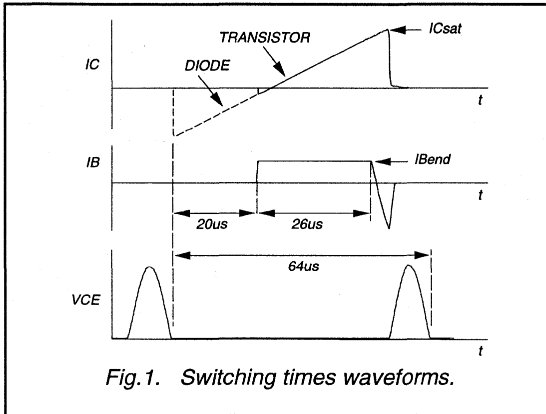


Fig.1. Switching times waveforms.

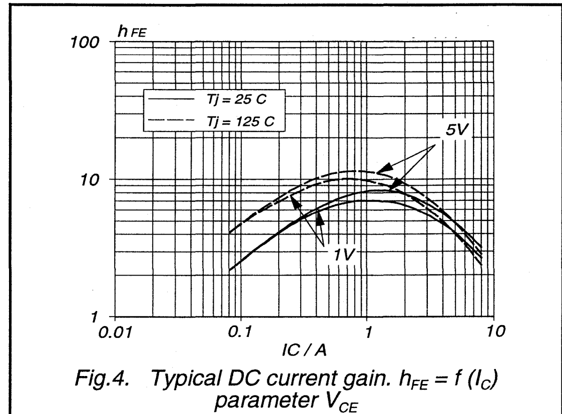


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

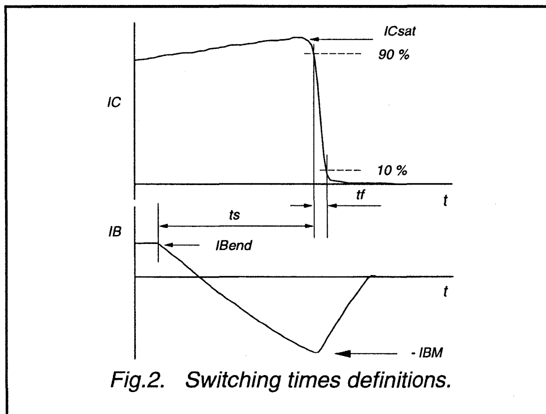


Fig.2. Switching times definitions.

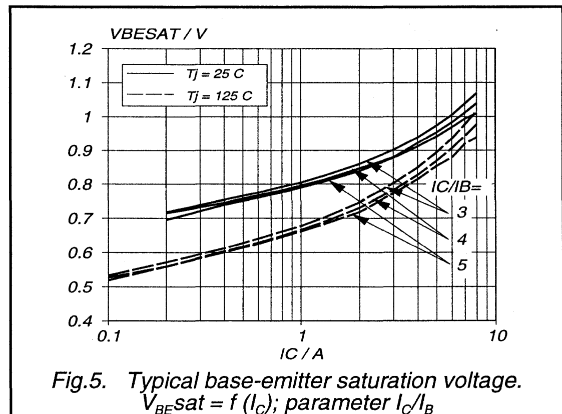


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

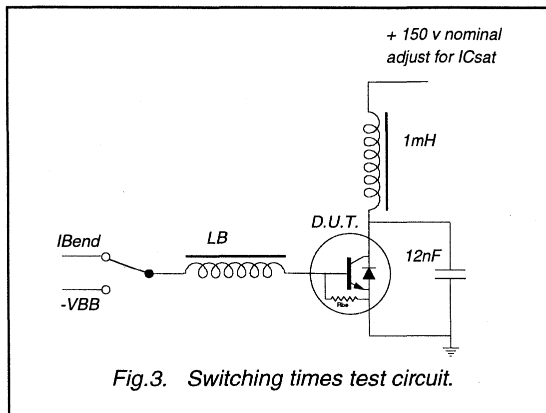


Fig.3. Switching times test circuit.

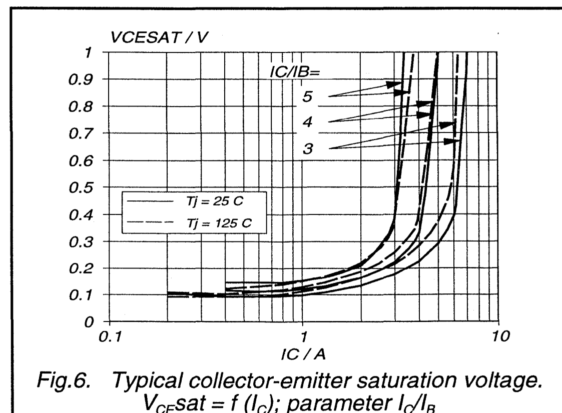


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

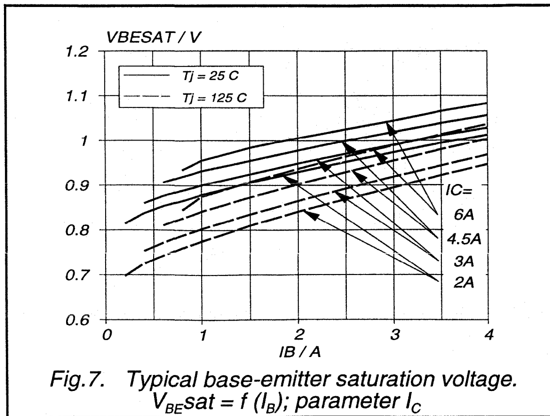


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

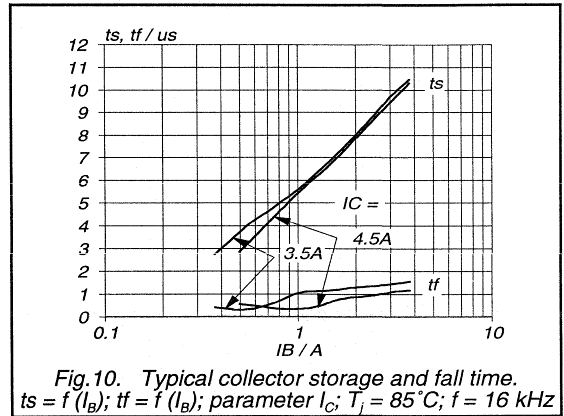


Fig.10. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

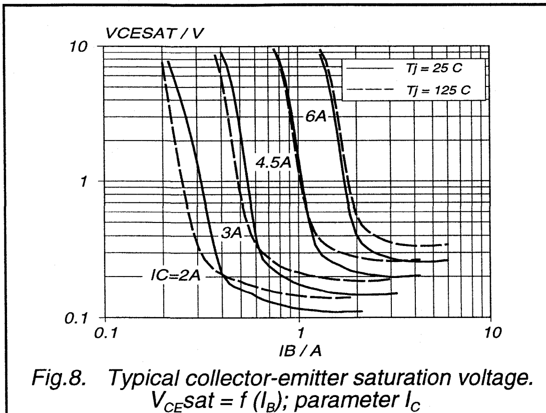


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

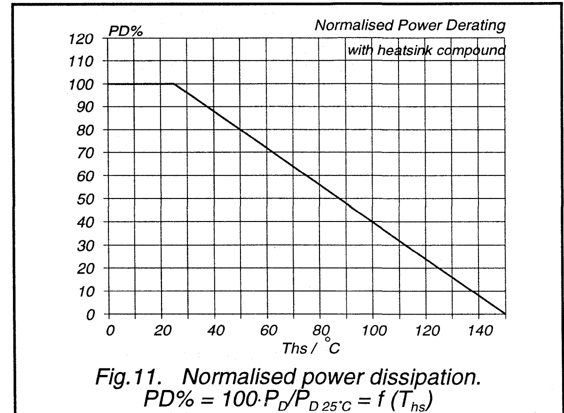


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

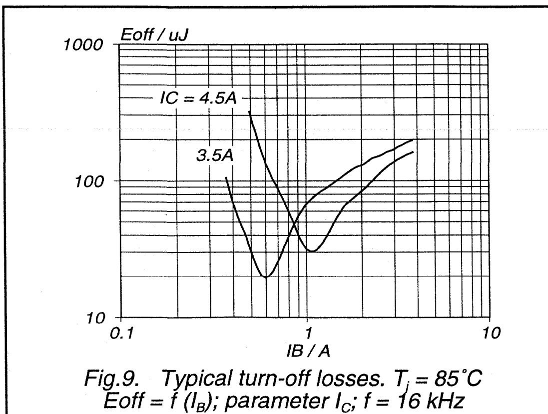


Fig.9. Typical turn-off losses. $T_j = 85˚C$ $Eoff = f(I_B)$; parameter I_C; $f = 16$ kHz

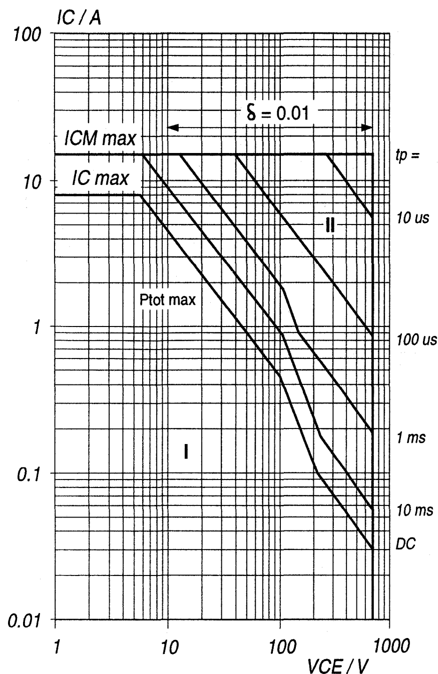


Fig.12. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

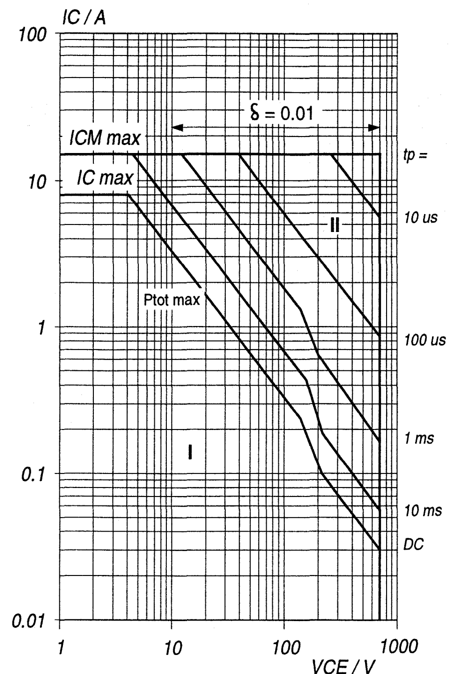


Fig.13. Forward bias safe operating area. T_{hs} = 25˚C
I *Region of permissible DC operation.*
II *Extension for repetitive pulse operation.*

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

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 pc monitors.

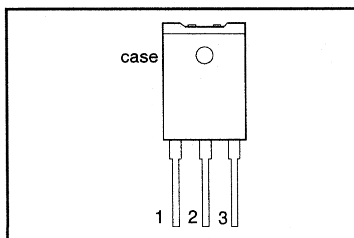
QUICK REFERENCE DATA

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ °C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 0.9$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 56 kHz	4.5	-	A
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 56 kHz	0.2	0.4	μs

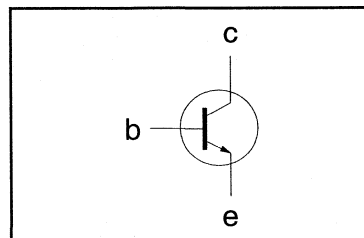
PINNING - SOT199

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
I_B	Base current (DC)		-	5	A
I_{BM}	Base current peak value		-	7.5	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	125	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	-	-	1.0	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 5 V	-	17.2	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 5 V	5	8.2	10.8	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (56 kHz line deflection circuit)	I_{Csat} = 4.5 A; L_C = 250 μH; C_{fb} = 4 nF; $I_{B(end)}$ =0.65 A; L_B = 1.5 μH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 2.7 A			
t_s	Turn-off storage time		2.2	3.0	μs
t_f	Turn-off fall time		0.2	0.4	μs

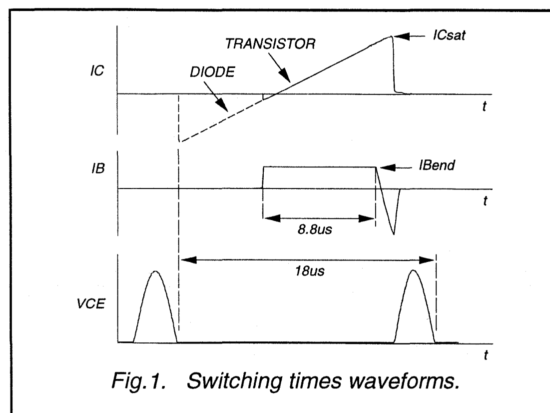


Fig.1. Switching times waveforms.

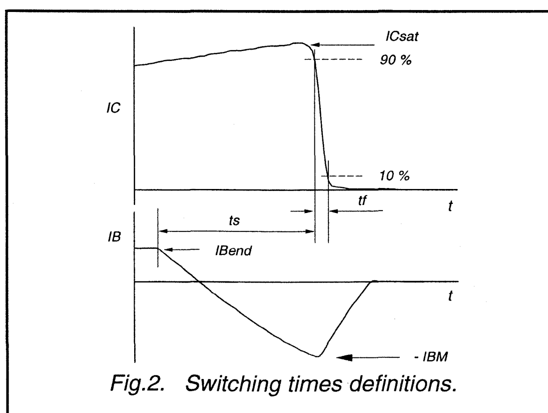


Fig.2. Switching times definitions.

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

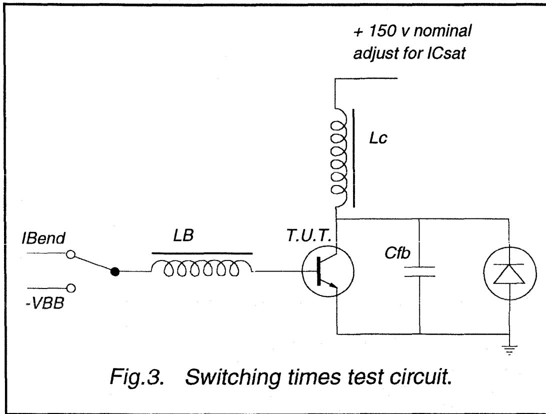


Fig.3. Switching times test circuit.

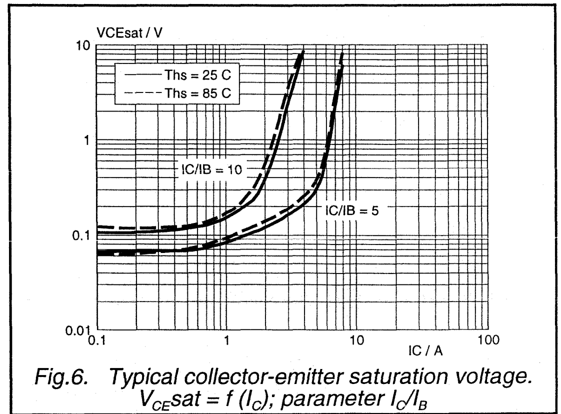


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

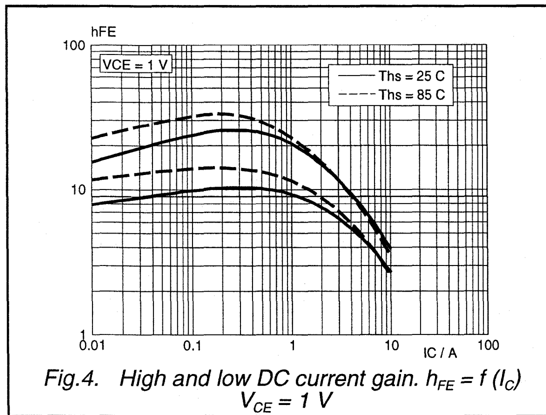


Fig.4. High and low DC current gain. $h_{FE} = f(I_C)$ $V_{CE} = 1$ V

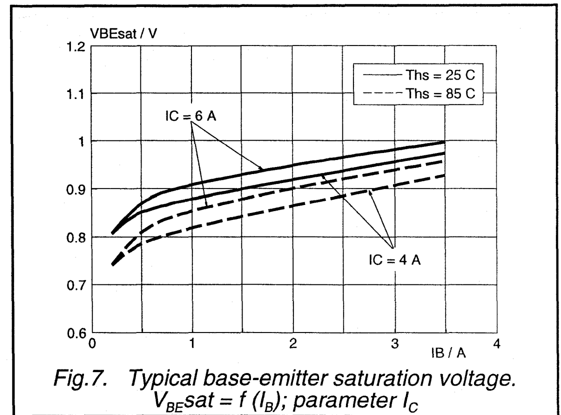


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

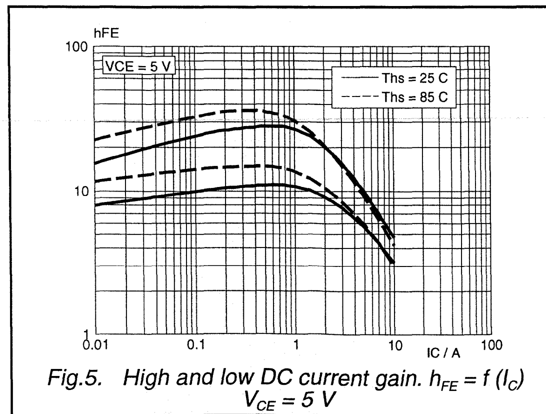


Fig.5. High and low DC current gain. $h_{FE} = f(I_C)$ $V_{CE} = 5$ V

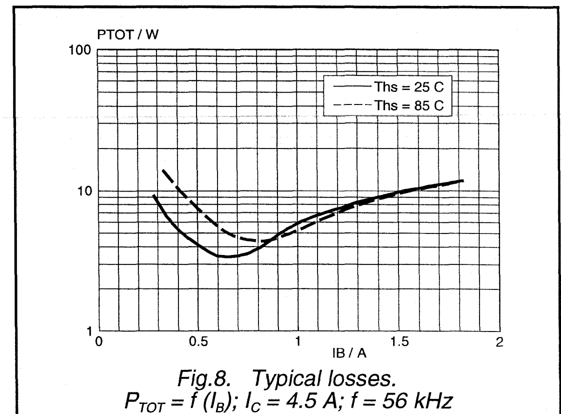


Fig.8. Typical losses. $P_{TOT} = f(I_B)$; $I_C = 4.5$ A; $f = 56$ kHz

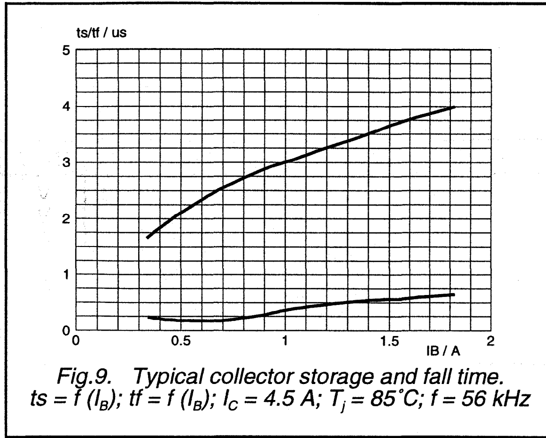


Fig.9. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; $I_C = 4.5$ A; $T_j = 85˚C$; f = 56 kHz

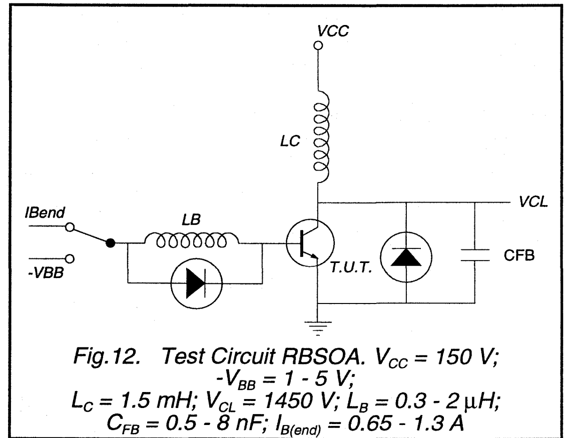


Fig.12. Test Circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 1 - 5$ V; $L_C = 1.5$ mH; $V_{CL} = 1450$ V; $L_B = 0.3 - 2$ µH; $C_{FB} = 0.5 - 8$ nF; $I_{B(end)} = 0.65 - 1.3$ A

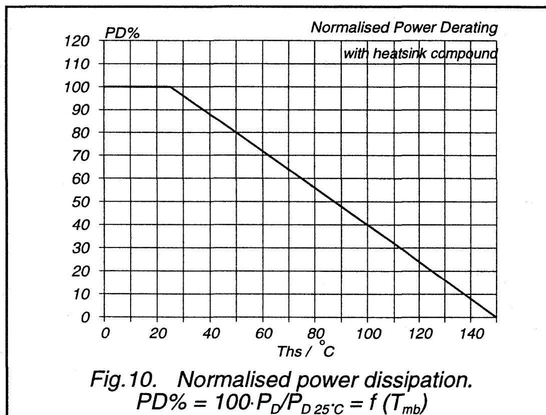


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25˚C} = f\ (T_{mb})$

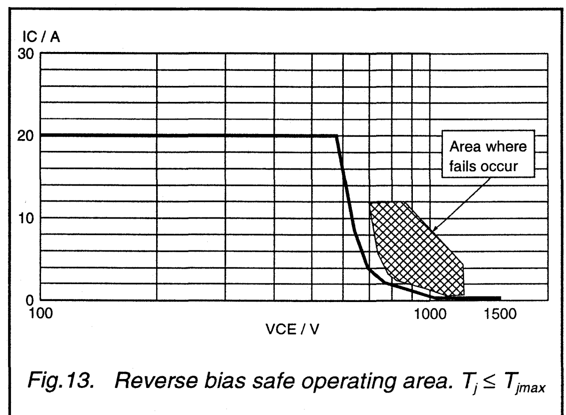


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

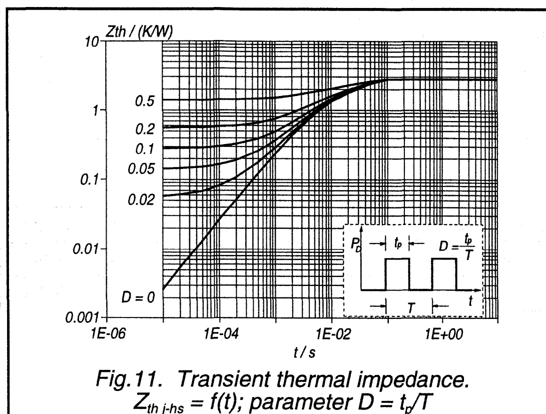


Fig.11. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

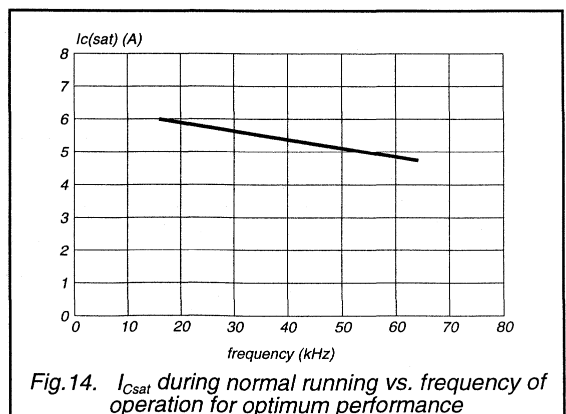


Fig.14. I_{Csat} during normal running vs. frequency of operation for optimum performance

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 pc monitors.

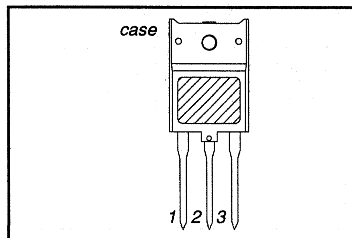
QUICK REFERENCE DATA

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 0.9$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 56 kHz	4.5	-	A
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 56 kHz	0.2	0.4	µs

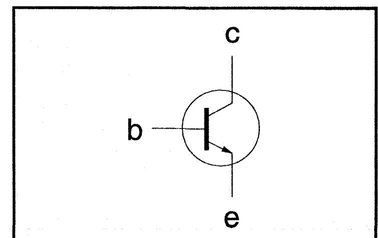
PINNING - SOT399

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
I_B	Base current (DC)		-	5	A
I_{BM}	Base current peak value		-	7.5	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	125	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	-	-	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 = 4.5 A; I_B = 0.9 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 500 mA; V_{CE} = 5 V	-	17.2	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 5 V	5	8.2	10.8	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (56 kHz line deflection circuit)	I_{Csat} = 4.5 A; L_C = 250 µH; C_{fb} = 4 nF; $I_{B(end)}$ =0.65 A; L_B = 1.5 µH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 2.7 A			
t_s	Turn-off storage time		2.2	3.0	µs
t_f	Turn-off fall time		0.2	0.4	µs

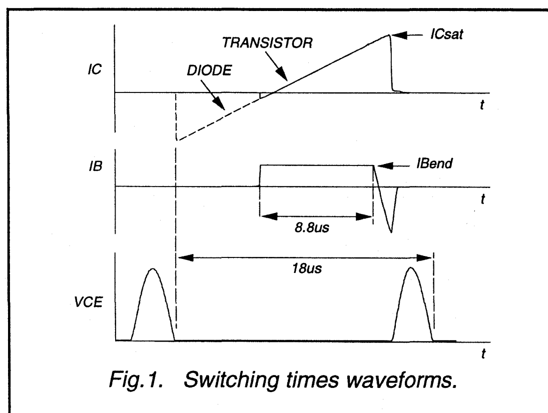


Fig.1. Switching times waveforms.

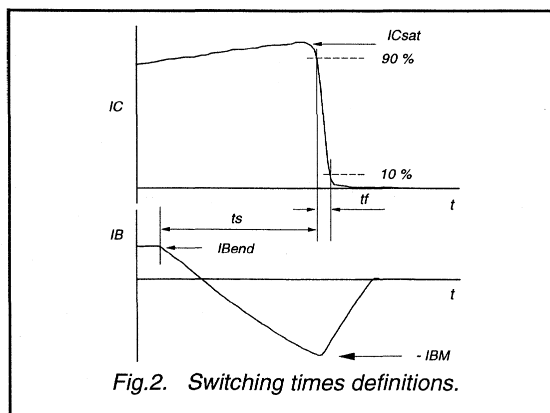


Fig.2. Switching times definitions.

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

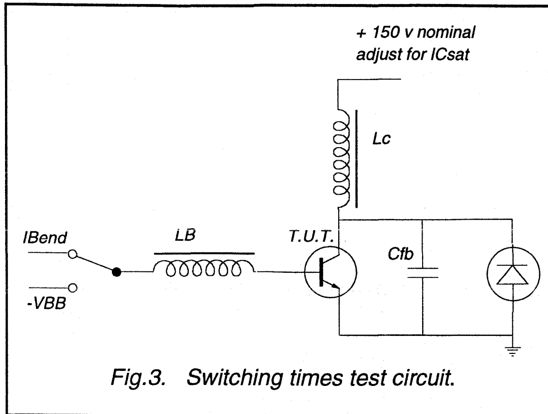


Fig.3. Switching times test circuit.

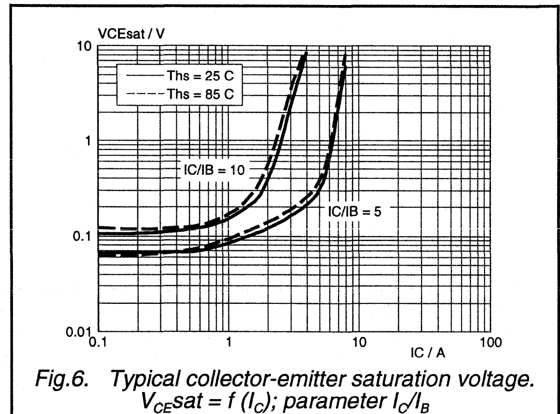


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

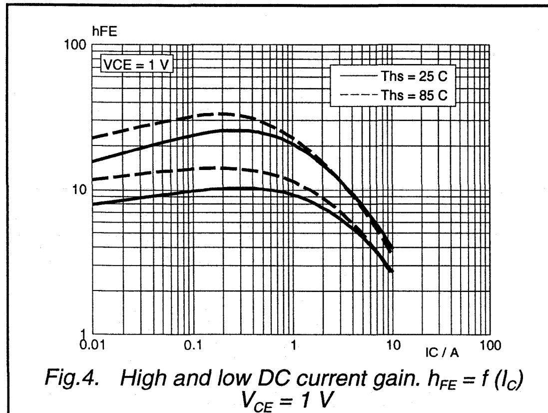


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 1\ V$

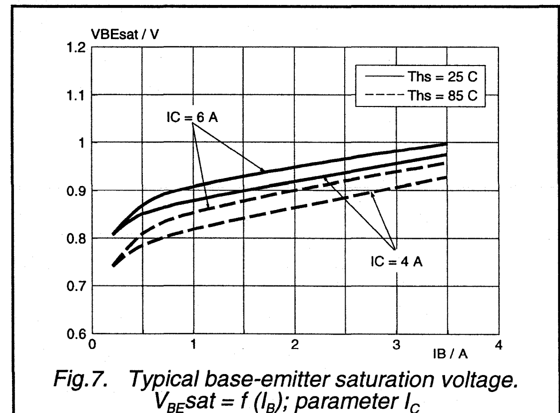


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

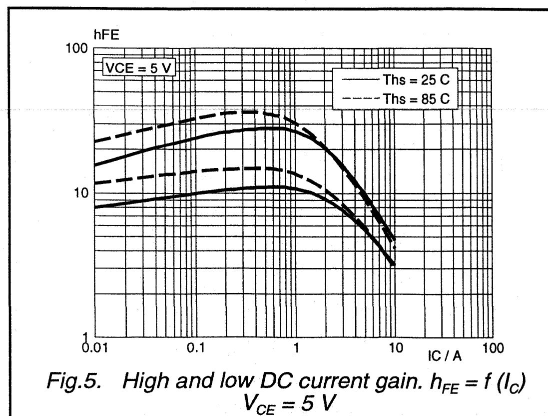


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 5\ V$

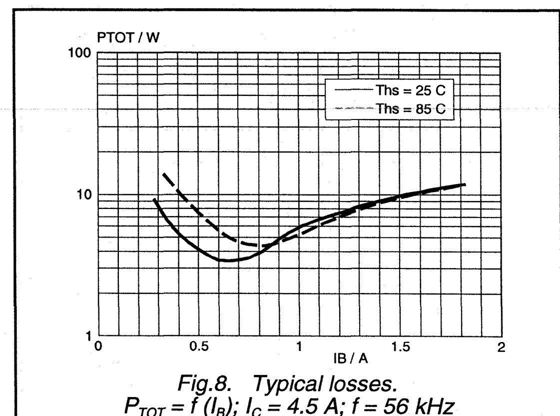


Fig.8. Typical losses. $P_{TOT} = f\ (I_B)$; $I_C = 4.5\ A$; $f = 56\ kHz$

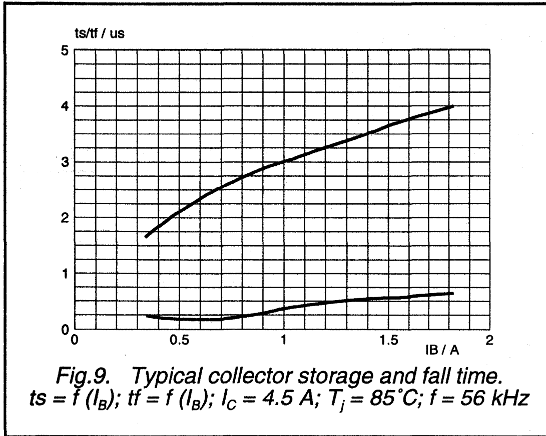


Fig.9. Typical collector storage and fall time. ts = f (I_B); tf = f (I_B); I_C = 4.5 A; T_j = 85˚C; f = 56 kHz

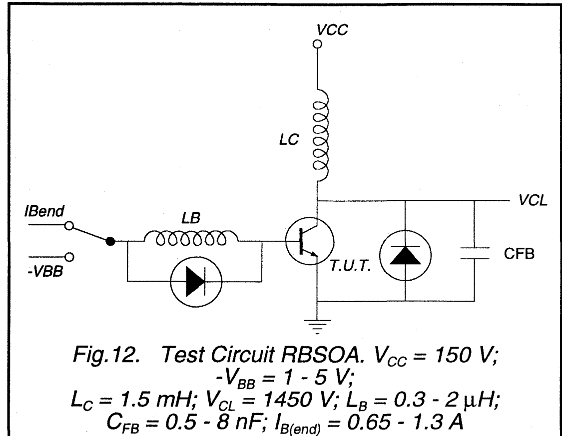


Fig.12. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 5 V; L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 0.3 - 2 µH; C_{FB} = 0.5 - 8 nF; $I_{B(end)}$ = 0.65 - 1.3 A

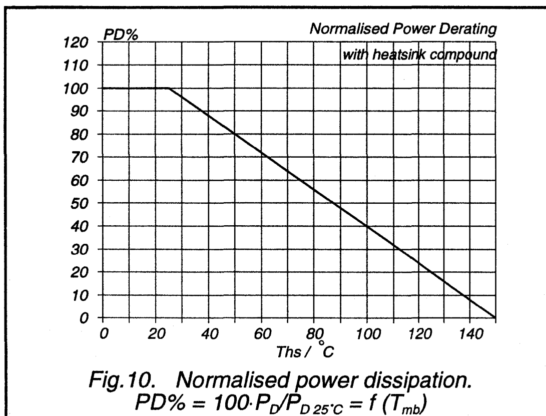


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

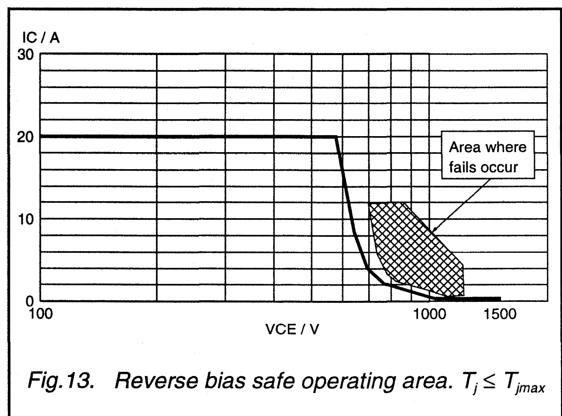


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

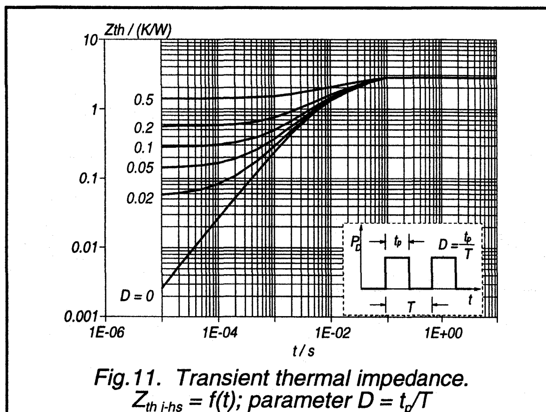


Fig.11. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

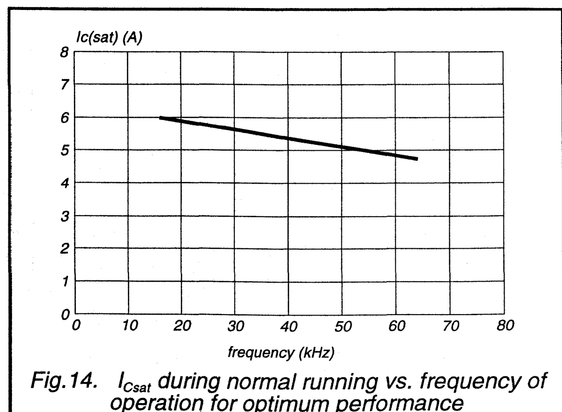


Fig.14. I_{Csat} during normal running vs. frequency of operation for optimum performance

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 pc monitors.

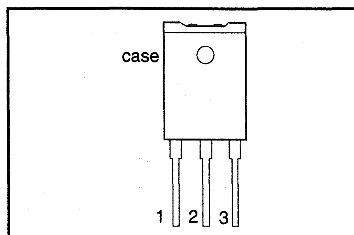
QUICK REFERENCE DATA

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 0.9$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 56 kHz	4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	-	2.2	V
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 56 kHz	0.2	0.4	µs

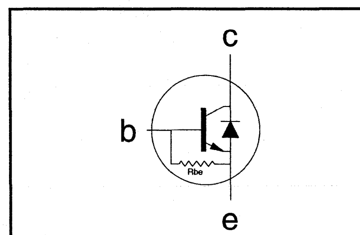
PINNING - SOT199

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
I_B	Base current (DC)		-	5	A
I_{BM}	Base current peak value		-	7.5	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	125	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	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} = 6 V; I_C = 0 A	-	130	-	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 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
R_{be}	Base-emitter resistance	V_{EB} = 6 V	-	46	-	Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 5 V	5	8	10.2	
V_F	Diode forward voltage	I_F = 4.5 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (56 kHz line deflection circuit)	I_{Csat} = 4.5 A; L_C = 250 µH; C_{fb} = 4 nF; $I_{B(end)}$ = 0.65 A; L_B = 1.5 µH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 2.7 A			
t_s	Turn-off storage time		2.2	3.0	µs
t_f	Turn-off fall time		0.2	0.4	µs
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 4.5 A; dI_F/dt = 50 A/µs	17	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	360	-	ns

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

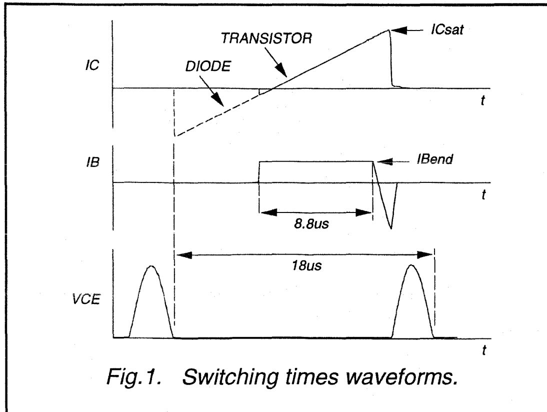


Fig.1. Switching times waveforms.

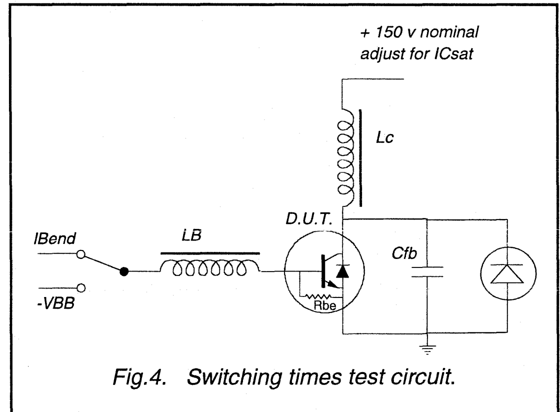


Fig.4. Switching times test circuit.

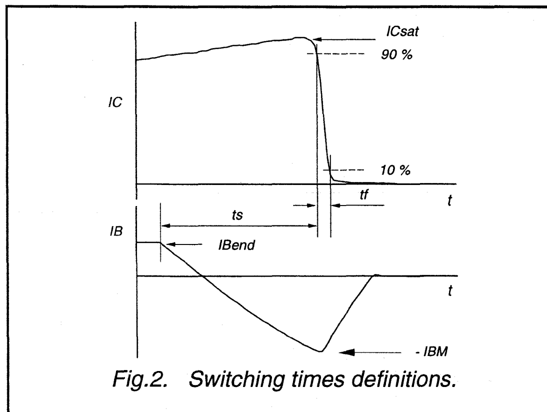


Fig.2. Switching times definitions.

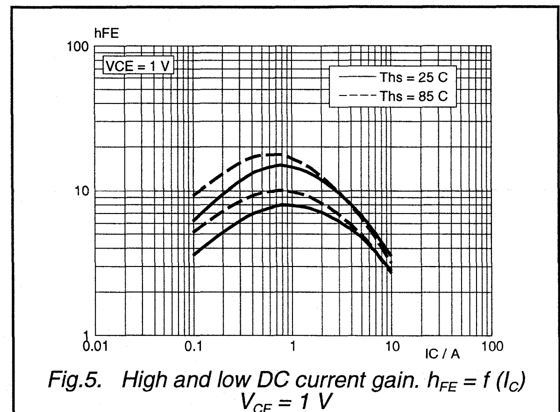


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

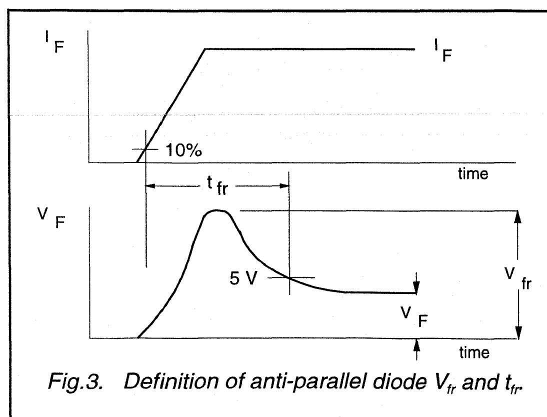


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}.

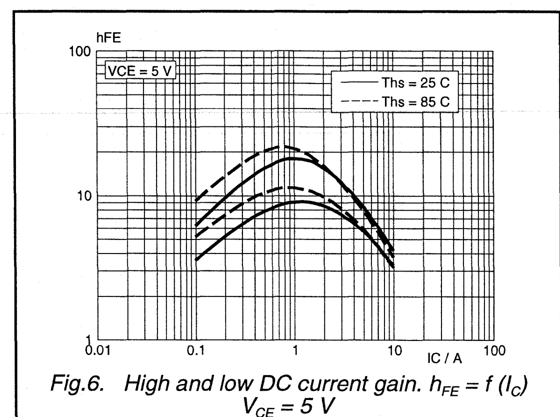


Fig.6. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

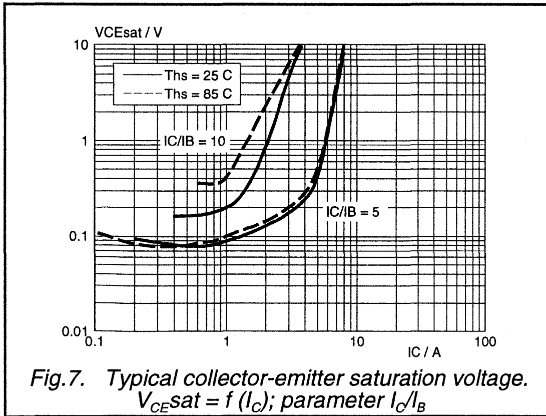


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

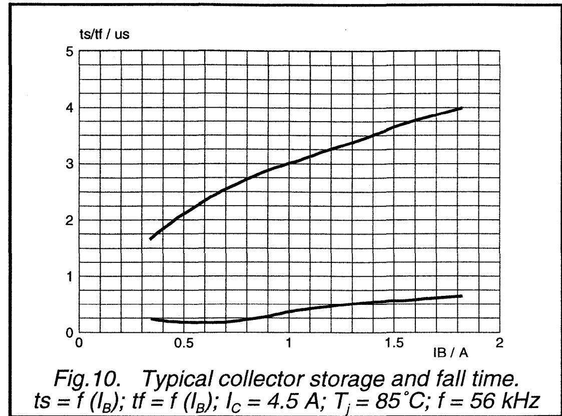


Fig.10. Typical collector storage and fall time. $ts = f (I_B)$; $tf = f (I_B)$; $I_C = 4.5$ A; $T_j = 85$˚C; f = 56 kHz

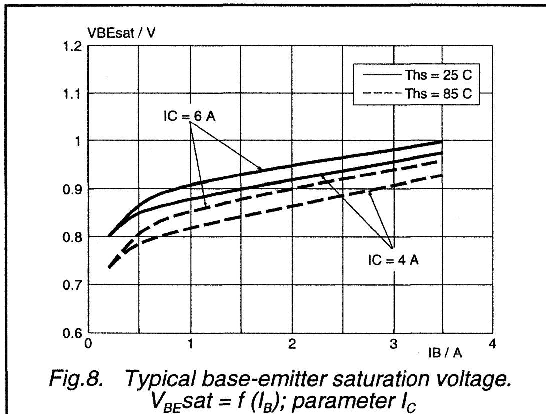


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

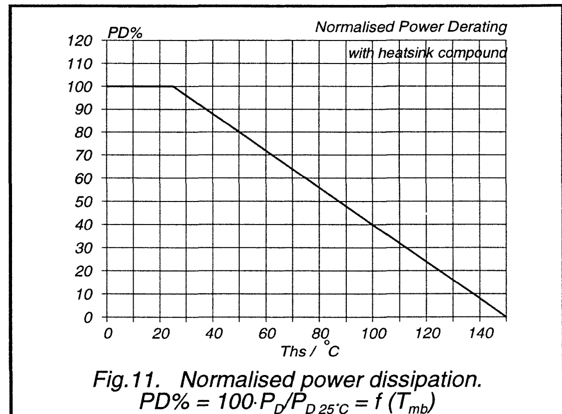


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f (T_{mb})$

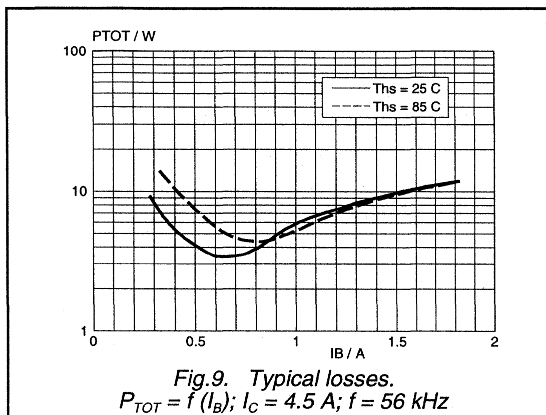


Fig.9. Typical losses. $P_{TOT} = f (I_B)$; $I_C = 4.5$ A; f = 56 kHz

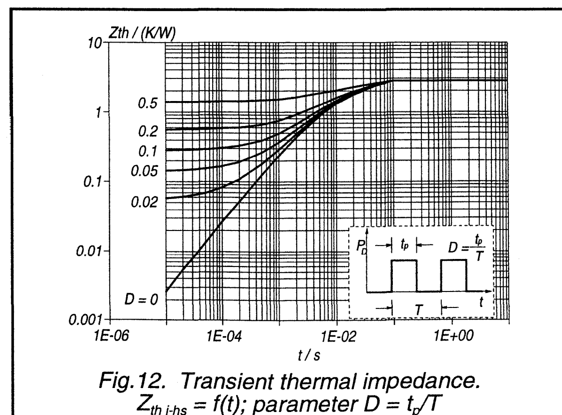


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

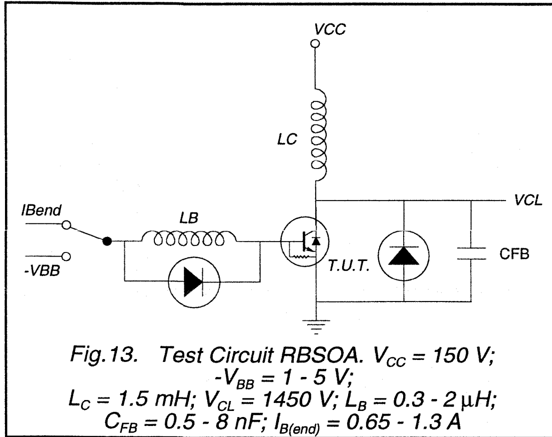


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 5 V; L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 0.3 - 2 µH; C_{FB} = 0.5 - 8 nF; $I_{B(end)}$ = 0.65 - 1.3 A

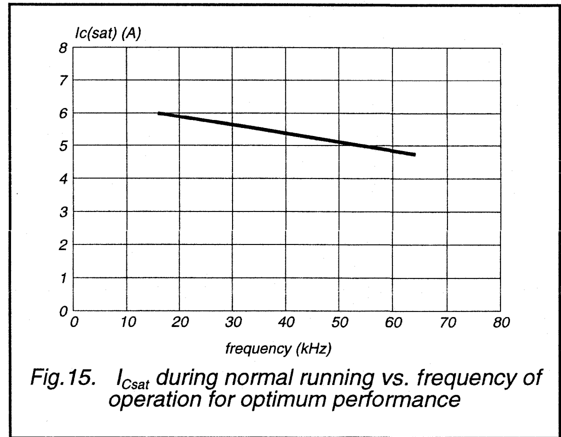


Fig.15. I_{Csat} during normal running vs. frequency of operation for optimum performance

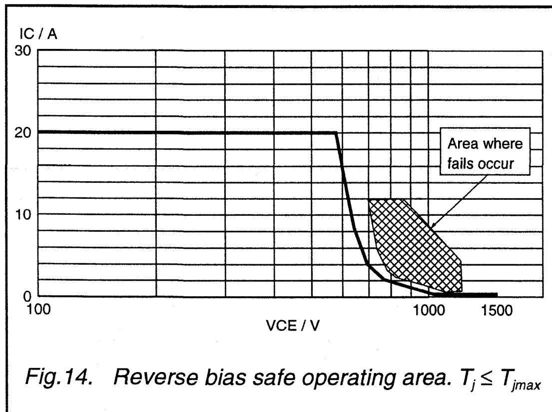


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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 pc monitors.

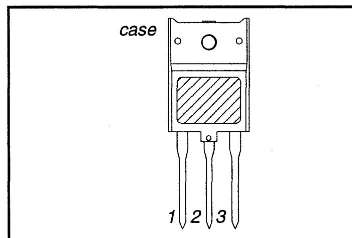
QUICK REFERENCE DATA

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)		-	9	A
I_{CM}	Collector current peak value		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 4.5$ A; $I_B = 0.9$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 56 kHz	4.5	-	A
V_F	Diode forward voltage	$I_F = 4.5$ A	-	2.2	V
t_f	Fall time	$I_{Csat} = 4.5$ A; f = 56 kHz	0.2	0.4	µs

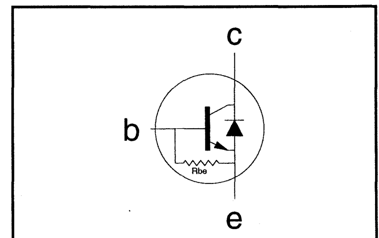
PINNING - SOT399

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
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I_C	Collector current (DC)		-	9	A
I_{CM}	Collector current peak value		-	20	A
I_B	Base current (DC)		-	5	A
I_{BM}	Base current peak value		-	7.5	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	125	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	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} = 6 V; I_C = 0 A	-	130	-	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 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
R_{be}	Base-emitter resistance	V_{EB} = 6 V	-	46	-	Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 4.5 A; I_B = 0.9 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 4.5 A; V_{CE} = 5 V	5	8	10.2	
V_F	Diode forward voltage	I_F = 4.5 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (56 kHz line deflection circuit)	I_{Csat} = 4.5 A; L_C = 250 µH; C_{fb} = 4 nF; $I_{B(end)}$ = 0.65 A; L_B = 1.5 µH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 2.7 A			
t_s	Turn-off storage time		2.2	3.0	µs
t_f	Turn-off fall time		0.2	0.4	µs
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 4.5 A; dI_F/dt = 50 A/µs	17	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	360	-	ns

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

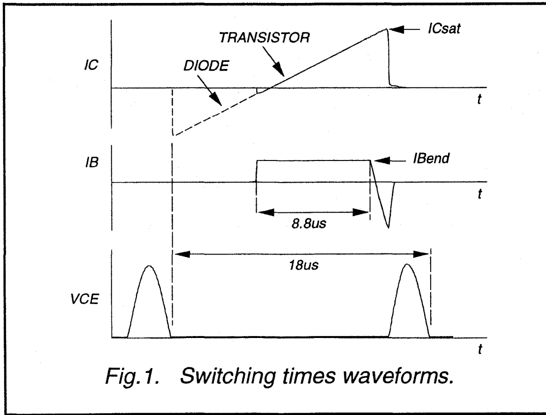


Fig.1. Switching times waveforms.

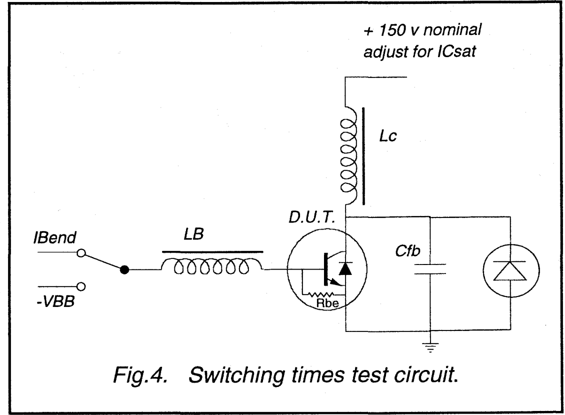


Fig.4. Switching times test circuit.

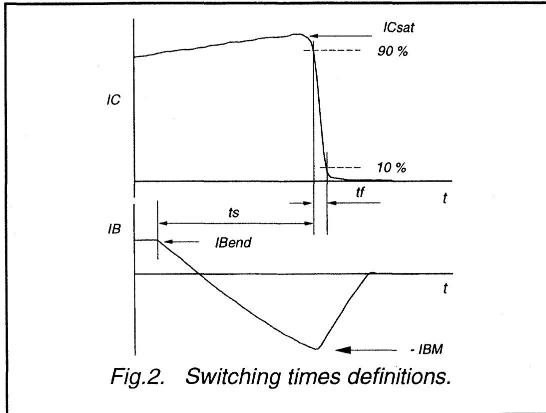


Fig.2. Switching times definitions.

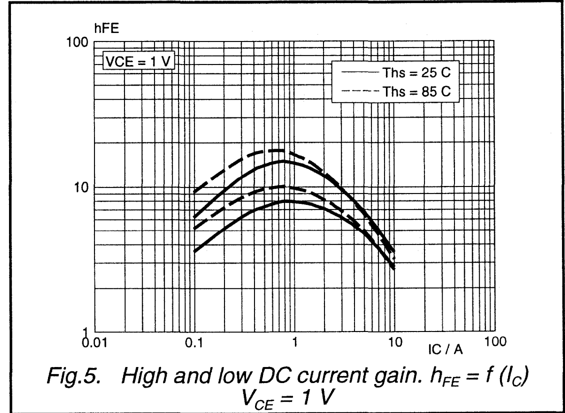


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

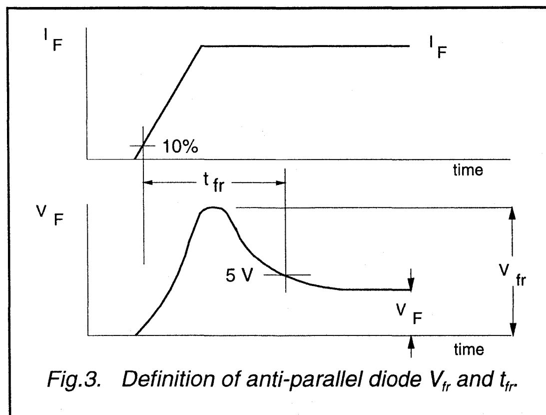


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}.

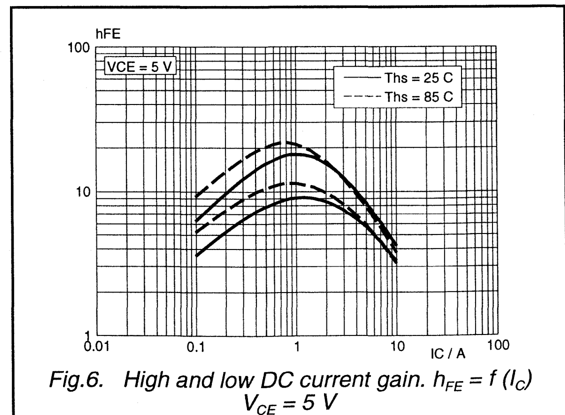


Fig.6. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

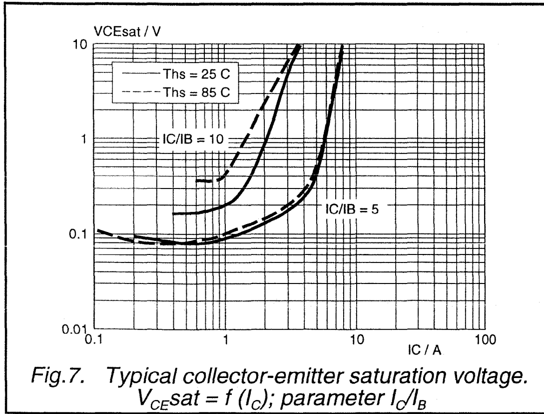


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

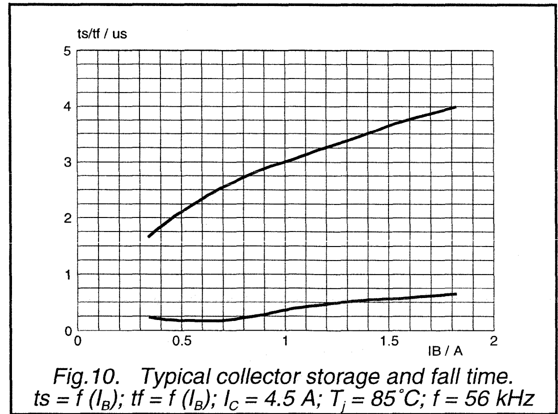


Fig.10. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; $I_C = 4.5$ A; $T_j = 85˚C$; $f = 56$ kHz

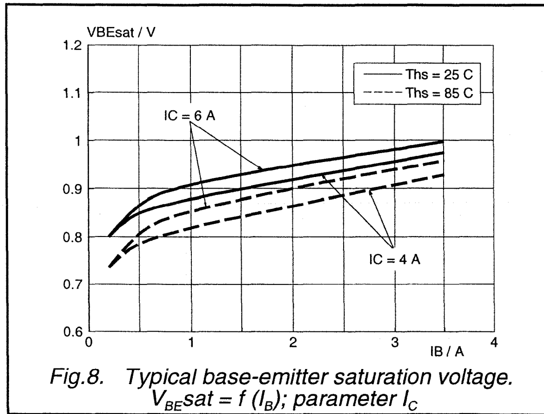


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

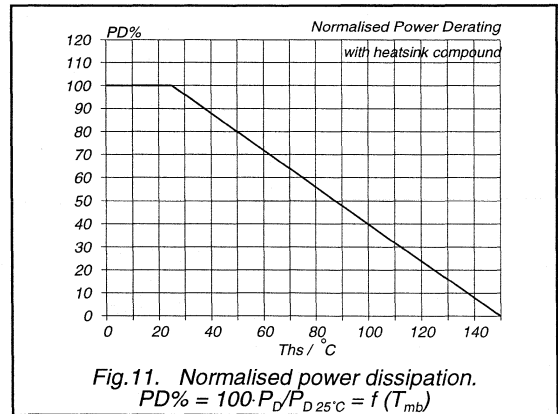


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{mb})$

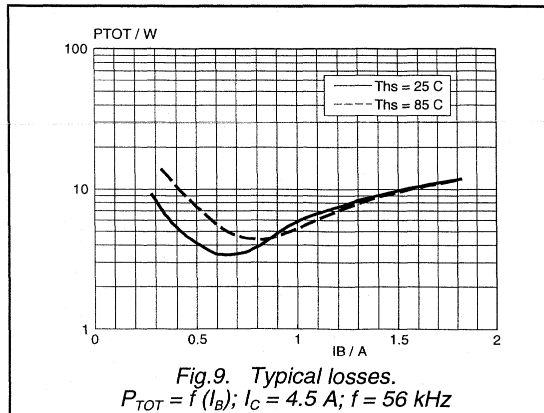


Fig.9. Typical losses. $P_{TOT} = f(I_B)$; $I_C = 4.5$ A; $f = 56$ kHz

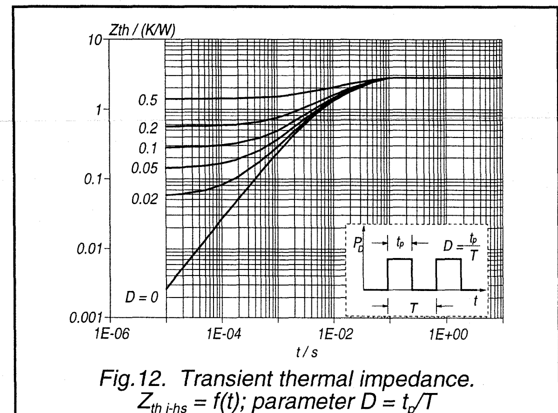


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

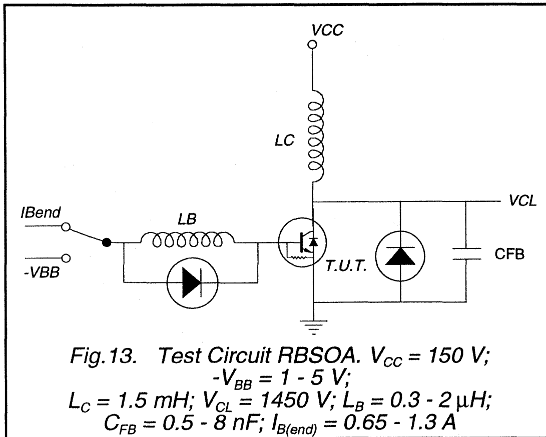


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 5 V; L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 0.3 - 2 µH; C_{FB} = 0.5 - 8 nF; $I_{B(end)}$ = 0.65 - 1.3 A

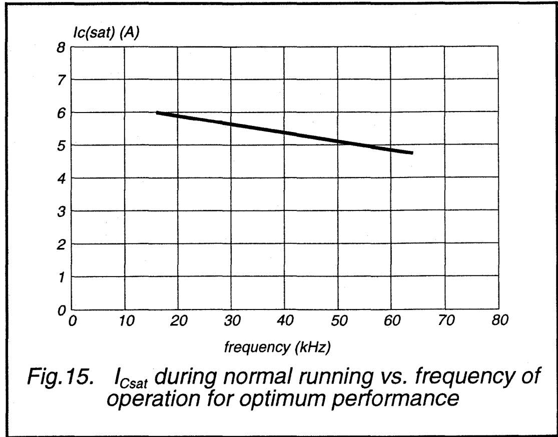


Fig.15. I_{Csat} during normal running vs. frequency of operation for optimum performance

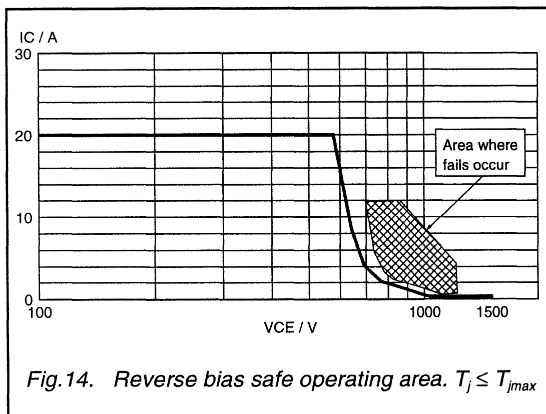


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

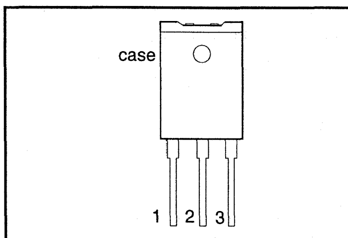
QUICK REFERENCE DATA

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	$I_{Csat} = 6.0$ A; $I_{B(end)} = 0.85$ A	0.2	0.35	µs

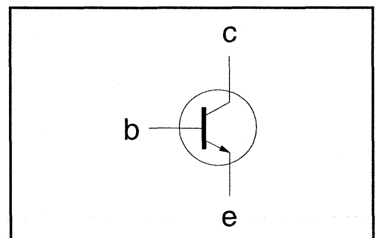
PINNING - SOT199

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
$R_{th\ j\text{-}hs}$	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	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9.5	

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	115	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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_{Csat} = 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).

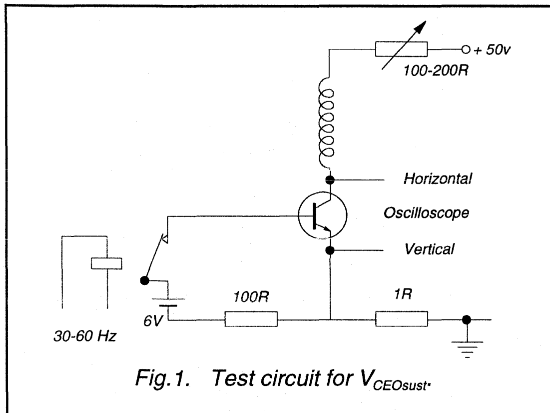


Fig.1. Test circuit for $V_{CEOsust}$.

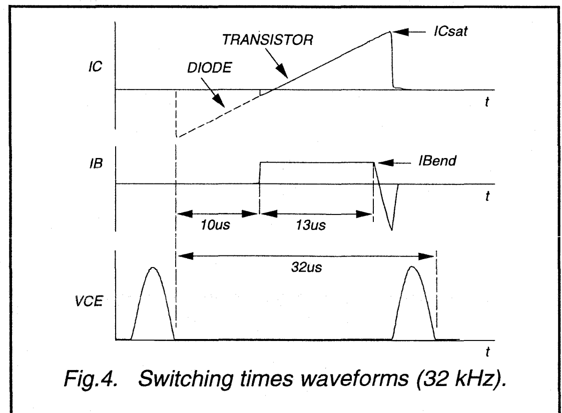


Fig.4. Switching times waveforms (32 kHz).

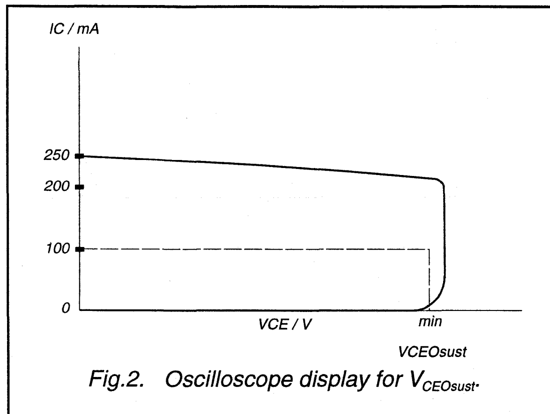


Fig.2. Oscilloscope display for $V_{CEOsust}$.

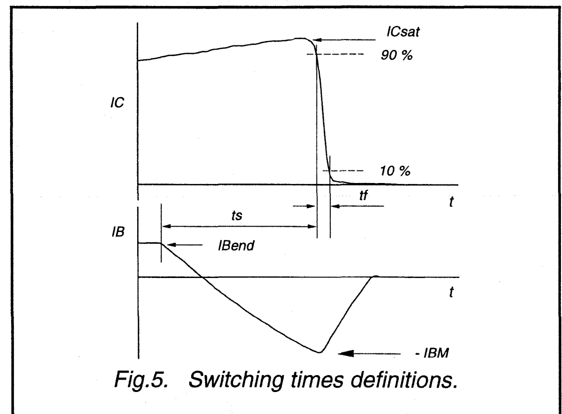


Fig.5. Switching times definitions.

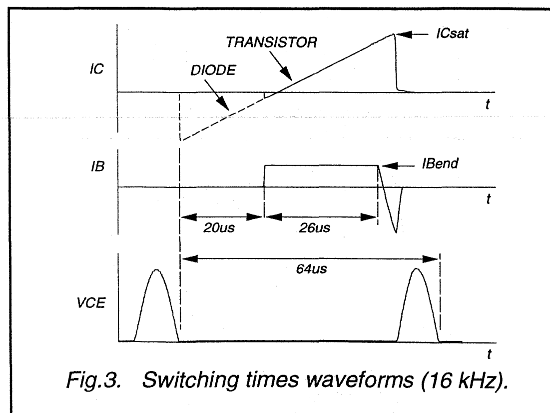


Fig.3. Switching times waveforms (16 kHz).

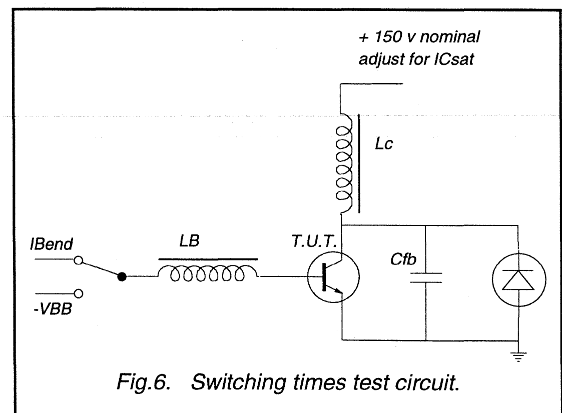


Fig.6. Switching times test circuit.

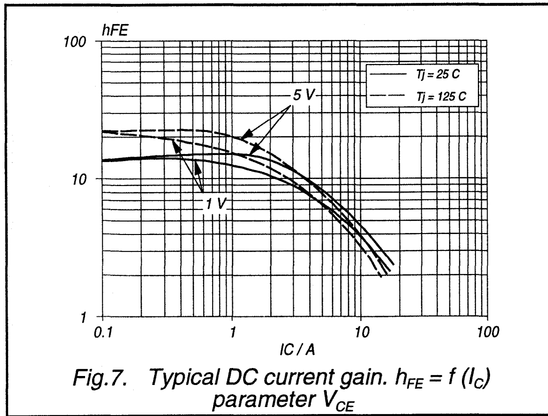


Fig.7. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

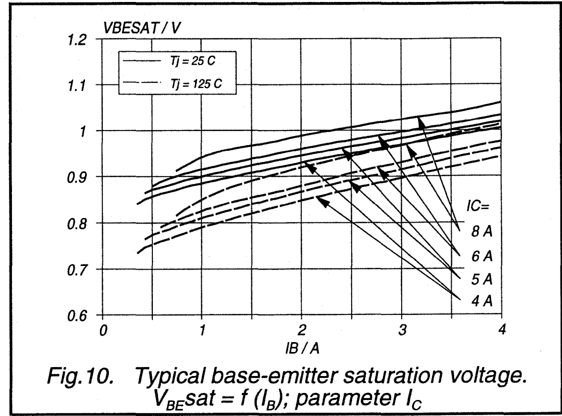


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

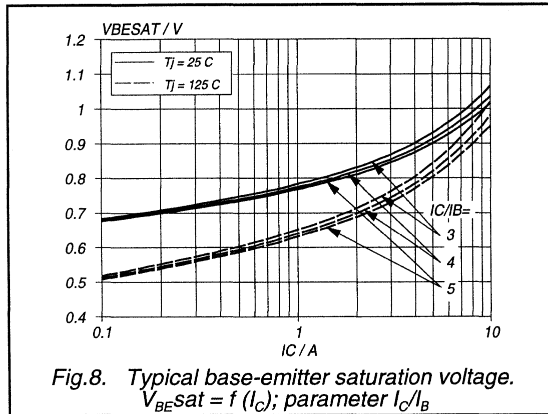


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

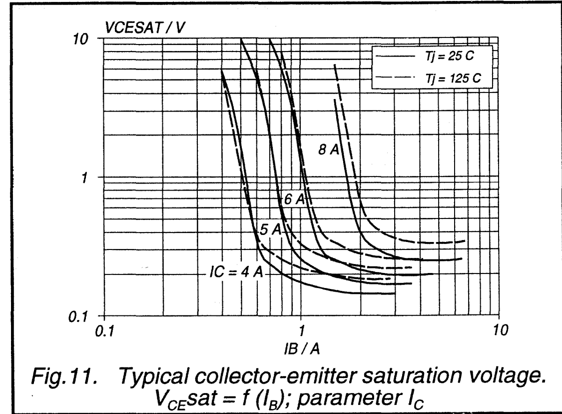


Fig.11. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

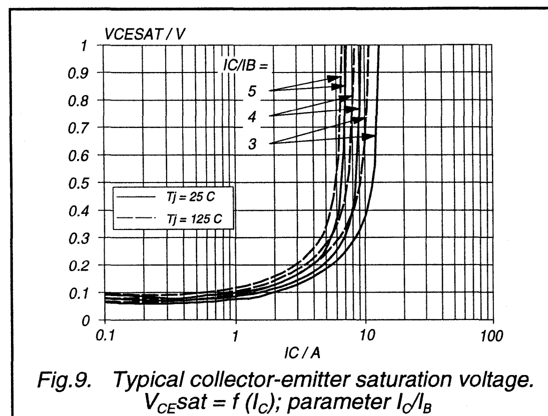


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

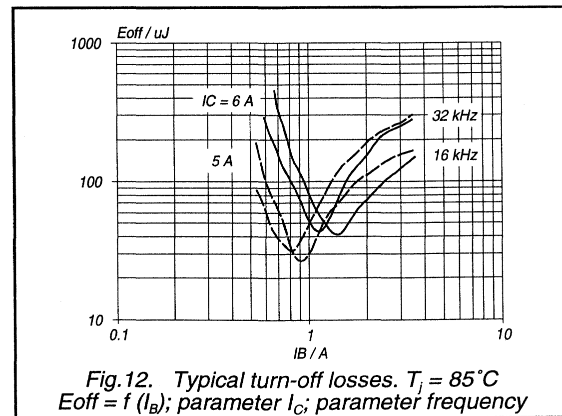


Fig.12. Typical turn-off losses. $T_j = 85^{\circ}C$ $E_{off} = f(I_B)$; parameter I_C; parameter frequency

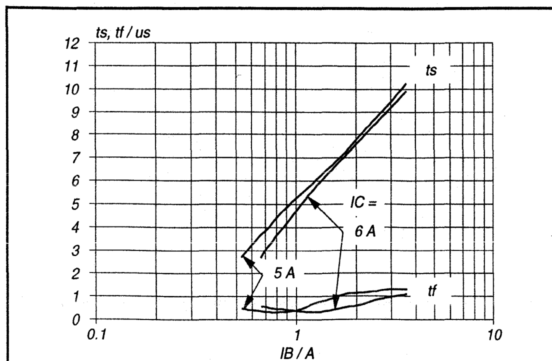


Fig.13. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 16$ kHz

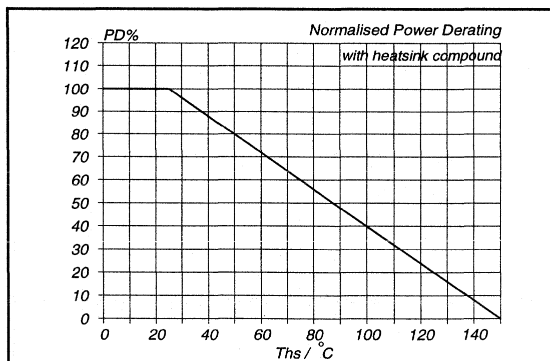


Fig.15. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

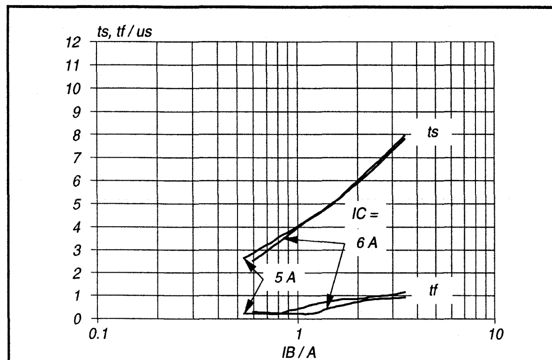


Fig.14. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 32$ kHz

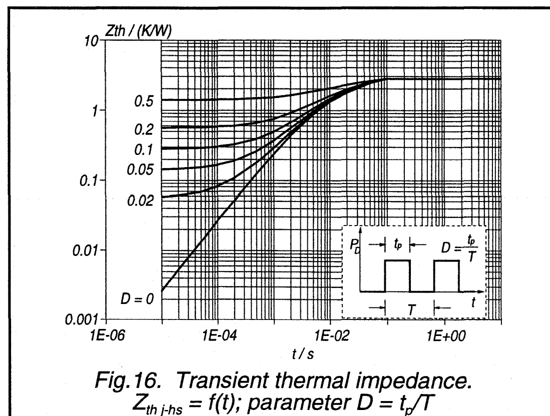


Fig.16. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

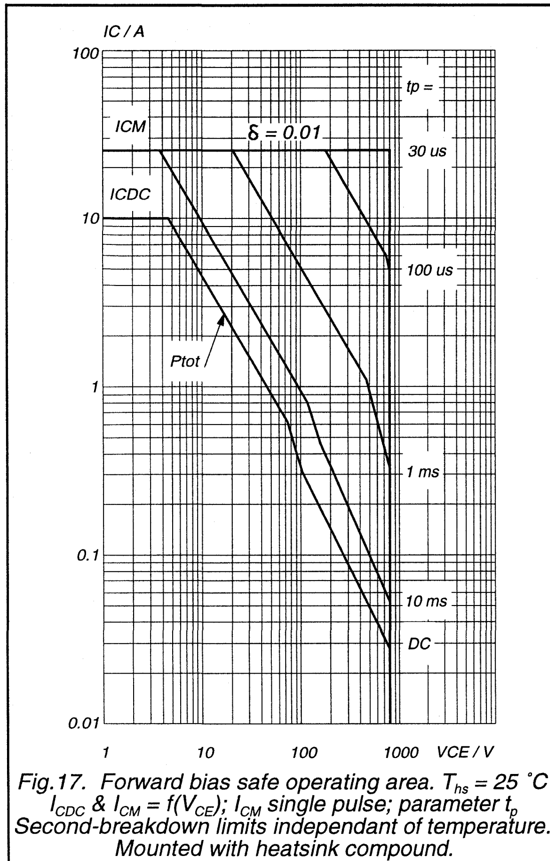


Fig.17. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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.

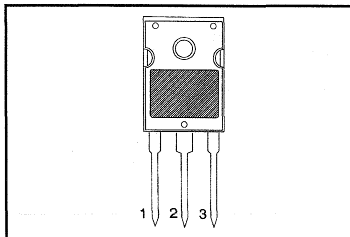
QUICK REFERENCE DATA

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	$I_{Csat} = 6.0$ A; $I_{B(end)} = 0.85$ A	0.2	0.35	µs

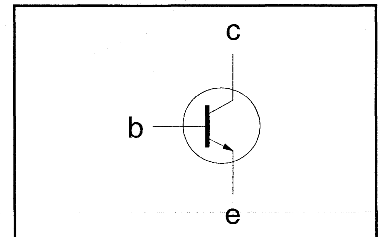
PINNING - SOT429

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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9.5	

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	115	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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_{Csat} = 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).

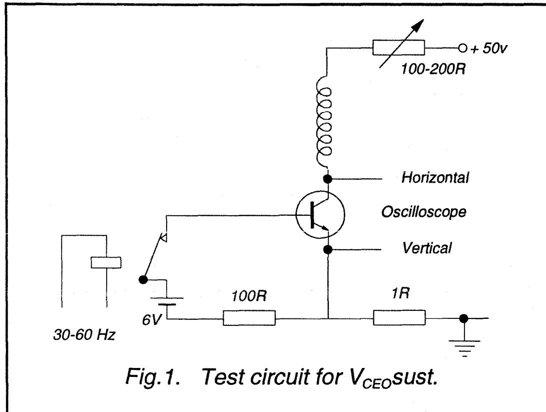


Fig.1. Test circuit for V_{CEO}sust.

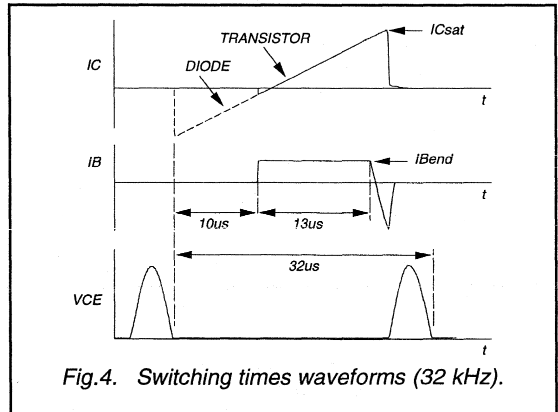


Fig.4. Switching times waveforms (32 kHz).

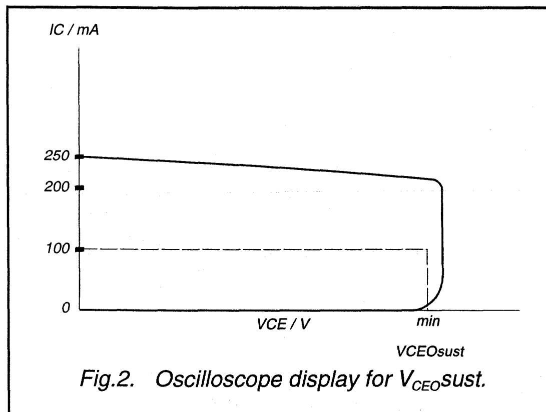


Fig.2. Oscilloscope display for V_{CEO}sust.

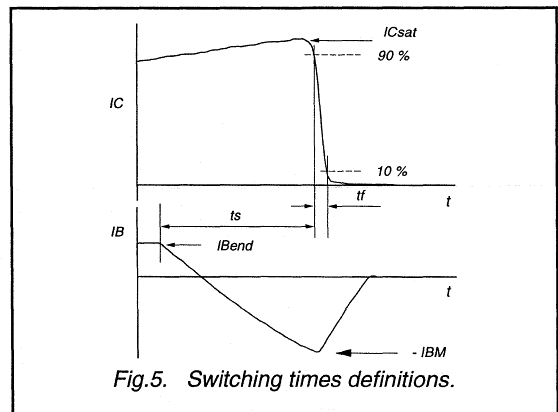


Fig.5. Switching times definitions.

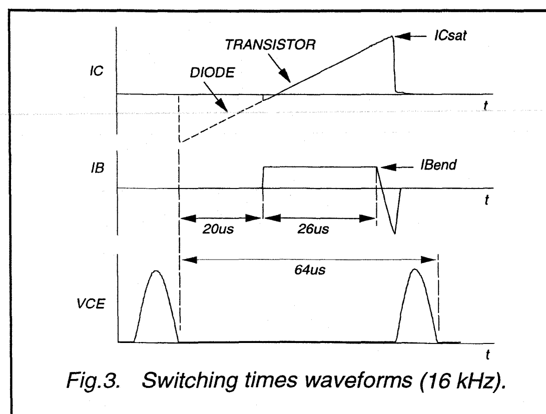


Fig.3. Switching times waveforms (16 kHz).

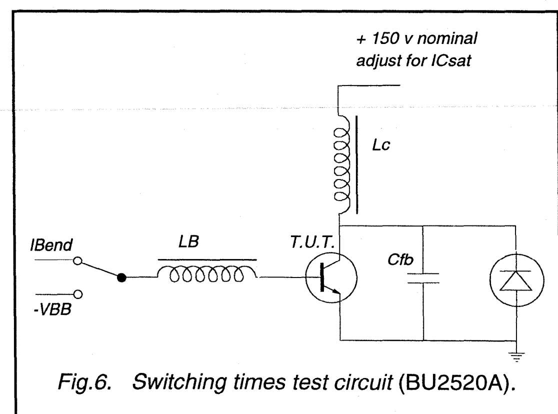


Fig.6. Switching times test circuit (BU2520A).

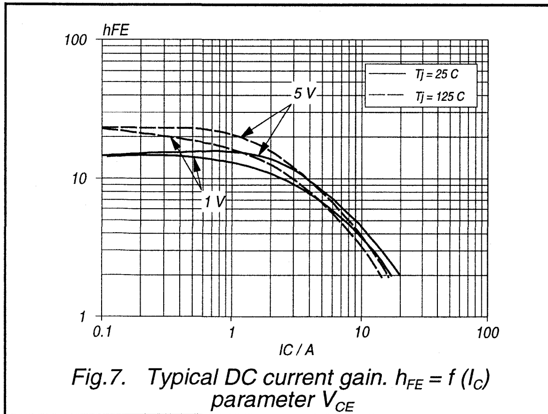


Fig.7. Typical DC current gain. $h_{FE} = f (I_C)$ parameter V_{CE}

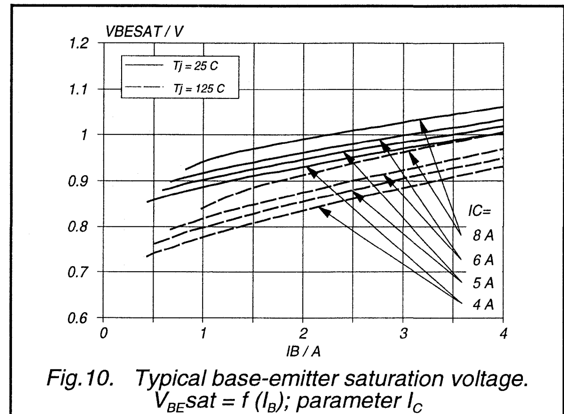


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

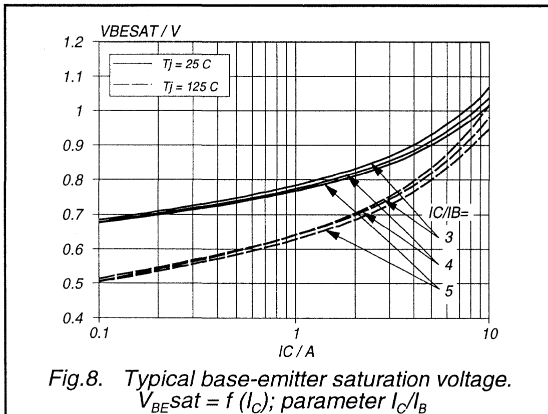


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_C)$; parameter I_C/I_B

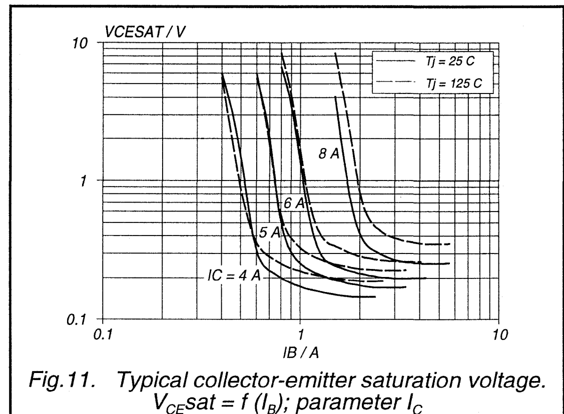


Fig.11. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_B)$; parameter I_C

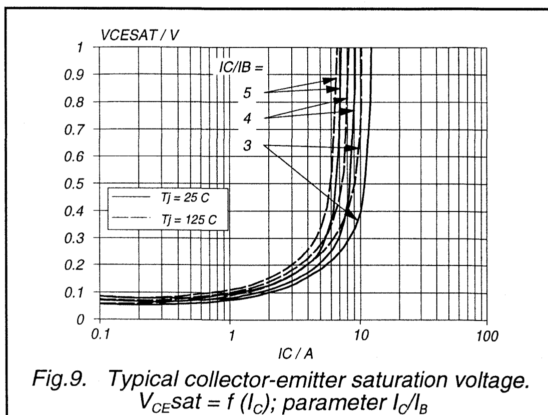


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

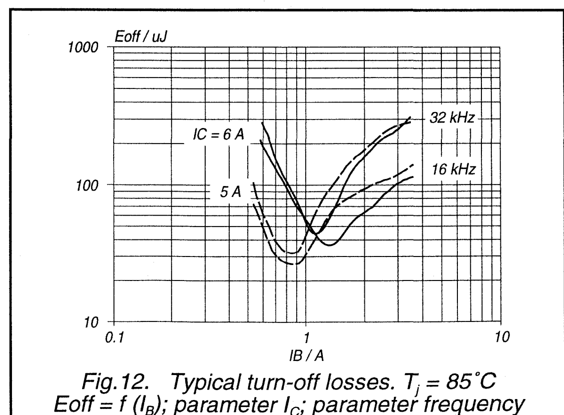


Fig.12. Typical turn-off losses. $T_j = 85^\circ C$ Eoff = f (I_B); parameter I_C; parameter frequency

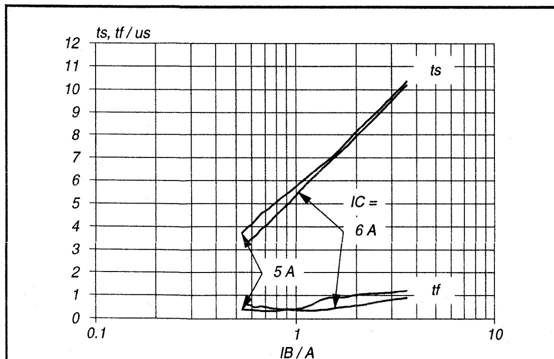


Fig.13. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

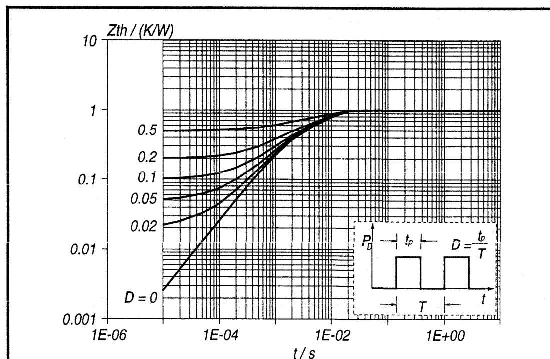


Fig.16. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

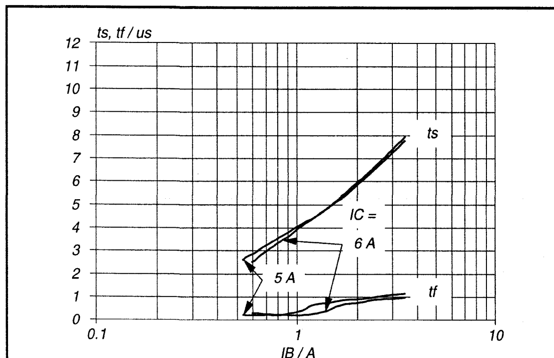


Fig.14. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 32 kHz

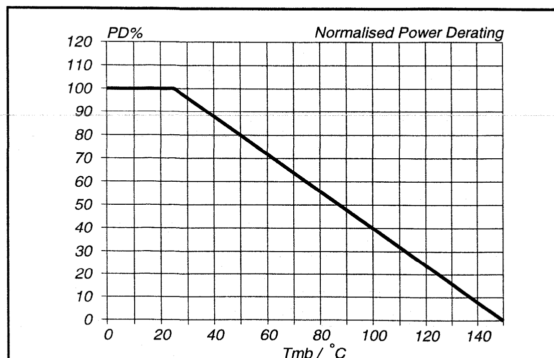


Fig.15. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f(T_{mb})$

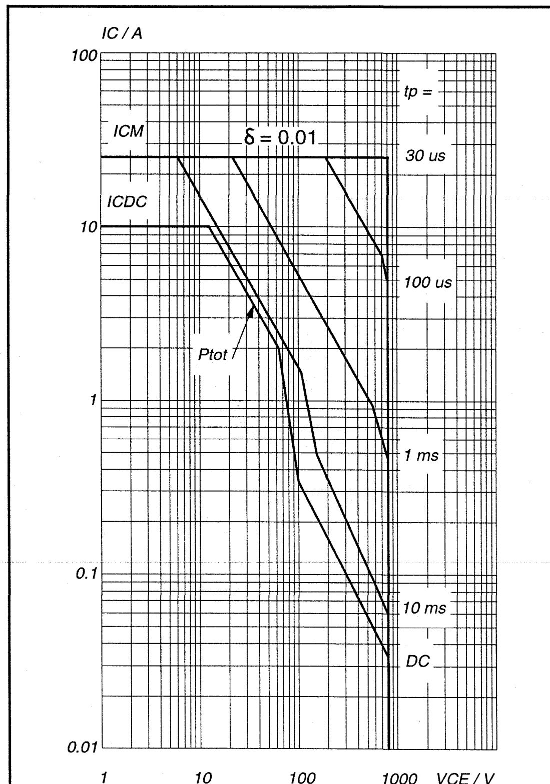


Fig.17. Forward bias safe operating area. $T_{mb} = 25\ ^{\circ}C$ I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p Second-breakdown limits independant of temperature.

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.

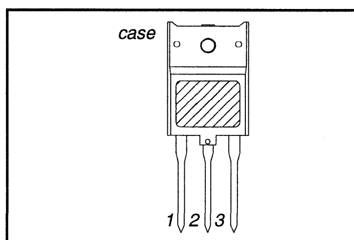
QUICK REFERENCE DATA

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_{Csat} = 6.0 A; $I_{B(end)}$ = 0.85 A	0.2	0.35	µs

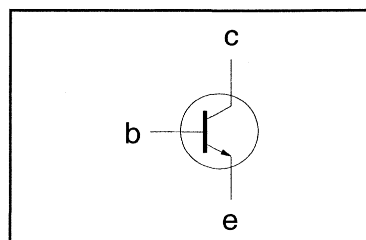
PINNING - SOT399

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
$R_{th\ j\text{-}hs}$	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	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9.5	

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	115	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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_{Csat} = 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).

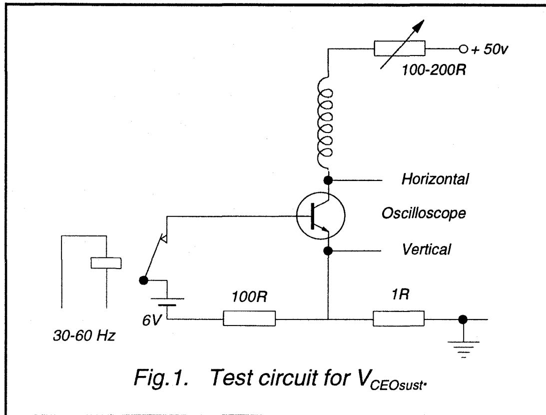


Fig.1. Test circuit for $V_{CEOsust}$.

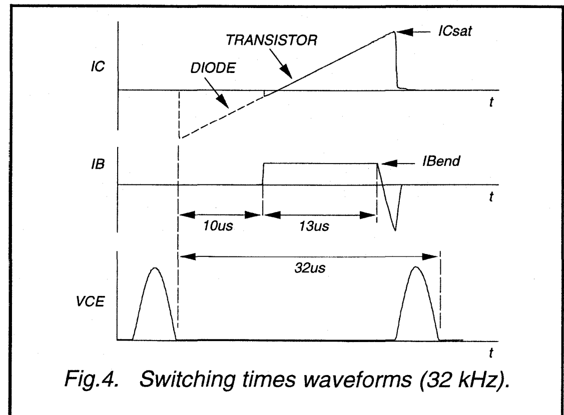


Fig.4. Switching times waveforms (32 kHz).

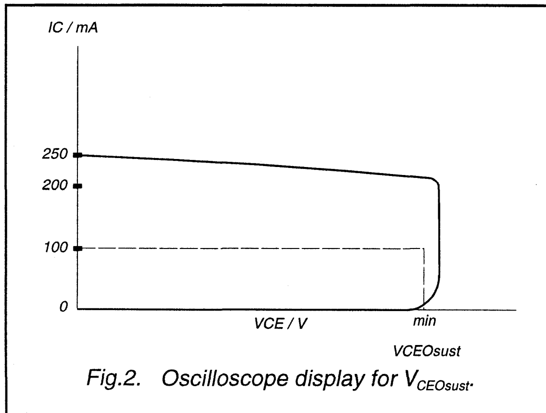


Fig.2. Oscilloscope display for $V_{CEOsust}$.

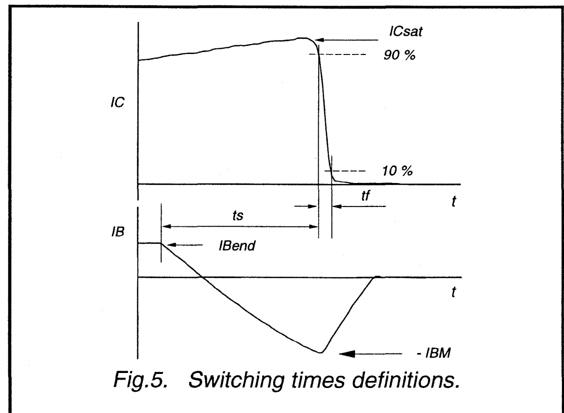


Fig.5. Switching times definitions.

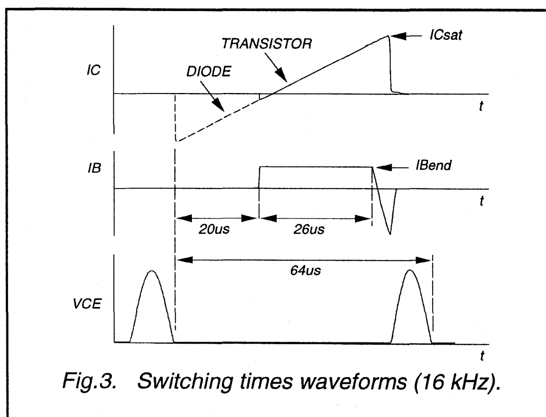


Fig.3. Switching times waveforms (16 kHz).

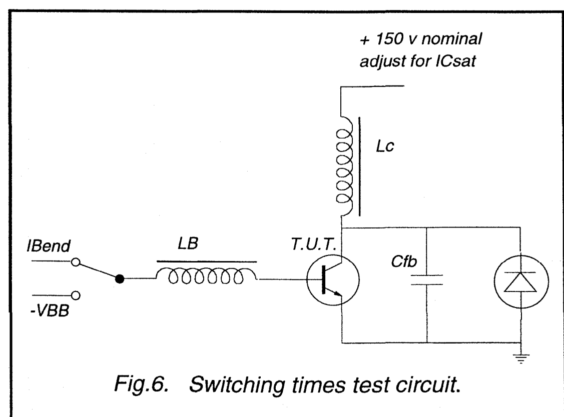


Fig.6. Switching times test circuit.

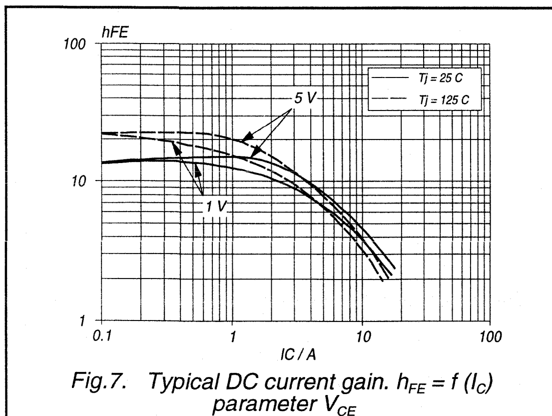


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

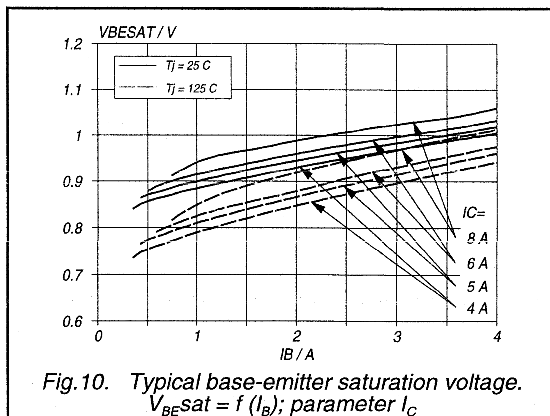


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

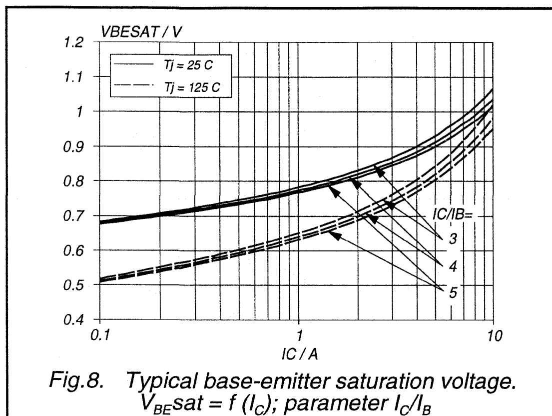


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

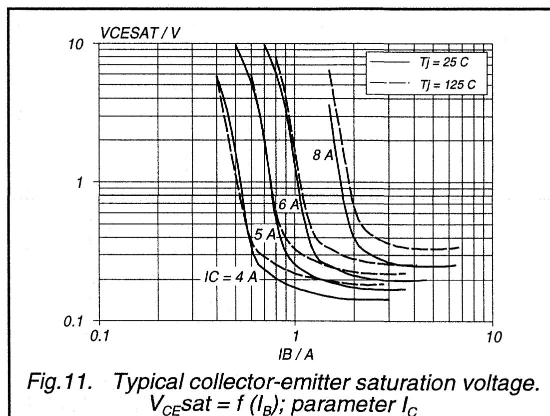


Fig.11. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

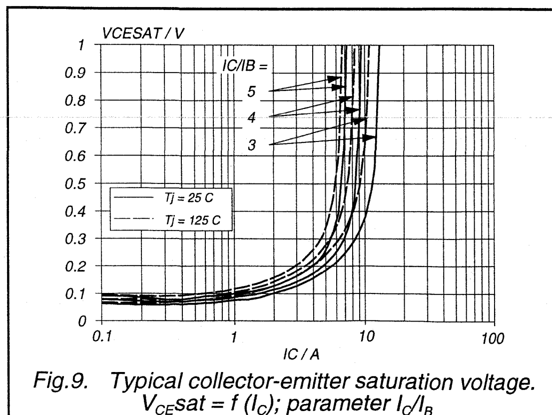


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

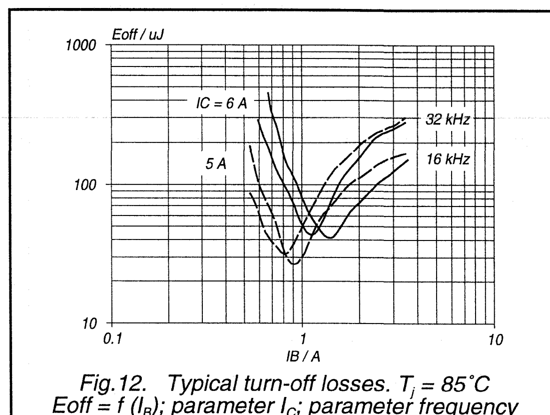


Fig.12. Typical turn-off losses. $T_j = 85^{\circ}C$ $E_{off} = f\ (I_B)$; parameter I_C; parameter frequency

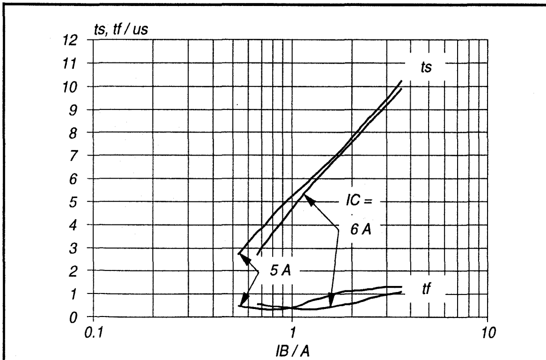


Fig. 13. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16$ kHz

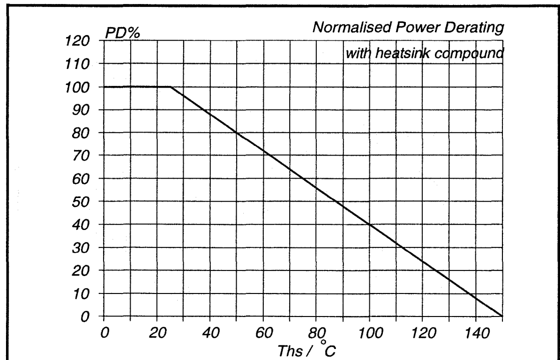


Fig. 15. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f(T_{hs})$

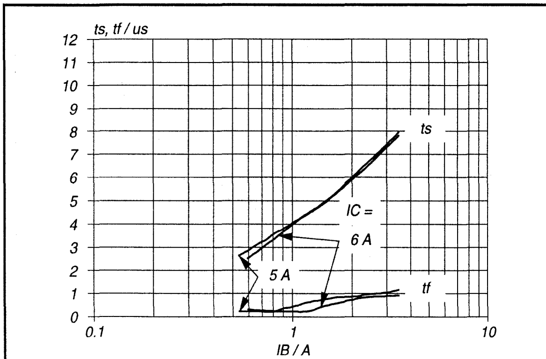


Fig. 14. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 32$ kHz

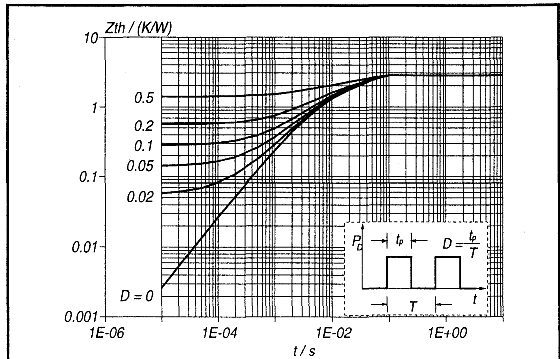


Fig. 16. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

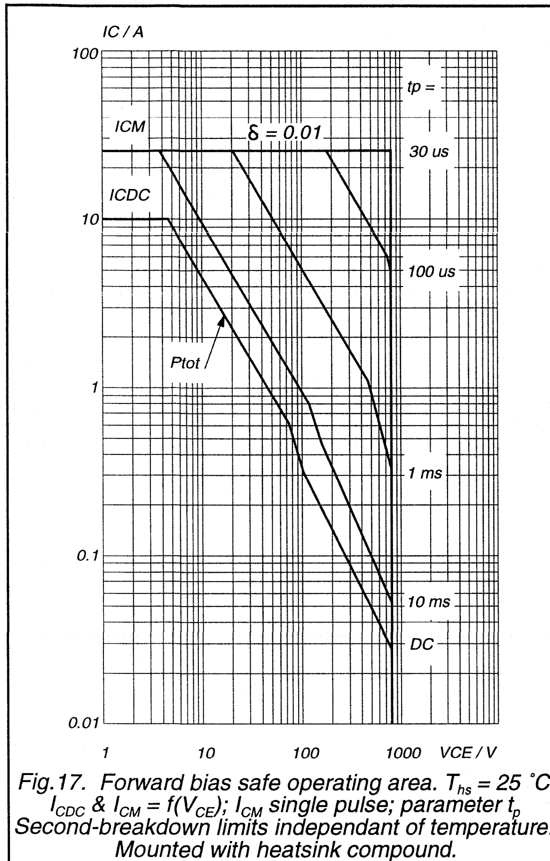


Fig.17. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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.

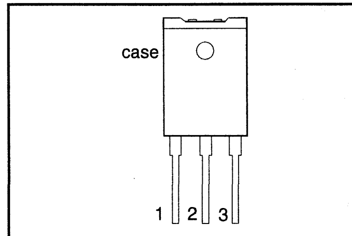
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
V_{CEO}	Collector-emmiter 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	$I_{Csat} = 6.0$ A; $I_{B(end)} = 1.0$ A	0.35	0.5	µs

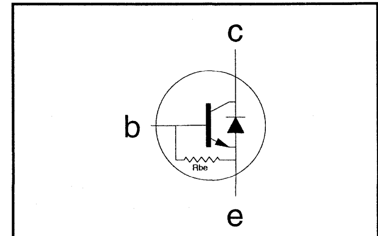
PINNING - SOT199

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
$R_{th\ j-hs}$	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	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9.5	
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_{Csat} = 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).

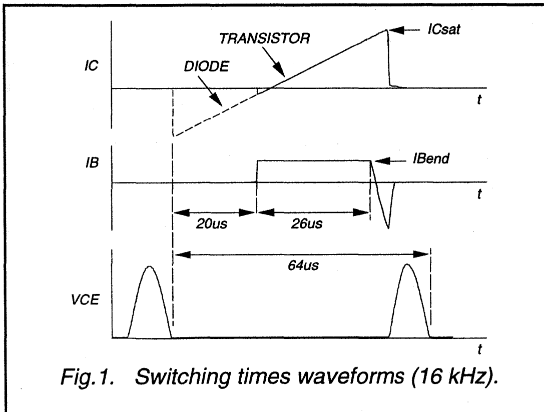


Fig.1. Switching times waveforms (16 kHz).

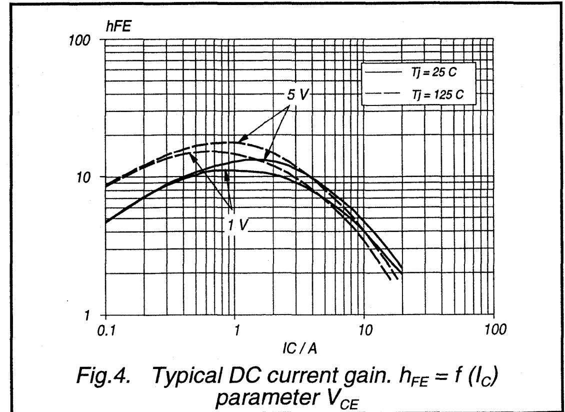


Fig.4. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

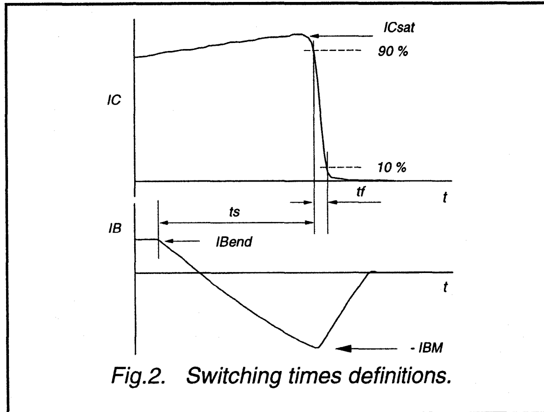


Fig.2. Switching times definitions.

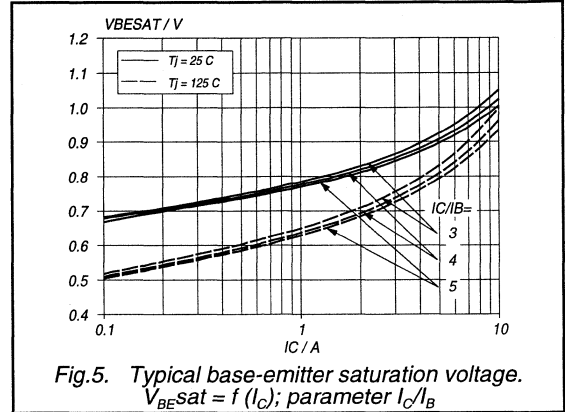


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

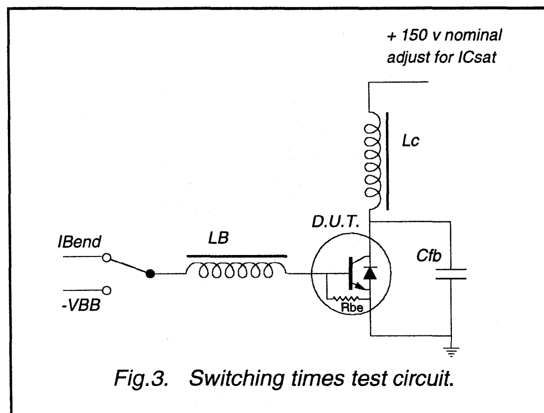


Fig.3. Switching times test circuit.

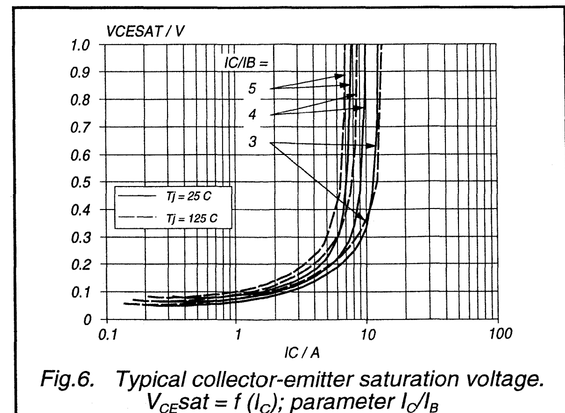


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

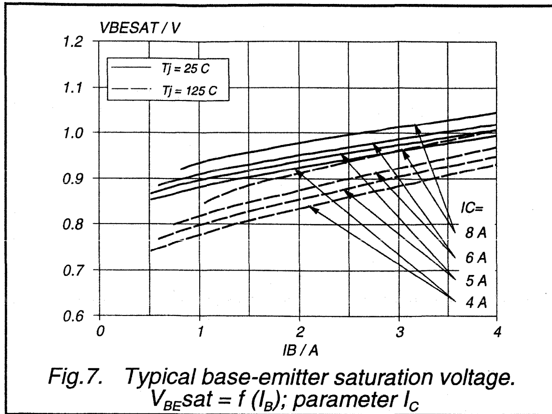


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

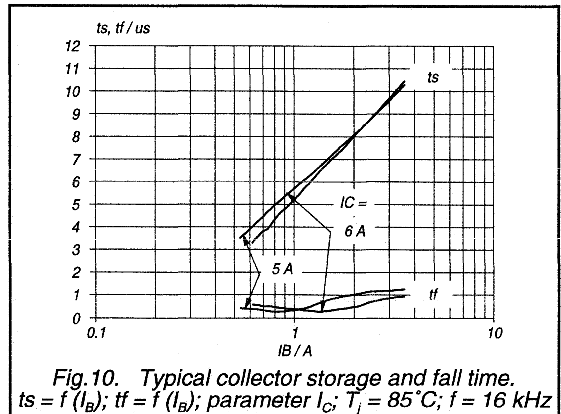


Fig.10. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

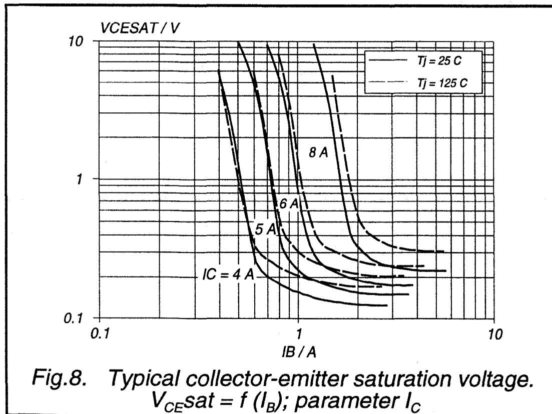


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

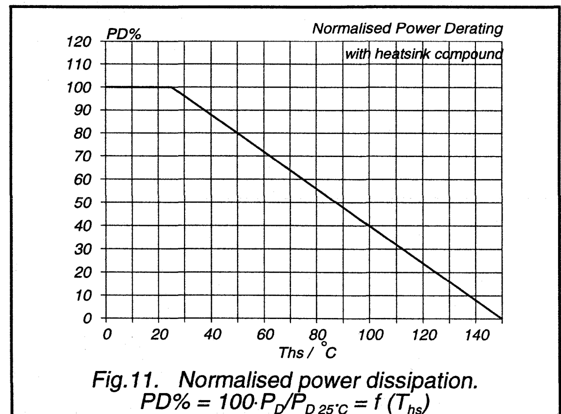


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

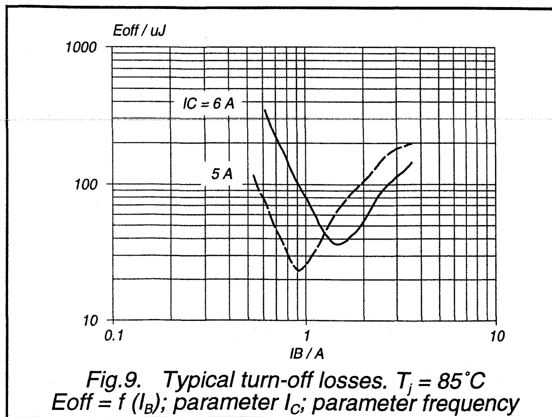


Fig.9. Typical turn-off losses. $T_j = 85˚C$ Eoff = $f(I_B)$; parameter I_C; parameter frequency

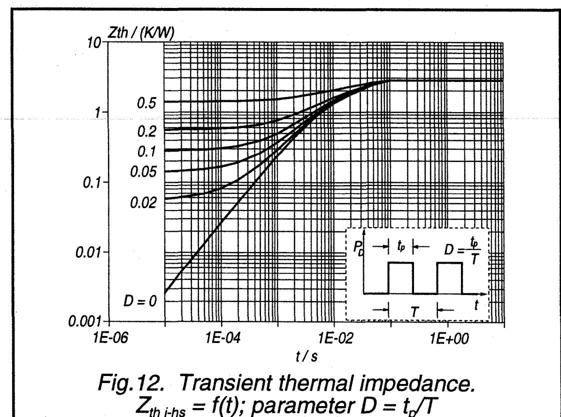


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

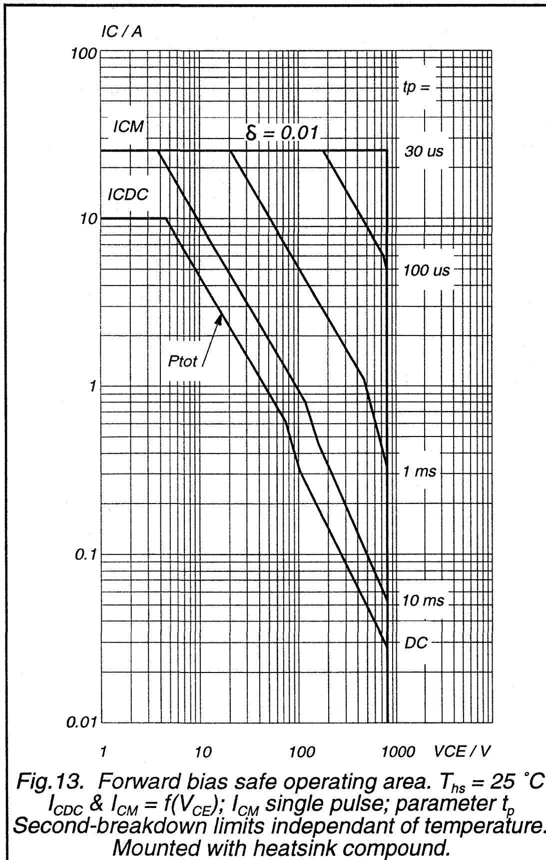


Fig.13. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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.

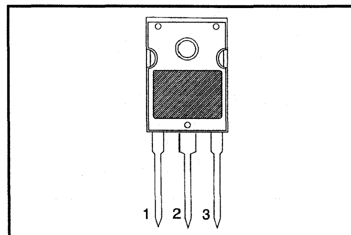
QUICK REFERENCE DATA

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_{Csat} = 6.0 A; $I_{B(end)}$ = 1.0 A	0.35	0.5	µs

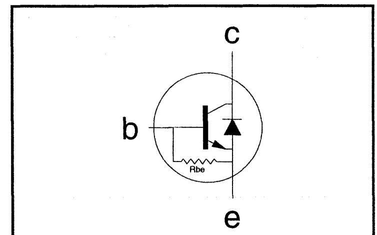
PINNING - SOT429

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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9.5	
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_{Csat} = 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

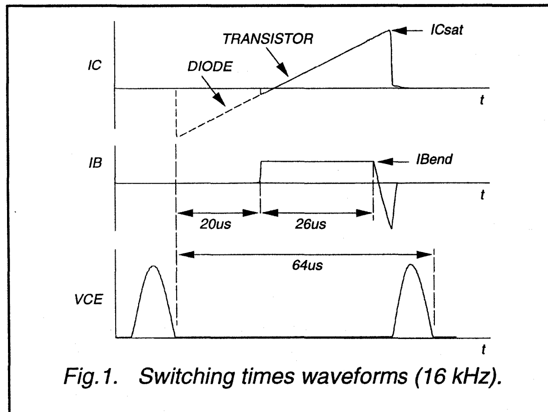


Fig.1. Switching times waveforms (16 kHz).

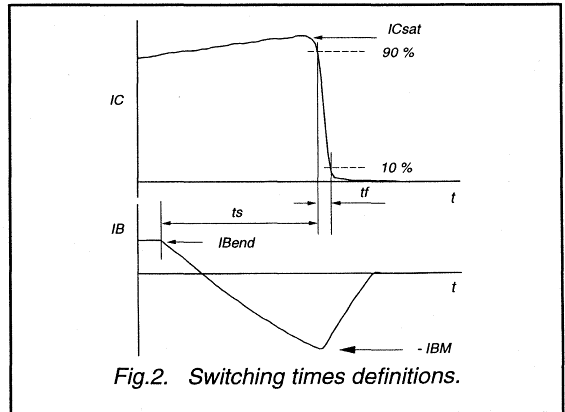


Fig.2. Switching times definitions.

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

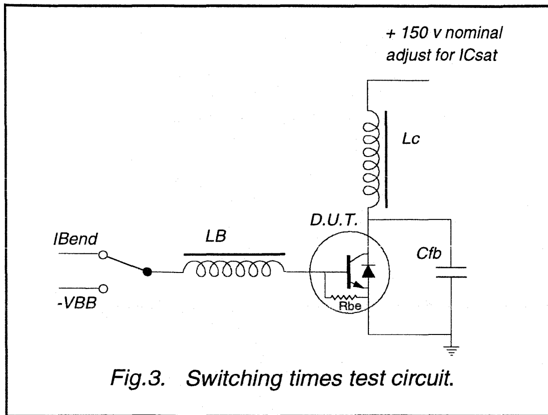


Fig.3. Switching times test circuit.

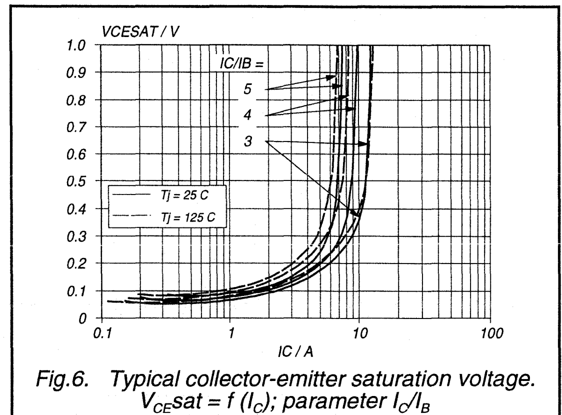


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

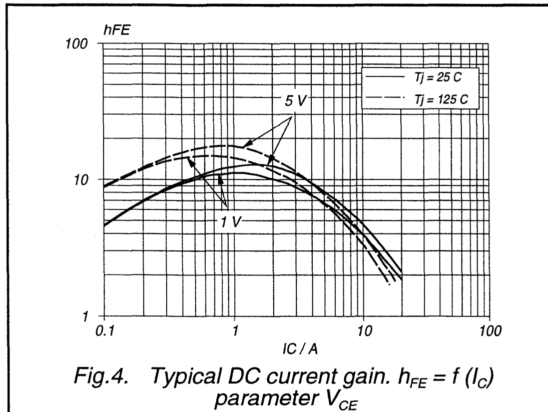


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

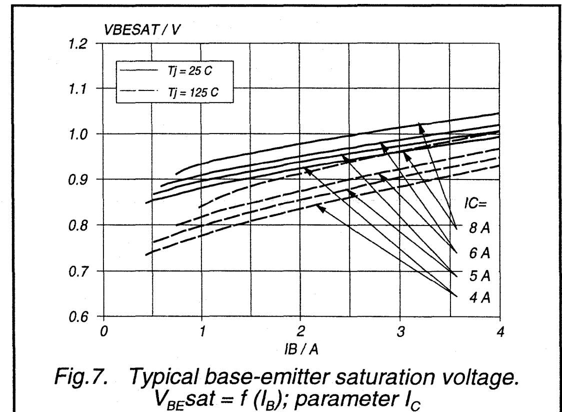


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

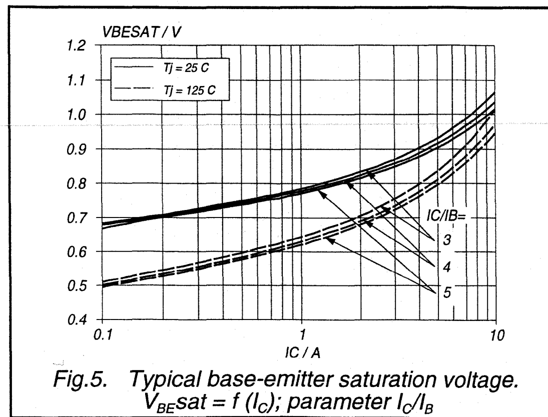


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

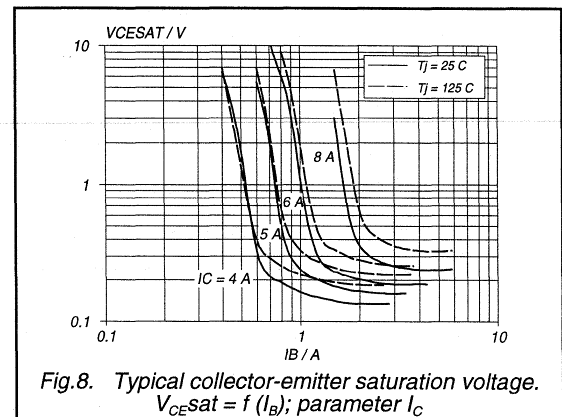


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

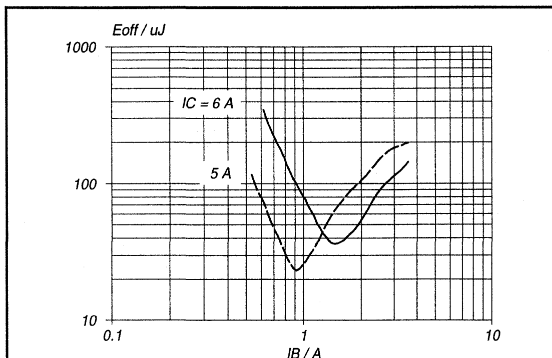


Fig.9. Typical turn-off losses. T_j = 85˚C
Eoff = f (I_B); parameter I_C; parameter frequency

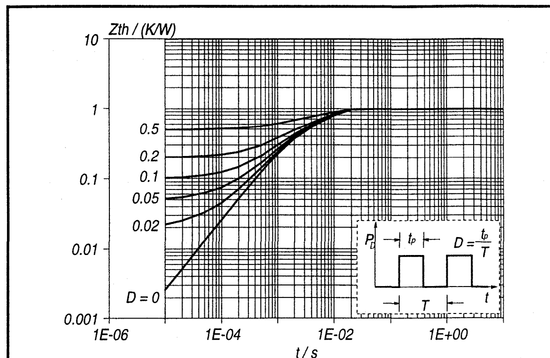


Fig.12. Transient thermal impedance.
$Z_{th\,j\text{-}mb}$ = f(t); parameter D = t_p/T

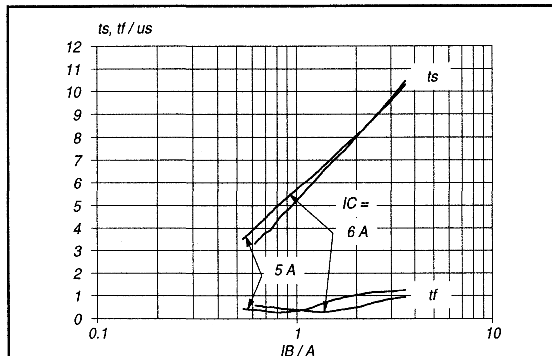


Fig.10. Typical collector storage and fall time.
ts = f (I_B); tf = f (I_B); parameter I_C; T_j = 85˚C; f = 16 kHz

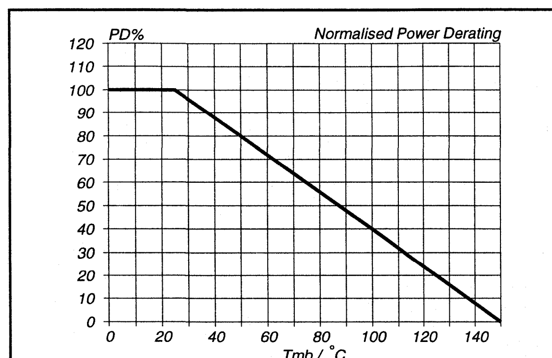


Fig.11. Normalised power dissipation.
PD% = 100·P_D/$P_{D\,25˚C}$ = f (T_{mb})

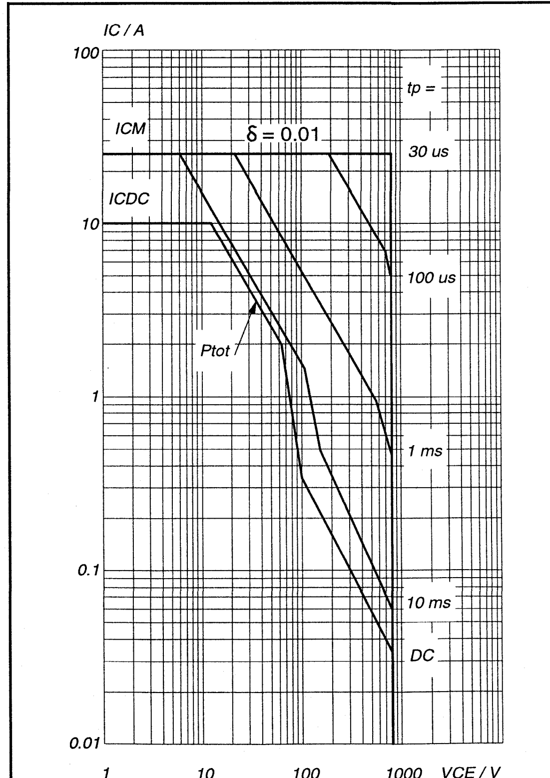


Fig.13. Forward bias safe operating area. T_{mb} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.

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.

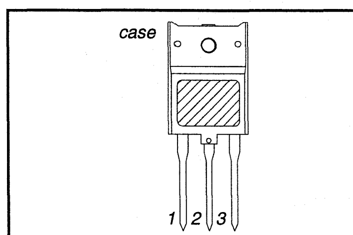
QUICK REFERENCE DATA

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	$I_{Csat} = 6.0$ A; $I_{B(end)} = 1.0$ A	0.35	0.5	µs

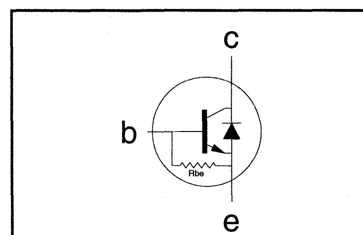
PINNING - SOT399

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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 6 A; V_{CE} = 5 V	5	7	9.5	
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_{Csat} = 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).

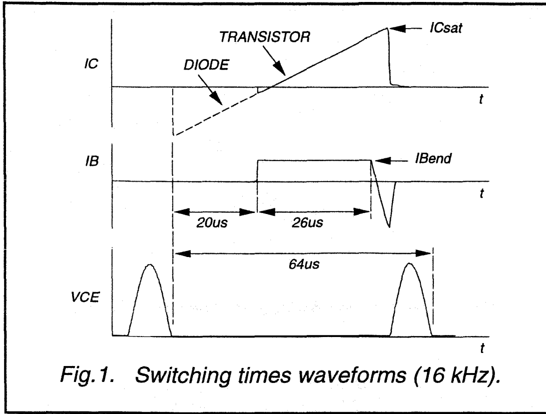


Fig.1. Switching times waveforms (16 kHz).

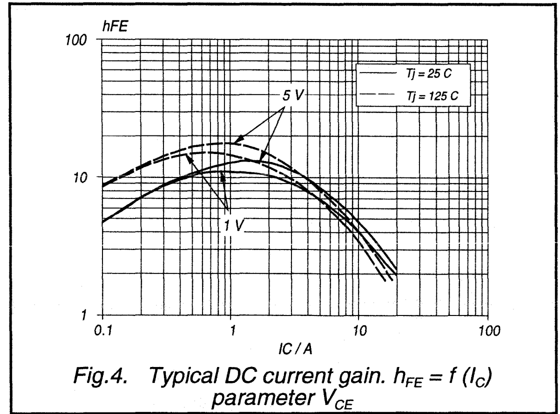


Fig.4. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

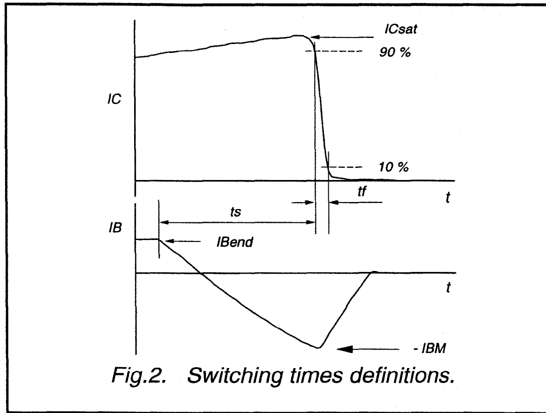


Fig.2. Switching times definitions.

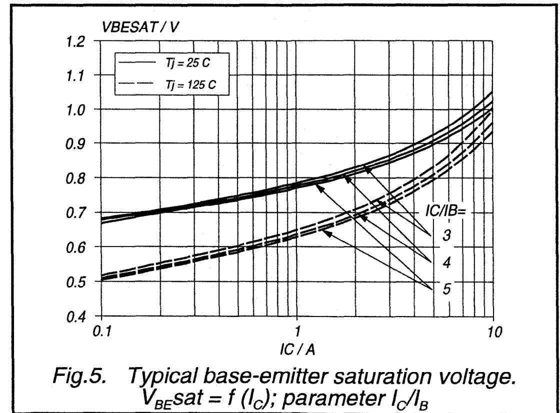


Fig.5. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

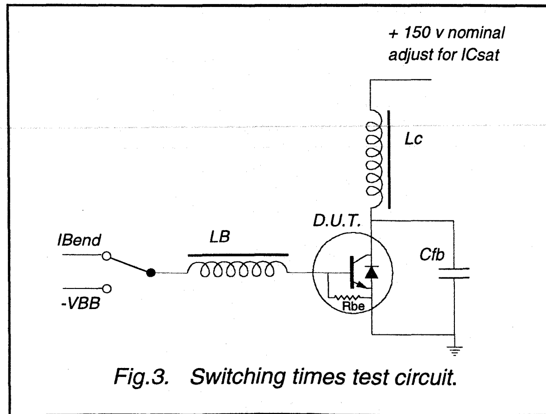


Fig.3. Switching times test circuit.

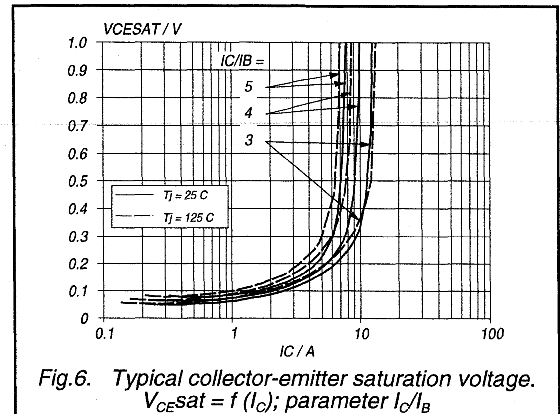


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

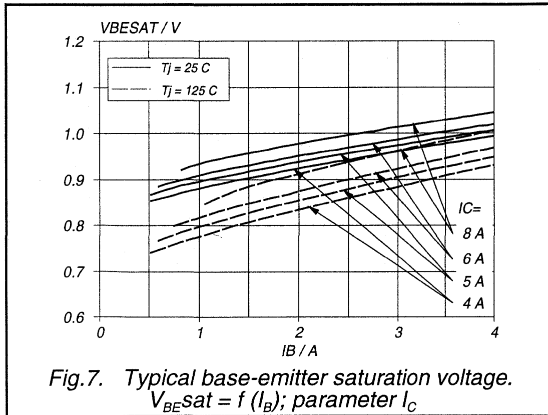


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

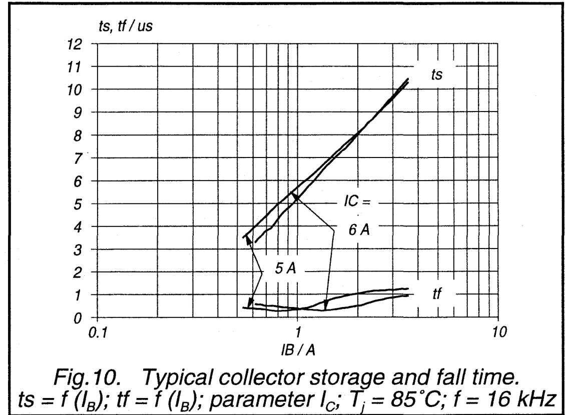


Fig.10. Typical collector storage and fall time. $ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85˚C$; $f = 16$ kHz

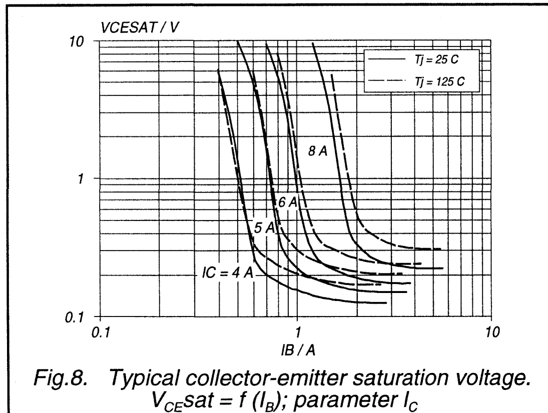


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_B)$; parameter I_C

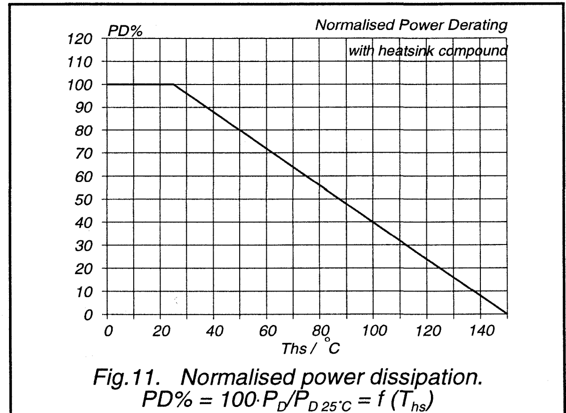


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f (T_{hs})$

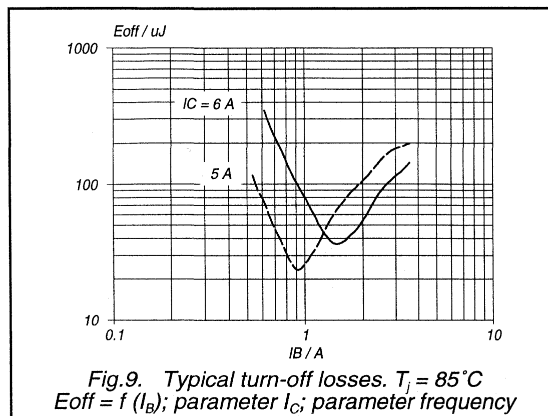


Fig.9. Typical turn-off losses. $T_j = 85˚C$ Eoff = f (I_B); parameter I_C; parameter frequency

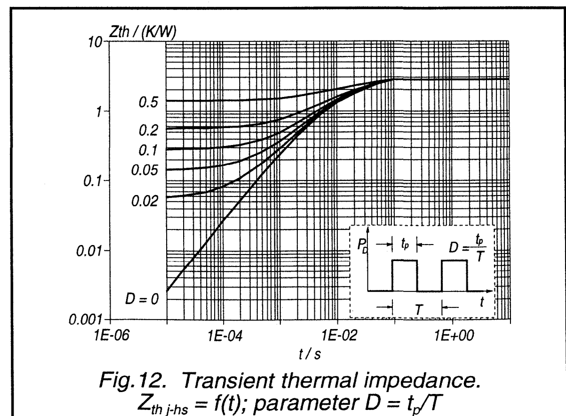


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

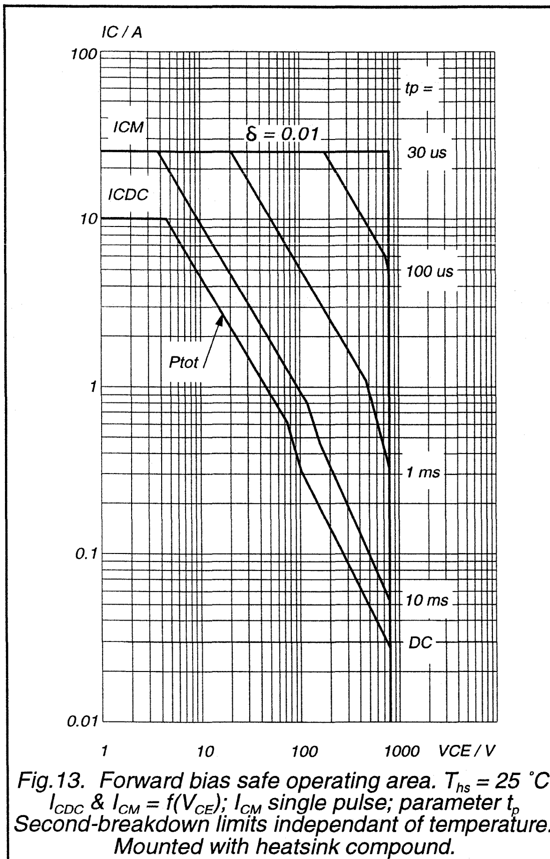


Fig.13. Forward bias safe operating area. T_{hs} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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 use in horizontal deflection circuits of pc monitors.

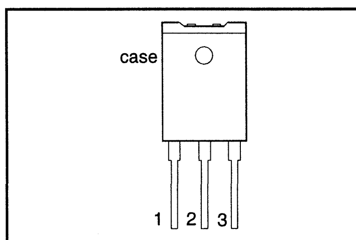
QUICK REFERENCE DATA

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	f = 64 kHz	6.0	-	A
t_f	Fall time	$I_{Csat} = 6.0$ A; f = 64 kHz	0.16	0.22	µs

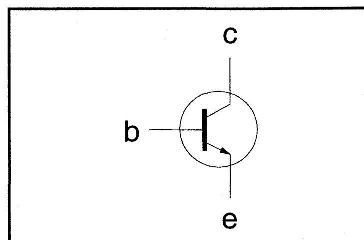
PINNING - SOT199

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	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	-	10	-	
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_{Csat} = 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).

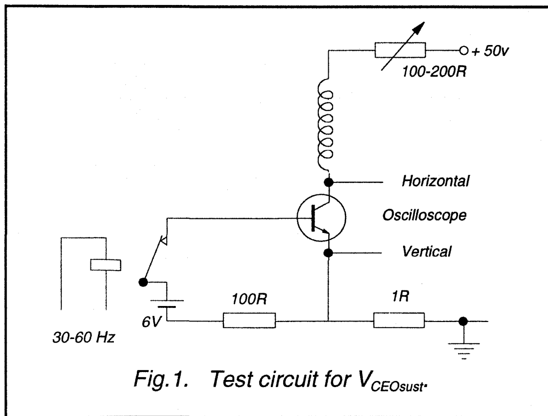


Fig.1. Test circuit for $V_{CEOsust}$.

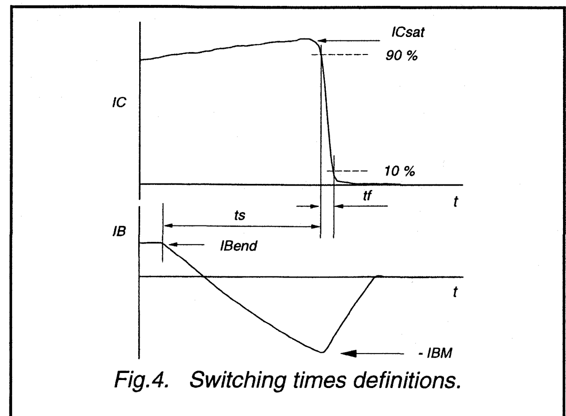


Fig.4. Switching times definitions.

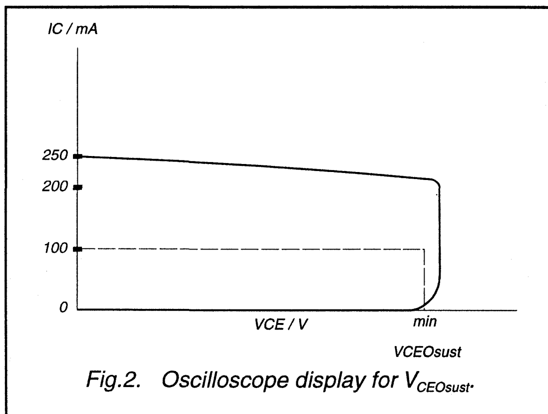


Fig.2. Oscilloscope display for $V_{CEOsust}$.

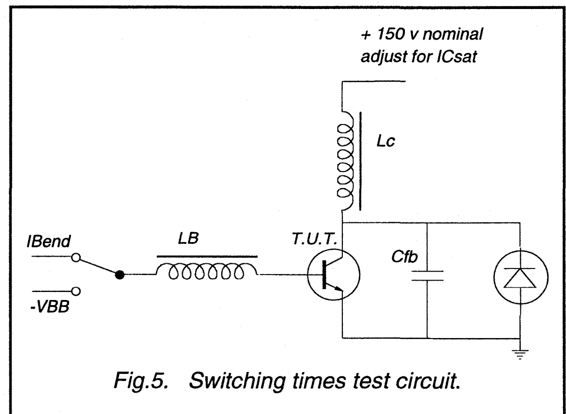


Fig.5. Switching times test circuit.

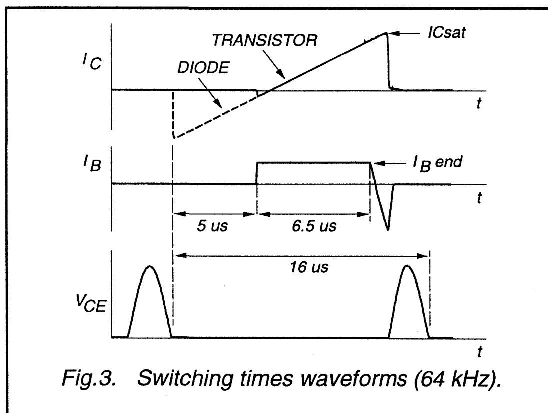


Fig.3. Switching times waveforms (64 kHz).

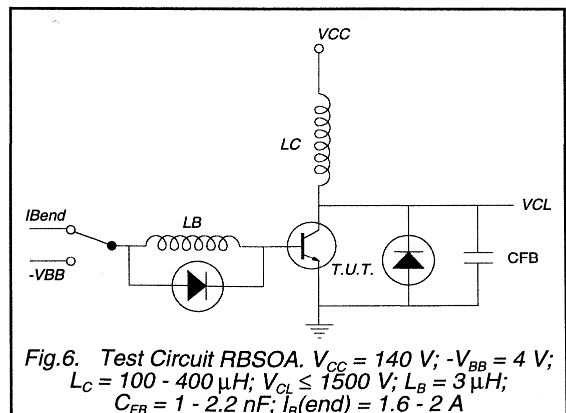


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 400 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1.6 - 2 A

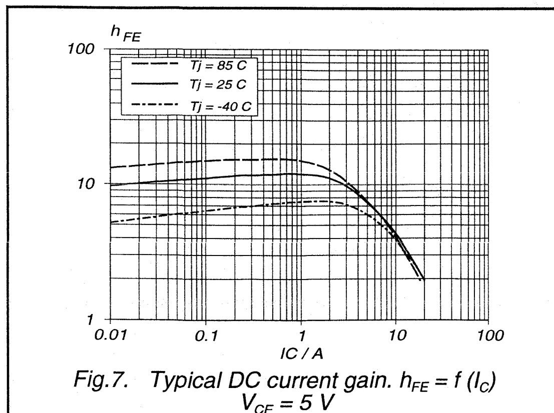


Fig.7. Typical DC current gain. $h_{FE} = f(I_C)$
$V_{CE} = 5$ V

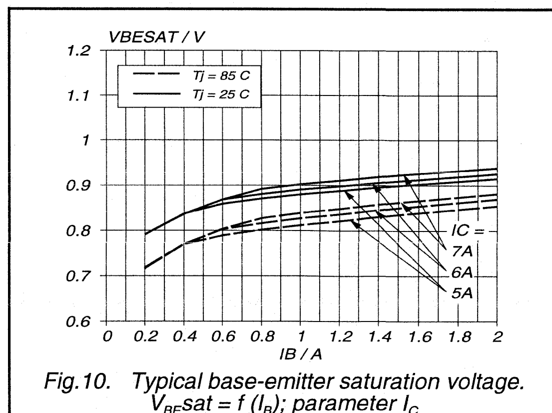


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

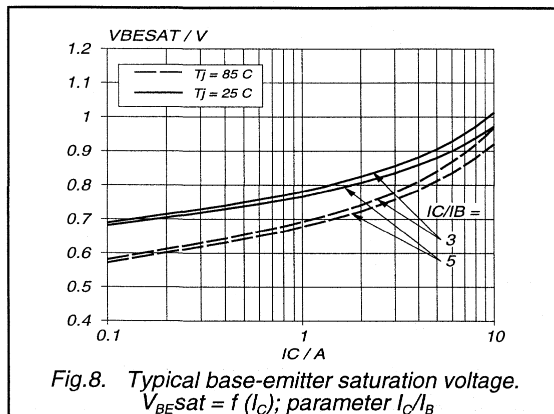


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_C)$; parameter I_C/I_B

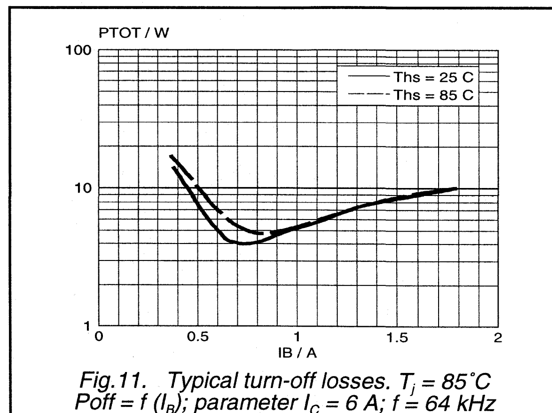


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$
$Poff = f(I_B)$; parameter $I_C = 6$ A; f = 64 kHz

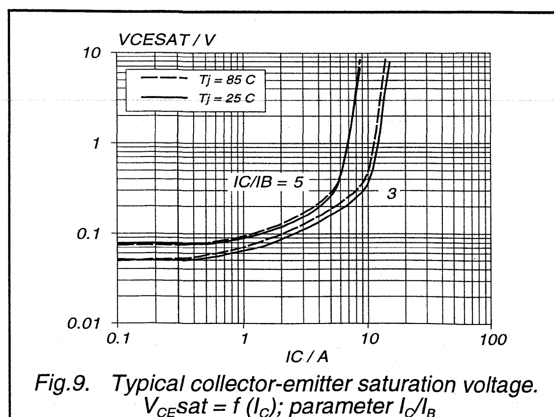


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

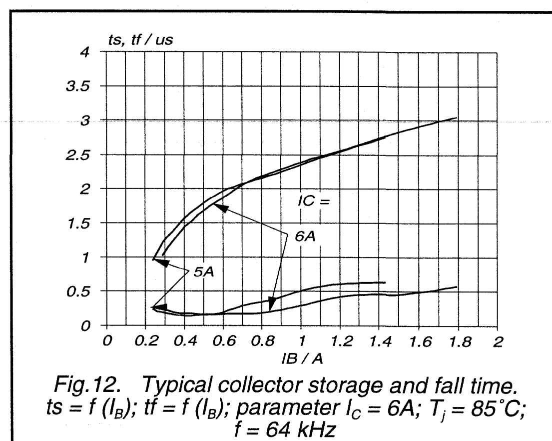


Fig.12. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter $I_C = 6A$; $T_j = 85^{\circ}C$;
f = 64 kHz

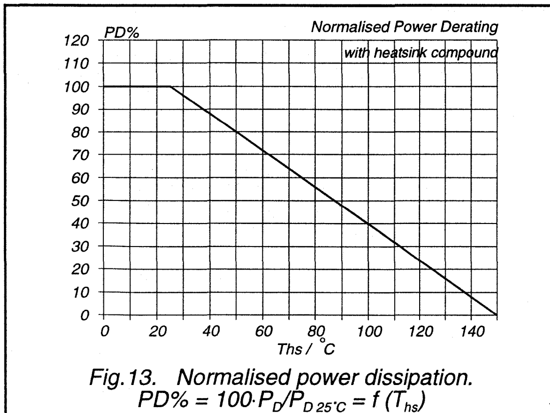


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{hs})$

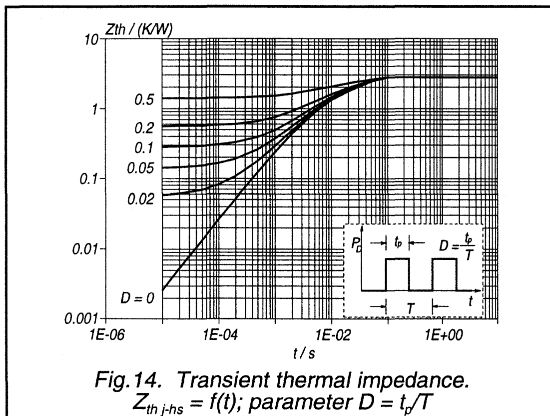


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

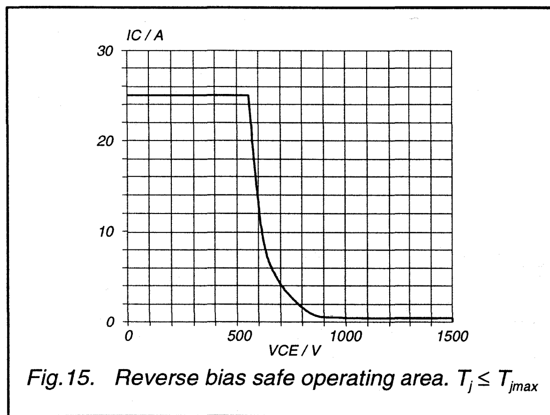


Fig.15. Reverse bias safe operating area. $T_j \leq T_{jmax}$

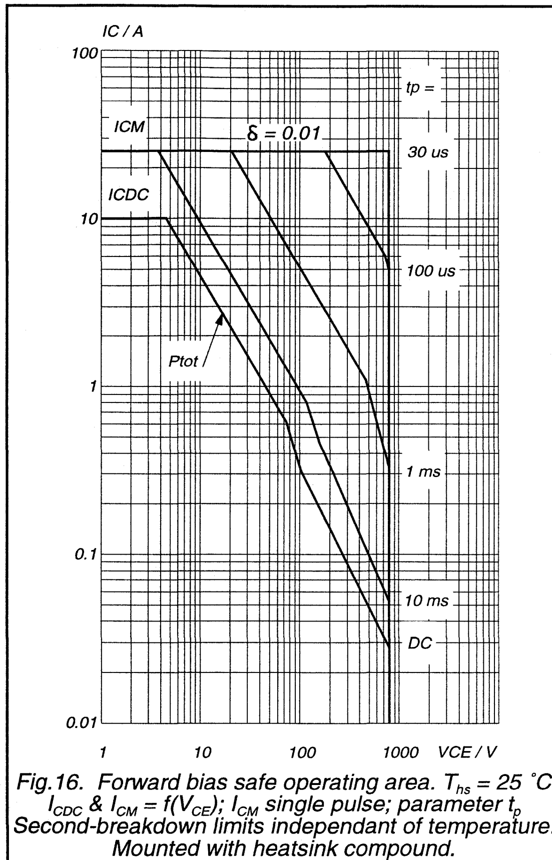


Fig.16. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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 use in horizontal deflection circuits of pc monitors.

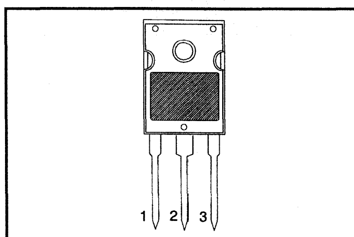
QUICK REFERENCE DATA

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	f = 64 kHz	6.0	-	A
t_f	Fall time	I_{Csat} = 6.0 A; f = 64 kHz	0.12	0.25	µs

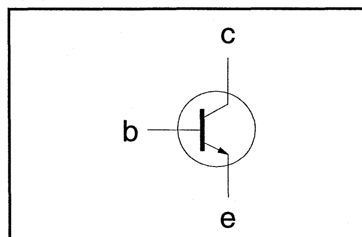
PINNING - SOT429

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	with heatsink compound	-	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	-	10	-	
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_{Csat} = 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; ($-dI_B/dt$ = 3.33A/µs)			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.12	0.25	µs

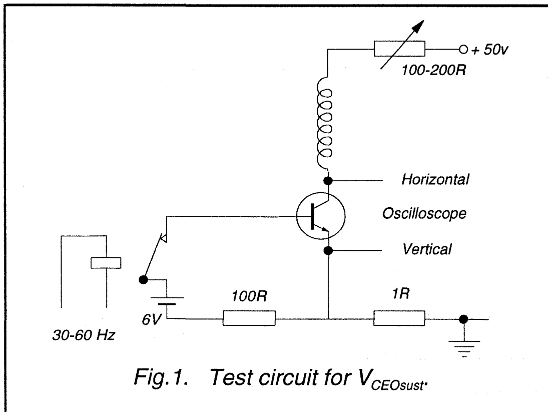


Fig.1. Test circuit for $V_{CEOsust}$.

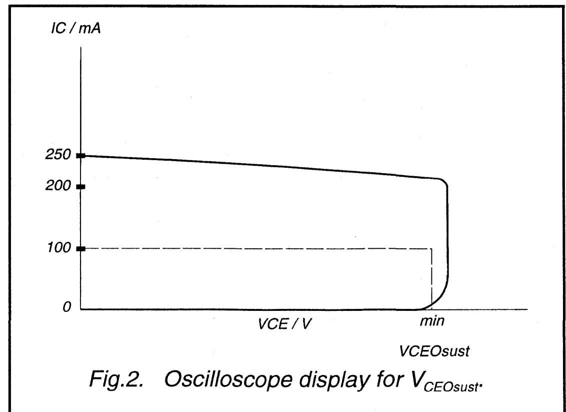


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

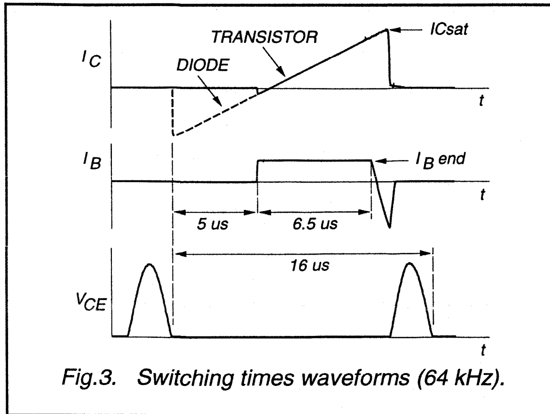


Fig.3. Switching times waveforms (64 kHz).

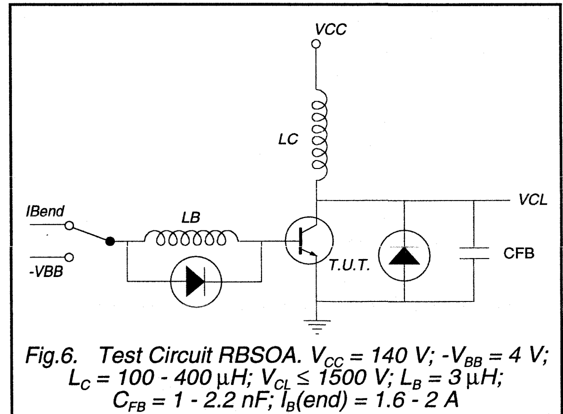


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 400 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1.6 - 2 A

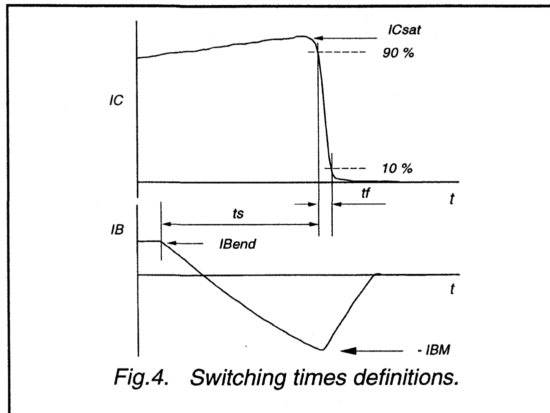


Fig.4. Switching times definitions.

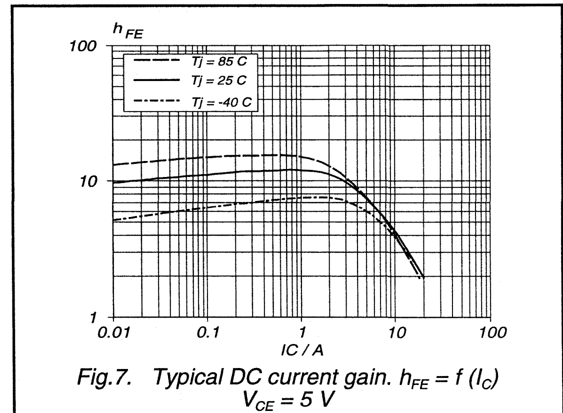


Fig.7. Typical DC current gain. $h_{FE} = f(I_C)$
V_{CE} = 5 V

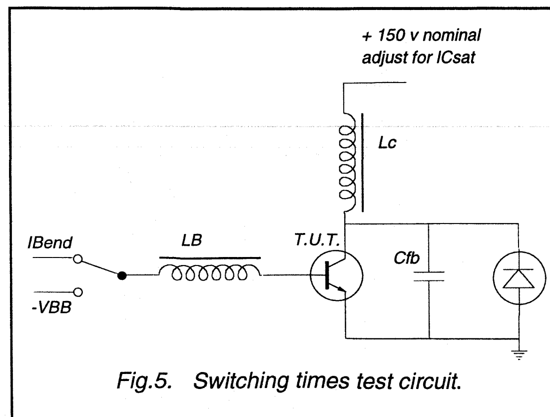


Fig.5. Switching times test circuit.

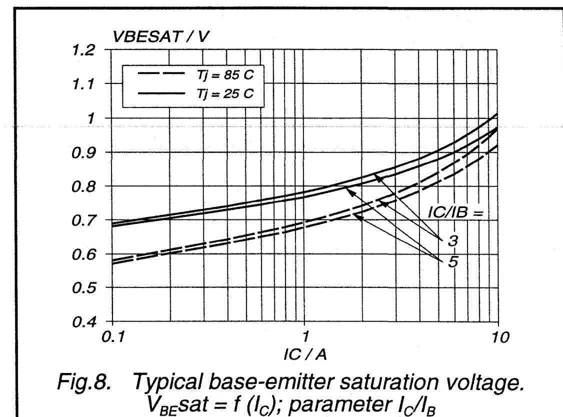


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

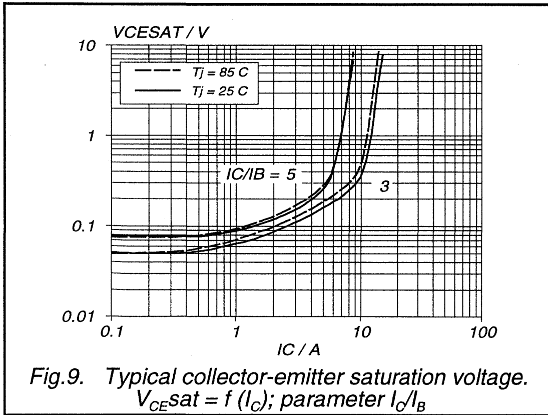


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

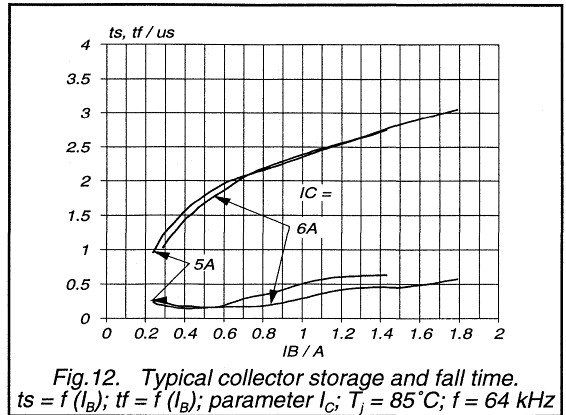


Fig.12. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 64\ kHz$

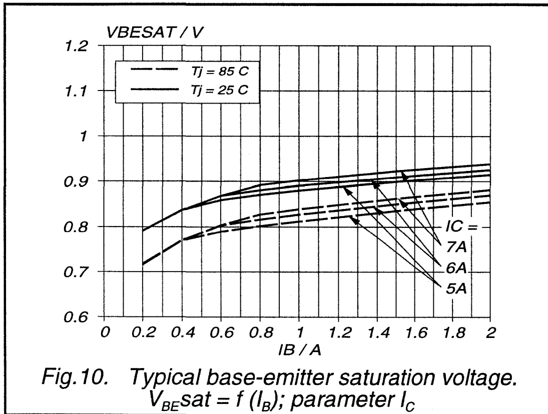


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

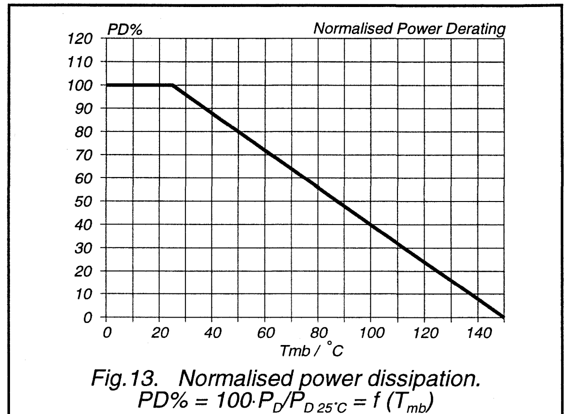


Fig.13. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25^\circ C} = f\ (T_{mb})$

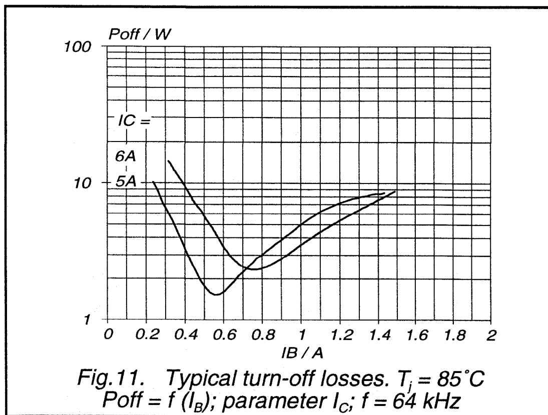


Fig.11. Typical turn-off losses. $T_j = 85^\circ C$ $Poff = f\ (I_B)$; parameter I_C; $f = 64\ kHz$

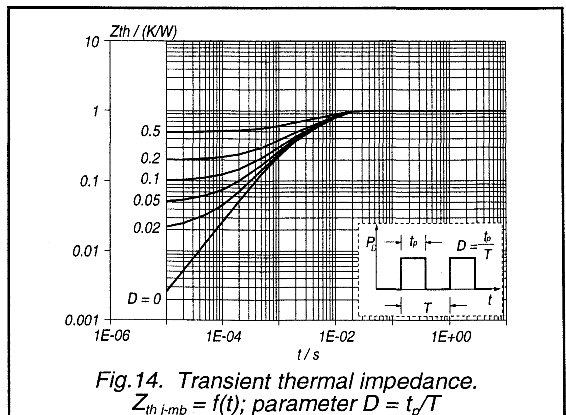


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

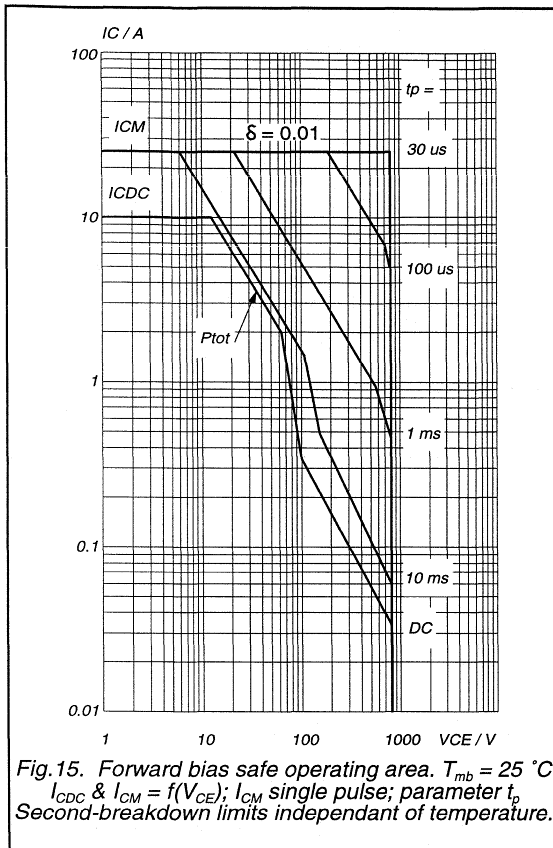


Fig.15. Forward bias safe operating area. T_{mb} = 25 ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.

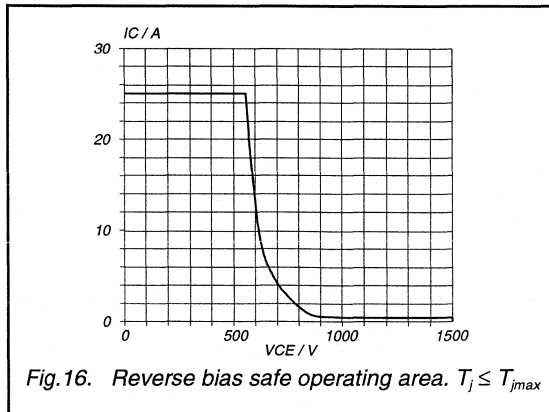


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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 use in horizontal deflection circuits of pc monitors.

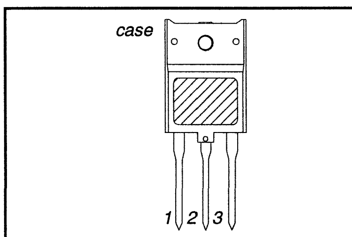
QUICK REFERENCE DATA

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	f = 64 kHz	6.0	-	A
t_f	Fall time	$I_{Csat} = 6.0$ A; f = 64 kHz	0.16	0.22	µs

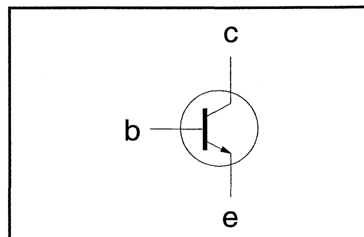
PINNING - SOT399

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} = $V_{CESMmax}$	-	-	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	-	10	-	
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_{Csat} = 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= 3.33A /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).

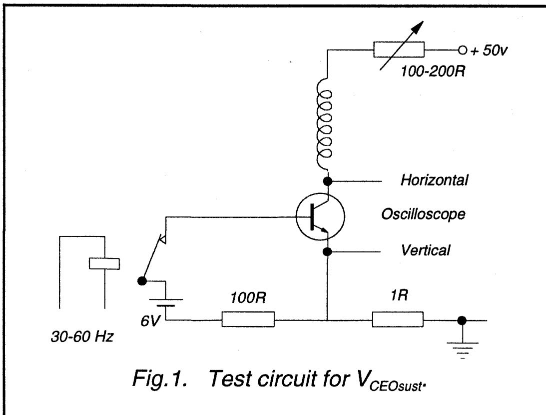


Fig.1. Test circuit for $V_{CEOsust}$.

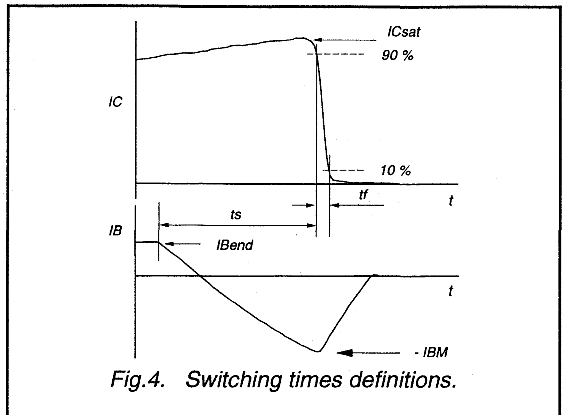


Fig.4. Switching times definitions.

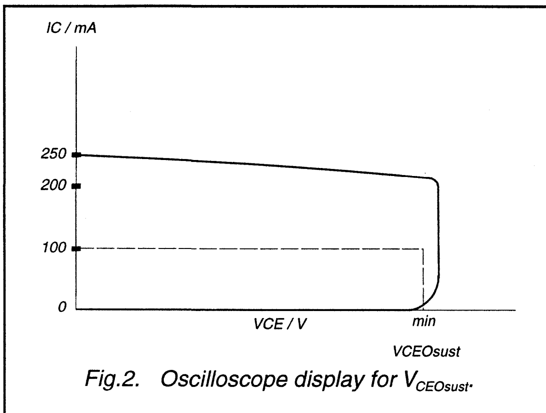


Fig.2. Oscilloscope display for $V_{CEOsust}$.

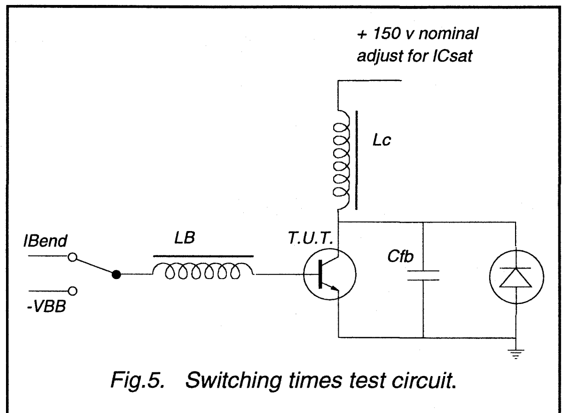


Fig.5. Switching times test circuit.

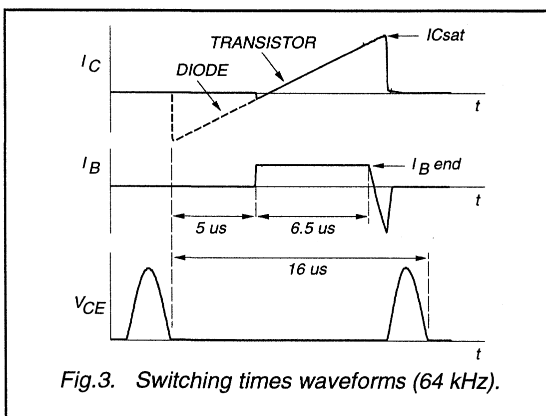


Fig.3. Switching times waveforms (64 kHz).

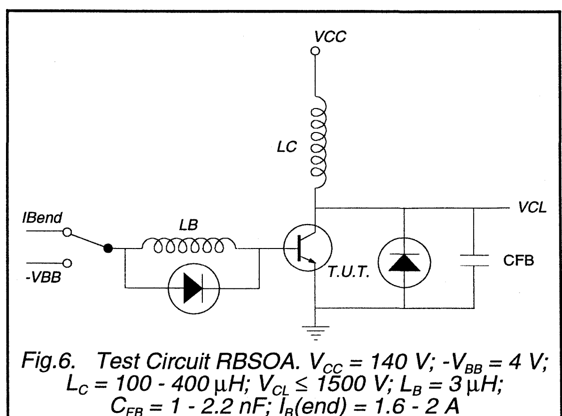


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 400 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; $I_B(end)$ = 1.6 - 2 A

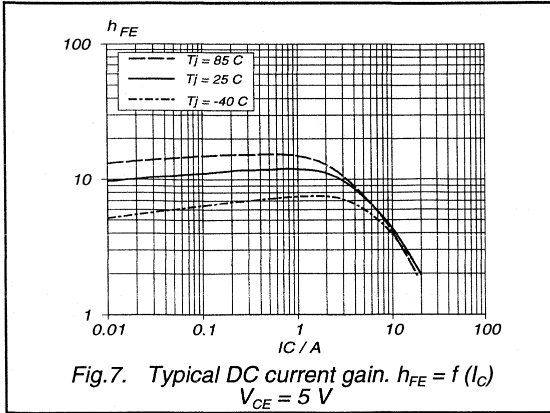


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

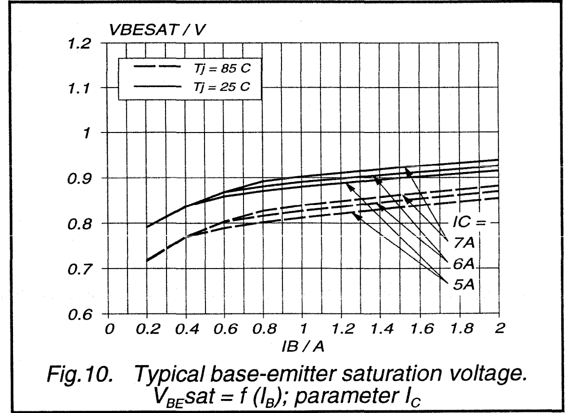


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

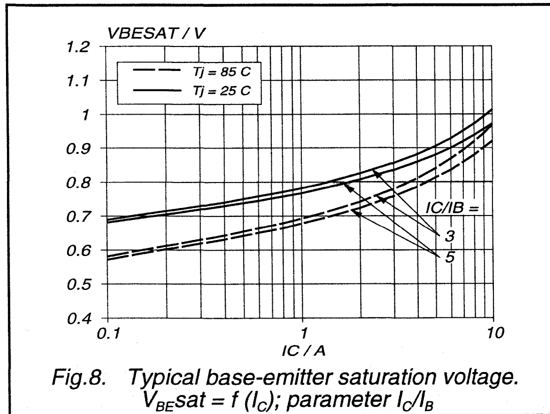


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

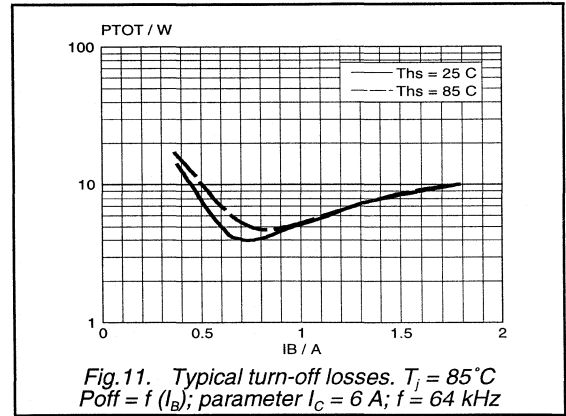


Fig.11. Typical turn-off losses. $T_j = 85^\circ C$
Poff = $f\ (I_B)$; parameter $I_C = 6\ A$; $f = 64\ kHz$

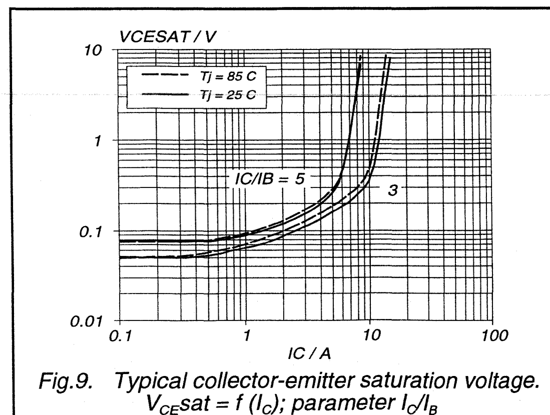


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

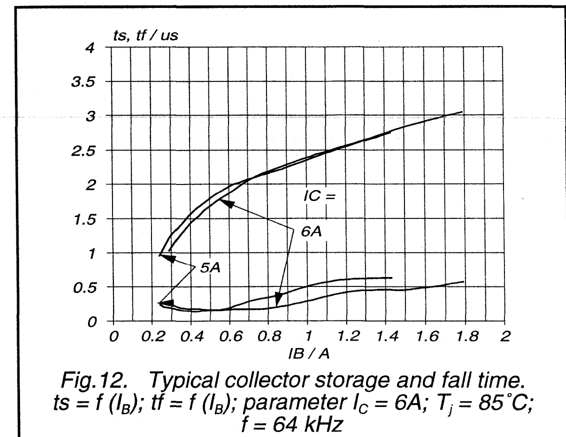


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter $I_C = 6A$; $T_j = 85^\circ C$;
$f = 64\ kHz$

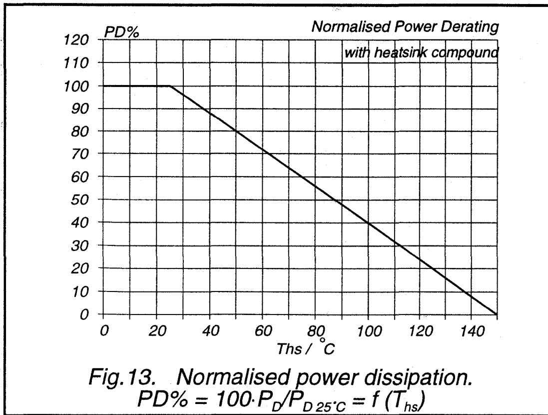


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

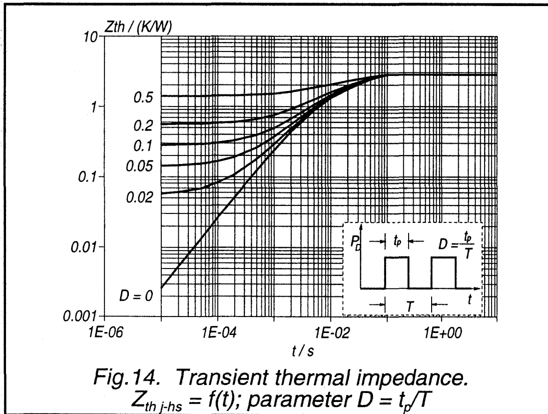


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

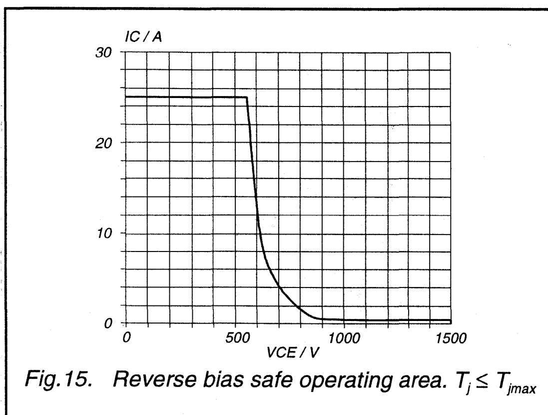


Fig.15. Reverse bias safe operating area. $T_j \leq T_{jmax}$

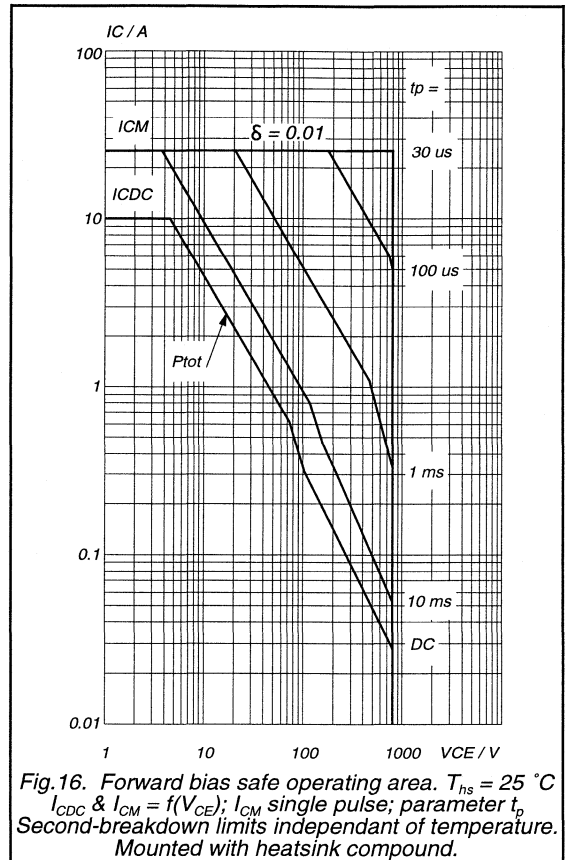


Fig.16. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

GENERAL DESCRIPTION

New generation, 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 high resolution monitors. Features improved RBSOA performance and is suitable for use in horizontal deflection circuits of pc monitors.

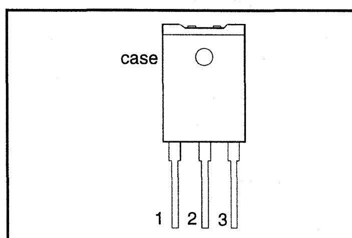
QUICK REFERENCE DATA

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	f = 64 kHz	6	-	A
V_F	Diode forward voltage	$I_F = 6.0$ A	-	2.2	V
t_f	Fall time	$I_{Csat} = 6.0$ A; f = 64 kHz	0.12	0.25	µs

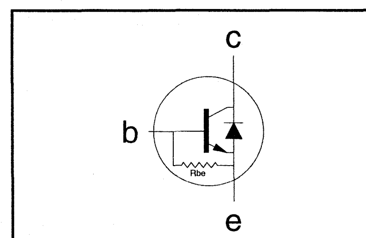
PINNING - SOT199

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	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	-	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	-	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
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_{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).

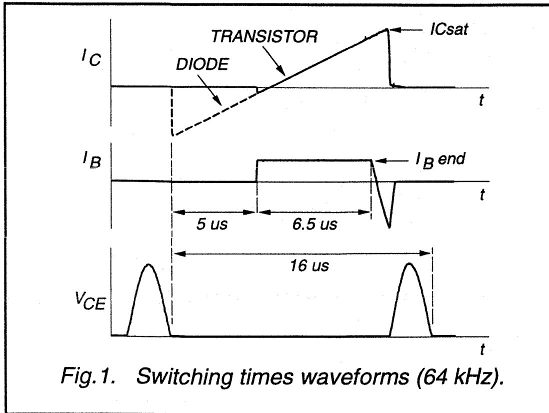


Fig.1. Switching times waveforms (64 kHz).

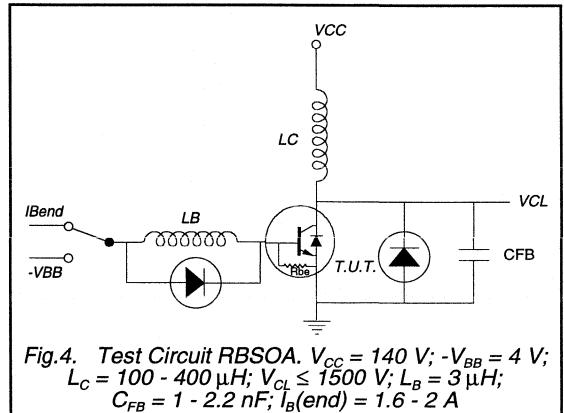


Fig.4. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 400 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1.6 - 2 A

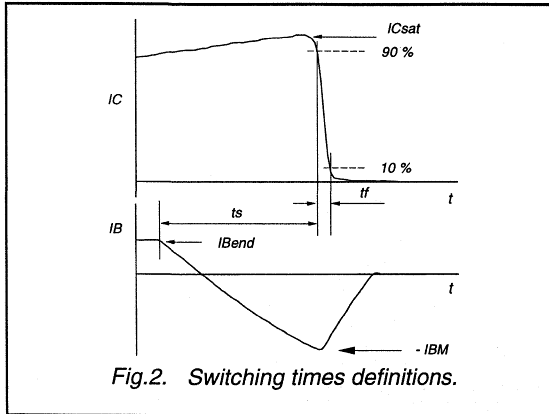


Fig.2. Switching times definitions.

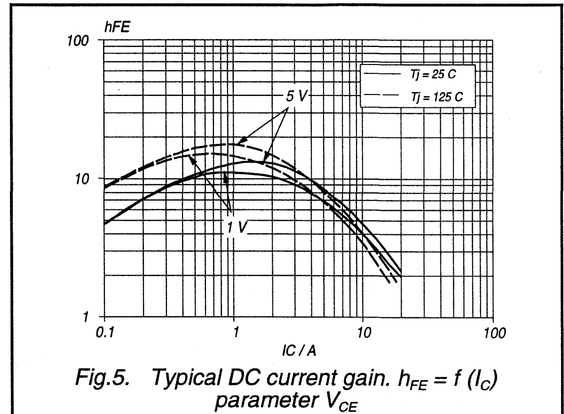


Fig.5. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

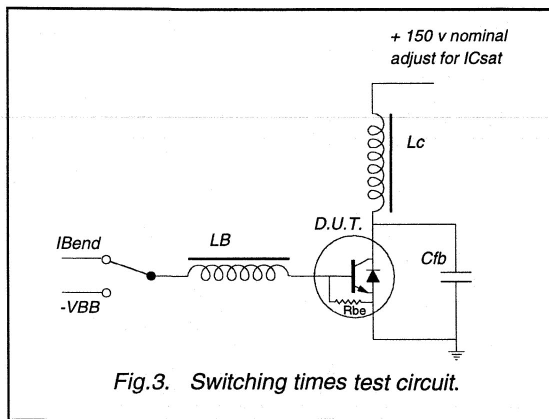


Fig.3. Switching times test circuit.

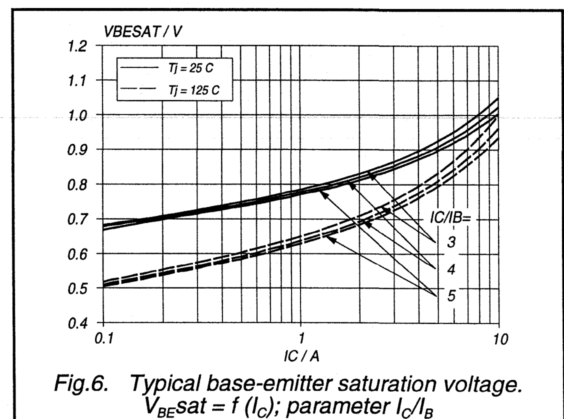


Fig.6. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

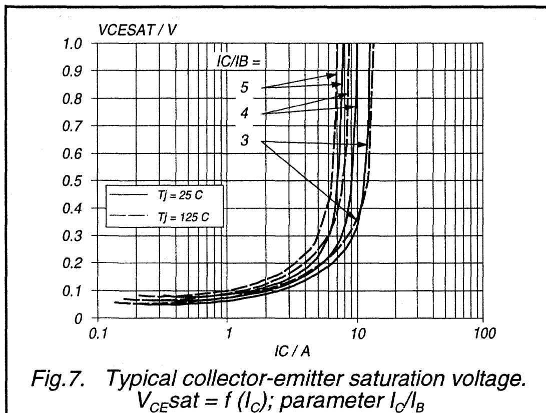


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

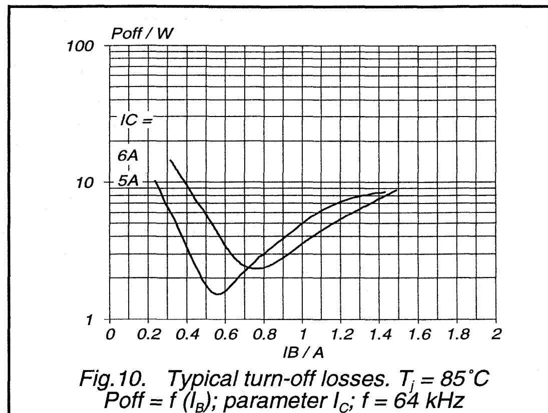


Fig.10. Typical turn-off losses. $T_j = 85˚C$ Poff = $f(I_B)$; parameter I_C; f = 64 kHz

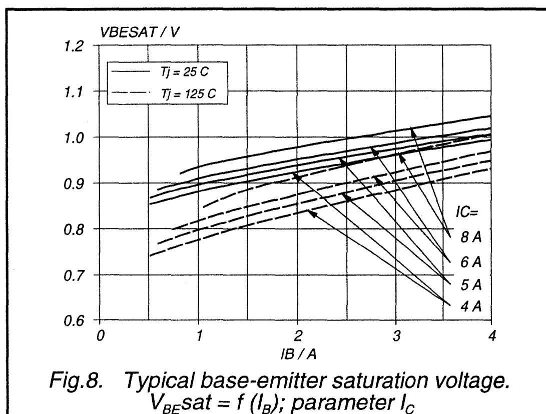


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

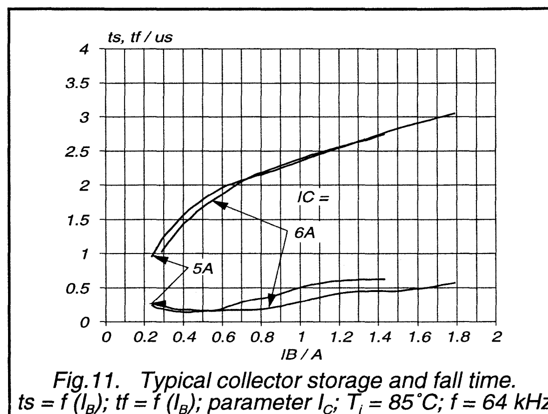


Fig.11. Typical collector storage and fall time. ts = $f(I_B)$; tf = $f(I_B)$; parameter I_C; $T_j = 85˚C$; f = 64 kHz

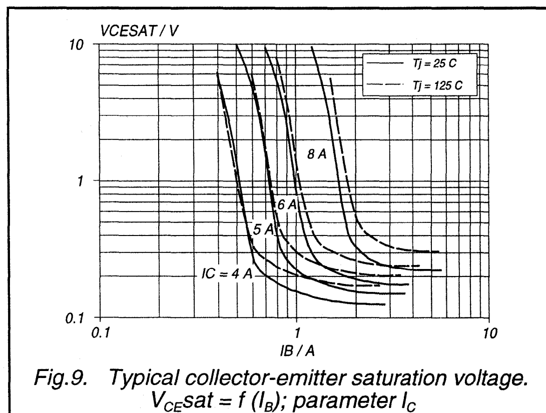


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

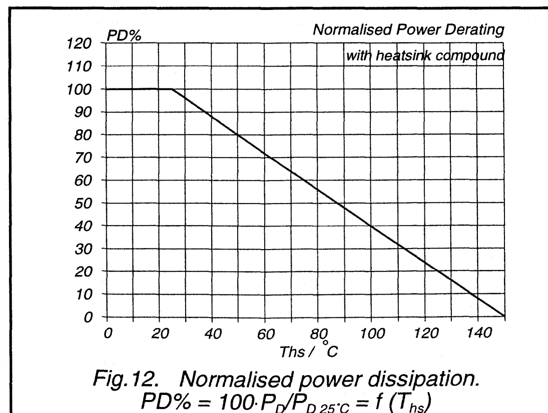


Fig.12. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f(T_{hs})$

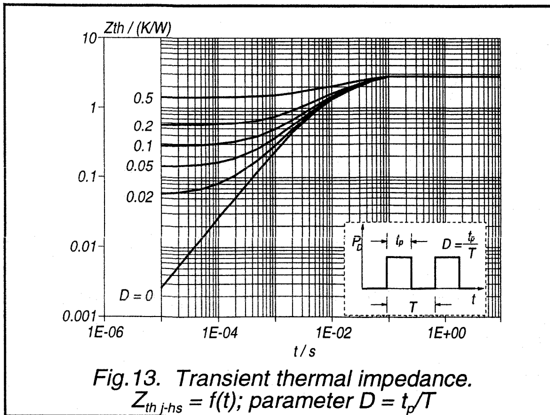


Fig. 13. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

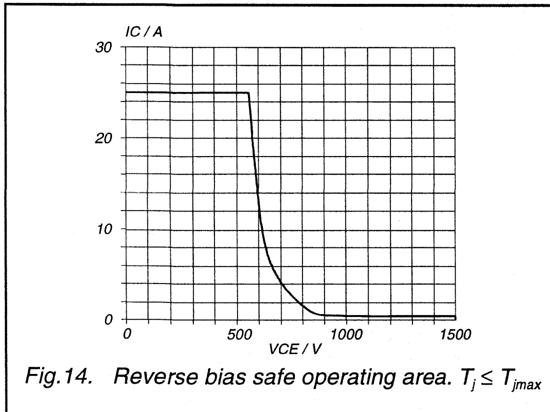


Fig. 14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

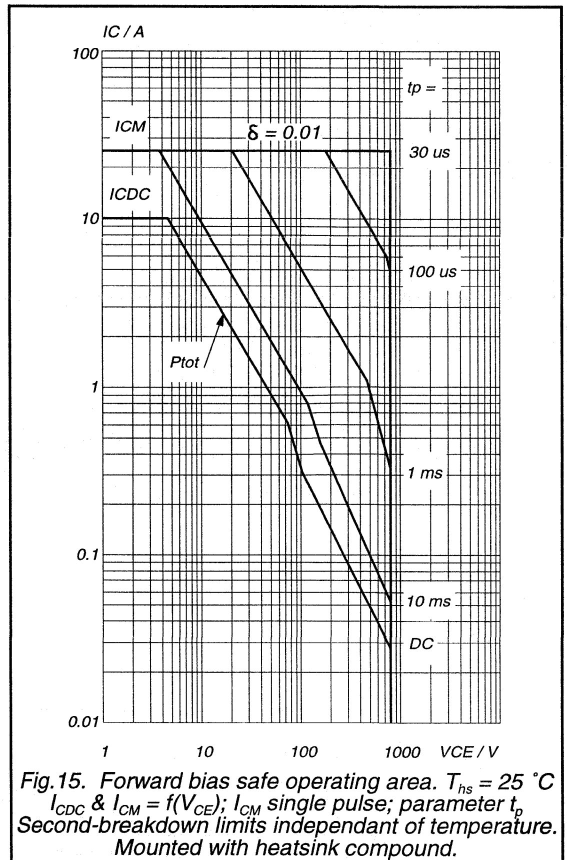


Fig. 15. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

GENERAL DESCRIPTION

New generation, 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 high resolution monitors. Features improved RBSOA performance and is suitable for use in horizontal deflection circuits of pc monitors.

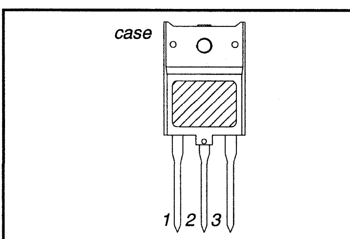
QUICK REFERENCE DATA

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	f = 64 kHz	6	-	A
V_F	Diode forward voltage	$I_F = 6.0$ A	-	2.2	V
t_f	Fall time	$I_{Csat} = 6.0$ A; f = 64 kHz	0.12	0.25	µs

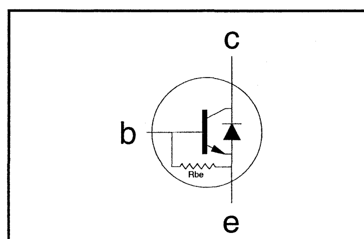
PINNING - SOT399

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		-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	-	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	-	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	13	-	
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_{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).

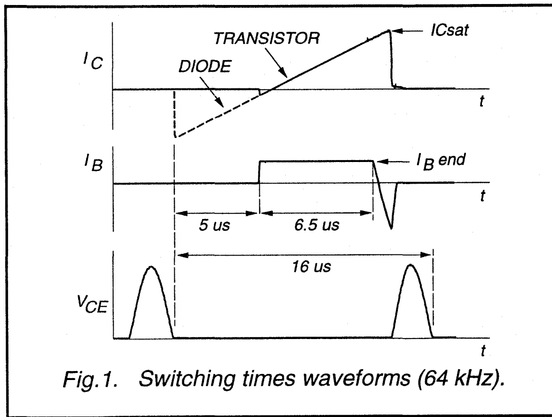


Fig.1. Switching times waveforms (64 kHz).

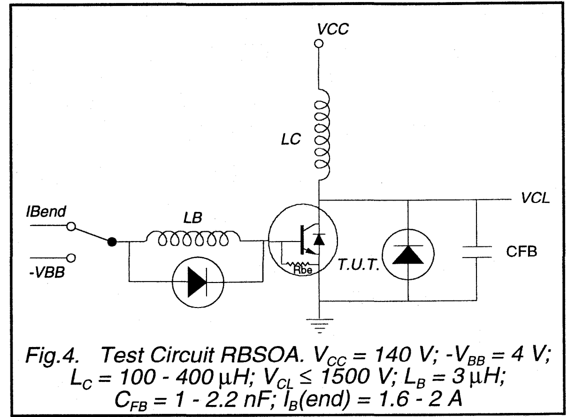


Fig.4. Test Circuit RBSOA. V_{CC} = 140 V; -V_{BB} = 4 V; L_C = 100 - 400 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1.6 - 2 A

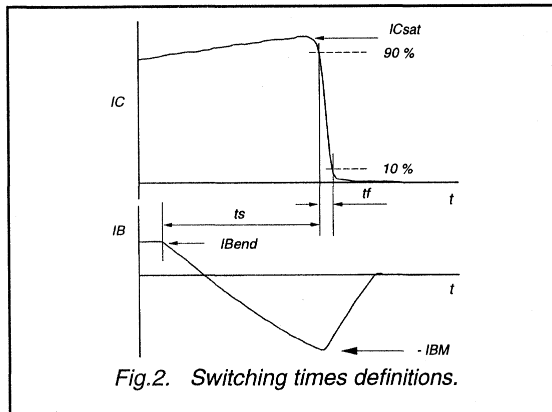


Fig.2. Switching times definitions.

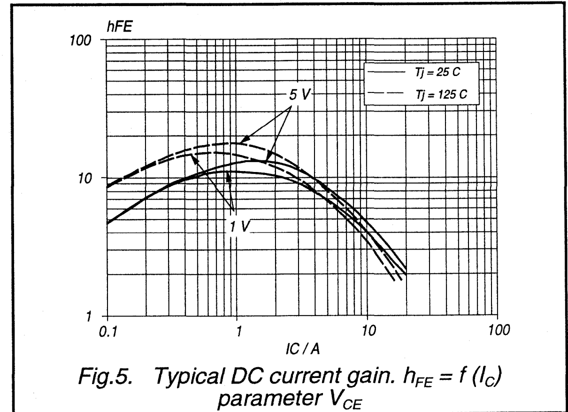


Fig.5. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

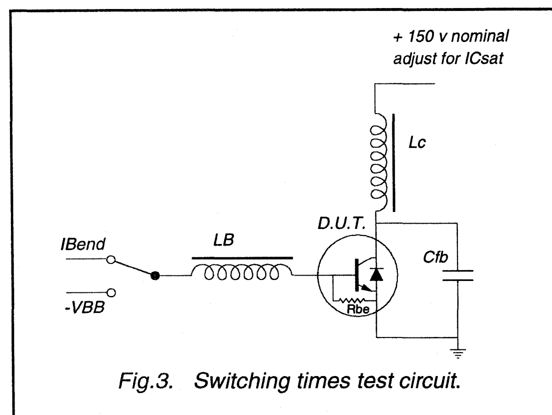


Fig.3. Switching times test circuit.

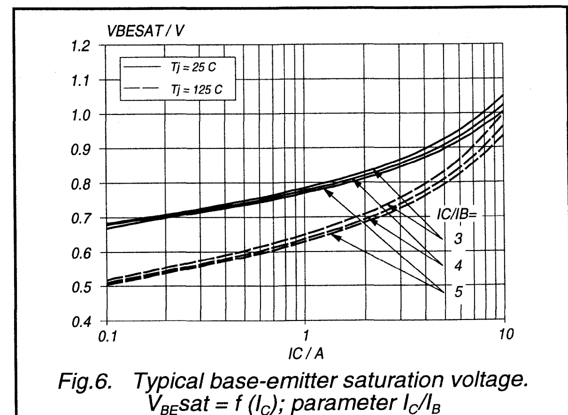


Fig.6. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

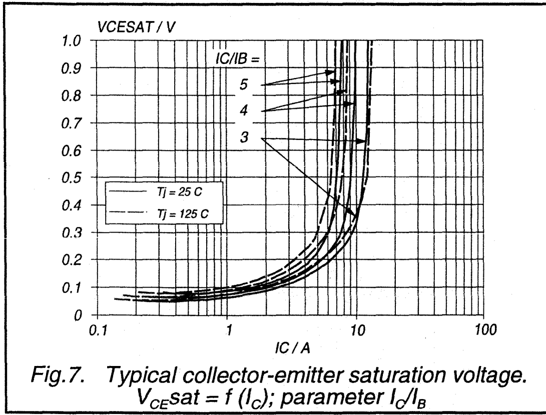


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

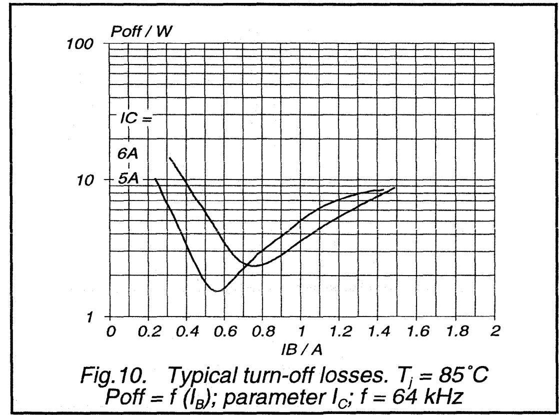


Fig.10. Typical turn-off losses. $T_j = 85˚C$ $Poff = f\ (I_B)$; parameter I_C; f = 64 kHz

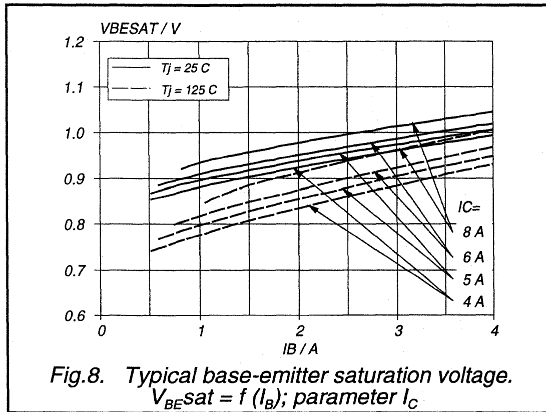


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

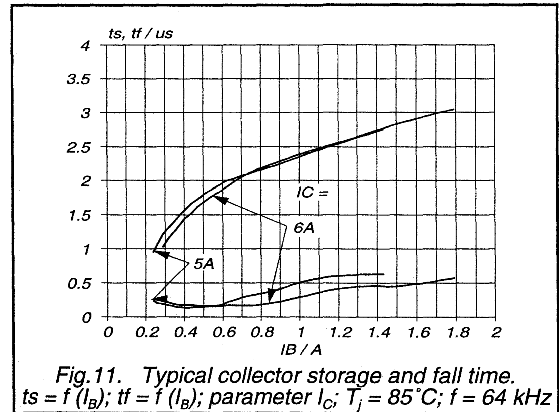


Fig.11. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85˚C$; f = 64 kHz

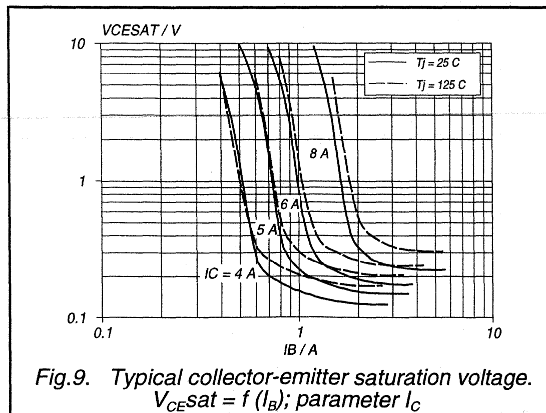


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

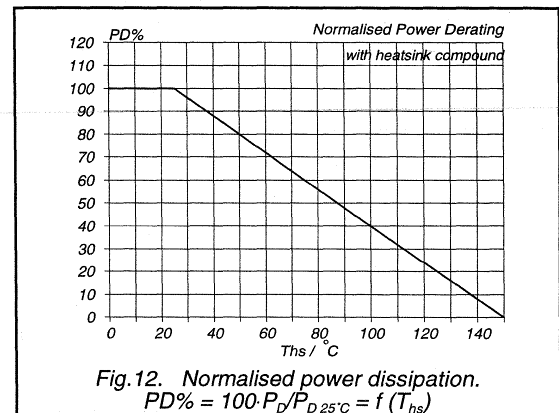


Fig.12. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25˚C} = f\ (T_{hs})$

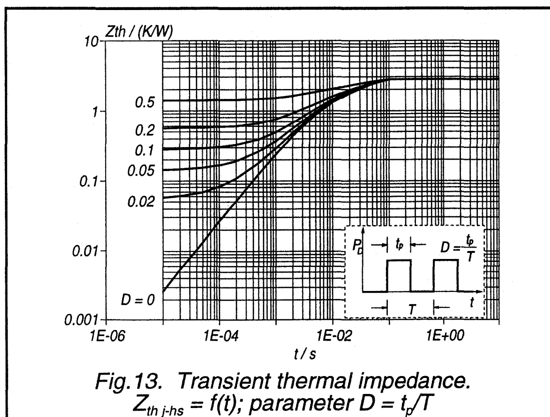


Fig.13. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

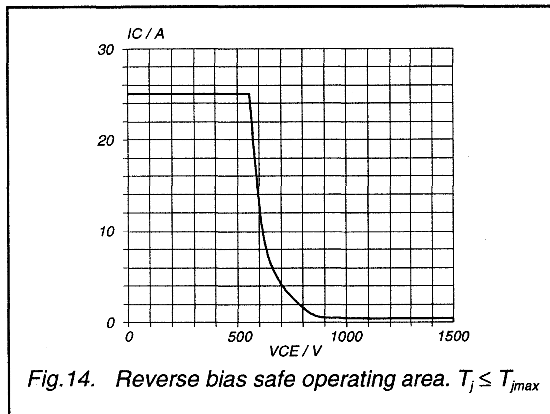


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

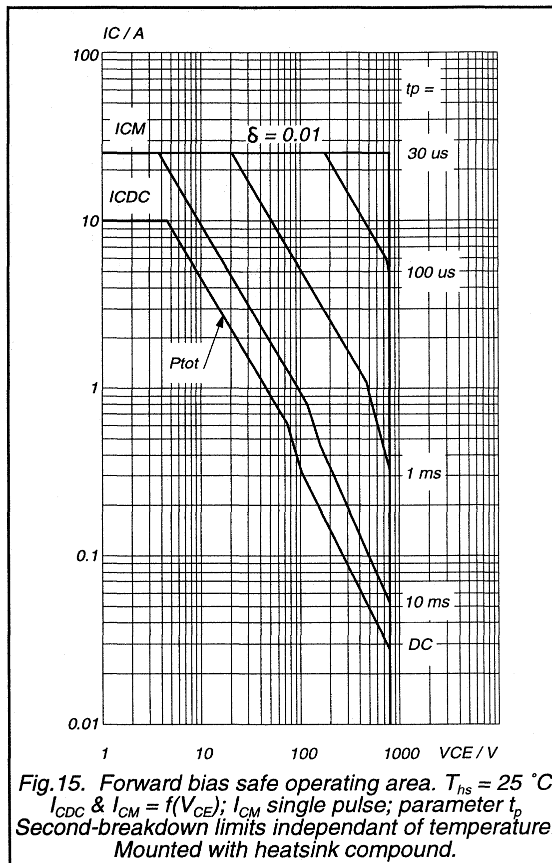


Fig.15. Forward bias safe operating area. $T_{hs} = 25$ ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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 HDTV receivers and pc monitors.

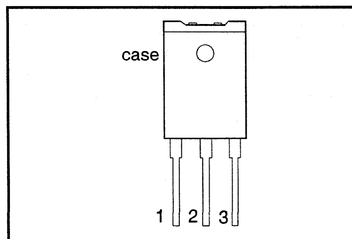
QUICK REFERENCE DATA

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 64 kHz	5.5	-	A
t_f	Fall time	$I_{Csat} = 5.5$ A; f = 64 kHz	0.15	0.3	µs

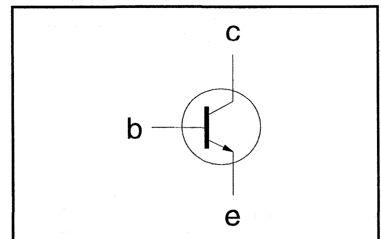
PINNING - SOT199

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
I_B	Base current (DC)		-	7	A
I_{BM}	Base current peak value		-	10	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	175	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	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	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	14	-	
h_{FE}		I_C = 5.5 A; V_{CE} = 5 V	5	8	10.3	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{Csat} = 5.5 A; L_C = 200 μH; C_{fb} = 4 nF; V_{CC} 145 V; $I_{B(end)}$ = 0.56 A; L_B = 0.4 μH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 3.3 A			
t_s	Turn-off storage time		1.5	2.0	μs
t_f	Turn-off fall time		0.15	0.3	μs

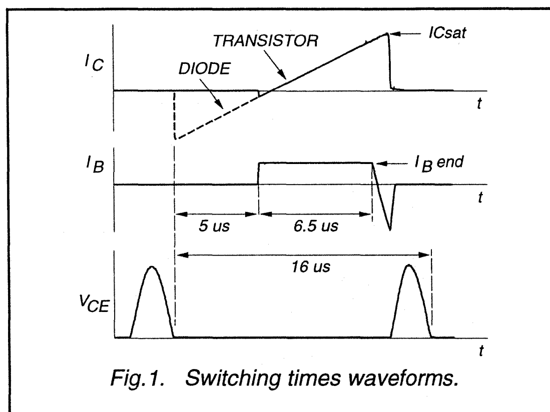


Fig.1. Switching times waveforms.

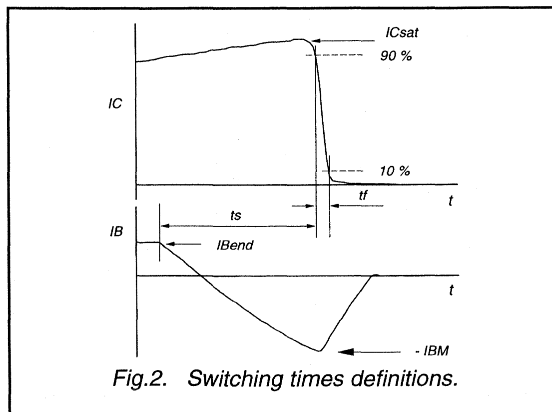


Fig.2. Switching times definitions.

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

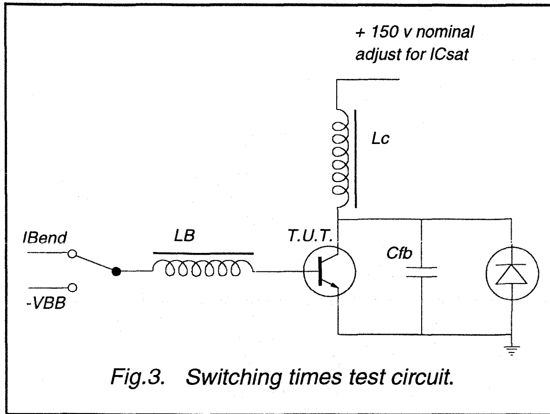


Fig.3. Switching times test circuit.

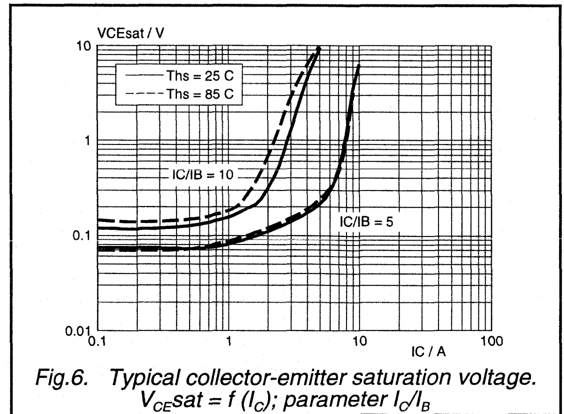


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

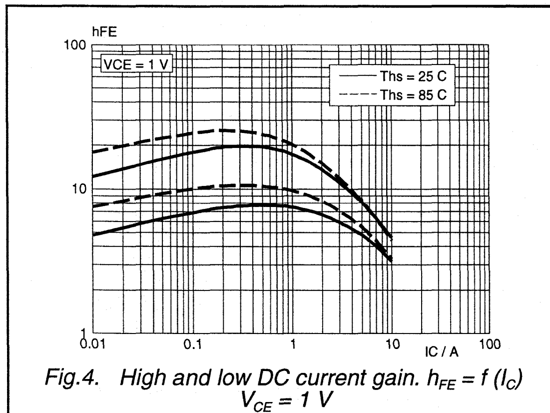


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 1\ V$

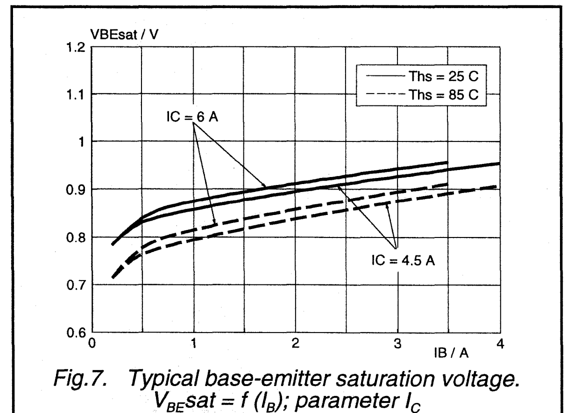


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

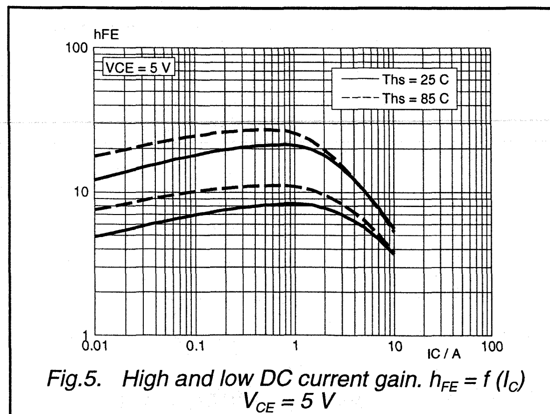


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 5\ V$

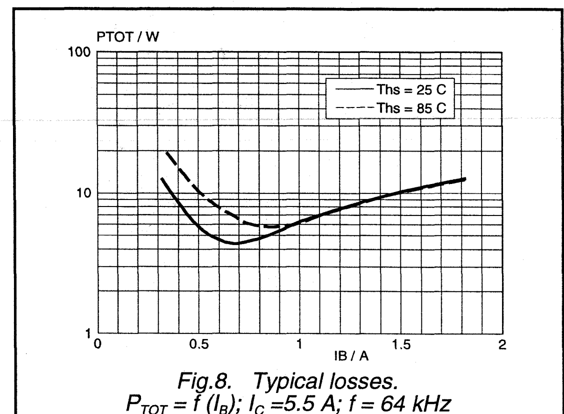


Fig.8. Typical losses. $P_{TOT} = f\ (I_B)$; $I_C = 5.5\ A$; $f = 64\ kHz$

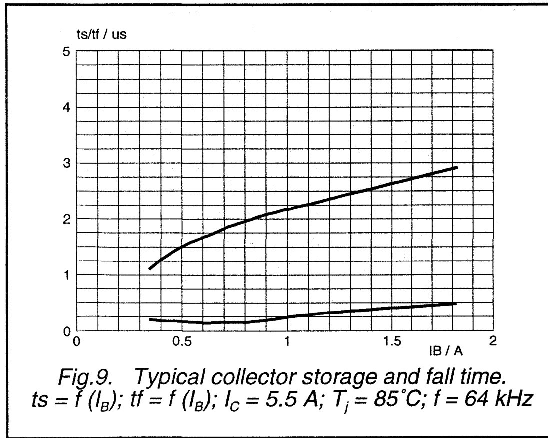


Fig.9. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; $I_C = 5.5$ A; $T_j = 85$˚C; $f = 64$ kHz

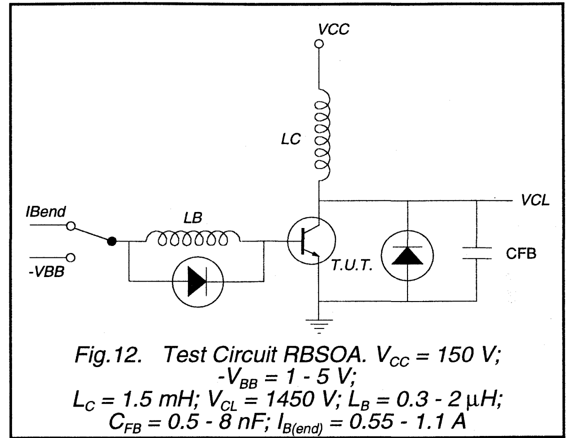


Fig.12. Test Circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 1 - 5$ V; $L_C = 1.5$ mH; $V_{CL} = 1450$ V; $L_B = 0.3 - 2$ µH; $C_{FB} = 0.5 - 8$ nF; $I_{B(end)} = 0.55 - 1.1$ A

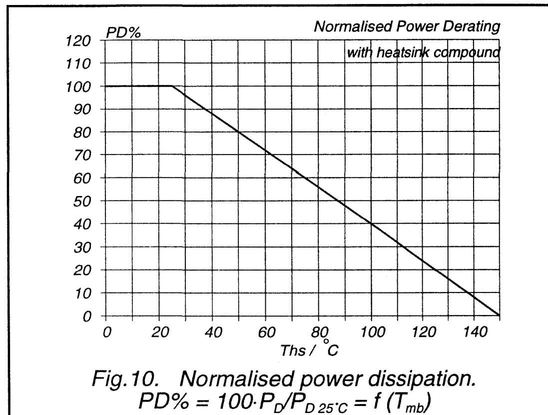


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25^\circ C} = f\ (T_{mb})$

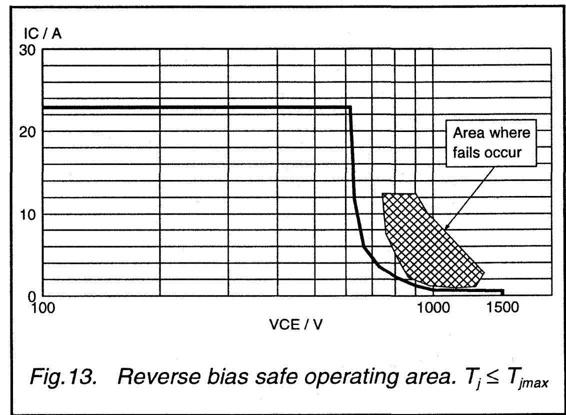


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

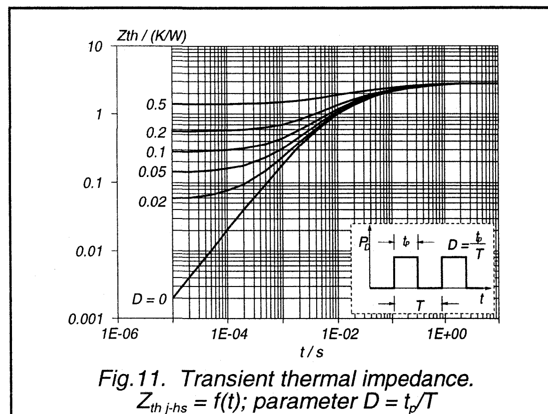


Fig.11. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

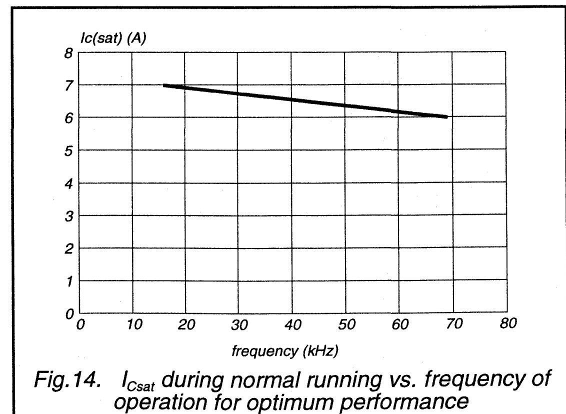


Fig.14. I_{Csat} during normal running vs. frequency of operation for optimum performance

Silicon Diffused Power Transistor | BU2523AX

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 HDTV receivers and pc monitors.

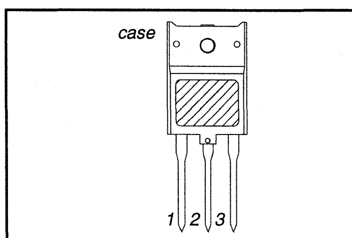
QUICK REFERENCE DATA

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 64 kHz	5.5	-	A
t_f	Fall time	$I_{Csat} = 5.5$ A; f = 64 kHz	0.15	0.3	µs

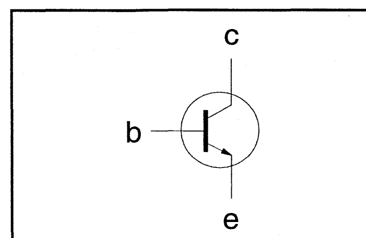
PINNING - SOT399

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
I_B	Base current (DC)		-	7	A
I_{BM}	Base current peak value		-	10	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	175	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	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	800	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	0.80	0.88	0.97	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	14	-	
h_{FE}		I_C = 5.5 A; V_{CE} = 5 V	5	8	10.3	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{Csat} = 5.5 A; L_C = 200 μH; C_{fb} = 4 nF; V_{CC} 145 V; $I_{B(end)}$ = 0.56 A; L_B = 0.4 μH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 3.3 A			
t_s	Turn-off storage time		1.5	2.0	μs
t_f	Turn-off fall time		0.15	0.3	μs

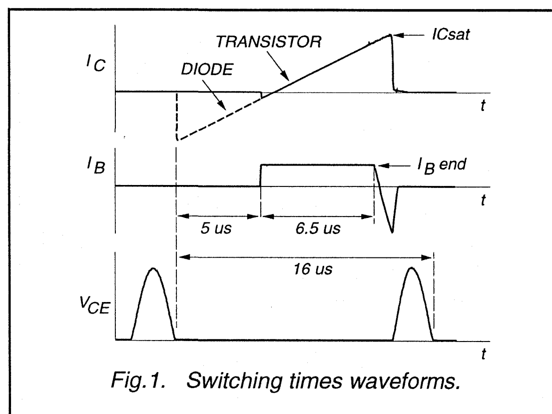


Fig.1. Switching times waveforms.

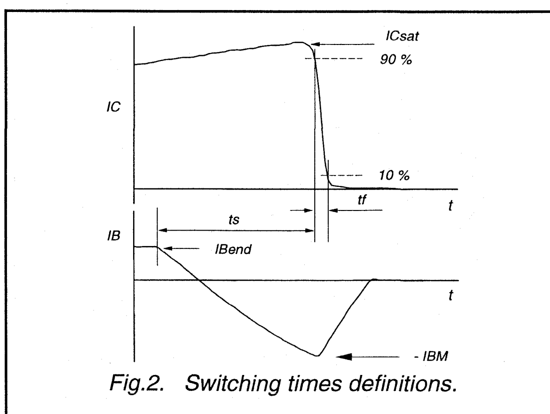


Fig.2. Switching times definitions.

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

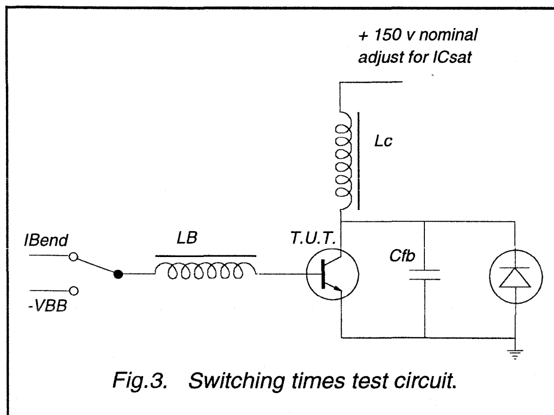


Fig.3. Switching times test circuit.

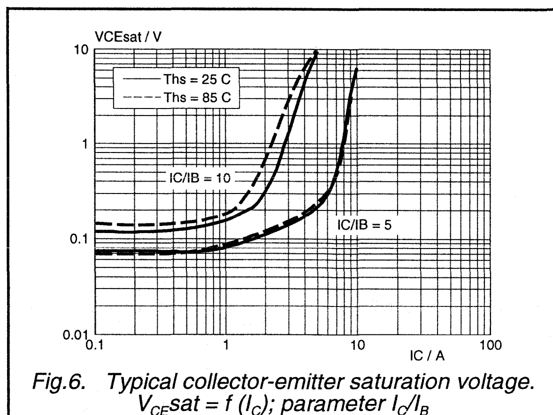


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

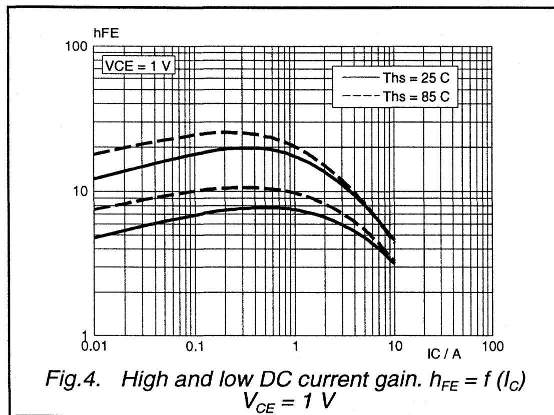


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 1\ V$

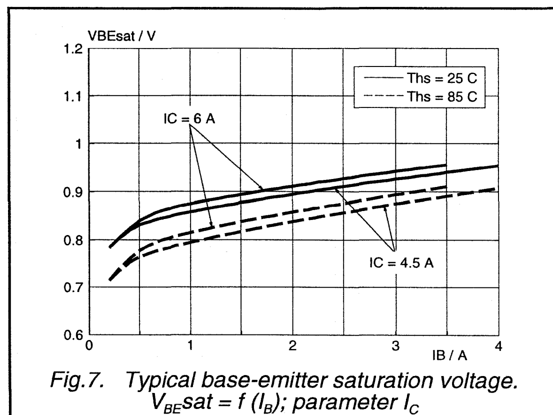


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

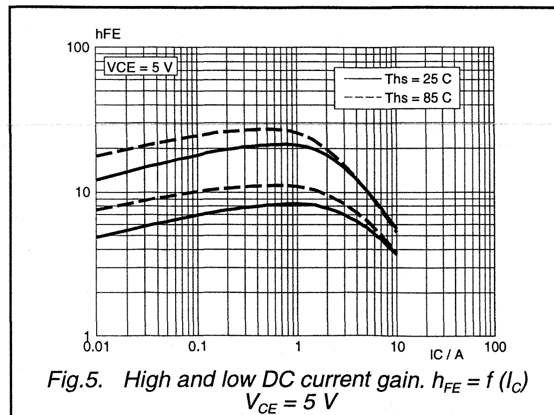


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 5\ V$

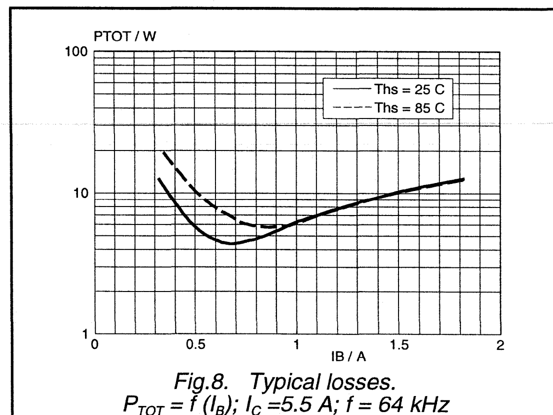


Fig.8. Typical losses. $P_{TOT} = f\ (I_B)$; $I_C = 5.5\ A$; $f = 64\ kHz$

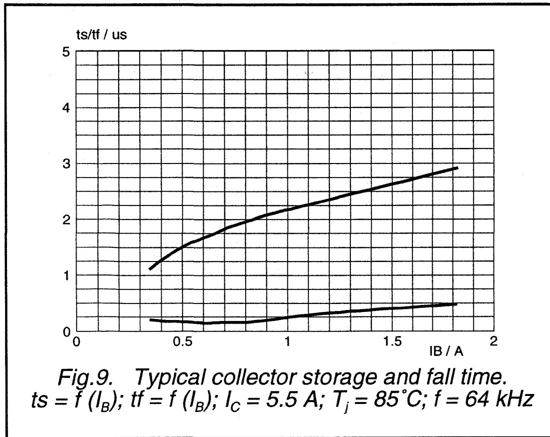


Fig.9. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; $I_C = 5.5$ A; $T_j = 85˚C$; f = 64 kHz

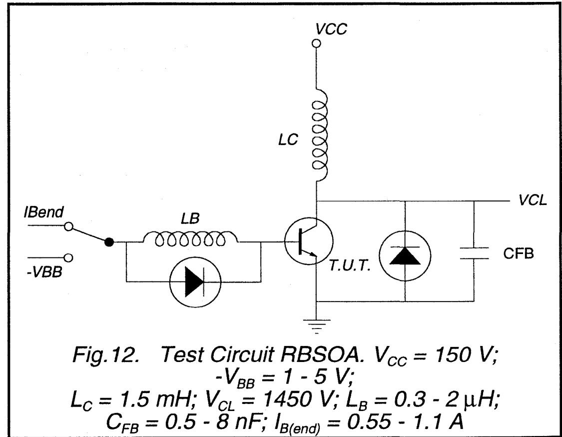


Fig.12. Test Circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 1 - 5$ V; $L_C = 1.5$ mH; $V_{CL} = 1450$ V; $L_B = 0.3 - 2\ \mu H$; $C_{FB} = 0.5 - 8$ nF; $I_{B(end)} = 0.55 - 1.1$ A

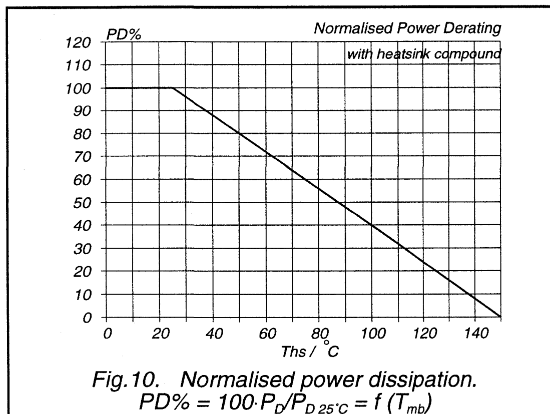


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25˚C} = f(T_{mb})$

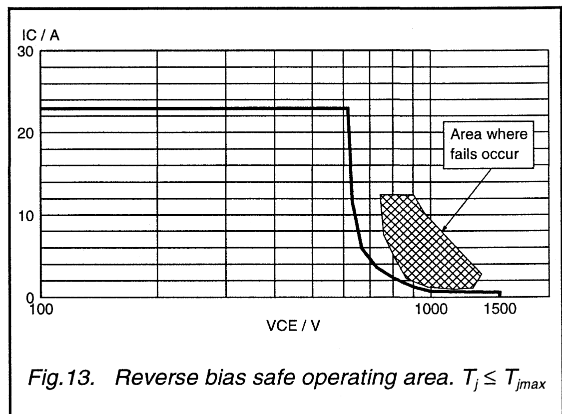


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

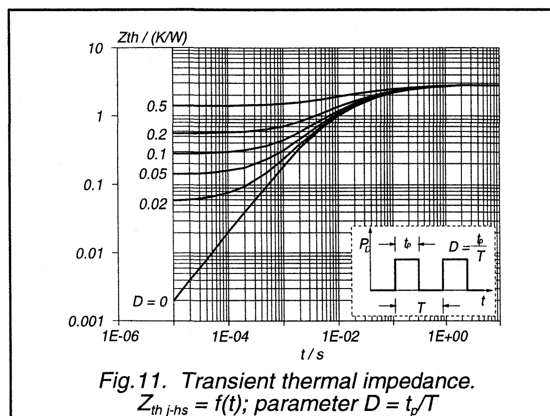


Fig.11. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

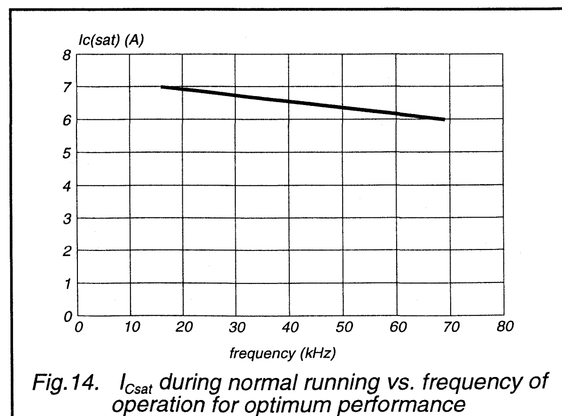


Fig.14. I_{Csat} during normal running vs. frequency of operation for optimum performance

Silicon Diffused Power Transistor | BU2523DF

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 HDTV receivers and pc monitors.

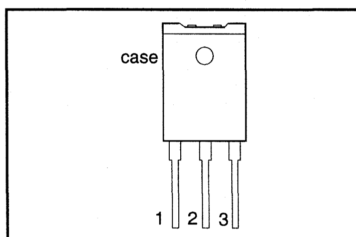
QUICK REFERENCE DATA

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
P_{tot}	Total power dissipation	$T_{hs} \le 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 64 kHz	5.5	-	A
V_F	Diode forward voltage	$I_F = 5.5$ A	-	2.2	V
t_f	Fall time	$I_{Csat} = 5.5$ A; f = 64 kHz	0.15	0.3	µs

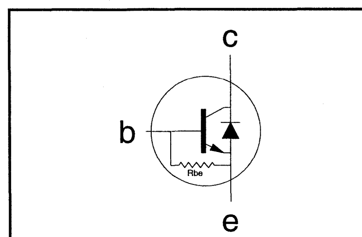
PINNING - SOT199

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
I_B	Base current (DC)		-	7	A
I_{BM}	Base current peak value		-	10	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	175	mA
$-I_{BM}$	Reverse base current peak value [1]		-	7	A
P_{tot}	Total power dissipation	$T_{hs} \le 25$ ˚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} = 6.0 V; I_C = 0 A	80	130	170	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 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
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	46	-	Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	12	-	
h_{FE}		I_C = 5.5 A; V_{CE} = 5 V	5	7.5	10.8	
V_F	Diode forward voltage	I_F = 5.5 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{Csat} = 5.5 A; L_C = 200 µH; C_{fb} = 4 nF; V_{CC} = 145 V; $I_{B(end)}$ = 0.56 A; L_B = 0.4 µH; $-V_{BB}$ = -4 V; $-I_{BM}$ = 3.3 A			
t_s	Turn-off storage time		1.5	2	µs
t_f	Turn-off fall time		0.15	0.3	µs
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 5.5 A; dI_F/dt = 50 A/µs	16.5	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	375	-	ns

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

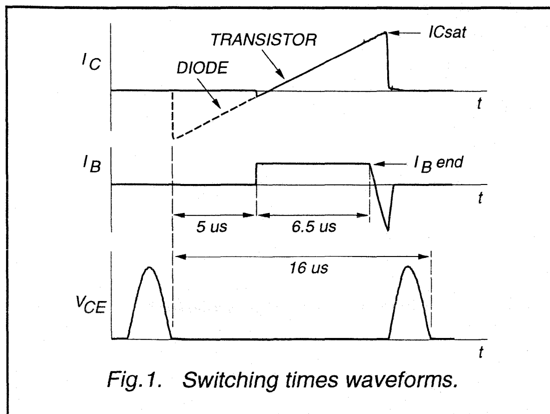


Fig.1. Switching times waveforms.

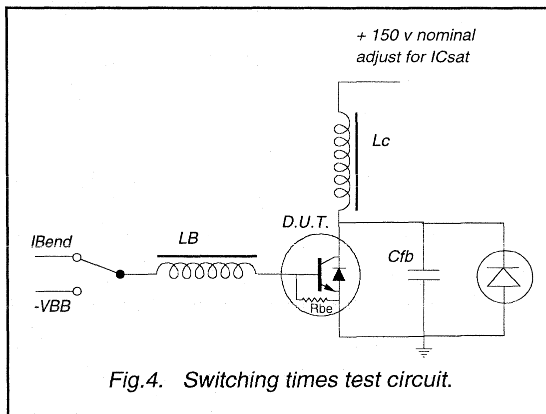


Fig.4. Switching times test circuit.

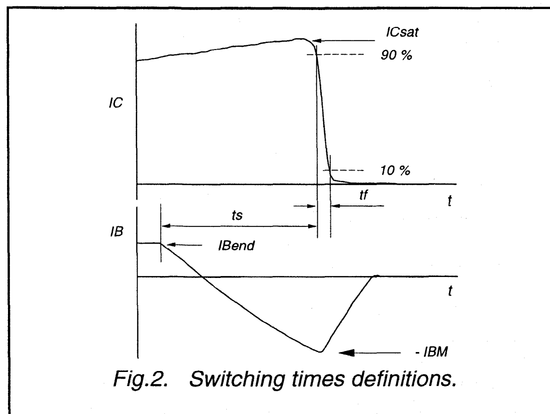


Fig.2. Switching times definitions.

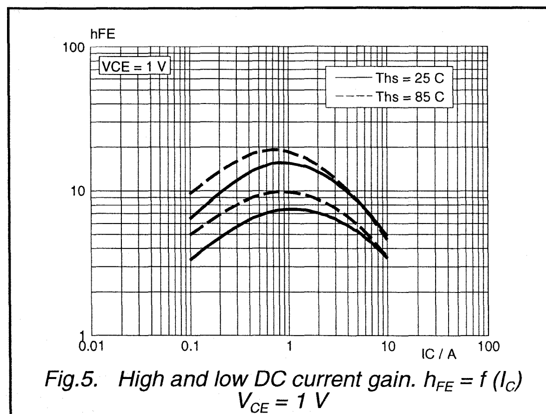


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

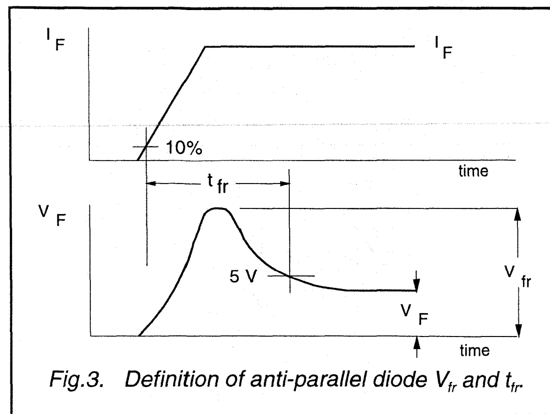


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}.

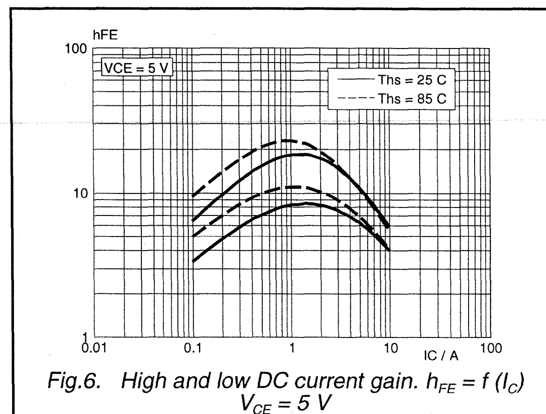


Fig.6. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

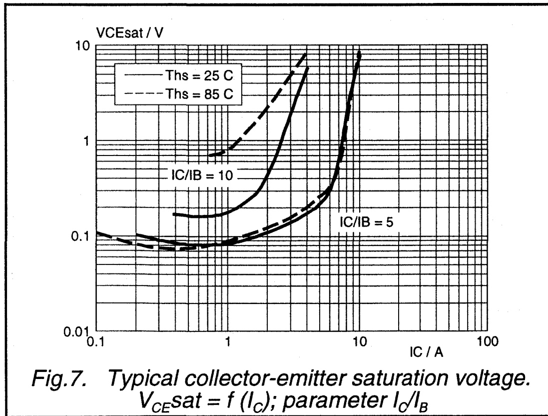


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

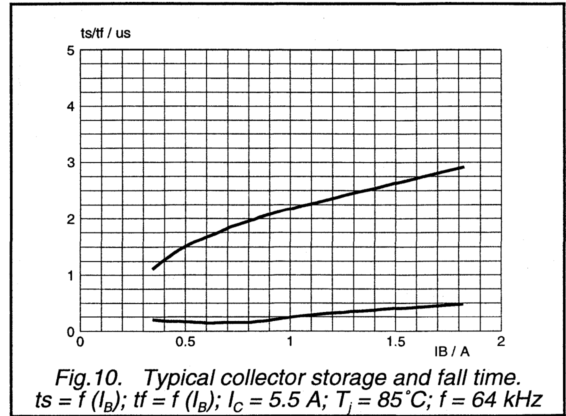


Fig.10. Typical collector storage and fall time. $ts = f (I_B)$; $tf = f (I_B)$; $I_C = 5.5$ A; $T_j = 85˚C$; f = 64 kHz

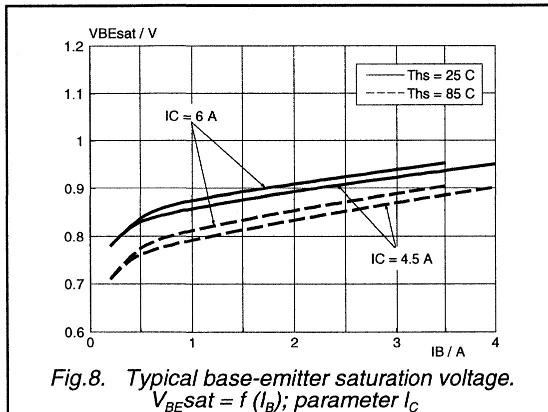


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

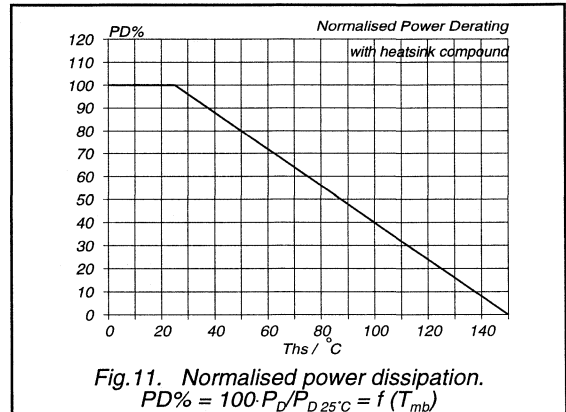


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f (T_{mb})$

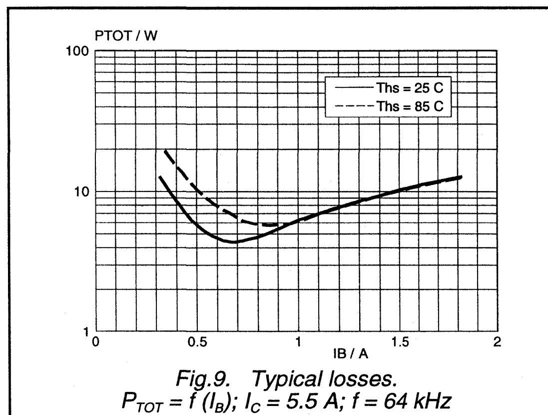


Fig.9. Typical losses. $P_{TOT} = f (I_B)$; $I_C = 5.5$ A; f = 64 kHz

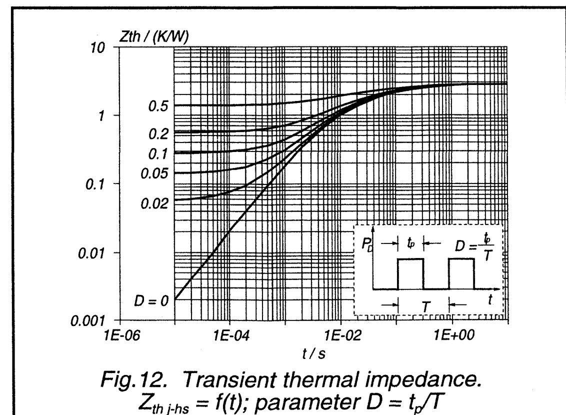


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

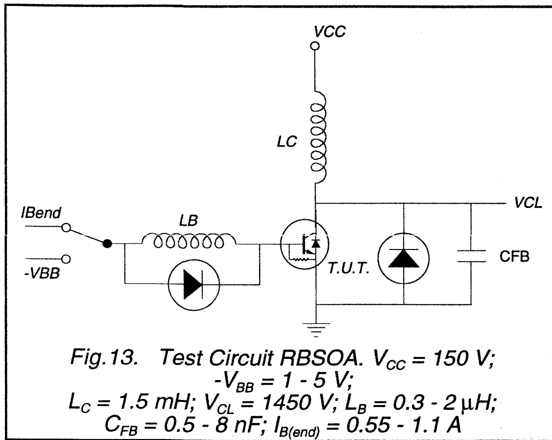


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 5 V; L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 0.3 - 2 µH; C_{FB} = 0.5 - 8 nF; $I_{B(end)}$ = 0.55 - 1.1 A

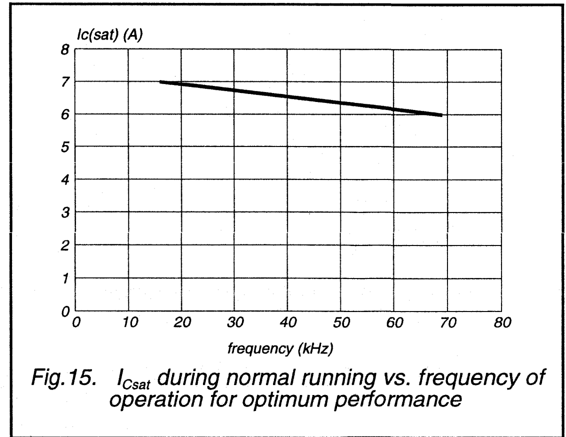


Fig.15. I_{Csat} during normal running vs. frequency of operation for optimum performance

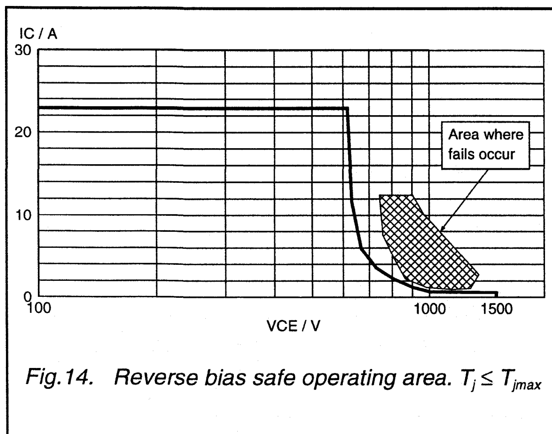


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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 HDTV receivers and pc monitors.

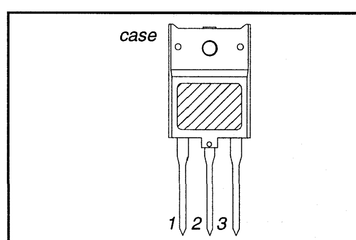
QUICK REFERENCE DATA

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	45	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.5$ A; $I_B = 1.1$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 64 kHz	5.5	-	A
V_F	Diode forward voltage	$I_F = 5.5$ A	-	2.2	V
t_f	Fall time	$I_{Csat} = 5.5$ A; f = 64 kHz	0.15	0.3	µs

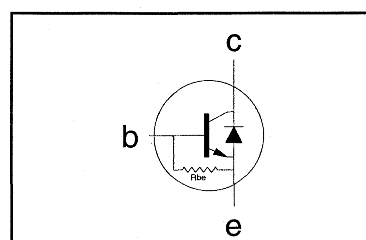
PINNING - SOT399

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)		-	11	A
I_{CM}	Collector current peak value		-	29	A
I_B	Base current (DC)		-	7	A
I_{BM}	Base current peak value		-	10	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	175	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	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} = 6.0 V; I_C = 0 A	80	130	170	mA
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 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
R_{be}	Base-emitter resistance	V_{EB} = 7.5 V	-	46	-	Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5.5 A; I_B = 1.1 A		-	1.0	V
h_{FE}	DC current gain	I_C = 1.0 A; V_{CE} = 5 V	-	12	-	
h_{FE}		I_C = 5.5 A; V_{CE} = 5 V	5	7.5	10.8	
V_F	Diode forward voltage	I_F = 5.5 A	-	-	2.2	V

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (64 kHz line deflection circuit)	I_{Csat} = 5.5 A; L_C = 200 µH; C_{fb} = 4 nF; V_{CC} = 145 V; $I_{B(end)}$ = 0.56 A; L_B = 0.4 µH; -V_{BB} = -4 V; -I_{BM} = 3.3 A			
t_s	Turn-off storage time		1.5	2	µs
t_f	Turn-off fall time		0.15	0.3	µs
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 5.5 A; dI_F/dt = 50 A/µs	16.5	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	375	-	ns

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

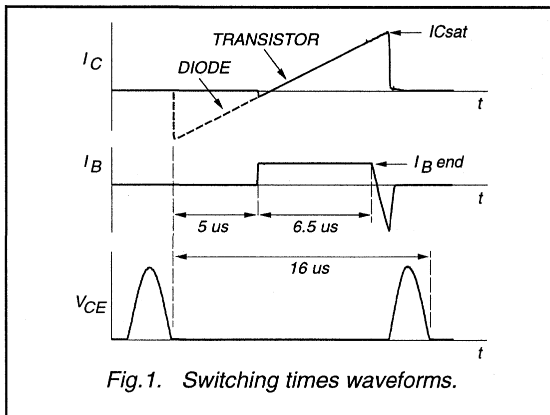


Fig.1. Switching times waveforms.

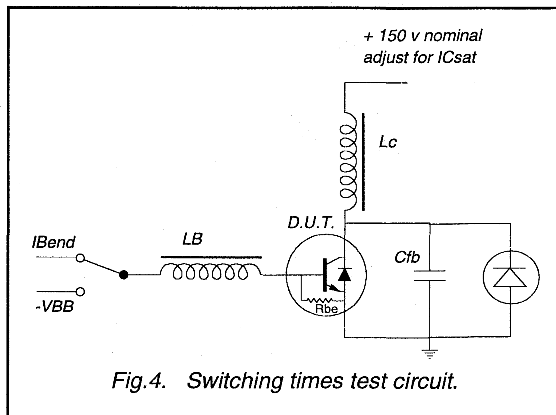


Fig.4. Switching times test circuit.

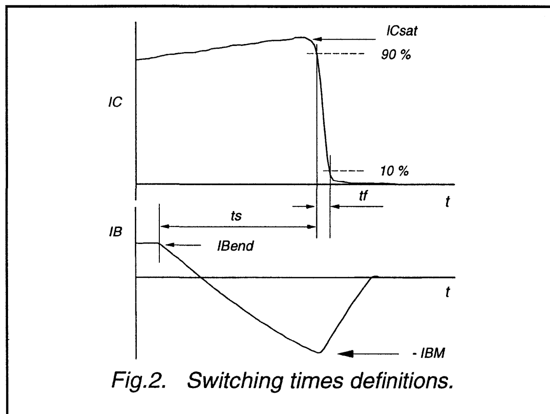


Fig.2. Switching times definitions.

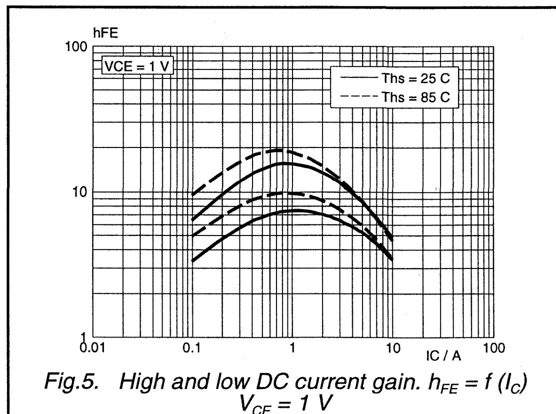


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 1\ V$

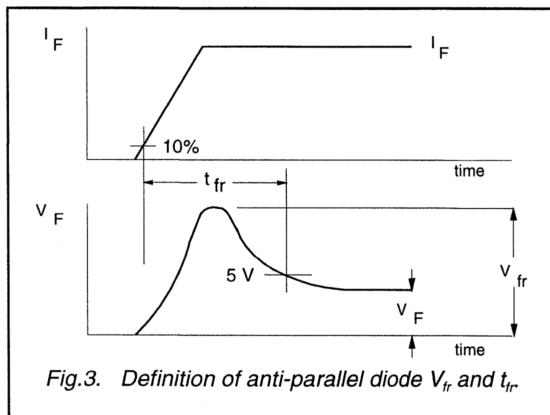


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}.

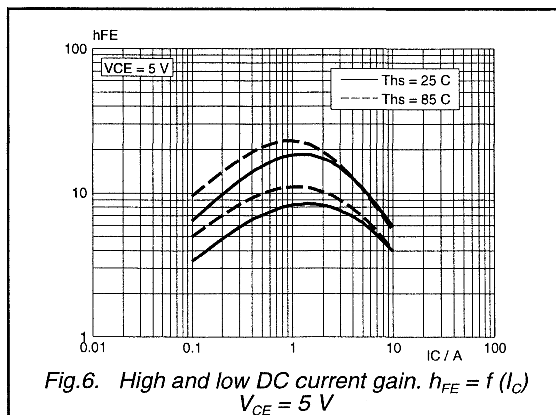


Fig.6. High and low DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

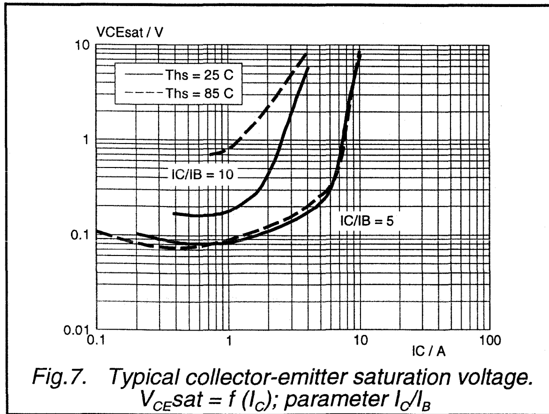


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

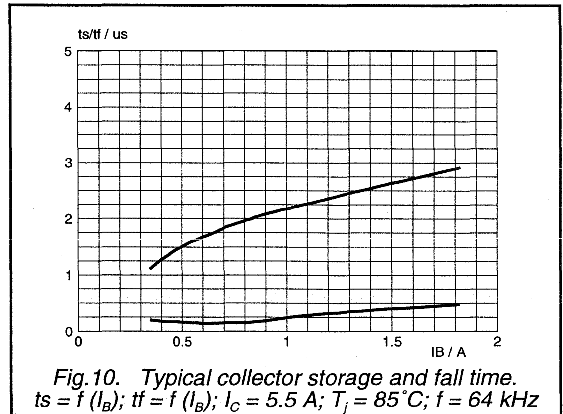


Fig.10. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; $I_C = 5.5$ A; $T_j = 85$˚C; f = 64 kHz

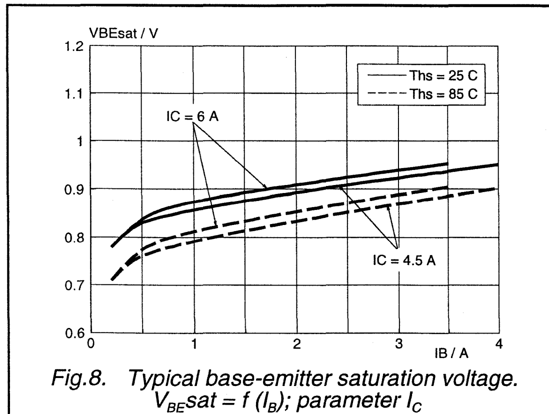


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

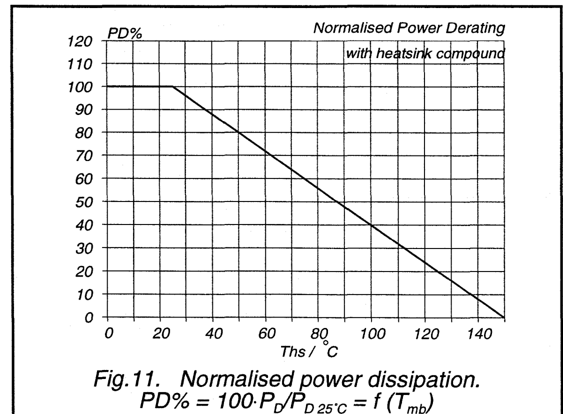


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

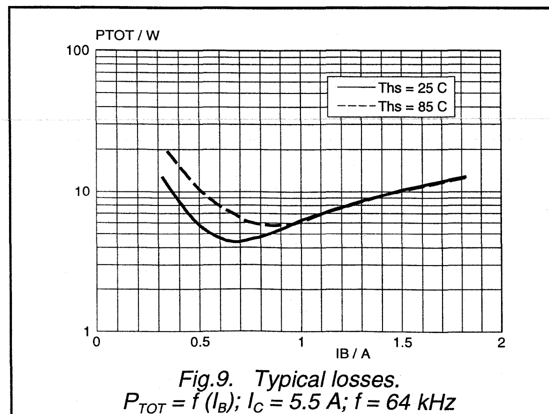


Fig.9. Typical losses. $P_{TOT} = f(I_B)$; $I_C = 5.5$ A; f = 64 kHz

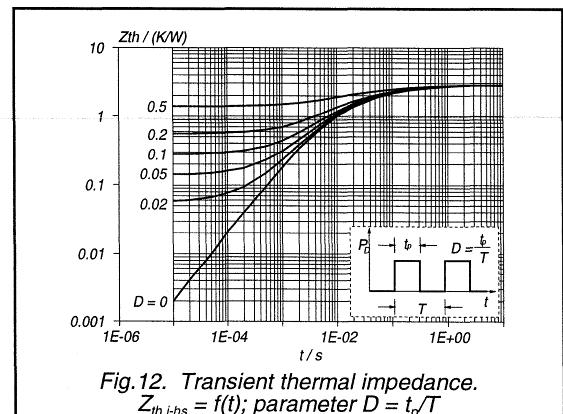


Fig.12. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

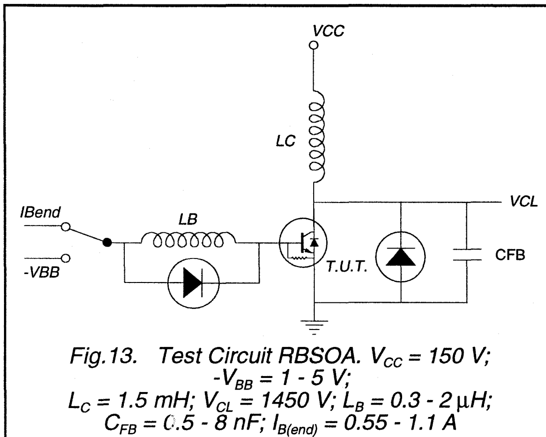


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 5 V; L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 0.3 - 2 µH; C_{FB} = 0.5 - 8 nF; $I_{B(end)}$ = 0.55 - 1.1 A

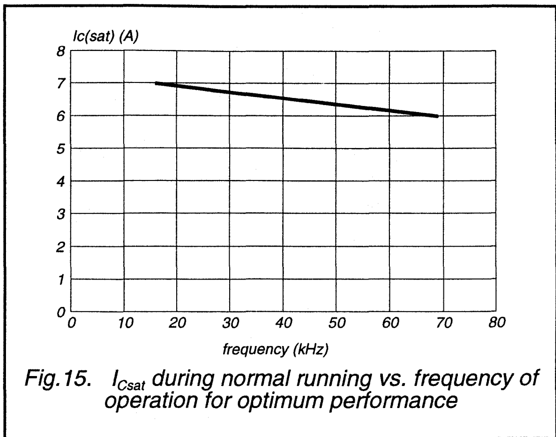


Fig.15. I_{Csat} during normal running vs. frequency of operation for optimum performance

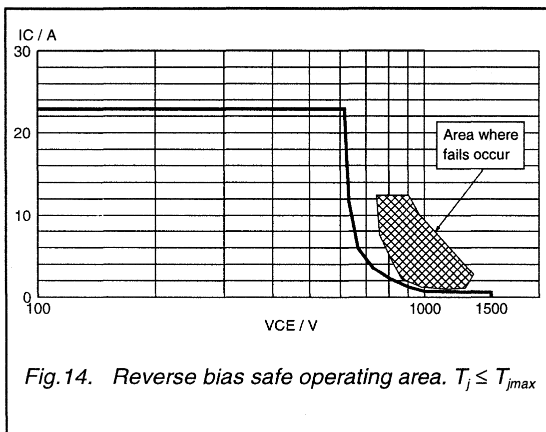


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

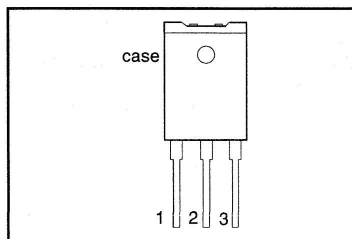
QUICK REFERENCE DATA

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	$I_{Csat} = 8.0$ A; $I_{B(end)} = 1.1$ A	0.2	0.35	µs

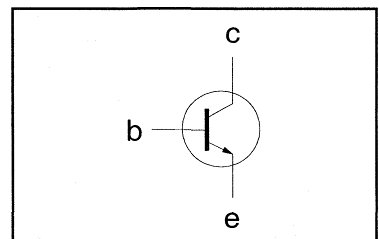
PINNING - SOT199

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
$R_{th\ j\text{-}hs}$	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	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	9.5	

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	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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).

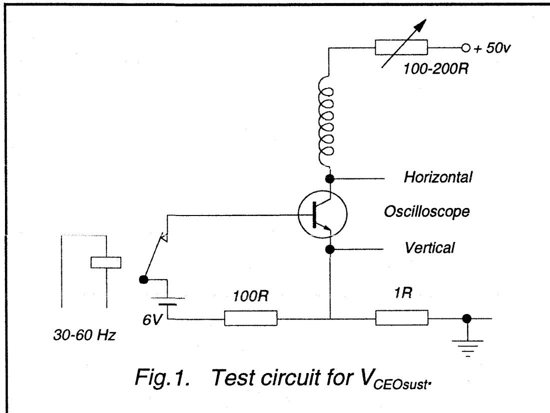


Fig.1. Test circuit for $V_{CEOsust}$.

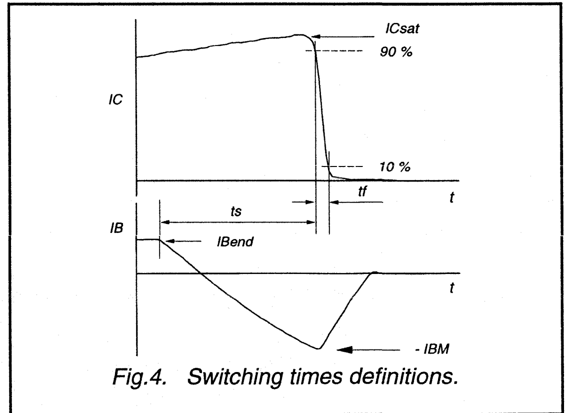


Fig.4. Switching times definitions.

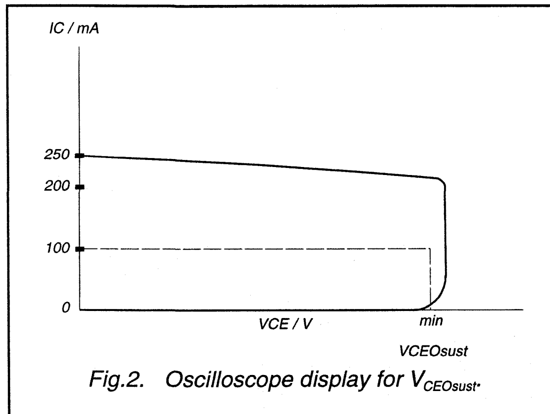


Fig.2. Oscilloscope display for $V_{CEOsust}$.

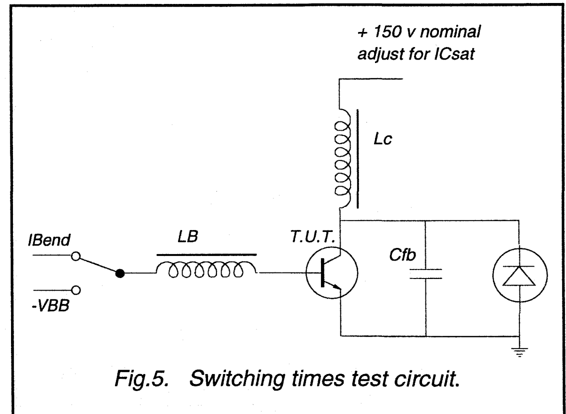


Fig.5. Switching times test circuit.

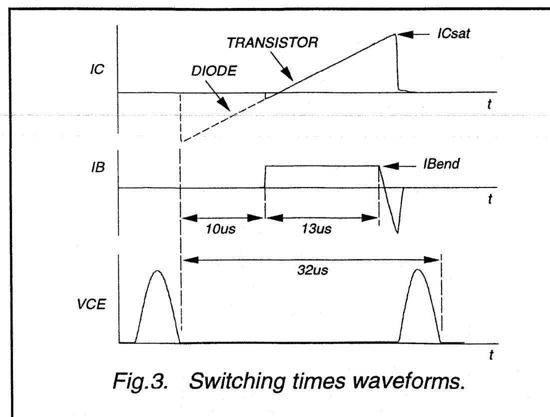


Fig.3. Switching times waveforms.

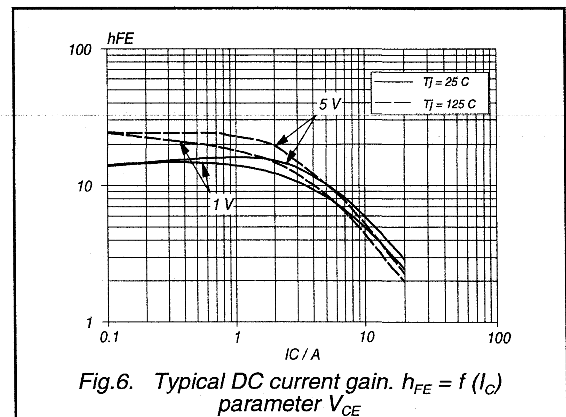


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

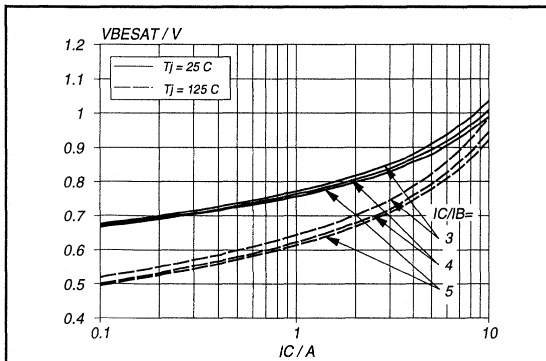


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

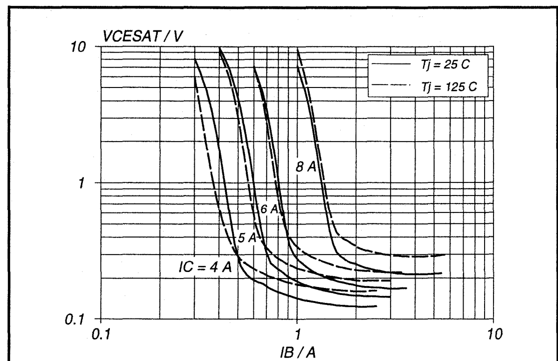


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

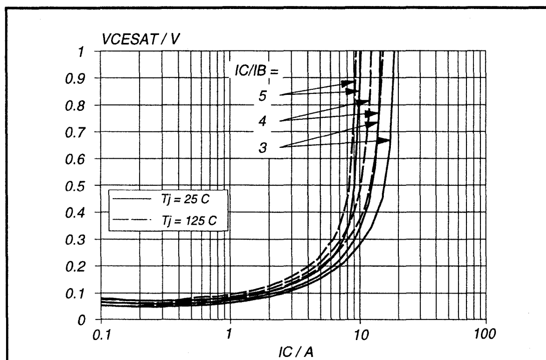


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

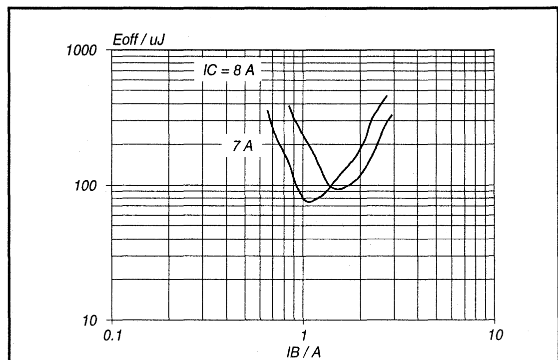


Fig.11. Typical turn-off losses. $T_j = 85˚C$ $Eoff = f\ (I_B)$; parameter I_C; $f = 32\ kHz$

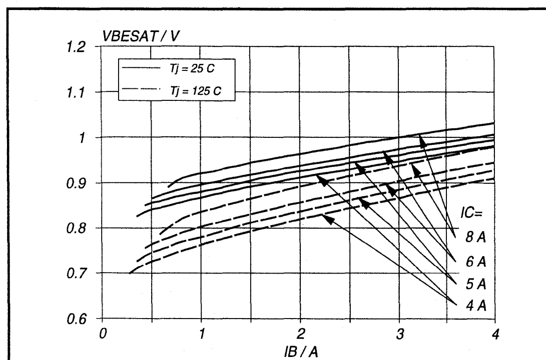


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

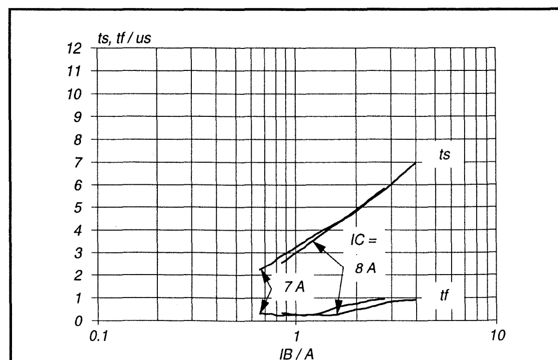


Fig.12. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85˚C$; $f = 32\ kHz$

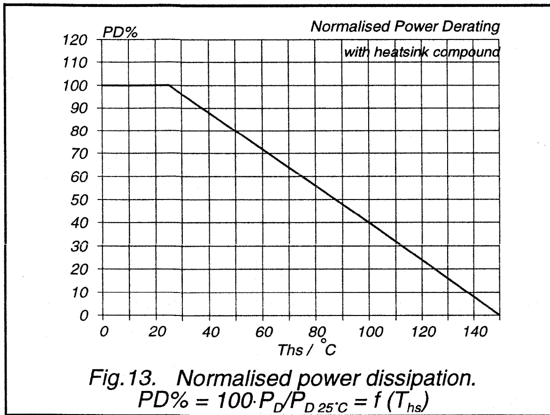


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

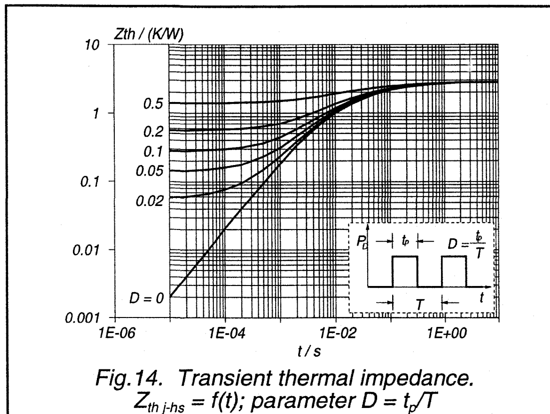


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

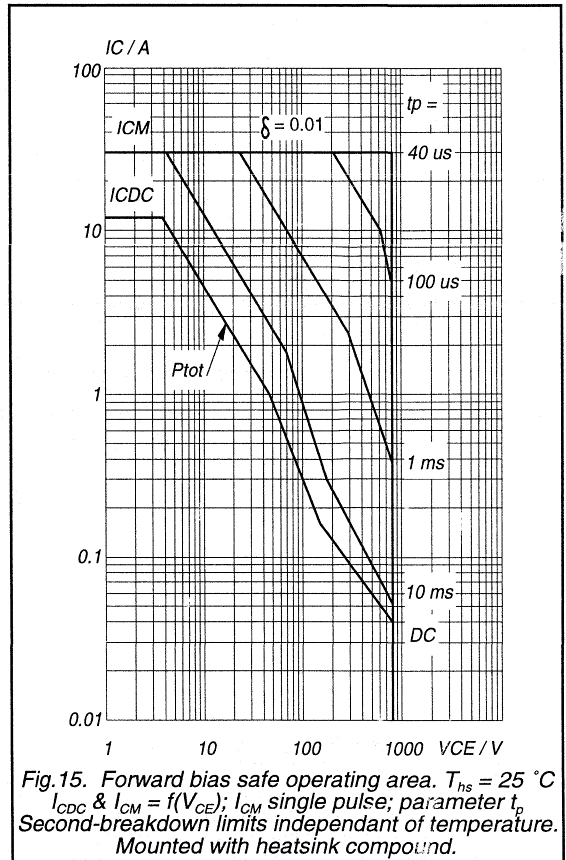


Fig.15. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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.

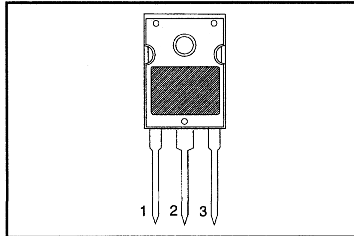
QUICK REFERENCE DATA

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	$I_{Csat} = 8.0$ A; $I_{B(end)} = 1.1$ A	0.2	0.35	µs

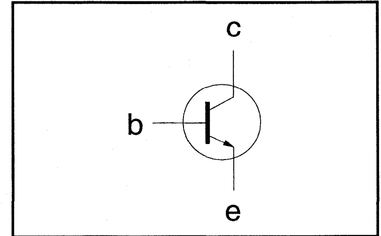
PINNING - SOT429

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	-	13	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	9.5	

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	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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

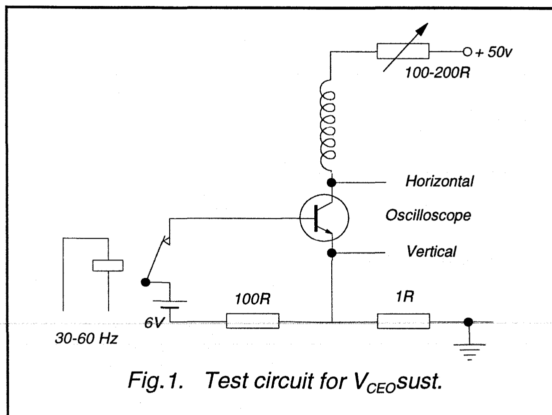


Fig.1. Test circuit for V_{CEO}sust.

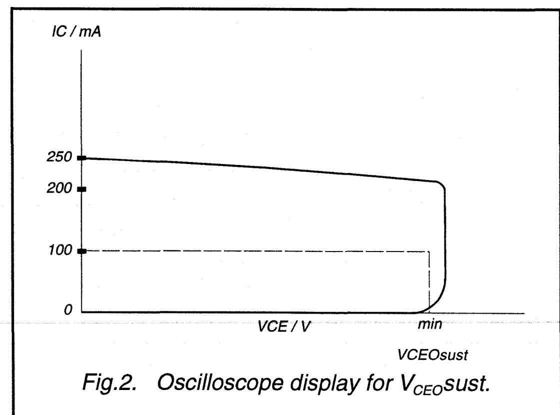


Fig.2. Oscilloscope display for V_{CEO}sust.

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

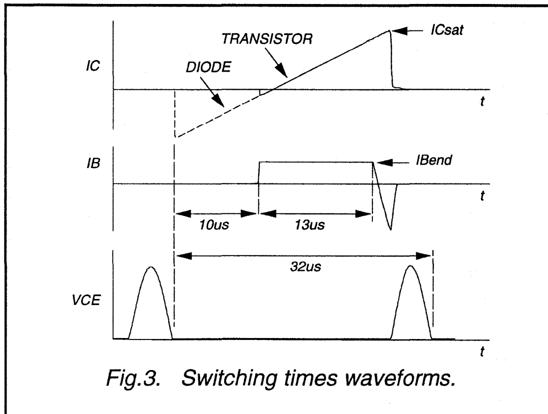


Fig.3. Switching times waveforms.

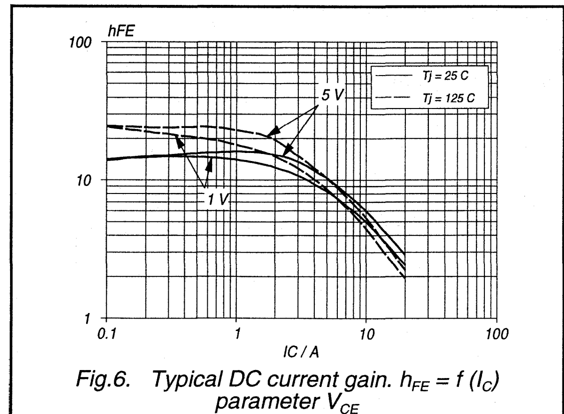


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

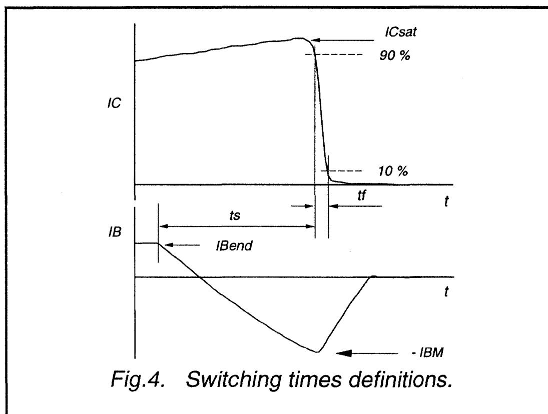


Fig.4. Switching times definitions.

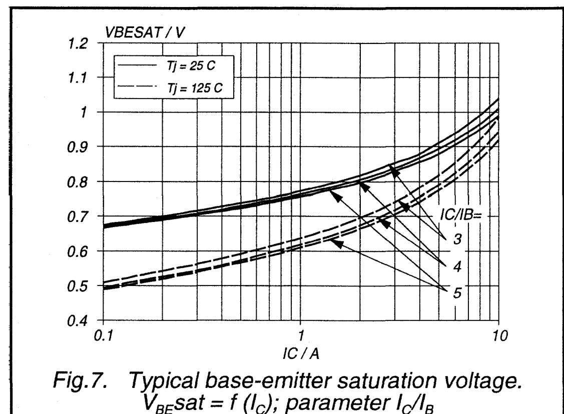


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

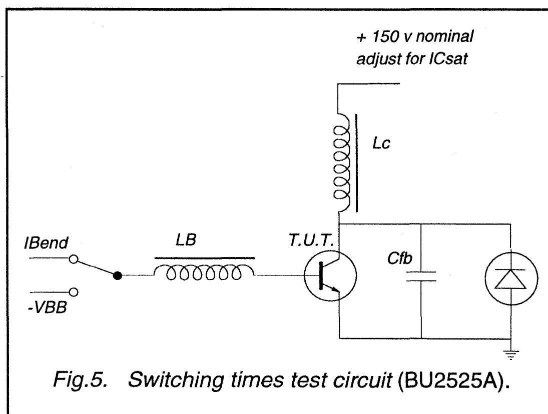


Fig.5. Switching times test circuit (BU2525A).

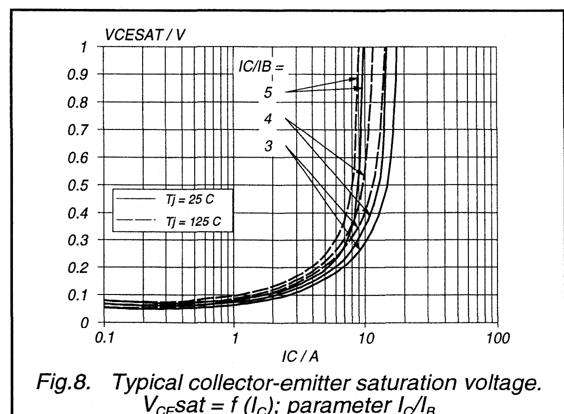


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

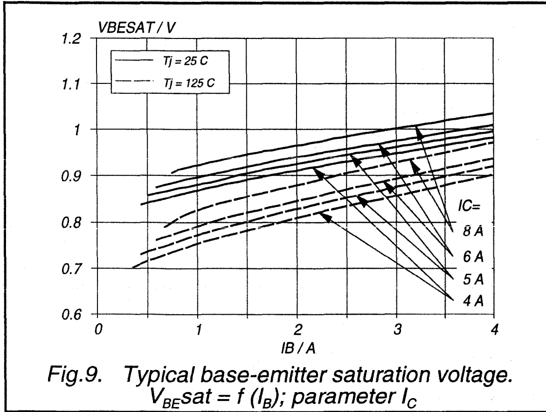


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

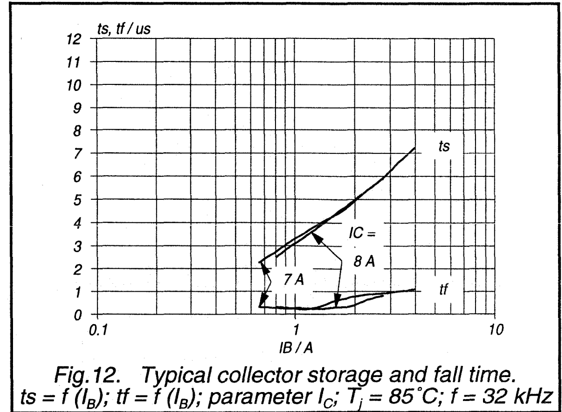


Fig.12. Typical collector storage and fall time. $ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85˚C$; $f = 32$ kHz

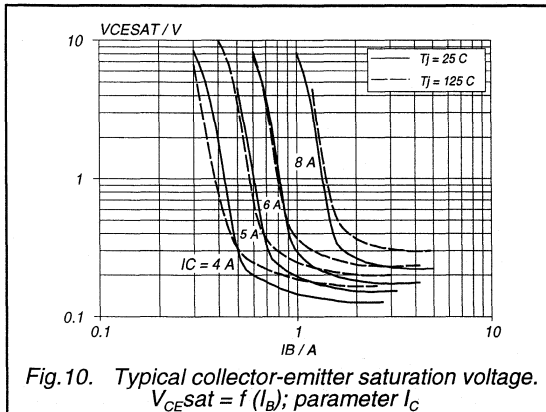


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_B)$; parameter I_C

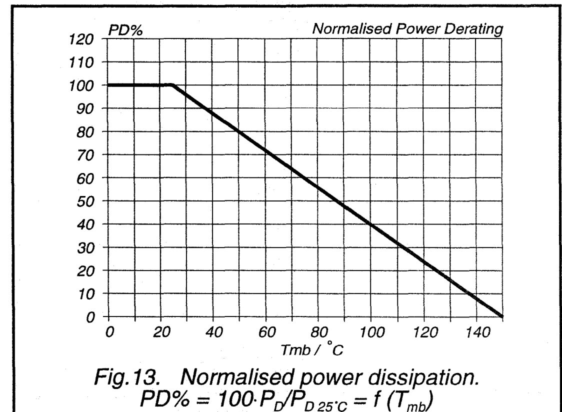


Fig.13. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25˚C} = f (T_{mb})$

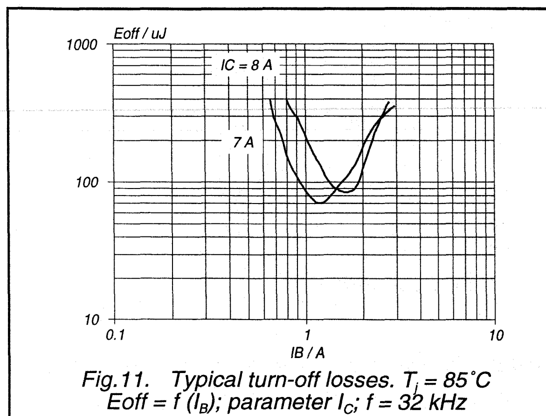


Fig.11. Typical turn-off losses. $T_j = 85˚C$ $Eoff = f (I_B)$; parameter I_C; $f = 32$ kHz

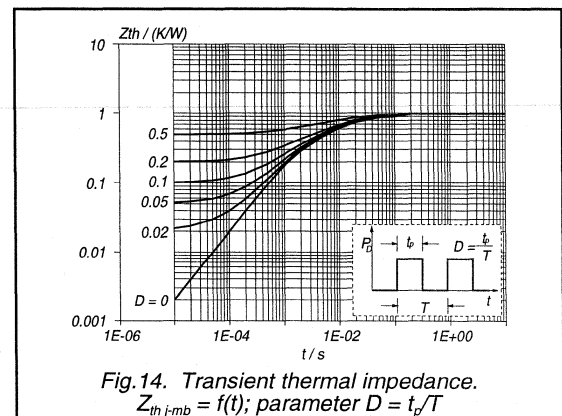


Fig.14. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

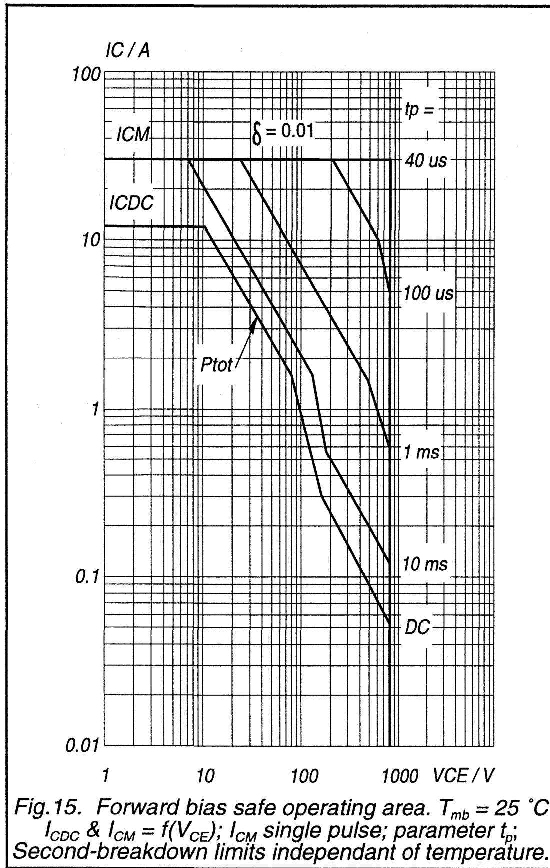


Fig.15. Forward bias safe operating area. T_{mb} = 25 ˚C I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p; Second-breakdown limits independant of temperature.

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.

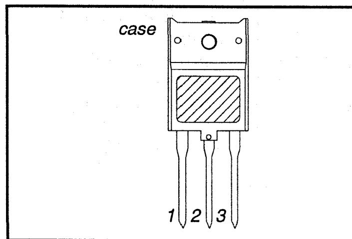
QUICK REFERENCE DATA

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	$I_{Csat} = 8.0$ A; $I_{B(end)} = 1.1$ A	0.2	0.35	μs

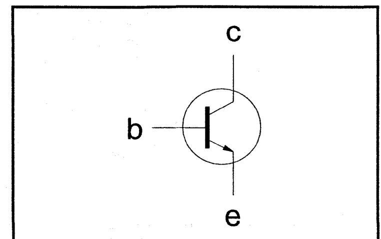
PINNING - SOT399

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
$R_{th\ j\text{-}hs}$	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	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	13	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	9.5	

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	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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).

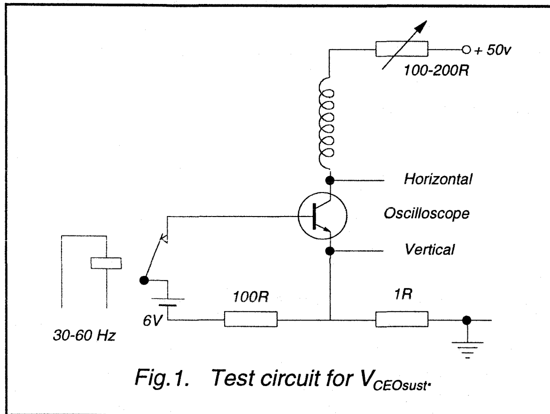


Fig.1. Test circuit for $V_{CEOsust}$.

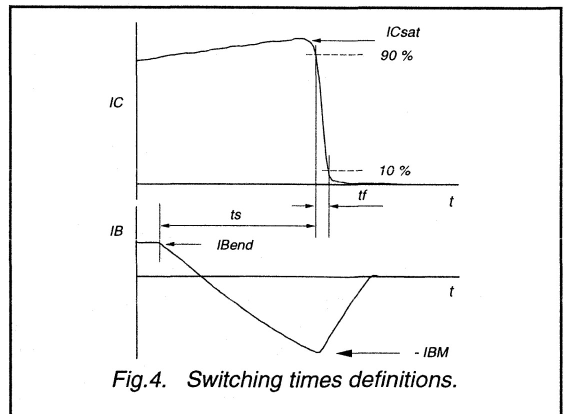


Fig.4. Switching times definitions.

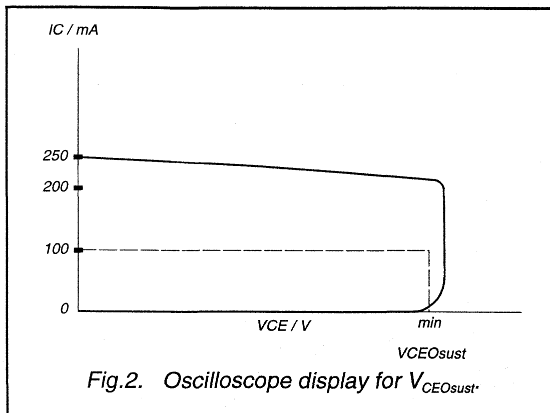


Fig.2. Oscilloscope display for $V_{CEOsust}$.

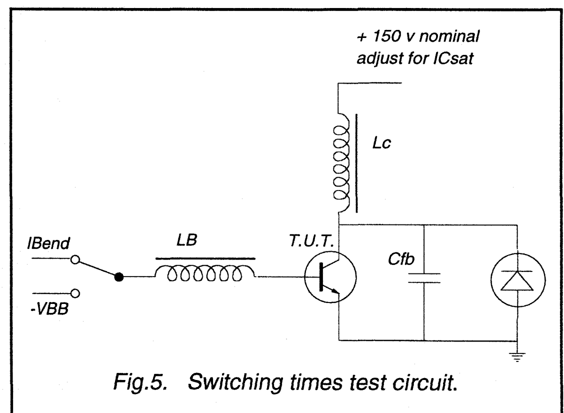


Fig.5. Switching times test circuit.

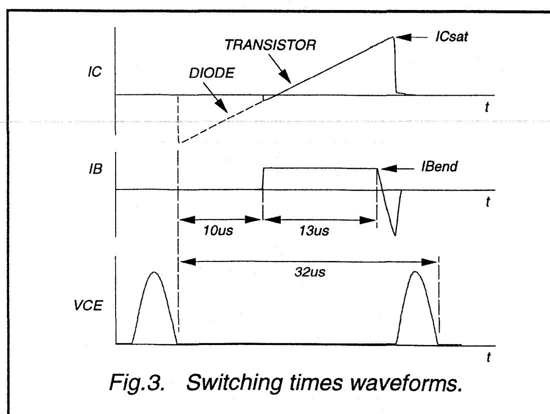


Fig.3. Switching times waveforms.

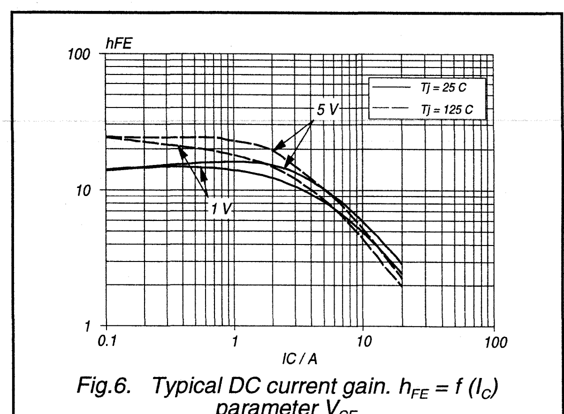


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

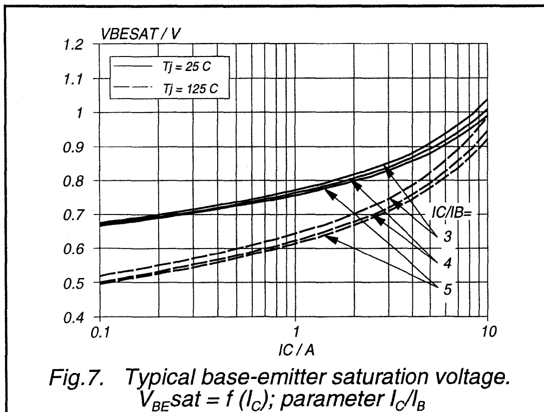


Fig.7. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_C)$; parameter I_C/I_B

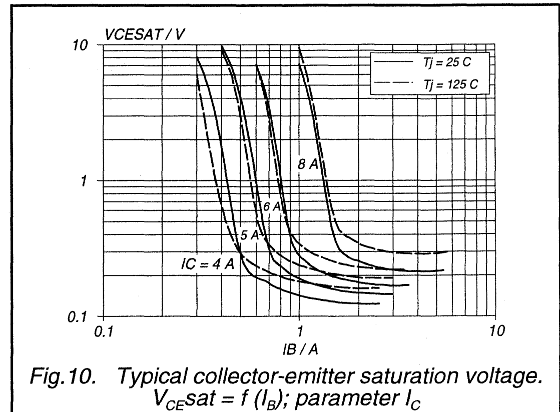


Fig.10. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_B)$; parameter I_C

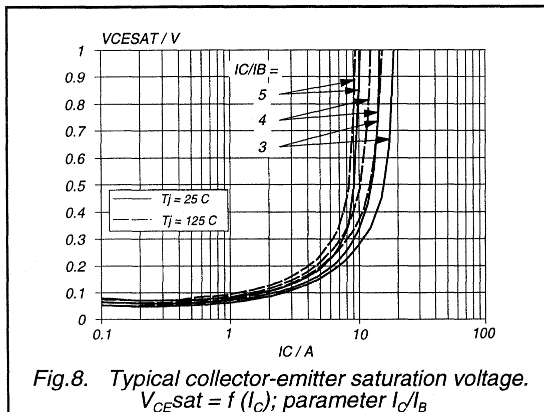


Fig.8. Typical collector-emitter saturation voltage.
$V_{CE}sat = f(I_C)$; parameter I_C/I_B

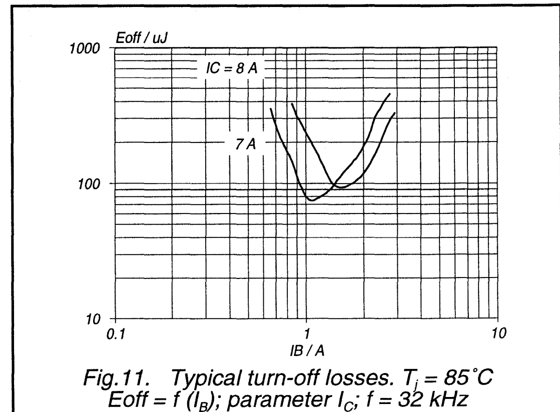


Fig.11. Typical turn-off losses. $T_j = 85˚C$
Eoff = $f(I_B)$; parameter I_C; f = 32 kHz

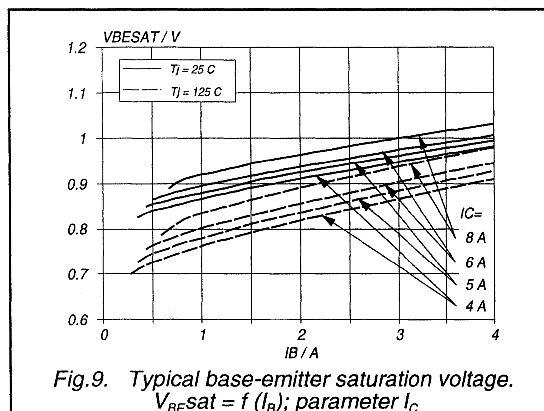


Fig.9. Typical base-emitter saturation voltage.
$V_{BE}sat = f(I_B)$; parameter I_C

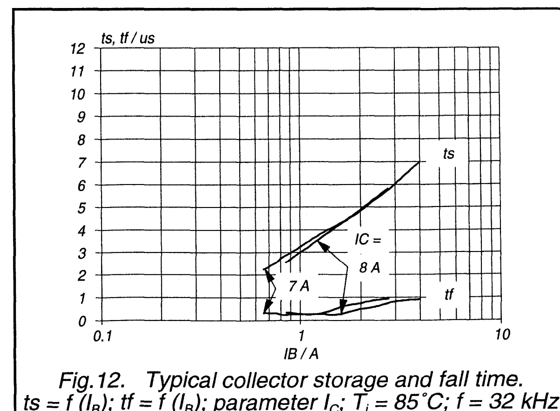


Fig.12. Typical collector storage and fall time.
ts = $f(I_B)$; tf = $f(I_B)$; parameter I_C; $T_j = 85˚C$; f = 32 kHz

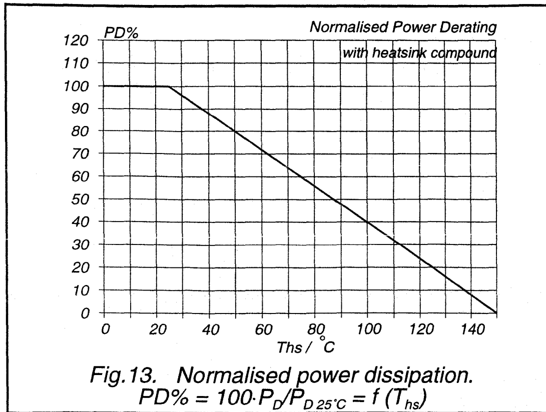


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

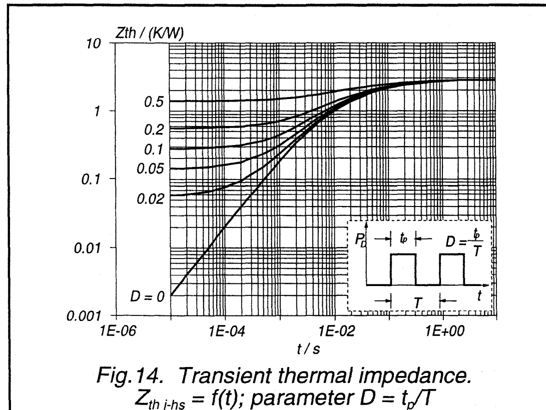


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

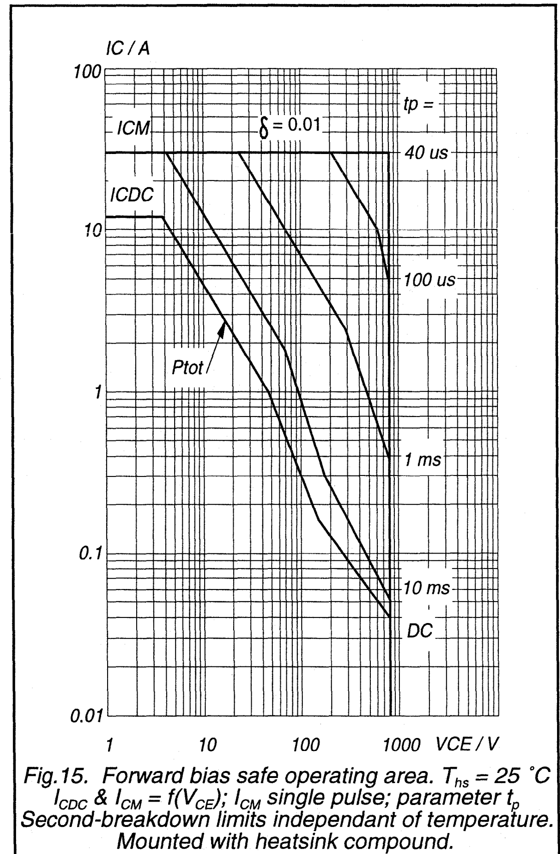


Fig.15. Forward bias safe operating area. $T_{hs} = 25$ °C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

GENERAL DESCRIPTION

New generation, 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 large screen colour television receivers up to 32 kHz.

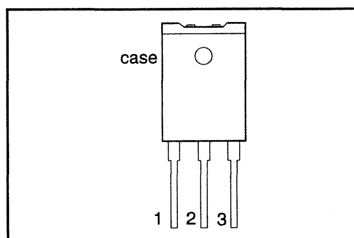
QUICK REFERENCE DATA

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_s	Storage time	$I_{Csat} = 8.0$ A; $I_{B(end)} = 1.1$ A	3.0	4.0	µs

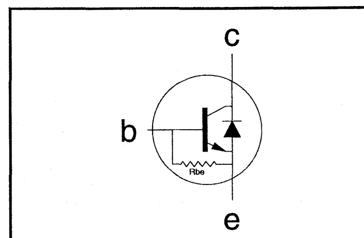
PINNING - SOT199

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]		-	9	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} = 6.0 V; I_C = 0 A	72	110	218	mA
R_{eb}	Base-emitter resistance	V_{EB} = 6.0 V	-	55	-	Ω
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B=0A ;I_c = 100mA; 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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	11	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	9.5	
V_F	Diode forward voltage	I_F = 8 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	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 8 A; dI_F/dt = 50 A/µs	16	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	410	-	ns

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

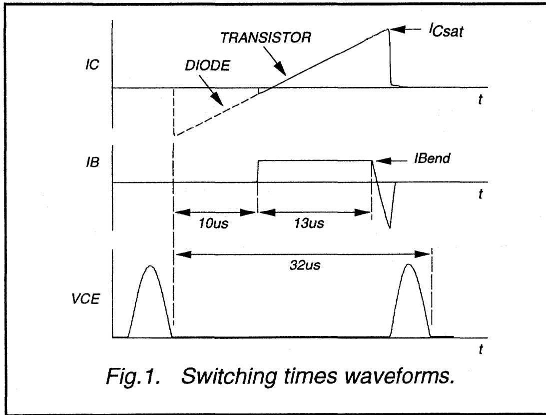


Fig.1. Switching times waveforms.

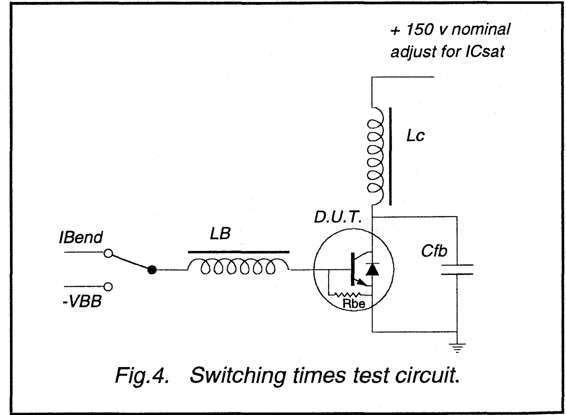


Fig.4. Switching times test circuit.

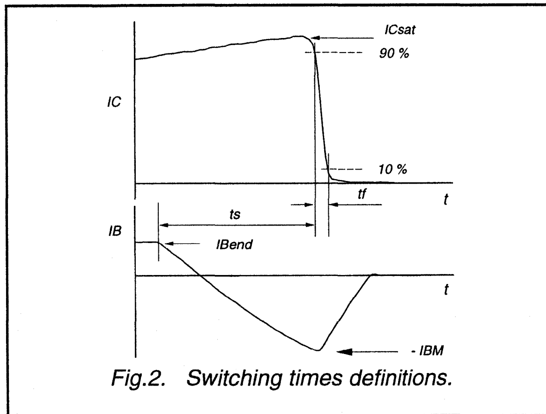


Fig.2. Switching times definitions.

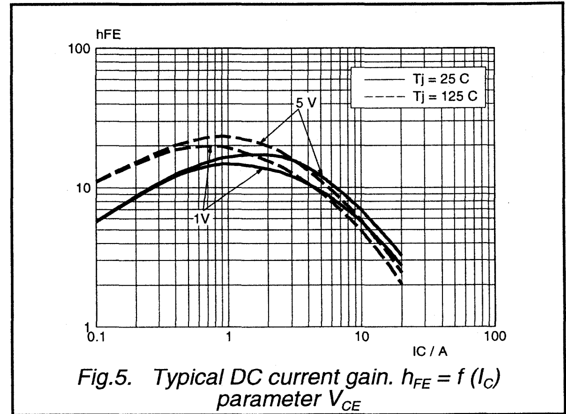


Fig.5. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

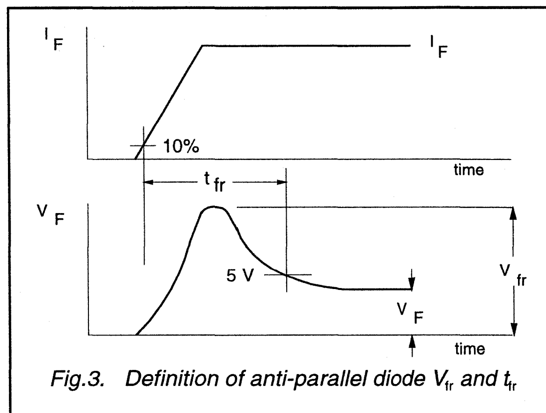


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}

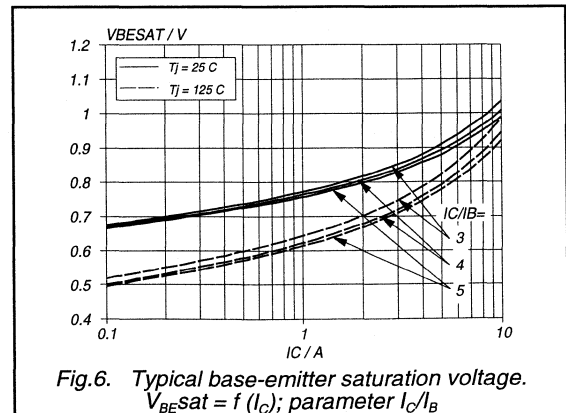


Fig.6. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

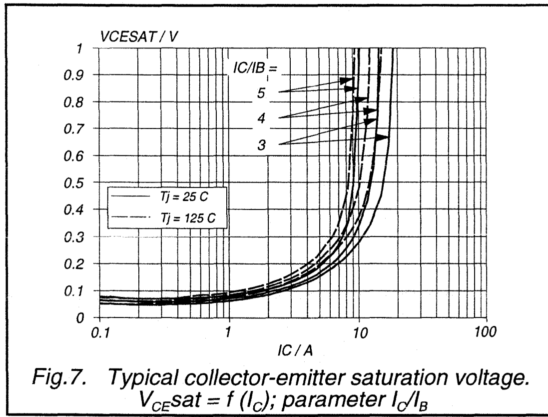


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

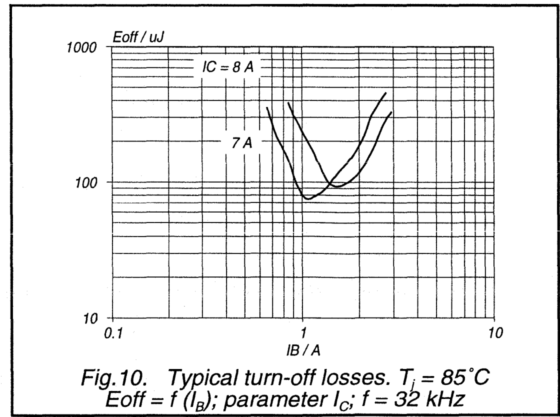


Fig.10. Typical turn-off losses. $T_j = 85^{\circ}C$ $Eoff = f (I_B)$; parameter I_C; f = 32 kHz

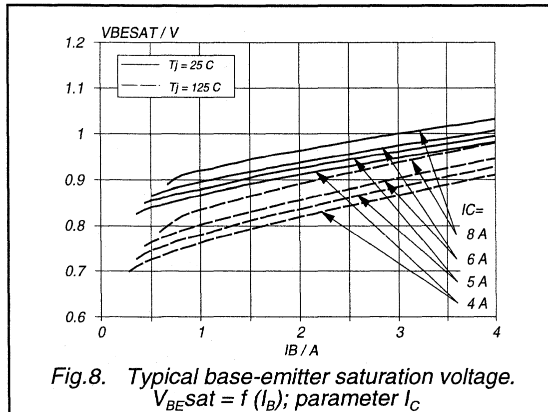


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

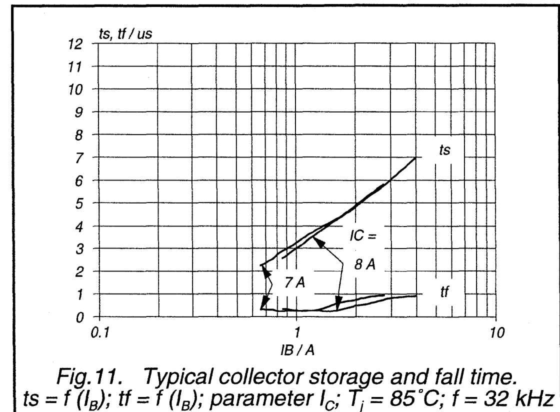


Fig.11. Typical collector storage and fall time. $ts = f (I_B)$; $tf = f (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 32 kHz

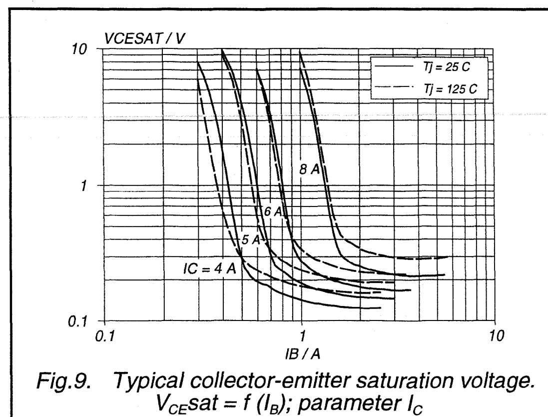


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_B)$; parameter I_C

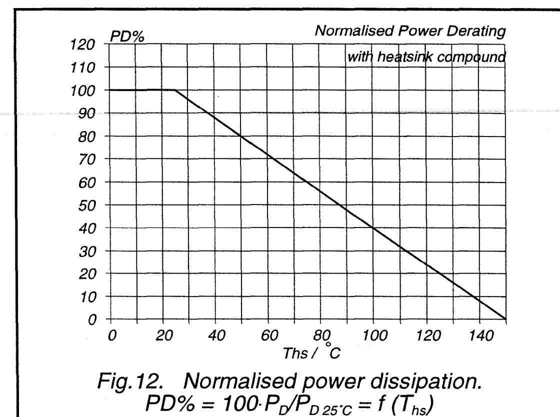


Fig.12. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^{\circ}C} = f (T_{hs})$

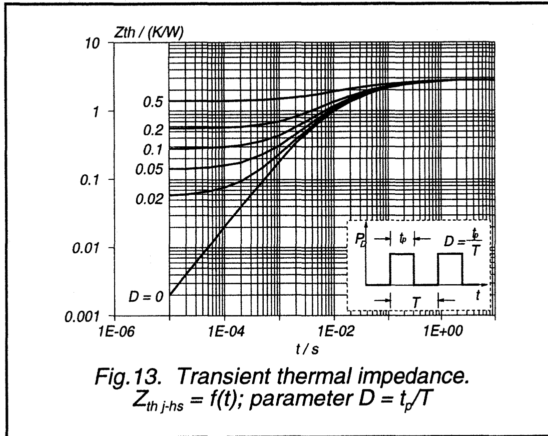


Fig.13. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

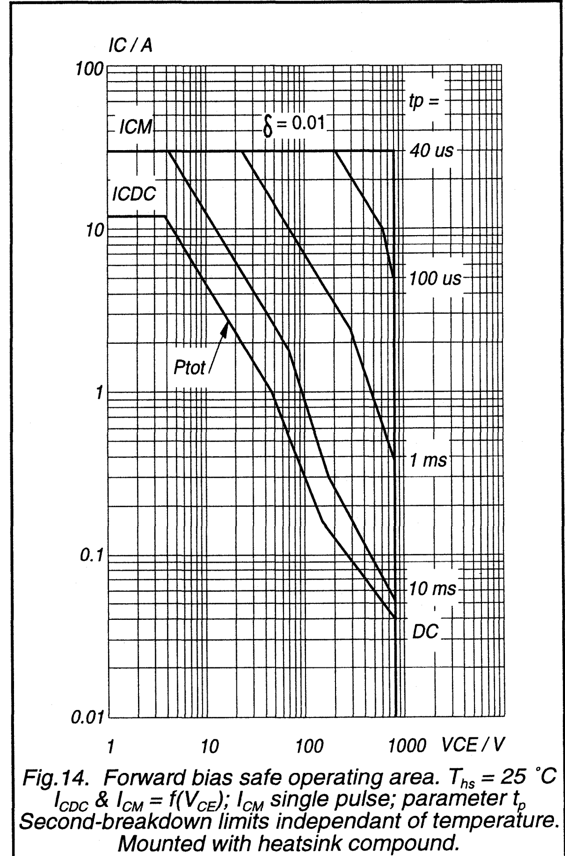


Fig.14. Forward bias safe operating area. T_{hs} = 25 °C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

GENERAL DESCRIPTION

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

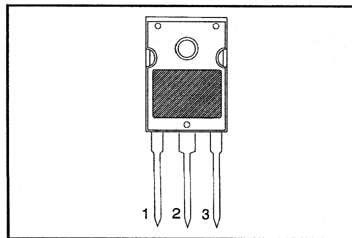
QUICK REFERENCE DATA

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_s	Storage time	$I_{Csat} = 8.0$ A; $I_{B(end)} = 1.1$ A	3.0	4.0	µs

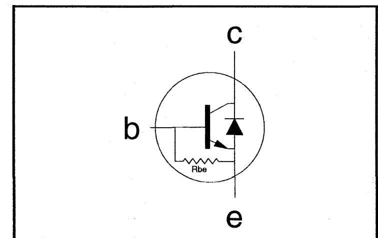
PINNING - SOT429

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]		-	9	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} = 6.0 V; I_C = 0 A	72	110	218	mA
R_{EB}	Base-emitter resistance	V_{EB} = 6.0 V	-	55	-	Ω
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector emitter-sustaining voltage	I_B = 0A;I_C= 100mA; 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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	11	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	9.5	
V_F	Diode forward voltage	I_F = 8 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	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 8 A; dI_F/dt = 50 A/µs	16		V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	410		ns

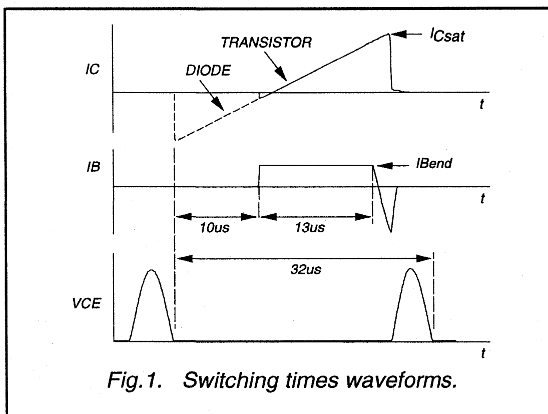


Fig.1. Switching times waveforms.

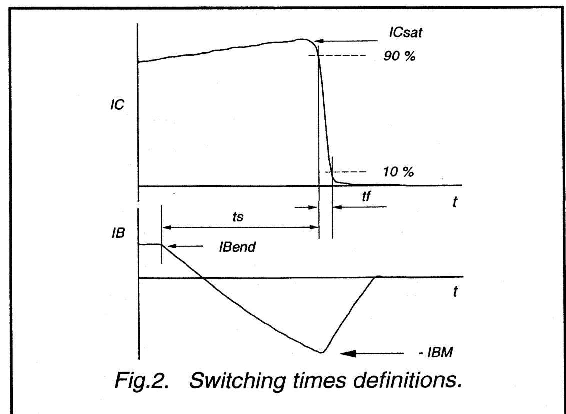


Fig.2. Switching times definitions.

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

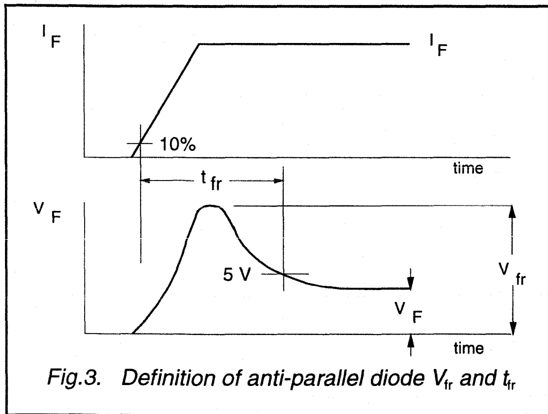


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}

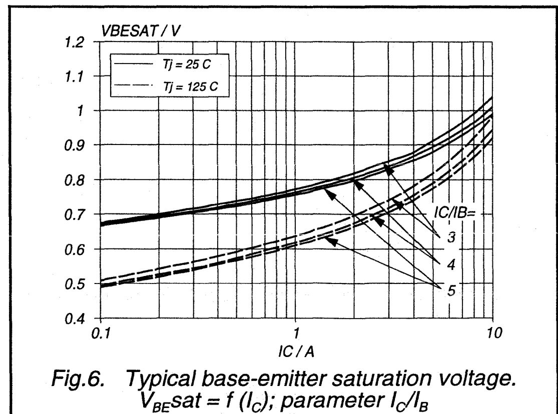


Fig.6. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

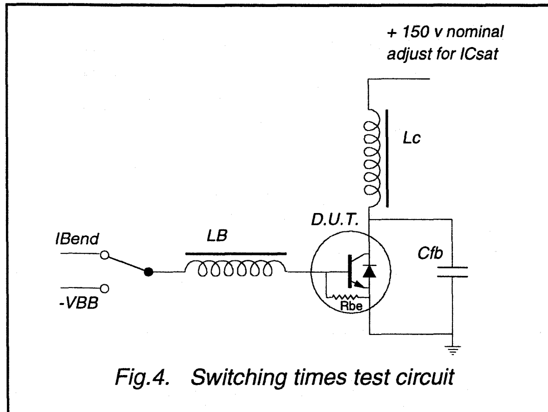


Fig.4. Switching times test circuit

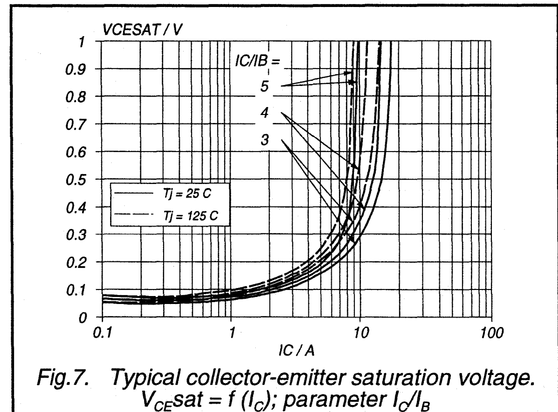


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

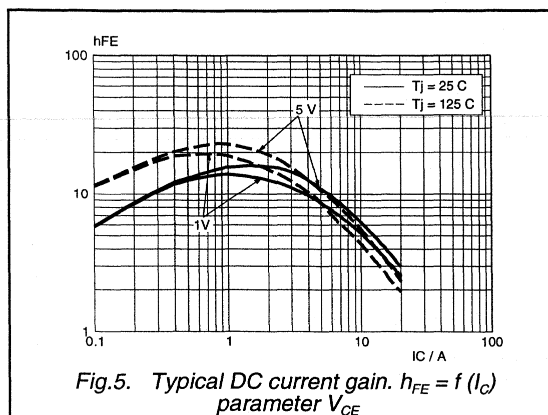


Fig.5. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

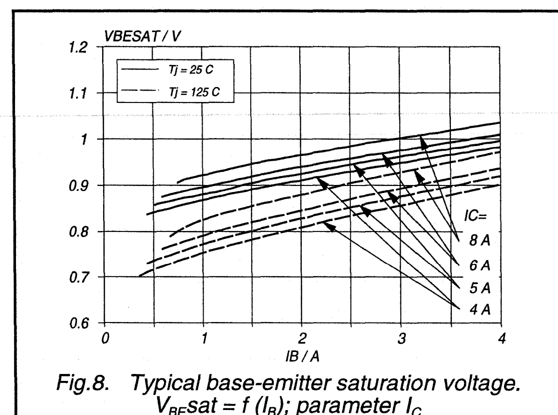


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

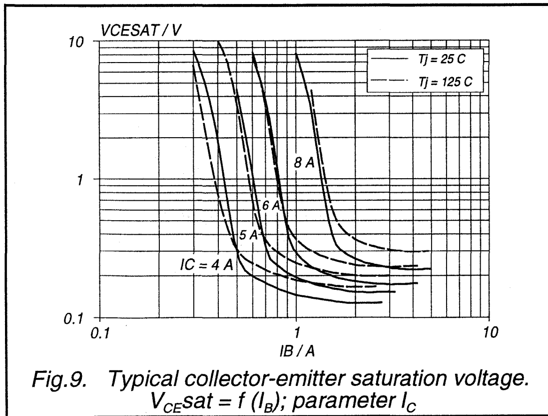


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

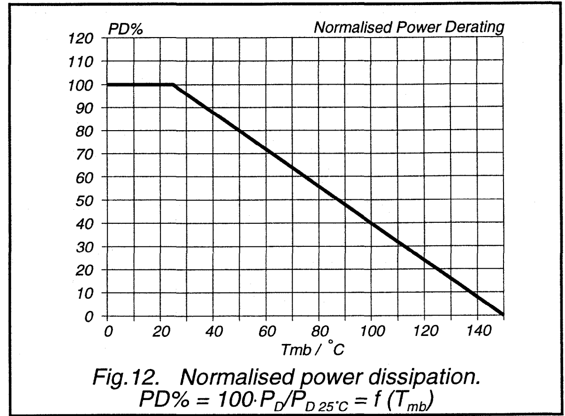


Fig.12. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

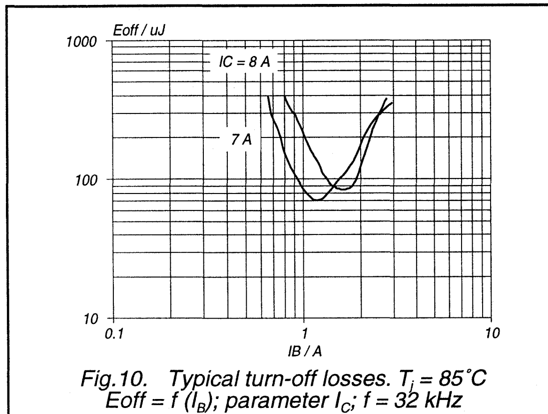


Fig.10. Typical turn-off losses. $T_j = 85^\circ C$ $Eoff = f(I_B)$; parameter I_C; $f = 32$ kHz

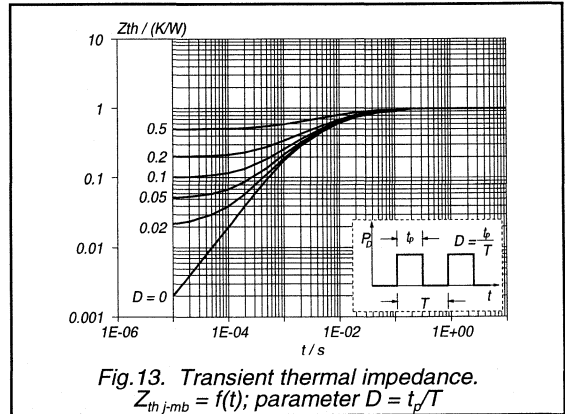


Fig.13. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

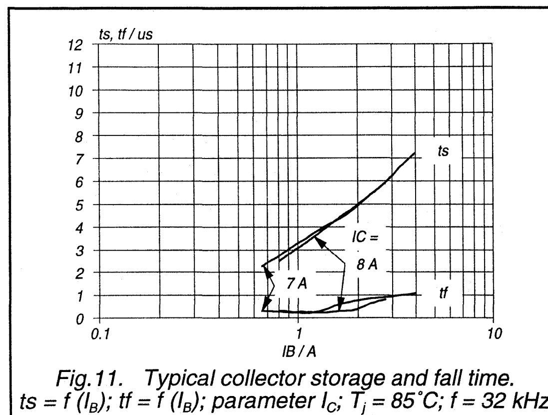


Fig.11. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 32$ kHz

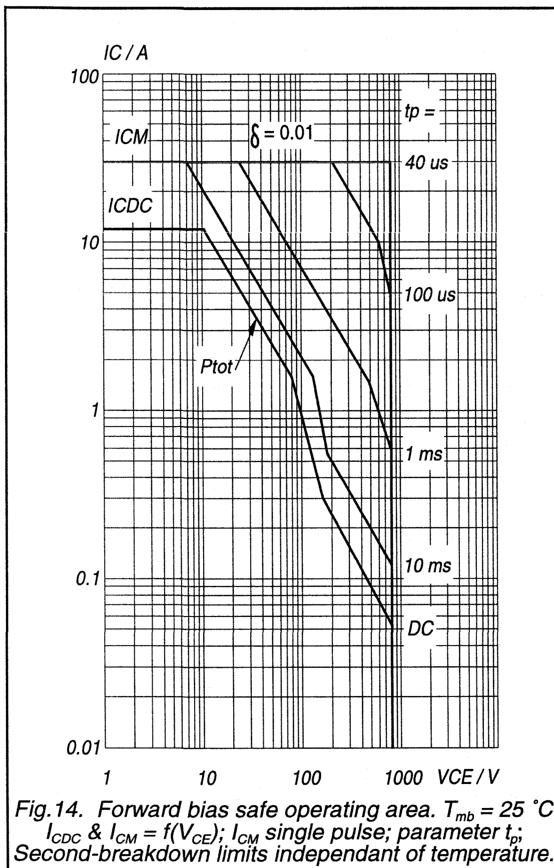


Fig.14. Forward bias safe operating area. T_{mb} = 25 ˚C
I_{CDC} & I_{CM} = f(V_{CE}); I_{CM} single pulse; parameter t_p;
Second-breakdown limits independant of temperature.

GENERAL DESCRIPTION

New generation, 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 large screen colour television receivers up to 32 kHz.

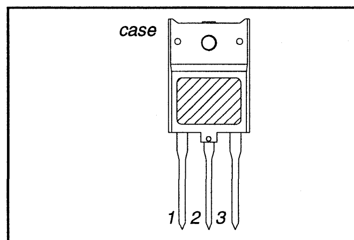
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	1500	V
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
V_{CEO}	Collector-emitter voltage (open base)		-	800	V
I_{Csat}	Collector saturation current		8.0	-	A
t_s	Storage time	$I_{Csat} = 8.0$ A; $I_{B(end)} = 1.1$ A	3.0	4.0	µs

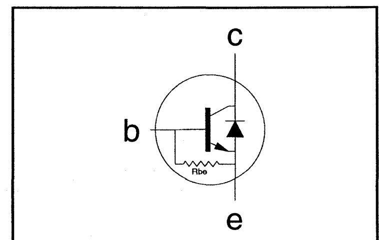
PINNING - SOT399

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]		-	9	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} = 6.0 V; I_C = 0 A	72	110	218	mA
R_{EB}	Base-emitter resistance	V_{EB} = 6.0 V	-	55	-	Ω
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	11	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	9.5	
V_F	Diode forward voltage	I_F = 8 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	145	-	pF
	Switching times (32 kHz line deflection circuit)	I_{Csat} = 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
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 8 A; dI_F/dt = 50 A/µs	16	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	410	-	ns

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

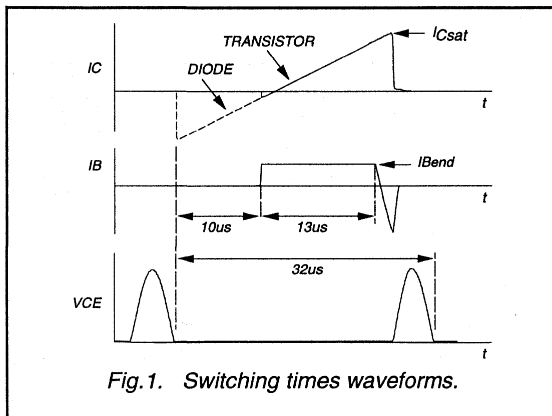


Fig.1. Switching times waveforms.

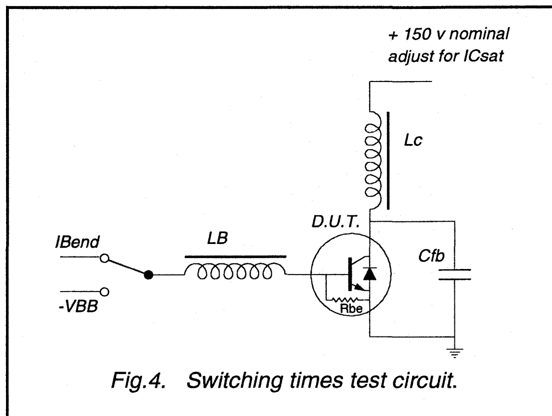


Fig.4. Switching times test circuit.

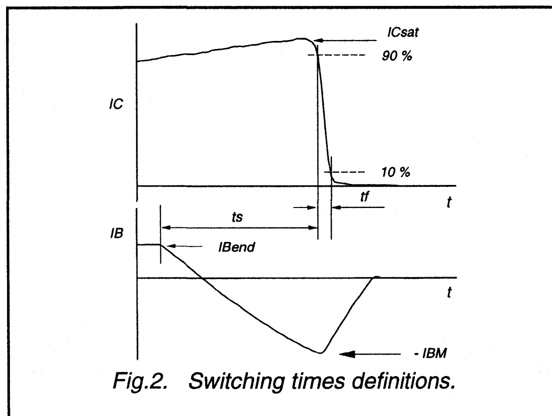


Fig.2. Switching times definitions.

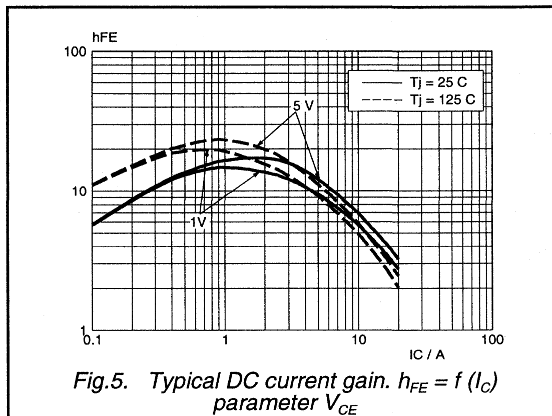


Fig.5. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

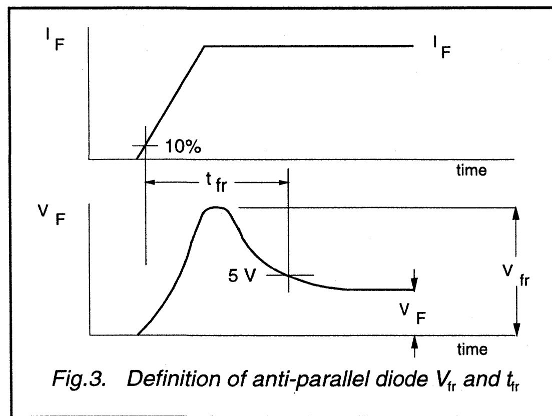


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}

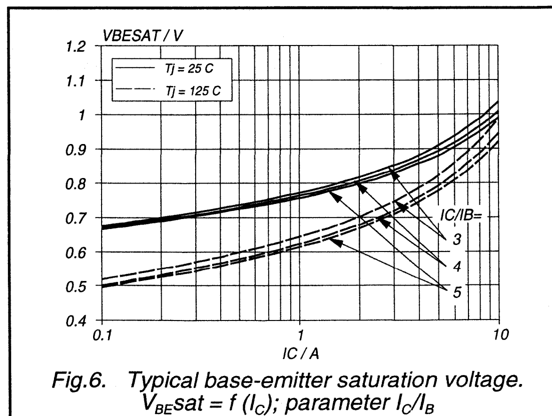


Fig.6. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

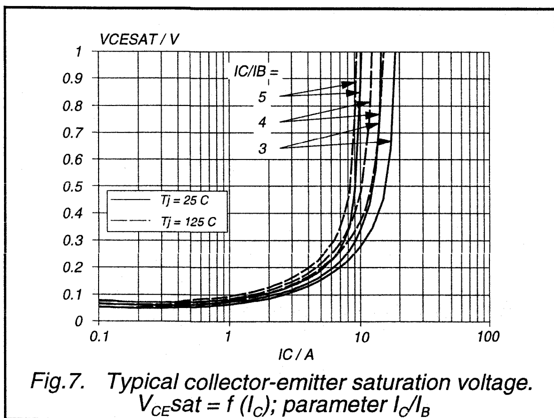


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

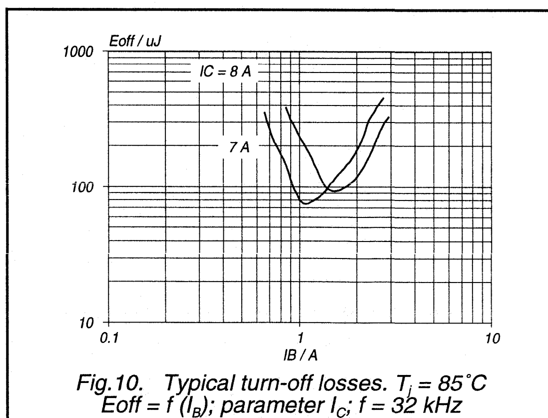


Fig.10. Typical turn-off losses. $T_j = 85^\circ C$ $Eoff = f\ (I_B)$; parameter I_C; f = 32 kHz

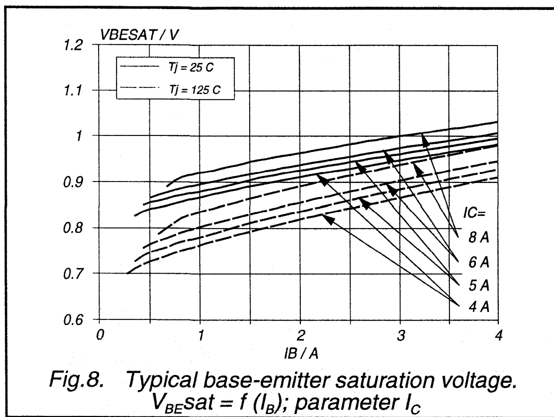


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

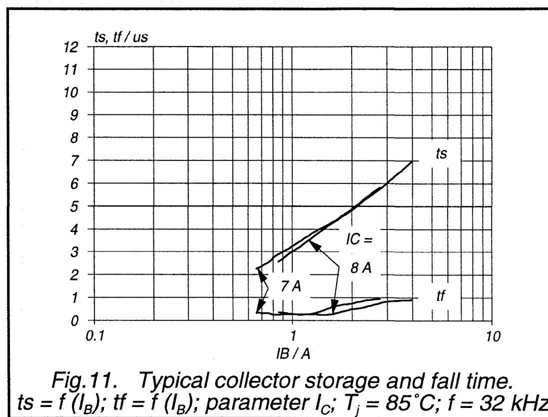


Fig.11. Typical collector storage and fall time. $ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^\circ C$; f = 32 kHz

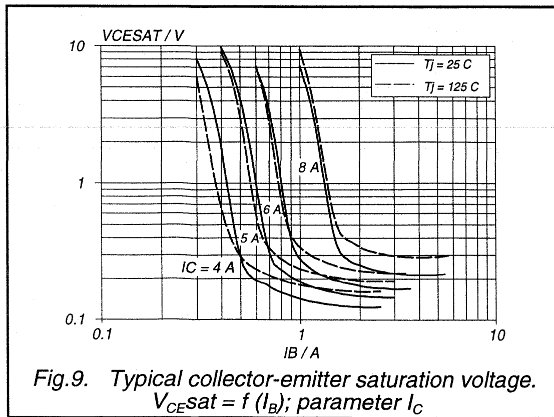


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_B)$; parameter I_C

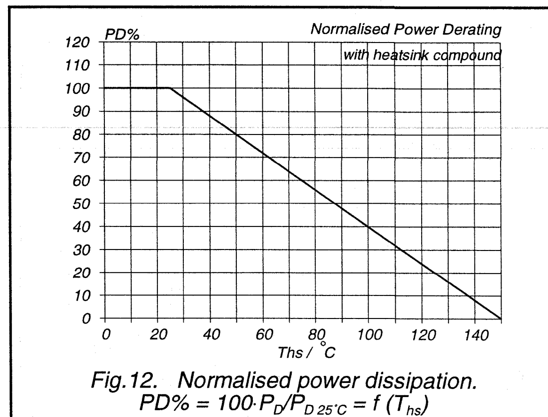


Fig.12. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25^\circ C} = f\ (T_{hs})$

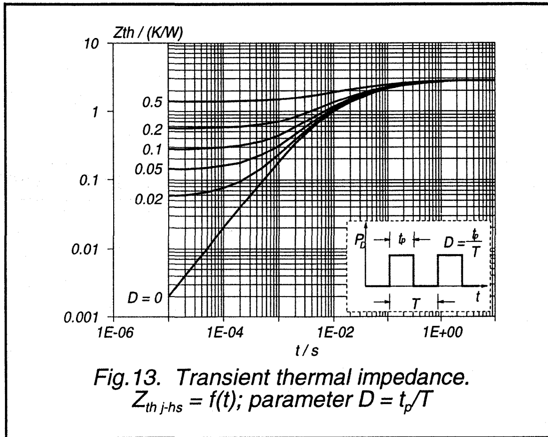


Fig. 13. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

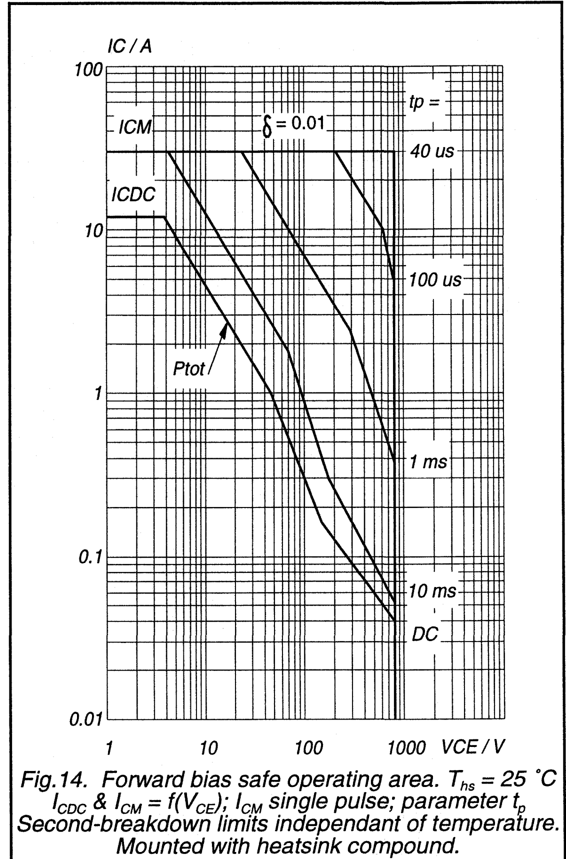


Fig. 14. Forward bias safe operating area. $T_{hs} = 25$ ˚C
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

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.

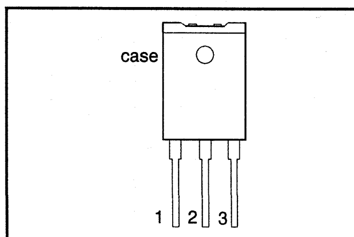
QUICK REFERENCE DATA

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	$I_{Csat} = 6.0$ A; $I_{B(end)} = 0.55$ A	1.7	2.0	µs

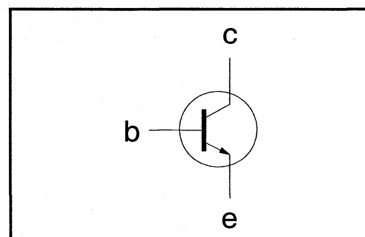
PINNING - SOT199

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	-	10	-	
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_{Csat} = 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).

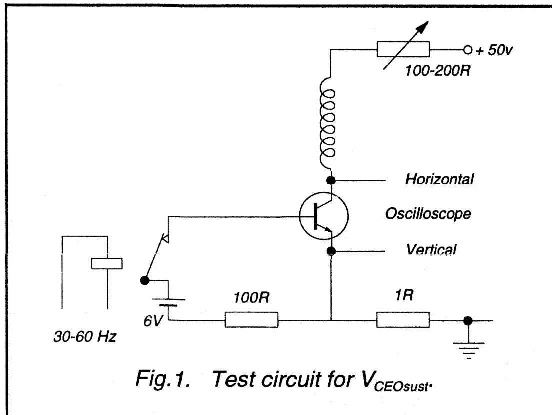


Fig.1. Test circuit for $V_{CEOsust}$.

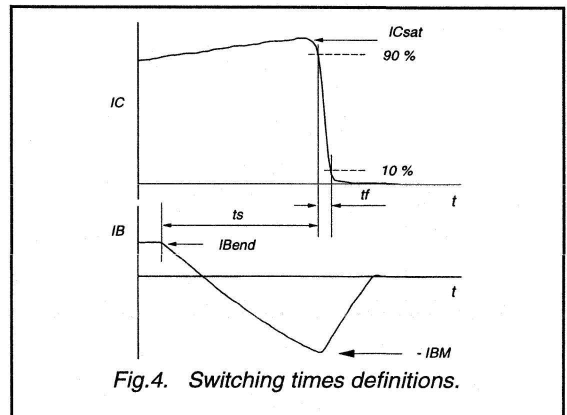


Fig.4. Switching times definitions.

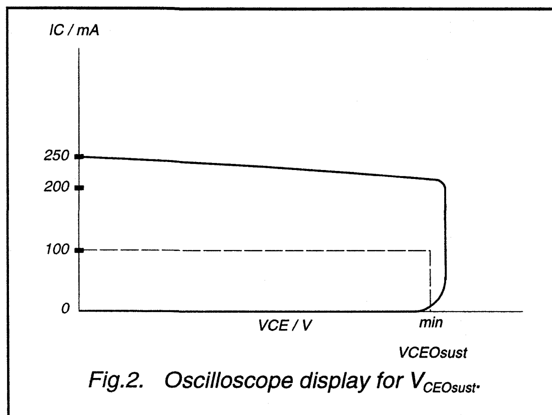


Fig.2. Oscilloscope display for $V_{CEOsust}$.

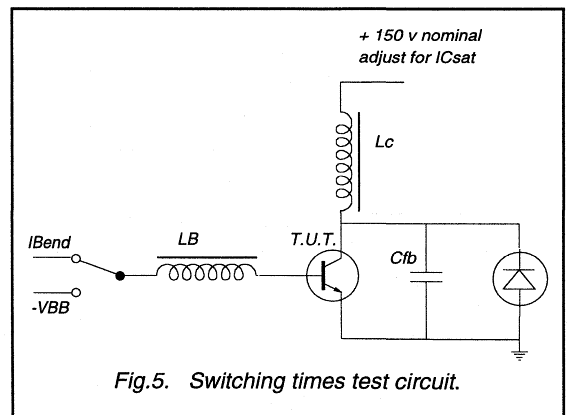


Fig.5. Switching times test circuit.

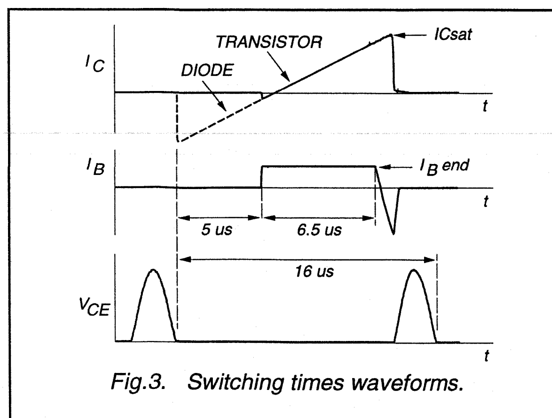


Fig.3. Switching times waveforms.

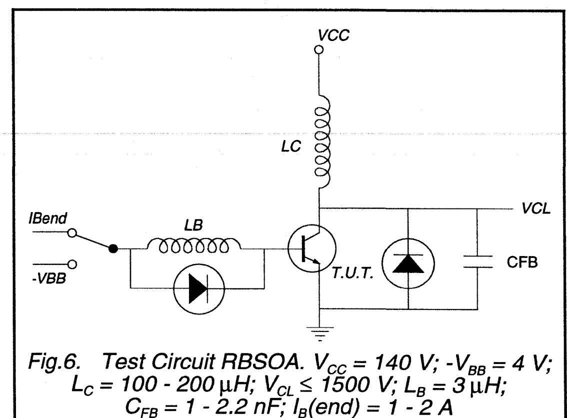


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; $I_B(end)$ = 1 - 2 A

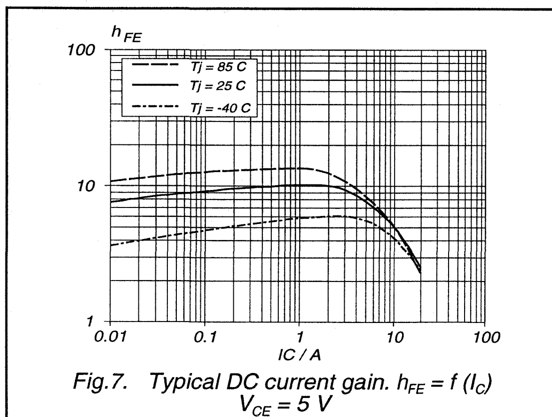


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 5\ V$

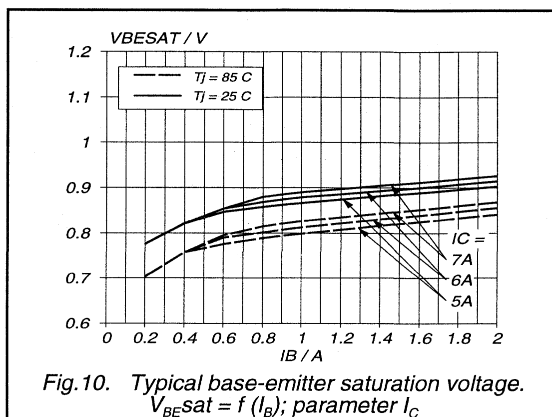


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

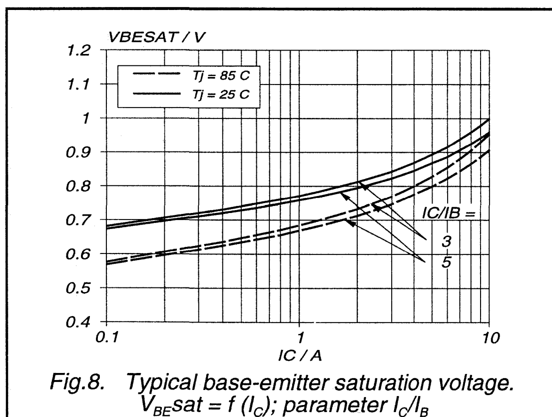


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

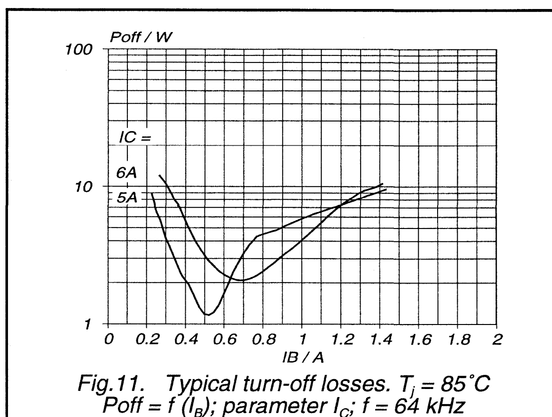


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$ Poff = f (I_B); parameter I_C; f = 64 kHz

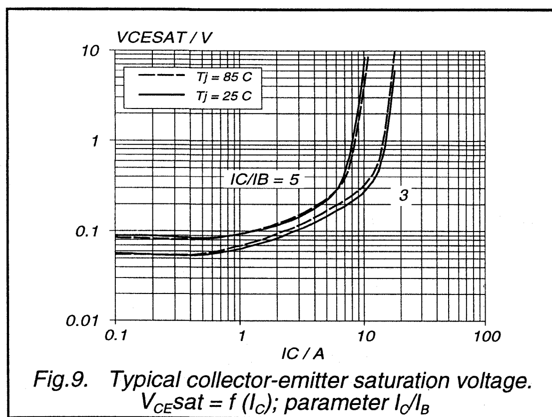


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

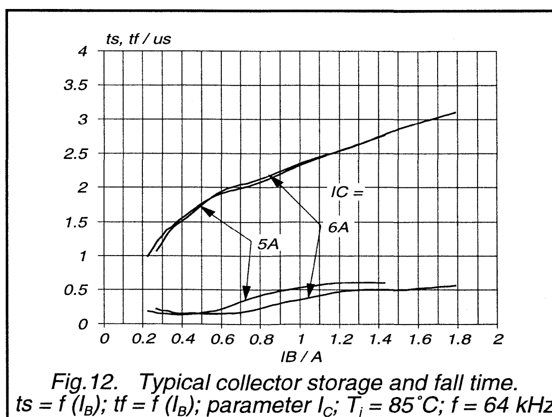


Fig.12. Typical collector storage and fall time. ts = f (I_B); tf = f (I_B); parameter I_C; $T_j = 85^{\circ}C$; f = 64 kHz

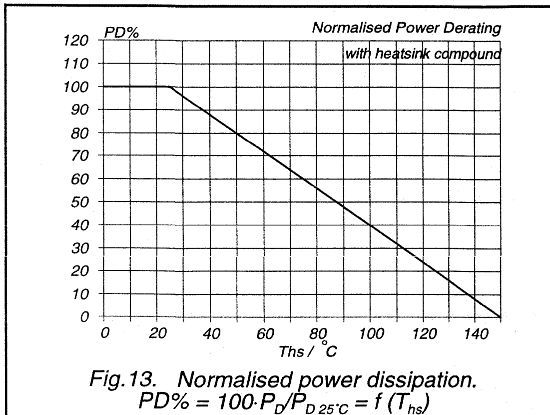


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

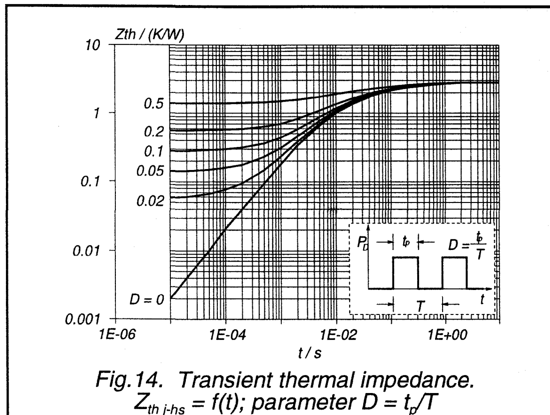


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

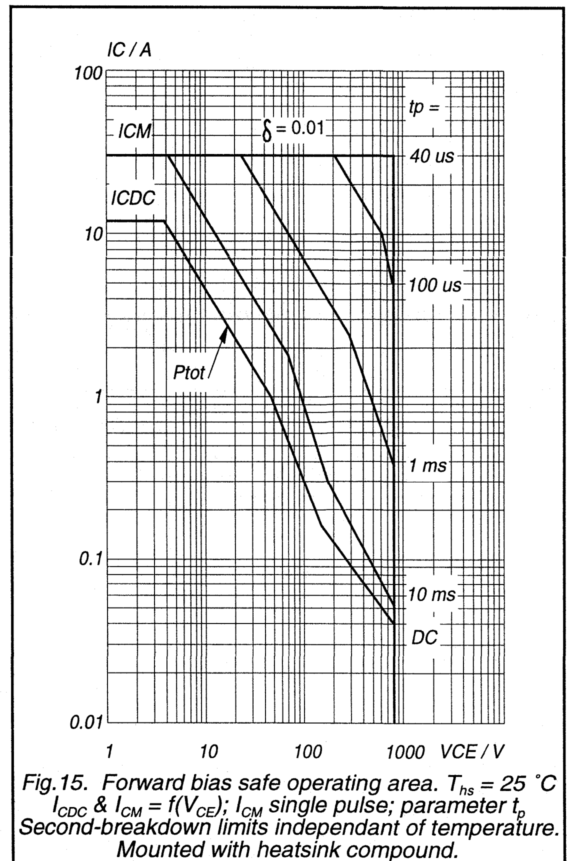


Fig.15. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

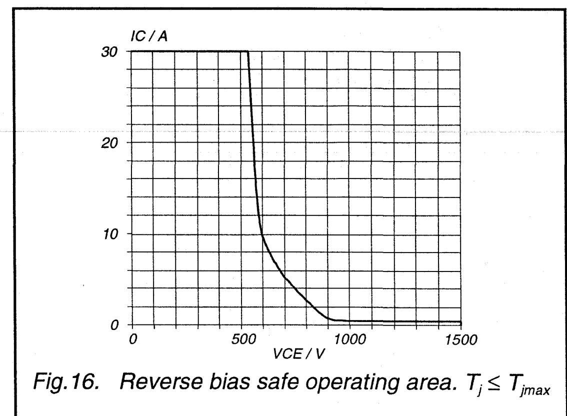


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

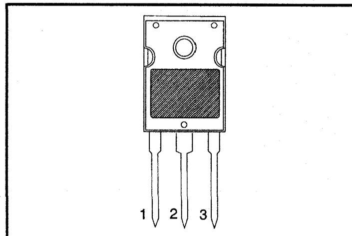
QUICK REFERENCE DATA

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	$I_{csat} = 6.0$ A; $I_{B(end)} = 0.55$ A	1.7	2.0	µs

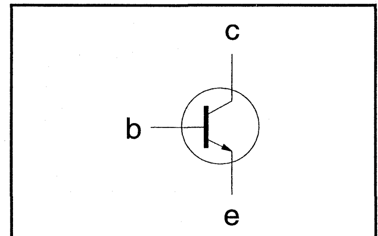
PINNING - SOT429

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} = $V_{CESMmax}$	-	-	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	-	10	-	
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

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

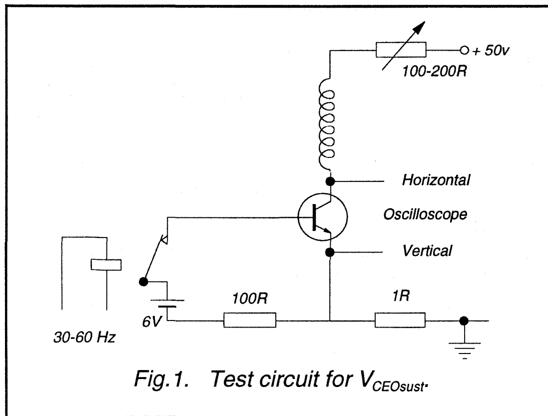


Fig.1. Test circuit for $V_{CEOsust}$.

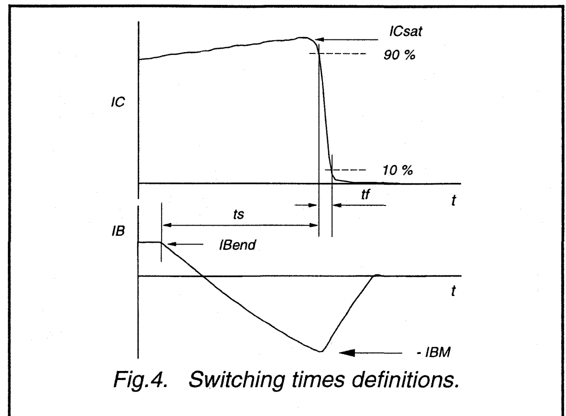


Fig.4. Switching times definitions.

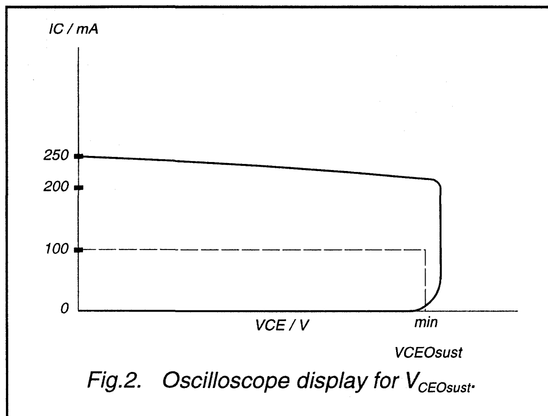


Fig.2. Oscilloscope display for $V_{CEOsust}$.

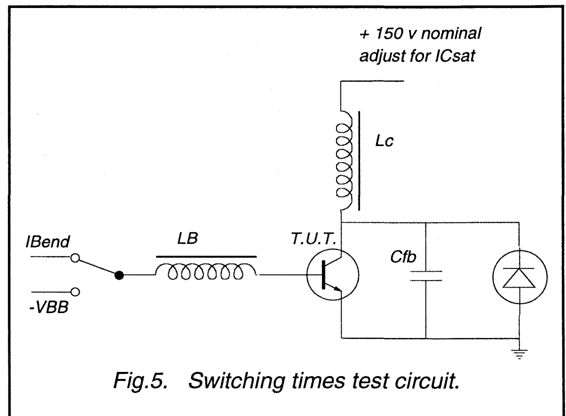


Fig.5. Switching times test circuit.

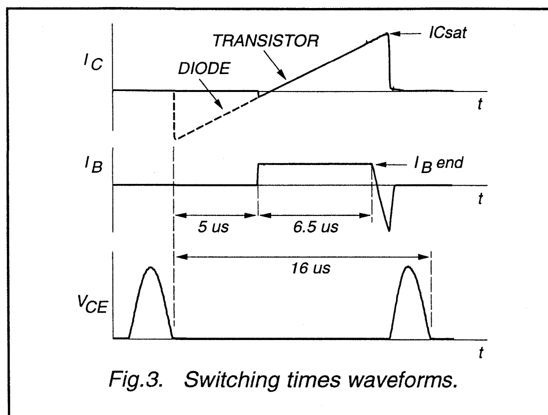


Fig.3. Switching times waveforms.

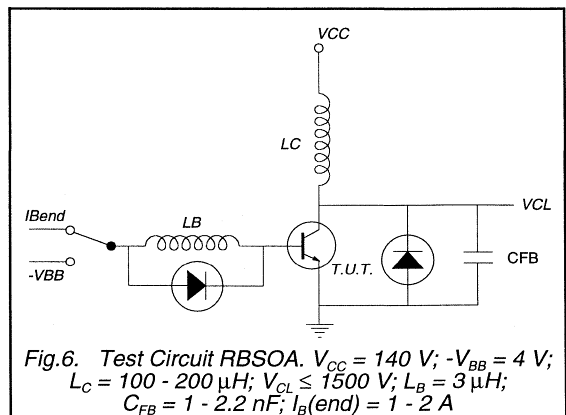


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; -V_{BB} = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1 - 2 A

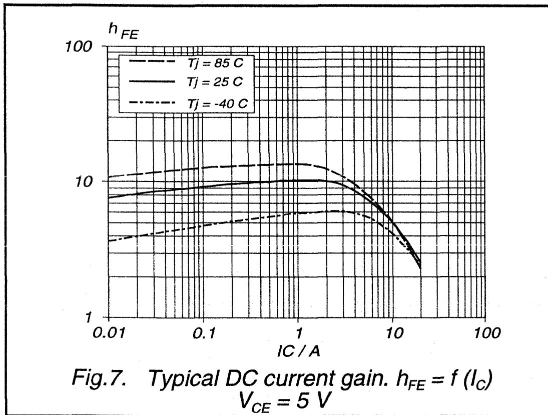


Fig.7. Typical DC current gain. $h_{FE} = f\ (I_C)$
$V_{CE} = 5\ V$

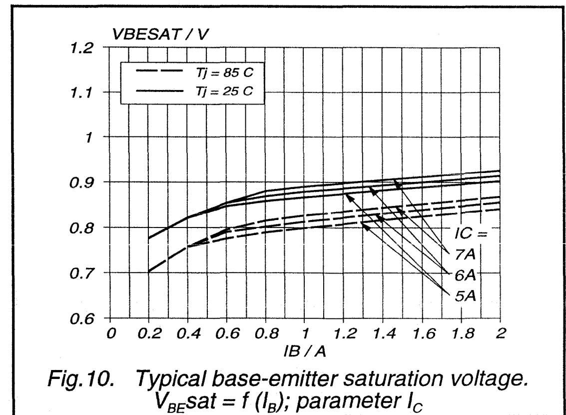


Fig.10. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_B)$; parameter I_C

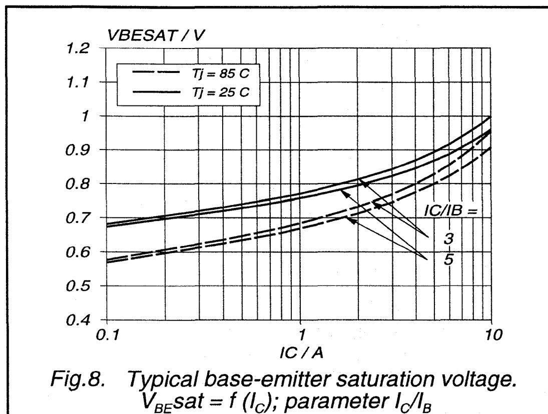


Fig.8. Typical base-emitter saturation voltage.
$V_{BE}sat = f\ (I_C)$; parameter I_C/I_B

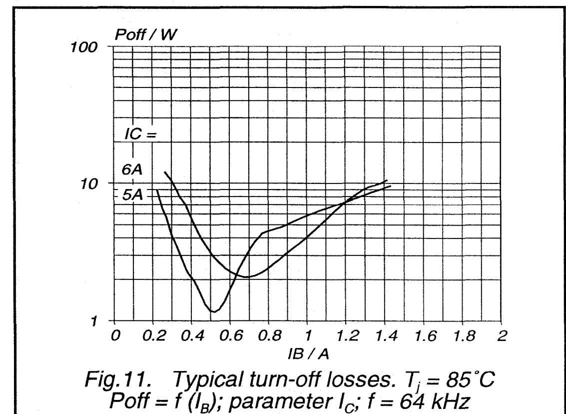


Fig.11. Typical turn-off losses. $T_j = 85˚C$
$Poff = f\ (I_B)$; parameter I_C; $f = 64\ kHz$

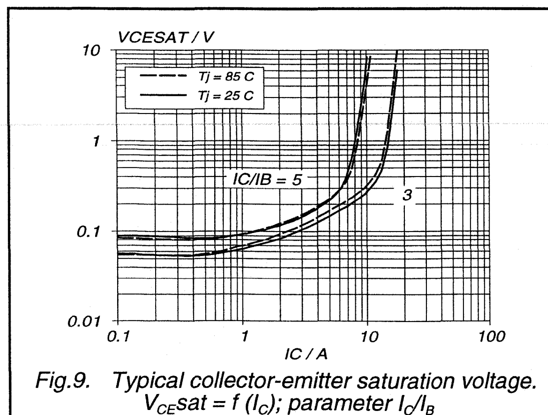


Fig.9. Typical collector-emitter saturation voltage.
$V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

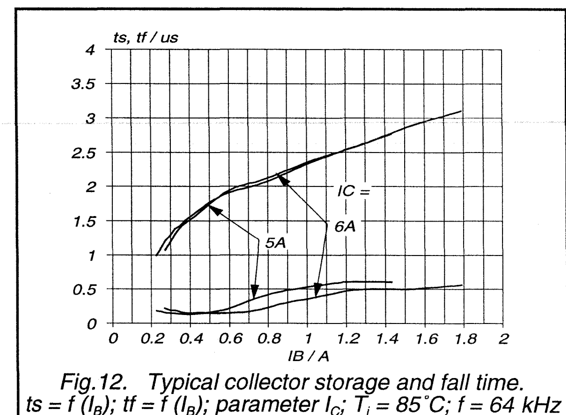


Fig.12. Typical collector storage and fall time.
$ts = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85˚C$; $f = 64\ kHz$

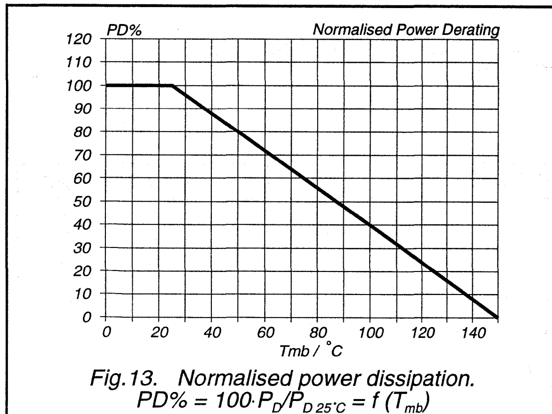


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{mb})$

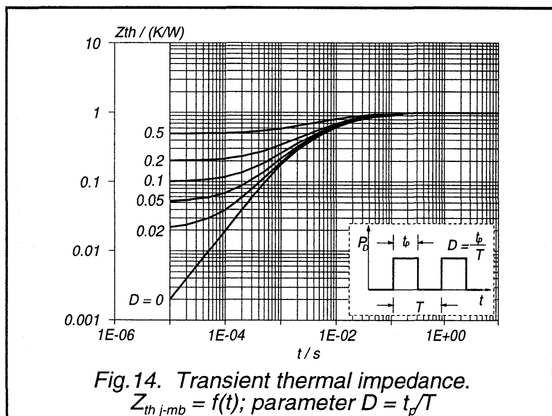


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

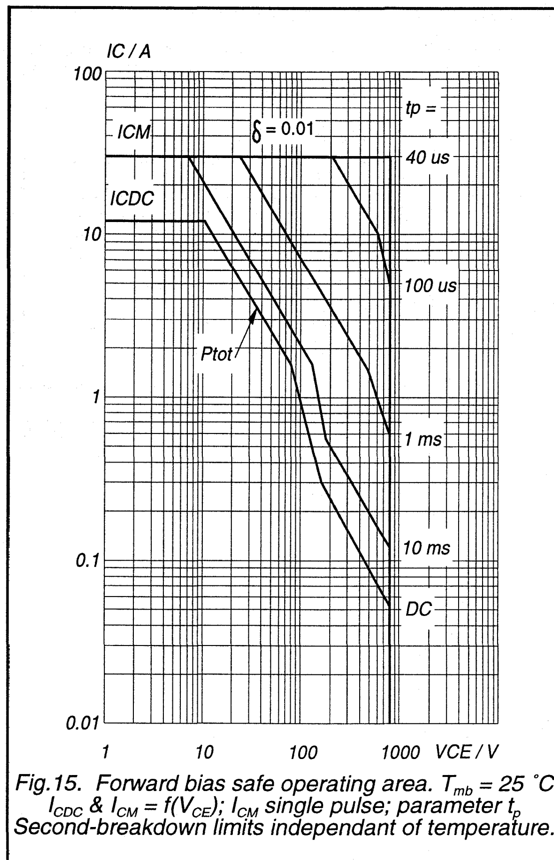


Fig.15. Forward bias safe operating area. $T_{mb} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.

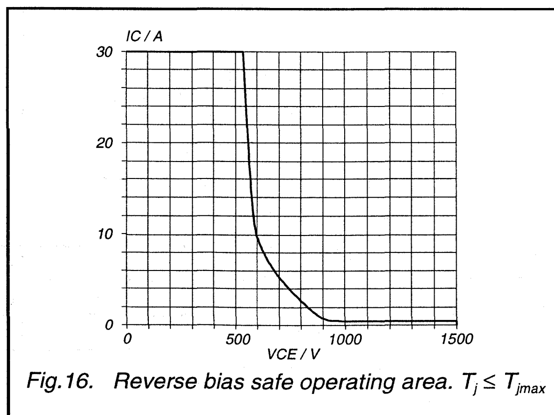


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

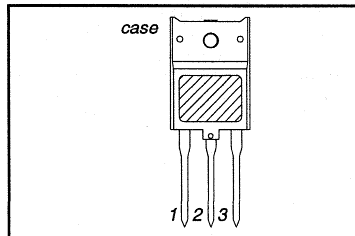
QUICK REFERENCE DATA

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	$I_{Csat} = 6.0$ A; $I_{B(end)} = 0.55$ A	1.7	2.0	µs

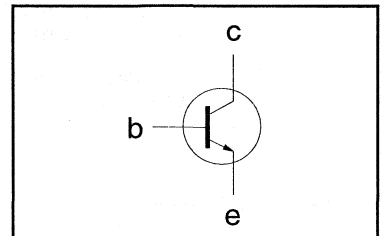
PINNING - SOT399

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_{Csat} = 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).

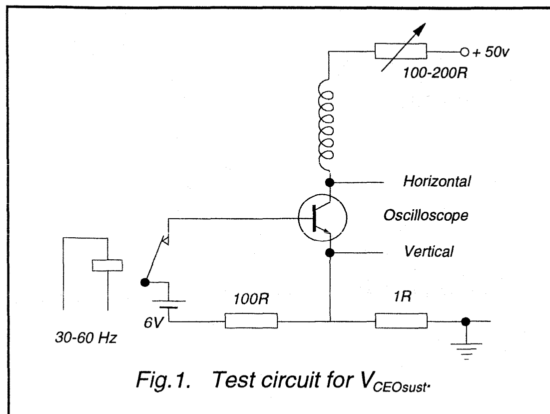


Fig.1. Test circuit for $V_{CEOsust}$.

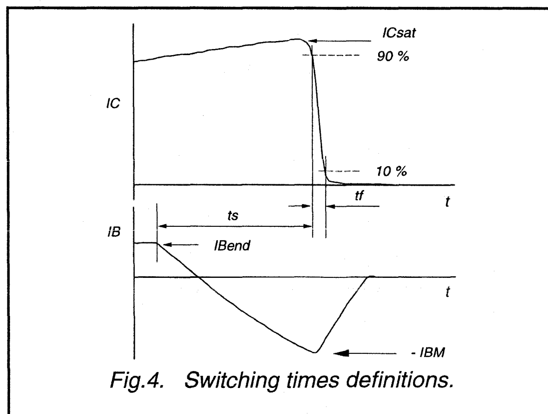


Fig.4. Switching times definitions.

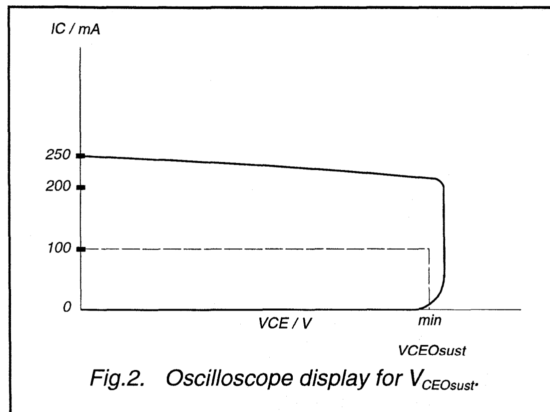


Fig.2. Oscilloscope display for $V_{CEOsust}$.

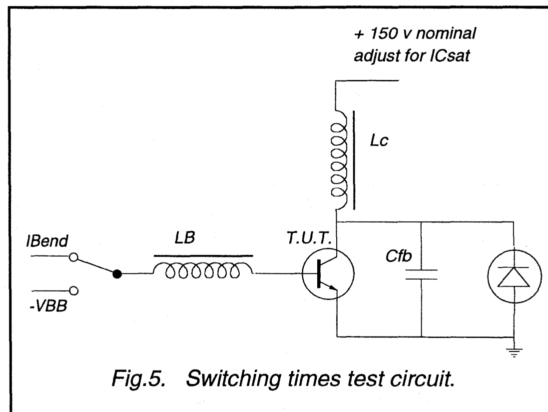


Fig.5. Switching times test circuit.

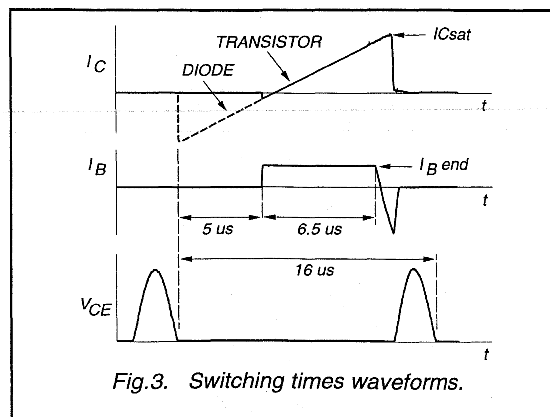


Fig.3. Switching times waveforms.

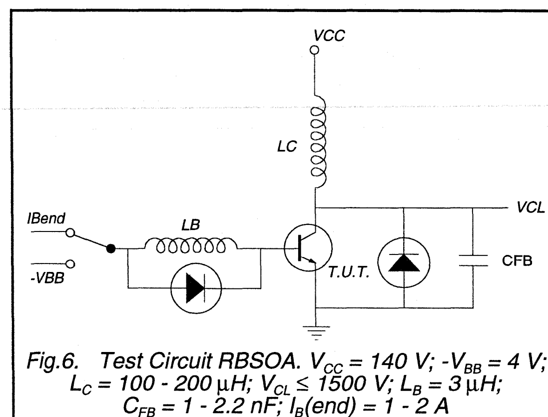


Fig.6. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1 - 2 A

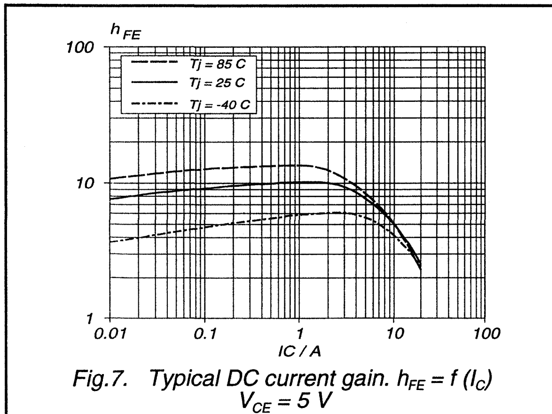


Fig.7. Typical DC current gain. $h_{FE} = f (I_C)$ $V_{CE} = 5$ V

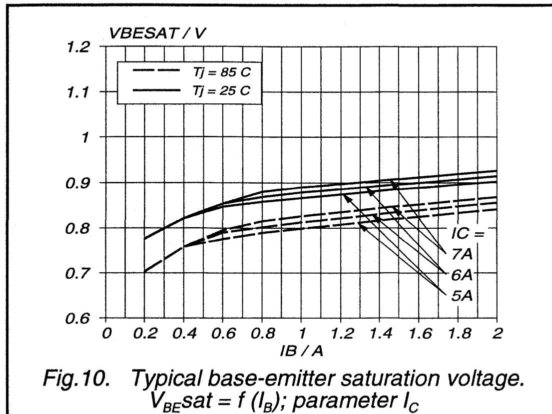


Fig.10. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

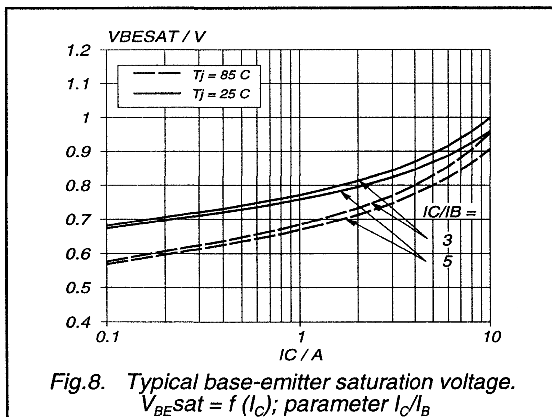


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_C)$; parameter I_C/I_B

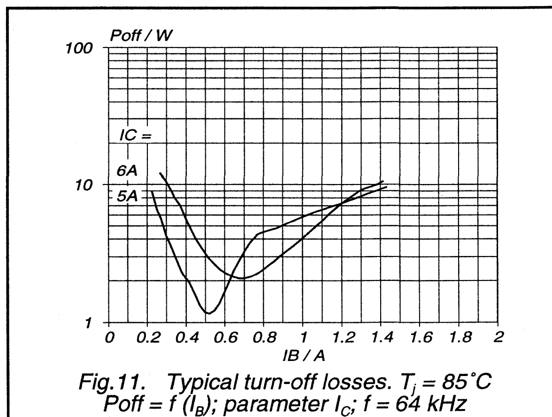


Fig.11. Typical turn-off losses. $T_j = 85$˚C Poff = $f (I_B)$; parameter I_C; f = 64 kHz

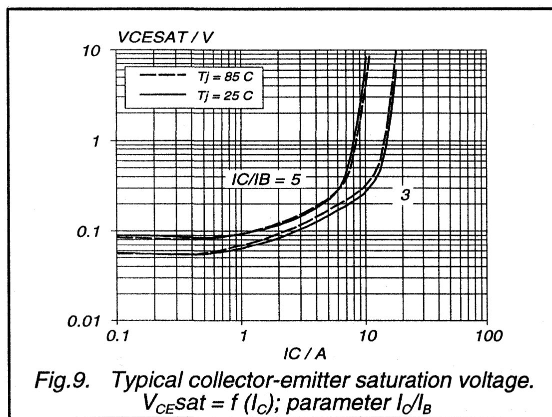


Fig.9. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

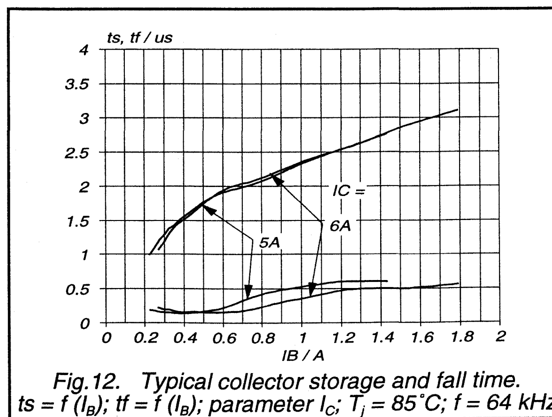


Fig.12. Typical collector storage and fall time. ts = $f (I_B)$; tf = $f (I_B)$; parameter I_C; $T_j = 85$˚C; f = 64 kHz

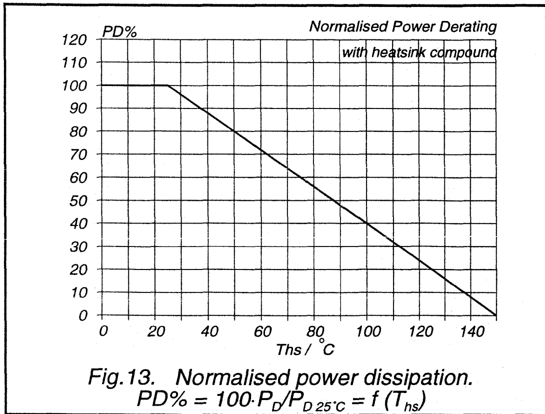


Fig.13. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

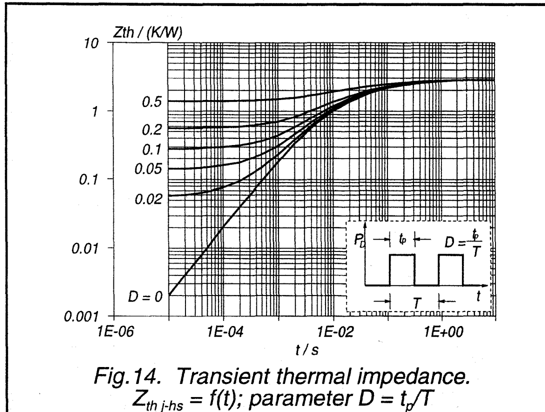


Fig.14. Transient thermal impedance. $Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

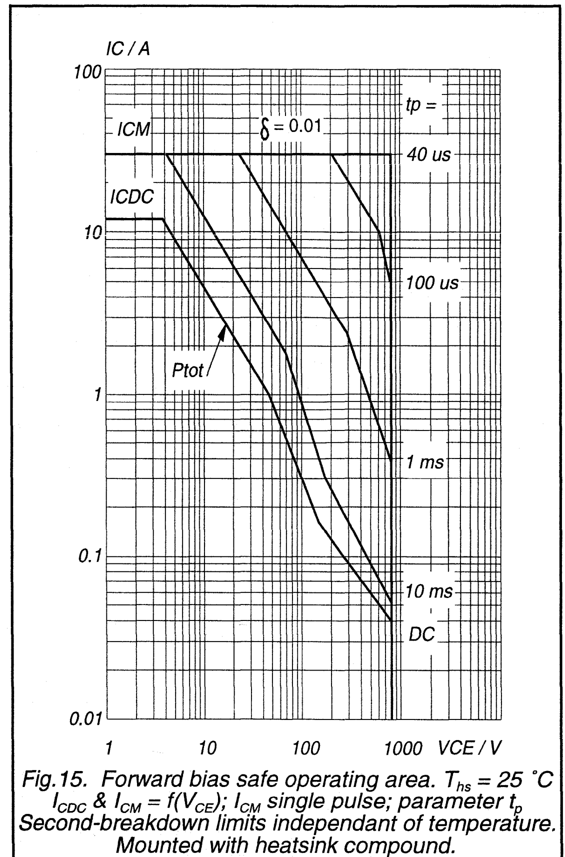


Fig.15. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$ I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p Second-breakdown limits independant of temperature. Mounted with heatsink compound.

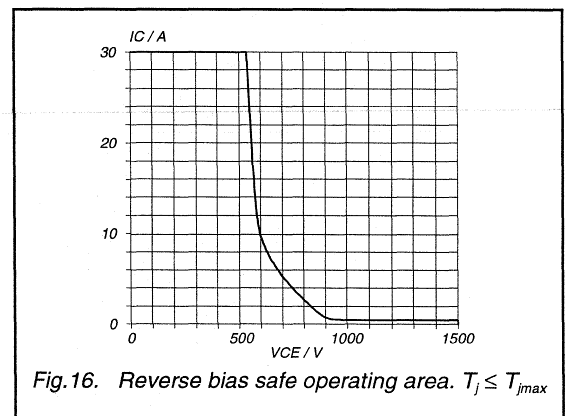


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

GENERAL DESCRIPTION

New generation, 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 high resolution monitors. Features improved RBSOA performance.

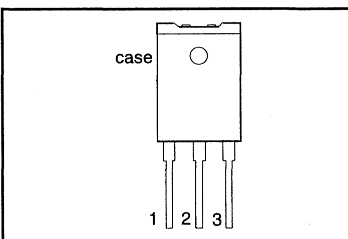
QUICK REFERENCE DATA

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	f = 64 kHz	6.0	-	A
t_s	Storage time	I_{Csat} = 6.0 A; f = 64 kHz	1.7	2.0	µs

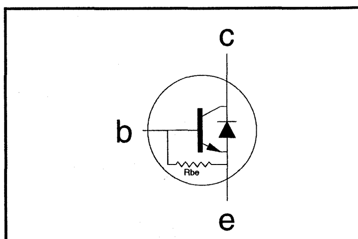
PINNING - SOT199

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} = $V_{CESMmax}$	-	-	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} = 6.0 V; I_C = 0 A	-	110	-	mA
R_{EB}	Base-emitter resistance	V_{EB} = 6.0 V	-	55	-	Ω
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A;I_C = 100mA; 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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	11	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	10	
V_F	Diode forward voltage	I_F = 8 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	145	-	pF
	Switching times (64 kHz line deflection circuit)	I_{Csat} = 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} = 4 V;-I_{BM} = 3.6 A			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.1	0.2	µs
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 8 A; dI_F/dt = 50 A/µs	16	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	410	-	ns

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

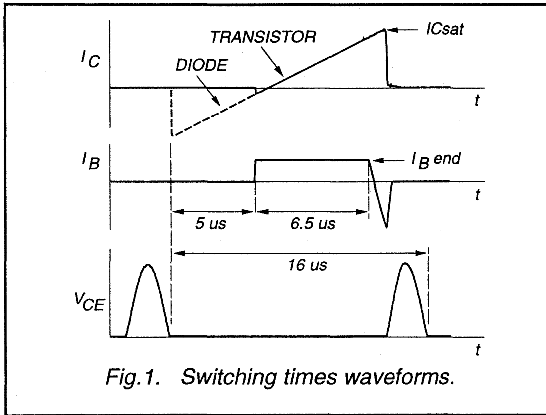


Fig.1. Switching times waveforms.

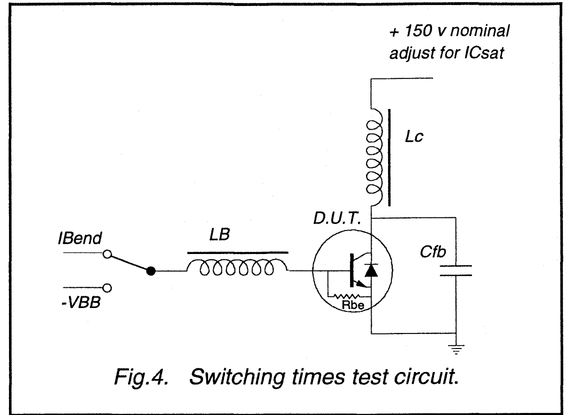


Fig.4. Switching times test circuit.

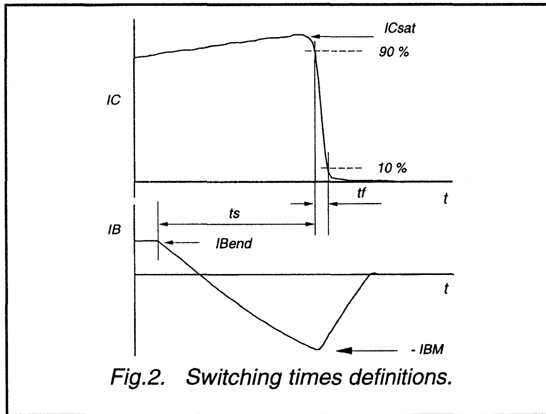


Fig.2. Switching times definitions.

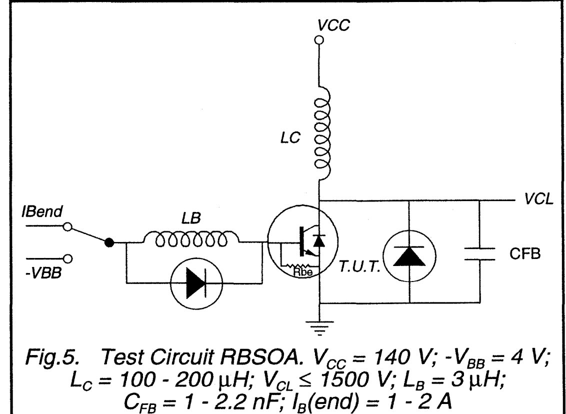


Fig.5. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; $I_B(end)$ = 1 - 2 A

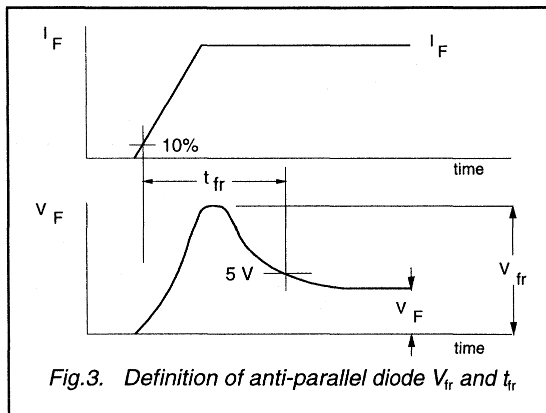


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}

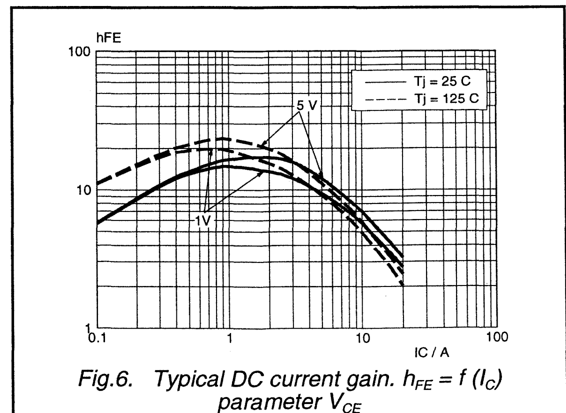


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

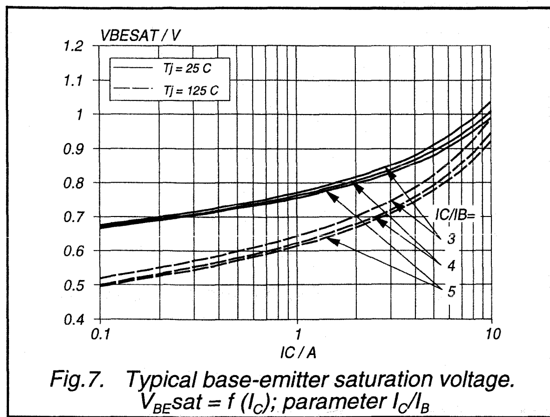


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

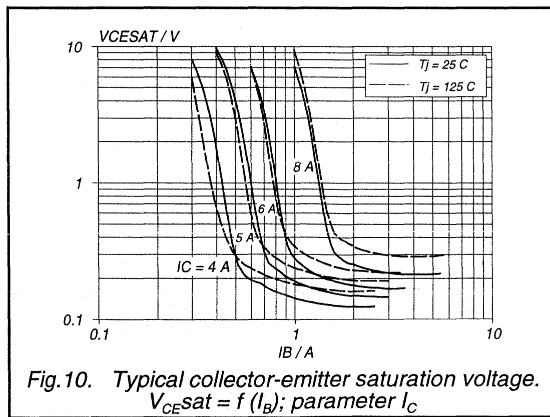


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

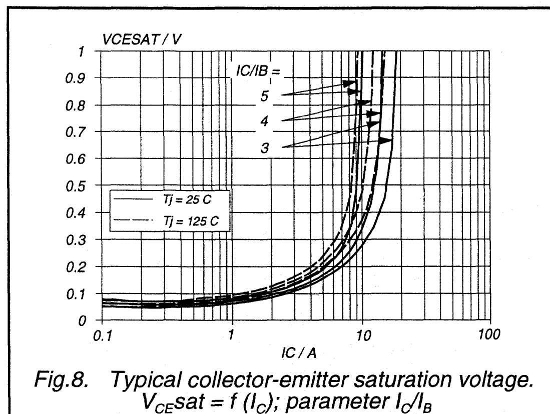


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

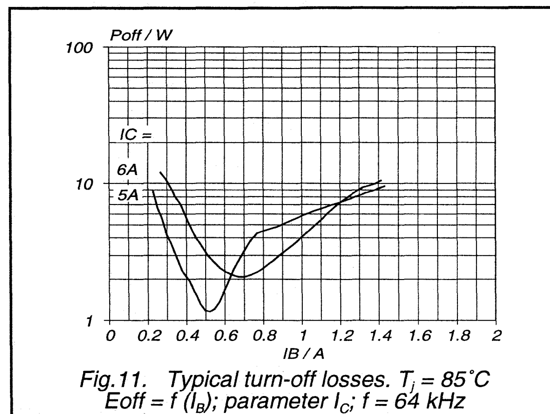


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$ $Eoff = f(I_B)$; parameter I_C; $f = 64$ kHz

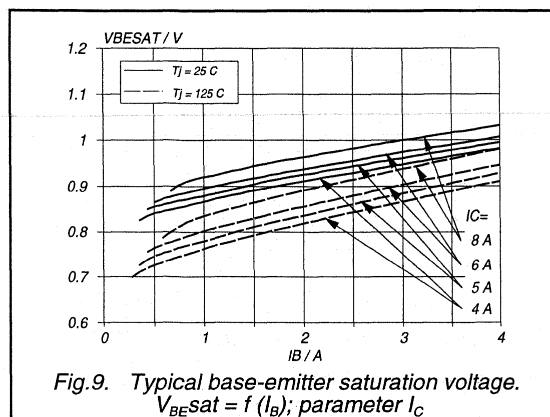


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

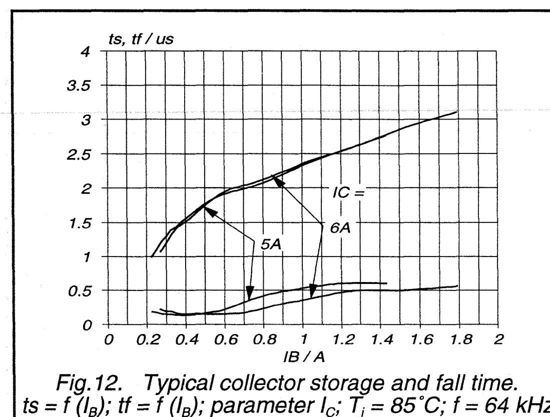


Fig.12. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 64$ kHz

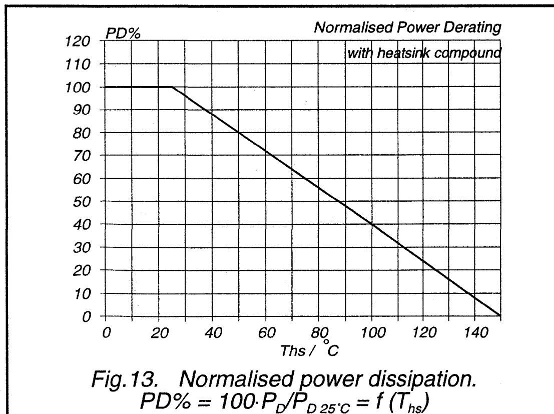


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

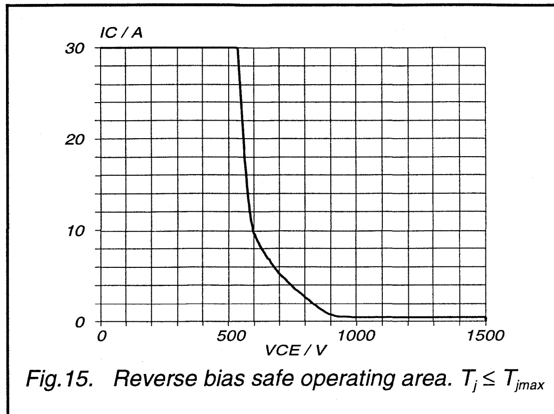


Fig.15. Reverse bias safe operating area. $T_j \leq T_{jmax}$

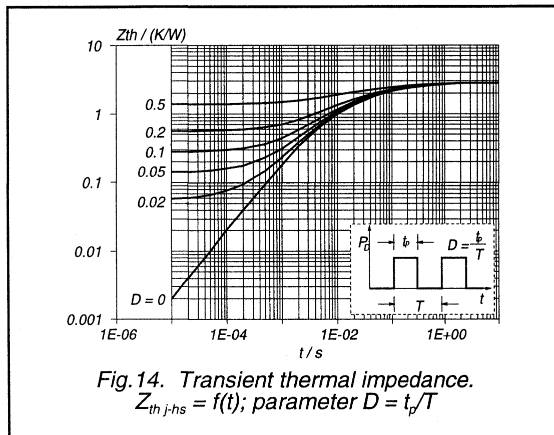


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

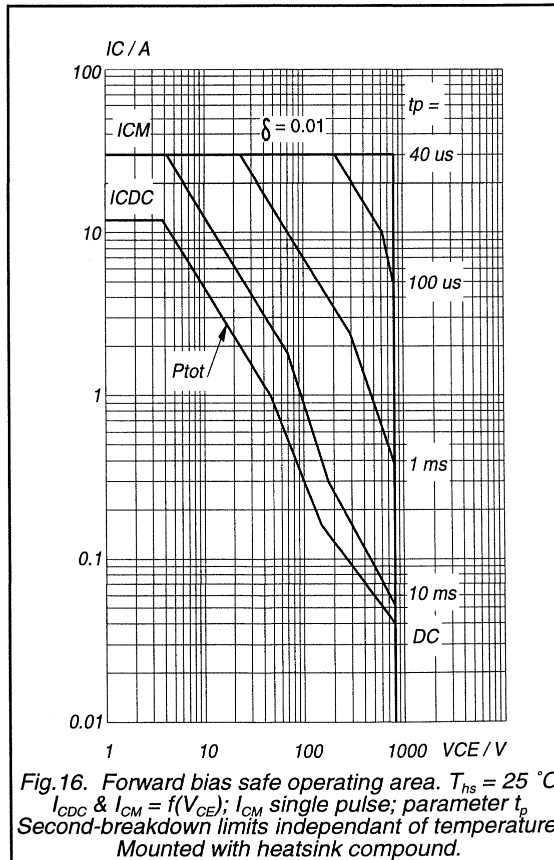


Fig.16. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

GENERAL DESCRIPTION

New generation, 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 high resolution monitors. Features improved RBSOA performance.

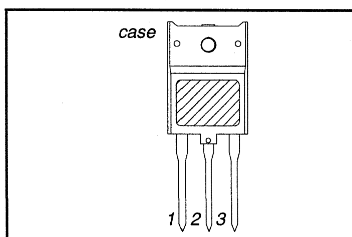
QUICK REFERENCE DATA

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	f = 64 kHz	6.0	-	A
t_s	Storage time	I_{Csat} = 6.0 A; f = 64 kHz	1.7	2.0	µs

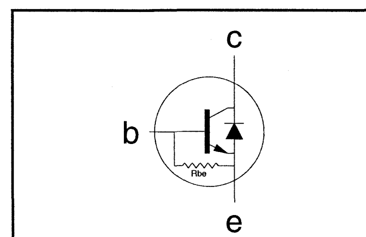
PINNING - SOT399

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		-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
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	800	-	-	V
I_{EBO}	Emitter cut-off current	V_{EB} = 6.0 V; I_C = 0 A	-	110	-	mA
R_{EB}	Base-emitter resistance	V_{EB} = 6.0 V	-	55	-	Ω
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	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	-	-	1.1	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	11	-	
h_{FE}		I_C = 8 A; V_{CE} = 5 V	5	7	10	
V_F	Diode forward voltage	I_F = 8 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	145	-	pF
	Switching times (64 kHz line deflection circuit)	I_{Csat} = 6.0 A; L_C = 170 µH; C_{fb} = 5.4 nF; $I_{B(end)}$ = 0.55 A; L_B = 0.6 µH; $-V_{BB}$ = 4 V;$-I_{BM}$ = 3.6 A			
t_s	Turn-off storage time		1.7	2.0	µs
t_f	Turn-off fall time		0.1	0.2	µs
V_{fr}	Anti-parallel diode forward recovery voltage	I_F = 8 A; dI_F/dt = 50 A/µs	16	-	V
t_{fr}	Anti-parallel diode forward recovery time	V_F = 5 V	410	-	ns

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

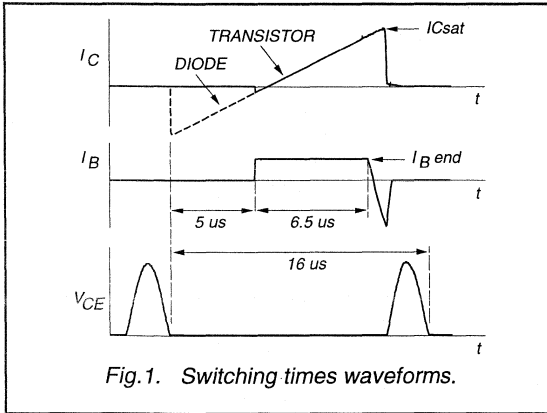


Fig.1. Switching times waveforms.

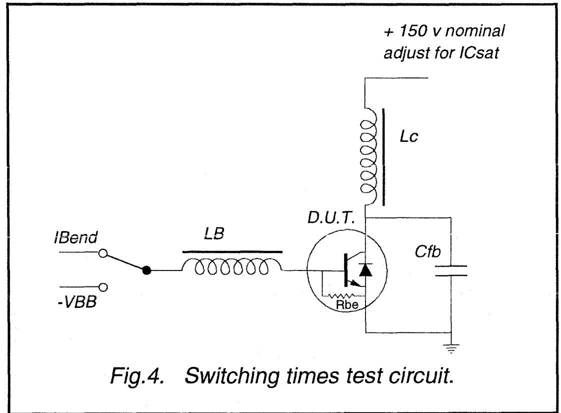


Fig.4. Switching times test circuit.

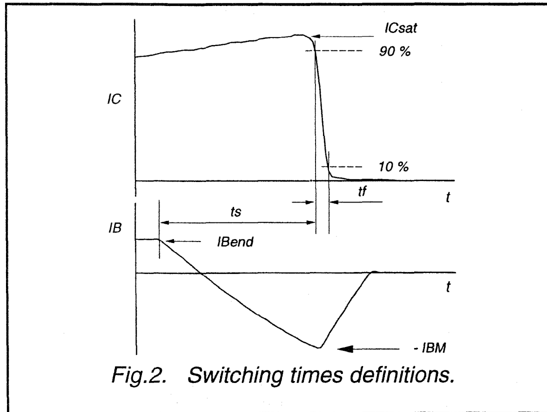


Fig.2. Switching times definitions.

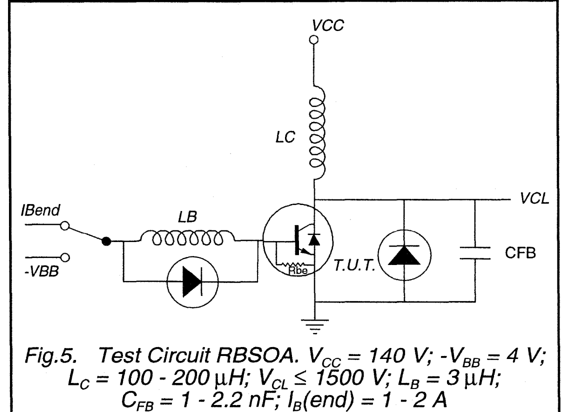


Fig.5. Test Circuit RBSOA. V_{CC} = 140 V; $-V_{BB}$ = 4 V; L_C = 100 - 200 µH; $V_{CL} \leq$ 1500 V; L_B = 3 µH; C_{FB} = 1 - 2.2 nF; I_B(end) = 1 - 2 A

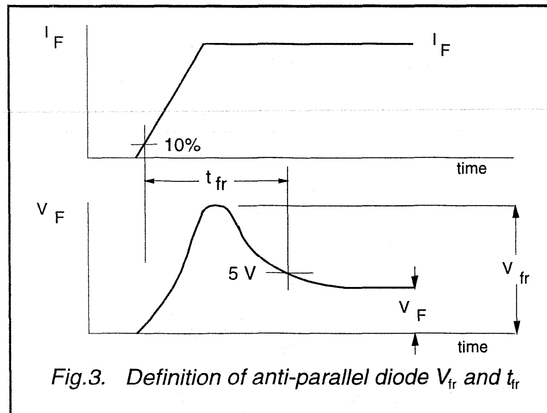


Fig.3. Definition of anti-parallel diode V_{fr} and t_{fr}

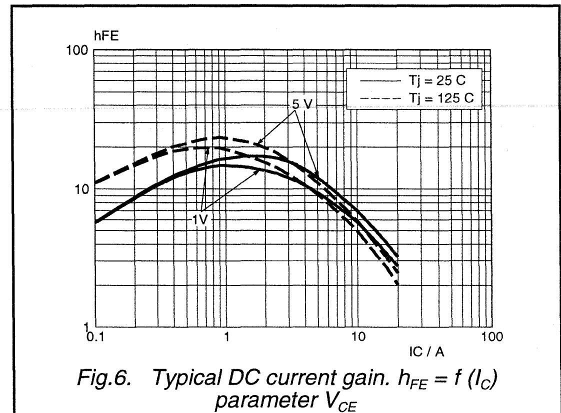


Fig.6. Typical DC current gain. $h_{FE} = f\ (I_C)$ parameter V_{CE}

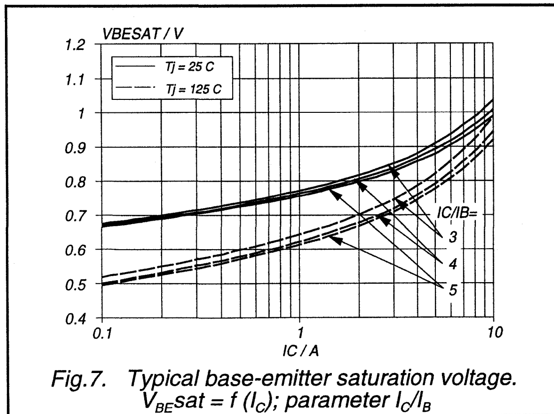


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_C)$; parameter I_C/I_B

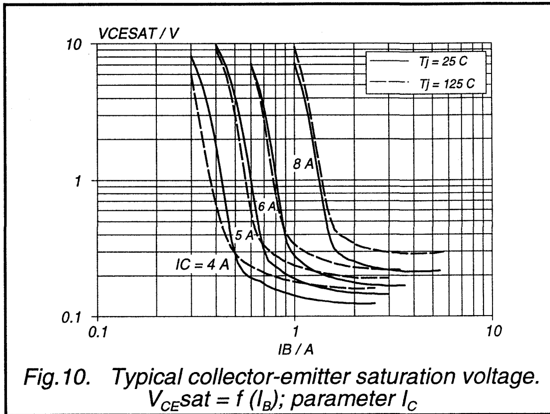


Fig.10. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

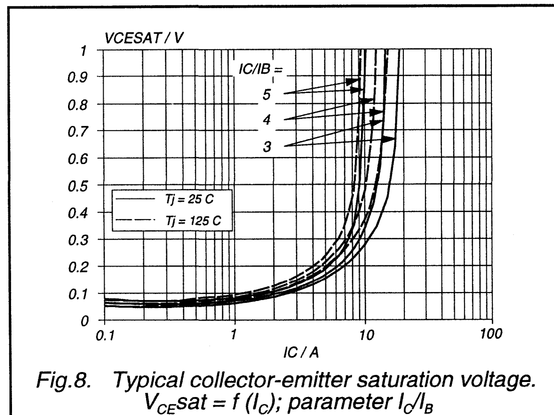


Fig.8. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

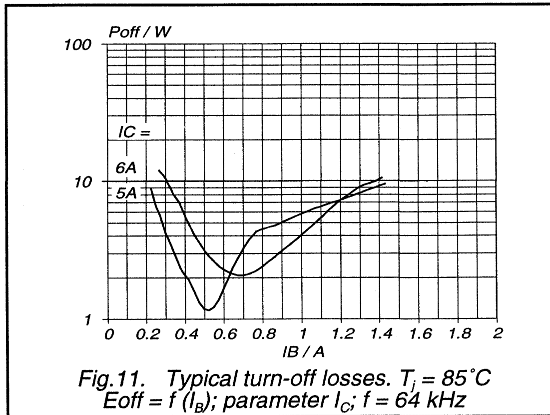


Fig.11. Typical turn-off losses. $T_j = 85^{\circ}C$ $Eoff = f(I_B)$; parameter I_C; $f = 64$ kHz

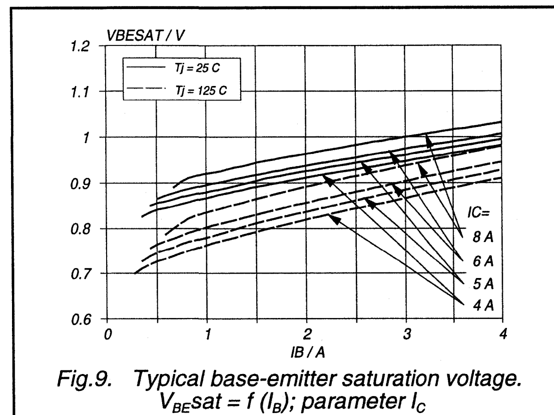


Fig.9. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

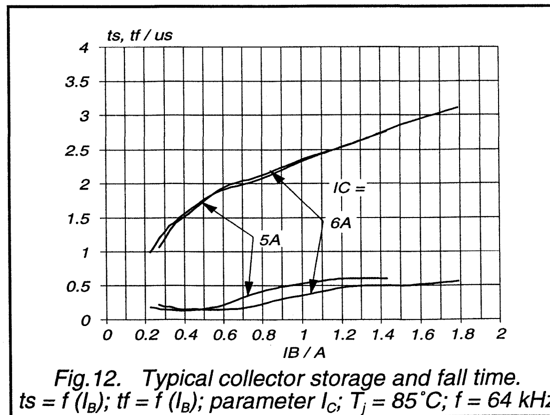


Fig.12. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 64$ kHz

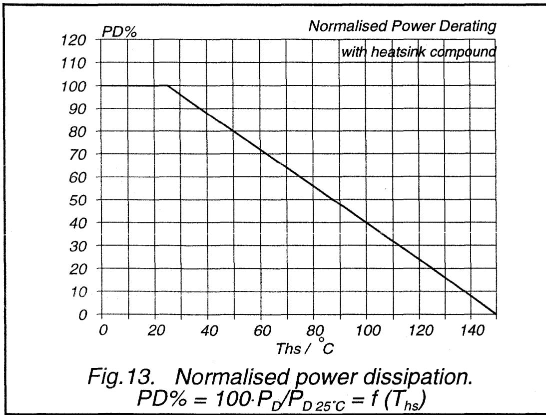


Fig.13. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{hs})$

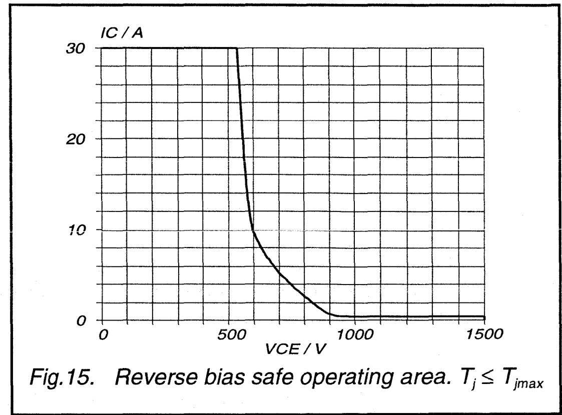


Fig.15. Reverse bias safe operating area. $T_j \leq T_{jmax}$

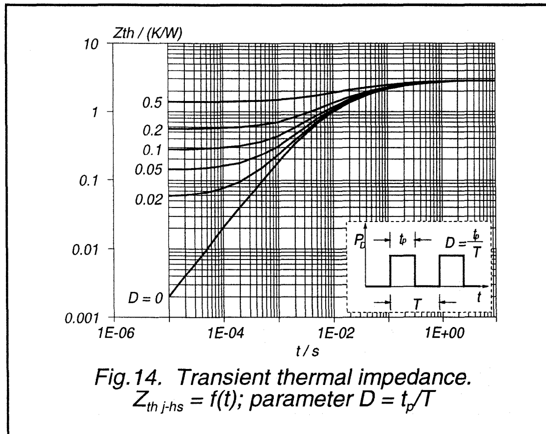


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

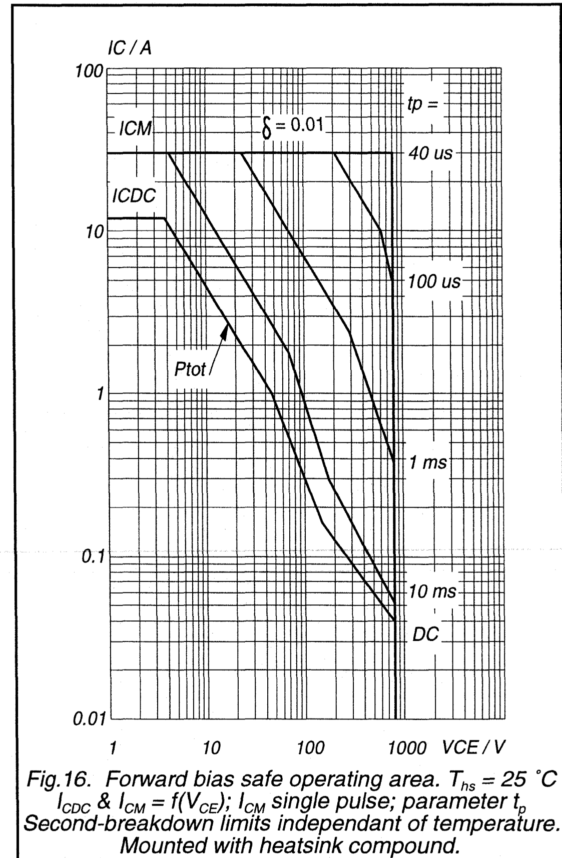


Fig.16. Forward bias safe operating area. $T_{hs} = 25\ ^\circ C$
I_{CDC} & $I_{CM} = f(V_{CE})$; I_{CM} single pulse; parameter t_p
Second-breakdown limits independant of temperature.
Mounted with heatsink compound.

Silicon Diffused Power Transistor — BU2530AL

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.

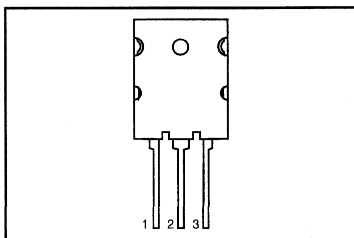
QUICK REFERENCE DATA

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; $I_B = 1.64$ A	-	5.0	V
I_{Csat}	Collector saturation current		9	-	A
t_s	Storage time	$I_{Csat} = 9.0$ A; $I_{B(end)} = 1.3$ A	3.5	4.5	µs

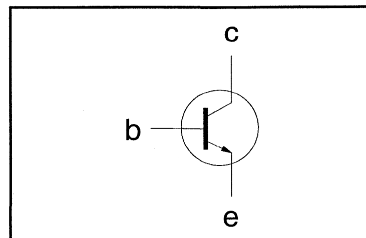
PINNING - SOT430

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)		-	10	A
I_{BM}	Base current peak value		-	15	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	10	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	35	-	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_{CEsat}	Collector-emitter saturation voltage	I_C = 9.0 A; I_B = 1.64 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 9.0 A; I_B = 1.64 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	17	-	
h_{FE}		I_C = 9 A; V_{CE} = 5 V	5.5	8	10	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (32 kHz line deflection dynamic test circuit).	I_{Csat} = 9.0 A; L_C = 200 µH; C_{fb} = 13 nF; V_{CC} = 138 V; $I_{B(end)}$ = 1.3 A; $-I_{BM}$ = 4.5 A; $-V_{BB}$ = 4 V; L_B = 1 µH			
t_s	Turn-off storage time		3.5	4.5	µs
t_f	Turn-off fall time		0.14	0.25	µs

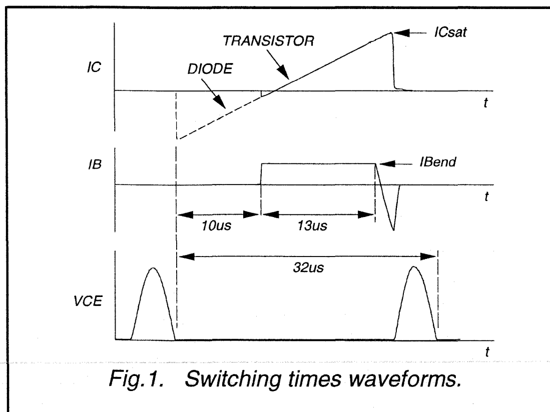


Fig.1. Switching times waveforms.

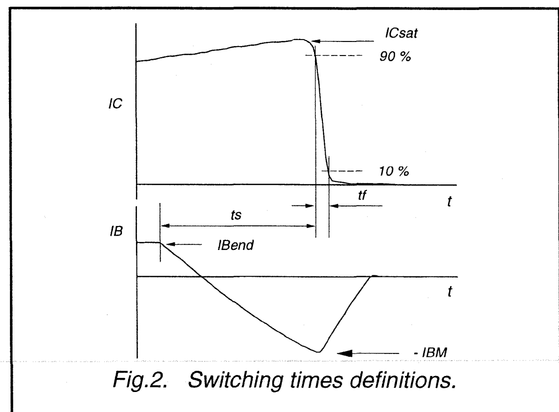


Fig.2. Switching times definitions.

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

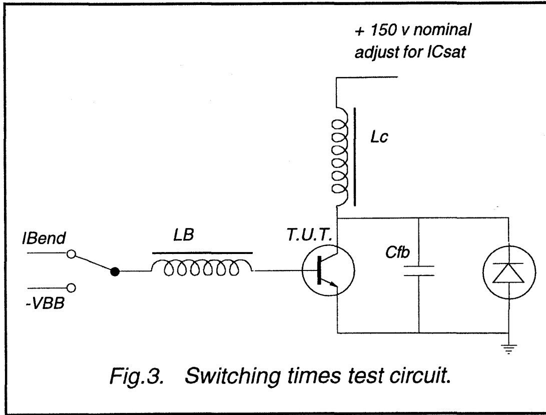


Fig.3. Switching times test circuit.

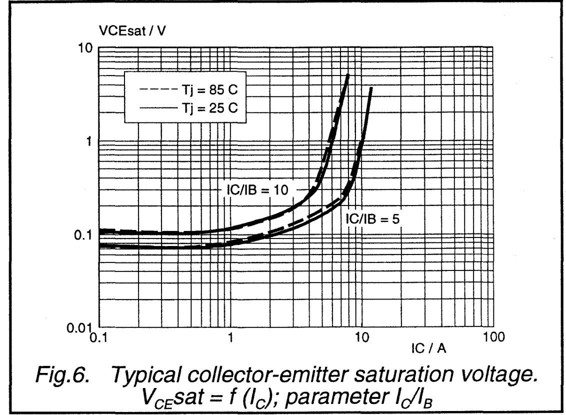


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f (I_C)$; parameter I_C/I_B

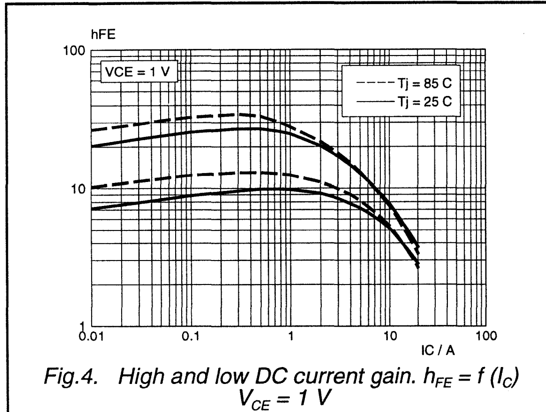


Fig.4. High and low DC current gain. $h_{FE} = f (I_C)$ $V_{CE} = 1$ V

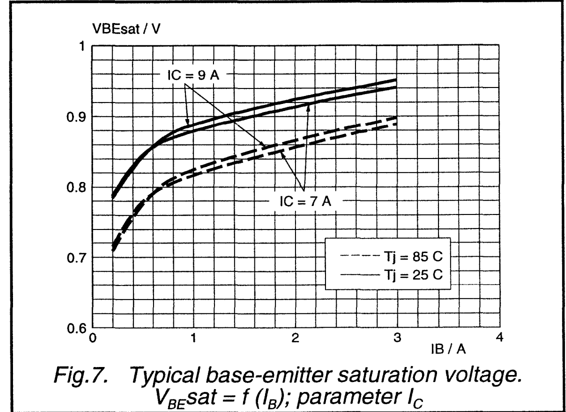


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f (I_B)$; parameter I_C

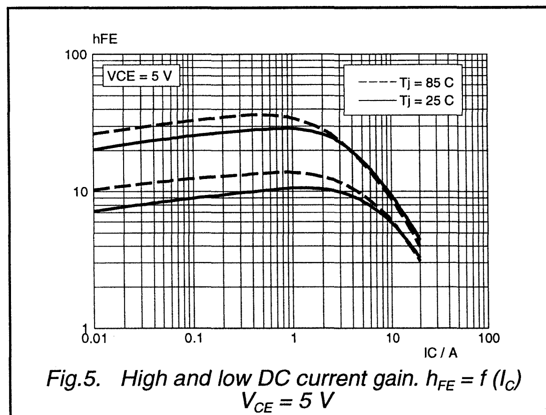


Fig.5. High and low DC current gain. $h_{FE} = f (I_C)$ $V_{CE} = 5$ V

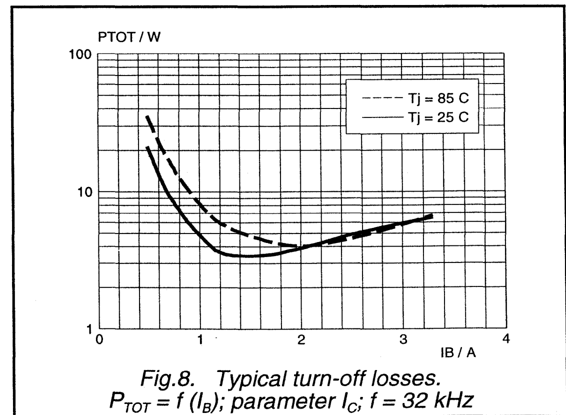


Fig.8. Typical turn-off losses. $P_{TOT} = f (I_B)$; parameter I_C; f = 32 kHz

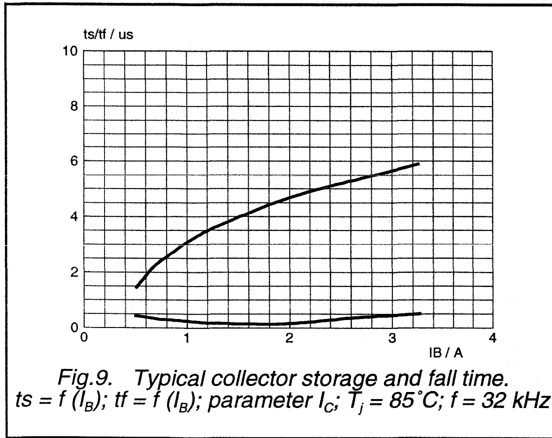


Fig.9. Typical collector storage and fall time. $ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; $T_j = 85^\circ C$; $f = 32$ kHz

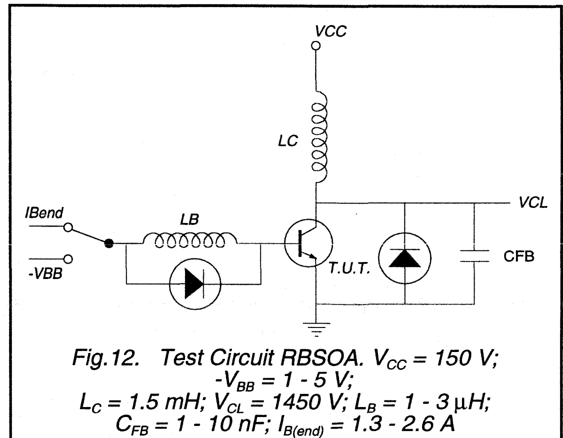


Fig.12. Test Circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 1 - 5$ V; $L_C = 1.5$ mH; $V_{CL} = 1450$ V; $L_B = 1 - 3\ \mu H$; $C_{FB} = 1 - 10$ nF; $I_{B(end)} = 1.3 - 2.6$ A

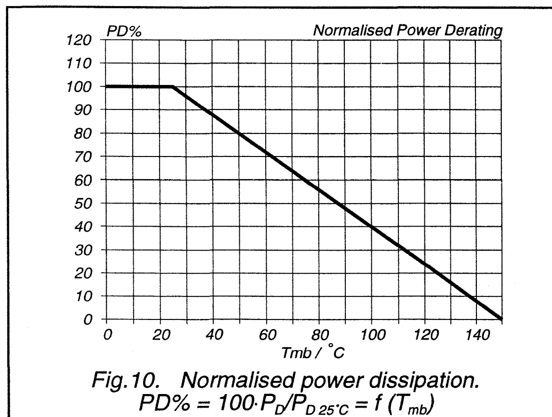


Fig.10. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

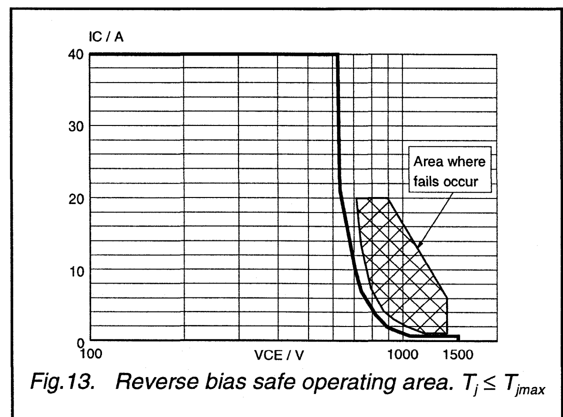


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

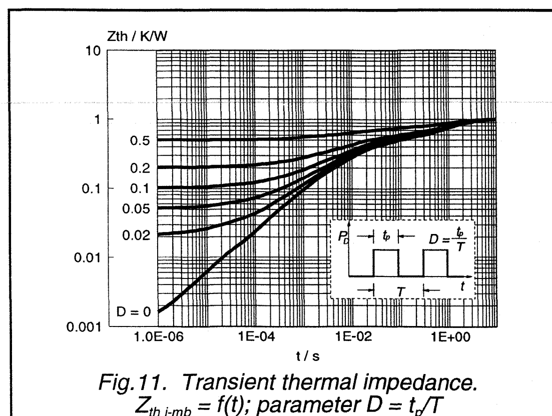


Fig.11. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

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.

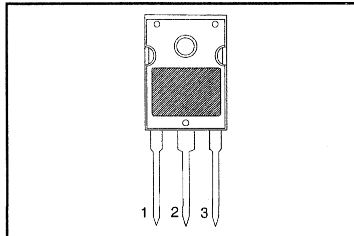
QUICK REFERENCE DATA

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; $I_B = 1.64$ A	-	5.0	V
I_{Csat}	Collector saturation current		9	-	A
t_s	Storage time	$I_{Csat} = 9.0$ A; $I_{B(end)} = 1.3$ A	3.5	4.5	µs

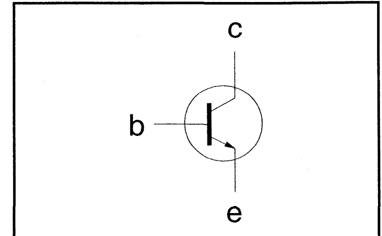
PINNING - SOT429

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)		-	16	A
I_{CM}	Collector current peak value		-	40	A
I_B	Base current (DC)		-	10	A
I_{BM}	Base current peak value		-	15	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	10	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
$R_{th\ j-mb}$	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	-	-	1.0	mA
BV_{EBO}	Base-emitter breakdown voltage	I_B = 1 mA	7.5	14	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 9.0 A; I_B = 1.64 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 9.0 A; I_B = 1.64 A	0.825	0.91	1.0	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	9	17	27	
h_{FE}		I_C = 9 A; V_{CE} = 5 V	5.5	8	10	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (32 kHz line deflection dynamic test circuit).	I_{Csat} = 9.0 A; L_C = 200 μH; C_{fb} = 13 nF; V_{CC} = 138 V; $I_{B(end)}$ = 1.3 A; $-I_{BM}$ = 4.5 A; $-V_{BB}$ = 4 V; L_B = 1 μH			
t_s	Turn-off storage time		3.5	4.5	μs
t_f	Turn-off fall time		0.14	0.25	μs

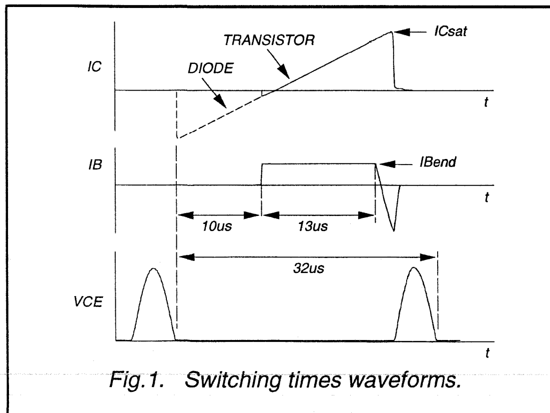


Fig.1. Switching times waveforms.

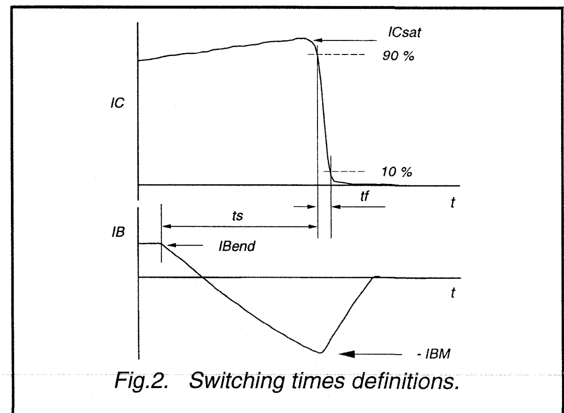


Fig.2. Switching times definitions.

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

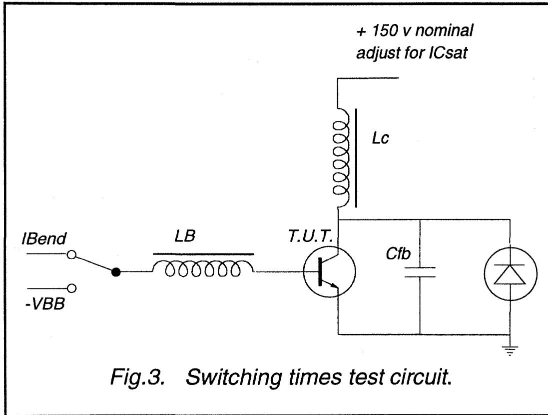


Fig.3. Switching times test circuit.

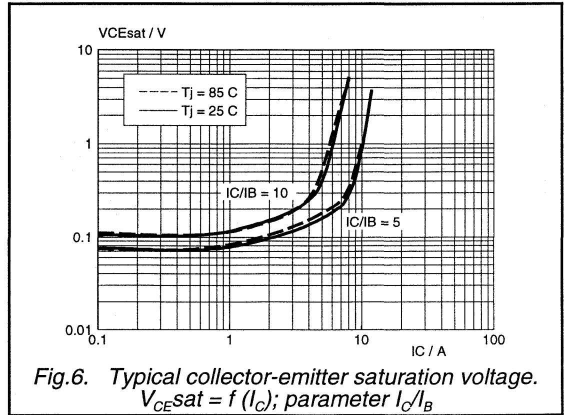


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_C)$; parameter I_C/I_B

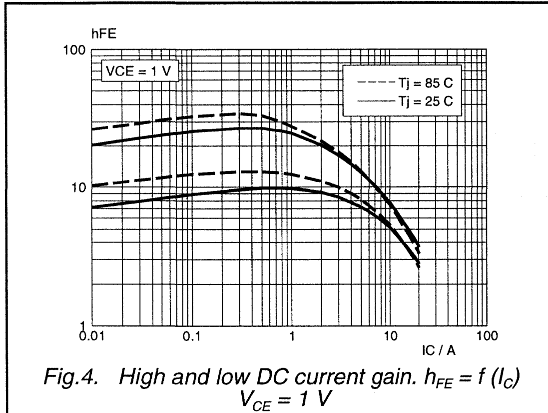


Fig.4. High and low DC current gain. $h_{FE} = f(I_C)$ $V_{CE} = 1$ V

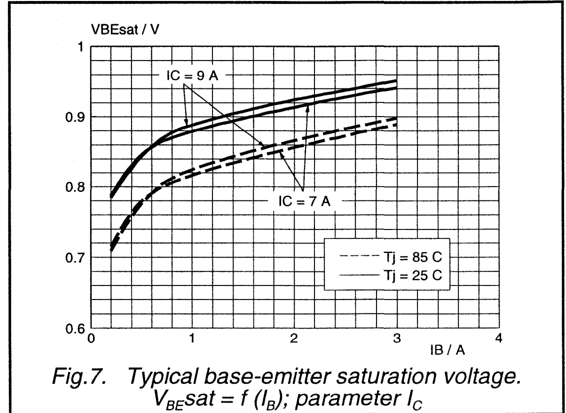


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

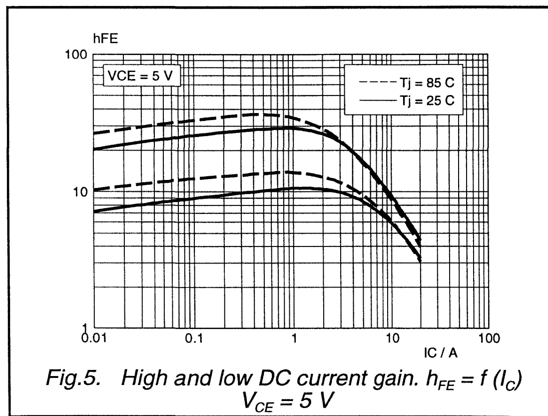


Fig.5. High and low DC current gain. $h_{FE} = f(I_C)$ $V_{CE} = 5$ V

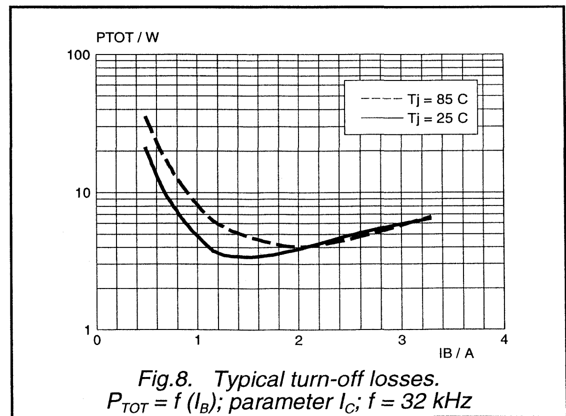


Fig.8. Typical turn-off losses. $P_{TOT} = f(I_B)$; parameter I_C; $f = 32$ kHz

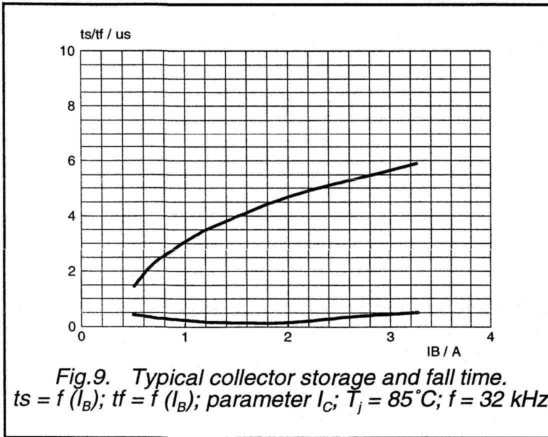


Fig.9. Typical collector storage and fall time.
$ts = f(I_B)$; $tf = f(I_B)$; parameter I_C; T_j = 85˚C; f = 32 kHz

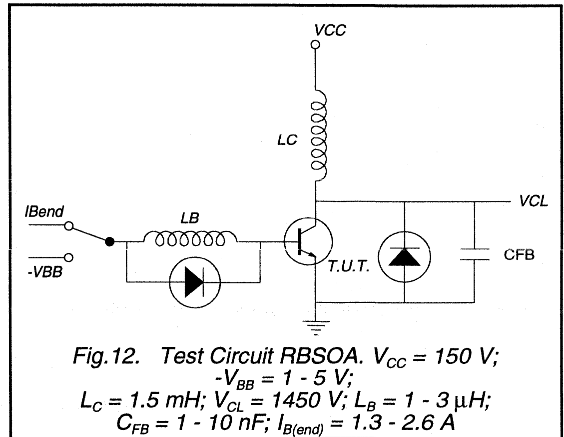


Fig.12. Test Circuit RBSOA. V_{CC} = 150 V;
$-V_{BB}$ = 1 - 5 V;
L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 1 - 3 µH;
C_{FB} = 1 - 10 nF; $I_{B(end)}$ = 1.3 - 2.6 A

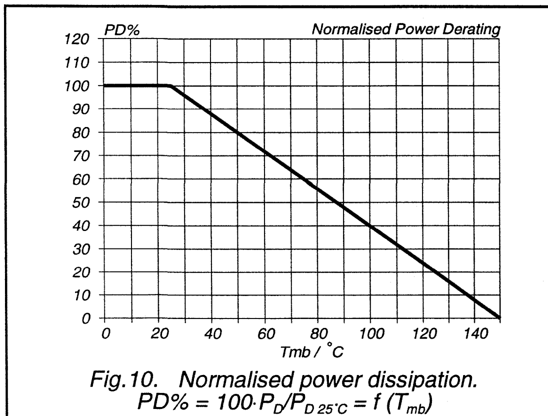


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

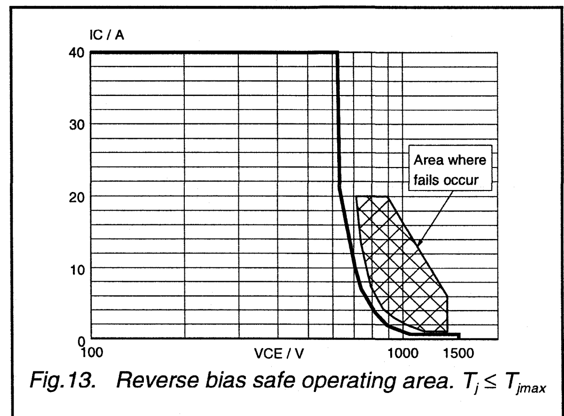


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

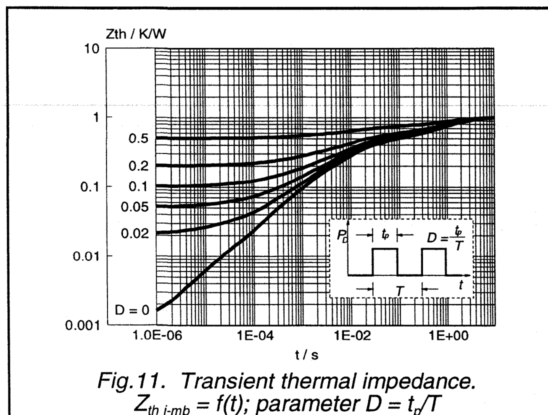


Fig.11. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

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 up to 82 kHz.

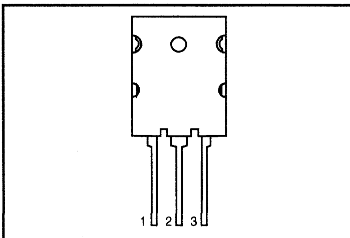
QUICK REFERENCE DATA

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	$I_C = 7.0$ A; $I_B = 1.17$ A	-	5.0	V
I_{Csat}	Collector saturation current		7	-	A
t_s	Storage time	$I_{Csat} = 7.0$ A; $I_{B(end)} = 1$ A	1.4	1.8	µs

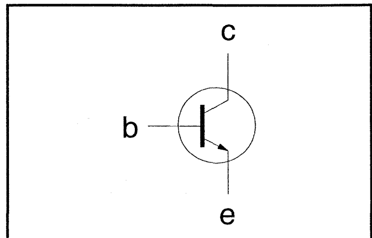
PINNING - SOT430

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)		-	10	A
I_{BM}	Base current peak value		-	15	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	10	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	35	-	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_{CEsat}	Collector-emitter saturation voltage	I_C = 7.0 A; I_B = 1.17 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 7.0 A; I_B = 1.17 A	-	-	1.0	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	17	-	
h_{FE}		I_C = 7 A; V_{CE} = 5 V	6	9	12.5	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (82 kHz line deflection dynamic test circuit).	I_{Csat} = 7.0 A; L_C = 100 µH; C_{fb} = 3 nF; V_{CC} = 138 V; $I_{B(end)}$ = 1.0 A			
t_s	Turn-off storage time		1.4	1.8	µs
t_f	Turn-off fall time		0.06	0.1	µs

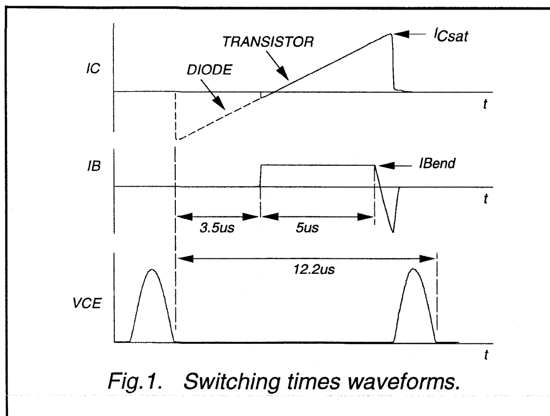


Fig.1. Switching times waveforms.

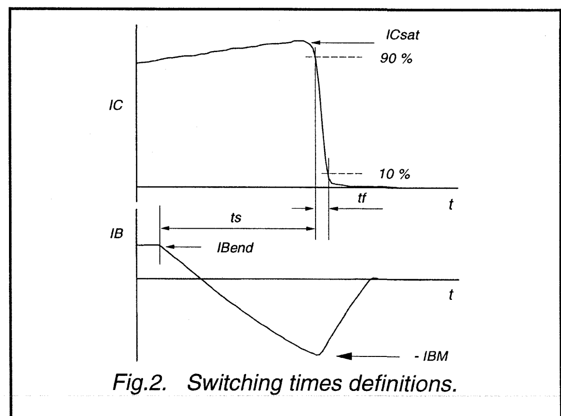


Fig.2. Switching times definitions.

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

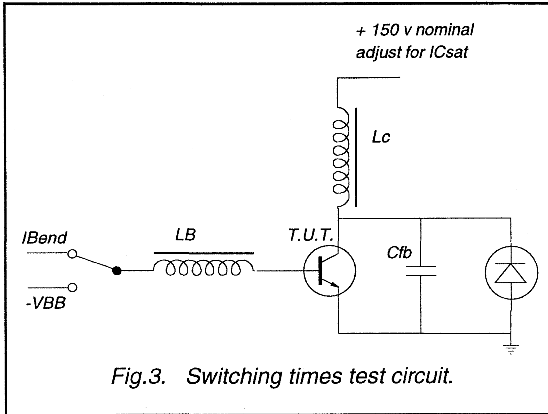


Fig.3. Switching times test circuit.

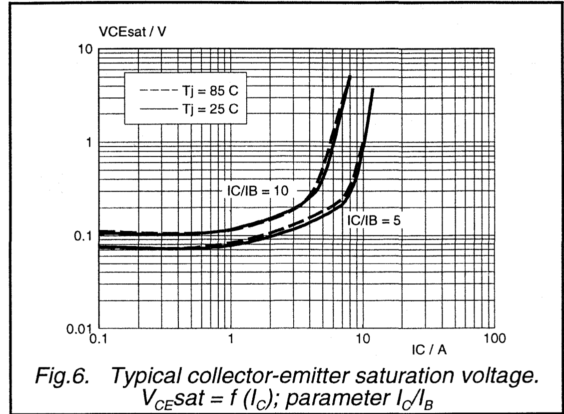


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\,(I_C)$; parameter I_C/I_B

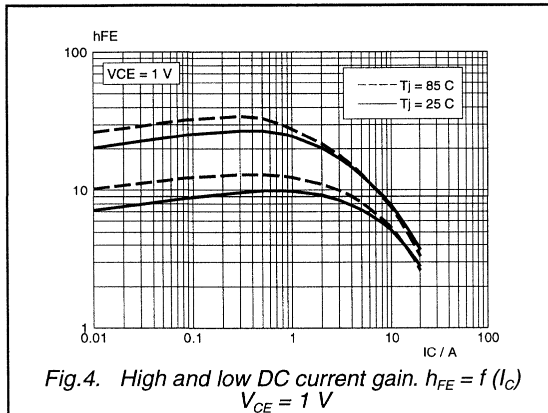


Fig.4. High and low DC current gain. $h_{FE} = f\,(I_C)$ $V_{CE} = 1$ V

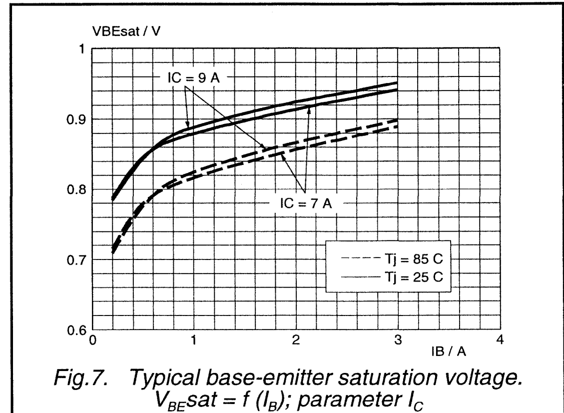


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\,(I_B)$; parameter I_C

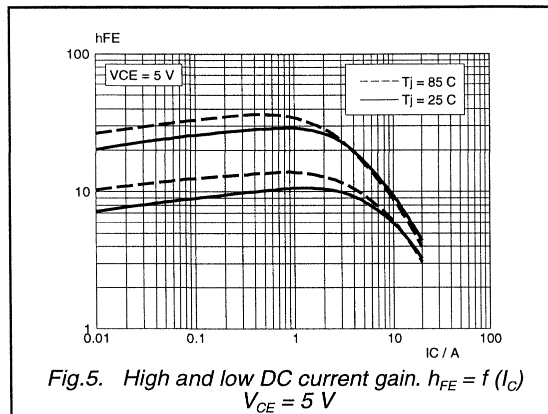


Fig.5. High and low DC current gain. $h_{FE} = f\,(I_C)$ $V_{CE} = 5$ V

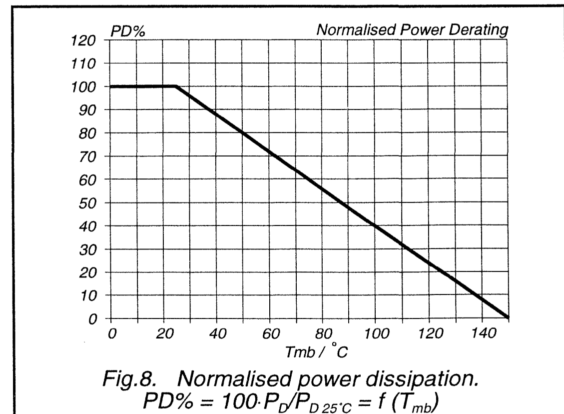


Fig.8. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f\,(T_{mb})$

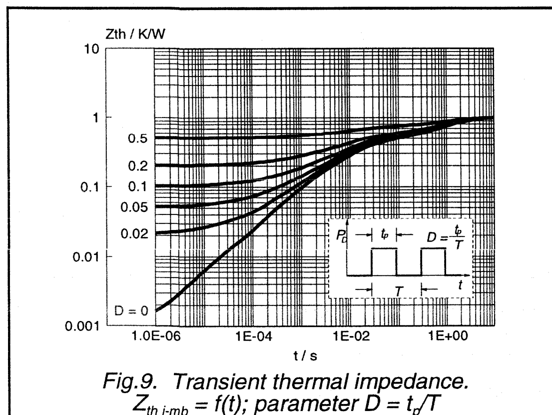


Fig.9. Transient thermal impedance. $Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

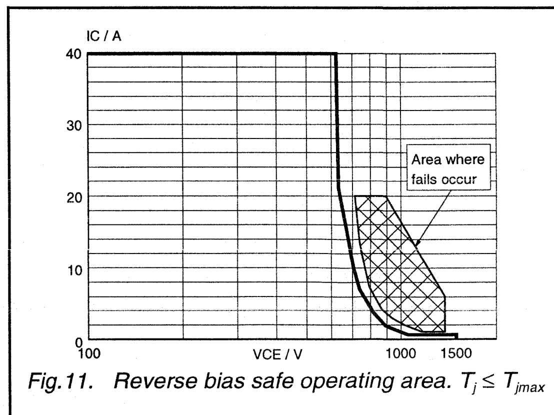


Fig.11. Reverse bias safe operating area. $T_j \leq T_{jmax}$

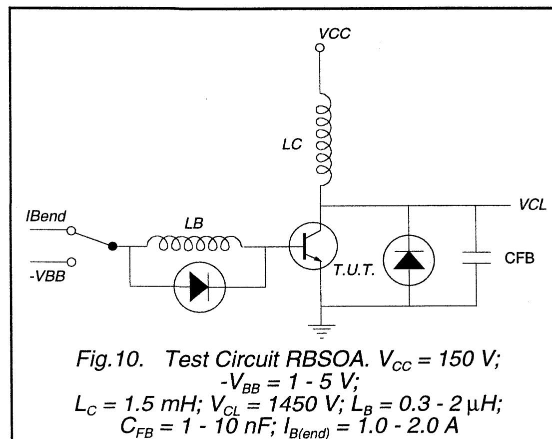


Fig.10. Test Circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 1 - 5$ V; $L_C = 1.5$ mH; $V_{CL} = 1450$ V; $L_B = 0.3 - 2\,\mu$H; $C_{FB} = 1 - 10$ nF; $I_{B(end)} = 1.0 - 2.0$ A

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.

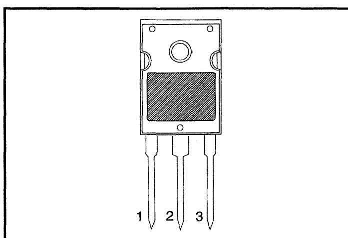
QUICK REFERENCE DATA

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	$I_C = 7.0$ A; $I_B = 1.17$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 82 kHz	7	-	A
t_s	Storage time	$I_{Csat} = 7.0$ A; f = 82 kHz	1.4	1.8	µs

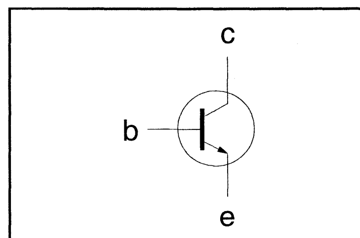
PINNING - SOT429

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)		-	16	A
I_{CM}	Collector current peak value		-	40	A
I_B	Base current (DC)		-	10	A
I_{BM}	Base current peak value		-	15	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	10	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

Objective specification
See Philips Semiconductors for Design-in information

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_{CEsat}	Collector-emitter saturation voltage	I_C = 7.0 A; I_B = 1.17 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 7.0 A; I_B = 1.17 A	0.80	0.88	0.97	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	9	17	27	
h_{FE}		I_C = 7 A; V_{CE} = 5 V	6	9	12.5	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (82 kHz line deflection dynamic test circuit).	I_{Csat} = 7.0 A; L_C = 100 µH; C_{fb} = 3 nF; V_{CC} = 138 V; $I_{B(end)}$ = 1.0 A			
t_s	Turn-off storage time		1.4	1.8	µs
t_f	Turn-off fall time		0.06	0.1	µs

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

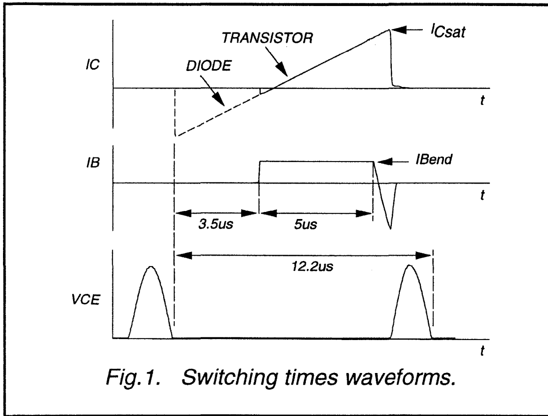


Fig.1. Switching times waveforms.

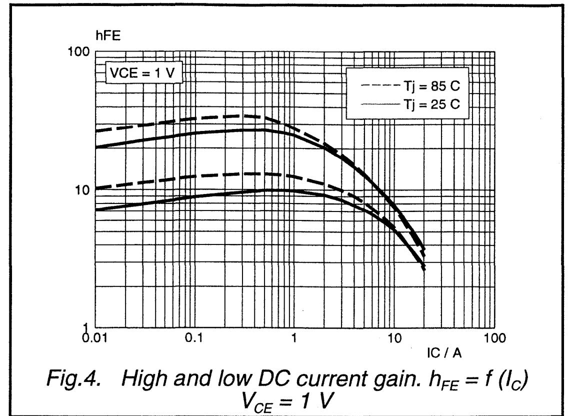


Fig.4. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 1\ V$

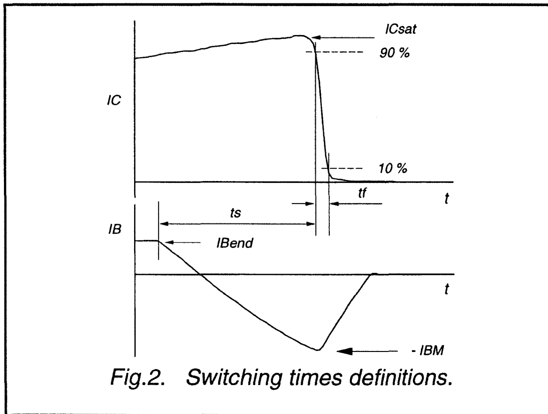


Fig.2. Switching times definitions.

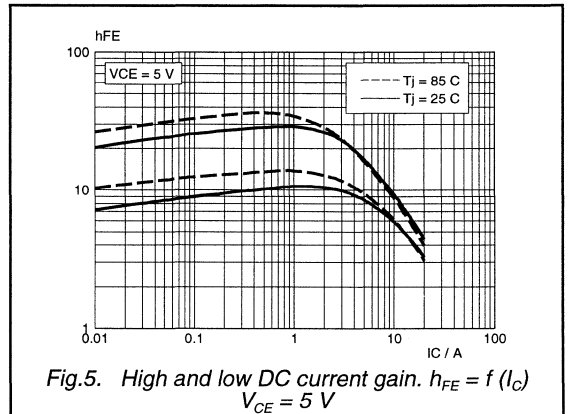


Fig.5. High and low DC current gain. $h_{FE} = f\ (I_C)$ $V_{CE} = 5\ V$

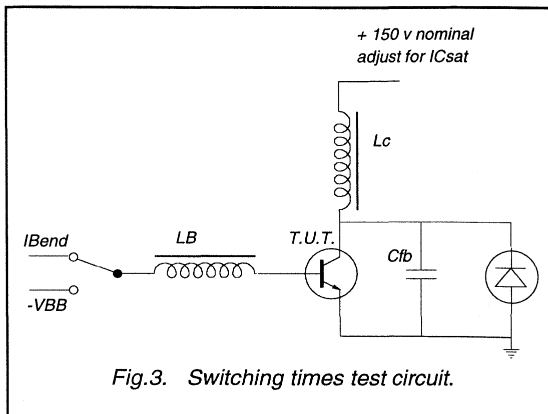


Fig.3. Switching times test circuit.

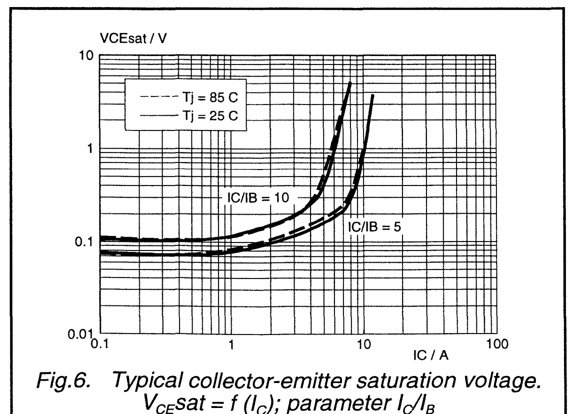


Fig.6. Typical collector-emitter saturation voltage. $V_{CE}sat = f\ (I_C)$; parameter I_C/I_B

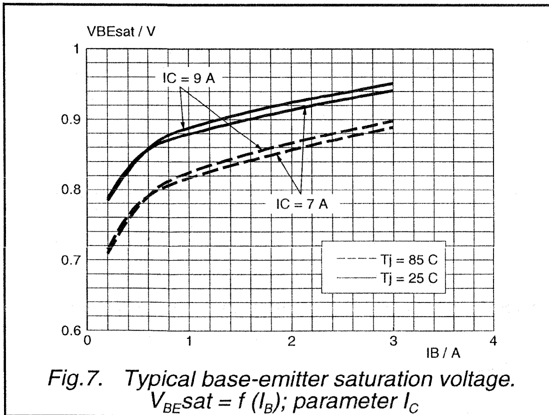


Fig.7. Typical base-emitter saturation voltage. $V_{BE}sat = f\ (I_B)$; parameter I_C

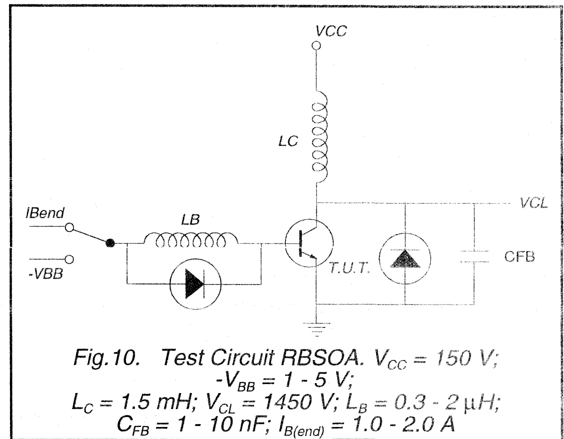


Fig.10. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 5 V; L_C = 1.5 mH; V_{CL} = 1450 V; L_B = 0.3 - 2 μH; C_{FB} = 1 - 10 nF; $I_{B(end)}$ = 1.0 - 2.0 A

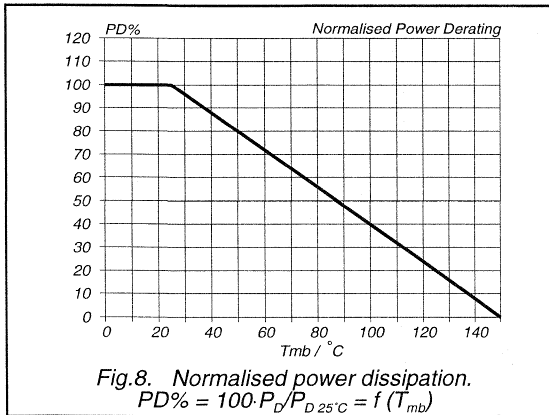


Fig.8. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\ 25^\circ C} = f\ (T_{mb})$

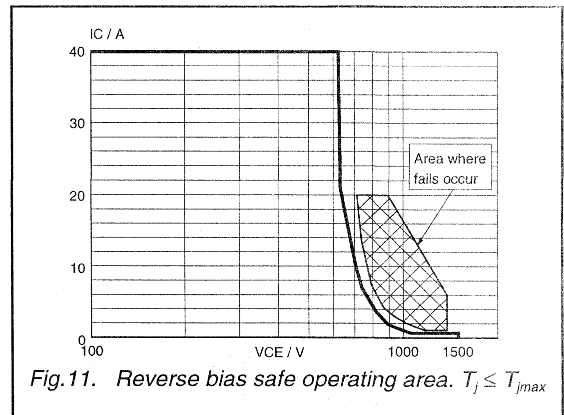


Fig.11. Reverse bias safe operating area. $T_j \leq T_{jmax}$

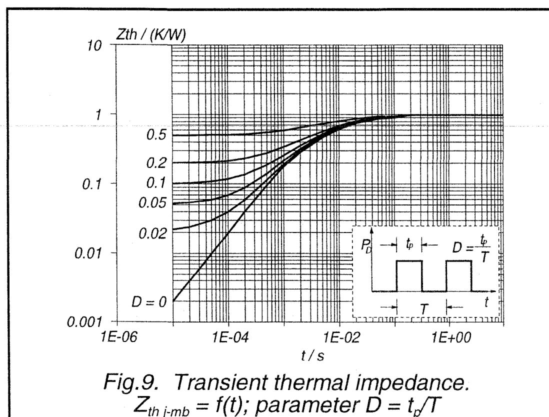


Fig.9. Transient thermal impedance. $Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

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.

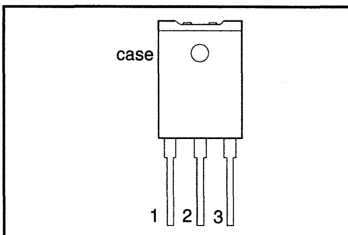
QUICK REFERENCE DATA

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	f = 16 kHz	4	-	A
t_s	Storage time	I_{Csat} = 4 A; f = 16 kHz	4.8	5.5	µs

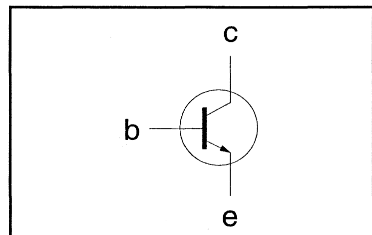
PINNING - SOT199

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
$R_{th\ j-hs}$	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} = 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	-	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_{Csat} = 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).

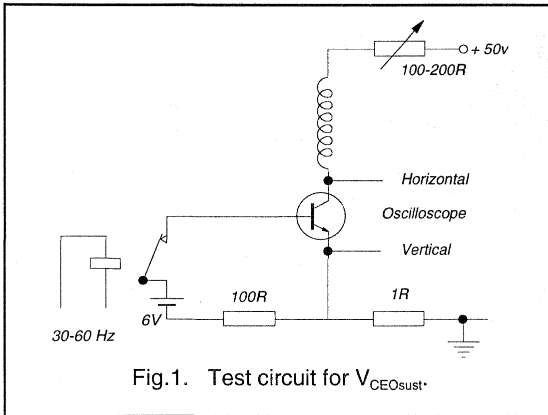


Fig.1. Test circuit for $V_{CEOsust}$.

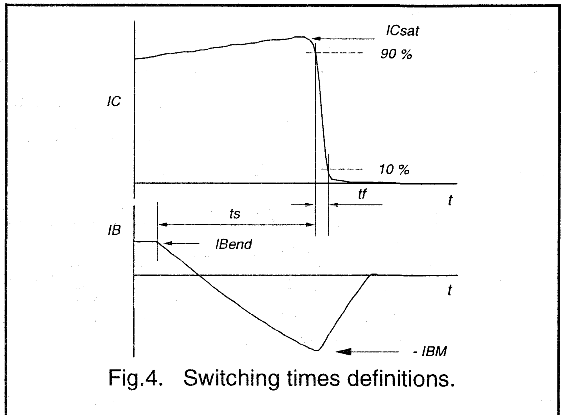


Fig.4. Switching times definitions.

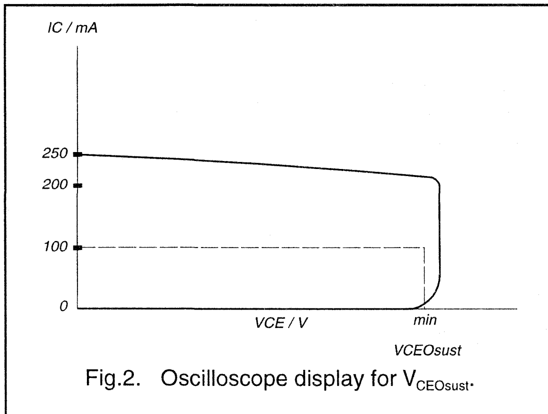


Fig.2. Oscilloscope display for $V_{CEOsust}$.

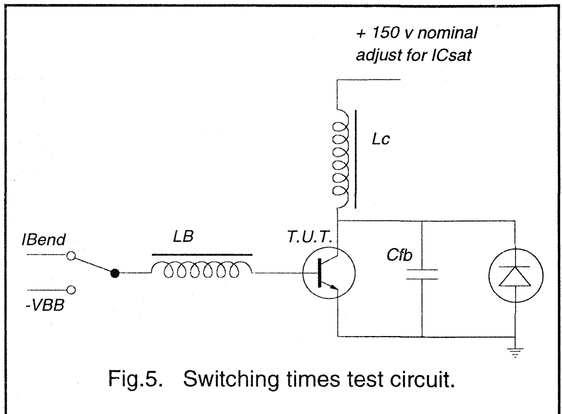


Fig.5. Switching times test circuit.

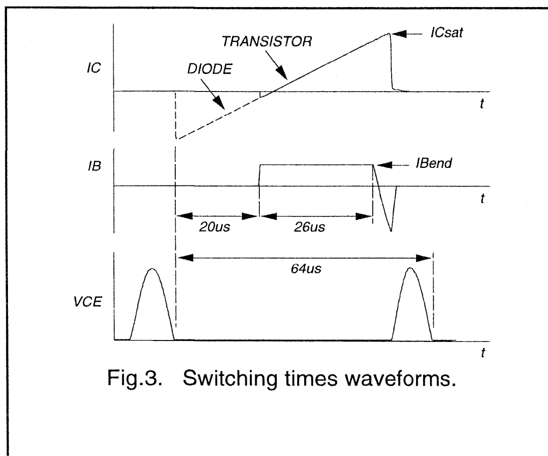


Fig.3. Switching times waveforms.

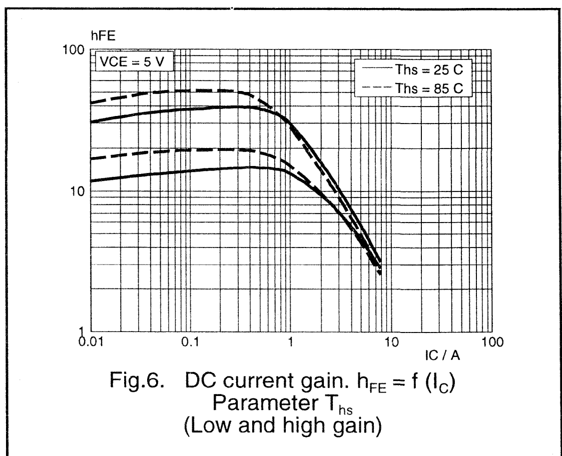


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

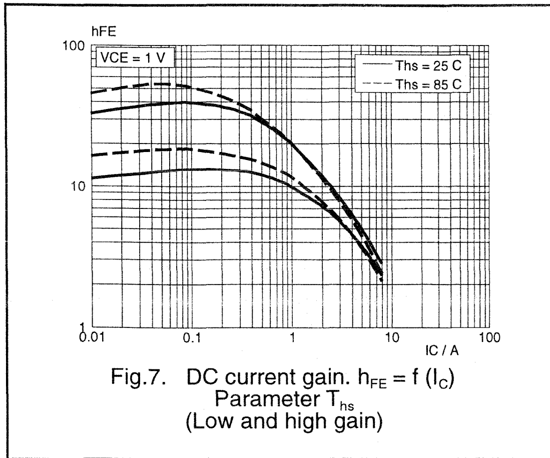


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

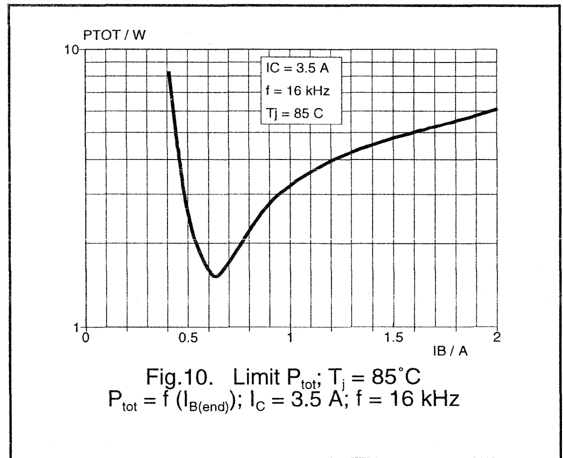


Fig.10. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 3.5$ A; f = 16 kHz

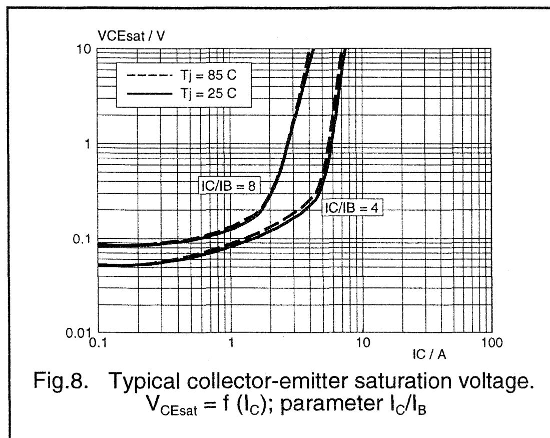


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

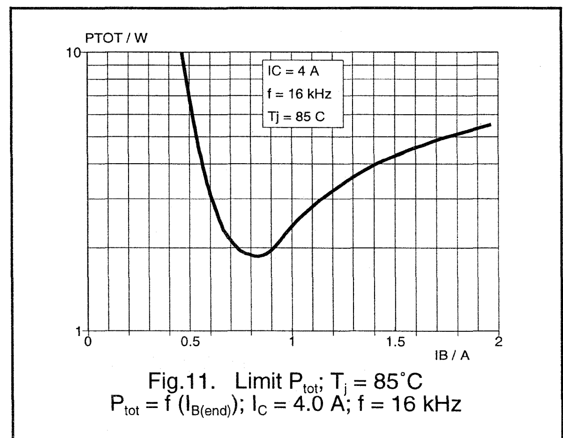


Fig.11. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.0$ A; f = 16 kHz

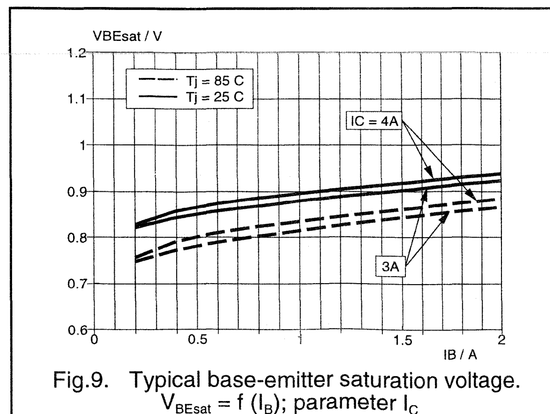


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

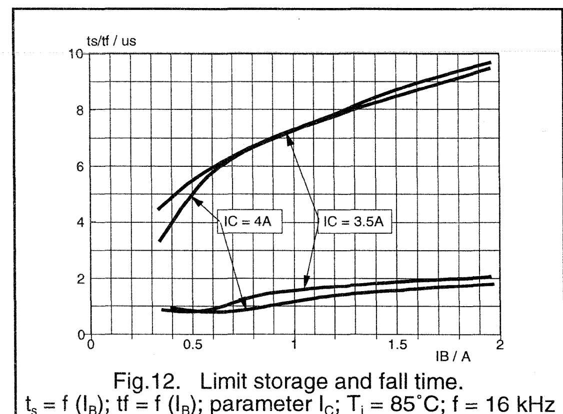


Fig.12. Limit storage and fall time.
$t_s = f\ (I_B)$; tf = f (I_B); parameter I_C; $T_j = 85^\circ C$; f = 16 kHz

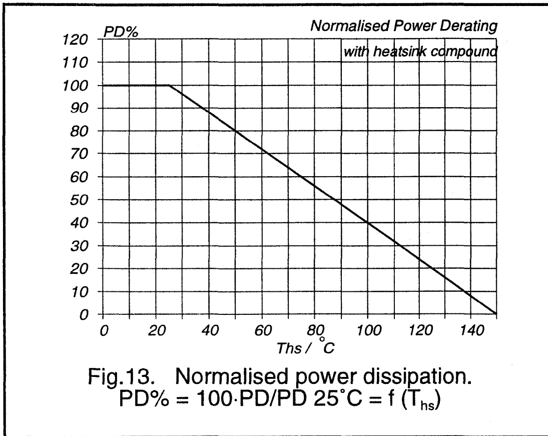


Fig.13. Normalised power dissipation. PD% = 100·PD/PD 25˚C = f (T_{hs})

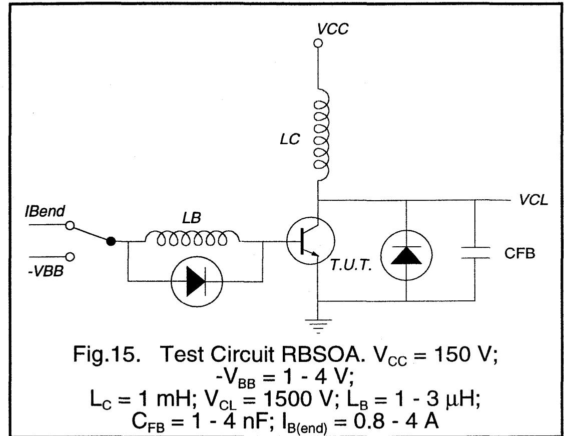


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

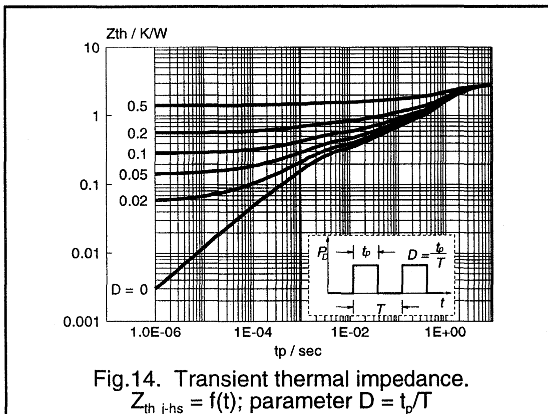


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

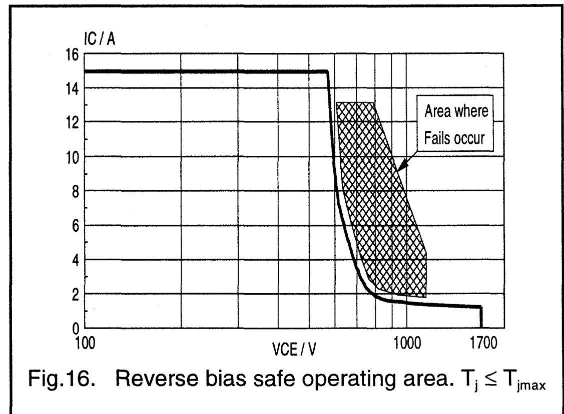


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

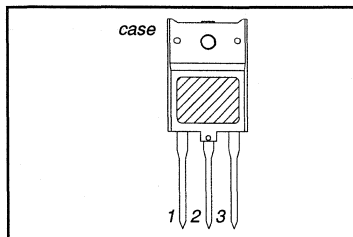
QUICK REFERENCE DATA

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	f = 16 kHz	4	-	A
t_s	Storage time	I_{Csat} = 4 A; f = 16 kHz	4.8	5.5	µs

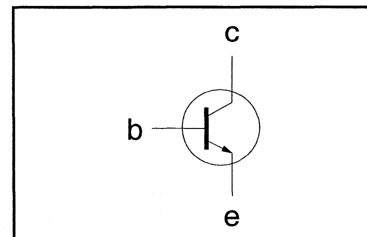
PINNING - SOT399

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	-	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	-	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_{Csat} = 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).

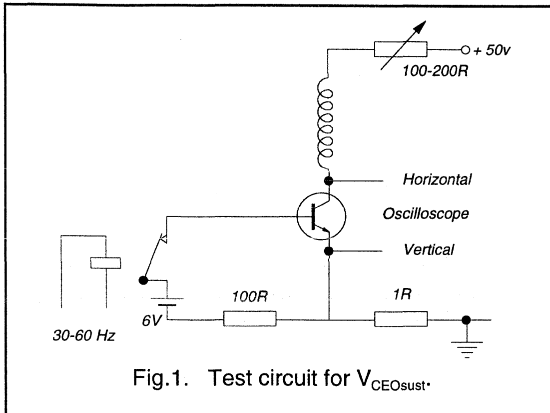


Fig.1. Test circuit for $V_{CEOsust}$.

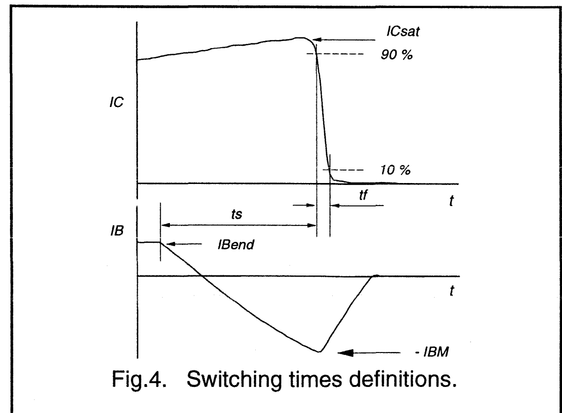


Fig.4. Switching times definitions.

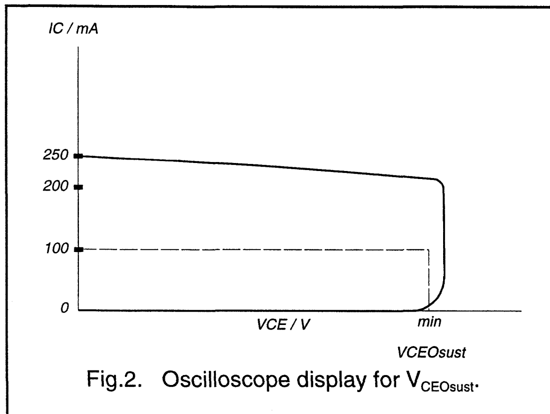


Fig.2. Oscilloscope display for $V_{CEOsust}$.

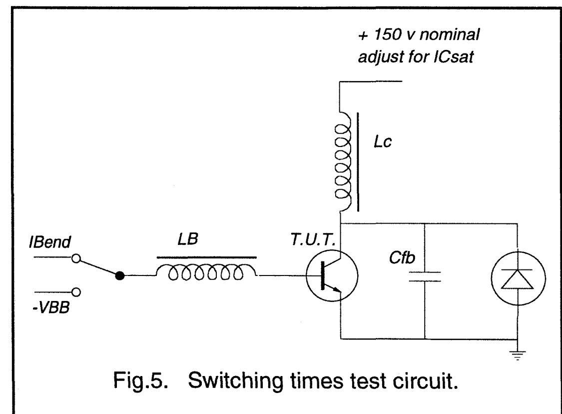


Fig.5. Switching times test circuit.

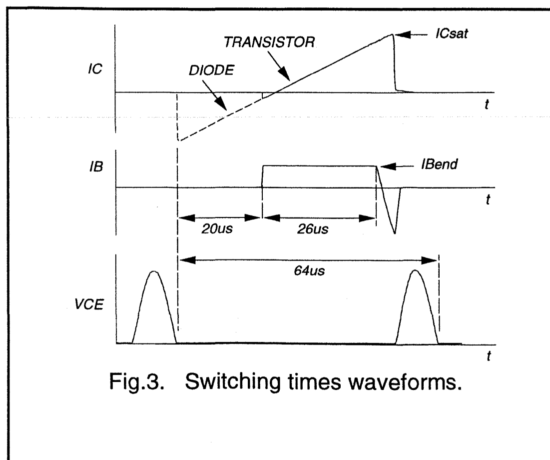


Fig.3. Switching times waveforms.

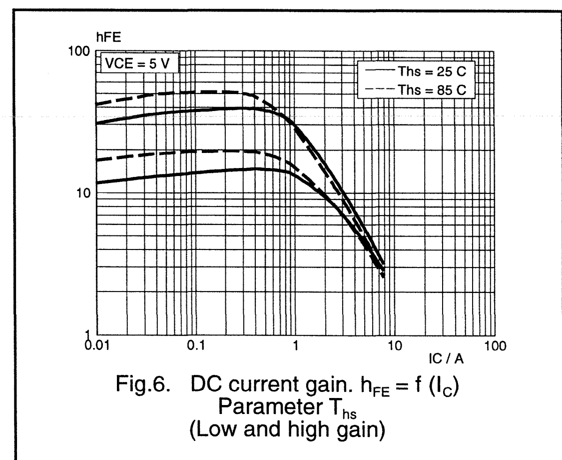


Fig.6. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

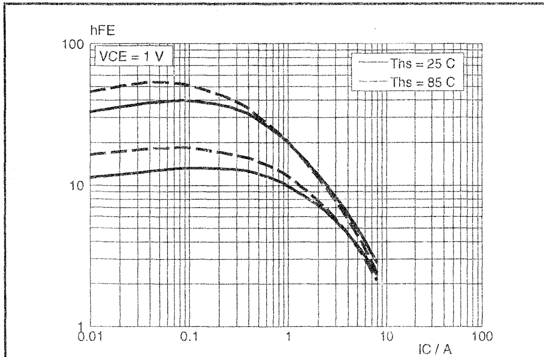


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

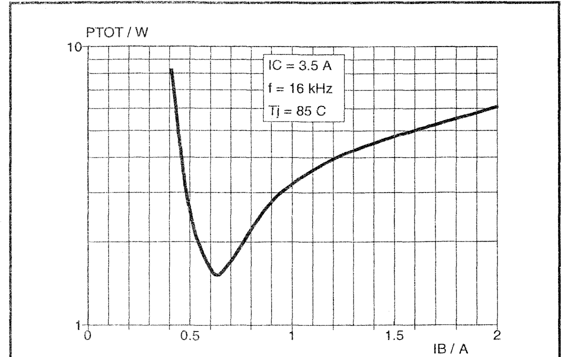


Fig.10. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 3.5$ A; f = 16 kHz

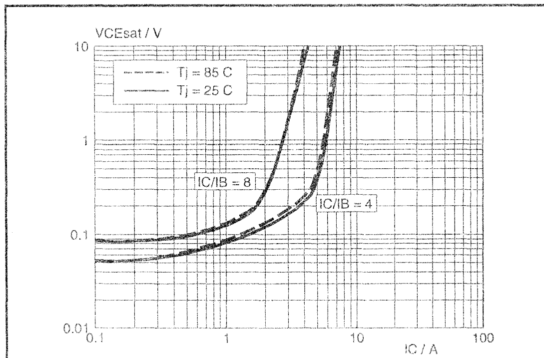


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

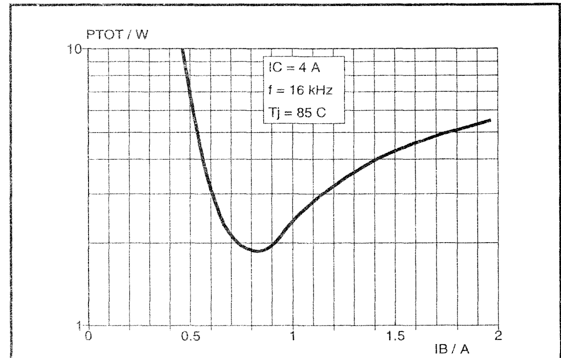


Fig.11. Limit P_{tot}; $T_j = 85^\circ C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.0$ A; f = 16 kHz

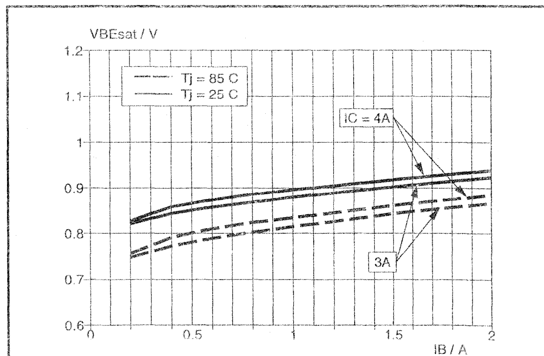


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

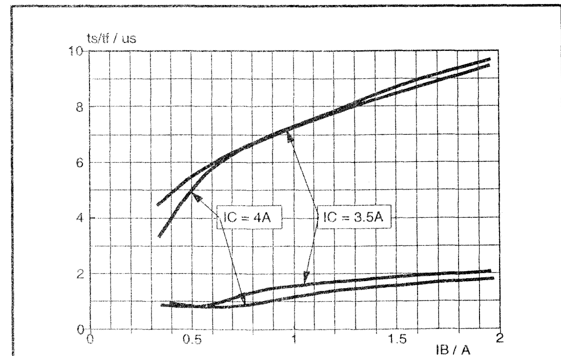


Fig.12. Limit storage and fall time.
$t_s = f\ (I_B)$; tf = f (I_B); parameter I_C; $T_j = 85^\circ C$; f = 16 kHz

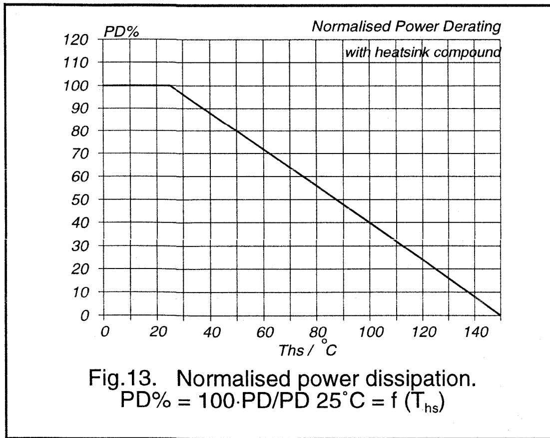


Fig.13. Normalised power dissipation. PD% = 100·PD/PD 25˚C = f (T_{hs})

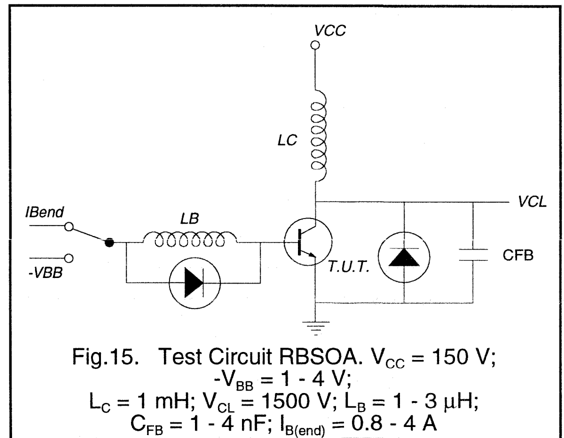


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

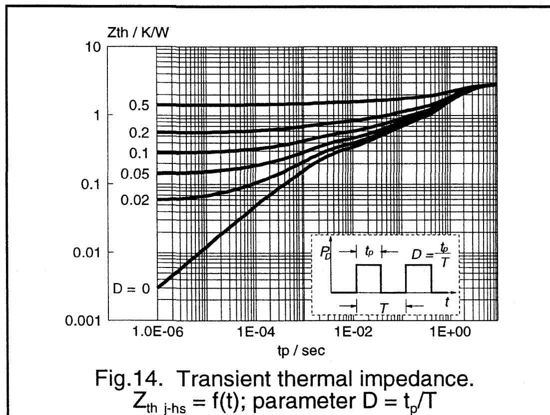


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

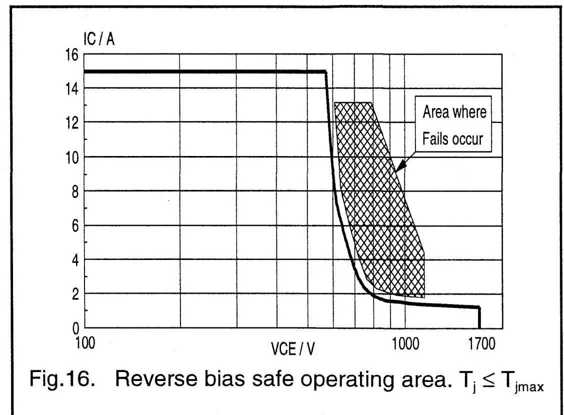


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

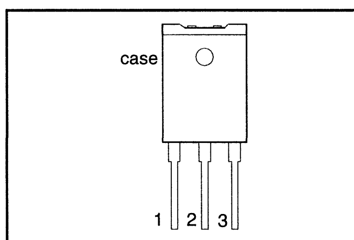
QUICK REFERENCE DATA

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	f = 16 kHz	4.0	-	A
V_F	Diode forward voltage	I_F = 4.0 A	1.6	-	V
t_s	Storage time	I_{Csat} = 4 A; f = 16 kHz	4.8	5.5	µs

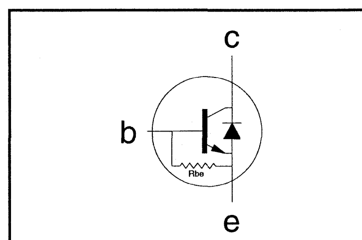
PINNING - SOT199

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
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	-	15	-	
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_{Csat} = 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).

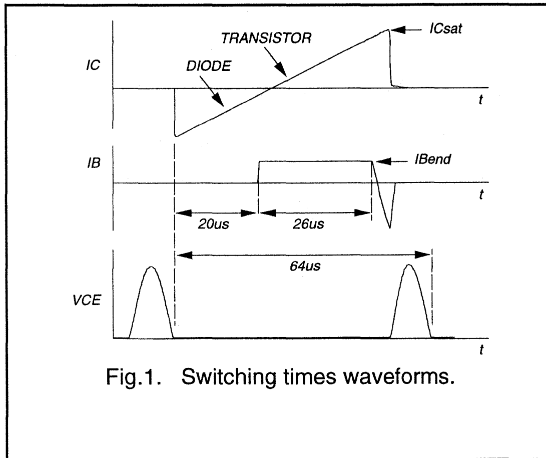


Fig.1. Switching times waveforms.

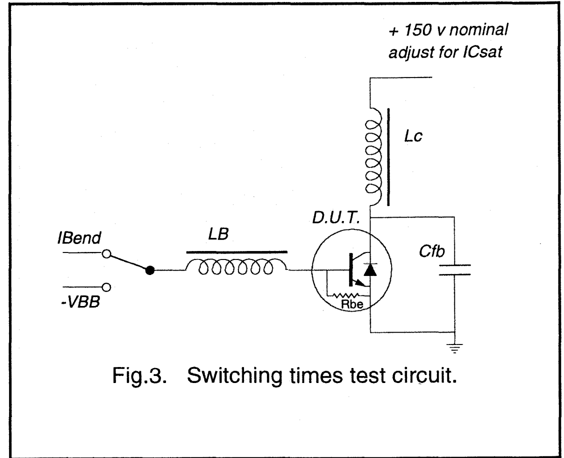


Fig.3. Switching times test circuit.

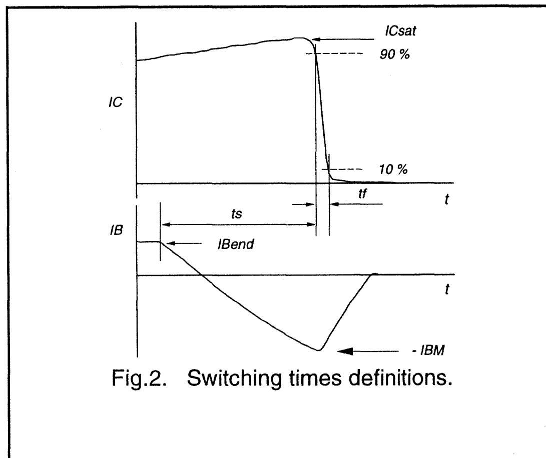


Fig.2. Switching times definitions.

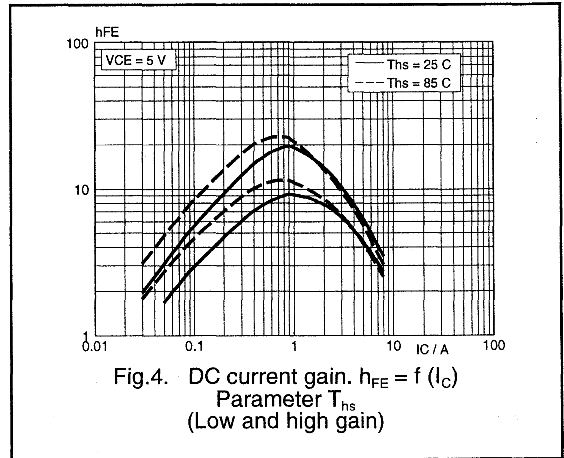


Fig.4. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

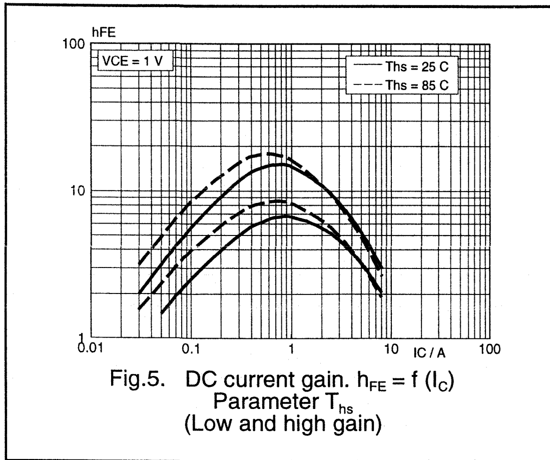


Fig.5. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

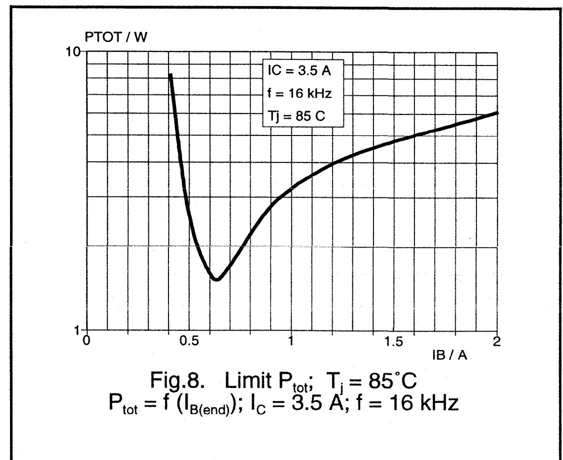


Fig.8. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 3.5\ A$; $f = 16\ kHz$

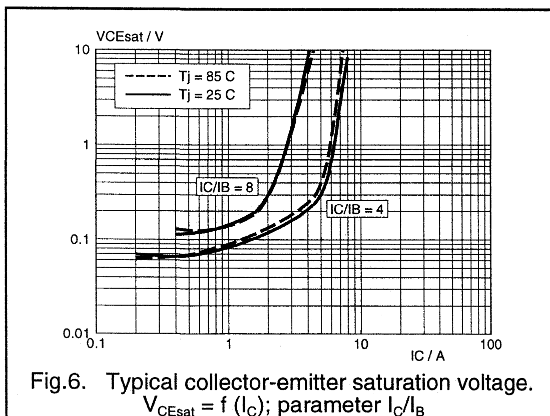


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

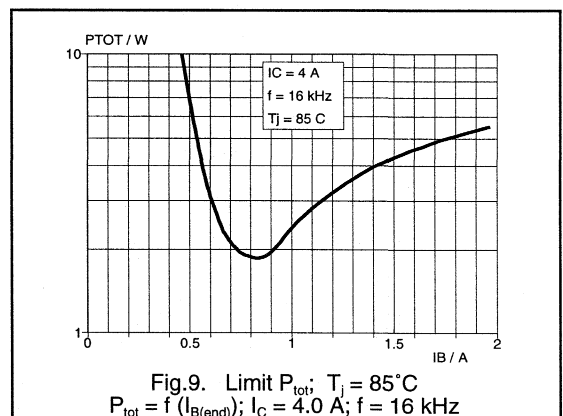


Fig.9. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.0\ A$; $f = 16\ kHz$

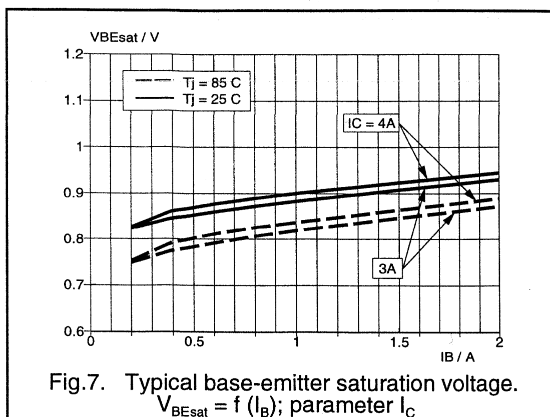


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

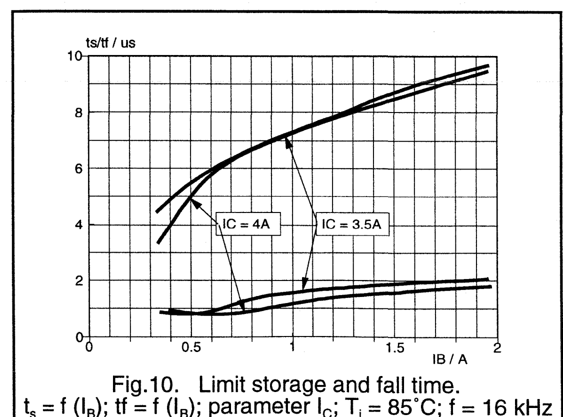


Fig.10. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; $f = 16\ kHz$

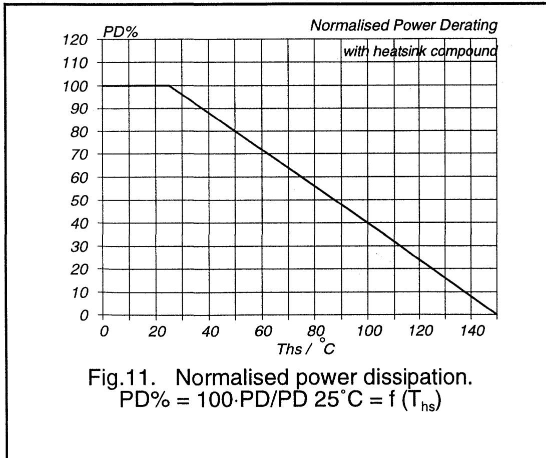


Fig.11. Normalised power dissipation. $PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{hs})$

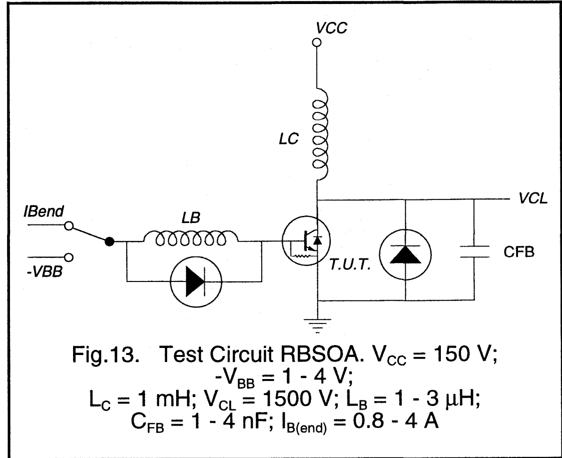


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 μH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

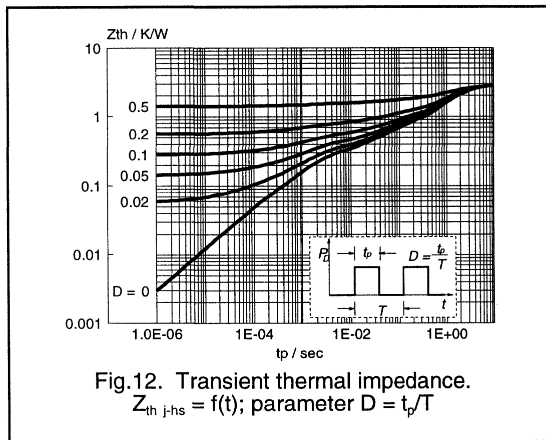


Fig.12. Transient thermal impedance. $Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

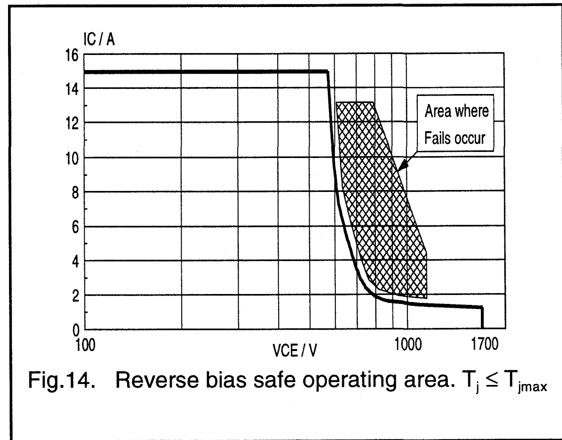


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

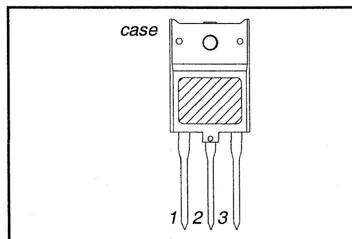
QUICK REFERENCE DATA

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	f = 16 kHz	4.0	-	A
V_F	Diode forward voltage	$I_F = 4.0$ A	1.6	-	V
t_s	Storage time	$I_{Csat} = 4$ A; f = 16 kHz	4.8	5.5	µs

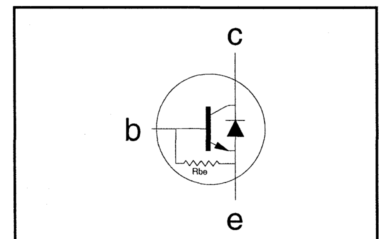
PINNING - SOT399

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	-	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
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	-	15	-	
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_{Csat} = 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).

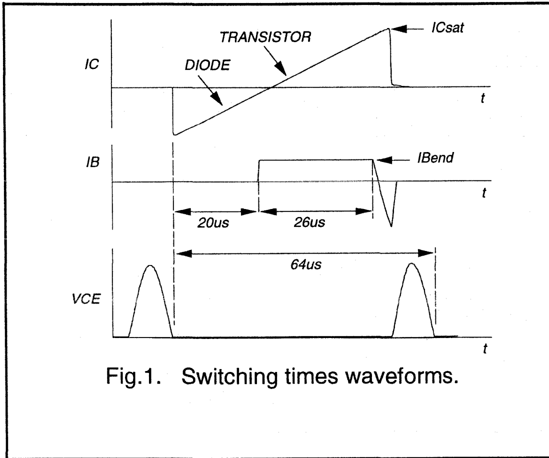


Fig.1. Switching times waveforms.

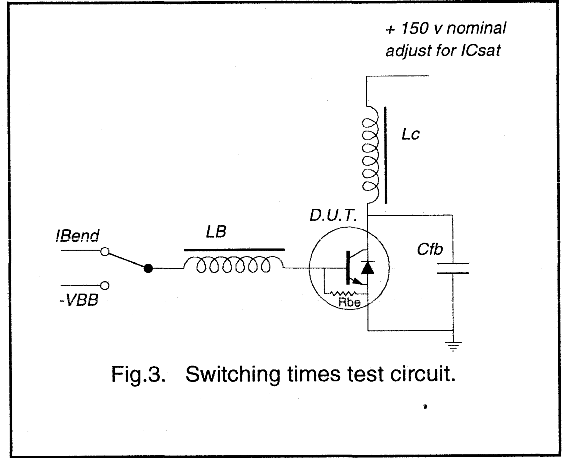


Fig.3. Switching times test circuit.

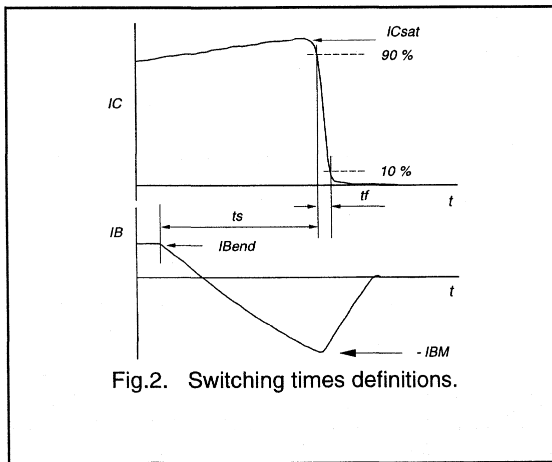


Fig.2. Switching times definitions.

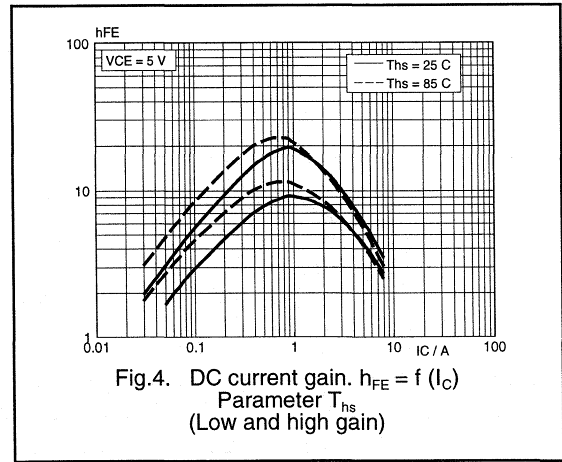


Fig.4. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

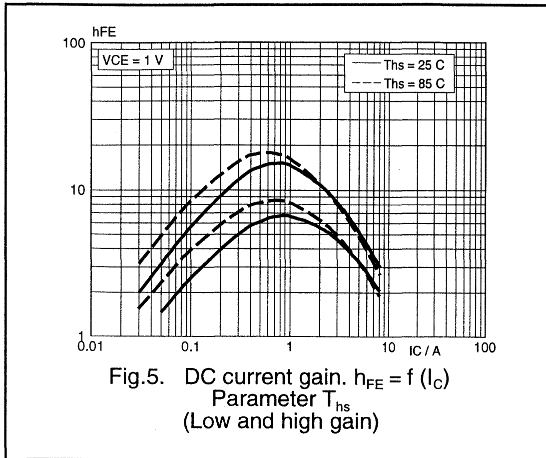


Fig.5. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

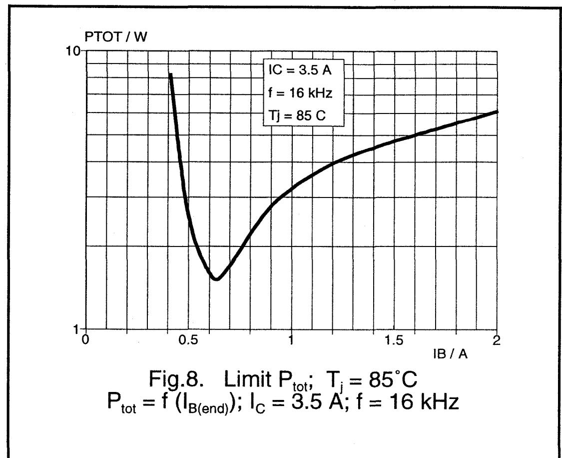


Fig.8. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 3.5$ A; f = 16 kHz

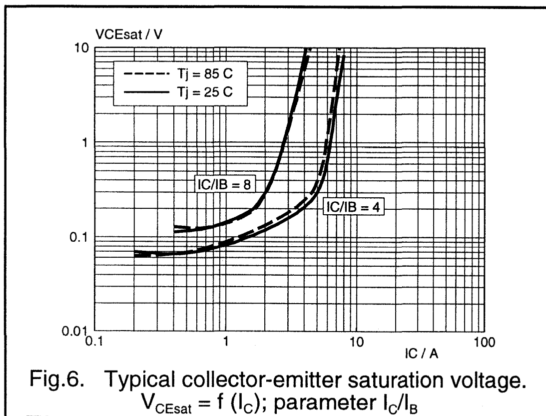


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

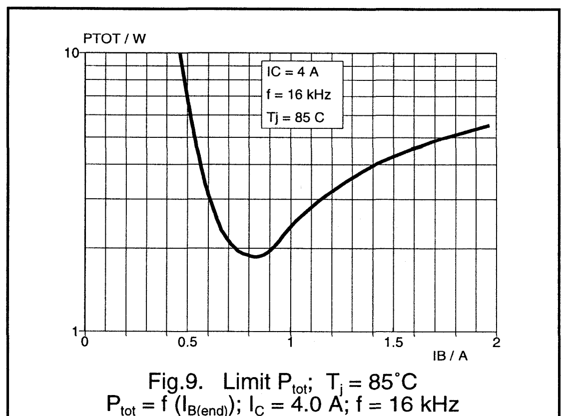


Fig.9. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.0$ A; f = 16 kHz

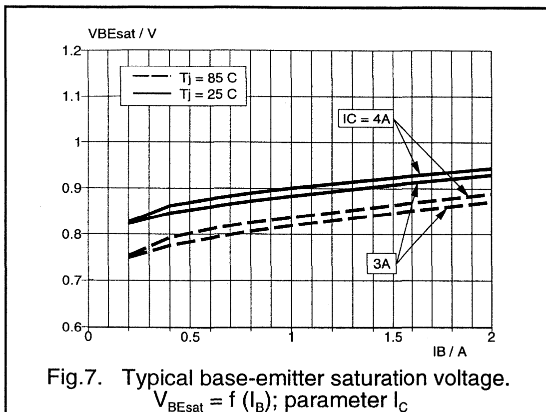


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

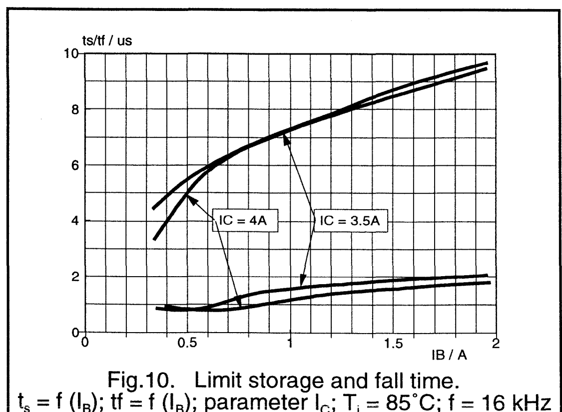


Fig.10. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

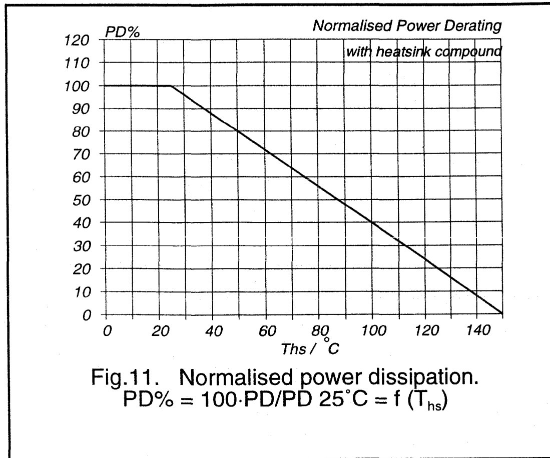


Fig.11. Normalised power dissipation. PD% = 100·PD/PD 25˚C = f (T_{hs})

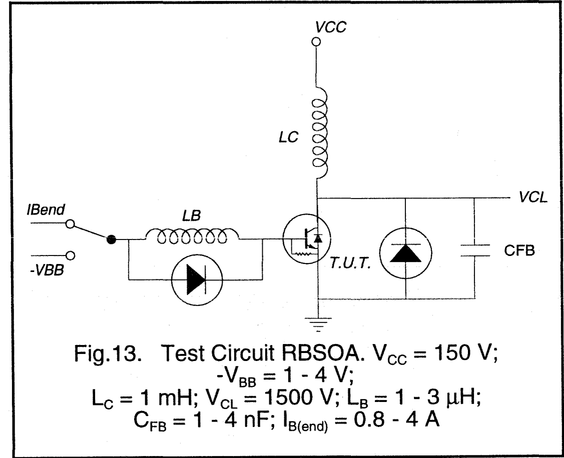


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 μH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

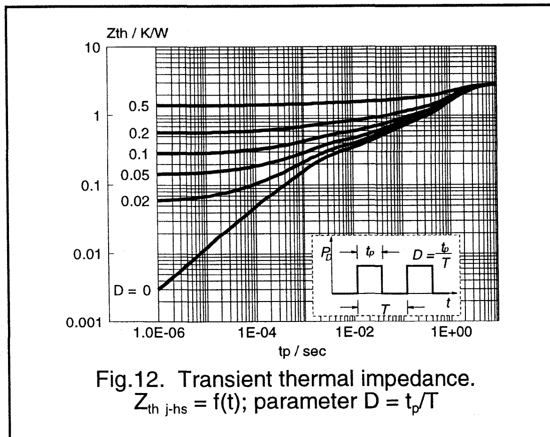


Fig.12. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

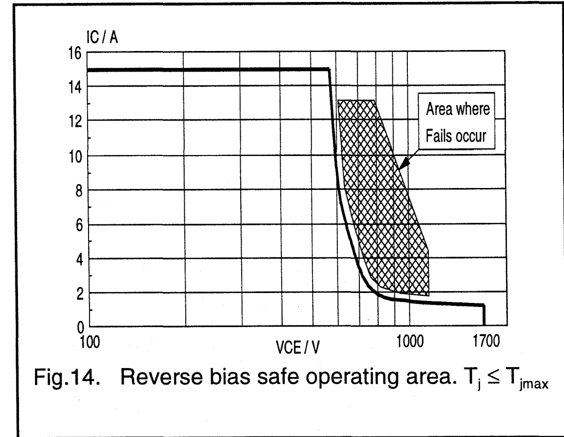


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

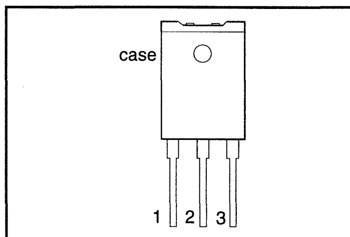
QUICK REFERENCE DATA

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	f = 16 kHz	5.5	-	A
t_s	Storage time	I_{Csat} = 5.5 A; f = 16 kHz	7.4	8.5	µs

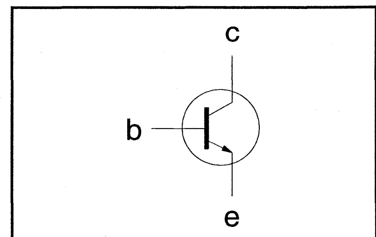
PINNING - SOT199

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)		-	14	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]		-	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

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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	22	-	
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_{Csat} = 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).

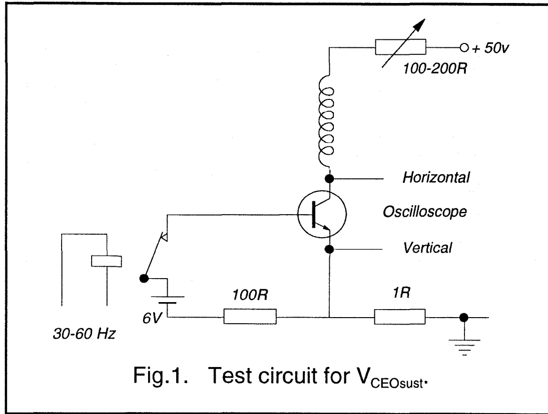


Fig.1. Test circuit for $V_{CEOsust}$.

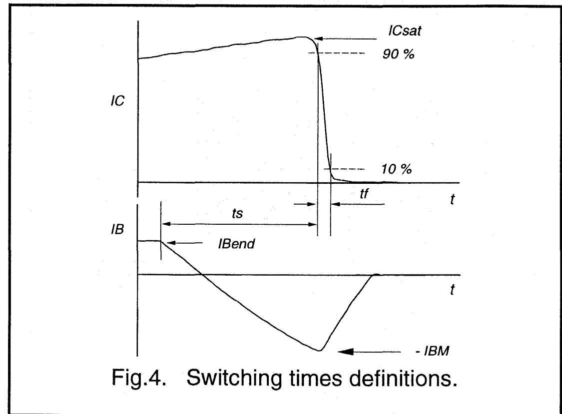


Fig.4. Switching times definitions.

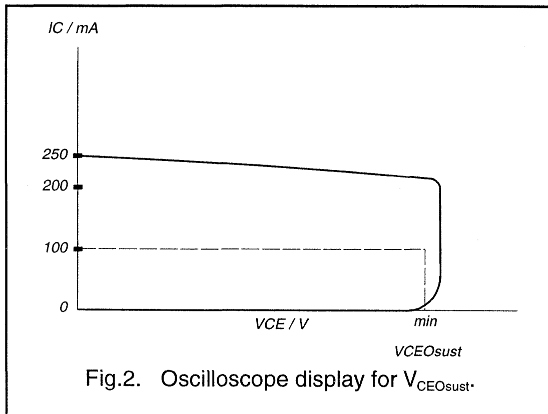


Fig.2. Oscilloscope display for $V_{CEOsust}$.

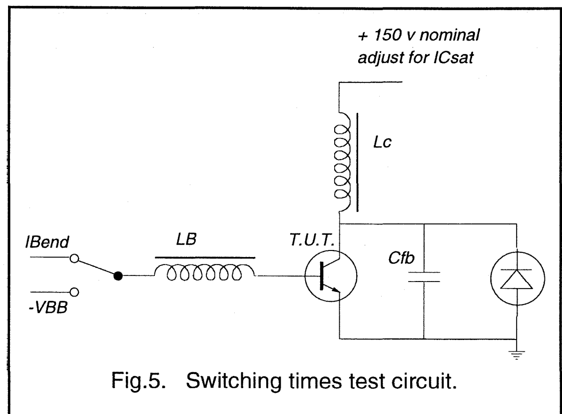


Fig.5. Switching times test circuit.

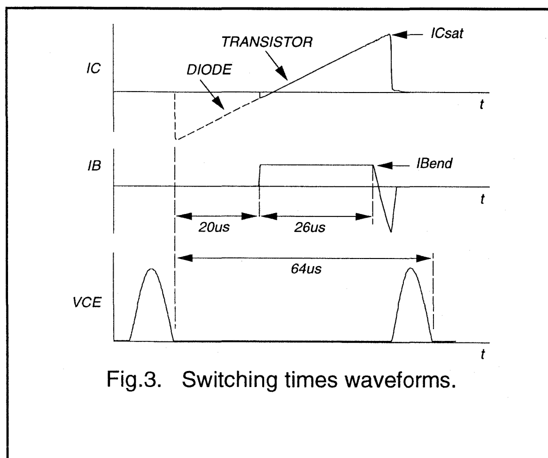


Fig.3. Switching times waveforms.

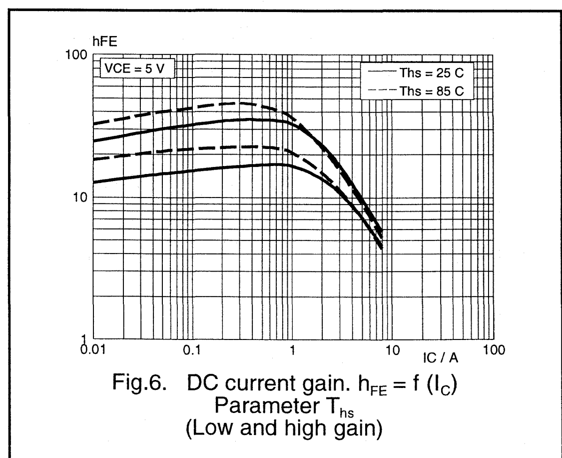


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

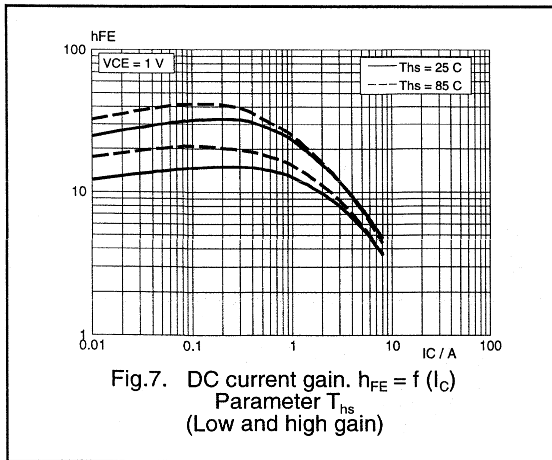


Fig.7. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

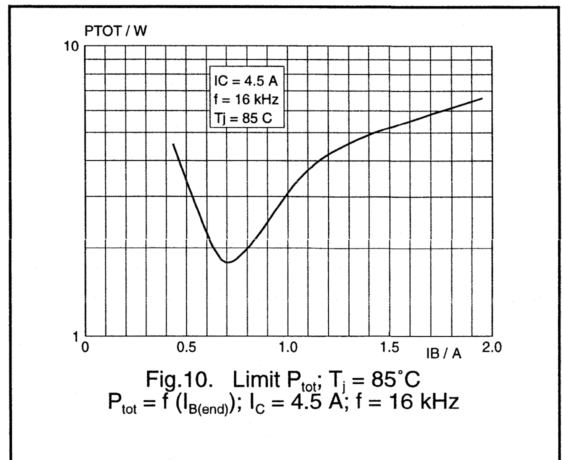


Fig.10. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f(I_{B(end)})$; $I_C = 4.5$ A; f = 16 kHz

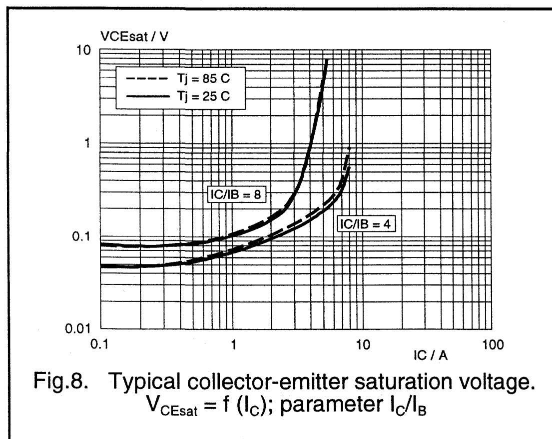


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

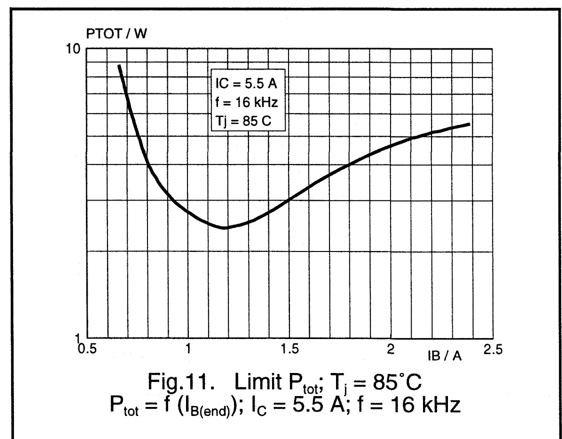


Fig.11. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f(I_{B(end)})$; $I_C = 5.5$ A; f = 16 kHz

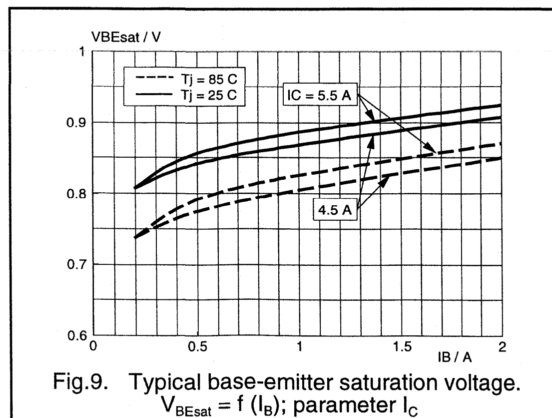


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

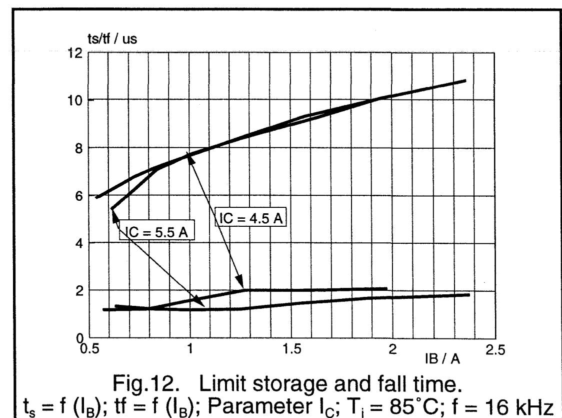


Fig.12. Limit storage and fall time.
$t_s = f(I_B)$; tf = f (I_B); Parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

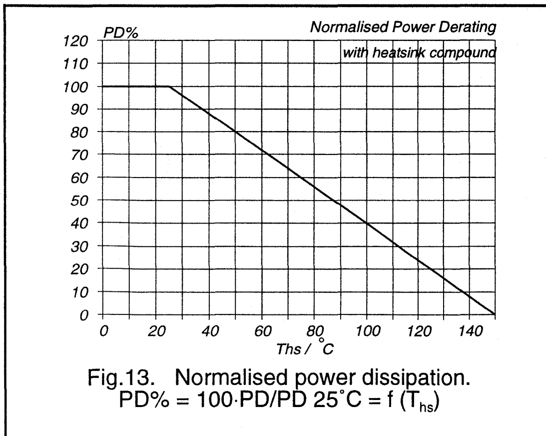


Fig.13. Normalised power dissipation. PD% = 100·PD/PD 25˚C = f (T_{hs})

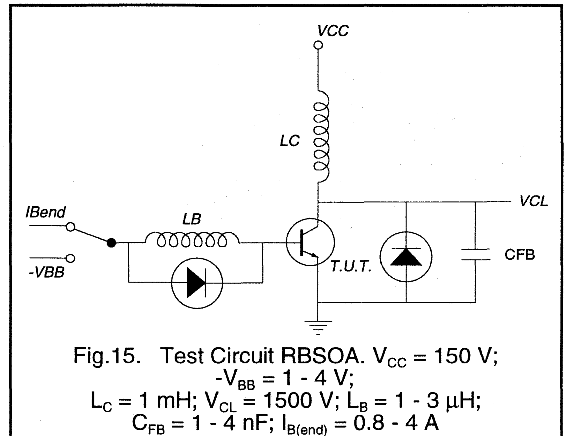


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

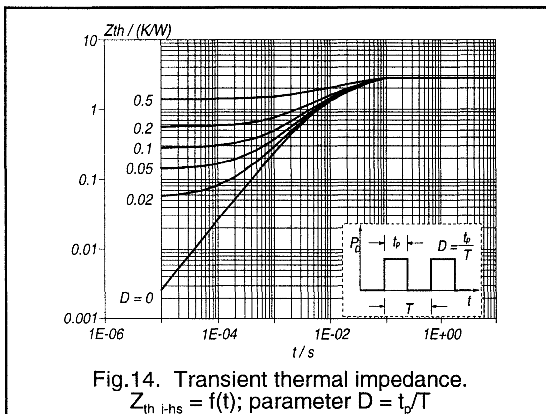


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

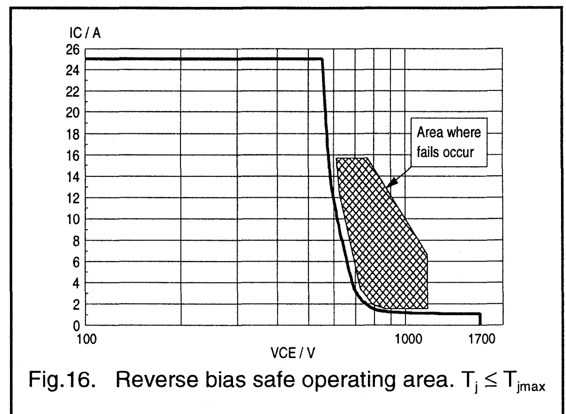


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

Silicon Diffused Power Transistor — BU2720AX

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. Designed to withstand V_{CES} pulses up to 1700V.

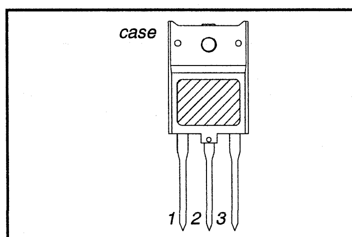
QUICK REFERENCE DATA

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	f = 16 kHz	5.5	-	A
t_s	Storage time	$I_{Csat} = 5.5$ A; f = 16 kHz	7.4	8.5	µs

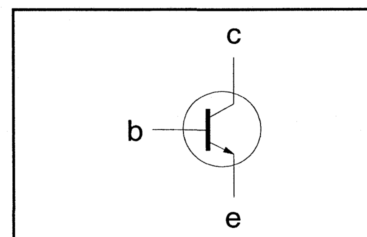
PINNING - SOT399

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	-	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		-	14	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

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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	22	-	
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_{Csat} = 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).

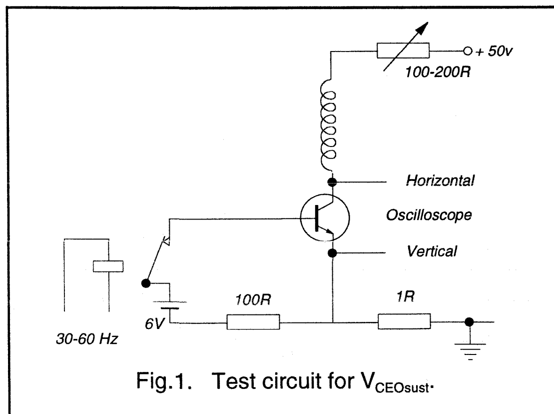


Fig.1. Test circuit for $V_{CEOsust}$.

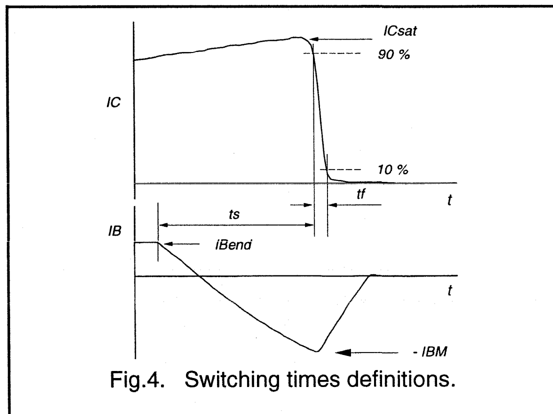


Fig.4. Switching times definitions.

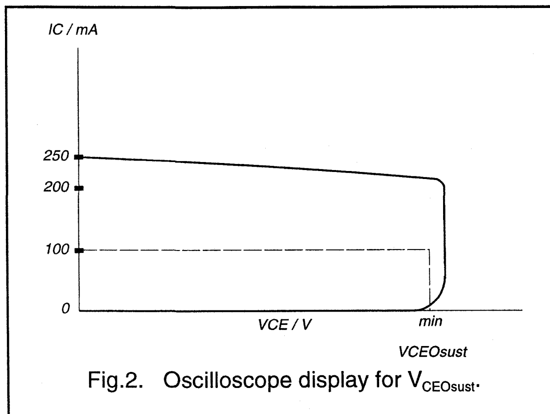


Fig.2. Oscilloscope display for $V_{CEOsust}$.

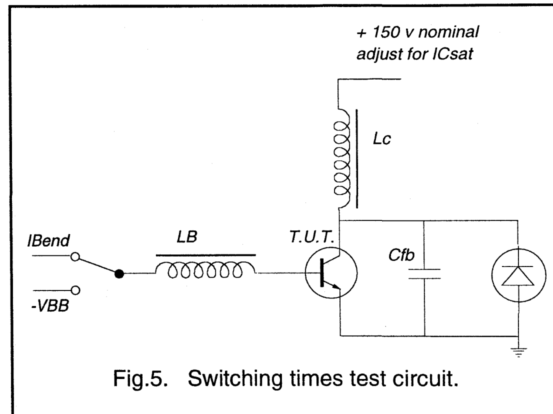


Fig.5. Switching times test circuit.

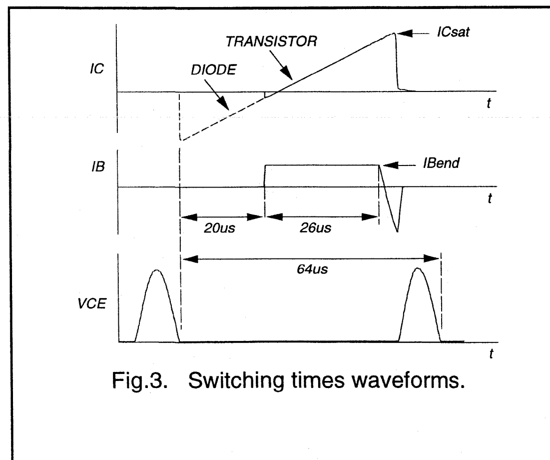


Fig.3. Switching times waveforms.

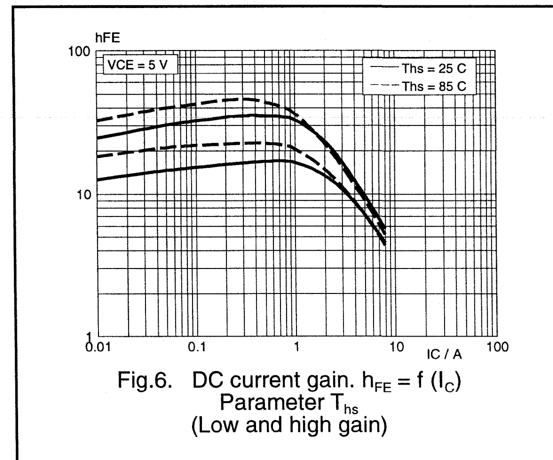


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

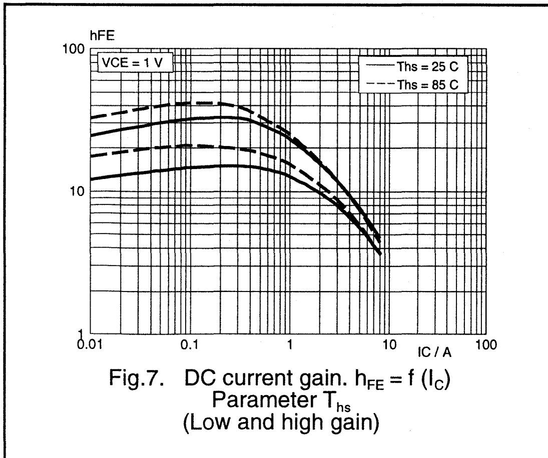


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

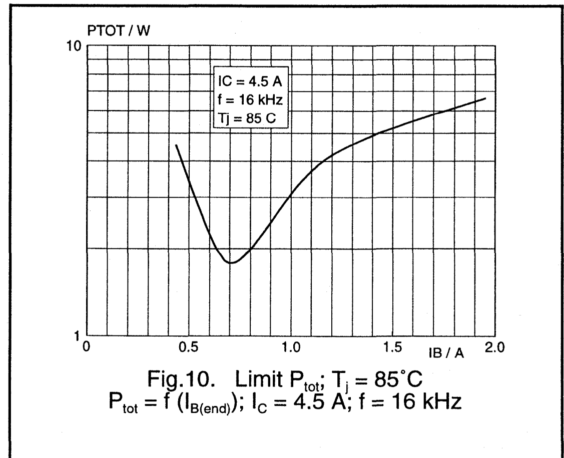


Fig.10. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.5$ A; f = 16 kHz

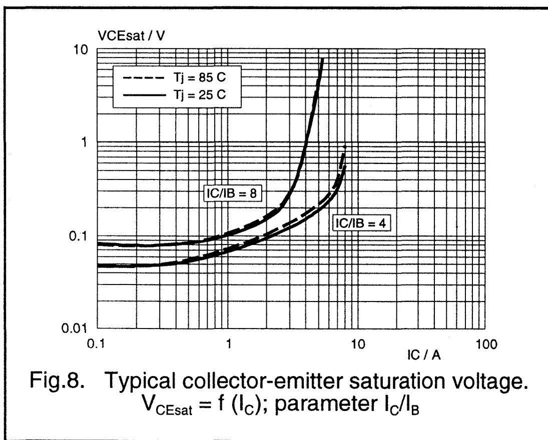


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

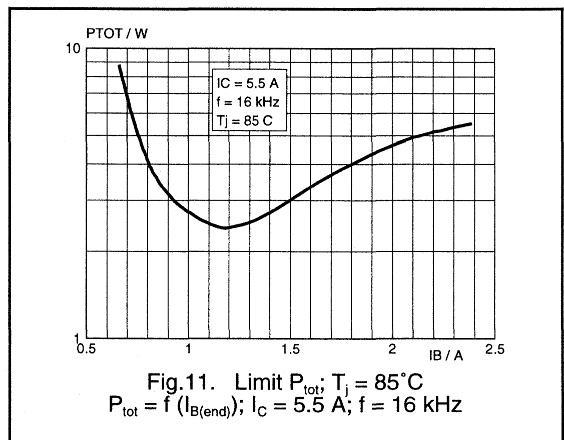


Fig.11. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 5.5$ A; f = 16 kHz

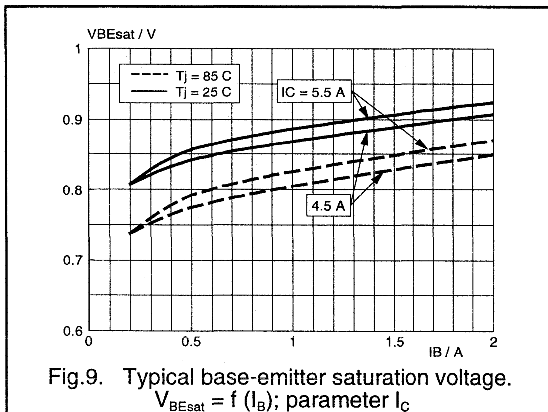


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

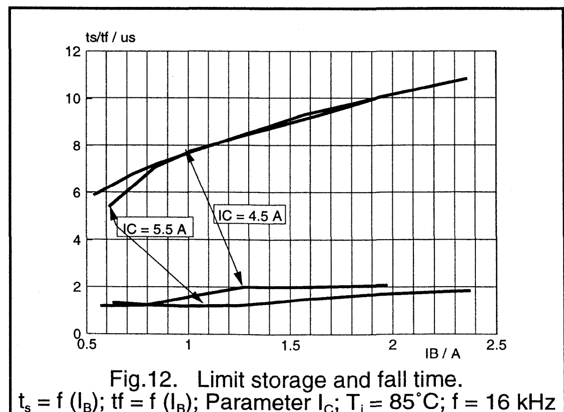


Fig.12. Limit storage and fall time.
$t_s = f\ (I_B)$; tf = f (I_B); Parameter I_C; $T_j = 85^{\circ}C$; f = 16 kHz

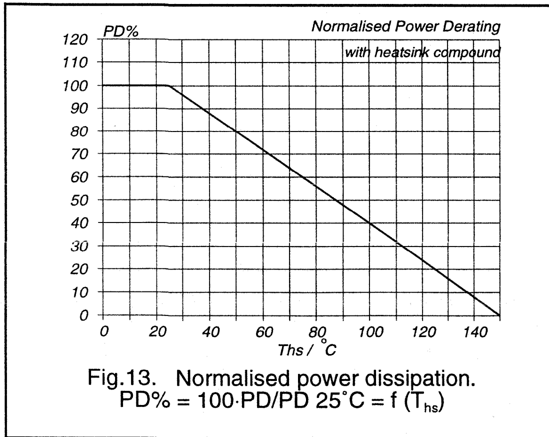


Fig.13. Normalised power dissipation. PD% = 100·PD/PD 25°C = f (T_{hs})

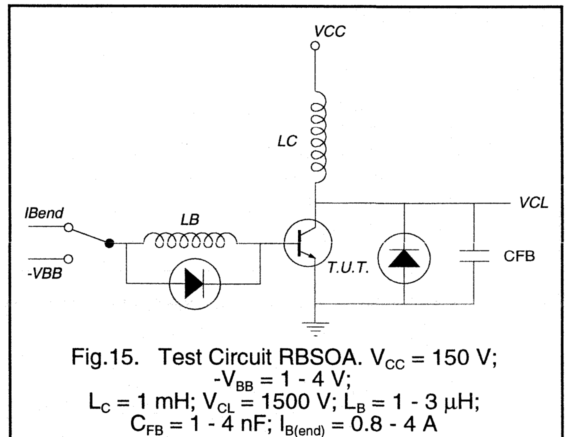


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V; L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH; C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

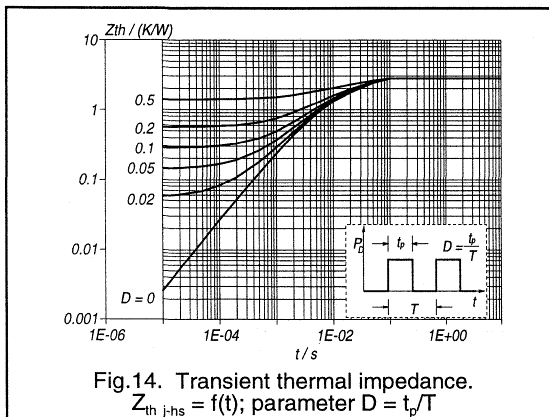


Fig.14. Transient thermal impedance. $Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

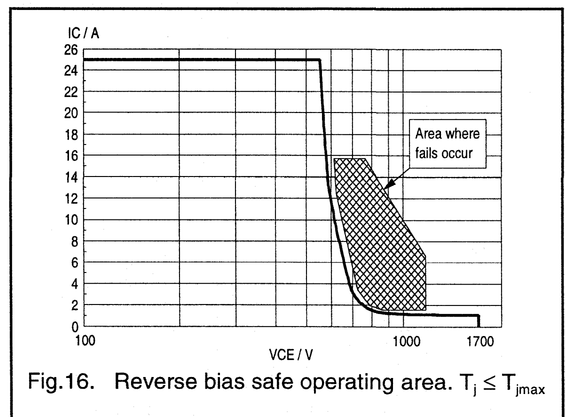


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

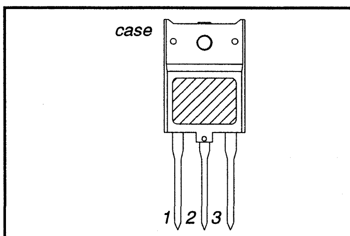
QUICK REFERENCE DATA

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	f = 16 kHz	5.5	-	A
t_s	Storage time	I_{Csat} = 5.5 A; f = 16 kHz	7.4	8.5	µs

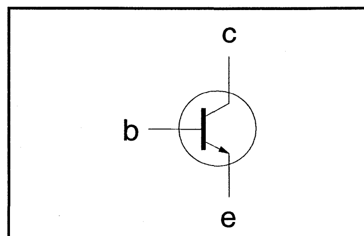
PINNING - SOT399

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	-	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		-	14	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

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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	22	-	
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_{Csat} = 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).

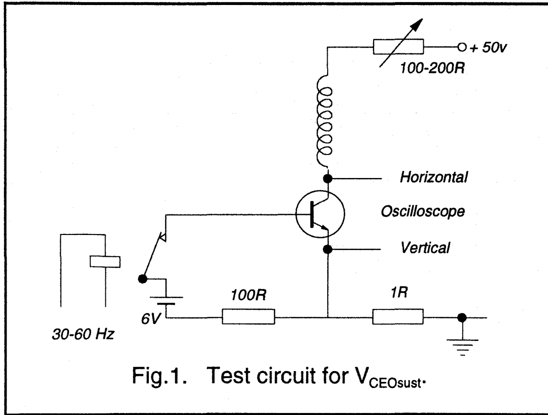


Fig.1. Test circuit for $V_{CEOsust}$.

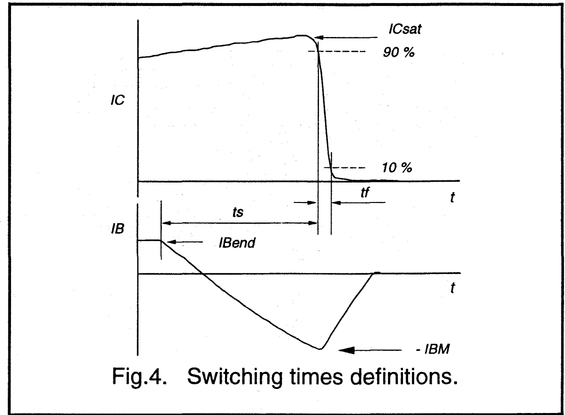


Fig.4. Switching times definitions.

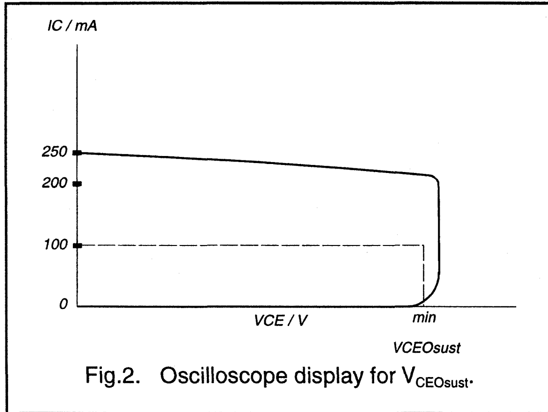


Fig.2. Oscilloscope display for $V_{CEOsust}$.

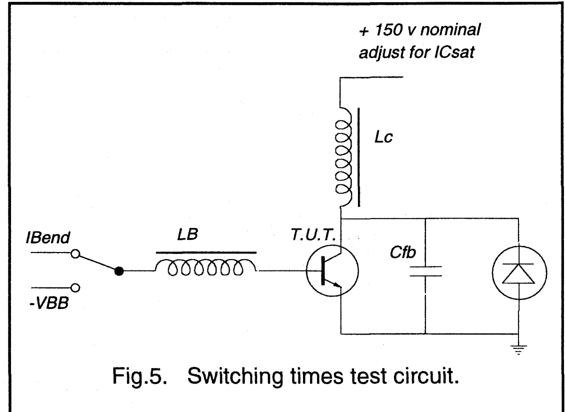


Fig.5. Switching times test circuit.

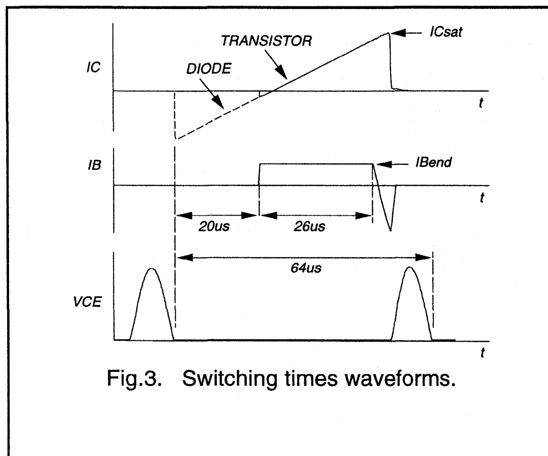


Fig.3. Switching times waveforms.

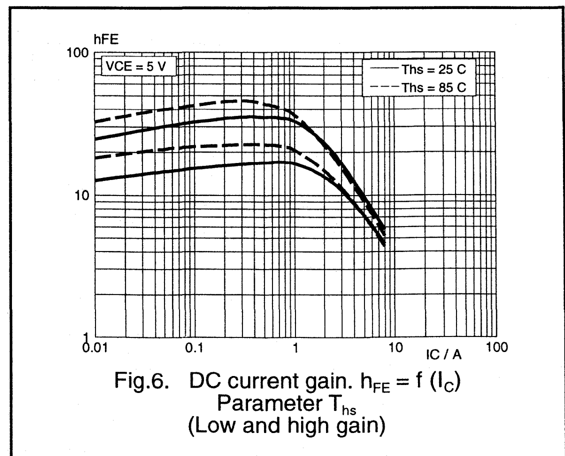


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

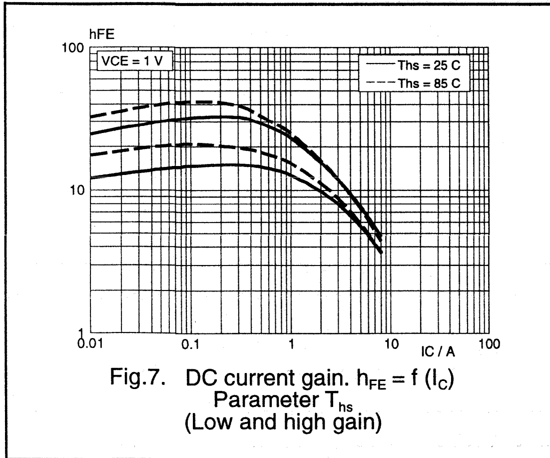


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

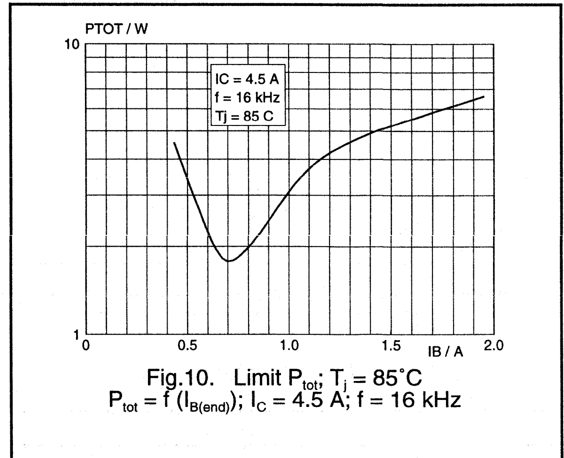


Fig.10. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 4.5\ A$; $f = 16\ kHz$

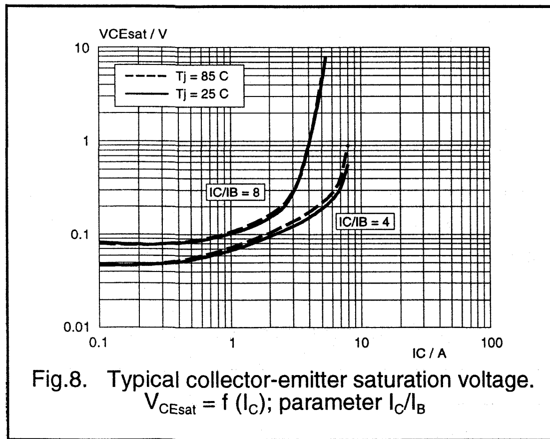


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

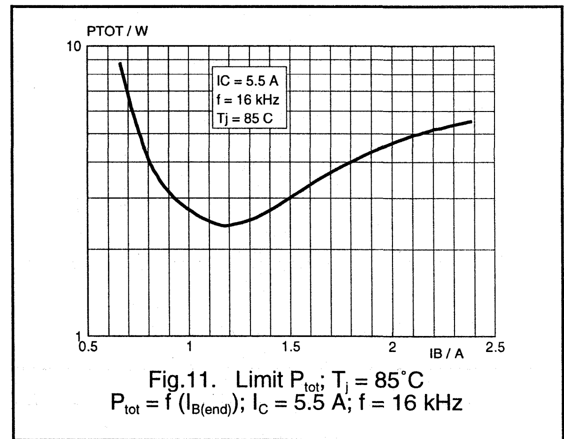


Fig.11. Limit P_{tot}; $T_j = 85^{\circ}C$
$P_{tot} = f\ (I_{B(end)})$; $I_C = 5.5\ A$; $f = 16\ kHz$

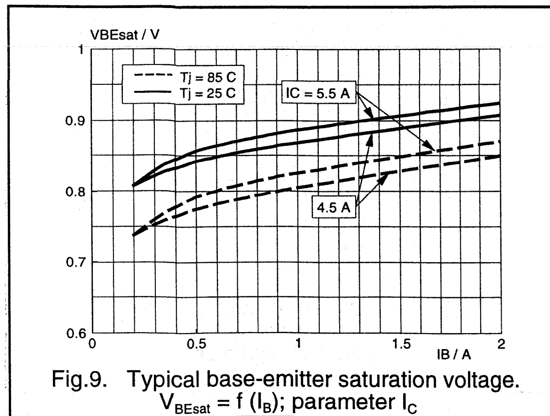


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

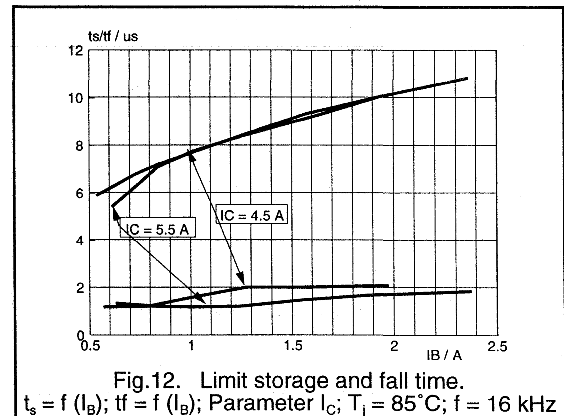


Fig.12. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; Parameter I_C; $T_j = 85^{\circ}C$; $f = 16\ kHz$

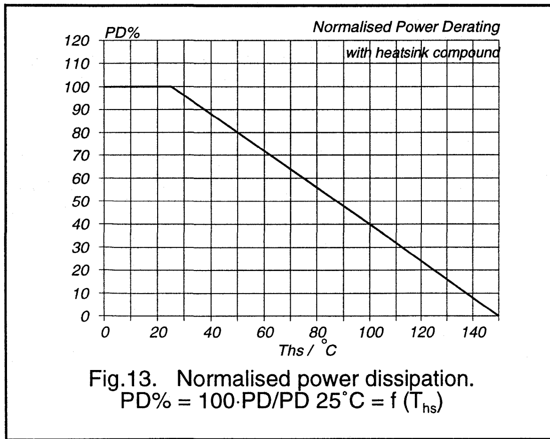


Fig.13. Normalised power dissipation.
PD% = 100·PD/PD 25˚C = f (T_{hs})

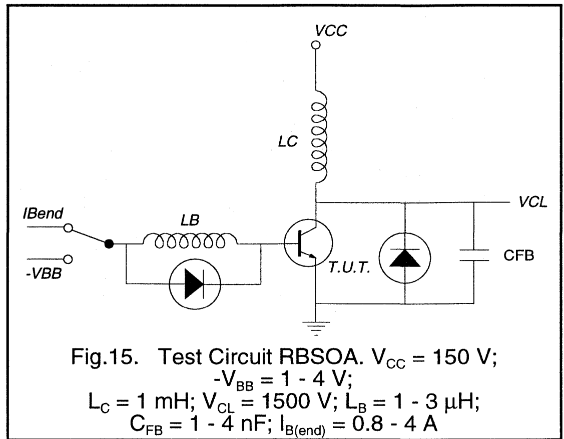


Fig.15. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 μH;
C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 0.8 - 4 A

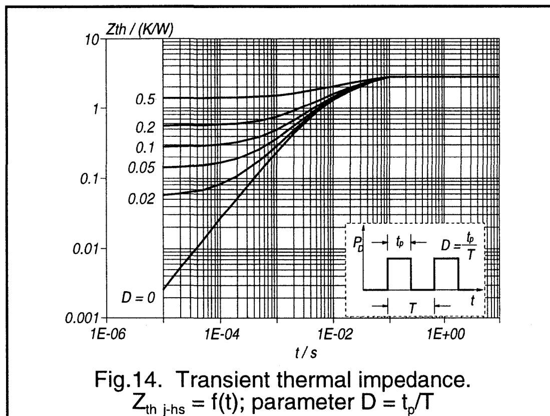


Fig.14. Transient thermal impedance.
$Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

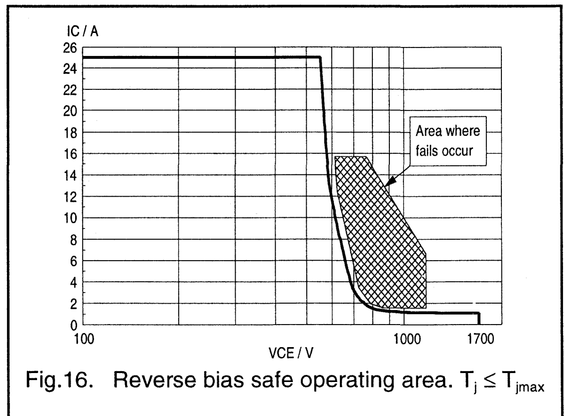


Fig.16. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

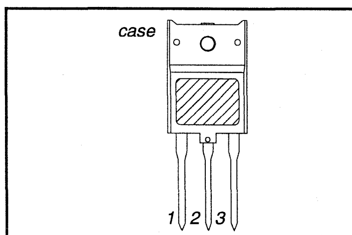
QUICK REFERENCE DATA

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	f = 16 kHz	5.5	-	A
t_s	Storage time	I_{Csat} = 5.5 A; f = 16kHz	7.4	8.5	µs

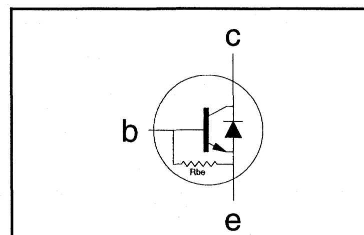
PINNING - SOT399

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	-	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		-	14	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

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
BV_{EBO}	Emitter-base breakdown voltage	I_B = 600 mA	7.5	13.5	-	V
R_{BE}	Base-emitter resistance	V_{EB} = 6 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	-	-	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		19		
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_{Csat} = 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).

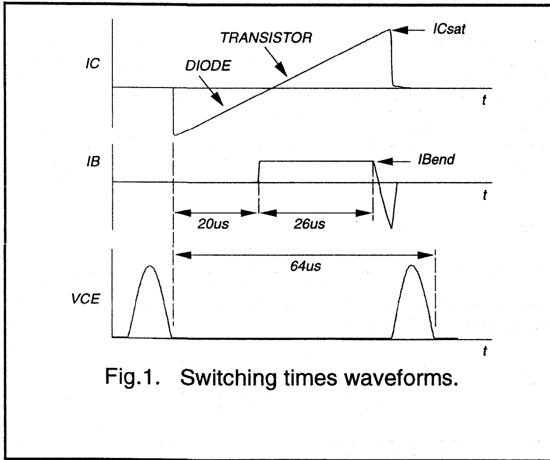


Fig.1. Switching times waveforms.

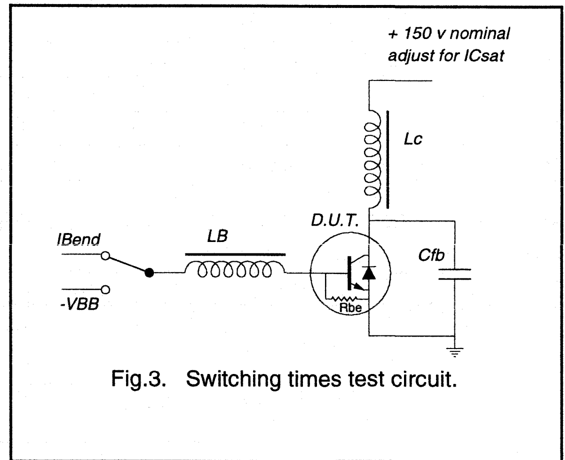


Fig.3. Switching times test circuit.

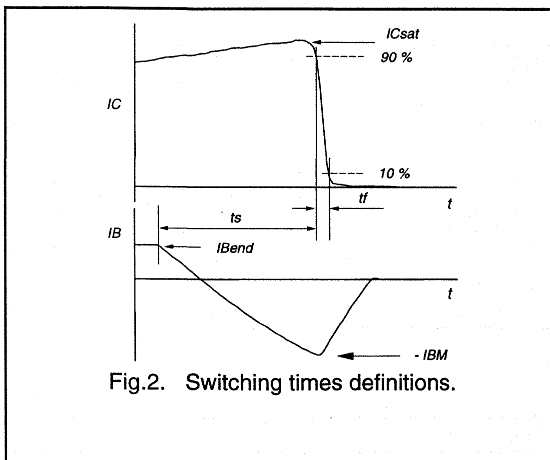


Fig.2. Switching times definitions.

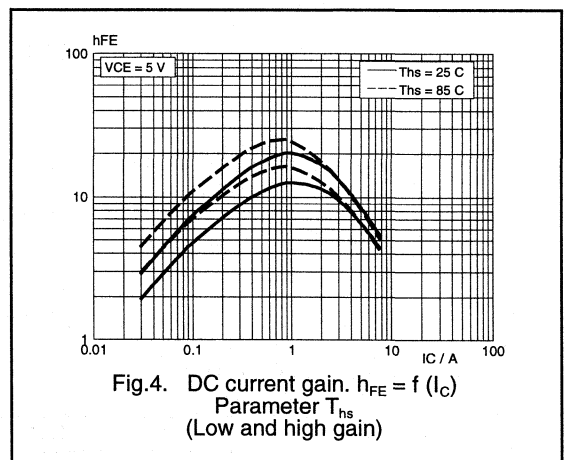


Fig.4. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

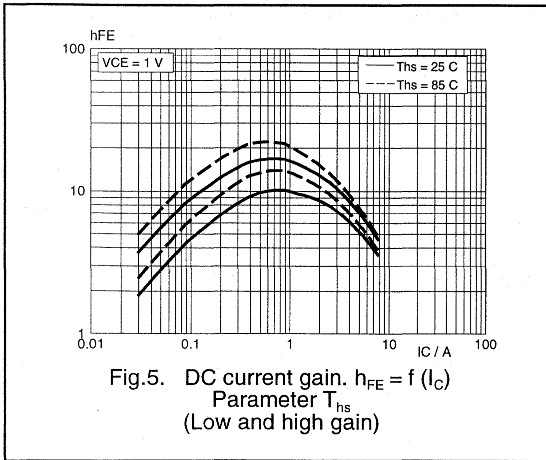


Fig.5. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

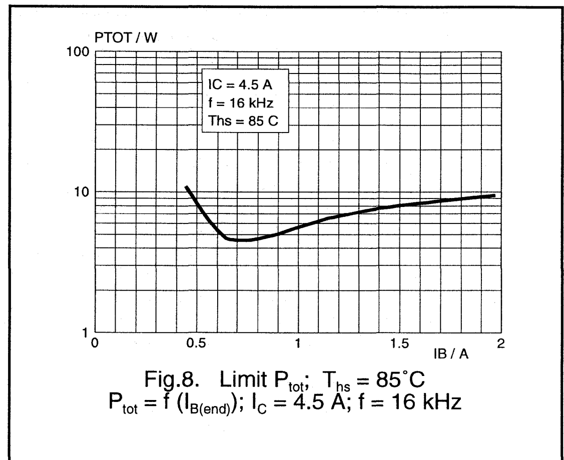


Fig.8. Limit P_{tot}; T_{hs} = 85˚C
$P_{tot} = f\ (I_{B(end)})$; I_C = 4.5 A; f = 16 kHz

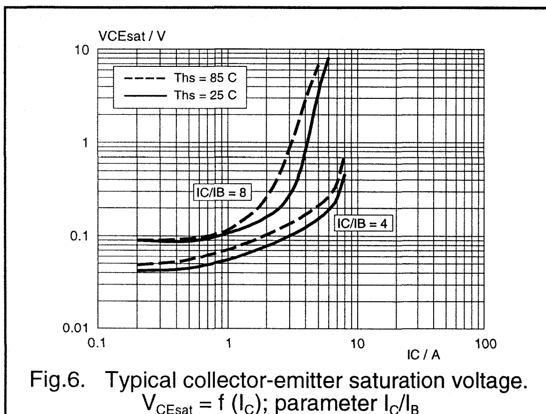


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

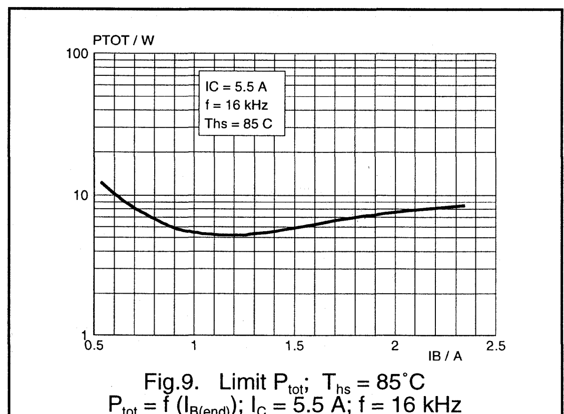


Fig.9. Limit P_{tot}; T_{hs} = 85˚C
$P_{tot} = f\ (I_{B(end)})$; I_C = 5.5 A; f = 16 kHz

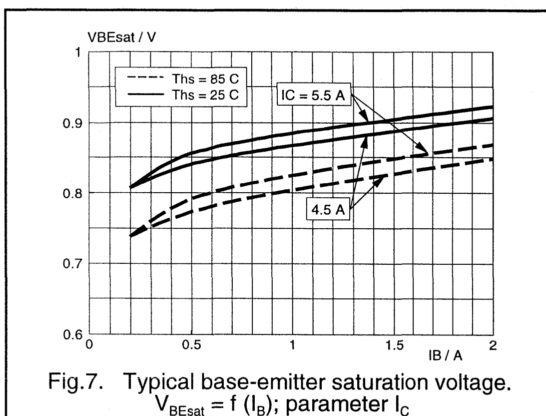


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

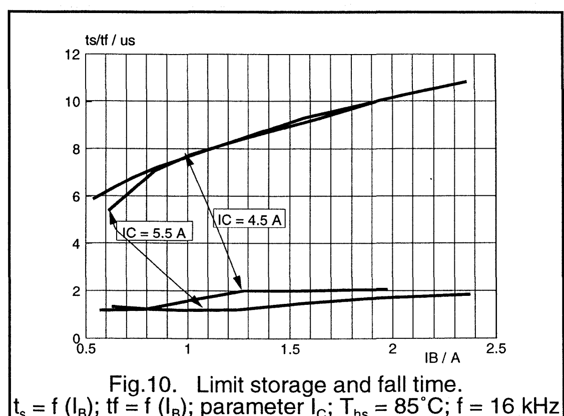


Fig.10. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; parameter I_C; T_{hs} = 85˚C; f = 16 kHz

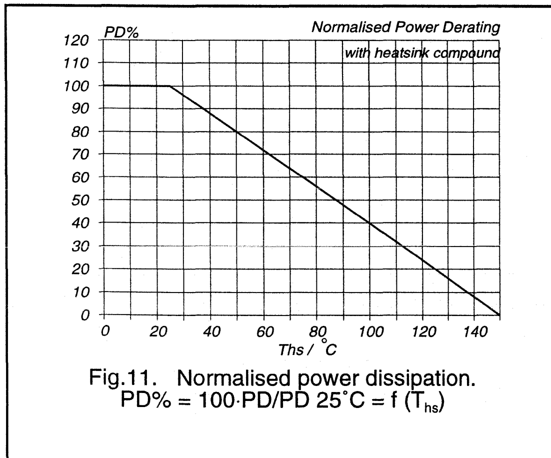


Fig.11. Normalised power dissipation.
PD% = 100·PD/PD 25˚C = f (T_{hs})

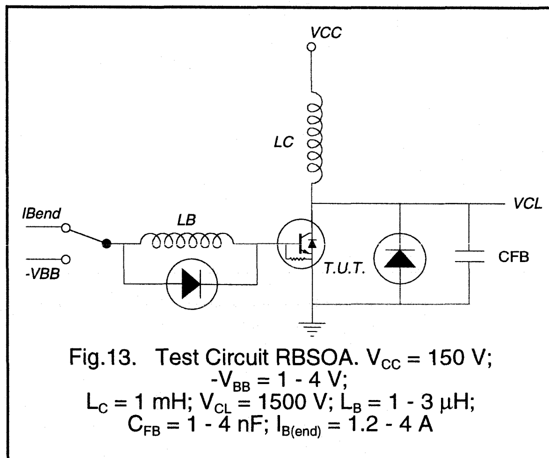


Fig.13. Test Circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 1 - 3 µH;
C_{FB} = 1 - 4 nF; $I_{B(end)}$ = 1.2 - 4 A

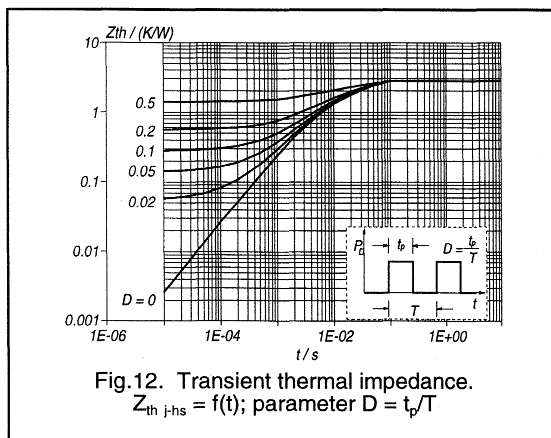


Fig.12. Transient thermal impedance.
$Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

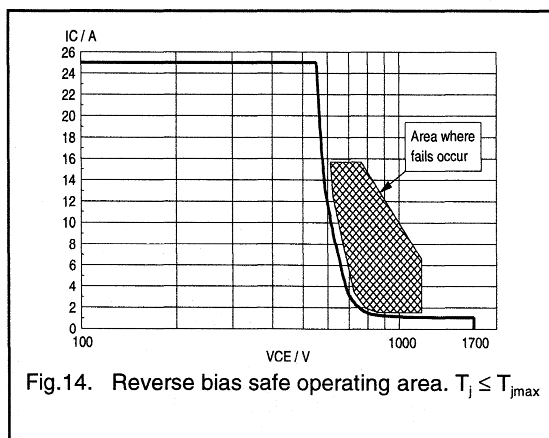


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

Silicon Diffused Power Transistor | BU2722AF

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. Designed to withstand V_{CES} pulses up to 1700 V.

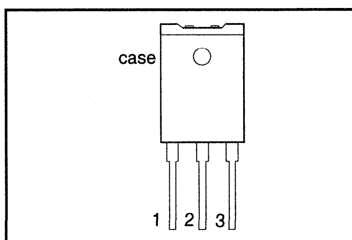
QUICK REFERENCE DATA

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	f = 64 kHz	4.5	-	A
t_s	Storage time	I_{Csat} = 4.5 A; f = 64 kHz	2.9	3.5	µs

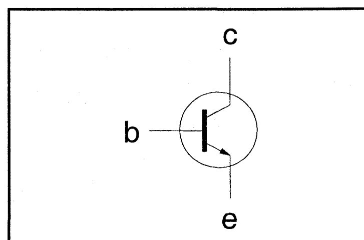
PINNING - SOT199

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		-	14	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

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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	22	-	
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_{Csat} = 4.5 A; L_C = 300 µH; C_{fb} = 2.5 nF; V_{CC} = 160 V; $I_{B(end)}$ = 1.0 A; L_B = 2.0 µH; $-V_{BB}$ = 4 V; $-I_{BM}$ = 2.7 A			
t_s	Turn-off storage time		2.9	3.5	µs
t_f	Turn-off fall time		0.19	0.25	µs

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

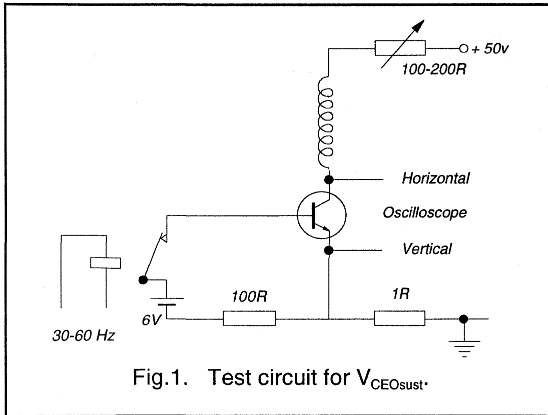


Fig.1. Test circuit for $V_{CEOsust}$.

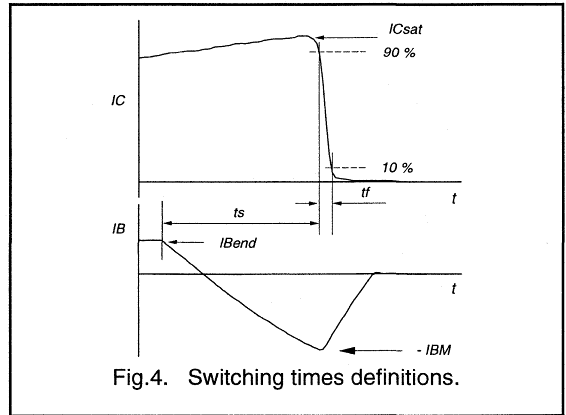


Fig.4. Switching times definitions.

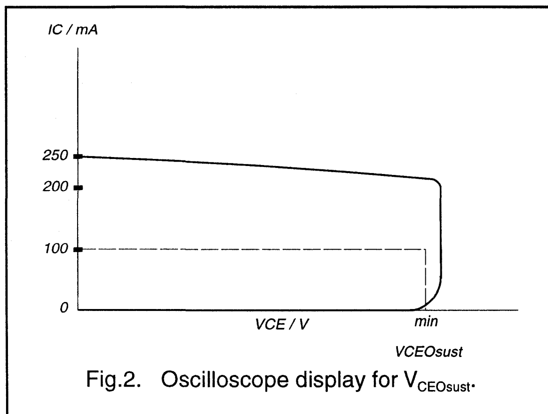


Fig.2. Oscilloscope display for $V_{CEOsust}$.

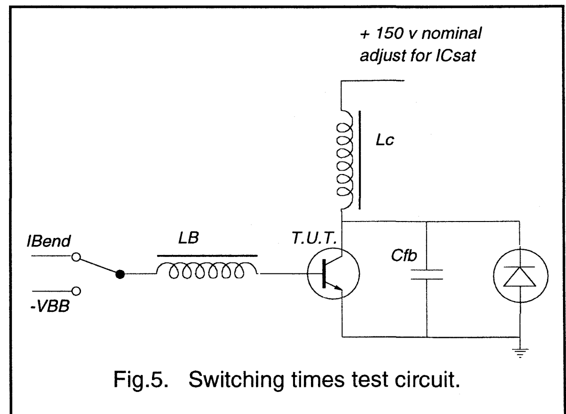


Fig.5. Switching times test circuit.

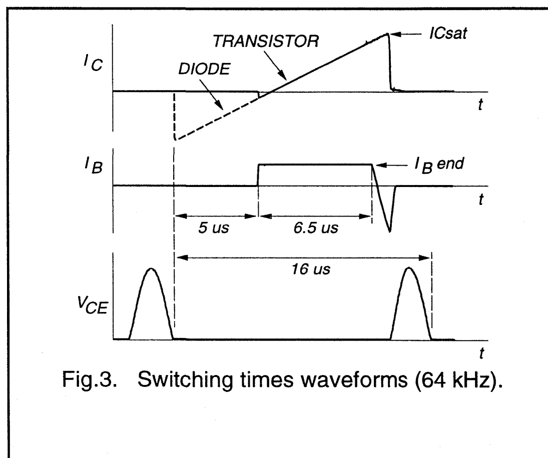


Fig.3. Switching times waveforms (64 kHz).

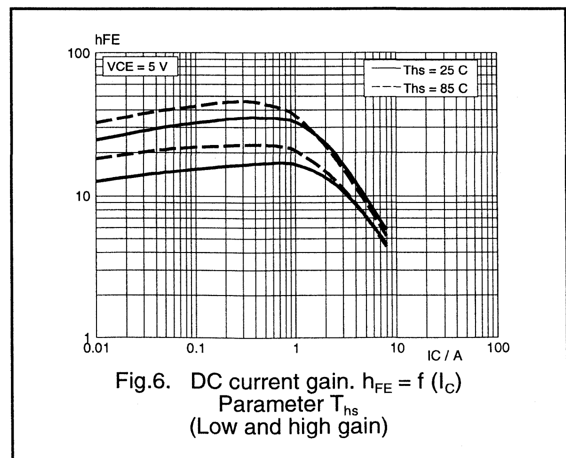


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

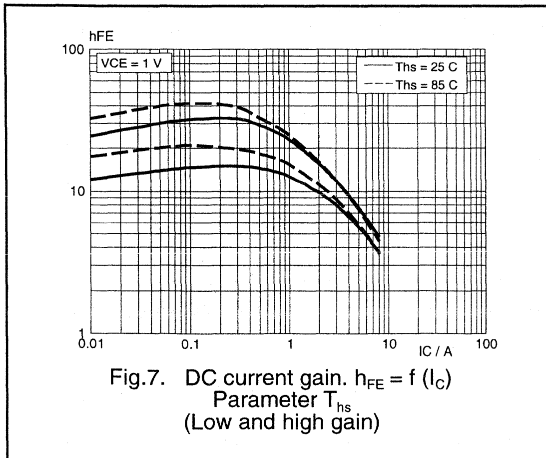


Fig.7. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

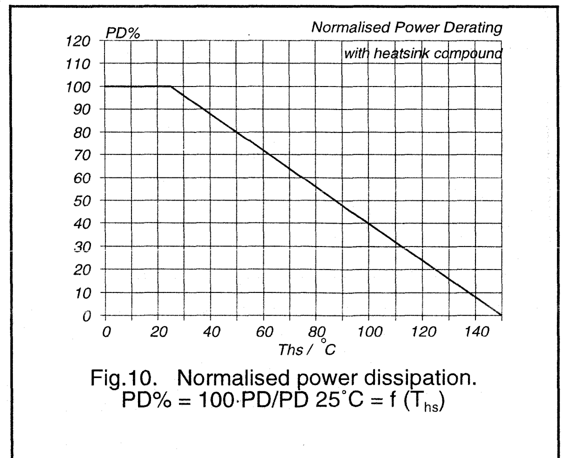


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{hs})$

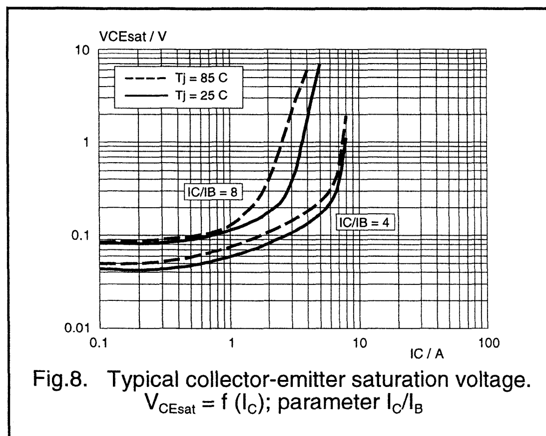


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

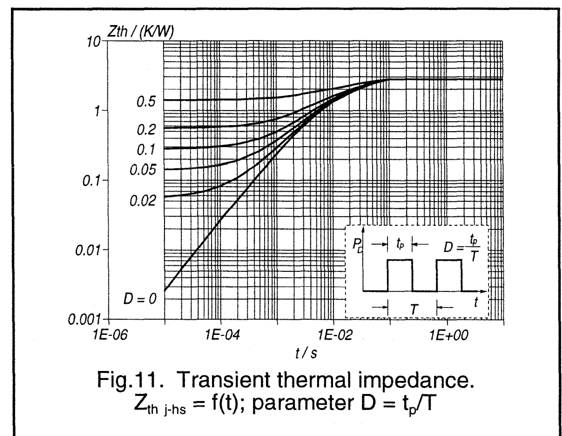


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

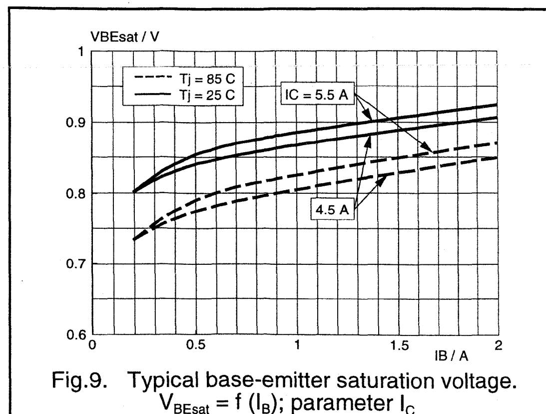


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

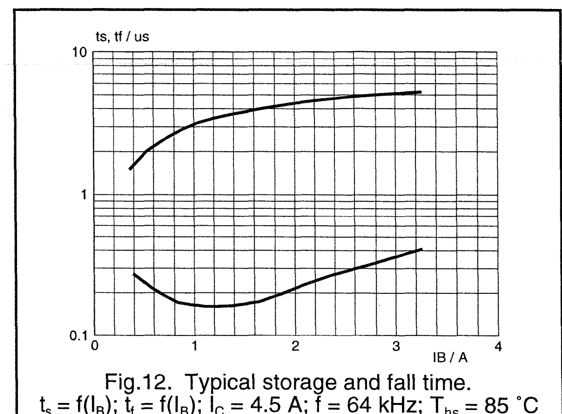


Fig.12. Typical storage and fall time.
$t_s = f(I_B)$; $t_f = f(I_B)$; $I_C = 4.5$ A; $f = 64$ kHz; $T_{hs} = 85$ °C

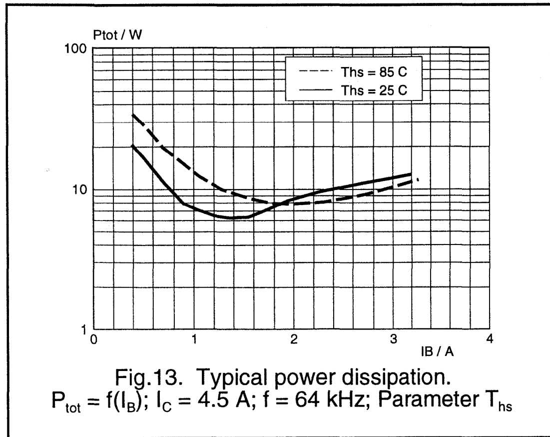


Fig.13. Typical power dissipation.
$P_{tot} = f(I_B)$; $I_C = 4.5$ A; f = 64 kHz; Parameter T_{hs}

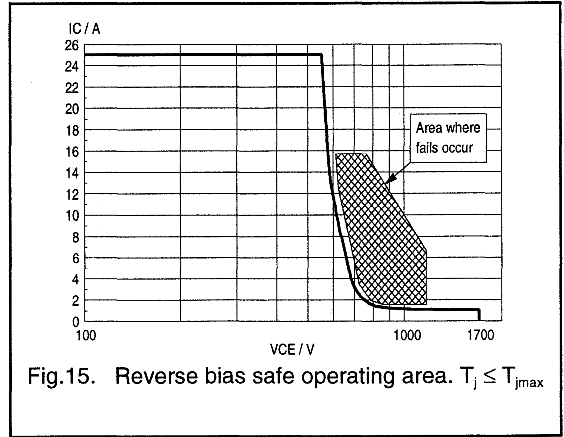


Fig.15. Reverse bias safe operating area. $T_j \leq T_{jmax}$

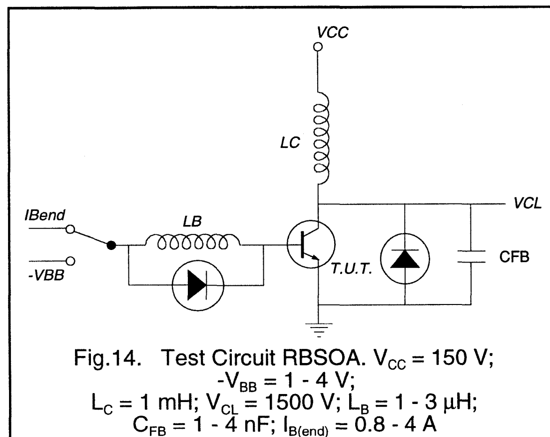


Fig.14. Test Circuit RBSOA. $V_{CC} = 150$ V;
$-V_{BB} = 1 - 4$ V;
$L_C = 1$ mH; $V_{CL} = 1500$ V; $L_B = 1 - 3$ µH;
$C_{FB} = 1 - 4$ nF; $I_{B(end)} = 0.8 - 4$ A

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. Designed to withstand V_{CES} pulses up to 1700 V.

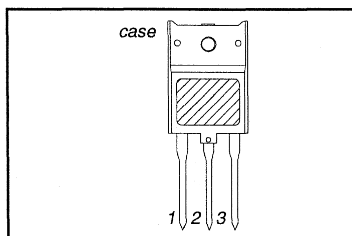
QUICK REFERENCE DATA

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	f = 64 kHz	4.5	-	A
t_s	Storage time	$I_{Csat} = 4.5$ A; f = 64 kHz	2.9	3.5	µs

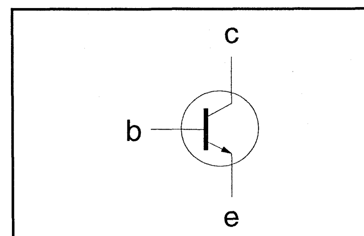
PINNING - SOT399

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	-	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		-	14	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

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 = 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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 100 mA; V_{CE} = 5 V	-	22	-	
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_{Csat} = 4.5 A; L_C = 300 µH; C_{fb} = 2.5 nF; V_{CC} = 160 V; $I_{B(end)}$ = 1.0 A; L_B = 2.0 µH; $-V_{BB}$ = 4 V; $-I_{BM}$ = 2.7 A			
t_s	Turn-off storage time		2.9	3.5	µs
t_f	Turn-off fall time		0.19	0.25	µs

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

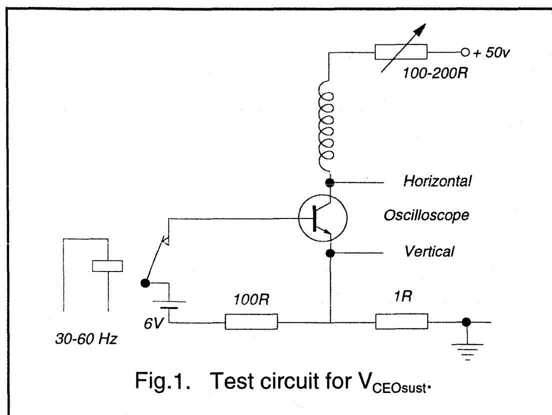


Fig.1. Test circuit for $V_{CEOsust}$.

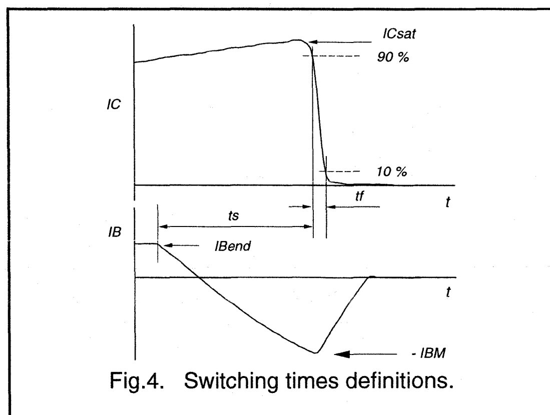


Fig.4. Switching times definitions.

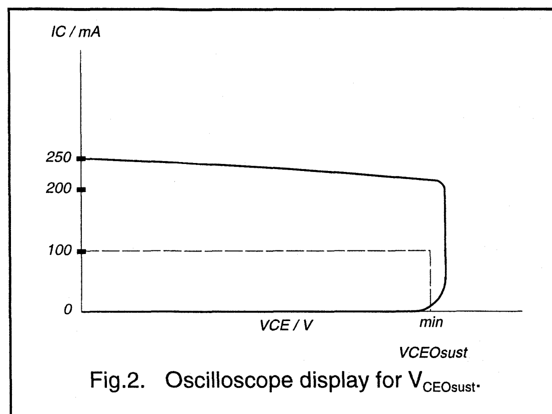


Fig.2. Oscilloscope display for $V_{CEOsust}$.

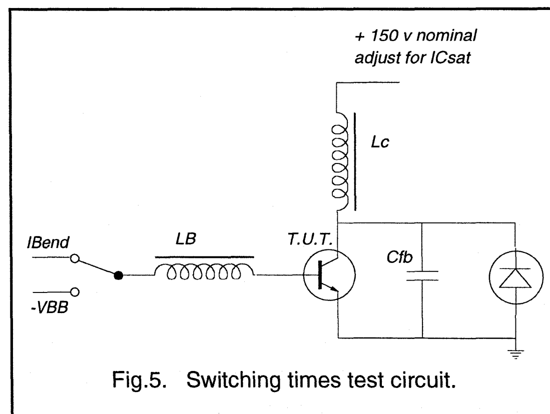


Fig.5. Switching times test circuit.

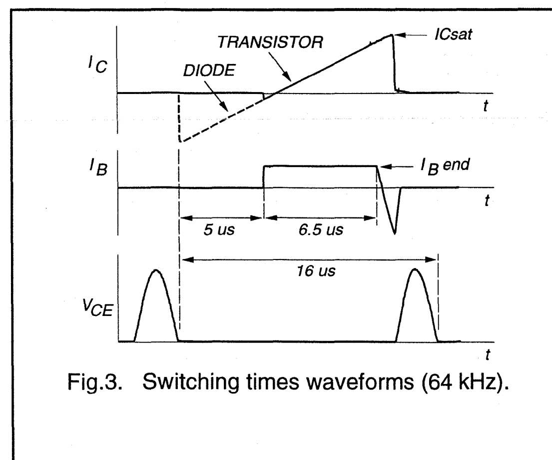


Fig.3. Switching times waveforms (64 kHz).

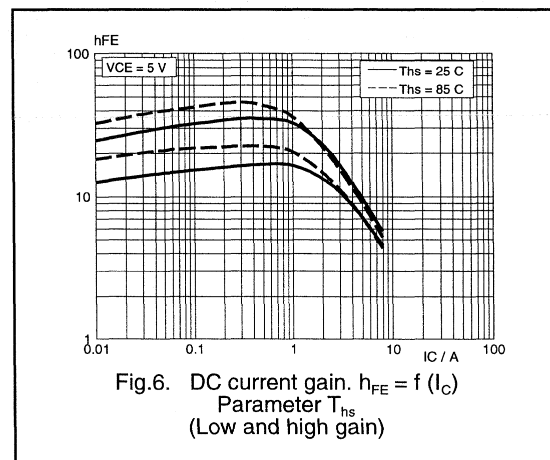


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

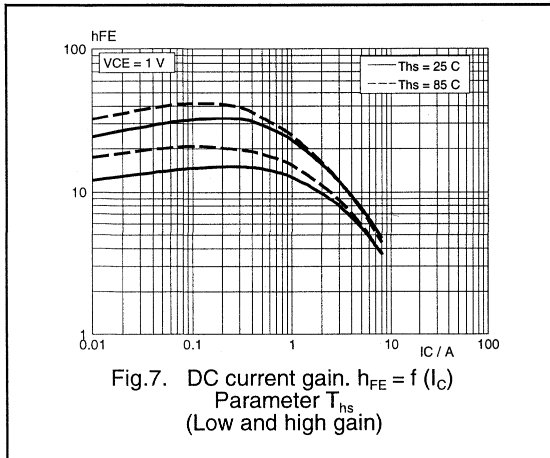


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

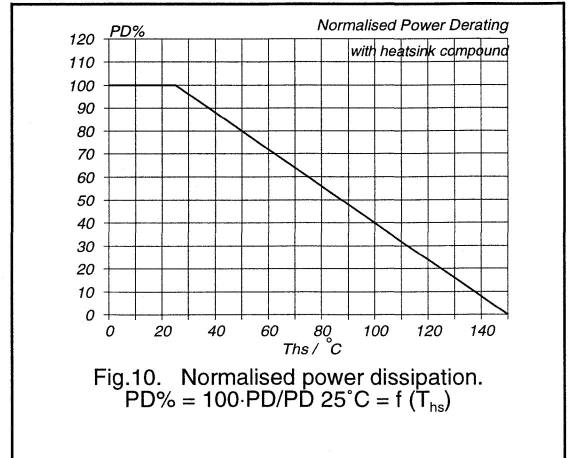


Fig.10. Normalised power dissipation.
PD% = 100·PD/PD 25˚C = f (T_{hs})

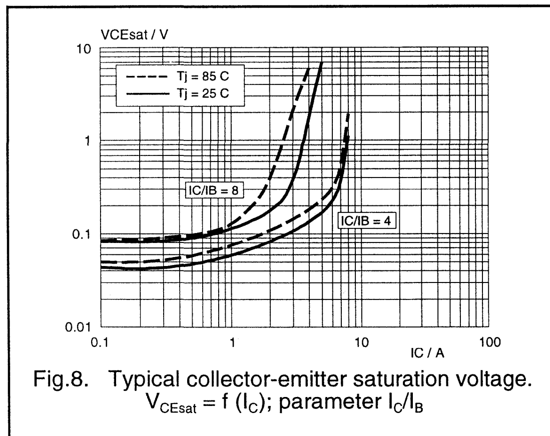


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

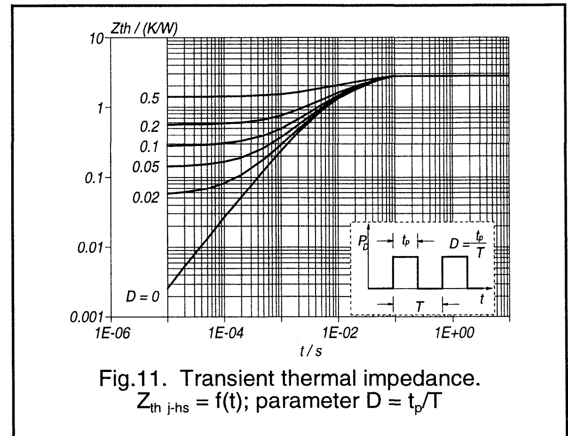


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

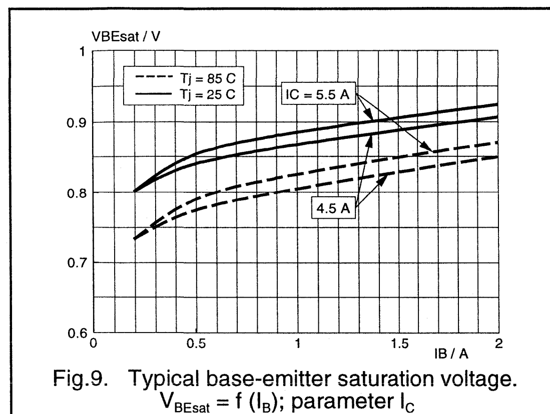


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

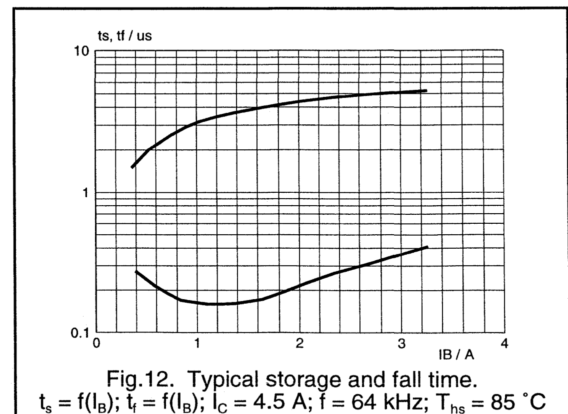


Fig.12. Typical storage and fall time.
$t_s = f(I_B)$; $t_f = f(I_B)$; I_C = 4.5 A; f = 64 kHz; T_{hs} = 85 ˚C

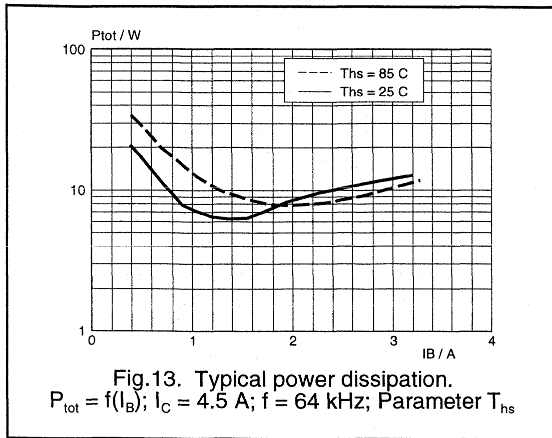


Fig.13. Typical power dissipation.
$P_{tot} = f(I_B)$; $I_C = 4.5$ A; f = 64 kHz; Parameter T_{hs}

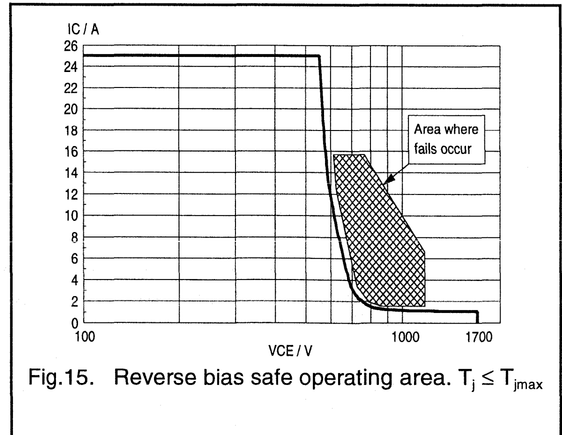


Fig.15. Reverse bias safe operating area. $T_j \leq T_{jmax}$

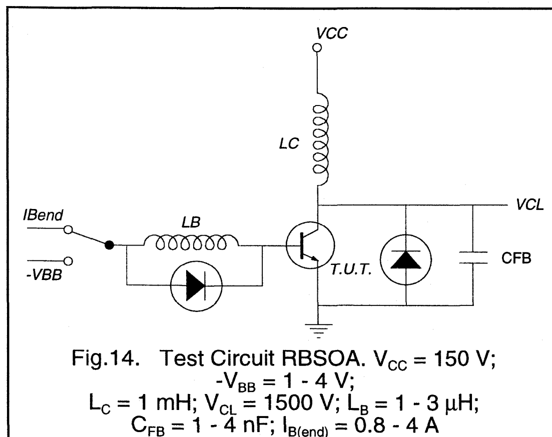


Fig.14. Test Circuit RBSOA. $V_{CC} = 150$ V;
$-V_{BB} = 1 - 4$ V;
$L_C = 1$ mH; $V_{CL} = 1500$ V; $L_B = 1 - 3$ µH;
$C_{FB} = 1 - 4$ nF; $I_{B(end)} = 0.8 - 4$ A

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. Designed to withstand V_{CES} pulses up to 1700V.

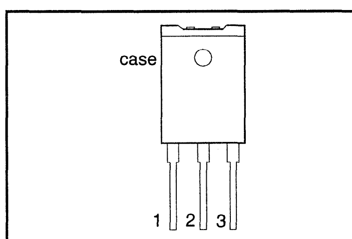
QUICK REFERENCE DATA

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 = 7.0 A; I_B = 1.75 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	7.0	-	A
t_s	Storage time	I_{Csat} = 7.0 A; f = 16 kHz	5.8	6.5	µs

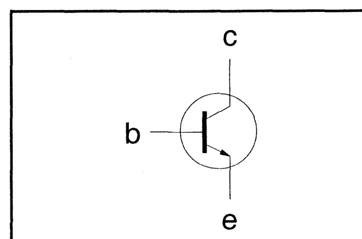
PINNING - SOT199

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)		-	12	A
I_{CM}	Collector current peak value		-	30	A
I_B	Base current (DC)		-	12	A
I_{BM}	Base current peak value		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	9	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	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 7.0 A; I_B = 1.75 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 7.0 A; I_B = 1.75 A	-	-	1.1	V
h_{FE}	DC current gain	I_C = 0.1 A; V_{CE} = 5 V	-	22	-	
h_{FE}		I_C = 7 A; V_{CE} = 1 V	4	6	8.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 7.0 A; L_C = 650 µH; C_{fb} = 18 nF; V_{CC} = 162 V; $I_{B(end)}$ = 1.5 A; L_B = 2 µH; $-V_{BB}$ = 4 V;			
t_s	Turn-off storage time		5.8	6.5	µs
t_f	Turn-off fall time		0.6	0.8	µs

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

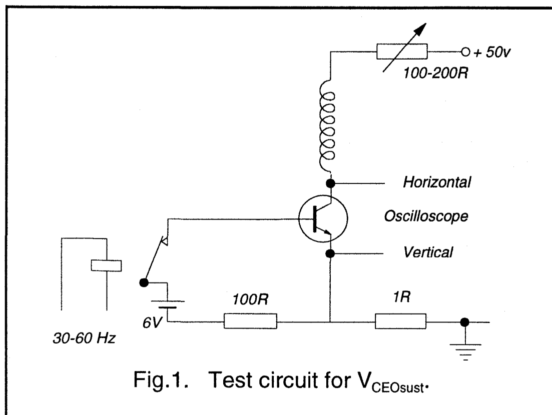


Fig.1. Test circuit for $V_{CEOsust}$.

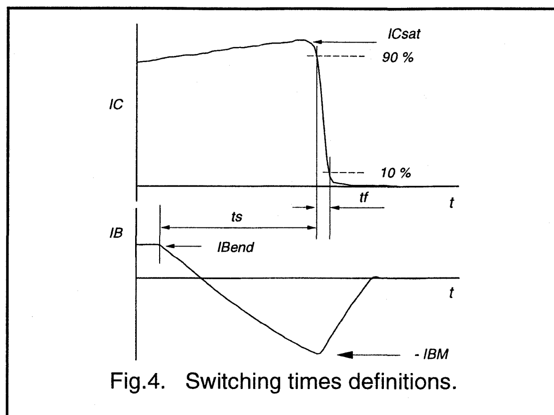


Fig.4. Switching times definitions.

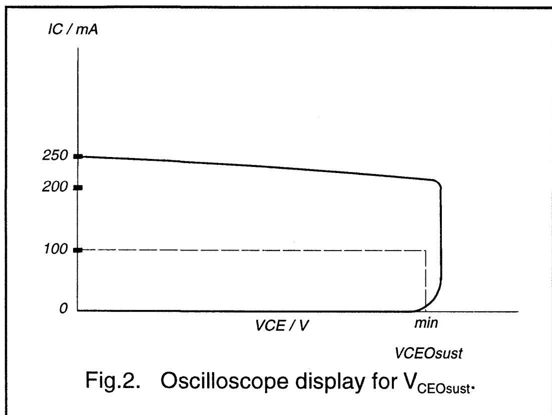


Fig.2. Oscilloscope display for $V_{CEOsust}$.

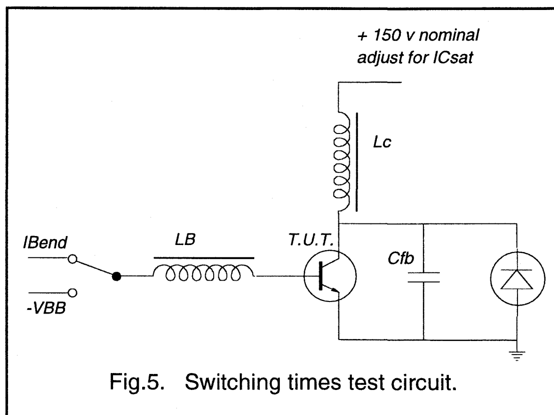


Fig.5. Switching times test circuit.

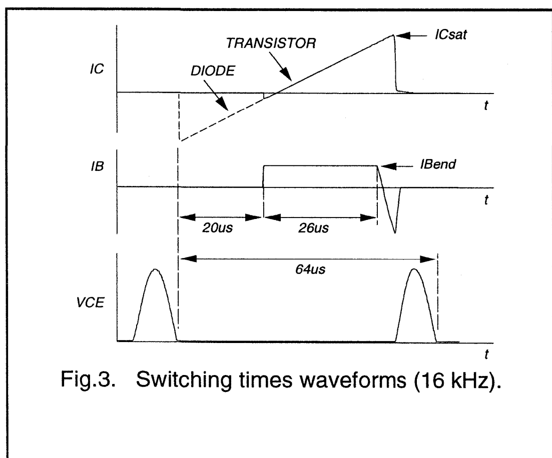


Fig.3. Switching times waveforms (16 kHz).

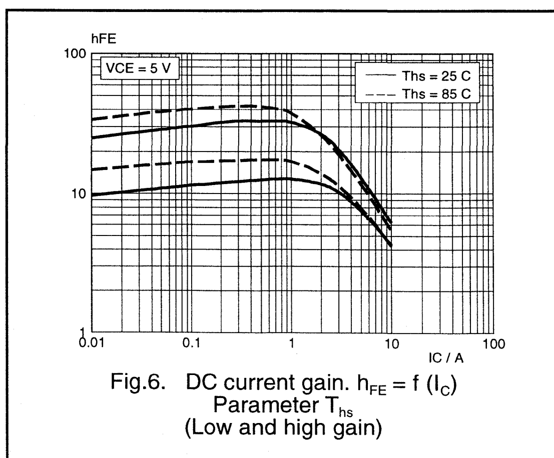


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

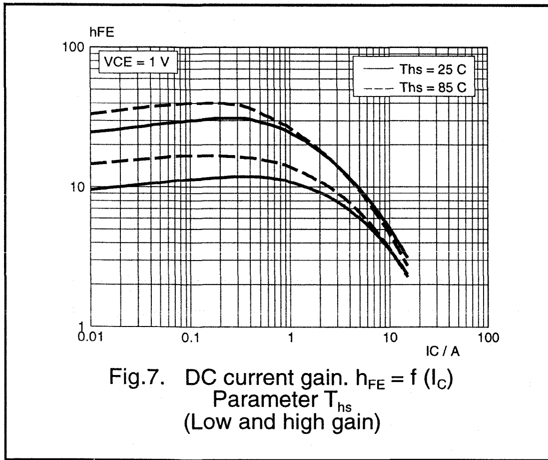


Fig.7. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

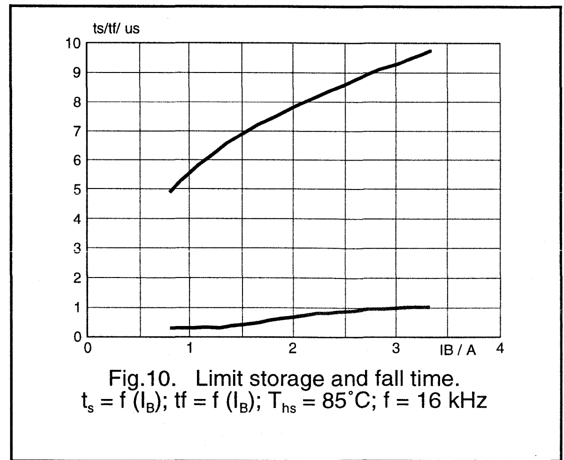


Fig.10. Limit storage and fall time.
$t_s = f(I_B)$; $tf = f(I_B)$; $T_{hs} = 85^{\circ}C$; f = 16 kHz

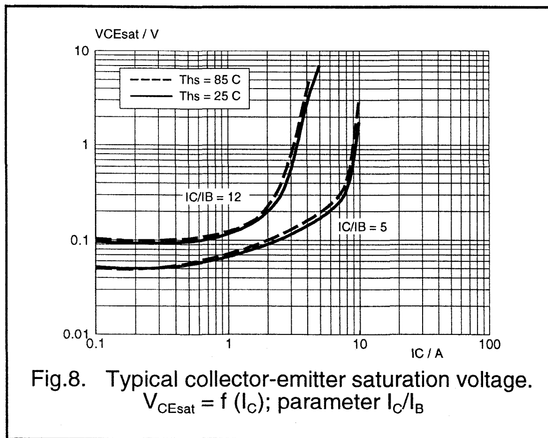


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

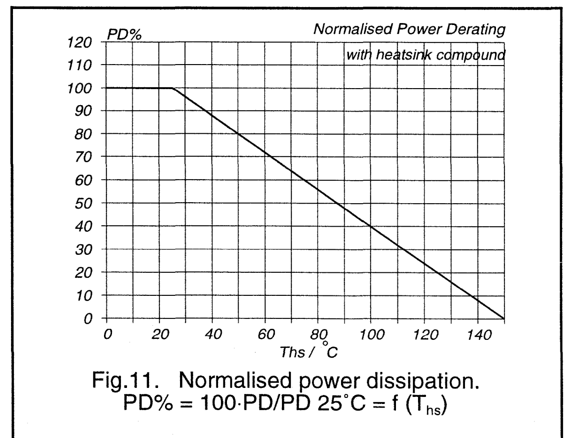


Fig.11. Normalised power dissipation.
PD% = 100·PD/PD 25°C = f (T_{hs})

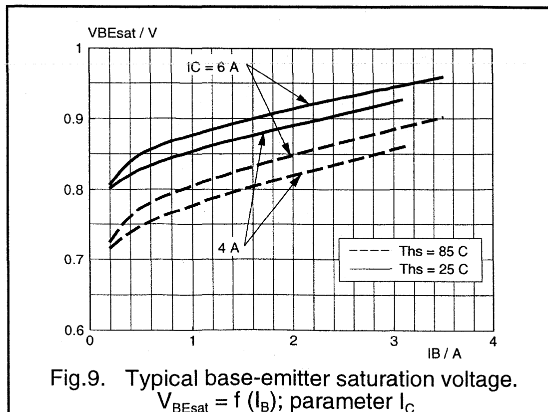


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

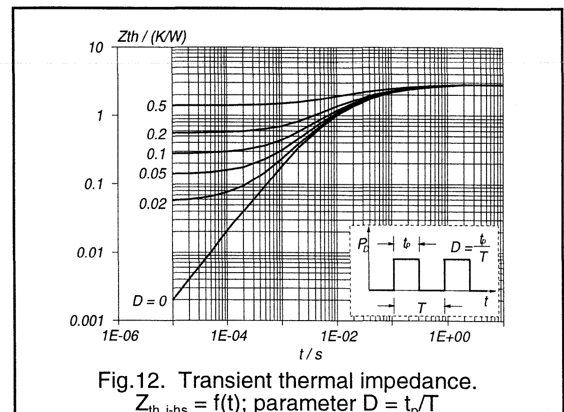


Fig.12. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

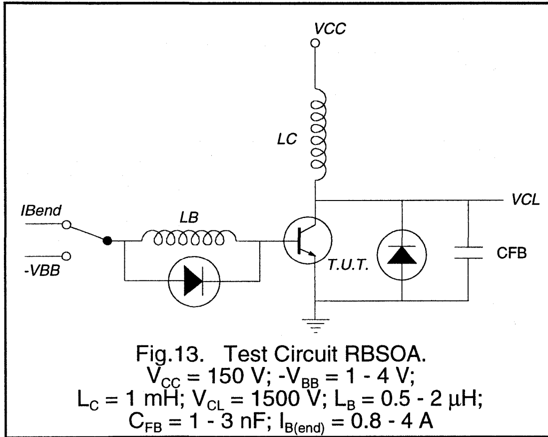


Fig.13. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 µH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

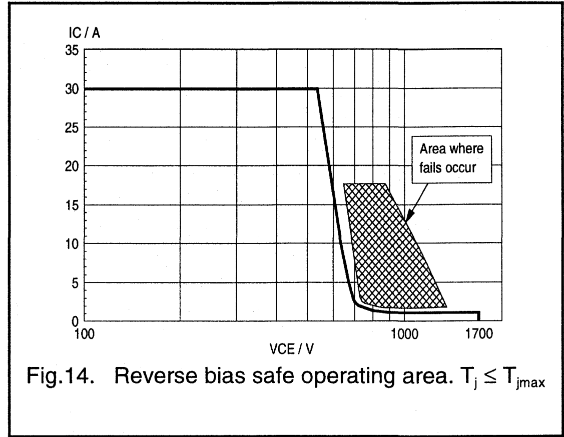


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

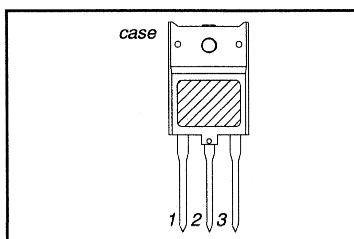
QUICK REFERENCE DATA

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 = 7.0 A; I_B = 1.75 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	7.0	-	A
t_s	Storage time	I_{Csat} = 7.0 A; f = 16kHz	5.8	6.5	µs

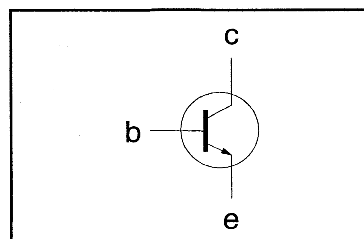
PINNING - SOT399

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	-	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		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	9	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	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 7.0$ A; $I_B = 1.75$ A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	$I_C = 7.0$ A; $I_B = 1.75$ A	-	-	1.1	V
h_{FE}	DC current gain	$I_C = 0.1$ A; $V_{CE} = 5$ V	-	22	-	
h_{FE}		$I_C = 7$ A; $V_{CE} = 1$ V	4	6	8.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (16 kHz line deflection circuit)	$I_{Csat} = 7.0$ A; $L_C = 650$ µH; $C_{fb} = 18$ nF; $V_{CC} = 162$ V; $I_{B(end)} = 1.5$ A; $L_B = 2$ µH; $-V_{BB} = 4$ V;			
t_s	Turn-off storage time		5.8	6.5	µs
t_f	Turn-off fall time		0.6	0.8	µs

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

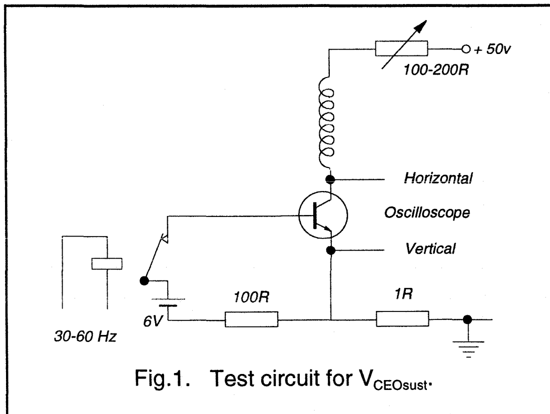


Fig.1. Test circuit for $V_{CEOsust}$.

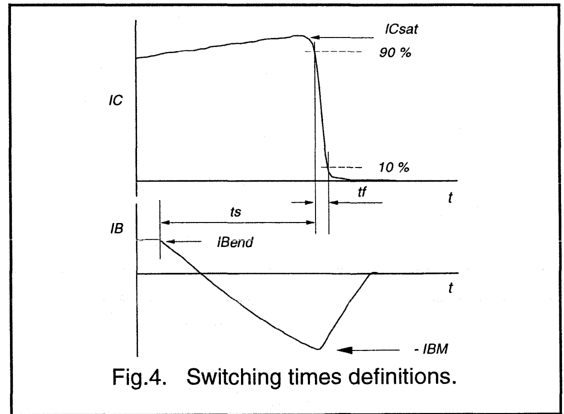


Fig.4. Switching times definitions.

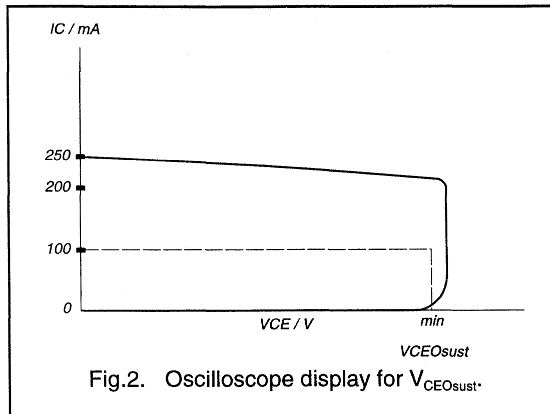


Fig.2. Oscilloscope display for $V_{CEOsust}$.

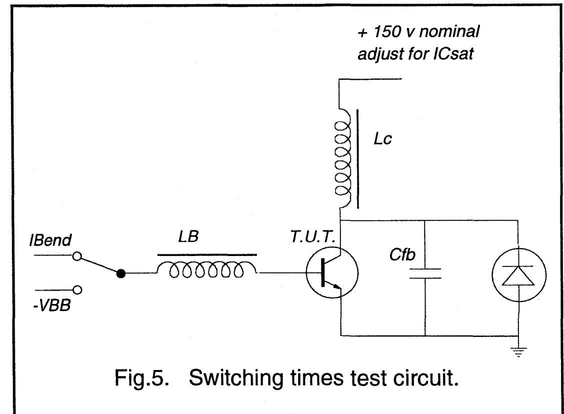


Fig.5. Switching times test circuit.

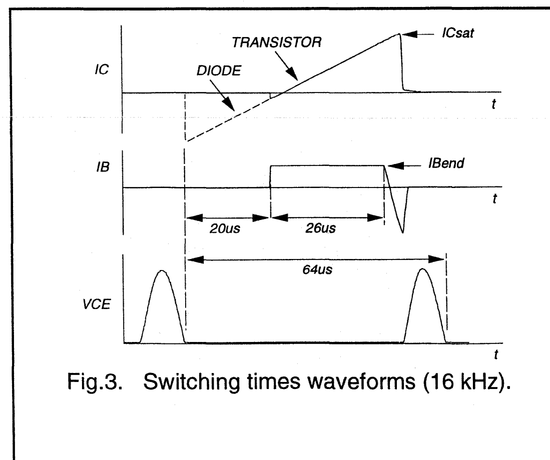


Fig.3. Switching times waveforms (16 kHz).

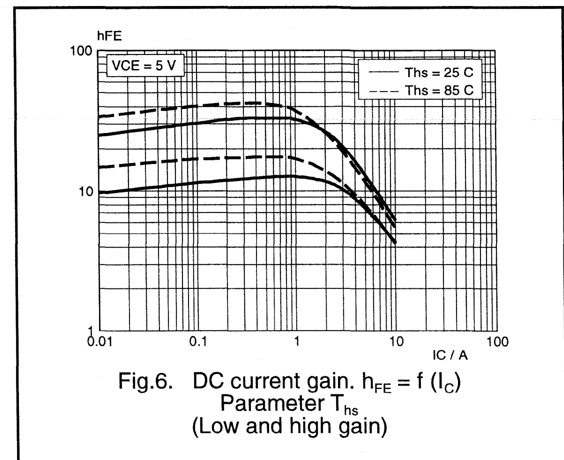


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

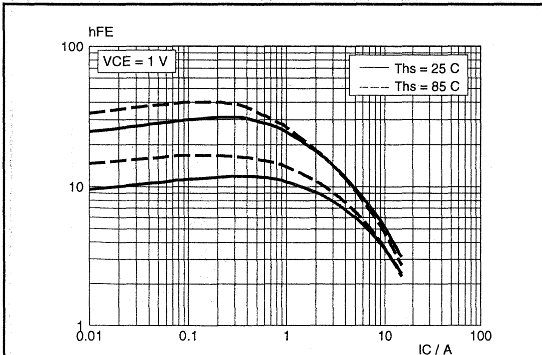


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

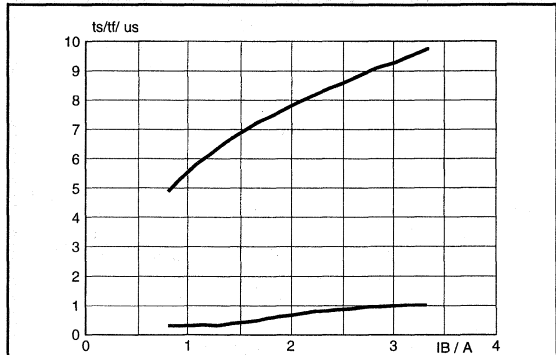


Fig.10. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; $T_{hs} = 85^{\circ}C$; $f = 16$ kHz

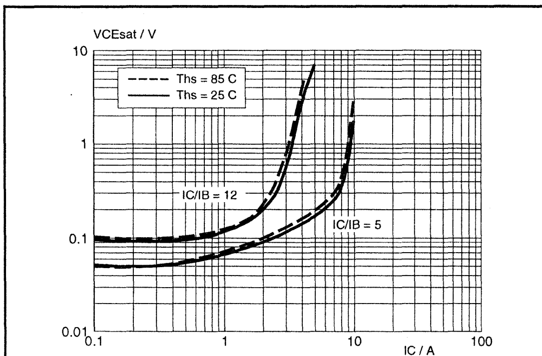


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

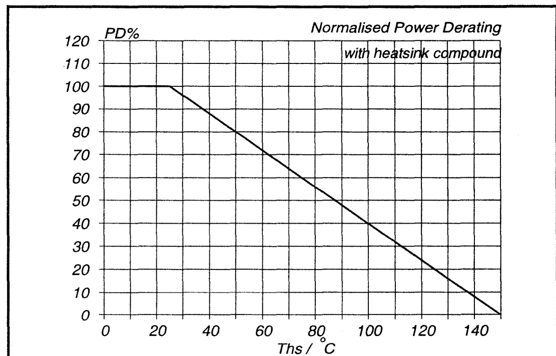


Fig.11. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD\ 25^{\circ}C = f\ (T_{hs})$

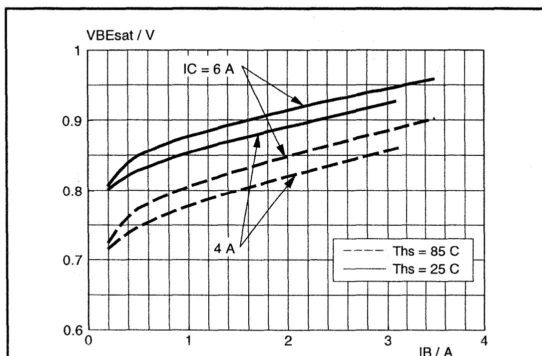


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

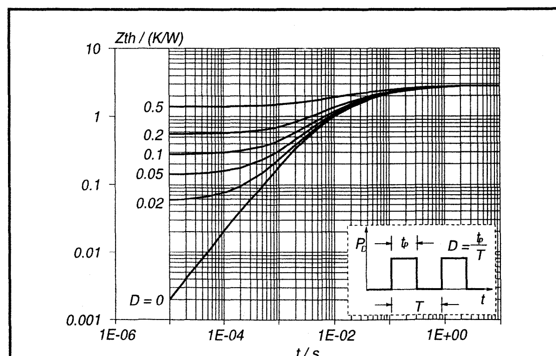


Fig.12. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

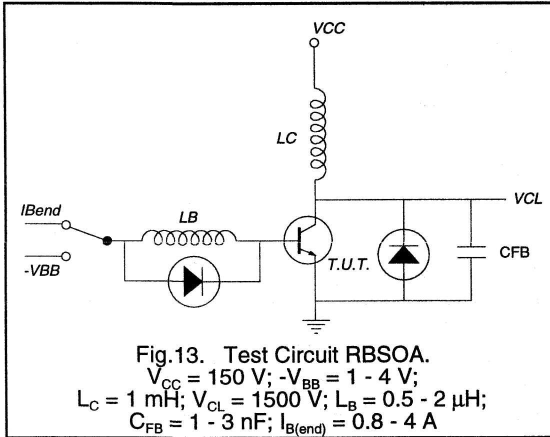


Fig.13. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 µH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

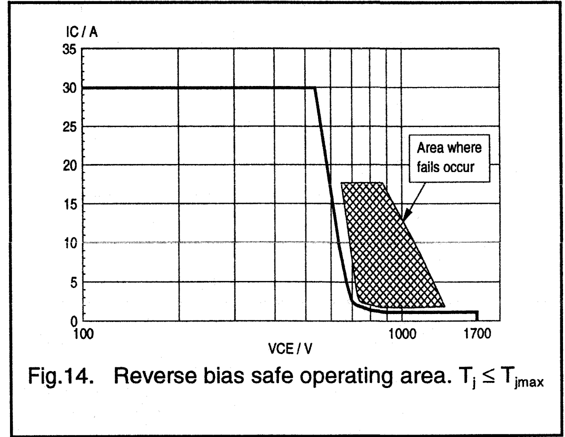


Fig.14. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

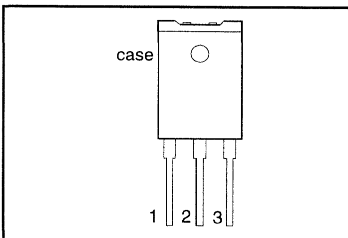
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
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 = 7.0 A; I_B = 1.75 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	7.0	-	A
t_s	Storage time	I_{Csat} = 7.0 A; f = 16 kHz	1.5	2	µs

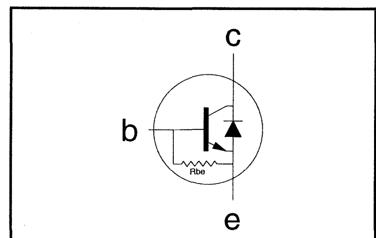
PINNING - SOT199

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
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		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	9	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	-	110	-	mA
B_{VEBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
R_{EB}	Base-emitter resistance	V_{EB} = 7.5 V		70		Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 7.0 A; I_B = 1.75 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 7.0 A; I_B = 1.75 A	0.78	0.86	0.95	V
V_F	Diode forward voltage	I_F = 7 A		1.4	2.2	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	19	-	
h_{FE}		I_C = 7 A; V_{CE} = 1 V	3.8	5.8	7.8	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 7.0 A; L_C = 650 µH; C_{fb} = 18 nF; V_{CC} = 162 V; $I_{B(end)}$ = 1.3 A; L_B = 2 µH; $-V_{BB}$ = 4 V;			
t_s	Turn-off storage time		1.5	2	µs
t_f	Turn-off fall time		0.14	0.3	µs

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

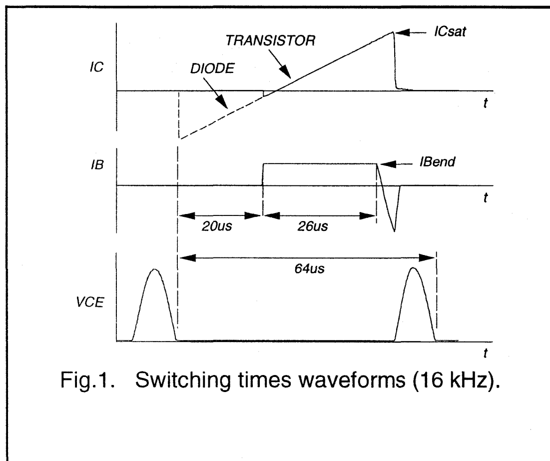


Fig.1. Switching times waveforms (16 kHz).

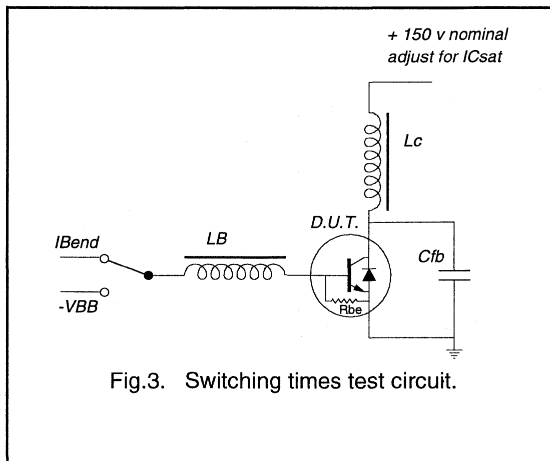


Fig.3. Switching times test circuit.

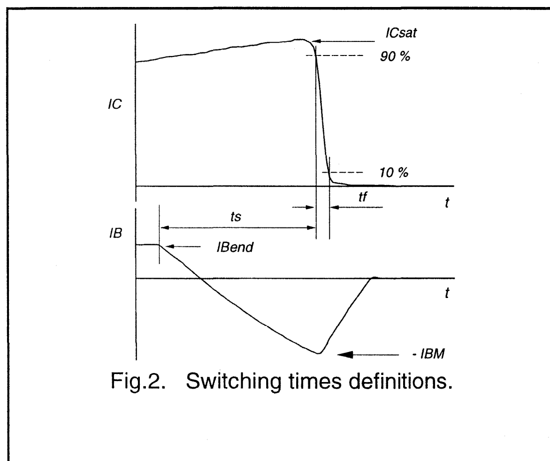


Fig.2. Switching times definitions.

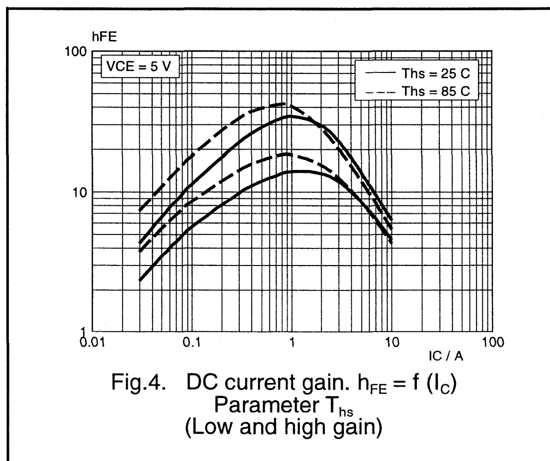


Fig.4. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

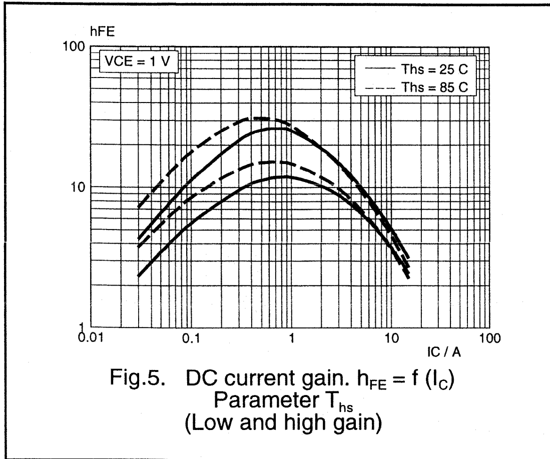


Fig.5. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

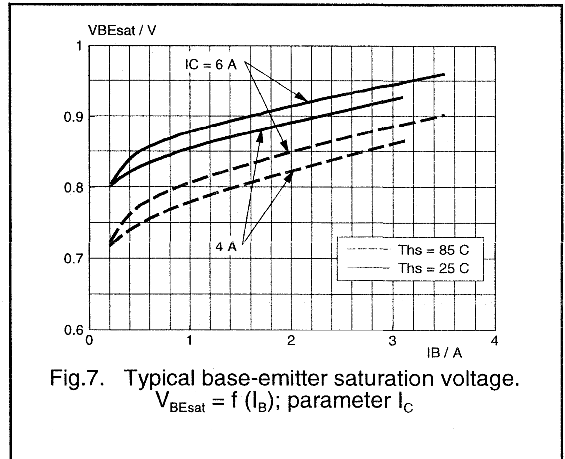


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

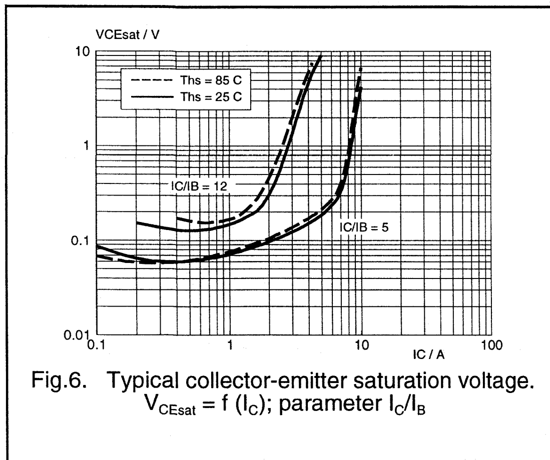


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

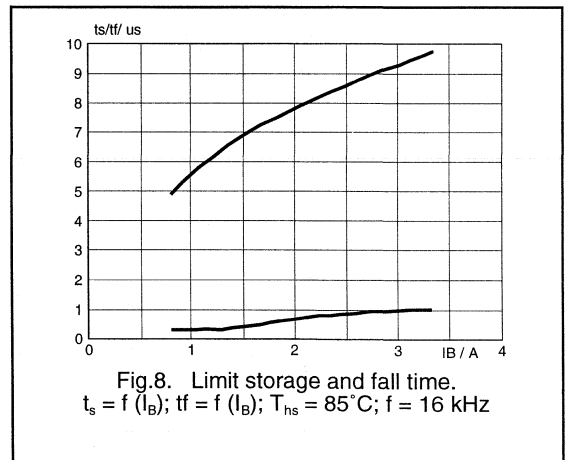


Fig.8. Limit storage and fall time.
$t_s = f\ (I_B)$; $tf = f\ (I_B)$; $T_{hs} = 85°C$; $f = 16$ kHz

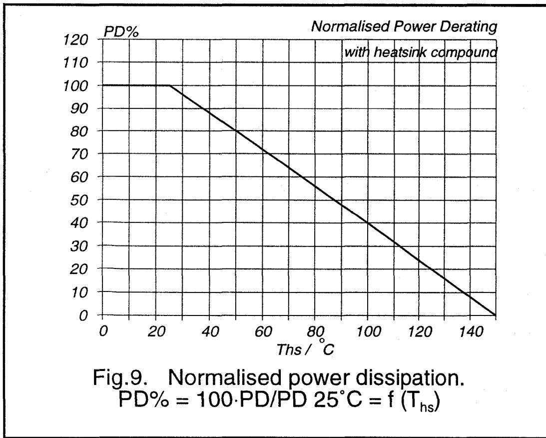


Fig.9. Normalised power dissipation.
PD% = 100·PD/PD 25˚C = f (T_{hs})

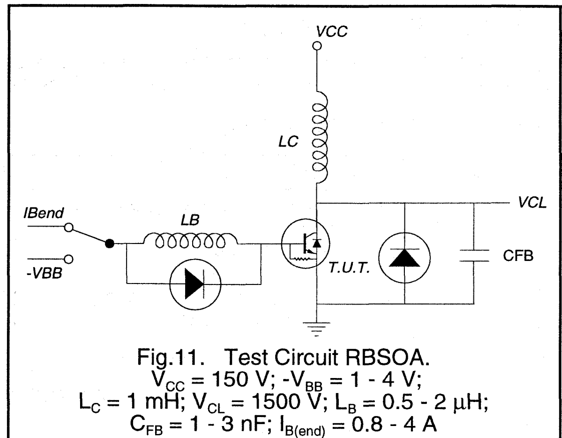


Fig.11. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 µH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

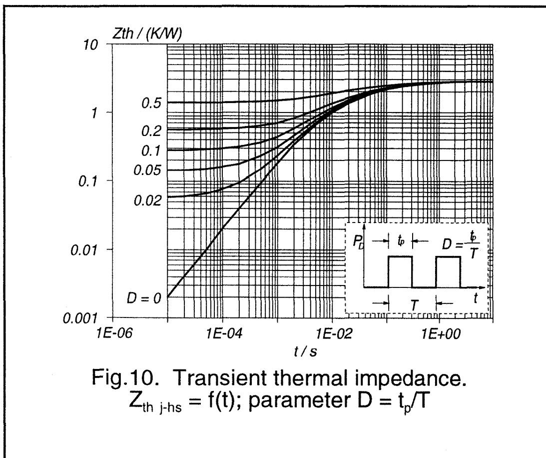


Fig.10. Transient thermal impedance.
$Z_{th\ j\text{-}hs}$ = f(t); parameter D = t_p/T

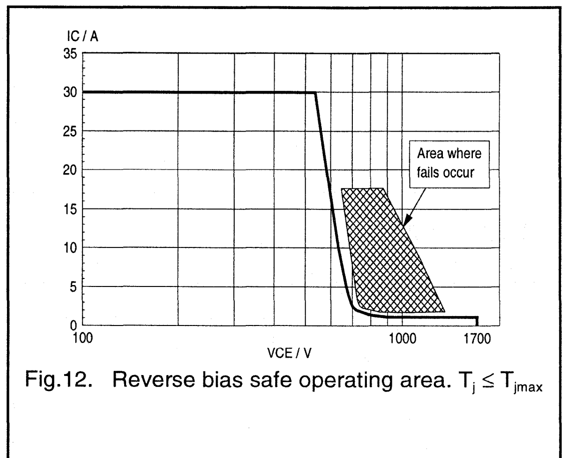


Fig.12. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

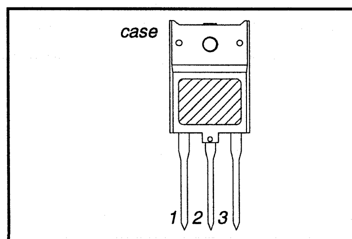
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	-	1700	V
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 = 7.0 A; I_B = 1.75 A	-	1.0	V
I_{Csat}	Collector saturation current	f = 16 kHz	7.0	-	A
t_s	Storage time	I_{Csat} = 7.0 A; f = 16kHz	1.5	2	µs

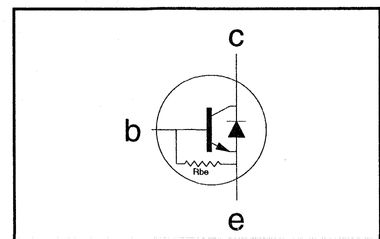
PINNING - SOT399

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	-	1700	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		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	9	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	-	110	-	mA
B_{VEBO}	Emitter-base breakdown voltage	I_B = 1 mA	7.5	13.5	-	V
R_{EB}	Base-emitter resistance	V_{EB} = 7.5 V		70		Ω
V_{CEsat}	Collector-emitter saturation voltage	I_C = 7.0 A; I_B = 1.75 A	-	-	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 7.0 A; I_B = 1.75 A	0.78	0.86	0.95	V
V_F	Diode forward voltage	I_F = 7 A		1.4	2.2	V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	19	-	
h_{FE}		I_C = 7 A; V_{CE} = 1 V	3.8	5.8	7.8	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (16 kHz line deflection circuit)	I_{Csat} = 7.0 A; L_C = 650 µH; C_{fb} = 18 nF; V_{CC} = 162 V; $I_{B(end)}$ = 1.3 A; L_B = 2 µH; $-V_{BB}$ = 4 V;			
t_s	Turn-off storage time		1.5	2	µs
t_f	Turn-off fall time		0.14	0.3	µs

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

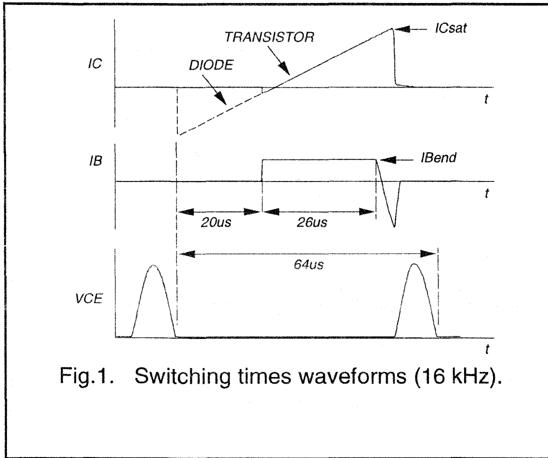


Fig.1. Switching times waveforms (16 kHz).

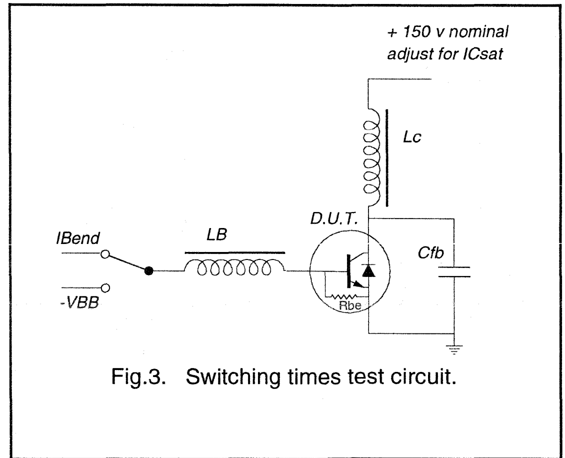


Fig.3. Switching times test circuit.

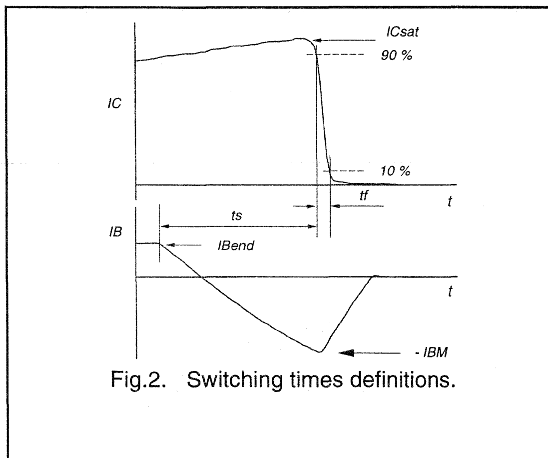


Fig.2. Switching times definitions.

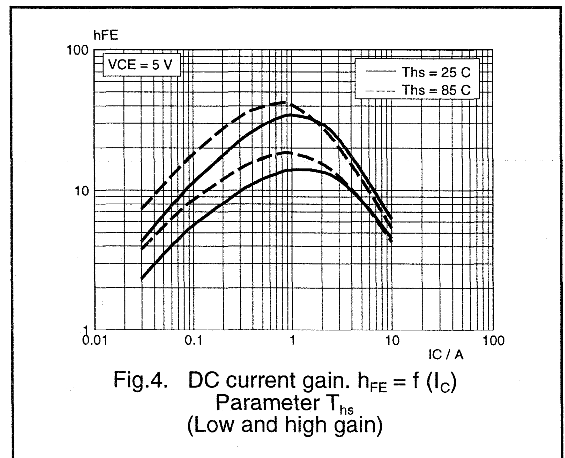


Fig.4. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

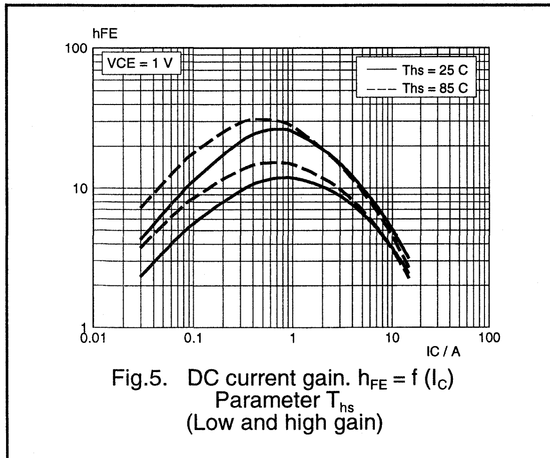


Fig.5. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

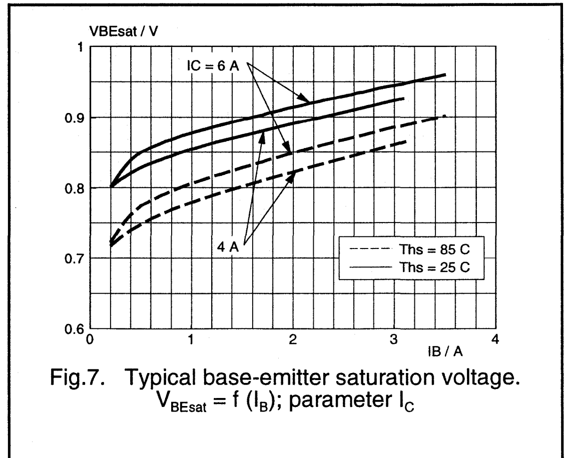


Fig.7. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

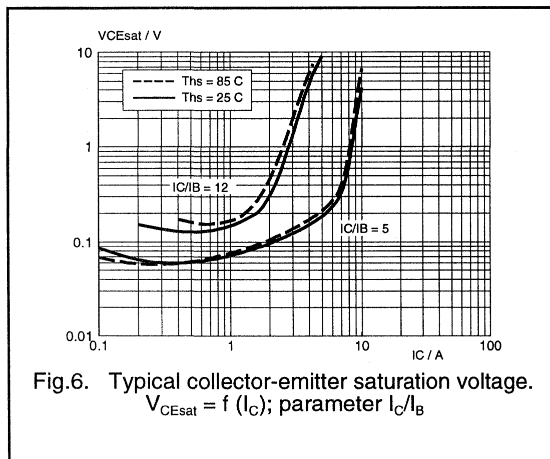


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

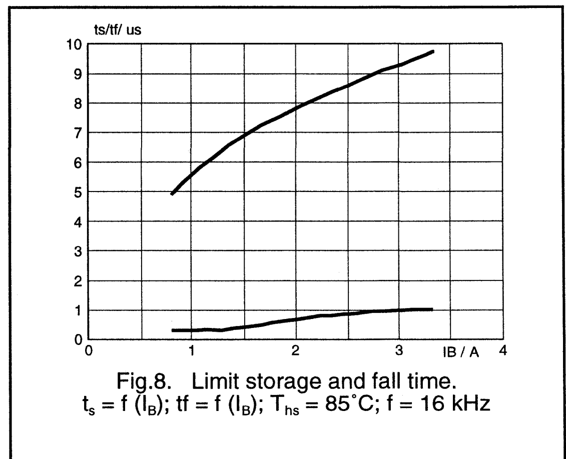


Fig.8. Limit storage and fall time.
$t_s = f(I_B)$; tf = f (I_B); T_{hs} = 85˚C; f = 16 kHz

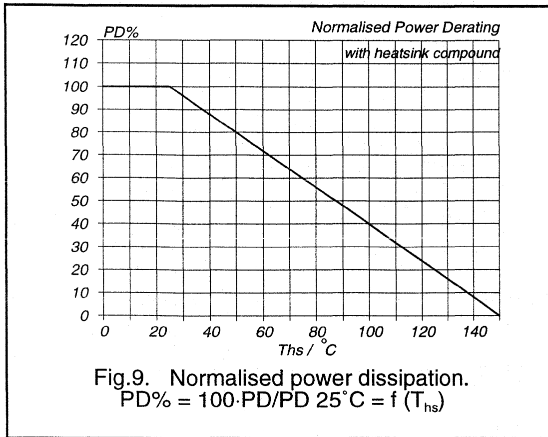


Fig.9. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{hs})$

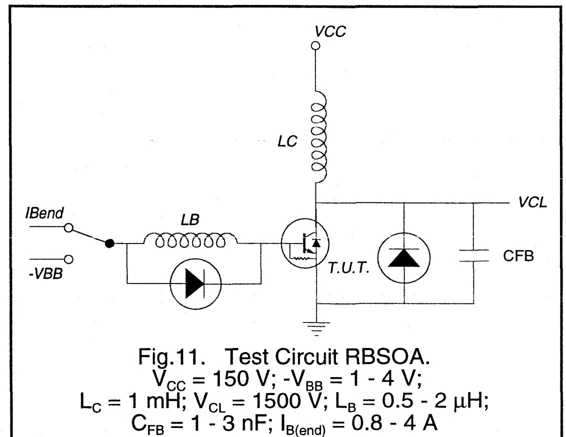


Fig.11. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 μH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

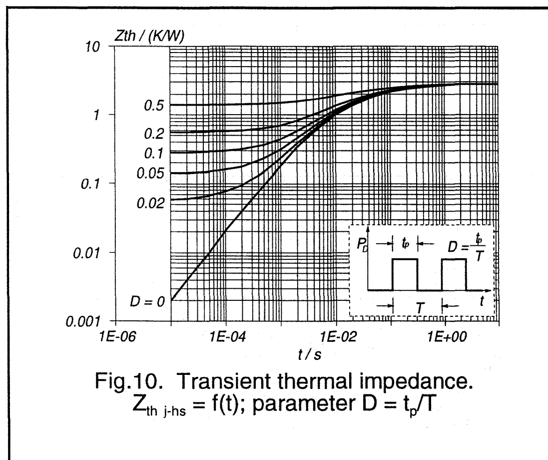


Fig.10. Transient thermal impedance.
$Z_{th\ j-hs} = f(t)$; parameter $D = t_p/T$

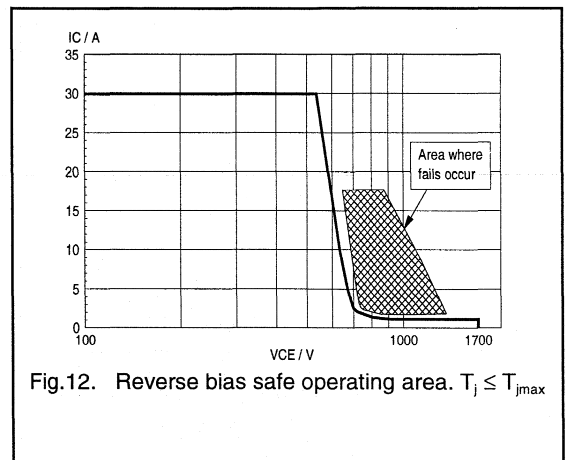


Fig.12. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

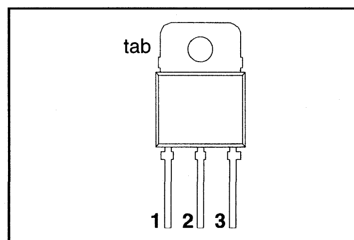
QUICK REFERENCE DATA

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

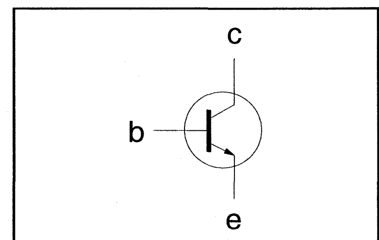
PINNING - SOT93

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

Preliminary specification
See Philips Semiconductors for Design-in information

1 Turn-off current.

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

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

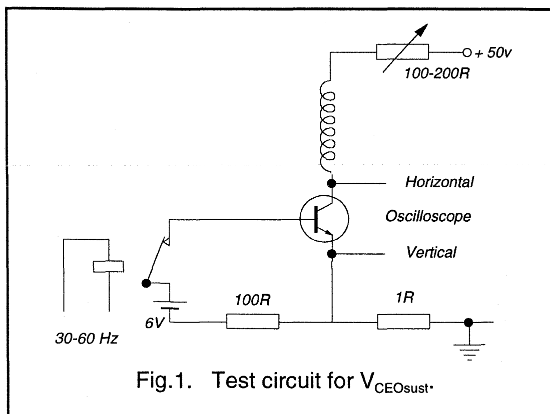


Fig.1. Test circuit for $V_{CEOsust}$.

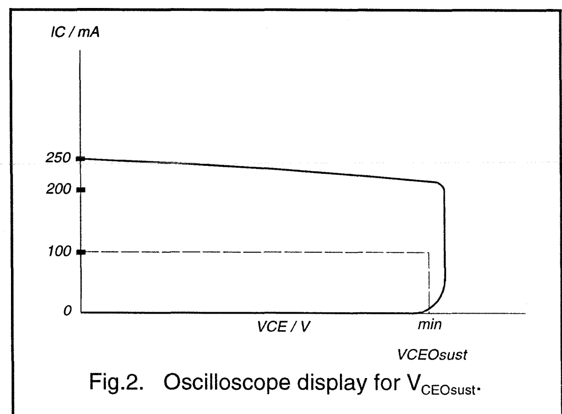


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

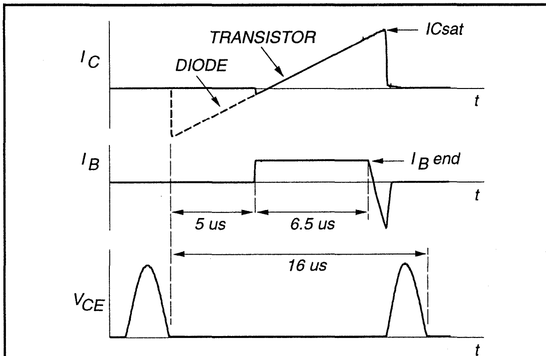


Fig.3. Switching times waveforms (64 kHz).

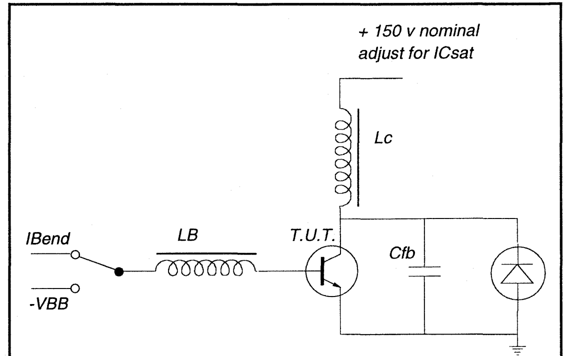


Fig.5. Switching times test circuit.

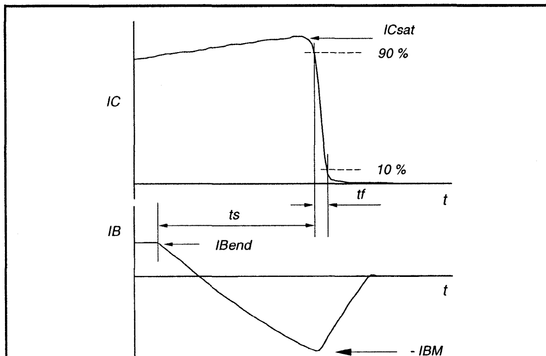


Fig.4. Switching times definitions.

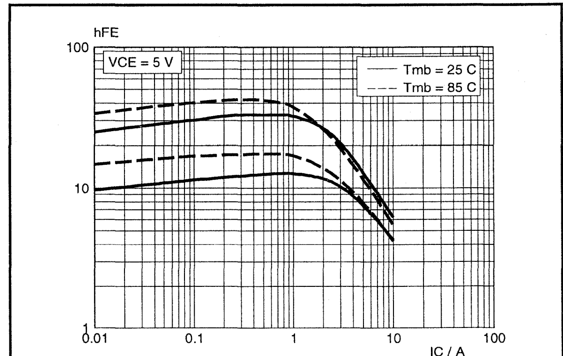


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{mb}
(Low and high gain)

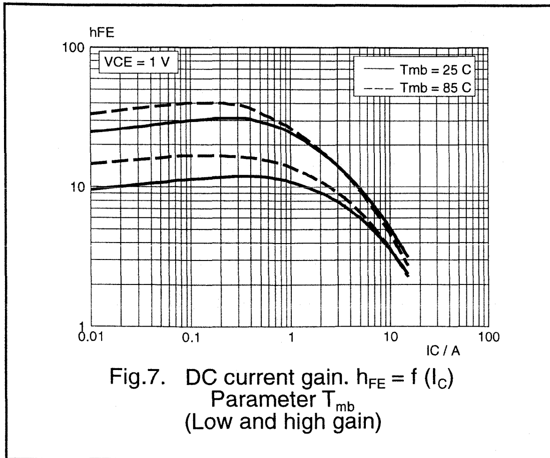


Fig.7. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{mb}
(Low and high gain)

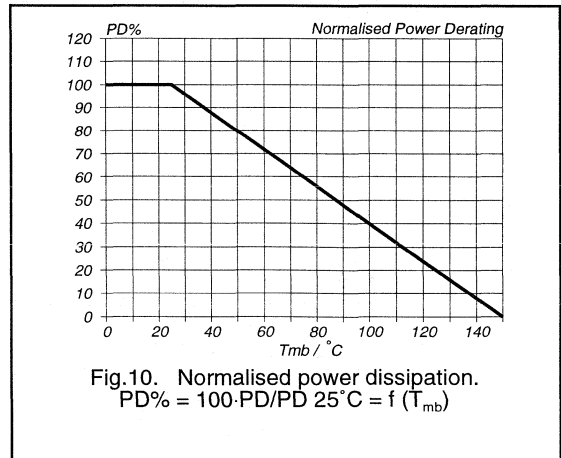


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{mb})$

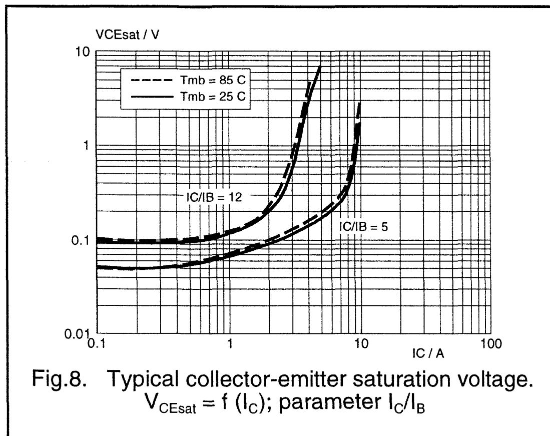


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

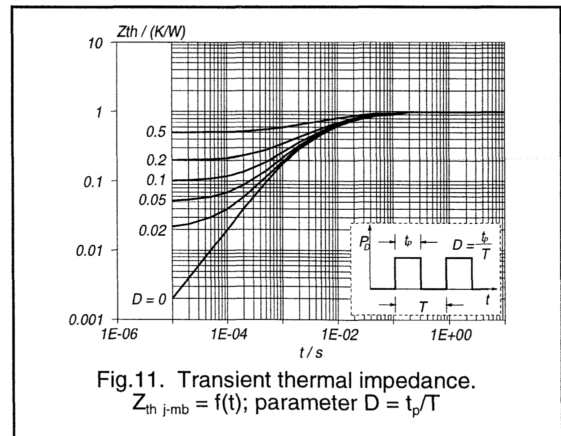


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

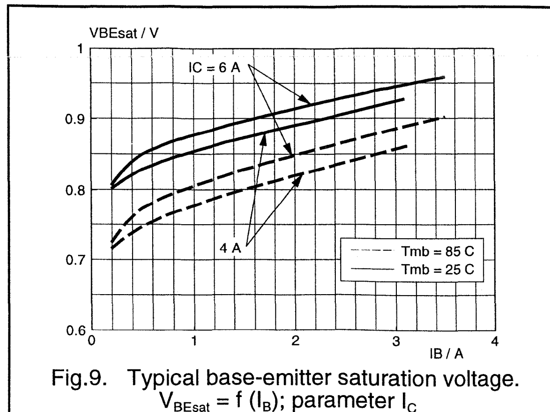


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

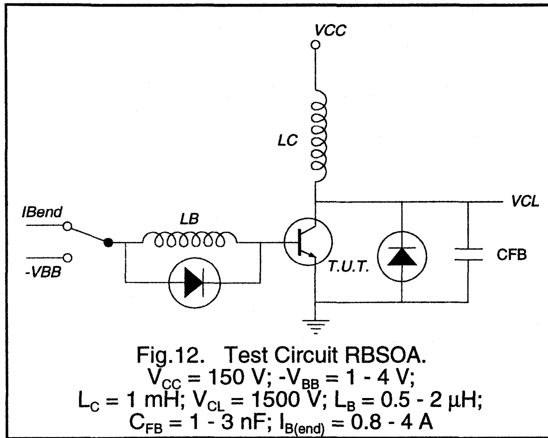


Fig.12. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 µH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

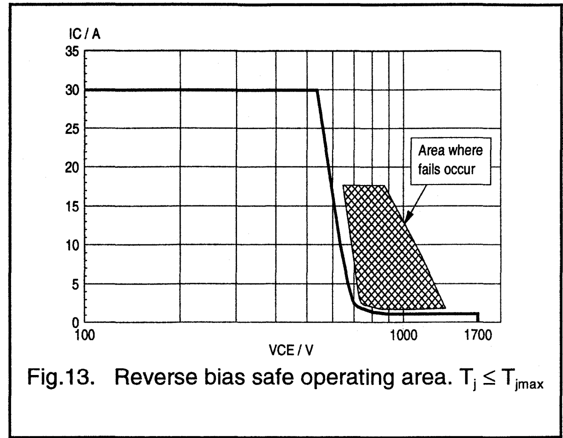


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

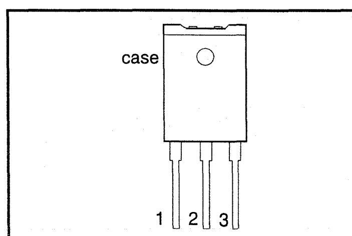
QUICK REFERENCE DATA

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	f = 64 kHz	5.0	-	A
t_s	Storage time	I_{Csat} = 5.0 A; f = 64 kHz	2.5	3.0	µs

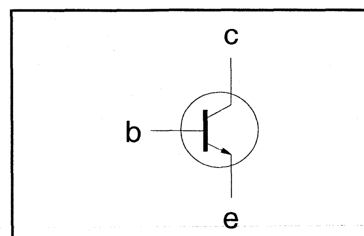
PINNING - SOT199

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	-	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
$R_{th\ j\text{-}hs}$	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	-	-	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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 0.1 A; V_{CE} = 5 V	-	22	-	
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_{Csat} = 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		2.5	3.0	µs
t_f	Turn-off fall time		0.30	0.39	µs

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

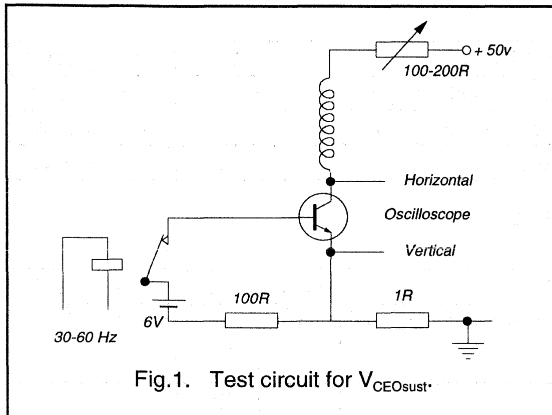


Fig.1. Test circuit for $V_{CEOsust}$.

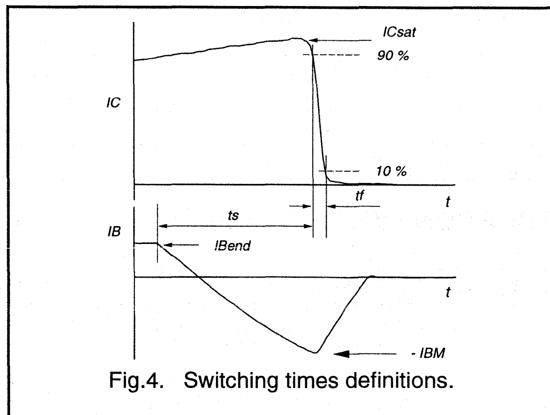


Fig.4. Switching times definitions.

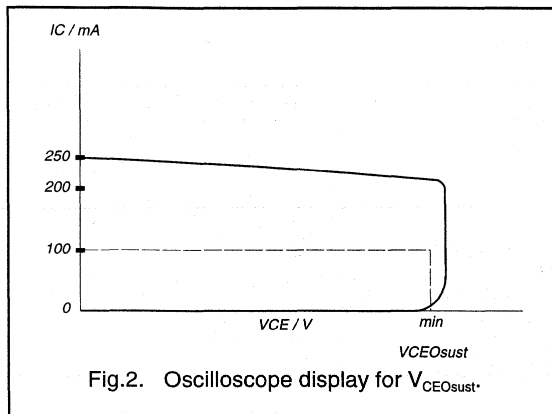


Fig.2. Oscilloscope display for $V_{CEOsust}$.

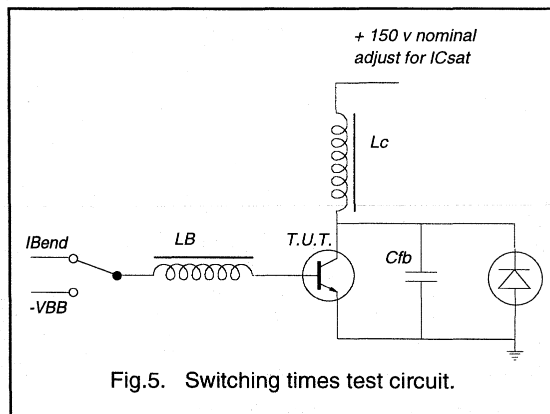


Fig.5. Switching times test circuit.

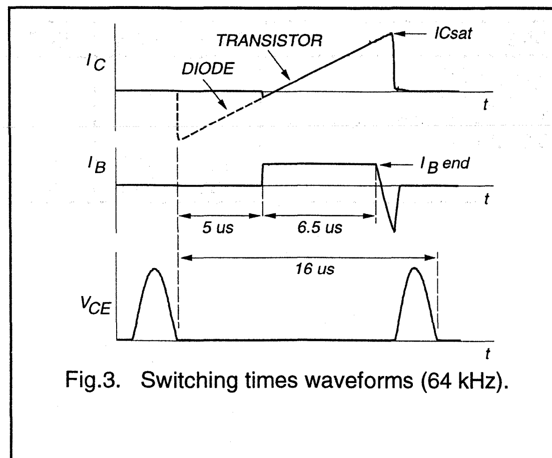


Fig.3. Switching times waveforms (64 kHz).

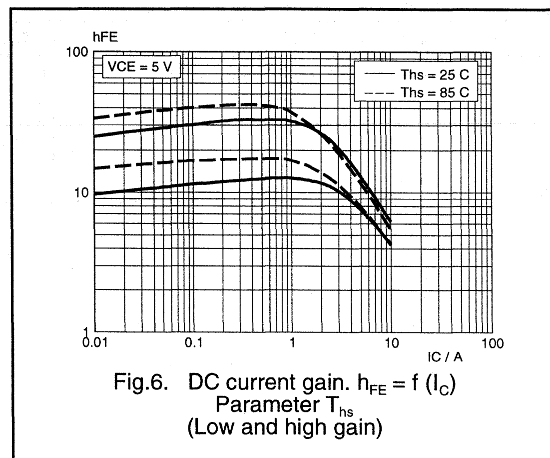


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

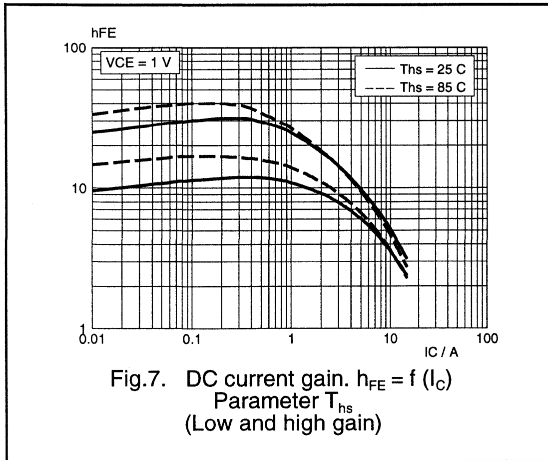


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

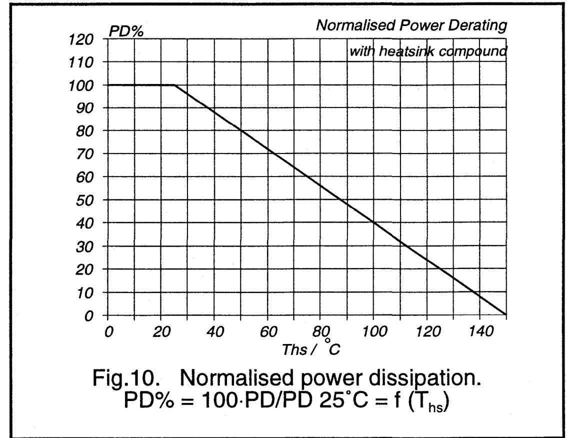


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f\ (T_{hs})$

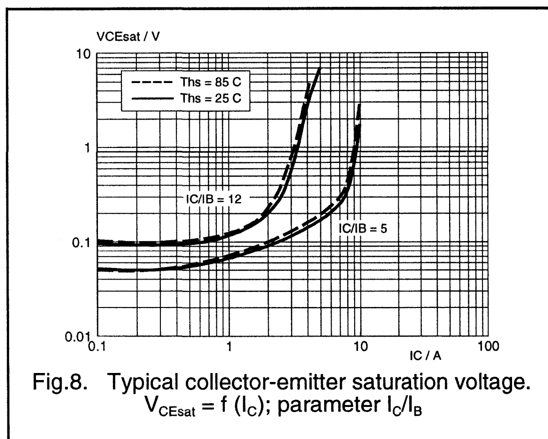


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

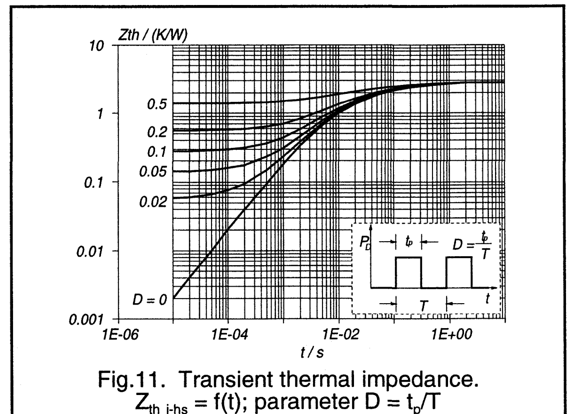


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

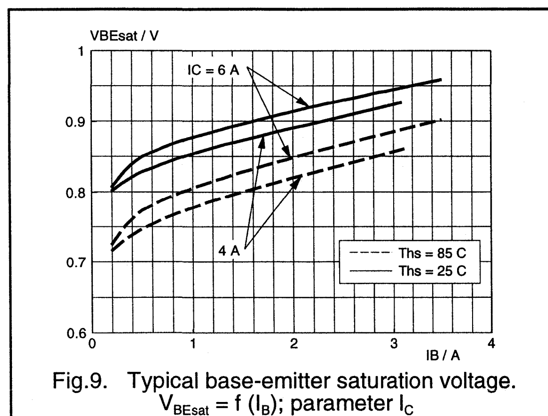


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

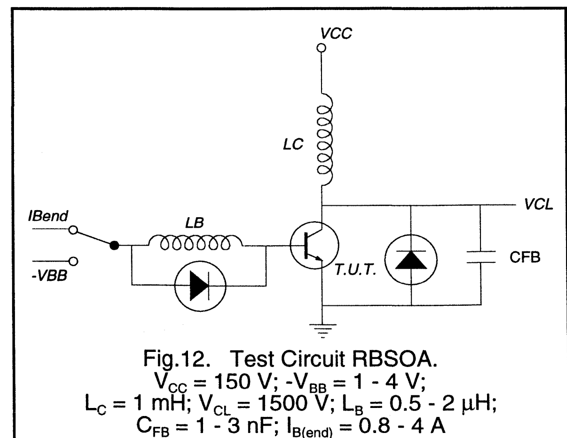


Fig.12. Test Circuit RBSOA.
$V_{CC} = 150$ V; $-V_{BB} = 1 - 4$ V;
$L_C = 1$ mH; $V_{CL} = 1500$ V; $L_B = 0.5 - 2$ µH;
$C_{FB} = 1 - 3$ nF; $I_{B(end)} = 0.8 - 4$ A

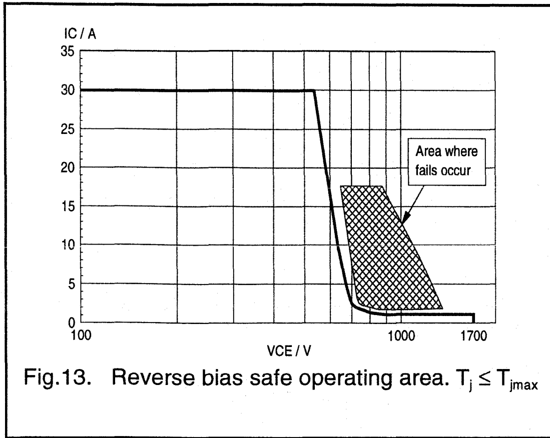


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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.

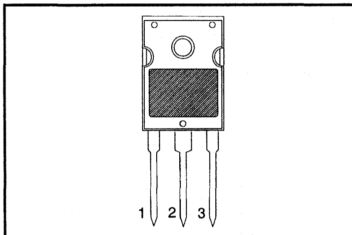
QUICK REFERENCE DATA

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

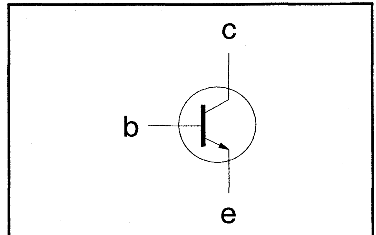
PINNING - SOT429

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

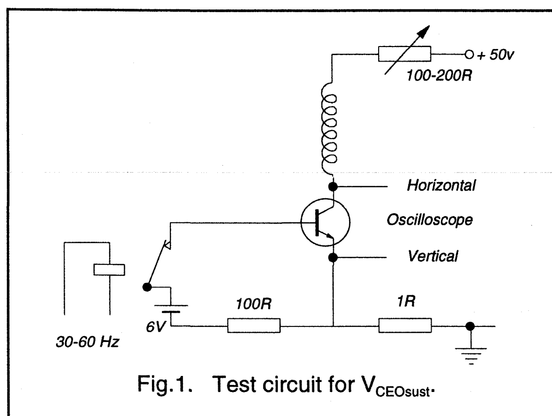


Fig.1. Test circuit for $V_{CEOsust}$.

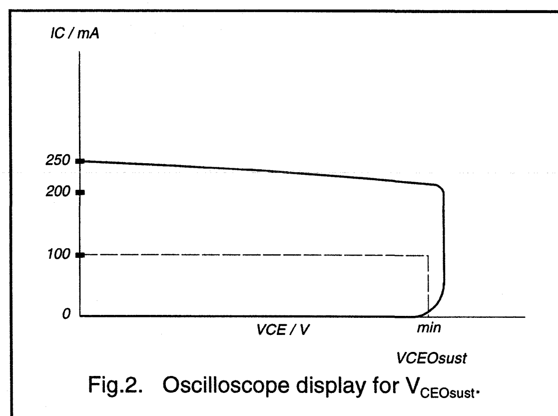


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

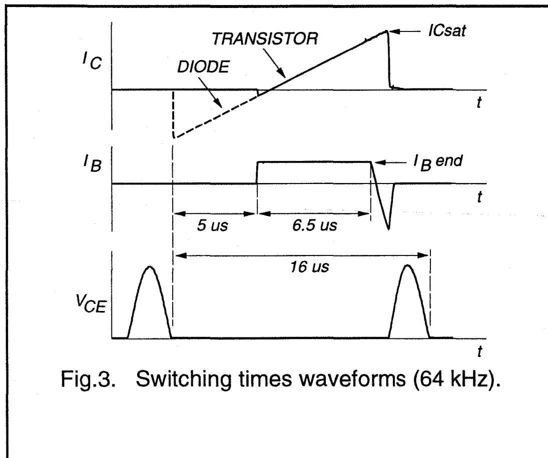


Fig.3. Switching times waveforms (64 kHz).

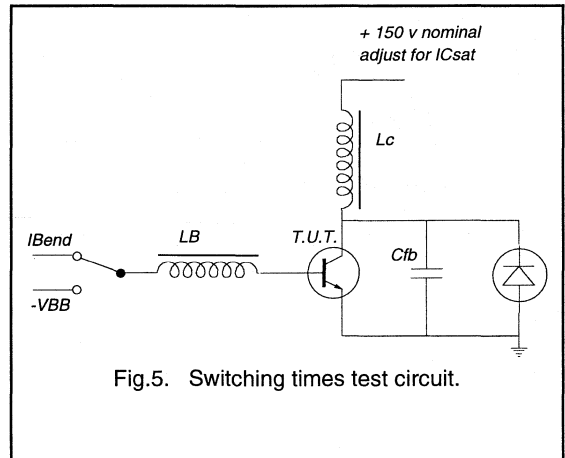


Fig.5. Switching times test circuit.

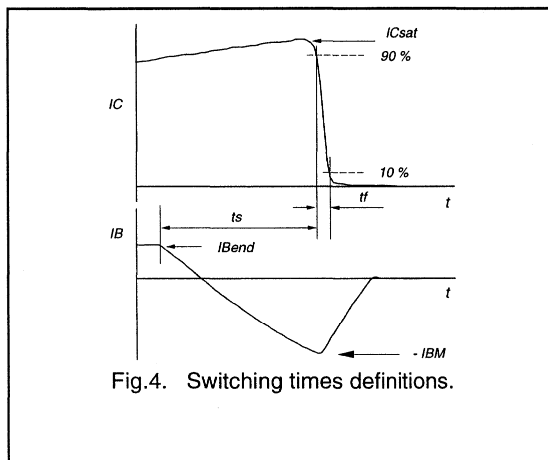


Fig.4. Switching times definitions.

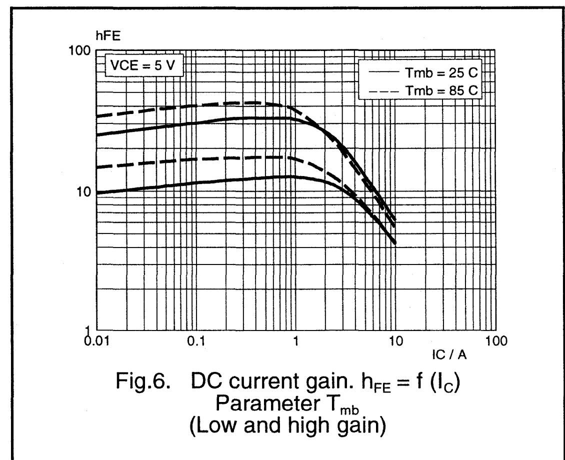


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{mb}
(Low and high gain)

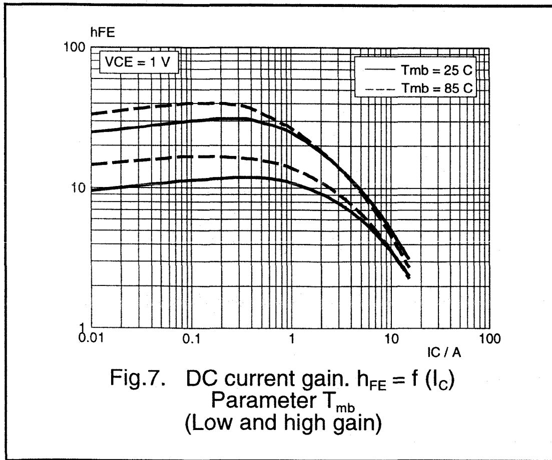


Fig.7. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{mb}
(Low and high gain)

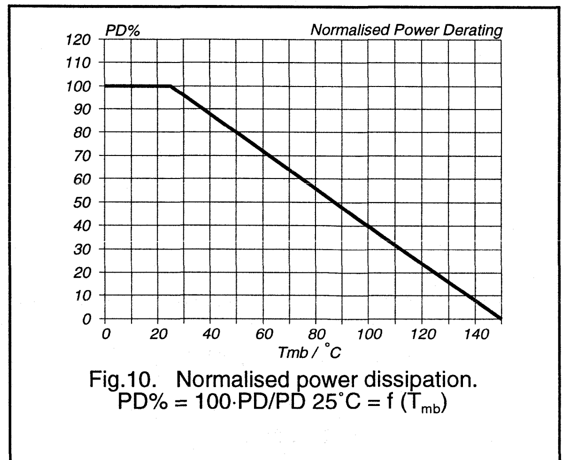


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f\ (T_{mb})$

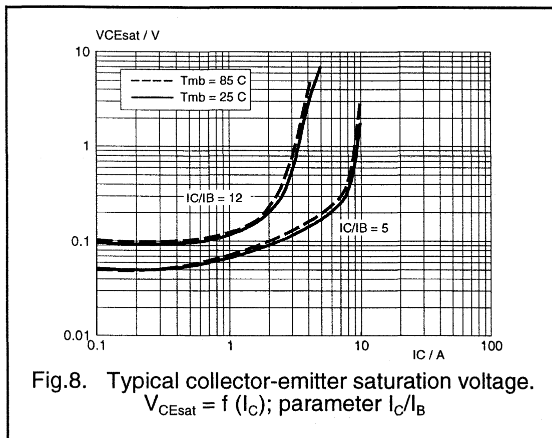


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f\ (I_C)$; parameter I_C/I_B

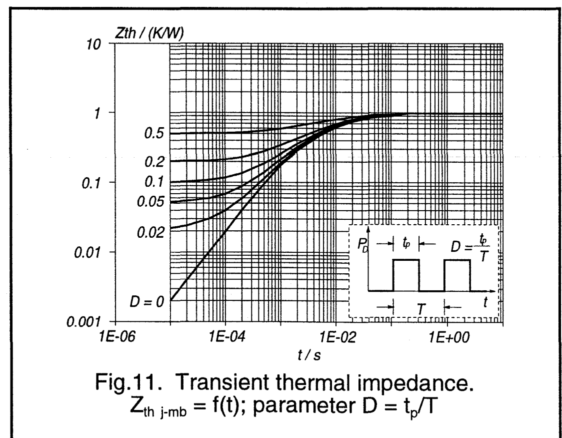


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}mb} = f(t)$; parameter $D = t_p/T$

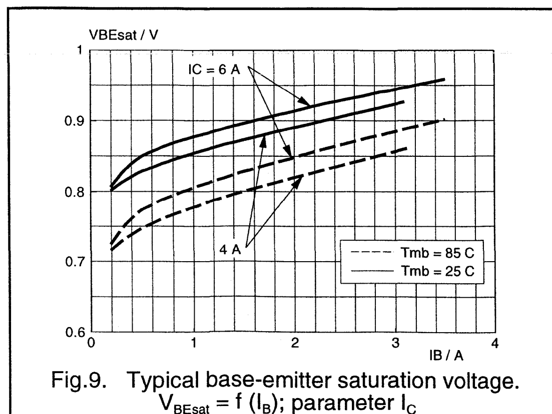


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f\ (I_B)$; parameter I_C

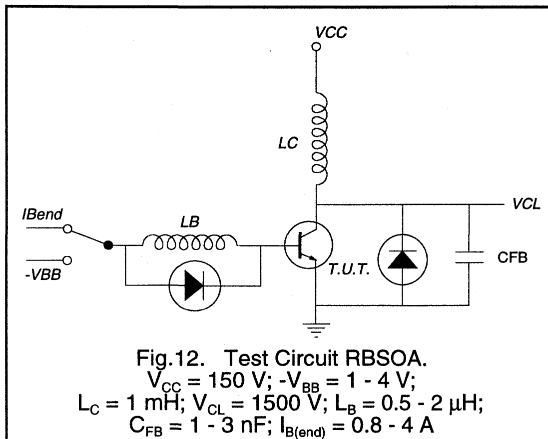


Fig.12. Test Circuit RBSOA.
V_{CC} = 150 V; $-V_{BB}$ = 1 - 4 V;
L_C = 1 mH; V_{CL} = 1500 V; L_B = 0.5 - 2 µH;
C_{FB} = 1 - 3 nF; $I_{B(end)}$ = 0.8 - 4 A

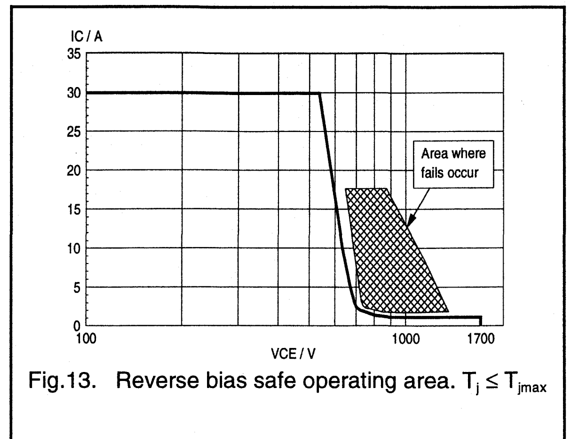


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

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. Designed to withstand V_{CES} pulses up to 1700V.

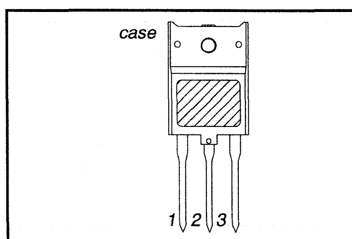
QUICK REFERENCE DATA

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	f = 64 kHz	5.0	-	A
t_s	Storage time	$I_{Csat} = 5.0$ A; f = 64kHz	2.5	3.0	µs

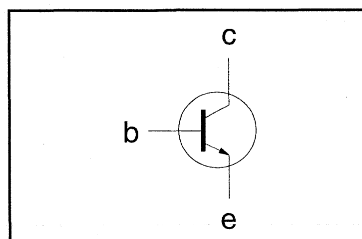
PINNING - SOT399

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	-	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		-	20	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	9	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	-	-	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	-	-	1.0	V
h_{FE}	DC current gain	I_C = 0.1 A; V_{CE} = 5 V	-	22	-	
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_{Csat} = 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		2.5	3.0	µs
t_f	Turn-off fall time		0.30	0.39	µs

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

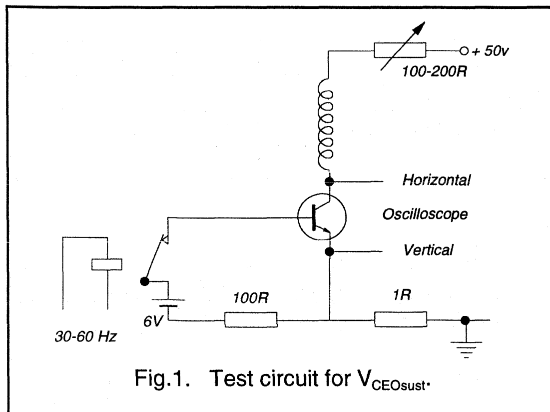


Fig.1. Test circuit for $V_{CEOsust}$.

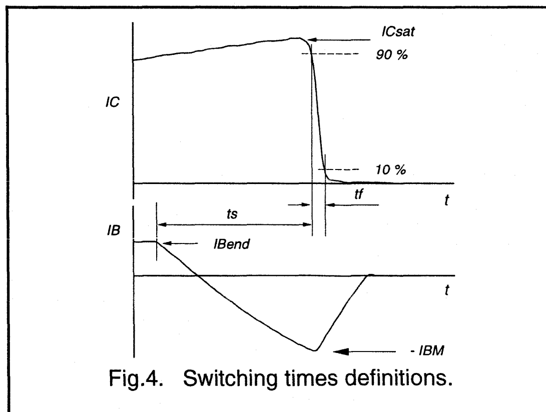


Fig.4. Switching times definitions.

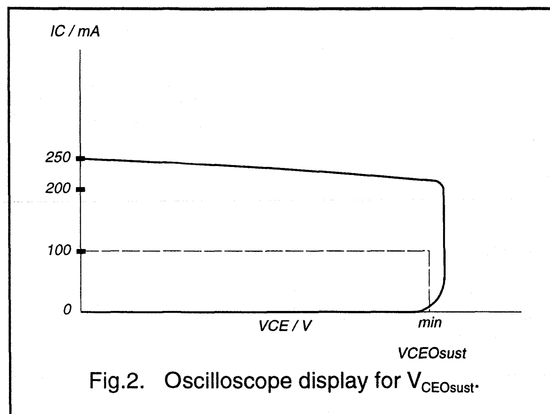


Fig.2. Oscilloscope display for $V_{CEOsust}$.

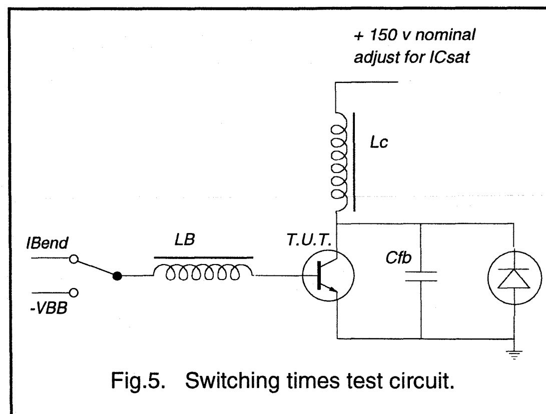


Fig.5. Switching times test circuit.

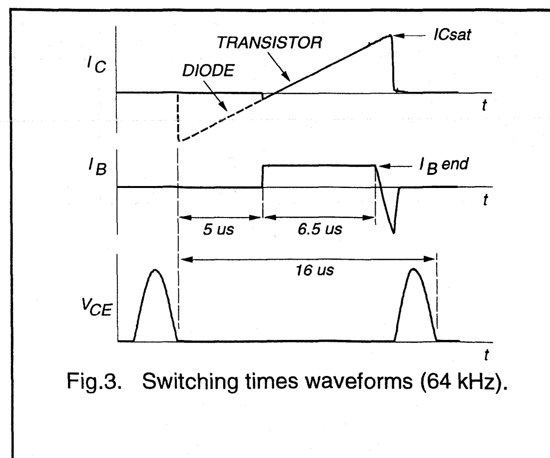


Fig.3. Switching times waveforms (64 kHz).

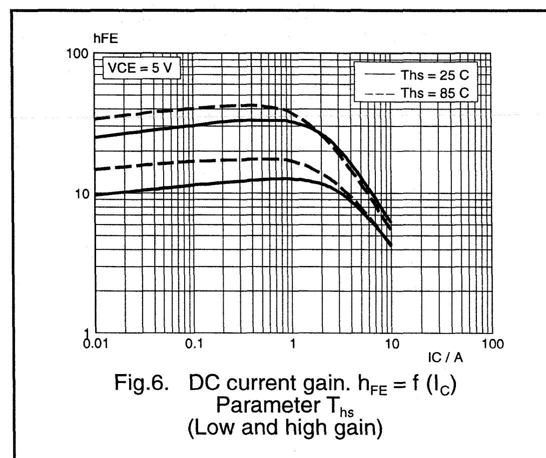


Fig.6. DC current gain. $h_{FE} = f\ (I_C)$
Parameter T_{hs}
(Low and high gain)

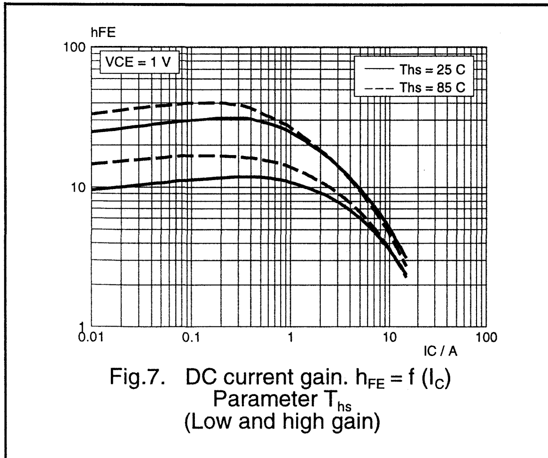


Fig.7. DC current gain. $h_{FE} = f(I_C)$
Parameter T_{hs}
(Low and high gain)

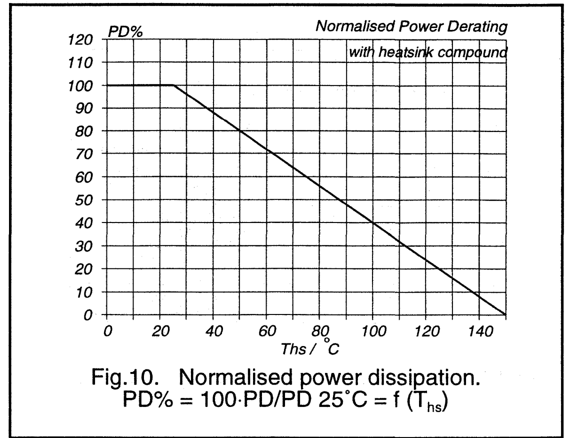


Fig.10. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{hs})$

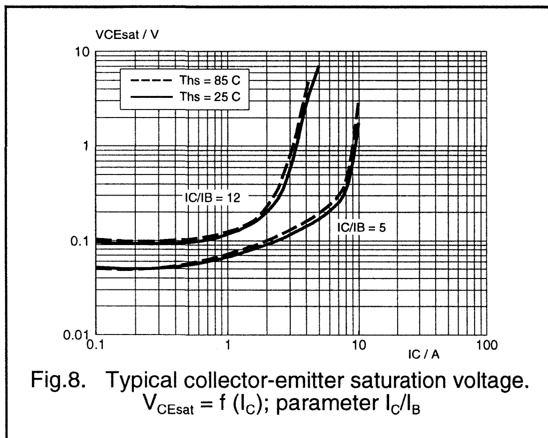


Fig.8. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

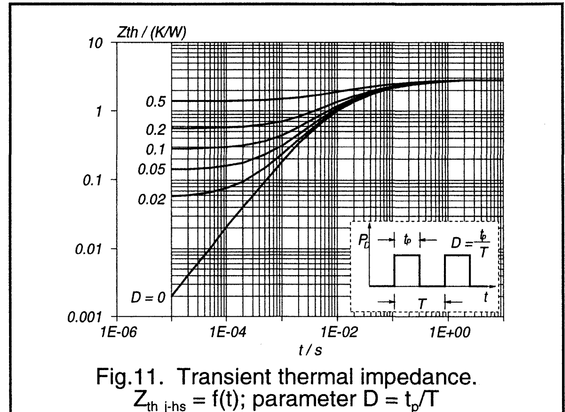


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

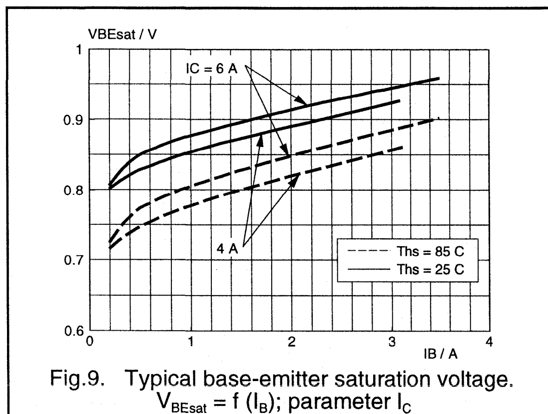


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

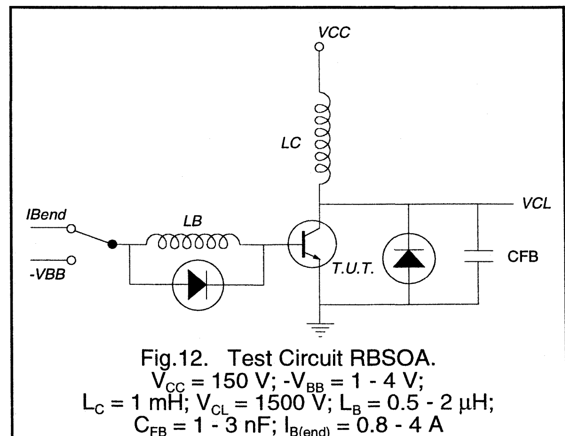


Fig.12. Test Circuit RBSOA.
$V_{CC} = 150$ V; $-V_{BB} = 1 - 4$ V;
$L_C = 1$ mH; $V_{CL} = 1500$ V; $L_B = 0.5 - 2$ µH;
$C_{FB} = 1 - 3$ nF; $I_{B(end)} = 0.8 - 4$ A

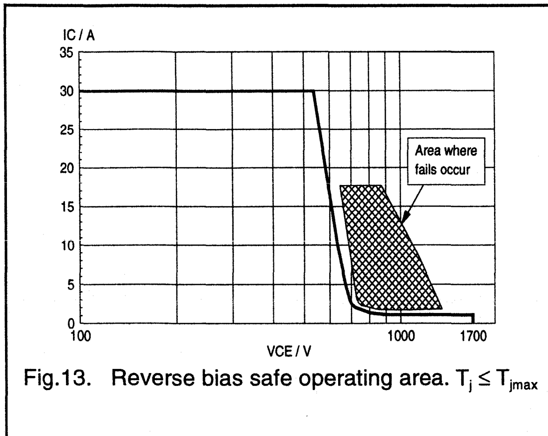


Fig.13. Reverse bias safe operating area. $T_j \leq T_{jmax}$

Silicon Diffused Power Transistor — BU2730AL

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.

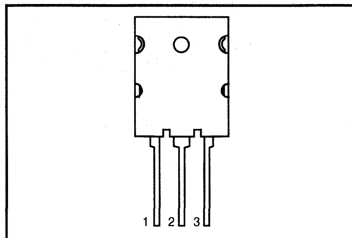
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	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	$I_C = 9$ A; $I_B = 1.8$ A	-	5.0	V
I_{Csat}	Collector saturation current	f = 32 kHz	9	-	A
t_s	Storage time	$I_{Csat} = 9$ A; f = 32 kHz	3.5	4.5	µs

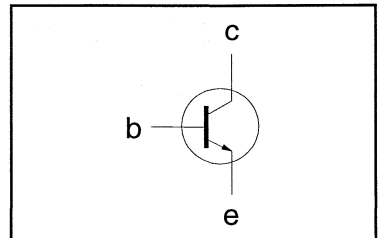
PINNING - SOT430

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	-	1700	V
V_{CEO}	Collector-emitter voltage (open base)		-	825	V
I_C	Collector current (DC)		-	16	A
I_{CM}	Collector current peak value		-	40	A
I_B	Base current (DC)		-	10	A
I_{BM}	Base current peak value		-	15	A
$-I_{B(AV)}$	Reverse base current	average over any 20 ms period	-	200	mA
$-I_{BM}$	Reverse base current peak value [1]		-	10	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	35	-	K/W

Preliminary specification
See Philips Semiconductors for Design-in information

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_{CEsat}	Collector-emitter saturation voltage	I_C = 9 A; I_B = 1.8 A	-	-	5.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 9 A; I_B = 1.8 A	-	0.91		V
h_{FE}	DC current gain	I_C = 1 A; V_{CE} = 5 V	-	17	-	
h_{FE}		I_C = 9 A; V_{CE} = 5 V	5	7.5	9.5	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (32 kHz line deflection dynamic test circuit).	I_{Csat} = 9 A; L_C = 200 µH; C_{fb} = 9 nF; V_{CC} = 142 V; $I_{B(end)}$ = tbf ; $-I_{BM}$ = 4.5 A; $-V_{BB}$ = 4 V; L_B = 5 µH			
t_s	Turn-off storage time		3.5	4.5	µs
t_f	Turn-off fall time		tbf	tbf	µs

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

GENERAL DESCRIPTION

High-voltage, high-speed planar-passivated npn power switching transistor in TO220AB envelope intended for use in electronic HF/OH lighting ballast applications, converters, inverters, switching regulators, motor control systems, etc.

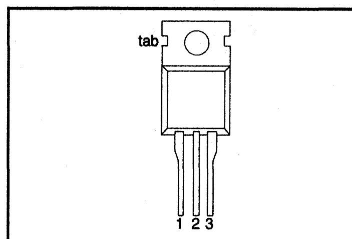
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	1300	1200	V
V_{CBO}	Collector-Base voltage (open emitter)		1300	1200	V
V_{CEO}	Collector-emitter voltage (open base)		700	600	V
I_C	Collector current (DC)		-	6	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		0.15	1.0	V
I_{Csat}	Collector saturation current		-	3	A
t_f	Fall time	$Ic=2A, I_{B1}=0.4A, I_{B2}=0.8A$	-	300	ns

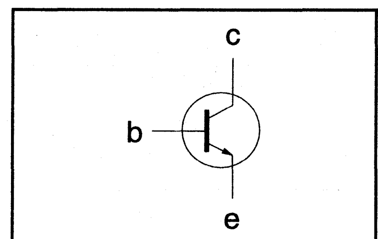
PINNING - TO220AB

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 to emitter voltage	$V_{BE} = 0$ V	-	1200	V
V_{CEO}	Collector to emitter voltage (open base)		-	600	V
V_{CBO}	Collector to base voltage (open emitter)		-	1200	V
I_C	Collector current (DC)		-	6	A
I_{CM}	Collector current peak value		-	10	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	5	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	-	1.25	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	-	60	K/W

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_{CBO}	Collector cut-off current [2]	V_{CBO} = $V_{CESMmax}$(1200V)V_{CEO} =	-	-	0.1	mA
I_{CEO}		$V_{CEOMmax}$(550V)	-	-	0.1	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 7 V; I_C = 0 A	-	-	0.1	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	550	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 2.0 A; I_B = 0.4 A	-	0.15	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 2.0 A; I_B = 0.4 A	-	0.91	1.5	V
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V	13	20	-	
h_{FE}		I_C = 500 mA; V_{CE} = 5 V	20	30	47	
h_{FEsat}		I_C = 2.0 A; V_{CE} = 5 V	13	18.5	25	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 2.0 A; I_{Bon} = -I_{Boff} = 0.4 A; R_L = 75 ohms; V_{BB2} = 4 V;			
t_{on}	Turn-on time		-	0.5	µs
t_s	Turn-off storage time		-	3	µs
t_f	Turn-off fall time		-	0.3	µs
	Switching times (inductive load)	I_{Con} = 2.0 A; I_{Bon} = 0.4 A; L_B = 1 µH; -V_{BB} = 5 V			
t_s	Turn-off storage time		-	1.5	µs
t_f	Turn-off fall time		-	300	ns
	Switching times (inductive load)	I_{Con} = 2.0 A; I_{Bon} = 0.4 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		-	300	ns

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

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

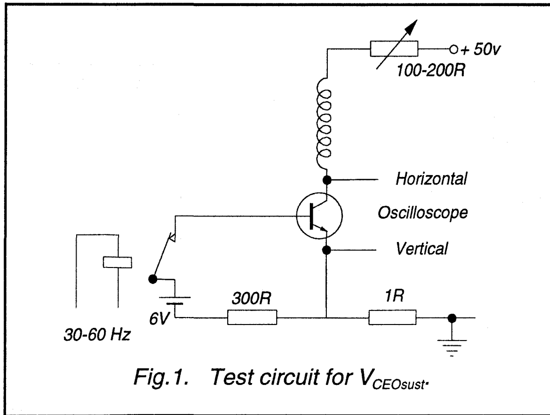


Fig.1. Test circuit for $V_{CEOsust}$.

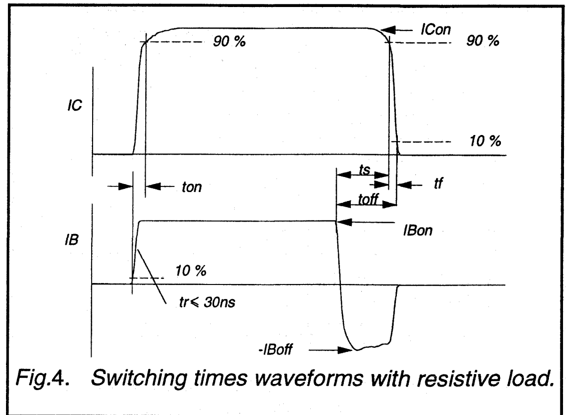


Fig.4. Switching times waveforms with resistive load.

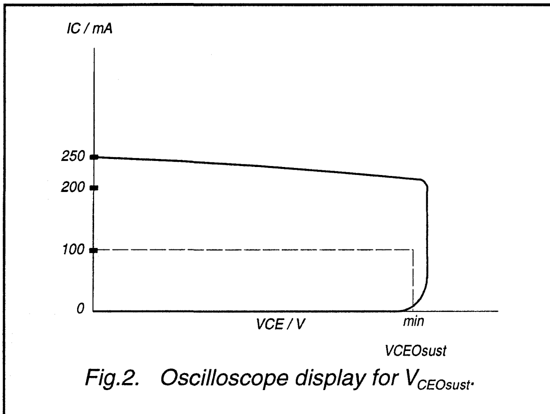


Fig.2. Oscilloscope display for $V_{CEOsust}$.

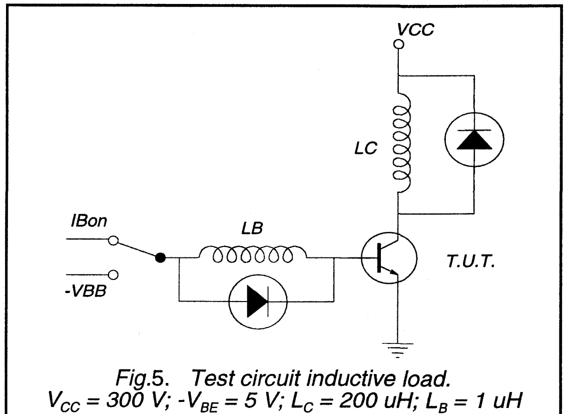


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_C = 200 uH; L_B = 1 uH

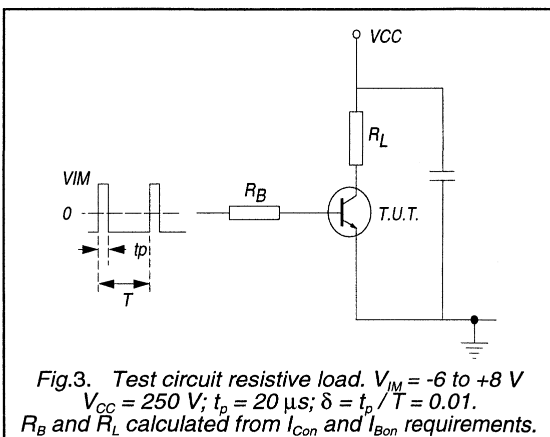


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; $\delta = t_p / T = 0.01$.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

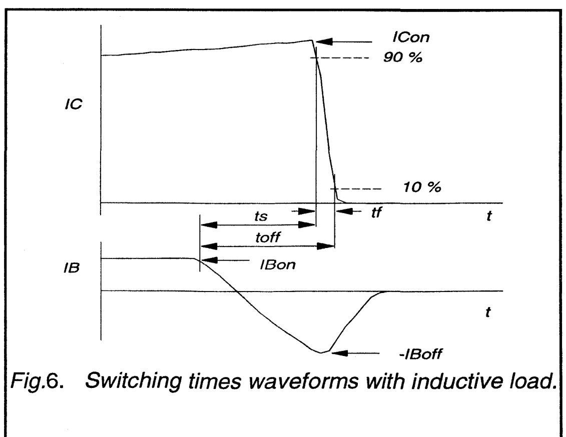


Fig.6. Switching times waveforms with inductive load.

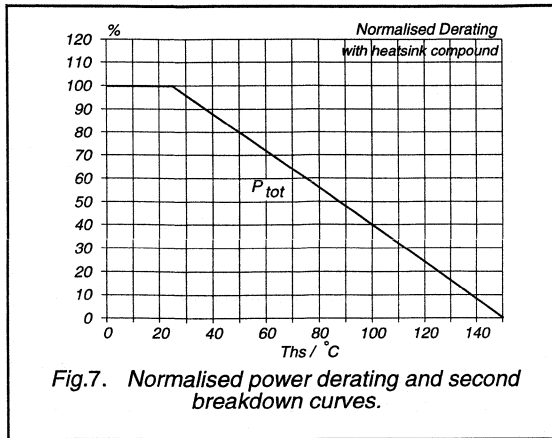


Fig.7. Normalised power derating and second breakdown curves.

GENERAL DESCRIPTION

High-voltage, high-speed planar-passivated npn power switching transistor in a plastic full-pack envelope intended for use in electronic HF/OH lighting ballast applications, converters, inverters, switching regulators, motor control systems, etc.

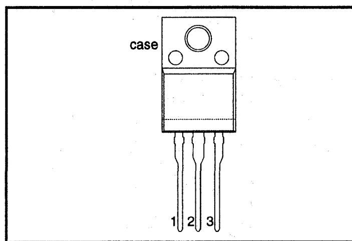
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	V_{BE} = 0 V	1300	1200	V
V_{CBO}	Collector-Base voltage (open emitter)		1300	1200	V
V_{CEO}	Collector-emitter voltage (open base)		650	550	V
I_C	Collector current (DC)		-	6	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		0.15	1.0	V
I_{Csat}	Collector saturation current		-	2	A
t_f	Fall time	Ic=2A,I_{B1}=0.4A,I_{B2}=0.8A	80	300	ns

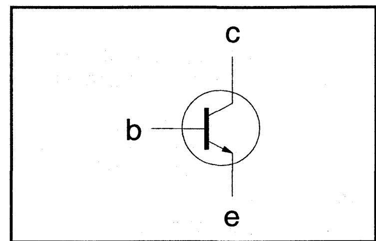
PINNING - SOT186A

PIN	DESCRIPTION
1	base
2	collector
3	emitter
case	isolated

PIN CONFIGURATION



SYMBOL



LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	Collector to emitter voltage	V_{BE} = 0 V	-	1200	V
V_{CEO}	Collector to emitter voltage (open base)		-	550	V
V_{CBO}	Collector to base voltage (open emitter)		-	1200	V
I_C	Collector current (DC)		-	6	A
I_{CM}	Collector current peak value		-	10	A
I_B	Base current (DC)		-	3	A
I_{BM}	Base current peak value		-	5	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_{CBO}	Collector cut-off current [2]	V_{CBO} = $V_{CESMmax}$(1200V)	-	-	0.1	mA
I_{CEO}		V_{CEO} = $V_{CEOMmax}$(550V)	-	-	0.1	mA
						mA
I_{EBO}	Emitter cut-off current	V_{EB} = 7 V; I_C = 0 A	-	-	0.1	
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	550	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 2.0 A; I_B = 0.4 A	-	0.15	1.0	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 2.0 A; I_B = 0.4 A	-	0.91	1.5	V
h_{FE}	DC current gain	I_C = 1 mA; V_{CE} = 5 V	13	20		
h_{FE}		I_C = 500 mA; V_{CE} = 5 V	20	30	40	
h_{FEsat}	DC current gain	I_C = 2 A; V_{CE} = 5 V	13	18.5	25	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 2.0 A; I_{Bon} = $-I_{Boff}$ = 0.4 A; R_L = 75 ohms; V_{BB2} = 4 V;			
t_{on}	Turn-on time		-	0.5	μs
t_s	Turn-off storage time		-	3	μs
t_f	Turn-off fall time		-	0.3	μs
	Switching times (inductive load)	I_{Con} = 2.0 A; I_{Bon} = 0.4 A; L_B = 1 μH; $-V_{BB}$ = 5 V			
t_s	Turn-off storage time		-	1.5	μs
t_f	Turn-off fall time		-	300	ns
	Switching times (inductive load)	I_{Con} = 2.0 A; I_{Bon} = 0.4 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		-	300	ns

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

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

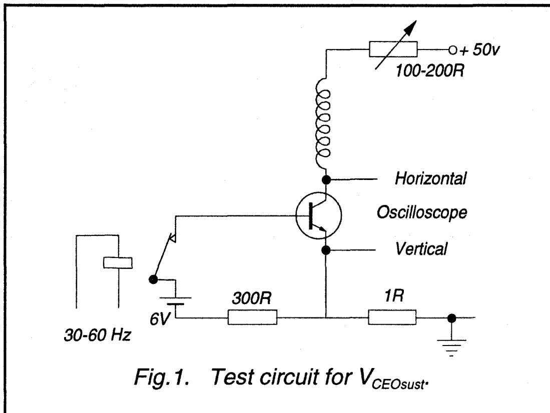


Fig.1. Test circuit for $V_{CEOsust}$.

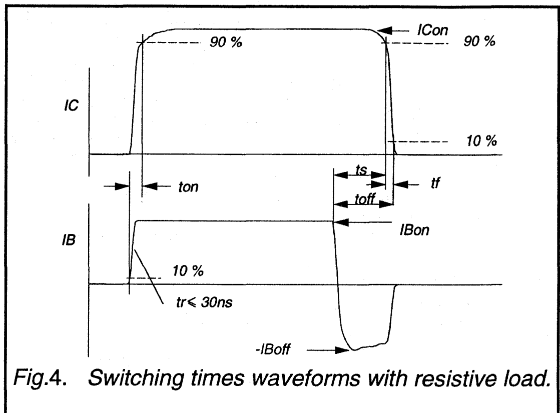


Fig.4. Switching times waveforms with resistive load.

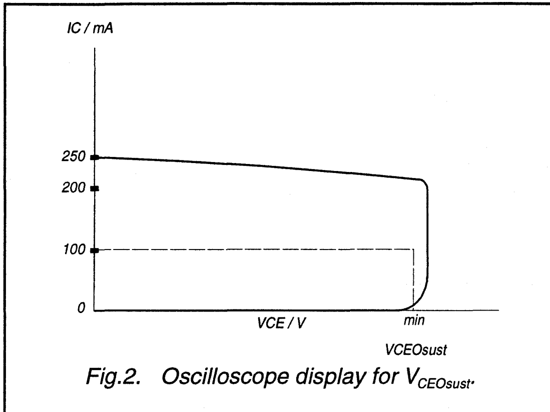


Fig.2. Oscilloscope display for $V_{CEOsust}$.

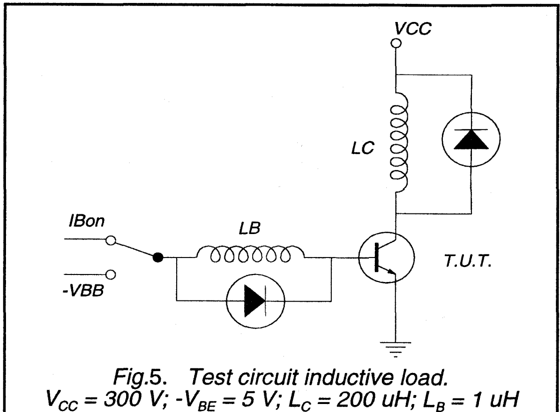


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V; L_C = 200 uH; L_B = 1 uH

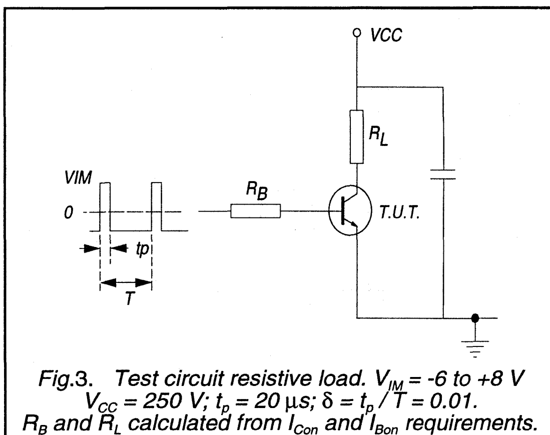


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; $\delta = t_p / T = 0.01$.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

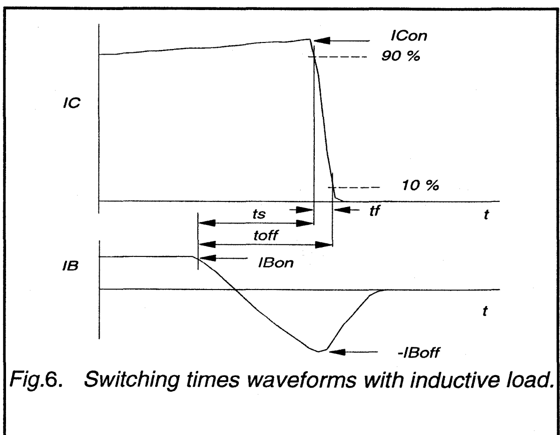


Fig.6. Switching times waveforms with inductive load.

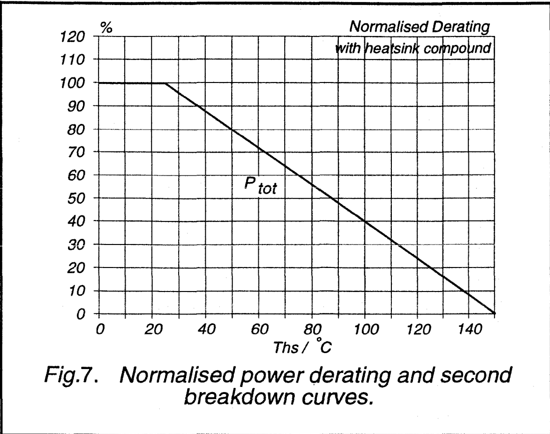


Fig.7. Normalised power derating and second breakdown curves.

Silicon diffused power transistors — BUT11; BUT11A

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a TO-220AB package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

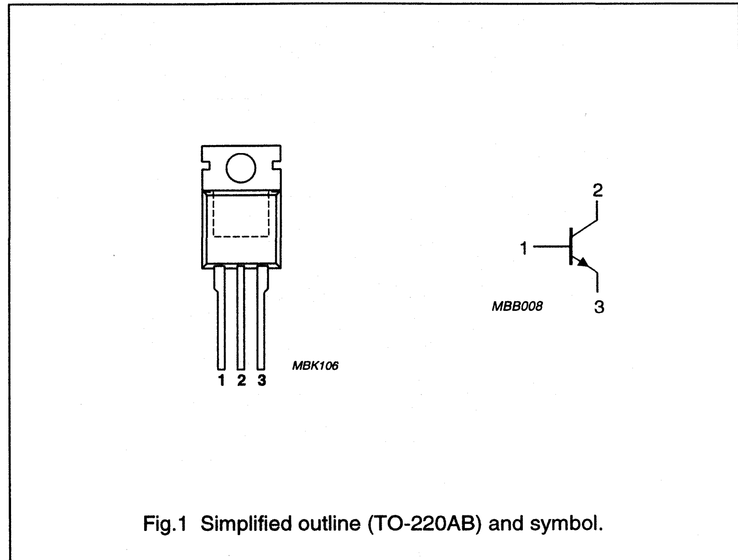


Fig.1 Simplified outline (TO-220AB) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUT11		850	V
	BUT11A		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT11		400	V
	BUT11A		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
I_C	collector current (DC)	see Figs 2 and 4	5	A
I_{CM}	collector current (peak value)	see Fig. 4	10	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	100	W
t_f	fall time	resistive load; see Figs 11 and 12	0.8	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1.25	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUT11		–	850	V
	BUT11A		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT11		–	400	V
	BUT11A		–	450	V
I_C	collector current (DC)	see Figs 2 and 4	–	5	A
I_{CM}	collector current (peak value)	$t_p < 2$ ms; see Fig. 4	–	10	A
I_B	base current (DC)		–	2	A
I_{BM}	base current (peak value)	$t_p < 2$ ms	–	4	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	–	100	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

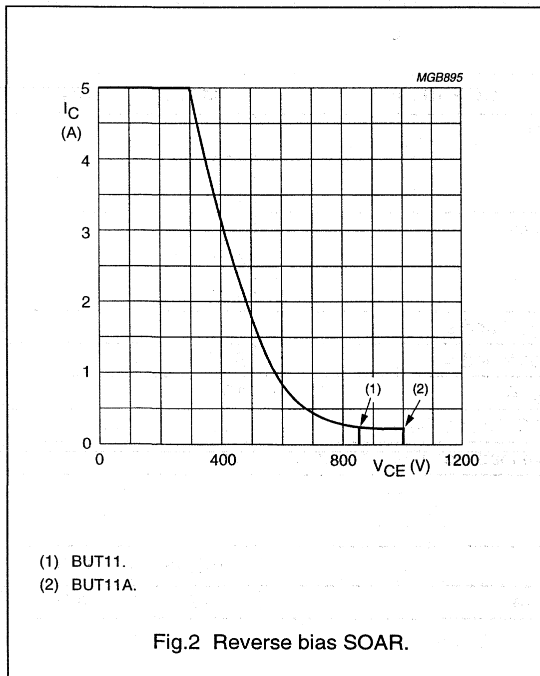


Fig.2 Reverse bias SOAR.

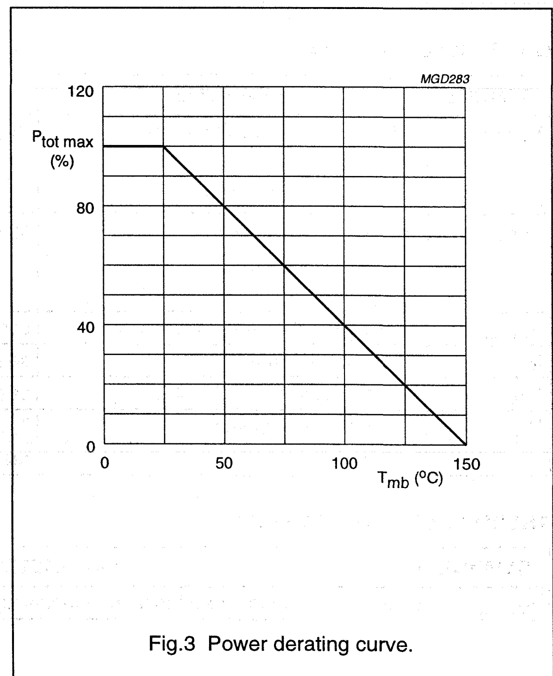


Fig.3 Power derating curve.

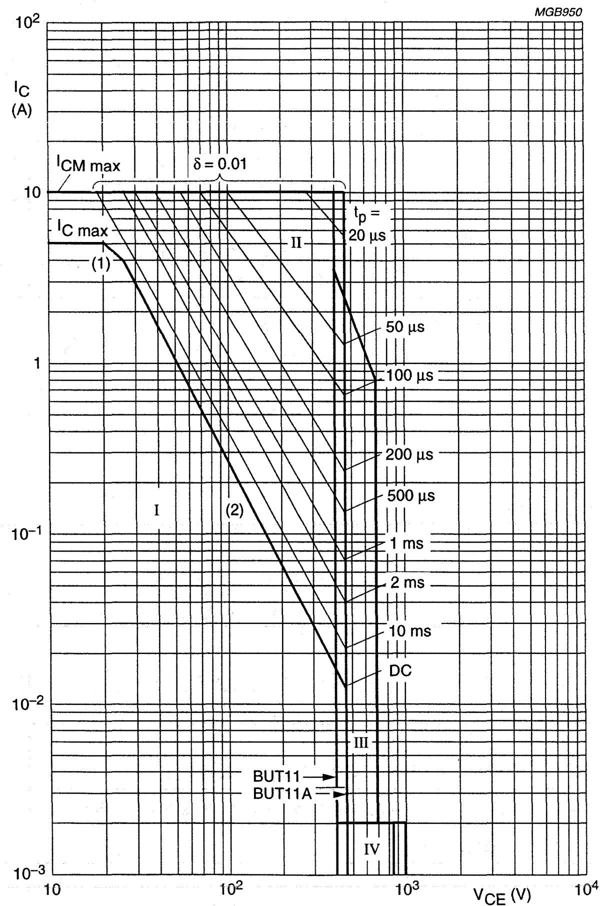
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 5 and 6				
	BUT11		400	–	–	V
	BUT11A		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUT11	I_C = 3 A; I_B = 600 mA; see Figs 7 and 9	–	–	1.5	V
	BUT11A	I_C = 2.5 A; I_B = 500 mA; see Figs 7 and 9	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUT11	I_C = 3 A; I_B = 0.6 A; see Fig.7	–	–	1.3	V
	BUT11A	I_C = 2.5 A; I_B = 0.5 A; see Fig.7	–	–	1.3	V
I_{CES}	collector-emitter cut-off current	V_{CE} = $V_{CESMmax}$; V_{BE} = 0; note 1	–	–	1	mA
		V_{CE} = $V_{CESMmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	2	mA
I_{EBO}	emitter-base 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; see Fig.10	10	18	35	
		V_{CE} = 5 V; I_C = 500 mA; see Fig.10	10	20	35	
Switching times resistive load (see Fig.12)						
t_{on}	turn-on time					
	BUT11	I_{Con} = 3 A; I_{Bon} = $-I_{Boff}$ = 600 mA	–	–	1	µs
	BUT11A	I_{Con} = 2.5 A; I_{Bon} = $-I_{Boff}$ = 500 mA	–	–	1	µs
t_s	storage time					
	BUT11	I_{Con} = 3 A; I_{Bon} = $-I_{Boff}$ = 600 mA	–	–	4	µs
	BUT11A	I_{Con} = 2.5 A; I_{Bon} = $-I_{Boff}$ = 500 mA	–	–	4	µs
t_f	fall time					
	BUT11	I_{Con} = 3 A; I_{Bon} = $-I_{Boff}$ = 600 mA	–	–	0.8	µs
	BUT11A	I_{Con} = 2.5 A; I_{Bon} = $-I_{Boff}$ = 500 mA	–	–	0.8	µs
Switching times inductive load (see Fig.14)						
t_s	storage time					
	BUT11	I_{Con} = 3 A; I_{Bon} = 600 mA	–	1.1	1.4	µs
		I_{Con} = 3 A; I_{Bon} = 600 mA; T_j = 100 °C	–	1.2	1.5	µs
	BUT11A	I_{Con} = 2.5 A; I_{Bon} = 500 mA	–	1.1	1.4	µs
		I_{Con} = 2.5 A; I_{Bon} = 500 mA; T_j = 100 °C	–	1.2	1.5	µs
t_f	fall time					
	BUT11	I_{Con} = 3 A; I_{Bon} = 600 mA	–	80	150	ns
		I_{Con} = 3 A; I_{Bon} = 600 mA; T_j = 100 °C	–	140	300	ns
	BUT11A	I_{Con} = 2.5 A; I_{Bon} = 500 mA	–	80	150	ns
		I_{Con} = 2.5 A; I_{Bon} = 500 mA; T_j = 100 °C	–	140	300	ns

Note

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



$T_{mb} \leq 25$ °C.

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 $t_p \leq 0.6$ µs.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 5$ ms.

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

(2) Second breakdown limits.

Fig.4 Forward bias SOAR.

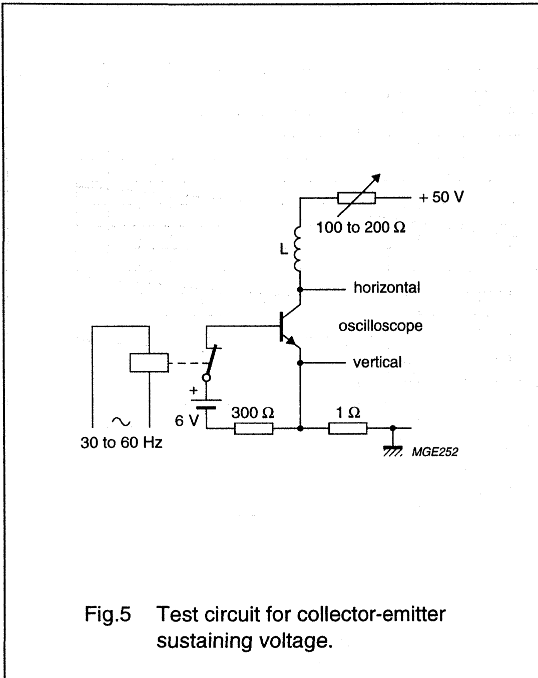


Fig.5 Test circuit for collector-emitter sustaining voltage.

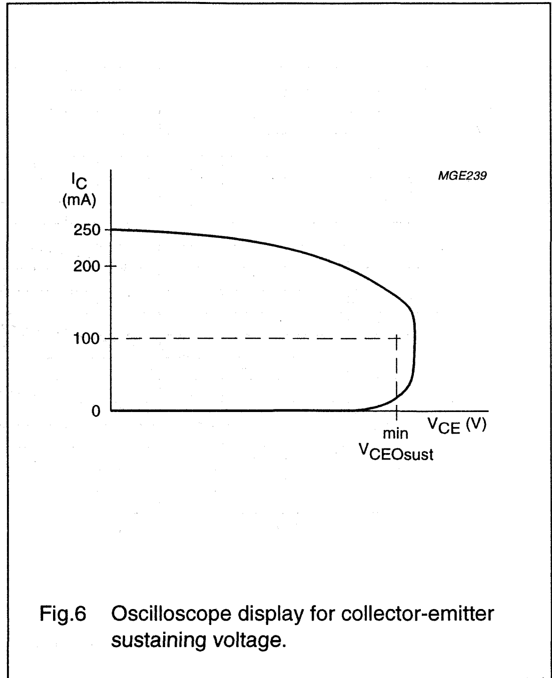
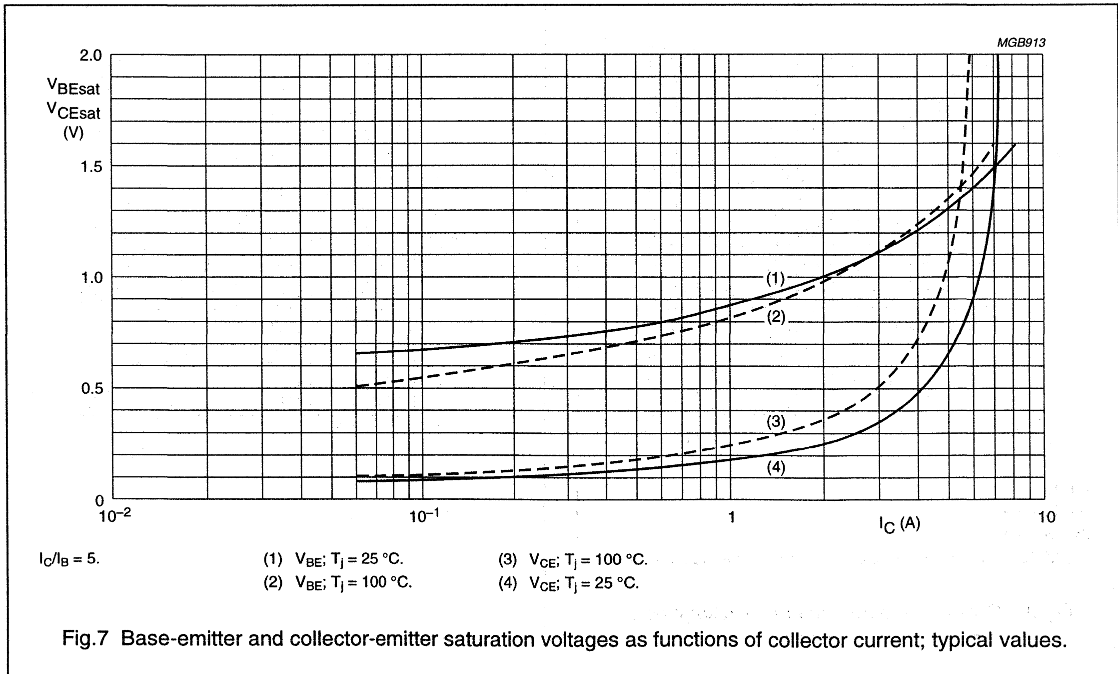


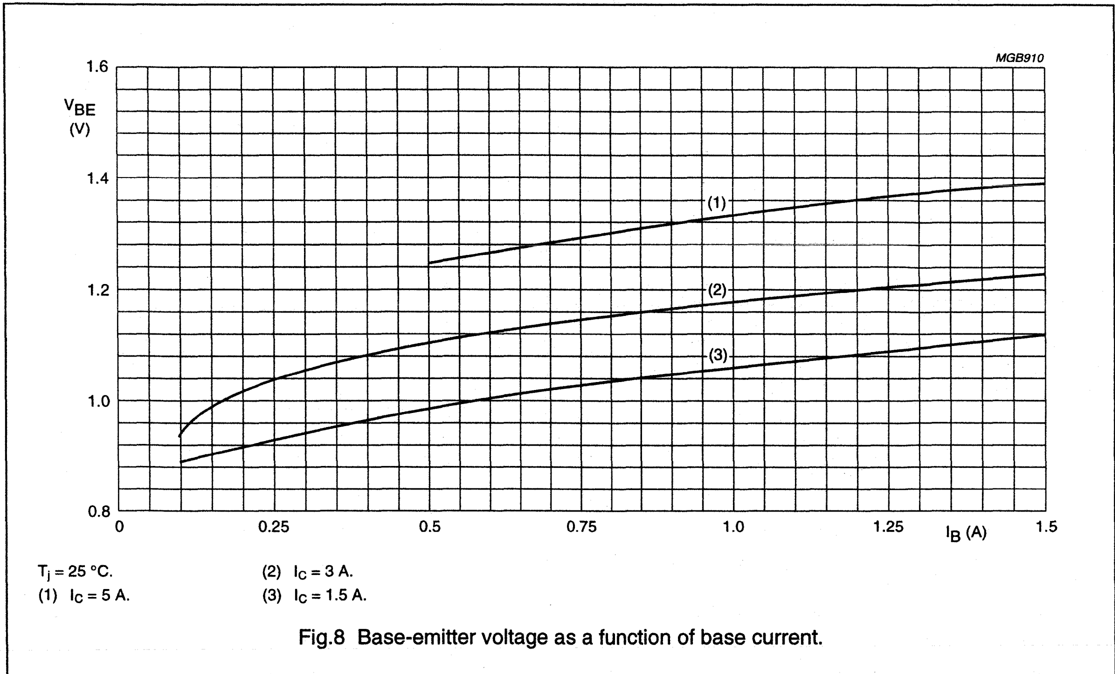
Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



$I_C/I_B = 5$.

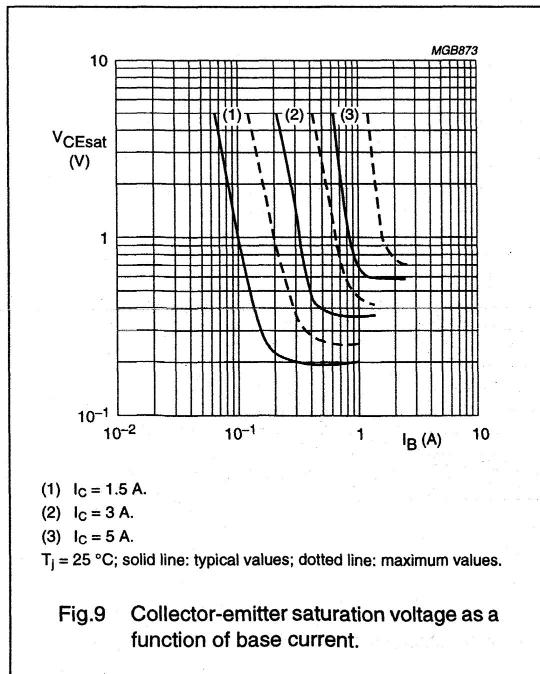
(1) V_{BE}; $T_j = 25\ °C$.
(2) V_{BE}; $T_j = 100\ °C$.
(3) V_{CE}; $T_j = 100\ °C$.
(4) V_{CE}; $T_j = 25\ °C$.

Fig.7 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.



$T_j = 25$ °C.
(1) $I_C = 5$ A.
(2) $I_C = 3$ A.
(3) $I_C = 1.5$ A.

Fig.8 Base-emitter voltage as a function of base current.



(1) $I_C = 1.5$ A.
(2) $I_C = 3$ A.
(3) $I_C = 5$ A.
$T_j = 25$ °C; solid line: typical values; dotted line: maximum values.

Fig.9 Collector-emitter saturation voltage as a function of base current.

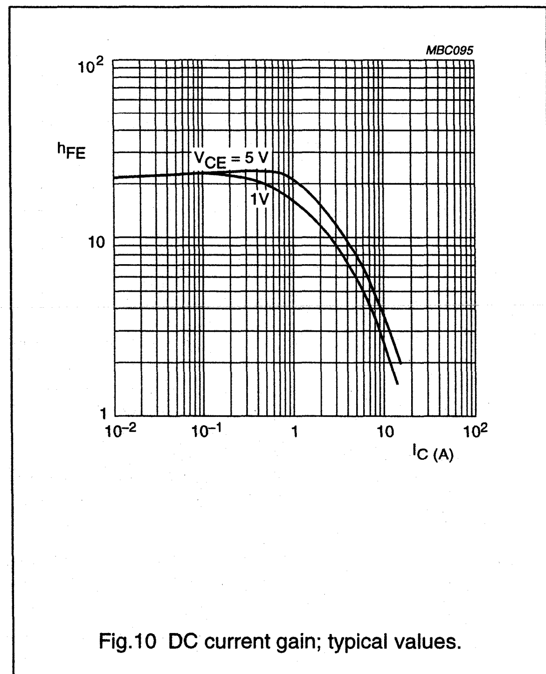
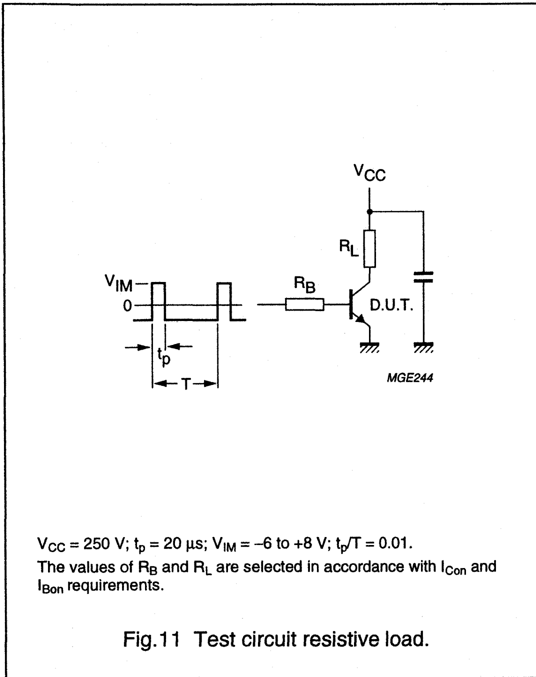


Fig.10 DC current gain; typical values.



V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.11 Test circuit resistive load.

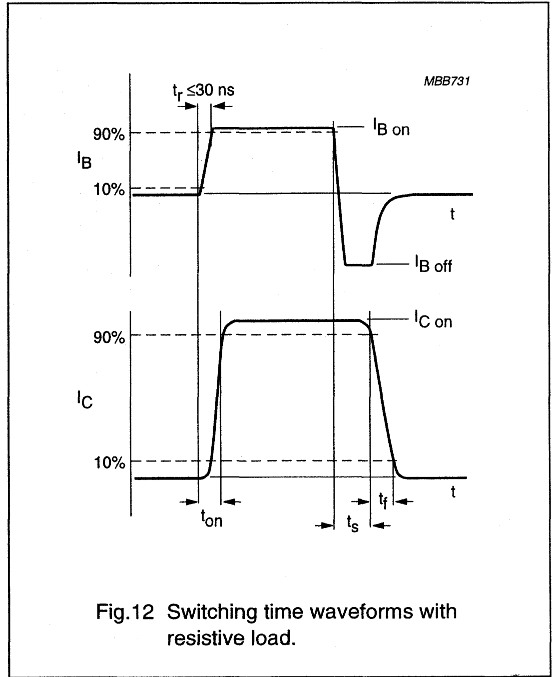
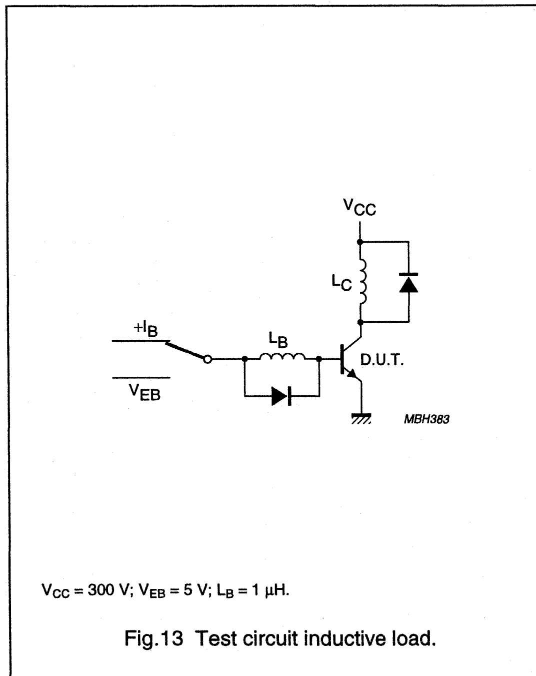


Fig.12 Switching time waveforms with resistive load.



V_{CC} = 300 V; V_{EB} = 5 V; L_B = 1 µH.

Fig.13 Test circuit inductive load.

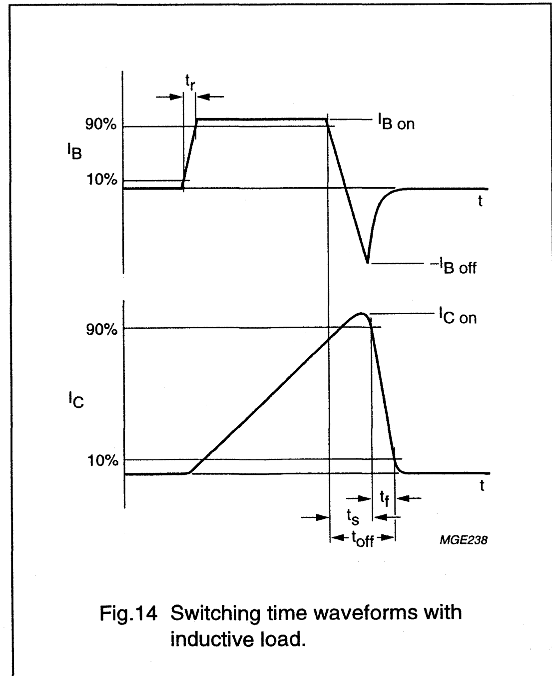


Fig.14 Switching time waveforms with inductive load.

GENERAL DESCRIPTION

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

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ 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	-	20	W
V_{CEsat}	Collector-emitter saturation voltage		-	1.5	V
I_{Csat}	Collector saturation current		2.5	-	A
t_f	Fall time		800	-	ns

[INCLUDE]

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ 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	-	20	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

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

ISOLATION LIMITING VALUE & CHARACTERISTIC

$T_{hs} = 25$ ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{isol}	Repetitive peak voltage from all three terminals to external heatsink	R.H. ≤ 65% ; clean and dustfree	-		1500	V
C_{isol}	Capacitance from T2 to external heatsink	f = 1 MHz	-	12	-	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		-	1	µs
t_s	Turn-off storage time		-	4	µs
t_f	Turn-off fall time		-	0.8	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		1.1	1.4	µs
t_f	Turn-off fall time		80	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		1.2	1.5	µs
t_f	Turn-off fall time		140	300	ns

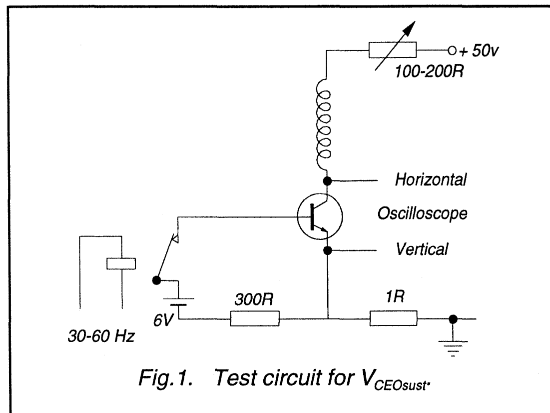


Fig.1. Test circuit for $V_{CEOsust}$.

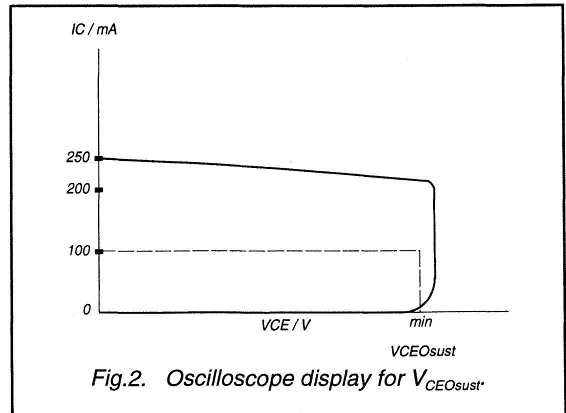


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

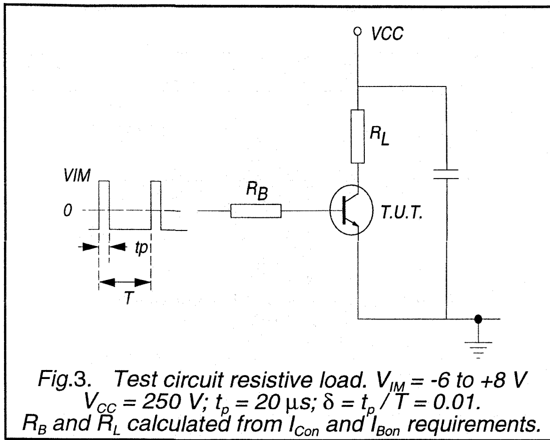


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; δ = t_p / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

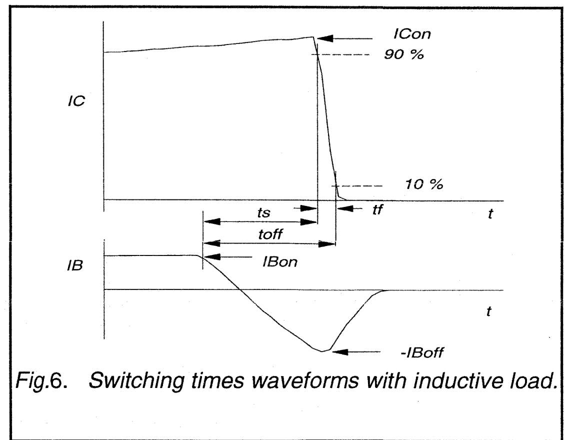


Fig.6. Switching times waveforms with inductive load.

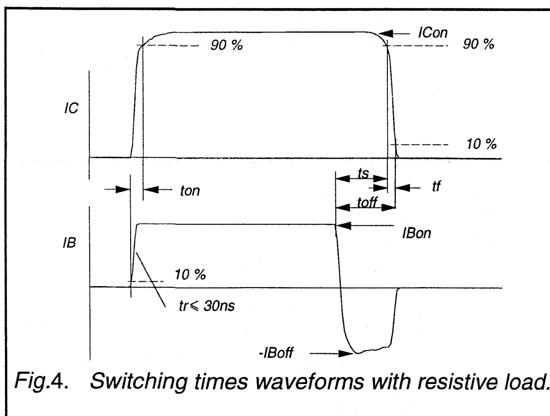


Fig.4. Switching times waveforms with resistive load.

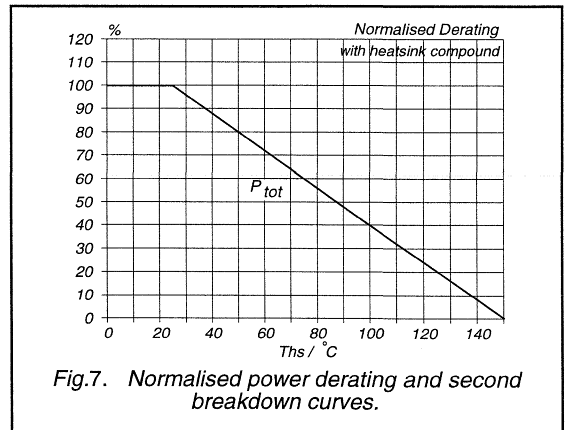


Fig.7. Normalised power derating and second breakdown curves.

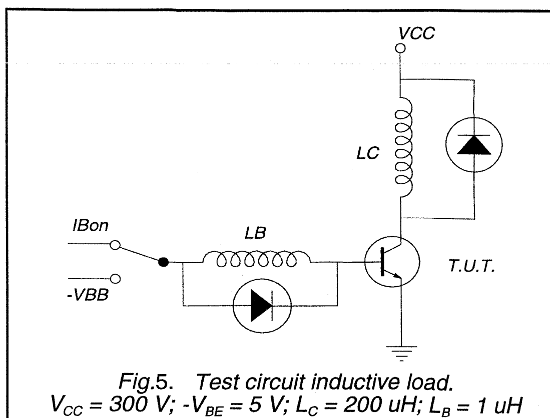


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_C = 200 uH; L_B = 1 uH

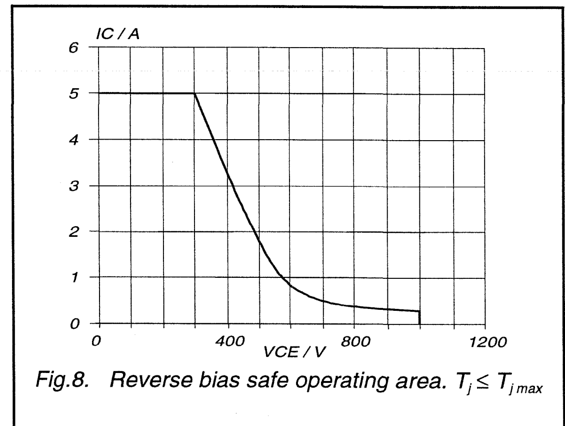


Fig.8. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

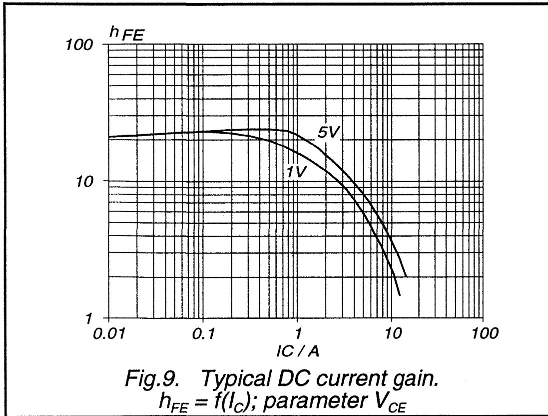


Fig.9. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

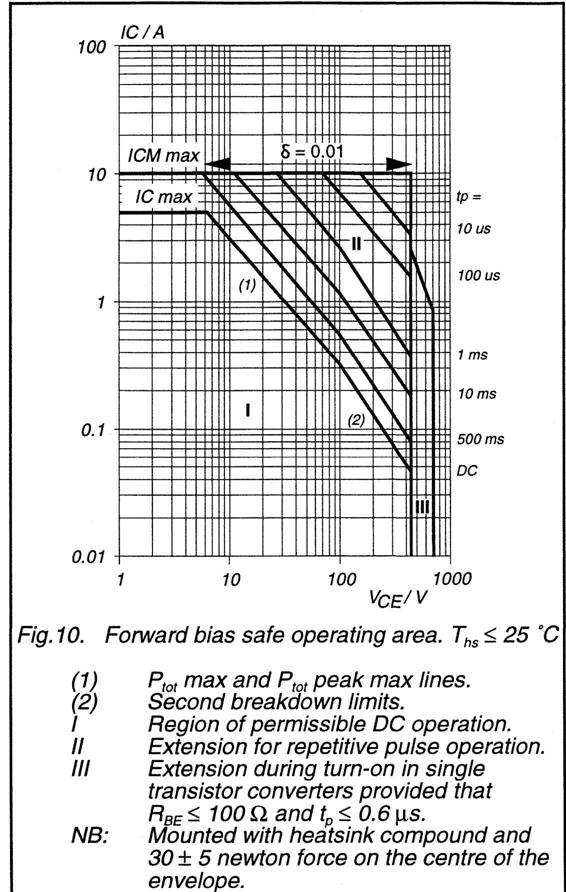


Fig.10. Forward bias safe operating area. $T_{hs} \leq 25$ ˚C

(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.

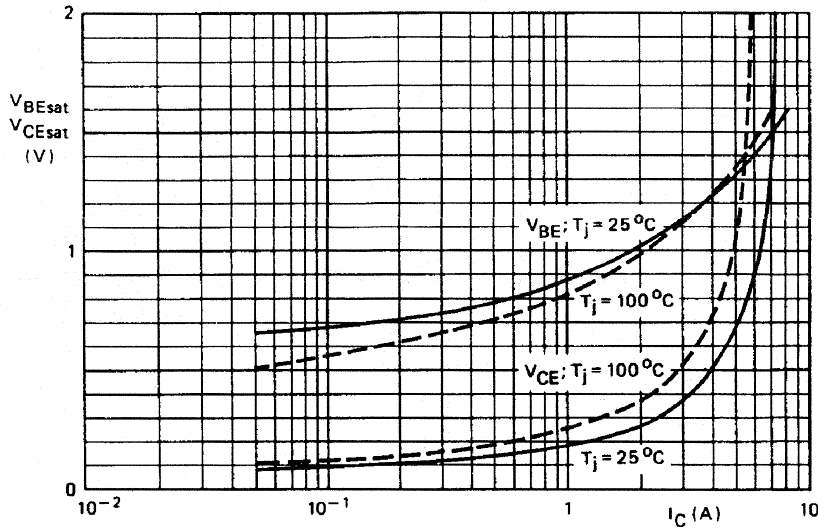


Fig.11. Typical base-emitter and collector-emitter saturation voltages.
$V_{BEsat} = f(I_C)$; $V_{CEsat} = f(I_C)$; $I_C/I_B = 5$

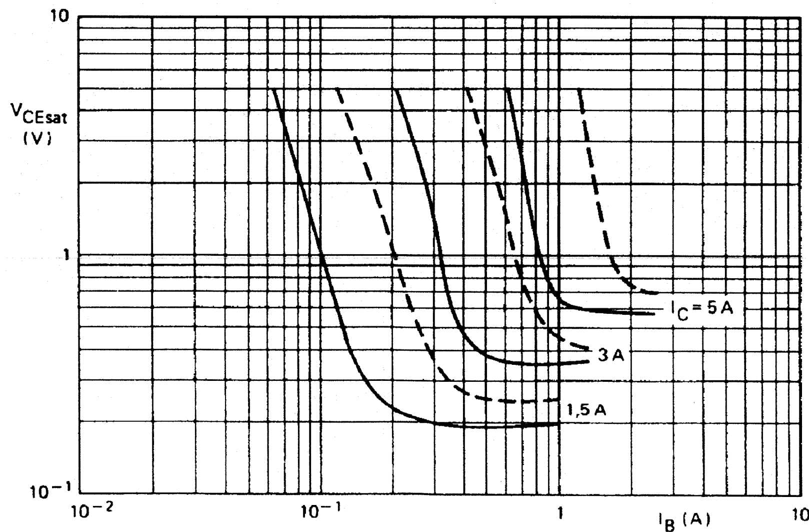


Fig.12. Collector-emitter saturation voltage. Solid lines = typ values, dotted lines = max values. $V_{CEsat} = f(I_B)$; parameter I_C

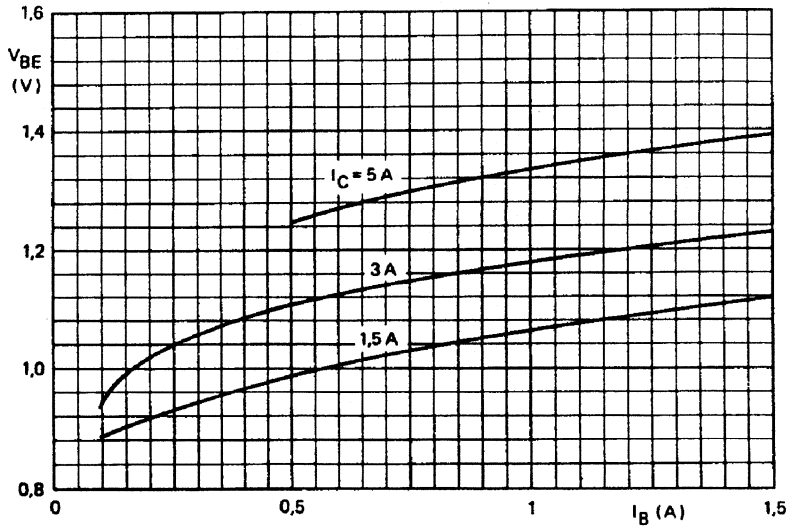


Fig.13. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

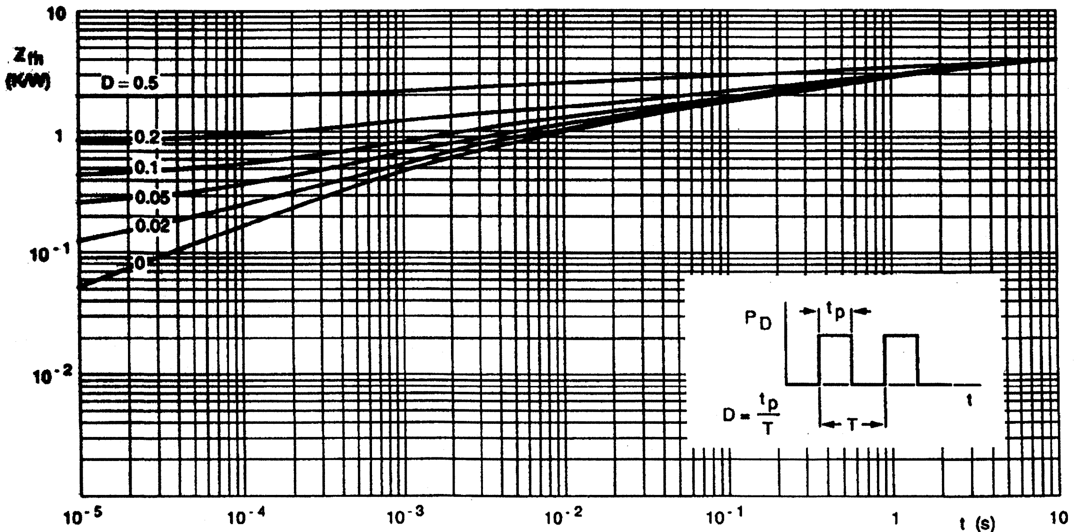


Fig.14. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

Silicon Diffused Power Transistor — BUT11AI

GENERAL DESCRIPTION

Enhanced performance, high speed switching npn transistor in TO220AB envelope specially suited for high frequency electronic lighting ballast applications and converters, inverters, switching regulators, motor control systems etc.

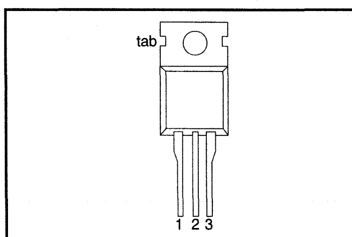
QUICK REFERENCE DATA

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	$T_{mb} \leq 25$ ˚C	-	100	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 2.5$ A; $I_B = 0.33$ A	-	1.5	V
I_{Csat}	Collector Saturation current		2.5		A
t_f	Inductive fall time	$I_{Con} = 2.5$ A; $I_{Bon} = 0.5$ A	0.08	0.15	µs

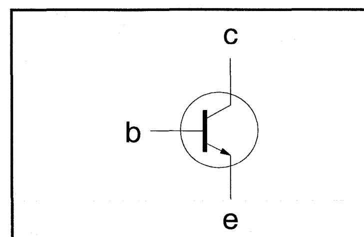
PINNING - TO220AB

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	-	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	$T_{mb} \leq 25$ ˚C	-	100	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
$R_{th\ j-mb}$	Junction to mounting base		-	1.25	K/W
$R_{th\ j-a}$	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	450	-	-	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 2.5 A;I_B = 0.33 A	-	-	1.5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 2.5 A;I_B = 0.33 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 5 V	10	20	35	
h_{FE}		I_C = 0.5 A; V_{CE} = 5 V	14	22	35	
h_{FEsat}		I_C = 2.5 A; V_{CE} = 5 V	9	13	17	

DYNAMIC CHARACTERISTICS

T_{mb} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times resistive load	I_{Con} = 2.5 A; I_{Bon} = 0.5 A; $-I_{Boff}$ = 0.5 A			
	Turn-on time		0.6	1.0	µs
t_{on}			3.4		
			0.6		
t_s	Turn-off storage time		-	4.0	µs
t_f	Turn-off fall time		-	0.8	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		1.1	1.4	µs
t_f	Turn-off fall time		80	150	ns
		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		1.2	1.5	µs
t_f	Turn-off fall time		140	300	ns

[INCLUDE]

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

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.

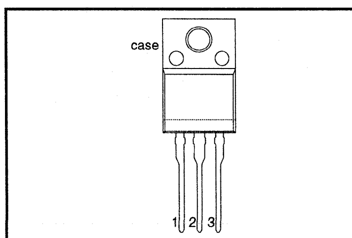
QUICK REFERENCE DATA

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

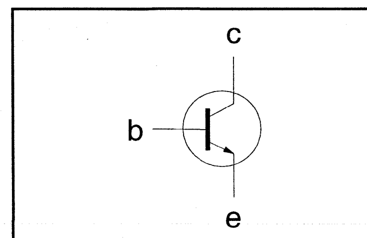
PINNING - SOT186A

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
$R_{th\ j\text{-}hs}$	Junction to heatsink	with heatsink compound	-	3.95	K/W
$R_{th\ j\text{-}a}$	Junction to ambient	in free air	55	-	K/W

ISOLATION LIMITING VALUE & CHARACTERISTIC

T_{hs} = 25 ˚C unless otherwise specified

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

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [1]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	1.0	mA
I_{CES}		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$; T_j = 125 ˚C	-	-	2.0	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 9 V; I_C = 0 A	-	-	10	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	450	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 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).

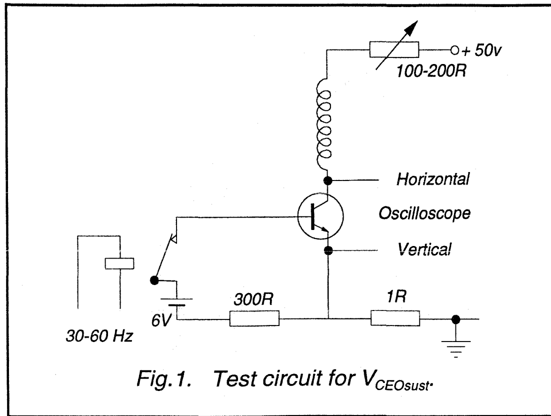


Fig.1. Test circuit for $V_{CEOsust}$.

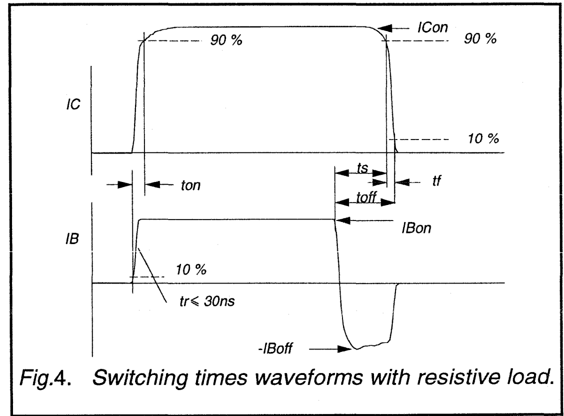


Fig.4. Switching times waveforms with resistive load.

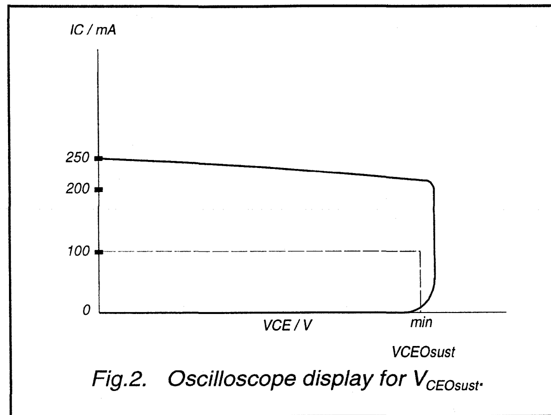


Fig.2. Oscilloscope display for $V_{CEOsust}$.

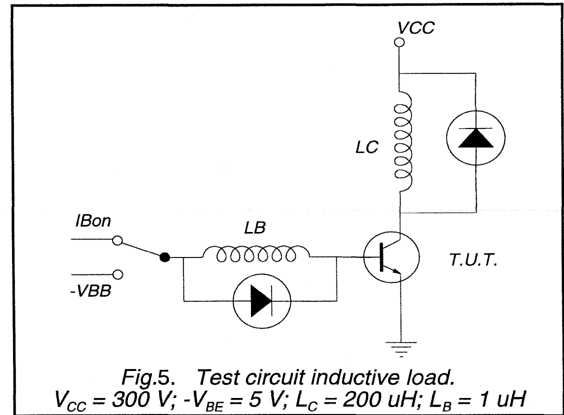


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V; L_C = 200 uH; L_B = 1 uH

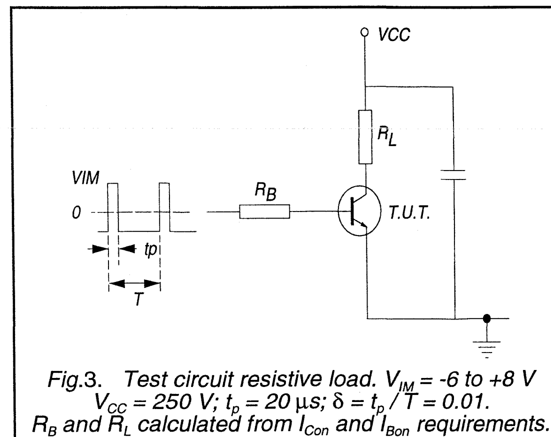


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; $\delta = t_p / T = 0.01$.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

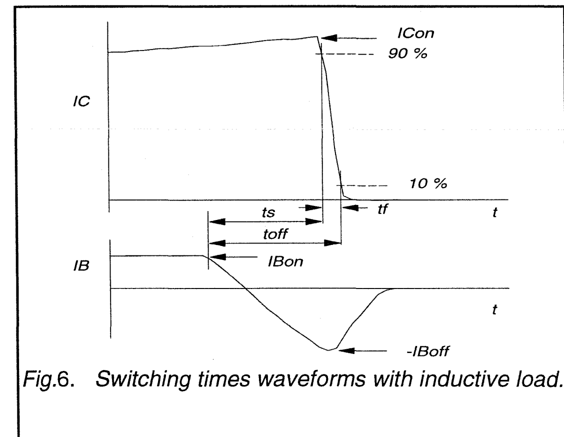


Fig.6. Switching times waveforms with inductive load.

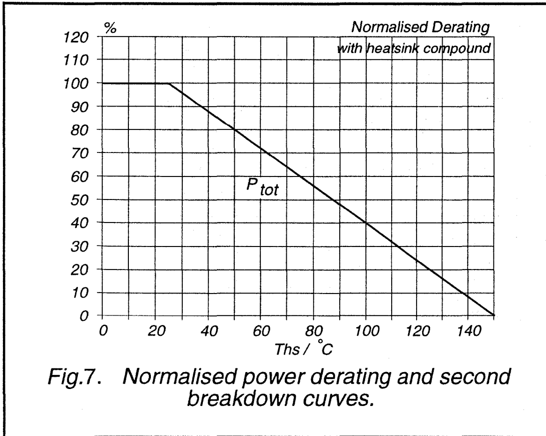


Fig.7. Normalised power derating and second breakdown curves.

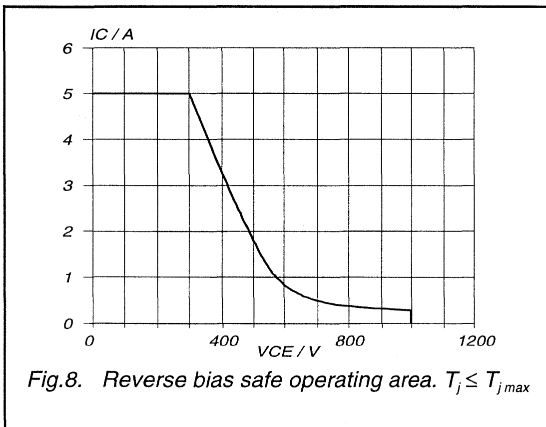


Fig.8. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

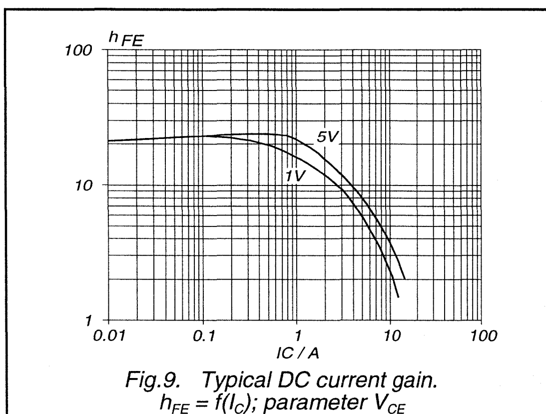


Fig.9. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

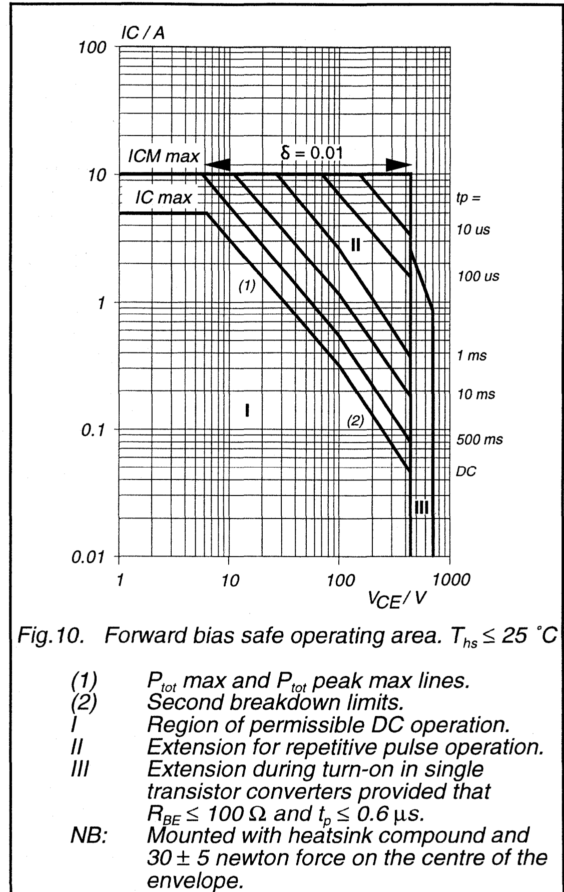


Fig.10. Forward bias safe operating area. $T_{hs} \leq 25$ °C

- (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.

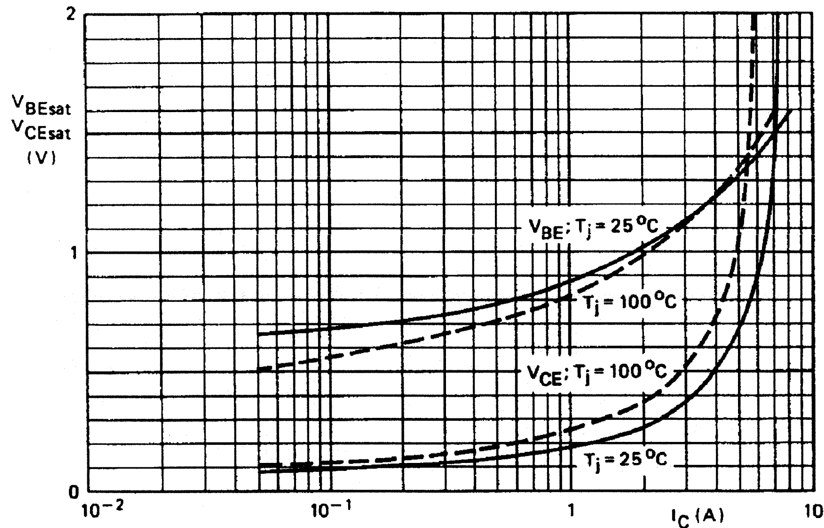


Fig.11. Typical base-emitter and collector-emitter saturation voltages.
$V_{BEsat} = f(I_C)$; $V_{CEsat} = f(I_C)$; $I_C/I_B = 5$

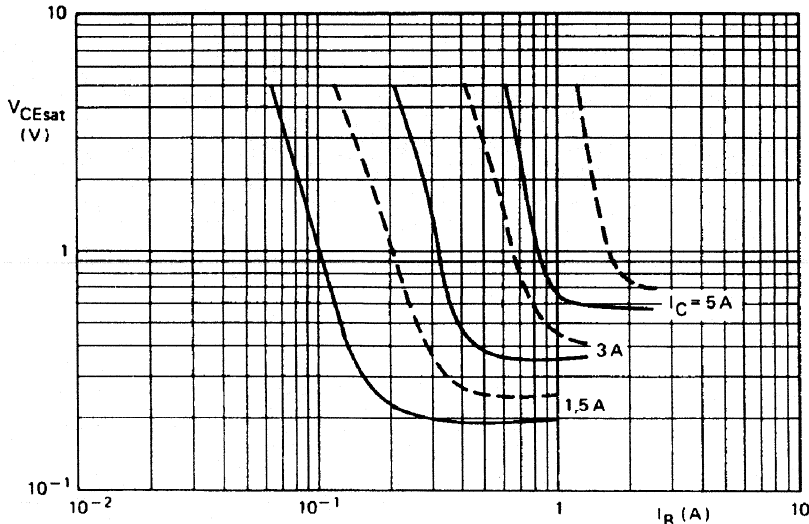


Fig.12. Collector-emitter saturation voltage. Solid lines = typ values, dotted lines = max values. $V_{CEsat} = f(I_B)$; parameter I_C

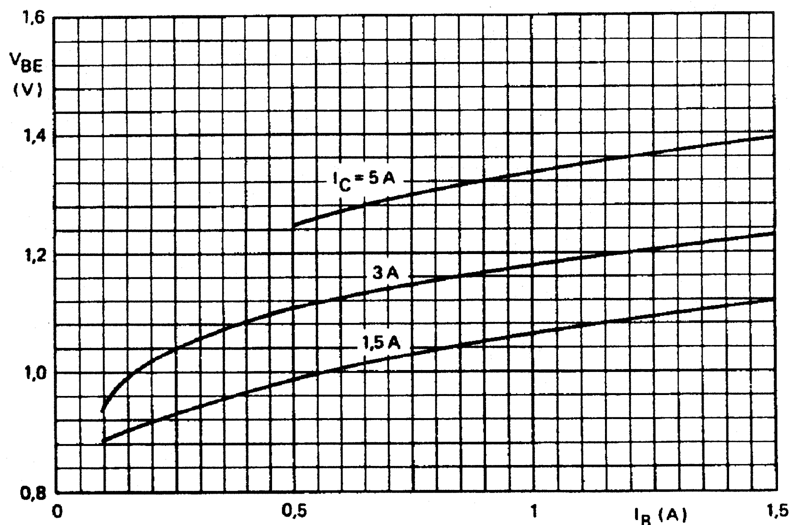


Fig.13. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

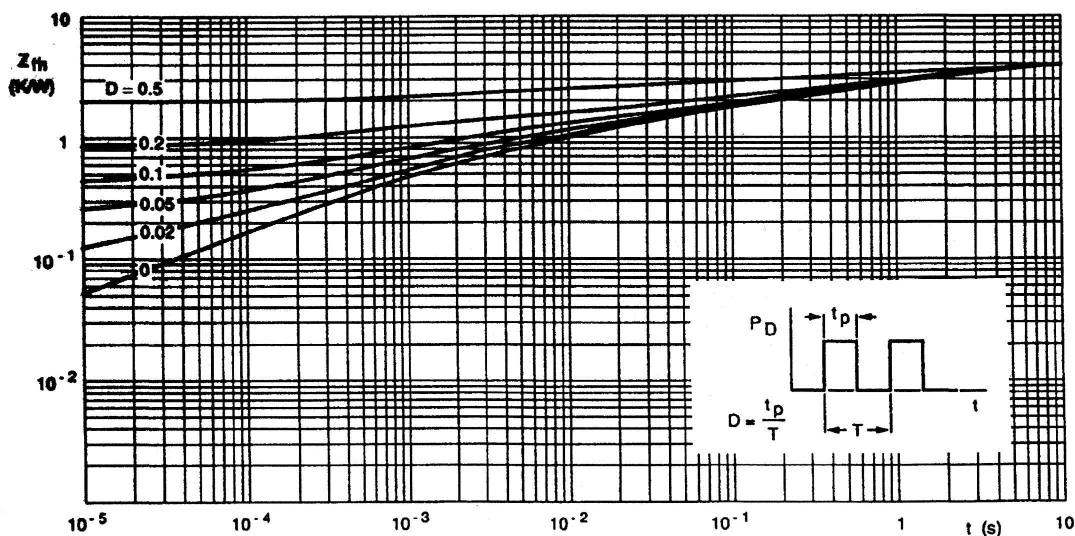


Fig.14. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

GENERAL DESCRIPTION

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

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ 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	-	20	W
V_{CEsat}	Collector-emitter saturation voltage		-	1.5	V
I_{Csat}	Collector saturation current		-	3	A
t_f	Fall time		-	800	ns

[INCLUDE]

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	Collector-emitter voltage peak value	$V_{BE} = 0$ V	-	850	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	-	20	W
T_{stg}	Storage temperature		-65	150	˚C
T_j	Junction temperature		-	150	˚C

THERMAL RESISTANCES

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

ISOLATION LIMITING VALUE & CHARACTERISTIC

$T_{hs} = 25$ ˚C unless otherwise specified

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

STATIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{CES}	Collector cut-off current [1]	V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$	-	-	1.0	mA
I_{CES}		V_{BE} = 0 V; V_{CE} = $V_{CESMmax}$; T_j = 125 ˚C	-	-	2.0	mA
I_{EBO}	Emitter cut-off current	V_{EB} = 9 V; I_C = 0 A	-	-	10	mA
$V_{CEOsust}$	Collector-emitter sustaining voltage	I_B = 0 A; I_C = 100 mA; L = 25 mH	450	-	-	V
V_{CEsat}	Collector-emitter saturation voltages	I_C = 3.0 A; I_B = 0.6 A	-	-	1.5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 3.0 A; I_B = 0.6 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		-	1	µs
t_s	Turn-off storage time		-	4	µs
t_f	Turn-off fall time		-	0.8	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		1.1	1.4	µs
t_f	Turn-off fall time		80	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		1.2	1.5	µs
t_f	Turn-off fall time		140	300	ns

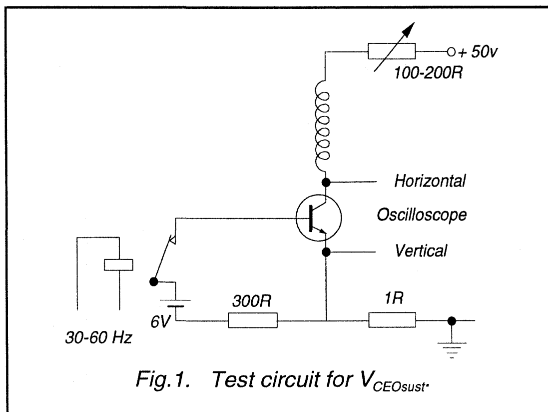


Fig.1. Test circuit for $V_{CEOsust}$.

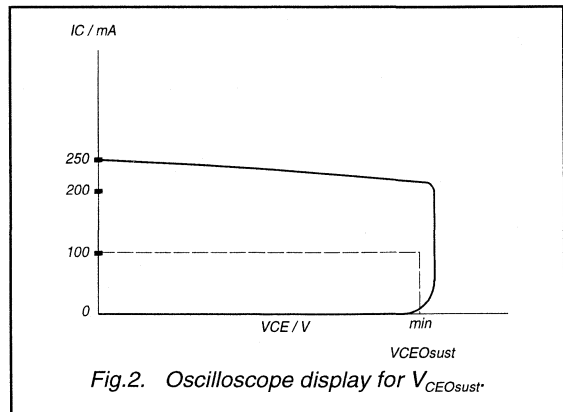


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

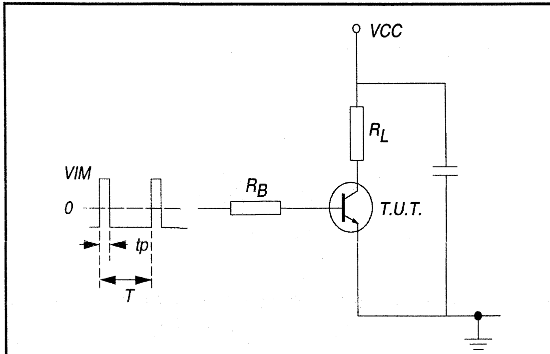


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; δ = t_p / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

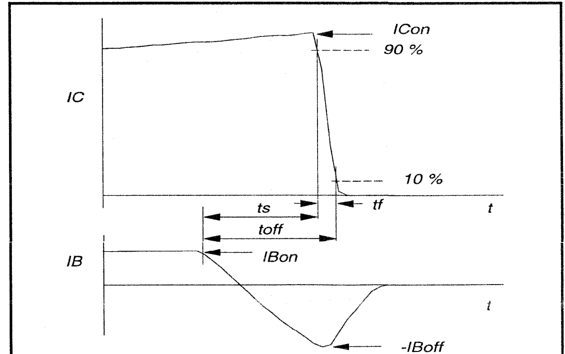


Fig.6. Switching times waveforms with inductive load.

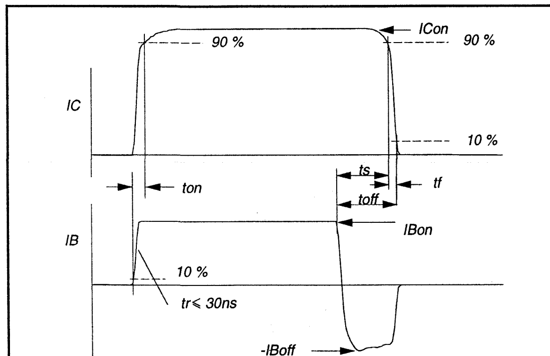


Fig.4. Switching times waveforms with resistive load.

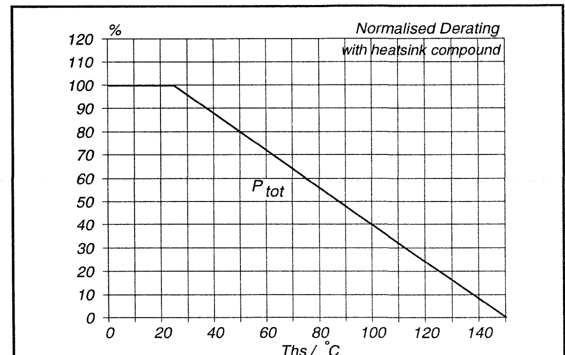


Fig.7. Normalised power derating and second breakdown curves.

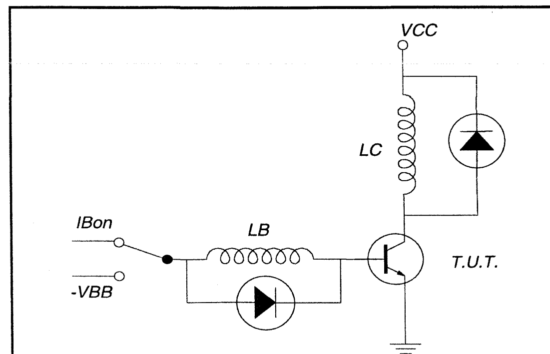


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_C = 200 uH; L_B = 1 uH

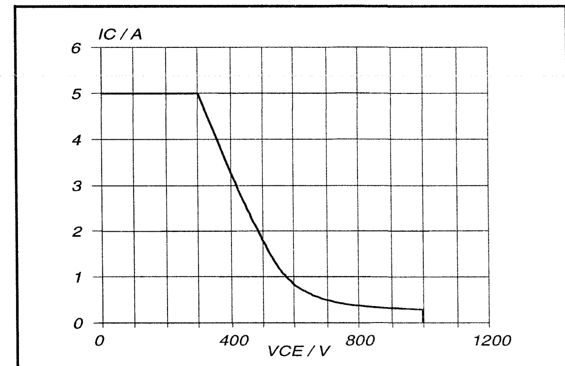


Fig.8. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

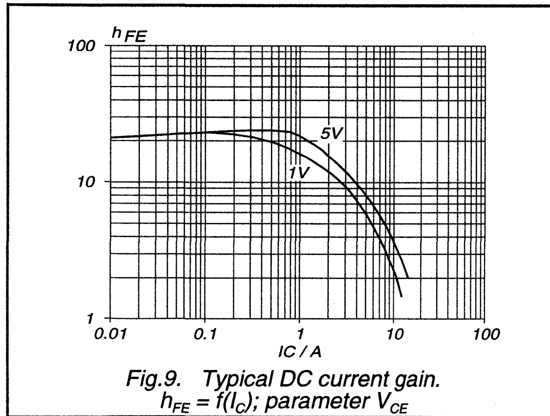


Fig.9. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

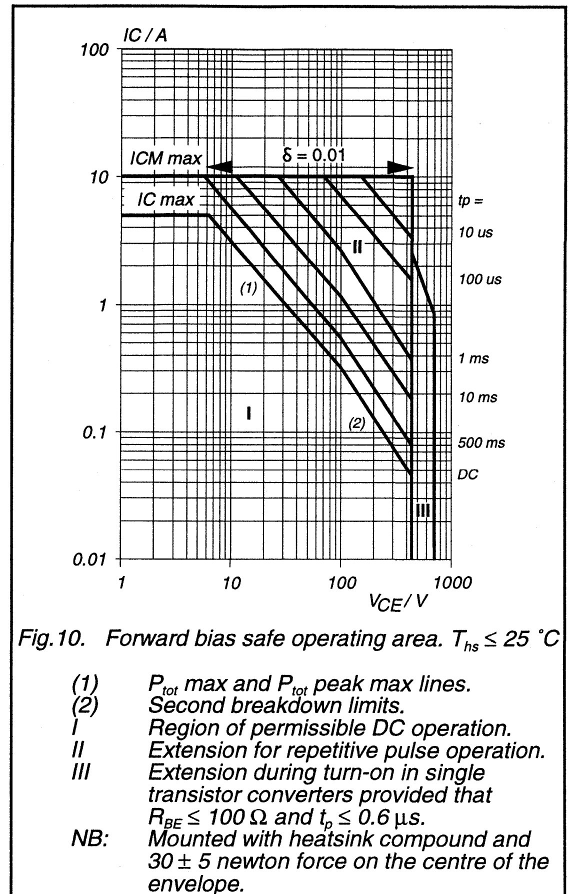


Fig.10. Forward bias safe operating area. $T_{hs} \leq 25$ °C

(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.

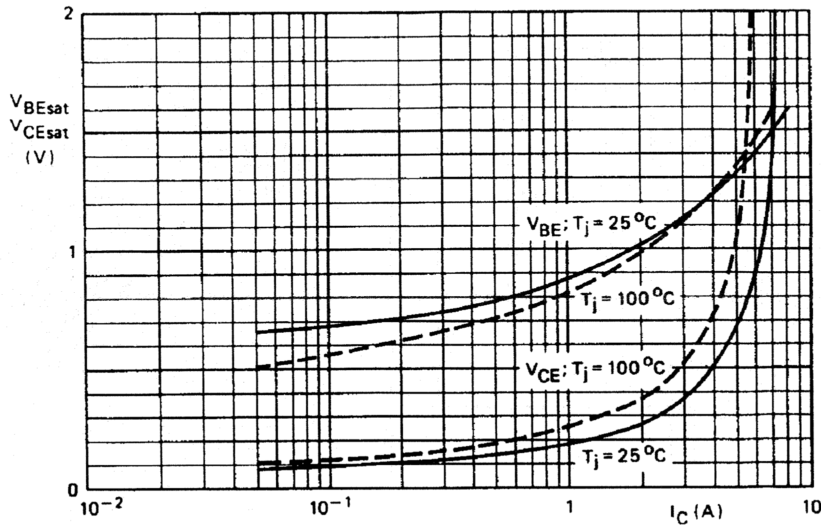


Fig.11. Typical base-emitter and collector-emitter saturation voltages.
$V_{BEsat} = f(I_C)$; $V_{CEsat} = f(I_C)$; $I_C/I_B = 5$

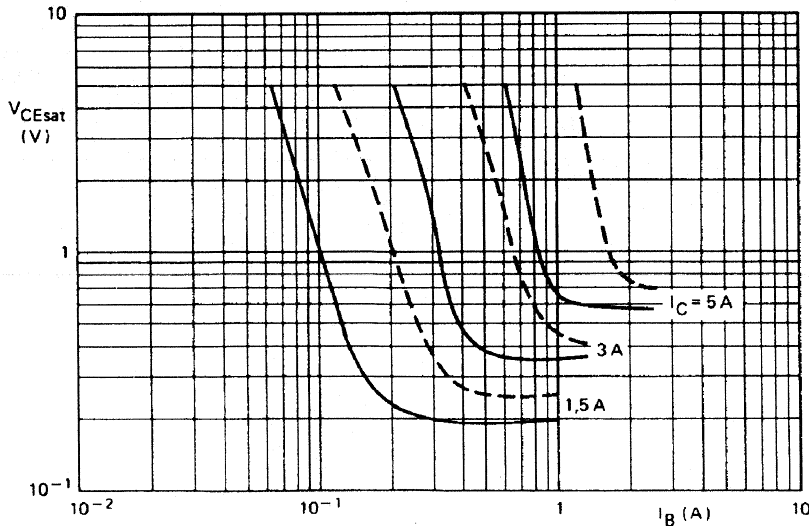


Fig.12. Collector-emitter saturation voltage. Solid lines = typ values,
dotted lines = max values. $V_{CEsat} = f(I_B)$; parameter I_C

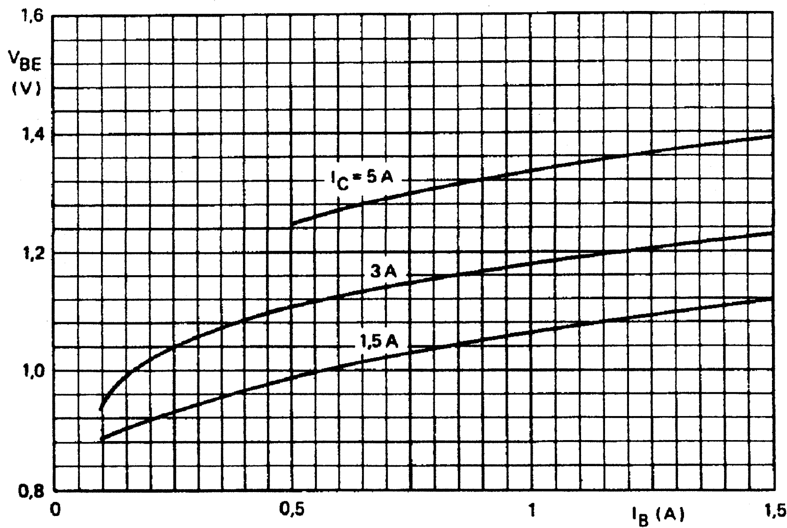


Fig.13. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

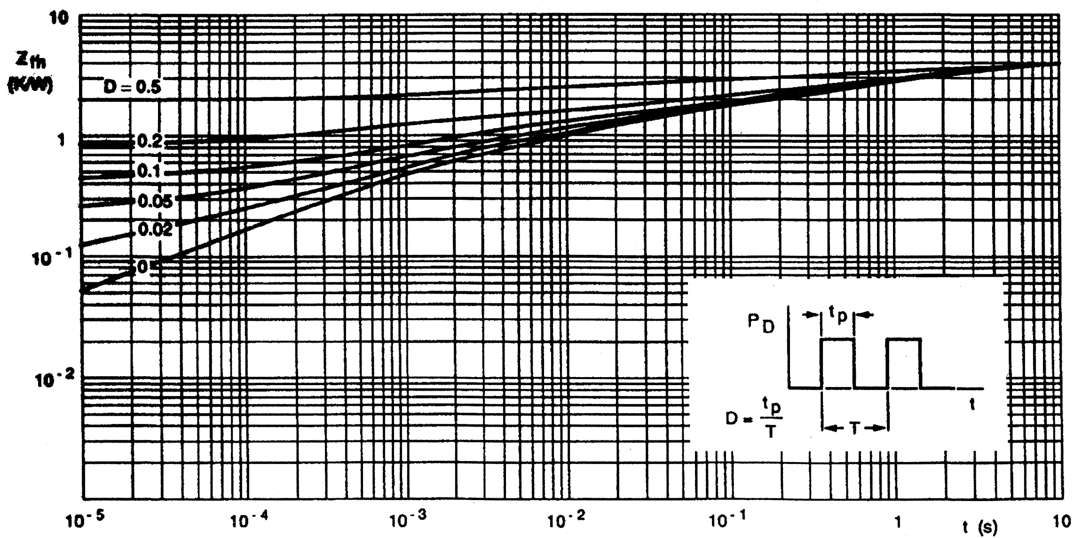


Fig.14. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

GENERAL DESCRIPTION

High-voltage, high-speed glass-passivated npn power transistor in a plastic full-pack envelope intended for use in electronic HF/OH lighting ballast applications, converters, inverters, switching regulators, motor control systems, etc.

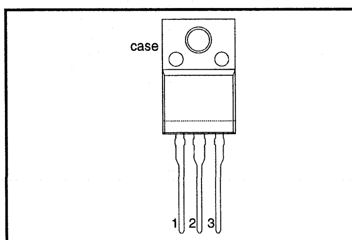
QUICK REFERENCE DATA

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	$I_C = 2.5$ A; $I_B = 0.33$ A	-	1.5	V
I_{Csat}	Collector saturation current		2.5	-	A
t_f	Fall time	I_{Con}=2.5 A; I_{Bon}=0.5 A	80	150	ns

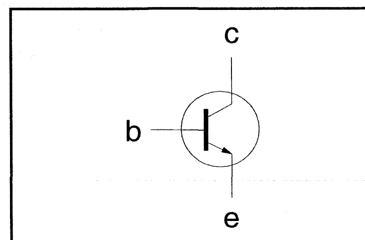
PINNING - SOT186A

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 = 0.33 A	-	-	1.5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 2.5 A; I_B = 0.33 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 5 mA; V_{CE} = 5 V	10	20	35	
h_{FE}		I_C = 500 mA; V_{CE} = 5 V	14	22	35	
h_{FEsat}		I_C = 2.5 A; V_{CE} = 5 V	9	13	17	

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	1.0	μs
t_s	Turn-off storage time		3.4	4.0	μs
t_f	Turn-off fall time		0.6	0.8	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		1.1	1.4	μs
t_f	Turn-off fall time		100	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		1.2	1.5	μs
t_f	Turn-off fall time		140	300	ns

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

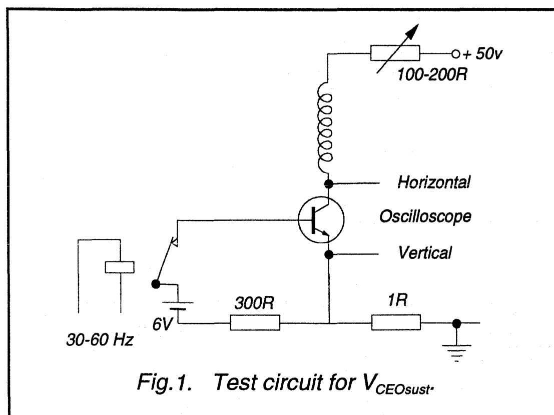


Fig.1. Test circuit for $V_{CEOsust}$.

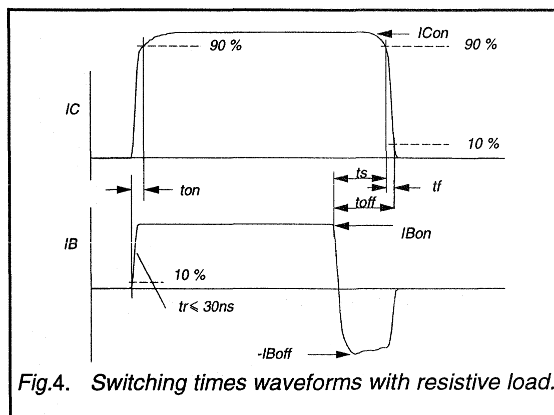


Fig.4. Switching times waveforms with resistive load.

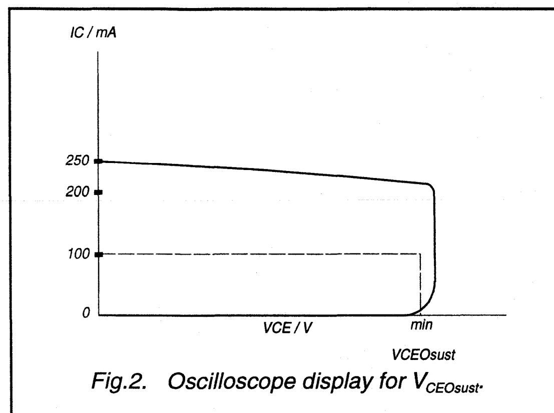


Fig.2. Oscilloscope display for $V_{CEOsust}$.

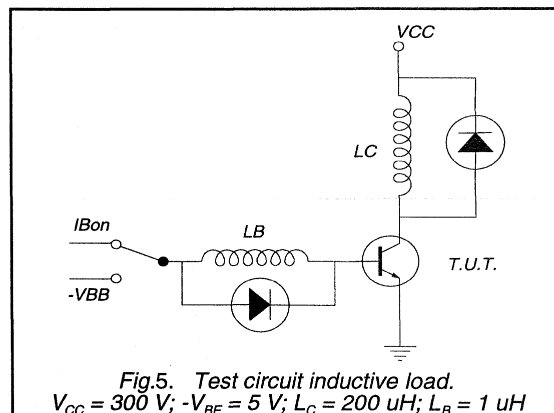


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_C = 200 uH; L_B = 1 uH

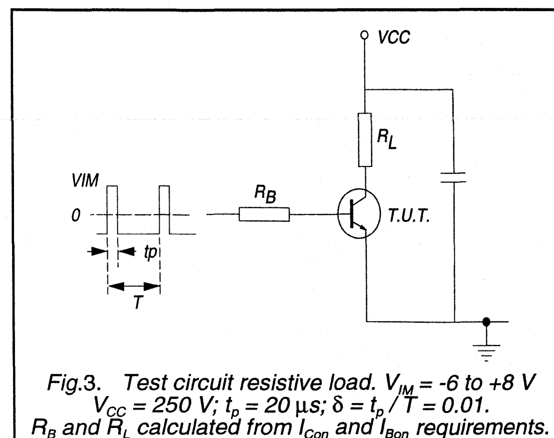


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; t_p = 20 µs; $\delta = t_p / T$ = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

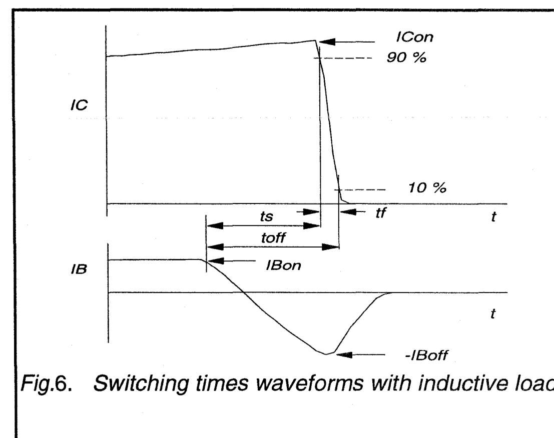


Fig.6. Switching times waveforms with inductive load.

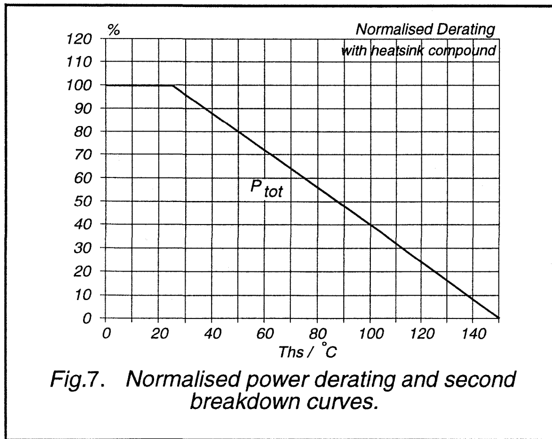


Fig.7. Normalised power derating and second breakdown curves.

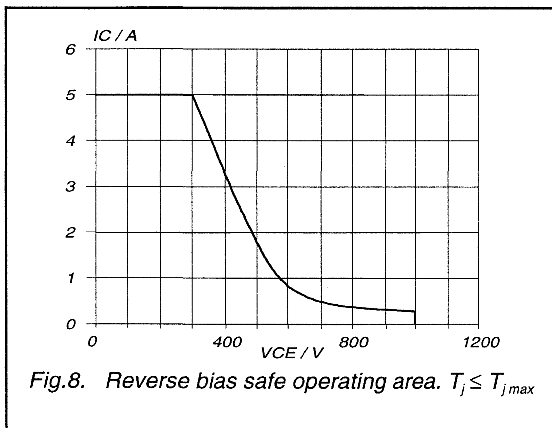


Fig.8. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

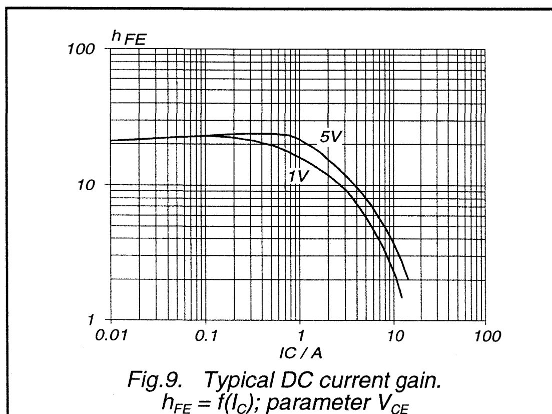


Fig.9. Typical DC current gain. $h_{FE} = f(I_C)$; parameter V_{CE}

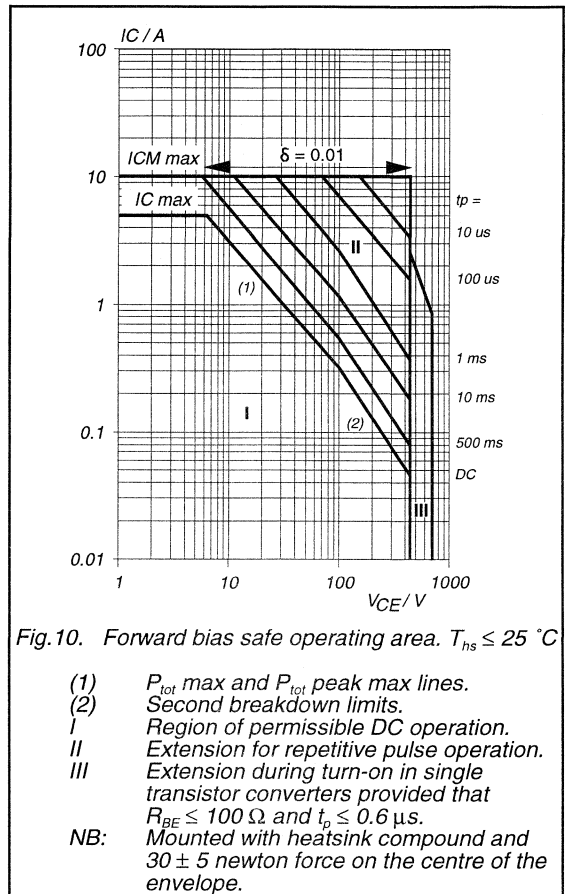


Fig.10. Forward bias safe operating area. $T_{hs} \leq 25$ ˚C

(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.

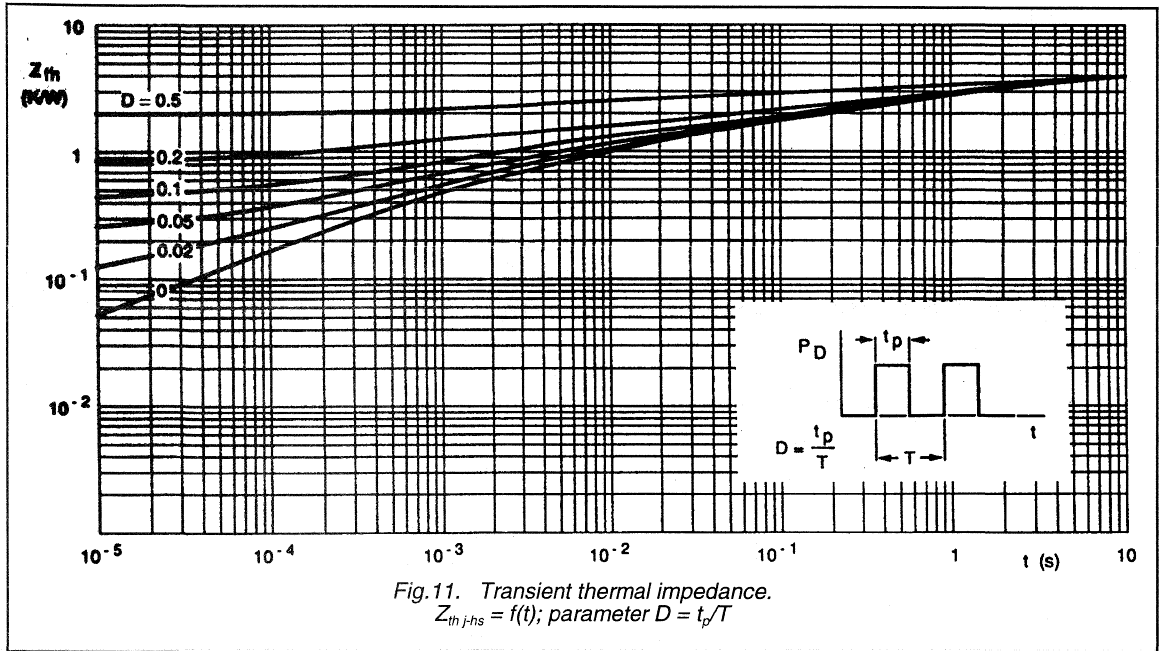


Fig.11. Transient thermal impedance.
$Z_{th\ j\text{-}hs} = f(t)$; parameter $D = t_p/T$

Silicon diffused power transistors BUT12; BUT12A

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a TO-220AB package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

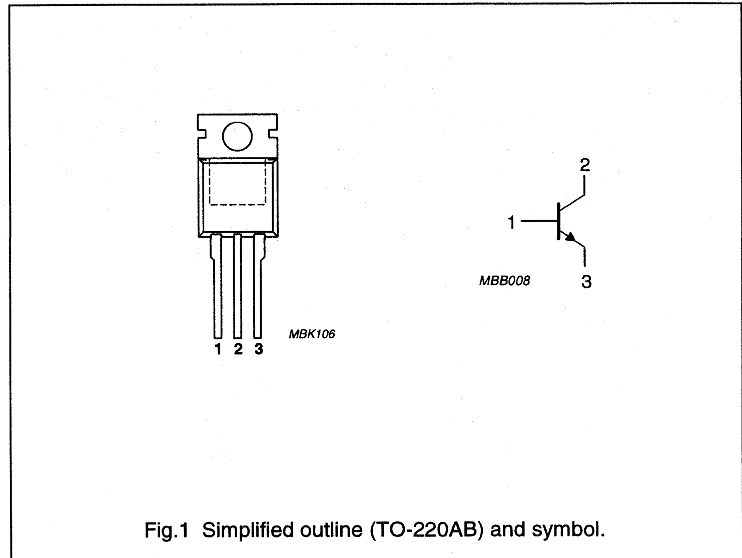


Fig.1 Simplified outline (TO-220AB) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUT12		850	V
	BUT12A		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT12		400	V
	BUT12A		450	V
V_{CEsat}	collector-emitter saturation voltage	see Fig.8	1.5	V
I_{Csat}	collector saturation current			
	BUT12		6	A
	BUT12A		5	A
I_C	collector current (DC)	see Figs 3 and 4	8	A
I_{CM}	collector current (peak value)	see Fig. 4	20	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.2	125	W
t_f	fall time	resistive load; see Figs 12 and 13	0.8	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUT12		–	850	V
	BUT12A		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT12		–	400	V
	BUT12A		–	450	V
I_{Csat}	collector saturation current				
	BUT12		–	6	A
	BUT12A		–	5	A
I_C	collector current (DC)	see Figs 3 and 4	–	8	A
I_{CM}	collector current (peak value)	see Fig. 4	–	20	A
I_B	base current (DC)		–	4	A
I_{BM}	base current (peak value)		–	6	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.2	–	125	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

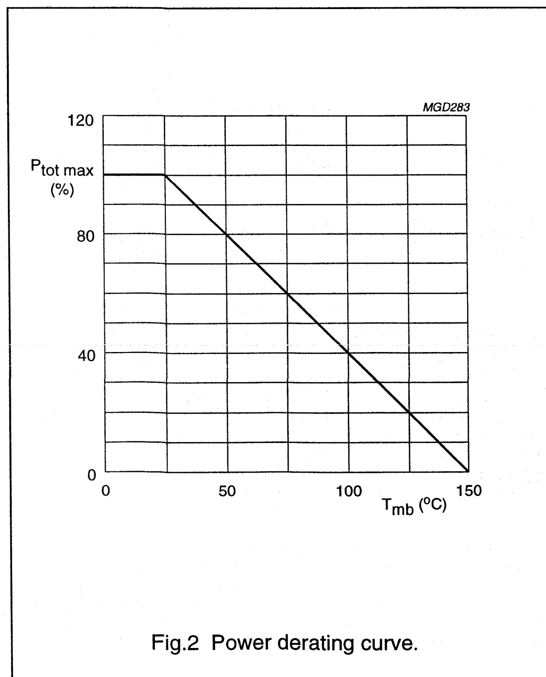
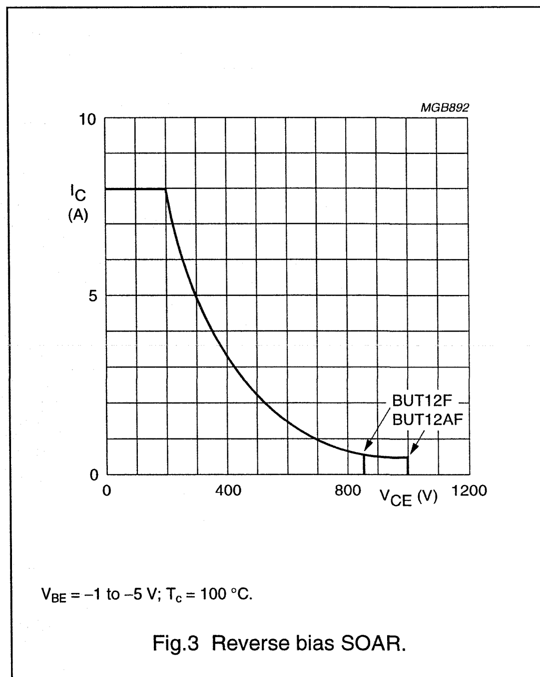


Fig.2 Power derating curve.



$V_{BE} = -1$ to -5 V; $T_c = 100$ °C.

Fig.3 Reverse bias SOAR.

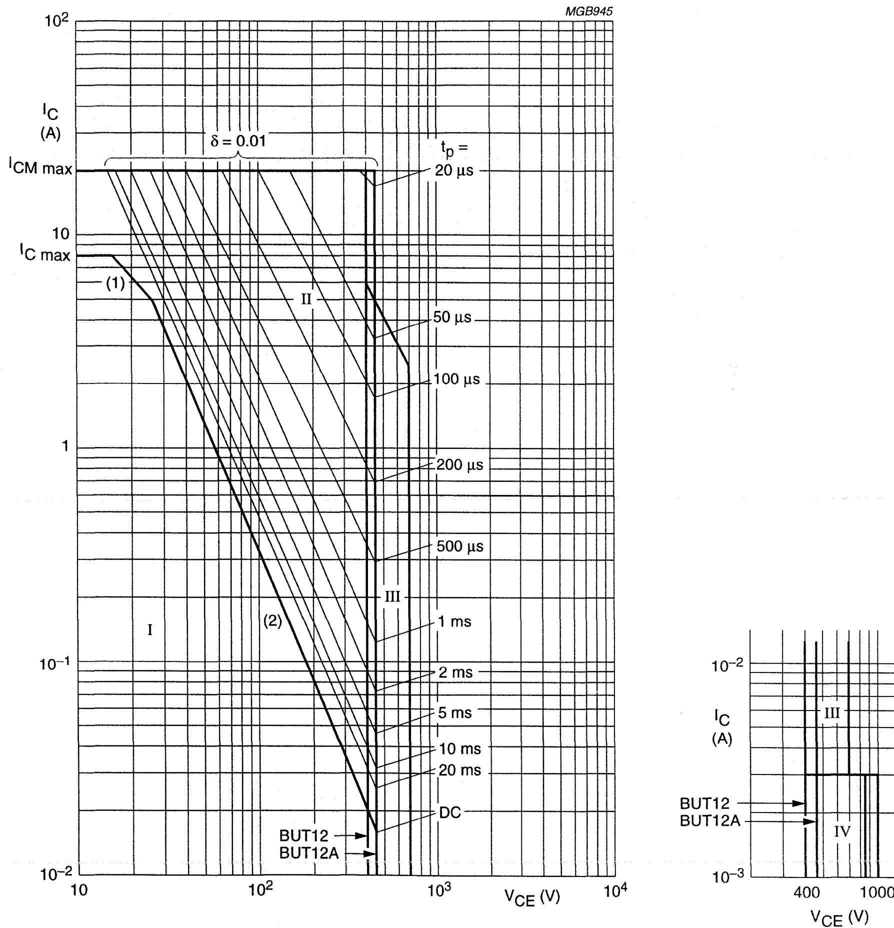
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 6 and 7				
	BUT12		400	–	–	V
	BUT12A		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUT12	I_C = 6 A; I_B = 1.2 A; see Figs 8 and 10	–	–	1.5	V
	BUT12A	I_C = 5 A; I_B = 1 A; see Figs 8 and 10	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUT12	I_C = 6 A; I_B = 1.2 A; see Fig.8	–	–	1.5	V
	BUT12A	I_C = 5 A; I_B = 1 A; see Fig.8	–	–	1.5	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$; V_{BE} = 0; note 1	–	–	1	mA
		$V_{CE} = V_{CESmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	3	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0	–	–	10	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 10 mA; see Fig.11	10	18	35	
		V_{CE} = 5 V; I_C = 1 A; see Fig.11	10	20	35	
Switching times resistive load (see Figs 12 and 13)						
t_{on}	turn-on time					
	BUT12	I_{Con} = 6 A; $I_{Bon} = -I_{Boff}$ = 1.2 A	–	–	1	μs
	BUT12A	I_{Con} = 5 A; $I_{Bon} = -I_{Boff}$ = 1 A	–	–	1	μs
t_s	storage time					
	BUT12	I_{Con} = 6 A; $I_{Bon} = -I_{Boff}$ = 1.2 A	–	–	4	μs
	BUT12A	I_{Con} = 5 A; $I_{Bon} = -I_{Boff}$ = 1 A	–	–	4	μs
t_f	fall time					
	BUT12	I_{Con} = 6 A; $I_{Bon} = -I_{Boff}$ = 1.2 A	–	–	0.8	μs
	BUT12A	I_{Con} = 5 A; $I_{Bon} = -I_{Boff}$ = 1 A	–	–	0.8	μs
Switching times inductive load (see Figs 14 and 15)						
t_s	storage time					
	BUT12	I_{Con} = 6 A; I_{Bon} = 1.2 A; V_{CL} = 250 V; T_c = 100 °C	–	1.9	2.5	μs
	BUT12A	I_{Con} = 5 A; I_{Bon} = 1 A; V_{CL} = 300 V; T_c = 100 °C	–	1.9	2.5	μs
t_f	fall time					
	BUT12	I_{Con} = 6 A; I_{Bon} = 1.2 A; V_{CL} = 250 V; T_c = 100 °C	–	200	300	ns
	BUT12A	I_{Con} = 5 A; I_{Bon} = 1 A; V_{CL} = 300 V; T_c = 100 °C	–	200	300	ns

Note

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



T_{mb} < 25 °C.

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.4 Forward bias SOAR.

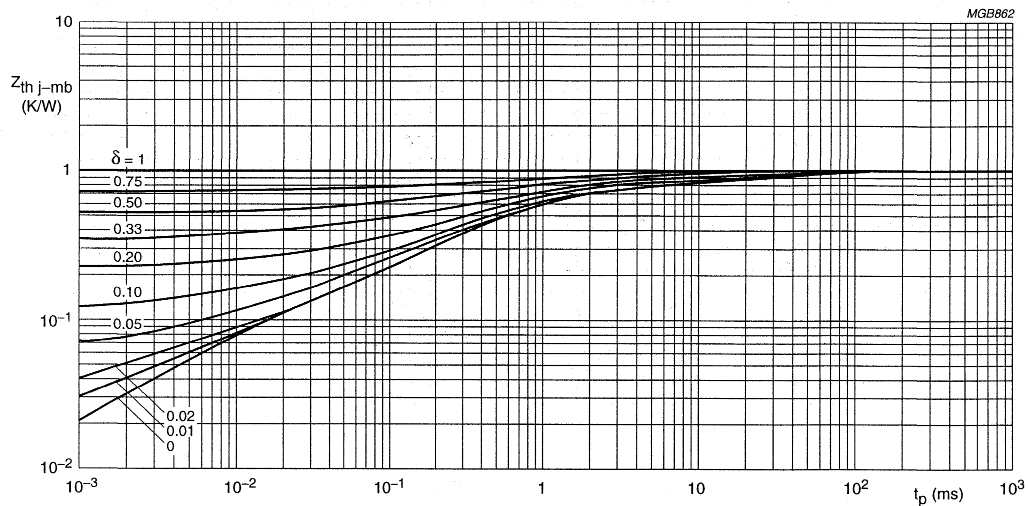


Fig.5 Transient thermal impedance.

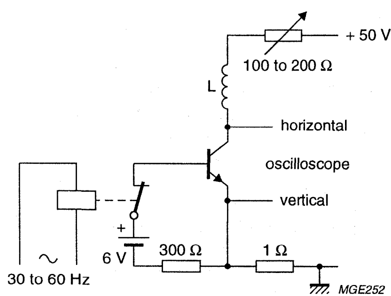


Fig.6 Test circuit for collector-emitter sustaining voltage.

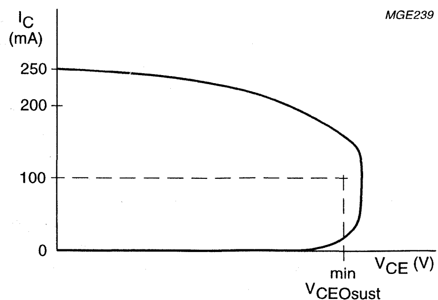
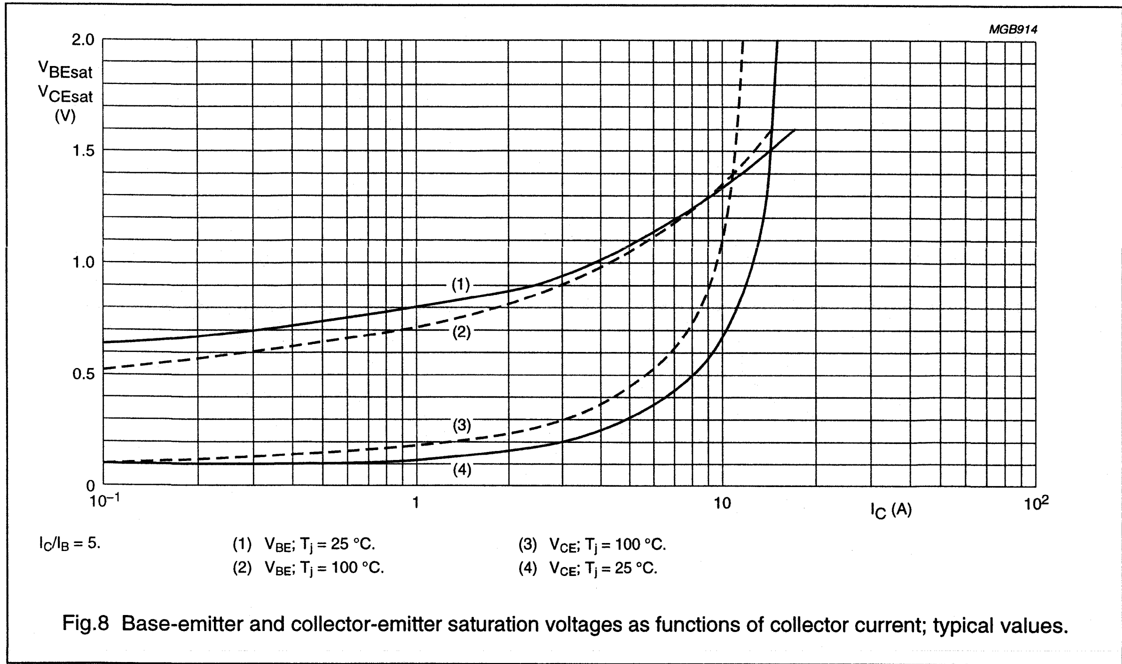


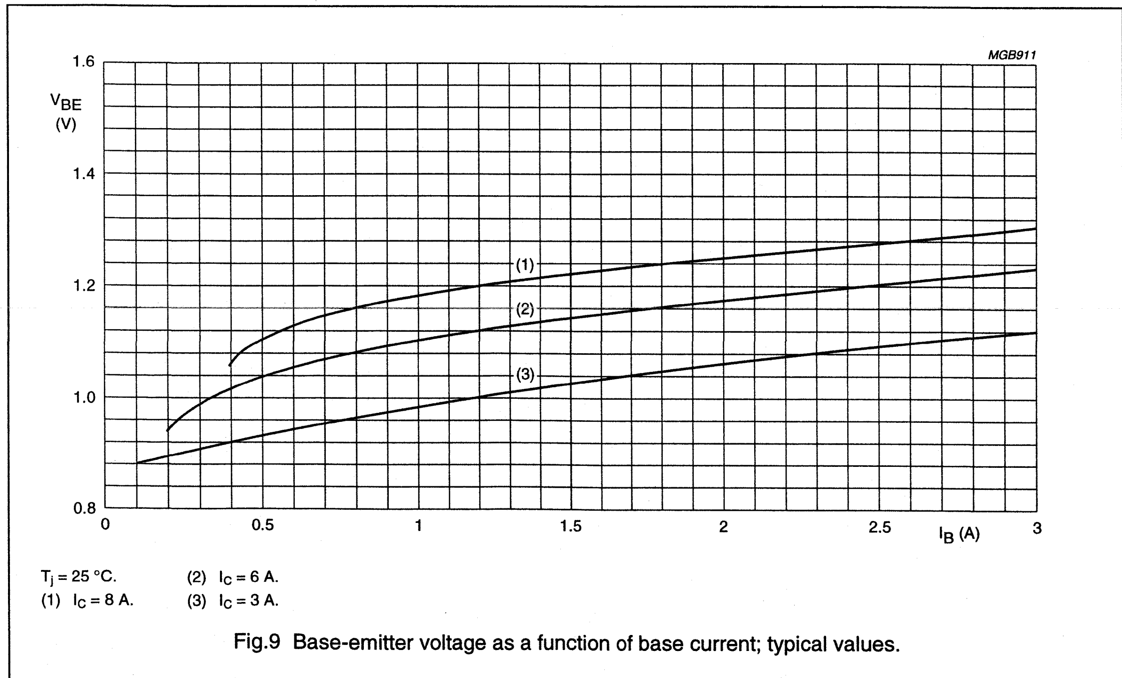
Fig.7 Oscilloscope display for collector-emitter sustaining voltage.



$I_C/I_B = 5$.

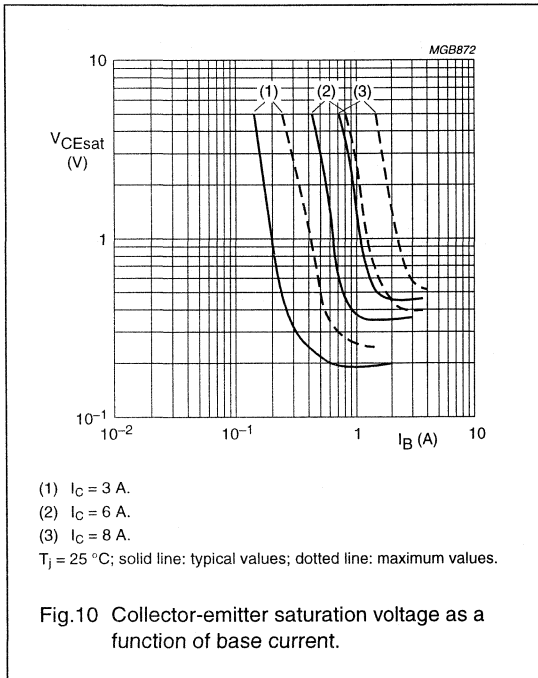
(1) V_{BE}; $T_j = 25$ °C.
(2) V_{BE}; $T_j = 100$ °C.
(3) V_{CE}; $T_j = 100$ °C.
(4) V_{CE}; $T_j = 25$ °C.

Fig.8 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.



$T_j = 25$ °C.
(1) $I_C = 8$ A.
(2) $I_C = 6$ A.
(3) $I_C = 3$ A.

Fig.9 Base-emitter voltage as a function of base current; typical values.



(1) I_C = 3 A.
(2) I_C = 6 A.
(3) I_C = 8 A.
T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.10 Collector-emitter saturation voltage as a function of base current.

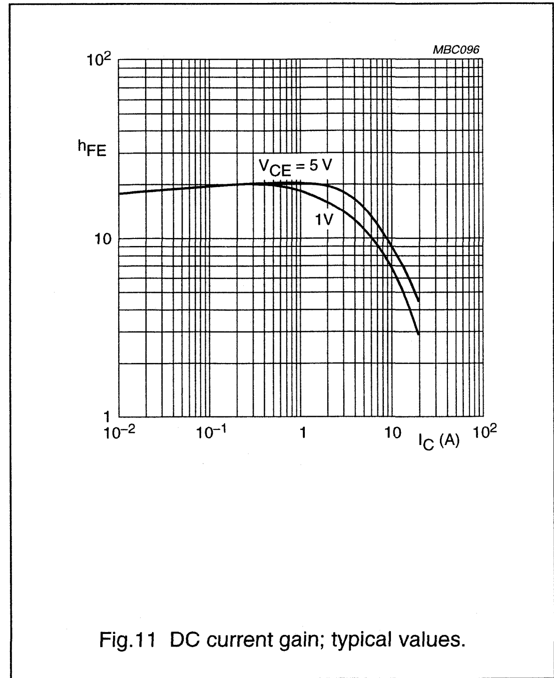
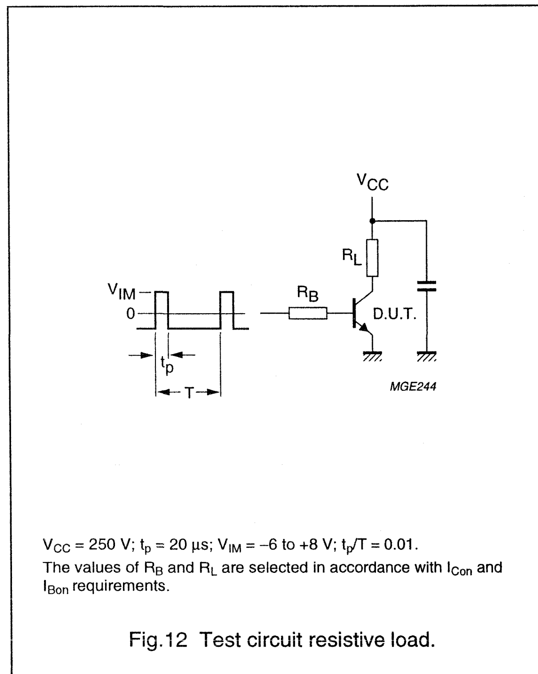
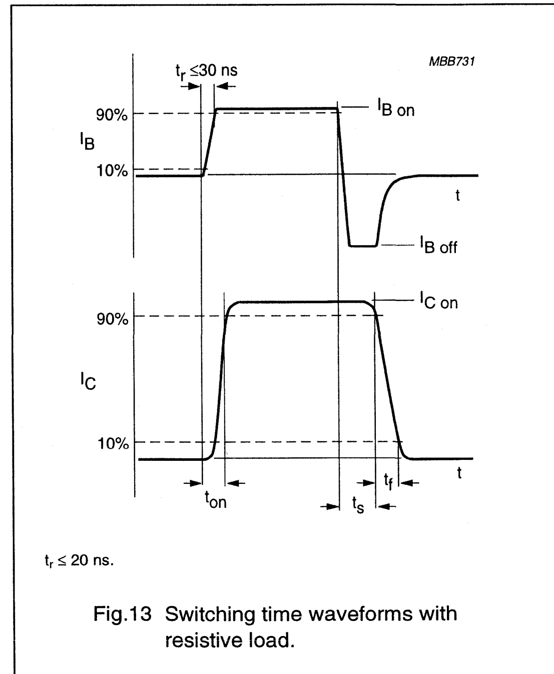


Fig.11 DC current gain; typical values.



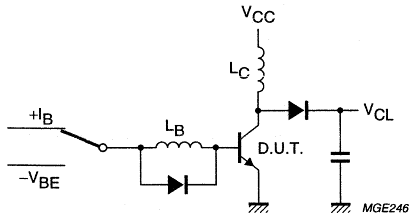
V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.12 Test circuit resistive load.



t_r ≤ 20 ns.

Fig.13 Switching time waveforms with resistive load.



V_{CL} = up to 1000 V; V_{CC} = 30 V; V_{BE} = −1 to −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.14 Test circuit inductive load and reverse bias SOAR.

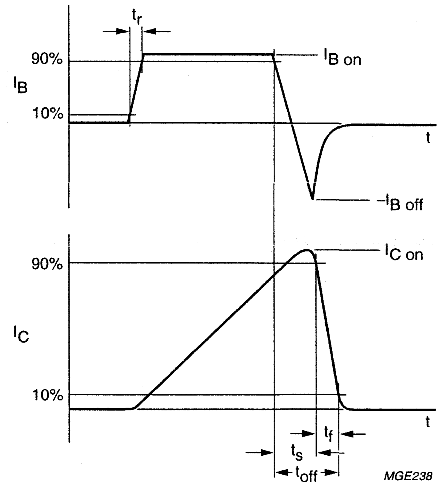


Fig.15 Switching time waveforms with inductive load.

Silicon diffused power transistors BUT12F; BUT12AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT186 plastic package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated from all pins

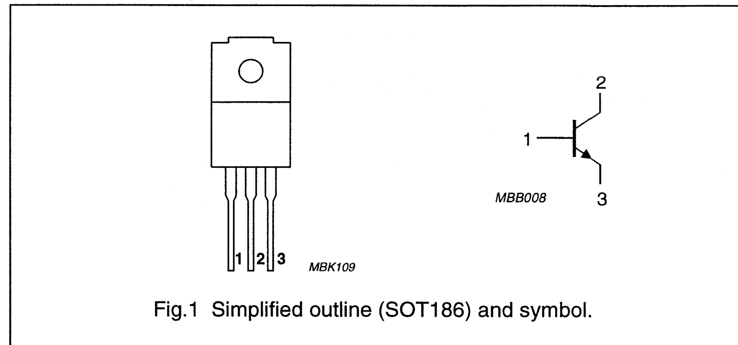


Fig.1 Simplified outline (SOT186) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUT12F		850	V
	BUT12AF		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT12F		400	V
	BUT12AF		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
I_{Csat}	collector saturation current			
	BUT12F		6	A
	BUT12AF		5	A
I_C	collector current (DC)	see Figs 2 and 4	8	A
I_{CM}	collector current (peak value)	see Fig.2	20	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.3	23	W
t_f	fall time	resistive load; see Figs 11 and 12	0.8	µs

Silicon diffused power transistors BUT12F; BUT12AF

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	5.5	K/W
		note 2	3.9	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		55	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUT12F		–	850	V
	BUT12AF		–	1 000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT12F		–	400	V
	BUT12AF		–	450	V
I_{Csat}	collector saturation current				
	BUT12F		–	6	A
	BUT12AF		–	5	A
I_C	collector current (DC)	see Figs 2 and 4	–	8	A
I_{CM}	collector current (peak value)	see Fig.2	–	20	A
I_B	base current (DC)		–	4	A
I_{BM}	base current (peak value)		–	6	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.3; note 1	–	23	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isolM}	isolation voltage from all terminals to external heatsink (peak value)	–	1 500	V
C_{isol}	isolation capacitance from collector to external heatsink	–	12	pF

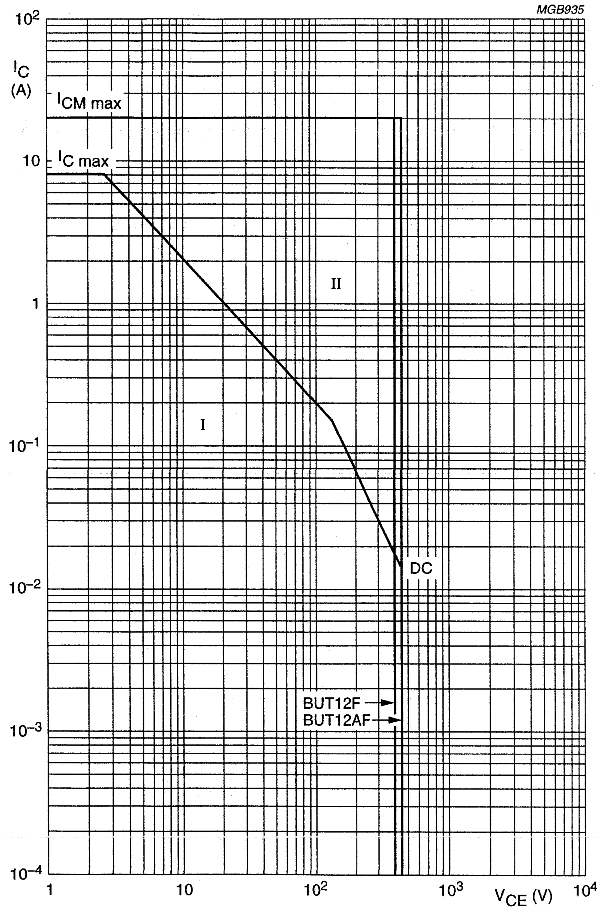
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 5 and 6				
	BUT12F		400	–	–	V
	BUT12AF		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUT12F	I_C = 6 A; I_B = 1.2 A; see Figs 7 and 9	–	–	1.5	V
	BUT12AF	I_C = 5 A; I_B = 1 A; see Figs 7 and 9	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUT12F	I_C = 6 A; I_B = 1.2 A; see Fig.7	–	–	1.5	V
	BUT12AF	I_C = 5 A; I_B = 1 A; see Fig.7	–	–	1.5	V
I_{CES}	collector-emitter cut-off current	V_{CE} = $V_{CESMmax}$; V_{BE} = 0; note 1	–	–	1	mA
		V_{CE} = $V_{CESMmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	3	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0	–	–	10	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 10 mA; see Fig.10	10	18	35	
		V_{CE} = 5 V; I_C = 1 A; see Fig.10	10	20	35	
Switching times resistive load (see Fig.12)						
t_{on}	turn-on time					
	BUT12F	I_{Con} = 6 A; I_{Bon} = $-I_{Boff}$ = 1.2 A	–	–	1	µs
	BUT12AF	I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 1 A	–	–	1	µs
t_s	storage time					
	BUT12F	I_{Con} = 6 A; I_{Bon} = $-I_{Boff}$ = 1.2 A	–	–	4	µs
	BUT12AF	I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 1 A	–	–	4	µs
t_f	fall time					
	BUT12F	I_{Con} = 6 A; I_{Bon} = $-I_{Boff}$ = 1.2 A	–	–	0.8	µs
	BUT12AF	I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 1 A	–	–	0.8	µs
Switching times inductive load (see Fig.14)						
t_s	storage time					
	BUT12F	I_{Con} = 6 A; I_{Bon} = 1.2 A; V_{CL} = 250 V; T_c = 100 °C	–	1.9	2.5	µs
	BUT12AF	I_{Con} = 5 A; I_{Bon} = 1 A; V_{CL} = 300 V; T_c = 100 °C	–	1.9	2.5	µs
t_f	fall time					
	BUT12F	I_{Con} = 6 A; I_{Bon} = 1.2 A; V_{CL} = 250 V; T_c = 100 °C	–	200	300	ns
	BUT12AF	I_{Con} = 5 A; I_{Bon} = 1 A; V_{CL} = 300 V; T_c = 100 °C	–	200	300	ns

Note

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



T_{mb} < 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

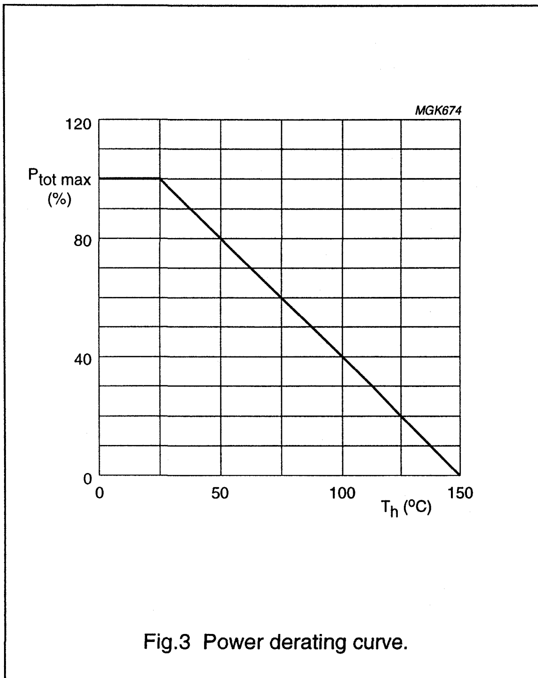
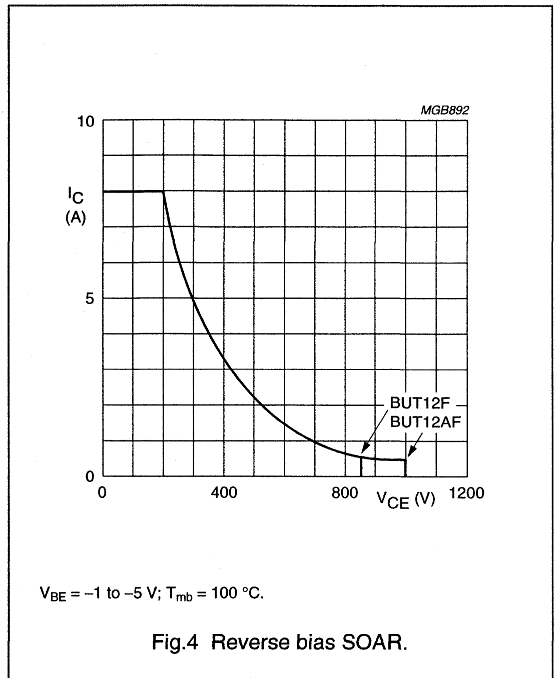


Fig.3 Power derating curve.



V_{BE} = −1 to −5 V; T_{mb} = 100 °C.

Fig.4 Reverse bias SOAR.

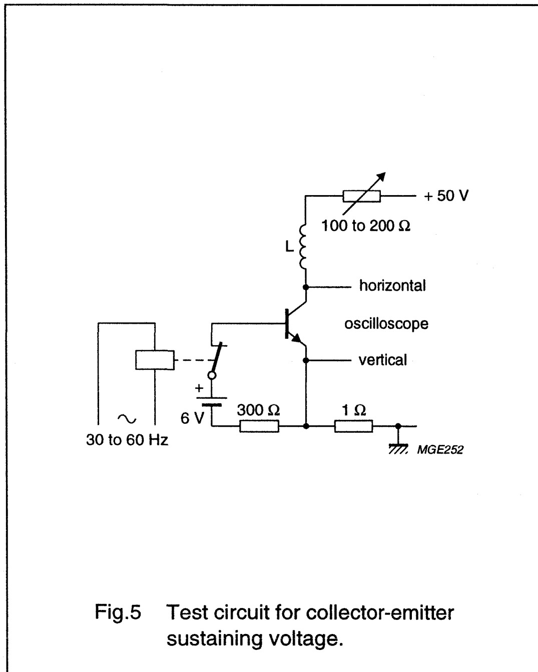


Fig.5 Test circuit for collector-emitter sustaining voltage.

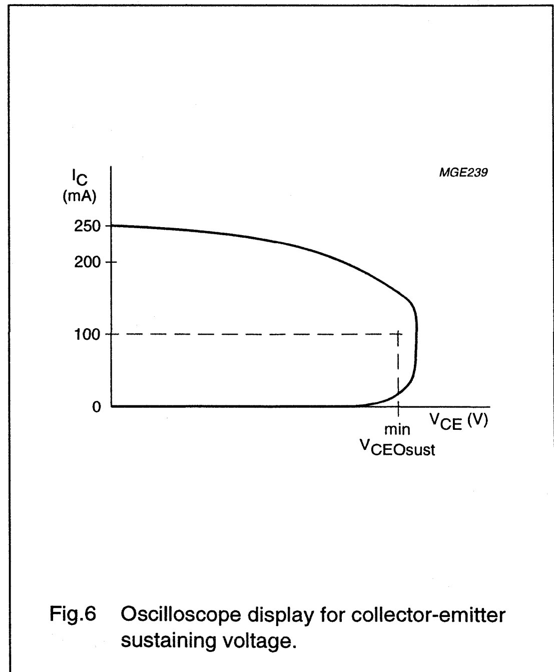
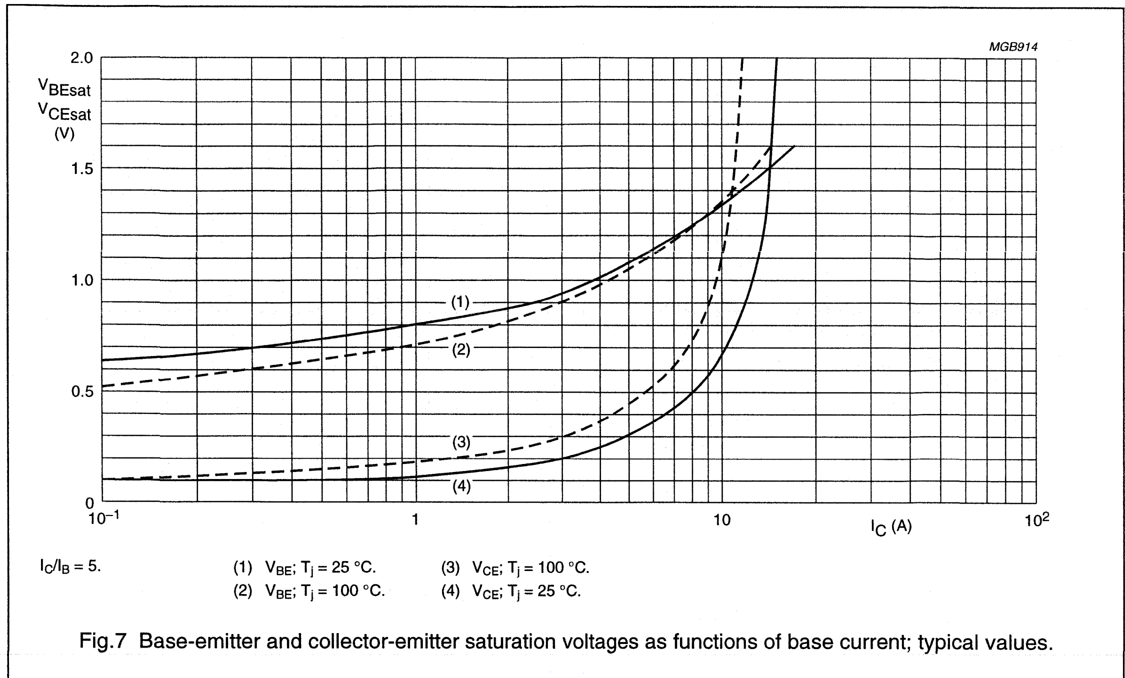


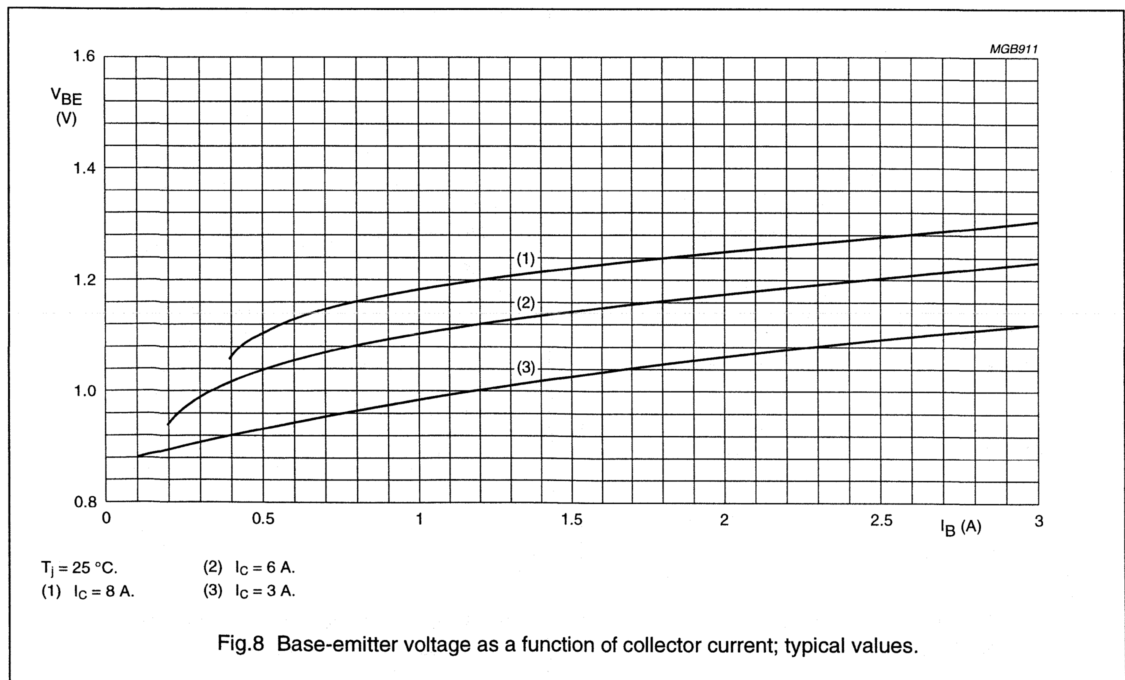
Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



$I_C/I_B = 5$.

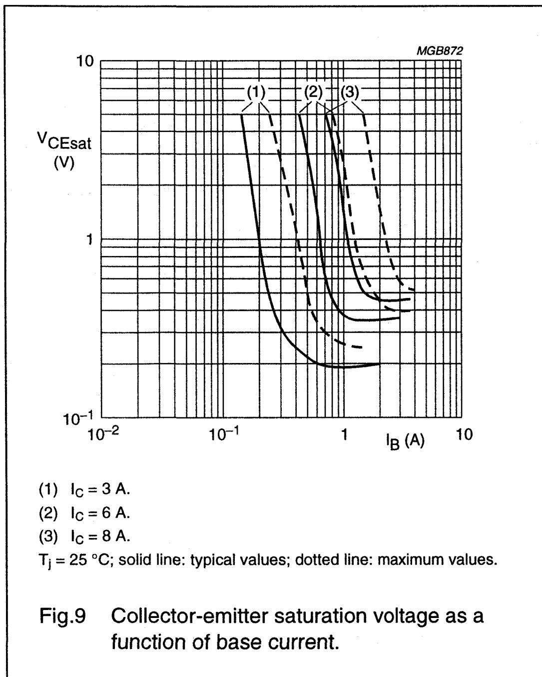
(1) V_{BE}; $T_j = 25$ °C.
(2) V_{BE}; $T_j = 100$ °C.
(3) V_{CE}; $T_j = 100$ °C.
(4) V_{CE}; $T_j = 25$ °C.

Fig.7 Base-emitter and collector-emitter saturation voltages as functions of base current; typical values.



$T_j = 25$ °C.
(1) $I_C = 8$ A.
(2) $I_C = 6$ A.
(3) $I_C = 3$ A.

Fig.8 Base-emitter voltage as a function of collector current; typical values.



(1) I_C = 3 A.
(2) I_C = 6 A.
(3) I_C = 8 A.
T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.9 Collector-emitter saturation voltage as a function of base current.

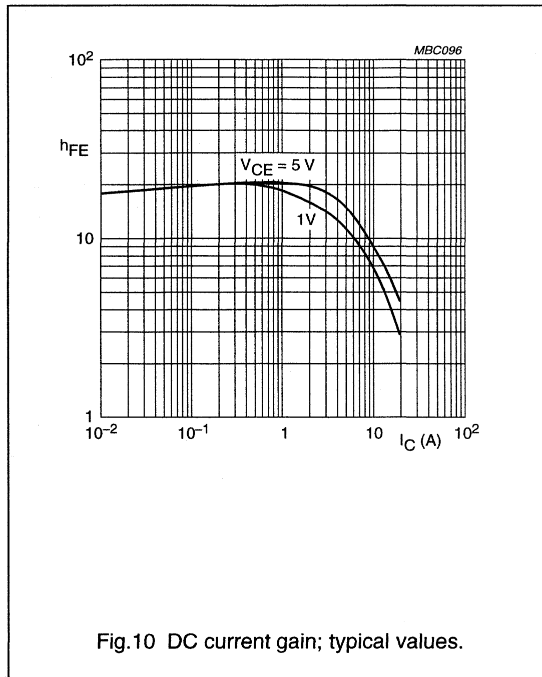
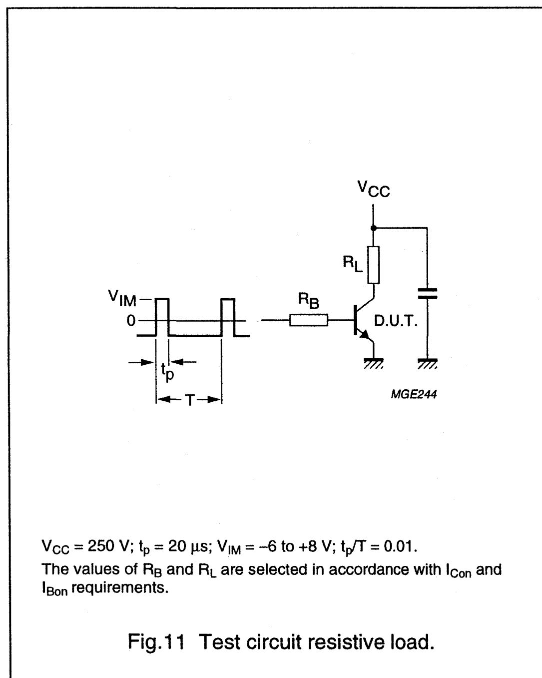
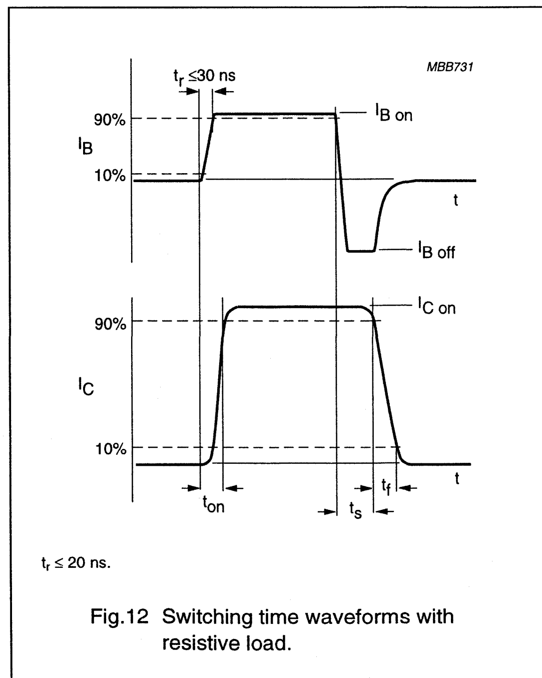


Fig.10 DC current gain; typical values.



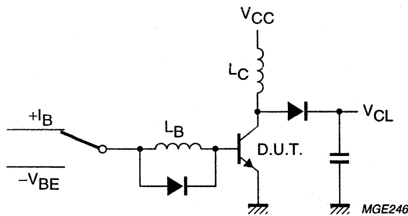
V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.11 Test circuit resistive load.



t_r ≤ 20 ns.

Fig.12 Switching time waveforms with resistive load.



V_{CL} = up to 1 000 V; V_{CC} = 30 V; V_{BE} = −1 to −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.13 Test circuit inductive load and reverse bias SOAR.

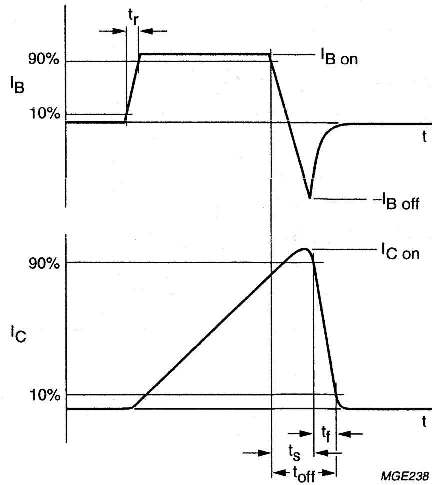


Fig.14 Switching times waveforms with inductive load.

GENERAL DESCRIPTION

Improved high-voltage, high-speed glass-passivated npn power transistor in a TO220AB envelope specially suited for use in overhead/high frequency lighting ballast applications and converters, inverters, switching regulators, motor control systems, etc.

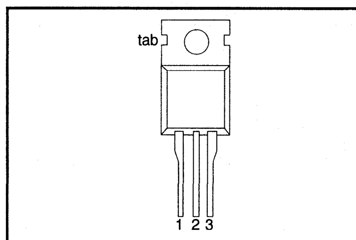
QUICK REFERENCE DATA

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)		-	8	A
I_{CM}	Collector current peak value		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	110	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5$ A; $I_B = 0.86$A	-	1.5	V
I_{Csat}	Collector saturation current		5	-	A
t_f	Inductive fall time	$I_{Con} = 5$ A; $I_{Bon} = 1.0$ A;$T_j \leq 100$˚C		300	ns

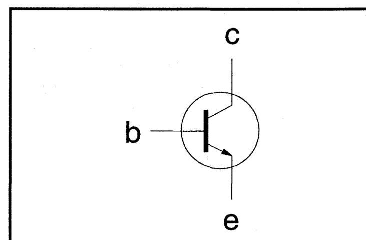
PINNING - TO220AB

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	-	1000	V
V_{CEO}	Collector-emitter voltage (open base)		-	450	V
I_C	Collector current (DC)		-	8	A
I_{CM}	Collector current peak value		-	20	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	110	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	-	1.15	K/W
$R_{th\ j-a}$	Junction to ambient	in free air	-	60	K/W

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	-	-	3.0	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 = 5 A; I_B = 0.86 A	-	-	1.5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5 A; I_B = 0.86 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 10mA; V_{CE} = 5 V	10	18	35	
h_{FE}		I_C = 1.0A; V_{CE} = 5 V	14	20	35	
h_{FEsat}		I_C = 5.0A; V_{CE} = 1.5 V	5.8	10	12.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} =5 A; I_{Bon} = -I_{Boff} = 1.0 A			
t_{on}	Turn-on time		-	1.0	µs
t_s	Turn-off storage time		-	4.0	µs
t_f	Turn-off fall time		-	0.8	µs
	Switching times (inductive load)	I_{Con} = 5 A; I_{Bon} = 1.0 A; L_B = 1 µH; -V_{BB} = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		1.9	2.5	µs
t_f	Turn-off fall time		150	300	ns

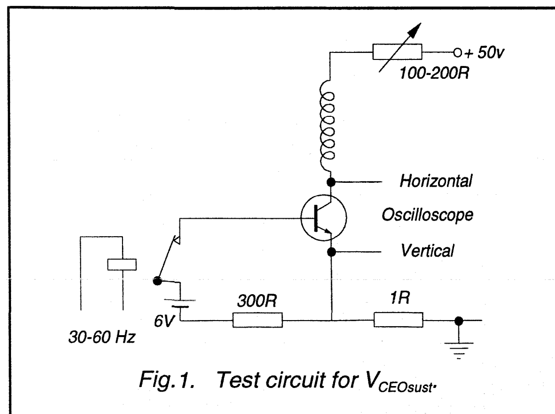


Fig.1. Test circuit for $V_{CEOsust}$.

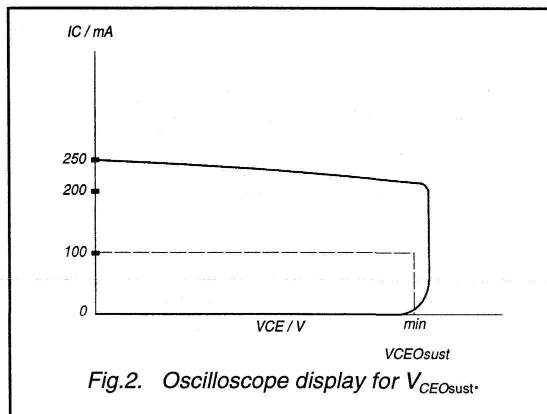


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

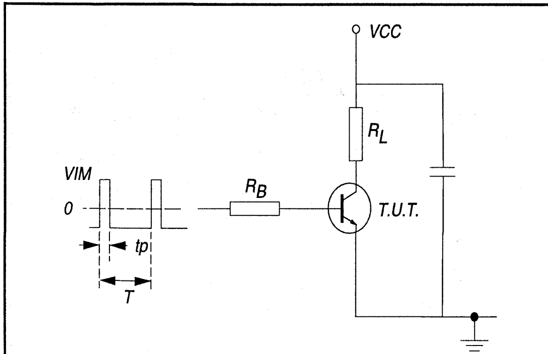


Fig.3. Test circuit resistive load. VIM = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

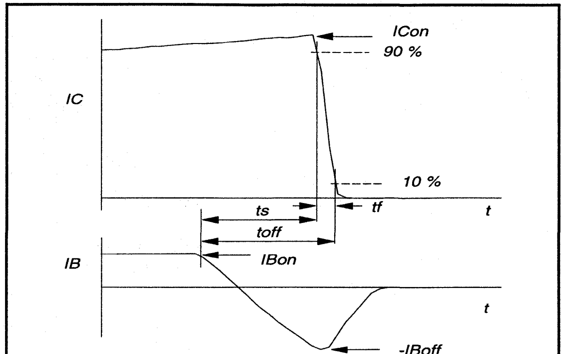


Fig.6. Switching times waveforms with inductive load.

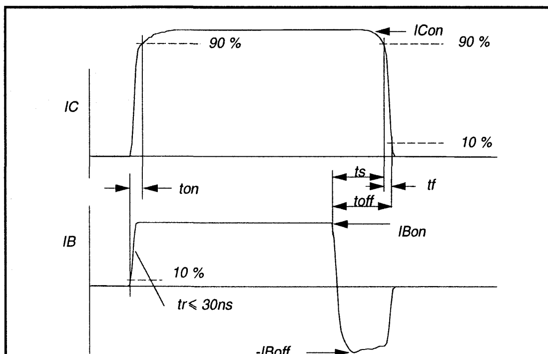


Fig.4. Switching times waveforms with resistive load.

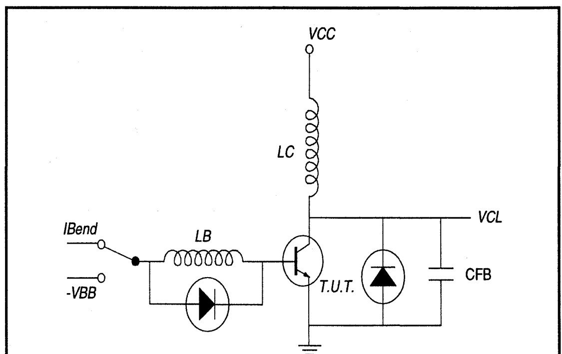


Fig.7. Test circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 5 V
L_C = 200 µH; V_{CL} ≤ 850 V; L_B = 1 µH

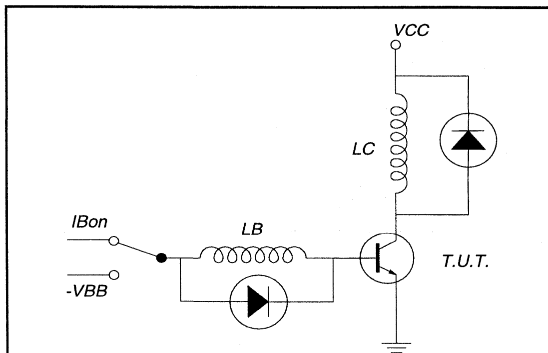


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V;L_B = 1 uH

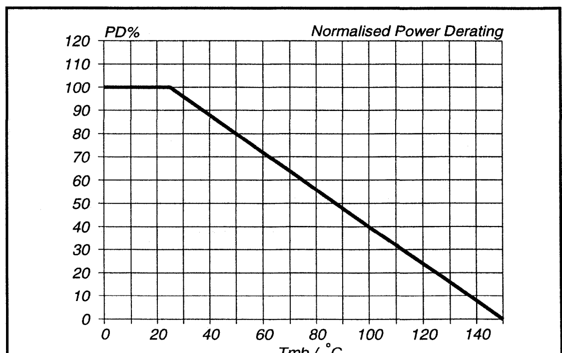


Fig.8. Normalised power dissipation.
PD% = 100·PD/PD $_{25°C}$ = f (T_{mb})

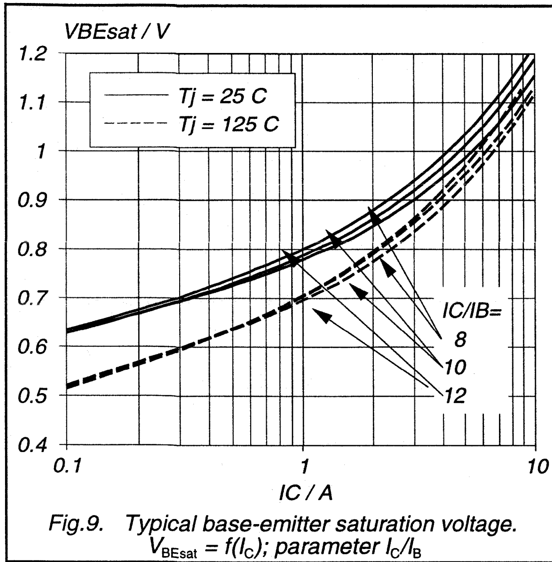


Fig.9. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_C)$; parameter I_C/I_B

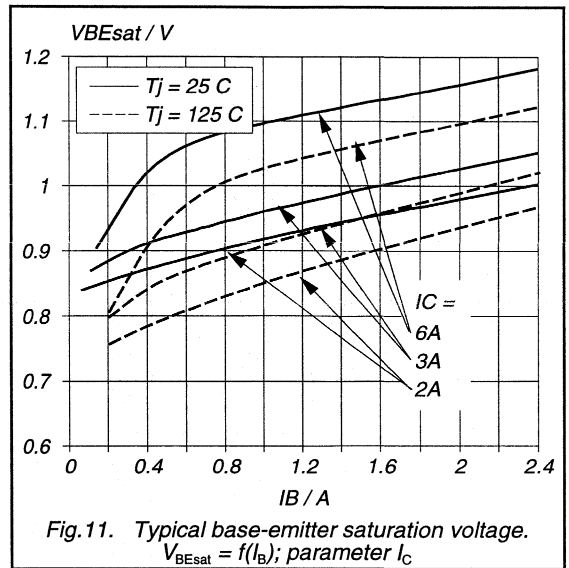


Fig.11. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_B)$; parameter I_C

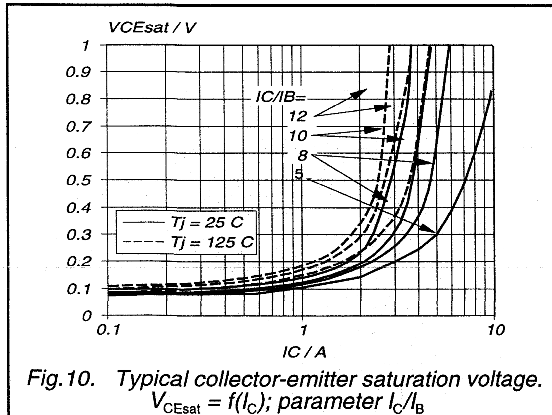


Fig.10. Typical collector-emitter saturation voltage. $V_{CEsat} = f(I_C)$; parameter I_C/I_B

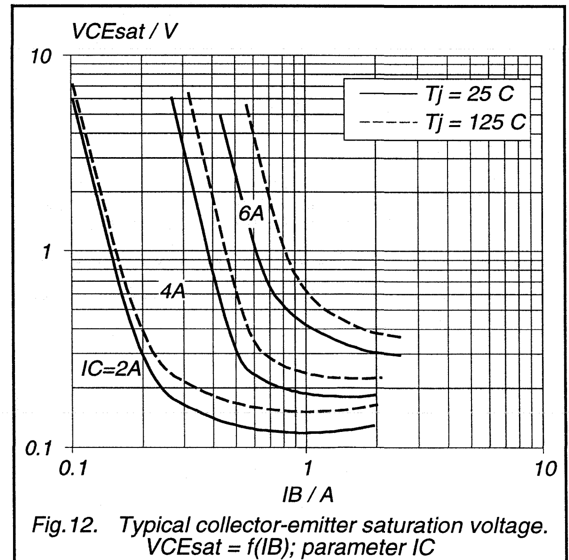


Fig.12. Typical collector-emitter saturation voltage. VCEsat = f(IB); parameter IC

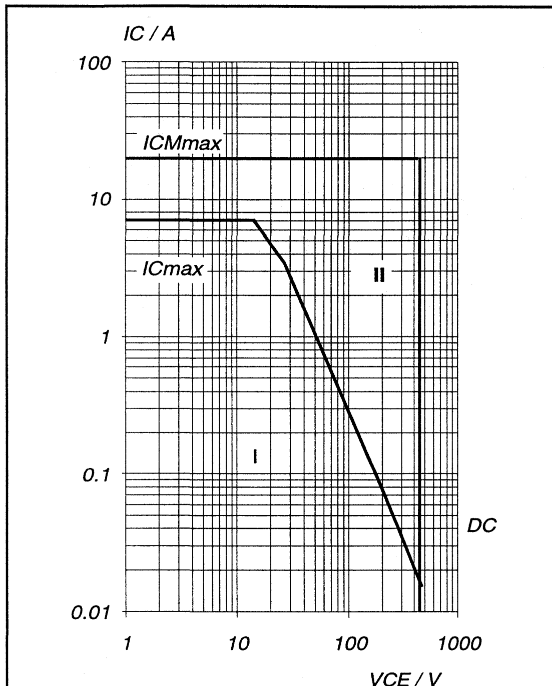


Fig.13. Forward bias safe operating area. T_{mb} = 25˚C

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.

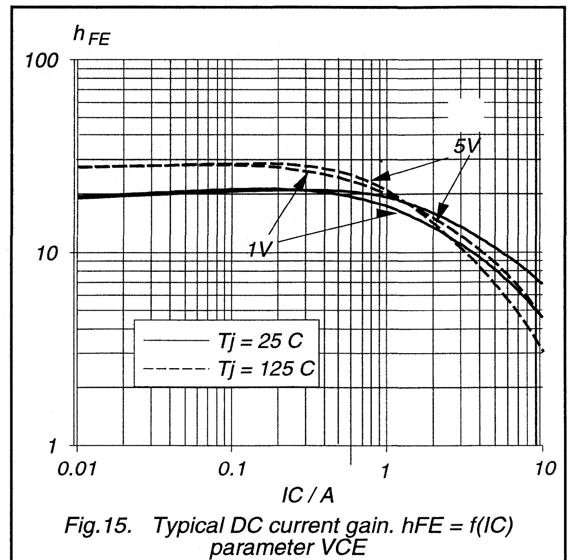


Fig.15. Typical DC current gain. hFE = f(IC) parameter VCE

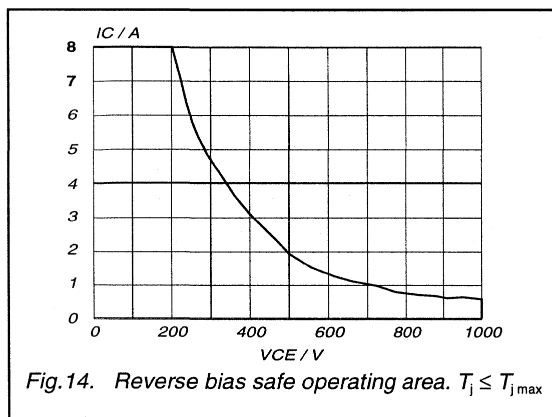


Fig.14. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

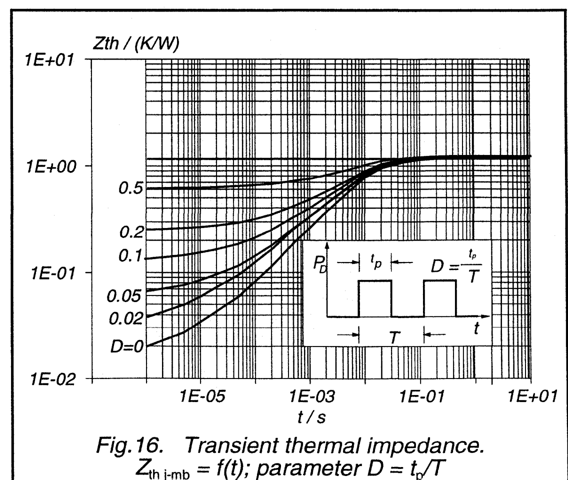


Fig.16. Transient thermal impedance. $Z_{th\,j\text{-}mb}$ = f(t); parameter $D = t_p/T$

GENERAL DESCRIPTION

Improved high-voltage, high-speed glass-passivated npn power transistor in a plastic full-pack envelope specially suited for overhead/high frequency lighting ballast applications and converters, inverters, switching regulators, motor control systems, etc.

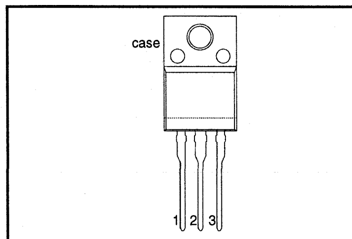
QUICK REFERENCE DATA

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)		-	8	A
I_{CM}	Collector current peak value		-	20	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	33	W
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 5.0$ A; $I_B = 0.86$ A	-	1.5	V
I_{Csat}	Collector saturation current		5	-	A
t_f	Inductive fall time	$I_{Con} = 5.0$A; $I_{Bon} = 1.0$A, $T_j \leq 100$˚C	-	300	ns

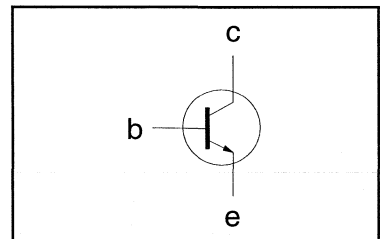
PINNING - SOT186A

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)		-	8	A
I_{CM}	Collector current peak value		-	20	A
I_B	Base current (DC)		-	4	A
I_{BM}	Base current peak value		-	6	A
P_{tot}	Total power dissipation	$T_{hs} \leq 25$ ˚C	-	33	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	-	3.65	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	-	-	3.0	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 = 5 A; I_B = 0.86 A	-	-	1.5	V
V_{BEsat}	Base-emitter saturation voltage	I_C = 5 A; I_B = 0.86 A	-	-	1.3	V
h_{FE}	DC current gain	I_C = 10 mA; V_{CE} = 5 V	10	18	35	
h_{FE}		I_C = 1 A; V_{CE} = 5 V	14	20	35	
h_{FEsat}		I_C = 5 A; V_{CE} = 1.5 V	5.8	10	12.5	

DYNAMIC CHARACTERISTICS

T_{hs} = 25 ˚C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
	Switching times (resistive load)	I_{Con} = 5.0 A; I_{Bon} = $-I_{Boff}$ = 1.0 A			
t_{on}	Turn-on time		-	1.0	µs
t_s	Turn-off storage time		-	4.0	µs
t_f	Turn-off fall time		-	0.8	µs
	Switching times (inductive load)	I_{Con} = 5.0 A; I_{Bon} = 1.0 A; L_B = 1 µH; $-V_{BB}$ = 5 V; T_j = 100 ˚C			
t_s	Turn-off storage time		1.9	2.5	µs
t_f	Turn-off fall time		150	300	ns

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

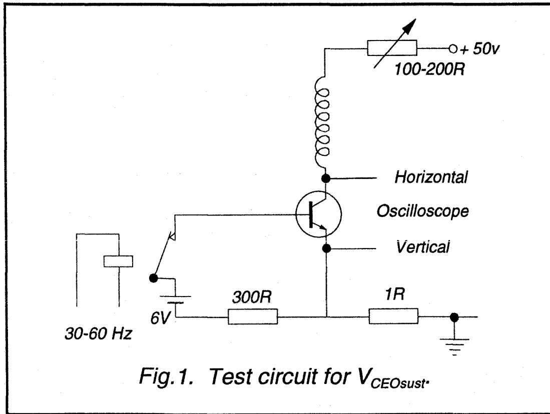


Fig.1. Test circuit for $V_{CEOsust}$.

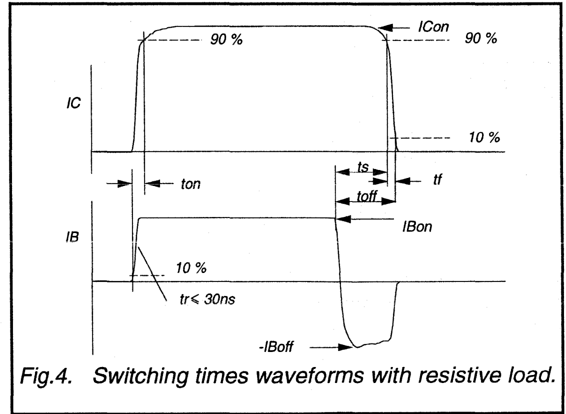


Fig.4. Switching times waveforms with resistive load.

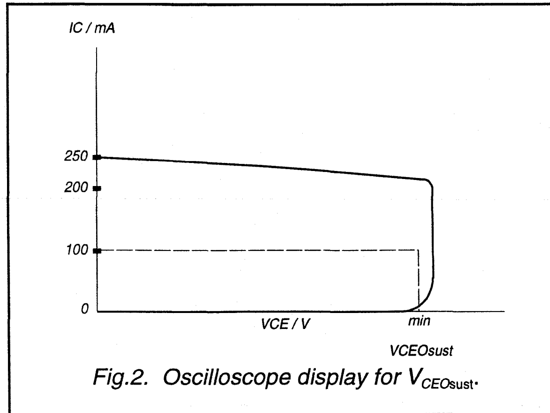


Fig.2. Oscilloscope display for $V_{CEOsust}$.

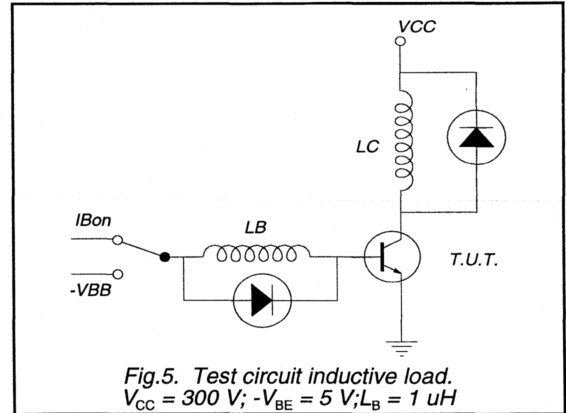


Fig.5. Test circuit inductive load. V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_B = 1 uH

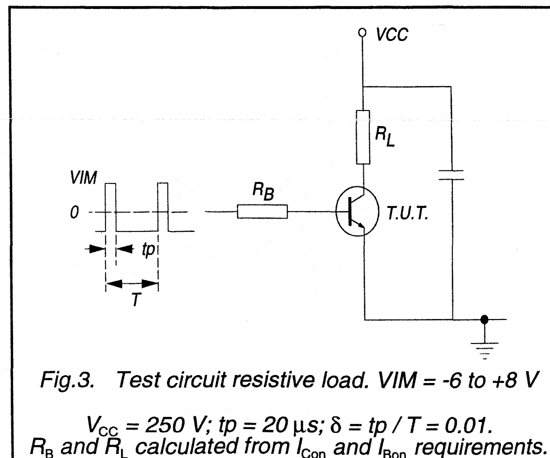


Fig.3. Test circuit resistive load. VIM = -6 to +8 V

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.

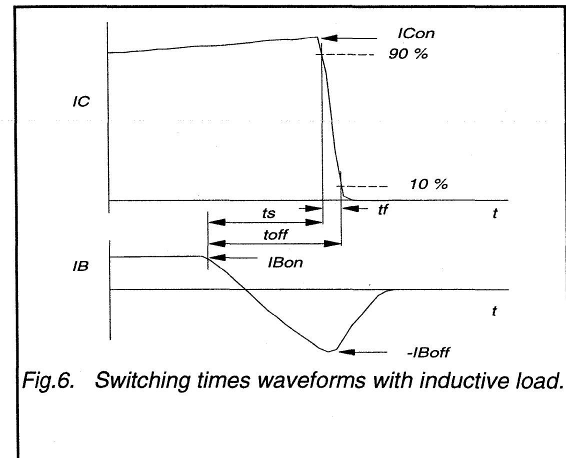


Fig.6. Switching times waveforms with inductive load.

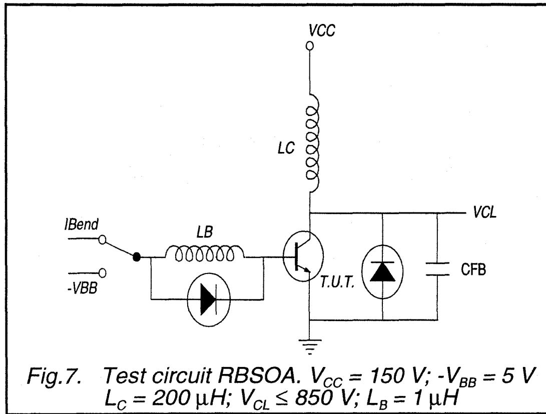


Fig.7. Test circuit RBSOA. V_{CC} = 150 V; $-V_{BB}$ = 5 V L_C = 200 μH; $V_{CL} \leq$ 850 V; L_B = 1 μH

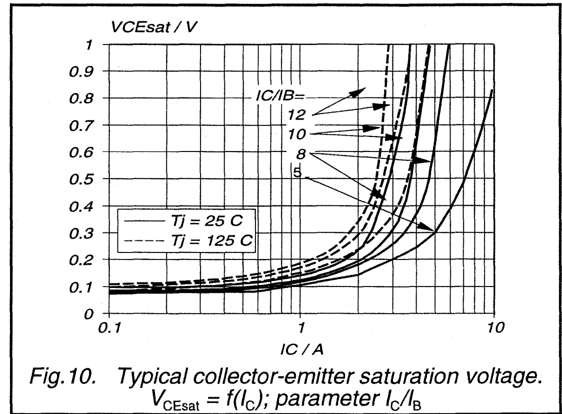


Fig.10. Typical collector-emitter saturation voltage. $V_{CEsat} = f(I_C)$; parameter I_C/I_B

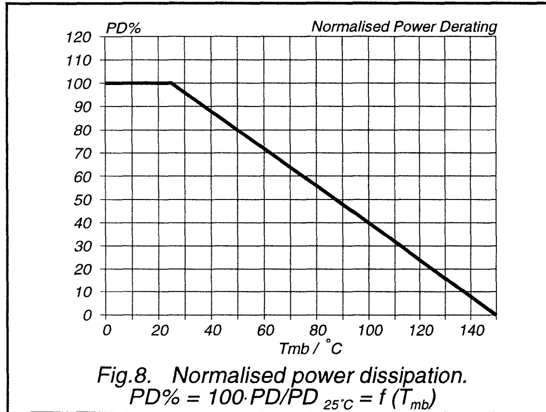


Fig.8. Normalised power dissipation. $PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{mb})$

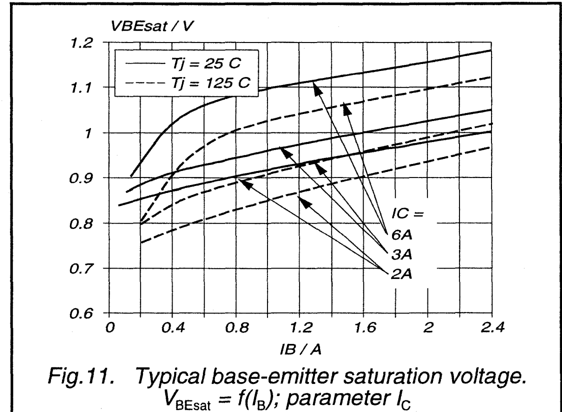


Fig.11. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_B)$; parameter I_C

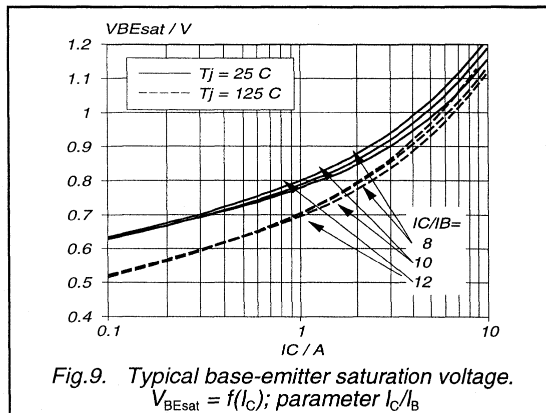


Fig.9. Typical base-emitter saturation voltage. $V_{BEsat} = f(I_C)$; parameter I_C/I_B

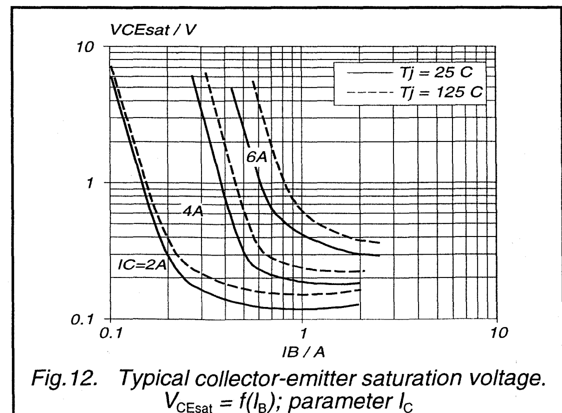


Fig.12. Typical collector-emitter saturation voltage. $V_{CEsat} = f(I_B)$; parameter I_C

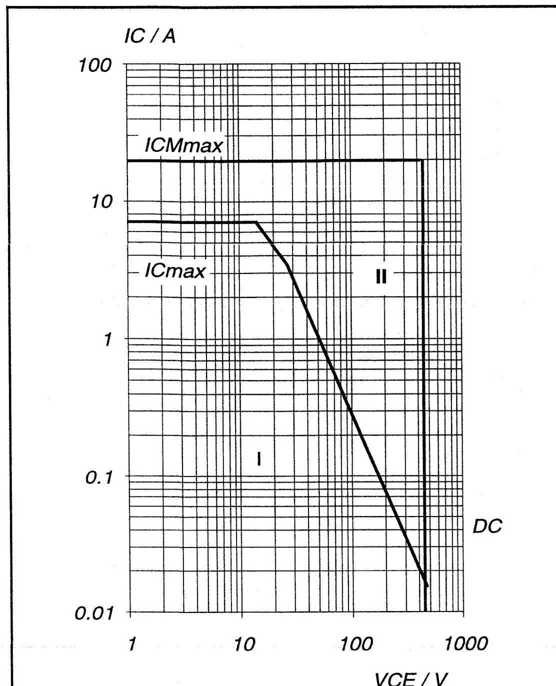


Fig.13. Forward bias safe operating area. T_{mb} = 25˚C

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.

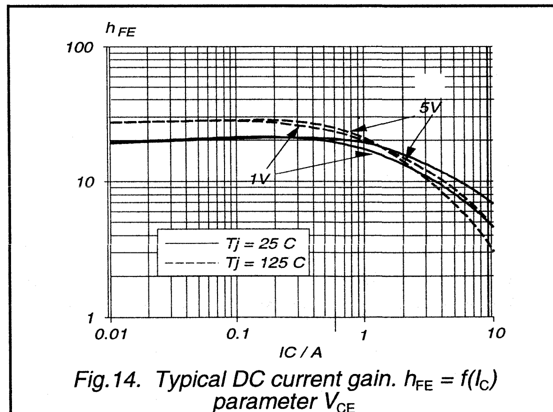


Fig.14. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

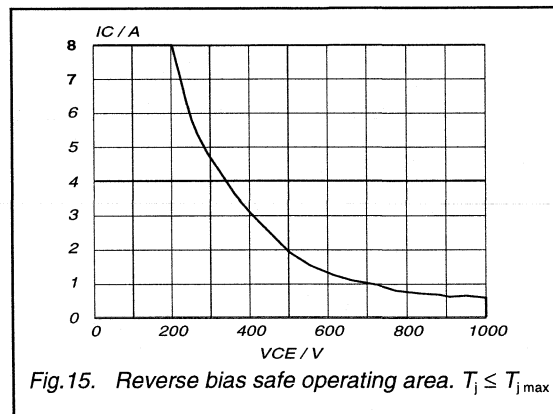


Fig.15. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

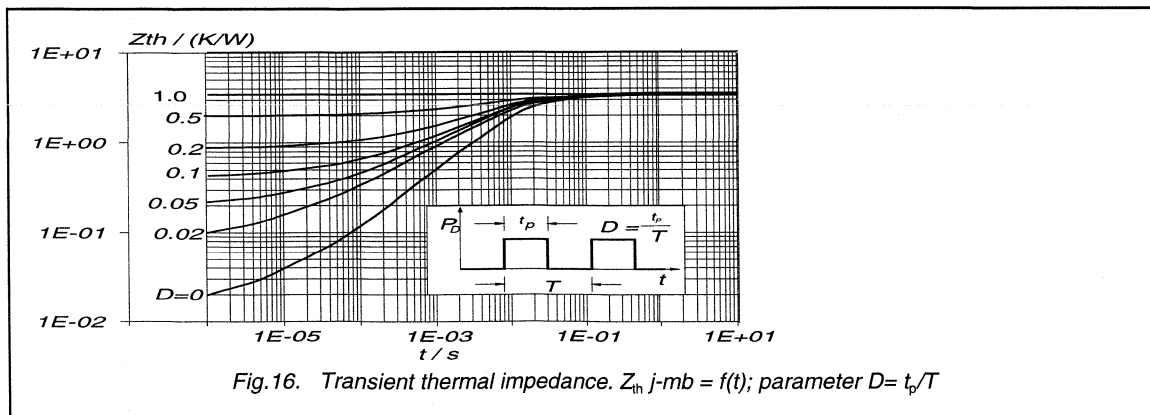


Fig.16. Transient thermal impedance. Z_{th} j-mb = f(t); parameter D= t_p/T

Silicon diffused power transistors — BUT18; BUT18A

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a TO-220AB package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

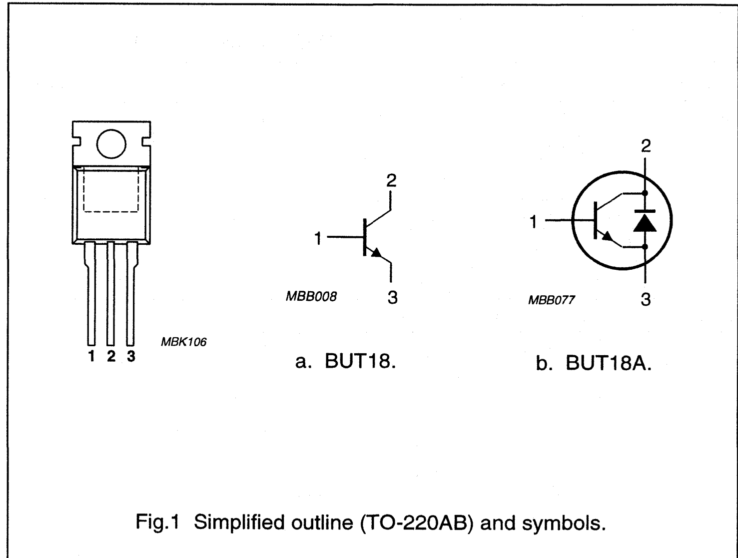


Fig.1 Simplified outline (TO-220AB) and symbols.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUT18		850	V
	BUT18A		1 000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT18		400	V
	BUT18A		450	V
V_{CEsat}	collector-emitter saturation voltage	see Fig.7	1.5	V
I_{Csat}	collector saturation current		4	A
I_C	collector current (DC)	see Fig.2	6	A
I_{CM}	collector current (peak value)	see Fig.2	12	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.4	110	W
t_f	fall time	resistive load; see Figs 10 and 11	0.8	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1.15	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUT18		–	850	V
	BUT18A		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT18		–	400	V
	BUT18A		–	450	V
I_{Csat}	collector saturation current		–	4	A
I_C	collector current (DC)	see Fig.2	–	6	A
I_{CM}	collector current (peak value)	see Fig.2	–	12	A
I_B	base current (DC)		–	3	A
I_{BM}	base current (peak value)		–	6	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.4	–	110	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

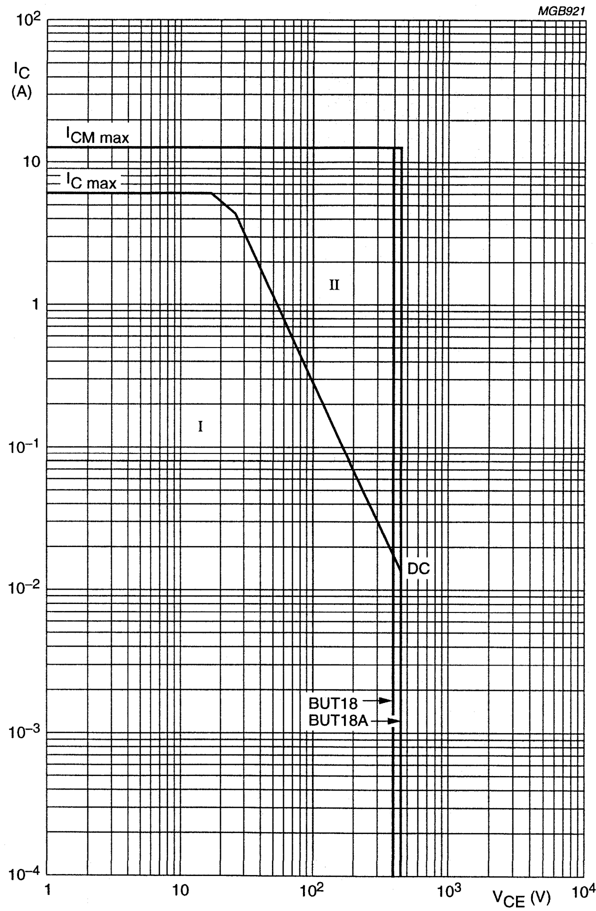
CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 0.1$ A; $I_{Boff} = 0$; L = 25 mH; see Figs 5 and 6				
	BUT18		400	–	–	V
	BUT18A		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 4$ A; $I_B = 0.8$ A; see Fig.7	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 4$ A; $I_B = 0.8$ A; see Fig.8	–	–	1.3	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	2	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9$ V; $I_C = 0$	–	–	10	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 10$ mA; see Fig.9	10	18	35	
		$V_{CE} = 5$ V; $I_C = 1$ A; see Fig.9	10	20	35	
Switching times resistive load (see Figs 10 and 11)						
t_{on}	turn-on time	$I_{Con} = 4$ A; $I_{Bon} = -I_{Boff} = 800$ mA	–	–	1	µs
t_s	storage time	$I_{Con} = 4$ A; $I_{Bon} = -I_{Boff} = 800$ mA	–	–	4	µs
t_f	fall time	$I_{Con} = 4$ A; $I_{Bon} = -I_{Boff} = 800$ mA	–	–	0.8	µs
Switching times inductive load (see Figs 10 and 13)						
t_s	storage time	$I_{Con} = 4$ A; $I_{Bon} = 800$ mA; $V_{CL} = 250$ V	–	1.6	2.5	µs
t_f	fall time	$I_{Con} = 4$ A; $I_{Bon} = 800$ mA; $V_{CL} = 250$ V	–	150	400	ns

Note

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



T_{mb} = 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

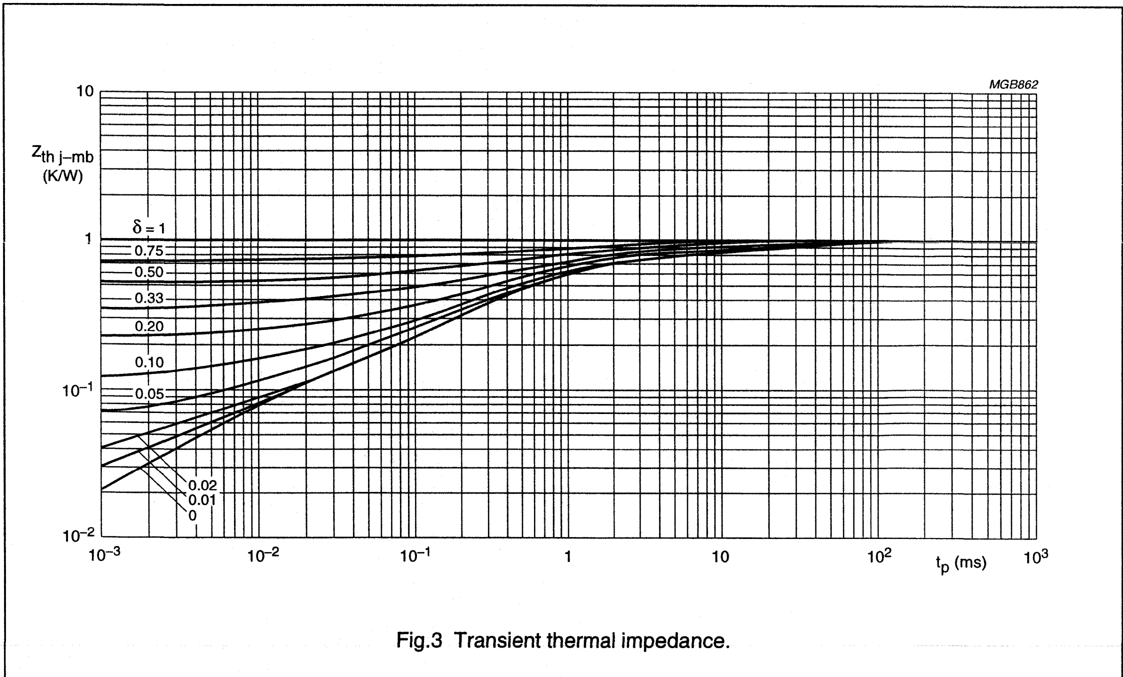


Fig.3 Transient thermal impedance.

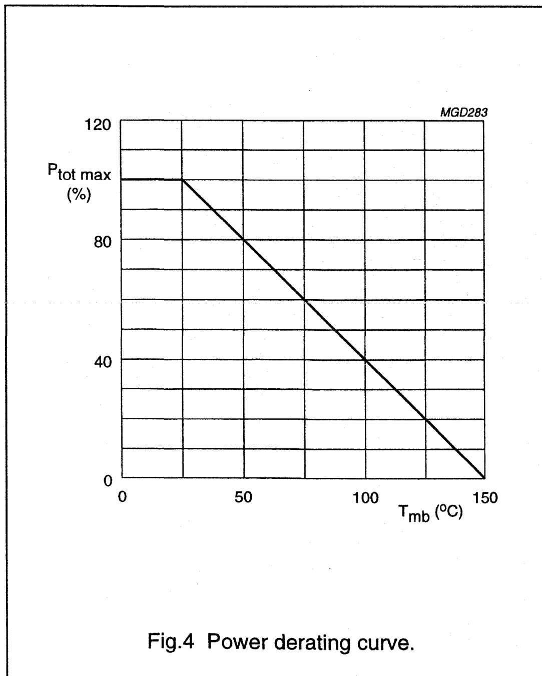


Fig.4 Power derating curve.

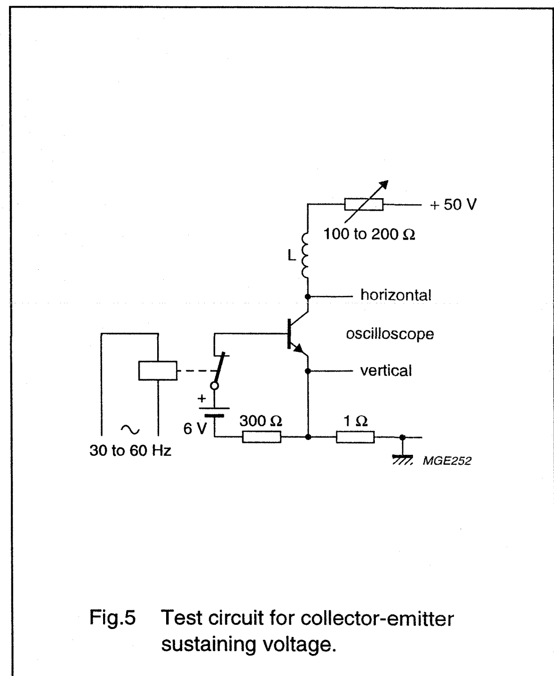


Fig.5 Test circuit for collector-emitter sustaining voltage.

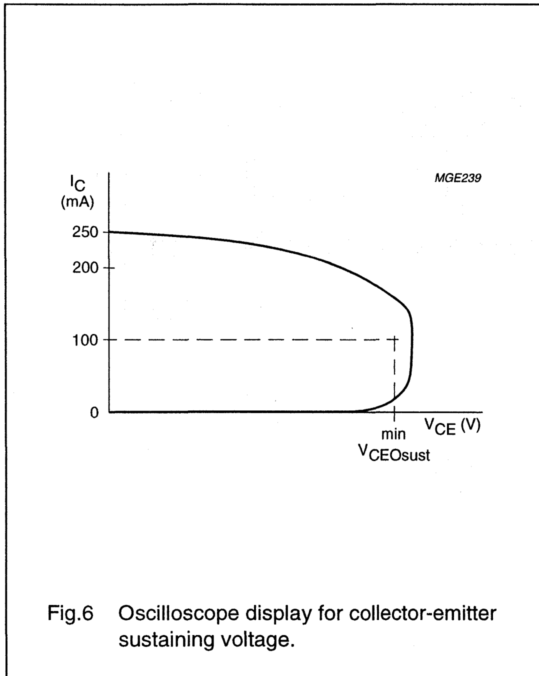
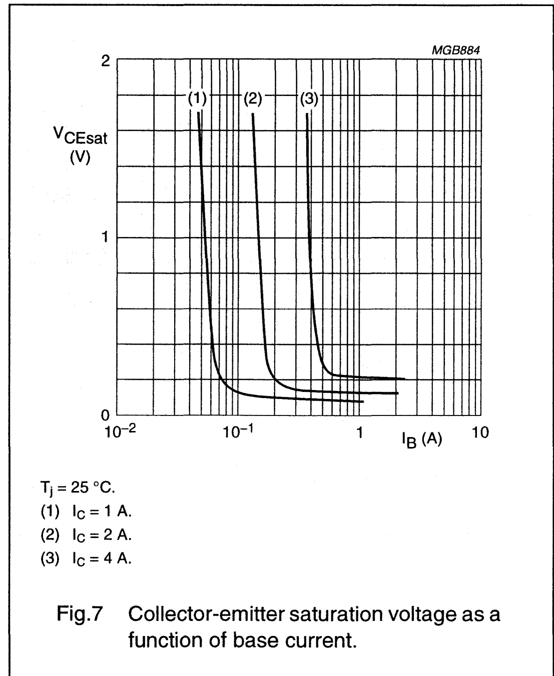
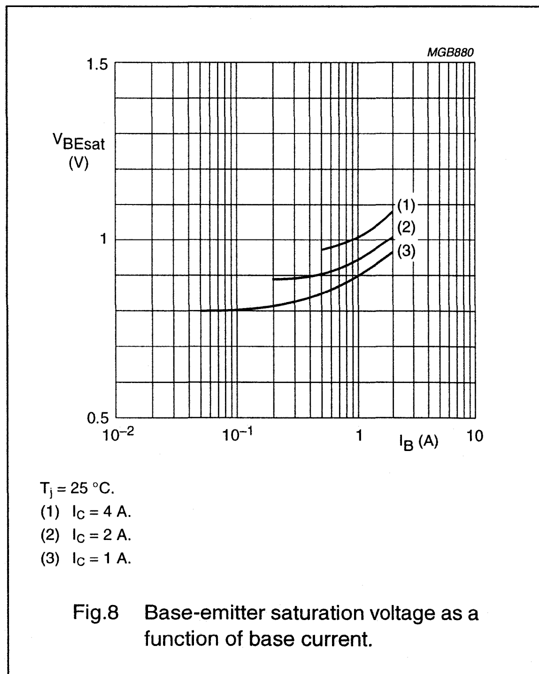


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



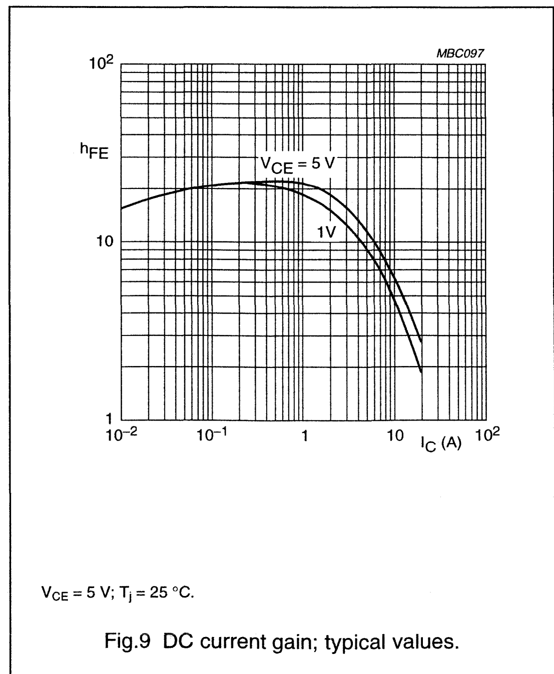
T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 2 A.
(3) I_C = 4 A.

Fig.7 Collector-emitter saturation voltage as a function of base current.



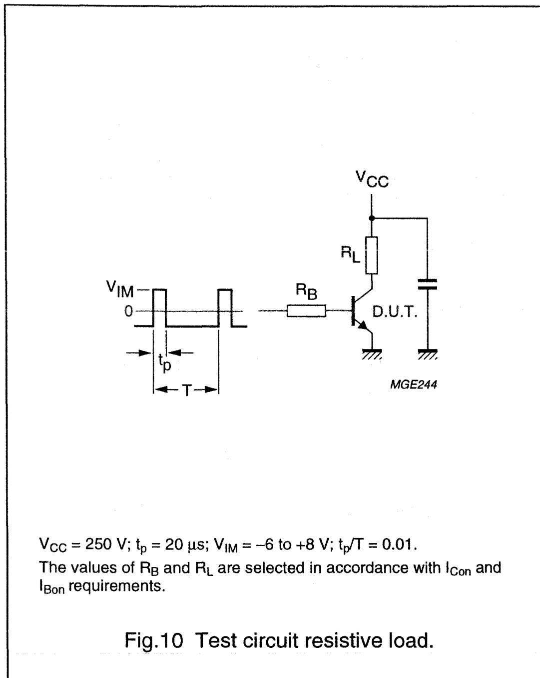
T_j = 25 °C.
(1) I_C = 4 A.
(2) I_C = 2 A.
(3) I_C = 1 A.

Fig.8 Base-emitter saturation voltage as a function of base current.



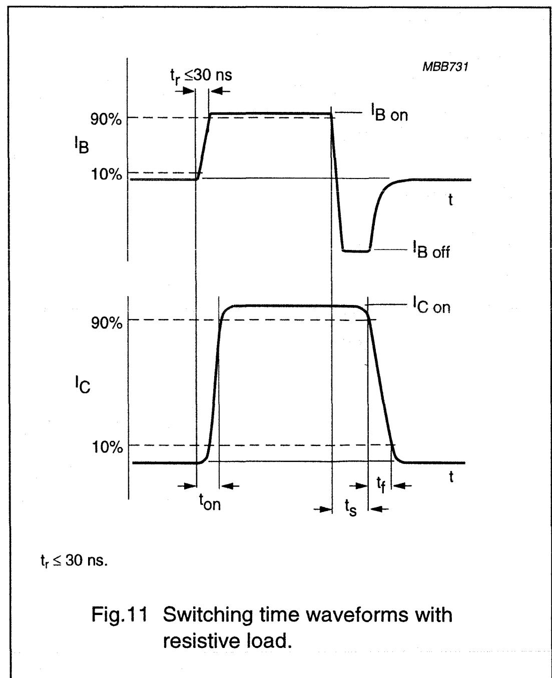
V_{CE} = 5 V; T_j = 25 °C.

Fig.9 DC current gain; typical values.



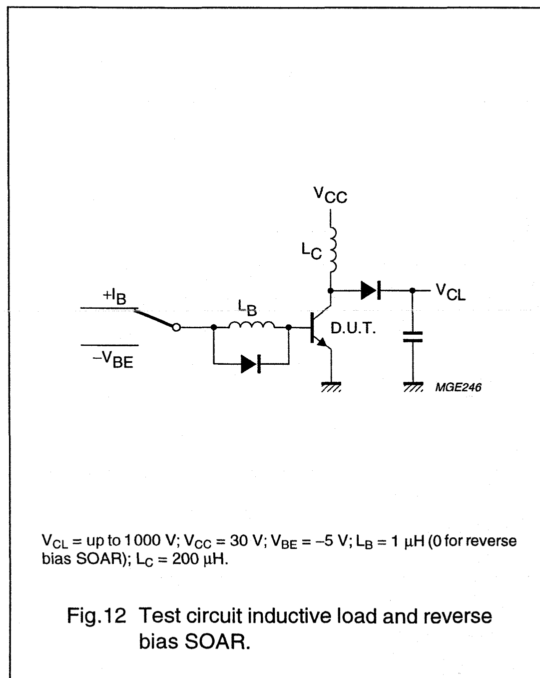
V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.10 Test circuit resistive load.



t_r ≤ 30 ns.

Fig.11 Switching time waveforms with resistive load.



V_{CL} = up to 1000 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 µH (0 for reverse bias SOAR); L_C = 200 µH.

Fig.12 Test circuit inductive load and reverse bias SOAR.

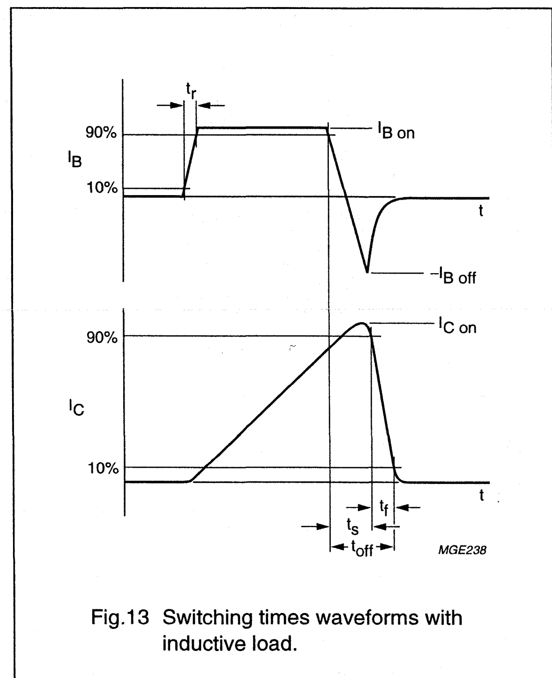


Fig.13 Switching times waveforms with inductive load.

Silicon diffused power transistors BUT18F; BUT18AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT186 package with electrically isolated mounting base.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated from all pins

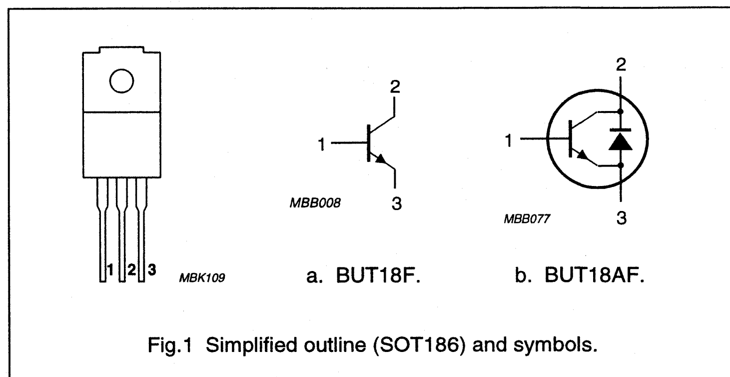


Fig.1 Simplified outline (SOT186) and symbols.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUT18F		850	V
	BUT18AF		1 000	V
V_{CEO}	collector-emitter voltage	open base		
	BUT18F		400	V
	BUT18AF		450	V
V_{CEsat}	collector-emitter saturation voltage	see Fig.7	1.5	V
I_{Csat}	collector saturation current		4	A
I_C	collector current (DC)	see Fig.4	6	A
I_{CM}	collector current (peak value)	see Fig.4	12	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2	33	W
t_f	fall time	resistive load; see Figs 10 and 11	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-h}$	thermal resistance from junction to external heatsink	note 1	6.15	K/W
		note 2	3.65	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUT18F		–	850	V
	BUT18AF		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUT18F		–	400	V
	BUT18AF		–	450	V
I_{Csat}	collector saturation current		–	4	A
I_C	collector current (DC)	see Fig.4	–	6	A
I_{CM}	collector current (peak value)	see Fig.4	–	12	A
I_B	base current (DC)		–	3	A
I_{BM}	base current (peak value)		–	6	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2; note 1	–	20	W
		$T_h \leq 25$ °C; see Fig.2; note 2	–	33	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Notes

1. **Without** heatsink compound.
2. **With** heatsink compound.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isolM}	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
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 3 and 6				
	BUT18F		400	–	–	V
	BUT18AF		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 4$ A; $I_B = 800$ mA; see Fig.7	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 4$ A; $I_B = 800$ mA; see Fig.8	–	–	1.3	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	2	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9$ V; $I_C = 0$	–	–	10	mA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 10 mA; see Fig.9	10	18	35	
		V_{CE} = 5 V; I_C = 1 A; see Fig.9	10	20	35	
Switching times resistive load (see Figs 10 and 11)						
t_{on}	turn-on time	I_{Con} = 4 A; I_{Bon} = $-I_{Boff}$ = 800 mA	–	–	1	µs
t_s	storage time	I_{Con} = 4 A; I_{Bon} = $-I_{Boff}$ = 800 mA	–	–	4	µs
t_f	fall time	I_{Con} = 4 A; I_{Bon} = $-I_{Boff}$ = 800 mA	–	–	0.8	µs
Switching times inductive load (see Figs 10 and 13)						
t_s	storage time	I_{Con} = 4 A; I_{Bon} = 800 mA	–	1.6	2.5	µs
t_f	fall time	I_{Con} = 4 A; I_{Bon} = 800 mA	–	150	400	ns

Note

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

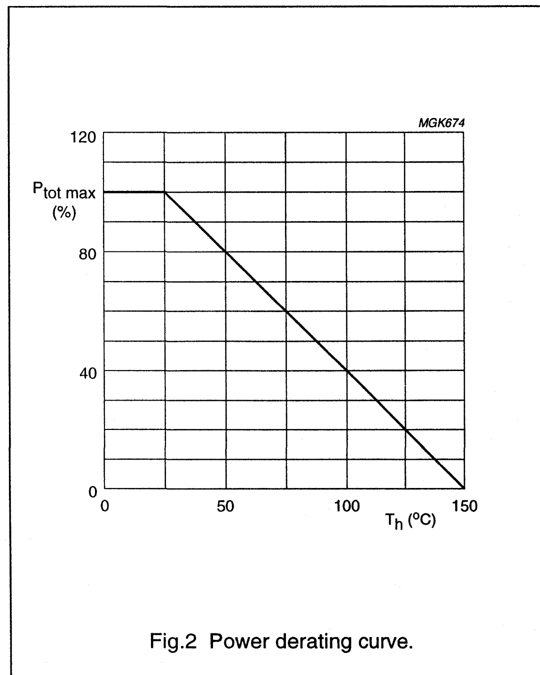


Fig.2 Power derating curve.

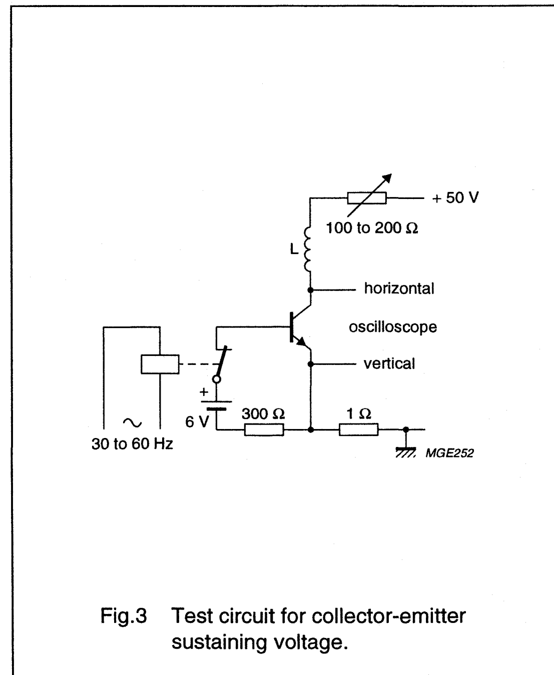
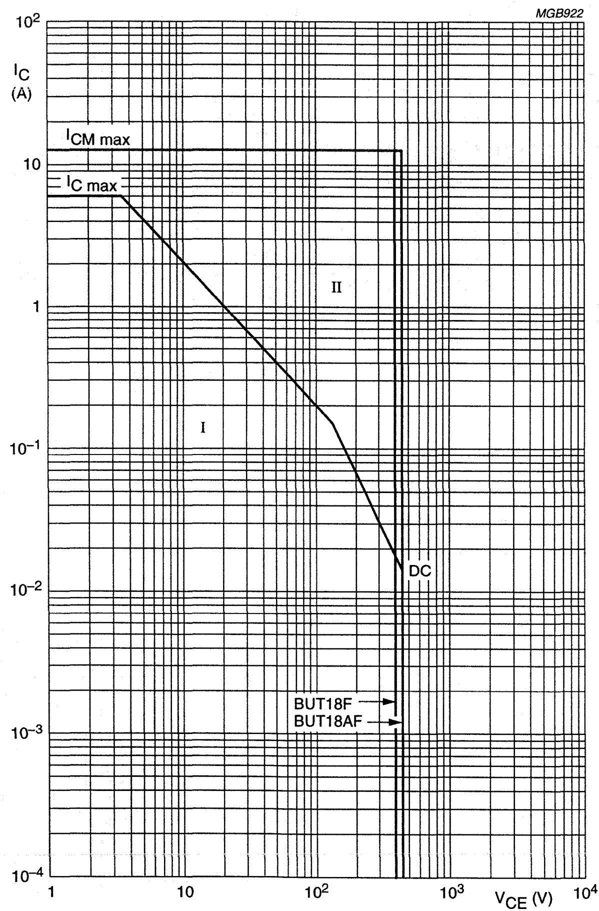


Fig.3 Test circuit for collector-emitter sustaining voltage.



Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

T_{mb} < 25 °C

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.4 Forward bias SOAR.

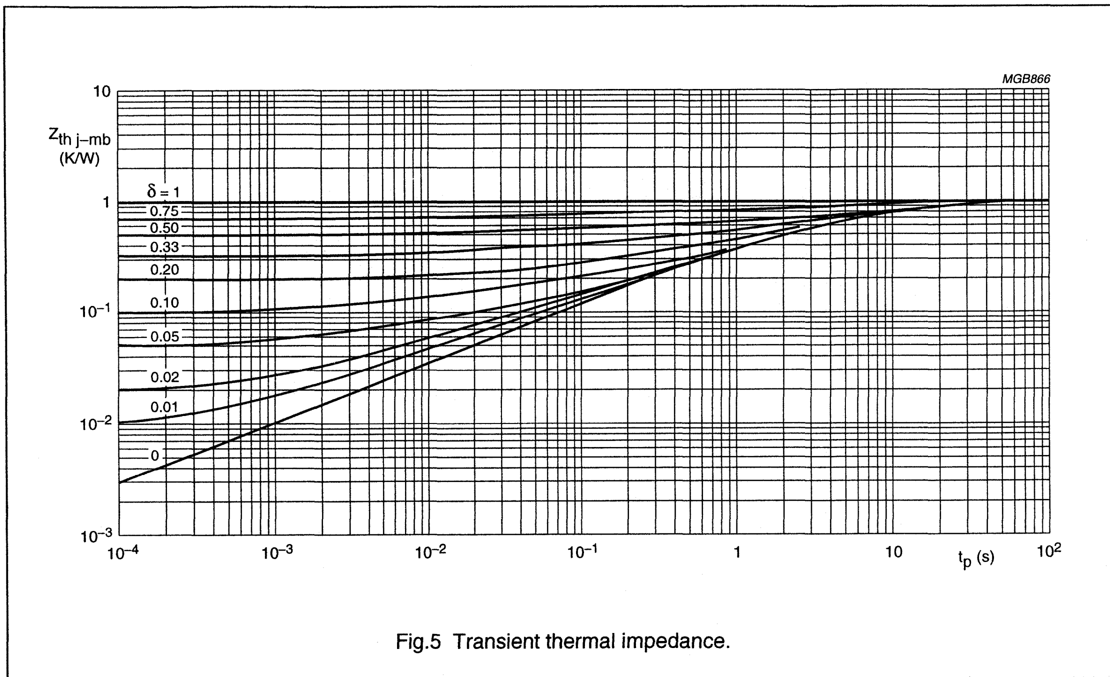


Fig.5 Transient thermal impedance.

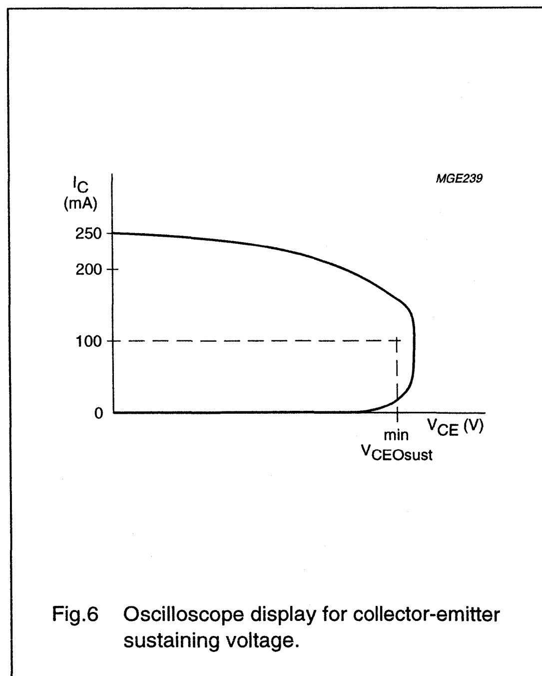
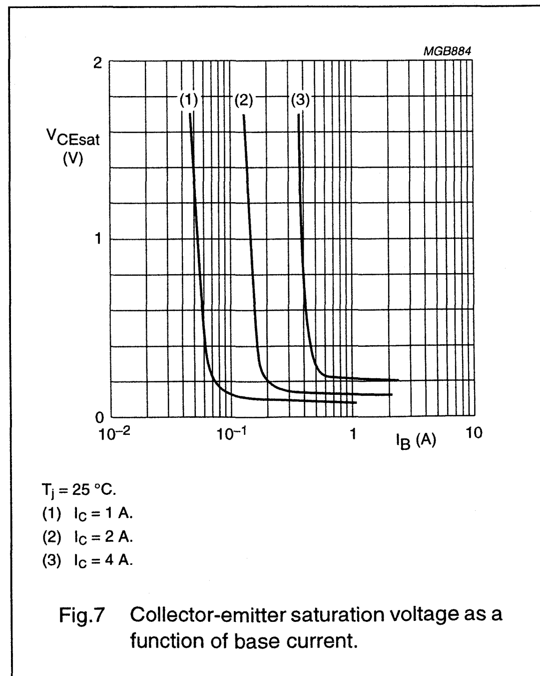
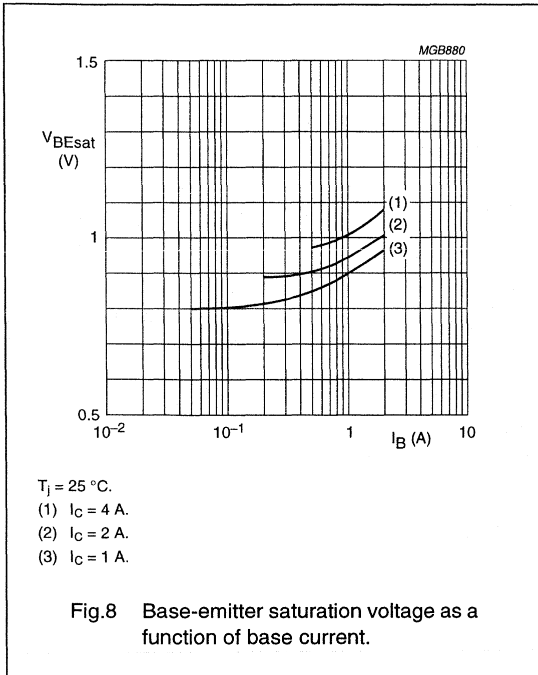


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



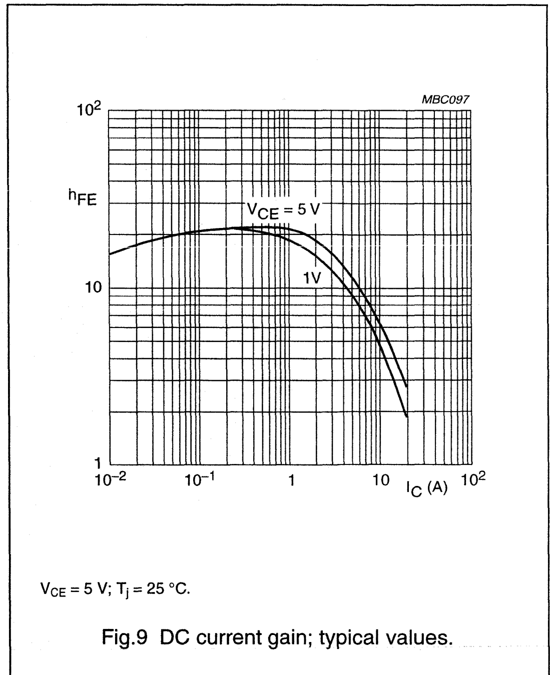
T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 2 A.
(3) I_C = 4 A.

Fig.7 Collector-emitter saturation voltage as a function of base current.



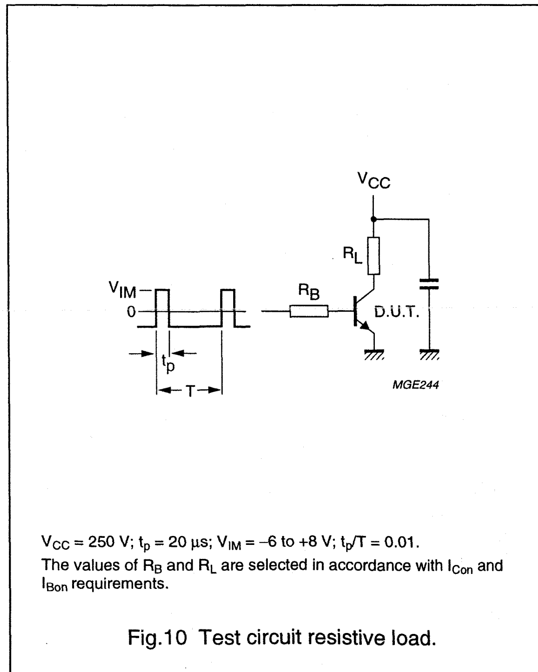
T_j = 25 °C.
(1) I_C = 4 A.
(2) I_C = 2 A.
(3) I_C = 1 A.

Fig.8 Base-emitter saturation voltage as a function of base current.



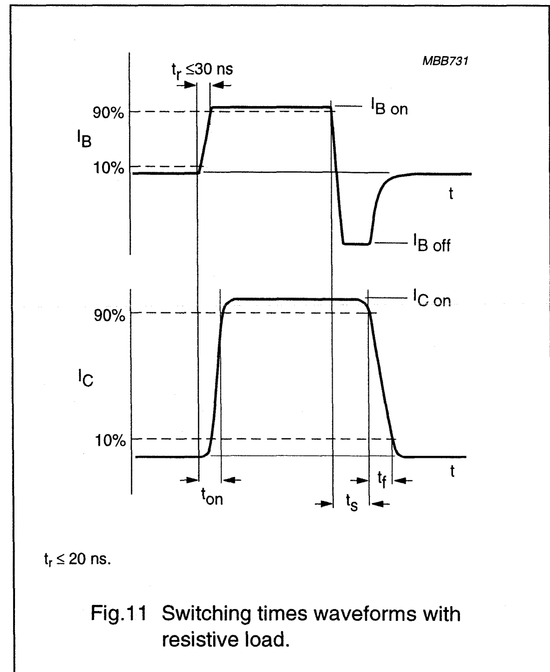
V_{CE} = 5 V; T_j = 25 °C.

Fig.9 DC current gain; typical values.



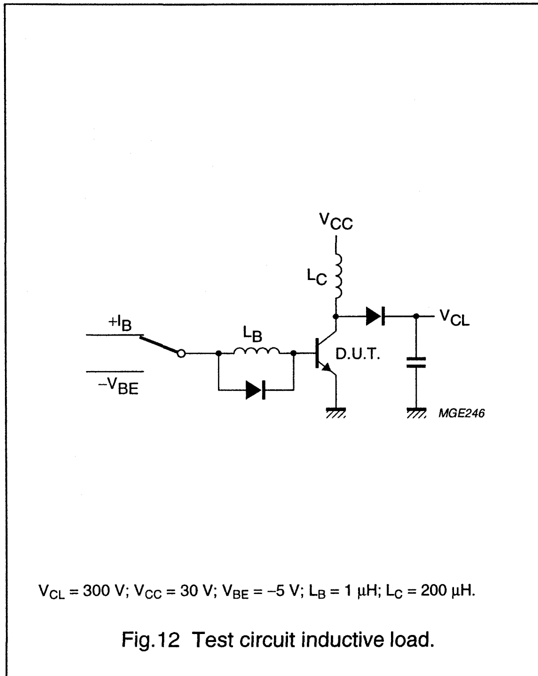
V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.10 Test circuit resistive load.



t_r ≤ 20 ns.

Fig.11 Switching times waveforms with resistive load.



V_{CL} = 300 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 µH; L_C = 200 µH.

Fig.12 Test circuit inductive load.

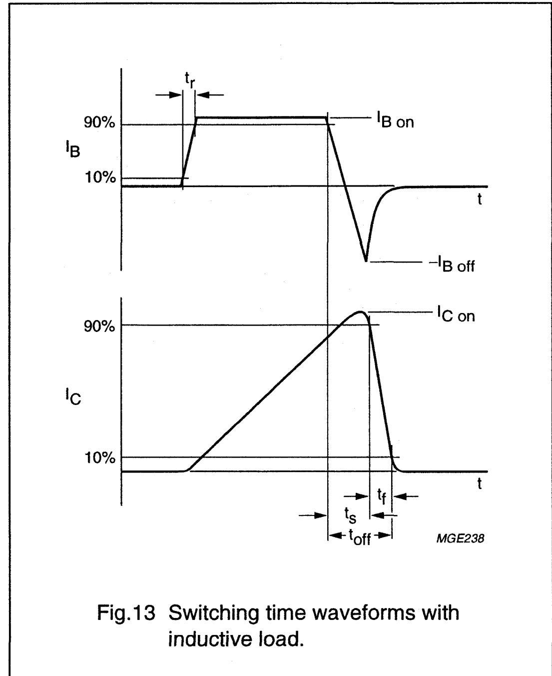


Fig.13 Switching time waveforms with inductive load.

GENERAL DESCRIPTION

Enhanced performance, new generation, high speed switching npn transistor in TO220AB envelope specially suited for high frequency electronic lighting ballast applications.

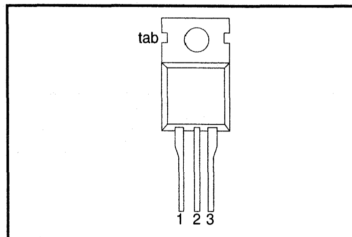
QUICK REFERENCE DATA

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; $I_B = 0.4$ A	-	2.0	V
t_f	Inductive fall time	$I_{Con} = 3.0$ A; $I_{Bon} = 0.3$ A	-	0.1	µs

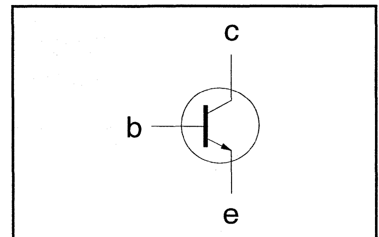
PINNING - TO220AB

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
$R_{th\ j-mb}$	Junction to mounting base		-	1.25	K/W
$R_{th\ j-a}$	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 = 0.4 A	-	0.8	2.0	V
V_{BEsat}	Base-emitter saturation voltage		I_C = 3.0 A;I_B = 0.4 A	-	-	1.3	V
h_{FE}	DC current gain		I_C = 1.0 A; V_{CE} = 2 V	13	21	30	
h_{FE}			I_C = 3.0 A; V_{CE} = 2 V	7.5	11	-	
h_{FE}	Gain bands[2]	1	I_C = 1.0 A; V_{CE} = 2 V	13	-	20	
	(Acceptance limits)	2		18	-	25	
		3		23	-	30	

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

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

2 Gain Banding.

Product is divided into 3 gain bands for matching purposes.
The gain band is printed on the device.
All devices within a device rail will be from the same gain band.
However, a box may contain rails from more than one band.
Band quantities are shown on the box label.
It is not possible to order specific gain bands.

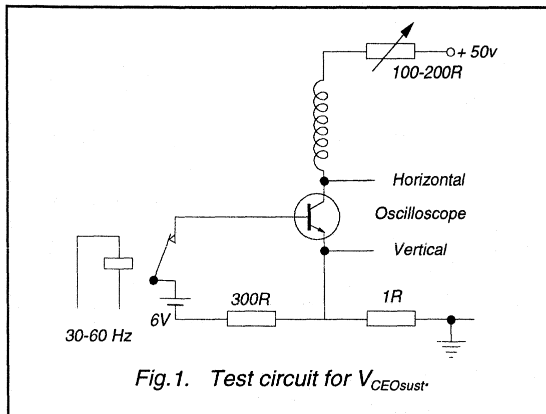


Fig.1. Test circuit for $V_{CEOsust}$.

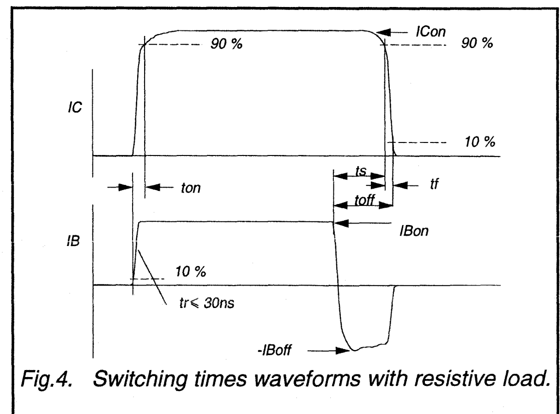


Fig.4. Switching times waveforms with resistive load.

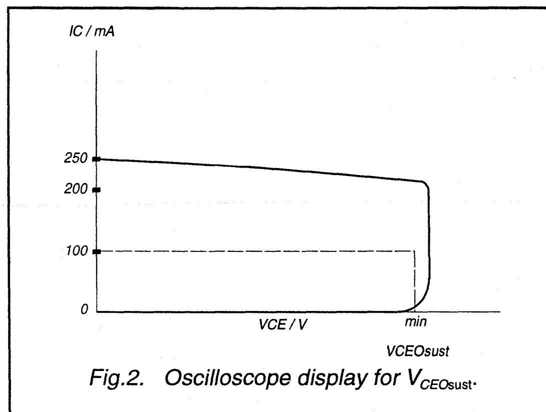


Fig.2. Oscilloscope display for $V_{CEOsust}$.

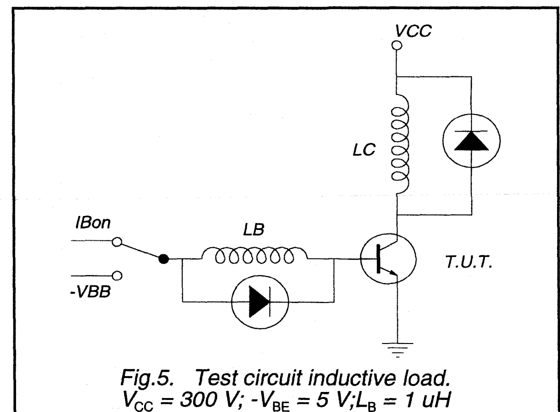


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; $-V_{BE}$ = 5 V; L_B = 1 uH

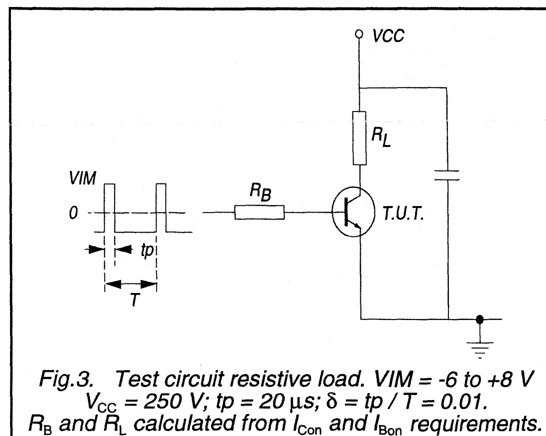


Fig.3. Test circuit resistive load. VIM = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

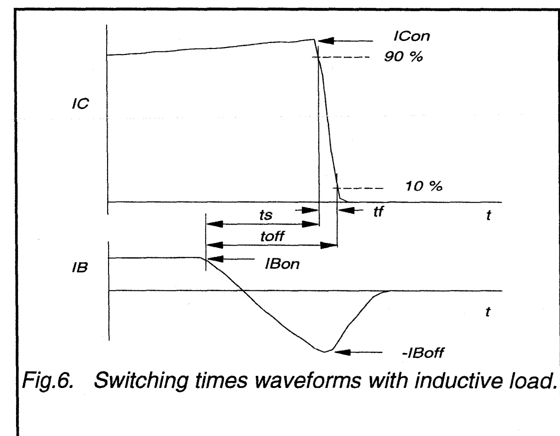


Fig.6. Switching times waveforms with inductive load.

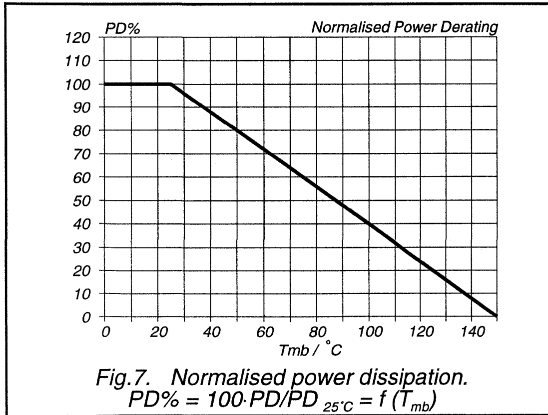


Fig.7. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f\,(T_{mb})$

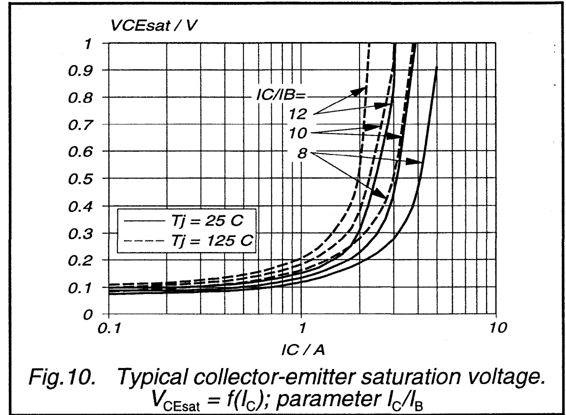


Fig.10. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

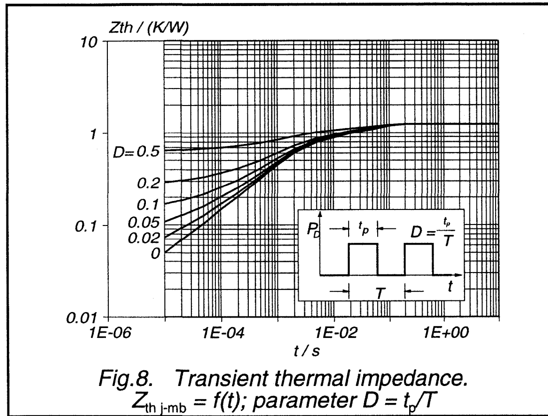


Fig.8. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

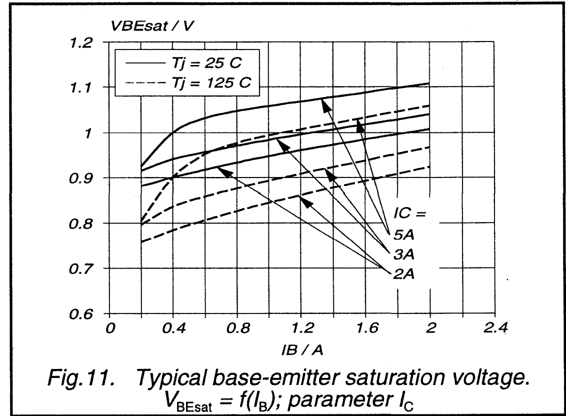


Fig.11. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

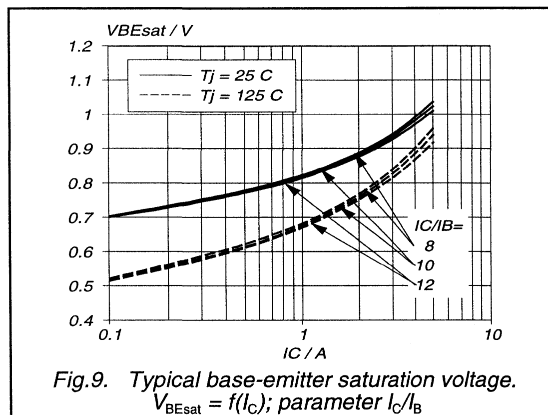


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_C)$; parameter I_C/I_B

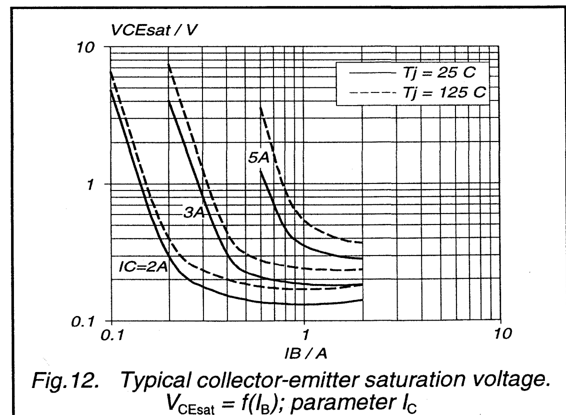


Fig.12. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

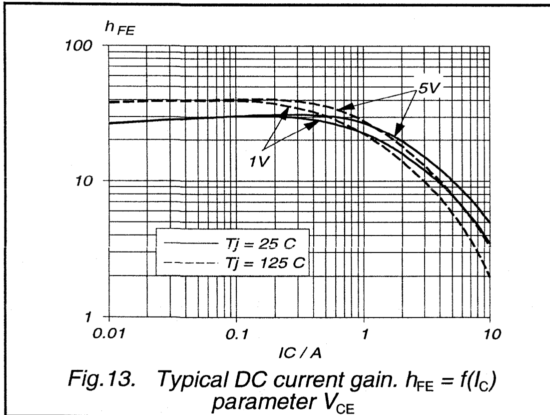


Fig.13. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

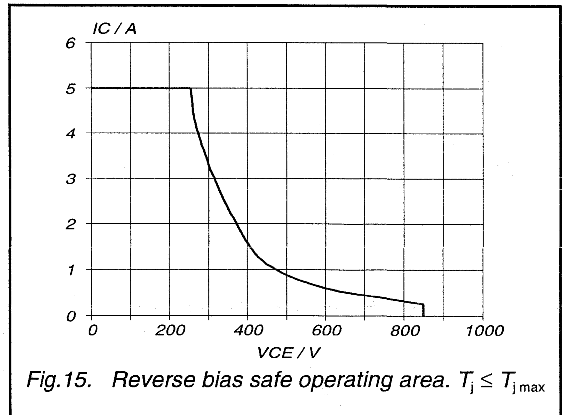


Fig.15. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

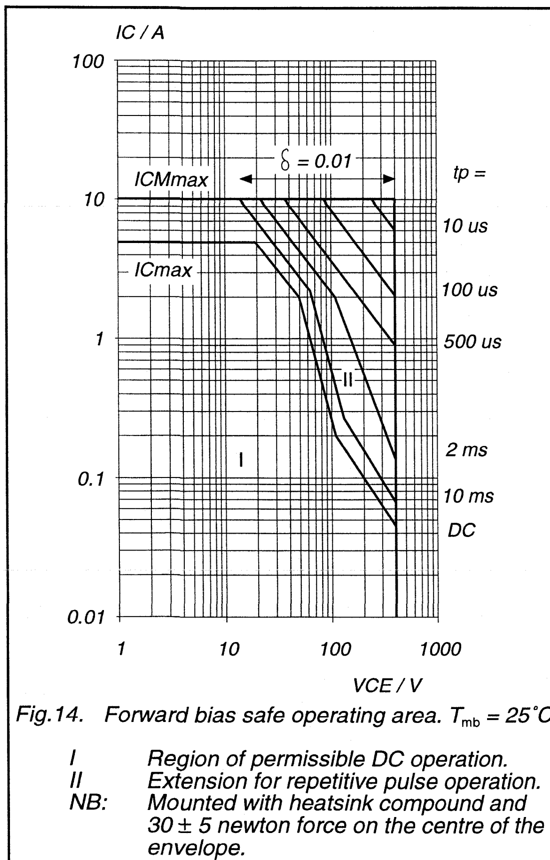


Fig.14. Forward bias safe operating area. $T_{mb} = 25^{\circ}C$

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.

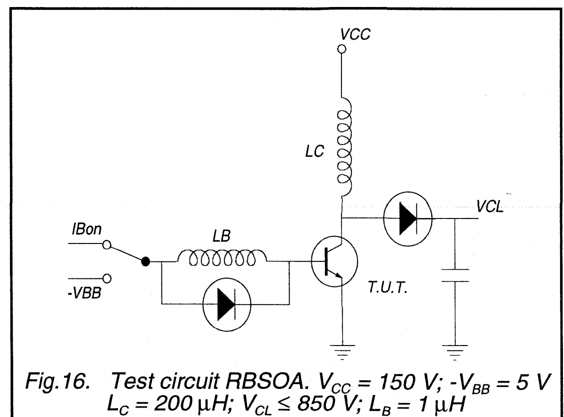


Fig.16. Test circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 5$ V $L_C = 200\ \mu H$; $V_{CL} \leq 850$ V; $L_B = 1\ \mu H$

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.

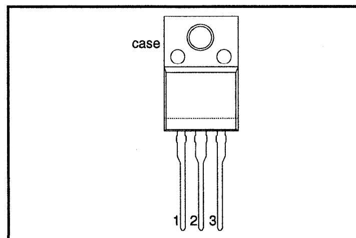
QUICK REFERENCE DATA

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; $I_B = 0.4$ A	-	2.0	V
t_f	Inductive fall time	$I_{Con} = 3.0$ A; $I_{Bon} = 0.3$ A	-	0.1	µs

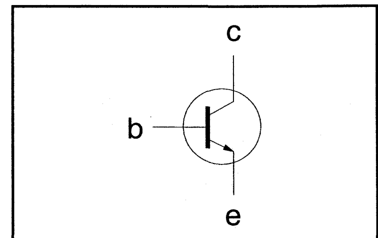
PINNING - SOT186A

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 = 0.4 A	-	0.8	2.0	V
V_{BEsat}	Base-emitter saturation voltage		I_C = 3.0 A; I_B = 0.4 A	-	-	1.3	V
h_{FE}	DC current gain		I_C = 1.0 A; V_{CE} = 2 V	13	21	30	
h_{FE}			I_C = 3.0 A; V_{CE} = 2 V	7.5	11	-	
h_{FE}	Gain bands[2] (Acceptance limits)	1	I_C = 1.0 A; V_{CE} = 2 V	13	-	20	
		2		18	-	25	
		3		23	-	30	

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).

2 Gain Banding.

Product is divided into 3 gain bands for matching purposes.
The gain band is printed on the device.
All devices within a device rail will be from the same gain band.
However, a box may contain rails from more than one band.
Band quantities are shown on the box label.
It is not possible to order specific gain bands.

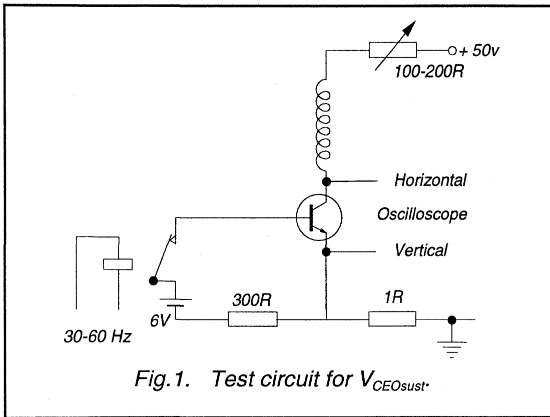


Fig.1. Test circuit for $V_{CEOsust}$.

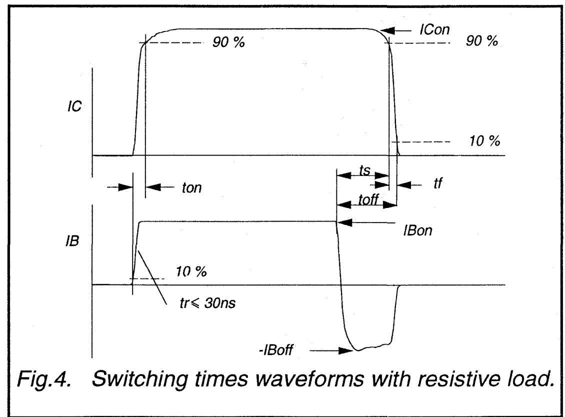


Fig.4. Switching times waveforms with resistive load.

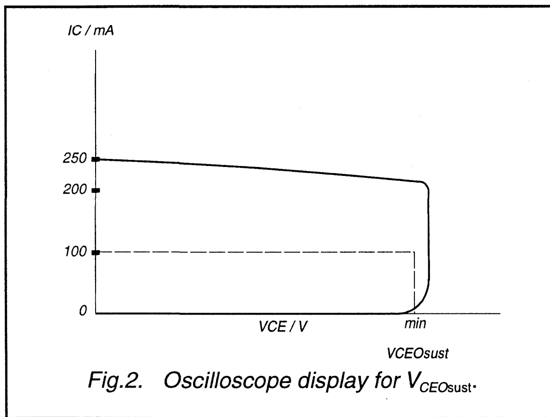


Fig.2. Oscilloscope display for $V_{CEOsust}$.

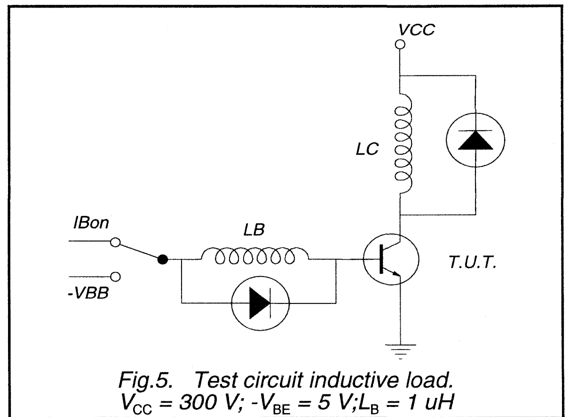


Fig.5. Test circuit inductive load.
V_{CC} = 300 V; -V_{BE} = 5 V; L_B = 1 uH

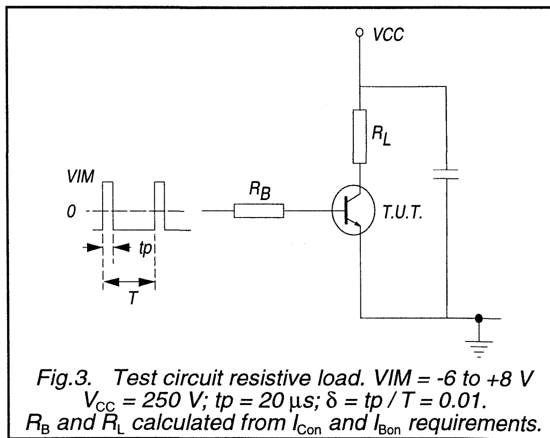


Fig.3. Test circuit resistive load. VIM = -6 to +8 V
V_{CC} = 250 V; tp = 20 µs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

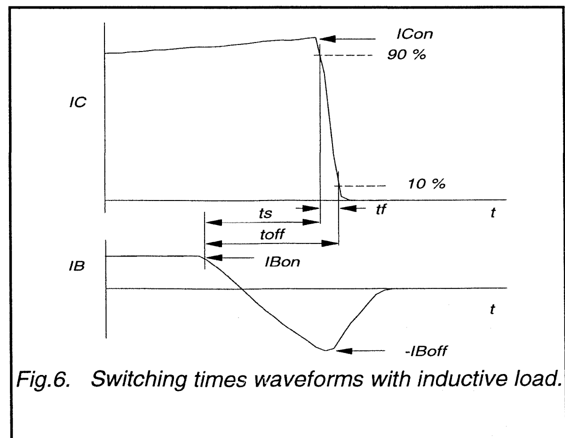


Fig.6. Switching times waveforms with inductive load.

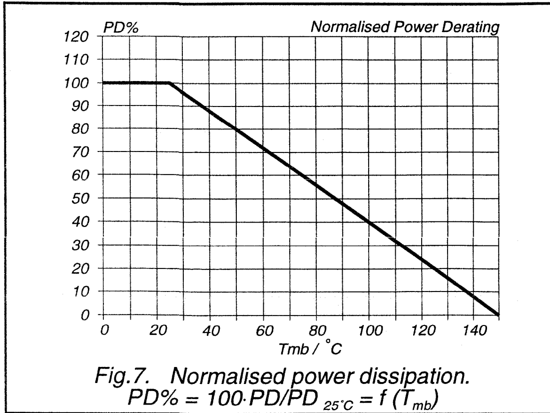


Fig.7. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25^\circ C} = f(T_{mb})$

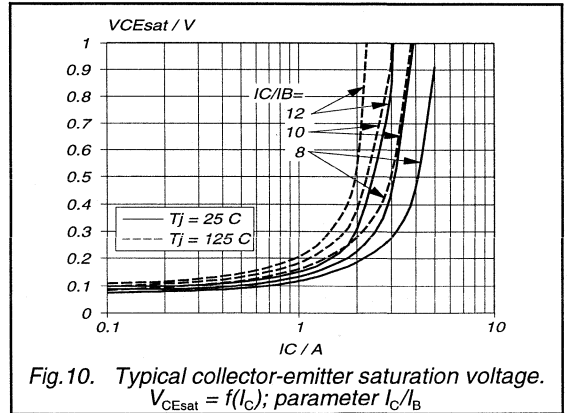


Fig.10. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_C)$; parameter I_C/I_B

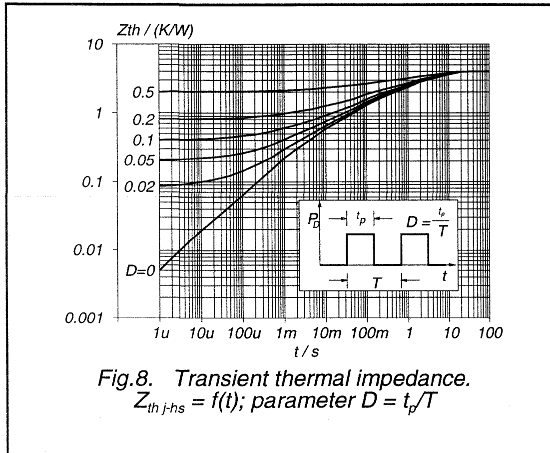


Fig.8. Transient thermal impedance.
$Z_{th\,j\text{-}hs} = f(t)$; parameter $D = t_p/T$

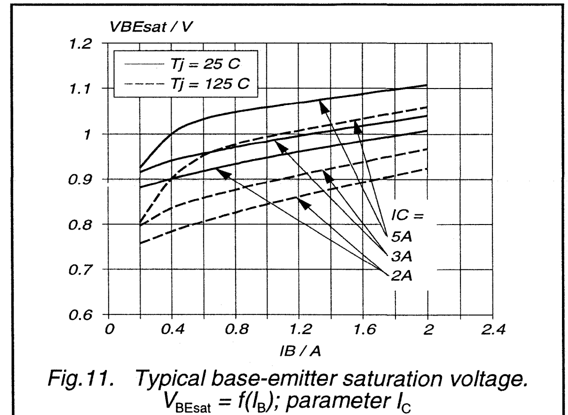


Fig.11. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

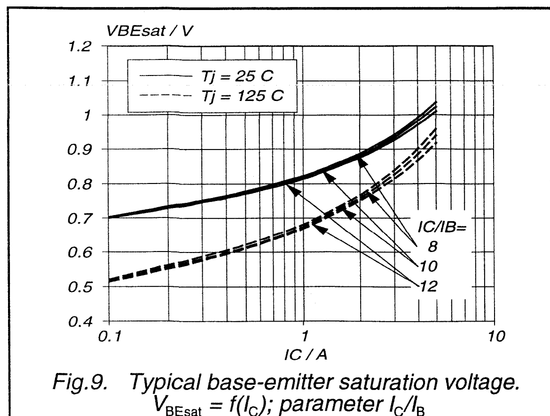


Fig.9. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_C)$; parameter I_C/I_B

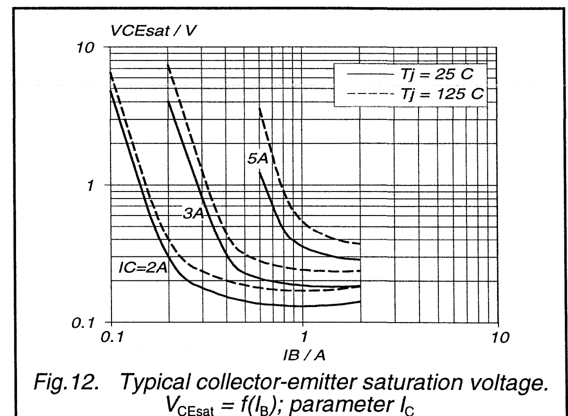


Fig.12. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

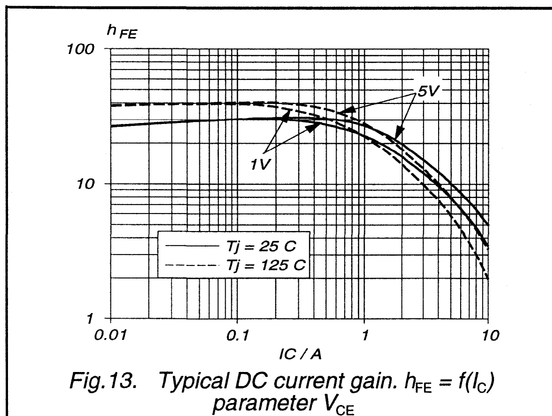


Fig.13. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

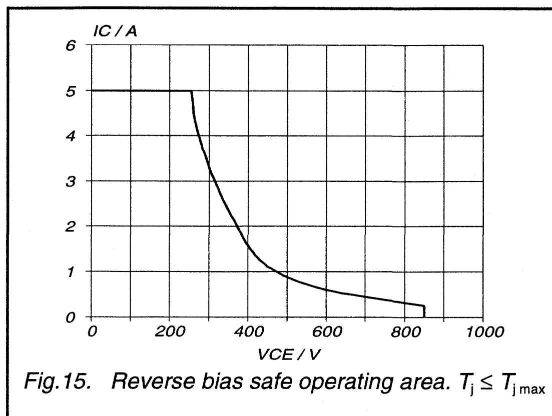


Fig.15. Reverse bias safe operating area. $T_j \leq T_{j\,max}$

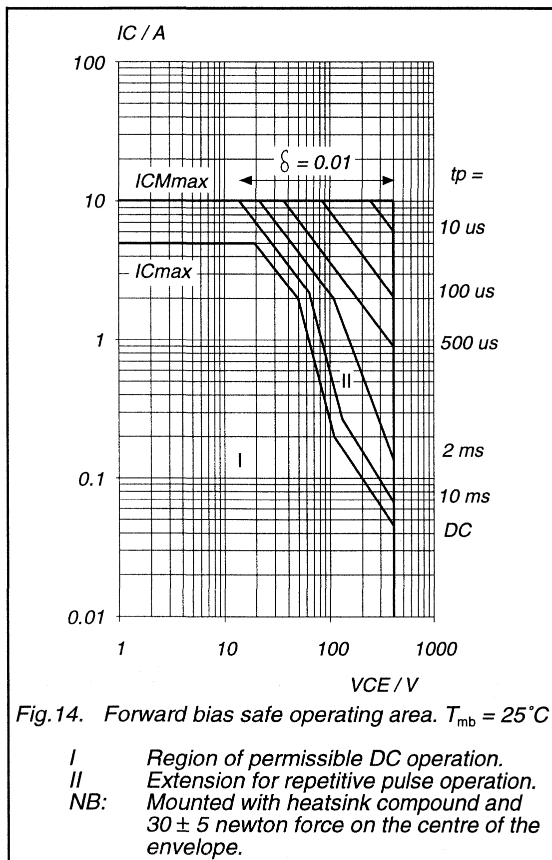


Fig.14. Forward bias safe operating area. $T_{mb} = 25^\circ C$

- 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.

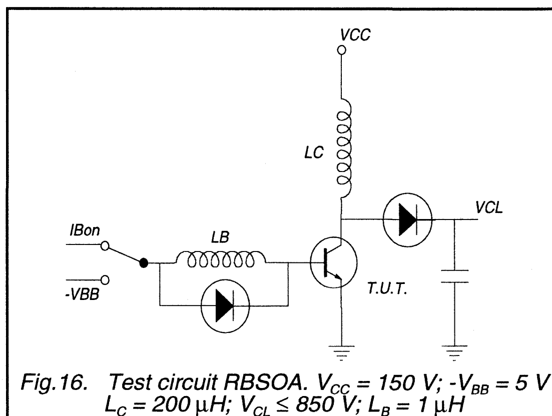


Fig.16. Test circuit RBSOA. $V_{CC} = 150$ V; $-V_{BB} = 5$ V $L_C = 200\,\mu H$; $V_{CL} \leq 850$ V; $L_B = 1\,\mu H$

Silicon diffused power transistors — BUW11F; BUW11AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT199 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated

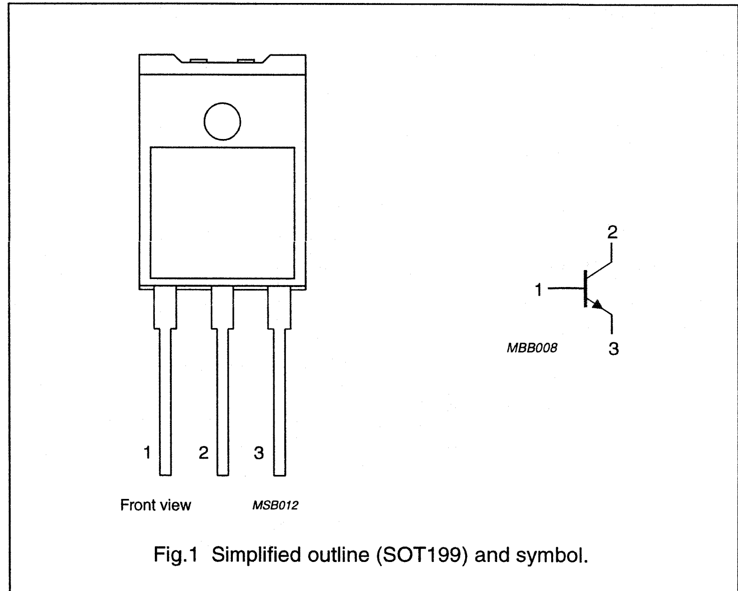


Fig.1 Simplified outline (SOT199) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUW11F		850	V
	BUW11AF		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUW11F		400	V
	BUW11AF		450	V
V_{CEsat}	collector-emitter saturation voltage		1.5	V
I_{Csat}	collector saturation current			
	BUW11F		3	A
	BUW11AF		2.5	A
I_C	collector current (DC)	see Figs 2 and 4	5	A
I_{CM}	collector current (peak value)	t_p < 20 ms; see Fig.2	10	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.3	32	W
t_f	fall time	resistive load; see Figs 8 and 9	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	3.95	K/W
		note 2	3.05	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		35	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW11F		–	850	V
	BUW11AF		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW11F		–	400	V
	BUW11AF		–	450	V
I_{Csat}	collector saturation current				
	BUW11F		–	3	A
	BUW11AF		–	2.5	A
I_C	collector current (DC)	see Figs 2 and 4	–	5	A
I_{CM}	collector current (peak value)	$t_p < 20$ ms; see Fig.2	–	10	A
I_B	base current (DC)		–	2	A
I_{BM}	base current (peak value)	$t_p < 20$ ms	–	4	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.3; note 1	–	32	W
		$T_h \leq 25$ °C; see Fig.3; note 2	–	41	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isolM}	isolation voltage from all terminals to external heatsink (peak value)	–	1500	V
C_{isol}	isolation capacitance from collector to external heatsink	–	21	pF

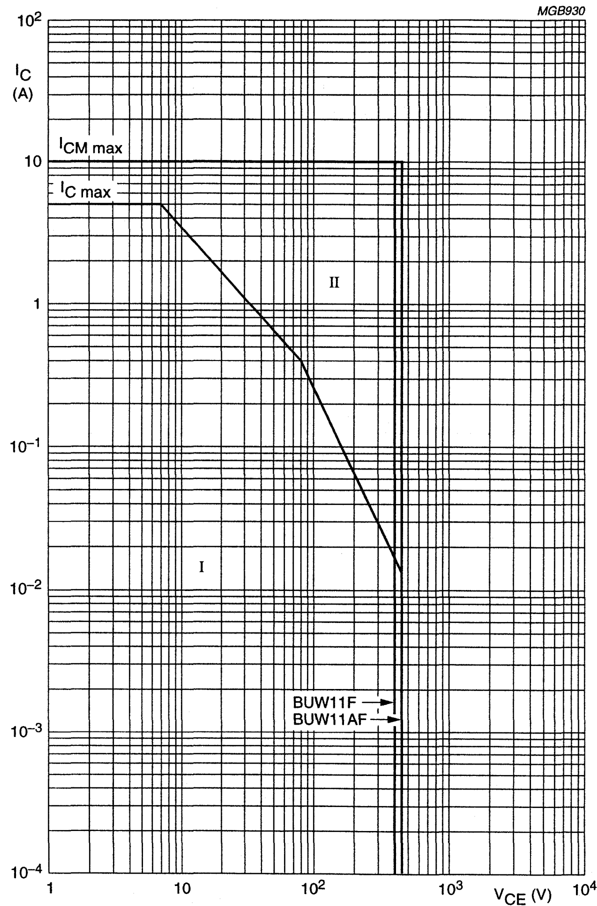
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 5 and 6				
	BUW11F		400	–	–	V
	BUW11AF		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUW11F	I_C = 3 A; I_B = 600 mA	–	–	1.5	V
	BUW11AF	I_C = 2.5 A; I_B = 500 mA	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUW11F	I_C = 3 A; I_B = 600 mA	–	–	1.4	V
	BUW11AF	I_C = 2.5 A; I_B = 500 mA	–	–	1.4	V
I_{Csat}	collector saturation current	V_{CE} = 1.5 V				
	BUW11F		–	–	3	A
	BUW11AF		–	–	2.5	A
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; V_{BE} = 0; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	2	mA
I_{EBO}	emitter-base 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; see Fig.7	10	18	35	
		V_{CE} = 5 V; I_C = 0.5 A; see Fig.7	10	20	35	
Switching times resistive load (Figs 8 and 9)						
t_{on}	turn-on time					
	BUW11F	I_{Con} = 3 A; $I_{Bon} = -I_{Boff}$ = 600 mA	–	–	1	µs
	BUW11AF	I_{Con} = 2.5 A; $I_{Bon} = -I_{Boff}$ = 500 mA	–	–	1	µs
t_s	storage time					
	BUW11F	I_{Con} = 3 A; $I_{Bon} = -I_{Boff}$ = 600 mA	–	–	4	µs
	BUW11AF	I_{Con} = 2.5 A; $I_{Bon} = -I_{Boff}$ = 500 mA	–	–	4	µs
t_f	fall time					
	BUW11F	I_{Con} = 3 A; $I_{Bon} = -I_{Boff}$ = 600 mA	–	–	0.8	µs
	BUW11AF	I_{Con} = 2.5 A; $I_{Bon} = -I_{Boff}$ = 500 mA	–	–	0.8	µs
Switching times inductive load (Figs 10 and 11)						
t_s	storage time					
	BUW11F	I_{Con} = 3 A; I_B = 600 mA; V_{CL} = 250 V; T_c = 100 °C	–	2	2.5	µs
	BUW11AF	I_{Con} = 2.5 A; I_B = 500 mA; V_{CL} = 300 V; T_c = 100 °C	–	2	2.5	µs
t_f	fall time					
	BUW11F	I_{Con} = 3 A; I_B = 600 mA; V_{CL} = 250 V; T_c = 100 °C	–	200	300	ns
	BUW11AF	I_{Con} = 2.5 A; I_B = 500 mA; V_{CL} = 300 V; T_c = 100 °C	–	200	300	ns

Note

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



Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

T_{mb} < 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

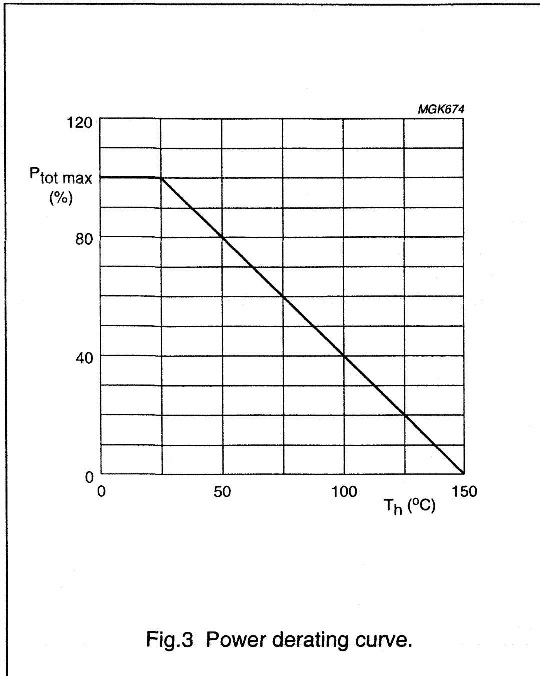
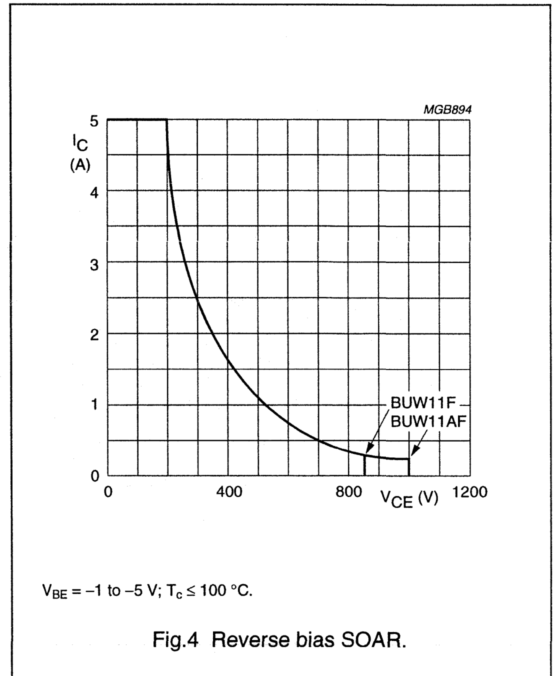


Fig.3 Power derating curve.



V_{BE} = −1 to −5 V; $T_c \leq 100$ °C.

Fig.4 Reverse bias SOAR.

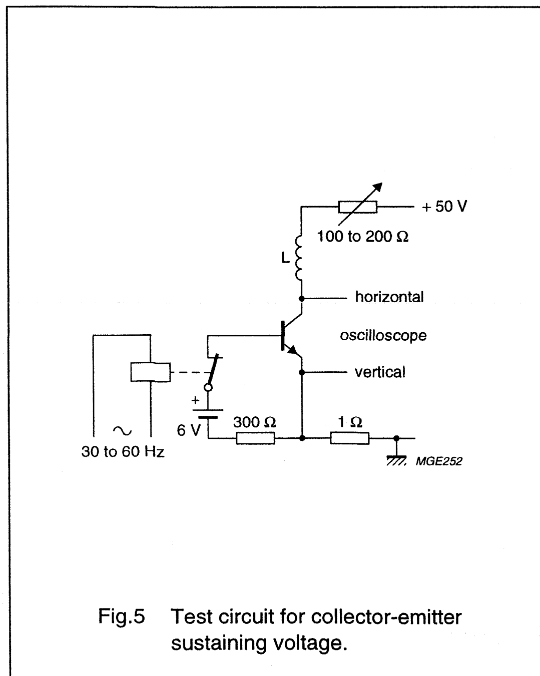


Fig.5 Test circuit for collector-emitter sustaining voltage.

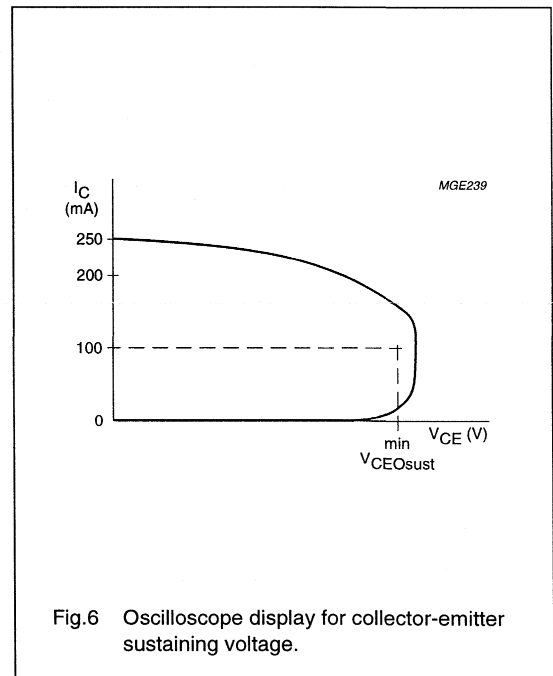
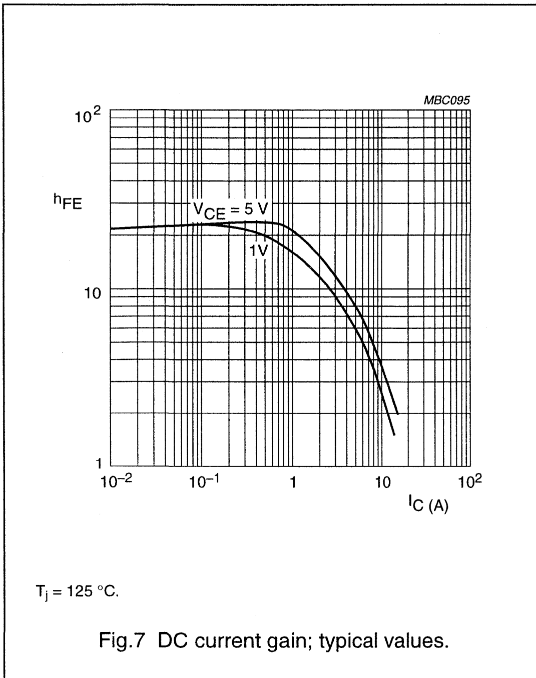
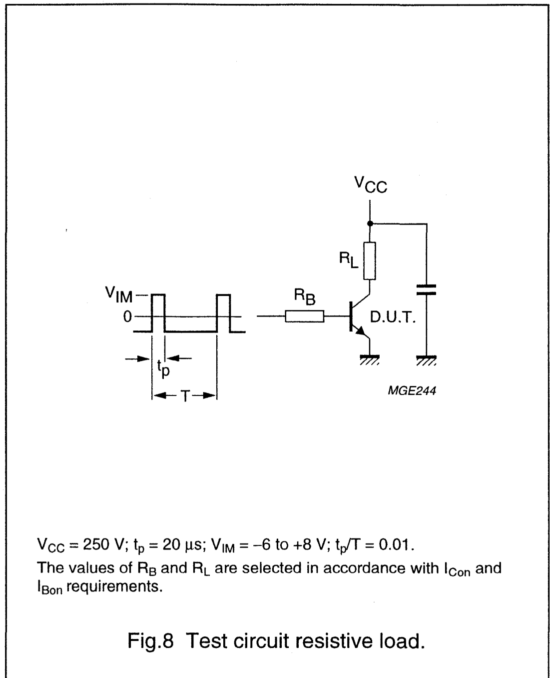


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



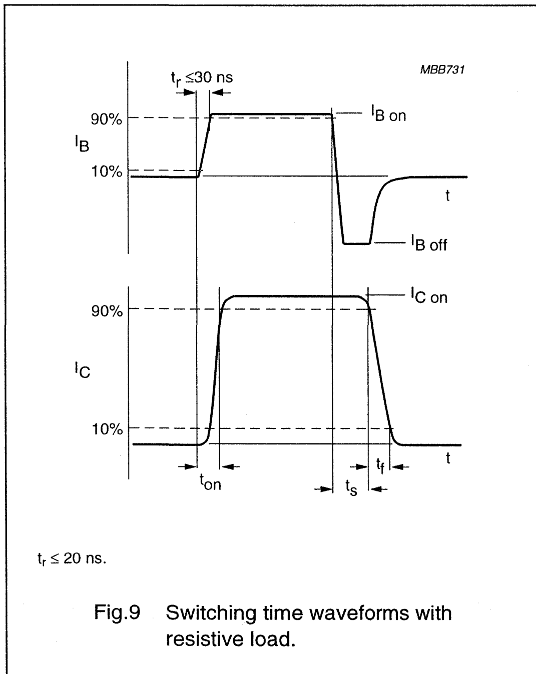
T_j = 125 °C.

Fig.7 DC current gain; typical values.



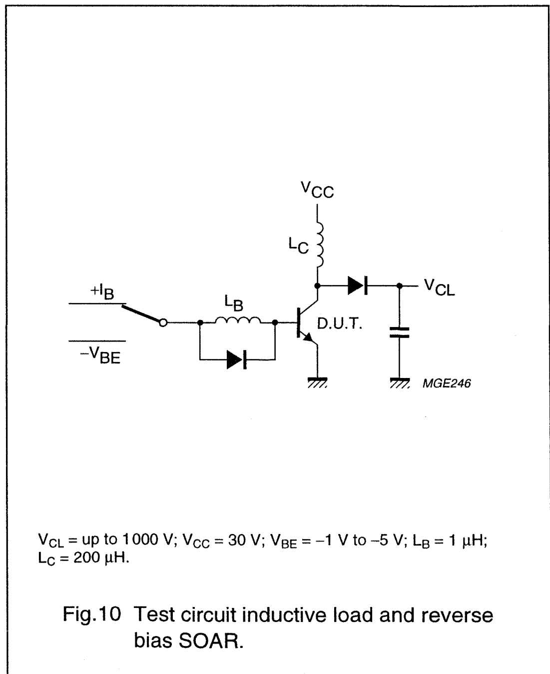
V_{CC} = 250 V; t_p = 20 μs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.8 Test circuit resistive load.



t_r ≤ 20 ns.

Fig.9 Switching time waveforms with resistive load.



V_{CL} = up to 1000 V; V_{CC} = 30 V; V_{BE} = −1 V to −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.10 Test circuit inductive load and reverse bias SOAR.

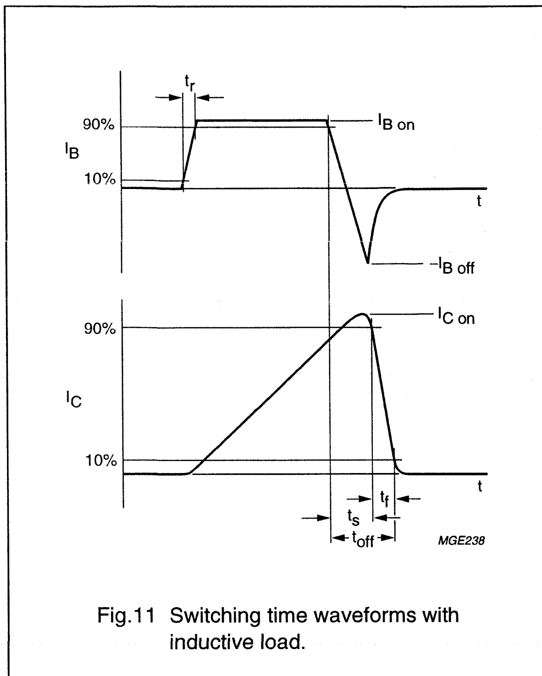


Fig.11 Switching time waveforms with inductive load.

Silicon diffused power transistors — BUW11W; BUW11AW

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT429 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

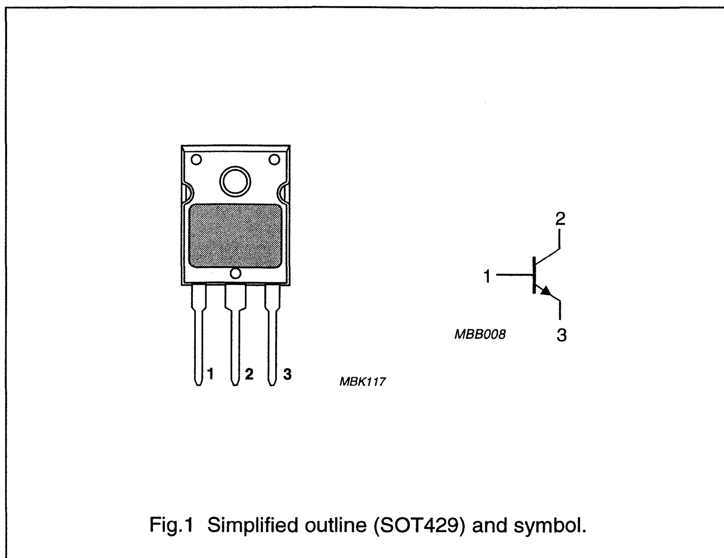


Fig.1 Simplified outline (SOT429) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUW11W		850	V
	BUW11AW		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUW11W		400	V
	BUW11AW		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
I_C	collector current (DC)	see Figs 2 and 4	5	A
I_{CM}	collector current (peak value)	see Fig 2	10	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	100	W
t_f	fall time	resistive load; see Figs 11 and 12	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1.25	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW11W		–	850	V
	BUW11AW		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW11W		–	400	V
	BUW11AW		–	450	V
I_{Csat}	collector saturation current				
	BUW11W		–	3	A
	BUW11AW		–	2.5	A
I_C	collector current (DC)	see Figs 2 and 4	–	5	A
I_{CM}	collector current (peak value)	$t_p < 2$ ms; see Fig 2	–	10	A
I_B	base current (DC)		–	2	A
I_{BM}	base current (peak value)	$t_p < 2$ ms	–	4	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	–	100	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

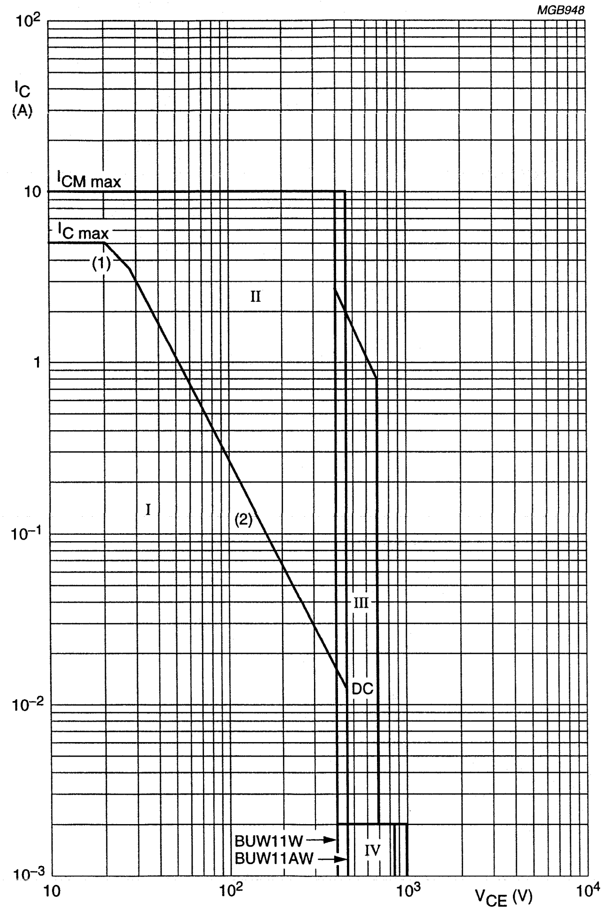
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 5 and 6				
	BUW11W		400	–	–	V
	BUW11AW		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUW11W	$I_C = 3$ A; $I_B = 600$ mA; see Figs 7 and 9	–	–	1.5	V
	BUW11AW	$I_C = 2.5$ A; $I_B = 500$ mA; see Figs 7 and 9	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUW11W	$I_C = 3$ A; $I_B = 600$ mA; see Fig.7	–	–	1.4	V
	BUW11AW	$I_C = 2.5$ A; $I_B = 500$ mA; see Fig.7	–	–	1.4	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	2	mA
I_{EBO}	emitter-base 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; see Fig.10	10	18	35	
		$V_{CE} = 5$ V; $I_C = 500$ mA; see Fig.10	10	20	35	

Silicon diffused power transistors BUW11W; BUW11AW

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times resistive load (see Figs 11 and 12)						
t_{on}	turn-on time					
	BUW11W	I_{Con} = 3 A; $I_{Bon} = -I_{Boff}$ = 600 mA	–	–	1	µs
	BUW11AW	I_{Con} = 2.5 A; $I_{Bon} = -I_{Boff}$ = 500 mA	–	–	1	µs
t_s	storage time					
	BUW11W	I_{Con} = 3 A; $I_{Bon} = -I_{Boff}$ = 600 mA	–	–	4	µs
	BUW11AW	I_{Con} = 2.5 A; $I_{Bon} = -I_{Boff}$ = 500 mA	–	–	4	µs
t_f	fall time					
	BUW11W	I_{Con} = 3 A; $I_{Bon} = -I_{Boff}$ = 600 mA	–	–	0.8	µs
	BUW11AW	I_{Con} = 2.5 A; $I_{Bon} = -I_{Boff}$ = 500 mA	–	–	0.8	µs
Switching times inductive load (see Figs 13 and 14)						
t_s	storage time					
	BUW11W	I_{Con} = 3 A; I_B = 600 mA	–	1.1	1.4	µs
		I_{Con} = 3 A; I_B = 600 mA; T_j = 100 °C	–	1.2	1.5	µs
	BUW11AW	I_{Con} = 2.5 A; I_B = 500 mA	–	1.1	1.4	µs
		I_{Con} = 2.5 A; I_B = 500 mA; T_j = 100 °C	–	1.2	1.5	µs
t_f	fall time					
	BUW11W	I_{Con} = 3 A; I_B = 600 mA	–	80	150	ns
		I_{Con} = 3 A; I_B = 600 mA; T_j = 100 °C	–	140	300	ns
	BUW11AW	I_{Con} = 2.5 A; I_B = 500 mA	–	80	150	ns
		I_{Con} = 2.5 A; I_B = 500 mA; T_j = 100 °C	–	140	300	ns

Note

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



$T_{mb} \leq 25$ °C.

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 $t_p \leq 0.6\ \mu s$.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 5$ ms.

(1) $P_{tot\ max}$ line.

(2) Second breakdown limits.

Fig.2 Forward bias SOAR.

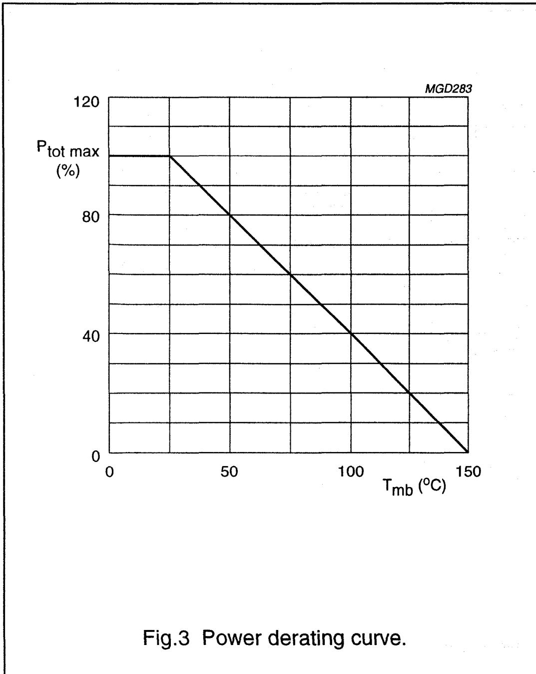
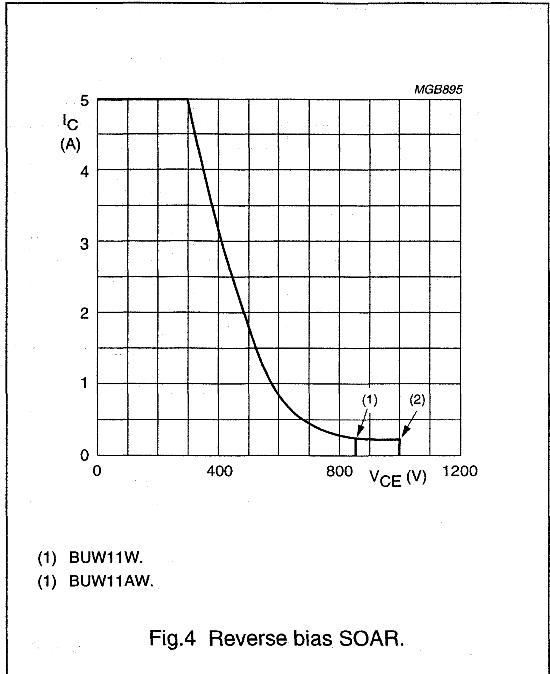


Fig.3 Power derating curve.



(1) BUW11W.
(1) BUW11AW.

Fig.4 Reverse bias SOAR.

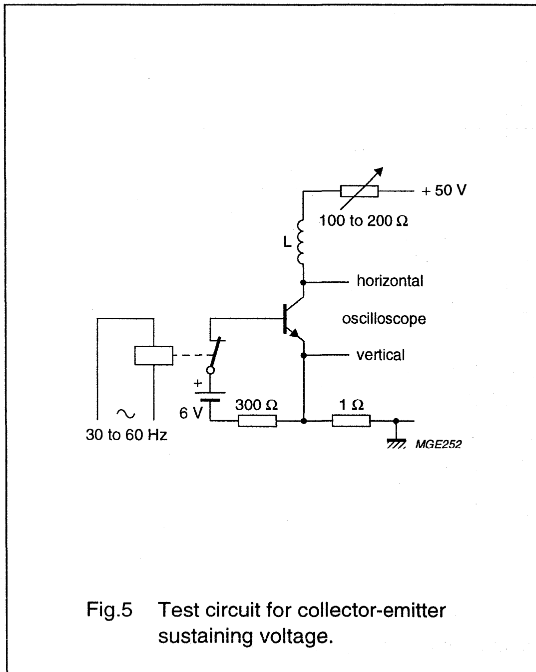


Fig.5 Test circuit for collector-emitter sustaining voltage.

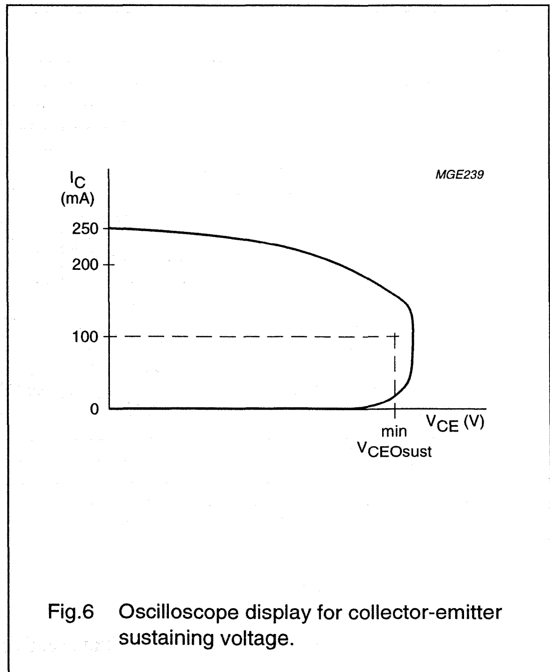


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.

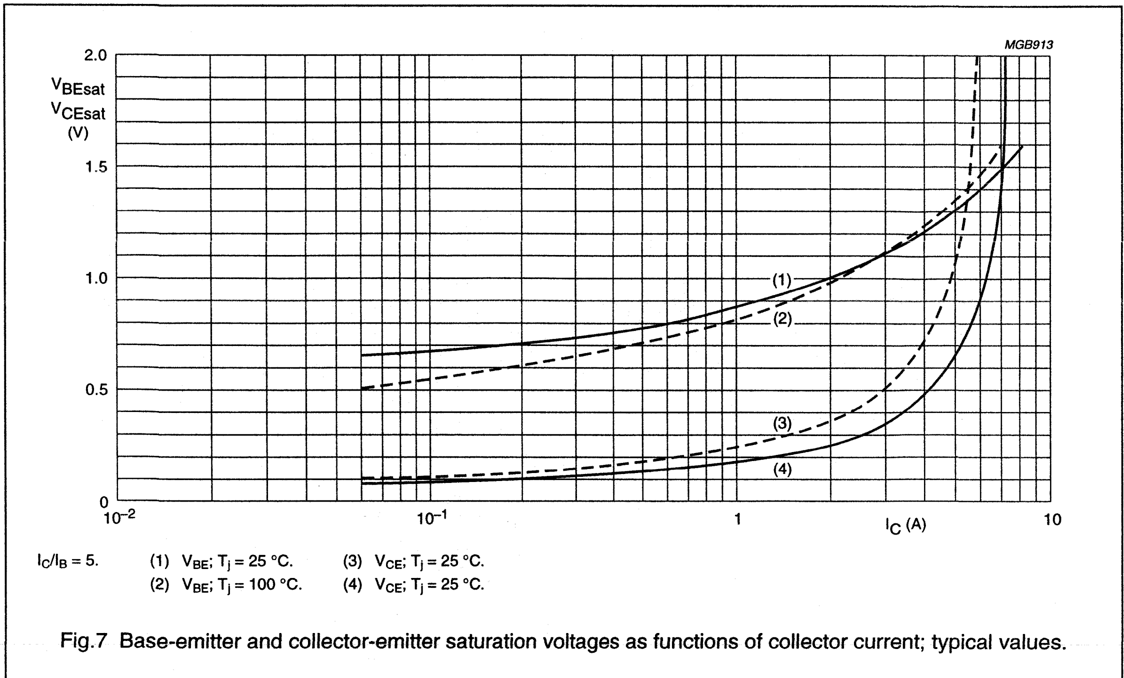


Fig.7 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.

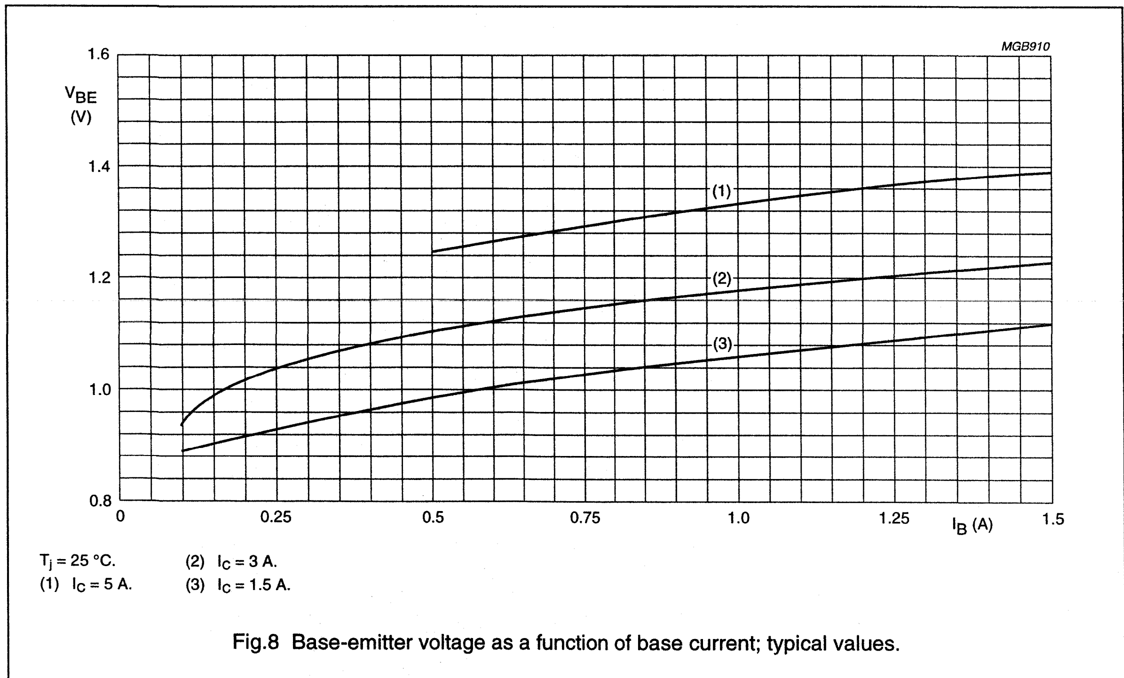
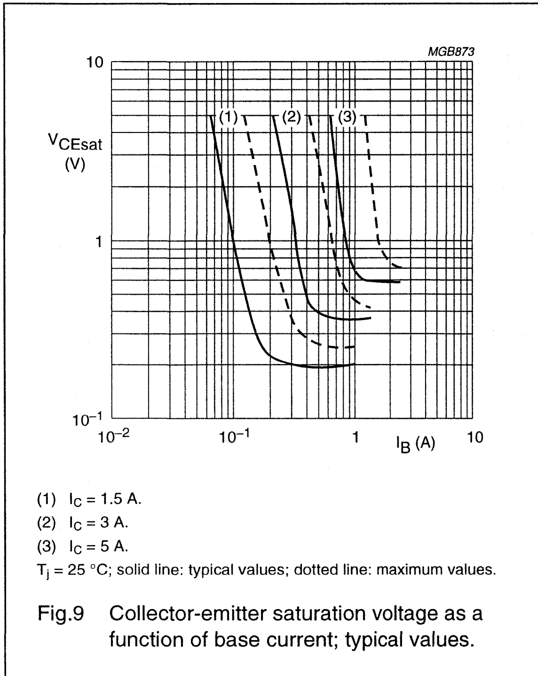


Fig.8 Base-emitter voltage as a function of base current; typical values.



(1) I_C = 1.5 A.
(2) I_C = 3 A.
(3) I_C = 5 A.
T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.9 Collector-emitter saturation voltage as a function of base current; typical values.

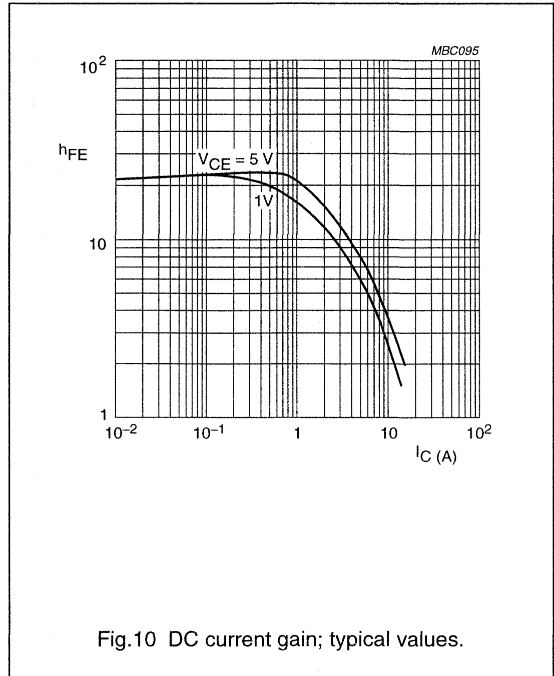
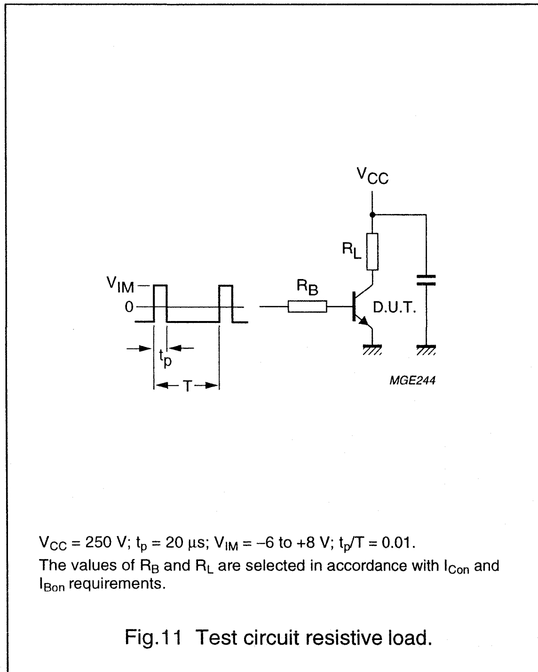


Fig.10 DC current gain; typical values.



V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.11 Test circuit resistive load.

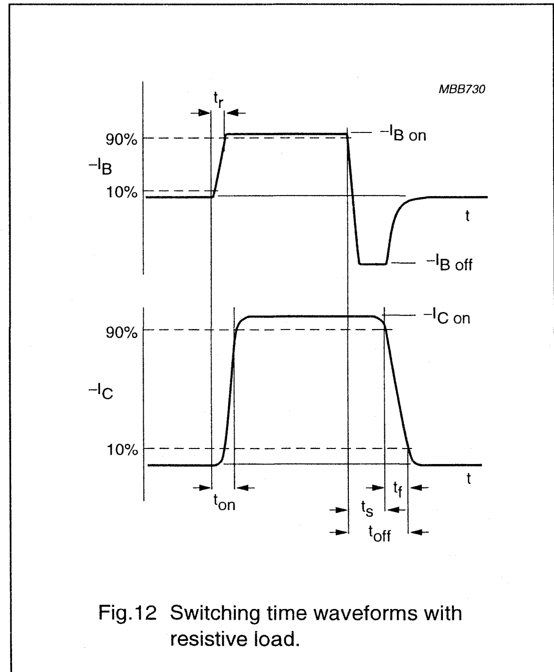
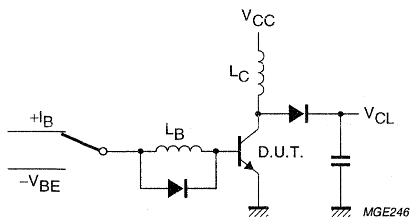


Fig.12 Switching time waveforms with resistive load.



V_{CL} = 300 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.13 Test circuit inductive load.

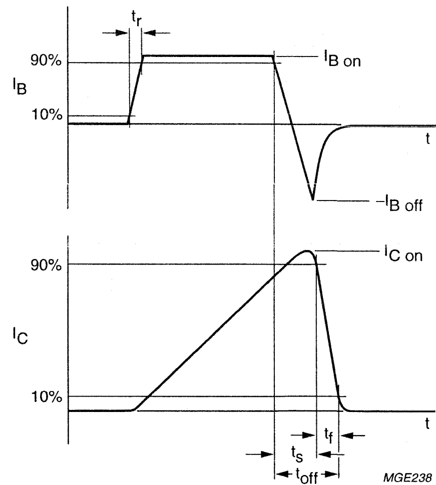


Fig.14 Switching time waveforms with inductive load.

Silicon diffused power transistors BUW12F; BUW12AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT199 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated

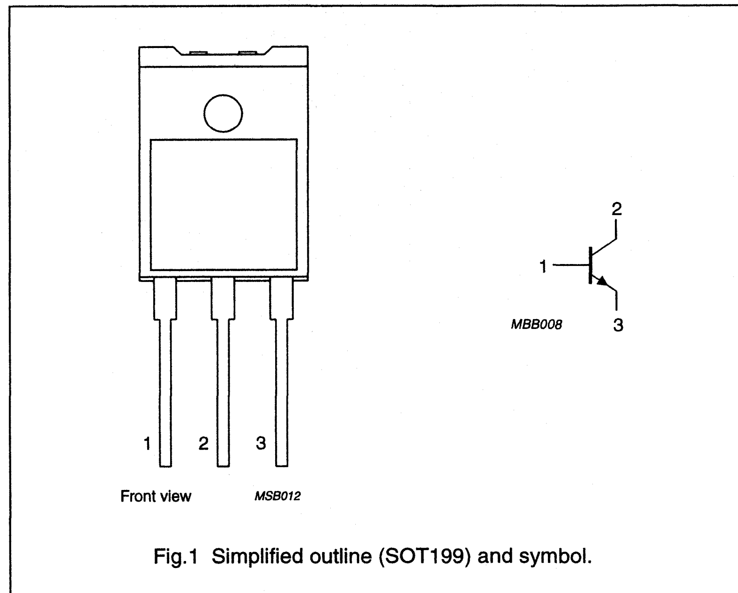


Fig.1 Simplified outline (SOT199) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUW12F		850	V
	BUW12AF		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUW12F		400	V
	BUW12AF		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 6 and 10	1.5	V
I_{Csat}	collector saturation current			
	BUW12F		6	A
	BUW12AF		5	A
I_C	collector current (DC)	see Figs 2 and 5	8	A
I_{CM}	collector current (peak value)	see Fig 2	20	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.4	34	W
t_f	fall time	resistive load; see Figs 12 and 13	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	3.7	K/W
		note 2	2.8	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		35	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW12F		–	850	V
	BUW12AF		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW12F		–	400	V
	BUW12AF		–	450	V
I_{Csat}	collector saturation current	$V_{CE} = 1.5$ V			
	BUW12F		–	6	A
	BUW12AF		–	5	A
I_C	collector current (DC)	see Figs 2 and 5	–	8	A
I_{CM}	collector current (peak value)	see Fig 2	–	20	A
I_B	base current (DC)		–	4	A
I_{BM}	base current (peak value)		–	6	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.4; note 1	–	34	W
		$T_h \leq 25$ °C; see Fig.4; note 2	–	45	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	MAX.	UNIT
V_{isolM}	isolation voltage from all terminals to external heatsink (peak value)	1500	V
C_{isol}	isolation capacitance from collector to external heatsink	21	pF

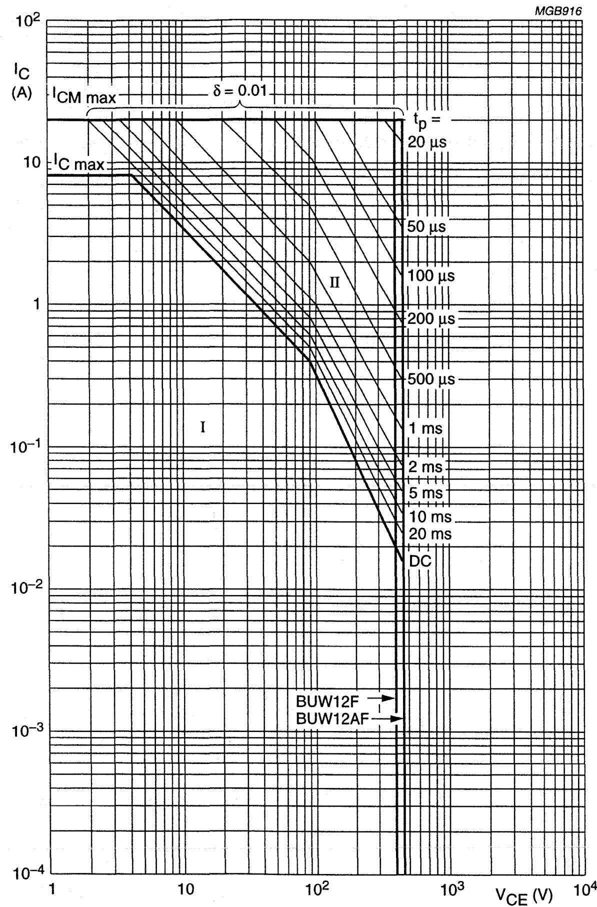
CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 8 and 9				
	BUW12F		400	–	–	V
	BUW12AF		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUW12F	I_C = 6 A; I_B = 1.2 A; see Figs 6 and 10	–	–	1.5	V
	BUW12AF	I_C = 5 A; I_B = 1 A; see Figs 6 and 10	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUW12F	I_C = 6 A; I_B = 1.2 A; see Fig.6	–	–	1.5	V
	BUW12AF	I_C = 5 A; I_B = 1 A; see Fig.6	–	–	1.5	V
I_{CES}	collector-emitter cut-off current	V_{CE} = $V_{CESMmax}$; V_{BE} = 0; note 1	–	–	1	mA
		V_{CE} = $V_{CESMmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	3	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0	–	–	10	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 10 mA; see Fig.11	10	18	35	
		V_{CE} = 5 V; I_C = 1 A; see Fig.11	10	20	35	
Switching times resistive load (see Figs 12 and 13)						
t_{on}	turn-on time					
	BUW12F	I_{Con} = 6 A; I_{Bon} = I_{Boff} = 1.2 A	–	–	1	µs
	BUW12AF	I_{Con} = 5 A; I_{Bon} = I_{Boff} = 1 A	–	–	1	µs
t_s	storage time					
	BUW12F	I_{Con} = 6 A; I_{Bon} = I_{Boff} = 1.2 A	–	–	4	µs
	BUW12AF	I_{Con} = 5 A; I_{Bon} = I_{Boff} = 1 A	–	–	4	µs
t_f	fall time					
	BUW12F	I_{Con} = 6 A; I_{Bon} = I_{Boff} = 1.2 A	–	–	0.8	µs
	BUW12AF	I_{Con} = 5 A; I_{Bon} = I_{Boff} = 1 A	–	–	0.8	µs
Switching times inductive load (see Figs 14 and 15)						
t_s	storage time					
	BUW12F	I_{Con} = 6 A; I_B = 1.2 A; V_{CL} = 250 V; T_c = 100 °C	–	1.9	2.5	µs
	BUW12AF	I_{Con} = 5 A; I_B = 1 A; V_{CL} = 300 V; T_c = 100 °C	–	1.9	2.5	µs
t_f	fall time					
	BUW12F	I_{Con} = 6 A; I_B = 1.2 A; V_{CL} = 250 V; T_c = 100 °C	–	200	300	ns
	BUW12AF	I_{Con} = 5 A; I_B = 1 A; V_{CL} = 300 V; T_c = 100 °C	–	200	300	ns

Note

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



Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

T_{mb} < 25 °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

Fig.2 Forward bias SOAR.

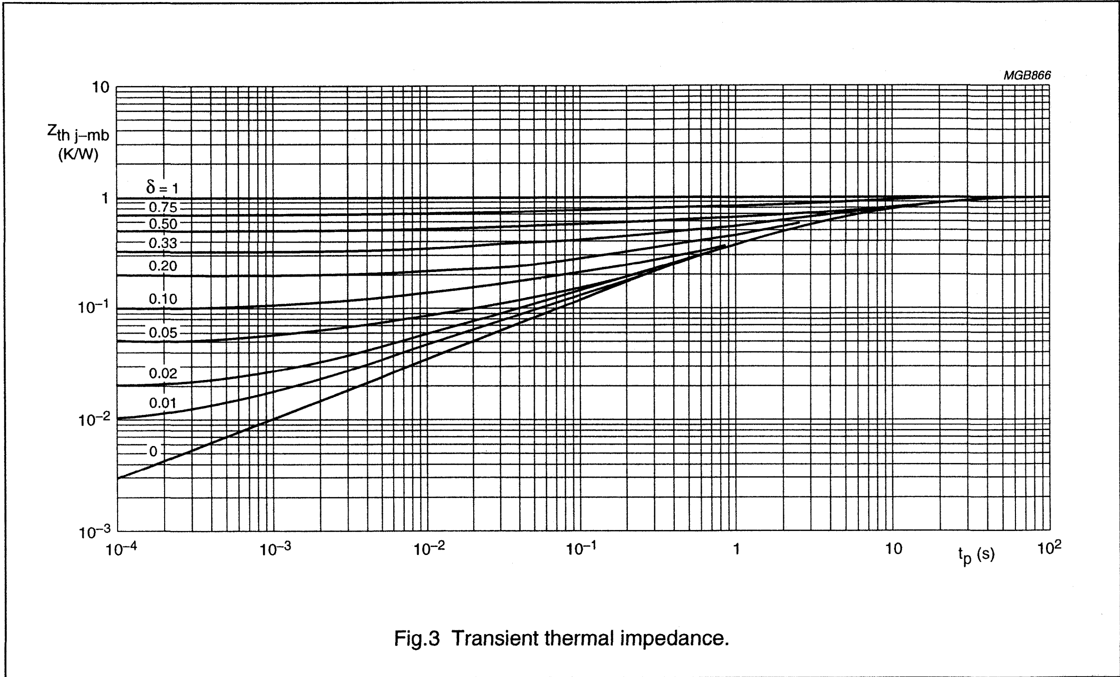


Fig.3 Transient thermal impedance.

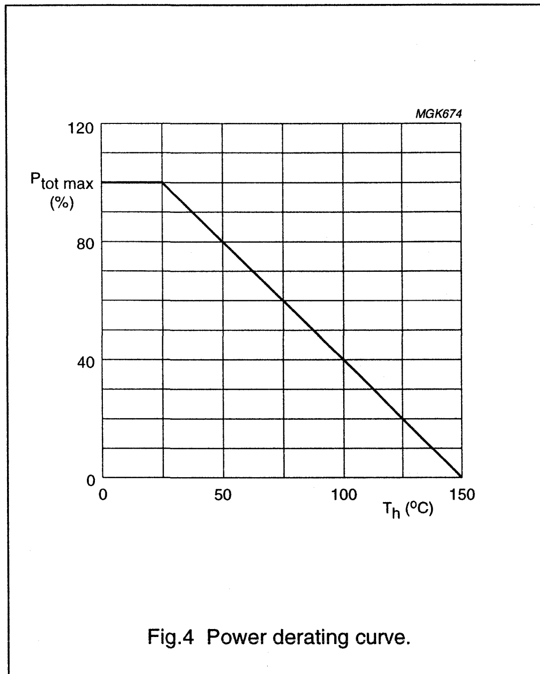
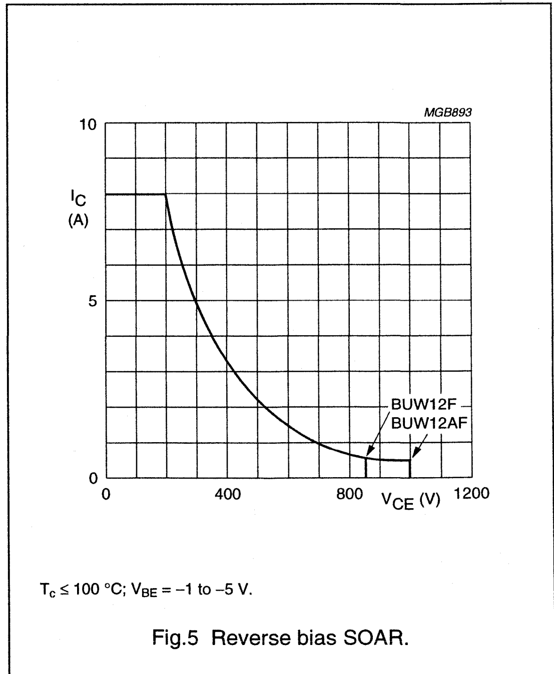
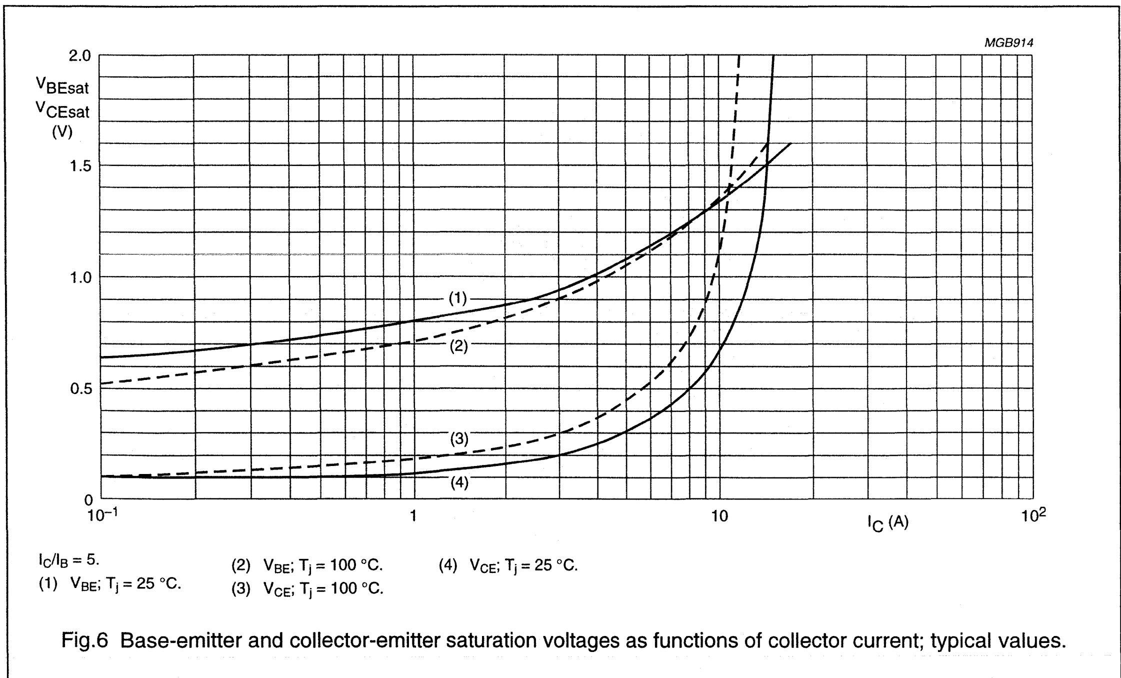


Fig.4 Power derating curve.



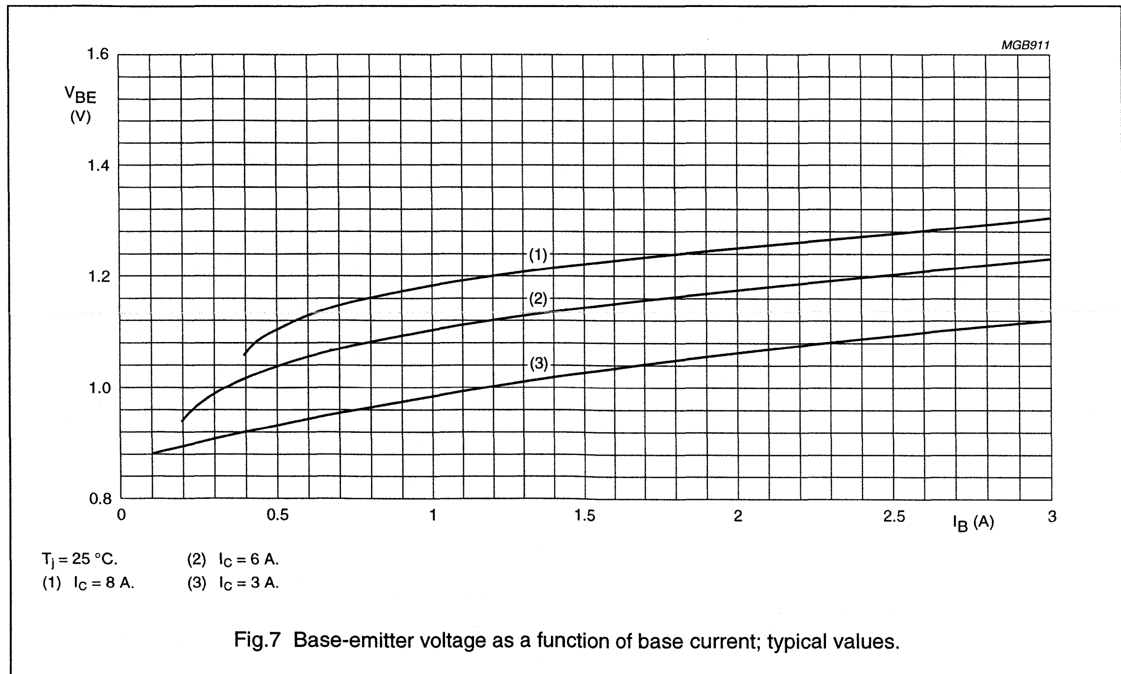
$T_c \leq 100$ °C; $V_{BE} = -1$ to -5 V.

Fig.5 Reverse bias SOAR.



$I_C/I_B = 5$.
(1) V_{BE}; $T_j = 25$ °C.
(2) V_{BE}; $T_j = 100$ °C.
(3) V_{CE}; $T_j = 100$ °C.
(4) V_{CE}; $T_j = 25$ °C.

Fig.6 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.



$T_j = 25$ °C.
(1) $I_C = 8$ A.
(2) $I_C = 6$ A.
(3) $I_C = 3$ A.

Fig.7 Base-emitter voltage as a function of base current; typical values.

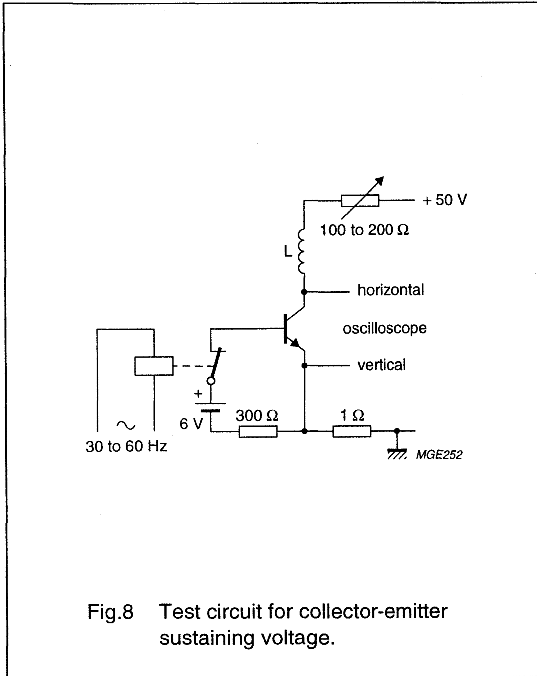


Fig.8 Test circuit for collector-emitter sustaining voltage.

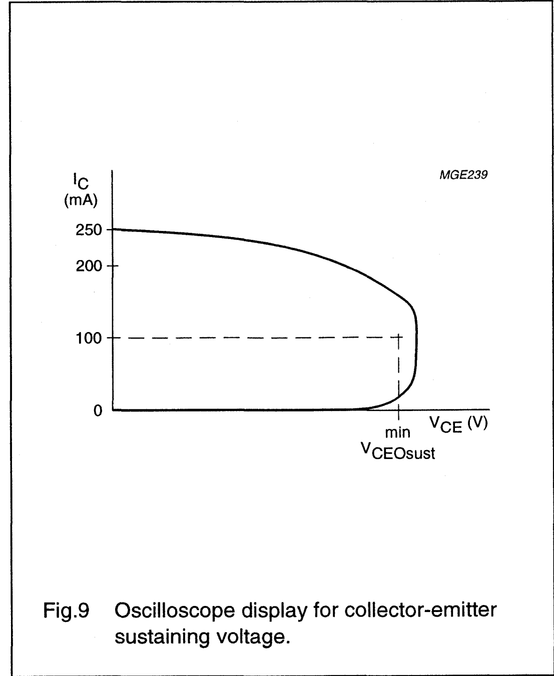
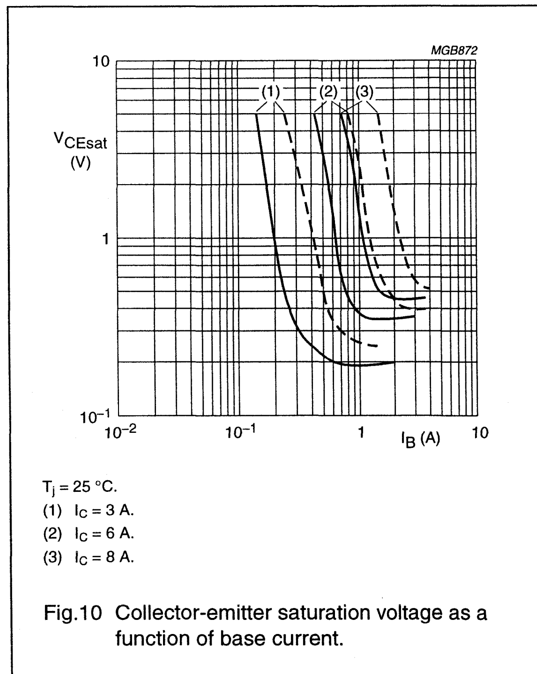
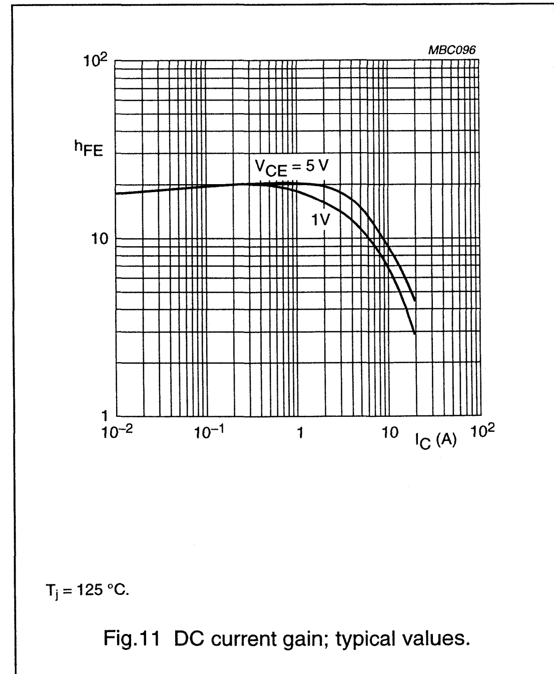


Fig.9 Oscilloscope display for collector-emitter sustaining voltage.



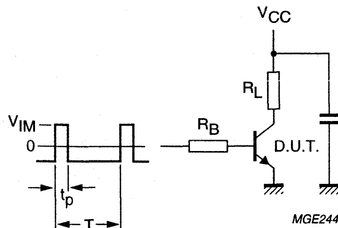
$T_j = 25\ °C$.
(1) $I_C = 3$ A.
(2) $I_C = 6$ A.
(3) $I_C = 8$ A.

Fig.10 Collector-emitter saturation voltage as a function of base current.



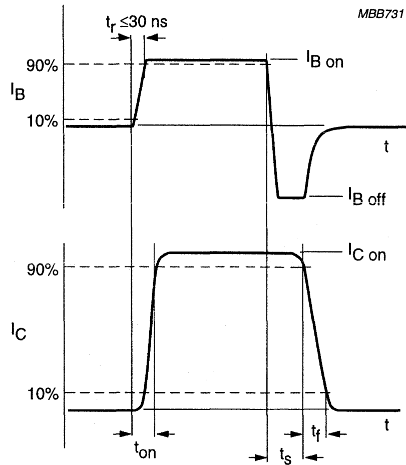
$T_j = 125\ °C$.

Fig.11 DC current gain; typical values.



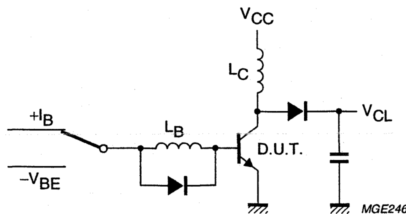
V_{CC} = 250 V; t_p = 20 μs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.12 Test circuit resistive load.



$t_r \le$ 20 ns.

Fig.13 Switching time waveforms with resistive load.



V_{CL} = up to 1000 V; V_{CC} = 30 V; V_{BE} = −1 V to −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.14 Test circuit inductive load and reverse bias SOAR.

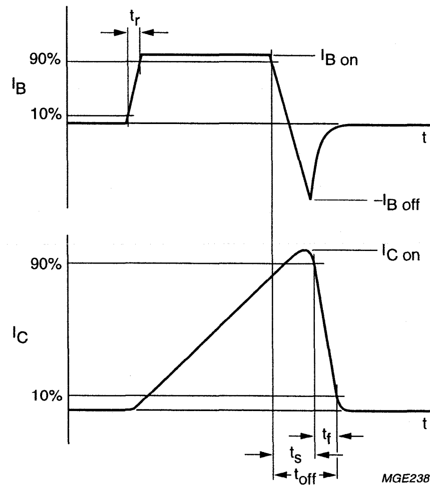


Fig.15 Switching time waveforms with inductive load.

Silicon diffused power transistors — BUW12W; BUW12AW

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT429 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

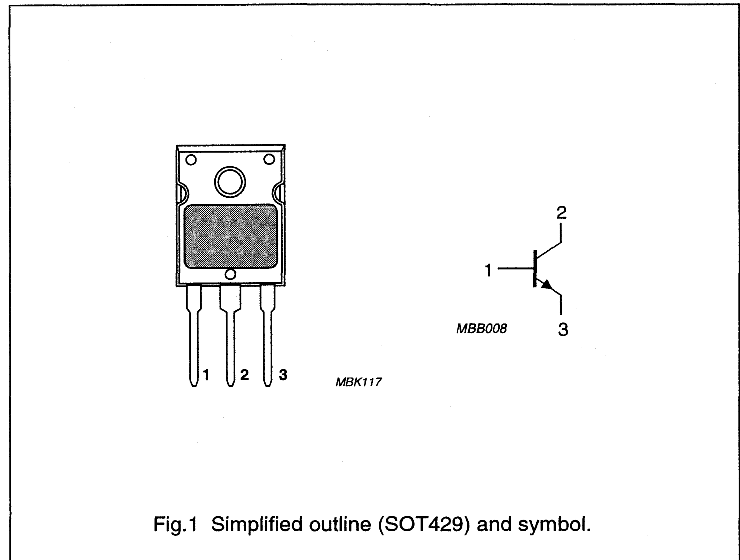


Fig.1 Simplified outline (SOT429) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUW12W		850	V
	BUW12AW		1 000	V
V_{CEO}	collector-emitter voltage	open base		
	BUW12W		400	V
	BUW12AW		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
I_C	collector current (DC)	see Figs 2 and 4	8	A
I_{CM}	collector current (peak value)	see Fig 2	20	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	125	W
t_f	fall time	resistive load; see Figs 11 and 12	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	1	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW12W		–	850	V
	BUW12AW		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW12W		–	400	V
	BUW12AW		–	450	V
I_C	collector current (DC)	see Figs 2 and 4	–	8	A
I_{CM}	collector current (peak value)	$t_p < 2$ ms; see Fig.2	–	20	A
I_B	base current (DC)		–	4	A
I_{BM}	base current (peak value)	$t_p \leq 2$ ms	–	6	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	–	125	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

CHARACTERISTICS

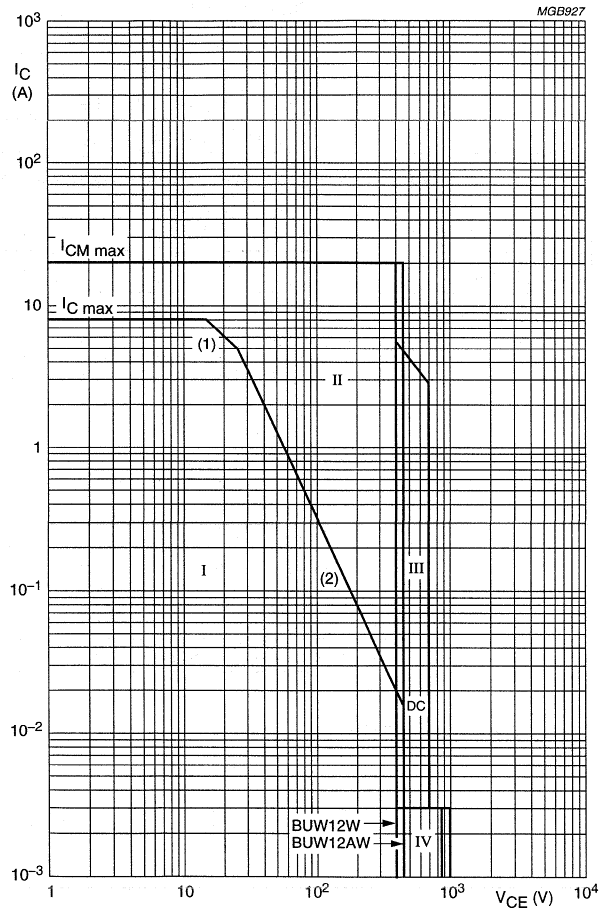
$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 5 and 6				
	BUW12W		400	–	–	V
	BUW12AW		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUW12W	$I_C = 6$ A; $I_B = 1.2$ A; see Figs 7 and 9	–	–	1.5	V
	BUW12AW	$I_C = 5$ A; $I_B = 1$ A; see Figs 7 and 9	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUW12W	$I_C = 6$ A; $I_B = 1.2$ A; see Fig.7	–	–	1.5	V
	BUW12AW	$I_C = 5$ A; $I_B = 1$ A; see Fig.7	–	–	1.5	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	3	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9$ V; $I_C = 0$	–	–	10	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 10$ mA; see Fig.10	10	18	35	
		$V_{CE} = 5$ V; $I_C = 1$ A; see Fig.10	10	20	35	

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times resistive load (see Figs 11 and 12)						
t_{on}	turn-on time					
	BUW12W	I_{Con} = 6 A; I_{Bon} = $-I_{Boff}$ = 1.2 A	–	–	1	μs
	BUW12AW	I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 1 A	–	–	1	μs
t_s	storage time					
	BUW12W	I_{Con} = 6 A; I_{Bon} = $-I_{Boff}$ = 1.2 A	–	–	4	μs
	BUW12AW	I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 1 A	–	–	4	μs
t_f	fall time					
	BUW12W	I_{Con} = 6 A; I_{Bon} = $-I_{Boff}$ = 1.2 A	–	–	0.8	μs
	BUW12AW	I_{Con} = 5 A; I_{Bon} = $-I_{Boff}$ = 1 A	–	–	0.8	μs
Switching times inductive load (see Figs 13 and 14)						
t_s	storage time					
	BUW12W	I_{Con} = 6 A; I_B = 1.2 A	–	1.6	2.1	μs
		I_{Con} = 6 A; I_B = 1.2 A; T_j = 100 °C	–	1.8	2.3	μs
	BUW12AW	I_{Con} = 5 A; I_B = 1 A	–	1.6	2.1	μs
		I_{Con} = 5 A; I_B = 1 A; T_j = 100 °C	–	1.8	2.3	μs
t_f	fall time					
	BUW12W	I_{Con} = 6 A; I_B = 1.2 A	–	80	150	ns
		I_{Con} = 6 A; I_B = 1.2 A; T_j = 100 °C	–	140	300	ns
	BUW12AW	I_{Con} = 5 A; I_B = 1 A	–	80	150	ns
		I_{Con} = 5 A; I_B = 1 A; T_j = 100 °C	–	140	300	ns

Note

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



$T_{mb} \leq 25$ °C.

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 $t_p \leq 0.6$ µs.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2$ ms.

(1) $P_{tot\ max}$ line.

(2) Second breakdown limits.

Fig.2 Forward bias SOAR.

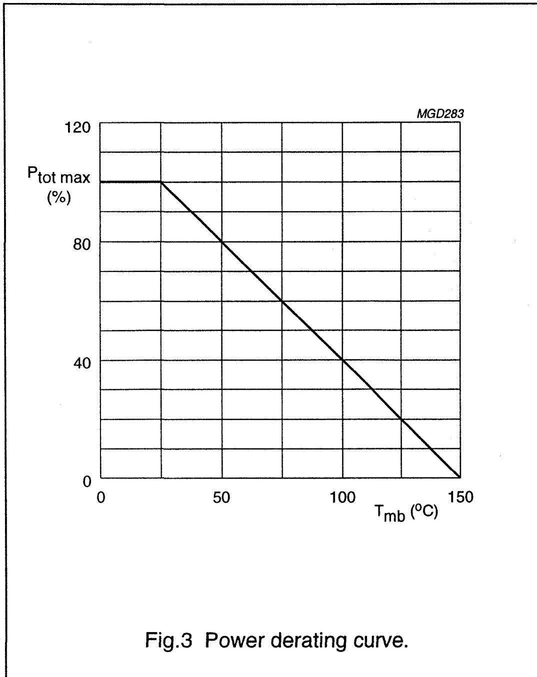


Fig.3 Power derating curve.

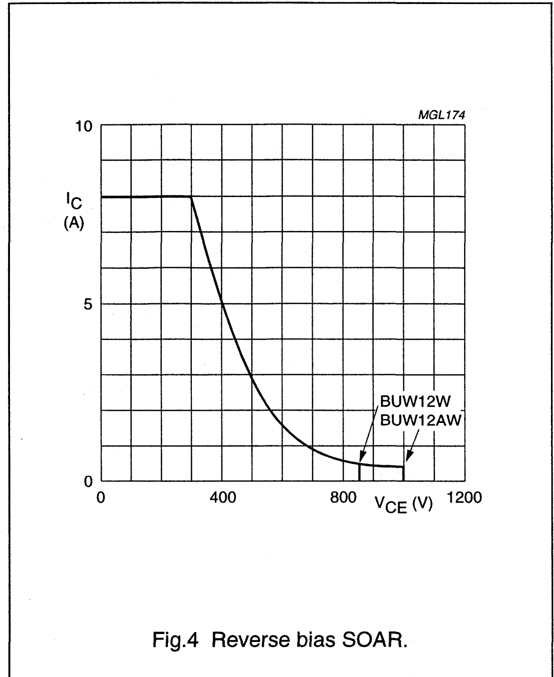


Fig.4 Reverse bias SOAR.

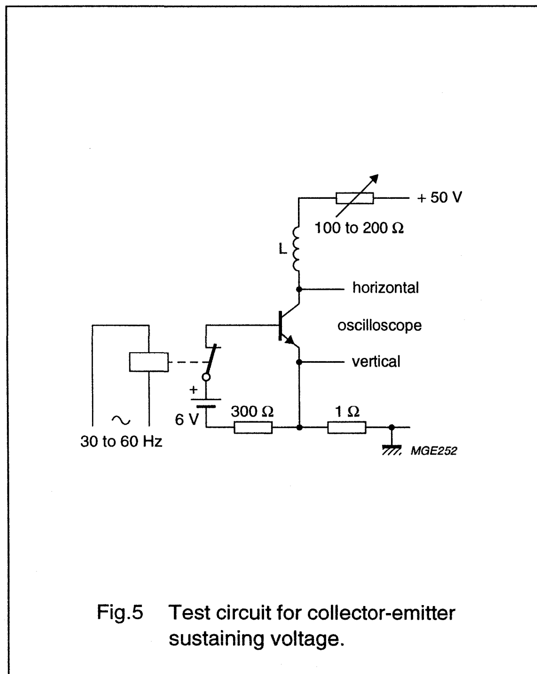


Fig.5 Test circuit for collector-emitter sustaining voltage.

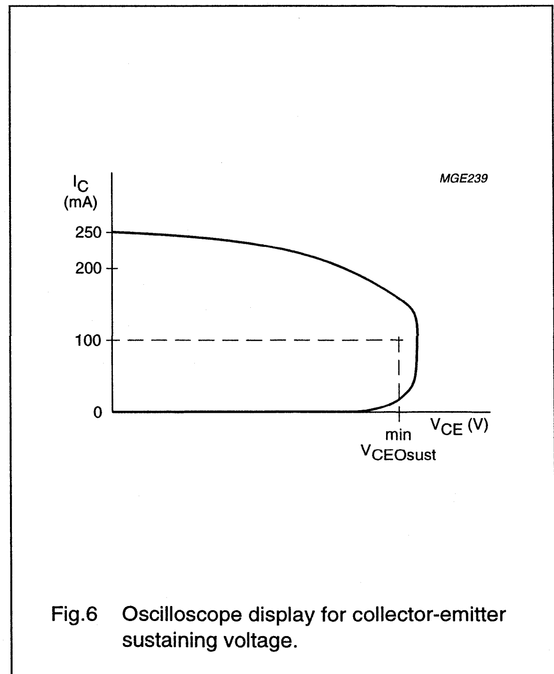
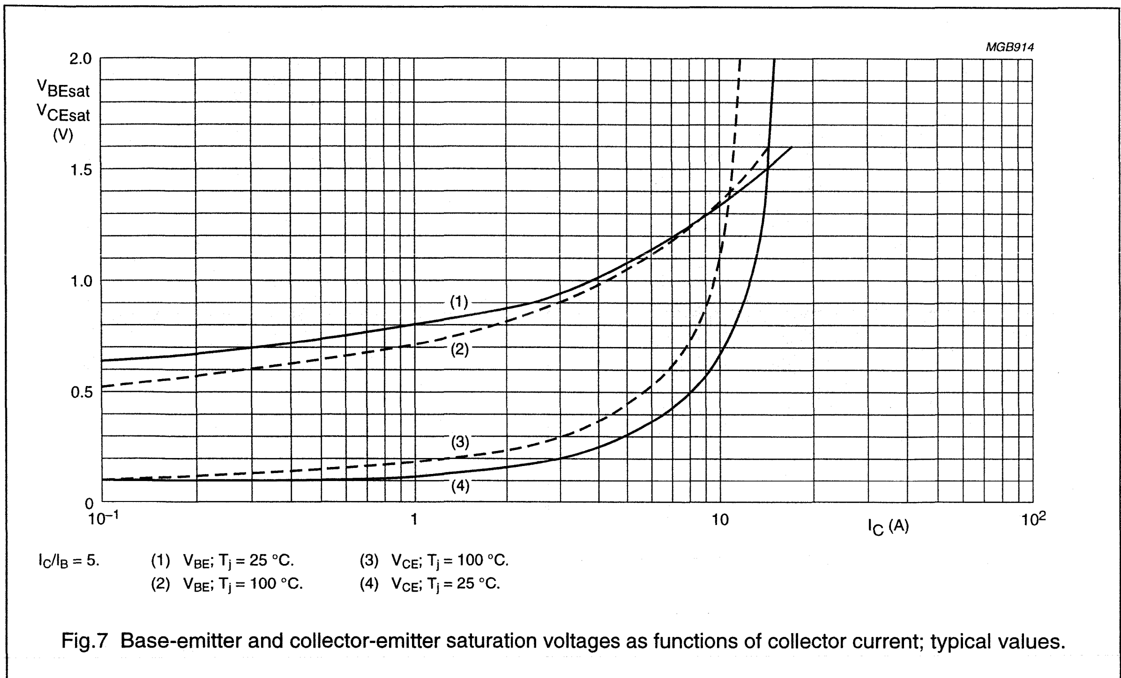
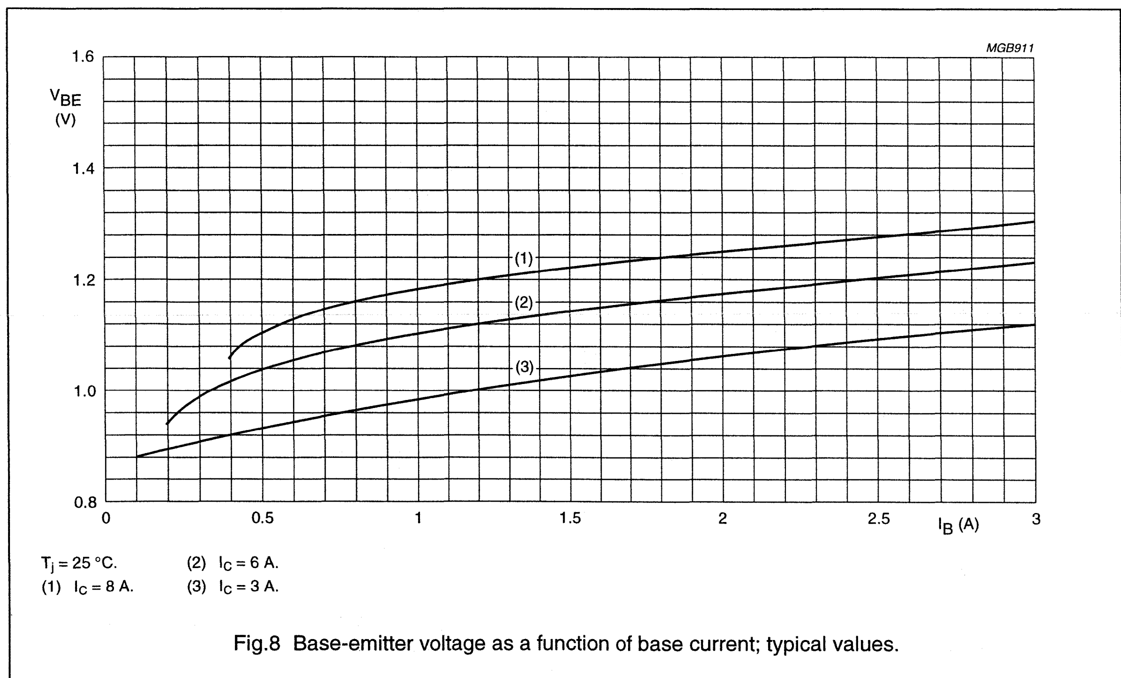


Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



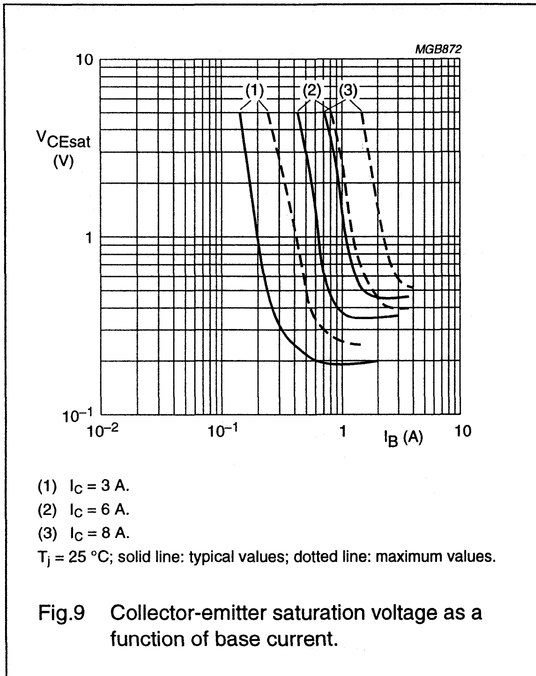
$I_C/I_B = 5$.
(1) V_{BE}; $T_j = 25$ °C.
(2) V_{BE}; $T_j = 100$ °C.
(3) V_{CE}; $T_j = 100$ °C.
(4) V_{CE}; $T_j = 25$ °C.

Fig.7 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.



$T_j = 25$ °C.
(1) $I_C = 8$ A.
(2) $I_C = 6$ A.
(3) $I_C = 3$ A.

Fig.8 Base-emitter voltage as a function of base current; typical values.



(1) I_C = 3 A.
(2) I_C = 6 A.
(3) I_C = 8 A.
T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.9 Collector-emitter saturation voltage as a function of base current.

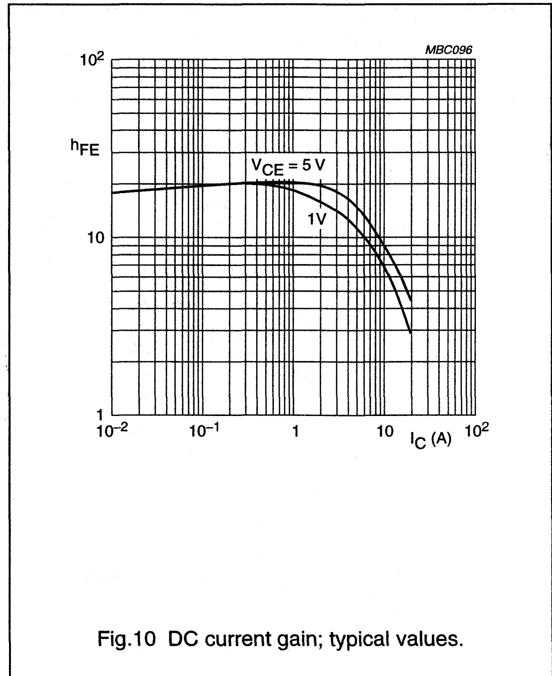
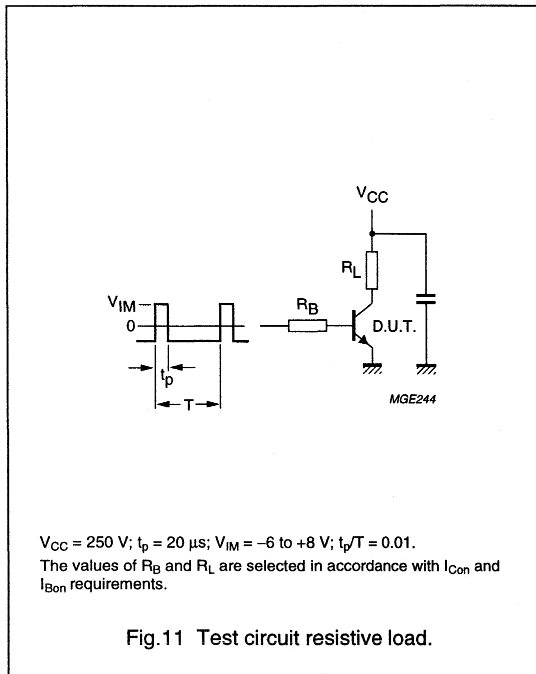


Fig.10 DC current gain; typical values.



V_{CC} = 250 V; t_p = 20 µs; V_{IM} = −6 to +8 V; t_p/T = 0.01.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.11 Test circuit resistive load.

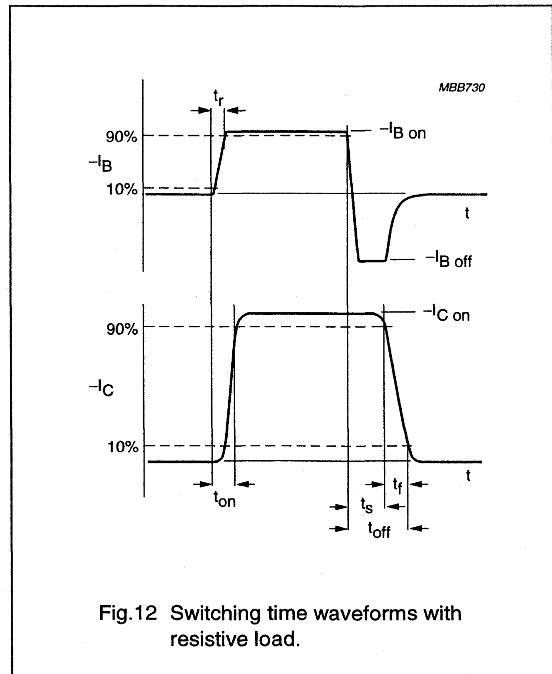
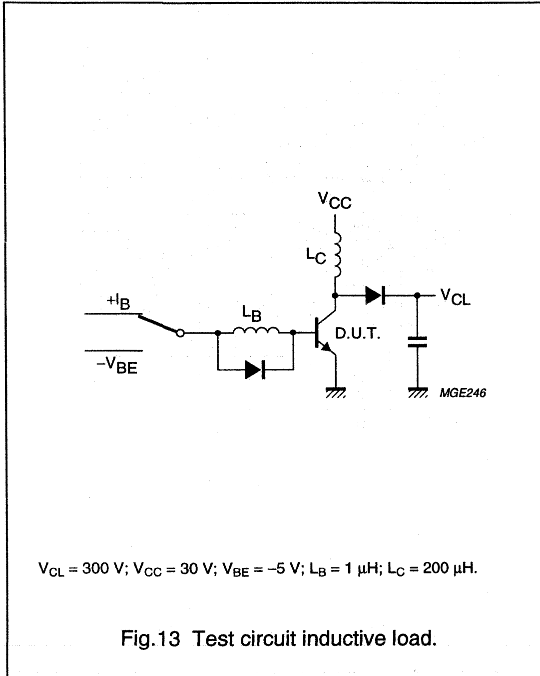


Fig.12 Switching time waveforms with resistive load.



V_{CL} = 300 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.13 Test circuit inductive load.

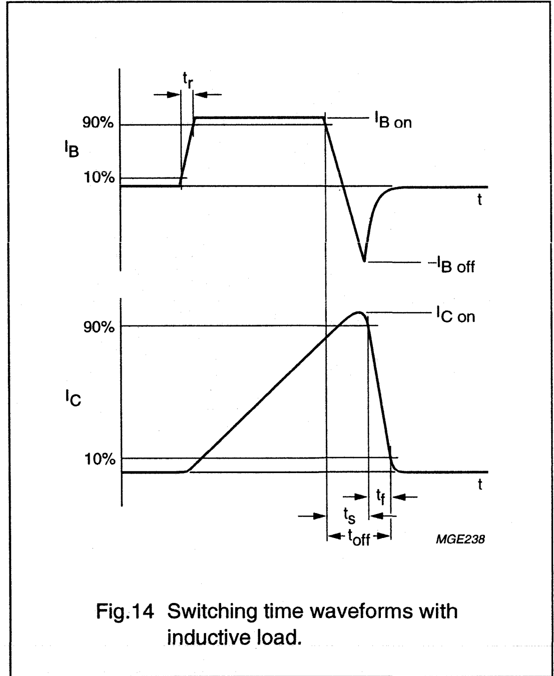


Fig.14 Switching time waveforms with inductive load.

Silicon diffused power transistors | BUW13F; BUW13AF

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT199 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated

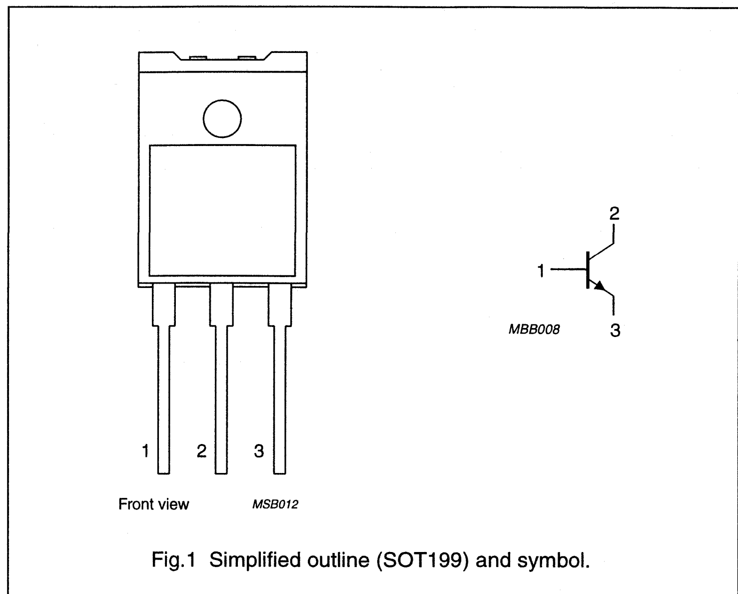


Fig.1 Simplified outline (SOT199) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUW13F		850	V
	BUW13AF		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUW13F		400	V
	BUW13AF		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 8 and 10	1.5	V
I_{Csat}	collector saturation current			
	BUW13F		10	A
	BUW13AF		8	A
I_C	collector current (DC)	see Figs 3 and 4	15	A
I_{CM}	collector current (peak value)	$t_p < 20$ ms; see Fig 4	30	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2	37	W
t_f	fall time	resistive load; see Fig.13	0.8	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	3.4	K/W
		note 2	2.5	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		35	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW13F		–	850	V
	BUW13AF		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW13F		–	400	V
	BUW13AF		–	450	V
I_{Csat}	collector saturation current				
	BUW13F		–	10	A
	BUW13AF		–	8	A
I_C	collector current (DC)	see Figs 3 and 4	–	15	A
I_{CM}	collector current (peak value)	$t_p < 20$ ms; see Fig 4	–	30	A
I_B	base current (DC)		–	6	A
I_{BM}	base current (peak value)	$t_p = -20$ ms	–	9	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; see Fig.2; note 1	–	37	W
		$T_h \leq 25$ °C; see Fig.2; note 2	–	50	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	MAX.	UNIT
V_{isolM}	isolation voltage from all terminals to external heatsink (peak value); note 1	2000	V
C_{isol}	isolation capacitance from collector to external heatsink	21	pF

Note

1. Repetitive peak operation with RH ≤ 65% under clean and dust-free conditions.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	I_C = 100 mA; I_{Boff} = 0; L = 25 mH; see Figs 6 and 7				
	BUW13F		400	–	–	V
	BUW13AF		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUW13F	I_C = 10 A; I_B = 2 A; see Figs 8 and 10	–	–	1.5	V
	BUW13AF	I_C = 8 A; I_B = 1.6 A; see Figs 8 and 10	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUW13F	I_C = 10 A; I_B = 2 A; see Fig.8	–	–	1.6	V
	BUW13AF	I_C = 8 A; I_B = 1.6 A; see Fig.8	–	–	1.6	V
I_{Csat}	collector saturation current	V_{CE} = 1.5 V				
	BUW13F		–	–	10	A
	BUW13AF		–	–	8	A
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; V_{BE} = 0; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; V_{BE} = 0; T_j = 125 °C; note 1	–	–	4	mA
I_{EBO}	emitter-base cut-off current	V_{EB} = 9 V; I_C = 0	–	–	10	mA
h_{FE}	DC current gain	V_{CE} = 5 V; I_C = 20 mA; see Fig.11	10	18	35	
		V_{CE} = 5 V; I_C = 1.5 A; see Fig.11	10	20	35	
Switching times resistive load (see Figs 12 and 13)						
t_{on}	turn-on time					
	BUW13F	I_{Con} = 10 A; $I_{Bon} = I_{Boff}$ = 2 A	–	–	1	µs
	BUW13AF	I_{Con} = 8 A; $I_{Bon} = I_{Boff}$ = 1.6 A	–	–	1	µs
t_s	storage time					
	BUW13F	I_{Con} = 10 A; $I_{Bon} = I_{Boff}$ = 2 A	–	–	4	µs
	BUW13AF	I_{Con} = 8 A; $I_{Bon} = I_{Boff}$ = 1.6 A	–	–	4	µs
t_f	fall time					
	BUW13F	I_{Con} = 10 A; $I_{Bon} = I_{Boff}$ = 2 A	–	–	0.8	µs
	BUW13AF	I_{Con} = 8 A; $I_{Bon} = I_{Boff}$ = 1.6 A	–	–	0.8	µs
Switching times inductive load (see Figs 14 and 15)						
t_s	storage time					
	BUW13F	I_{Con} = 10 A; I_B = 2 A; V_{CL} = 250 V; T_c = 100 °C	–	2.8	3.5	µs
	BUW13AF	I_{Con} = 8 A; I_B = 1.6 A; V_{CL} = 300 V; T_c = 100 °C	–	2.8	3.5	µs

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
t_f	fall time					
	BUW13F	I_{Con} = 10 A; I_B = 2 A; V_{CL} = 250 V; T_c = 100 °C	–	200	300	ns
	BUW13AF	I_{Con} = 8 A; I_B = 1.6 A; V_{CL} = 300 V; T_c = 100 °C	–	200	300	ns

Note

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

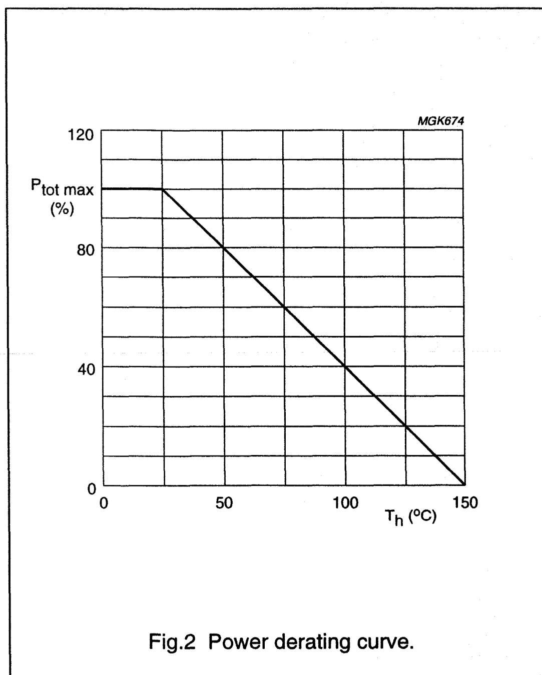


Fig.2 Power derating curve.

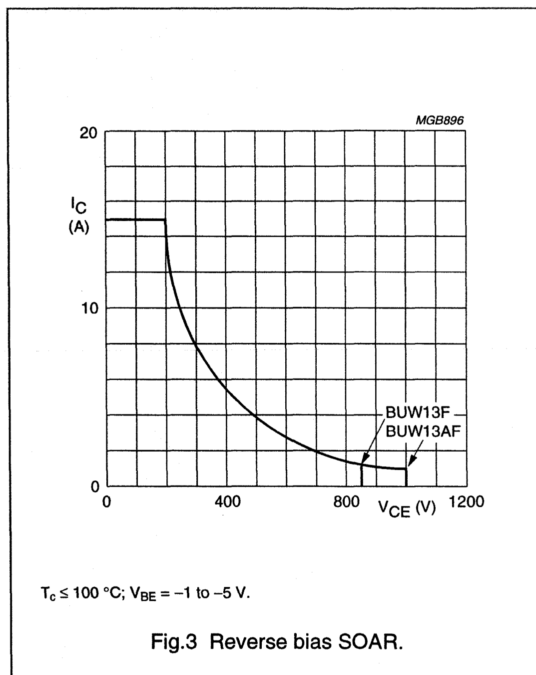
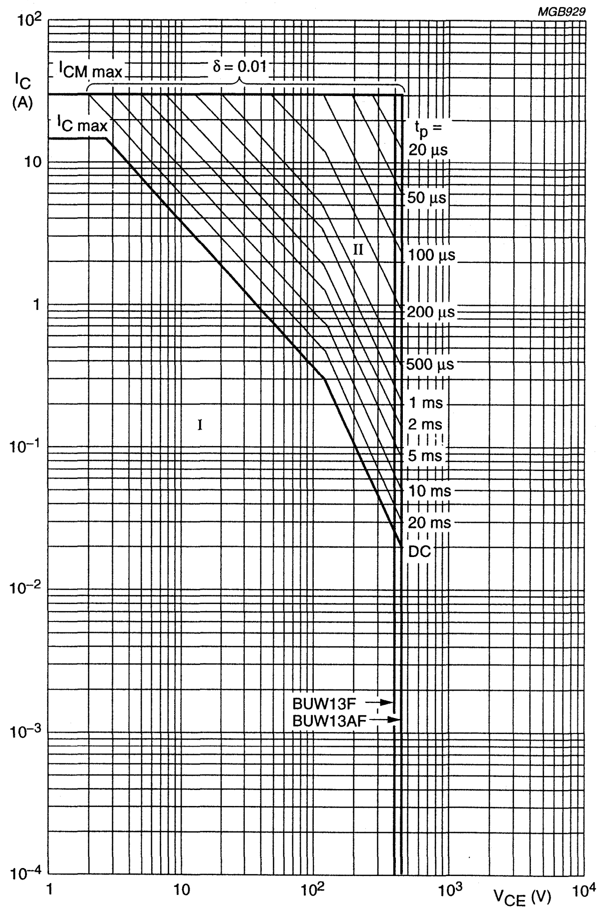


Fig.3 Reverse bias SOAR.



T_{mb} = 25 °C.

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 (independent of temperature).

Fig.4 Forward bias SOAR.

Silicon diffused power transistors BUW13F; BUW13AF

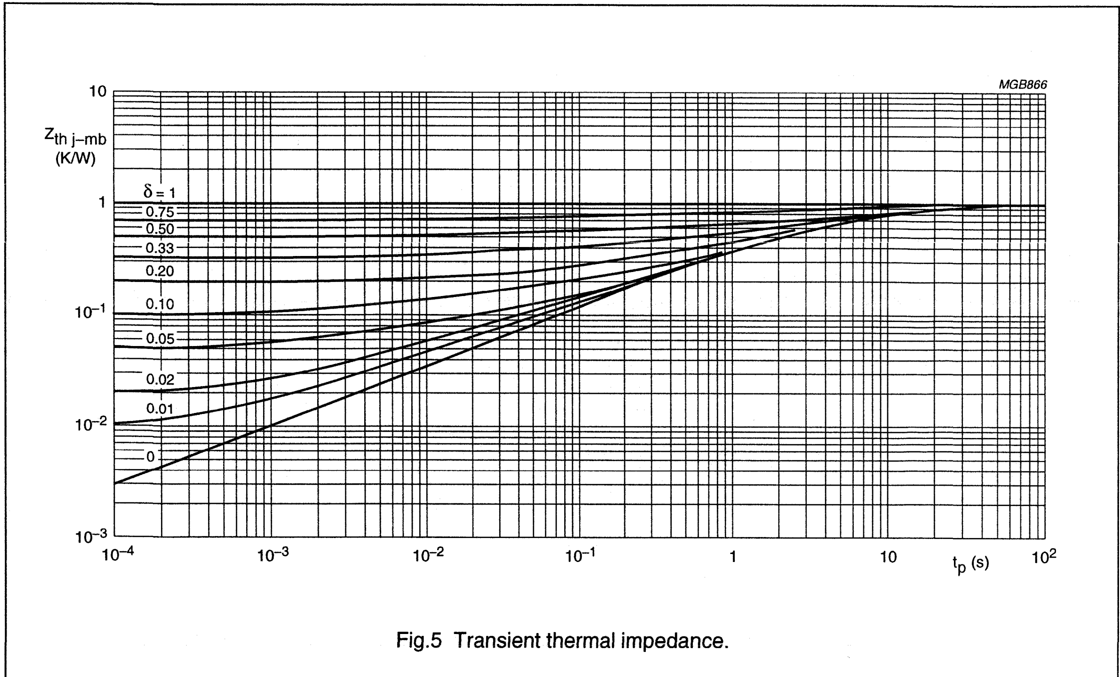


Fig.5 Transient thermal impedance.

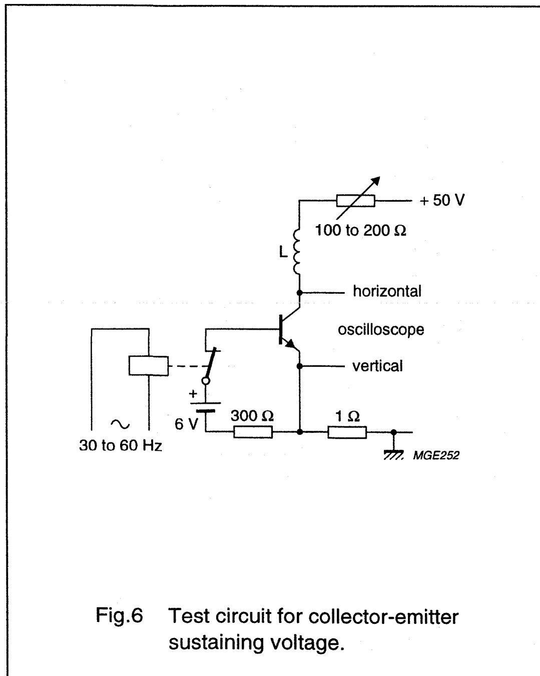


Fig.6 Test circuit for collector-emitter sustaining voltage.

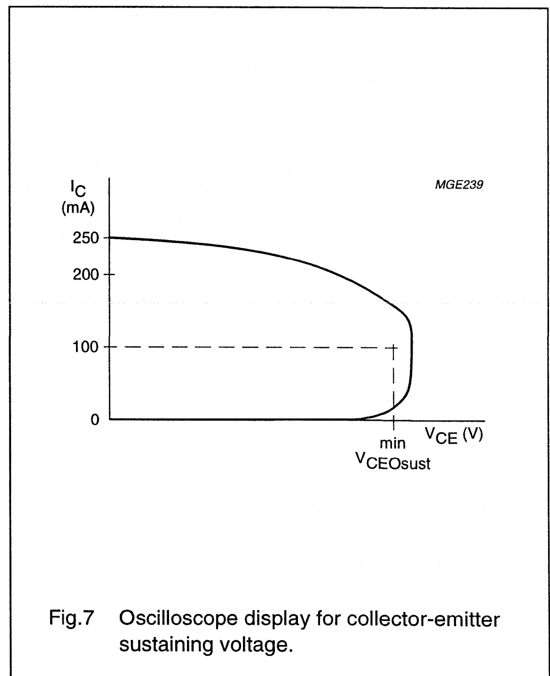
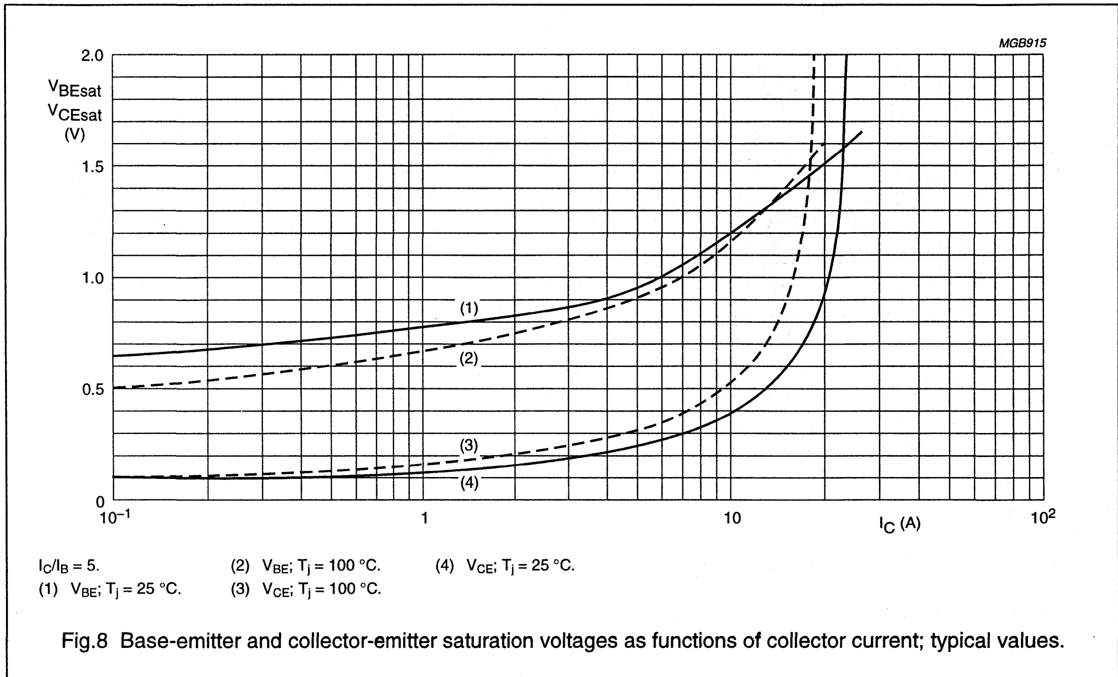


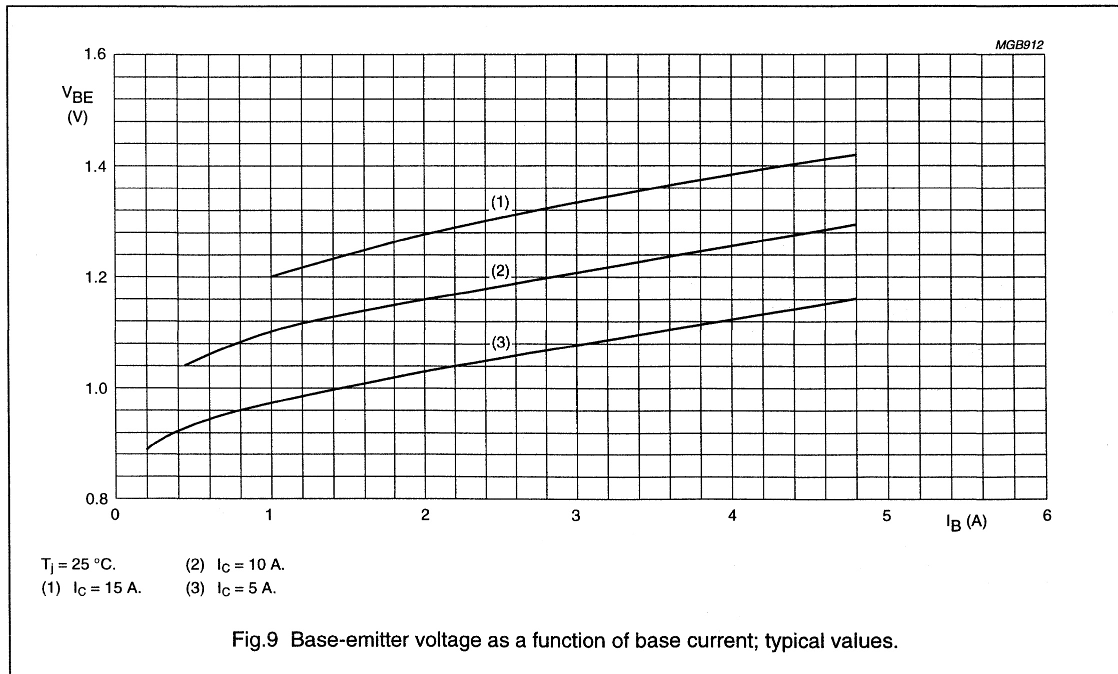
Fig.7 Oscilloscope display for collector-emitter sustaining voltage.

Silicon diffused power transistors BUW13F; BUW13AF



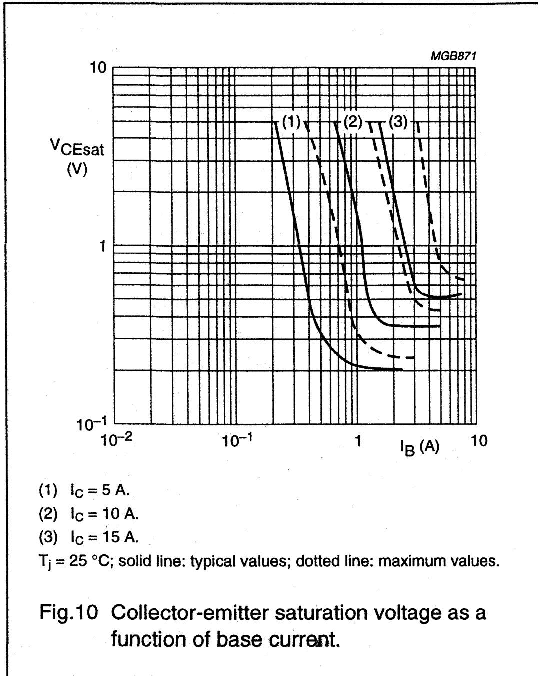
$I_C/I_B = 5$.
(1) V_{BE}; $T_j = 25$ °C.
(2) V_{BE}; $T_j = 100$ °C.
(3) V_{CE}; $T_j = 100$ °C.
(4) V_{CE}; $T_j = 25$ °C.

Fig.8 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.



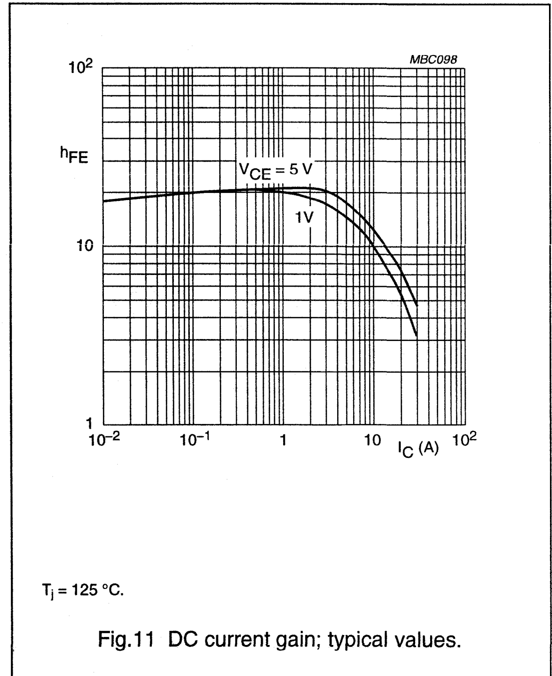
$T_j = 25$ °C.
(1) $I_C = 15$ A.
(2) $I_C = 10$ A.
(3) $I_C = 5$ A.

Fig.9 Base-emitter voltage as a function of base current; typical values.



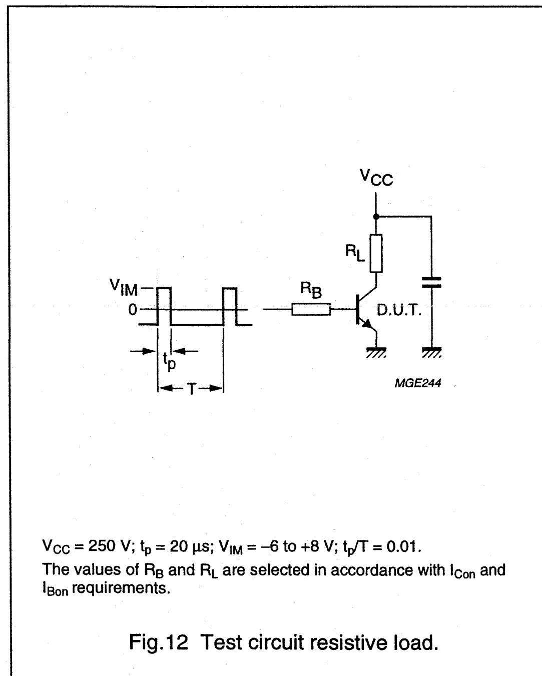
(1) $I_C = 5$ A.
(2) $I_C = 10$ A.
(3) $I_C = 15$ A.
$T_j = 25$ °C; solid line: typical values; dotted line: maximum values.

Fig.10 Collector-emitter saturation voltage as a function of base current.



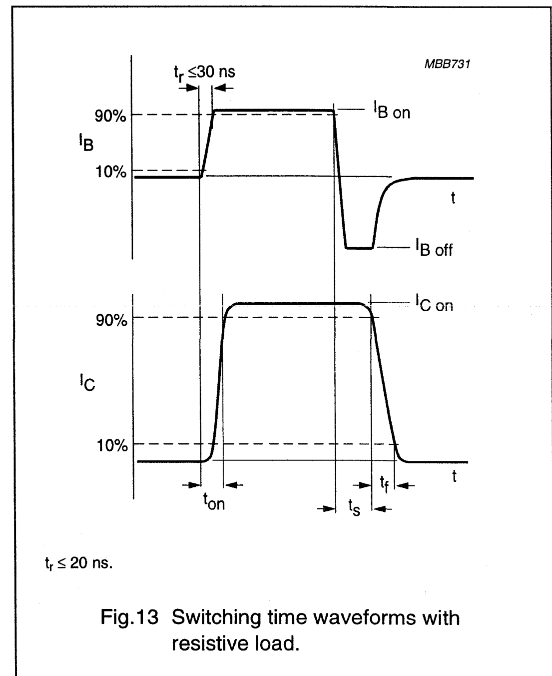
$T_j = 125$ °C.

Fig.11 DC current gain; typical values.



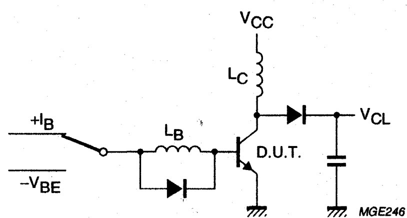
$V_{CC} = 250$ V; $t_p = 20$ µs; $V_{IM} = -6$ to $+8$ V; $t_p/T = 0.01$.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.12 Test circuit resistive load.



$t_r \leq 20$ ns.

Fig.13 Switching time waveforms with resistive load.



V_{CL} ≤ up to 1000 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 μH;
L_C = 200 μH.

Fig.14 Test circuit inductive load and reverse bias SOAR.

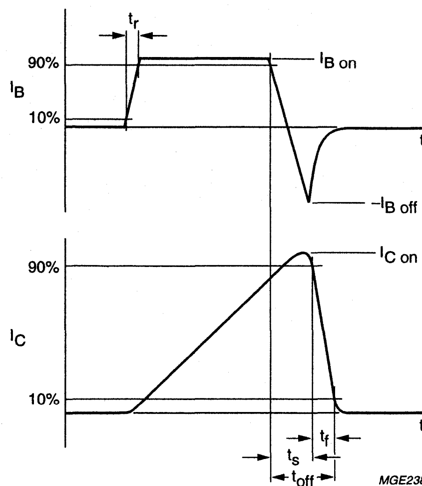


Fig.15 Switching time waveforms with inductive load.

Silicon diffused power transistors BUW13W; BUW13AW

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT429 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

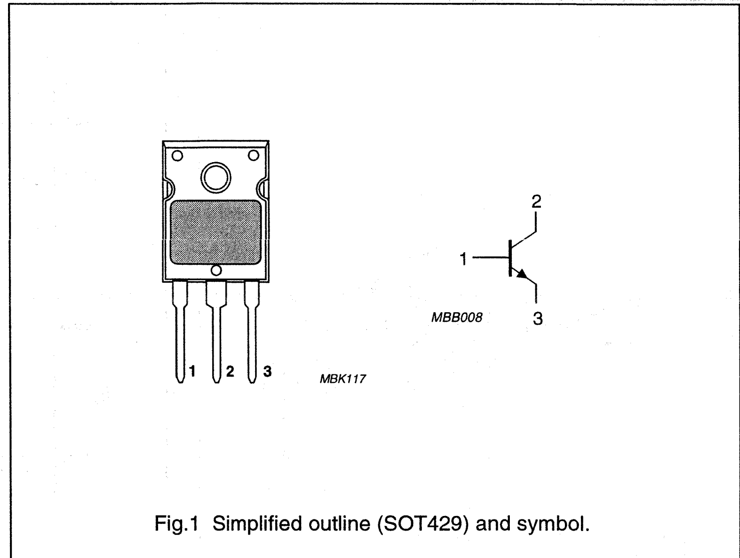


Fig.1 Simplified outline (SOT429) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$		
	BUW13W		850	V
	BUW13AW		1000	V
V_{CEO}	collector-emitter voltage	open base		
	BUW13W		400	V
	BUW13AW		450	V
V_{CEsat}	collector-emitter saturation voltage	see Figs 7 and 9	1.5	V
I_C	collector current (DC)	see Figs 2 and 4	15	A
I_{CM}	collector current (peak value)	see Fig 2	30	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	175	W
t_f	fall time	resistive load; see Figs 11 and 12	0.8	µs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	0.7	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW13W		–	850	V
	BUW13AW		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW13W		–	400	V
	BUW13AW		–	450	V
I_C	collector current (DC)	see Figs 2 and 4	–	15	A
I_{CM}	collector current (peak value)	$t_p < 2$ ms; see Fig 2	–	30	A
I_B	base current (DC)		–	6	A
I_{BM}	base current (peak value)	$t_p < 2$ ms	–	9	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.3	–	175	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

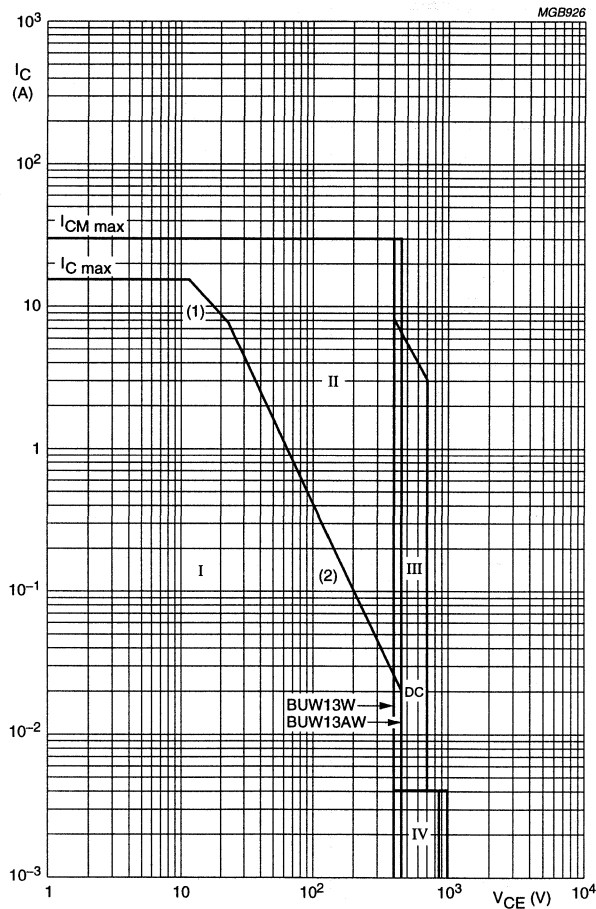
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 5 and 6				
	BUW13W		400	–	–	V
	BUW13AW		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage					
	BUW13W	$I_C = 10$ A; $I_B = 2$ A; see Figs 7 and 9	–	–	1.5	V
	BUW13AW	$I_C = 8$ A; $I_B = 1.6$ A; see Figs 7 and 9	–	–	1.5	V
V_{BEsat}	base-emitter saturation voltage					
	BUW13W	$I_C = 10$ A; $I_B = 2$ A; see Fig.7	–	–	1.6	V
	BUW13AW	$I_C = 8$ A; $I_B = 1.6$ A; see Fig.7	–	–	1.6	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; note 1	–	–	1	mA
		$V_{CE} = V_{CESMmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	4	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 9$ V; $I_C = 0$	–	–	10	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 20$ mA; see Fig.10	10	18	35	
		$V_{CE} = 5$ V; $I_C = 1.5$ A; see Fig.10	10	20	35	

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times resistive load (see Figs 11 and 12)						
t_{on}	turn-on time					
	BUW13W	I_{Con} = 10 A; I_{Bon} = $-I_{Boff}$ = 2 A	–	–	1	μs
	BUW13AW	I_{Con} = 8 A; I_{Bon} = $-I_{Boff}$ = 1.6 A	–	–	1	μs
t_s	storage time					
	BUW13W	I_{Con} = 10 A; I_{Bon} = $-I_{Boff}$ = 2 A	–	–	4	μs
	BUW13AW	I_{Con} = 8 A; I_{Bon} = $-I_{Boff}$ = 1.6 A	–	–	4	μs
t_f	fall time					
	BUW13W	I_{Con} = 10 A; I_{Bon} = $-I_{Boff}$ = 2 A	–	–	0.8	μs
	BUW13AW	I_{Con} = 8 A; I_{Bon} = $-I_{Boff}$ = 1.6 A	–	–	0.8	μs
Switching times inductive load (see Figs 13 and 14)						
t_s	storage time					
	BUW13W	I_{Con} = 10 A; I_B = 2 A	–	2.3	3	μs
		I_{Con} = 10 A; I_B = 2 A; T_j = 100 °C	–	2.5	3.2	μs
	BUW13AW	I_{Con} = 8 A; I_B = 1.6 A	–	2.3	3	μs
		I_{Con} = 8 A; I_B = 1.6 A; T_j = 100 °C	–	2.5	3.2	μs
t_f	fall time					
	BUW13W	I_{Con} = 10 A; I_B = 2 A	–	80	150	ns
		I_{Con} = 10 A; I_B = 2 A; T_j = 100 °C	–	140	300	ns
	BUW13AW	I_{Con} = 8 A; I_B = 1.6 A	–	80	150	ns
		I_{Con} = 8 A; I_B = 1.6 A; T_j = 100 °C	–	140	300	ns

Note

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

Silicon diffused power transistors BUW13W; BUW13AW



$T_{mb} \leq 25$ °C.

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 $t_p \leq 0.6\ \mu s$.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 5$ ms.

(1) $P_{tot\ max}$ line.

(2) Second breakdown limits.

Fig.2 Forward bias SOAR.

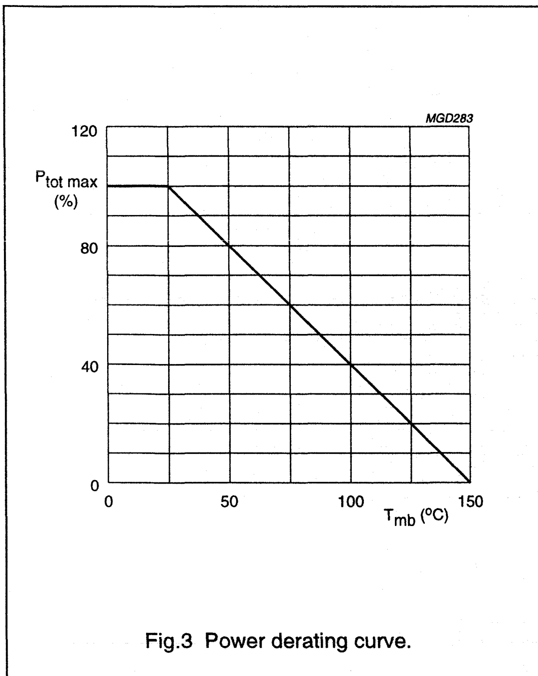


Fig.3 Power derating curve.

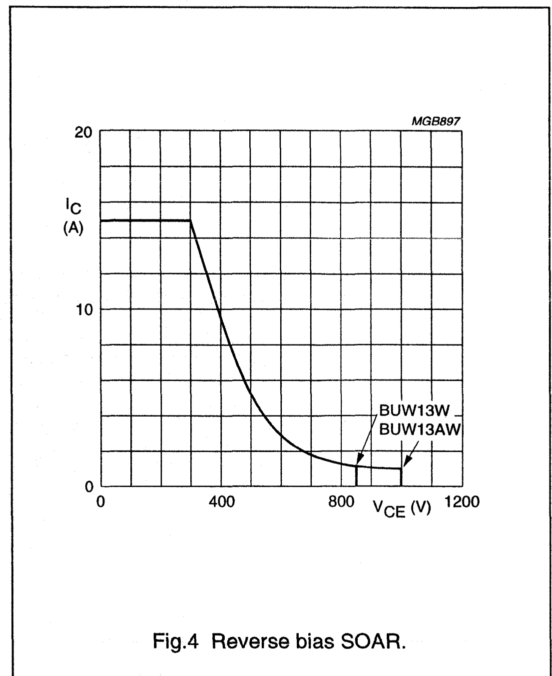


Fig.4 Reverse bias SOAR.

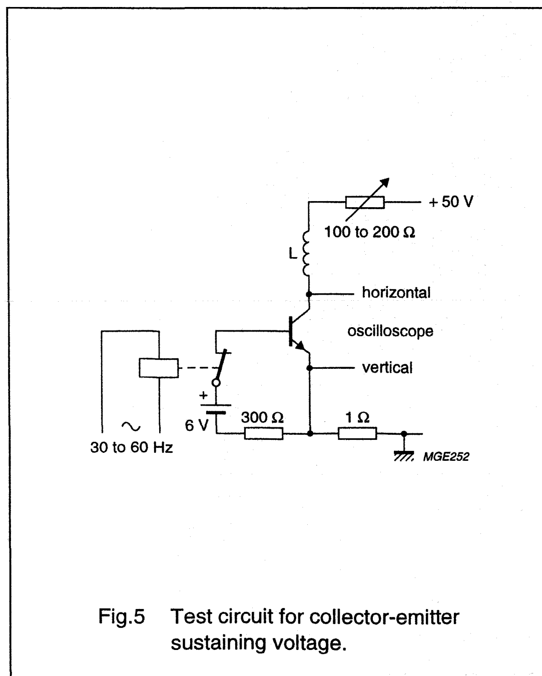


Fig.5 Test circuit for collector-emitter sustaining voltage.

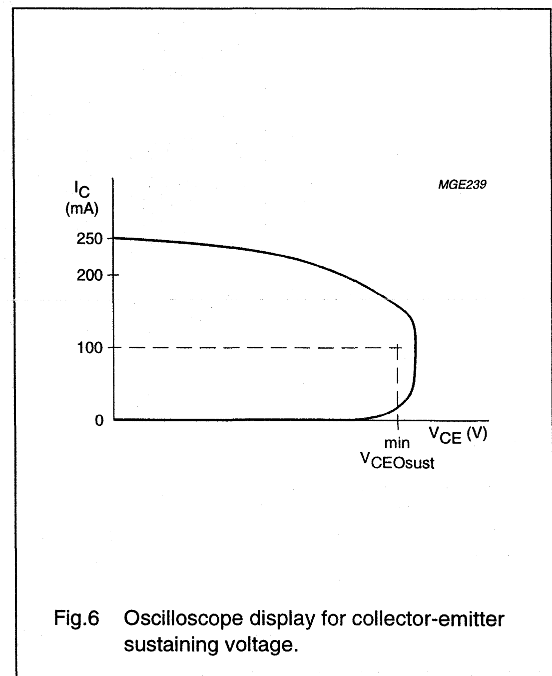
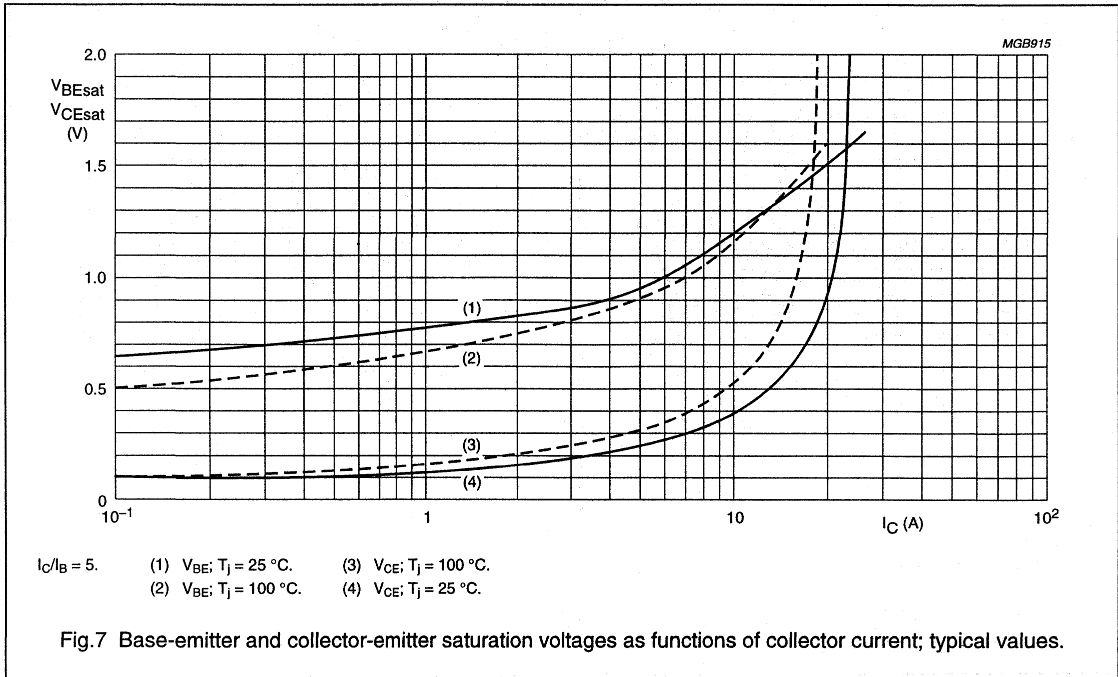


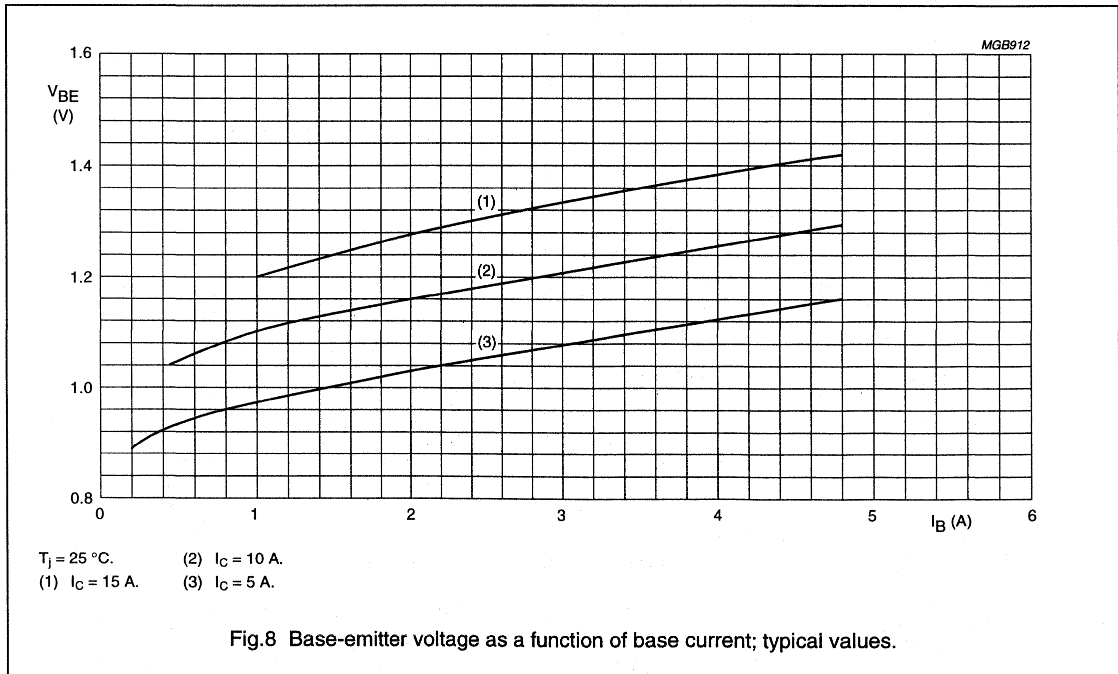
Fig.6 Oscilloscope display for collector-emitter sustaining voltage.



$I_C/I_B = 5$.

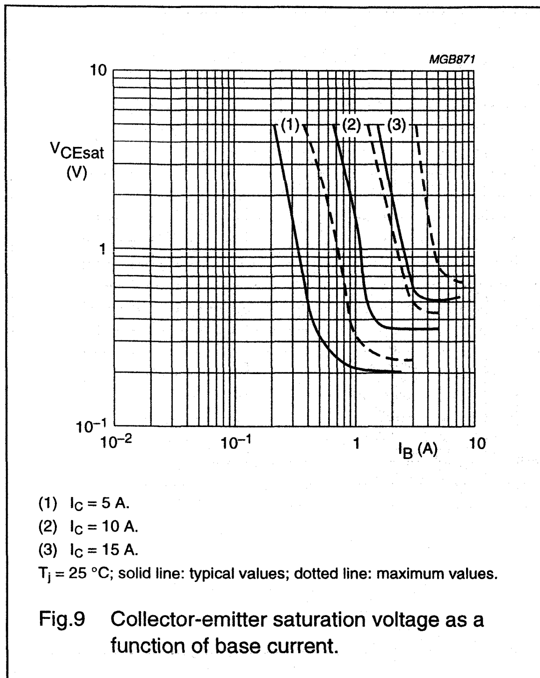
(1) V_{BE}; $T_j = 25$ °C.
(2) V_{BE}; $T_j = 100$ °C.
(3) V_{CE}; $T_j = 100$ °C.
(4) V_{CE}; $T_j = 25$ °C.

Fig.7 Base-emitter and collector-emitter saturation voltages as functions of collector current; typical values.



$T_j = 25$ °C.
(1) $I_C = 15$ A.
(2) $I_C = 10$ A.
(3) $I_C = 5$ A.

Fig.8 Base-emitter voltage as a function of base current; typical values.



(1) $I_C = 5$ A.
(2) $I_C = 10$ A.
(3) $I_C = 15$ A.
$T_j = 25$ °C; solid line: typical values; dotted line: maximum values.

Fig.9 Collector-emitter saturation voltage as a function of base current.

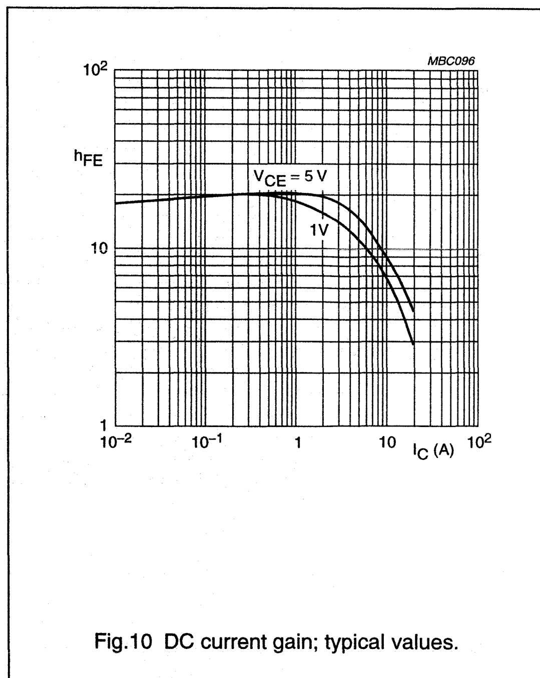
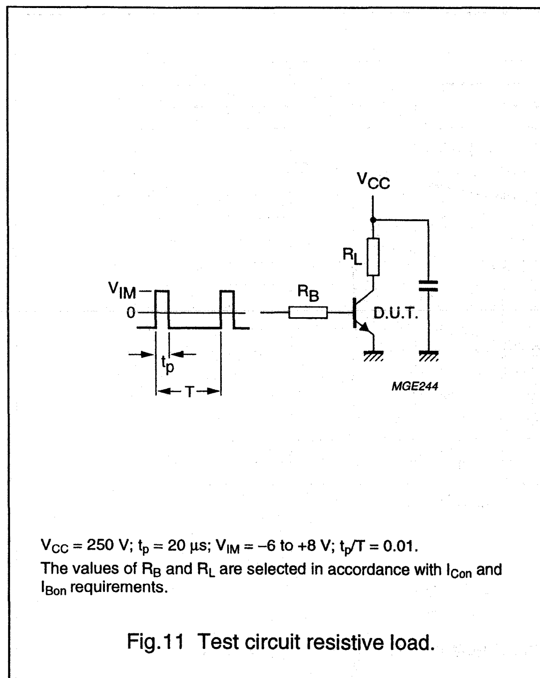


Fig.10 DC current gain; typical values.



$V_{CC} = 250$ V; $t_p = 20$ µs; $V_{IM} = -6$ to $+8$ V; $t_p/T = 0.01$.
The values of R_B and R_L are selected in accordance with I_{Con} and I_{Bon} requirements.

Fig.11 Test circuit resistive load.

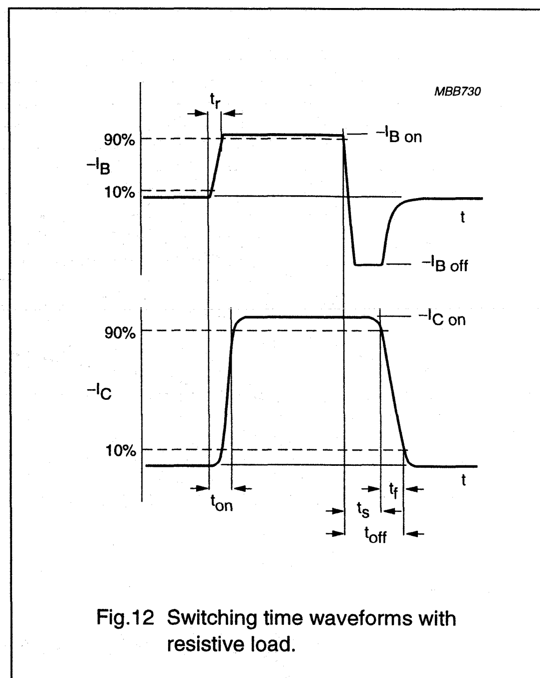
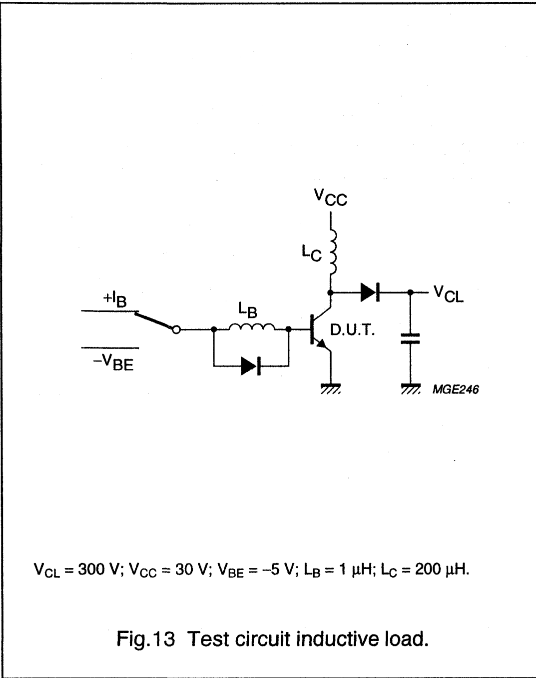


Fig.12 Switching time waveforms with resistive load.



V_{CL} = 300 V; V_{CC} = 30 V; V_{BE} = −5 V; L_B = 1 μH; L_C = 200 μH.

Fig.13 Test circuit inductive load.

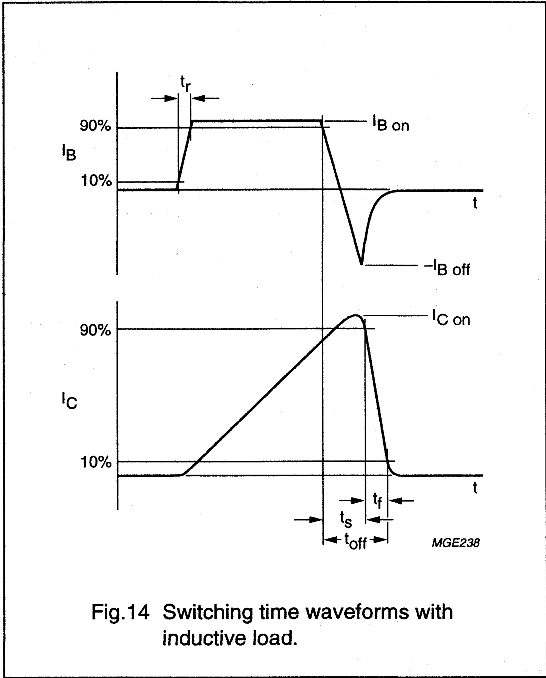


Fig.14 Switching time waveforms with inductive load.

Silicon Diffused Power Transistor — BUW14

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.

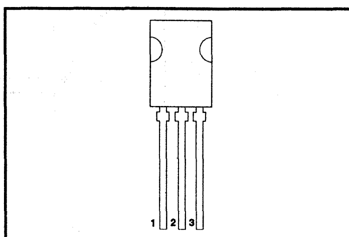
QUICK REFERENCE DATA

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

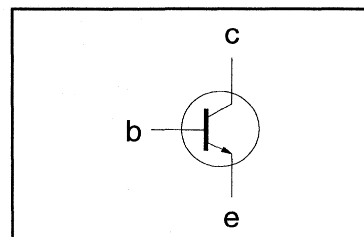
PINNING - SOT82

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

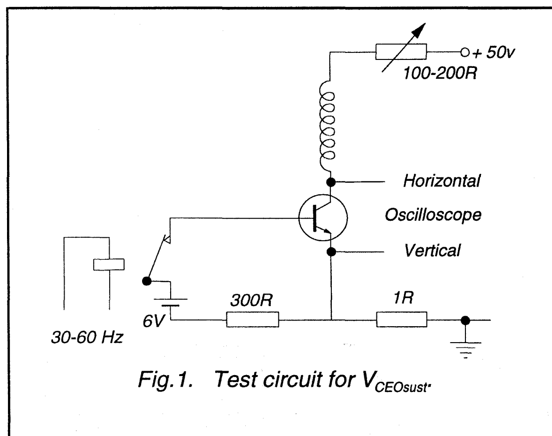


Fig.1. Test circuit for $V_{CEOsust}$.

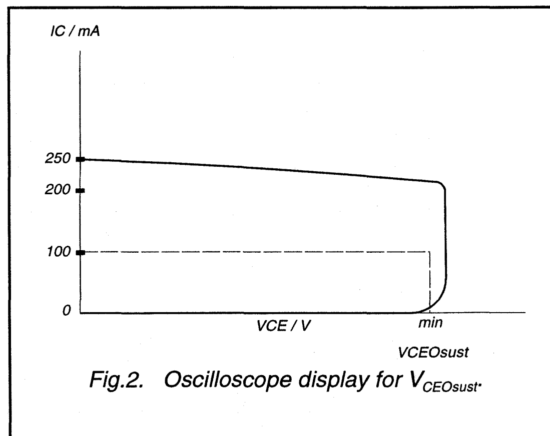


Fig.2. Oscilloscope display for $V_{CEOsust}$.

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

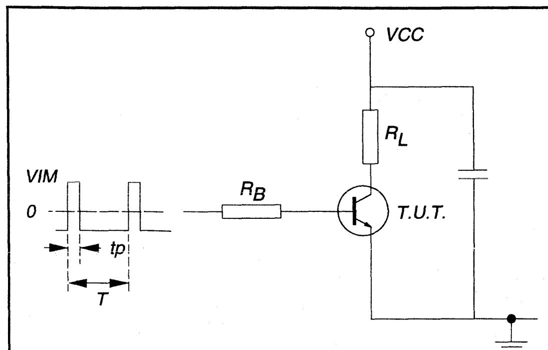


Fig.3. Test circuit resistive load. V_{IM} = -6 to +8 V V_{CC} = 150 V; tp = 20 μs; δ = tp / T = 0.01. R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

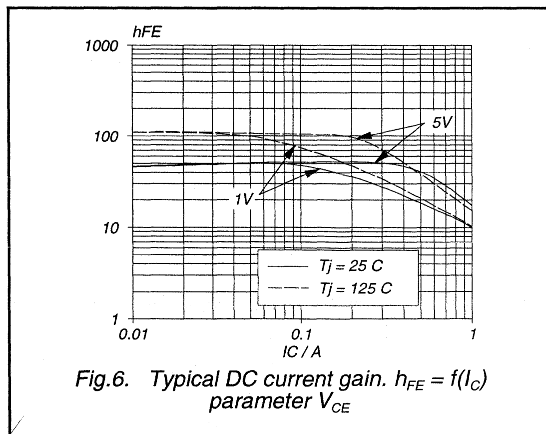


Fig.6. Typical DC current gain. $h_{FE} = f(I_C)$ parameter V_{CE}

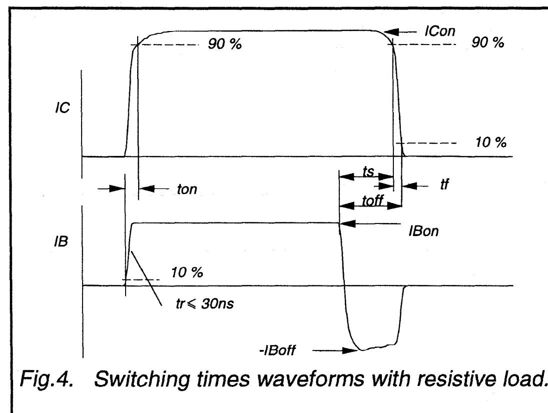


Fig.4. Switching times waveforms with resistive load.

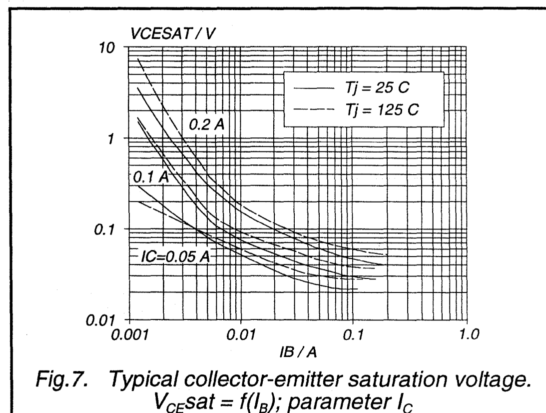


Fig.7. Typical collector-emitter saturation voltage. $V_{CE}sat = f(I_B)$; parameter I_C

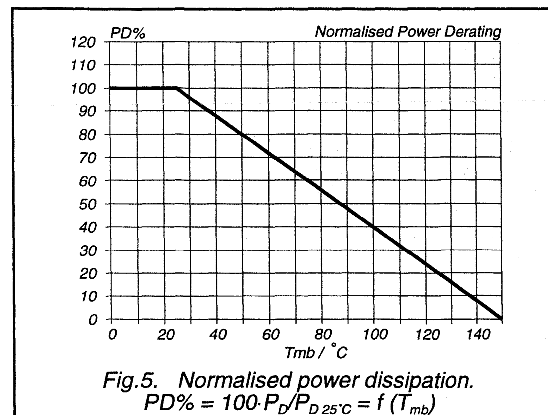


Fig.5. Normalised power dissipation. $PD\% = 100 \cdot P_D/P_{D\,25^\circ C} = f(T_{mb})$

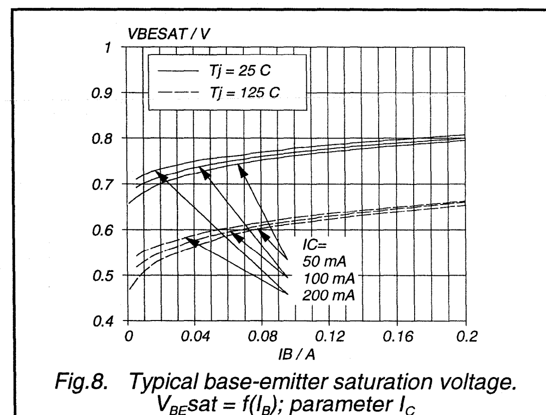


Fig.8. Typical base-emitter saturation voltage. $V_{BE}sat = f(I_B)$; parameter I_C

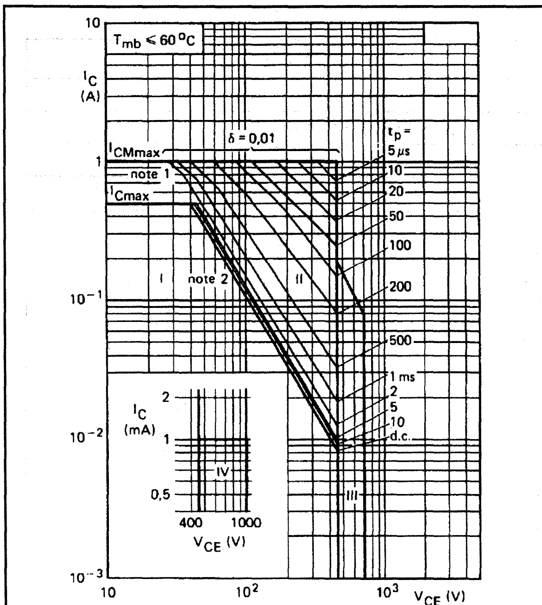


Fig.9. Forward bias safe operating area.
(1) P_{tot} *max line.*
(2) *Second-breakdown limits.*
I *Region of permissible DC operation.*
II *Permissible extension for repetitive pulse operation.*
III *Area of permissible operation during turn-on in single transistor converters, provided* $R_{BE} \leq 100\ \Omega$ *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.*

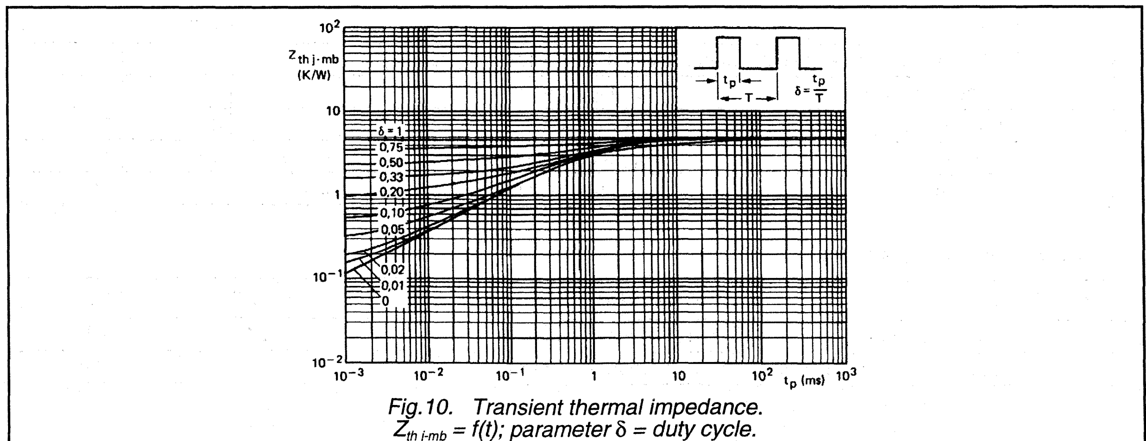


Fig.10. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; *parameter* δ = *duty cycle.*

Silicon diffused power transistors — BUW84; BUW85

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT82 package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems
- Switching applications.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

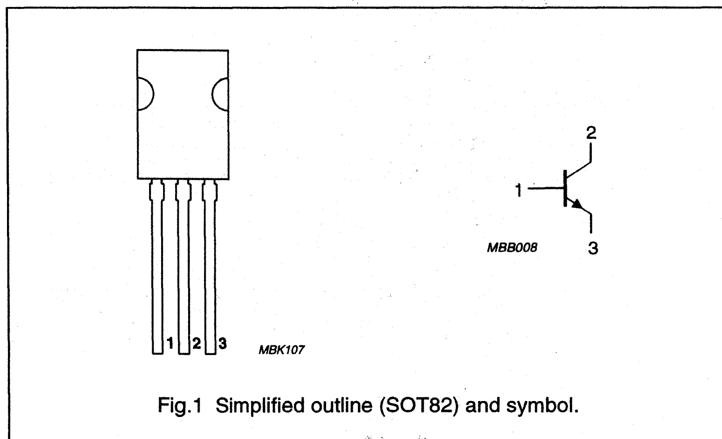


Fig.1 Simplified outline (SOT82) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW84		–	800	V
	BUW85		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW84		–	400	V
	BUW85		–	450	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1$ A; $I_B = 200$ mA; see Fig.7	–	1	V
I_C	collector current (DC)	see Figs 4 and 5	–	2	A
I_{CM}	collector current (peak value)	see Figs 4 and 5	–	3	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.8	–	50	W
t_f	fall time	resistive load; see Fig.11	0.4	–	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	2.1	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air	100	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUW84		–	800	V
	BUW85		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUW84		–	400	V
	BUW85		–	450	V
V_{EBO}	emitter-base voltage	open collector	–	5	V
I_C	collector current (DC)	see Figs 4 and 5	–	2	A
I_{CM}	collector current (peak value)	$t_p = 2$ ms; see Figs 4 and 5	–	3	A
I_B	base current (DC)		–	0.75	A
I_{BM}	base current (peak value)		–	1	A
I_{BM}	base current (reversed; peak value)	turn-off current	–	−1	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.8	–	50	W
T_{stg}	storage temperature		−65	+150	°C
T_j	junction temperature		–	150	°C

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 2 and 3				
	BUW84		400	–	–	V
	BUW85		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.3$ A; $I_B = 30$ mA; see Fig.7	–	–	0.8	V
		$I_C = 1$ A; $I_B = 200$ mA; see Fig.7	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 200$ mA	–	–	1.1	V
I_{CES}	collector-emitter cut-off current	$V_{CEM} = V_{CEMSmax}$; $V_{BE} = 0$; note 1	–	–	200	μA
		$V_{CEM} = V_{CEMSmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	1.5	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5$ V; $I_C = 0$	–	–	1	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 5$ A; see Fig.10	15	–	–	
		$V_{CE} = 5$ V; $I_C = 100$ mA; see Fig.10	20	50	100	
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 200$ mA; f = 1 MHz	–	20	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times in horizontal deflection circuit (see Fig.11)						
t_{on}	turn-on time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = −400 mA; V_{CC} = 250 V	–	0.2	0.5	μs
t_s	storage time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = −400 mA; V_{CC} = 250 V	–	2	3.5	μs
t_f	fall time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = −400 mA; V_{CC} = 250 V	–	0.4	–	μs
		I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = −400 mA; V_{CC} = 250 V; T_{mb} = 95 °C	–	–	1.4	μs

Note

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

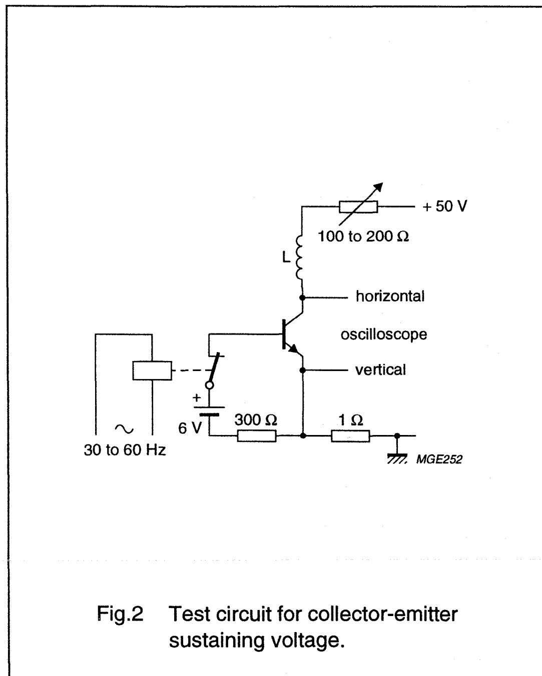


Fig.2 Test circuit for collector-emitter sustaining voltage.

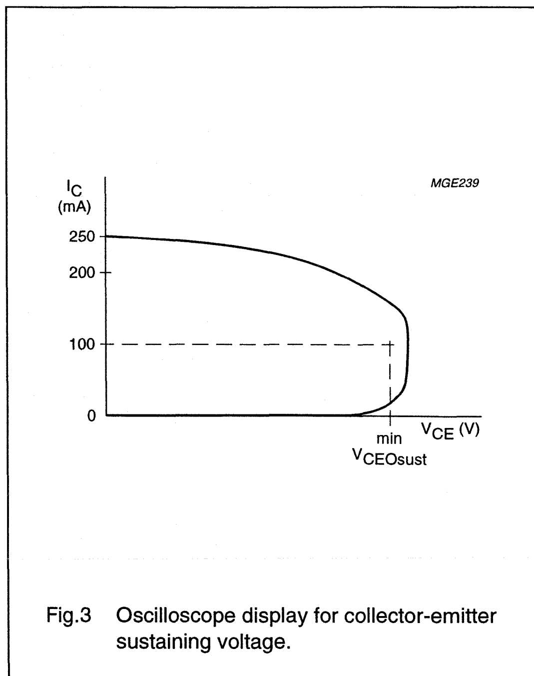
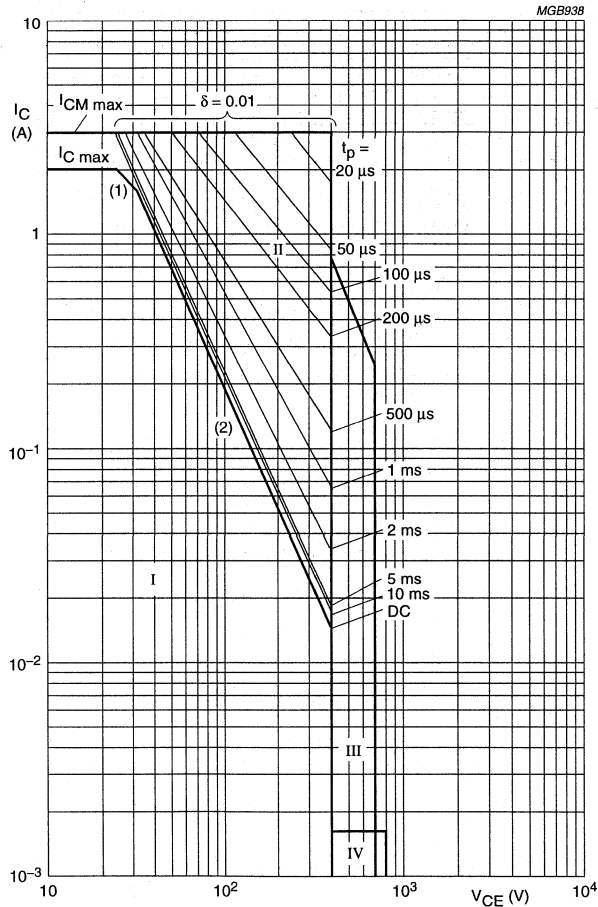


Fig.3 Oscilloscope display for collector-emitter sustaining voltage.



BUW84.

$T_{mb} \leq 25$ °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

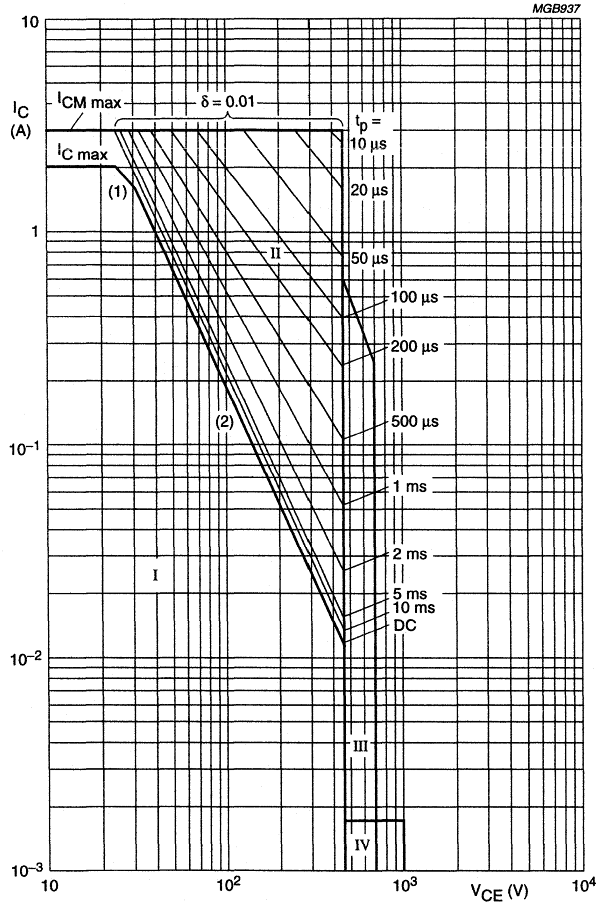
III - Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6$ μs.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2$ ms.

(1) $P_{tot\,max}$ line.

(2) Second breakdown limits.

Fig.4 Forward bias SOAR.



BUW85.

$T_{mb} \leq 25$ °C.

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 $t_p \leq 0.6$ µs.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2$ ms.

(1) $P_{tot\,max}$ line.

(2) Second breakdown limits.

Fig.5 Forward bias SOAR.

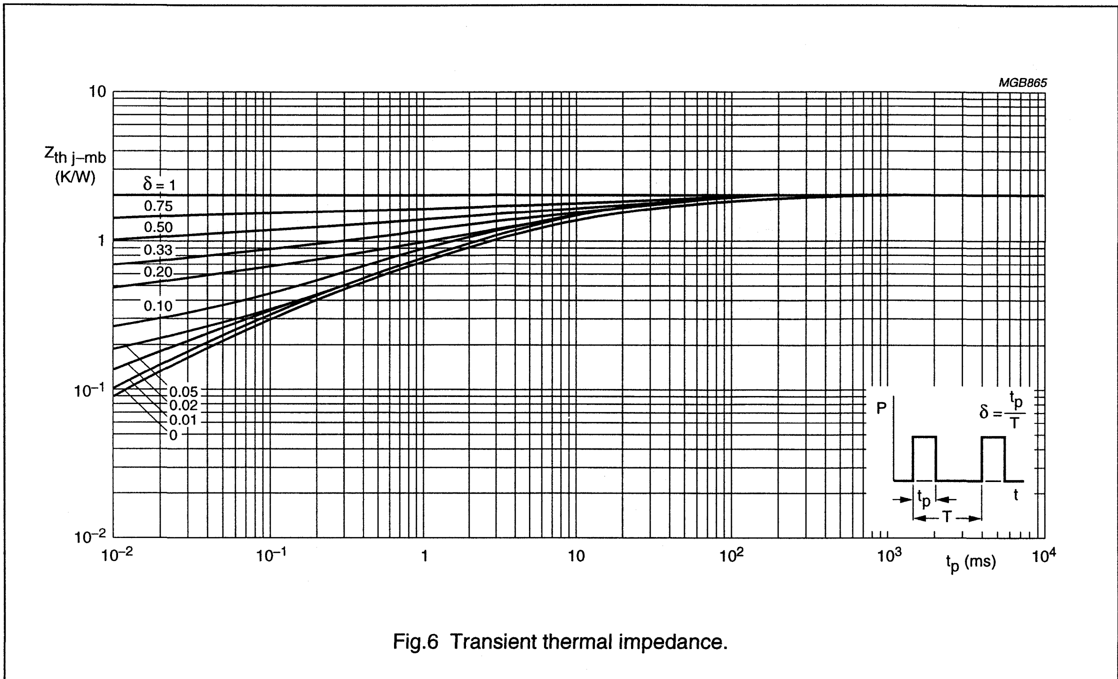
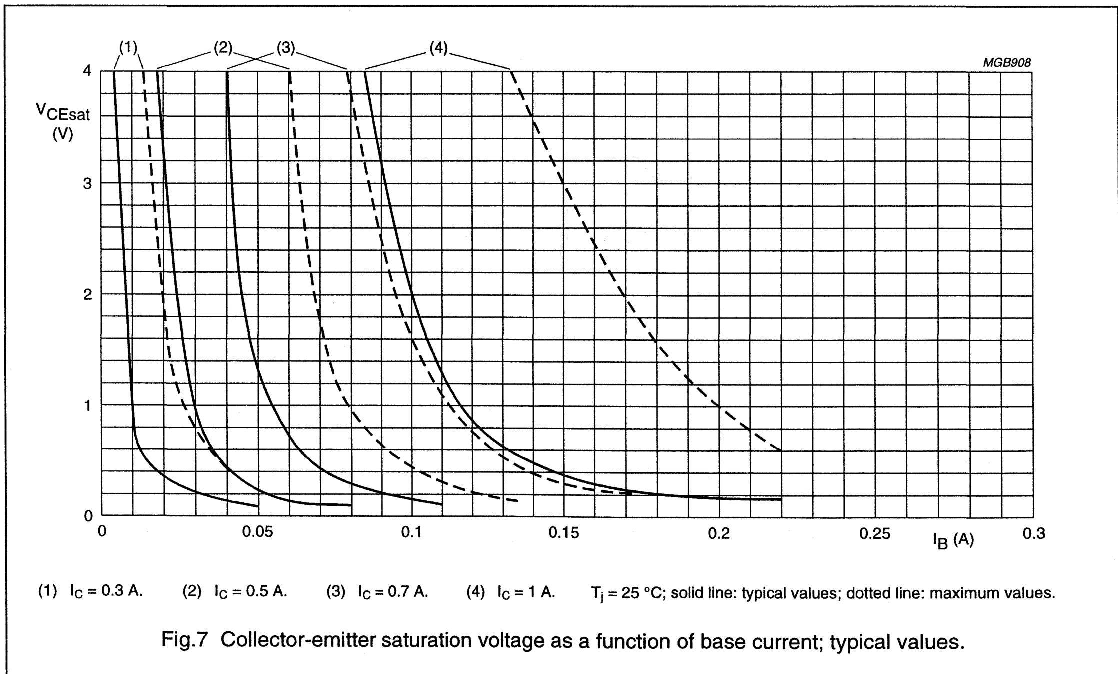


Fig.6 Transient thermal impedance.



(1) I_C = 0.3 A. (2) I_C = 0.5 A. (3) I_C = 0.7 A. (4) I_C = 1 A. T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.7 Collector-emitter saturation voltage as a function of base current; typical values.

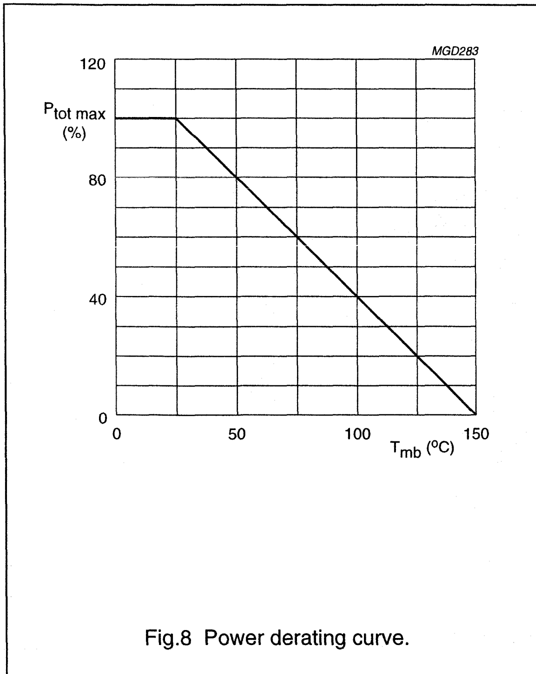
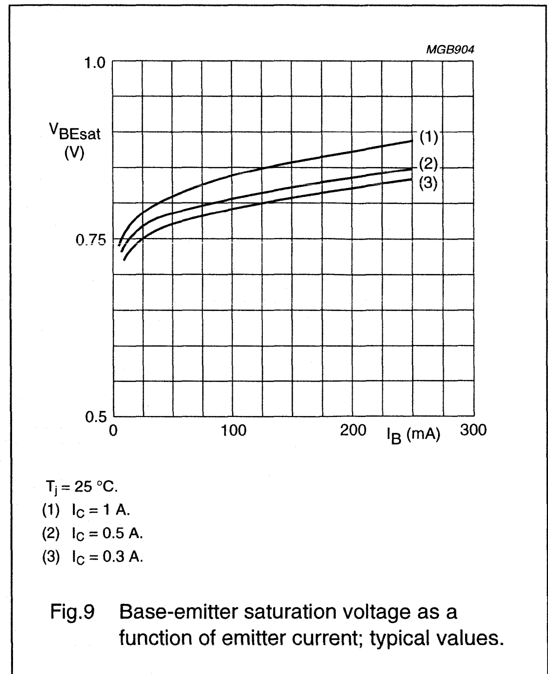


Fig.8 Power derating curve.



T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 0.5 A.
(3) I_C = 0.3 A.

Fig.9 Base-emitter saturation voltage as a function of emitter current; typical values.

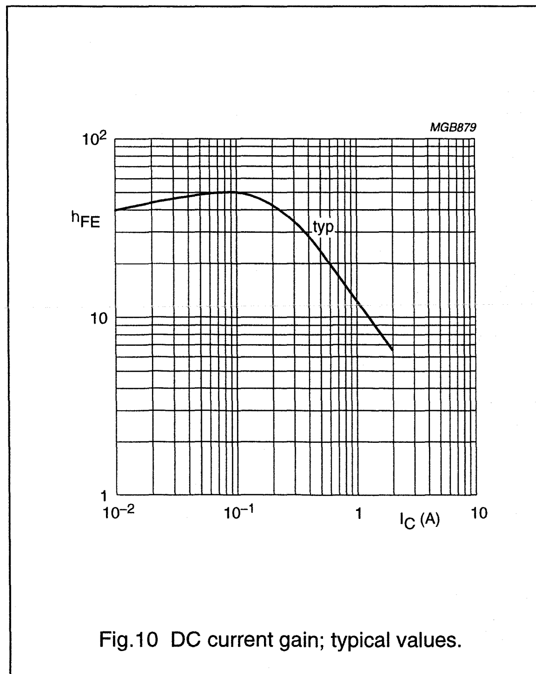


Fig.10 DC current gain; typical values.

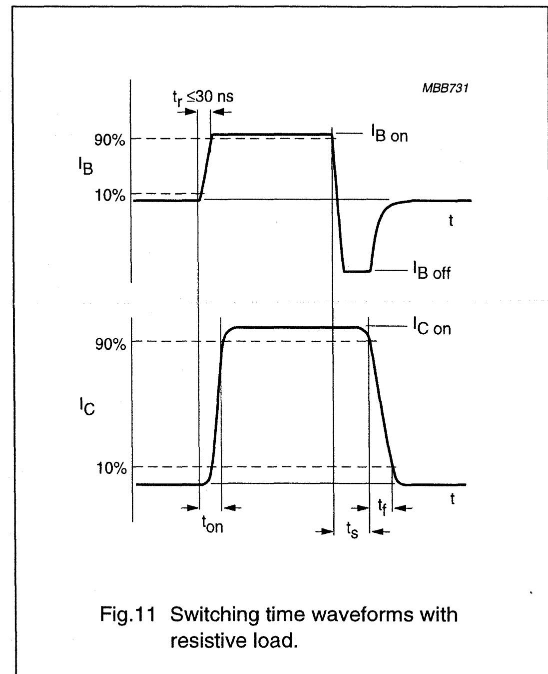


Fig.11 Switching time waveforms with resistive load.

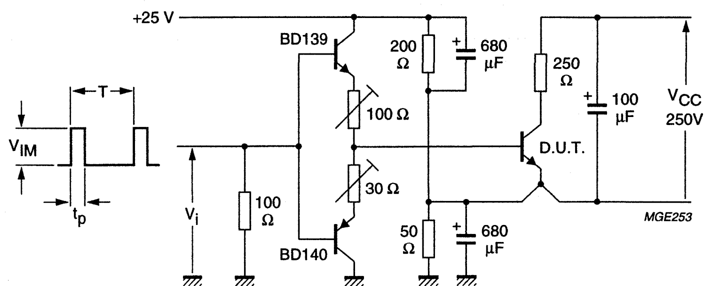


Fig.12 Test circuit resistive load.

Silicon diffused power transistors BUX84; BUX85

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a TO-220AB package.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems
- Switching applications.

PINNING

PIN	DESCRIPTION
1	base
2	collector; connected to mounting base
3	emitter

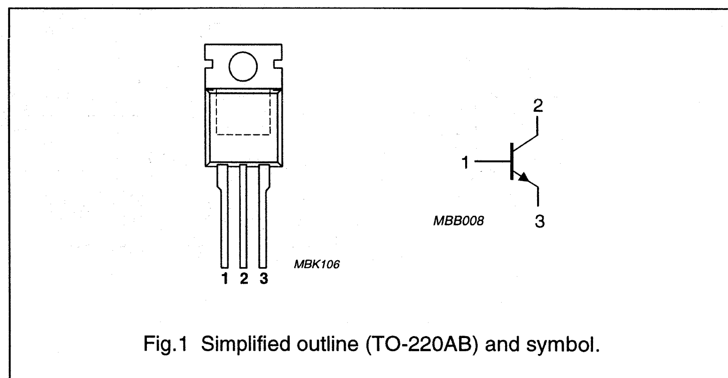


Fig.1 Simplified outline (TO-220AB) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUX84		–	800	V
	BUX85		–	1 000	V
V_{CEO}	collector-emitter voltage	open base			
	BUX84		–	400	V
	BUX85		–	450	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 1$ A; $I_B = 200$ mA; see Fig.7	–	1	V
I_C	collector current (DC)	see Figs 4 and 5	–	2	A
I_{CM}	collector current (peak value)	see Figs 4 and 5	–	3	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.8	–	40	W
t_f	fall time	resistive load; see Fig.11	0.4	–	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	2.5	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air	70	K/W

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUX84		–	800	V
	BUX85		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUX84		–	400	V
	BUX85		–	450	V
I_C	collector current (DC)	see Figs 4 and 5	–	2	A
I_{CM}	collector current (peak value)	$t_p = 2$ ms; see Figs 4 and 5	–	3	A
I_B	base current (DC)		–	0.75	A
I_{BM}	base current (peak value)		–	1	A
I_{BM}	base current (reversed; peak value)	turn-off current	–	–1	A
P_{tot}	total power dissipation	$T_{mb} \leq 25$ °C; see Fig.8	–	40	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 2 and 3				
	BUX84		400	–	–	V
	BUX85		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.3$ A; $I_B = 30$ mA; see Fig.7	–	–	0.8	V
		$I_C = 1$ A; $I_B = 200$ mA; see Fig.7	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 200$ mA; see Fig.9	–	–	1.1	V
I_{CES}	collector-emitter cut-off current	$V_{CEM} = V_{CEMSmax}$; $V_{BE} = 0$; note 1	–	–	200	μA
		$V_{CEM} = V_{CEMSmax}$; $V_{BE} = 0$; $T_j = 125$ °C; note 1	–	–	1.5	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5$ V; $I_C = 0$	–	–	1	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 5$ A; see Fig.10	15	–	–	
		$V_{CE} = 5$ V; $I_C = 100$ mA; see Fig.10	20	50	100	
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 200$ mA; f = 1 MHz	–	20	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times in horizontal deflection circuit (see Fig.11)						
t_{on}	turn-on time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V	–	0.2	0.5	µs
t_f	fall time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V	–	0.4	–	µs
		I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V; T_{mb} = 95 °C	–	–	1.4	µs
t_s	storage time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V	–	2	3.5	µs

Note

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

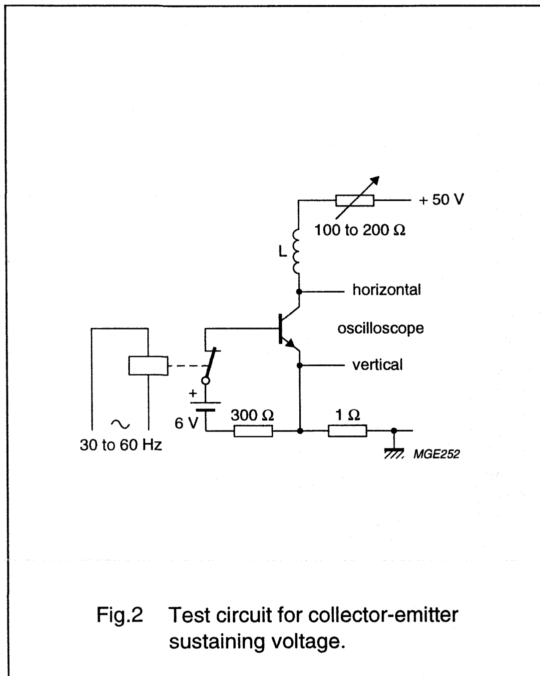


Fig.2 Test circuit for collector-emitter sustaining voltage.

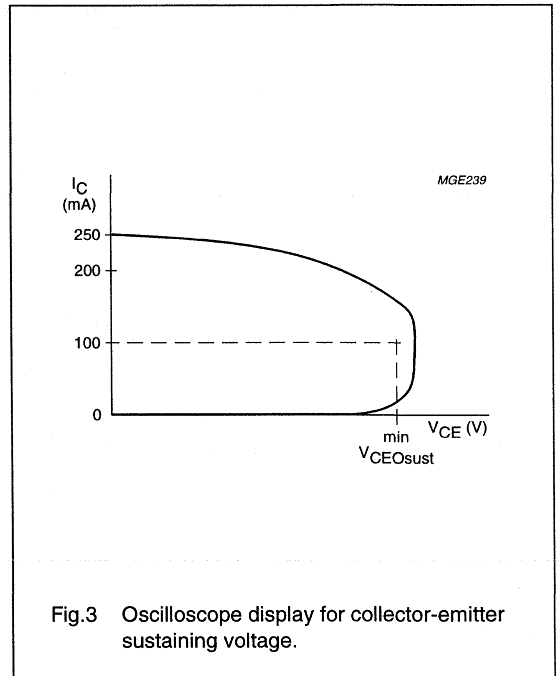
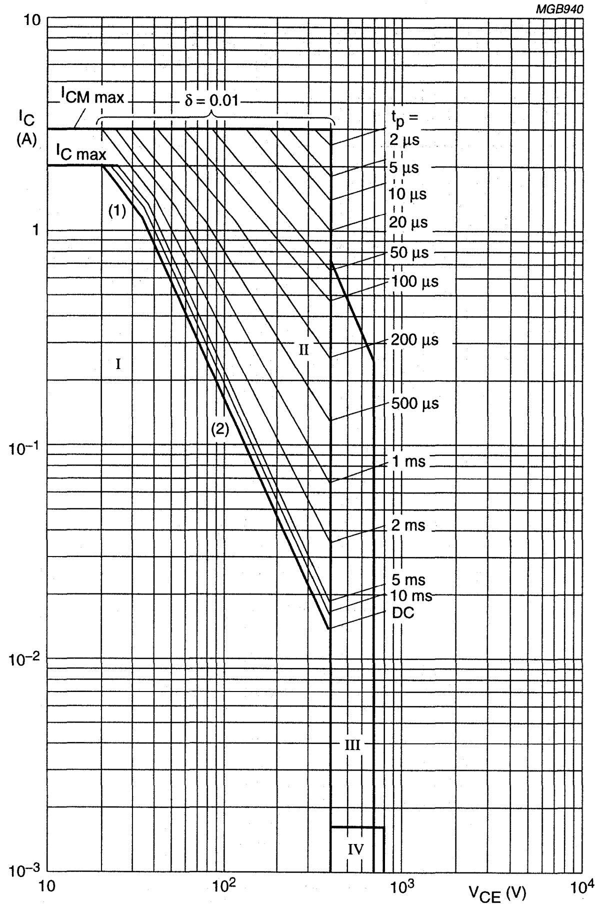


Fig.3 Oscilloscope display for collector-emitter sustaining voltage.



BUX84.

$T_{mb} \leq 50$ °C.

I - Region of permissible DC operation.

II - Permissible extension for repetitive pulse operation.

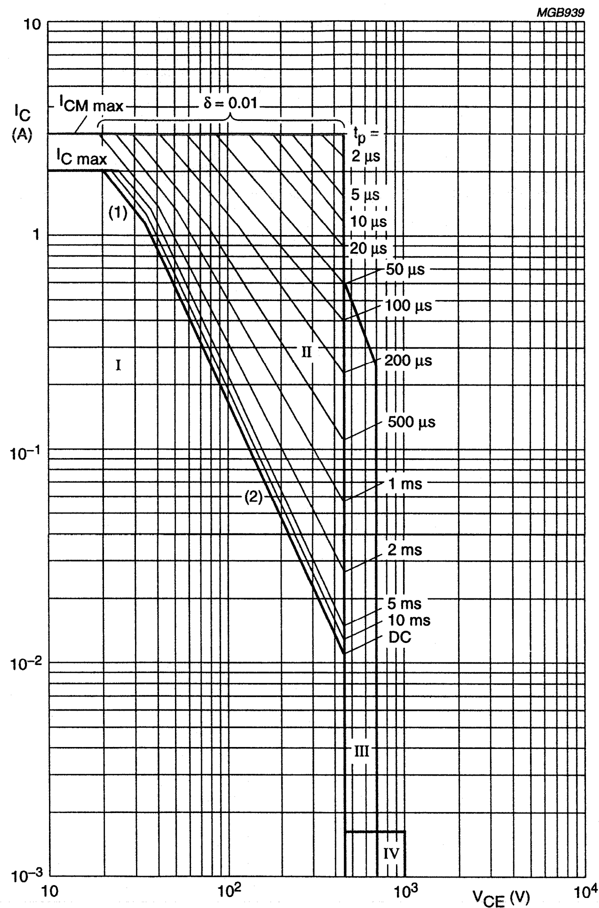
III - Area of permissible operation during turn-on in single transistor converters, provided $R_{BE} \leq 100\ \Omega$ and $t_p \leq 0.6$ μs.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2$ ms.

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

(2) Second breakdown limits.

Fig.4 Forward bias SOAR.



BUX85.

$T_{mb} \leq 50$ °C.

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 $t_p \leq 0.6\ \mu s$.

IV - Repetitive pulse operation in this region is permissible provided $V_{BE} \leq 0$ and $t_p \leq 2$ ms.

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

(2) Second breakdown limits.

Fig.5 Forward bias SOAR.

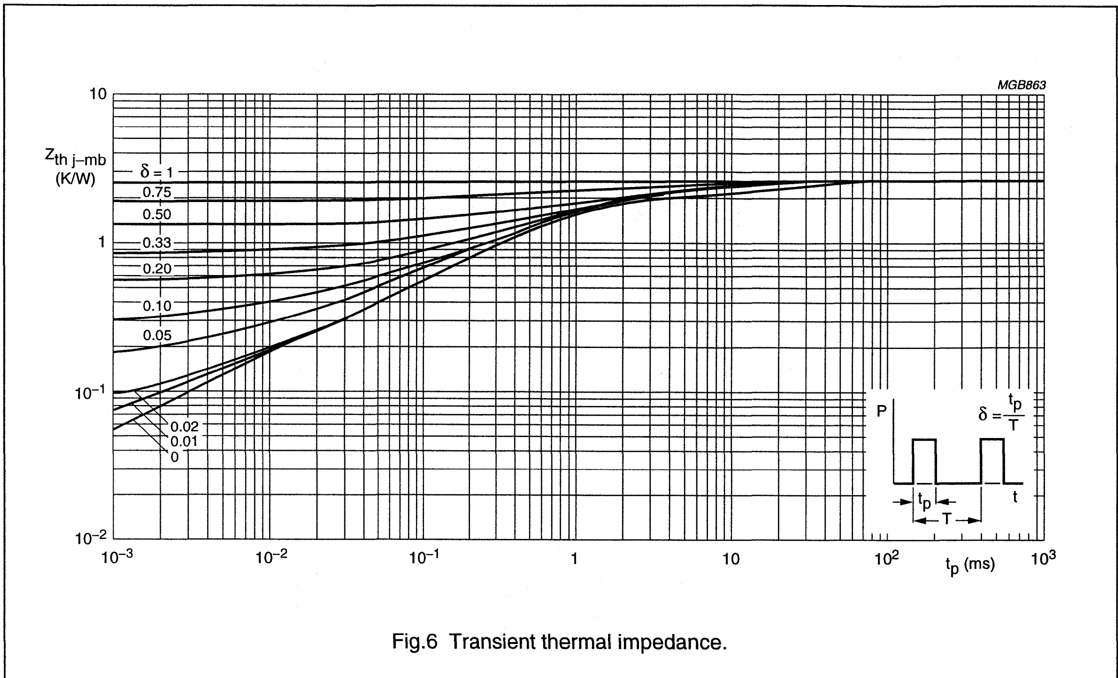
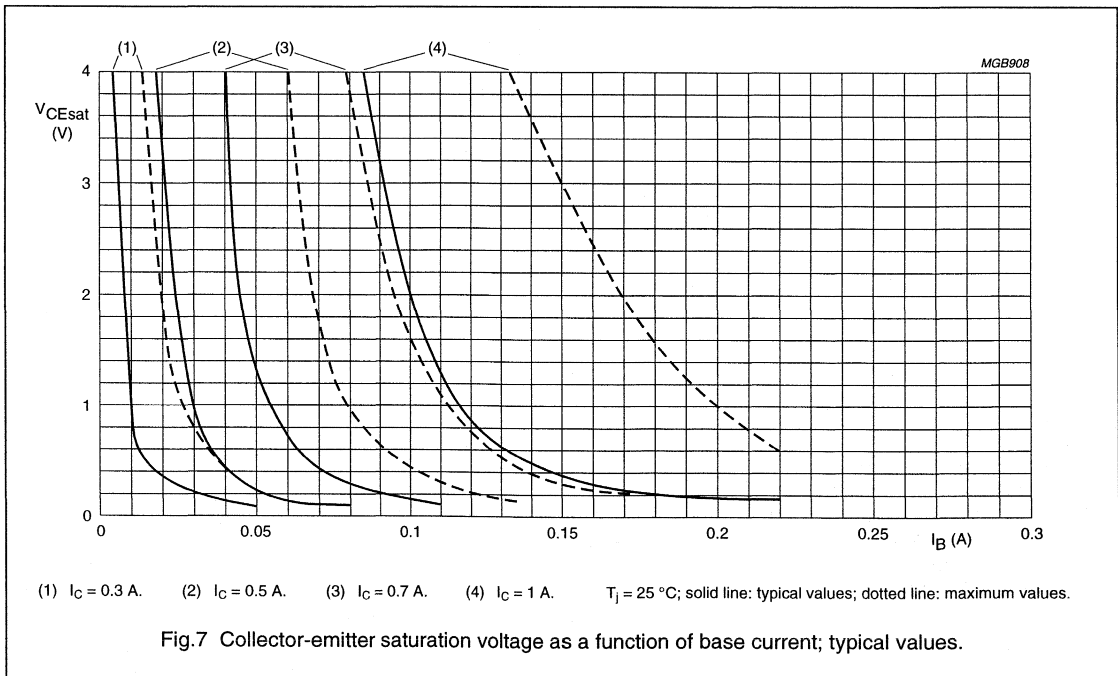


Fig.6 Transient thermal impedance.



(1) I_C = 0.3 A. (2) I_C = 0.5 A. (3) I_C = 0.7 A. (4) I_C = 1 A. T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.7 Collector-emitter saturation voltage as a function of base current; typical values.

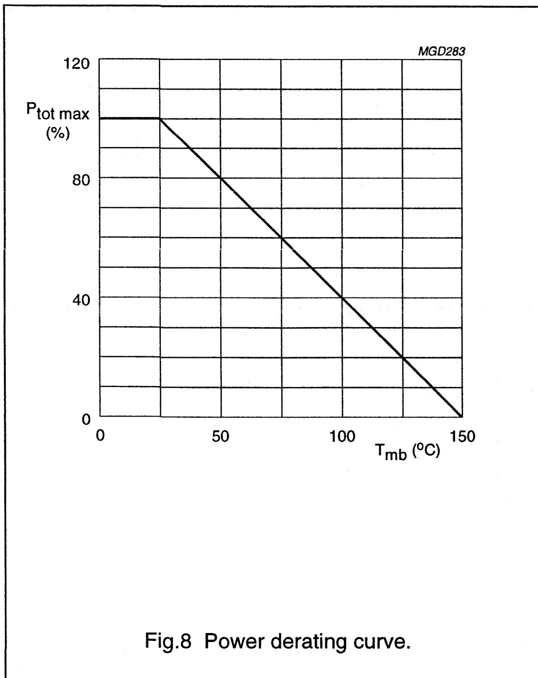
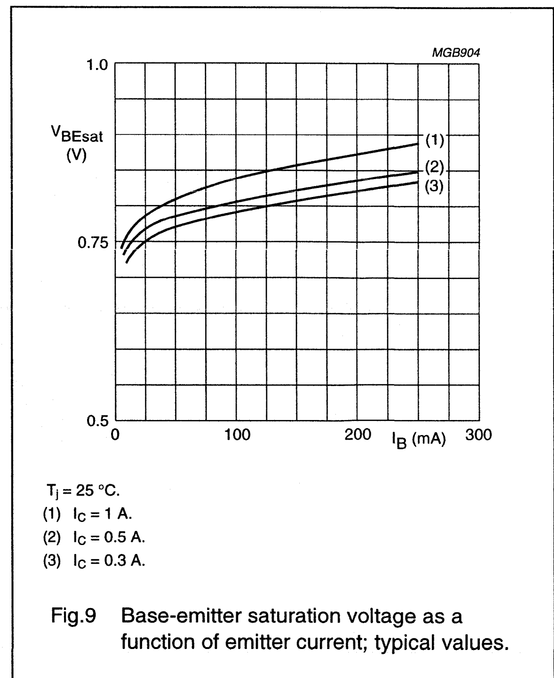


Fig.8 Power derating curve.



T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 0.5 A.
(3) I_C = 0.3 A.

Fig.9 Base-emitter saturation voltage as a function of emitter current; typical values.

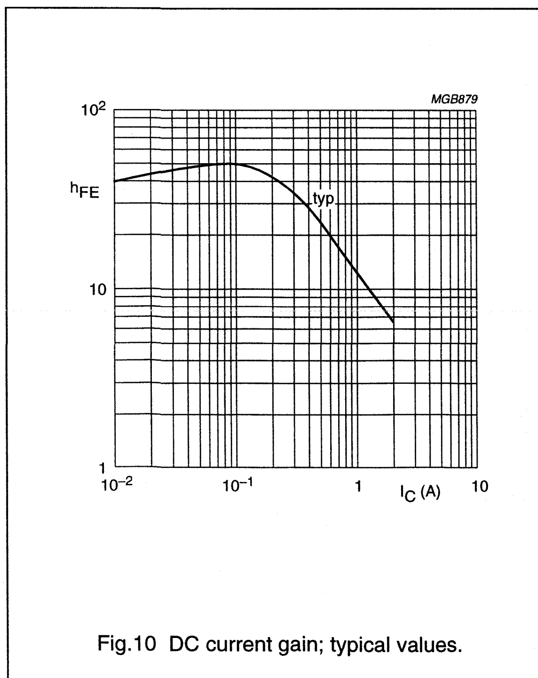


Fig.10 DC current gain; typical values.

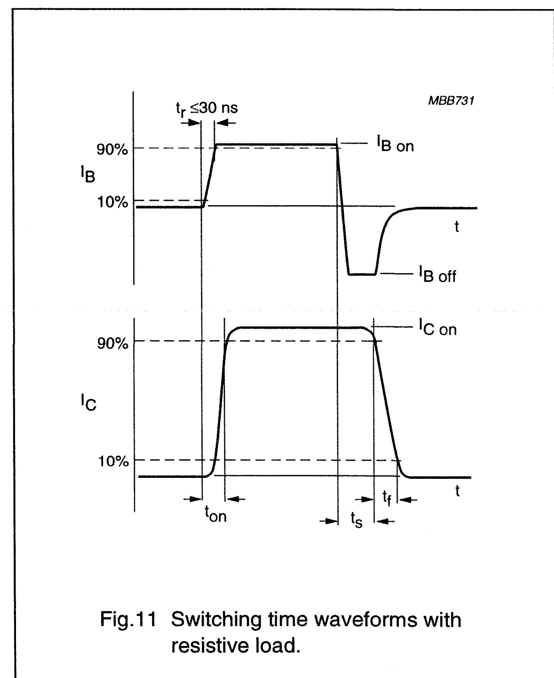
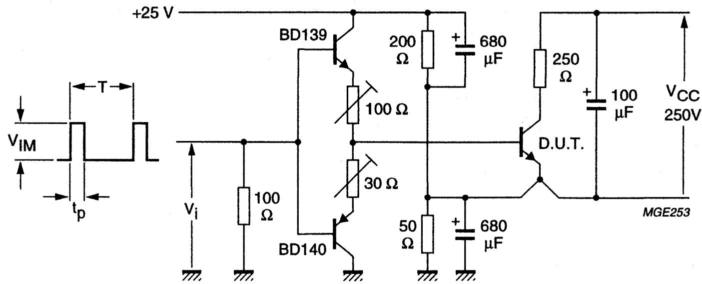


Fig.11 Switching time waveforms with resistive load.



t_p = 20 µs; T = 2 ms; V_{IM} = 15 V.

Fig.12 Test circuit resistive load.

Silicon diffused power transistors BUX84F; BUX85F

DESCRIPTION

High-voltage, high-speed, glass-passivated NPN power transistor in a SOT186 package with electrically isolated mounting base.

APPLICATIONS

- Converters
- Inverters
- Switching regulators
- Motor control systems.

PINNING

PIN	DESCRIPTION
1	base
2	collector
3	emitter
mb	mounting base; electrically isolated from all pins

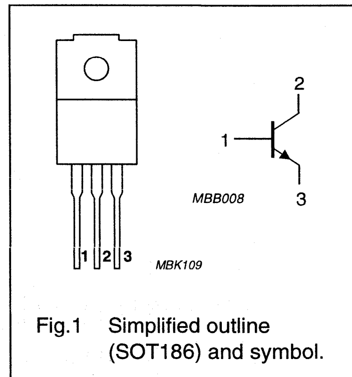


Fig.1 Simplified outline (SOT186) and symbol.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUX84F		–	800	V
	BUX85F		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUX84F		–	400	V
	BUX85F		–	450	V
V_{CEsat}	collector-emitter saturation voltage	see Fig.4	–	1	V
I_{Csat}	collector saturation current		–	1	A
I_C	collector current (DC)		–	2	A
I_{CM}	collector current (peak value)		–	3	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C	–	18	W
t_f	fall time		0.4	–	μs

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}h}$	thermal resistance from junction to external heatsink	note 1	7.2	K/W
		note 2	4.7	K/W
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient		55	K/W

Notes

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.
2. Mounted **with** heatsink compound and 30 ±5 N force on centre of package.

ISOLATION CHARACTERISTICS

SYMBOL	PARAMETER	TYP.	MAX.	UNIT
V_{isolM}	isolation voltage from all terminals to external heatsink (peak value)	–	1500	V
C_{isol}	isolation capacitance from collector to external heatsink	12	–	pF

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CESM}	collector-emitter peak voltage	$V_{BE} = 0$			
	BUX84F		–	800	V
	BUX85F		–	1000	V
V_{CEO}	collector-emitter voltage	open base			
	BUX84F		–	400	V
	BUX85F		–	450	V
I_C	collector current (DC)		–	2	A
I_{CM}	collector current (peak value)		–	3	A
I_B	base current (DC)		–	0.75	A
I_{BM}	base current (peak value)		–	1	A
P_{tot}	total power dissipation	$T_h \leq 25$ °C; note 1	–	18	W
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		–	150	°C

Note

1. Mounted **without** heatsink compound and 30 ±5 N force on centre of package.

CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEOsust}$	collector-emitter sustaining voltage	$I_C = 100$ mA; $I_{Boff} = 0$; L = 25 mH; see Figs 2 and 3				
	BUX84		400	–	–	V
	BUX85		450	–	–	V
V_{CEsat}	collector-emitter saturation voltage	$I_C = 0.3$ A; $I_B = 30$ mA; see Fig.4	–	–	0.8	V
		$I_C = 1$ A; $I_B = 200$ mA; see Fig.4	–	–	1	V
V_{BEsat}	base-emitter saturation voltage	$I_C = 1$ A; $I_B = 200$ mA; see Fig.5	–	–	1.1	V
I_{CES}	collector-emitter cut-off current	$V_{CE} = V_{CESmax}$; $V_{BE} = 0$	–	–	0.2	mA
		$V_{CE} = V_{CESmax}$; $V_{BE} = 0$; $T_j = 125$ °C	–	–	1.5	mA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5$ V; $I_C = 0$	–	–	1	mA
h_{FE}	DC current gain	$V_{CE} = 5$ V; $I_C = 5$ A; see Fig.6	15	–	–	
		$V_{CE} = 5$ V; $I_C = 100$ mA; see Fig.6	20	50	100	
f_T	transition frequency	$V_{CE} = 10$ V; $I_C = 200$ mA; f = 1 MHz	–	20	–	MHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Switching times resistive load (see Fig.7)						
t_{on}	turn-on time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V	–	0.2	0.5	μs
t_s	storage time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V	–	2	3.5	μs
t_f	fall time	I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V	–	0.4	–	μs
		I_{Con} = 1 A; I_{Bon} = 200 mA; I_{Boff} = –400 mA; V_{CC} = 250 V; T_{mb} = 95 °C	–	–	1.4	μs

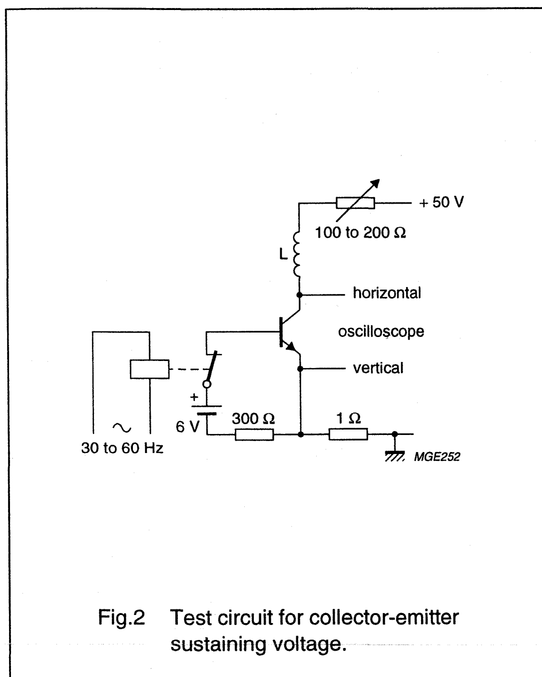


Fig.2 Test circuit for collector-emitter sustaining voltage.

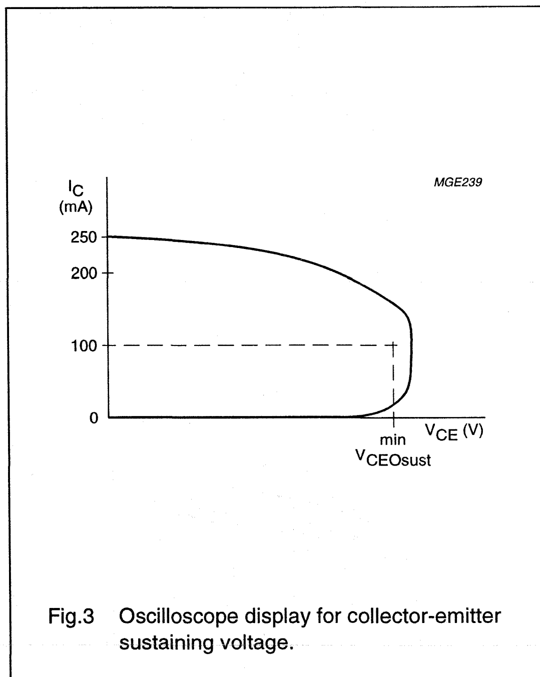
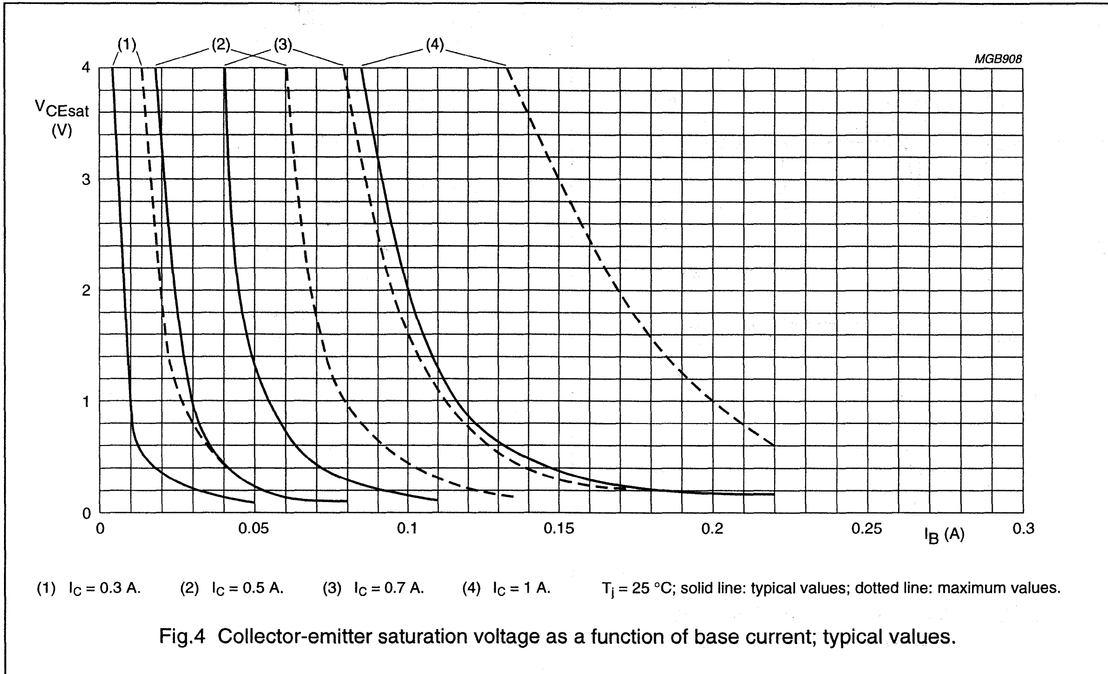
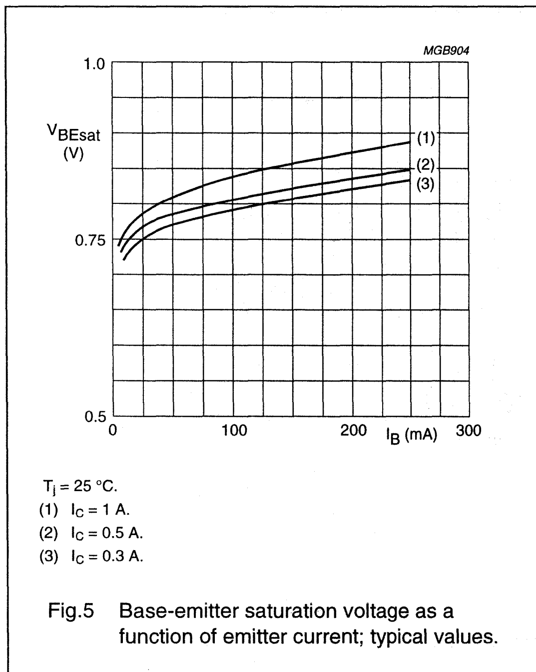


Fig.3 Oscilloscope display for collector-emitter sustaining voltage.



(1) I_C = 0.3 A. (2) I_C = 0.5 A. (3) I_C = 0.7 A. (4) I_C = 1 A. T_j = 25 °C; solid line: typical values; dotted line: maximum values.

Fig.4 Collector-emitter saturation voltage as a function of base current; typical values.



T_j = 25 °C.
(1) I_C = 1 A.
(2) I_C = 0.5 A.
(3) I_C = 0.3 A.

Fig.5 Base-emitter saturation voltage as a function of emitter current; typical values.

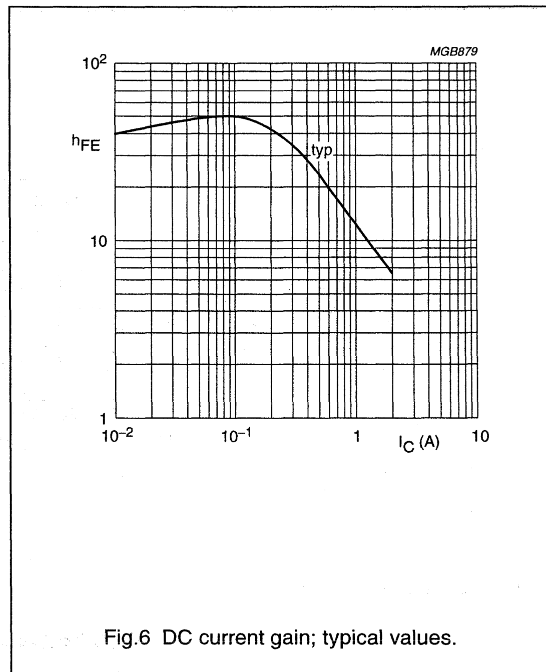


Fig.6 DC current gain; typical values.

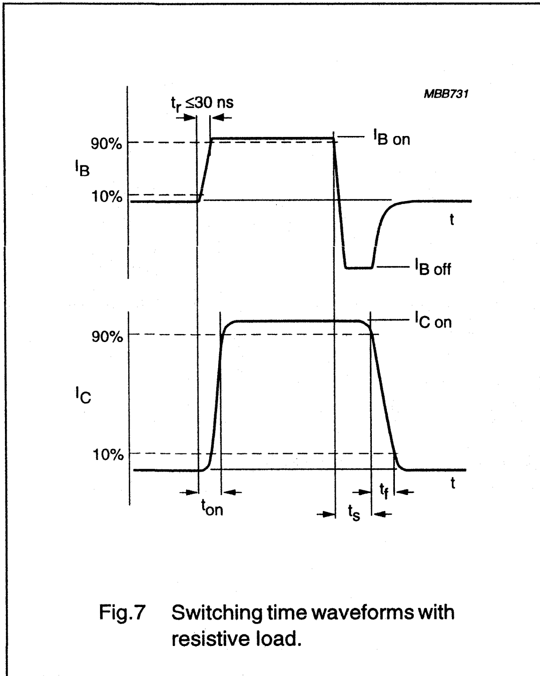
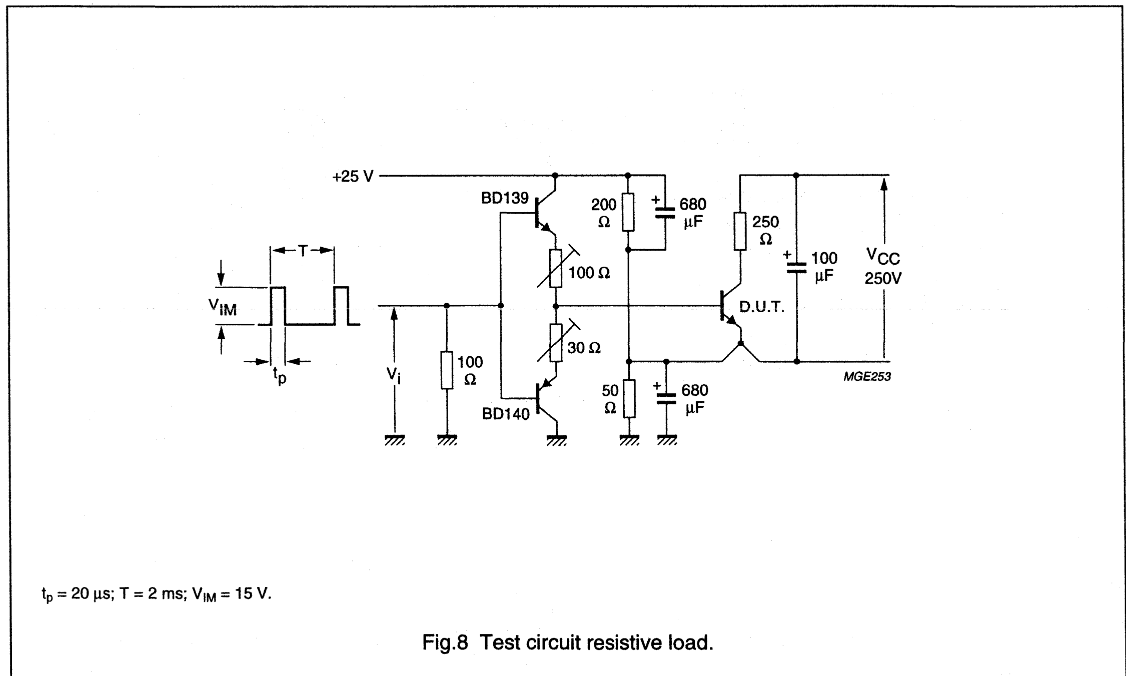


Fig.7 Switching time waveforms with resistive load.



t_p = 20 µs; T = 2 ms; V_{IM} = 15 V.

Fig.8 Test circuit resistive load.

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.

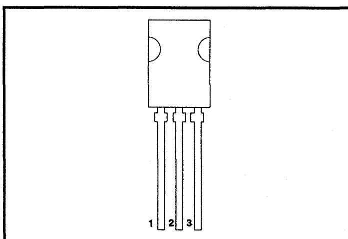
QUICK REFERENCE DATA

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

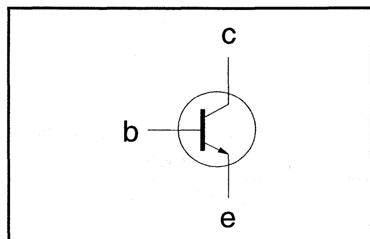
PINNING - SOT82

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
$R_{th\,j-mb}$	Junction to mounting base		-	3	K/W
$R_{th\,j-a}$	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

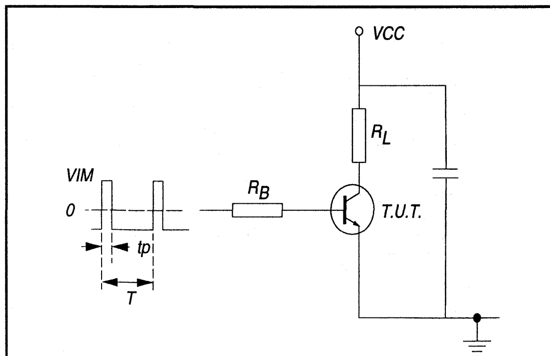


Fig.1. Test circuit resistive load. V_{IM} = -6 to +8 V
V_{CC} = 250 V; tp = 20 μs; δ = tp / T = 0.01.
R_B and R_L calculated from I_{Con} and I_{Bon} requirements.

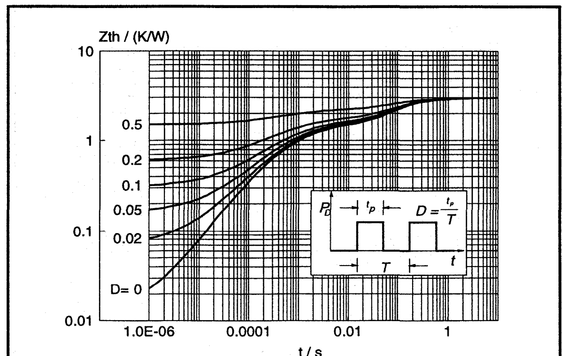


Fig.4. Transient thermal impedance.
$Z_{th\,j\text{-}mb} = f(t)$; parameter $D = t_p/T$

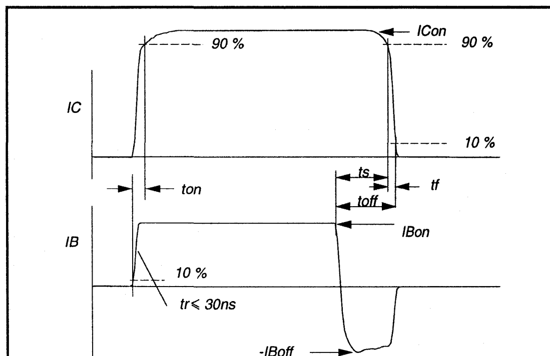


Fig.2. Switching times waveforms with resistive load.

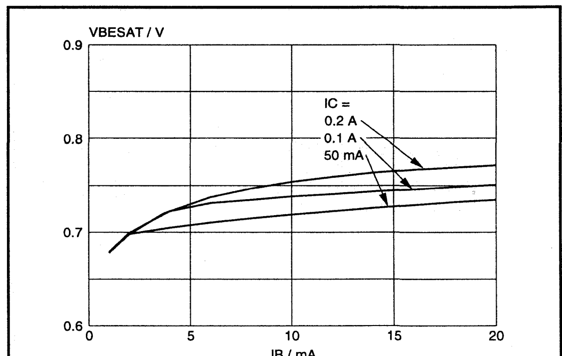


Fig.5. Typical base-emitter saturation voltage.
$V_{BEsat} = f(I_B)$; parameter I_C

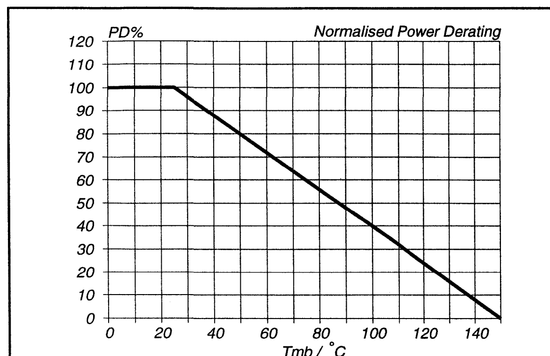


Fig.3. Normalised power dissipation.
$PD\% = 100 \cdot PD/PD_{25\,^\circ C} = f(T_{mb})$

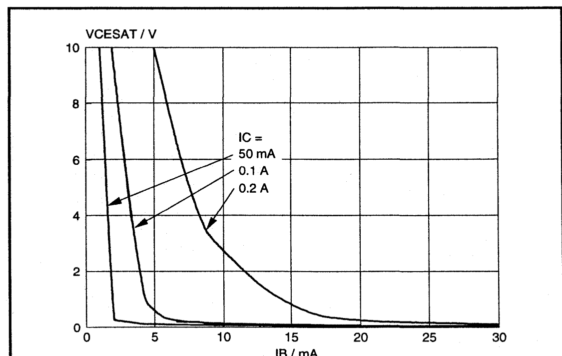


Fig.6. Typical collector-emitter saturation voltage.
$V_{CEsat} = f(I_B)$; parameter I_C

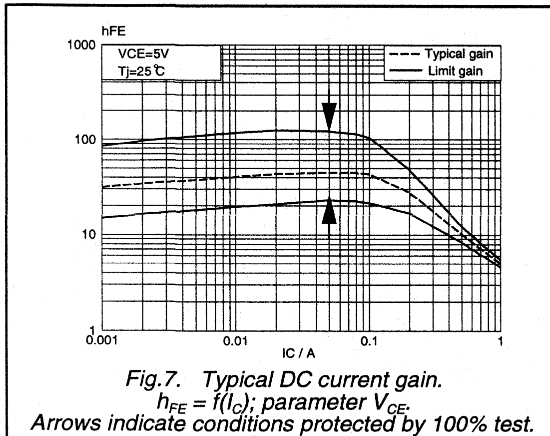


Fig.7. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}.
Arrows indicate conditions protected by 100% test.

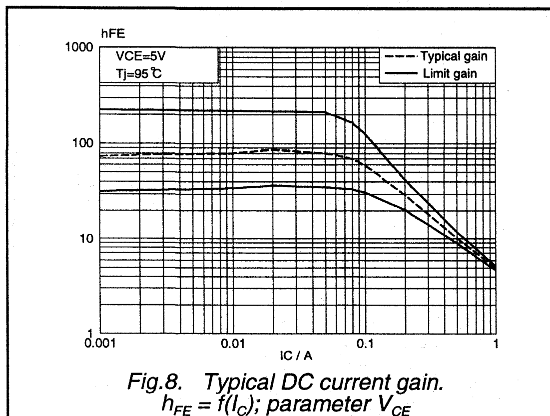


Fig.8. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

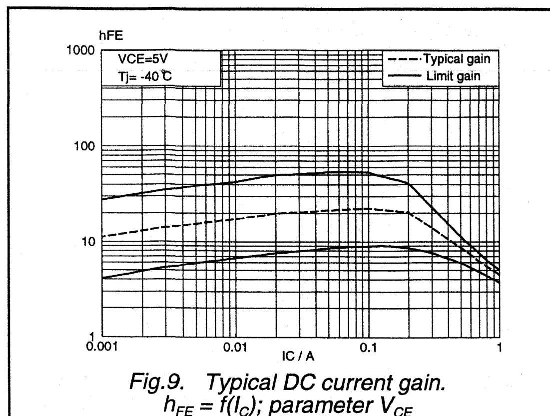


Fig.9. Typical DC current gain.
$h_{FE} = f(I_C)$; parameter V_{CE}

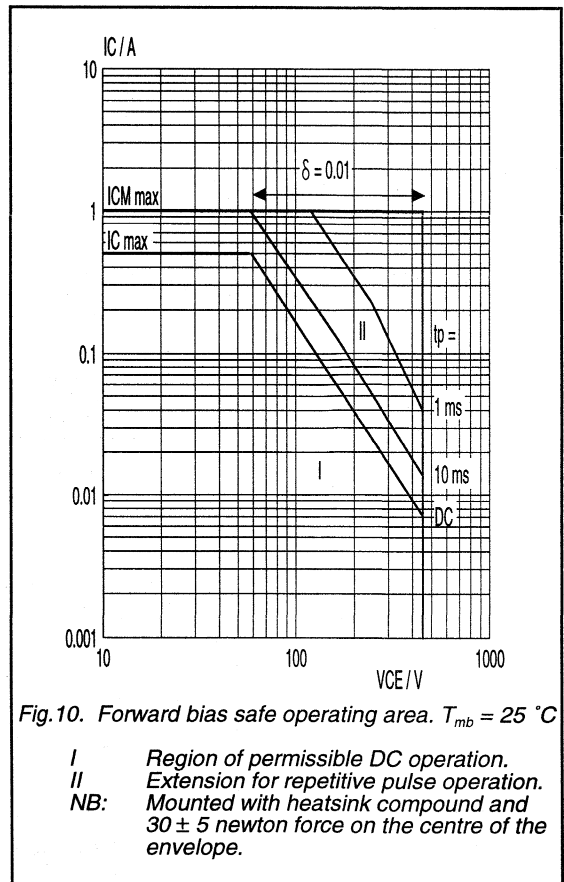


Fig.10. Forward bias safe operating area. $T_{mb} = 25$ °C

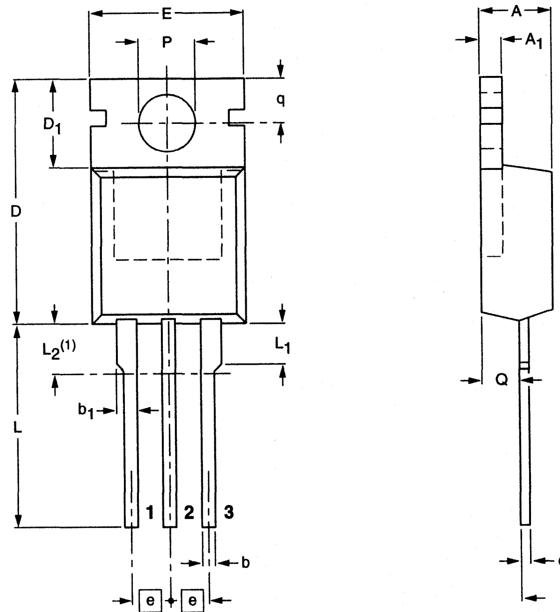
I	Region of permissible DC operation.
II	Extension for repetitive pulse operation.
NB:	Mounted with heatsink compound and 30 ± 5 newton force on the centre of the envelope.

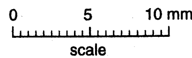
PACKAGE OUTLINES

	Page
SOT78 (TO-220AB)	602
SOT82	603
SOT93B	604
SOT186	605
SOT186A	606
SOT199	607
SOT399	608
SOT429	609
SOT430	610

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-220AB

SOT78





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D	D_1	E	e	L	L_1	$L_2^{(1)}$ max.	P	q	Q
mm	4.5 4.1	1.39 1.27	0.9 0.7	1.3 1.0	0.7 0.4	15.8 15.2	6.4 5.9	10.3 9.7	2.54	15.0 13.5	3.30 2.79	3.0	3.8 3.6	3.0 2.7	2.6 2.2

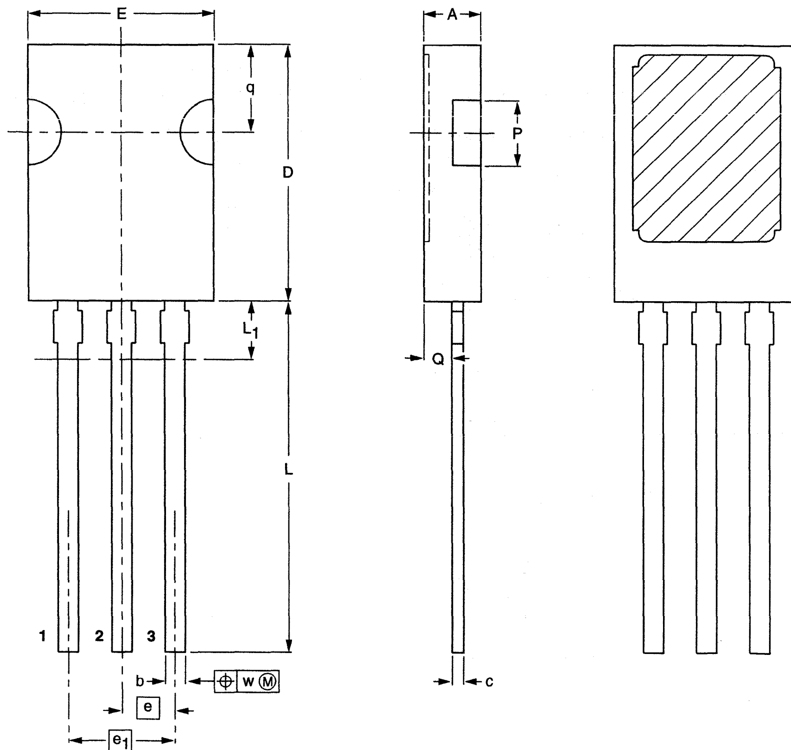
Note

1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT78		TO-220AB				97-06-11

PACKAGE OUTLINE

Plastic single-ended package; 3 leads (in-line) **SOT82**



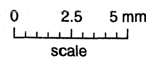
0 2.5 5 mm
scale

DIMENSIONS (mm are the original dimensions)

UNIT	A	b	c	D	E	e	e_1	L	$L_1^{(1)}$ max.	P	Q	q	w
mm	2.8 2.3	0.88 0.65	0.58 0.47	11.1 10.5	7.8 7.2	2.29	4.58	16.5 15.3	2.54	3.1 2.5	1.5 0.9	3.9 3.5	0.254

Note

1. Terminal dimensions within this zone are uncontrolled to allow for body and terminal irregularities.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT82						97-06-11

PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3 leads (in-line) **SOT93B**

0 5 10 mm

scale

DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	c	D	D_1	E	E_1	E_2	e	e_1	L(1)	L_1(2) max.	P	Q	q	R	s_1	w
mm	4.6	2.05	1.15	0.50	21	12.7	15.2	14.15	13.8	5.5	11.0	14.1	2.2	4.25	1.7	4.55	2	0.7	0.5
	4.4	1.95	0.95	0.35	20	12.3	14.8	13.85	13.4			13.6	max	4.15	1.5	4.25	1	0.5	

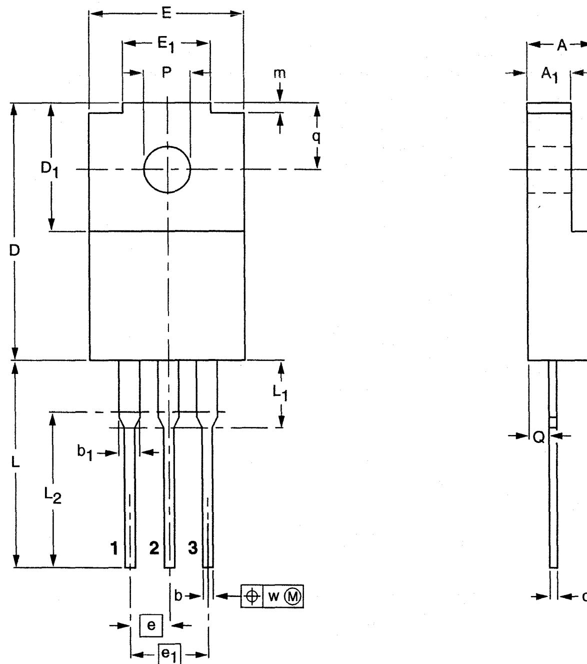
Notes

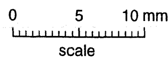
1. Dimensions are for untinned terminals.
2. Terminal dimensions within this zone are uncontrolled to allow for body and terminal irregularities.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT93B						97-06-11

PACKAGE OUTLINE

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 lead TO-220 exposed tabs **SOT186**





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D	D_1	E	E_1	e	e_1	L	$L_1^{(1)}$	L_2	m	P	Q	q	w
mm	4.4 4.0	2.9 2.5	0.9 0.7	1.5 1.3	0.55 0.38	17.0 16.4	7.9 7.5	10.2 9.6	5.7 5.3	2.54	5.08	14.3 13.5	4.8 4.0	10	0.9 0.5	3.2 3.0	1.4 1.2	4.4 4.0	0.4

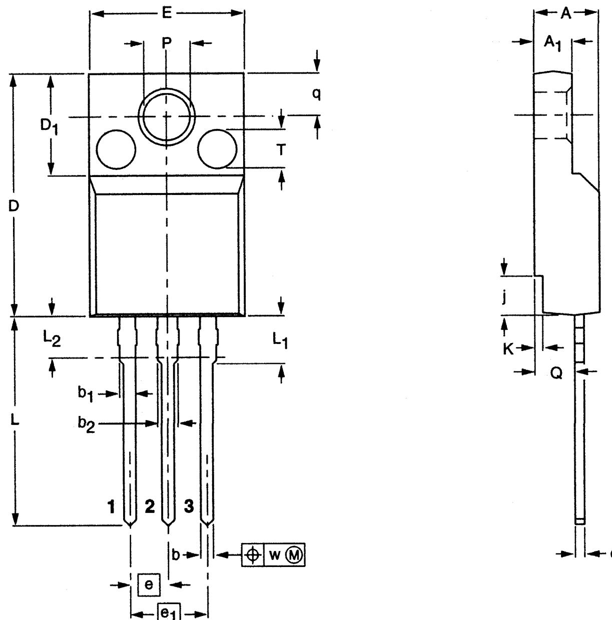
Note

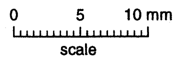
1. Terminal dimensions within this zone are uncontrolled. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT186		TO-220				97-06-11

PACKAGE OUTLINE

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3 lead TO-220 **SOT186A**





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	D_1	E	e	e_1	j	K	L	L_1	L_2(1) max.	P	Q	q	T(2)	w
mm	4.6 4.0	2.9 2.5	0.9 0.7	1.1 0.9	1.4 1.2	0.7 0.4	15.8 15.2	6.5 6.3	10.3 9.7	2.54	5.08	2.7 2.3	0.6 0.4	14.4 13.5	3.30 2.79	3	3.2 3.0	2.6 2.3	3.0 2.6	2.5	0.4

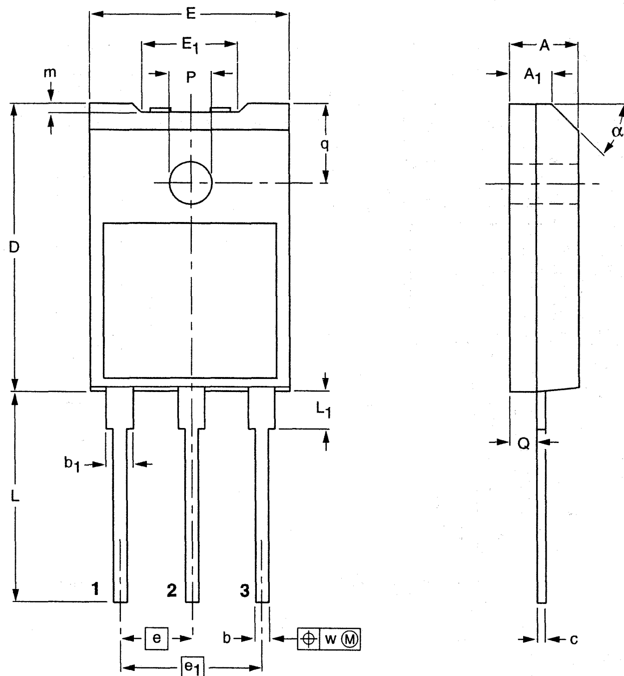
Notes

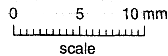
1. Terminal dimensions within this zone are uncontrolled. Terminals in this zone are not tinned.
2. Both recesses are ∅ 2.5 × 0.8 max. depth

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT186A		TO-220				97-06-11

PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3 leads (in-line) **SOT199**





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	c	D	E	E_1	e	e_1	L	L_1(1)	m	P	Q	q	w	α
mm	5.2 4.8	3.4 3.0	1.2 1.0	2.1 1.9	0.6 0.5	21.5 20.5	15.3 14.7	7.8 6.8	5.45	10.9	16.5 15.7	3.7 3.3	0.8 0.6	3.3 3.1	2.1 1.9	6.2 5.8	0.4	45°

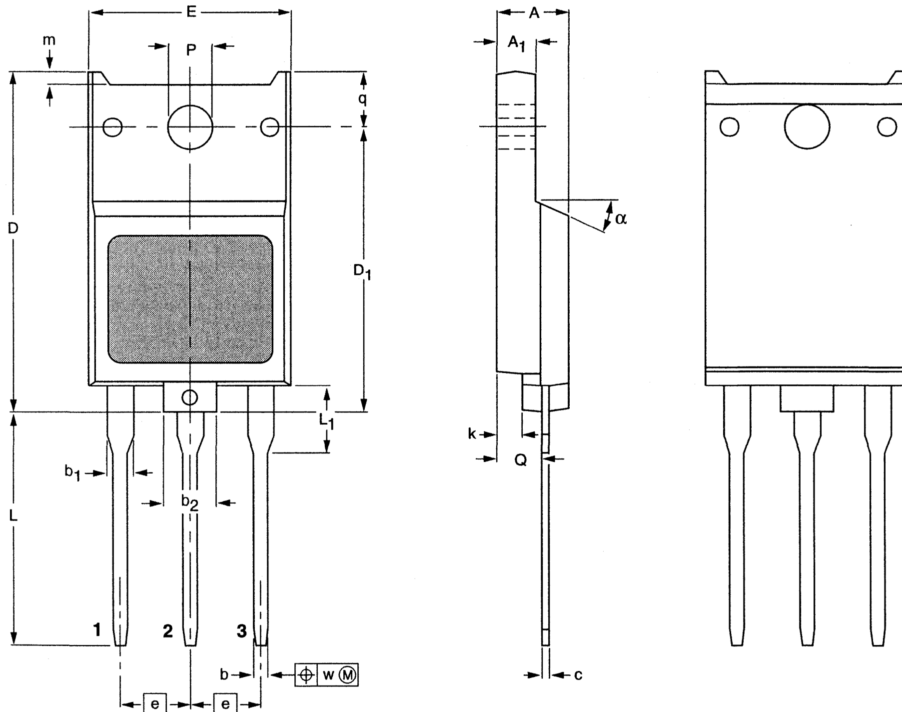
Note

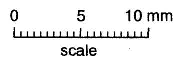
1. Terminals in this zone are not tinned.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT199						97-06-27

PACKAGE OUTLINE

Plastic single-ended through-hole package; mountable to heatsink; 1 mounting hole; 3 in-line leads SOT399





DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	D_1	E	e	k	L	$L_1^{(1)}$	m	P	Q	q	w	α
mm	5.8 4.8	3.3 2.7	1.2 0.9	2.2 1.8	4.7 4.2	0.9 0.6	27 26	22.5 21.5	16 15	5.45	2.2 1.8	19.1 18.1	5.4 4.8	0.8 0.6	3.4 3.1	3.4 3.2	4.7 4.3	0.4	27° 23°

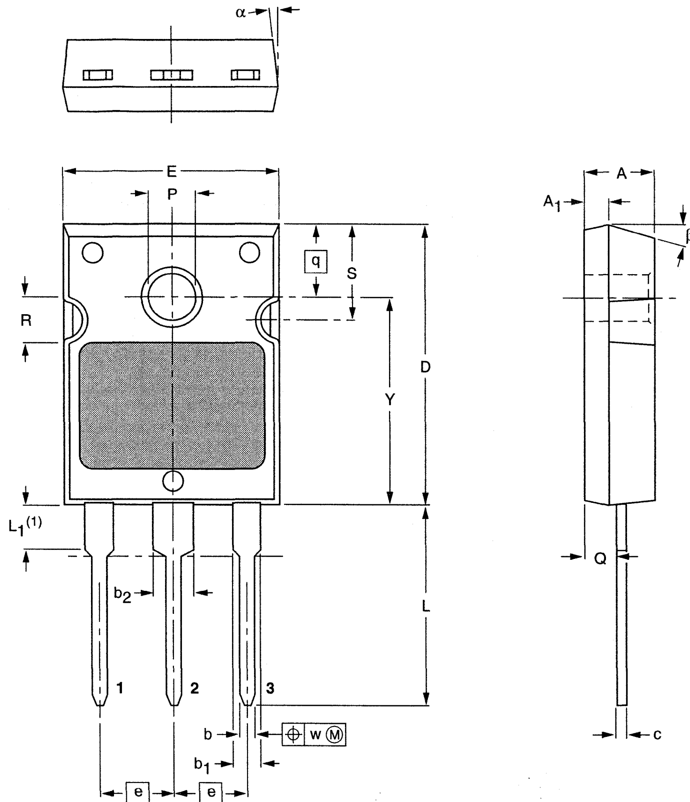
Note

1. Tinning of terminals uncontrolled in this zone.
2. All release angles 5°

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT399						97-06-11

PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead TO-247 **SOT429**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b	b_1	b_2	c	D	E	e	L	L_1	P	Q	q	R	S	w	Y	α	β
mm	5.3 4.7	1.9 1.7	1.2 0.9	2.2 1.8	3.2 2.8	0.9 0.6	21 20	16 15	5.45	16 15	4.0 3.6	3.7 3.3	2.6 2.4	5.3	3.5 3.3	7.5 7.1	0.4	15.7 15.3	6° 4°	17° 13°

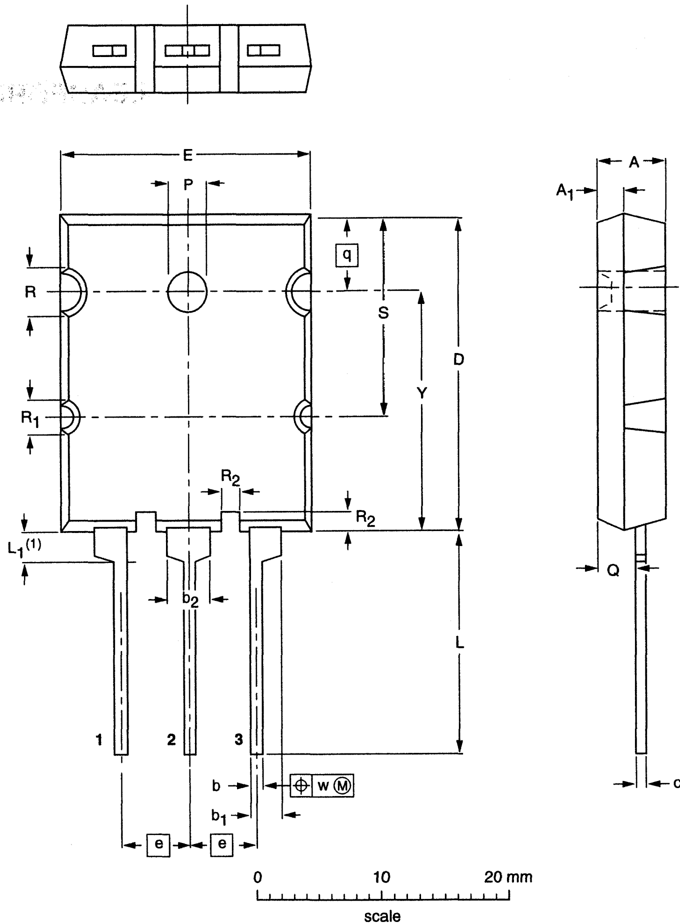
Note

1. Terminals are uncontrolled within zone L_1.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT429		TO-247				97-06-11

PACKAGE OUTLINE

Plastic single-ended package; heatsink mounted; 1 mounting hole; 3-lead JUMBO TO-247 **SOT430**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	b	b_1 max.	b_2 max.	c max.	D	E max.	e	L min.	L_1	P	Q max.	q	R	R_1	R_2	S	w	Y
mm	5.3	2.3	1.0 0.8	2.5	3.5	0.8	26.5 25.5	20.5	5.45	19.5	2.5	3.5 3.1	3.0	6.0	4.0	3.0	1.5	16	0.4	20.5 19.5

Note

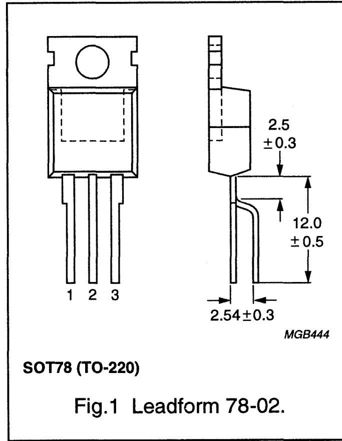
1. Terminals are uncontrolled within zone L_1.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT430						97-06-23

LEADFORM OPTIONS

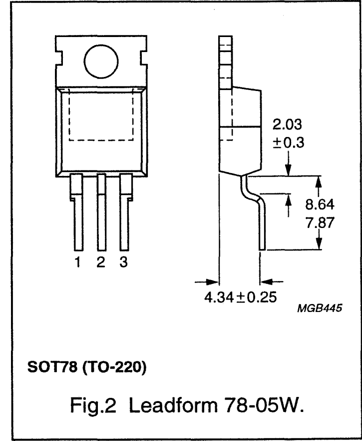
LEADFORM OPTIONS

- These options require a special part number before ordering.
- Contact your local Philips Semiconductors representative for pricing, minimum order quantities and part number.



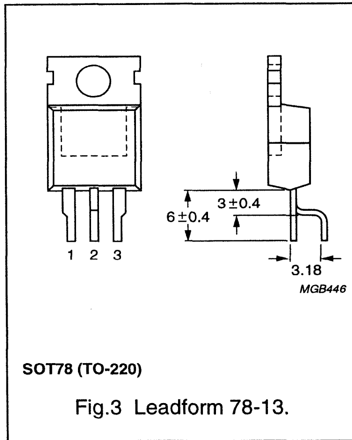
SOT78 (TO-220)

Fig.1 Leadform 78-02.



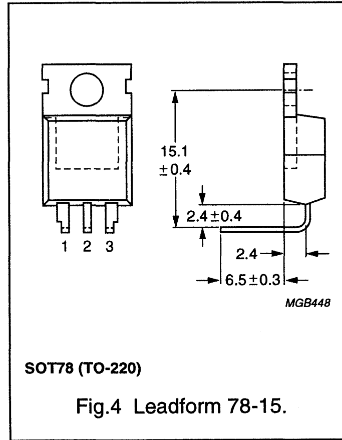
SOT78 (TO-220)

Fig.2 Leadform 78-05W.



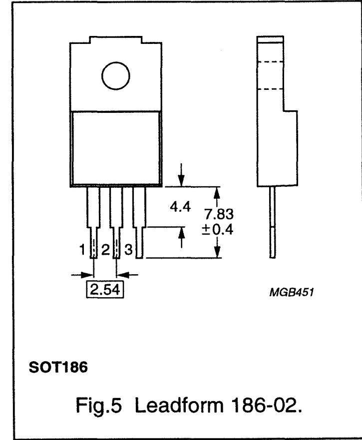
SOT78 (TO-220)

Fig.3 Leadform 78-13.



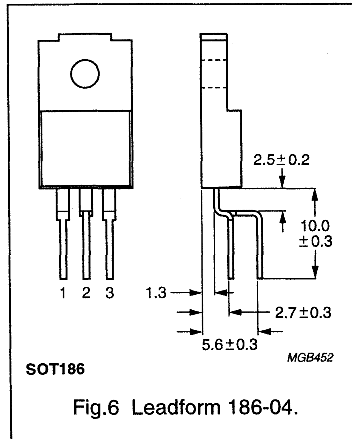
SOT78 (TO-220)

Fig.4 Leadform 78-15.



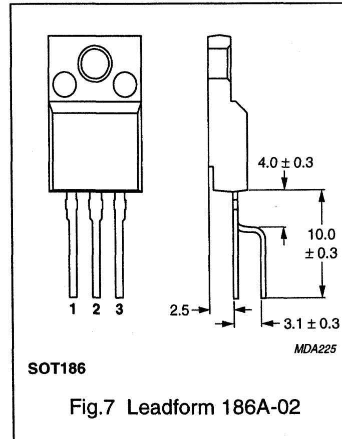
SOT186

Fig.5 Leadform 186-02.



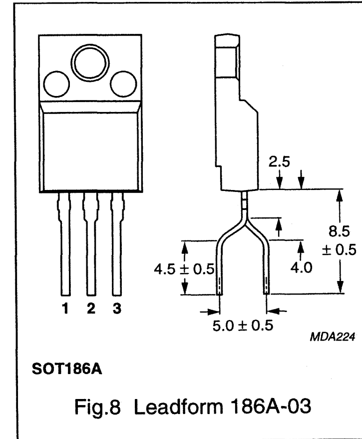
SOT186

Fig.6 Leadform 186-04.



SOT186

Fig.7 Leadform 186A-02



SOT186A

Fig.8 Leadform 186A-03

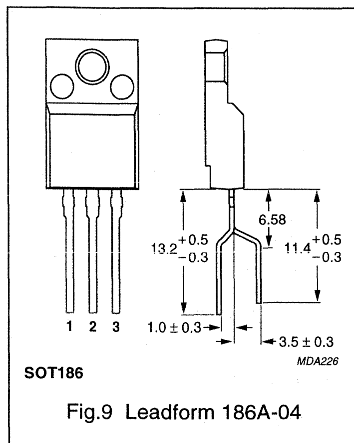


Fig.9 Leadform 186A-04

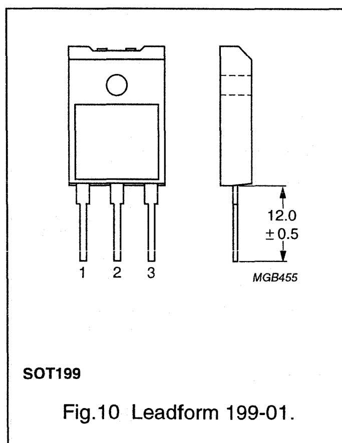


Fig.10 Leadform 199-01.

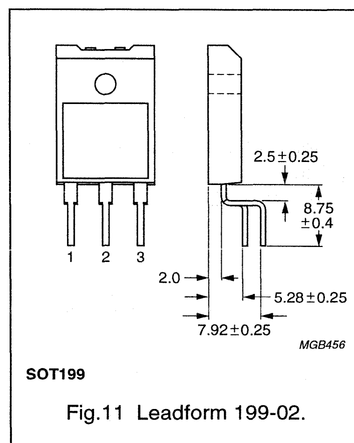


Fig.11 Leadform 199-02.

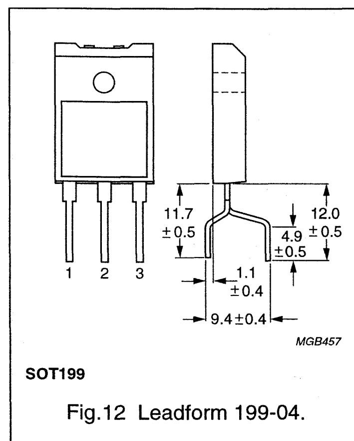


Fig.12 Leadform 199-04.

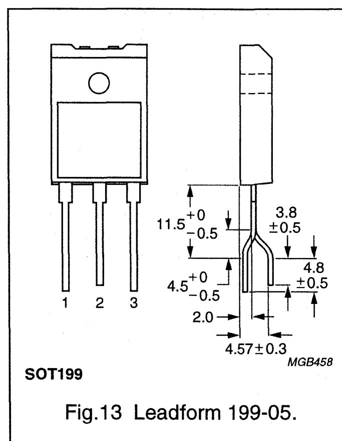


Fig.13 Leadform 199-05.

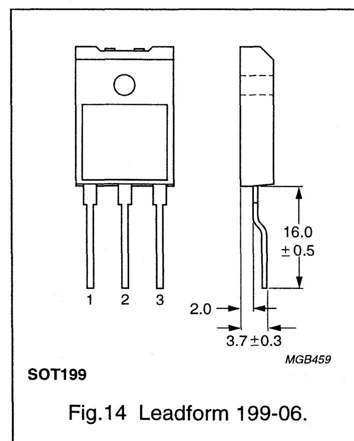


Fig.14 Leadform 199-06.

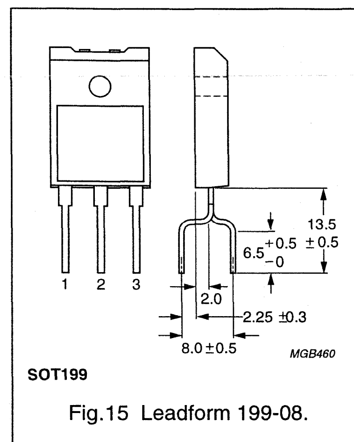


Fig.15 Leadform 199-08.

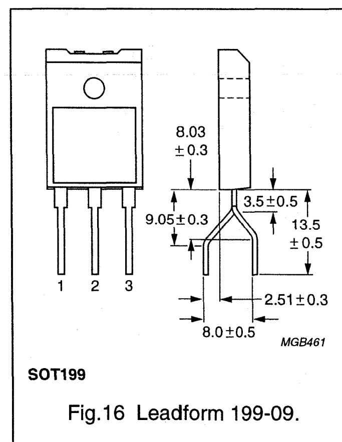


Fig.16 Leadform 199-09.

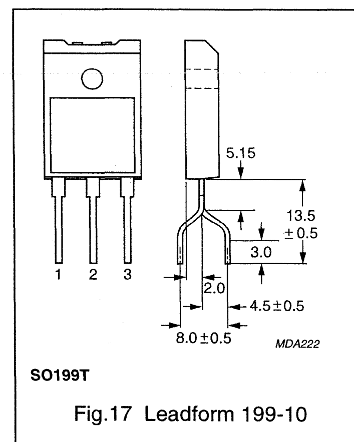


Fig.17 Leadform 199-10

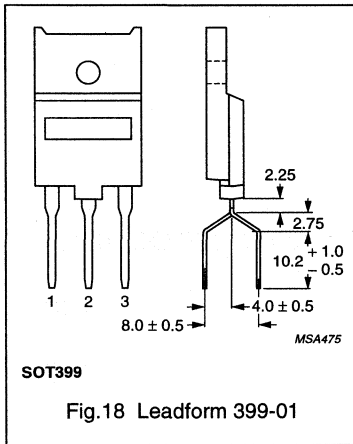


Fig.18 Leadform 399-01

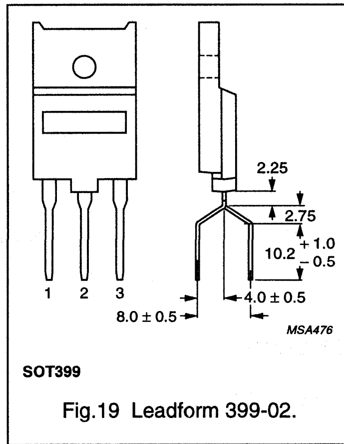


Fig.19 Leadform 399-02.

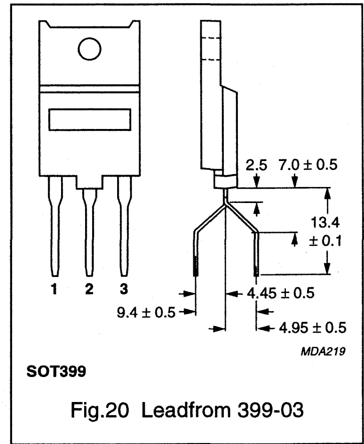


Fig.20 Leadfrom 399-03

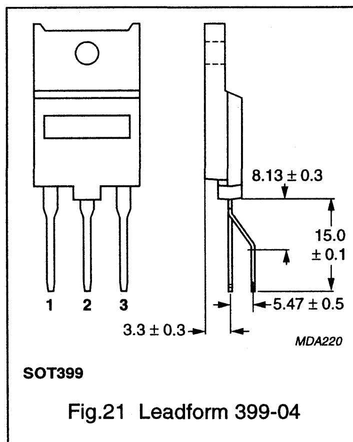


Fig.21 Leadform 399-04

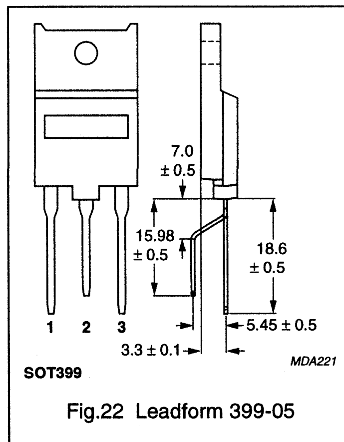


Fig.22 Leadform 399-05

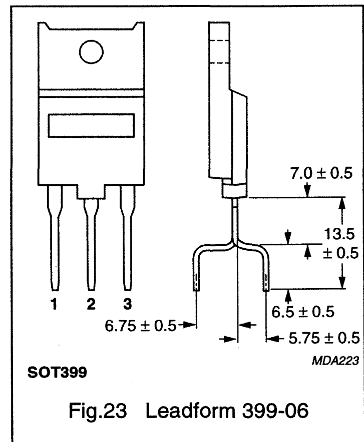


Fig.23 Leadform 399-06

MOUNTING INSTRUCTIONS

	page
TO126/SOT82	616
SOT186/A; TO220AB	620
SOT199/SOT429/TOP3D	624

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

$R_{th\ mb-h}$	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.

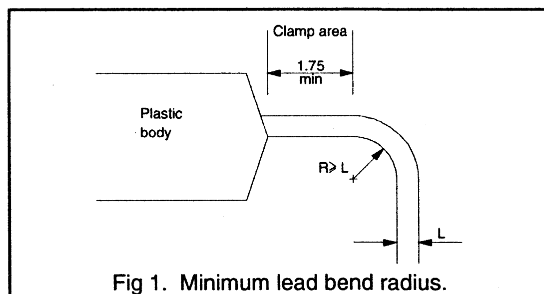


Fig 1. Minimum lead bend radius.

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.

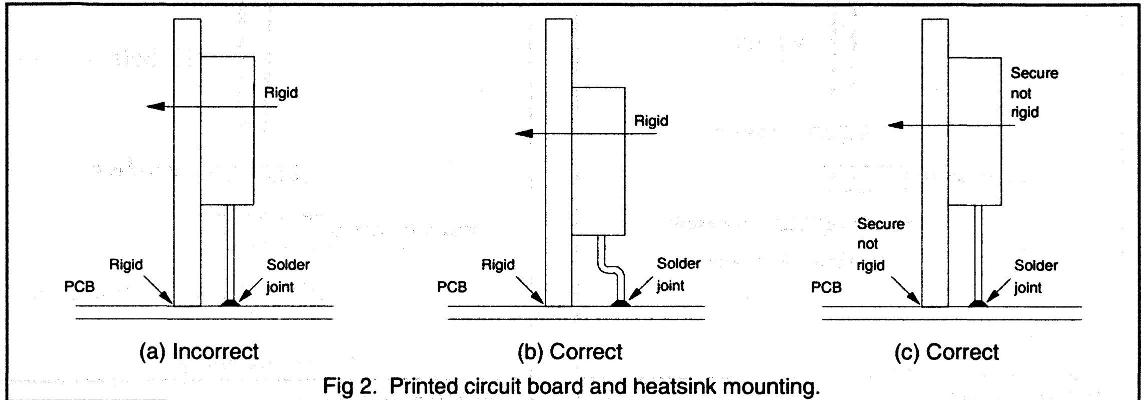


Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting with screw and spacing washer

THROUGH HEATSINK WITH NUT.

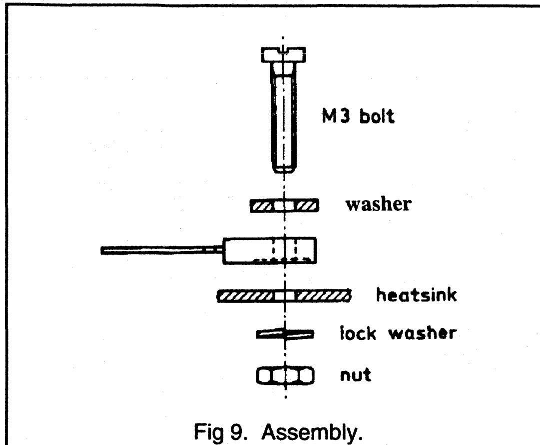


Fig 9. Assembly.

Dimensions in mm

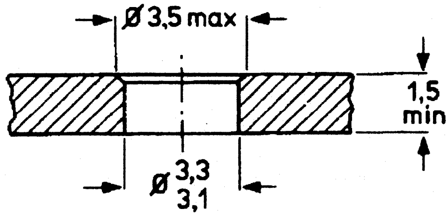


Fig 10. Heatsink requirements.

INTO TAPPED HEATSINK

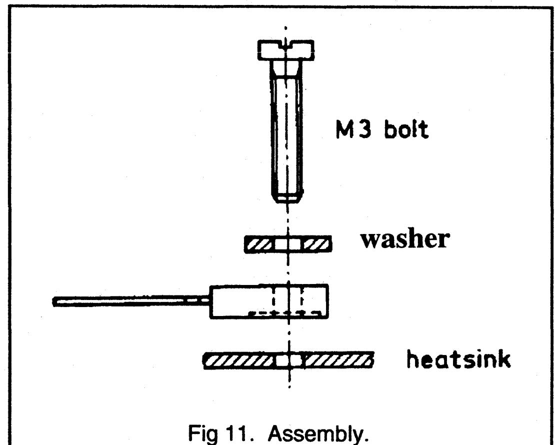


Fig 11. Assembly.

Dimensions in mm

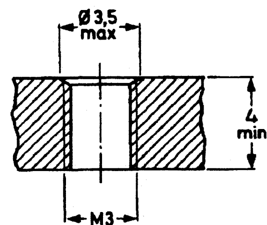


Fig 12. Heatsink requirements.

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 ($R_{th\ mb-h}$) 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.

$R_{th\ mb-h}$ 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.

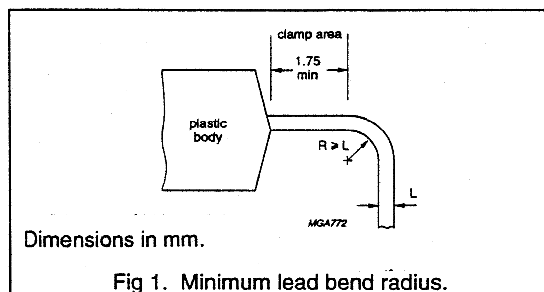
Lead bending

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.

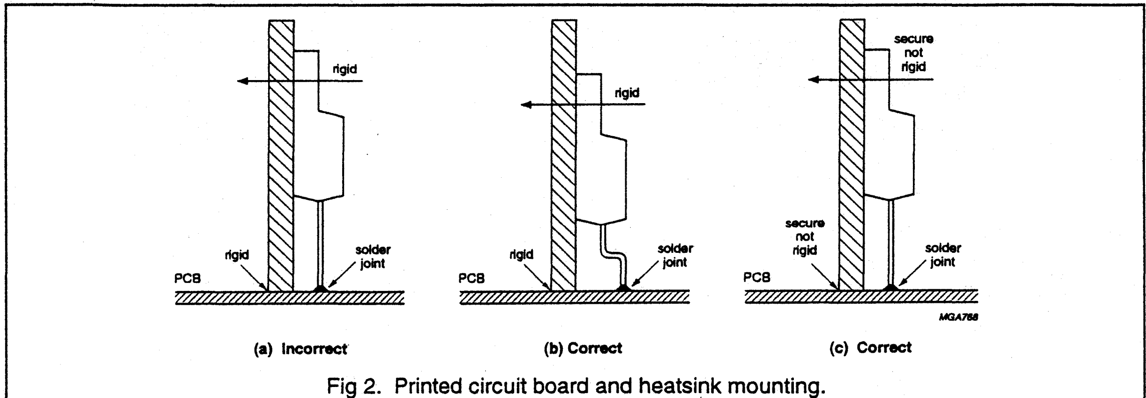


Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting with screw and spacing washer

THROUGH HEATSINK WITH NUT

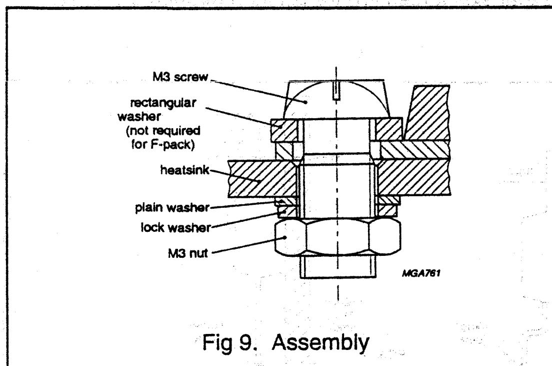
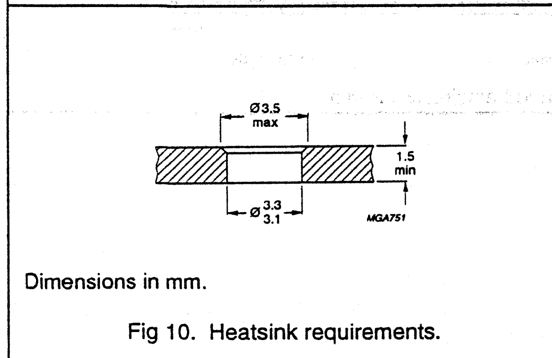


Fig 9. Assembly



Dimensions in mm.

Fig 10. Heatsink requirements.

INTO TAPPED HEATSINK

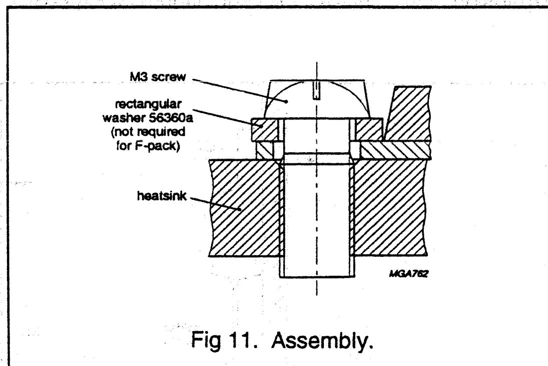
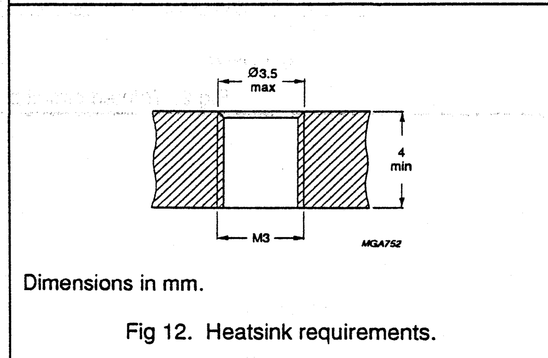


Fig 11. Assembly.



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, 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.

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.

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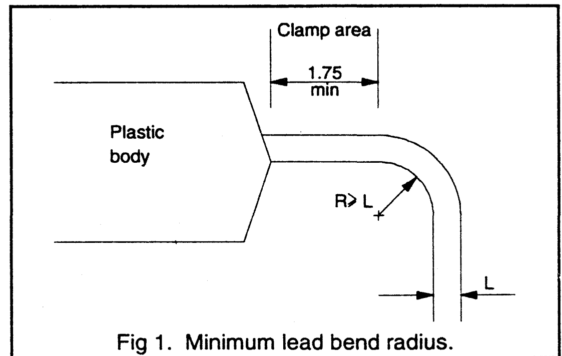

Fig 1. Minimum lead bend radius.

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.

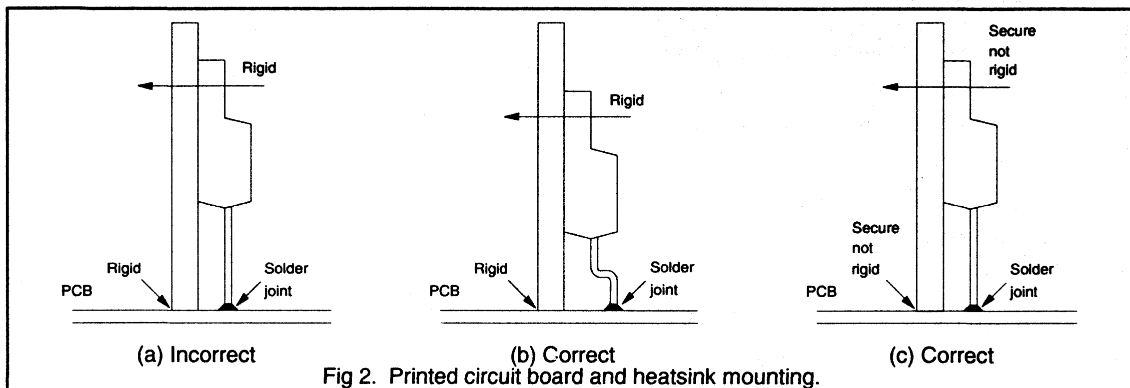

Fig 2. Printed circuit board and heatsink mounting.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting through heatsink with nut

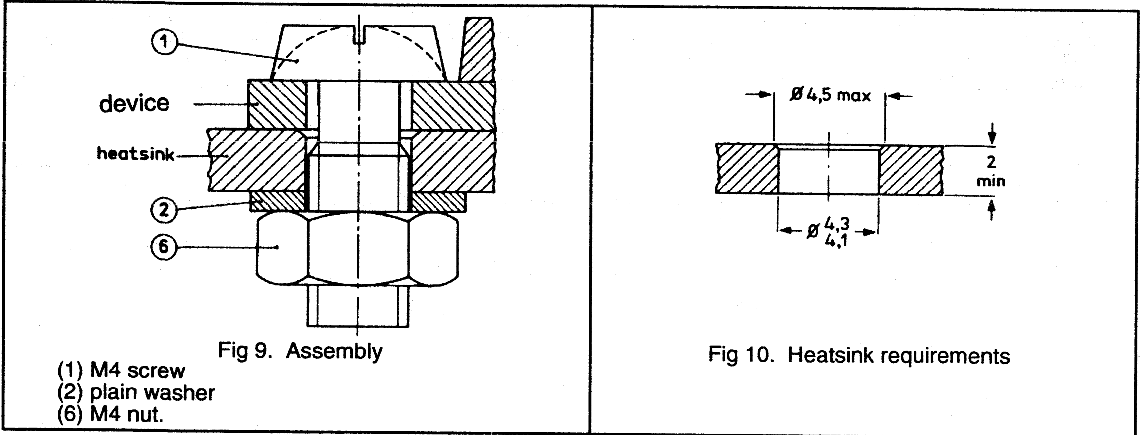

Fig 9. Assembly

(1) M4 screw
(2) plain washer
(6) M4 nut.

Fig 10. Heatsink requirements

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

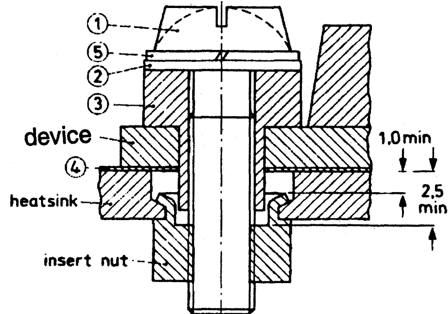

Fig 15. Assembly and heatsink requirements for 500V insulation. See also figures 9 and 10.

(1) M3 screw
(2) plain washer
(3) insulating bush (56368b)
(4) mica insulator (56368c)
(5) lock washer

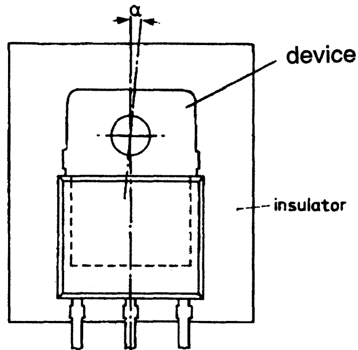

Fig 16. Mica insulator
The axial deviation (α) between package and mica should not exceed 5°

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Data handbook system

DATA HANDBOOK SYSTEM

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