PHILIPS

Data handbook

Electronic components and materials

Semiconductors and integrated circuits

Part 4c July 1978

Discrete semiconductors for

Hybrid thick and thin-film circuits

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SEMICONDUCTORS AND INTEGRATED CIRCUITS

PART 4c - JULY 1978

DISCRETE SEMICONDUCTORS FOR HYBRID THICK AND THIN-FILM CIRCUITS

DATA HANDBOOK SYSTEM
INDEX OF SEMICONDUCTORS

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of three series of handbooks each comprising several parts.

ELECTRON TUBES	BLUE
SEMICONDUCTORS AND INTEGRATED CIRCUITS	RED
COMPONENTS AND MATERIALS	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

ELECTRON TUBES (BLUE SERIES)

Part 1a	**December 1975**	**ET1a 12-75**	**Transmitting tubes for communication, tubes for r.f. heating** Types PE05/25 to TBW15/25
Part 1b	**August 1977**	**ET1b 08-77**	**Transmitting tubes for communication, tubes for r.f. heating, amplifier circuit assemblies**
Part 2a	**November 1977**	**ET2a 11-77**	**Microwave tubes** Communication magnetrons, magnetrons for microwave heating, klystrons, travelling-wave tubes, diodes, triodes T-R switches
Part 2b	**May 1978**	**ET2b 05-78**	**Microwave semiconductors and components** Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	**January 1975**	**ET3 01-75**	**Special Quality tubes, miscellaneous devices**
Part 4	**March 1975**	**ET4 03-75**	**Receiving tubes**
Part 5a	**March 1978**	**ET5a 03-78**	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 5b	**May 1975**	**ET5b 05-75**	**Camera tubes, image intensifier tubes**
Part 6	**January 1977**	**ET6 01-77**	**Products for nuclear technology** Channel electron multipliers, neutron tubes, Geiger-Müller tubes
Part 7a	**March 1977**	**ET7a 03-77**	**Gas-filled tubes** Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	**March 1977**	**ET7b 03-77**	**Gas-filled tubes** Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	**May 1977**	**ET8 05-77**	**TV picture tubes**
Part 9	**March 1978**	**ET9 03-78**	**Photomultiplier tubes; phototubes**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Part 1a	**March 1976**	**SC1a 03-76**	**Rectifier diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes (> 1,5 W), transient suppressor diodes, rectifier stacks, thyristors, triacs
Part 1b	**May 1977**	**SC1b 05-77**	**Diodes** Small signal germanium diodes, small signal silicon diodes, special diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes
Part 2	**November 1977**	**SC2 11-77**	**Low-frequency and dual transistors**
Part 3	**January 1978**	**SC3 01-78**	**High-frequency, switching and field-effect transistors**
Part 4a	**June 1976**	**SC4a 06-76**	**Special semiconductors*** Transmitting transistors, field-effect transistors, dual transistors, microminiature devices for thick and thin-film circuits
Part 4b	**July 1978**	**SC4b 07-78**	**Devices for optoelectronics** Photosensitive diodes and transistors, light emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices
Part 4c	**July 1978**	**SC4c 07-78**	**Discrete semiconductors for hybrid thick and thin-film circuits**
Part 5a	**November 1976**	**SC5a 11-76**	**Professional analogue integrated circuits**
Part 5b	**March 1977**	**SC5b 03-77**	**Consumer integrated circuits** Radio-audio, television
Part 6	**October 1977**	**SC6 10-77**	**Digital integrated circuits** LOCMOS HE4000B family
Signetics integrated circuits 1978			Bipolar and MOS memories Bipolar and MOS microprocessors Analogue circuits

* The most recent information on field-effect transistors can be found in SC3 01-78, on dual transistors in SC2 11-77, and on microminiature devices in SC4c 05-78.

COMPONENTS AND MATERIALS (GREEN SERIES)

Part 1	June 1977	CM1 06-77	**Assemblies for industrial use** High noise immunity logic FZ/30-series, counter modules 50-series, NORbits 60-series, 61-series, circuit blocks 90-series, circuit block CSA70(L), PLC modules, input/output devices, hybrid circuits, peripheral devices, ferrite core memory products
Part 2a	October 1977	CM2a 10-77	**Resistors** Fixed resistors, variable resistors, voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC), test switches
Part 2b	February 1978	CM2b 02-78	**Capacitors** Electrolytic and solid capacitors, film capacitors, ceramic capacitors, variable capacitors
Part 3	January 1977	CM3 01-77	**Radio, audio, television** FM tuners, loudspeakers, television tuners and aerial input assemblies, components for black and white television, components for colour television
Part 4a	October 1976	CM4a 10-76	**Soft ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	December 1976	CM4b 12-76	**Piezoelectric ceramics, permanent magnet materials**
Part 5	July 1975	CM5 07-75	**Ferrite core memory products** Ferroxcube memory cores, matrix planes and stacks, core memory systems
Part 6	April 1977	CM6 04-77	**Electric motors and accessories** Small synchronous motors, stepper motors, miniature direct current motors
Part 7	September 1971	CM7 09-71	**Circuit blocks** Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 8	February 1977	CM8 02-77	**Variable mains transformers**
Part 9	March 1976	CM9 03-76	**Piezoelectric quartz devices**
Part 10	April 1978	CM10 04-78	**Connectors**

INDEX OF TYPE NUMBERS

Data Handbooks SC1a to SC4c

The inclusion of a type number in this publication does not necessarily imply its availability.

AD = Silicon alloyed diodes
GB = Germanium gold bonded diodes
HFSW = High-frequency and switching transistors
LF = Low-frequency transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors
PC = Germanium point contact diodes
R = Rectifier diodes
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

type no.	part	section	type no.	part	section	type no.	part	section
BC149	2	LF	BCW33;R	4c	Mm	BD138	2	P
BC157	2	LF	BCW69;R	4c	Mm	BD139	2	P
BC158	2	LF	BCW70;R	4c	Mm	BD140	2	P
BC159	2	LF	BCW71;R	4c	Mm	BD181	2	P
BC160	2	LF	BCW72;R	4c	Mm	BD182	2	P
BC161	2	LF	BCX17;R	4c	Mm	BD183	2	P
BC177	2	LF	BCX18;R	4c	Mm	BD201	2	P
BC178	2	LF	BCX19;R	4c	Mm	BD202	2	P
BC179	2	LF	BCX20;R	4c	Mm	BD203	2	P
BC200	2	LF	BCX51	4c	Mm	BD204	2	P
BC264A	3	FET	BCX52	4c	Mm	BD226	2	P
BC264B	3	FET	BCX53	4c	Mm	BD227	2	P
BC264C	3	FET	BCX54	4c	Mm	BD228	2	P
BC264D	3	FET	BCX55	4c	Mm	BD229	2	P
BC327	2	LF	BCX56	4c	Mm	BD230	2	P
BC328	2	LF	BCY30A	2	LF	BD231	2	P
BC337	2	LF	BCY31A	2	LF	BD232	2	P
BC338	2	LF	BCY32A	2	LF	BD233	2	P
BC368	2	LF	BCY33A	2	LF	BD234	2	P
BC369	2	LF	BCY34A	2	LF	BD235	2	P
BC546	2	LF	BCY55	2	DT	BD236	2	P
BC547	2	LF	BCY56	2	LF	BD237	2	P
BC548	2	LF	BCY57	2	LF	BD238	2	P
BC549	2	LF	BCY58	2	LF	BD262	2	P
BC550	2	LF	BCY59	2	LF	BD262A	2	P
BC556	2	LF	BCY70	2	LF	BD262B	2	P
BC557	2	LF	BCY71	2	LF	BD263	2	P
BC558	2	LF	BCY72	2	LF	BD263A	2	P
BC559	2	LF	BCY78	2	LF	BD263B	2	P
BC560	2	LF	BCY79	2	LF	BD266	2	P
BC635	2	LF	BCY87	2	DT	BD266A	2	P
BC636	2	LF	BCY88	2	DT	BD266B	2	P
BC637	2	LF	BCY89	2	DT	BD267	2	P
BC638	2	LF	BD115	2	P	BD267A	2	P
BC639	2	LF	BD131	2	P	BD267B	2	P
BC640	2	LF	BD132	2	P	BD291	2	P
BCW29;R	4c	Mm	BD133	2	P	BD292	2	P
BCW30;R	4c	Mm	BD135	2	P	BD293	2	P
BCW31;R	4c	Mm	BD136	2	P	BD294	2	P
BCW32;R	4c	Mm	BD137	2	P	BD329	2	P

DT = Dual transistors
FET = Field-effect transistors
LF = Low-frequency transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors

FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits

P = Low-frequency power transistors

FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
PDT = Photodiodes or transistors
R = Rectifier diodes
Th = Thyristors
Tra = Transmitting transistors

FET = Field-effect transistors
HFSW = High-frequency and switching transistors
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors
R = Rectifier diodes
Th = Thyristors
Tri = Triacs
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

AD = Silicon alloyed diodes
D = Displays
GB = Germanium gold bonded diodes
I = Infrared devices
LED = Light-emitting diodes
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
PC = Germanium point contact diodes
Ph = Photoconductive devices
PhC = Photocouplers
St = Rectifier stacks
V_{rf} = Voltage reference diodes
V_{rg} = Voltage regulator diodes
WD = Silicon whiskerless diodes

A = Accessories
DH = Diecast heatsinks
FET = Field-effect transistors
HE = Heatsink extrusions
HFSW = High-frequency and switching transistors
I = Infrared devices
LF = Low-frequency transistors
P = Low-frequency power transistors
Tra = Transmitting transistors
Vrg = Voltage regulator diodes

A = Accessories

DH = Diecast heatsinks

GENERAL

Pro Electron Type designation
Rating Systems
Letter Symbols
S-parameters

PRO ELECTRON TYPE DESIGNATION CODE FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete semiconductor devices — as opposed to integrated circuits —, multiples of such devices and semiconductor chips.

A basic type number consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST LETTER

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

A. GERMANIUM or other material with band gap of 0,6 to 1,0 eV.
B. SILICON or other material with band gap of 1,0 to 1,3 eV.
C. GALLIUM-ARSENIDE or other material with 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.

A. DIODE; signal, low power
B. DIODE; variable capacitance
C. TRANSISTOR; low power, audio frequency ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
D. TRANSISTOR; power, audio frequency ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
E. DIODE; tunnel
F. TRANSISTOR; low power, high frequency ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
G. MULTIPLE OF DISSIMILAR DEVICES — MISCELLANEOUS; e.g. oscillator
H. DIODE; magnetic sensitive
L. TRANSISTOR; power, high frequency ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
N. PHOTO-COUPLER
P. RADIATION DETECTOR; e.g. high sensitivity phototransistor
Q. RADIATION GENERATOR; e.g. light-emitting diode (LED)
R. CONTROL AND SWITCHING DEVICE; e.g. thyristor, low power ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
S. TRANSISTOR; low power, switching ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
U. TRANSISTOR; power, switching ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
X. DIODE: multiplier, e.g. varactor, step recovery
Y. DIODE; rectifying, booster
Z. DIODE; voltage reference or regulator (transient suppressor diode, with third letter W)

SERIAL NUMBER

Three figures, running from 100 to 999, for devices primarily intended for consumer equipment.
One letter (Z, Y, X, etc.) and two figures, running from 10 to 99, for devices primarily intended for industrial/professional equipment.
This letter has no fixed meaning except W, which is used for transient suppressor diodes.

VERSION LETTER

It indicates a minor variant of the basic type either electrically or mechanically. The letter never has a fixed meaning, except letter R, indicating reverse voltage, e.g. collector to case or anode to stud.

SUFFIX

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

1. VOLTAGE REFERENCE and VOLTAGE REGULATOR DIODES: *ONE LETTER and ONE NUMBER*
   The LETTER indicates the nominal tolerance of the Zener (regulation, working or reference) voltage
   A. 1% (according to IEC 63: series E96)
   B. 2% (according to IEC 63: series E48)
   C. 5% (according to IEC 63: series E24)
   D. 10% (according to IEC 63: series E12)
   E. 20% (according to IEC 63: series E6)
   The number denotes the typical operating (Zener) voltage related to the nominal current rating for the whole range.
   The letter 'V' is used instead of the decimal point.

2. TRANSIENT SUPPRESSOR DIODES: *ONE NUMBER*
   The NUMBER indicates the maximum recommended continuous reversed (stand-off) voltage V_R. The letter 'V' is used as above.

3. CONVENTIONAL and CONTROLLED AVALANCHE RECTIFIER DIODES and THYRISTORS: *ONE NUMBER*
   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 is indicated by letter R, immediately after the number.

4. RADIATION DETECTORS: *ONE NUMBER,* preceded by a hyphen (–)
   The NUMBER indicates the depletion layer in μm. The resolution is indicated by a version LETTER.

5. ARRAY OF RADIATION DETECTORS and GENERATORS: *ONE NUMBER,* preceded by a stroke (/).
   The NUMBER indicates how many basic devices are assembled into the array.

RATING SYSTEMS

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

DEFINITIONS OF TERMS USED

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note
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 which are directly related to the application.

Rating. A value which 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.

Note
Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note
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 life, 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 life, no design maximum value for the intended service is exceeded with a bogey 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 FOR TRANSISTORS AND SIGNAL DIODES

based on IEC Publication 148

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters

The basic letters to be used are:

I, i = current
V, v = voltage
P, p = power.

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time.
In all other instances upper-case basic letters shall be used.

Subscripts

A, a	Anode terminal
(AV), (av)	Average value
B, b	Base terminal, for MOS devices: Substrate
(BR)	Breakdown
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 circuited
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)	R.M.S. value
S, s	As first or second subscript: Source terminal (for FETS only) As second subscript: Non-repetitive (not for 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.

Note: No additional subscript is used for d.c. values.

Upper-case subscripts shall be used for the indication of:

a) continuous (d.c.) values (without signal)

Example I_B

b) instantaneous total values

Example i_B

c) average total values

Example $I_{B(AV)}$

d) peak total values

Example I_{BM}

e) root-mean-square total values

Example $I_{B(RMS)}$

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

a) instantaneous values

Example i_b

b) root-mean-square values

Example $I_{b(rms)}$

c) peak values

Example I_{bm}

d) average values

Example $I_{b(av)}$

Note: If more than one subscript is used, subscript for which both styles exist shall either be all upper-case or all lower-case.

Additional rules for subscripts

Subscripts for currents

Transistors: 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}

Diodes: 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, $I_{f(rms)}$

Subscripts for voltages

Transistors: 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}

Diodes: 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}

Subscripts for supply voltages or supply currents

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

Examples: V_{CC}, I_{EE}

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

Example : V_{CCE}

Subscripts for devices having 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 misunderstanding.

Examples: I_{B2} = continuous (d.c.) current flowing into the second base terminal

V_{B2-E} = continuous (d.c.) voltage between the terminals of second base and emitter

Subscripts for multiple devices

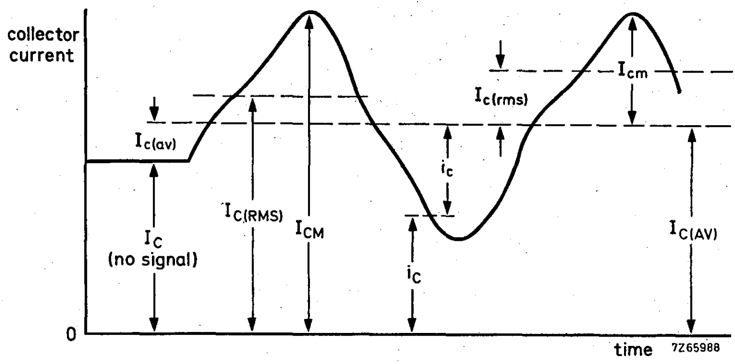
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I_{2C} = continuous (d.c.) current flowing into the collector terminal of the second unit

V_{1C-2C} = continuous (d.c.) voltage between the collector terminals of the first and the second unit.

Application of the rules

The figure below represents a transistor collector current as a function of time. It consists of a continuous (d.c.) current and a varying component.



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 is a list of 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 shall be used for the representation of:

a) electrical parameters of external circuits and of circuits in which the device forms only a part;

b) all inductances and capacitances.

Lower-case letters shall be used for the representation of electrical parameters inherent in the device (with the exception of inductances and capacitances).

Subscripts

General subscripts

The following is a list of 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 shall be used for the designation of static (d.c.) values.

Examples : h_{FE} = static value of forward current transfer ratio in common-emitter configuration (d.c. current gain)

R_E = d.c. value of the external emitter resistance.

Note: 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 shall be 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

Note: If more than one subscript is used, subscripts for which both styles exist shall either be all upper-case or all lower-case

Examples: 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.

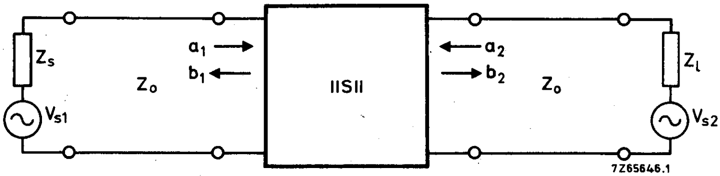
Examples: $Z_i = R_i + jX_i$
$y_{fe} = g_{fe} + jb_{fe}$

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

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

SCATTERING PARAMETERS

In distinction to the conventional h, y and z-parameters, s-parameters relate to travelling wave conditions. The figure below shows a two-port network with the incident and reflected waves a_1, b_1, a_2 and b_2.



$$a_1 = \frac{V_{i1}}{\sqrt{Z_o}} \qquad a_2 = \frac{V_{i2}}{\sqrt{Z_o}} \qquad ^{1)}$$

$$b_1 = \frac{V_{r1}}{\sqrt{Z_o}} \qquad b_2 = \frac{V_{r2}}{\sqrt{Z_o}}$$

Z_o = characteristic impedance of the transmission line in which the two-port is connected.

V_i = incident voltage

V_r = reflected (generated) voltage

The four-pole equations for s-parameters are:

$$b_1 = s_{11}a_1 + s_{12}a_2$$

$$b_2 = s_{21}a_1 + s_{22}a_2$$

Using the subscripts i for 11, r for 12, f for 21 and o for 22, it follows that:

$$s_i = s_{11} = \left.\frac{b_1}{a_1}\right|_{a_2 = 0}$$

$$s_r = s_{12} = \left.\frac{b_1}{a_2}\right|_{a_1 = 0}$$

$$s_f = s_{21} = \left.\frac{b_2}{a_1}\right|_{a_2 = 0}$$

$$s_o = s_{22} = \left.\frac{b_2}{a_2}\right|_{a_1 = 0}$$

1) The squares of these quantities have the dimension of power.

The s-parameters can be named and expressed as follows:

$s_i = s_{11}$ = Input reflection coefficient.
The complex ratio of the reflected wave and the incident wave at the input, under the conditions $Z_l = Z_\sigma$ and $V_{s2} = 0$.

$s_r = s_{12}$ = Reverse transmission coefficient.
The complex ratio of the generated wave at the input and the incident wave at the output, under the conditions $Z_s = Z_o$ and $V_{s1} = 0$.

$s_f = s_{21}$ = Forward transmission coefficient.
The complex ratio of the generated wave at the output and the incident wave at the input, under the conditions $Z_l = Z_o$ and $V_{s2} = 0$

$s_o = s_{22}$ = Output reflection coefficient.
The complex ratio of the reflected wave and the incident wave at the output, under the conditions $Z_s = Z_o$ and $V_{s1} = 0$.

SOLDERING RECOMMENDATIONS

SOLDERING RECOMMENDATIONS SOT-23 AND SOT-89

REFLOW SOLDERING

The preferred technique for mounting microminiature components on hybrid thick and thin-film is the method of reflow soldering.

The tags of both SOT-23 and SOT-89 envelopes are pre-tinned and the best results are obtained if a similar solder is applied to the corresponding soldering areas on the substrate. This can be done by either dipping the substrate in a solder bath or by screen printing a solder paste.

For reliable connections it should be kept in mind that:
The maximum temperature of the leads or tab during the soldering cycle does not exceed 275 °C.
The flux must affect neither components nor connectors.
The residue of the flux must be easy to remove.

Good flux or solder paste with these properties are available on the market.

The most economic method of soldering is a process in which all different components are soldered simultaneously for example SOT-23 or SOT-89 devices, capacitors and resistors.

Having first been fluxed, all components are positioned on the substrate. The slight adhesive force of the flux is sufficient to keep the components in place. Solder paste contains a flux and has therefore good inherent adhesive properties which eases positioning of the components.

With the components in position the substrate is heated to a point where the solder begins to flow. This can be done on a heating plate or on a conveyor belt running through an infrared tunnel. The maximum allowed temperature of the plastic body of a device must be kept below 250 °C during the soldering cycle. For further temperature behaviour during the soldering process see Figs 1 and 2.

The surface tension of the liquid solder tends to draw the tags of the device towards the centre of the soldering area and has thus a correcting effect on slight mispositionings. However, if the layout leaves something to be desired the same effect can result in undesirable shifts; particularly if the soldering areas on the substrate and the components are not concentrally arranged. This problem can be solved using a standard contact pattern, which leaves sufficient scope for the self-positioning effect.

After the solder has set and cooled the connections are visually inspected and, where necessary, put right with a soldering iron. Finally the remnants of the flux must be removed carefully.

IMMERSION SOLDERING

Maximum allowed temperature of the soldering bath is 235 °C. Maximum duration of soldering cycle is 5 seconds and forced cooling must be applied.

HAND SOLDERING

It is possible to solder SOT-23 and SOT-89 devices with a miniature hand-held soldering iron, but this method has particular drawbacks and should therefore be restricted to laboratory use and/or incidental repairs on production circuits.

1. It is time-consuming and expensive.
2. The device cannot be positioned accurately and therefore the connecting tags may come into contact with the substrate and damage it.
3. There is a great risk of breaking either substrate or internal connections inside the encapsulation.
4. The envelope may be damaged by the iron.

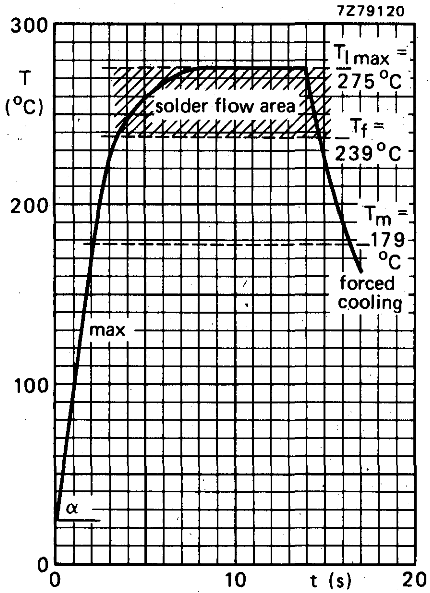


Fig. 1 Reflow soldering without pre-heating.

$T_{l\,max}$ = Maximum lead or tab temperature is 275 °C.

T_f = Flow temperature of the solder is 239 °C.

T_m = Melting point of the solder is 179 °C.

α = Maximum permissible rate of temperature change is 75 °C/s.

T_{amb} = 25 °C.

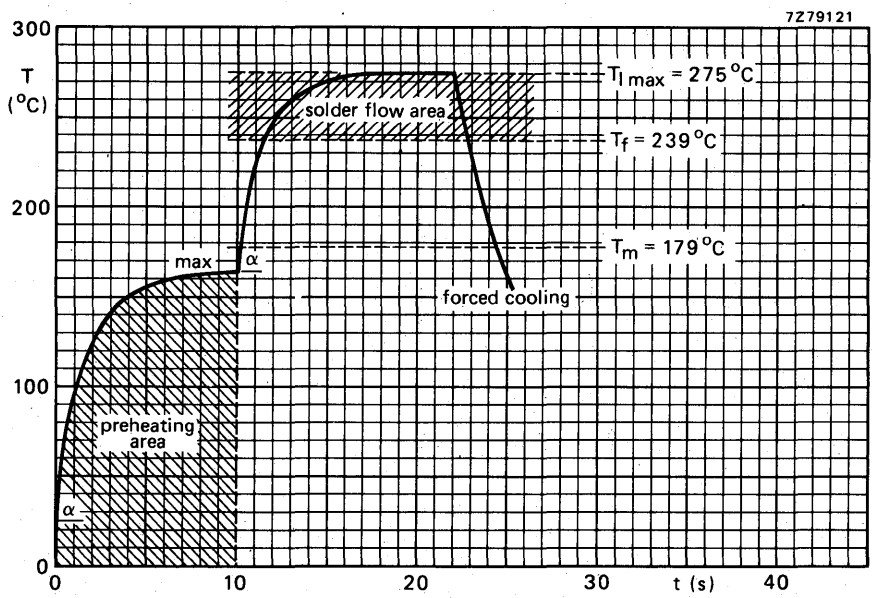


Fig. 2 Reflow soldering with pre-heating.

Minimum required dimensions of metal connection pads on hybrid thick and thin-film substrates.

Dimensions in mm

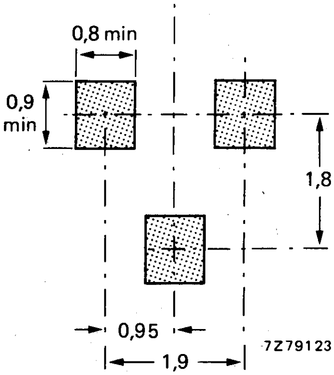


Fig. 3 SOT-23 pattern.

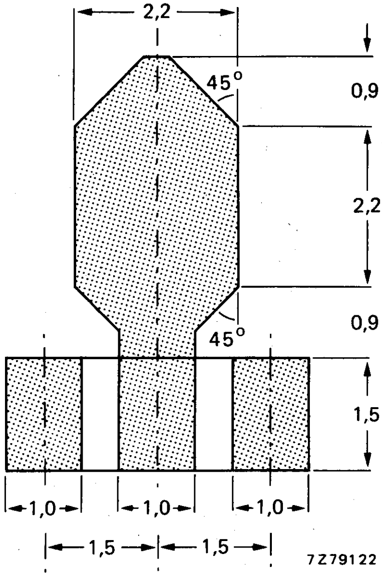


Fig. 4 SOT-89 pattern.

GENERAL NOTES

Recommended metal-alloy

a. 62 Sn/36 Pb/2 Ag (85% metal weight, when solder paste is used).

b. 60 Sn/40 Pb.

Pre-heating

Pre-heating is recommended for good soldering and avoiding damage to the SOT-23 or SOT-89 devices, other components and the substrate. Maximum pre-heating temperature is 165 °C while the maximum pre-heating duration may be 10 seconds.

Duration of soldering cycle

The maximum duration of soldering cycle without pre-heating is 14 seconds; with pre-heating 22 seconds (see Figs 1 and 2). Pre-heating duration may be 10 seconds.

TYPE NUMBER SURVEY

NUMERICAL INDEX
REVERSE TYPES
Mark and Marking code
Nearest conventional types

NUMERICAL TYPE LIST

The full type number is marked on the encapsulation of semiconductors mounted in SOT-89. Types in SOT-23 are marked with a code.

type number	marking	reverse type	marking	outline	device type	complement	nearest conventional type
BAS16	A6			SOT-23	D		BAW62/1N4148
BAT17	A3			SOT-23	D		BA280
BAT18	A2			SOT-23	D		BA182/BA243
BAV70	A4			SOT-23	D		BAW62/1N4148
BAV99	A7			SOT-23	D		BAW62/1N4148
BAW56	A1			SOT-23	D		BAW62/1N4148
BBY31	S1			SOT-23	D		BB105G
BCW29	C1	BCW29R	C4	SOT-23	PNP	BCW31; R	BC178A/BC558A
BCW30	C2	BCW30R	C5	SOT-23	PNP	BCW32; R	BC178B/BC558B
BCW31	D1	BCW31R	D4	SOT-23	NPN	BCW29; R	BC108A/BC548A
BCW32	D2	BCW32R	D5	SOT-23	NPN	BCW30; R	BC108B/BC548B
BCW33	D3	BCW33R	D6	SOT-23	NPN	—	BC108C/BC548C
BCW69	H1	BCW69R	H4	SOT-23	PNP	BCW71; R	BC177A/BC557A
BCW70	H2	BCW70R	H5	SOT-23	PNP	BCW72; R	BC177B/BC557B
BCW71	K1	BCW71R	K4	SOT-23	NPN	BCW69; R	BC107A/BC547A
BCW72	K2	BCW72R	K5	SOT-23	NPN	BCW70; R	BC107B/BC547B
BCX17	T1	BCW17R	T4	SOT-23	PNP	BCX19; R	BC327
BCX18	T2	BCW18R	T5	SOT-23	PNP	BCX20; R	BC328
BCX19	U1	BCW19R	U4	SOT-23	NPN	BCX17; R	BC337
BCX20	U2	BCX20R	U5	SOT-23	NPN	BCX18; R	BC338
BCX51				SOT-89	PNP	BCX54	BC636
BCX52				SOT-89	PNP	BCX55	BC638
BCX53				SOT-89	PNP	BCX56	BC640
BCX54				SOT-89	NPN	BCX51	BC635
BCX55				SOT-89	NPN	BCX52	BC637
BCX56				SOT-89	NPN	BCX53	BC639
BF550	G2	BF550R	G5	SOT-23	PNP		BF450
BF622				SOT-89	NPN	BF623	BF422
BF623				SOT-89	PNP	BF622	BF423
BFQ17				SOT-89	NPN		BFW16A
BFQ18A				SOT-89	NPN		BFQ34
BFQ19				SOT-89	NPN		BFR96
BFR30	M1			SOT-23	FET		BFW11
BFR31	M2			SOT-23	FET		BFW12
BFR53	N1	BFR53R	N4	SOT-23	NPN		BFW30/BFW93

type number	marking	reverse type	marking	outline	device type	complement	nearest conventional type
BFR92	P1	BFR92R	P4	SOT-23	NPN	BFT92; R	BFR90
BFR93	R1	BFR93R	R4	SOT-23	NPN	BFT93; R	BFR91
BFS17	E1	BFS17R	E4	SOT-23	NPN		BFY90/BFW92
BFS18	F1	BFS18R	F4	SOT-23	NPN		BF185/BF495
BFS19	F2	BFS19R	F5	SOT-23	NPN		BF184/BF494
BFS20	G1	BFS20R	G4	SOT-23	NPN		BF199
BFT25	V1	BFT25R	V4	SOT-23	NPN		BFT24
BFT46	M3			SOT-23	FET		BFW13
BFT92	W1	BFT92R	W4	SOT-23	PNP	BFR92; R	—
BFT93	X1	BFT93R	X4	SOT-23	PNP	BFR93; R	BFQ23/24
BRY61	A5			SOT-23	PNPN		BRY56/BRY39 PUT
BSR12	B5	BSR12R	B8	SOT-23	PNP	BSV52	2N2894A
BSR30				SOT-89	PNP	BSR40	BSV16/17 2N4030–4033
BSR31				SOT-89	PNP	BSR41	
BSR32				SOT-89	PNP	BSR42	
BSR33				SOT-89	PNP	BSR43	
BSR40				SOT-89	NPN	BSR30	BSX46/47 2N3019/3020
BSR41				SOT-89	NPN	BSR31	
BSR42				SOT-89	NPN	BSR32	
BSR43				SOT-89	NPN	BSR33	
BSR56	M4			SOT-23	FET		2N4856
BSR57	M5			SOT-23	FET		2N4857
BSR58	M6			SOT-23	FET		2N4858
BSS63	T3	BSS63R	T6	SOT-23	PNP	BSS64; R	BSS68
BSS64	U3	BSS64R	U6	SOT-23	NPN	BSS63; R	BSS38
BSV52	B2	BSV52R	B4	SOT-23	NPN	BSR12	BSX20/2N2369
BZX84-							
-C4V7	Z1			SOT-23	D		BZX79 SERIES
-C5V1	Z2						
-C5V6	Z3						
-C6V2	Z4						
-C6V8	Z5						
-C7V5	Z6						
-C8V2	Z7						
-C9V1	Z8						
-C10	Z9						
-C11	Y1						
-C12	Y2						
-C13	Y3						
-C15	Y4						
-C16	Y5						
-C18	Y6						
-C20	Y7						
-C22	Y8						
-C24	Y9						
-C27	Y10						
-C30	Y11						

type number	marking	reverse type	marking	outline	device type	complement	nearest conventional type
BZX84-							
-C33	Y12			SOT-23	D		BZX79 SERIES
-C36	Y13			SOT-23	D		BZX79 SERIES
-C39	Y14			SOT-23	D		BZX79 SERIES
-C43	Y15			SOT-23	D		BZX79 SERIES
-C47	Y16			SOT-23	D		BZX79 SERIES
-C51	Y17			SOT-23	D		BZX79 SERIES
-C56	Y18			SOT-23	D		BZX79 SERIES
-C62	Y19			SOT-23	D		BZX79 SERIES
-C68	Y20			SOT-23	D		BZX79 SERIES
-C75	Y21			SOT-23	D		BZX79 SERIES

CONVERSION LIST

MARKING SOT-89

The full type number is marked on the encapsulation of semiconductors mounted in SOT-89.

MARKING CODE SOT-23

Types in a SOT-23 envelope are marked by the following code.

MARKING CODE

	A	B	C	D
1	BAW56		BCW29	BCW31
2	BAT18	BSV52	BCW30	BCW32
3	BAT17			BCW33
4	BAV70	BSV52R	BCW29R	BCW31R
5	BRY61	BSR12	BCW30R	BCW32R
6	BAS16			BCW33R
7	BAV99			
8		BSR12R		
9				

	E	F	G	H
1	BFS17	BFS18	BFS20	BCW69
2		BFS19	BF550	BCW70
3				
4	BFS17R	BFS18R	BFS20R	BCW69R
5		BFS19R	BF550R	BCW70R
6				
7				
8				
9				

	K	M	N	P
1	BCW71	BFR30	BFR53	BFR92
2	BCW72	BFR31		
3		BFT46		
4	BCW71R	BSR56	BFR53R	BFR92R
5	BCW72R	BSR57		
6		BSR58		
7				
8				
9				

	R	S	T	U
1	BFR93	BBY31	BCX17	BCX19
2			BCX18	BCX20
3			BSS63	BSS64
4	BFR93R		BCX17R	BCX19R
5			BCX18R	BCX20R
6			BSS63R	BSS64R
7				
8				
9				

	V	W	X	
1	BFT25	BFT92	BFT93	
2				
3				
4	BFT25R	BFT92R	BFT93R	
5				
6				
7				
8				
9				

	Y		Y		Y		Z
1	BZX84-C11	10	BZX84-C27	19	BZX84-C62	1	BZX84-C4V7
2	-C12	11	-C30	20	-C68	2	5V1
3	-C13	12	-C33	21	-C75	3	5V6
4	-C15	13	-C36			4	6V2
5	-C16	14	-C39			5	6V8
6	-C18	15	-C43			6	7V5
7	-C20	16	-C47			7	8V2
8	-C22	17	-C51			8	9V1
9	-C24	18	-C56			9	10V

SELECTION GUIDE

GENERAL PURPOSE TRANSISTORS

type	RATINGS V_{CBO} V	V_{CEO} V	I_c mA	P_{tot} mW	h_{FE} min/max	at I_c/V_{CE} mA/V	V_{CEsat} max V	at I_c/I_B mA	f_T typ. MHz
P-N-P									
BCW29;R	30	20	100	200	120/260	2/5	0,30	10/0,5	150
BCW30;R	30	20	100	200	215/500	2/5	0,30	10/0,5	150
BCW69;R	50	45	100	200	120/260	2/5	0,30	10/0,5	150
BCW70;R	50	45	100	200	215/500	2/5	0,30	10/0,5	150
BCX17;R	50	45	500	310	100/600	100/1	0,62	500/50	100
BCX18;R	30	25	500	310	100/600	100/1	0,62	500/50	100
BCX51	45	45	1000	1000	40/250	150/2	0,50	500/50	50
BCX52	60	60	1000	1000	40/160	150/2	0,50	500/50	50
BCX53	100	80	1000	1000	40/160	150/2	0,50	500/50	50
N-P-N									
BCW31;R	30	20	100	200	110/220	2/5	0,25	10/0,5	300
BCW32;R	30	20	100	200	200/450	2/5	0,25	10/0,5	300
BCW33;R	30	20	100	200	420/800	2/5	0,25	10/0,5	300
BCW71;R	50	45	100	200	110/200	2/5	0,25	10/0,5	300
BCW72;R	50	45	100	200	220/450	2/5	0,25	10/0,5	300
BCX19;R	50	45	500	310	100/600	100/1	0,62	500/50	200
BCX20;R	30	25	500	310	100/600	100/1	0,62	500/50	200
BCX54	45	45	1000	1000	40/250	150/2	0,50	500/50	130
BCX55	60	60	1000	1000	40/160	150/2	0,50	500/50	130
BCX56	100	80	1000	1000	40/160	150/2	0,50	500/50	130

VIDEO B/W AND COLOUR TELEVISION

type	RATINGS V_{CBO} V	V_{CEO} V	I_c mA	P_{tot} mW	h_{FE} min/max	at I_c/V_{CE} mA/V	V_{CEsat} max V	at I_c/I_B mA	f_T typ. MHz
P-N-P									
BF623	250	250	20	1000	50/–	25/20	–	–	60
N-P-N									
BF622	250	250	20	1000	50/–	25/20	–	–	60

HIGH-FREQUENCY TRANSISTORS

type	RATINGS V_{CBO} V	V_{CEO} V	I_c mA	P_{tot} mW	h_{FE} min/max	at I_c/V_{CE} mA/V	F typ. dB	at f MHz	f_T typ. MHz	C_{re} typ. pF
P-N-P										
BF550;R	40	40	25	180	50/–	1/10	2	0,1	325	0,5
N-P-N										
BFS18;R	30	20	30	200	35/125	1/10	4	100	200	0,85
BFS19;R	30	20	30	200	65/225	1/10	4	100	260	0,85
BFS20;R	30	20	25	200	40/85	7/10	–	–	450	0,35

SWITCHING TRANSISTORS

type	RATINGS V_{CBO} V	V_{CEO} V	I_c mA	P_{tot} mW	h_{FE} min/max	at I_c/V_{CE} mA/V	V_{CEsat} max V	at I_c/I_B	t max on/off ns	at I_c/I_B mA
P-N-P										
BSR12;R	15	15	100	200	30/120	50/1	0,45	100/10	20/30	30/3
BSR30	70	60	1000	1000	40/120	100/5	1,2	500/50	500/650	100/5
BSR31	70	60	1000	1000	100/300	100/5	1,2	500/50	500/650	100/5
BSR32	90	80	1000	1000	40/120	100/5	1,2	500/50	500/650	100/5
BSR33	90	80	1000	1000	100/300	100/5	1,2	500/50	500/650	100/5
BSS63;R	110	100	100	200	30/–	25/1	2,5	25/2,5	–	–
N-P-N										
BSR40	70	60	1000	1000	40/120	100/5	1,2	500/50	250/1000	100/5
BSR41	70	60	1000	1000	100/300	100/5	1,2	500/50	250/1000	100/5
BSR42	90	80	1000	1000	40/120	100/5	1,2	500/50	250/1000	100/5
BSR43	90	80	1000	1000	100/300	100/5	1,2	500/50	250/1000	100/5
BSS64;R	120	80	100	200	20/80	10/1	0,2	50/15	/1000	15/1
BSV52;R	20	12	100	200	40/120	10/1	0,4	50/5	12/18	10/3
P-N-P-N										
BRY61	V_{CA} max. 70 V; I_A max. 175 mA; I_P = 5/1 μA; I_V = 30/50 μA									

WIDEBAND TRANSISTORS

type	RATINGS V_{CBO} V	V_{CEO} V	I_c mA	P_{tot} mW	h_{FE} min/max	at I_c/V_{CE} mA/V	d_{im} typ. dB	at f MHz	f_T typ GHz	G_{um} at f = MHz 200/500/800
P-N-P										
BFT92;R	20	15	25	180	20/–	14/10	60	493,25	5	– 18 –
BFT93;R	15	12	35	180	20/–	30/5	60	493,25	5	– 16,5 –
N-P-N										
BFQ17	40	25	150	1000	25/–	150/5		–	1,2	16 – 6,5
BFQ18A	25	15	150	1000	25/–	100/10	60	793,25	3,6	–
BFQ19	20	15	75	500	25/–	75/10		–	5,0	18,5 – 7,5
BFR53;R	18	10	50	180	25/–	50/5	60	217,0	2,0	22 – 10,5
BFR92;R	20	15	25	180	25/–	14/10	60	493,25	5,0	– 18 –
BFR93;R	15	12	35	180	25/–	30/5	60	493,25	5,0	– 16,5 –
BFS17;R	25	15	25	200	20/150	2/1	45	217	1,3	–
BFT25;R	8	5	2,5	30	20/–	1/1		–	2,3	25 – 12

FIELD-EFFECT TRANSISTORS

type	RATINGS V_{DS} V	$-V_{GSO}$ V	I_D mA	P_{tot} mW	$-I_{GSS}$ max. nA	I_{DSS} min/max. mA	$-V_{PGS}$ max. V	y_{fs} min. mA/V	C_{rs} max. pF	V_n max. μV
BFR30	25	25	10	200	0,2	4/10	5	1	1,5	0,5
BFR31	25	25	10	200	0,2	1/5	2,5	1,5	1,5	0,5
BFT46	25	25	10	200	0,2	0,2/1,5	1,0	1,0	1,5	0,5
BSR56	40	40	–	200	1	50/–	10		5	–
BSR57	40	40	–	200	1	20/100	6		5	–
BSR58	40	40	–	200	1	8/80	4		5	–

SWITCHING DIODES

type	description	RATINGS V_R V	I_F mA	t_{rr} max. ns	V_F max. V at I_F = mA 10/100	C_d max. pF
BAS16	high-speed switch	75	100	6	855/1300	2
BAT17	Schottky barrier	4	30	—	600/—	1
BAT18	band switch	35	100	—	—/1200	1
BAV70	common cathode double diode	70	100	6	855/1300	1,5
BAV99	two diodes in series	70	100	6	855/1300	1,5
BAW56	common anode double diode	70	100	6	855/1300	2

VARIABLE CAPACITANCE DIODE

type	RATINGS		CHARACTERISTICS					
	V_R V	I_F mA	I_R at nA	V_R V	C_d pF	at V_R V	capacitance ratio typ.	r_D Ω
BBY31	28	20	< 50	28	typ. 17,5/1 typ. 11,5/3 1,8 –2,8/25		5	< 1,2

VOLTAGE REGULATOR DIODES BZX84-series

type suffix	V_{Znom} V	r_{diff} Ω	S_Z mV/°C	type suffix	V_{Znom} V	r_{diff} Ω	S_Z mV/°C
–C4V7	4,7	80	0,2	–C20	20	55	18,0
–C5V1	5,1	60	1,2	–C22	22	55	20,0
–C5V6	5,6	40	2,5	–C24	24	70	22,0
–C6V2	6,2	10	3,7	–C27	27	80	25,3
–C6V8	6,8	15	4,5	–C30	30	80	29,4
–C7V5	7,5	15	5,3	–C33	33	80	33,4
–C8V2	8,2	15	6,2	–C36	36	90	37,4
–C9V1	9,1	15	7,0	–C39	39	130	41,2
–C10	10	20	8,0	–C43	43	150	46,6
–C11	11	20	9,0	–C47	47	170	51,8
–C12	12	25	10,0	–C51	51	180	57,2
–C13	13	30	11,0	–C56	56	200	63,8
–C15	15	30	13,0	–C62	62	215	71,6
–C16	16	40	14,0	–C68	68	240	79,8
–C18	18	45	16,0	–C75	75	255	88,6

–C4V7 to –C24 at I_Z = 5 mA; –C27 to –C75 at I_Z = 2 mA.
BZX84 series; $I_{FRM} = I_{ZRM}$ = 200 mA; P_{tot} = 200 mW.

DEVICE DATA

SILICON PLANAR EPITAXIAL HIGH-SPEED DIODE

Silicon epitaxial high-speed diode in a microminiature plastic envelope. It is intended for high-speed switching in hybrid thick and thin-film circuits.

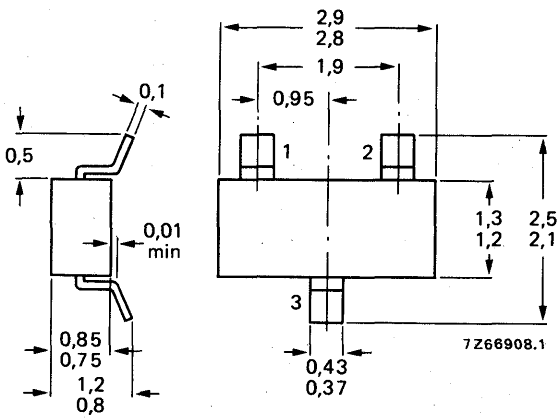
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	85	V
Repetitive peak forward current	I_{FRM}	max.	200	mA
Junction temperature	T_j	max.	150	°C
Forward voltage at I_F = 50 mA	V_F	<	1,1	V
Reverse recovery time when switched from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA	t_{rr}	<	6	ns
Recovery charge when switched from I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	45	pC

MECHANICAL DATA

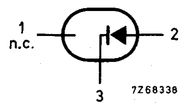
Dimensions in mm

Fig. 1 SOT-23.



Marking code

BAS16 = A6



See also *Soldering recommendations.*

RATINGS

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

Continuous reverse voltage	V_R	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	85	V
Average rectified forward current * (averaged over any 20 ms period)	$I_{F(AV)}$	max.	100	mA
Forward current (d.c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	200	mA
Storage temperature	T_{stg}	–65 to +150		^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,62	$^oC/mW$

CHARACTERISTICS

$T_j = 25\ ^oC$ unless otherwise specified.

Forward voltage				
$I_F = 1$ mA	V_F	<	715	mV
$I_F = 10$ mA	V_F	<	855	mV
$I_F = 50$ mA	V_F	<	1100	mV
$I_F = 100$ mA	V_F	<	1300	mV
Reverse current				
$V_R = 25$ V; $T_j = 150\ ^oC$	I_R	<	30	μA
$V_R = 75$ V	I_R	<	1	μA
$V_R = 75$ V; $T_j = 150\ ^oC$	I_R	<	50	μA
Diode capacitance $V_R = 0$; f = 1 MHz	C_d	<	2	pF
Forward recovery voltage (see also Fig. 2) when switched to $I_F = 10$ mA; $t_p = 20$ ns	V_{fr}	<	1,75	V
Reverse recovery time (see also Fig. 3) when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100\ \Omega$; measured at $I_R = 1$ mA	t_{rr}	<	6	ns
Recovery charge (see also Fig. 4) when switched from $I_F = 10$ mA to $V_R = 5$ V; $R_L = 500\ \Omega$	Q_s	<	45	pC

* Measured under pulse conditions. Pulse time = $t_p \leqslant 0,5$ ms.
For sinusoidal operation $I_{F(AV)} = 65$ mA averaging time $t_{(av)} \leqslant 1$ ms.

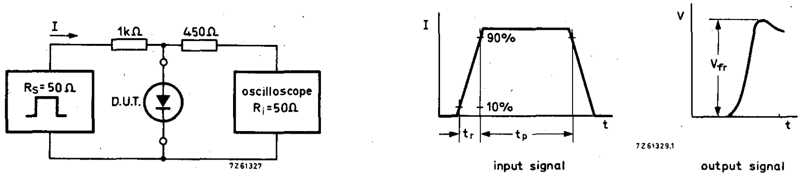


Fig. 2 Forward recovery voltage test circuit and waveforms.

Input signal: forward pulse rise time = t_r = 20 ns; forward current pulse duration t_p = 120 ns; duty factor = δ = 0,01.
Oscilloscope: rise time = t_r = 0,35 ns.
Circuit capacitance C ⩽ 1 pF (C = oscilloscope input capacitance + parasitic capacitance).

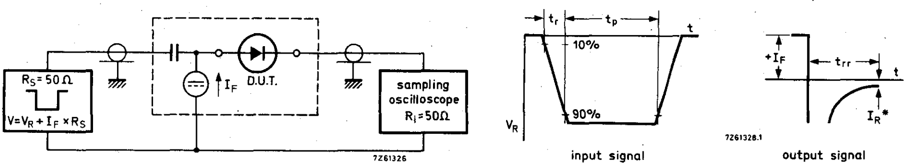


Fig. 3 Reverse recovery time test circuit and waveforms.

Input signal: reverse pulse rise time = t_r = 0,6 ns; reverse pulse duration = t_p = 100 ns; duty factor = δ = 0,05. * t_{rr} up to I_R = 1 mA.
Oscilloscope: rise time = t_r = 0,35 ns.
Circuit capacitance C ⩽ 1 pF (C = oscilloscope input capacitance + parasitic capacitance).

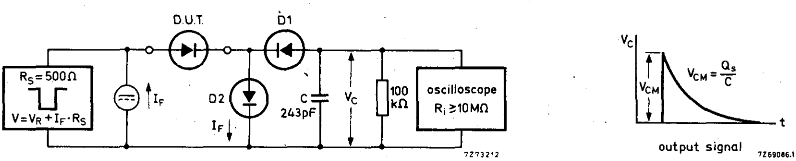


Fig. 4 Recovery charge test circuit and waveform.

D1 = BAW62; D2 = diode with minority carrier life time at 10 mA: < 200 ps
Input signal

Rise time of the reverse pulse	t_r	=	2 ns
Reverse pulse duration	t_p	=	400 ns
Duty factor	δ	=	0,02

Circuit capacitance C ⩽ 7 pF (C = oscilloscope input capacitance + parasitic capacitance).

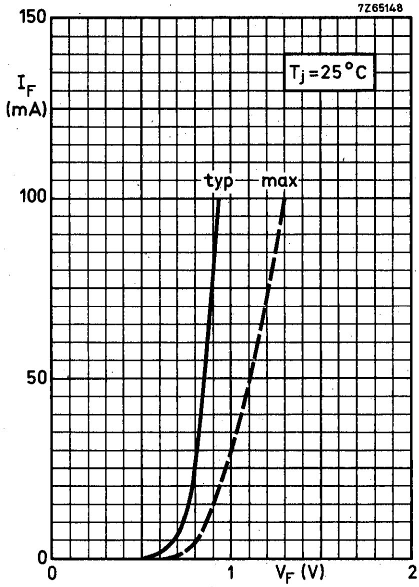


Fig. 5.

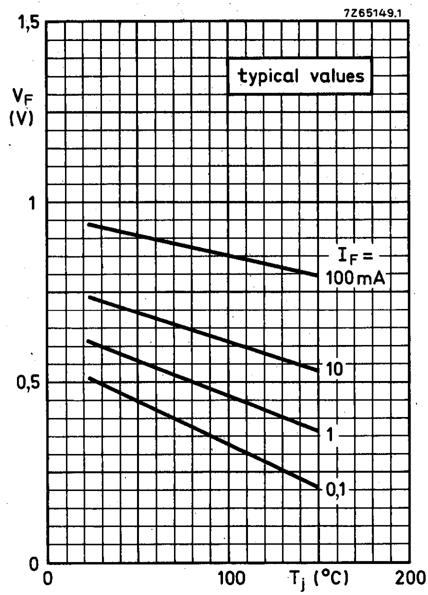


Fig. 6.

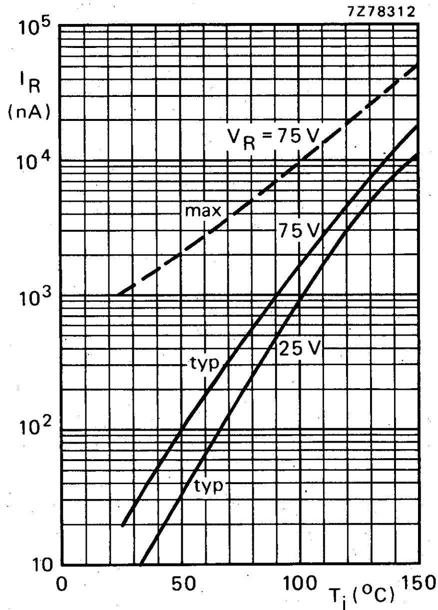


Fig. 7.

SCHOTTKY BARRIER DIODE

Silicon epitaxial diode in a microminiature plastic envelope. Intended for u.h.f. mixer and fast switching applications in thick and thin-film circuits.

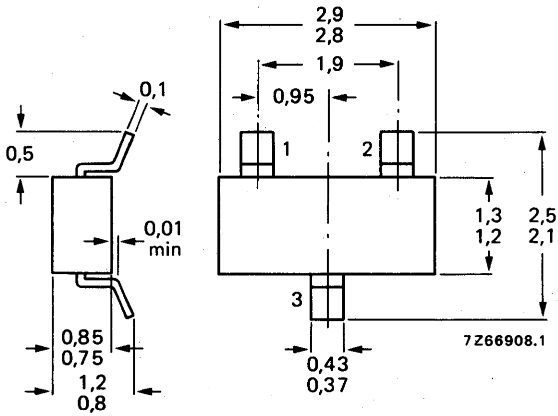
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	4	V
Forward current (d.c.)	I_F	max.	30	mA
Junction temperature	T_j	max.	100	^oC
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0,62	$^oC/mW$
Forward voltage at I_F = 10 mA	V_F	<	600	mV
Diode capacitance at V_R = 0; f = 1 MHz	C_d	<	1,0	pF
Noise figure at f = 900 MHz	F	<	8,0	dB

MECHANICAL DATA

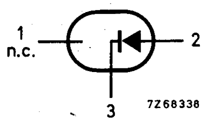
Dimensions in mm

Fig.1 SOT-23.



Marking code

BAT17 = A3



See also *Soldering recommendations.*

RATINGS

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

Continuous reverse voltage	V_R	max.	4	V
Forward current (d.c.)	I_F	max.	30	mA
Storage temperature	T_{stg}	–65 to +100		^oC
Junction temperature	T_j	max.	100	^oC

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j-a}$	=	0,62	$^oC/mW$

CHARACTERISTICS

T_{amb} = 25 ^oC unless otherwise specified

Reverse current				
V_R = 3 V	I_R	<	0,25	μA
V_R = 3 V; T_{amb} = 60 ^oC	I_R	<	1,25	μA
Reverse breakdown voltage				
I_R = 10 μA	$V_{(BR)R}$	>	4	V
Forward voltage				
I_F = 10 mA	V_F	<	600	mV
Diode capacitance				
V_R = 0; f = 1 MHz	C_d	<	1,0	pF
Noise figure at f = 900 MHz *	F	<	8,0	dB
Series resistance at f = 1 kHz				
I_F = 5 mA	r_D	<	15	Ω

* The local oscillator is adjusted for a diode current of 2 mA. I.F. amplifier noise F_{if} = 1,5 dB; f = 35 MHz.

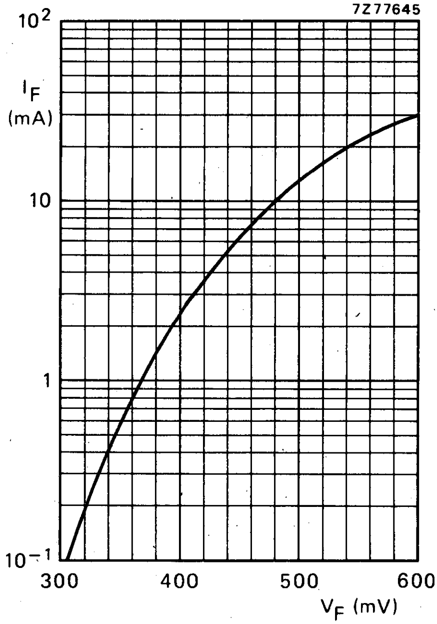


Fig. 2.

SILICON PLANAR DIODE

Switching diode in a microminiature plastic envelope. Intended for thick and thin-film circuits.

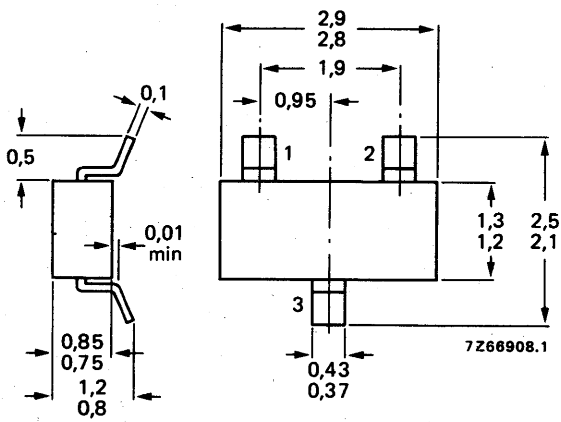
QUICK REFERENCE DATA

Continuous reverse voltage	V_R	max.	35	V
Forward current (d.c.)	I_F	max.	100	mA
Junction temperature	T_j	max.	100	^oC
Diode capacitance at f = 1 MHz V_R = 20 V	C_d	typ. <	0,8 1,0	pF pF
Series resistance at f = 200 MHz I_F = 5 mA	r_D	typ. <	0,5 0,7	Ω Ω

MECHANICAL DATA

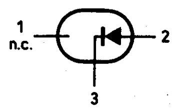
Dimensions in mm

Fig. 1 SOT-23.



Marking code

BAT18 = A2



See also *Soldering recommendations.*

RATINGS

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

Continuous reverse voltage	V_R	max.	35 V
Forward current (d.c.)	I_F	max.	100 mA
Storage temperature	T_{stg}	−55 to +100	°C
Junction temperature	T_j	max.	100 °C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,62 °C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Forward voltage at I_F = 100 mA	V_F	<	1,2 V
Reverse current			
V_R = 20 V	I_R	<	100 nA
V_R = 20 V; T_j = 60 °C	I_R	<	1 μA
Diode capacitance at f = 1 MHz V_R = 20 V	C_d	typ. <	0,8 pF 1,0 pF
Series resistance at f = 200 MHz I_F = 5 mA	r_D	typ. <	0,5 Ω 0,7 Ω

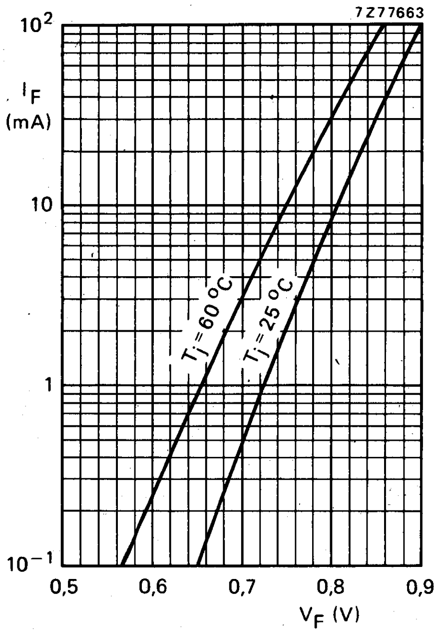


Fig. 2 Typical values.

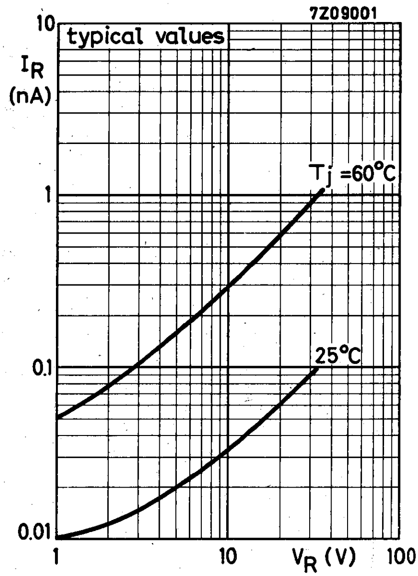


Fig. 3.

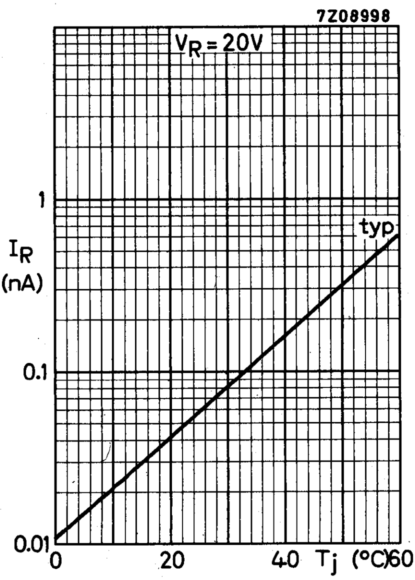


Fig. 4.

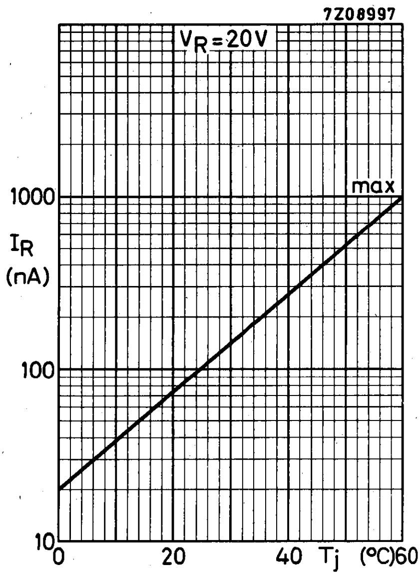


Fig. 5.

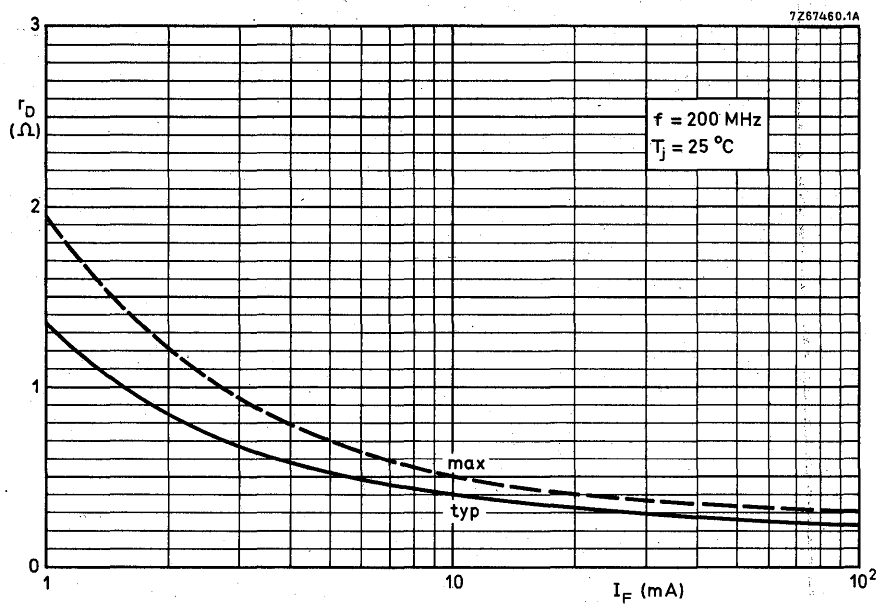


Fig. 6.

SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAV70 consists of two diodes in a microminiature plastic envelope. The cathodes are commoned and the unit is intended for high-speed switching in thick and thin-film circuits.

QUICK REFERENCE DATA (per diode)

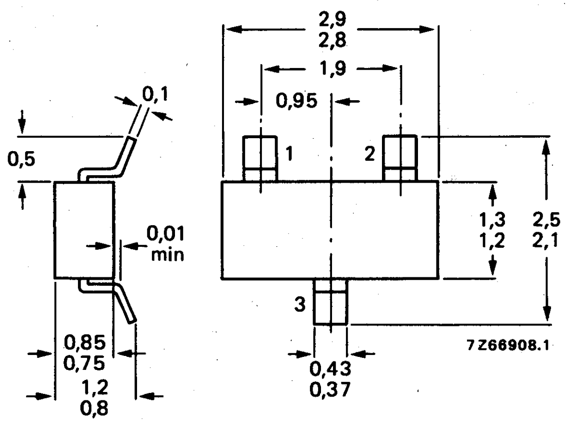
Continuous reverse voltage	V_R	max.	70	V
Repetitive peak reverse voltage	V_{RRM}	max.	70	V
Repetitive peak forward current	I_{FRM}	max.	200	mA
Junction temperature	T_j	max.	150	^oC
Forward voltage at I_F = 50 mA	V_F	<	1,1	V
Reverse recovery time when switched from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA	t_{rr}	<	6	ns
Recovery charge when switched from I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	45	pC

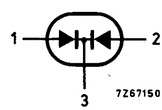
MECHANICAL DATA Dimensions in mm

Fig. 1 SOT-23.

Marking code

BAV70 = A4





See also *Soldering recommendations.*

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

Voltages				
Continuous reverse voltage	V_R	max.	70	V
Repetitive peak reverse voltage	V_{RRM}	max.	70	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	100	mA [1]
Forward current (d.c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	200	mA
Temperatures				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE (per diode)

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm

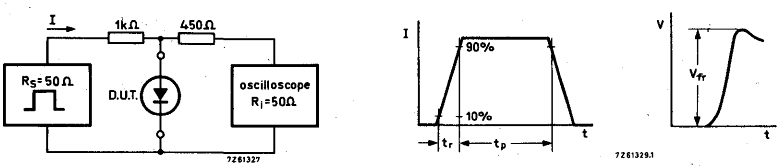
both diodes loaded simultaneously	$R_{th\ j\text{-}a}$	=	1,10	°C/mW
one diode loaded	$R_{th\ j\text{-}a}$	=	0,67	°C/mW

[1]) Measured under pulse conditions: pulse time $t_p \leq 0,5$ ms.
For sinusoidal operation $I_{F(AV)} = 65$ mA; averaging time $t_{(av)} \leq 1$ ms).

CHARACTERISTICS (per diode) $T_j = 25\ ^oC$ unless otherwise specified

Forward voltage				
$I_F = 1$ mA	V_F	<	715	mV
$I_F = 10$ mA	V_F	<	855	mV
$I_F = 50$ mA	V_F	<	1100	mV
$I_F = 100$ mA	V_F	<	1300	mV
Reverse current				
$V_R = 25$ V; $T_j = 150\ ^oC$	I_R	<	60	µA
$V_R = 70$ V	I_R	<	5	µA
$V_R = 70$ V; $T_j = 150\ ^oC$	I_R	<	100	µA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	1,5	pF
Forward recovery voltage when switched to				
$I_F = 10$ mA; $t_r = 20$ ns	V_{fr}	<	1,75	V

Test circuit and waveforms :



Input signal : Rise time of the forward pulse $t_r = 20$ ns

Forward current pulse duration $t_p = 120$ ns

Duty factor $\delta = 0,01$

Oscilloscope: Rise time $t_r = 0,35$ ns

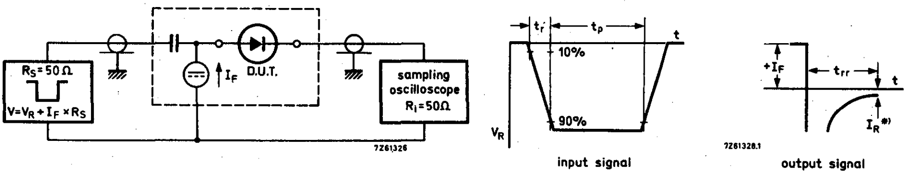
Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

CHARACTERISTICS (per diode) (continued) T_j = 25 °C

→ Reverse recovery time when switched from

I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA | t_{rr} < 6 ns

Test circuit and waveforms:



Input signal : Rise time of the reverse pulse t_r = 0,6 ns *) I_R = 1 mA

Reverse pulse duration t_p = 100 ns

Duty factor δ = 0,05

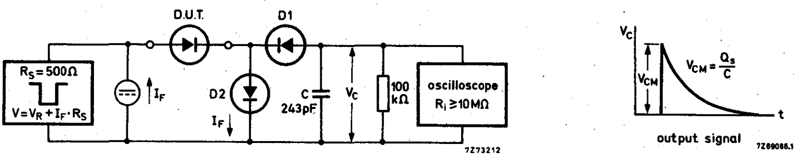
Oscilloscope: Rise time t_r = 0,35 ns

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Recovery charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω | Q_s < 45 pC

Test circuit and waveform:



D1 = BAW62

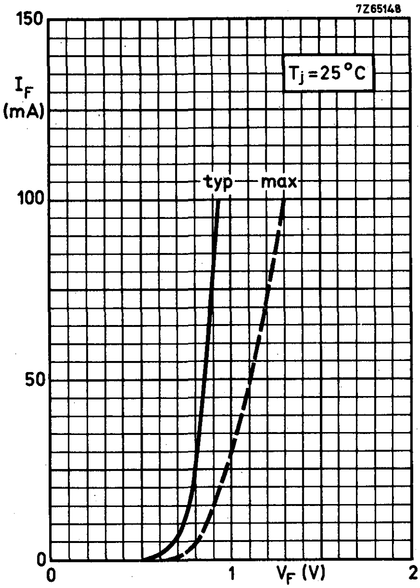
D2 = diode with minority carrier life time at 10 mA: < 200 ps

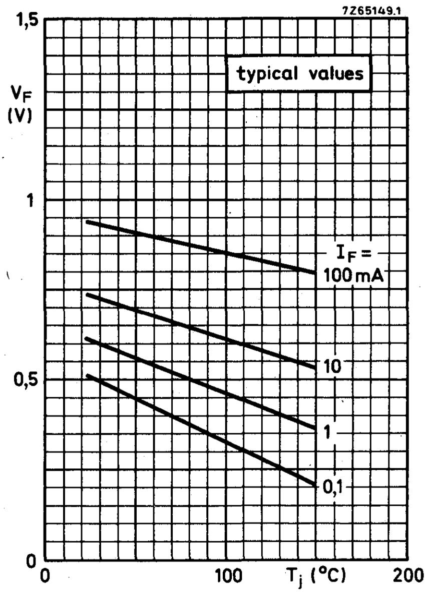
Input signal : Rise time of the reverse pulse t_r = 2 ns

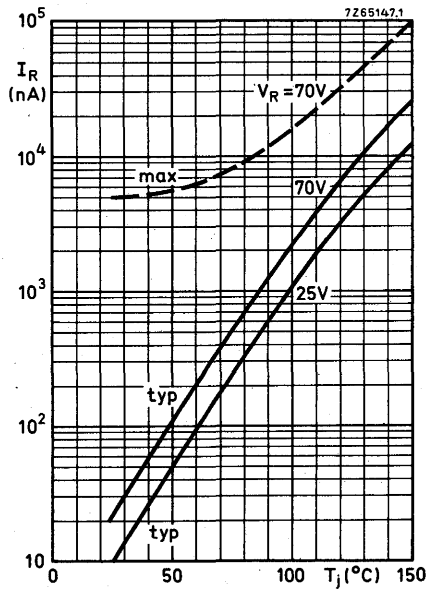
Reverse pulse duration t_p = 400 ns

Duty factor δ = 0,02

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance)


7Z65148
150
I_F
(mA)
$T_j = 25\,°C$
typ
max
100
50
0
0
1
V_F (V)
2


7Z65149.1
1,5
V_F
(V)
typical values
1
I_F =
100 mA
10
0,5
1
0,1
0
0
100
T_j (°C)
200


7Z65147.1
10^5
I_R
(nA)
V_R = 70V
10^4
max
70V
10^3
25V
typ
10^2
typ
10
0
50
100
T_j (°C)
150

SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAV99 consists of two diodes in a microminiature plastic envelope. The diodes are connected in series and the unit is intended for high-speed switching in thick and thin-film circuits.

QUICK REFERENCE DATA (per diode)

Continuous reverse voltage	V_R	max.	70	V
Repetitive peak reverse voltage	V_{RRM}	max.	70	V
Repetitive peak forward current	I_{FRM}	max.	200	mA
Junction temperature	T_j	max.	150	°C
Forward voltage at I_F = 50 mA	V_F	<	1,1	V
Reverse recovery time when switched from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA	t_{rr}	<	6	ns
Recovery charge when switched from I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	45	pC

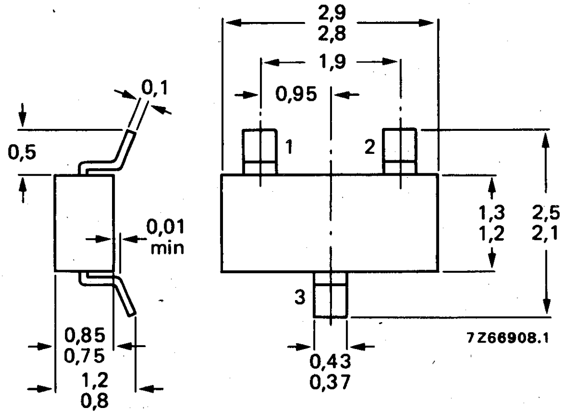
MECHANICAL DATA

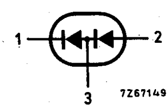
Fig. 1 SOT-23.

Dimensions in mm

Marking code

BAV99 = A7





See also *Soldering recommendations.*

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

Voltages

Continuous reverse voltage	V_R	max.	70	V	
Repetitive peak reverse voltage	V_{RRM}	max.	70	V	

Currents

Average rectified forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	100	mA	1)
Forward current (d.c.)	I_F	max.	100	mA	
Repetitive peak forward current	I_{FRM}	max.	200	mA	

Temperatures

Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE (per diode)

From junction to ambient
mounted on a ceramic substrate of
7 mm x 5 mm x 0,5 mm

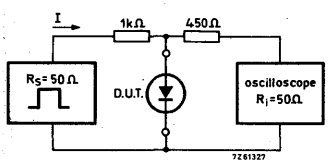
both diodes loaded simultaneously	$R_{th\ j\text{-}a}$	=	1,10	°C/mW
one diode loaded	$R_{th\ j\text{-}a}$	=	0,67	°C/mW

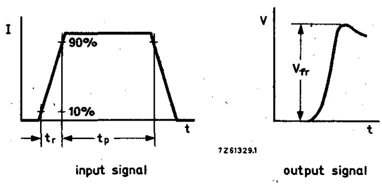
1) Measured under pulse conditions: pulse time $t_p \leq 0,5$ ms.
For sinusoidal operation $I_{F(AV)}$ = 65 mA; averaging time $t_{(av)} \leq 1$ ms.

CHARACTERISTICS (per diode) $T_j = 25\ ^oC$ unless otherwise specified

Forward voltage				
$I_F = 1$ mA	V_F	<	715	mV
$I_F = 10$ mA	V_F	<	855	mV
$I_F = 50$ mA	V_F	<	1100	mV
$I_F = 100$ mA	V_F	<	1300	mV
Reverse current				
$V_R = 25$ V; $T_j = 150\ ^oC$	I_R	<	30	µA
$V_R = 70$ V	I_R	<	2,5	µA
$V_R = 70$ V; $T_j = 150\ ^oC$	I_R	<	50	µA
Diode capacitance				
$V_R = 0$; f = 1 MHz	C_d	<	1,5	pF
Forward recovery voltage when switched to				
$I_F = 10$ mA; $t_r = 20$ ns	V_{fr}	<	1,75	V

Test circuit and waveforms:





Input signal : Rise time of the forward pulse $t_r = 20$ ns

Forward current pulse duration $t_p = 120$ ns

Duty factor $\delta = 0,01$

Oscilloscope: Rise time $t_r = 0,35$ ns

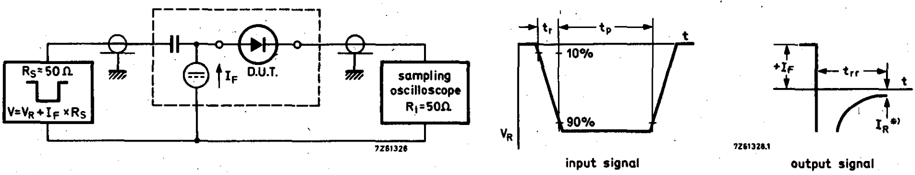
Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

CHARACTERISTICS (per diode) (continued) T_j = 25 °C

Reverse recovery time whe switched from

I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω;
measured at I_R = 1 mA | t_{rr} | < | 6 | ns

Test circuit and waveforms :



Input signal : Rise time of the reverse pulse t_r = 0,6 ns *) I_R = 1 mA

Reverse pulse duration t_p = 100 ns

Duty factor δ = 0,05

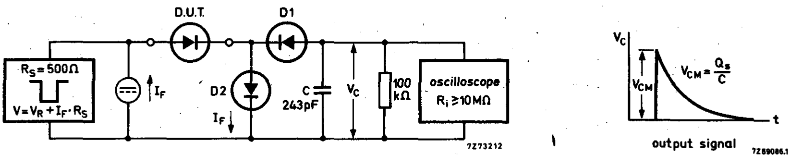
Oscilloscope: Rise time t_r = 0,35 ns

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Recovery charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω | Q_s | < | 45 | pC

Test circuit and waveform:



D1 = BAW62

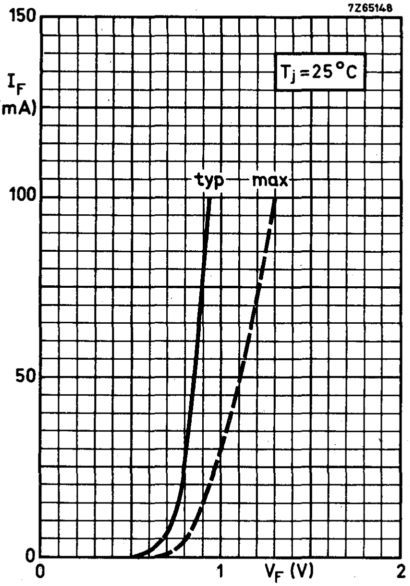
D2 = diode with minority carrier life time at 10 mA: < 200 ps

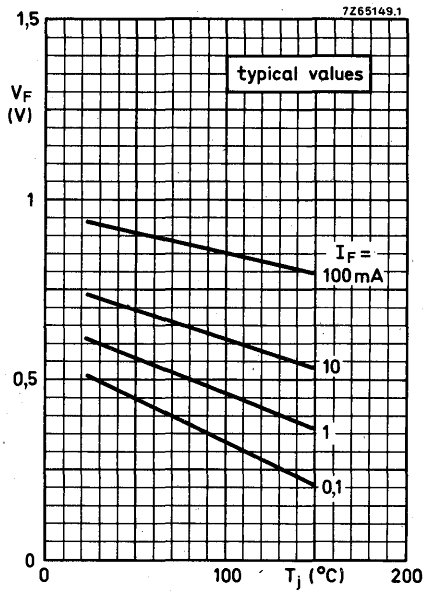
Input signal : Rise time of the reverse pulse t_r = 2 ns

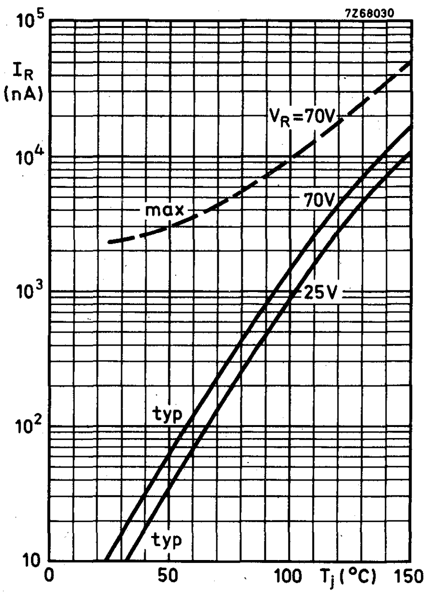
Reverse pulse duration t_p = 400 ns

Duty factor δ = 0,02

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance)


7Z65148
I_F (mA)
150
100
50
0
$T_j = 25\,^\circ C$
typ
max
0
1
V_F (V)
2


7Z65149.1
V_F (V)
1,5
1
0,5
0
typical values
I_F = 100 mA
10
1
0,1
0
100
T_j (°C)
200


7Z68030
I_R (nA)
10^5
10^4
10^3
10^2
10
V_R=70V
max
70V
25V
typ
typ
0
50
100
T_j (°C)
150

SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAW56 consists of two diodes in a microminiature plastic envelope. The anodes are commoned and the unit is intended for high-speed switching in thick and thin-film circuits.

QUICK REFERENCE DATA (per diode)

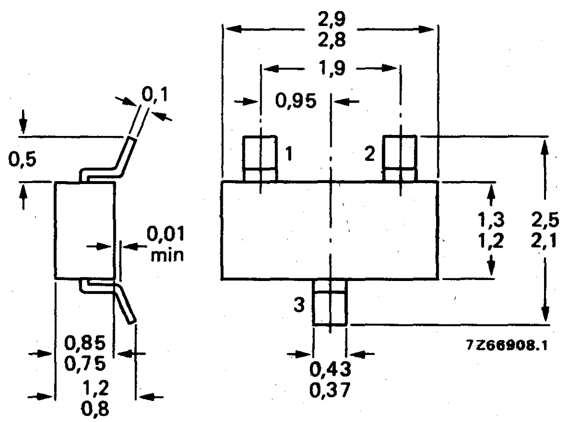
Continuous reverse voltage	V_R	max.	70	V
Repetitive peak reverse voltage	V_{RRM}	max.	70	V
Repetitive peak forward current	I_{FRM}	max.	200	mA
Junction temperature	T_j	max.	150	°C
Forward voltage at I_F = 50 mA	V_F	<	1,1	V
Reverse recovery time when switched from I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω; measured at I_R = 1 mA	t_{rr}	<	6	ns
Recovery charge when switched from I_F = 10 mA to V_R = 5 V; R_L = 500 Ω	Q_s	<	45	pC

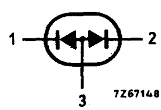
MECHANICAL DATA Dimensions in mm

Fig. 1 SOT-23.

Marking code

BAW56 = A1





See also *Soldering recommendations.*

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

Voltages				
Continuous reverse voltage	V_R	max.	70	V
Repetitive peak reverse voltage	V_{RRM}	max.	70	V
Currents				
Average rectified forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	100	mA [1]
Forward current (d.c.)	I_F	max.	100	mA
Repetitive peak forward current	I_{FRM}	max.	200	mA
Temperatures				
Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE (per diode)

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm

both diodes loaded simultaneously	$R_{th\ j\text{-}a}$	=	1,10	°C/mW
one diode loaded	$R_{th\ j\text{-}a}$	=	0,67	°C/mW

[1] Measured under pulse conditions: pulse time $t_p \leq 0,5$ ms.
For sinusoidal operation $I_{F(AV)} = 65$ mA; averaging time $t_{(av)} \leq 1$ ms.

CHARACTERISTICS (per diode) T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 1 mA	V_F	<	715	mV
I_F = 10 mA	V_F	<	855	mV
I_F = 50 mA	V_F	<	1100	mV
I_F = 100 mA	V_F	<	1300	mV

Reverse current

V_R = 25 V; T_j = 150 °C	I_R	<	30	μA
V_R = 70 V	I_R	<	2,5	μA
V_R = 70 V; T_j = 150 °C	I_R	<	50	μA

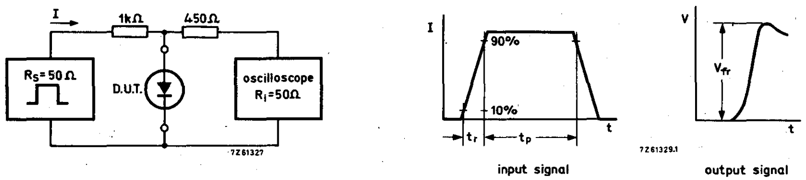
Diode capacitance

V_R = 0; f = 1 MHz	C_d	<	2	pF

Forward recovery voltage when switched to

I_F = 10 mA; t_r = 20 ns	V_{fr}	<	1,75	V

Test circuit and waveforms:



Input signal : Rise time of the forward pulse t_r = 20 ns

Forward current pulse duration t_p = 120 ns

Duty factor δ = 0,01

Oscilloscope: Rise time t_r = 0,35 ns

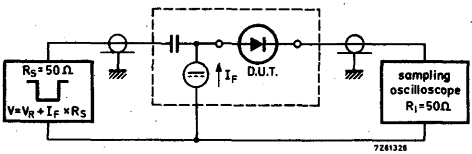
Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

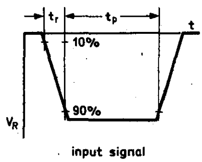
CHARACTERISTICS (per diode) (continued) $T_j = 25\ ^oC$

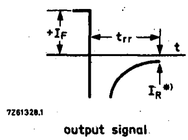
→ Reverse recovery time when switched from

I_F = 10 mA to I_R = 10 mA; R_L = 100 Ω;
measured at I_R = 1 mA — t_{rr} < 6 ns

Test circuit and waveforms :







Input signal : Rise time of the reverse pulse	t_r =	0,6 ns	*) I_R = 1 mA
Reverse pulse duration	t_p =	100 ns	
Duty factor	δ	= 0,05	

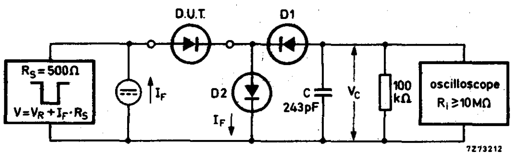
Oscilloscope: Rise time t_r = 0,35 ns

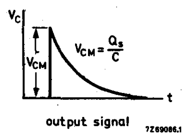
Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Recovery charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω — Q_s < 45 pC

Test circuit and waveform:



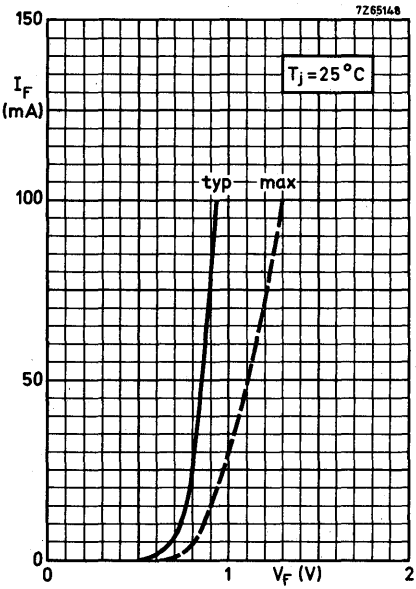


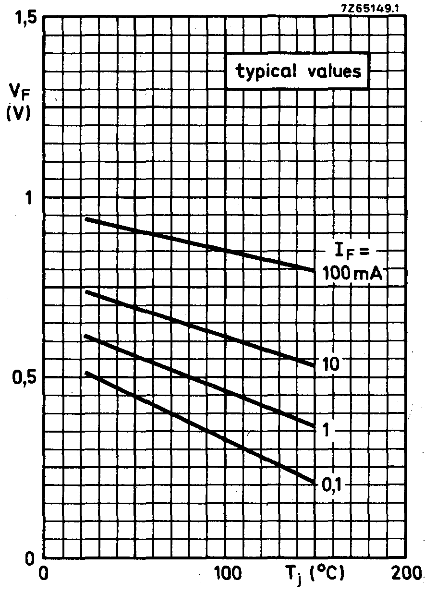
D1 = BAW62

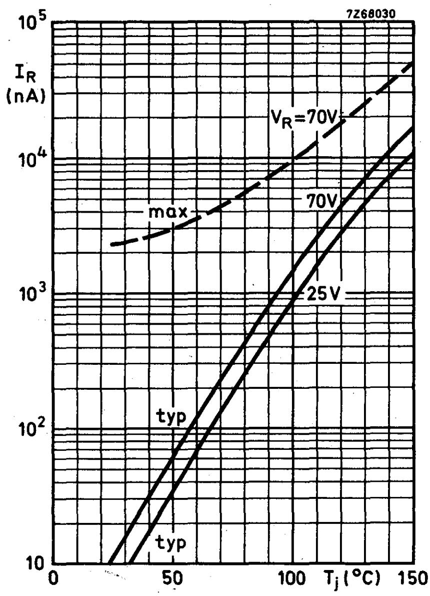
D2 = diode with minority carrier life time at 10 mA: < 200 ps

Input signal : Rise time of the reverse pulse	t_r =	2 ns
Reverse pulse duration	t_p =	400 ns
Duty factor	δ	= 0,02

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance)


7Z65148
150
I_F
(mA)
Tj = 25 °C
typ
max
100
50
0
0
1
V_F (V)
2


7Z65149.1
1,5
V_F
(V)
typical values
1
I_F =
100 mA
10
0,5
1
0,1
0
0
100
Tj (°C)
200


7Z68030
10^5
I_R
(nA)
V_R = 70V
10^4
max
70V
10^3
25V
10^2
typ
typ
10
0
50
100
Tj (°C)
150

VARIABLE CAPACITANCE DIODE

Silicon planar variable capacitance diode in a microminiature envelope. It is intended for electronic tuning applications in thick and thin-film circuits.

QUICK REFERENCE DATA

Reverse voltage	V_R	max.	28 V
Reverse current at V_R = 28 V	I_R	<	50 nA
Diode capacitance at f = 1 MHz V_R = 25 V	C_d		1,8 to 2,8 pF
Capacitance ratio at f = 1 MHz	$\frac{C_d\ (V_R = 3\ V)}{C_d\ (V_R = 25\ V)}$	typ.	5
Series resistance at f = 470 MHz V_R = that value at which C_d = 9 pF	r_D	<	1,2 Ω

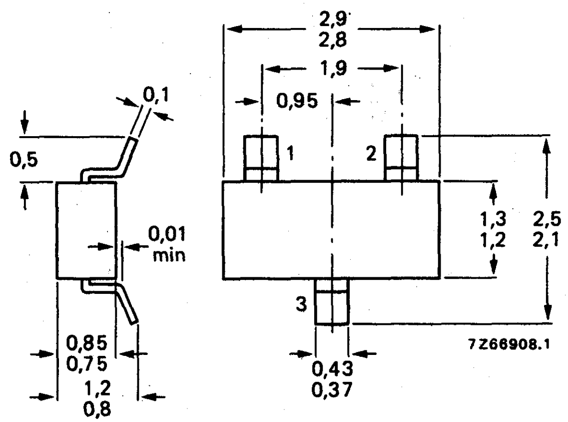
MECHANICAL DATA

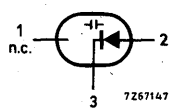
Dimensions in mm

Fig. 1 SOT-23.

Marking code

BBY31 = S1





See also *Soldering recommendations.*

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

Continuous reverse voltage	V_R	max.	28	V
Reverse voltage (peak value)	V_{RM}	max.	30	V
Forward current (d.c.)	I_F	max.	20	mA
Storage temperature	T_{stg}	−65 to +100		^oC
→ Operating junction temperature	T_j	max.	85	^oC

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,62	^oC/mW

CHARACTERISTICS T_j = 25 ^oC unless otherwise specified

Reverse current

V_R = 28 V	I_R	<	50	nA
→ V_R = 28 V; T_j = 85 ^oC	I_R	<	1000	nA

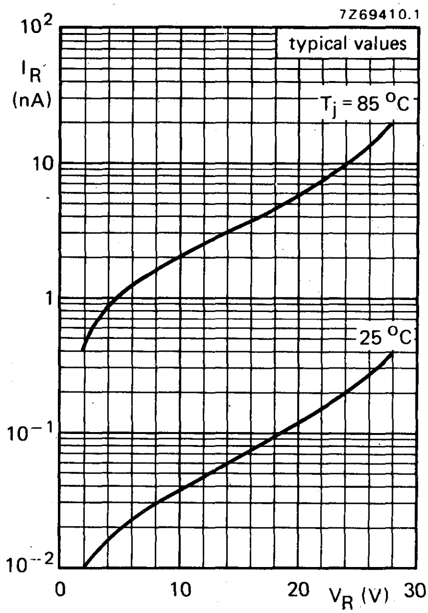
Diode capacitance at f = 1 MHz

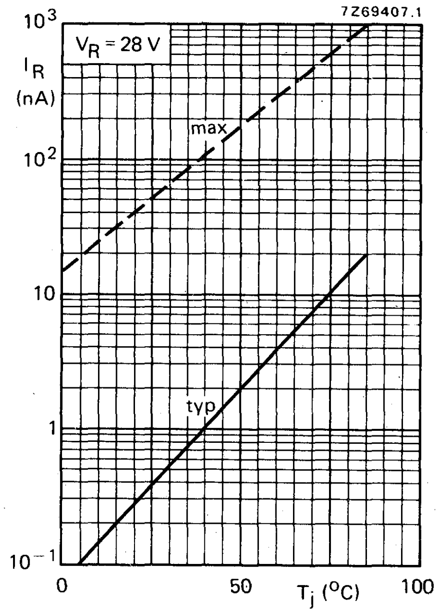
V_R = 1 V	C_d	typ.	17,5	pF
V_R = 3 V	C_d	typ.	11,5	pF
V_R = 25 V	C_d	1,8 to 2,8		pF

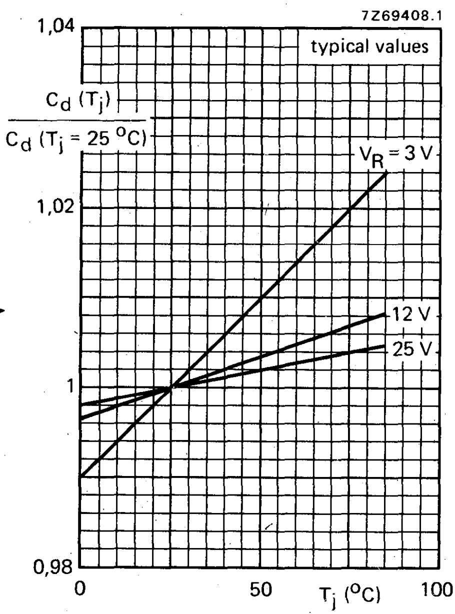
Capacitance ratio at f = 1 MHz $\frac{C_d(V_R = 3\ V)}{C_d(V_R = 25\ V)}$ typ. 5

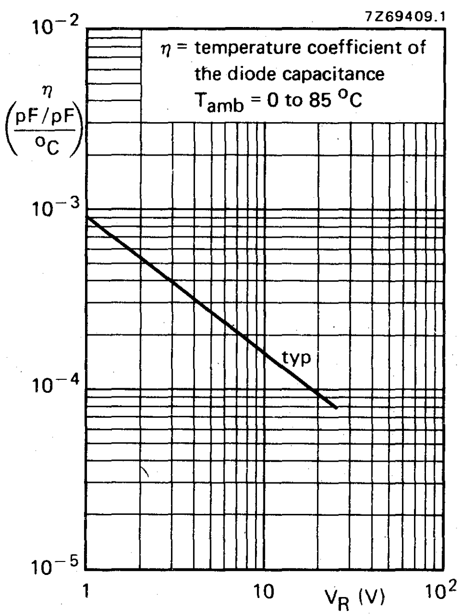
Series resistance

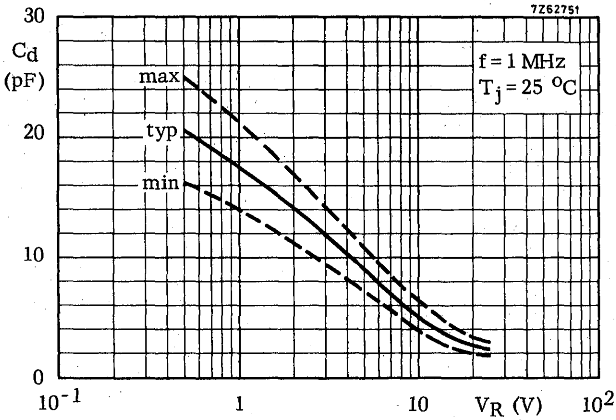
at f = 470 MHz and at that value of V_R at which C_d = 9 pF	r_D	<	1,2	Ω


7Z69410.1
typical values
I_R (nA)
T_j = 85 °C
25 °C
10^2
10
1
10^{-1}
10^{-2}
0
10
20
V_R (V)
30


7Z69407.1
V_R = 28 V
I_R (nA)
max
typ
10^3
10^2
10
1
10^{-1}
0
50
T_j (°C)
100


7Z69408.1
typical values
$\frac{C_d (T_j)}{C_d (T_j = 25\ ^oC)}$
V_R = 3 V
12 V
25 V
1,04
1,02
1
0,98
0
50
T_j (°C)
100


7Z69409.1
η = temperature coefficient of
the diode capacitance
T_{amb} = 0 to 85 °C
η (pF/pF / °C)
typ
10^{-2}
10^{-3}
10^{-4}
10^{-5}
1
10
V_R (V)
10^2


7Z62751
30
C_d
(pF)
20
10
0
max
typ
min
f = 1 MHz
T_j = 25 °C
10^{-1}
1
10
V_R (V)
10^2

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

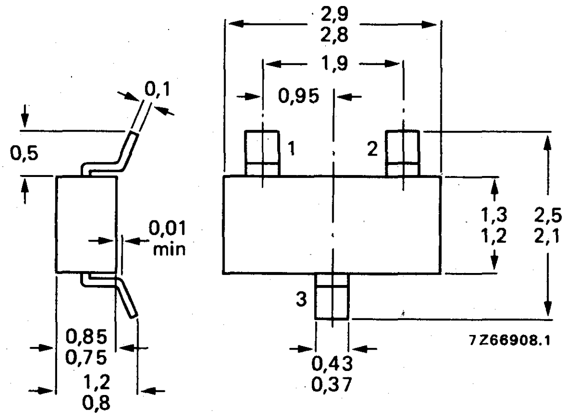
QUICK REFERENCE DATA

			BCW29 BCW29R	BCW30 BCW30R	
D.C. current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	120 260	215 500	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30		V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20		V
Collector current (peak value)	$-I_{CM}$	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

MECHANICAL DATA

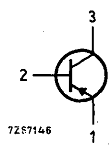
Dimensions in mm

Fig. 1 SOT-23.

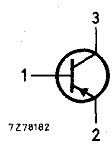


Marking code

BCW29 = C1
BCW30 = C2



BCW29R = C4
BCW30R = C5



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	30	V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V

Currents

Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}		-65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	$R_{th\ j-a}$	=	0.62	°C/mW

CHARACTERISTICS

Collector cut-off current

I_E = 0; $-V_{CB}$ = 20 V; T_j = 25 °C	$-I_{CBO}$	<	100	nA
T_j = 100 °C	$-I_{CBO}$	<	10	μA

Base-emitter voltage

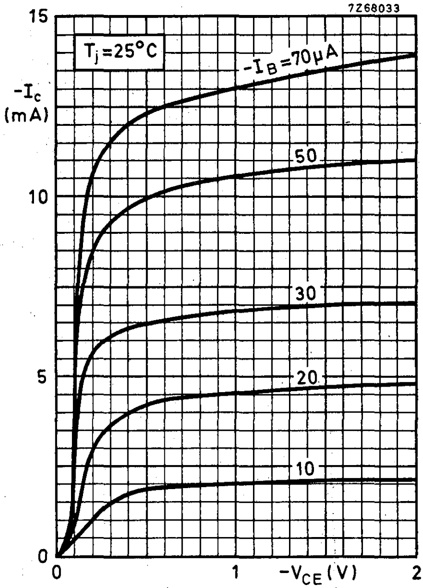
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; T_j = 25 °C	$-V_{BE}$		600 to 750	mV

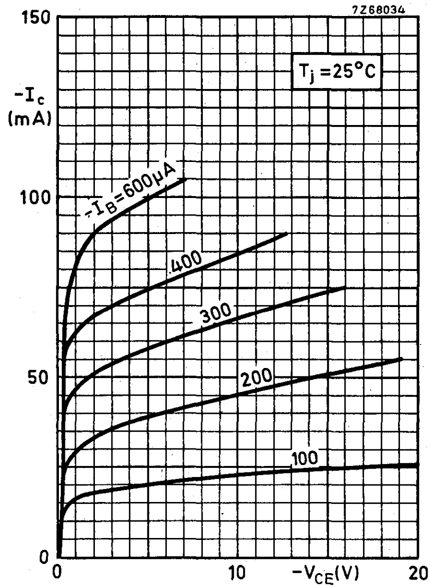
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

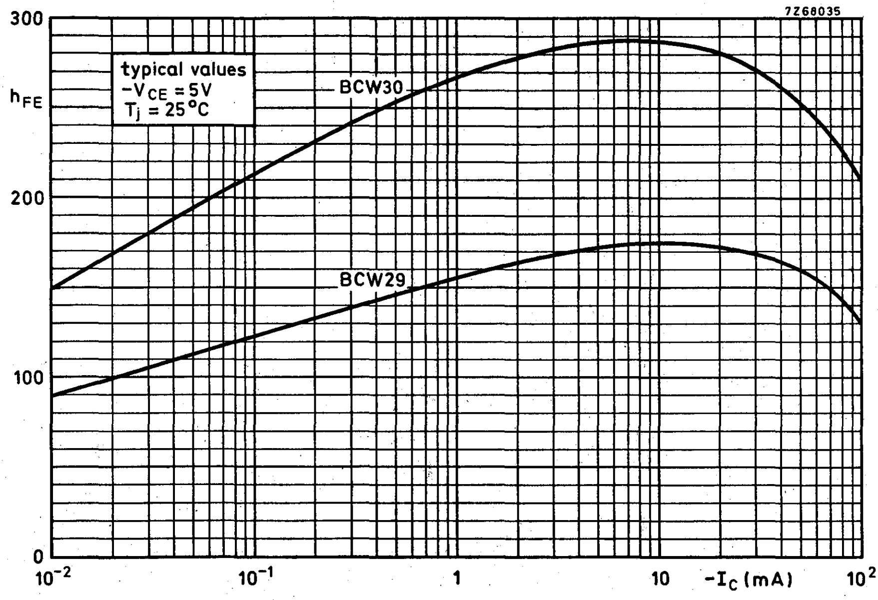
Saturation voltages				
$-I_C$ = 10 mA; $-I_B$ = 0.5 mA	$-V_{CEsat}$	typ.	80	mV
		<	300	mV
	$-V_{BEsat}$	typ.	720	mV
$-I_C$ = 50 mA; $-I_B$ = 2.5 mA	$-V_{CEsat}$	typ.	150	mV
	$-V_{BEsat}$	typ.	810	mV

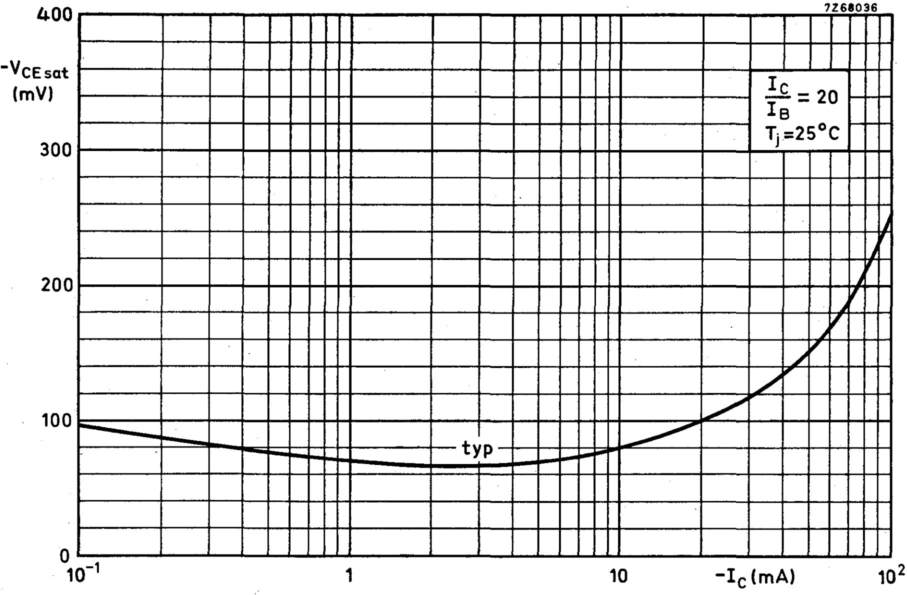
D.C. current gain			BCW29	BCW30
$-I_C$ = 10 μA; $-V_{CE}$ = 5 V	h_{FE}	typ.	90	150
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	>	120	215
		<	260	500

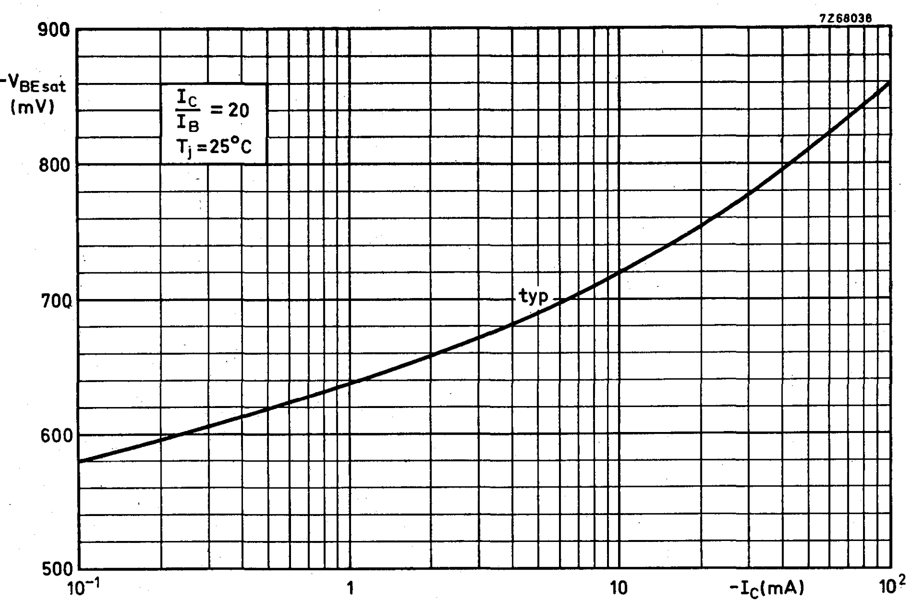
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB}$ = 10 V	C_c	<	7.0	pF
Transition frequency at f = 35 MHz				
$-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150	MHz
Noise figure at R_S = 2 kΩ				
$-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10	dB

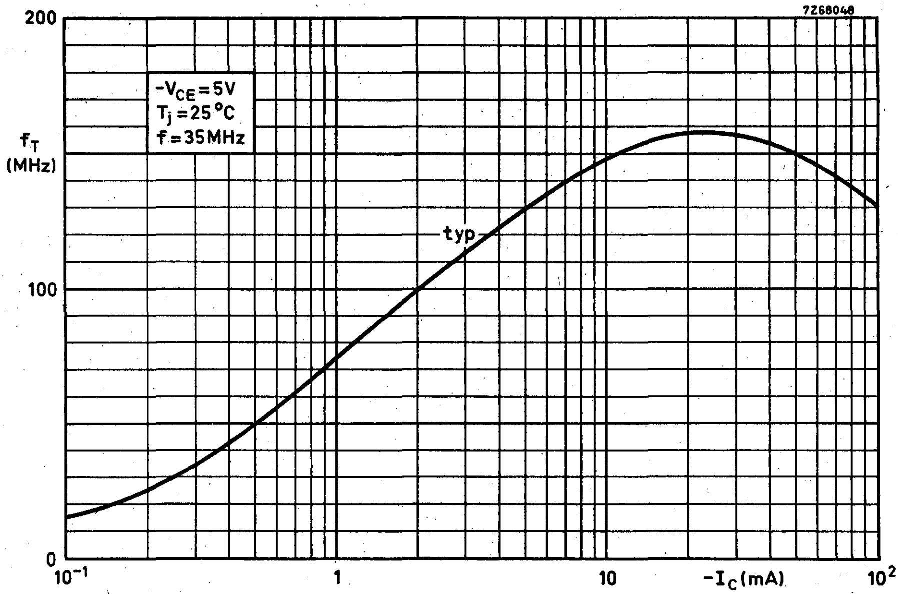

7Z68033
15
10
5
0
$-I_c$
(mA)
$T_j = 25°C$
$-I_B = 70 \mu A$
50
30
20
10
0
1
$-V_{CE}$ (V)
2

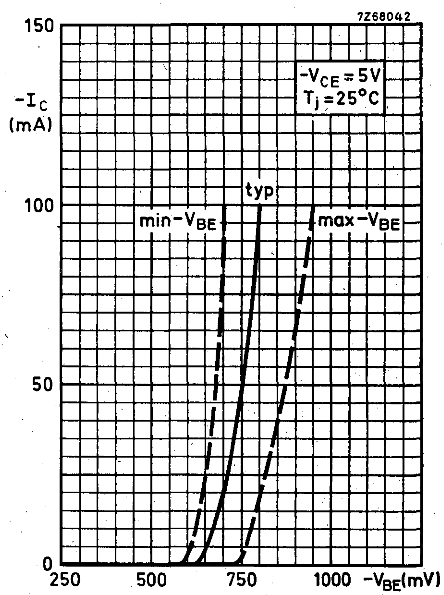

7Z68034
150
100
50
0
$-I_c$
(mA)
$T_j = 25°C$
$-I_B = 600 \mu A$
400
300
200
100
0
10
$-V_{CE}$(V)
20

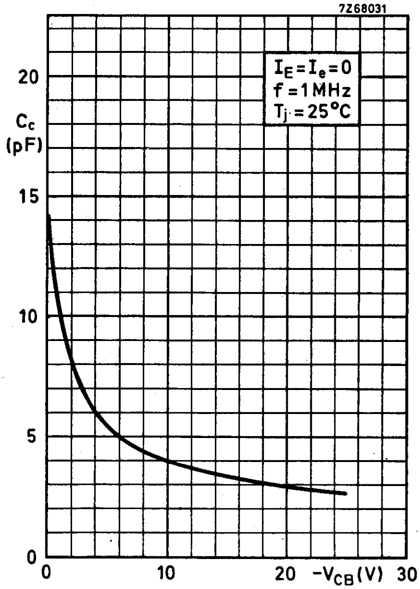

7Z68035
300
200
100
0
h_{FE}
typical values
$-V_{CE} = 5V$
$T_j = 25°C$
BCW30
BCW29
10^{-2}
10^{-1}
1
10
$-I_C$ (mA)
10^2

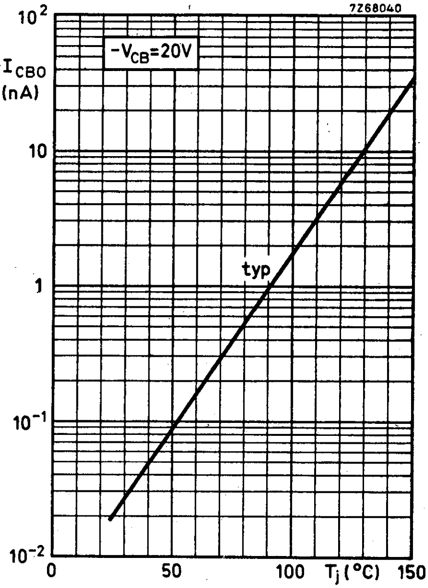

7Z68036
$-V_{CEsat}$ (mV)
400
300
200
100
0
10^{-1}
1
10
$-I_C$ (mA)
10^2
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ


7Z68038
$-V_{BEsat}$ (mV)
900
800
700
600
500
10^{-1}
1
10
$-I_C$(mA)
10^2
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ


7Z68048
200
100
0
f_T
(MHz)
$-V_{CE} = 5V$
$T_j = 25°C$
f = 35MHz
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2


7Z68042
150
100
50
0
$-I_C$
(mA)
$-V_{CE} = 5V$
$T_j = 25°C$
typ
min $-V_{BE}$
max $-V_{BE}$
250
500
750
1000
$-V_{BE}$(mV)


7Z68031
$I_E = I_e = 0$
f = 1 MHz
$T_j = 25\,^{\circ}C$
C_c (pF)
20
15
10
5
0
0
10
20
$-V_{CB}$ (V)
30


7Z68040
$-V_{CB} = 20V$
$-I_{CBO}$ (nA)
10^2
10
1
10^{-1}
10^{-2}
typ
0
50
100
T_j (°C)
150

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic envelope. They are intended for low level general purpose applications in thick and thin-film circuits.

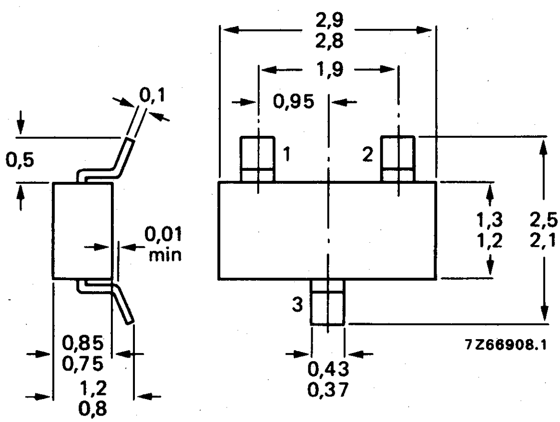
QUICK REFERENCE DATA

			BCW31 BCW31R	BCW32 BCW32R	BCW33 BCW33R	
D.C. current gain at T_j = 25 °C I_C = 2 mA; V_{CE} = 5 V	h_{FE}	> <	110 220	200 450	420 800	
Collector-base voltage (open emitter)	V_{CBO}	max.		30		V
Collector-emitter voltage (open base)	V_{CEO}	max.		20		V
Collector current (peak value)	I_{CM}	max.		200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		200		mW
Junction temperature	T_j	max.		150		°C
Transition frequency at f = 35 MHz I_C = 2 mA; V_{CE} = 5 V	f_T	typ.		300		MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	<		10		dB

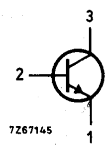
MECHANICAL DATA

Dimensions in mm

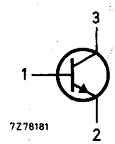
Fig. 1 SOT-23.



Marking code



BCW31 = D1
BCW32 = D2
BCW33 = D3



BCW31R = D4
BCW32R = D5
BCW33R = D6

See also *Soldering recommendations.*

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

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) I_C = 2 mA	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}	-65 to	+150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	$R_{th\ j\text{-}a}$	=	0.62	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; V_{CB} = 20 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 20 V; T_j = 100 °C	I_{CBO}	<	10	μA

Base-emitter voltage

I_C = 2 mA; V_{CE} = 5 V	V_{BE}	550 to	700	mV

CHARACTERISTICS (continued)

T_j = 25 °C unless otherwise specified

Saturation voltages

I_C = 10 mA; I_B = 0.5 mA	V_{CEsat}	typ.	120	mV
		<	250	mV
	V_{BEsat}	typ.	750	mV
I_C = 50 mA; I_B = 2.5 mA	V_{CEsat}	typ.	210	mV
	V_{BEsat}	typ.	850	mV

D.C. current gain

			BCW31	BCW32	BCW33
I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.	90	150	270
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	200	420
		<	220	450	800

Collector capacitance at f = 1 MHz

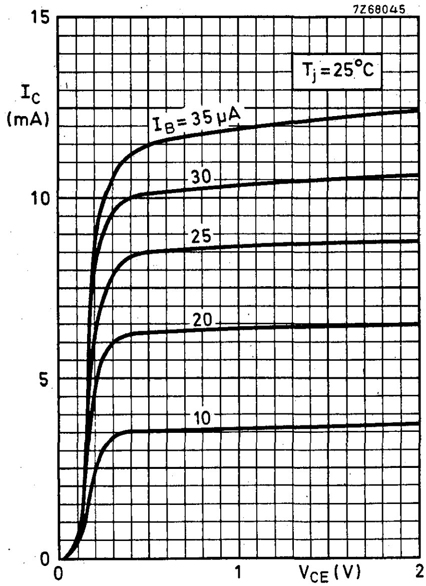
I_E = I_e = 0; V_{CB} = 10 V	C_c	<	4.0	pF

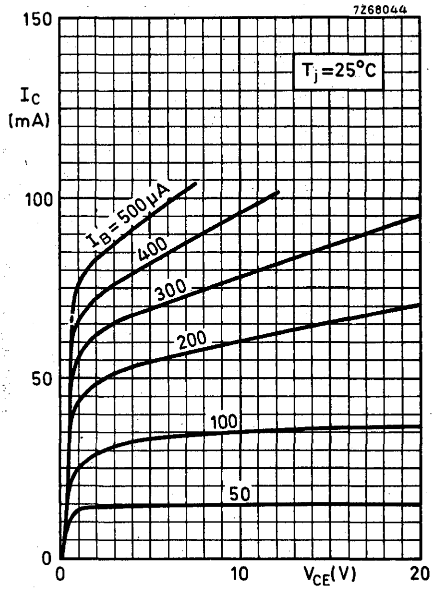
Transition frequency at f = 35 MHz

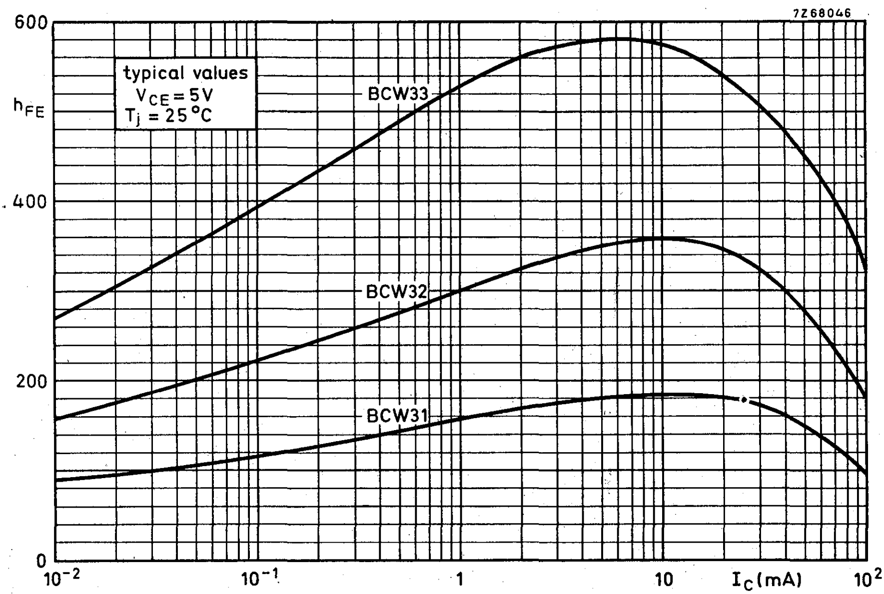
I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300	MHz

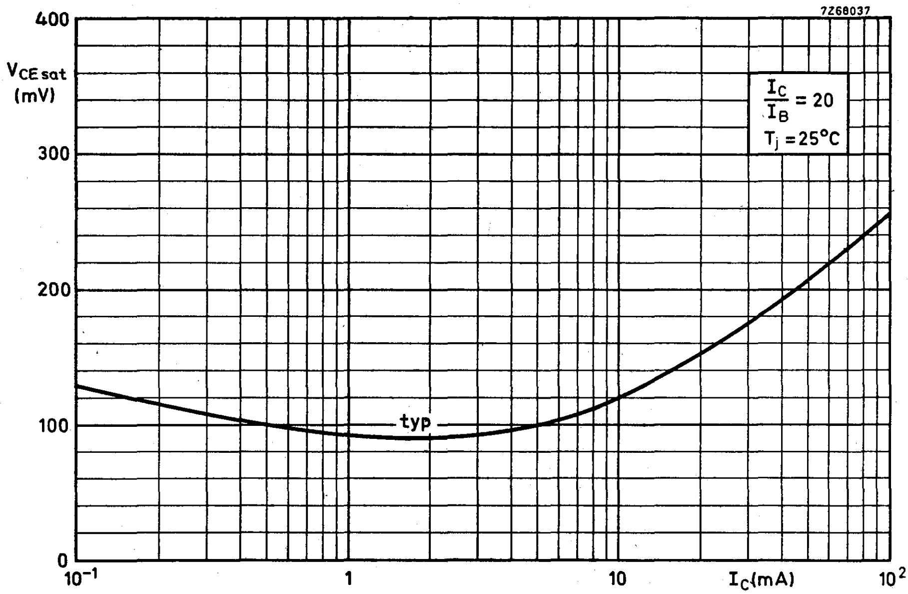
Noise figure at R_S = 2 kΩ

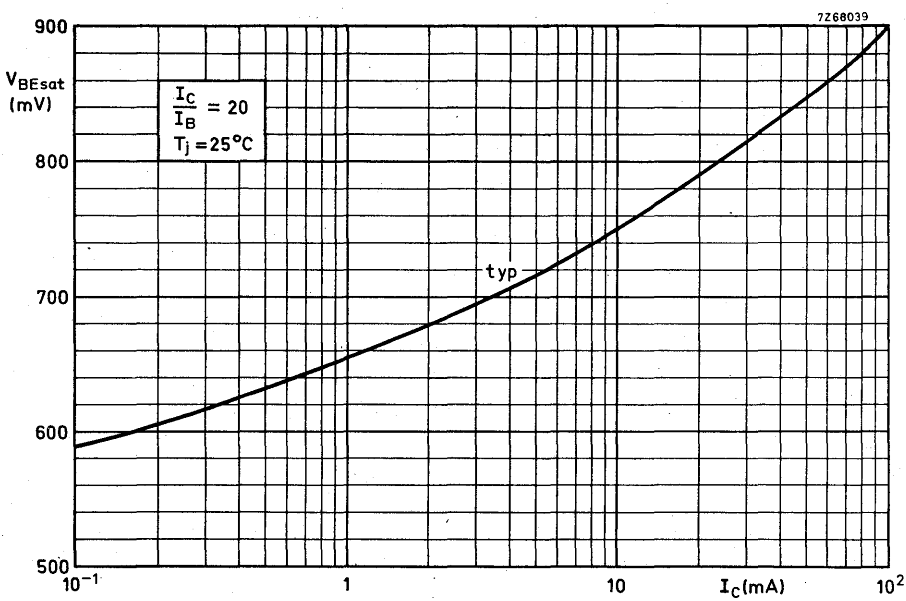
I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	<	10	dB

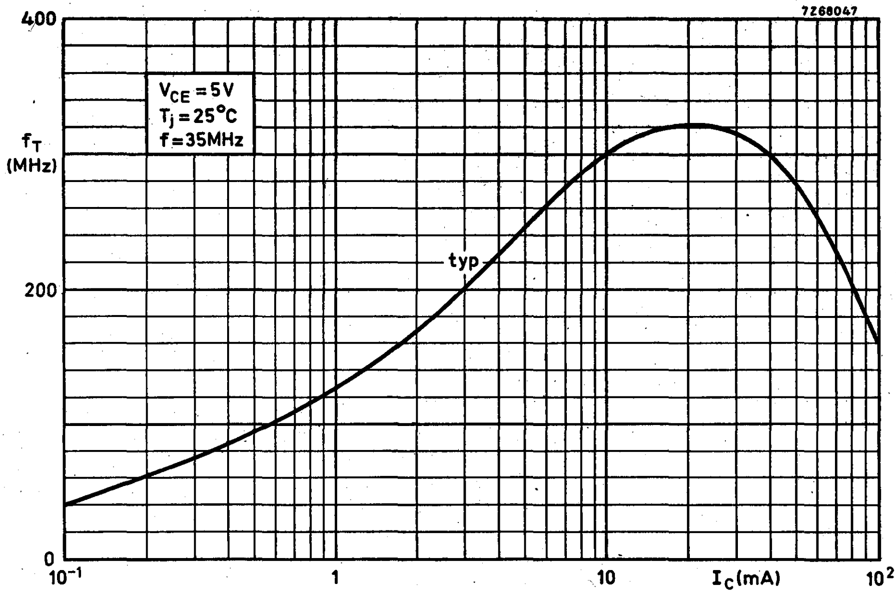

7Z68045
$T_j = 25\,^\circ C$
I_C (mA)
$I_B = 35\,\mu A$
30
25
20
10
V_{CE} (V)
15
10
5
0
0
1
2

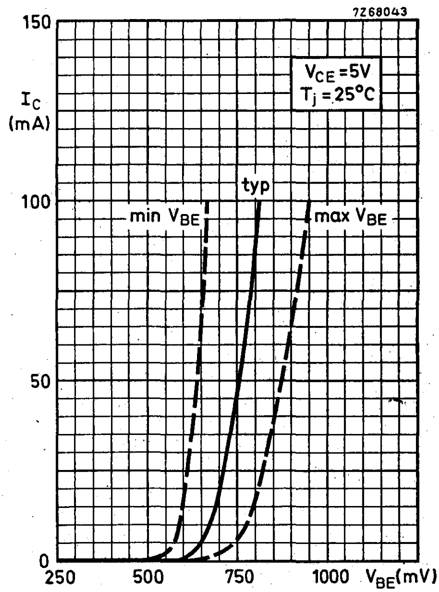

7Z68044
$T_j = 25\,^\circ C$
I_C (mA)
$I_B = 500\,\mu A$
400
300
200
100
50
V_{CE} (V)
150
100
50
0
0
10
20

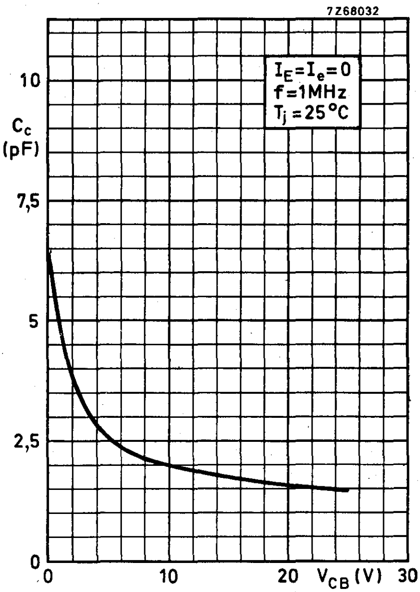

7Z68046
typical values
$V_{CE} = 5\,V$
$T_j = 25\,^\circ C$
h_{FE}
BCW33
BCW32
BCW31
I_C (mA)
600
400
200
0
10^{-2}
10^{-1}
1
10
10^2

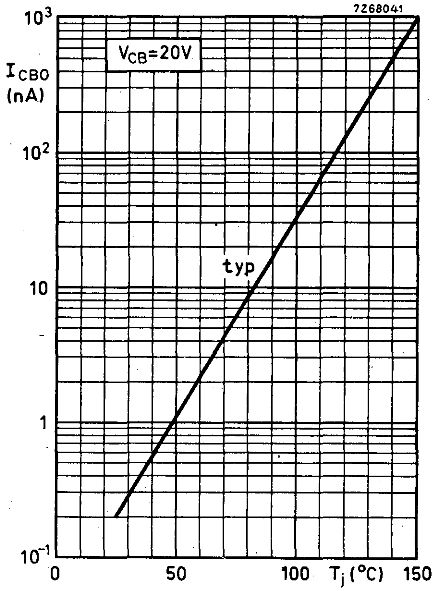

7Z68037
V_{CEsat} (mV)
400
300
200
100
0
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ
10^{-1}
1
10
I_C (mA)
10^2


7Z68039
V_{BEsat} (mV)
900
800
700
600
500
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ
10^{-1}
1
10
I_C (mA)
10^2


7Z68047
400
200
0
f_T
(MHz)
$V_{CE} = 5V$
$T_j = 25°C$
f = 35MHz
typ
10^{-1}
1
10
I_C(mA)
10^2


7Z68043
150
100
50
0
I_C
(mA)
$V_{CE} = 5V$
$T_j = 25°C$
typ
min V_{BE}
max V_{BE}
250
500
750
1000
V_{BE}(mV)


7Z68032
$I_E = I_e = 0$
f = 1 MHz
$T_j = 25\,^{\circ}C$
C_c (pF)
10
7,5
5
2,5
0
0
10
20
V_{CB} (V)
30


7Z68041
$V_{CB} = 20V$
I_{CBO} (nA)
10^3
10^2
10
1
10^{-1}
typ
0
50
100
T_j (°C)
150

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

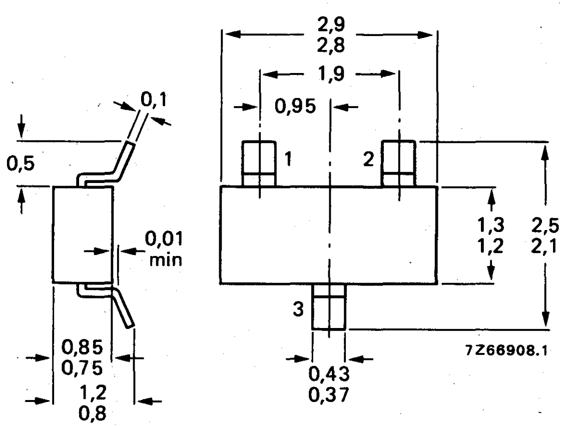
QUICK REFERENCE DATA

			BCW69 BCW69R	BCW70 BCW70R	
D.C. current gain at T_j = 25 °C $-I_C$ = 2 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	120 260	215 500	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50		V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45		V
Collector current (peak value)	$-I_{CM}$	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	150		MHz
Noise figure at R_S = 2 kΩ $-I_C$ = 200 μA; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

MECHANICAL DATA

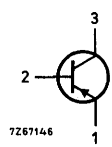
Dimensions in mm

Fig. 1 SOT-23.

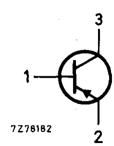


Marking code

BCW69 = H1
BCW70 = H2



BCW69R = H4
BCW70R = H5



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	V
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	V
Collector-emitter voltage (open base) $-I_C$ = 2 mA	$-V_{CEO}$	max.	45	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V

Currents

Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	$R_{th\ j-a}$	=	0.62	°C/mW

CHARACTERISTICS

Collector cut-off current

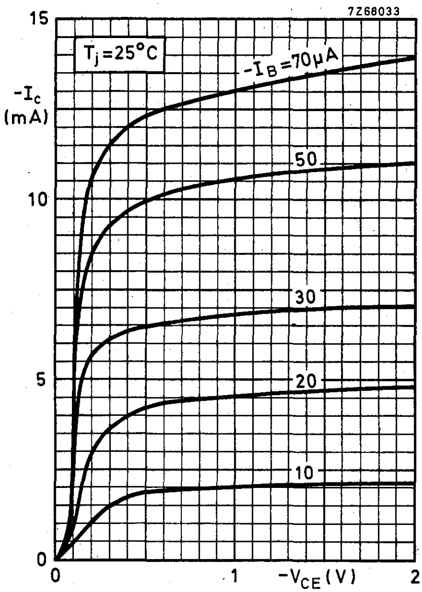
I_E = 0; $-V_{CB}$ = 20 V; T_j = 25 °C	$-I_{CBO}$	<	100	nA
T_j = 100 °C	$-I_{CBO}$	<	10	µA

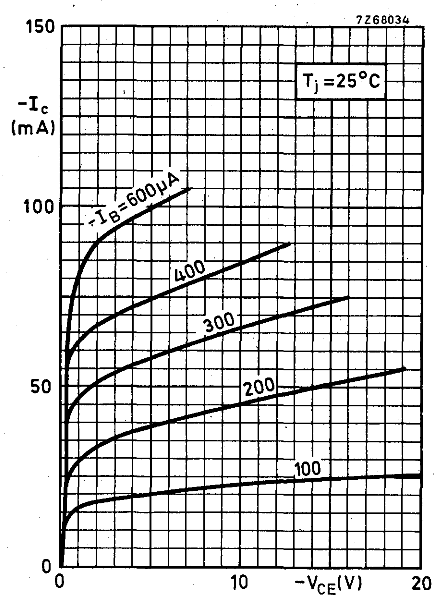
Base-emitter voltage

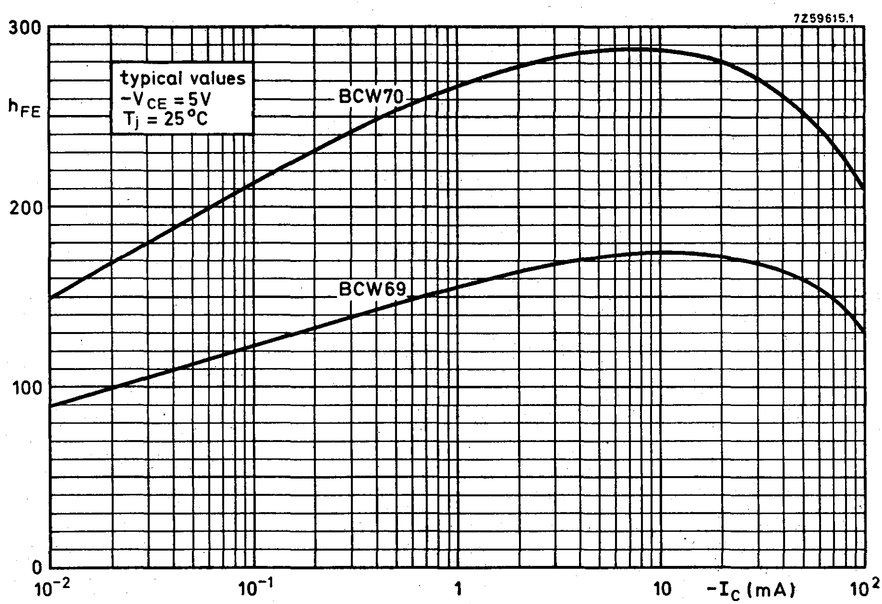
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; T_j = 25 °C	$-V_{BE}$	600 to	750	mV

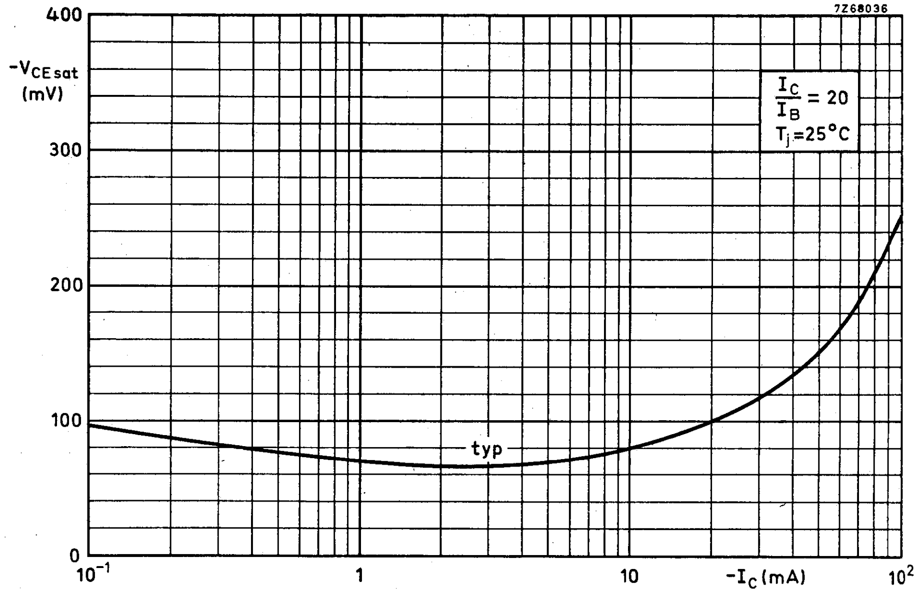
CHARACTERISTICS (continued) $T_j = 25\ ^oC$ unless otherwise specified

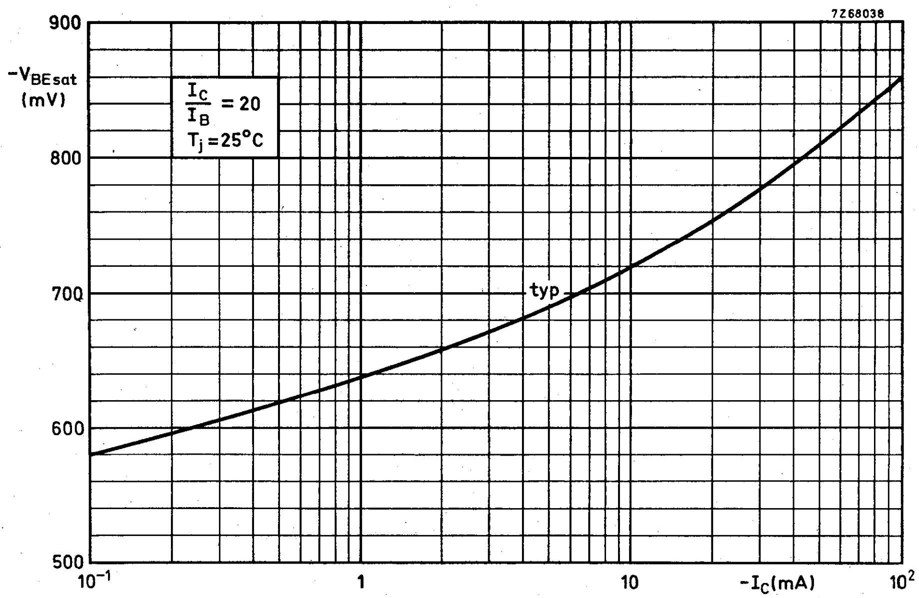
Saturation voltages					
$-I_C = 10$ mA; $-I_B = 0.5$ mA	$-V_{CEsat}$	typ.	80		mV
		<	300		mV
	$-V_{BEsat}$	typ.	720		mV
$-I_C = 50$ mA; $-I_B = 2.5$ mA	$-V_{CEsat}$	typ.	150		mV
	$-V_{BEsat}$	typ.	810		mV
D. C. current gain			BCW69	BCW70	
$-I_C = 10\ \mu A$; $-V_{CE} = 5$ V	h_{FE}	typ.	90	150	
$-I_C = 2$ mA; $-V_{CE} = 5$ V	h_{FE}	>	120	215	
		<	260	500	
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	<	7.0		pF
Transition frequency at f = 35 MHz					
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	typ.	150		MHz
Noise figure at $R_S = 2\ k\Omega$					
$-I_C = 200\ \mu A$; $-V_{CE} = 5$ V; f = 1 kHz; B = 200 Hz	F	<	10		dB

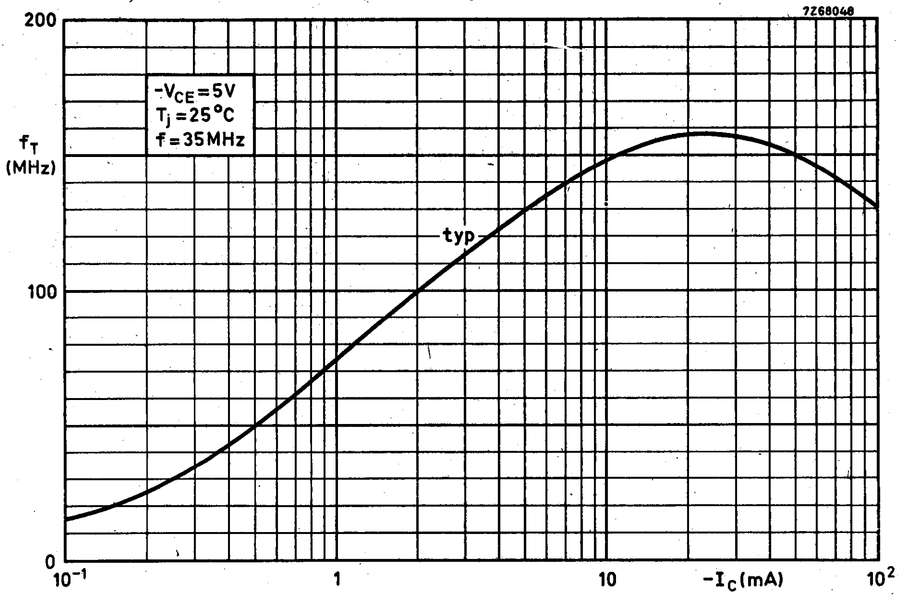

7Z68033
$T_j = 25\,^\circ C$
$-I_C$ (mA)
$-I_B = 70\,\mu A$
50
30
20
10
15
10
5
0
0
1
2
$-V_{CE}$ (V)

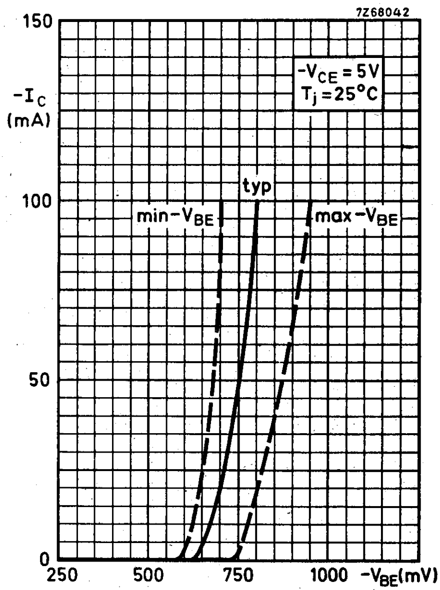

7Z68034
$T_j = 25\,^\circ C$
$-I_C$ (mA)
$-I_B = 600\,\mu A$
400
300
200
100
150
100
50
0
0
10
20
$-V_{CE}$ (V)

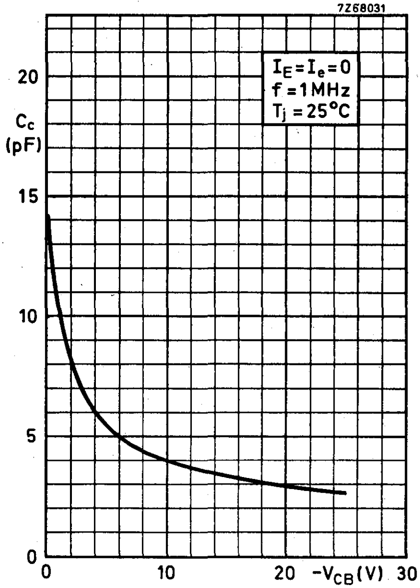

7Z59615.1
typical values
$-V_{CE} = 5\,V$
$T_j = 25\,^\circ C$
h_{FE}
BCW70
BCW69
300
200
100
0
10^{-2}
10^{-1}
1
10
10^2
$-I_C$ (mA)

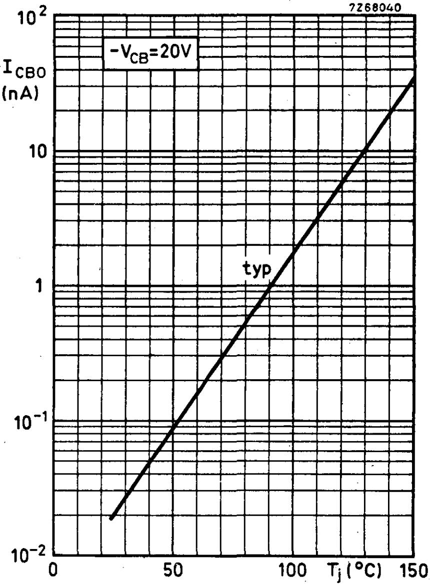

7Z68036
400
$-V_{CEsat}$ (mV)
300
200
100
0
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2


7Z68038
900
$-V_{BEsat}$ (mV)
800
700
600
500
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2


7Z68048
200
100
0
f_T
(MHz)
$-V_{CE} = 5V$
$T_j = 25°C$
f = 35 MHz
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2


7Z68042
150
100
50
0
$-I_C$
(mA)
$-V_{CE} = 5V$
$T_j = 25°C$
typ
min $-V_{BE}$
max $-V_{BE}$
250
500
750
1000
$-V_{BE}$ (mV)


7Z68031
$I_E = I_e = 0$
f = 1 MHz
$T_j = 25\,^\circ C$
C_c
(pF)
20
15
10
5
0
0
10
20
30
$-V_{CB}$ (V)


7Z68040
$-V_{CB} = 20 V$
$-I_{CBO}$
(nA)
10^2
10
1
10^{-1}
10^{-2}
typ
0
50
100
150
T_j (°C)

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

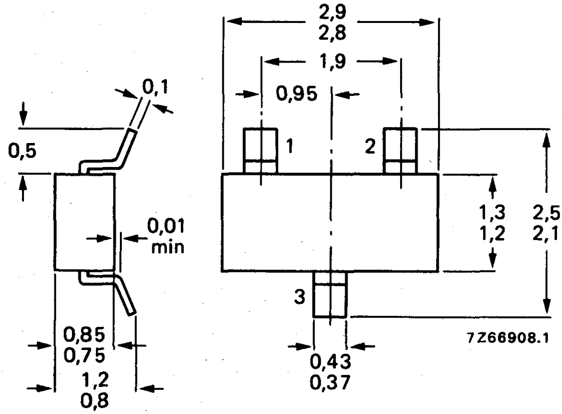
QUICK REFERENCE DATA

			BCW71 BCW71R	BCW72 BCW72R	
D.C. current gain at T_j = 25 °C; I_C = 2 mA; V_{CE} = 5 V	h_{FE}	>	110	200	
		<	220	450	
Collector-base voltage (open emitter)	V_{CBO}	max.	50		V
Collector-emitter voltage (open base)	V_{CEO}	max.	45		V
Collector current (peak value)	I_{CM}	max.	200		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200		mW
Junction temperature	T_j	max.	150		°C
Transition frequency at f = 35 MHz; I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300		MHz
Noise figure at R_S = 2 kΩ; I_C = 200 μA; V_{CE} = 5 V; f = 1 kHz; B = 200 Hz	F	<	10		dB

MECHANICAL DATA

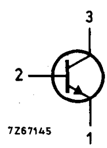
Dimensions in mm

Fig. 1 SOT-23.

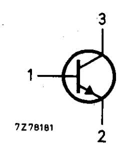


Marking code

BCW71 = K1
BCW72 = K2



BCW71R = K4
BCW72R = K5



See also *Soldering recommendations.*

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

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	50	V
Collector-emitter voltage (open base) I_C = 2 mA	V_{CEO}	max.	45	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}	-65 to	+150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	$R_{th\ j-a}$	=	0.62	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; V_{CB} = 20 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 20 V; T_j = 100 °C	I_{CBO}	<	10	µA

Base emitter voltage

I_C = 2 mA; V_{CE} = 5 V	V_{BE}	550 to	700	mV

CHARACTERISTICS (continued) $T_j = 25\,^oC$ unless otherwise specified

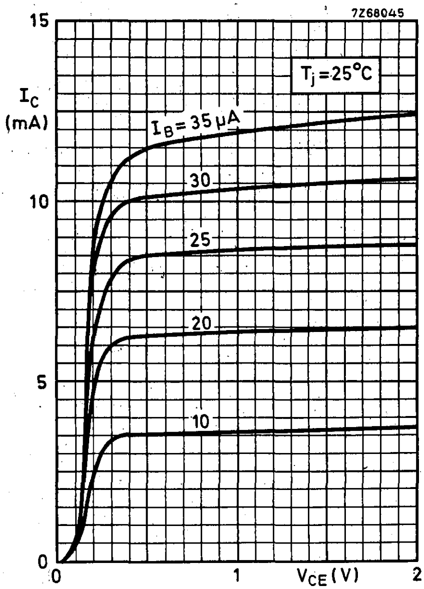
Saturation voltages

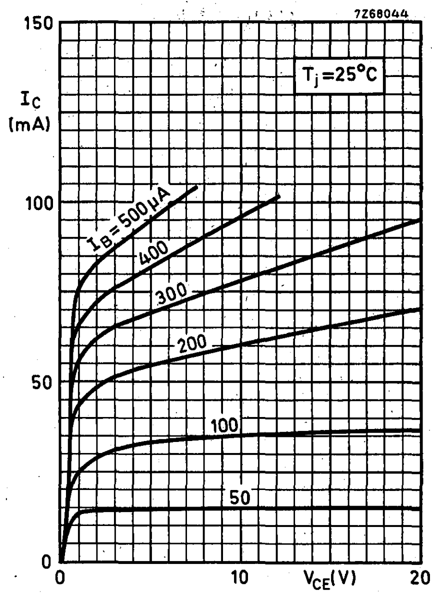
$I_C = 10$ mA; $I_B = 0.5$ mA	V_{CEsat}	typ.	120	mV
		<	250	mV
	V_{BEsat}	typ.	750	mV
$I_C = 50$ mA; $I_B = 2.5$ mA	V_{CEsat}	typ.	210	mV
	V_{BEsat}	typ.	850	mV

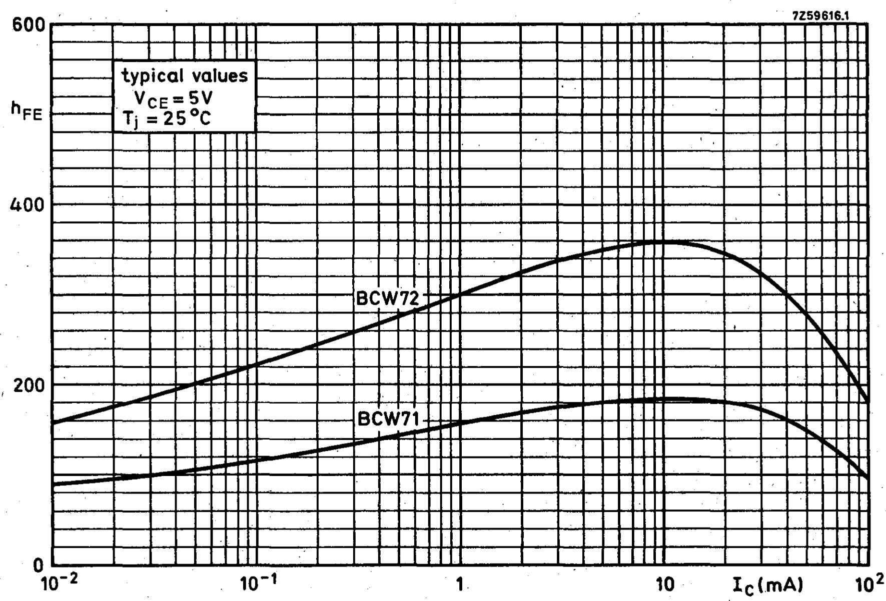
D.C. current gain

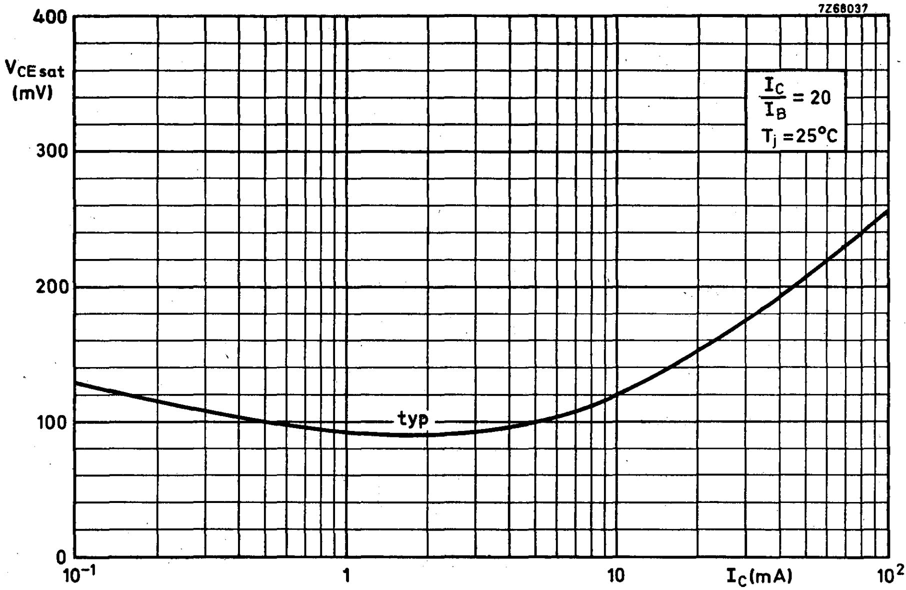
			BCW71	BCW72
$I_C = 10\ \mu A$; $V_{CE} = 5$ V	h_{FE}	typ.	90	150
$I_C = 2$ mA; $V_{CE} = 5$ V	h_{FE}	>	110	200
		<	220	450

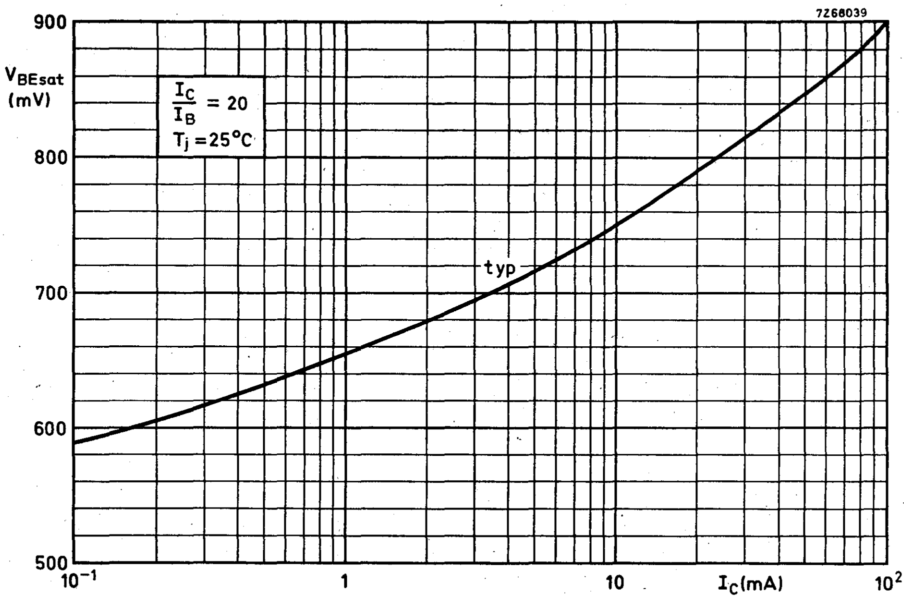
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	4.0	pF
Transition frequency at f = 35 MHz				
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	typ.	300	MHz
Noise figure at $R_S = 2\ k\Omega$				
$I_C = 200\ \mu A$; $V_{CE} = 5$ V; f = 1 kHz; B = 200 Hz	F	<	10	dB

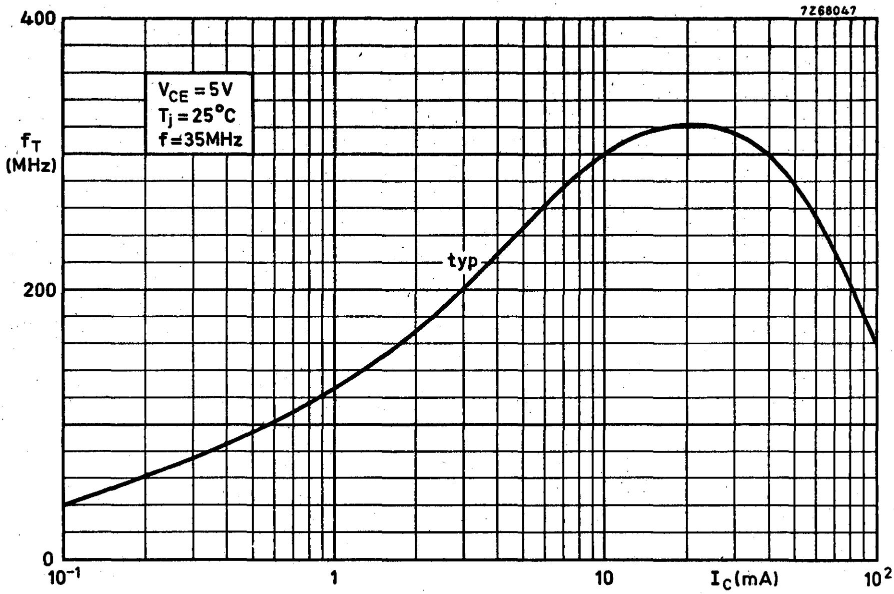

7Z68045
$T_j = 25°C$
I_C (mA)
$I_B = 35\ \mu A$
30
25
20
10
15
10
5
0
0
1
2
V_{CE} (V)

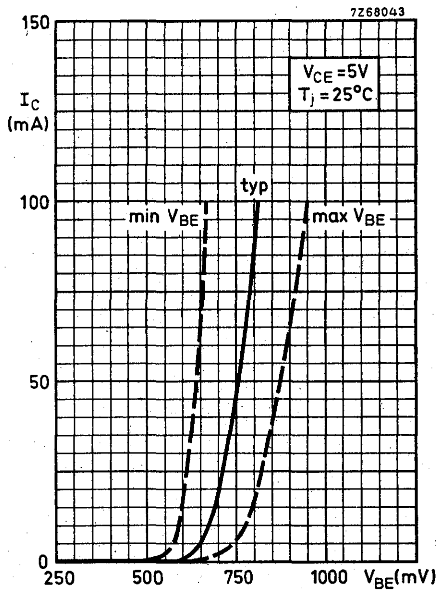

7Z68044
$T_j = 25°C$
I_C (mA)
$I_B = 500\ \mu A$
400
300
200
100
50
150
100
50
0
0
10
20
V_{CE}(V)

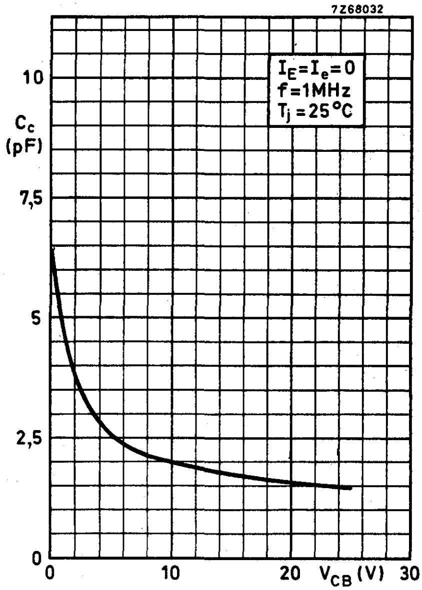

7Z59616.1
typical values
$V_{CE} = 5V$
$T_j = 25°C$
h_{FE}
BCW72
BCW71
600
400
200
0
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

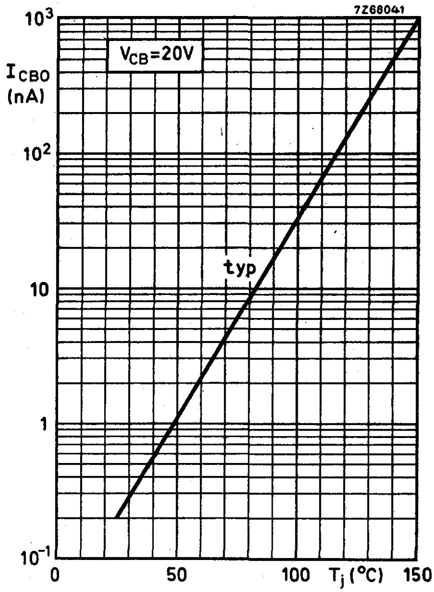

7Z68037
400
$V_{CE sat}$
(mV)
300
200
100
0
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ
10^{-1}
1
10
I_C(mA)
10^2


7Z68039
900
V_{BEsat}
(mV)
800
700
600
500
$\frac{I_C}{I_B} = 20$
$T_j = 25°C$
typ
10^{-1}
1
10
I_C(mA)
10^2


7Z68047
400
200
0
f_T
(MHz)
$V_{CE} = 5V$
$T_j = 25°C$
f = 35MHz
typ
10^{-1}
1
10
I_C(mA)
10^2


7Z68043
150
100
50
0
I_C
(mA)
$V_{CE} = 5V$
$T_j = 25°C$
typ
min V_{BE}
max V_{BE}
250
500
750
1000
V_{BE}(mV)


7Z68032
$I_E = I_e = 0$
f = 1 MHz
$T_j = 25\,^\circ C$
C_c (pF)
10
7,5
5
2,5
0
0
10
20
V_{CB} (V)
30


7Z68041
$V_{CB} = 20V$
I_{CBO} (nA)
10^3
10^2
10
1
10^{-1}
typ
0
50
100
T_j (°C)
150

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic envelope, intended for application in thick and thin-film circuits. These transistors are intended for general purposes as well as saturated switching and driver applications for industrial service.
N-P-N complements are BCX19; 19R and BCX20; 20R respectively.

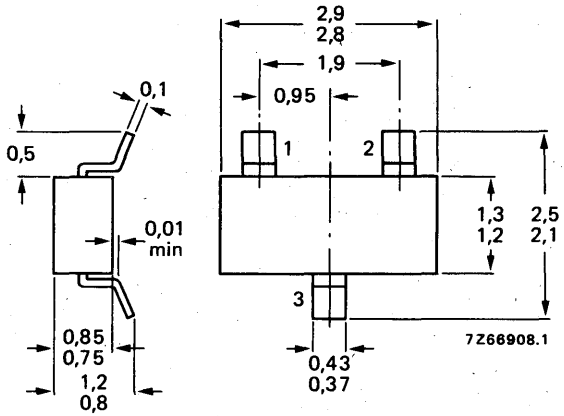
QUICK REFERENCE DATA

			BCX17 BCX17R	BCX18 BCX18R	
Collector-emitter voltage (V_{BE} = 0)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	V
Collector current (peak value)	$-I_{CM}$	max.	1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	310		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}		100 to 600		
Transition frequency $-I_C$ = 10 mA; $-V_{CE}$ = 5 V; f = 35 MHz	f_T	typ.	100		MHz

MECHANICAL DATA

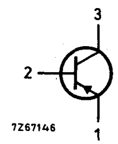
Dimensions in mm

Fig. 1 SOT-23.

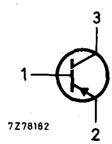


Marking code

BCX17 = T1
BCX18 = T2



BCX17R = T4
BCX18R = T5



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

			BCX17	BCX18	
Voltages					
Collector-emitter voltage ($V_{BE} = 0$)	$-V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base) $-I_C = 10$ mA	$-V_{CEO}$	max.	45	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V

Currents

Collector current (d.c.)	$-I_C$	max.	500	mA
Collector current (peak value)	$-I_{CM}$	max.	1000	mA
Emitter current (peak value)	I_{EM}	max.	1000	mA
Base current (d.c.)	$-I_B$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25\ ^oC$ mounted on a ceramic substrate of 15 mm x 15 mm x 0, 5 mm	P_{tot}	max.	310	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	^oC
Junction temperature	T_j	max.	150	^oC

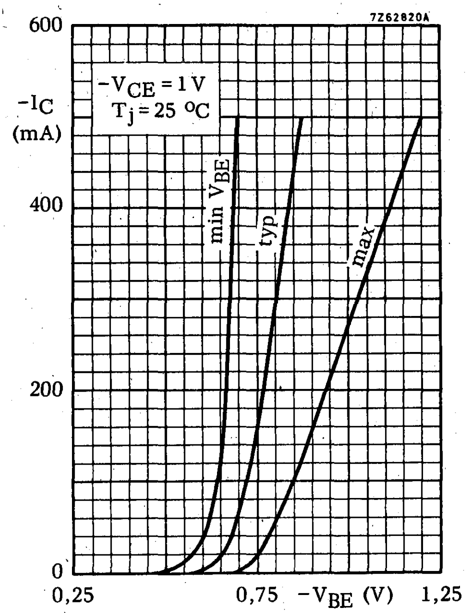
THERMAL RESISTANCE

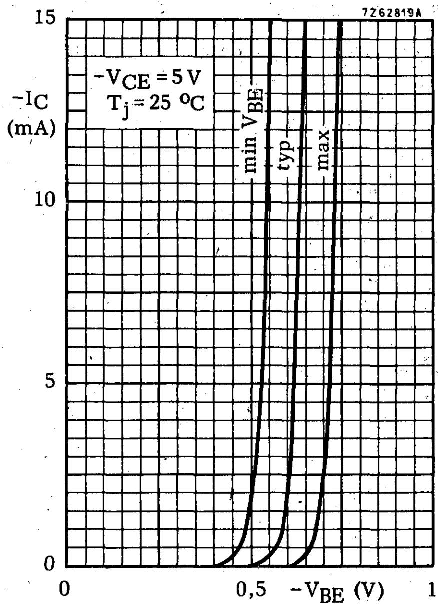
From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 15 mm x 0, 5 mm	$R_{th\ j-a}$	=	0,4	$^oC/mW$

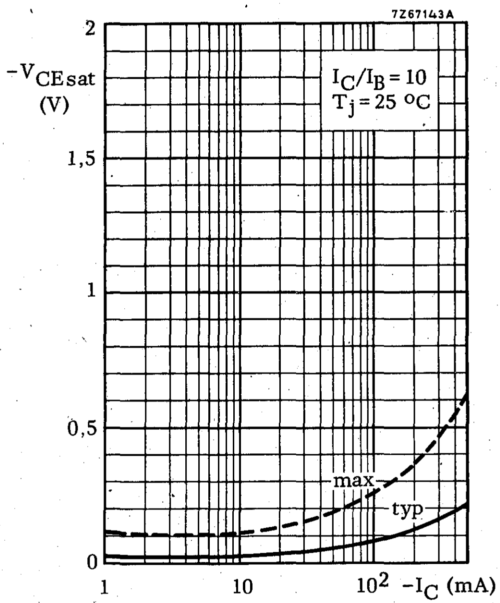
CHARACTERISTICS T_j = 25 °C unless otherwise specified

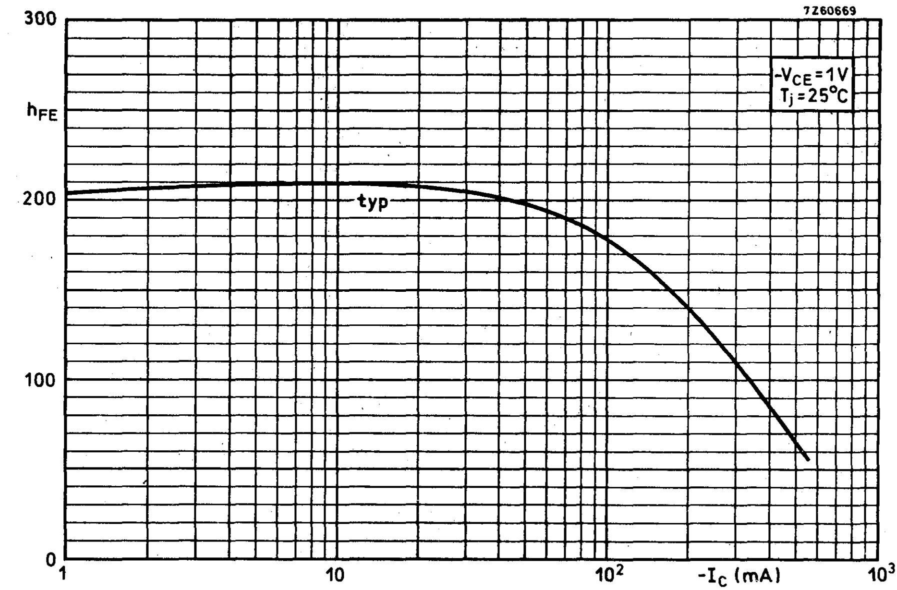
Collector cut-off current				
$I_E = 0$; $-V_{CB} = 20$ V	$-I_{CBO}$	<	100	nA
$I_E = 0$; $-V_{CB} = 20$ V; $T_j = 150$ °C	$-I_{CBO}$	<	5	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10	μA
Base emitter voltage [1]				
$-I_C = 500$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	1,2	V
Saturation voltage				
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	620	mV
D.C. current gain				
$-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}	100 to	600	
$-I_C = 300$ mA; $-V_{CE} = 1$ V	h_{FE}	>	70	
$-I_C = 500$ mA; $-V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 35 MHz				
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	typ.	100	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	8	pF

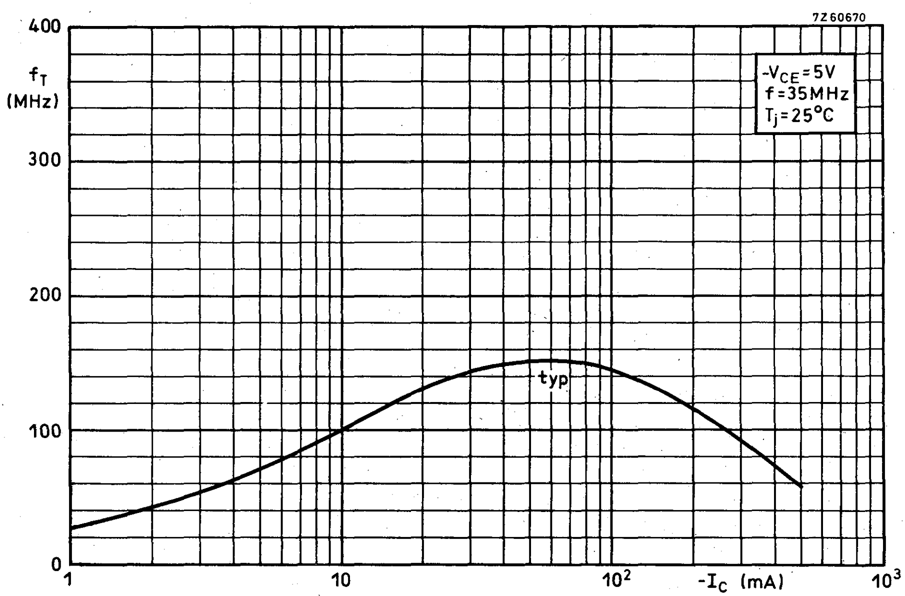
1) $-V_{BE}$ decreases by about 2 mV/°C with increasing temperature.


7Z62820A
600
400
200
0
$-I_C$ (mA)
$-V_{CE}$ = 1 V
T_j = 25 °C
min V_{BE}
typ
max
0,25
0,75
1,25
$-V_{BE}$ (V)


7Z62819A
15
10
5
0
$-I_C$ (mA)
$-V_{CE}$ = 5 V
T_j = 25 °C
min V_{BE}
typ
max
0
0,5
1
$-V_{BE}$ (V)


7Z67143A
2
1,5
1
0,5
0
$-V_{CEsat}$ (V)
I_C/I_B = 10
T_j = 25 °C
max
typ
1
10
10^2
$-I_C$ (mA)


7Z60669
300
h_{FE}
200
100
0
-V_{CE} = 1 V
T_j = 25 °C
typ
1
10
10^2
$-I_C$ (mA)
10^3


7Z60670
400
f_T
(MHz)
300
200
100
0
-V_{CE} = 5 V
f = 35 MHz
T_j = 25 °C
typ
1
10
10^2
$-I_C$ (mA)
10^3

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic envelope, intended for application in thick and thin-film circuits. These transistors are intended for general purposes as well as saturated switching and driver applications for industrial service.
P-N-P complements are BCX17; 17R and BCX18; 18R respectively.

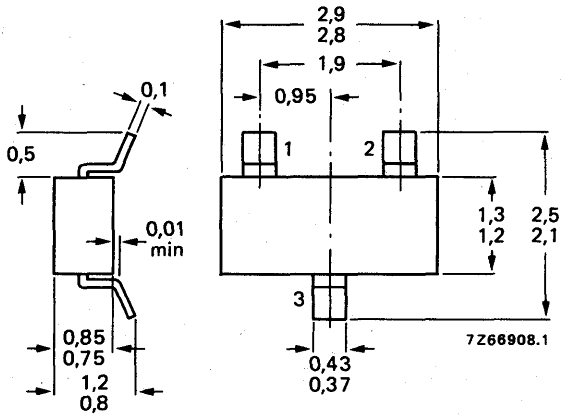
QUICK REFERENCE DATA

			BCX19 BCX19R	BCX20 BCX20R	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	25	V
Collector current (peak value)	I_{CM}	max.	1000		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	310		mW
Junction temperature	T_j	max.	150		°C
D.C. current gain I_C = 100 mA; V_{CE} = 1 V	h_{FE}		100 to 600		
Transition frequency I_C = 10 mA; V_{CE} = 5 V; f = 35 MHz	f_T	typ.	200		MHz

MECHANICAL DATA

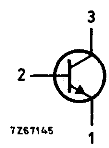
Dimensions in mm

Fig. 1 SOT-23.

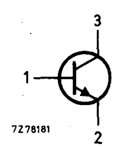


Marking code

BCX19 = U1
BCX20 = U2



BCX19R = U4
BCX20R = U5



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

			BCX19	BCX20	
Voltages					
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	50	30	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	45	25	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	V
Currents					
Collector current (d.c.)	I_C	max.	500		mA
Collector current (peak value)	I_{CM}	max.	1000		mA
Emitter current (peak value)	$-I_{EM}$	max.	1000		mA
Base current (d.c.)	I_B	max.	100		mA
Base current (peak value)	I_{BM}	max.	200		mA
Power dissipation					
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 15 mm x 15 mm x 0,5 mm	P_{tot}	max.	310		mW
Temperatures					
Storage temperature	T_{stg}		−65 to +150		°C
Junction temperature	T_j	max.	150		°C

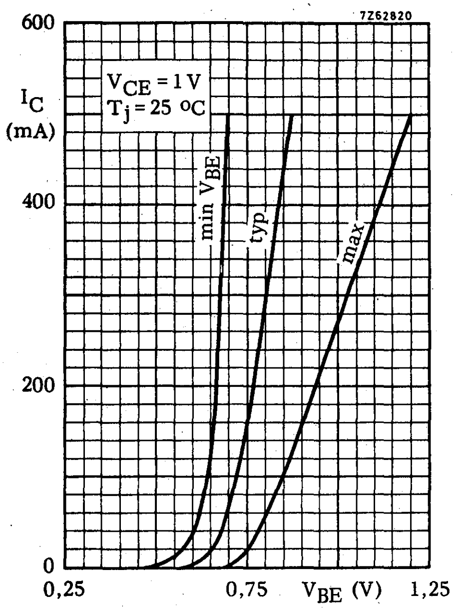
THERMAL RESISTANCE

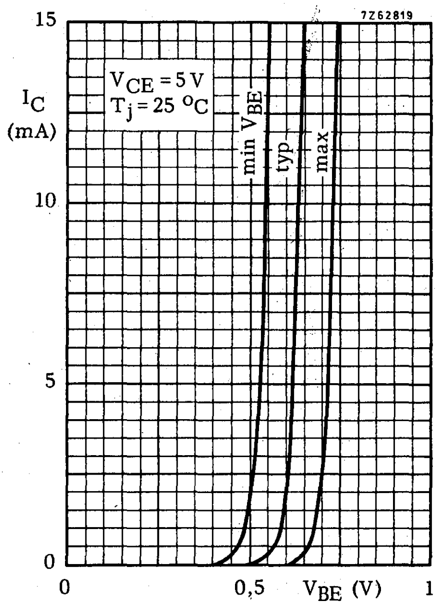
From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 15 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,4	°C/mW

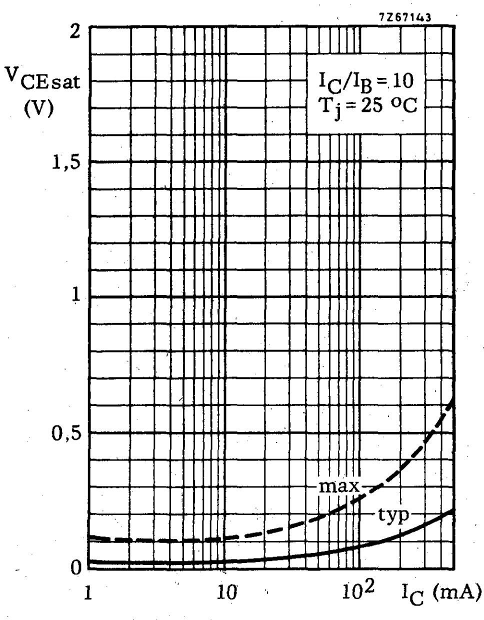
CHARACTERISTICS T_j = 25 °C unless otherwise specified

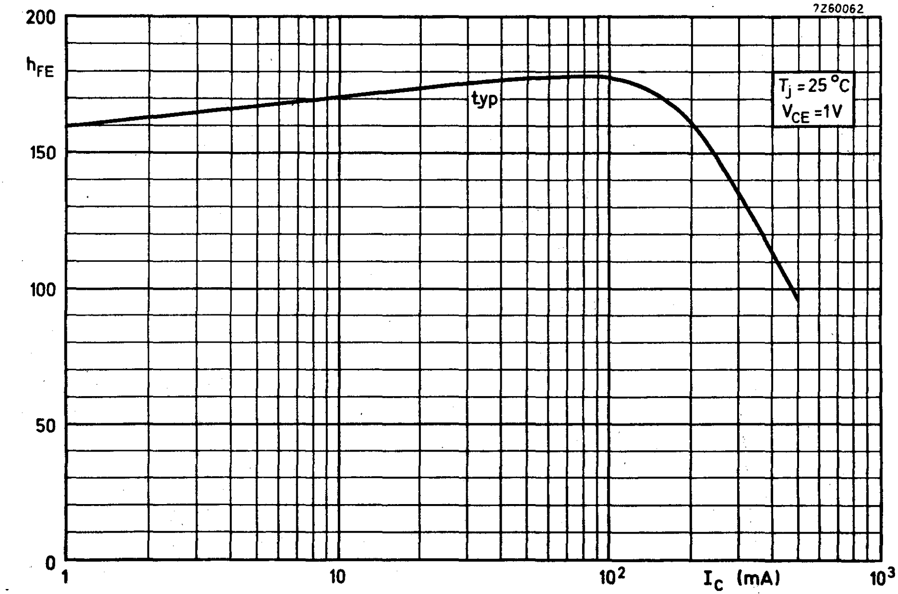
Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	I_{CBO}	<	5	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<	10	μA
Base emitter voltage [1]				
$I_C = 500$ mA; $V_{CE} = 1$ V	V_{BE}	<	1,2	V
Saturation voltage				
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	620	mV
D.C. current gain				
$I_C = 100$ mA; $V_{CE} = 1$ V	h_{FE}	100 to	600	
$I_C = 300$ mA; $V_{CE} = 1$ V	h_{FE}	>	70	
$I_C = 500$ mA; $V_{CE} = 1$ V	h_{FE}	>	40	
Transition frequency at f = 35 MHz				
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	typ.	200	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	5	pF

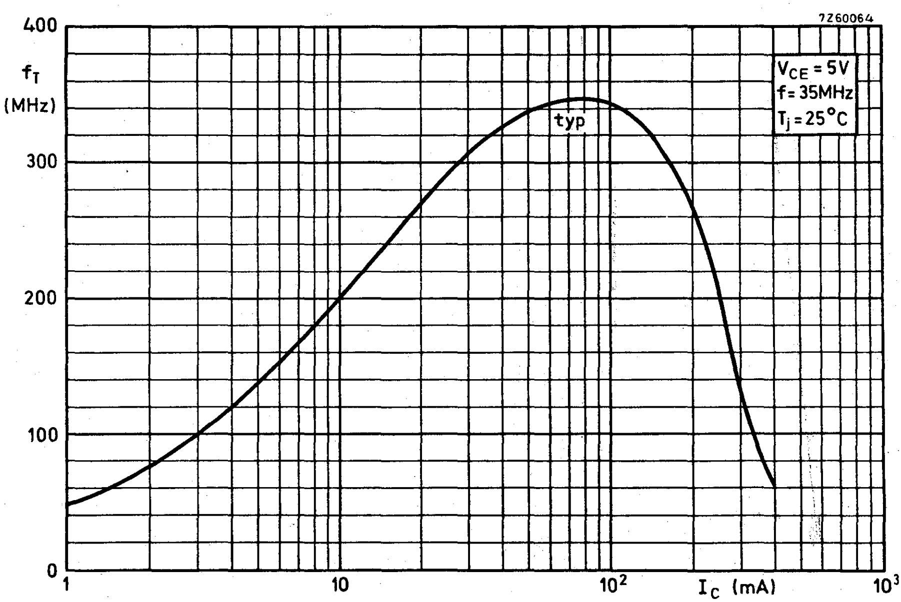
1) V_{BE} decreases by about 2 mV/°C with increasing temperature.


7Z62820
600
400
200
0
I_C
(mA)
V_CE = 1 V
T_j = 25 °C
min V_BE
typ
max
0,25
0,75
V_BE (V)
1,25


7Z62819
15
10
5
0
I_C
(mA)
V_CE = 5 V
T_j = 25 °C
min V_BE
typ
max
0
0,5
V_BE (V)
1


7Z67143
2
1,5
1
0,5
0
V_CEsat
(V)
I_C/I_B = 10
T_j = 25 °C
max
typ
1
10
10^2
I_C (mA)


7Z60062
200
h_{FE}
150
100
50
0
1
10
10^2
I_C (mA)
10^3
typ
T_j = 25 °C
V_{CE} = 1V


7Z60064
400
f_T
(MHz)
300
200
100
0
1
10
10^2
I_C (mA)
10^3
typ
V_{CE} = 5V
f = 35MHz
T_j = 25°C

SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power p-n-p transistors in a miniature plastic envelope intended for applications in thick and thin-film circuits. These transistors are intended for general purposes as well as for use in driver stages of audio amplifiers.

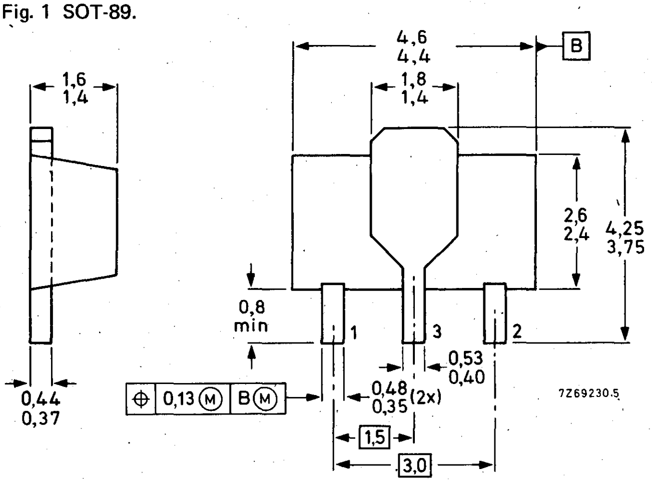
N-P-N complements are BCX54, BCX55 and BCX56 respectively.

QUICK REFERENCE DATA

			BCX51	BCX52	BCX53	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector current (peak value)	$-I_{CM}$	max.	1,5	1,5	1,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	>	40	40	40	
		<	250	160	160	
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f_T	typ.	50	50	50	MHz

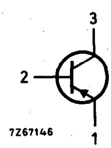
MECHANICAL DATA Dimensions in mm

Fig. 1 SOT-89.



Mark

BCX51
BCX52
BCX53



See also *Soldering recommendations.*

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

Voltages

			BCX51	BCX52	BCX53	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V

Currrents

Collector current (d.c.)	$-I_C$	max.	1,0	A
Collector current (peak value)	$-I_{CM}$	max.	1,5	A
Base current (d.c.)	$-I_B$	max.	0,1	A
Base current (peak value)	$-I_{BM}$	max.	0,2	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	P_{tot}	max.	1,0	W

Temperatures

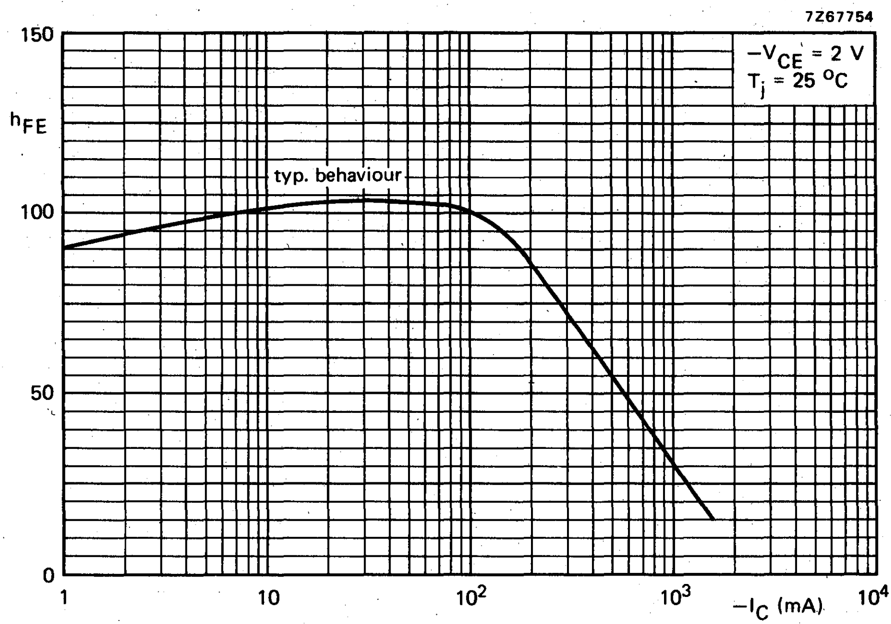
Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

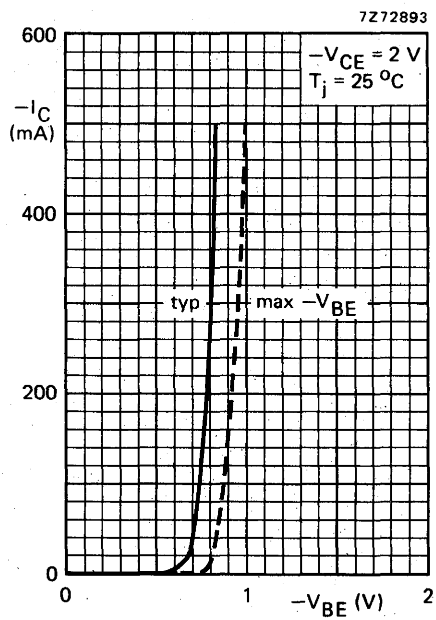
THERMAL RESISTANCE

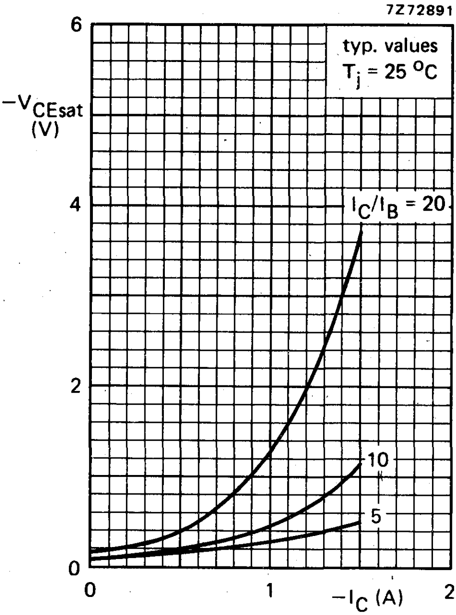
→ From junction to collector tab	$R_{th\,j\text{-}tab}$	=	10	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	$R_{th\,j\text{-}a}$	=	125	°C/W

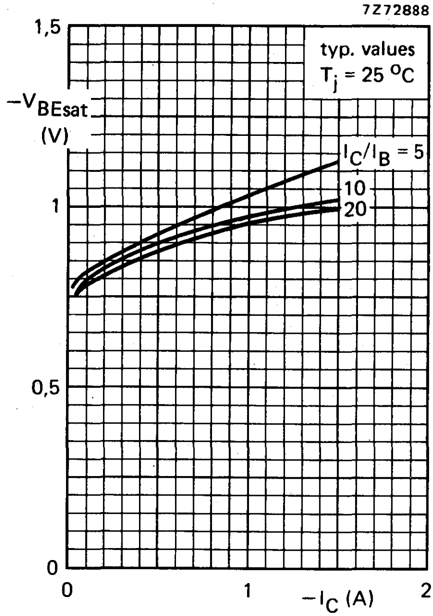
CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

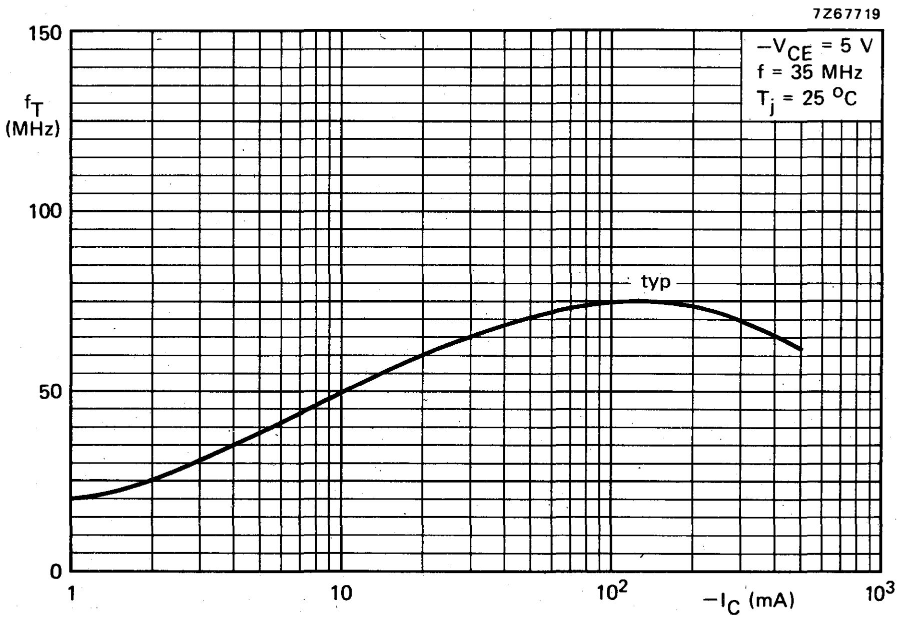
Collector cut-off current						
$I_E = 0$; $-V_{CB} = 30$ V	$-I_{CBO}$	<		100		nA
$I_E = 0$; $-V_{CB} = 30$ V; $T_j = 125$ °C	$-I_{CBO}$	<		10		μA
Emitter cut-off current						
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<		10		μA
Base-emitter voltage						
$-I_C = 500$ mA; $-V_{CE} = 2$ V	$-V_{BE}$	<		1		V
Saturation voltage						
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<		0,5		V
D.C. current gain			BCX51	BCX52	BCX53	
$-I_C = 5$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25	25	25	
$-I_C = 150$ mA; $-V_{CE} = 2$ V	h_{FE}	>	40	40	40	
		<	250	160	160	
$-I_C = 500$ mA; $-V_{CE} = 2$ V	h_{FE}	>	25	25	25	
Transition frequency at f = 35 MHz						
$-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T	typ.		50		MHz


7Z67754
150
100
50
0
h_{FE}
typ. behaviour
$-V_{CE}$ = 2 V
T_j = 25 °C
1
10
10^2
10^3
10^4
$-I_C$ (mA)


7Z72893
600
400
200
0
$-I_C$ (mA)
$-V_{CE}$ = 2 V
T_j = 25 °C
typ
max $-V_{BE}$
0
1
2
$-V_{BE}$ (V)


7Z72891
typ. values
T_j = 25 °C
$-V_{CEsat}$ (V)
I_C/I_B = 20
10
5
$-I_C$ (A)
0
2
4
6
0
1
2


7Z72888
typ. values
T_j = 25 °C
$-V_{BEsat}$ (V)
I_C/I_B = 5
10
20
$-I_C$ (A)
0
0,5
1
1,5
0
1
2


7Z67719
$-V_{CE}$ = 5 V
f = 35 MHz
T_j = 25 °C
f_T (MHz)
typ
$-I_C$ (mA)
0
50
100
150
1
10
10^2
10^3

SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power n-p-n transistors in a miniature plastic envelope intended for applications in thick and thin-film circuits. These transistors are intended for general purposes as well as for use in driver stages of audio amplifiers.

P-N-P complements are BCX51, BCX52 and BCX53 respectively.

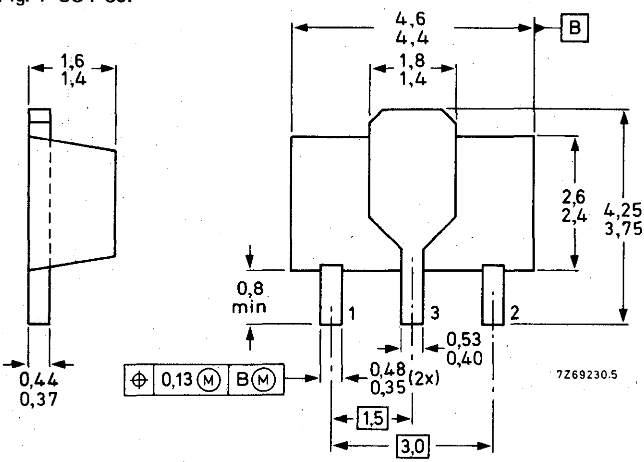
QUICK REFERENCE DATA

			BCX54	BCX55	BCX56	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (peak value)	I_{CM}	max.	1,5	1,5	1,5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain I_C = 150 mA; V_{CE} = 2 V	h_{FE}	> <	40 250	40 160	40 160	
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	130	130	130	MHz

MECHANICAL DATA

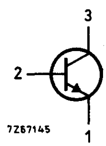
Dimensions in mm

Fig. 1 SOT-89.



Mark

BCX54
BCX55
BCX56



See also *Soldering recommendations.*

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

Voltages

			BCX54	BCX55	BCX56	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage ($R_{BE} \leq 1$ kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V

Currents

Collector current (d.c.)	I_C	max.	1,0	A
Collector current (peak value)	I_{CM}	max.	1,5	A
Base current (d.c.)	I_B	max.	0,1	A
Base current (peak value)	I_{BM}	max.	0,2	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	1,0	W

Temperatures

Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

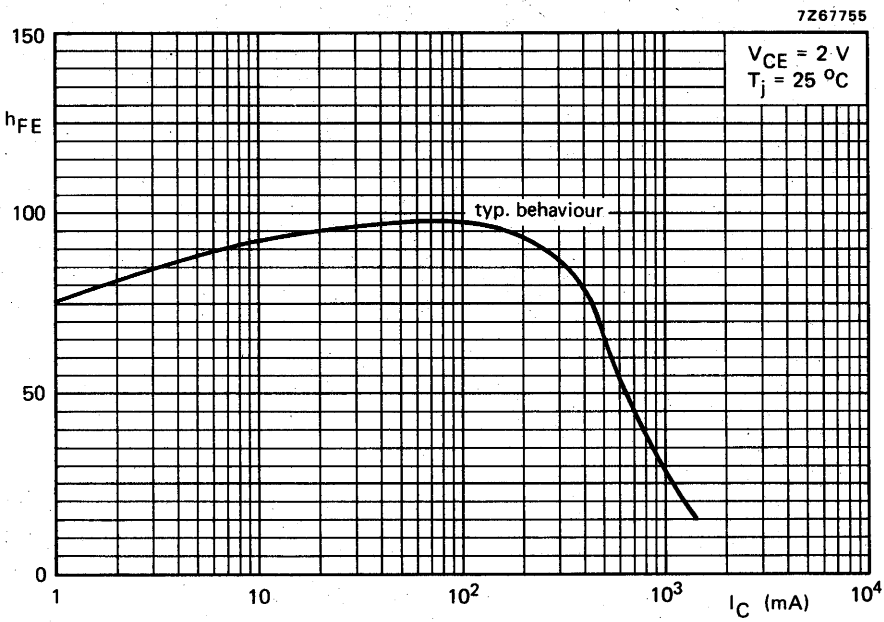
THERMAL RESISTANCE

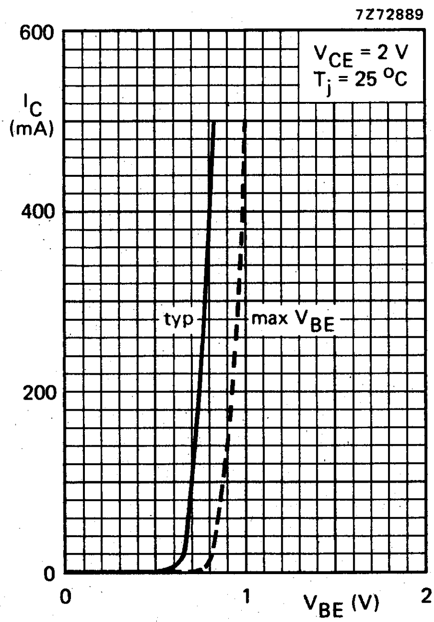
→ From junction to collector tab	$R_{th\,j\text{-}tab}$	=	10	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	$R_{th\,j\text{-}a}$	=	125	°C/W

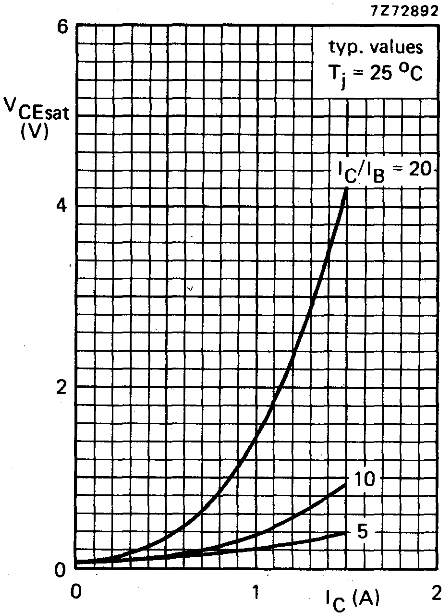
CHARACTERISTICS

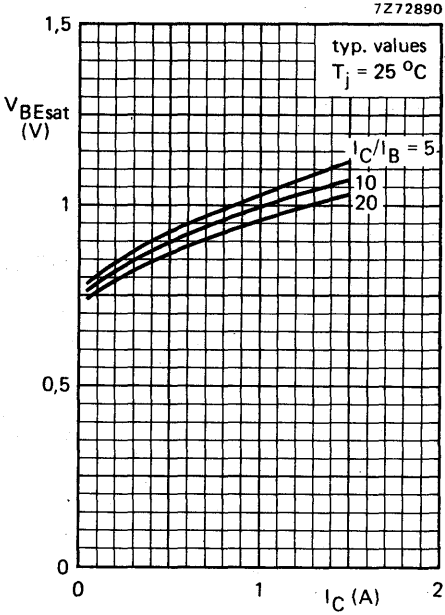
T_{amb} = 25 °C unless otherwise specified

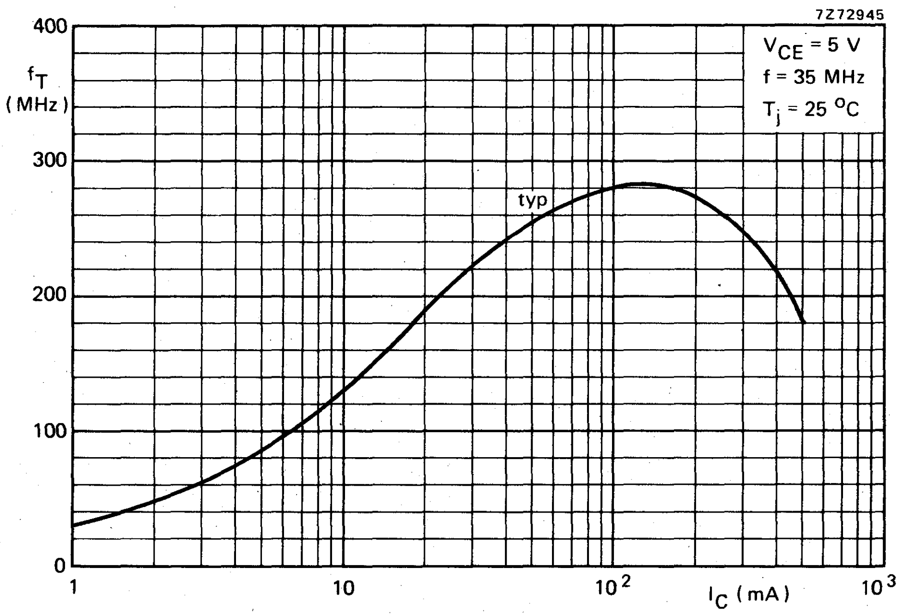
Collector cut-off current						
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	<		100		nA
$I_E = 0$; $V_{CB} = 30$ V; $T_j = 125$ °C	I_{CBO}	<		10		μA
Emitter cut-off current						
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	<		10		μA
Base-emitter voltage						
$I_C = 500$ mA; $V_{CE} = 2$ V	V_{BE}	<		1		V
Saturation voltage						
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<		0, 5		V
D. C. current gain			BCX54	BCX55	BCX56	
$I_C = 5$ mA; $V_{CE} = 2$ V	h_{FE}	>	25	25	25	
$I_C = 150$ mA; $V_{CE} = 2$ V	h_{FE}	>	40	40	40	
		<	250	160	160	
$I_C = 500$ mA; $V_{CE} = 2$ V	h_{FE}	>	25	25	25	
Transition frequency at f = 35 MHz						
$I_C = 10$ mA; $V_{CE} = 5$ V	f_T	typ.		130		MHz


7Z67755
150
hFE
100
50
0
1
10
10^2
10^3
10^4
I_C (mA)
V_{CE} = 2 V
T_j = 25 °C
typ. behaviour


7Z72889
600
I_C
(mA)
400
200
0
0
1
2
V_{BE} (V)
V_{CE} = 2 V
T_j = 25 °C
typ
max V_{BE}


7Z72892
typ. values
T_j = 25 °C
V_{CEsat} (V)
I_C/I_B = 20
10
5
I_C (A)
0
1
2
4
6


7Z72890
typ. values
T_j = 25 °C
V_{BEsat} (V)
I_C/I_B = 5
10
20
I_C (A)
0
0,5
1
1,5
2


7Z72945
V_{CE} = 5 V
f = 35 MHz
T_j = 25 °C
f_T (MHz)
typ
I_C (mA)
0
100
200
300
400
1
10
10^2
10^3

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor, in a microminiature plastic envelope, intended for applications in thick and thin-film circuits. This transistor is primarily intended for use in i.f. detection applications.

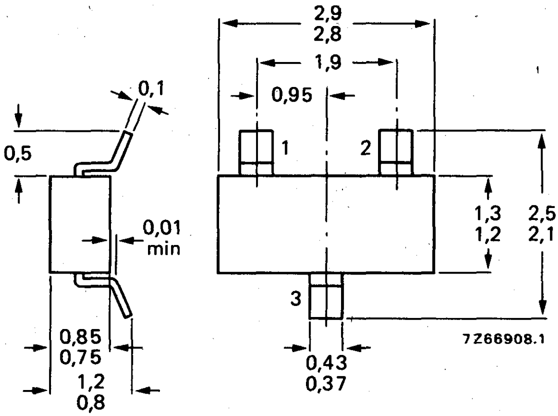
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	V
Collector current (d.c.)	$-I_C$	max.	25	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	180	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain at T_j = 25 °C $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	50	
Transition frequency at f = 100 MHz $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	f_T	typ.	325	MHz
Noise figure at R_S = 300 Ω $-I_C$ = 1 mA; $-V_{CE}$ = 10 V; f = 100 kHz	F	typ.	2	dB

MECHANICAL DATA

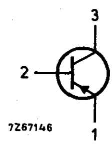
Dimensions in mm

Fig. 1 SOT-23

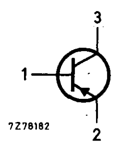


Marking code

BF550 = G2



BF550R = G5



See also *Soldering Recommendations*.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4 V
Collector current (d.c.)	$-I_C$	max.	25 mA
Total power dissipation up to T_{amb} = 60 °C *	P_{tot}	max.	180 mW
Storage temperature	T_{stg}		−55 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE *

From junction to ambient	$R_{th\ j\text{-}a}$	=	0,5 °C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $-V_{CB}$ = 30 V	$-I_{CBO}$	<	50 nA
Emitter cut-off current $I_C = 0$; $-V_{EB}$ = 3 V	$-I_{EBO}$	<	100 μA
Base-emitter voltage $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	$-V_{BE}$	typ.	750 mV
D.C. current gain $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	h_{FE}	>	50
Transition frequency at f = 100 MHz $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	f_T	typ.	325 MHz
Feedback capacitance at f = 1 MHz $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	C_{re}	typ.	0,5 pF
Noise figure at R_S = 300 Ω $-I_C$ = 1 mA; $-V_{CE}$ = 10 V; f = 100 kHz	F	typ.	2 dB

* Mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm.

SILICON EPITAXIAL TRANSISTOR

- **for video output stages**

N-P-N transistor in a miniature plastic envelope intended for application in thick and thin-film circuits. This device is intended for class-B video output stages in colour television receivers.

P-N-P complement is BF623.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	V
Collector current (peak value)	I_{CM}	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50	
Transition frequency at f = 35 MHz I_C = 10 mA; V_{CE} = 10 V	f_T	>	60	MHz
Feedback capacitance at f = 1 MHz I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6	pF

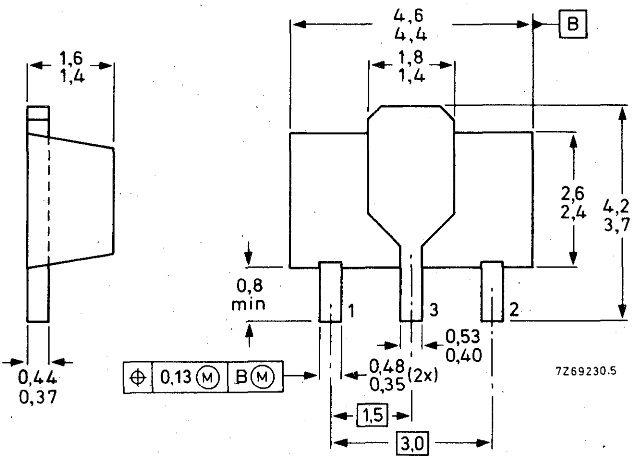
MECHANICAL DATA

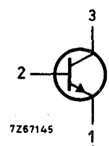
Dimensions in mm

Mark

Fig. 1 SOT-89.

BF622





See also *Soldering recommendations.*

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	250	V
Collector-emitter voltage (open base)	V_{CEO}	max.	250	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V
Collector current (d.c.)	I_C	max.	20	mA
Collector current (peak value)	I_{CM}	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	1	W
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	25	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	°C/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified			
Collector cut-off current			
I_E = 0; V_{CB} = 200 V	I_{CBO}	<	10 nA
R_{BE} = 10 kΩ; V_{CE} = 200 V; T_j = 150 °C	I_{CER}	<	50 μA
Emitter cut-off current			
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10 μA
Base-emitter voltage			
I_C = 25 mA; V_{CE} = 20 V	V_{BE}	typ.	0,73 V
D.C. current gain			
I_C = 25 mA; V_{CE} = 20 V	h_{FE}	>	50
High-frequency knee voltage at T_j = 150 °C *			
I_C = 25 mA	V_{CEK}	typ.	20 V
Transition frequency at f = 35 MHz			
I_C = 10 mA; V_{CE} = 10 V	f_T	>	60 MHz
Feedback capacitance at f = 1 MHz			
I_C = 0; V_{CE} = 30 V	C_{re}	<	1,6 pF
Feedback time constant at f = 10,7 MHz **			
I_C = 10 mA; V_{CE} = 20 V	$r_{bb'}C_{b'c}$	<	70 ps

* The high-frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small-signal gain, measured in a practical circuit, has dropped to 80% of the gain at V_{CE} = 50 V. A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

** $r_{bb'}C_{b'c} = \frac{|h_{rb}|}{\omega}$.

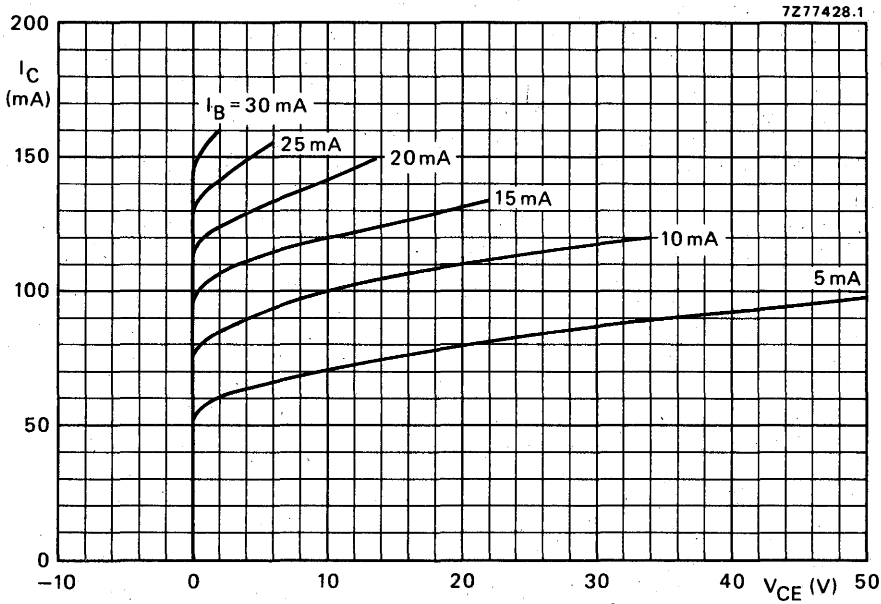


Fig. 2 Typical values at T_j = 25 °C.

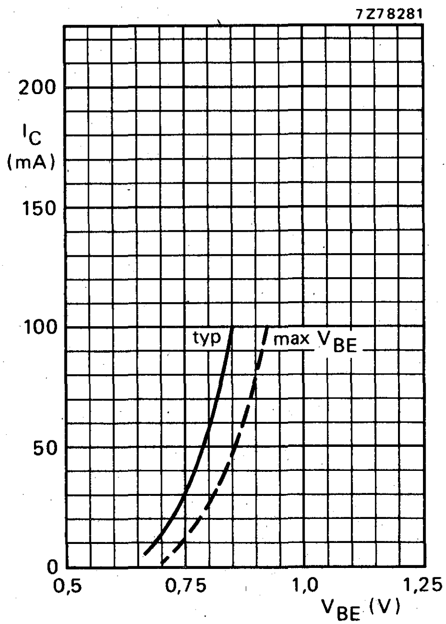


Fig. 3 V_{CE} = 20 V; T_j = 25 °C.

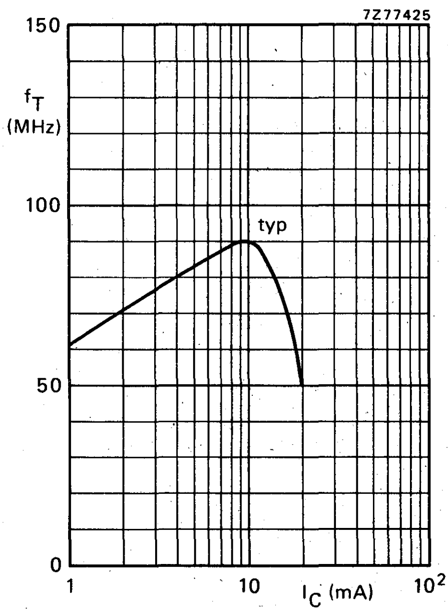


Fig. 4 V_{CE} = 10 V; T_j = 25 °C; f = 35 MHz.

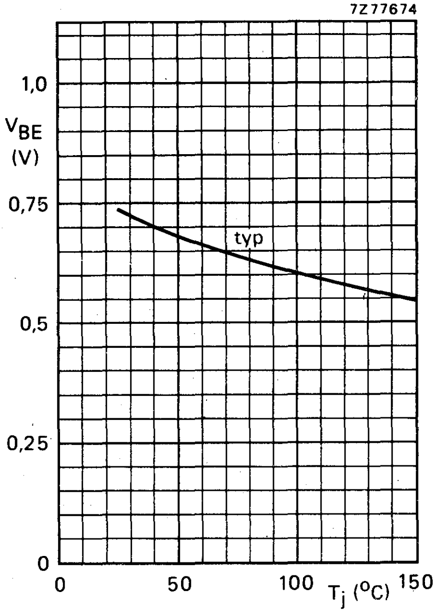


Fig. 5 I_C = 25 mA; V_{CE} = 20 V.

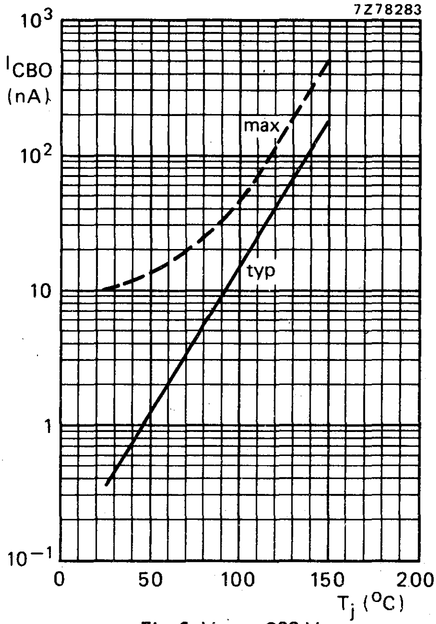


Fig. 6 V_{CB} = 200 V.

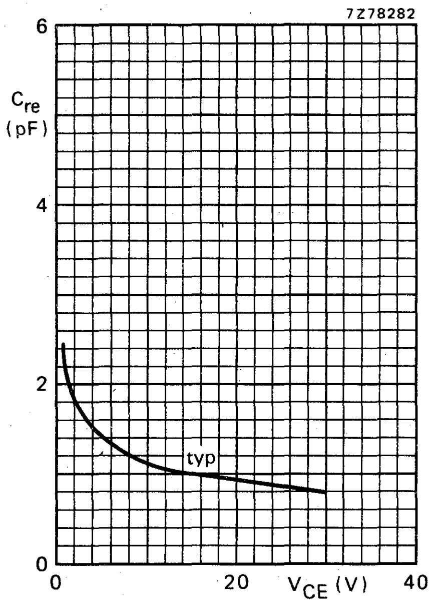


Fig. 7 I_C = 0; f = 1 MHz; T_j = 25 °C.

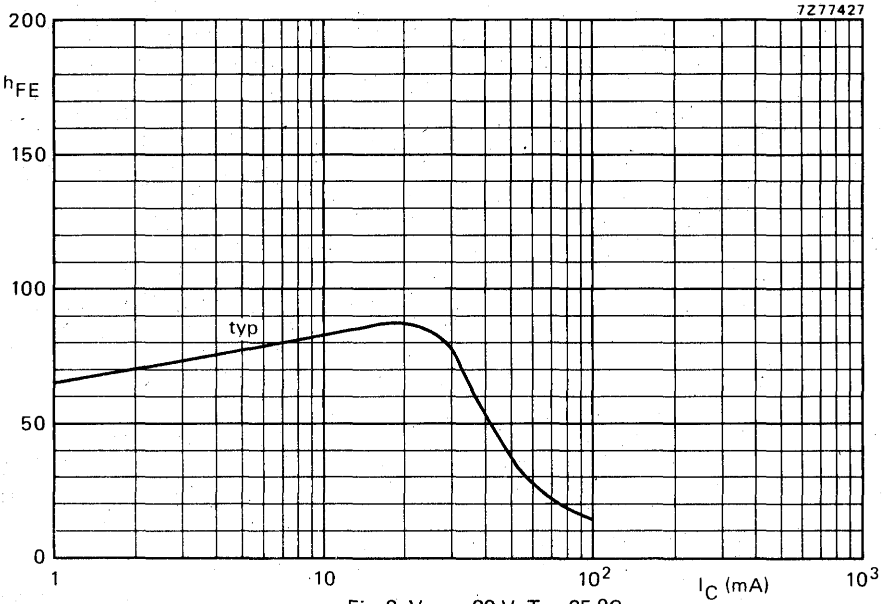


Fig. 8 V_{CE} = 20 V; T_j = 25 °C.

SILICON EPITAXIAL TRANSISTOR

- **for video output stages**

P-N-P transistor in a miniature plastic envelope intended for application in thick and thin-film circuits. This device is intended for class-B video output stages in colour television receivers.

N-P-N complement is BF622.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250 V
Collector current (peak value)	$-I_{CM}$	max.	100 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Junction temperature	T_j	max.	150 °C
D.C. current gain $-I_C$ = 25 mA; $-V_{CE}$ = 20 V	h_{FE}	>	50
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 10 V	f_T	>	60 MHz
Feedback capacitance at f = 1 MHz I_C = 0; $-V_{CE}$ = 30 V	C_{re}	<	1,6 pF

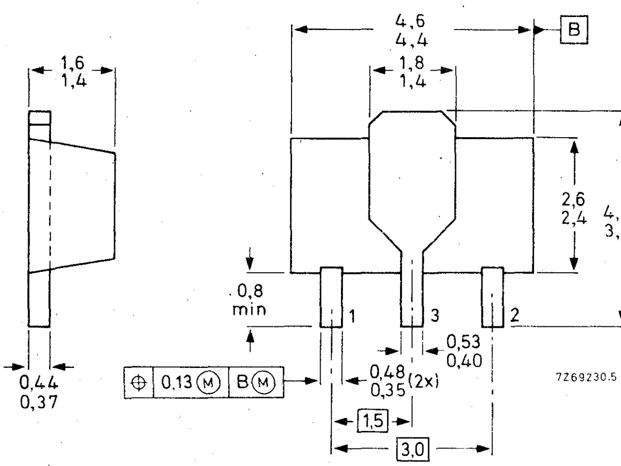
MECHANICAL DATA

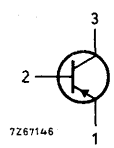
Dimensions in mm

Mark

Fig. 1 SOT-89.

BF623





See also *Soldering recommendations*.

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	250	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	250	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	$-I_C$	max.	20	mA
Collector current (peak value)	$-I_{CM}$	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	P_{tot}	max.	1	W
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	25	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	°C/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 200$ V	$-I_{CBO}$	<	10 nA
$R_{BE} = 10$ kΩ; $-V_{CE} = 200$ V; $T_j = 150$ °C	$-I_{CER}$	<	50 μA
Emitter cut-off current			
$I_C = 0$; $-V_{EB} = 5$ V	$-I_{EBO}$	<	10 μA
Base-emitter voltage			
$-I_C = 25$ mA; $-V_{CE} = 20$ V	$-V_{BE}$	typ.	0,75 V
D.C. current gain			
$-I_C = 25$ mA; $-V_{CE} = 20$ V	h_{FE}	>	50
High-frequency knee voltage at $T_j = 150$ °C *			
$-I_C = 25$ mA	$-V_{CEK}$	typ.	20 V
Transition frequency at f = 35 MHz			
$-I_C = 10$ mA; $-V_{CE} = 10$ V	f_T	>	60 MHz
Feedback capacitance at f = 1 MHz			
$I_C = 0$; $-V_{CE} = 30$ V	C_{re}	<	1,6 pF
Feedback time constant at f = 10,7 MHz **			
$-I_C = 10$ mA; $-V_{CE} = 20$ V	$r_{bb'}C_{b'c}$	<	70 ps

* The high-frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small-signal gain, measured in a practical circuit, has dropped to 80% of the gain at $-V_{CE} = 50$ V. A further reduction of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

** $r_{bb'}C_{b'c} = \frac{|h_{rb}|}{\omega}$.

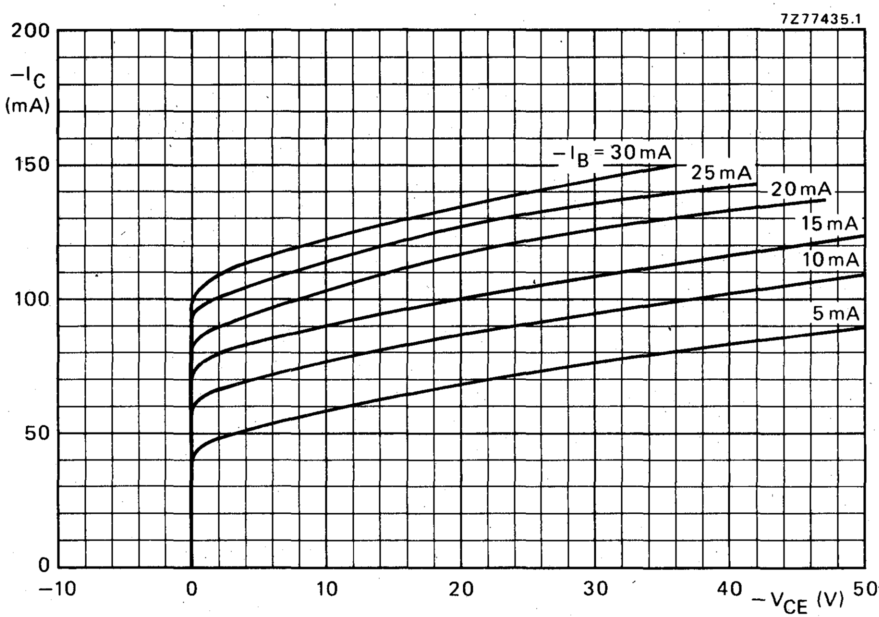


Fig. 2 Typical values at T_j = 25 °C.

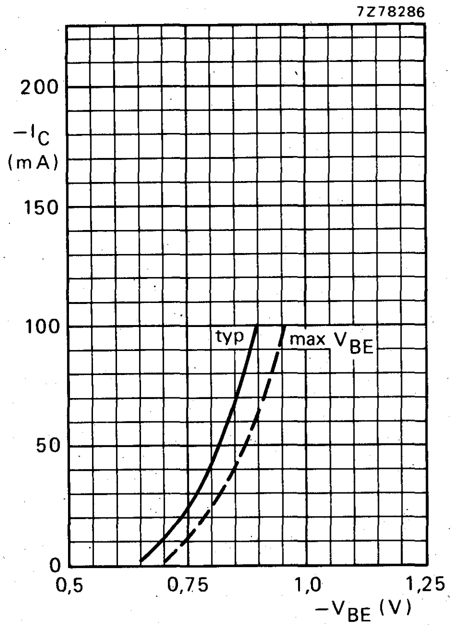


Fig. 3 $-V_{CE}$ = 20 V; T_j = 25 °C.

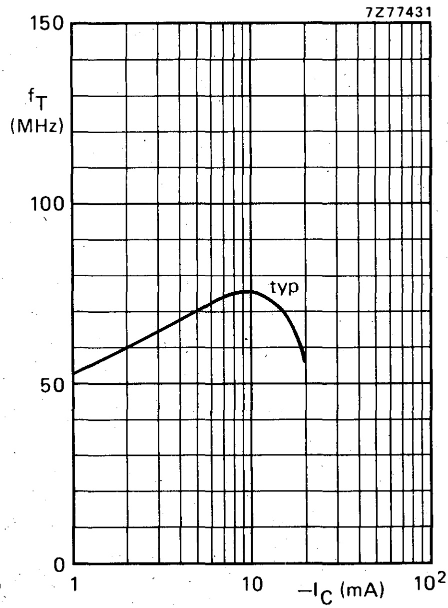


Fig. 4 $-V_{CE}$ = 10 V; T_j = 25 °C; f = 35 MHz.

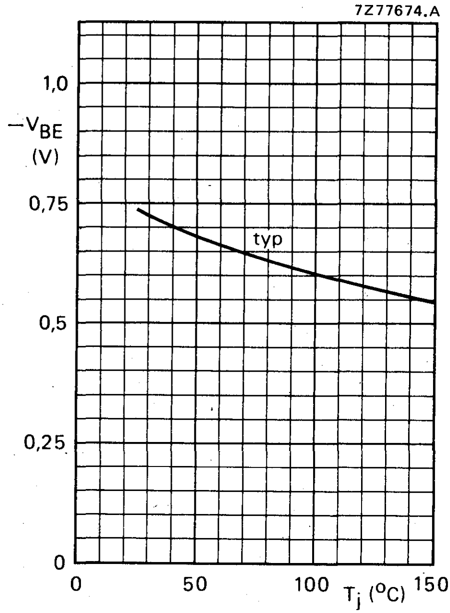


Fig. 5 $-I_C$ = 25 mA; $-V_{CE}$ = 20 V.

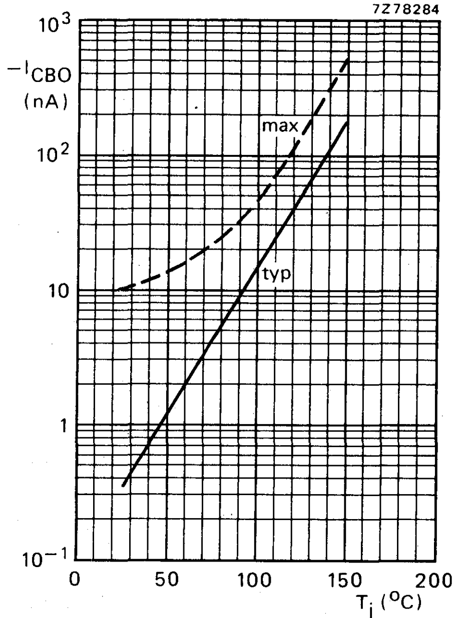


Fig. 6 $-V_{CB}$ = 200 V.

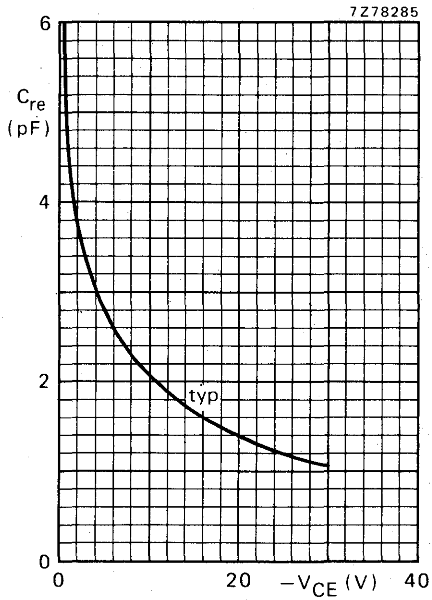


Fig. 7 I_C = 0; f = 1 MHz; T_j = 25 °C.

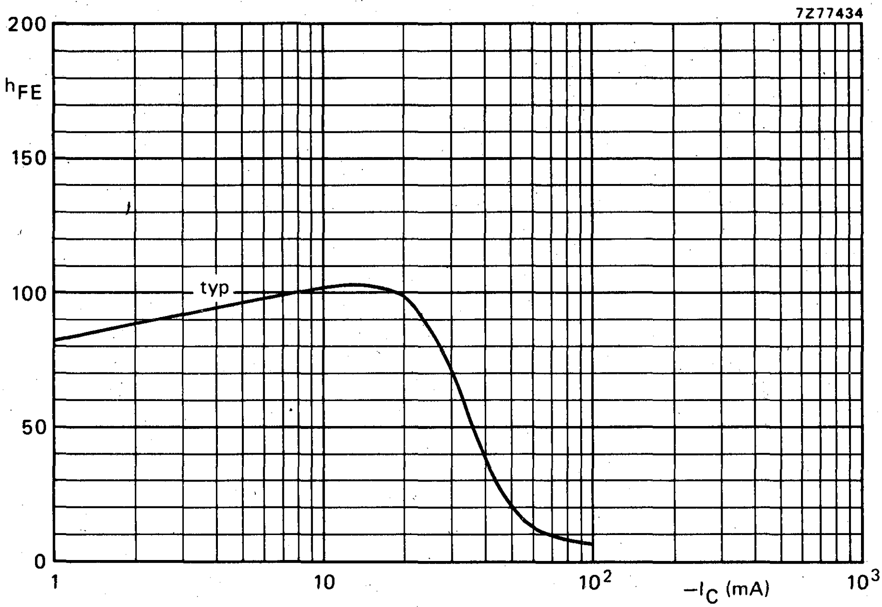


Fig. 8 $-V_{CE}$ = 20 V; T_j = 25 °C.

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N multi-emitter transistor in a miniature plastic envelope intended for application in thick and thin-film circuits. The transistor has extremely good intermodulation properties and a high power gain. It is primarily intended for:

- Output and driver stages of channel and band serial amplifiers with high output power for bands I, II, III and IV/V (40–860 MHz).
- Output and driver stages of wideband amplifiers.

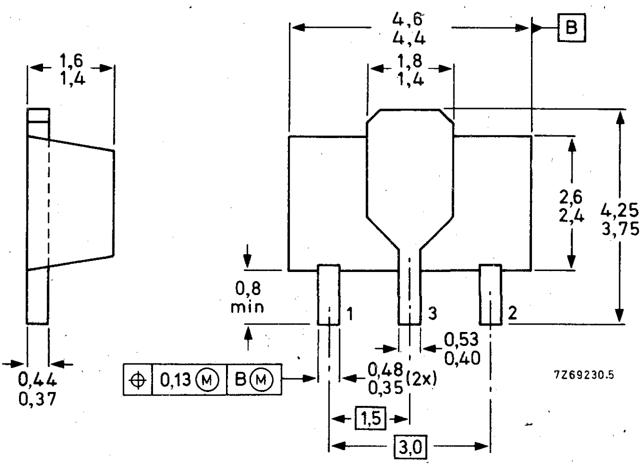
QUICK REFERENCE DATA

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	40	V
Collector-emitter voltage (open base)	V_{CEO}	max.	25	V
Collector current (peak value; f > 1 MHz)	I_{CM}	max.	300	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	W
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 150 mA; V_{CE} = 15 V	f_T	typ.	1,2	GHz
Feedback capacitance at f = 1 MHz I_C = 10 mA; V_{CE} = 15 V; T_{amb} = 25 °C	C_{re}	typ.	1,9	pF

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89.



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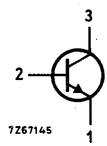


See also *Soldering recommendations.*

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

Voltages

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	40	V	
Collector-emitter voltage ($R_{BE} \leq 50\ \Omega$; peak value)	V_{CERM}	max.	40	V	[1]
Collector-emitter voltage (open base)	V_{CEO}	max.	25	V	[1]
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V	

Currents

Collector current (d.c.)	I_C	max.	150	mA
Collector current (peak value; f > 1 MHz)	I_{CM}	max.	300	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	1	W

Temperatures

Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\,j-tab}$	=	30	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	$R_{th\,j-a}$	=	125	°C/W

[1] I_C = 10 mA.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C	I_{CBO}	<	20	μA
Saturation voltage				
$I_C = 100$ mA; $I_B = 10$ mA	V_{CEsat}	<	0,5	V
D.C. current gain				
$I_C = 50$ mA; $V_{CE} = 5$ V	h_{FE}	>	25	
$I_C = 150$ mA; $V_{CE} = 5$ V	h_{FE}	>	25	
Transition frequency at f = 500 MHz [1]				
$I_C = 150$ mA; $V_{CE} = 15$ V	f_T	typ.	1,2	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 15$ V	C_c	<	4	pF
Feedback capacitance at f = 1 MHz				
$I_C = 10$ mA; $V_{CE} = 15$ V; $T_{amb} = 25$ °C	C_{re}	typ.	1,9	pF

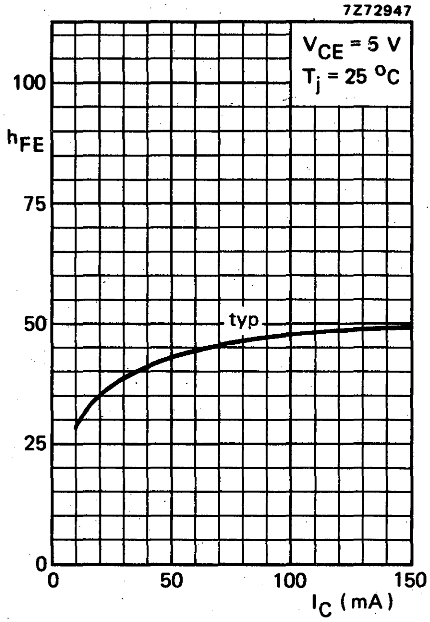
Max. unilateral power gain (s_{re} assumed to be zero)

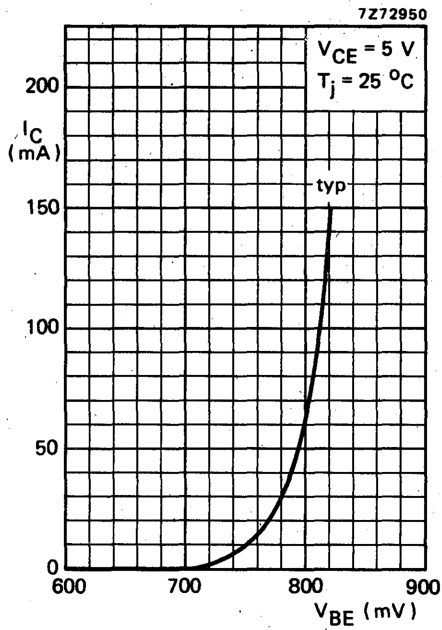
$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$$

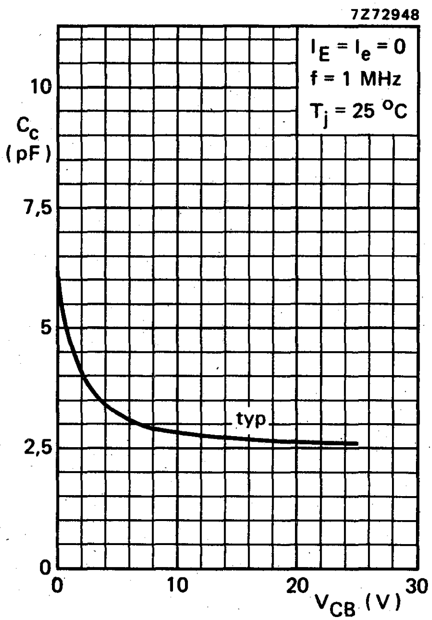
$I_C = 60$ mA; $V_{CE} = 15$ V; $T_{amb} = 25$ °C;

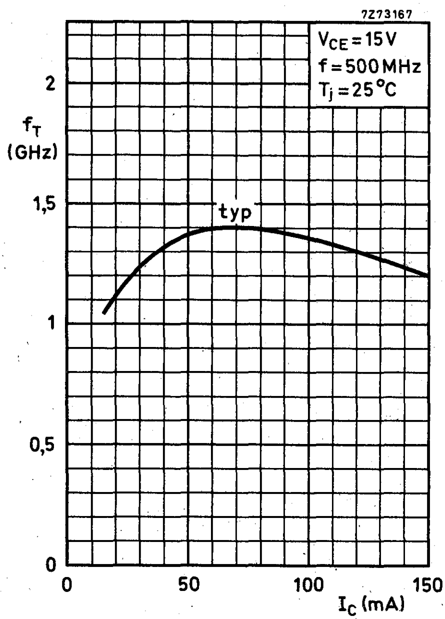
f = 200 MHz	G_{UM}	typ.	16	dB
f = 800 MHz	G_{UM}	typ.	6,5	dB

[1] Measured under pulse conditions.


7Z72947
V_{CE} = 5 V
T_j = 25 °C
100
h_{FE}
75
50
typ
25
0
0
50
100
150
I_C (mA)


7Z72950
V_{CE} = 5 V
T_j = 25 °C
200
I_C
(mA)
typ
150
100
50
0
600
700
800
900
V_{BE} (mV)


7Z72948
I_E = I_e = 0
f = 1 MHz
T_j = 25 °C
10
C_c
(pF)
7,5
5
typ
2,5
0
0
10
20
30
V_{CB} (V)


7Z73167
V_{CE} = 15 V
f = 500 MHz
T_j = 25 °C
2
f_T
(GHz)
1,5
typ
1
0,5
0
0
50
100
150
I_C (mA)

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a miniature plastic envelope intended for application in thick and thin-film circuits. It is primarily intended for MATV purposes.

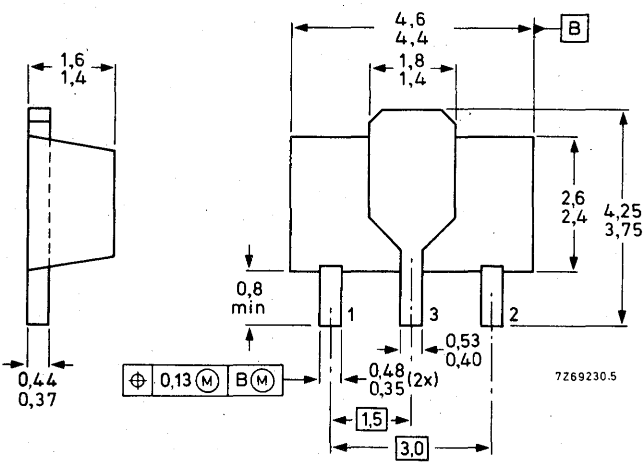
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	25 V
Collector-emitter voltage (open base)	V_{CEO}	max.	15 V
Collector current (d.c.)	I_C	max.	150 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1 W
Junction temperature	T_j	max.	150 °C
Transition frequency at f = 500 MHz I_C = 100 mA; V_{CE} = 10 V	f_T	typ.	3,6 GHz
Feedback capacitance at f = 10,7 MHz I_C = 0; V_{CE} = 10 V	C_{re}	typ.	1,2 pF
Intermodulation distortion I_C = 80 mA; V_{CE} = 10 V; R_L = 75 Ω measured at $f_{(p+q-r)}$ = 793,25 MHz	d_{im}	<	−60 dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89.



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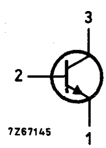


See also *Soldering recommendations.*

RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V
Collector current (d.c.)	I_C	max.	150	mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	1	W
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	25	°C/W
From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	125	°C/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

D.C. current gain **				
I_C = 50 mA; V_{CE} = 10 V	h_{FE}	>	25	
I_C = 100 mA; V_{CE} = 10 V	h_{FE}	>	25	
Transition frequency at f = 500 MHz **				
I_C = 50 mA; V_{CE} = 10 V	f_T	typ.	3,2	GHz
I_C = 100 mA; V_{CE} = 10 V	f_T	typ.	3,6	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	typ.	2,0	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; V_{EB} = 0,5 V	C_e	typ.	11	pF
Feedback capacitance at f = 10,7 MHz				
$I_C = 0$; V_{CE} = 10 V	C_{re}	typ.	1,2	pF

* The device mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm.
** Measured under pulse conditions.

Intermodulation distortion (see Fig. 2)

I_C = 80 mA; V_{CE} = 10 V; R_L = 75 Ω
$V_p = V_o$ = 700 mV at f_p = 795,25 MHz
$V_q = V_o$ −6 dB at f_q = 803,25 MHz
$V_r = V_o$ −6 dB at f_r = 805,25 MHz
Measured at $f_{(p+q-r)}$ = 793,25 MHz d_{im} $<$ −60 dB

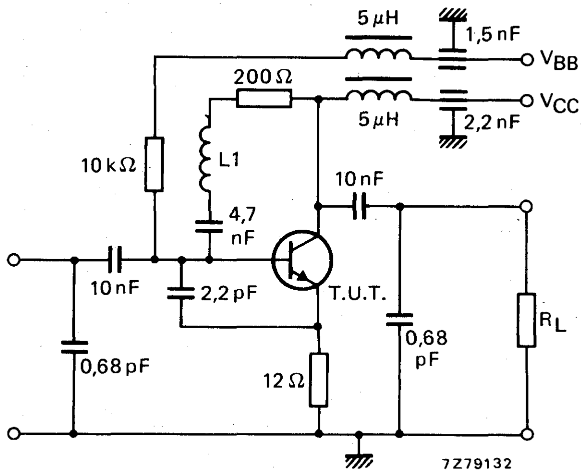


Fig. 2 MATV-test circuit (40–860 MHz).

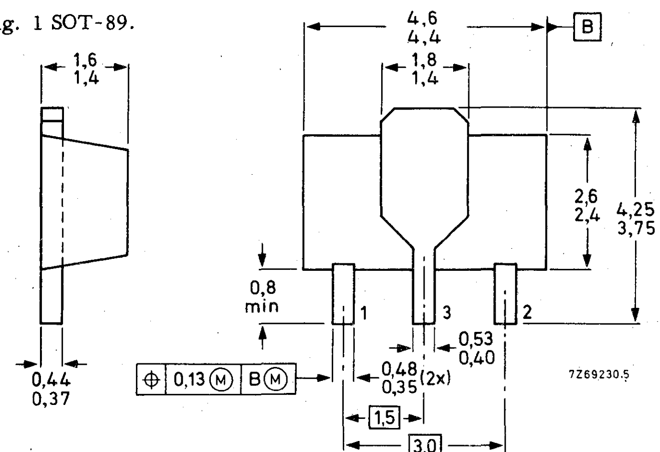
SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a miniature plastic envelope intended for application in thick- and thin-film circuits.
It is primarily intended for use in u.h.f. and microwave amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc.
The transistor features very low intermodulation distortion and high power gain. Thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (d.c.)	I_C	max.	75	mA
Total power dissipation up to T_{amb} = 87,5 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz I_C = 10 mA; V_{CE} = 10 V; T_{amb} = 25 °C	C_{re}	typ.	1,3	pF
Noise figure at optimum source impedance I_C = 50 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	3,3	dB

MECHANICAL DATA Dimensions in mm

Fig. 1 SOT-89.



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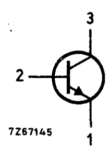


See also Soldering recommendations.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3,0	V

Currents

Collector current (d.c.)	I_C	max.	75	mA
Collector current (peak value); f > 1 MHz	I_{CM}	max.	150	mA

Power dissipation

Total power dissipation up to T_{amb} = 87,5 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	500	mW

Temperatures

Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\,j-tab}$	=	40	°C/W ←
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	$R_{th\,j-a}$	=	125	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

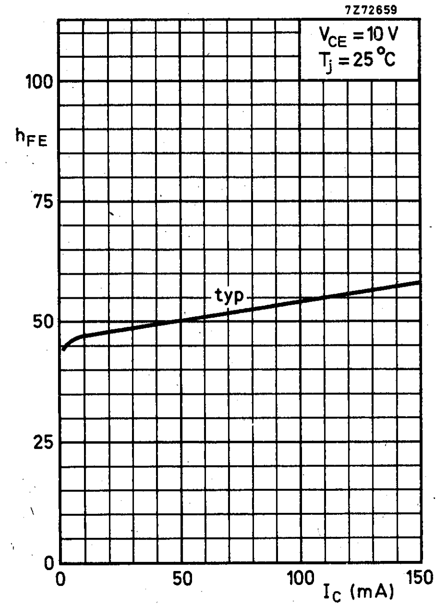
Collector cut-off current				
$I_E = 0$: $V_{CB} = 10$ V	I_{CBO}	<	100	nA
D.C. current gain [1]				
$I_C = 50$ mA; $V_{CE} = 10$ V	h_{FE}	> typ.	25 50	
$I_C = 75$ mA; $V_{CE} = 10$ V	h_{FE}	> typ.	25 52	
Transition frequency at f = 500 MHz [1]				
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	> typ.	4,0 5,0	GHz GHz
$I_C = 75$ mA; $V_{CE} = 10$ V	f_T	> typ.	4,4 5,5	GHz GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	1,6	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0,5$ V	C_e	typ.	5,0	pF
Feedback capacitance at f = 1 MHz				
$I_C = 10$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C	C_{re}	typ.	1,3	pF
Noise figure at optimum source impedance				
$I_C = 50$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	3,3	dB

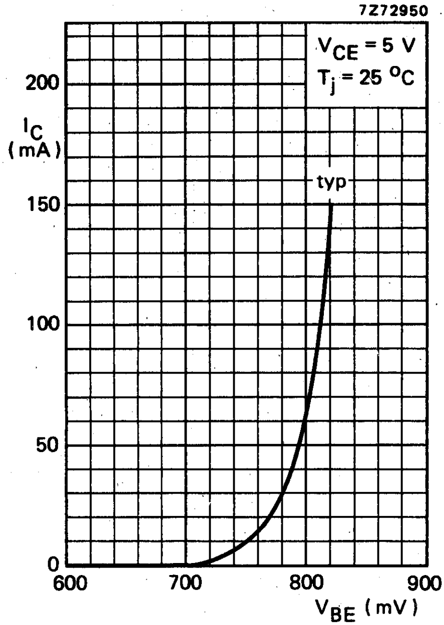
Max. unilateral power gain (s_{re} assumed to be zero)

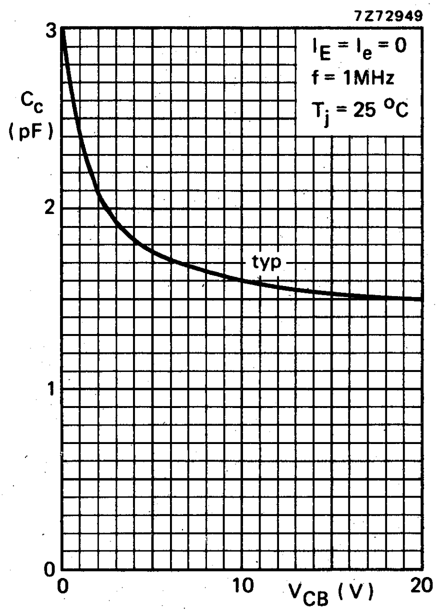
$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{fe}|^2}{(1-|s_{ie}|^2)(1-|s_{oe}|^2)}$$

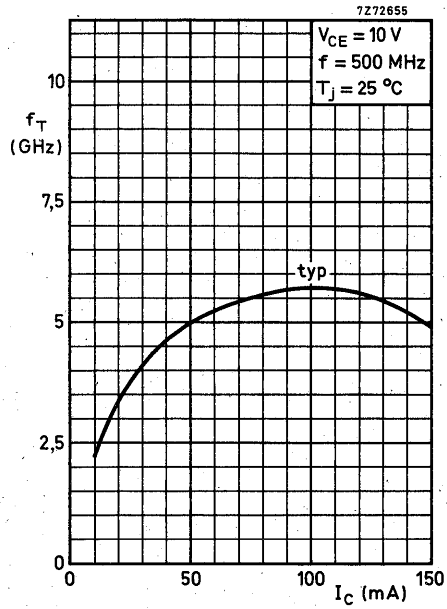
$I_C = 50$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C;				
f = 200 MHz	G_{UM}	typ.	18,5	dB
f = 500 MHz	G_{UM}	typ.	11,5	dB
f = 800 MHz	G_{UM}	typ.	7,5	dB

1) Measured under pulse conditions.


7Z72659
$V_{CE} = 10$ V
$T_j = 25$ °C
h_{FE}
100
75
50
25
0
typ
0
50
100
150
I_C (mA)


7Z72950
$V_{CE} = 5$ V
$T_j = 25$ °C
I_C (mA)
200
150
100
50
0
typ
600
700
800
900
V_{BE} (mV)


7Z72949
$I_E = I_e = 0$
f = 1MHz
$T_j = 25$ °C
C_c (pF)
3
2
1
0
typ
0
10
20
V_{CB} (V)


7Z72655
$V_{CE} = 10$ V
f = 500 MHz
$T_j = 25$ °C
f_T (GHz)
10
7,5
5
2,5
0
typ
0
50
100
150
I_C (mA)

N-CHANNEL SILICON FIELD EFFECT TRANSISTOR

Planar epitaxial junction field effect transistor in a microminiature plastic envelope. It is intended for low level general purpose amplifiers in thick and thin-film circuits.

QUICK REFERENCE DATA

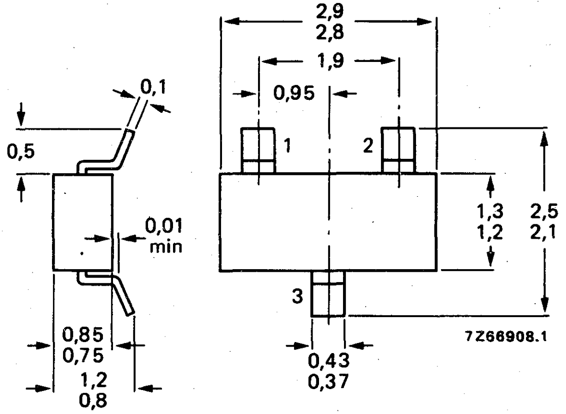
Drain-source voltage	$\pm V_{DS}$	max.	25		V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25		V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200		mW
			BFR30	BFR31	
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	>	4	1	mA
		<	10	5	mA
Transfer admittance (common source) I_D = 1 mA; V_{DS} = 10 V; f = 1 kHz	$\|y_{fs}\|$	>	1,0	1,5	mA/V
		<	4,0	4,5	mA/V

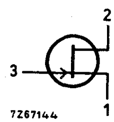
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.

Marking code
BFR30 = M1
BFR31 = M2





See also *Soldering recommendations.*

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

Voltages				
Drain-source voltage	$\pm V_{DS}$	max.	25	V
Drain-gate voltage (open source)	V_{DGO}	max.	25	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	V
Current				
Drain current	I_D	max.	10	mA
Gate current	I_G	max.	5	mA
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	P_{tot}	max.	200	mW
Temperatures				
Storage temperature	T_{stg}	−65 to	+150	°C
Junction temperature	T_j	max.	150	°C

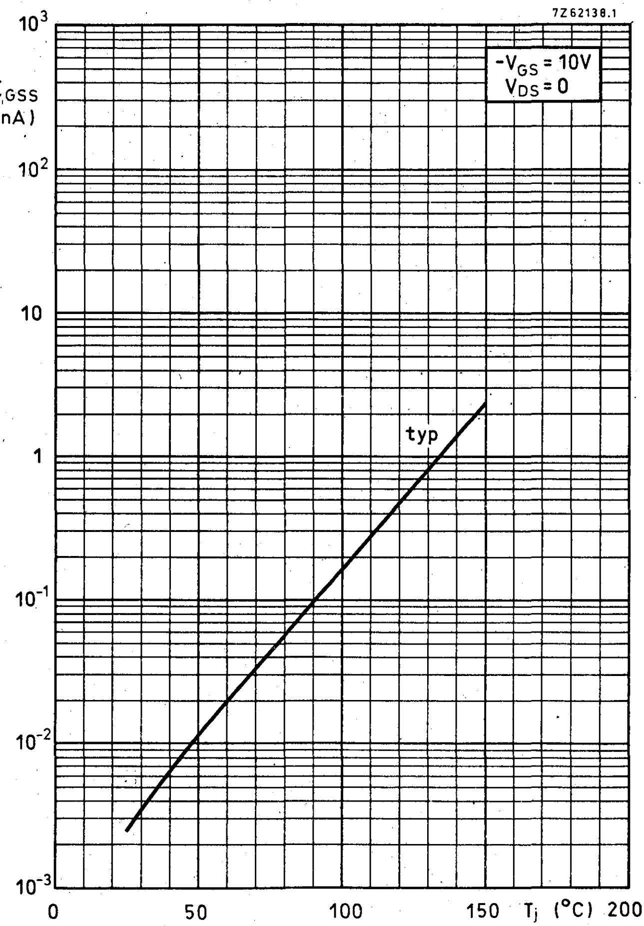
THERMAL RESISTANCE

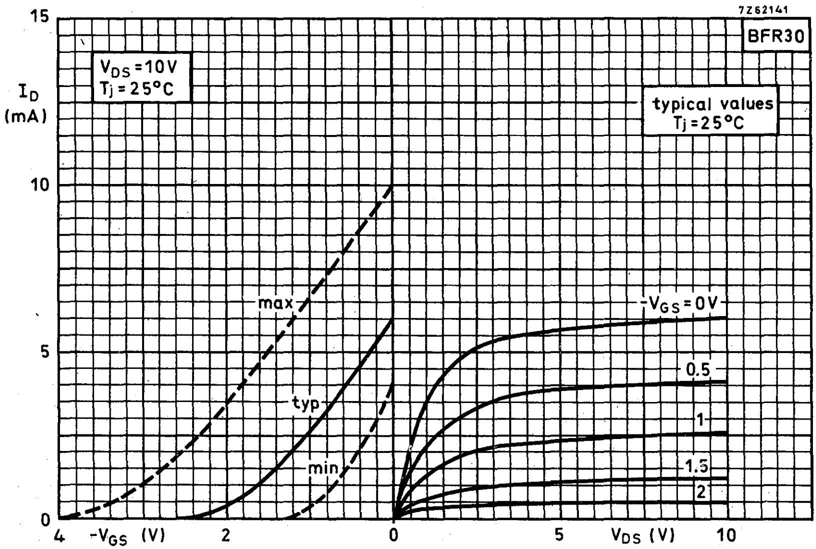
From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	$R_{th\ j-a}$	=	0.62	°C/mW

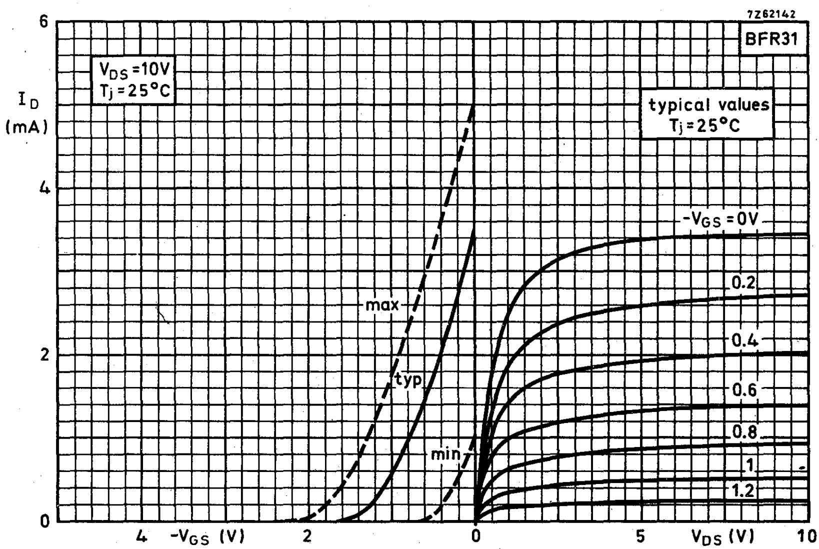
CHARACTERISTICS

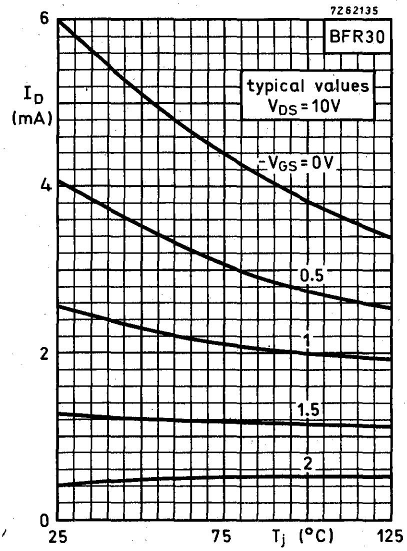
T_j = 25 °C unless otherwise specified

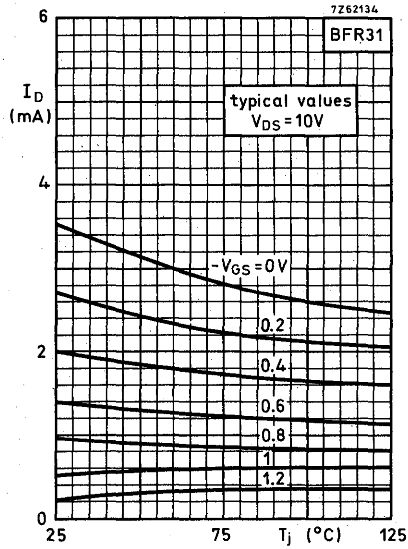
			BFR30	BFR31	
Gate cut-off current					
$-V_{GS}$ = 10 V; V_{DS} = 0	$-I_{GSS}$	<	0.2	0.2	nA
Drain current					
V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	>	4	1	mA
		<	10	5	mA
Gate-source voltage					
I_D = 1 mA; V_{DS} = 10 V	$-V_{GS}$	>	0.7	0	V
		<	3.0	1.3	V
I_D = 50 μA; V_{DS} = 10 V	$-V_{GS}$	<	4.0	2.0	V
Gate-source cut-off voltage					
I_D = 0.5 nA; V_{DS} = 10 V	$-V_{(P)GS}$	<	5	2.5	V
y parameters					
Transfer admittance at f = 1 kHz; T_{amb} = 25 °C					
I_D = 1 mA; V_{DS} = 10 V	$\|y_{fs}\|$	>	1.0	1.5	mA/V
		<	4.0	4.5	mA/V
I_D = 200 μA; V_{DS} = 10 V	$\|y_{fs}\|$	>	0.5	0.75	mA/V
Output admittance at f = 1 kHz					
I_D = 1 mA; V_{DS} = 10 V	$\|y_{os}\|$	<	40	25	μA/V
I_D = 200 μA; V_{DS} = 10 V	$\|y_{os}\|$	<	20	15	μA/V
Input capacitance at f = 1 MHz					
I_D = 1 mA; V_{DS} = 10 V	C_{is}	<	4	4	pF
I_D = 200 μA; V_{DS} = 10 V	C_{is}	<	4	4	pF
Feedback capacitance at f = 1 MHz; T_{amb} = 25 °C					
I_D = 1 mA; V_{DS} = 10 V	C_{rs}	<	1.5	1.5	pF
I_D = 200 μA; V_{DS} = 10 V	C_{rs}	<	1.5	1.5	pF
Equivalent noise voltage					
I_D = 200 μA; V_{DS} = 10 V B = 0.6 to 100 Hz	V_n	<	0.5	0.5	μV

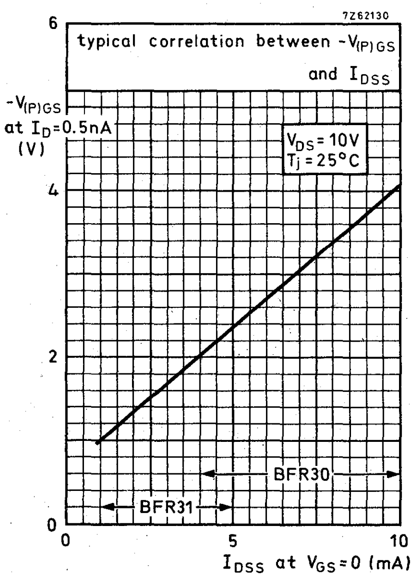

7Z62138.1
I_{GSS} (nA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$-V_{GS} = 10V$
$V_{DS} = 0$
typ
0
50
100
150
T_j (°C)
200

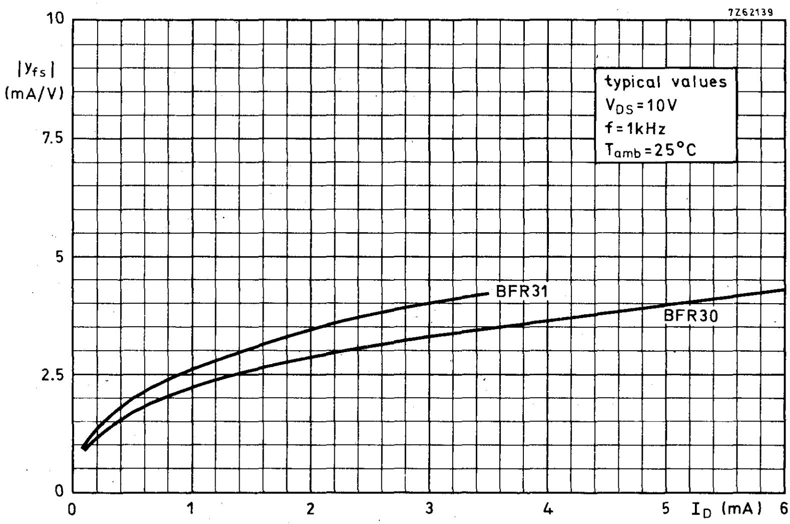

7Z62141
BFR30
V_{DS} = 10 V
T_j = 25 °C
I_D
(mA)
typical values
T_j = 25 °C
max
typ
min
$-V_{GS}$ = 0 V
0.5
1
1.5
2
15
10
5
0
4
$-V_{GS}$ (V)
2
0
5
V_{DS} (V)
10

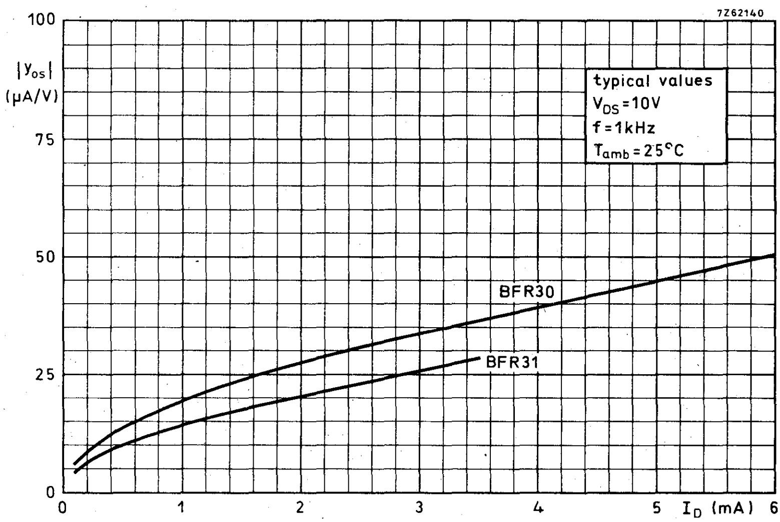

7Z62142
BFR31
V_{DS} = 10 V
T_j = 25 °C
I_D
(mA)
typical values
T_j = 25 °C
max
typ
min
$-V_{GS}$ = 0 V
0.2
0.4
0.6
0.8
1
1.2
6
4
2
0
4
$-V_{GS}$ (V)
2
0
5
V_{DS} (V)
10

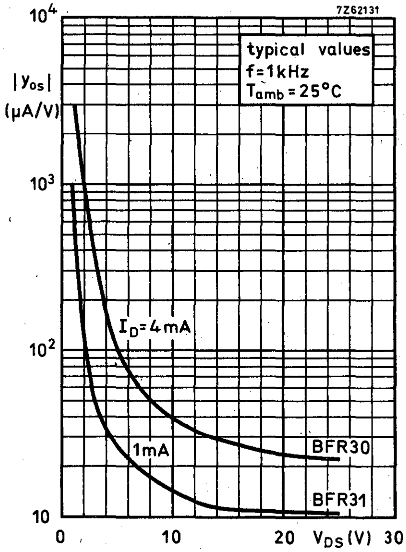

7Z62135
BFR30
typical values
V_{DS} = 10V
I_D (mA)
$-V_{GS}$ = 0V
0.5
1
1.5
2
T_j (°C)
0
2
4
6
25
75
125

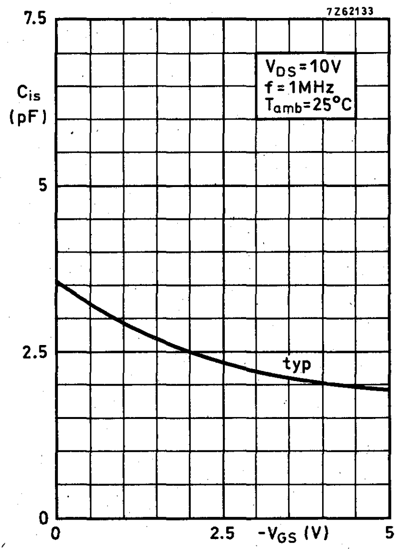

7Z62134
BFR31
typical values
V_{DS} = 10V
I_D (mA)
$-V_{GS}$ = 0V
0.2
0.4
0.6
0.8
1
1.2
T_j (°C)
0
2
4
6
25
75
125

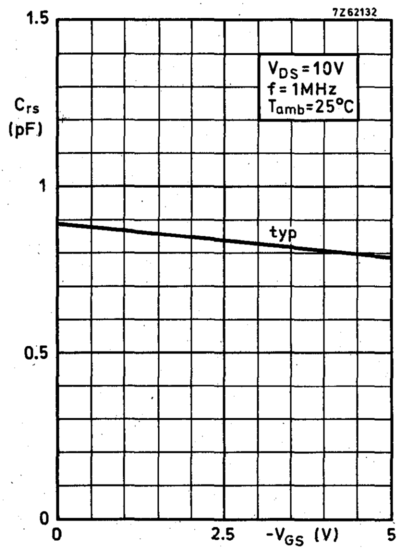

7Z62130
typical correlation between $-V_{(P)GS}$ and I_{DSS}
$-V_{(P)GS}$ at I_D = 0.5nA (V)
V_{DS} = 10V
T_j = 25°C
BFR30
BFR31
I_{DSS} at V_{GS} = 0 (mA)
0
2
4
6
0
5
10

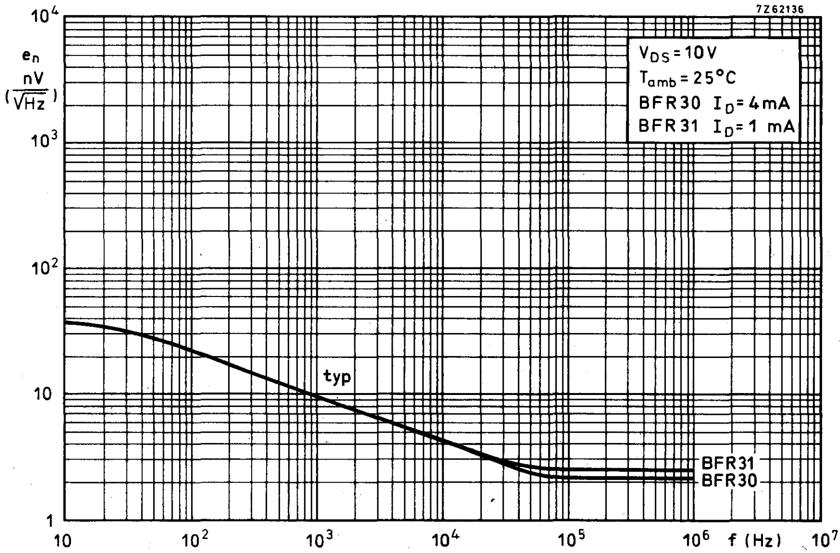

7Z62139
|yfs|
(mA/V)
10
7.5
5
2.5
0
typical values
VDS = 10V
f = 1kHz
Tamb = 25°C
BFR31
BFR30
0
1
2
3
4
5
ID (mA)
6

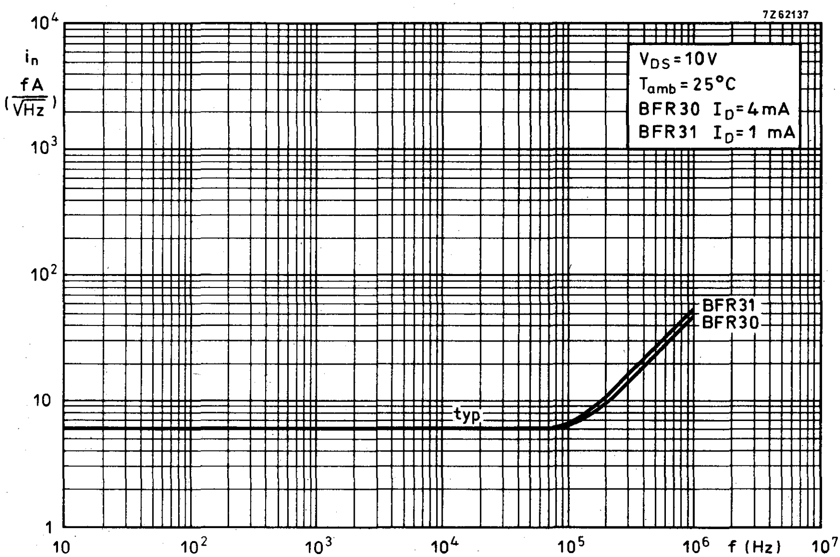

7Z62140
|yos|
(µA/V)
100
75
50
25
0
typical values
VDS = 10V
f = 1kHz
Tamb = 25°C
BFR30
BFR31
0
1
2
3
4
5
ID (mA)
6


7Z62131
typical values
f=1kHz
T_{amb}=25°C
$|y_{os}|$
(μA/V)
10^4
10^3
10^2
10
I_D=4mA
1mA
BFR30
BFR31
0
10
20
V_{DS}(V)
30


7Z62133
V_{DS}=10V
f=1MHz
T_{amb}=25°C
C_{is}
(pF)
7.5
5
2.5
0
typ
0
2.5
$-V_{GS}$ (V)
5


7Z62132
V_{DS}=10V
f=1MHz
T_{amb}=25°C
C_{rs}
(pF)
1.5
1
0.5
0
typ
0
2.5
$-V_{GS}$ (V)
5


7Z62136
10^4
e_n
nV
($\sqrt{Hz}$)
10^3
10^2
10
1
V_{DS} = 10 V
T_{amb} = 25 °C
BFR30 I_D = 4 mA
BFR31 I_D = 1 mA
typ
BFR31
BFR30
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7


7Z62137
10^4
i_n
fA
($\sqrt{Hz}$)
10^3
10^2
10
1
V_{DS} = 10 V
T_{amb} = 25 °C
BFR30 I_D = 4 mA
BFR31 I_D = 1 mA
BFR31
BFR30
typ
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N multi-emitter transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. The transistor has very low intermodulation distortion and very high power gain. It is primarily intended for:
– Wideband vertical amplifiers in high speed oscilloscopes.
– Television distribution amplifiers.

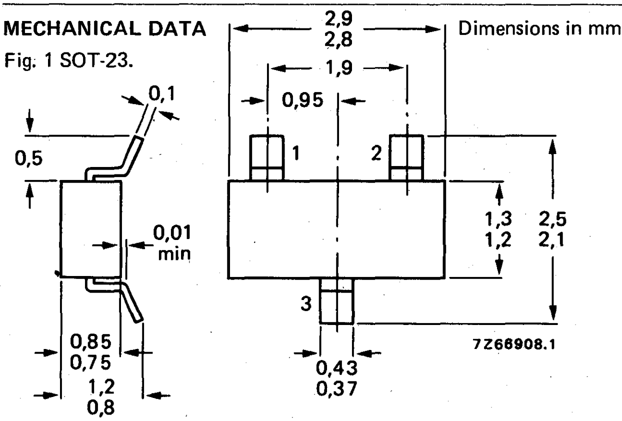
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	18	V
Collector-emitter voltage (open base)	V_{CEO}	max.	10	V
Collector current (peak value; f > 1 MHz)	I_{CM}	max.	100	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	180	mW
Junction temperature	T_j	max.	150	°C
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C	$-C_{re}$	typ.	0,9	pF
Transition frequency at f = 500 MHz I_C = 25 mA; V_{CE} = 5 V	f_T	typ.	2,0	GHz
Max. unilateral power gain (see page 3) I_C = 30 mA; V_{CE} = 5 V; f = 200 MHz; T_{amb} = 25 °C	G_{UM}	typ.	22	dB
I_C = 30 mA; V_{CE} = 5 V; f = 800 MHz; T_{amb} = 25 °C	G_{UM}	typ.	10,5	dB
Intermodulation distortion at T_{amb} = 25 °C I_C = 30 mA; V_{CE} = 5 V; R_L = 37,5 Ω V_o = 100 mV at f_p = 183 MHz V_o = 100 mV at f_q = 200 MHz measured at $f_{(2q-p)}$ = 217 MHz	d_{im}	typ.	−60	dB

MECHANICAL DATA

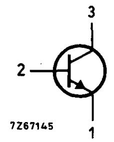
Fig. 1 SOT-23.

Dimensions in mm

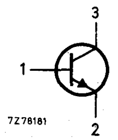


Marking code

BFR53 = N1



BFR53R = N4



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	18	V
Collector-emitter voltage (open base)	V_{CEO}	max.	10	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,5	V

Currents

Collector current (d. c.)	I_C	max.	50	mA
Collector current (peak value; f > 1 MHz)	I_{CM}	max.	100	mA

Power dissipation

Total power dissipation up to T_{amb} = 60 °C mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	P_{tot}	max.	180	mW

Temperatures

Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j-a}$	=	0,50	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	<	50	nA
D.C. current gain [1]				
$I_C = 25$ mA; $V_{CE} = 5$ V	h_{FE}	>	25	
$I_C = 50$ mA; $V_{CE} = 5$ V	h_{FE}	>	25	
Transition frequency at f = 500 MHz [1]				
$I_C = 25$ mA; $V_{CE} = 5$ V	f_T	typ.	2.0	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	typ.	0.9	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0.5$ V	C_e	typ.	1.5	pF
Feedback capacitance at f = 1 MHz				
$I_C = 2$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	C_{re}	typ.	0.9	pF
Noise figure at f = 500 MHz [2]				
$I_C = 2$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C				
$G_S = 20$ mA/V; B_S is tuned	F	<	5	dB

Max. unilateral power gain (s_{re} assumed to be zero)

$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$$

$I_C = 30$ mA; $V_{CE} = 5$ V; f = 200 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	22	dB
$I_C = 30$ mA; $V_{CE} = 5$ V; f = 800 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	10.5	dB

1) Measured under pulse conditions.
2) Crystal mounted in a BFW30 envelope.

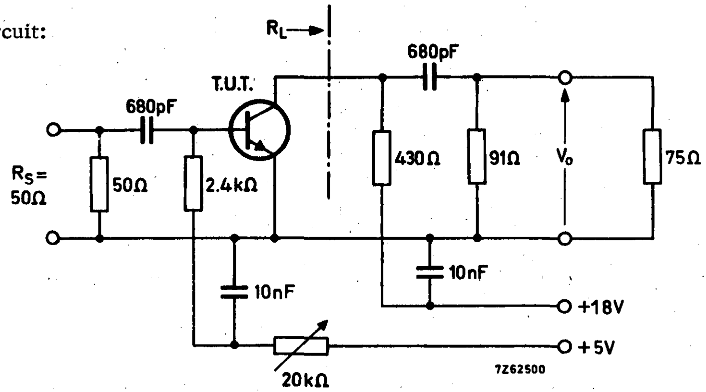
CHARACTERISTICS (continued) T_{amb} = 25 °C unless otherwise specified

Intermodulation distortion [1])

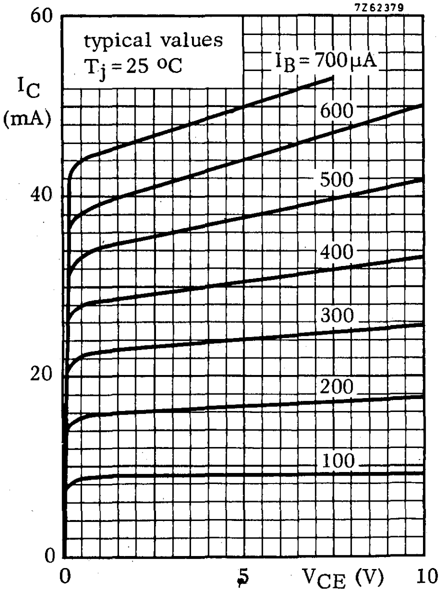
I_C = 30 mA; V_{CE} = 5 V; R_L = 37.5 Ω

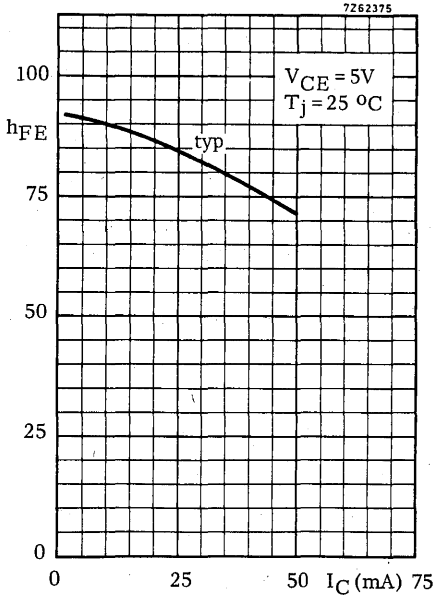
V_o = 100 mV at f_p = 183 MHz
V_o = 100 mV at f_q = 200 MHz
Measured at $f_{(2q-p)}$ = 217 MHz d_{im} typ. −60 dB

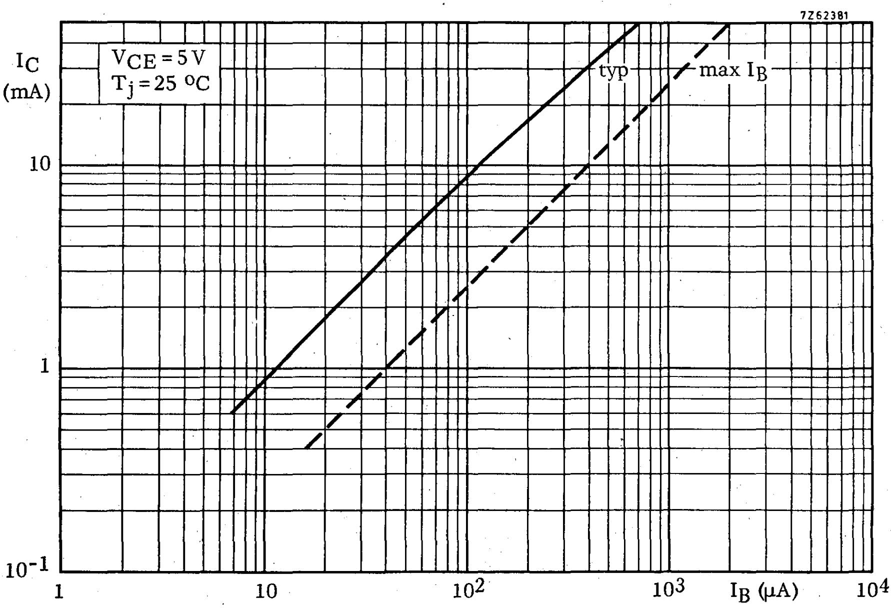
Test circuit:

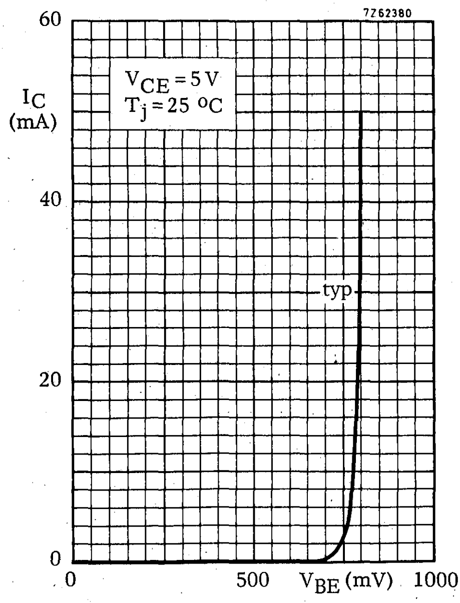


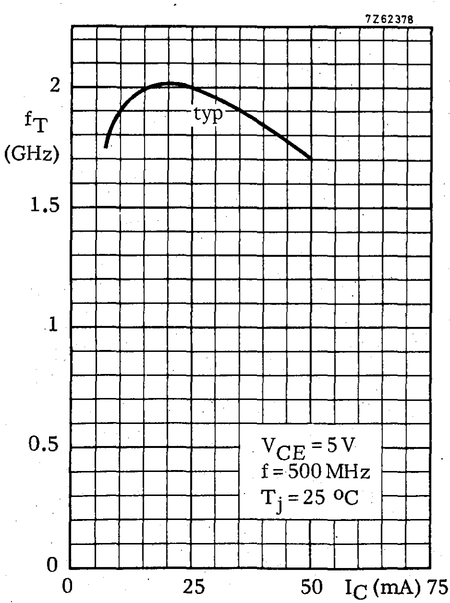
1) Crystal mounted in a BFW30 envelope.

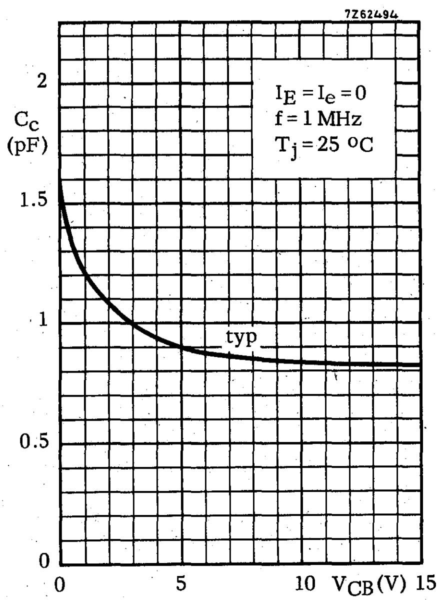

7Z62379
typical values
$T_j = 25\ ^oC$
$I_B = 700\ \mu A$
600
500
400
300
200
100
I_C (mA)
60
40
20
0
0
5
V_{CE} (V)
10


7Z62375
$V_{CE} = 5V$
$T_j = 25\ ^oC$
h_{FE}
typ
100
75
50
25
0
0
25
50
I_C (mA)
75

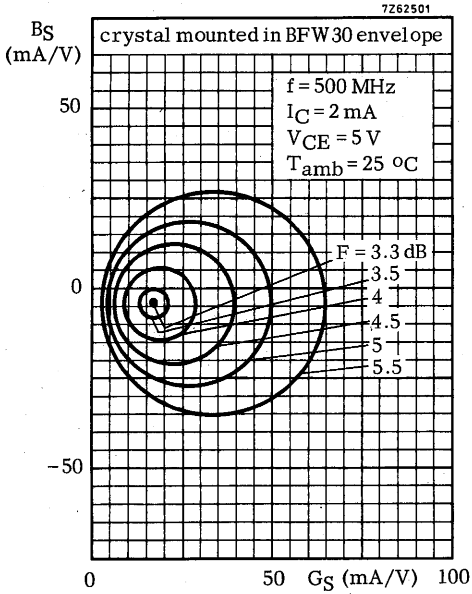

7Z62381
$V_{CE} = 5\ V$
$T_j = 25\ ^oC$
I_C (mA)
typ
max I_B
10
1
10^{-1}
1
10
10^2
10^3
I_B (μA)
10^4

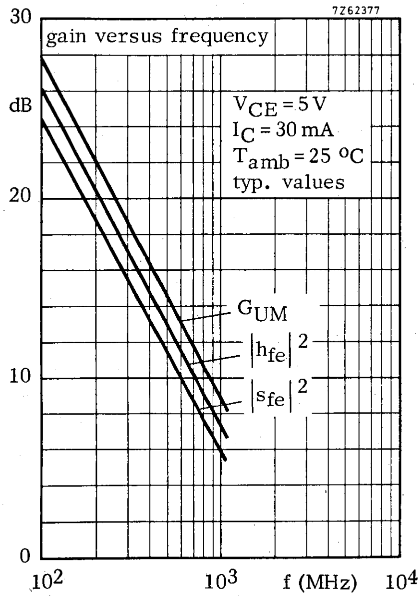

7Z62380
I_C (mA)
60
40
20
0
V_{CE} = 5 V
T_j = 25 °C
typ
0
500
V_{BE} (mV)
1000

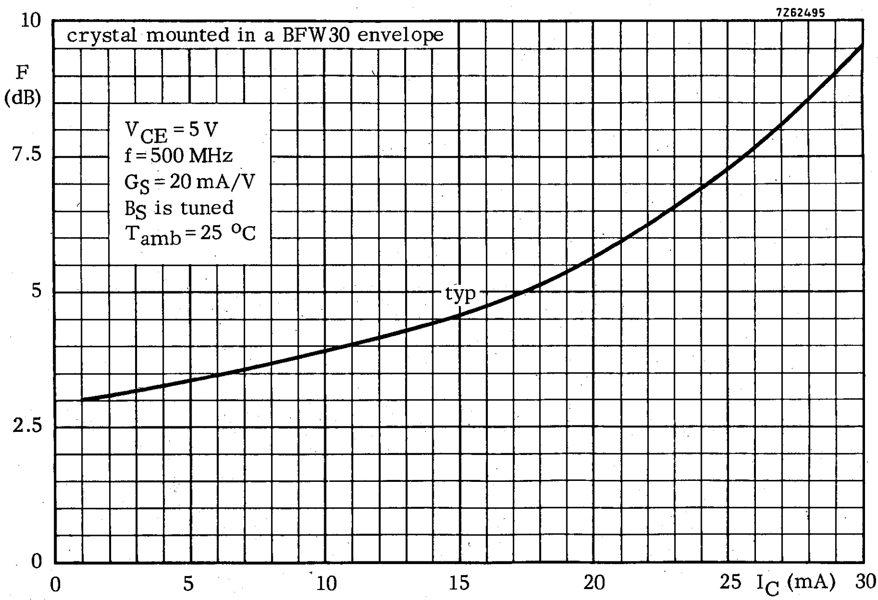

7Z62378
f_T (GHz)
2
1.5
1
0.5
0
typ
V_{CE} = 5 V
f = 500 MHz
T_j = 25 °C
0
25
50
I_C (mA) 75


7Z62494
C_c (pF)
2
1.5
1
0.5
0
$I_E = I_e = 0$
f = 1 MHz
T_j = 25 °C
typ
0
5
10
V_{CB} (V) 15

circles of constant noise figure



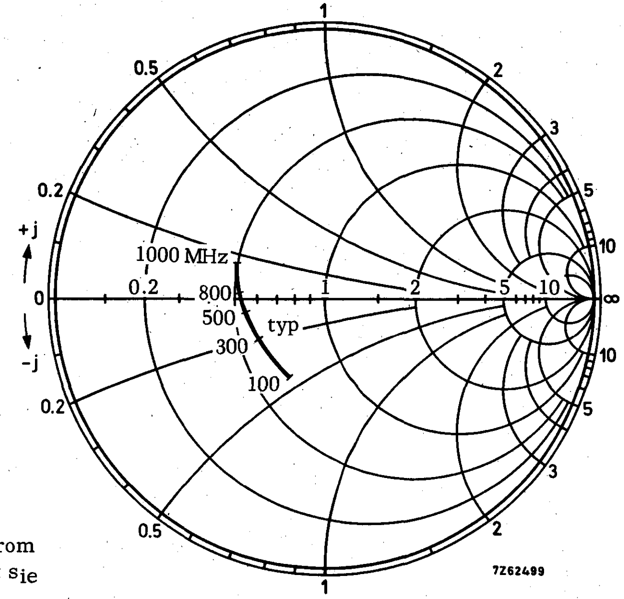




V_{CE} = 5 V

I_C = 30 mA

T_{amb} = 25 °C

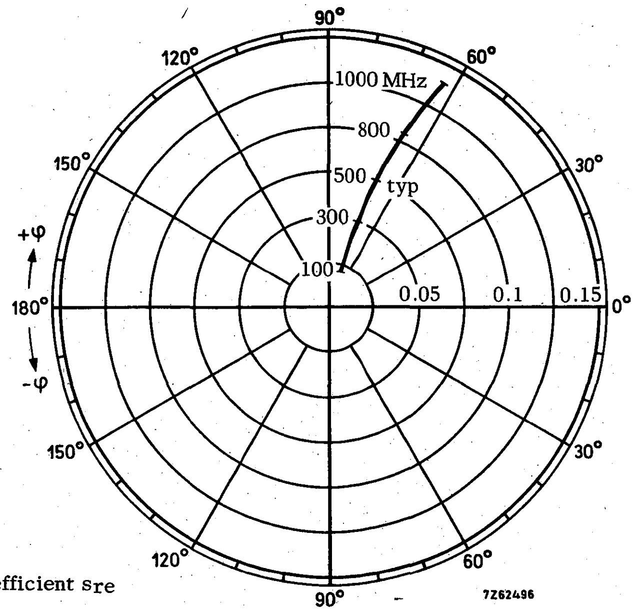


Input impedance derived from input reflection coefficient s_{ie} coordinates in ohm x 50

V_{CE} = 5 V

I_C = 30 mA

T_{amb} = 25 °C

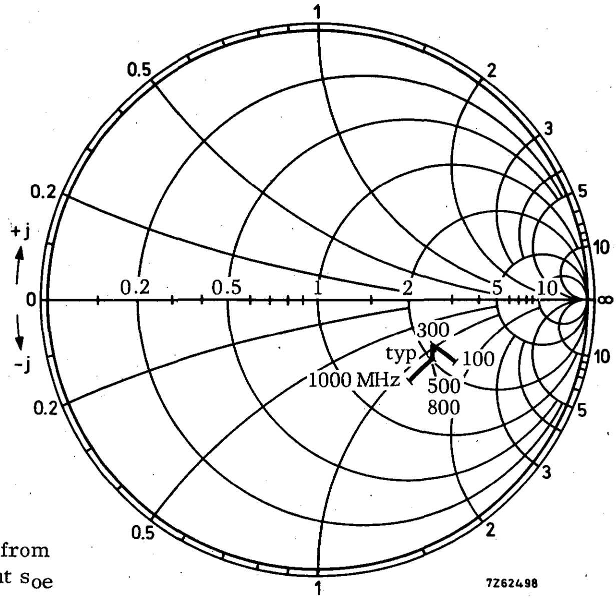


Reverse transmission coefficient s_{re}

V_{CE} = 5 V

I_C = 30 mA

T_{amb} = 25 °C

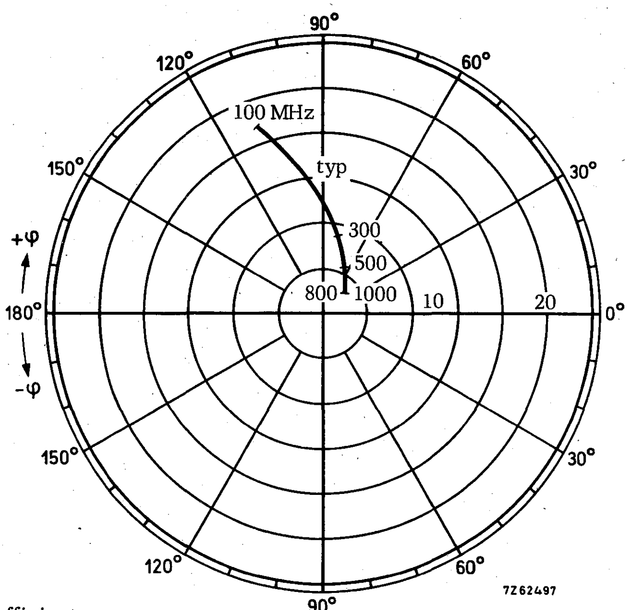


Output impedance derived from output reflection coefficient s_{oe} coordinates in ohm x 50

V_{CE} = 5 V

I_C = 30 mA

T_{amb} = 25 °C



Forward transmission coefficient s_{fe}

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc. The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

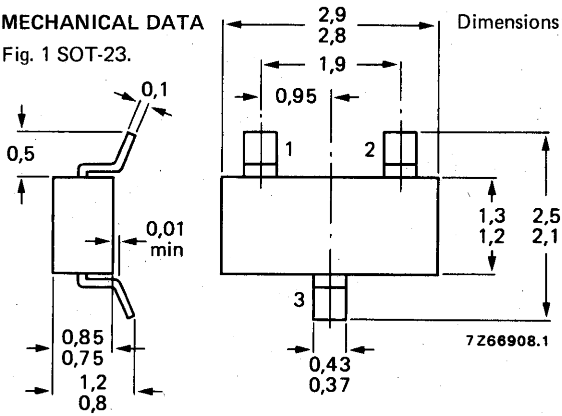
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (d.c.)	I_C	max.	25	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	180	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 14 mA; V_{CE} = 10 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 10 V; T_{amb} = 25 °C	C_{re}	typ.	0,7	pF
Noise figure at optimum source impedance I_C = 2 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	2,4	dB
Max. unilateral power gain (see page 3) I_C = 14 mA; V_{CE} = 10 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	18	dB
Intermodulation distortion at T_{amb} = 25 °C I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; V_o = 150 mV $f_{(p+q-r)}$ = 493,25 MHz (see page 4)	d_{im}	typ.	−60	dB

MECHANICAL DATA

Fig. 1 SOT-23.

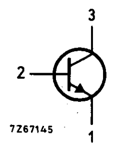
Dimensions in mm



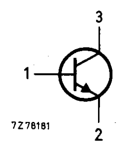
See also *Soldering recommendations.*

Marking code

BFR92 = P1



BFR92R = P4



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,0	V

Current

Collector current (d.c.)	I_C	max.	25	mA

Power dissipation

Total power dissipation up to T_{amb} = 60 °C mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	P_{tot}	max.	180	mW

Temperatures

Storage temperature	T_{stg}	-65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j-a}$	=	0,5	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	<	50	nA
D.C. current gain [1]				
$I_C = 14$ mA; $V_{CE} = 10$ V	h_{FE}	>	25	
		typ.	50	
Transition frequency at f = 500 MHz [1]				
$I_C = 14$ mA; $V_{CE} = 10$ V	f_T	typ.	5	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	0,75	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.	0,8	pF
Feedback capacitance at f = 1 MHz				
$I_C = 2$ mA; $V_{CE} = 10$ V; $T_{amb} = 25$ °C	C_{re}	typ.	0,7	pF
Noise figure at optimum source impedance [2]				
$I_C = 2$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	2,4	dB

Max. unilateral power gain (s_{re} assumed to be zero)

$$G_{UM} \text{ (in dB)} \triangleq 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$$

$I_C = 14$ mA; $V_{CE} = 10$ V; f = 500 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	18	dB

1) Measured under pulse conditions.
2) Crystal mounted in a BFR90 envelope.

CHARACTERISTICS (continued)

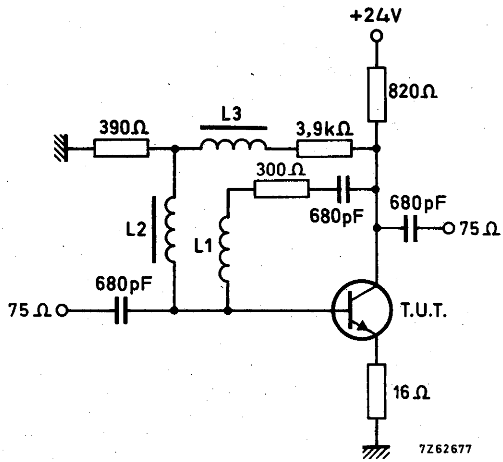
Intermodulation distortion at T_{amb} = 25 °C

I_C = 14 mA; V_{CE} = 10 V; R_L = 75 Ω; V.S.W.R. < 2

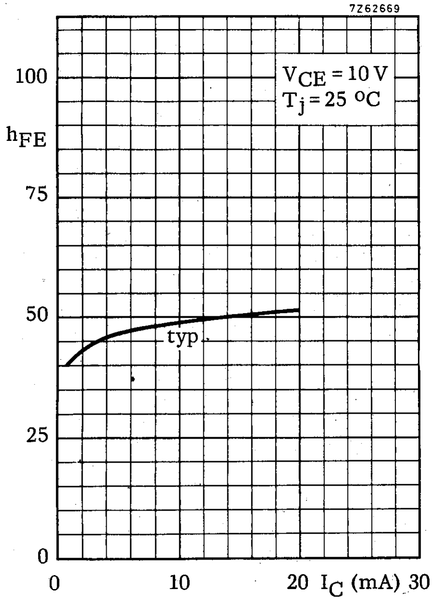
$V_p = V_o$ = 150 mV at f_p = 495,25 MHz
$V_q = V_o$ −6 dB at f_q = 503,25 MHz
$V_r = V_o$ −6 dB at f_r = 505,25 MHz

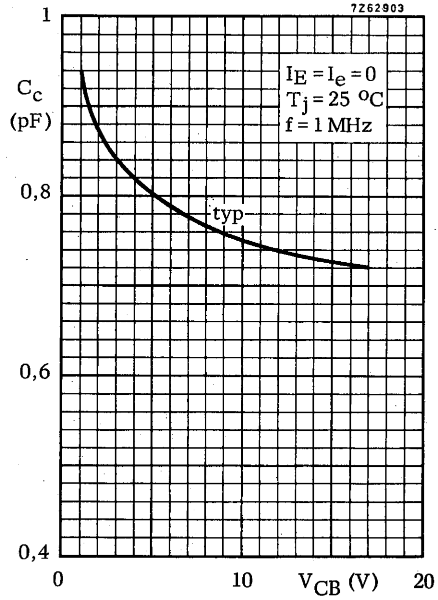
Measured at $f_{(p+q-r)}$ = 493,25 MHz | d_{im} | typ. | −60 | dB

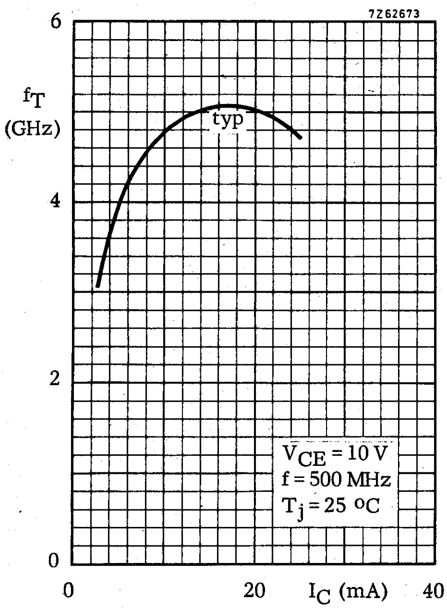
Intermodulation test circuit:

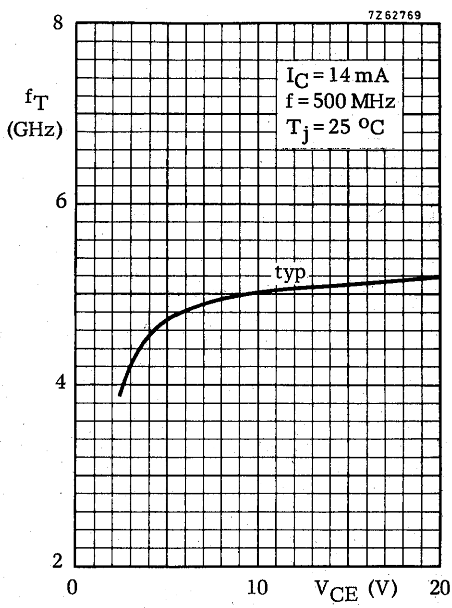


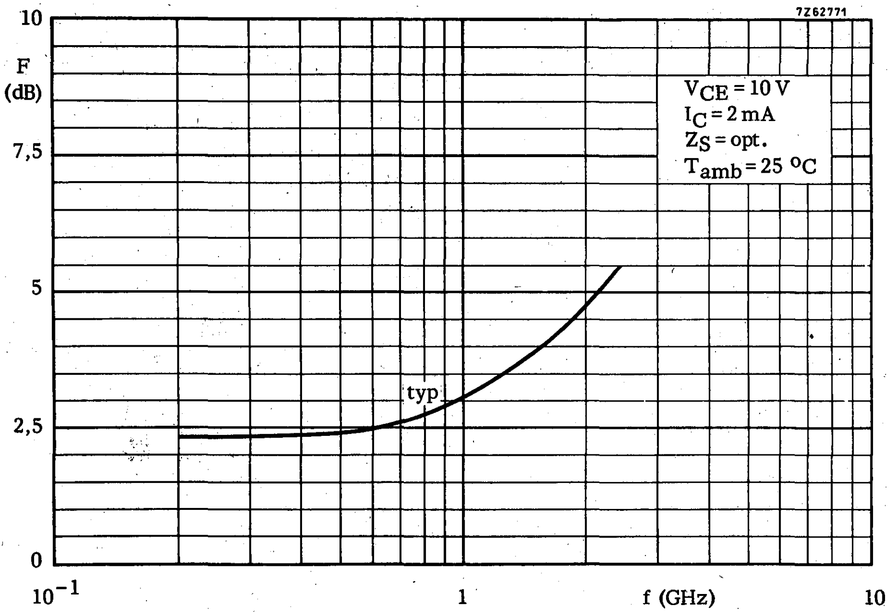
L1 = 4 turns Cu wire (0,35 mm); winding pitch 1 mm; int. diam. 4 mm
L2 = L3 = 5 μH (code number: 3122 108 20150)

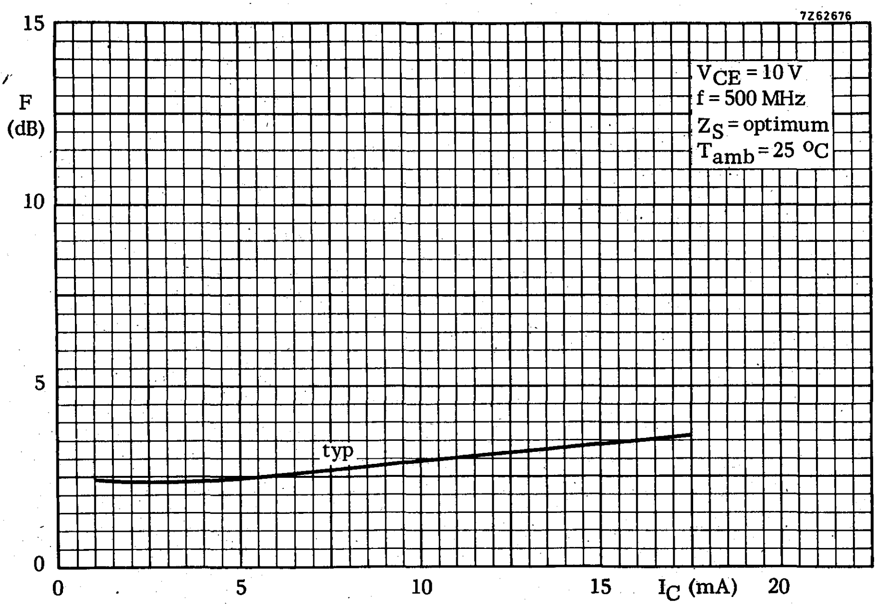

7Z62669
100
75
50
25
0
hFE
VCE = 10 V
Tj = 25 °C
typ
0
10
20
IC (mA)
30

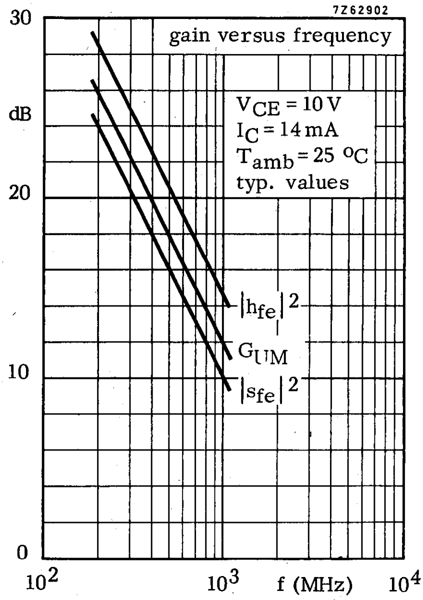

7Z62903
1
0,8
0,6
0,4
Cc
(pF)
IE = Ie = 0
Tj = 25 °C
f = 1 MHz
typ
0
10
VCB (V)
20


7Z62673
6
4
2
0
fT
(GHz)
typ
VCE = 10 V
f = 500 MHz
Tj = 25 °C
0
20
IC (mA)
40

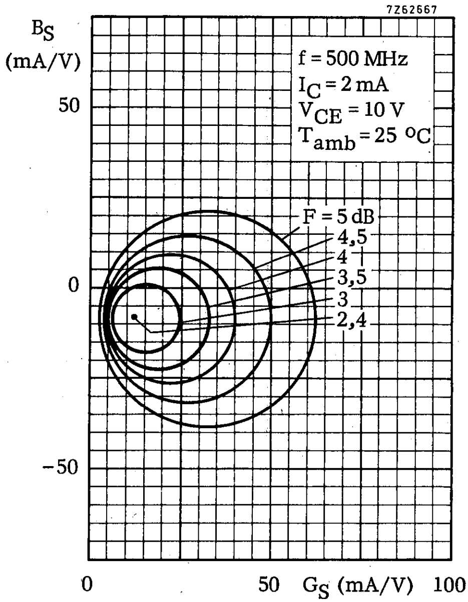

7Z62769
8
6
4
2
fT
(GHz)
IC = 14 mA
f = 500 MHz
Tj = 25 °C
typ
0
10
VCE (V)
20


7Z62771
F
(dB)
10
7,5
5
2,5
0
V_{CE} = 10 V
I_C = 2 mA
Z_S = opt.
T_{amb} = 25 °C
typ
10^{-1}
1
f (GHz)
10

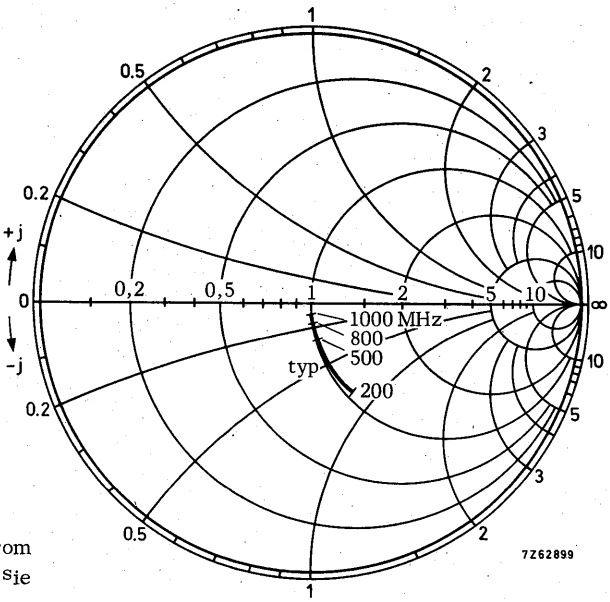

7Z62676
F
(dB)
15
10
5
0
V_{CE} = 10 V
f = 500 MHz
Z_S = optimum
T_{amb} = 25 °C
typ
0
5
10
15
I_C (mA)
20



circles of constant noise figure

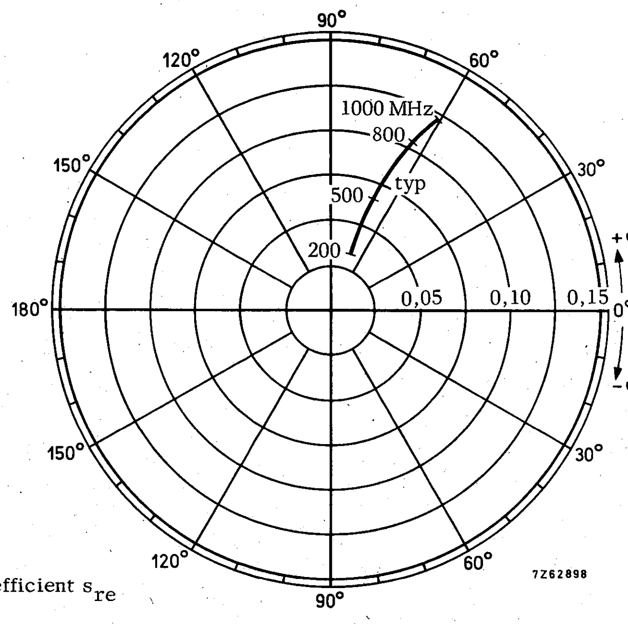


V_{CE} = 10 V
I_C = 14 mA
T_{amb} = 25 °C



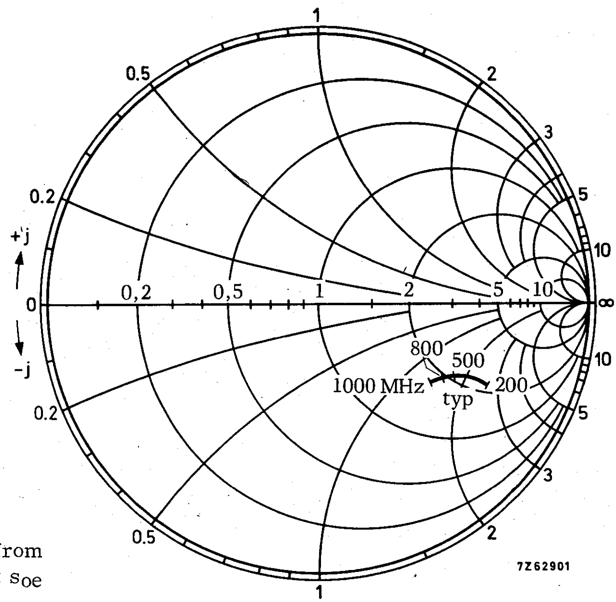
Input impedance derived from input reflection coefficient s_{ie} coordinates in ohm x 50

V_{CE} = 10 V
I_C = 14 mA
T_{amb} = 25 °C



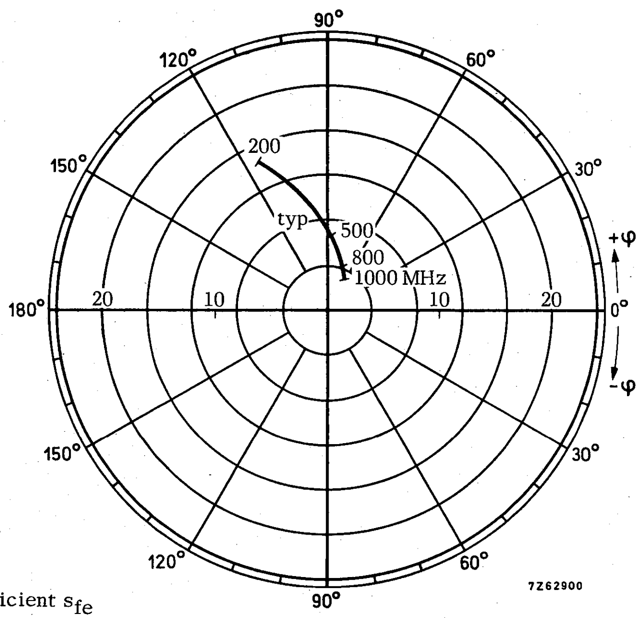
Reverse transmission coefficient s_{re}

V_{CE} = 10 V
I_C = 14 mA
T_{amb} = 25 ^oC



Output impedance derived from output reflection coefficient s_{oe} coordinates in ohm x 50

V_{CE} = 10 V
I_C = 14 mA
T_{amb} = 25 ^oC



Forward transmission coefficient s_{fe}

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc. The transistor features very low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

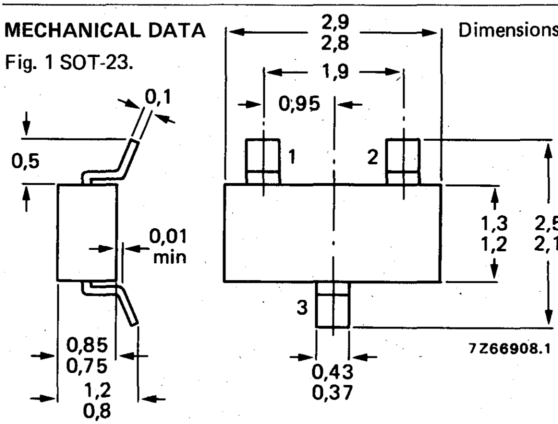
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	15	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector current (d.c.)	I_C	max.	35	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	180	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 30 mA; V_{CE} = 5 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz I_C = 2 mA; V_{CE} = 5 V; T_{amb} = 25 °C	C_{re}	typ.	0,8	pF
Noise figure at optimum source impedance I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	1,9	dB
Max. unilateral power gain (see page 3) I_C = 30 mA; V_{CE} = 5 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	16,5	dB
Intermodulation distortion at T_{amb} = 25 °C I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; V_o = 300 mV $f_{(p+q-r)}$ = 493,25 MHz (see page 4)	d_{im}	typ.	−60	dB

MECHANICAL DATA

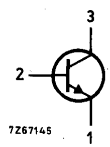
Fig. 1 SOT-23.

Dimensions in mm

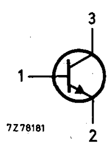


Marking code

BFR93 = R1



BFR93R = R4



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	15	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2,0	V

Current

Collector current (d.c.)	I_C	max.	35	mA

Power dissipation

Total power dissipation up to T_{amb} = 60 °C mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	P_{tot}	max.	180	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j-a}$	=	0,50	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 10$ V	I_{CBO}	<	50	nA
D.C. current gain [1]				
$I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}	>	25	
		typ.	50	
Transition frequency at f = 500 MHz [1]				
$I_C = 30$ mA; $V_{CE} = 5$ V	f_T	typ.	5	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	0,7	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	typ.	1,8	pF
Feedback capacitance at f = 1 MHz				
$I_C = 2$ mA; $V_{CE} = 5$ V; $T_{amb} = 25$ °C	C_{re}	typ.	0,8	pF
Noise figure at optimum source impedance [2]				
$I_C = 2$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	1,9	dB
Max. unilateral power gain (s_{re} assumed to be zero)				
G_{UM} (in dB) $= 10 \log \dfrac{\lvert s_{fe}\rvert^2}{(1-\lvert s_{ie}\rvert^2)(1-\lvert s_{oe}\rvert^2)}$				
$I_C = 30$ mA; $V_{CE} = 5$ V; f = 500 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	16,5	dB

1) Measured under pulse conditions.
2) Crystal mounted in a BFR91 envelope.

CHARACTERISTICS (continued)

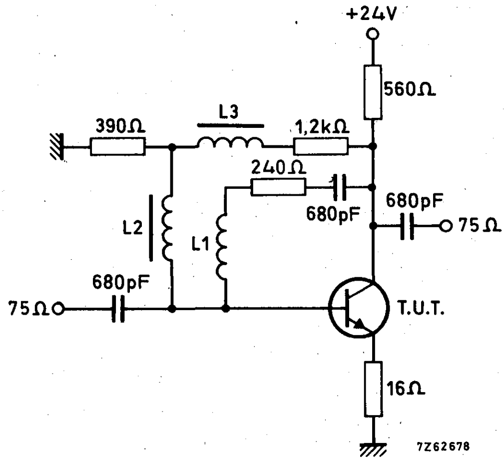
Intermodulation distortion at T_{amb} = 25 °C

I_C = 30 mA; V_{CE} = 5 V; R_L = 75 Ω; V.S.W.R. < 2

$V_p = V_o$ = 300 mV at f_p = 495, 25 MHz
$V_q = V_o$ -6 dB at f_q = 503, 25 MHz
$V_r = V_o$ -6 dB at f_r = 505, 25 MHz

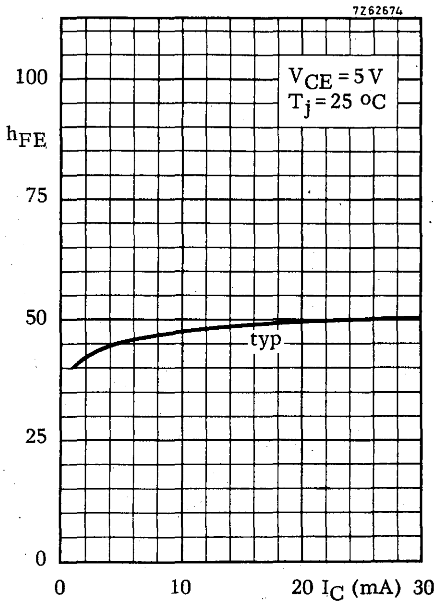
Measured at $f_{(p+q-r)}$ = 493, 25 MHz d_{im} typ. -60 dB [1]

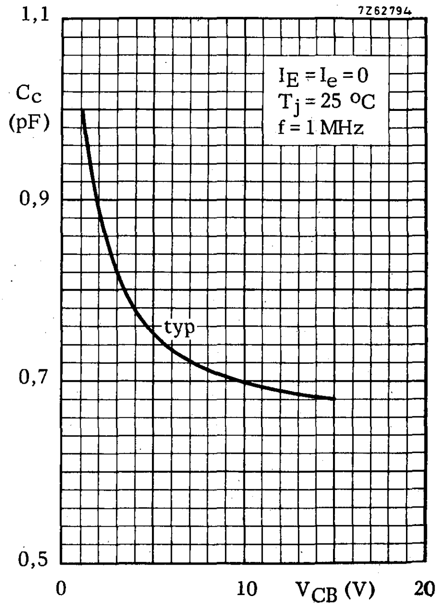
Intermodulation test circuit:

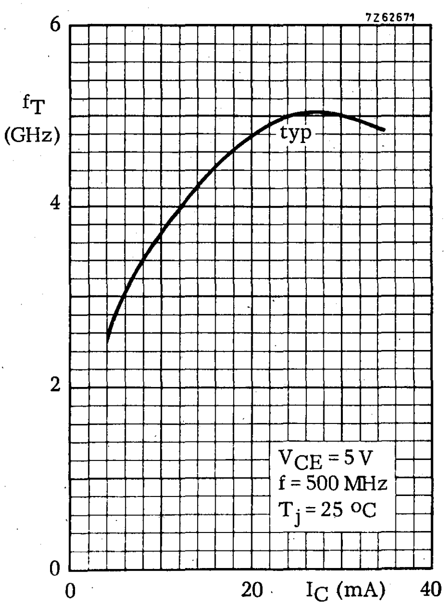


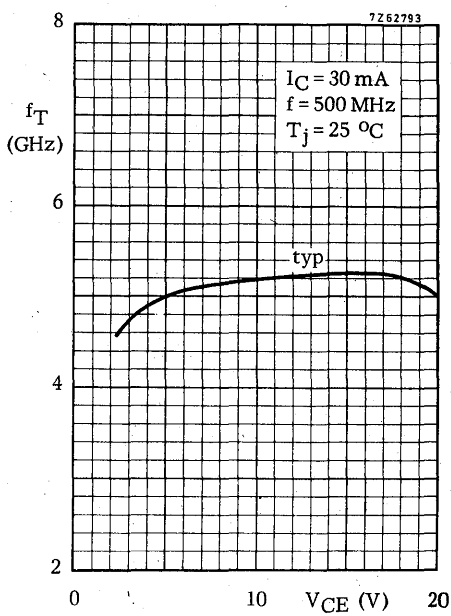
L1 = 4 turns Cu wire (0, 35); winding pitch 1 mm; int.diam. 4 mm
L2 and L3 5 μH (code number: 3122 108 20150)

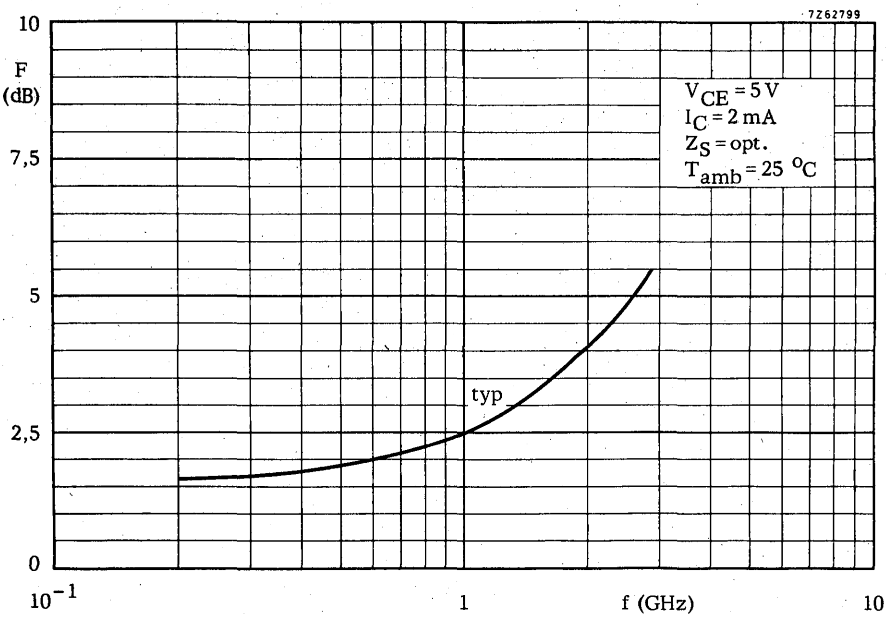
1) Crystal mounted in a BFR91 envelope.

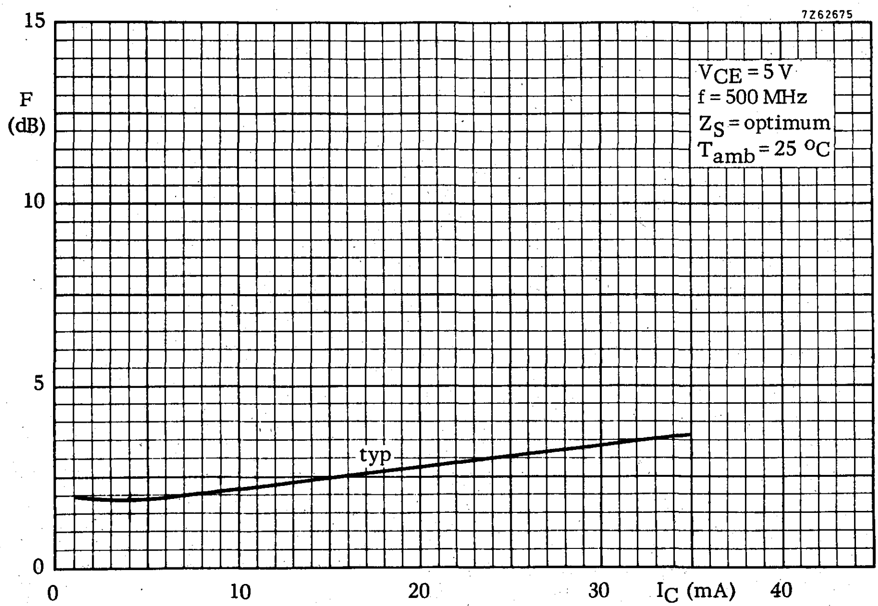

7Z62674
100
75
50
25
0
h_FE
V_CE = 5 V
T_j = 25 °C
typ
0
10
20
I_C (mA)
30

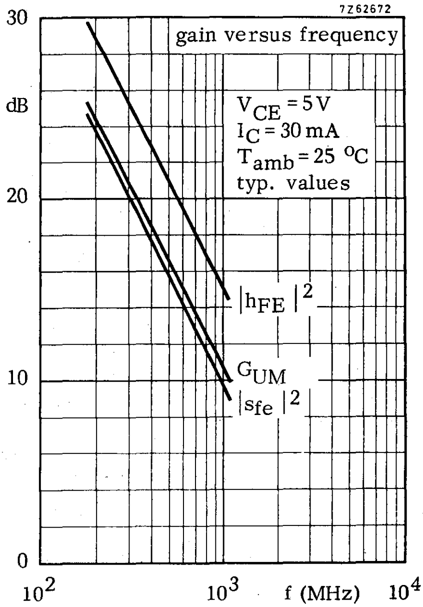

7Z62794
1,1
0,9
0,7
0,5
C_c
(pF)
I_E = I_e = 0
T_j = 25 °C
f = 1 MHz
typ
0
10
V_CB (V)
20


7Z62671
6
4
2
0
f_T
(GHz)
typ
V_CE = 5 V
f = 500 MHz
T_j = 25 °C
0
20
I_C (mA)
40

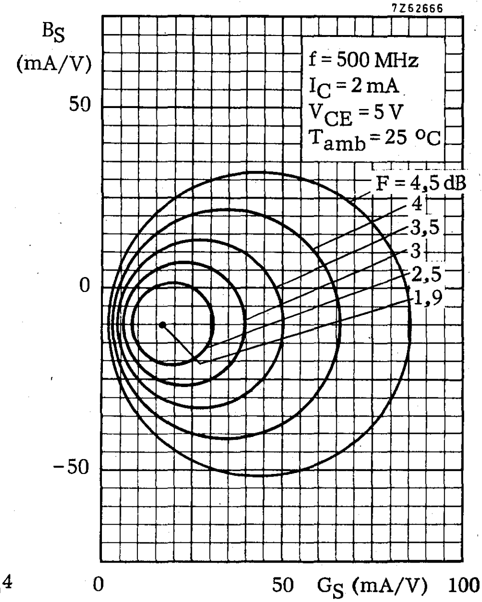

7Z62793
8
6
4
2
f_T
(GHz)
I_C = 30 mA
f = 500 MHz
T_j = 25 °C
typ
0
10
V_CE (V)
20


7Z62799
F
(dB)
10
7,5
5
2,5
0
10^{-1}
1
f (GHz)
10
$V_{CE} = 5\ V$
$I_C = 2\ mA$
Z_S = opt.
$T_{amb} = 25\ ^oC$
typ

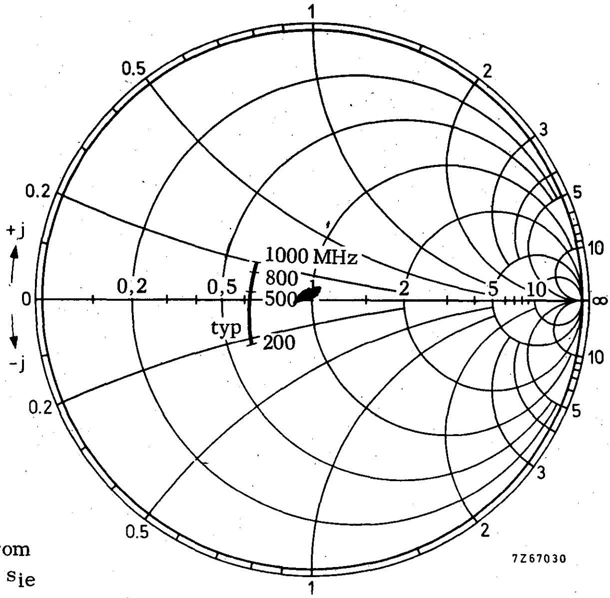

7Z62675
F
(dB)
15
10
5
0
0
10
20
30
I_C (mA)
40
$V_{CE} = 5\ V$
f = 500 MHz
Z_S = optimum
$T_{amb} = 25\ ^oC$
typ



circles of constant noise figure

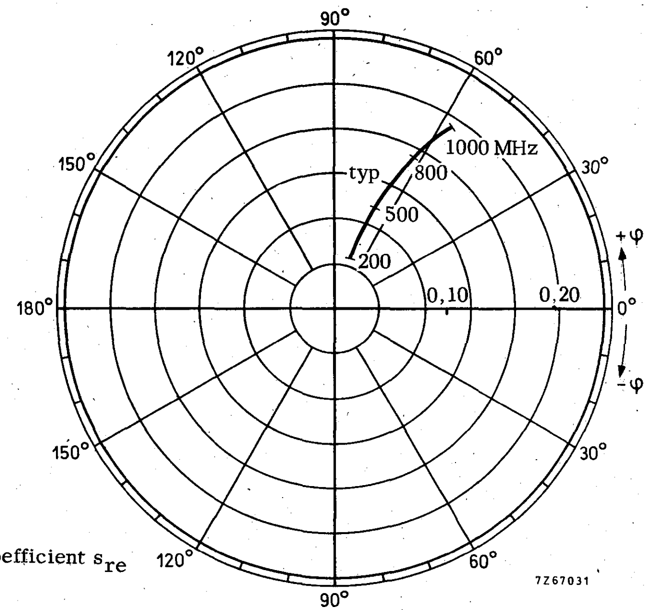


V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 ^oC



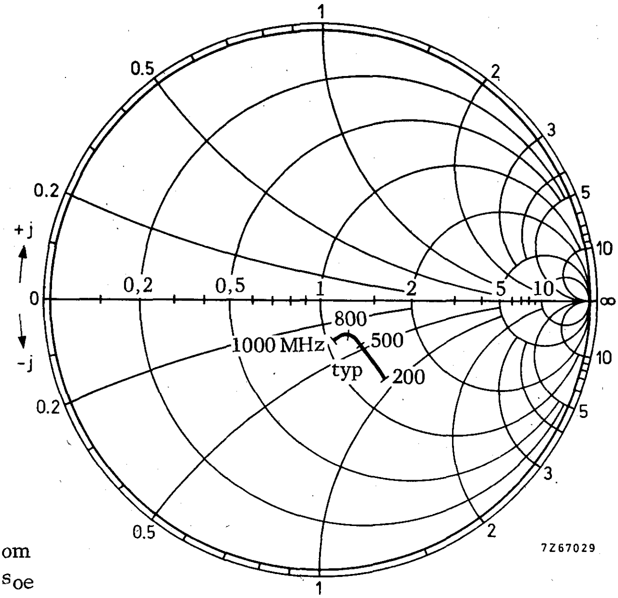
Input impedance derived from input reflection coefficient s_{ie} coordinates in ohm x 50

V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 ^oC



Reverse transmission coefficient s_{re}

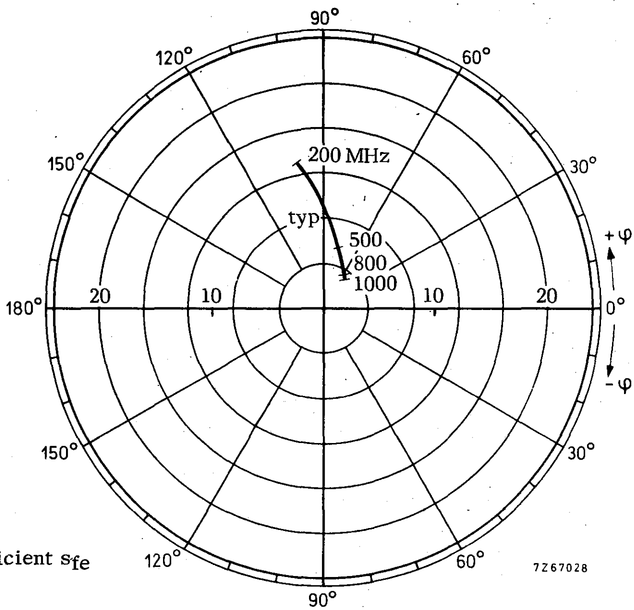
V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C



7Z67029

Output impedance derived from output reflection coefficient s_{oe} coordinates in ohm x 50

V_{CE} = 5 V
I_C = 30 mA
T_{amb} = 25 °C



7Z67028

Forward transmission coefficient s_{fe}

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic envelope. It is intended for a wide range of v.h.f. and u.h.f. applications in thick and thin-film circuits.

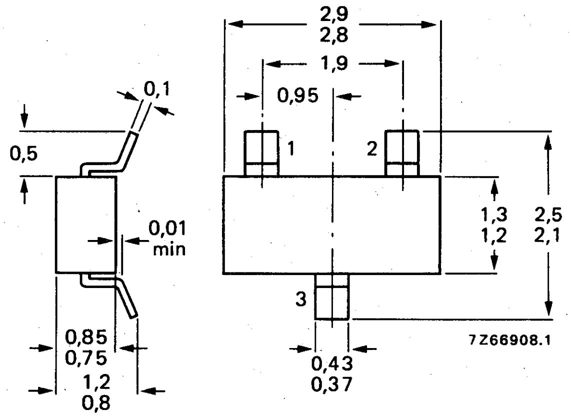
QUICK REFERENCE DATA

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V
Collector current (peak value)	I_{CM}	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 2 mA; V_{CE} = 1 V	h_{FE}		20 to 150	
Transition frequency I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	f_T	typ.	1,3	GHz
Noise figure I_C = 2 mA; V_{CE} = 5 V; R_S = 50 Ω; f = 500 MHz	F	typ.	4,5	dB

MECHANICAL DATA

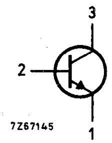
Dimensions in mm

Fig. 1 SOT-23.

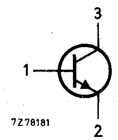


Marking code

BFS17 = E1



BFS17R = E4



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter; peak value)	V_{CBOM}	max.	25	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2.5	V

Currents

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value)	I_{CM}	max.	50	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on a **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	$R_{th\ j\text{-}a}$	=	0.62	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; V_{CB} = 10 V	I_{CBO}	<	10	nA
I_E = 0; V_{CB} = 10 V; T_j = 100 °C	I_{CBO}	<	10	μA

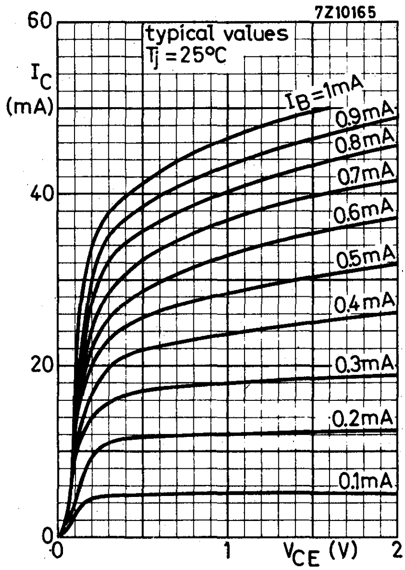
D.C. current gain

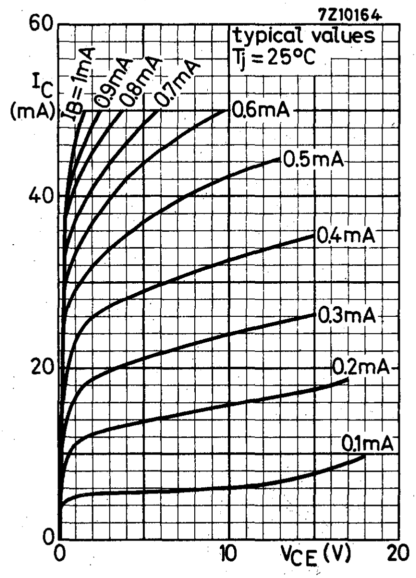
I_C = 2 mA; V_{CE} = 1 V	h_{FE}	20 to	150
I_C = 25 mA; V_{CE} = 1 V	h_{FE}	>	20

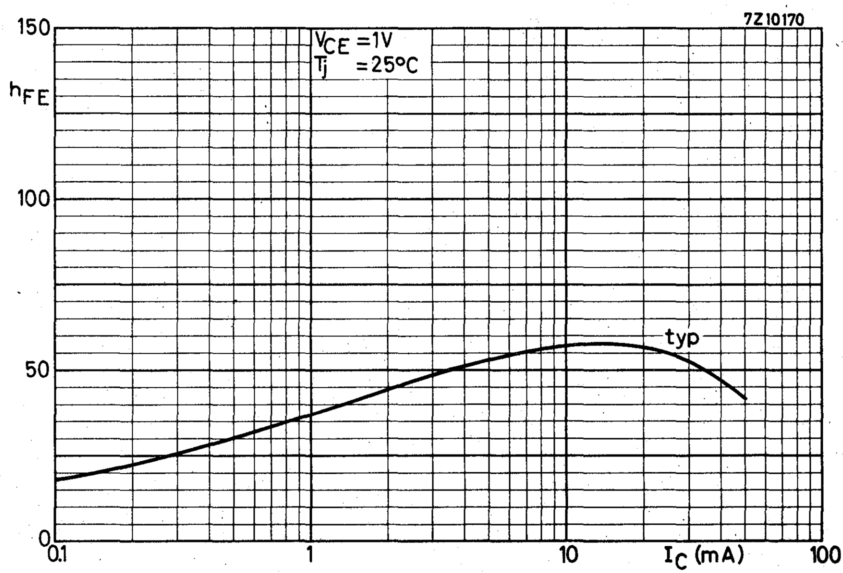
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

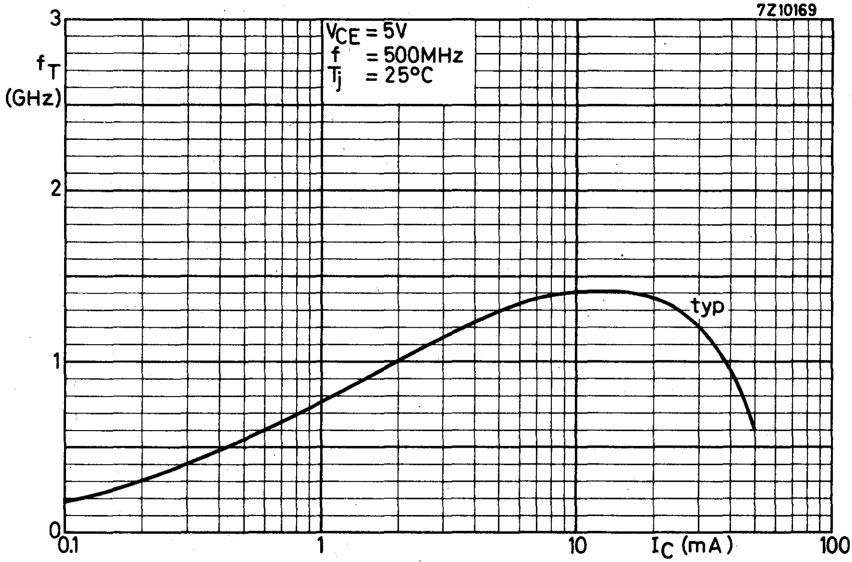
Transition frequency				
I_C = 2 mA; V_{CE} = 5 V; f = 500 MHz	f_T	typ.	1.0	GHz
I_C = 25 mA; V_{CE} = 5 V; f = 500 MHz	f_T	typ.	1.3	GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; V_{CB} = 10 V	C_c	<	1.5	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; V_{EB} = 0.5 V	C_e	<	2.0	pF
Feedback capacitance at f = 1 MHz				
I_C = 2 mA; V_{CE} = 5 V	C_{re}	typ.	0.65	pF
Noise figure				
I_C = 2 mA; V_{CE} = 5 V f = 500 MHz; R_S = 50 Ω	F	typ.	4.5	dB[1]
Intermodulation distortion				
I_C = 10 mA; V_{CE} = 6 V; R_L = 37.5 Ω; T_{amb} = 25 °C V_o = 100 mV at f_p = 183 MHz V_o = 100 mV at f_q = 200 MHz measured at $f_{(2q-p)}$ = 217 MHz	d_{im}	typ.	−45	dB

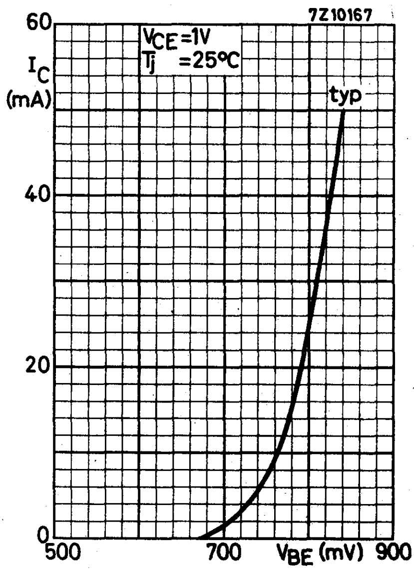
[1]) Crystal mounted in a BFY90 envelope.

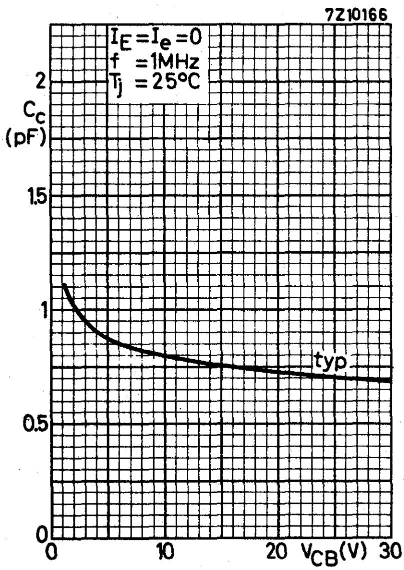

7Z10165
typical values
Tj = 25°C
IC (mA)
IB=1mA
0.9mA
0.8mA
0.7mA
0.6mA
0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
VCE (V)
0
20
40
60
1
2

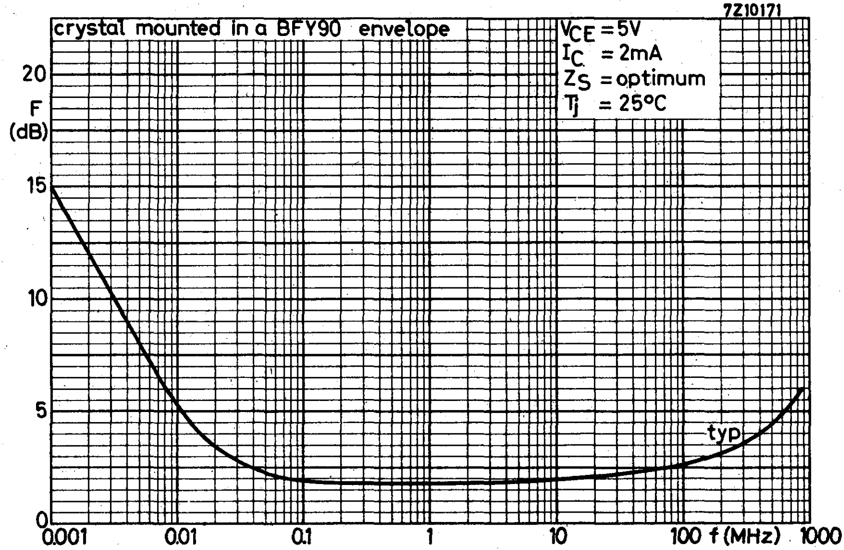

7Z10164
typical values
Tj = 25°C
IC (mA)
IB=1mA
0.9mA
0.8mA
0.7mA
0.6mA
0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
VCE (V)
0
20
40
60
10
20

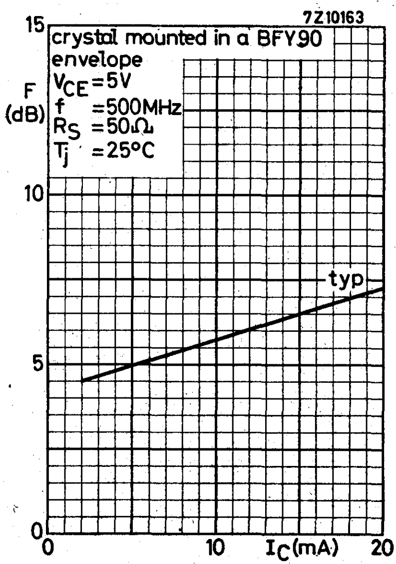

7Z10170
VCE = 1V
Tj = 25°C
hFE
typ
IC (mA)
0
50
100
150
0.1
1
10
100

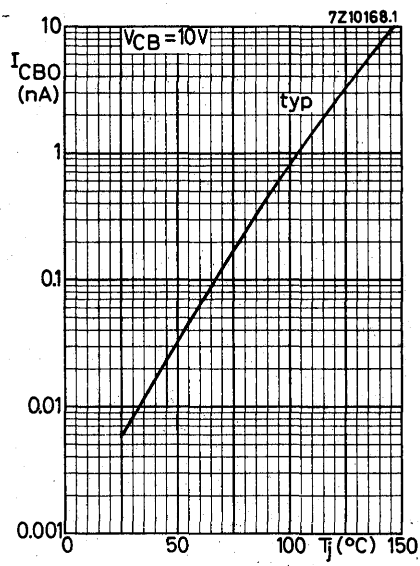

7Z10169
V_{CE} = 5V
f = 500MHz
T_j = 25°C
f_T (GHz)
3
2
1
0
typ
0.1
1
10
I_C (mA)
100


7Z10167
V_{CE} =1V
T_j =25°C
I_C (mA)
60
40
20
0
typ
500
700
V_{BE} (mV)
900


7Z10166
$I_E = I_e = 0$
f =1MHz
T_j = 25°C
C_c (pF)
2
1.5
1
0.5
0
typ
0
10
20
V_{CB}(V)
30


7Z10171
crystal mounted in a BFY90 envelope
VCE = 5V
IC = 2mA
ZS = optimum
Tj = 25°C
F (dB)
20
15
10
5
0
typ
0.001
0.01
0.1
1
10
100
f (MHz)
1000


7Z10163
crystal mounted in a BFY90 envelope
VCE = 5V
f = 500MHz
RS = 50Ω
Tj = 25°C
F (dB)
15
10
5
0
typ
0
10
IC (mA)
20


7Z10168.1
VCB = 10V
ICBO (nA)
10
1
0.1
0.01
0.001
typ
0
50
100
Tj (°C)
150

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic envelope. They are intended for general purpose and h.f. applications in thick and thin-film circuits.

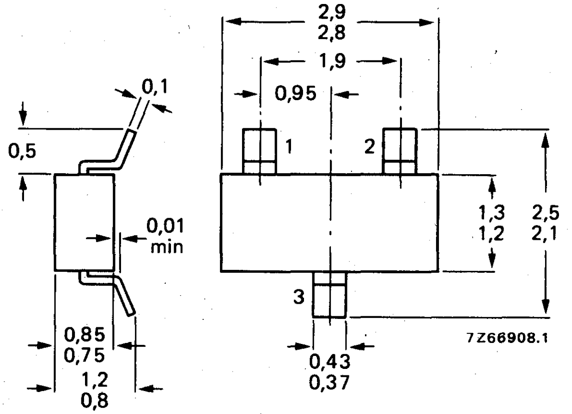
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	30		V
Collector-emitter voltage (open base)	V_{CEO}	max.	20		V
Collector current (d.c.)	I_C	max.	30		mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200		mW
Junction temperature	T_j	max.	150		°C
			BFS18	BFS19	
D.C. current gain I_C = 1 mA; V_{CE} = 10 V	h_{FE}		35 to 125	65 to 225	
Transition frequency at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	260	MHz
Noise figure at f = 100 MHz I_C = 1 mA; V_{CE} = 10 V; G_S = 10 mΩ^{-1}	F	typ.	4		dB

MECHANICAL DATA

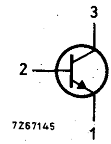
Dimensions in mm

Fig. 1 SOT-23.

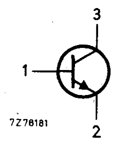


Marking code

BFS18 = F1
BFS19 = F2



BFS18R = F4
BFS19R = F5



See also *Soldering recommendations.*

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

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) $I_C = 2$ mA	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	30	mA
Colector current (peak value)	I_{CM}	max.	30	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on a **ceramic substrate of 7 mm x 5 mm x 0.5 mm**	Rth j-a	=	0.62	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	I_{CBO}	<	10	μA

Base-emitter voltage

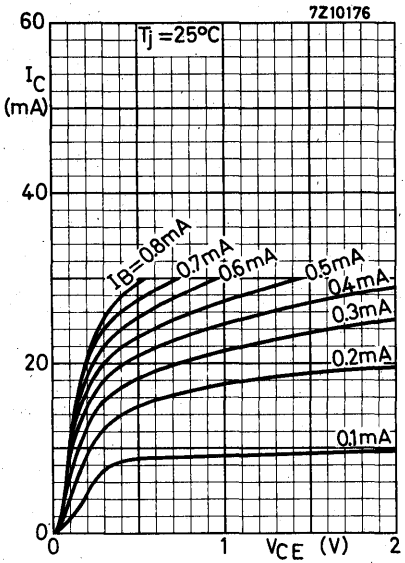
$I_C = 1$ mA; $V_{CE} = 10$ V	V_{BE}	0.65 to 0.74	V

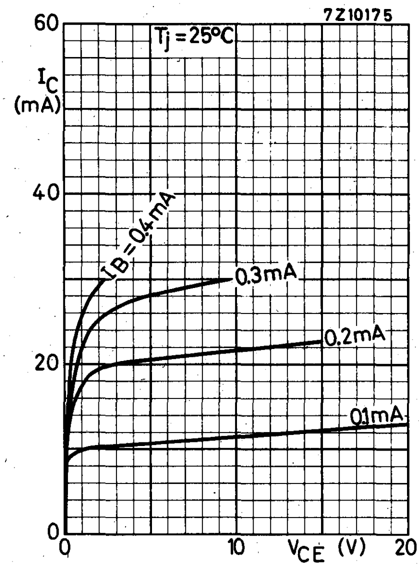
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

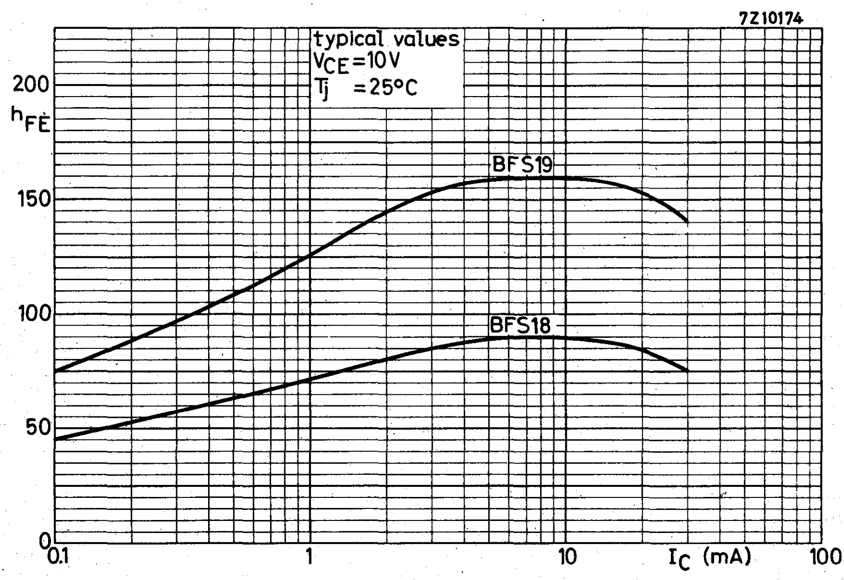
			BFS18	BFS19	
D.C. current gain					
I_C = 1 mA; V_{CE} = 10 V	h_{FE}		35 to 125	65 to 225	
Transition frequency at f = 100 MHz					
I_C = 1 mA; V_{CE} = 10 V	f_T	typ.	200	260	MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e$ = 0; V_{CB} = 10 V	C_c	typ.	1		pF
Feedback capacitance at f = 1 MHz					
I_C = 1 mA; V_{CE} = 10 V	C_{re}	typ.	0.85		pF
Noise figure					
I_C = 1 mA; V_{CE} = 10 V G_S = 10 mΩ^{-1}; f = 100 MHz	F	typ.	4		dB [1]

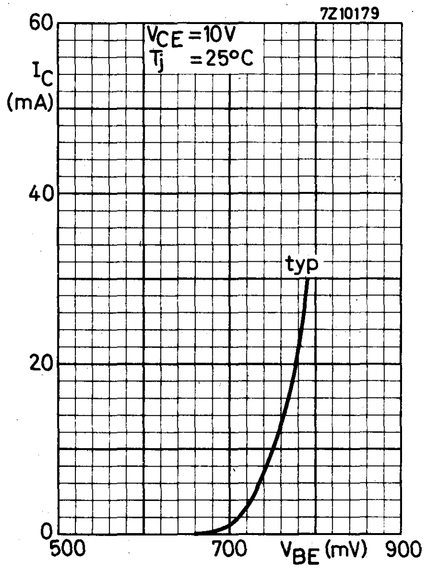
[1] Crystal mounted in a BF115 envelope.

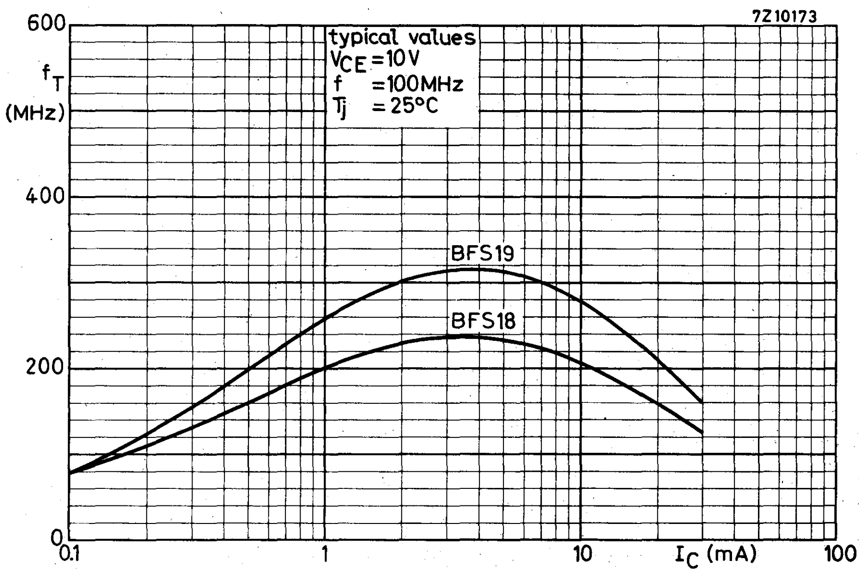
Typical behaviour of collector current versus collector-emitter voltage

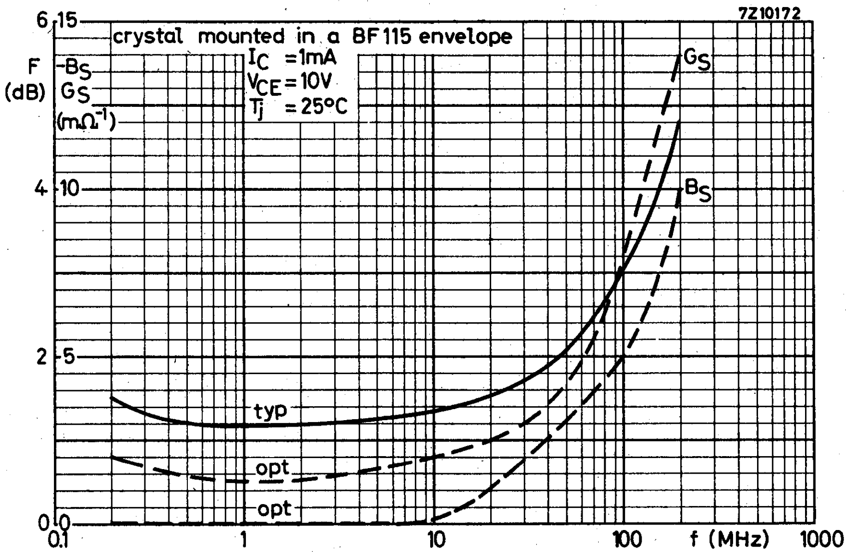


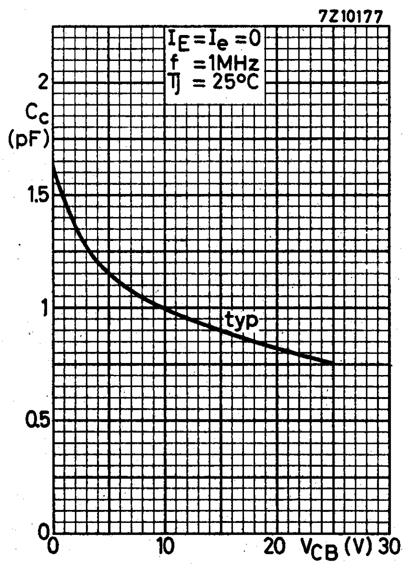


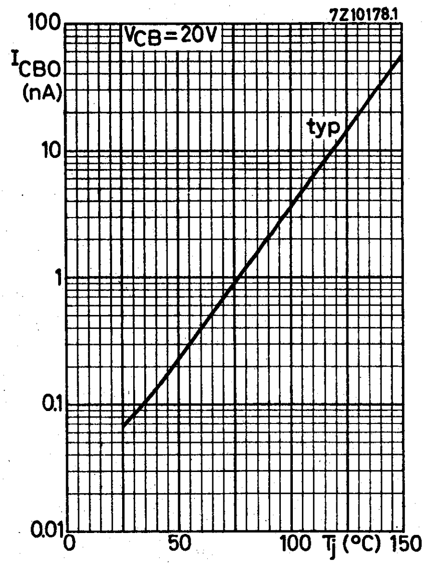



7Z10179
V_{CE} = 10 V
T_j = 25°C
I_C (mA)
60
40
20
0
typ
500
700
V_{BE} (mV)
900


7Z10173
typical values
V_{CE} = 10 V
f = 100 MHz
T_j = 25°C
f_T (MHz)
600
400
200
0
BFS19
BFS18
0.1
1
10
I_C (mA)
100


7Z10172
crystal mounted in a BF115 envelope
I_C = 1mA
V_{CE} = 10V
T_j = 25°C
F (dB)
$-B_S$
G_S
(mΩ^{-1})
6
4
2
0
15
10
5
0
G_S
B_S
typ
opt
opt
0.1
1
10
100
f (MHz)
1000


7Z10177
$I_E = I_e = 0$
f = 1MHz
T_j = 25°C
C_c (pF)
2
1.5
1
0.5
0
typ
0
10
20
V_{CB} (V)
30


7Z10178.1
V_{CB} = 20V
I_{CBO} (nA)
100
10
1
0.1
0.01
typ
0
50
100
T_j (°C)
150

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic envelope. It has a very low feedback capacitance and is intended for i.f. and v.h.f. applications in thick and thin-film circuits.

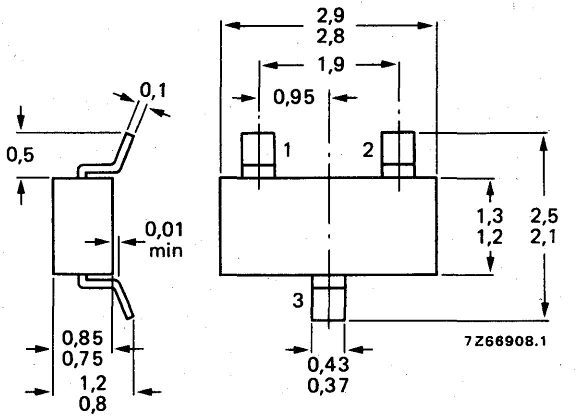
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Collector-emitter voltage (open base)	V_{CEO}	max.	20 V
Collector current (d.c.)	I_C	max.	25 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Junction temperature	T_j	max.	150 °C
D.C. current gain I_C = 7 mA; V_{CE} = 10 V	h_{FE}	>	40
Transition frequency at f = 100 MHz I_C = 5 mA; V_{CE} = 5 V	f_T	typ.	450 MHz
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 10 V	C_{re}	typ.	350 fF

MECHANICAL DATA

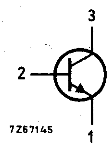
Dimensions in mm

Fig. 1 SOT-23.

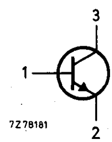


Marking code

BFS20 = G1



BFS20R = G4



See also *Soldering recommendations.*

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

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base) I_C = 2 mA	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	4	V

Currents

Collector current (d.c.)	I_C	max.	25	mA
Collector current (peak value)	I_{CM}	max.	25	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	P_{tot}	max.	200	mW

Temperatures

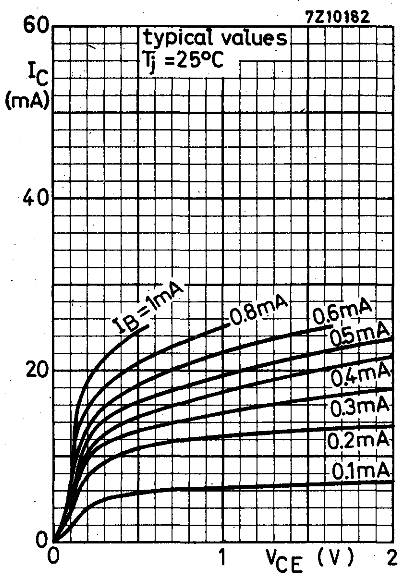
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

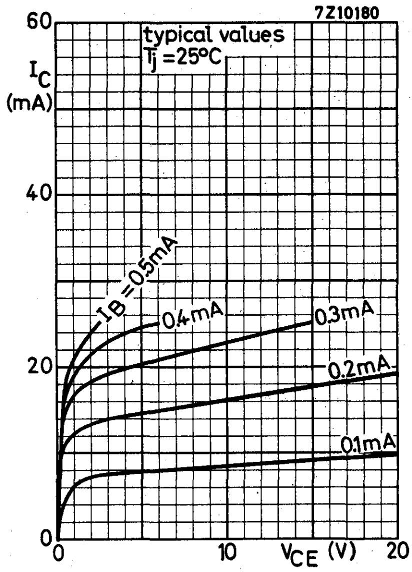
THERMAL RESISTANCE

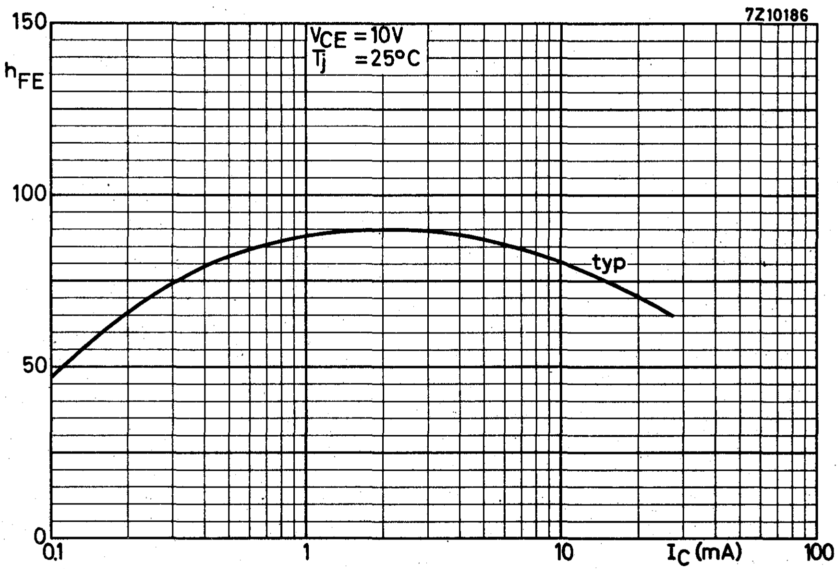
From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	$R_{th\ j-a}$	=	0.62	°C/mW

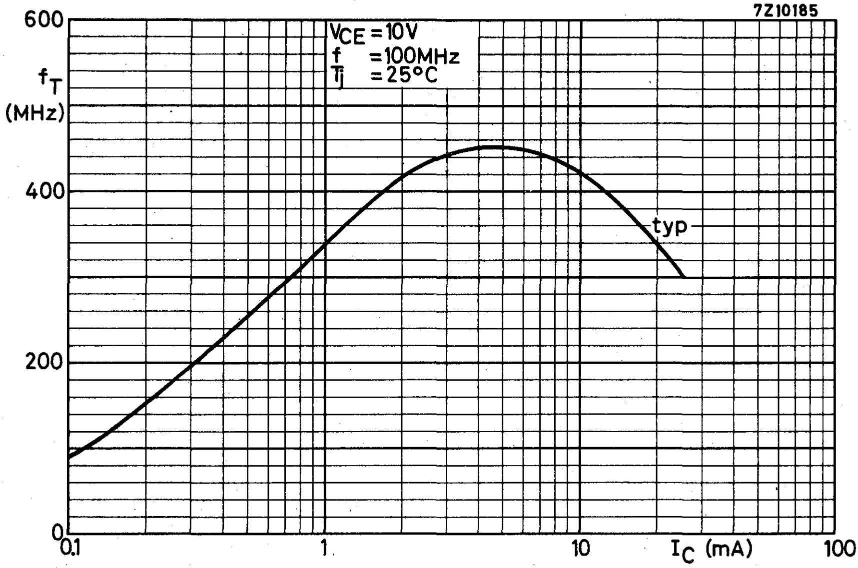
CHARACTERISTICS T_j = 25 °C unless otherwise specified

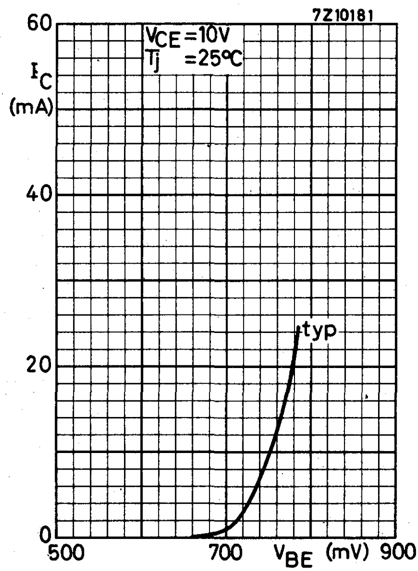
Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100	nA
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 100$ °C	I_{CBO}	<	10	μA
Base-emitter voltage				
$I_C = 7$ mA; $V_{CE} = 10$ V	V_{BE}	typ.	740	mV
		<	900	mV
D.C. current gain				
$I_C = 7$ mA; $V_{CE} = 10$ V	h_{FE}	>	40	
		typ.	85	
Transition frequency at f = 100 MHz				
$I_C = 5$ mA; $V_{CE} = 10$ V	f_T	>	275	MHz
		typ.	450	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	0.8	pF
Feedback capacitance at f = 1 MHz				
$I_C = 1$ mA; $V_{CE} = 10$ V	C_{re}	typ.	350	fF

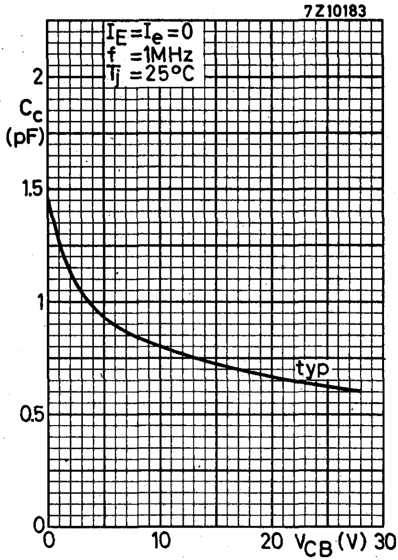

7Z10182
typical values
Tj =25°C
IC
(mA)
60
40
20
0
IB=1mA
0.8mA
0.6mA
0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
0
1
VCE (V)
2

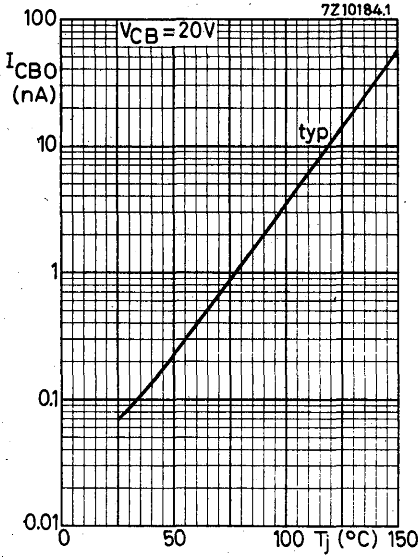

7Z10180
typical values
Tj =25°C
IC
(mA)
60
40
20
0
IB=0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
0
10
VCE (V)
20


7Z10186
VCE =10V
Tj =25°C
hFE
150
100
50
0
typ
0.1
1
10
IC (mA)
100


7Z10185
V_{CE} = 10 V
f = 100 MHz
T_j = 25 °C
f_T
(MHz)
600
400
200
0
0.1
1
10
100
I_C (mA)
typ


7Z10181
V_{CE} = 10 V
T_j = 25 °C
I_C
(mA)
60
40
20
0
500
700
900
V_{BE} (mV)
typ


7Z10183
$I_E = I_e = 0$
f = 1MHz
T_j = 25°C
C_c
(pF)
2
1.5
1
0.5
0
0
10
20
V_{CB} (V)
30
typ


7Z10184.1
V_{CB} = 20V
I_{CBO}
(nA)
100
10
1
0.1
0.01
0
50
100
T_j (°C)
150
typ

SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic envelope, primarily intended for use in u.h.f. low power amplifiers in thick and thin-film circuits, such as in pocket phones, paging systems, etc. The transistor features low current consumption (100 μA – 1 mA); thanks to its high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

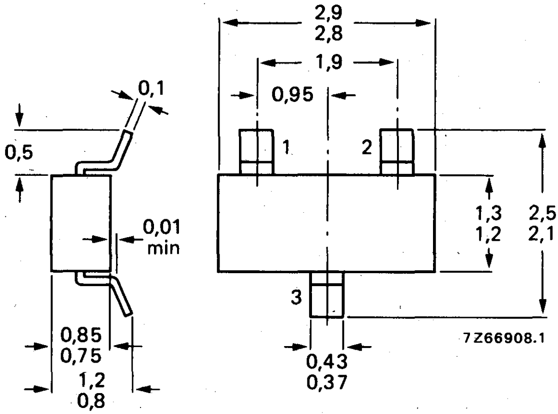
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	8	V
Collector-emitter voltage (open base)	V_{CEO}	max.	5	V
Collector current (d.c.)	I_C	max.	2,5	mA
Total power dissipation up to T_{amb} = 135 °C	P_{tot}	max.	30	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz I_C = 1 mA; V_{CE} = 1 V	f_T	typ.	2,3	GHz
Feedback capacitance at f = 1 MHz I_C = 1 mA; V_{CE} = 1 V; T_{amb} = 25 °C	C_{re}	<	0,45	pF
Noise figure at optimum source impedance I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	3,8	dB
Max. unilateral power gain (see page 3) I_C = 1 mA; V_{CE} = 1 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	18	dB

MECHANICAL DATA

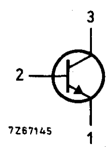
Dimensions in mm

Fig. 1 SOT-23.

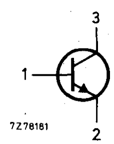


Marking code

BFT25 = V1



BFT25R = V4



See also *Soldering recommendations.*

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	8	V
Collector-emitter voltage (open base)	V_{CEO}	max.	5	V
Emitter-base voltage (open collector)	V_{EBO}	max.	2	V

Currents

Collector current (d.c.)	I_C	max.	2,5	mA
Collector current (peak value; f > 1 MHz)	I_{CM}	max.	5,0	mA

Power dissipation

Total power dissipation up to T_{amb} = 135 °C mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	P_{tot}	max.	30	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

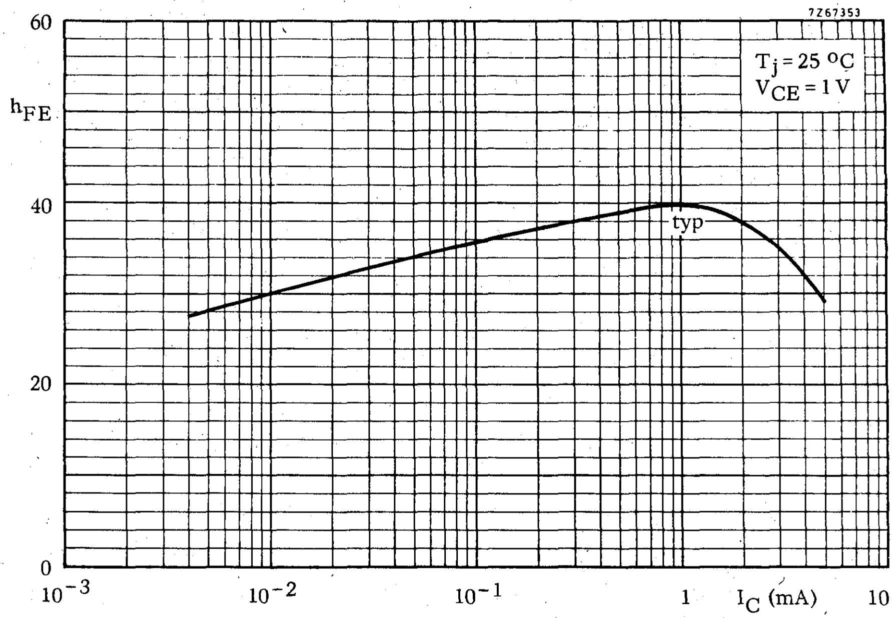
Collector cut-off current				
$I_E = 0$; $V_{CB} = 5$ V	I_{CBO}	<	50	nA
D.C. current gain [1]				
$I_C = 10\ \mu A$; $V_{CE} = 1$ V	h_{FE}	> typ.	20 30	
$I_C = 1$ mA; $V_{CE} = 1$ V	h_{FE}	> typ.	20 40	
Saturation voltages				
$I_C = 10\ \mu A$; $I_B = 1\ \mu A$	V_{CEsat} V_{BEsat}	< <	200 750	mV mV
$I_C = 1$ mA; $I_B = 0{,}1$ mA	V_{CEsat} V_{BEsat}	< <	175 900	mV mV
Transition frequency at f = 500 MHz [1]				
$I_C = 1$ mA; $V_{CE} = 1$ V	f_T	> typ.	1,2 2,3	GHz GHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 0{,}5$ V	C_c	<	0,6	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 0$	C_e	<	0,5	pF
Feedback capacitance at f = 1 MHz				
$I_C = 1$ mA; $V_{CE} = 1$ V; $T_{amb} = 25$ °C	C_{re}	<	0,45	pF
Noise figure at optimum source impedance				
$I_C = 0{,}1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	5,5	dB
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	F	typ.	3,8	dB

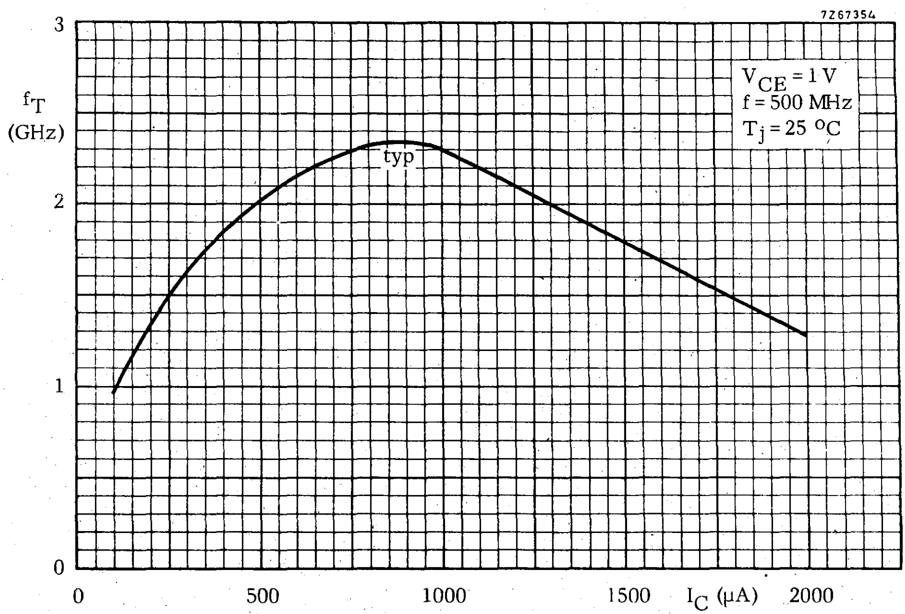
Max. unilateral power gain (s_{re} assumed to be zero)

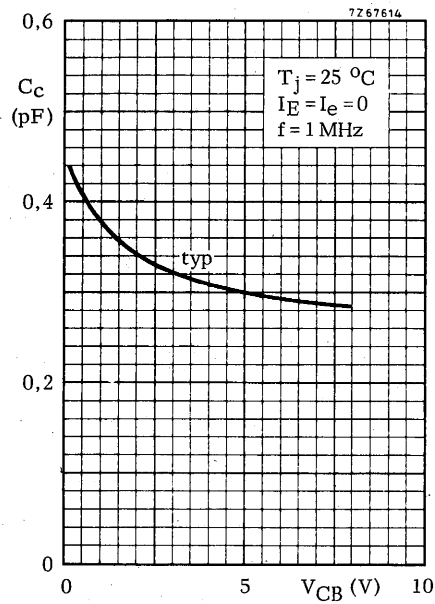
$$G_{UM} \text{ (in dB)} = 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$$

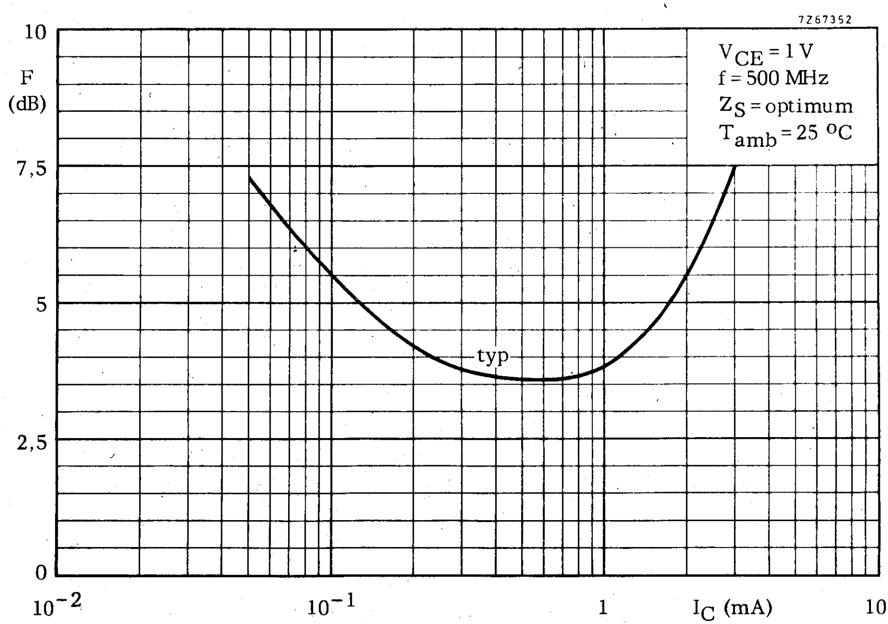
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 200 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	25	dB
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 500 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	18	dB
$I_C = 1$ mA; $V_{CE} = 1$ V; f = 800 MHz; $T_{amb} = 25$ °C	G_{UM}	typ.	12	dB

[1]) Measured under pulse conditions.

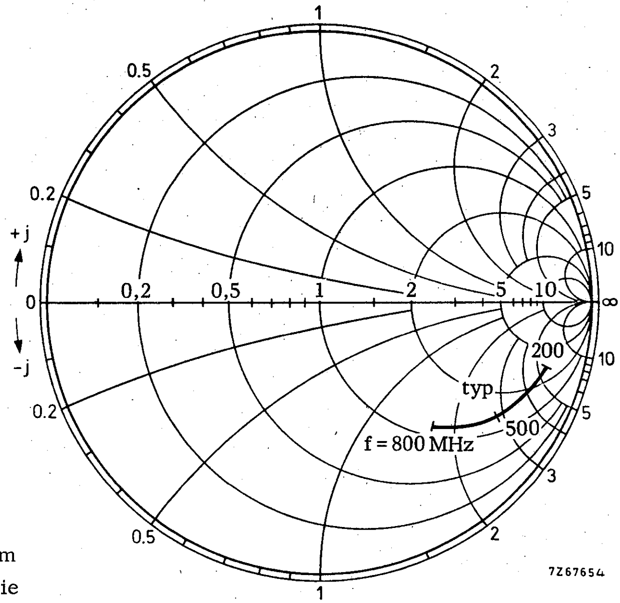

7Z67353
$T_j = 25\ ^oC$
$V_{CE} = 1\ V$
h_{FE}
60
40
20
0
typ
10^{-3}
10^{-2}
10^{-1}
1
I_C (mA)
10


7Z67354
$V_{CE} = 1\ V$
f = 500 MHz
$T_j = 25\ ^oC$
f_T
(GHz)
3
2
1
0
typ
0
500
1000
1500
I_C (μA)
2000


7Z67614
0,6
Cc
(pF)
0,4
0,2
0
Tj = 25 °C
IE = Ie = 0
f = 1 MHz
typ
0
5
VCB (V)
10

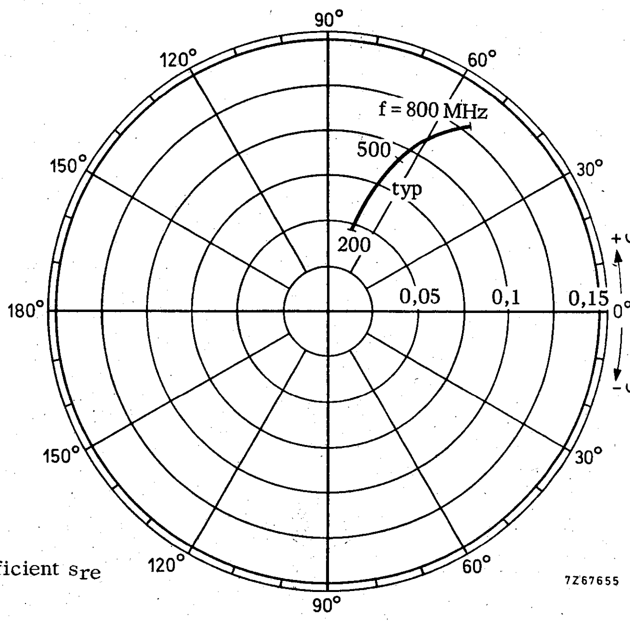

7Z67352
10
F
(dB)
7,5
5
2,5
0
VCE = 1 V
f = 500 MHz
ZS = optimum
Tamb = 25 °C
typ
10−2
10−1
1
IC (mA)
10

V_{CE} = 1 V
I_C = 1 mA
T_{amb} = 25 ^oC



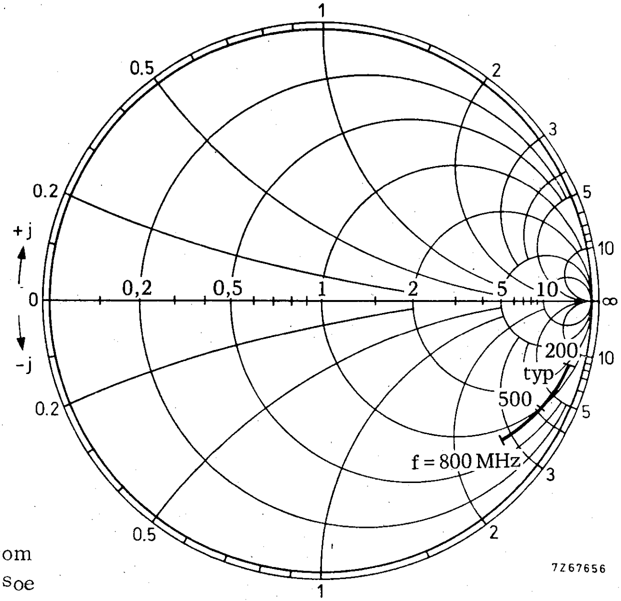
Input impedance derived from input reflection coefficient s_{ie} coordinates in ohm x 50

V_{CE} = 1 V
I_C = 1 mA
T_{amb} = 25 ^oC



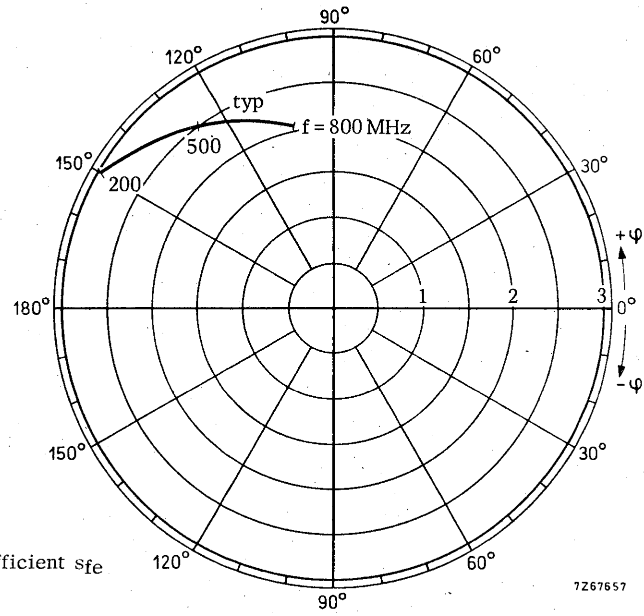
Reverse transmission coefficient s_{re}

$V_{CE} = 1\ V$
$I_C = 1\ mA$
$T_{amb} = 25\ ^oC$



Output impedance derived from output reflection coefficient s_{oe} coordinates in ohm x 50

$V_{CE} = 1\ V$
$I_C = 1\ mA$
$T_{amb} = 25\ ^oC$



Forward transmission coefficient s_{fe}

N-CHANNEL SILICON FET

N-channel silicon epitaxial planar junction field-effect transistor in a microminiature plastic envelope. The transistor is intended for low level general purpose amplifiers in thick and thin-film circuits.

QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$	max.	25 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25 V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200 mW
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	> <	0,2 mA 1,5 mA
Transfer admittance (common source) I_D = 0,2 mA; V_{DS} = 10 V; f = 1 kHz	$\|y_{fs}\|$	>	0,5 mA/V
Equivalent noise voltage V_{DS} = 10 V; I_D = 200 μA; B = 0,6 to 100 Hz	V_n	<	0,5 μV

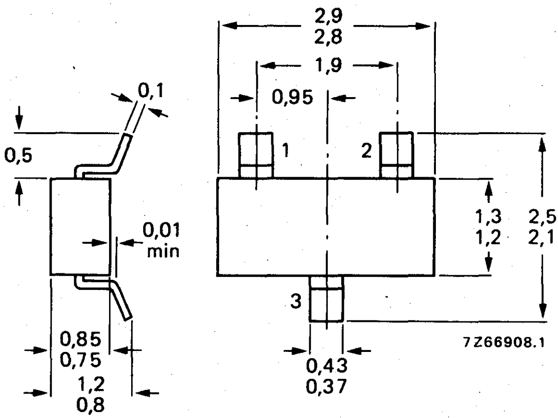
MECHANICAL DATA

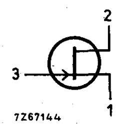
Dimensions in mm

Marking code

BFT46 = M3

Fig. 1 SOT-23.





See also *Soldering recommendations.*

RATINGS

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

Drain-source voltage	$\pm V_{DS}$	max.	25 V
Drain-gate voltage (open source)	V_{DGO}	max.	25 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25 V
Drain current	I_D	max.	10 mA
Gate current	I_G	max.	5 mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	200 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

from junction to ambient *	$R_{th\ j\text{-}a}$	=	0,62 °C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Gate cut-off current $-V_{GS}$ = 10 V; V_{DS} = 0	$-I_{GSS}$	<	0,2 nA
Drain current ** V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	> <	0,2 mA 1,5 mA
Gate-source voltage I_D = 50 μA; V_{DS} = 10 V	$-V_{GS}$	> <	0,1 V 1,0 V
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 10 V	$-V_{(P)GS}$	<	1,2 V
Y parameters at f = 1 kHz; V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C			
Transfer admittance	$\lvert y_{fs}\rvert$	>	1,0 mA/V
Output admittance	$\lvert y_{os}\rvert$	<	10 μA/V
V_{DS} = 10 V; I_D = 200 μA;			
Transfer admittance	$\lvert y_{fs}\rvert$	>	0,5 mA/V
Output admittance	$\lvert y_{os}\rvert$	<	5 μA/V
Input capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C	C_{is}	<	5 pF
Feedback capacitance at f = 1 MHz; V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C	C_{rs}	<	1,5 pF
Equivalent noise voltage V_{DS} = 10 V; I_D = 200 μA; T_{amb} = 25 °C B = 0,6 to 100 Hz	V_n	<	0,5 μV

* Mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm.
** Measured under pulse conditions.

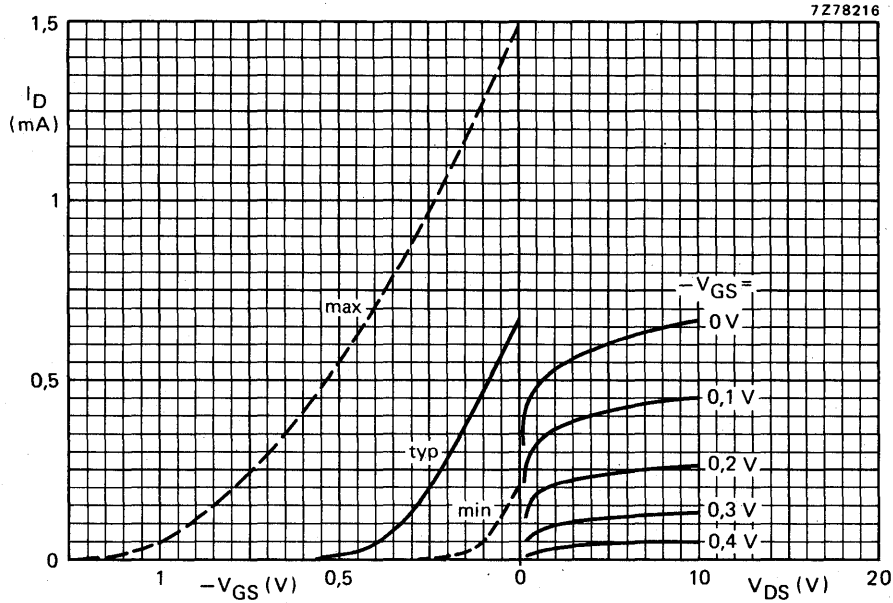


Fig. 2 Typical values. V_{DS} = 10 V; T_j = 25 °C.

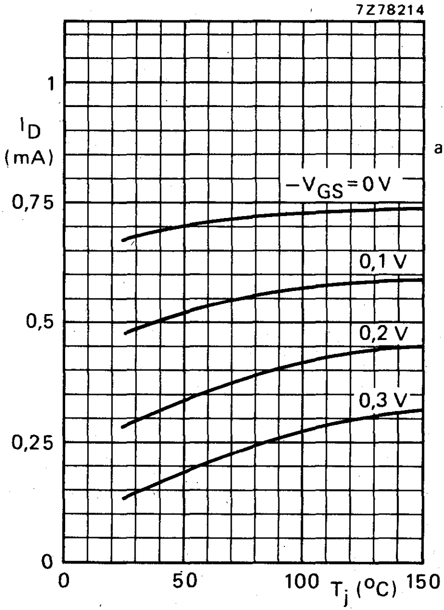


Fig. 3 Typical values. V_{DS} = 10 V.

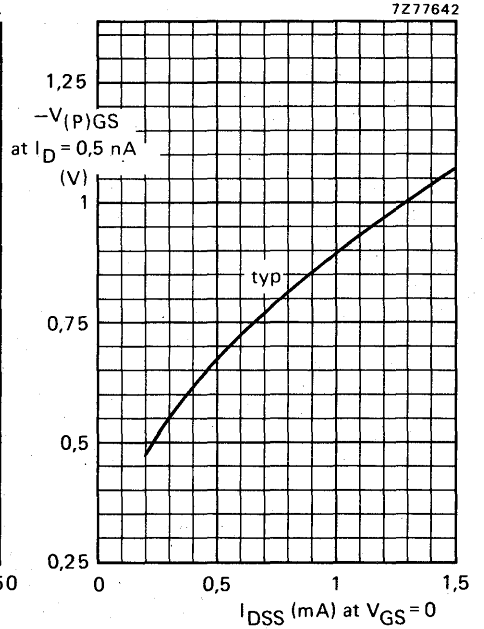


Fig. 4 Correlation between $-V_{(P)GS}$ and I_{DSS}. V_{DS} = 10 V; T_j = 25 °C.

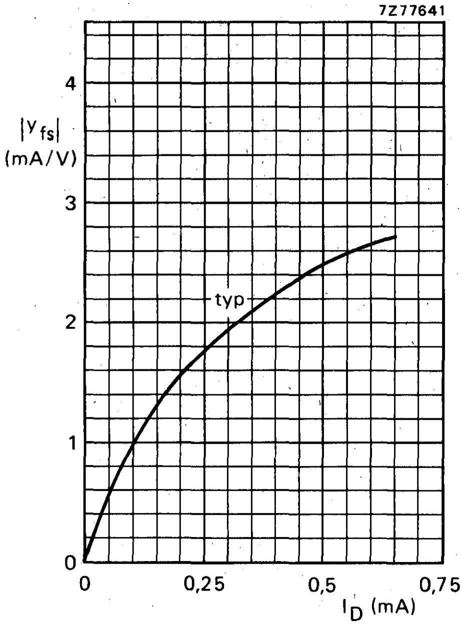


Fig. 5.

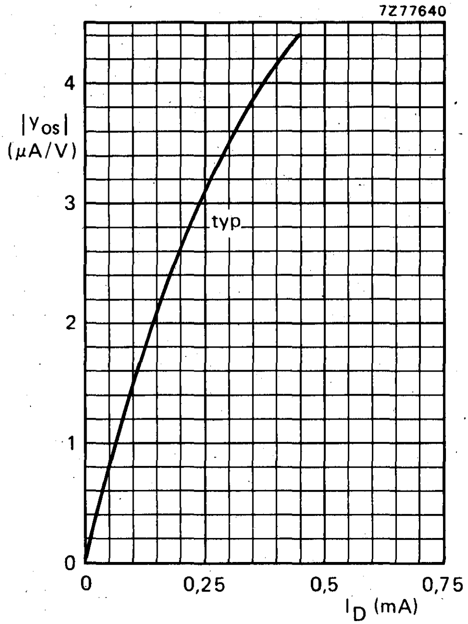


Fig. 6.

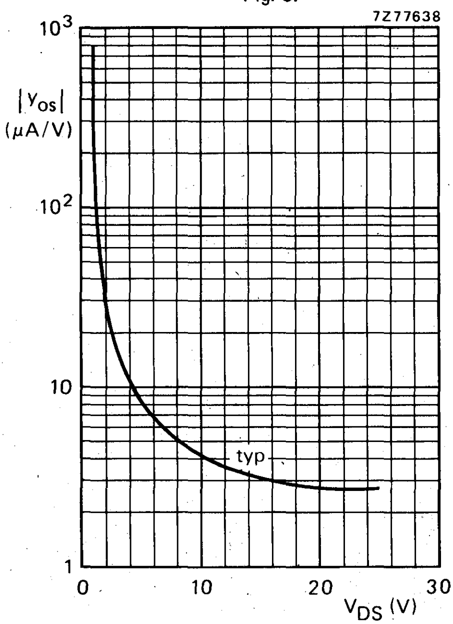


Fig. 7.

Fig. 5 $|y_{fs}|$ versus I_D.
V_{DS} = 10 V; f = 1 kHz; T_{amb} = 25 °C.

Fig. 6 $|y_{os}|$ versus I_D.
V_{DS} = 10 V; f = 1 kHz; T_{amb} = 25 °C.

Fig. 7 $|y_{os}|$ versus V_{DS}.
I_D = 0,4 mA; f = 1 kHz; T_{amb} = 25 °C.

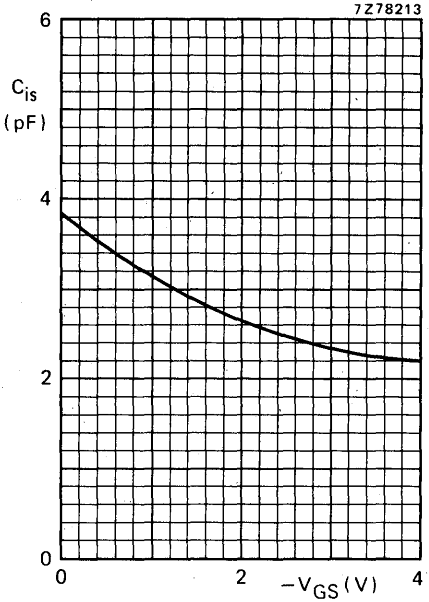


Fig. 8.

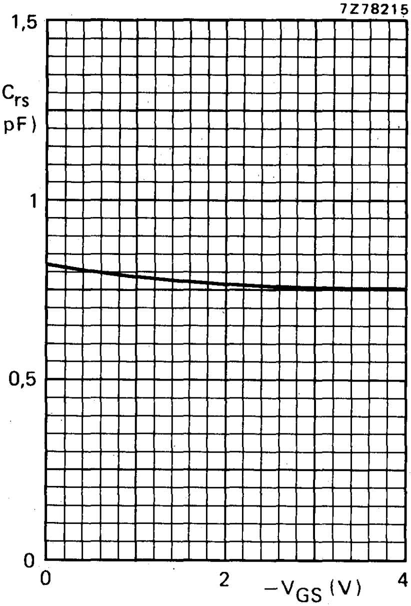


Fig. 9.

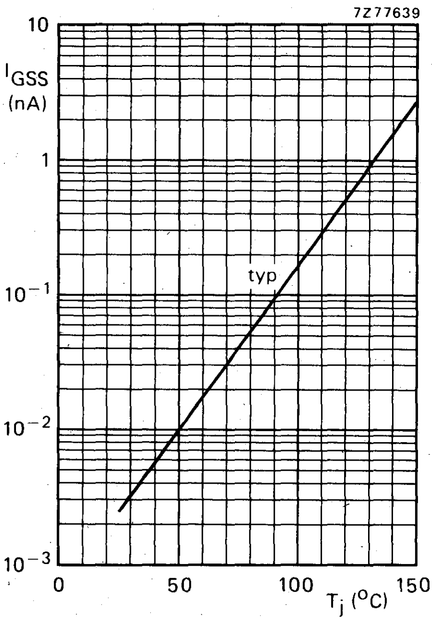


Fig. 10.

Fig. 8 Typical values.
V_{DS} = 10 V, T_{amb} = 25 °C.

Fig. 9 Typical values.
V_{DS} = 10 V, T_{amb} = 25 °C.

Fig. 10 I_{GSS} versus T_j.
$-V_{GSS}$ = 10 V; V_{DS} = 0.

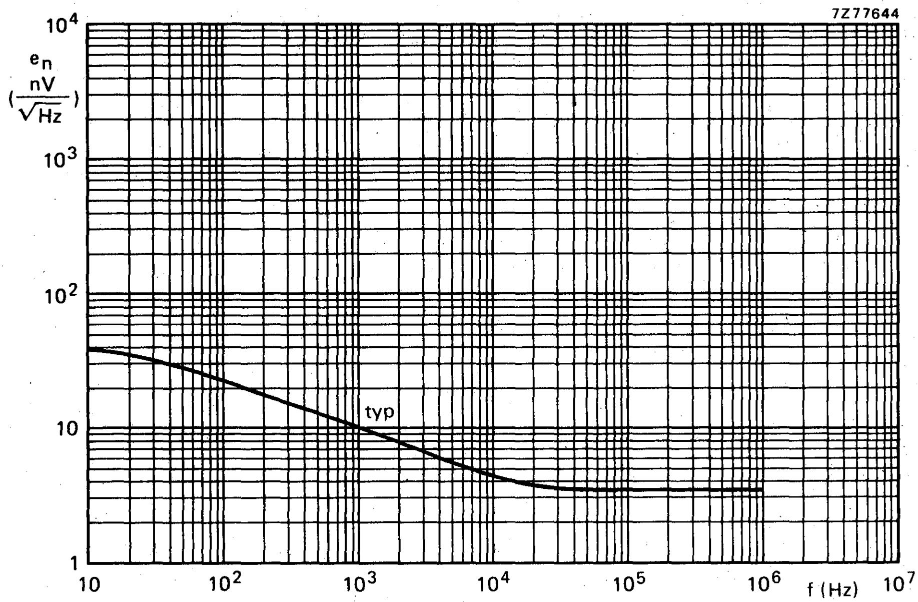


Fig. 11 V_{DS} = 10 V; I_D = 0,2 mA; T_{amb} = 25 °C.

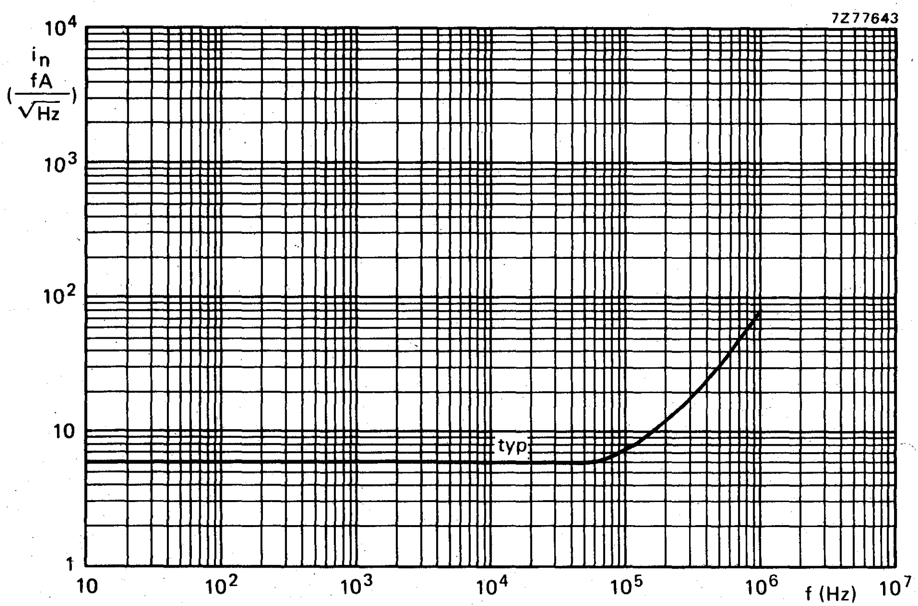


Fig. 12 V_{DS} = 10 V; I_D = 0,2 mA; T_{amb} = 25 °C.

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a microminiature plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers, etc.

The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

This type is complementary to BFR92.

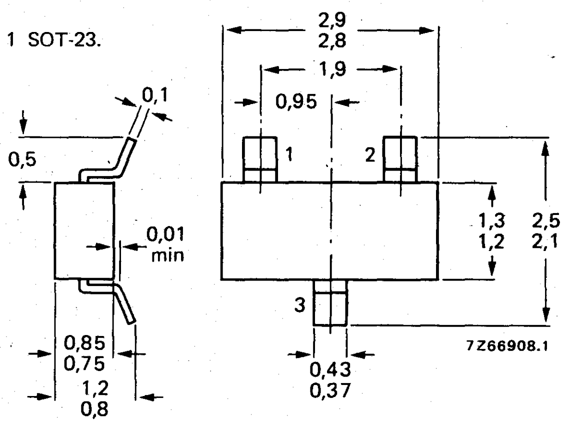
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (d.c.)	$-I_C$	max.	25	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	180	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz $-I_C$ = 14 mA; $-V_{CE}$ = 10 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; T_{amb} = 25 °C	C_{re}	typ.	0,7	pF
Noise figure at optimum source impedance $-I_C$ = 2 mA; $-V_{CE}$ = 10 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	2,7	dB
Max. unilateral power gain (see page 3) $-I_C$ = 14 mA; $-V_{CE}$ = 10 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	18	dB
Intermodulation distortion at T_{amb} = 25 °C $-I_C$ = 14 mA; $-V_{CE}$ = 10 V; R_L = 75 Ω; V_o = 150 mV $f_{(p+q-r)}$ = 493,25 MHz (see page 3)	d_{im}	typ.	−60	dB

MECHANICAL DATA

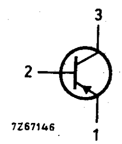
Dimensions in mm

Fig. 1 SOT-23.

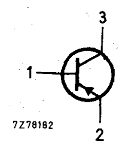


Marking code

BFT92 = W1



BFT92R = W4



RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	2,0 V
Collector current (d.c.)	$-I_C$	max.	25 mA
Collector current (peak value; f > 1 MHz)	$-I_{CM}$	max.	35 mA
Total power dissipation up to T_{amb} = 60 °C mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	P_{tot}	max.	180 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,5 °C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	<	50 nA
D.C. current gain * $-I_C = 14$ mA; $-V_{CE} = 10$ V	h_{FE}	> typ.	20 50
Transition frequency at f = 500 MHz * $-I_C = 14$ mA; $-V_{CE} = 10$ V	f_T	typ.	5 GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	0,75 pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $-V_{EB} = 0,5$ V	C_e	typ.	0,8 pF

* Measured under pulse conditions.

CHARACTERISTICS (continued)

T_{amb} = 25 °C			
Feedback capacitance at f = 1 MHz			
$-I_C$ = 2 mA; $-V_{CE}$ = 10 V	C_{re}	typ.	0,7 pF
Noise figure at optimum source impedance *			
$-I_C$ = 2 mA; $-V_{CE}$ = 10 V; f = 500 MHz	F	typ.	2,7 dB
Max. unilateral power gain (s_{re} assumed to be zero)			
$G_{UM}(\text{in dB}) = 10 \log \frac{\lvert s_{fe}\rvert^2}{(1-\lvert s_{ie}\rvert^2)(1-\lvert s_{oe}\rvert^2)}$			
$-I_C$ = 14 mA; $-V_{CE}$ = 10 V; f = 500 MHz	G_{UM}	typ.	18 dB
Intermodulation distortion *			
$-I_C$ = 14 mA; $-V_{CE}$ = 10 V; R_L = 75 Ω; VSWR < 2			
V_p = V_o = 150 mV at f_p = 495,25 MHz			
V_q = V_o −6 dB at f_q = 503,25 MHz			
V_r = V_o −6 dB at f_r = 505,25 MHz			
Measured at $f_{(p+q-r)}$ = 493,25 MHz	d_{im}	typ.	−60 dB

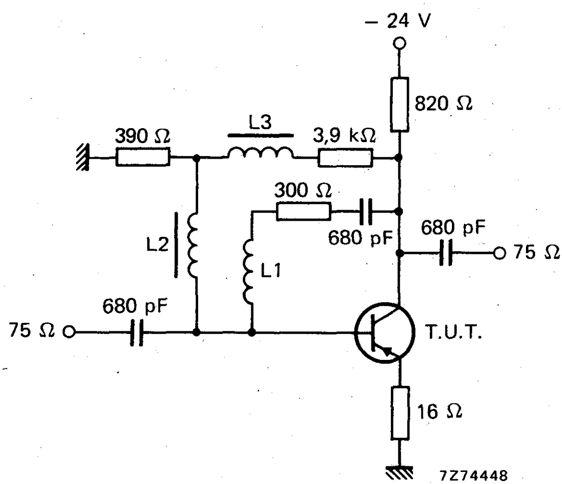


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35 mm); winding pitch 1 mm; int. dia. 4 mm.
L2 = L3 = 5 μH (catalogue number: 3122 108 20150).

* Crystal mounted in SOT-37 envelope.

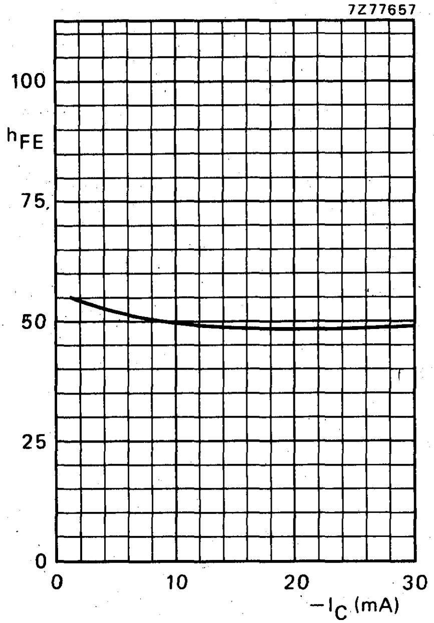


Fig. 3 $-V_{CE}$ = 10 V; T_j = 25 °C.

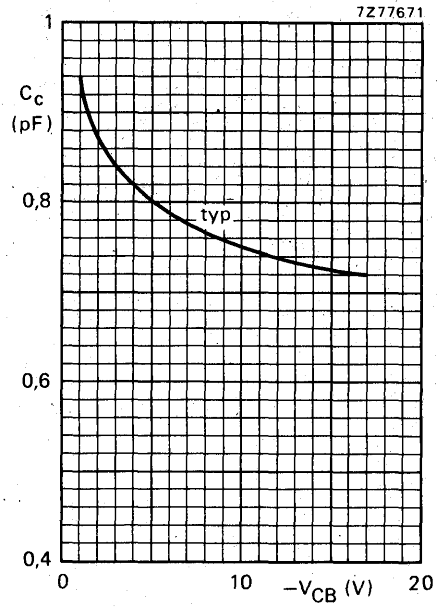


Fig. 4 $I_E = I_e = 0$; T_j = 25 °C; f = 1 MHz.

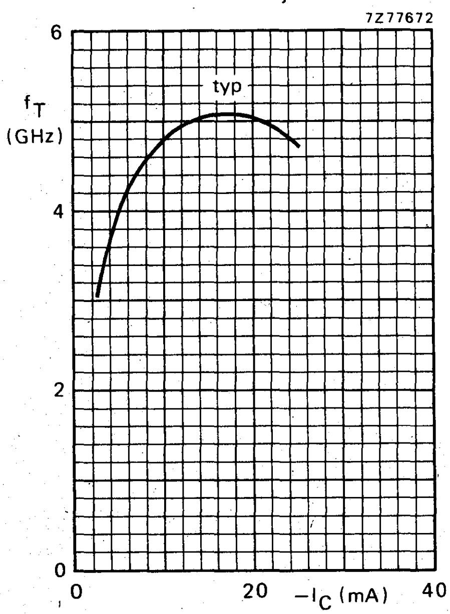


Fig. 5 $-V_{CE}$ = 10 V; f = 500 MHz; T_j = 25 °C.

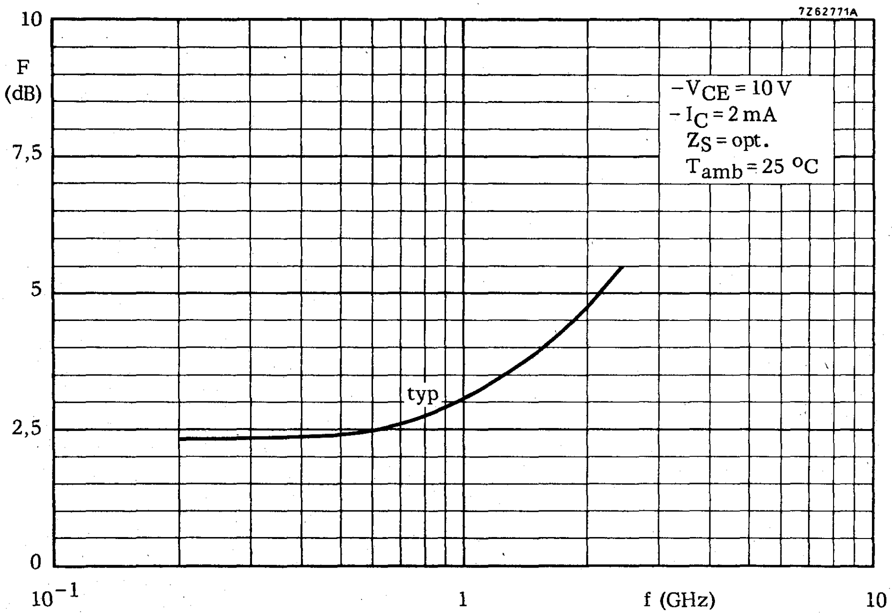

7Z62771A
10
F
(dB)
7,5
5
2,5
0
$-V_{CE} = 10$ V
$-I_C = 2$ mA
Z_S = opt.
$T_{amb} = 25$ °C
typ
10^{-1}
1
f (GHz)
10

Fig. 6.

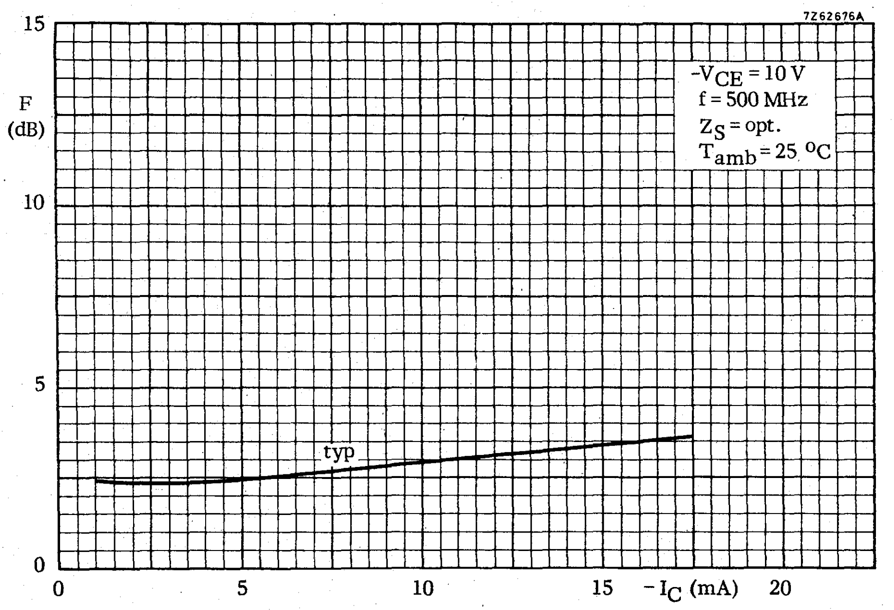

7Z62676A
15
F
(dB)
10
5
0
$-V_{CE} = 10$ V
f = 500 MHz
Z_S = opt.
$T_{amb} = 25$ °C
typ
0
5
10
15
$-I_C$ (mA)
20

Fig. 7.

SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a microminiature plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers, etc.

The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

This type is complementary to BFR93.

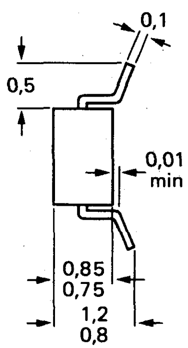
QUICK REFERENCE DATA

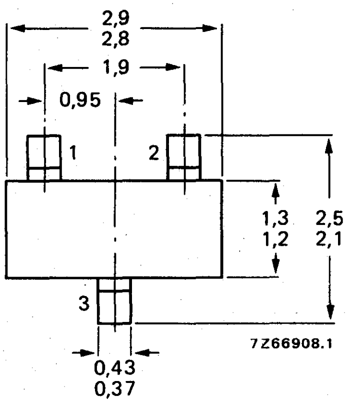
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	12	V
Collector current (d.c.)	$-I_C$	max.	35	mA
Total power dissipation up to T_{amb} = 60 °C	P_{tot}	max.	180	mW
Junction temperature	T_j	max.	150	°C
Transition frequency at f = 500 MHz $-I_C$ = 30 mA; $-V_{CE}$ = 5 V	f_T	typ.	5	GHz
Feedback capacitance at f = 1 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 5 V; T_{amb} = 25 °C	C_{re}	typ.	1,0	pF
Noise figure at optimum source impedance $-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 500 MHz; T_{amb} = 25 °C	F	typ.	2,4	dB
Max. unilateral power gain (see page 3) $-I_C$ = 30 mA; $-V_{CE}$ = 5 V; f = 500 MHz; T_{amb} = 25 °C	G_{UM}	typ.	16,5	dB
Intermodulation distortion at T_{amb} = 25 °C $-I_C$ = 30 mA; $-V_{CE}$ = 5 V; R_L = 75 Ω; V_o = 300 mV $f_{(p+q-r)}$ = 493,25 MHz (see page 3)	d_{im}	typ.	−60	dB

MECHANICAL DATA

Dimensions in mm

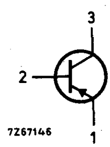
Fig. 1 SOT-23.



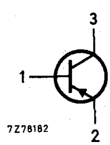


Marking code

BFT93 = X1



BFT93R = X4



RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	12	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	2,0	V
Collector current (d.c.)	$-I_C$	max.	35	mA
Collector current (peak value; f > 1 MHz)	$-I_{CM}$	max.	50	mA
Total power dissipation up to T_{amb} = 60 °C mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	P_{tot}	max.	180	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0$; $-V_{CB} = 5$ V	$-I_{CBO}$	<	50	nA
D.C. current gain * $-I_C = 30$ mA; $-V_{CE} = 5$ V	h_{FE}	>	20	
		typ.	50	
Transition frequency at f = 500 MHz * $-I_C = 30$ mA; $-V_{CE} = 5$ V	f_T	typ.	5	GHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$; $-V_{CB} = 10$ V	C_c	typ.	0,95	pF
Emitter capacitance at f = 1 MHz $I_C = I_c = 0$; $-V_{EB} = 0,5$ V	C_e	typ.	1,8	pF

* Measured under pulse conditions.

CHARACTERISTICS (continued)

T_{amb} = 25 °C

Feedback capacitance at f = 1 MHz			
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V	C_{re}	typ.	1,0 pF
Noise figure at optimum source impedance *			
$-I_C$ = 2 mA; $-V_{CE}$ = 5 V; f = 500 MHz	F	typ.	2,4 dB
Max. unilateral power gain (s_{re} assumed to be zero)			
$G_{UM}(\text{in dB}) = 10 \log \frac{\|s_{fe}\|^2}{(1-\|s_{ie}\|^2)(1-\|s_{oe}\|^2)}$			
$-I_C$ = 30 mA; $-V_{CE}$ = 5 V; f = 500 MHz	G_{UM}	typ.	16,5 dB
Intermodulation distortion *			
$-I_C$ = 30 mA; $-V_{CE}$ = 5 V; R_L = 75 Ω; VSWR < 2			
$V_p = V_o$ = 300 mV at f_p = 495,25 MHz			
$V_q = V_o$ −6 dB at f_q = 503,25 MHz			
$V_r = V_o$ −6 dB at f_r = 505,25 MHz			
Measured at $f_{(p+q-r)}$ = 493,25 MHz	d_{im}	typ.	−60 dB

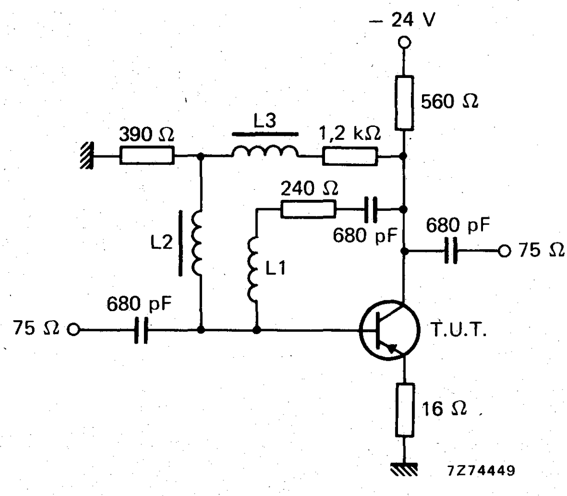


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35); winding pitch 1 mm; int. dia. 4 mm.
L2 and L3 = 5 μH (catalogue number: 3122 108 20150).

* Crystal mounted in SOT-37 envelope.

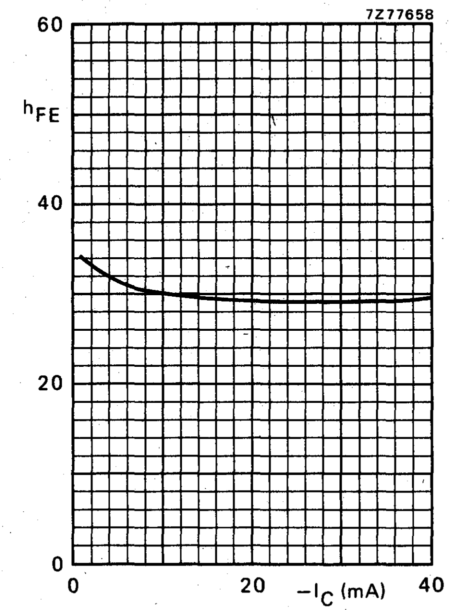


Fig. 3 $-V_{CE} = 5$ V; $T_j = 25$ °C.

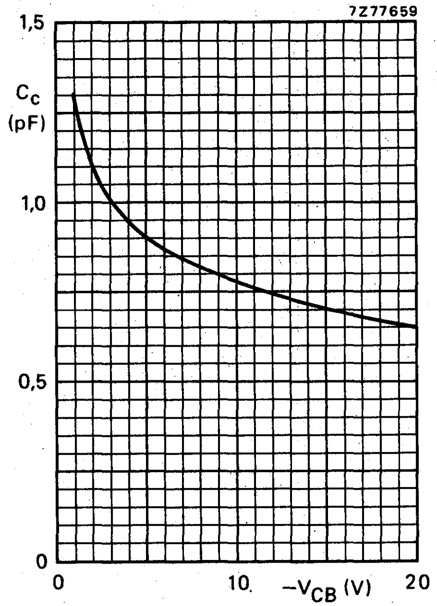


Fig. 4 $I_E = I_e = 0$; $T_j = 25$ °C; f = 1 MHz.

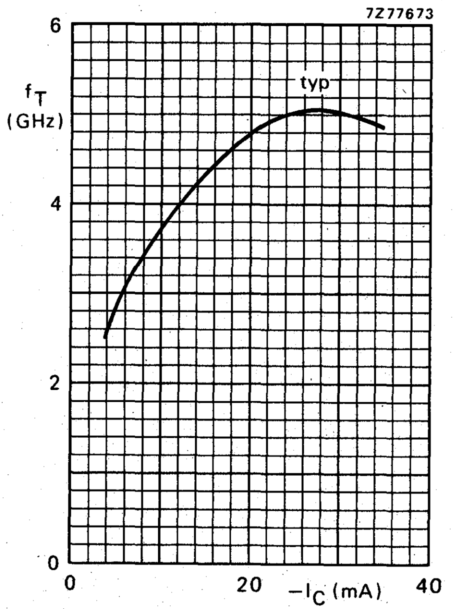


Fig. 5 $-V_{CE} = 5$ V; $T_j = 25$ °C; f = 500 MHz.

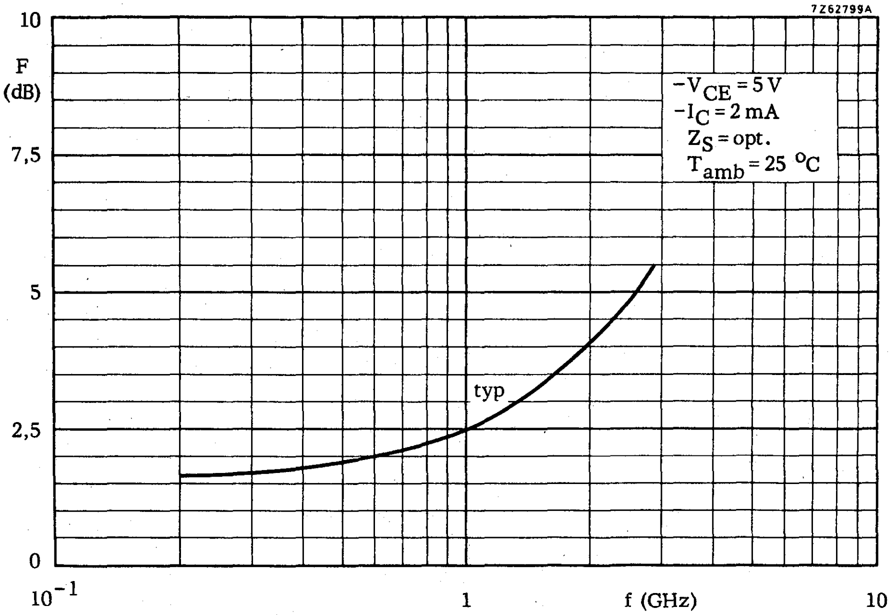

7Z62799A
10
F
(dB)
7,5
5
2,5
0
10^{-1}
1
f (GHz)
10
typ
$-V_{CE} = 5$ V
$-I_C = 2$ mA
Z_S = opt.
$T_{amb} = 25$ °C

Fig. 6.

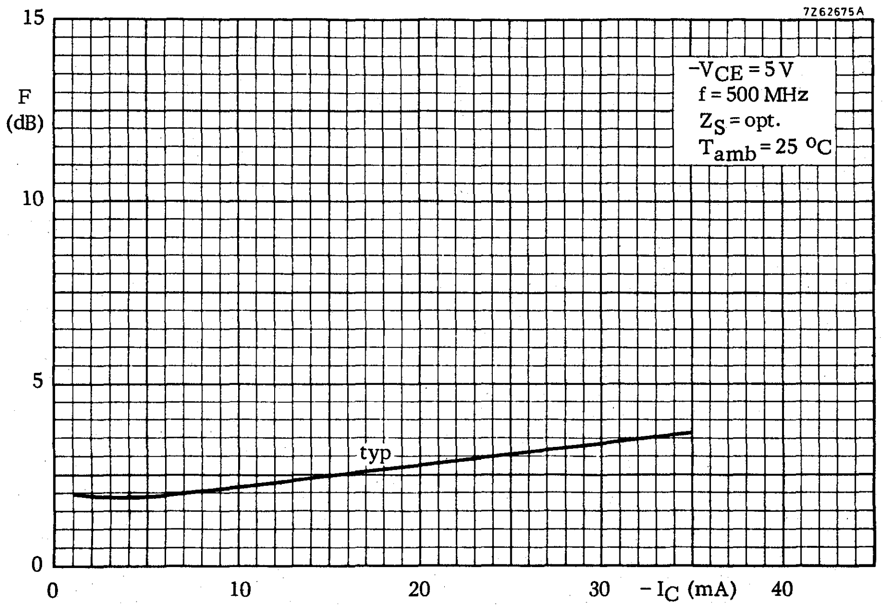

7Z62675A
15
F
(dB)
10
5
0
0
10
20
30
$-I_C$ (mA)
40
typ
$-V_{CE} = 5$ V
f = 500 MHz
Z_S = opt.
$T_{amb} = 25$ °C

Fig. 7.

PROGRAMMABLE UNIJUNCTION TRANSISTOR

Planar p-n-p-n trigger device in a microminiature plastic envelope intended for applications in thick and thin-film circuits. It is intended for use in switching applications such as motor control, oscillators, relay replacement, timers, pulse shaper, trigger device etc.

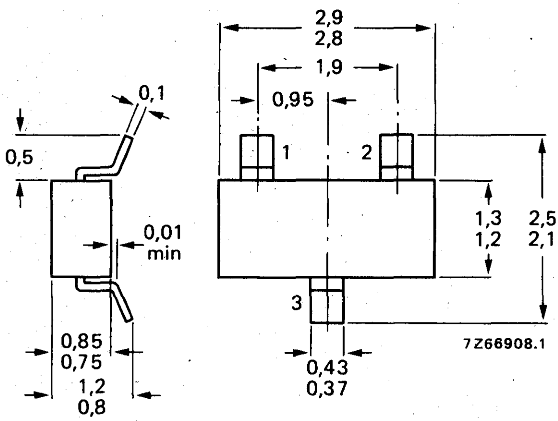
QUICK REFERENCE DATA

Gate-anode voltage	V_{GA}	max.	70 V
Anode current (d.c.) up to T_{case} = 85 °C	I_A	max.	250 mA
Junction temperature	T_j	max.	150 °C
Peak point current V_S = 10 V; R_G = 10 kΩ	I_P	<	5 μA
Valley point current V_S = 10 V; R_G = 10 kΩ	I_V	>	30 μA

MECHANICAL DATA

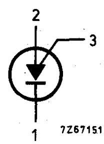
Dimensions in mm

Fig. 1 SOT-23.



Marking code

BRY61 = A5



See also *Soldering Recommendations*.

RATINGS

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

Gate-anode voltage	V_{GA}	max.	70	V
Anode current (d.c.) up to T_{amb} = 25 °C	I_A	max.	175	mA
Anode current (d.c.) up to T_{case} = 85 °C	I_A	max.	250	mA
Repetitive peak anode current t = 10 μs; δ = 0,01	I_{ARM}	max.	2,5	A
Non-repetitive peak anode current t = 10 μs; T_j = 150 °C	I_{ASM}	max.	3	A
Rate of rise of anode current up to I_A = 2,5 A	$\frac{dI_A}{dt}$	max.	20	A/μs
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 mm x 10 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,50	°C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Peak point current				
V_S = 10 V; R_G = 10 kΩ	I_P	<	5	μA
V_S = 10 V; R_G = 1 MΩ	I_P	<	1	μA
Valley point current (see also Figs 3 and 4)				
V_S = 10 V; R_G = 10 kΩ	I_V	>	30	μA
V_S = 10 V; R_G = 1 MΩ	I_V	<	50	μA
Offset voltage I_A = 0	V_{offset}	=	$V_P - V_S$	V

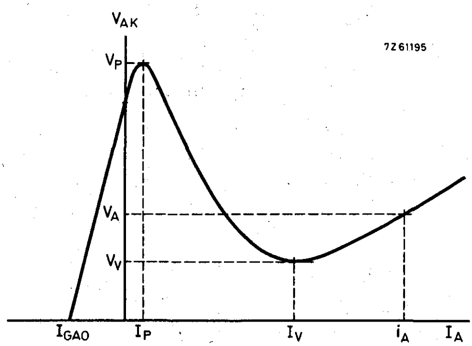


Fig. 2 See also Fig. 12.

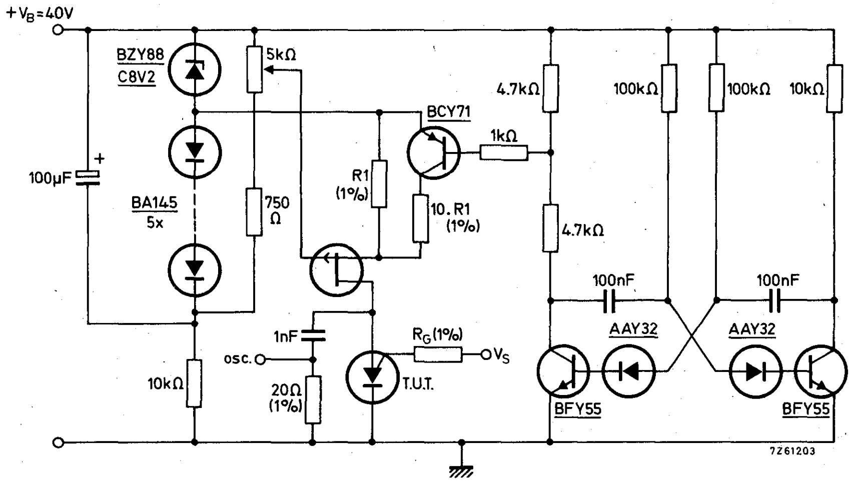
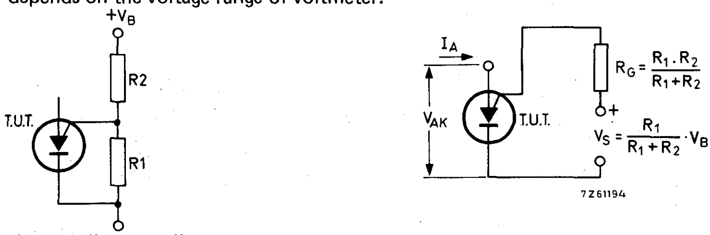


Fig. 3 Practical test circuit.

Notes

Remove BCY71 during measurement of I_P.

Value of R1 depends on the voltage range of voltmeter.



(a) BRY61 with "program" resistors R1 and R2.

(b) Equivalent test circuit for characteristics testing.

Fig. 4 Equivalent test circuit.

Gate-anode leakage current

$I_K = 0$; $V_{GA} = 70$ V $\qquad I_{GAO} < 10$ nA

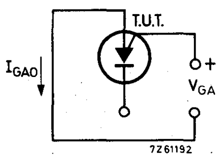


Fig. 5.

Gate-cathode leakage current $V_{AK} = 0$; $V_{GK} = 70$ V	I_{GKS}	<	100 nA

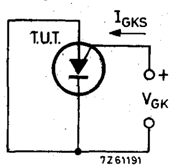


Fig. 6.

Anode voltage at $I_A = 100$ mA	V_A	<	1,4 V
Peak output voltage $V_{AA} = 20$ V; C = 200 nF (see Fig. 13)	V_{OM}	>	6 V
Rise time $V_{AA} = 20$ V; C = 10 nF (see Fig. 13)	t_r	<	80 ns

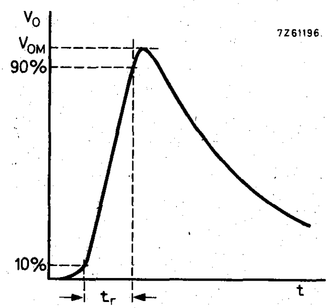


Fig. 7.

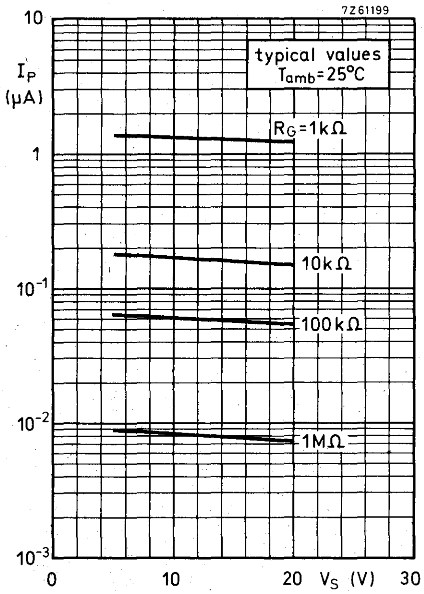


Fig. 8.

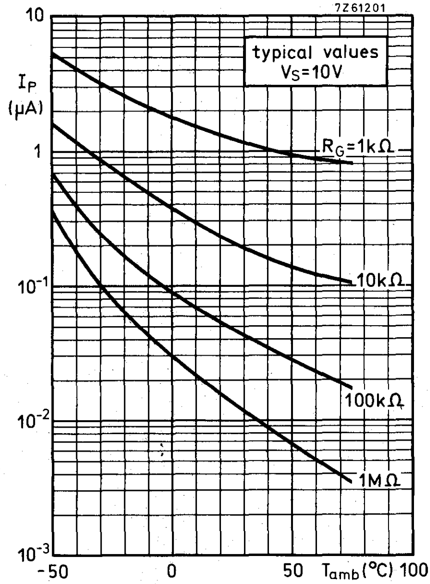


Fig. 9.

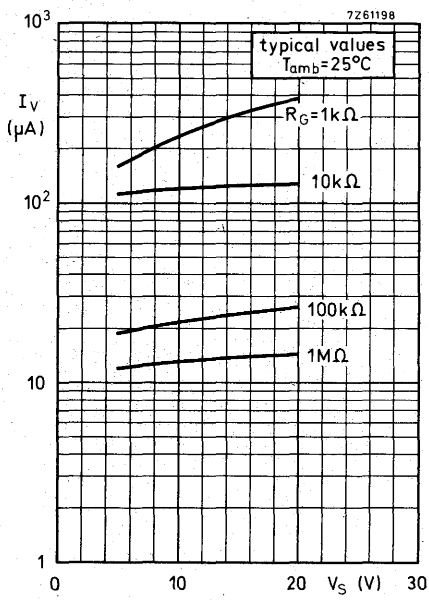


Fig. 10.

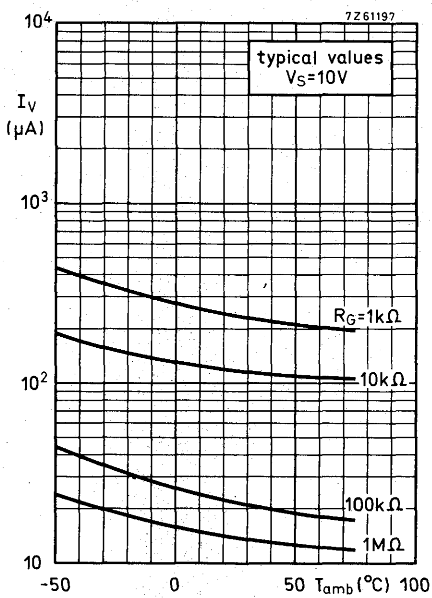


Fig. 11.

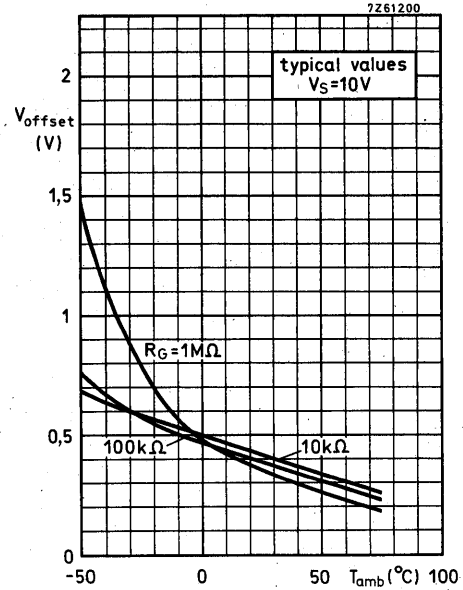

7Z61200
typical values
V_S=10V
V_{offset}
(V)
2
1,5
1
0,5
0
R_G=1MΩ
100kΩ
10kΩ
-50
0
50
T_{amb} (°C)
100

Fig. 12.

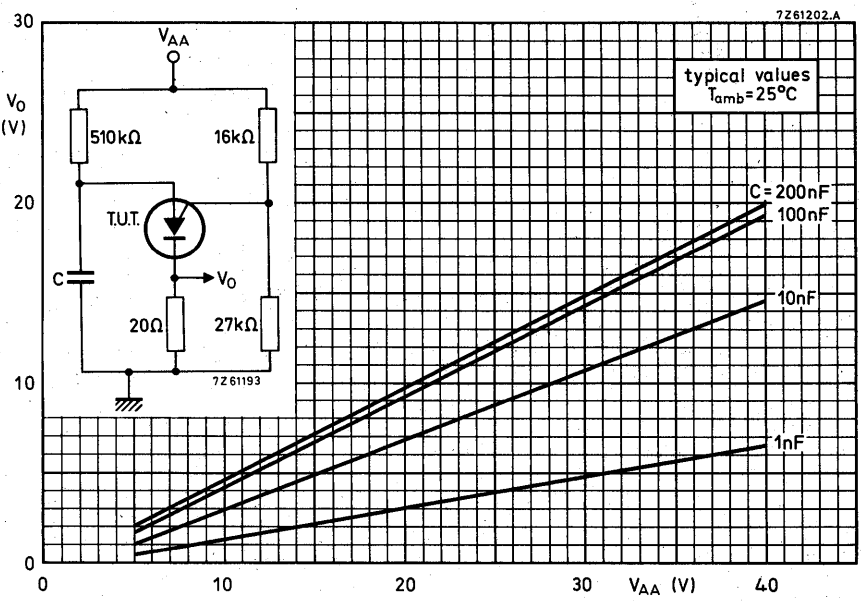

7Z61202.A
typical values
T_{amb}=25°C
V_O
(V)
30
20
10
0
V_{AA}
510kΩ
16kΩ
T.U.T.
C
V_O
20Ω
27kΩ
7Z61193
C = 200nF
100nF
10nF
1nF
0
10
20
30
V_{AA} (V)
40

Fig. 13.

SILICON LOW-POWER SWITCHING TRANSISTOR

P-N-P silicon transistor in a microminiature plastic envelope. It is intended for high-speed, saturated switching applications for industrial service in thick and thin-film circuits.

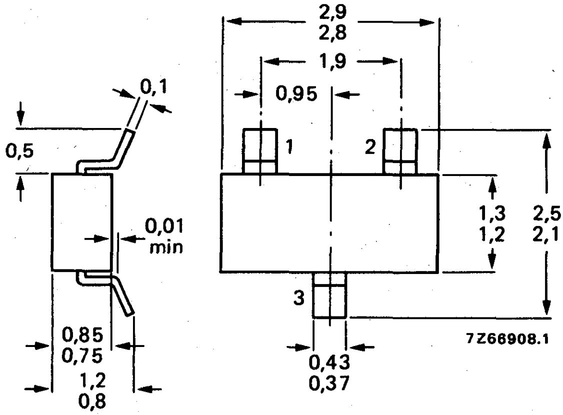
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (peak value)	$-I_{CM}$	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain				
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30	
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}		30 to 120	
Transition frequency at f = 500 MHz				
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	1,5	GHz
Turn-off time				
$-I_{Con}$ = 30 mA; $-I_{Bon}$ = $+I_{Boff}$ = 3,0 mA	t_{off}	<	30	ns

MECHANICAL DATA

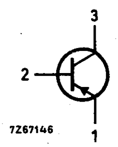
Dimensions in mm

Fig. 1 SOT-23.

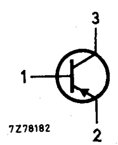


Marking code

BSR12 = B5



BSR12R = B8



See also *Soldering recommendations.*

RATINGS

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

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	3 V
Collector current (d.c.)	$-I_C$	max.	100 mA
Collector current (peak value)	$-I_{CM}$	max.	200 mA
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	P_{tot}	max.	200 mW
Storage temperature	T_{stg}		−65 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,62 °C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	<	50 nA
$I_E = 0$; $-V_{CB} = 10$ V; $T_{amb} = 125$ °C	$-I_{CBO}$	<	5 μA
$V_{BE} = 0$; $-V_{CE} = 10$ V	$-I_{CES}$	<	50 nA
Breakdown voltages			
$I_E = 0$; $-I_C = 10$ μA	$-V_{(BR)CBO}$	>	15 V
$V_{BE} = 0$; $-I_C = 10$ μA	$-V_{(BR)CES}$	>	15 V
$I_C = 0$; $-I_E = 100$ μA	$-V_{(BR)EBO}$	>	3 V
Collector-emitter sustaining voltage			
$I_B = 0$; $-I_C = 10$ mA	$-V_{CEOsust}$	>	15 V
Saturation voltages *			
$-I_C = 10$ mA; $-I_B = 1$ mA	$-V_{CEsat}$	<	130 mV
	$-V_{BEsat}$		725 to 920 mV
$-I_C = 50$ mA; $-I_B = 5$ mA	$-V_{CEsat}$	<	190 mV
	$-V_{BEsat}$		800 to 1150 mV
$-I_C = 100$ mA; $-I_B = 10$ mA	$-V_{CEsat}$	<	450 mV
	$-V_{BEsat}$		900 to 1500 mV

* Measured under pulse conditions; $t_p = 300$ μs; $\delta = 0{,}01$.

D.C. current gain *			
$-I_C$ = 1 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
$-I_C$ = 10 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}		30 to 120
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V; T_{amb} = 55 °C	h_{FE}	>	30
$-I_C$ = 100 mA; $-V_{CE}$ = 1 V	h_{FE}	>	20
Transition frequency at f = 500 MHz			
$-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	1,5 GHz
Collector capacitance			
$I_E = I_e = 0$; $-V_{CB}$ = 5 V	C_c	<	4,5 pF
Emitter capacitance			
$I_C = I_c = 0$; $-V_{EB}$ = 0,5 V	C_e	<	6,0 pF
Switching times			
Turn-on time	t_{on}	<	20 ns
Turn-off time	t_{off}	<	30 ns

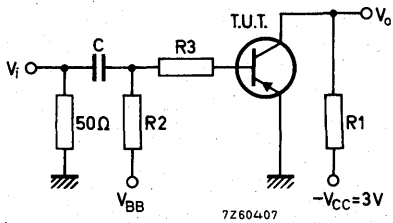


Fig. 2 Test circuit switching times.

Pulse generator

Pulse duration	t_p	= 400 ns
Rise time	t_r	< 1 ns
Output impedance	Z_o	= 50 Ω

Sampling scope

Rise time	t_r	< 1 ns
Input impedance	Z_i	= 100 kΩ

	V_i V	V_{BB} V	R1 Ω	R2 kΩ	R3 kΩ	$-I_{Con}$ mA	$-I_{Bon}$ mA	I_{Boff} mA	C µF
t_{on}	−6,85	0	94	1,0	2,0	30	3,0	–	0,1
t_{off}	11,7	−9,85	94	1,0	2,0	30	3,0	3,0	0,1

* Measured under pulse conditions; t_p = 300 µs; δ = 0,01.

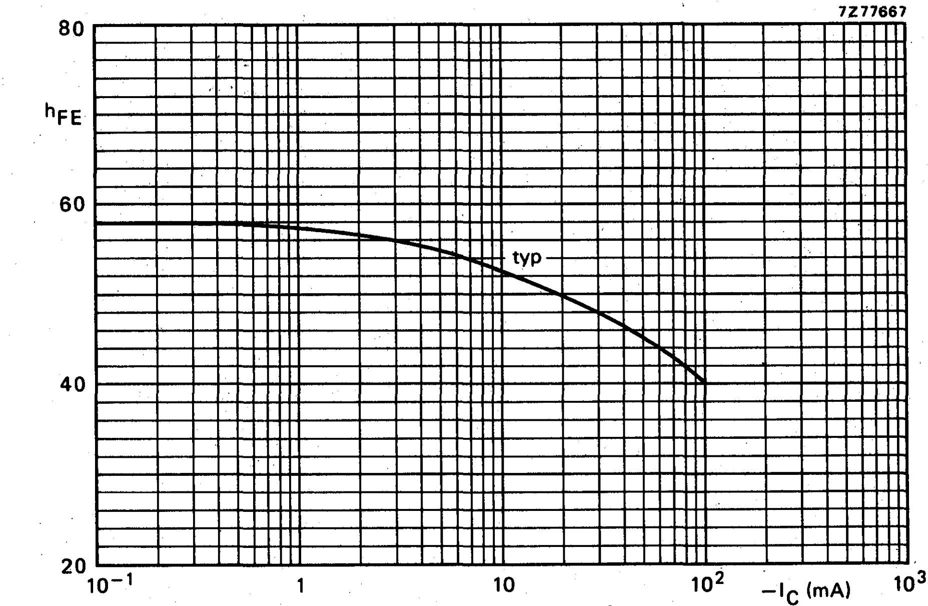


Fig. 4 $-V_{CE}$ = 1 V; T_{amb} = 25 °C.

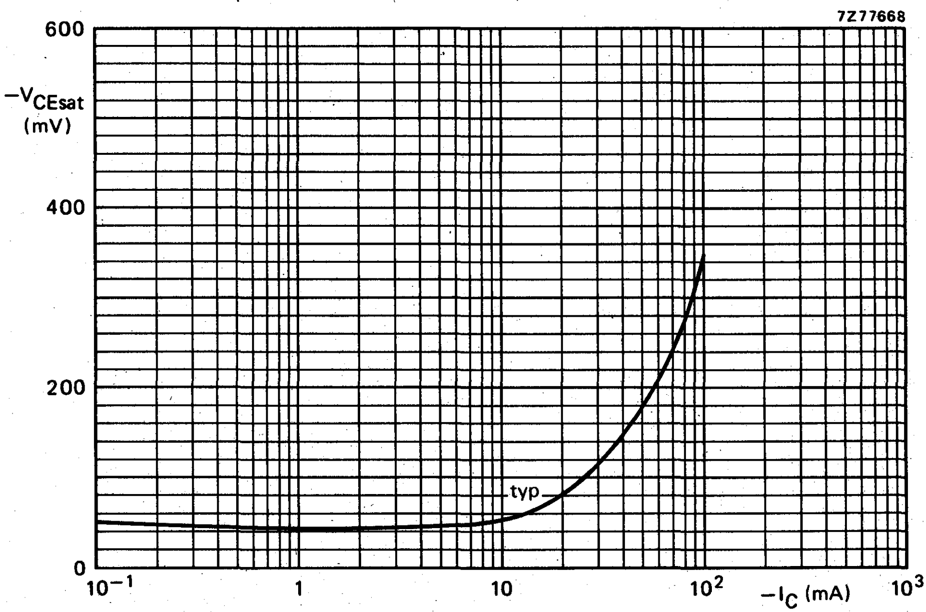


Fig. 5 V_{CEsat} as a function of I_C at I_C/I_B = 10.

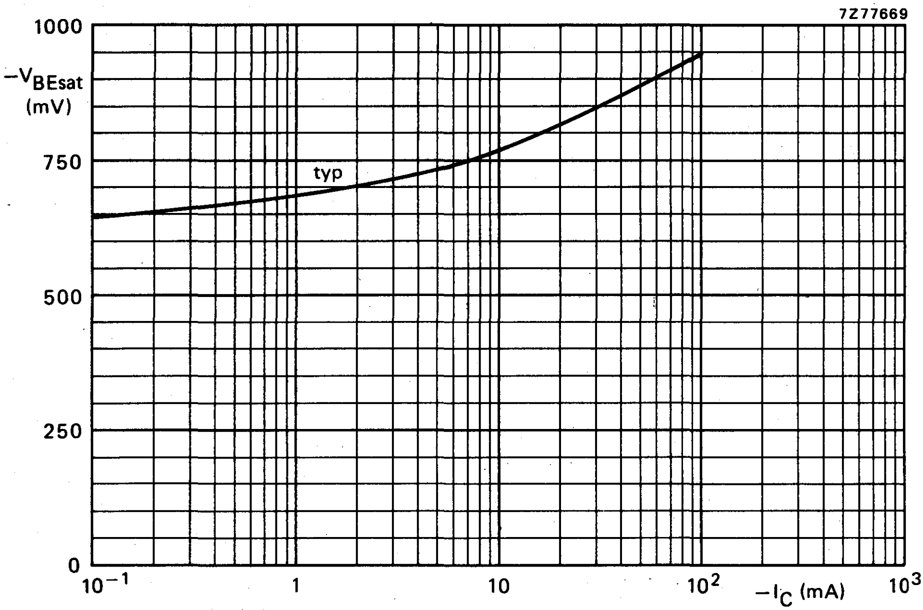


Fig. 6 V_{BEsat} as a function of I_C at $I_C/I_B = 10$.

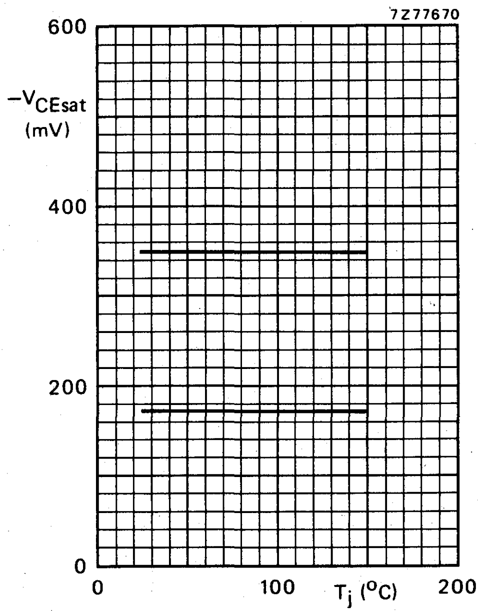


Fig. 7 V_{CEsat} as a function of T_j; typical values.
Upper graph at I_C = 100 mA; I_B = 10 mA. Lower graph at I_C = 50 mA and I_B = 5 mA.

SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

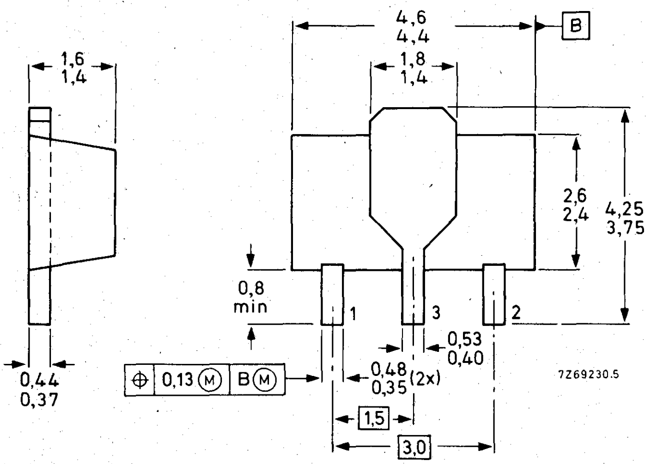
QUICK REFERENCE DATA

			BSR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Collector current (d.c.)	$-I_C$	max.	1	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	1	W
Junction temperature	T_j	max.	150	150	150	150	°C
D.C. current gain $-I_C$ = 100 mA; $-V_{CE}$ = 5 V	h_{FE}	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 35 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	f_T	>	100	100	100	100	MHz

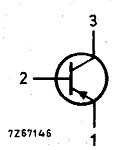
MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-89.



Mark
BSR30
BSR31
BSR32
BSR33



See also *Soldering recommendations.*

RATINGS

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

Voltages			BSR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	70	70	90	90	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	60	80	80	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	5	V

Currents				
Collector current (d.c.)	$-I_C$	max.	1	A
Base current (d.c.)	$-I_B$	max.	0,1	A

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	P_{tot}	max.	1	W

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm^2; thickness = 0,7 mm	$R_{th\ j\text{-}a}$	=	125	°C/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR30	BSR31	BSR32	BSR33	
Collector cut-off current							
$I_E = 0; -V_{CB} = 60$ V	$-I_{CBO}$	<	100				nA
$I_E = 0; -V_{CB} = 60$ V; $T_j = 150$ °C	$-I_{CBO}$	<	50				μA
Breakdown voltages							
$I_B = 0; -I_C = 10$ mA	$-V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0; -I_C = 10$ μA	$-V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0; -I_E = 10$ μA	$-V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$-I_C = 150$ mA; $-I_B = 15$ mA	$-V_{CEsat}$	<	0,25	0,25	0,25	0,25	V
	$-V_{BEsat}$	<	1,0	1,0	1,0	1,0	V
$-I_C = 500$ mA; $-I_B = 50$ mA	$-V_{CEsat}$	<	0,5	0,5	0,5	0,5	V
	$-V_{BEsat}$	<	1,2	1,2	1,2	1,2	V
D.C. current gain *							
$-I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$-I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$-I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 35 MHz							
$-I_C = 50$ mA; $-V_{CE} = 10$ V	f_T	>	100				MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0; -V_{CB} = 10$ V	C_c	<	20				pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0; -V_{EB} = 0,5$ V	C_e	<	120				pF

Switching times see page 4

* Measured under pulse conditions: $t_p = 300$ μs; $\delta < 0,01$.

CHARACTERISTICS (continued)

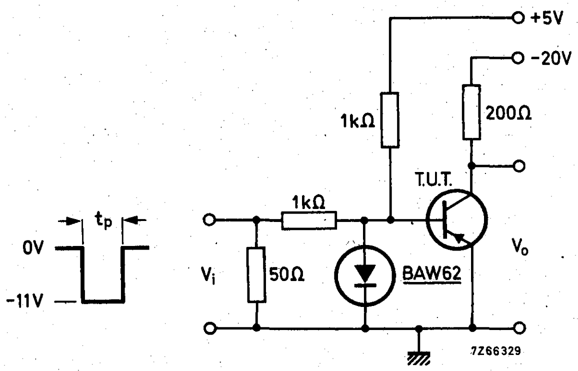
T_{amb} = 25 °C

Switching times

$-I_{Con}$ = 100 mA; $-I_{Bon}$ = $+I_{Boff}$ = 5 mA

Turn-on time	t_{on}	<	500 ns
Turn-off time	t_{off}	<	650 ns

Test circuit



Pulse generator:

Pulse duration	t_p = 10 μs
Rise time	t_r ≤ 15 ns
Fall time	t_f ≤ 15 ns
Source impedance	Z_S = 50 Ω

Oscilloscope:

Rise time	t_r ≤ 15 ns
Input impedance	Z_I ≥ 100 kΩ

SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

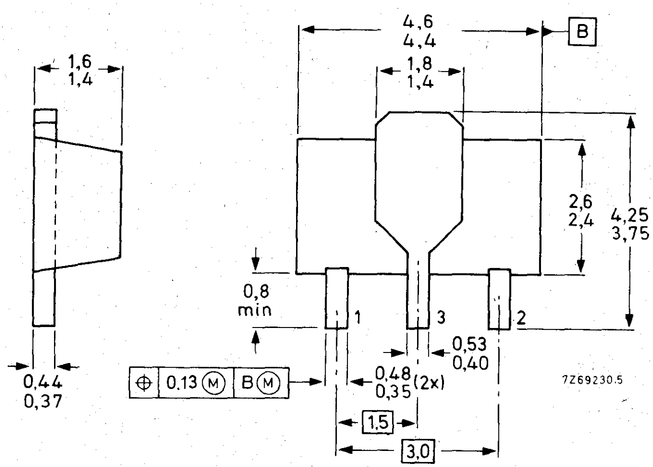
QUICK REFERENCE DATA

			BSR40	BSR41	BSR42	BSR43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Collector current (d.c.)	I_C	max.	1	1	1	1	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	1	1	1	1	W
Junction temperature	T_j	max.	150	150	150	150	°C
D.C. current gain I_C = 100 mA; V_{CE} = 5 V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
Transition frequency at f = 35 MHz I_C = 50 mA; V_{CE} = 10 V	f_T	>	100	100	100	100	MHz

MECHANICAL DATA

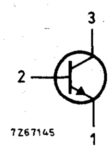
Dimensions in mm

Fig. 1 SOT-89.



Mark

BSR40
BSR41
BSR42
BSR43



RATINGS

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

Voltages			BSR40	BSR41	BSR42	BSR43	
Collector-base voltage (open emitter)	V_{CBO}	max.	70	70	90	90	V
Collector-emitter voltage (open base)	V_{CEO}	max.	60	60	80	80	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	5	V

Currents				
Collector current (d.c.)	I_C	max.	1	A
Base current (d.c.)	I_B	max.	0,1	A
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm	P_{tot}	max.	1	W
Temperatures				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to collector tab	$R_{th\ j\text{-}tab}$	=	10	°C/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 m	$R_{th\ j\text{-}a}$	=	125	°C/W

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			BSR40	BSR41	BSR42	BSR43	
Collector cut-off current							
$I_E = 0$; $V_{CB} = 60$ V	I_{CBO}	<	100				nA
$I_E = 0$; $V_{CB} = 60$ V; $T_j = 150$ °C	I_{CBO}	<	50				μA
Breakdown voltages							
$I_B = 0$; $I_C = 10$ mA	$V_{(BR)CEO}$	>	60	60	80	80	V
$V_{BE} = 0$; $I_C = 10$ μA	$V_{(BR)CES}$	>	70	70	90	90	V
$I_C = 0$; $I_E = 10$ μA	$V_{(BR)EBO}$	>	5	5	5	5	V
Saturation voltages *							
$I_C = 150$ mA; $I_B = 15$ mA	V_{CEsat}	<	0,25	0,25	0,25	0,25	V
	V_{BEsat}	<	1,0	1,0	1,0	1,0	V
$I_C = 500$ mA; $I_B = 50$ mA	V_{CEsat}	<	0,5	0,5	0,5	0,5	V
	V_{BEsat}	<	1,2	1,2	1,2	1,2	V
D.C. current gain *							
$I_C = 100$ μA; $V_{CE} = 5$ V	h_{FE}	>	10	30	10	30	
$I_C = 100$ mA; $V_{CE} = 5$ V	h_{FE}	>	40	100	40	100	
		<	120	300	120	300	
$I_C = 500$ mA; $V_{CE} = 5$ V	h_{FE}	>	30	50	30	50	
Transition frequency at f = 35 MHz							
$I_C = 50$ mA; $V_{CE} = 10$ V	f_T	>	100				MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	<	12				pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0$; $V_{EB} = 0{,}5$ V	C_e	<	90				pF

Switching times see page 4

* Measured under pulse conditions: $t_p = 300$ μs; $\delta < 0{,}01$.

CHARACTERISTICS (continued)

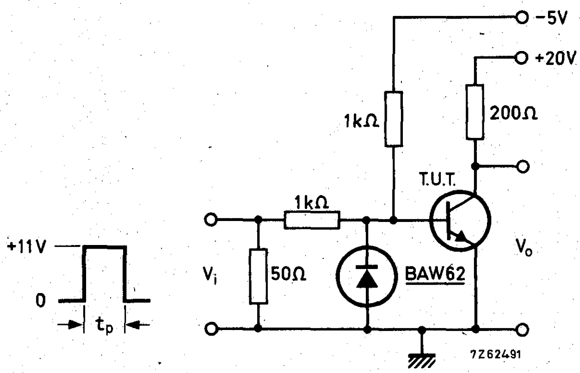
$T_{amb} = 25\ ^oC$

Switching times

$I_{Con} = 100$ mA; $I_{Bon} = -I_{Boff} = 5$ mA

Turn-on time	t_{on}	<	250 ns
Turn-off time	t_{off}	<	1000 ns

Test circuit



Pulse generator:

Pulse duration	$t_p = 10\ \mu s$
Rise time	$t_r \leqslant 15$ ns
Fall time	$t_f \leqslant 15$ ns
Source impedance	$Z_S = 50\ \Omega$

Oscilloscope:

Rise time	$t_r \leqslant 15$ ns
Input impedance	$Z_I \geqslant 100$ kΩ

N-CHANNEL FETS

Silicon n-channel depletion type junction field-effect transistors in a plastic microminiature envelope intended for application in thick and thin-film circuits. The transistors are intended for low-power, chopper or switching applications in industrial service.

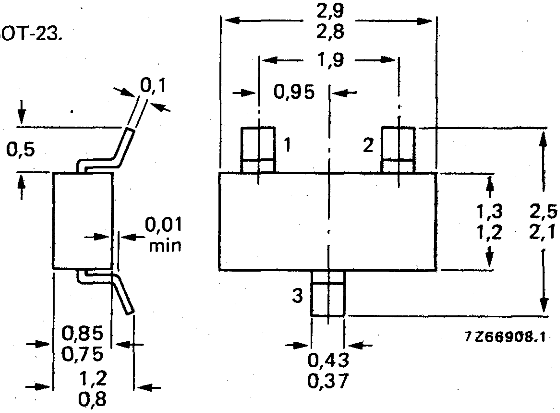
QUICK REFERENCE DATA

			BSR56	BSR57	BSR58	
Drain-source voltage	$\pm V_{DS}$	max.	40	40	40	V
Total power dissipation up to T_{amb} = 70 °C	P_{tot}	max.	200	200	200	mW
Drain current						
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	8	mA
		<	–	100	80	mA
Gate-source cut-off voltage						
V_{DS} = 15 V; I_D = 0,5 nA	$-V_{(P)GS}$	>	4	2	0,8	V
		<	10	6	4	V
Drain-source resistance (on) at f = 1 kHz						
I_D = 0; V_{GS} = 0	$r_{ds\ on}$	<	25	40	60	Ω
Feedback capacitance at f = 1 MHz						
$-V_{GS}$ = 10 V; V_{DS} = 0	C_{rs}	<	5	5	5	pF
Turn-off time						
V_{DD} = 10 V; V_{GS} = 0						
I_D = 20 mA; $-V_{GSM}$ = 10 V	t_{off}	<	25	–	–	ns
I_D = 10 mA; $-V_{GSM}$ = 6 V	t_{off}	<	–	50	–	ns
I_D = 5 mA; $-V_{GSM}$ = 4 V	t_{off}	<	–	–	100	ns

MECHANICAL DATA

Dimensions in mm

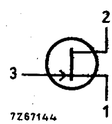
Fig. 1 SOT-23.



See also *Soldering Recommendations.*

Marking code

BSR56 = M4
BSR57 = M5
BSR58 = M6



RATINGS

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

Drain-source voltage	$\pm V_{DS}$	max.	40	V
Drain-gate voltage	V_{DGO}	max.	40	V
Gate-source voltage	$-V_{GSO}$	max.	40	V
Forward gate current	I_{GF}	max.	50	mA
Total power dissipation up to T_{amb} = 70 °C	P_{tot}	max.	200	mW
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on a ceramic substrate of 15 x 15 x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,4	°C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Gate-source cut-off current V_{DS} = 0 V; $-V_{GS}$ = 20 V	$-I_{GSS}$	<	1	nA
Drain cut-off current V_{DS} = 15 V; $-V_{GS}$ = 10 V	I_{DSX}	<	1	nA

			BSR56	BSR57	BSR58	
Drain current * V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	8	mA
		<	–	100	80	mA
Gate-source breakdown voltage $-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	>	40	40	40	V
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 15 V	$-V_{(P)GS}$	>	4	2	0,8	V
		<	10	6	4	V
Drain-source voltage (on) I_D = 20 mA; V_{GS} = 0	V_{DSon}	<	750	–	–	mV
I_D = 10 mA; V_{GS} = 0	V_{DSon}	<	–	500	–	mV
I_D = 5 mA; V_{GS} = 0	V_{DSon}	<	–	–	400	mV
Drain-source resistance (on) at f = 1 kHz I_D = 0; V_{GS} = 0	$r_{ds\ on}$	<	25	40	60	Ω

* Measured under pulsed conditions; t_p = 100 ms; $\delta \leq 0{,}1$.

			BSR56	BSR57	BSR58	
Switching times*						
V_{DD} = 10 V; V_{GS} = 0						
Conditions I_D and $-V_{GSM}$	I_D	=	20	10	5	mA
	$-V_{GSM}$	=	10	6	4	V
Delay time	t_d	<	6	6	10	ns
Rise time	t_r	<	3	4	10	ns
Turn-off time	t_{off}	<	25	50	100	ns

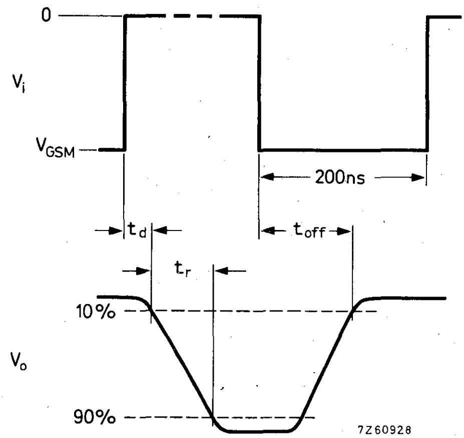


Fig. 2 Switching times waveforms.

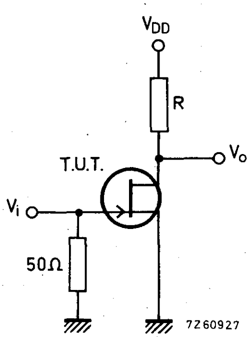


Fig. 3 Test circuit.

BSR56; R = 464 Ω
BSR57; R = 953 Ω
BSR58; R = 1910 Ω

Pulse generator

$t_r = t_f \leqslant 1$ ns
δ = 0,02
Z_o = 50 Ω

Oscilloscope

$t_r \leqslant 0{,}75$ ns
$R_i \geqslant$ 1 MΩ
$C_i \leqslant$ 2,5 pF

* Switching times measured on devices in SOT-18 envelope.

HIGH VOLTAGE P-N-P TRANSISTOR

Silicon planar epitaxial transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. This transistor is intended for high voltage general purpose and switching applications.

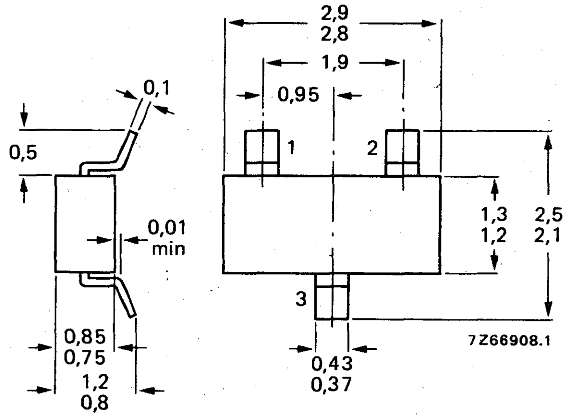
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	110	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	100	V
Collector current (peak value)	$-I_{CM}$	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain at T_j = 25 °C $-I_C$ = 25 mA; $-V_{CE}$ = 5 V	h_{FE}	>	30	
Transition frequency at f = 35 MHz $-I_C$ = 25 mA; $-V_{CE}$ = 5 V	f_T	> typ.	50 85	MHz MHz

MECHANICAL DATA

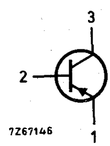
Dimensions in mm

Fig. 1 SOT-23.

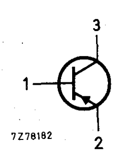


Marking code

BSS63 = T3



BSS63R = T6



See also *Soldering recommendations.*

RATINGS

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

Collector-base voltage (open emitter) $-I_C = 10\ \mu A$	$-V_{CBO}$	max.	110	V
Collector-emitter voltage (open base) $-I_C = 100\ \mu A$	$-V_{CEO}$	max.	100	V
Emitter-base voltage (open collector) $-I_E = 10\ \mu A$	$-V_{EBO}$	max.	6	V
Collector current (d.c.)	$-I_C$	max.	100	mA
Collector current (peak value)	$-I_{CM}$	max.	100	mA
Base current (peak value)	$-I_{BM}$	max.	100	mA
Total power dissipation up to T_{amb} = 25 °C *	P_{tot}	max.	200	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	0,62	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current $I_E = 0; -V_{CB} = 90$ V	$-I_{CBO}$	<	100	nA
$I_E = 0; -V_{CB} = 90$ V; T_j = 150 °C	$-I_{CBO}$	typ.	0,25	μA
		<	50	μA
Emitter cut-off current $I_C = 0; -V_{EB} = 6$ V	$-I_{EBO}$	<	200	nA
Saturation voltage $-I_C = 25$ mA; $-I_B = 2,5$ mA	$-V_{CEsat}$	<	250	mV
	$-V_{BEsat}$	<	900	mV
D.C. current gain $-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	>	30	
$-I_C = 25$ mA; $-V_{CE} = 1$ V	h_{FE}	>	30	
Collector capacitance at f = 1 MHz $I_E = I_e = 0; -V_{CB} = 10$ V	C_c	typ.	3	pF
Transition frequency at f = 35 MHz $-I_C = 25$ mA; $-V_{CE} = 5$ V	f_T	>	50	MHz
		typ.	85	MHz

* Device mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm.

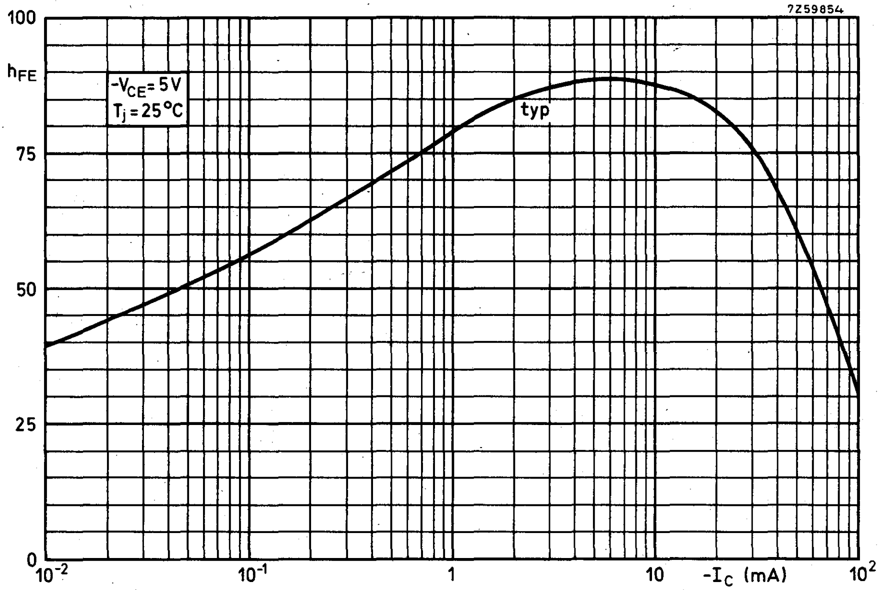

7Z59854
100
h_{FE}
75
50
25
0
$-V_{CE} = 5\,V$
$T_j = 25\,°C$
typ
10^{-2}
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 2.

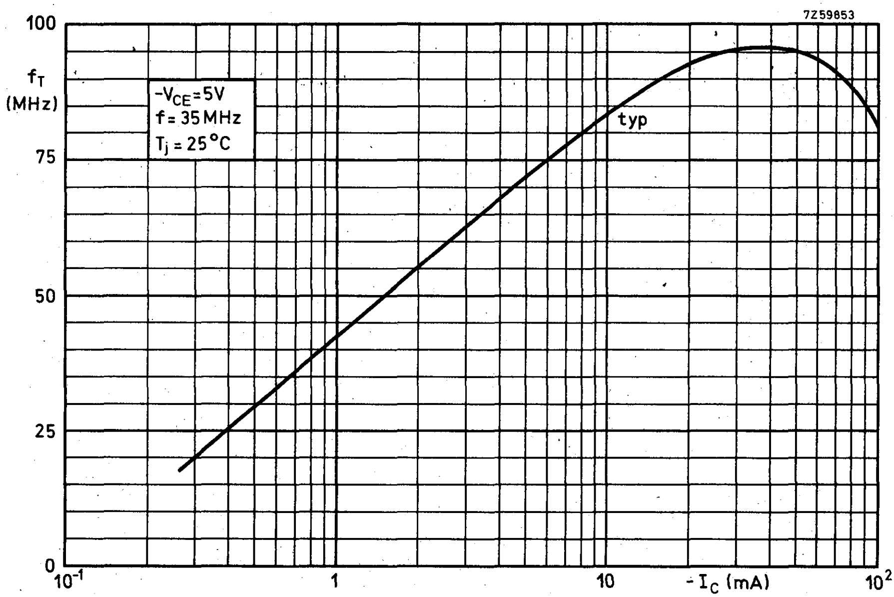

7Z59853
100
f_T
(MHz)
75
50
25
0
$-V_{CE} = 5V$
f = 35 MHz
$T_j = 25\,°C$
typ
10^{-1}
1
10
$-I_C$ (mA)
10^2

Fig. 3.

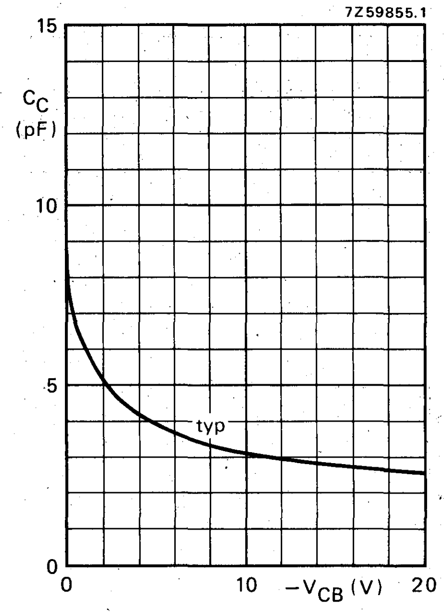


Fig. 4 Typical values collector capacitance as a function of collector-base voltage.
$I_E = I_e = 0$; $T_j = 25$ °C; f = 1 MHz.

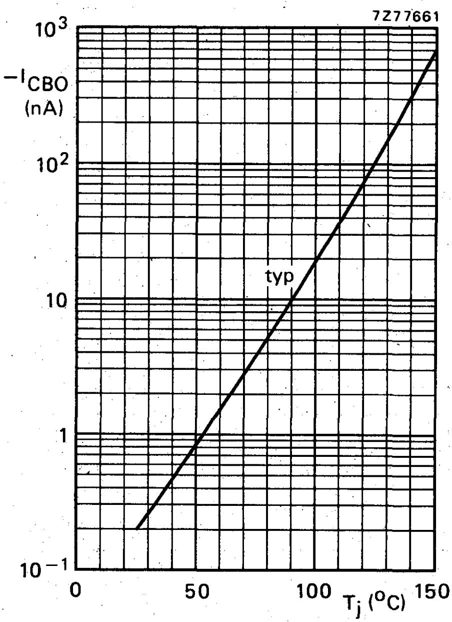


Fig. 5 Typical values collector-base current as a function of the junction temperature at a collector-base voltage of −90 V.

HIGH-VOLTAGE N-P-N TRANSISTOR

Silicon planar epitaxial transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. This transistor is intended for high-voltage general purpose and switching applications.

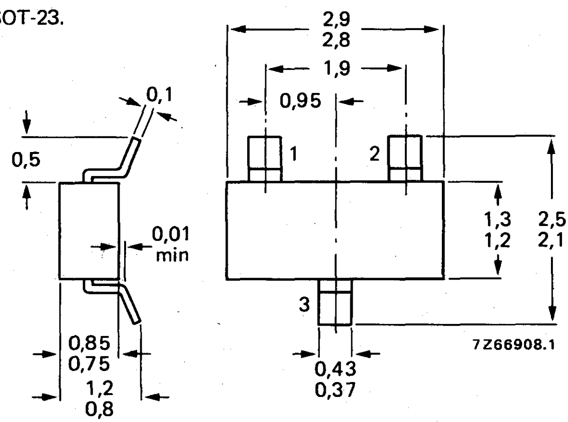
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	120	V
Collector-emitter voltage (open base)	V_{CEO}	max.	80	V
Collector current (peak value)	I_{CM}	max.	250	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	150	°C
D.C. current gain I_C = 10 mA; V_{CE} = 1 V; T_j = 25 °C	h_{FE}	> typ.	20 80	
Transition frequency at f = 35 MHz I_C = 4 mA; V_{CE} = 10 V	f_T	>	60	MHz
Turn-off time I_C = 15 mA; I_{Bon} − I_{Boff} = 1 mA	t_{off}	<	1	μs

MECHANICAL DATA

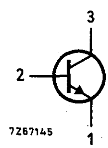
Dimensions in mm

Fig. 1 SOT-23.

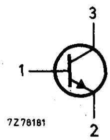


Marking code

BSS64 = U3



BSS64R = U6



See also *Soldering recommendations.*

RATINGS

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

Collector-base voltage (open emitter) $I_C = 100\ \mu A$	V_{CBO}	max.	120	V
Collector-emitter voltage (open base) $I_C = 4$ mA	V_{CEO}	max.	80	V
Emitter-base voltage (open collector) $I_E = 100\ \mu A$	V_{EBO}	max.	5	V
Collector current (d.c. or averaged over any 20 ms period)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	250	mA
Base current (peak value)	I_{BM}	max.	100	mA
Total power dissipation up to $T_{amb} = 25$ °C *	P_{tot}	max.	200	mW
Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air *	$R_{th\ j\text{-}a}$	=	0,62	°C/mW

* Device mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 90$ V	I_{CBO}	typ.	1	nA
		<	100	nA
$I_E = 0$; $V_{CB} = 90$ V; $T_j = 150$ °C	I_{CBO}	typ.	0,25	μA
		<	50	μA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 5$ V	I_{EBO}	typ.	0,5	nA
		<	200	nA
Saturation voltages				
$I_C = 4$ mA; $I_B = 400$ μA	V_{CEsat}	<	150	mV
	V_{BEsat}	<	1200	mV
$I_C = 50$ mA; $I_B = 15$ mA	V_{CEsat}	<	200	mV
D.C. current gain				
$I_C = 1$ mA; $V_{CE} = 1$ V	h_{FE}	typ.	60	
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	>	20	
		typ.	80	
$I_C = 20$ mA; $V_{CE} = 1$ V	h_{FE}	typ.	55	
Transition frequency at f = 35 MHz				
$I_C = 4$ mA; $V_{CE} = 10$ V	f_T	>	60	MHz
		typ.	100	MHz
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 10$ V	C_c	typ.	3	pF
		<	5	pF
Turn-off switching time				
$I_{Con} = 15$ mA; $I_{Bon} = -I_{Boff} = 1$ mA	t_{off}	<	1	μs

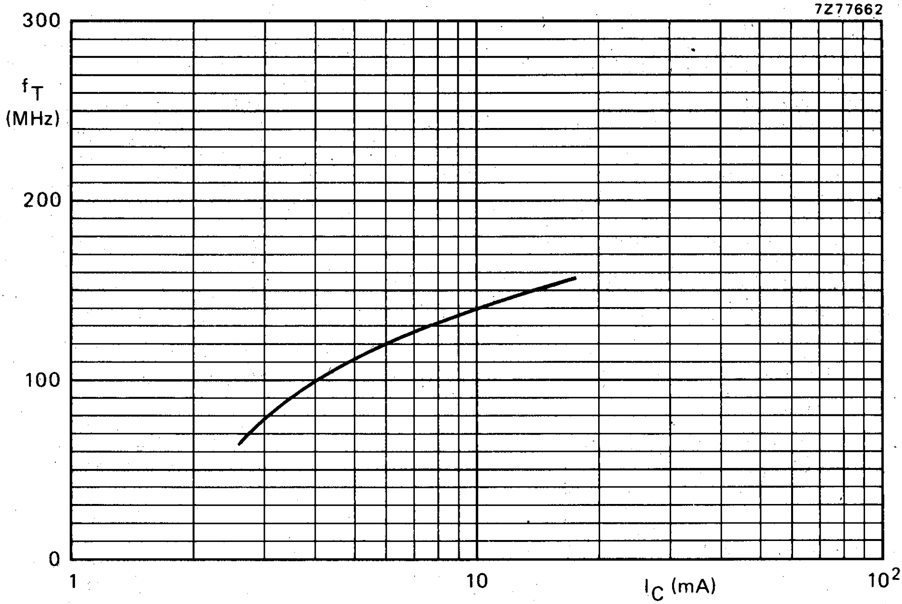


Fig. 2 Typical values transition frequency.
V_{CE} = 10 V; f = 35 MHz; T_j = 25 °C.

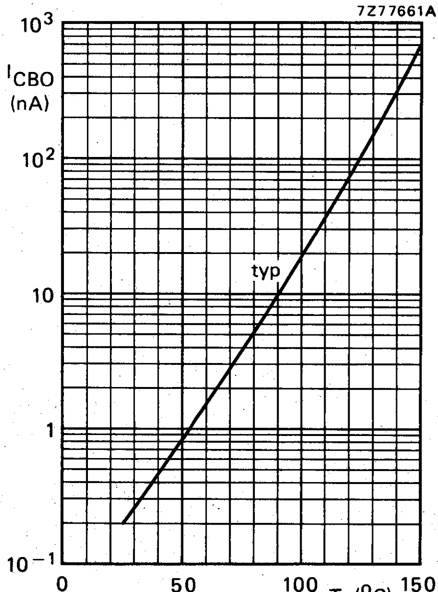


Fig. 3 Typical values collector-base currents as a function of the junction temperature at a collector-base voltage of 90 V.

SILICON PLANAR EPITAXIAL TRANSISTOR

- **High-speed switching**

N-P-N transistor in a microminiature plastic envelope. It is intended for very high-speed saturated switching in thick and thin-film circuits.

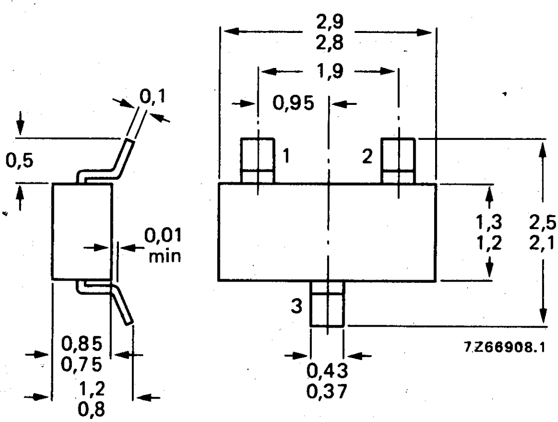
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	20	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector current (peak value)	I_{CM}	max.	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	−65 to + 150		°C
D.C. current gain				
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	25	
Transition frequency at f = 100 MHz		>	400	MHz
I_C = 10 mA; V_{CE} = 10 V	f_T	typ.	500	MHz
Storage time				
$I_C = I_B = -I_{BM}$ = 10 mA	t_s	<	13	ns

MECHANICAL DATA

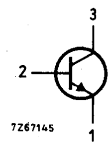
Dimensions in mm

Fig. 1 SOT-23.

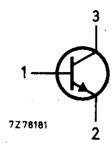


Marking code

BSV52 = B2



BSV52R = B4



See also *Soldering recommendations.*

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

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	20	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	20	V
Collector-emitter voltage (open base) I_C = 10 mA	V_{CEO}	max.	12	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0.5 mm	$R_{th\ j\text{-}a}$	=	0.62	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; V_{CB} = 10 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 10 V; T_j = 125 °C	I_{CBO}	<	5	μA

Saturation voltages

I_C = 10 mA; I_B = 300 μA	V_{CEsat}	<	300	mV
I_C = 10 mA; I_B = 1 mA	V_{CEsat}	<	250	mV
	V_{BEsat}		700 to 850	mV
I_C = 50 mA; I_B = 5 mA	V_{CEsat}	<	400	mV
	V_{BEsat}	<	1200	mV

CHARACTERISTICS (continued)

D.C. current gain

I_C = 1 mA; V_{CE} = 1 V	h_{FE}	>	25	
I_C = 10 mA; V_{CE} = 1 V	h_{FE}		40 to 120	
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	>	25	

Transition frequency at f = 100 MHz

I_C = 10 mA; V_{CE} = 10 V	f_T	>	400	MHz
		typ.	500	MHz

Collector capacitance at f = 1 MHz

$I_E = I_e = 0$; V_{CB} = 5 V	C_c	<	4	pF

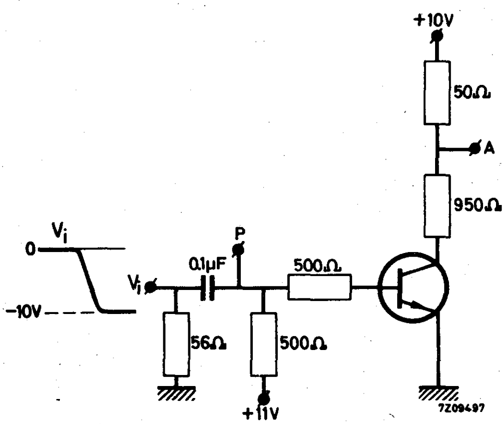
Emitter capacitance at f = 1 MHz

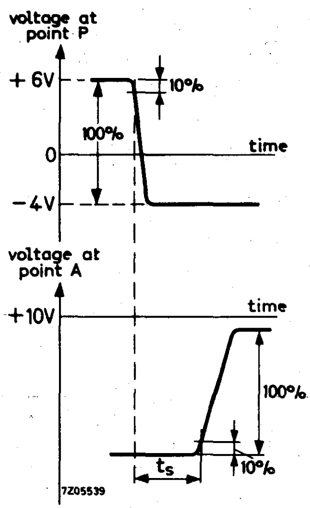
$I_C = I_c = 0$; V_{EB} = 1 V	C_e	<	4.5	pF

Switching times

Storage time $I_C = I_B = -I_{BM}$ = 10 mA	t_s	<	13	ns

Test circuit:





Pulse generator:			
Rise time	t_r	<	1 ns
Pulse duration	t	>	300 ns
Duty cycle	δ	<	0.02
Source impedance	R_S	=	50 Ω

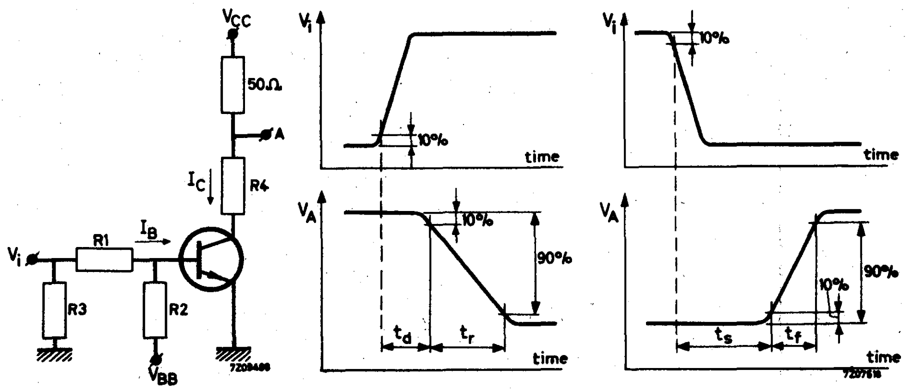
Oscilloscope:			
Input impedance	R_i	=	50 Ω
Rise time	t_r	<	1 ns

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Switching times

Turn on time when switched from $-V_{BE}$ = 1.5 V to I_C = 10 mA; I_B = 3 mA	t_{on}	<	12	ns
Turn off time when switched from I_C = 10 mA; I_B = 3 mA to cut-off with $-I_{BM}$ = 1.5 mA	t_{off}	<	18	ns

Test circuit:



Pulse generator:

Rise time	t_r	<	1 ns
Pulse duration	t	>	300 ns
Duty cycle	δ	<	0.02
Source impedance	R_S	=	50 Ω

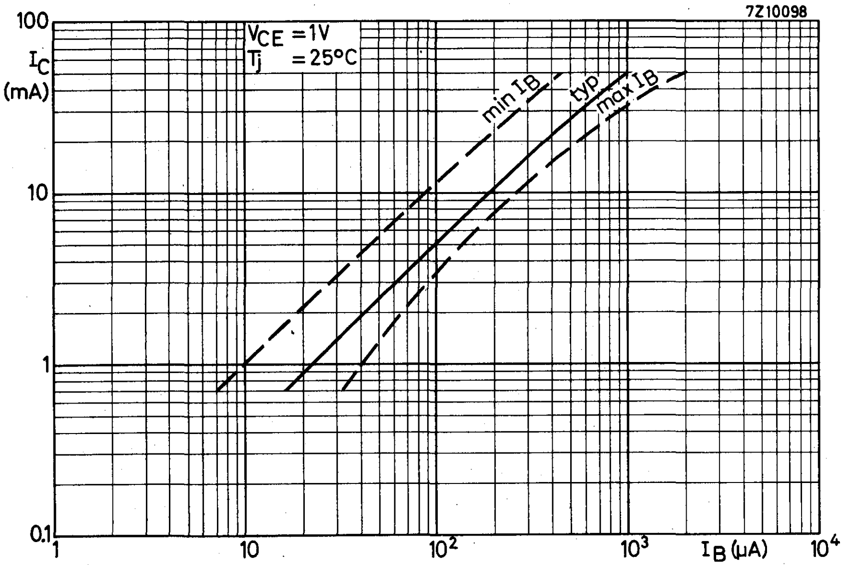
Oscilloscope:

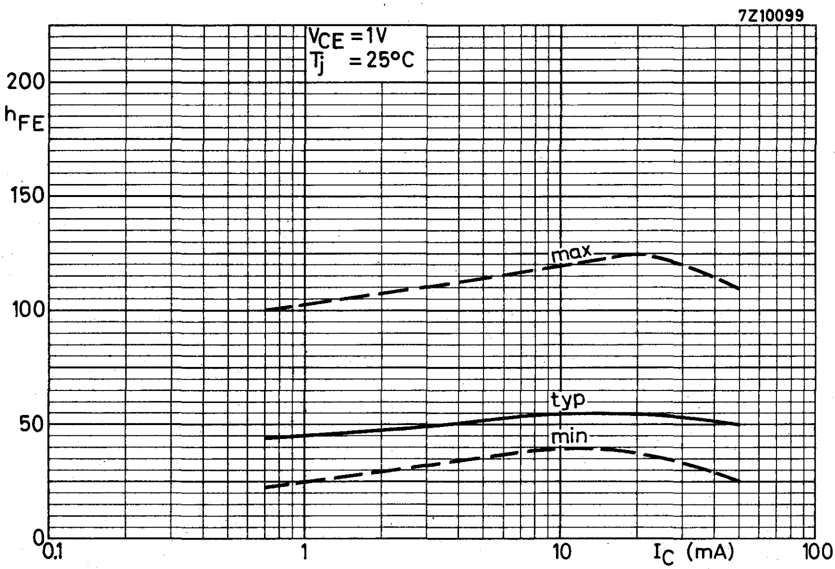
Input impedance	R_i	=	50 Ω
Rise time	t_r	<	1 ns

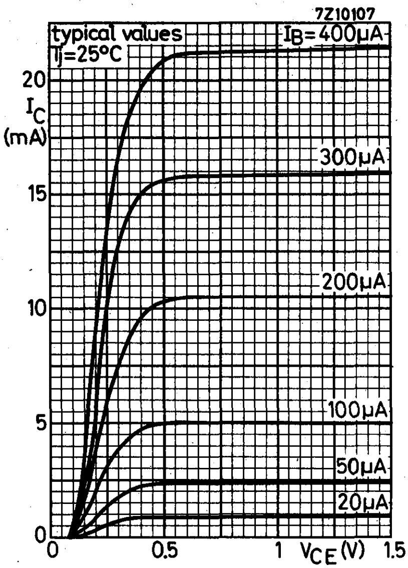
							turn on time			turn off time	
I_C (mA)	I_B (mA)	$-I_{BM}$ (mA)	V_{CC} (V)	R_1;R_2 (kΩ)	R_3 (Ω)	R_4 (Ω)	$-V_{BB}$ (V)	$-V_{BE}$ (V)	V_i (V)	$-V_{BB}$ (V)	$-V_i$ (V)
10	3	1.5	3	3.3	50	220	3.0	1.5	15	12.0	15

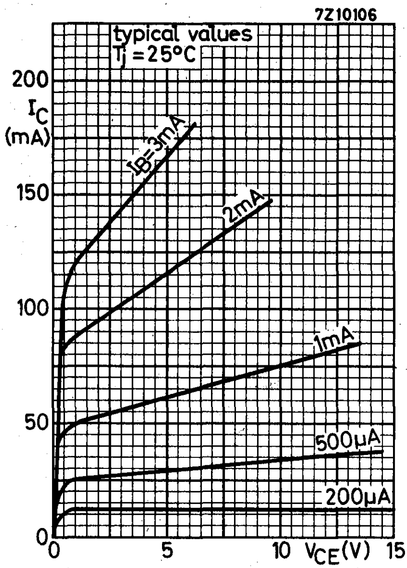
Note

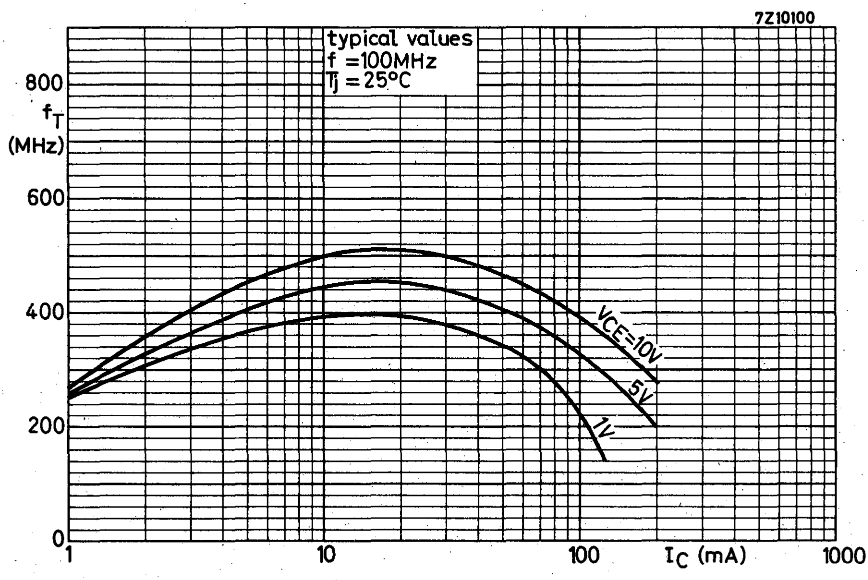
$-I_{BM}$ is the reverse current that can flow during switching off. The indicated $-I_{BM}$ is determined and limited by the applied cut-off voltage and series resistance.

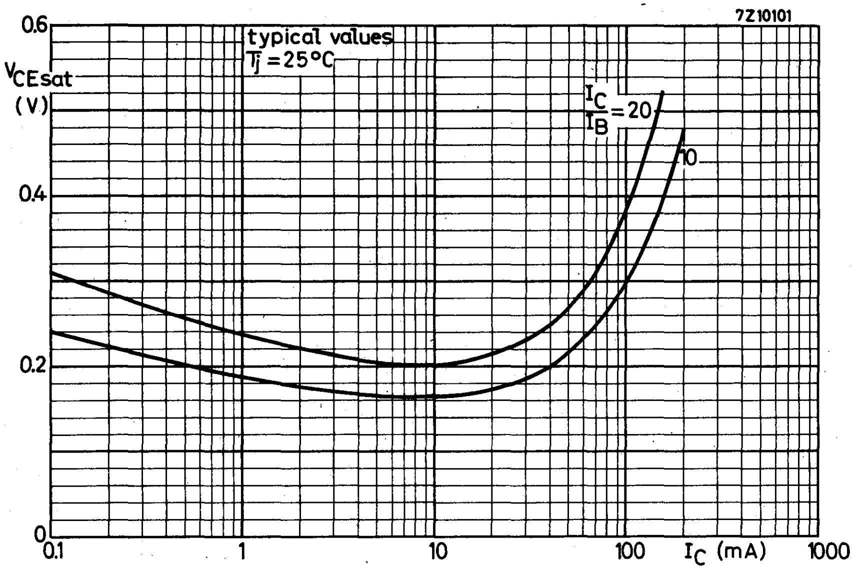

7Z10098
V_{CE} = 1V
T_j = 25°C
I_C (mA)
100
10
1
0.1
1
10
10^2
10^3
I_B (μA)
10^4
min I_B
typ
max I_B

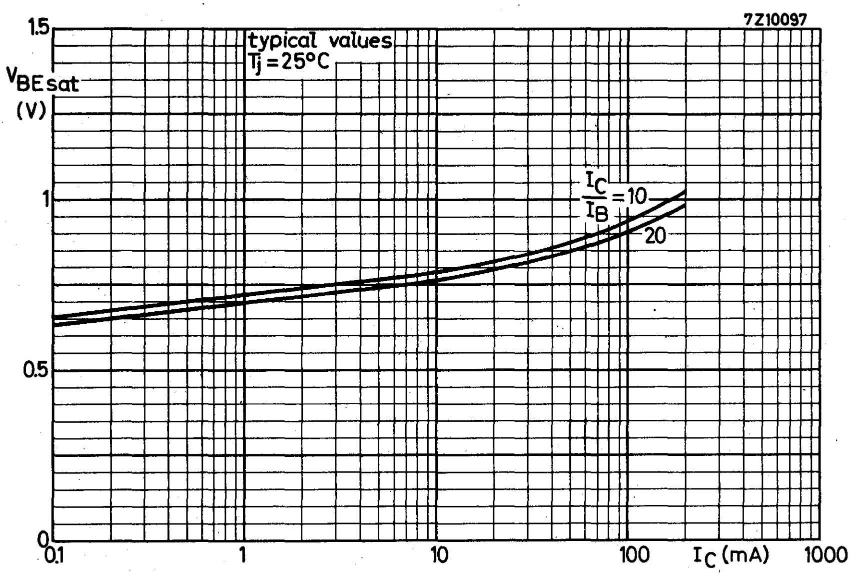

7Z10099
V_{CE} = 1V
T_j = 25°C
h_{FE}
200
150
100
50
0
0.1
1
10
I_C (mA)
100
max
typ
min

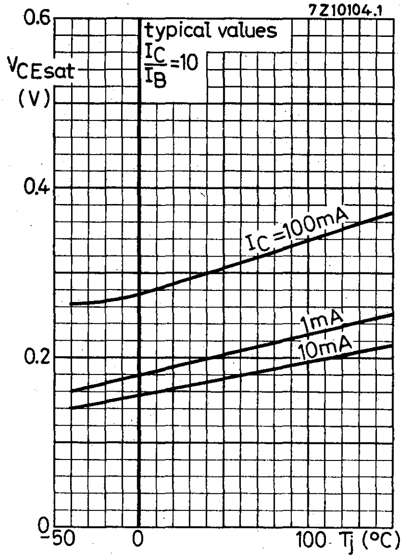

7Z10107
typical values
Tj=25°C
IB=400μA
300μA
200μA
100μA
50μA
20μA
IC
(mA)
20
15
10
5
0
0
0.5
1
VCE(V)
1.5

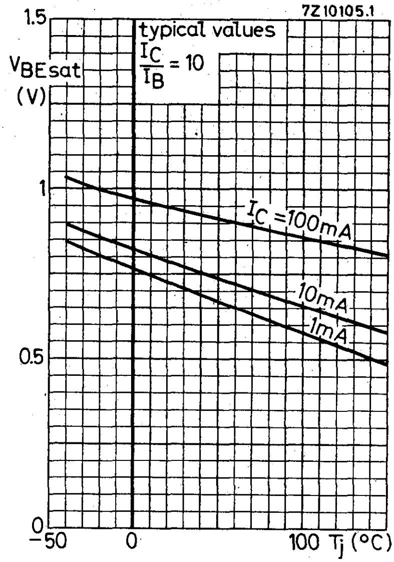

7Z10106
typical values
Tj=25°C
IB=3mA
2mA
1mA
500μA
200μA
IC
(mA)
200
150
100
50
0
0
5
10
VCE(V)
15

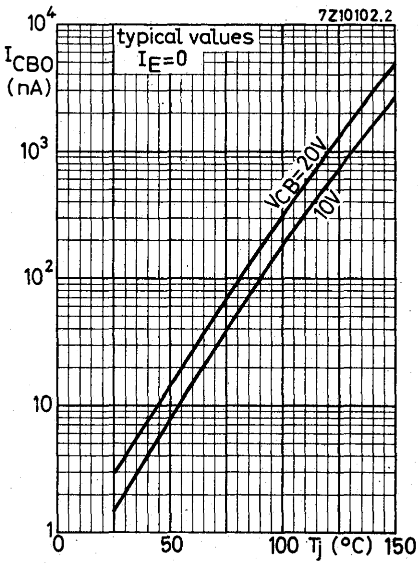

7Z10100
typical values
f =100MHz
Tj=25°C
fT
(MHz)
800
600
400
200
0
VCE=10V
5V
1V
1
10
100
IC (mA)
1000

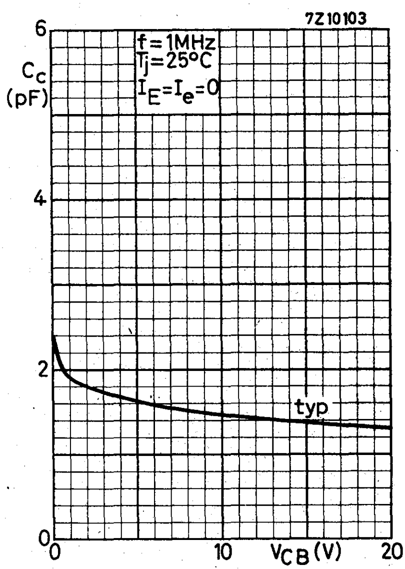

7Z10101
typical values
Tj = 25 °C
VCEsat (V)
0.6
0.4
0.2
0
IC/IB = 20
10
0.1
1
10
100
1000
IC (mA)


7Z10097
typical values
Tj = 25 °C
VBEsat (V)
1.5
1
0.5
0
IC/IB = 10
20
0.1
1
10
100
1000
IC (mA)


7Z10104.1
typical values
$\frac{I_C}{I_B}$=10
V_{CEsat} (V)
I_C=100mA
1mA
10mA
0.6
0.4
0.2
0
-50
0
100 T_j (°C)


7Z10105.1
typical values
$\frac{I_C}{I_B}$ = 10
V_{BEsat} (V)
I_C =100mA
10mA
1mA
1.5
1
0.5
0
-50
0
100 T_j (°C)


7Z10102.2
typical values
I_E=0
I_{CBO} (nA)
V_{CB}=20V
10V
10^4
10^3
10^2
10
1
0
50
100 T_j (°C) 150


7Z10103
f = 1MHz
T_j=25°C
I_E=I_e=0
C_c (pF)
typ
6
4
2
0
0
10
V_{CB} (V)
20

SILICON PLANAR VOLTAGE REGULATOR DIODES

Low power general purpose voltage regulator diodes in a microminiature plastic envelope intended for application in thick and thin-film circuits. The series covers the whole normalized range of nominal working voltages from 4,7 V to 75 V with a tolerance of ± 5%.

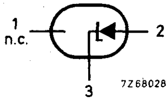
QUICK REFERENCE DATA

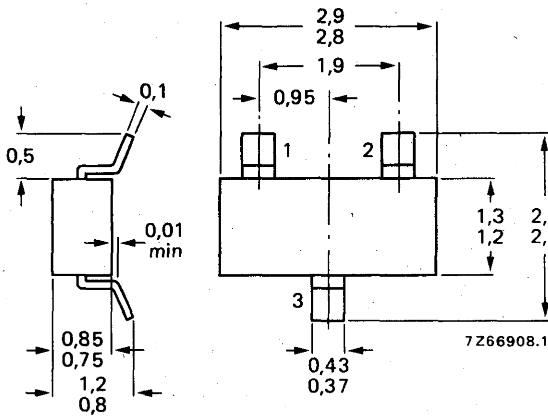
Working voltage range	V_Z	nom.	4,7 to 75	V
Working voltage tolerance			± 5	%
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	200	mW
Junction temperature	T_j	max.	150	°C

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-23.





See also *Soldering recommendations.*

Marking code

BZX84-C4V7 = Z1
C5V1 = Z2
C5V6 = Z3
C6V2 = Z4
C6V8 = Z5
C7V5 = Z6
C8V2 = Z7
C9V1 = Z8
C10 = Z9
C11 = Y1

BZX84-C12 = Y2
C13 = Y3
C15 = Y4
C16 = Y5
C18 = Y6
C20 = Y7
C22 = Y8
C24 = Y9
C27 = Y10
C30 = Y11

BZX84-C33 = Y12
C36 = Y13
C39 = Y14
C43 = Y15
C47 = Y16
C51 = Y17
C56 = Y18
C62 = Y19
C68 = Y20
C75 = Y21

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

Currents

Repetitive peak forward current	I_{FRM}	max.	200	mA
Repetitive peak working current	I_{ZRM}	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm	$R_{th\ j\text{-}a}$	=	0,62	°C/mW

CHARACTERISTICS T_j = 25 °C

Forward voltage

I_F = 10 mA	V_F	<	0,9	V

→ Reverse current

BZX84-C4V7	V_R = 2 V	I_R	<	3000	nA
BZX84-C5V1	V_R = 2 V	I_R	<	2000	nA
BZX84-C5V6	V_R = 2 V	I_R	<	1000	nA
BZX84-C6V2	V_R = 4 V	I_R	<	3000	nA
BZX84-C6V8	V_R = 4 V	I_R	<	2000	nA
BZX84-C7V5	V_R = 5 V	I_R	<	1000	nA
BZX84-C8V2	V_R = 5 V	I_R	<	700	nA
BZX84-C9V1	V_R = 6 V	I_R	<	500	nA
BZX84-C10	V_R = 7 V	I_R	<	200	nA
BZX84-C11	V_R = 8 V	I_R	<	100	nA
BZX84-C12	V_R = 8 V	I_R	<	100	nA
BZX84-C13	V_R = 8 V	I_R	<	100	nA
BZX84-C15 to C75	V_R = 0,7 V_{Znom}	I_R	<	50	nA

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

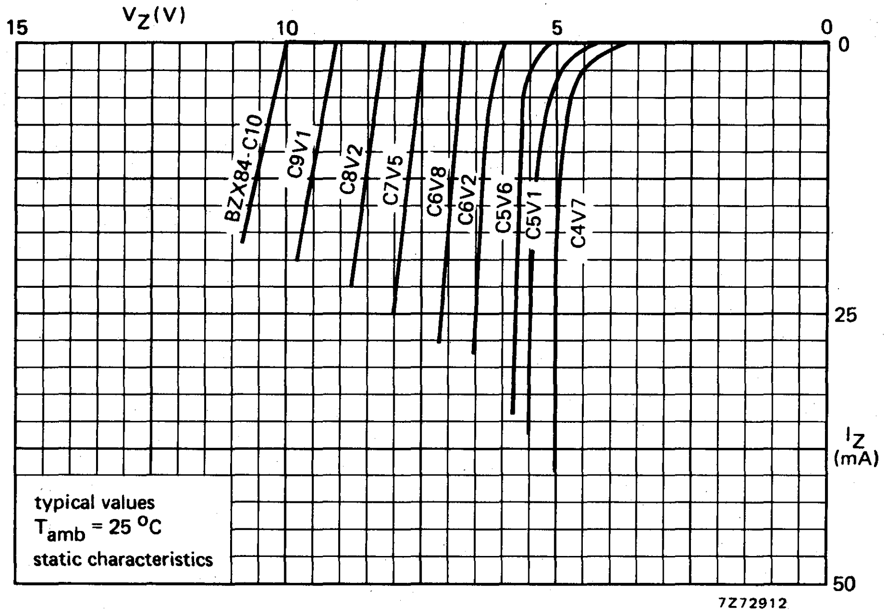
E24 (± 5%) logarithmic range.

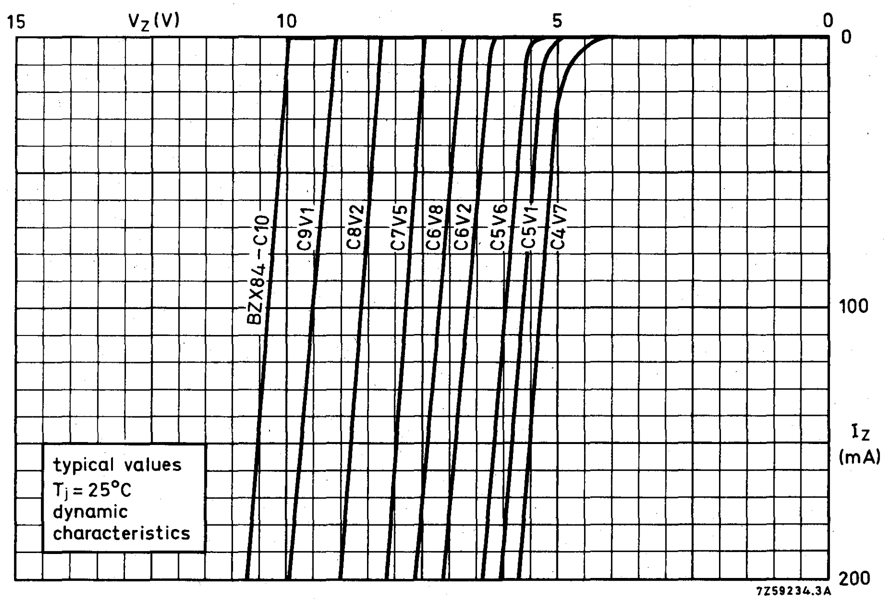
BZX84-...	Working voltage		Differential resistance		Temperature coefficient			Diode capacitance	
	V_Z (V)		r_{diff} (Ω)		S_Z (mV/°C)			C_d (pF); f = 1 MHz	
	at I_Z = 5 mA		**at I_Z = 5 mA**		**at I_Z = 5 mA**			$V_R = 0$	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
C4V7	4,4	5,0	50	80	−3,5	−1,4	0,2	130	180
C5V1	4,8	5,4	40	60	−2,7	−0,8	1,2	110	160
C5V6	5,2	6,0	15	40	−2,0	1,2	2,5	95	140
C6V2	5,8	6,6	6	10	0,4	2,3	3,7	90	130
C6V8	6,4	7,2	6	15	1,2	3,0	4,5	85	110
C7V5	7,0	7,9	6	15	2,5	4,0	5,3	80	100
C8V2	7,7	8,7	6	15	3,2	4,6	6,2	75	95
C9V1	8,5	9,6	6	15	3,8	5,5	7,0	70	90
C10	9,4	10,6	8	20	4,5	6,4	8,0	70	90
C11	10,4	11,6	10	20	5,4	7,4	9,0	65	85
C12	11,4	12,7	10	25	6,0	8,4	10,0	65	85
C13	12,4	14,1	10	30	7,0	9,4	11,0	60	80
C15	13,8	15,6	10	30	9,2	11,4	13,0	55	75
C16	15,3	17,1	10	40	10,4	12,4	14,0	52	75
C18	16,8	19,1	10	45	12,4	14,4	16,0	47	70
C20	18,8	21,2	15	55	14,4	16,4	18,0	36	60
C22	20,8	23,3	20	55	16,4	18,4	20,0	34	60
C24	22,8	25,6	25	70	18,4	20,4	22,0	33	55
	at I_Z = 2 mA		**at I_Z = 2 mA**		**at I_Z = 2 mA**				
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
C27	25,1	28,9	25	80	21,4	23,4	25,3	30	50
C30	28,0	32,0	30	80	24,4	26,6	29,4	27	50
C33	31,0	35,0	35	80	27,4	29,7	33,4	25	45
C36	34,0	38,0	35	90	30,4	33,0	37,4	23	45
C39	37,0	41,0	40	130	33,4	36,4	41,2	21	45
C43	40,0	46,0	45	150	37,6	41,2	46,6	21	40
C47	44,0	50,0	50	170	42,0	46,1	51,8	19	40
C51	48,0	54,0	60	180	46,6	51,0	57,2	19	40
C56	52,0	60,0	70	200	52,2	57,0	63,8	18	40
C62	58,0	66,0	80	215	58,8	64,4	71,6	17	35
C68	64,0	72,0	90	240	65,6	71,7	79,8	17	35
C75	70,0	79,0	95	255	73,4	80,2	88,6	16,5	35

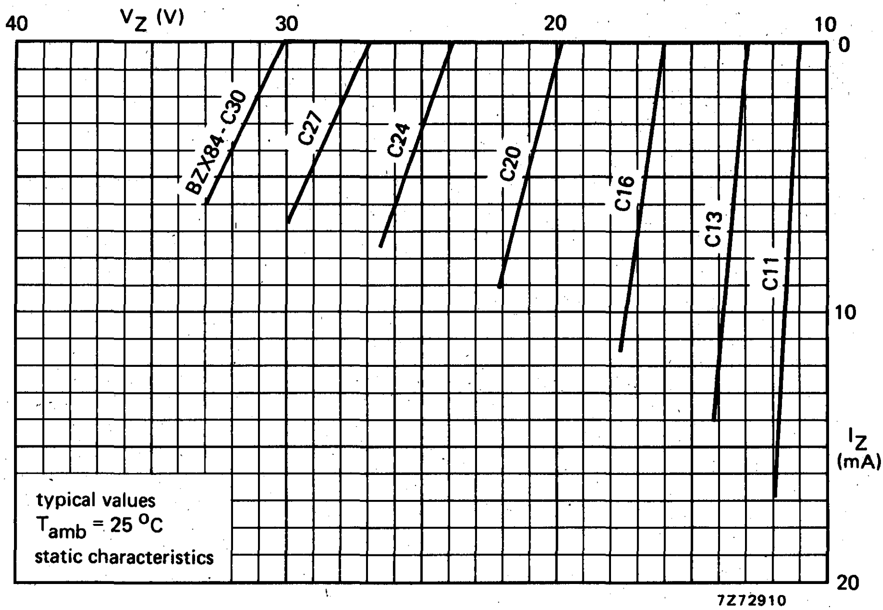
→ **CHARACTERISTICS** (continued) T_j = 25 °C

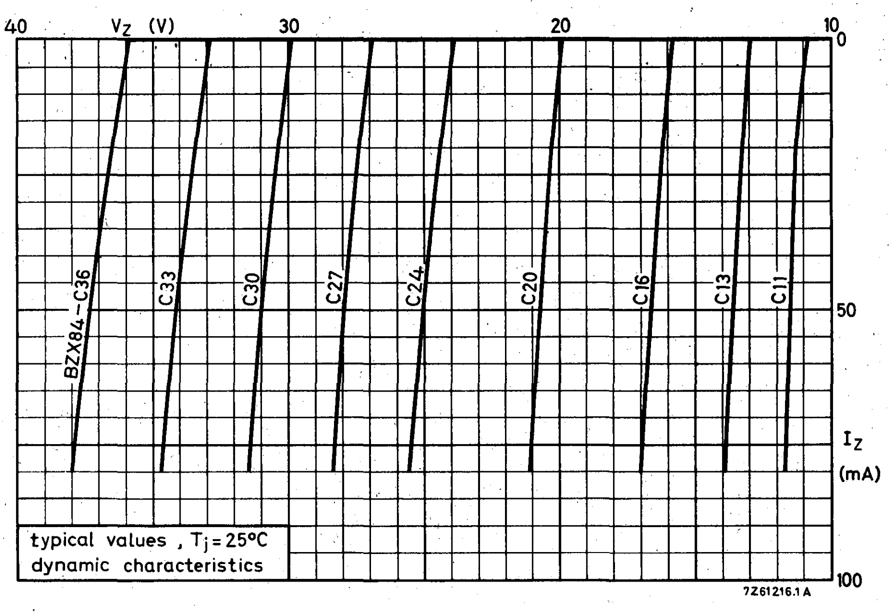
E24 (± 5%) logarithmic range.

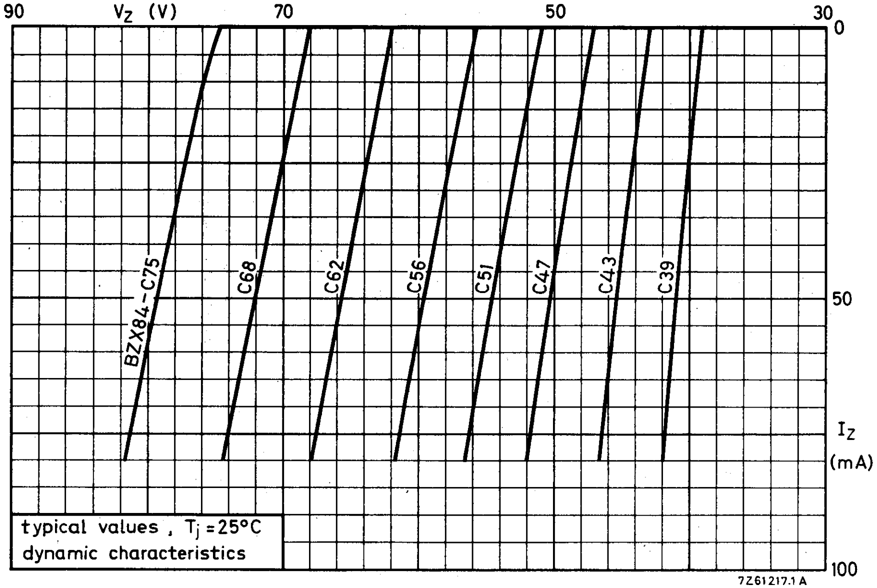
BZX84-...	Working voltage V_Z (V) at I_Z = 1 mA			Differential resistance r_{diff} (Ω) at I_Z = 1 mA		Working voltage V_Z (V) at I_Z = 20 mA			Differential resistance r_{diff} (Ω) at I_Z = 20 mA	
	min.	nom.	max.	typ.	max.	min.	nom.	max.	typ.	max.
C4V7	3,7	4,2	4,7	425	500	4,5	5,0	5,4	8	15
C5V1	4,2	4,7	5,3	400	480	5,0	5,4	5,9	6	15
C5V6	4,8	5,4	6,0	80	400	5,2	5,7	6,3	4	10
C6V2	5,6	6,1	6,6	40	150	5,8	6,3	6,8	3	6
C6V8	6,3	6,7	7,2	30	80	6,4	6,9	7,4	2,5	6
C7V5	6,9	7,4	7,9	30	80	7,0	7,6	8,0	2,5	6
C8V2	7,6	8,1	8,7	40	80	7,7	8,3	8,8	3	6
C9V1	8,4	9,0	9,6	40	100	8,5	9,2	9,7	4	8
C10	9,3	9,9	10,6	50	150	9,4	10,1	10,7	4	10
C11	10,2	10,9	11,6	50	150	10,4	11,1	11,8	5	10
C12	11,2	11,9	12,7	50	150	11,4	12,1	12,9	5	10
C13	12,3	12,9	14,0	50	170	12,5	13,1	14,2	5	15
C15	13,7	14,9	15,5	50	200	13,9	15,1	15,7	6	20
C16	15,2	15,9	17,0	50	200	15,4	16,1	17,2	6	20
C18	16,7	17,9	19,0	50	225	16,9	18,1	19,2	6	20
C20	18,7	19,9	21,1	60	225	18,9	20,1	21,4	7	20
C22	20,7	21,9	23,2	60	250	20,9	22,1	23,4	7	25
C24	22,7	23,9	25,5	60	250	22,9	24,1	25,7	7	25
	at I_Z = 0,1 mA			at I_Z = 0,5 mA		at I_Z = 10 mA			at I_Z = 10 mA	
	min.	nom.	max.	typ.	max.	min.	nom.	max.	typ.	max.
C27	25,0	26,9	28,9	65	300	25,2	27,1	29,3	10	45
C30	27,8	29,9	32,0	70	300	28,1	30,1	32,4	15	50
C33	30,8	32,9	35,0	75	325	31,1	33,1	35,4	20	55
C36	33,8	35,9	38,0	80	350	34,1	36,1	38,4	25	60
C39	36,7	38,9	41,0	80	350	37,1	39,1	41,5	25	70
C43	39,7	42,9	46,0	85	375	40,1	43,1	46,5	25	80
C47	43,7	46,8	50,0	85	375	44,1	47,1	50,5	30	90
C51	47,6	50,8	54,0	90	400	48,1	51,1	54,6	35	100
C56	51,5	55,7	60,0	100	425	52,1	56,1	60,8	45	110
C62	57,4	61,7	66,0	120	450	58,2	62,1	67,0	60	120
C68	63,4	67,7	72,0	150	475	64,2	68,2	73,2	75	130
C75	69,4	74,7	79,0	170	500	70,3	75,3	80,2	90	140

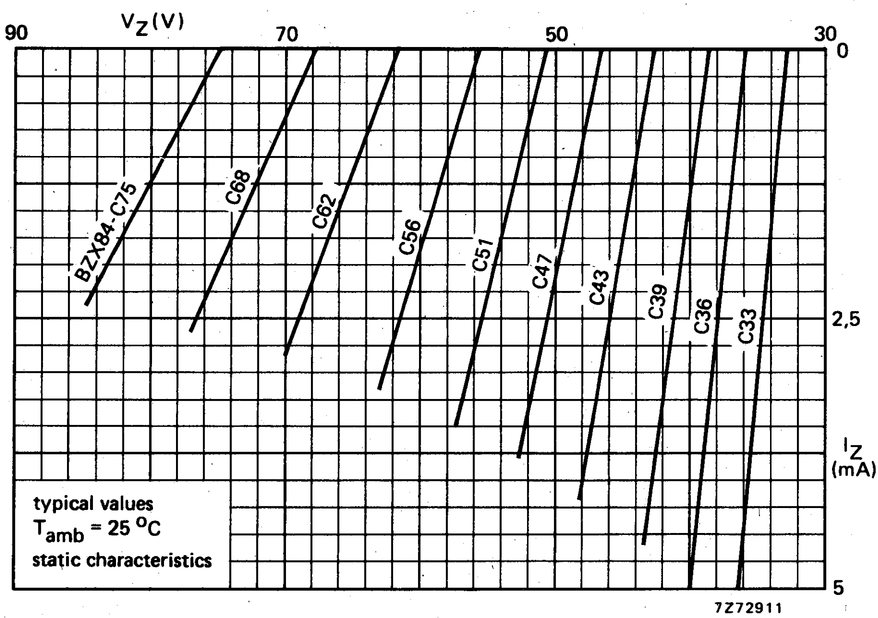

15
V_Z (V)
10
5
0
0
25
50
I_Z (mA)
BZX84-C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
typical values
T_{amb} = 25 °C
static characteristics
7Z72912

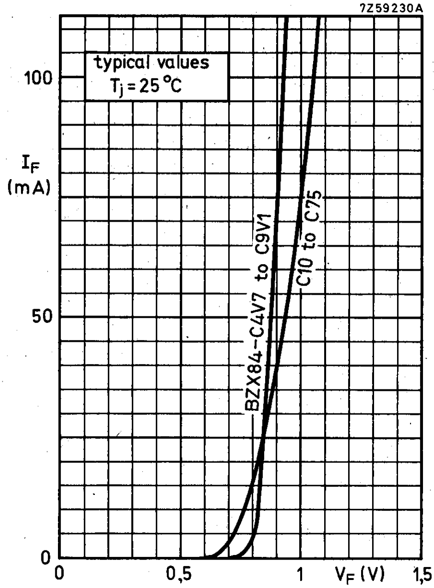

15
V_Z (V)
10
5
0
0
100
200
I_Z (mA)
BZX84–C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
typical values
T_j = 25°C
dynamic characteristics
7Z59234.3A

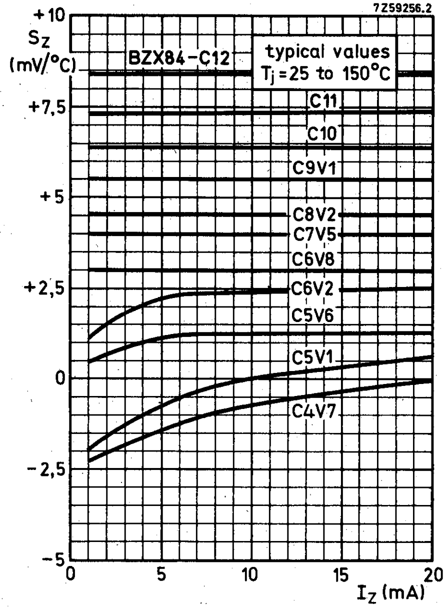

V_Z (V)
40
30
20
10
0
10
20
I_Z (mA)
BZX84-C30
C27
C24
C20
C16
C13
C11
typical values
T_{amb} = 25 °C
static characteristics
7Z72910

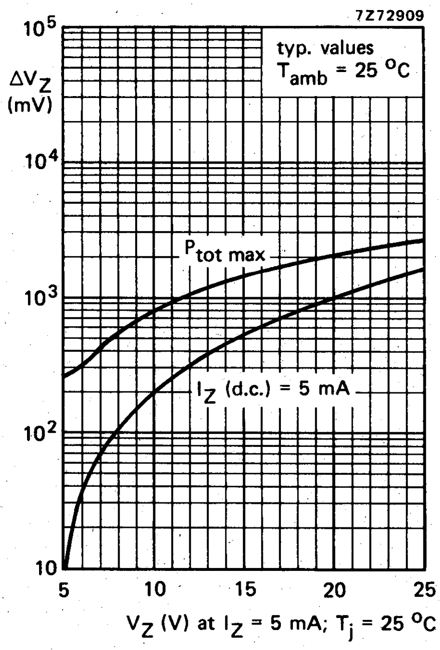

V_Z (V)
40
30
20
10
0
50
100
I_Z (mA)
BZX84-C36
C33
C30
C27
C24
C20
C16
C13
C11
typical values , T_j = 25°C
dynamic characteristics
7Z61216.1 A

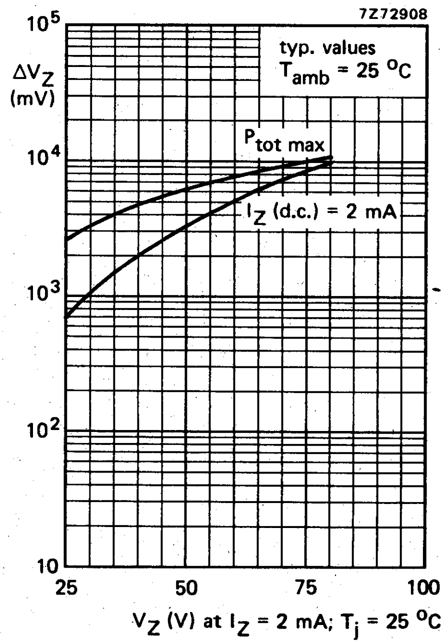

90
V_Z (V)
70
50
30
0
50
100
I_Z
(mA)
BZX84-C75
C68
C62
C56
C51
C47
C43
C39
typical values , T_j = 25°C
dynamic characteristics
7Z61217.1 A

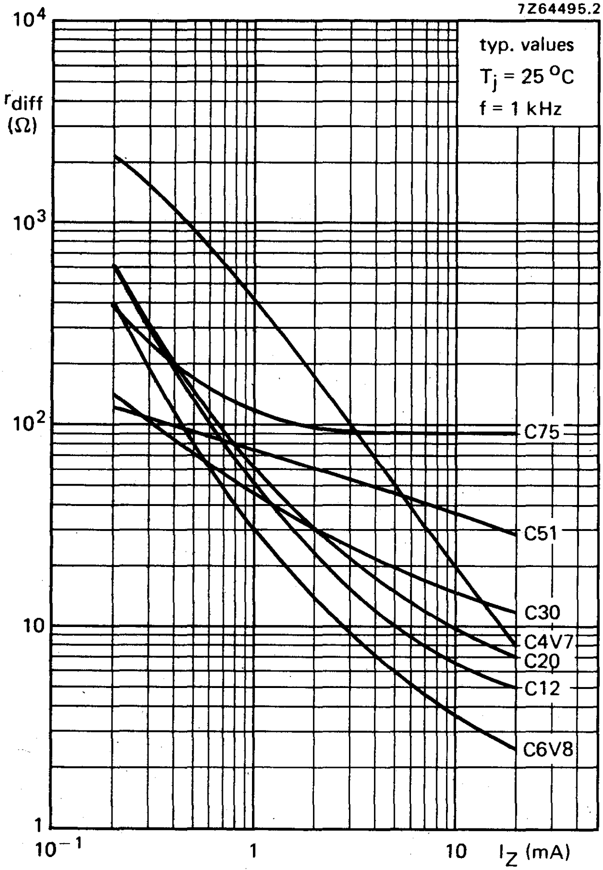

90
V_Z(V)
70
50
30
0
2,5
5
I_Z
(mA)
BZX84-C75
C68
C62
C56
C51
C47
C43
C39
C36
C33
typical values
T_{amb} = 25 °C
static characteristics
7Z72911


7Z59230A
typical values
T_j = 25 °C
I_F (mA)
100
50
0
0
0,5
1
V_F (V)
1,5
BZX84–C4V7 to C9V1
C10 to C75


7Z59256.2
S_Z (mV/°C)
+10
+7,5
+5
+2,5
0
−2,5
−5
BZX84–C12
typical values
T_j = 25 to 150 °C
C11
C10
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
0
5
10
15
20
I_Z (mA)


7Z72909
10^5
ΔV_Z (mV)
10^4
10^3
10^2
10
typ. values
T_{amb} = 25 °C
$P_{tot\,max}$
I_Z (d.c.) = 5 mA
5
10
15
20
25
V_Z (V) at I_Z = 5 mA; T_j = 25 °C


7Z72908
10^5
ΔV_Z (mV)
10^4
10^3
10^2
10
typ. values
T_{amb} = 25 °C
$P_{tot\,max}$
I_Z (d.c.) = 2 mA
25
50
75
100
V_Z (V) at I_Z = 2 mA; T_j = 25 °C


7Z64495.2
typ. values
T_j = 25 °C
f = 1 kHz
r_{diff}
(Ω)
10^4
10^3
10^2
10
1
10^{-1}
1
10
I_Z (mA)
C75
C51
C30
C4V7
C20
C12
C6V8

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