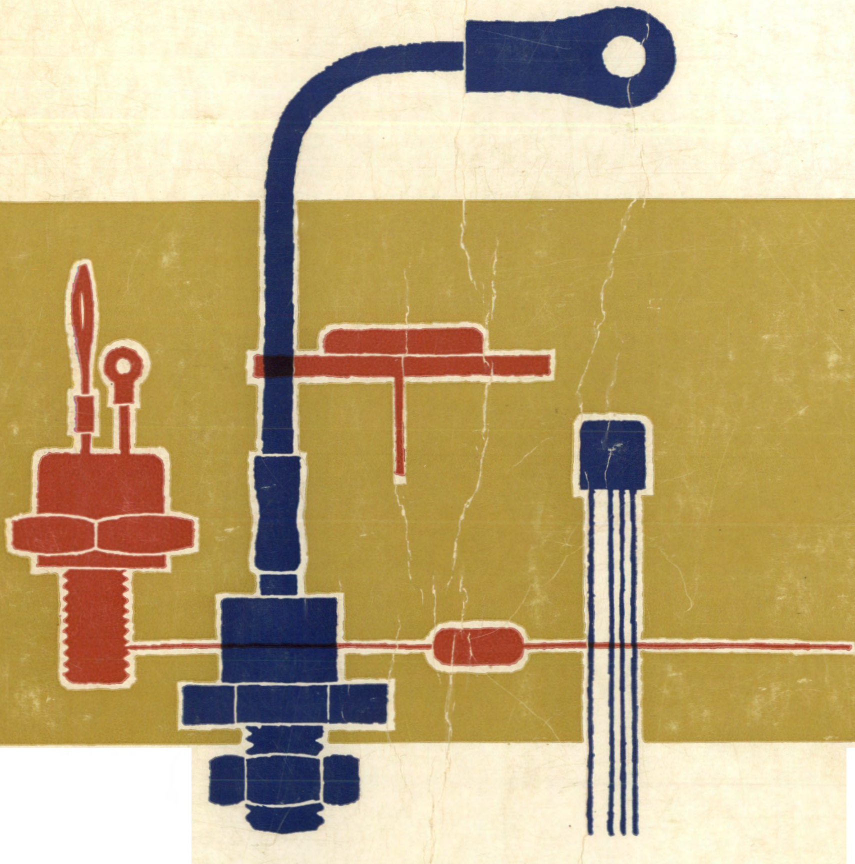
OCTOBER 1966

PHILIPS

SEMICONDUCTOR HANDBOOK

Part 1



ELECTRONIC COMPONENTS AND MATERIALS DIVISION

SEMICONDUCTOR HANDBOOK

OCTOBER 1966

Part 1

General section

Diodes

Thyristors
(Silicon controlled rectifiers)

Rectifier Stacks

Transistors

Photoelectric devices

Integrated circuits

Accessories

Supplement (latest data)

INTRODUCTION

THE ELECTRON TUBE AND SEMICONDUCTOR HANDBOOK contains extensive data, supported by curves, on current types of tubes and semiconductor devices. For the sake of completeness, obsolescent types have been incorporated, though in an abridged form.

THE SEMICONDUCTOR HANDBOOK is one volume of the complete system mentioned above.
It comprises all tentative and final data available at the time of preparation of the Handbook.

In the SUPPLEMENT at the end of the book, the latest data, which appeared during the interval between printing and binding, has been incorporated in order to keep the Handbook up to date.

General section

Index of type numbers
Type designation
Rating systems
Letter symbols

INDEX OF TYPE NUMBERS

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

Type No.	Section	Type No.	Section	Type No.	Section
AA119	D	AF121	T	ASZ21	T
AAY11	D	AF124	T	ASZ23	T
AAY21	D	AF125	T	AU101	T
AAY30	D	AF126	T	AU102	T
AAY32	D	AF127	T	AU103	T
AAZ12	D	AF139	T	AU104	T
AAZ13	D	AF178	T	AUY10	T
AAZ15	D	AF179	T	BA100	D
AAZ17	D	AF181	T	BA102	D
AAZ18	D	AF185	T	BA114	D
AC107	T	AF186	T	BAX13	D
AC125	T	AFY19	T	BAY32	D
AC126	T	AFZ12	T	BAY33	D
AC127	T	ASY26	T	BAY38	D
AC128	T	ASY27	T	BAY39	D
AC132	T	ASY28	T	BAY96	D
AC172	T	ASY29	T	BC107	T
AD139	T	ASY31	T	BC108	T
AD149	T	ASY32	T	BC109	T
AD161	T	ASY73	T	BC112	T
AD162	T	ASY74	T	BCY10	T
ADY26	T	ASY75	T	BCY11	T
ADZ11	T	ASY76	T	BCY12	T
ADZ12	T	ASY77	T	BCY30	T
AF102	T	ASY80	T	BCY31	T
AF114	T	ASZ15	T	BCY32	T
AF115	T	ASZ16	T	BCY33	T
AF116	T	ASZ17	T	BCY34	T
AF117	T	ASZ18	T	BCY38	T
AF118	T	ASZ20	T	BCY39	T

D = Diodes
T = Transistors

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Type No.	Section	Type No.	Section	Type No.	Section
BCY40	T	BSX44	T	BYY15	D
BCY54	T	BSY10	T	BYY16	D
BCZ10	T	BSY11	T	BYY20	D
BCZ11	T	BSY38	T	BYY21	D
BCZ12	T	BSY39	T	BYY22	D
BCZ13	T			BYY23	D
BCZ14	T			BYY24	D
BDY10	T	BTX12 series	Thyr.	BYY25	D
BDY11	T	BTX13 series	Thyr.	BYY67	D
BF115	T	BTX35 series	Thyr.	BYY68	D
BF167	T	BTX36 series	Thyr.	BYY73	D
BF173	T	BTX37 series	Thyr.	BYY74	D
BF180	T	BTX38 series	Thyr.	BYY75	D
BF181	T	BTY79 series	Thyr.	BYY76	D
BF184	T	BTY80	Thyr.	BYY77	D
BF185	T	BTY81	Thyr.	BYY78	D
BFX43	T	BTY87 series	Thyr.	BYZ10	D
BFX44	T	BTY91 series	Thyr.	BYZ11	D
BFY10	T	BTY95 series	Thyr.	BYZ12	D
BFY11	T	BTY99 series	Thyr.	BYZ13	D
BFY44	T	BY100	D	BYZ14	D
BFY50	T	BY114	D	BYZ15	D
BFY51	T	BY118	D	BYZ16	D
BFY52	T	BY122	D	BYZ17	D
BFY55	T	BY123	D	BYZ18	D
BFY67	T	BYX10	D	BYZ19	D
BFY68	T	BYX13 series	D	BZY56	D
BFY70	T	BYX14 series	D	BZY57	D
BFY90	T	BYX20-200(R)	D	BZY58	D
BLY14	T	BYX23 series	D	BZY59	D
BLY17	T	BYX25 series	D	BZY60	D
BPY10	P	BYX27 series	D	BZY61	D
BSX19	T	BYX30 series	D	BZY62	D
BSX20	T	BYX32 series	D	BZY63	D
BSX21	T	BYX33 series	D	BZY64	D

D = Diodes
P = Photoelectric devices
T = Transistors
Thyr. = Thyristors

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Type No.	Section	Type No.	Section	Type No.	Section
BZY65	D	OA92	D	OC70	T
BZY66	D	OA95	D	OC71	T
BZY67	D	OA200	D	OC72	T
BZY68	D	OA202	D	OC74	T
BZY69	D	OA210	D	OC75	T
BZY74	D	OA211	D	OC76	T
BZY75	D	OA214	D	OC77	T
BZY76	D	OAP12	P	OC79	T
BZY88 series	D	OAZ200	D	OC80	T
BZY91 series	D	OAZ201	D	OC122	T
BZZ10	D	OAZ202	D	OC123	T
BZZ11	D	OAZ203	D	OC139	T
BZZ12	D	OAZ204	D	OC140	T
BZZ13	D	OAZ205	D	OC141	T
BZZ14	D	OAZ206	D	OC169	T
BZZ15	D	OAZ207	D	OC170	T
BZZ16	D	OAZ208	D	OC171	T
BZZ17	D	OAZ209	D	OCP70	P
BZZ18	D	OAZ210	D	OM200	IC
BZZ19	D	OAZ211	D	OSH2504	St
BZZ20	D	OAZ212	D	OSH4502	St
OA5	D	OAZ213	D	OSH4503	St
OA7	D	OC22	T	OSK2503	St
OA9	D	OC23	T	OSK4509	St
OA31	D	OC24	T	OSK4510	St
OA47	D	OC26	T		
OA70	D	OC30	T	2N706A	T
OA72	D	OC44	T	2N708	T
OA73	D	OC45	T	2N709	T
OA79	D	OC46	T	2N743	T
OA81	D	OC47	T	2N744	T
OA85	D	OC57	T	2N753	T
OA86(C)	D	OC58	T	2N914	T
OA90	D	OC59	T	2N918	T
OA91	D	OC60	T	2N929	T

D = Diodes
IC = Integrated Circuits
P = Photoelectric devices
St = Rectifier Stacks
T = Transistors

7Z3 0678

Type No.	Section	Type No.	Section	Type No.	Section
2N930	T	2N1711	T	2N2484	T
2N1302	T	2N2218	T	2N3570	T
2N1303	T	2N2219	T	2N3571	T
2N1304	T	2N2221	T	2N3572	T
2N1305	T	2N2222	T	40809	T
2N1306	T	2N2297	T		
2N1307	T	2N2368	T		
2N1308	T	2N2369	T		
2N1309	T	2N2369A	T		
2N1613	T	2N2483	T		

T = Transistors

For Mounting Accessories and Heatsinks refer to the separate index, in the section Accessories, pages 2 and 3.

7Z3 0679

TYPE DESIGNATION CODE

FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete devices either with or without junctions, and to multiple devices [1])

The type designation consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

The first letter distinguishes between junction and non-junction devices and gives an indication of the material

- A Devices with one or more junctions, using material with a band gap of 0.6 to 1.0 eV, such as germanium
- B Devices with one or more junctions, using material with a band gap of 1.0 to 1.3 eV, such as silicon
- C Devices with one or more junctions, using material with a band gap of 1.3 eV and more, such as gallium arsenide
- D Devices with one or more junctions, using material with a band gap of less than 0.6 eV, such as indium antimonide
- R Devices without junction, using materials such as those employed in Hall generators and photoconductive cells

[1]) A multiple device is defined as a combination of similar or dissimilar active devices, contained in a common encapsulation that cannot be dismantled, and of which all electrodes of the individual devices are accessible from the outside.

Multiples of similar devices as well as multiples consisting of a main device and an auxiliary device are designated according to the code for discrete devices described above.
Multiples of dissimilar devices of other nature are designated by the second letter G.

7Z3 0364

The second letter indicates primarily the main application respectively main application and construction if a further differentiation is essential

- A Detection diode, high speed diode, mixer diode
- B Variable capacitance diode
- C Transistor for a.f. applications ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
- D Power transistor for a.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
- E Tunnel diode
- F Transistor for r.f. applications ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
- G Multiple of dissimilar devices (see note at page 1)
- H Field probe
- K Hall generator in an open magnetic circuit, e.g. magnetogram or signal probe
- L Power transistor for r.f. applications ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
- M Hall generator in a closed electrically energised magnetic circuit, e.g. Hall modulator or multiplier
- P Radiation sensitive device
- Q Radiation generating device
- R Electrically triggered controlling and switching device having a breakdown characteristic ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
- S Transistor for switching applications ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
- T Electrically, or by means of light, triggered controlling and switching power device having a breakdown characteristic ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)[1)]
- U Power transistor for switching applications ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
- X Multiplier diode, e.g. varactor, step recovery diode
- Y Rectifying diode, booster diode, efficiency diode [1)]
- Z Voltage reference or voltage regulator diode [1)]

[1)] For the type designation of a range see page 4

7Z3 0365

The serial number consists of:

Three figures for semiconductor devices designed for use primarily in consumer goods

One letter and two figures for semiconductor devices designed for use primarily in professional equipment

EXAMPLES

AF139 Germanium r.f. transistor intended primarily for "entertainment" applications

BYX27 Silicon rectifying diode intended primarily for "industrial" applications

7Z3 0366

TYPE DESIGNATION FOR A RANGE OF SEMICONDUCTOR DEVICES

The type designation of a range of variants of:

a) voltage reference or voltage regulator diodes (second letter Z)

b) rectifying diodes (second letter Y)

c) thyristors (second letter T)

distinctly belonging to one basic type may be qualified by a suffix part which is clearly separated from the basic part by a dash (-)
The basic part being the same for the whole range, is in accordance with the designation code for discrete devices.

The suffix part consists of:

a) for voltage reference or voltage regulator diodes

One letter followed by the typical zener voltage and where appropriate the letter R [1])
The first letter indicates the nominal tolerance of the zener voltage in %

A	1%
B	2%
C	5%
D	10%
E	15%

The typical zener voltage is related to the nominal current rating for the whole range. The letter V is used to denote the decimal point when this occurs.

b) for rectifying diodes

A number and where appropriate the letter R [1])
The number indicates the maximum repetitive peak reverse voltage

c) for thyristors

a number and where appropriate the letter R [1])
The number indicates either the maximum repetitive peak reverse voltage or the maximum peak off-state voltage, whichever is lower

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1) The letter R indicates reverse polarity (stud anode). The normal polarity (stud cathode) and symmetrical executions are not specially indicated.

7Z3 0367

EXAMPLES

BZY88series	Range of silicon voltage regulator diodes for industrial applications
BZY88-C9V1	The particular type out of the range with a typical zener voltage of 9.1 V ± 5%
BYX13-1200	The particular normal polarity type out of the BYX13series with a maximum repetitive peak reverse voltage of 1200 V
BTX13-200R	The particular reverse polarity type out of the BTX13 thyristor range of which the lower maximum repetitive peak voltage is 200 V

OLD SYSTEM

The first letter is always "O", indicating a semiconductor device. The second (and third) letter(s) indicate the general class of device.

A	- diode or rectifier	C	- transistor
AP	- photodiode	CP	- phototransistor
AZ	- zener diode	RP	- photoconductive cell

The group of figures is a serial number indicating a particular design or development.

EXAMPLES

OA81	Semiconductor diode
OAZ200	Zener diode
OC72	Transistor

7Z3 0368

TYPE DESIGNATION FOR SEMICONDUCTOR RECTIFIER STACKS

The type designation consists of:

Three letters followed by a serial number

The first 2 letters indicate the type of stack:

OS Denotes a semiconductor rectifier diode stack

OT Denotes a semiconductor stack in which also thyristors are used

The third letter indicates the type of circuit:

A Single phase half wave

B Two phase half wave

C Three phase half wave (three phase star)

D Four phase half wave (four phase star)

E Six phase half wave (six phase star)

F Three phase double Y with interphase transformer

H Single phase full wave (single phase bridge)

J Single phase magnetic amplifier bridge

K Three phase full wave (three phase bridge)

L Four phase full wave (four phase bridge)

M Voltage doubler (half a single phase full wave)

S Miscellaneous (such as combinations of single diodes and passive components)

The serial number is sometimes followed by a suffix letter for the indication of variants.

7Z3 0632

TYPE DESIGNATION FOR NETWORKS

This code applies to networks in non-accessible envelopes, such as integrated circuit devices.
The type designations according to this code distinguish between solitary networks and networks belonging to a family. A family is defined as a group of networks which are related in their specifications, and primarily designed to be mutually connected.

The type designation consists of:

THREE LETTERS FOLLOWED BY THREE FIGURES

The two first letters indicate a family respectively a solitary type

Family types: FA, FB, FC, etc.
GA, GB, GC, etc.

Solitary types: TA, TB, TC, etc.

The third letter indicates the circuit function in categories

A Linear amplification
B Frequency conversion/demodulation
C Oscillating/generating (continuous)
D Multiples of dissimilar linear networks
G Multiple of non-interconnected discrete devices when belonging to a family of networks
H Logic
J Storage (continuous)
K Timing (incl. temporary storage)
L Digital level conversion
Y Miscellaneous

The two first figures represent the serial number

The third figure indicates the temperature range

1 0 to +75 °C
2 -55 to +125 °C
0 other temperature ranges

7Z3 0633

RATING SYSTEMS

ACCORDING TO I.E.C. PUBLICATION 134

1. DEFINITIONS OF TERMS USED

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

Note: This definition excludes inductors, capacitors, resistors and similar components.

1.2 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.

1.3 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.

1.4 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.

1.5 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.

2. 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.

7Z3 0362

p.t.o.

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.

3. 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.

4. 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.

NOTE

It is common use to apply the Absolute Maximum System in semiconductor published data. 7Z3 0363

LETTER SYMBOLS

LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES
excluding power diodes and thyristors

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION as published in I.E.C. Publication 148.

QUANTITY SYMBOLS

1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

   Examples: i, v, p

2. Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

   Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

1. Total values are indicated by upper case subscripts.

   Examples: I_C, I_{CM}, I_{CAV}, i_C, V_{EB}

2. Values of varying components are indicated by lower case subscripts.

   Examples: i_c, I_c, v_{eb}, V_{eb}

3. To distinguish between maximum (peak), average, d.c. and root-mean-square values, the following subscripts are added:

   For maximum (peak) values : M or m

   For average values : AV or av (only if it is necessary to distinguish between d.c. and average)

   For d.c. values : no additional subscript

   For root-mean-square values : (rms)

   Examples: I_C, I_{cm}, I_{CAV}, $I_{c(rms)}$, $I_{C(rms)}$

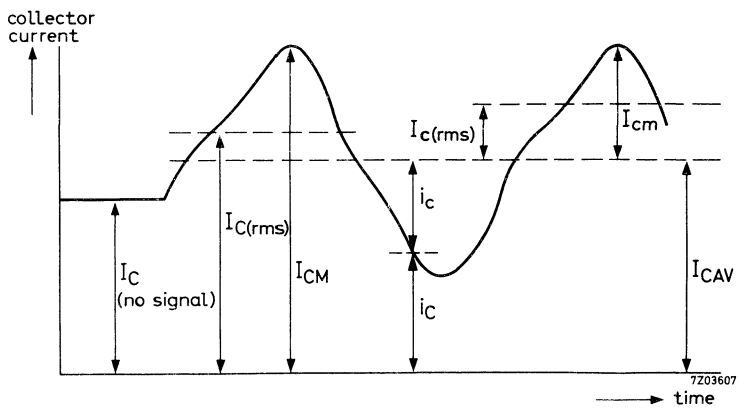
7Z3 0339

4. List of subscripts (examples, see figure 1)

A, a	=	Anode terminal
K, k	=	Cathode terminal
E, e	=	Emitter terminal
B, b	=	Base terminal
C, c	=	Collector terminal
(BR)	=	Break-down
X, x	=	Specified circuit
M, m	=	Maximum (peak) value
AV, av	=	Average value
(rms)	=	R.M.S. value
F, f	=	Forward
R, r	=	As first subscript : Reverse. As second subscript : Repetitive
O	=	As third subscript : The terminal not mentioned is open circuited
S	=	As second subscript : Non repetitive As third subscript : Short circuit between the terminal not mentioned and the reference terminal
Z	=	Zener. (Replaces R to indicate the actual zener voltage, current or power of voltage reference or voltage regulator diodes)

5. Examples of the application of the rules:
Figure 1 represents a transistor collector current, consisting of a direct current and a signal, as a function of time.

Fig. 1



7Z3 0340

CONVENTIONS FOR SUBSCRIPT SEQUENCE

1. Currents

For transistors: the first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive)

For diodes: a forward current (conventional current flow into the anode terminal) is represented by the subscript F or f; a reverse current (conventional current flow out of the anode terminal) is represented by the subscript R or r.

2. Voltages

For transistors: normally, two subscripts are used to indicate the points between which the voltage is measured. The first subscript indicates one terminal point and the second the reference terminal.
Where there is no possibility of confusion, the second subscript may be omitted.

For diodes: a forward voltage (anode positive with respect to cathode) is represented by the subscript F or f and a reverse voltage (anode negative with respect to cathode) by the subscript R or r.

3. Supply voltages

Supply voltages may be indicated by repeating the terminal subscript.

Examples: V_{EE}, V_{CC}, V_{BB}

The reference terminal may then be indicated by a third subscript.

Examples: V_{EEB}, V_{CCB}, V_{BBC}

4. In devices having more than one terminal of the same type, the terminal subscripts are modified by adding a number following the subscript and on the same line.

Example: V_{B2-E} voltage between second base and emitter

In multiple unit devices, the terminal subscripts are modified by a number preceding the terminal subscripts:

Example: V_{1B-2B} voltage between the base of the first unit and that of the second one.

7Z3 0341

ELECTRICAL PARAMETER SYMBOLS

1. The values of four pole matrix parameters or other resistances, impedances admittances, etc... inherent in the device, are represented by the lower case symbol with the appropriate subscripts.

   Examples: h_{ib}, z_{fb}, y_{oc}, h_{FE}

2. The four pole matrix parameters of external circuits and of circuits in which the device forms only a part are represented by the upper case symbols with the appropriate subscripts.

   Examples: H_i, Z_o, H_F, Y_R

SUBSCRIPTS FOR PARAMETER SYMBOLS

1. The static values of parameters are indicated by upper case subscripts.

   Examples: h_{IB}, h_{FE}

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.

2. The small-signal values of parameters are indicated by lower case subscripts.

   Examples: h_{ib}, z_{ob}

3. The first subscript, in matrix notation identifies the element of the four pole matrix.

   i (for 11) = input
   o (for 22) = output
   f (for 21) = forward transfer
   r (for 12) = reverse transfer

   Examples:
   $$V_1 = h_i I_1 + h_r V_2$$
   $$I_2 = h_f I_1 + h_o V_2$$

Notes [1]) The voltage and current symbols in matrix notation are indicated by a single digit subscript.
The subscript 1 = input; the subscript 2 = output

[2]) The voltages and currents in these equations may be complex quantities.

7Z3 0342

4. The second subscript identifies the circuit configuration.

e = common emitter
b = common base
c = common collector
j = common terminal, general

Examples: (common base)

$$I_1 = y_{ib} V_{1b} + y_{rb} V_{2b}$$

$$I_2 = y_{fb} V_{1b} + y_{ob} V_{2b}$$

When the common terminal is understood, the second subscript may be omitted.

5. If it is necessary to distinguish between real and imaginary parts of the four pole parameters, the following notations may be used.

$Re(h_{ib})$ etc.. for the real part

$Im(h_{ib})$ etc.. for the imaginary part

7Z3 0343

Letter symbol	Definition
C_c [1]	Collector capacitance (emitter open-circuited to a.c. and d.c.)
C_d [1]	Diode capacitance
C_e [1]	Emitter capacitance (collector open-circuited to a.c. and d.c.)
C_{ib}, C_{ie}, C_{ob}, C_{oe} [1]	See y parameters
d	Distortion
F	Noise figure
f	Frequency
f_{hfb}, f_{hfe}, f_{yfe}	Cut-off frequency (frequency at which the parameter indicated by the subscript is 0.7 of its low frequency value)
f_T	Transition frequency (Gain-bandwidth product)
g_{ie}, g_{ib}, g_{oe}, g_{ob}	See y parameters
G_p	Power gain
G_S	Source conductance
G_{tr}	Transducer gain
G_{UM}	Maximum unilateralised power gain
h_{FB}, h_{FC}, h_{FE}	Static value of the forward current transfer ratio or D.C. current gain (output voltage held constant)
h_{fb}, h_{fc}, h_{fe}	Small-signal value of the forward current transfer ratio or Small-signal current gain (output short-circuited to a.c.)
h_{IB}, h_{IC}, h_{IE}	Static value of the input resistance (output voltage held constant
h_{ib}, h_{ic}, h_{ie}	Small-signal value of the input impedance (output short-circuited to a.c.)

[1]) As an exception to the general rule for electrical parameters capacitances are represented by the upper-case letter.

7Z3 0344

Letter symbol	Definition
h_{OB}, h_{OC}, h_{OE}	Static value of the output conductance (input current held constant)
h_{ob}, h_{oc}, h_{oe}	Small-signal value of the output admittance (input open-circuited to a.c.)
h_{RB}, h_{RC}, h_{RE}	Static value of the reverse voltage transfer ratio (input current held constant)
h_{rb}, h_{rc}, h_{re}	Small-signal value of the reverse voltage transfer ratio (input open-circuited to a.c.)
I_B, I_C, I_E	Total d.c. (or average) current
I_b, I_c, I_e	Varying component of the current
i_B, i_C, i_E	Instantaneous total value of the current
i_b, i_c, i_e	Instantaneous value of the varying component of the current
I_{BAV}, I_{CAV}, I_{EAV}	Total average current (to distinguish between average and d.c. if necessary)
I_{BEX}, I_{CEX}	Total base, respectively collector current under specified conditions. These symbols are commonly used in case of a reverse biased emitter junction
I_{BM}, I_{CM}, I_{EM}	Maximum (peak) value of the total current
I_{bm}, I_{cm}, I_{em}	Maximum (peak) value of the varying component of the current
I_{CBO}	Collector cut-off current (open emitter)
I_{CEO}	Collector cut-off current (open base)
I_{CBS} or I_{CES}	Collector cut-off current (emitter short-circuited to base)
I_{EBO}	Emitter cut-off current (open collector)
I_F	Total forward current of a diode (d.c. or average)
i_F	Instantaneous total value of the forward current of a diode
I_{FAV}	Total average forward current of a diode (to distinguish between average and d.c. if necessary)
I_{FM}	Peak forward current of a diode

7Z3 0345

Letter symbol	Definition
I_i, I_o	Input, respectively output current of a specified circuit
I_R	Total reverse (cut-off) current of a diode
i_R	Instantaneous total value of the reverse current of a diode
I_{RRM}	Repetitive peak reverse current of a diode
I_{RSM}	Non repetitive peak reverse current of a diode
I_Z	Zener current (d.c. or average)
I_{ZM}	Peak zener current
I_{ZS}	Non repetitive zener current
P_i, P_o	Input, respectively output power of a specified circuit
P_{tot}	Total power dissipation in the device
P_Z	Zener power dissipation
P_{ZM}	Peak zener power dissipation
P_{ZSM}	Non repetitive peak zener power dissipation
Q_s	Recovered charge
r_D	Diode (internal) series resistance
R_S	Source resistance
R_{th}	Thermal resistance
$R_{th\ j\text{-}a}$	Thermal resistance from junction to ambient
$R_{th\ j\text{-}mb}$	Thermal resistance from junction to mounting base
$R_{th\ j\text{-}c}$	Thermal resistance from junction to case
$R_{th\ mb\text{-}h}$	Thermal resistance from mounting base to heatsink
r_z	Dynamic-slope resistance of a zener diode
S_z	Temperature coefficient of the operating voltage of a zener diode
T_{amb}	Ambient temperature
T_{case}	Case temperature

7Z3 0346

Letter symbol	Definition
t_d	Delay time
t_f	Fall time
t_{fr}	Forward recovery time of a diode
T_j	Junction temperature
t_{off}	Turn off time ($t_{off} = t_s + t_f$)
t_{on}	Turn on time ($t_{on} = t_d + t_r$)
t_r	Rise time
t_{rr}	Reverse recovery time of a diode
t_s	Storage time
T_{stg}	Storage temperature
V_{BB}, V_{CC}, V_{EE}	Supply voltage
V_{BE}, V_{CB}, V_{CE}, V_{EB}	Total value of the voltage (d.c. or average)
V_{be}, V_{cb}, V_{ce}, V_{eb}	Varying component of the voltage
v_{BE}, v_{CB}, v_{CE}, v_{EB}	Instantaneous value of the total voltage
v_{be}, v_{cb}, v_{ce}, v_{eb}	Instantaneous value of the varying component of the voltage
V_{BEfl}	Base-emitter floating voltage (open base)
V_{BEsat}, V_{CEsat}	Saturation voltage at specified bottoming conditions
$V_{(BR)}$	Breakdown voltage
$V_{(BR)CBO}$, $V_{(BR)CEO}$, $V_{(BR)EBO}$	Breakdown voltage between the terminal indicated by the first subscript and the reference terminal (second subscript) when the third terminal is open circuited
$V_{(BR)CER}$	Collector-emitter breakdown voltage with a specified resistance between emitter and base
$V_{(BR)CES}$	Collector-emitter breakdown voltage with the emitter short circuited to the base
V_{CBO}, V_{CEO}, V_{EBO}	Voltage of the terminal indicated by the first subscript w.r.t. the reference terminal (second subscript) with the third terminal open circuited
V_{CEK}	Knee voltage at specified conditions

7Z3 0347

Letter symbol	Definition
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base
V_{CES}	Collector-emitter voltage with the emitter short circuited to the base
$V_{CE.sust}$	Collector-emitter sustaining voltage under the condition, indicated by the third subscript
V_{CEX}	Collector-emitter voltage in a specified circuit. This symbol is commonly used to indicate a reverse biased emitter junction
V_{EBfl}	Emitter-base floating voltage (open emitter)
V_F	Continuous forward voltage of a diode
V_{FM}	Peak forward voltage of a diode
V_i, V_o	Input, respectively output voltage of a specified circuit
V_{pt}	Punch through voltage
V_R	Continuous reverse voltage of a diode
V_{RM}	Peak reverse voltage of a diode
V_{RSM}	Non repetitive peak reverse voltage of a diode
V_Z	Operating voltage (zener voltage) of a zener diode
y_{ib}, y_{ie}	Input admittance } Output short circuited to a.c.
g_{ib}, g_{ie}	Input conductance } Output short circuited to a.c.
C_{ib}, C_{ie}	Input capacitance } Output short circuited to a.c.
φ_{ib}, φ_{ie}	Phase angle of input admittance } Output short circuited to a.c.
y_{fb}, y_{fe}	Transfer admittance } Output short circuited to a.c.
g_{fb}, g_{fe}	Transfer conductance } Output short circuited to a.c.
C_{fb}, C_{fe}	Transfer capacitance } Output short circuited to a.c.
φ_{fb}, φ_{fe}	Phase angle of transfer admittance } Output short circuited to a.c.

7Z3 0348

Letter symbol	Definition	
y_{ob}, y_{oe}	Output admittance	Input short circuited to a.c.
g_{ob}, g_{oe}	Output conductance	
C_{ob}, C_{oe}	Output capacitance	
φ_{ob}, φ_{oe}	Phase angle of output admittance	
y_{rb}, y_{re}	Feedback admittance	Input short circuited to a.c.
g_{rb}, g_{re}	Feedback conductance	
C_{rb}, C_{re}	Feedback capacitance	
φ_{rb}, φ_{re}	Phase angle of feedback admittance	

7Z3 0349

LETTER SYMBOLS
FOR POWER DIODES AND THYRISTORS

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION.

QUANTITY SYMBOLS

1. Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

   Examples: i, v, p

2. Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

   Examples: I, V, P

SUBSCRIPTS FOR QUANTITY SYMBOLS

1. Total values are indicated by upper case subscripts.
2. Values of varying components are indicated by lower case subscripts.
3. For power rectifier diodes and thyristors the terminal(s) are <u>not</u> indicated in the subscripts, except for the gate-terminal of thyristors.
4. List of subscripts:

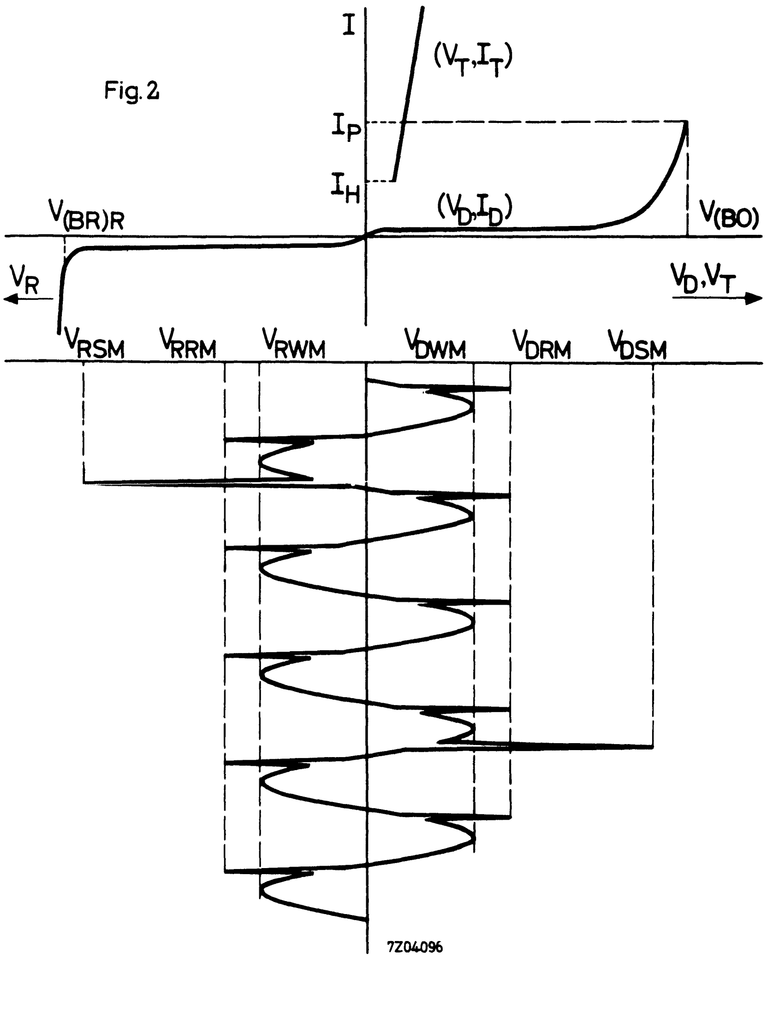
G, g	=	Gate terminal
F, f	=	Forward [1]
D, d	=	Forward off-state [1]; non trigger (gate voltage or current)
T, t	=	Forward on-state [1]; trigger (gate voltage or current)
R, r	=	As first subscript; Reverse As second subscript: Repetitive
AV, av	=	Average value
M, m	=	Maximum (peak or crest) value
(rms)	=	R.M.S. value
(BR)	=	Breakdown
(BO)	=	Breakover
H	=	Holding
P	=	Pick-up
Q	=	Turn off
S	=	As a second subscript: Non repetitive
W	=	Working

[1]) For the anode-cathode voltage of thyristors F is replaced either by D or by T, to distinguish between "off-state" (non triggered) and "on-state" (triggered).

7Z3 0350

5. Examples of the application of the rules.
   Fig. 2 represents a simplified thyristor characteristic together with an anode-cathode voltage as a function of time (no gate signal).

Fig. 2



7Z3 0351

LIST OF LETTER SYMBOLS IN ALPHABETICAL ORDER
for Rectifier Diodes (R) and Thyristors (T)

Instantaneous values (i, p, v) and a.c. components (lower case subscripts) have been omitted.

Letter symbol	R	T	Description
I_D	-	T	Off-state current (d.c.)
I_F	R	-	Forward current (d.c. or average)
I_{FAV}	R	-	Total average forward current (to distinguish between average and d.c. if necessary)
I_{FGM}	-	T	Forward peak gate current
I_{FRM}	R	-	Repetitive peak forward current
I_{FSM}	R	-	Non repetitive peak forward current
I_H	-	T	Holding current
I_{GT}	-	T	Gate current to trigger the device
I_P	-	T	Pick up current
I_R	R	T	Reverse current (d.c.)
I_{RG}	-	T	Reverse gate current
I_{RRM}	R	T	Repetitive peak reverse current
I_T	-	T	Forward on-state current (d.c.)
I_{TAV}	-	T	Average (forward) on-state current
$I_{T(rms)}$	-	T	R.M.S. value of the (forward) on-state current
I_{TRM}	-	T	Repetitive peak (forward) on-state current
I_{TSM}	-	T	Non repetitive peak (forward) on-state current
P_{GAV}	-	T	Average gate power dissipation
P_{GM}	-	T	Peak gate power dissipation
P_{RAV}	R	T	Average reverse power dissipation
P_{RRM}	R	T	Repetitive peak reverse power dissipation

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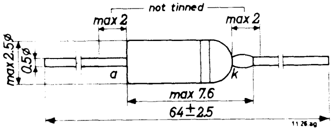
Letter symbol	R	T	Description
P_{RSM}	R	T	Non repetitive peak reverse power dissipation
$V_{(BO)}$	-	T	Breakover voltage
$V_{(BR)R}$	R	T	Reverse breakdown voltage
V_D	-	T	Continuous off-state voltage
V_{DRM}	-	T	Repetitive peak off-state voltage
V_{DSM}	-	T	Non repetitive peak off-state voltage
V_{DWM}	-	T	Crest working off-state voltage
V_F	R	-	Continuous forward voltage
V_{FGM}	-	T	Forward peak voltage, gate-cathode
V_{GD}	-	T	Gate-cathode voltage not to trigger the device
V_{GT}	-	T	Gate-cathode voltage to trigger the device
V_R	R	T	Continuous reverse voltage
V_{RGM}	-	T	Reverse peak voltage, gate-cathode
V_{RRM}	R	T	Repetitive peak reverse voltage
V_{RSM}	R	T	Non repetitive peak reverse voltage
V_{RWM}	R	T	Crest working reverse voltage
V_T	-	T	Continuous (forward) on-state voltage

7Z3 0353

Diodes

POINT-CONTACT GERMANIUM DIODE in miniature all-glass construction for use in A.M. detector and ratio detector circuits. Type 2-AA119 consists of 2 diodes AA119 selected for operation in a ratio detector circuit.
Dimensions in mm The white band indicates the cathode side



LIMITING VALUES (Absolute max. values)

		25 °C	60 °C
	T_{amb} =	25 °C	60 °C
Inverse voltage			
Average value (averaging time max. 50 msec)	$-V_D$ = max.	30 V	30 V
	(t_{av} = max.	50 msec	50 msec)
Peak value	$-V_{DM}$ = max.	45 V	45 V
Forward current			
Average value (averaging time max. 50 msec) (See page D)	I_D = max.	35 mA	15 mA
	(t_{av} = max.	50 msec	50 msec)
Peak value	I_{DM} = max.	100 mA	100 mA
Surge current (max. duration 1 sec)	I_{Dsurge} = max.	200 mA	200 mA
	(t = max.	1 sec	1 sec)

Temperatures

Storage temperature	T_s =	-55 °C to +75 °C
Operating ambient temperature	T_{amb} =	-55 °C to +60 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air K = max. 0.45 °C/mW

7Z2 3753 1.

CHARACTERISTICS at T_{amb} = 25 °C

Forward current (I_D)	Forward voltage (V_D) =	Forward voltage (V_D) max.
0.1 mA	= 0.23 V	< 0.30 V
1 mA	= 0.56 V	< 0.88 V
30 mA	= 2.8 V	< 4.0 V[1])

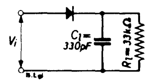
Inverse voltage ($-V_D$)	Reverse current ($-I_D$) =	Reverse current ($-I_D$) max.
1.5 V	= 0.8 µA	< 2.8 µA
10 V	= 4.5 µA	< 18 µA
30 V	= 35 µA	< 150 µA
45 V	= 90 µA	< 350 µA

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Forward current (I_D)	Forward voltage (V_D)			
	T_{amb} = 25 °C		T_{amb} = 60 °C	
	=	max.	=	max.
0.1 mA			= 0.16 V	< 0.25 V
1 mA			= 0.50 V	< 0.80 V
10 mA	= 1.5 V	< 2.2 V	= 1.4 V	< 2.1 V
30 mA[1])			= 2.6 V	< 3.8 V

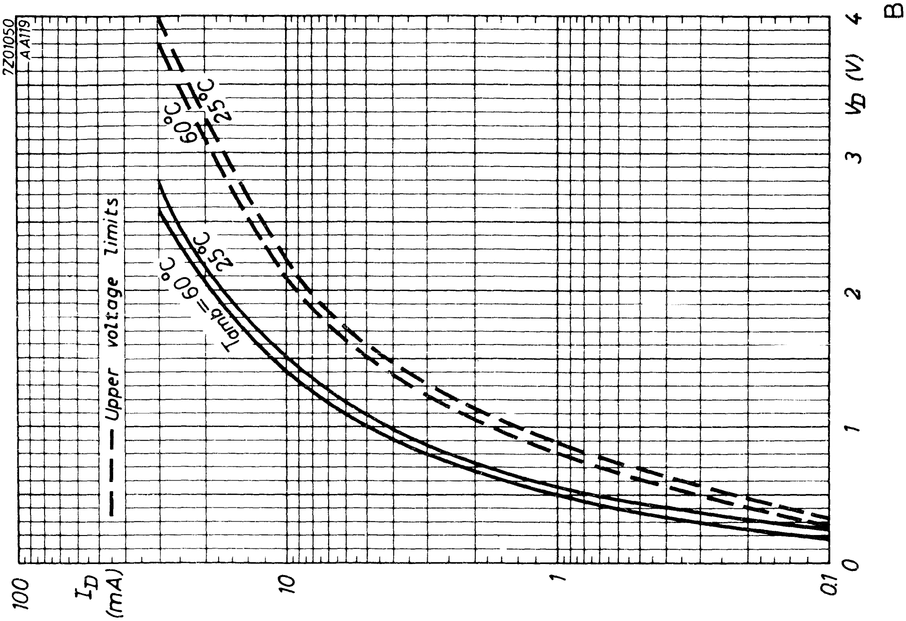
Inverse voltage ($-V_D$)	Reverse current ($-I_D$)			
	T_{amb} = 25 °C		T_{amb} = 60 °C	
	=	max.	=	max.
0.1 V	= 0.35 µA	< 1.0 µA	= 4.5 µA	< 12 µA
1.5 V			= 6 µA	< 25 µA
10 V			= 16 µA	< 60 µA
30 V			= 60 µA	< 300 µA
45 V			= 170 µA	< 500 µA

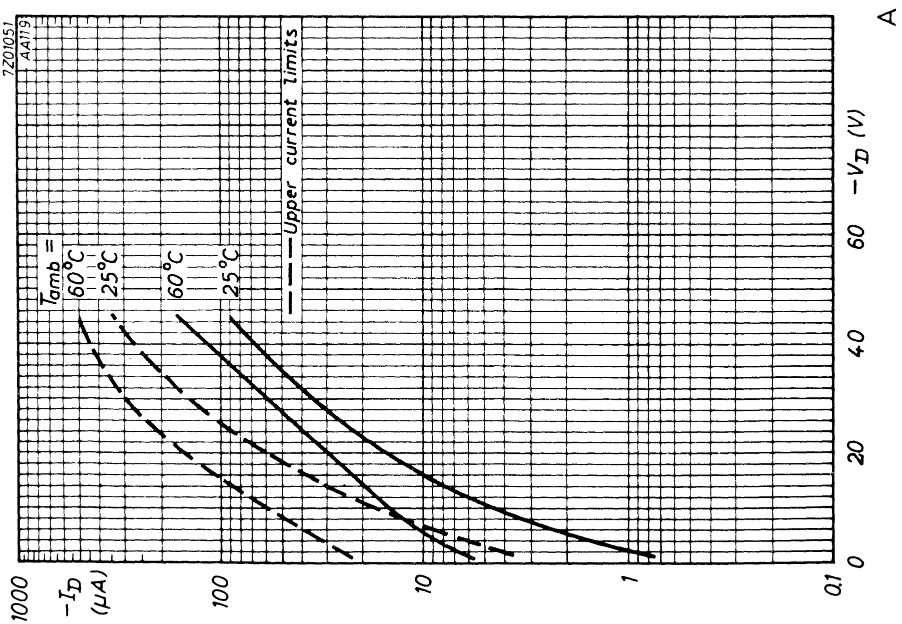
Input voltage V_1 = 3 Vrms
Frequency f = 10.7 Mc/s
Efficiency η = 85 %
Damping resistance r_d = 15 kΩ > 13.5 kΩ < 19 kΩ

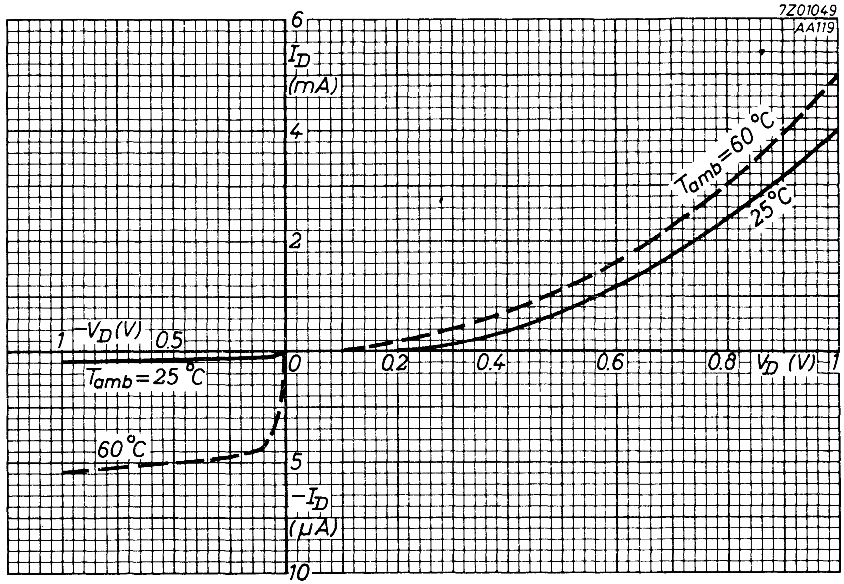


[1]) Measured with current pulses to prevent excessive dissipation

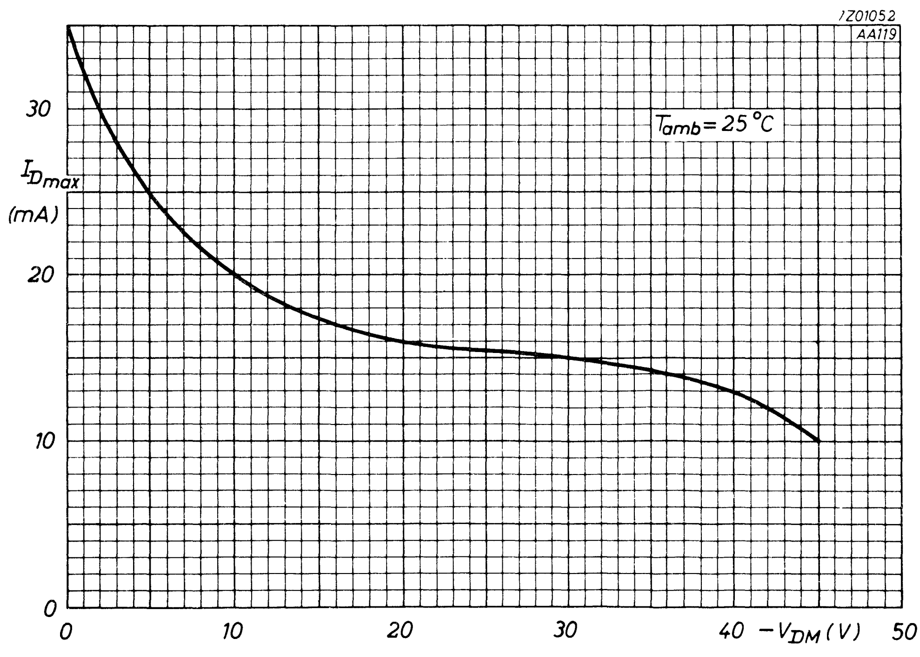
7Z2 1231 2.


7Z01050
AA119
Upper voltage limits
T_{amb} = 60 °C
25 °C
60 °C
25 °C
I_D (mA)
100
10
1
0.1
0
1
2
3
4
V_D (V)
B


7Z01051
AA119
Upper current limits
T_{amb} =
60 °C
25 °C
60 °C
25 °C
$-I_D$ (µA)
1000
100
10
1
0.1
0
20
40
60
$-V_D$ (V)
A


7Z01049
AA119
6
I_D
(mA)
4
2
1
$-V_D$(V)
0.5
T_{amb}=25 °C
T_{amb}=60 °C
25°C
60 °C
0
0.2
0.4
0.6
0.8
V_D (V)
1
5
$-I_D$
(μA)
10

C


7Z01052
AA119
30
I_{Dmax}
(mA)
20
10
0
T_{amb}= 25 °C
0
10
20
30
40
$-V_{DM}$ (V)
50

D

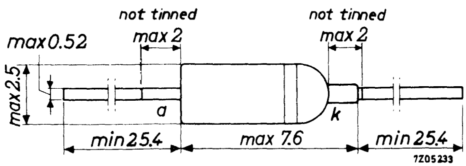
POINT CONTACT DIODE

Germanium point contact diode in a subminiature all glass DO-7 envelope primarily intended for computer applications.

QUICK REFERENCE DATA				
Repetitive peak reverse voltage	V_{RRM}	max.	90	V
Forward current (d.c.)	I_F	max.	35	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.4	°C/mW
Forward voltage at I_F = 5 mA; T_j = 25 °C	V_F	<	1.0	V
Reverse recovery current when switched from I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ measured at t_{rr} = 3.5 μs	I_R	<	90	μA

MECHANICAL DATA Dimensions in mm

DO-7



The red band indicates the cathode side

7Z3 0329

RATINGS (Limiting values) [1])

Voltages

Continuous reverse voltage	V_R	max.	60	V
Repetitive peak reverse voltage	V_{RRM}	max.	90	V

Currents

Forward current (d.c.)	I_F	max.	35	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	35	mA [2])
Repetitive peak forward current	I_{FRM}	max.	150	mA [2])
Non repetitive peak forward current	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}		−55 to +75	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 5 mA	V_F	typ.	0.72	V
		<	1.0	V
I_F = 30 mA	V_F	typ.	2.1	V
			1.5 to 3.0	V

Reverse current

V_R = 50 V	I_R	typ.	25	μA
		<	65	μA
V_R = 50 V; T_j = 60 °C	I_R	<	150	μA
V_R = 90 V	I_R	typ.	130	μA
		<	250	μA

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) For pulse operation see page A.

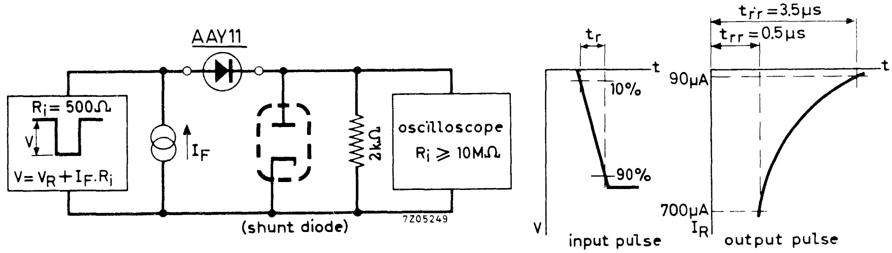
7Z3 0330

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

Reverse recovery current when switched from
I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ

measured at t_{rr} = 0.5 µs	I_R	typ.	200	µA
		<	700	µA
measured at t_{rr} = 3.5 µs	I_R	typ.	25	µA
		<	90	µA

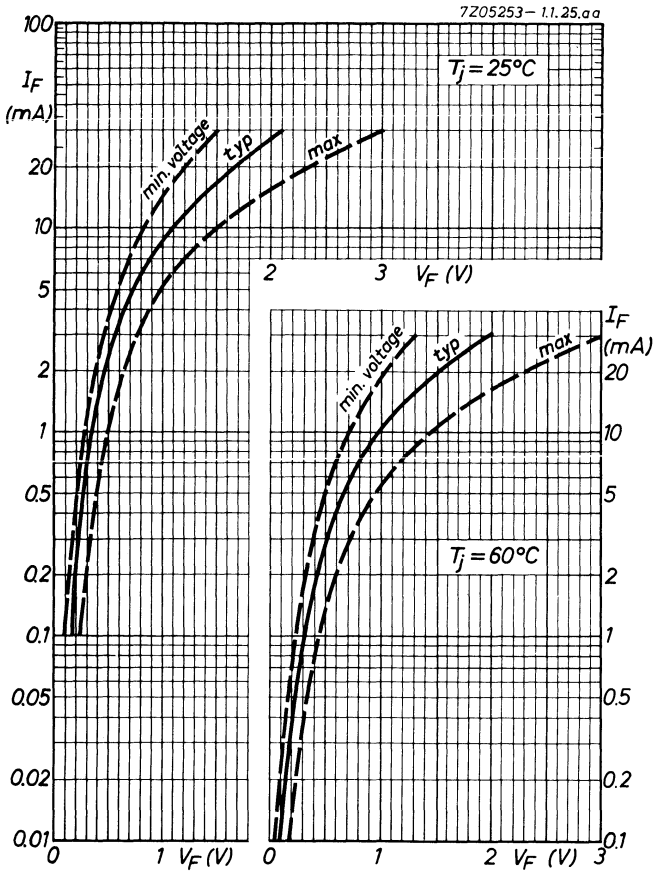
Test circuit

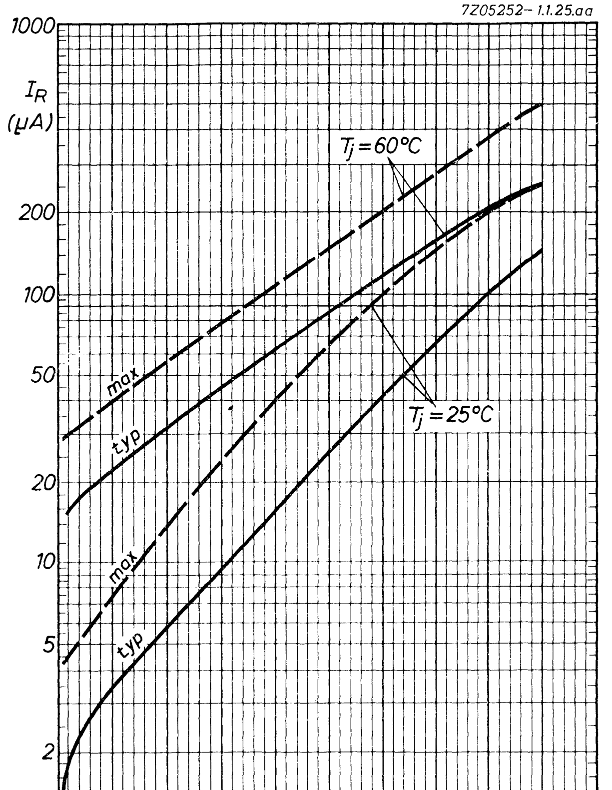


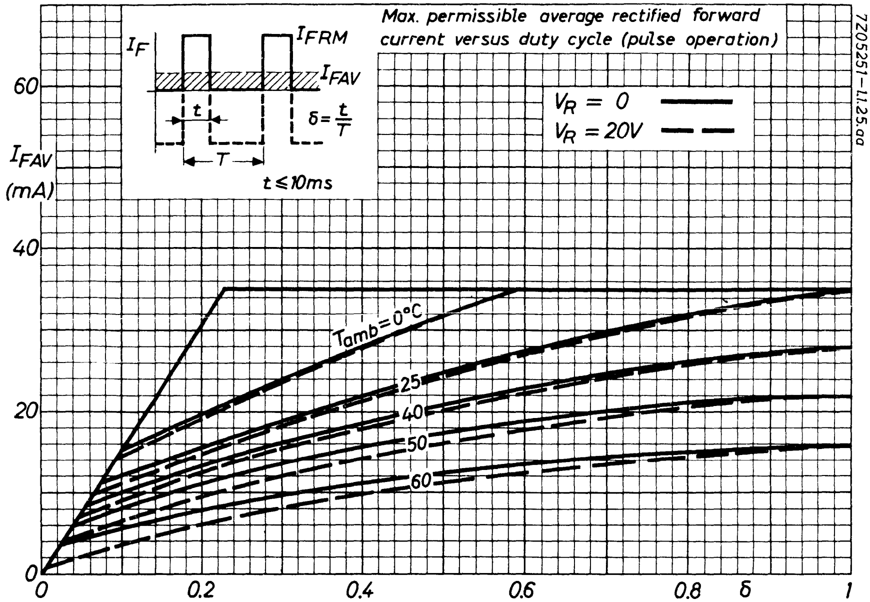
Reverse pulse:

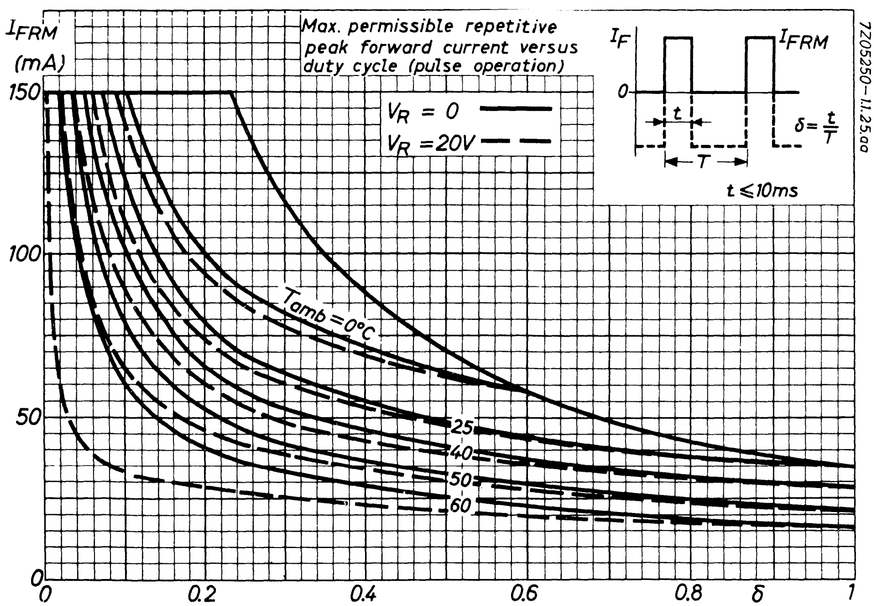
Rise time	t_r	≤	0.1	µs
Duty cycle	δ	=	0.5	
Frequency	f	=	50	kHz
Circuit capacitance	C	≤	30	pF (C = Oscilloscope + parasitical capacitance)

7Z3 0331


7Z05253– 1.1.25.aa
$T_j = 25°C$
I_F (mA)
100
20
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
min. voltage
typ
max
0
1
2
3
V_F (V)
$T_j = 60°C$
0.1
0.2
0.5
1
2
5
10
20


7Z05252– 1.1.25.aa
1000
I_R
(μA)
200
100
50
20
10
5
2
1
0
20
40
60
80
V_R (V)
100
$T_j = 60°C$
$T_j = 25°C$
max
typ
max
typ


Max. permissible average rectified forward current versus duty cycle (pulse operation)
7Z05251-1.1.25.aa
I_F
I_{FRM}
I_{FAV}
t
T
$\delta = \frac{t}{T}$
t ≤ 10ms
V_R = 0
V_R = 20V
I_{FAV} (mA)
60
40
20
0
T_{amb}=0°C
25
40
50
60
0
0.2
0.4
0.6
0.8
δ
1


Max. permissible repetitive peak forward current versus duty cycle (pulse operation)
7Z05250-1.1.25.aa
I_F
I_{FRM}
0
t
T
$\delta = \frac{t}{T}$
t ≤ 10ms
V_R = 0
V_R = 20V
I_{FRM} (mA)
150
100
50
0
T_{amb}=0°C
25
40
50
60
0
0.2
0.4
0.6
0.8
δ
1

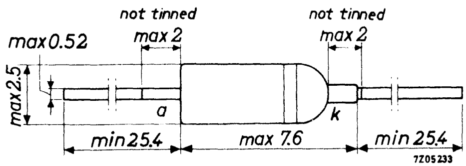
POINT CONTACT DIODE

Germanium point contact diode in a subminiature all glass DO-7 envelope primarily intended for computer applications.

QUICK REFERENCE DATA				
Forward current (d.c.)	I_F	max.	20	mA
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.75	$^oC/mW$
Forward voltage at I_F = 2 mA; T_j = 25 ^oC	V_F	0.25 to 0.45		V
Reverse recovery current when switched from I_F = 3 mA to V_R = 5 V; R_L = 0.5 kΩ measured at t_{rr} = 50 ns	I_R	<	0.5	mA

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

7Z3 0587

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	15	V

Currents

Forward current (d.c.)	I_F	max.	20	mA
Peak forward current	I_{FM}	max.	50	mA

Temperatures

Storage temperature	T_{stg}		-65 to +75	^oC
Junction temperature	T_j	max.	75	^oC
Operating ambient temperature	T_{amb}	max.	60	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.75	$^oC/mW$

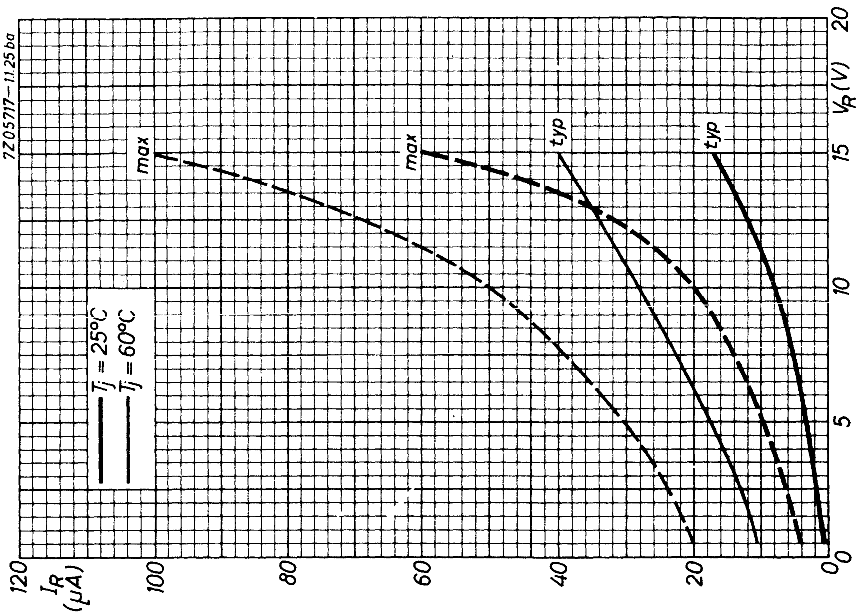
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

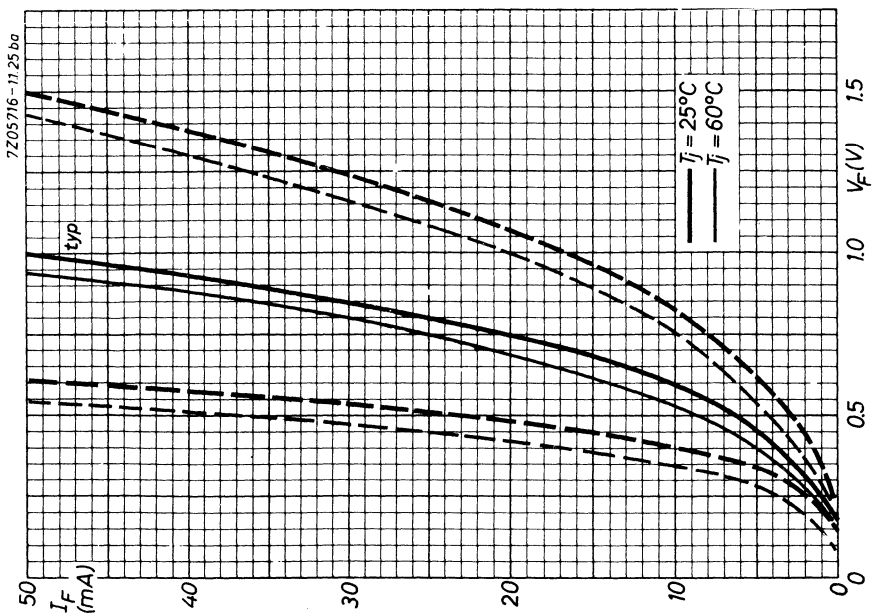
7Z3 0588

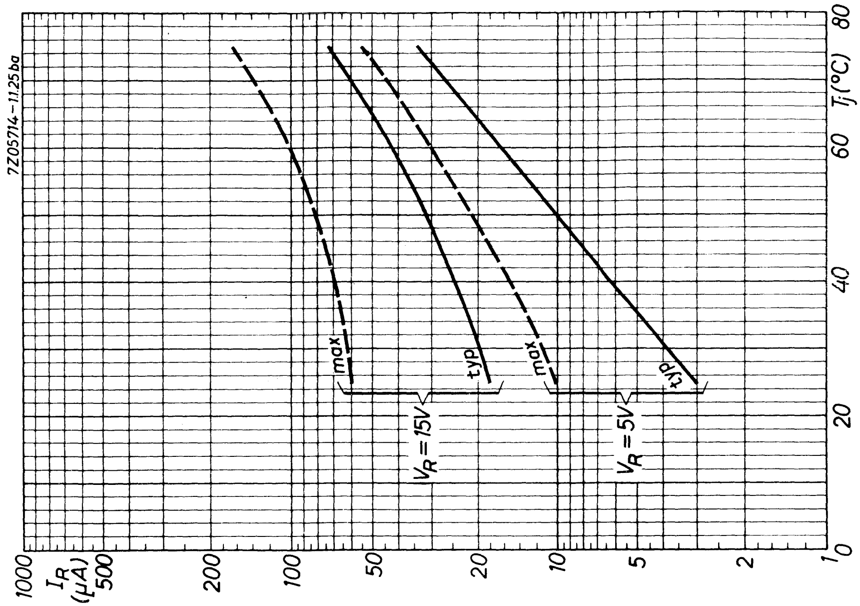
CHARACTERISTICS T_j = 25 °C unless otherwise specified

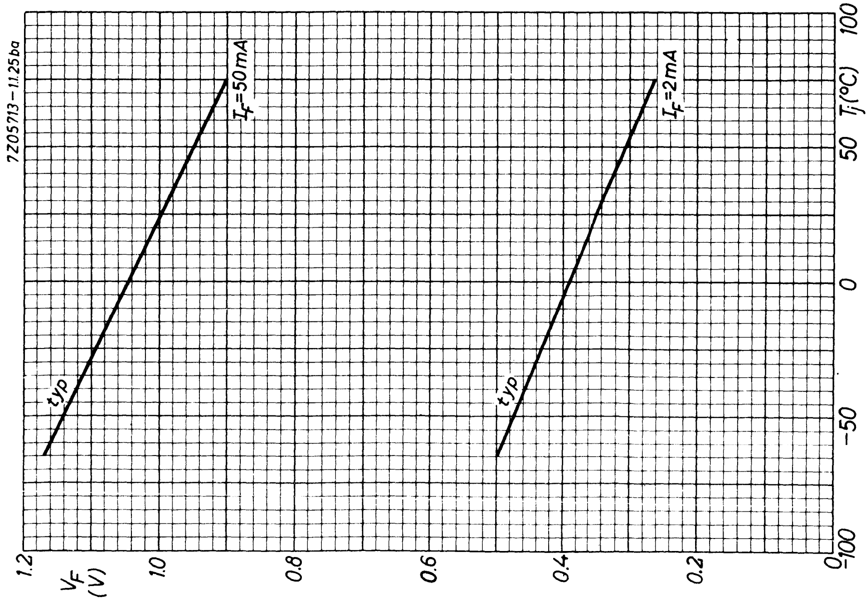
Forward voltage				
I_F = 2 mA	V_F	0.25 to 0.45		V
I_F = 2 mA; T_j = 60 °C	V_F	0.19 to 0.39		V
I_F = 10 mA	V_F	0.40 to 0.80		V
I_F = 10 mA; T_j = 60 °C	V_F	0.34 to 0.74		V
I_F = 50 mA	V_F	0.60 to 1.5		V
I_F = 50 mA; T_j = 60 °C	V_F	0.54 to 1.44		V
Reverse current				
V_R = 5 V; T_{amb} = 60 °C	I_R	<	30	μA
V_R = 5 V; T_{amb} = 25 °C	I_R	<	10	μA
V_R = 15 V; T_{amb} = 60 °C	I_R	<	100	μA
V_R = 15 V; T_{amb} = 25 °C	I_R	<	60	μA
Diode capacitance				
V_R = 1 V; f = 0.5 MHz	C_d	<	1.2	pF
Reverse recovery current when switched from				
I_F = 3 mA to V_R = 5 V; R_L = 0.5 kΩ				
measured at t_{rr} = 50 ns	I_R	<	0.5	mA
Reverse recovery time when switched from				
I_D = 3 mA to V_R = 1 V; R_L = 100 Ω				
measured at I_R = 1 mA	t_{rr}	typ.	5	ns
		<	12	ns

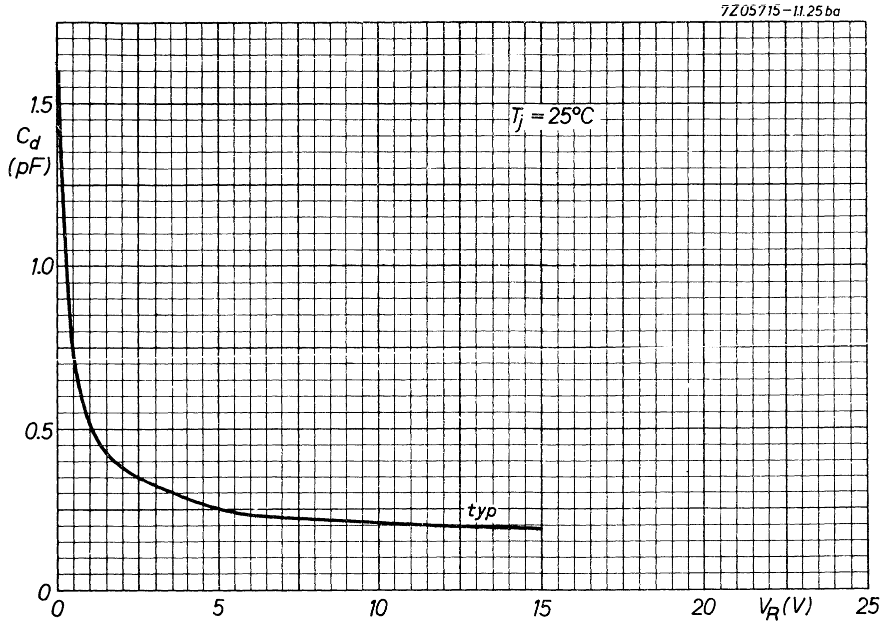
7Z3 0589


7Z05717-11.25 ba
max
max
typ
typ
T_j = 25°C
T_j = 60°C
V_R (V)
20
15
10
5
0
I_R (μA)
120
100
80
60
40
20
0


7Z05716-11.25 ba
typ
T_j = 25°C
T_j = 60°C
V_F (V)
1.5
1.0
0.5
0
I_F (mA)
50
40
30
20
10
0


7Z05714 - 1.1.25ba
I_R (μA)
1000
500
200
100
50
20
10
5
2
1
0
20
40
60
80
T_j (°C)
max
typ
max
typ
$V_R = 15V$
$V_R = 5V$


7Z05713 - 1.1.25ba
V_F (V)
1.2
1.0
0.8
0.6
0.4
0.2
0
-100
-50
0
50
100
T_j (°C)
typ
typ
I_F=50mA
I_F=2mA


7Z05715-1.1.25ba
1.5
C_d
(pF)
1.0
0.5
0
0
5
10
15
20
V_R (V)
25
T_j = 25°C
typ

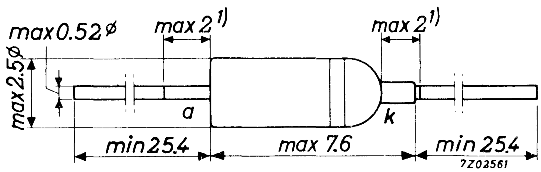
GOLD BONDED DIODES

Gold bonded germanium diodes in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA					
			AAY30	AAY32	
Continuous reverse voltage	V_R	max.	30	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	30	V
Forward current (d.c.)	I_F	max.	110	110	mA
Repetitive peak forward current	I_{FRM}	max.	400	150	mA
Junction temperature	T_j	max.	75	85	^oC
Forward voltage at I_F = 150 mA	V_F	<	1.0	1.0	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	500	150	pC

MECHANICAL DATA Dimensions in mm

DO-7



The red band indicates the cathode side

1) Not tinned

7Z3 0012

RATINGS (Limiting values) [1])

			AAY30	AAY32	
Voltages					
Continuous reverse voltage	V_R	max.	30	30	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	30	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	50	30	V
Currents					
Forward current (d.c.)	I_F	max.	110	110	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	110	110	mA
Repetitive peak forward current	I_{FRM}	max.	400	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	200	mA

Temperatures

Storage temperature	AAY30	T_{stg}	−65 to +75	°C
	AAY32	T_{stg}	−65 to +85	°C
Junction temperature	AAY30	T_j	max. 75	°C
	AAY32	T_j	max. 85	°C

THERMAL RESISTANCE

From junction to ambient in free air $R_{th\,j\text{-}a}$ = 0.45 °C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0013

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F = 0.1 mA	V_F	<	0.20	V
I_F = 1.0 mA	V_F	<	0.31	V
I_F = 10 mA	V_F	<	0.45	V
I_F = 30 mA	V_F	<	0.60	V
I_F = 150 mA	V_F	<	1.0	V

Forward voltage at T_j = 60 °C

I_F = 0.1 mA	V_F	<	0.14	V
I_F = 1.0 mA	V_F	<	0.26	V
I_F = 10 mA	V_F	<	0.41	V
I_F = 30 mA	V_F	<	0.57	V
I_F = 150 mA	V_F	<	0.99	V

			AAY30	AAY32	
Reverse current at T_j = 25 °C					
V_R = 1.5 V	I_R	<	9	2.5	μA
V_R = 10 V	I_R	<	15	8	μA
V_R = 20 V	I_R	<	25	25	μA
V_R = 25 V	I_R	<	35	35	μA
V_R = 30 V	I_R	<	50	70	μA
V_R = 50 V	I_R	<	200	-	μA
Reverse current at T_j = 60 °C					
V_R = 1.5 V	I_R	<	40	15	μA
V_R = 10 V	I_R	<	60	30	μA
V_R = 20 V	I_R	<	120	60	μA
V_R = 25 V	I_R	<	150	100	μA
V_R = 30 V	I_R	<	200	200	μA
V_R = 50 V	I_R	<	500	-	μA
Diode capacitance					
V_R = 1 V; f = 1 MHz	C_d	<	1.0	1.5	pF

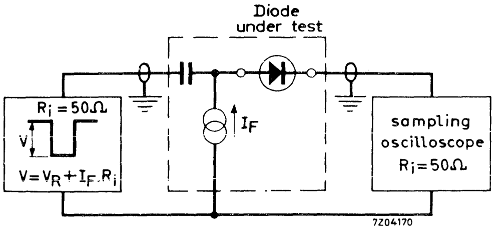
7Z3 0014

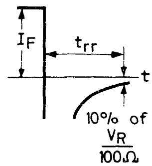
CHARACTERISTICS (continued) $T_j = 25\ ^oC$

Reverse recovery time when switched
from $I_F = 10$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$	AAY30	t_{rr}	<	150	ns
	AAY32	t_{rr}	<	50	ns

Test circuit:





output pulse

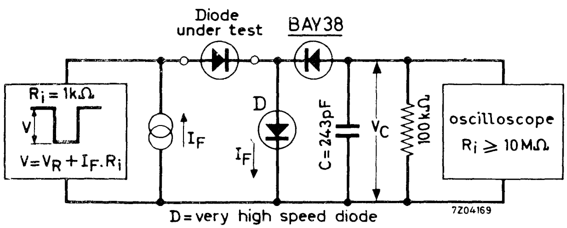
Reverse pulse:	Rise time	t_r =	0.6	ns
	Pulse duration	t_p =	100	ns
	Duty cycle	δ =	0.05	

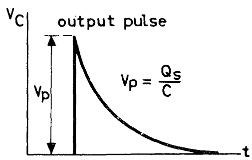
Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched
from $I_F = 10$ mA to $V_R = 10$ V; $R_L = 1$ kΩ

AAY30	Q_s	<	500	pC
AAY32	Q_s	<	150	pC

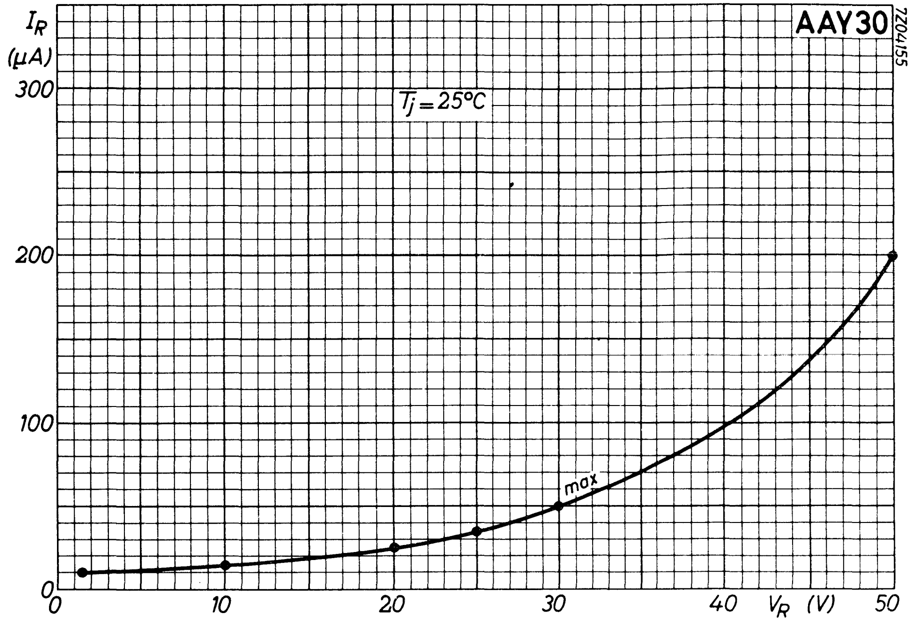
Test circuit:

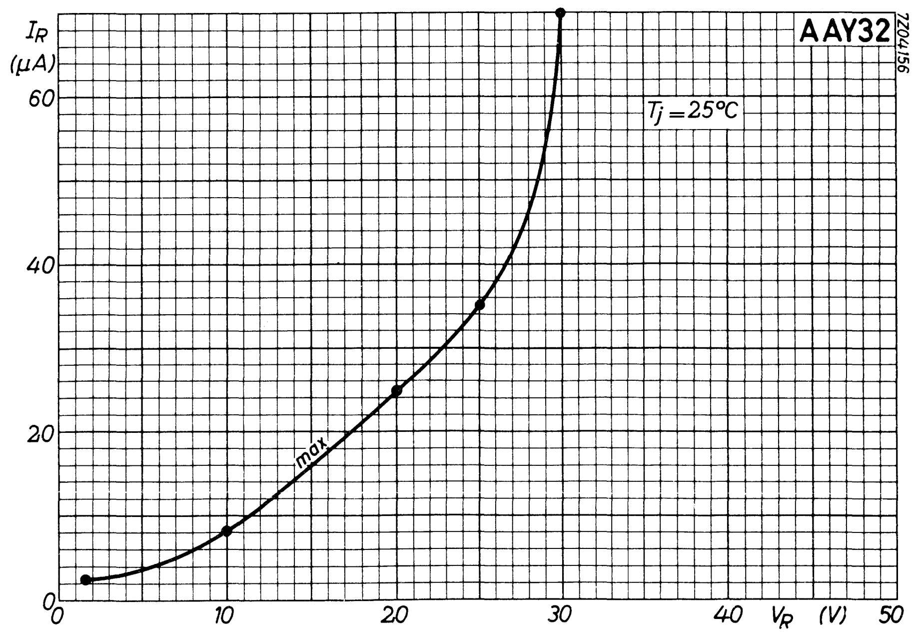


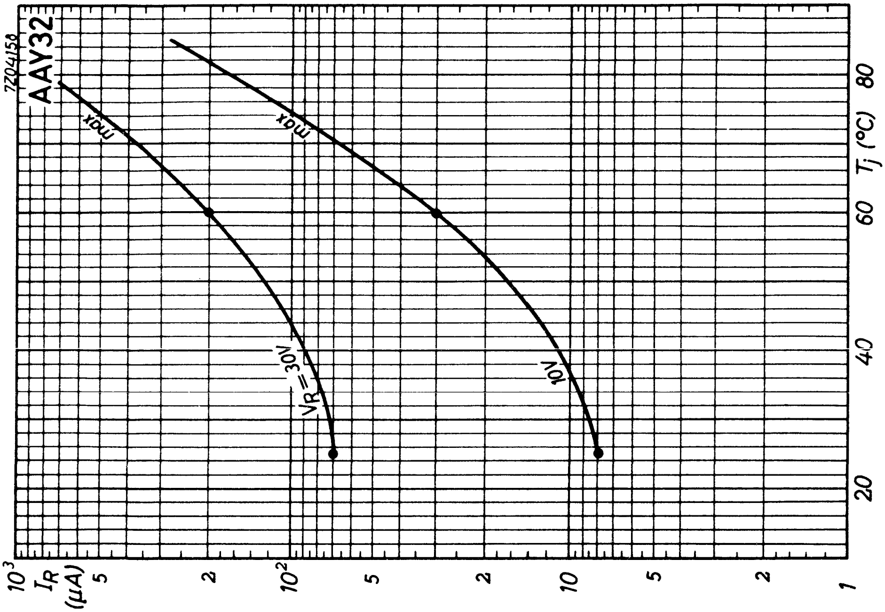


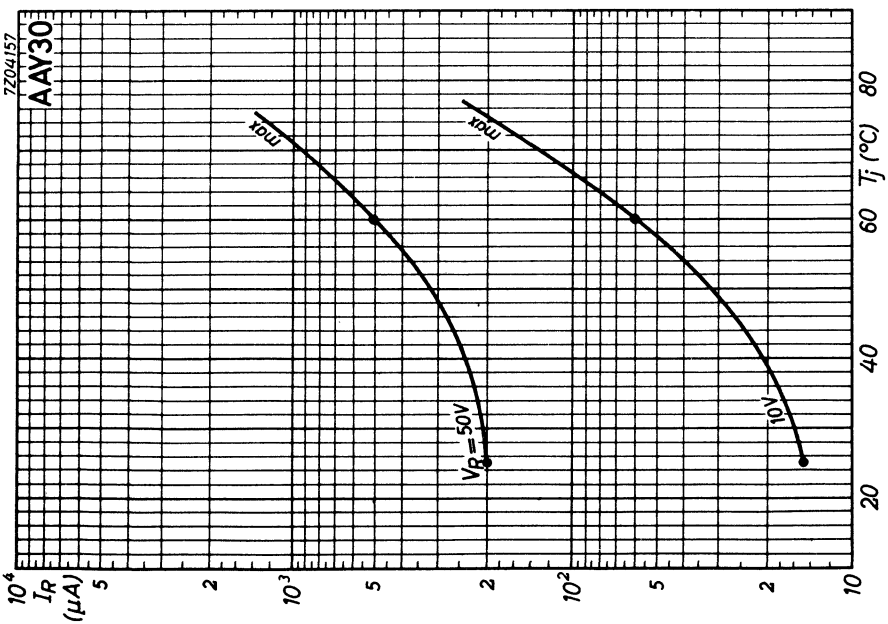
Reverse pulse:	Rise time	t_r =	2	ns
	Pulse duration	t_p =	0.4	μs
	Duty cycle	δ =	0.02	

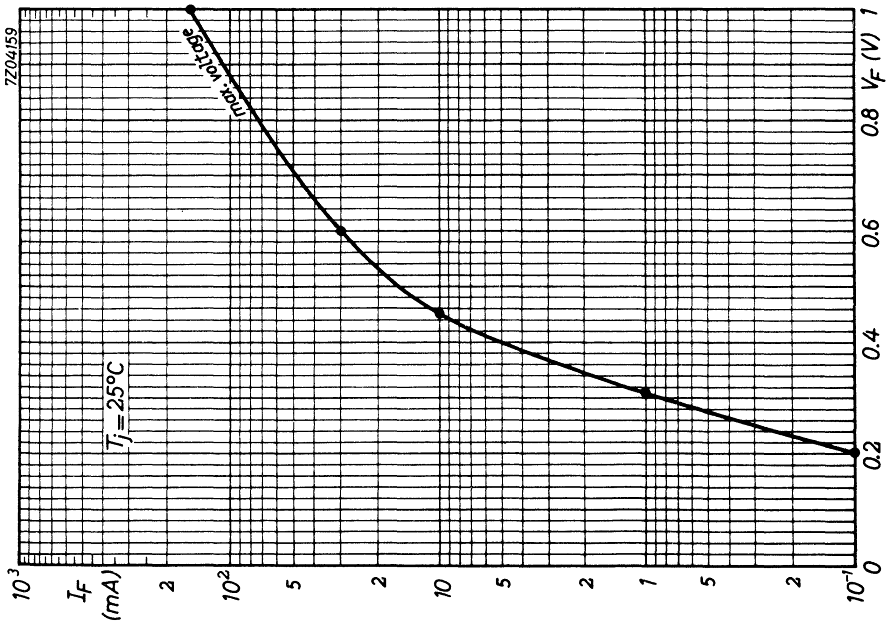
7Z3 0015

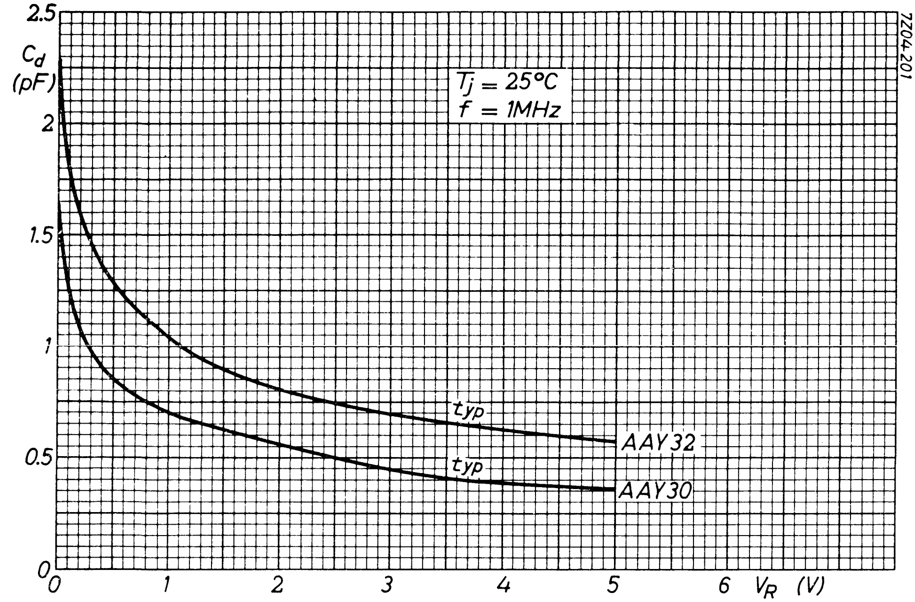

AAY30
7Z04155
I_R
(μA)
300
200
100
0
$T_j = 25°C$
max
0
10
20
30
40
V_R (V)
50

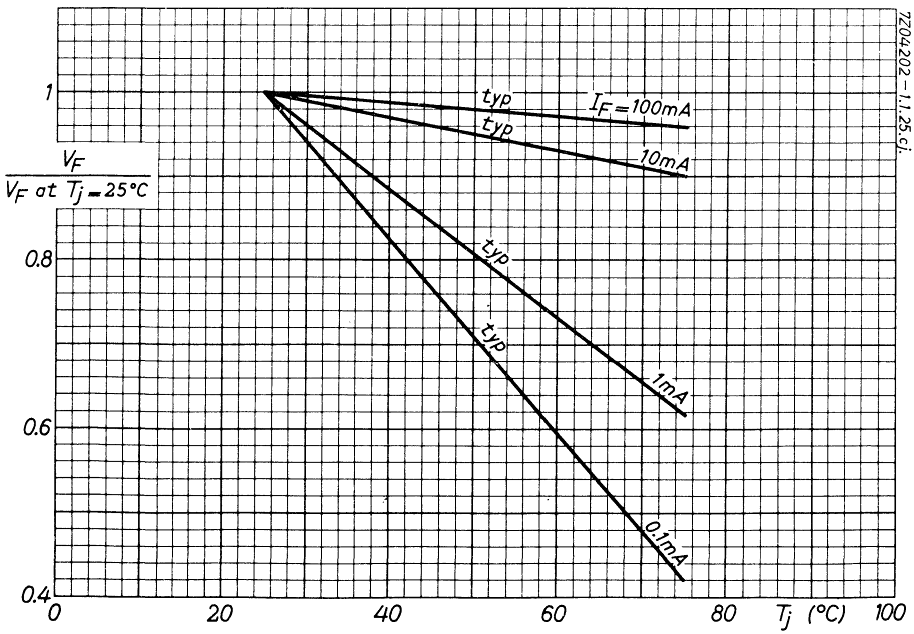

AAY32
7Z04156
I_R
(μA)
60
40
20
0
$T_j = 25°C$
max
0
10
20
30
40
V_R (V)
50

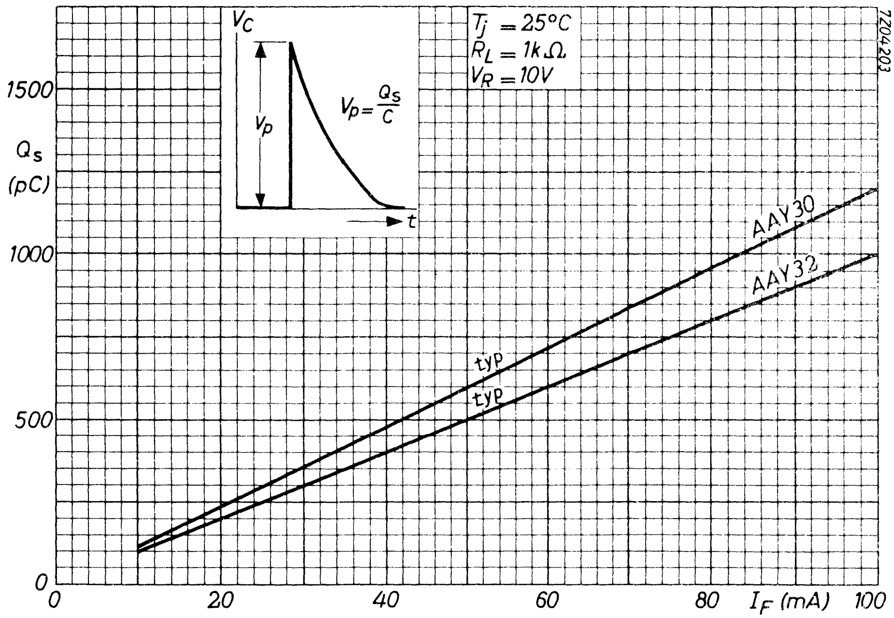

7Z04158
AAY32
max
max
$V_R = 30V$
10V
I_R (μA)
T_j (°C)

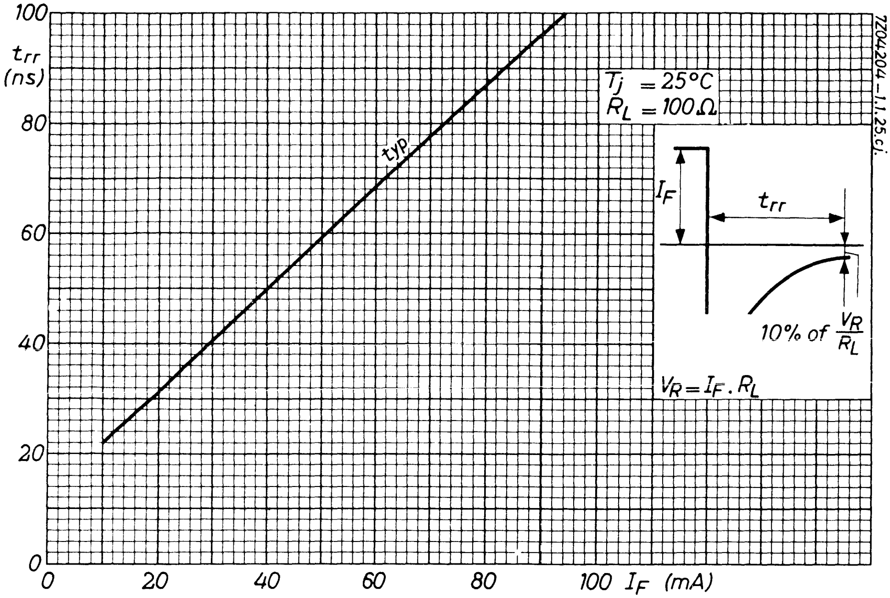

7Z04157
AAY30
max
max
$V_R = 50V$
10V
I_R (μA)
T_j (°C)

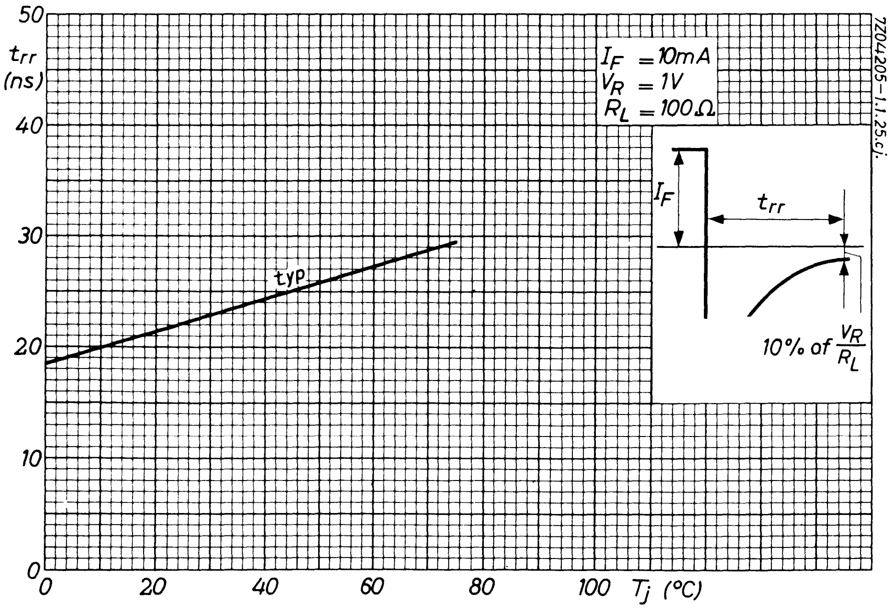

7Z04159
max. voltage
$T_j = 25°C$
I_F (mA)
10^3
2
10^2
5
2
10
5
2
1
5
2
10^{-1}
0
0.2
0.4
0.6
0.8
V_F (V) 1


7Z04 201
C_d (pF)
2.5
2
1.5
1
0.5
0
$T_j = 25°C$
$f = 1MHz$
typ
AAY32
typ
AAY30
0
1
2
3
4
5
6
V_R (V)


7Z04202 – 1.1.25.cj.
$\frac{V_F}{V_F \text{ at } T_j = 25°C}$
1
0.8
0.6
0.4
typ
$I_F = 100mA$
typ
10mA
typ
1mA
typ
0.1mA
0
20
40
60
80
T_j (°C)
100


7Z04203
V_C
V_p
$V_p = \frac{Q_s}{C}$
t
$T_j = 25°C$
$R_L = 1k\Omega$
$V_R = 10V$
1500
Q_s
(pC)
1000
500
0
0
20
40
60
80
I_F (mA)
100
AAY30
AAY32
typ
typ


100
t_{rr} (ns)
80
60
40
20
0
0
20
40
60
80
100 I_F (mA)
typ
T_j = 25°C
R_L = 100 Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F \cdot R_L$
7Z04204–1.1.25.cj.


50
t_{rr} (ns)
40
30
20
10
0
0
20
40
60
80
100 T_j (°C)
typ
I_F = 10mA
V_R = 1V
R_L = 100 Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
7Z04205–1.1.25.cj.

GERMANIUM JUNCTION DIODE FOR FAST SWITCHING APPLICATIONS

Germanium junction diode in all glass envelope for high current low hole storage applications

QUICK REFERENCE DATA

Max. reverse voltage	$-V_D$	= max.	30 V
Max. forward current	I_D	= max.	220 mA
Forward voltage at I_D = 200 mA (T_{amb} = 25 °C)	V_D	<	0.5 V
Recovered charge	Q_{rec}	<	200 pC
Thermal resistance	K	<	0.4 °C/mW

LIMITING VALUES (Absolute max. values)

Reverse voltage

	$-V_D$	= max.	30 V

Forward current

Continuous or averaged over any 50 msec period	I_D	= max.	220 mA
See also pag. D	(t_{av}	=	50 msec)
Repetitive peak (pulse duration 25 msec)	I_{DM}	= max.	1 A
	(t	=	25 msec)
At T_{amb} = 60 °C	I_{DM}	= max.	0.5 A
	(t	=	25 msec)
Surge (see also page E)	I_{Dsurge}	= max.	4 A

Temperatures

Junction temperature	T_j	= max.	75 °C
Storage temperature	T_s	=	−55 to +75 °C

7Z2 2246

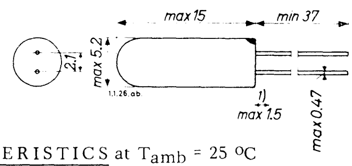
THERMAL DATA

Thermal resistance from junction to ambience K = max. 0.4 °C/mW

MECHANICAL DATA

Dimensions in mm

The red dot indicates the position of the cathode



CHARACTERISTICS at T_{amb} = 25 °C

Forward current (I_D)	Forward voltage (V_D)
0.3 mA	< 0.19 V
30 mA	< 0.33 V
100 mA	< 0.42 V

Inverse voltage ($-V_D$)	Reverse current ($-I_D$)
1.5 V	< 5 μA
10 V	< 10 μA
30 V	< 60 μA

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{amb} = 25 °C unless otherwise specified

Reverse currents See page C

Forward voltage

I_D = 1 A; T_j = 25 °C V_D = 0.7 V

Capacitance (measured with small signal)

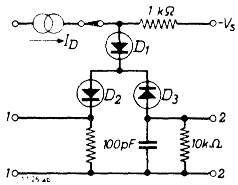
$-V_D$ = 3 V	c_D	=	7.3 pF	< 12 pF
V_D = 0 V	c_D	=	27 pF	

[1]) Not tinned

7Z2 2245

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN
(continued) T_{amb} = 25 °C

Recovered charge



I_D = 10 mA; $-V_S$ = 10 V

Fall time of I_D < 0.01 μsec

Q_{rec} = 150 pC < 200 pC

D_1 = diode under test
D_2 = low hole storage diode
D_3 = diode with low forward voltage drop

Terminals 1: forward current wave form
Terminals 2: measuring of recovered charge

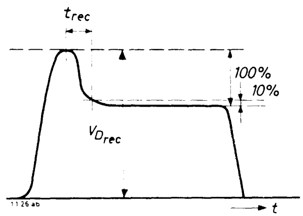
Recombination time

The recombination time is the time taken for the recovered charge in excess of that due to capacitance to fall to 10% of its peak value. Test circuit as for recovered charge but with delayed application of $-V_S$.

t_{recomb} = 0.05 μsec < 0.12 μsec

Forward recovery

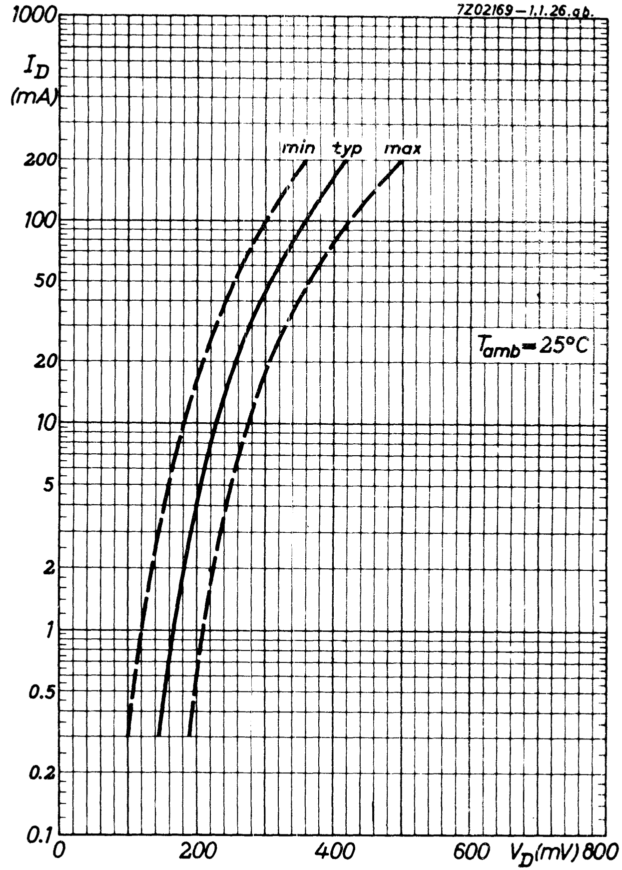
I_D = 400 mA; rise time of I_D = 0.04 μsec



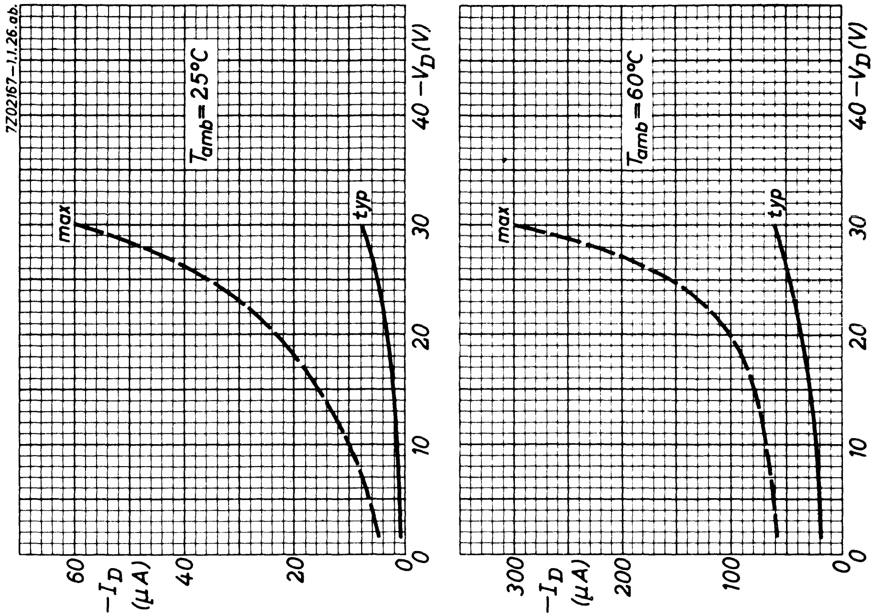
Forward recovery voltage V_{Drec} = 0.8 V < 2.0 V

Forward recovery time t_{rec} = 0.06 μsec

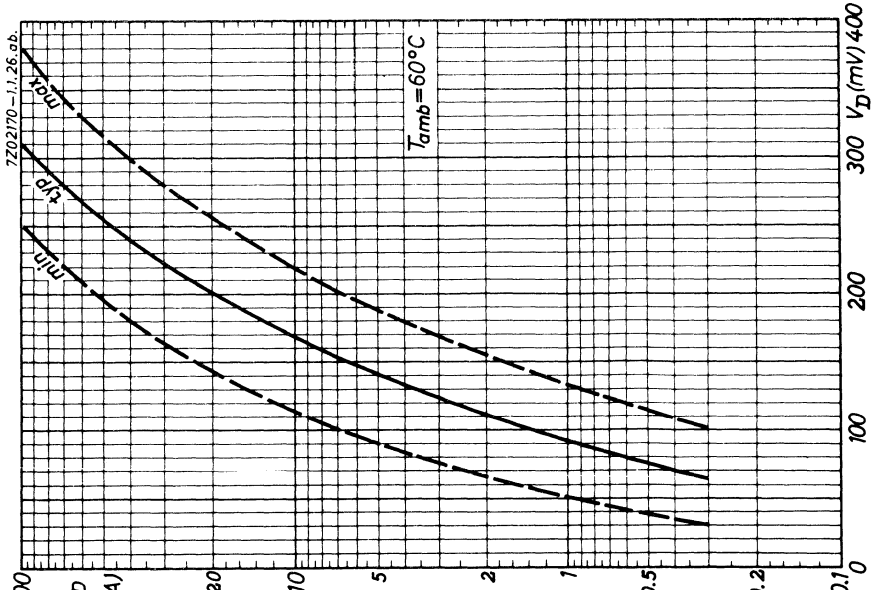
7Z2 2247



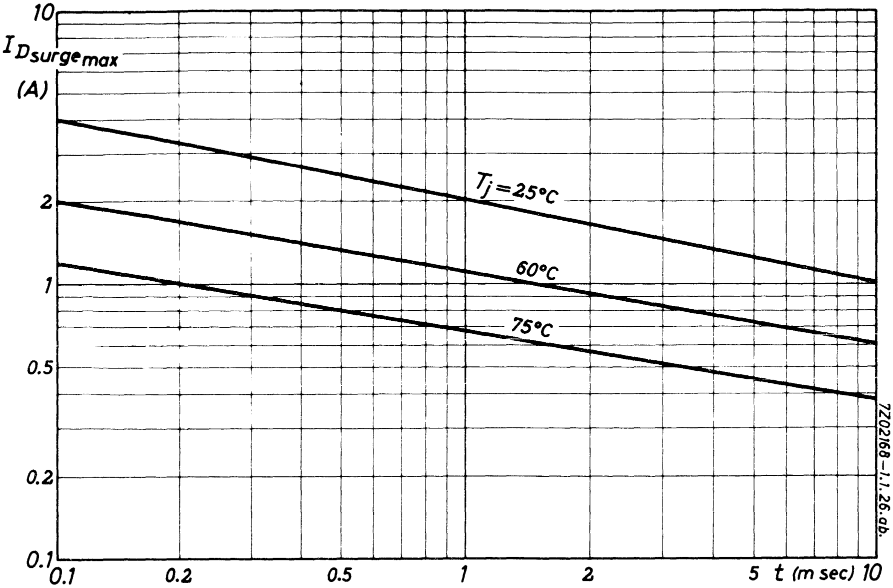
A


7Z02167–1.1.26.ab.
Tamb = 25°C
max
typ
−ID (μA)
40 −VD(V)
Tamb = 60°C
max
typ
−ID (μA)
40 −VD(V)

C

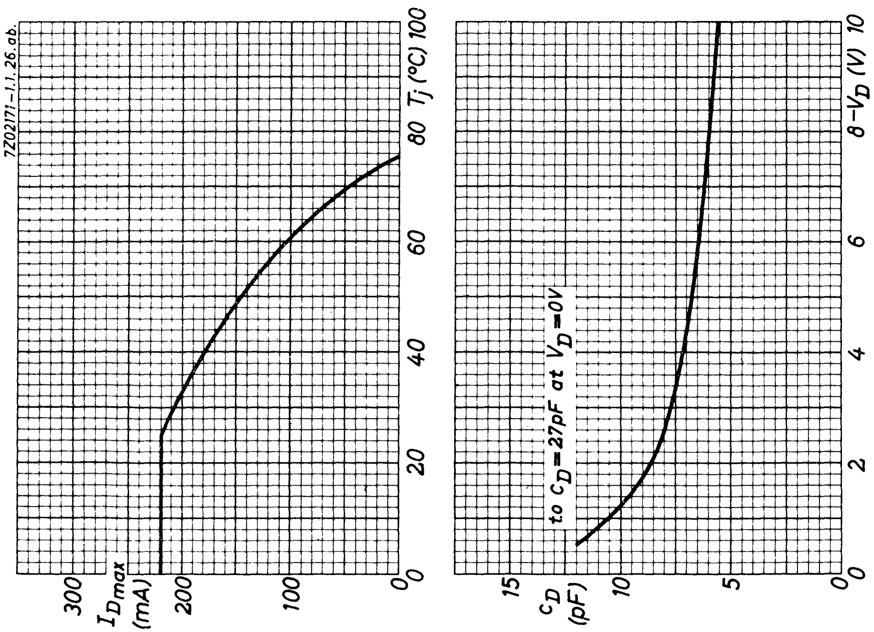

7Z02170–1.1.26.ab.
Tamb = 60°C
max
typ
min
ID (mA)
VD(mV)

B



10
$I_{D surge max}$
(A)
T_j = 25°C
60°C
75°C
2
1
0.5
0.2
0.1
0.1
0.2
0.5
1
2
5
t (m sec)
10
7Z02168–1.1.26.ab.

E



7Z02171–1.1.26.ab.
T_j (°C)
0
20
40
60
80
100
300
200
100
0
$I_{D max}$
(mA)
to C_D=27pF at V_D=0V
15
10
5
0
C_D
(pF)
0
2
4
6
8
10
$-V_D$ (V)

D

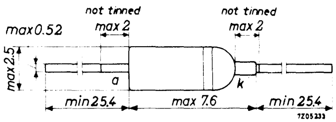
GOLD-BONDED GERMANIUM DIODE in miniature double-ended all-glass construction for use in high-speed switching applications

DIODE AU GERMANIUM À POINTE D'OR en construction miniature tout-verre à sorties bilatérales destinée aux applications de commutation à grande vitesse

GERMANIUM-GOLDDRAHTDIODE in Miniatur-Allglastechnik mit zweiseitig ausgeführten Anschlüssen zur Verwendung als Schalter grosser Geschwindigkeit

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc indique la position de la cathode
Der weisse Ring bezeichnet die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

T_{amb} =		25	60 °C
$-V_D$	= max.	8	8 V
I_D (t_{av} = max. 50 msec)	= max.	30	20 mA
I_{DM} (t = max. 5 msec)	= max.	100	50 mA
T_j	=	max. 75 °C	

Storage temperature
Température d'emmagasinage = -55 °C/+75 °C
Lagerungstemperatur

[1]) Not tinned; non étamé; nicht verzinnt

7Z2 0951 1.

Thermal data. Thermal resistance from junction to ambience in free air K ≦ 0.5 °C/mW
Données thermiques. Résistance thermique entre la jonction et l'ambiance à l'air libre K ≦ 0,5 °C/mW
Thermische Daten. Wärmewiderstand zwischen Kristall und Umgebung in freier Luft K ≦ 0,5 °C/mW

Characteristics range values for equipment design
Gammes de valeurs des caractéristiques pour l'étude d'équipements.
Kenndatenbereiche für Gerätentwurf

T_{amb} = 25 °C { unless otherwise specified / sauf indication différente / wenn nicht anders angegeben }

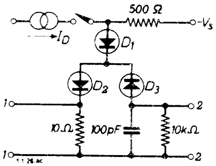
I_D = 1		mA	
V_D = 270	<	320 mV	
I_D = 10		mA	
V_D = 500	<	600 mV	
I_D = 30		mA	
V_D = 600	<	1000 mV	
$-V_D$ = 1		V	
c_{dk} = 3,3		pF[1])	
$-V_D$ = 3		V	
c_{dk} = 1,3	<	2,0 pF[1])	

$-V_D$ = 3		V	
$-I_D$ = 5	<	25 µA	
T_{amb} = 60		°C	
$-V_D$ = 3		V	
$-I_D$ = 30	<	85 µA	
$-\hat{V}_D$ = 8		V	
$-I_D$ = 30	<	150 µA	
T_{amb} = 60		°C	
$-V_D$ = 8		V	
$-I_D$ = 190		µA	

[1]) Capacitance with small signals
Capacité à faible signal
Kapazität bei kleiner Signalstärke

7Z2 0952 2.

Recovered charge
Récupération de charge
Freikommende Ladung



D_1 = diode under test
D_1 = diode à l'essai
D_1 = geprüfte Diode

D_2 = low hole storage diode
D_2 = diode à faible accumulation de lacunes
D_2 = Diode mit geringer Löcheraufspeicherung

D_3 = diode with low forward voltage drop
D_3 = diode à faible chute de tension en sens conducteur
D_3 = Diode mit niedrigem Spannungsabfall im Durchlasszustand

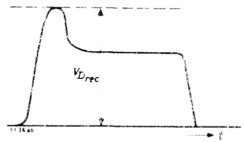
Terminals 1: forward current wave form
Bornes 1 : forme d'onde du courant en sens conducteur
Anschlussklemmen 1: Wellenform des Stromes in Durchlassrichtung

Terminals 2: measuring of recovered charge
Bornes 2 : mesure de la charge de récupération
Anschlussklemmen 2: Messung der freigekommenen Ladung

I_D	=	10		mA
Fall time of I_D Temps de descente de I_D Abfallzeit von I_D	<	0,005		μsec
$-V_S$	=	5		V
Q	=	20	< 30	pC

7Z2 0953

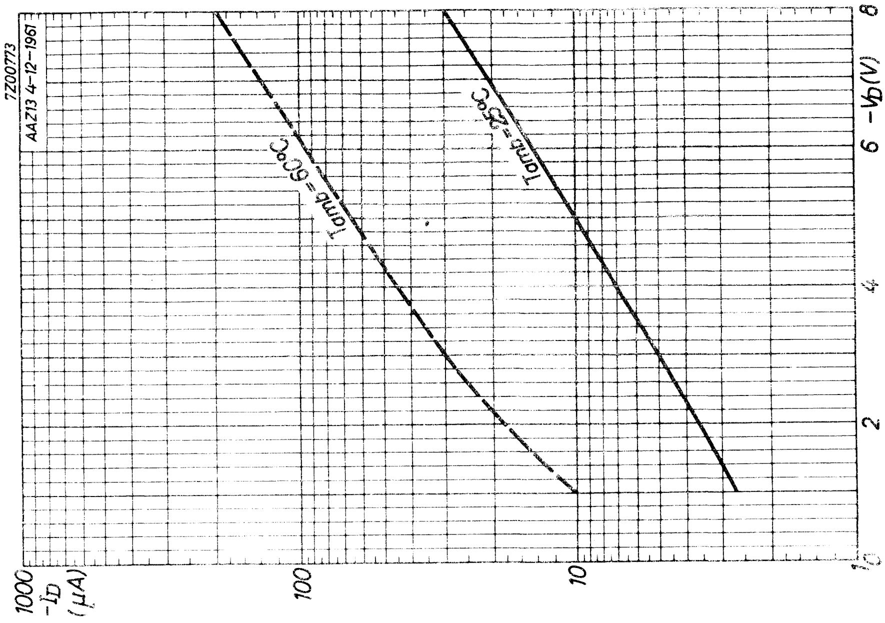
Forward recovery voltage
Tension de recouvrement en sens conducteur
Übergangsspannung in Durchlassrichtung



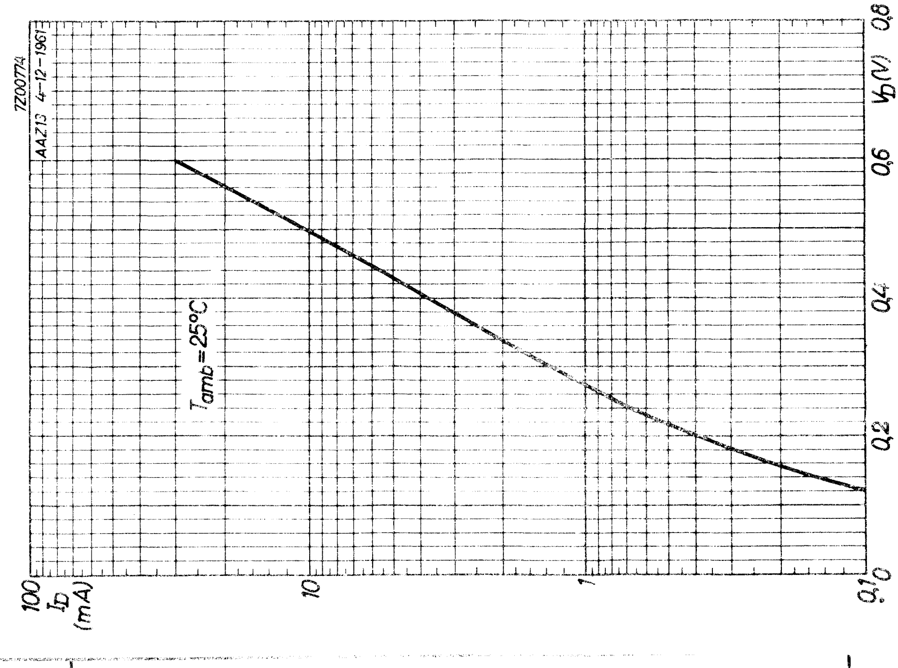
Measured at 10 mm from the seal
Mesuré à 10 mm du scellement
10 mm von der Einschmelzung gemessen

I_D	=	20		mA
Rise time of I_D Temps de montée de I_D Anstiegszeit von I_D	=	0,005		μsec
$V_{D\ rec}$	=	0,7	< 1,5	V

7Z2 0955


7Z00773
AAZ13 4-12-1961
1000
$-I_D$
(μA)
100
10
1
0
2
4
6
8
$-V_D$(V)
$T_{amb}=60°C$
$T_{amb}=25°C$

B


7Z00774
AAZ13 4-12-1961
100
I_D
(mA)
10
1
0,1
0
0,2
0,4
0,6
0,8
V_D(V)
$T_{amb}=25°C$

A

GOLD BONDED DIODES

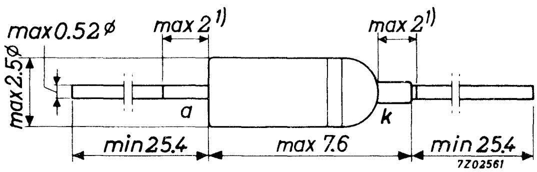
Gold bonded germanium diodes in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA

			AAZ15	AAZ17	
Continuous reverse voltage	V_R	max.	75	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	75	V
Forward current (d.c.)	I_F	max.	140	140	mA
Repetitive peak forward current	I_{FRM}	max.	250	250	mA
Junction temperature	T_j	max.	85	85	°C
Forward voltage at I_F = 250 mA	V_F	<	1.1	1.1	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	1800	900	pC

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

1) Not tinned

7Z3 0004

RATINGS (Limiting values) [1])

			AAZ15	AAZ17	
Voltages					
Continuous reverse voltage	V_R	max.	75	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	75	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	115	75	V

Currents				
Forward current (d.c.)	I_F	max.	140	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	140	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	500	mA
Temperatures				
Storage temperature	T_{stg}		−65 to +85	°C
Junction temperature	T_j	max.	85	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.45	°C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0005

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F = 0.1 mA	V_F	<	0.20	V
I_F = 10 mA	V_F	<	0.45	V
I_F = 250 mA	V_F	<	1.10	V

Forward voltage at T_j = 60 °C

I_F = 0.1 mA	V_F	<	0.15	V
I_F = 10 mA	V_F	<	0.40	V
I_F = 250 mA	V_F	<	1.07	V

			AAZ15	AAZ17	
Reverse current at T_j = 25 °C					
V_R = 1.5 V	I_R	<	2.5	2.5	μA
V_R = 10 V	I_R	<	4	15	μA
V_R = 50 V	I_R	<	15	150	μA
V_R = 75 V	I_R	<	25	300	μA
V_R = 100 V	I_R	<	100	–	μA
Reverse current at T_j = 60 °C					
V_R = 1.5 V	I_R	<	30	30	μA
V_R = 10 V	I_R	<	40	60	μA
V_R = 50 V	I_R	<	80	300	μA
V_R = 75 V	I_R	<	120	500	μA
V_R = 100 V	I_R	<	300	–	μA
Diode capacitance					
V_R = 1 V; f = 1 MHz	C_d	<	2	2	pF

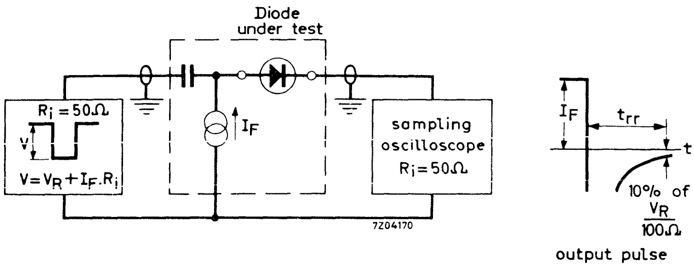
7Z3 0006

CHARACTERISTICS (continued) T_j = 25 °C

Reverse recovery time when switched
from I_F = 10 mA to V_R = 1 V; R_L = 100 Ω

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$	AAZ15	t_{rr}	typ.	350	ns
	AAZ17	t_{rr}	<	350	ns

Test circuit:



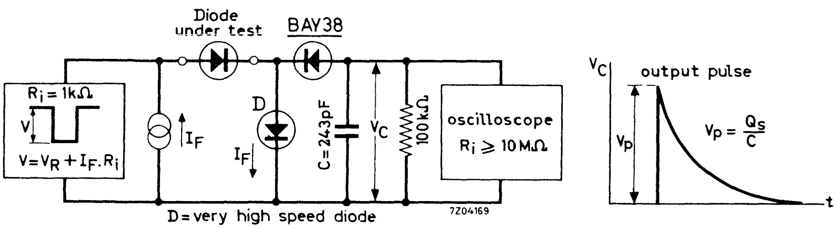
Reverse pulse: Rise time	t_r	=	0.6	ns
Pulse duration	t_p	=	100	ns
Duty cycle	δ	=	0.05	

Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched
from I_F = 10 mA to V_R = 10 V; R_L = 1 kΩ

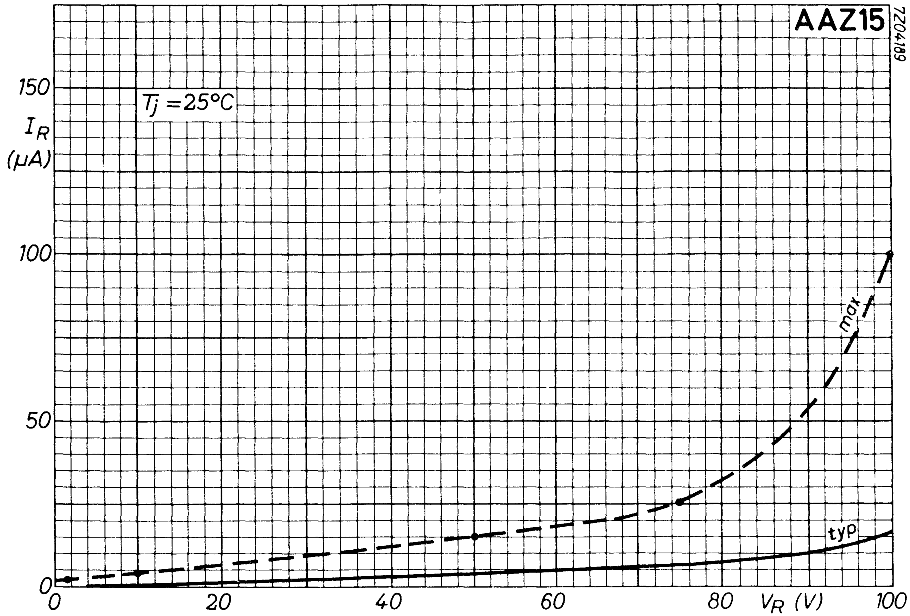
AAZ15	Q_s	<	1800	pC
AAZ17	Q_s	<	900	pC

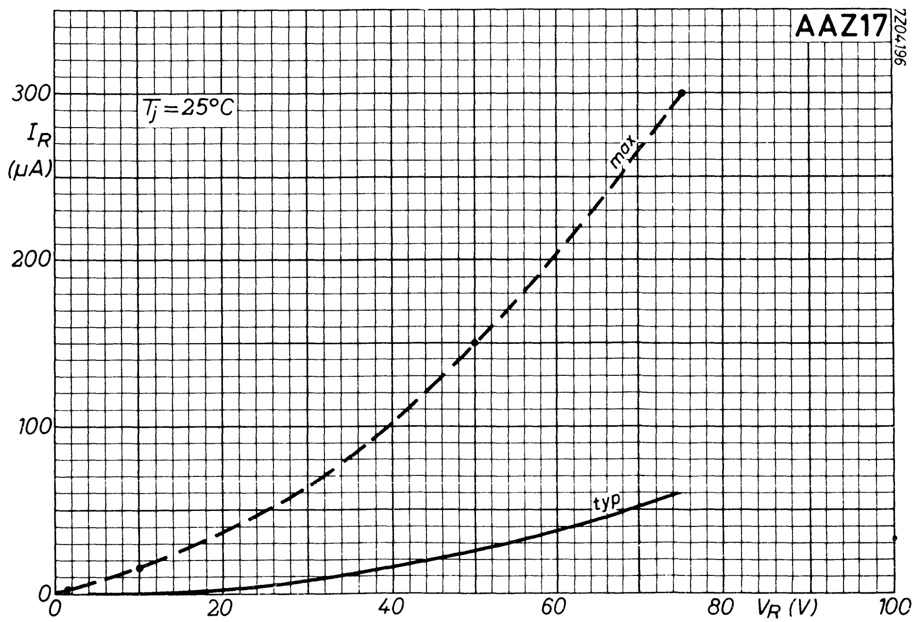
Test circuit:

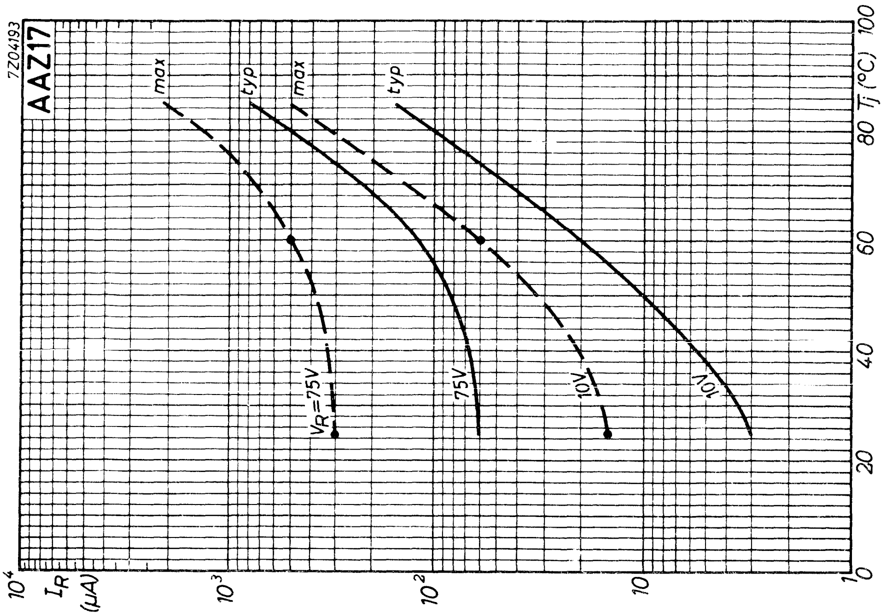


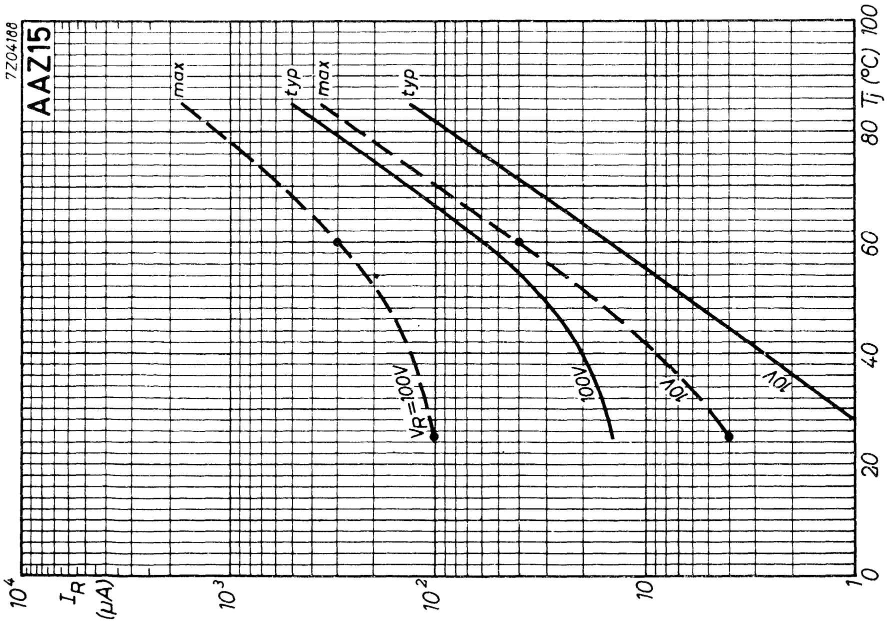
Reverse pulse: Rise time	t_r	=	2	ns
Pulse duration	t_p	=	0.4	μs
Duty cycle	δ	=	0.02	

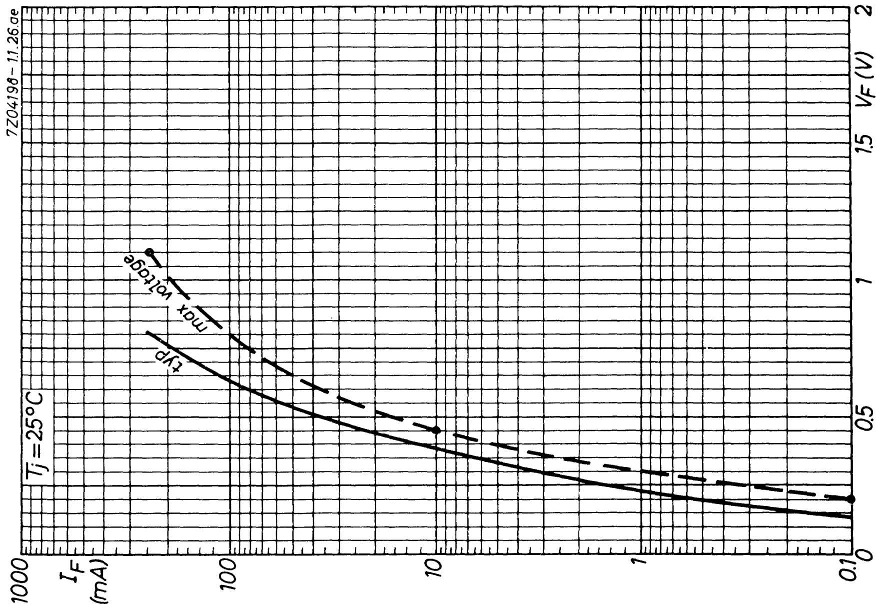
7Z3 0007

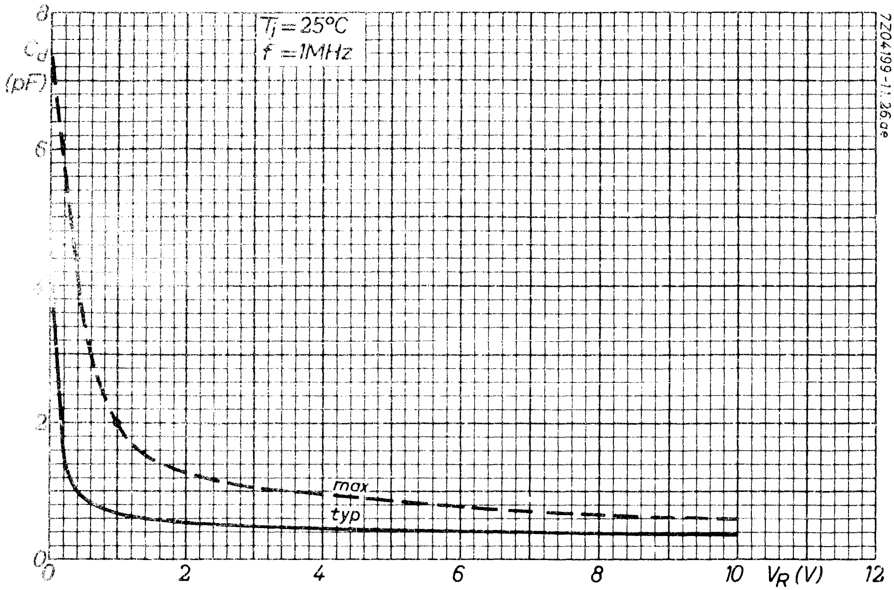

AAZ15
7Z04189
150
100
50
0
I_R
(μA)
$T_j = 25°C$
max
typ
0
20
40
60
80
V_R (V)
100

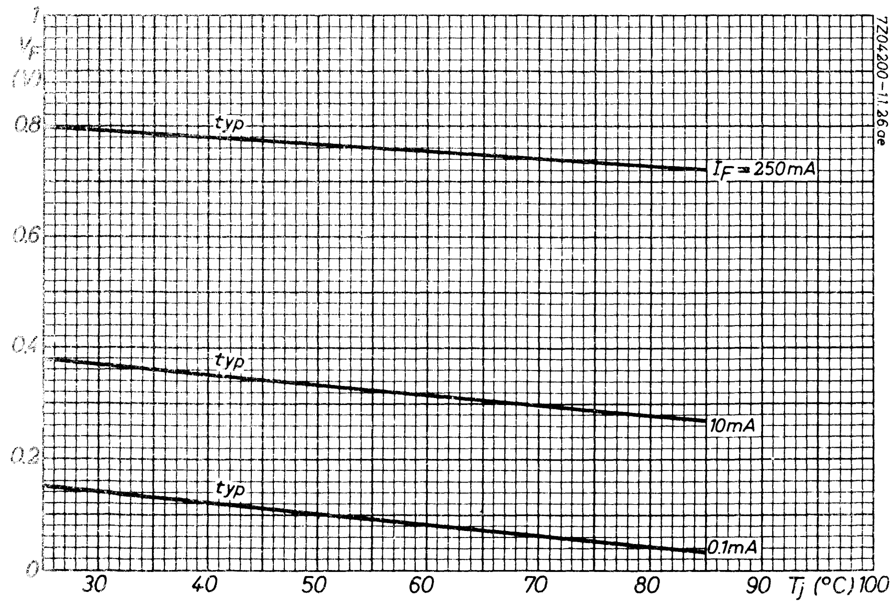

AAZ17
7Z04196
300
200
100
0
I_R
(μA)
$T_j = 25°C$
max
typ
0
20
40
60
80
V_R (V)
100

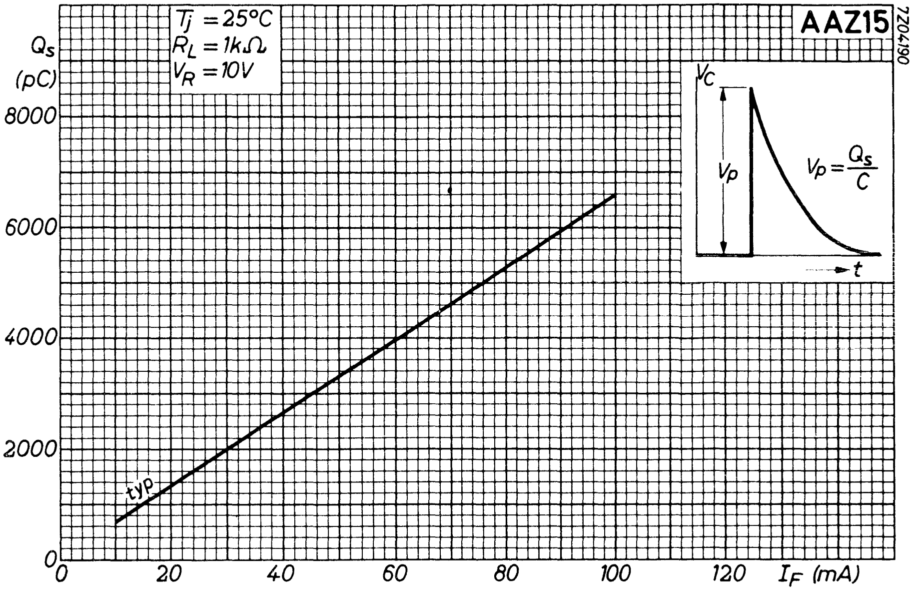

7Z04193
AAZ17
max
typ
max
typ
VR=75V
75V
10V
10V
10^4
IR
(μA)
10^3
10^2
10
1
0
20
40
60
80
100
Tj (°C)

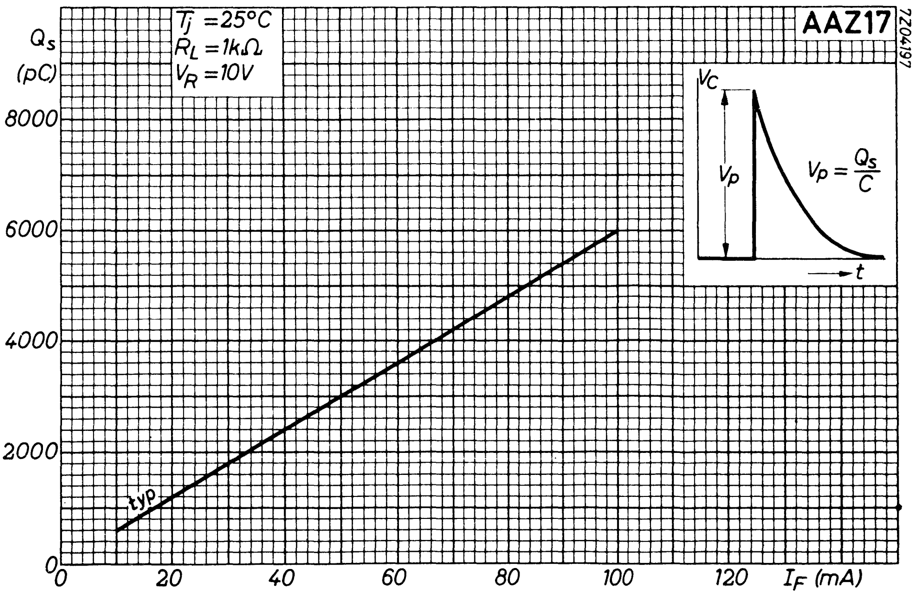

7Z04188
AAZ15
max
typ
max
typ
VR=100V
100V
10V
10V
10^4
IR
(μA)
10^3
10^2
10
1
0
20
40
60
80
100
Tj (°C)

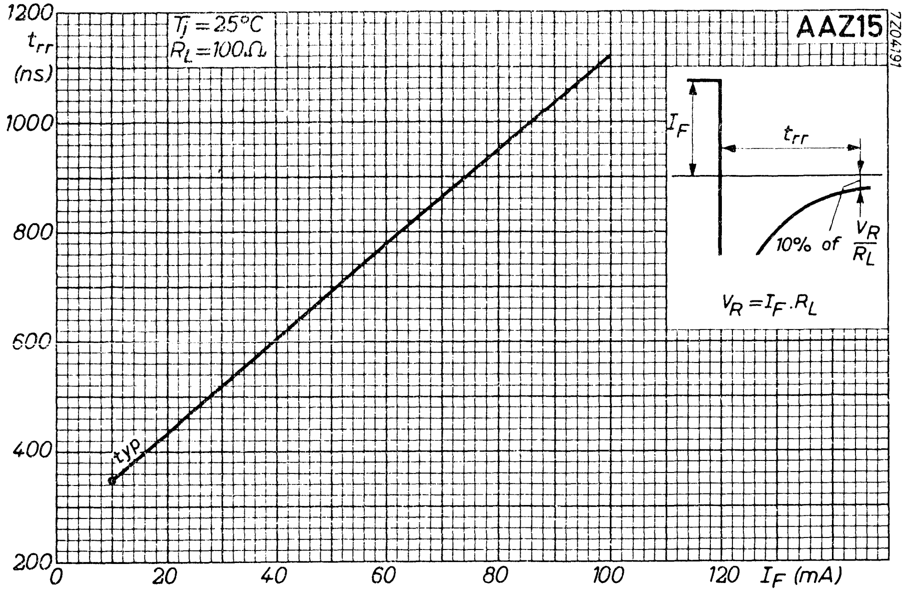

7Z04198-1.1.26.ae
T_j = 25°C
max voltage
typ
I_F (mA)
1000
100
10
1
0.1
V_F (V)
0
0.5
1
1.5
2

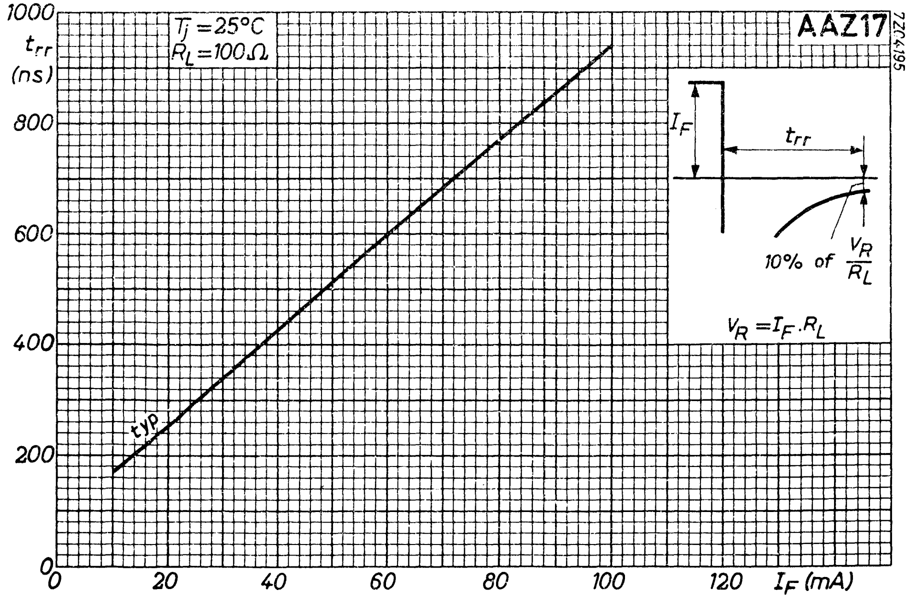

7Z04199-11.26ae
$T_j = 25°C$
f = 1MHz
C_d (pF)
max
typ
V_R (V)
0
2
4
6
8
10
12

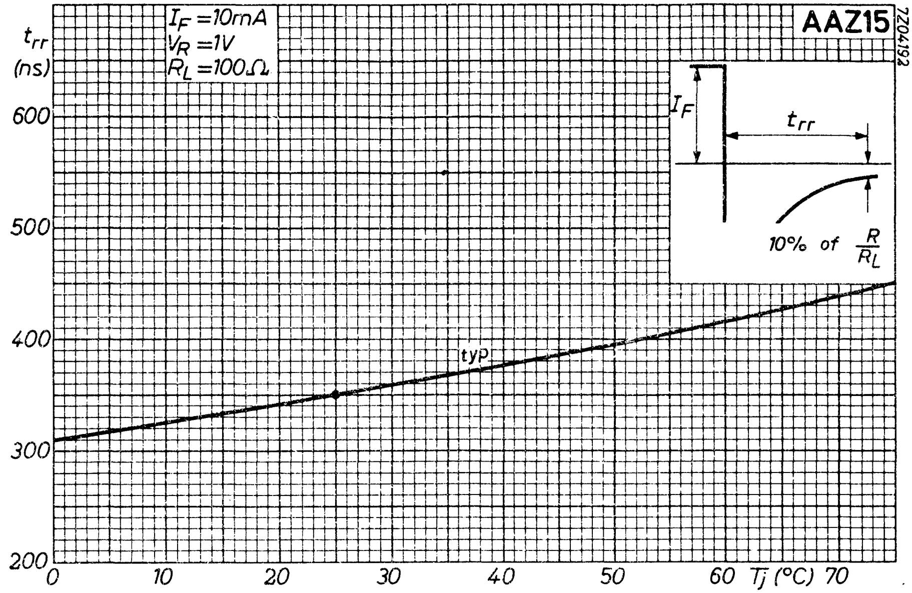

7Z04200-11.26ae
V_F (V)
typ
I_F = 250mA
10mA
0.1mA
T_j (°C)
0
0.2
0.4
0.6
0.8
1
30
40
50
60
70
80
90
100

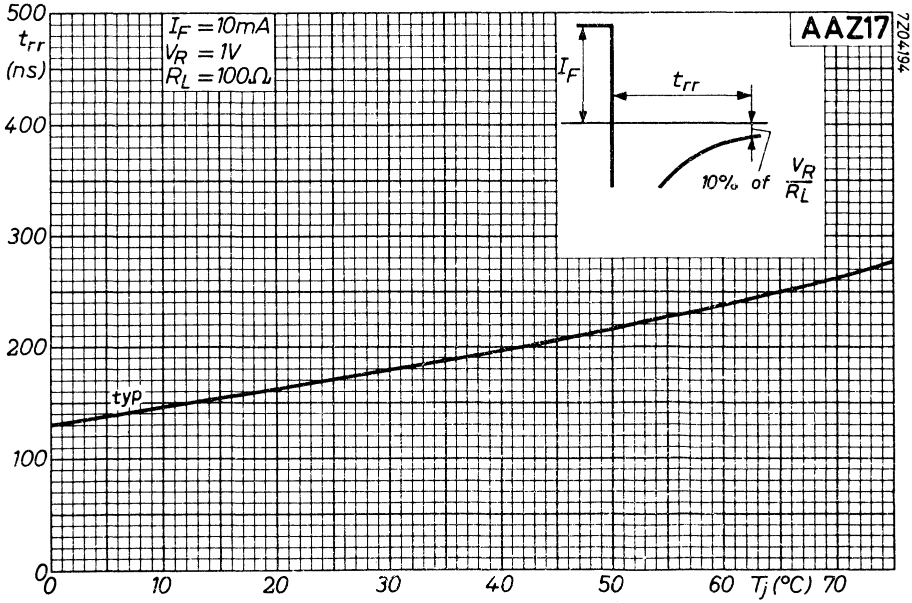

AAZ15
7Z04190
T_j = 25°C
R_L = 1kΩ
V_R = 10V
Q_s
(pC)
8000
6000
4000
2000
0
0
20
40
60
80
100
120
I_F (mA)
typ
V_C
V_p
$V_p = \frac{Q_s}{C}$
t


AAZ17
7Z04197
T_j = 25°C
R_L = 1kΩ
V_R = 10V
Q_s
(pC)
8000
6000
4000
2000
0
0
20
40
60
80
100
120
I_F (mA)
typ
V_C
V_p
$V_p = \frac{Q_s}{C}$
t


1200
t_{rr}
(ns)
1000
800
600
400
200
0
20
40
60
80
100
120
I_F (mA)
$T_j = 25°C$
$R_L = 100 \Omega$
AAZ15
7Z04191
typ
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$


1000
t_{rr}
(ns)
800
600
400
200
0
0
20
40
60
80
100
120
I_F (mA)
$T_j = 25°C$
$R_L = 100 \Omega$
AAZ17
7Z04195
typ
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$


I_F = 10mA
V_R = 1V
R_L = 100Ω
AAZ15
7Z04192
t_{rr} (ns)
600
500
400
300
200
I_F
t_{rr}
10% of R/R_L
typ
0
10
20
30
40
50
60
T_j (°C)
70


I_F = 10mA
V_R = 1V
R_L = 100Ω
AAZ17
7Z04194
500
t_{rr} (ns)
400
300
200
100
0
I_F
t_{rr}
10% of V_R/R_L
typ
0
10
20
30
40
50
60
T_j (°C)
70

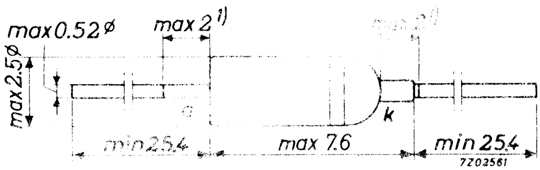
GOLD BONDED DIODE

Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	20	V
Forward current (d.c.)	I_F	max.	180	mA
Repetitive peak forward current	I_{FRM}	max	300	mA
Junction temperature	T_j	max.	75	°C
Forward voltage at I_F = 300 mA	V_F	<	0.78	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	200	pC

MECHANICAL DATA Dimensions in mm

DO-7



The red band indicates the cathode side

1) Not tinned

7Z3 0008

RATINGS (Limiting values) [1])

Voltages

Continuous reverse voltage	V_R	max.	20	V
Repetitive peak reverse voltage	V_{RRM}	max.	20	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	30	V

Currents

Forward current (d.c.)	I_F	max.	180	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	180	mA
Repetitive peak forward current	I_{FRM}	max.	300	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	400	mA

Temperatures

Storage temperature	T_{stg}		-65 to +75	^oC
Junction temperature	T_j	max.	75	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	0.45	$^oC/mW$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0009

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F = 0.1 mA	V_F < 0.20 V
I_F = 1.0 mA	V_F < 0.30 V
I_F = 10 mA	V_F < 0.41 V
I_F = 30 mA	V_F < 0.49 V
I_F = 150 mA	V_F < 0.65 V
I_F = 300 mA	V_F < 0.78 V

Forward voltage at T_j = 60 °C

I_F = 0.1 mA	V_F < 0.14 V
I_F = 1.0 mA	V_F < 0.25 V
I_F = 10 mA	V_F < 0.36 V
I_F = 30 mA	V_F < 0.45 V
I_F = 150 mA	V_F < 0.62 V
I_F = 300 mA	V_F < 0.76 V

Reverse current at T_j = 25 °C

V_R = 1.5 V	I_R < 3.5 μA
V_R = 10 V	I_R < 15 μA
V_R = 20 V	I_R < 50 μA

Reverse current at T_j = 60 °C

V_R = 1.5 V	I_R < 30 μA
V_R = 10 V	I_R < 45 μA
V_R = 20 V	I_R < 100 μA

Diode capacitance

V_R = 1 V; f = 1 MHz	C_d < 1.5 pF

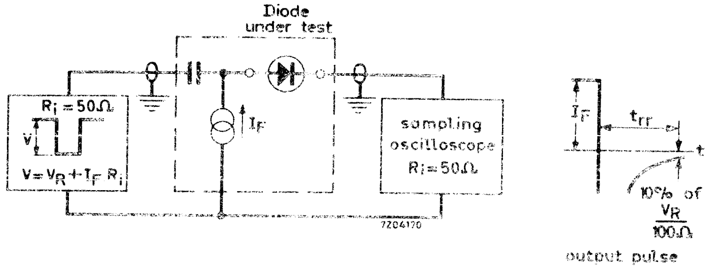
7Z3 0010

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

Reverse recovery time when switched
from $I_F = 10$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$ $t_{rr} < 70$ ns

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$

Test circuit:

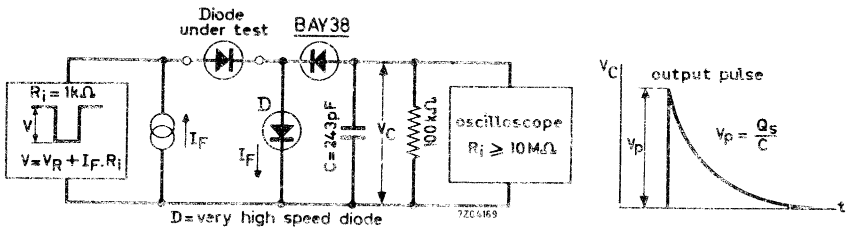


Reverse pulse:	Rise time	t_r =	0.6	ns
	Pulse duration	t_p =	100	ns
	Duty cycle	δ =	0.05	

Circuit capacitance $C < 1$ pF (C = Oscilloscope + parasitical capacitance)

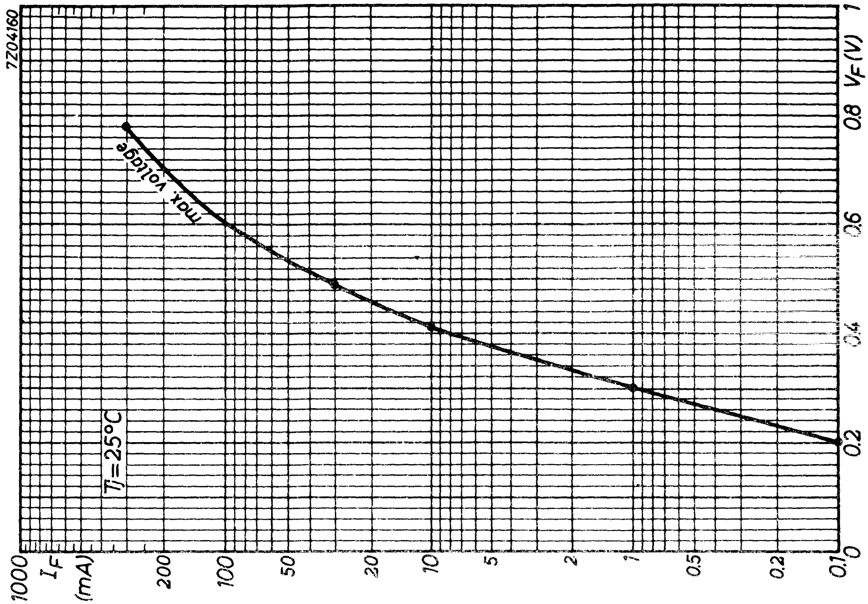
Recovered charge when switched
from $I_F = 10$ mA to $V_R = 10$ V; $R_L = 1$ kΩ $Q_s < 200$ pC

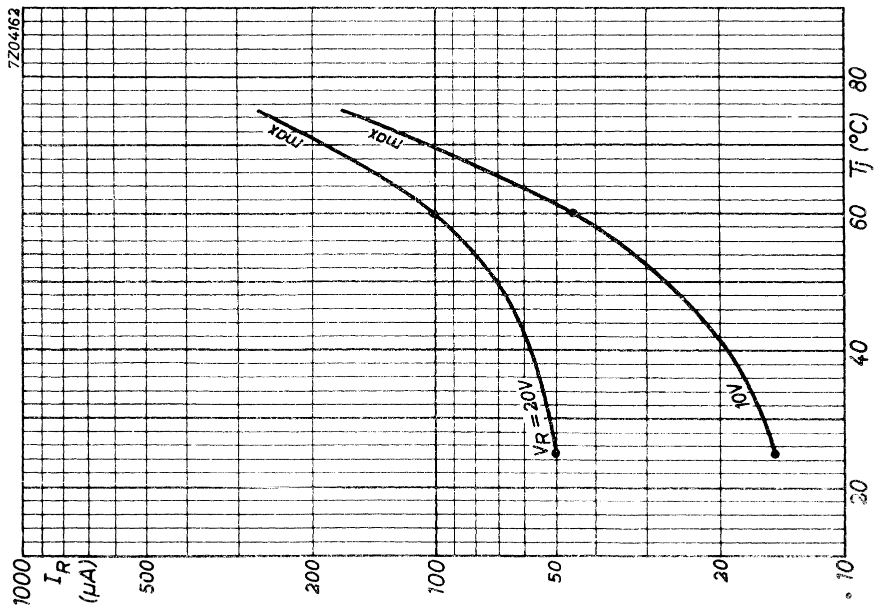
Test circuit:

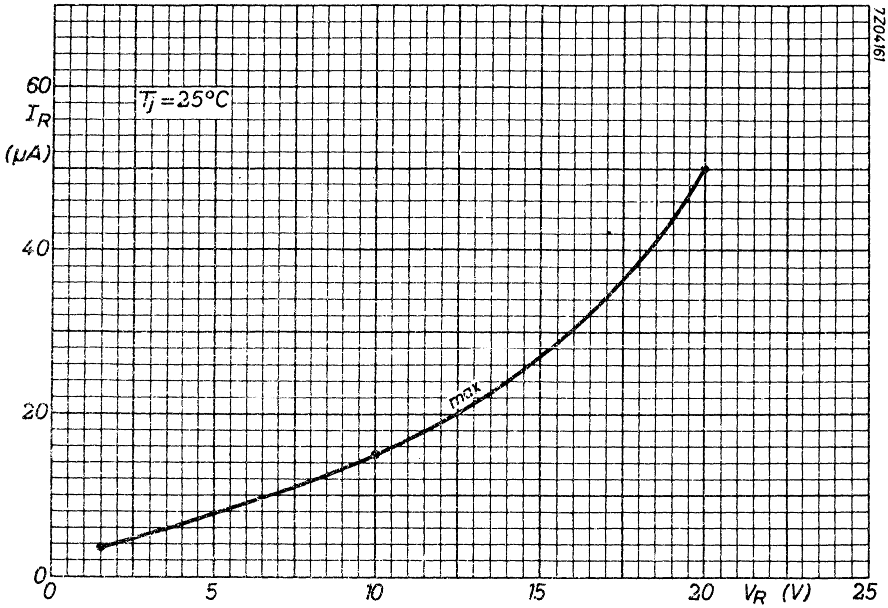


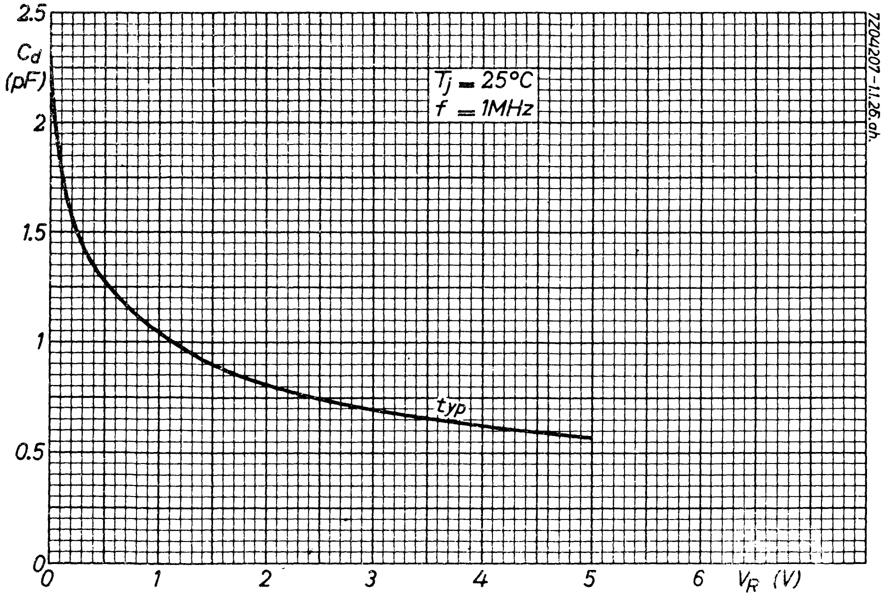
Reverse pulse:	Rise time	t_r =	2	ns
	Pulse duration	t_p =	0.4	μs
	Duty cycle	δ =	0.02	

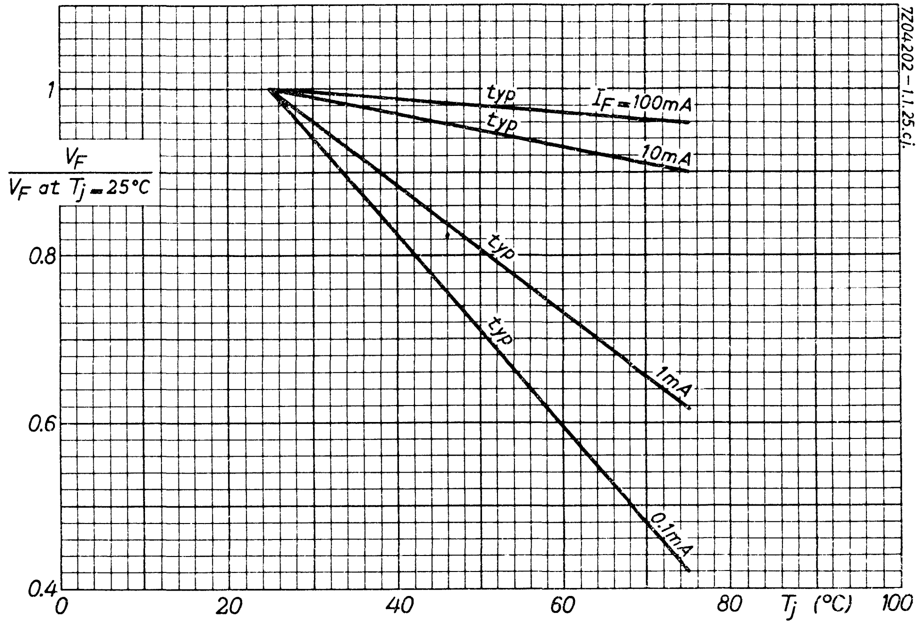
7Z3 0011

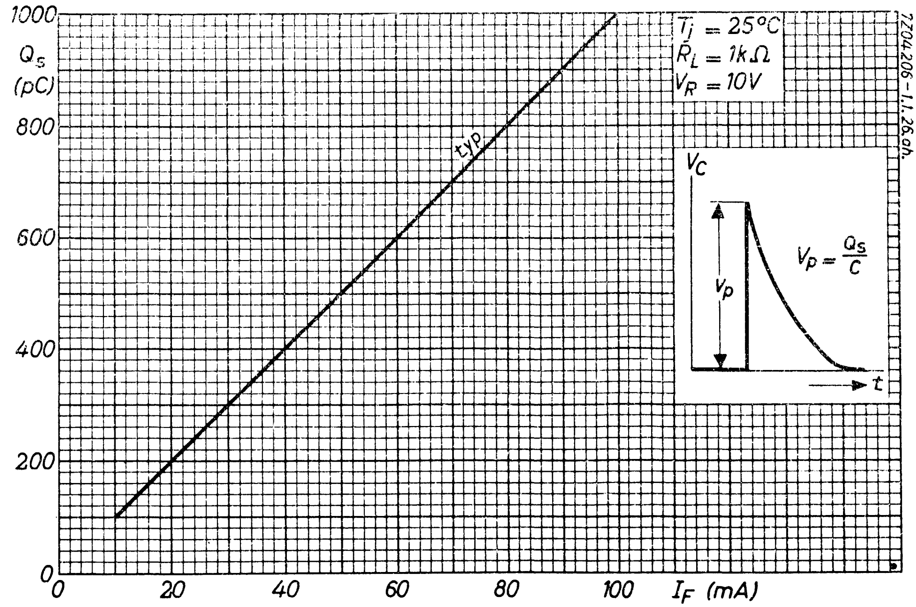

7Z04160
max. voltage
Tj=25°C
I_F (mA)
V_F (V)
1000
200
100
50
20
10
5
2
1
0.5
0.2
0.1
0
0.2
0.4
0.6
0.8
1

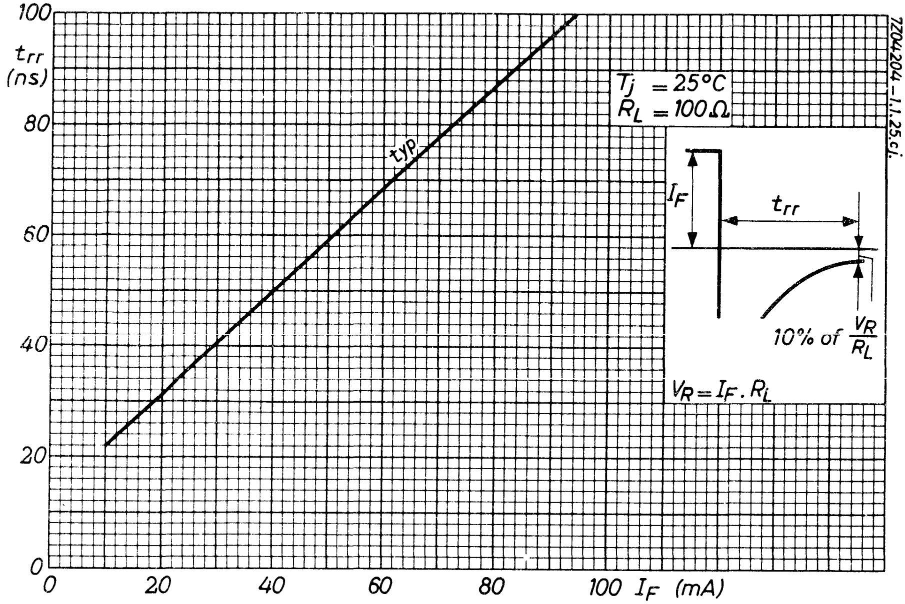

7Z04162
max
max
V_R=20V
10V
I_R (µA)
T_j (°C)
1000
500
200
100
50
20
10
20
40
60
80

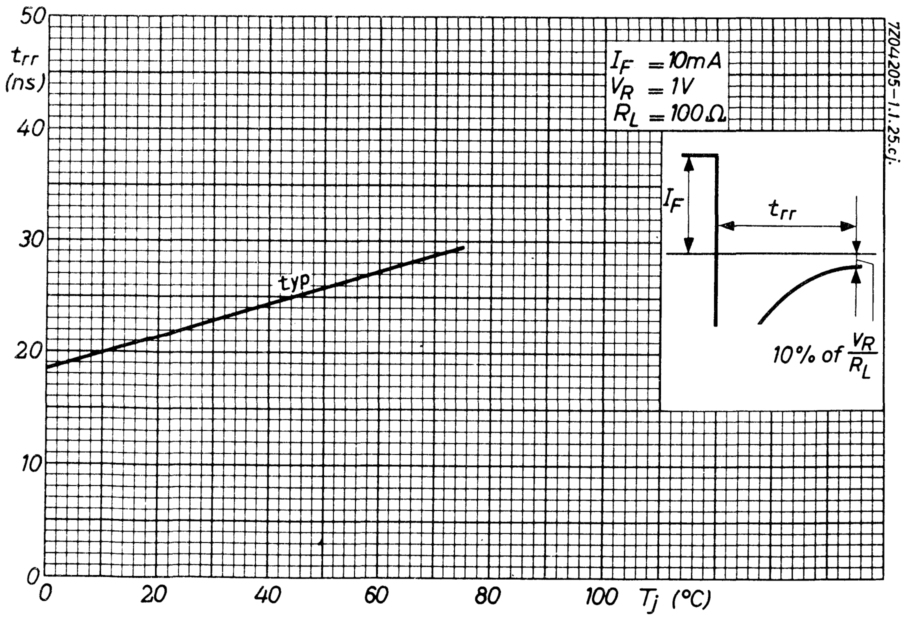

7Z04161
$T_j = 25°C$
I_R (μA)
max
V_R (V)
0
5
10
15
20
25
20
40
60


7Z04207-1.1.26.ah.
$T_j = 25°C$
$f = 1MHz$
C_d (pF)
typ
V_R (V)
0
1
2
3
4
5
6
0.5
1
1.5
2
2.5


7Z04202 - 1.1.25.cj.
1
0.8
0.6
0.4
$\frac{V_F}{V_F \text{ at } T_j = 25°C}$
typ
$I_F = 100mA$
typ
10mA
typ
1mA
typ
0.1mA
0
20
40
60
80
100
T_j (°C)


7Z04206 - 1.1.26.ah.
1000
Q_s
(pC)
800
600
400
200
0
typ
$T_j = 25°C$
$R_L = 1k\Omega$
$V_R = 10V$
V_C
V_p
$V_p = \frac{Q_s}{C}$
t
0
20
40
60
80
100
I_F (mA)

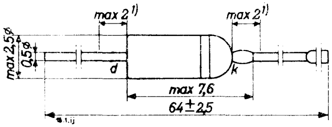

100
t_{rr} (ns)
80
60
40
20
0
0
20
40
60
80
100 I_F (mA)
typ
T_j = 25°C
R_L = 100Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$
7Z04204–1.1.25.ci.


50
t_{rr} (ns)
40
30
20
10
0
0
20
40
60
80
100 T_j (°C)
typ
I_F = 10mA
V_R = 1V
R_L = 100Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
7Z04205–1.1.25.ci.

GENERAL PURPOSE SILICON DIODE in miniature all-glass construction
DIODE A SILICIUM de construction miniature tout verre pour les usages généraux
ALLZWECKSILIZIUMDIODE in Miniatur- Allglasausführung

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc indique la position de la cathode
Der weisse Ring bezeichnet die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

		T_{amb} = 25°C	T_{amb} = 90°C
$-V_D$	=	max. 60 V	max. 60 V
I_D	=	max. 90 mA	max. 18 mA [2]
I_{DM}	=	max. 100 mA	max. 100 mA
$I_{D\ surge}$ (T = max. 1 sec)	=	max. 200 mA	max. 200 mA
T_{amb}	=	-55 °C/ + 90 °C	

Storage temperature
Température d'emmagasinage = -55 °C/ + 90 °C
Lagerungstemperatur

Thermal data. Junction temperature rise to ambient temperature in free air K $\leq$ 0.4 °C/mW

Données thermiques. Augmentation de la température de la jonction au regard de la température de l'ambiance à l'air libre K $\leq$ 0,4 °C/mW

Thermische Daten. Temperaturerhöhung des Kristalls in Bezug auf die Umgebungstemperatur in freier Luft K $\leq$ 0,4 °C/mW

[1]) Not tinned; non étamé; nicht verzinnt

[2]) See pages B,C and D; voir pages B,C et D; siehe Seiten B,C und D

7Z2 0013 1.

Characteristics
Caractéristiques
Kenndaten

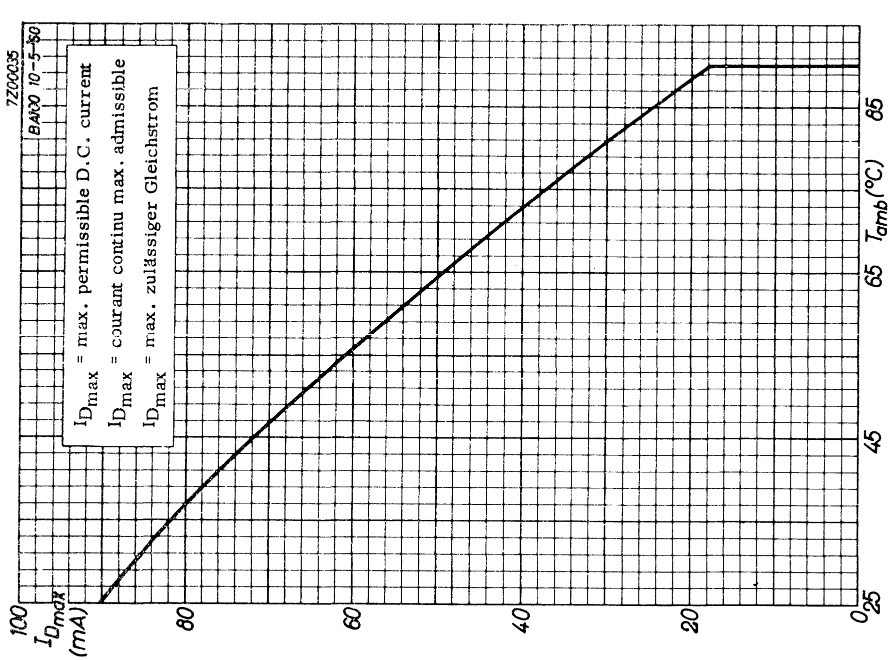
I_D (mA)	V_D (V) T_{amb} = 25 °C ≈	min.	max.	T_{amb} = 60 °C ≈	min.	max.
0,1	≈ 0,55		< 0,75	≈ 0,5		
1,0	≈ 0,65	> 0,5	< 1,0	≈ 0,6	> 0,4	< 0,9
30	≈ 0,9		< 1,5	≈ 0,85		< 1,5

T_{amb} = 60 °C	
$-V_D$	$-I_D$
10 V	5,0 µA
60 V	10 µA

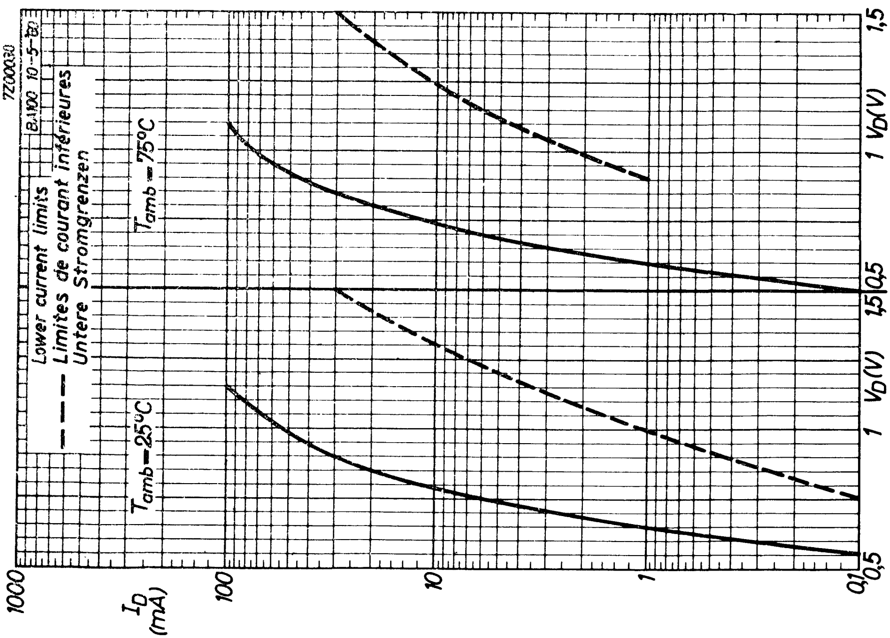
Characteristic range values for equipment design (see also page A)
Gamme de valeurs caractéristiques pour l'étude d'équipements (voir aussi page A)
Charakteristischer Wertbereich für Gerätentwurf (siehe auch Seite A)

T_{amb} = 75 °C	
$-V_D$	$-I_D$
10 V	< 10 µA
60 V	< 20 µA

7Z2 0014 2.

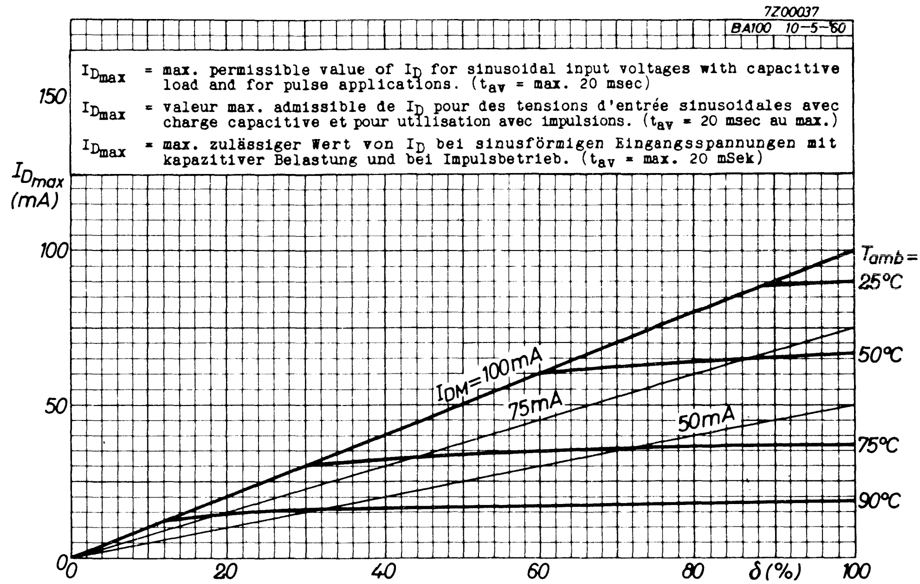

7Z00035
BA100 10-5-60
I_{Dmax} = max. permissible D.C. current
I_{Dmax} = courant continu max. admissible
I_{Dmax} = max. zulässiger Gleichstrom
I_{Dmax} (mA)
100
80
60
40
20
0
25
45
65
85
T_{amb} (°C)

B

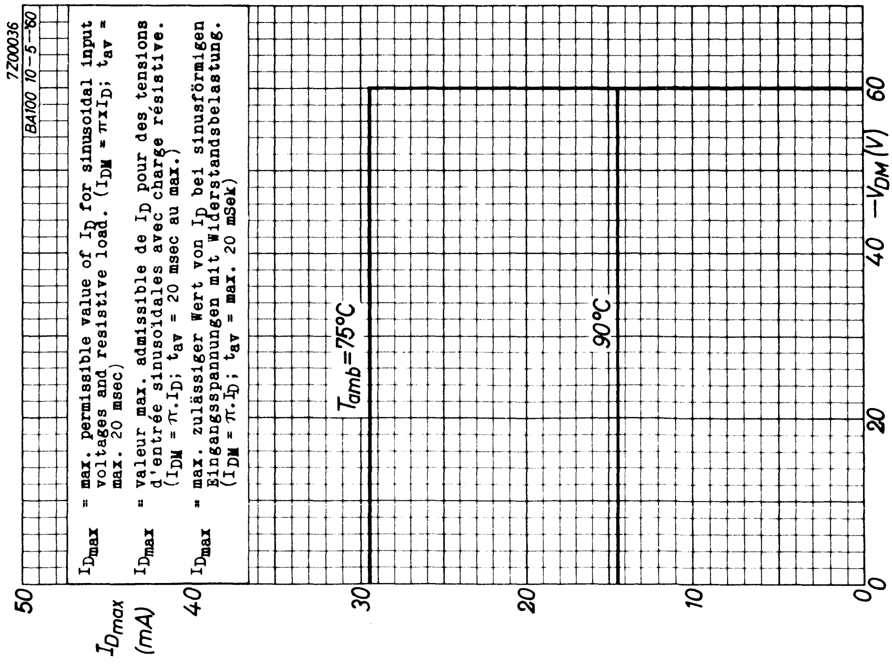

7Z00030
BA100 10-5-60
Lower current limits
Limites de courant inférieures
Untere Stromgrenzen
T_{amb} = 25°C
T_{amb} = 75°C
I_D (mA)
1000
100
10
1
0,1
0,5
1
1,5
V_D(V)

A

D


7Z00037
BA100 10-5-'60
I_{Dmax} = max. permissible value of I_D for sinusoidal input voltages with capacitive load and for pulse applications. (t_{av} = max. 20 msec)
I_{Dmax} = valeur max. admissible de I_D pour des tensions d'entrée sinusoidales avec charge capacitive et pour utilisation avec impulsions. (t_{av} = 20 msec au max.)
I_{Dmax} = max. zulässiger Wert von I_D bei sinusförmigen Eingangsspannungen mit kapazitiver Belastung und bei Impulsbetrieb. (t_{av} = max. 20 mSek)
I_{Dmax} (mA)
150
100
50
0
I_{DM}=100mA
75mA
50mA
T_{amb}=
25°C
50°C
75°C
90°C
0
20
40
60
80
δ (%)
100

C


7Z00036
BA100 10-5-'60
I_{Dmax} = max. permissible value of I_D for sinusoidal input voltages and resistive load. ($I_{DM} = \pi x I_D$; t_{av} = max. 20 msec)
I_{Dmax} = valeur max. admissible de I_D pour des tensions d'entrée sinusoidales avec charge résistive. ($I_{DM} = \pi . I_D$; t_{av} = 20 msec au max.)
I_{Dmax} = max. zulässiger Wert von I_D bei sinusförmigen Eingangsspannungen mit Widerstandsbelastung. ($I_{DM} = \pi . I_D$; t_{av} = max. 20 mSek)
T_{amb}=75°C
90°C
$-V_{DM}$ (V)
60
40
20
0
I_{Dmax} (mA)
50
40
30
20
10
0

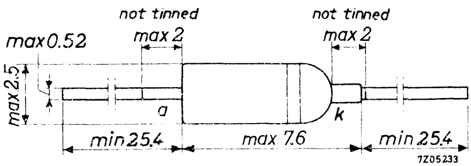
VOLTAGE DEPENDENT CAPACITOR

Silicon voltage dependent capacitor in subminiature all-glass DO-7 construction intended for automatic frequency control in television receivers.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	20	V
Reverse current (d.c.)	I_R	max.	100	μA
Junction temperature	T_j	max.	90	^oC
Capacitance ratio	$\frac{C_d\ (V_R = 10\ V)}{C_d\ (V_R = 4\ V)}$	<	0.7	

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

RATINGS (Limiting values) [1])

Continuous reverse voltage	V_R	max.	20	V
Reverse current (d.c.)	I_R	max.	100	μA
Junction temperature	T_j	max.	90	^oC
Storage temperature	T_{stg}		-55 to +90	^oC

THERMAL RESISTANCE

From junction to ambient in free air $R_{th\ j-a}$ = 0.4 $^oC/mW$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0332

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Reverse current at T_j = 80 °C V_R = 20 V	I_R	< 5	μA
Diode capacitance V_R = 4 V; f = 0.5 MHz	C_d	20 to 45	pF [1]
Capacitance ratio at f ≦ 300 MHz	$\frac{C_d\ (V_R = 10\ V)}{C_d\ (V_R = 4\ V)}$	< 0.7	
Series resistance at V_R = 4 V	r_D	typ. 1.7 < 3	Ω Ω

Simplified equivalent circuit

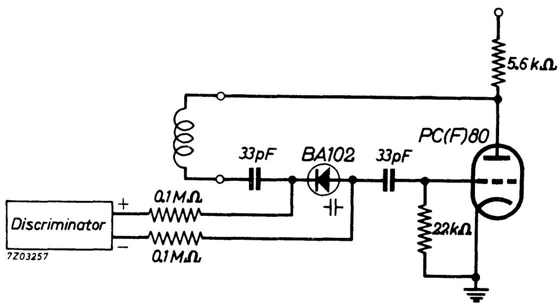
L = lead inductance ≈ 6 nH
r_D = series resistance
C_d = diode capacitance (see page A)

} frequency independent up to f = 300 MHz

These data apply at a distance between the two measuring points of 10 mm.

APPLICATION INFORMATION

Basic circuit for automatic frequency control in television receivers using the BA102 in series with the oscillator coil.

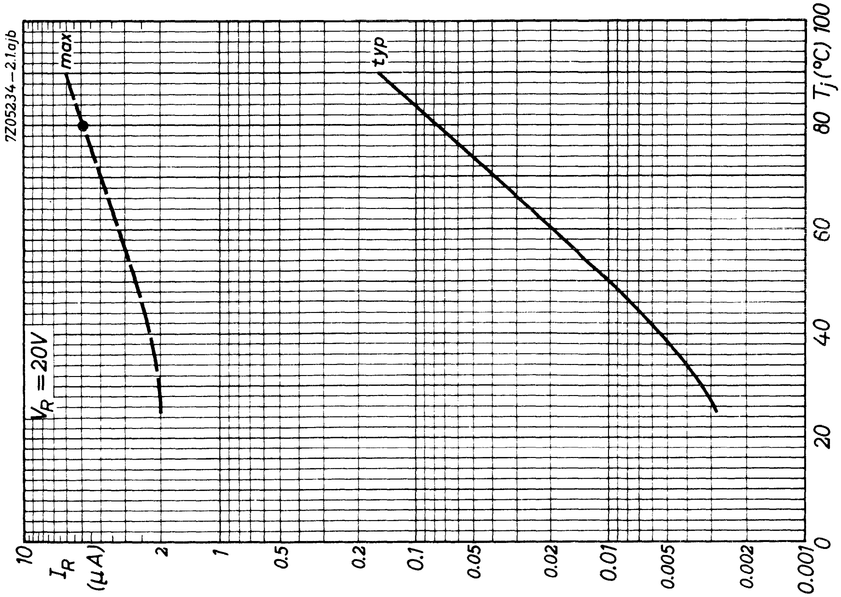


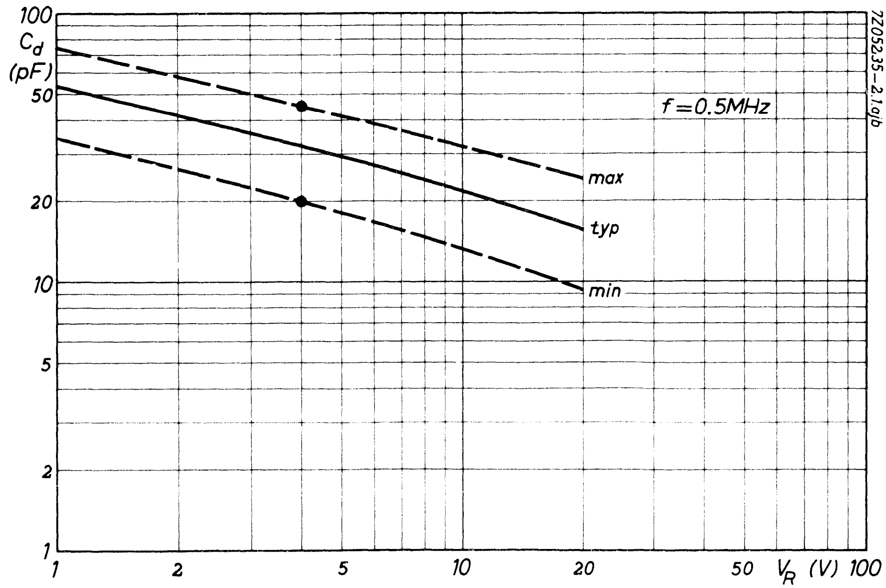
Sensitivity of the discriminator	:	25	V/MHz
Reduction of the frequency deviation Band I	:	1:10	
Band III	:	1:25	

[1]) For convenience reasons only the spread in the magnitude of C_d is indicated in more detail by means of coloured dots.
At V_R = 4 V; f = 0.5 MHz; T_j = 25 °C

white dot	: C_d	20 to 24	pF
yellow dot	: C_d	24 to 30	pF
blue dot	: C_d	30 to 37	pF
green dot	: C_d	37 to 45	pF

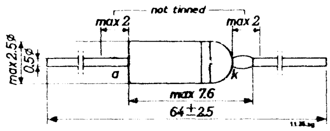
7Z3 0333


7Z05234—2.1ajb
max
typ
V_R = 20V
T_j (°C)
100
80
60
40
20
0
I_R (μA)
10
2
1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0.001


C_d (pF)
100
50
20
10
5
2
1
f = 0.5MHz
max
typ
min
7Z05235—2.1ajb
1
2
5
10
20
50
V_R (V)
100

SILICON ALLOYED JUNCTION DIODE in miniature all-glass construction for use as low voltage stabilizer

Dimensions in mm   The white band indicates the cathode side



LIMITING VALUES (Absolute max. values)

Continuous forward current	I_D	= max. 20 mA
Storage temperature	T_s	= -55 °C to +90 °C
Operating ambient temperature	T_{amb}	= -55 °C to +90 °C

THERMAL DATA

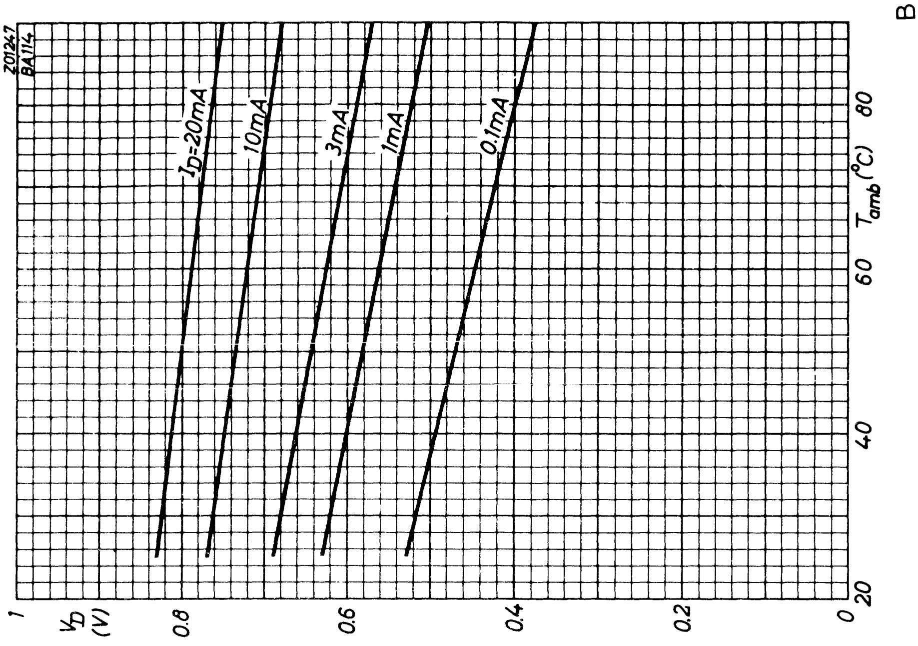
Thermal resistance from junction to ambience in free air	K_{j-amb}	= max. 0.4 °C/mW

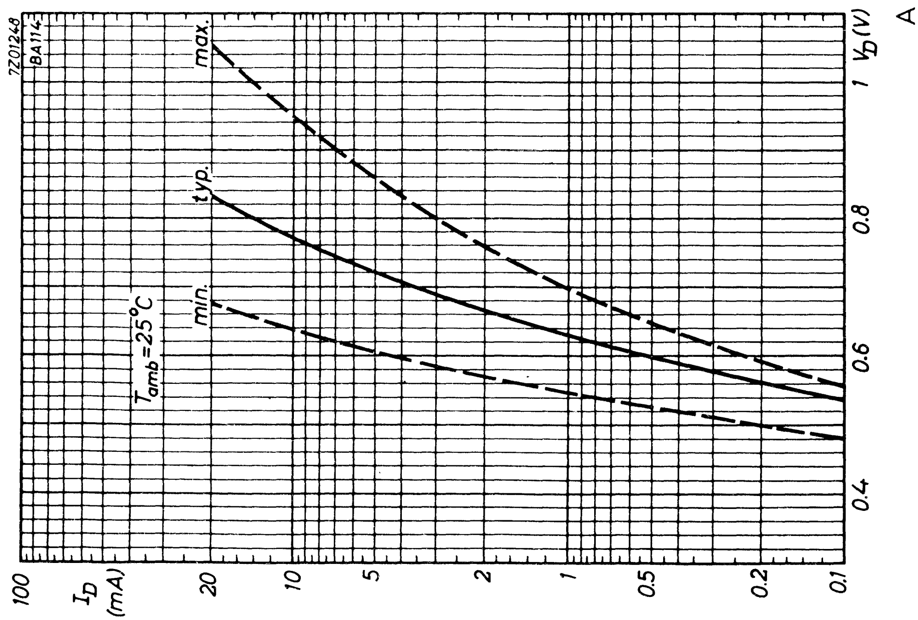
CHARACTERISTICS at T_{amb} = 25 °C

Forward voltage

V_D (I_D = 0.2 mA)	> 0.5 V
V_D (I_D = 3 mA)	< 0.8 V

7Z2 1739 1.


7Z01247
BA114
I_D=20mA
10mA
3mA
1mA
0.1mA
T_{amb} (°C)
20
40
60
80
V_D
(V)
1
0.8
0.6
0.4
0.2
0
B

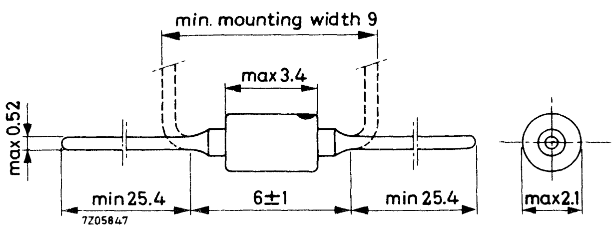

7Z01248
BA114
max.
typ.
min.
T_{amb}=25°C
V_D (V)
1
0.8
0.6
0.4
I_D
(mA)
100
20
10
5
2
1
0.5
0.2
0.1
A

SILICON OXIDE PASSIVATED DIODE

Whiskerless diode in a molybdenum hard glass subminiature envelope. The BAX13 is primarily intended for fast logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	40	V
Repetitive peak forward current	I_{FRM}	max.	150	mA
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.63	°C/mW
Forward voltage at I_F = 20 mA	V_F	<	1.0	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 6 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	4	ns
Recovered 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



The coloured dot indicates the cathode side

7Z3 0693

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	40	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	75	mA [2]
Forward current (d.c.)	I_F	max.	75	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	2000	mA
t = 1 s	I_{FSM}	max.	500	mA

Temperatures

Storage temperature	T_{stg}		-65 to +200	^oC
Junction temperature	T_j	max.	200	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.63	$^oC/mW$

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

Forward voltage

I_F = 2 mA	V_F	<	0.7	V
I_F = 10 mA; T_j = 100 ^oC	V_F	<	0.8	V
I_F = 20 mA	V_F	<	1.0	V
I_F = 75 mA	V_F	<	1.53	V

Reverse current

V_R = 10 V	I_R	<	25	nA
V_R = 10 V; T_j = 150 ^oC	I_R	<	15	μA
V_R = 25 V	I_R	<	50	nA
V_R = 25 V; T_j = 150 ^oC	I_R	<	25	μA

Diode capacitance (see also page F)

V_R = 0; f = 1 MHz	C_d	<	3	pF

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) For sinusoidal operation see page A
For pulse operation see page B

7Z3 0694

SILICON PLANAR DIODE

Silicon planar diode in subminiature all glass DO-7 envelope for general purpose industrial applications.

RATINGS (Limiting values) [1])

Continuous reverse voltage	V_R	max.	150	V
Forward current (d.c.)	I_F	max.	170	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Junction temperature	T_j	max.	190	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	$^oC/mW$

CHARACTERISTICS $T_j = 25\ ^oC$

Forward voltage

$I_F = 100$ mA	V_F	<	1.5	V

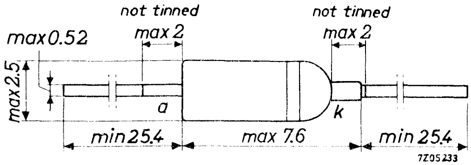
Reverse recovery time, when switched from

$I_F = 30$ mA to $V_R = 35$ V; $R_L = 2.5$ kΩ

measured at $I_R = 4$ mA	t_{rr}	<	2.5	μs

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

FOR NEW DESIGN THE SUCCESSOR TYPE BAX16 IS RECOMMENDED.

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0388

SILICON PLANAR DIODE

Silicon planar diode in subminiature all glass DO-7 envelope for general purpose industrial applications.

RATINGS (Limiting values) [1])

Continuous reverse voltage	V_R	max. 150	V
Forward current (d.c.)	I_F	max. 130	mA
Repetitive peak forward current	I_{FRM}	max. 200	mA
Junction temperature	T_j	max. 190	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	$^oC/mW$

CHARACTERISTICS $T_j = 25\ ^oC$

Forward voltage

$I_F = 100$ mA	V_F	<	2.5	V

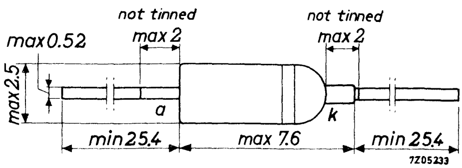
Reverse recovery time, when switched from

$I_F = 30$ mA to $V_R = 35$ V; $R_L = 2.5$ kΩ

measured at $I_R = 4$ mA	t_{rr}	<	0.25	μs

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

FOR NEW DESIGN THE SUCCESSOR TYPE BAX16 IS RECOMMENDED.

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0389

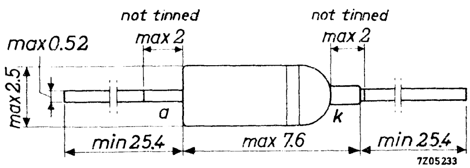
SILICON PLANAR EPITAXIAL DIODE

Silicon planar epitaxial diode in subminiature all glass DO-7 envelope.
The BAY38 is a very high speed general purpose diode, primarily intended for logic applications.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	50	V
Repetitive peak forward current	I_{FRM}	max.	225	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.4	$^oC/mW$
Forward voltage at I_F = 50 mA	V_F	<	1	V
Reverse recovery time when switched from I_F = 10 mA to V_R = 1 V; R_L = 100 Ω measured at I_R = 1 mA	t_{rr}	<	4	ns

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

7Z3 0602

RATINGS (Limiting values) [1])

Voltage

Continuous reverse voltage	V_R	max.	50	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	115	mA [2])
Forward current (d.c.)	I_F	max.	115	mA
Repetitive peak forward current	I_{FRM}	max.	225	mA
Non repetitive peak forward current t = 1 μs	I_{FSM}	max.	2000	mA
t = 1 s	I_{FSM}	max.	500	mA

Temperatures

Storage temperature	T_{stg}	−65 to +200		°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 50 mA	V_F	<	1	V

Reverse current

V_R = 50 V;	I_R	<	50	nA
V_R = 50 V; T_j = 150 °C	I_R	<	50	μA

Diode capacitance (see also page B)

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

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) For sinusoidal operation see page C.
For pulse operation see page D.

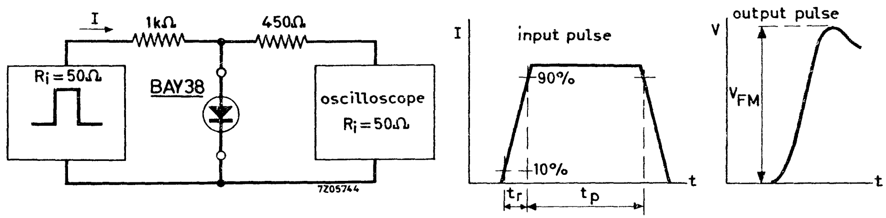
7Z3 0603

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

Forward recovery voltage

I_F = 10 mA; t_r = 20 ns	V_{FM}	<	1.75	V
I_F = 100 mA; t_r = 50 ns	V_{FM}	<	1.75	V

Test circuit:



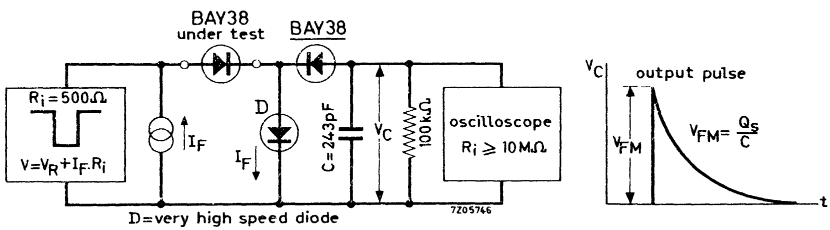
Current pulse:	Rise time (10 mA)	t_r =	20	ns
	Rise time (100 mA)	t_r =	50	ns
	Pulse duration	t_p =	120	ns
	Duty cycle	δ =	0.01	

Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched from

I_F = 10 mA to V_R = 5 V; R_L = 500 Ω Q_s < 35 pC

Test circuit:



Reverse pulse:	Rise time	t_r =	2	ns
	Pulse duration	t_p =	400	μs
	Duty cycle	δ =	0.02	

Circuit capacitance C < 7 pF (C = Oscilloscope + parasitical capacitance)

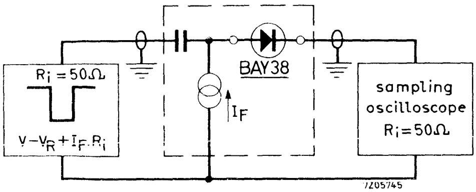
7Z3 0604

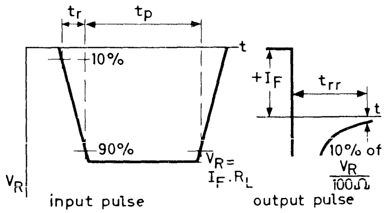
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Reverse recovery time when switched from

I_F = 10 mA to V_R = 1 V; R_L = 100 Ω
measured at I_R = 1 mA t_{rr} < 4 ns

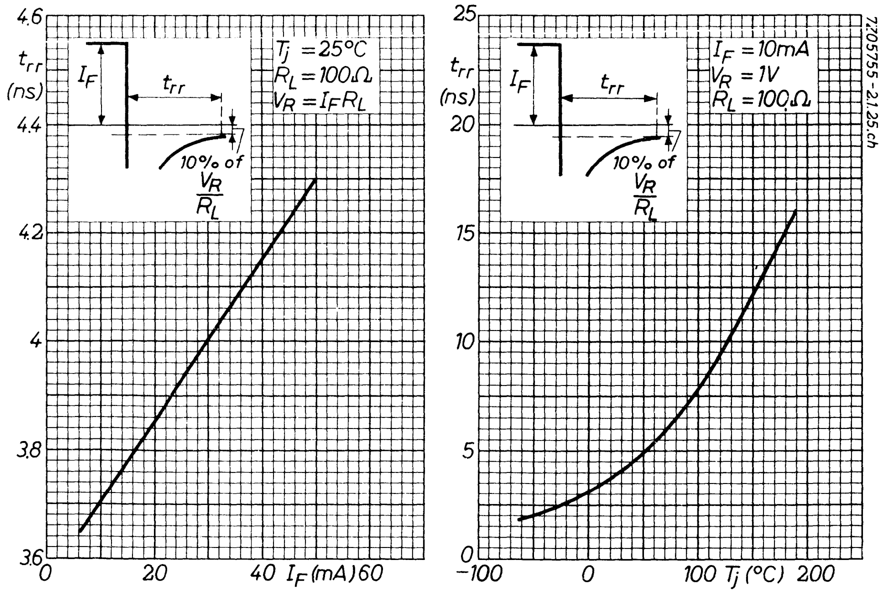
Test circuit:



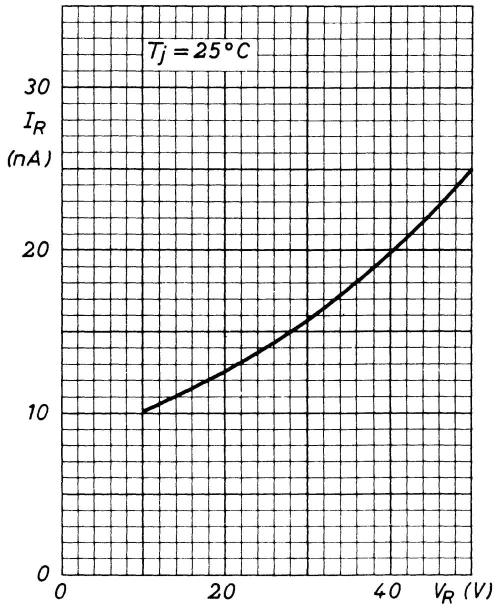


Reverse pulse:	Rise time	t_r	=	0.6 ns
	Pulse duration	t_p	=	100 ns
	Duty cycle	δ	=	0.05

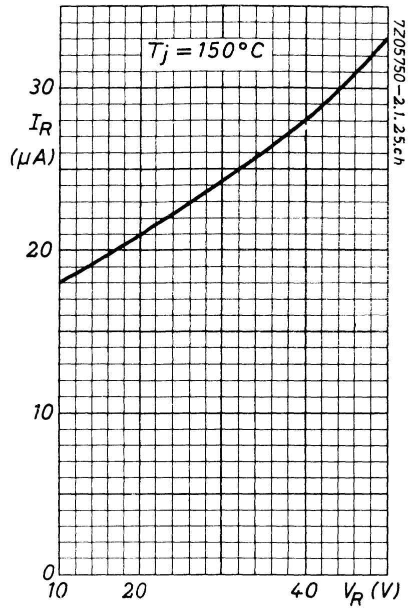
Circuit capacitance C ≤ 1 pF (C = Oscilloscope + parasitical capacitance)



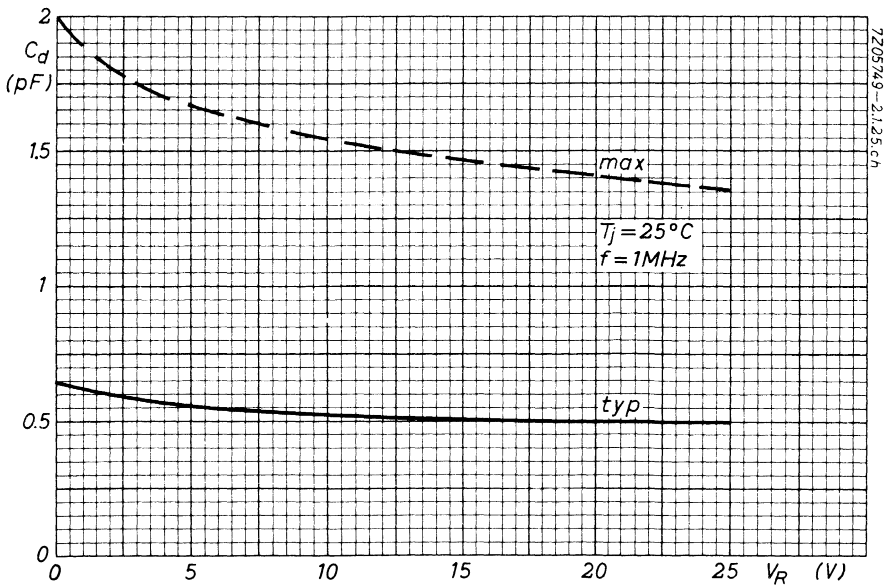
7Z3 0605



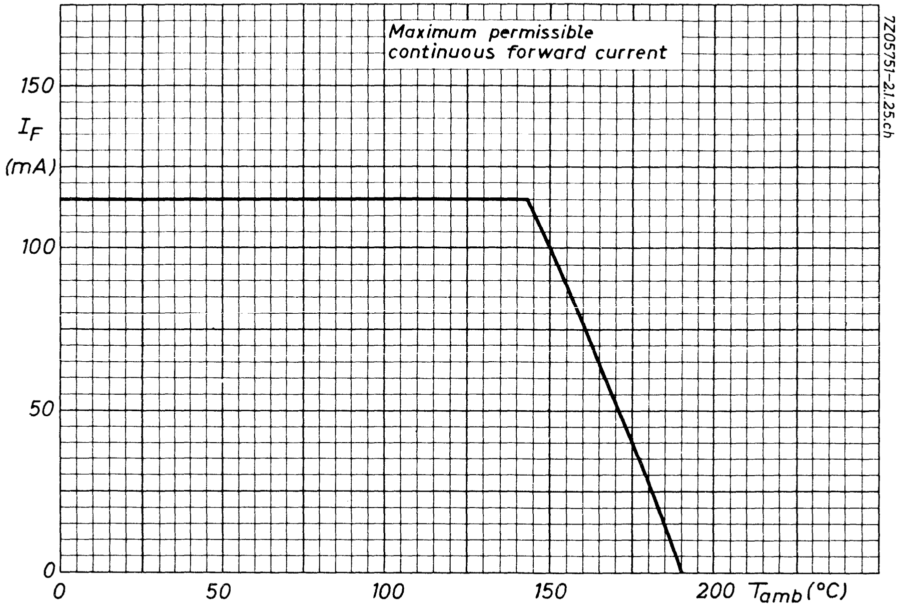
Tj = 25°C
30
IR
(nA)
20
10
0
0
20
40
VR (V)

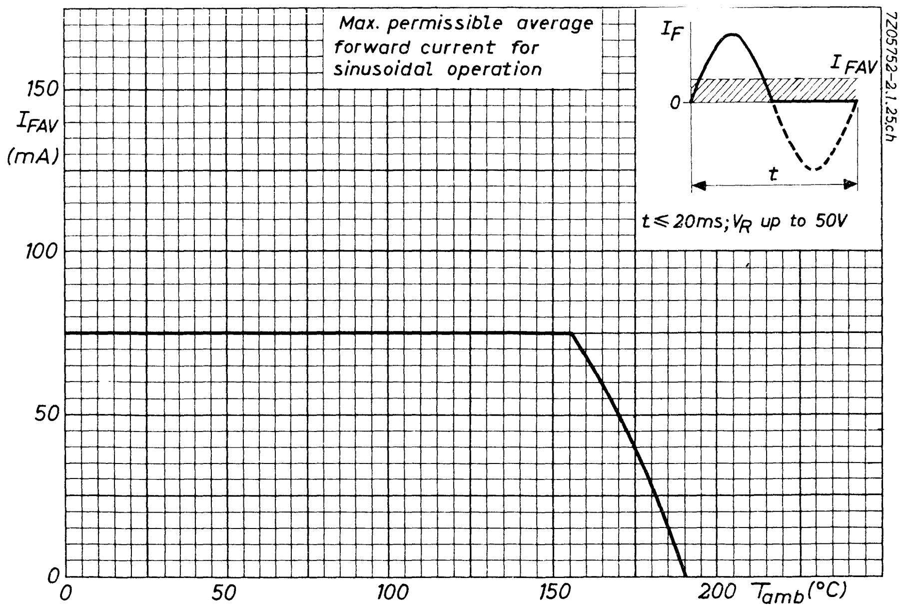


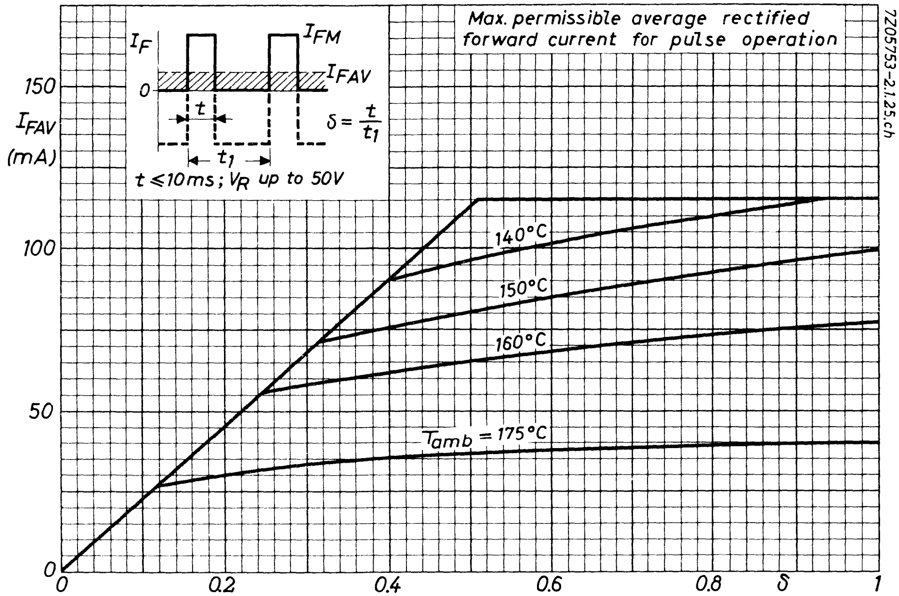
Tj = 150°C
30
IR
(μA)
20
10
0
10
20
40
VR (V)
7Z05750—2.1.25.ch

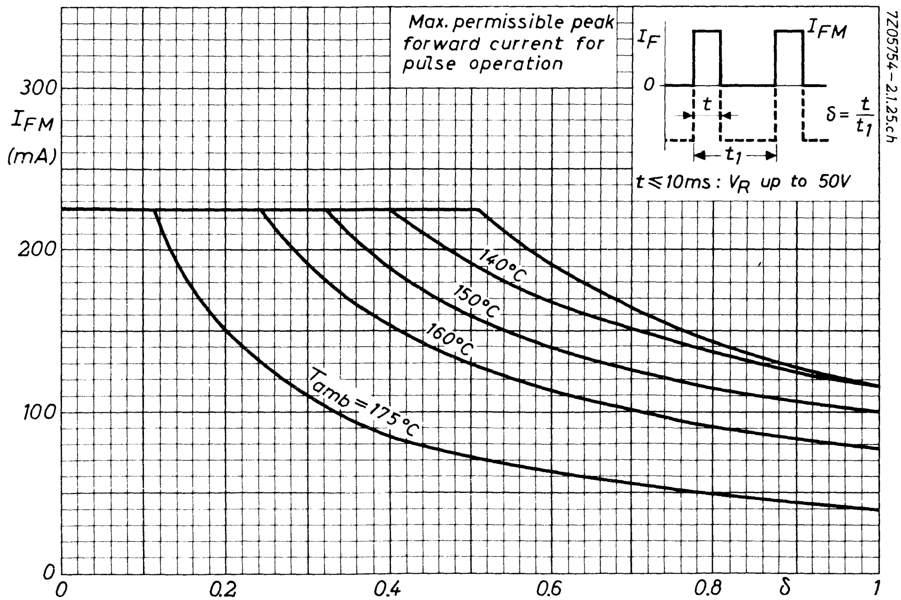


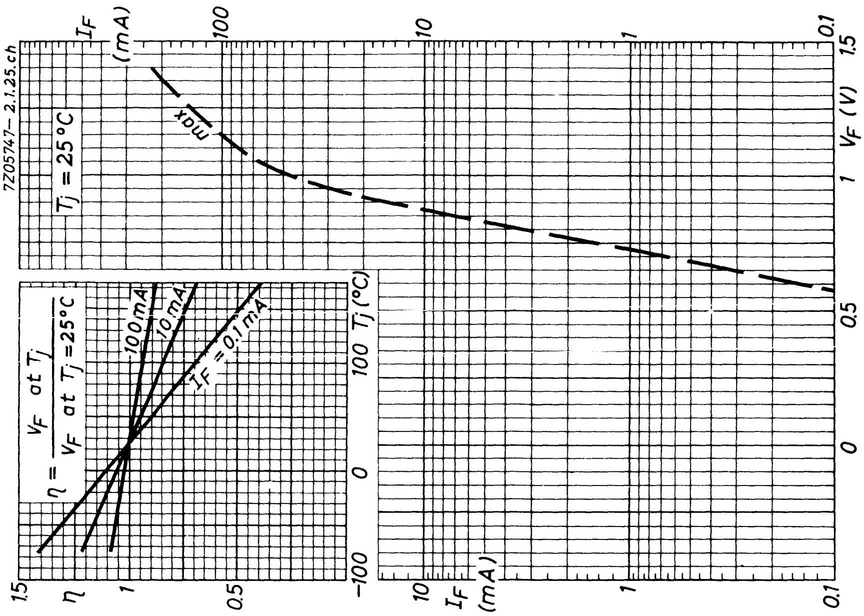
2
Cd
(pF)
1.5
1
0.5
0
0
5
10
15
20
25
VR (V)
max
Tj = 25°C
f = 1MHz
typ
7Z05749—2.1.25.ch

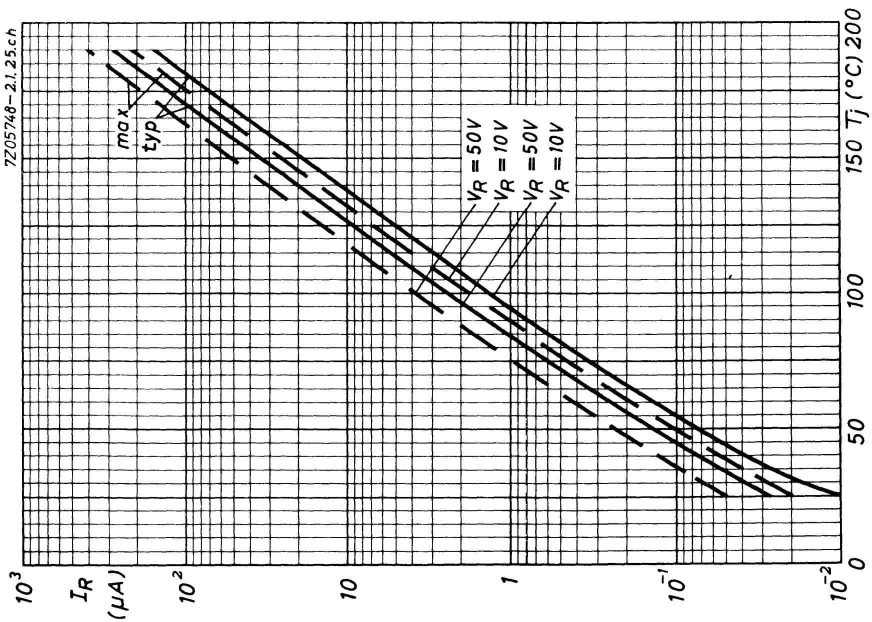

Maximum permissible
continuous forward current
150
I_F
(mA)
100
50
0
0
50
100
150
200
T_{amb} (°C)
7Z05751-2.1.25.ch


Max. permissible average
forward current for
sinusoidal operation
150
I_{FAV}
(mA)
100
50
0
0
50
100
150
200
T_{amb} (°C)
I_F
I_{FAV}
0
t
$t \leq 20ms; V_R$ up to 50V
7Z05752-2.1.25.ch


Max. permissible average rectified forward current for pulse operation
I_F
I_{FM}
I_{FAV}
0
t
t_1
$\delta = \frac{t}{t_1}$
$t \leq 10 ms$; V_R up to 50V
150
100
50
0
I_{FAV}
(mA)
0
0.2
0.4
0.6
0.8
δ
1
140°C
150°C
160°C
$T_{amb} = 175°C$
7Z05753-2.1.25.ch


Max. permissible peak forward current for pulse operation
I_F
I_{FM}
0
t
t_1
$\delta = \frac{t}{t_1}$
$t \leq 10 ms$: V_R up to 50V
300
200
100
0
I_{FM}
(mA)
0
0.2
0.4
0.6
0.8
δ
1
140°C
150°C
160°C
$T_{amb} = 175°C$
7Z05754-2.1.25.ch


7Z05747– 2.1.25.ch
$T_j = 25°C$
I_F (mA)
V_F (V)
max
$\eta = \frac{V_F \text{ at } T_j}{V_F \text{ at } T_j = 25°C}$
100 mA
10 mA
$I_F = 0.1$ mA
T_j (°C)
η


7Z05748–2.1.25.ch
max
typ
$V_R = 50V$
$V_R = 10V$
$V_R = 50V$
$V_R = 10V$
I_R (μA)
T_j (°C)

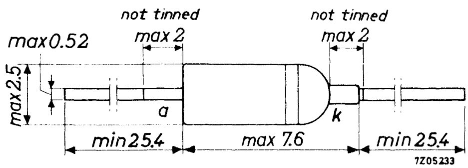
SILICON PLANAR EPITAXIAL DIODE

Silicon planar epitaxial diode in subminiature all glass DO-7 envelope for general purposes and especially for core gating in fast memories.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	75	V
Repetitive peak forward current	I_{FRM}	max.	750	mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.4	^{o}C/mW
Forward voltage at I_F = 500 mA	V_F		0.8 to 1.0	V
Reverse recovery time when switched from I_F = 500 mA to V_R = 50 V; R_L = 1 kΩ measured at I_R = 5 mA	t_{rr}	<	160	ns

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

7Z3 0406

RATINGS (Limiting values) [1]

Voltage

Continuous reverse voltage	V_R	max.	75	V

Currents

Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	450	mA [2]
Forward current (d.c.)	I_F	max.	450	mA
Repetitive peak forward current	I_{FRM}	max.	750	mA
Non repetitive peak forward current (t = 1 μs)	I_{FSM}	max.	4000	mA

Temperatures

Storage temperature	T_{stg}		-65 °C to +200	°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.4	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Forward voltage

I_F = 10 mA	V_F	<	0.7	V
I_F = 500 mA	V_F		0.8 to 1.0	V

Reverse current

V_R = 75 V	I_R	<	100	nA
V_R = 75 V; T_j = 150 °C	I_R	<	100	μA

Diode capacitance (see also page F)

V_R = 10 V; f = 1 MHz	C_d	<	7.5	pF

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) For sinusoidal operation see page A

For pulse operation see page B

7Z3 0407

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

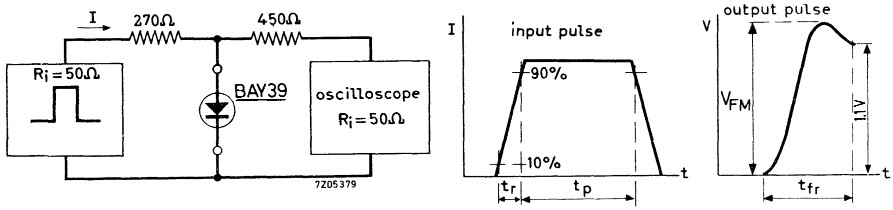
Forward recovery voltage (see also page D)

I_F = 500 mA; t_r = 50 ns	V_{FM}	< 3.0 V

Forward recovery time

I_F = 500 mA; t_r = 50 ns measured at V_F = 1.1 V	t_{fr}	< 60 ns

Test circuit:



Current pulse: Rise time t_r = 50 ns

Pulse duration t_p = 200 ns

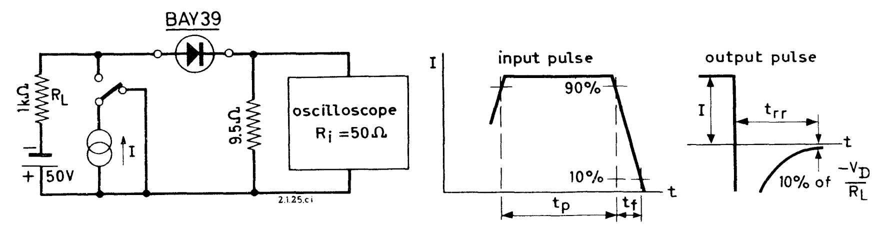
Duty cycle δ = 0.01

Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Reverse recovery time when switched from

I_F = 500 mA to V_R = 50 V; R_L = 1 kΩ measured at I_R = 5 mA (see also page C)	t_{rr}	< 160 ns

Test circuit:



Current pulse: Fall time t_f = 5 ns

Pulse duration t_p = 5 ns

Duty cycle δ = 0.01

Circuit capacitance C < 10 pF (C = Oscilloscope + parasitical capacitance)

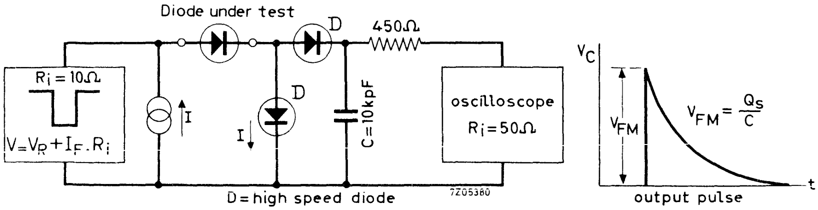
7Z3 0408

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

Recovered charge when switched from

I_F = 500 mA to V_R = 5 V; R_L = 10 Ω Q_s < 15 nC [1]

Test circuit:



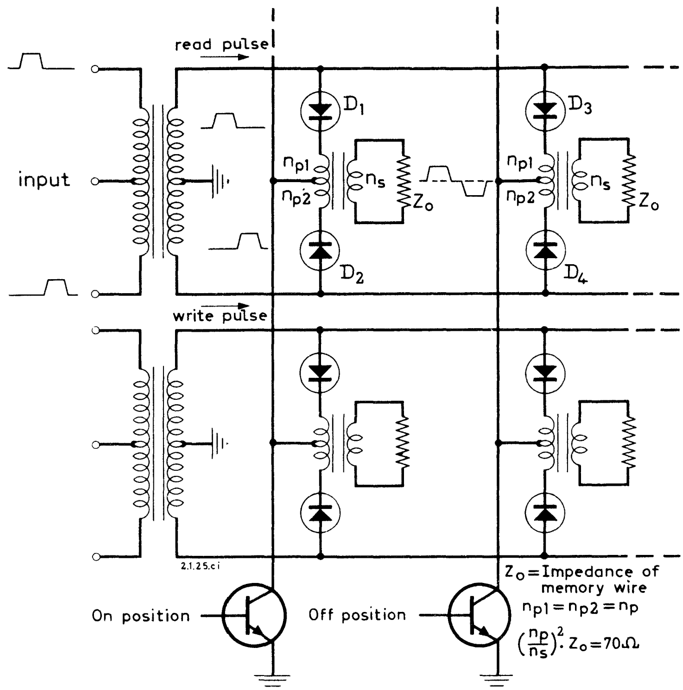
Reverse pulse: Rise time	t_r	=	4	ns
Pulse duration	t_p	=	150	µs
Duty cycle	δ	=	0.99	

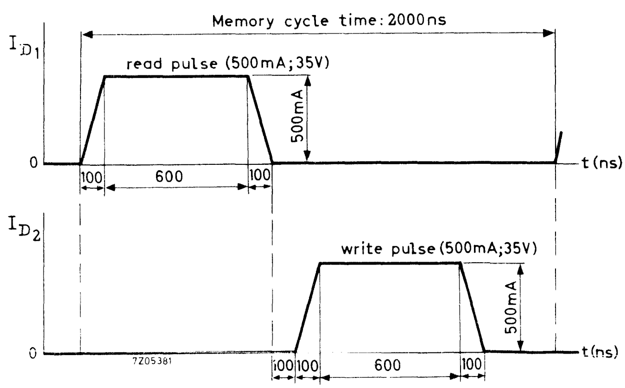
[1]) See also page C

7Z3 0409

APPLICATION INFORMATION

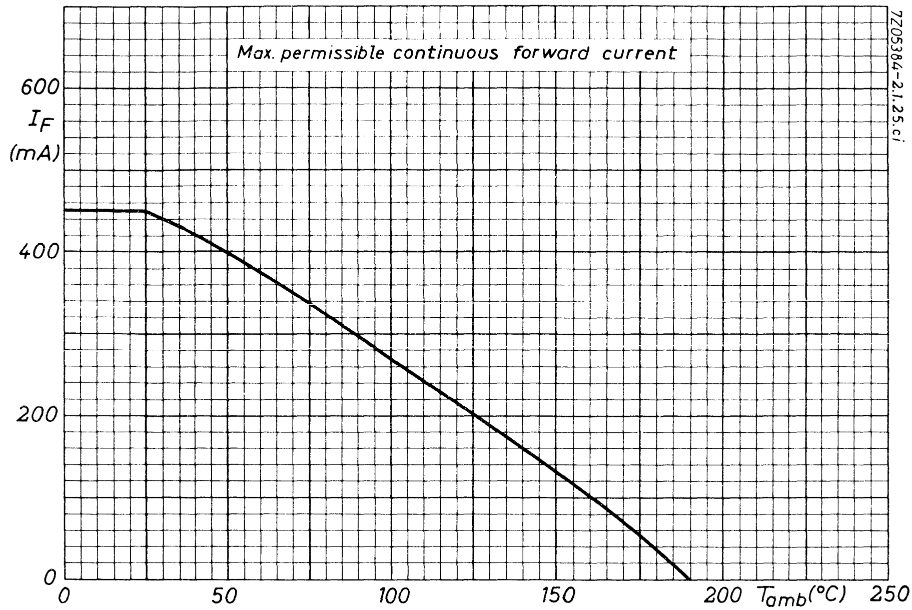
Transformer type selection matrix of a core memory

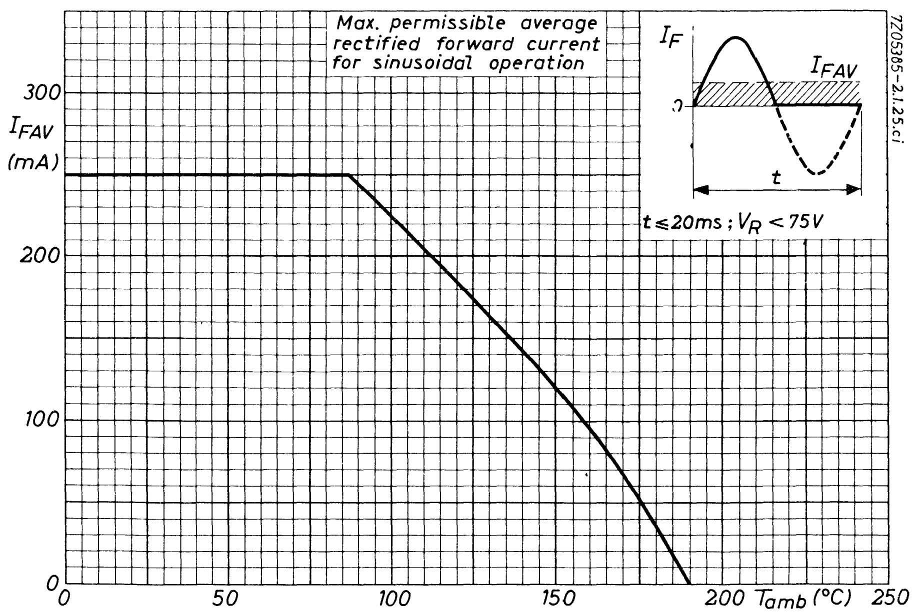


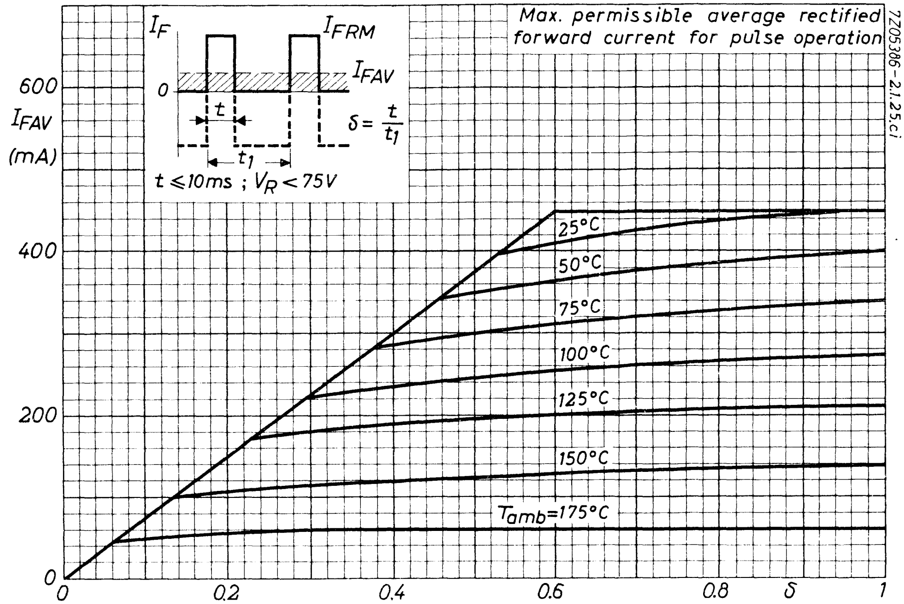


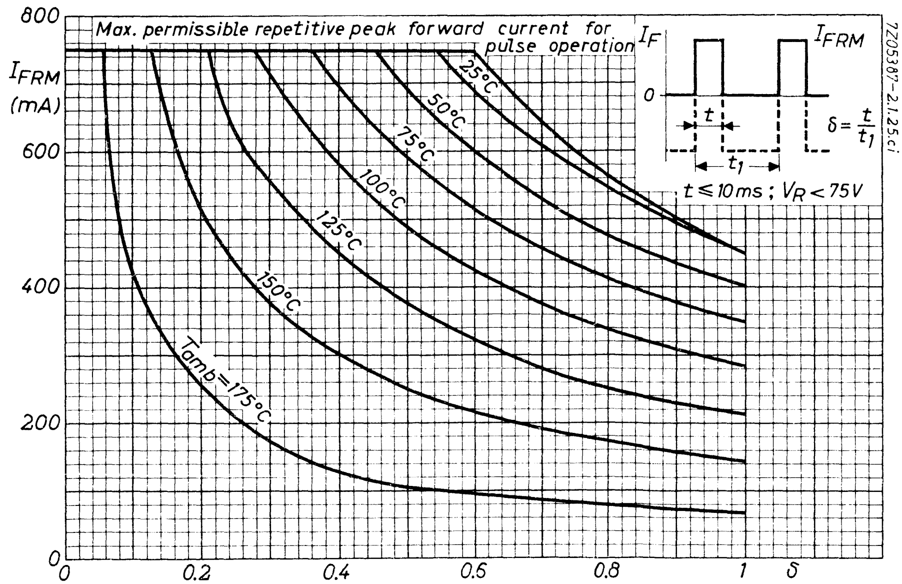
All diodes are of type BAY39

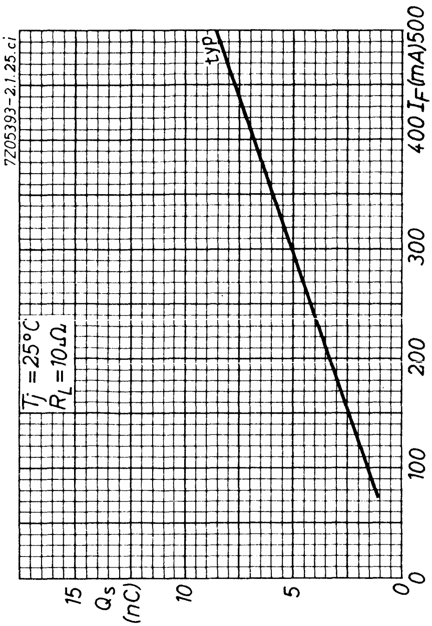
7Z3 0410

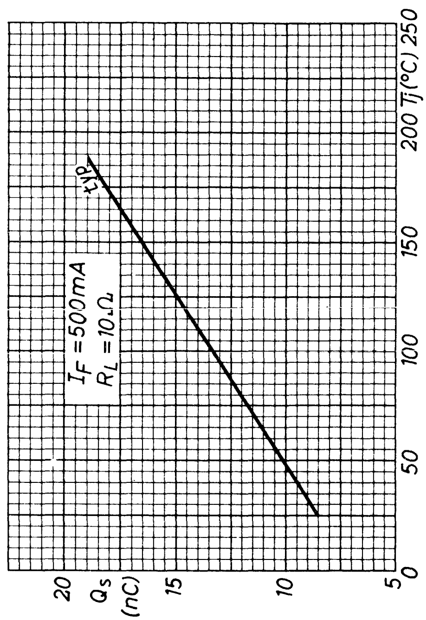

Max. permissible continuous forward current
600
400
200
0
I_F
(mA)
0
50
100
150
200
T_amb (°C)
250
7Z05384-2.1.25.ci

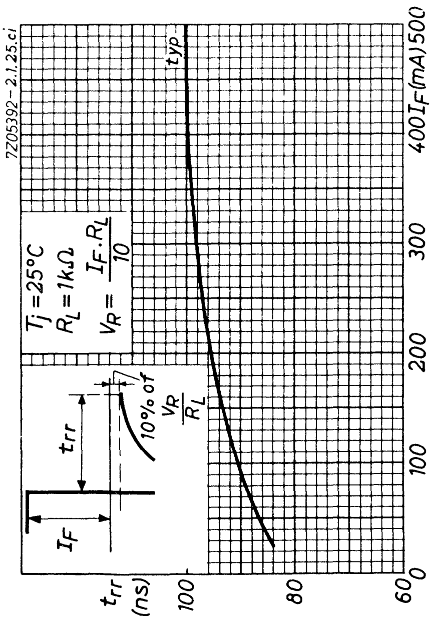

Max. permissible average rectified forward current for sinusoidal operation
300
200
100
0
I_FAV
(mA)
I_F
I_FAV
0
t
t ≤ 20ms ; V_R < 75V
0
50
100
150
200
T_amb (°C)
250
7Z05385-2.1.25.ci

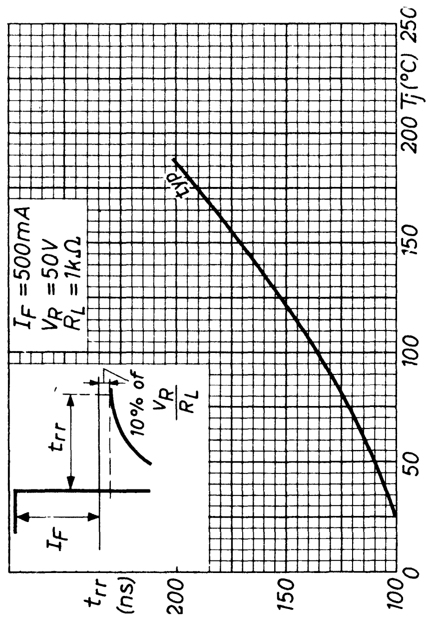

Max. permissible average rectified forward current for pulse operation
7Z05386-2.1.25.ci
I_{FAV}
(mA)
600
400
200
0
0
0.2
0.4
0.6
0.8
δ
1
I_F
I_{FRM}
I_{FAV}
t
t_1
δ = $\frac{t}{t_1}$
t ≤ 10ms ; V_R < 75V
25°C
50°C
75°C
100°C
125°C
150°C
T_{amb}=175°C

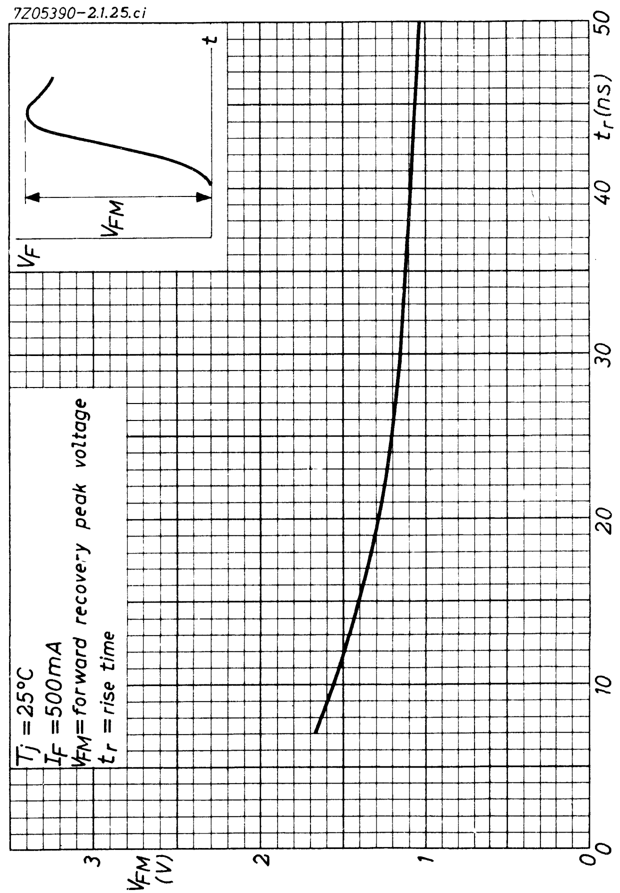

Max. permissible repetitive peak forward current for pulse operation
7Z05387-2.1.25.ci
I_{FRM}
(mA)
800
600
400
200
0
0
0.2
0.4
0.6
0.8
1
δ
I_F
I_{FRM}
t
t_1
δ = $\frac{t}{t_1}$
t ≤ 10ms ; V_R < 75V
25°C
50°C
75°C
100°C
125°C
150°C
T_{amb}=175°C

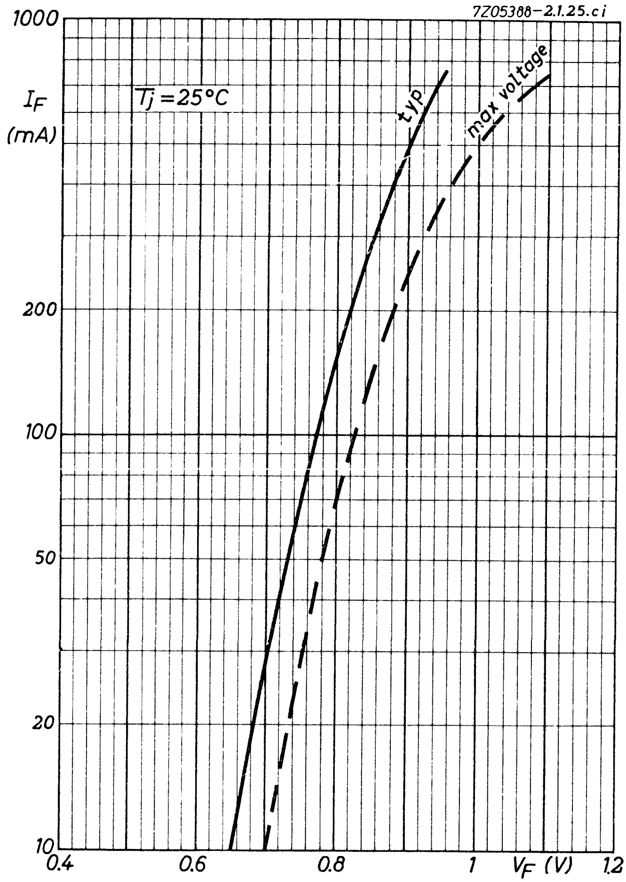

7Z05393-2.1.25.ci
T_j = 25°C
R_L = 10 Ω
typ
Q_s (nC)
15
10
5
0
0
100
200
300
400 I_F (mA) 500

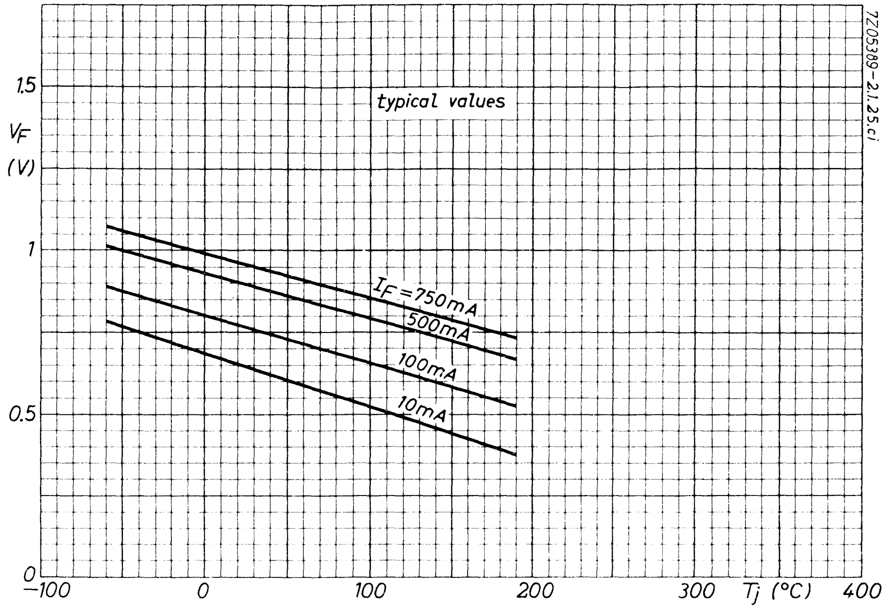

I_F = 500 mA
R_L = 10 Ω
typ
Q_s (nC)
20
15
10
5
0
50
100
150
200 T_j (°C) 250

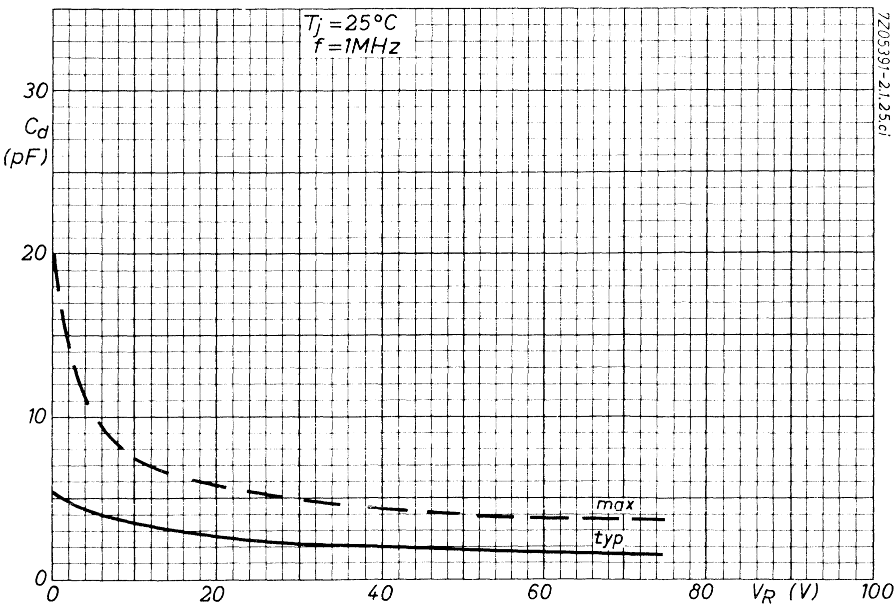

7Z05392-2.1.25.ci
T_j = 25°C
R_L = 1 kΩ
$V_R = \frac{I_F \cdot R_L}{10}$
t_{rr}
I_F
10% of $\frac{V_R}{R_L}$
typ
t_{rr} (ns)
100
80
60
0
100
200
300
400 I_F (mA) 500

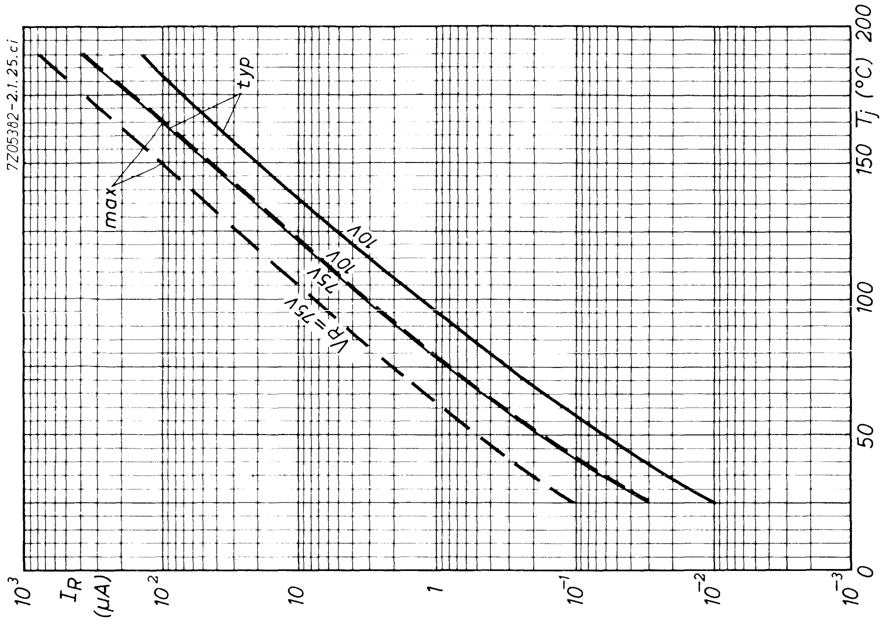

I_F = 500 mA
V_R = 50 V
R_L = 1 kΩ
t_{rr}
I_F
10% of $\frac{V_R}{R_L}$
typ
t_{rr} (ns)
200
150
100
0
50
100
150
200 T_j (°C) 250

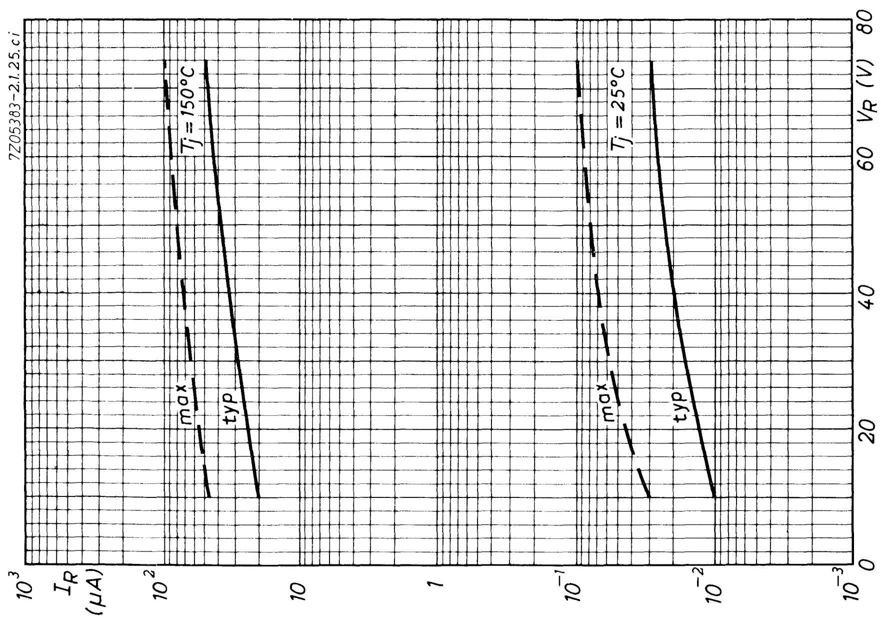

7Z05390-2.1.25.ci
T_j = 25°C
I_F = 500mA
V_{FM} = forward recovery peak voltage
t_r = rise time
V_F
V_{FM}
t
t_r (ns)
V_{FM} (V)
0
10
20
30
40
50
0
1
2
3


7Z05388-2.1.25.ci
1000
I_F
(mA)
$T_j = 25°C$
typ
max voltage
200
100
50
20
10
0.4
0.6
0.8
1
V_F (V)
1.2


typical values
7Z05389-2.1.25.ci
1.5
V_F
(V)
1
0.5
0
−100
0
100
200
300
T_j (°C)
400
I_F = 750mA
500mA
100mA
10mA


T_j = 25°C
f = 1MHz
7Z05391-2.1.25.ci
30
C_d
(pF)
20
10
0
0
20
40
60
80
V_R (V)
100
max
typ


7Z05382-2.1.25.ci
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
T_j (°C)
0
50
100
150
200
typ
max
10V
10V
75V
V_R = 75V


7Z05383-2.1.25.ci
I_R (μA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
V_R (V)
0
20
40
60
80
T_j = 150°C
T_j = 25°C
max
typ
max
typ

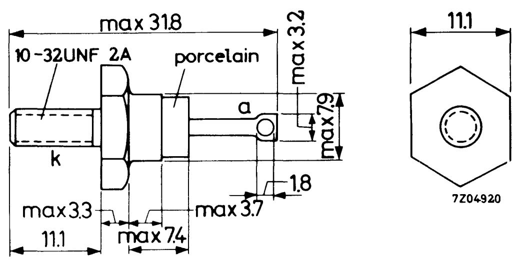
SILICON PLANAR EPITAXIAL VARACTOR DIODE

Varactor diode with a very low series resistance, in a low inductance, hermetically sealed, welded ceramic-metal DO-4 envelope.
The BAY96 is a high efficiency frequency multiplier designed for use in the v.h.f. and u.h.f. regions.
With the reverse voltage rating of 120 V, it can handle an input power up to 40 W.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	120	V
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	20	W
Junction temperature	T_j	max.	175	°C
Total capacitance at f = 1 MHz				
V_R = 6 V	C_d		28 to 39	pF
Diode series resistance at f = 400 MHz				
V_R = 6 V	r_D	max.	1.2	Ω
Cut-off frequency $\frac{1}{2\pi r_D C_d}$ at V_R = 120 V	f_{co}	typ.	25	GHz

MECHANICAL DATA Dimensions in mm

DO-4



7Z3 0172

RATINGS (Limiting values) [1])

Voltage

Continuous reverse voltage	V_R	max.	120	V

Power dissipation

Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	20	W

Temperatures

Storage temperature	T_{stg}		-65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	7.5	°C/W

CHARACTERISTICS

Total capacitance at f = 1 MHz				
V_R = 6 V	C_d	28 to	39	pF
Diode series resistance at f = 400 MHz				
V_R = 6 V	r_D	typ.	0.9	Ω
		<	1.2	Ω
Cut-off frequency $\frac{1}{2\pi r_D C_d}$ at V_R = 120 V	f_{co}	typ.	25	GHz

APPLICATION INFORMATION

Frequency tripler 150 to 450 MHz

The tripler circuit at page 3 consists of a parallel connection of the varactor, the input and output circuits, and the idler circuits. This shunt configuration has two outstanding advantages for high power harmonic generation.

1. The varactor can be grounded on one side, thus utilizing the chassis as a heatsink.
2. The varactor, being a low impedance device, operates best in a circuit that requires a low impedance coupling element between input and output circuits.

The function of the input and output networks is to provide impedance matching, and at the same time eliminate undesired r.f. current components, minimizing losses. A single tuned circuit is insufficient for the reduction of spurious response and therefore, a suitable output filter should follow the multiplier.

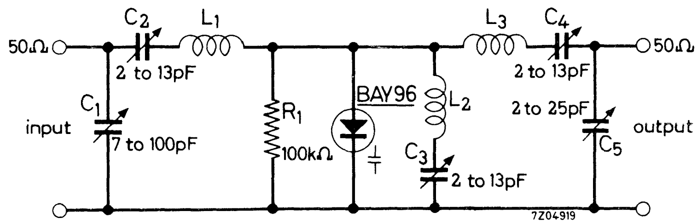
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0173

APPLICATION INFORMATION (continued)

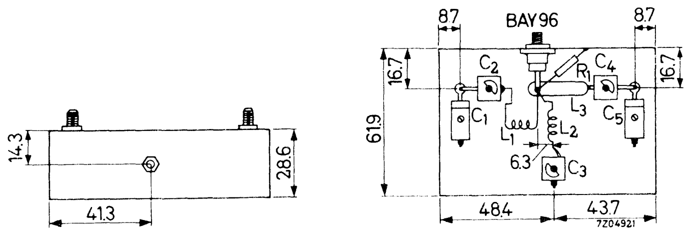
140 to 450 MHz tripler circuit

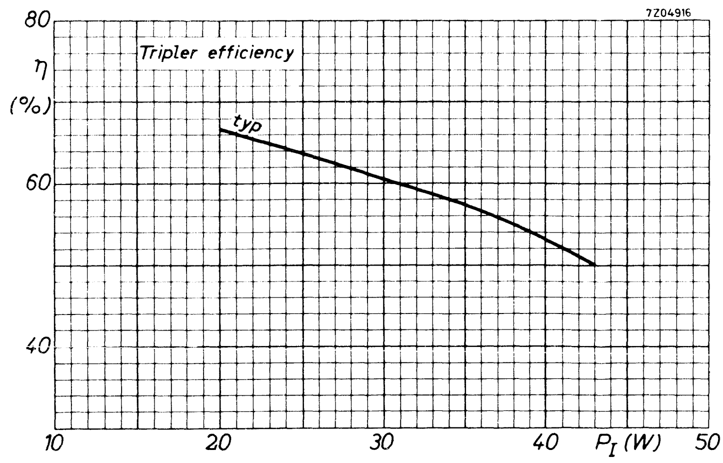
Efficiency at P_I = 25 W	η	>	60 %
		typ.	64 %



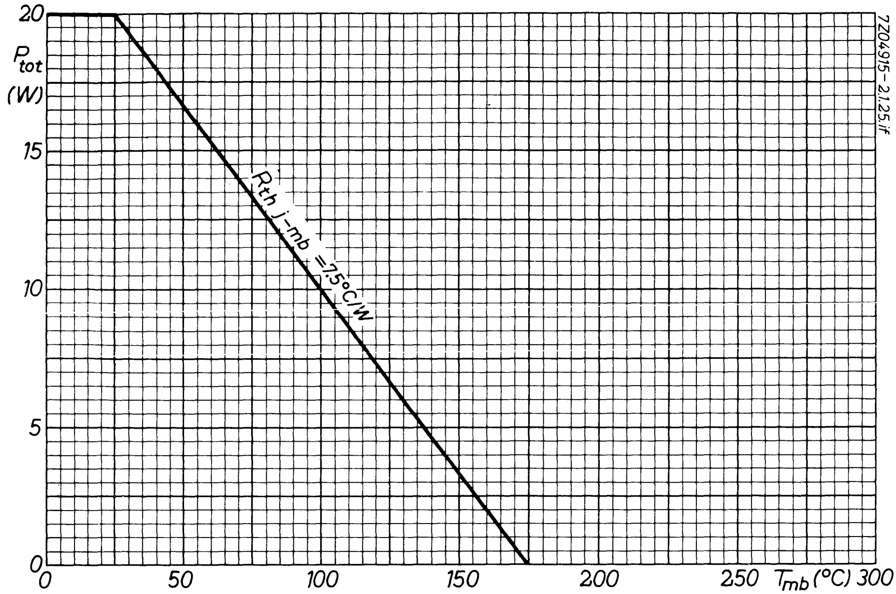
L_1 = 6.5 turns; d = 1.3 mm. Length of coil: 14.3 mm, inner diameter: 7.5 mm.
L_2 = 2 tunrs; d = 2 mm. Length of coil: 7.9 mm, inner diameter: 6.7 mm.
L_3 = copper strip, cross section 6.3 x 0.5 mm^2, length: 25.4 mm, height above chassis: 14.3 mm.

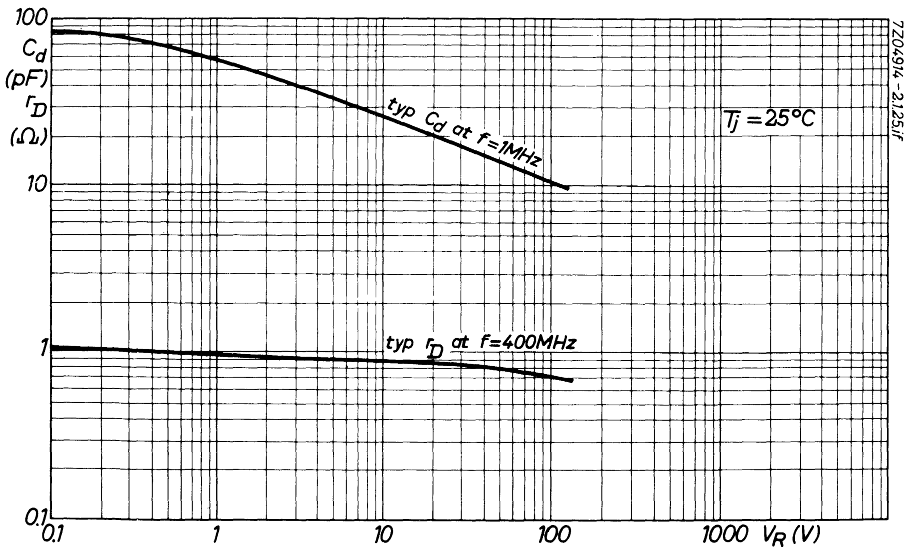
Component lay-out of tripler circuit: Dimensions in mm

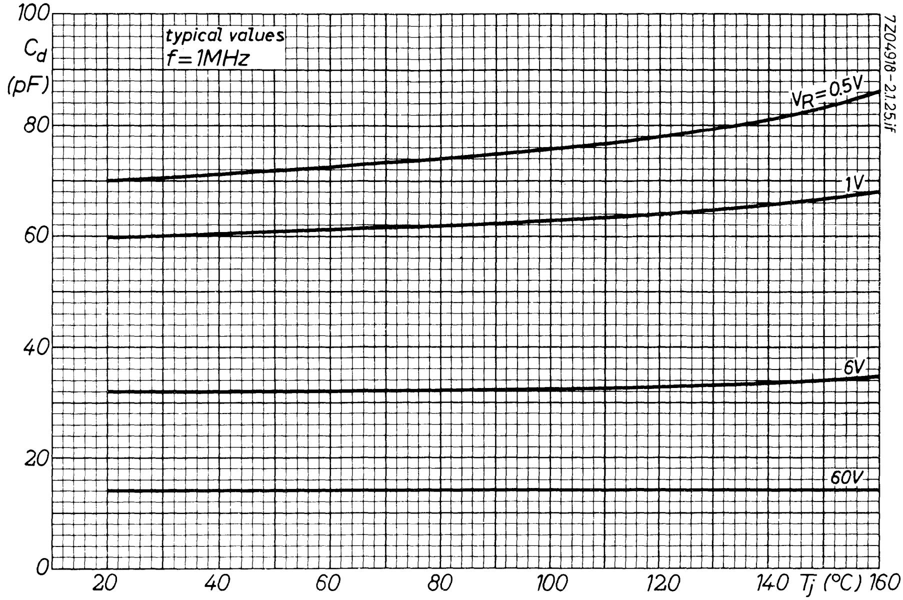


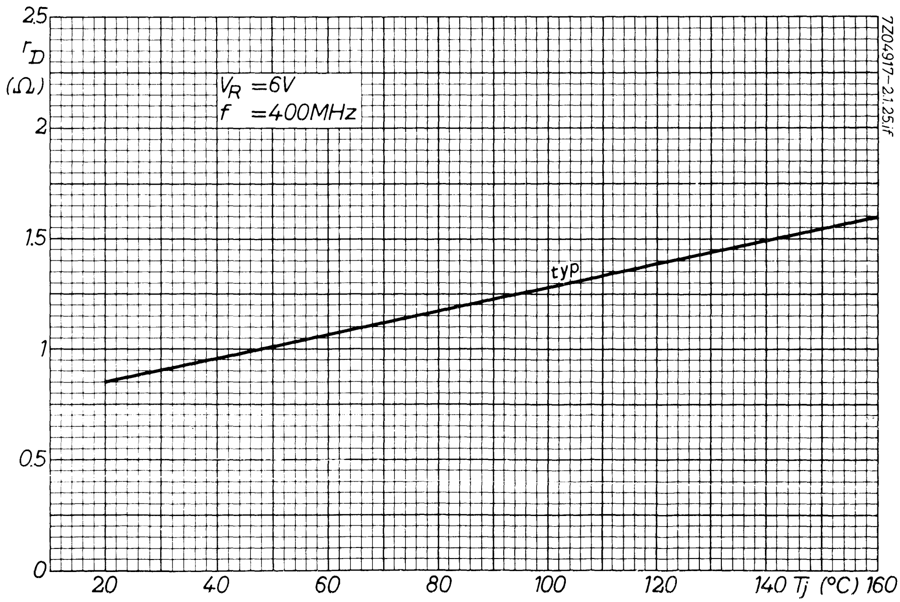


7Z2 0174


20
P_{tot}
(W)
15
10
5
0
0
50
100
150
200
250
T_{mb} (°C) 300
$R_{th\ j\text{-}mb}$ = 7.5°C/W
7Z04915-2.1.25.if


100
C_d
(pF)
r_D
(Ω)
10
1
0.1
0.1
1
10
100
1000
V_R (V)
typ C_d at f=1MHz
typ r_D at f=400MHz
T_j = 25°C
7Z04914-2.1.25.if


typical values
f = 1MHz
C_d
(pF)
100
80
60
40
20
0
20
40
60
80
100
120
140
T_j (°C)
160
V_R = 0.5V
1V
6V
60V
7Z04918-2.1.25.if


V_R = 6V
f = 400MHz
r_D
(Ω)
2.5
2
1.5
1
0.5
0
20
40
60
80
100
120
140
T_j (°C)
160
typ
7Z04917-2.1.25.if

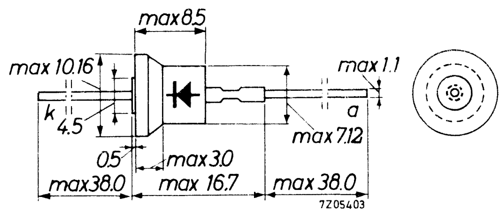
SILICON RECTIFIER DIODE

Silicon double diffused power diode in a DO-1 metal envelope. It is intended for mains rectifier application in television receivers.

QUICK REFERENCE DATA				
Repetitive peak reverse voltage	V_{RRM}	max.	800	V
Average forward current	I_{FAV}	max.	0.75	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	20	A
Operating ambient temperature	T_{amb}	max.	130	°C

MECHANICAL DATA Dimensions in mm

DO-1



7Z3 0687

RATINGS (Limiting values) [1]

Voltages

Repetitive peak reverse voltage	V_{RRM}	max.	800	V
Non repetitive peak reverse voltage (t < 10 ms)	V_{RSM}	max.	1250	V

Currents

Average forward current (averaged over any 50 ms period) (see page C)	I_{FAV}	max.	0.75	A
Repetitive peak forward current	I_{FRM}	max.	7.5	A
Non repetitive peak forward current (t = 10 ms; see page C)	I_{FSM}	max.	20	A [2]

TEMPERATURES

Storage temperature	T_{stg}	-55 to +150		^oC
Operating ambient temperature	T_{amb}	max.	130	^oC

CHARACTERISTICS

Voltage

Forward voltage I_F = 5 A; T_{mb} = 25 ^oC	V_F	<	1.5	V [3]

Current

Reverse current V_R = 1250 V; T_{mb} = 25 ^oC	I_R	<	10	μA

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

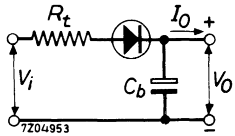
[2] The diode withstands the surge current during switching on (inrush current) with an uncharged capacitor of 200 μF and a limiting resistance of 5 Ω at the specified maximum operating condition.

[3] Measured with current pulses to prevent excessive dissipation. 7Z3 0386

APPLICATION INFORMATION

Typical operation as rectifier at T_{amb} = 70 °C

See page D

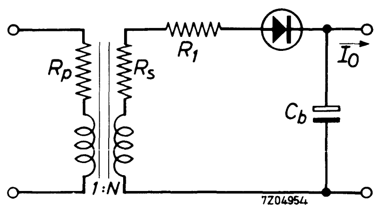


If large mains voltage fluctuations may be expected, a capacitor of 2.2 nF, 800 V across the diode is recommended.

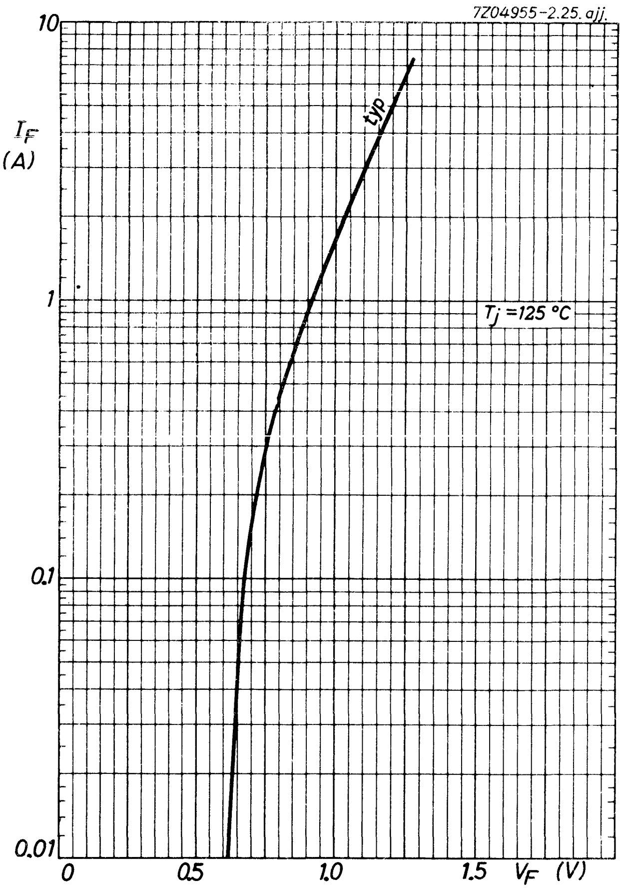
Input r.m.s. voltage	$V_{i\,(rms)}$	220	240	V
Buffer capacitor	C_b	200	200	μF
Surge limiting resistance	R_t	5	5	Ω [1]
Average output current	I_O	400	400	mA
Average output voltage	V_O	280	300	V

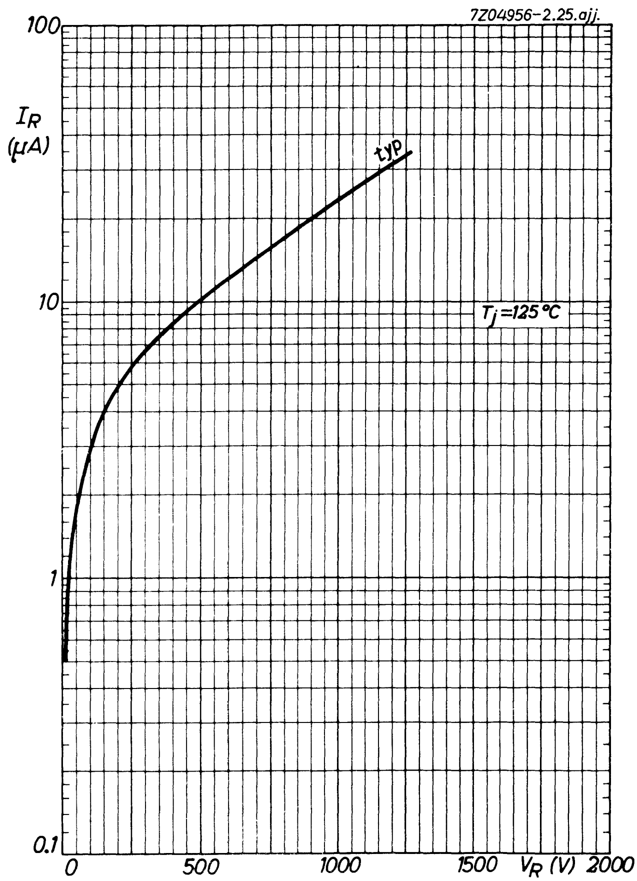
[1]) R_t = minimum required circuit resistance.
When a transformer is used between mains and rectifier circuit, then R_t may be calculated as follows:

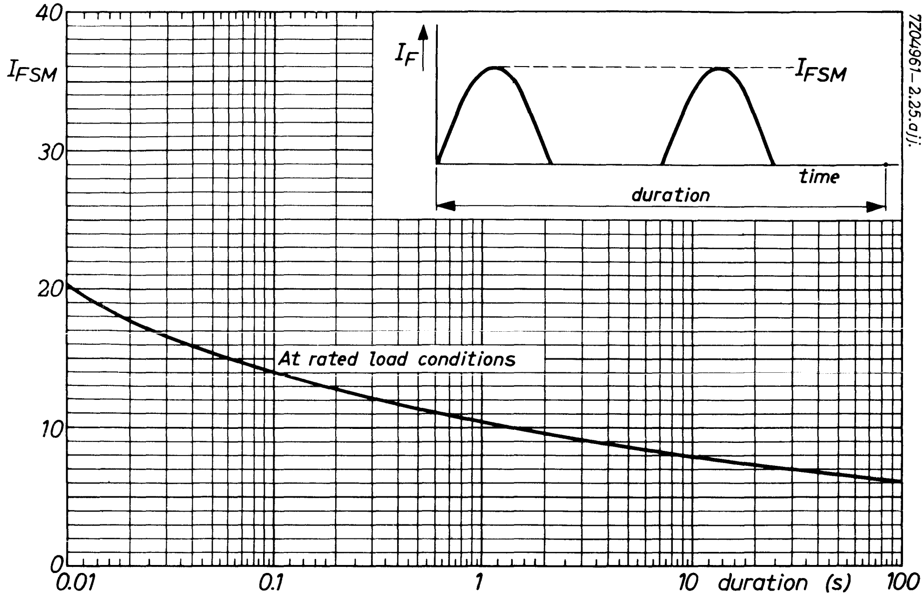
$$R_t = R_s + N^2 R_p + R_l$$



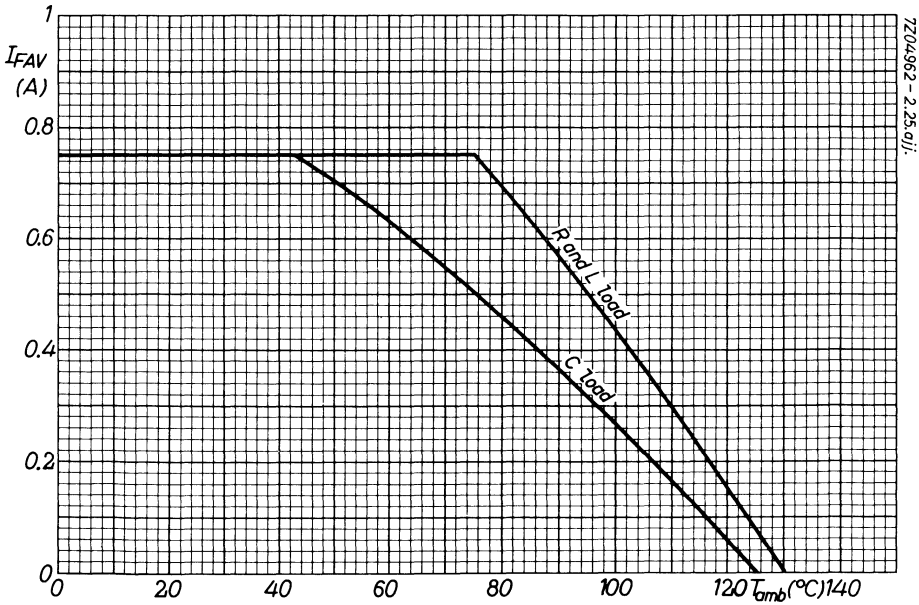
7Z3 0177


7Z04955-2.25. ajj.
10
1
0.1
0.01
I_F
(A)
typ
T_j =125 °C
0
0.5
1.0
1.5
V_F (V)

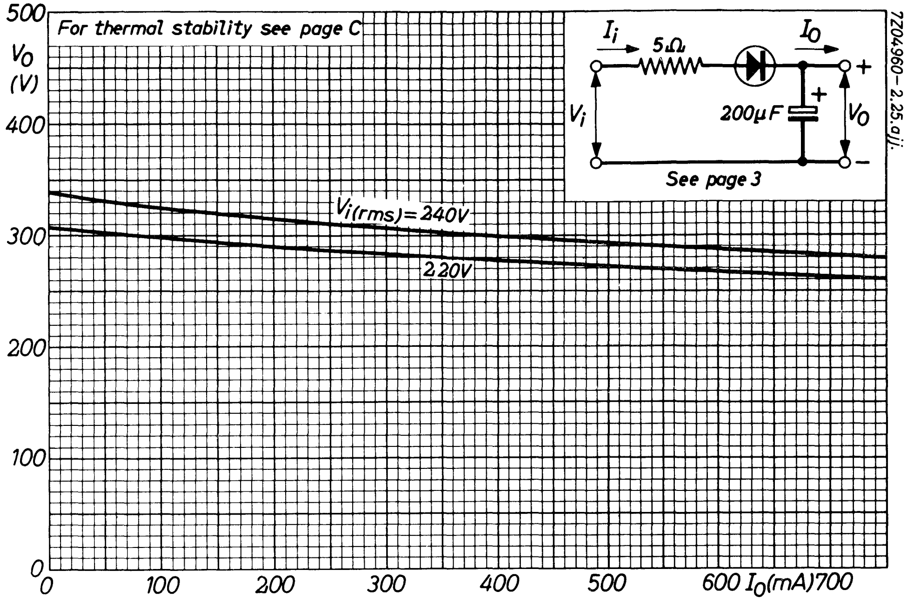

7Z04956-2.25.ajj.
100
I_R
(μA)
typ
10
T_j = 125 °C
1
0.1
0
500
1000
1500
V_R (V)
2000

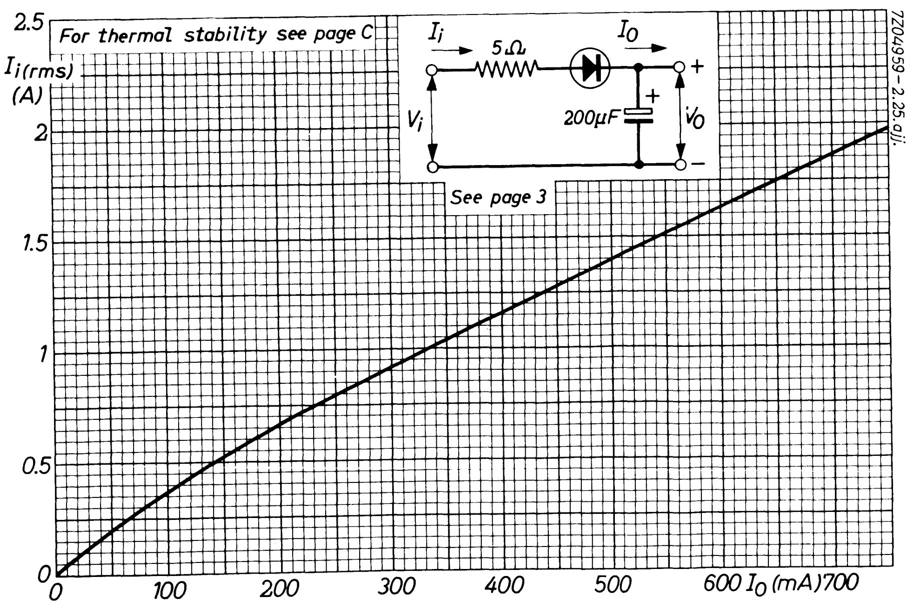


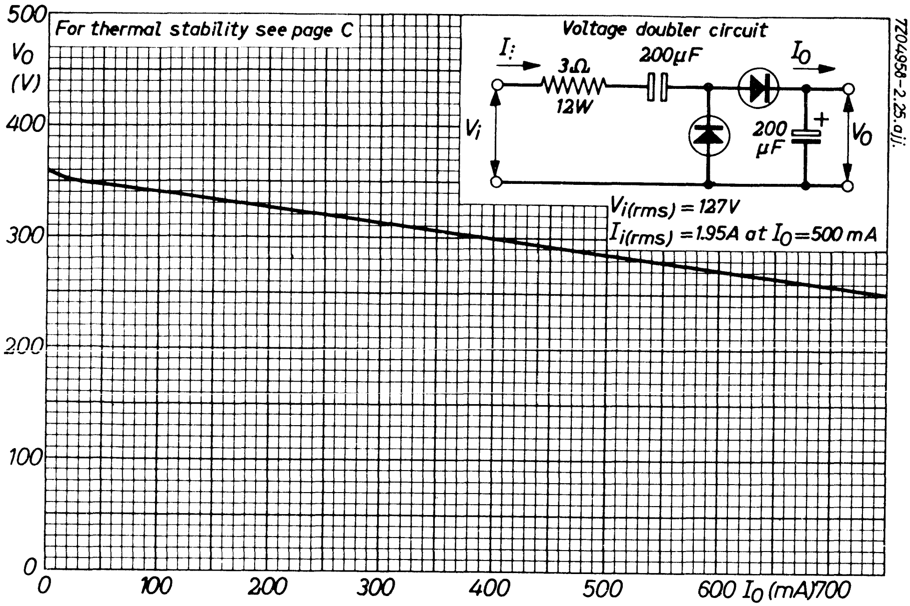
7Z04961–2.25.aij.
I_{FSM}
40
30
20
10
0
I_F
I_{FSM}
time
duration
At rated load conditions
0.01
0.1
1
10
duration (s)
100

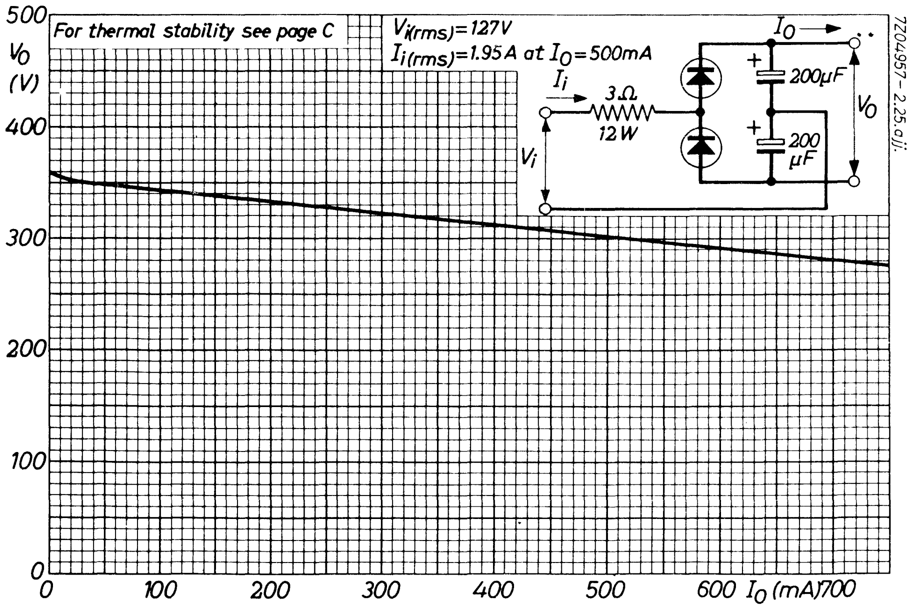


7Z04962–2.25.aij.
I_{FAV} (A)
1
0.8
0.6
0.4
0.2
0
R and L load
C load
0
20
40
60
80
100
120
T_{amb} (°C)
140


500
V_O
(V)
400
300
200
100
0
For thermal stability see page C
$V_{i(rms)}$ = 240V
220V
0
100
200
300
400
500
600 I_O(mA)700
I_i
5Ω
I_O
+
V_i
200µF
V_O
–
See page 3
7Z04960–2.25.aj.


2.5
$I_{i(rms)}$
(A)
2
1.5
1
0.5
0
For thermal stability see page C
0
100
200
300
400
500
600 I_O (mA)700
I_i
5Ω
I_O
+
V_i
200µF
V_O
–
See page 3
7Z04959–2.25.aj.


For thermal stability see page C
Voltage doubler circuit
V_O (V)
I_i
3Ω 12W
200µF
I_O
V_i
200 µF
V_O
$V_{i(rms)}$ = 127V
$I_{i(rms)}$ = 1.95A at I_O = 500 mA
I_O (mA)
7Z04958-2.25.aij.


For thermal stability see page C
$V_{i(rms)}$ = 127V
$I_{i(rms)}$ = 1.95A at I_O = 500mA
V_O (V)
I_i
3Ω 12W
V_i
200µF
200 µF
I_O
V_O
I_O (mA)
7Z04957-2.25.aij.

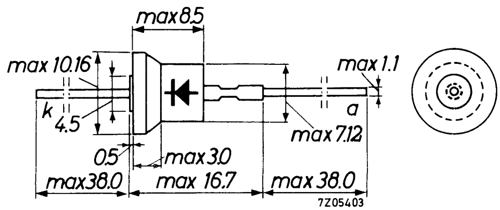
SILICON RECTIFIER DIODE

Silicon double diffused power diode in a DO-1 metal envelope. It is intended for mains rectifier application in television receivers.

QUICK REFERENCE DATA				
Repetitive peak reverse voltage	V_{RRM}	max.	450	V
Average forward current	I_{FAV}	max.	0.45	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	20	A
Operating ambient temperature	T_{amb}	max.	70	°C

MECHANICAL DATA Dimensions in mm

DO-1



7Z3 0584

RATINGS (Limiting values) [1])

Voltages

Repetitive peak reverse voltage	V_{RRM}	max.	450	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	650	V

Currents

Average forward current (averaged over any 50 ms period) (see page C)	I_{FAV}	max.	0.45	A
Repetitive peak forward current	I_{FRM}	max.	5	A
Non repetitive peak forward current ($t = 10$ ms; see page C)	I_{FSM}	max.	20	A [2])

TEMPERATURES

Storage temperature	T_{stg}		-55 to +150	^{o}C
Operating ambient temperature	T_{amb}	max.	70	^{o}C

CHARACTERISTICS

Voltage

Forward voltage $I_F = 5$ A; $T_{mb} = 25$ ^{o}C	V_F	<	1.5	V [3])

Current

Reverse current $V_R = 650$ V; $T_{mb} = 25$ ^{o}C	I_R	<	10	μA

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) The diode withstands the surge current during switching on (inrush current) with an uncharged capacitor of 200 μF and a limiting resistance of 3 Ω at the specified maximum operating condition.

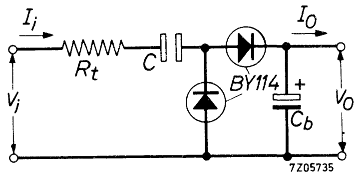
[3]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0585

APPLICATION INFORMATION

Typical operation as rectifier at T_{amb} = 70 °C

See page D

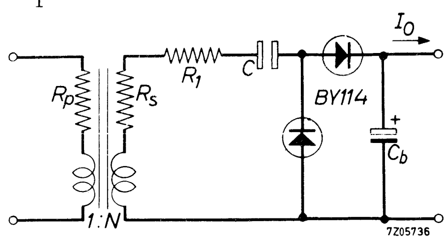


If large mains voltage fluctuations may be expected, a capacitor of 2.2 nF, 500 V across the diode is recommended.

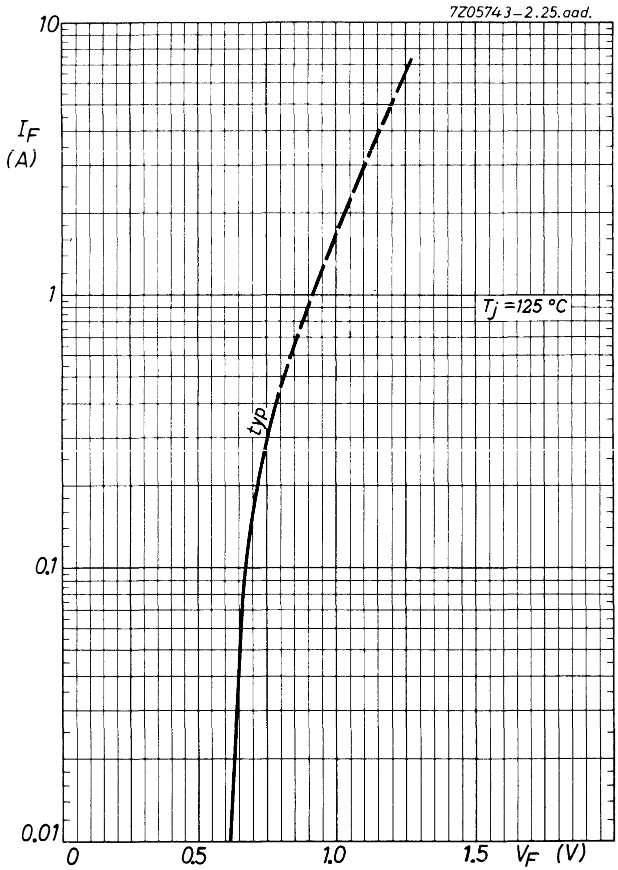
Input r.m.s. voltage	$V_{i\,(rms)}$	110	127	V
Buffer capacitor	C_b	200	200	µF
Surge limiting resistance	R_t	3	3	Ω [1]

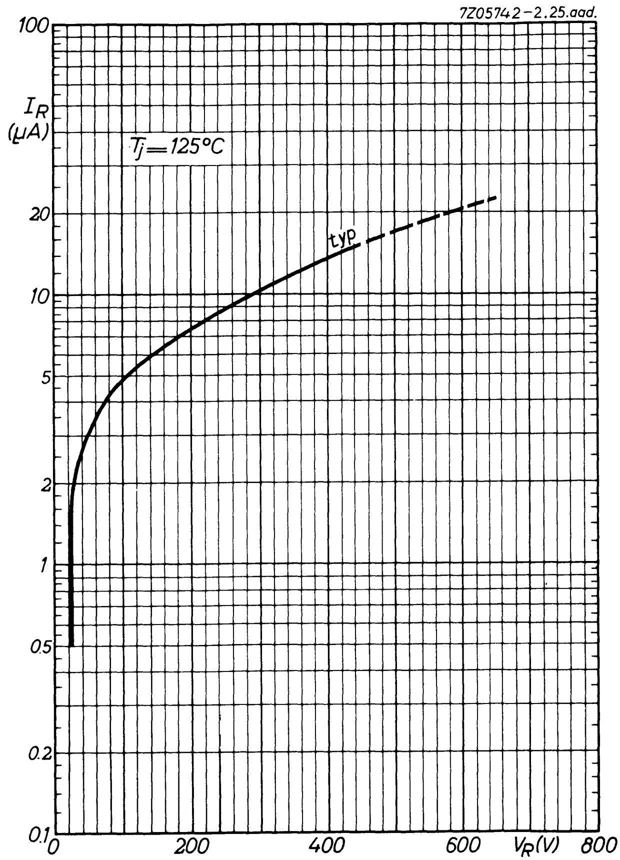
[1]) R_t = minimum required circuit resistance.
When a transformer is used between mains and rectifier circuit, then R_t may be calculated as follows:

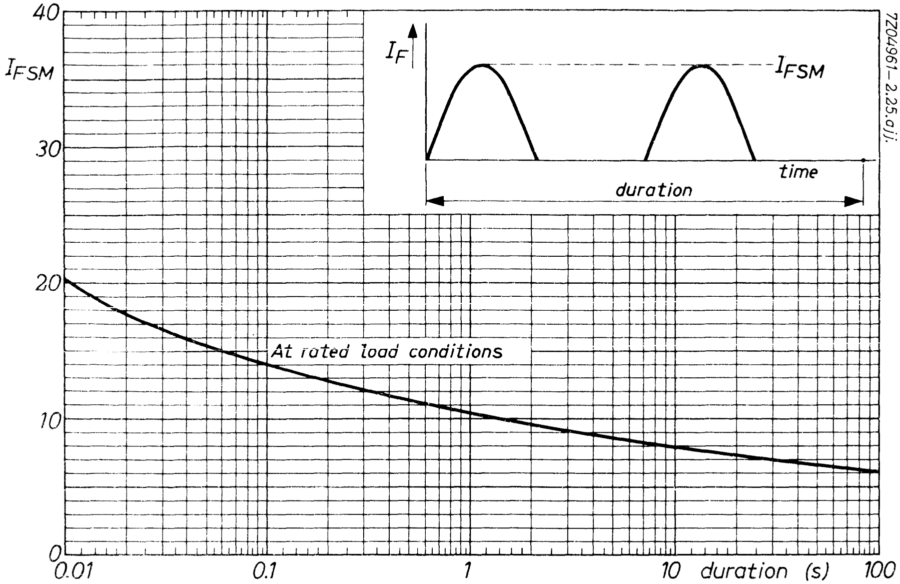
$$R_t = R_s + N^2 R_p + R_1$$



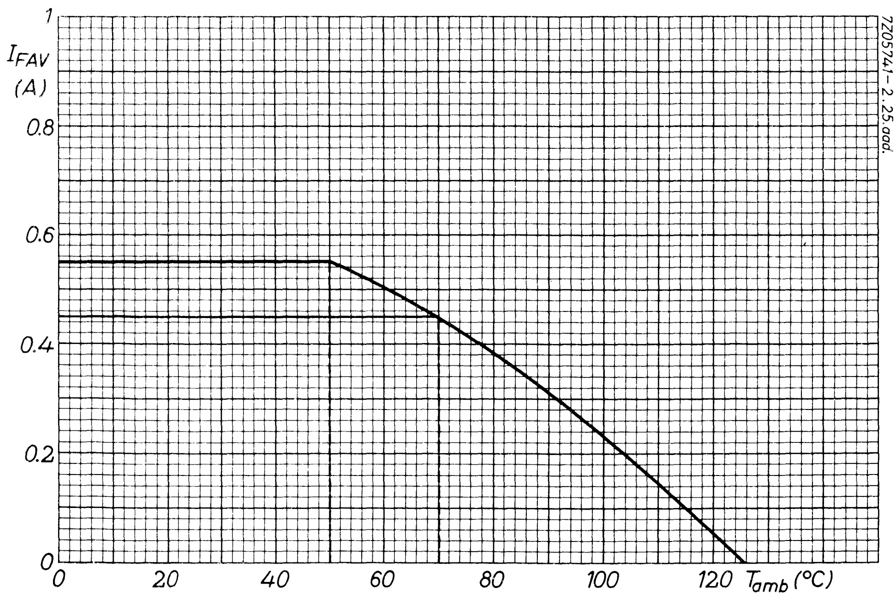
7Z3 0586


7Z05743-2.25.aad.
10
I_F
(A)
1
T_j =125 °C
typ
0.1
0.01
0
0.5
1.0
1.5
V_F (V)

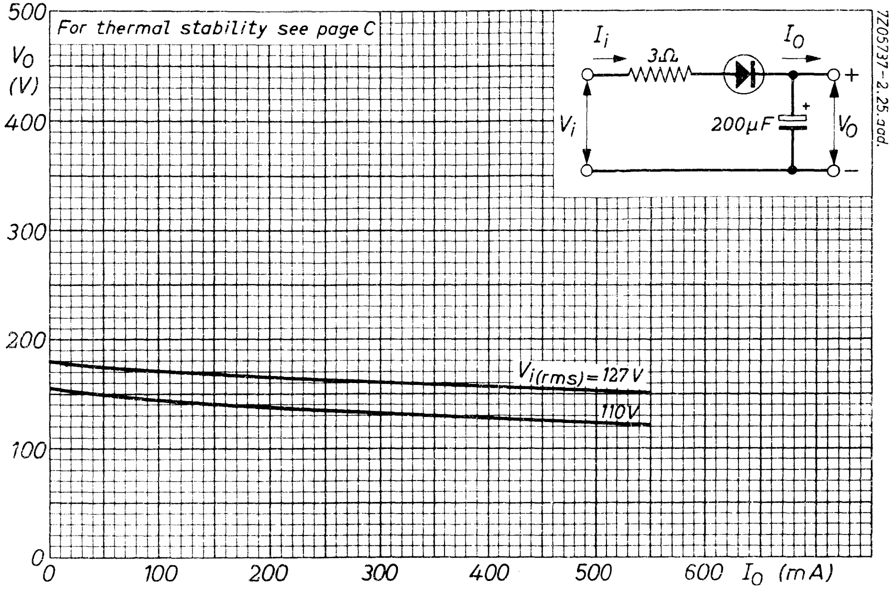

7Z05742-2.25.aad.
100
I_R
(μA)
T_j = 125°C
20
typ
10
5
2
1
0.5
0.2
0.1
0
200
400
600
V_R(V)
800



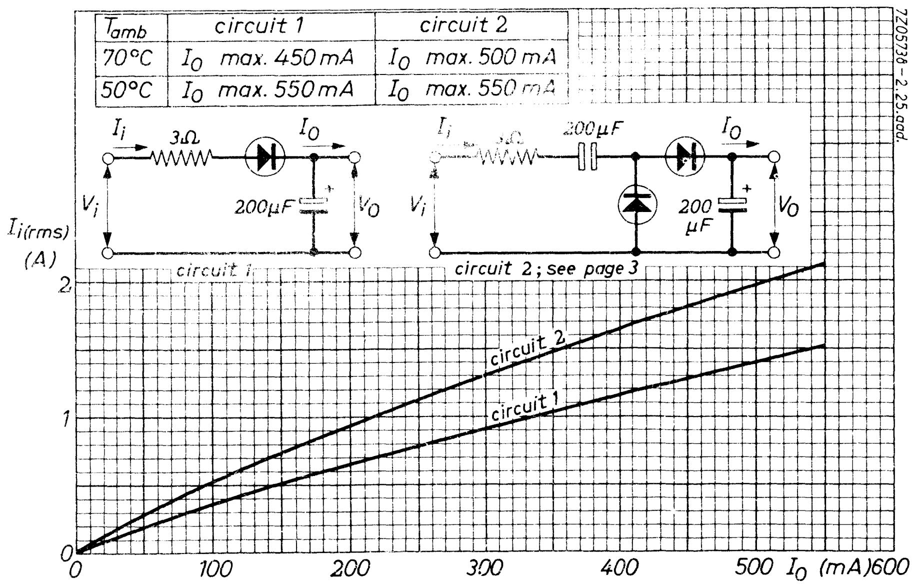
40
30
20
10
0
I_{FSM}
0.01
0.1
1
10
100
duration (s)
At rated load conditions
I_F
I_{FSM}
time
duration
7Z04961–2.25.a/j.

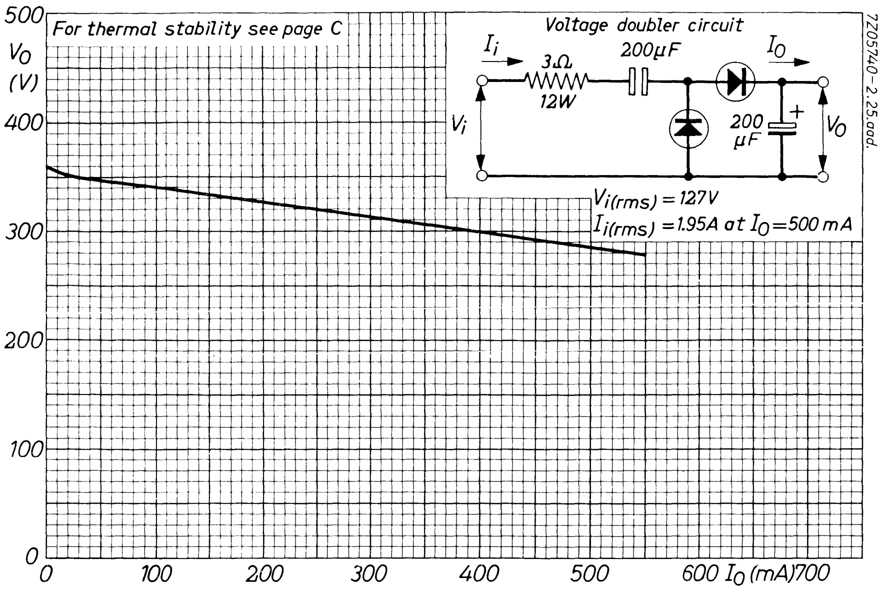


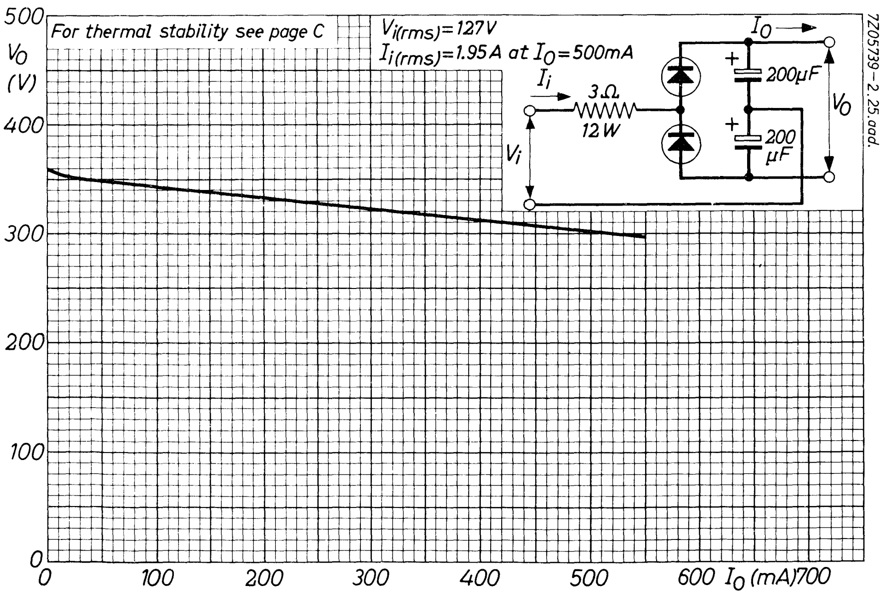
1
I_{FAV}
(A)
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
120
T_{amb} (°C)
7Z05741–2.25.aad.



T_{amb}	circuit 1	circuit 2
70°C	I_O max. 450 mA	I_O max. 500 mA
50°C	I_O max. 550 mA	I_O max. 550 mA




For thermal stability see page C
Voltage doubler circuit
V_O (V)
I_O (mA)
I_i
3Ω
12W
$200\mu F$
I_O
V_i
200 μF
V_O
$V_{i(rms)} = 127V$
$I_{i(rms)} = 1.95A$ at $I_O = 500\,mA$
7Z05740-2.25.aad.


For thermal stability see page C
$V_{i(rms)} = 127V$
$I_{i(rms)} = 1.95A$ at $I_O = 500mA$
V_O (V)
I_O (mA)
I_O
I_i
3Ω
12 W
$200\mu F$
200 μF
V_i
V_O
7Z05739-2.25.aad.

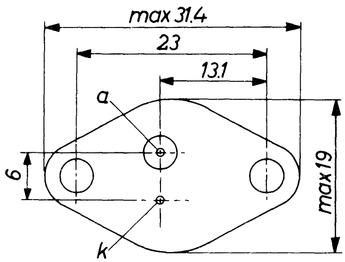
SILICON POWER DIODE

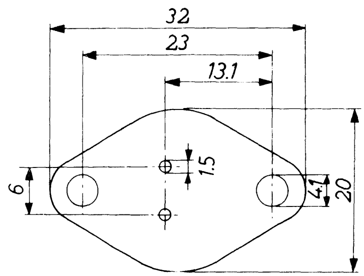
Silicon diffused power diode in a metal envelope for use as efficiency diode in line deflection circuits of television receivers.

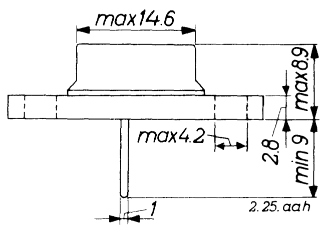
QUICK REFERENCE DATA				
Repetitive peak reverse voltage	V_{RRM}	max.	300	V
Average forward current	I_{FAV}	max.	5	A
Repetitive peak forward current	I_{FRM}	max.	14	A
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	^{o}C/W

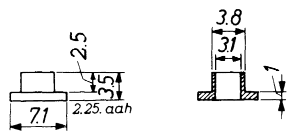
MECHANICAL DATA

Dimensions in mm



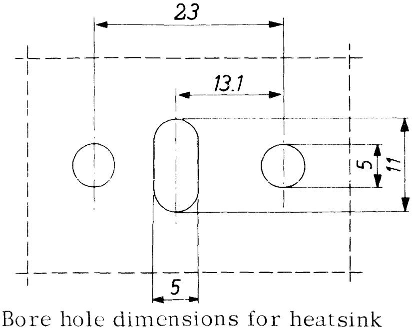






Mica insulation (50 to 100 μm) and insulation tubes

The cathode is connected to the case



7Z3 0590

Bore hole dimensions for heatsink

RATINGS (Limiting values) [1])

Voltage

Repetitive peak reverse voltage	V_{RRM}	max.	300	V

Currents

Forward current (d.c.)	I_F	max.	6	A
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	5	A
Repetitive peak forward current	I_{FRM}	max.	14	A
Repetitive peak forward current (t = 3 μs)	I_{FRM}	max.	20	A

Temperatures

Storage temperature	T_{stg}		−55 to +150	^{o}C
Junction temperature	T_j	max.	150	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^{o}C/W$
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	1.5	$^{o}C/W$

CHARACTERISTICS T_j = 25 ^{o}C unless otherwise specified

Forward voltage at I_F = 14 A	V_F	<	1.2	V
Reverse current at V_R = 300 V	I_R	<	100	μA

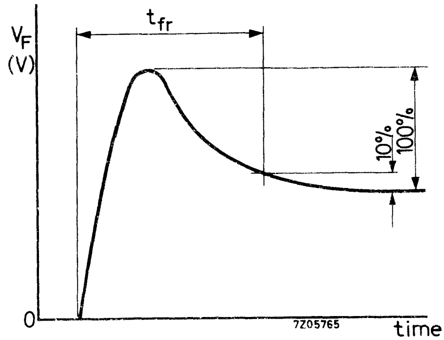
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0591

CHARACTERISTICS (continued) T_j up to 150 °C

Forward recovery time

I_F = 14 A; t_r = 0.25 μs — t_{fr} < 1.0 μs

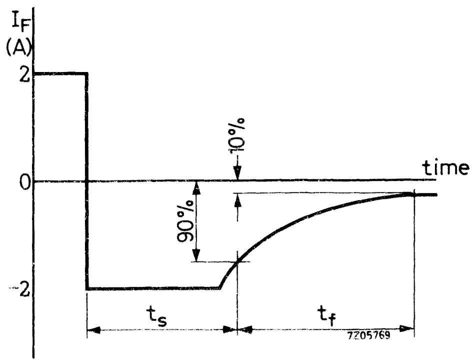


Forward output wave form

Reverse recovery time when switched from

I_F = 2 A to V_R = 30 V; I_R limited to 2 A;
t_r < 0.25 μs

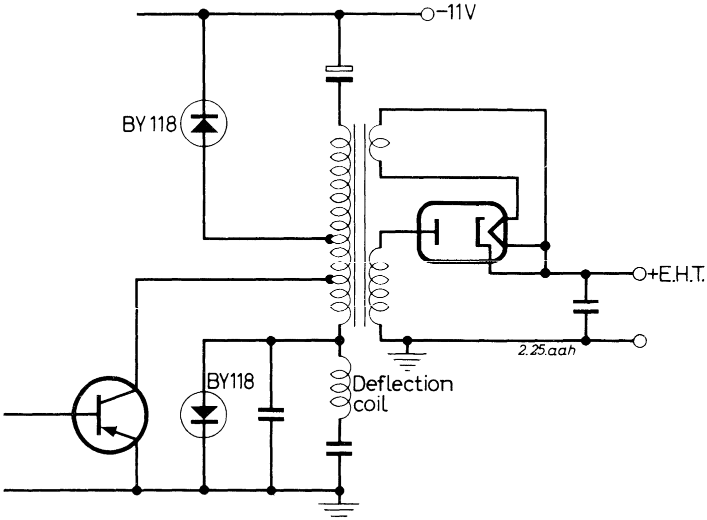
Storage time	t_s	<	3	μs
Fall time	t_f	<	1	μs



Reverse output wave form

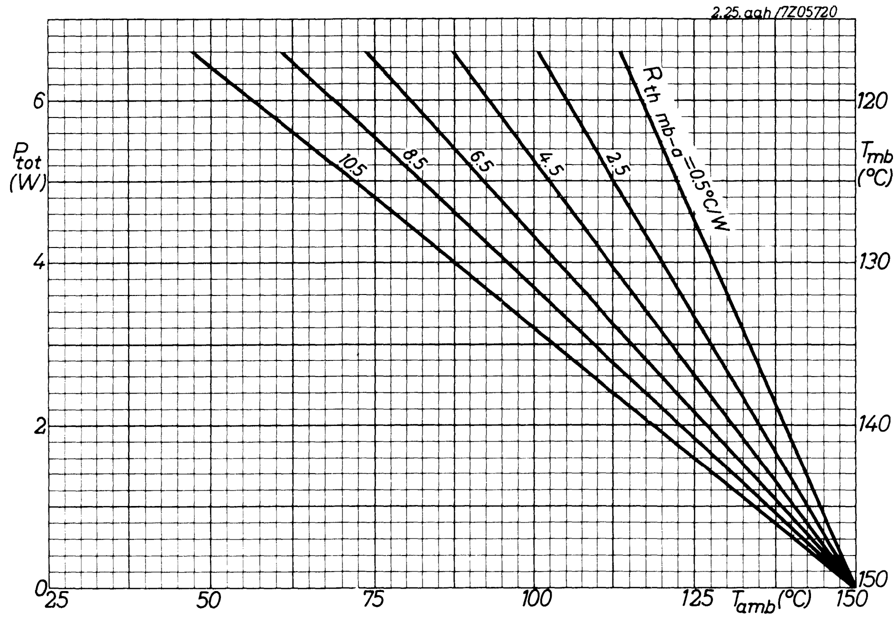
7Z3 0592

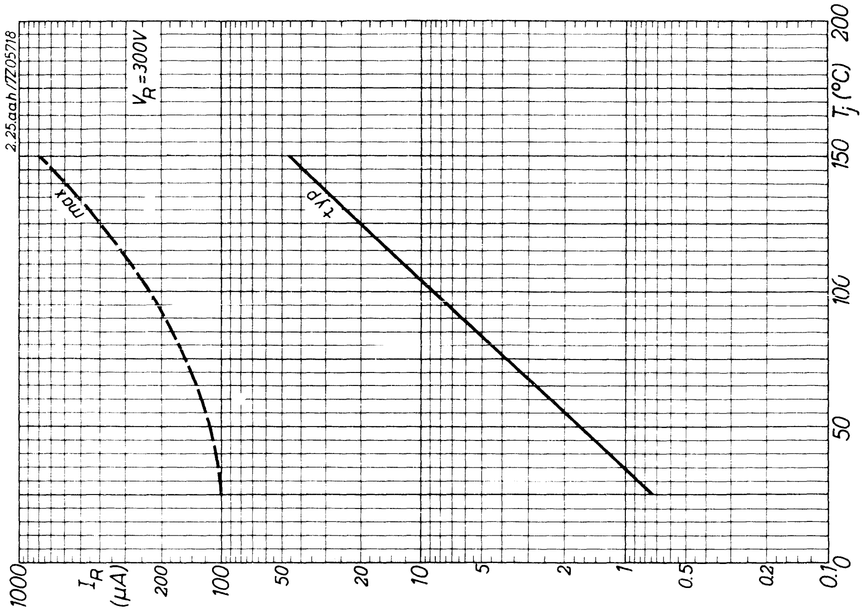
APPLICATION INFORMATION

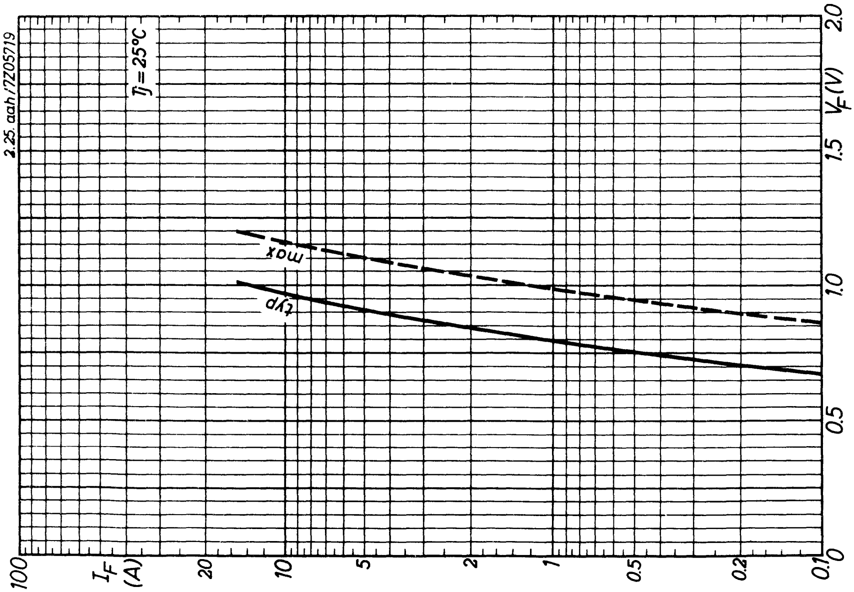


Typical fundamental line deflection circuit with a series efficiency diode and a parallel efficiency diode

7Z3 0593


2.25.aah /7Z05720
6
4
2
0
P_{tot}
(W)
25
50
75
100
125
T_{amb} (°C)
150
120
130
140
150
T_{mb}
(°C)
$R_{th\ mb-a}$ = 0.5°C/W
2.5
4.5
6.5
8.5
10.5


2.25.aah/7Z05718
$V_R = 300V$
max
typ
I_R (μA)
1000
200
100
50
20
10
5
2
1
0.5
0.2
0.1
T_j (°C)
0
50
100
150
200


2.25.aah/7Z05719
$T_j = 25°C$
max
typ
I_F (A)
100
20
10
5
2
1
0.5
0.2
0.1
V_F (V)
0
0.5
1.0
1.5
2.0

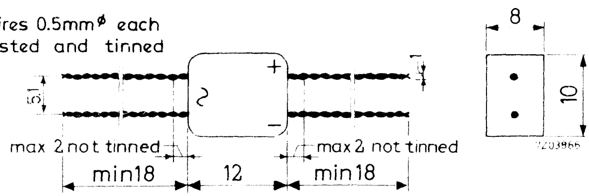
BRIDGE RECTIFIER ASSEMBLY

Bridge rectifier assembly in a plastic envelope equipped with four silicon double diffused junction diodes.
It is primarily intended for transistorized equipment drawing its power from mains with frequencies up to 400 Hz.

QUICK REFERENCE DATA				
For meaning of symbols see page 2				
<u>Input</u>				
R.M.S. voltage	$V_{I(rms)}$	max.	42	V
Repetitive peak voltage	V_{IRM}	max.	120	V
<u>Output</u>				
Continuous voltage with C load	V_O		60	V
with R and L load	V_O		38	V
Average current with R and L load up to T_{amb} = 35 °C	I_O	max.	0.8	A
Repetitive peak current	I_{ORM}	max.	3	A
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	55	°C/W

MECHANICAL DATA Dimensions in mm

Plastic envelope with polarity indications at both sides.



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles) 7Z3 0447

All information applies to mains frequencies up to 400 Hz.

RATINGS (Limiting values) [1])

Input

R.M.S. voltage	$V_{I(rms)}$	max.	42	V
Crest working voltage	V_{IWM}	max.	60	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Non repetitive peak voltage; $t < 10$ ms	V_{ISM}	max.	120	V

Output

Average current with C load	See pages A and C			
Average current with R and L load up to $T_{amb} = 35$ °C (See also page A)	I_O	max.	0.8	A
Repetitive peak current	I_{ORM}	max.	3	A
Non repetitive peak current (See also page B)	I_{OSM}	max.	15	A

Temperatures

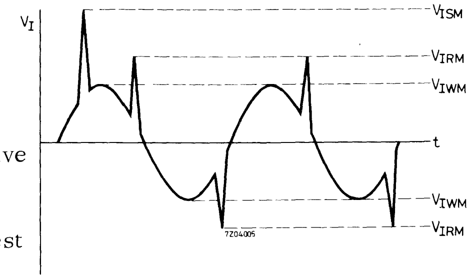
Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	55	°C/W

MEANING OF SYMBOL SUBSCRIPTS

First subscript	I	=	input
	O	=	output
Second subscript	R	=	repetitive
	S	=	non repetitive
	W	=	working
Third subscript	M	=	peak or crest



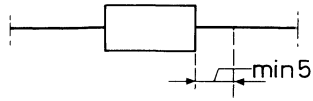
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0448

MOUNTING INSTRUCTIONS

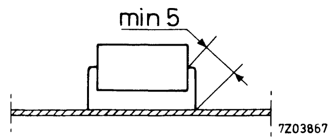
Iron soldering

At a maximum iron temperature of 300 $^{\circ}C$, the maximum permissible soldering time is 3 seconds, provided the soldering spot is at least 5 mm from the seal.



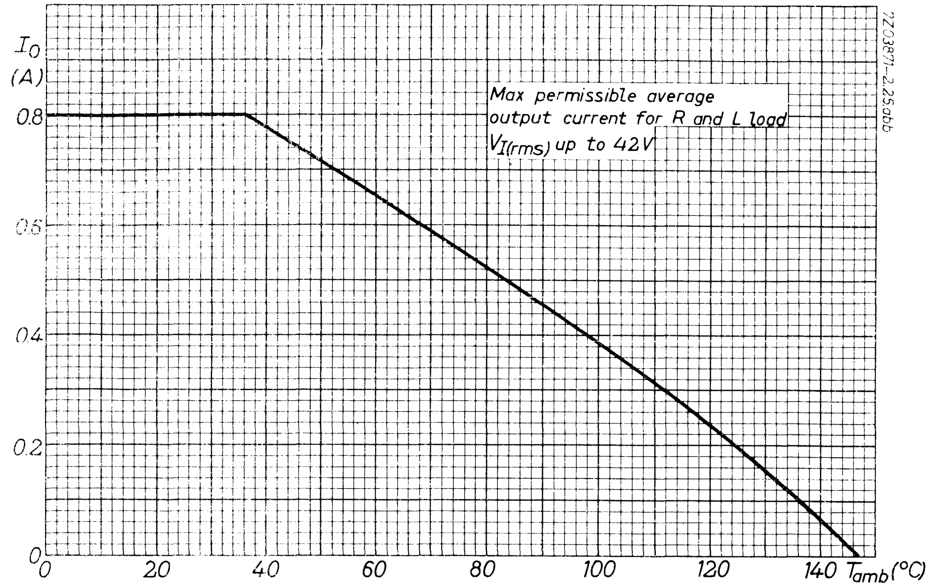
Dip soldering

At a maximum solder temperature of 300 $^{\circ}C$, the maximum permissible soldering time is 3 seconds, provided the soldering spot is at least 5 mm from the seal.

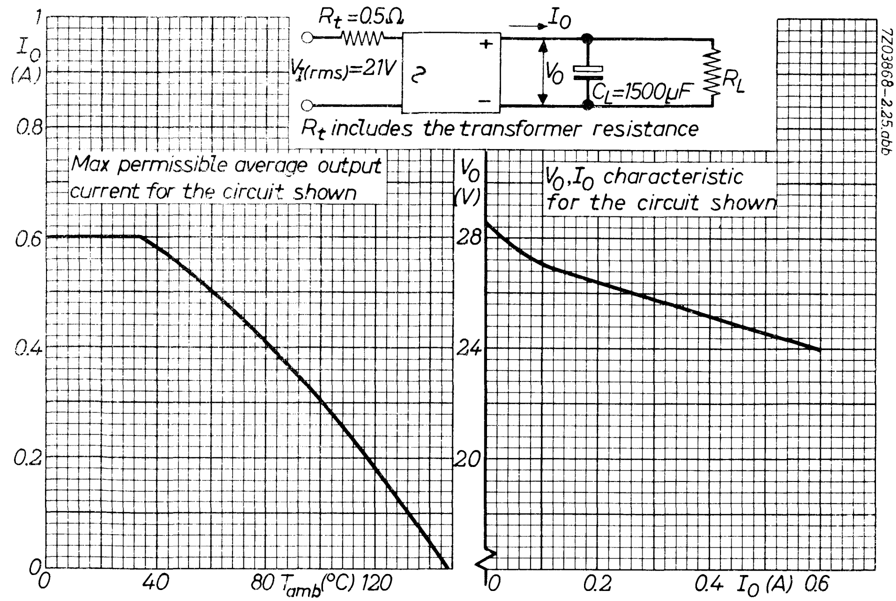


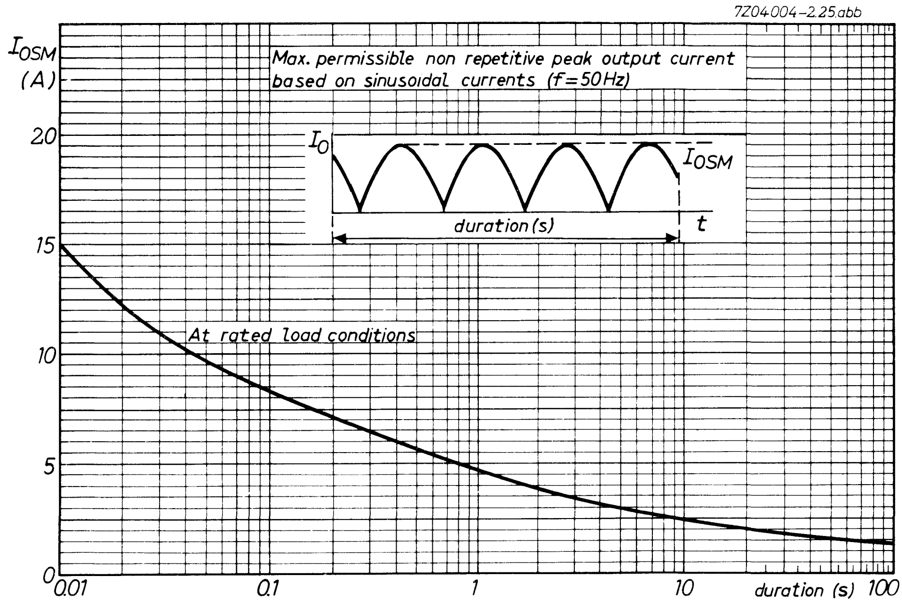
Note: If during soldering the assembly is in contact with the printed board the maximum permissible temperature of the point of contact is 125 $^{\circ}C$.

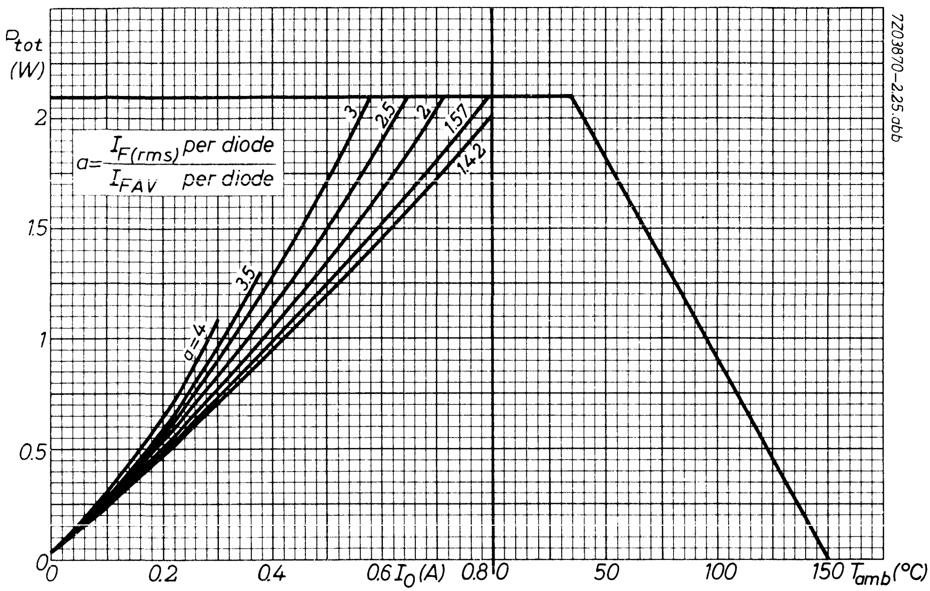
7Z3 0449



TYPICAL OPERATION WITH C–LOAD




7Z04004-2.25.abb
I_{OSM}
(A)
20
15
10
5
0
0.01
0.1
1
10
duration (s)
100
Max. permissible non repetitive peak output current
based on sinusoidal currents (f=50Hz)
I_O
I_{OSM}
duration (s)
t
At rated load conditions



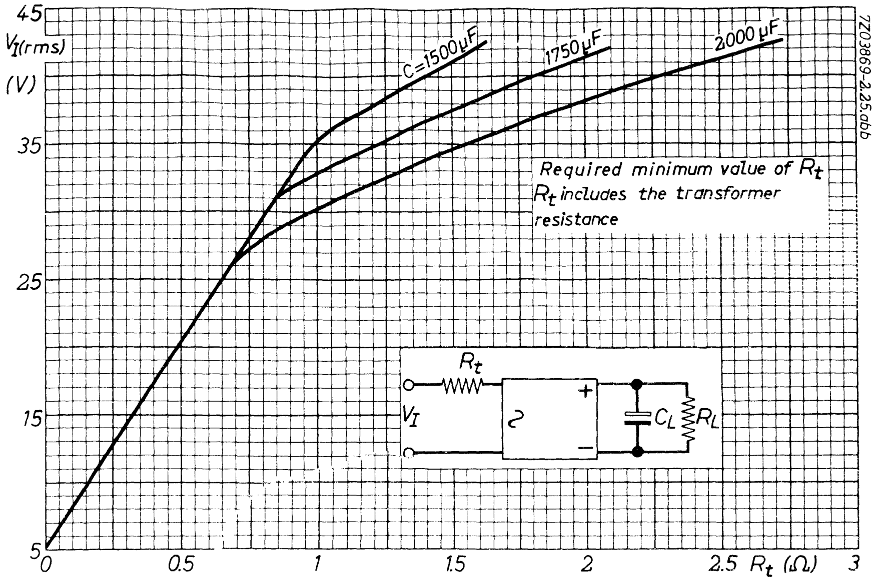
From the lefthand graph the total power dissipation can be found as a function of the average output current.

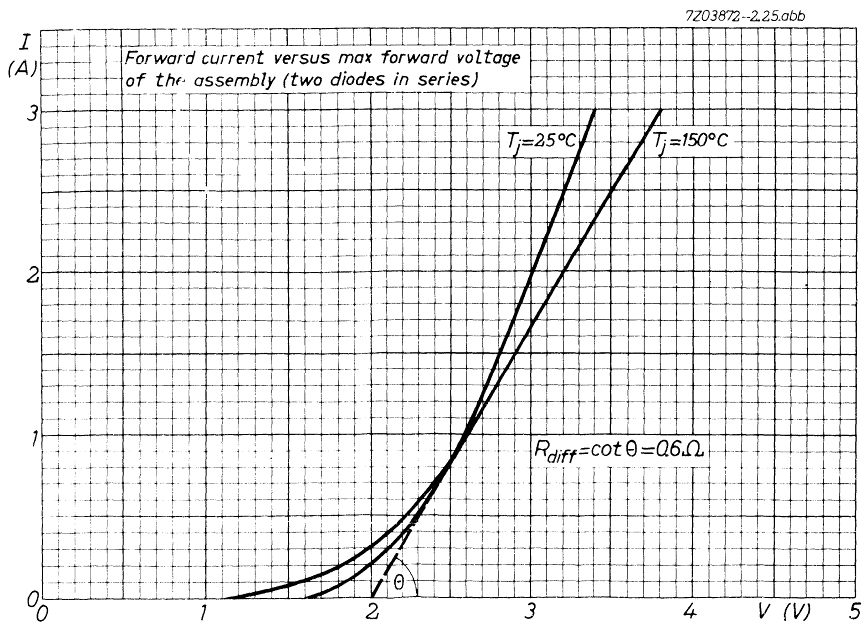
The parameter $a = \frac{I_{F(rms)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\frac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

See for instance "Power rectification with silicon diodes".
Once the power dissipation is known, the max. permissible ambient temperature follows from the righthand graph.

For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph at page D.
R_{diff} is shown at page D, lower figure.

7Z2 3577


45
V_I(rms)
(V)
35
25
15
5
0
0.5
1
1.5
2
2.5
R_t (Ω)
3
C=1500μF
1750μF
2000μF
7Z03669-2.25.abb
Required minimum value of R_t
R_t includes the transformer resistance
R_t
V_I
+
−
C_L
R_L


7Z03872--2.25.abb
I
(A)
Forward current versus max forward voltage of the assembly (two diodes in series)
3
2
1
0
0
1
2
3
4
V (V)
5
T_j=25°C
T_j=150°C
R_{diff}=cot θ=0.6Ω
θ

BRIDGE RECTIFIER ASSEMBLY

Bridge rectifier assembly in a plastic envelope equipped with four silicon double diffused junction diodes.
It is primarily intended for transistorized equipment drawing its power from mains with frequencies up to 400 Hz.

QUICK REFERENCE DATA

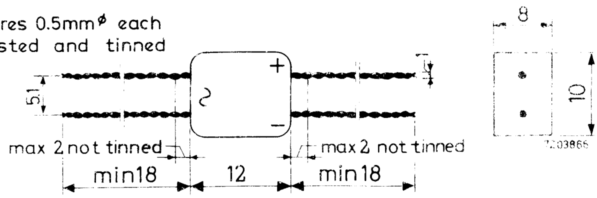
For meaning of symbols see page 2

Input				
R.M.S. voltage	$V_{I(rms)}$	max.	280	V
Repetitive peak voltage	V_{IRM}	max.	800	V
Output				
Continuous voltage				
with C load	V_O		400	V
with R and L load	V_O		255	V
Average current with R and L load up to T_{amb} = 40 °C	I_O	max.	0.6	A
Repetitive peak current	I_{ORM}	max.	2	A
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	55	°C/W

MECHANICAL DATA

Dimensions in mm

Plastic envelope with polarity indications at both sides



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles)

7Z3 0450

All information applies to mains frequencies up to 400 Hz.

RATINGS (Limiting values) [1])

Input

R.M.S. voltage	$V_{I(rms)}$	max.	280	V
Crest working voltage	V_{IWM}	max.	400	V
Repetitive peak voltage	V_{IRM}	max.	800	V
Non repetitive peak voltage; $t < 10$ ms	V_{ISM}	max.	800	V

Output

Average current with C load	See pages A and C			
Average current with R and L load up to T_{amb} = 40 °C (See also page A)	I_O	max.	0.6	A
Repetitive peak current	I_{ORM}	max.	2	A
Non repetitive peak current (See also page B)	I_{OSM}	max.	15	A

Temperatures

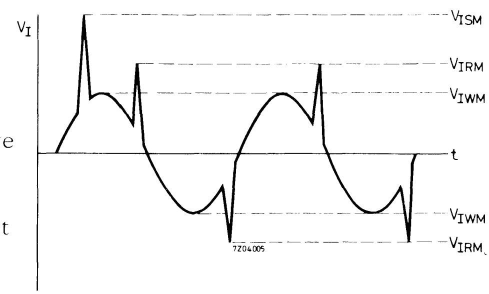
Storage temperature	T_{stg}	-65 to +125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	55	°C/W

MEANING OF SYMBOL SUBSCRIPTS

First subscript	I	=	input
	O	=	output
Second subscript	R	=	repetitive
	S	=	non repetitive
	W	=	working
Third subscript	M	=	peak or crest



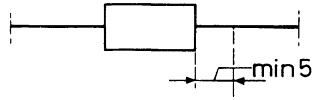
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0451

MOUNTING INSTRUCTIONS

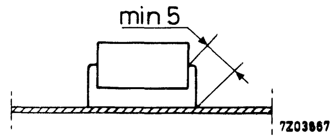
Iron soldering

At a maximum iron temperature of 300 ^{o}C, the maximum permissible soldering time is 3 seconds, provided the soldering spot is at least 5 mm from the seal.



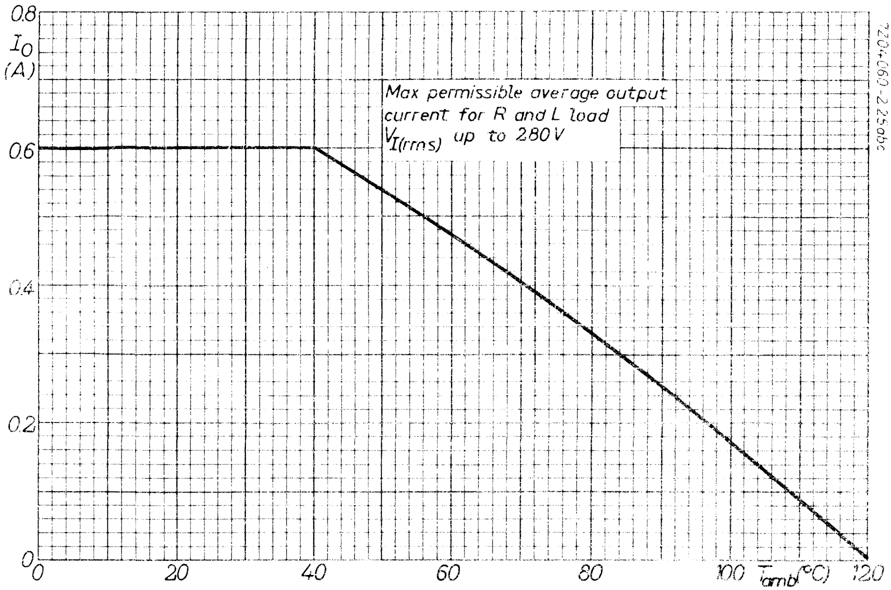
Dip soldering

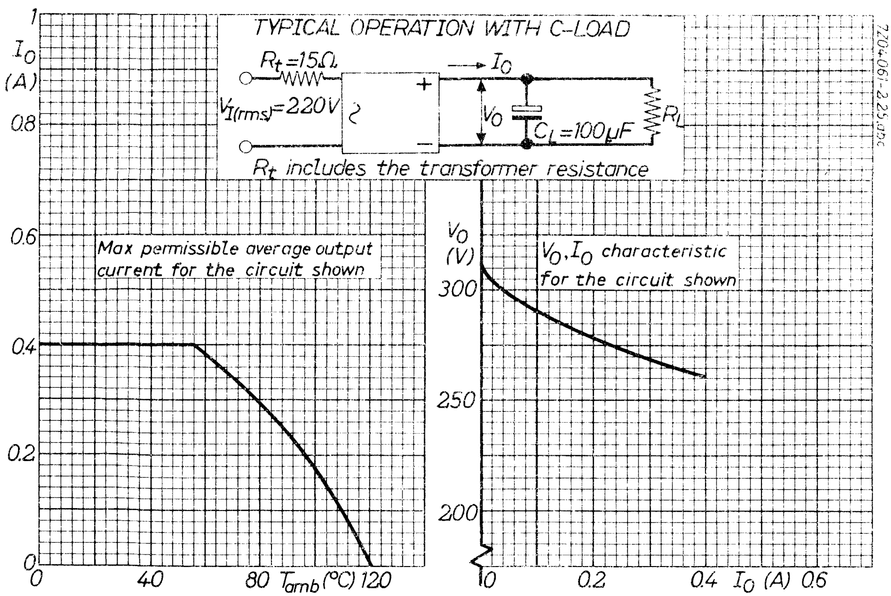
At a maximum solder temperature of 300 ^{o}C, the maximum permissible soldering time is 3 seconds, provided the soldering spot is at least 5 mm from the seal.

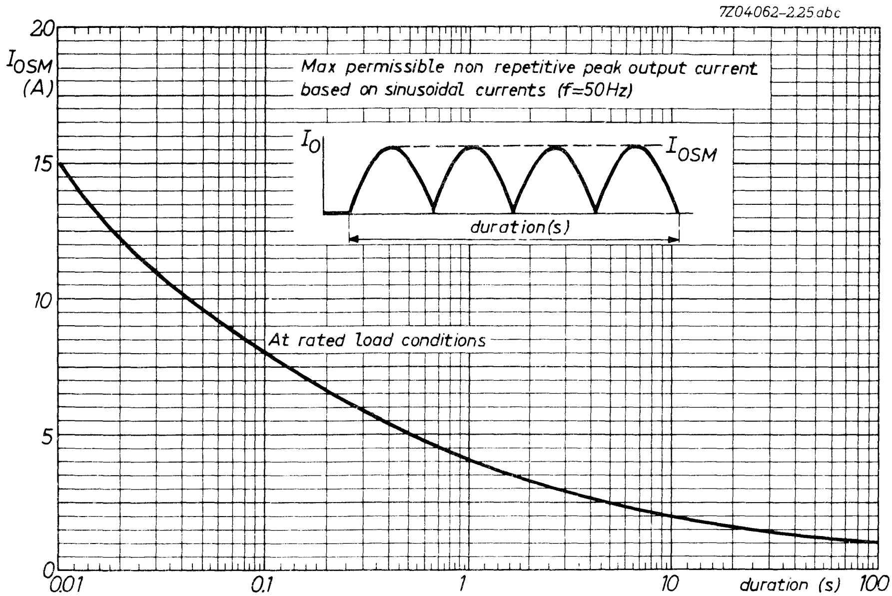


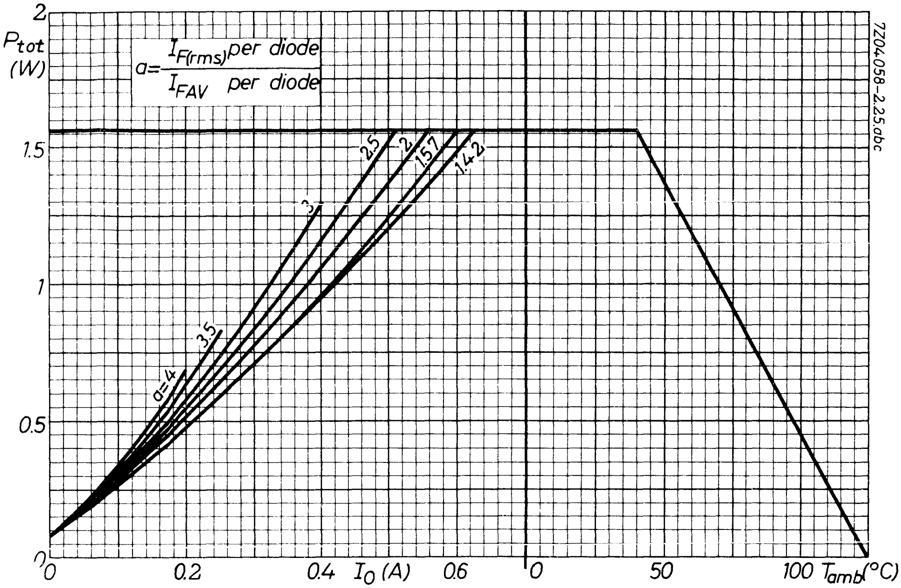
Note: If during soldering the assembly is in contact with the printed board the maximum permissible temperature of the point of contact is 125 ^{o}C.

7Z3 0449


0.8
I_O
(A)
0.6
0.4
0.2
0
Max permissible average output current for R and L load $V_{I(rms)}$ up to 280 V
0
20
40
60
80
100 T_{amb} (°C) 120


TYPICAL OPERATION WITH C-LOAD
R_t = 15 Ω
I_O
$V_{I(rms)}$ = 220 V
+
−
V_O
C_L = 100 μF
R_L
R_t includes the transformer resistance
1
I_O
(A)
0.8
0.6
0.4
0.2
0
Max permissible average output current for the circuit shown
0
40
80 T_{amb} (°C) 120
V_O
(V)
300
250
200
V_O, I_O characteristic for the circuit shown
0
0.2
0.4 I_O (A) 0.6


7Z04062-2.25abc
20
I_{OSM}
(A)
15
10
5
0
Max permissible non repetitive peak output current
based on sinusoidal currents (f=50Hz)
I_O
I_{OSM}
duration(s)
At rated load conditions
0.01
0.1
1
10
duration (s)
100

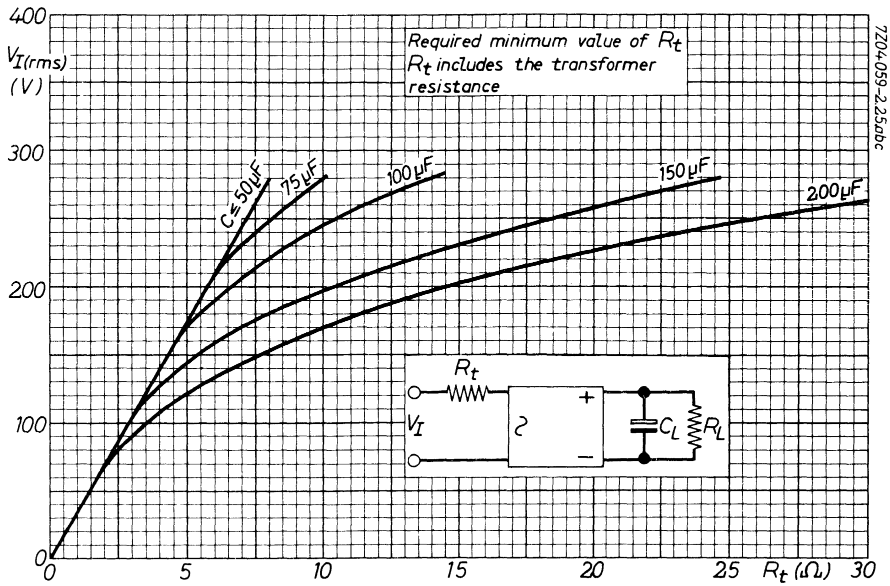


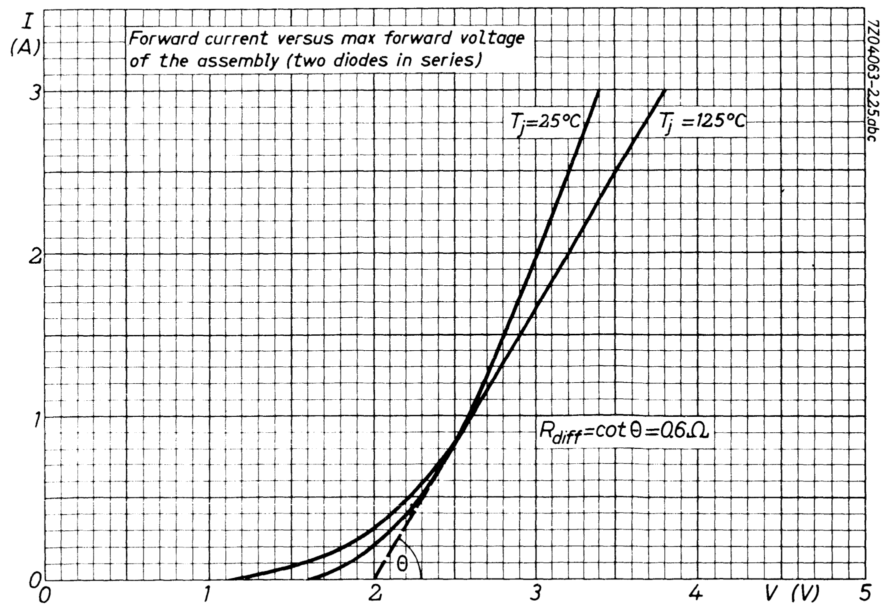
From the lefthand graph the total power dissipation can be found as a function of the average output current.

The parameter $a = \frac{I_{F(rms)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\frac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

See for instance "Power rectification with silicon diodes"
Once the power dissipation is known, the max. permissible ambient temperature follows from the righthand graph.

For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from the upper graph at page D.
R_{diff} is shown at page D, lower figure. 7Z2 3577


Required minimum value of R_t
R_t includes the transformer resistance
7Z04059-2.25abc
$V_{I(rms)}$ (V)
400
300
200
100
0
C≤50μF
75μF
100μF
150μF
200μF
R_t
V_I
C_L
R_L
+
−
0
5
10
15
20
25
R_t (Ω)
30


Forward current versus max forward voltage of the assembly (two diodes in series)
7Z04063-2.25abc
I (A)
3
2
1
0
T_j=25°C
T_j =125°C
R_{diff}=cot Θ=0.6Ω
Θ
0
1
2
3
4
V (V)
5

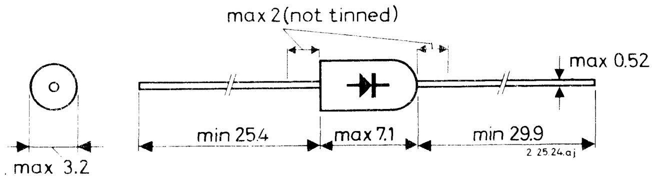
SILICON RECTIFIER DIODE

Double diffused silicon diode in a DO-14 plastic envelope for low current rectifier applications.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	1600	V
Average forward current	I_{FAV}	max.	0.2	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	15	A
Junction temperature	T_j	max.	125	°C
Operating ambient temperature	T_{amb}	max.	70	°C
Thermal resistance from junction to ambient	$R_{th\ j-a}$	=	0.2	°C/mW

MECHANICAL DATA

Dimensions in mm



DO-14 plastic envelope

The envelope fulfils the accelerated damp heat test described in I.E.C. publication 68.2 (test D, severity IV, 6 cycles).

7Z3 0387

RATINGS (Limiting values) [1])

Voltages

Crest working reverse voltage	V_{RWM}	max.	800	V
Repetitive peak reverse voltage (t = 1 ms)	V_{RRM}	max.	1600	V
Non repetitive peak reverse voltage (t = 10 ms)	V_{RSM}	max.	1600	V

Currents

Average forward current (averaged over any 20 ms period)				
for resistive or inductive load	I_{FAV}	max.	0.2	A
for capacitive load	I_{FAV}	max.	0.15	A
Repetitive peak forward current	I_{FRM}	max.	1.5	A
Non repetitive peak forward current [2]) (t = 10 ms) (See page B)	I_{FSM}	max.	15	A

Temperatures

Storage temperature	T_{stg}	−65 to +125		°C
Junction temperature	T_j	max.	125	°C
Operating ambient temperature	T_{amb}	max.	70	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j-a}$	=	0.2	°C/mW

CHARACTERISTICS

Forward voltage at	I_F = 0.2 A; T_j = 25 °C	V_F	< 1.1	V
	I_F = 1.5 A; T_j = 25 °C	V_F	< 1.6	V
Reverse current at	V_R = 800 V; T_j = 25 °C	I_R	< 1.0	µA
	V_R = 800 V; T_j = 125 °C	I_R	< 50	µA

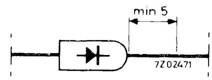
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) The BYX10 withstands also surge currents of max. 25 A during switching on (inrush current) with an uncharged capacitor of max. 100 µF. 7Z3 0536

MOUNTING INSTRUCTIONS

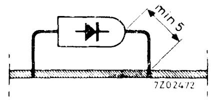
Iron soldering

At a max. iron temperature of 300 °C, the max. permissible soldering time is 3 s, provided the soldering spot is at least 5 mm from the seal.



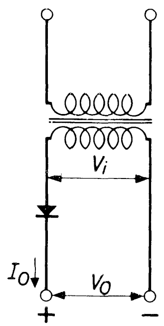
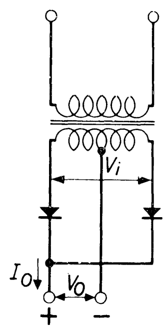
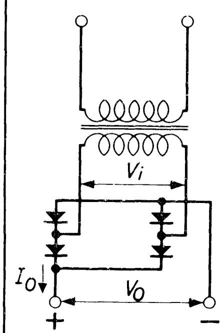
Dip soldering

At a max. solder temperature of 300 °C, the max. permissible soldering time is 3 s, provided the soldering spot is at least 5 mm from the seal.



Note: If during soldering the diode is in contact with the printed board the maximum permissible temperature of the point of contact is 125 °C.

APPLICATION INFORMATION

Operation as rectifier	Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)	
						
$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
120	0.2	53	0.4	53	0.4	106
240	0.2	106	0.4	106	0.4	212
560	0.2	250	0.4	250	0.4	500

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_O = average output voltage in V

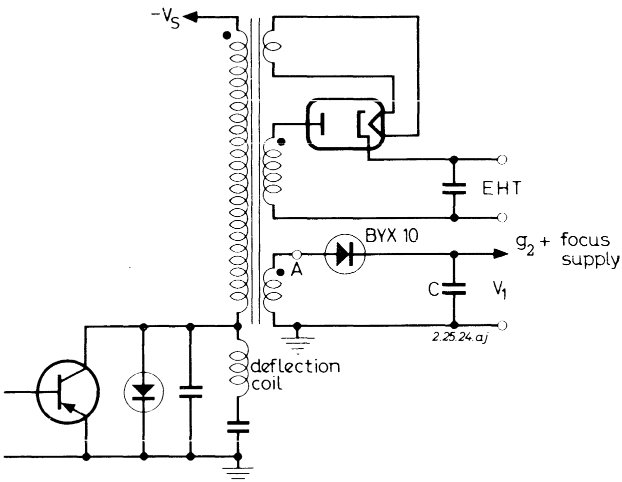
The I_O figures are absolute maximum values for resistive or inductive load.

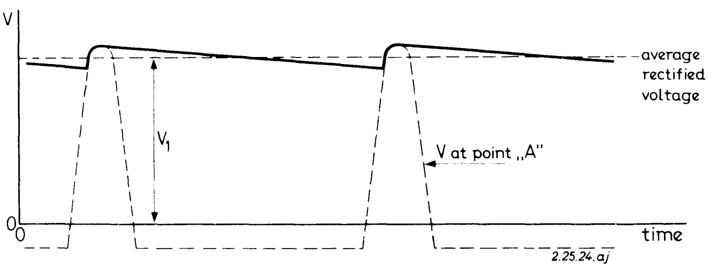
7Z3 0096

APPLICATION INFORMATION (continued)

BYX10 in the supply part for the first anode and the focus electrode of a television picture tube

The first figure shows a typical line deflection circuit with EHT transformer, the second figure shows the voltage wave form of g_2 and focus supply.





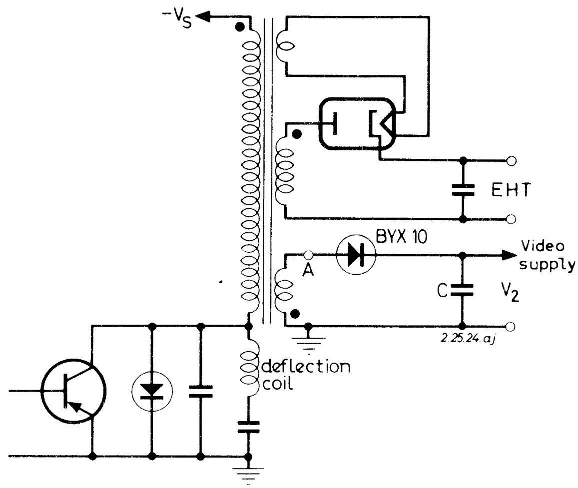
If capacitor C has such a value, that the "inrush current" through the diode could be higher than allowed, a resistor in series with the diode is recommended.

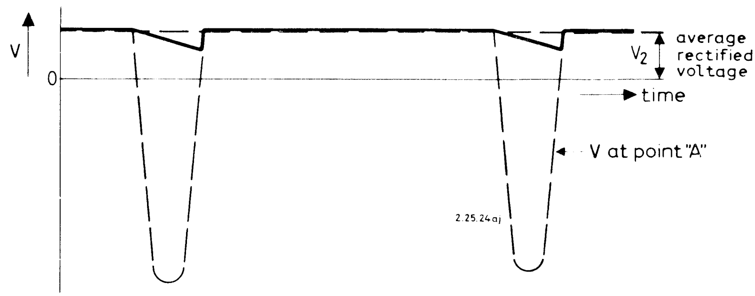
7Z3 0097

APPLICATION INFORMATION (continued)

BYX10 in the supply part for the video amplifier transistor of a television set

The first figure shows a typical line deflection circuit with EHT transformer, the second figure shows the voltage wave form of the video supply.

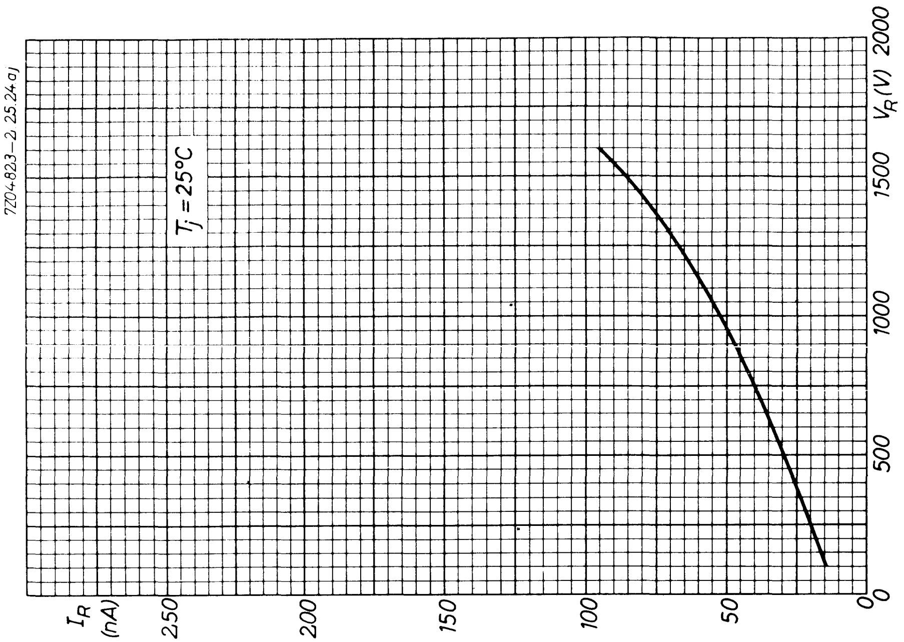


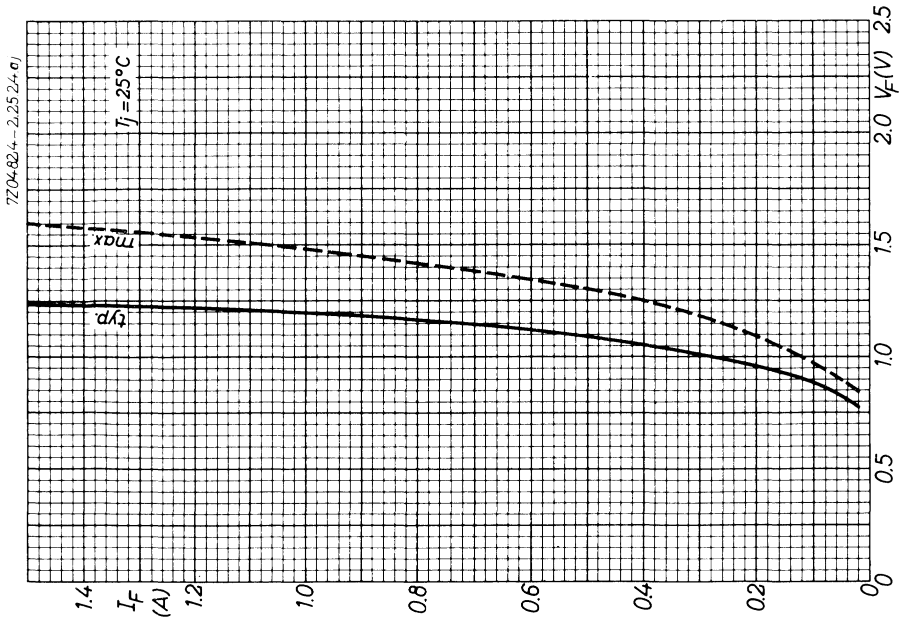


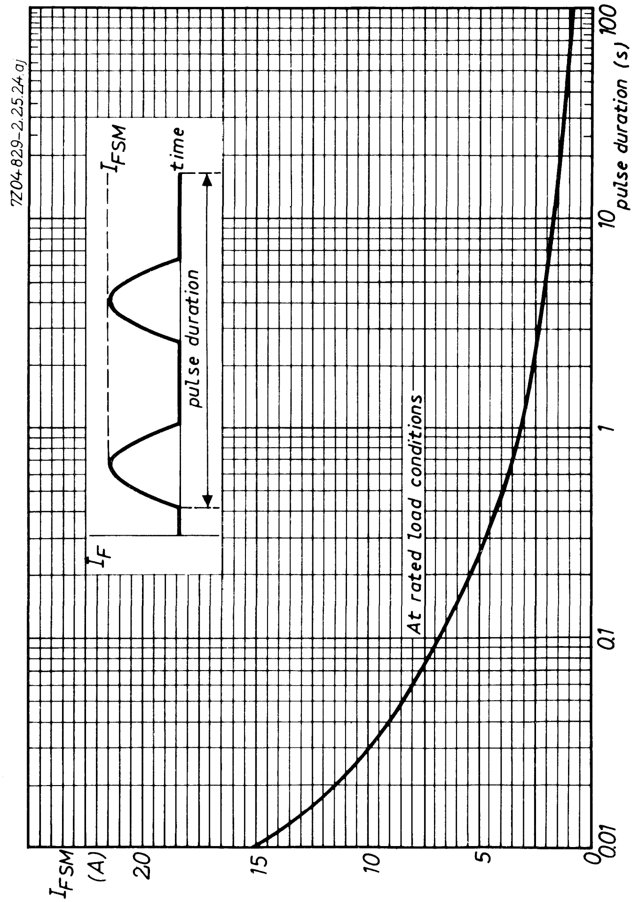
For thermal stability the ambient temperature should not exceed 55 ^{o}C.

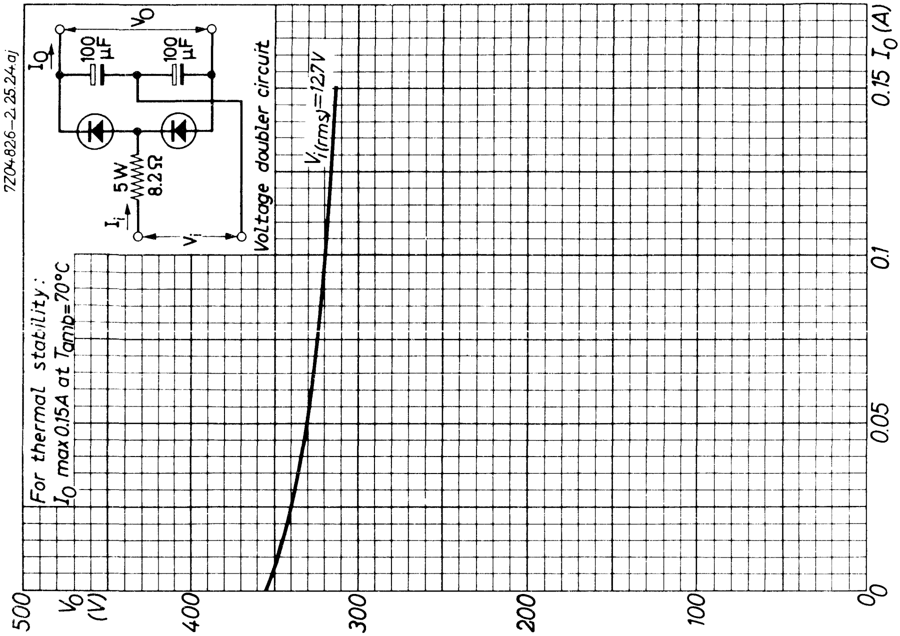
If capacitor C has such a value, that the "inrush current" through the diode could be higher than allowed, a resistor in series with the diode is recommended.

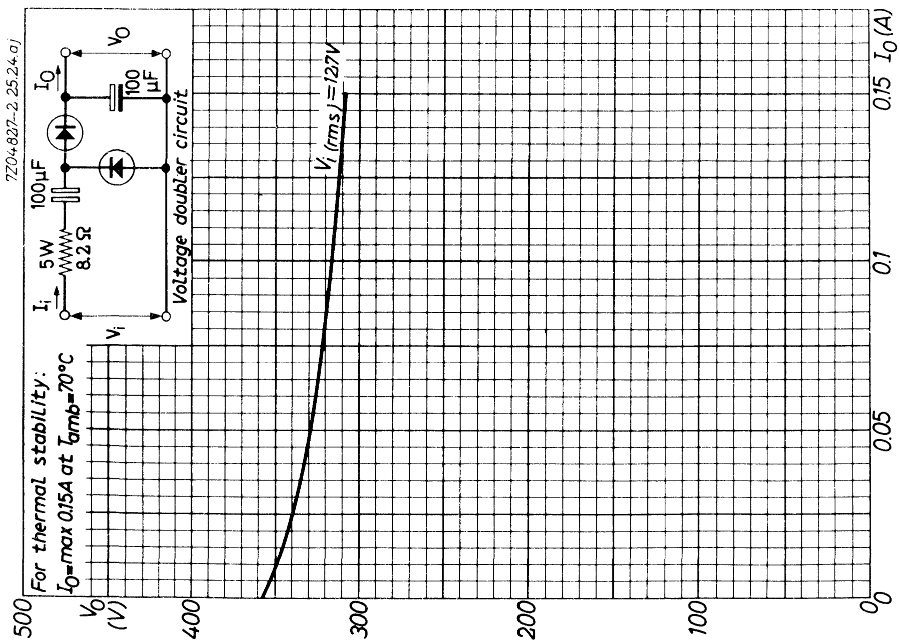
7Z3 0098

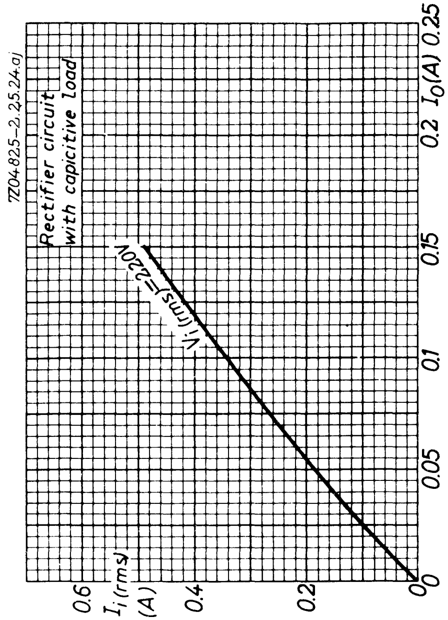

7Z04823-2.25.24(a)
$T_j = 25 °C$
V_R (V)
0
500
1000
1500
2000
I_R (nA)
0
50
100
150
200
250

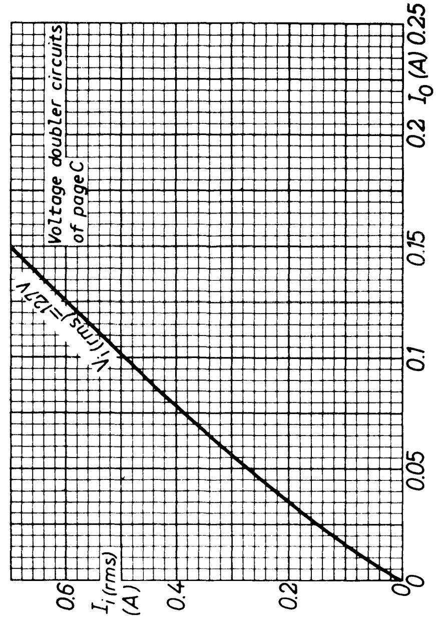

7Z04824-2.25.24(a)
$T_j = 25 °C$
max.
typ.
V_F (V)
0
0.5
1.0
1.5
2.0
2.5
I_F (A)
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4

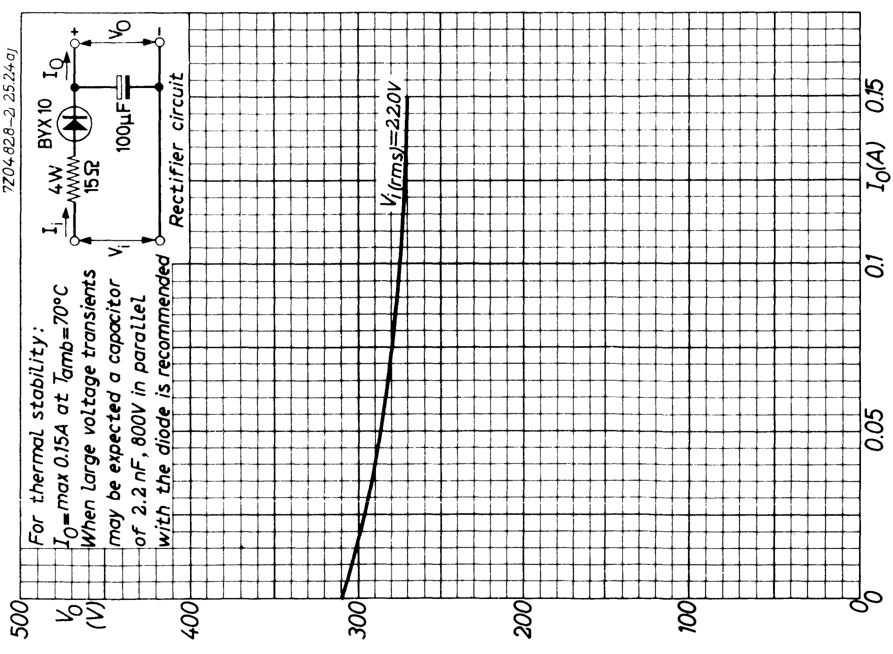

7Z04829-2.25.24.aj
I_FSM
time
pulse duration
I_F
At rated load conditions
I_FSM (A)
20
15
10
5
0
0.01
0.1
1
10
100
pulse duration (s)


7Z04826-2.25.24.aj
For thermal stability:
IO max 0.15A at Tamb=70°C
Voltage doubler circuit
Vi(rms)=127V
VO
IO
100 µF
100 µF
5W
8.2Ω
Ii
Vi
IO (A)
0.15
0.1
0.05
0
500
VO (V)
400
300
200
100
0


7Z04827-2.25.24.aj
For thermal stability:
IO=max 0.15A at Tamb=70°C
Voltage doubler circuit
Vi(rms)=127V
VO
IO
100 µF
100µF
5W
8.2Ω
Ii
Vi
IO (A)
0.15
0.1
0.05
0
500
VO (V)
400
300
200
100
0


7Z04825-2.25.24.aj
Rectifier circuit
with capicitive load
$V_{i(rms)}$=220V
$I_{i(rms)}$
(A)
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
I_O(A) 0.25


Voltage doubler circuits
of page C
$V_{i(rms)}$=127V
$I_{i(rms)}$
(A)
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
I_O(A) 0.25


7Z04828-2.25.24.aj
For thermal stability:
I_O=max 0.15A at T_{amb}=70°C
When large voltage transients
may be expected a capacitor
of 2.2 nF, 800V in parallel
with the diode is recommended
I_i
4W
15Ω
BYX10
I_O
100µF
V_i
V_O
+
–
Rectifier circuit
$V_{i(rms)}$=220V
500
V_O
(V)
400
300
200
100
0
0
0.05
0.1
I_O(A)
0.15

SILICON POWER DIODES

Double diffused silicon diodes in metal envelopes, intended for power rectifier applications.

The series consists of the following types:

Normal polarity (stud cathode):

BYX13-400; BYX13-600; BYX13-800; BYX13-1000; BYX13-1200

Reverse polarity (stud anode):

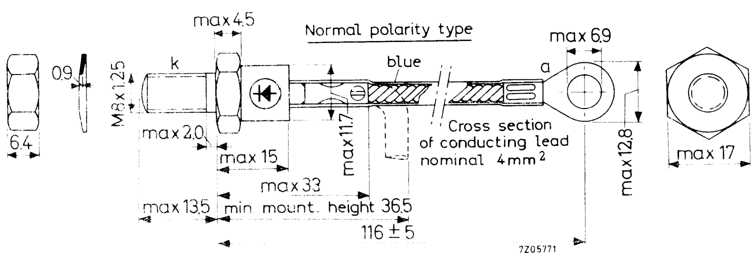
BYX13-400R; BYX13-600R; BYX13-800R; BYX13-1000R; BYX13-1200R

QUICK REFERENCE DATA

			BYX13-400(R)	600(R)	800(R)	1000(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	V

Average forward current	I_{FAV}	max.	20	A
Non repetitive peak forward current $t = 10$ ms; $T_{mb} = 125$ °C	I_{FSM}	max.	400	A
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.1	°C/W

MECHANICAL DATA Dimensions in mm



Reverse polarity type: Reversed symbol and red cable

Net weight ≈ 25 g

With accessories ≈ 35 g

Torque on nut: min. 30 cm kg
max. 60 cm kg

Diameter of hole in heatsink: max. 8.5 mm.

7Z3 0623

RATINGS (Limiting values) [1]

Voltages			BYX13-400(R)	600(R)	800(R)	1000(R)	1200(R)	
Continuous reverse voltage	V_R	max.	200	300	400	500	600	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	400	600	800	1000	1200	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	100	A
Non repetitive peak forward current $t = 10$ ms; $T_{mb} = 125$ °C (See page D)	I_{FSM}	max.	400	A
I squared t, for fusing ($t = 10$ ms)	I^2t	max.	570	A^2s

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.1	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.3	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0624

CHARACTERISTICS

Forward voltage at T_{mb} = 25 °C

I_F = 1 A	V_F	<	0.9	V
I_F = 100 A	V_F	<	2.0	V [1]

Reverse current at T_{mb} = 125 °C

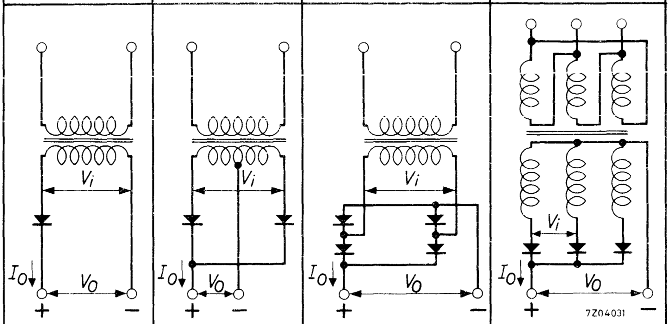
			BYX13-400(R)	600(R)	800(R)	1000(R)	1200(R)	
V_R = 200 V	I_R	<	2.0					mA
V_R = 300 V	I_R	<		2.0				mA
V_R = 400 V	I_R	<			2.0			mA
V_R = 500 V	I_R	<				1.7		mA
V_R = 600 V	I_R	<					1.4	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0625

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYX13- 400	140	20	60	40	60	40	125	60	95
BYX13- 600	210	20	90	40	90	40	185	60	135
BYX13- 800	280	20	125	40	125	40	250	60	190
BYX13-1000	350	20	155	40	155	40	310	60	235
BYX13-1200	420	20	185	40	185	40	375	60	280

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

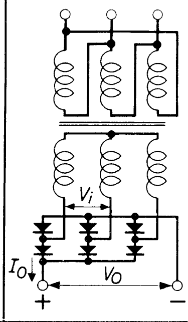
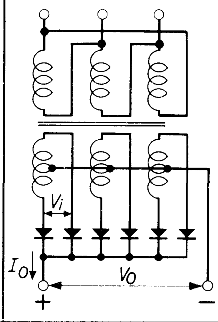
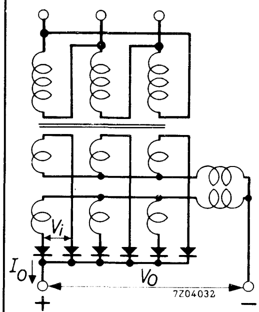
I_O = average output current in A

V_O = average output voltage in V

7Z3 0626

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX13- 400	140	60	185	96	95	120	80
BYX13- 600	210	60	280	96	135	120	120
BYX13- 800	280	60	375	96	190	120	160
BYX13-1000	350	60	470	96	235	120	200
BYX13-1200	420	60	565	96	280	120	240

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

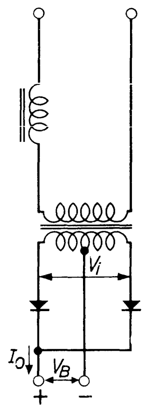
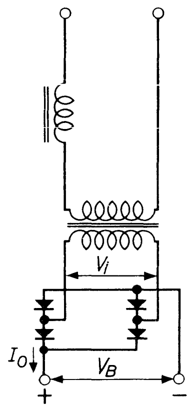
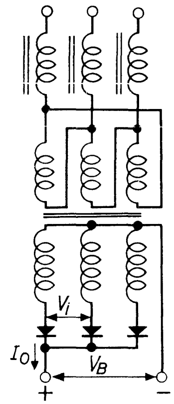
I_O = average output current in A

V_O = average output voltage in V

7Z3 0627

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
										
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX13- 400	125	20	60	27	20	120	54	30	70	32
BYX13- 600	190	20	90	41	20	180	82	30	105	47
BYX13- 800	255	20	120	54	20	240	108	30	135	60
BYX13-1000	315	20	150	68	20	300	136	30	170	77
BYX13-1200	380	20	180	81	20	360	162	30	205	93

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

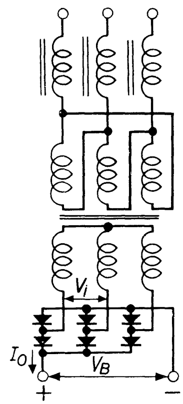
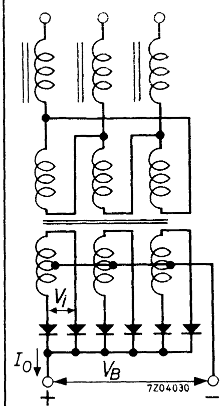
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0628

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX13- 400	125	30	120	54	60	60	27
BYX13- 600	190	30	180	82	60	90	41
BYX13- 800	255	30	240	108	60	120	54
BYX13-1000	315	30	300	136	60	150	68
BYX13-1200	380	30	360	162	60	180	81

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0629

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

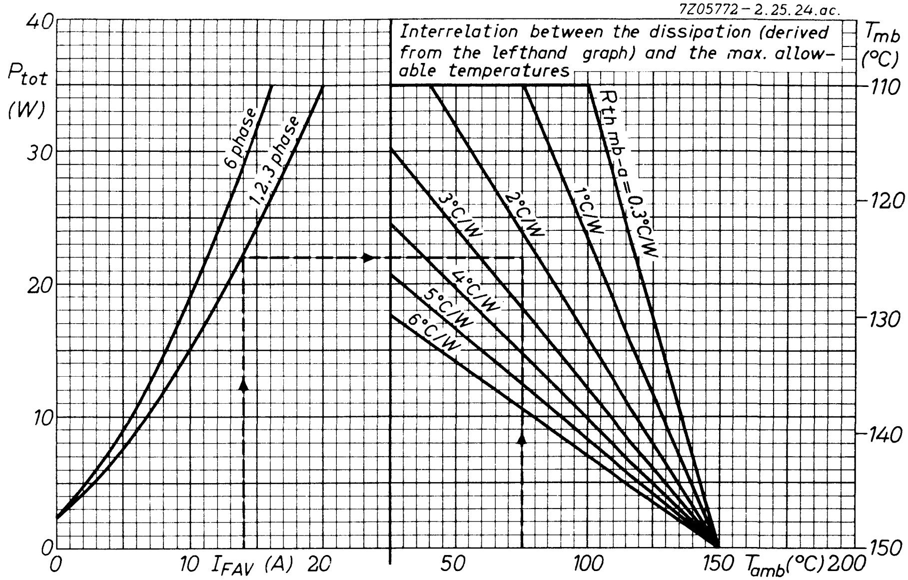
RC across primary of transformer	
C (μF)	R (Ω)
$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$

RC across secondary of transformer	
C (μF)	R (Ω)
$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2

2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at page D a fast fuse is recommended.

7Z3 0630



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the diode used in a 50 Hz three phase full wave rectifier circuit with a total output current of 42 A at T_{amb} = 75 °C. The average forward current I_{FAV} = 14 A (per diode).

From the left hand part of the graph above it follows that at I_{FAV} = 14 A the average forward power + average leakage power = 22 W per diode.

From the right hand part follows the thermal resistance, required for P_{tot} = 22 W at T_{amb} = 75 °C.

$$R_{th\ mb-a} \approx 2.3\ ^{\circ}C/W$$

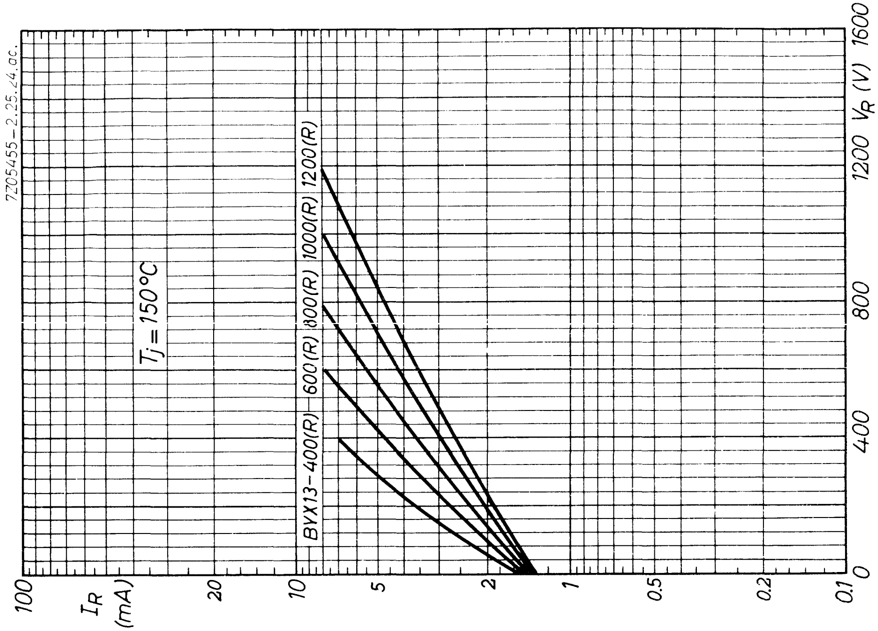
The contact thermal resistance $R_{th\ mb-h}$ = 0.3 °C/W.

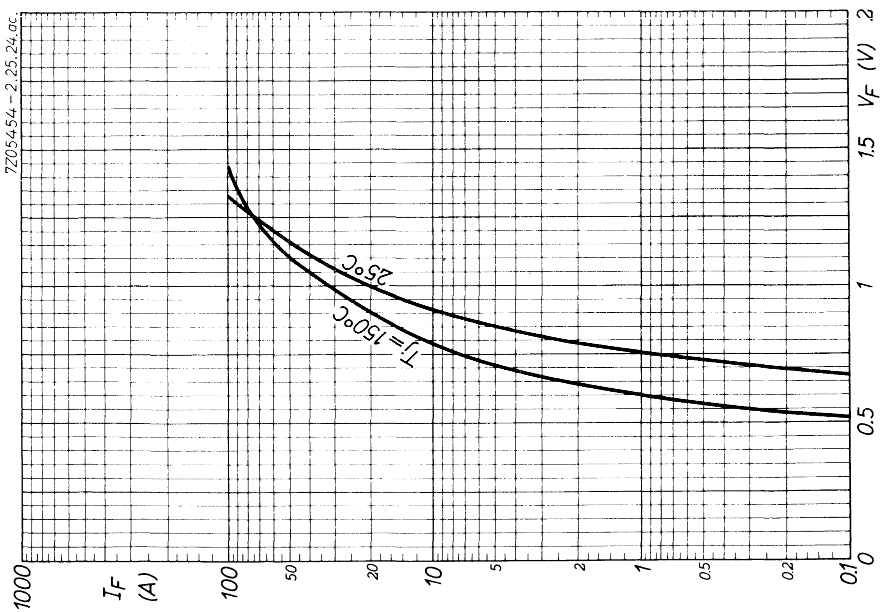
Hence the heatsink thermal resistance should be:

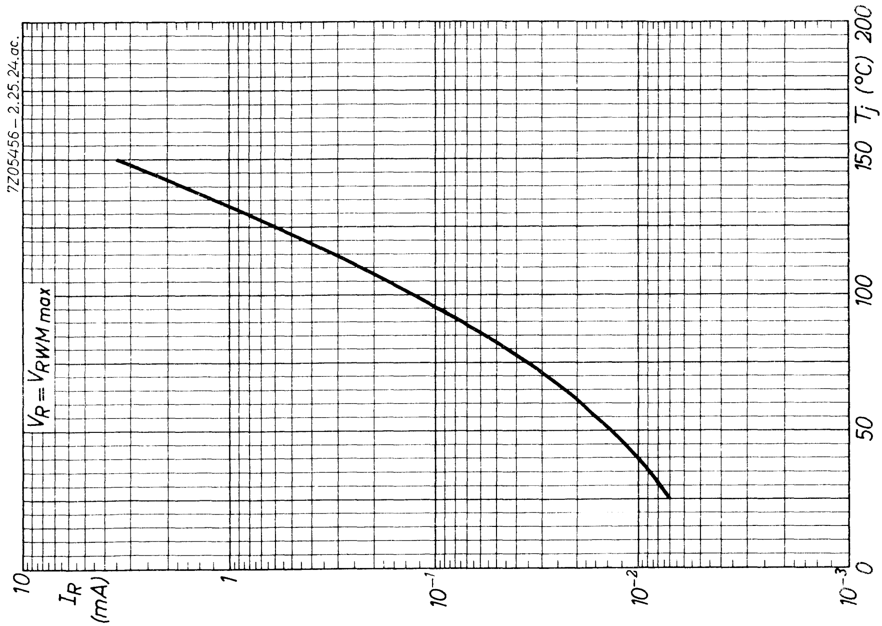
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (2.3 - 0.3)\ ^{\circ}C/W = 2\ ^{\circ}C/W.$$

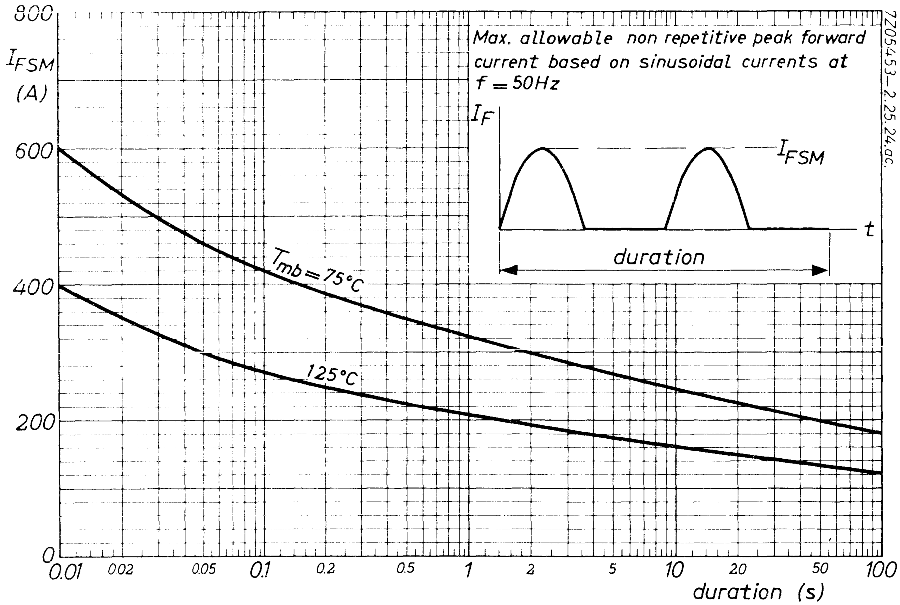
Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found.

7Z3 0631


7Z05455-2.25.24.ac.
$T_j = 150\,^\circ C$
BYX13-400(R)
600(R)
800(R)
1000(R)
1200(R)
I_R (mA)
100
20
10
5
2
1
0.5
0.2
0.1
V_R (V)
0
400
800
1200
1600


7Z05454-2.25.24.ac.
$T_j = 150\,^\circ C$
25 °C
I_F (A)
1000
100
50
20
10
5
2
1
0.5
0.2
0.1
V_F (V)
0
0.5
1
1.5
2


7Z05456 – 2.25.24.ac.
V_R = V_RWM max
I_R (mA)
10
1
10^-1
10^-2
10^-3
T_j (°C)
0
50
100
150
200


800
600
400
200
0
I_{FSM}
(A)
Max. allowable non repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_F
I_{FSM}
t
duration
T_{mb} = 75 °C
125 °C
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
duration (s)
7Z05453-2.25.24.ac

SILICON POWER DIODES

Double diffused silicon diodes in metal envelopes, intended for power rectifier applications.
The series consists of the following types:
Normal polarity (stud cathode):
BYX14-400; BYX14-600; BYX14-800; BYX14-1000; BYX14-1200
Reverse polarity (stud anode):
BYX14-400R; BYX14-600R; BYX14-800R; BYX14-1000R; BYX14-1200R.

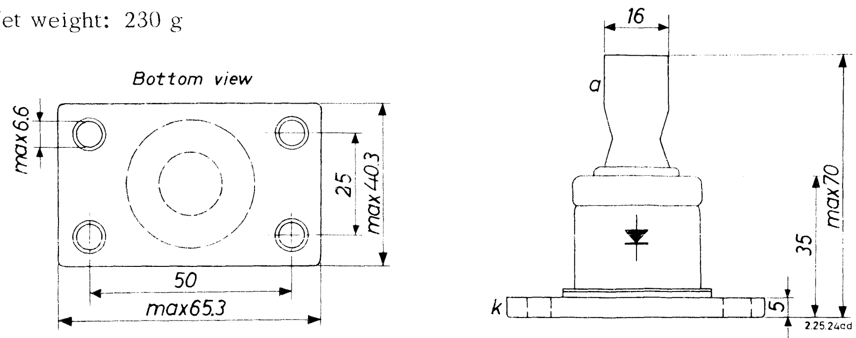
QUICK REFERENCE DATA

			BYX14-400(R)	600(R)	800(R)	1000(R)	1200(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	V

Average forward current	I_{FAV}	max.	150	A
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	3000	A
Junction temperature	T_j	max.	190	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.28	$^oC/W$

MECHANICAL DATA Dimensions in mm

Net weight: 230 g



Accessories and mounting instructions: see page 3. 7Z3 0548

RATINGS (Limiting values) [1]

Voltages			BYX14-400(R)	600(R)	800(R)	1000(R)	1200(R)	
Continuous reverse voltage	V_R	max.	200	300	400	500	600	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	400	600	800	1000	1200	V

Currents

Average forward current (averaged over any 20 ms period) [2]	I_{FAV}	max.	150	A
Repetitive peak forward current	I_{FRM}	max.	750	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 150$ °C; see page D	I_{FSM}	max.	3000	A
I squared t, for fusing ($t < 10$ ms)	I^2t	max.	32000	A^2s

Temperatures

Storage temperature	T_{stg}		-65 to +190	°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.28	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.07	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) If the applied crest working reverse voltage does not exceed 200 V, an average forward current I_{FAV} = 200 A is allowed.
For six-phase circuits or capacitive load:
I_{FAVmax} = 120 A when $V_{RWM} \geqq 200$ V
and I_{FAVmax} = 160 A when $V_{RWM} \leqq 200$ V

7Z3 0549

CHARACTERISTICS

Forward voltage at T_{mb} = 175 °C

I_F = 750 A	V_F	<	1.8	V [1])

Reverse current at T_{mb} = 175 °C

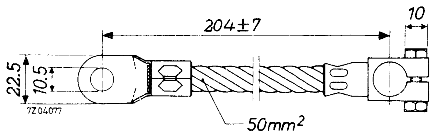
$V_R = V_{RWMmax}$	I_R	<	15	mA

ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

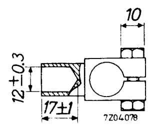
Flexible top lead

Type number 56243
Weight ≈ 170 g



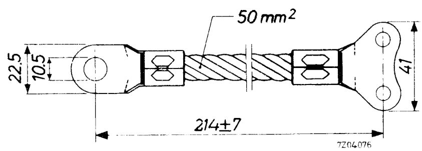
Clamp

Type number 56244
Weight ≈ 70 g



Flexible base lead

Type number 56247
Weight ≈ 130 g



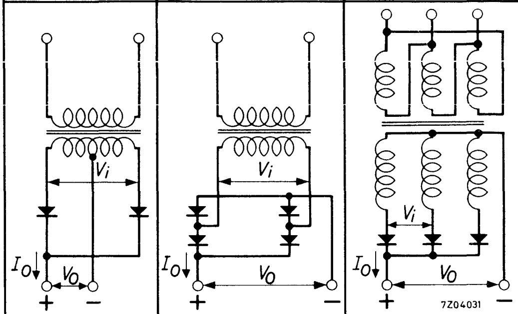
1. These accessories are available on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 cm kg for good thermal contact; max. 60 cm kg.
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact: 30 cm kg
   Max. torque : 60 cm kg

1) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0550

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX14- 400	140	300	60	300	125	450	95
BYX14- 600	210	300	90	300	185	450	135
BYX14- 800	280	300	125	300	250	450	190
BYX14-1000	350	300	155	300	310	450	235
BYX14-1200	420	300	185	300	375	450	280

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

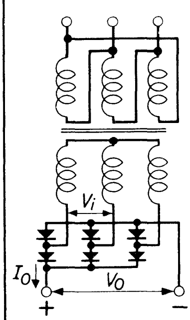
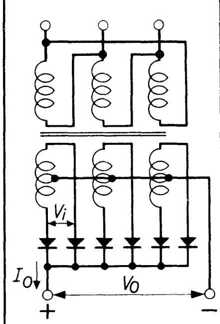
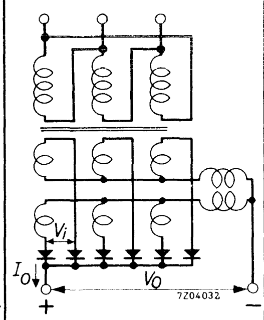
I_O = average output current in A

V_O = average output voltage in V

7Z3 0551

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX14- 400	140	450	185	720	95	900	80
BYX14- 600	210	450	280	720	135	900	120
BYX14- 800	280	450	375	720	190	900	160
BYX14-1000	350	450	470	720	235	900	200
BYX14-1200	420	450	565	720	280	900	240

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

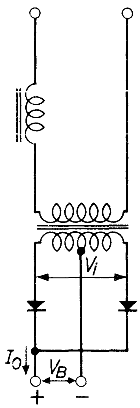
I_O = average output current in A

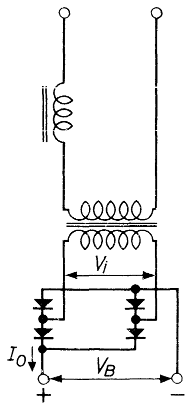
V_O = average output voltage in V

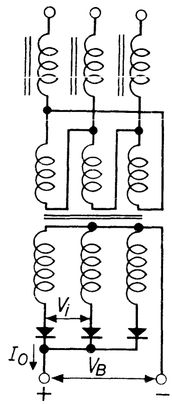
7Z3 0552

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING







		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX14- 400	125	150	60	27	150	120	54	225	70	32
BYX14- 600	190	150	90	41	150	180	82	225	105	47
BYX14- 800	255	150	120	54	150	240	108	225	135	60
BYX14-1000	315	150	150	68	150	300	136	225	170	77
BYX14-1200	380	150	180	81	150	360	162	225	205	93

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

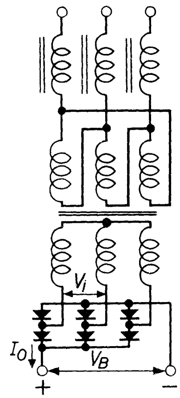
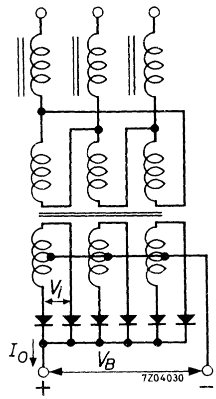
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0553

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX14- 400	125	225	120	54	450	60	27
BYX14- 600	190	225	180	82	450	90	41
BYX14- 800	255	225	240	108	450	120	54
BYX14-1000	315	225	300	136	450	150	68
BYX14-1200	380	225	360	162	450	180	81

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0554

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

RC across primary of transformer	
C (μF)	R (Ω)
$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$

RC across secondary of transformer	
C (μF)	R (Ω)
$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)

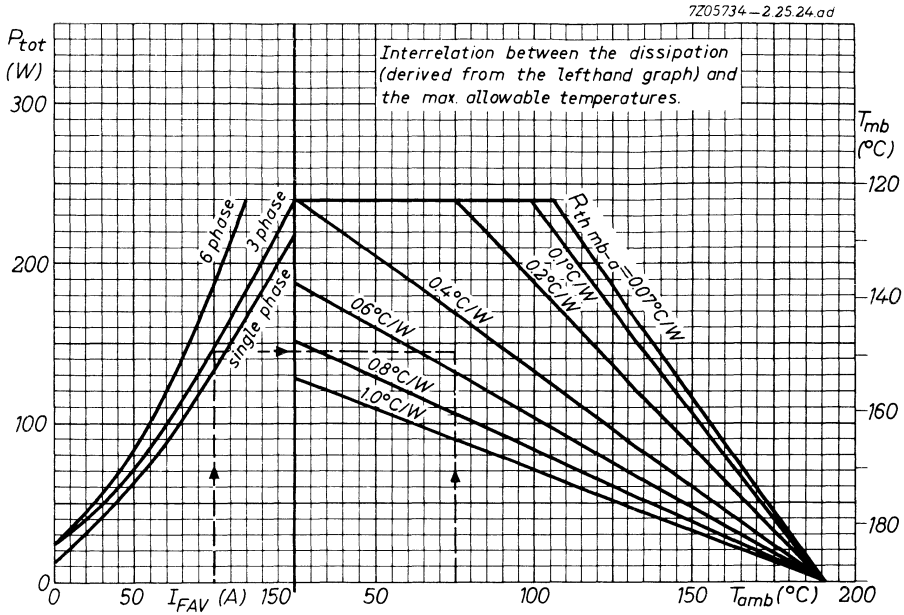
V_1 = transformer primary r.m.s. voltage (V)

V_2 = transformer secondary r.m.s. voltage (V)

T = V_1/V_2

2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curve at page D, a fast fuse is recommended.

7Z3 0555



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the diode, used in a 50 Hz three phase full wave rectifier circuit with a total output current of 300 A at T_{amb} = 75 °C. The average forward current I_{FAV} = 100 A (per diode).

From the left hand part of the graph above it follows that at I_{FAV} = 100 A the average forward power + average leakage power = 145 W per diode.

From the right hand part follows the thermal resistance, required for P_{tot} = 145 W at T_{amb} = 75 °C.

$$R_{th\ mb\text{-}a} \approx 0.52\ ^{o}C/W$$

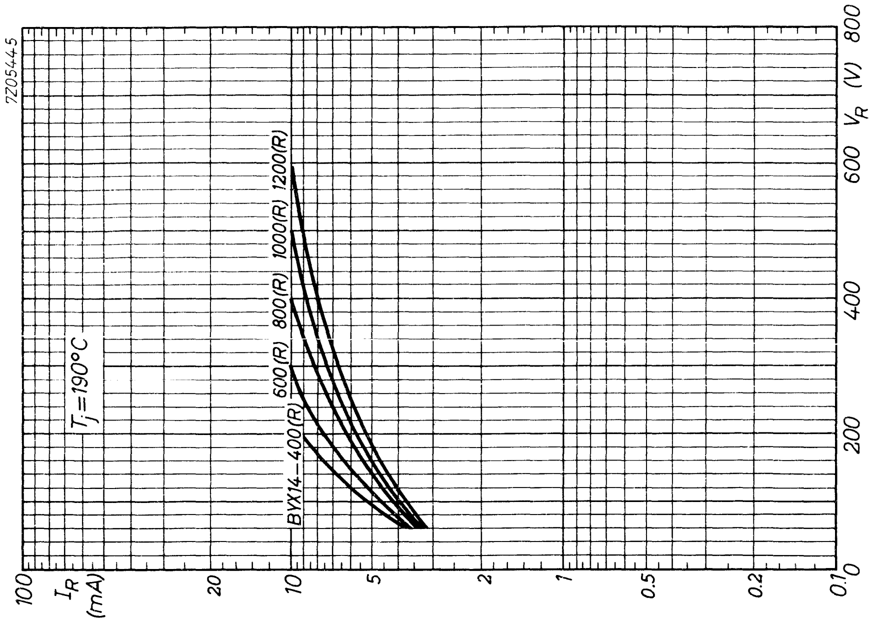
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.07 °C/W.

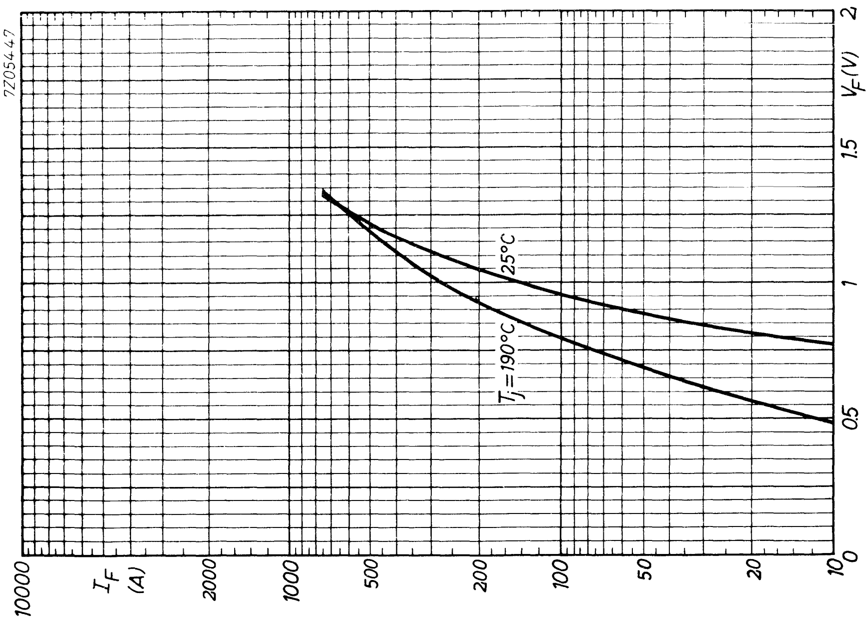
Hence the heatsink thermal resistance should be:

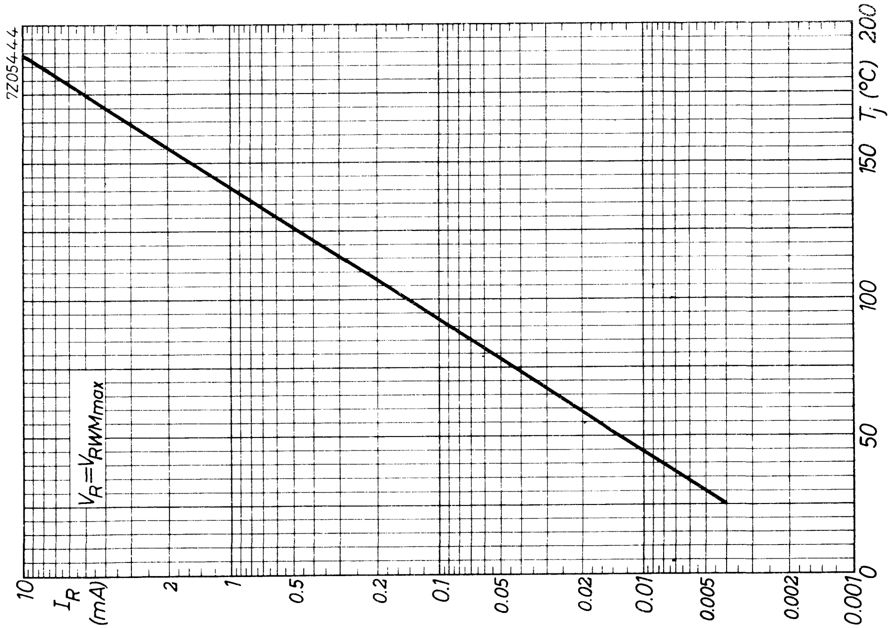
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.52 - 0.07)\ ^{o}C/W = 0.45\ ^{o}C/W.$$

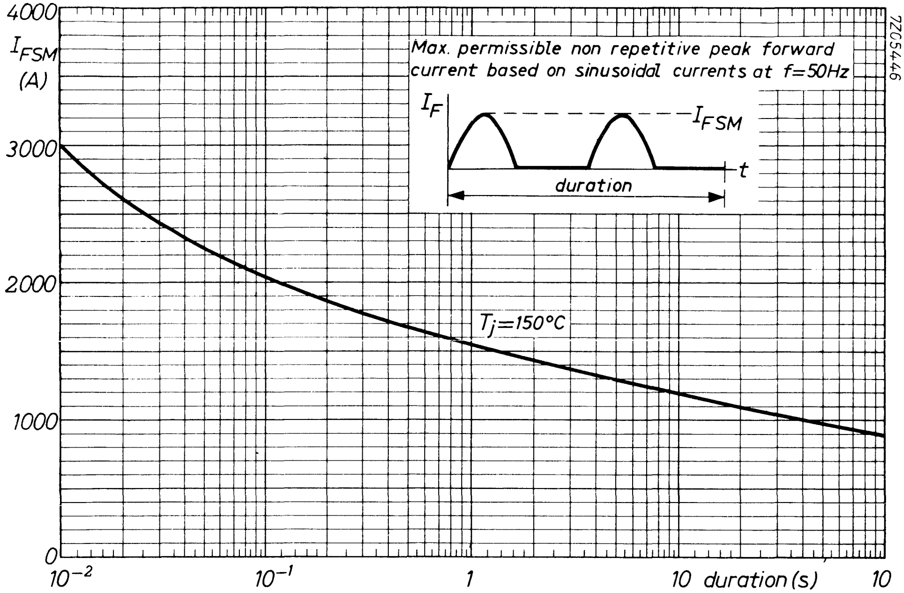
Alternatively, when the heatsink and $R_{th\ h\text{-}a}$ are known, the maximum permissible ambient temperature can be found.

7Z3 0556


7Z05445
Tj=190°C
BYX14–400(R)
600(R)
800(R)
1000(R)
1200(R)
VR (V)
IR (mA)
100
20
10
5
2
1
0.5
0.2
0.1
0
200
400
600
800


7Z05447
25°C
Tj=190°C
VF(V)
IF (A)
10000
2000
1000
500
200
100
50
20
10
0
0.5
1
1.5
2


7Z05444
$V_R = V_{RWMmax}$
I_R (mA)
10
2
1
0.5
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0.001
0
50
100
150
200
T_j (°C)

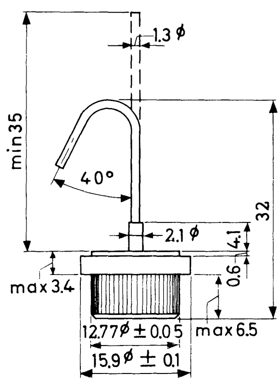

4000
I_{FSM}
(A)
3000
2000
1000
0
10^{-2}
10^{-1}
1
10
duration (s)
10
7Z05446
Max. permissible non repetitive peak forward current based on sinusoidal currents at f=50Hz
I_F
I_{FSM}
t
duration
T_j=150°C

SILICON POWER DIODES

Diffused silicon diodes in metal cases for use in power rectifiers, especially in a.c. generating systems of motor cars with battery voltages of up to 24 V. The diodes can be press-mounted or soldered at the bottom or mounted with an adaptor.
The BYX20-200R (anode to case) is the reverse polarity type of the BYX20-200 (cathode to case).

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	85	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	V
Average forward current	I_{FAV}	max.	25	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	300	A
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to case	$R_{th\ j\text{-}c}$	=	1	°C/W

MECHANICAL DATA Dimensions in mm



Marked in red : Cathode connected to case BYX20-200

Marked in blue: Anode connected to case BYX20-200R

For mounting instructions see pages 3 and 4

Not delivered with the device:
Mounting adaptor 56232

7Z3 0472

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	75	V
Crest working reverse voltage	V_{RWM}	max.	85	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	V
Non repetitive peak reverse voltage (t < 10 ms)	V_{RSM}	max.	200	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	25	A
Repetitive peak forward current	I_{FRM}	max.	80	A
Non repetitive peak forward current t = 10 ms; see page D	I_{FSM}	max.	300	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to case	$R_{th\,j\text{-}c}$	=	1	$^oC/W$
From case to heatsink				
press mounted	$R_{th\,c\text{-}h}$	=	0.5	$^oC/W$
mounted with adaptor 56232	$R_{th\,c\text{-}h}$	=	1	$^oC/W$

CHARACTERISTICS

Forward voltage at T_j = 25 ^oC

I_F = 25 A	V_F	<	1.2	V
I_F = 80 A	V_F	<	1.4	V

Reverse current at T_j = 125 ^oC

V_R = 75 V	I_R	<	1.1	mA

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0473

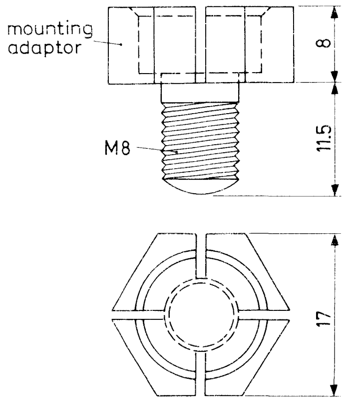
ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

Mounting adaptor 56232

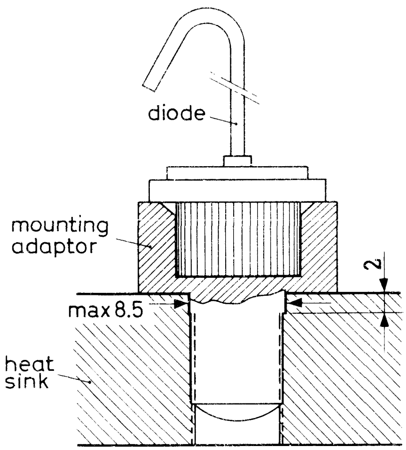
Type 56232 consists of a body, a spring washer and a nut.

Thermal resistance from case to heatsink: $R_{th\ c\text{-}h} = 1\ ^{o}C/W$



Mounting method 1

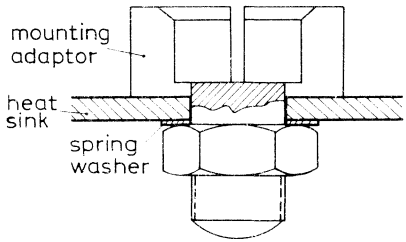
Torque on nut = min. 50 cm kg
= max. 100 cm kg



Mounting method 2

Diameter of hole in heatsink = max. 8.5 mm

Torque on nut = max. 50 cm kg



7Z3 0474

ACCESSORIES AND MOUNTING INSTRUCTIONS (continued)

Bottom-mounting

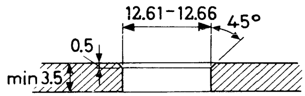
Soldering temperature	T	max.	235	°C
Soldering time	t	max.	30	s

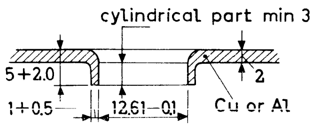
Press-mounting

Diameter of hole in heatsink: from 12.61 to 12.66 mm [1])

Force to seat the diode : max. 400 kg

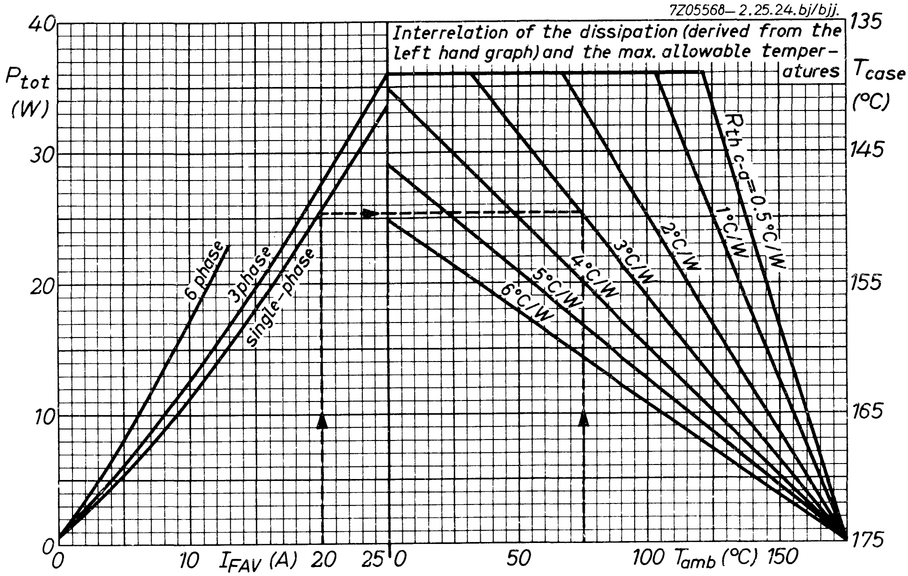
Examples:





[1]) Diameter required depends on hardness of heatsink material.

7Z3 0475



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the diode used in single phase bridge rectifier circuit with a total output current of 40 A at T_{amb} = 75 °C. (Diodes press-mounted). The average forward current I_{FAV} = 20 A (per diode).

From the left hand part of the graph above it follows that at I_{FAV} = 20 A the average forward power + average leakage power is 25.5 W.

From the right hand part follows the thermal resistance, required for P_{tot} = 25.5 W at T_{amb} = 75 °C

$$R_{th\,c\text{-}a} \approx 3\ ^{\circ}C/W$$

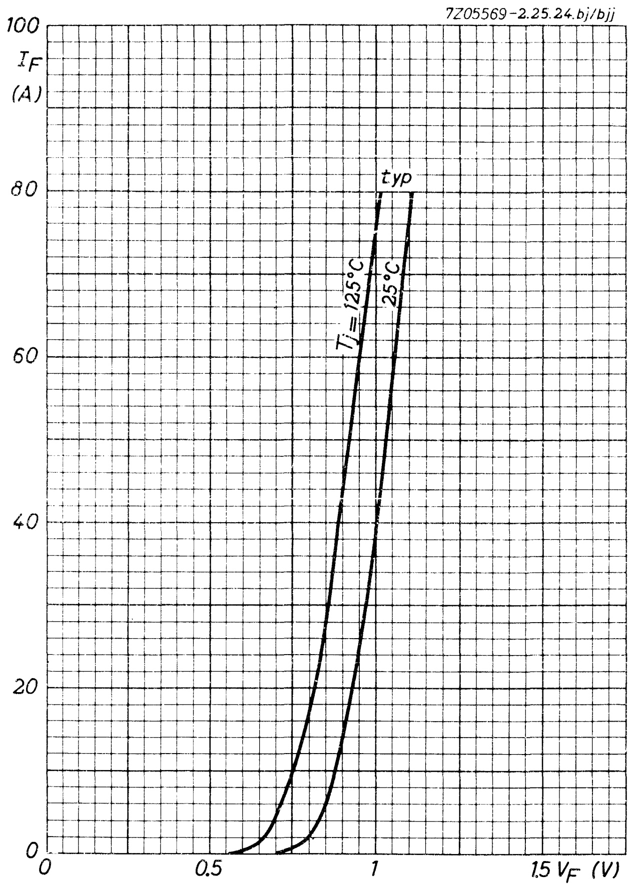
The contact thermal resistance $R_{th\,c\text{-}h}$ = 0.5 °C/W for press-mounted diodes.

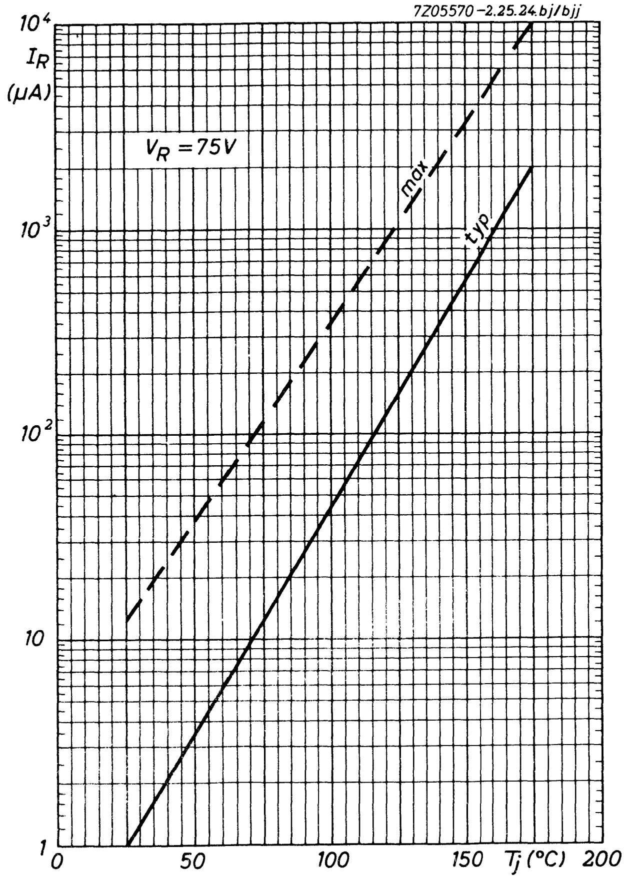
Hence the heatsink thermal resistance should be

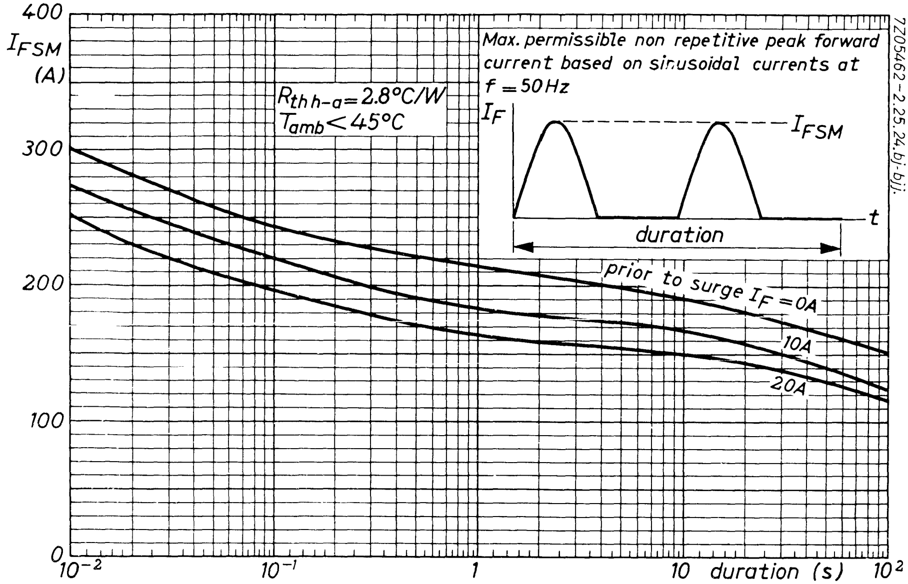
$$R_{th\,h\text{-}a} = R_{th\,c\text{-}a} - R_{th\,c\text{-}h} = (3 - 0.5)\ ^{\circ}C/W = 2.5\ ^{\circ}C/W$$

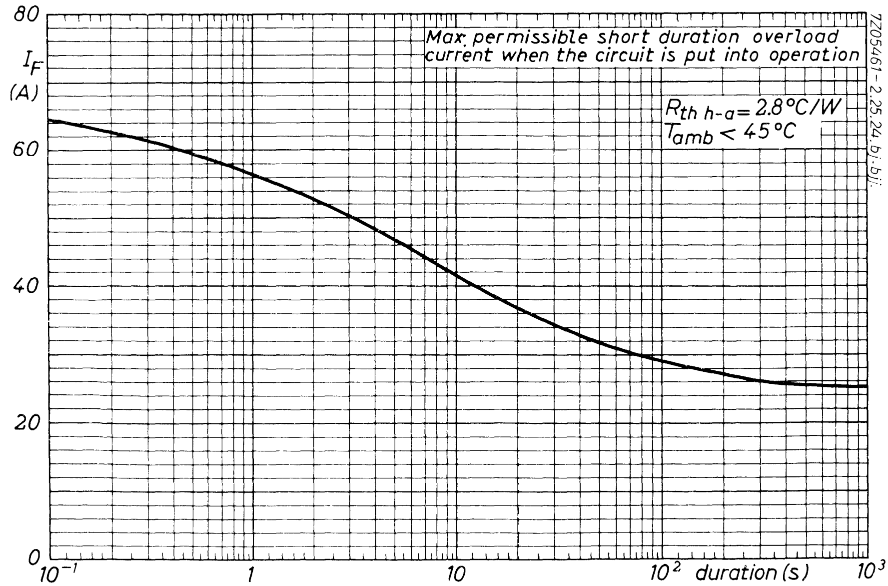
Alternatively, when the heatsink and $R_{th\,h\text{-}a}$ are known, the maximum permissible ambient temperature can be found.

7Z3 0476


7Z05569-2.25.24.bj/bjj
100
I_F
(A)
80
60
40
20
0
typ
T_j = 125°C
25°C
0
0.5
1
1.5 V_F (V)


7Z05570-2.25.24.bj/bjj
10^4
I_R
(μA)
V_R = 75V
max
typ
10^3
10^2
10
1
0
50
100
150
T_j (°C)
200


400
I_{FSM}
(A)
300
200
100
0
Max. permissible non repetitive peak forward current based on sinusoidal currents at f = 50 Hz
I_F
I_{FSM}
t
duration
$R_{th\,h-a}$ = 2.8°C/W
T_{amb} < 45°C
prior to surge I_F = 0A
10A
20A
10^{-2}
10^{-1}
1
10
duration (s)
10^2
7Z05462-2.25.24.bj.bj.


80
I_F
(A)
60
40
20
0
Max. permissible short duration overload current when the circuit is put into operation
$R_{th\,h-a}$ = 2.8°C/W
T_{amb} < 45°C
10^{-1}
1
10
10^2
duration (s)
10^3
7Z05461-2.25.24.bj.bj.

CONTROLLED AVALANCHE POWER DIODES

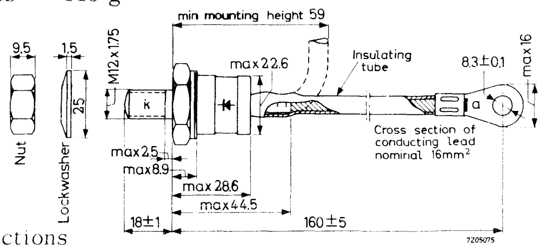
Diffused silicon diodes in metal envelopes with ceramic insulation, capable of absorbing transients and intended for power rectifier application.
The series consists of the following types: BYX23-400, BYX23-600, BYX23-800 and BYX23-1000.

QUICK REFERENCE DATA

		BYX23-	400	600	800	1000	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V
Average forward current	I_{FAV}	max.	100				A
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	1600				A
Repetitive peak reverse power (t = 10 μs) T_j = 190 °C	P_{RRM}	max.	8				kW
Non repetitive peak reverse power (t = 10 μs) T_j = 25 °C	P_{RSM}	max.	30				kW
Junction temperature	T_j	max.	190				°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4				°C/W

MECHANICAL DATA Dimensions in mm

Net weight ≈ 95 g
With accessories ≈ 115 g



Mounting instructions
1. Hole in heatsink: d = max. 13 mm
2. Torque on nut : min. 100 cm kg
max. 250 cm kg

7Z3 0178

RATINGS (Limiting values) [1]

Voltages [2]

			BYX23-	400	600	800	1000	
Continuous reverse voltage	V_R	max.		400	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.		400	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	100	A
Forward current (d.c.)	I_F	max.	130	A
Repetitive peak forward current	I_{FRM}	max.	500	A
Non repetitive peak forward current $t = 10$ ms (See page B)	I_{FSM}	max.	1600	A

Reverse power dissipation

Average reverse power (averaged over any 20 ms period) $T_j = 190$ °C	P_{RAV}	max.	30	W
Repetitive peak reverse power; $t = 10$ µs (square wave; $f = 50$ Hz) $T_j = 190$ °C	P_{RRM}	max.	8	kW
Non repetitive peak reverse power $t = 10$ µs; $T_j = 25$ °C (See page B)	P_{RSM}	max.	30	kW
Non repetitive peak reverse power $t = 10$ µs; $T_j = 190$ °C (See page B)	P_{RSM}	max.	15	kW

Temperatures

Storage temperature	T_{stg}		−55 to +200	°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.1	°C/W
From mounting base to heatsink with heatsink compound (Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.04	°C/W

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2] These ratings apply at $R_{th\ j\text{-}a} \leq 1.7$ °C/W (d.c.) or ≤ 3.3 °C/W (a.c.)

7Z3 0179

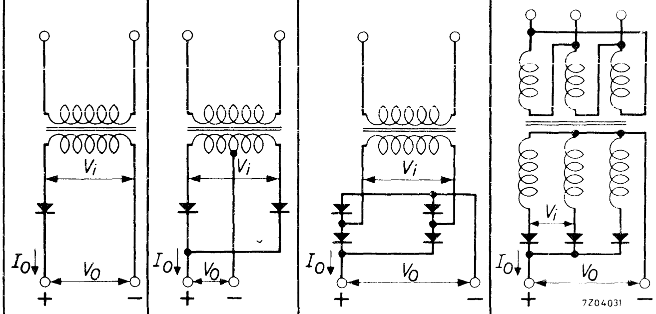
CHARACTERISTICS

Forward voltage at I_F = 500 A; T_j = 190 °C	V_F	<	1.7	V
Reverse breakdown voltage				
I_R = 10 mA; T_j = 25 °C				
BYX23-400	$V_{(BR)R}$	500 to	800	V
BYX23-600	$V_{(BR)R}$	750 to	1050	V
BYX23-800	$V_{(BR)R}$	1000 to	1320	V
BYX23-1000	$V_{(BR)R}$	1250 to	1600	V
(See also reverse characteristics at page E)				
Reverse current at T_j = 175 °C				
BYX23-400 : V_R = 400 V	I_R	<	20	mA
BYX23-600 : V_R = 600 V	I_R	<	17	mA
BYX23-800 : V_R = 800 V	I_R	<	13	mA
BYX23-1000: V_R = 1000 V	I_R	<	10	mA

7Z3 0180

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYX23- 400	280	100	125	200	125	200	250	300	190
BYX23- 600	420	100	185	200	185	200	375	300	280
BYX23- 800	560	100	250	200	250	200	505	300	380
BYX23-1000	700	100	315	200	315	200	635	300	475

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

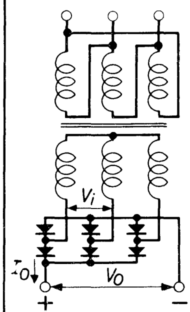
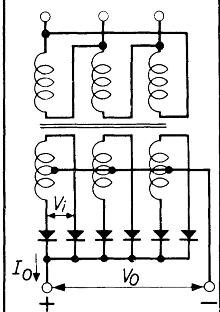
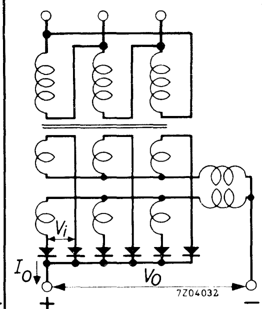
I_O = average output current in A

V_O = average output voltage in V

7Z3 0181

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX23- 400	280	300	375	480	190	600	160
BYX23- 600	420	300	565	480	280	600	240
BYX23- 800	560	300	760	480	380	600	320
BYX23-1000	700	300	940	480	475	600	400

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

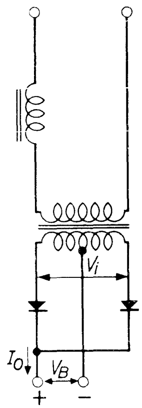
I_O = average output current in A

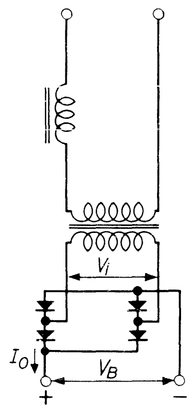
V_O = average output voltage in V

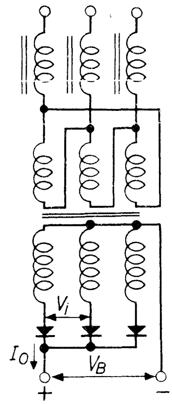
7Z3 0182

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING







		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX23- 400	255	100	120	54	100	240	109	150	140	64
BYX23- 600	380	100	180	82	100	360	164	150	210	95
BYX23- 800	510	100	240	109	100	480	217	150	270	122
BYX23-1000	640	100	300	136	100	600	272	150	340	154

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10 % has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

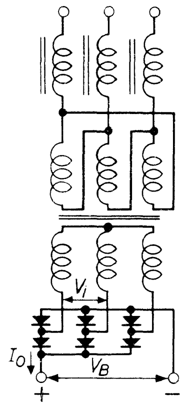
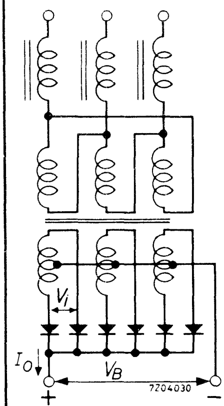
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0183

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX23- 400	255	150	240	109	300	120	54
BYX23- 600	380	150	360	164	300	180	82
BYX23- 800	510	150	480	217	300	240	109
BYX23-1000	640	150	600	272	300	300	136

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10 % has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0184

OPERATING NOTES

1. Voltage sharing of series connected controlled avalanche diodes.

   When diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. Switching transients for controlled avalanche diodes.

   In an unloaded rectifier circuit, when the transformer is switched off, energy is released.
   When, as a result, no diode rating is exceeded, special provisions are not needed. If, however, the rated non repetitive peak power dissipation per device could be exceeded, damping across the transformer is necessary in order to protect the device.

   The duration of the transformer's energy release can be found in first approximation from the empirical formula:

$$t = \frac{V_{RWM}}{V_{(BR)R\,min}}\ ;\ \text{(milliseconds)}$$

where V_{RWM} = actually applied crest working voltage

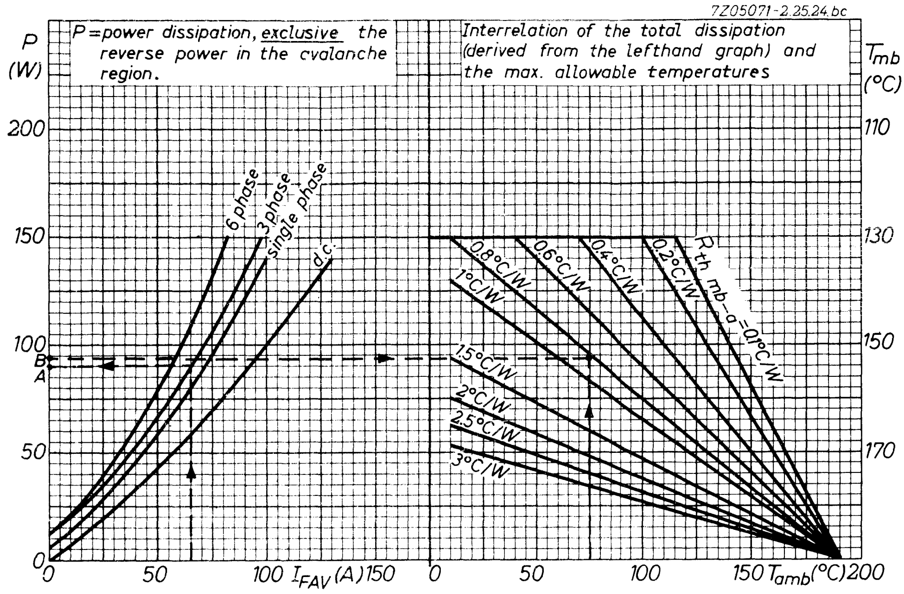
$V_{(BR)R\,min}$ = minimum reverse breakdown voltage

The non repetitive peak power that can be absorbed by a single device during t ms can be derived from the graph on page B. Multiplying that amount with the time in which it is released results in the energy absorbed by one diode. (E_D).
A series string of n diodes can absorb n times as much. ($n.E_D$)

The difference between the energy released by the transformer and that absorbed by the n diodes should be absorbed by series connected R and C elements across the secondary winding of the transformer.
The magnitudes of R and C have to be derived from the following formulae:

$$C = \frac{E_T - n.E_D}{(n.V_{(BR)R\,min})^2} \cdot 10^6 \quad (\mu F) \qquad R = \frac{310}{C} \quad (\Omega)$$

where C = capacitance in μF
E_T = energy released by the transformer in Ws
n = number of diodes in series
E_D = energy absorbed by one diode in Ws
$V_{(BR)R\,min}$ = minimum reverse breakdown voltage of one diode in V
R = resistance in Ω



EXAMPLE (Determination of the heatsink thermal resistance)

Assume a diode, used in a three phase, 50 Hz rectifier circuit at an ambient temperature of 75 °C. The average forward current I_{FAV} = 65 A (per diode). Furthermore assume a repetitive peak reverse power in the avalanche region P_{RRM} = 6 kW (per diode) during 10 microseconds.

From the graph above it follows that in a three phase rectifier circuit at I_{FAV} = 65 A the average forward power + average leakage power = 90 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{10\ \mu s}{20\ ms} = 0.0005$$

Thus: $P_{RAV} = 0.0005 \times 6\ kW = 3\ W$

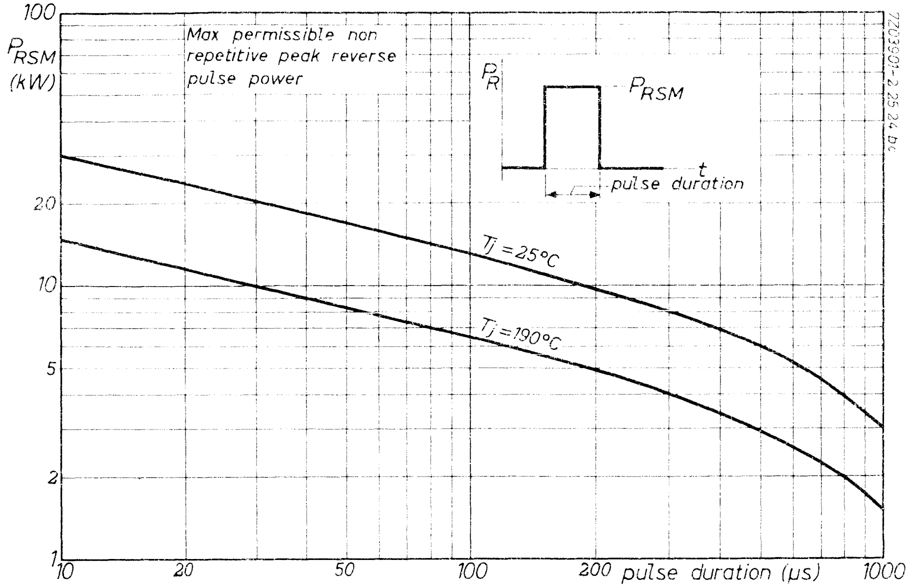
Therefore the total device power dissipation $P_{tot} = 90 + 3 = 93$ W (point B).

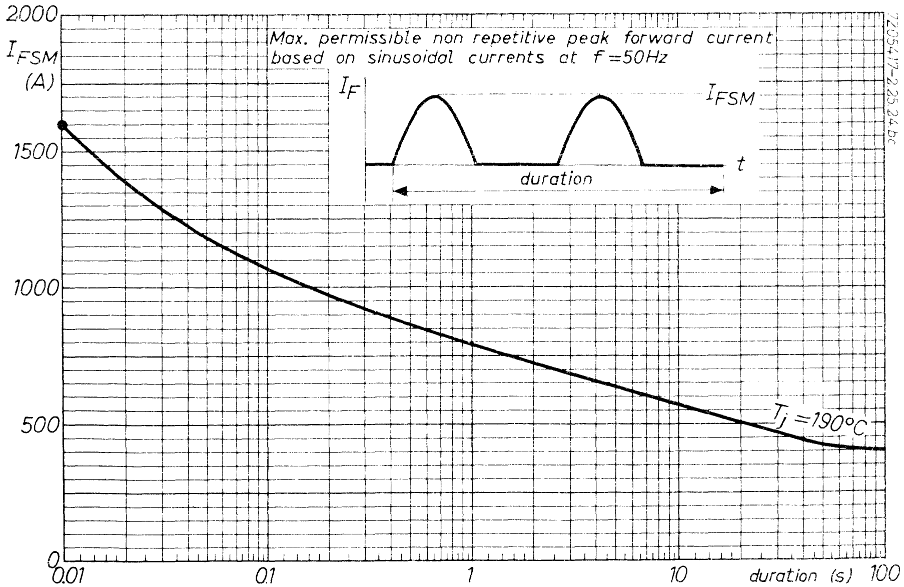
From the curves it follows that at $T_{amb} = 75$ °C the required thermal resistance $R_{th\ mb-a} \approx 0.8$ °C/W. The contact thermal resistance $R_{th\ mb-h} = 0.1$ °C/W.

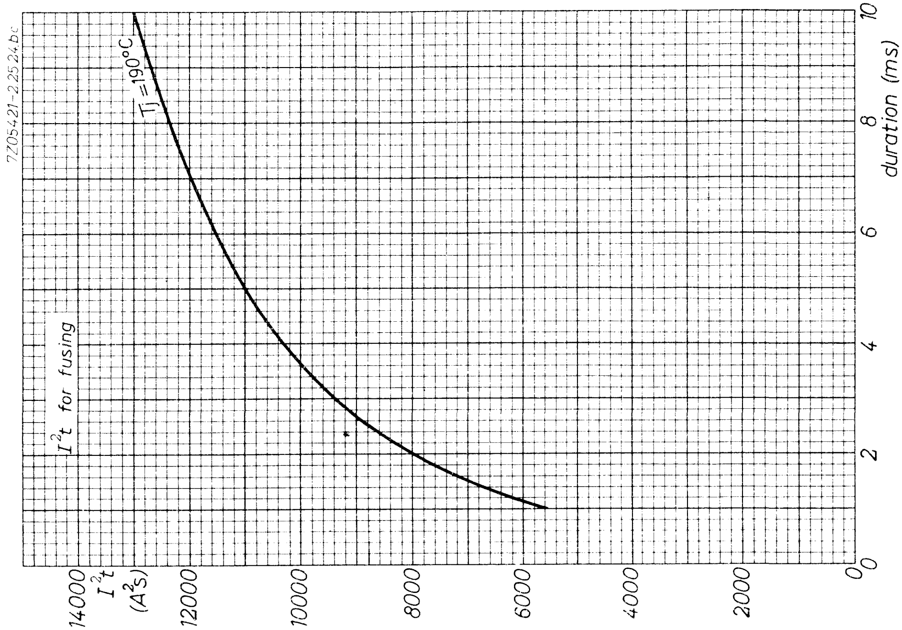
Hence the heatsink thermal resistance should be:

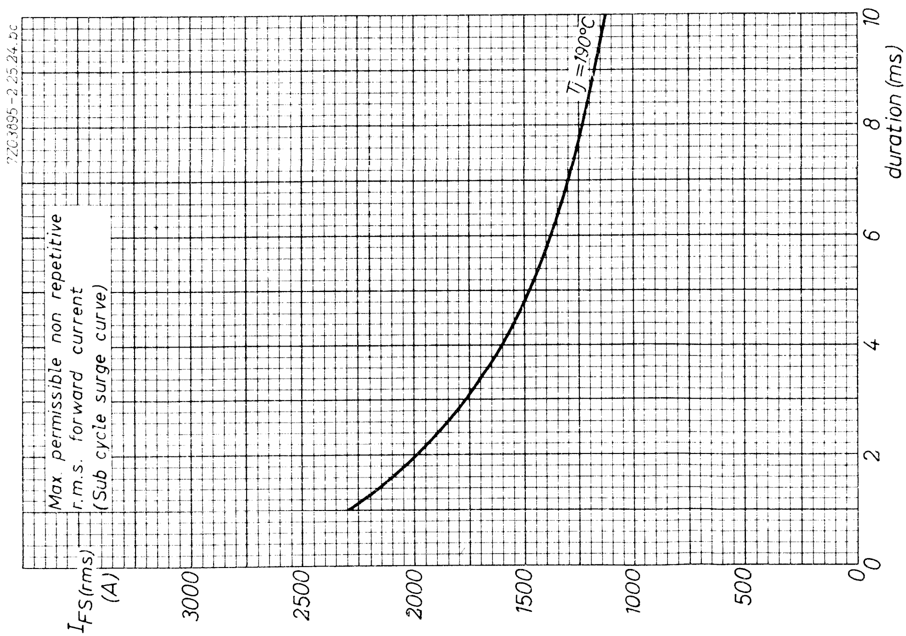
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (0.8 - 0.1)\ °C/W = 0.7\ °C/W.$$

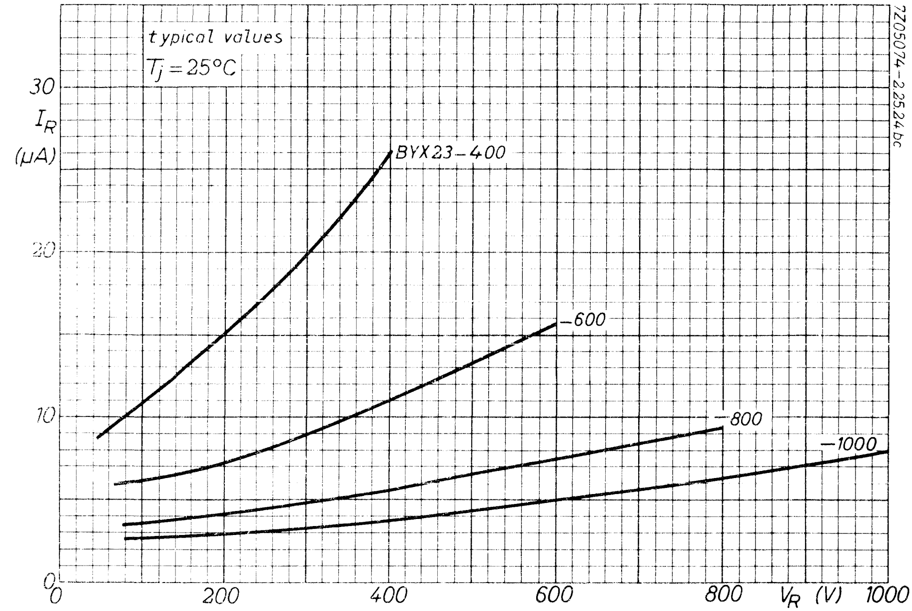
7Z3 0186

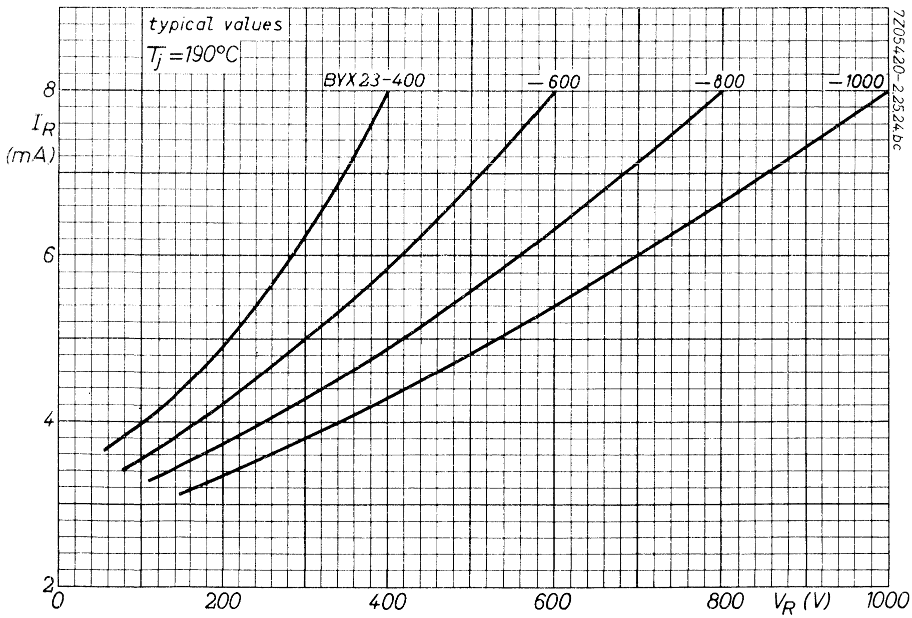

100
P_{RSM}
(kW)
Max permissible non repetitive peak reverse pulse power
P_R
P_{RSM}
t
pulse duration
$T_j = 25°C$
$T_j = 190°C$
20
10
5
2
1
10
20
50
100
200
pulse duration (μs)
1000
7Z03901-2.25.24.bc

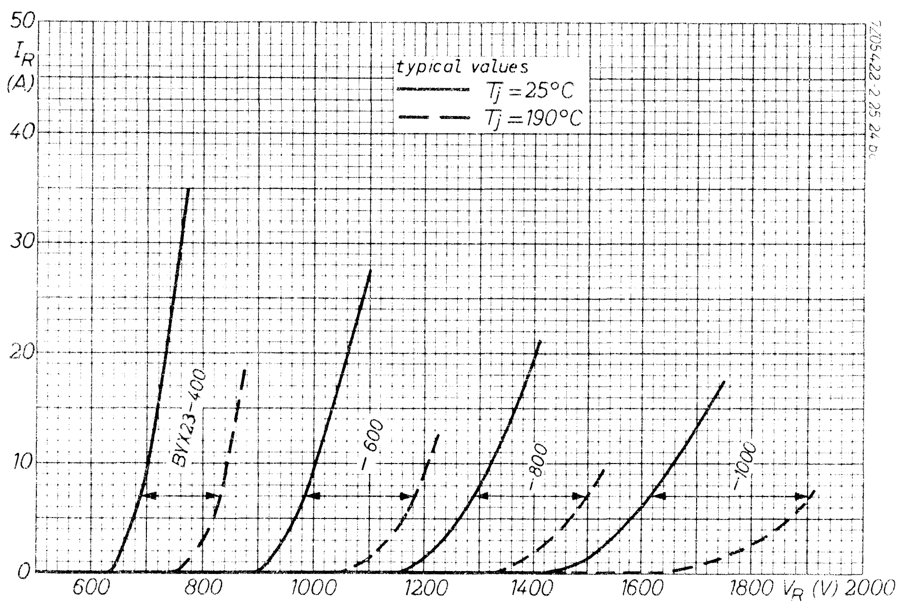

2000
I_{FSM}
(A)
Max. permissible non repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_F
I_{FSM}
t
duration
1500
1000
500
0
0.01
0.1
1
10
duration (s)
100
$T_j = 190°C$
7Z05417-2.25.24.bc

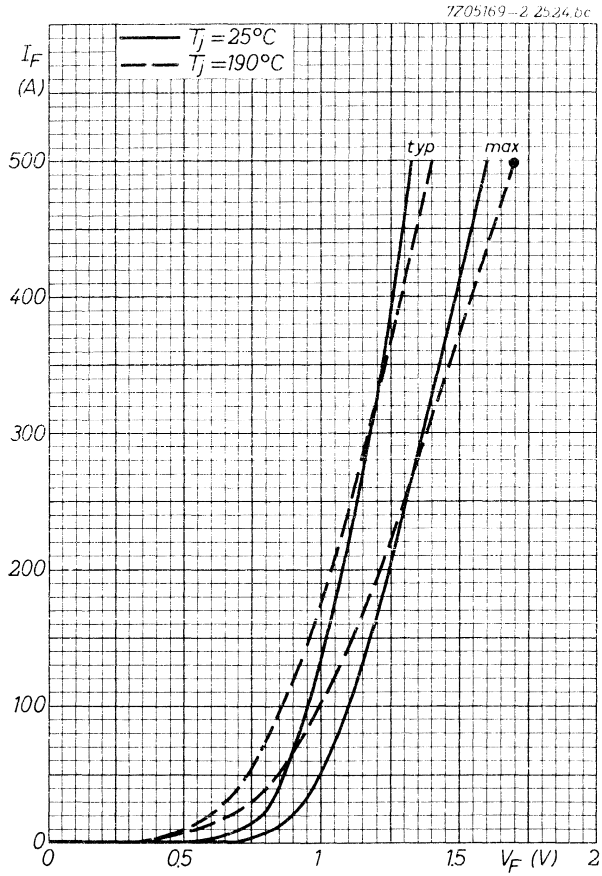

7Z05421-2.25.24.bc
I^2t for fusing
$T_j = 190°C$
I^2t (A^2s)
14000
12000
10000
8000
6000
4000
2000
0
0
2
4
6
8
10
duration (ms)


7Z03895-2.25.24.bc
Max. permissible non repetitive
r.m.s. forward current
(Sub cycle surge curve)
$T_j = 190°C$
$I_{FS(rms)}$ (A)
3000
2500
2000
1500
1000
500
0
0
2
4
6
8
10
duration (ms)


typical values
$T_j = 25°C$
30
I_R
(μA)
20
10
0
0
200
400
600
800
V_R (V)
1000
BYX23–400
–600
–800
–1000
7Z05074–2.25.24.bc


typical values
$T_j = 190°C$
8
I_R
(mA)
6
4
2
0
200
400
600
800
V_R (V)
1000
BYX23–400
–600
–800
–1000
7Z05420–2.25.24.bc


50
I_R
(A)
40
30
20
10
0
600
800
1000
1200
1400
1600
1800 V_R (V) 2000
typical values
T_j = 25°C
T_j = 190°C
BYX23-400
-600
-800
-1000
7Z05422.2.25.24 pc


7Z05169-2.2524.bc
$T_j = 25°C$
$T_j = 190°C$
I_F
(A)
500
400
300
200
100
0
typ
max
0
0.5
1
1.5
V_F (V)
2

CONTROLLED AVALANCHE POWER DIODES

Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (stud cathode): BYX25-600, BYX25-800, BYX25-1000.
Reverse polarity (stud anode): BYX25-600R, BYX25-800R, BYX25-1000R.

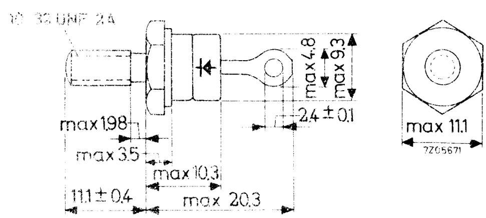
QUICK REFERENCE DATA

			BYX25-600(R)	800(R)	1000(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V
Average forward current	I_{FAV}	max.		20		A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.		360		A
Repetitive peak reverse power t = 10 μs; T_j = 175 °C	P_{RRM}	max.		3.0		kW
Non repetitive peak reverse power t = 10 μs; T_j = 25 °C	P_{RSM}	max.		18		kW
Junction temperature	T_j	max.		175		°C
Thermal resistance from junction to mounting base	$R_{th\ j-mb}$	=		1.3		°C/W

MECHANICAL DATA Dimensions in mm

Supplied with the device: nut, plain washer and lock washer

DO-4



Net weight : 5.6 g
With accessories: 7.5 g

Torque on nut: min. 8 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm

7Z3 0594

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages [2]			BYX25-600(R)	800(R)	1000(R)	
Continuous reverse voltage	V_R	max.	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	20	A
Forward current (d.c.)	I_F	max.	25	A
Repetitive peak forward current	I_{FRM}	max.	440	A
Non repetitive peak forward current t = 10 ms (see also page C)	I_{FSM}	max.	360	A

Reverse power dissipation

Reverse power (d.c. or average over any 20 ms period)	P_R	max.	38	W
Repetitive peak reverse power (square wave) f = 50 Hz; T_j = 175 °C; t = 10 μs	P_{RRM}	max.	3.0	kW
Non repetitive peak reverse power (square wave) (see also page B) T_j = 25 °C; t = 10 μs	P_{RSM}	max.	18	kW
T_j = 175 °C; t = 10 μs	P_{RSM}	max.	3.0	kW

Temperatures

Storage temperature	T_{stg}		-55 to +175	°C
Junction temperature	T_j	max.	175	°C

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2] These ratings apply up to T_j = 175 °C, provided (to ensure thermal stability): $R_{th\ j-a} \leq 2.5$ °C/W (d.c.) or ≤ 5 °C/W (a.c.).
At higher values of $R_{th\ j-a}$ the temperature should be derated (see page A).

7Z3 0595

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

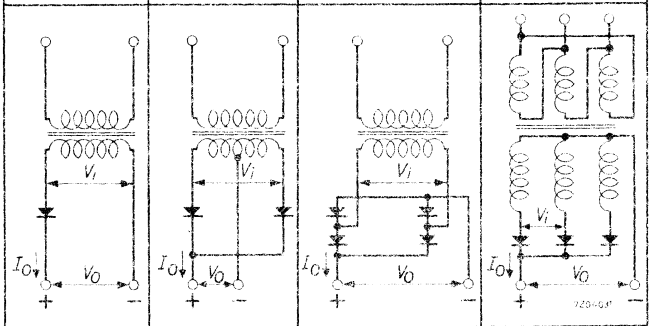
Voltages			BYX25-600(R)	800(R)	1000(R)	
Forward voltage at						
I_F = 50 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	V [1]
Reverse breakdown voltage (see also page D)						
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	V
		<	1050	1320	1600	V
Currents						
Reverse current at T_j = 125 °C						
V_R = 600 V	I_R	<	1.0			mA
V_R = 800 V	I_R	<		0.8		mA
V_R = 1000 V	I_R	<			0.6	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0596

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYX25- 600	420	20	185	40	185	40	375	60	280
BYX25- 800	560	20	250	40	250	40	505	60	380
BYX25-1000	700	20	310	40	315	40	635	60	475

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

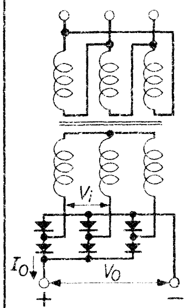
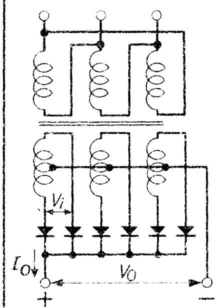
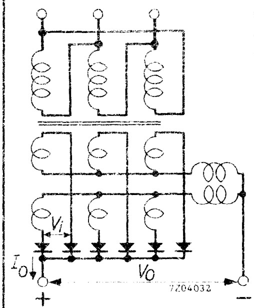
I_O = average output current in A

V_O = average output voltage in V

7Z3 0597

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX25- 600	420	60	565	95	280	120	240
BYX25- 800	560	60	760	95	380	120	320
BYX25-1000	700	60	940	95	475	120	400

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

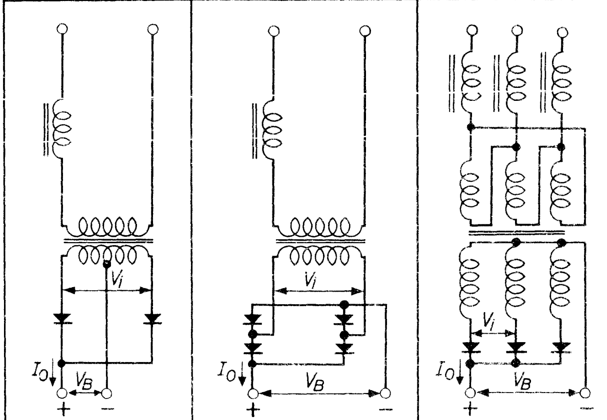
I_O = average output current in A

V_O = average output voltage in V

7Z3 0598

APPLICATION INFORMATION (continued)

OPERATION FOR BATTERY CHARGING



		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX25- 600	380	20	180	82	20	360	164	30	210	95
BYX25- 800	510	20	240	109	20	480	217	30	270	122
BYX25-1000	640	20	300	136	20	600	272	30	340	154

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

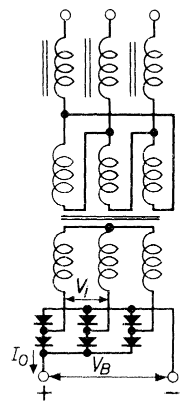
V_B = battery voltage in V

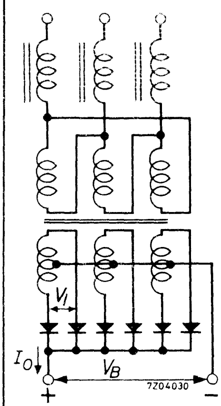
n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0599

APPLICATION INFORMATION (continued)

OPERATION FOR BATTERY CHARGING





		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX25- 600	380	30	360	164	60	180	82
BYX25- 800	510	30	480	217	60	240	109
BYX25-1000	640	30	600	272	60	300	136

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0600

OPERATING NOTES

1. Voltage sharing of series connected controlled avalanche diodes.

   If diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. The top connector should not be bent; it should be soldered into the circuit so there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

EXAMPLE (Determination of the heatsink thermal resistance)

Assume a diode, used in a three phase, 50 Hz rectifier circuit at an ambient temeprature of 40 ^{o}C. The average forward current I_{FAV} = 10 A (per diode). Furthermore assume a repetitive peak reverse power in the avalanche region P_{RRM} = 2 kW (per diode) during 40 microseconds.

From the upper graph at page A it follows that in a three phase rectifier circuit at I_{FAV} = 10 A the average forward power + average leakage power = 19.5 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{40\ \mu s}{20\ ms} = 0.002$$

Thus: $P_{RAV} = 0.002 \times 2\ kW = 4\ W$

Therefore the total device power dissipation P_{tot} = 19.5 + 4 = 23.5 W (point B). From the graph follows a maximum permissible mounting base temperature T_{mb} = 144 ^{o}C (point C).

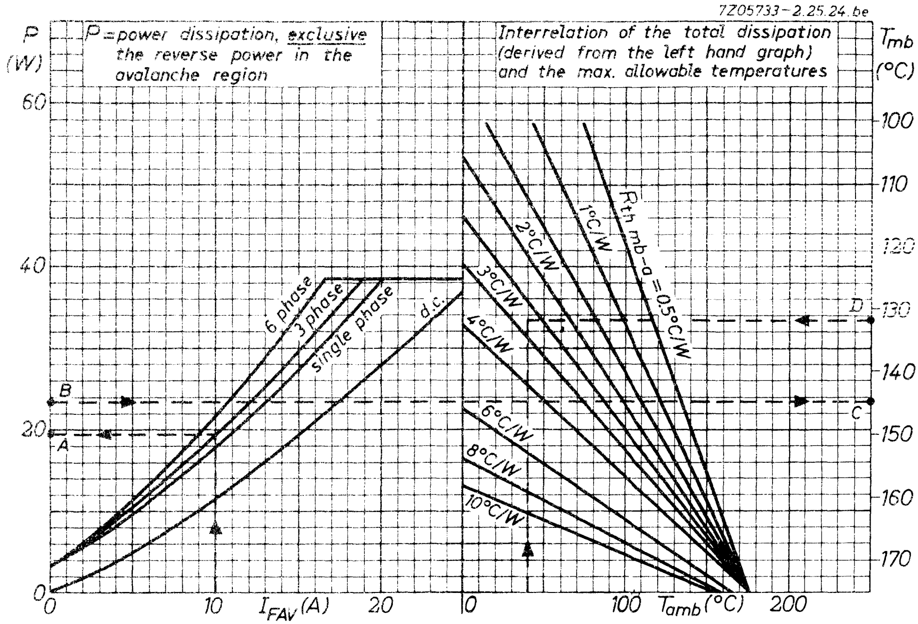
However, to avoid excessive peak junction temperatures resulting from the pulse character of the repetitive peak reverse power in the avalanche region, this value of the mounting base temperature should be decreased as follows: If the repetitive peak reverse power in the avalanche region is 2 kW; t = 40 μs; f = 50 Hz, the maximum allowable junction temperature should be 163 ^{o}C instead of 175 ^{o}C (see the lower graph at page A).
Therefore the mounting base temperature should be decreased with 175 - 163 = 12 ^{o}C as well.

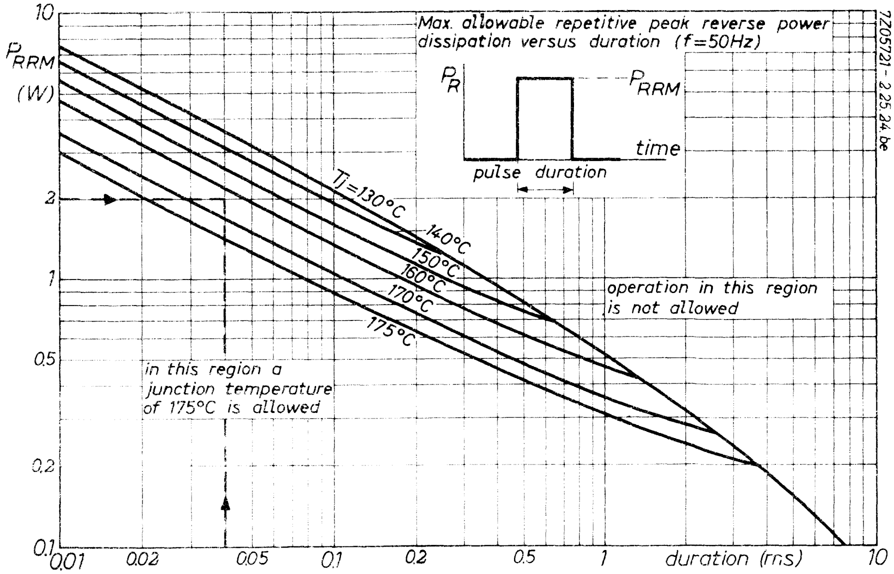
So the maximum allowable mounting base temperature is 144 - 12 = 132 ^{o}C (point D).

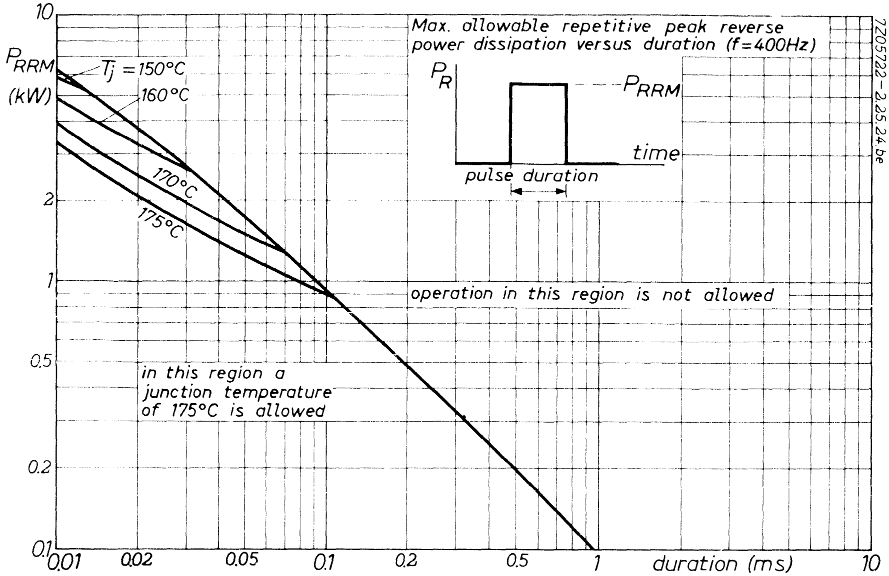
Then from the upper graph at page A it follows that at T_{amb} = 40 ^{o}C, the required thermal resistance $R_{th\ mb-a} \approx 2.8$ ^{o}C/W.
Hence the heatsink thermal resistance should be:

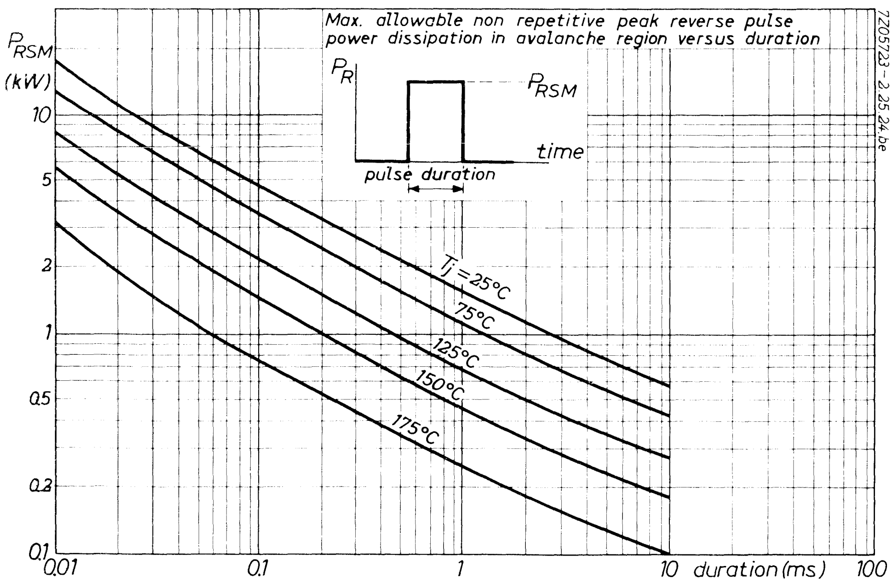
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (2.8 - 0.5)\ ^{o}C/W = 2.3\ ^{o}C/W.$$

7Z3 0601

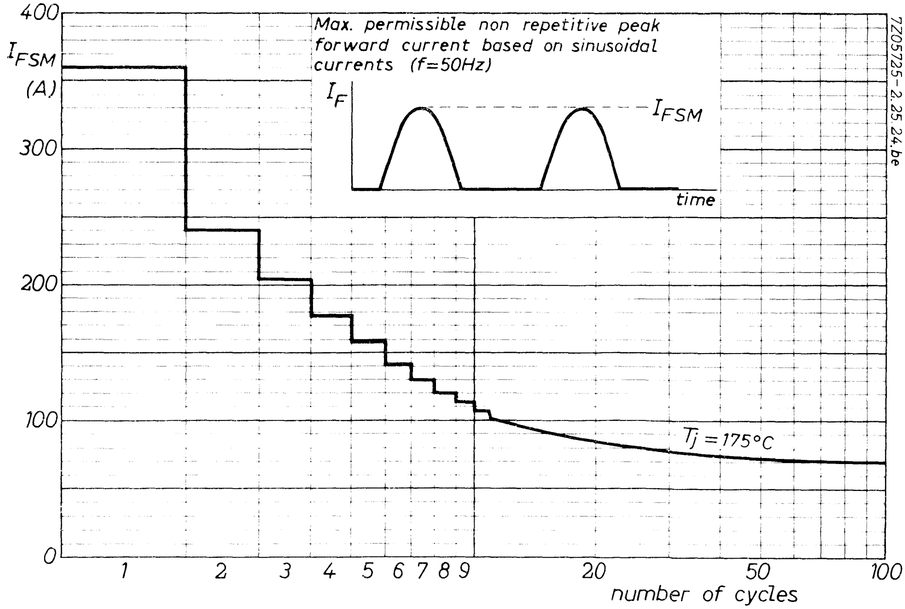

7Z05733-2.25.24.be
P = power dissipation, exclusive the reverse power in the avalanche region
Interrelation of the total dissipation (derived from the left hand graph) and the max. allowable temperatures
P (W)
T_{mb} (°C)
6 phase
3 phase
single phase
d.c.
$R_{th\,mb-a}$ = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
10°C/W
A
B
C
D
I_{FAV} (A)
T_{amb} (°C)

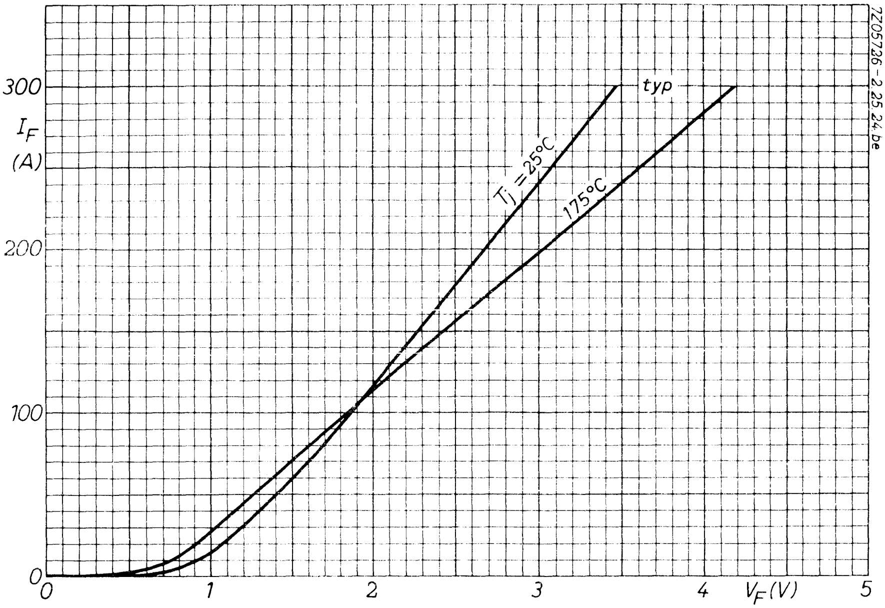

7Z05721-2.25.24.be
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
P_{RRM} (W)
T_j = 130°C
140°C
150°C
160°C
170°C
175°C
operation in this region is not allowed
in this region a junction temperature of 175°C is allowed
duration (ms)

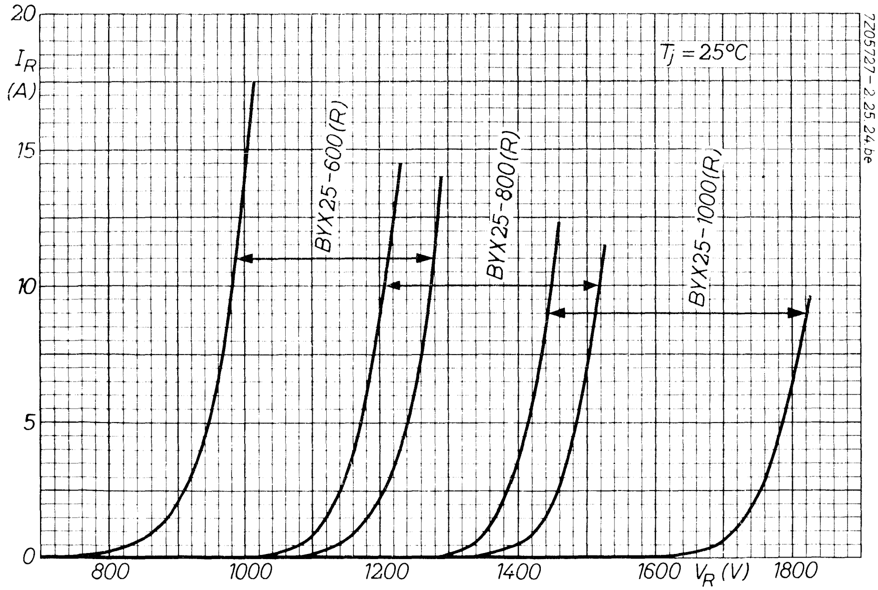

Max. allowable repetitive peak reverse power dissipation versus duration (f=400Hz)
P_R
P_RRM
time
pulse duration
P_RRM (kW)
Tj = 150°C
160°C
170°C
175°C
operation in this region is not allowed
in this region a junction temperature of 175°C is allowed
duration (ms)
7Z05722-2.25.24.be


Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_R
P_RSM
time
pulse duration
P_RSM (kW)
Tj = 25°C
75°C
125°C
150°C
175°C
duration (ms)
7Z05723-2.25.24.be


Max. allowable non repetitive r.m.s. forward current (sub cycle surge curve)
$I_{FS(rms)}$ (A)
800
600
400
200
0
0
2
4
6
8
10
12
duration (ms)
$T_j = 175°C$
7Z05724-2.25.24.be


Max. permissible non repetitive peak forward current based on sinusoidal currents (f=50Hz)
I_{FSM} (A)
400
300
200
100
0
I_F
I_{FSM}
time
1
2
3
4
5
6
7
8
9
20
50
100
number of cycles
$T_j = 175°C$
7Z05725-2.25.24.be


7Z05726-2.25.24.be
300
I_F
(A)
200
100
0
0
1
2
3
4
5
V_F (V)
typ
T_j = 25°C
175°C


7Z05727-2.25.24.be
20
I_R
(A)
15
10
5
0
800
1000
1200
1400
1600
1800
V_R (V)
T_j = 25°C
BYX25-600(R)
BYX25-800(R)
BYX25-1000(R)

CONTROLLED AVALANCHE POWER DIODES

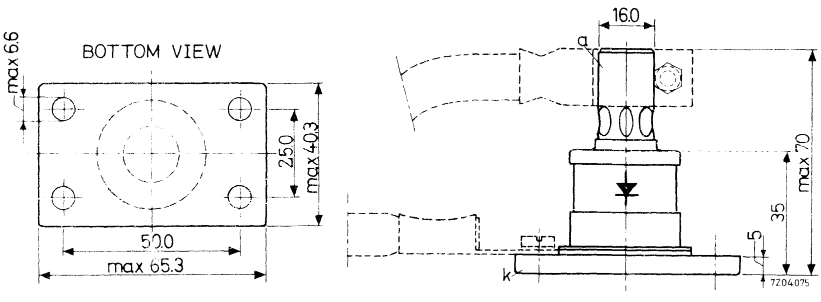
Diffused silicon diodes in metal envelopes with ceramic insulation, capable of absorbing transients and intended for power rectifier application.
The series consists of the following types: BYX27-400, BYX27-600, BYX27-800 and BYX27-1000.

QUICK REFERENCE DATA

		BYX27-	400	600	800	1000	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V
Average forward current	I_{FAV}	max.	250				A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	4000				A
Repetitive peak reverse power t = 10 μs; T_j = 190 °C	P_{RRM}	max.	20				kW
Non repetitive peak reverse power t = 10 μs; T_j = 25 °C	P_{RSM}	max.	80				kW
Junction temperature	T_j	max.	190				°C
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=	0.2				°C/W

MECHANICAL DATA Dimensions in mm

Net weight ≈ 235 g



Accessories and mounting instructions: see page 3. 7Z3 0187

RATINGS (Limiting values) [1])

Voltages [2])

		BYX27-	400	600	800	1000	
Continuous reverse voltage	V_R	max.	400	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	400	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	A
Forward current (d.c.)	I_F	max.	325	A
Repetitive peak forward current	I_{FRM}	max.	1250	A
Non repetitive peak forward current t = 10 ms (See page B)	I_{FSM}	max.	4000	A

Reverse power dissipation

Average reverse power at T_j = 190 °C (averaged over any 20 ms period)	P_{RAV}	max.	80	W
Repetitive peak reverse power; t = 10 μs (square wave; f = 50 Hz) T_j = 190 °C	P_{RRM}	max.	20	kW
Non repetitive peak reverse power t = 10 μs; T_j = 25 °C (See page B)	P_{RSM}	max.	80	kW
Non repetitive peak reverse power t = 10 μs; T_j = 190 °C (See page B)	P_{RSM}	max.	40	kW

Temperatures

Storage temperature	T_{stg}		-55 to +200	°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	0.2	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\,mb\text{-}h}$	=	0.07	°C/W
From mounting base to heatsink with heatsink compound (Dow corning 340)	$R_{th\,mb\text{-}h}$	=	0.03	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC Publication 134.

[2]) These ratings apply at $R_{th\,j\text{-}a} \leq 0.7$ °C/W (d.c.) or ≤ 1.3 °C/W (a.c.).

7Z3 0188

CHARACTERISTICS

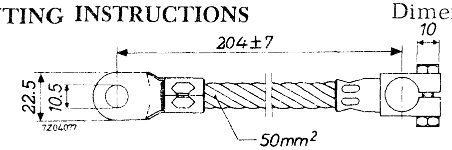
Forward voltage at I_F = 1250 A; T_j = 190 °C	V_F	<	1.8	V
Reverse breakdown voltage				
I_R = 25 mA; T_j = 25 °C				
BYX27-400	$V_{(BR)R}$		500 to 800	V
BYX27-600	$V_{(BR)R}$		750 to 1050	V
BYX27-800	$V_{(BR)R}$		1000 to 1320	V
BYX27-1000	$V_{(BR)R}$		1250 to 1600	V
(See also reverse characteristics at page E)				
Reverse current at T_j = 175 °C				
BYX27-400 : V_R = 400 V	I_R	<	50	mA
BYX27-600 : V_R = 600 V	I_R	<	42	mA
BYX27-800 : V_R = 800 V	I_R	<	32	mA
BYX27-1000: V_R = 1000 V	I_R	<	25	mA

ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

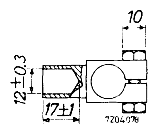
Flexible top lead

Type number 56243
Weight ≈ 170 g



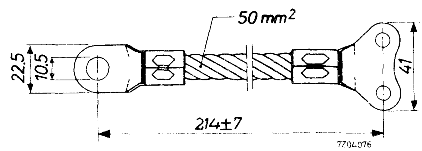
Clamp

Type number 56244
Weight ≈ 70 g



Flexible base lead

Type number 56247
Weight ≈ 135 g

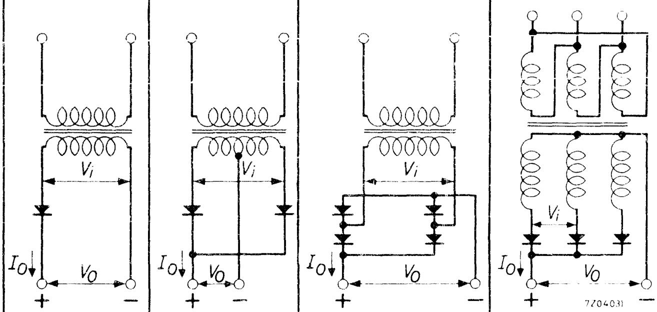


1. These accessories are available on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 cm kg; max. 60 cm kg.
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact : 30 cm kg
   Max. torque : 60 cm kg

7Z3 0189

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYX27- 400	280	250	125	500	125	500	250	750	190
BYX27- 600	420	250	185	500	185	500	375	750	280
BYX27- 800	560	250	250	500	250	500	505	750	380
BYX27-1000	700	250	315	500	315	500	635	750	475

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

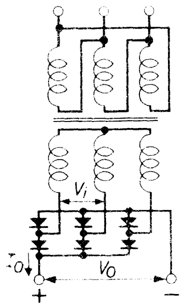
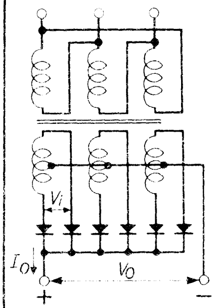
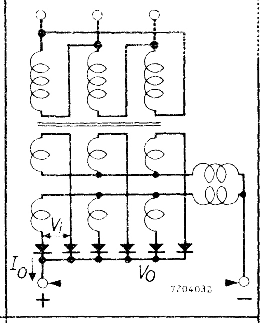
I_O = average output current in A

V_O = average output voltage in V

7Z3 0190

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX27- 400	280	750	375	1200	190	1500	160
BYX27- 600	420	750	565	1200	280	1500	240
BYX27- 800	560	750	760	1200	380	1500	320
BYX27-1000	700	750	940	1200	475	1500	400

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

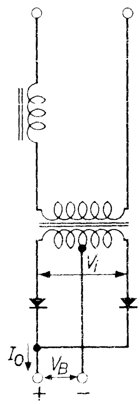
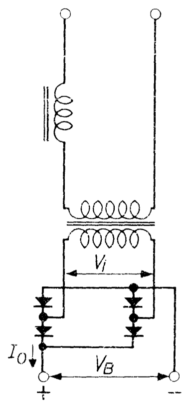
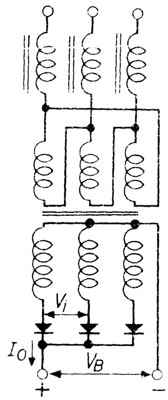
I_O = average output current in A

V_O = average output voltage in V

7Z3 0191

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
										
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX27- 400	255	250	120	54	250	240	109	375	140	64
BYX27- 600	380	250	180	82	250	360	164	375	210	95
BYX27- 800	510	250	240	109	250	480	217	375	270	122
BYX27-1000	640	250	300	136	250	600	272	375	340	154

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

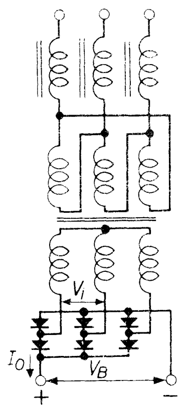
V_B = battery voltage in V

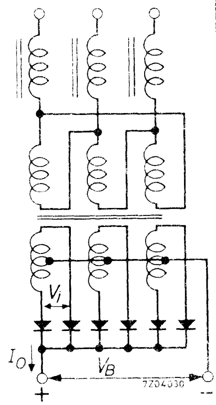
n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0192

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING





		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX27- 400	255	375	240	109	750	120	54
BYX27- 600	380	375	360	164	750	180	82
BYX27- 800	510	375	480	217	750	240	109
BYX27-1000	640	375	600	272	750	300	136

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10 % has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0193

OPERATING NOTES

1. Voltage sharing of series connected controlled avalanche diodes.

When diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. Switching transients for controlled avalanche diodes.

In an unloaded rectifier circuit, when the transformer is switched off, energy is released.
When, as a result, no diode rating is exceeded, special provisions are not needed. If, however, the rated non repetitive peak power dissipation per device could be exceeded, damping across the transformer is necessary in order to protect the device.

The duration of the transformer's energy release can be found in first approximation from the empirical formula:

$$t = \frac{V_{RWM}}{V_{(BR)R\,min}}\ ;\ \text{(milliseconds)}$$

where V_{RWM} = actually applied crest working voltage

$V_{(BR)R\,min}$ = minimum reverse breakdown voltage

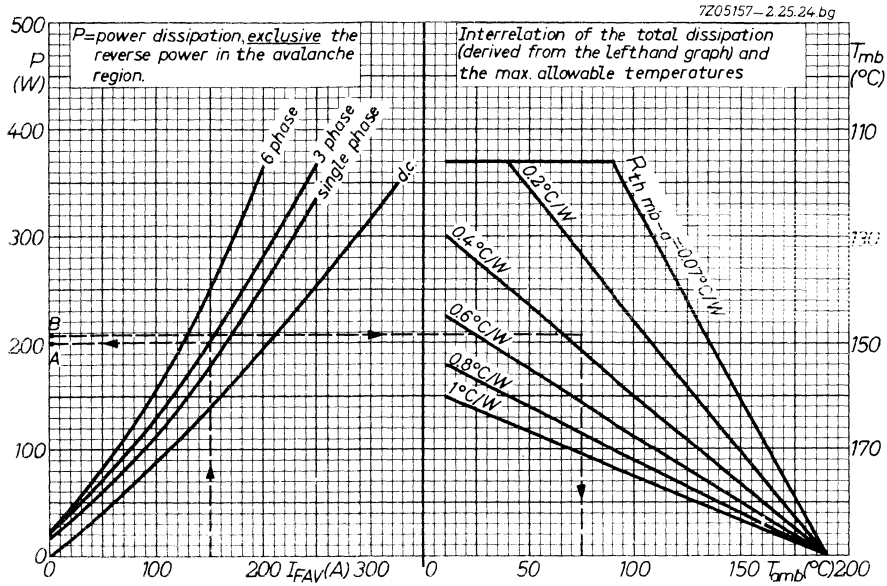
The non repetitive peak power that can be absorbed by a single device during t ms can be derived from the graph on page B. Multiplying that amount with the time in which it is released results in the energy absorbed by one diode. (E_D).
A series string of n diodes can absorb n times as much. ($n.E_D$)

The difference between the energy released by the transformer and that absorbed by the n diodes should be absorbed by series connected R and C elements across the secondary winding of the transformer.
The magnitudes of R and C have to be derived from the following formulae:

$$C = \frac{E_T - n.E_D}{(n.V_{(BR)R\,min})^2} \cdot 10^6 \quad (\mu F) \qquad R = \frac{310}{C} \quad (\Omega)$$

where C = capacitance in μF
E_T = energy released by the transformer in Ws
n = number of diodes in series
E_D = energy absorbed by one diode in Ws
$V_{(BR)R\,min}$ = minimum reverse breakdown voltage of one diode in V
R = resistance in Ω

7Z3 0185



EXAMPLE (Determination of the heatsink thermal resistance)

Assume a diode, used in a three phase, 50 Hz rectifier circuit at an ambient temperature of 75 °C. The average forward current I_{FAV} = 150 A (per diode) Furthermore assume a repetitive peak reverse power in the avalanche region P_{RRM} = 16 kW (per diode) during 10 microseconds.

From the graph above it follows that in a three phase rectifier circuit at I_{FAV} = 150 A the average forward power + average leakage power = 200 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{10\ \mu s}{20\ ms} = 0.0005$$

Thus: P_{RAV} = 0.0005 x 16 kW = 8 W

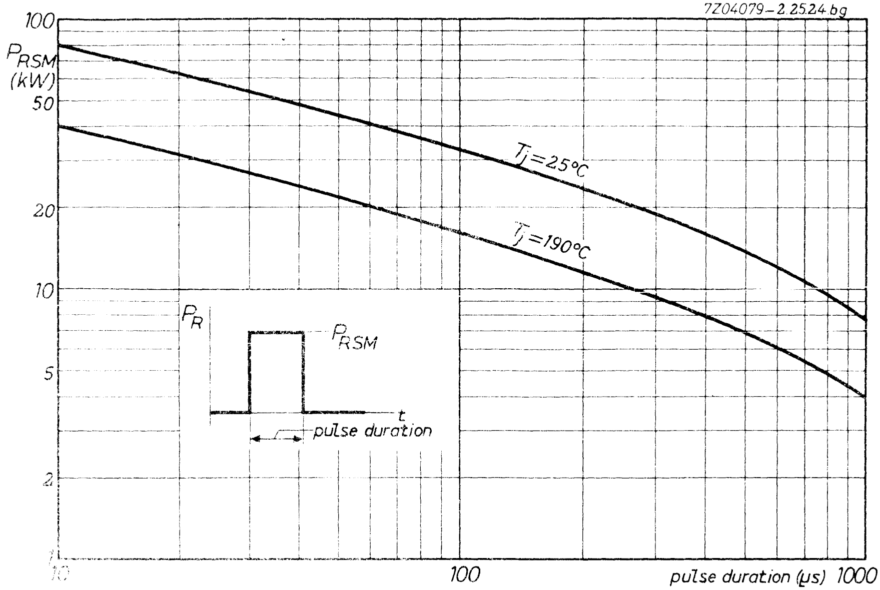
Therefore the total device power dissipation P_{tot} = 200 + 8 = 208 W (point B).

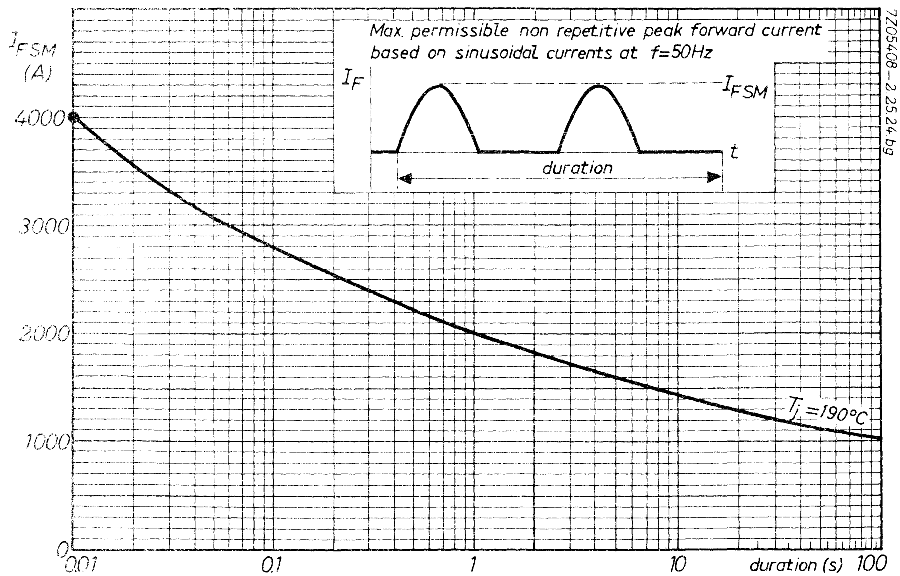
From the curves it follows that at T_{amb} = 75 °C the required thermal resistance $R_{th\ mb-a}$ ≈ 0.35 °C/W. The contact thermal resistance $R_{th\ mb-h}$ = 0.07 °C/W.

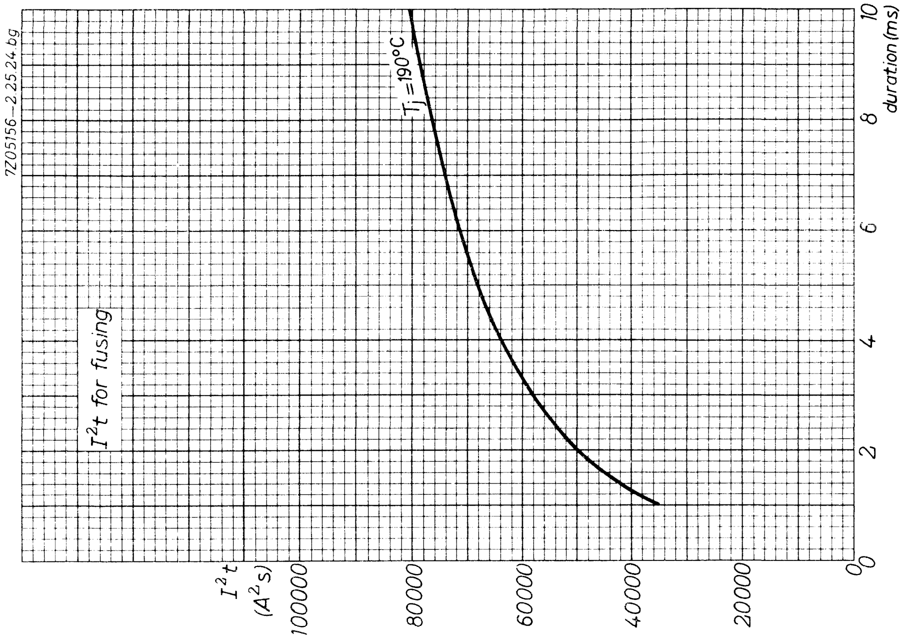
Hence the heatsink thermal resistance should be:

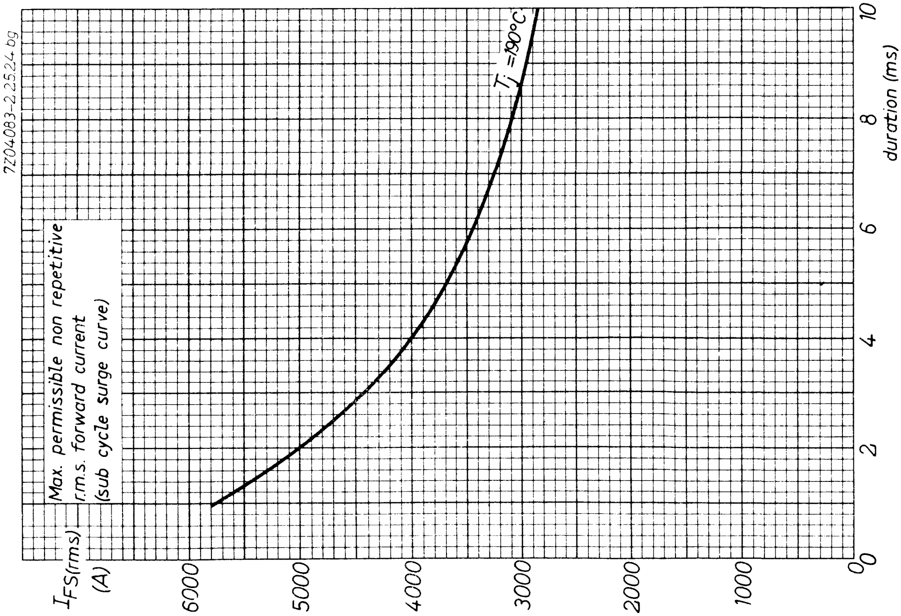
$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h}$ = (0.35 - 0.07)°C/W = 0.28 °C/W.

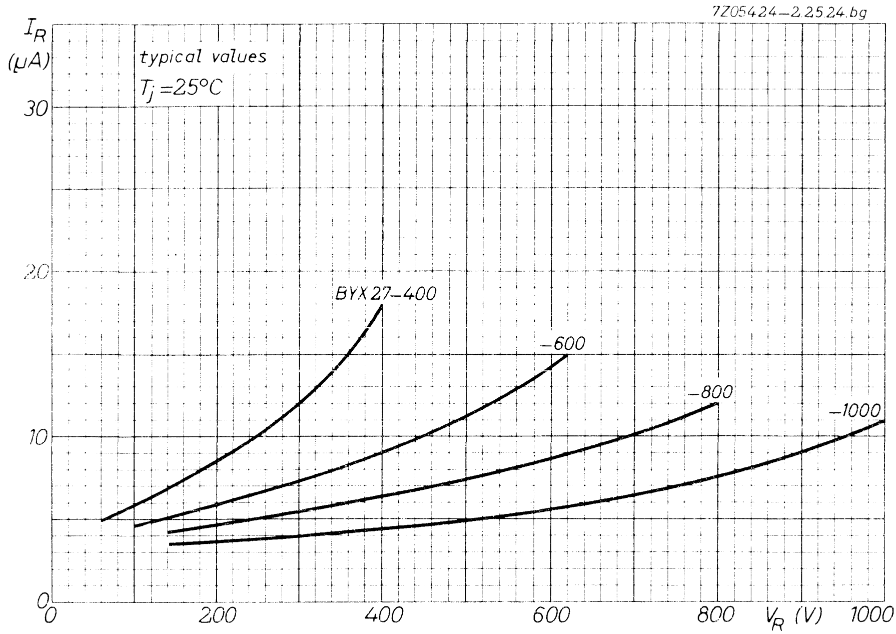
7Z3 0194

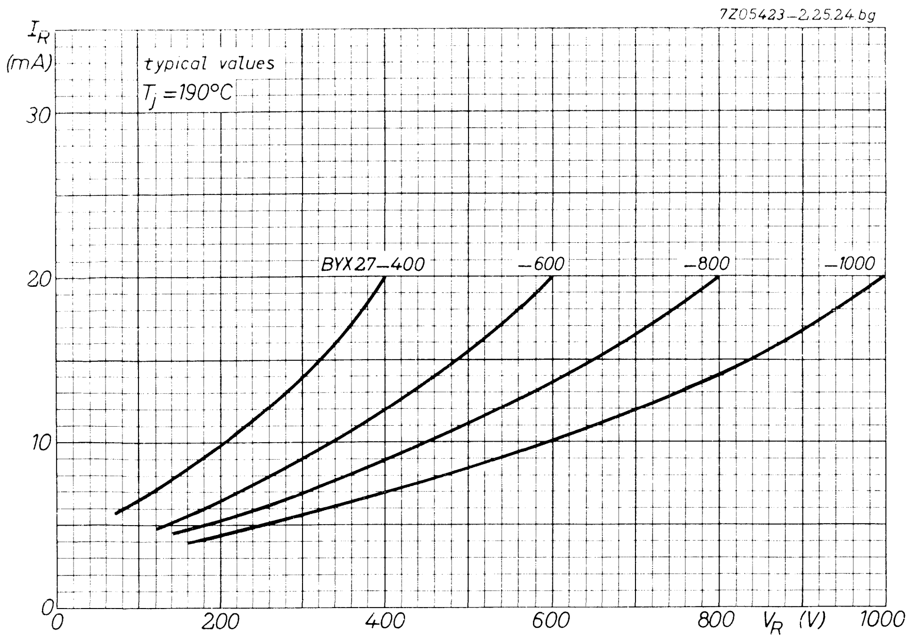

7Z04079–2.25.24.bg
100
P_{RSM}
(kW)
50
20
10
5
2
1
10
100
pulse duration (μs) 1000
T_j=25°C
T_j=190°C
P_R
P_{RSM}
t
pulse duration

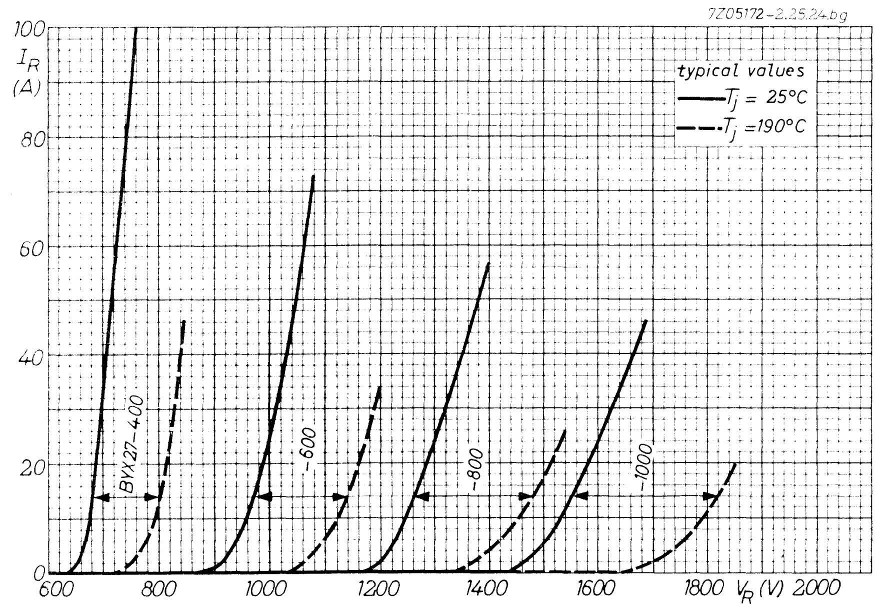

I_{FSM}
(A)
4000
3000
2000
1000
0
0.01
0.1
1
10
duration (s) 100
Max. permissible non repetitive peak forward current
based on sinusoidal currents at f=50Hz
I_F
I_{FSM}
t
duration
T_j=190°C
7Z05408–2.25.24.bg

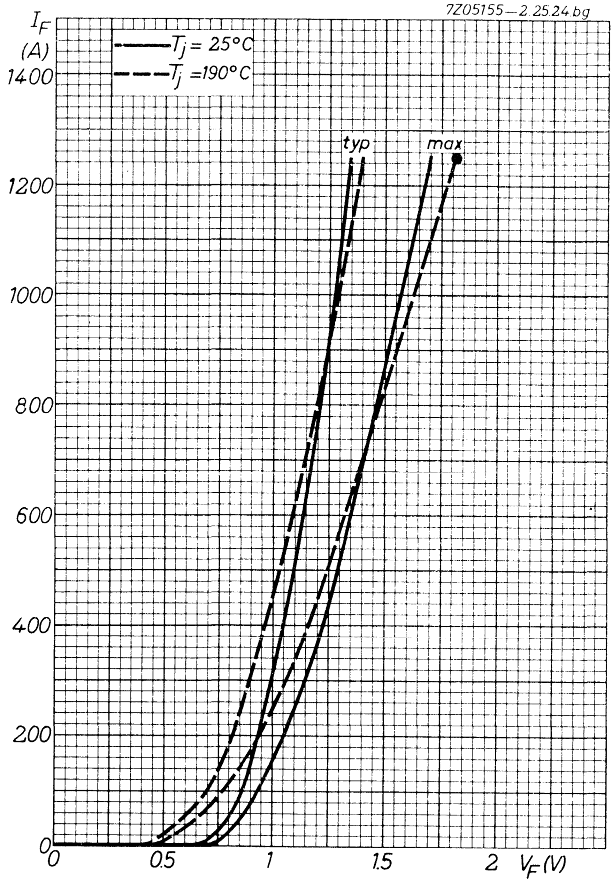

7Z05156—2.25.24.bg
I²t for fusing
Tj =190°C
I²t
(A²s)
100000
80000
60000
40000
20000
0
0
2
4
6
8
10
duration (ms)


7Z04083-2.25.24.bg
Max. permissible non repetitive
r.m.s. forward current
(sub cycle surge curve)
Tj =190°C
IFS(rms)
(A)
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
duration (ms)


7Z05424–2.25.24.bg
I_R (μA)
typical values
T_j = 25°C
BYX27–400
–600
–800
–1000
0
10
20
30
0
200
400
600
800
1000
V_R (V)


7Z05423–2.25.24.bg
I_R (mA)
typical values
T_j = 190°C
BYX27–400
–600
–800
–1000
0
10
20
30
0
200
400
600
800
1000
V_R (V)


7Z05172-2.25.24.bg
100
I_R
(A)
80
60
40
20
0
600
800
1000
1200
1400
1600
1800
V_R (V)
2000
typical values
T_j = 25°C
T_j =190°C
BYX27-400
-600
-800
-1000


7Z05155—2.25.24.bg
I_F
(A)
1400
1200
1000
800
600
400
200
0
T_j = 25°C
T_j =190°C
typ
max
0
0.5
1
1.5
2
V_F (V)

HIGH SPEED
POWER DIODES WITH CONTROLLED AVALANCHE

Diffused silicon diodes in a DO-4 metal envelope, capable of absorbing transients. They are primarily intended for use in high frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (stud cathode): BYX30-200 to BYX30-500
Reverse polarity (stud anode) : BYX30-200R to BYX30-500R.

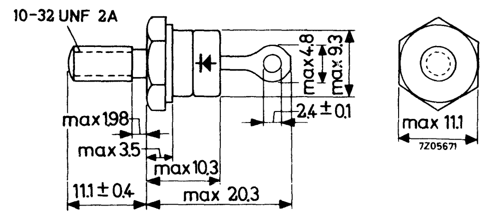
QUICK REFERENCE DATA

			BYX30-200(R)	300(R)	400(R)	500(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	V
Average forward current	I_{FAV}	max.	14				A
Non repetitive peak forward current; t = 10 ms	I_{FSM}	max.	250				A
Repetitive peak reverse power t = 10 μs; T_j = 150 ^oC	P_{RRM}	max.	5.5				kW
Non repetitive peak reverse power; t = 10 μs; T_j = 25 ^oC	P_{RSM}	max.	18				kW
Junction temperature	T_j	max.	150				^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3				$^oC/W$
Recovered charge, switched from I_F = 2 A to V_R = 30 V, $-\frac{dI}{dt}$ = 100 A/μs; I_R limited to 2 A; T_{mb} = 25 ^oC	Q_s	<	0.7				μC

MECHANICAL DATA Dimensions in mm

Supplied with the device: nut, metal washer, metal lock washer

DO-4



Net weight : 5.6 g
With accessories: 7.5 g
Diameter of hole in heatsink: max. 5.2 mm

Torque on nut: min. 8 cm kg
max. 17 cm kg

7Z3 0700

All information applies to frequencies up to 50 kHz

RATINGS (Limiting values) [1])

Voltages [2])

		BYX30-200(R)	300(R)	400(R)	500(R)	
Continuous reverse voltage	V_R	max. 200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max. 200	300	400	500	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	14	A
Forward current (d.c.)	I_F	max.	17	A
Repetitive peak forward current	I_{FRM}	max.	310	A
Non repetitive peak forward current $t = 10$ ms	I_{FSM}	max.	250	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Reverse power dissipation

Reverse power (d.c. or average over any 20 ms period)	P_R	max.	38	A
Repetitive peak reverse power (square wave f = 50 Hz) $t = 10\ \mu s$; $T_j = 150\ ^oC$	P_{RRM}	max.	5.5	kW
Non repetitive peak reverse power (square wave) $t = 10\ \mu s$; $T_j = 25\ ^oC$	P_{RSM}	max.	18	kW
$T_j = 150\ ^oC$	P_{RSM}	max.	5.5	kW

Temperatures

Storage temperature	T_{stg}	-55 to	+150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	50	$^oC/W$
From junction to mounting base	$R_{th\ j-mb}$	=	1.3	$^oC/W$
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.5	$^oC/W$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply up to $T_j = 175\ ^oC$, provided (for thermal stability) $R_{th\ j-a} \leq 2.5\ ^oC/W$ (d.c.) or $R_{th\ j-a} \leq 5\ ^oC/W$ (a.c.)
At higher values of $R_{th\ j-a}$ the junction temperature should be derated.

7Z3 0701

SILICON POWER DIODES

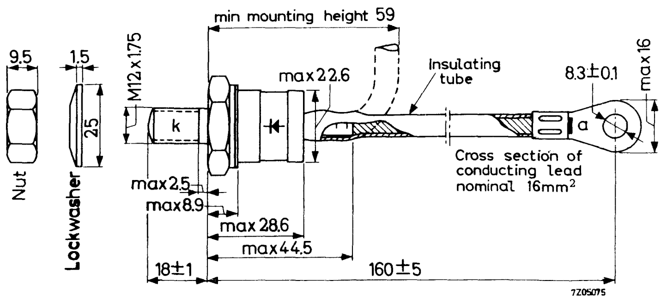
Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application.
The series consists of the following types: BYX32-200; BYX32-400; BYX32-600; BYX32-800 and BYX32-1000.

QUICK REFERENCE DATA

			BYX32-200	400	600	800	1000	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	1000	V
Average forward current	I_{FAV}	max.			100	A		
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.			1600	A		
Junction temperature	T_j	max.			190	^oC		
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=			0.4	$^oC/W$		

MECHANICAL DATA Dimensions in mm

Net weight ≈ 95 g
With accessories ≈ 115 g



Mounting instructions

1. Hole in heatsink: d = max. 13 mm
2. Torque on nut : min. 100 cm kg
   max. 250 cm kg

7Z3 0238

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages [2]

			BYX32-200	400	600	800	1000	
Continuous reverse voltage	V_R	max.	200	400	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	1000	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	1000	V
Non repetitive peak reverse voltage (t < 10 ms)	V_{RSM}	max.	200	400	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	100	A
Forward current (d.c.)	I_F	max.	130	A
Repetitive peak forward current	I_{FRM}	max.	500	A
Non repetitive peak forward current t = 10 ms (See page B)	I_{FSM}	max.	1600	A

Temperatures

Storage temperature	T_{stg}		-55 to +200	^oC
Junction temperature	T_j	max.	190	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	0.4	$^oC/W$
From mounting base to heatsink without heatsink compound	$R_{th\ mb-h}$	=	0.1	$^oC/W$
From mounting base to heatsink with heatsink compound (Dow Corning 340)	$R_{th\ mb-h}$	=	0.04	$^oC/W$

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) These ratings apply at $R_{th\ j-a} \leqq 1.7\ ^oC/W$ (d.c.) or $\leqq 3.3\ ^oC/W$ (a.c.).

7Z3 0416

CHARACTERISTICS

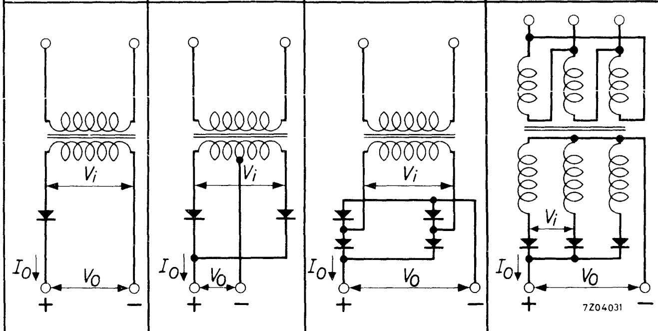
Forward voltage at I_F = 500 A; T_j = 190 °C	V_F	<	1.7	V[1]
Reverse current at T_j = 175 °C				
BYX32-200 : V_R = 200 V	I_R	<	20	mA
BYX32-400 : V_R = 400 V	I_R	<	20	mA
BYX32-600 : V_R = 600 V	I_R	<	17	mA
BYX32-800 : V_R = 800 V	I_R	<	13	mA
BYX32-1000: V_R = 1000 V	I_R	<	10	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0240

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYX32- 200	140	100	60	200	60	200	125	300	95
BYX32- 400	280	100	125	200	125	200	250	300	190
BYX32- 600	420	100	185	200	185	200	375	300	280
BYX32- 800	560	100	250	200	250	200	505	300	380
BYX32-1000	700	100	315	200	315	200	635	300	475

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

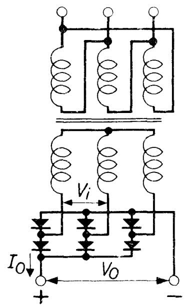
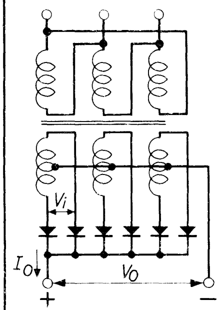
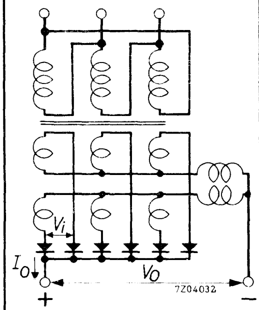
I_O = average output current in A

V_O = average output voltage in V

7Z3 0241

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYX32- 200	140	300	185	480	95	600	80
BYX32- 400	280	300	375	480	190	600	160
BYX32- 600	420	300	565	480	280	600	240
BYX32- 800	560	300	760	480	380	600	320
BYX32-1000	700	300	940	480	475	600	400

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

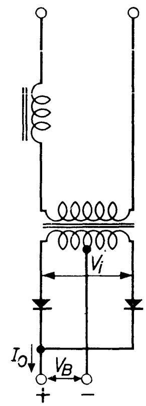
V_O = average output voltage in V

7Z3 0242

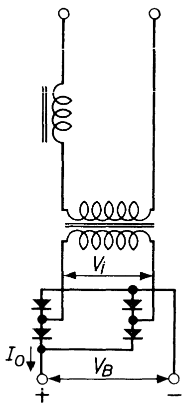
APPLICATION INFORMATION (continued)

OPERATION FOR BATTERY CHARGING

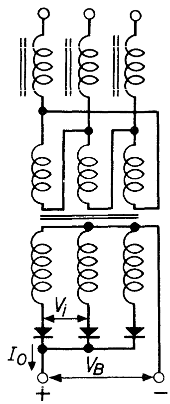
Two phase half wave:



Single phase full wave (Single phase bridge):



Three phase half wave (Three phase star):



		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX32- 200	125	100	60	27	100	120	54	150	70	32
BYX32- 400	255	100	120	54	100	240	109	150	140	64
BYX32- 600	380	100	180	82	100	360	164	150	210	95
BYX32- 800	510	100	240	109	100	480	217	150	270	122
BYX32-1000	640	100	300	136	100	600	272	150	340	154

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

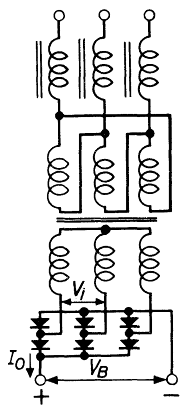
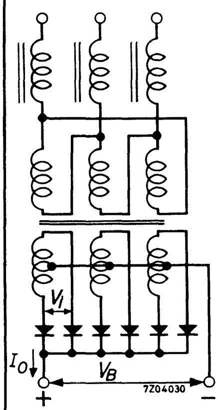
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0243

APPLICATION INFORMATION (continued)

OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX32- 200	125	150	120	54	300	60	27
BYX32- 400	255	150	240	109	300	120	54
BYX32- 600	380	150	360	164	300	180	82
BYX32- 800	510	150	480	217	300	240	109
BYX32-1000	640	150	600	272	300	300	136

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0244

OPERATING NOTES

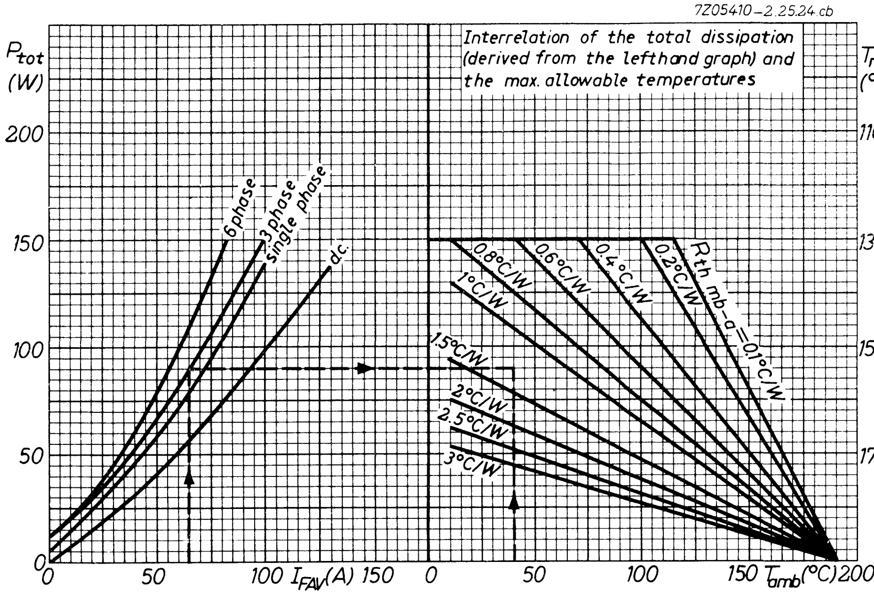
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working reverse voltage

2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at pages B and C a fast fuse is recommended.

7Z3 0245



EXAMPLE (Determination of the heatsink thermal resistance)

Assume a diode, used in a three phase, 50 Hz rectifier circuit at an ambient temperature of 40 °C. The average forward current I_{FAV} = 65 A (per diode).

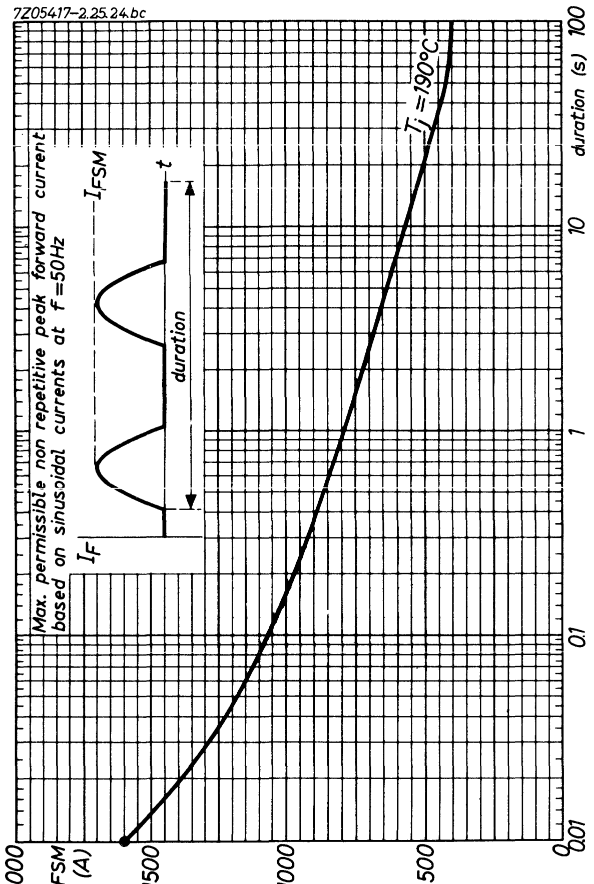
From the graph above it follows that in a three phase rectifier circuit at I_{FAV} = 65 A the average forward power + average leakage power = 90 W per diode.

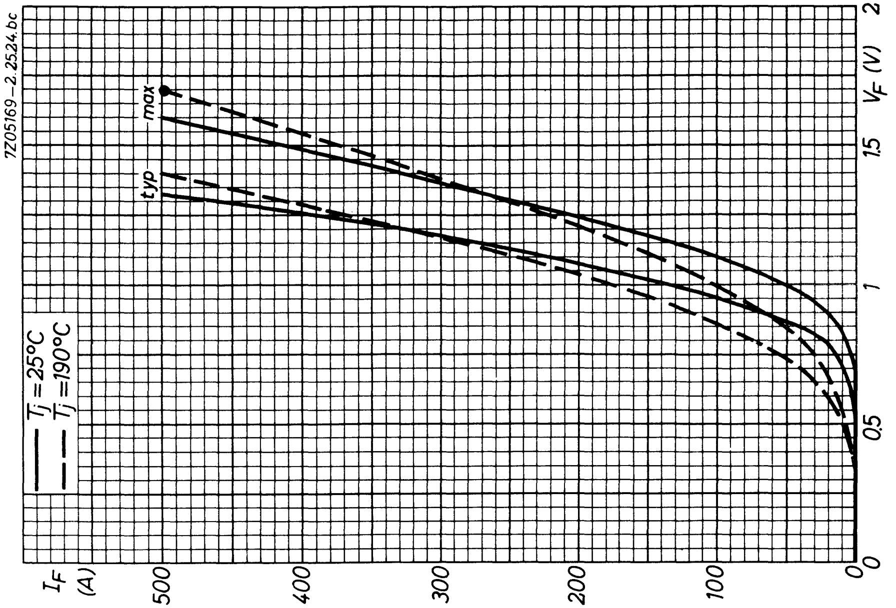
Tracing to the right until the vertical through T_{amb} = 40 °C, gives a required thermal resistance $R_{th\ mb-a} \approx 1.3$ °C/W. The contact thermal resistance $R_{th\ mb-h} = 0.1$ °C/W.

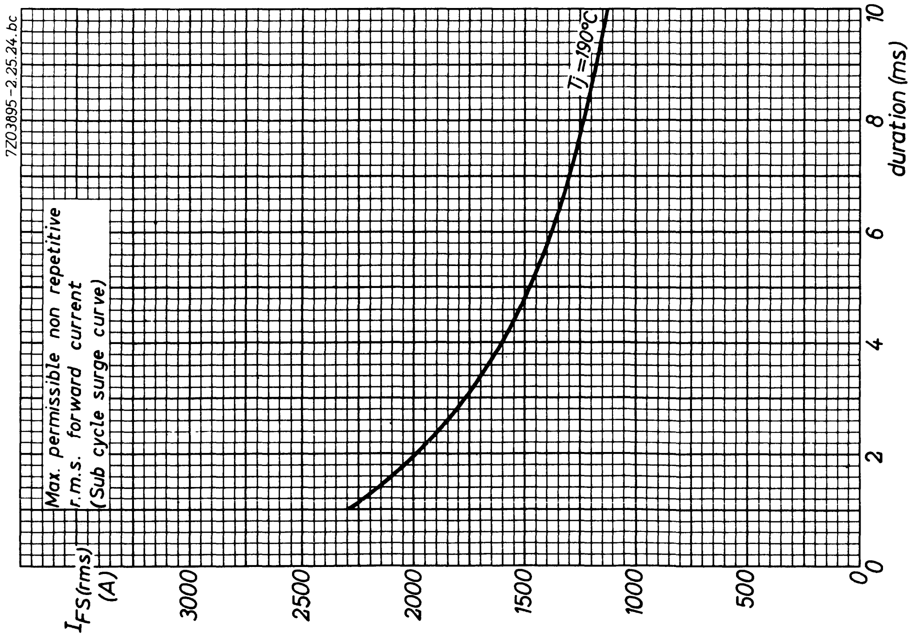
Hence the heatsink thermal resistance should be:

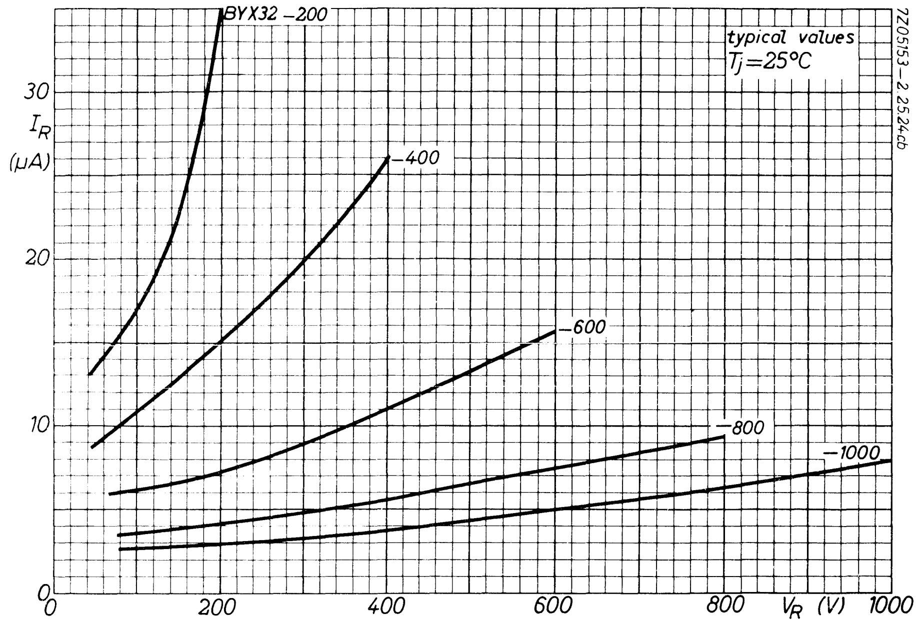
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (1.3 - 0.1)\ ^{o}C/W = 1.2\ ^{o}C/W.$$

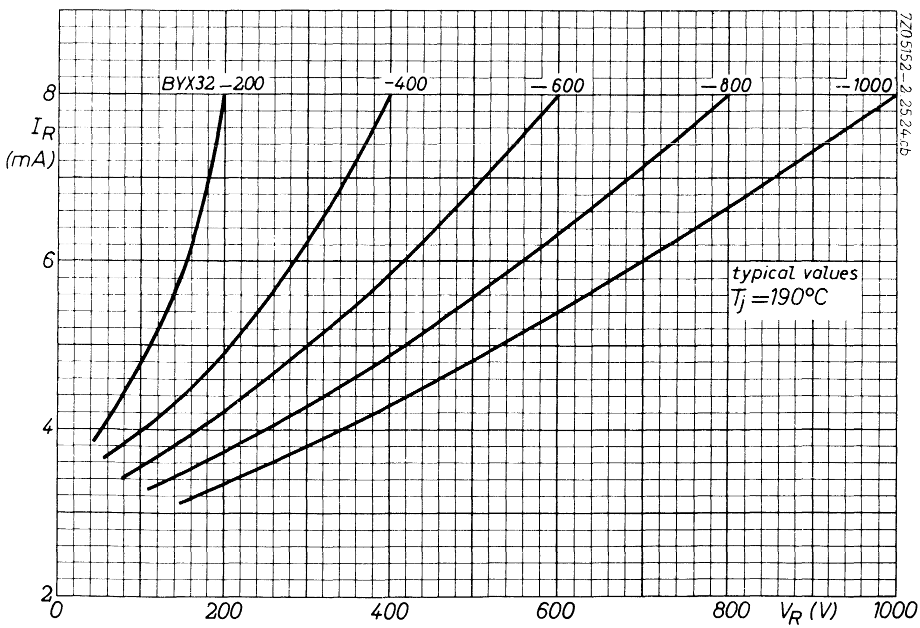
7Z3 0246


7Z05417-2.25.24.bc
Max. permissible non repetitive peak forward current
based on sinusoidal currents at f = 50Hz
I_F
I_FSM
t
duration
T_j = 190°C
I_FSM (A)
2000
1500
1000
500
0
0.01
0.1
1
10
100
duration (s)


7Z05169-2.25.24.bc
max
typ
Tj = 25°C
Tj = 190°C
IF (A)
500
400
300
200
100
0
VF (V)
0
0.5
1
1.5
2


7Z03895-2.25.24.bc
Tj = 190°C
Max. permissible non repetitive
r.m.s. forward current
(Sub cycle surge curve)
IFS(rms) (A)
3000
2500
2000
1500
1000
500
0
duration (ms)
0
2
4
6
8
10


BYX32 −200
−400
−600
−800
−1000
typical values
T_j = 25°C
7Z05153−2.25.24.cb
30
I_R
(µA)
20
10
0
0
200
400
600
800
V_R (V)
1000


7Z05152−2.25.24.cb
BYX32 −200
−400
−600
−800
−1000
8
I_R
(mA)
6
4
2
typical values
T_j = 190°C
0
200
400
600
800
V_R (V)
1000

SILICON POWER DIODES

Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application.
The series consists of the following types: BYX33-200; BYX33-400; BYX33-600; BYX33-800 and BYX33-1000.

QUICK REFERENCE DATA

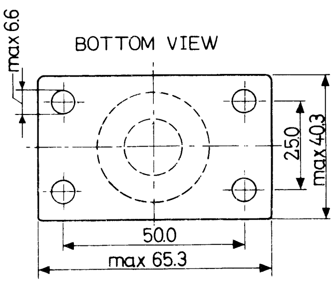
			BYX33-200	400	600	800	1000	
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	1000	V
Average forward current	I_{FAV}	max.			250			A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.			4000			A
Junction temperature	T_j	max.			190			^oC
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=			0.2			$^oC/W$

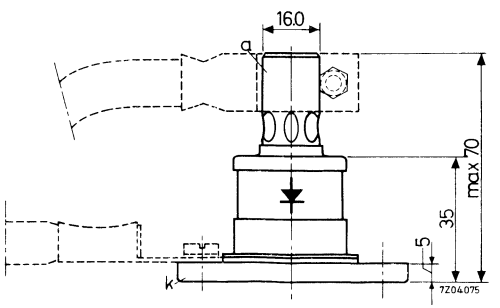
MECHANICAL DATA

Dimensions in mm

Net weight ≈ 240 g

With accessories ≈ 540 g





Accessories and mounting instructions: see page 3.

7Z3 0251

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages [2]			BYX33-200	400	600	800	1000	
Continuous reverse voltage	V_R	max.	200	400	600	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	200	400	600	800	1000	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	1000	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	200	400	600	800	1000	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	250	A
Forward current (d.c.)	I_F	max.	325	A
Repetitive peak forward current	I_{FRM}	max.	1250	A
Non repetitive peak forward current t = 10 ms (See page B)	I_{FSM}	max.	4000	A

Temperatures

Storage temperature	T_{stg}		-55 to +200	°C
Junction temperature	T_j	max.	190	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	0.2	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\,mb\text{-}h}$	=	0.07	°C/W
From mounting base to heatsink with heatsink compound (Dow Corning 340)	$R_{th\,mb\text{-}h}$	=	0.03	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply at $R_{th\,j\text{-}a} \leqq 0.7$ °C/W (d.c.) or $\leqq 1.3$ °C/W (a.c.)

7Z3 0417

CHARACTERISTICS

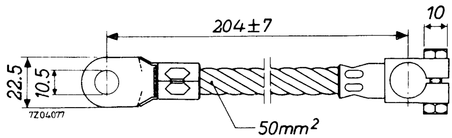
Forward voltage at I_F = 1250 A; T_j = 190 °C	V_F	<	1.8	V [1]
Reverse current at T_j = 175 °C				
BYX33-200 : V_R = 200 V	I_R	<	50	mA
BYX33-400 : V_R = 400 V	I_R	<	50	mA
BYX33-600 : V_R = 600 V	I_R	<	42	mA
BYX33-800 : V_R = 800 V	I_R	<	32	mA
BYX33-1000: V_R = 1000 V	I_R	<	25	mA

ACCESSORIES AND MOUNTING INSTRUCTIONS

Dimensions in mm

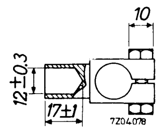
Flexible top lead

Type number 56243
Weight ≈ 170 g



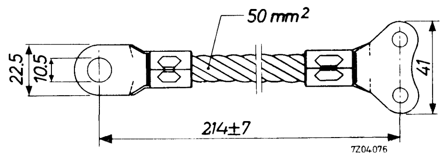
Clamp

Type number 56244
Weight ≈ 70 g



Flexible base lead

Type number 56247
Weight ≈ 135 g



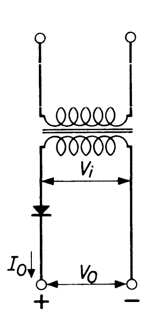
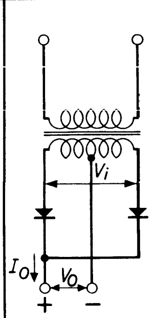
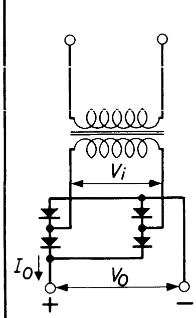
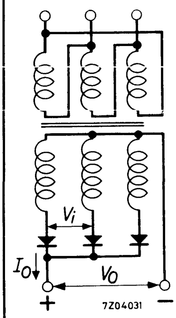
1. These accessories are available on request.
2. For mounting of the flexible top lead it is recommended to use two spanners to avoid damage.
   Torque on nut: min. 30 cm kg; max. 60 cm kg.
3. For mounting the diode on a heatsink use steel bolts.
   Min. torque for good thermal and electrical contact : 30 cm kg
   Max. torque : 60 cm kg

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0253

APPLICATION INFORMATION

OPERATION AS RECTIFIER

		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
									
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYX33- 200	140	250	60	500	60	500	125	750	95
BYX33- 400	280	250	125	500	125	500	250	750	190
BYX33- 600	420	250	185	500	185	500	375	750	280
BYX33- 800	560	250	250	500	250	500	505	750	380
BYX33-1000	700	250	315	500	315	500	635	750	475

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

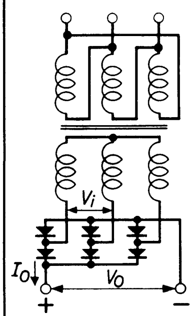
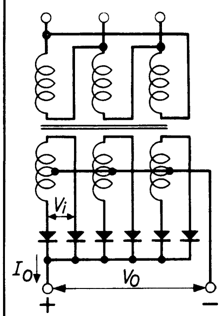
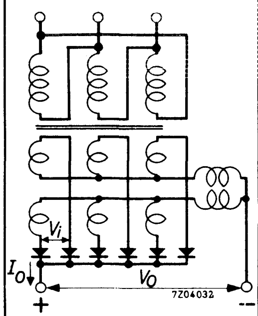
I_O = average output current in A

V_O = average output voltage in V

7Z3 0254

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	V_i(rms)	I_O	V_O	I_O	V_O	I_O	V_O
BYX33- 200	140	750	185	1200	95	1500	80
BYX33- 400	280	750	375	1200	190	1500	160
BYX33- 600	420	750	565	1200	280	1500	240
BYX33- 800	560	750	760	1200	380	1500	320
BYX33-1000	700	750	940	1200	475	1500	400

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

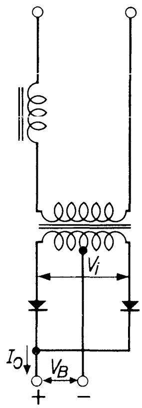
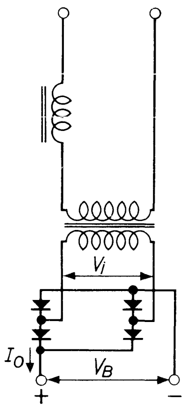
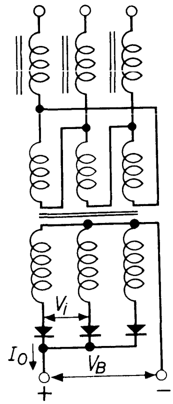
I_O = average output current in A

V_O = average output voltage in V

7Z3 0255

APPLICATION INFORMATION (continued)

OPERATION FOR BATTERY CHARGING

		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
										
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYX33- 200	125	250	60	27	250	120	54	375	70	32
BYX33- 400	255	250	120	54	250	240	109	375	140	64
BYX33- 600	380	250	180	82	250	360	164	375	210	95
BYX33- 800	510	250	240	109	250	480	217	375	270	122
BYX33-1000	640	250	300	136	250	600	272	375	340	154

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

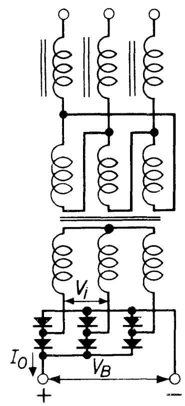
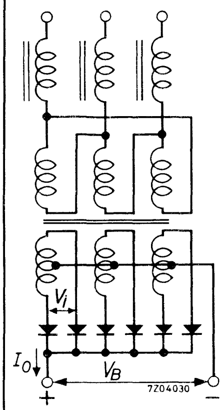
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0256

APPLICATION INFORMATION (continued)

OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYX33- 200	125	375	120	54	750	60	27
BYX33- 400	255	375	240	109	750	120	54
BYX33- 600	380	375	360	164	750	180	82
BYX33- 800	510	375	480	217	750	240	109
BYX33-1000	640	375	600	272	750	300	136

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0257

OPERATING NOTES

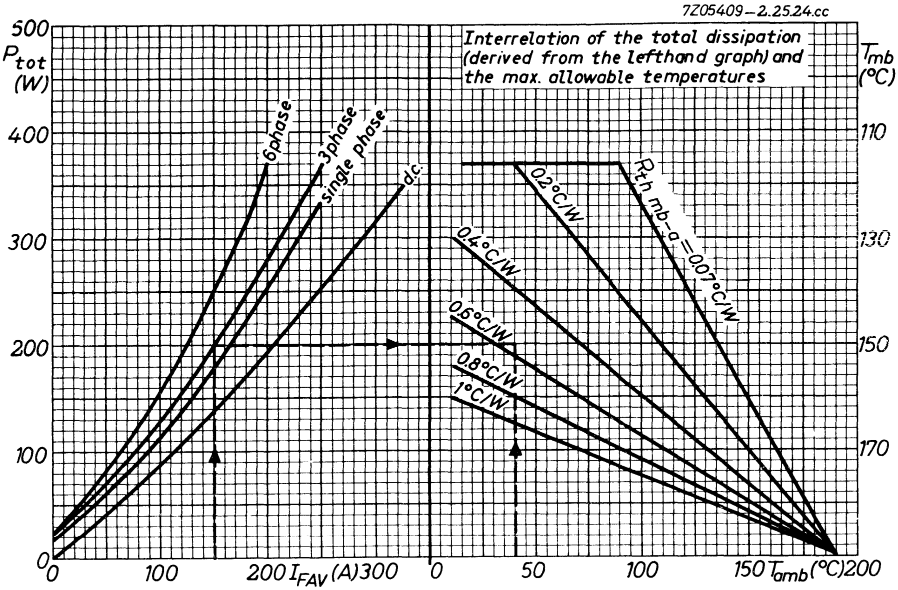
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (µF)	R (Ω)	C (µF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working reverse voltage

2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at pages B and C a fast fuse is recommended.

7Z3 0245



EXAMPLE (Determination of the heatsink thermal resistance)

Assume a diode, used in a three phase, 50 Hz rectifier circuit at an ambient temperature of 40 °C. The average forward current I_{FAV} = 150 A (per diode).

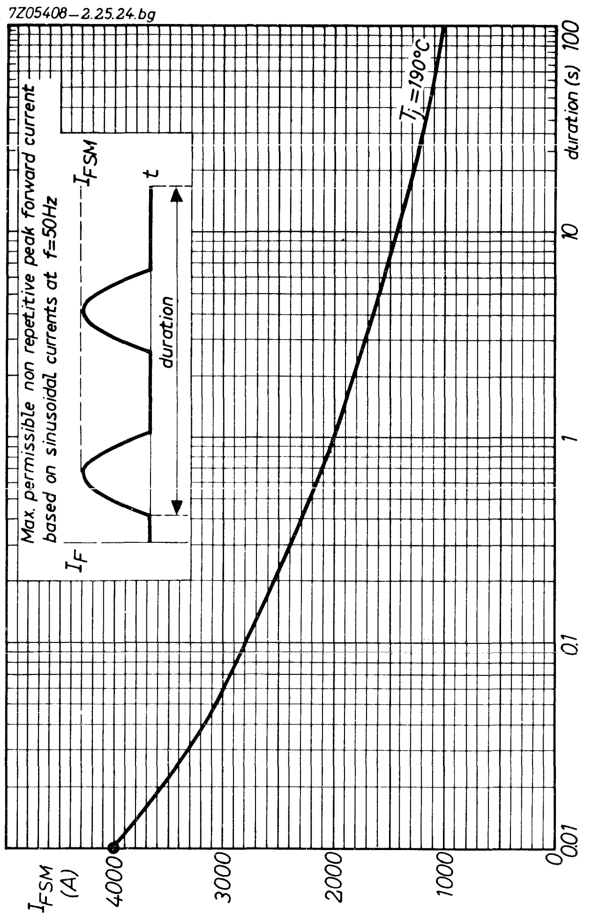
From the graph above it follows that in a three phase rectifier circuit at I_{FAV} = 150 A the average forward power + average leakage power = 200 W per diode.

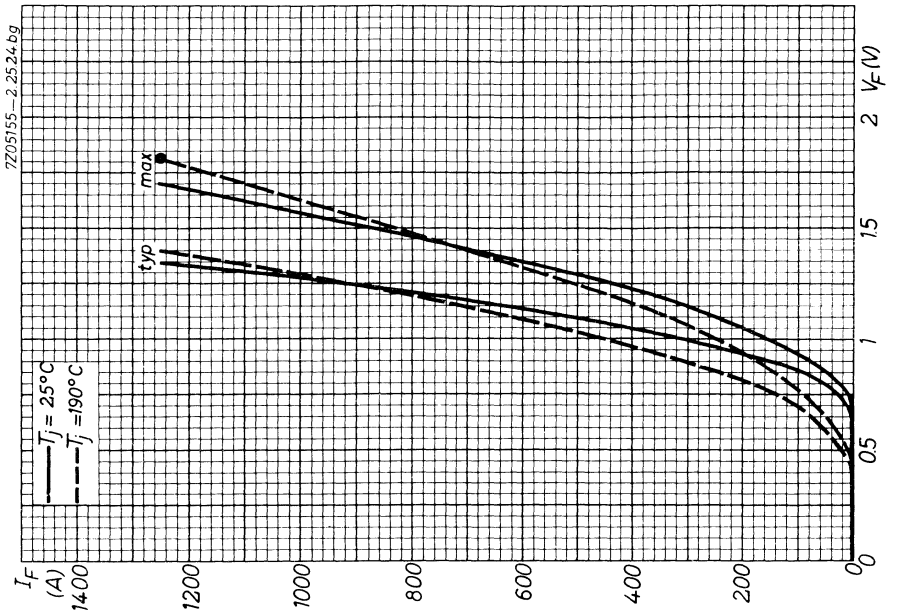
Tracing to the right until the vertical through T_{amb} = 40 °C, gives a required thermal resistance $R_{th\ mb-a}$ = 0.55 °C/W. The contact thermal resistance $R_{th\ mb-h}$ = 0.07 °C/W.

Hence the heatsink thermal resistance should be:

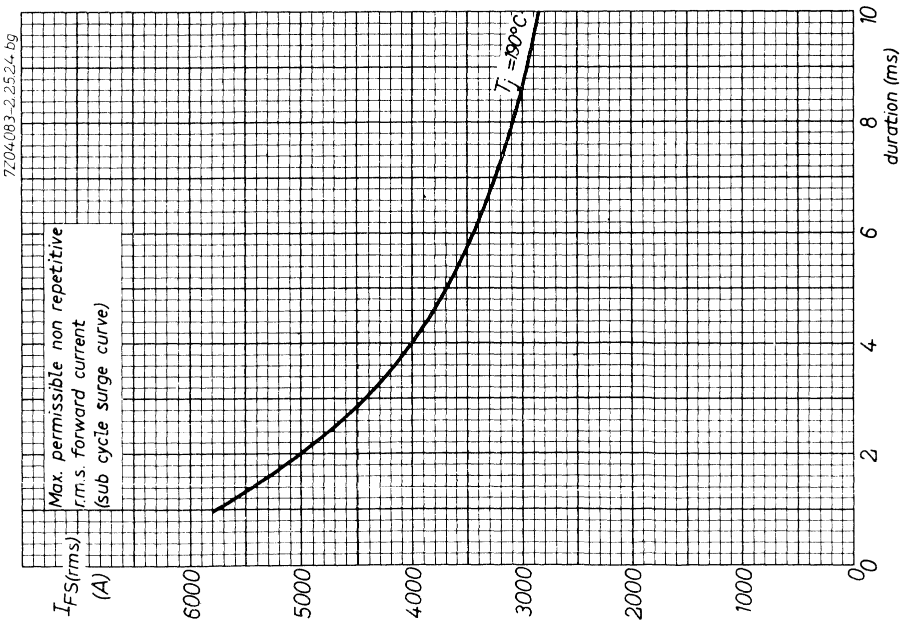
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (0.55 - 0.07)\ °C/W = 0.48\ °C/W.$$

7Z3 0258

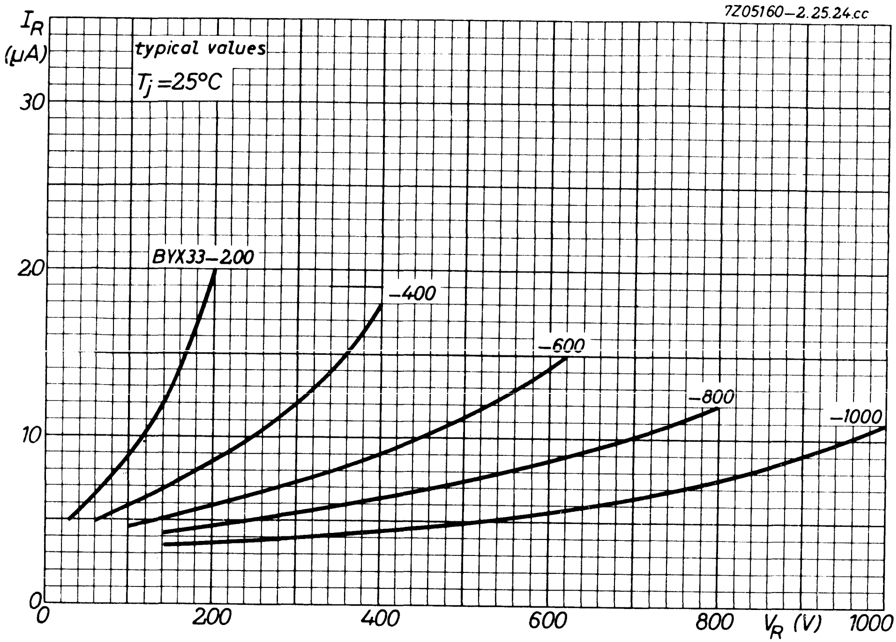

7Z05408-2.25.24.bg
Max. permissible non repetitive peak forward current
based on sinusoidal currents at f=50Hz
I_FSM
t
duration
I_F
T_j=190°C
duration (s)
0.01
0.1
1
10
100
I_FSM (A)
4000
3000
2000
1000
0

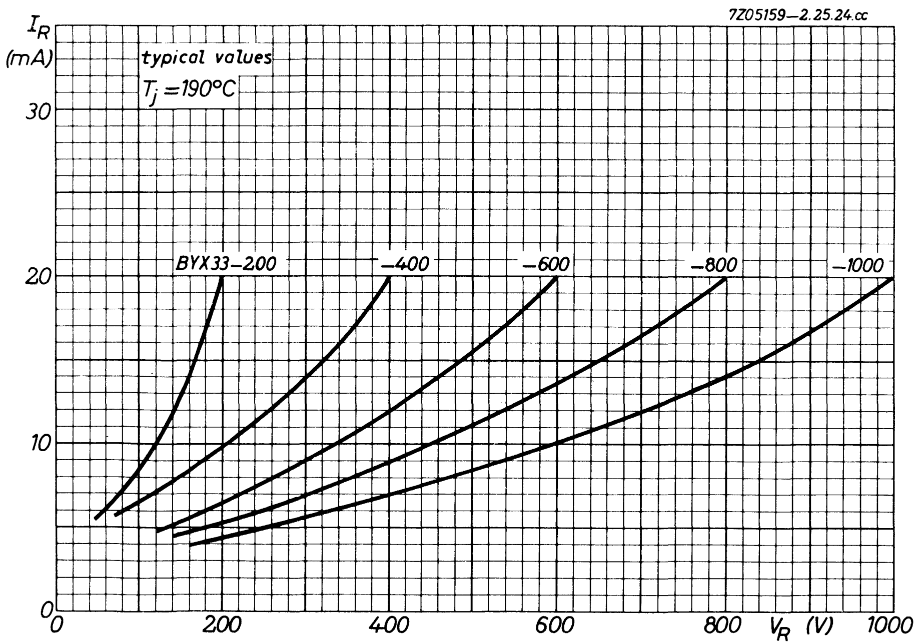


7Z05155—2.25.24 bg
I_F (A)
1400
1200
1000
800
600
400
200
0
0
0.5
1
1.5
2
V_F(V)
max
typ
T_j = 25°C
T_j =190°C



7Z04083-2.25.24 bg
$I_{FS(rms)}$ (A)
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
duration (ms)
T_j =190°C
Max. permissible non repetitive
r.m.s. forward current
(sub cycle surge curve)


7Z05160—2.25.24.cc
I_R (μA)
typical values
T_j = 25°C
BYX33–200
–400
–600
–800
–1000
0
10
20
30
200
400
600
800
1000
V_R (V)


7Z05159—2.25.24.cc
I_R (mA)
typical values
T_j = 190°C
BYX33–200
–400
–600
–800
–1000
0
10
20
30
200
400
600
800
1000
V_R (V)

SILICON POWER DIODES

For data of these diodes please refer to the BYZ14series.

7Z3 0453

SILICON POWER DIODES

Silicon diffused diodes in a metal case, intended for use in power rectifiers, especially in a.c. generating systems of motor cars, with battery voltages up to 24 V. The diodes can be press-mounted or soldered at the bottom or mounted with an adaptor. The BYY20 (anode to case) is the reverse polarity type.
The BYY21 (cathode to case) is the normal polarity type.

RATINGS (Limiting values) [1])

Voltages

Continuous reverse voltage	V_R	max.	75	V
Crest working reverse voltage	V_{RWM}	max.	75	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	200	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	18	A
Repetitive peak forward current	I_{FRM}	max.	60	A
Non repetitive peak forward current (square wave; $t = 100$ ms)	I_{FSM}	max.	140	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to case	$R_{th\ j-c}$	=	2	°C/W
From case to heatsink if press-mounted	$R_{th\ c-h}$	=	0.5	°C/W
From case to heatsink with adaptor 56232	$R_{th\ c-h}$	=	1.0	°C/W

CHARACTERISTICS

Forward voltage

$I_F = 18$ A; $T_j = 25$ °C	V_F	<	1.15	V
$I_F = 60$ A; $T_j = 25$ °C	V_F	<	1.35	V

Reverse current

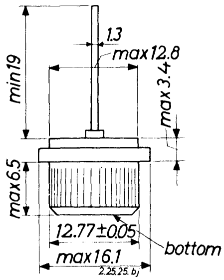
$V_R = 75$ V; $T_j = 140$ °C	I_R	<	4	mA

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0695

MECHANICAL DATA

Dimensions in mm



Marked in blue: BYY20 (anode to case)

Marked in red : BYY21 (cathode to case)

MOUNTING INSTRUCTIONS

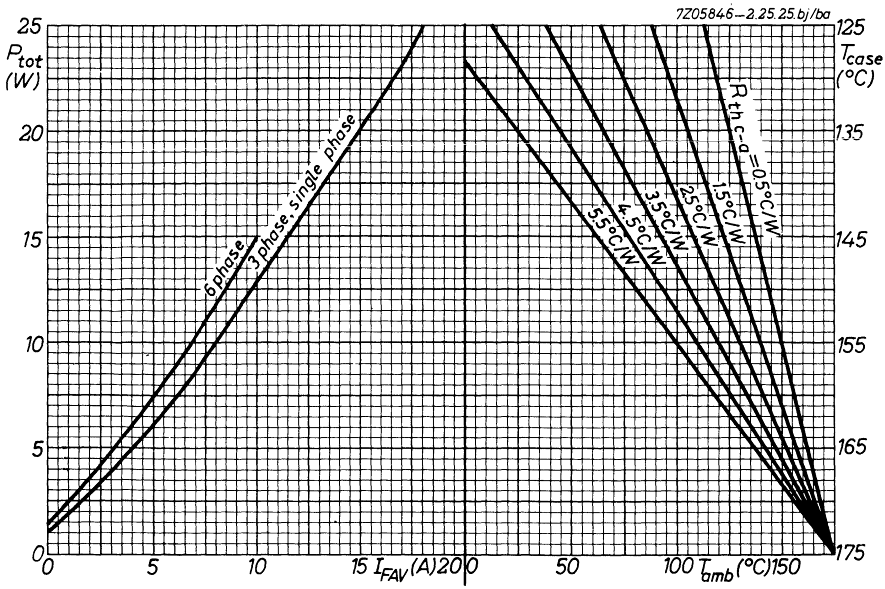
Bottom-mounting

Soldering temperature	T	max.	235	°C
Soldering time	t	max.	30	s

Press-mounting

Diameter of hole in heatsink: from 12.61 to 12.66 mm

Force to seat the diode : max. 300 kg



7Z3 0696

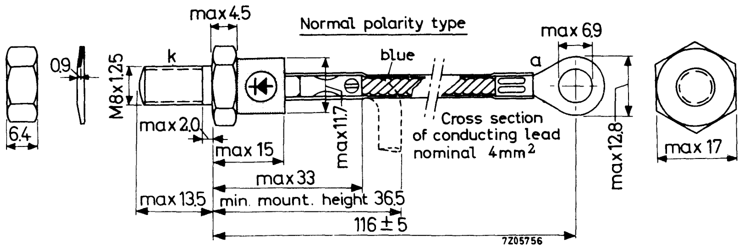
SILICON POWER DIODES

Double diffused silicon diodes in metal envelopes intended for power rectifier applications.
The series consists of the following types:
Normal polarity (stud cathode): BYY22; BYY67; BYY24.
Reverse polarity (stud anode) : BYY23; BYY68; BYY25.

QUICK REFERENCE DATA

			BYY22 BYY23	BYY67 BYY68	BYY24 BYY25	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	V
Average forward current	I_{FAV}	max.		10		A
Non repetitive peak forward current t = 10 ms; T_{mb} = 125 °C	I_{FSM}	max.		200		A
Junction temperature	T_j	max.		150		°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=		1.1		°C/W

MECHANICAL DATA Dimensions in mm



Net weight ≈ 25 g
With accessories ≈ 35 g

Torque on nut: min. 30 cm kg
max. 60 cm kg

Diameter of hole in heatsink: max. 8.5 mm

7Z3 0614

RATINGS (Limiting values) [1]

		BYY22 BYY23	BYY67 BYY68	BYY24 BYY25	
Voltages					
Continuous reverse voltage	V_R	max. 200	300	400	V
Crest working reverse voltage	V_{RWM}	max. 200	300	400	V
Repetitive peak reverse voltage	V_{RRM}	max. 400	600	800	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max. 400	600	800	V

Currents				
Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	50	A
Non repetitive peak forward current $t = 10$ ms; $T_{mb} = 125$ °C (see page D)	I_{FSM}	max.	200	A
Temperatures				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.1	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.3	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0615

CHARACTERISTICS

Forward voltage at T_{mb} = 25 °C

I_F = 1 A	V_F	<	0.9	V
I_F = 50 A	V_F	<	1.5	V [1]

Reverse current at T_{mb} = 125 °C

BYY22 BYY23	V_R = 200 V	I_R	<	2	mA
BYY67 BYY68	V_R = 300 V	I_R	<	2	mA
BYY24 BYY25	V_R = 400 V	I_R	<	2	mA

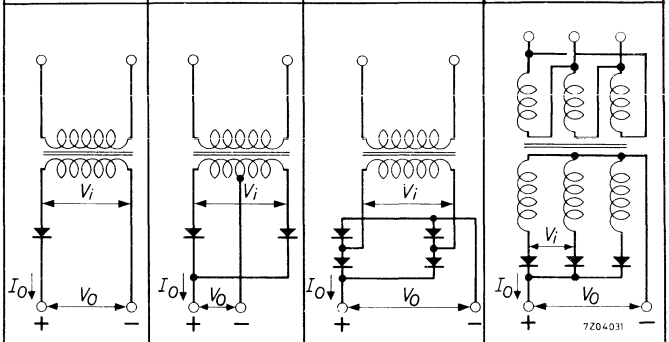
[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0616

APPLICATION INFORMATION

OPERATION AS RECTIFIER

	Single phase half wave	Two phase half wave	Single phase full wave (Single phase bridge)	Three phase half wave (Three phase star)



Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYY22/23	140	10	60	20	60	20	125	30	95
BYY67/68	210	10	90	20	90	20	185	30	140
BYY24/25	280	10	125	20	125	20	250	30	190

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

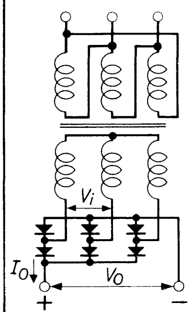
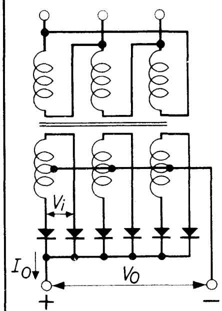
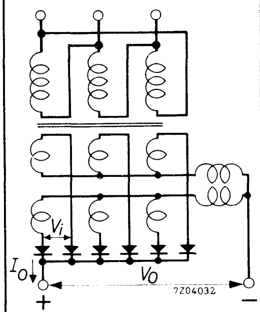
I_O = average output current in A

V_O = average output voltage in V

7Z3 0617

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYY22/23	140	30	190	48	95	60	80
BYY67/68	210	30	285	48	135	60	120
BYY24/25	280	30	380	48	190	60	165

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

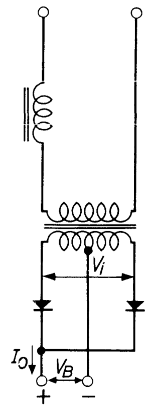
V_O = average output voltage in V

7Z3 0618

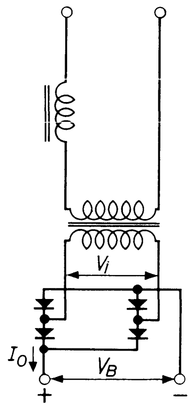
APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

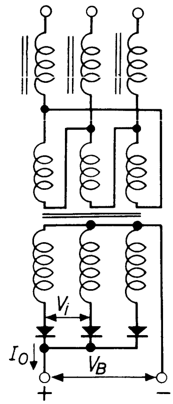
Two phase half wave:



Single phase full wave (Single phase bridge):



Three phase half wave (Three phase star):



		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYY22/23	125	12	60	27	12	120	54	18	70	32
BYY67/68	190	12	90	41	12	180	82	18	105	47
BYY24/25	255	12	120	54	12	240	108	18	135	60

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10 % has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

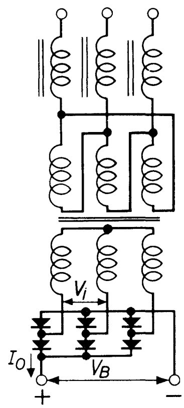
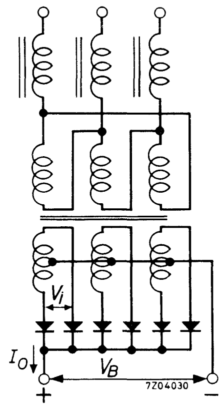
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0619

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYY22/23	125	18	120	54	36	60	27
BYY67/68	190	18	180	82	36	90	41
BYY24/25	255	18	240	108	36	120	54

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10 % has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V)

7Z3 0620

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

RC across primary of transformer		RC across secondary of transformer	
C (μF)	R (Ω)	C (μF)	R (Ω)
$200 \frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225 \frac{I_{mag} T^2}{V_1}$	$\frac{200}{C}$

where:

I_{mag} = magnetising primary r.m.s. current (A)

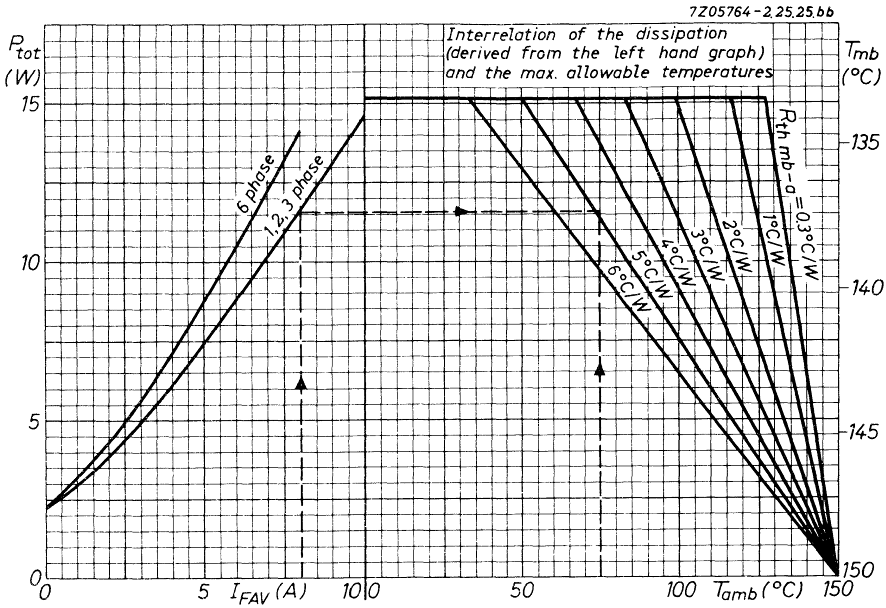
V_1 = transformer primary r.m.s. voltage (V)

V_2 = transformer secondary r.m.s. voltage (V)

T = V_1/V_2

2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at page D a fast fuse is recommended.

7Z3 0621



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the diode used in a 50 Hz three phase full wave rectifier circuit with a total output current of 24 A at T_{amb} = 75 °C. The average forward current I_{FAV} = 8 A (per diode). From the left hand part of the graph above it follows that at I_{FAV} = 8 A the average forward power + average leakage power = 11.6 W per diode.

From the right hand part follows the thermal resistance, required for P_{tot} = 11.6 W at T_{amb} = 75 °C:

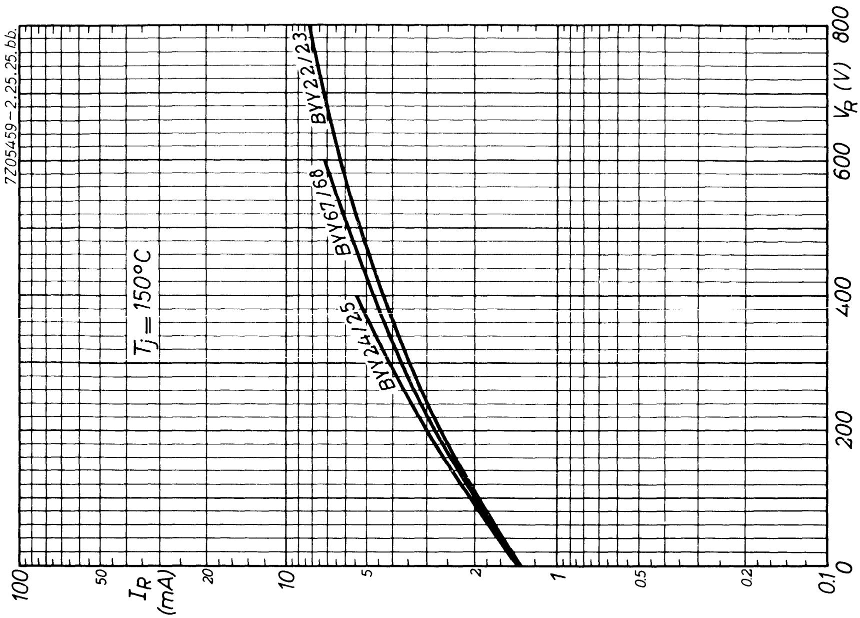
$$R_{th\ mb-a} \approx 4.9\ ^{o}C/W$$

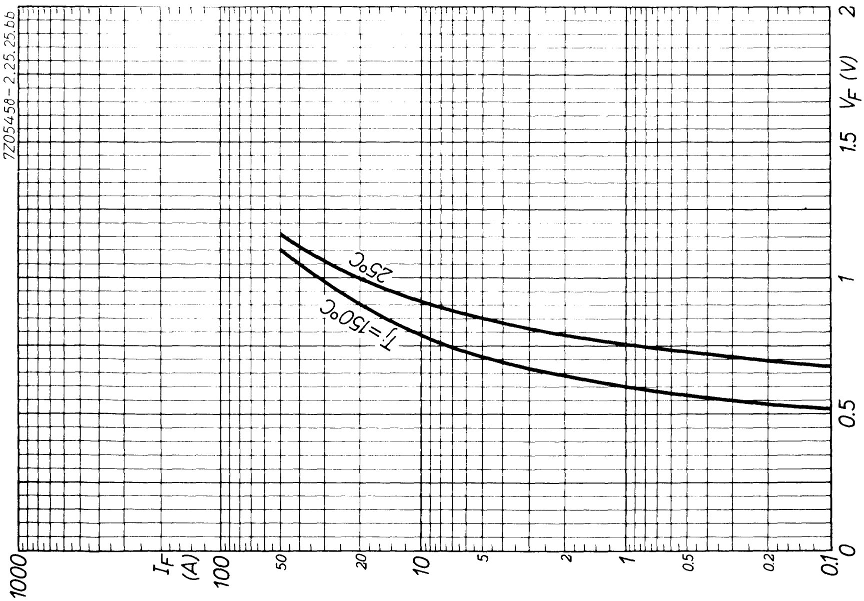
The contact thermal resistance $R_{th\ mb-h}$ = 0.3 °C/W. Hence the heatsink thermal resistance should be:

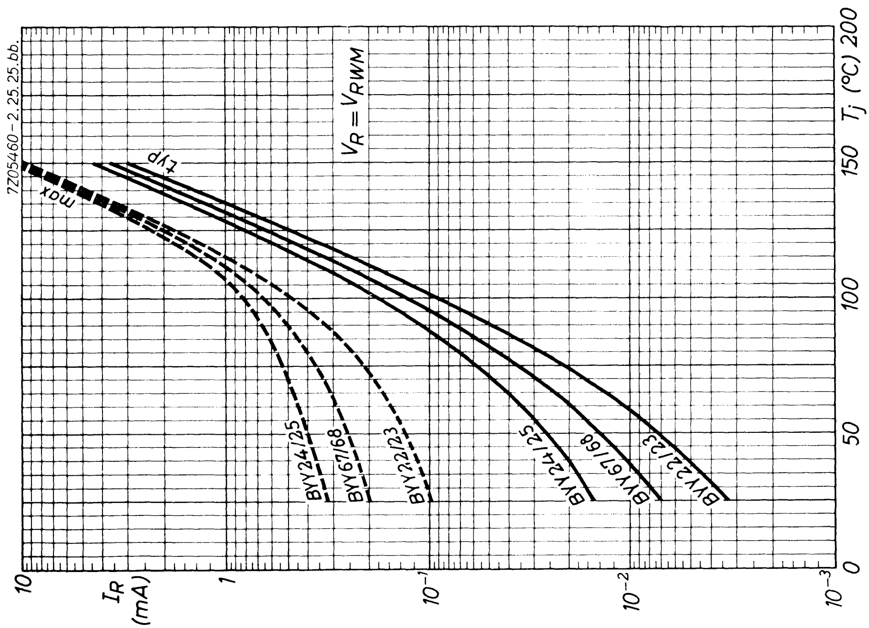
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (4.9 - 0.3)^{o}C = 4.6\ ^{o}C/W$$

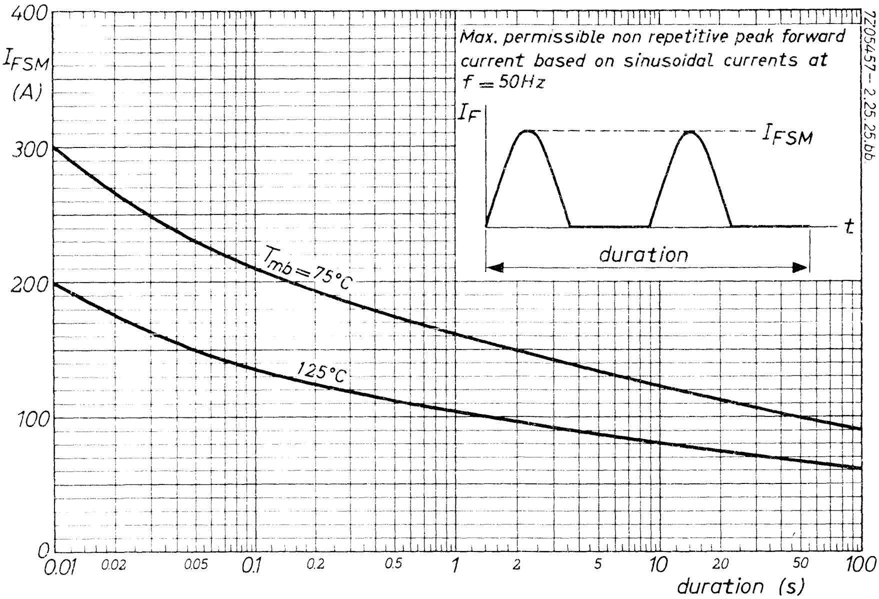
Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found.

7Z3 0622


7Z05459-2.25.25.bb.
$T_j = 150°C$
BYY22/23
BYY67/68
BYY24/25
V_R (V)
800
600
400
200
0
I_R (mA)
100
50
20
10
5
2
1
0.5
0.2
0.1


7Z05458-2.25.25.bb
25°C
T_j=150°C
V_F (V)
2
1.5
1
0.5
0
I_F (A)
1000
100
50
20
10
5
2
1
0.5
0.2
0.1


7Z05460-2.25.25.bb.
max
typ
$V_R = V_{RWM}$
BYY24/25
BYY67/68
BYY22/23
BYY24/25
BYY67/68
BYY22/23
I_R (mA)
10
1
10^{-1}
10^{-2}
10^{-3}
T_j (°C)
0
50
100
150
200


Max. permissible non repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_F
I_{FSM}
t
duration
T_{mb} = 75°C
125°C
400
300
200
100
0
I_{FSM} (A)
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
duration (s)
7Z05457–2.25.25.bb

SILICON POWER DIODES

For data of these diodes please refer to the BYY22series.

7Z3 0454

SILICON POWER DIODES

For data of these diodes please refer to the BYZ14 series.

7Z3 0455

SILICON POWER DIODES

Double diffused silicon diodes in a DO-4 metal envelope intended for power rectifier applications.
The BYZ16, BYZ17 and BYZ18 are the reverse polarity versions (stud anode) of the normal polarity types (stud cathode) BYZ10, BYZ11 and BYZ12 respectively.

QUICK REFERENCE DATA

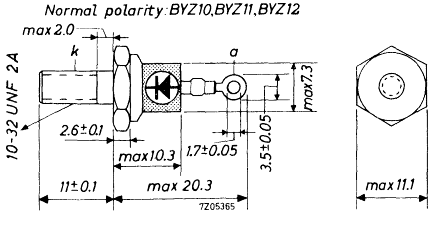
			BYZ12 BYZ18	BYZ11 BYZ17	BYZ10 BYZ16	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	V
Average forward current	I_{FAV}	max.		6		A
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.		38		A
Junction temperature	T_j	max.		150		^oC
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=		5		$^oC/W$

MECHANICAL DATA Dimensions in mm

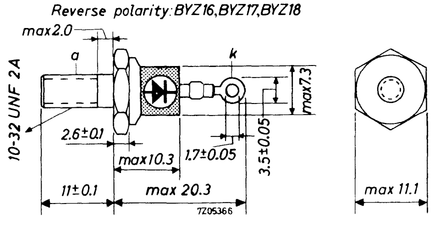
Supplied with the device: Nut, plain washer and lock washer

DO-4

Normal polarity: BYZ10, BYZ11, BYZ12



Reverse polarity: BYZ16, BYZ17, BYZ18



Net weight : ≈ 5.6 g

With accessories: ≈ 7.5 g

Mounting torque : min. 8 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm

7Z3 0390

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages

			BYZ12 BYZ18	BYZ11 BYZ17	BYZ10 BYZ16	
Crest working reverse voltage	V_{RWM}	max.	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	600	900	1200	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	600	900	1200	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	6	A
Repetitive peak forward current	I_{FRM}	max.	20	A
Non repetitive peak forward current $t = 10$ ms; $T_{mb} = 125$ °C (See also page B)	I_{FSM}	max.	38	A

Temperatures

Storage temperature	T_{stg}		-55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.6	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0391

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Voltages [1]

Forward voltage at I_F = 5 A	V_F	typ.	1.2	V
		<	1.7	V
I_F = 15 A	V_F	typ.	1.6	V
		<	2.1	V

Currents

Reverse current			BYZ12 BYZ18	BYZ11 BYZ17	BYZ10 BYZ16	
V_R = 600 V	I_R	<	10			μA
V_R = 900 V	I_R	<		10		μA
V_R = 1200 V	I_R	<			10	μA
Reverse current at T_j = 125 °C						
V_R = 400 V	I_R	<	200			μA
V_R = 600 V	I_R	<		200		μA
V_R = 800 V	I_R	<			200	μA

[1] Measured under pulsed conditions to prevent excessive dissipation.

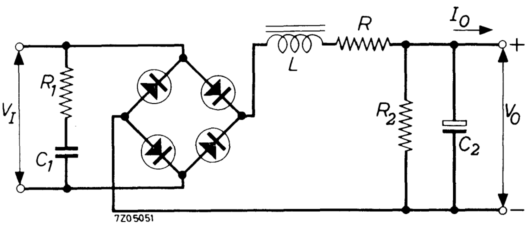
7Z3 0399

APPLICATION INFORMATION

Full wave rectifier circuit with choke input filter

Operating ambient temperature T_{amb} up to 50 °C

		BYZ12 BYZ18	BYZ11 BYZ17	BYZ10 BYZ16	
R.M.S. input voltage	$V_{I(rms)}$	130	200	250	V
Average output voltage	V_O	100	150	200	V
Average output current	I_O	0 to 4	0 to 4	0 to 4	A
Maximum ripple		0.5	0.5	0.5	%



Each diode is mounted on a 6 cm x 6 cm blackened aluminium cooling fin. Thickness 1.6 mm

Table of circuit components

	BYZ12 BYZ18	BYZ11 BYZ17	BYZ10 BYZ16	
R_1	220	220	390	Ω [1]
C_1	1.0	1.0	0.5	μF [1]
L	0.5 (R = 3)	1.0 (R = 5)	1.0 (R = 5)	H Ω
R_2	200 (50)	300 (75)	400 (100)	Ω W
C_2	500	250	250	μF

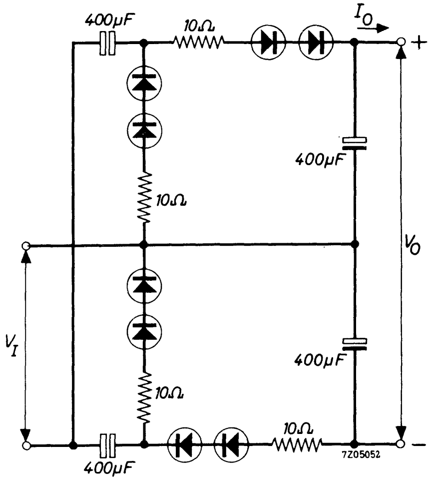
[1]) RC damping circuit; see operating notes at page 6

7Z3 0229

APPLICATION INFORMATION (continued)

Voltage quadrupler circuit with BYZ10 or BYZ16 rectifier diodes

Operating ambient temperature	T_{amb}	up to 50	^{o}C
R.M.S. input voltage	$V_{I(rms)}$	220	V
Average output voltage	V_O	910	V
Average output current	I_O	840	mA



Each diode is mounted on a 4.5 cm x 4.5 cm blackened aluminium cooling fin. Thickness 1.6 mm.

7Z3 0230

OPERATING NOTES

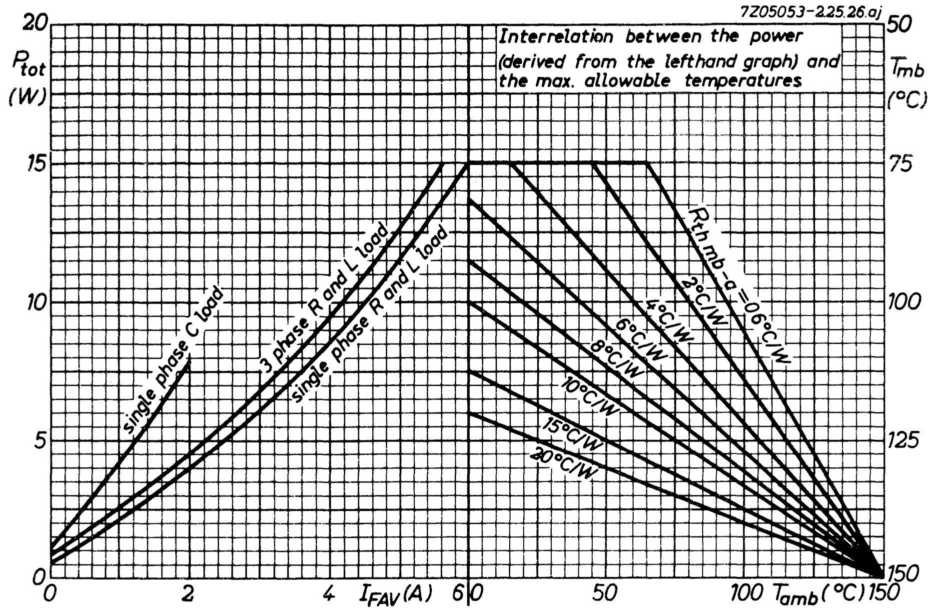
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used.
   Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working voltage

2. The top connector should not be bent; it should be soldered into the circuit so there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

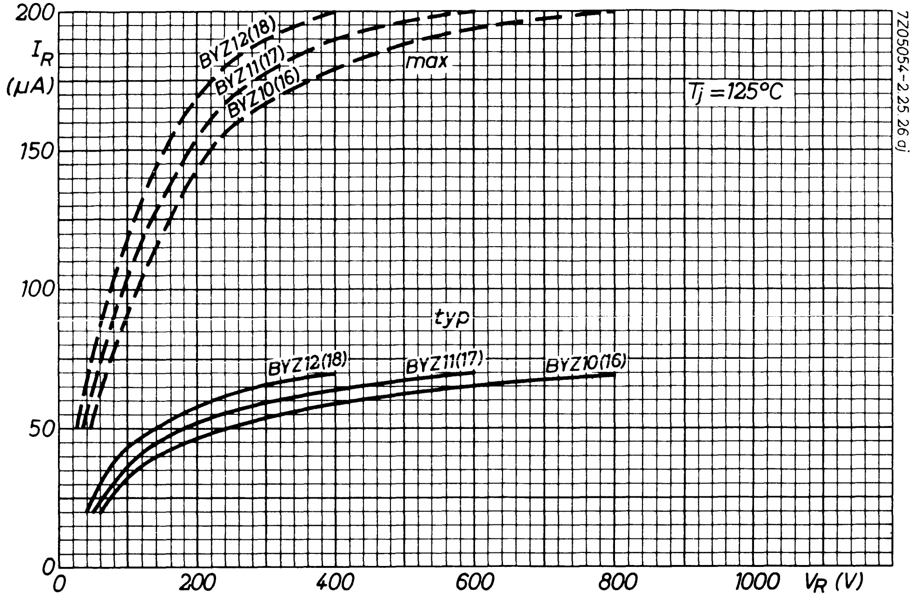
7Z3 0400

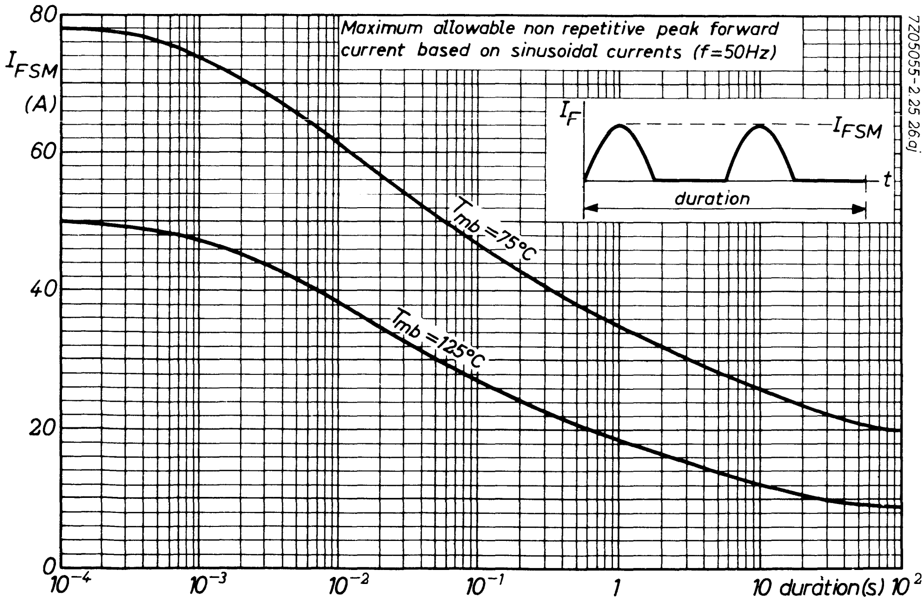


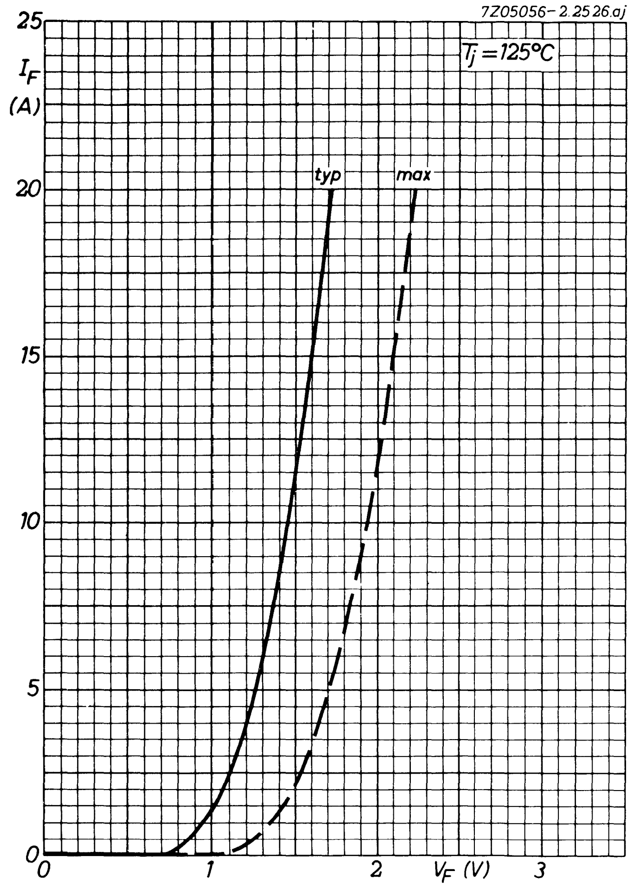
The method of using these curves is as follows:
Starting with the left hand graph, for a particular current value trace upwards to meet the appropriate curve.
Then trace horizontally until the appropriate R_{th}-curve is reached (in the case of a given heatsink). Finally trace downwards to determine the maximum permissible ambient temperature.

Alternatively, when the maximum ambient temperature is known and the heatsink required is to be determined, trace horizontally until the vertical through the given ambient temperature is reached. The R_{th}-value corresponding to the intersection is the maximum thermal resistance from mounting base to ambient. Subtracting the contact thermal resistance gives the maximum thermal resistance of the heatsink.

7Z3 0237


200
I_R
(μA)
150
100
50
0
0
200
400
600
800
1000
V_R (V)
BYZ12(18)
BYZ11(17)
BYZ10(16)
max
typ
BYZ12(18)
BYZ11(17)
BYZ10(16)
T_j = 125°C
7Z05054-2.25 26 aj


80
I_{FSM}
(A)
60
40
20
0
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10 duration(s) 10^2
Maximum allowable non repetitive peak forward current based on sinusoidal currents (f=50Hz)
I_F
I_{FSM}
t
duration
T_{mb} = 75°C
T_{mb} = 125°C
7Z05055-2.25 26 aj


7Z05056-2.2526.aj
T_j = 125°C
I_F
(A)
25
20
15
10
5
0
typ
max
0
1
2
3
V_F (V)

SILICON POWER DIODES

Double diffused silicon diodes in a DO-4 metal envelope intended for power rectifier applications.
The BYZ19 is the reverse polarity version (stud anode) of the normal polarity type (stud cathode) BYZ13.

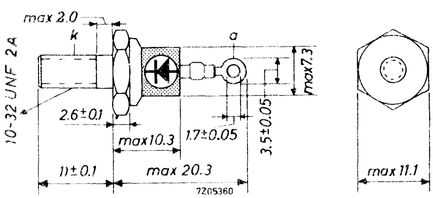
QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	200	V
Average forward current	I_{FAV}	max.	6	A
Non repetitive peak forward current (t = 10 ms)	I_{FSM}	max.	30	A
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=	6	°C/W

MECHANICAL DATA — Dimensions in mm

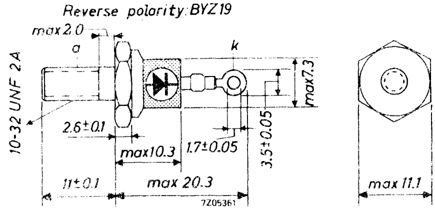
Supplied with the device: Nut, plain washer and lock washer

DO-4

Normal polarity: BYZ13



Reverse polarity: BYZ19



Net weight : ≈ 5.6 g

With accessories: ≈ 7.6 g

Mounting torque : min. 8 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm

7Z3 0392

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

Voltages

Crest working reverse voltage	V_{RWM}	max.	200	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	300	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	6	A
Repetitive peak forward current	I_{FRM}	max.	20	A
Non repetitive peak forward current t = 10 ms; T_{mb} = 125 °C (see also page A)	I_{FSM}	max.	30	A

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	6.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.6	°C/W

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Voltages [2]

Forward voltage at I_F = 5 A	V_F	typ.	1.4	V
I_F = 15 A	V_F	typ.	2.0	V
		<	3.0	V

Currents

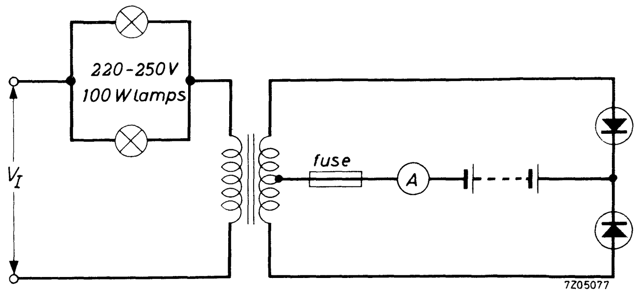
Reverse current V_R = 200 V; T_j = 125 °C	I_R	<	600	μA

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.
2) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0393

APPLICATION INFORMATION

Protected battery charger with BYZ13 or BYZ19 rectifier diodes



Both rectifier diodes are mounted on a 15 cm x 15 cm blackened aluminium flat heatsink. Thickness 1.6 mm.

$V_{I(rms)}$	Mean charging current for a battery voltage of:	
	6 V	12 V
220 V	5.6 A	3.4 A
250 V	5.0 A	3.4 A

Transformer data:

n (primary to half secondary)	0.094	
$V_{T(rms)}$	150	V
$I_{primary(rms)}$	0.75	A
$I_{secondary(rms)}$	4.5	A
$I_{primary}$ (off-load saturation current with two 100 W lamps in parallel, connected in series with primary)	0.6	A

7Z3 0401

OPERATING NOTES

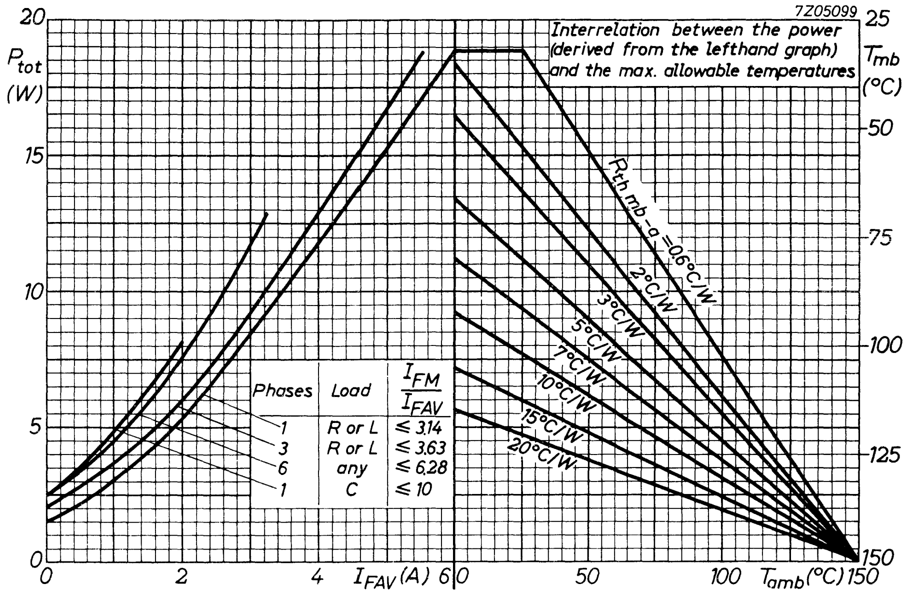
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
Either a series RC circuit or a voltage dependent resistor may be used.
Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

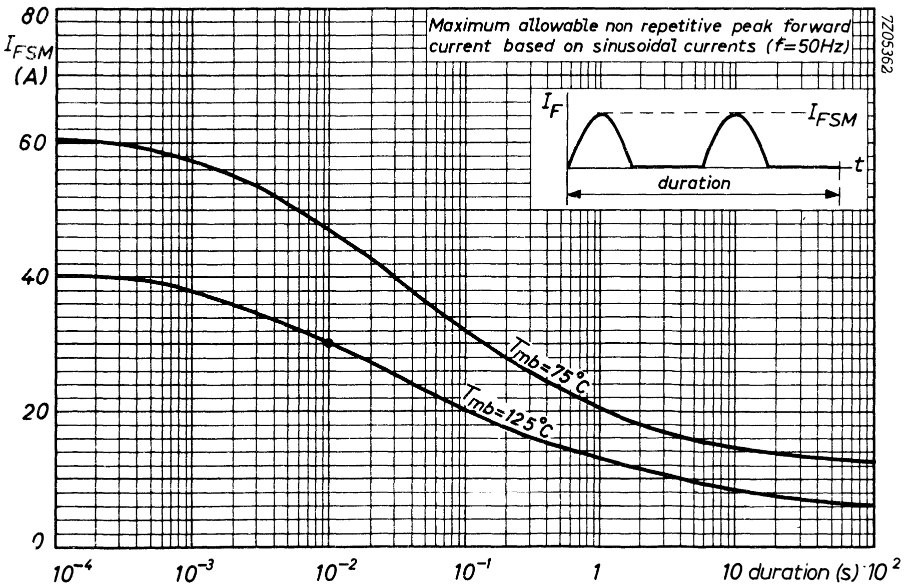
$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$

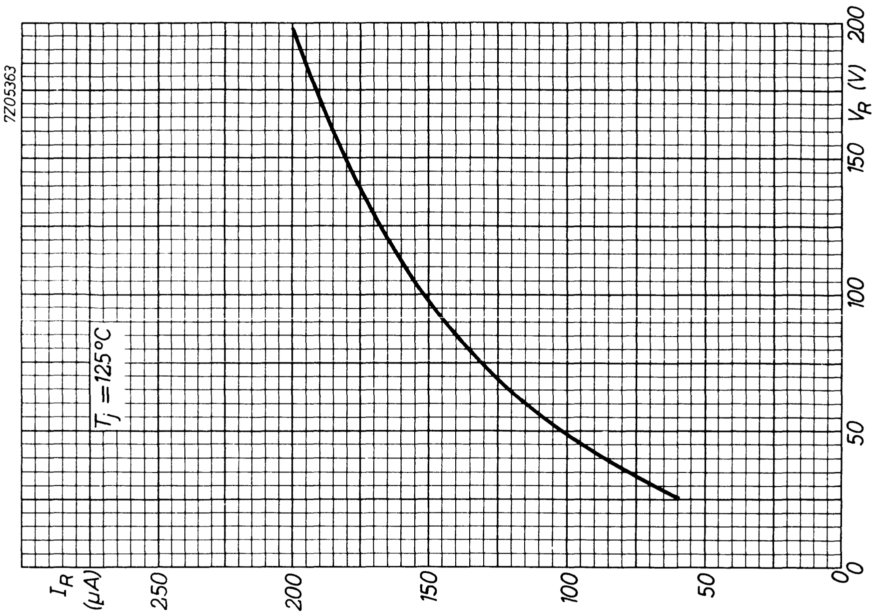
where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working voltage

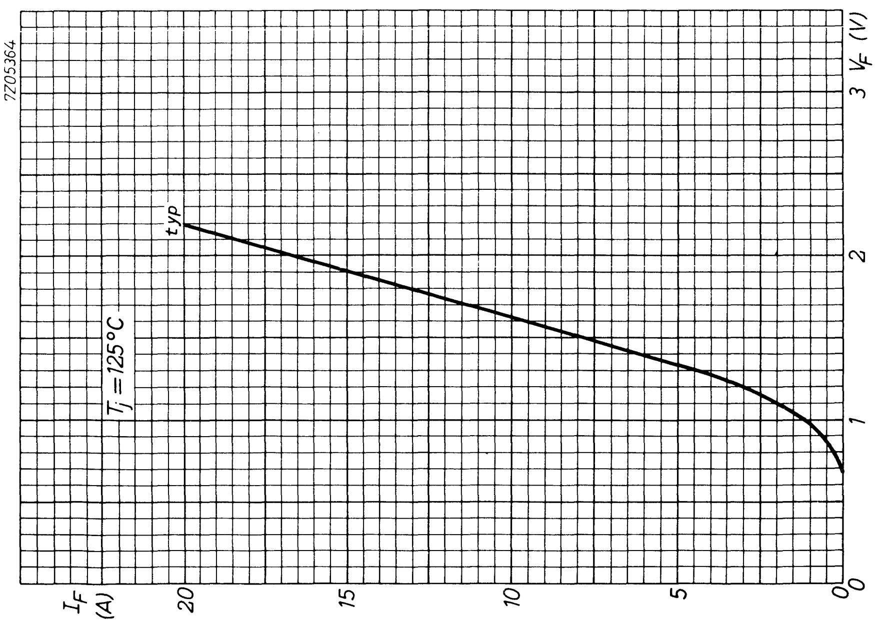
2. The top connector should not be bent; it should be soldered into the circuit so there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

7Z3 0400


7Z05099
Interrelation between the power (derived from the lefthand graph) and the max. allowable temperatures
P_{tot} (W)
T_{mb} (°C)
Phases | Load | I_{FM}/I_{FAV}
1 | R or L | ≤ 3.14
3 | R or L | ≤ 3.63
6 | any | ≤ 6.28
1 | C | ≤ 10
$R_{th\ mb-a}$ = 0.6°C/W
2°C/W
3°C/W
5°C/W
7°C/W
10°C/W
15°C/W
20°C/W
I_{FAV} (A)
T_{amb} (°C)


7Z05362
Maximum allowable non repetitive peak forward current based on sinusoidal currents (f=50Hz)
I_{FSM} (A)
I_F
I_{FSM}
t
duration
T_{mb}=75°C
T_{mb}=125°C
duration (s)


7Z05363
$T_j = 125\,°C$
I_R (μA)
0
50
100
150
200
250
V_R (V)
0
50
100
150
200


7Z05364
$T_j = 125\,°C$
typ
I_F (A)
0
5
10
15
20
V_F (V)
0
1
2
3

SILICON POWER DIODES

Double diffused silicon diodes in metal envelopes intended for power rectifier applications.
The series consists of the following types:
Normal polarity (stud cathode): BYZ14; BYY73; BYY15; BYY75; BYY77.
Reverse polarity (stud anode) : BYZ15; BYY74; BYY16; BYY76; BYY78.

QUICK REFERENCE DATA

			BYZ14 BYZ15	BYY73 BYY74	BYY15 BYY16	BYY75 BYY76	BYY77 BYY78	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	V

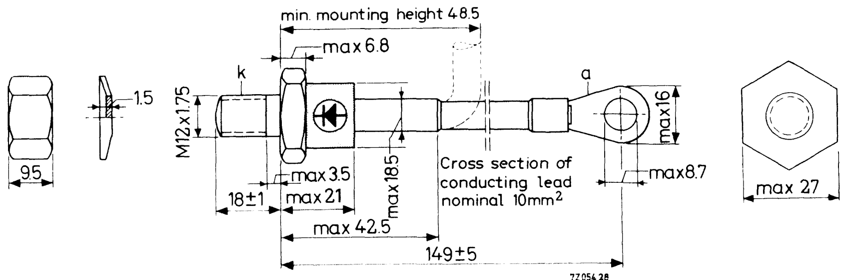
Average forward current	I_{FAV}	max.	40	A
Non repetitive peak forward current t = 10 ms	I_{FSM}	max.	800	A
Junction temperature	T_j	max.	150	^{o}C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	$^{o}C/W$

MECHANICAL DATA

Dimensions in mm

Net weight ≈ 80 g
With accessories ≈ 100 g

The mark shown applies to normal polarity diodes



Mounting instructions

Hole in heatsink: d max. 13 mm
Mounting torque: min. 100 cm kg
max. 250 cm kg

7Z3 0513

RATINGS (Limiting values) [1])

Voltages

			BYZ14 BYZ15	BYY73 BYY74	BYY15 BYY16	BYY75 BYY76	BYY77 BYY78	
Continuous reverse voltage	V_R	max.	200	300	400	500	600	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	600	800	1000	1200	V
Non repetitive peak reverse voltage ($t < 10$ ms)	V_{RSM}	max.	400	600	800	1000	1200	V

Currents

Average forward current (averaged any 20 ms period)	I_{FAV}	max.	40	A
Repetitive peak forward current	I_{FRM}	max.	200	A
Non repetitive peak forward current $t = 10$ ms; See page C	I_{FSM}	max.	800	A
I squared for focusing ($t = 10$ ms)	I^2t	max.	2250	A^2s

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.15	$^oC/W$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0514

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F = 1 A	V_F	< 0.9 V
I_F = 200 A	V_F	< 1.8 V [1]

Reverse current at T_j = 125 °C

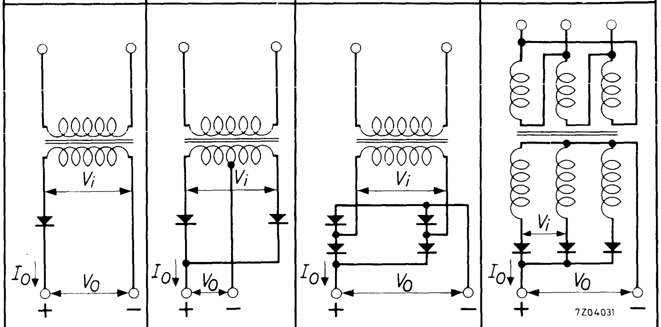
		BYZ14 BYZ15	BYY73 BYY74	BYY15 BYY16	BYY75 BYY76	BYY77 BYY78	
V_R = 200 V	I_R	< 2					mA
V_R = 300 V	I_R		<2				mA
V_R = 400 V	I_R			< 2			mA
V_R = 500 V	I_R				< 1.7		mA
V_R = 600 V	I_R					< 1.4	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0515

APPLICATION INFORMATION

OPERATION AS RECTIFIER



		Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)	
Number of diodes		1		2		4		3	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
BYZ14(15)	140	40	60	80	60	80	125	120	95
BYY73(74)	210	40	90	80	90	80	185	120	135
BYY15(16)	280	40	125	80	125	80	250	120	190
BYY75(76)	350	40	155	80	155	80	310	120	235
BYY77(78)	420	40	185	80	185	80	375	120	280

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

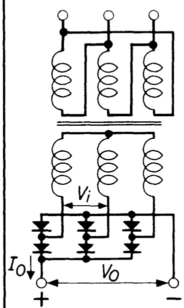
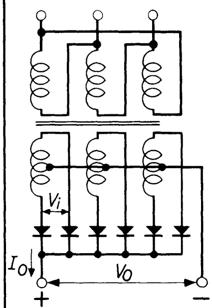
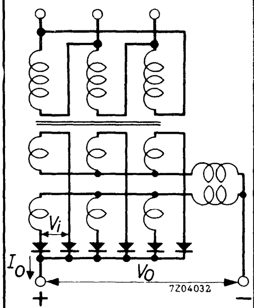
I_O = average output current in A

V_O = average output voltage in V

7Z3 0516

APPLICATION INFORMATION (continued)

OPERATION AS RECTIFIER

		Three phase full wave (Three phase bridge)		Six phase half wave (Six phase star)		Three phase double Y with interphase transformer	
							
Number of diodes		6		6		6	
	$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O
BYZ14(15)	140	120	185	192	95	240	80
BYY73(74)	210	120	280	192	135	240	120
BYY15(16)	280	120	375	192	190	240	160
BYY75(76)	350	120	470	192	235	240	200
BYY77(78)	420	120	565	192	280	240	240

These V_i and I_O figures are absolute max. values for resistive or inductive load; no source impedance is assumed. The equipment designer has to determine an average design such that these values will not be exceeded.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

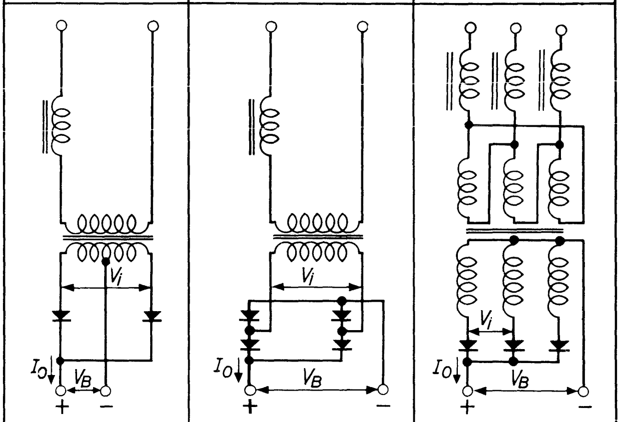
I_O = average output current in A

V_O = average output voltage in V

7Z3 0517

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING



		Two phase half wave			Single phase full wave (Single phase bridge)			Three phase half wave (Three phase star)		
Number of diodes		2			4			3		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n	I_O	V_B	n
BYZ14(15)	125	40	60	27	40	120	54	60	70	32
BYY73(74)	190	40	90	41	40	180	82	60	105	47
BYY15(16)	255	40	120	54	40	240	108	60	135	60
BYY75(76)	315	40	150	68	40	300	136	60	170	77
BYY77(78)	380	40	180	81	40	360	162	60	205	93

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

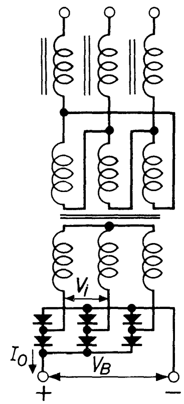
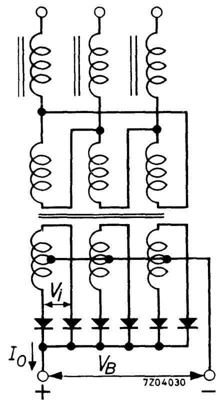
V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V).

7Z3 0518

APPLICATION INFORMATION (continued)

TYPICAL OPERATION FOR BATTERY CHARGING

		Three phase full wave (Three phase bridge)			Six phase half wave (Six phase star)		
							
Number of diodes		6			6		
	$V_{i(rms)}$	I_O	V_B	n	I_O	V_B	n
BYZ14(15)	125	60	120	54	120	60	27
BYY73(74)	190	60	180	82	120	90	41
BYY15(16)	255	60	240	108	120	120	54
BYY75(76)	315	60	300	136	120	150	68
BYY77(78)	380	60	360	162	120	180	81

The above data are nominal values with battery load. The possibility of mains voltage fluctuations of max. 10% has been taken into account. For current limiting use is made of inductors in series with the primary of the mains transformer.

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_B = battery voltage in V

n = maximum number of Pb cells in series (nominal voltage per cell is 2.2 V).

7Z3 0519

OPERATING NOTES

1) When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

RC across primary of transformer	
C (μF)	R (Ω)
$200 \frac{I_{mag}}{V_1}$	$\frac{150}{C}$

RC across secondary of transformer	
C (μF)	R (Ω)
$225 \frac{I_{mag} T^2}{V_1}$	$\frac{200}{C}$

where:

I_{mag} = magnetising primary r.m.s. current (A)

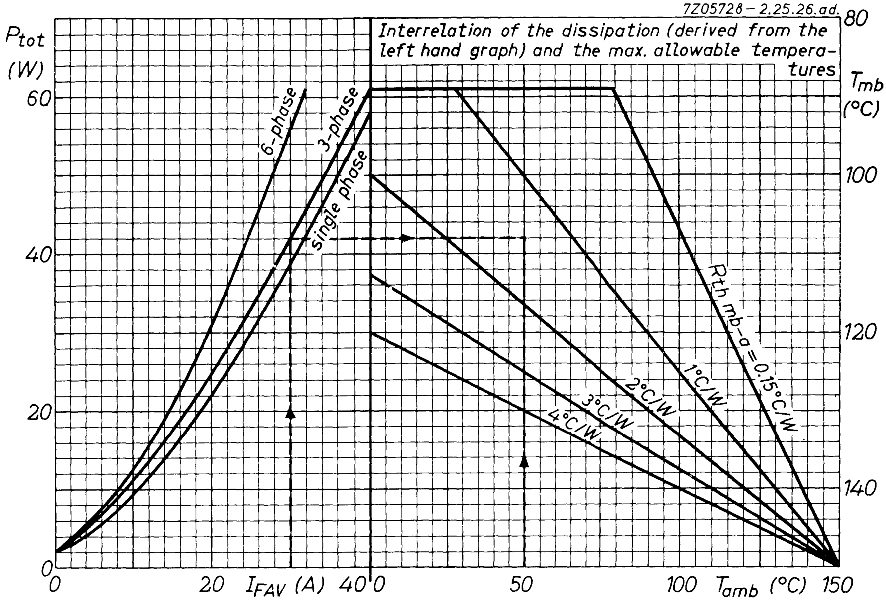
V_1 = transformer primary r.m.s. voltage (V)

V_2 = transformer secondary r.m.s. voltage (V)

T = V_1/V_2

2) In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curves at page C a fast fuse is recommended.

7Z3 0520



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the diode used in a 50 Hz three phase full wave rectifier circuit with a total output current of 90 A at T_{amb} = 50 ^{o}C. The average forward current I_{FAV} = 30 A (per diode).
From the lefthand part of the graph above it follows that at I_{FAV} = 30 A the average forward power + average leakage power = 42 W per diode. From the righthand part follows the thermal resistance, required for P_{tot} = 42 W at T_{amb} = 50 ^{o}C:

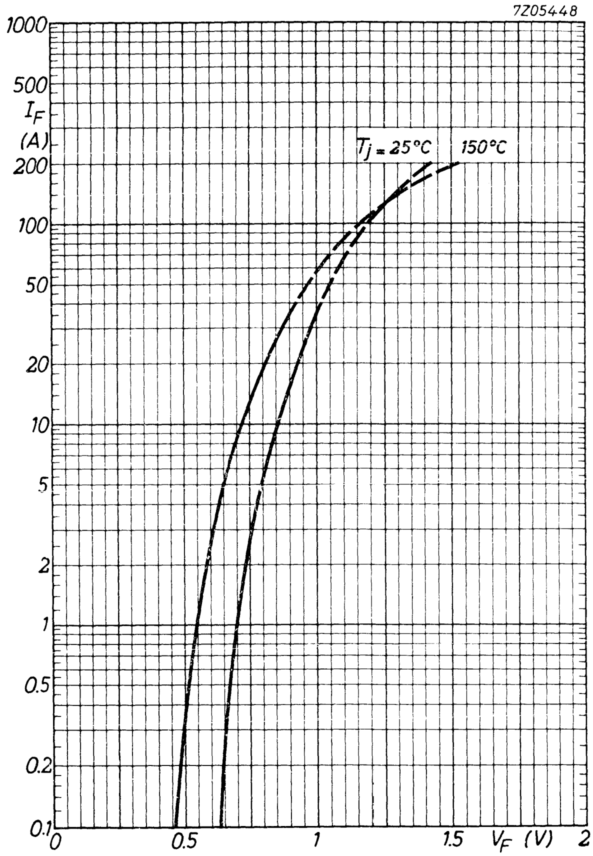
$$R_{th\ mb\text{-}a} \approx 1.4\ ^{o}C/W$$

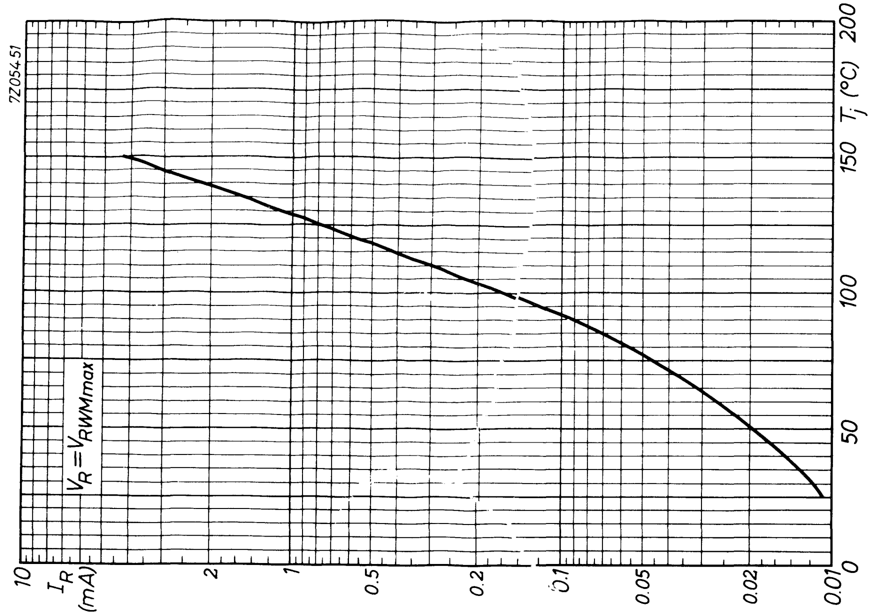
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.15 ^{o}C/W
Hence the heatsink thermal resistance should be:

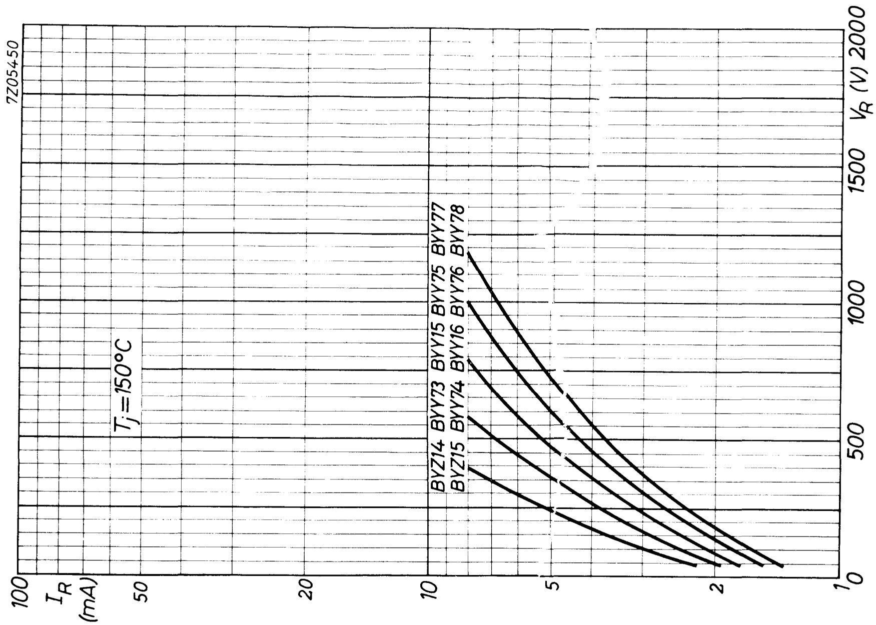
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} - (1.4 - 0.15)\ ^{o}C/W = 1.25\ ^{o}C/W.$$

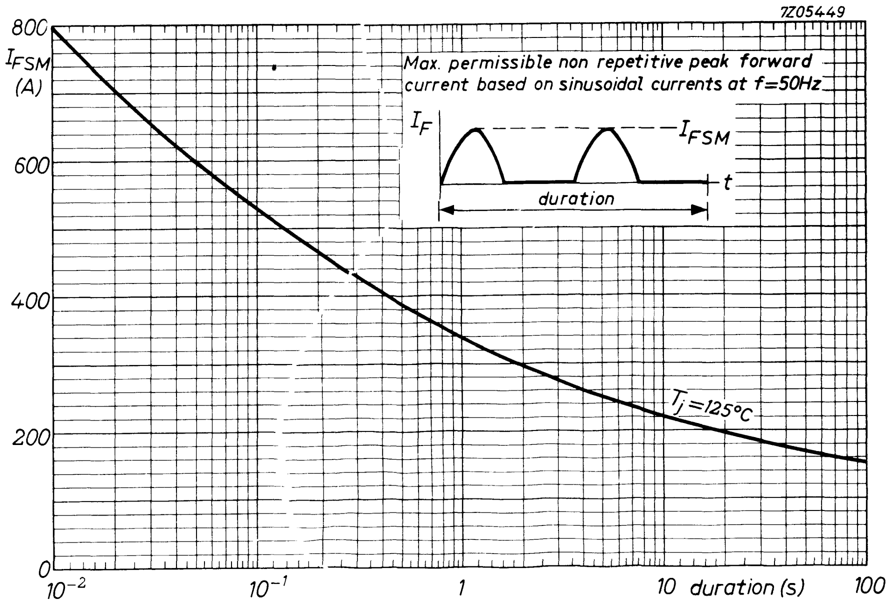
Alternatively, when the heatsink and $R_{th\ h\text{-}a}$ are known, the maximum permissible ambient temperature can be found.

7Z3 0521


7Z05448
1000
500
I_F
(A)
200
100
50
20
10
5
2
1
0.5
0.2
0.1
0
0.5
1
1.5
V_F (V)
2
T_j = 25°C
150°C


7Z05451
$V_R = V_{RWMmax}$
I_R (mA)
T_j (°C)
10
2
1
0.5
0.2
0.1
0.05
0.02
0.01
0
50
100
150
200


7Z05450
$T_j = 150°C$
BYZ14 BYY73 BYY15 BYY75 BYY77
BYZ15 BYY74 BYY16 BYY76 BYY78
I_R (mA)
V_R (V)
100
50
20
10
5
2
1
0
500
1000
1500
2000


7Z05449
800
600
400
200
0
I_{FSM}
(A)
Max. permissible non repetitive peak forward current based on sinusoidal currents at f=50Hz
I_F
I_{FSM}
t
duration
T_j=125°C
10^{-2}
10^{-1}
1
10
100
duration (s)

SILICON POWER DIODES

For data of these diodes please refer to the BYZ10 to 12.

7Z3 0456

SILICON POWER DIODE

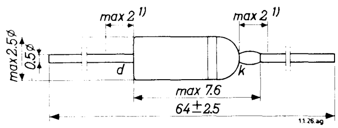
For data of this diode please refer to the BYZ13.

7Z3 0457

SILICON ALLOY JUNCTION DIODE with 5 % tolerance in miniature double-ended all-glass construction for use as low-current VOLTAGE STABILIZER or as a VOLTAGE REFERENCE

Dimensions in mm

The white band indicates the position of the cathode



LIMITING VALUES (Absolute max. values)

Forward current	I_D	= max.	50 mA
Reverse current	$-I_D$	= max.	25 mA
Total dissipation (see also page C)	P_{tot}	= max.	$\frac{150 - T_{amb}}{0.45}$ mW
Junction temperature	T_j	= max.	150 °C
Storage temperature	T_s	= -55 °C to +150	°C

THERMAL DATA

Thermal resistance from junction to ambience in free air K = max. 0.45 °C/mW

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C	
Forward current	Forward voltage
I_D	V_D
0.1 mA	610 mV
10 mA	760 mV

T_{amb} = 60 °C	
Reverse voltage	Reverse current
$-V_D$	$-I_D$
1.0 V	0.004 μA

1) Not tinned

7Z2 1123

7Z2 1124

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_{amb} = 25 °C

Type No.	Zener current $-I_D$	Zener voltage $-V_D$ average	Zener voltage $-V_D$ range values	Temperature coefficient $\Delta(-V_D)/\Delta T$	Dynamic impedance r_D
BZY56	1 mA	4.7 V	4.4 to 5.0 V	-2.0 mV/°C	370 Ω
	5 mA	5.2 V		-1.2 mV/°C	62 Ω
	20 mA	5.6 V		0.0 mV/°C	9.5 Ω
BZY57	1 mA	5.1 V	4.8 to 5.4 V	-1.8 mV/°C	360 Ω
	5 mA	5.6 V		-0.5 mV/°C	50 Ω
	20 mA	5.9 V		+1.0 mV/°C	6.0 Ω
BZY58	1 mA	5.6 V	5.3 to 6.0 V	-1.0 mV/°C	280 Ω
	5 mA	6.0 V		+1.0 mV/°C	28 Ω
	20 mA	6.2 V		+2.0 mV/°C	3.2 Ω
BZY59	1 mA	6.2 V	5.8 to 6.6 V	+0.5 mV/°C	200 Ω
	5 mA	6.3 V		+1.8 mV/°C	12 Ω
	20 mA	6.4 V		+2.5 mV/°C	2.0 Ω

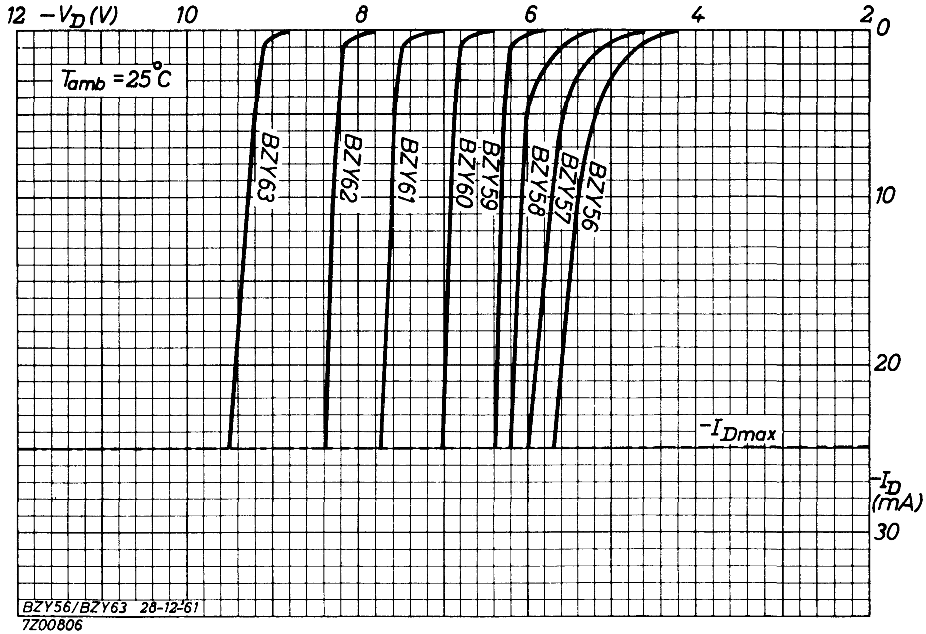
2.

7Z2 1128

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_{amb} = 25 °C

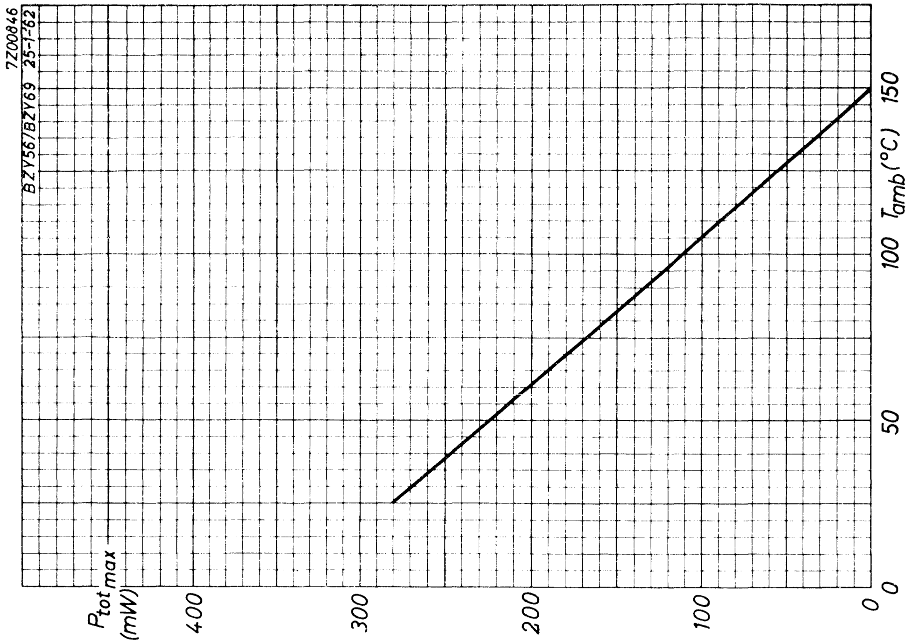
Type No.	Zener current $-I_D$	Zener voltage $-V_D$ average	Zener voltage $-V_D$ range values	Temperature coefficient $\Delta(-V_D)/\Delta T$	Dynamic impedance r_D
BZY60	1 mA	6.8 V	6.4 to 7.2 V	+2.7 mV/°C	5.0 Ω
	5 mA	6.9 V		+3.1 mV/°C	3.5 Ω
	20 mA	7.0 V		+3.6 mV/°C	1.5 Ω
BZY61	1 mA	7.5 V	7.1 to 7.9 V	+4.0 mV/°C	8.0 Ω
	5 mA	7.6 V		+4.3 mV/°C	2.8 Ω
	20 mA	7.7 V		+4.6 mV/°C	1.7 Ω
BZY62	1 mA	8.2 V	7.7 to 8.7 V	+5.0 mV/°C	6.2 Ω
	5 mA	8.25 V		+5.2 mV/°C	3.2 Ω
	20 mA	8.4 V		+5.5 mV/°C	2.0 Ω
BZY63	1 mA	9.1 V	8.6 to 9.6 V	+6.2 mV/°C	8.0 Ω
	5 mA	9.2 V		+6.4 mV/°C	4.4 Ω
	20 mA	9.4 V		+6.6 mV/°C	2.7 Ω

3.

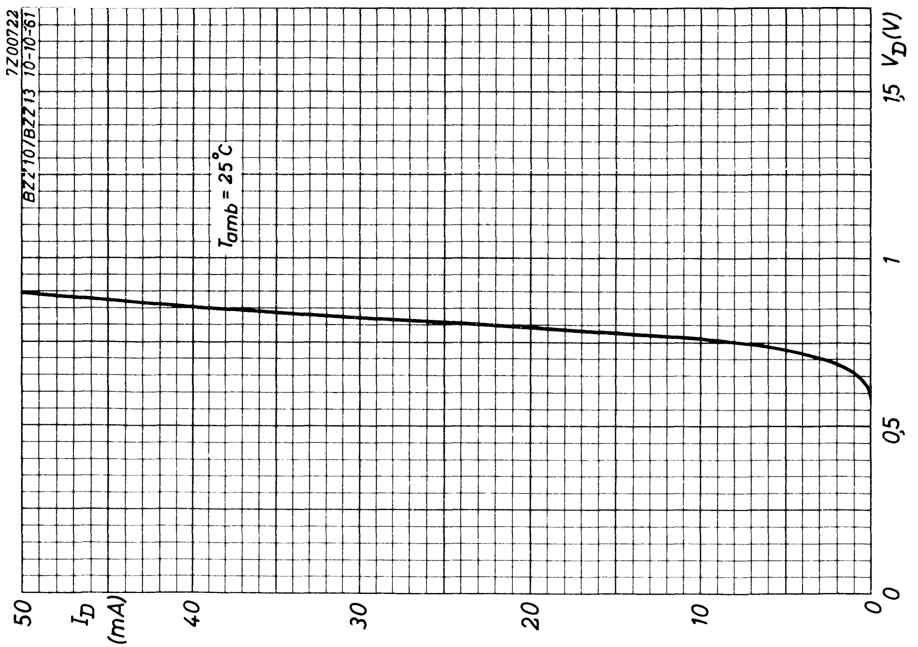


12 −V_D (V) 10 8 6 4 2
0
10
20
−I_D (mA)
30
T_amb = 25°C
BZY63
BZY62
BZY61
BZY60
BZY59
BZY58
BZY57
BZY56
−I_Dmax
BZY56/BZY63 28-12-61
7Z00806

A


7Z00846
BZY56/BZY69 25-1-62
$P_{tot\ max}$
(mW)
400
300
200
100
0
0
50
100
150
T_{amb} (°C)

C

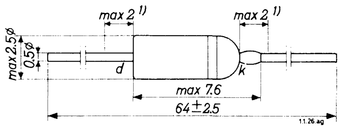

7Z00722
BZZ10/BZZ13 10-10-61
T_{amb} = 25°C
I_D
(mA)
50
40
30
20
10
0
0
0,5
1
1,5
V_D (V)

B

SILICON ALLOY JUNCTION DIODE with 15 % tolerance in miniature double-ended all-glass construction for use as low-current VOLTAGE STABILIZER or as a VOLTAGE REFERENCE

Dimensions in mm

The white band indicates the position of the cathode



LIMITING VALUES (Absolute max. values)

Forward current	I_D	= max.	50 mA
Reverse current	$-I_D$	= max.	25 mA
Total dissipation (see also page C)	P_{tot}	= max.	$\frac{150 - T_{amb}}{0.45}$ mW
Junction temperature	T_j	= max.	150 °C
Storage temperature	T_S	=	-55 °C to +150 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air   K = max. 0.45 °C/mW

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C	
Forward current	Forward voltage
I_D	V_D
0.1 mA	610 mV
10 mA	760 mV

T_{amb} = 60 °C	
Reverse voltage	Reverse current
$-V_D$	$-I_D$
1.0 V	0.004 μA

1) Not tinned

7Z2 1126

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_{amb} = 25 °C

Type No.	Zener current $-I_D$	Zener voltage $-V_D$ average	Zener voltage $-V_D$ range values	Temperature coefficient $\Delta(-V_D)/\Delta T$	Dynamic impedance r_D
BZY64	1 mA	4.3 V	3.3 to 5.0 V	-2.2 mV/°C	375 Ω
	5 mA	4.9 V		-1.7 mV/°C	77 Ω
	20 mA	5.3 V		-1.2 mV/°C	12 Ω
BZY65	1 mA	5.1 V	4.4 to 6.0 V	-1.8 mV/°C	360 Ω
	5 mA	5.6 V		-0.5 mV/°C	50 Ω
	20 mA	5.9 V		+1.0 mV/°C	6.0 Ω
BZY66	1 mA	6.2 V	5.3 to 7.2 V	+0.5 mV/°C	200 Ω
	5 mA	6.3 V		+1.8 mV/°C	12 Ω
	20 mA	6.4 V		+2.5 mV/°C	2.0 Ω
BZY67	1 mA	7.5 V	6.4 to 8.7 V	+4.0 mV/°C	8.0 Ω
	5 mA	7.6 V		+4.3 mV/°C	2.8 Ω
	20 mA	7.7 V		+4.6 mV/°C	1.7 Ω

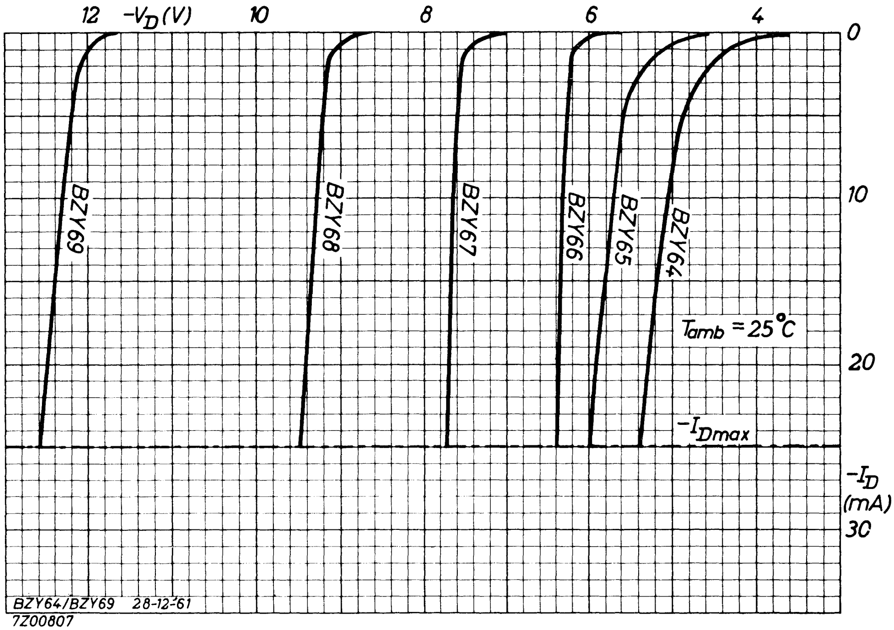
2.

7Z2 1127

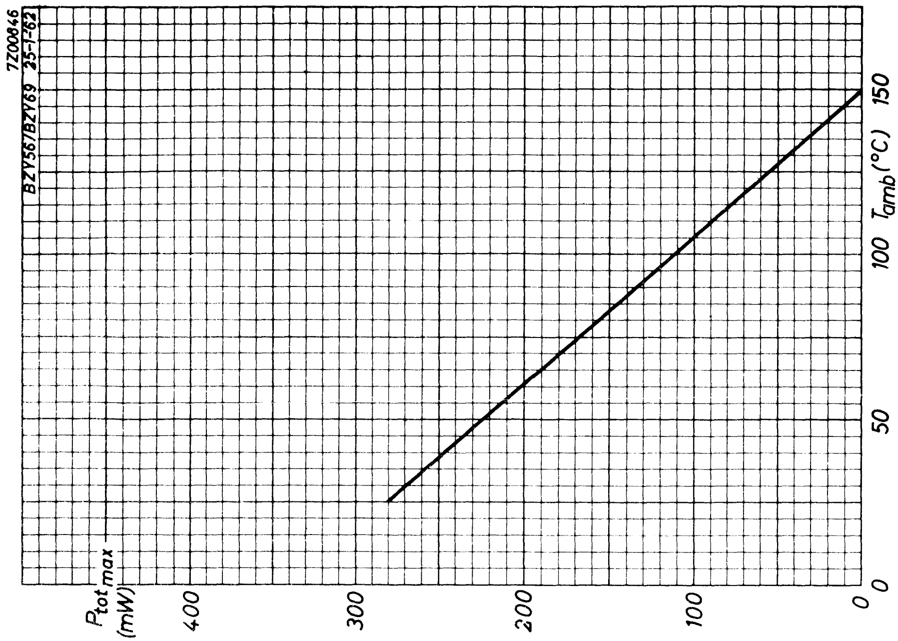
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_{amb} = 25 °C

type No.	Zener current $-I_D$	Zener voltage $-V_D$ average	Zener voltage $-V_D$ range values	Temperature coefficient $\Delta(-V_D)/\Delta T$	Dynamic impedance r_D
BZY68	1 mA	9.1 V	7.7 to 10.6 V	+6.2 mV/°C	8.0 Ω
	5 mA	9.2 V		+6.4 mV/°C	3.5 Ω
	20 mA	9.4 V		+6.6 mV/°C	3.0 Ω
BZY69	1 mA	12.0 V	9.4 to 15.0 V	+9.2 mV/°C	21 Ω
	5 mA	12.2 V		+9.3 mV/°C	11 Ω
	20 mA	12.5 V		+9.4 mV/°C	7.0 Ω

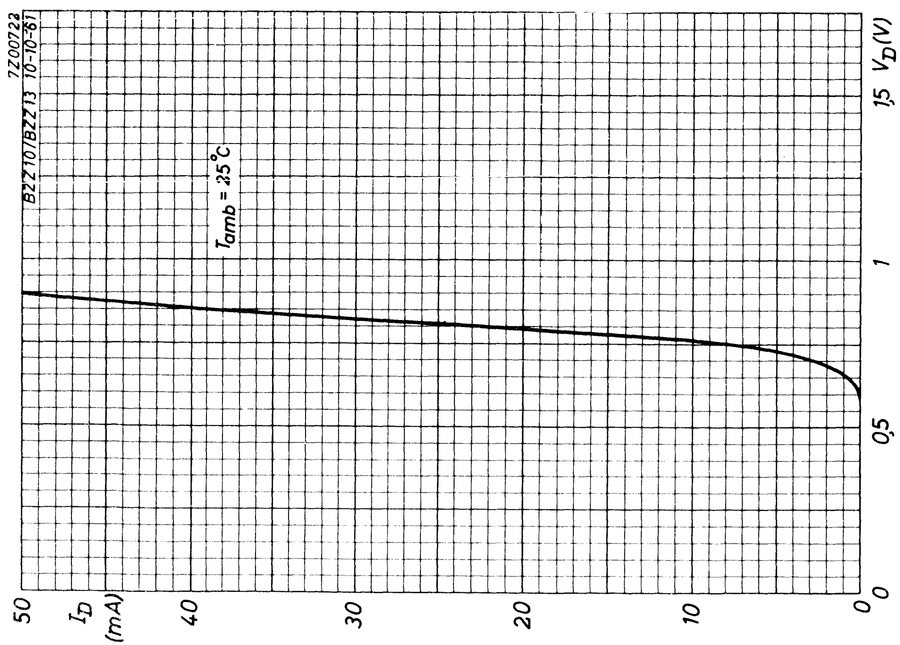
3.


12
$-V_D$ (V)
10
8
6
4
0
10
20
30
$-I_D$
(mA)
BZY69
BZY68
BZY67
BZY66
BZY65
BZY64
$T_{amb} = 25\,^{\circ}C$
$-I_{Dmax}$
BZY64/BZY69 28-12-61
7Z00807

A


7Z00846 25-1-62
BZY56/BZY69
P_tot max (mW)
400
300
200
100
0
T_amb (°C)
0
50
100
150

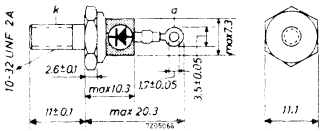
C


7Z00728 10-10-61
BZZ10/BZZ13
T_amb = 25°C
I_D (mA)
50
40
30
20
10
0
V_D (V)
0
0,5
1
1,5

B

SILICON ALLOY JUNCTION DIODE with 15 % tolerance for use as medium current VOLTAGE STABILIZER or as a VOLTAGE REFERENCE

Dimensions in mm



The diode is supplied with nut, metal washer and metal locking washer

LIMITING VALUES (Absolute max. values)

Forward current	I_D	= max.	0.5 A
Reverse current	$-I_D$	= max.	0.5 A
Surge reverse current (max. duration 100 µsec)	$-I_{D\,surge}$ (t	= max. = max.	10 A [1]) 100 µsec)
Dissipation (See also pages J and K)	P	= max.	$\frac{T_{j\,max}-T_{amb}}{K}$
Storage temperature	T_s	=	-55 °C to +150 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air	K_{j-amb} = max.	70 °C/W
Thermal resistance from junction to case	K_{j-c} = max.	10 °C/W

[1]) For surge currents of longer duration see page I

7Z2 1743 1.

CHARACTERISTICS at a case temperature of 25°C

		BZY74	BZY75	BZY76
Forward voltage (V_D) at I_D = 200 mA	min.	0.8 V	0.8 V	0.8 V
	max.	1.05 V	1.05 V	1.05 V
Zener voltage ($-V_D$) at $-I_D$ = 20 mA	min.	5.3 V	6.4 V	7.7 V
	typ.	6.2 V	7.5 V	9.1 V
	max.	7.2 V	8.7 V	10.6 V
Dynamic resistance (r_D) at $-I_D$ = 20 mA	max.	13 Ω	10 Ω	11 Ω
Leakage current ($-I_D$) at $-V_D$ = 3 V	typ.	0.15 µA	0.04 µA	
	max.	0.5 µA	0.5 µA	
Leakage current ($-I_D$) at $-V_D$ = 5 V	typ.			0.04 µA
	max.			0.4 µA

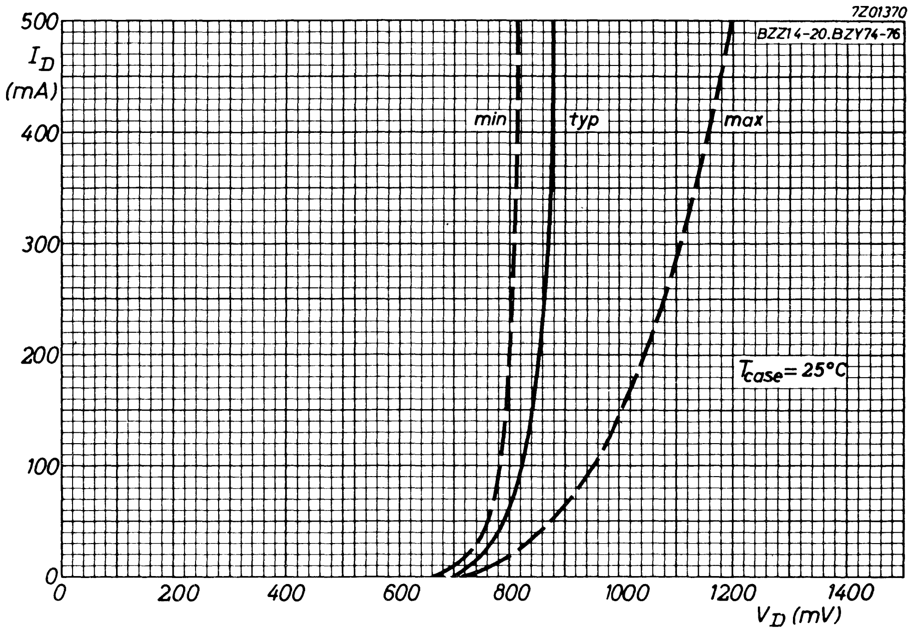
7Z2 1744 2.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

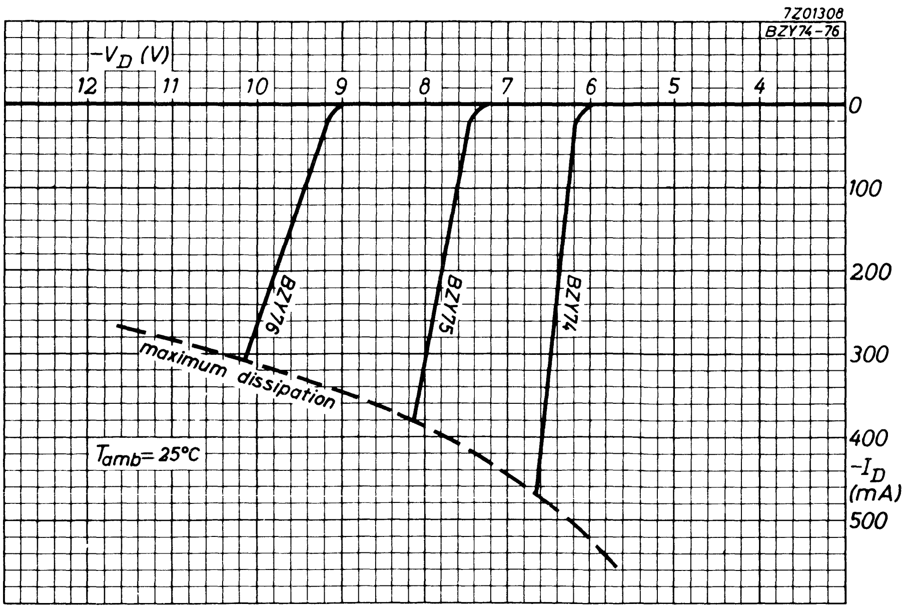
Case temperature = 25 °C

			BZY74	BZY75	BZY76	
Forward voltage (V_D)	I_D = 0-0.5 A	min. typ. max.	See page A			
Zener voltage ($-V_D$)	$-I_D$ = 50 mA	min.	5.4	6.4	7.8	V
		typ.	6.25	7.5	9.2	V
		max.	7.2	8.8	10.7	V
	$-I_D$ = 100 mA	min.	5.5	6.4	7.8	V
		typ.	6.3	7.6	9.3	V
		max.	7.4	9.0	11.0	V
	$-I_D$ = 200 mA	min.	5.5	6.6	8.0	V
		typ.	6.35	7.7	9.45	V
		max.	7.4	9.4	11.3	V
	$-I_D$ = 500 mA	min.	5.5	6.6	8.0	V
		typ.	6.6	7.82	9.55	V
		max.	7.9	9.5	11.6	V
Dynamic resistance (r_D)	$-I_D$ = 100 mA	typ.	See page G			
		max.	4.0	5.0	5.0	Ω
	$-I_D$ = 500 mA	typ.	See page G			
		max.	2.5	3.0	3.0	Ω
Temperature coefficient $\frac{\Delta(-V_D)}{\Delta T}$	$-I_D$ = 20 mA	typ.	See page F			
		min.	-0.4	2.0	4.0	mV/°C
		max.	4.0	6.0	8.0	mV/°C
	$-I_D$ = 100 mA	typ.	See page F			
		min.	0.5	2.5	3.0	mV/°C
		max.	4.0	6.1	11.0	mV/°C
	$-I_D$ = 500 mA	typ.	See page F			
		min.	0.0	2.5	3.0	mV/°C
		max.	4.0	7.0	11.0	mV/°C
Capacitance (c_{dk})	$-V_D$ = 2 V	typ.	475	350	250	pF

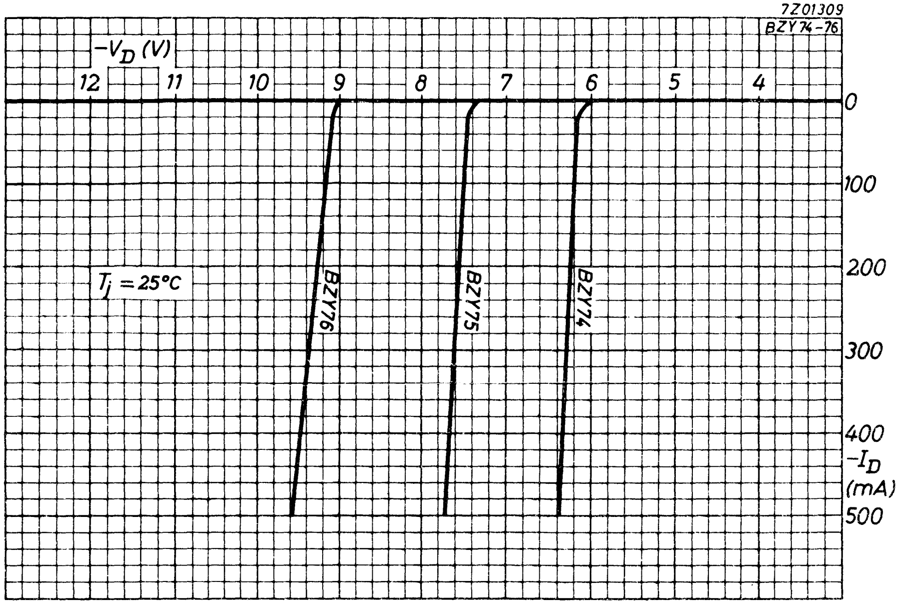
7Z2 1745 3.


7Z01370
BZZ14-20.BZY74-76
500
I_D
(mA)
400
300
200
100
0
0
200
400
600
800
1000
1200
1400
V_D (mV)
min
typ
max
T_{case}= 25°C

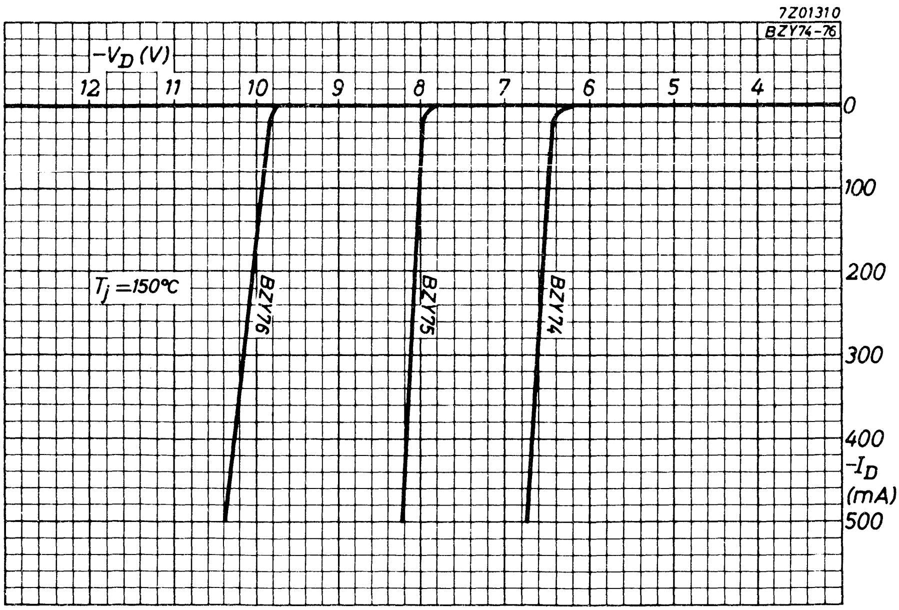
A


7Z01308
BZY74-76
$-V_D$ (V)
12
11
10
9
8
7
6
5
4
0
100
200
300
400
$-I_D$
(mA)
500
BZY76
BZY75
BZY74
maximum dissipation
T_{amb}= 25°C

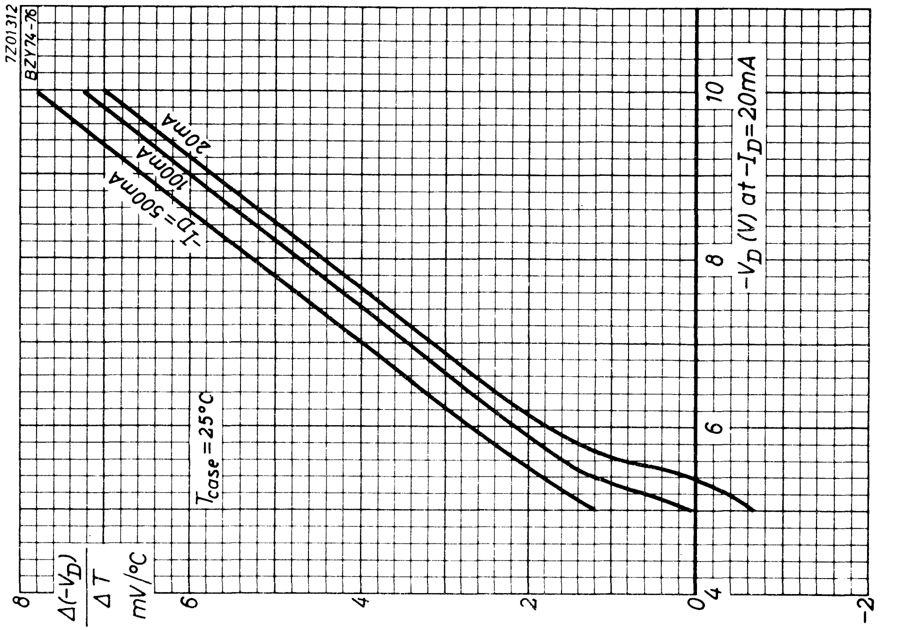
B


7Z01309
BZY74-76
$-V_D$ (V)
12
11
10
9
8
7
6
5
4
0
100
200
300
400
$-I_D$ (mA)
500
$T_j = 25°C$
BZY76
BZY75
BZY74

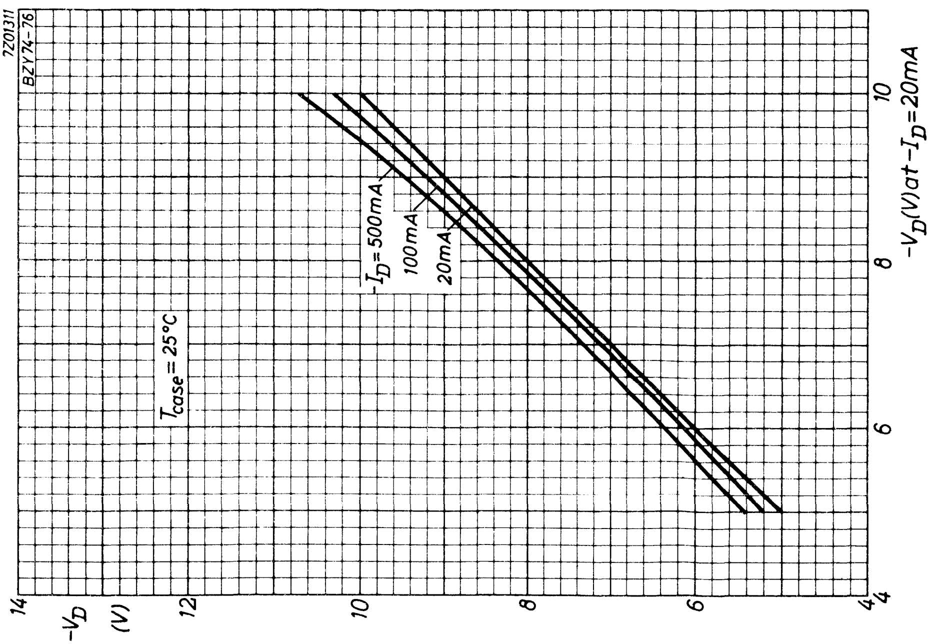
C


7Z01310
BZY74-76
$-V_D$ (V)
12
11
10
9
8
7
6
5
4
0
100
200
300
400
$-I_D$ (mA)
500
$T_j = 150°C$
BZY76
BZY75
BZY74

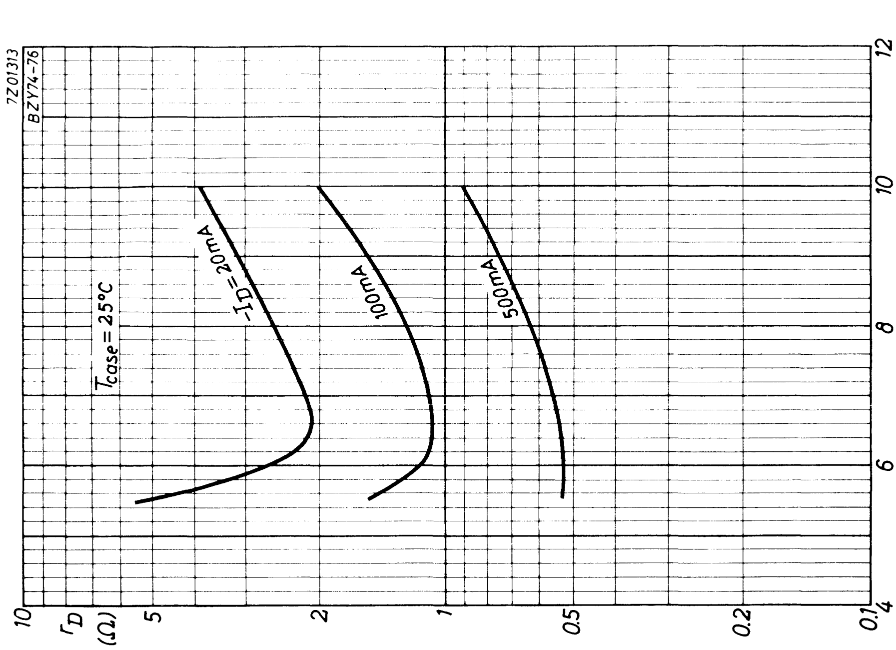
D


7Z01312
BZY74-76
$T_{case}=25°C$
$-I_D=500mA$
100mA
20mA
$\frac{\Delta(-V_D)}{\Delta T}$
mV/°C
$-V_D$ (V) at $-I_D=20mA$

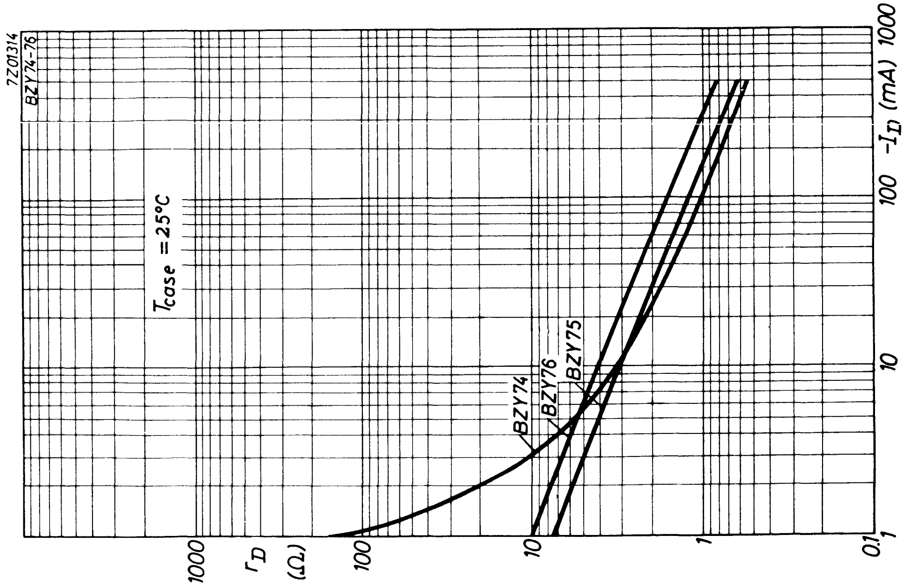
F


7Z01311
BZY74-76
$T_{case}=25°C$
$-I_D=500mA$
100mA
20mA
$-V_D$
(V)
$-V_D$(V)at$-I_D=20mA$

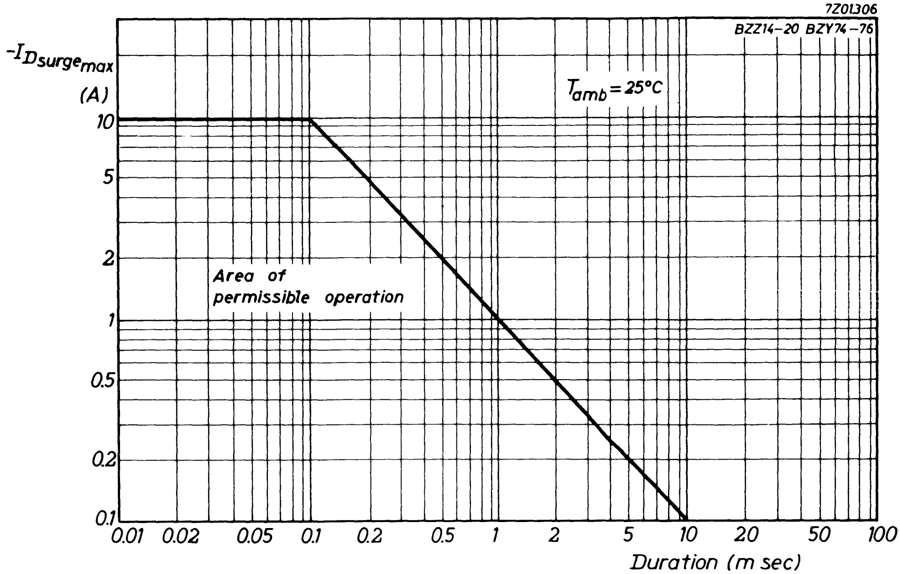
E

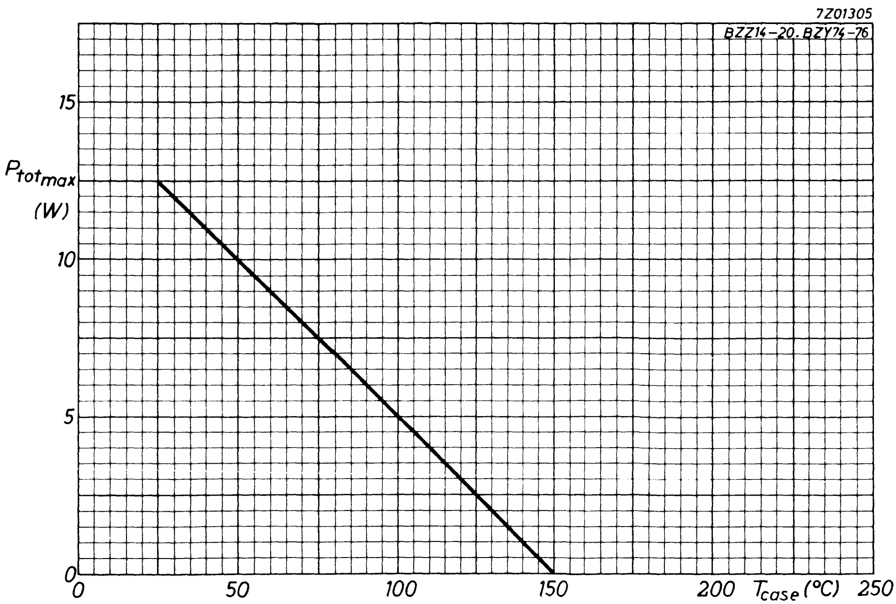

7Z01313
BZY74-76
Tcase = 25°C
-ID = 20mA
100mA
500mA
rD
(Ω)
10
5
2
1
0.5
0.2
0.1
4
6
8
10
12
-VD (V) at -ID = 20mA

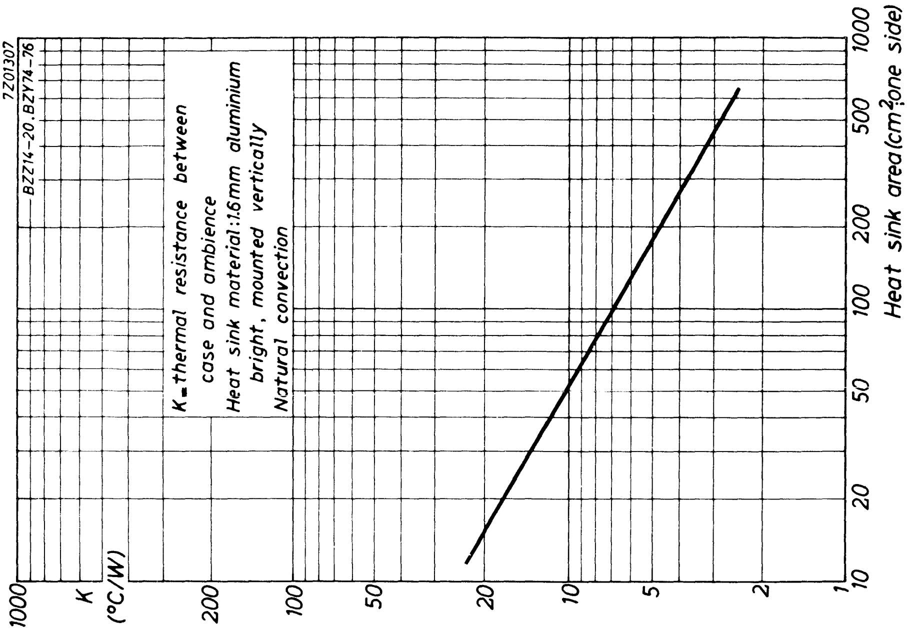
H


7Z01314
BZY74-76
Tcase = 25°C
BZY74
BZY76
BZY75
1000
rD
(Ω)
100
10
1
0.1
1
10
100
1000
-ID (mA)

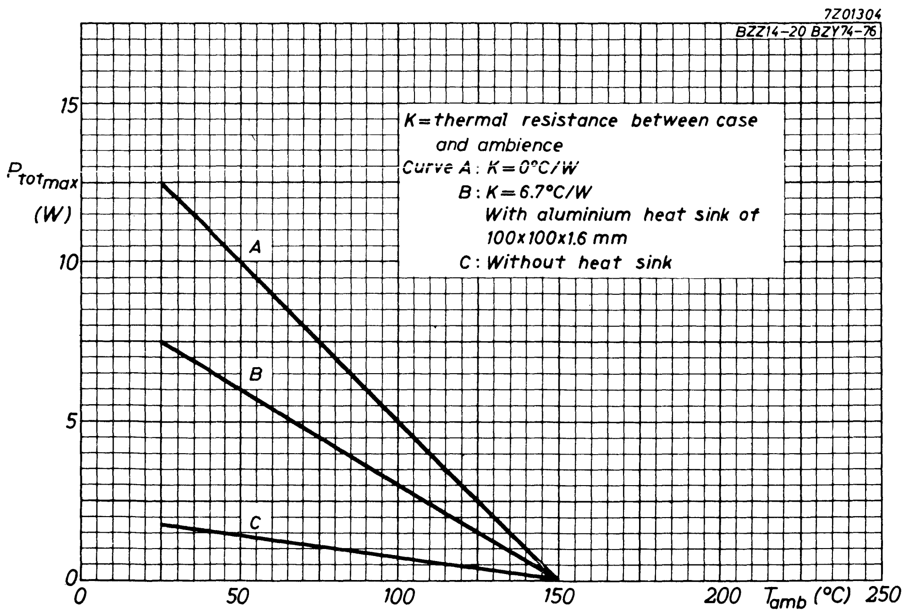
G


7Z01306
BZZ14-20 BZY74-76
$-I_{D surge max}$ (A)
$T_{amb} = 25°C$
Area of permissible operation
10
5
2
1
0.5
0.2
0.1
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
Duration (m sec)


7Z01305
BZZ14-20. BZY74-76
$P_{tot max}$ (W)
15
10
5
0
0
50
100
150
200
T_{case} (°C)
250


7Z01307
BZZ14-20.BZY74-76
K = thermal resistance between case and ambience
Heat sink material: 1.6 mm aluminium bright, mounted vertically
Natural convection
K (°C/W)
1000
200
100
50
20
10
5
2
1
Heat sink area (cm²; one side)
10
20
50
100
200
500
1000

L


7Z01304
BZZ14-20 BZY74-76
K = thermal resistance between case and ambience
Curve A: K = 0°C/W
B: K = 6.7°C/W
With aluminium heat sink of 100x100x1.6 mm
C: Without heat sink
$P_{tot max}$ (W)
15
10
5
0
A
B
C
0
50
100
150
200
T_{amb} (°C)
250

K

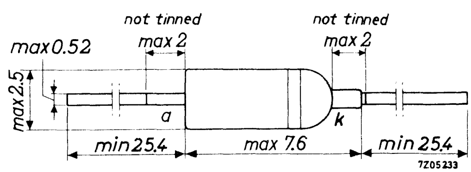
VOLTAGE REGULATOR DIODES

Silicon alloy junction diodes in subminiature all glass DO-7 envelope for use as low current voltage stabilisers or voltage references.
The series consists of eight types with nominal zener voltages ranging from 4.7 V to 9.1 V with a tolerance of ± 5% [1]).

QUICK REFERENCE DATA				
Peak zener current	I_{ZM}	max.	250	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	400	mW
Junction temperature	T_j	max.	150	°C
Thermal resistance from junction to ambient in free air	$R_{th\ j-a}$	=	0.31	°C/mW

MECHANICAL DATA Dimensions in mm

DO-7



The coloured band indicates the cathode side

[1]) The part of the typenumber after the hyphen consists of a letter, indicating the nominal tolerance in % (C = 5%) and a voltage, indicating the nominal zener voltage in volts (the letter V is used in place of the decimal point where this occurs).

7Z3 0606

RATINGS (Limiting values) [1]

Currents

Average zener current	I_{ZAV}	see pages D and F		
Peak zener current	I_{ZM}	max.	250	mA
Peak forward current	I_{FM}	max.	250	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	400	mW
Non repetitive reverse power dissipation	P_{ZS}	see page C		

Temperatures

Storage temperature	T_{stg}	-55 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.31	°C/mW

CHARACTERISTICS T_{amb} = 25 °C

				BZY88-C4V7		BZY88-C5V1	
Operating voltage	I_Z = 1 mA	V_Z	nom.	4.1		4.65	V
	I_Z = 5 mA	V_Z	nom.	4.7		5.1	V
				4.4 to 5.0		4.8 to 5.4	V
	I_Z = 20 mA	V_Z	nom.	5.1		5.35	V
Forward voltage	I_F = 10 mA	V_F	<	900		900	mV
Reverse current	V_R = 2 V	I_R	<	900		900	nA
Temperature coefficient of the operating voltage	I_Z = 1 mA	S_Z	typ.	-2.00		-1.9	mV/°C
	I_Z = 5 mA	S_Z	typ.	-1.55		-1.2	mV/°C
	I_Z = 20 mA	S_Z	typ.	-0.75		-0.1	mV/°C
Dynamic slope resistance	I_Z = 1 mA	r_Z	typ.	390		340	Ω
	I_Z = 5 mA	r_Z	typ.	62		46	Ω
			<	85		75	Ω
	I_Z = 20 mA	r_Z	typ.	16		7	Ω
Diode capacitance	V_R = 3 V	C_d	typ.	290		275	pF

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0607

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

	Conditions	Symbol	BZY88-C5V6	-C6V2	-C6V8
Operating voltage	I_Z = 1 mA	V_Z	nom. 5.3	5.9	6.7 V
	I_Z = 5 mA	V_Z	nom. 5.6	6.2	6.8 V
			5.3 to 6.0	5.8 to 6.6	6.4 to 7.2 V
	I_Z = 20 mA	V_Z	nom. 5.75	6.4	6.9 V
Forward voltage	I_F = 10 mA	V_F	< 900	900	900 mV
Reverse current	V_R = 2 V	I_R	< 450	-	- nA
	V_R = 3 V	I_R	< -	450	450 nA
Temperature coefficient of the operating voltage	I_Z = 1 mA	S_Z	typ. -1.4	+1.6	+3.2 mV/°C
	I_Z = 5 mA	S_Z	typ. -0.2	+2.0	+3.2 mV/°C
	I_Z = 20 mA	S_Z	typ. +1.0	+2.2	+3.2 mV/°C
Dynamic slope resistance	I_Z = 1 mA	r_z	typ. 290	205	60 Ω
	I_Z = 5 mA	r_z	typ. 22	7.0	3 Ω
			< 55	30	15 Ω
	I_Z = 20 mA	r_z	typ. 2.7	1.4	1.1 Ω
Diode capacitance	V_R = 3 V	C_d	typ. 260	240	220 pF

	Conditions	Symbol	BZY88-C7V5	-C8V2	-C9V1
Operating voltage	I_Z = 1 mA	V_Z	nom. 7.45	8.1	9.0 V
	I_Z = 5 mA	V_Z	nom. 7.5	8.2	9.1 V
			7.1 to 7.9	7.7 to 8.7	8.6 to 9.6 V
	I_Z = 20 mA	V_Z	nom. 7.65	8.4	9.4 V
Forward voltage	I_F = 10 mA	V_F	< 900	900	900 mV
Reverse current	V_R = 3 V	I_R	< 450	-	- nA
	V_R = 5 V	I_R	< -	350	350 nA
Temperature coefficient of the operating voltage	I_Z = 1 mA	S_Z	typ. +4.2	+5.0	+6.0 mV/°C
	I_Z = 5 mA	S_Z	typ. +4.2	+5.0	+6.0 mV/°C
	I_Z = 20 mA	S_Z	typ. +4.2	+5.0	+6.0 mV/°C
Dynamic slope resistance	I_Z = 1 mA	r_z	typ. 8.6	10	14 Ω
	I_Z = 5 mA	r_z	typ. 3.0	3.5	4.75 Ω
			< 15	20	25 Ω
	I_Z = 20 mA	r_z	typ. 1.16	1.35	1.8 Ω
Diode capacitance	V_R = 3 V	C_d	typ. 190	150	140 pF

7Z3 0608

OPERATING NOTES

1. Dissipation and heatsink considerations.

(a) Steady-state conditions

The maximum allowable steady-state dissipation P_S is given by the relationship

$$P_{S\,max.} = \frac{T_{j\,max.} - T_{amb}}{R_{th\,j\text{-}a}}$$

where $T_{j\,max.}$ is the maximum permissible operating junction temperature,

T_{amb} is the ambient temperature,

$R_{th\,j\text{-}a}$ is the total thermal resistance from junction to ambient.

(b) Pulse conditions (see fig. next page)

The maximum allowable pulse power P_p is given by the formula

$$P_p = \frac{(T_{j\,max.} - T_{amb}) - (P_S . R_{th\,j\text{-}a})}{R_{th\,t}}$$

where P_S is the steady-state dissipation, excluding that in the pulses,

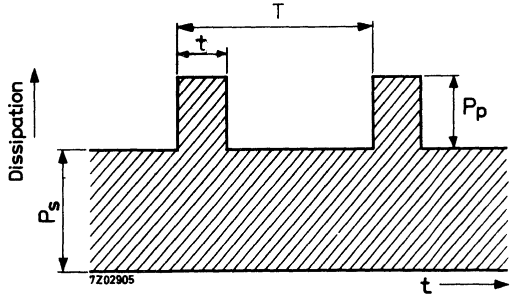
$R_{th\,t}$ is the effective transient thermal resistance of the device from junction to ambient and is a function of the pulse duration t and duty cycle δ (see page F, lower figure),

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T.

The steady-state power P_S when biased in the zener direction at a given zener current can be found from page F, upper figure. With the additional pulsed power dissipation P_p calculated from the above expression, the total peak zener power dissipation P_{tot} is $P_S + P_p$. From page F, upper figure the maximum allowable peak zener current at P_{tot} can now be read. This peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilisation time of the diode t_{stab}, the maximum dissipation P_{tot} is equal to the steady-state power $P_{S\,max}$. The temperature stabilisation time for the BZY88-C4V7 to BZY88-C9V1 is 100 s (see page F, lower figure).

7Z3 0609

OPERATING NOTES (continued)



Example

The following example illustrates how to calculate the maximum permissible peak zener current of a BZY88-C7V5 zener diode mounted in free air at a maximum ambient temperature of 60 °C. The steady-state zener current is 10 mA, the duty cycle $\delta = 0.1$ and the pulse duration t = 1 ms.

The steady-state dissipation P_S at a zener current of 10 mA (from page F, upper figure) = 0.076 W.

The transient thermal resistance $R_{th\ t}$ with a duty cycle $\delta = 0.1$ and a pulse duration t = 1 ms (from page F, lower figure)

$$R_{th\ t} = 41.5\ ^{o}C/W$$

The maximum pulse power dissipation

$$P_p = \frac{(T_{j\ max.} - T_{amb}) - P_S . R_{th\ j\text{-}a}}{R_{th\ t}}$$

If $P_S = 0.076$ W, $R_{th\ t} = 41.5\ ^{o}C/W$,

then $$P_p = \frac{(150 - 60)-(0.076 \times 310)}{41.5} = 1.6\ W$$

therefore, the total peak power,

$$P_{tot} = (1.6\ W + 0.076\ W) \approx 1.68\ W$$

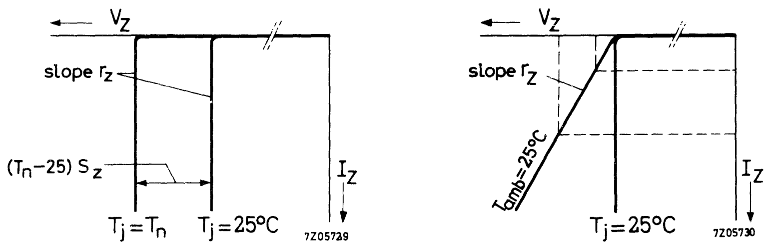
From page F, upper figure, the corresponding peak zener current is 200 mA. This is within the maximum peak rating of the BZY88-C7V5 and is therefore permissible.

7Z3 0610

OPERATING NOTES (continued)

2. Zener characteristics

The basic characteristic of a zener diode is the dynamic zener characteristic, that is, the variation of zener voltage when a current pulse is applied in the reverse direction. The slope of this characteristic is r_Z. Typical dynamic characteristics at T_j = 25 and 150 ^oC are given at page B for each type of diode. Because of the temperature sensitivity of the zener characteristics, the dynamic characteristics at any other operating temperature will be displaced from those at T_j = 25 ^oC by a voltage corresponding to $S_Z \times (T_n - 25)^oC$, where S_Z is the temperature coefficient of the diode and T_n is a nominal operating temperature. This is illustrated below.



Dynamic characteristics

Static characteristic

The static characteristic of the diode is obtained by connecting the steady-state zener voltages at various direct zener currents and may, therefore, be used to determine the operating point at any zener current. This is shown above. The slope of the static characteristic will depend on

(1) the dynamic resistance, r_Z

(2) the rise in junction temperature due to internal dissipation and the thermal resistance from junction to ambient, $V_Z . I_Z . R_{th\ j-a}$.

(3) the temperature coefficient of the diode, S_Z

From the above, the static slope resistance r_Z is found to be

$$r_Z = r_z + V_Z . R_{th\ j-a} . S_Z$$

where r_z is the dynamic resistance, V_Z is the steady-state zener voltage and is equal to

$$\frac{V_Z'}{1 - I_Z . R_{th\ j-a} . S_Z}$$

V_Z' being the zener voltage at $T_j = T_n$ at the working current I_Z.

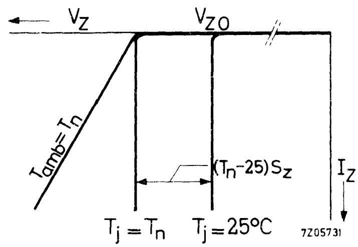
7Z3 0611

OPERATING NOTES (continued)

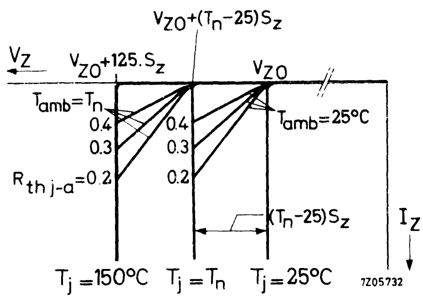
The position of this static characteristic in relation to the dynamic characteristic at T_j = 25 °C is dependent on the ambient temperature and the temperature coefficient, the low-current voltage being displaced by

$$S_Z \times (T_n - 25)\,^{\circ}C$$

from the low current voltage, V_{ZO} on the dynamic characteristic at T_j = 25 °C (See figure below)



Next figure shows typical dynamic characteristics at T_j = 25, 150 and a nominal temperature, T_n °C. It also shows static characteristics at ambient temperatures of 25 and T_n °C with various values of $R_{th\ j\text{-}a}$.



Typical static characteristics for each type of diode are given at page A. These curves were obtained with the device mounted in free air at an ambient temperature of 25 °C.

The slope resistance for pulse operation can be calculated by incorporating the transient thermal resistance $R_{th\ t}$ into the formula for r_Z. Curves of $R_{th\ t}$ plotted against pulse duration and duty cycle are given in the lower figure on page F.

7Z3 0612

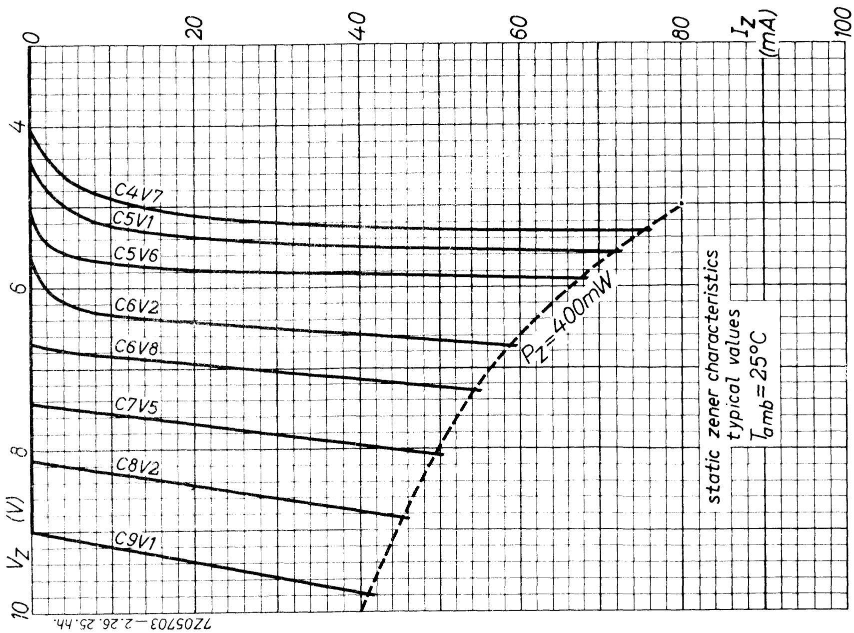
3. When using a soldering iron, the diode may be soldered directly into a circuit, but heat conducted to the junction should be kept to a minimum by use of a thermal shunt.

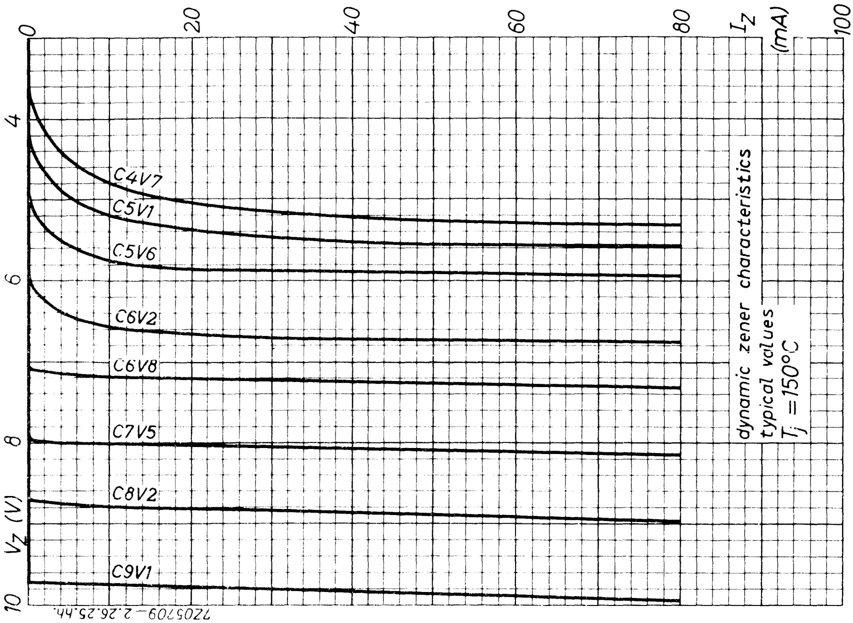
4. Diodes may be dip soldered at a solder temperature of 245 ^{o}C for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on the board with punched-through holes. For mounting the cathode end onto the board the diode must be spaced 5mm from the underside of the printed circuit board in the case of punched-through holes or 5 mm from the top of the board for plated-through holes.

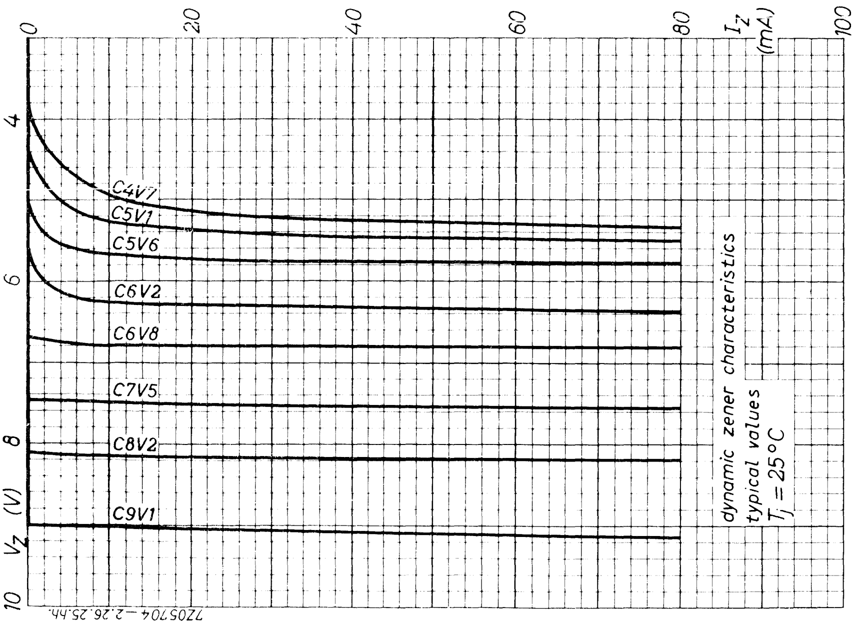
5. Care should be taken not to bend the leads nearer than 1.5 mm from the seals.

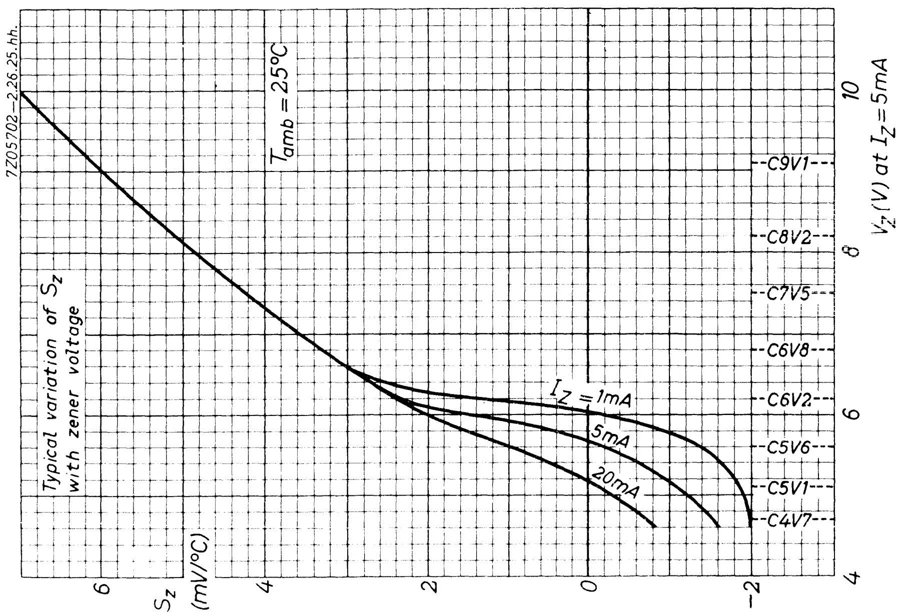
7Z3 0613

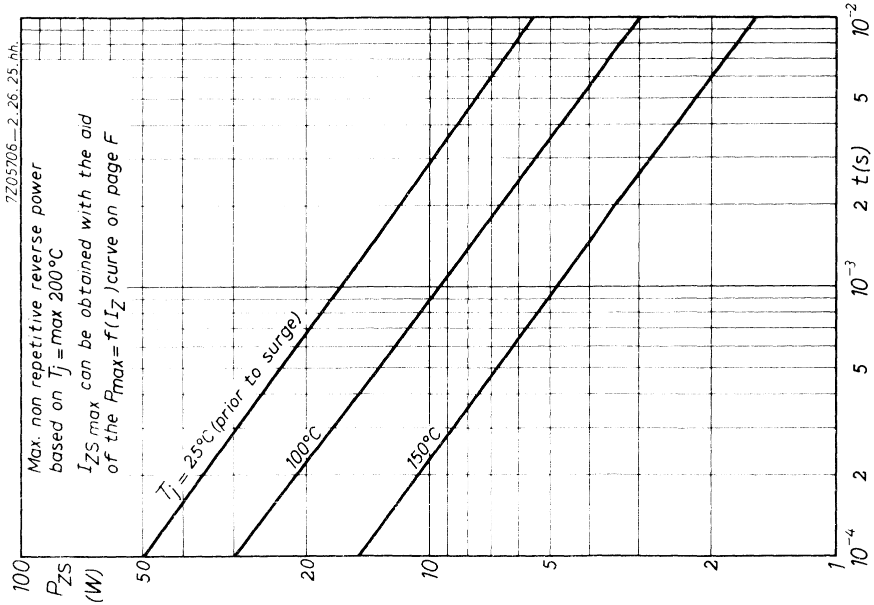

7Z05701-2.26.25.hh.
$T_{amb} = 25°C$
typ
V_F (mV)
0
500
1000
1500
I_F (mA)
50
40
30
20
10
0

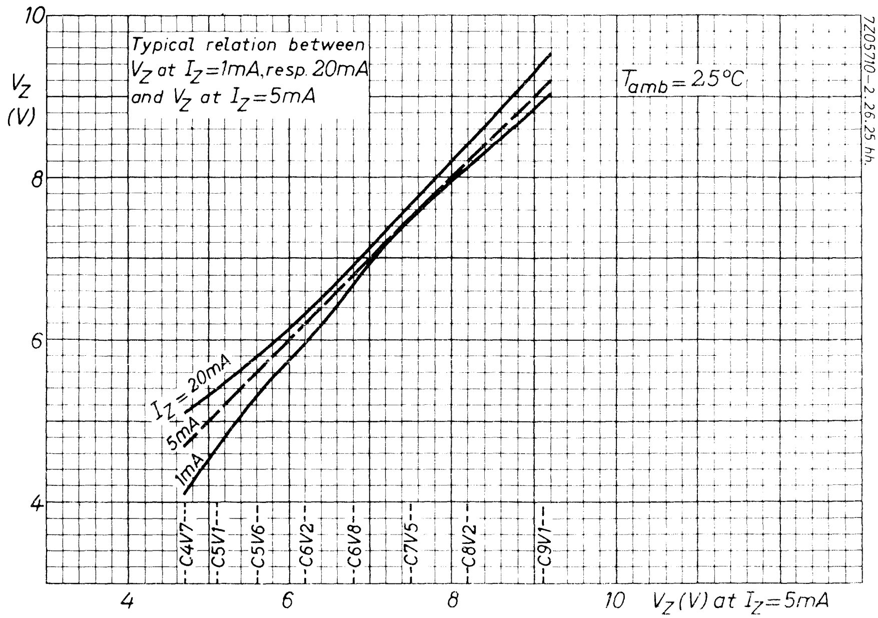

0
20
40
60
80
100
I_Z (mA)
4
6
8
10
V_Z (V)
C4V7
C5V1
C5V6
C6V2
C6V8
C7V5
C8V2
C9V1
P_Z=400mW
static zener characteristics
typical values
T_{amb}=25°C
7Z05703-2.26.25.hh.

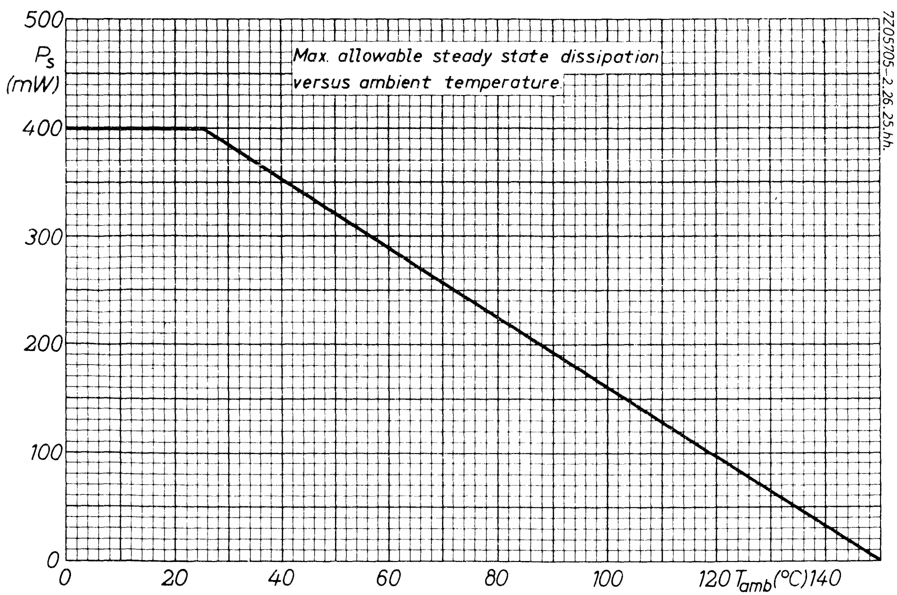

I_Z (mA)
V_Z (V)
C4V7
C5V1
C5V6
C6V2
C6V8
C7V5
C8V2
C9V1
dynamic zener characteristics
typical values
T_j = 150°C
7Z05709 – 2.26.25.hh.

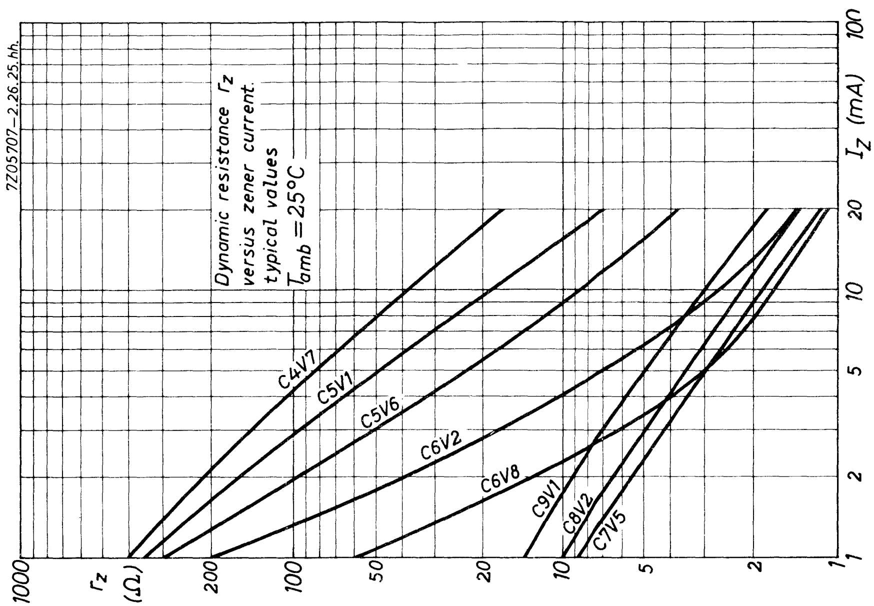

I_Z (mA)
V_Z (V)
C4V7
C5V1
C5V6
C6V2
C6V8
C7V5
C8V2
C9V1
dynamic zener characteristics
typical values
T_j = 25°C
7Z05704 – 2.26.25.hh.

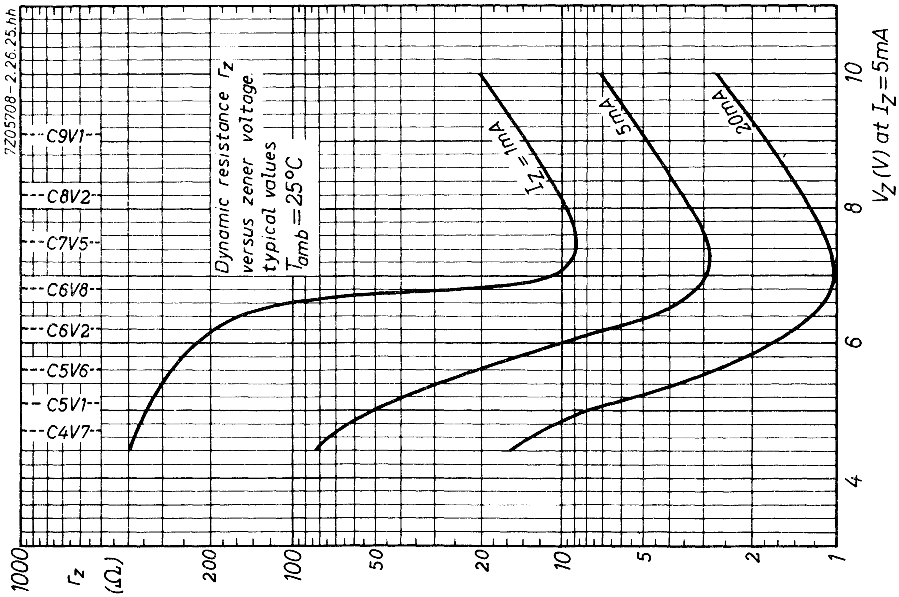

7Z05702—2.26.25.hh.
$T_{amb} = 25°C$
Typical variation of S_z with zener voltage
$I_Z = 1mA$
5mA
20mA
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
6
4
2
0
−2
S_z (mV/°C)
4
6
8
10
V_Z (V) at $I_Z = 5mA$

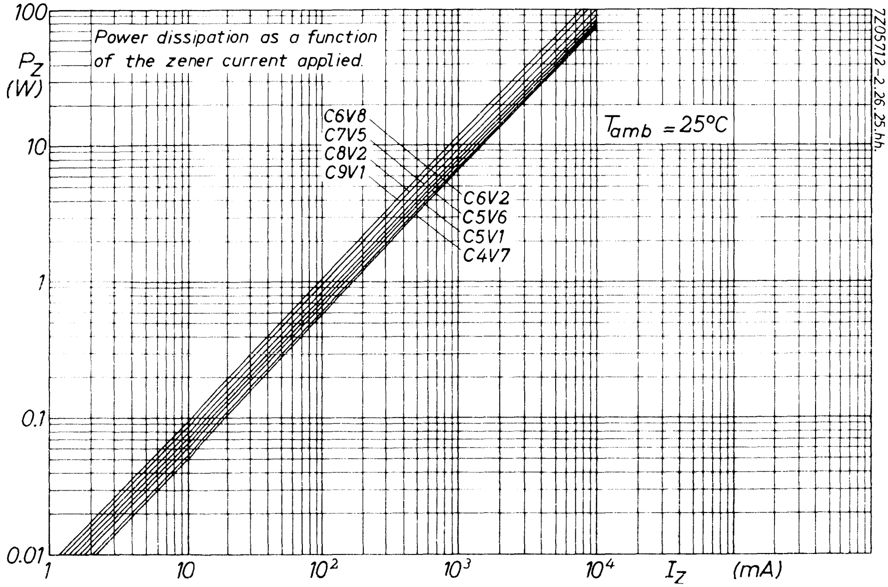

7Z05706—2.26.25.hh.
Max. non repetitive reverse power based on T_j = max 200°C
$I_{ZS\,max}$ can be obtained with the aid of the $P_{max} = f(I_Z)$ curve on page F
$T_j = 25°C$ (prior to surge)
100°C
150°C
100
50
20
10
5
2
1
P_{ZS} (W)
10^{-4}
2
5
10^{-3}
2
5
10^{-2}
t(s)

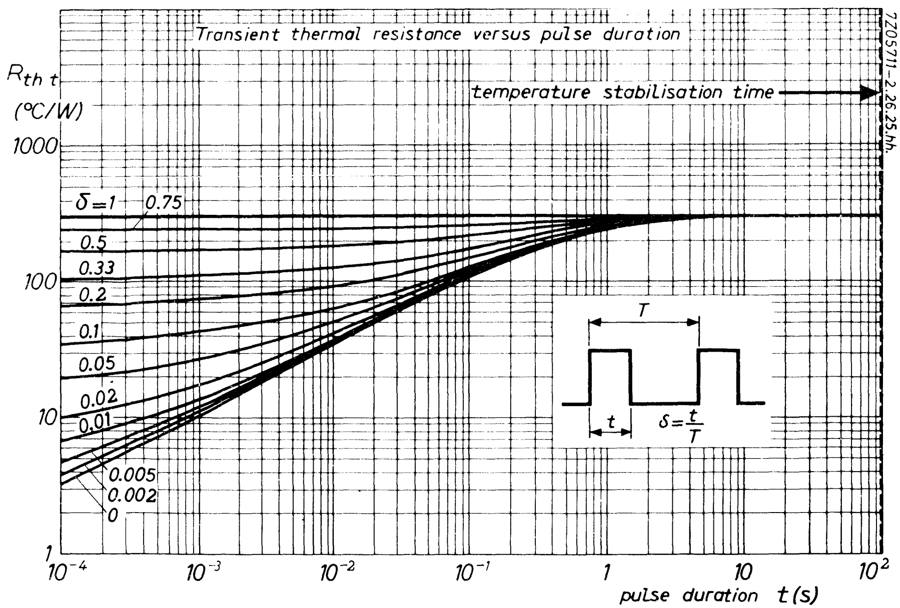

Typical relation between
V_Z at I_Z=1mA, resp. 20mA
and V_Z at I_Z=5mA
T_{amb} = 25°C
V_Z
(V)
10
8
6
4
I_Z = 20mA
5mA
1mA
C4V7
C5V1
C5V6
C6V2
C6V8
C7V5
C8V2
C9V1
4
6
8
10
V_Z (V) at I_Z=5mA
7Z05710-2.26.25 hh.


Max. allowable steady state dissipation
versus ambient temperature
P_s
(mW)
500
400
300
200
100
0
0
20
40
60
80
100
120
T_{amb}(°C)
140
7Z05705-2.26.25.hh.


7Z05707-2.26.25.hh
Dynamic resistance r_Z versus zener current.
typical values
$T_{amb} = 25°C$
C4V7
C5V1
C5V6
C6V2
C6V8
C9V1
C8V2
C7V5
r_Z (Ω)
1000
200
100
50
20
10
5
2
1
I_Z (mA)
1
2
5
10
20
100


7Z05708-2.26.25.hh
Dynamic resistance r_Z versus zener voltage.
typical values
$T_{amb} = 25°C$
C9V1
C8V2
C7V5
C6V8
C6V2
C5V6
C5V1
C4V7
$I_Z = 1mA$
5mA
20mA
r_Z (Ω)
1000
200
100
50
20
10
5
2
1
V_Z (V) at $I_Z = 5mA$
4
6
8
10


100
10
1
0.1
0.01
P_Z
(W)
Power dissipation as a function of the zener current applied.
C6V8
C7V5
C8V2
C9V1
C6V2
C5V6
C5V1
C4V7
T_{amb} = 25°C
7Z05712-2.26.25.hh.
1
10
10^2
10^3
10^4
I_Z (mA)


Transient thermal resistance versus pulse duration
$R_{th\ t}$
(°C/W)
temperature stabilisation time
7Z05711-2.26.25.hh.
1000
100
10
1
δ=1
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0
T
t
$\delta = \frac{t}{T}$
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
pulse duration t (s)

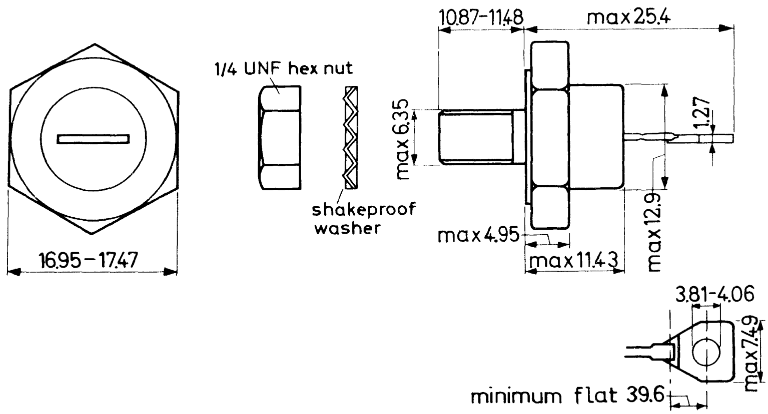
VOLTAGE REGULATOR DIODES

Diffused silicon diodes in DO-5 envelope for use in power stabilisation and transient suppression circuits.
The series consists of 22 types with nominal zener voltages ranging from 10 V to 75 V with a tolerance of ± 5%. Both normal polarity types (stud cathode) and reverse polarity types (stud anode) are available. [1])

QUICK REFERENCE DATA				
Peak zener current	I_{ZM}	max.	100	A
Total power dissipation up to T_{mb} = 65 °C	P_{tot}	max.	75	W
Non repetitive reverse power T_{mb} = 65 °C; t = 100 μs	P_{ZS}	max.	4.4	kW
Junction temperature	T_j	max.	175	°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.47	°C/W

MECHANICAL DATA Dimensions in mm

DO-5



Torque on nut : max. 35 cm kg
min. 17.5 cm kg

Polarity of connections: BZY91 - C10 to C75 stud cathode
BZY91 - C10R to C75R stud anode

[1]) The part after the hyphen consists of one lettter indicating the nominal tolerance in % (C = 5%) and a number, indicating the nominal zener voltage in volts. Reverse polarity types are denoted by "R" at the end of the type number.

7Z3 0636

RATINGS (Limiting values) [1])

Currents

Peak zener current		I_{ZM}	max. 100	A
Average forward current (averaged over any 20 ms period)		I_{FAV}	max. 10	A
Peak forward current		I_{FM}	max. 30	A

Power dissipation

Total power dissipation up to T_{mb} = 65 °C

Non repetitive reverse power at T_{mb} = 65 °C; $\delta = 0$

	t = 100 μs	P_{ZS}	max. 4.4	kW
	t = 1 ms	P_{ZS}	max. 1.48	kW
	t = 10 ms	P_{ZS}	max. 500	W
	t = 100 ms	P_{ZS}	max. 170	W

Temperatures

Storage temperature	T_{stg}	-55 to 175	°C
Junction temperature	T_j	max. 175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 1.47	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	= 0.2	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0637

CHARACTERISTICS at T_{mb} = 25 °C

Forward voltage at I_F = 10 A

BZY91-..	Zener voltage V_Z at I_Z = 2 A [1]) nom.	Dynamic resistance r_z; I_Z = 2 A	Reverse voltage V_R at which $I_R \leqq$ 1 mA
C10(R)	10 9.4 to 10.6 V	< 0.4 Ω	6.8 V
C11(R)	11 10.4 to 11.6 V	< 0.4 Ω	7.5 V
C12(R)	12 11.4 to 12.6 V	< 0.5 Ω	8.2 V
C13(R)	13 12.4 to 14.1 V	< 0.5 Ω	9.1 V
C15(R)	15 13.9 to 15.6 V	< 0.6 Ω	10 V
C16(R)	16 15.4 to 17.1 V	< 0.6 Ω	11 V
C18(R)	18 16.9 to 19.1 V	< 0.7 Ω	12 V

BZY91-..	Zener voltage V_Z at I_Z = 1 A [1]) nom.	Dynamic resistance r_z; I_Z = 1 A	Reverse voltage V_R at which $I_R \leqq$ 1 mA
C20(R)	20 18.9 to 21.2 V	< 0.8 Ω	13 V
C22(R)	22 20.8 to 23.3 V	< 0.8 Ω	15 V
C24(R)	24 22.7 to 25.9 V	< 0.9 Ω	16 V
C27(R)	27 25.1 to 28.9 V	< 1.0 Ω	18 V
C30(R)	30 28 to 32 V	< 1.1 Ω	20 V
C33(R)	33 31 to 35 V	< 1.2 Ω	22 V
C36(R)	36 34 to 38 V	< 1.3 Ω	24 V

BZY91-..	Zener voltage V_Z at I_Z = 0.5 A [1]) nom.	Dynamic resistance r_z; I_Z = 0.5 A	Reverse voltage V_R at which $I_R \leqq$ 1 mA
C39(R)	39 37 to 41 V	< 1.4 Ω	27 V
C43(R)	43 40 to 45 V	< 1.5 Ω	30 V
C47(R)	47 44 to 50 V	< 1.7 Ω	33 V
C51(R)	51 48 to 54 V	< 1.8 Ω	36 V
C56(R)	56 53 to 60 V	< 2.0 Ω	39 V
C62(R)	62 58 to 66 V	< 2.2 Ω	43 V
C68(R)	68 64 to 72 V	< 2.4 Ω	47 V
C75(R)	75 71 to 79 V	< 2.6 Ω	51 V

[1]) The zener voltage is measured by a pulse method with $t_p \leqq 100\,\mu s$, duty cycle $\delta \leqq 0.001$ and $T_j \approx 25$ °C.

7Z3 0638

OPERATING NOTES

1. Dissipation and heatsink considerations.

a. Steady-state conditions.

The maximum allowable steady-state dissipation P_s is given by the relationship

$$P_{s\,max.} = \frac{T_{j\,max.} - T_{amb}}{R_{th\,j\text{-}a}}$$

where $T_{j\,max.}$ is the maximum permissible operating junction temperature,

T_{amb} is the ambient temperature,

$R_{th\,j\text{-}a}$ is the total thermal resistance from junction to ambient $R_{th\,j\text{-}a} = R_{th\,j\text{-}mb} + R_{th\,mb\text{-}h} + R_{th\,h\text{-}a}$,

$R_{th\,mb\text{-}h}$ is the thermal resistance from mounting base to heatsink, that is 0.2 $^oC/W$,

$R_{th\,h\text{-}a}$ is the thermal resistance of the heatsink (see page J).

b. Pulse conditions (see fig. next page).

The maximum allowable pulse power P_p is given by the formula

$$P_p = \frac{(T_{j\,max.} - T_{amb}) - (P_s \cdot R_{th\,j\text{-}a})}{R_{th\,t} + \delta \cdot R_{th\,mb\text{-}a}}$$

where P_s is the steady-state dissipation, excluding that in the pulses,

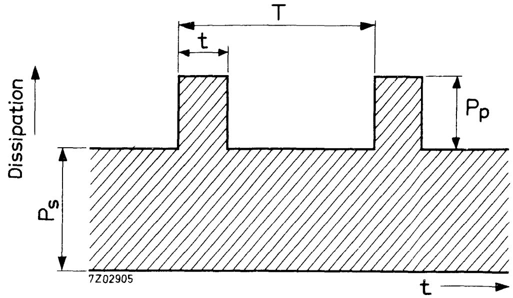
$R_{th\,t}$ is the effective transient thermal resistance of the device from junction to mounting base and is a function of the pulse duration t and duty cycle δ (see page H),

δ is the duty cycle and is equal to the pulse duration t divided by the period duration T,

$R_{th\,mb\text{-}a}$ is the total thermal resistance from mounting base to ambient. $R_{th\,mb\text{-}a} = R_{th\,mb\text{-}h} + R_{th\,h\text{-}a}$.

7Z3 0639

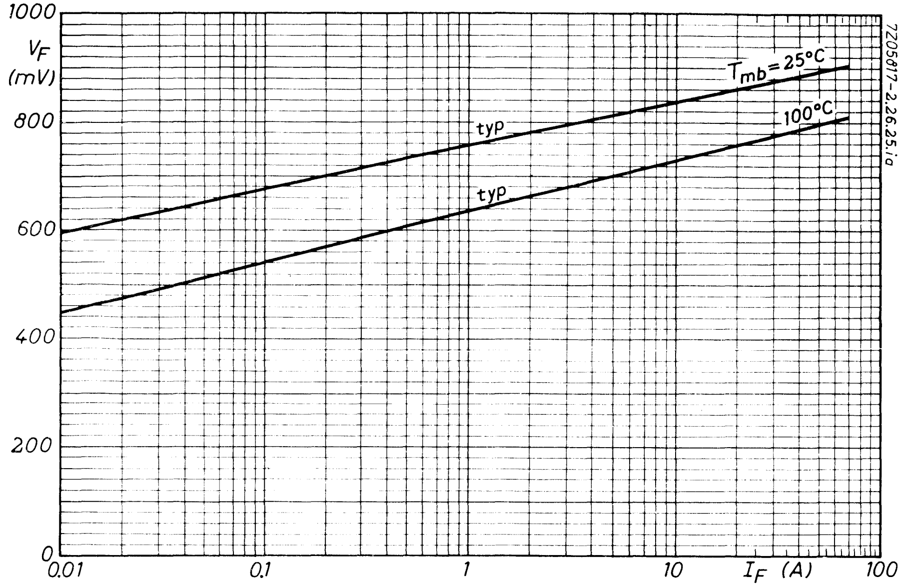
OPERATING NOTES (continued)

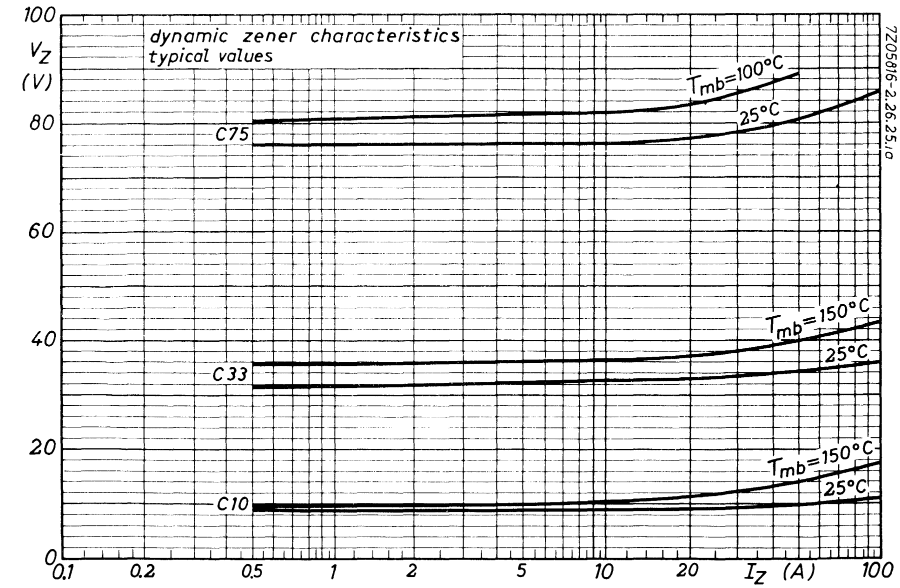


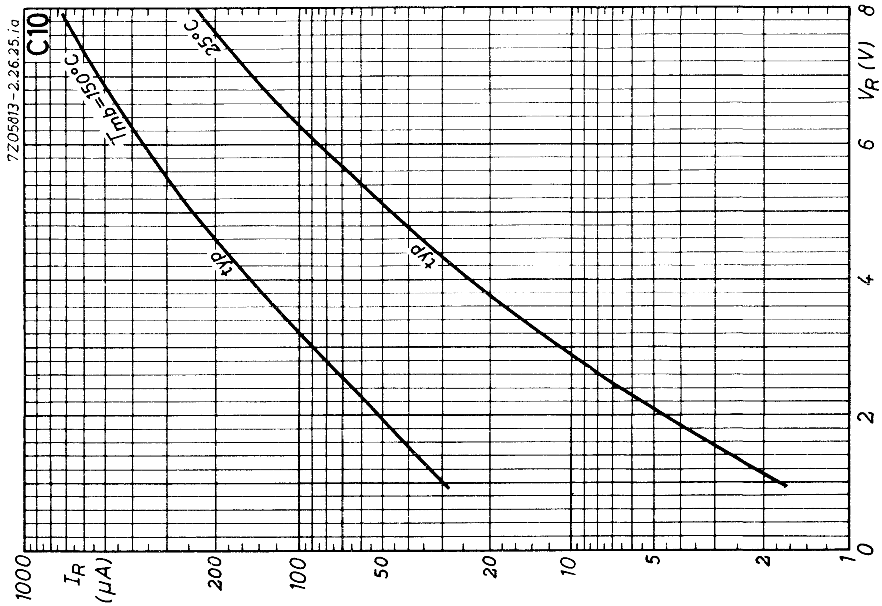
The steady-state power P_s when biased in the zener direction at a given zener current can be found from page K, lower figure. With the additional pulsed power dissipation P_p calculated from the expression on page 4, the total peak zener power dissipation $P_{tot} = P_s + P_p$. From page K, upper figure the maximum allowable peak zener current at P_{tot} can now be read. This peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilisation time of the diode t_{stab}, the maximum allowable power P_{tot} is equal to the maximum steady-state power $P_{s\ max}$. The temperature stabilisation time for the BZY91 series is 2 s (see page H).

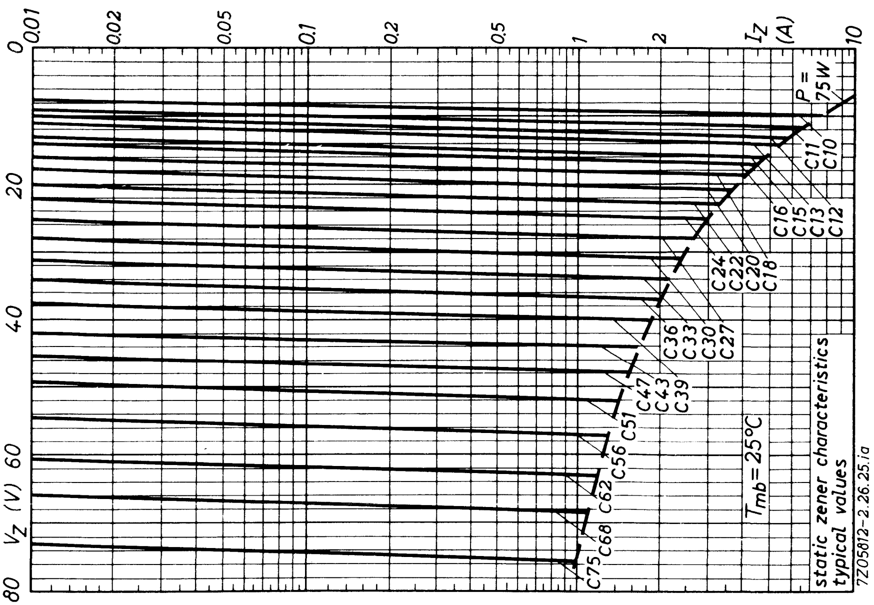
2. Care must be taken to ensure that the connecting lug is not bent or twisted.

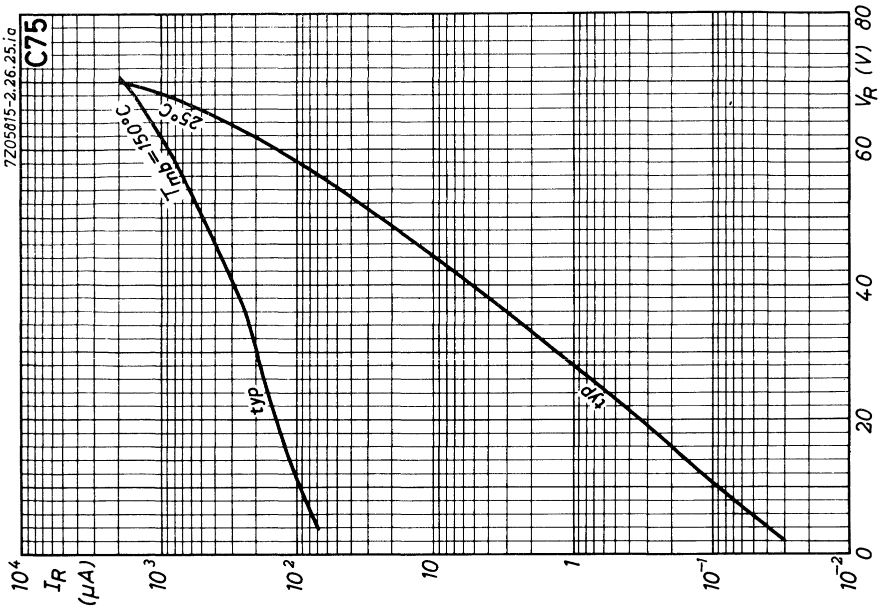
7Z3 0640

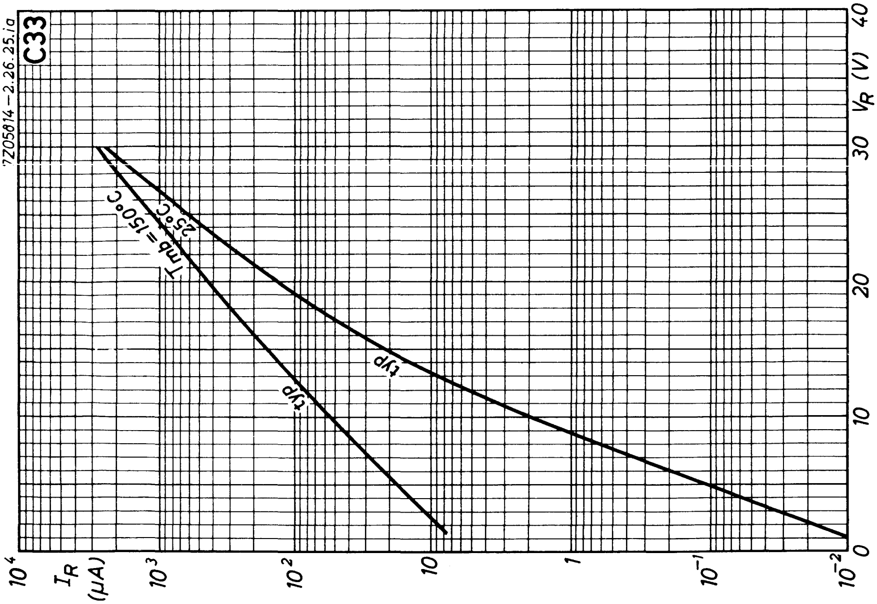

1000
V_F
(mV)
800
600
400
200
0
0.01
0.1
1
10
100
I_F (A)
T_{mb} = 25°C
100°C
typ
typ
7Z05817-2.26.25.ia

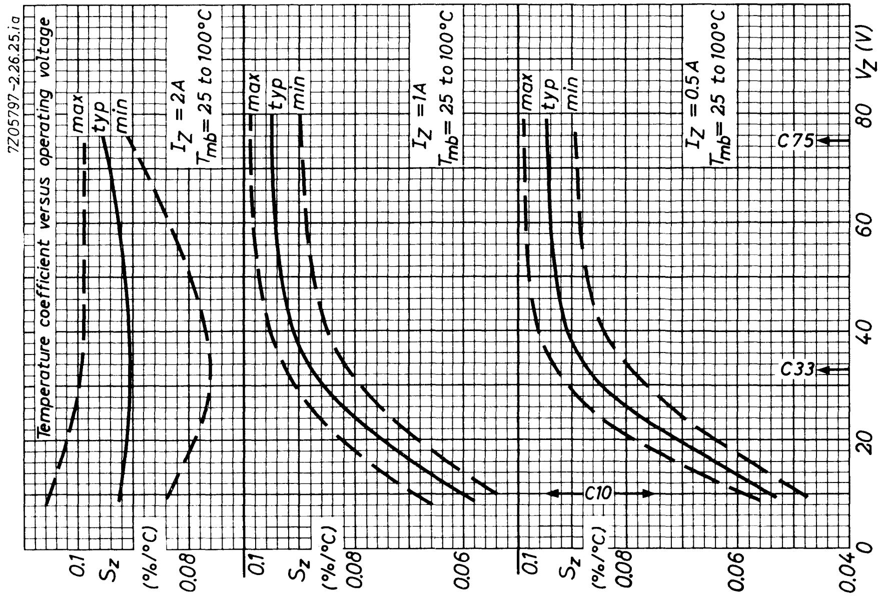

dynamic zener characteristics
typical values
100
V_Z
(V)
80
60
40
20
0
0.1
0.2
0.5
1
2
5
10
20
100
I_Z (A)
C75
C33
C10
T_{mb}=100°C
25°C
T_{mb}=150°C
25°C
T_{mb}=150°C
25°C
7Z05816-2.26.25.ia

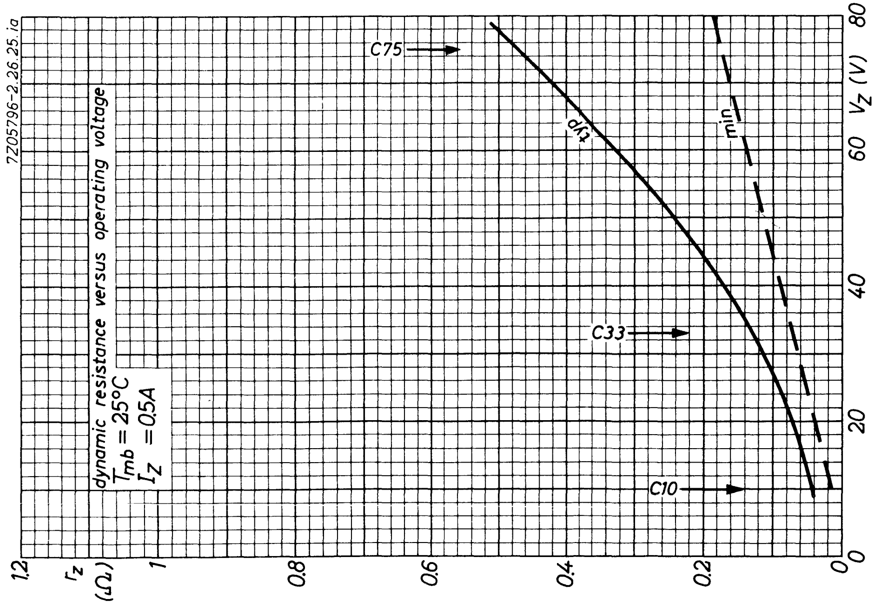

7Z05813-2.26.25.ia
C10
T_{mb}=150°C
25°C
typ
typ
I_R (μA)
1000
200
100
50
20
10
5
2
1
0
2
4
6
8
V_R (V)

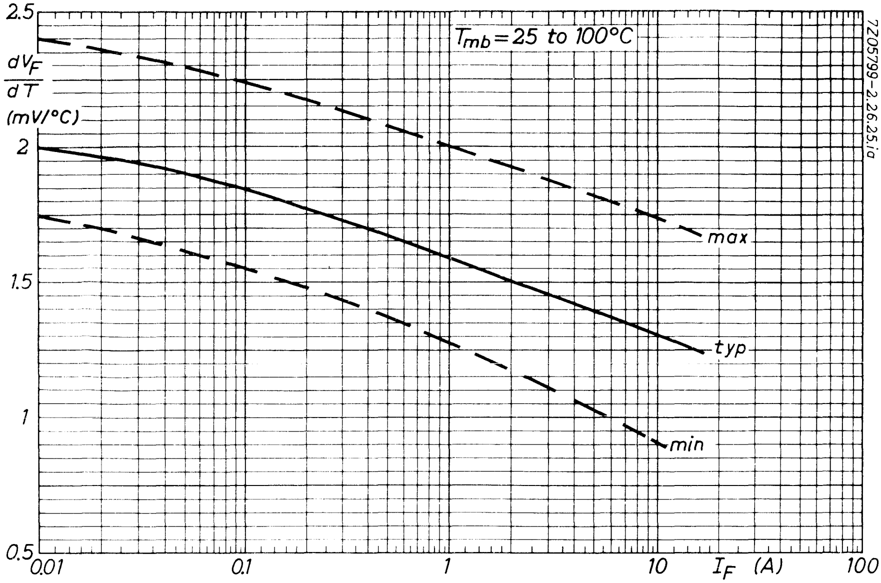

0.01
0.02
0.05
0.1
0.2
0.5
1
2
10
I_Z (A)
0
20
40
60
80
V_Z (V)
P = 75W
C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
T_{mb}=25°C
static zener characteristics
typical values
7Z05812-2.26.25.ia

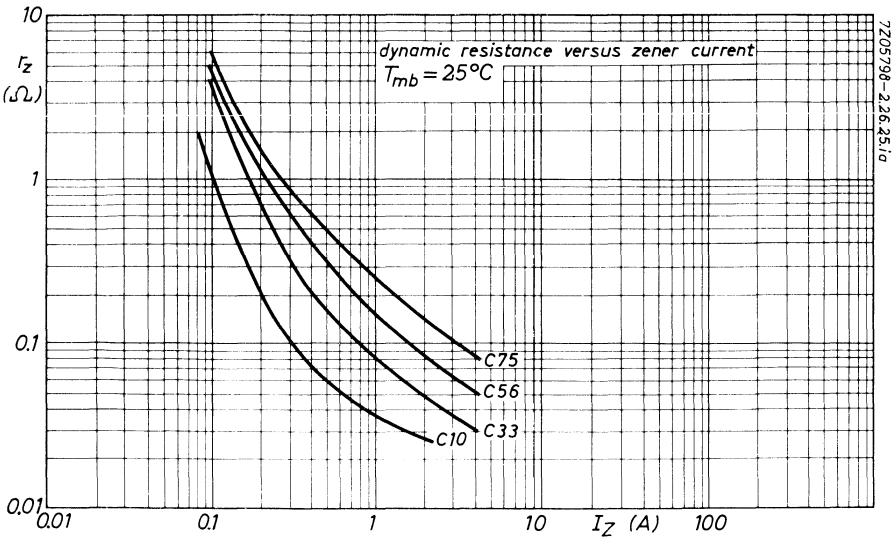

7Z05815-2.26.25.ia
C75
V_R (V)
80
60
40
20
0
I_R (μA)
10^4
10^3
10^2
10
1
10^{-1}
10^{-2}
T_{mb} = 150 °C
25 °C
typ
typ

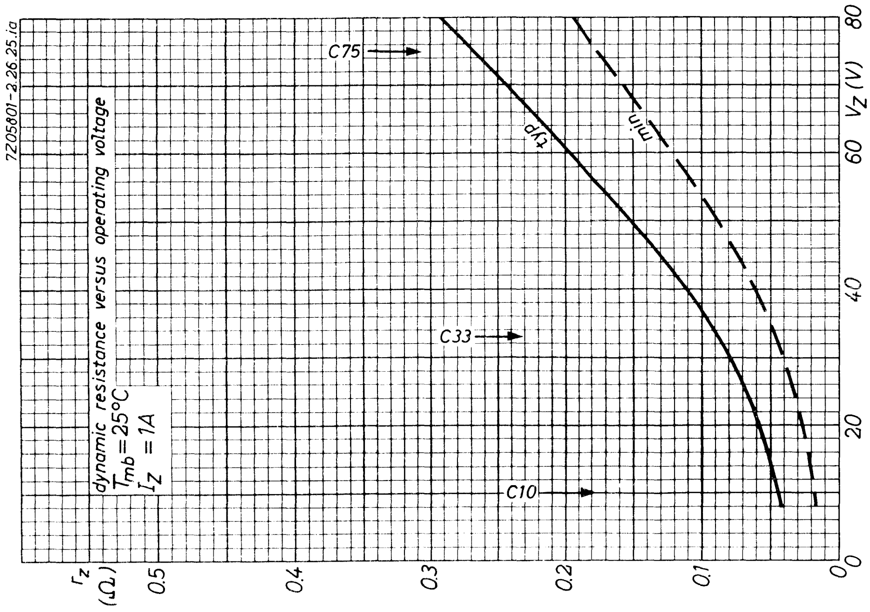

7Z05814-2.26.25.ia
C33
V_R (V)
40
30
20
10
0
I_R (μA)
10^4
10^3
10^2
10
1
10^{-1}
10^{-2}
T_{mb} = 150 °C
25 °C
typ
typ

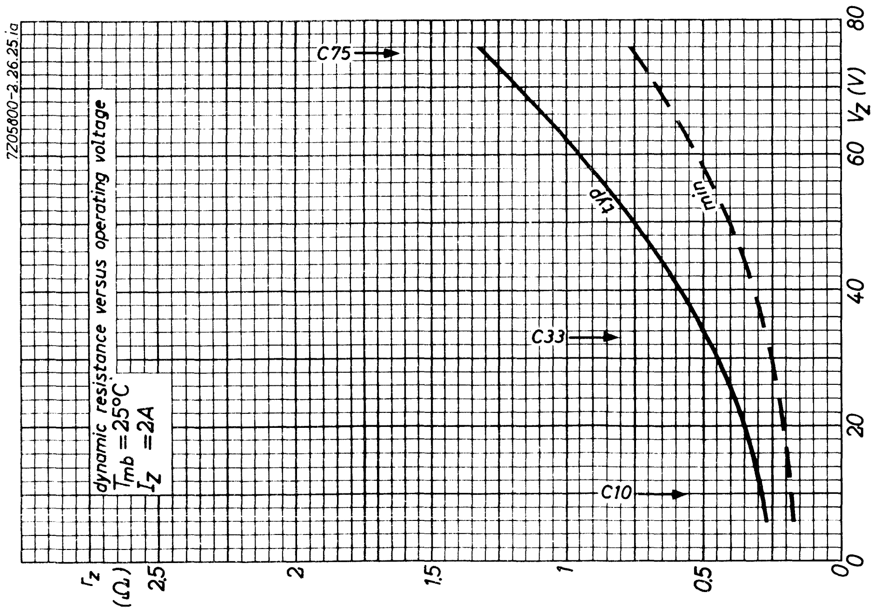

7Z05797-2.26.25.ia
Temperature coefficient versus operating voltage
$I_Z = 2A$
$T_{mb} = 25$ to $100°C$
$I_Z = 1A$
$T_{mb} = 25$ to $100°C$
$I_Z = 0.5A$
$T_{mb} = 25$ to $100°C$
max
typ
min
C75
C33
C10
S_z
(%/°C)
0.1
0.08
0.06
0.04
0
20
40
60
80
V_Z (V)

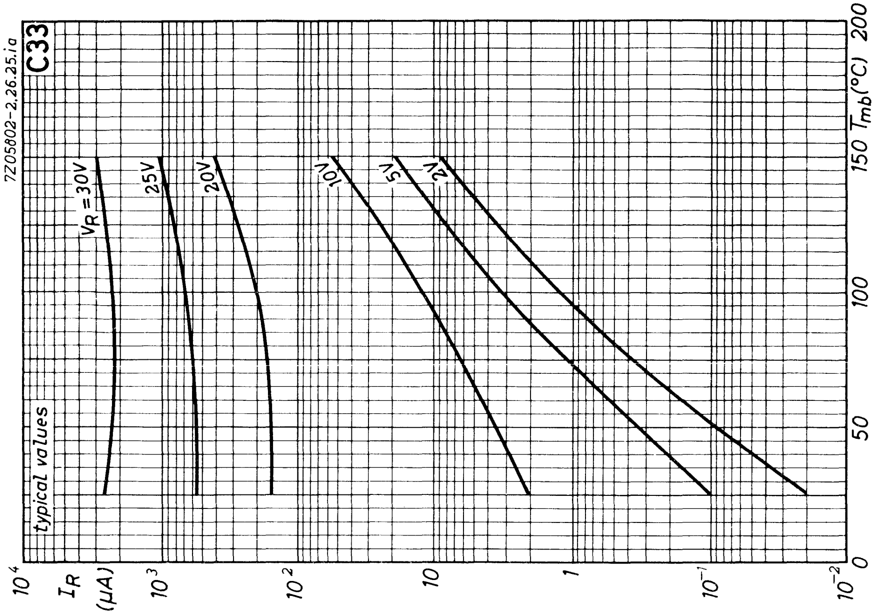

7Z05796-2.26.25.ia
dynamic resistance versus operating voltage
$T_{mb} = 25°C$
$I_Z = 0.5A$
typ
min
C75
C33
C10
r_z
(Ω)
1.2
1
0.8
0.6
0.4
0.2
0
20
40
60
80
V_Z (V)

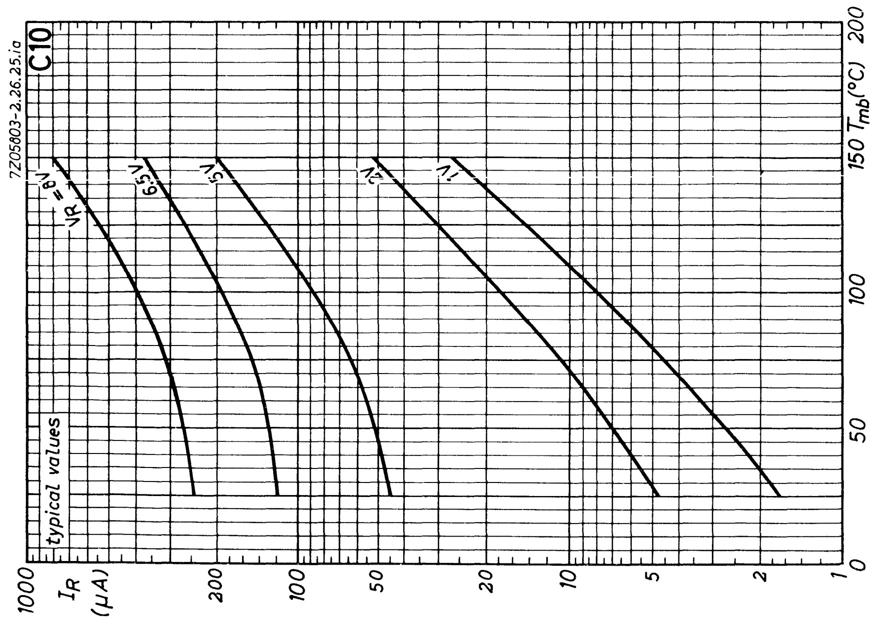

2.5
dVF/dT
(mV/°C)
2
1.5
1
0.5
0.01
0.1
1
10
IF (A)
100
Tmb = 25 to 100°C
max
typ
min
7Z05799-2.26.25.ia

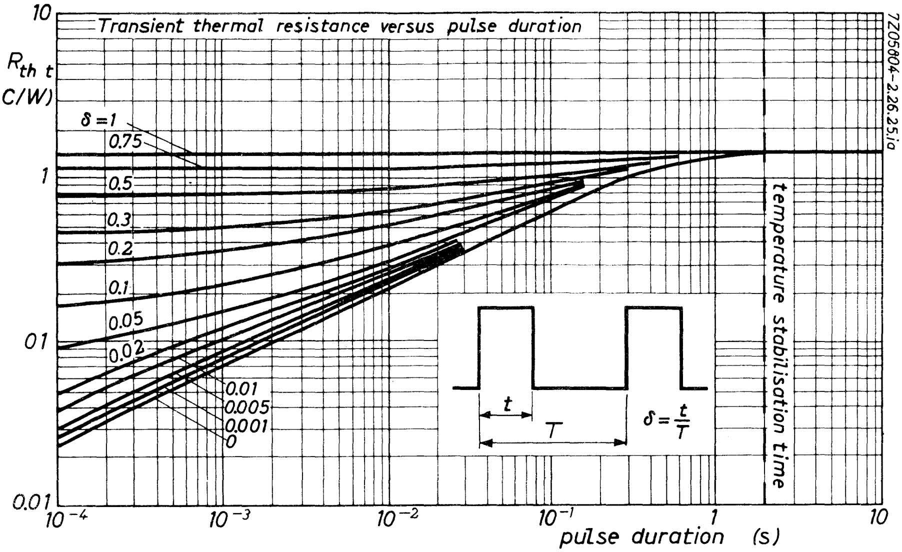

10
rz
(Ω)
1
0.1
0.01
0.01
0.1
1
10
IZ (A)
100
dynamic resistance versus zener current
Tmb = 25°C
C75
C56
C33
C10
7Z05798-2.26.25.ia

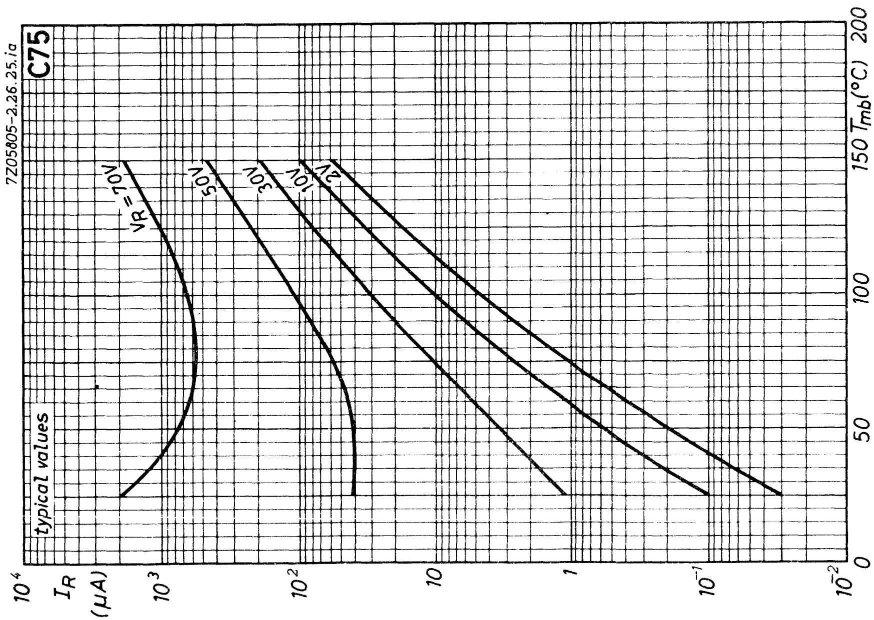

7Z05801-2.26.25.ia
dynamic resistance versus operating voltage
$T_{mb} = 25^{\circ}C$
$I_Z = 1A$
C75
C33
C10
typ
min
r_Z (Ω)
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
V_Z (V)

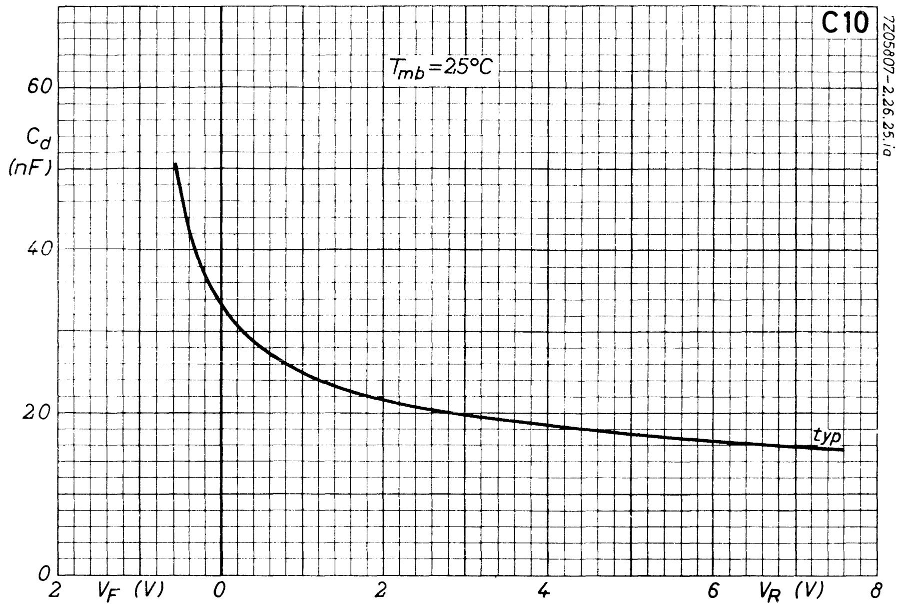

7Z05800-2.26.25.ia
dynamic resistance versus operating voltage
$T_{mb} = 25^{\circ}C$
$I_Z = 2A$
C75
C33
C10
typ
min
r_Z (Ω)
2.5
2
1.5
1
0.5
0
0
20
40
60
80
V_Z (V)

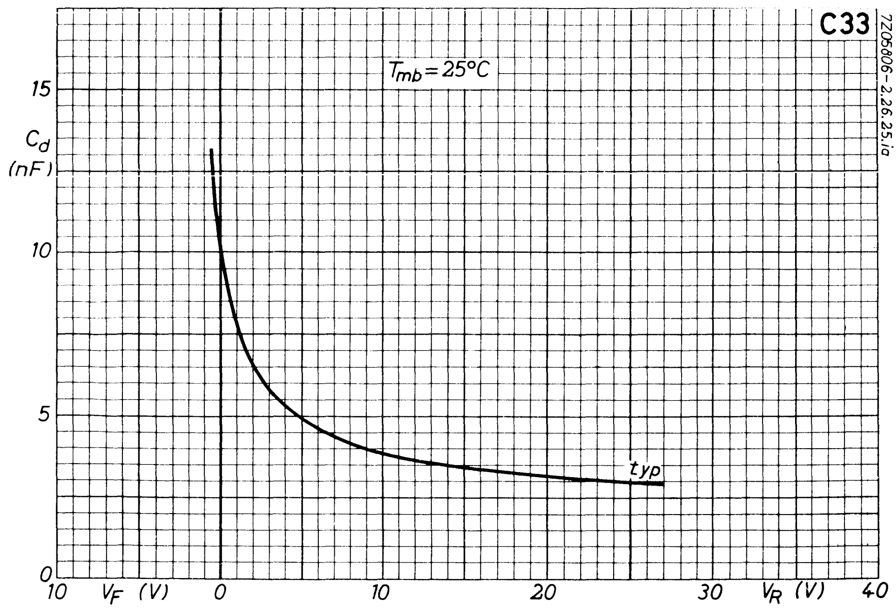

7Z05802-2.26.25.ia
C33
typical values
V_R = 30V
25V
20V
10V
5V
2V
I_R (μA)
T_{mb} (°C)

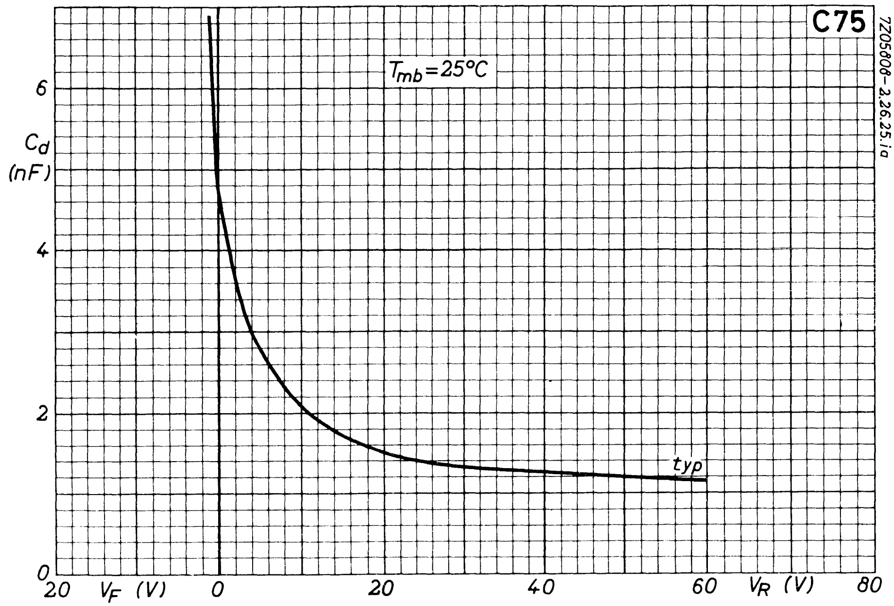

7Z05803-2.26.25.ia
C10
typical values
V_R = 8V
6.5V
5V
2V
1V
I_R (μA)
T_{mb} (°C)

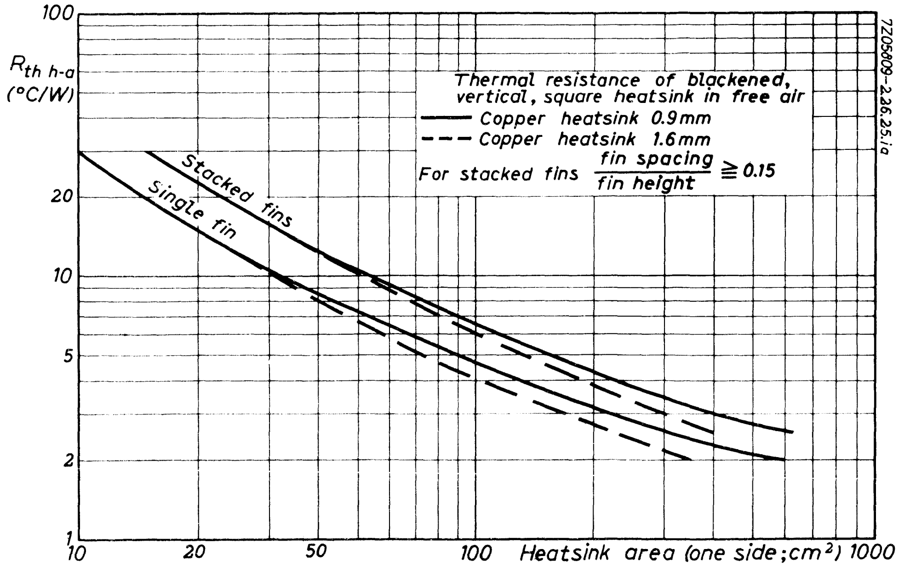

Transient thermal resistance versus pulse duration
$R_{th\ t}$ (°C/W)
δ = 1
0.75
0.5
0.3
0.2
0.1
0.05
0.02
0.01
0.005
0.001
0
t
T
δ = t/T
temperature stabilisation time
pulse duration (s)
7Z05804-2.26.25.ia

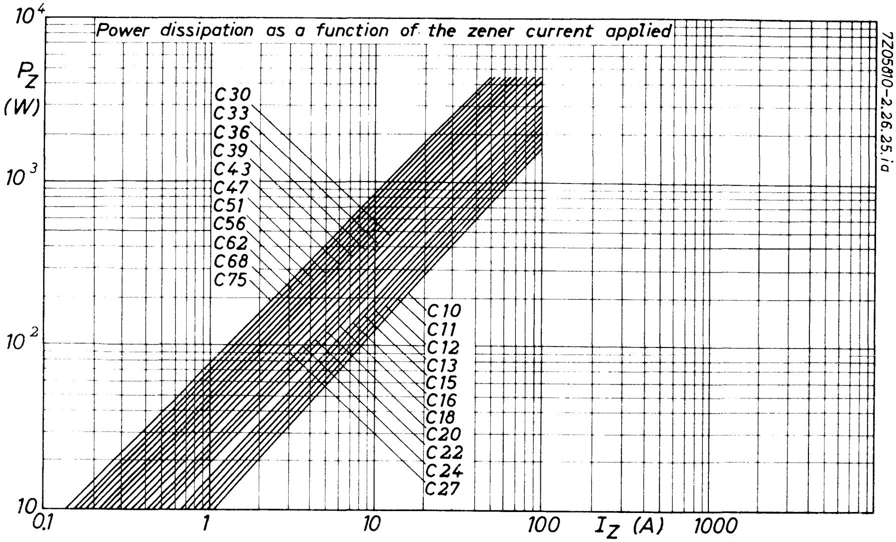

C75
7Z05805-2.26.25.ia
typical values
VR = 70V
50V
30V
10V
2V
I_R (μA)
T_{mb} (°C)

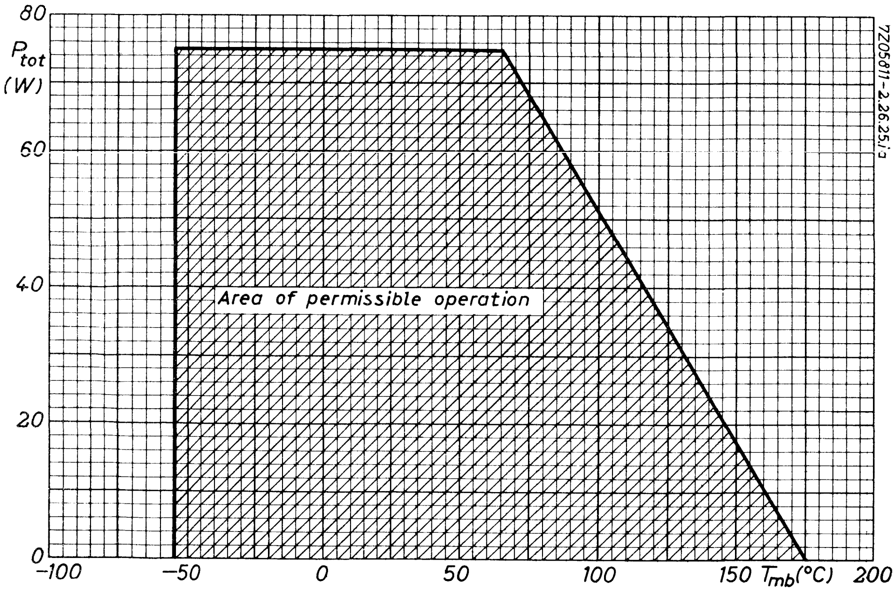

C10
7Z05807-2.26.25.ia
T_{mb} = 25°C
60
C_d
(nF)
40
20
0
typ
2
V_F (V)
0
2
4
6
V_R (V)
8


C33
7Z05806-2.26.25.ia
T_{mb} = 25°C
15
C_d
(nF)
10
5
0
typ
10
V_F (V)
0
10
20
30
V_R (V)
40


C75
7Z05808-2.26.25.ia
T_{mb}=25°C
6
C_d
(nF)
4
2
0
20
V_F (V)
0
20
40
60
V_R (V)
80
typ


7Z05809-2.26.25.ia
100
$R_{th\ h-a}$
(°C/W)
20
10
5
2
1
10
20
50
100
Heatsink area (one side;cm²)
1000
Thermal resistance of blackened, vertical, square heatsink in free air
Copper heatsink 0.9mm
Copper heatsink 1.6mm
For stacked fins fin spacing / fin height ≧ 0.15
Stacked fins
Single fin

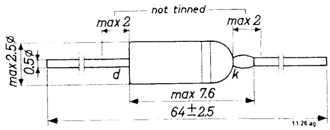

Power dissipation as a function of the zener current applied
P_Z (W)
10^4
10^3
10^2
10
C30
C33
C36
C39
C43
C47
C51
C56
C62
C68
C75
C10
C11
C12
C13
C15
C16
C18
C20
C22
C24
C27
0.1
1
10
100
I_Z (A)
1000
7Z05810-2.26.25.ia


80
P_{tot} (W)
60
40
20
0
Area of permissible operation
−100
−50
0
50
100
150
T_{mb}(°C)
200
7Z05811-2.26.25.ia

SILICON ALLOY JUNCTION DIODE in double-ended all-glass construction for use as low current VOLTAGE STABILIZER or as a VOLTAGE REFERENCE

Dimensions in mm

The white band indicates the position of the cathode



LIMITING VALUES (Absolute maximum values)

Forward current	I_D = max.	50 mA
Reverse current	$-I_D$ = max.	25 mA
Total dissipation (see also page C)	P_{tot} = max.	$\frac{150-T_{amb}}{0.45}$ mW
Junction temperature	T_j = max.	150 °C
Storage temperature	T_S =	-55 °C to +150 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air — K = max. 0.45 °C/mW

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C	
Forward current	Forward voltage
I_D	V_D
0.1 mA	610 mV
10 mA	760 mV

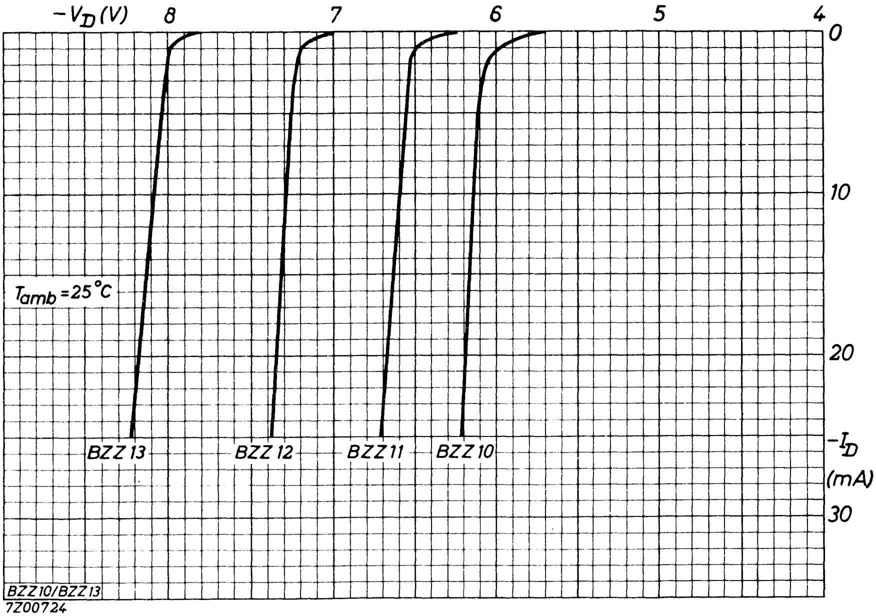
T_{amb} = 60 °C	
Reverse voltage	Reverse current
$-V_D$	$-I_D$
1.0 V	0.004 µA

7Z2 1081

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{amb} = 25 °C, unless otherwise specified

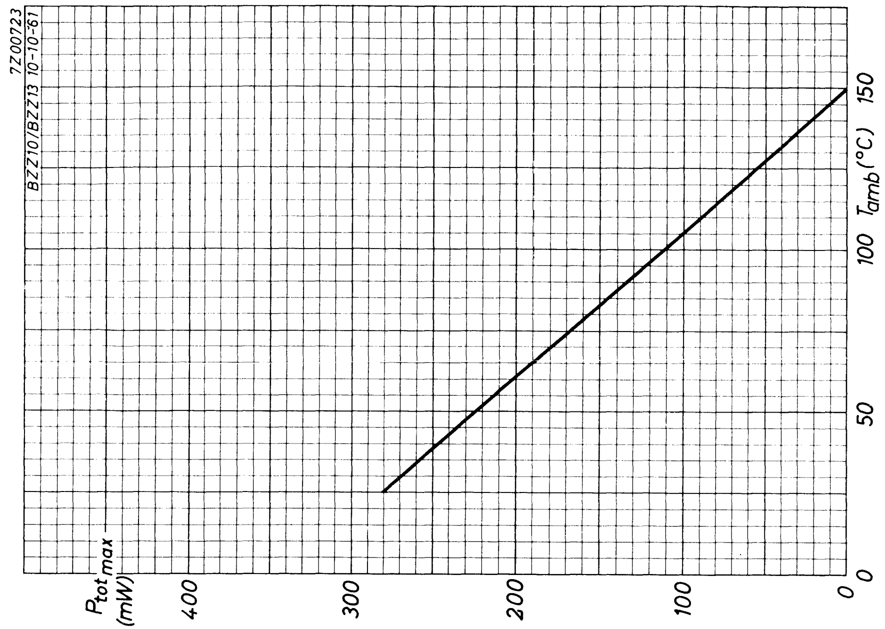
Type No.	Zener current	Zener voltage		Temperature coefficient	Dynamic impedance
	$-I_D$	$-V_D$		$\Delta(-V_D)/\Delta T$	r_D
		average	range values		
BZZ10	1 mA	6.0 V	5.3 to 6.6 V	-1.0 mV/°C	280 Ω
	5 mA	6.15 V		+1.0 mV/°C	27 Ω
	20 mA	6.3 V		+2.0 mV/°C	3.0 Ω
	1 to 15 mA		5.0 to 7.0 V [1]		
BZZ11	1 mA	6.5 V	5.8 to 7.2 V	+1.5 mV/°C	140 Ω
	5 mA	6.55 V		+2.2 mV/°C	6.0 Ω
	20 mA	6.75 V		+3.0 mV/°C	2.0 Ω
	1 to 15 mA		5.5 to 7.5 V [1]		
BZZ12	1 mA	7.2 V	6.4 to 7.9 V	+3.3 mV/°C	17 Ω
	5 mA	7.25 V		+3.7 mV/°C	3.0 Ω
	20 mA	7.35 V		+4.1 mV/°C	1.5 Ω
	1 to 15 mA		6.2 to 8.2 V [1]		
BZZ13	1 mA	8.0 V	7.1 to 8.7 V	+4.6 mV/°C	6.0 Ω
	5 mA	8.05 V		+4.9 mV/°C	3.0 Ω
	20 mA	8.2 V		+5.2 mV/°C	2.0 Ω
	1 to 15 mA		7.0 to 9.0 V [1]		

[1]) In the temperature range T_{amb} = 10 to 60 °C

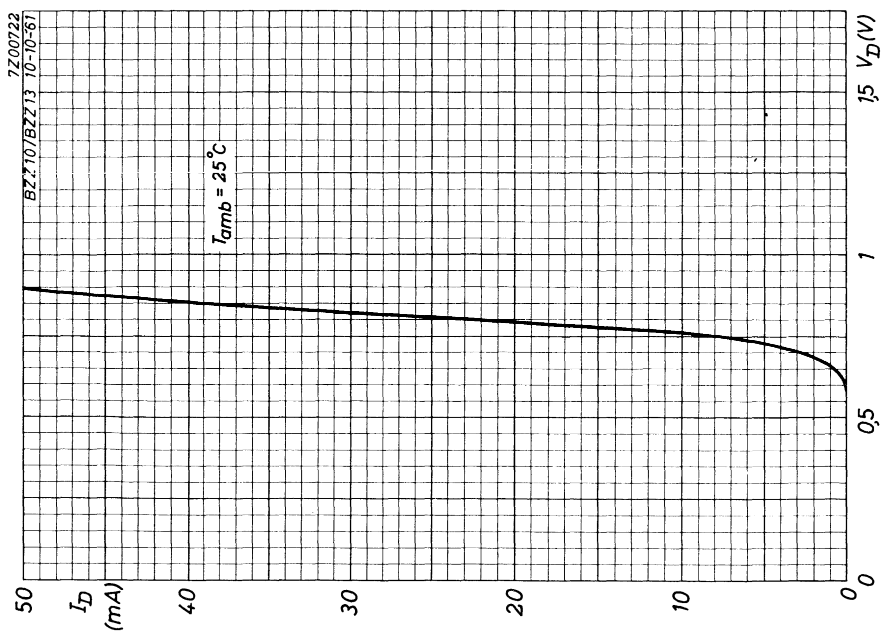


$-V_D$ (V)
8
7
6
5
4
0
10
20
30
$-I_D$ (mA)
T_{amb} = 25 °C
BZZ 13
BZZ 12
BZZ 11
BZZ 10
BZZ10/BZZ13
7Z00724

A


7Z00723
BZZ10/BZZ13 10-10-61
$P_{tot\,max}$ (mW)
400
300
200
100
0
0
50
100
150
T_{amb} (°C)

C


7Z00722
BZZ10/BZZ13 10-10-61
T_{amb} = 25°C
I_D (mA)
50
40
30
20
10
0
0
0,5
1
1,5
V_D (V)

B

7Z2 1747

CHARACTERISTICS at a case temperature of 25 °C

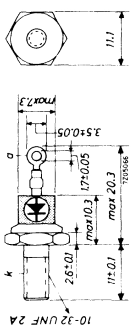
		BZZ14	BZZ15	BZZ16	BZZ17	BZZ18	BZZ19	BZZ20
Forward voltage (V_D) at I_D = 200 mA	min.	0.8 V	0.8 V	0.8 V	0.8 V	0.8 V	0.8 V	0.8 V
	max.	1.05 V	1.05 V	1.05 V	1.05 V	1.05 V	1.05 V	1.05 V
Zener voltage ($-V_D$) at $-I_D$ = 20 mA	min.	5.3 V	5.8 V	6.4 V	7.1 V	7.7 V	8.6 V	9.5 V
	typ.	5.6 V	6.2 V	6.8 V	7.5 V	8.2 V	9.1 V	10.0 V
	max.	6.0 V	6.6 V	7.2 V	7.9 V	8.7 V	9.6 V	10.6 V
Dynamic resistance (r_D) at $-I_D$ = 20 mA	max.	13 Ω	6 Ω	5 Ω	7.5 Ω	10 Ω	10 Ω	11 Ω
Leakage current ($-I_D$) at $-V_D$ = 2 V	typ.	0.15 µA	0.125 µA					
	max.	0.5 µA	0.5 µA					
Leakage current ($-I_D$) at $-V_D$ = 3 V	typ.			0.04 µA	0.04 µA			
	max.			0.5 µA	0.5 µA			
Leakage current ($-I_D$) at $-V_D$ = 5 V	typ.					0.04 µA	0.04 µA	
	max.					0.4 µA	0.4 µA	0.4 µA

2.

1.

SILICON ALLOY JUNCTION DIODE with 5 % tolerance for use as medium current VOLTAGE STABILIZER or as a VOLTAGE REFERENCE

Dimensions in mm



The diode is supplied with nut, metal washer and metal locking washer

LIMITING VALUES (Absolute max. values)

Forward current	I_D	= max.	0.5 A
Reverse current	$-I_D$	= max.	0.5 A
Surge reverse current (max. duration 100 µsec)	$-I_{Dsurge}$ (t	= max. = max.	10 A [1] 100 µsec)
Dissipation (See also pages I and J)	P	= max.	$\frac{T_{jmax}-T_{amb}}{K}$
Storage temperature	T_s	=	-55 °C to +150 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air	K_{j-amb}	= max.	70 °C/W
Thermal resistance from junction to case	K_{j-c}	= max.	10 °C/W

[1]) For surge currents of longer duration see page H

7Z2 1746

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Case temperature = 25 °C

			BZZ14	BZZ15	BZZ16	BZZ17	
Forward voltage (V_D)	I_D = 0-0.5 A	min. typ. max.	See page A				
Zener voltage ($-V_D$)	$-I_D$ = 50 mA	min.	5.4	5.8	6.4	7.0	V
		typ.	5.7	6.25	6.8	7.5	V
		max.	6.2	6.8	7.2	8.0	V
	$-I_D$ = 100 mA	min.	5.5	5.8	6.4	7.2	V
		typ.	5.72	6.3	6.9	7.6	V
		max.	6.3	6.8	7.4	8.2	V
	$-I_D$ = 200 mA	min.	5.5	5.9	6.6	7.2	V
		typ.	5.85	6.35	6.95	7.7	V
		max.	6.4	7.0	7.4	8.4	V
	$-I_D$ = 500 mA	min.	5.5	6.0	6.6	7.1	V
		typ.	5.97	6.6	7.12	7.82	V
		max.	6.5	7.4	7.9	8.5	V
Dynamic resistance (r_D)	$-I_D$ = 100 mA	typ.	See page G				
		max.	4	2.5	2.5	3.5	Ω
	$-I_D$ = 500 mA	typ.	See page G				
		max.	1.0	2.0	2.5	3.0	Ω
Temperature coefficient $\frac{\Delta(-V_D)}{\Delta T}$	$-I_D$ = 20 mA	typ.	See page F				
		min.	-0.4	1.0	2.0	3.0	mV/°C
		max.	2.5	3.5	4.0	4.5	mV/°C
	$-I_D$ = 100 mA	typ.	See page F				
		min.	0.5	2.0	2.5	3.0	mV/°C
		max.	3.0	4.0	4.0	4.0	mV/°C
	$-I_D$ = 500 mA	typ.	See page F				
		min.	0.0	1.5	2.5	3.0	mV/°C
		max.	3.0	4.0	4.0	7.0	mV/°C
Capacitance (c_{dk})	$-V_D$ = 2 V	typ.	575	475	375	350	pF

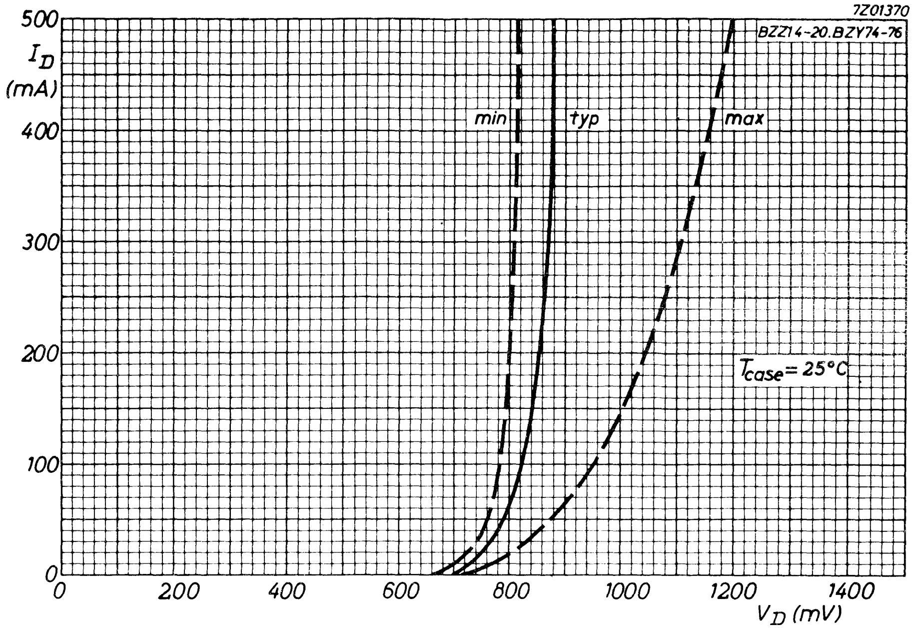
7Z2 1748 3.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued)

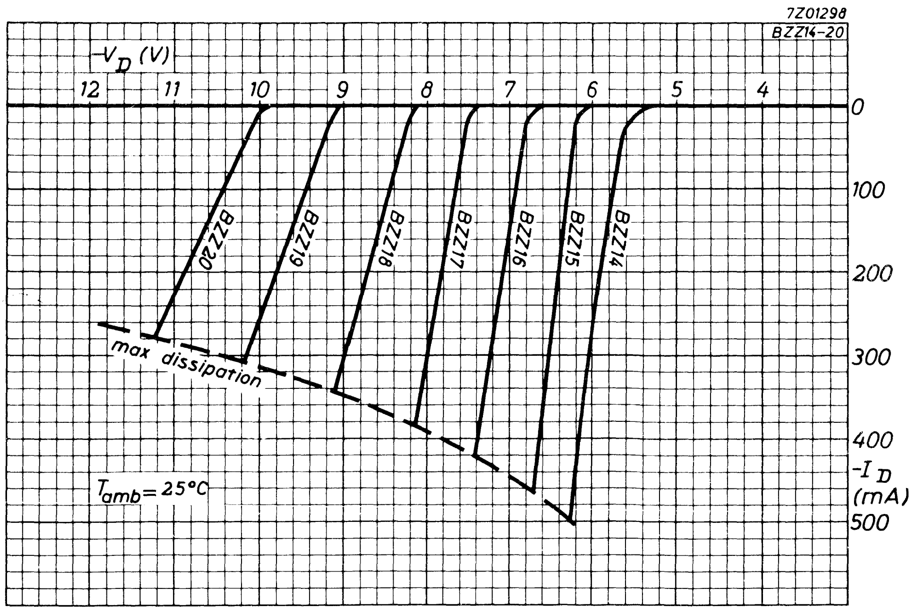
Case temperature = 25 °C

			BZZ18	BZZ19	BZZ20	
Forward voltage (V_D)	I_D = 0-0.5 A	min. typ. max.	See page A			
Zener voltage ($-V_D$)	$-I_D$ = 50 mA	min.	7.8	8.6	9.6	V
		typ.	8.25	9.2	10.2	V
		max.	8.8	9.8	10.7	V
	$-I_D$ = 100 mA	min.	7.8	8.8	9.6	V
		typ.	8.35	9.3	10.3	V
		max.	9.0	10.0	11.0	V
	$-I_D$ = 200 mA	min.	8.0	9.0	9.9	V
		typ.	8.45	9.45	10.5	V
		max.	9.4	10.5	11.3	V
	$-I_D$ = 500 mA	min.	8.0	8.8	10.0	V
		typ.	8.57	9.55	10.72	V
		max.	9.5	10.2	11.6	V
Dynamic resistance (r_D)	$-I_D$ = 100 mA	typ.	See page G			
		max.	5	5	5	Ω
	$-I_D$ = 500 mA	typ.	See page G			
		max.	3.0	3.0	3.0	Ω
Temperature coefficient $\frac{\Delta(-V_D)}{\Delta T}$	$-I_D$ = 20 mA	typ.	See page F			
		min.	4.0	5.5	6.0	mV/°C
		max.	6.0	6.5	8.0	mV/°C
	$-I_D$ = 100 mA	typ.	See page F			
		min.	3.0	4.0	3.0	mV/°C
		max.	6.1	7.0	11.0	mV/°C
	$-I_D$ = 500 mA	typ.	See page F			
		min.	3.5	4.5	3.0	mV/°C
		max.	6.8	7.5	11.0	mV/°C
Capacitance (c_{dk})	$-V_D$ = 2 V	typ.	300	250		pF

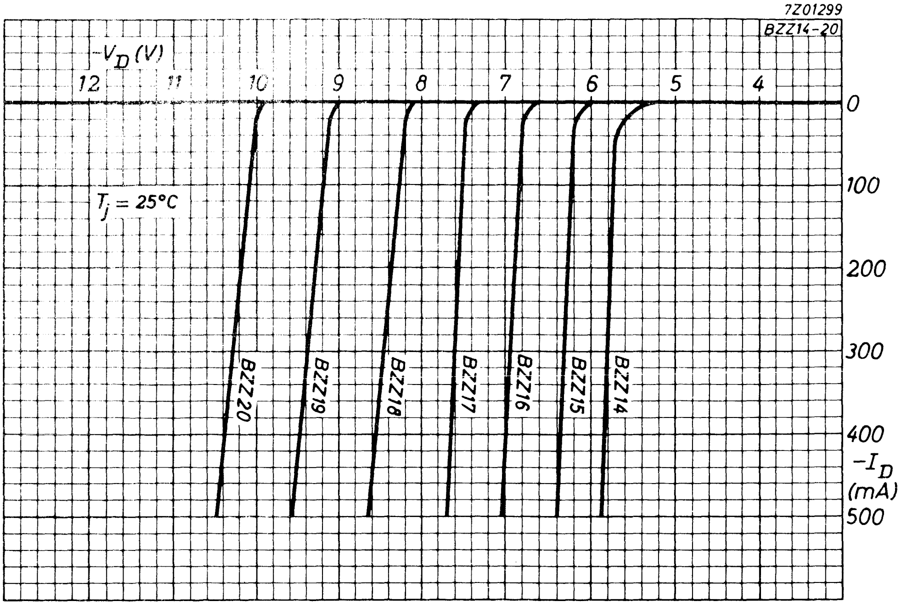
7Z2 1749 4.


7Z01370
BZZ14-20.BZY74-76
500
I_D
(mA)
400
300
200
100
0
min
typ
max
T_{case}= 25°C
0
200
400
600
800
1000
1200
1400
V_D (mV)

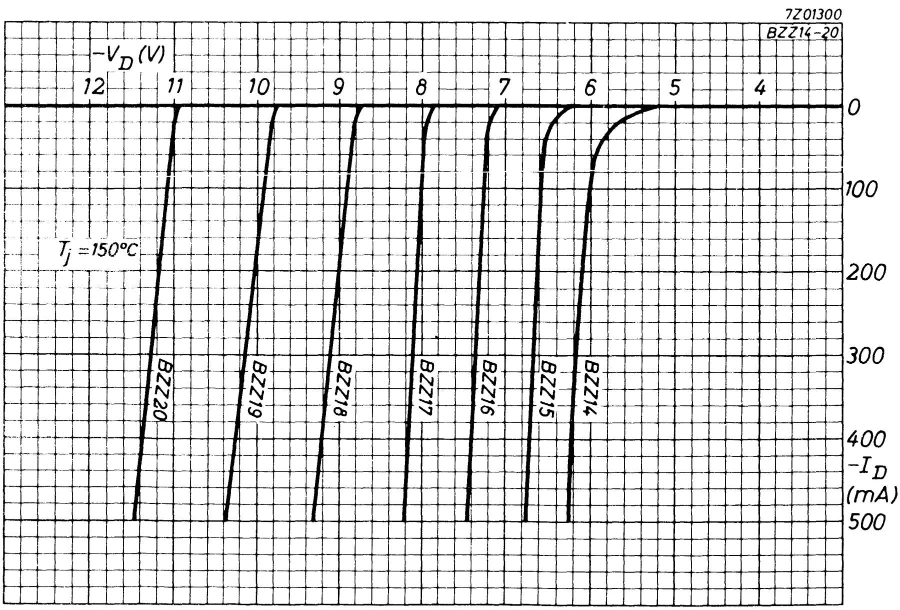
A


7Z01298
BZZ14-20
$-V_D$ (V)
12
11
10
9
8
7
6
5
4
0
100
200
300
400
$-I_D$
(mA)
500
BZZ20
BZZ19
BZZ18
BZZ17
BZZ16
BZZ15
BZZ14
max dissipation
T_{amb}= 25°C

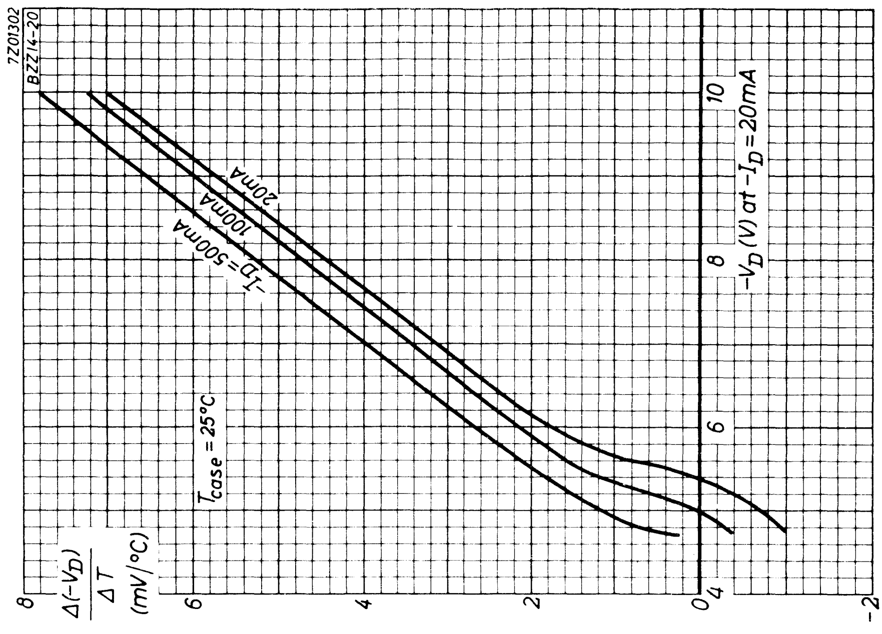
B


7Z01299
BZZ14-20
$-V_D$ (V)
12
11
10
9
8
7
6
5
4
0
100
200
300
400
500
$-I_D$ (mA)
$T_j = 25°C$
BZZ20
BZZ19
BZZ18
BZZ17
BZZ16
BZZ15
BZZ14

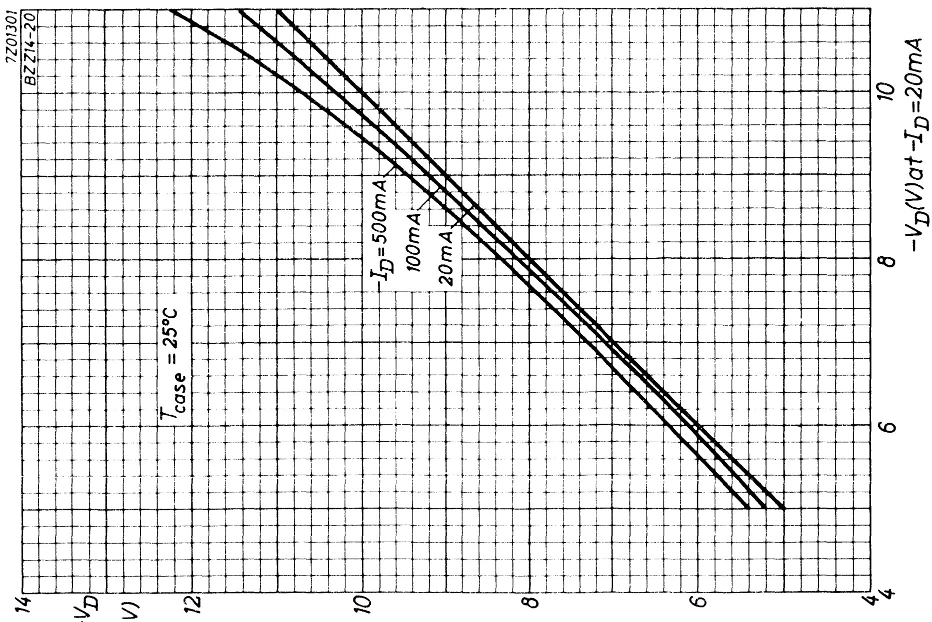
C


7Z01300
BZZ14-20
$-V_D$ (V)
12
11
10
9
8
7
6
5
4
0
100
200
300
400
500
$-I_D$ (mA)
$T_j = 150°C$
BZZ20
BZZ19
BZZ18
BZZ17
BZZ16
BZZ15
BZZ14

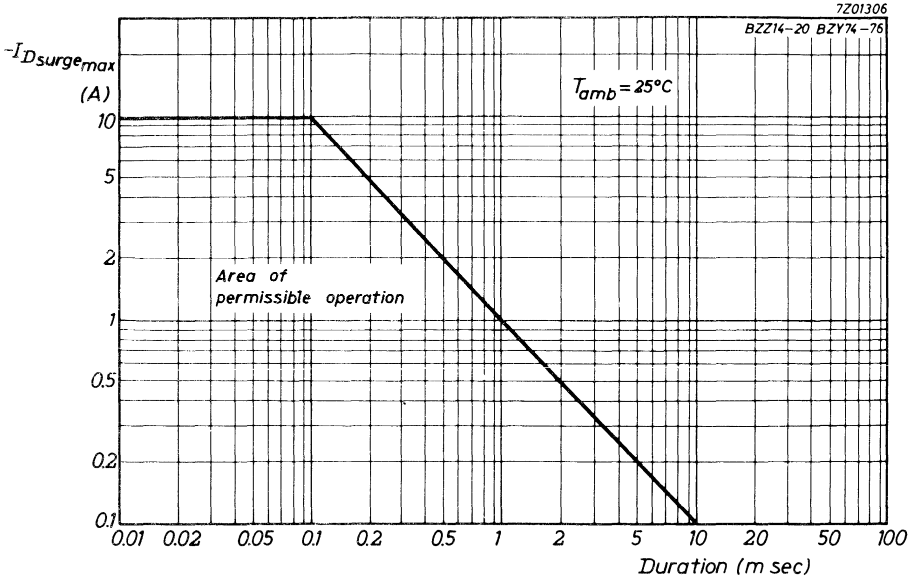
D


7Z01302
BZZ14-20
Δ(−V_D) / ΔT
(mV/°C)
8
6
4
2
0
−2
4
6
8
10
−V_D (V) at −I_D=20mA
T_case = 25°C
−I_D=500mA
100mA
20mA

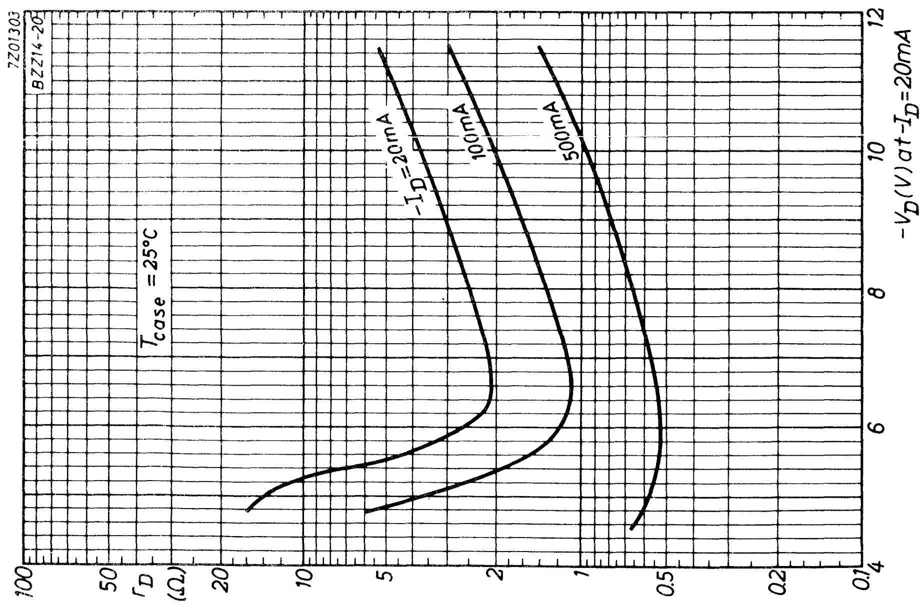
F


7Z01301
BZZ14-20
−V_D
(V)
14
12
10
8
6
4
4
6
8
10
−V_D(V)at −I_D=20mA
T_case = 25°C
−I_D=500mA
100mA
20mA

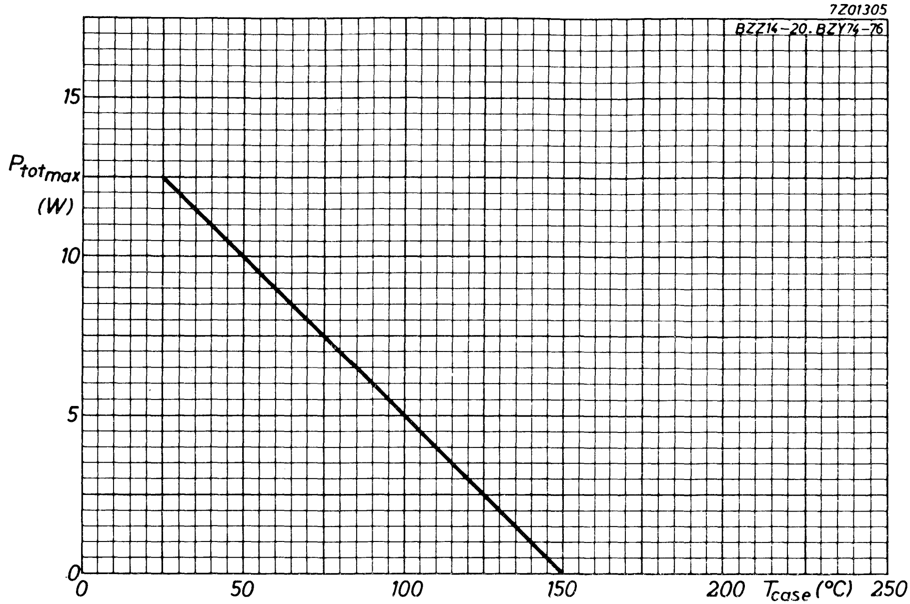
E

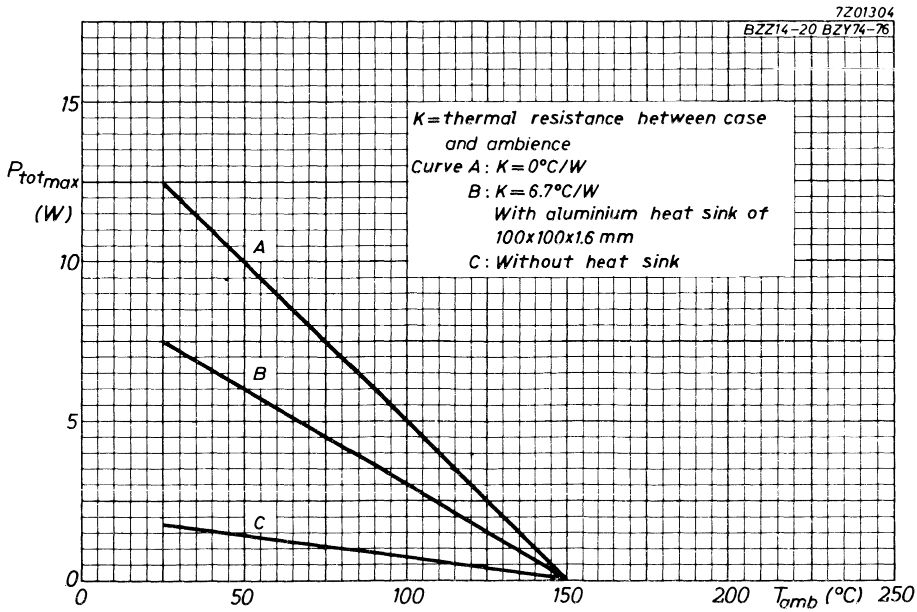

7Z01306
BZZ14–20 BZY74–76
$-I_{D\,surge\,max}$
(A)
T_{amb} = 25°C
Area of
permissible operation
10
5
2
1
0.5
0.2
0.1
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
Duration (m sec)

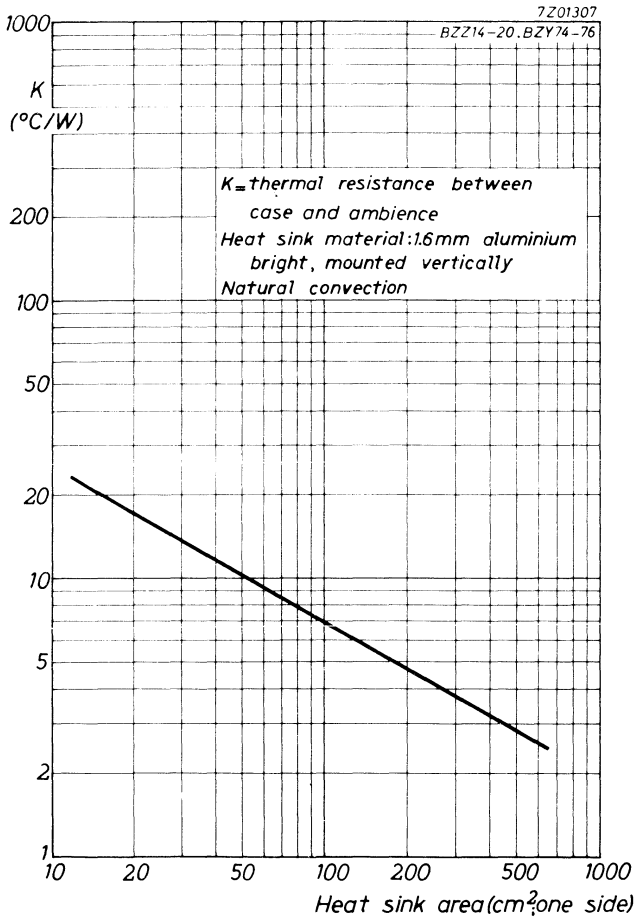
H


7Z01303
BZZ14–20
T_{case} = 25°C
$-I_D$=20mA
100mA
500mA
r_D
(Ω)
100
50
20
10
5
2
1
0.5
0.2
0.1
$-V_D(V)$ at $-I_D$=20mA
4
6
8
10
12

G


7Z01305
BZZ14−20, BZY74−76
15
10
5
0
$P_{tot max}$ (W)
0
50
100
150
200
250
T_{case} (°C)


7Z01304
BZZ14−20 BZY74−76
15
10
5
0
$P_{tot max}$ (W)
K = thermal resistance between case and ambience
Curve A: K = 0°C/W
B: K = 6.7°C/W
With aluminium heat sink of 100x100x1.6 mm
C: Without heat sink
A
B
C
0
50
100
150
200
250
T_{amb} (°C)


7Z01307
BZZ14-20, BZY74-76
1000
K
(°C/W)
200
100
50
20
10
5
2
1
K = thermal resistance between case and ambience
Heat sink material: 1.6mm aluminium bright, mounted vertically
Natural convection
10
20
50
100
200
500
1000
Heat sink area (cm²; one side)

K

GERMANIUM GOLD BONDED DIODE

Germanium gold bonded diode in single ended all glass construction.

RATINGS (Limiting values) [1]

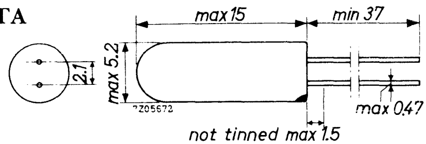
		T_{amb} = 25 °C		T_{amb} = 75 °C	
Continuous reverse voltage	V_R	max.	100	50	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	50	V
Average forward current	I_{FAV}	max.	125	50	mA
Repetitive peak forward current	I_{FRM}	max.	350	350	mA
Non rep. peak forw. current; t < 1 s	I_{FSM}	max.	500		mA
t < 1 μs; δ = 0.01	I_{FSM}	max.	1000		mA
Operating ambient temperature	T_{amb}	max.		75	°C
Storage temperature	T_{stg}			−55 to +90	°C

CHARACTERISTICS

		T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage				
I_F = 0.1 mA	V_F	0.10 to 0.25	0.03 to 0.20	V
I_F = 10 mA	V_F	0.25 to 0.55	0.20 to 0.50	V
I_F = 200 mA	V_F	0.50 to 1.0	0.48 to 1.0	V
I_F = 300 mA	V_F	0.55 to 1.25	0.55 to 1.25	V
Reverse current				
V_R = 1.5 V	I_R	0.2 to 5	5 to 26	μA
V_R = 10 V	I_R	0.3 to 6	5.5 to 30	μA
V_R = 50 V	I_R	0.45 to 9	7.5 to 60	μA
V_R = 100 V	I_R	0.7 to 30	10 to 120	μA

MECHANICAL DATA

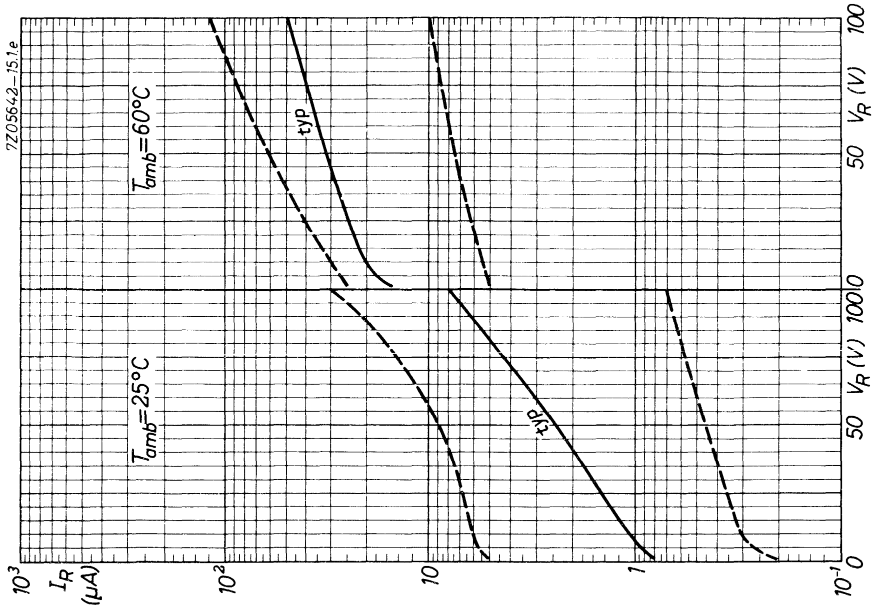
Dimensions in mm

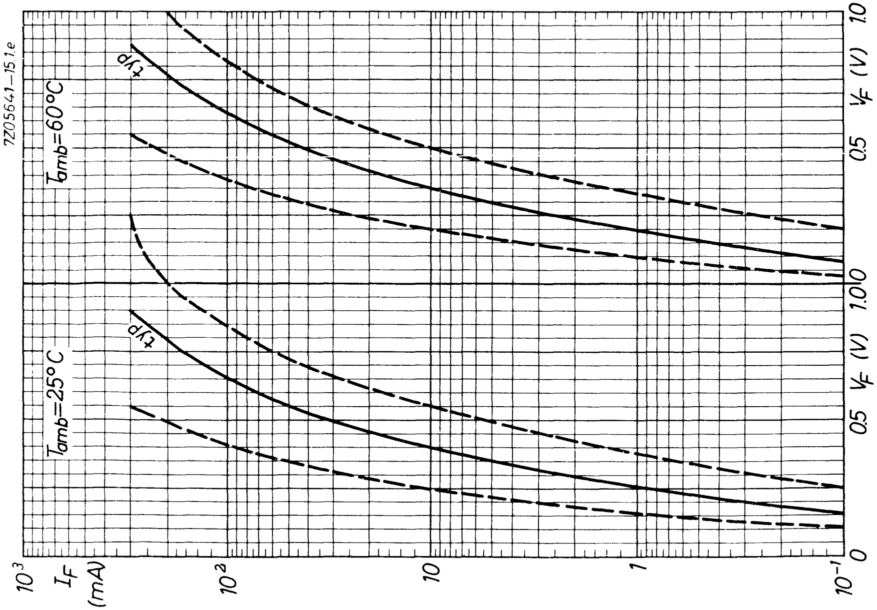


The red dot indicates the cathode side

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0566


7Z05642-15.1.e
T_{amb}=60°C
T_{amb}=25°C
typ
typ
I_R (μA)
V_R (V)
10^3
10^2
10
1
10^{-1}
0
50
100


7Z05641-15.1.e
T_{amb}=60°C
T_{amb}=25°C
typ
typ
I_F (mA)
V_F (V)
10^3
10^2
10
1
10^{-1}
0
0.5
1.0

GERMANIUM GOLD BONDED DIODE

Germanium gold bonded diode in single ended all glass construction intended for switching applications.

RATINGS (Limiting values)

Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Non repetitive peak reverse voltage ($t \leq 1$ s)	V_{RSM}	max.	30	V
Average forward current; T_{amb} = 25 °C	I_{FAV}	max.	80	mA
T_{amb} = 75 °C	I_{FAV}	max.	40	mA
Forward current (d.c.) T_{amb} = 25 °C	I_F	max.	140	mA
T_{amb} = 75 °C	I_F	max.	50	mA
Repetitive peak forward current	I_{FRM}	max.	250	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	400	mA
Operating ambient temperature	T_{amb}	max.	75	°C
Storage temperature	T_{stg}		−55 to +75	°C

THERMAL RESISTANCE

From junction to ambient $R_{th\ j\text{-}a}$ = 0.4 °C/mW

CHARACTERISTICS

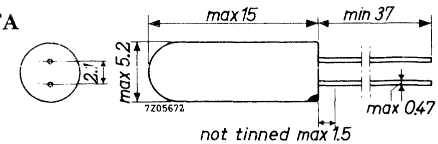
			T_{amb} = 25 °C	T_{amb} = 60 °C	
Forward voltage	I_F = 0.1 mA	V_F	0.12 to 0.26	0.06 to 0.19	V
	I_F = 10 mA	V_F	0.30 to 0.48	0.14 to 0.28	V
	I_F = 50 mA	V_F	0.40 to 0.78	0.37 to 0.75	V
	I_F = 250 mA	V_F	< 1.65		V
Reverse current	V_R = 1.5 V	I_R	typ. 0.4	< 20	μA
	V_R = 10 V	I_R	typ. 1.5	< 30	μA
	V_R = 25 V	I_R	typ. 6.0	< 150	μA

Reverse recovery current when switched from I_F = 5 mA to V_R = 5 V; T_{amb} = 25 °C

measured at t_{rr} = 0.5 μs	I_R	typ.	140	μA
		<	250	μA
measured at t_{rr} = 3.5 μs	I_R	<	25	μA

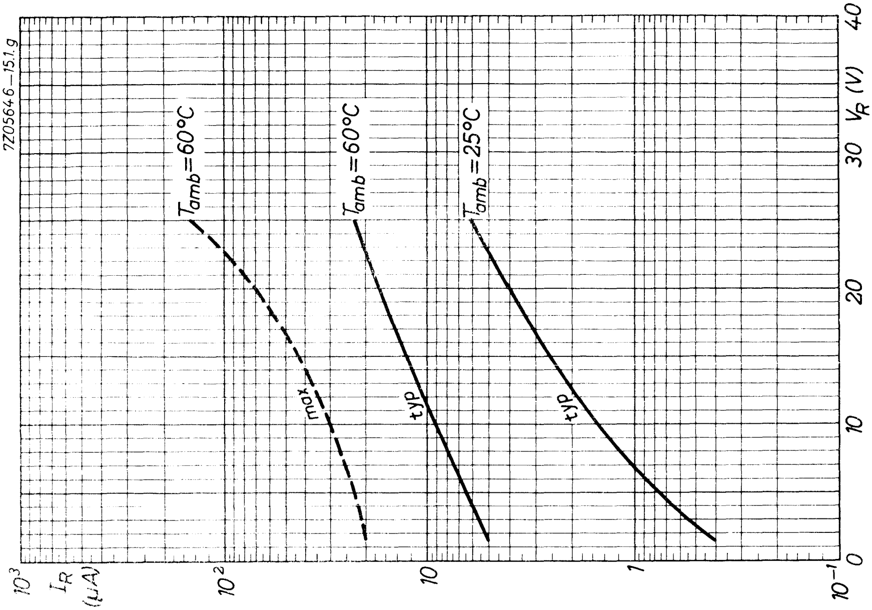
MECHANICAL DATA

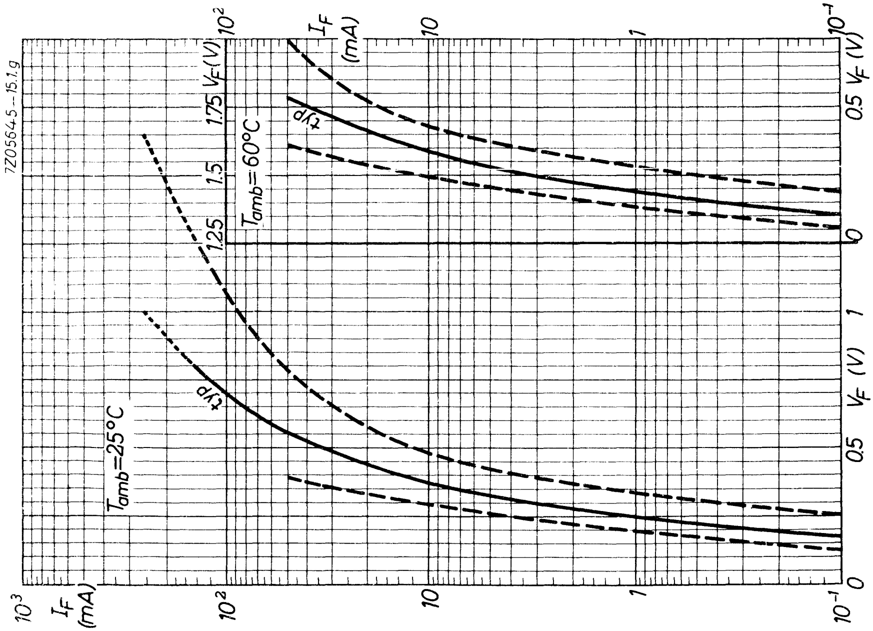
Dimensions in mm



The red dot indicates the cathode side

7Z3 0567


7Z05646–15.1.g
I_R (µA)
10^3
10^2
10
1
10^{-1}
V_R (V)
0
10
20
30
40
T_{amb}=60°C
max
T_{amb}=60°C
typ
T_{amb}=25°C
typ


7Z05645–15.1.g
I_F (mA)
10^3
10^2
10
1
10^{-1}
V_F (V)
0
0.5
1
T_{amb}=25°C
typ
T_{amb}=60°C
typ
V_F (V)
1.25
1.5
1.75
I_F (mA)

GERMANIUM GOLD BONDED DIODE

Germanium gold bonded diode in single ended all glass construction intended for switching applications.

RATINGS (Limiting values)

Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Non repetitive peak reverse voltage ($t \leq 1$ s)	V_{RSM}	max.	40	V
Average forward current: $T_{amb} = 25\ ^oC$	I_{FAV}	max.	160	mA
$T_{amb} = 75\ ^oC$	I_{FAV}	max.	70	mA
Forward current (d.c.) $T_{amb} = 25\ ^oC$	I_F	max.	270	mA
$T_{amb} = 75\ ^oC$	I_F	max.	90	mA
Repetitive peak forward current	I_{FRM}	max.	500	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	800	mA
Operating ambient temperature	T_{amb}	max.	75	^oC
Storage temperature	T_{stg}		-55 to +90	^oC

THERMAL RESISTANCE

From junction to ambient $R_{th\ j\text{-}a}$ = 0.35 $^oC/mW$

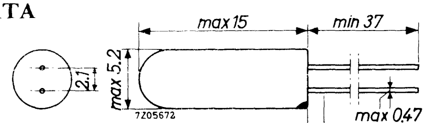
CHARACTERISTICS

			$T_{amb} = 25\ ^oC$	$T_{amb} = 60\ ^oC$	
Forward voltage	$I_F = 0.1$ mA	V_F	< 0.21	< 0.15	V
	$I_F = 10$ mA	V_F	< 0.41	< 0.35	V
	$I_F = 500$ mA	V_F	< 0.90		V
Reverse current	$V_R = 1.5$ V	I_R	< 3.5	< 20	μA
	$V_R = 10$ V	I_R	< 10	< 45	μA
	$V_R = 25$ V	I_R	< 50	< 100	μA

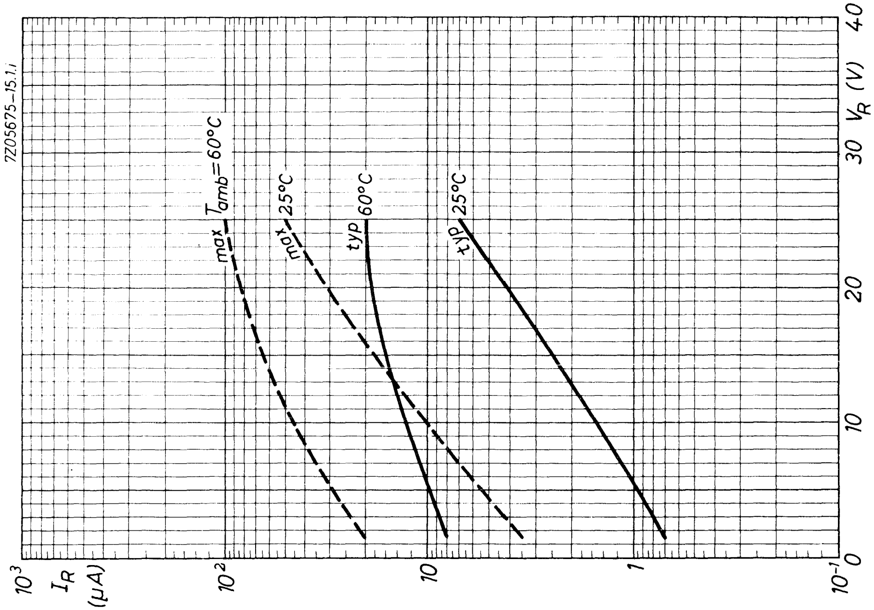
Reverse recovery current when switched
from $I_F = 400$ mA to $V_R = 10$ V; $T_{amb} = 25\ ^oC$
measured at $t_{rr} = 3.5\ \mu s$ — I_R < 150 μA

Diode capacitance at f = 0.5 MHz
$V_R = 0.75$ V; $T_{amb} = 25\ ^oC$ — C_d < 7 pF

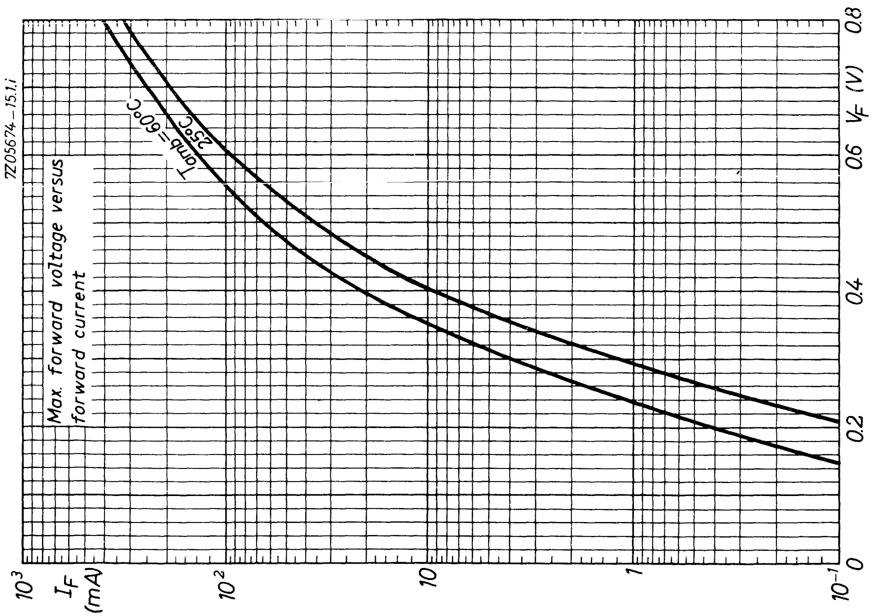
MECHANICAL DATA Dimensions in mm



The red dot indicates the cathode side 7Z3 0568



7Z05675-15.1.i
max T_{amb}=60°C
max 25°C
typ 60°C
typ 25°C
V_R (V)
I_R (μA)



7Z05674-15.1.i
Max. forward voltage versus forward current
T_{amb}=60°C
25°C
V_F (V)
I_F (mA)

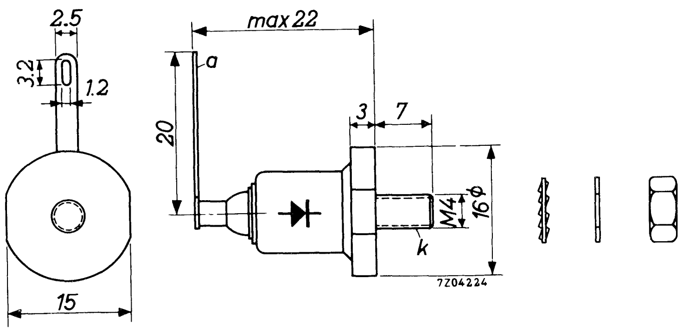
GERMANIUM POWER DIODE

Germanium diode in a metal envelope, primarily intended for medium-power rectifier applications.

QUICK REFERENCE DATA				
Crest working reverse voltage	V_{RWM}	max.	95	V
Repetitive peak reverse voltage	V_{RRM}	max.	120	V
Average forward current	I_{FAV}	max.	3.8	A
Non repetitive peak forward current (t < 10 ms)	I_{FSM}	max.	90	A
Junction temperature	T_j	max.	75	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	$^oC/W$

MECHANICAL DATA

Dimensions in mm



When fastening the diode, a torque of 3 cmkg should not be exceeded.

7Z3 0016

All information applies to frequencies up to 1000 Hz

RATINGS (Limiting values) [1]

Voltages

Continuous reverse voltage	V_R	max.	85	V
Crest working reverse voltage	V_{RWM}	max.	95	V
Repetitive peak reverse voltage	V_{RRM}	max.	120	V
Non repetitive peak reverse voltage	V_{RSM}	max.	120	V

Currents

Average forward current (averaged over any 20 ms period)	I_{FAV}	max.	3.8	A
Forward current (d.c.)	I_F	max.	12	A
Repetitive peak forward current	I_{FRM}	max.	12	A
Non repetitive peak forward current $t < 10$ ms (See page B)	I_{FSM}	max.	90	A

TEMPERATURES

Storage temperature	T_{stg}		−25 to +75	°C
Junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\,j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\,j\text{-}mb}$	=	5	°C/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	=	1	°C/W

CHARACTERISTICS

Voltages

Forward voltage at I_F = 12 A; T_j = 25 °C	V_F	<	0.70	V
T_j = 75 °C	V_F	<	0.65	V

Currents

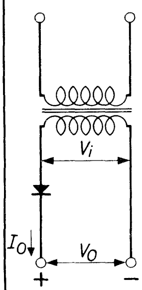
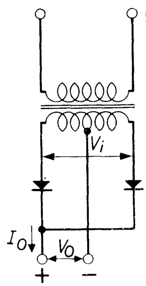
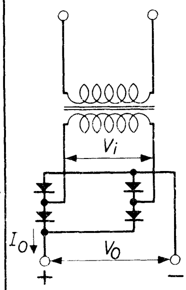
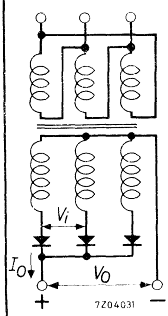
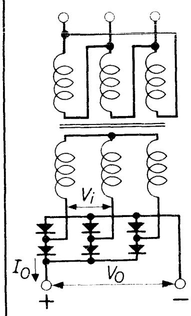
Reverse current V_R = 85 V; T_j = 25 °C	I_R	<	100	µA
V_R = 85 V; T_j = 75 °C	I_R	<	4	mA

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0403

APPLICATION INFORMATION

TYPICAL OPERATION AS RECTIFIER

	Single phase half wave		Two phase half wave		Single phase full wave (Single phase bridge)		Three phase half wave (Three phase star)		Three phase full wave (Three phase bridge)	
										
$V_{i(rms)}$	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O	I_O	V_O
60	3.5	27	7	27	7	54	10.5	40	10.5	80

$V_{i(rms)}$ = transformer secondary r.m.s. voltage in V

I_O = average output current in A

V_O = average output voltage in V

The above data are nominal values. The possibility of mains voltage fluctuations of maximum 10% has been taken into account.

7Z3 0404

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)

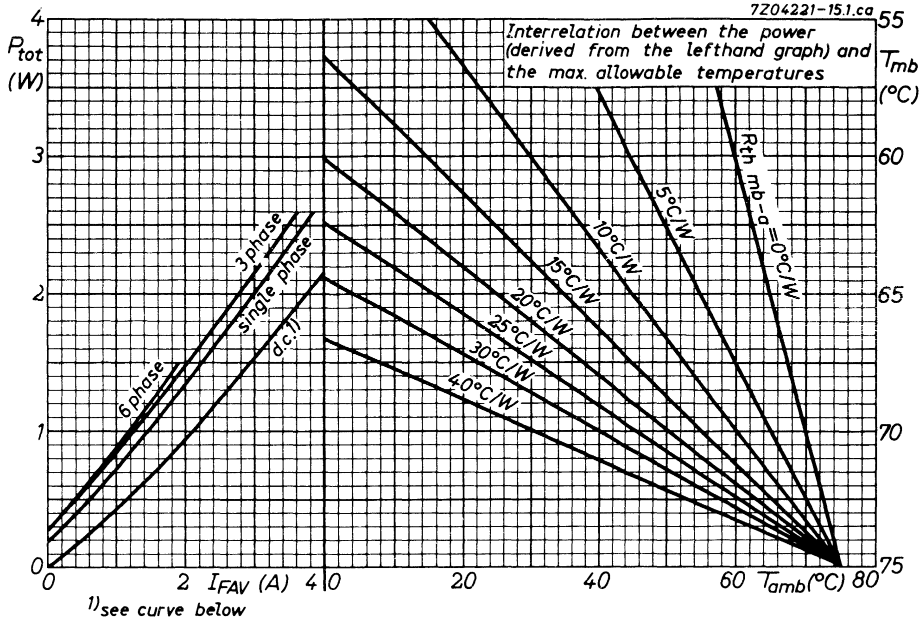
V_1 = transformer primary r.m.s. voltage (V)

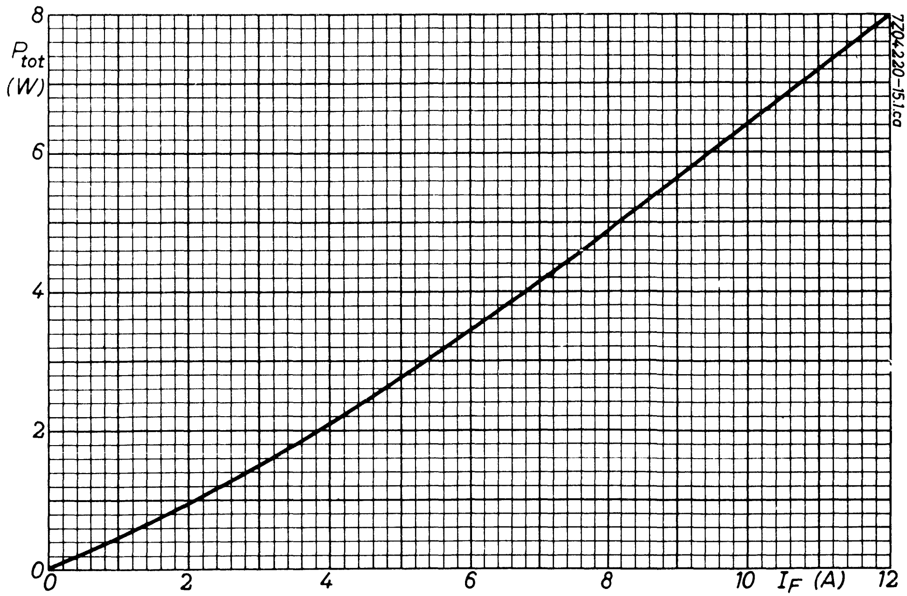
V_2 = transformer secondary r.m.s. voltage (V)

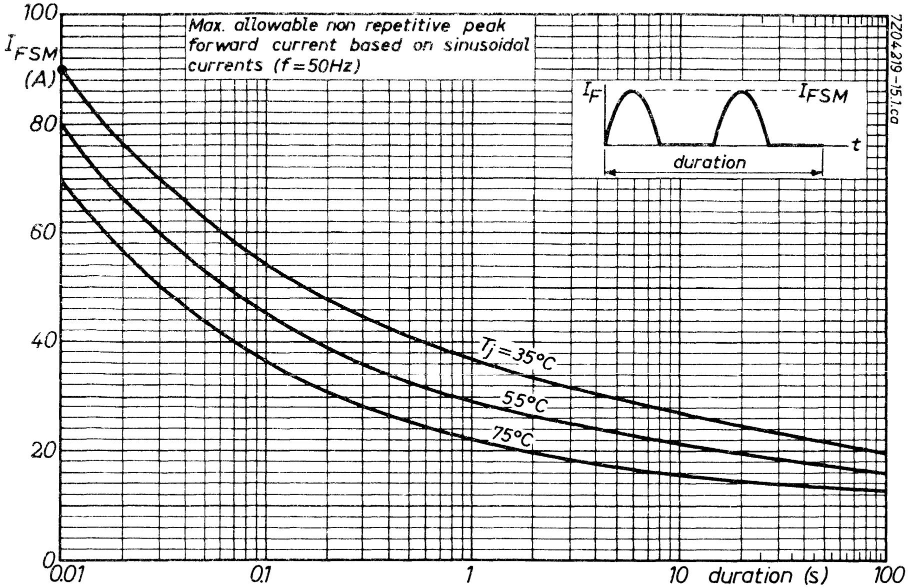
T = V_1/V_2

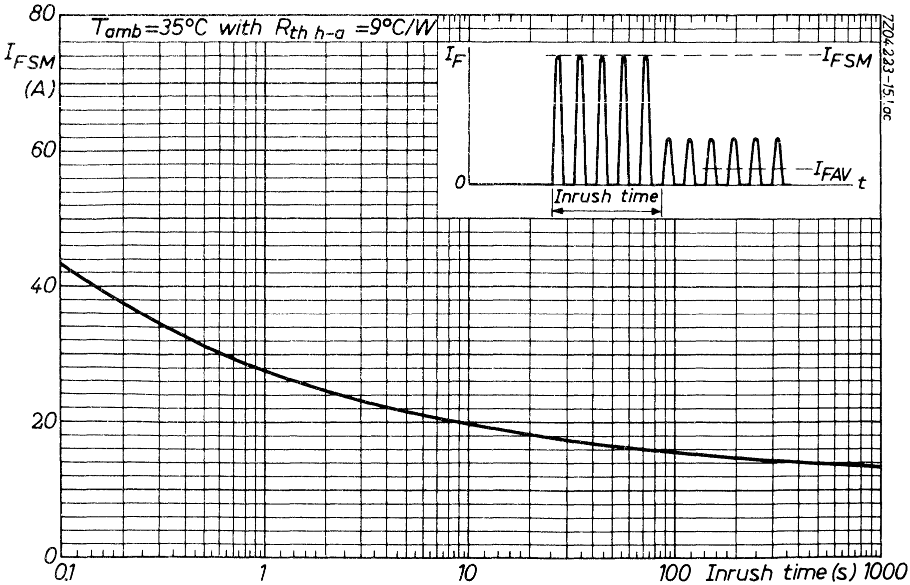
V_{RWM} stands for the actually applied crest working reverse voltage

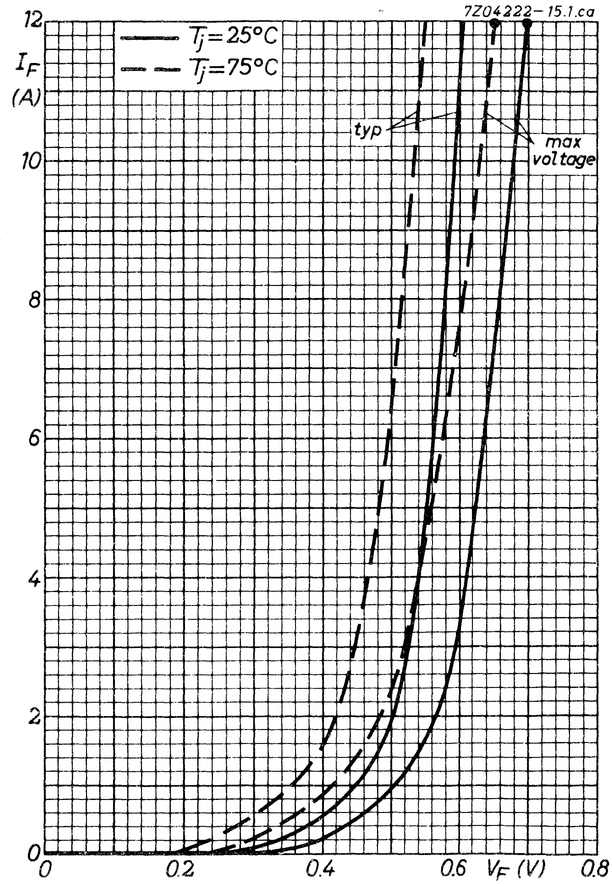
7Z3 0405

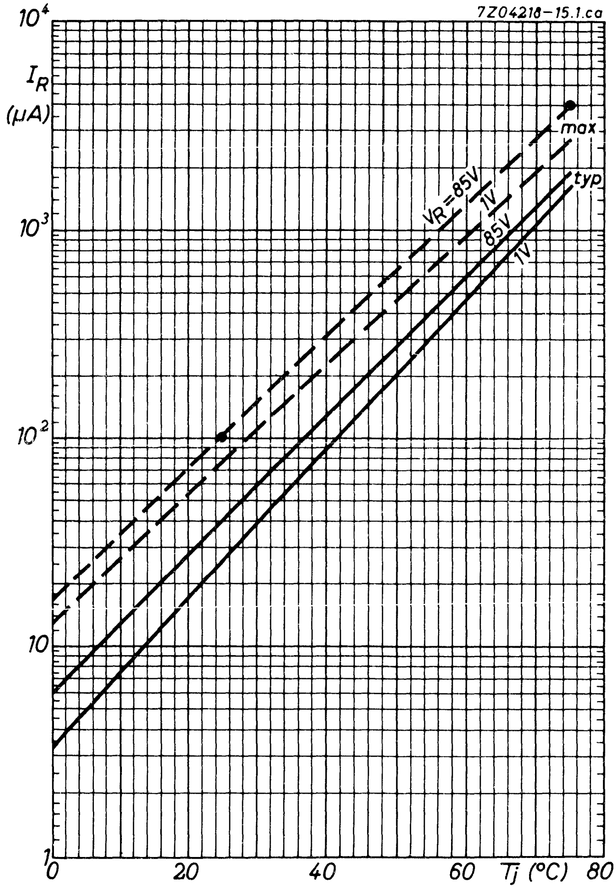

7Z04221-15.1.ca
Interrelation between the power (derived from the lefthand graph) and the max. allowable temperatures
Ptot (W)
Tmb (°C)
6 phase
3 phase
single phase
d.c.1)
Rth mb-a =0°C/W
5°C/W
10°C/W
15°C/W
20°C/W
25°C/W
30°C/W
40°C/W
IFAV (A)
Tamb(°C)
1)see curve below


Ptot (W)
7Z04220-15.1.ca
IF (A)


Max. allowable non repetitive peak forward current based on sinusoidal currents (f=50Hz)
I_{FSM} (A)
100
80
60
40
20
0
0.01
0.1
1
10
duration (s)
100
T_j=35°C
55°C
75°C
I_F
I_{FSM}
t
duration
7Z04219-15.1.ca


T_{amb}=35°C with $R_{th\ h-a}$ =9°C/W
I_{FSM} (A)
80
60
40
20
0
0.1
1
10
100
Inrush time (s)
1000
I_F
I_{FSM}
I_{FAV}
t
0
Inrush time
7Z04223-15.1.ac


7Z04222-15.1.ca
12
I_F
(A)
10
8
6
4
2
0
0
0.2
0.4
0.6
V_F (V)
0.8
T_j=25°C
T_j=75°C
typ
max
voltage


7Z04218-15.1.ca
10^4
I_R
(μA)
10^3
10^2
10
1
0
20
40
60
80
T_j (°C)
V_R=85V
1V
85V
1V
max
typ

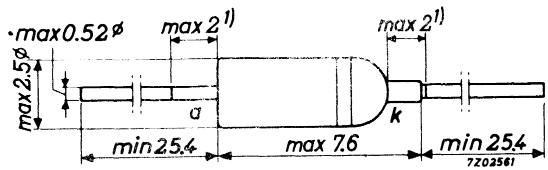
GOLD BONDED DIODE

Gold bonded germanium diode in subminiature all glass DO-7 envelope, intended for switching applications and general purposes.

QUICK REFERENCE DATA				
Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Forward current (d.c.)	I_F	max.	110	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Junction temperature	T_j	max.	75	°C
Forward voltage at I_F = 150 mA	V_F	<	1.1	V
Recovered charge when switched from I_F = 10 mA to V_R = 10 V	Q_s	<	600	pC

MECHANICAL DATA Dimensions in mm

DO-7



The red band indicates the cathode side

[1]) Not tinned

7Z3 0000

RATINGS (Limiting values) [1])

Voltages

Continuous reverse voltage	V_R	max.	25	V
Repetitive peak reverse voltage	V_{RRM}	max.	25	V
Non repetitive peak reverse voltage ($t < 1$ s)	V_{RSM}	max.	30	V

Currents

Forward current (d.c.)	I_F	max.	110	mA
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	110	mA
Repetitive peak forward current	I_{FRM}	max.	150	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	200	mA

Temperatures

Storage temperature	T_{stg}		-65 to +75	^oC
Junction temperature	T_j	max.	75	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.45	$^oC/mW$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0001

CHARACTERISTICS

Forward voltage at T_j = 25 °C

I_F	= 0.1 mA	V_F	< 0.20 V
I_F	= 1.0 mA	V_F	< 0.31 V
I_F	= 10 mA	V_F	< 0.45 V
I_F	= 30 mA	V_F	< 0.65 V
I_F	= 150 mA	V_F	< 1.10 V

Forward voltage at T_j = 60 °C

I_F	= 0.1 mA	V_F	< 0.14 V
I_F	= 1.0 mA	V_F	< 0.28 V
I_F	= 10 mA	V_F	< 0.43 V
I_F	= 30 mA	V_F	< 0.62 V
I_F	= 150 mA	V_F	< 1.10 V

Reverse current at T_j = 25 °C

V_R	= 1.5 V	I_R	< 3.5 μA
V_R	= 10 V	I_R	< 15 μA
V_R	= 20 V	I_R	< 50 μA
V_R	= 25 V	I_R	< 100 μA

Reverse current at T_j = 60 °C

V_R	= 1.5 V	I_R	< 20 μA
V_R	= 10 V	I_R	< 40 μA
V_R	= 20 V	I_R	< 90 μA
V_R	= 25 V	I_R	< 160 μA

Diode capacitance

V_R	= 1 V; f = 1 MHz	C_d	< 3.5 pF

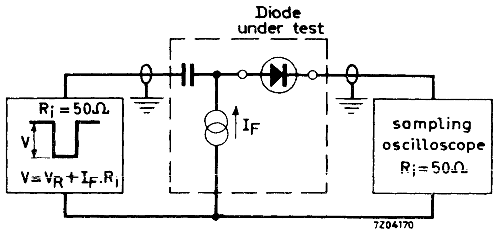
7Z3 0002

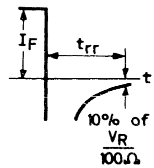
CHARACTERISTICS (continued) $T_j = 25\ ^oC$

Reverse recovery time when switched
from $I_F = 10$ mA to $V_R = 1$ V; $R_L = 100\ \Omega$

Measured at $I_R = 10\ \%$ of $\frac{V_R}{R_L}$ t_{rr} < 70 ns

Test circuit:





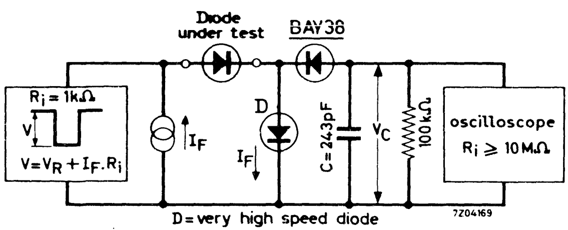
output pulse

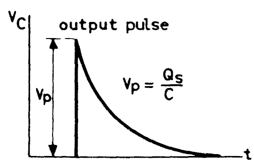
Reverse pulse: Rise time	t_r	= 0.6	ns
Pulse duration	t_p	= 100	ns
Duty cycle	δ	= 0.05	

Circuit capacitance C < 1 pF (C = Oscilloscope + parasitical capacitance)

Recovered charge when switched
from $I_F = 10$ mA to $V_R = 10$ V; $R_L = 1\ k\Omega$ Q_s < 600 pC

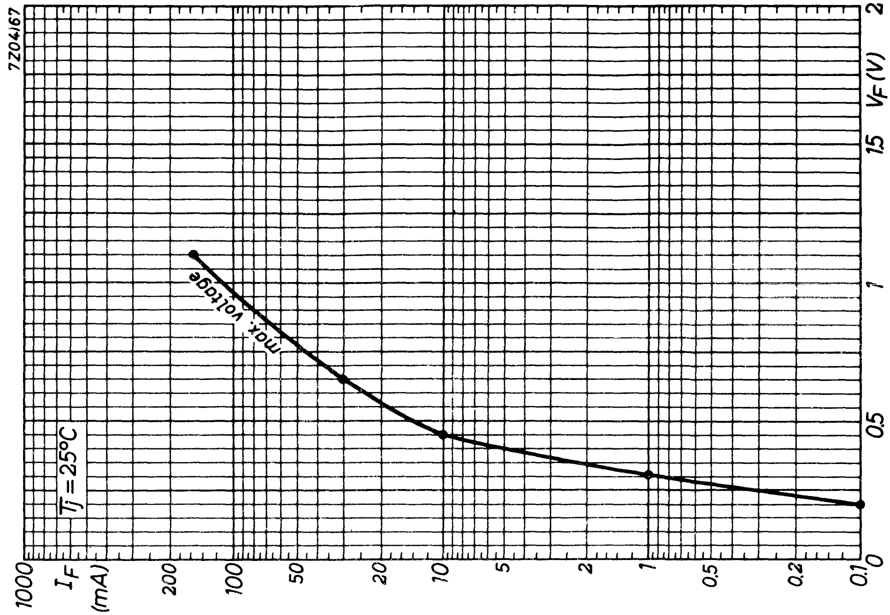
Test circuit:

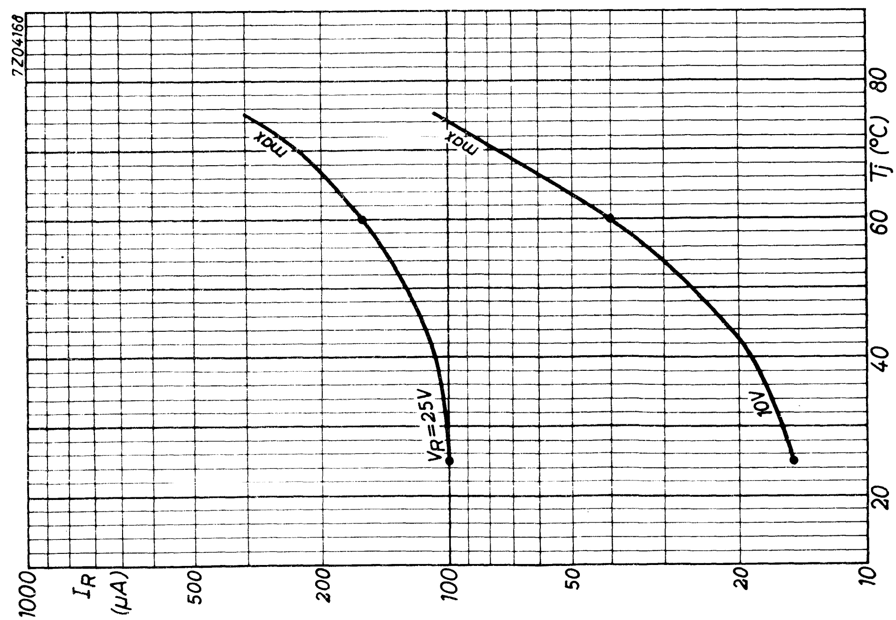


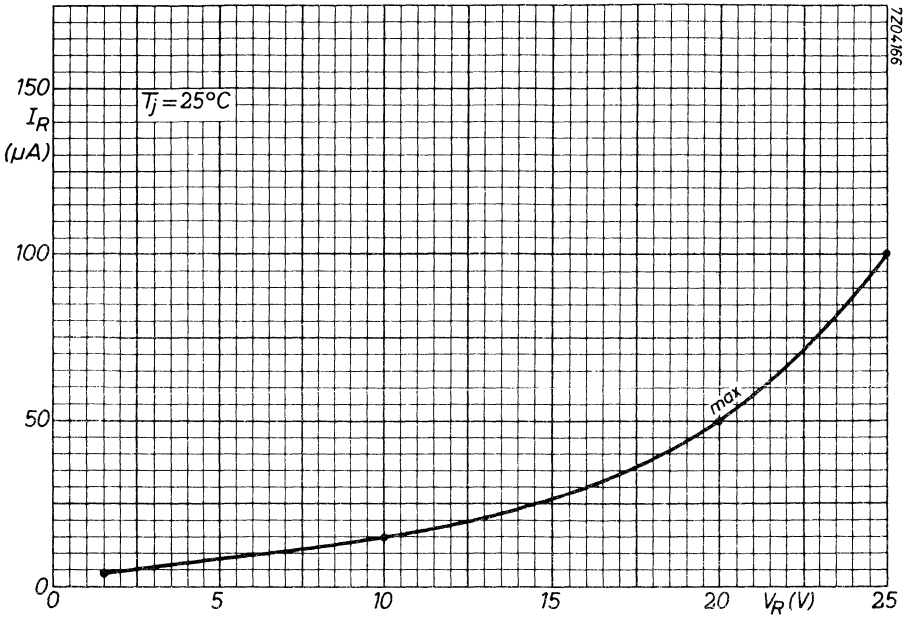


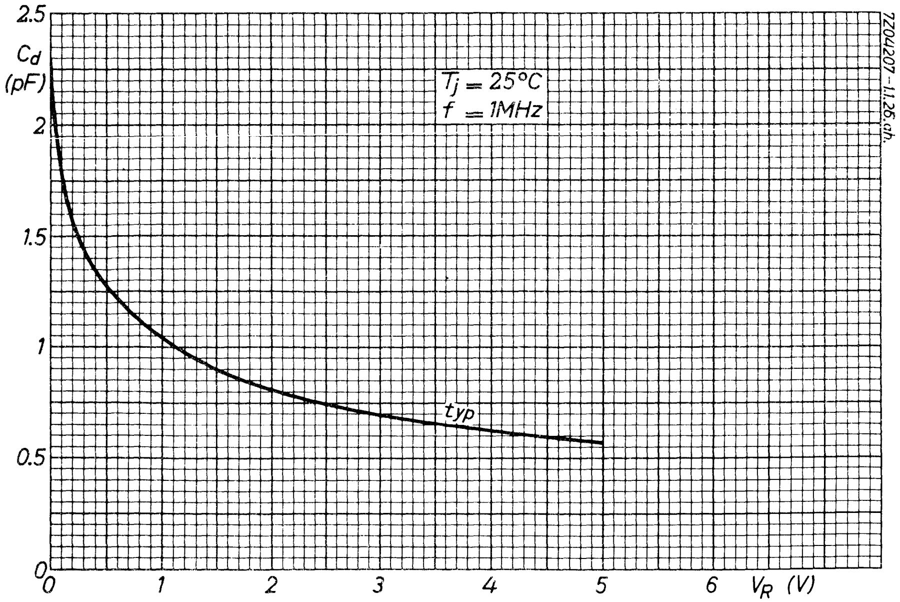
Reverse pulse: Rise time	t_r	= 2	ns
Pulse duration	t_p	= 0.4	µs
Duty cycle	δ	= 0.02	

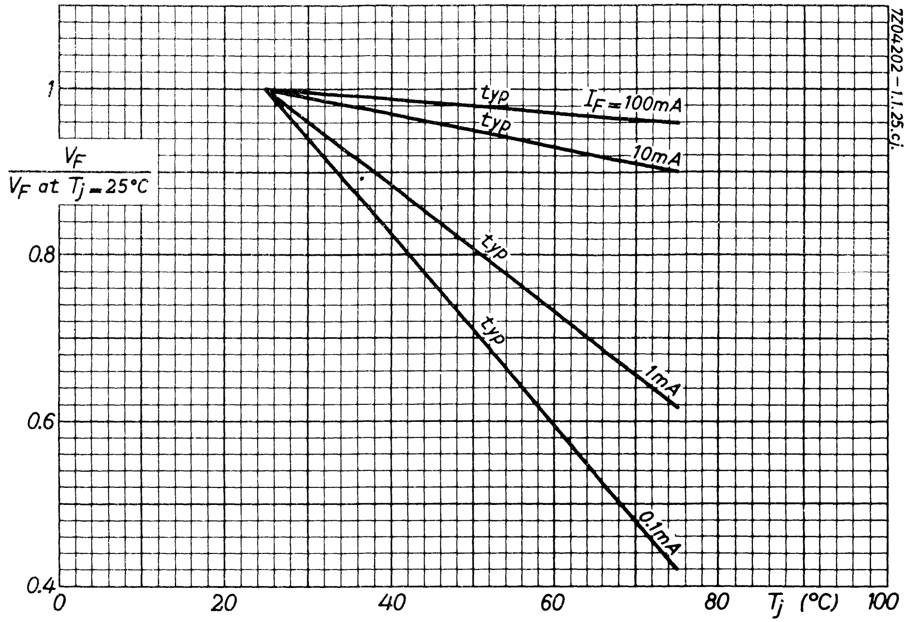
7Z3 0003

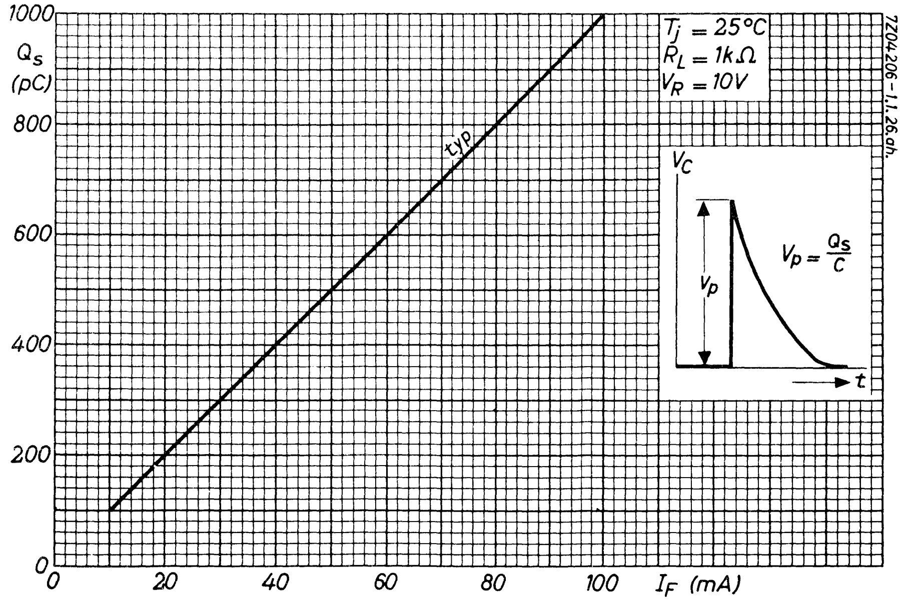

7Z04167
$T_j = 25°C$
max. voltage
V_F (V)
0
0.5
1
1.5
2
I_F (mA)
1000
200
100
50
20
10
5
2
1
0.5
0.2
0.1

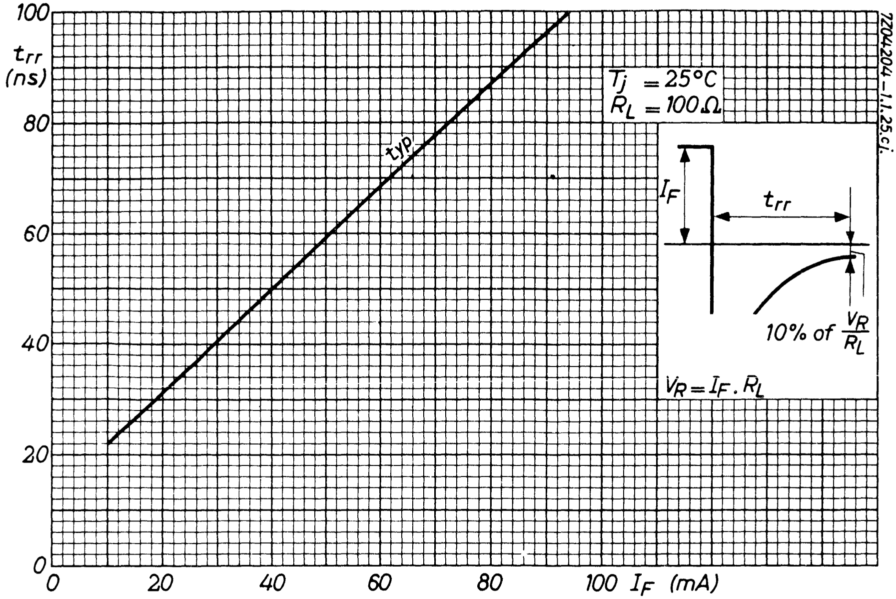

7Z04168
max
max
$V_R = 25V$
10V
T_j (°C)
20
40
60
80
I_R (μA)
1000
500
200
100
50
20
10

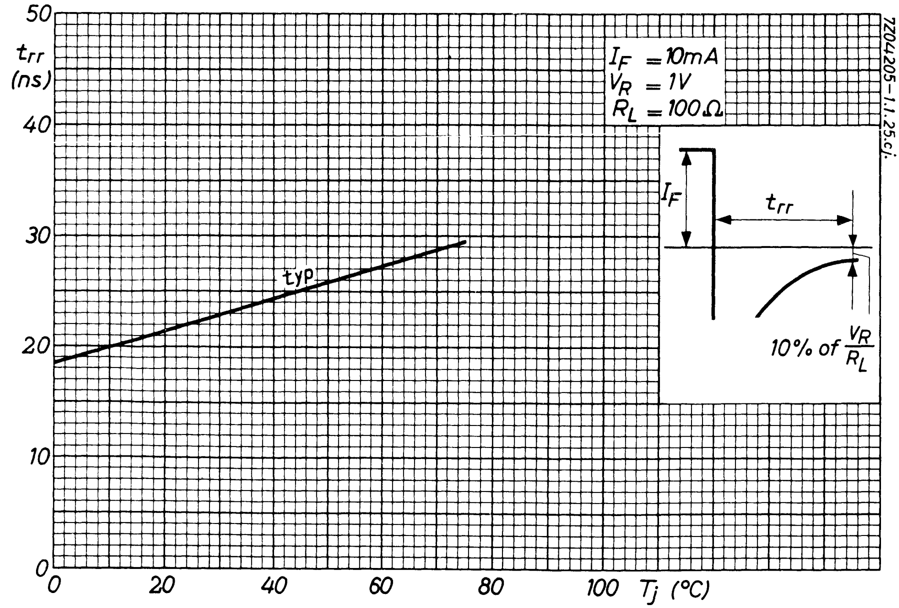

7Z04166
$T_j = 25°C$
150
I_R
(µA)
100
50
0
max
0
5
10
15
20
V_R (V)
25


7Z04207-1.1.26.ah.
2.5
C_d
(pF)
2
1.5
1
0.5
0
$T_j = 25°C$
f = 1MHz
typ
0
1
2
3
4
5
6
V_R (V)


7Z04202 - 1.1.25.cj.
1
0.8
0.6
0.4
V_F / V_F at $T_j = 25°C$
typ
$I_F = 100mA$
typ
10mA
typ
1mA
typ
0.1mA
0
20
40
60
80
T_j (°C)
100


7Z04206 - 1.1.26.ah.
1000
Q_s (pC)
800
600
400
200
0
$T_j = 25°C$
$R_L = 1k\Omega$
$V_R = 10V$
typ
V_C
V_p
$V_p = \frac{Q_s}{C}$
t
0
20
40
60
80
100
I_F (mA)

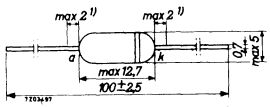

100
t_{rr}
(ns)
80
60
40
20
0
0
20
40
60
80
100 I_F (mA)
typ
T_j = 25°C
R_L = 100 Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
$V_R = I_F . R_L$
7Z04204-1.1.25.cj.


50
t_{rr}
(ns)
40
30
20
10
0
0
20
40
60
80
100 T_j (°C)
typ
I_F = 10mA
V_R = 1V
R_L = 100 Ω
I_F
t_{rr}
10% of $\frac{V_R}{R_L}$
7Z04205-1.1.25.cj.

GERMANIUM DIODE for use as video detector
DIODE A CRISTAL DE GERMANIUM pour la détection vidéo
GERMANIUMDIODE zur Video-Demodulation

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

$-V_{DM}$	= max. 22,5 V	
$-V_D$ (t_{av} = max. 50 msec)	= max. 15 V	
I_D	= max. 50 mA	2)
I_{DM}	= max. 150 mA	
I_{surge}	= max. 400 mA	3)
T_{amb}	= -50°C/+75 °C	

1) Not tinned; non étamé; nicht verzinnt

2) For the relation between simultaneously allowable maximum values of $-V_{DM}$ and I_D see the derating curve (page D). Operation in accordance with this derating curve is prescribed. The derating curve is valid at $T_{amb} \leq 25$ °C. At higher temperatures an extra derating of I_D by a factor $\frac{25}{T_{amb}}$ is prescribed.

Pour le rapport entre les valeurs maximum de $-V_{DM}$ et I_D admissibles simultanément voir la courbe de réduction (page D). Une opération en accord avec cette courbe est prescrite. La courbe de réduction est valable à $T_{amb} \leq 25$°C. A des températures plus élevées une réduction supplémentaire de I_D par un facteur $\frac{25}{T_{amb}}$ est prescrite.

Für die Beziehung zwischen den gleichzeitig zulässigen Höchstwerten von $-V_{DM}$ und I_D siehe die Reduktionskurve (Seite D). Betrieb entsprechend dieser Kurve ist vorgeschrieben. Die Reduktionskurve ist gültig bei $T_{amb} \leq 25$ °C. Bei höheren Temperaturen ist eine zusätzliche Reduktion von I_D mit einem Faktor $\frac{25}{T_{amb}}$ vorgeschrieben.

3) Max. duration 1 sec.
Durée 1 sec. au max.
Max. Dauer 1 Sek.

939 2437 1.

Capacitance
Capacité
Kapazität

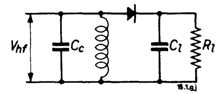
C_{dk} = 1 pF

Characteristics
Caractéristiques
Kenndaten

T_{amb} = 25 °C

V_D (I_D = 0,1 mA)	> 0,1	< 0,25 V
$-I_D$ ($-V_D$ = 1,5 V)	> 1	< 30 µA

Operating characteristics as video detector
Caractéristiques d'utilisation en détectrice vidéo
Betriebsdaten als Video-Demodulator



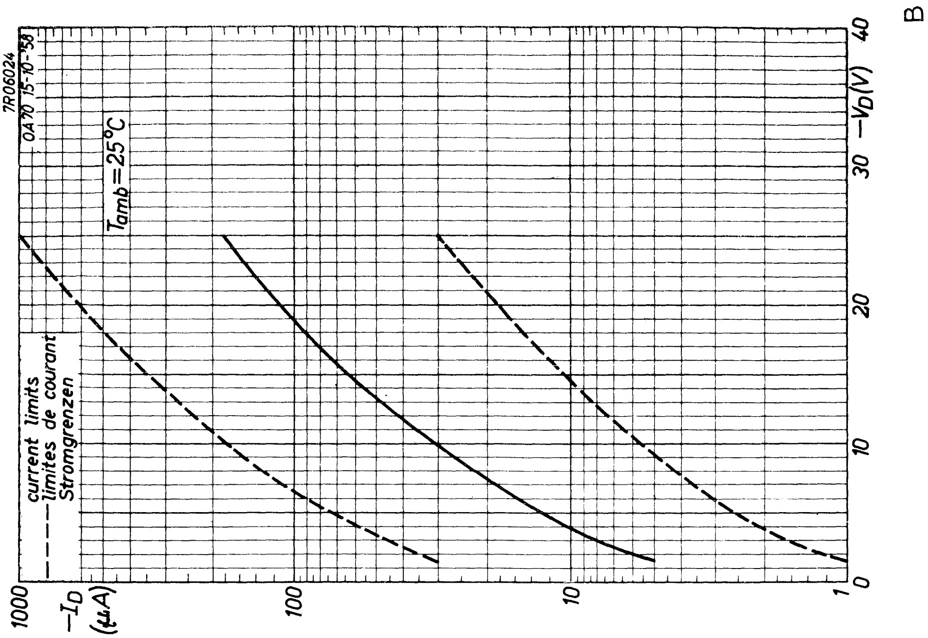
V_{hfm}	= 5 V
R_l	= 3,9 kΩ
C_l	= 10 pF
Cc	= 20 pF
f	= 30 Mc/s
η	= 62 %
rd	= 3 kΩ

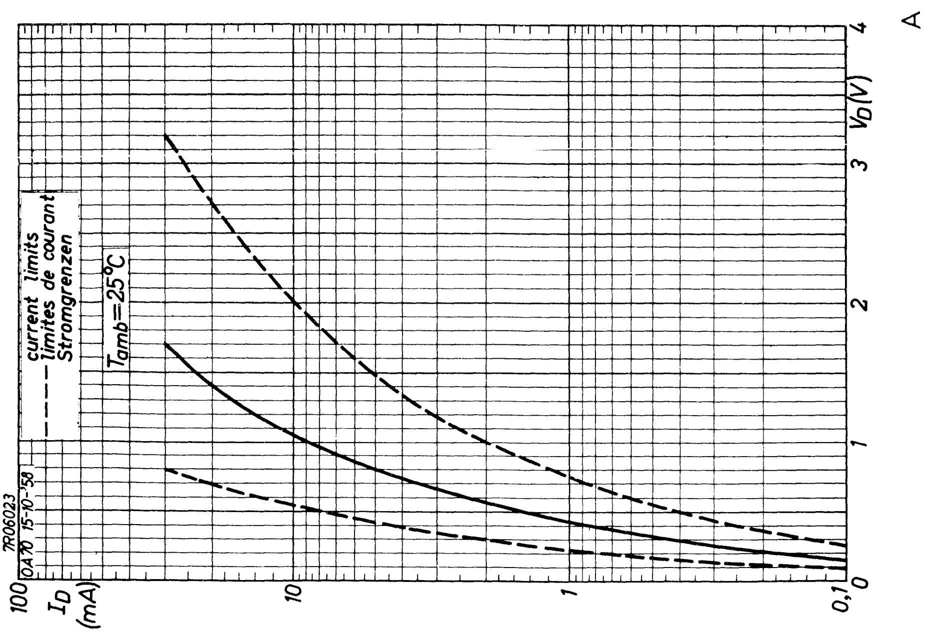
See also pages E to J
Voir aussi pages E jusqu'à J
Siehe also Seiten E bis J

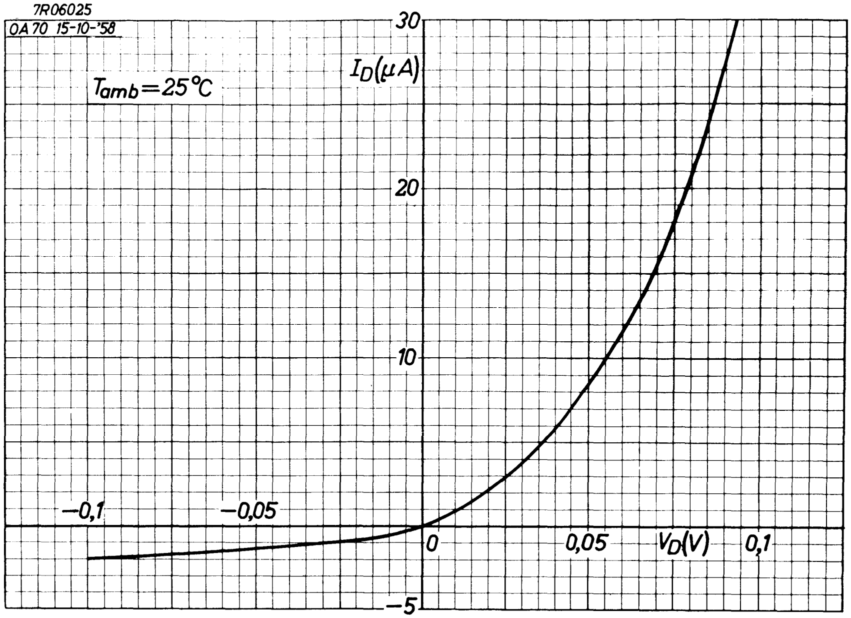
Net weight
Poids net
Nettogewicht

0,6 g

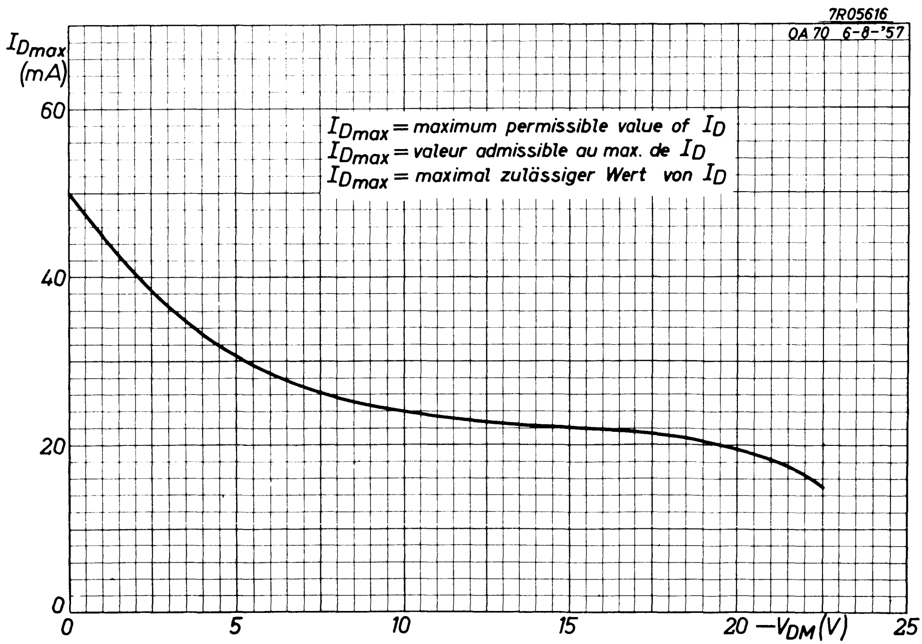
939 2438 - 2.


7R06024
OA70 15-10-'58
T_amb=25°C
current limits
limites de courant
Stromgrenzen
1000
100
10
1
−I_D
(μA)
0
10
20
30
40
−V_D(V)
B

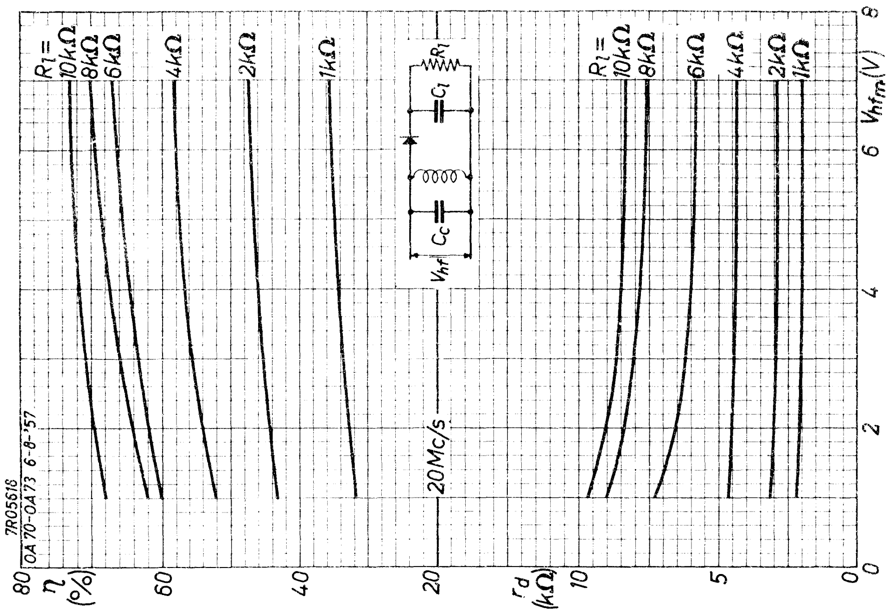

7R06023
OA70 15-10-'58
T_amb=25°C
current limits
limites de courant
Stromgrenzen
100
10
1
0,1
I_D
(mA)
0
1
2
3
4
V_D(V)
A


7R06025
OA 70 15-10-'58
$T_{amb} = 25°C$
$I_D (\mu A)$
30
20
10
−5
−0,1
−0,05
0
0,05
$V_D (V)$
0,1

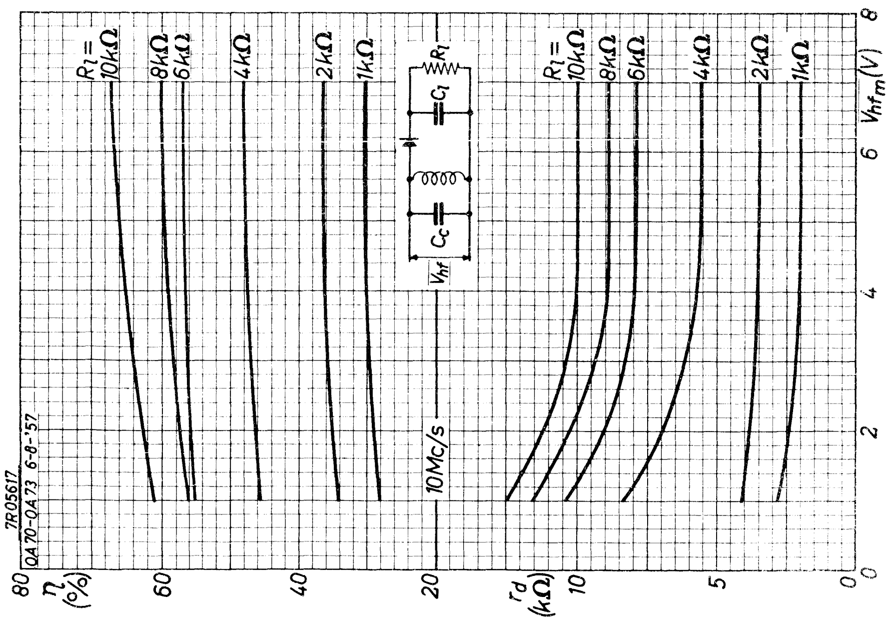
C


7R05616
OA 70 6-8-'57
I_{Dmax} (mA)
60
40
20
0
I_{Dmax} = maximum permissible value of I_D
I_{Dmax} = valeur admissible au max. de I_D
I_{Dmax} = maximal zulässiger Wert von I_D
0
5
10
15
20
$-V_{DM} (V)$
25

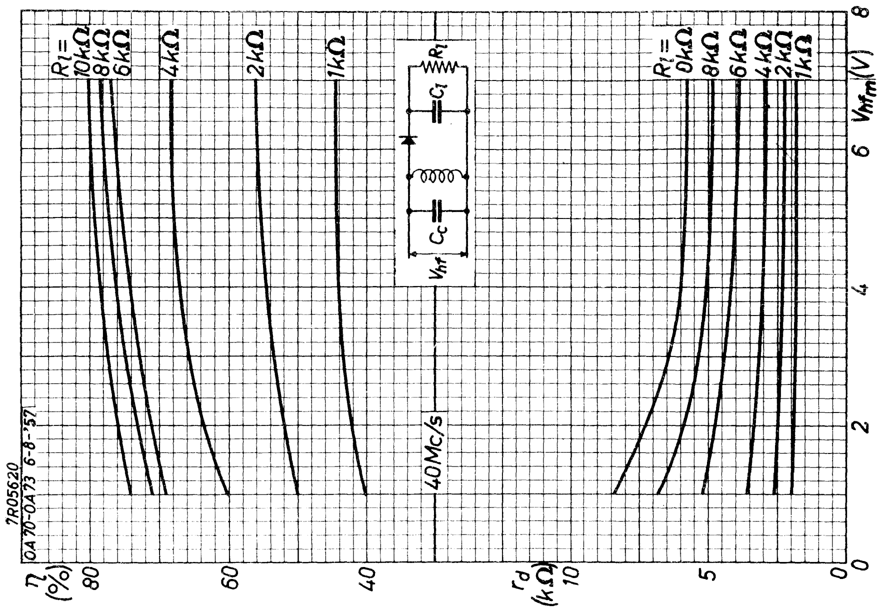
D


7R05618
OA70-OA73 6-8-'57
20Mc/s
η (%)
r_d (kΩ)
V_{hfm} (V)
R_l =
10kΩ
8kΩ
6kΩ
4kΩ
2kΩ
1kΩ
V_{hf}
C_c
C_l
R_l

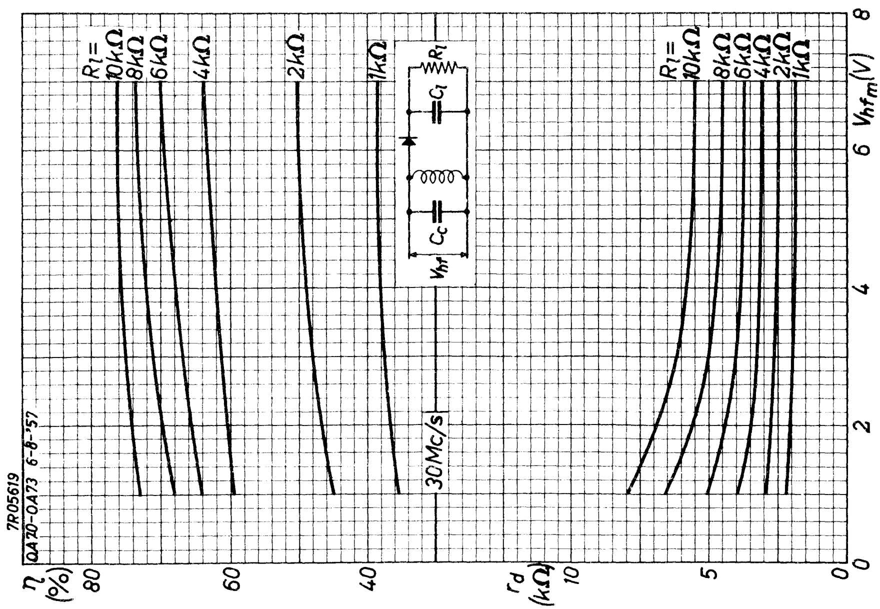
F


7R05617
OA70-OA73 6-8-'57
10Mc/s
η (%)
r_d (kΩ)
V_{hfm} (V)
R_l =
10kΩ
8kΩ
6kΩ
4kΩ
2kΩ
1kΩ
V_{hf}
C_c
C_l
R_l

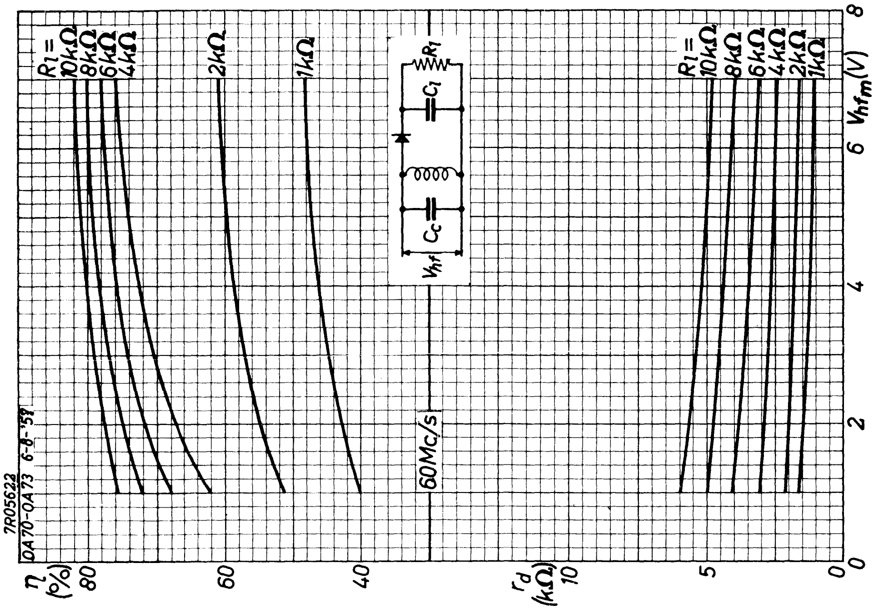
E

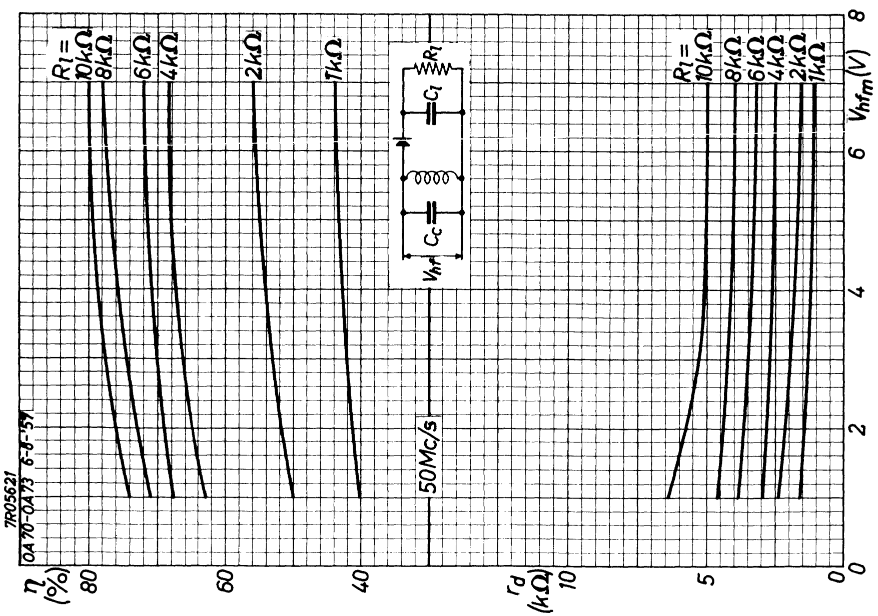

7R05620
OA70-OA73 6-8-'57
40Mc/s
η (%)
r_d (kΩ)
V_{hfm} (V)
R_l=
10kΩ
8kΩ
6kΩ
4kΩ
2kΩ
1kΩ
V_{hf}
C_c
C_l
R_l

H


7R05619
OA70-OA73 6-8-'57
30Mc/s
η (%)
r_d (kΩ)
V_{hfm} (V)
R_l=
10kΩ
8kΩ
6kΩ
4kΩ
2kΩ
1kΩ
V_{hf}
C_c
C_l
R_l

G


7R05622
OA70-OA73 6-8-'59
60Mc/s
Rl =
10kΩ
8kΩ
6kΩ
4kΩ
2kΩ
1kΩ
η (%)
rd (kΩ)
Vhfm (V)
Vhf
Cc
Cl
Rl


7R05621
OA70-OA73 6-8-'59
50Mc/s
Rl =
10kΩ
8kΩ
6kΩ
4kΩ
2kΩ
1kΩ
η (%)
rd (kΩ)
Vhfm (V)
Vhf
Cc
Cl
Rl

GERMANIUM DIODES

Germanium r.f. rectifier diode in all glass construction with high reverse resistance.
Type 2-OA72 consists of 2 diodes OA72 selected for operation in a ratio detector or similar circuits.

RATINGS (Limiting values) [1])

		T_{amb} = 25 °C	T_{amb} = 60 °C
Reverse voltage	V_R	max. 30 V	30 V
Peak reverse voltage	V_{RM}	max. 45 V	45 V
Forward current (d.c.) at $V_{RM\,max.}$	I_F	max. 10 mA	4 mA
Forward current (peak value)	I_{FM}	max.100 mA	100 mA
Non rep. peak forward current (t = 1 s)	I_{FSM}	max.200 mA	200 mA

CHARACTERISTICS T_{amb} = 25 °C

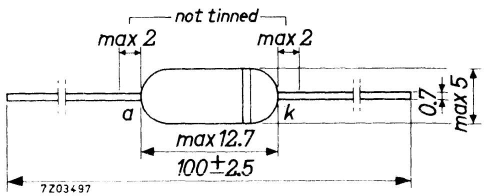
Forward voltage

I_F = 0.1 mA	V_F	typ. 0.2	V
I_F = 10 mA	V_F	typ. 1.4	V
I_F = 30 mA	V_F	typ. 2.4	V

Reverse current

V_R = 1.5 V	I_R	typ. 0.8	μA
V_R = 10 V	I_R	typ. 4.5	μA
V_R = 30 V	I_R	typ. 50	μA
V_R = 45 V	I_R	typ. 130	μA

MECHANICAL DATA Dimensions in mm



The white band indicates the cathode side.

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0164

GERMANIUM DIODE

Germanium diode in all glass construction for use in video detector circuits.

RATINGS (Limiting values) [1]

Continuous reverse voltage	V_R	max.	20	V
Peak reverse voltage	V_{RM}	max.	30	V
Forward current (d.c.)	I_F	max.	50	mA
Peak forward current	I_{FM}	max.	150	mA
Non repetitive peak forward current; t = 1 s	I_{FSM}	max.	400	mA
Operating ambient temperature	T_{amb}		−50 to +75	^{o}C

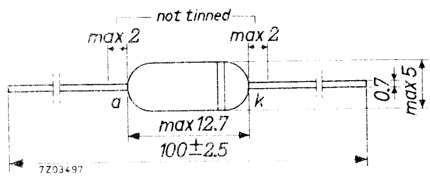
CHARACTERISTICS

Forward voltage at T_{amb} = 25 ^{o}C				
I_F = 0.1 mA	V_F	0.1 to	0.2	V
I_F = 8 mA	V_F	0.5 to	1.0	V
Reverse current at T_{amb} = 25 ^{o}C				
V_R = 1.5 V	I_R	1 to	18	μA
V_R = 10 V	I_R	8 to	100	μA
V_R = 20 V	I_R	25 to	400	μA
V_R = 30 V	I_R	45 to	1200	μA
Diode capacitance	C_d	typ.	1	pF

MECHANICAL DATA

Dimensions in mm

Net weight: 0.6 g



The white band indicates the cathode side

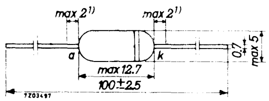
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0777

GERMANIUM DIODE in all glass construction for use in AM detection circuits
TYPE 2-OA79 consists of 2 diodes OA 79 selected for operation in a ratio detector circuit
DIODE A CRISTAL DE GERMANIUM de construction tout verre pour opération en circuits détecteur AM
LE TYPE 2-OA79 est composé de deux diodes OA 79 selectionnées pour opération en circuits détecteur ratio
GERMANIUMDIODE in Allglastechnik zur Verwendung in AM-Gleichrichterschaltungen
TYPENNUMMER 2-OA79 besteht aus 2 Dioden OA 79 die ausgesucht sind zur Verwendung in Ratiodetektorschaltungen

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

Valid at / Valable à / Gültig bei			
T_{amb}	=	25	60 °C
$-V_D$ (tav = 50 msec)	= max.	30	30 V
$-V_{DM}$	= max.	45	45 V[2)]
I_D (tav = 50 msec)	= max.	35	15 mA[2)]
I_{DM}	= max.	100	100 mA
I_{surge}	= max.	200	200 mA[3)]
T_{amb}	=	-50 °C/+ 60 °C	

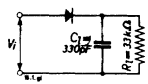
1) Not tinned
Non étamé
Nicht verzinnt

2) See page 4
Voir page 4
Siehe Seite 4

3) Max. duration 1 sec
Durée 1 sec. au max.
Max. Dauer 1 Sek.

Characteristics
Caractéristiques
Kenndaten

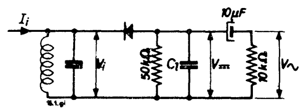
	T_{amb} = 25°C =	Min.	Max.	T_{amb} = 60°C =	Min.	Max.
V_D(I_D = 0,1 mA)	= 0,23	>0,15	<0,30	= 0,16	>0,1	<0,25 V
V_D(I_D = 10 mA)	= 1,5	>0,8	<2,2	= 1,4	>0,7	<2,1 V
V_D(I_D = 30 mA)	= 2,8	>1,4	<4,0	= 2,6	>1,2	<3,8 V
$-I_D$($-V_D$ = 0,1 V)	= 0,35		<1,0	= 4,5		<12 µA
$-I_D$($-V_D$ = 1,5 V)	= 0,8	>0,1	<2,8	= 6	>0,8	<25 µA
$-I_D$($-V_D$ = 10 V)	= 4,5	>0,4	<18	= 16	>2,5	<60 µA
$-I_D$($-V_D$ = 30 V)	= 35	>1,5	<150	= 60	>8	<300 µA
$-I_D$($-V_D$ = 45 V)	= 90	>4	<350	= 170	>15	<500 µA



T_{amb} = 25 °C
V_1 = 3 Veff
f = 10,7 Mc/s
η = 85 %
r_d = 15 kΩ >13,5 kΩ <19 kΩ

Operating characteristics as A.M. detector
Caractéristiques d'utilisation en détectrice A.M.
Betriebsdaten als AM-Signalgleichrichter

T_{amb} = 25 °C
V_1 = 0,1 Veff
f = 0,5 Mc/s
$V_=$ = 55 mV
$V_\sim$ = 4,5 mVeff [1)]
r_d = 40 kΩ [2)]

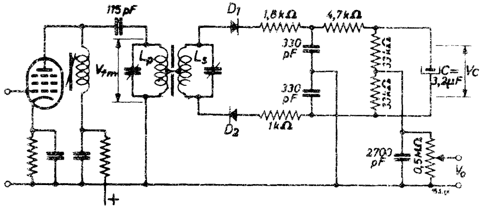


1) Ii 30 % modulated
Ii modulé de 30 %
Ii 30 % moduliert

2) Unmodulated input signal
Signal d'entrée non modulé
Nicht-moduliertes Eingangssignal

Operating characteristics of a matched pair 2-0A 79 as ratio detector
Caractéristiques d'utilisation d'une paire jumelle 2-0A 79 en détectrice ratio
Betriebsdaten eines Diodenpaars 2-0A 79 als Ratio-Detektor

T_{amb} = 25°C



For optimum **A.M.** suppression D_1 must be that diode of the matched pair which has the better dynamic forward characteristic

Afin d'obtenir la suppression A.M. optimum, D_1 sera cette diode de la paire jumelle qui a la meilleure caractéristique dynamique en sens conducteur

Zur Erhaltung der optimalen AM-Unterdrückung muss D_1 diejenige Diode des Diodenpaars sein die die beste dynamische Kennlinie in Durchlassrichtung hat

Primary circuit / Circuit primaire / Primärkreis	L_p	=	7,4 µH
	Q	=	80 [1]
	R	=	40 kΩ [1]
Tap / Prise / Anzapfung		=	0,5
Secundary circuit / Circuit secondaire / Sekundärkreis	L_s	=	4,4 µH
	Q	>	150 [1]
	R	>	45 kΩ [1]
KQ		=	0,8 [2]
f_o		=	10,7 Mc/s
Δf		=	15 kc/s
m		=	30 %
$\alpha \begin{Bmatrix} f = f_o \\ 2\ V < V_C < 20\ V \end{Bmatrix}$		≥	30
$\alpha \begin{Bmatrix} f = f_o \pm 25\ kc/s \\ 2\ V < V_C < 20\ V \end{Bmatrix}$		≥	15

f_o = resonance frequency; fréquence de résonance; Resonanzfrequenz
Δf = Frequency sweep; balayage de fréquence; Frequenzhub
m = AM modulation factor; facteur de modulation AM; AM-Modulationstiefe
α = AM suppression factor; coefficient de suppression AM; AM Unterdrückungsfaktor

1) Undamped / Non amorti / Ungedämpft

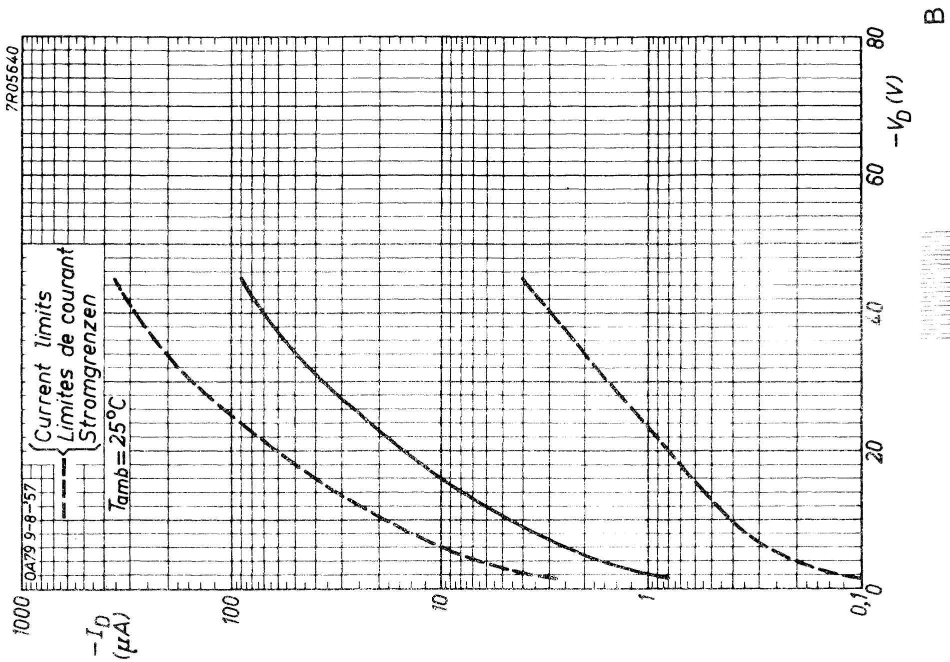
2) Measured in the circuit with V_{fm} = 350 mV / Mesuré dans le circuit avec V_{fm} = 350 mV / In der Schaltung mit V_{fm} = 350 mV gemessen

2) For the relation between simultaneously allowable maximum values of $-V_{DM}$ and I_D see the derating curve (page E.) Operation in accordance with this derating curve is prescribed. The derating curve is valid at $T_{amb} \leq 25$ °C. At higher temperatures an extra derating of I_D by a factor $\frac{25}{T_{amb}}$ is prescribed.

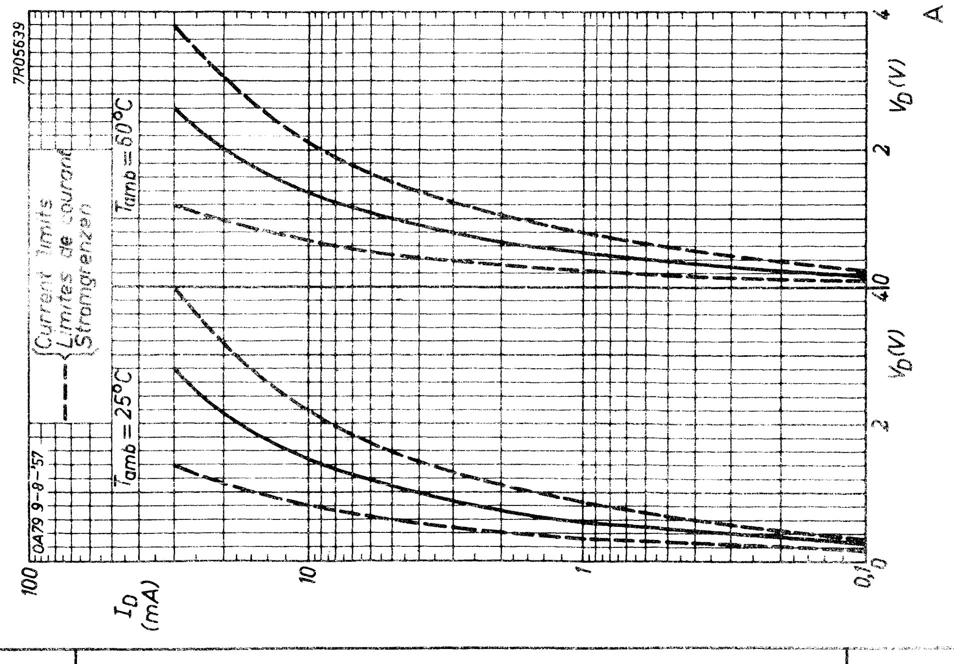
Pour le rapport entre les valeurs maximum de $-V_{DM}$ et I_D admissibles simultanément voir la courbe de réduction (page E). Une opération en accord avec cette courbe est prescrite. La courbe de réduction est valable à $T_{amb} \leq 25$ °C A des températures plus élevées une réduction supplémentaire de I_D par un facteur $\frac{25}{T_{amb}}$ est prescrite.

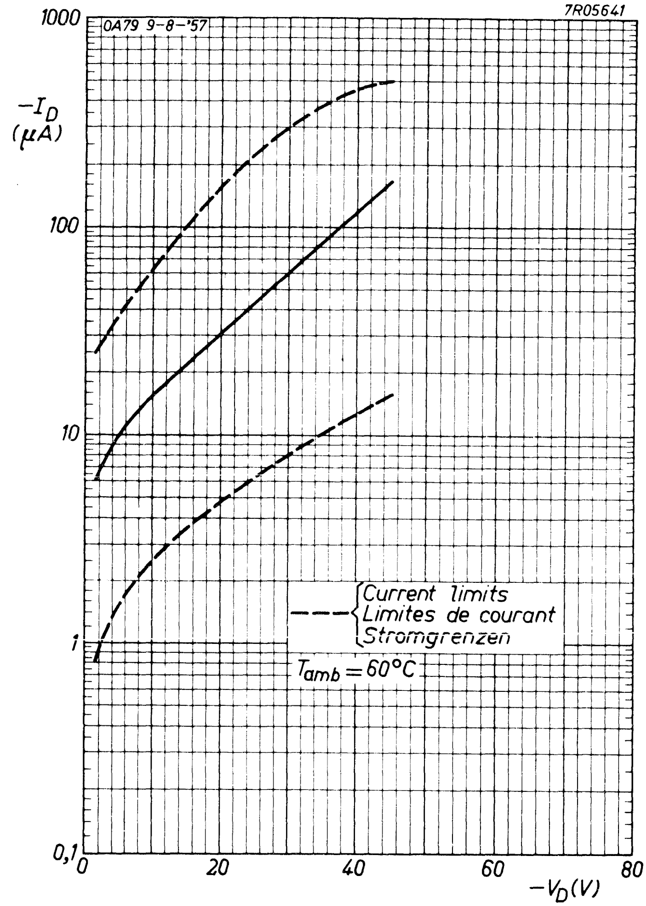
Für die Beziehung zwischen den gleichzeitig zulässigen Höchstwerten von $-V_{DM}$ und I_D siehe die Reduktionskurve (Seite E). Betrieb entsprechend dieser Kurve ist vorgeschrieben. Die Reduktionskurve ist gültig bei $T_{amb} \leq 25$ °C. Bei höheren Temperaturen ist eine zusätzliche Reduktion von I_D mit einem Faktor $\frac{25}{T_{amb}}$ vorgeschrieben.

B

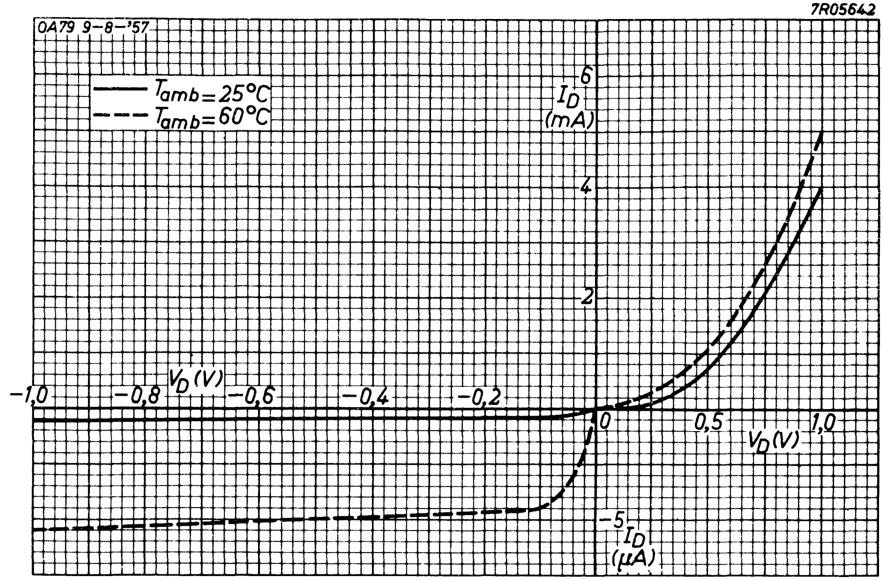

7R05640
OA79 9-8-'57
Current limits
Limites de courant
Stromgrenzen
Tamb = 25°C
−I_D (μA)
−V_D (V)
1000
100
10
1
0,1
0
20
40
60
80

A

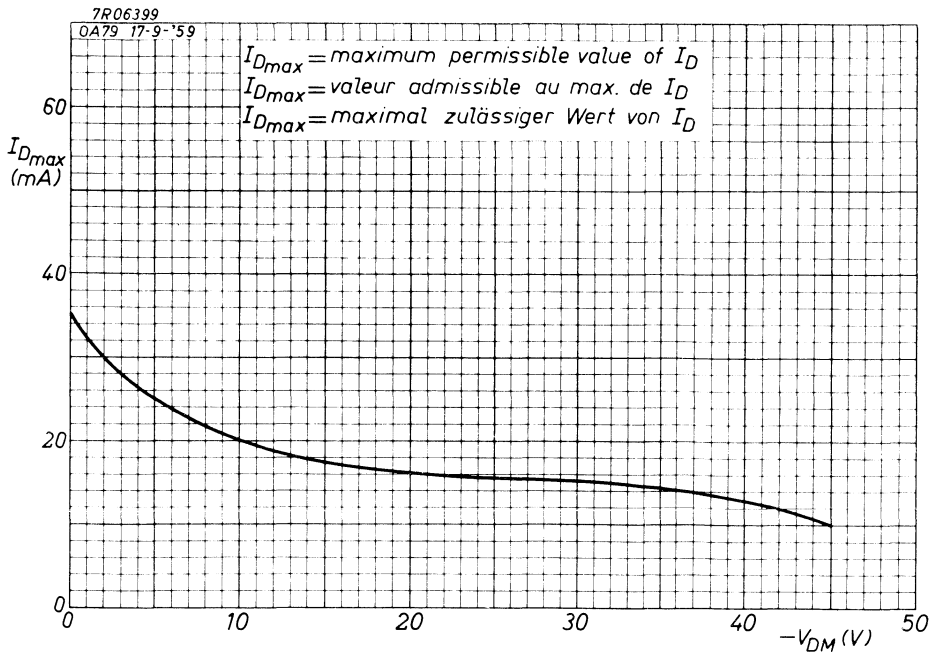

7R05639
OA79 9-8-'57
Current limits
Limites de courant
Stromgrenzen
Tamb = 25°C
Tamb = 60°C
I_D (mA)
V_D (V)
V_D (V)
100
10
1
0,1
0
2
4
0
2
4


7R05641
OA79 9-8-'57
$-I_D$ (μA)
1000
100
10
1
0,1
0
20
40
60
80
$-V_D$(V)
Current limits
Limites de courant
Stromgrenzen
$T_{amb} = 60°C$

C


7R05642
OA79 9-8-'57
T_{amb} = 25°C
T_{amb} = 60°C
I_D (mA)
6
4
2
V_D (V)
−1,0
−0,8
−0,6
−0,4
−0,2
0
0,5
1,0
V_D (V)
−5
I_D (μA)

D

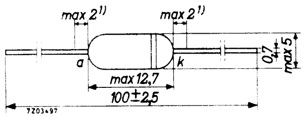

7R06399
OA79 17-9-'59
I_{Dmax} = maximum permissible value of I_D
I_{Dmax} = valeur admissible au max. de I_D
I_{Dmax} = maximal zulässiger Wert von I_D
60
I_{Dmax} (mA)
40
20
0
0
10
20
30
40
50
$-V_{DM}$ (V)

E

GERMANIUM DIODE in all glass construction for high inverse voltages
DIODE A CRISTAL DE GERMANIUM de construction tout verre pour des tensions inverses élevées
GERMANIUMDIODE in Allglastechnik für hohe Sperrspannungen

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

Valid at / Valable à / Gültig bei				
T_{amb}	=		25	75 °C
$-V_D$(t_{av} = max.50 msec)	= max.	90	75 V	
$-V_{DM}$	= max.	115	100 V [2)]	
I_D(t_{av} = max.50 msec)	= max.	50	17 mA[2)]	
I_{DM}	= max.	150	150 mA	
I_{surge}	= max.	500	500 mA[3)]	
T_{amb}	=	-50°C/+75 °C		

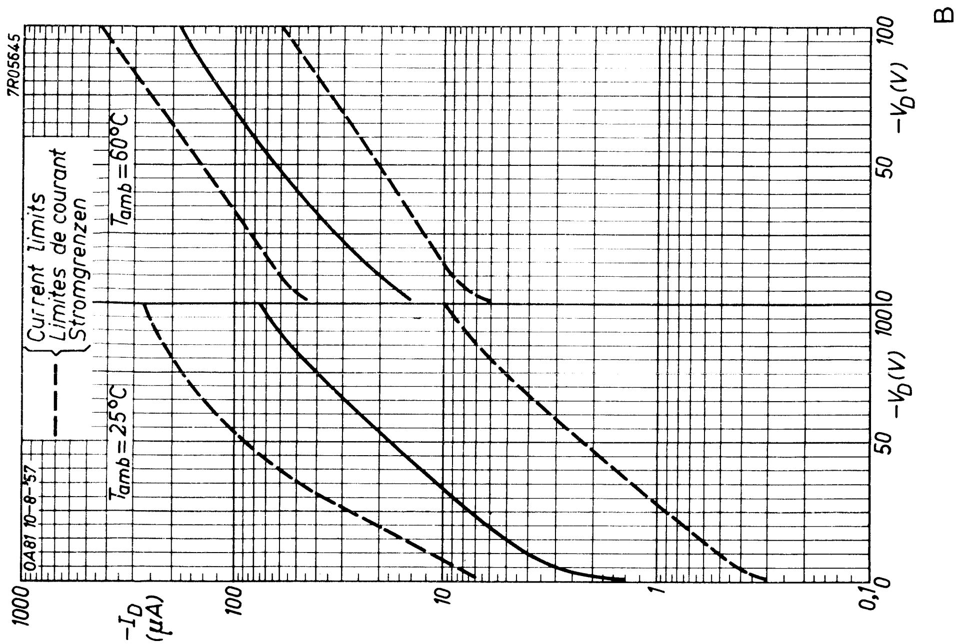
[1)] Not tinned; non étamé; nicht verzinnt

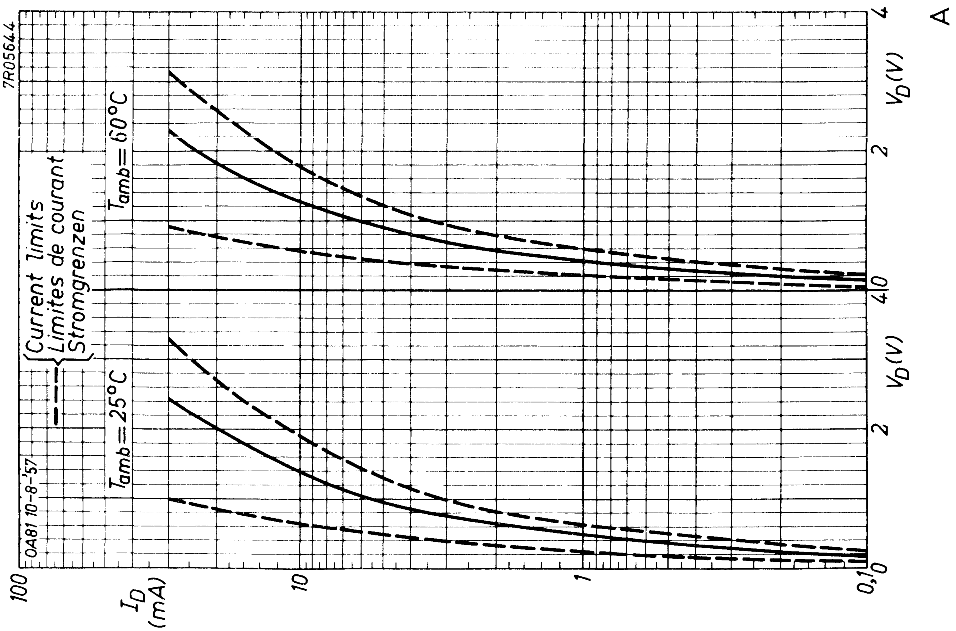
[2)] At page D derating curves are given representing the max. permissible value of I_D as a function of $-V_{DM}$ at T_{amb} = 25, 50 and 75 °C. At intermediate temperatures the max. permissible values of I_D can be found by linear interpolation
Sur la page D des courbes de réduction sont données représentant la valeur max. admissible de I_D en fonction de $-V_{DM}$ à T_{amb} = 25, 50 et 75 °C. A des températures intermédiaires les valeurs admissibles aux max. de I_D peuvent être trouvées par interpolation linéaire
Auf Seite D sind Reduktionskurven gegeben, die den max. zulässigen Wert von I_D als Funktion von $-V_{DM}$ bei T_{amb} = 25, 50 and 75 °C darstellen. Bei zwischenliegenden Temperaturen können die max. zulässigen Werte von I_D mittels linearer Interpolation gefunden werden

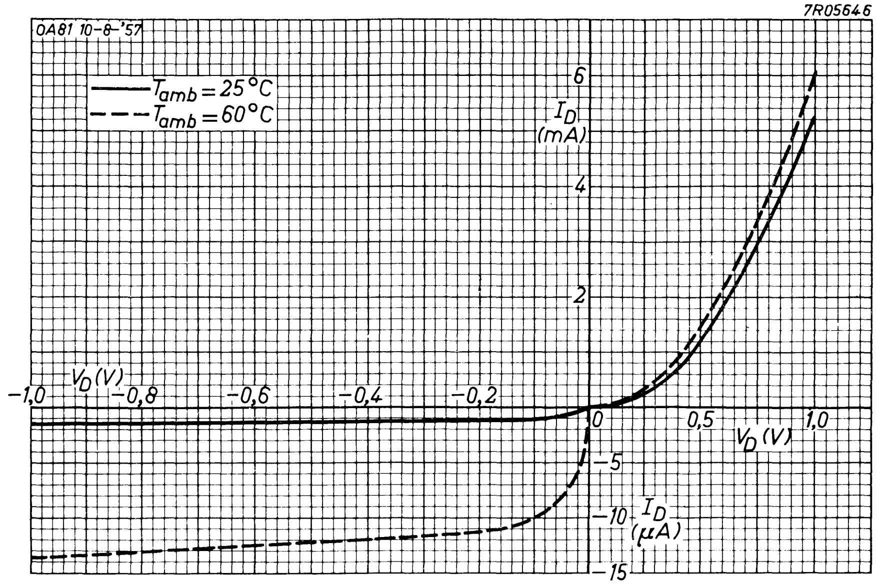
[3)] Max. duration 1 sec.; Durée 1 sec. au max.; Max.Dauer 1 Sek.

Characteristics
Caractéristiques
Kenndaten

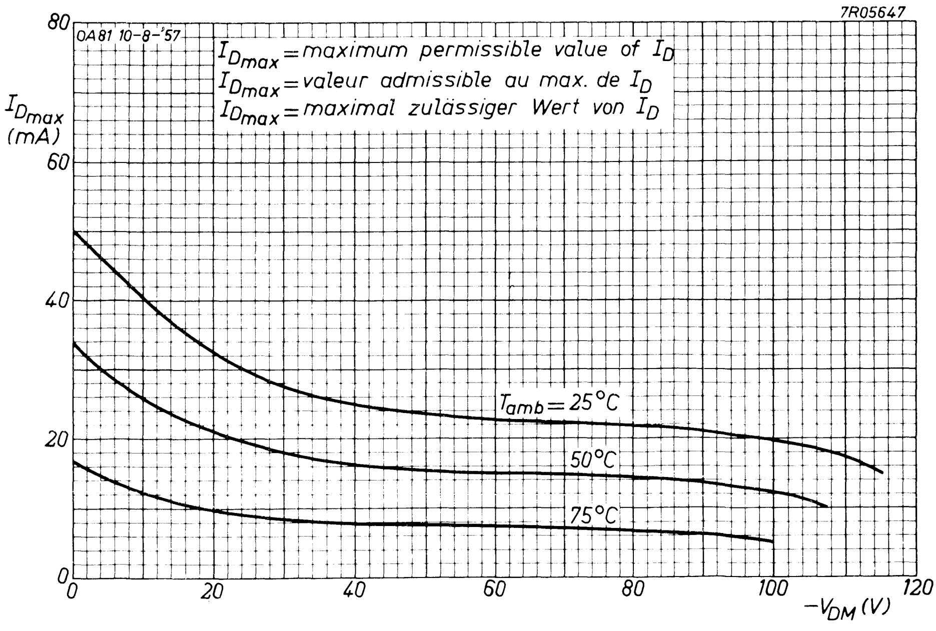
	T_{amb} = 25 °C			T_{amb} = 60 °C		
	=	Min.	Max.	=	Min.	Max.
V_D(I_D = 0,1 mA)	= 0,2	>0,1	<0,25	= 0,13	>0,05	<0,2 V
V_D(I_D = 10 mA)	= 1,4	>0,65	<1,9	= 1,3	>0,55	<1,8 V
V_D(I_D = 30 mA)	= 2,45	>1,0	<3,3	= 2,3	>0,9	<3,15 V
$-I_D$($-V_D$ = 1,5 V)	= 1,5	>0,3	<7	= 15	>6	<45 µA
$-I_D$($-V_D$ = 10 V)	= 4	>0,5	<11	= 20	>9	<60 µA
$-I_D$($-V_D$ = 75 V)	= 40	>5,5	<180	= 115	>35	<260 µA
$-I_D$($-V_D$ = 100 V)	= 75	>10	<275	= 190	>60	<450 µA


B
7R05645
OA81 10-8-'57
Current limits
Limites de courant
Stromgrenzen
$T_{amb}=60°C$
$T_{amb}=25°C$
$-I_D$ (μA)
$-V_D$ (V)
1000
100
10
1
0,1
0
50
100


A
7R05644
OA81 10-8-'57
Current limits
Limites de courant
Stromgrenzen
$T_{amb}=60°C$
$T_{amb}=25°C$
I_D (mA)
V_D (V)
100
10
1
0,1
0
2
4


7R05646
OA81 10-8-'57
T_{amb} = 25 °C
T_{amb} = 60 °C
I_D (mA)
6
4
2
V_D (V)
−1,0
−0,8
−0,6
−0,4
−0,2
0
0,5
1,0
V_D (V)
−5
−10
I_D (μA)
−15

C

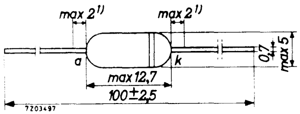

7R05647
OA81 10-8-'57
I_{Dmax} = maximum permissible value of I_D
I_{Dmax} = valeur admissible au max. de I_D
I_{Dmax} = maximal zulässiger Wert von I_D
I_{Dmax} (mA)
80
60
40
20
0
T_{amb} = 25 °C
50 °C
75 °C
0
20
40
60
80
100
120
$-V_{DM}$ (V)

D

GERMANIUM DIODE in all glass construction for high inverse voltages
DIODE A CRISTAL DE GERMANIUM de construction tout verre pour des tensions inverses élevées
GERMANIUMDIODE in Allglastechnik für hohe Sperrspannungen

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

Valid at / Valable à / Gültig bei				
T_{amb}	=	25	75	°C
$-V_D$(tav = max.50 msec)	= max.	90	75	V
$-V_{DM}$	= max.	115	100	V [2)]
I_D(tav = max.50 msec)	= max.	50	17	mA [2)]
I_{DM}	= max.	150	150	mA
I_{surge}	= max.	500	500	mA [3)]
T_{amb}	=	-50°C/+75		°C

[1)] Not tinned; non étamé; nicht verzinnt

[2)] At page D derating curves are given representing the max. permissible value of I_D as a function of $-V_{DM}$ at T_{amb} = 25, 50 and 75 °C. At intermediate temperatures the max. permissible values of I_D can be found by linear interpolation
Sur la page D des courbes de réduction sont données représentant la valeur max. admissible de I_D en fonction de $-V_{DM}$ à T_{amb} = 25, 50 et 75 °C. A des températures intermédiaires les valeurs admissibles aux max. de I_D peuvent être trouvées par interpolation linéaire
Auf Seite D sind Reduktionskurven gegeben, die den max. zulässigen Wert von I_D als Funktion von $-V_{DM}$ bei T_{amb} = 25, 50 and 75 °C darstellen. Bei zwischenliegenden Temperaturen können die max. zulässigen Werte von I_D mittels linearer Interpolation gefunden werden

[3)] Max. duration 1 sec.; Durée 1 sec. au max.; Max.Dauer 1 Sek.

939 2476

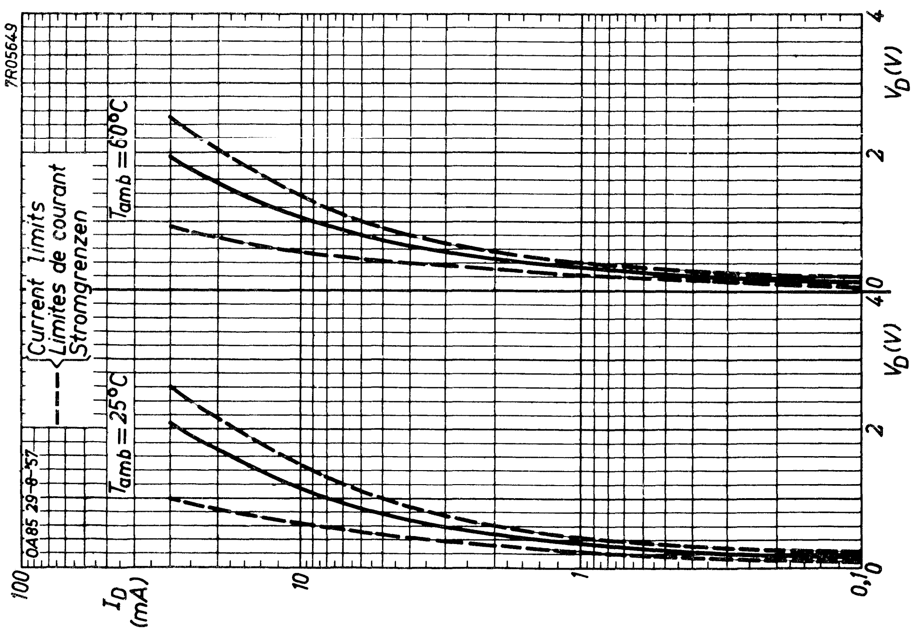
Characteristics
Caractéristiques
Kenndaten

	T_{amb} = 25 °C			T_{amb} = 60 °C		
	=	Min.	Max.	=	Min.	Max.
V_D (I_D = 0,1 mA)	= 0,2	>0,1	<0,25	= 0,13	>0,05	<0,2 V
V_D (I_D = 10 mA)	=1,15	>0,65	<1,5	= 1,05	>0,55	<1,4 V
V_D (I_D = 30 mA)	=2,05	>1,0	<2,6	= 1,95	>0,9	<2,5 V
$-I_D$ ($-V_D$ = 1,5 V)	= 1,2	>0,4	<4,5	= 12	>5,5	<26 µA
$-I_D$ ($-V_D$ = 10 V)	= 2,5	>0,8	<7	= 17	>8	<40 µA
$-I_D$ ($-V_D$ = 75 V)	= 35	>5,7	<110	= 100	>20	<250 µA
$-I_D$ ($-V_D$ = 100 V)	= 75	>10	<250	= 190	>30	<430 µA

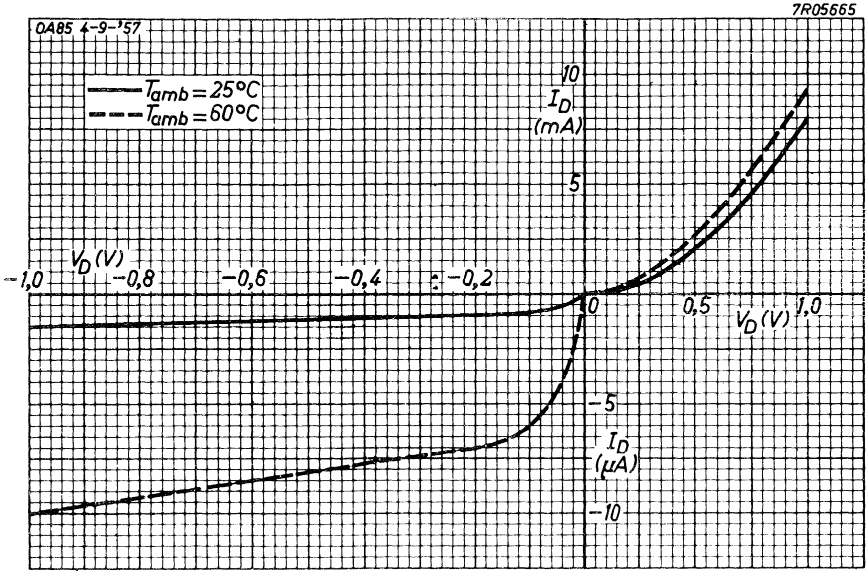
939 2478


7R05666
OA85 4-9-'57
Current limits
Limites de courant
Stromgrenzen
$T_{amb} = 25°C$
$T_{amb} = 60°C$
$-I_D$ (μA)
$-V_D$ (V)
1000
100
10
1
0,1
0
50
100

B

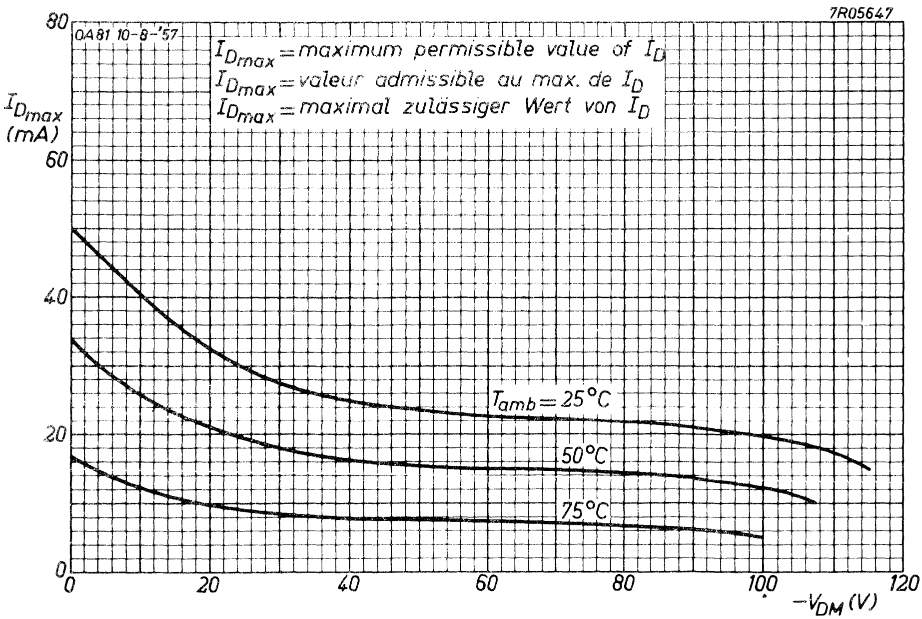

7R05649
OA85 29-8-'57
Current limits
Limites de courant
Stromgrenzen
$T_{amb} = 25°C$
$T_{amb} = 60°C$
I_D (mA)
V_D (V)
100
10
1
0,1
0
2
4

A



7R05665
OA85 4-9-'57
T_{amb} = 25°C
T_{amb} = 60°C
I_D (mA)
V_D (V)
I_D (μA)
-1,0
-0,8
-0,6
-0,4
-0,2
0
0,5
1,0
10
5
-5
-10

C



7R05647
OA81 10-8-'57
I_{Dmax} = maximum permissible value of I_D
I_{Dmax} = valeur admissible au max. de I_D
I_{Dmax} = maximal zulässiger Wert von I_D
I_{Dmax} (mA)
T_{amb} = 25°C
50°C
75°C
$-V_{DM}$ (V)
0
20
40
60
80
100
120

D

GERMANIUM DIODES

Germanium diodes in all glass construction for use in computers.

RATINGS (Limiting values) [1]

		T_{amb} = 25 °C	T_{amb} = 60 °C
Reverse voltage	V_R	max. 60 V	60 V
Peak reverse voltage	V_{RM}	max. 90 V	90 V
Forward current	I_F	max. 35 mA	15 mA
Peak forward current	I_{FM}	max. 150 mA	150 mA

CHARACTERISTICS

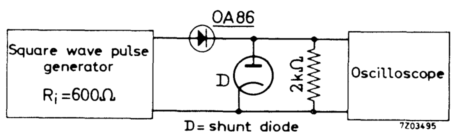
		T_{amb} = 25 °C	T_{amb} = 60 °C
Forward voltage			
I_F = 5 mA	V_F	typ 0.78 V	typ 0.72 V
		0.6 to 1 V	0.5 to 0.95 V
I_F = 30 mA	V_F	typ 2.15 V	typ 1.9 V
		1.5 to 3 V	1.3 to 2.8 V
Reverse current			
V_R = 10 V	I_R	typ 2.5 μA	typ 20 μA
		0.8 to 7 μA	6 to 40 μA
V_R = 60 V	I_R	typ 35 μA	typ 75 μA
		5.7 to 92 μA	25 to 200 μA

Reverse recovery time, when switched from I_F = 30 mA to V_R = 35 V

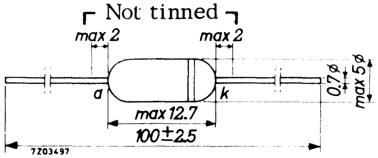
Measured at I_R = 700 μA t_{rr} < 0.5 μs
Measured at I_R = 87.5 μA t_{rr} < 3.5 μs

Test circuit

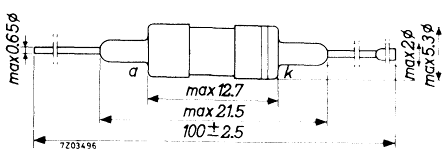
Pulse: f = 50 kHz
δ = 0.5
t_r < 0.1 μs
Oscilloscope: C_{inp} = 40 pF
t_r < 25 ns



MECHANICAL DATA



The white band indicates the cathode side



Clip-in execution (OA86C)

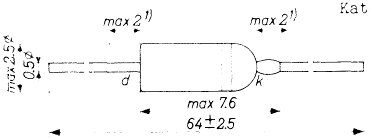
[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0202

GERMANIUM DIODE in miniature all glass construction for use as video detector
Type 2-OA90 consists of 2 diodes OA90 selected for operation in a ratio detector circuit

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

T_{amb} = 75 °C

$-V_D$ (t_{av} = max. 50 msec)	= max.	20 V
$-V_{DM}$	= max.	30 V
$-V_{Dsurge}$	= max.	40 V 2)
I_D (t_{av} = max. 50 msec)	= max.	8 mA 3)
I_{DM}	= max.	45 mA
I_{Dsurge} (t = max. 1 sec)	= max.	200 mA
T_{amb}	=	-55 °C/+75 °C

Storage temperature
Température d'emmagasinage = -55 °C/+90 °C
Lagerungstemperatur

1) Not tinned; non étamé; nicht verzinnt

2) Allowable in a video detector circuit. See also page F.
Admis dans un circuit détecteur vidéo. Voir aussi page F.
Erlaubt in einer Video-Demodulationsschaltung. Siehe auch Seite F.

3) At the max. allowed value of $-V_{DM}$
A la valeur max. admissible de $-V_{DM}$
Bei dem max. zulässigen Wert von $-V_{DM}$

7Z2 3943 1

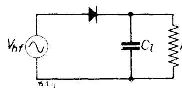
Characteristics
Caractéristiques
Kenndaten

Statical
Statique
Statisch

	T_{amb} = 25 °C			T_{amb} = 60 °C		
	=	min.	max.	=	min.	max.
V_D(I_D=0,1 mA)	=0,18	>0,1	<0,25	=0,12	-	<0,20 V
V_D(I_D= 10 mA)	= 1,0	>0,5	<1,5	=0,95	>0,4	<1,4 V
V_D(I_D= 30 mA)	= 2,0	>1,1	<3,2	=1,95	>1,0	<3,1 V
$-I_D$($-V_D$=1,5 V)	= 2,4	-	<10	= 11	-	<40 µA
$-I_D$($-V_D$= 10 V)	= 20	-	<135	= 45	-	<270 µA
$-I_D$($-V_D$= 20 V)	= 90	-	<450	= 140	-	<650 µA
$-I_D$($-V_D$= 30 V)	= 300	-	<1100	= 400	-	<1500 µA

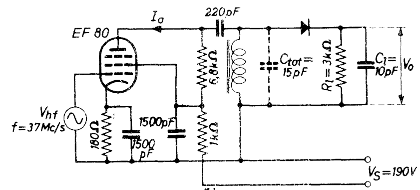
Dynamical
Dynamique
Dynamisch

T_{amb} = 25 °C



Vhfm	=	5	1,4	0,5	5 V
R	=	3	3	3	3,9 kΩ
C	=	10	10	10	10 pF
f	=	40	40	40	30 Mc/s
η	=	63	54	34	>60 %
rd	=	2,4	2,8	3,7	>2,9 kΩ

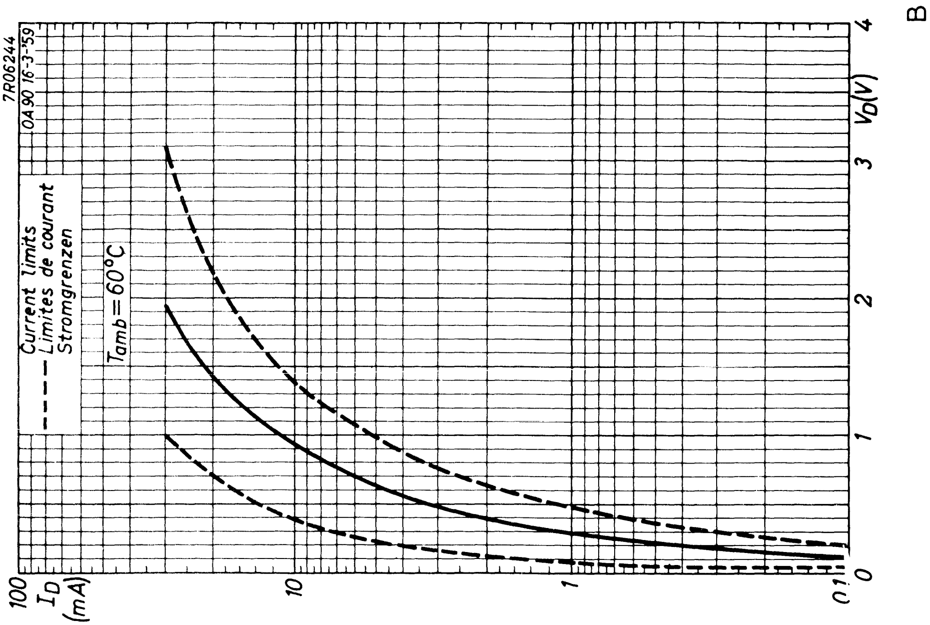
Operating characteristics for use as video detector
Caractéristiques d'utilisation en détectrice vidéo
Betriebsdaten als Video-Demodulator

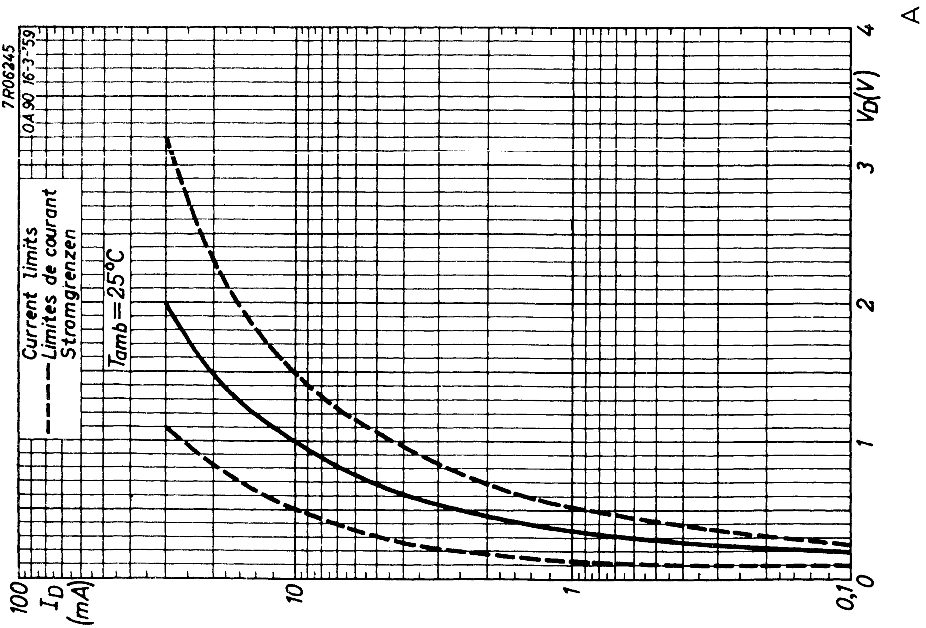


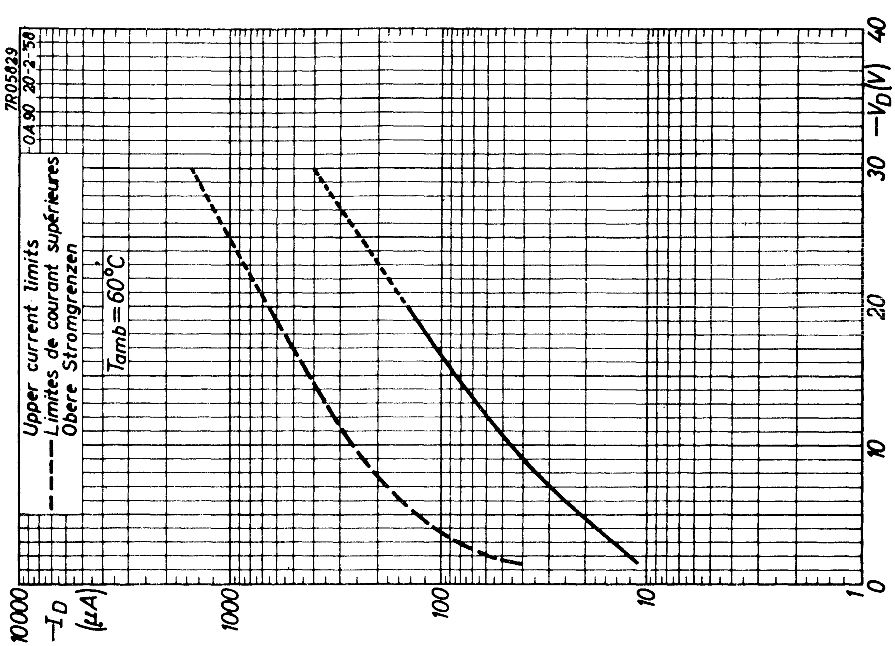
Q of the tuned circuit = 19 (diode removed)
Q du circuit accordé = 19 (diode éloignée)
Q des abgestimmten Kreises = 19 (Diode entfernt)

I_{am}	=	2,5	0,25	mA
V_o	=	2,7	0,20	V
B	=	4,7	4,1	Mc/s

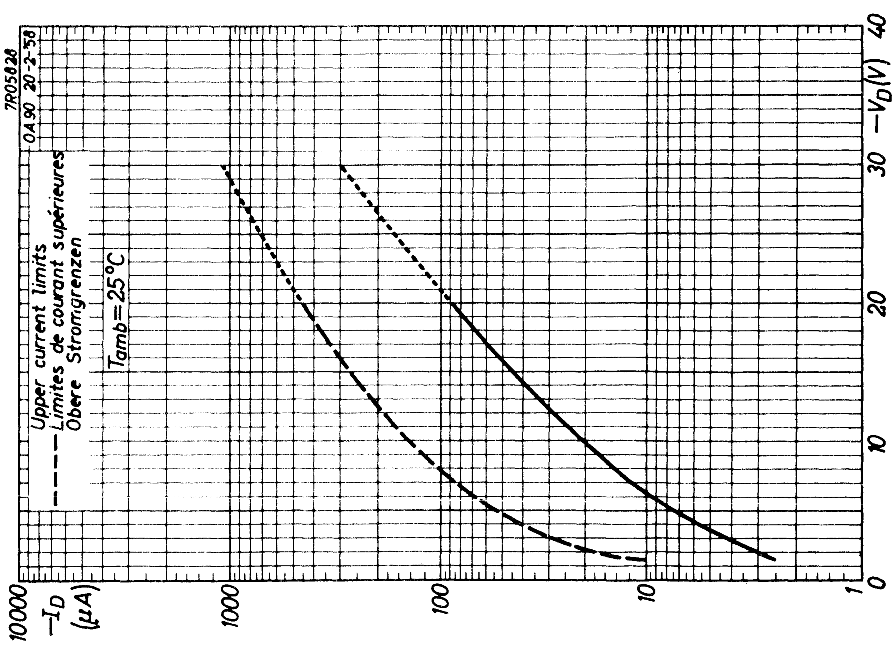
938 2910 2.


7R06244
OA 90 16-3-'59
Current limits
Limites de courant
Stromgrenzen
Tamb=60°C
100
I_D
(mA)
10
1
0,1
0
1
2
3
4
V_D(V)
B


7R06245
OA 90 16-3-'59
Current limits
Limites de courant
Stromgrenzen
Tamb=25°C
100
I_D
(mA)
10
1
0,1
0
1
2
3
4
V_D(V)
A

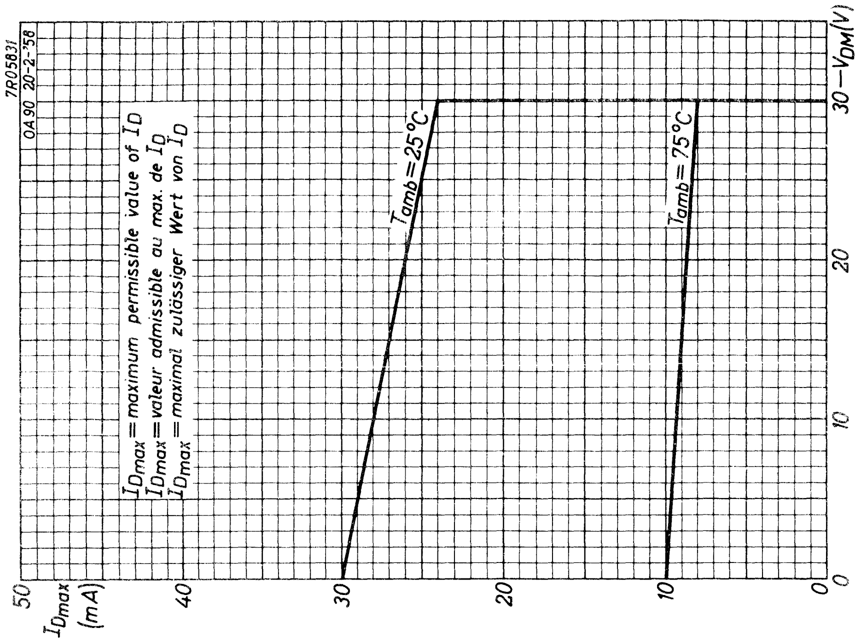

7R05829 OA90 20-2-'58
Upper current limits
Limites de courant supérieures
Obere Stromgrenzen
Tamb=60°C
$-I_D$ (μA)
10000
1000
100
10
1
$-V_D$(V)
0
10
20
30
40

D

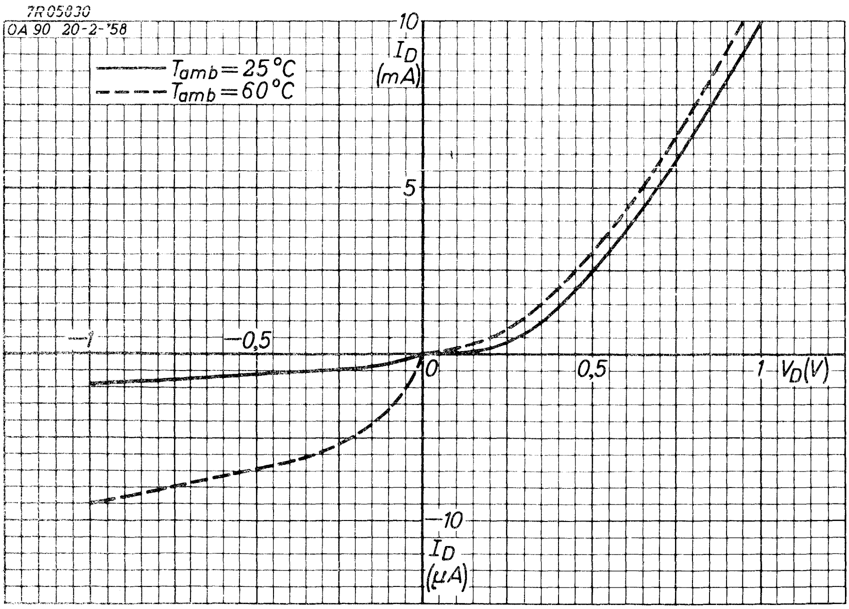

7R05828 OA90 20-2-'58
Upper current limits
Limites de courant supérieures
Obere Stromgrenzen
Tamb=25°C
$-I_D$ (μA)
10000
1000
100
10
1
$-V_D$(V)
0
10
20
30
40

C

F


7R05831
OA 90 20-2-'58
I_{Dmax} = maximum permissible value of I_D
I_{Dmax} = valeur admissible au max. de I_D
I_{Dmax} = maximal zulässiger Wert von I_D
T_{amb} = 25°C
T_{amb} = 75°C
30 — V_{DM}(V)
20
10
0
50
I_{Dmax} (mA)
40
30
20
10
0

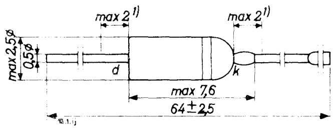
E


7R05830
OA 90 20-2-'58
T_{amb} = 25°C
T_{amb} = 60°C
10
I_D (mA)
5
−1
−0,5
0
0,5
1 V_D(V)
−10
I_D (μA)

GENERAL PURPOSE GERMANIUM DIODE in miniature all glass construction for high inverse voltages
DIODE A CRISTAL DE GERMANIUM de construction tout verre miniature pour les usages généraux à tension inverse élevée
ALLZWECKGERMANIUMDIODE in Miniatur-Allglasausführung für hohe Sperrspannungen

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

Valid at / Valable à / Gültig bei			25	75 °C
$-V_D$ (t_{av} = max. 50 msec)	=	max.	90	75 V
$-V_{DM}$	=	max.	115	100 V
I_D (t_{av} = max. 50 msec)	=	max.	50	17 mA 2)
I_{DM}	=	max.	150	150 mA
I_{Dsurge} (t = max. 1 sec)	=	max.	500	500 mA
T_{amb}	=		-55°C/+75°C	
Storage temperature / Température d'emmagasinage / Lagerungstemperatur			-55°C/+75°C	

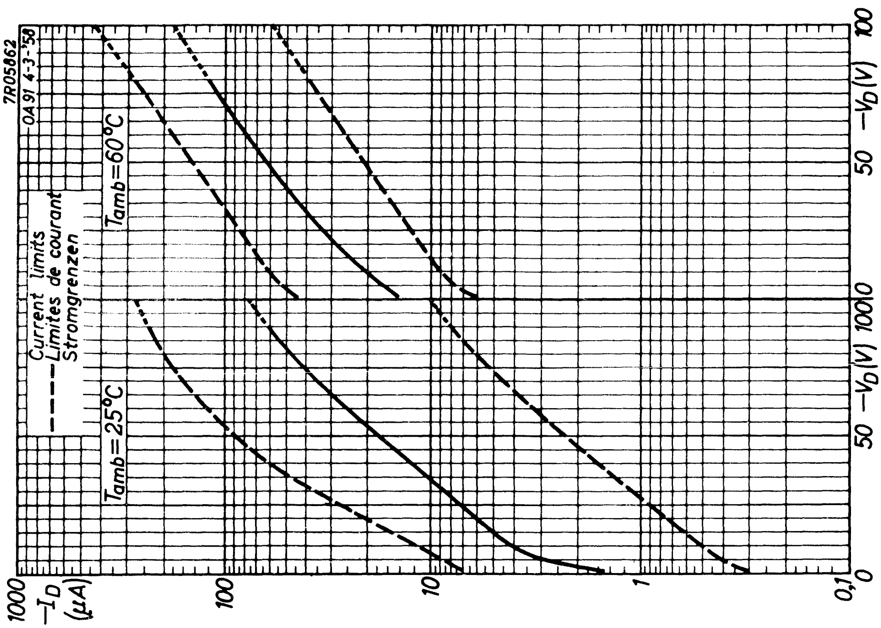
1) Not tinned; non étamé; nicht verzinnt

2) At page D derating curves are given representing the max. permissible value of I_D as a function of $-V_{DM}$ at T_{amb} = 25, 50 and 75 °C. At intermediate temperatures the max.permissible values of I_D can be found by linear interpolation
Sur la page D des courbes de réduction sont données représentant la valeur max.admissible de I_D en fonction de $-V_{DM}$ à T_{amb} = 25, 50 et 75 °C. A des températures intermédiaires les valeurs admissibles aux max. de I_D peuvent être trouvées par interpolation linéaire
Auf Seite D sind Reduktionskurven gegeben, die den max. zulässigen Wert von I_D als Funktion von $-V_{DM}$ bei T_{amb} = 25, 50 und 75 °C darstellen. Bei zwischenliegenden Temperaturen können die max. zulässigen Werte von I_D mittels linearer Interpolation gefunden werden

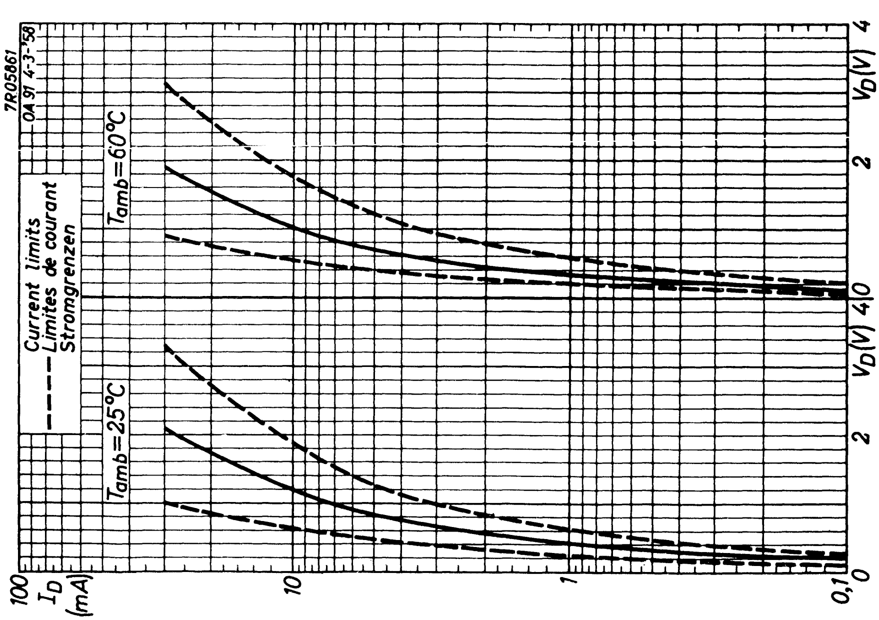
Characteristics
Caractéristiques
Kenndaten

Thermal resistance (junction to free air)
Résistance thermique (de la jonction jusqu'à l'air libre)
Thermischer Widerstand (vom Kristall bis freier Luft)
K = max.0,4 °C/mW

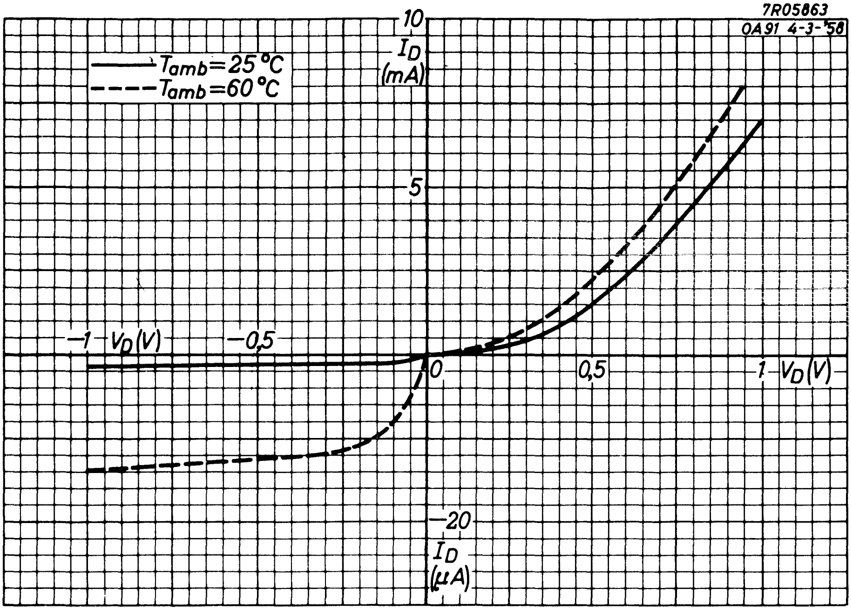
	T_{amb} = 25 °C			T_{amb} = 60 °C		
	=	min.	max.	=	min.	max.
V_D (I_D = 0,1 mA)	=0,18	> 0,1	<0,25	= 0,1	>0,05	<0,2 V
V_D (I_D = 10 mA)	= 1,2	>0,65	< 1,9	=1,05	>0,55	<1,8 V
V_D (I_D = 30 mA)	= 2,1	> 1,0	< 3,3	= 1,9	> 0,9	<3,15 V
$-I_D$ ($-V_D$ = 1,5 V)	= 1,5	> 0,3	< 7	= 15	> 6	< 45 µA
$-I_D$ ($-V_D$ = 10 V)	= 4	> 0,5	< 11	= 20	> 9	< 60 µA
$-I_D$ ($-V_D$ = 75 V)	= 40	> 5,5	< 180	= 115	> 35	<260 µA
$-I_D$ ($-V_D$ = 100 V)	= 75	> 10	< 275	= 190	> 60	<450 µA


7R05862
OA 91 4-3-'58
Current limits
Limites de courant
Stromgrenzen
T_{amb}=25°C
T_{amb}=60°C
$-I_D$ (μA)
1000
100
10
1
0,1
0
50
100
$-V_D$(V)

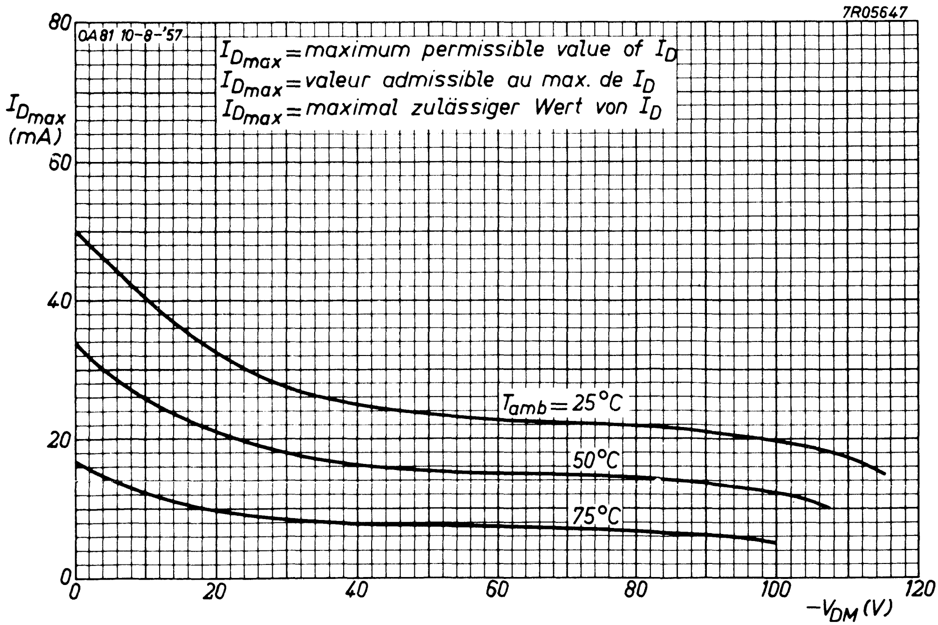
B


7R05861
OA 91 4-3-'58
Current limits
Limites de courant
Stromgrenzen
T_{amb}=25°C
T_{amb}=60°C
I_D (mA)
100
10
1
0,1
0
2
4
V_D(V)

A


7R05863
OA91 4-3-'58
T_{amb}=25 °C
T_{amb}=60 °C
10
I_D
(mA)
5
−1 V_D(V)
−0,5
0
0,5
1 V_D(V)
−20
I_D
(μA)

C


7R05647
OA81 10-8-'57
I_{Dmax} = maximum permissible value of I_D
I_{Dmax} = valeur admissible au max. de I_D
I_{Dmax} = maximal zulässiger Wert von I_D
I_{Dmax}
(mA)
80
60
40
20
0
0
20
40
60
80
100
120
$-V_{DM}$ (V)
T_{amb} = 25 °C
50 °C
75 °C

D

GERMANIUM DIODE

Germanium diode in subminiature allglass DO-7 envelope, intended for switching applications.

RATINGS (Limiting values) T_{amb} = 75 °C

Continuous reverse voltage	V_R	max.	15	V
Repetitive peak reverse voltage	V_{RRM}	max.	15	V
Non repetitive peak reverse voltage ($t \leq 1$ s)	V_{RSM}	max.	20	V
Average forward current	I_{FAV}	max.	7	mA
Forward current (d.c.)	I_F	max.	10	mA
Repetitive peak forward current	I_{FRM}	max.	50	mA
Non repetitive peak forward current ($t < 1$ s)	I_{FSM}	max.	100	mA
Operating ambient temperature	T_{amb}	max.	75	°C
Storage temperature	T_{stg}		−55 to +90	°C

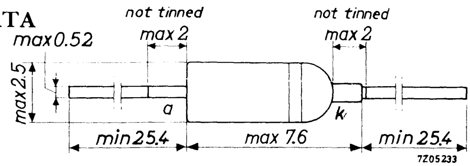
THERMAL RESISTANCE

From junction to ambient	$R_{th\ j-a}$	=	0.55	°C/mW

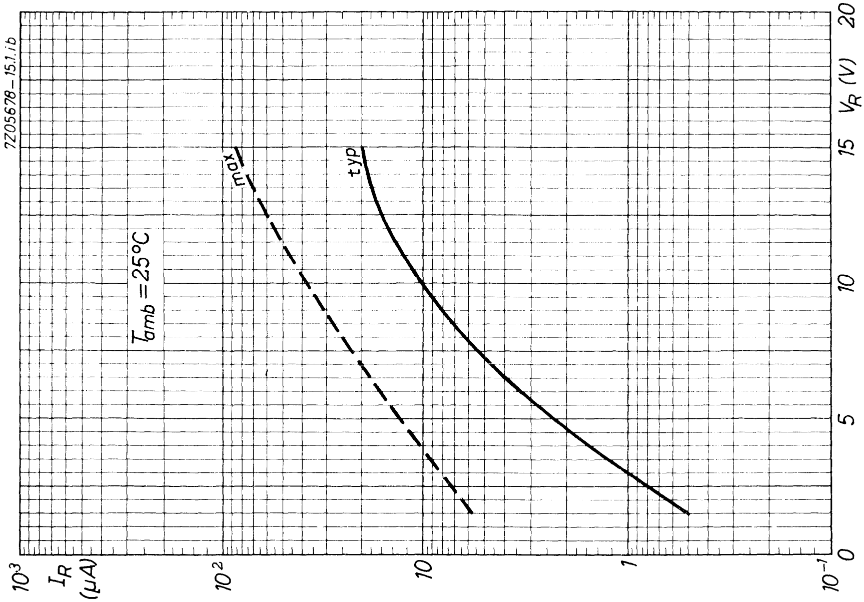
CHARACTERISTICS

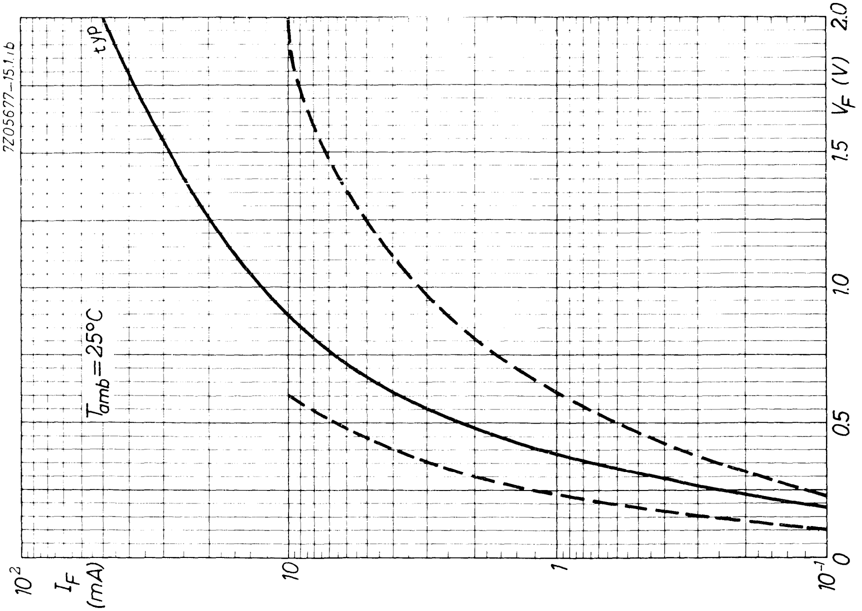
Forward voltage at T_{amb} = 25 °C				
I_F = 3 mA	V_F	typ.	0.55	V
			0.30 to 1.00	V
Reverse current at T_{amb} = 60 °C				
V_R = 15 V	I_R	typ.	40	µA
		<	155	µA
Reverse recovery current when switched from I_F = 5 mA to V_R = 5 V; T_{amb} = 25 °C				
measured at t_{rr} = 0.5 µs	I_R	typ.	80	µA
		<	300	µA
measured at t_{rr} = 3.5 µs	I_R	typ.	15	µA
		<	60	µA
Diode capacitance at f = 0.5 MHz				
V_R = 0.75 V; T_{amb} = 25 °C	C_d	<	0.5	pF

MECHANICAL DATA Dimensions in mm



The white band indicates the cathode side 7Z3 0569

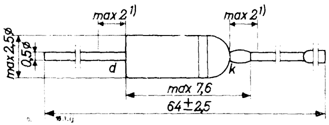

7Z05678–15.1.ib
T_{amb} = 25°C
max
typ
V_R (V)
0
5
10
15
20
I_R (μA)
10^3
10^2
10
1
10^{-1}


7Z05677–15.1.ib
T_{amb} = 25°C
typ
V_F (V)
0
0.5
1.0
1.5
2.0
I_F (mA)
10^2
10
1
10^{-1}

GENERAL PURPOSE GERMANIUM DIODE in miniature all glass construction for high inverse voltages
DIODE A CRISTAL DE GERMANIUM de construction tout verre miniature pour les usages généraux à tension inverse élevée
ALLZWECKGERMANIUMDIODE in Miniatur-Allglasausführung für hohe Sperrspannungen

Dimensions in mm
Dimensions en mm
Abmessungen in mm

The white band indicates the position of the cathode
L'anneau blanc marque la position de la cathode
Der weisse Ring indiziert die Katodenseite



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

Valid at / Valable à / Gültig bei	T_{amb} =	25	75	°C
$-V_D$ (t_{av} = max. 50 msec)	= max.	90	75	V
$-V_{DM}$	= max.	115	100	V
I_D (t_{av} = max. 50 msec)	= max.	50	17	mA 2)
I_{DM}	= max.	150	150	mA
I_{Dsurge} (t = max. 1 sec)	= max.	500	500	mA
T_{amb}	=	-55°C/+75°C		
Storage temperature / Température d'emmagasinage / Lagerungstemperatur	=	-55°C/+75°C		

1) Not tinned; non étamé; nicht verzinnt

2) At page E derating curves are given representing the max. permissible value of I_D as a function of $-V_{DM}$ at T_{amb} = 25, 50 and 75 °C. At intermediate temperatures the max. permissible values of I_D can be found by linear interpolation
Sur la page E des courbes de réduction sont données représentant la valeur max.admissible de I_D en fonction de $-V_{DM}$ à T_{amb} = 25, 50 et 75 °C. A des températures intermédiaires les valeurs admissibles aux max. de I_D peuvent être trouvées par interpolation linéaire
Auf Seite E sind Reduktionskurven gegeben, die den max. zulässigen Wert von I_D als Funktion von $-V_{DM}$ bei T_{amb} = 25, 50 und 75 °C darstellen. Bei zwischenliegenden Temperaturen können die max. zulässigen Werte von I_D mittels linearer Interpolation gefunden werden

938 2913

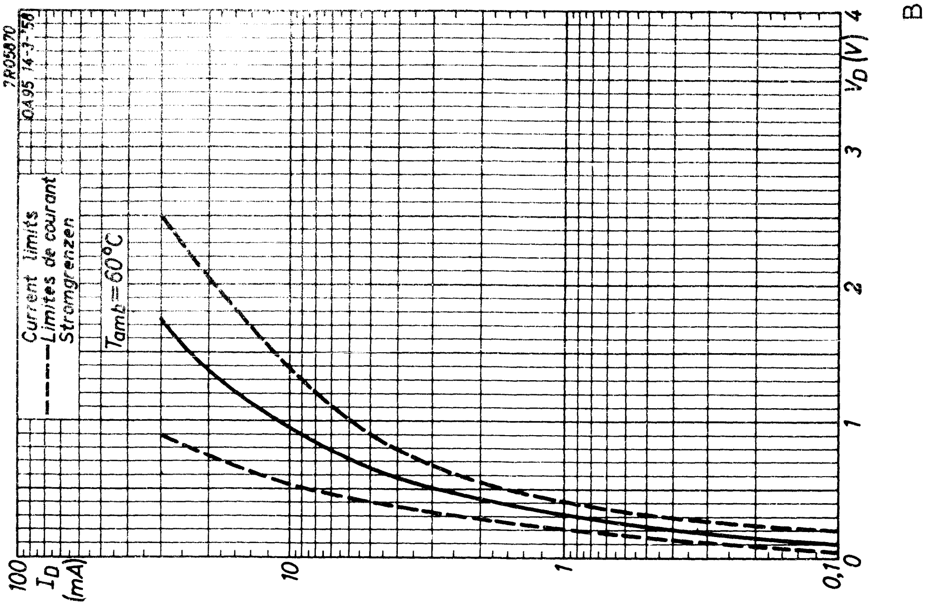
Characteristics
Caractéristiques
Kenndaten

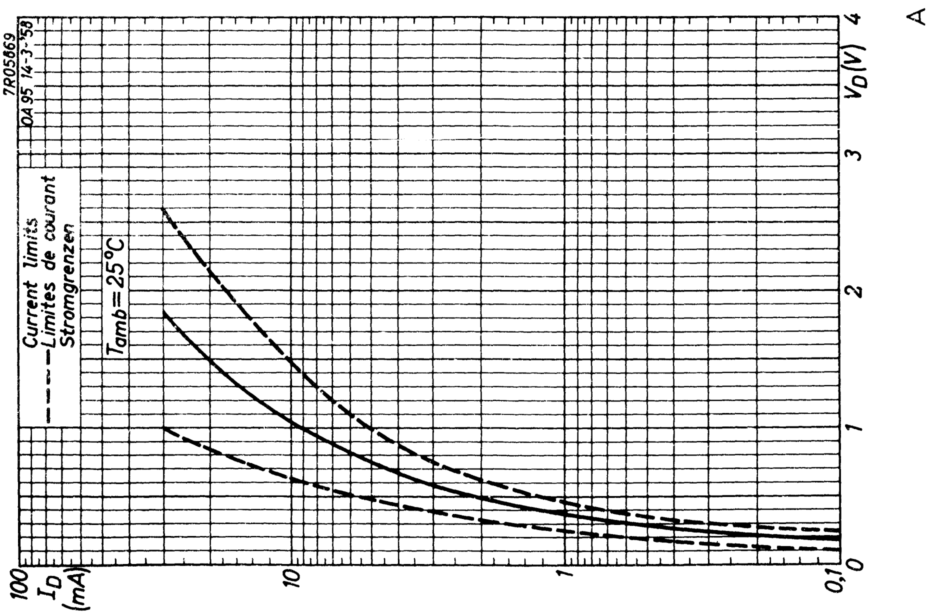
Thermal resistance (junction to free air)
Résistance thermique (de la jonction jusqu'à l'air libre)
Thermischer Widerstand (vom Kristall bis freier Luft)

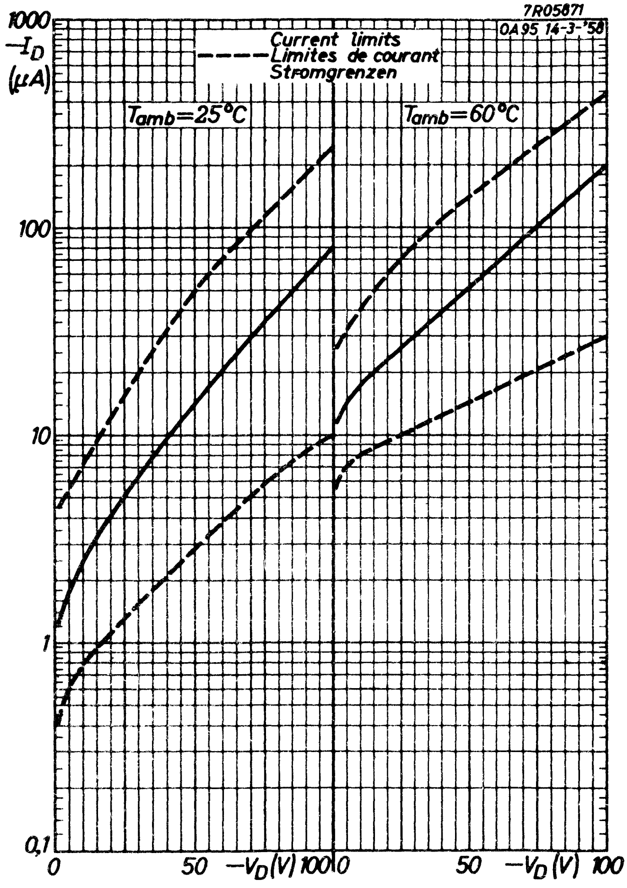
K = max. 0,4 °C/mW

	T_{amb} = 25 °C			T_{amb} = 60 °C		
	=	min.	max.	=	min.	max.
V_D(I_D = 0,1 mA)	=0,18	>0,1	<0,25	= 0,1	>0,05	< 0,2 V
V_D(I_D = 10 mA)	=1,05	>0,65	<1,5	=0,95	>0,55	< 1,4 V
V_D(I_D = 30 mA)	=1,85	>1,0	<2,6	=1,75	>0,9	< 2,5 V
$-I_D$($-V_D$ = 1,5 V)	= 1,2	>0,4	<4,5	= 12	>5,5	< 26 µA
$-I_D$($-V_D$ = 10 V)	= 2,5	>0,8	< 7	= 17	> 8	< 40 µA
$-I_D$($-V_D$ = 75 V)	= 35	>5,7	<110	= 100	> 20	< 250 µA
$-I_D$($-V_D$ = 100 V)	= 80	> 10	<250	= 200	> 30	< 430 µA

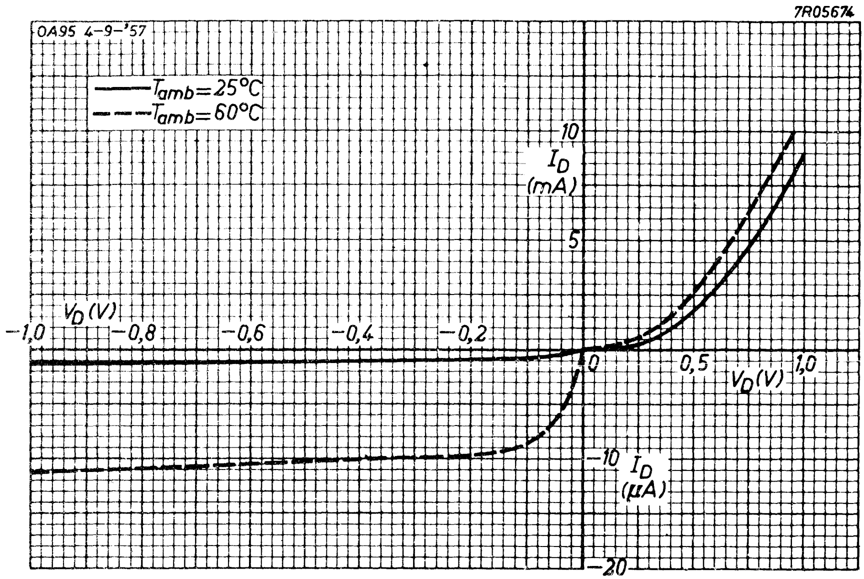
938 2914


7R05870
OA95 14-3-'58
Current limits
Limites de courant
Stromgrenzen
T_{amb}=60°C
I_D (mA)
100
10
1
0,1
V_D (V)
0
1
2
3
4
B

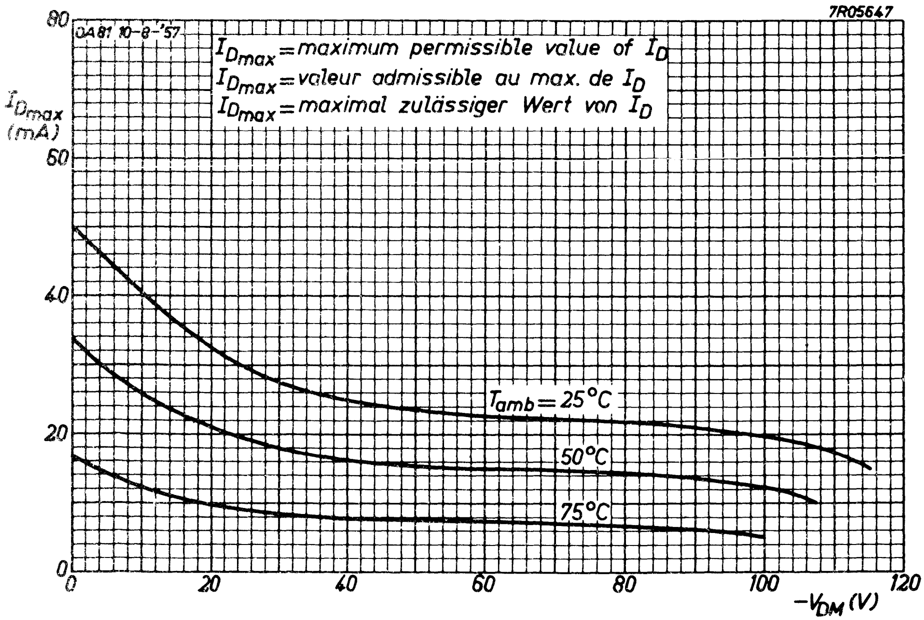

7R05869
OA95 14-3-'58
Current limits
Limites de courant
Stromgrenzen
T_{amb}=25°C
I_D (mA)
100
10
1
0,1
V_D (V)
0
1
2
3
4
A


7R05871
OA95 14-3-'58
1000
$-I_D$
(μA)
Current limits
Limites de courant
Stromgrenzen
T_{amb}=25°C
T_{amb}=60°C
100
10
1
0,1
0
50
$-V_D$(V)
100
0
50
$-V_D$(V)
100

C


7R05674
OA95 4-9-'57
T_{amb}=25°C
T_{amb}=60°C
10
I_D
(mA)
5
V_D(V)
−1,0
−0,8
−0,6
−0,4
−0,2
0
0,5
1,0
V_D(V)
−10
I_D
(μA)
−20

D


7R05647
OA81 10-8-'57
I_{Dmax}=maximum permissible value of I_D
I_{Dmax}=valeur admissible au max. de I_D
I_{Dmax}=maximal zulässiger Wert von I_D
I_{Dmax}
(mA)
80
60
40
20
0
T_{amb}=25°C
50°C
75°C
0
20
40
60
80
100
120
$-V_{DM}$(V)

E

SILICON DIODES

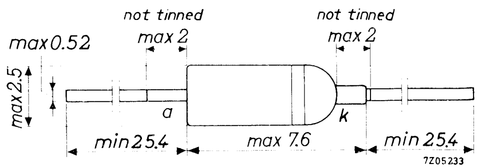
Silicon alloyed general purpose diodes in a subminiature all glass DO-7 envelope.

QUICK REFERENCE DATA

			OA200	OA202	
Continuous reverse voltage	V_R	max.	50	150	V
Repetitive peak forward current	I_{FRM}	max.	250		mA
Thermal resistance from junction to ambient	$R_{th\ j\text{-}a}$	=	0.4		°C/mW
Forward voltage I_F = 30 mA; T_{amb} = 25 °C	V_F	typ.	0.9		V
Reverse recovery time when switched from I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ measured at I_R = 4 mA	t_{rr}	typ.	3.5		μs

MECHANICAL DATA Dimensions in mm

DO-7



The white band indicates the cathode side

7Z3 0697

RATINGS (Limiting values) [1])

Voltage

Continuous reverse voltage	OA200	V_R	max.	50	V
	OA202	V_R	max.	150	V

Currents

			T_{amb} = 25 °C	T_{amb} = 125 °C	
Average rectified forward current (averaged over any 20 ms period)	I_{FAV}	max.	160	48	mA
Average forward current for sinusoidal operation	I_{FAV}	max.	80	40	mA
Forward current (d.c.; see page A)	I_F	max.	160	48	mA
Repetitive peak forward current	I_{FRM}	max.	250	125	mA

Temperatures

Storage temperature	T_{stg}	-55 °C to +125	°C
Operating ambient	T_{amb}	max. 125	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j-a}$	=	0.4	°C/mW

CHARACTERISTICS

				T_{amb} = 25 °C	T_{amb} = 125 °C	
Forward voltage						
I_F = 0.1 mA		V_F	typ.	0.52	–	V
			<	0.62	0.30	V
I_F = 10 mA		V_F	typ.	0.80	–	V
			<	0.96	0.65	V
I_F = 30 mA		V_F	typ.	0.90	–	V
			<	1.15	0.80	V
Reverse current						
$V_R = V_{Rmax}$	OA200	I_R	typ.	0.02	1	μA
			<	0.10	10	μA
	OA202	I_R	typ.	0.01	0.5	μA
			<	0.10	10	μA

Diode capacitance

V_R = 0.75 V; f = 0.5 MHz	C_d	typ.	10	pF
		<	25	pF

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0698

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

Reverse recovery current when switched from

I_F = 5 mA to V_R = 5 V; R_L = 2 .5 kΩ

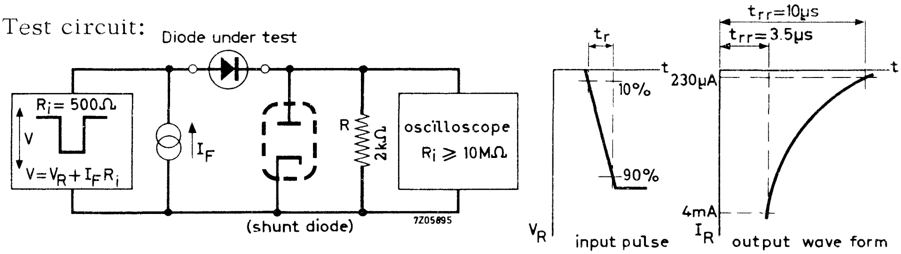
measured at t_{rr} = 3.5 μs	I_R	typ. 1.2	mA
t_{rr} = 10 μs	I_R	typ. 35	μA

Reverse recovery current when switched from

I_F = 30 mA to V_R = 35 V; R_L = 2.5 kΩ

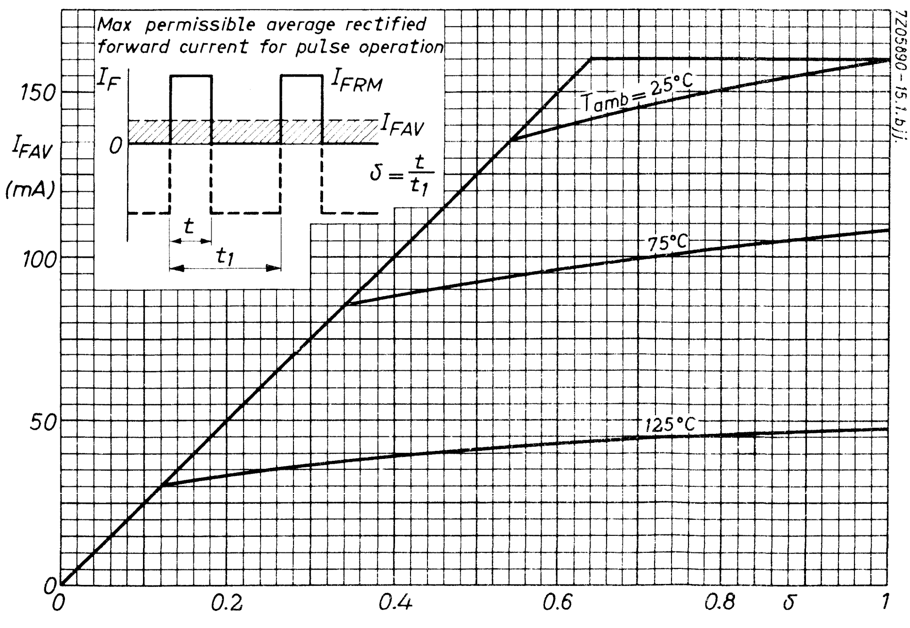
measured at t_{rr} = 3.5 μs	I_R	typ. 4	mA
t_{rr} = 10 μs	I_R	typ. 230	μA

Test circuit:

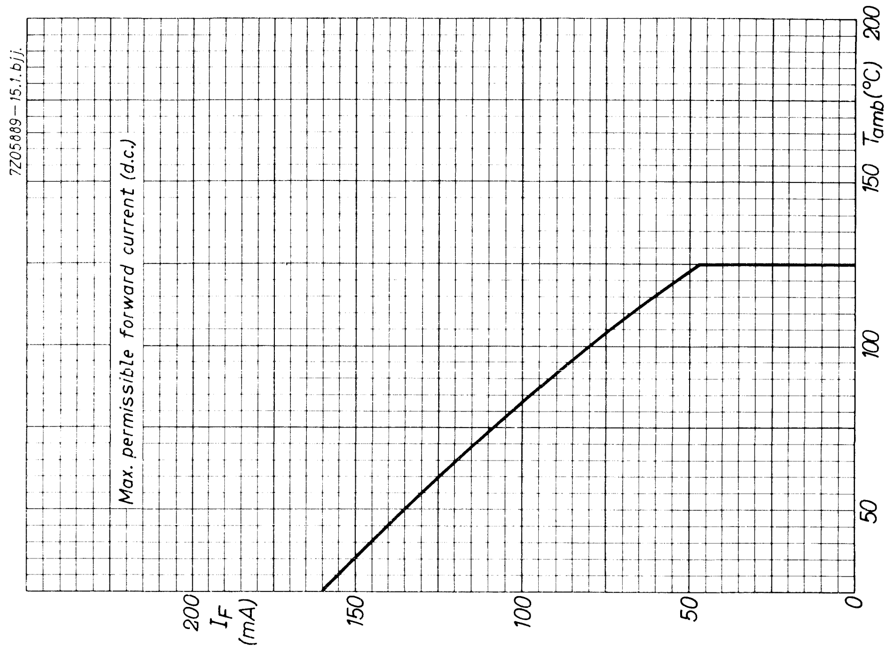


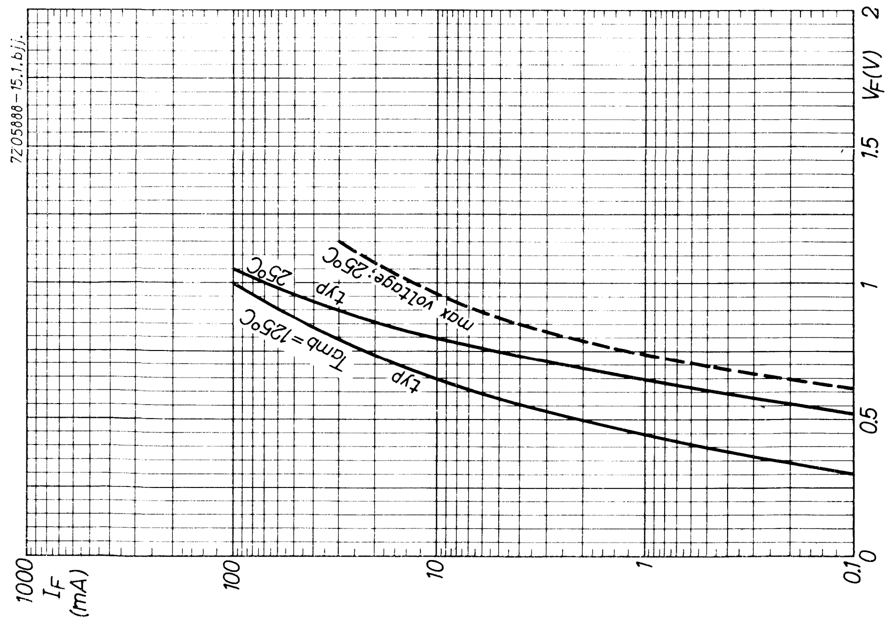
Reverse pulse: Rise time $t_r \leq 0.1$ μs
Duty cycle δ = 0.5
Frequency f = 50 kHz

Oscilloscope: Capacitance C = 40 pF
Rise time t_r = 25 ns



7Z3 0699


7Z05889-15.1.bjj.
Max. permissible forward current (d.c.)
I_F (mA)
200
150
100
50
0
T_{amb} (°C)
200
150
100
50


7Z05888-15.1.bjj.
max voltage; 25°C
typ 25°C
typ T_{amb} = 125°C
I_F (mA)
1000
100
10
1
0.1
V_F (V)
2
1.5
1
0.5
0

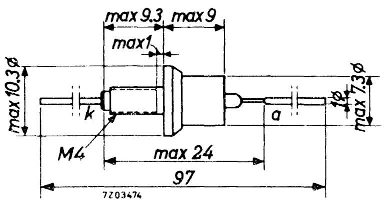
SILICON DIODE

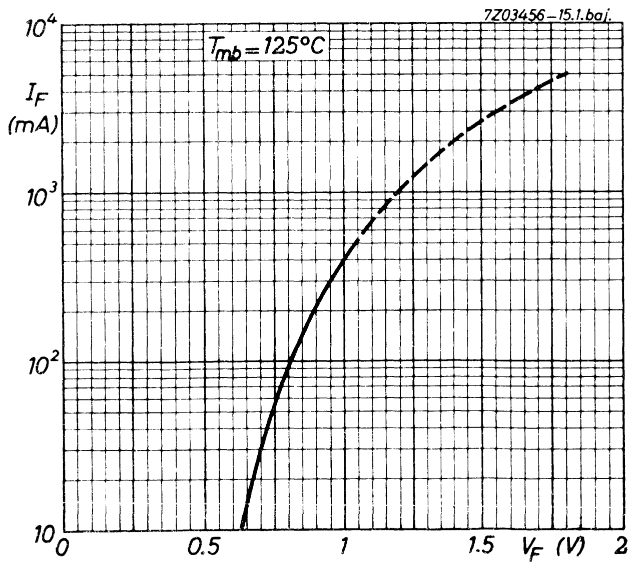
Silicon junction diode for use as a 127 V mains rectifier in television receivers.

RATINGS (Limiting values) [1])

Peak reverse voltage	V_{RM}	max.	400	V
Average forward current (t_{av} = 50 ms)	I_{FAV}	max.	0.5	A
Peak forward current	I_{FM}	max.	5	A

MECHANICAL DATA Dimensions in mm





[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0165

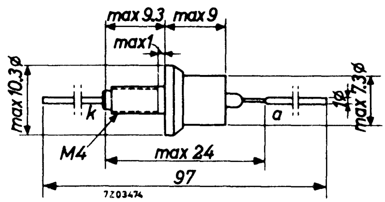
SILICON DIODE

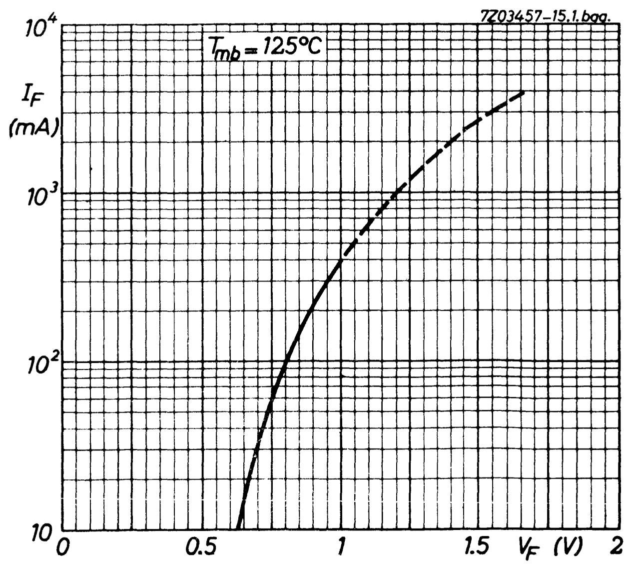
Silicon junction diode for use as a 250 V mains rectifier in television receivers.

RATINGS (Limiting values) [1])

Peak reverse voltage	V_{RM}	max.	800	V
Average forward current (t_{av} = 50 ms)	I_{FAV}	max.	0.4	A
Peak forward current	I_{FM}	max.	4	A

MECHANICAL DATA Dimensions in mm





[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134. 7Z3 0166

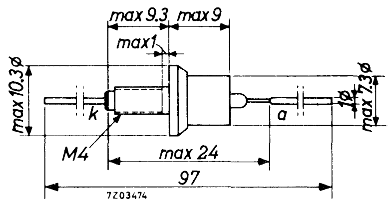
SILICON DIODE

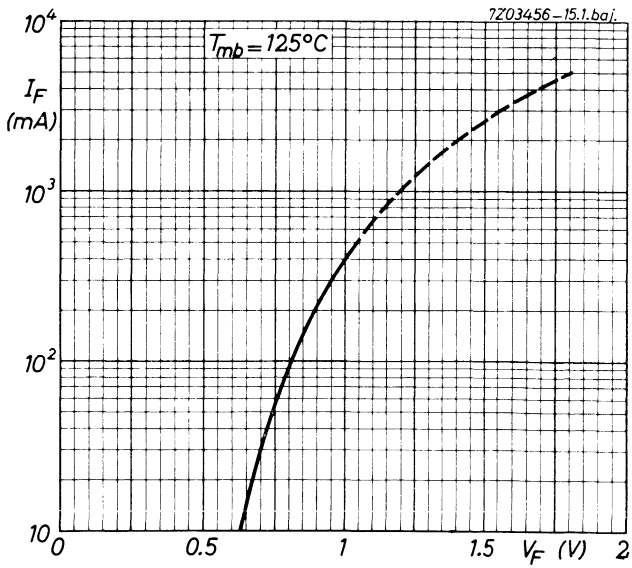
Silicon junction diode for use as a 220 V mains rectifier in television receivers.

RATINGS (Limiting values) [1])

Peak reverse voltage	V_{RM}	max.	700	V
Average forward current (t_{av} = 50 ms)	I_{FAV}	max.	0.5	A
Peak forward current	I_{FM}	max.	5	A

MECHANICAL DATA Dimensions in mm





1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0167

2.2.1964

SILICON ZENER DIODES

Silicon alloy junction diodes in all-glass construction with external metal can for use as low current voltage stabilizer or as a voltage reference.

QUICK REFERENCE DATA

		OAZ200/207	OAZ208/213
Reverse zener voltage	$-V_D$ =	4.7 to 9.1 V	4.3 to 12 V
Zener voltage tolerance		5 %	15 %
Max. reverse zener current (repetitive peak)	$-I_{DM}$ =	max. 250 mA	
Max. junction temperature	T_j =	max. 150 °C	
Thermal resistance between junction and case	K =	0.15 °C/mW	

LIMITING VALUES (Absolute max. values)

Forward current

Continuous and averaged over any 20 msec period	I_D (t_{av}	= max. =	100 mA 20 msec)
Repetitive peak	I_{DM}	= max.	250 mA

Reverse zener current

Continuous and averaged over any 20 msec period	See pages I and J		
Repetitive peak	$-I_{DM}$	= max.	250 mA
Surge current, duration 100 μsec See also page L	$-I_{Dsurge}$ (t	= max. =	10 A 100 μsec)

Dissipation

See pages 8, 9, I and J

Temperatures

Junction temperature	T_j	= max.	150 °C
Storage temperature	T_s	=	−55 to +150 °C

7Z2 2250

THERMAL DATA

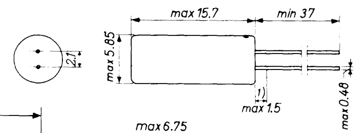
Thermal resistance

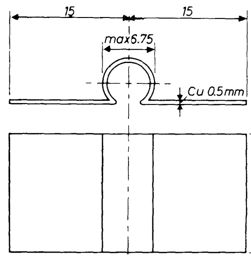
between junction and case	K	=	0.15 °C/mW
between junction and ambience a. without cooling fin in free air	K	=	0.4 °C/mW
b. with type A or extended type B cooling fin in free air	K	=	0.3 °C/mW
c. with standard type B cooling fin on heat sink of 3.5 x 3.5 cm^2 of 1.6 mm aluminium	K	=	0.25 °C/mW

MECHANICAL DATA

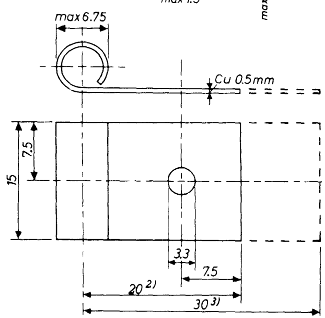
Dimensions in mm

The coloured dot indicates the position of the cathode





Type A
Type No. 56209



Type B
Type No. 56210

1) Not tinned
2) Standard type B cooling fin
3) Extended type B cooling fin

7Z2 2251

CHARACTERISTICS at T_{case} = 25 °C

I_D (mA)	V_D (mV)		
	typ.	min.	max.
10	= 730	> 620	< 820
100	= 800	> 700	< 920

Type No.	$-I_D$ (mA)	$-V_D$ (V)			$-V_D$ (V)	$-I_D$ (μA)	
		typ.	min.	max.		typ.	max.
OAZ200	1	= 4.7	> 4.4	< 5.0	2	= 0.12	< 0.50
	5	= 5.2	> 4.9	< 5.6			
	20	= 5.6	> 5.3	< 5.9			
OAZ201	1	= 5.1	> 4.8	< 5.4	2	= 0.04	< 0.50
	5	= 5.6	> 5.2	< 6.0			
	20	= 5.9	> 5.6	< 6.2			
OAZ202	1	= 5.6	> 5.3	< 6.0	2	= 0.02	< 0.30
	5	= 6.0	> 5.6	< 6.3			
	20	= 6.2	> 5.9	< 6.6			
OAZ203	1	= 6.2	> 5.8	< 6.6	2	= 0.04	< 0.30
	5	= 6.3	> 6.1	< 6.8			
	20	= 6.4	> 6.1	< 6.9			
OAZ204	1	= 6.8	> 6.4	< 7.2	3	= 0.02	< 0.25
	5	= 6.9	> 6.4	< 7.3			
	20	= 7.0	> 6.5	< 7.4			
OAZ205	1	= 7.5	> 7.1	< 7.9	3	= 0.005	< 0.20
	5	= 7.6	> 7.1	< 8.0			
	20	= 7.7	> 7.1	< 8.2			
OAZ206	1	= 8.2	> 7.7	< 8.7	5	= 0.02	< 0.20
	5	= 8.2	> 7.7	< 8.8			
	20	= 8.4	> 7.8	< 9.0			
OAZ207	1	= 9.1	> 8.6	< 9.6	5	= 0.015	< 0.15
	5	= 9.2	> 8.6	< 9.8			
	20	= 9.4	> 8.8	< 10.0			

7Z2 2252

3

CHARACTERISTICS at T_{case} = 25 °C (continued)

Type No.	$-I_D$ (mA)	$-V_D$ (V)			$-V_D$ (V)	$-I_D$ (μA)	
		typ.	min.	max.		typ.	max.
OAZ208	1	= 4.3	> 3.3	< 5.0	1.5	= 0.10	< 0.50
	5	= 4.9	> 3.8	< 5.6			
	20	= 5.3	> 4.3	< 5.9			
OAZ209	1	= 5.1	> 4.4	< 6.0	1.5	= 0.04	< 0.50
	5	= 5.6	> 4.9	< 6.3			
	20	= 5.9	> 5.3	< 6.4			
OAZ210	1	= 6.2	> 5.3	< 7.2	2	= 0.02	< 0.50
	5	= 6.3	> 5.6	< 7.3			
	20	= 6.4	> 5.9	< 7.4			
OAZ211	1	= 7.5	> 6.4	< 8.7	2	= 0.02	< 0.30
	5	= 7.6	> 6.4	< 8.8			
	20	= 7.7	> 6.5	< 9.0			
OAZ212	1	= 9.1	> 7.7	< 10.6	5	= 0.015	< 0.20
	5	= 9.2	> 7.7	< 10.8			
	20	= 9.4	> 7.8	< 11.1			
OAZ213	1	= 12	> 9.4	< 15.0	5	= 0.010	< 0.15
	5	= 12.2	> 9.4	< 15.3			
	20	= 12.5	> 9.6	< 15.7			

7Z2 2253

4

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{case} = 25 °C

Type No.	$-I_D$ (mA)	$\Delta(-V_D)/\Delta T$ (mV/°C)[1] typ.	min.	max.	r_D (Ω) [2] typ.	min.	max.
OAZ200	1	= −2.0	> −2.75	< −1.25	= 350	> 320	< 400
	5	= −1.2	> −1.75	< 0.0	= 56	> 30	< 70
	20	= 0.2	> −1.5	< 1.5	= 9.0	> 3.0	< 15
OAZ201	1	= −1.8	> −2.5	< −1.0	= 330	> 270	< 400
	5	= −0.6	> −1.5	< 1.0	= 45	> 12	< 75
	20	= 1.0	> −0.5	< 2.5	= 5.7	> 1.0	< 13
OAZ202	1	= −1.0	> −2.5	< 1.5	= 275	> 50	< 380
	5	= 0.8	> −1.0	< 2.5	= 24	> 5.0	< 55
	20	= 1.9	> 0.5	< 3.5	= 3.2	> 1.0	< 6
OAZ203	1	= 0.5	> −1.0	< 3.0	= 215	> 10	< 280
	5	= 1.7	> 0.5	< 3.5	= 9.5	> 2.5	< 25
	20	= 2.6	> 1.0	< 4.0	= 2.3	> 1.0	< 11
OAZ204	1	= 2.5	> 0.0	< 4.0	= 40	> 5.0	< 170
	5	= 3.0	> 2.0	< 4.0	= 4.7	> 2.0	< 24
	20	= 3.6	> 2.0	< 5.0	= 2.0	> 0.5	< 8
OAZ205	1	= 4.0	> 2.0	< 5.0	= 8.6	> 3.0	< 35
	5	= 4.3	> 2.0	< 5.0	= 3.7	> 1.0	< 17
	20	= 4.6	> 2.0	< 5.5	= 2.2	> 0.75	< 12
OAZ206	1	= 5.0	> 2.0	< 7.0	= 7.6	> 2.5	< 28
	5	= 5.2	> 2.0	< 7.5	= 3.8	> 1.0	< 15
	20	= 5.4	> 2.0	< 7.5	= 2.4	> 1.0	< 10
OAZ207	1	= 6.2	> 4.0	< 7.0	= 9.6	> 2.5	< 45
	5	= 6.4	> 4.0	< 7.0	= 4.9	> 1.5	< 25
	20	= 6.6	> 4.0	< 8.0	= 2.9	> 0.75	< 20

1) Temperature coefficient of zener voltage
2) Dynamic impedance

7Z2 2254

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{case} = 25 °C (continued)

Type No.	$-I_D$ (mA)	$\Delta(-V_D)/\Delta T$ (mV/°C [1]) typ.	min.	max.	r_D (Ω) [2] typ.	min.	max.
OAZ208	1	= −2.0	> −3.5	< −0.5	= 350	> 320	< 400
	5	= −1.4	> −2.2	< 0.0	= 62	> 30	< 80
	20	= −0.5	> −2.0	< 1.5	= 12	> 3.0	< 20
OAZ209	1	= −1.8	> −2.75	< 1.5	= 330	> 50	< 400
	5	= −0.6	> −1.75	< 2.5	= 45	> 5.0	< 75
	20	= 1.0	> −1.5	< 3.5	= 5.7	> 1.0	< 15
OAZ210	1	= 0.5	> −2.5	< 4.0	= 215	> 5.0	< 380
	5	= 1.7	> −1.0	< 4.0	= 9.5	> 2.0	< 55
	20	= 2.6	> 0.5	< 5.0	= 2.3	> 0.5	< 11
OAZ211	1	= 4.0	> 0.0	< 7.0	= 8.6	> 2.5	< 170
	5	= 4.3	> 2.0	< 7.5	= 3.7	> 1.0	< 24
	20	= 4.6	> 2.0	< 7.5	= 2.2	> 0.5	< 12
OAZ212	1	= 6.2	> 2.5	< 8.5	= 9.6	> 2.5	< 45
	5	= 6.4	> 2.5	< 8.5	= 4.9	> 1.0	< 25
	20	= 6.6	> 2.5	< 8.5	= 2.9	> 0.7	< 20
OAZ213	1	= 9.2	> 4.0	< 12	= 35	−	< 70
	5	= 9.3	> 4.0	< 12	= 12	−	< 40
	20	= 9.4	> 4.0	< 12	= 5.6	−	< 16

1) Temperature coefficient of zener voltage
2) Dynamic impedance

7Z2 2255

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{case} = 25 °C (continued)

Type No.	c_D (pF) at $-V_D$ = 3 V		
	typ.	min.	max.
OAZ200	= 420	> 200	< 650
OAZ201	= 400	> 100	< 650
OAZ202	= 360	> 100	< 600
OAZ203	= 300	> 100	< 500
OAZ204	= 300	> 100	< 450
OAZ205	= 250	> 100	< 400
OAZ206	= 220	> 50	< 350
OAZ207	= 170	> 50	< 300
OAZ208	= 420	> 200	< 700
OAZ209	= 400	> 100	< 650
OAZ210	= 300	> 100	< 600
OAZ211	= 300	> 50	< 450
OAZ212	= 170	> 50	< 350
OAZ213	= 150	> 50	< 250

7Z2 2256

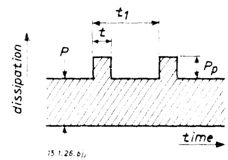
DETERMINATION OF THE PEAK POWER RATING

For a pulse duration, shorter than the "temperature stabilisation time"

$$P_p = \frac{T_{j\,max} - T_{amb} - K_{j\text{-}amb} \times P}{K_t + \delta \times K_{c\text{-}amb}}$$

For a pulse duration, longer than the "temperature stabilisation time"

$$P_p = \frac{T_{j\,max} - T_{amb}}{K_{j\text{-}amb}} - P$$



t	= pulse duration
t_1	= pulse period
δ	= t/t_1 = duty factor
P	= constant power dissipation
P_p	= permissible pulse power dissipation over P
K_t	= transient thermal resistance, which is a function of t and δ (see page K)
$K_{j\text{-}amb}$	= thermal resistance between junction and ambience
$K_{c\text{-}amb}$	= thermal resistance between case and ambience
$T_{j\,max}$	= maximum permissible junction temperature
T_{amb}	= ambient temperature

Temperature stabilisation time = 30 sec (see page K)

7Z2 2313

DETERMINATION OF THE PEAK POWER RATING (continued)

Example

Calculation of the permissible peak zener current of an OAZ205 when:

1. The diode is mounted in free air with $T_{amb} = 60\ ^{o}C$
2. The steady-state zener current $-I_D = 10$ mA
3. The pulses have a duration $t = 1$ msec and a duty factor $\delta = 0.1$

The pulses have duration, shorter than the temperature stabilisation time of 30 sec, so the peak power can be calculated from

$$P_p = \frac{T_{j\,max} - T_{amb} - K_{j\text{-}amb} \times P}{K_t + \delta \times K_{c\text{-}amb}}$$

where

$T_{j\,max}$ = 150 ^{o}C

T_{amb} = 60 ^{o}C

$K_{j\text{-}amb}$ = 0.4 $^{o}C/mW$

P = 86 mW, according to page J

K_t (at t = 1 msec and $\delta = 0.1$) = 0.018 $^{o}C/mW$, according to page K

δ = 0.1

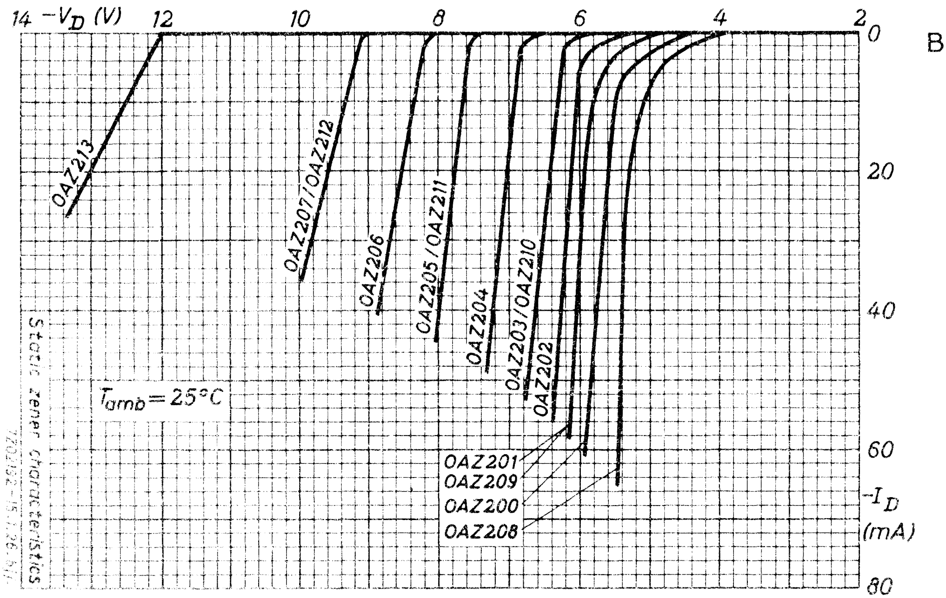
$K_{c\text{-}amb} = K_{j\text{-}amb} - K_{j\text{-}c} = 0.4 - 0.15 = 0.25\ ^{o}C/mW$

$$\text{So } P_p = \frac{150 - 60 - 0.4 \times 86}{0.018 + 0.1 \times 0.25} = 1294 \text{ mW}$$

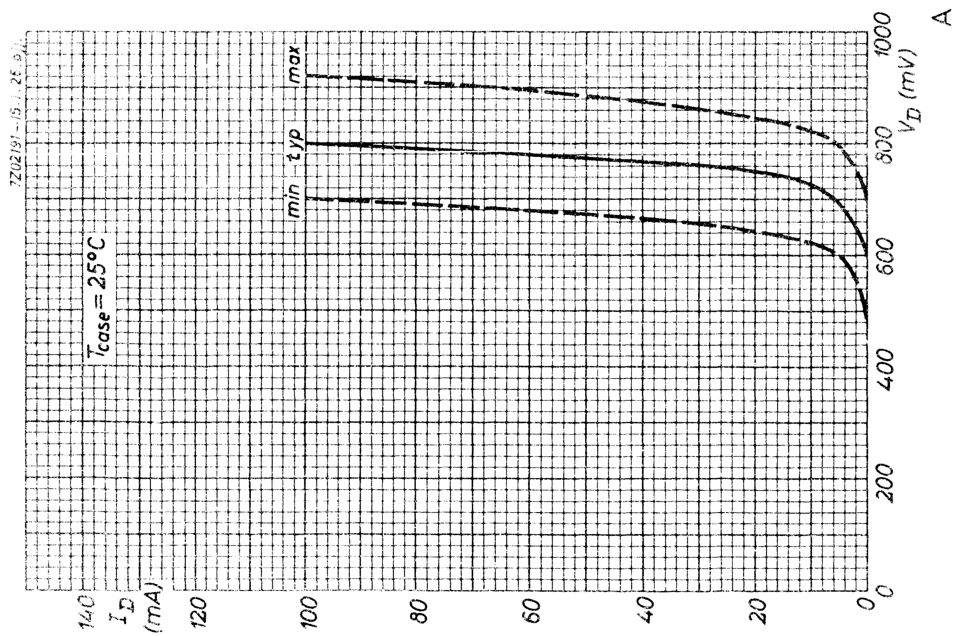
The total peak power $P_{tot} = 1294 + 86 = 1380$ mW = 1.38 W.

From page J it may be seen that the corresponding zener current $-I_D = 180$ mA

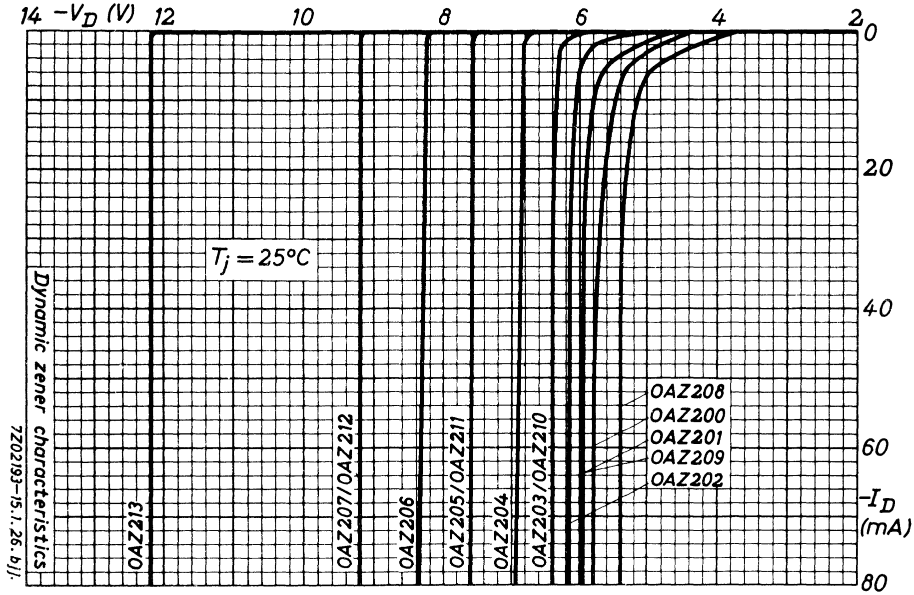
7Z2 2314



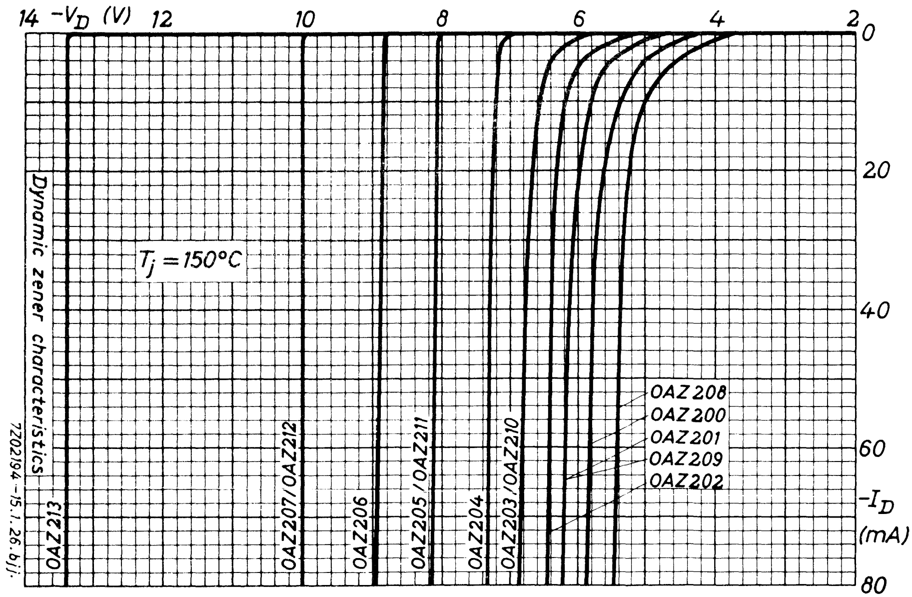
14 −VD (V) 12 10 8 6 4 2 0
B
20
40
60
−ID
(mA)
80
OAZ213
OAZ207/OAZ212
OAZ206
OAZ205/OAZ211
OAZ204
OAZ203/OAZ210
OAZ202
OAZ201
OAZ209
OAZ200
OAZ208
Tamb = 25°C
Static zener characteristics



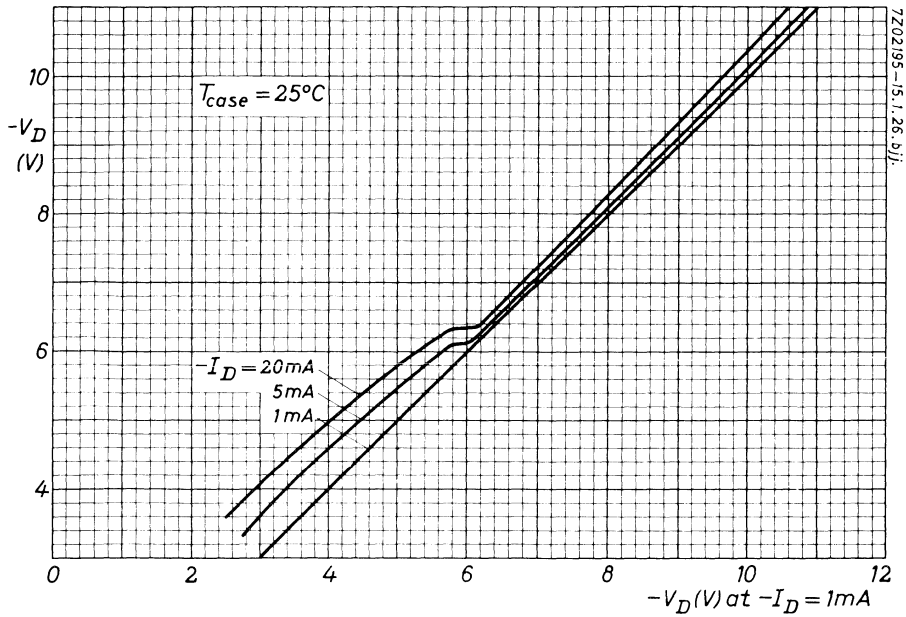
A
max
typ
min
Tcase = 25°C
VD (mV)
1000
800
600
400
200
0
ID (mA)
140
120
100
80
60
40
20
0


14 −V_D (V) 12 10 8 6 4 2
0
20
40
60
80
−I_D (mA)
T_j = 25°C
Dynamic zener characteristics
7Z02193−15.1.26. bij.
OAZ213
OAZ207/OAZ212
OAZ206
OAZ205/OAZ211
OAZ204
OAZ203/OAZ210
OAZ208
OAZ200
OAZ201
OAZ209
OAZ202

C

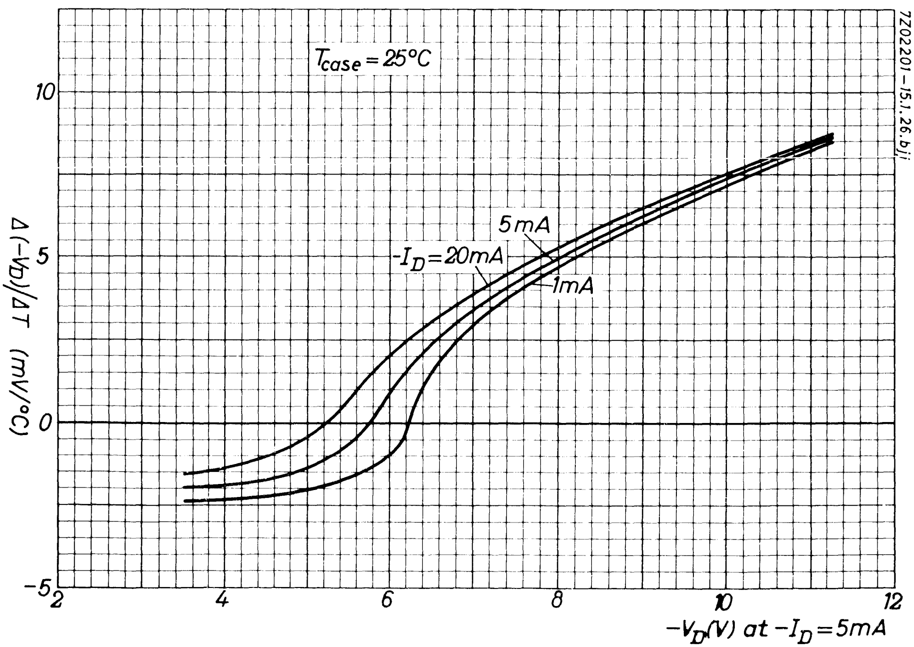

14 −V_D (V) 12 10 8 6 4 2
0
20
40
60
80
−I_D (mA)
T_j = 150°C
Dynamic zener characteristics
7Z02194−15.1.26. bij.
OAZ213
OAZ207/OAZ212
OAZ206
OAZ205/OAZ211
OAZ204
OAZ203/OAZ210
OAZ208
OAZ200
OAZ201
OAZ209
OAZ202

D



$T_{case} = 25°C$
$-V_D$ (V)
$-I_D = 20mA$
5mA
1mA
$-V_D$(V) at $-I_D = 1mA$
7Z02195-15.1.26.bjj.

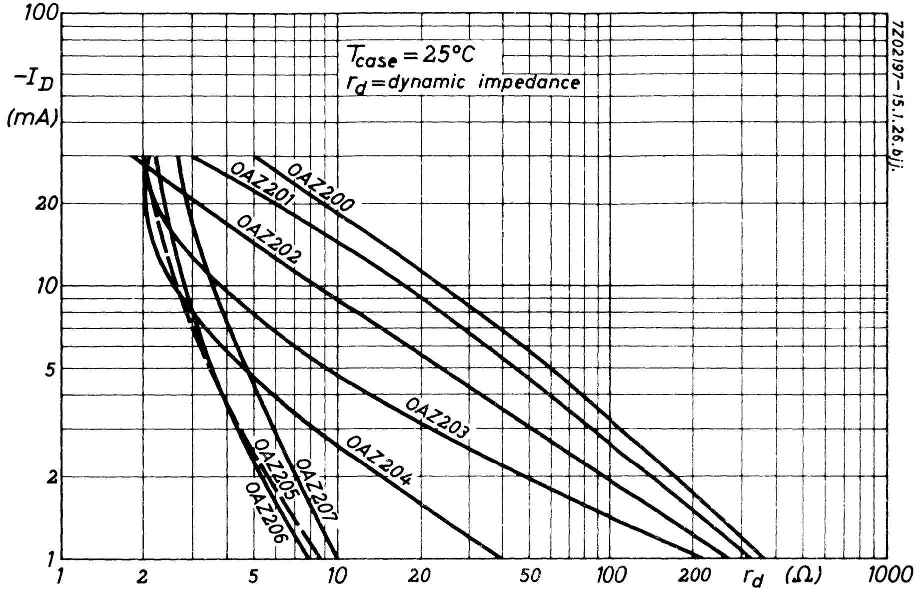
E



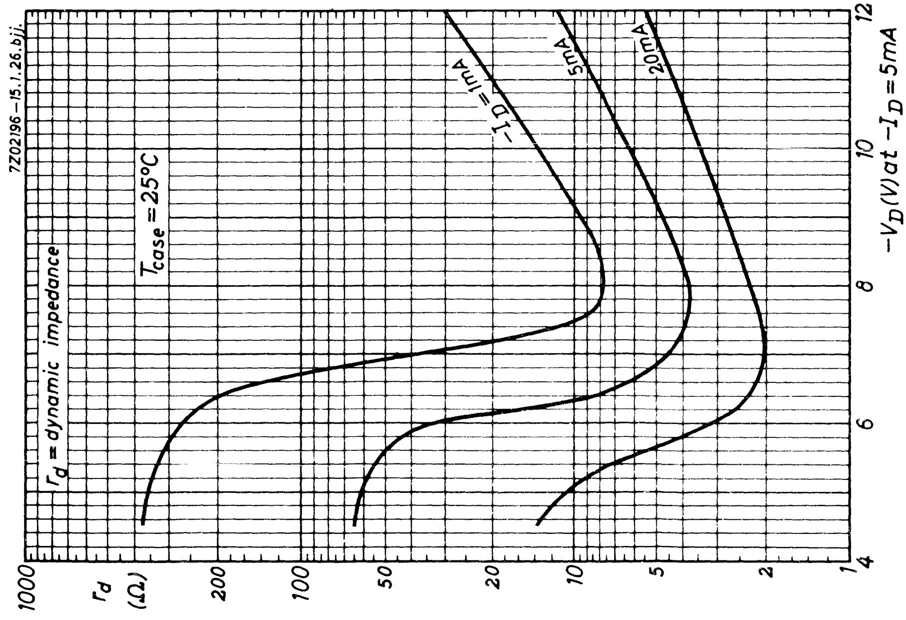
$T_{case} = 25°C$
$\Delta(-V_D)/\Delta T$ (mV/°C)
$-I_D = 20mA$
5mA
1mA
$-V_D$(V) at $-I_D = 5mA$
7Z02201-15.1.26.bjj.

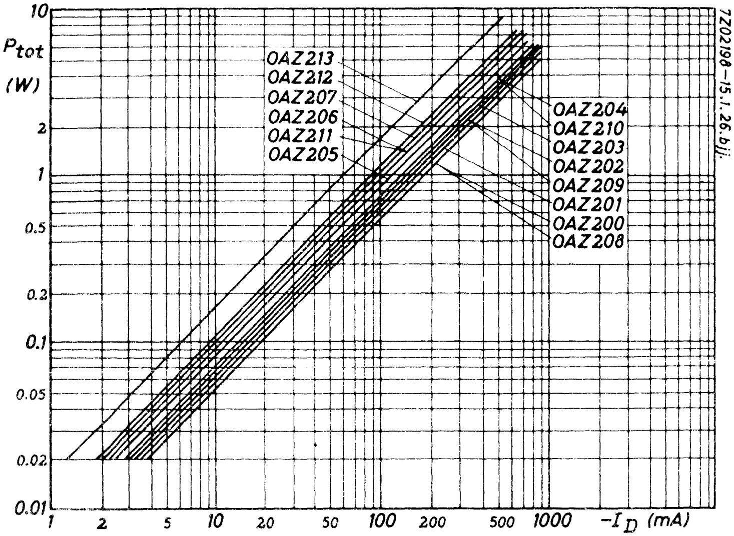
F

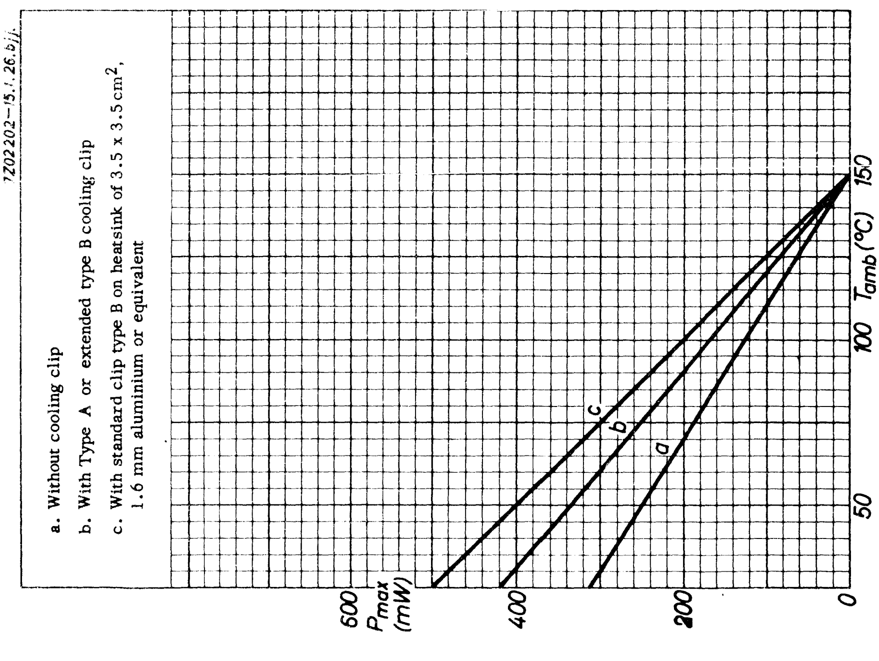
H

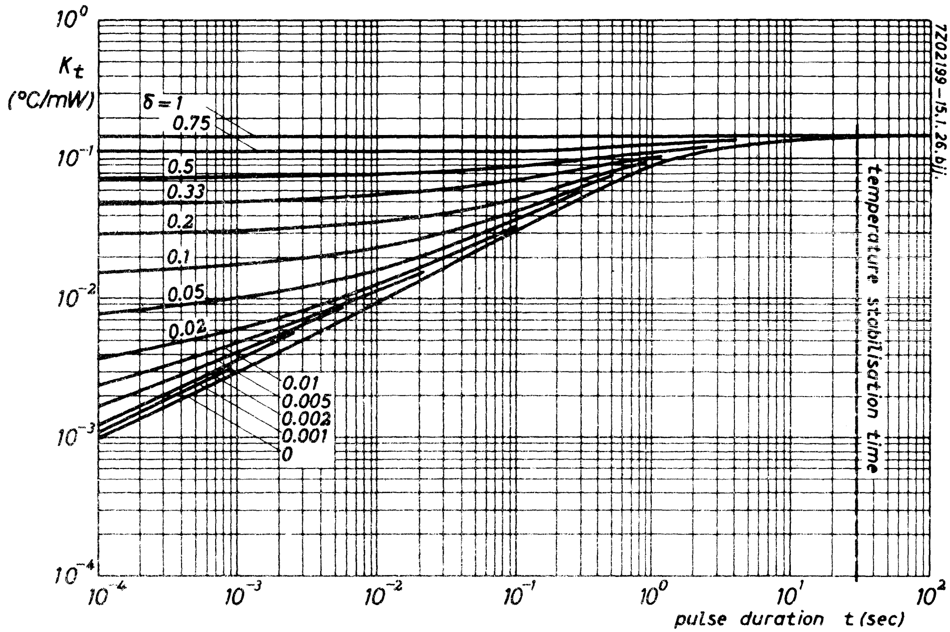

$T_{case} = 25°C$
r_d = dynamic impedance
$-I_D$ (mA)
100
20
10
5
2
1
1
2
5
10
20
50
100
200
r_d (Ω)
1000
OAZ200
OAZ201
OAZ202
OAZ203
OAZ204
OAZ205
OAZ206
OAZ207
7Z02197-15.1.26.bij.

G


r_d = dynamic impedance
$T_{case} = 25°C$
7Z02196-15.1.26.bij.
$-I_D = 1mA$
5mA
20mA
$-V_D$(V) at $-I_D = 5mA$
r_d (Ω)
1000
200
100
50
20
10
5
2
1
4
6
8
10
12

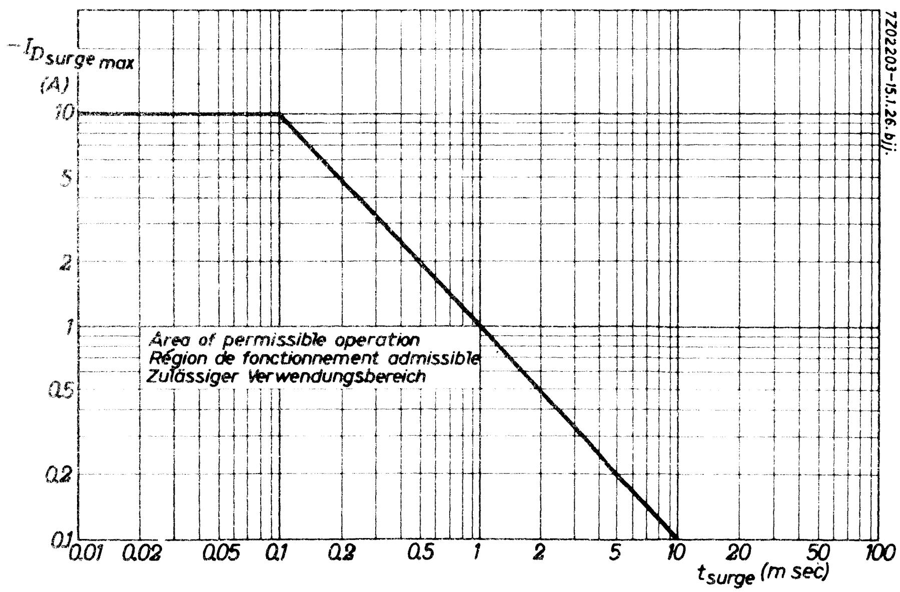

10
P_{tot}
(W)
2
1
0.5
0.2
0.1
0.05
0.02
0.01
1
2
5
10
20
50
100
200
500
1000
$-I_D$ (mA)
OAZ213
OAZ212
OAZ207
OAZ206
OAZ211
OAZ205
OAZ204
OAZ210
OAZ203
OAZ202
OAZ209
OAZ201
OAZ200
OAZ208
7Z02198-15.1.26.bjj.


7Z02202-15.1.26.bjj.
a. Without cooling clip
b. With Type A or extended type B cooling clip
c. With standard clip type B on heatsink of 3.5 x 3.5 cm^2, 1.6 mm aluminium or equivalent
a
b
c
600
P_{max}
(mW)
400
200
0
50
100
T_{amb} (°C)
150



10^0
K_t
(°C/mW)
10^-1
10^-2
10^-3
10^-4
δ = 1
0.75
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0.001
0
10^-4
10^-3
10^-2
10^-1
10^0
10^1
10^2
pulse duration t (sec)
temperature stabilisation time
7Z02199-15.1.26.bjj.

K



$-I_{D surge max}$
(A)
10
5
2
1
0.5
0.2
0.1
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
t_{surge} (m sec)
Area of permissible operation
Région de fonctionnement admissible
Zulässiger Verwendungsbereich
7Z02203-15.1.26.bjj.

L

Thyristors
(Silicon controlled rectifiers)

P-GATE SILICON THYRISTORS

P-gate all diffused silicon thyristors in a metal case for power control and power switching applications.
The series consists of the reverse polarity types (stud-anode): BTX12-100R, BTX12-200R, BTX12-300R, BTX12-400R, BTX12-500R, BTX12-600R.

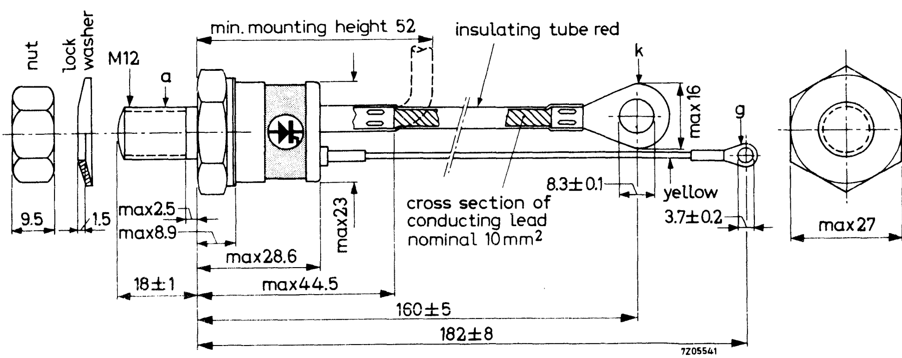
QUICK REFERENCE DATA

			BTX12-100R	200R	300R	400R	500R	600R	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	600	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	600	V

Average forward current	I_{TAV}	max.	20	A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	250	A
Junction temperature	T_j	max.	125	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.45	$^oC/W$

MECHANICAL DATA

Dimensions in mm



Net weight : 95 g
With accessories: 115 g
Diameter of hole in heatsink: max 13 mm

Torque on nut: min. 100 cm kg
max. 200 cm kg

7Z3 0061

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])		BTX12-100R	200R	300R	400R	500R	600R	
Crest working reverse voltage	V_{RWM}	max. 100	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max. 400	400	500	500	600	600	V
Non repetitive peak reverse voltage $t \leq 10$ ms	V_{RSM}	max. 400	400	500	500	700	700	V
Crest working off-state voltage	V_{DWM}	max. 100	200	300	400	500	600	V
Repetitive peak off-state voltage	V_{DRM}	max. 100	200	300	400	500	600	V
Non repetitive peak off-state voltage [3])	V_{DSM}	max. 500	500	500	500	700	700	V

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	20	A
R.M.S. forward current	$I_{T(rms)}$	max.	31	A
Repetitive peak forward current	I_{TRM}	max.	175	A
Non repetitive peak forward current t = 10 ms (see page D)	I_{TSM}	max.	250	A
I squared t for fusing	I^2t	max.	250	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	5	A/µs
Repetitive peak reverse current (during commutation or turn-off)	I_{RRM}	max.	20	A

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V and at $R_{th\ j-a}$ = 7 °C/W.

[3]) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0062

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		-55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.45	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.15	°C/W

7Z3 0063

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages			BTX12-100R	200R	300R	400R	500R	600R	
Forward on-state voltage; I_T = 175 A	V_T	<	3.5	3.5	3.5	3.5	3.5	3.5	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	500	600	V
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	20	V/μs
Currents									
Reverse current $V_R = V_{RRM}$ max	I_R	<	8	8	5	5	5	5	mA
Off-state current $V_D = V_{DRM}$ max	I_D	<	8	8	5	5	5	5	mA

Holding current I_H typ. 40 mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices T_j = 25 °C	I_{GT}	>	50	mA

SWITCHING CHARACTERISTICS (See also page F)

Turn on time ($t_d + t_r$)	t_{on}	typ.	4	μs
delay time	t_d	typ.	1.3	μs
rise time	t_r	typ.	2.7	μs
Turn off time	t_{off}	typ.	6	μs

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0064

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

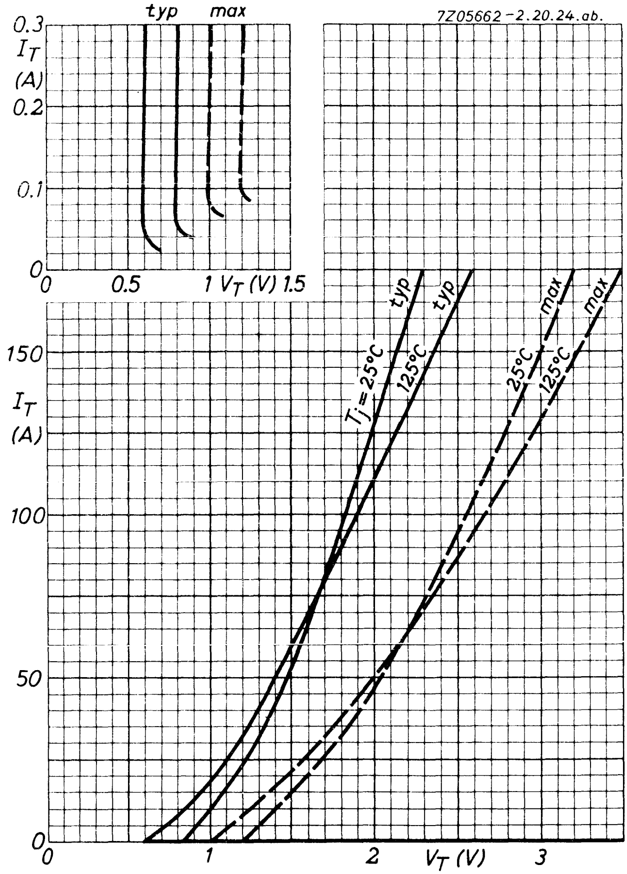
$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

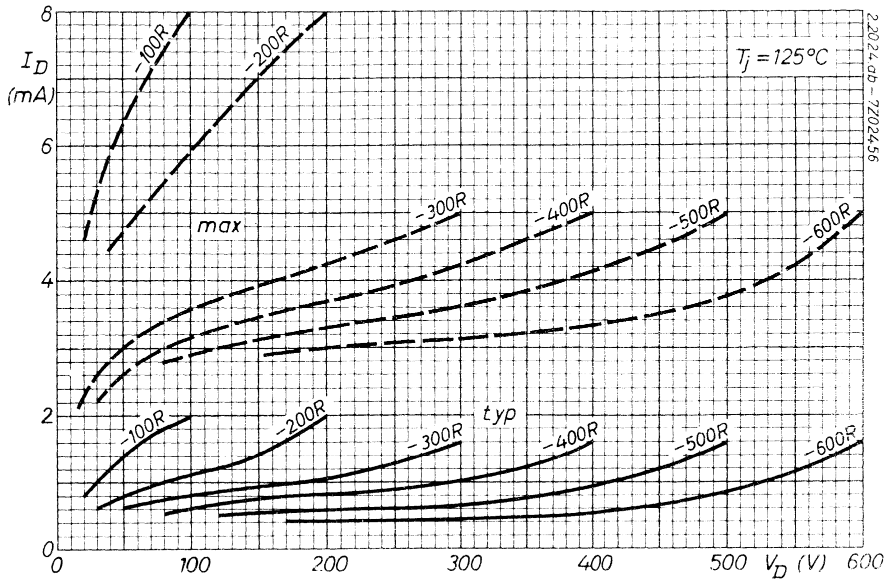
where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2

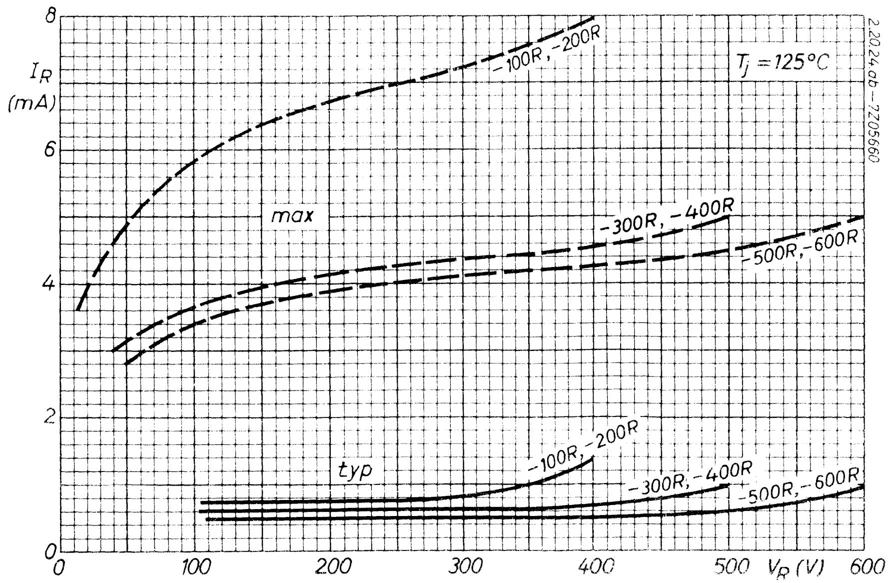
V_{RWM} stands for the actually applied crest working reverse voltage.

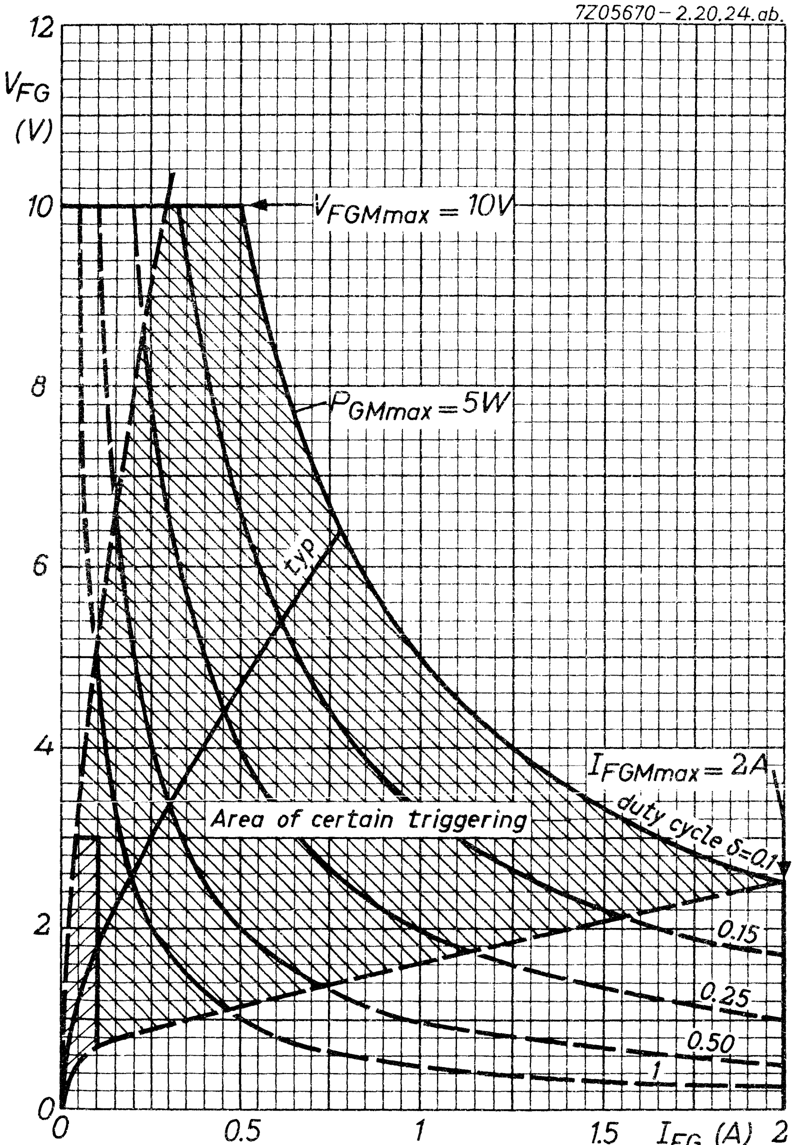
2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curve at page D a fast fuse is recommended.

7Z3 0065

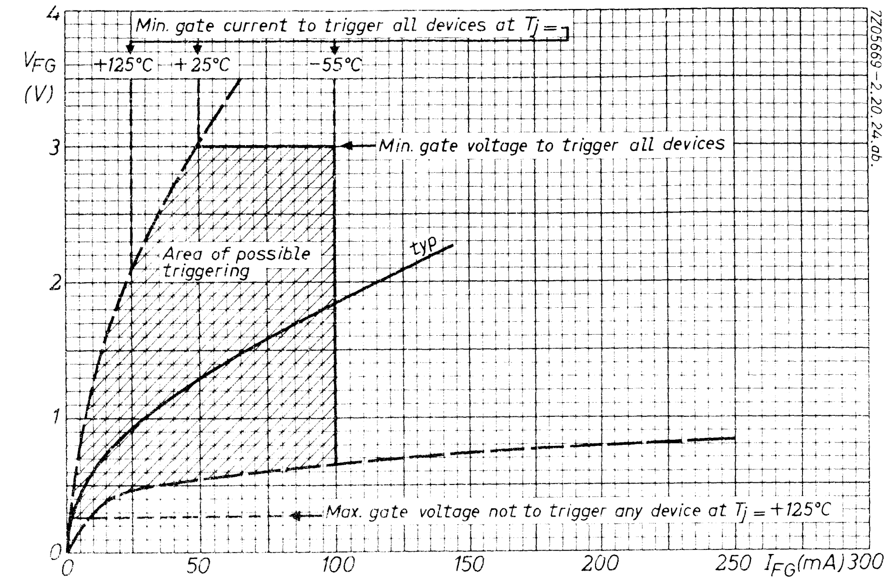

7Z05662-2.20.24.ab.
typ
max
0.3
I_T
(A)
0.2
0.1
0
0
0.5
1 V_T (V) 1.5
150
I_T
(A)
100
50
0
0
1
2
V_T (V)
3
T_j = 25°C
125°C
25°C
125°C
typ
typ
max
max

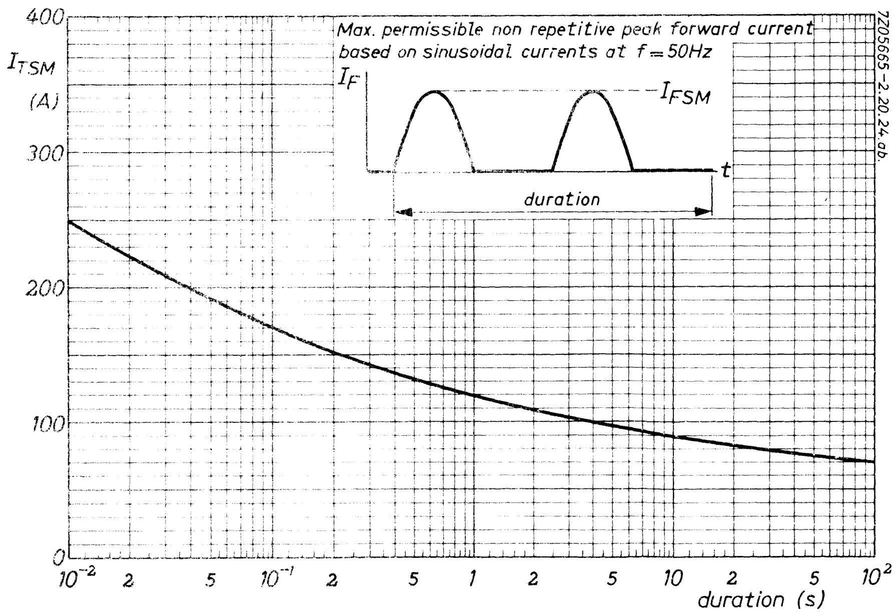

I_D (mA)
T_j = 125 °C
max
typ
−100R
−200R
−300R
−400R
−500R
−600R
V_D (V)
2.2024.ab − 7Z02456

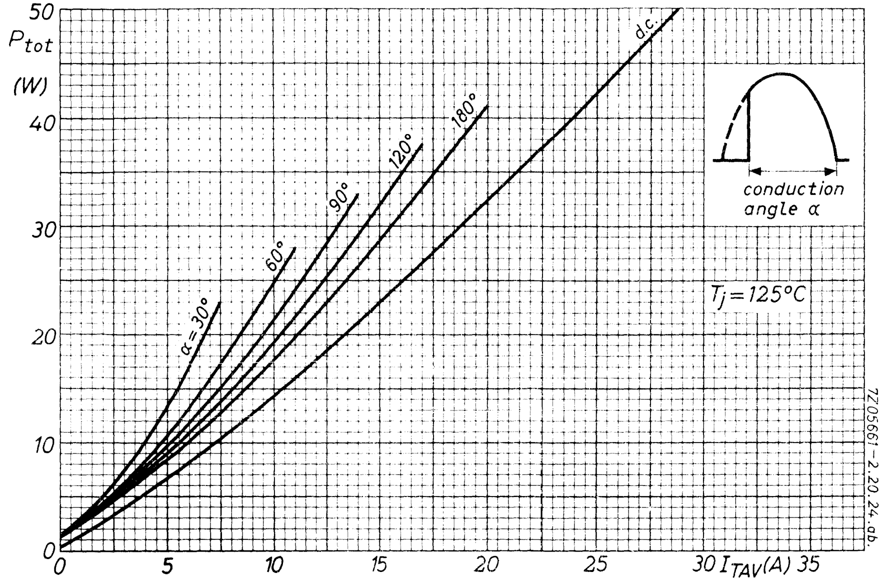

I_R (mA)
T_j = 125 °C
max
typ
−100R, −200R
−300R, −400R
−500R, −600R
V_R (V)
2.2024.ab − 7Z05660

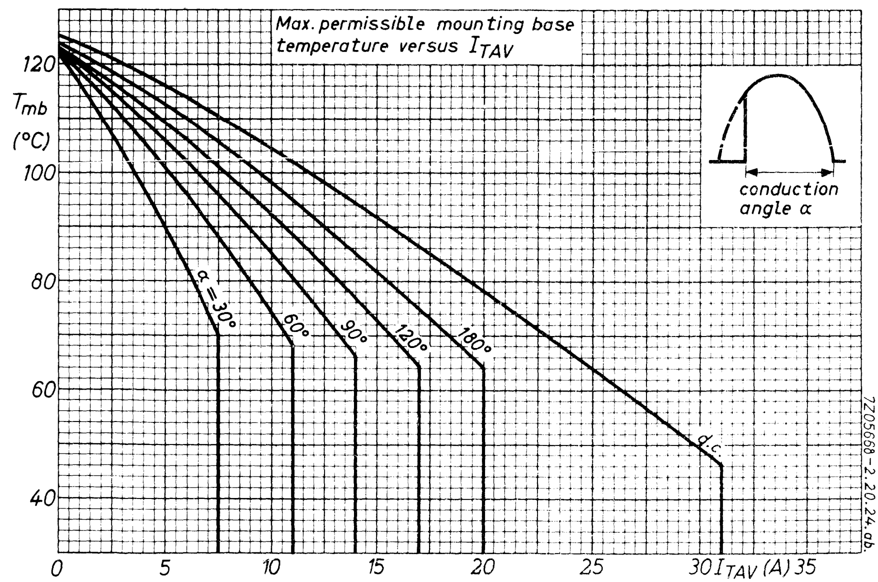


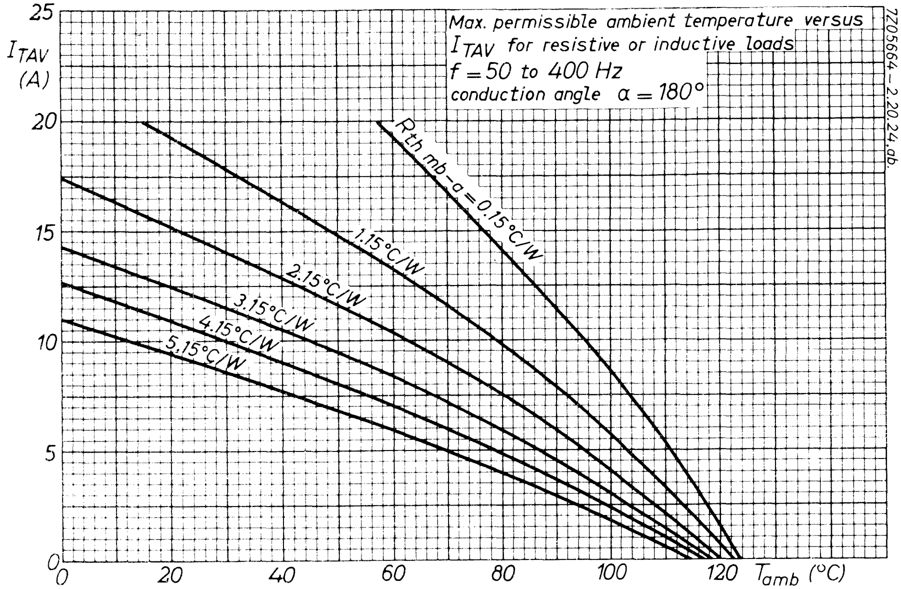
Gate characteristics with curves $P_{GAV} = 0.5W$

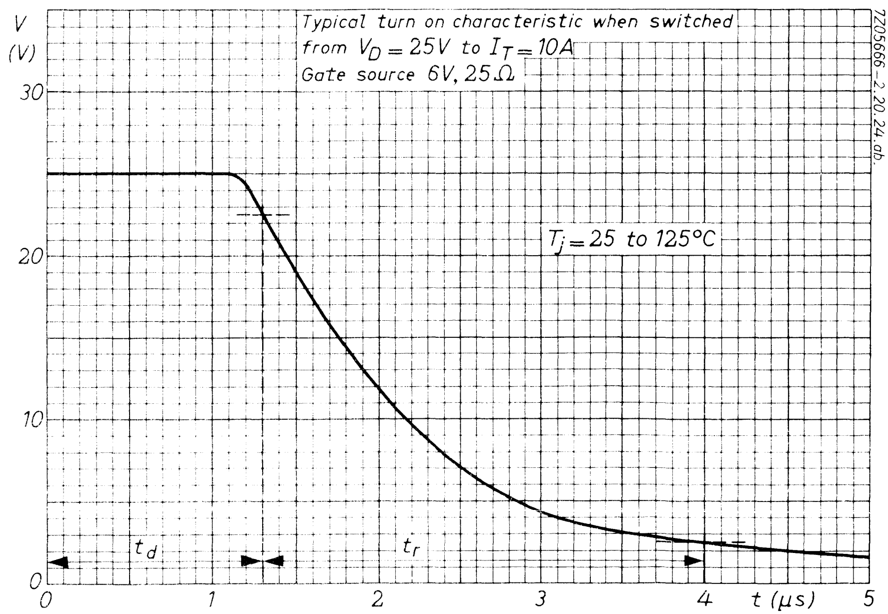

Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−55°C
V_{FG} (V)
Min. gate voltage to trigger all devices
Area of possible triggering
typ
Max. gate voltage not to trigger any device at T_j = +125°C
I_{FG}(mA)
0
50
100
150
200
250
300
1
2
3
4
7Z05669−2.20.24.ab.


Max. permissible non repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_F
I_{FSM}
t
duration
I_{TSM} (A)
0
100
200
300
400
10^{-2}
2
5
10^{-1}
2
5
1
2
5
10
2
5
10^2
duration (s)
7Z05665−2.20.24.ab.


50
P_{tot}
(W)
40
30
20
10
0
0
5
10
15
20
25
30 I_{TAV}(A) 35
d.c.
180°
120°
90°
60°
$\alpha = 30°$
conduction
angle α
$T_j = 125°C$
7Z05661-2.20.24.ab.


Max. permissible mounting base
temperature versus I_{TAV}
120
T_{mb}
(°C)
100
80
60
40
0
5
10
15
20
25
30 I_{TAV} (A) 35
$\alpha = 30°$
60°
90°
120°
180°
d.c.
conduction
angle α
7Z05668-2.20.24.ab.


Max. permissible ambient temperature versus
I_{TAV} for resistive or inductive loads
f = 50 to 400 Hz
conduction angle α = 180°
$R_{th\ mb-a}$ = 0.15°C/W
1.15°C/W
2.15°C/W
3.15°C/W
4.15°C/W
5.15°C/W
I_{TAV} (A)
T_{amb} (°C)
7Z05664-2.20.24.ab.


Typical turn on characteristic when switched
from V_D = 25V to I_T = 10A
Gate source 6V, 25Ω
T_j = 25 to 125°C
V (V)
t_d
t_r
t (μs)
7Z05666-2.20.24.ab.

P-GATE SILICON THYRISTORS

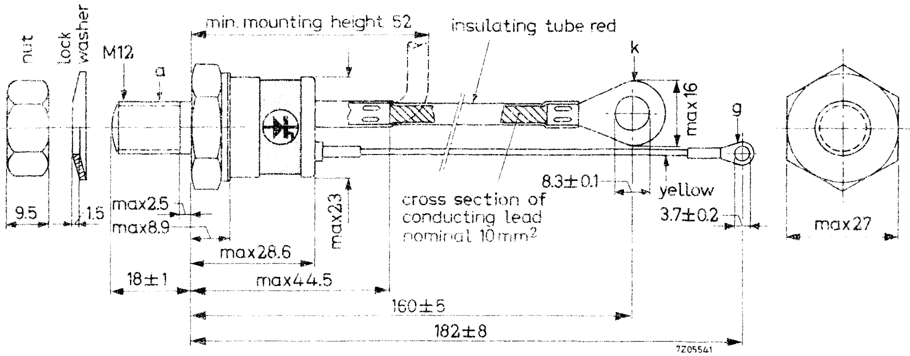
P-gate all diffused silicon thyristors in a metal case for power control and power switching applications.
The series consists of the reverse polarity types (stud-anode): BTX13-100R, BTX13-200R, BTX13-300R, BTX13-400R, BTX13-500R and BTX13-600R.

QUICK REFERENCE DATA

			BTX13-100R	200R	300R	400R	500R	600R	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	600	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	600	V

Average forward current	I_{TAV}	max.	30	A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	250	A
Junction temperature	T_j	max.	125	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.90	$^oC/W$

MECHANICAL DATA Dimensions in mm



Net weight : 95 g
With accessories: 115 g
Diameter of hole in heatsink: max. 13 mm

Torque on nut: min. 100 cm kg
max. 200 cm kg

7Z3 0537

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])			BTX13-100R	200R	300R	400R	500R	600R	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	400	400	500	500	600	600	V
Non repetitive peak reverse voltage $t \leqq 10$ ms	V_{RSM}	max.	400	400	500	500	700	700	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	600	V
Repetitive peak off-state voltage	V_{DRM}	max.	100	200	300	400	500	600	V
Non repetitive peak off-state voltage [3])	V_{DSM}	max.	500	500	500	500	700	700	V

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	30	A
R.M.S. forward current	$I_{T(rms)}$	max.	48	A
Repetitive peak forward current	I_{TRM}	max.	250	A
Non repetitive peak forward current t = 10 ms (see page D)	I_{TSM}	max.	300	A
I squared t for fusing	I^2t	max.	300	A^2s
Rate of rise of forward current	$\frac{dI_T}{dt}$	max.	5	A/μs
Repetitive peak reverse current (during commutation or turn-off)	I_{RRM}	max.	20	A

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V and at $R_{th\ j\text{-}a} \leqq 7\ ^{o}C/W$.

[3]) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0538

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}	-55 to +125		^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.45	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.15	$^{o}C/W$

7Z3 0539

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX13-100R	200R	300R	400R	500R	600R	
Forward on-state voltage; I_T = 250 A	V_T	<	3.5	3.5	3.5	3.5	3.5	3.5	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	500	600	V
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	20	V/μs
Currents									
Reverse current $V_R = V_{RRM}$ max	I_R	<	8	8	5	5	5	5	mA
Off-state current $V_D = V_{DRM}$ max	I_D	<	8	8	5	5	5	5	mA

Holding current I_H typ. 40 mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices T_j = 25 °C	I_{GT}	>	50	mA

SWITCHING CHARACTERISTICS (See also page F)

Turn on time ($t_d + t_r$)	t_{on}	typ.	4	μs
delay time	t_d	typ.	1.3	μs
rise time	t_r	typ.	2.7	μs
Turn off time	t_{off}	typ.	6	μs

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0540

OPERATING NOTES

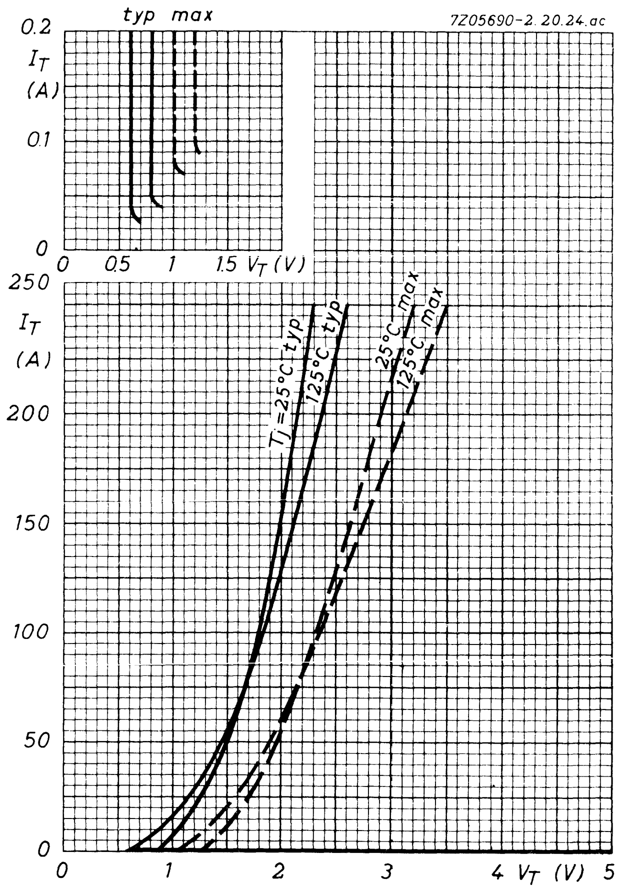
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

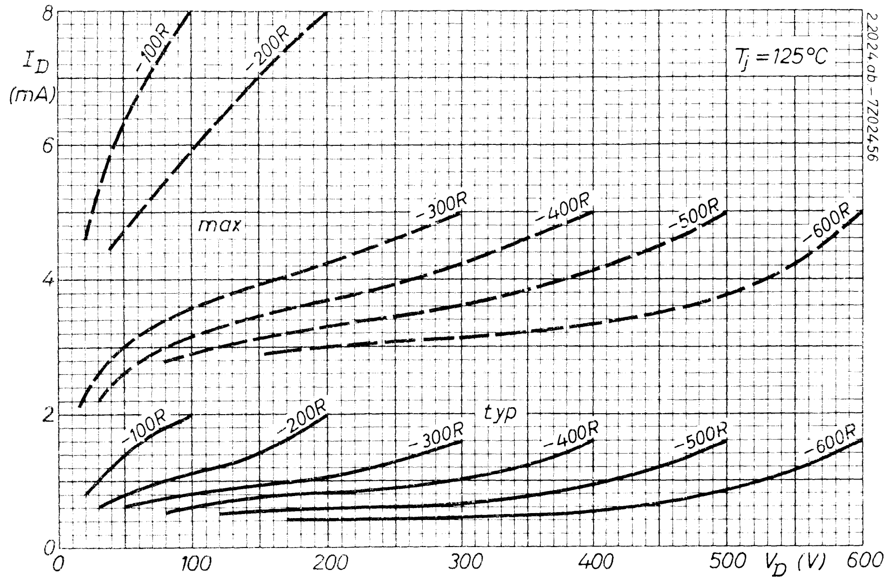
$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

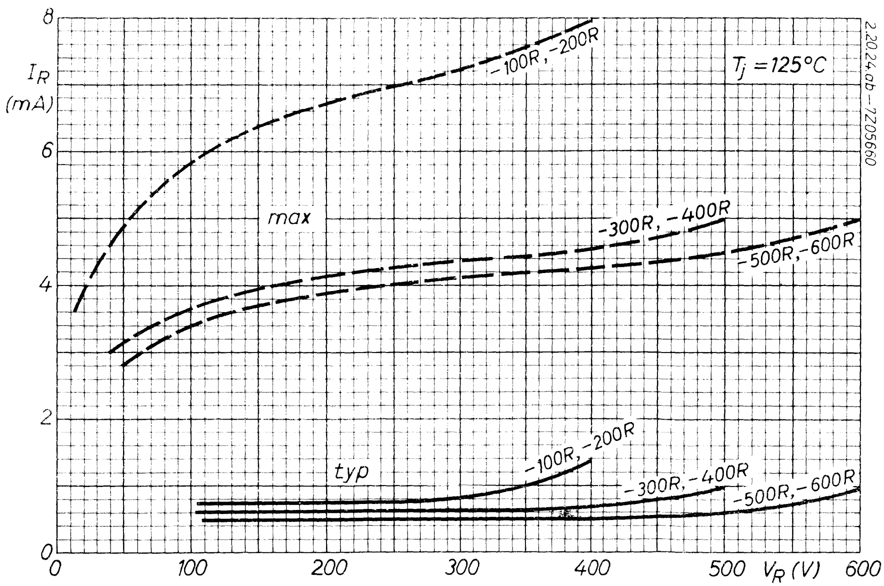
   where I_{mag} = magnetising primary r.m.s. current (A)
   V_1 = transformer primary r.m.s. voltage (V)
   V_2 = transformer secondary r.m.s. voltage (V)
   T = V_1/V_2
   V_{RWM} stands for the actually applied crest working reverse voltage.

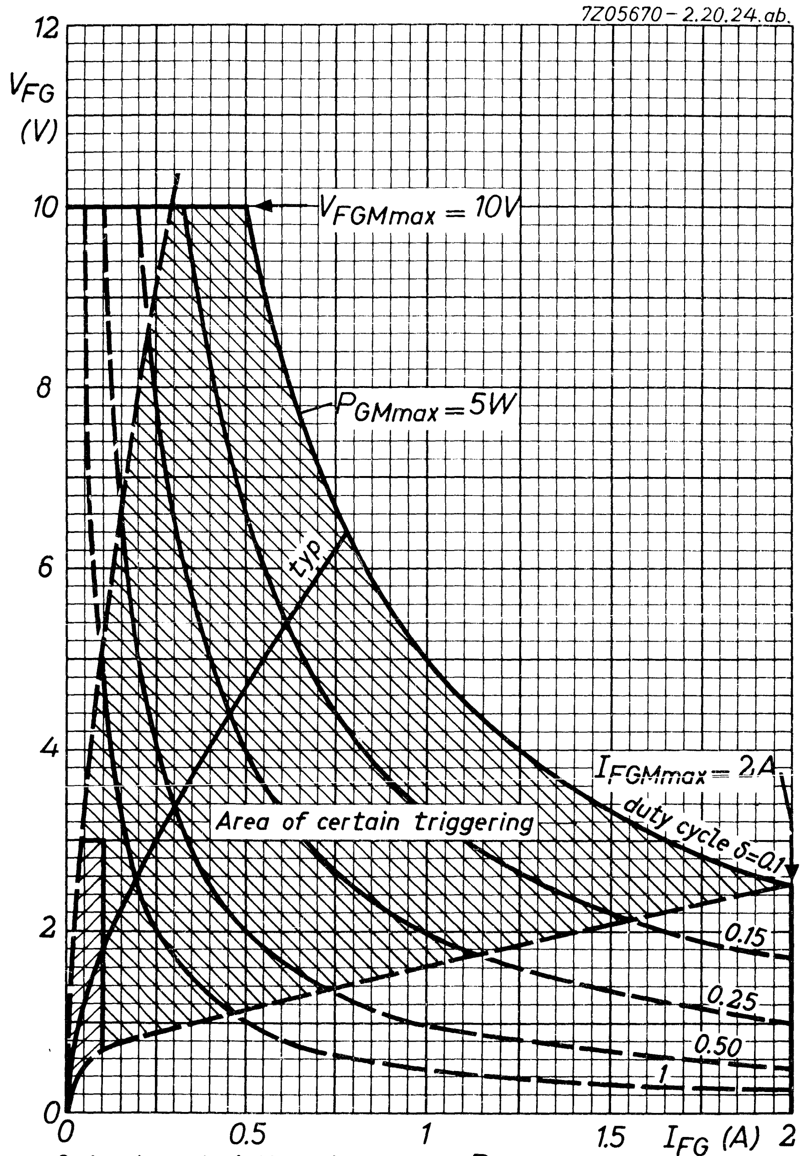
2. In order to prevent the diodes from being damaged by surge currents higher than those mentioned in the curve at page D a fast fuse is recommended.

7Z3 0065

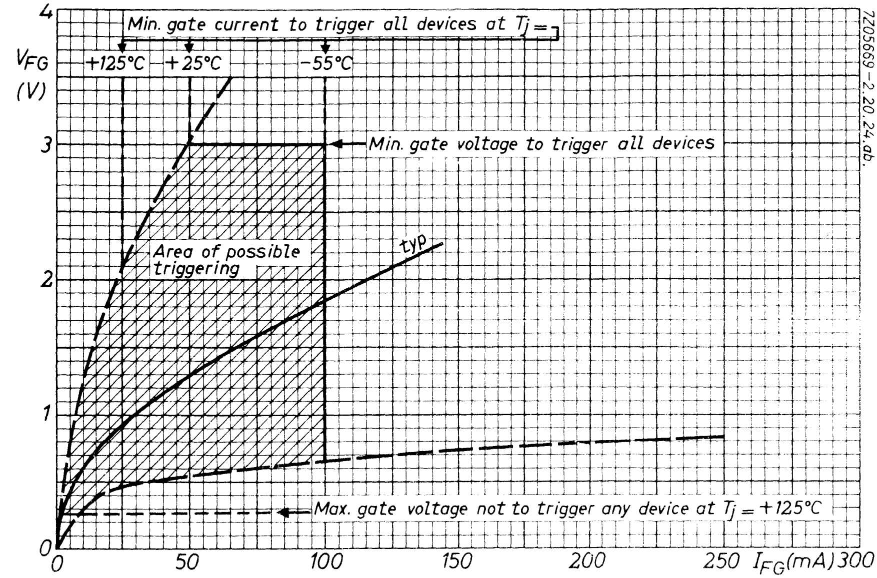

typ max
7Z05690-2.20.24.ac
0.2
I_T
(A)
0.1
0
0 0.5 1 1.5 V_T (V)
250
I_T
(A)
200
150
100
50
0
0 1 2 3 4 V_T (V) 5
T_j = 25 °C typ
125 °C typ
25 °C max
125 °C max

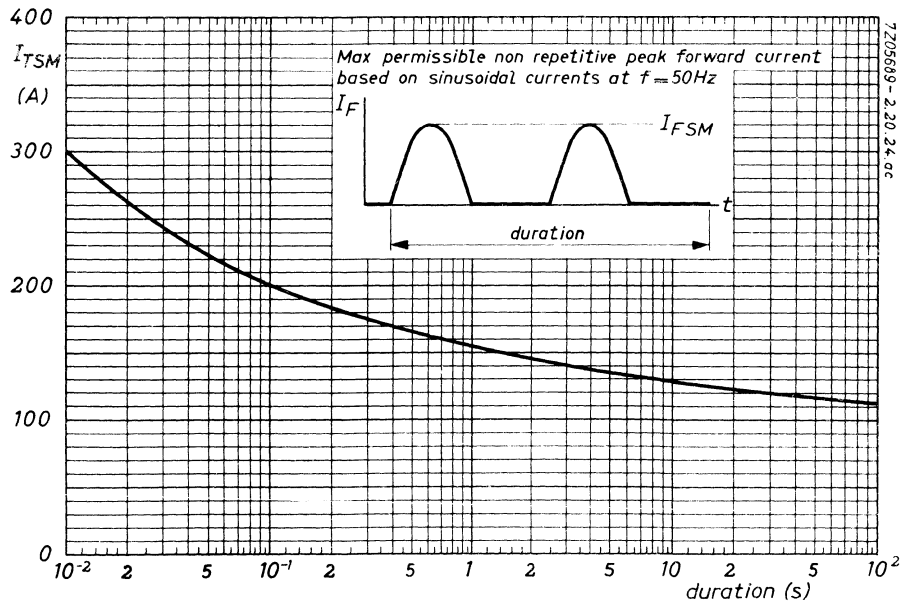

I_D
(mA)
Tj = 125°C
max
typ
−100R
−200R
−300R
−400R
−500R
−600R
V_D (V)
0
100
200
300
400
500
600
2
4
6
8
2.2024.ab − 7Z02456

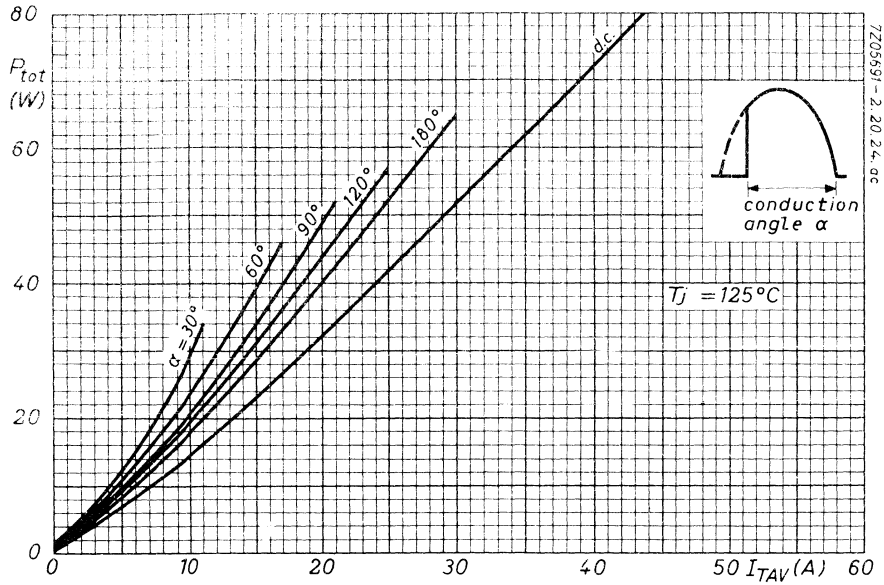

I_R
(mA)
Tj = 125°C
max
typ
−100R, −200R
−300R, −400R
−500R, −600R
V_R (V)
0
100
200
300
400
500
600
2
4
6
8
2.20.24.ab − 7Z05660

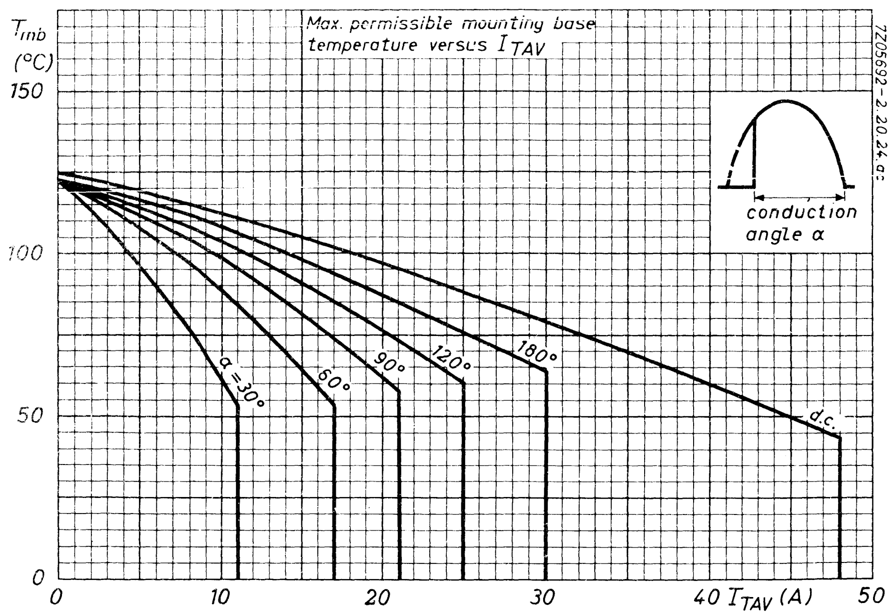


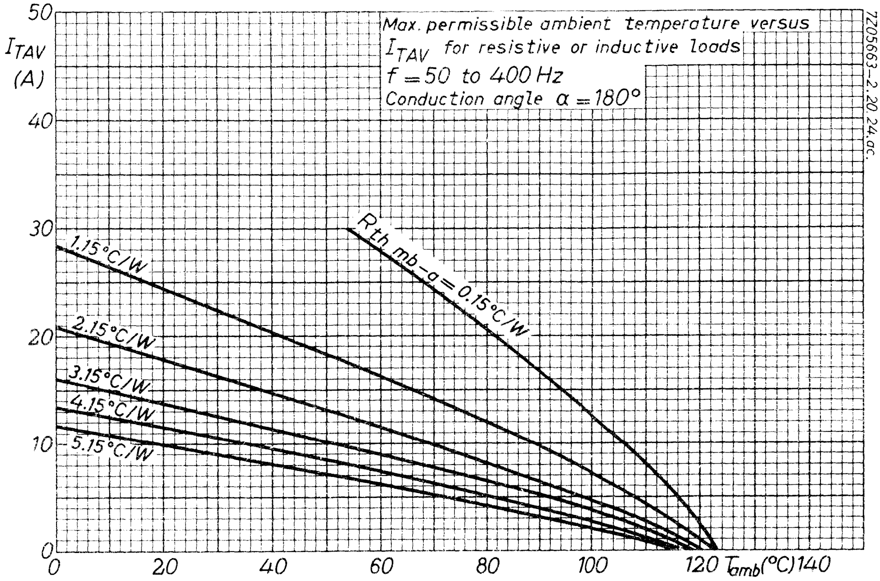
Gate characteristics with curves $P_{GAV} = 0.5W$

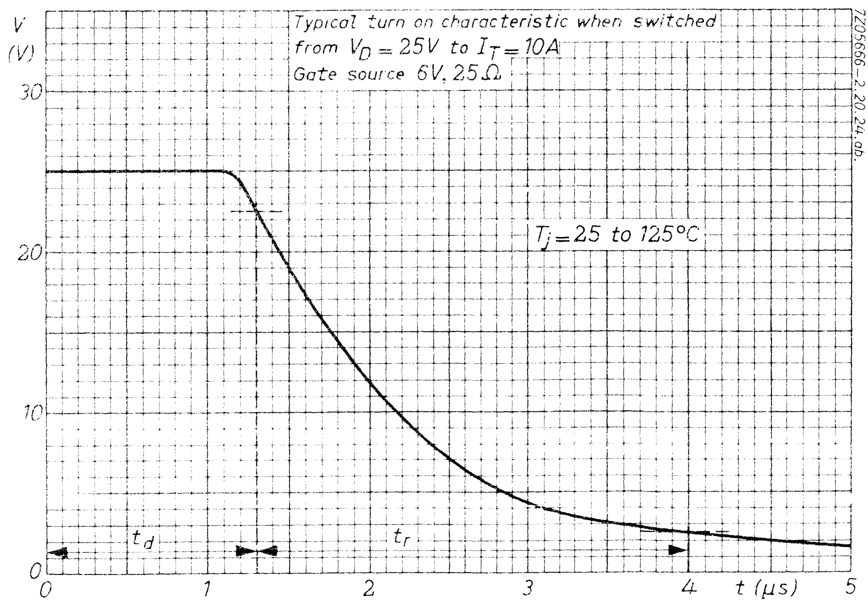

Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−55°C
V_{FG} (V)
Min. gate voltage to trigger all devices
Area of possible triggering
typ
Max. gate voltage not to trigger any device at T_j = +125°C
I_{FG} (mA)
0
1
2
3
4
50
100
150
200
250
300
7Z05689-2.20.24.ab


Max permissible non repetitive peak forward current based on sinusoidal currents at f = 50Hz
I_F
I_{FSM}
t
duration
I_{TSM} (A)
0
100
200
300
400
10^{-2}
2
5
10^{-1}
2
5
1
2
5
10
2
5
10^{2}
duration (s)
7Z05689-2.20.24.ac


80
60
40
20
0
P_{tot}
(W)
0
10
20
30
40
50 I_{TAV} (A)
60
$\alpha = 30°$
60°
90°
120°
180°
d.c.
conduction
angle α
$T_j = 125°C$
7Z05691-2.20.24.ac


T_{mb}
(°C)
150
100
50
0
0
10
20
30
40 I_{TAV} (A)
50
Max. permissible mounting base
temperature versus I_{TAV}
$\alpha = 30°$
60°
90°
120°
180°
d.c.
conduction
angle α
7Z05692-2.20.24.ac


Max. permissible ambient temperature versus
I_{TAV} for resistive or inductive loads
f = 50 to 400 Hz
Conduction angle α = 180°
I_{TAV} (A)
1.15°C/W
2.15°C/W
3.15°C/W
4.15°C/W
5.15°C/W
$R_{th\ mb-a}$ = 0.15°C/W
T_{amb} (°C)
7Z05663-2.20.24.ac.


Typical turn on characteristic when switched
from V_D = 25V to I_T = 10A
Gate source 6V, 25 Ω
V (V)
T_j = 25 to 125°C
t_d
t_r
t (μs)
7Z05666-2.20.24.ab.

CONTROLLED AVALANCHE THYRISTORS

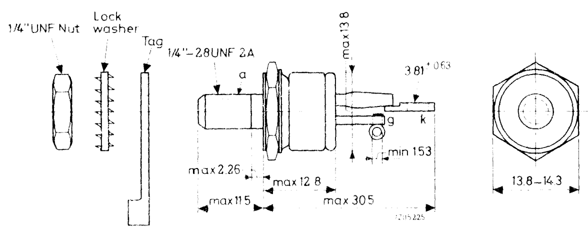
P-gate siliconthyristors in a TO-48 metal envelope, capable of absorbing transients and intended for power control and power switching applications. The series consists of the following reverse polarity types (stud anode):
BTX35-500R; BTX35-600R; BTX35-700R and BTX35-800R.

QUICK REFERENCE DATA

			BTX35-500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V
Average forward current	I_{TAV}	max.	12				A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	106				A
Non repetitive peak reverse dissipation t = 10 μs; T_j = 25 °C	P_{RSM}	max.	18				kW
Junction temperature	T_j	max.	125				°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0				°C/W

MECHANICAL DATA Dimensions in mm

TO-48



Net weight : 10 g
With accessories: 15 g

Torque on nut: min. 17 cm kg
max. 35 cm kg

Insulating bush and mica washer (type number 56264) available on request.
Diameter of hole in heatsink without insulating bush: max. 6.5 mm
with insulating bush : max. 8.5 mm

7Z3 0309

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])

			BTX35-500R	600R	700R	800R	
Continuous reverse voltage	V_R	max.	500	600	700	800	V
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Continuous off-state voltage	V_D	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V [3])

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	12	A
Forward current (d.c.)	I_T	max.	15	A
Repetitive peak forward current	I_{TRM}	max.	115	A
Non repetitive peak forward current t = 10 ms (See also page B)	I_{TSM}	max.	106	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	55	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Power dissipation

Non repetitive peak reverse dissipation (See also page B)

t = 10 μs; T_j = 25 °C	P_{RSM}	max.	18	kW
t = 10 μs; T_j = 125 °C	P_{RSM}	max.	7.5	kW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
For thermal stability: $R_{th\ j\text{-}a} \leq 4.5$ °C/W (d.c.) or ≤ 9 °C/W (a.c.)

[3]) Off-state voltages higher than V_{DWMmax} are allowed, but at voltages higher than the forward breakover voltage (see page 4) the device may switch into the on-state.

7Z3 0663

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		−55 to +125	^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^{o}C/W$
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	$^{o}C/W$

7Z3 0280

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX35-500R	600R	700R	800R	
Forward on-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	3.0	3.0	3.0	3.0	V [1]
Reverse breakdown voltage in avalanche region	$V_{(BR)R}$	>	550	660	770	880	V
Forward breakover voltage	$V_{(BO)}$	>	550	660	770	880	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	100	100	100	100	V/μs
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	V/μs

Currents

			BTX35-500R	600R	700R	800R	
Reverse current $V_R = V_{RWMmax}$	I_R	<	6.0	5.0	4.5	4.0	mA [2]
Off-state current $V_D = V_{DWMmax}$	I_D	<	6.0	5.0	4.5	4.0	mA
Pick up current	I_P	typ.	20 (all types)				mA
Holding current	I_H	typ.	10 (all types)				mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.5	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	65	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0311

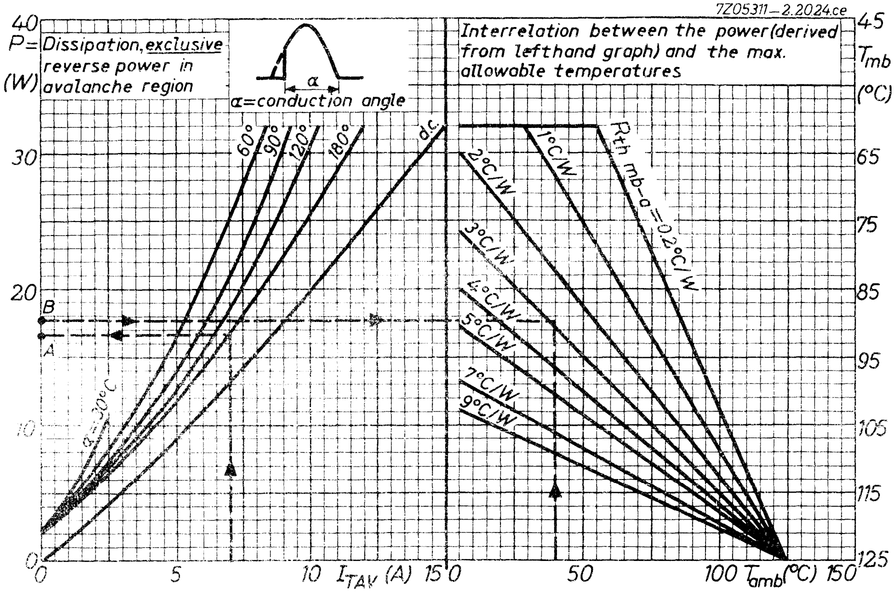
SWITCHING CHARACTERISTICS (See also page E)

Turn on time when switched from V_D = 400 V to I_T = 50 A				
Gate source 5 V, 25 Ω, T_j = 125 °C	t_{on}	typ.	2.0	μs
Turn off time when switched from I_T = 10 A to I_R between 5 and 20 A				
dV_D/dt = 20 V/μs T_j = 125 °C	t_{off}	typ.	15	μs
T_j = 25 °C	t_{off}	typ.	7.5	μs

OPERATING NOTES

1. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at page B a fast fuse is recommended.
2. The gate and cathode connectors should not be bent; they should be soldered into the circuit so there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

7Z3 0312



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle $\alpha = 180^{\circ}$) at $T_{amb} = 40\ ^{\circ}C$.

The average forward current (per thyristor) $I_{TAV} = 7$ A.

Furthermore assume a repetitive peak reverse power in the avalanche region $P_{RRM} = 2$ kW (per thyristor) during 10 μs.

From the left hand part of the graph above it follows that at $I_{TAV} = 7$ A and $\alpha = 180^{\circ}$ the average forward power + average leakage power = 16.6 W per thyristor (point A). The average reverse power in the avalanche region, averaged over any cycle follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{10\ \mu s}{20\ ms} = 0.0005$$

Thus $P_{RAV} = 0.0005 \times 2\ kW = 1$ W.

Therefore the total device power dissipation $P_{tot} = (16.6 + 1)$ W = 17.6 W (point B).

From the right hand part follows the thermal resistance, required for $P_{tot} = 17.6$ W at $T_{amb} = 40\ ^{\circ}C$.

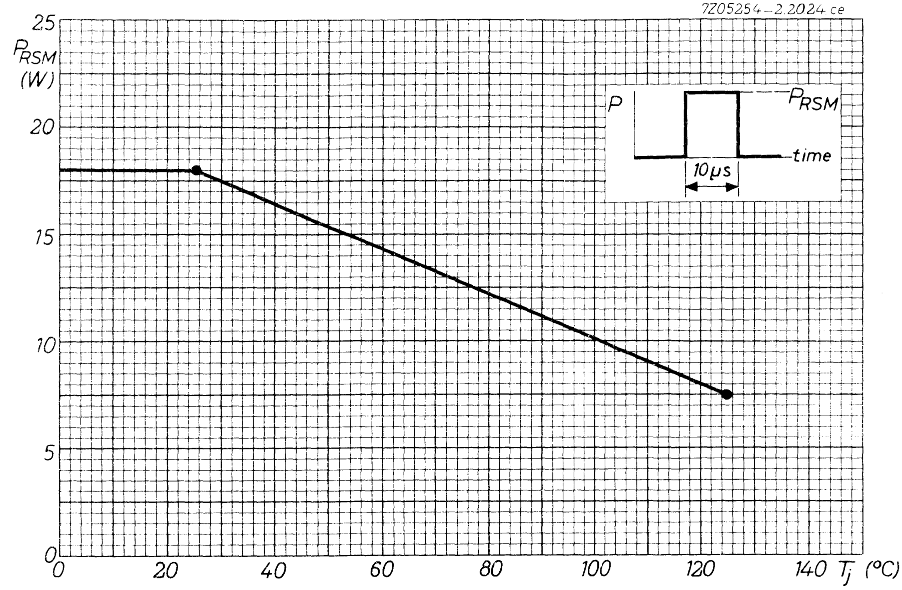
$$R_{th\ mb-a} \approx 2.9\ ^{\circ}C/W.$$

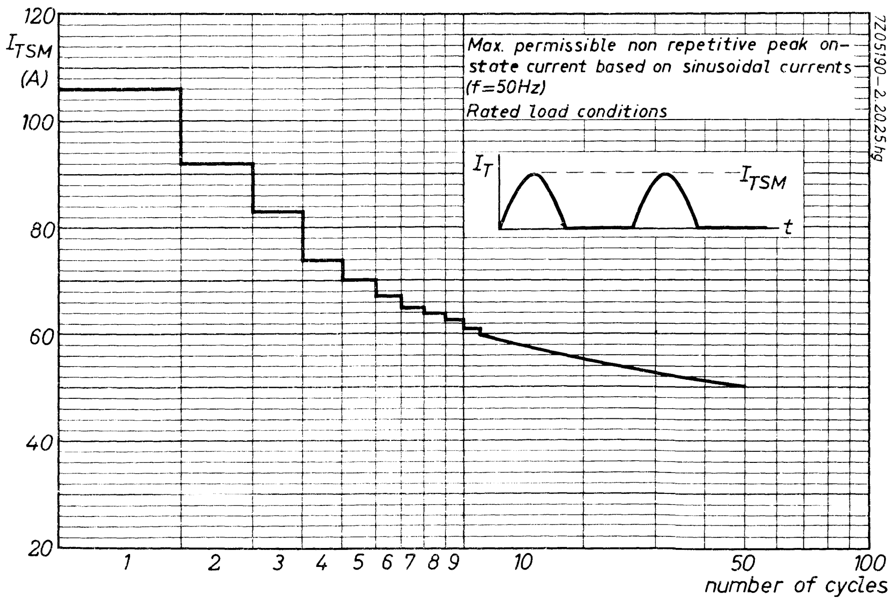
The contact thermal resistance $R_{th\ mb-h} = 0.2\ ^{\circ}C/W$.

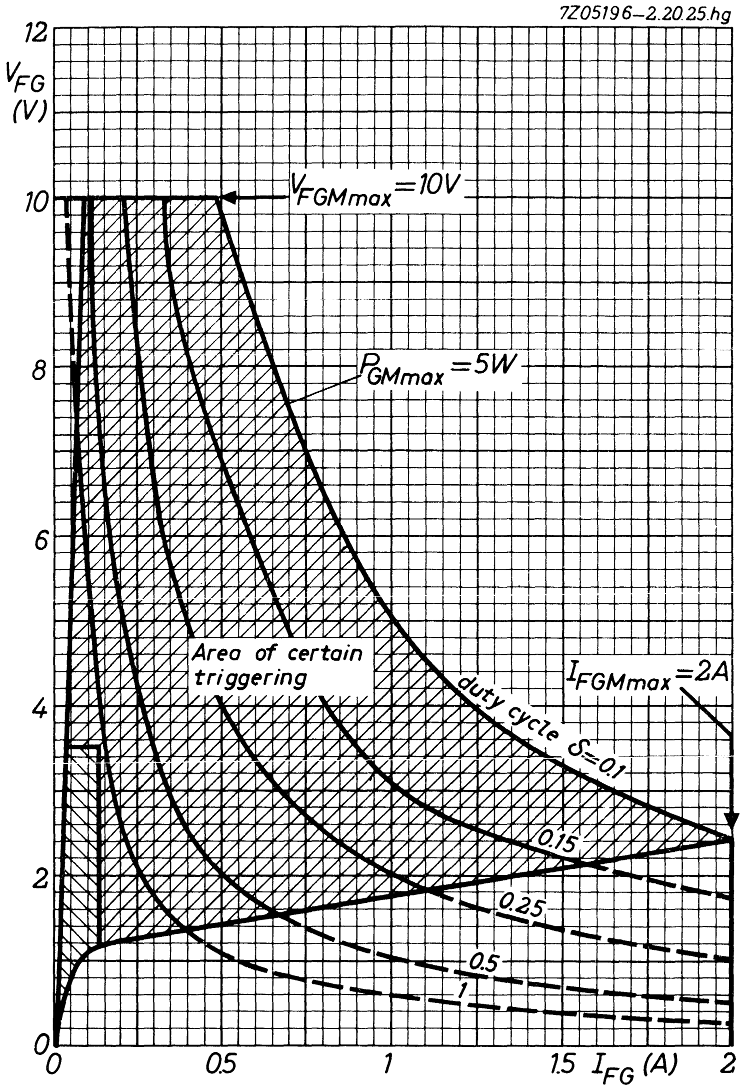
Hence the heatsink thermal resistance should be:

$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (2.9 - 0.2)\ ^{\circ}C/W = 2.7\ ^{\circ}C/W.$$

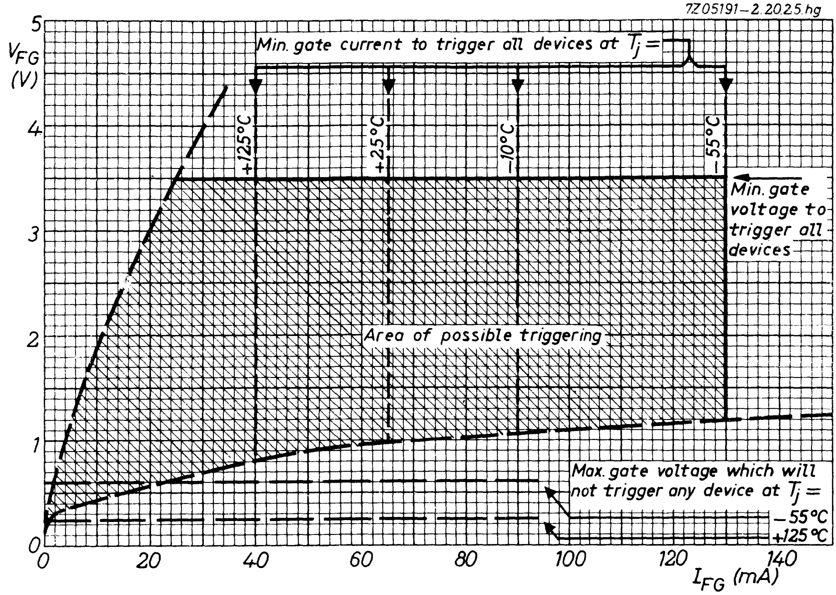
Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found. 7Z3 0313

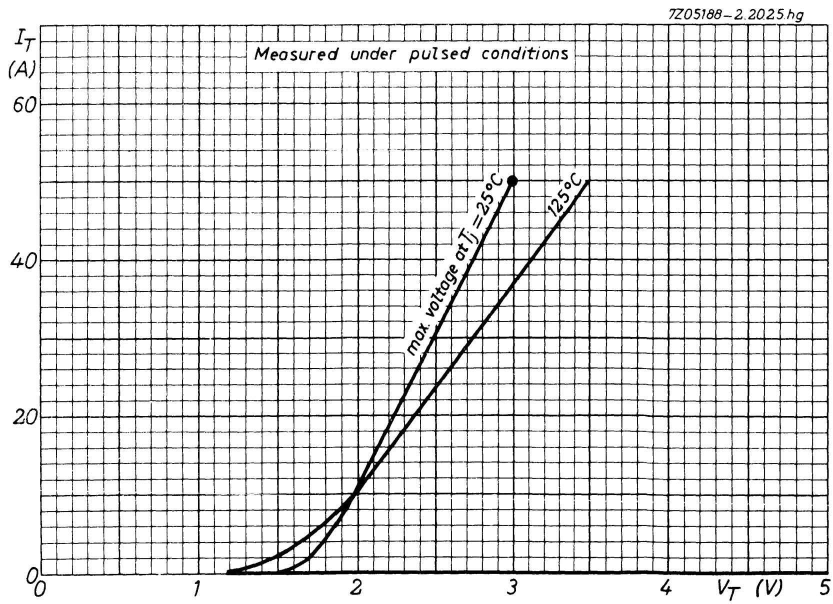

7Z05254-2.2024.ce
25
P_{RSM}
(W)
20
15
10
5
0
P
P_{RSM}
time
10μs
0
20
40
60
80
100
120
140 T_j (°C)

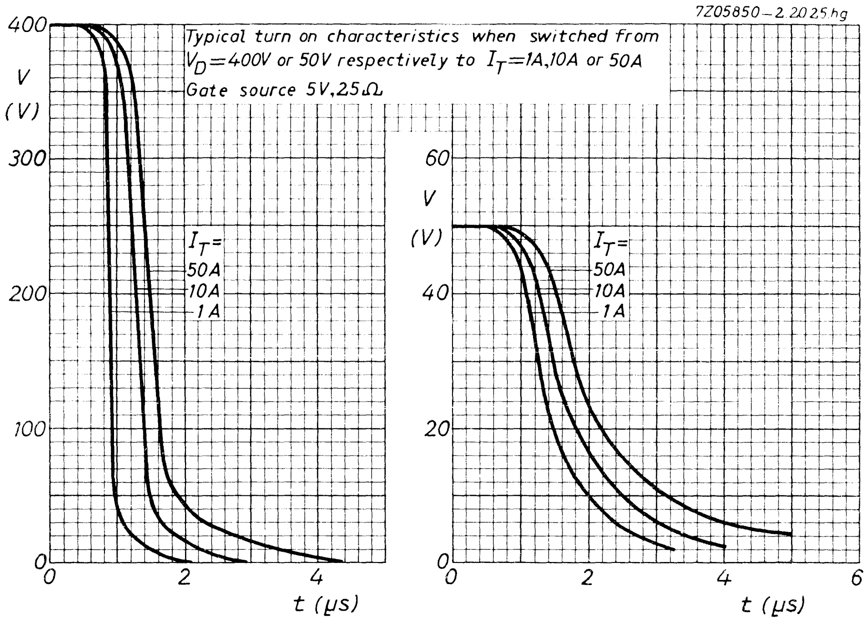

120
I_{TSM}
(A)
100
80
60
40
20
7Z05190-2.2025.hg
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles

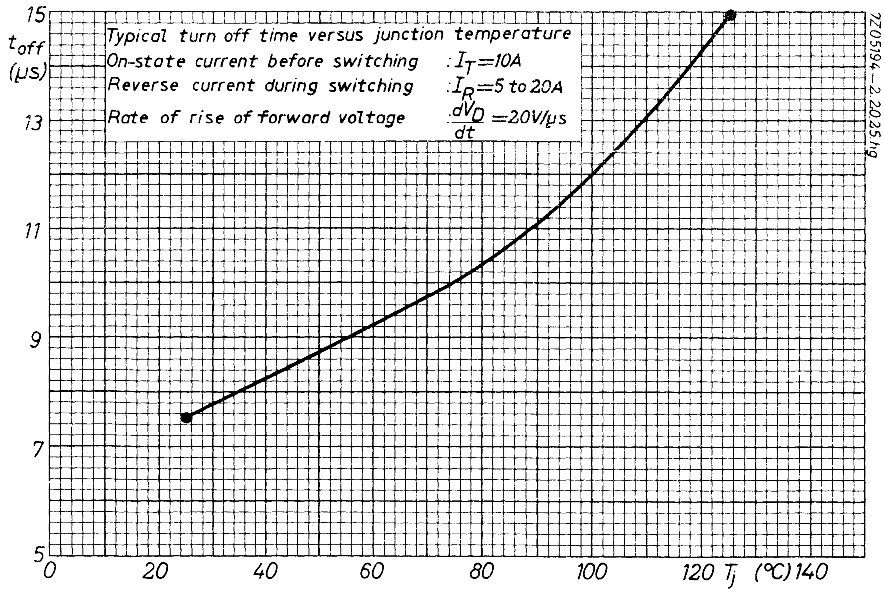


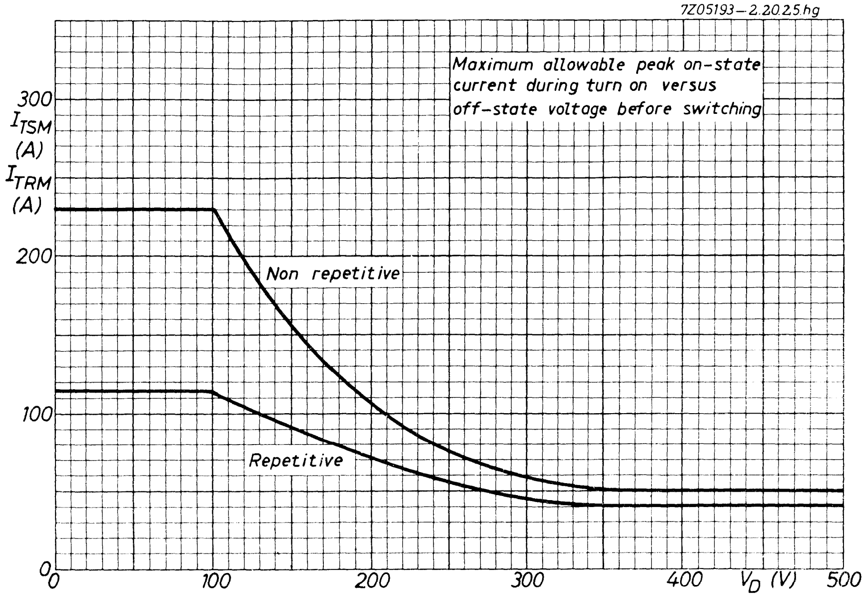
Gate characteristics with curves P_{GAV}=0.5W

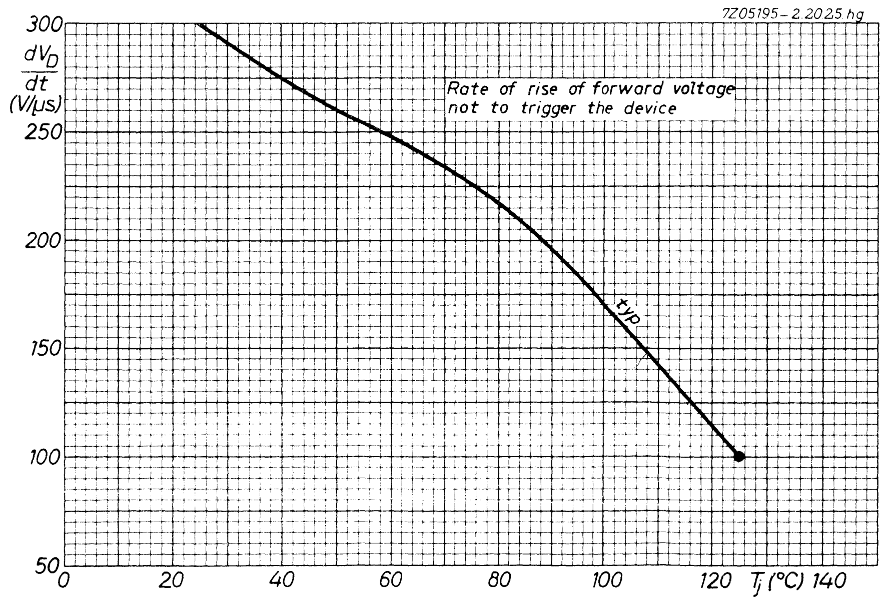

7Z05191–2.20.25.hg
V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage which will not trigger any device at T_j =
−55°C
+125°C
0
1
2
3
4
5
0
20
40
60
80
100
120
140
I_{FG} (mA)


7Z05188–2.20.25.hg
I_T (A)
Measured under pulsed conditions
max. voltage at T_j = 25°C
125°C
0
20
40
60
0
1
2
3
4
5
V_T (V)


7Z05850–2.20.25.hg
Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V,25Ω
V
(V)
400
300
200
100
0
I_T=
50A
10A
1A
0
2
4
t (μs)
60
V
(V)
40
20
0
I_T=
50A
10A
1A
0
2
4
6
t (μs)


7Z05194–2.20.25.hg
Typical turn off time versus junction temperature
On-state current before switching : I_T=10A
Reverse current during switching : I_R=5 to 20A
Rate of rise of forward voltage $\frac{dV_D}{dt}$ =20V/μs
t_{off}
(μs)
15
13
11
9
7
5
0
20
40
60
80
100
120
T_j (°C)
140


7Z05193–2.20.2.5.hg
Maximum allowable peak on-state current during turn on versus off-state voltage before switching
I_{TSM} (A)
I_{TRM} (A)
300
200
100
0
Non repetitive
Repetitive
0
100
200
300
400
V_D (V)
500


7Z05195–2.20.2.5.hg
Rate of rise of forward voltage not to trigger the device
$\frac{dV_D}{dt}$ (V/µs)
300
250
200
150
100
50
typ
0
20
40
60
80
100
120
T_j (°C)
140

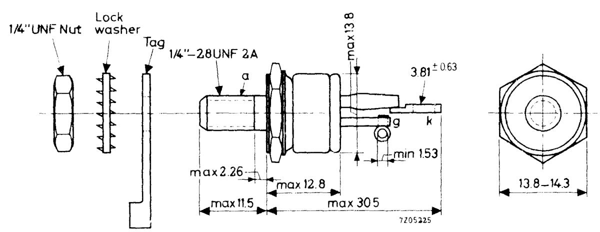
CONTROLLED AVALANCHE THYRISTORS

P-gate silicon thyristors in a TO-48 metal envelope, capable of absorbing transients and intended for power control and power switching applications. The series consists of the following reverse polarity types (stud anode):
BTX36-500R; BTX36-600R; BTX36-700R and BTX36-800R.

QUICK REFERENCE DATA			BTX36-500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V
Average forward current	I_{TAV}	max.	16				A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	136				A
Non repetitive peak reverse dissipation t = 10 μs; T_j = 25 °C	P_{RSM}	max.	18				kW
Junction temperature	T_j	max.	125				°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0				°C/W

MECHANICAL DATA Dimensions in mm

TO-48



Net weight : 10 g
With accessories: 15 g

Torque on nut: min. 17 cm kg
max. 35 cm kg

Insulating bush and mica washer (type number 56264) available on request.
Diameter of hole in heatsink without insulating bush: max. 6.5 mm
with insulating bush : max. 8.5 mm

7Z3 0314

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]

			BTX36-500R	600R	700R	800R	
Continuous reverse voltage	V_R	max.	500	600	700	800	V
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Continuous off-state voltage	V_D	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V [3]

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	16	A
Forward current (d.c.)	I_T	max.	19	A
Repetitive peak forward current	I_{TRM}	max.	140	A
Non repetitive peak forward current t = 10 ms (See also page B)	I_{TSM}	max.	136	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	75	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

Power dissipation

Non repetitive peak reverse dissipation (See also page B)

t = 10 μs; T_j = 25 °C	P_{RSM}	max.	18	kW
t = 10 μs; T_j = 125 °C	P_{RSM}	max.	7.5	kW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
For thermal stability: $R_{th\ j\text{-}a} \leqq 4.5$ °C/W (d.c.) or ≤ 9 °C/W (a.c.)

[3]) Off-state voltages higher than V_{DWMmax} are allowed, but at voltages higher than the forward breakover voltage (see page 4) the device may switch into the on-state.

7Z3 0664

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	°C/W

7Z3 0280

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX36-500R	600R	700R	800R	
Forward on-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	2.0	2.0	2.0	2.0	V 1)
Reverse breakdown voltage in avalanche region	$V_{(BR)R}$	>	550	660	770	880	V
Forward breakover voltage	$V_{(BO)}$	>	550	660	770	880	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	100	100	100	100	V/μs
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	V/μs

Currents

			BTX36-500R	600R	700R	800R	
Reverse current $V_R = V_{RWMmax}$	I_R	<	6.0	5.0	4.5	4.0	mA 2)
Off-state current $V_D = V_{DWMmax}$	I_D	<	6.0	5.0	4.5	4.0	mA

Pick up current	I_P	typ.	20	mA
Holding current	I_H	typ.	10	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.0	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	40	mA

1) Measured under pulsed conditions to prevent excessive dissipation.

2) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0316

SWITCHING CHARACTERISTICS (See also page E)

Turn on time when switched from
V_D = 400 V to I_T = 50 A

Gate source 5 V, 25 Ω, T_j = 125 °C	t_{on}	typ.	2.0	μs

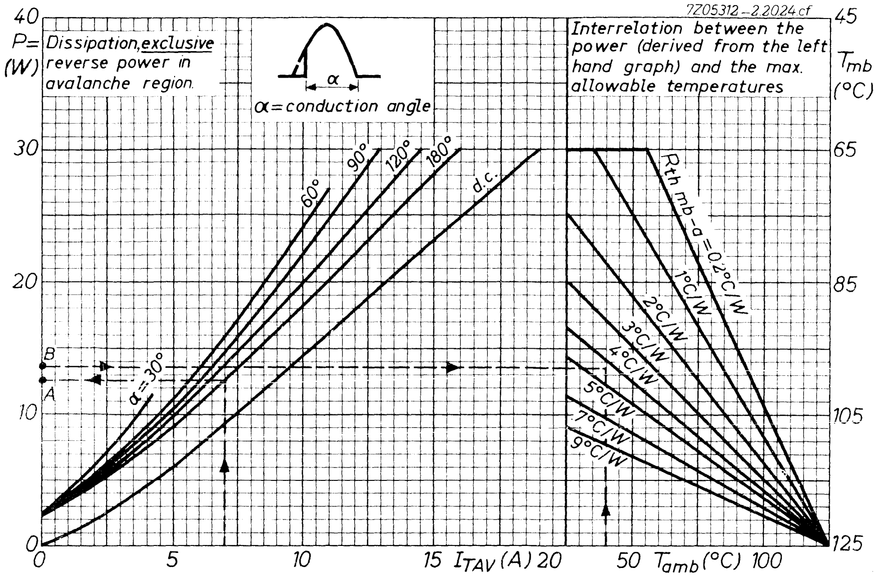
Turn off time when switched from
I_T = 10 A to I_R between 5 and 20 A

dV_D/dt = 20 V/μs	T_j = 125 °C	t_{off}	typ.	20	μs
	T_j = 25 °C	t_{off}	typ.	10	μs

OPERATING NOTES

1. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at page B a fast fuse is recommended.
2. The gate and cathode connectors should not be bent; they should be soldered into the circuit so there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

7Z3 0317



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle α = 180°) at T_{amb} = 40 °C.
The average forward current (per thyristor) I_{TAV} = 7 A.
Furthermore assume a repetitive peak reverse power in the avalanche region P_{RRM} = 2 kW (per thyristor) during 10 μs.

From the left hand part of the graph above it follows that at I_{TAV} = 7 A and α = 180° the average forward power + average leakage power = 12.5 W per thyristor (point A). The average reverse power in the avalanche region, averaged over any cycle follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{10\ \mu s}{20\ ms} = 0.0005$$

Thus P_{RAV} = 0.0005 x 2 kW = 1 W.

Therefore the total device power dissipation P_{tot} = (12.5 + 1) W = 13.5 W (point B).

From the right hand part follows the thermal resistance, required for P_{tot} = 13.5 W at T_{amb} = 40 °C.

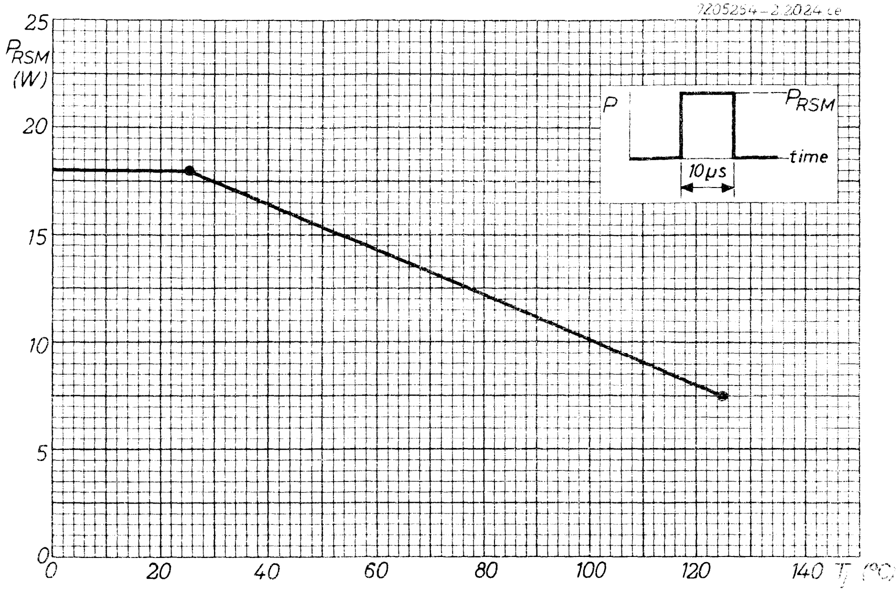
$R_{th\ mb-a} \approx 4.4$ °C/W

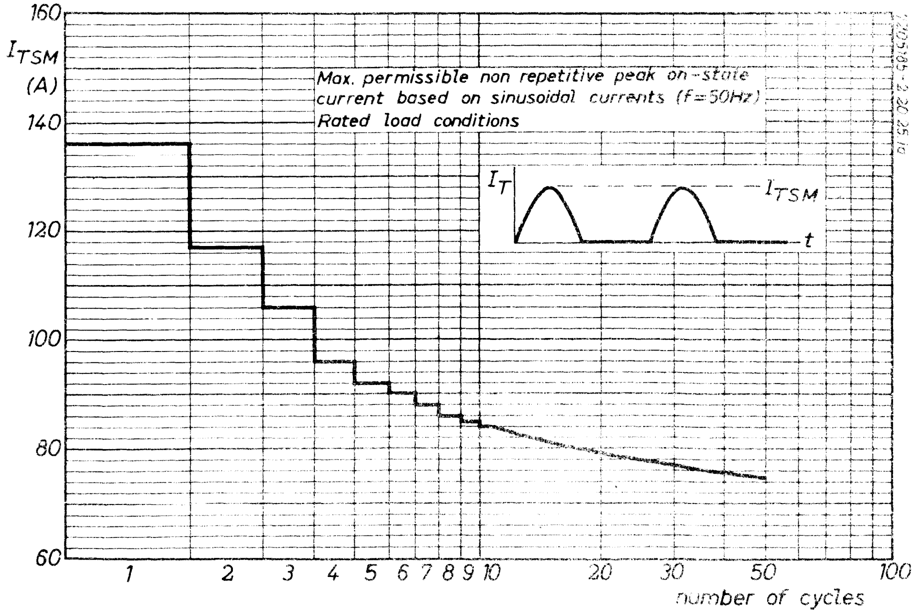
The contact thermal resistance $R_{th\ mb-h}$ = 0.2 °C/W.

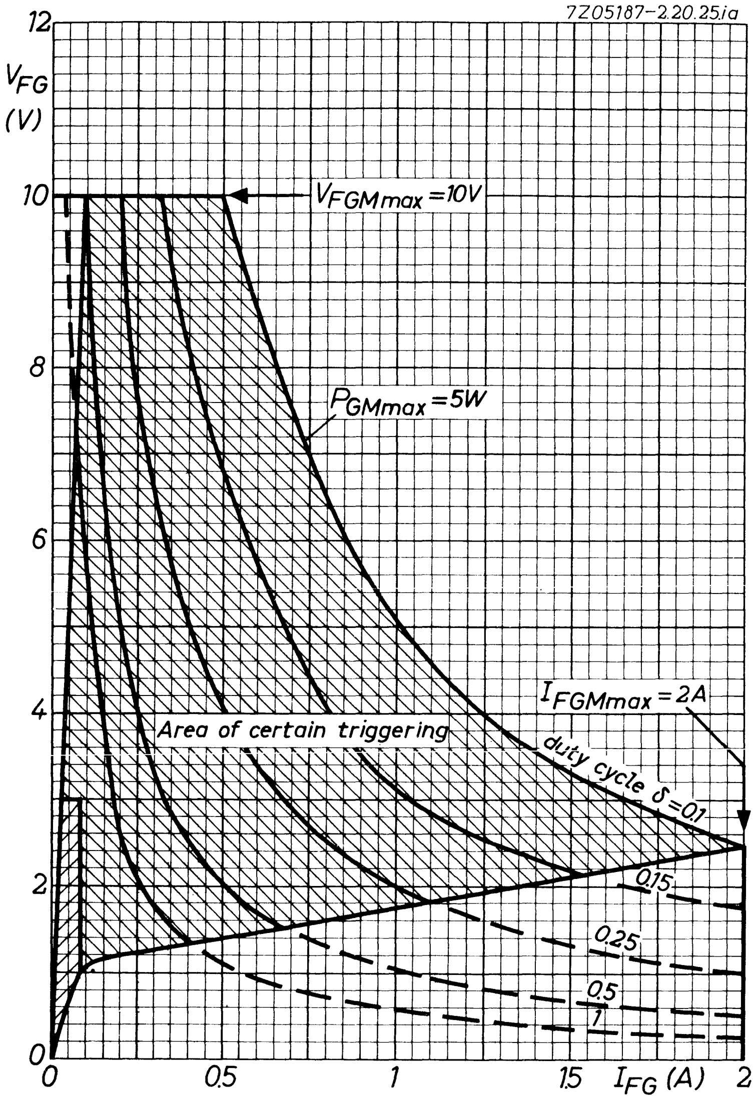
Hence the heatsink thermal resistance should be:

$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (4.4 - 0.2)\ °C/W = 4.2\ °C/W.$$

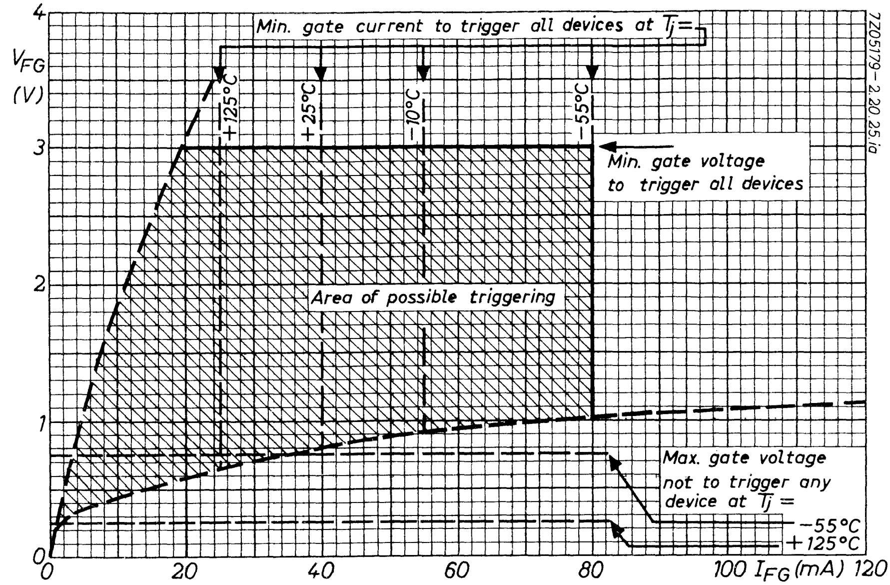
Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found. 7Z3 0318

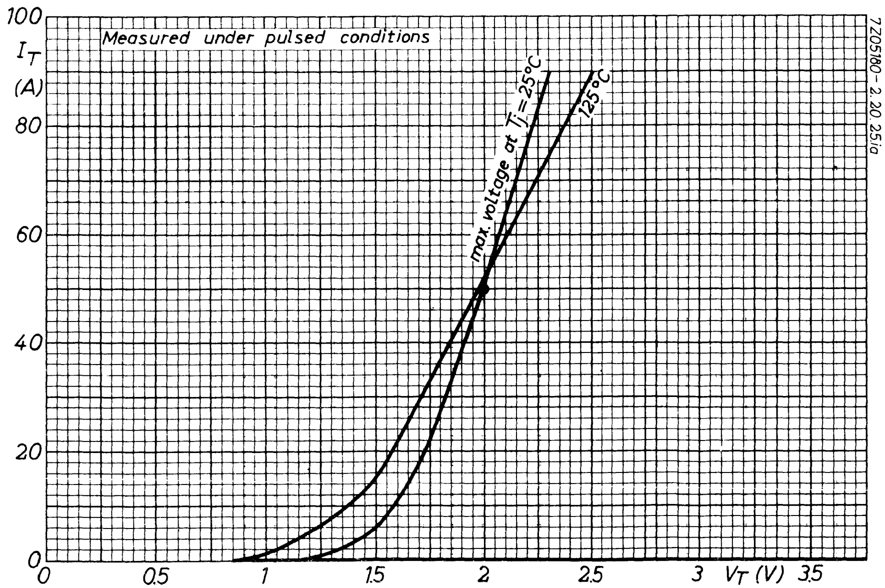

7Z05254-2.2024.ce
25
P_{RSM}
(W)
20
15
10
5
0
0
20
40
60
80
100
120
140 T_j (°C)
P
P_{RSM}
time
10 µs

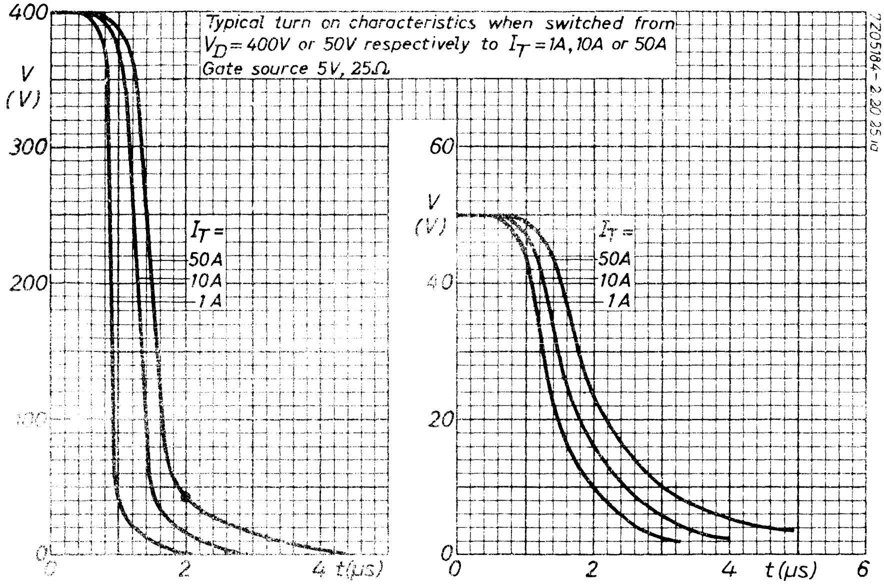

160
I_{TSM}
(A)
140
120
100
80
60
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t
1
2
3
4
5
6
7
8
9
10
20
30
50
100
number of cycles

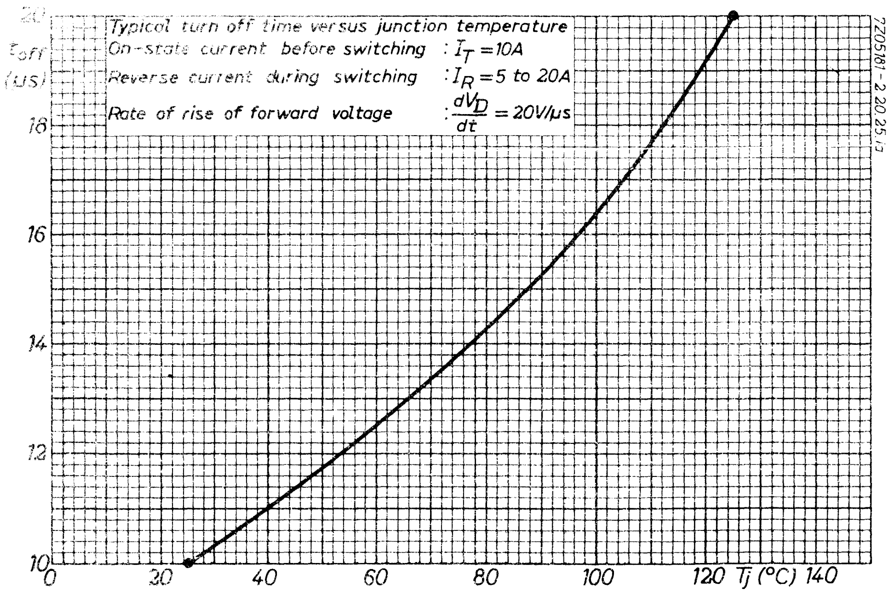


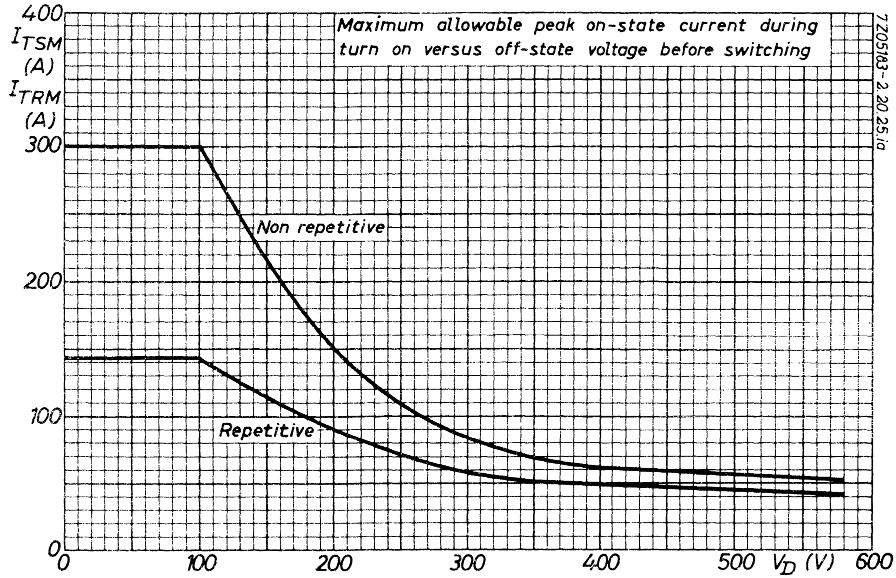
Gate characteristics with curves $P_{GAV} = 0.5W$

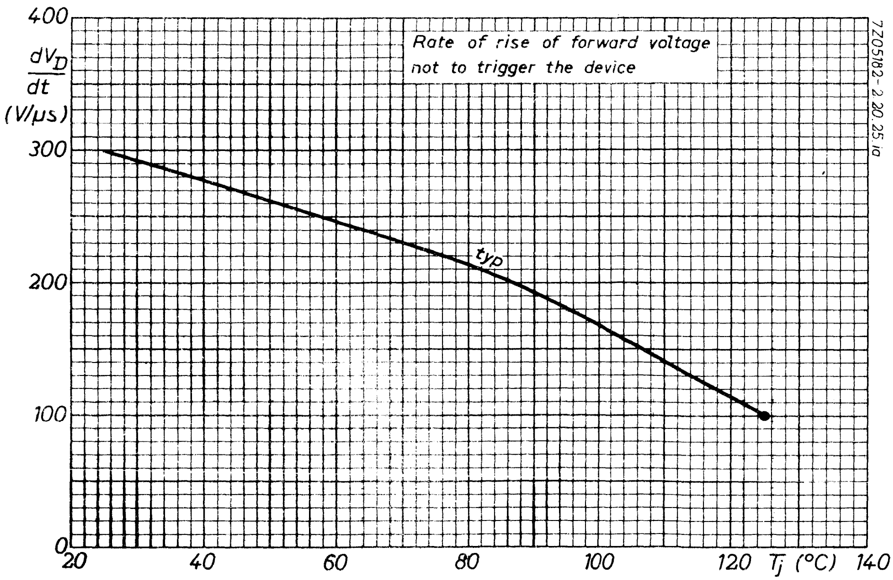

Min. gate current to trigger all devices at Tj =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at Tj =
−55°C
+125°C
VFG (V)
IFG (mA)
7Z05179−2.20.25.ia


Measured under pulsed conditions
max. voltage at Tj = 25°C
125°C
IT (A)
VT (V)
7Z05180−2.20.25.ia


Typical turn on characteristics when switched from V_D = 400V or 50V respectively to I_T = 1A, 10A or 50A
Gate source 5V, 25Ω
V (V)
400
300
200
100
0
I_T =
50A
10A
1A
0
2
4 t(μs)
60
40
20
6
7Z05184 - 2.20.25.ID


Typical turn off time versus junction temperature
On-state current before switching : I_T = 10A
Reverse current during switching : I_R = 5 to 20A
Rate of rise of forward voltage : $\frac{dV_D}{dt}$ = 20V/μs
t_{off} (μs)
20
18
16
14
12
10
0
20
40
60
80
100
120 T_j (°C) 140
7Z05181 - 2.20.25.ID


Maximum allowable peak on-state current during turn on versus off-state voltage before switching
7Z05183-2.20.25.ia
400
I_{TSM} (A)
I_{TRM} (A)
300
200
100
0
Non repetitive
Repetitive
0
100
200
300
400
500
V_D (V)
600


Rate of rise of forward voltage not to trigger the device
7Z05182-2.20.25.ia
400
$\frac{dV_D}{dt}$ (V/μs)
300
200
100
0
typ
20
40
60
80
100
120
T_j (°C)
140

CONTROLLED AVALANCHE THYRISTORS

P-gate silicon thyristors in a metal envelope with ceramic insulation. They are capable of absorbing transients and intended for power control and power switching applications. The series consists of the following reverse polarity types (stud anode):

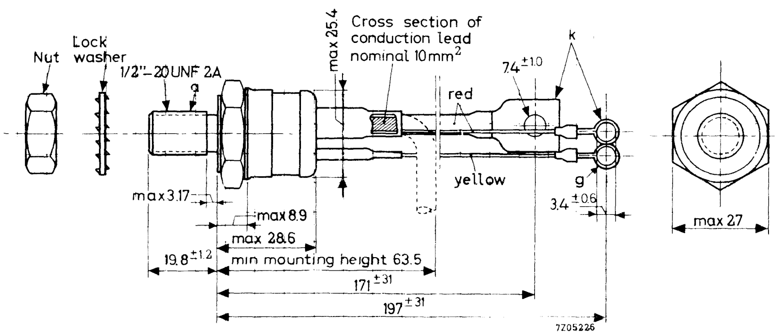
BTX37-500R; BTX37-600R; BTX37-700R and BTX37-800R.

QUICK REFERENCE DATA

			BTX37-500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V
Average forward current	I_{TAV}	max.	50				A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	680				A
Non repetitive peak reverse dissipation t = 10 μs; T_j = 25 °C	P_{RSM}	max.	40				kW
Junction temperature	T_j	max.	125				°C
Thermal resistance from junction to mounting base	$R_{th\,j\text{-}mb}$	=	0.6				°C/W

MECHANICAL DATA

Dimensions in mm



Net weight : 80 g
With accessories: 108 g

Torque on nut: min. 90 cm kg
max. 175 cm kg

Diameter of hole in heatsink: max. 13 mm

7Z3 0319

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])			BTX37-500R	600R	700R	800R	
Continuous reverse voltage	V_R	max.	500	600	700	800	V
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Continuous off-state voltage	V_D	max.	500	600	700	800	V
Crest-working off-state voltage	V_{DWM}	max.	500	600	700	800	V[3])

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	50	A
Forward current (d.c.)	I_T	max.	75	A
Repetitive peak forward current	I_{TRM}	max.	700	A
Non repetitive peak forward current t = 10 ms (See also page B)	I_{TSM}	max.	680	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	2000	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

Power dissipation

Non repetitive peak reverse dissipation (See also page B) $t = 10\ \mu s$; $T_j = 25\ ^oC$	P_{RSM}	max.	40	kW
$t = 10\ \mu s$; $T_j = 125\ ^oC$	P_{RSM}	max.	18	kW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
For thermal stability: $R_{th\ j\text{-}a} \leqq 1.5\ ^oC/W$ (d.c.) or $\leqq 3\ ^oC/W$ (a.c.)

[3]) Off-state voltages higher than V_{DWMmax} are allowed, but at voltages higher than the forward breakover voltage (see page 4) the device may switch into the on-state.

7Z3 0665

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		−55 to +125	^oC
Junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^oC/W$

7Z3 0290

CHARACTERISTICS

T_j = 125 ^oC unless otherwise specified

ANODE TO CATHODE

			BTX37-500R	600R	700R	800R	
Voltages							
Forward on-state voltage I_T = 500 A; T_j = 25 ^oC	V_T	<	3.3	3.3	3.3	3.3	V [1]
Reverse breakdown voltage in avalanche region	$V_{(BR)R}$	>	550	660	770	880	V
Forward breakover voltage	$V_{(BO)}$	>	550	660	770	880	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	10	10	10	10	V/µs
Currents							
Reverse current V_R = V_{RWMmax}	I_R	<	12	12	12	10	mA [2]
Off-state current V_D = V_{DWMmax}	I_D	<	12	12	12	10	mA
Pick up current	I_P	typ.	20				mA
Holding current	I_H	typ.	10				mA

GATE TO CATHODE

Voltages				
Voltage to trigger all devices V_D = 6 V; T_j = 25 ^oC	V_{GT}	>	3	V
Voltage not to trigger any device	V_{GD}	<	0.25	V
Current				
Current to trigger all devices V_D = 6 V; T_j = 25 ^oC	I_{GT}	>	80	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) The I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0321

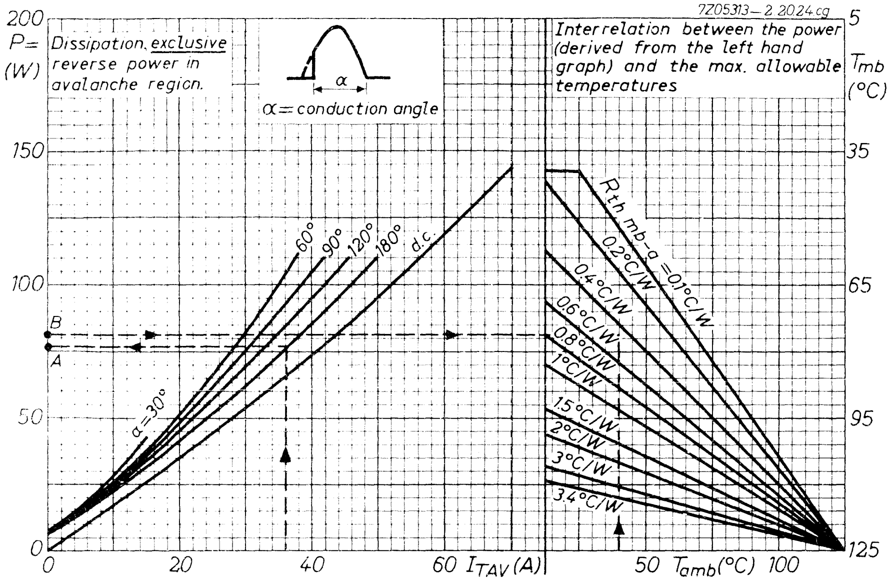
SWITCHING CHARACTERISTICS (See also page E)

Turn on time when switched from V_D = 400 V to I_T = 50 A				
Gate source 5 V, 25 Ω, T_j = 125 °C	t_{on}	typ.	3.0	μs
Turn off time when switched from I_T = 50 A to I_R between 10 and 30 A				
dV_D/dt = 5 V/μs T_j = 125 °C	t_{off}	typ.	20	μs
T_j = 25 °C	t_{off}	typ.	10	μs

OPERATING NOTE

In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at page B a fast fuse is recommended.

7Z3 0322



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle α = 180 °C) at T_{amb} = 40 °C.
The average forward current (per thyristor) I_{TAV} = 36 A.
Furthermore assume a repetitive peak reverse power in the avalanche region P_{RRM} = 8 kW (per thyristor) during 10 μs.

From the left hand part of the graph above it follows that at I_{TAV} = 36 A and α = 180° the average forward power + average leakage power = 77 W per thyristor (point A). The average reverse power in the avalanche region, averaged over any cycle follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } = \frac{10\ \mu s}{20\ ms} = 0.0005$$

Thus P_{RAV} = 0.0005 x 8 kW = 4 W.

Therefore the total device power dissipation P_{tot} = (77 + 4) W = 81 W (point B).

From the right hand part follows the thermal resistance, required for P_{tot} = 81 W at T_{amb} = 40 °C.

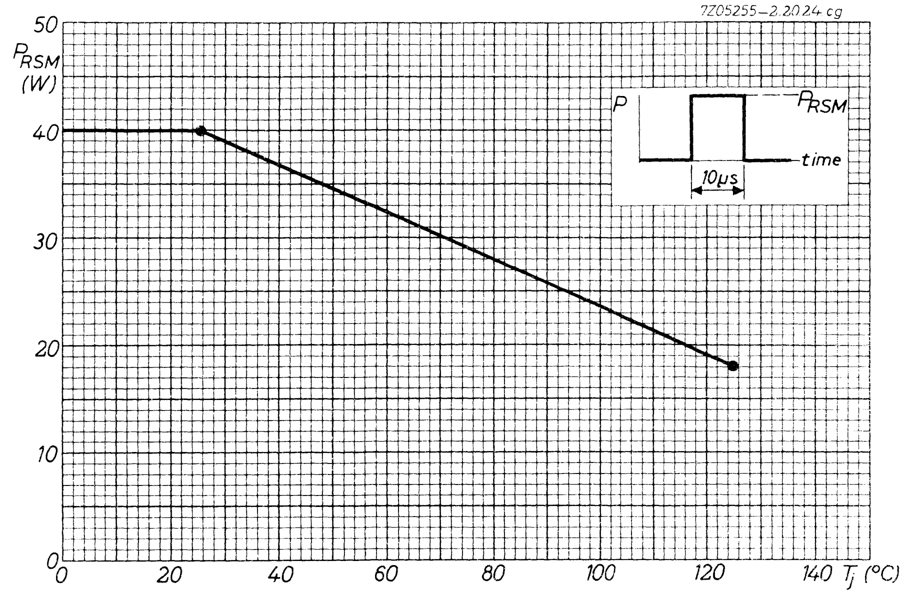
$$R_{th\ mb\text{-}a} \approx 0.47\ ^{\circ}C/W$$

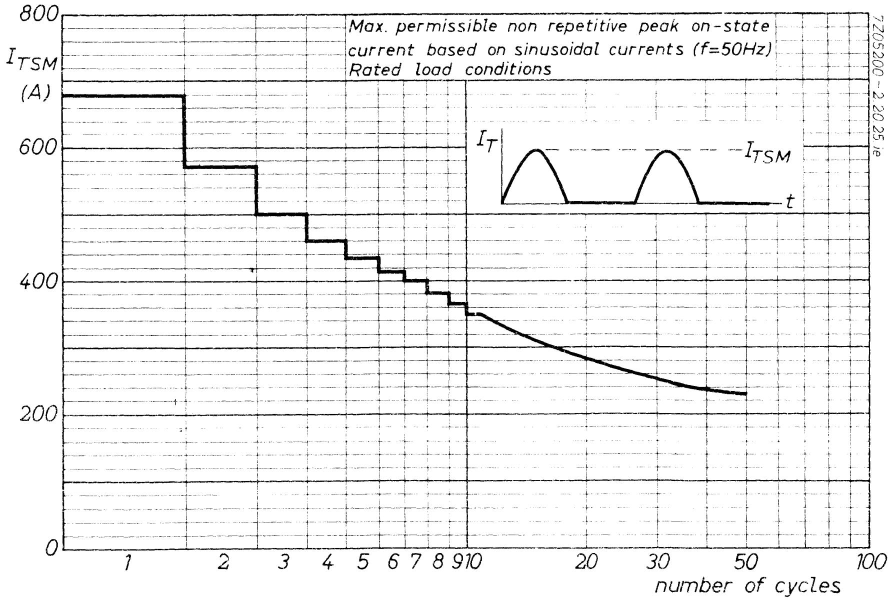
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.1 °C/W.

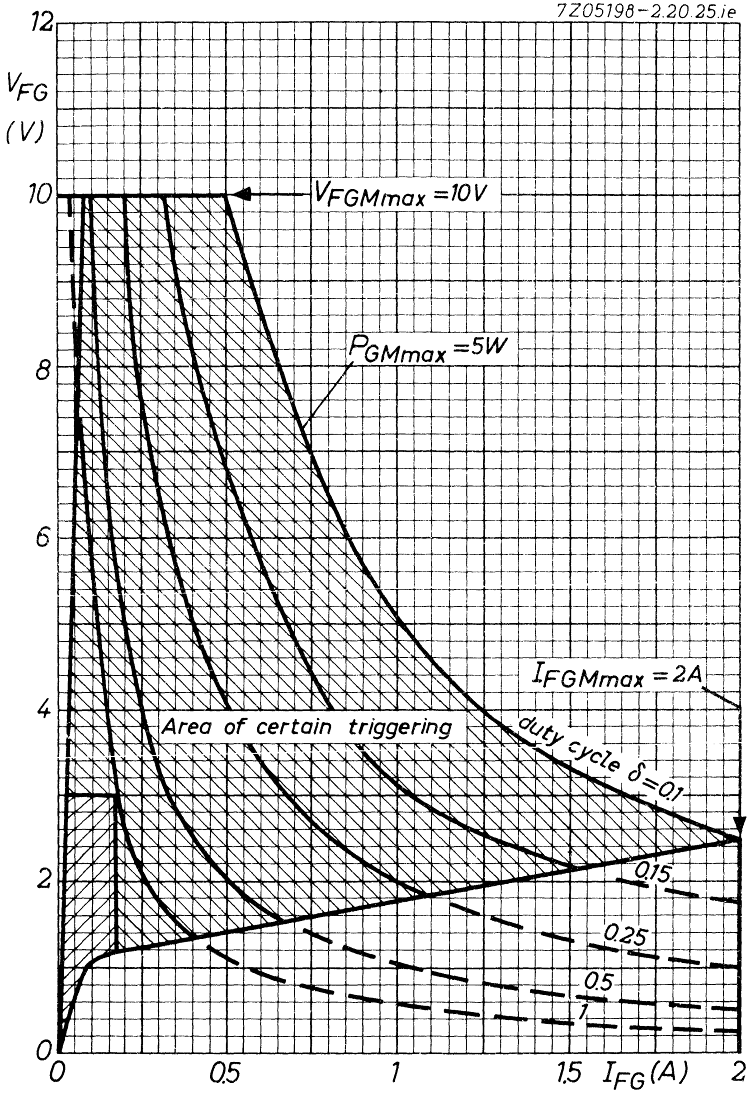
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.47 - 0.1)\ ^{\circ}C/W = 0.37\ ^{\circ}C/W.$$

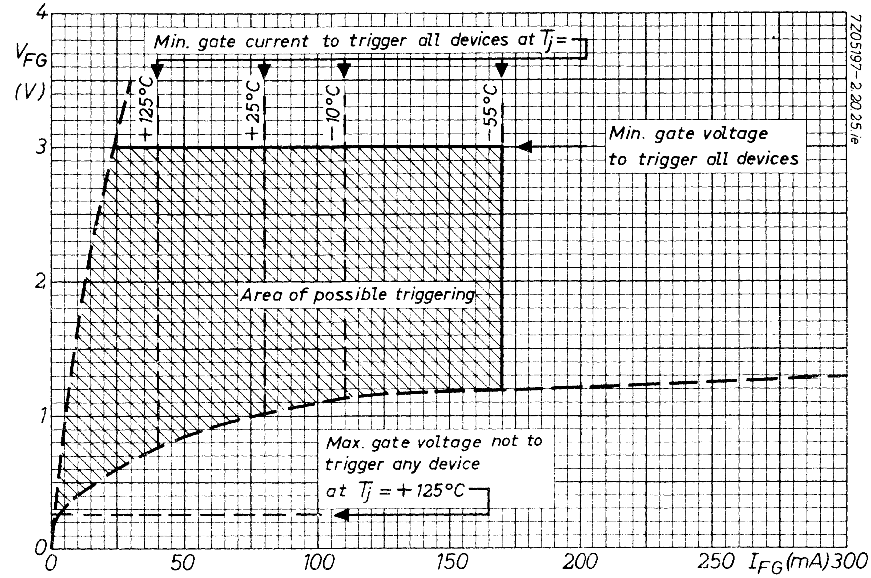
Alternatively, when the heatsink and $R_{th\ h\text{-}a}$ are known, the maximum permissible ambient temperature can be found. 7Z3 0323

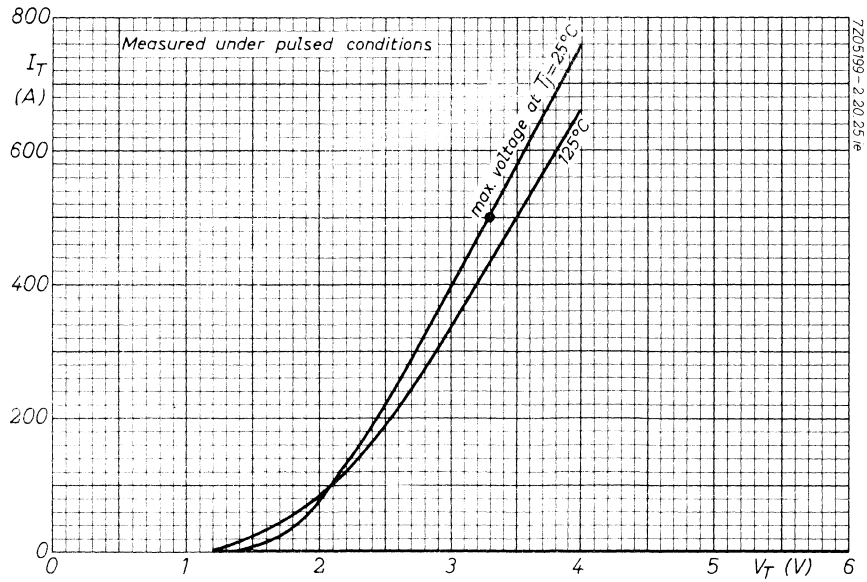

7Z05255–2.20.24 cg
50
P_{RSM}
(W)
40
30
20
10
0
0
20
40
60
80
100
120
140 T_j (°C)
P
P_{RSM}
time
10μs

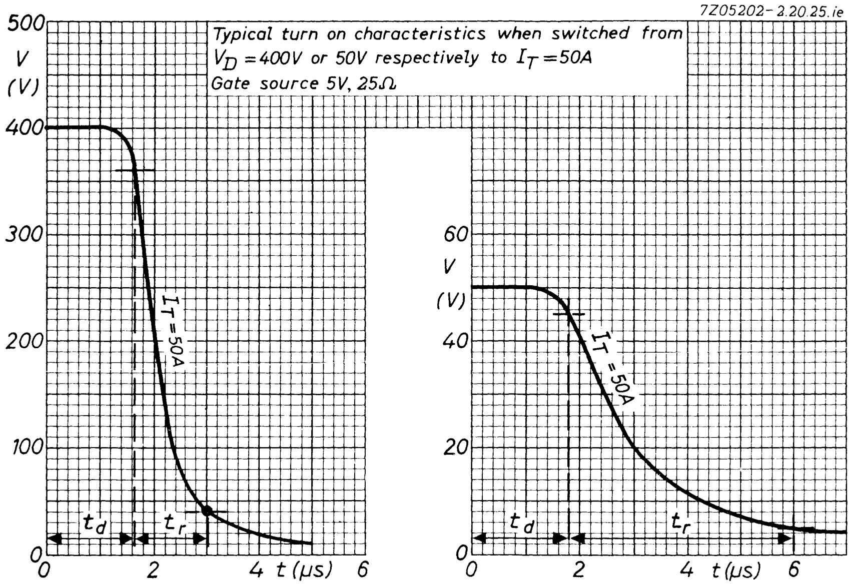

800
I_{TSM}
(A)
600
400
200
0
Max. permissible non repetitive peak on-state
current based on sinusoidal currents (f=50Hz)
Rated load conditions
7Z05200–2.20.25 ie
I_T
I_{TSM}
t
1
2
3
4
5
6
7
8
9
10
20
30
50
100
number of cycles

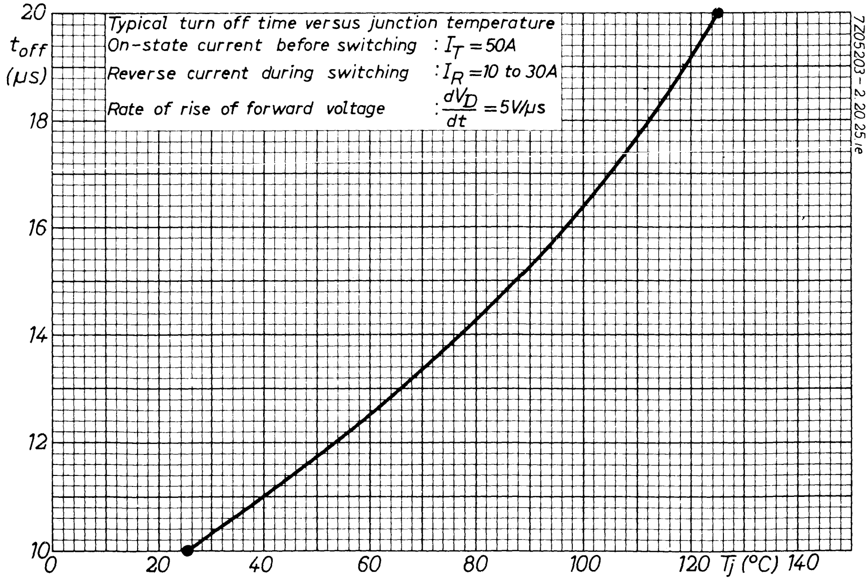


Gate characteristics with curves P_{GAV} =0.5W


4
V_{FG}
(V)
3
2
1
0
0
50
100
150
200
250
I_{FG} (mA) 300
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage
to trigger all devices
Area of possible triggering
Max. gate voltage not to
trigger any device
at T_j = +125°C
7Z05197-2.20.25.ie


800
I_T
(A)
600
400
200
0
0
1
2
3
4
5
V_T (V)
6
Measured under pulsed conditions
max. voltage at T_j = 25°C
125°C
7Z05199-2.20.25.ie


7Z05202-2.20.25.ie
Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 50A
Gate source 5V, 25Ω
500
V
(V)
400
300
200
100
0
I_T = 50A
t_d
t_r
0
2
4
t (μs)
6
60
V
(V)
40
20
0
I_T = 50A
t_d
t_r
0
2
4
t (μs)
6


7Z05203-2.20.25.ie
Typical turn off time versus junction temperature
On-state current before switching : I_T = 50A
Reverse current during switching : I_R = 10 to 30A
Rate of rise of forward voltage : $\frac{dV_D}{dt}$ = 5V/μs
20
t_{off}
(μs)
18
16
14
12
10
0
20
40
60
80
100
120
T_j (°C)
140

CONTROLLED AVALANCHE THYRISTORS

P-gate silicon thyristors in a metal envelope with ceramic insulation. They are capable of absorbing transients and intended for power control and power switching applications. The series consists of the following reverse polarity types (stud anode):

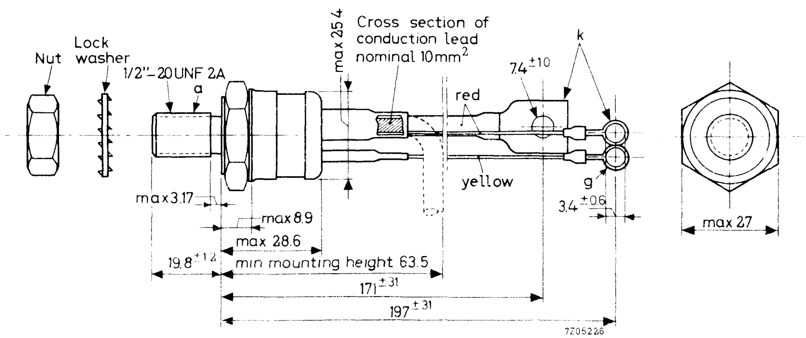
BTX38-500R; BTX38-600R; BTX38-700R and BTX38-800R.

QUICK REFERENCE DATA

			BTX38-500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V
Average forward current	I_{TAV}	max.	70				A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	900				A
Non repetitive peak reverse dissipation t = 10 μs; T_j = 25 °C	P_{RSM}	max.	40				kW
Junction temperature	T_j	max.	125				°C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4				°C/W

MECHANICAL DATA

Dimensions in mm



Net weight : 80 g
With accessories: 108 g

Torque on nut: min. 90 cm kg
max. 175 cm kg

Diameter of hole in heatsink: max. 13 mm

7Z3 0324

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]			BTX38-500R	600R	700R	800R	
Continuous reverse voltage	V_R	max.	500	600	700	800	V
Crest working reverse voltage	V_{RWM}	max.	500	600	700	800	V
Continuous off-state voltage	V_D	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	500	600	700	800	V

Currents				
Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	70	A
Forward current (d.c.)	I_T	max.	100	A
Repetitive peak forward current	I_{TRM}	max.	1000	A
Non repetitive peak forward current t = 10 ms (See also page B)	I_{TSM}	max.	900	A
I squared t for fusing (t = 1.5 to 10 ms)	I^2t	max.	4000	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

Power dissipation				
Non repetitive peak reverse dissipation (See also page B)				
t = 10 μs; T_j = 25 ^oC	P_{RSM}	max.	40	kW
t = 10 μs; T_j = 125 ^oC	P_{RSM}	max.	18	kW

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[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
For thermal stability: $R_{th\ j\text{-}a} \leqq 1.5\ ^oC/W$ (d.c.) or $\leqq 3\ ^oC/W$ (a.c.)

[3]) Off-state voltages higher than V_{DWMmax} are allowed, but at voltages higher than the forward breakover voltage (see page 4) the device may switch into the on-state.

7Z3 0666

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Currents

Forward peak current	I_{FGM}	max.	2	W

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		-55 to +125	^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^{o}C/W$

7Z3 0296

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTX38-500R	600R	700R	800R	
Forward on-state voltage I_T = 500 A; T_j = 25 °C	V_T	<	2.5	2.5	2.5	2.5	V [1]
Reverse breakdown voltage in avalanche region	$V_{(BR)R}$	>	550	660	770	880	V
Forward breakover voltage	$V_{(BO)}$	>	550	660	770	880	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	10	10	10	10	V/μs

Currents

			BTX38-500R	600R	700R	800R	
Reverse current $V_R = V_{RWMmax}$	I_R	<	12	12	12	10	mA [2]
Off-state current $V_D = V_{DWMmax}$	I_D	<	12	12	12	10	mA
Pick up current	I_P	typ.		20			mA
Holding current	I_H	typ.		10			mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.0	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	70	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0326

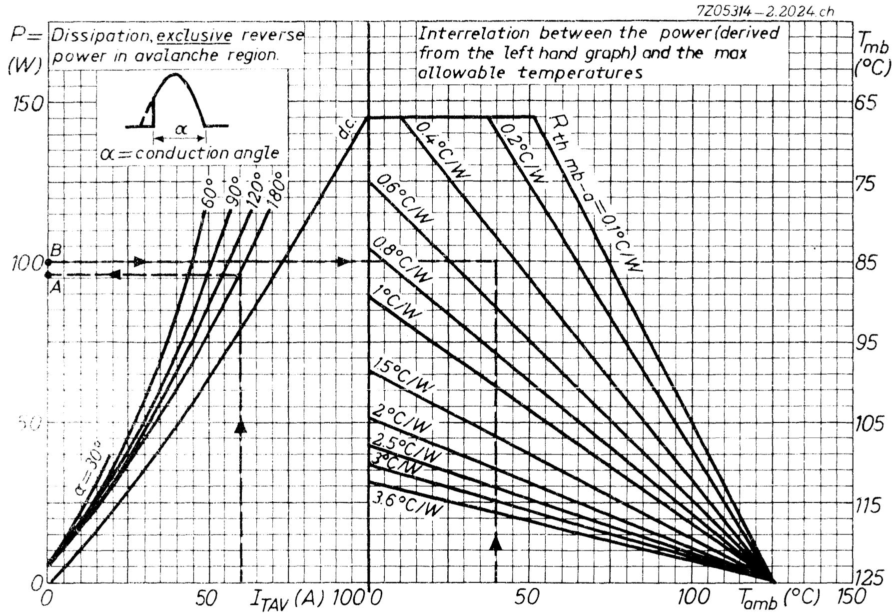
SWITCHING CHARACTERISTICS (See also page E)

Turn on time when switched from V_D = 400 V to I_T = 50 A				
Gate source 5 V, 25 Ω, T_j = 125 °C	t_{on}	typ.	3.0	µs
Turn off time when switched from I_T = 50 A to I_R between 10 and 30 A				
dV_D/dt = 5 V/µs; T_j = 125 °C	t_{off}	typ.	20	µs
T_j = 25 °C	t_{off}	typ.	10	µs

OPERATING NOTE

In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at page B a fast fuse is recommended.

7Z3 0327



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle α - 180°) at T_{amb} = 40 °C.
The average forward current (per thyristor) I_{TAV} = 60 A.
Furthermore assume a repetitive peak reverse power in the avalanche region P_{RRM} = 8 kW (per thyristor) during 10 μs.

From the left hand part of the graph above it follows that at I_{TAV} = 60 A and α = 180° the average forward power + average leakage power = 96 W per thyristor (point A). The average reverse power in the avalanche region, averaged over any cycle follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{10\ \mu s}{20\ ms} = 0.0005$$

Thus P_{RAV} = 0.0005 x 8 kW = 4 W.

Therefore the total device power dissipation P_{tot} = (96 + 4) W = 100 W (point B).

From the right hand part follows the thermal resistance, required for P_{tot} = 100 W at T_{amb} = 40 °C.

$$R_{th\ mb-a} \approx 0.45\ ^{\circ}C/W$$

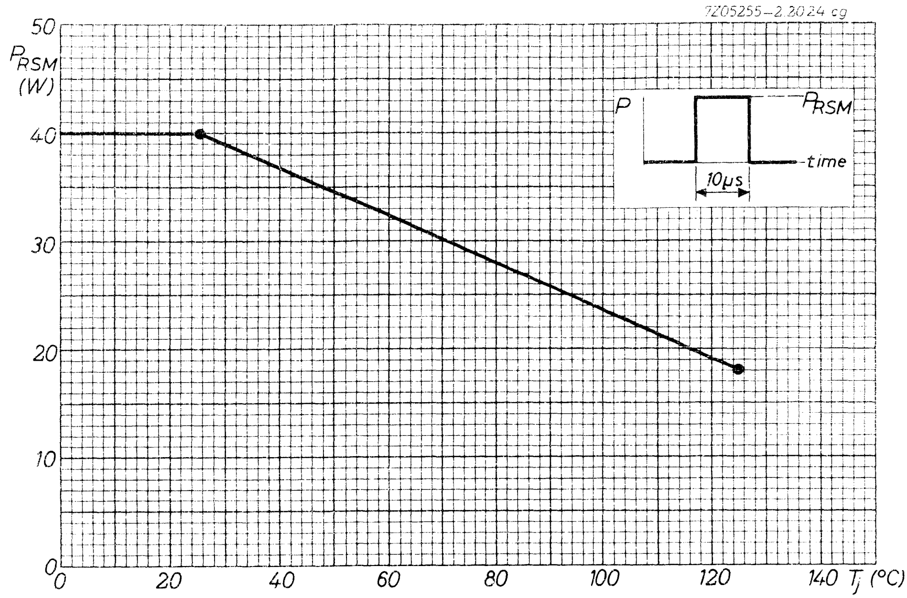
The contact thermal resistance $R_{th\ mb-h}$ = 0.1 °C/W.

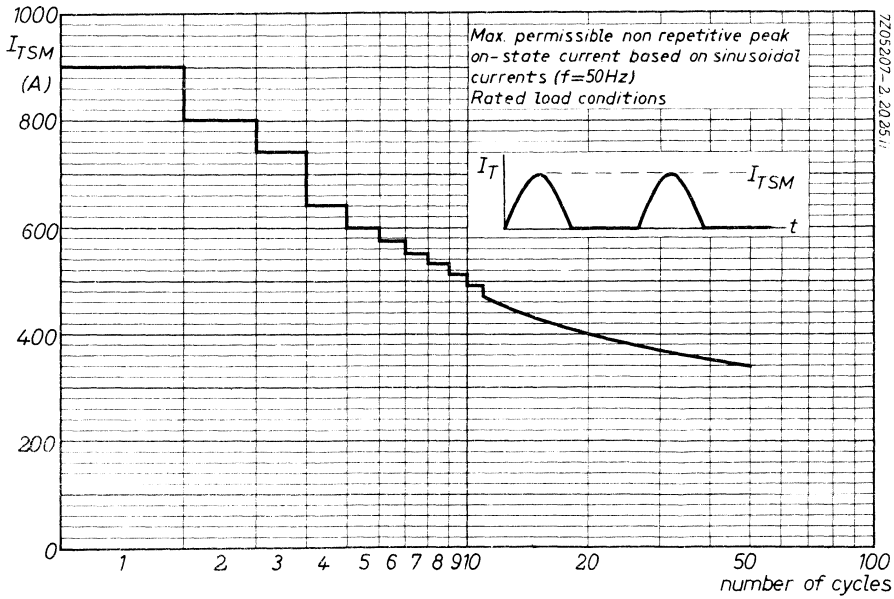
Hence the heatsink thermal resistance should be:

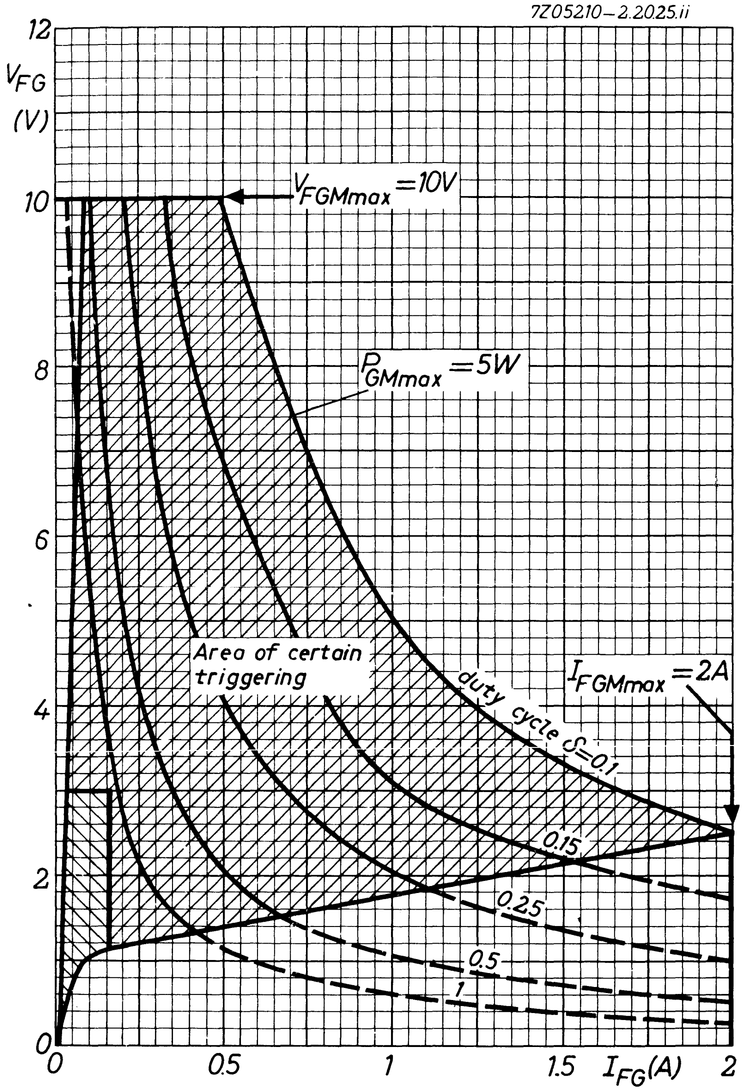
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (0.45 - 0.1)\ ^{\circ}C/W = 0.35\ ^{\circ}C/W.$$

Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found.

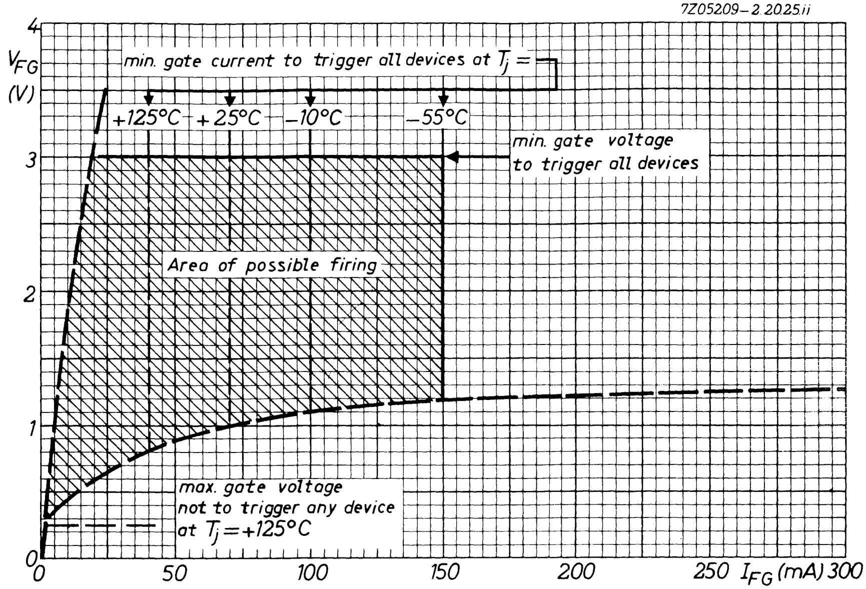
7Z3 0328

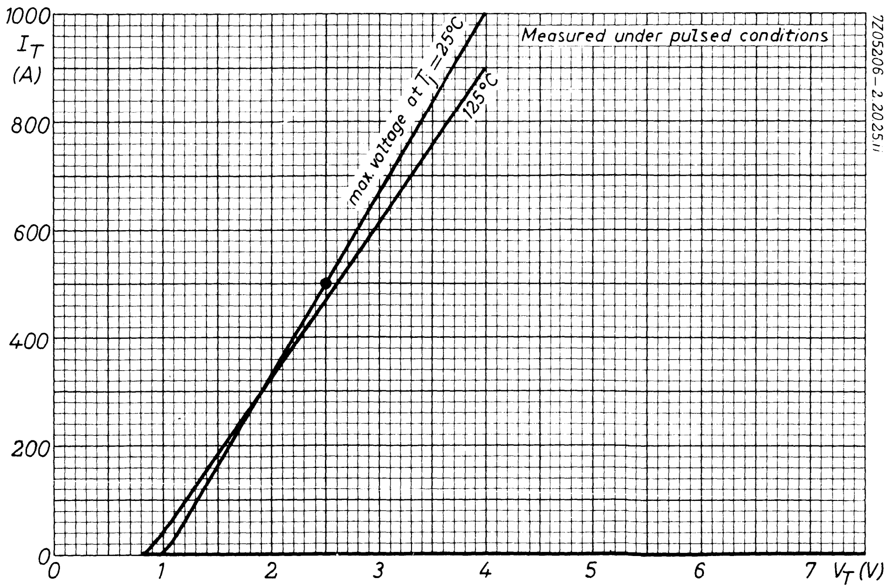

7Z05255–2.2024 cg
P_{RSM} (W)
50
40
30
20
10
0
0
20
40
60
80
100
120
140 T_j (°C)
P
P_{RSM}
time
10µs

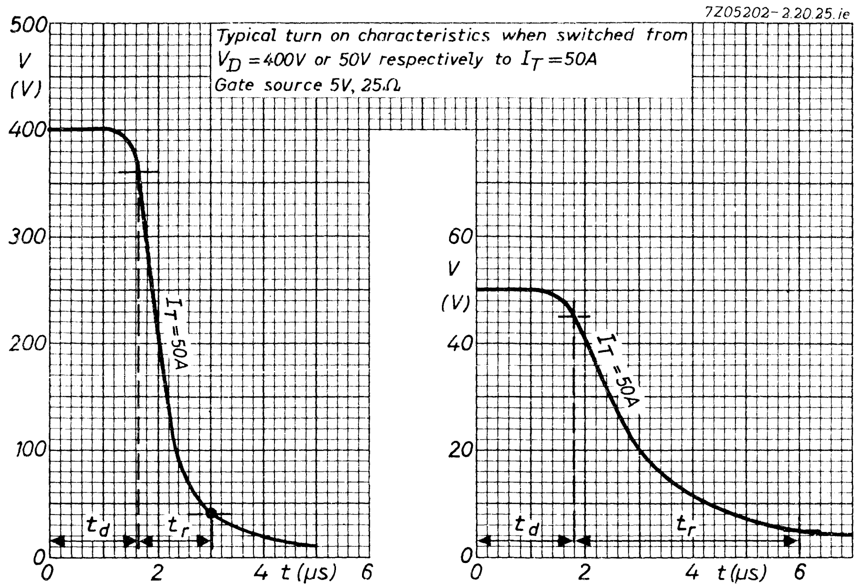

7Z05207–2.2025 ii
I_{TSM} (A)
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t

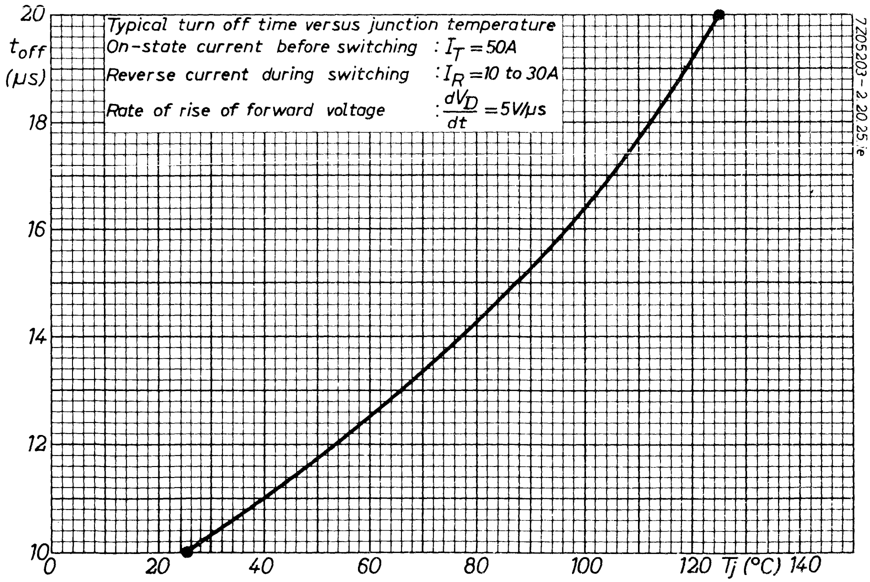


Gate characteristics with curves P_{GAV} = 0.5W


7Z05209–2.2025.ii
V_{FG} (V)
min. gate current to trigger all devices at T_j =
+125°C
+25°C
–10°C
–55°C
min. gate voltage to trigger all devices
Area of possible firing
max. gate voltage not to trigger any device at T_j = +125°C
I_{FG} (mA)
0
50
100
150
200
250
300
1
2
3
4


I_T (A)
Measured under pulsed conditions
7Z05206–2.2025.ii
max. voltage at T_j = 25°C
125°C
V_T (V)
0
200
400
600
800
1000
1
2
3
4
5
6
7


7Z05202-2.20.25.ie
Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 50A
Gate source 5V, 25Ω
500
V
(V)
400
300
200
100
0
I_T = 50A
t_d
t_r
0
2
4
t (μs)
6
60
V
(V)
40
20
0
I_T = 50A
t_d
t_r
0
2
4
t (μs)
6


Typical turn off time versus junction temperature
On-state current before switching : I_T = 50A
Reverse current during switching : I_R = 10 to 30A
Rate of rise of forward voltage : $\frac{dV_D}{dt}$ = 5V/μs
7Z05203-2.20.25.ie
20
t_{off}
(μs)
18
16
14
12
10
0
20
40
60
80
100
120
T_j (°C)
140

P-GATE SILICON THYRISTORS

P-gate thyristors in a metal envelope. They are intended for power control and power switching applications. The series consists of the following reverse polarity types (stud anode):

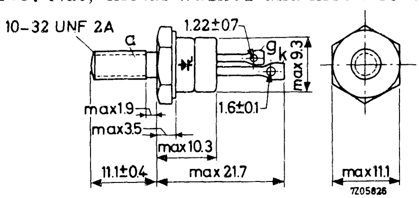
BTY79-100R, BTY79-200R, BTY79-300R, BTY79-400R.

QUICK REFERENCE DATA

			BTY79-100R	200R	300R	400R	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	V
Average forward current	I_{TAV}	max.		6.4			A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.		50			A
Junction temperature	T_j	max.		125			$^{\circ}C$
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=		3.0			$^{\circ}C/W$

MECHANICAL DATA Dimensions in mm

Supplied with the device: Nut, metal washer and metal lock washer.



Net weight : 5.6 g
With accessories: 7.5 g

Torque on nut: min. 8 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm

7Z3 0655

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])

			BTY79-100R	200R	300R	400R	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	V
Repetitive peak reverse voltage	V_{RRM}	max.	100	200	300	400	V
Non repetitive peak reverse voltage $t < 5$ ms	V_{RSM}	max.	150	300	400	500	V
Continuous off-state voltage	V_D	max.	100	200	300	400	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	V
Repetitive peak off-state voltage	V_{DRM}	max.	100	200	300	400	V
Non repetitive peak off-state voltage [3])	V_{DSM}	max.	500	500	500	500	V

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	6.4	A
Forward current (d.c.)	I_T	max.	10	A
Repetitive peak forward current	I_{TRM}	max.	30	A
Non repetitive peak forward current $t = 10$ ms (see also page E)	I_{TSM}	max.	50	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	5	A

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
To ensure thermal stability: $R_{th\ j-a} \leq 6\ ^oC/W$ (d.c.) or $\leq 12\ ^oC/W$ (a.c.)

[3]) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0656

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}	-55 to +125		^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^{o}C/W$
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	$^{o}C/W$

7Z3 0657

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTY79-100R	200R	300R	400R	
Forward on-state voltage I_T = 20 A; T_j = 25 °C	V_T	<	2.3	2.3	2.3	2.3	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	100				V/µs
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20				V/µs

Currents

Reverse current $V_R = V_{RWMmax}$	I_R	<	5	mA
Off-state current $V_D = V_{DWMmax}$	I_D	<	5	mA
Holding current	I_H	typ.	10	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2.5	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	25	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V. 7Z3 0658

SWITCHING CHARACTERISTICS (See also page D)

Turn on time when switched from V_D = 50 V to I_T = 10 A				
Gate source 3 V, 20 Ω, T_j = 125 °C	t_{on}	typ.	3.0	μs
Turn off time when switched from I_T = 10 A to I_R = 5 A				
dV_D/dt = 20 V/μs; T_j = 125 °C	t_{off}	typ.	15	μs
		<	25	μs

7Z3 0659

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

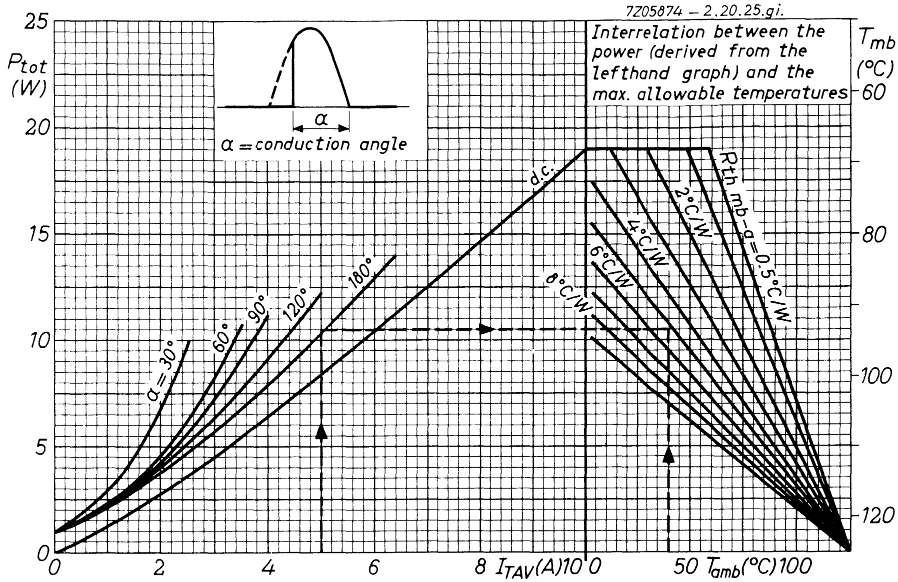
   where I_{mag} = magnetising primary r.m.s. current (A)
   V_1 = transformer primary r.m.s. voltage (V)
   V_2 = transformer secondary r.m.s. voltage (V)
   T = V_1/V_2

   V_{RWM} stands for the actually applied crest working reverse voltage.

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at pages D and E a fast fuse is recommended.

3. The gate and cathode connectors should not be bent; they should be soldered into the circuit so there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

7Z3 0660



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle $\alpha = 180^{\circ}$) at $T_{amb} = 40\ ^{\circ}C$.
The average forward current (per thyristor) $I_{TAV} = 5$ A.

From the left hand part of the graph above it follows that at $I_{TAV} = 5$ A and $\alpha = 180^{\circ}$ the average forward power + average leakage power = 10.5 W per thyristor.

From the right hand part follows the thermal resistance, required for $P_{tot} = 10.5$ W at $T_{amb} = 40\ ^{\circ}C$.

$$R_{th\ mb\text{-}a} \approx 5.2\ ^{\circ}C/W$$

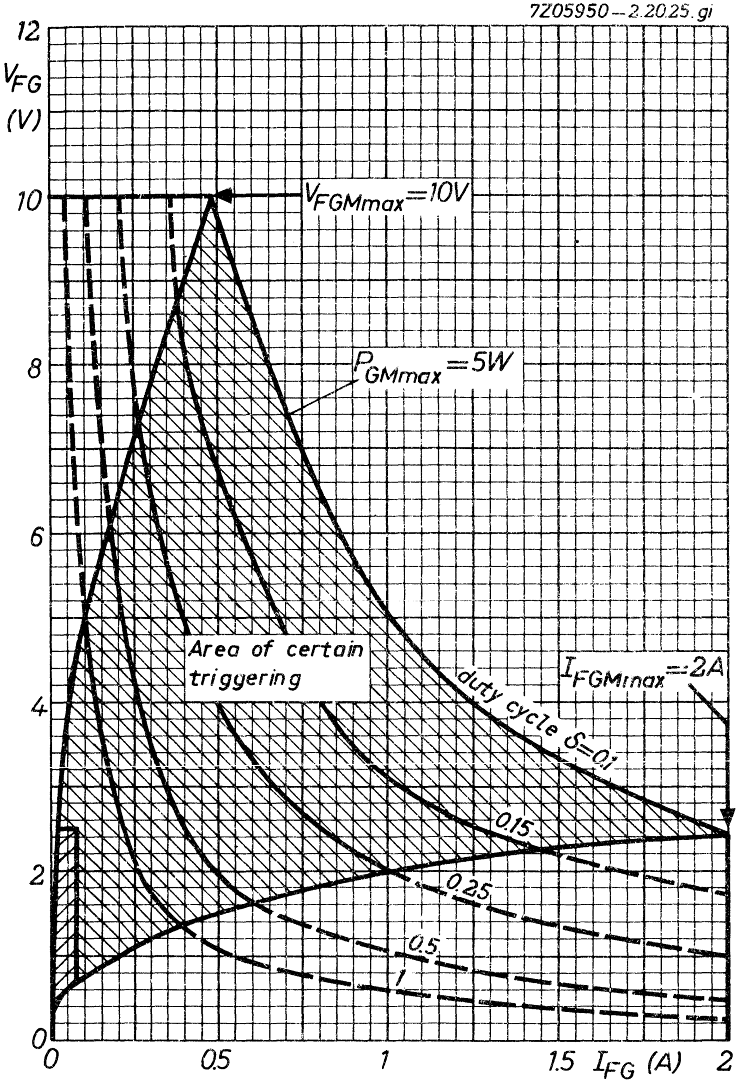
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5\ ^{\circ}C/W$

Hence the heatsink thermal resistance should be:

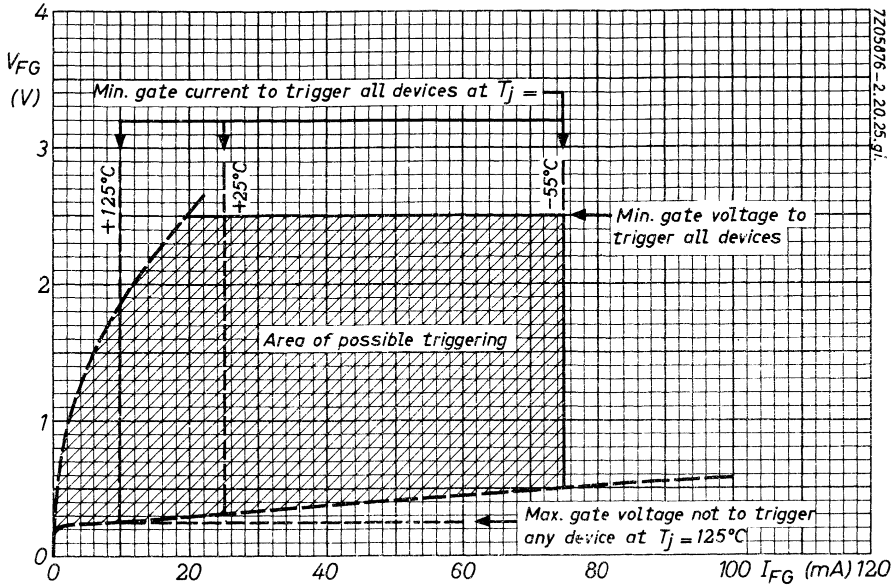
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5.2 - 0.5)\ ^{\circ}C/W = 4.7\ ^{\circ}C/W$$

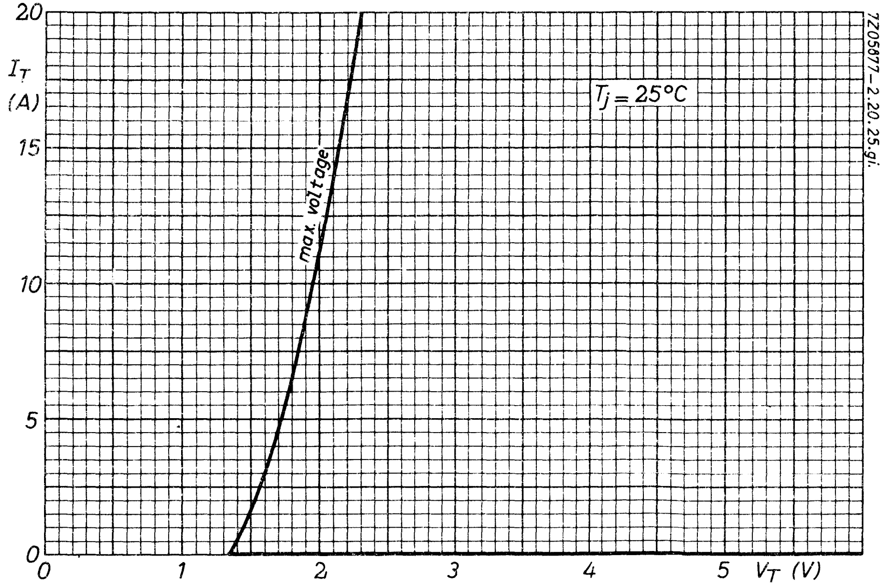
Alternatively, when the heatsink and $R_{th\ h\text{-}a}$ are known, the maximum permissible ambient temperature can be found.

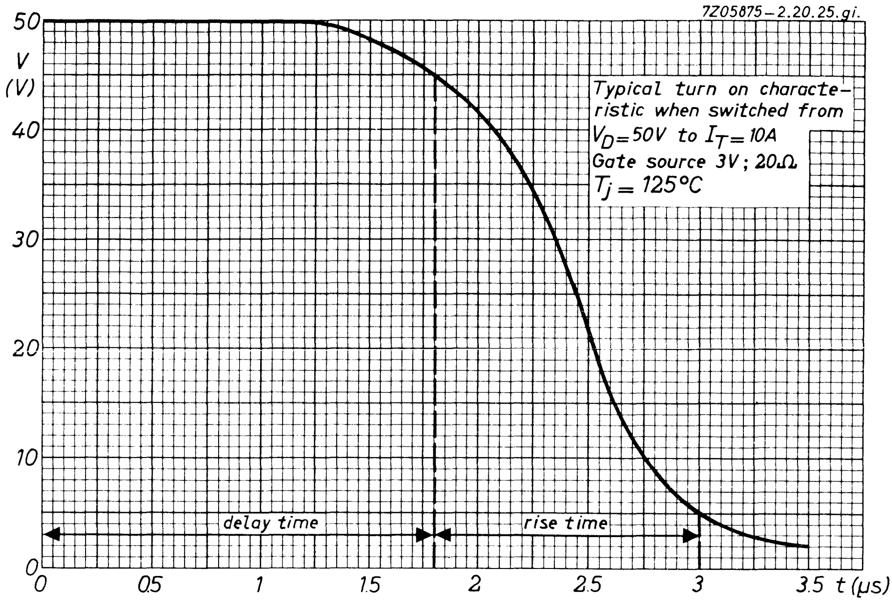
7Z3 0661

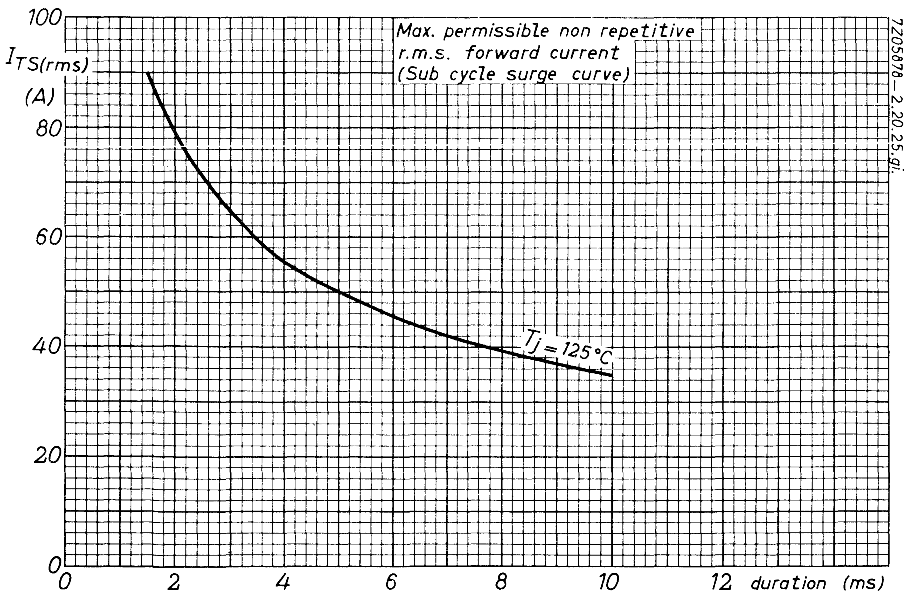


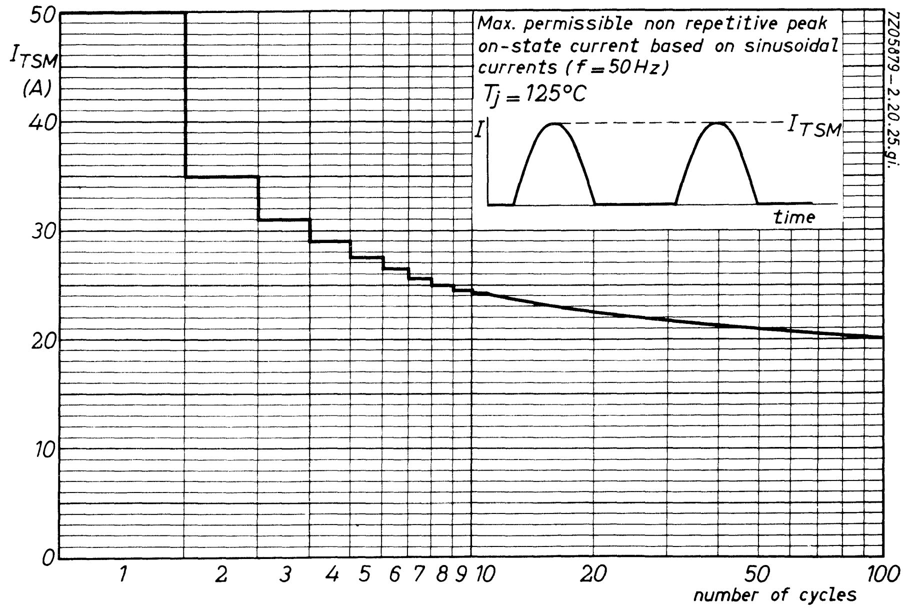
Gate characteristics with curves P_{GAV}=0.5W


7Z05876-2.20.25.gi.
V_{FG}
(V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j = 125°C
I_{FG} (mA)
0
1
2
3
4
20
40
60
80
100
120


7Z05877-2.20.25.gi.
I_T
(A)
T_j = 25°C
max. voltage
V_T (V)
0
5
10
15
20
1
2
3
4
5


7Z05875–2.20.25.gi.
Typical turn on characteristic when switched from $V_D = 50V$ to $I_T = 10A$
Gate source 3V; 20Ω
$T_j = 125°C$
V (V)
delay time
rise time
t (μs)


7Z05876–2.20.25.gi.
Max. permissible non repetitive r.m.s. forward current
(Sub cycle surge curve)
$I_{TS(rms)}$ (A)
$T_j = 125°C$
duration (ms)


50
40
30
20
10
0
I_{TSM}
(A)
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
$T_j = 125°C$
I
I_{TSM}
time
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles
7Z05879-2.20.25.gi.

P-GATE SILICON THYRISTORS

P-gate silicon thyristors in a metal envelope for power control and power switching applications. Both are reverse polarity types (stud anode).

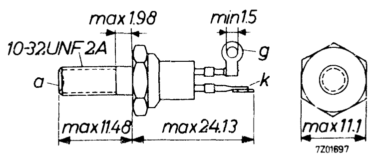
QUICK REFERENCE DATA

			BTY80	BTY81	
Crest working reverse voltage	V_{RWM}	max.	250	400	V
Crest working off-state voltage	V_{DWM}	max.	250	400	V
Average forward current	I_{TAV}	max.	4.7		A
Non repetitive peak forward current t = 10 ms	I_{TSM}	max.	40		A
Junction temperature	T_j	max.	104		^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.1		$^oC/W$

MECHANICAL DATA Dimensions in mm

Net weight : 7.6 g

Supplied with device: Nut, plain washer and lock washer



Torque on nut : min. 9 cm kg
max. 17 cm kg

Diameter of hole in heatsink: max. 5.2 mm

7Z3 0542

All information applies to frequencies up to 400 Hz

RATINGS (Limiting values) [1])

ANODE TO CATHODE

Voltages [2])

		BTY80	BTY81	
Continuous reverse voltage	V_R	max. 250	400	V
Crest working reverse voltage	V_{RWM}	max. 250	400	V
Repetitive peak reverse voltage	V_{RRM}	max. 250	400	V
Non repetitive peak reverse voltage $t < 5$ ms	V_{RSM}	max. 350	500	V
Crest working off-state voltage	V_{DWM}	max. 250	400	V
Repetitive peak off-state voltage	V_{DRM}	max. 250	400	V
Non repetitive peak off-state voltage	V_{DSM}	max. 480	480	V [3])

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	4.7	A
R.M.S. forward current	$I_{T(rms)}$	max.	7.4	A
Repetitive peak forward current	I_{TRM}	max.	20	A
Non repetitive peak forward current $t = 10$ ms	I_{TSM}	max.	40	A
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	5	A

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
For thermal stability: $R_{th\ j\text{-}a} \leqq 6\ ^{o}C/W$ (d.c.) or $\leqq 12\ ^{o}C/W$ (a.c.)

[3]) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0543

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	-55 to +104		^{o}C
Junction temperature	T_j	max.	104	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.1	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.6	$^{o}C/W$

7Z3 0544

CHARACTERISTICS T_j = 104 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTY80	BTY81	
Forward on-state voltage I_T = 20 A; T_j = 25 °C	V_T	<	2.3	2.3	V [1]
Forward breakover voltage	$V_{(BO)}$	>	250	400	V

Currents

			BTY80	BTY81	
Reverse current V_R = 250 V	I_R	<	5.0	-	mA [2]
V_R = 400 V	I_R	<	-	2.0	mA [2]
Off-state current V_D = 250 V	I_D	<	5.0	-	mA
V_D = 400 V	I_D	<	-	2.0	mA
Holding current	I_H	typ.	15	15	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices T_j = 25 °C	V_{GT}	>	2.0	V
Voltage not to trigger any device T_j = 100 °C	V_{GD}	<	0.25	V

Current

Current to trigger all devices T_j = 25 °C	I_{GT}	>	25	mA
T_j = 100 °C	I_{GT}	>	0.19	mA

SWITCHING CHARACTERISTICS

Turn on time when switched to I_T = 10 A; Gate source 3 V; 20 Ω	t_{on}	typ.	3.0	µs
Turn off time when switched to I_T = 10 A; dV_D/dt = 25 V/µs	t_{off}	typ.	15	µs

1) Measured under pulsed conditions to prevent excessive dissipation.

2) These I_R values apply to a gate voltage range of −5 to +0.25 V. 7Z3 0545

OPERATING NOTES

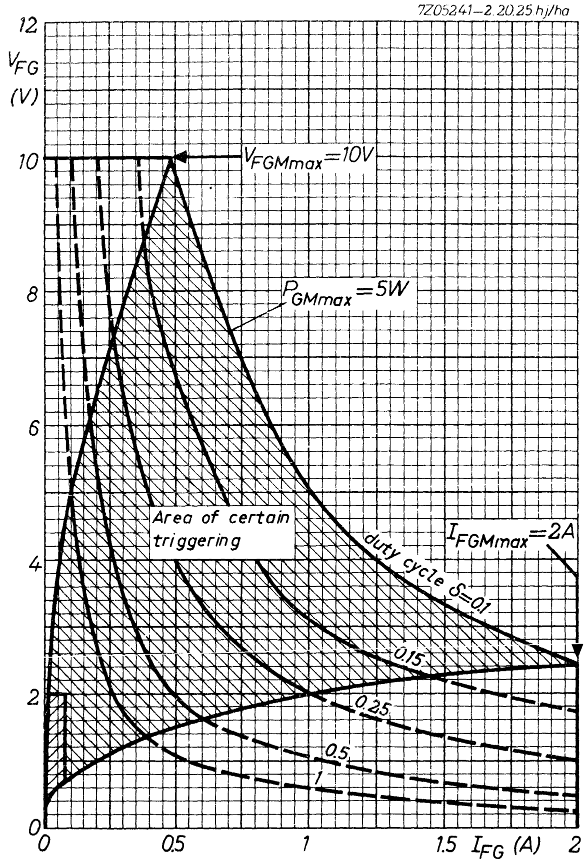
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

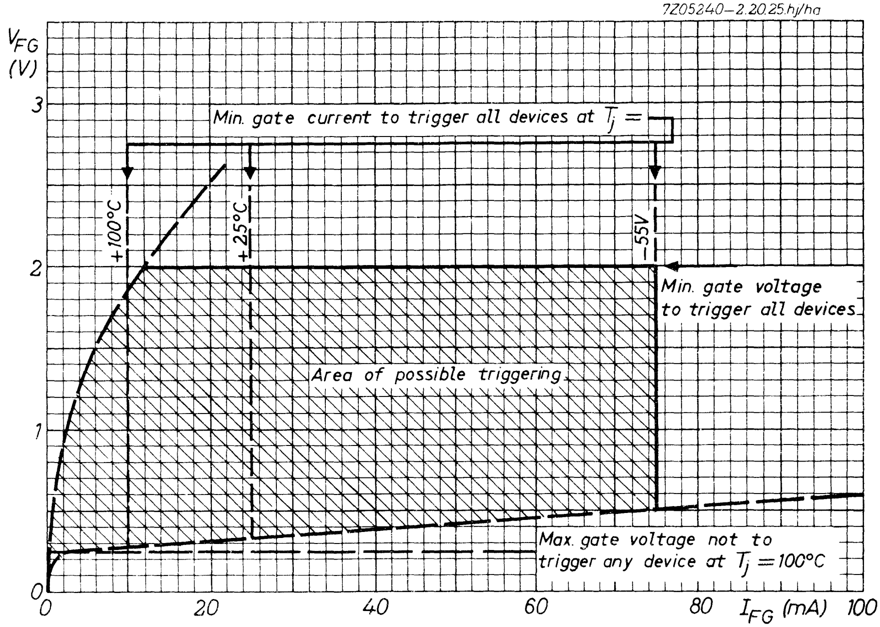
where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working reverse voltage

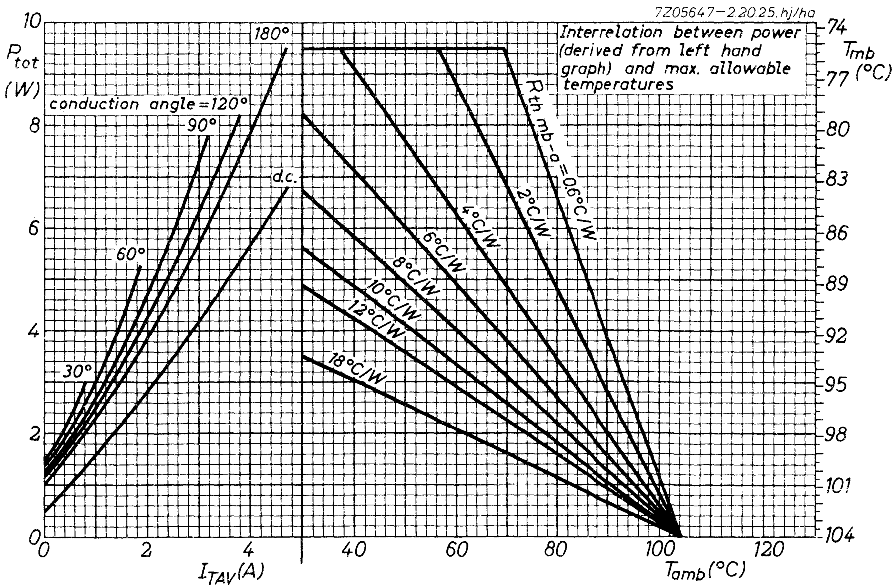
2. The gate and cathode connectors should not be bent; they should be soldered into the circuit so there is no strain on them.
   During soldering the heat conduction the the junction should be kept to a minimum by using a thermal shunt.

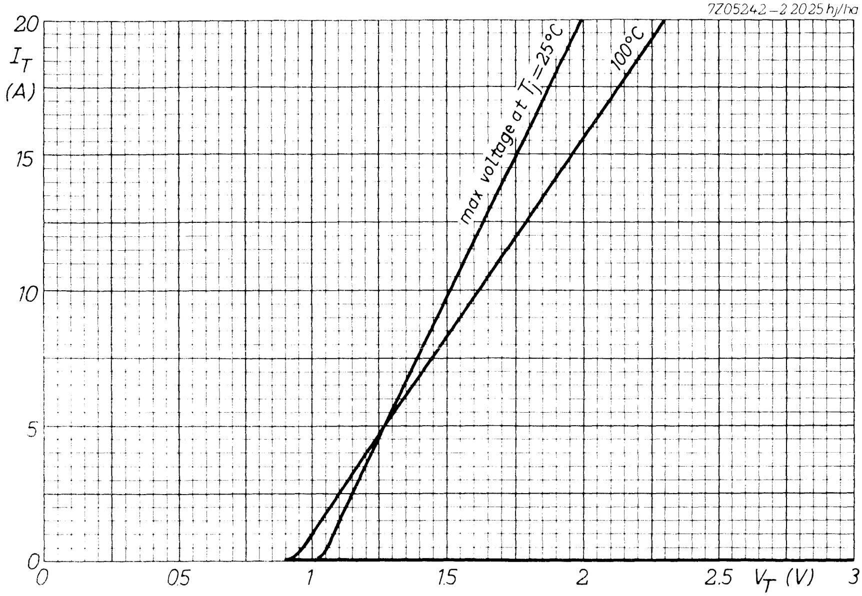
7Z3 0546

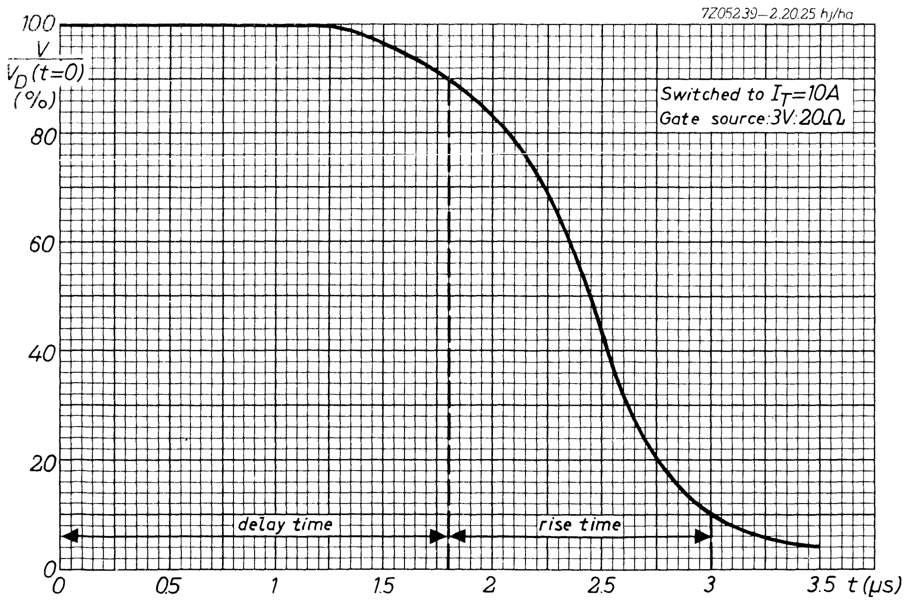


Gate characteristics with curves P_{GAV}=0.5W


7Z05240-2.20.25.hj/ha
V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+100°C
+25°C
−55V
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j = 100°C
I_{FG} (mA)
0
1
2
3
0
20
40
60
80
100


7Z05647-2.20.25.hj/ha
P_{tot} (W)
conduction angle = 120°
180°
90°
60°
30°
d.c.
Interrelation between power (derived from left hand graph) and max. allowable temperatures
$R_{th\ mb-a}$ = 0.6°C/W
2°C/W
4°C/W
6°C/W
8°C/W
10°C/W
12°C/W
18°C/W
T_{mb} (°C)
74
77
80
83
86
89
92
95
98
101
104
I_{TAV}(A)
T_{amb}(°C)
0
2
4
6
8
10
0
2
4
40
60
80
100
120


7Z05242-2.20.25 hj/ha
I_T (A)
max voltage at T_j=25°C
100°C
V_T (V)
0
0.5
1
1.5
2
2.5
3
5
10
15
20


7Z05239-2.20.25 hj/ha
$\frac{V}{V_D(t=0)}$ (%)
Switched to I_T=10A
Gate source:3V:20Ω
delay time
rise time
t (μs)
0
0.5
1
1.5
2
2.5
3
3.5
20
40
60
80
100

P-GATE SILICON THYRISTORS

P-gate thyristors in a TO-48 metal envelope. They are intended for power control and power switching applications.

The series consists of the following reverse polarity types (stud anode):
BTY87-100R, BTY87-200R, BTY87-300R, BTY87-400R,
BTY87-500R, BTY87-600R, BTY87-700R and BTY87-800R.

QUICK REFERENCE DATA

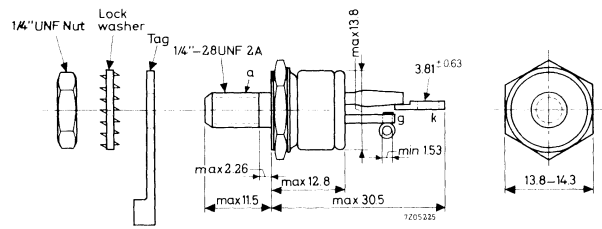
		BTY87-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V

Average forward current	I_{TAV}	max.	12	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	106	A
Junction temperature	T_j	max.	125	^{o}C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	$^{o}C/W$

MECHANICAL DATA

Dimensions in mm

TO-48



Net weight : 10 g

With accessories : 15 g

Torque on nut: min. 17 cm kg

max. 35 cm kg

Insulating bush and mica washer (type number 56264) available on request.

Diameter of hole in heatsink without insulating bush: max. 6.5 mm

with insulating bush: max. 8.5 mm

7Z3 0278

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]		BTY87-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	100	200	300	400	500	600	700	800	V
Non repetitive peak reverse voltage (t < 5 ms)	V_{RSM} max.	150	300	400	500	600	720	850	960	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	100	200	300	400	500	600	700	800	V
Non rep. peak off-state voltage	V_{DSM} max.	500	500	500	500	850	850	850	850	V [3]

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	12	A
Forward current (d.c.)	I_T	max.	15	A
Repetitive peak forward current	I_{TRM}	max.	115	A
Non repetitive peak forward current (t = 10 ms) See page F	I_{TSM}	max.	106	A
I squared t, for fusing (t = 1.5 to 10 ms)	I^2t	max.	55	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) These ratings apply to a gate voltage range of −5 to +0.25 V
To ensure thermal stability: $R_{th\ j-a} \leqq 4.5\ ^oC/W$ (d.c.) or $< 9\ ^oC/W$ (a.c.)

[3]) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0667

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}	-55 to +125		^{o}C
Junction temperature	T_j	max.	125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	$^{o}C/W$
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	4.0	$^{o}C/W$

7Z3 0280

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages			BTY87-100R	200R	300R	400R	500R	600R	700R	800R	
Forward on-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	500	600	700	800	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	100	100	100	100	100	100	100	100	V/μs
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	20	20	20	V/μs
Currents											
Reverse current $V_R = V_{RWMmax.}$	I_R	<	13	12	10	8.0	6.0	5.0	4.5	4.0	mA [2]
Off-state current $V_D = V_{DWMmax.}$	I_D	<	13	12	10	8.0	6.0	5.0	4.5	4.0	mA

Pick up current	I_P	typ.	20	mA
Holding current	I_H	typ.	10	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.5	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	65	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0281

SWITCHING CHARACTERISTICS (See also page D)

Turn on time when switched from

V_D = 400 V to I_T = 50 A

Gate source 5 V, 25 Ω; T_j = 125 °C	t_{on}	typ.	2.0	μs

Turn off time when switched from

I_T = 10 A to I_R between 5 and 20 A

$\frac{dV_D}{dt}$ = 20 V/μs; T_j = 125 °C	t_{off}	typ.	15	μs
T_j = 25 °C	t_{off}	typ.	7.5	μs

7Z3 0282

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

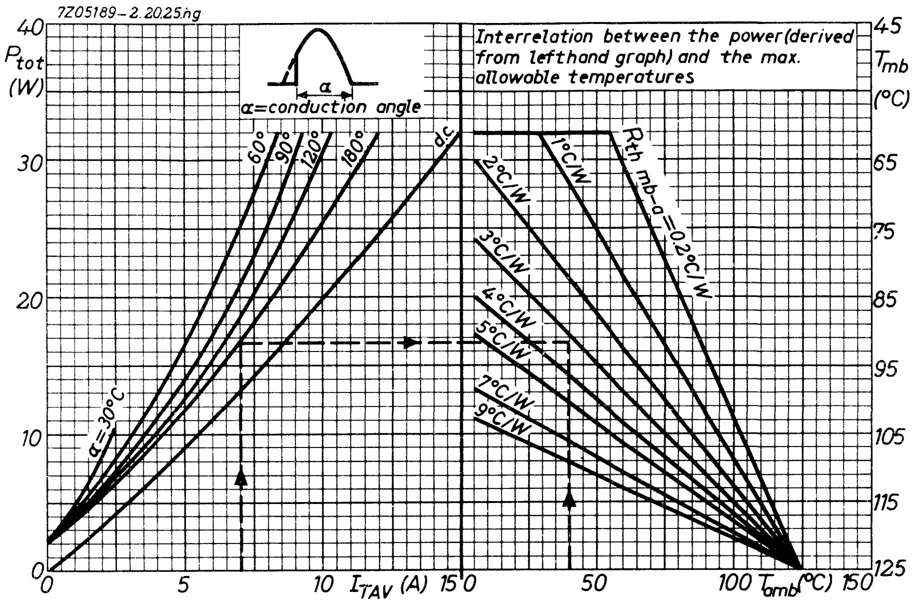
where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2

V_{RWM} stands for the actually applied crest working reverse voltage

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at pages E and F a fast fuse is recommended.

3. The gate and cathode connectors should not be bent; they should be soldered into the circuit so there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

7Z3 0283



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle α = 180^{o}) at T_{amb} = 40 ^{o}C.
The average forward current (per thyristor) I_{TAV} = 7 A.

From the left hand part of the graph above it follows that at I_{TAV} = 7 A and α = 180^{o} the average forward power + average leakage power = 16.6 W per thyristor.

From the right hand part follows the thermal resistance, required for P_{tot} = 16.6 W at T_{amb} = 40 ^{o}C.

$$R_{th\ mb-a} \approx 3.2\ ^{o}C/W$$

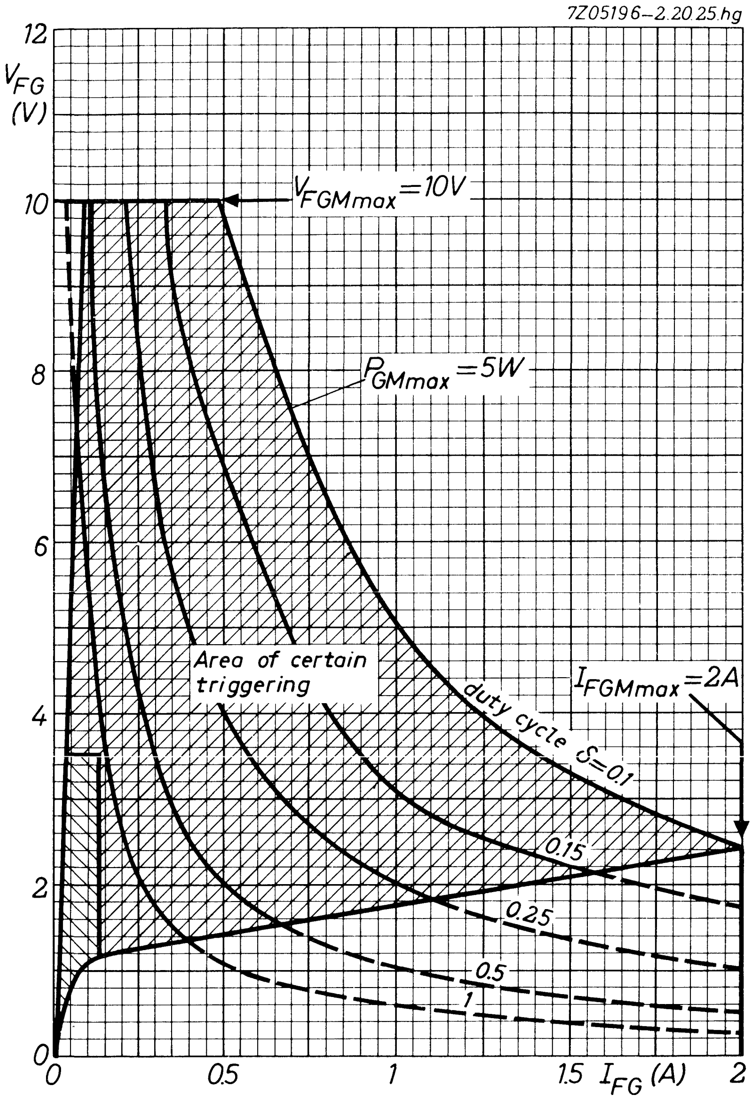
The contact thermal resistance $R_{th\ mb-h}$ = 0.2 ^{o}C/W

Hence the heatsink thermal resistance should be:

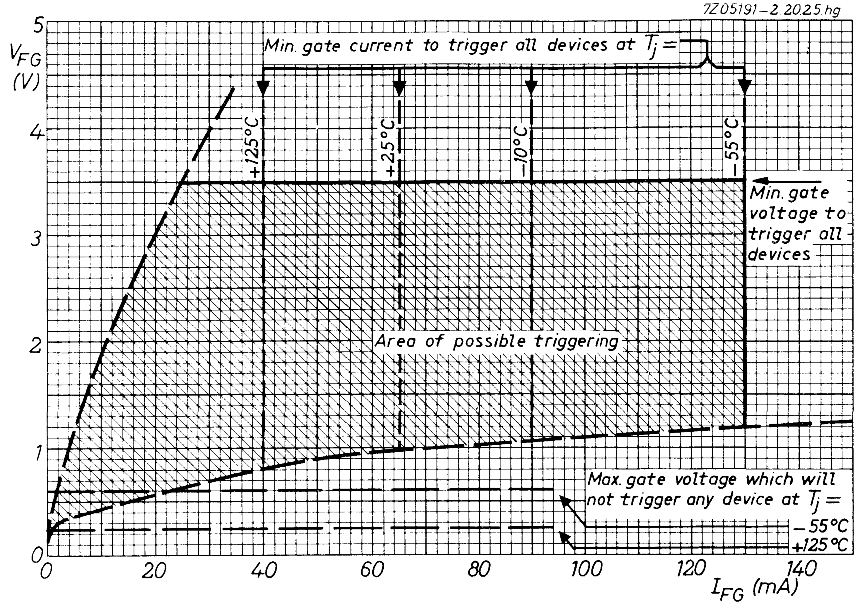
$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h} = (3.2 - 0.2)\ ^{o}C/W = 3\ ^{o}C/W$

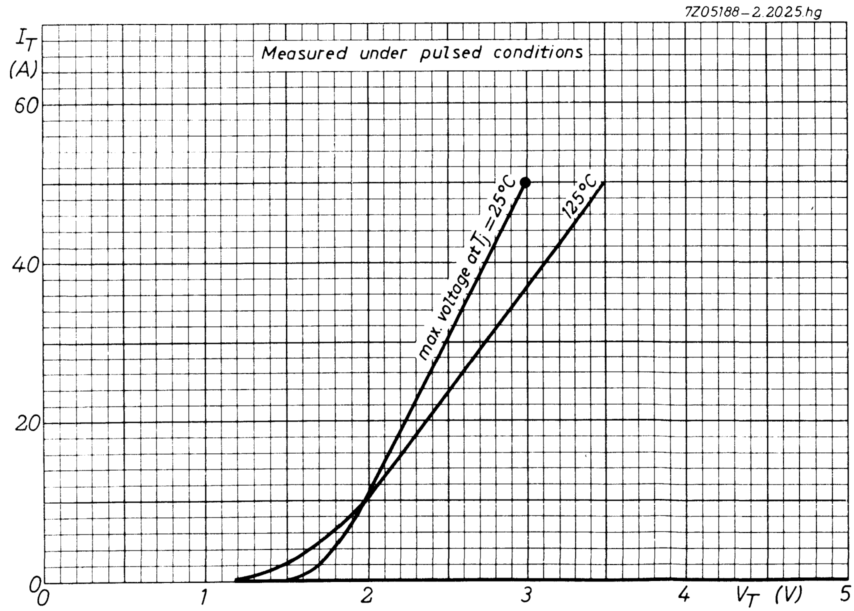
Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found.

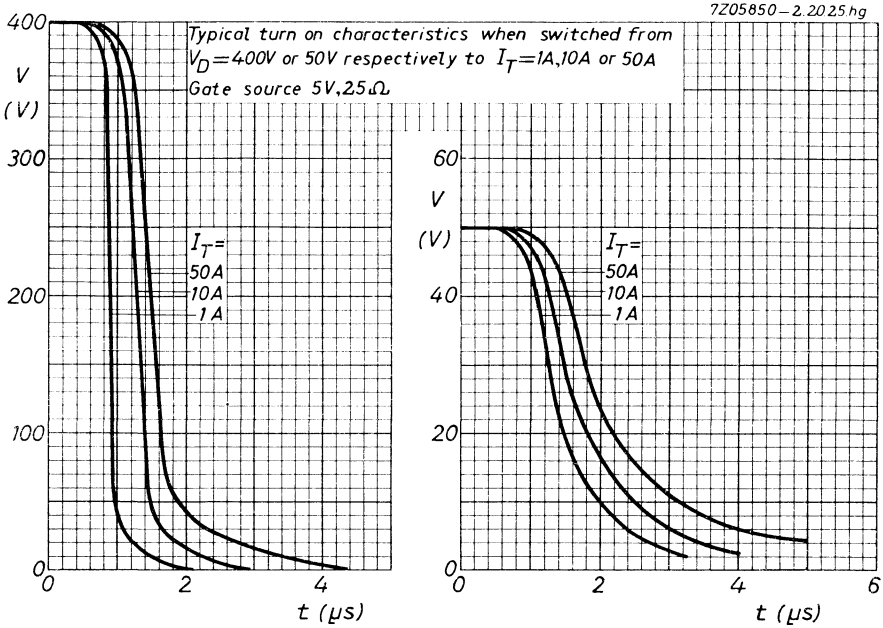
7Z3 0305

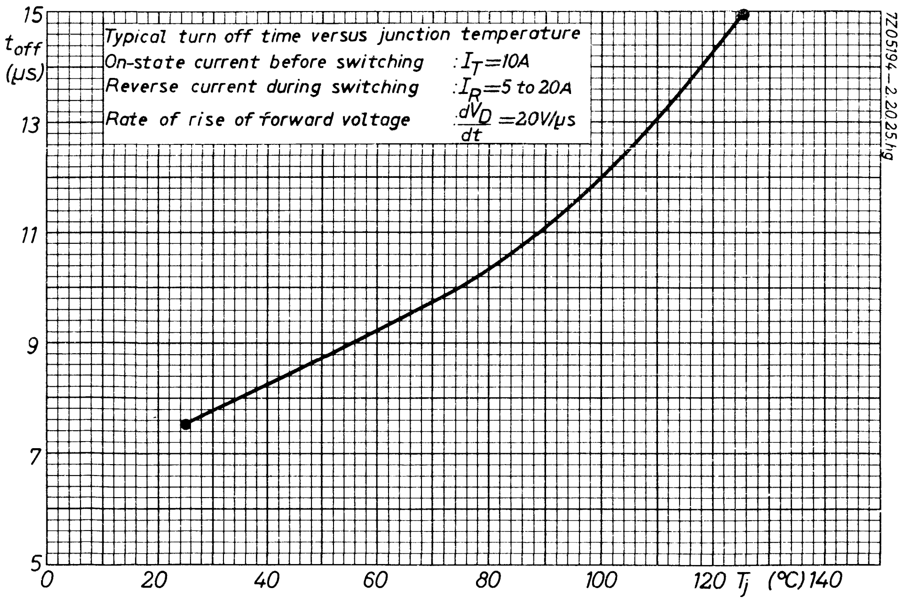


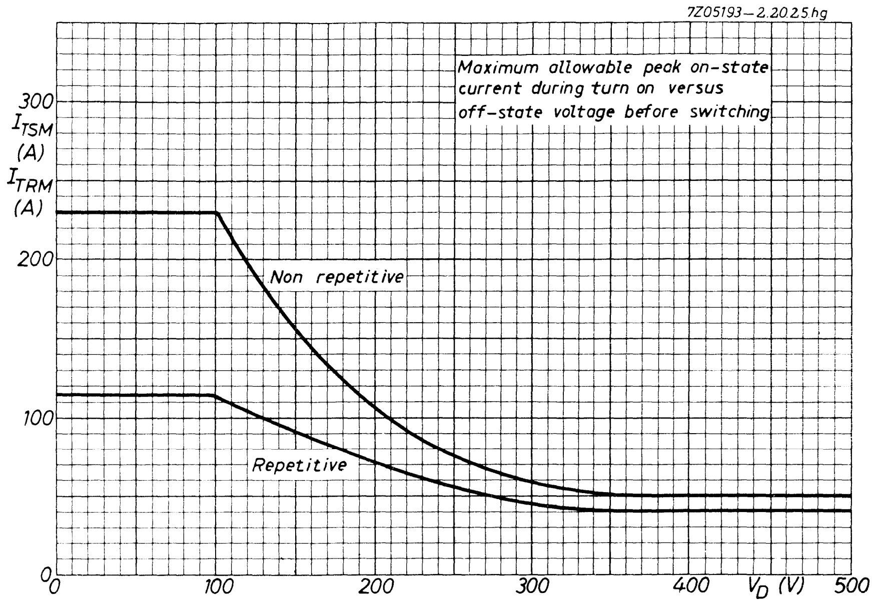
Gate characteristics with curves P_{GAV} = 0.5W

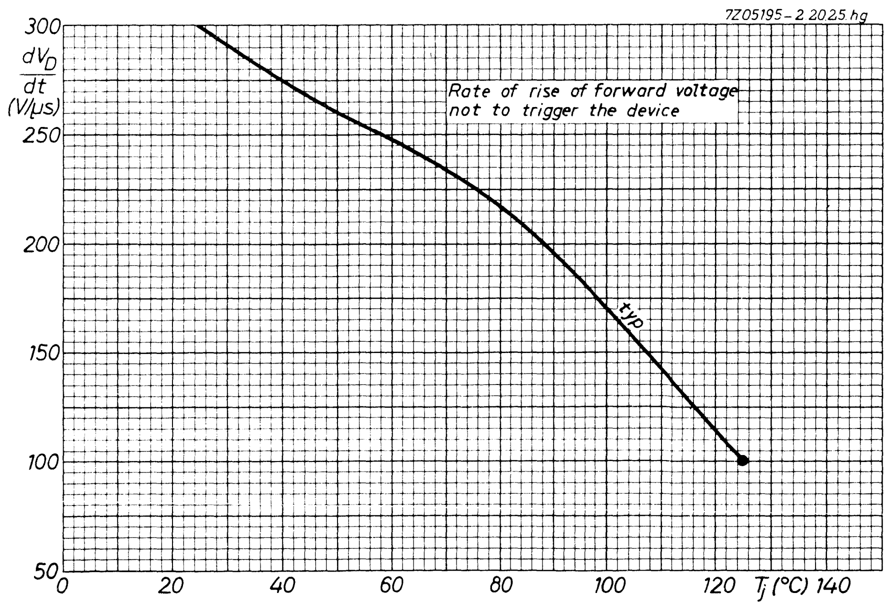

7Z05191–2.2025.hg
V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage which will not trigger any device at T_j =
−55°C
+125°C
I_{FG} (mA)

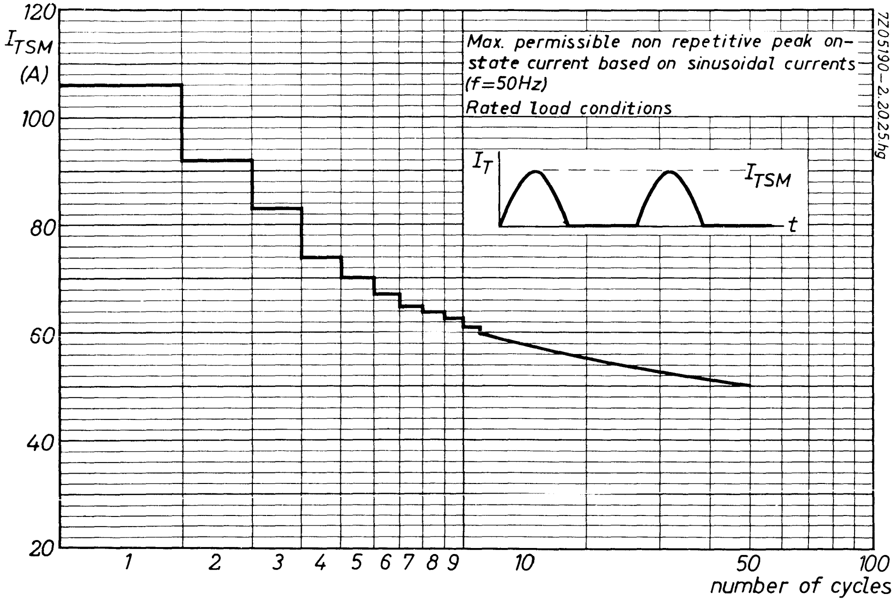

7Z05188–2.2025.hg
I_T (A)
Measured under pulsed conditions
max. voltage at T_j = 25°C
125°C
V_T (V)


7Z05850–2.20.25.hg
Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V, 25 Ω
400
V
(V)
300
200
100
0
I_T=
50A
10A
1 A
0
2
4
t (μs)
60
V
(V)
40
20
0
I_T=
50A
10A
1 A
0
2
4
6
t (μs)


7Z05194–2.20.25.hg
Typical turn off time versus junction temperature
On-state current before switching : I_T=10A
Reverse current during switching : I_R=5 to 20A
Rate of rise of forward voltage $\frac{dV_D}{dt}$ =20V/μs
15
t_{off}
(μs)
13
11
9
7
5
0
20
40
60
80
100
120
T_j (°C)
140


7Z05193–2.20.2.5.hg
Maximum allowable peak on-state current during turn on versus off-state voltage before switching
300
I_{TSM}
(A)
I_{TRM}
(A)
200
100
0
Non repetitive
Repetitive
0
100
200
300
400
V_D (V)
500


7Z05195–2.20.2.5.hg
Rate of rise of forward voltage not to trigger the device
300
$\frac{dV_D}{dt}$
(V/μs)
250
200
150
100
50
typ
0
20
40
60
80
100
120
T_j (°C)
140


120
I_{TSM}
(A)
100
80
60
40
20
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t
7Z05190-2.2025.hg

P-GATE SILICON THYRISTORS

P-gate thyristors in a TO-48 metal envelope. They are intended for power control and power switching applications.
The series consists of the following reverse polarity types (stud anode):
BTY91-100R, BTY91-200R, BTY91-300R, BTY91-400R,
BTY91-500R, BTY91-600R, BTY91-700R and BTY91-800R.

QUICK REFERENCE DATA

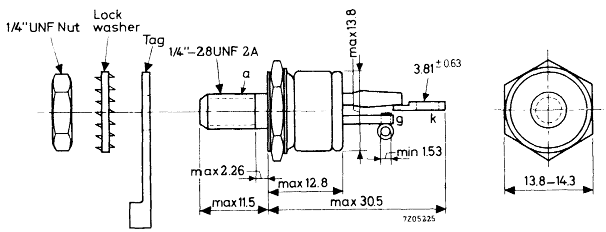
		BTY91-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V

Average forward current	I_{TAV}	max.	16	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	136	A
Junction temperature	T_j	max.	125	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	$^oC/W$

MECHANICAL DATA

Dimensions in mm

TO-48



Net weight: : 10 g

With accessories: 15 g

Torque on nut: min. 17 cm kg

max. 35 cm kg

Insulating bush and mica washer (type number 56264) available on request.

Diameter of hole in heatsink without insulating bush: max. 6.5 mm

with insulating bush: max. 8.5 mm

7Z3 0284

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]		BTY91-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	100	200	300	400	500	600	700	800	V
Non repetitive peak reverse voltage (t < 5 ms)	V_{RSM} max.	150	300	400	500	600	720	850	960	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	100	200	300	400	500	600	700	800	V
Non rep. peak off-state voltage	V_{DSM} max.	500	500	500	500	850	850	850	850	V [3]

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	16	A
Forward current (d.c.)	I_T	max.	19	A
Repetitive peak forward current	I_{TRM}	max.	140	A
Non repetitive peak forward current (t = 10 ms) See page F	I_{TSM}	max.	136	A
I squared t, for fusing (t = 1.5 to 10 ms)	I^2t	max.	75	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	20	A

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) These ratings apply to a gate voltage range of −5 to +0.25 V
For thermal stability: $R_{th\ j-a} \leqq 4.5\ ^oC/W$ (d.c.) or $\leqq 9\ ^oC/W$ (a.c.)

3) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0668

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		-55 to +125	^oC
Junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	2.0	$^oC/W$
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.2	$^oC/W$
From mounting base to heatsink with mica washer	$R_{th\ mb-h}$	=	4.0	$^oC/W$

7Z3 0280

CHARACTERISTICS

T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages

			BTY91-100R	200R	300R	400R	500R	600R	700R	800R	
Forward on-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	500	600	700	800	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	100	100	100	100	100	100	100	100	V/μs
Rate of rise of forward voltage not to trigger any device	$\frac{dV_D}{dt}$	<	20	20	20	20	20	20	20	20	V/μs
Currents											
Reverse current $V_R = V_{RWMmax.}$	I_R	<	13	12	10	8.0	6.0	5.0	4.5	4.0	mA [2]
Off-state current $V_D = V_{DWMmax.}$	I_D	<	13	12	10	8.0	6.0	5.0	4.5	4.0	mA

Pick up current	I_P	typ.	20	mA
Holding current	I_H	typ.	10	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.0	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	40	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0286

SWITCHING CHARACTERISTICS (See also page D)

Turn on time when switched from				
V_D = 400 V to I_T = 50 A				
Gate source 5 V, 25 Ω; T_j = 125 °C	t_{on}	typ.	2.0	μs
Turn off time when switched from				
I_T = 10 A to I_R between 5 and 20 A				
$\frac{dV_D}{dt}$ = 20 V/μs; T_j = 125 °C	t_{off}	typ.	20	μs
T_j = 25 °C	t_{off}	typ.	10	μs

7Z3 0287

OPERATING NOTES

1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

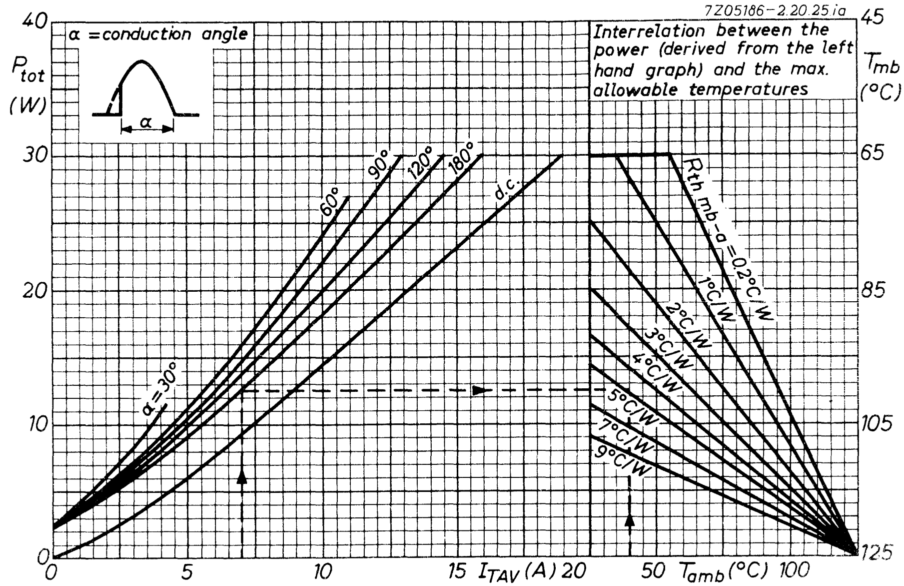
   where I_{mag} = magnetising primary r.m.s. current (A)
   V_1 = transformer primary r.m.s. voltage (V)
   V_2 = transformer secondary r.m.s. voltage (V)
   T = V_1/V_2

   V_{RWM} stands for the actually applied crest working reverse voltage

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at pages E and F a fast fuse is recommended.

3. The gate and cathode connectors should not be bent; they should be soldered into the circuit so there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

7Z3 0283



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle α = 180°) at T_{amb} = 40 °C.
The average forward current (per thyristor) I_{TAV} = 7 A.

From the left hand part of the graph above it follows that at I_{TAV} = 7 A and α = 180° the average forward power + average leakage power = 12.5 W per thyristor.

From the right hand part follows the thermal resistance, required for P_{tot} = 12.5 W at T_{amb} = 40 °C

$$R_{th\ mb-a} \approx 4.9\ ^{o}C/W$$

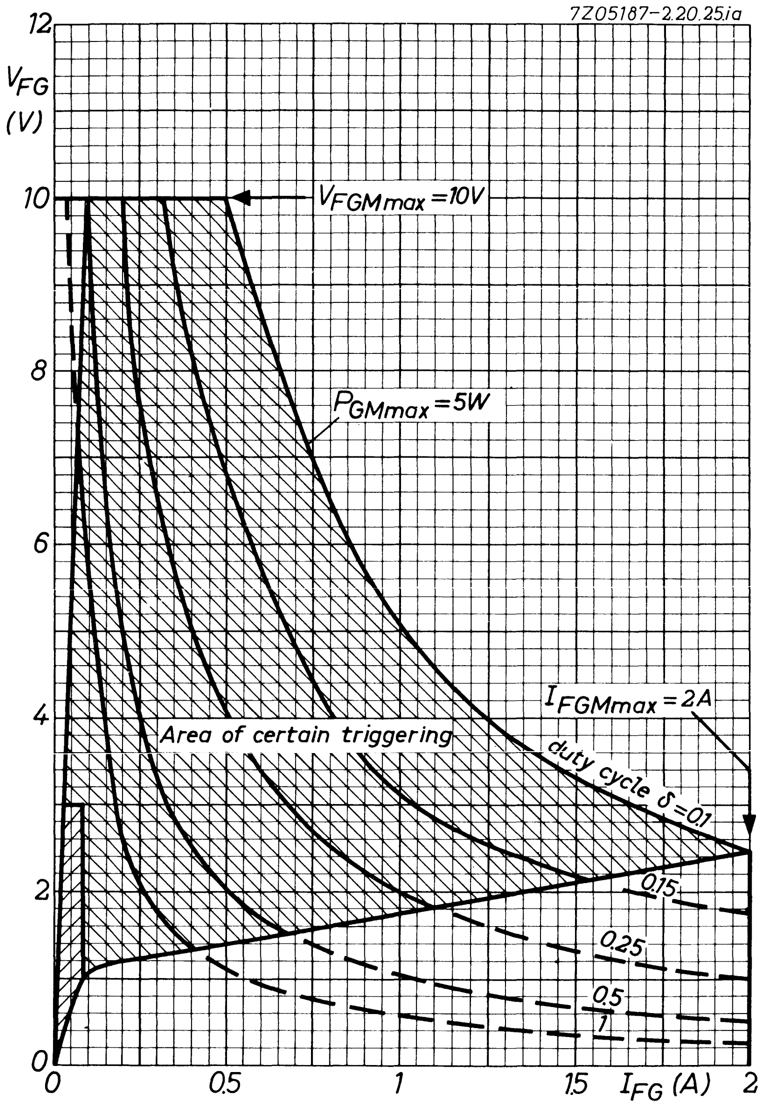
The contact thermal resistance $R_{th\ mb-h}$ = 0.2 °C/W

Hence the heatsink thermal resistance should be:

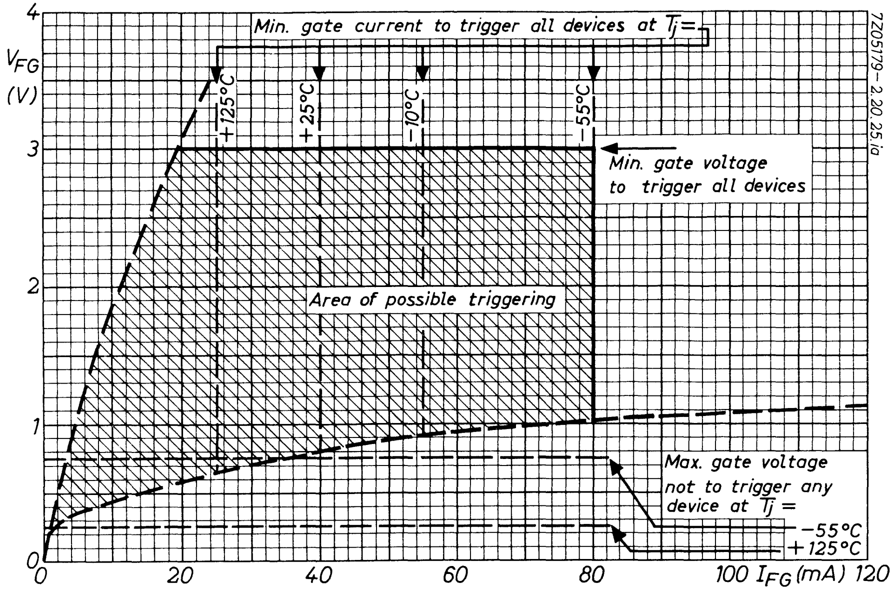
$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h}$ = (4.9 - 0.2) °C/W = 4.7 °C/W

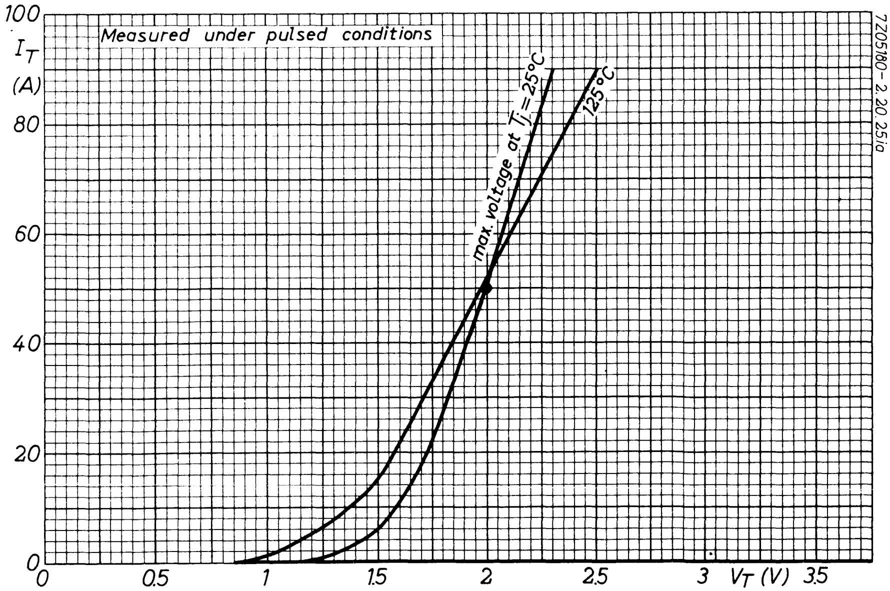
Alternatively, when the heatsink and $R_{th\ h-a}$ are known, the maximum permissible ambient temperature can be found.

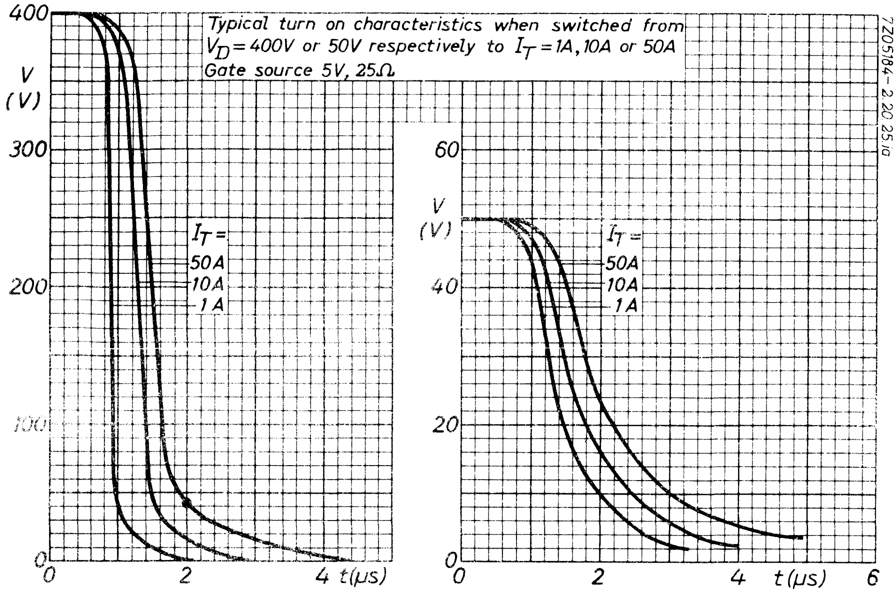
7Z3 0306

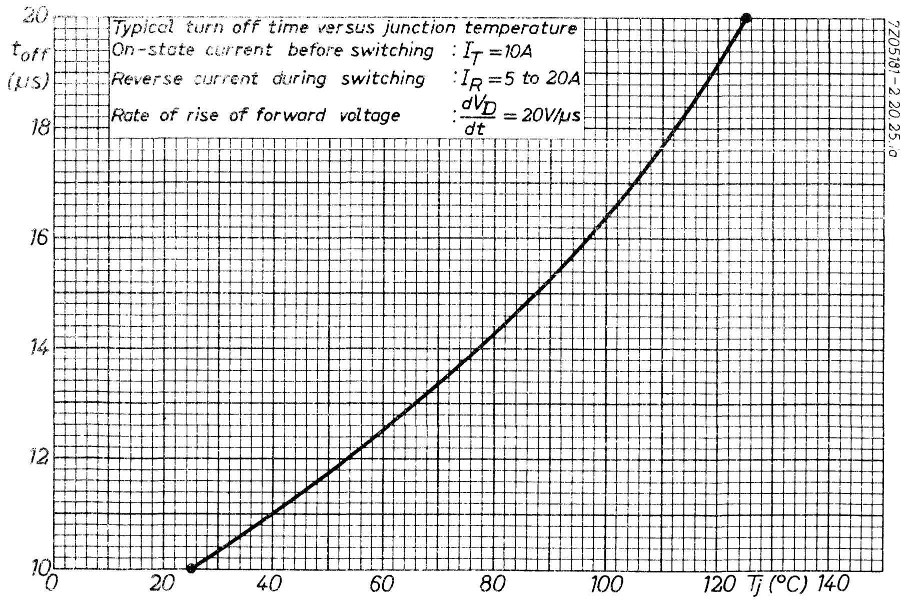


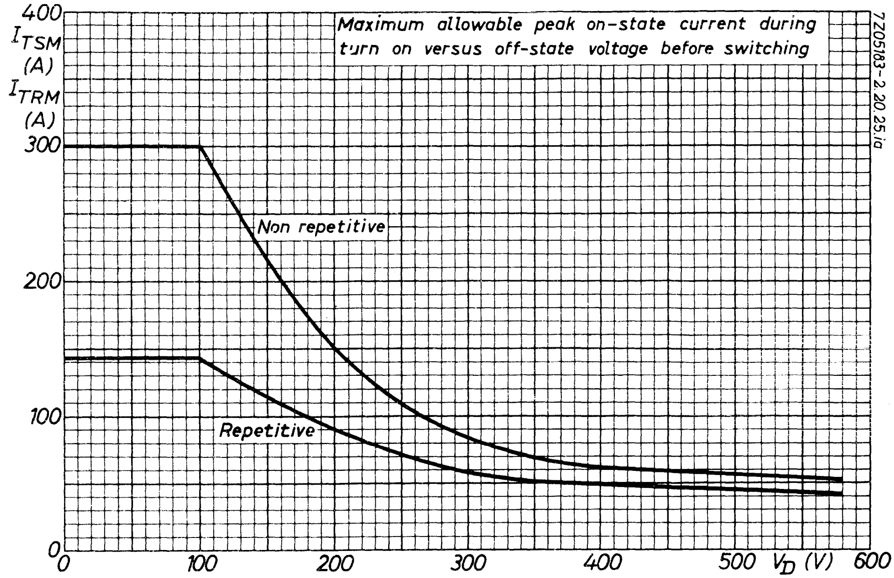
Gate characteristics with curves P_{GAV} = 0.5W

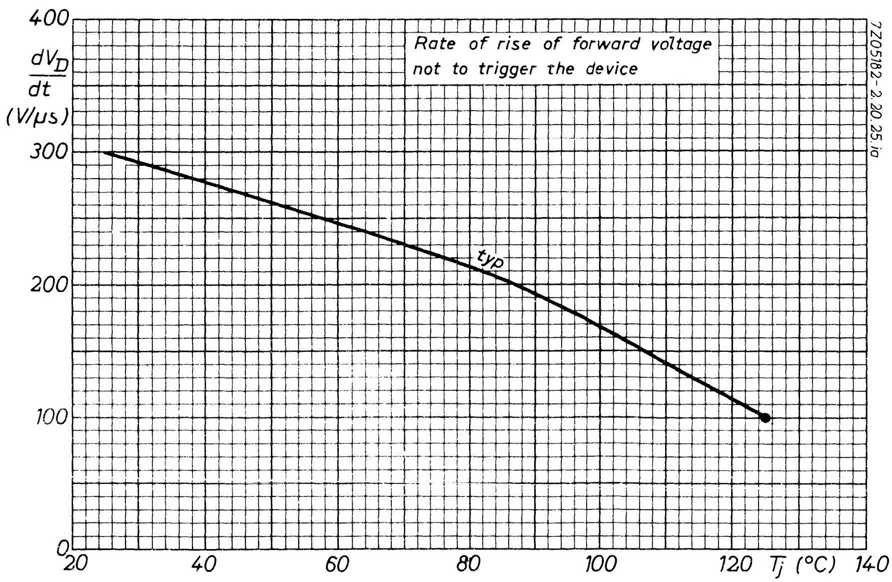

Min. gate current to trigger all devices at T_j =
V_{FG} (V)
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j =
−55°C
+125°C
I_{FG} (mA)
7Z05179−2.20.25.ia

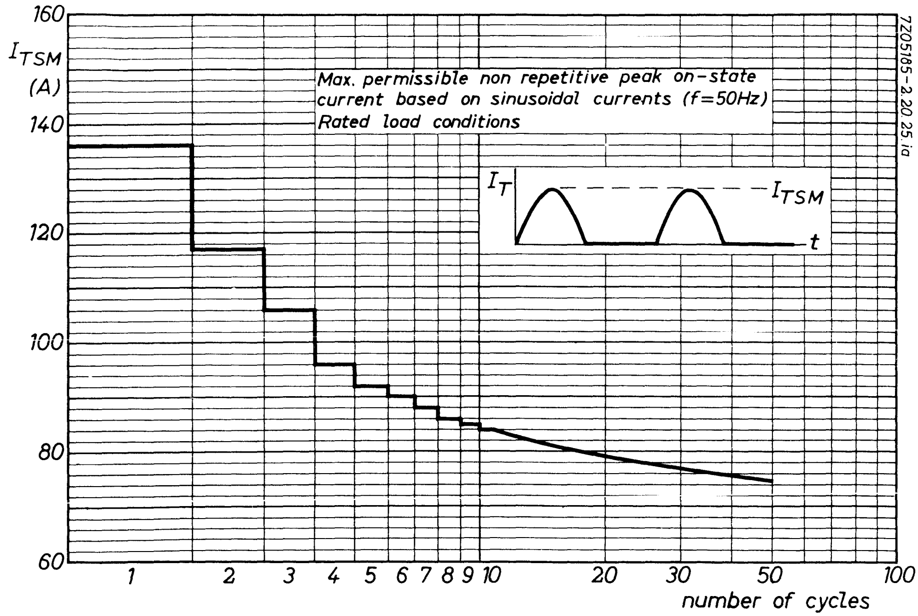

Measured under pulsed conditions
I_T (A)
max. voltage at T_j = 25°C
125°C
V_T (V)
7Z05180−2.20.25.ia


Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V, 25Ω
400
V
(V)
300
200
100
0
0
2
4 t(μs)
I_T=
50A
10A
1A
60
V
(V)
40
20
0
0
2
4
t(μs)
6
7Z05184-2.20.25.ia


Typical turn off time versus junction temperature
On-state current before switching : I_T=10A
Reverse current during switching : I_R=5 to 20A
Rate of rise of forward voltage : $\frac{dV_D}{dt}$ = 20V/μs
20
t_{off}
(μs)
18
16
14
12
10
0
20
40
60
80
100
120
T_j (°C)
140
7Z05181-2.20.25.ia


Maximum allowable peak on-state current during turn on versus off-state voltage before switching
I_{TSM} (A)
I_{TRM} (A)
400
300
200
100
0
Non repetitive
Repetitive
0
100
200
300
400
500
V_D (V)
600
7Z05183-2.20.25.ia


Rate of rise of forward voltage not to trigger the device
$\frac{dV_D}{dt}$ (V/μs)
400
300
200
100
0
typ
20
40
60
80
100
120
T_j (°C)
140
7Z05182-2.20.25.ia


160
140
120
100
80
60
I_{TSM} (A)
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t
1
2
3
4
5
6
7
8
9
10
20
30
50
100
number of cycles
7Z05185-2.20.25.ia

P-GATE SILICON THYRISTORS

P-gate thyristors in a metal envelope with ceramic insulation. They are intended for power control and power switching applications.
The series consists of the following reverse polarity types (stud anode):
BTY95-100R, BTY95-200R, BTY95-300R, BTY95-400R,
BTY95-500R, BTY95-600R, BTY95-700R and BTY95-800R.

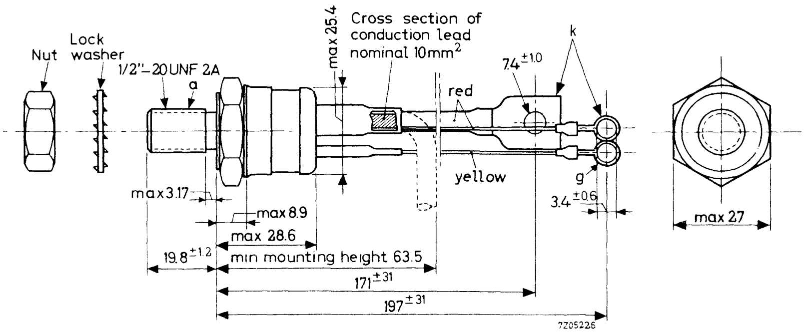
QUICK REFERENCE DATA

		BTY95-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V

Average forward current	I_{TAV}	max.	50	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	680	A
Junction temperature	T_j	max.	125	^{o}C
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6	$^{o}C/W$

MECHANICAL DATA

Dimensions in mm



Net weight : 80 g

With accessories: 108 g

Diameter of hole in heatsink: max. 13 mm

Torque on nut: min. 90 cm kg

max. 175 cm kg

7Z3 0288

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]		BTY95-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	100	200	300	400	500	600	700	800	V
Non repetitive peak reverse voltage ($t < 5$ ms)	V_{RSM} max.	150	300	400	500	600	720	850	960	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	100	200	300	400	500	600	700	800	V
Non repetitive peak off-state voltage	V_{DSM} max.	850	850	850	850	850	850	850	850	V [3]

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	50	A
Forward current (d.c.)	I_T	max.	75	A
Repetitive peak forward current	I_{TRM}	max.	700	A
Non repetitive peak forward current ($t = 10$ ms) See page E	I_{TSM}	max.	680	A
I squared t, for fusing ($t = 1.5$ to 10 ms)	I^2t	max.	2000	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) These ratings apply to a gate voltage range of -5 to $+0.25$ V. For thermal stability: $R_{th\ j\text{-}a} \leqq 4.5$ °C/W (d.c.) or $\leqq 9$ °C/W (a.c.) for -100 to -400 types,
$R_{th\ j\text{-}a} \leqq 1.5$ °C/W (d.c.) or $\leqq 3$ °C/W (a.c.) for -500 to -800 types.

3) This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0669

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}		-55 to +125	^oC
Junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	0.6	$^oC/W$
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.1	$^oC/W$

7Z3 0290

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages			BTY95-100R	200R	300R	400R	500R	600R	700R	800R	
Forward on-state voltage I_T = 500 A; T_j = 25 °C	V_T	<	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	500	600	700	800	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	10	10	10	10	10	10	10	10	V/μs
Currents											
Reverse current V_R = V_{RWMmax}	I_R	<	13	12	10	8.0	12	12	12	10	mA [2]
Off-state current V_D = V_{DWMmax}	I_D	<	13	12	10	8.0	12	12	12	10	mA

Pick up current	I_P	typ.	20	mA
Holding current	I_H	typ.	10	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.0	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	80	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0291

SWITCHING CHARACTERISTICS (See also page D)

Turn on time when switched from V_D = 400 V to I_T = 50 A Gate source 5 V, 25 Ω, T_j = 125 °C	t_{on}	typ.	3.0	μs
Turn off time when switched from I_T = 50 A to I_R between 10 and 30 A $\frac{dV_D}{dt}$ = 5 V/μs ; T_j = 125 °C	t_{off}	typ.	20	μs
T_j = 25 °C	t_{off}	typ.	10	μs

7Z3 0292

OPERATING NOTES

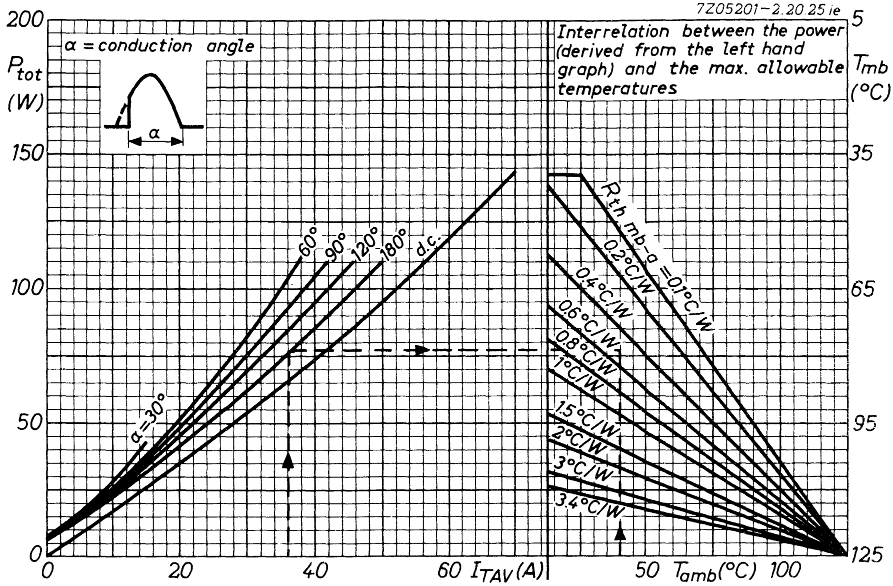
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transfomer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working reverse voltage.

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at page E a fast fuse is recommended.

7Z3 0293



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle $\alpha = 180^{\circ}$) at $T_{amb} = 40\ ^{\circ}C$.
The average forward current (per thyristor) $I_{TAV} = 36$ A.

From the left hand part of the graph above it follows that at $I_{TAV} = 36$ A and $\alpha = 180^{\circ}$ the average forward power + average leakage power = 77 W per thyristor

From the right hand part follows the thermal resistance, required for $P_{tot} = 77$ W at $T_{amb} = 40\ ^{\circ}C$.

$$R_{th\ mb\text{-}a} \approx 0.52\ ^{\circ}C/W$$

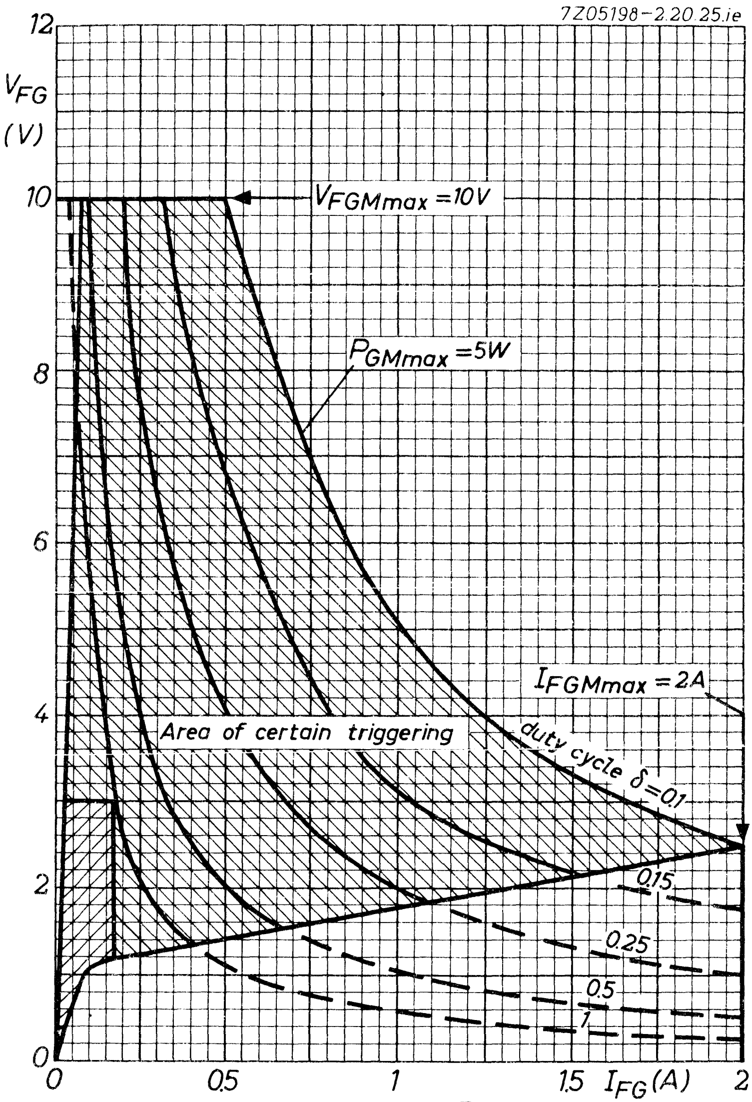
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^{\circ}C/W$

Hence the heatsink thermal resistance should be:

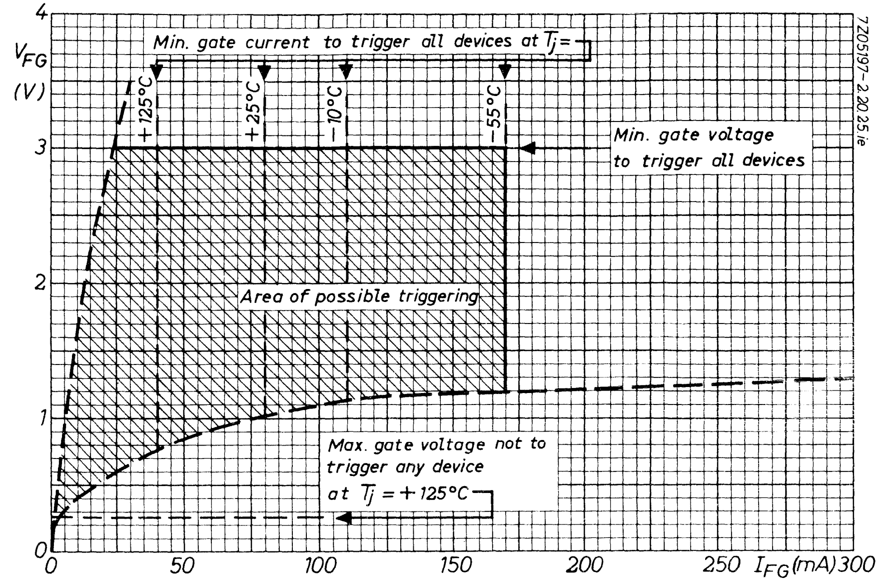
$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.52 - 0.1)\ ^{\circ}C/W = 0.42\ ^{\circ}C/W$

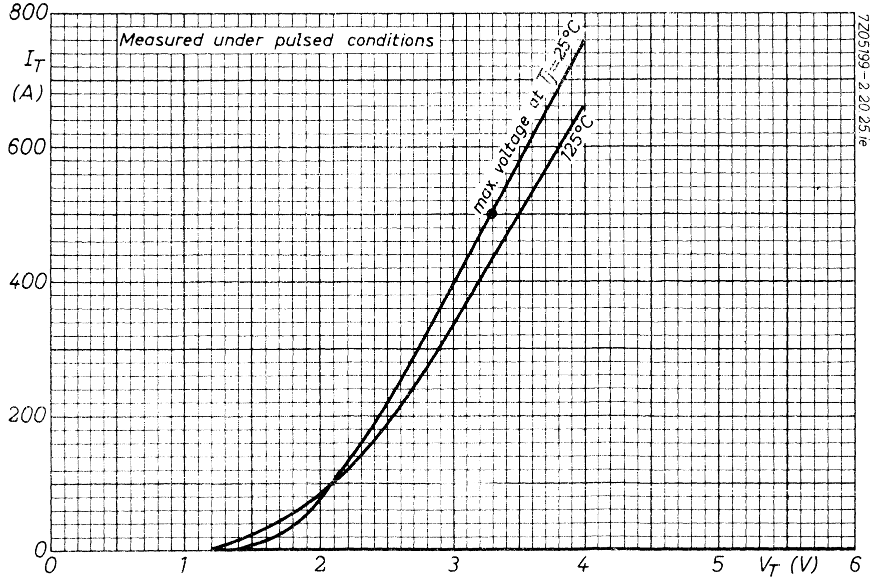
Alternatively, when the heatsink and $R_{th\ h\text{-}a}$ are known, the maximum permissible ambient temperature can be found.

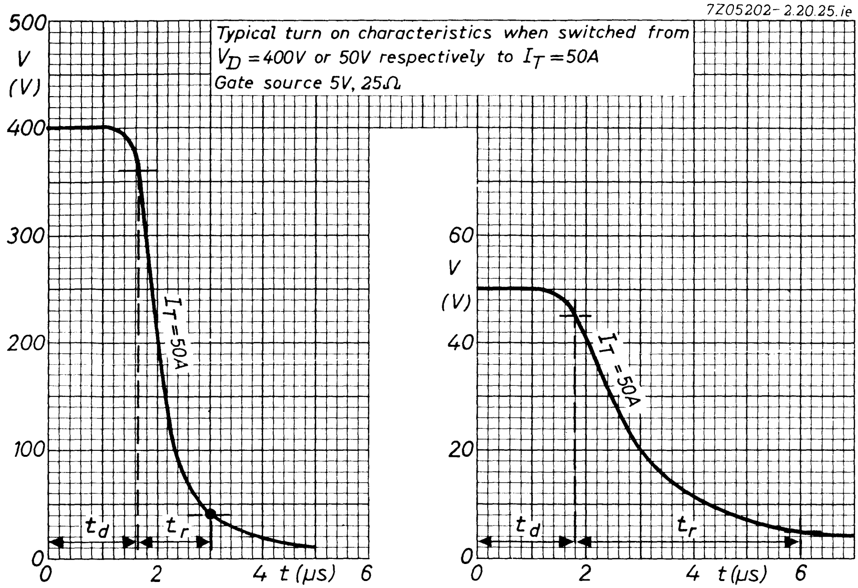
7Z3 0307

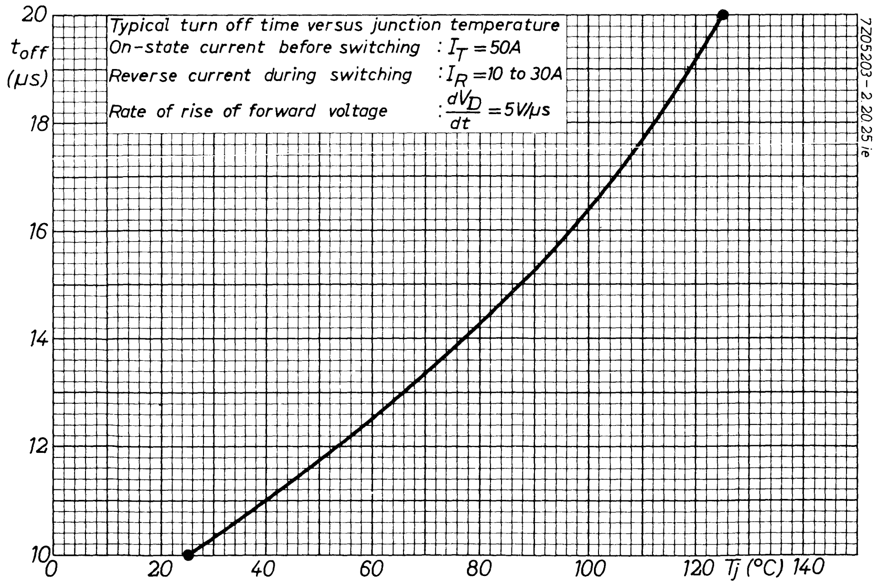


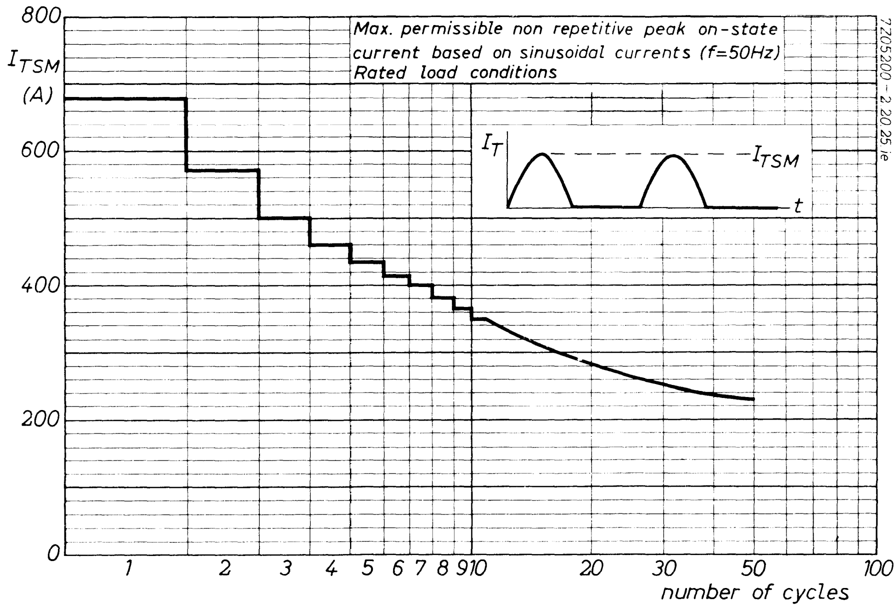
Gate characteristics with curves $P_{GAV} = 0.5W$


V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j = +125°C
I_{FG} (mA)
0
50
100
150
200
250
300
1
2
3
4
7Z05197-2.20.25.ie


I_T (A)
Measured under pulsed conditions
max. voltage at T_j = 25°C
125°C
V_T (V)
0
1
2
3
4
5
6
200
400
600
800
7Z05199-2.20.25.ie


7Z05202- 2.20.25.ie
Typical turn on characteristics when switched from
VD =400V or 50V respectively to IT =50A
Gate source 5V, 25Ω
500
V
(V)
400
300
200
100
0
IT =50A
td
tr
0
2
4 t (μs) 6
60
V
(V)
40
20
0
IT =50A
td
tr
0
2
4 t (μs)
6


Typical turn off time versus junction temperature
On-state current before switching : IT =50A
Reverse current during switching : IR =10 to 30A
Rate of rise of forward voltage : dVD/dt =5V/μs
7Z05203- 2.20.25.ie
20
toff
(μs)
18
16
14
12
10
0
20
40
60
80
100
120 Tj (°C) 140


800
600
400
200
0
I_{TSM}
(A)
Max. permissible non repetitive peak on-state current based on sinusoidal currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t
1
2
3
4
5
6
7
8
9
10
20
30
50
100
number of cycles
7205200 - 2 20 25 ie

P-GATE SILICON THYRISTORS

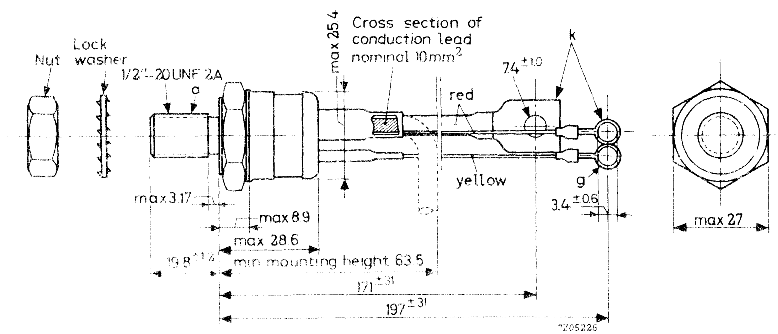
P-gate thyristors in a metal envelope with ceramic insulation. They are intended for power control and power switching applications.
The series consists of the following reverse polarity types (stud anode):
BTY99-100R, BTY99-200R, BTY99-300R, BTY99-400R,
BTY99-500R, BTY99-600R, BTY99-700R and BTY99-800R.

QUICK REFERENCE DATA

		BTY99-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V

Average forward current	I_{TAV}	max.	70	A
Non repetitive peak forward current (t = 10 ms)	I_{TSM}	max.	900	A
Junction temperature	T_j	max.	125	^oC
Thermal resistance from junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	$^oC/W$

MECHANICAL DATA Dimensions in mm



Net weight : 80 g

With accessories: 108 g

Diameter of hole in heatsink: max. 13 mm

Torque on nut: min. 90 cm kg

max. 175 cm kg

7Z3 0294

All information applies to frequencies up to 400 Hz.

RATINGS (Limiting values) [1]

ANODE TO CATHODE

Voltages [2]		BTY99-100R	200R	300R	400R	500R	600R	700R	800R	
Crest working reverse voltage	V_{RWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak reverse voltage	V_{RRM} max.	100	200	300	400	500	600	700	800	V
Non repetitive peak reverse voltage (t < 5 ms)	V_{RSM} max.	150	300	400	500	600	720	850	960	V
Crest working off-state voltage	V_{DWM} max.	100	200	300	400	500	600	700	800	V
Repetitive peak off-state voltage	V_{DRM} max.	100	200	300	400	500	600	700	800	V
Non repetitive peak off-state voltage	V_{DSM} max.	850	850	850	850	850	850	850	850	V [3]

Currents

Average forward current (averaged over any 20 ms period)	I_{TAV}	max.	70	A
Forward current (d.c.)	I_T	max.	100	A
Repetitive peak forward current	I_{TRM}	max.	1000	A
Non repetitive peak forward current (t = 10 ms) See page E	I_{TSM}	max.	900	A
I squared t, for fusing (t = 1.5 to 10 ms)	I^2t	max.	4000	A^2s
Repetitive peak reverse current (during turn-off)	I_{RRM}	max.	30	A

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2] These ratings apply to a gate voltage range of −5 to +0.25 V. For thermal stability: $R_{th\ j\text{-}a} \leqq 4.5\ ^{o}C/W$ (d.c.) or $\leqq 9\ ^{o}C/W$ (a.c.) for −100 to −400 types, $R_{th\ j\text{-}a} \leqq 1.5\ ^{o}C/W$ (d.c.) or $\leqq 3\ ^{o}C/W$ (a.c.) for −500 to −800 types.

[3] This voltage may be applied without damage but the thyristor may switch into the on-state. Care should be taken that no current ratings are exceeded.

7Z3 0670

RATINGS (Limiting values) (continued)

GATE TO CATHODE

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Currents

Forward peak current	I_{FGM}	max.	2	W

Power dissipation

Average power dissipation (averaged over any 20 ms period)	P_{GAV}	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

TEMPERATURES

Storage temperature	T_{stg}	−55 to +125	^{o}C
Junction temperature	T_j	max. 125	^{o}C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4	$^{o}C/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.1	$^{o}C/W$

7Z3 0296

CHARACTERISTICS T_j = 125 °C unless otherwise specified

ANODE TO CATHODE

Voltages			BTY99–100R	200R	300R	400R	500R	600R	700R	800R	
Forward on-state voltage I_T = 500 A; T_j = 25 °C	V_T	<	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	V [1]
Forward breakover voltage	$V_{(BO)}$	>	100	200	300	400	500	600	700	800	V
Rate of rise of forward voltage not to trigger the device	$\frac{dV_D}{dt}$	typ.	10	10	10	10	10	10	10	10	V/μs
Currents											
Reverse current $V_R = V_{RWMmax}$	I_R	<	13	12	10	8.0	12	12	12	10	mA [2]
Off-state current $V_D = V_{DWMmax}$	I_D	<	13	12	10	8.0	12	12	12	10	mA

Pick up current	I_P	typ.	20	mA
Holding current	I_H	typ.	10	mA

GATE TO CATHODE

Voltages

Voltage to trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3.0	V
Voltage not to trigger any device	V_{GD}	<	0.25	V

Current

Current to trigger all devices V_D = 6 V	I_{GT}	>	70	mA

[1]) Measured under pulsed conditions to prevent excessive dissipation.

[2]) These I_R values apply to a gate voltage range of −5 to +0.25 V.

7Z3 0297

SWITCHING CHARACTERISTICS (See also page D)

Turn on time when switched from V_D = 400 V to I_T = 50 A; Gate source 5 V, 25 Ω, T_j = 125 °C	t_{on}	typ.	3.0	μs
Turn off time when switched from I_T = 50 A to I_R between 10 and 30 A; $\frac{dV_D}{dt}$ = 5 V/μs ; T_j = 125 °C	t_{off}	typ.	20	μs
T_j = 25 °C	t_{off}	typ.	10	μs

7Z3 0292

OPERATING NOTES

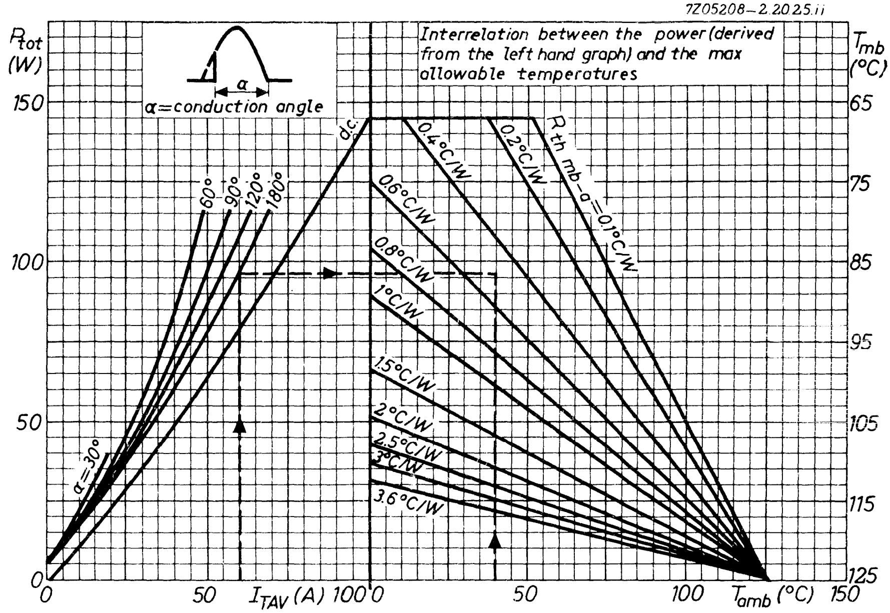
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transfomer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2
V_{RWM} stands for the actually applied crest working reverse voltage.

2. In order to prevent the thyristors from being damaged by surge currents higher than those mentioned in the curves at page E a fast fuse is recommended.

7Z3 0293



EXAMPLE (Determination of the heatsink thermal resistance)

Assume the thyristor used in a 50 Hz single phase full wave rectifier circuit (conduction angle $\alpha = 180^o$) at $T_{amb} = 40\ ^oC$.
The average forward current (per thyristor) $I_{TAV} = 60$ A.

From the left hand part of the graph above it follows that at $I_{TAV} = 60$ A and $\alpha = 180^o$ the average forward power + average leakage power = 96 W per thyristor.

From the right hand part follows the thermal resistance, required for $P_{tot} = 96$ W at $T_{amb} = 40\ ^oC$.

$$R_{th\ mb\text{-}a} \approx 0.5\ ^oC/W$$

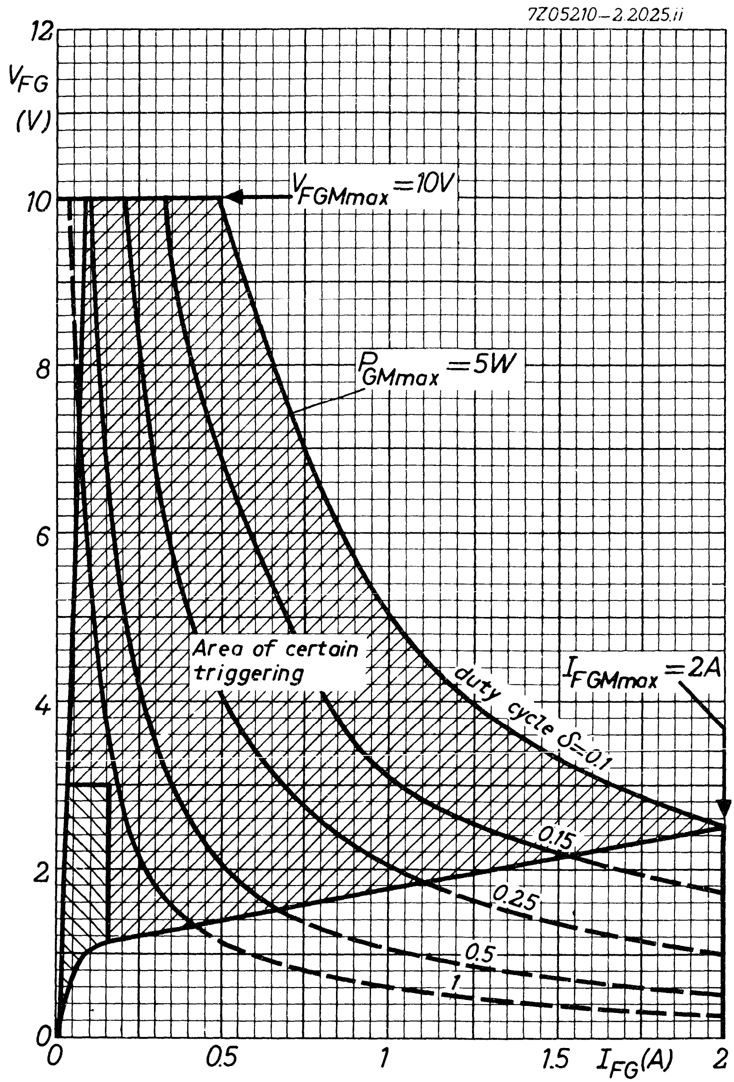
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.1\ ^oC/W$

Hence the heatsink thermal resistance should be:

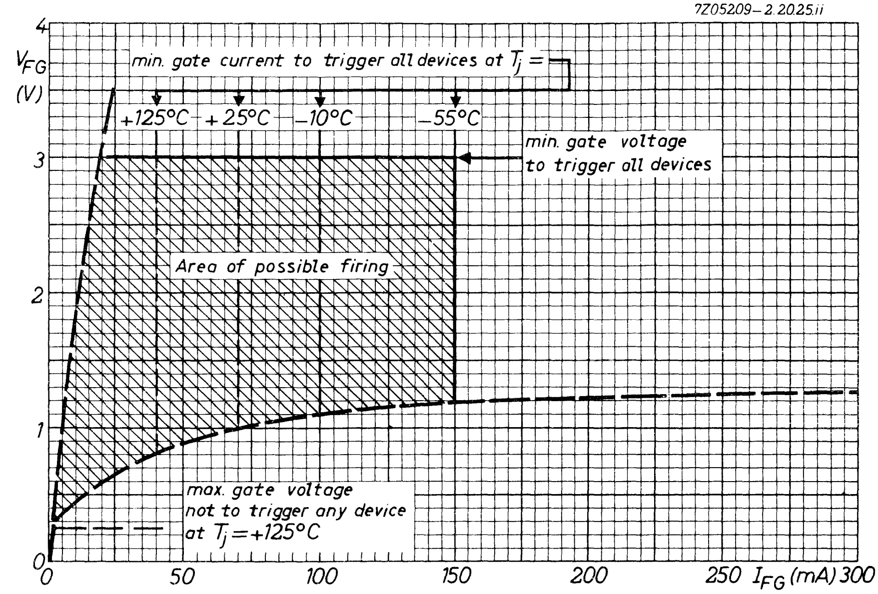
$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (0.5 - 0.1)\ ^oC/W = 0.4\ ^oC/W$

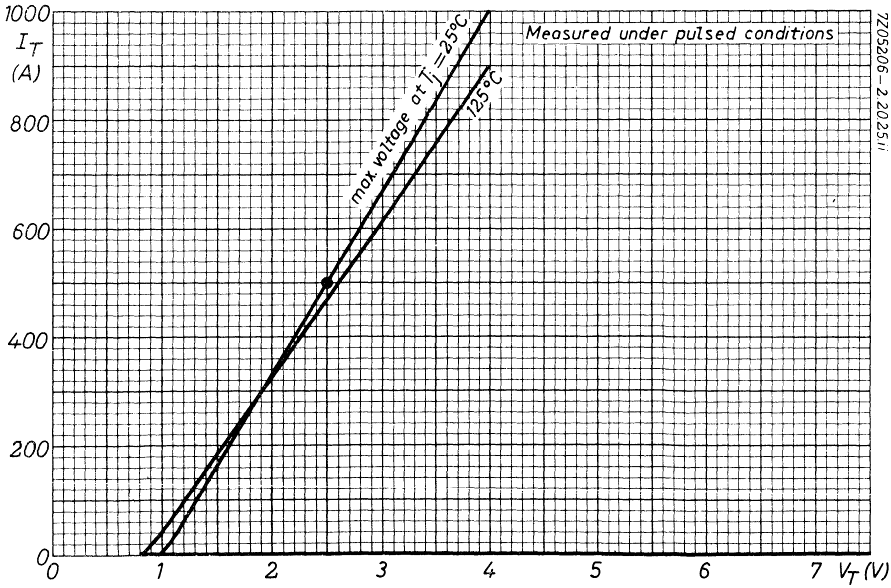
Alternatively, when the heatsink and $R_{th\ h\text{-}a}$ are known, the maximum permissible ambient temperature can be found.

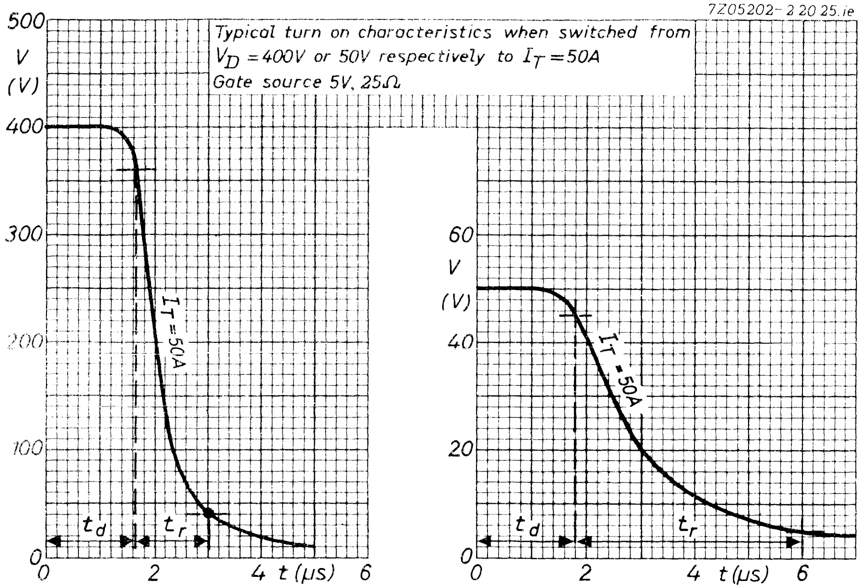
7Z3 0308

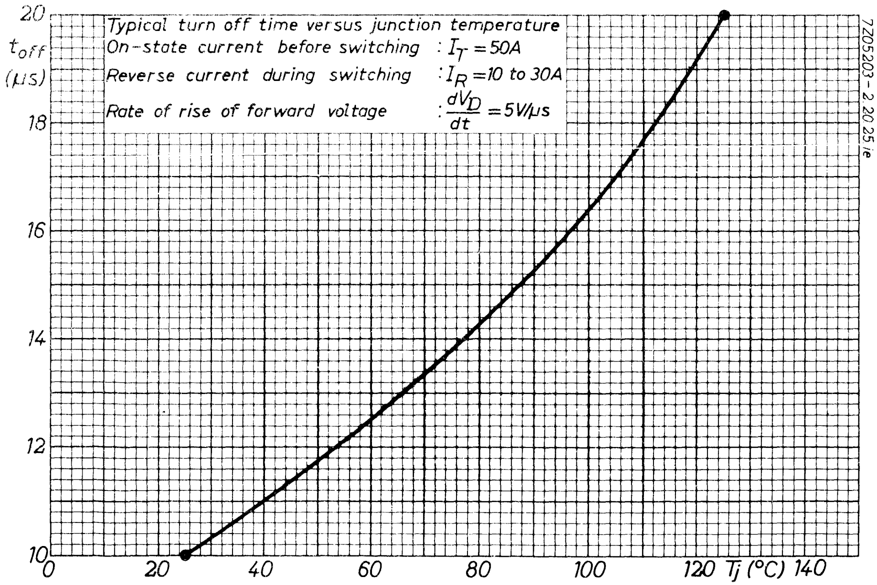


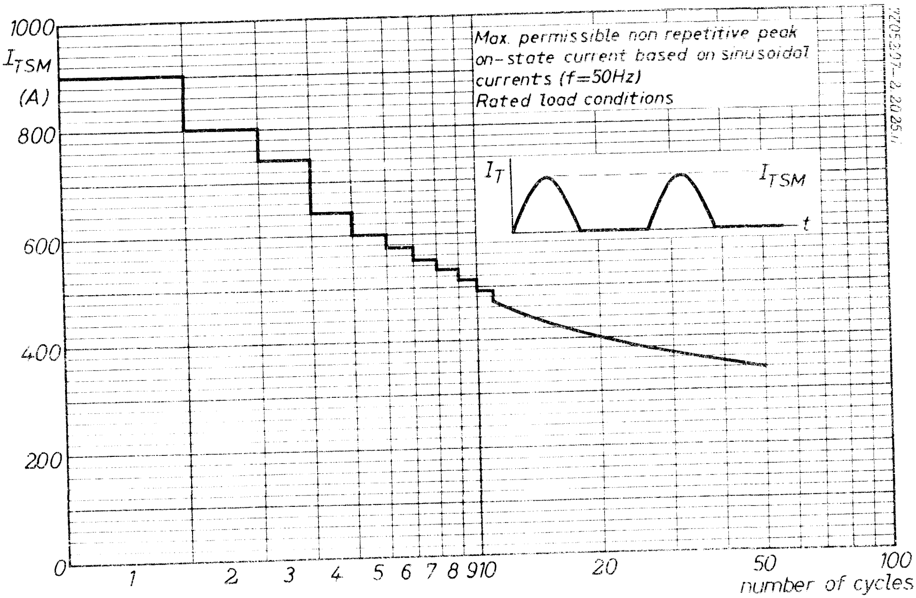
Gate characteristics with curves $P_{GAV} = 0.5W$


7Z05209-2.20.25.ii
V_{FG} (V)
min. gate current to trigger all devices at T_j =
+125°C
+25°C
-10°C
-55°C
min. gate voltage to trigger all devices
Area of possible firing
max. gate voltage not to trigger any device at T_j = +125°C
I_{FG} (mA)
0
1
2
3
4
50
100
150
200
250
300


I_T (A)
Measured under pulsed conditions
7Z05206-2.20.25.ii
max. voltage at T_j = 25°C
125°C
V_T (V)
0
200
400
600
800
1000
1
2
3
4
5
6
7


7Z05202-2 20 25.ie
Typical turn on characteristics when switched from
V_D = 400V or 50V respectively to I_T = 50A
Gate source 5V, 25Ω
500
V
(V)
400
300
200
100
0
I_T = 50A
t_d
t_r
0
2
4 t (μs) 6
60
V
(V)
40
20
0
I_T = 50A
t_d
t_r
0
2
4 t (μs) 6


7Z05203-2 20 25.ie
Typical turn off time versus junction temperature
On-state current before switching : I_T = 50A
Reverse current during switching : I_R = 10 to 30A
Rate of rise of forward voltage : $\frac{dV_D}{dt}$ = 5V/μs
20
t_{off}
(μs)
18
16
14
12
10
0
20
40
60
80
100
120 T_j (°C) 140


1000
I_{TSM}
(A)
800
600
400
200
0
Max. permissible non repetitive peak
on-state current based on sinusoidal
currents (f=50Hz)
Rated load conditions
I_T
I_{TSM}
t
1
2
3
4
5
6
7
8
9
10
20
50
100
number of cycles

Rectifier Stacks

SINGLE PHASE FULL WAVE RECTIFIER STACKS

Single phase full wave rectifier stacks (bridge connected) incorporating four double diffused silicon diodes. The stacks may be used either with forced air or free convection cooling.

QUICK REFERENCE DATA

		OSH2504	OSH4502	OSH4503	
Input					
R.M.S. voltage	$V_{I(rms)}$	max. 140	280	420	V
Repetitive peak voltage	V_{IRM}	max. 400	800	1200	V
Output					
Average voltage with R and L load	V_O	max. 125	250	375	V
Average current with R and L load					
free convection; T_{amb} = 50 °C	I_O	max. 47	47	47	A
forced cooling; T_{amb} = 40 °C	I_O	max. 80	80	80	A

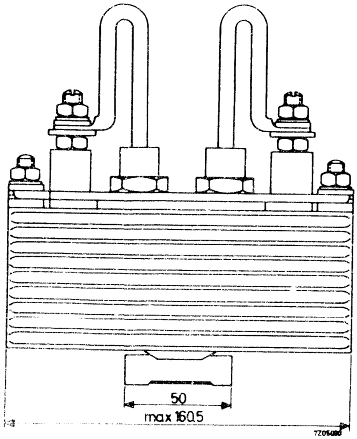
MECHANICAL DATA

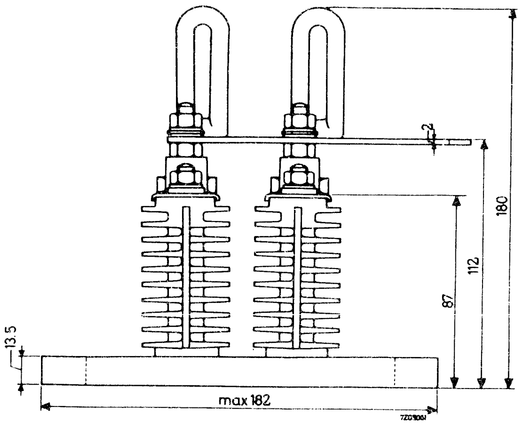
See page 2

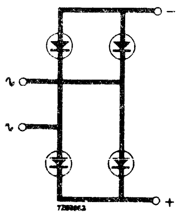
7Z3 0220

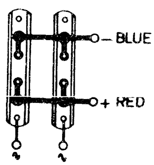
MECHANICAL DATA

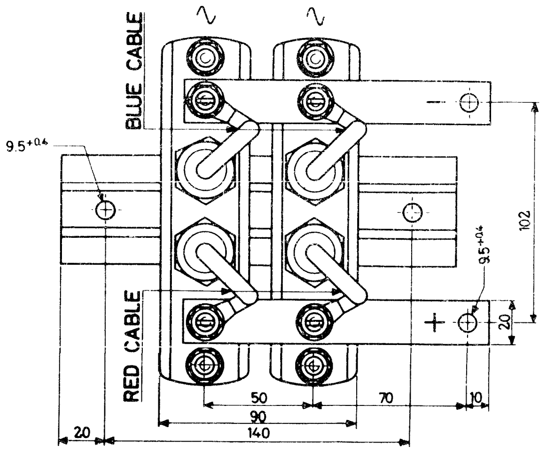
Dimensions in mm











7Z3 0221

All information applies to mains frequencies up to 400 Hz.

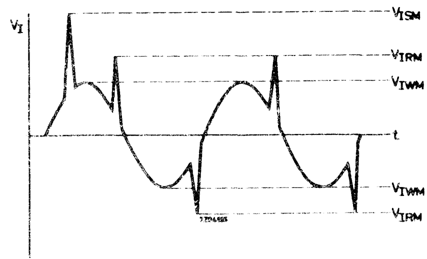
RATINGS (Limiting values) [1])

Input		OSH2504	OSH4502	OSH4503	
R.M.S. voltage	$V_{I(rms)}$	max. 140	280	420	V
Crest working voltage	V_{IWM}	max. 200	400	600	V
Repetitive peak voltage	V_{IRM}	max. 400	800	1200	V
Non repetitive peak voltage (t < 10 ms)	V_{ISM}	max. 400	800	1200	V

Non repetitive peak current (t = 10 ms; see page A)	I_{ISM}	max.	800	A
Output				
Average current with R and L load				
free convection; $T_{amb} = 50\,^{o}C$	I_O	max.	47	A
forced cooling 3 m/s; $T_{amb} = 40\,^{o}C$	I_O	max.	80	A
Repetitive peak current	I_{ORM}	max.	200	A
Temperatures				
Storage temperature	T_{stg}		-65 to +150	^{o}C

MEANING OF SYMBOL SUBSCRIPTS

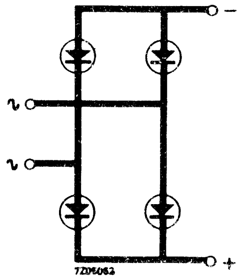
First subscript	I	=	input
	O	=	output
Second subscript	R	=	repetitive
	S	=	non repetitive
	W	=	working
Third subscript	M	=	peak or crest



[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0411

MAXIMUM OPERATING CONDITIONS[1])



		OSH2504	OSH4502	OSH4503	
Input					
R.M.S. voltage	$V_{I(rms)}$	140	280	420	V
R.M.S. current					
free convection					
T_{amb} = 50 °C; R load	$I_{I(rms)}$	52	52	52	A
L load	$I_{I(rms)}$	47	47	47	A
forced cooling 3 m/s					
T_{amb} = 40 °C; R load	$I_{I(rms)}$	88	88	88	A
L load	$I_{I(rms)}$	80	80	80	A
Output					
Average voltage with R and L load	V_O	125	250	375	V
Average current with R and L load					
free convection; T_{amb} = 50 °C	I_O	47	47	47	A
forced cooling 3 m/s; T_{amb} = 40 °C	I_O	80	80	80	A

Required transformer volt amperes: 1.11 x average output power.

1) The V_I and I_O figures are absolute maximum values for resistive or inductive load; no source impedance is assumed.
The equipment designer has to determine an average design such that these values will not be exceeded.

7Z3 0223

OPERATING NOTES

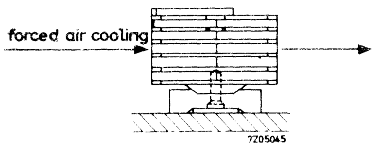
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

RC across primary of transformer		RC across secondary of transformer	
C (μF)	R (Ω)	C (μF)	R (Ω)
$200 \frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225 \frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$

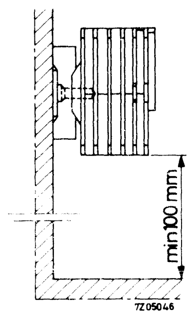
where:

I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2

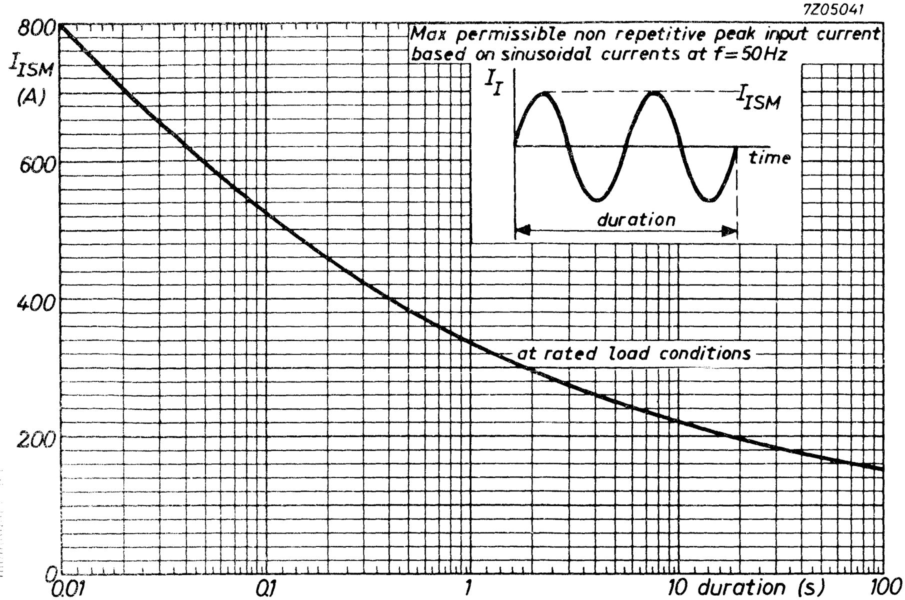
2. With forced air cooling at more than 0.5 m/s the stack may be mounted in any position, provided the air flow is parallel to the cooling fins.

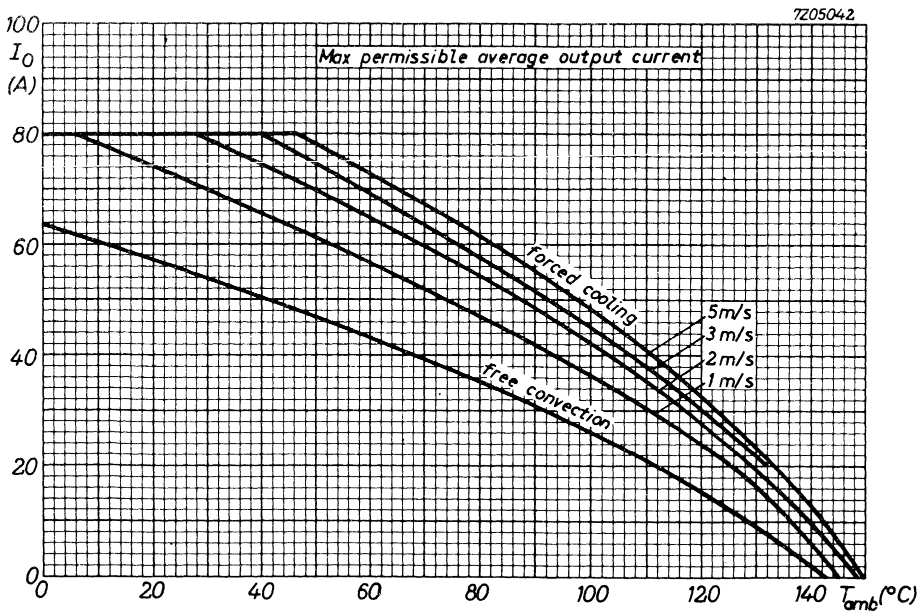


With forced air cooling at less than 0.5 m/s and in the case of free convection, the stack should be mounted with a minimum clearance of 100 mm above the chassis, as shown below.



7Z3 0224


7Z05041
Max permissible non repetitive peak input current based on sinusoidal currents at f=50Hz
I_{ISM} (A)
800
600
400
200
0
0.01
0.1
1
10 duration (s)
100
I_I
I_{ISM}
time
duration
at rated load conditions


7Z05042
Max permissible average output current
I_O (A)
100
80
60
40
20
0
0
20
40
60
80
100
120
140 T_{amb}(°C)
forced cooling
5m/s
3m/s
2m/s
1m/s
free convection

THREE PHASE FULL WAVE RECTIFIER STACKS

Three phase full wave rectifier stacks (bridge connected) incorporating six double diffused silicon diodes. The stacks may be used either with forced air or free convection cooling.

QUICK REFERENCE DATA					
		OSK2503	OSK4509	OSK4510	
Input					
R.M.S. voltage	$V_{I(rms)}$	max. 140	280	420	V
Repetitive peak voltage	V_{IRM}	max. 400	800	1200	V
Output					
Average voltage with R and L load	V_O	max. 185	375	565	V
Average current with R and L load					
free convection; T_{amb} = 50 °C	I_O	max. 63	63	63	A
forced cooling ; T_{amb} = 40 °C	I_O	max. 120	120	120	A

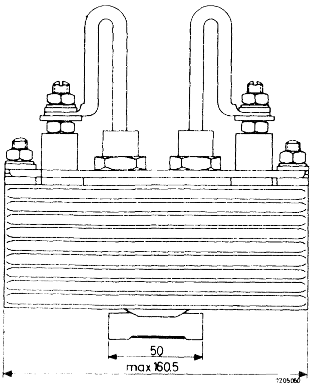
MECHANICAL DATA

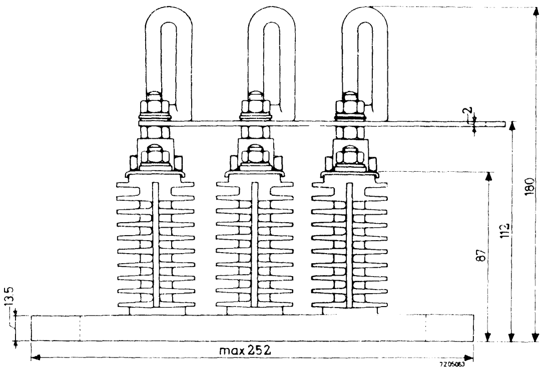
See page 2

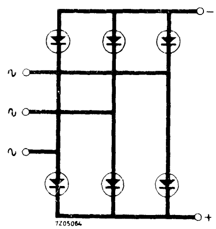
7Z3 0247

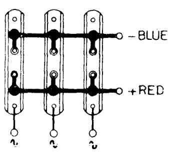
MECHANICAL DATA

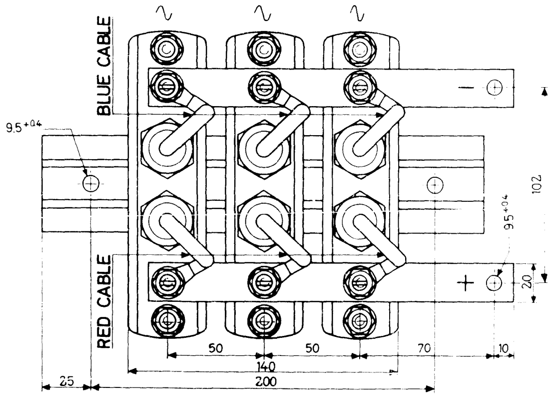
Dimensions in mm











7Z3 0248

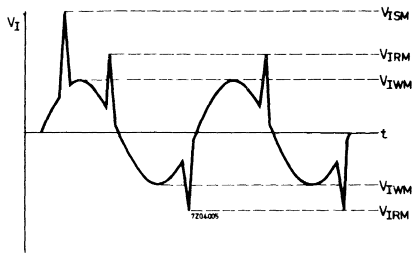
All information applies to mains frequencies up to 400 Hz.

RATINGS (Limiting values) [1]

		OSK2503	OSK4509	OSK4510	
Input					
R.M.S. voltage	$V_{I(rms)}$	max. 140	280	420	V
Crest working voltage	V_{IWM}	max. 200	400	600	V
Repetitive peak voltage	V_{IRM}	max. 400	800	1200	V
Non repetitive peak voltage (t < 10 ms)	V_{ISM}	max. 400	800	1200	V
Non repetitive peak current (t = 10 ms; see page A)	I_{ISM}	max.	800		A
Output					
Average current with R and L load					
free convection; T_{amb} = 50 °C	I_O	max.	63		A
forced cooling 5 m/s; T_{amb} = 40 °C	I_O	max.	120		A
Repetitive peak current	I_{ORM}	max.	200		A
Temperatures					
Storage temperature	T_{stg}		−65 to +150		°C

MEANING OF SYMBOL SUBSCRIPTS

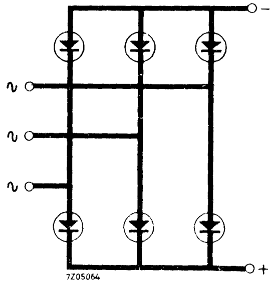
First subscript	I	= input
	O	= output
Second subscript	R	= repetitive
	S	= non repetitive
	W	= working
Third subscript	M	= peak or crest



[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0412

MAXIMUM OPERATING CONDITIONS [1])



Input		OSK2503	OSK4509	OSK4510	
R.M.S. voltage (line to line)	$V_{I(rms)}$	140	280	420	V
R.M.S. current					
free convection					
T_{amb} = 50 C; R load L load	$I_{I(rms)}$	52	52	52	A
forced cooling 5 m/s					
T_{amb} = 40 ^{o}C; R load L load	$I_{I(rms)}$	98	98	98	A
Output					
Average voltage with R and L load	V_O	185	375	565	V
Average current with R and L load					
free convection; T_{amb} = 50 ^{o}C	I_O	63	63	63	A
forced cooling 5 m/s; T_{amb} = 40 ^{o}C	I_O	120	120	120	A

Required transformer volt amperes: 1.05 x average output power

[1]) The V_I and I_O figures are absolute maximum values for resistive or inductive load; no source impedance is assumed.
The equipment designer has to determine an average design such that these values will not be exceeded. 7Z3 0250

OPERATING NOTES

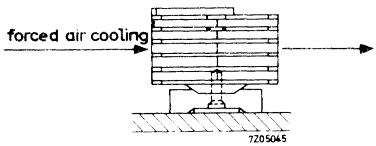
1. When there is a possibility that transient voltages, caused by the stored energy in the transformer core, will exceed the maximum permissible non repetitive peak reverse voltage, a damping circuit across the transformer should be applied.
   Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

RC across primary of transformer		RC across secondary of transformer	
C (μF)	R (Ω)	C (μF)	R (Ω)
$200 \frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225 \frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$

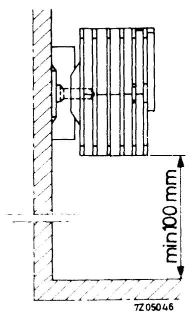
where:

I_{mag} = magnetising primary r.m.s. current (A)
V_1 = transformer primary r.m.s. voltage (V)
V_2 = transformer secondary r.m.s. voltage (V)
T = V_1/V_2

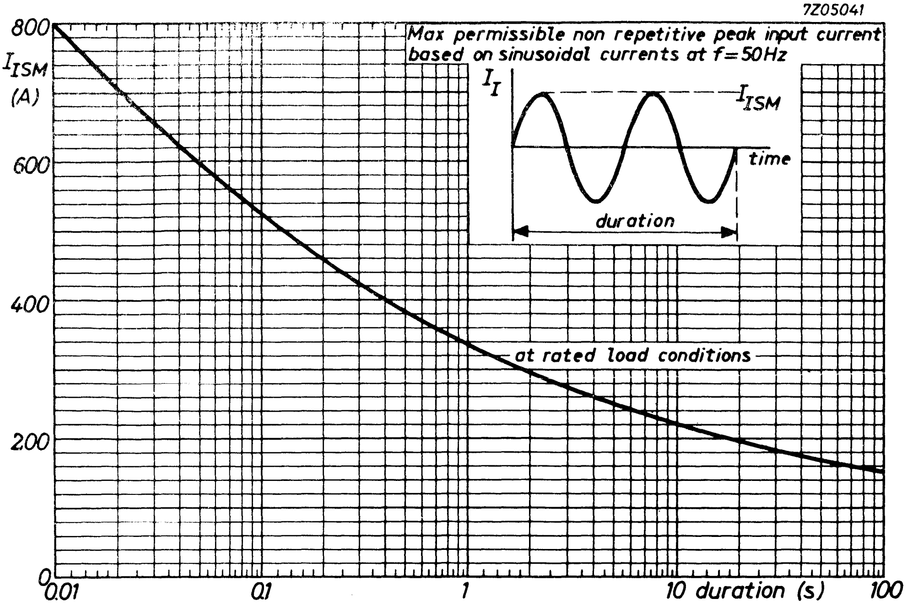
2. With forced air cooling at more than 0.5 m/s the stack may be mounted in any position, provided the air flow is parallel to the cooling fins.

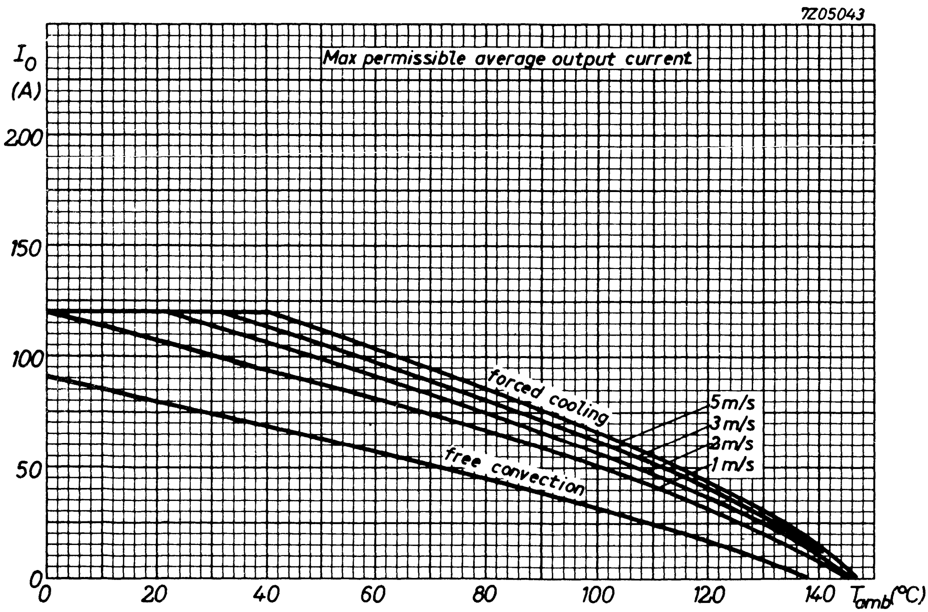


   With forced air cooling at less than 0.5 m/s and in the case of free convection, the stack should be mounted with a minimum clearance of 100 mm above the chassis, as shown below.



7Z3 0224


7Z05041
Max permissible non repetitive peak input current
based on sinusoidal currents at f=50Hz
I_{ISM}
(A)
800
600
400
200
0
I_I
I_{ISM}
time
duration
at rated load conditions
0.01
0.1
1
10
duration (s)
100


7Z05043
Max permissible average output current
I_O
(A)
200
150
100
50
0
forced cooling
5 m/s
3 m/s
2 m/s
1 m/s
free convection
0
20
40
60
80
100
120
140
T_{amb} (°C)

Transistors

GERMANIUM P-N-P TRANSISTOR

Low noise germanium transistor in all glass envelope for use as input stage of tape recorders with a speed of up to 19 cm/s.

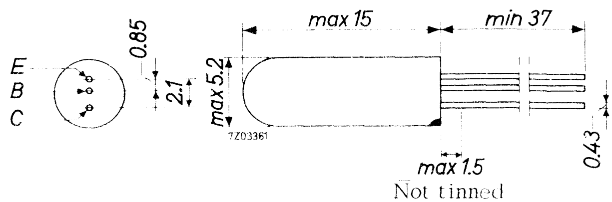
RATINGS (Limiting values) [1])

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	15	V
Collector-emitter voltage with $R_{BE} < 1.5\ k\Omega$	$-V_{CER}$	max.	15	V
Collector current (peak value)	$-I_{CM}$	max.	10	mA
Total dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	80	mW
Junction temperature	T_j	max.	75	^oC

CHARACTERISTICS $T_j = 25\ ^oC$

Small signal current gain				
$-I_C = 0.3$ mA; $-V_{CE} = 5$ V	h_{fe}	typ.	60	
			35 to 160	
Cut-off frequency				
$I_E = 0.3$ mA; $-V_{CB} = 5$ V	f_{hfb}	>	2	MHz
Noise figure at f = 30 Hz to 15 kHz				
$I_E = 0.3$ mA; $-V_{CB} = 5$ V; $R_S = 1.5\ k\Omega$	F	<	5	dB

MECHANICAL DATA Dimensions in mm



The red dot indicates the collector.

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0168

GERMANIUM ALLOY JUNCTION TRANSISTOR of the p-n-p type in metal envelope for use in pre-amplifier and driver stages with battery voltages up to 14 V.

LIMITING VALUES (Absolute max. values)

Collector		
Voltage (base reference)	$-V_{CB}$	= max. 32 V
Voltage (emitter reference)	$-V_{CE}$	= max. 32 V [1]
Current	$-I_C$	= max. 100 mA
Emitter		
Voltage (base reference)	$-V_{EB}$	= max. 10 V
Base		
Current	$-I_B$	= max. 5 mA
Dissipation		
Total dissipation	P_{tot}	= max. 500 mW
Temperatures		
Storage temperature	T_s	= -55 °C to +90 °C
Junction temperature	T_j	= max. 90 °C

THERMAL DATA

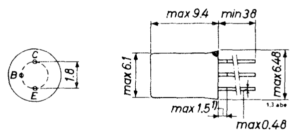
Thermal resistance from junction to ambience in free air	K = max. 0.3 °C/mW
Thermal resistance from junction to ambience with cooling fin mounted on heat sink of at least 12.5 cm²	K = max. 0.09 °C/mW

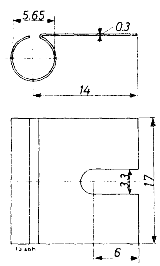
[1]) For recommended practical limits of $-V_{CE}$ see page

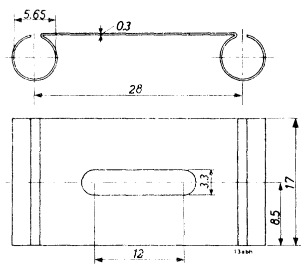
7Z2 3102

Dimensions in mm

The red dot indicates the collector side







Cooling fin 56227 Cooling fin 56226

CHARACTERISTICS at Tamb = 25 °C

Collector current at I_E = 0 mA		
$-I_{CBO}$ ($-V_{CB}$ = 10 V; I_E = 0 mA)	<	10 µA
Collector voltage at V_{BE} = 0 V		
$-V_{CB}$ ($-I_C$ = 500 µA; V_{BE} = 0 V)	>	32 V
Emitter voltage at I_C = 0 mA		
$-V_{EB}$ ($-I_E$ = 200 µA; I_C = 0 mA)	>	10 V

[1]) Not tinned

7Z2 1751

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C unless otherwise specified

Collector current at I_E = 0 mA			
$-I_{CBO}$		See page D	
Emitter current at I_C = 0 mA			
$-I_{EBO}$	$-V_{EB}$ = 5 V; I_C = 0 mA; T_j = 75 °C		< 550 µA
Current amplification factor $\frac{I_C - I_{CBO}}{I_B + I_{CBO}}$			
h_{FE}	(I_E = 2 mA; $-V_{CB}$ = 5 V)	= 100	> 50
h_{FE}	(I_E = 50 mA; V_{CB} = 0 V)	= 95	
h_{FE}	(I_E = 100 mA; V_{CB} = 0 V)	= 80	
Base voltage			
$-V_{BE}$	(I_E = 2 mA; $-V_{CB}$ = 5 V)	= 105 mV	
$-V_{BE}$	(I_E = 100 mA; V_{CB} = 0 V)		< 400 mV
Frequency at which $\|h_{fe}\|$ = 1			
f_1	($-V_{CB}$ = 2 V; I_E = 10 mA)	= 1.7 Mc/s	> 1.3 Mc/s
Cut-off frequency			
$f_{\alpha e}$	($-V_{CB}$ = 2 V; I_E = 10 mA)	= 17 kc/s	> 10 kc/s
Base resistance			
$\|z_{rb}\|$	$-V_{CB}$ = 5 V; I_E = 1 mA; f = 0.45 Mc/s	= 90 Ω	
Collector capacitance			
c_c	$-V_{CB}$ = 5 V; I_E = 0 mA; f = 0.45 Mc/s	= 40 pF	< 50 pF
Noise figure			
F	$-V_{CB}$ = 5 V; I_E = 0.5 mA; f = 1 kc/s; B = 200 c/s; Input source resistance = 500 Ω	= 4 dB	< 10 dB

7Z2 1752 | 3.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued)

T_{amb} = 25 °C

Small signal parameters

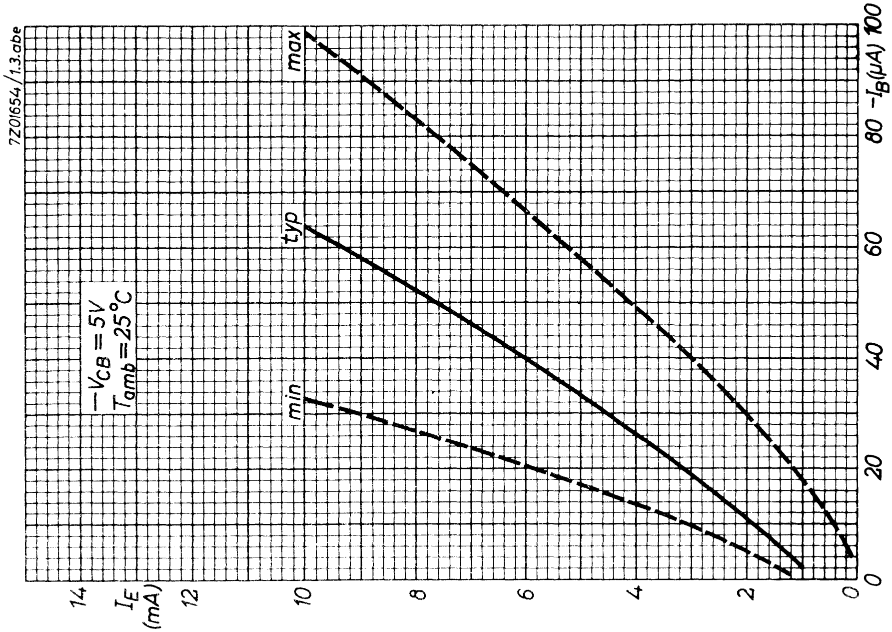
Measured at

Collector voltage	$-V_{CB}$ = 5 V	
Emitter current	I_E = 2 mA	
Frequency	f = 1 kc/s	

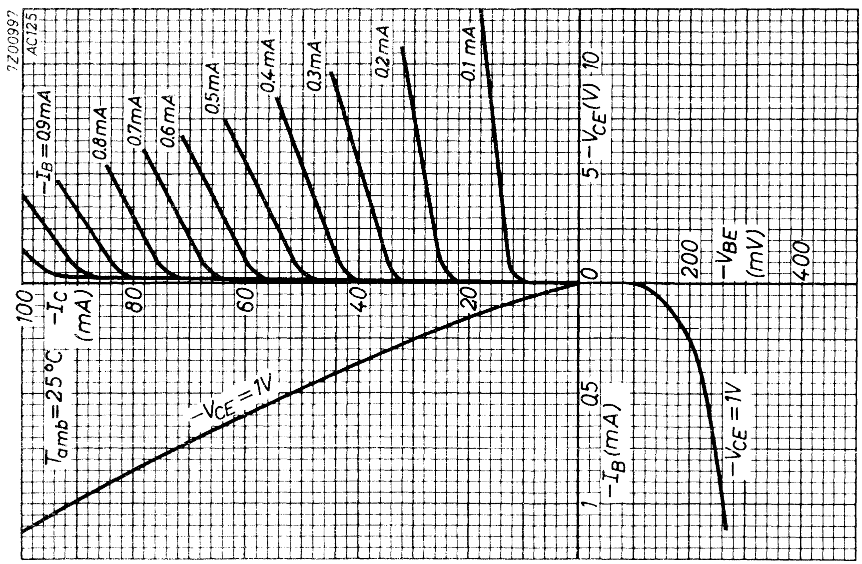
Input impedance	h_{ie} = 1.7 kΩ	> 1.1 kΩ < 2.5 kΩ
Voltage feedback ratio	h_{re} = 6.5×10^{-4}	< 8.5×10^{-4}
Current amplification factor	h_{fe} = 125	> 80 < 170
Output admittance	h_{oe} = 80 µA/V	< 110 µA/V

7Z2 1172 | 4.

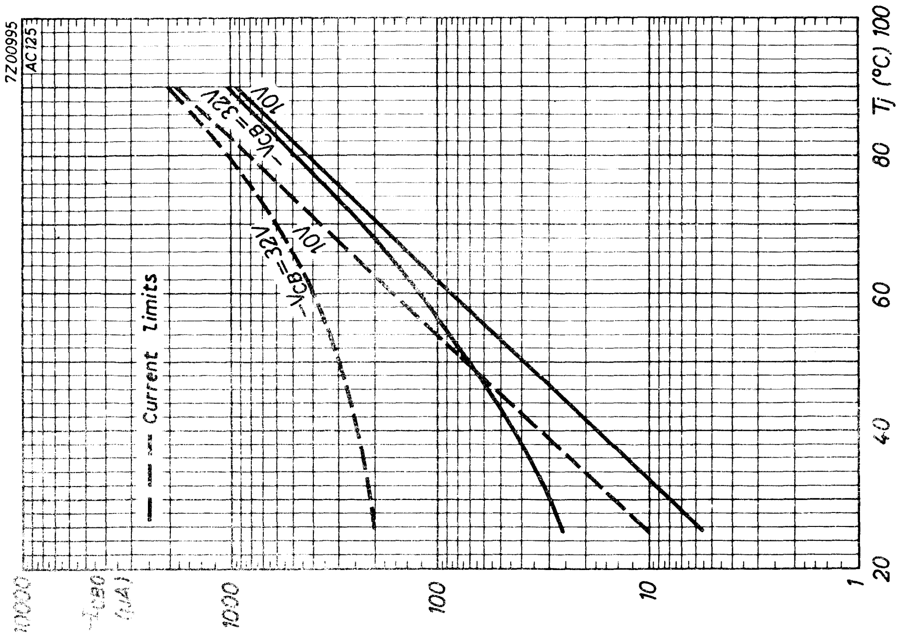
B


7Z01654/1.3.abe
$-V_{CB} = 5V$
$T_{amb} = 25°C$
max
typ
min
I_E (mA)
14
12
10
8
6
4
2
0
20
40
60
80
100
$-I_B$ (μA)

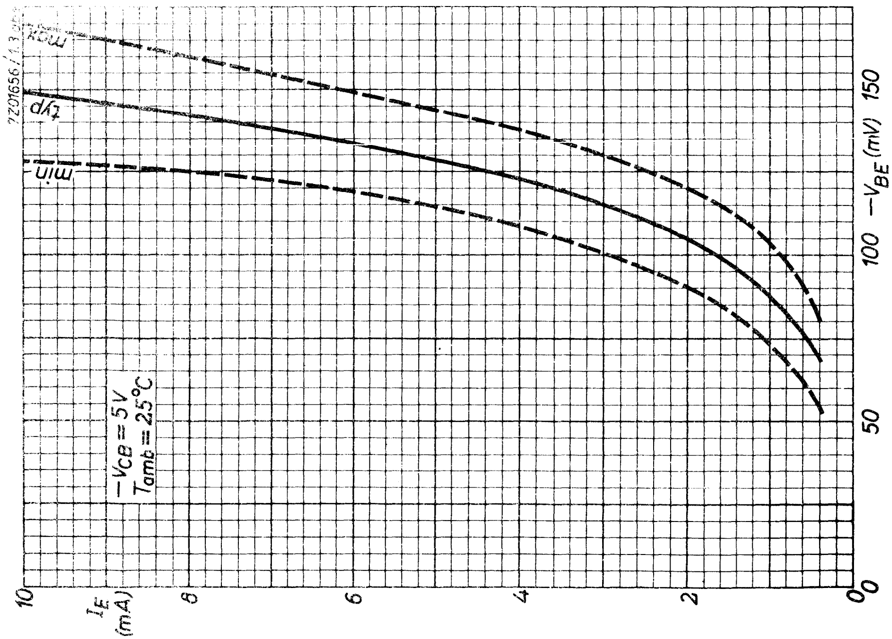
A

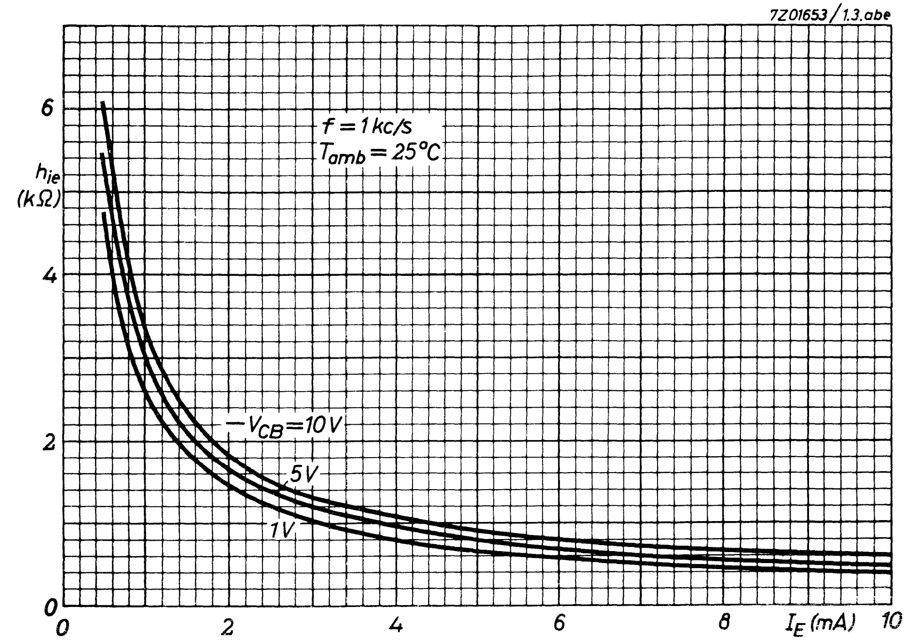

7Z00997 AC125
$-I_B = 0.9mA$
0.8mA
0.7mA
0.6mA
0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
$-I_C$ (mA)
100
80
60
40
20
0
5
10
$-V_{CE}$ (V)
200
400
$-V_{BE}$ (mV)
$T_{amb} = 25°C$
$-V_{CE} = 1V$
0.5
1
$-I_B$ (mA)
$-V_{CE} = 1V$

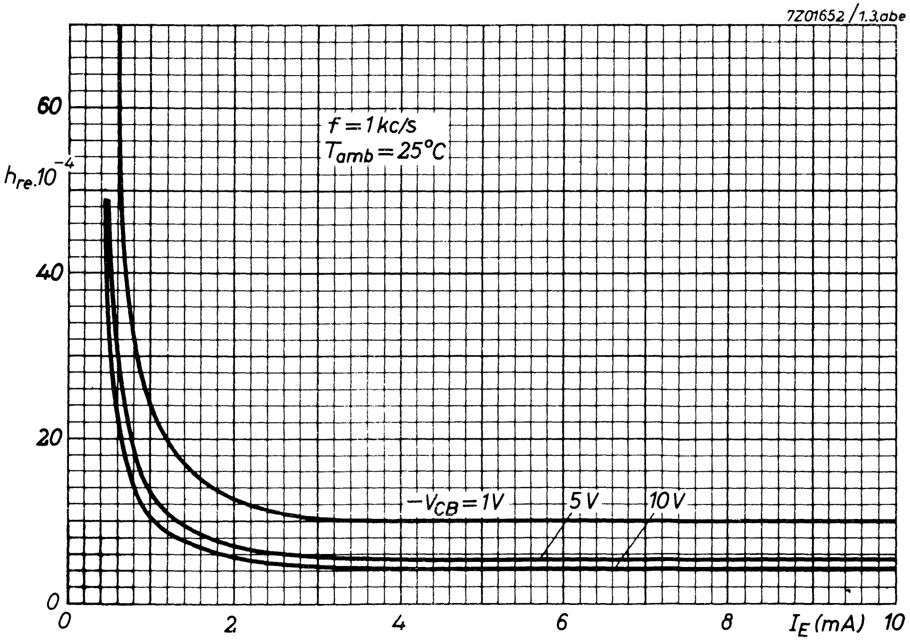
D

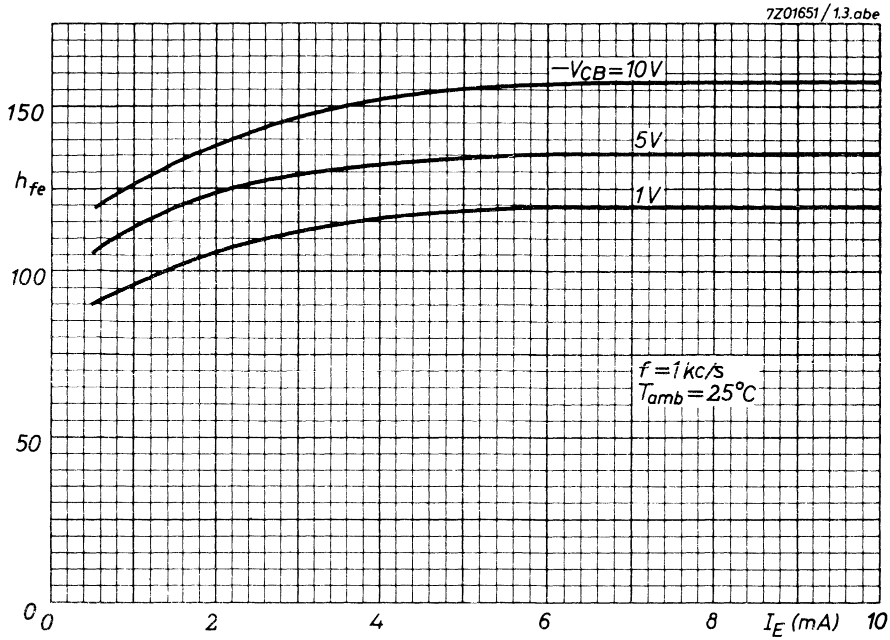

7Z00995
AC125
Current
Limits
$-V_{CB}=32V$
10V
$-V_{CB}=32V$
10V
T_j (°C)
20
40
60
80
100
I_{CBO} (μA)
10000
1000
100
10
1

C

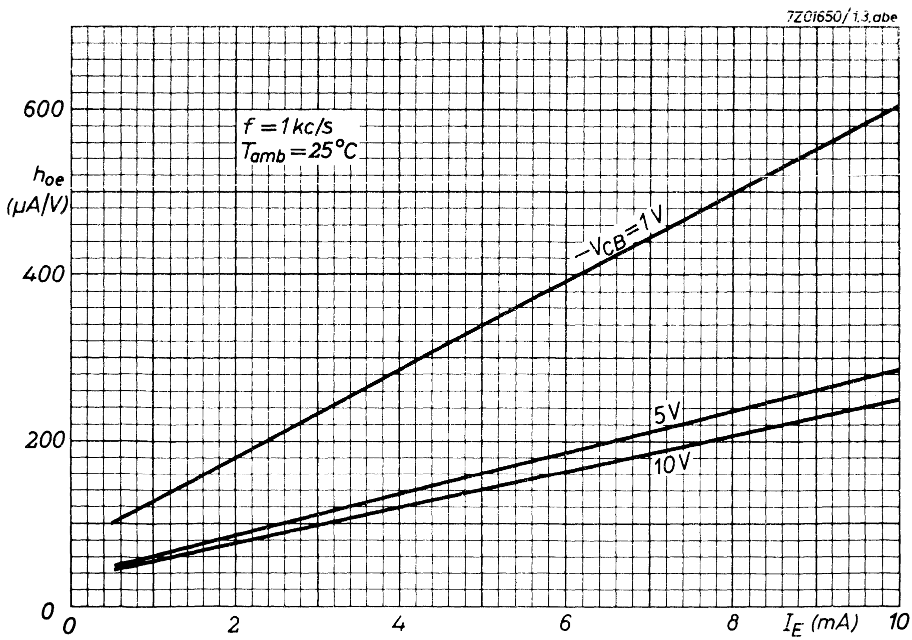

max
typ
min
$-V_{CB}=5V$
$T_{amb}=25°C$
I_E (mA)
10
8
6
4
2
0
0
50
100
150
$-V_{BE}$ (mV)


7Z01653/1.3.abe
6
4
2
0
hie
(kΩ)
f = 1 kc/s
Tamb = 25°C
−VCB = 10 V
5 V
1 V
0
2
4
6
8
IE (mA)
10

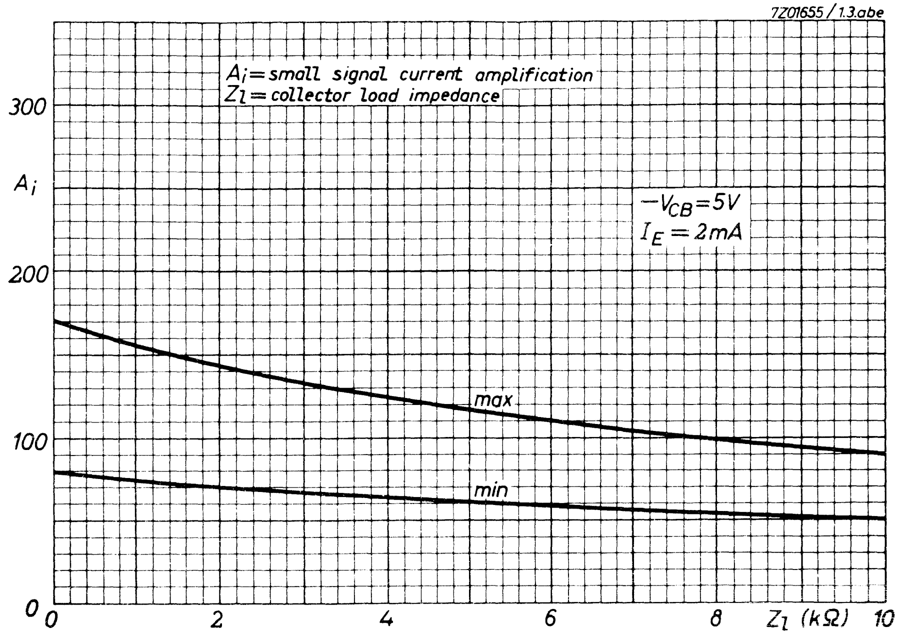

7Z01652/1.3.abe
60
40
20
0
hre.10−4
f = 1 kc/s
Tamb = 25°C
−VCB = 1V
5 V
10 V
0
2
4
6
8
IE (mA)
10

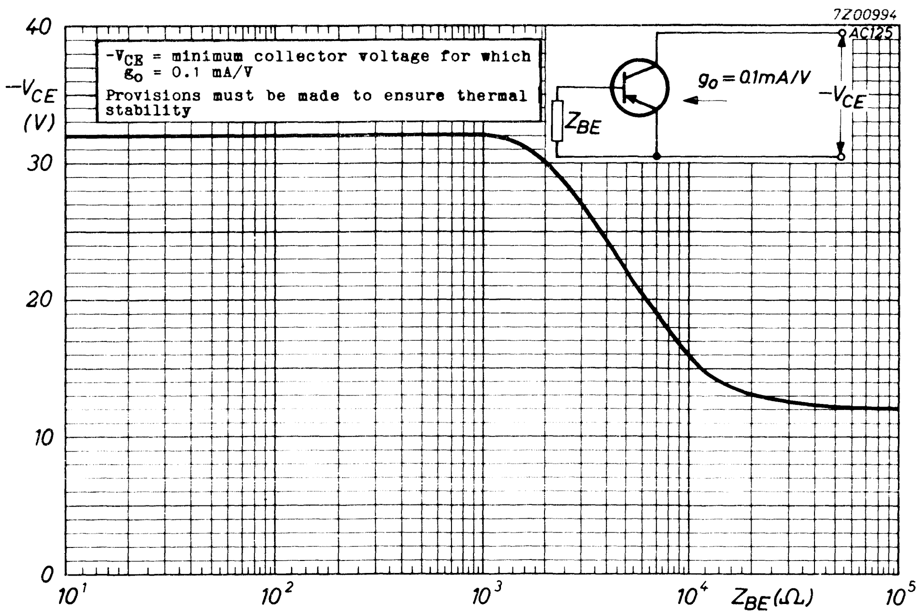

7Z01651/1.3.abe
$-V_{CB}=10V$
5V
1V
150
h_{fe}
100
50
0
$f=1kc/s$
$T_{amb}=25°C$
0
2
4
6
8
I_E (mA)
10

G


7Z01650/1.3.abe
600
h_{oe}
(µA/V)
400
200
0
$f=1kc/s$
$T_{amb}=25°C$
$-V_{CB}=1V$
5V
10V
0
2
4
6
8
I_E (mA)
10

H


7Z01655 / 1.3.abe
A_i = small signal current amplification
Z_l = collector load impedance
$-V_{CB}$ = 5V
I_E = 2mA
300
A_i
200
100
0
max
min
0
2
4
6
8
Z_l (kΩ)
10


7Z00994
AC125
$-V_{CE}$ = minimum collector voltage for which g_o = 0.1 mA/V
Provisions must be made to ensure thermal stability
Z_{BE}
g_o = 0.1mA/V
$-V_{CE}$
40
$-V_{CE}$
(V)
30
20
10
0
10^1
10^2
10^3
10^4
Z_{BE} (Ω)
10^5

GERMANIUM ALLOY JUNCTION TRANSISTOR of the p-n-p type in metal envelope for use in pre-amplifier and driver stages with battery voltages up to 14 V.

LIMITING VALUES (Absolute max. values)

Collector

Voltage (base reference)	$-V_{CB}$	= max.	32 V
Voltage (emitter reference)	$-V_{CE}$	= max.	32 V [1]
Current	$-I_C$	= max.	100 mA

Emitter

Voltage (base reference)	$-V_{EB}$	= max.	10 V

Base

Current	$-I_B$	= max.	5 mA

Dissipation

Total dissipation	P_{tot}	= max.	500 mW

Temperatures

Storage temperature	T_s	=	-55 °C to +90 °C
Junction temperature	T_j	= max.	90 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air	K = max. 0.3 °C/mW
Thermal resistance from junction to ambience with cooling fin mounted on heat sink of at least 12.5 cm^2	K = max. 0.09 °C/mW

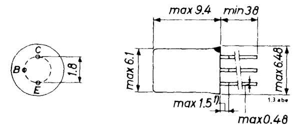
[1]) For recommended practical limits of $-V_{CE}$ see page)

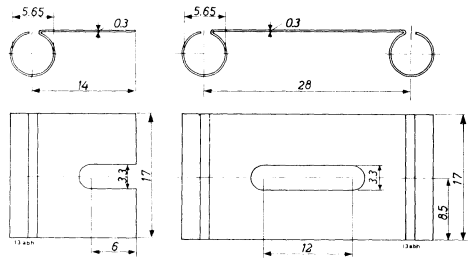
7Z2 3102

1.

Dimensions in mm

The red dot indicates the collector side





Cooling fin 56227

Cooling fin 56226

CHARACTERISTICS at Tamb = 25 °C

Collector current at I_E = 0 mA

$-I_{CBO}$ ($-V_{CB}$ = 10 V; I_E = 0 mA)	<	10 µA

Collector voltage at V_{BE} = 0 V

$-V_{CB}$ ($-I_C$ = 500 µA; V_{BE} = 0 V)	>	32 V

Emitter voltage at I_C = 0 mA

$-V_{EB}$ ($-I_E$ = 200 µA; I_C = 0 mA)	>	10 V

[1]) Not tinned

7Z2 1751

2.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C unless otherwise specified

Collector current at I_E = 0 mA

$-I_{CBO}$		See page D	

Emitter current at I_C = 0 mA

$-I_{EBO}$	$-V_{EB}$ = 5 V; I_C = 0 mA; T_j = 75 °C		< 550 µA

Current amplification factor $\frac{I_C - I_{CBO}}{I_B + I_{CBO}}$

h_{FE}	(I_E = 2 mA; $-V_{CB}$ = 5 V)	= 140	> 65
h_{FE}	(I_E = 50 mA; V_{CB} = 0 V)	= 135	
h_{FE}	(I_E = 100 mA; V_{CB} = 0 V)	= 105	

Base voltage

$-V_{BE}$	(I_E = 2 mA; $-V_{CB}$ = 5 V)	= 105 mV	
$-V_{BE}$	(I_E = 100 mA; V_{CB} = 0 V)		< 400 mV

Frequency at which $|h_{fe}|$ = 1

f_1	($-V_{CB}$ = 2 V; I_E = 10 mA)	= 2.3 Mc/s	> 1.7 Mc/s

Cut-off frequency

$f_{\alpha e}$	($-V_{CB}$ = 2 V; I_E = 10 mA)	= 17 kc/s	> 10 kc/s

Base resistance

$\|z_{rb}\|$	$-V_{CB}$ = 5 V; I_E = 1 mA; f = 0.45 Mc/s	= 90 Ω	

Collector capacitance

c_c	$-V_{CB}$ = 5 V; I_E = 0 mA; f = 0.45 Mc/s	= 40 pF	< 50 pF

Noise figure

F	$-V_{CB}$ = 5 V; I_E = 0.5 mA; f = 1 kc/s; B = 200 c/s; Input source resistance = 500 Ω	= 4 dB	< 10 dB

7Z2 1804

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued)

T_{amb} = 25 °C

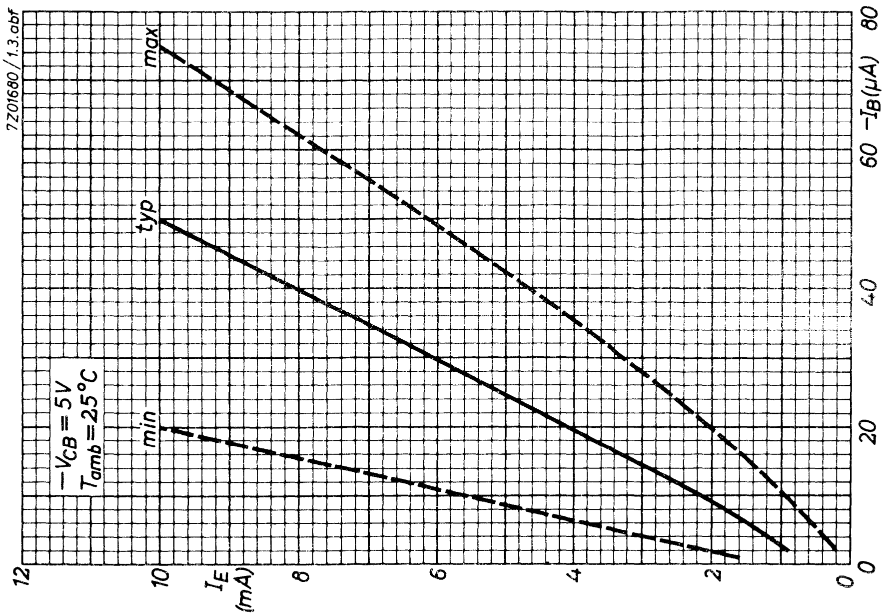
Small signal parameters

Measured at

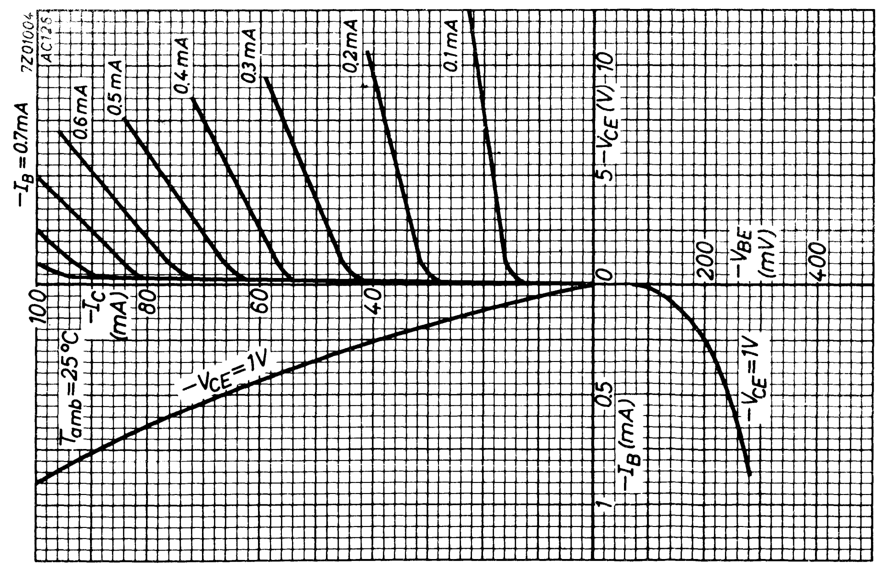
Collector voltage	$-V_{CB}$ = 5 V	
Emitter current	I_E = 2 mA	
Frequency	f = 1 kc/s	
Input impedance	h_{ie} = 2.4 kΩ	> 1.7 kΩ < 3.8 kΩ
Voltage feedback ratio	h_{re} = 8×10^{-4}	< 13×10^{-4}
Current amplification factor	h_{fe} = 180	> 130 < 300
Output admittance	h_{oe} = 100 µA/V	< 170 µA/V

7Z2 1174

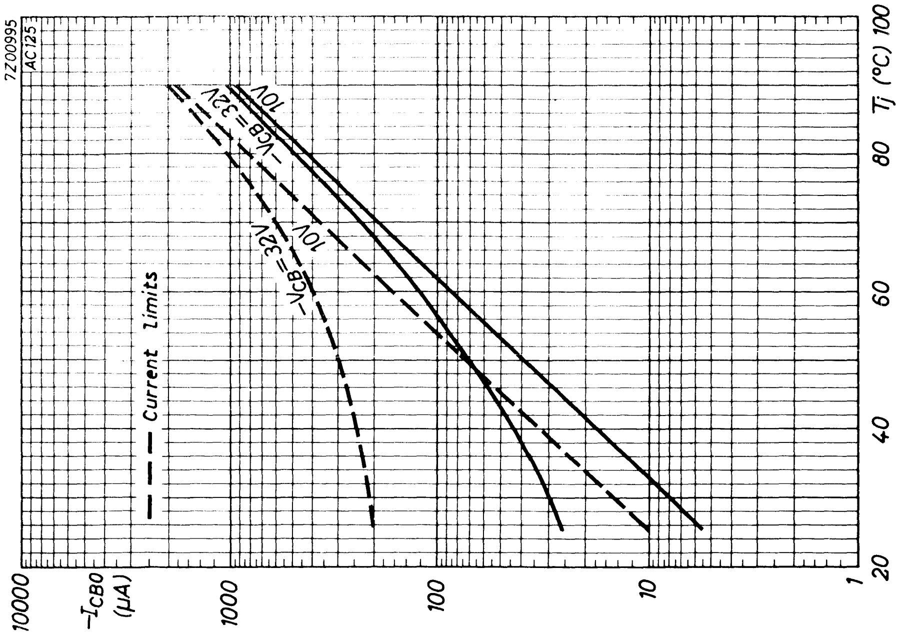
B


7Z01680/1.3.abf
$-V_{CB} = 5V$
$T_{amb} = 25°C$
max
typ
min
I_E (mA)
$-I_B$ (μA)
0
20
40
60
80
0
2
4
6
8
10
12

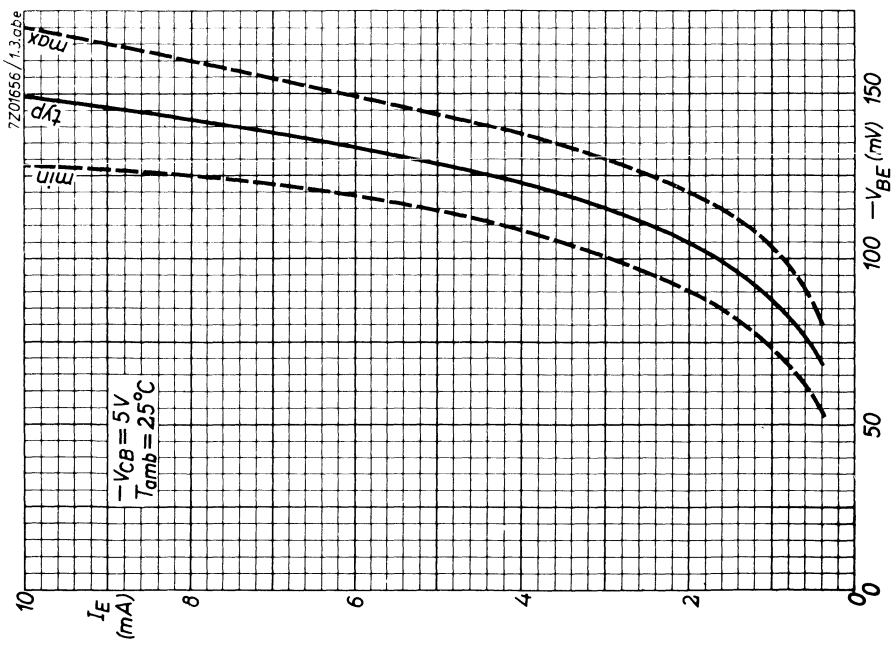
A

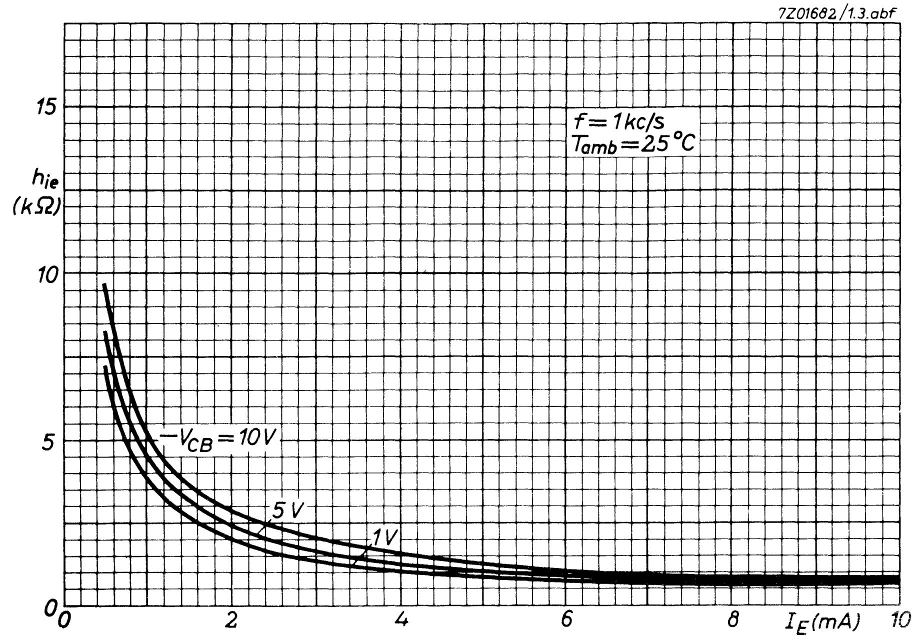

7Z01004
AC125
$-I_B = 0.7mA$
0.6mA
0.5mA
0.4mA
0.3mA
0.2mA
0.1mA
$-I_C$ (mA)
$-V_{CE}$ (V)
$-V_{BE}$ (mV)
$-I_B$ (mA)
$T_{amb} = 25°C$
$-V_{CE} = 1V$
$-V_{CE} = 1V$
100
80
60
40
0
5
10
200
400
0.5
1

D

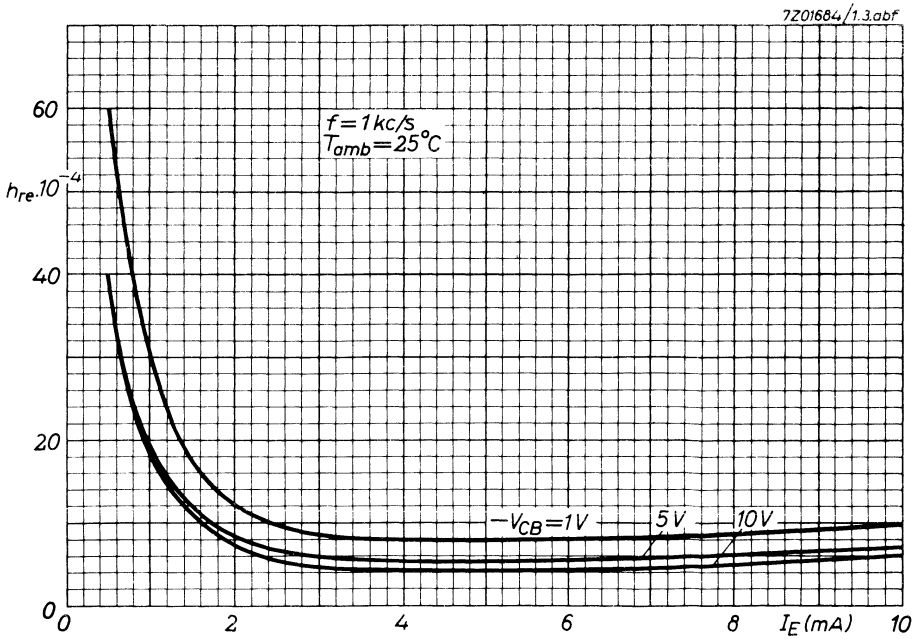

7Z00995
AC125
$-I_{CBO}$ (μA)
10000
1000
100
10
1
20
40
60
80
100
Tj (°C)
$-V_{CB}$ = 32V
10V
Current limits

C

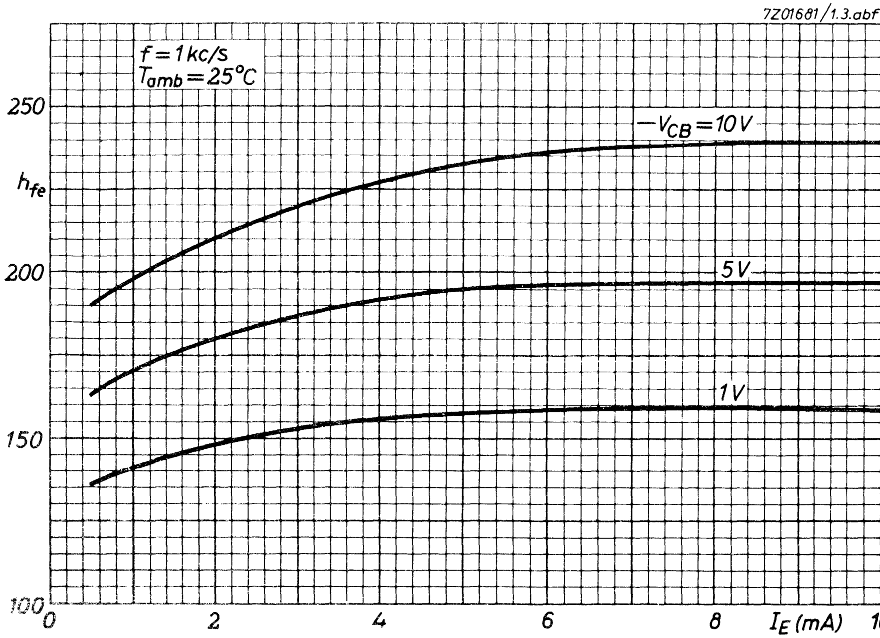

7Z01656/1.3.abe
I_E (mA)
10
8
6
4
2
0
0
50
100
150
$-V_{BE}$ (mV)
max
typ
min
$-V_{CB}$ = 5 V
T_{amb} = 25°C


7Z01682/1.3.abf
f = 1kc/s
T_{amb} = 25 °C
h_{ie} (kΩ)
15
10
5
0
$-V_{CB}$ = 10 V
5 V
1 V
0
2
4
6
8
I_E (mA)
10

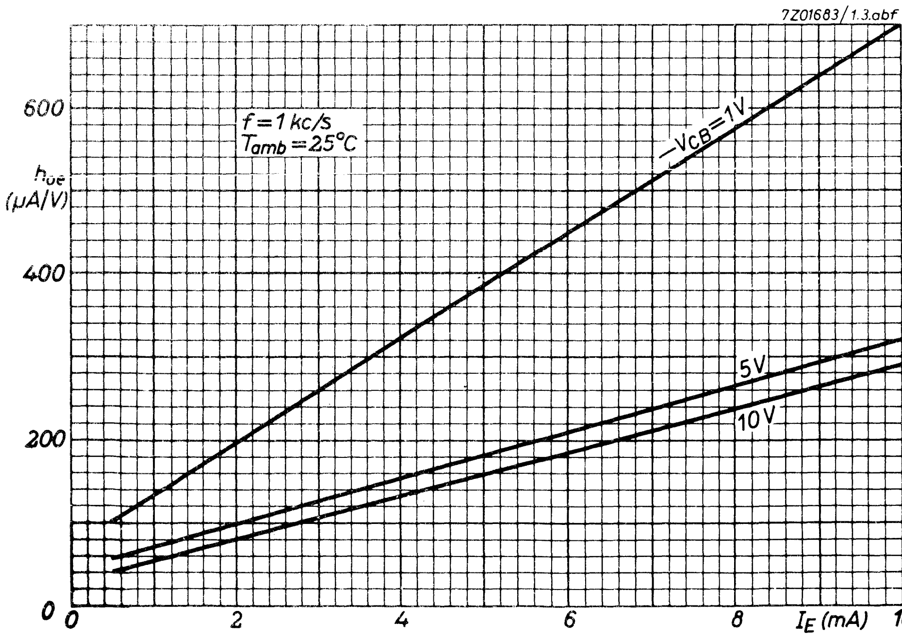
E


7Z01684/1.3.abf
f = 1kc/s
T_{amb} = 25 °C
$h_{re}.10^{-4}$
60
40
20
0
$-V_{CB}$ = 1 V
5 V
10 V
0
2
4
6
8
I_E (mA)
10

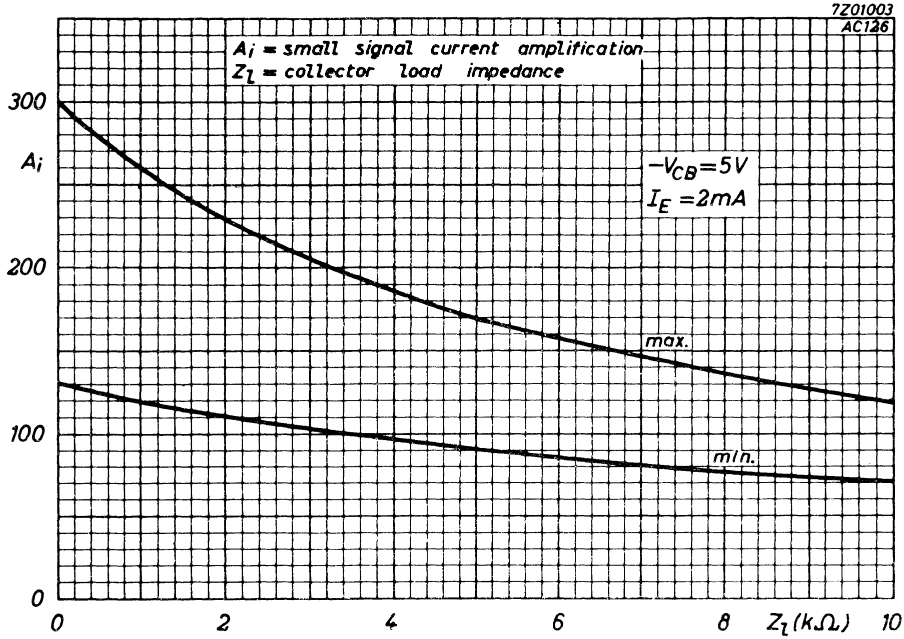
F

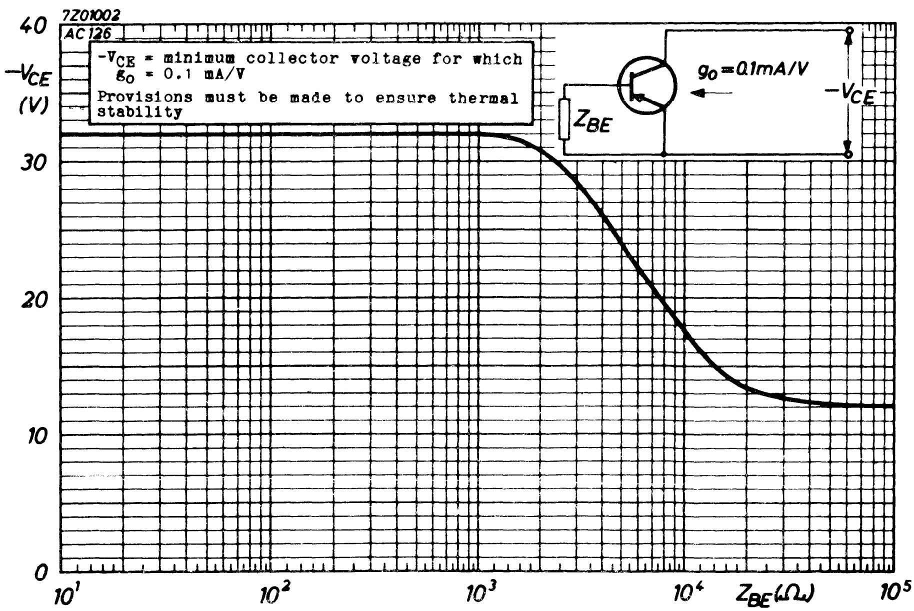

7Z01681/1.3.abf
f = 1 kc/s
T_amb = 25°C
250
h_fe
200
150
100
0
2
4
6
8
I_E (mA)
10
−V_CB = 10 V
5 V
1 V

G


7Z01683/1.3.abf
f = 1 kc/s
T_amb = 25°C
600
h_oe
(μA/V)
400
200
0
0
2
4
6
8
I_E (mA)
10
−V_CB = 1 V
5 V
10 V

H


7Z01003
AC126
A_i = small signal current amplification
Z_l = collector load impedance
$-V_{CB}$=5V
I_E =2mA
max.
min.
300
A_i
200
100
0
0
2
4
6
8
Z_l (kΩ)
10


7Z01002
AC 126
$-V_{CE}$ = minimum collector voltage for which g_o = 0.1 mA/V
Provisions must be made to ensure thermal stability
g_o=0.1mA/V
Z_{BE}
$-V_{CE}$
40
$-V_{CE}$ (V)
30
20
10
0
10^1
10^2
10^3
10^4
Z_{BE}(Ω)
10^5

HIGH GAIN GERMANIUM N-P-N TRANSISTOR

Germanium alloy junction transistor of the n-p-n type in metal case with high gain primarily intended for operation in complementary symmetrical class B output stages in combination with type AC128 or AC132.

LIMITING VALUES (Absolute max. values)

Collector			
Voltage (base reference)	V_{CB}	= max.	32 V
Voltage (emitter reference)	V_{CE}	= max.	32 V [1])
Current	I_C	= max.	500 mA
Emitter			
Voltage (base reference)	V_{EB}	= max.	10 V
Base			
Current	I_B	= max.	25 mA
Dissipation			
Total dissipation	P_{tot}	= max.	340 mW
Temperatures			
Storage temperature	T_s	=	−55 °C to +90 °C
Junction temperature			
continuous	T_j	= max.	90 °C
incidentally (max. 200 hrs)	T_j	= max.	100 °C

1) See page G

7Z2 3049

THERMAL DATA

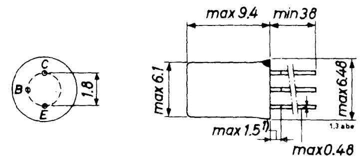
Thermal resistance from

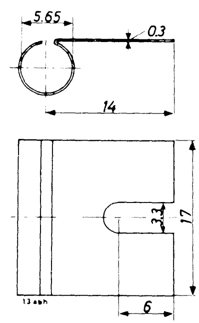
junction to case	K = max. 0.11 °C/mW
junction to ambience in free air	K = max. 0.37 °C/mW
junction to ambience with cooling fin mounted on a heatsink of at least 12.5 cm^2	K = max. 0.16 °C/mW

MECHANICAL DATA

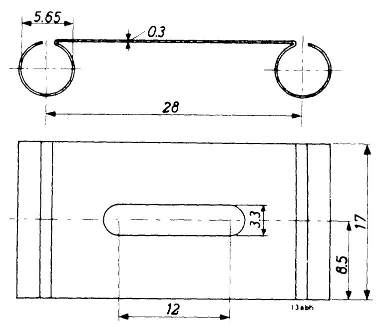
The blue dot indicates the collector

Dimensions in mm





Cooling fin 56227



Cooling fin 56226

1) Not tinned

7Z2 2310

CHARACTERISTICS at T_{amb} = 25 °C

Collector current at $I_E = 0$			
V_{CB} = 0.5 V	I_{CBO}	<	10 μA
Collector voltage at $V_{BE} = 0$			
I_C = 500 μA	V_{CB}	>	32 V
Emitter voltage at $I_C = 0$			
I_E = 200 μA	V_{EB}	>	10 V

Characteristics of matched pairs AC127/AC128

Ratio of D.C. current amplification factors			
$\lvert I_E\rvert$ = 300 mA; V_{CB} = 0	h_{FE1}/h_{FE2}	=	1.1

Characteristics of matched pairs AC127/AC132

Ratio of D.C. current amplification factors			
$\lvert I_E\rvert$ = 50 mA; V_{CB} = 0	h_{FE1}/h_{FE2}	= <	1.1 1.25

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN T_{amb} = 25 °C, unless otherwise specified

Collector current at $I_E = 0$	I_{CBO}	See page 10	
Emitter current at $I_C = 0$			
V_{EB} = 5 V; T_j = 75 °C	I_{EBO}	<	550 μA
Large signal current amplification factor [1])			
$-I_E$ = 20 mA; V_{CB} = 0	h_{fel}	=	100
$-I_E$ = 50 mA; V_{CB} = 0	h_{fel}	=	105
$-I_E$ = 200 mA; V_{CB} = 0	h_{fel}	=	90
$-I_E$ = 500 mA; V_{CB} = 0	h_{fel}	=	50

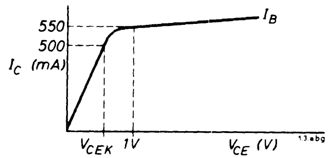
---

[1]) $h_{fel} = \frac{I_C - I_{CBO}}{I_B + I_{CBO}}$ for V_{CE} = constant.

7Z2 2311

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_{amb} = 25 °C

Base voltage. See also page 11			
V_{CB} = 5 V; $-I_E$ = 2 mA	V_{BE} = 120 mV		
V_{CB} = 0 V; $-I_E$ = 500 mA	V_{BE}		< 1.2 V
Collector knee voltage at I_C = 500 mA			
	I_B = value at which I_C = 550 mA and V_{CE} = 1 V		

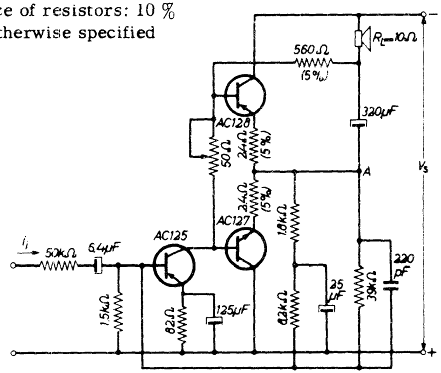


	V_{CEK}		< 1 V
Frequency at which $\lvert h_{fe}\rvert = 1$			
V_{CB} = 2 V; $-I_E$ = 10 mA	f_1	= 2.5 Mc/s	> 1.5 Mc/s
Cut-off frequency			
V_{CB} = 2 V; $-I_E$ = 10 mA	$f_{\alpha e}$	= 20 kc/s	> 10 kc/s
Base impedance at f = 0.45 Mc/s			
V_{CB} = 5 V; $-I_E$ = 1 mA	$\lvert z_{rb}\rvert$	= 70 Ω	
Collector capacitance			
V_{CB} = 5 V; I_E = 0; f = 0.45 Mc/s	c_c	= 70 pF	
Noise figure at f = 1 kc/s			
V_{CB} = 5 V; $-I_E$ = 0.5 mA			
B = 200 c/s; Input source resistance = 500 Ω	F	= 4 dB	< 10 dB

7Z2 2312

OPERATING CHARACTERISTICS OF A MATCHED PAIR AC127/AC128 as class B complementary symmetrical amplifier with an output power of 550 mW.

Tolerance of resistors: 10 %
unless otherwise specified



7Z2 2321

Stable continuous operation is ensured up to an ambient temperature of 45 °C provided each transistor is mounted with a cooling fin (code No. 56226)

Figures apply for T_{amb} = 25 °C

Supply voltage	V_S	= 9 V	
Output power (d_{tot} = 10%)	P_o	= 550 mW	> 500 mW
Distortion	d_{tot}	= see curve page 6	

Output stage

Zero signal emitter current	$\lvert I_E \rvert$	= 3 mA
Peak collector current	$\lvert I_{CM} \rvert$	= 300 mA
Midtap voltage on point A	V_A	= 4.9 V

Driver stage

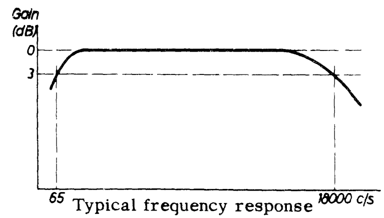
Collector current	$-I_C$	= 7 mA

OPERATING CHARACTERISTICS OF A MATCHED PAIR AC127/AC128 as class B complementary symmetrical amplifier with an output power of 550 mW (continued)

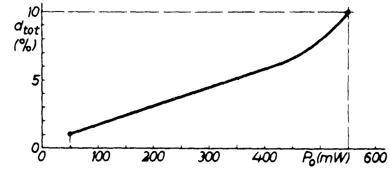
Sensitivity

Input current (R.M.S. value)

P_o = 550 mW	I_i = 120 µA
P_o = 50 mW	I_i = 35 µA



Typical frequency response

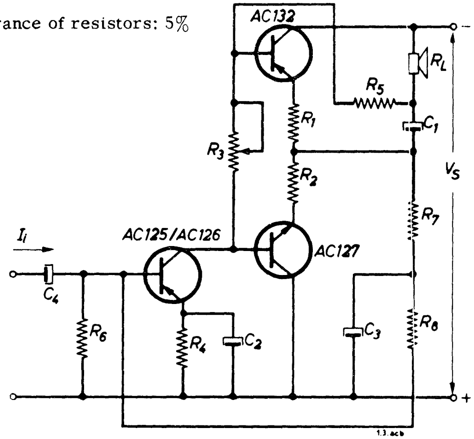


Typical distortion as a function of output power

7Z2 2322

OPERATING CHARACTERISTICS OF A MATCHED PAIR AC127/AC132 as class B complementary symmetrical amplifier with an output power of 370 mW

Tolerance of resistors: 5%



Stable continuous operation is ensured up to T_{amb} = 45 °C

For the 370 mW circuit each transistor should be mounted with a cooling fin.

For tables see next page

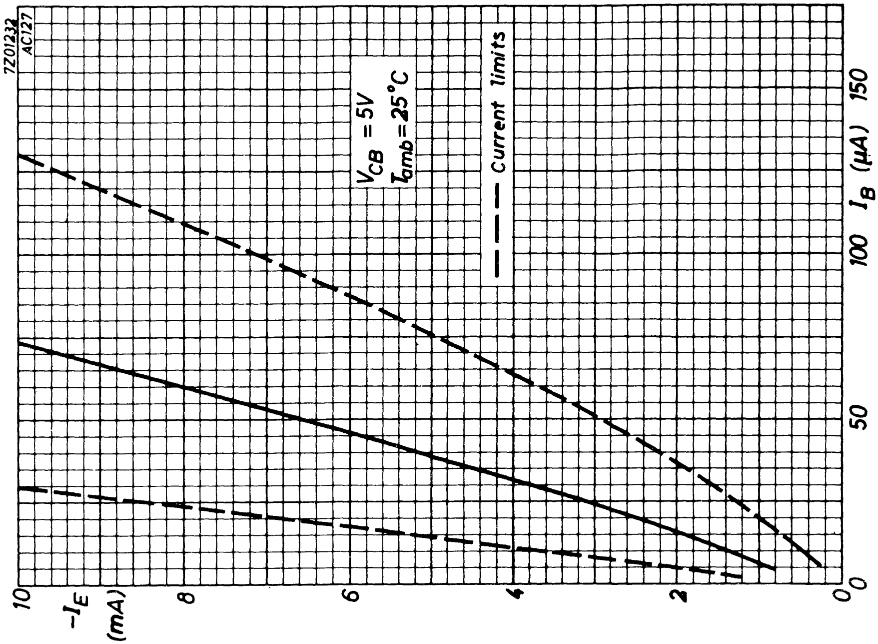
7Z2 2323

OPERATING CHARACTERISTICS OF A MATCHED PAIR AC127/AC132 (continued)

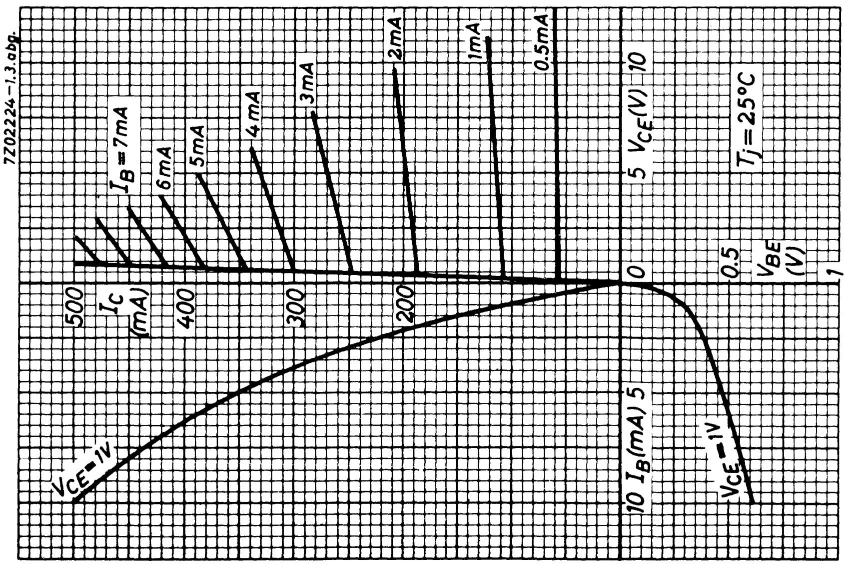
			I	II	III
Supply voltage	V_S	=	6	9	9 V
Power output (at d = 10%)	P_o	=	115	110	370 mW
	P_o	= min.	105	100	300 mW
Distortion	d	=	See page 9		
Output stage					
Zero signal emitter current	I_{E1}	=	2	2	2 mA
	$-I_{E2}$	=	2	2	2 mA
Emitter resistors	R_1	=	3.3	4.7	3.9 Ω
	R_2	=	3.3	4.7	3.9 Ω
Bias resistor	R_3	= max.	100	250	50 Ω
Coupling capacitor	C_1	=	200	64	320 μF
Load resistance	R_L	=	25	70	15 Ω
Peak collector current at P_o = max.	$\|I_{CM}\|$	=	90	50	200 mA
Driver stage					
Collector current	$-I_C$	=	2.7	1.2	7.6 mA
Emitter resistor	R_4	=	180	680	82 Ω
Collector resistor	R_5	=	910	3300	510 Ω
Bias resistors	R_6	=	4.7	6.8	1.8 kΩ
	R_7	=	3.9	4.7	2.2 kΩ
	R_8	=	15	24	6.8 kΩ
Decoupling capacitors	C_2	=	40	25	120 μF
	C_3	=	25	25	25 μF
Coupling capacitor	C_4	=	6.4	6.4	6.4 μF
Input current at P_o = max. (RMS value)					
with AC125	I_i	=	20	10	55 μA
with AC126	I_i	=	15	8	40 μA
Input current at P_o = 50 mW (RMS value)					
with AC125	I_i	=	11.5	6	17 μA
with AC126	I_i	=	9	4.5	12.5 μA
Total harmonic distortion at P_o = 50 mW	d_{tot}	=	2.5	3.8	2.0 %

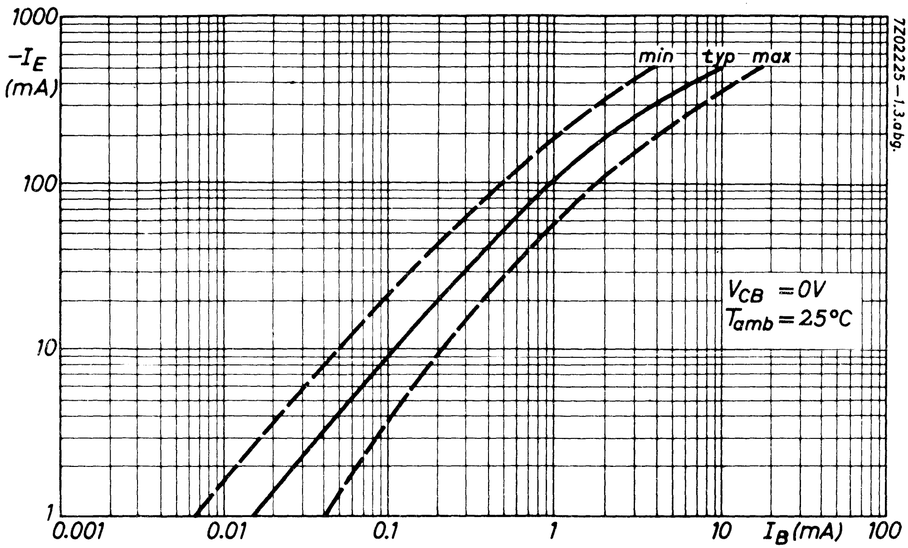
7Z2 2324

B

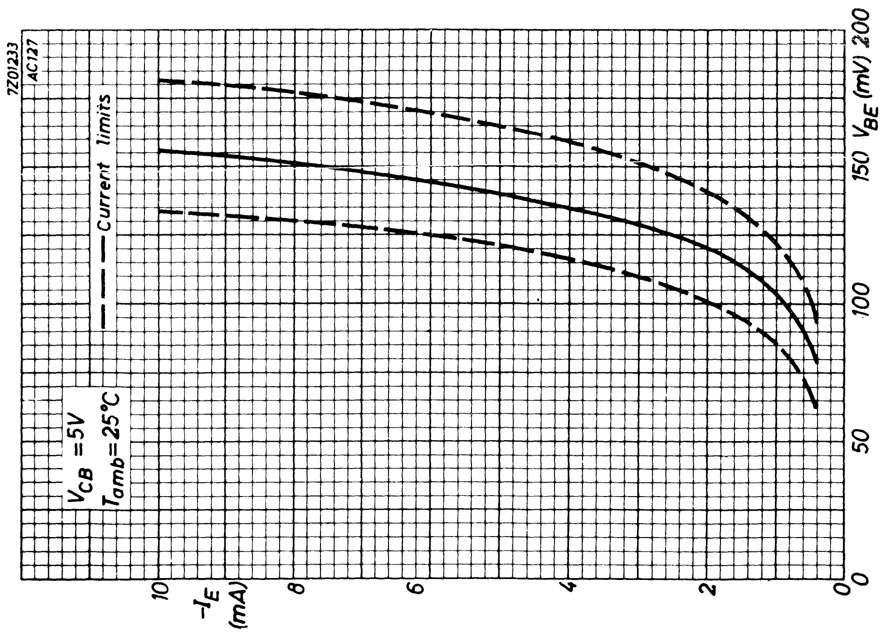

7Z01232
AC127
V_{CB} = 5V
T_{amb}=25°C
Current limits
I_B (μA)
0
50
100
150
$-I_E$
(mA)
0
2
4
6
8
10

A

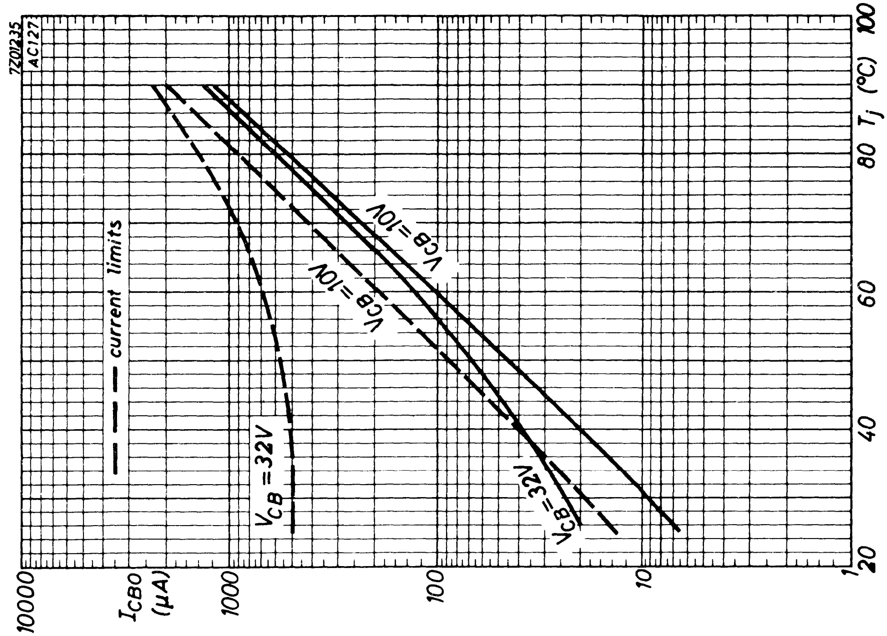

7Z02224-1.3.abg.
I_B=7mA
6mA
5mA
4mA
3mA
2mA
1mA
0.5mA
T_j=25°C
I_C
(mA)
500
400
300
200
0
5 V_{CE}(V) 10
0.5
V_{BE}
(V)
1
10 I_B(mA) 5
V_{CE}=1V
V_{CE}=1V


1000
$-I_E$
(mA)
100
10
1
0.001
0.01
0.1
1
10
I_B(mA)
100
min
typ
max
V_{CB} = 0V
T_{amb} = 25°C
7Z02225-1.3.abg.

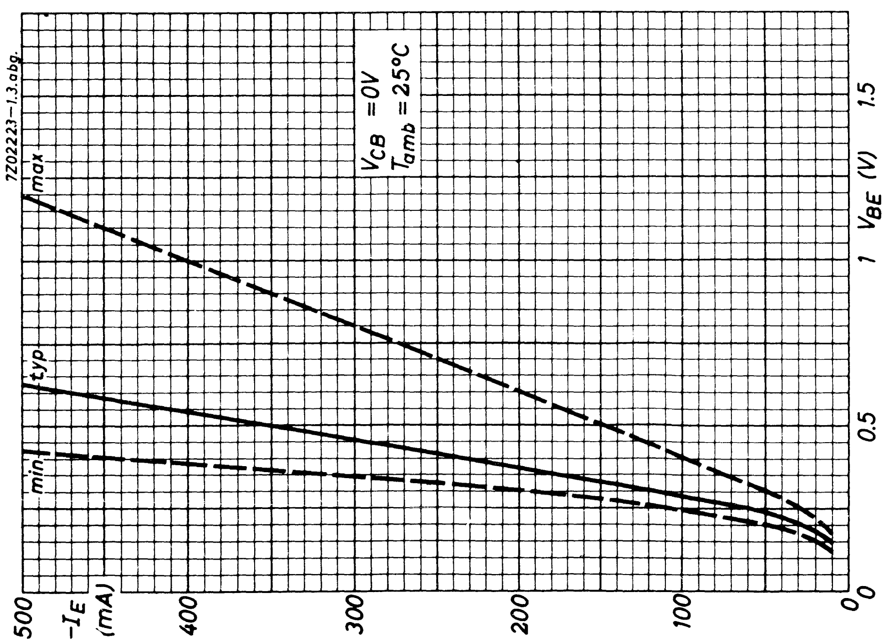
D


7Z01233
AC127
Current limits
V_{CB} = 5V
T_{amb} = 25°C
10
$-I_E$
(mA)
8
6
4
2
0
0
50
100
150
200
V_{BE} (mV)

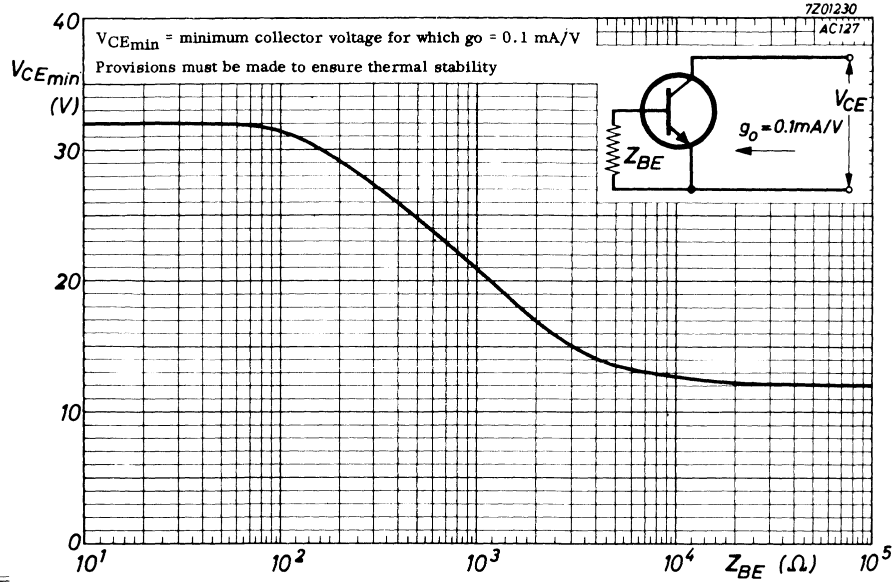
C


7Z01235
AC127
current limits
VCB = 10V
VCB = 10V
VCB = 32V
VCB = 32V
Tj (°C)
20
40
60
80
100
ICBO (μA)
10000
1000
100
10
1

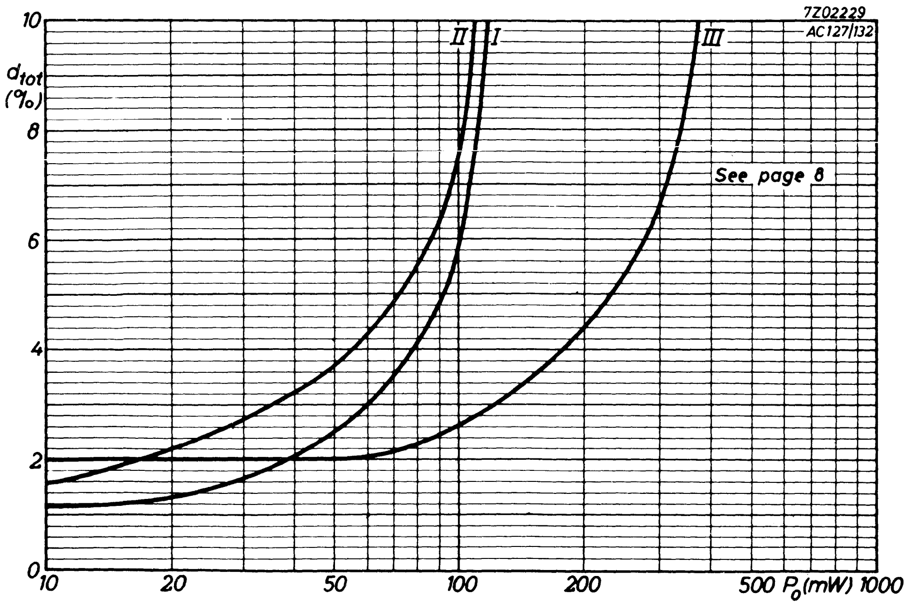
F


7Z02223-1.3.abg.
max
typ
min
VCB = 0V
Tamb = 25°C
VBE (V)
0
0.5
1
1.5
-IE (mA)
500
400
300
200
100
0

E


7Z01230
AC127
V_{CEmin} = minimum collector voltage for which go = 0.1 mA/V
Provisions must be made to ensure thermal stability
V_{CEmin}
(V)
Z_{BE}
V_{CE}
g_o = 0.1mA/V
Z_{BE} (Ω)
40
30
20
10
0
10^1
10^2
10^3
10^4
10^5

G


7Z02229
AC127/132
d_{tot}
(%)
II
I
III
See page 8
10
8
6
4
2
0
10
20
50
100
200
500 P_o(mW) 1000

H

HIGH GAIN GERMANIUM P-N-P TRANSISTOR

Germanium alloy junction transistor of the p-n-p type in metal case with high gain for use in class A and class B output stages with battery voltages up to 14 volts and a power output up to 4 watts.

Type 2-AC128 consists of 2 transistors AC128 that are matched for operation in a low distortion class B amplifier.

LIMITING VALUES (Absolute max. values)

Collector				
Voltage (base reference)	$-V_{CB}$	= max.	32	V
Voltage (emitter reference)	$-V_{CE}$	= max.	32	V [1]
Current	$-I_C$	= max.	1	A
	$-I_{CM}$	= max.	2	A
Emitter				
Voltage (base reference)	$-V_{EB}$	= max.	10	V
Base				
Current	$-I_B$	= max.	40	mA
Dissipation				
Total dissipation	P_{tot}	= max.	1000	mW
Temperatures				
Storage temperature	T_s	=	-55 to +100	°C
Junction temperature continuous	T_j	= max.	90	°C
incidentally	T_j	= max.	100	°C

[1]) See page H.

7Z2 3970

THERMAL DATA

Thermal resistance from

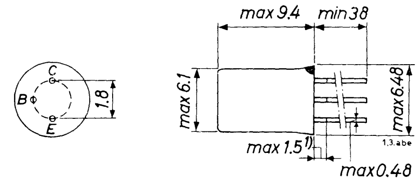
junction to case	K	= max. 0.04	°C/mW
junction to ambience in free air	K	= max. 0.29	°C/mW
junction to ambience with cooling fin in free air	K	= max. 0.14	°C/mW
junction to ambience with cooling fin mounted on a heatsink of at least 12.5 cm^2	K	= max. 0.08	°C/mW

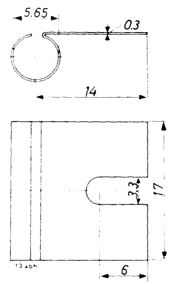
MECHANICAL DATA

The red dot indicates the collector

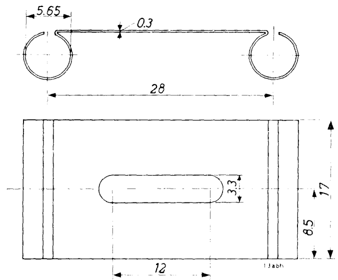
Dimensions in mm

[1]) Not tinned





Cooling fin 56227



Cooling fin 56226

7Z2 2327

CHARACTERISTICS at T_{amb} = 25 °C

Collector current at I_E = 0			
$-V_{CB}$ = 10 V	$-I_{CBO}$	<	10 μA
Collector voltage at I_E = 0			
$-I_C$ = 200 μA	$-V_{CB}$	>	32 V
Emitter voltage at I_C = 0			
$-I_E$ = 200 μA	$-V_{EB}$	>	10 V
Base voltage at V_{CB} = 0			
I_E = 50 mA	$-V_{BE}$	<	300 mV
I_E = 300 mA	$-V_{BE}$	<	450 mV

Characteristics of matched pairs 2-AC128

Ratio of D.C. current amplification factors

I_E = 50 mA; V_{CB} = 0	h_{FE1}/h_{FE2}	= 1.1	< 1.25
I_E = 300 mA; V_{CB} = 0	h_{FE1}/h_{FE2}	= 1.1	< 1.25

Characteristics of matched pairs AC127/AC128

Ratio of D.C. current amplification factors

$\lvert I_E \rvert$ = 300 mA; V_{CB} = 0	h_{FE1}/h_{FE2}	= 1.1

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

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

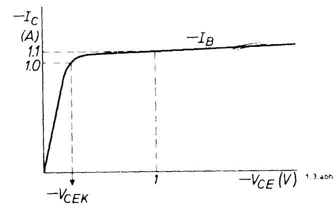
Emitter current at I_C = 0			
$-V_{EB}$ = 5 V; T_j = 75 °C	$-I_{EBO}$		< 500 μA
D.C. current amplification factor			
I_E = 50 mA; V_{CB} = 0	h_{FE}	= 90	> 55 < 175
I_E = 300 mA; V_{CB} = 0	h_{FE}	= 90	> 60 < 175
I_E = 1 A; V_{CB} = 0	h_{FE}	= 80	> 45 < 165

7Z2 2328

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued)

T_{amb} = 25 °C

Collector knee voltage at $-I_C$ = 1 A			
$-I_B$ = value at which $-I_C$ = 1.1 A			
and $-V_{CE}$ = 1 V	$-V_{CEK}$		< 0.6 V



Frequency at which $\lvert h_{fe} \rvert$ = 1			
$-V_{CB}$ = 2 V; I_E = 10 mA	f_1	= 1.5 Mc/s	> 1.0 Mc/s
Cut-off frequency			
$-V_{CB}$ = 2 V; I_E = 10 mA	$f_{\alpha e}$	= 15 kc/s	> 10 kc/s
Base resistance			
$-V_{CB}$ = 5 V; I_E = 1 mA	$r_{bb'}$	= 25 Ω	
Collector capacitance			
$-V_{CB}$ = 5 V; I_E = 0	c_c	= 100 pF	
Current gain linearity (see curve B, page 9)	λ_{500}	= 0.60	> 0.50 [1]

[1] $\lambda_{500} = \frac{A_i \text{ at } 500 \text{ mA}}{A_i \text{ max.}}$, where A_i = loaded small-signal current amplification.

7Z2 2329

OPERATING CHARACTERISTICS OF A MATCHED PAIR 2-AC128 as class B output amplifier

For circuit diagram see page 6

V_S	=	6	9	9 V
T_{amb}	=	max. 55	max. 55	max. 45 °C
I_E (V_i = 0)	=	2 x 3	2 x 3	2 x 3 mA
R_1 [1]	=	2.0	2.2	3.5 [2] kΩ
R_2 [1]	=	47	39	[3] Ω
R_E	=	2.2	3.9	1.5 Ω
R_p	=	1.5	1.5	1.0 kΩ
R_{cc}	=	65	98	62 Ω
P_c max. [4]	=	2 x 0.425	2 x 0.65	2 x 1.05 W
P_o max. [5]	=	0.75	1.1	1.9 W
$-I_{CM}$ (P_o = max.)	=	300	300	500 mA
$-I_C$ (P_o = max.)	=	2 x 95	2 x 95	2 x 150 mA
V_{im} (P_o = max.)	=	5.5	6.0	6.6 V [6]
d_{tot} (P_o = max.)	=	3.5	4.0	5.5 %
V_{im} (P_o = 50 mW)	=	1.6	1.4	1.1 V [6]
d_{tot} (P_o = 50 mW)	=	2.0	2.0	2.5 %

[1]) Tolerance of bias resistors: 5 %

[2]) Variable resistor

[3]) This resistance is composed of a 68 Ω resistor in parallel with a 130 Ω NTC resistor (code No. E201 BC/A 130E)

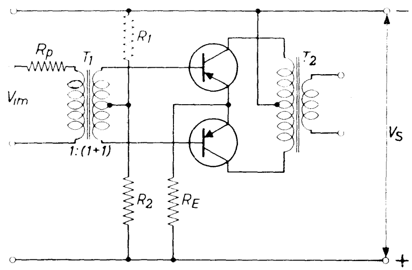
[4]) Output power of two transistors

[5]) Power delivered to the primary of the output transformer

[6]) Losses in the driver transformer are not taken into account

7Z2 2330

OPERATING CHARACTERISTICS OF A MATCHED PAIR 2-AC128 as class B output amplifier (continued)

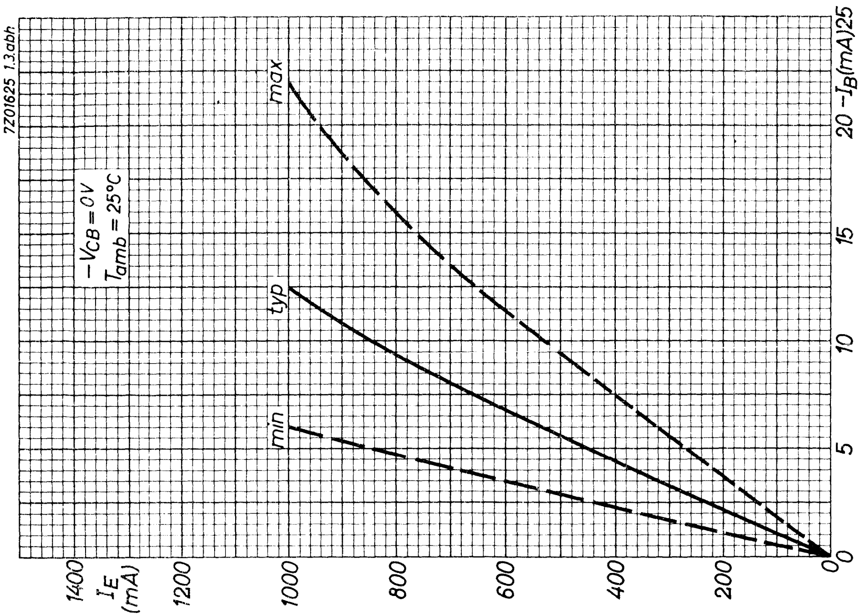


To provide stability the total resistance in the base circuit of each transistor is less than 100 Ω.

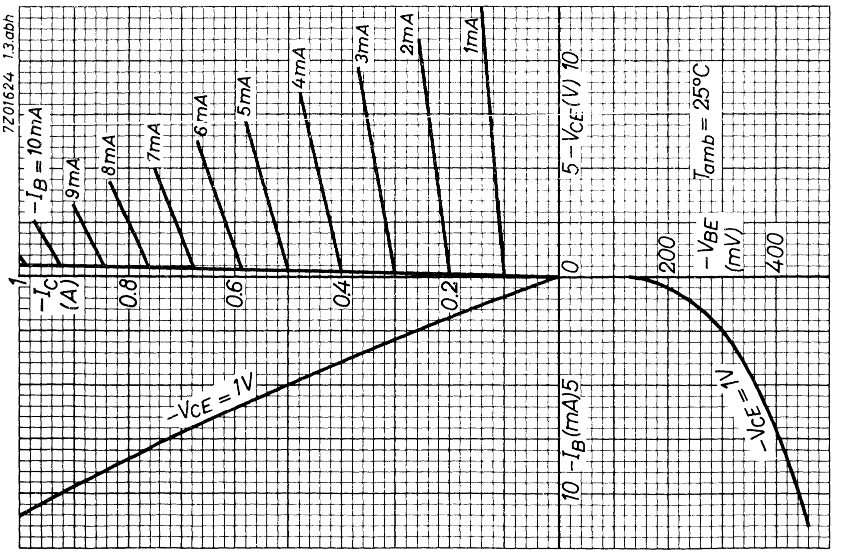
The data on page 5 are valid for continuous operation up to the ambient temperatures specified in the tables. Then the junction temperature will not exceed 90 °C (K = 0.09 °C/mW)

R_p = input source resistance.

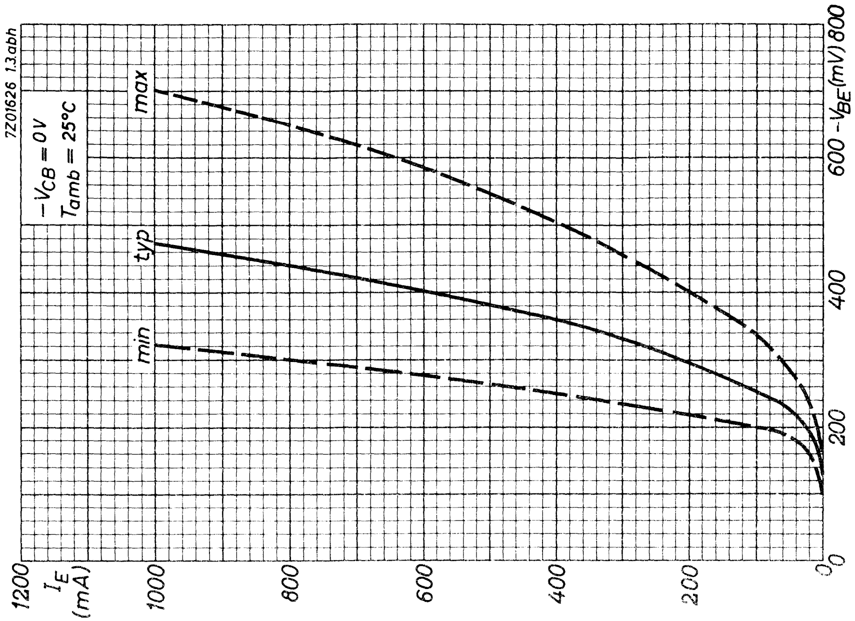
7Z2 2331


7Z01625 1.3.abh
$-V_{CB} = 0V$
$T_{amb} = 25°C$
max
typ
min
$-I_B$ (mA)
0
5
10
15
20
25
I_E (mA)
0
200
400
600
800
1000
1200
1400

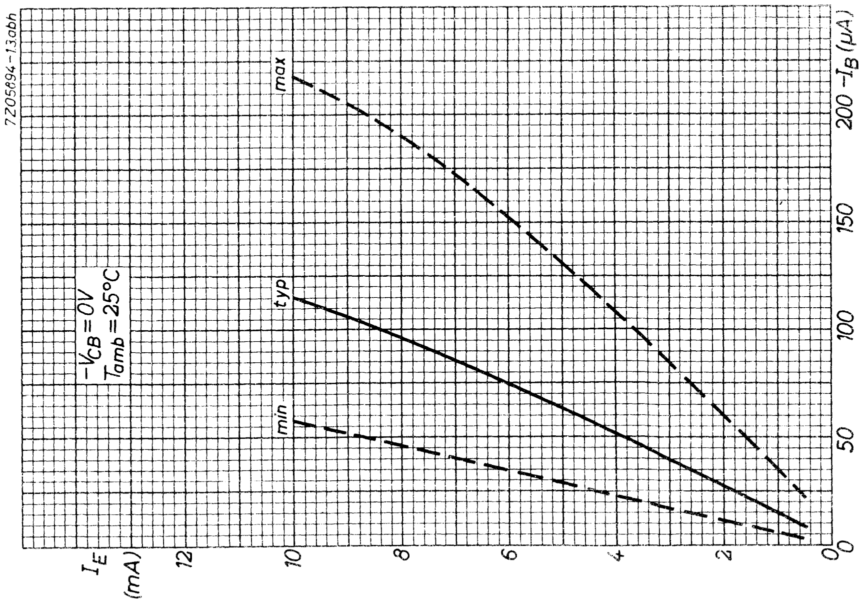
B


7Z01624 1.3.abh
$-I_B = 10mA$
9mA
8mA
7mA
6mA
5mA
4mA
3mA
2mA
1mA
$-V_{CE}$ (V)
0
5
10
$T_{amb} = 25°C$
$-I_C$ (A)
1
0.8
0.6
0.4
0.2
$-V_{CE} = 1V$
$-I_B$ (mA)
5
10
$-V_{BE}$ (mV)
200
400
$-V_{CE} = 1V$

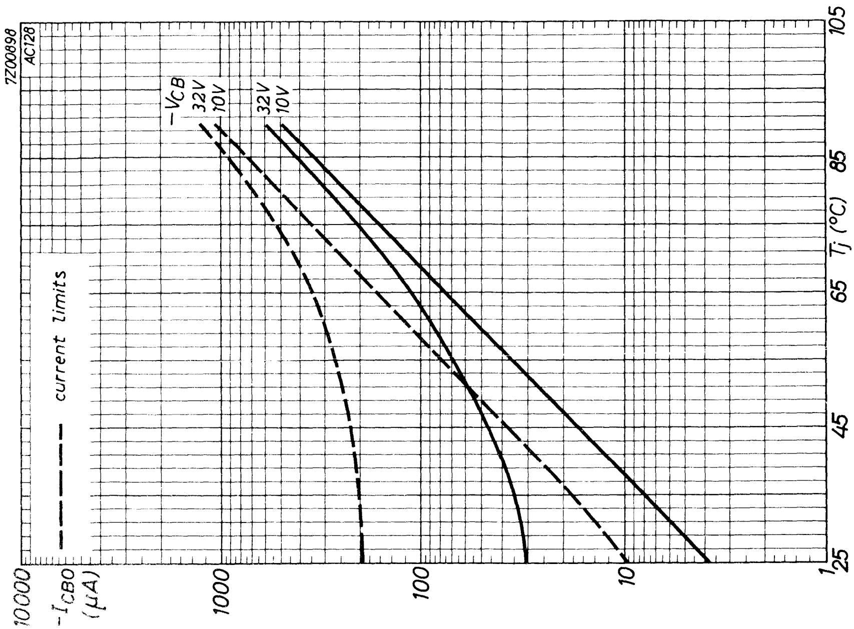
A


7Z01626 1.3.abh
$-V_{CB} = 0V$
$T_{amb} = 25°C$
max
typ
min
I_E (mA)
1200
1000
800
600
400
200
0
0
200
400
600
$-V_{BE}$(mV)
800

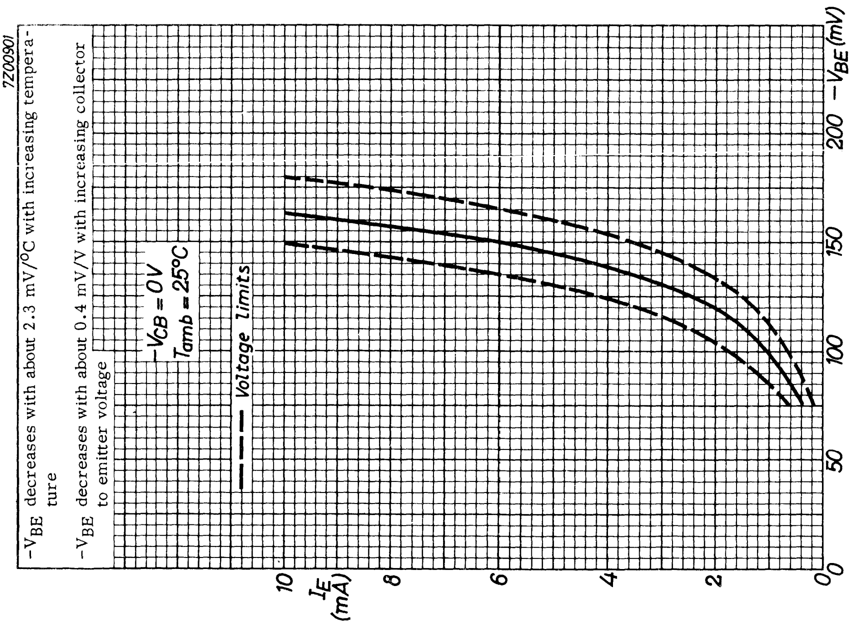
D


7Z05894-1.3.abh
$-V_{CB}=0V$
$T_{amb}=25°C$
max
typ
min
I_E (mA)
12
10
8
6
4
2
0
0
50
100
150
200
$-I_B$ (μA)

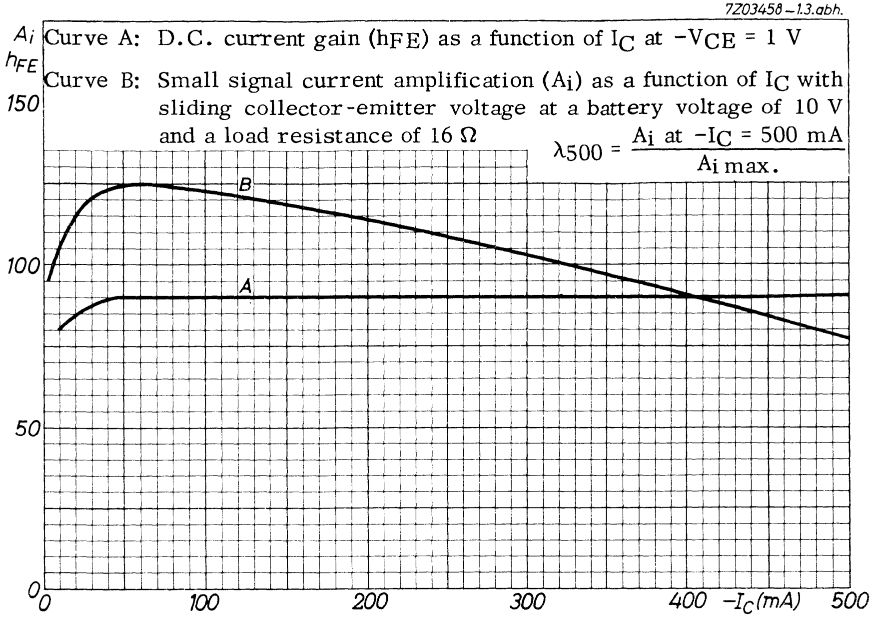
C


7Z00898
AC128
$-V_{CB}$
32V
10V
32V
10V
current limits
105
85
T_j (°C)
65
45
25
10000
$-I_{CBO}$ (μA)
1000
100
10
1

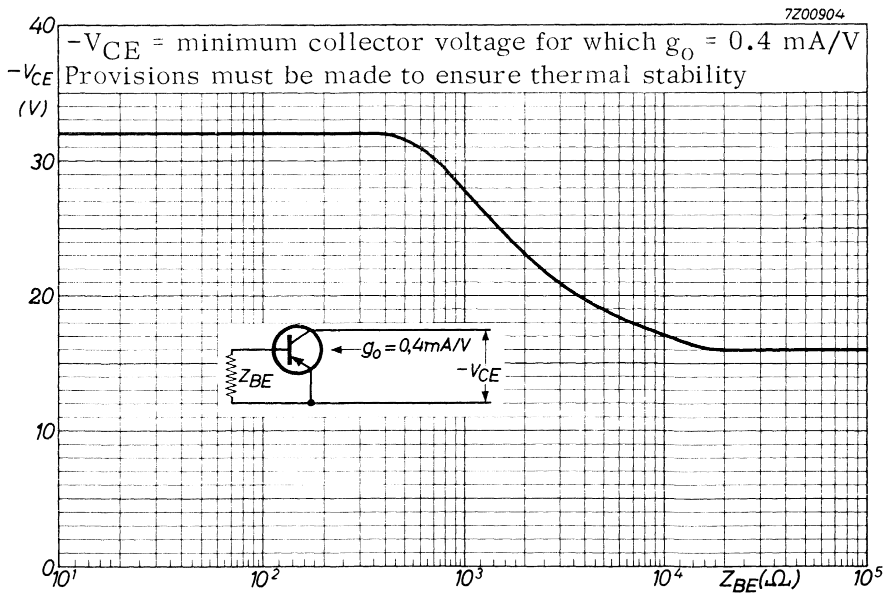
F


7Z00901
$-V_{BE}$ decreases with about 2.3 mV/°C with increasing temperature
$-V_{BE}$ decreases with about 0.4 mV/V with increasing collector to emitter voltage
$-V_{CB} = 0V$
$T_{amb} = 25°C$
Voltage limits
$-V_{BE}$ (mV)
200
150
100
50
0
I_E (mA)
10
8
6
4
2
0

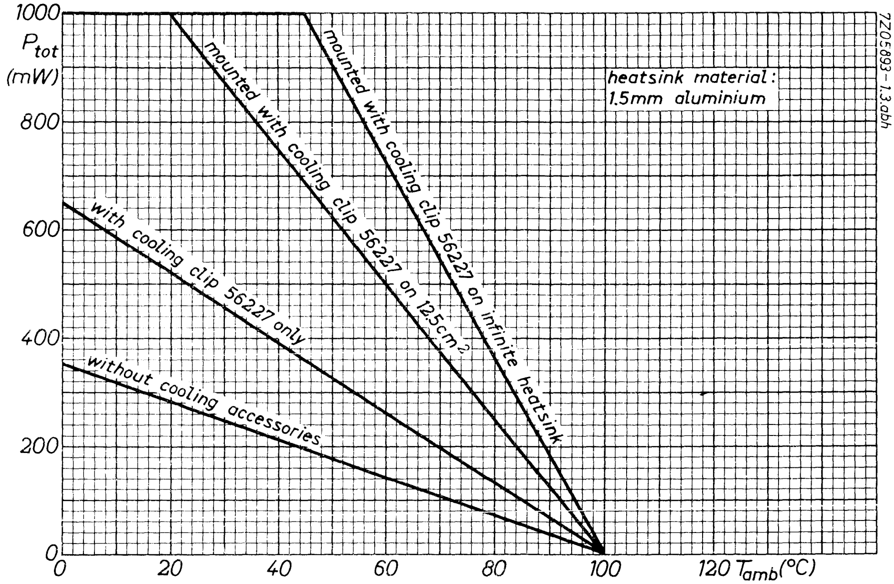
E


7Z03458 – 1.3.abh.
Curve A: D.C. current gain (h_{FE}) as a function of I_C at $-V_{CE}$ = 1 V
Curve B: Small signal current amplification (A_i) as a function of I_C with sliding collector-emitter voltage at a battery voltage of 10 V and a load resistance of 16 Ω
$\lambda_{500} = \frac{A_i \text{ at } -I_C = 500 \text{ mA}}{A_i \text{ max.}}$
A_i
h_{FE}
150
100
50
0
0
100
200
300
400
$-I_C$(mA)
500
A
B

G


7Z00904
$-V_{CE}$ = minimum collector voltage for which g_o = 0.4 mA/V
Provisions must be made to ensure thermal stability
40
$-V_{CE}$
(V)
30
20
10
0
10^1
10^2
10^3
10^4
Z_{BE}(Ω)
10^5
g_o = 0,4mA/V
$-V_{CE}$
Z_{BE}

H


1000
P_{tot}
(mW)
800
600
400
200
0
0
20
40
60
80
100
120 T_{amb}(°C)
mounted with cooling clip 56227 on 12.5cm^2
mounted with cooling clip 56227 on infinite heatsink
with cooling clip 56227 only
without cooling accessories
heatsink material:
1.5mm aluminium
7Z05893-1.3.abh

HIGH GAIN GERMANIUM P-N-P TRANSISTOR

Germanium alloy junction transistor of the p-n-p type in metal case with high gain primarily intended for operation in complementary symmetrical class B output stages in combination with type AC127.

Type 2-AC132 consists of 2 transistors AC132 that are matched for operation in a class B output amplifier

LIMITING VALUES (Absolute max. values)

Collector			
Voltage (base reference)	$-V_{CB}$	= max.	32 V
Voltage (emitter reference)	$-V_{CE}$	= max.	32 V [1])
Current	$-I_C$	= max.	200 mA
Emitter			
Voltage (base reference)	$-V_{EB}$	= max.	10 V
Base			
Current	$-I_B$	= max.	10 mA
Dissipation			
Total dissipation	P_{tot}	= max.	500 mW
Temperatures			
Storage temperature	T_s	=	−55 °C to +90 °C
Junction temperature	T_j	= max.	90 °C

[1]) See page G

7Z2 3101

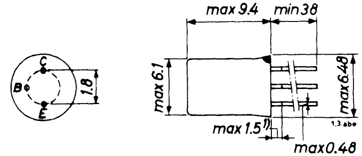
THERMAL DATA

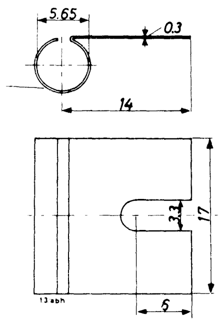
Thermal resistance from

junction to case	K = max. 0.05 °C/mW
junction to ambience in free air	K = max. 0.30 °C/mW
junction to ambience with cooling fin mounted on a heatsink of at least 12.5 cm^2	K = max. 0.09 °C/mW

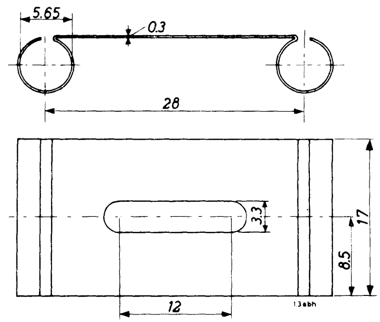
MECHANICAL DATA

The red dot indicates the collector — Dimensions in mm





Cooling fin 56227



Cooling fin 56226

[1]) Not tinned

7Z2 2333

CHARACTERISTICS at T_{amb} = 25 °C

Collector current at $I_E = 0$			
$-V_{CB}$ = 0.5 V	$-I_{CBC}$	<	10 μA
Collector voltage at $V_{BE} = 0$			
$-I_C$ = 500 μA	$-V_{CB}$	>	32 V
Emitter voltage at $I_C = 0$			
$-I_E$ = 200 μA	$-V_{EB}$	>	10 V

Characteristics of matched pairs 2-AC132

Ratio of D.C. current amplification factors

I_E = 20 mA; V_{CB} = 0	h_{FE1}/h_{FE2} = 1.1	< 1.25
I_E = 200 mA; V_{CB} = 0	h_{FE1}/h_{FE2} = 1.1	< 1.25

Characteristics of matched pairs AC127/AC132
(See also data sheets of AC127)

Ratio of D.C. current amplification factors

$\lvert I_E \rvert$ = 50 mA; V_{CB} = 0	h_{FE1}/h_{FE2} = 1.1	< 1.25

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C unless otherwise specified

Collector current at $I_E = 0$	$-I_{CBO}$	See page 6	
Emitter current at $I_C = 0$			
$-V_{EB}$ = 5 V; T_j = 75 °C	$-I_{EBO}$	<	550 μA
Large signal current amplification factor 1)			
I_E = 20 mA; V_{CB} = 0	h_{fel}	=	135
I_E = 50 mA; V_{CB} = 0	h_{fel}	=	115
I_E = 200 mA; V_{CB} = 0	h_{fel}	=	70

1) $h_{fel} = \dfrac{I_C - I_{CBO}}{I_B + I_{CBO}}$ for V_{CE} = constant

7Z2 2334

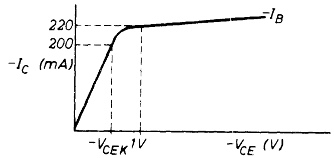
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued)

T_{amb} = 25 °C

Base voltage (emitter reference)		
$-V_{CB}$ = 5 V; I_E = 2 mA	$-V_{BE}$	= 105 mV
V_{CB} = 0 ; I_E = 200 mA	$-V_{BE}$	< 550 mV

Collector knee voltage at $-I_C$ = 200 mA

$-I_B$ = value at which $-I_C$ = 220 mA and $-V_{CE}$ = 1 V



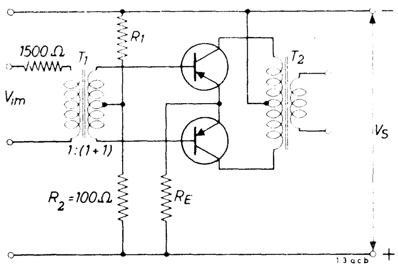
$-V_{CEK}$ < 350 mV

Frequency at which $\lvert h_{fe} \rvert$ = 1			
$-V_{CB}$ = 2 V; I_E = 10 mA	f_1 = 2 Mc/s	> 1.3 Mc/s
Cut-off frequency			
$-V_{CB}$ = 2 V; I_E = 10 mA	$f_{\alpha e}$ = 17 kc/s	> 10 kc/s
Base impedance at f = 0.45 Mc/s			
$-V_{CB}$ = 5 V; I_E = 1 mA	$\lvert z_{rb} \rvert$ = 90 Ω	
Collector capacitance			
$-V_{CB}$ = 5 V; I_E = 0, f = 0.45 Mc/s	c_c = 40 pF	
Noise figure at f = 1 kc/s			
$-V_{CB}$ = 5 V; I_E = 0.5 mA, B = 200 c/s; Input source resistance = 500 Ω	F = 4 dB	< 10 dB

OPERATING CHARACTERISTICS OF A MATCHED PAIR AC127/AC132 please refer to data sheets of AC127

7Z2 2335

OPERATING CHARACTERISTICS OF A MATCHED PAIR 2-AC132 as class B output amplifier

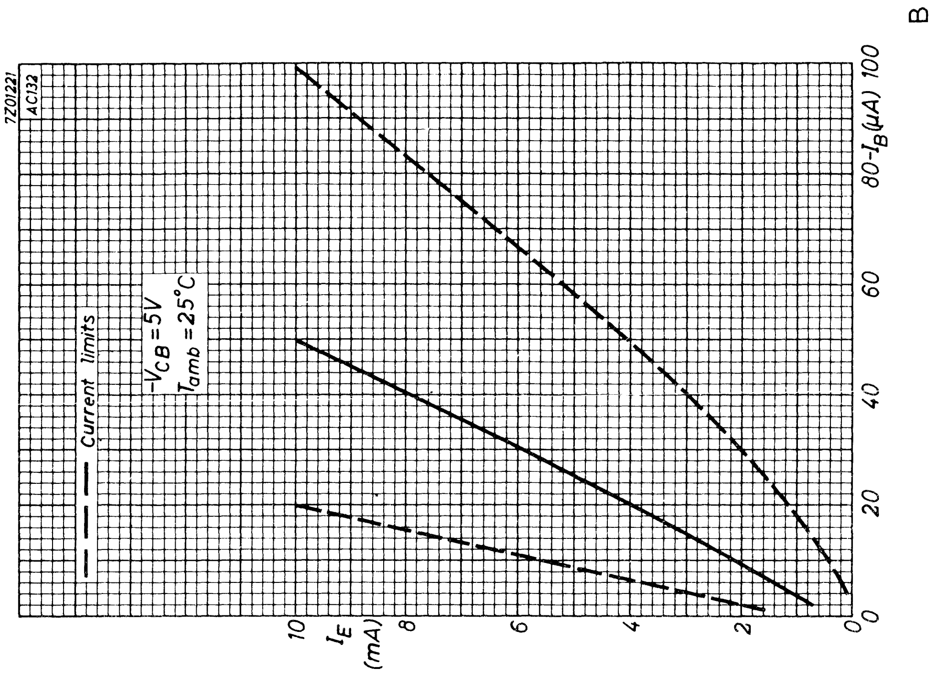


The transistors can be used without cooling fins or heatsinks. Stable continuous operation is ensured up to T_{amb} = 45 °C
Figures apply for T_{amb} = 25 °C

V_S	=	6	9	V
I_E (V_i = 0)	=	2 x 1.5	2 x 1.5	mA
R_1	=	5.6	6.8	kΩ
R_E	=	5	14	Ω
R_{cc}	=	160	292	Ω
P_{cmax} 1)	=	2 x 180	2 x 220	mW
P_{omax} 2)	=	310	365	mW
$-I_{CM}$ (P_o = max.)	=	125	100	mA
$-I_C$ (P_o = max.)	=	40	32	mA
V_i (P_o = max.)	=	4	3.8	V
d_{tot} (P_o = max.)	=	7	6	%
V_i (P_o = 50 mW)	=	1.40	1.35	V
d_{tot} (P_o = 50 mW)	=	2.5	3.0	%

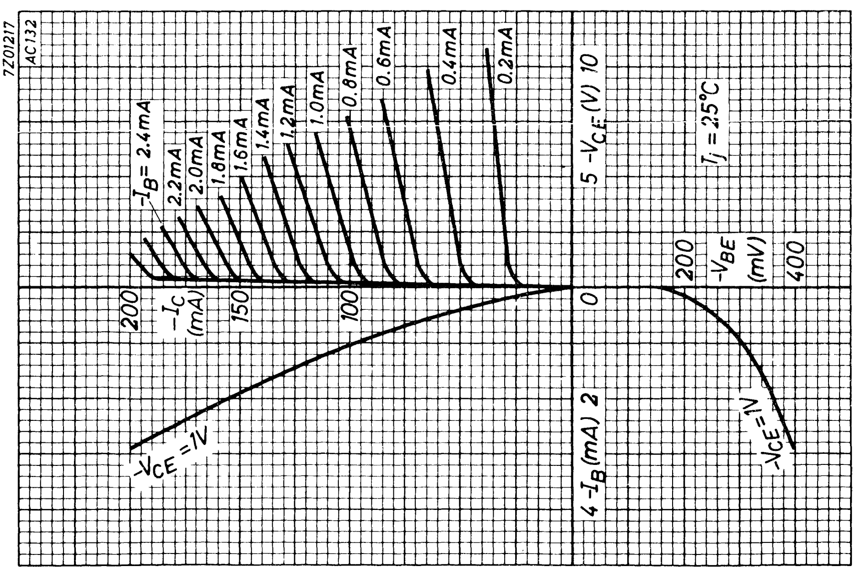
1) Output power of two transistors
2) Power delivered to the primary of the output transformer

7Z2 2336



7Z01221
AC132
Current limits
-VCB = 5V
Tamb = 25°C
IE (mA)
-IB (μA)
0
2
4
6
8
10
20
40
60
80
100

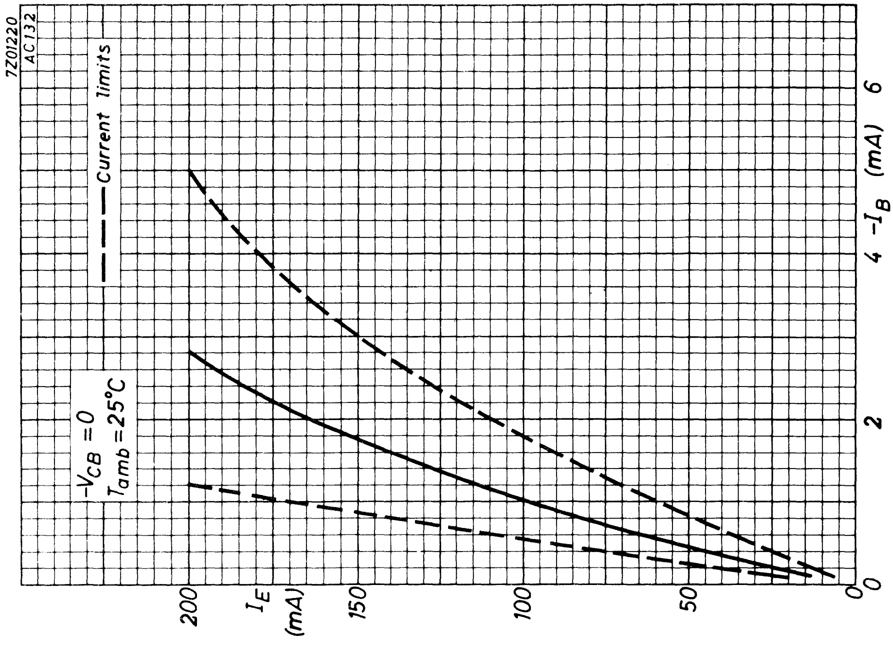
B



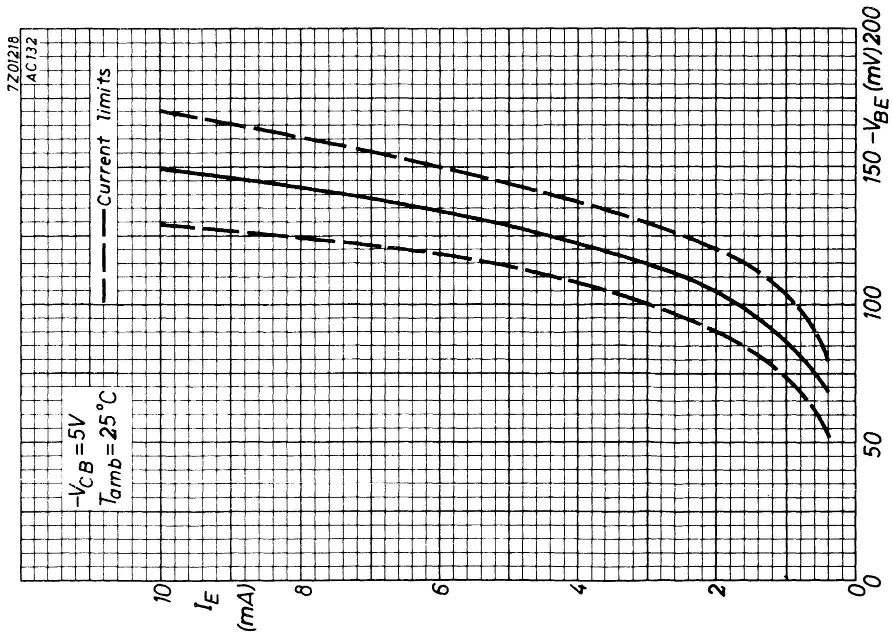
7Z01217
AC132
-IB = 2.4mA
2.2mA
2.0mA
1.8mA
1.6mA
1.4mA
1.2mA
1.0mA
0.8mA
0.6mA
0.4mA
0.2mA
-IC (mA)
200
150
100
0
5 -VCE (V) 10
Tj = 25°C
-VBE (mV)
200
400
-VCE = 1V
-VCE = 1V
4 -IB (mA) 2

A

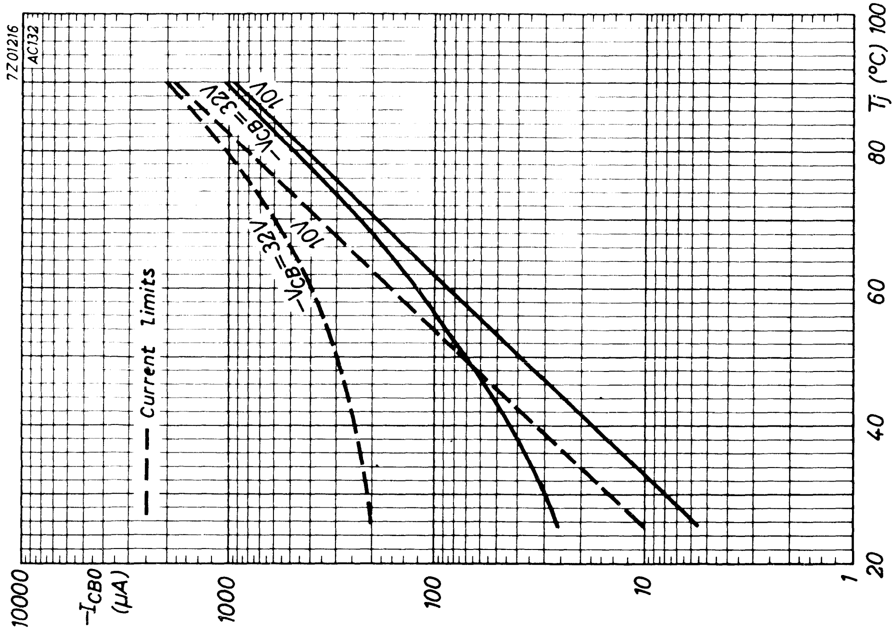
D


7Z01220
AC132
Current limits
$-V_{CB} = 0$
$T_{amb} = 25°C$
I_E (mA)
200
150
100
50
0
0
2
4
6
$-I_B$ (mA)

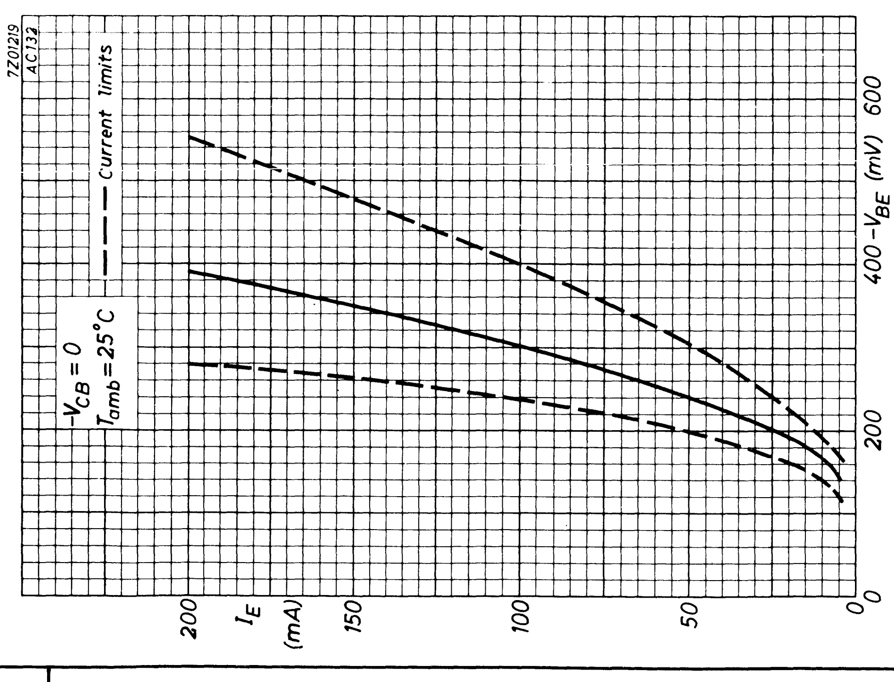
C

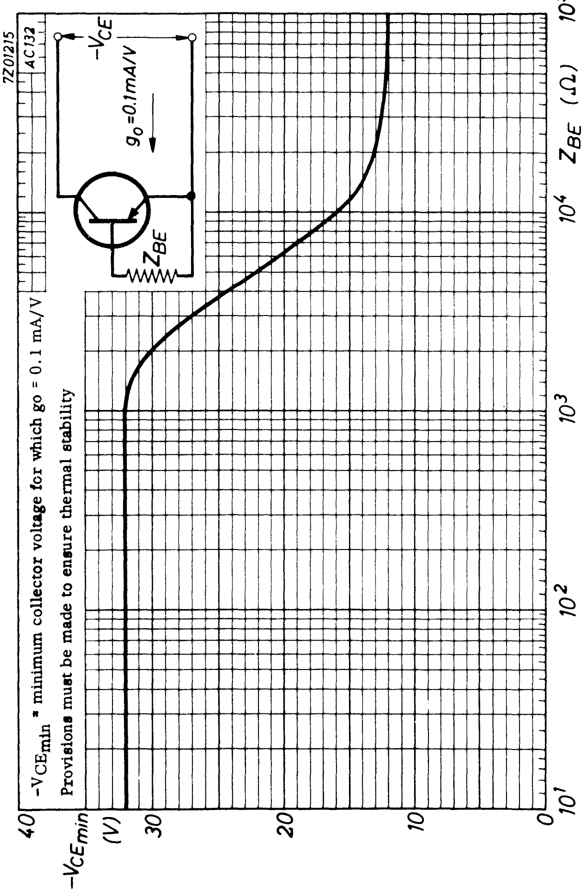

7Z01218
AC132
Current limits
$-V_{CB} = 5V$
$T_{amb} = 25°C$
I_E (mA)
10
8
6
4
2
0
0
50
100
150
$-V_{BE}$ (mV) 200

F


7Z01216
AC132
— — — Current limits
$-V_{CB} = 32V$
10V
$-V_{CB} = 32V$
10V
$-I_{CBO}$ (μA)
10000
1000
100
10
1
Tj (°C)
20
40
60
80
100

E


7Z01219
AC132
— — — Current limits
$-V_{CB} = 0$
$T_{amb} = 25°C$
I_E (mA)
200
150
100
50
0
$-V_{BE}$ (mV)
0
200
400
600


7Z01215
AC132
$-V_{CEmin}$ = minimum collector voltage for which go = 0.1 mA/V
Provisions must be made to ensure thermal stability
$-V_{CE}$
g_o=0.1mA/V
Z_{BE}
$-V_{CEmin}$ (V)
40
30
20
10
0
10^1
10^2
10^3
10^4
10^5
Z_{BE} (Ω)

G

GERMANIUM N-P-N TRANSISTOR

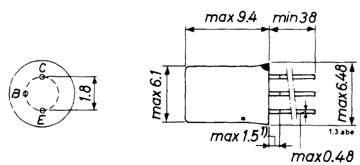
Germanium alloy junction transistor of the n-p-n type in TO-1 metal case for operation in low noise pre-amplifiers.

QUICK REFERENCE DATA

Collector voltage (base reference)	V_{CB}	= max.	32 V
Collector current	I_C	= max.	10 mA
Total dissipation	P_{tot}	= max.	200 mW
Current amplification factor			
$-I_E$ = 500 μA; V_{CB} = 5 V	h_{fe}	> 45	< 110
Transition frequency			
I_C = 10 mA; V_{CE} = 2 V	f_T	=	2.5 Mc/s
Thermal resistance from junction to ambience	K	<	0.37 °C/mW
Noise figure	F	=	3 dB

MECHANICAL DATA

The blue dot indicates the collector — Dimensions in mm



7Z2 2494

1) Not tinned

LIMITING VALUES (Absolute max. values)

Collector			
Voltage (base reference)	V_{CB}	= max.	32 V
Voltage (emitter reference)	V_{CE}	= max.	32 V 1)
Current	I_C	= max.	10 mA
Emitter			
Voltage (base reference)	V_{EB}	= max.	10 V
Dissipation			
Total dissipation	P_{tot}	= max.	200 mW
Temperatures			
Storage temperature	T_s	=	−55 °C to +90 °C
Junction temperature			
Continuous	T_j	= max.	90 °C
Incidentally (up to a total of 200 hours)	T_j	= max.	100 °C

THERMAL DATA

Thermal resistance between junction and ambience in free air	K	= max.	0.37 °C/mW

CHARACTERISTICS at T_j = 25 °C

Collector current at I_E = 0			
V_{CB} = 10 V	I_{CBO}	<	10 μA
Emitter current at I_C = 0			
V_{EB} = 10 V	I_{EBO}	<	200 μA
Current amplification factor			
$-I_E$ = 500 μA; V_{CB} = 5 V; f = 1 kc/s	h_{fe}	>	45
		<	110

1) See also page I

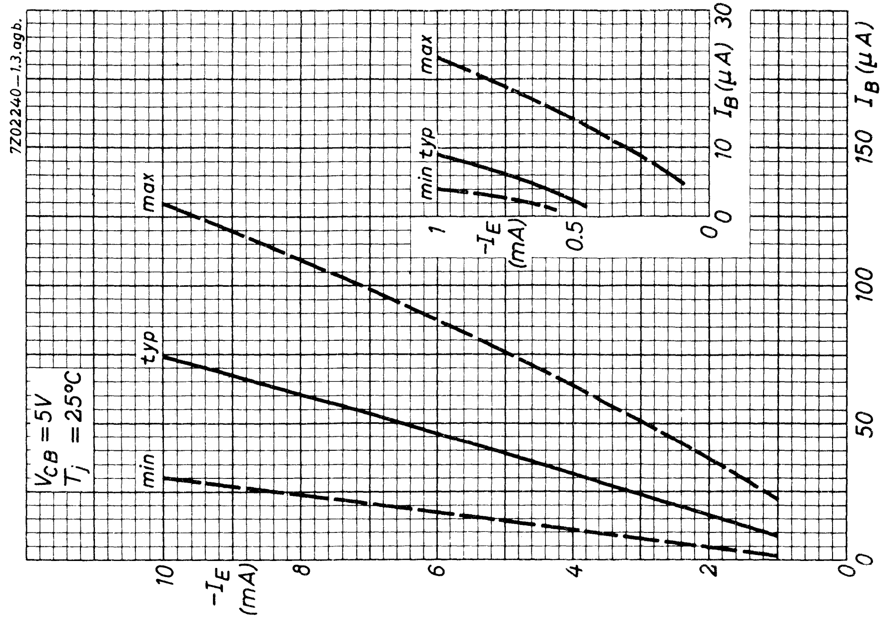
7Z2 2495

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_j = 25 °C, unless otherwise specified

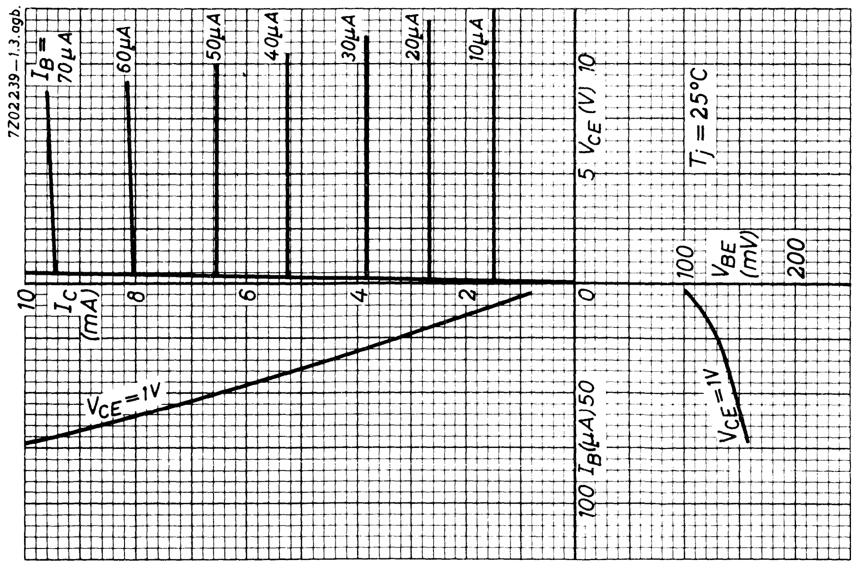
Collector current at $I_E = 0$			
V_{CB} = 32 V (See also page D)	I_{CBO}	<	200 μA
Emitter current at $I_C = 0$			
V_{EB} = 5 V; T_j = 75 °C	I_{EBO}	<	550 μA
Transition frequency			
V_{CE} = 2 V; I_C = 10 mA	f_T	=	2.5 Mc/s
		>	1.5 Mc/s
Noise figure at f = 1 kc/s			
V_{CE} = 5 V; I_C = 0.5 mA			
Bandwidth B = 200 c/s			
Input source resistance = 500 Ω	F	=	3 dB
		<	4 dB
Cut-off frequency			
V_{CE} = 2 V; I_C = 10 mA	$f_{\alpha e}$	=	20 kc/s
		>	10 kc/s
Base impedance at f = 0.45 Mc/s			
V_{CB} = 5 V; $-I_E$ = 1 mA	$\lvert z_{rb} \rvert$	=	70 Ω
Collector capacitance at f = 0.45 Mc/s			
V_{CB} = 5 V; I_E = 0	c_c	=	70 pF

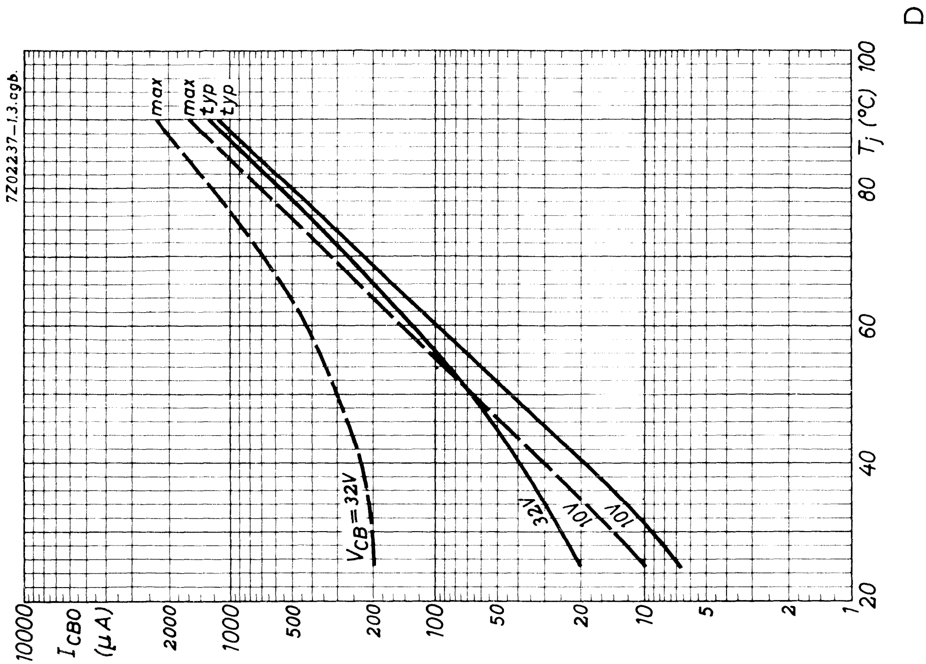
7Z2 2496

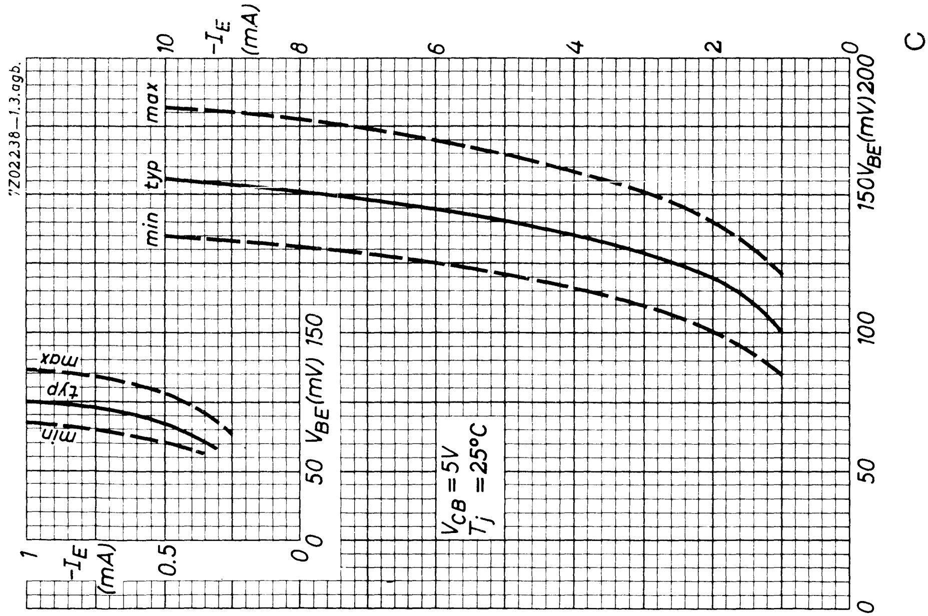
B

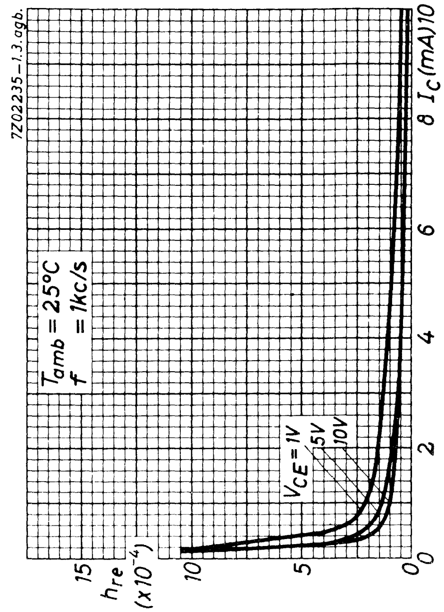

7Z02240—1.3.agb.
V_{CB} = 5V
T_j = 25°C
max
typ
min
$-I_E$ (mA)
I_B (μA)
max
min typ
$-I_E$ (mA)
I_B (μA)

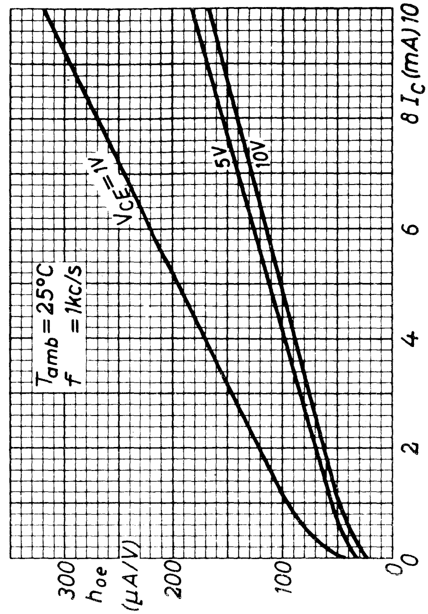
A

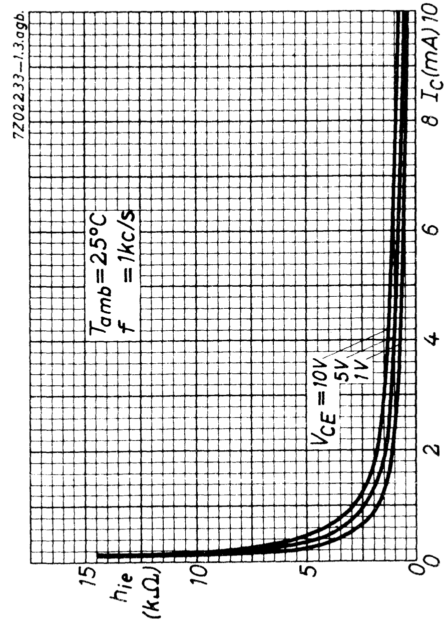

7Z02239—1.3.agb.
I_B = 70μA
60μA
50μA
40μA
30μA
20μA
10μA
V_{CE} (V)
T_j = 25°C
I_C (mA)
V_{BE} (mV)
V_{CE}=1V
V_{CE}=1V
I_B(μA)

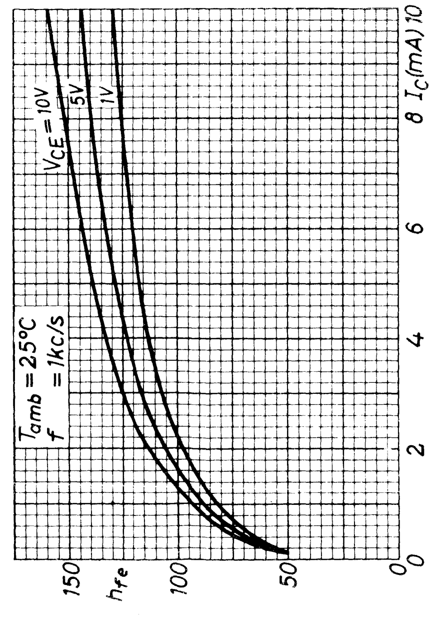

7Z02237-1.3.agb.
D
I_{CBO} (μA)
10000
2000
1000
500
200
100
50
20
10
5
2
1
T_j (°C)
20
40
60
80
100
max
max
typ
typ
V_{CB} = 32V
32V
10V
10V


7Z02238-1.3.agb.
C
$-I_E$ (mA)
10
8
6
4
2
0
V_{BE} (mV)
0
50
100
150
200
max
typ
min
$-I_E$ (mA)
1
0.5
0
V_{BE} (mV)
0
50
150
max
typ
min
V_{CB} = 5V
T_j = 25°C


7Z02235-1.3.agb.
$T_{amb} = 25°C$
$f = 1kc/s$
$V_{CE} = 1V$
5V
10V
h_{re}
$(x10^{-4})$
15
10
5
0
0
2
4
6
8
I_C(mA)
10


$T_{amb} = 25°C$
$f = 1kc/s$
$V_{CE} = 1V$
5V
10V
h_{oe}
(µA/V)
300
200
100
0
0
2
4
6
8
I_C(mA)
10

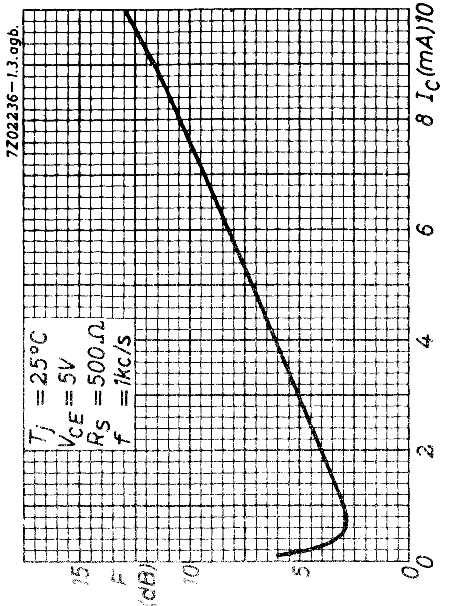

7Z02233-1.3.agb.
$T_{amb} = 25°C$
$f = 1kc/s$
$V_{CE} = 10V$
5V
1V
h_{ie}
(kΩ)
15
10
5
0
0
2
4
6
8
I_C(mA)
10

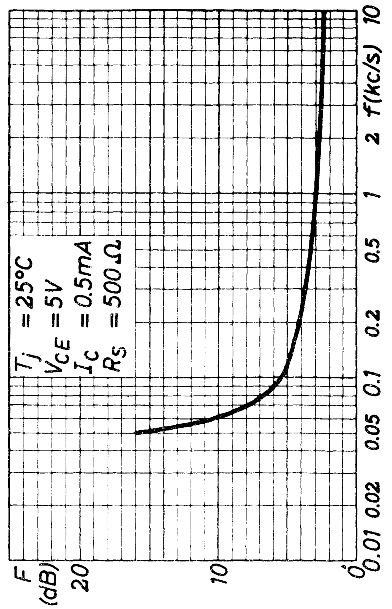

$T_{amb} = 25°C$
$f = 1kc/s$
$V_{CE} = 10V$
5V
1V
h_{fe}
150
100
50
0
0
2
4
6
8
I_C(mA)
10

F

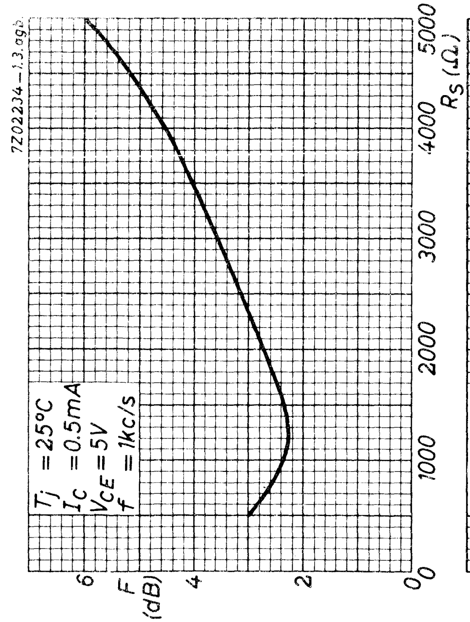
E

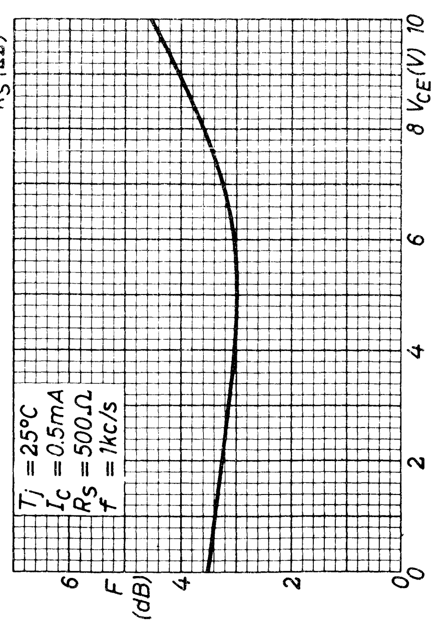
H

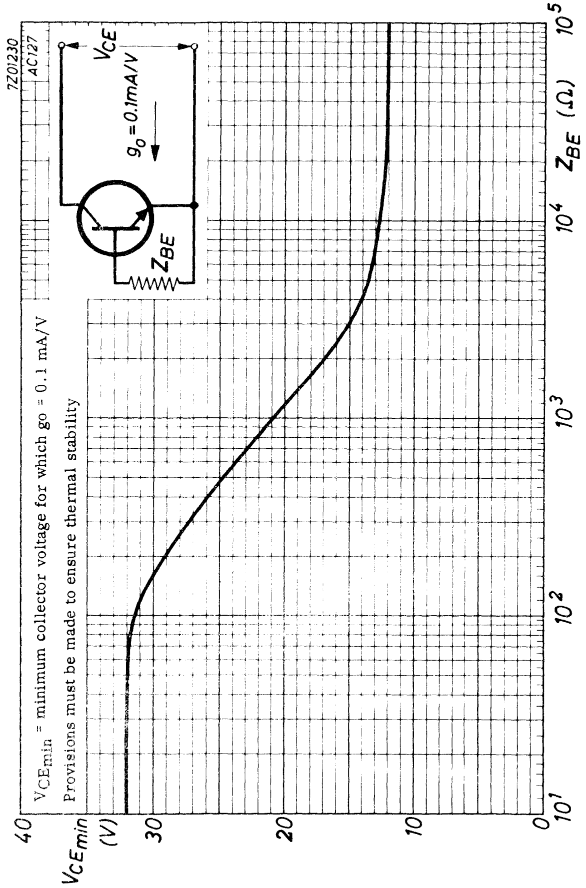

7Z02236-1.3.agb.
T_j = 25°C
V_{CE} = 5V
R_S = 500 Ω
f = 1kc/s
F (dB)
0 5 10 15
0 2 4 6 8 10
I_C (mA)


T_j = 25°C
V_{CE} = 5V
I_C = 0.5mA
R_S = 500 Ω
F (dB)
0 10 20
0.01 0.02 0.05 0.1 0.2 0.5 1 2 10
f(kc/s)

G


7Z02234-1.3.agb.
T_j = 25°C
I_C = 0.5mA
V_{CE} = 5V
f = 1kc/s
F (dB)
0 2 4 6
0 1000 2000 3000 4000 5000
R_S (Ω)


T_j = 25°C
I_C = 0.5mA
R_S = 500 Ω
f = 1kc/s
F (dB)
0 2 4 6
0 2 4 6 8 10
V_{CE} (V)



7Z01230
AC127
V_{CE}
$g_o = 0.1mA/V$
Z_{BE}
V_{CEmin} = minimum collector voltage for which go = 0.1 mA/V
Provisions must be made to ensure thermal stability
40
V_{CEmin} (V)
30
20
10
0
10^1
10^2
10^3
10^4
10^5
Z_{BE} (Ω)

P-N-P GERMANIUM POWER TRANSISTOR

Germanium alloy junction transistor of the p-n-p type in a metal case for low frequency high quality output stages.

Type 2-AD139 consists of two transistors AD139 that are matched to operate in a low-distortion class B amplifier.

LIMITING VALUES (Absolute max. values)

Collector

Voltage (base reference)	$-V_{CB}$	= max.	32 V
Voltage (emitter reference)	$-V_{CE}$	= max.	32 V [1]
Current, peak value	$-I_{CM}$	= max.	3 A
Current, averaged over any 50 msec period	$-I_C$ (t_{av}	= max. =	1 A 50 msec)

Emitter

Voltage (base reference)	$-V_{EB}$	= max.	10 V

Base

Current, averaged over any 50 msec period	$-I_B$ (t_{av}	= max. =	0.2 A 50 msec)

Dissipation

Total dissipation	P_{tot}	= max.	13 W

[1] a. See also page F.
b. At high voltages a maximum transient energy of 3 mWsec should not be exceeded.

7Z2 2402

LIMITING VALUES (Absolute max. values) (continued)

Temperatures

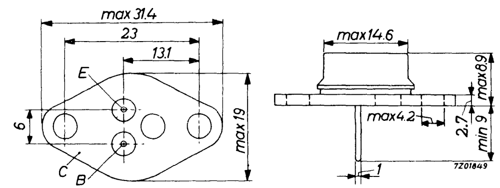
Storage temperature	T_s	=	−55 °C to +75 °C
Junction temperature			
Continuous	T_j	= max.	90 °C
Incidentally (total duration max. 200 hrs)	T_j (t	= max. = max.	100 °C 200 hrs)

THERMAL DATA

Thermal resistance from junction to base of device	K	= max.	4 °C/W
Thermal resistance from base of device to heatsink			
without mica washer	K	=	0.5 °C/W
with mica washer	K	=	1.5 °C/W

MECHANICAL DATA

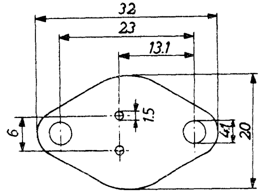
Dimensions in mm

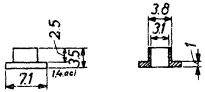


7Z2 3092

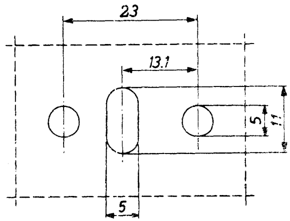
MECHANICAL DATA (continued)

Dimensions in mm





Mica insulation washer
(thickness 50 to 100 μ)
and insulation tubes



Bore-hole dimensions
for heatsink

Code number of mica insulation washer and insulation tubes : 56239

CHARACTERISTICS at T_j = 25 °C

Collector current			
$-V_{CE}$ = 32 V; V_{BE} = 1 V	$-I_C$	<	1 mA
Emitter current at I_C = 0			
$-V_{EB}$ = 10 V	$-I_{EBO}$	<	1 mA
Base current			
I_E = 0.1 A; V_{CB} = 0	$-I_B$	>	1 mA
		<	4 mA
I_E = 1 A; V_{CB} = 0	$-I_B$	>	9 mA
		<	33 mA

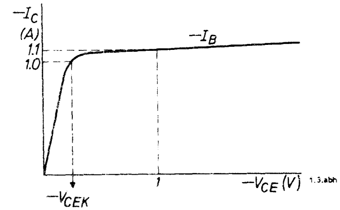
Characteristics of matched pairs 2-AD139

Ratio of D.C. amplification factors			
$-V_{CB}$ = 0 I_E = 100 mA	h_{FE1}/h_{FE2}	<	1.25
$-V_{CB}$ = 0 I_E = 1 A	h_{FE1}/h_{FE2}	<	1.25

7Z2 2404

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN T_j = 25 °C unless otherwise specified

Collector current at I_E = 0 [1]			
$-V_{CB}$ = 0.5 V	$-I_{CBO}$	<	25 μA
Collector voltage (emitter reference)			
$-I_C$ = 0.5 A; V_{BE} = 2 V	$-V_{CE}$	>	32 V
$-I_C$ = 0.5 A; I_B = 0	$-V_{CE}$	>	16 V
Collector knee voltage at $-I_C$ = 1 A			
$-I_B$ = value at which $-I_C$ = 1.1 A and $-V_{CE}$ = 1 V	$-V_{CEK}$	<	0.4 V



Base current			
I_E = 10 mA; $-V_{CB}$ = 10 V (See also page B)	$-I_B$	<	0.5 mA
Base voltage (emitter reference)			
I_E = 10 mA; $-V_{CB}$ = 10 V (See also page C)	$-V_{BE}$	>	115 mV
		<	155 mV
Cut-off frequency at			
$-V_{CE}$ = 2 V; I_E = 0.1 A	$f_{\alpha e}$	>	10 kc/s

[1] See also page D.

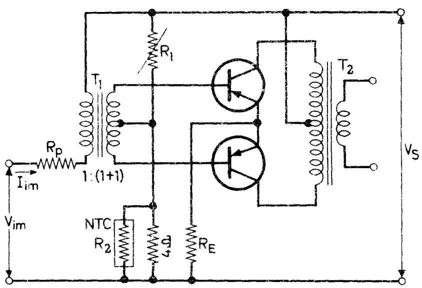
7Z2 2405

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_j = 25 °C

Current gain linearity at

R_L = 12 Ω; V_S = 14 V λ_{1A} = 0.55 > 0.45 [1])

OPERATING CHARACTERISTICS OF A MATCHED PAIR 2-AD139 as class B output amplifier



Stable continuous operation is ensured up to an ambient temperature of 60 °C provided each transistor has been mounted on a 1.5 mm copper heatsink of at least 10 cm x 10 cm.

[1]) R_L = load resistance, V_S = battery voltage

$\lambda_{1A} = \frac{A_i \text{ at } 1\text{ A}}{A_i \text{ max.}}$, where A_i = loaded small-signal current amplification.

7Z2 2406

OPERATING CHARACTERISTICS OF A MATCHED PAIR 2-AD139 as class B output amplifier (continued)

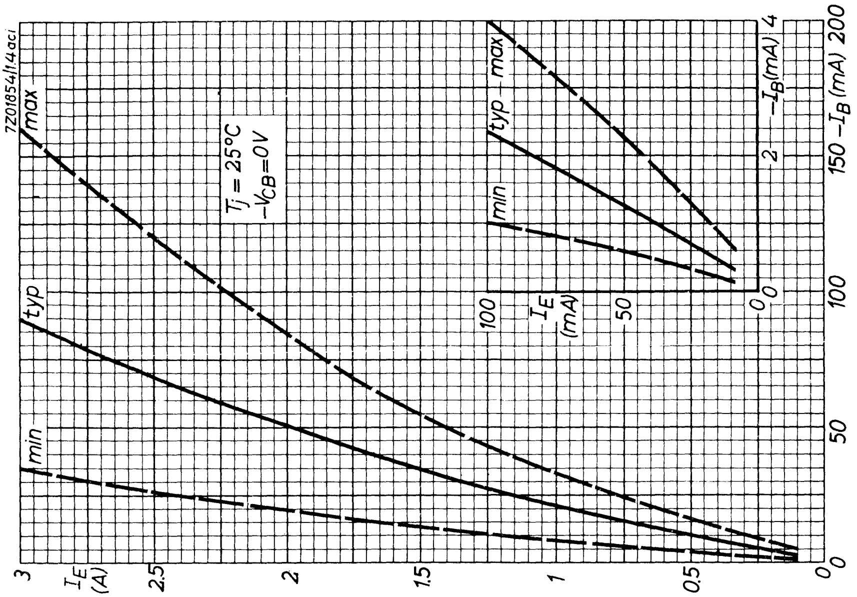
V_S	=	7 (<8)	14 (<16)	V
$-I_C$ (V_i = 0)	=	60	60	mA
R_1	=	100	200	Ω
R_2 [1])	=	4	4	Ω
R_E	=	0.1	0.39	Ω
R_p	=	200	130	Ω
R_{cc}	=	17.5	72	Ω
P_c max. [2])	=	2 x 2.55	2 x 2.55	W
P_o max. [3])	=	2 x 2.5	2 x 2.5	W
$-I_{CM}$ (P_o = 5 W)	=	1500	750	mA
$-I_C$ (P_o = 5 W)	=	480	240	mA
V_{im} (P_o = 5 W)	=	7.5	2.65	V
I_{im} (P_o = 5 W)	=	36	16.7	mA
d_{tot} (P_o = 5 W)	=	6	4.5	%
I_{im} (P_o = 50 mW)	=	3.4	1.67	mA
d_{tot} (P_o = 50 mW)	=	1.5	1	%

[1]) Code No. B8 320 0../4E. This NTC resistor must be mounted on the heatsink, close to the transistor.

[2]) Max. output power of the two transistors.

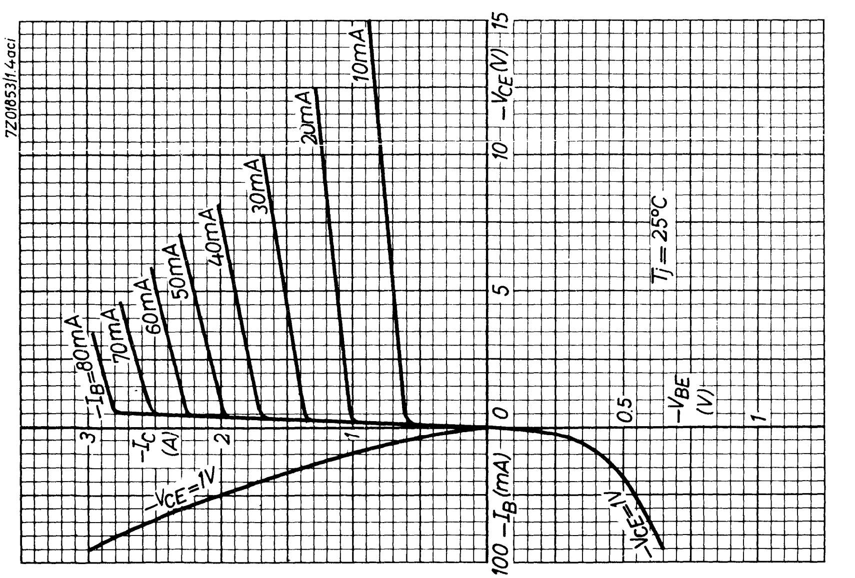
[3]) Max. power delivered to the primary of the output transformer.

7Z2 2407



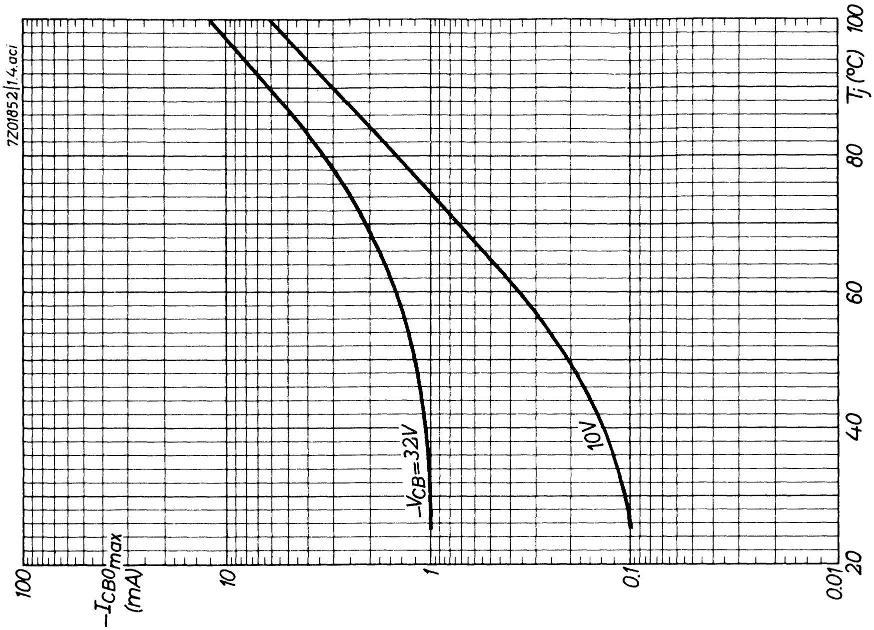
7Z01854/1.4aci
max
typ
min
Tj = 25°C
−VCB=0V
IE (A)
IE (mA)
−IB(mA)
−IB (mA)

B

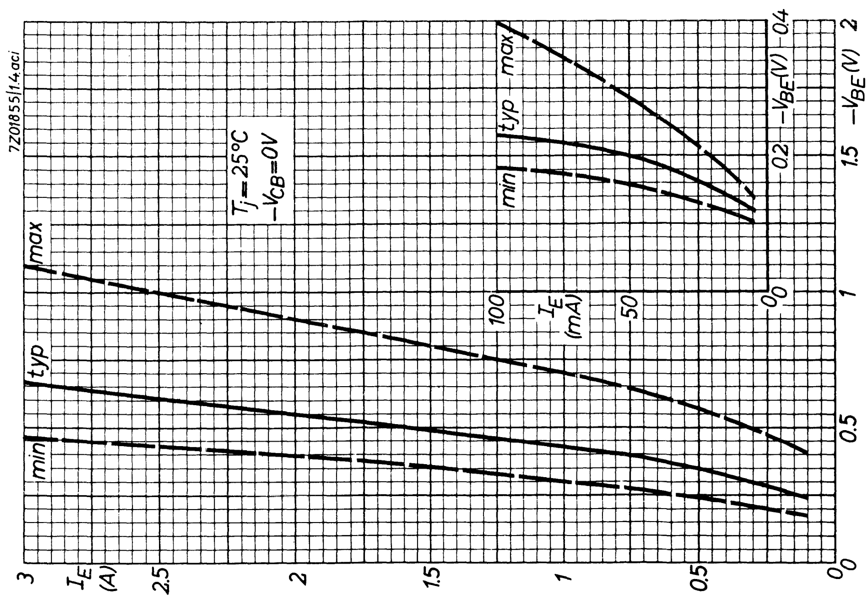


7Z01853/1.4aci
−IB=80mA
70mA
60mA
50mA
40mA
30mA
20mA
10mA
−VCE (V)
−IC (A)
−IB (mA)
−VBE (V)
−VCE=1V
−VCE=1V
Tj = 25°C

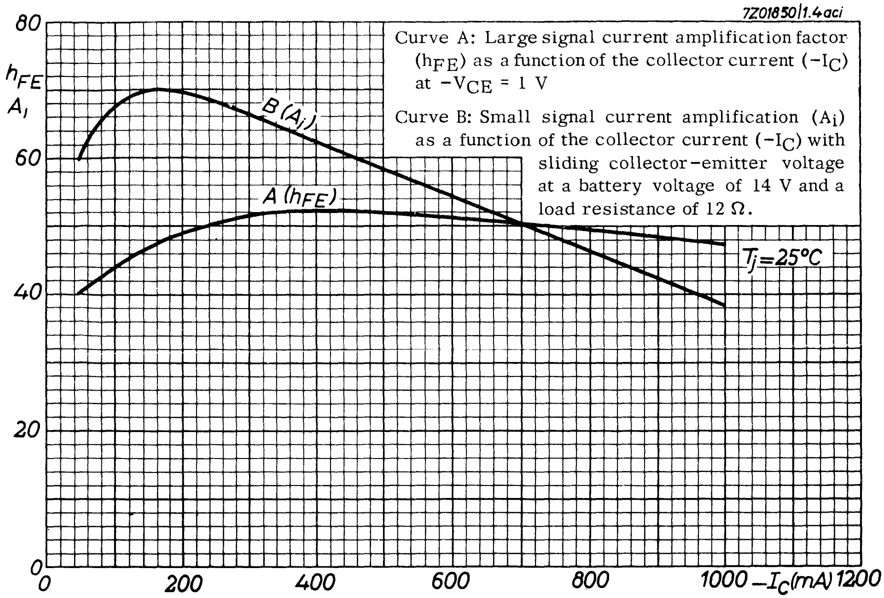
A


7Z01852/1.4.aci
$-I_{CBO}max$ (mA)
$-V_{CB}$=32V
10V
T_j (°C)

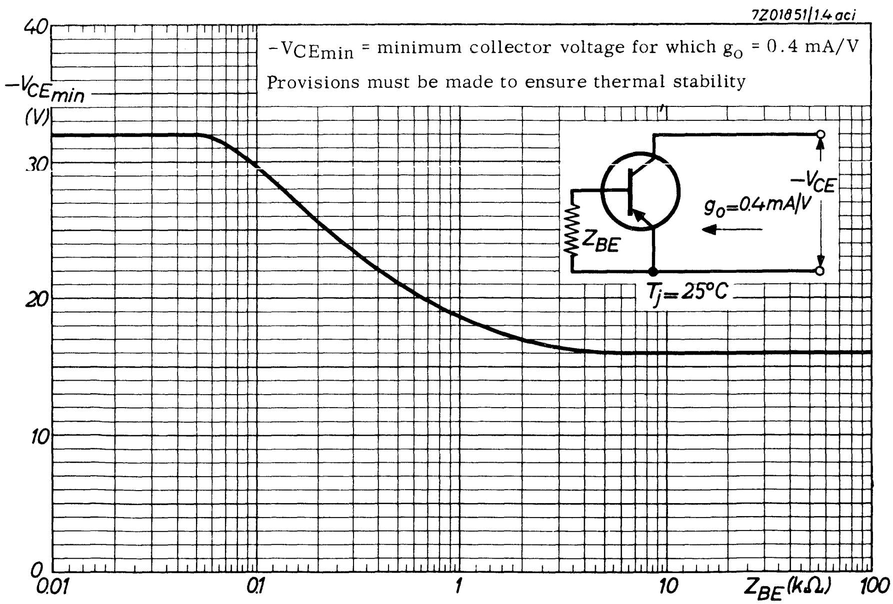
D


7Z01855/1.4.aci
T_j = 25°C
$-V_{CB}$=0V
I_E (A)
I_E (mA)
min
typ
max
$-V_{BE}$(V)

C


7Z01850/1.4aci
Curve A: Large signal current amplification factor (h_{FE}) as a function of the collector current ($-I_C$) at $-V_{CE}$ = 1 V
Curve B: Small signal current amplification (A_i) as a function of the collector current ($-I_C$) with sliding collector-emitter voltage at a battery voltage of 14 V and a load resistance of 12 Ω.
h_{FE}
A_i
B (A_i)
A (h_{FE})
T_j=25°C
0
20
40
60
80
200
400
600
800
1000
$-I_C$(mA)
1200

E


7Z01851/1.4aci
$-V_{CEmin}$ = minimum collector voltage for which g_o = 0.4 mA/V
Provisions must be made to ensure thermal stability
$-V_{CEmin}$
(V)
0
10
20
30
40
Z_{BE}
$-V_{CE}$
g_o=0.4mA/V
T_j=25°C
0.01
0.1
1
10
Z_{BE}(kΩ)
100

F

P-N-P GERMANIUM POWER TRANSISTORS

Germanium alloy junction power transistors of the p-n-p type in TO-3 metal case, primarily intended for use in class B push-pull output stages with a power output up to 20 Watts and frame deflection output stages.

Type 2-AD149 consists of 2 transistors AD149 that are matched for operation in a class B output amplifier.

QUICK REFERENCE DATA				
Collector voltage (base reference)	$-V_{CB}$	=	max.	50 V
Collector voltage (emitter reference)	$-V_{CE}$	=	max.	50 V
Collector current	$-I_C$	=	max.	3.5 A
Total dissipation	P_{tot}	=	max.	22.5 W
Junction temperature (continuous)	T_j	=	max.	100 °C
Cut-off frequency	$f_{\alpha e}$	=		10 kc/s
Thermal resistance between junction and transistor bottom	K	<		2.0 °C/W
D.C. current amplification factor				
$-I_C$ = 1 A	h_{FE}	> 30		< 100
$-I_C$ = 3 A	h_{FE}	> 20		< 85

7Z2 2497

LIMITING VALUES (Absolute max. values)

Collector				
Voltage (base reference)	$-V_{CB}$	=	max.	50 V
Voltage (emitter reference)	$-V_{CE}$	=	max.	50 V [1]
Current	$-I_C$	=	max.	3.5 A
Emitter				
Voltage (base reference)	$-V_{EB}$	=	max.	20 V
Base				
Current	$-I_B$	=	max.	0.5 A
Dissipation				
Total dissipation	P_{tot}	=	max.	22.5 W
Temperatures				
Storage temperature	T_s	=		-65 °C to 100 °C
Junction temperature				
continuous	T_j	=	max.	100 °C
incidentally (max. 200 hrs)	T_j	=	max.	110 °C

THERMAL DATA

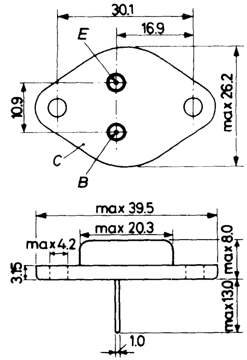
Thermal resistance between			
junction and transistor bottom	K	<	2 °C/W
transistor bottom and heatsink without insulating materials and with lead washer	K	=	0.2 °C/W
transistor bottom and heatsink with mica and insulating tubes	K	=	0.5 °C/W

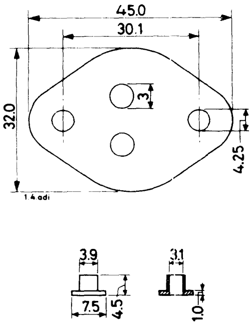
1) See also fig.J

7Z2 2498

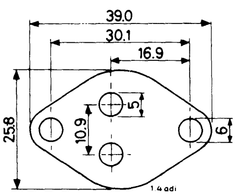
MECHANICAL DATA

Dimensions in mm





Codenumber 56201A
Mica insulation (50 μm)
and insulation tubes



Codenumber 56201B
Lead washer (1 mm)

7Z2 2499

CHARACTERISTICS at T_j = 25 °C

Emitter current at $I_C = 0$			
$-V_{EB}$ = 20 V	$-I_{EBO}$		< 3 mA
Base current			
I_E = 1 A; V_{CB} = 0	$-I_B$	> 10 mA	< 32 mA
I_E = 3 A; V_{CB} = 0	$-I_B$	> 35 mA	< 140 mA

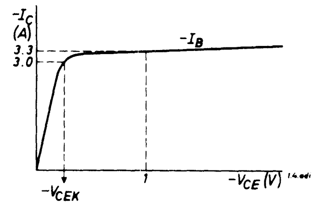
CHARACTERISTICS OF MATCHED PAIRS

Ratio of the D.C. current amplification factors

at $-I_C$ = 0.3 A	h_{FE1}/h_{FE2} = 1.1	< 1.25
at $-I_C$ = 3 A	h_{FE1}/h_{FE2} = 1.1	< 1.25

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_j = 25 °C

Collector current at $I_E = 0$	$-I_{CBO}$, see fig. G	
Base current	$-I_B$, see fig. F and H	
Base voltage	$-V_{BE}$, see fig. D and E	
Collector knee voltage at		
$-I_C$ = 3 A; $-I_B$ = value at		
which $-I_C$ = 3.3 A		
and $-V_{CE}$ = 1 V	$-V_{CEK}$	< 0.7 V



see also fig.B

7Z2 2500

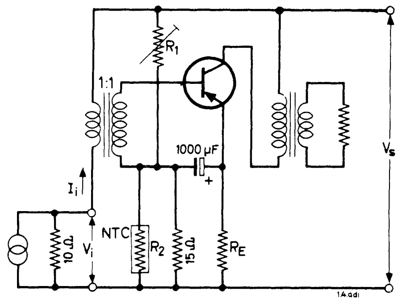
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued) T_j = 25 °C

Avalanche breakdown voltage	See fig. C		
Base impedance at f = 450 kc/s			
I_E = 1 mA; $-V_{CB}$ = 5 V	$\|z_{rb}\|$ =	30 Ω	
Collector capacitance at f = 450 kc/s			
$-V_{CB}$ = 5 V; I_E = 0	c_c =	220 pF	
Emitter capacitance at f = 450 kc/s			
$-V_{EB}$ = 5 V; I_C = 0	c_e =	140 pF	
Transition frequency			
$-V_{CE}$ = 2 V; $-I_C$ = 0.5 A	f_T =	500 kc/s	> 300 kc/s
Cut-off frequency			
$-V_{CE}$ = 2 V; $-I_C$ = 0.5 A	$f_{\alpha e}$ =	10 kc/s	> 7 kc/s
Current gain linearity [1]	λ_{3A} =	0.35	> 0.2

[1] $\lambda_{3A} = \frac{A_i \text{ at } 3\text{ A}}{A_i \text{ at } 0.1\text{ A}}$ (See figure I)

7Z2 2501

OPERATING CHARACTERISTICS in a class A amplifier



NOTES

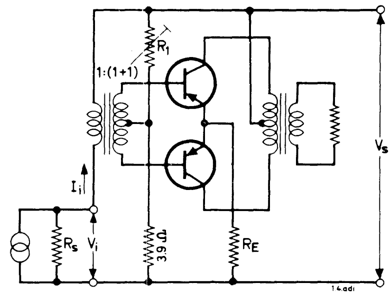
1. R_2, an NTC-resistor B8 320 01P/50E, shall be mounted on the heatsink near the transistor.
2. Stable continuous operation is ensured up to T_{amb} = 55 °C, provided each transistor has been mounted on a 1.5 mm copper heatsink of at least 18 x 18 cm^2 (circuit I) or 15 x 15 cm^2 (circuit II).

		Circuit I	Circuit II	
V_S	=	7 (max. 8)	14 (max. 16)	V
$-I_C$ (V_i = 0)	=	1.8	0.72	A
R_1	=	50	200	Ω
R_E	=	0.3	0.5	Ω
R_c	=	4	23	Ω
$P_{c\,max}$ [1]	=	4.3	4.1	W
$P_{o\,max}$ [2]	=	4	4	W
V_{im} (P_o = 4 W)	=	0.48	0.40	V
I_{im} (P_o = 4 W)	=	35	12	mA
d_{tot} (P_o = 4 W)	=	9.5	7.5	%
I_{im} (P_o = 50 mW)	=	2.5	1	mA
d_{tot} (P_o = 50 mW)	=	2.5	1.5	%

[1] Output power of the transistor.
[2] Power, delivered to the primary of the output transformer.

7Z2 2512

OPERATING CHARACTERISTICS OF A MATCHED PAIR 2-AD149 as class B output amplifier



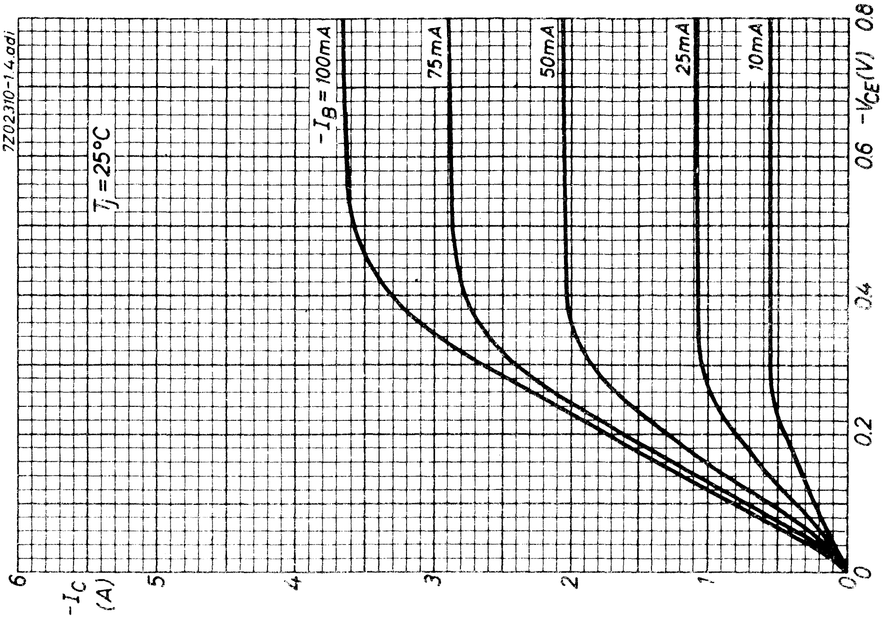
NOTE

Stable continuous operation is ensured up to T_{amb} = 55 °C, provided each transistor has been mounted on a 1.5 mm copper heatsink of at least 5 x 5 cm^2 (circuit I) or 6 x 6 cm^2 (circuit II).

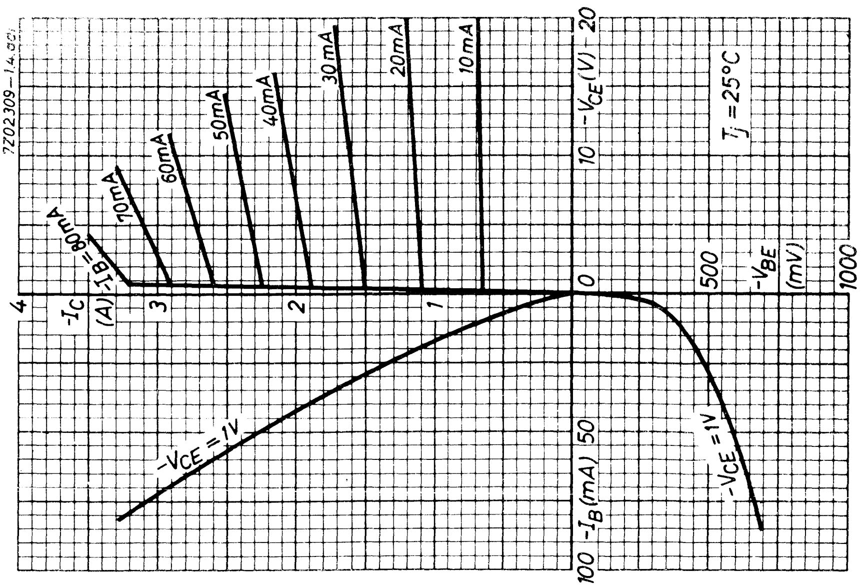
		Circuit I	Circuit II	
V_S	=	7 (max. 8)	14 (max. 16)	V
$-I_C$ (V_i = 0)	=	2 x 30	2 x 30	mA
R_1	=	200	350	Ω
R_E	=	0	0.47	Ω
R_S	=	450	370	Ω
R_{cc}	=	9	16	Ω
$P_{c\,max}$ 1)	=	9.75	20	W
$P_{o\,max}$ 2)	=	9.75	17.9	W
$-I_{CM}$ (P_o = max)	=	3	3	A
$-I_C$ (P_o = max)	=	2 x 0.48	2 x 0.48	A
V_{im} (P_o = max)	=	0.81	2.2	V
I_{im} (P_o = max)	=	75	75	mA
d_{tot} (P_o = max)	=	10	10	%
I_{im} (P_o = 50 mW)		4	2.5	mA
d_{tot} (P_o = 50 mW)		2.5	2	%

1) Output power of two transistors.
2) Power, delivered to the primary of the output transformer.

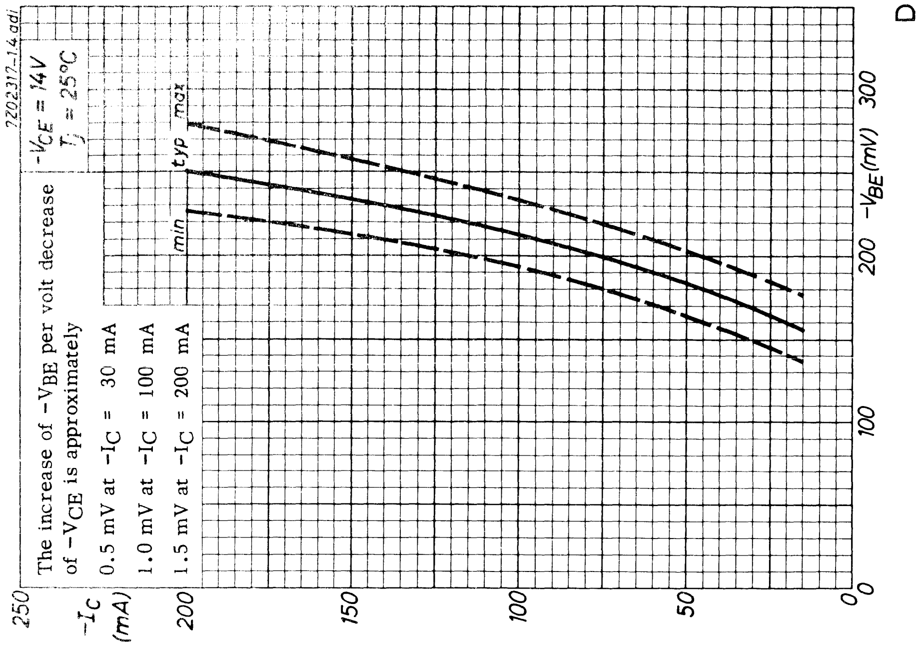
7Z2 2513

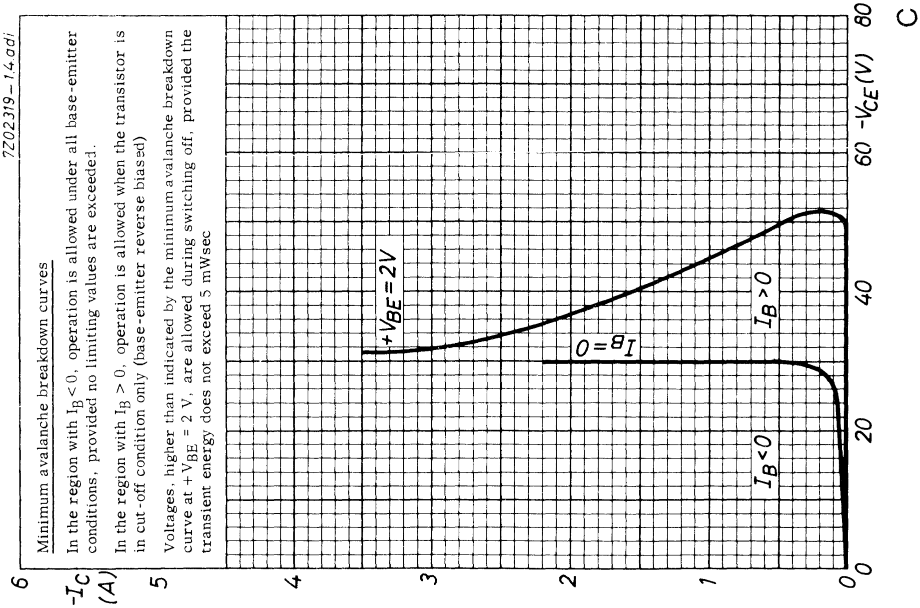

7Z02310-1.4.adi
$T_j = 25°C$
$-I_B = 100mA$
75mA
50mA
25mA
10mA
$-V_{CE}(V)$
$-I_C$ (A)
0
0.2
0.4
0.6
0.8
1
2
3
4
5
6

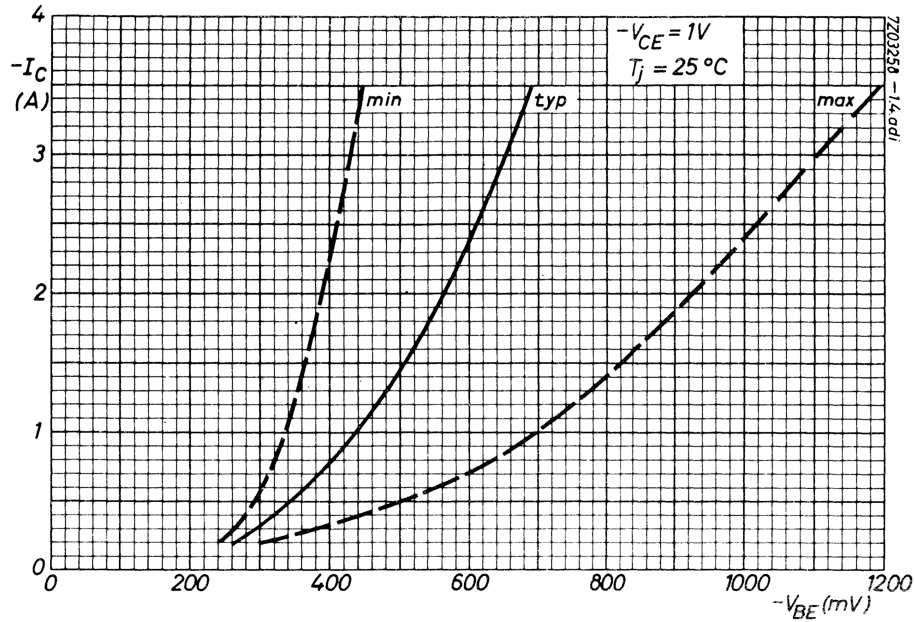
B

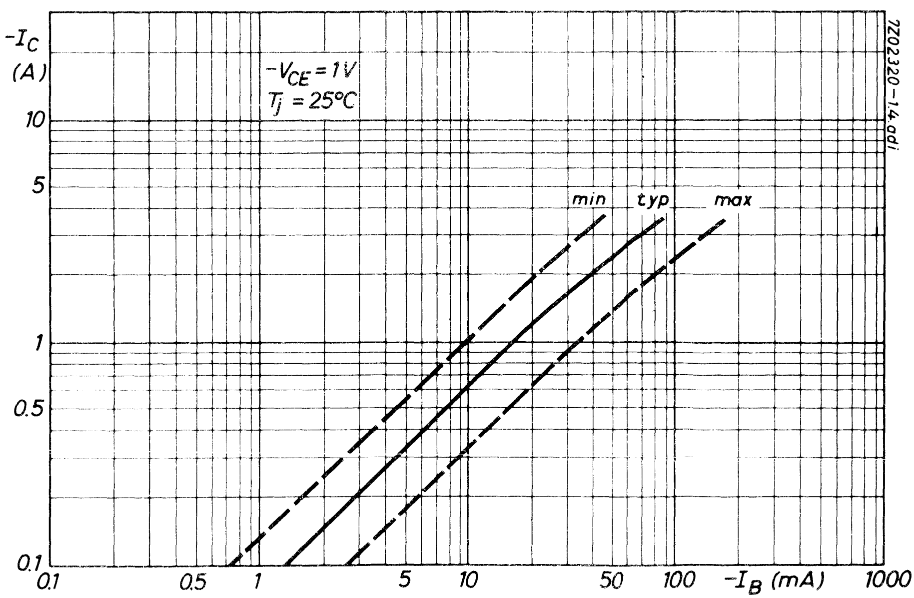

$-I_B = 80mA$
70mA
60mA
50mA
40mA
30mA
20mA
10mA
$-V_{CE}(V)$
$T_j = 25°C$
$-I_C$ (A)
$-I_B$ (mA)
$-V_{BE}$ (mV)
$-V_{CE} = 1V$
$-V_{CE} = 1V$
0
10
20
500
1000
50
100
1
2
3
4

A


7Z02317-1.4.adi
The increase of $-V_{BE}$ per volt decrease of $-V_{CE}$ is approximately
0.5 mV at $-I_C$ = 30 mA
1.0 mV at $-I_C$ = 100 mA
1.5 mV at $-I_C$ = 200 mA
$-V_{CE}$ = 14V
T_j = 25°C
max
typ
min
$-I_C$ (mA)
250
200
150
100
50
0
0
100
200
300
$-V_{BE}$ (mV)
D

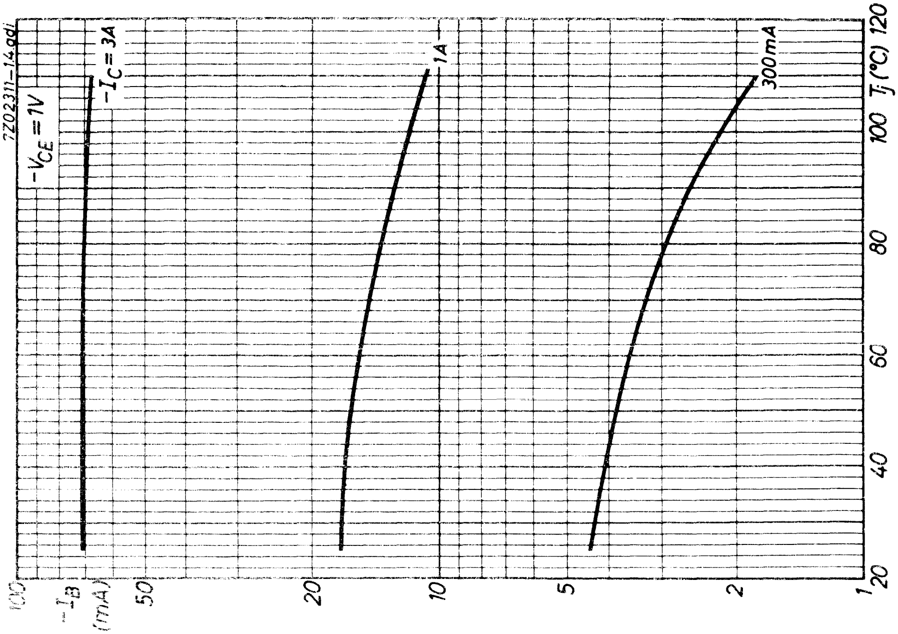

7Z02319-1.4.adi
Minimum avalanche breakdown curves
In the region with $I_B<0$, operation is allowed under all base-emitter conditions, provided no limiting values are exceeded.
In the region with $I_B>0$, operation is allowed when the transistor is in cut-off condition only (base-emitter reverse biased)
Voltages, higher than indicated by the minimum avalanche breakdown curve at $+V_{BE}$ = 2 V, are allowed during switching off, provided the transient energy does not exceed 5 mWsec
$+V_{BE}=2V$
$I_B=0$
$I_B>0$
$I_B<0$
$-I_C$ (A)
6
5
4
3
2
1
0
0
20
40
60
80
$-V_{CE}$ (V)
C


$-V_{CE} = 1V$
$T_j = 25\ °C$
min
typ
max
$-I_C$ (A)
$-V_{BE}$ (mV)
7Z03258 – 1.4.adi

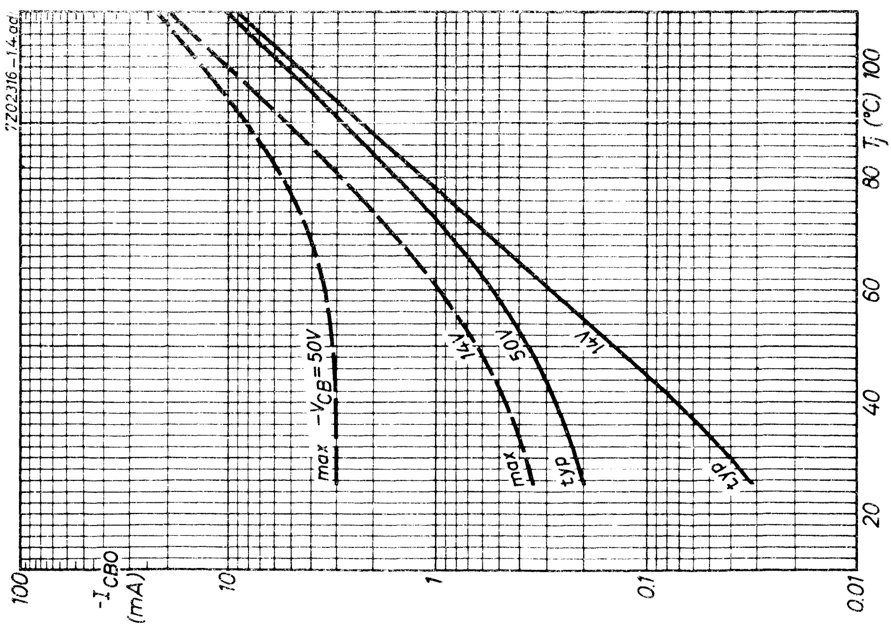

$-V_{CE} = 1V$
$T_j = 25°C$
min
typ
max
$-I_C$ (A)
$-I_B$ (mA)
7Z02320 – 1.4.adi

E

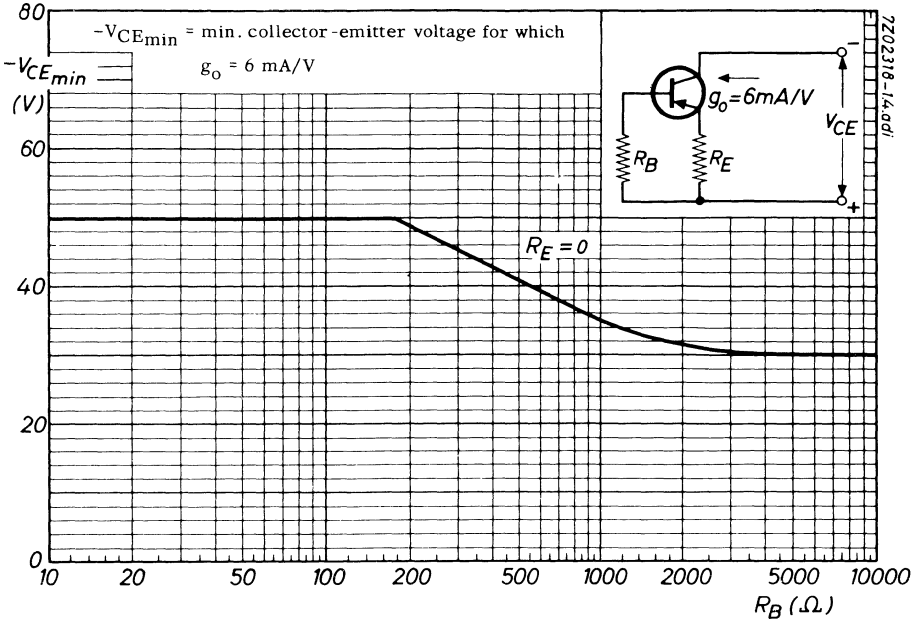
F

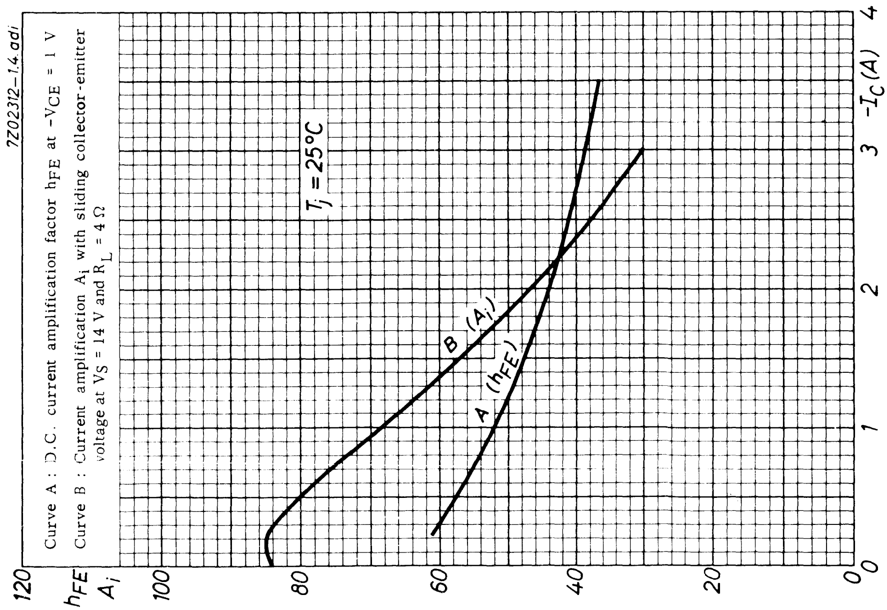

7Z02311-1.4adi
$-V_{CE} = 1V$
$-I_C = 3A$
1A
300mA
$-I_B$ (mA)
100
50
20
10
5
2
1
T_j (°C)
20
40
60
80
100
120

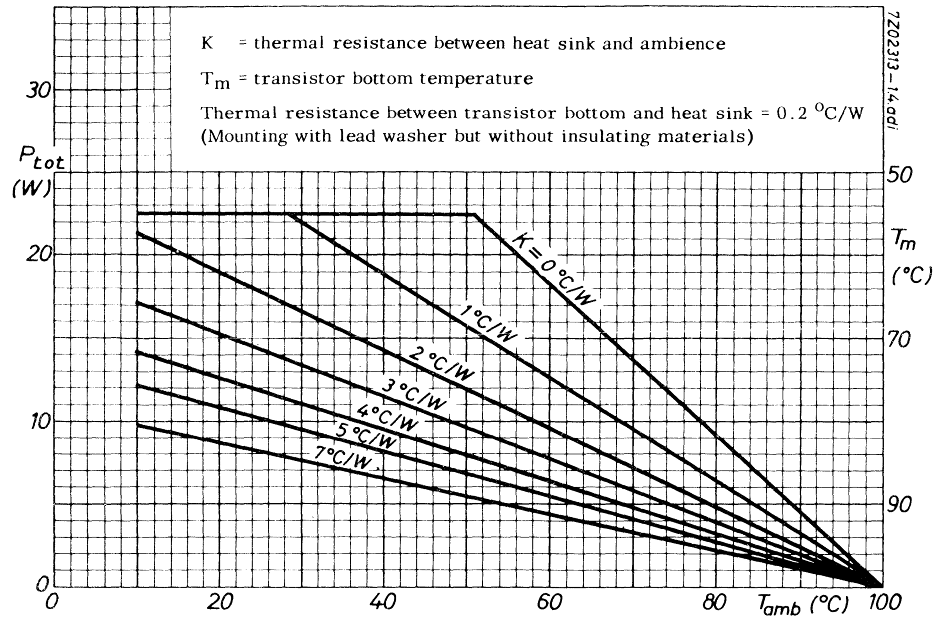
H


7Z02316-1.4ad
$-V_{CB} = 50V$
max
14V
max
50V
typ
14V
typ
$-I_{CBO}$ (mA)
100
10
1
0.1
0.01
T_j (°C)
20
40
60
80
100

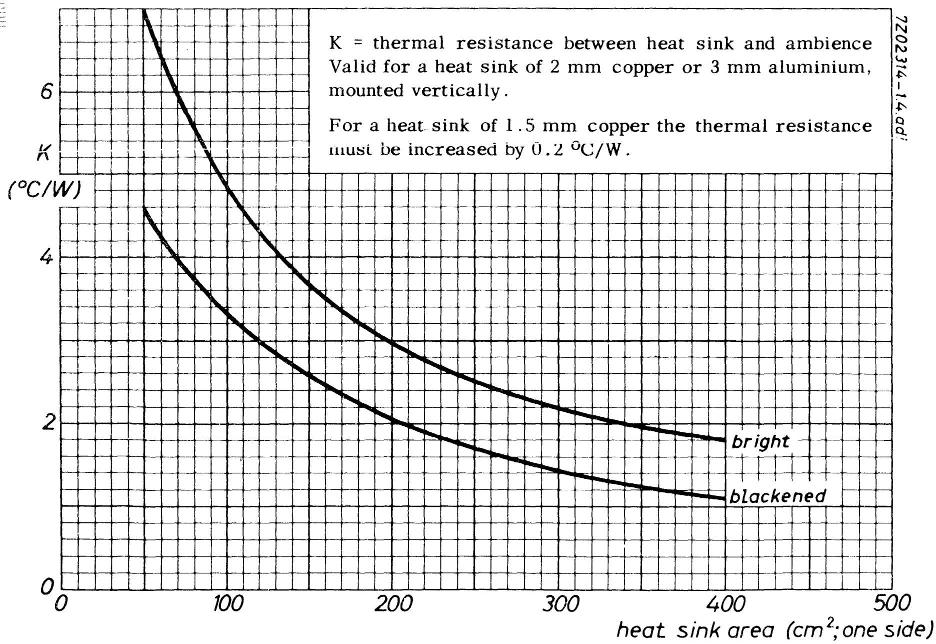
G


$-V_{CEmin}$ = min. collector-emitter voltage for which
g_o = 6 mA/V
$-V_{CEmin}$ (V)
g_o=6mA/V
V_{CE}
R_B
R_E
$R_E = 0$
7Z02318-1.4.adi
80
60
40
20
0
10
20
50
100
200
500
1000
2000
5000
10000
R_B (Ω)


Curve A : D.C. current amplification factor h_{FE} at $-V_{CE}$ = 1 V
Curve B : Current amplification A_i with sliding collector-emitter voltage at V_S = 14 V and R_L = 4 Ω
7Z02312-1.4.adi
$T_j = 25°C$
B (A_i)
A (h_{FE})
h_{FE}
A_i
120
100
80
60
40
20
0
$-I_C$ (A)
0
1
2
3
4


K = thermal resistance between heat sink and ambience
T_m = transistor bottom temperature
Thermal resistance between transistor bottom and heat sink = 0.2 °C/W
(Mounting with lead washer but without insulating materials)
7Z02313-1.4.adi
P_{tot} (W)
30
20
10
0
T_m (°C)
50
70
90
K = 0 °C/W
1 °C/W
2 °C/W
3 °C/W
4 °C/W
5 °C/W
7 °C/W
0
20
40
60
80
T_{amb} (°C)
100

K


K = thermal resistance between heat sink and ambience
Valid for a heat sink of 2 mm copper or 3 mm aluminium, mounted vertically.
For a heat sink of 1.5 mm copper the thermal resistance must be increased by 0.2 °C/W.
7Z02314-1.4.adi
K (°C/W)
6
4
2
0
bright
blackened
0
100
200
300
400
500
heat sink area (cm²; one side)

L

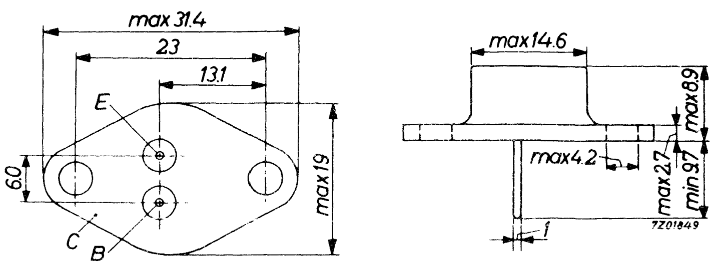
GERMANIUM ALLOYED POWER TRANSISTOR

N-P-N power transistor in a metal envelope with the collector connected to the mounting base.
The AD161 is primarily intended for use together with the p-n-p power transistor AD162 as matched pair AD161/AD162 in 11 W complementary symmetry class B output stages of mains operated amplifiers and radio receivers.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	V_{CBO}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (peak value)	I_{CM}	max.	2	A
Total power dissipation up to $T_{mb} = 65\ ^oC$	P_{tot}	max.	3	W
Junction temperature (incidentally)	T_j	max.	100	^oC
D.C. current gain at $T_j = 25\ ^oC$				
$I_C = 0.5$ A; $V_{CE} = 1$ V	h_{FE}		50 to 300	
Cut-off frequency				
$I_C = 0.3$ A; $V_{CE} = 2$ V	f_{hfe}	typ.	35	kHz

MECHANICAL DATA Dimensions in mm

Collector connected to mounting base



Accessories and mounting instructions see page 4.

7Z3 0149

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector-emitter voltage with $-V_{BE} = 0.6$ V (See also page B)	V_{CEX}	max.	32	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V

Currents

Collector current (d.c. or average over any 50 ms period)	I_C	max.	1	A
Collector current (peak value)	I_{CM}	max.	2	A

Power dissipation

Total power dissipation up to $T_{mb} = 65$ °C	P_{tot}	max.	3	W

Temperatures

Storage temperature	T_{stg}		-65 to +90	°C
Junction temperature: continuous	T_j	max.	90	°C
incidentally	T_j	max.	100	°C

THERMAL RESISTANCE

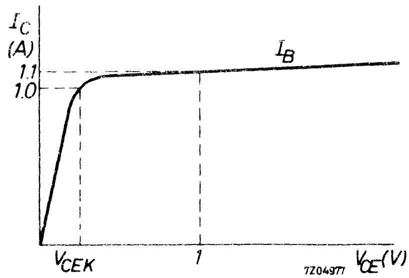
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	8.5	°C/W
From mounting base to heatsink with mica washer	$R_{th\ mb\text{-}h}$	=	1.5	°C/W
without mica washer	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0150

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current			
I_E = 0; V_{CB} = 32 V	I_{CBO}	typ.	20 μA
		<	500 μA
I_E = 0; V_{CB} = 32 V; T_j = 90 °C	I_{CBO}	<	3 mA
$-V_{BE}$ = 0.6 V; V_{CE} = 32 V; T_j = 90 °C	I_{CEX}	<	3 mA
Emitter cut-off current			
I_C = 0; V_{EB} = 10 V	I_{EBO}	typ.	20 μA
		<	200 μA
I_C = 0; V_{EB} = 10 V; T_j = 90 °C	I_{EBO}	<	2 mA
Base-emitter voltage [1]			
I_C = 5 mA; V_{CE} = 10 V	V_{BE}	110 to	140 mV
I_C = 50 mA; V_{CE} = 1 V	V_{BE}	<	300 mV
I_C = 500 mA; V_{CE} = 1 V	V_{BE}	<	650 mV
I_C = 2 A; V_{CE} = 1 V	V_{BE}	<	1300 mV
Knee voltage			
I_C = 1 A; I_B = value for which I_C = 1.1 A at V_{CE} = 1 V	V_{CEK}	<	800 mV



Floating voltage			
I_E = 0; V_{CB} = 32 V; T_j = 90 °C	V_{EBfl}	<	400 mV
Collector capacitance at f = 450 kHz			
I_E = I_e = 0; V_{CB} = 5 V	C_c	typ.	150 pF

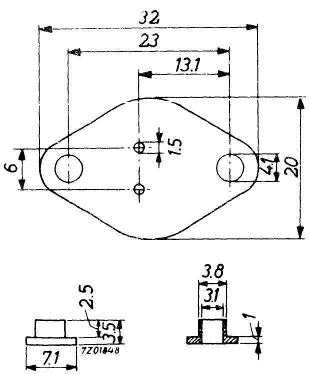
[1]) V_{BE} decreases with about 2 mV/°C at increasing temperature.

7Z3 0151

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

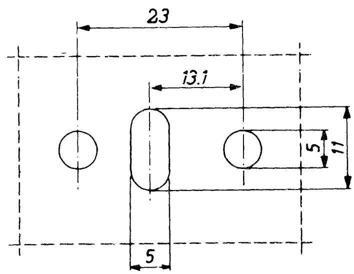
D.C. current gain		
I_C = 5 mA; V_{CE} = 10 V	h_{FE}	> 35
I_C = 50 mA; V_{CE} = 1 V	h_{FE}	typ. 82 45 to 275
I_C = 500 mA; V_{CE} = 1 V	h_{FE}	typ. 90 50 to 300
I_C = 2 A; V_{CE} = 1 V	h_{FE}	> 24
Transition frequency		
I_C = 10 mA; V_{CE} = 2 V	f_T	typ. 3 MHz
Cut-off frequency		
I_C = 300 mA; V_{CE} = 2 V	f_{hfe}	> 20 kHz typ. 35 kHz
D.C. current gain ratio of matched pair AD161/AD162		
$\|I_C\|$ = 500 mA; $\|V_{CE}\|$ = 1 V	h_{FE1}/h_{FE2}	typ. 1.1 < 1.25

ACCESSORIES AND MOUNTING INSTRUCTIONS Dimensions in mm



56239

Mica washer (50 to 100 μm) and insulation bushes

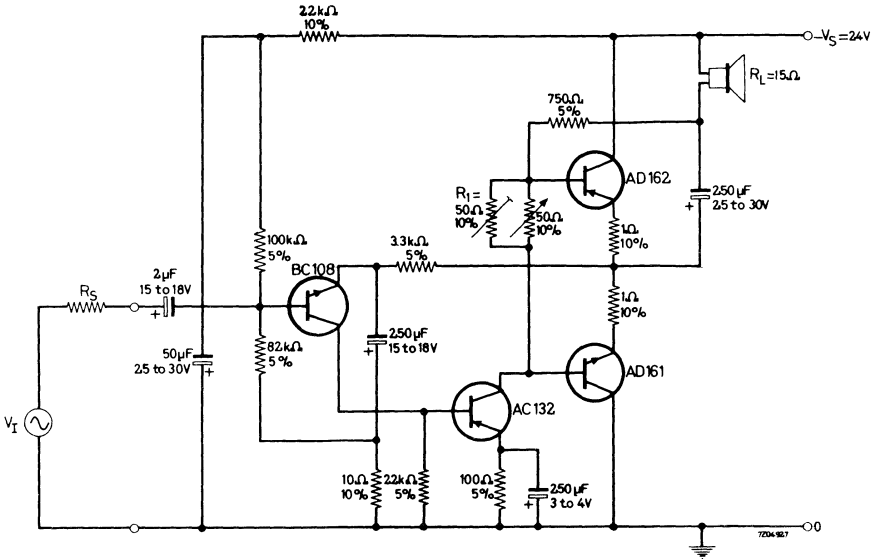


Bore-hole dimensions for heatsink

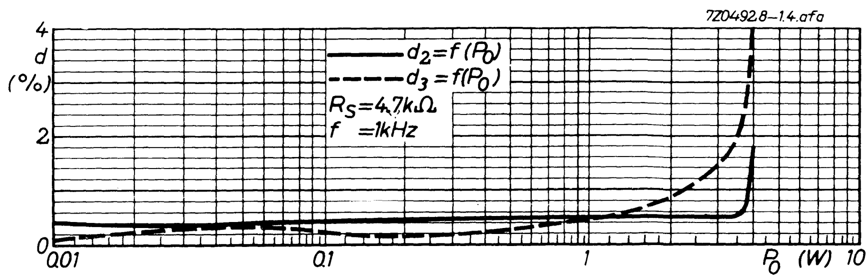
7Z3 0152

APPLICATION INFORMATION

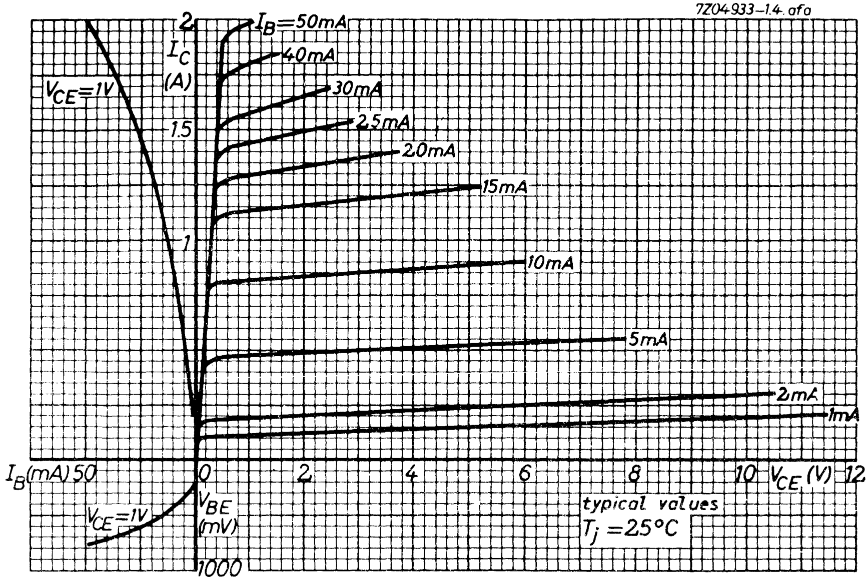
4 W transformerless audio frequency amplifier with matched pair AD161/AD162 in complementary symmetry class B output stage.

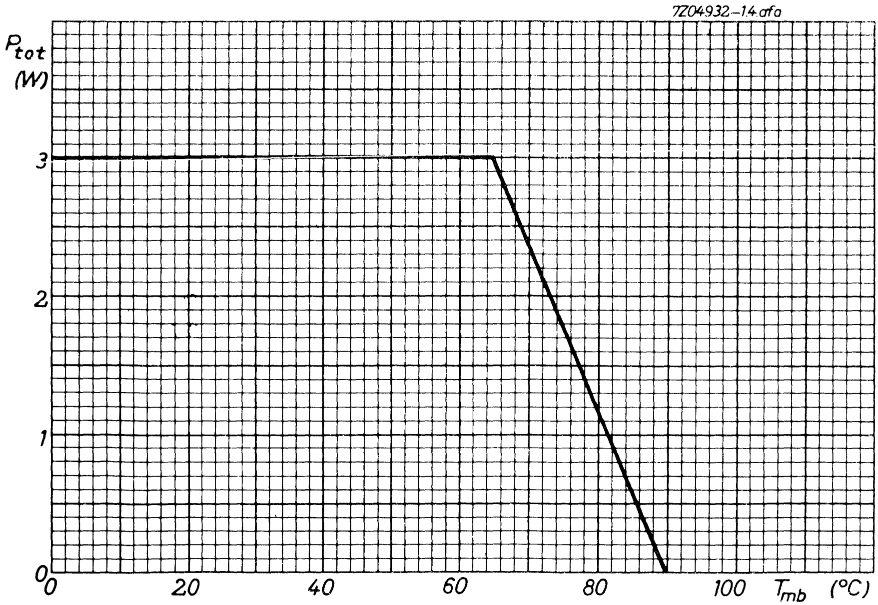


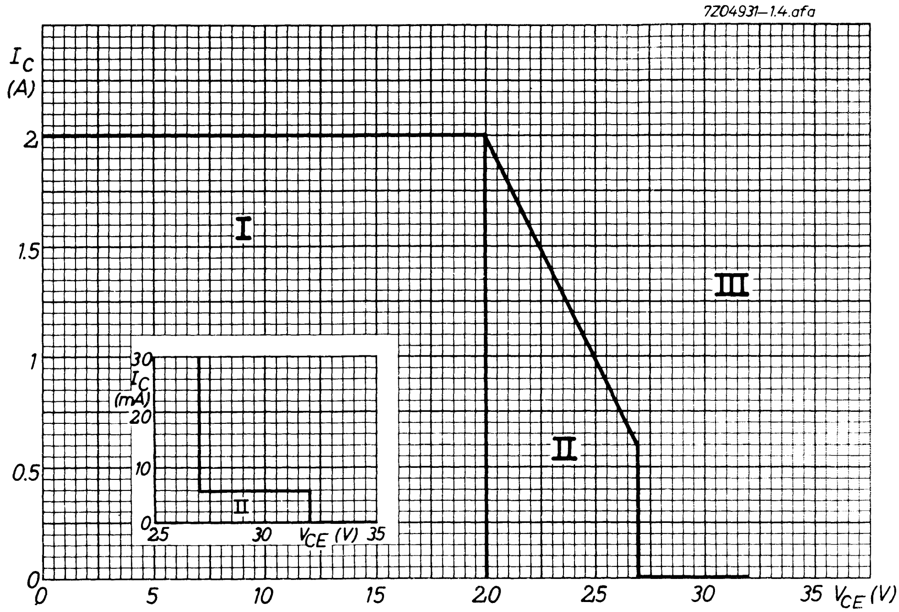
Typical input requirements for an output power of 4 W	$V_{i(rms)}$ = 28 mV; $I_{i(rms)}$ = 0.7 μA; R_i = 40 kΩ; T_{amb} max. 45 °C	
Typical bandwidth (3 dB)	B	= 70 Hz to 16 kHz
Quiescent current	I_{cq}	= 8 mA, adjustable with R_1
Heatsink for AC132		10 cm^2 Al, thickness 1 mm
Heatsinks for AD161 and AD162	$R_{th\ h\text{-}a}$	< 14.5 °C/W
Supply voltage	$-V_S$	= 24 V, max. 27 V



7Z3 0153


7Z04933-1.4.afa
I_C (A)
2
1.5
1
I_B=50mA
40mA
30mA
25mA
20mA
15mA
10mA
5mA
2mA
1mA
V_{CE}=1V
I_B(mA) 50
0
2
4
6
8
10
12
V_{CE} (V)
V_{BE} (mV)
1000
V_{CE}=1V
typical values
T_j =25°C


7Z04932-1.4.afa
P_{tot} (W)
3
2
1
0
0
20
40
60
80
100
T_{mb} (°C)

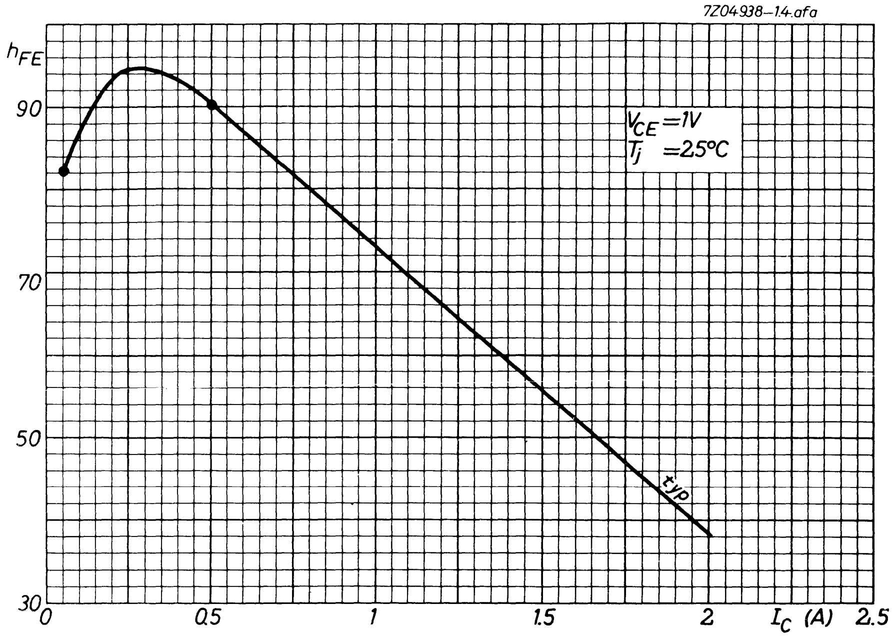


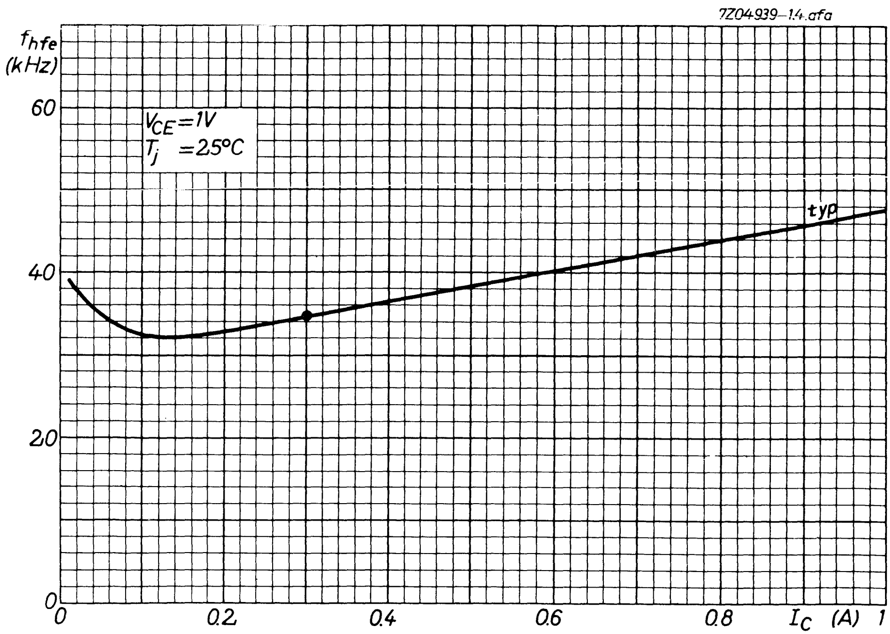
I = Permissible region of operation under all base-emitter conditions.

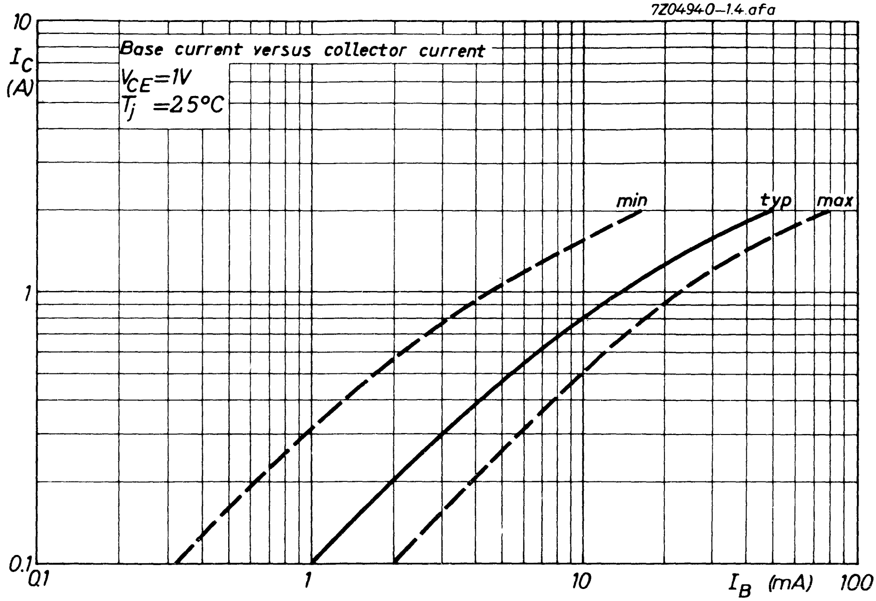
II = Additional region of operation when the transistor is cut-off with $-V_{BE} > -V_{BEfl}$.

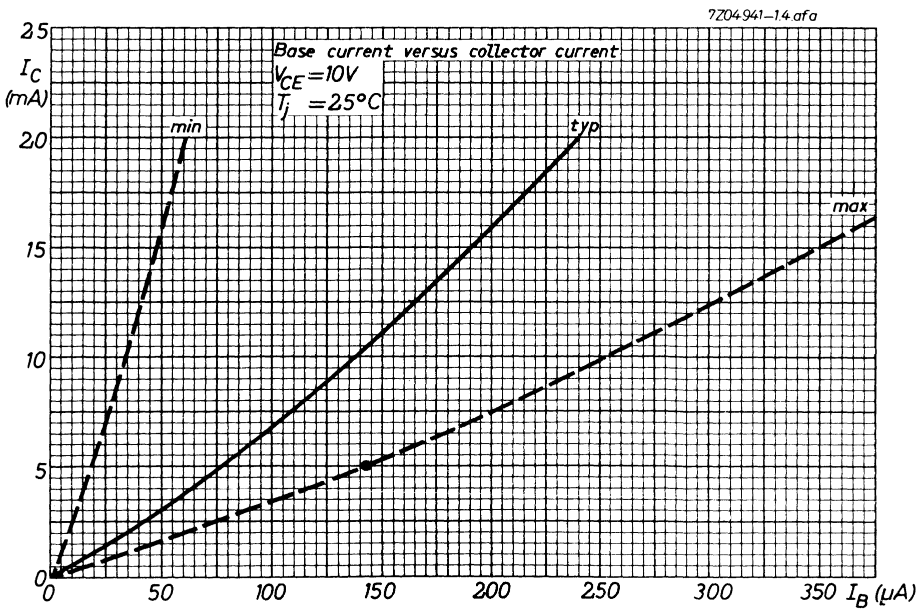
III Outside regions I and II, the transistor can withstand transient energies of 1.0 mWs, provided it is cut-off with $-V_{BB} < 0.6$ V; $R_i = 18\ \Omega$.

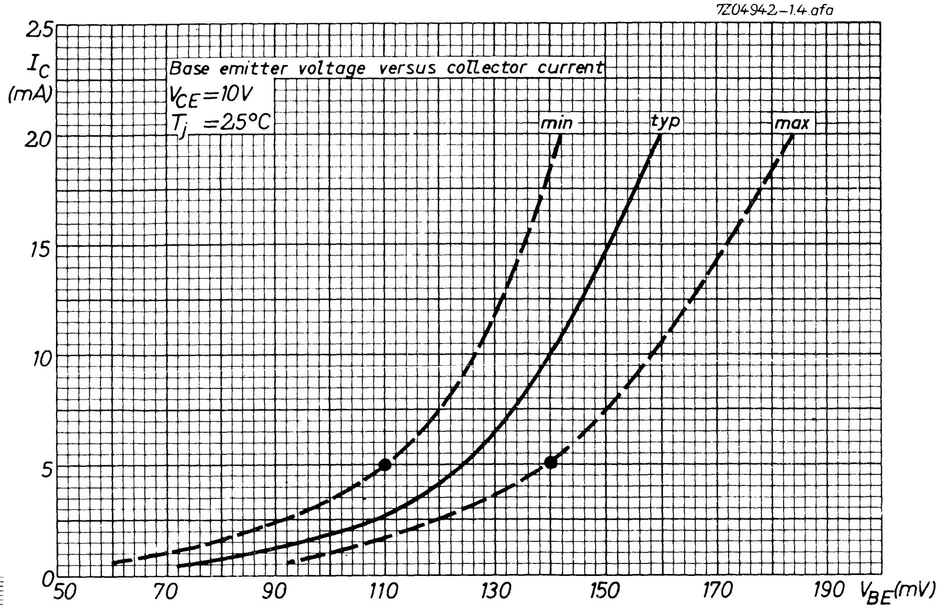
7Z3 0154

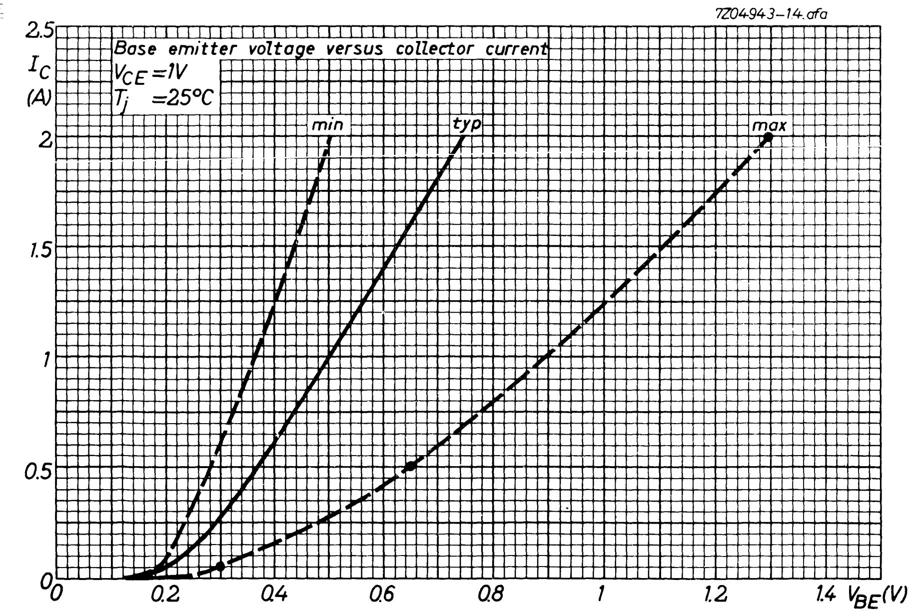

7Z04938–1.4.afa
h_{FE}
90
70
50
30
V_{CE} = 1V
T_j = 25°C
typ
0
0.5
1
1.5
2
I_C (A)
2.5

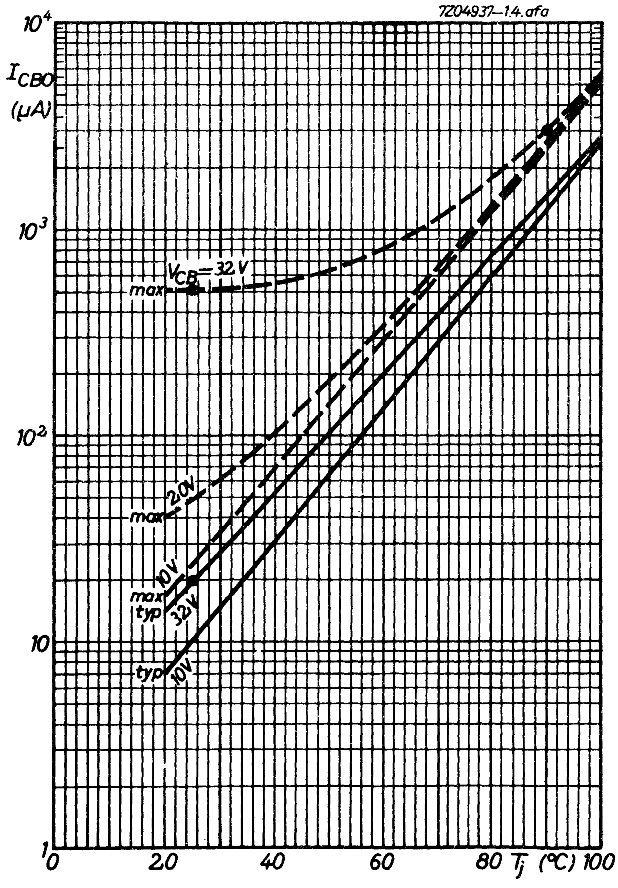

7Z04939–1.4.afa
f_{hfe}
(kHz)
60
40
20
0
V_{CE} = 1V
T_j = 25°C
typ
0
0.2
0.4
0.6
0.8
I_C (A)
1


7Z04940–1.4.afa
Base current versus collector current
V_{CE}=1V
T_j =25°C
I_C (A)
10
1
0.1
min
typ
max
0.1
1
10
I_B (mA)
100


7Z04941–1.4.afa
Base current versus collector current
V_{CE}=10V
T_j =25°C
I_C (mA)
25
20
15
10
5
0
min
typ
max
0
50
100
150
200
250
300
350
I_B (μA)


7Z04942-1.4.afa
Base emitter voltage versus collector current
V_{CE}=10V
T_j =25°C
min
typ
max
I_C
(mA)
2.5
20
15
10
5
0
50
70
90
110
130
150
170
190
V_{BE}(mV)


7Z04943-1.4.afa
Base emitter voltage versus collector current
V_{CE}=1V
T_j =25°C
min
typ
max
I_C
(A)
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
V_{BE}(V)


7Z04937-1.4.afa
10^4
I_{CBO}
(μA)
10^3
V_{CB} = 32 V
max
10^2
20V
max
10V
max
typ
32V
10
typ
10V
1
0
20
40
60
80
T_j (°C)
100

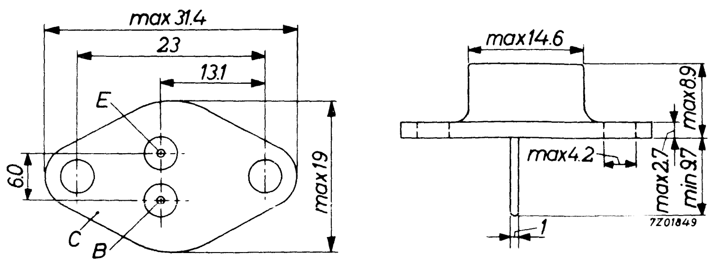
GERMANIUM ALLOYED POWER TRANSISTOR

P-N-P power transistor in a metal envelope with the collector connected to the mounting base.
It is primarily intended for use as matched pair 2-AD162 in class B push-pull output stages and together with the n-p-n power transistor AD161 as matched pair AD161/AD162 in 11 W complementary symmetry class B output stages of mains operated amplifiers and radio receivers.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Collector current (peak value)	$-I_{CM}$	max.	2	A
Total power dissipation up to $T_{mb} = 45\ ^{o}C$	P_{tot}	max.	6	W
Junction temperature (incidentally)	T_j	max.	100	^{o}C
D.C. current gain at $T_j = 25\ ^{o}C$				
$-I_C = 0.5$ A; $-V_{CE} = 1$ V	h_{FE}	50 to 300		
Cut-off frequency				
$-I_C = 0.3$ A; $-V_{CE} = 2$ V	f_{hfe}	typ.	18	kHz

MECHANICAL DATA Dimensions in mm

Collector connected to mounting base



Accessories and mounting instructions see page 4. 7Z3 0155

RATINGS (Limiting values) [1])

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20	V
Collector-emitter voltage with $+V_{BE} = 0.6$ V (See also page B)	$-V_{CEX}$	max.	32	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V

Currents

Collector current (d.c. or average over any 50 ms period)	$-I_C$	max.	1	A
Collector current (peak value)	$-I_{CM}$	max.	2	A

Power dissipation

Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	6	W

Temperatures

Storage temperature	T_{stg}	-65 to +90		°C
Junction temperature: continuous	T_j	max.	90	°C
incidentally	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	7.5	°C/W
From mounting base to heatsink with mica washer	$R_{th\ mb-h}$	=	1.5	°C/W
without mica washer	$R_{th\ mb-h}$	=	0.5	°C/W

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0156

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; $-V_{CB}$ = 32 V	$-I_{CBO}$	typ.	15	μA
		<	200	μA
I_E = 0; $-V_{CB}$ = 32 V; T_j = 90 °C	$-I_{CBO}$	<	2	mA
$+V_{BE}$ = 0.6 V; $-V_{CE}$ = 32 V; T_j = 90 °C	$-I_{CEX}$	<	2	mA

Emitter cut-off current

I_C = 0; $-V_{EB}$ = 10 V	$-I_{EBO}$	typ.	15	μA
		<	200	μA
I_C = 0; $-V_{EB}$ = 10 V; T_j = 90 °C	$-I_{EBO}$	<	2	mA

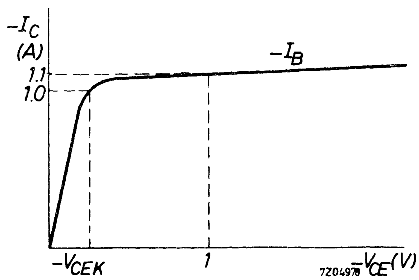
Base-emitter voltage [1]

$-I_C$ = 5 mA; $-V_{CE}$ = 10 V	$-V_{BE}$	120 to	150	mV
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	$-V_{BE}$	<	300	mV
$-I_C$ = 500 mA; $-V_{CE}$ = 1 V	$-V_{BE}$	<	550	mV
$-I_C$ = 2 A; $-V_{CE}$ = 1 V	$-V_{BE}$	<	1000	mV

Knee voltage

$-I_C$ = 1 A; $-I_B$ = value for which

$-I_C$ = 1.1 A at $-V_{CE}$ = 1 V $-V_{CEK}$ < 600 mV



Floating voltage

I_E = 0; $-V_{CB}$ = 32 V; T_j = 90 °C $-V_{EBfl}$ < 400 mV

Collector capacitance at f = 450 kHz

I_E = I_e = 0; $-V_{CB}$ = 5 V C_c typ. 90 pF

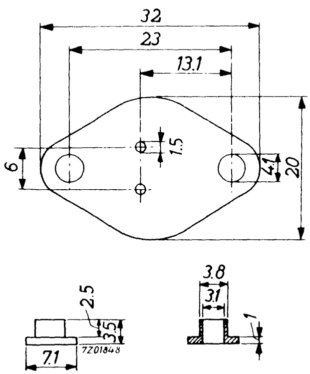
[1]) $-V_{BE}$ decreases with about 2 mV/°C at increasing temperature.

7Z3 0157

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

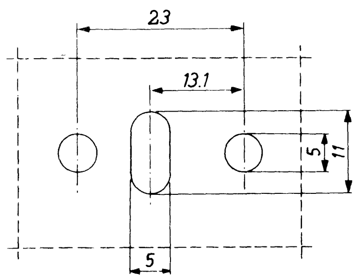
D.C. current gain				
$-I_C$ = 5 mA; $-V_{CE}$ = 10 V	h_{FE}	>	35	
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE}	typ.	82	
		45 to 275		
$-I_C$ = 500 mA; $-V_{CE}$ = 1 V	h_{FE}	typ.	90	
		50 to 300		
$-I_C$ = 2 A; $-V_{CE}$ = 1 V	h_{FE}	>	35	
Transition frequency				
$-I_C$ = 10 mA; $-V_{CE}$ = 2 V	f_T	typ.	1.5	MHz
Cut-off frequency				
$-I_C$ = 300 mA; $-V_{CE}$ = 2 V	f_{hfe}	>	10	kHz
		typ.	18	kHz
D.C. current gain ratio of matched pair AD161/AD162				
$\|I_C\|$ = 500 mA; $\|V_{CE}\|$ = 1 V	h_{FE1}/h_{FE2}	typ.	1.1	
		<	1.25	
matched pair 2-AD162				
$-I_C$ = 50 mA; $-V_{CE}$ = 1 V	h_{FE1}/h_{FE2}	typ.	1.1	
$-I_C$ = 500 mA; $-V_{CE}$ = 1 V		<	1.25	

ACCESSORIES AND MOUNTING INSTRUCTIONS Dimensions in mm



56239

Mica washer (50 to 100 μm)
and insulation bushes

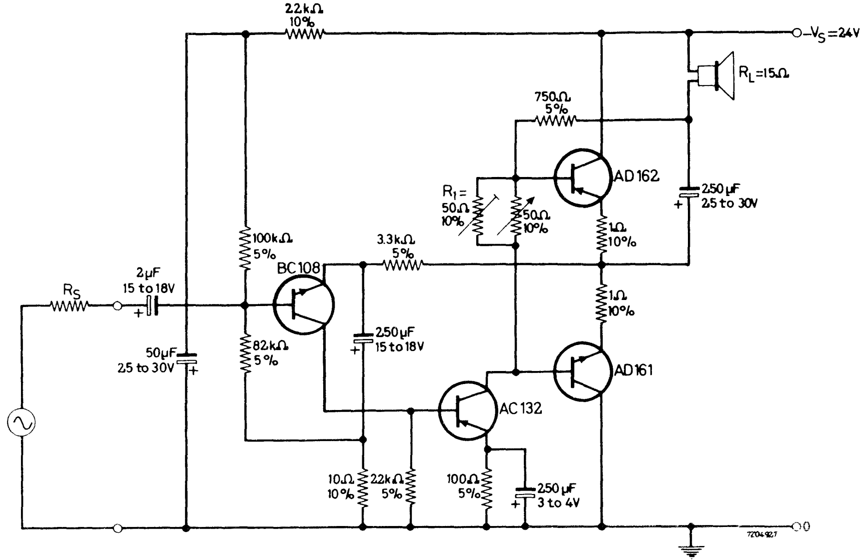


Bore-hole dimensions
for heatsink

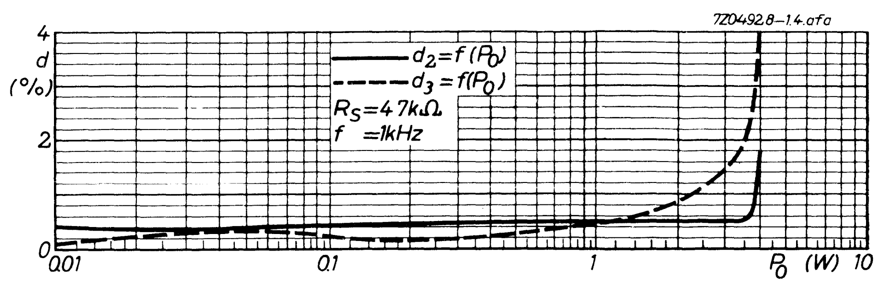
7Z3 0158

APPLICATION INFORMATION

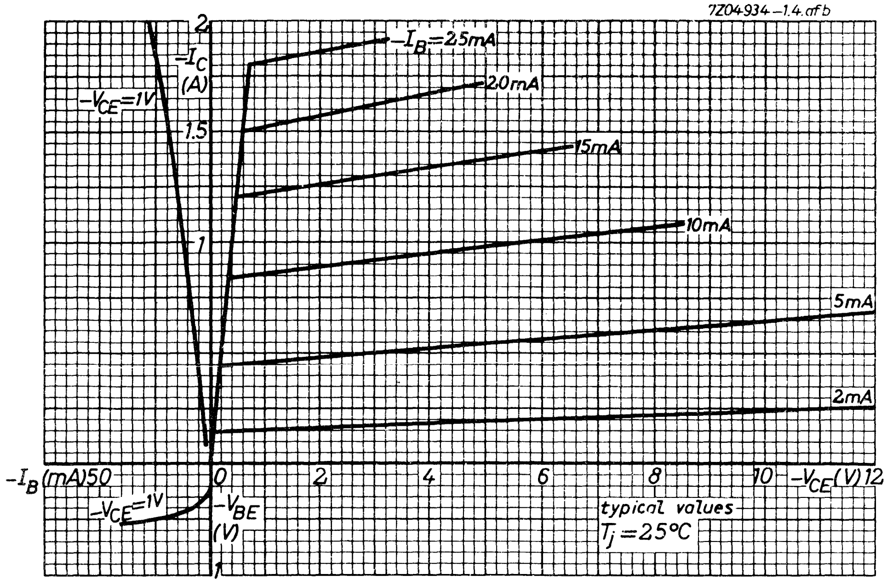
4 W transformerless audio frequency amplifier with matched pair AD161/AD162 in complementary symmetry class B output stage.

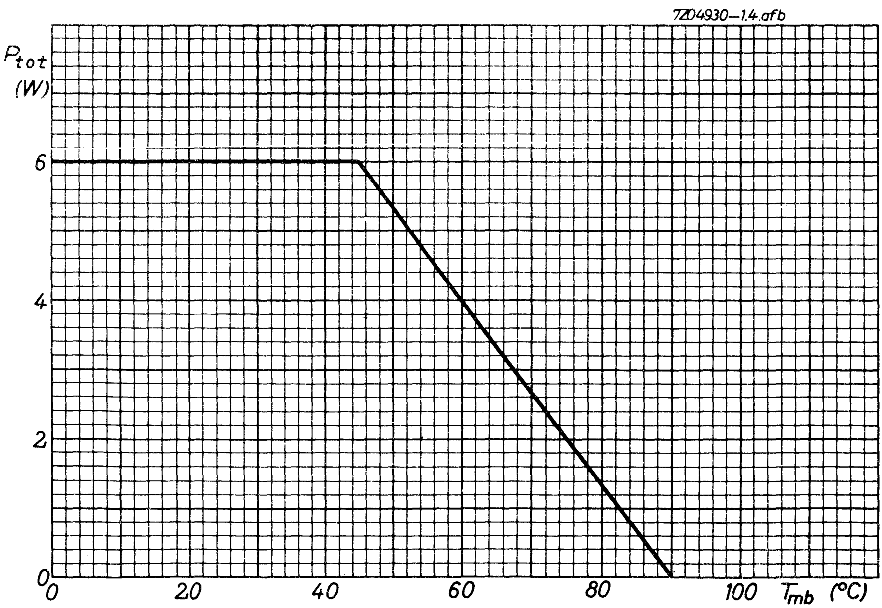


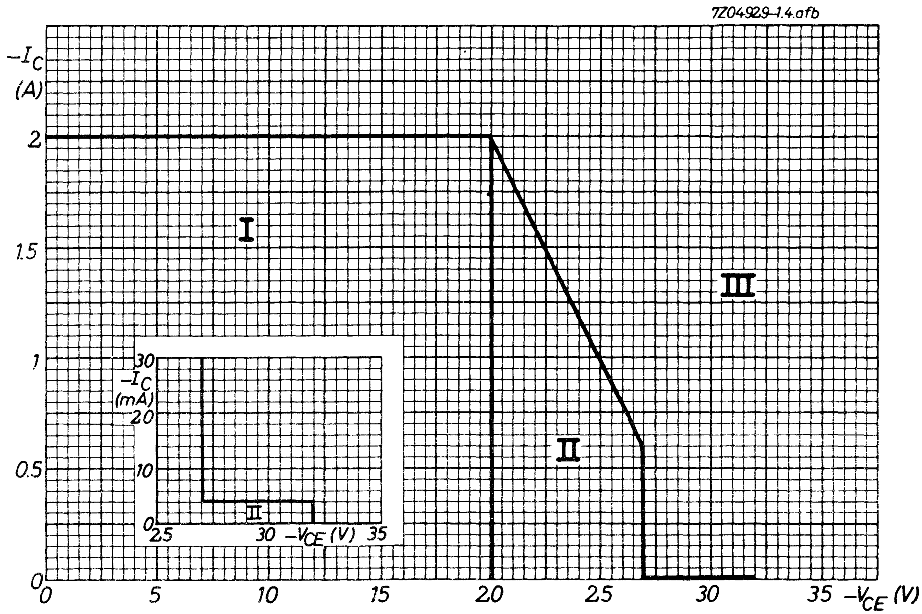
Typical input requirements for an output power of 4 W	$V_{i(rms)}$	=	28 mV; $I_{i(rms)}$ = 0.7 μA;
	R_i	=	40 kΩ; T_{amb} max. 45 °C
Typical bandwidth (3 dB)	B	=	70 Hz to 16 kHz
Quiescent current	I_{cq}	=	8 mA, adjustable with R_1
Heatsink for AC132			10 cm^2 Al, thickness 1 mm
Heatsinks for AD161 and AD162	$R_{th\ h\text{-}a}$	<	14.5 °C/W
Supply voltage	$-V_S$	=	24 V, max. 27 V



7Z3 0153


7Z04934-1.4.afb
$-I_B$=25mA
20mA
15mA
10mA
5mA
2mA
$-I_C$ (A)
2
1.5
1
$-V_{CE}$=1V
$-I_B$ (mA) 50
0
2
4
6
8
10
$-V_{CE}$ (V) 12
$-V_{CE}$=1V
$-V_{BE}$ (V)
1
typical values
T_j = 25°C


7Z04930-1.4.afb
P_{tot} (W)
6
4
2
0
0
20
40
60
80
100
T_{mb} (°C)

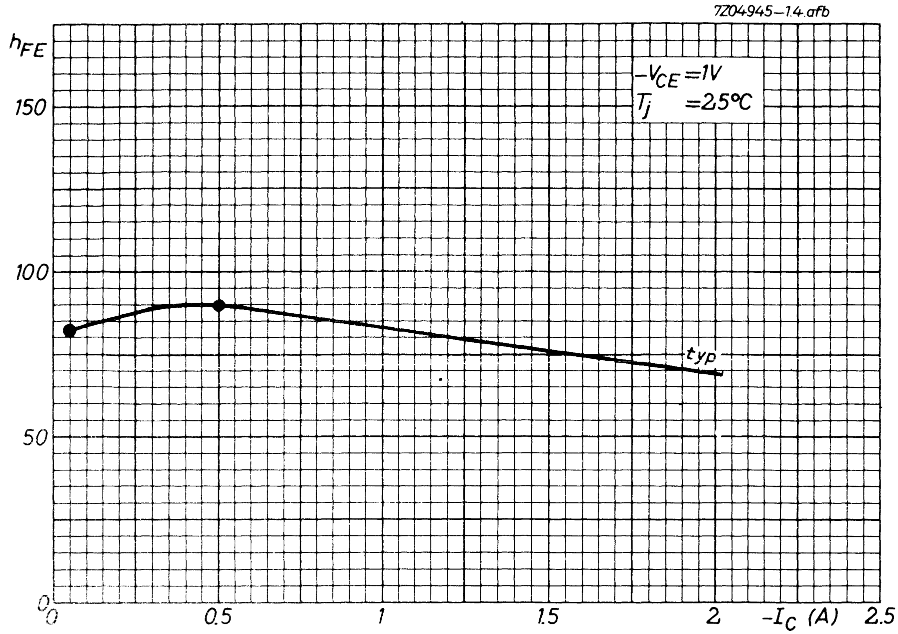


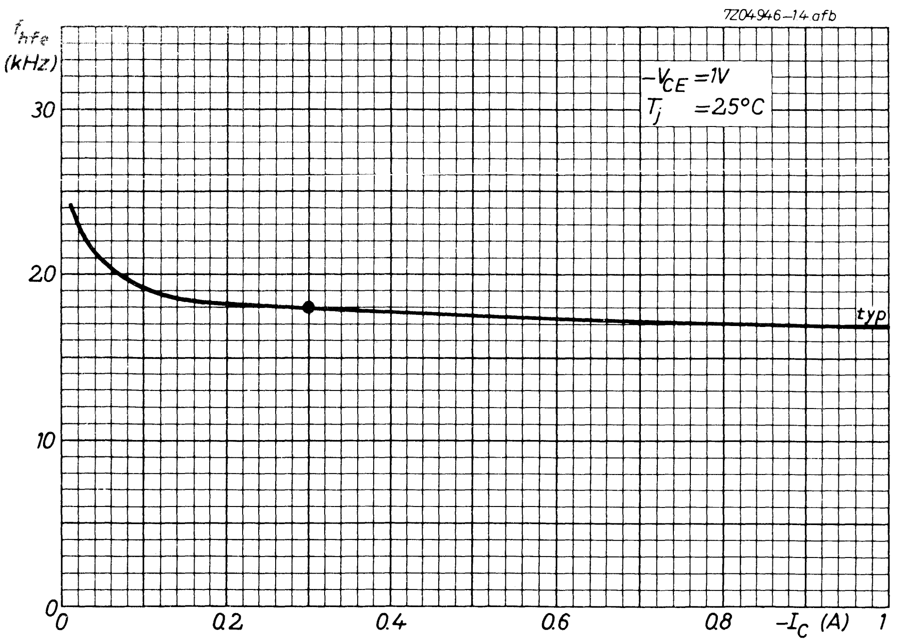
I = Permissible region of operation under all base-emitter conditions.

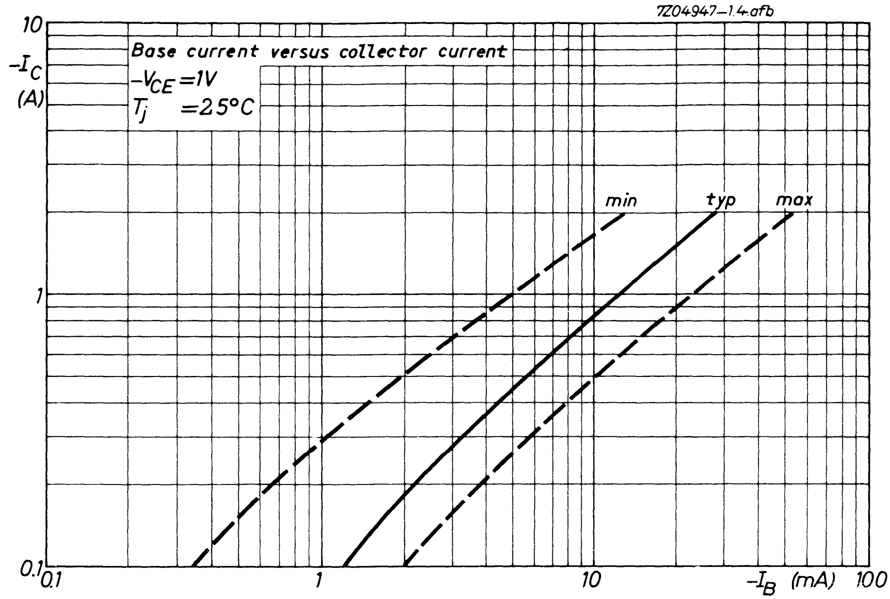
II = Additional region of operation when the transistor is cut-off with $V_{BE} > V_{BEfl}$.

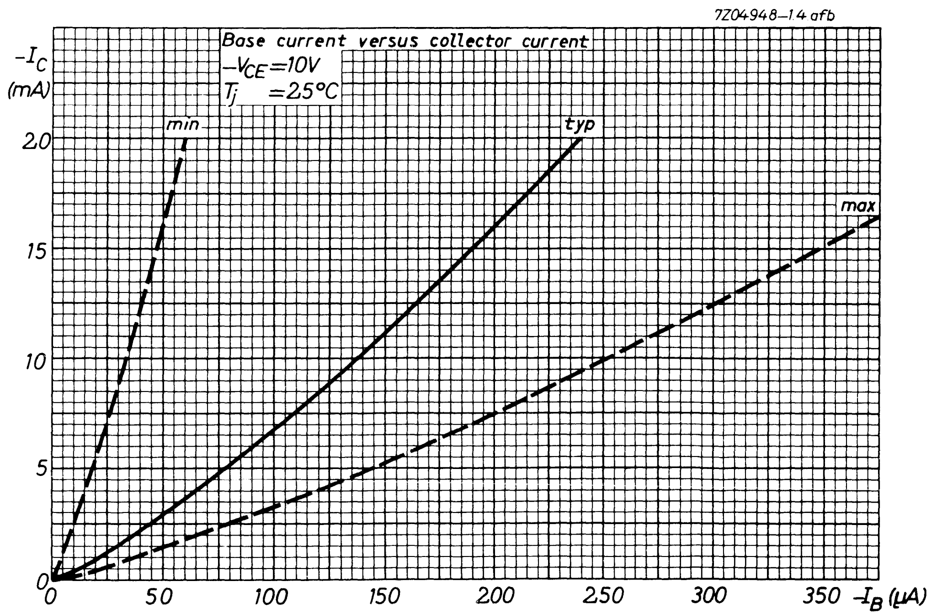
III Outside regions I and II, the transistor can withstand transient energies of 4.5 mWs, provided it is cut-off with $+V_{BB} < 0.6$ V; $R_i = 18\ \Omega$.

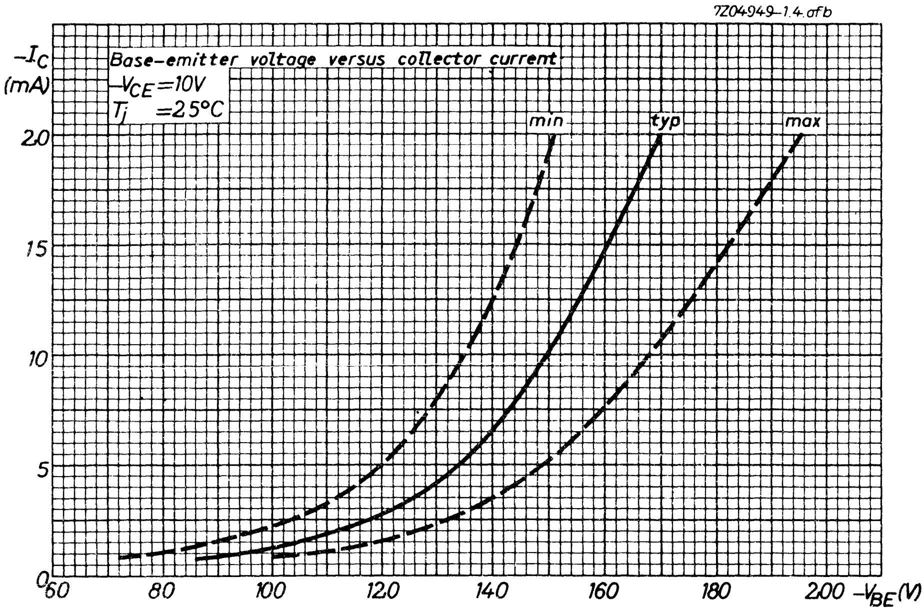
7Z3 0159

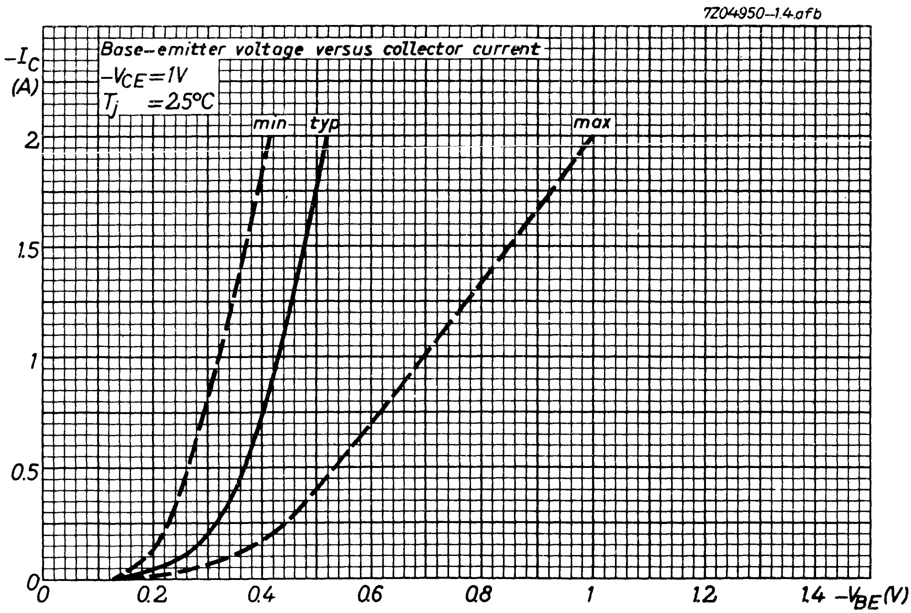

7Z04945–1.4.afb
h_{FE}
150
100
50
0
0
0.5
1
1.5
2
$-I_C$ (A)
2.5
$-V_{CE}$ = 1V
T_j = 25°C
typ

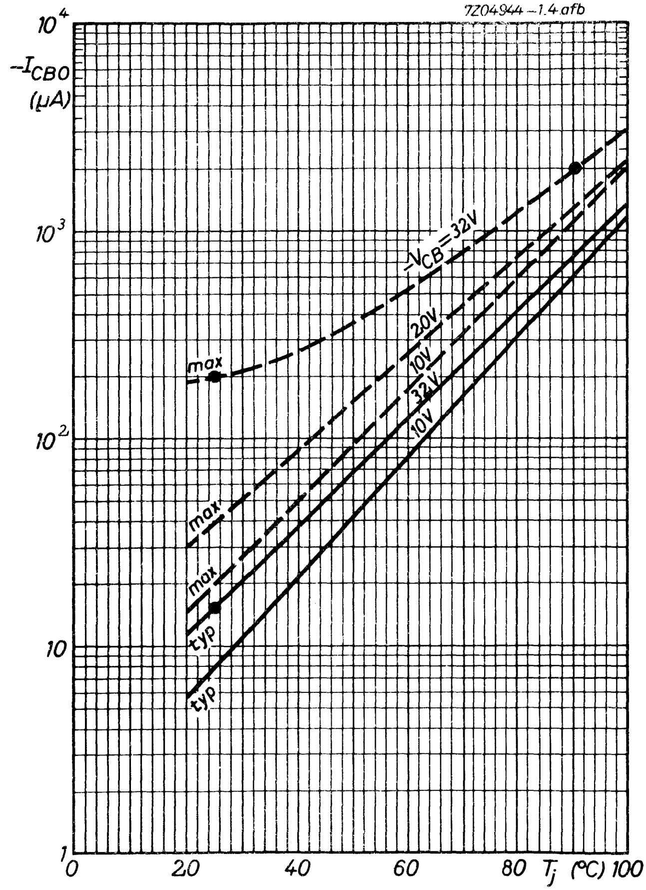

7Z04946–14.afb
f_{hfe}
(kHz)
30
20
10
0
0
0.2
0.4
0.6
0.8
$-I_C$ (A)
1
$-V_{CE}$ = 1V
T_j = 25°C
typ


7Z04947–1.4-afb
Base current versus collector current
$-V_{CE}$ = 1V
T_j = 25°C
$-I_C$ (A)
10
1
0.1
min
typ
max
0.1
1
10
100
$-I_B$ (mA)


7Z04948–1.4 afb
Base current versus collector current
$-V_{CE}$ = 10V
T_j = 25°C
$-I_C$ (mA)
20
15
10
5
0
min
typ
max
0
50
100
150
200
250
300
350
$-I_B$ (μA)


7Z04949–1.4.afb
$-I_C$ (mA)
Base–emitter voltage versus collector current
$-V_{CE}$ = 10V
T_j = 25°C
min
typ
max
0
5
10
15
20
60
80
100
120
140
160
180
200 $-V_{BE}$ (V)


7Z04950–1.4.afb
$-I_C$ (A)
Base–emitter voltage versus collector current
$-V_{CE}$ = 1V
T_j = 25°C
min
typ
max
0
0.5
1
1.5
2
0
0.2
0.4
0.6
0.8
1
1.2
1.4 $-V_{BE}$ (V)


7Z04944 - 1.4 afb
10^4
$-I_{CBO}$ (μA)
10^3
10^2
10
1
0
20
40
60
80
T_j (°C)
100
$-V_{CB}$=32V
20V
10V
32V
10V
max
max
max
typ
typ

P-N-P POWER TRANSISTOR

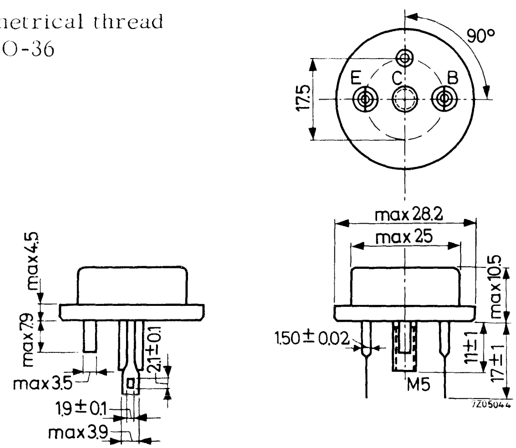
Germanium alloy transistor in a metal envelope. Except for the metrical thread the outline conforms to TO-36. The ADY26 is primarily intended for high power and high current application.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	40	V
Collector current (peak value)	$-I_{CM}$	max.	30	A
Total power dissipation up to T_{mb} = 30 °C	P_{tot}	max.	100	W
Junction temperature	T_j	max.	90	°C
D.C. current gain at T_j = 25 °C I_E = 25 A; V_{CB} = 0	h_{FE}	>	15	

MECHANICAL DATA

Dimensions in mm

Except for the metrical thread conforming to TO-36



Supplied with the device: Nut and mica washer

7Z3 0680

RATINGS (Limiting values) [1])

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	80	V
Collector-emitter voltage (open base) see also page F	$-V_{CEO}$	max.	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	40	V

Currents

Collector current (averaged over any 20 ms period)	$-I_C$	max.	25	A
Collector current (peak value)	$-I_{CM}$	max.	30	A
Base current (averaged over any 20 ms period)	$-I_B$	max.	3	A
Base current (peak value)	$-I_{BM}$	max.	5	A

Power dissipation

Total power dissipation up to $T_{mb} = 30$ °C see also page G	P_{tot}	max.	100	W

Temperatures

Storage temperature	T_{stg}		-55 to +90	°C
Junction temperature	T_j	max.	90	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6	°C/W

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[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0681

CHARACTERISTICS

Collector cut-off current		
$I_E = 0$; $-V_{CB} = 2$ V	$-I_{CBO}$	typ. 50 μA < 200 μA
$I_E = 0$; $-V_{CB} = 80$ V	$-I_{CBO}$	typ. 0.5 mA < 4 mA
Emitter cut-off current		
$I_C = 0$; $-V_{EB} = 2$ V	$-I_{EBO}$	typ. 50 μA < 200 μA
$I_C = 0$; $-V_{EB} = 40$ V	$-I_{EBO}$	typ. 0.5 mA < 4 mA
Currents at reverse biased emitter junction		
$+V_{BE} = 1$ V; $-V_{CE} = 80$ V; $T_j = 90$ °C	$-I_{CEX}$	typ. 3 mA
Sustaining voltage		
$-I_C = 25$ A; $+V_{BE} = 2$ V	$-V_{CEXsust}$	> 40 V
Base-emitter voltage		
$I_E = 5$ A; $V_{CB} = 0$	$-V_{BE}$	typ. 0.6 V < 1 V
$I_E = 25$ A; $V_{CB} = 0$ [1]	$-V_{BE}$	typ. 1.2 V < 2 V
Saturation voltage [1]		
$-I_C = 25$ A; $-I_B = 2.5$ A	$-V_{CEsat}$	typ. 0.15 V < 0.5 V
Emitter floating voltage		
$I_E = 0$; $-V_{CB} = 80$ V	$-V_{EBfl}$	typ. 0.2 V < 1.0 V
D.C. current gain		
$I_E = 5$ A; $V_{CB} = 0$	h_{FE}	typ. 60 40 to 120
$I_E = 25$ A; $V_{CB} = 0$ [1]	h_{FE}	> 15 typ. 25
Collector capacitance		
$I_E = I_e = 0$; $-V_{CB} = 12$ V	C_c	typ. 350 pF

[1]) Measured under pulsed conditions to prevent excessive dissipation.

7Z3 0682

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

Small signal current gain

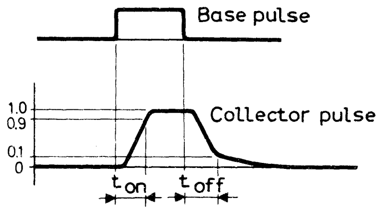
$-I_C$ = 1 A; $-V_{CE}$ = 12 V; f = 100 kHz	h_{fe}	>	1.0
		typ.	1.7

Turn on time

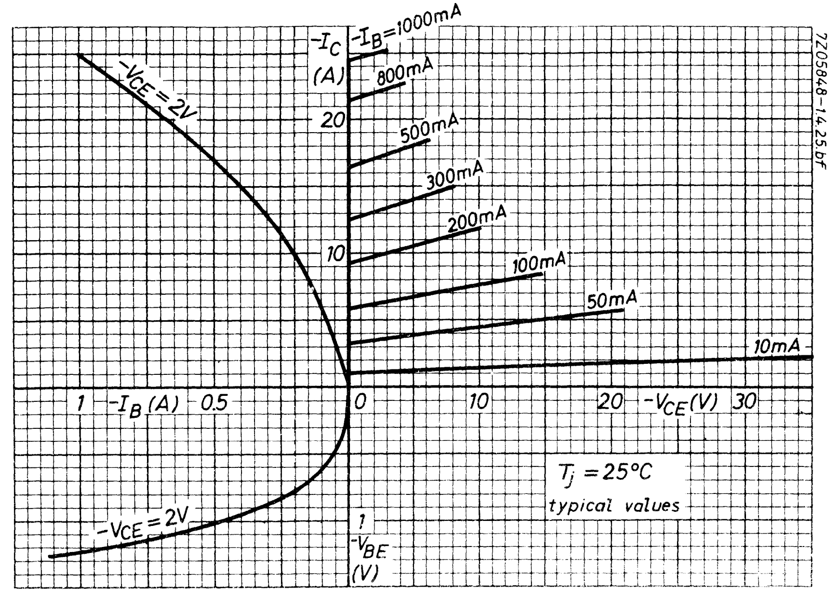
$-I_C$ = 25 A; $-I_B$ = 2 A; $-V_{CC}$ = 18 V	t_{on}	typ.	25	μs

Turn off time

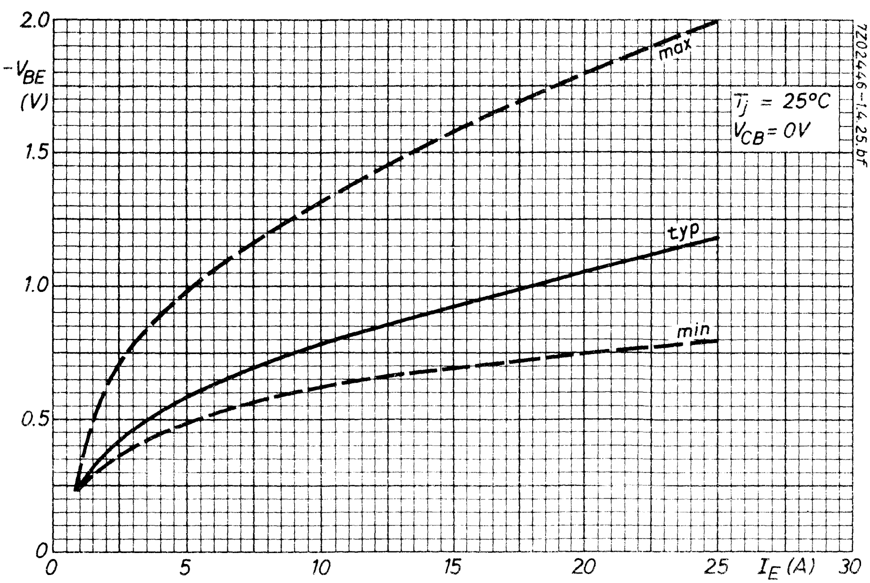
$-I_C$ = 25 A; V_{BEoff} = 6 V; R_{BE} = 10 Ω	t_{off}	typ.	75	μs



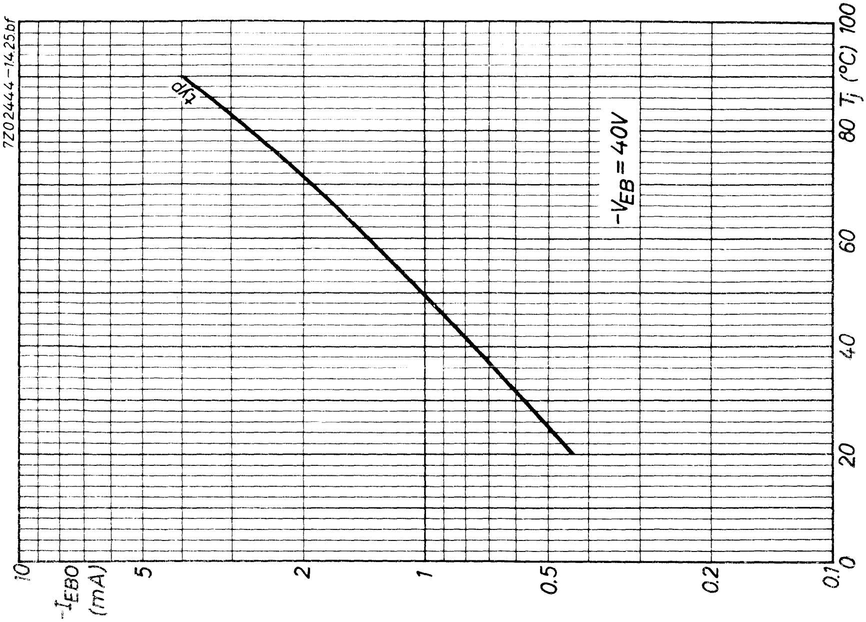
7Z3 0683

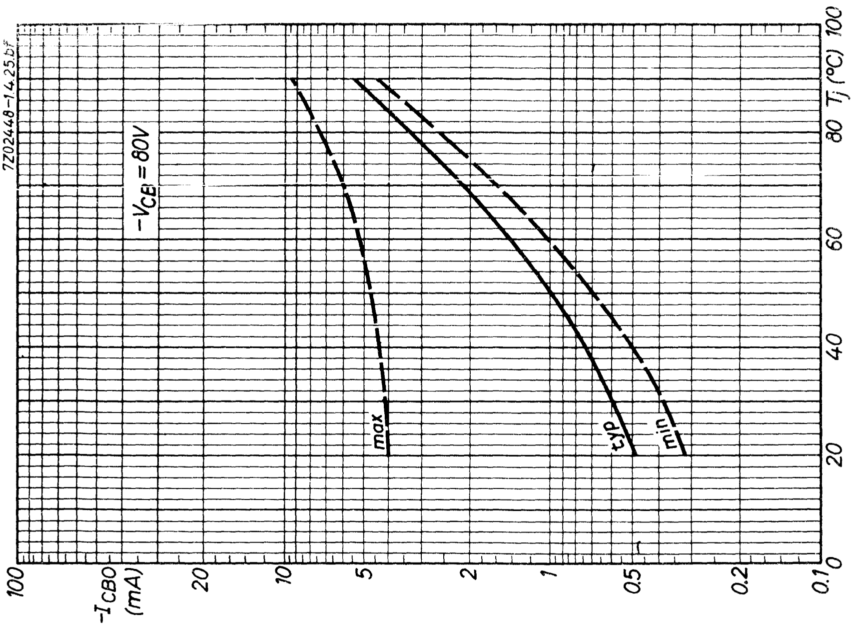


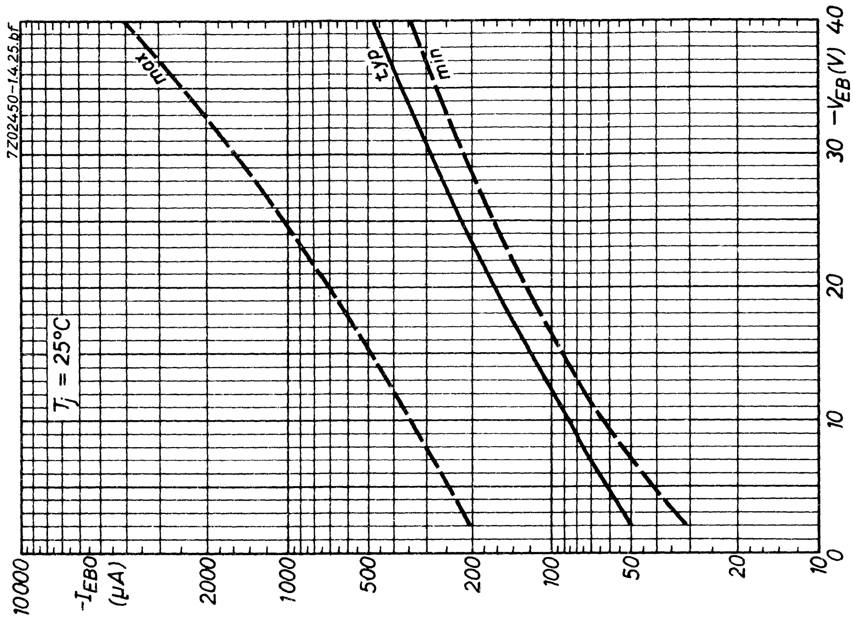
$-I_C$ (A)
$-I_B$=1000mA
800mA
500mA
300mA
200mA
100mA
50mA
10mA
20
10
$-V_{CE}$=2V
1
$-I_B$ (A)
0.5
0
10
20
$-V_{CE}$(V)
30
T_j =25°C
typical values
$-V_{CE}$=2V
1
$-V_{BE}$ (V)
7Z05848-1.4.25.bf

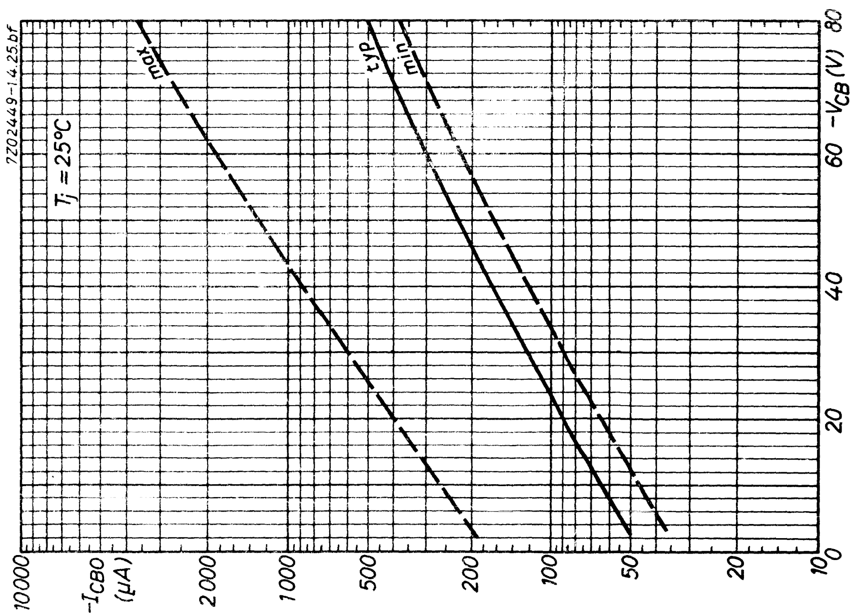


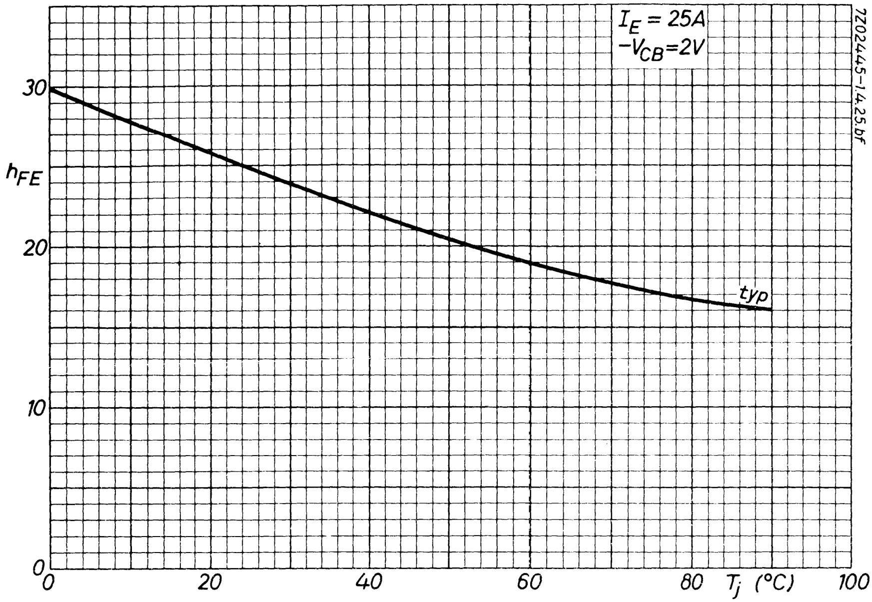
2.0
$-V_{BE}$ (V)
1.5
1.0
0.5
0
max
typ
min
T_j = 25°C
V_{CB}= 0V
0
5
10
15
20
25
I_E (A)
30
7Z02446-1.4.25.bf


7Z02444-1.4.25bf
typ
$-V_{EB} = 40V$
$-I_{EBO}$ (mA)
T_j (°C)
10
5
2
1
0.5
0.2
0.1
0
20
40
60
80
100

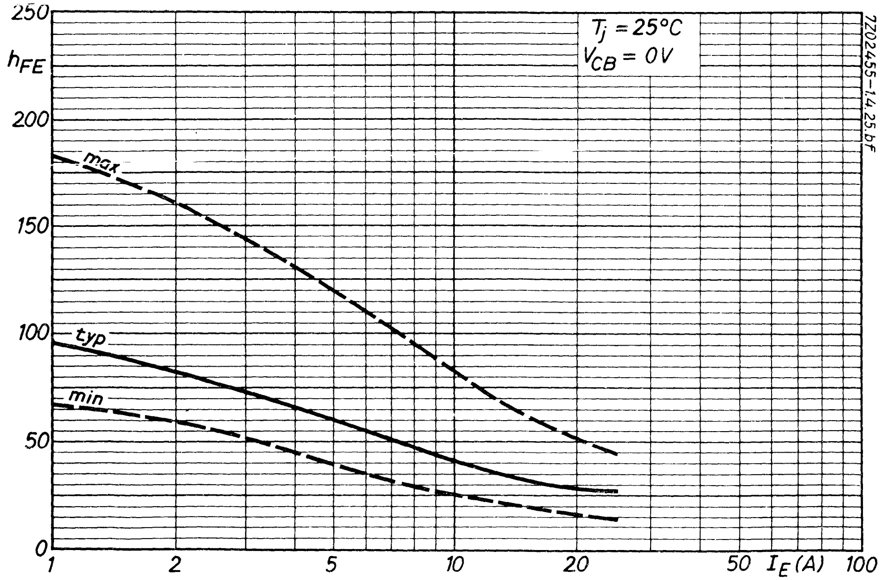

7Z02448-1.4.25bf
$-V_{CB} = 80V$
max
typ
min
$-I_{CBO}$ (mA)
T_j (°C)
100
20
10
5
2
1
0.5
0.2
0.1
0
20
40
60
80
100


7Z02450-1.4.25.bf
$T_j = 25°C$
max
typ
min
$-I_{EBO}$ (μA)
10000
2000
1000
500
200
100
50
20
10
0
10
20
30
40
$-V_{EB}$(V)

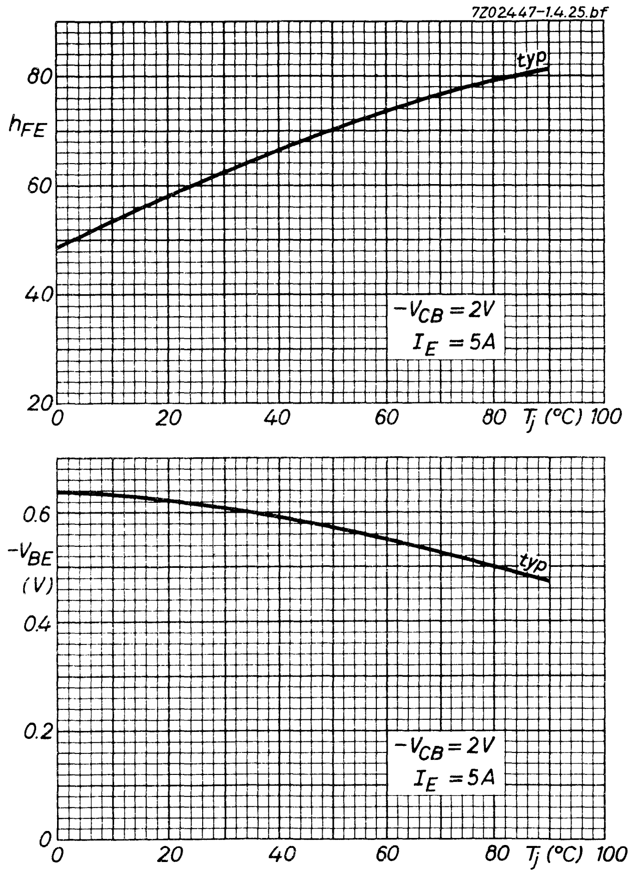

7Z02449-1.4.25.bf
$T_j = 25°C$
max
typ
min
$-I_{CBO}$ (μA)
10000
2000
1000
500
200
100
50
20
10
0
20
40
60
80
$-V_{CB}$(V)

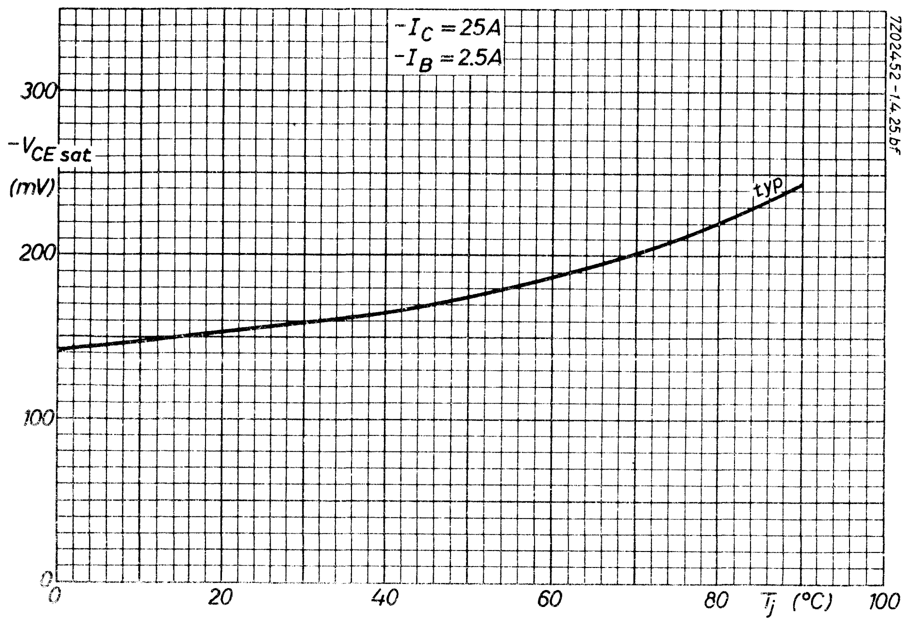


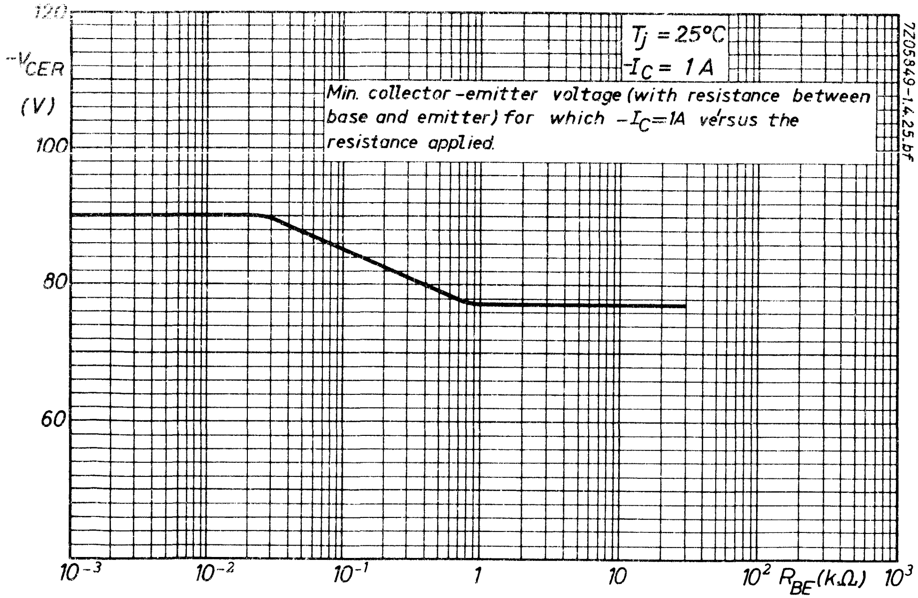
$I_E = 25A$
$-V_{CB}=2V$
7Z02445-1.4.25.bf
30
h_{FE}
20
10
0
0
20
40
60
80
T_j (°C)
100
typ

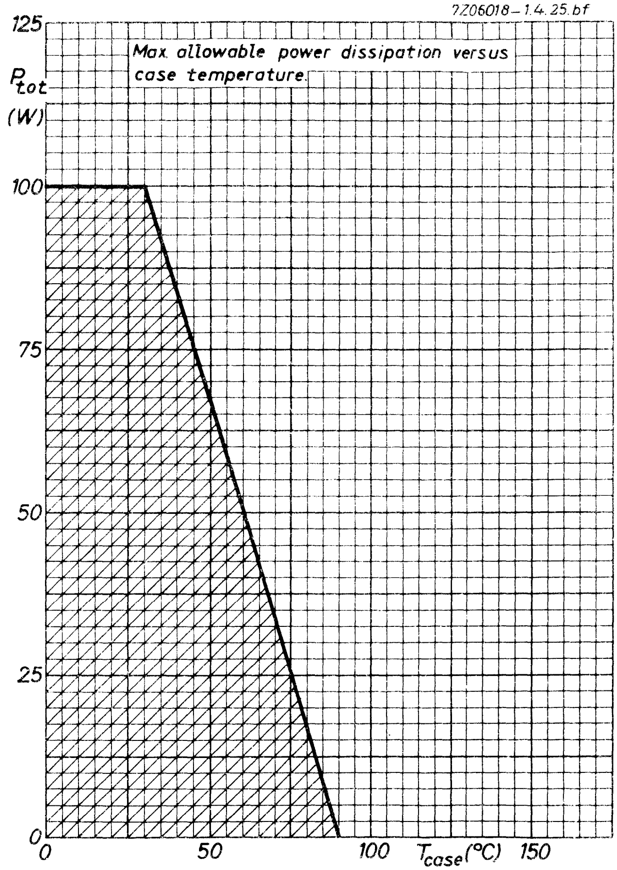


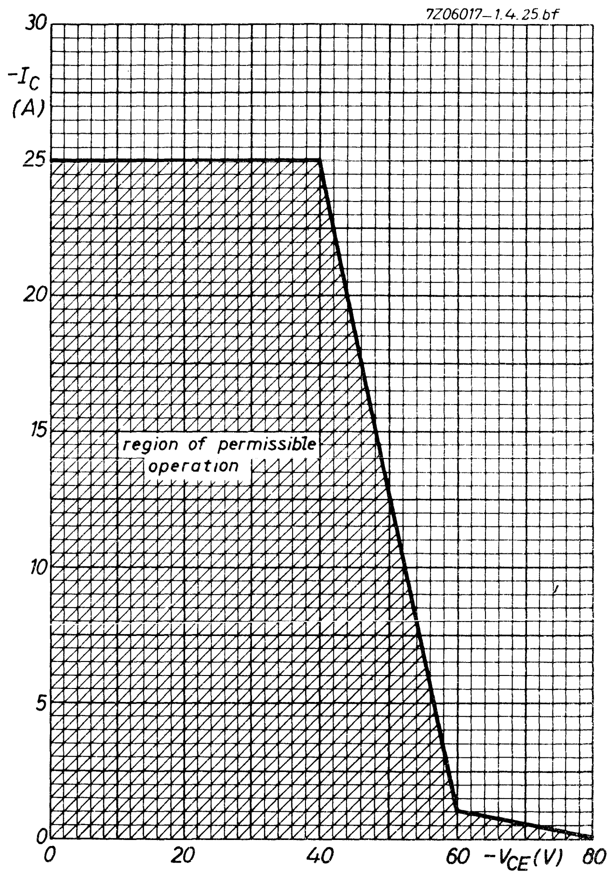
250
h_{FE}
200
150
100
50
0
$T_j = 25°C$
$V_{CB} = 0V$
7Z02455-1.4.25.bf
max
typ
min
1
2
5
10
20
50
I_E (A)
100


7Z02447-1.4.25.bf
80
h_{FE}
60
40
20
typ
$-V_{CB} = 2V$
$I_E = 5A$
0
20
40
60
80
T_j (°C)
100
0.6
$-V_{BE}$ (V)
0.4
0.2
0
typ
$-V_{CB} = 2V$
$I_E = 5A$
0
20
40
60
80
T_j (°C)
100


$-I_C = 25A$
$-I_B = 2.5A$
7Z02452-1.4.25.bf
300
$-V_{CE\,sat}$
(mV)
typ
200
100
0
0
20
40
60
80
T_j (°C)
100


120
$-V_{CER}$
(V)
100
80
60
$T_j = 25°C$
$-I_C = 1\,A$
Min. collector-emitter voltage (with resistance between base and emitter) for which $-I_C$=1A versus the resistance applied.
7Z05849-1.4.25.bf
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
R_{BE} (kΩ)
10^3


7Z06018-1.4.25.bf
Max. allowable power dissipation versus case temperature.
125
P_{tot}
(W)
100
75
50
25
0
0
50
100
T_{case}(°C)
150



7Z06017–1.4.25.bf
30
$-I_C$
(A)
25
20
15
10
5
0
region of permissible operation
0
20
40
60
$-V_{CE}$ (V)
80

A.F. GERMANIUM P-N-P POWER TRANSISTORS

GERMANIUM ALLOY JUNCTION POWER TRANSISTORS of the p-n-p type in metal envelope for A.F. applications.

LIMITING VALUES (Absolute max. values)

			ADZ11	ADZ12
Collector				
Voltage (base reference)	$-V_{CB}$	= max.	50 V	80 V
Voltage (emitter reference)	$-V_{CE}$	= max.	40 V	60 V
Current				
Peak value	$-I_{CM}$	= max.	20 A	20 A
D.C. value	$-I_C$	= max.	15 A	15 A
Dissipation	P_C	= max.	45 W	45 W
Emitter				
Voltage (base reference)	$-V_{EB}$	= max.	30 V	50 V
Current				
Peak value	I_{EM}	= max.	22 A	22 A
D.C. value	I_E	= max.	17 A	17 A
Base				
Current				
Peak value	$-I_{BM}$	= max.	4 A	4 A
D.C. value	$-I_B$	= max.	2 A	2 A

Temperatures

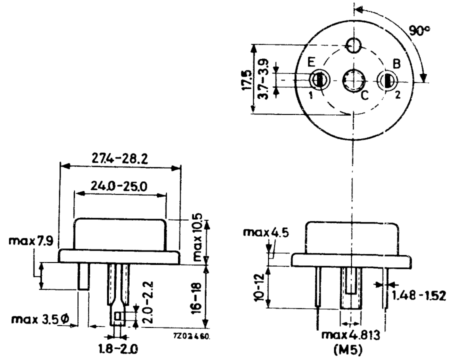
Storage temperature	T_s	= −55 °C to +75 °C
Junction temperature	T_j	= max. 90 °C

THERMAL DATA

Thermal resistance between junction and transistor bottom	K	= max. 0.8 °C/W

7Z2 2148

Dimensions in mm



CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Transistor bottom temperature = 25 °C

Collector current at $I_E = 0$

$-V_{CB} =$ 2 V	$-I_{CBO}$	<	0.2	mA
$-V_{CB} =$ 50 V (ADZ11) $-V_{CB} =$ 80 V (ADZ12)	$-I_{CBO}$	<	8	mA

Emitter current at $I_C = 0$

$-V_{EB} =$ 2 V	$-I_{EBO}$	<	0.2	mA
$-V_{EB} =$ 30 V (ADZ11) $-V_{EB} =$ 50 V (ADZ12)	$-I_{EBO}$	<	8	mA

Emitter voltage at $I_E = 0$

$-V_{CB} =$ 50 V (ADZ11) $-V_{CB} =$ 80 V (ADZ12)	$-V_{EB}$	<	1	V

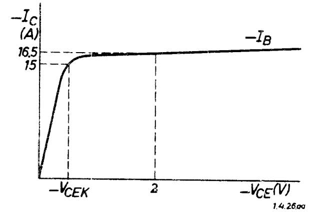
7Z2 3364

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Transistor bottom temperature = 25 °C (continued)

Collector knee-voltage

$-I_C$ = 15 A; $-I_B$ is that value at which $-I_C$ = 16.5 A and $-V_{CE}$ = 2 V $-V_{CEK}$ < 1 V



Base voltage

$-V_{CB} = 0$; $-I_C =$ 1.2 A	$-V_{BE}$	<	0.7	V
$-V_{CB} = 0$; $-I_C =$ 5 A	$-V_{BE}$	<	1.2	V
$-V_{CB} = 0$; $-I_C =$ 15 A	$-V_{BE}$	<	2	V

Cut-off frequency

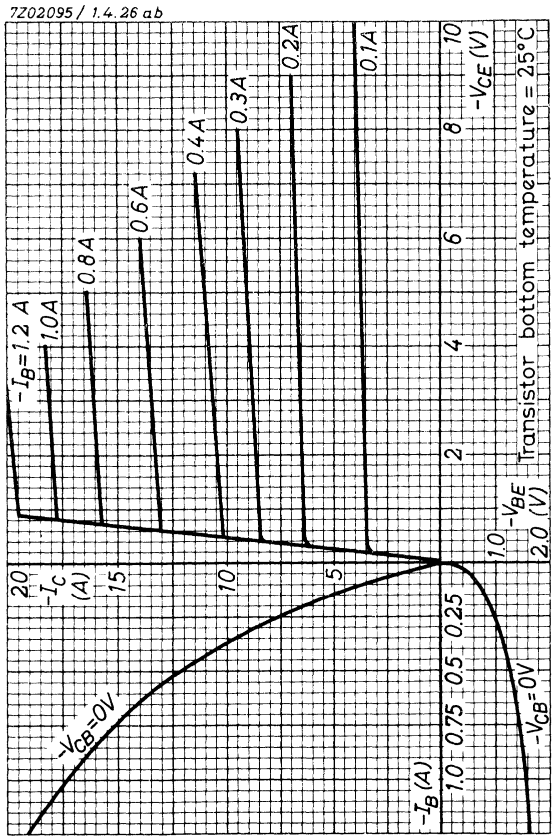
$-V_{CB} = 12$; $I_E =$ 1 A	ADZ11:	$f_{\alpha b}$	>	80	kc/s
	ADZ12:	$f_{\alpha b}$	>	100	kc/s

D.C. current amplification factor

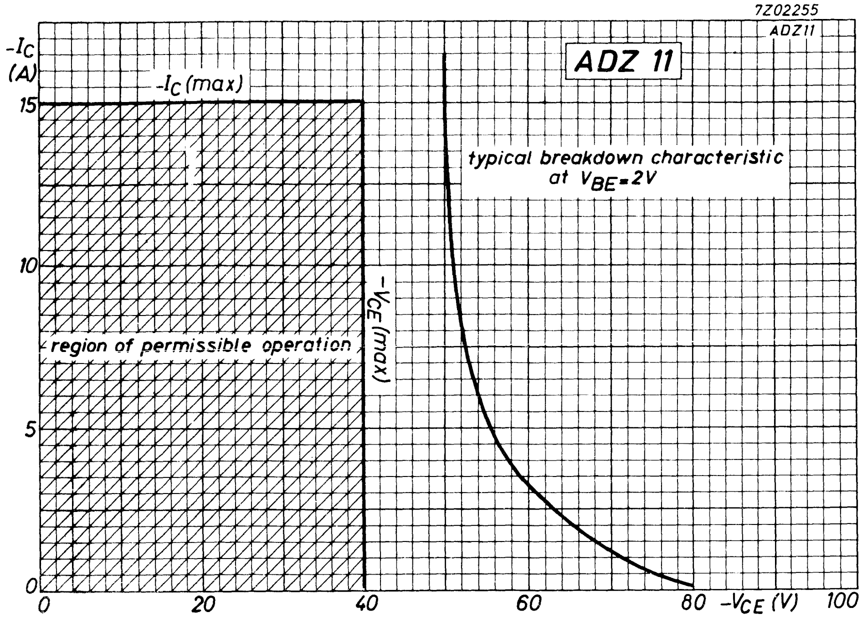
$-V_{CB} = 0$; $-I_C =$ 1.2 A	h_{FE} h_{FE}	> <	40 120
$-V_{CB} = 0$; $-I_C =$ 5 A	h_{FE}	>	25
$-V_{CB} = 0$; $-I_C =$ 15 A	h_{FE}	>	15

7Z2 2150

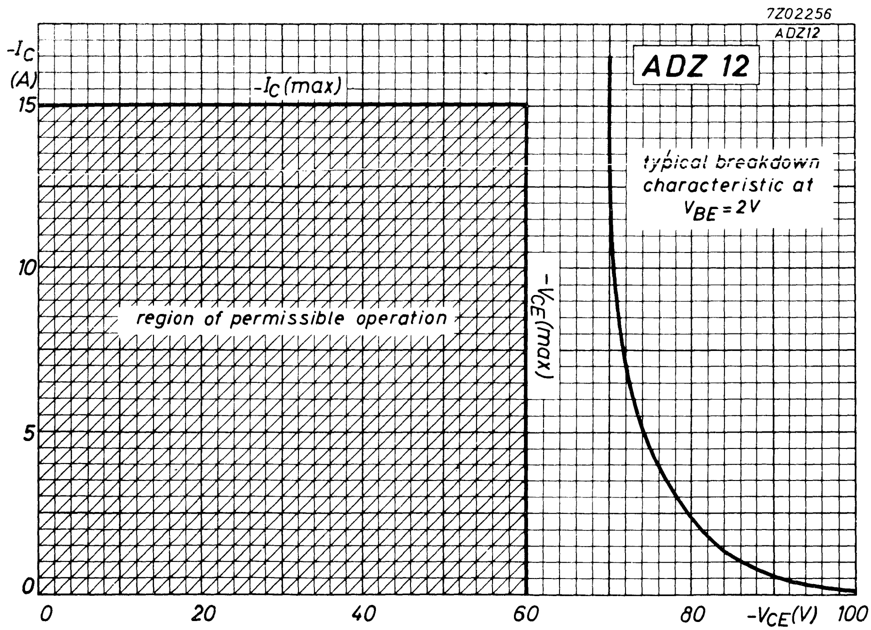
A



TENTATIVE DATA


7Z02255
ADZ11
ADZ 11
$-I_C$ (A)
$-I_C$(max)
typical breakdown characteristic at V_{BE}=2V
region of permissible operation
$-V_{CE}$(max)
15
10
5
0
0
20
40
60
80
100
$-V_{CE}$ (V)

B


7Z02256
ADZ12
ADZ 12
$-I_C$ (A)
$-I_C$(max)
typical breakdown characteristic at V_{BE}=2V
region of permissible operation
$-V_{CE}$(max)
15
10
5
0
0
20
40
60
80
100
$-V_{CE}$(V)

C

R.F. ALLOY-DIFFUSED GERMANIUM TRANSISTOR of the p-n-p type with low noise and high gain at V.H.F. for amplifier, oscillator and convertor circuits up to 260 Mc/s. The transistor is hermetically sealed in a metal can and absolutely moisture proof.

TRANSISTOR H.F. À CRISTAL DE GERMANIUM du type p-n-p en technique alliage-diffusion à faible bruit et amplification élevée aux fréquences V.H.F. pour les circuits amplificateurs, oscillateurs et convertisseurs jusqu'à 260 MHz. Le transistor est scellé hermétiquement dans un boîtier métallique et protégé contre l'humidité.

HF p-n-p GERMANIUMTRANSISTOR nach dem Legierungs-Diffusionsverfahren mit schwachem Rauschen und hoher Verstärkung bei VHF-Frequenzen zur Verwendung in Verstärker-, Oszillator und Mischschaltungen bis zu 260 MHz. Der Transistor ist hermetisch abgeschlossen in einem Metallgehäuse und absolut sicher für Feuchtigkeit.

Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

$-V_{CB}$	= max.	25	V
$-I_C$	= max.	10	mA
I_E	= max.	10	mA
$-I_E$	= max.	1	mA
P_C ($T_{amb} \leq 45\ ^{o}C$)	= max.	75	mW
T_j { continuous operation / service continu / Dauerbetrieb	= max.	75	^{o}C
T_j { intermittent operation / service intermittent / aussetzender Betrieb	= max.	90	^{o}C [1]
Storage temperature / Température d'emmagasinage / Lagerungstemperatur	=	$-55^{o}C/+75$	^{o}C

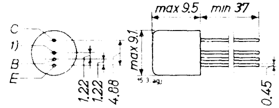
Thermal data; Données thermiques; Thermische Daten

Thermal resistance from junction to ambience in free air	K	$\leq$ 0.6 $^{o}C/mW$
Résistance thermique entre la jonction et l'ambiance à l'air libre	K	$\leq$ 0,6 $^{o}C/mW$
Thermischer Widerstand zwischen dem Kristall und der Umgebung in freier Luft	K	$\leq$ 0,6 $^{o}C/mW$

[1]) Total duration max. 200 hours
Durée totale 200 heures au max.
Gesamtdauer max. 200 Stunden

7Z2 3971 1.

Dimensions in mm
Dimensions en mm
Abmessungen in mm



Characteristics
Caractéristiques T_{amb} = 25 ^{o}C
Kenndaten

$-I_{CBO}$	($-V_{CB}$ = 12 V)		< 10 µA
$-V_{CB}$	($-I_C$ = 50 µA; I_E = 0 mA)		> 25 V
$-V_{EB}$	($-I_E$ = 50 µA; I_C = 0 mA)		> 0,5 V
$-I_B$	($-V_{CB}$ = 12 V; $-I_C$ = 1 mA)		< 50 µA
$-V_{BE}$	($-V_{CB}$ = 12 V; $-I_C$ = 1 mA)	> 220 mV	< 360 mV

Characteristics range values for equipment design
Gammes de valeurs des caractéristiques pour l'étude d'équipements
Kenndatenbereiche für Gerätentwurf T_{amb} = 25 ^{o}C

$-V_{CB}$ = 12 V; I_E = 1 mA	f_1 = 180 Mc/s [2])	
$-V_{CE}$ = 12 V; $-I_C$ = 1 mA f = 1 kc/s	h_{fe} > 20	
$-V_{CB}$ = 12 V; I_E = 1 mA f = 2 Mc/s	$\|z_{rb}\|$ = 10 Ω [3])	
$-V_{CE}$ = 12 V; $-I_C$ = 1 mA f = 200 Mc/s; R_S = 30 Ω [4])	F = 6 dB	< 7,5 dB
Circuit page 4 Schaltung Seite 4	G = 13 dB	> 10 dB [5])

[1]) Interlead shield and metal case
Blindage entre les connexions et boîtier métallique
Abschirmung zwischen den Anschlüssen und Metallgehäuse

[2])[3])[4])[5]) See page 3; voir page 3; siehe Seite 3

7Z2 1805 2.

Characteristics range values for equipment design (continued)
Gammes de valeurs des caractéristiques pour l'étude d'équipements (suite)
Kenndatenbereiche für Gerätentwurf (Fortsetzung)

T_{amb} = 25 °C

Small signal characteristics
Caractéristiques pour les signaux faibles
Kenndaten für kleine Signale

Conditions			
$-V_{CE}$ = 12 V; $-I_C$ = 1 mA; f = 0,45 Mc/s	$-c_{re}$	=	0,8 pF
$-V_{CE}$ = 12 V; $-I_C$ = 1 mA; f = 35 Mc/s	g_{oe}	=	10 µA/V
	c_{oe}	=	2 pF
$-V_{CB}$ = 12 V; I_E = 1 mA; f = 200 Mc/s	g_{ib}	=	30 mA/V
	$-c_{ib}$	=	12 pF
	$\|y_{rb}\|$	=	0,4 mA/V
	$-\varphi_{rb}$	=	90 °
	$\|y_{fb}\|$	=	25 mA/V
	φ_{fb}	=	90 °
	g_{ob}	=	0,3 mA/V
	c_{ob}	=	1,8 pF

2) f_1 = Frequency at which $|h_{fe}|$ = 1
f_1 = la fréquence à laquelle $|h_{fe}|$ = 1
f_1 = Frequenz bei der $|h_{fe}|$ = 1

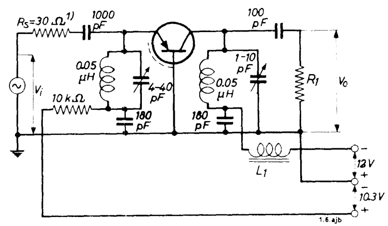
3) Intrinsic base impedance
Impédance intrinsèque de la base
Innere Impedanz der Basis

4) Input source impedance
Impédance de la source d'entrée
Impedanz der Eingangsspannungsquelle

5) Available power gain
Amplification de puissance disponible
Verfügbare Leistungsverstärkung

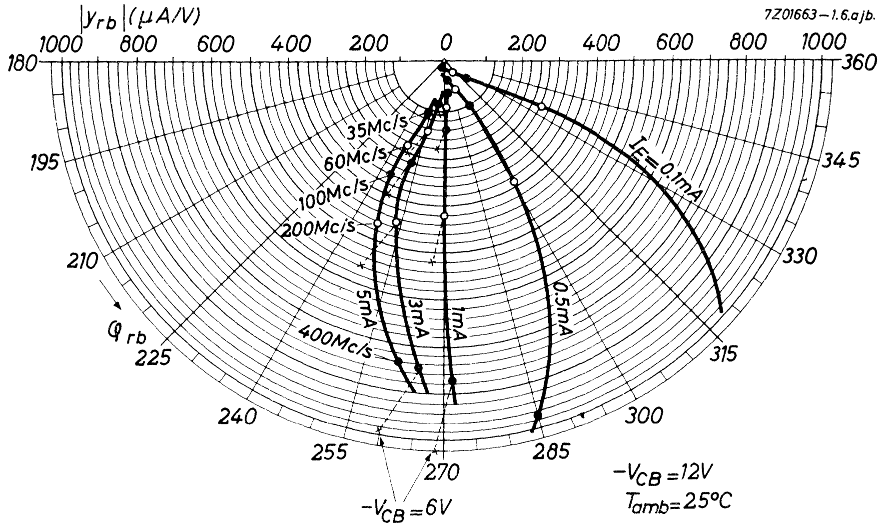
R_1 is chosen so that the total impedance R_L of the tuned circuit is 2.0 kΩ
R_1 est choisie tellement que l'impédance totale R_L du circuit accordé est de 2,0 kΩ
R_1 wird derartig gewählt, dass die Gesamtimpedanz R_L des abgestimmten Kreises 2,0 kΩ ist.

L_1 = ferrite bead
L_1 = perle magnétique
L_1 = Ferritperle

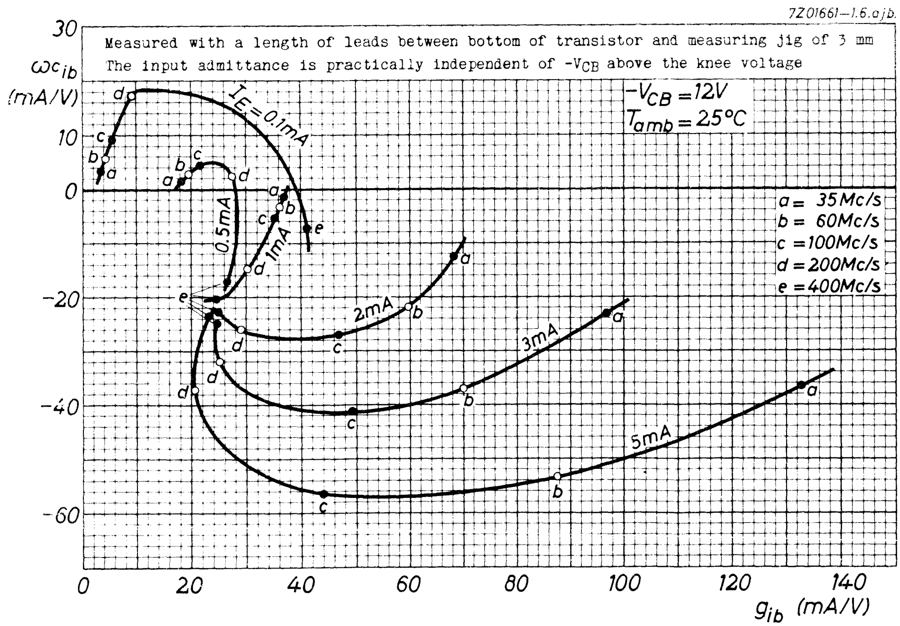


4) Input source impedance
Impédance de la source d'entrée
Impedanz der Eingangsspannungsquelle

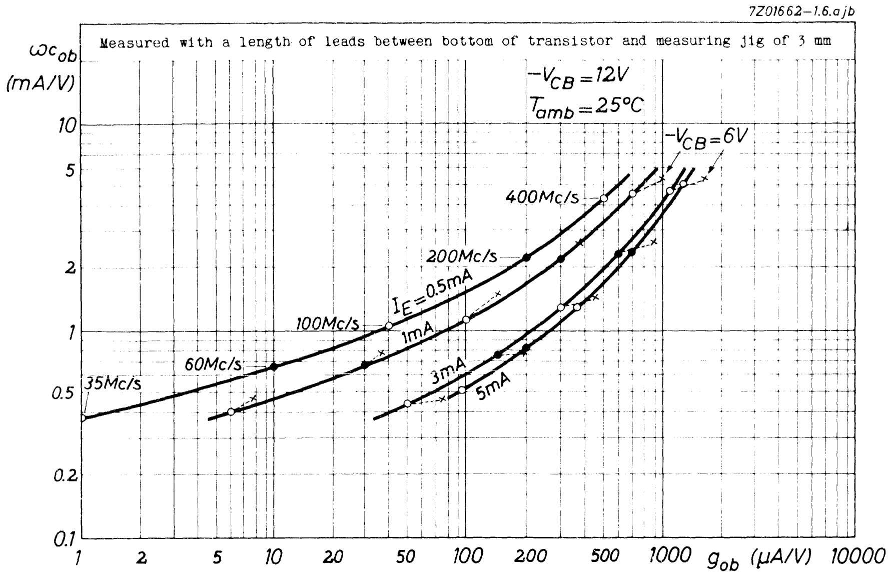
Measured with a length of leads between bottom of transistor and measuring jig of 3 mm



A



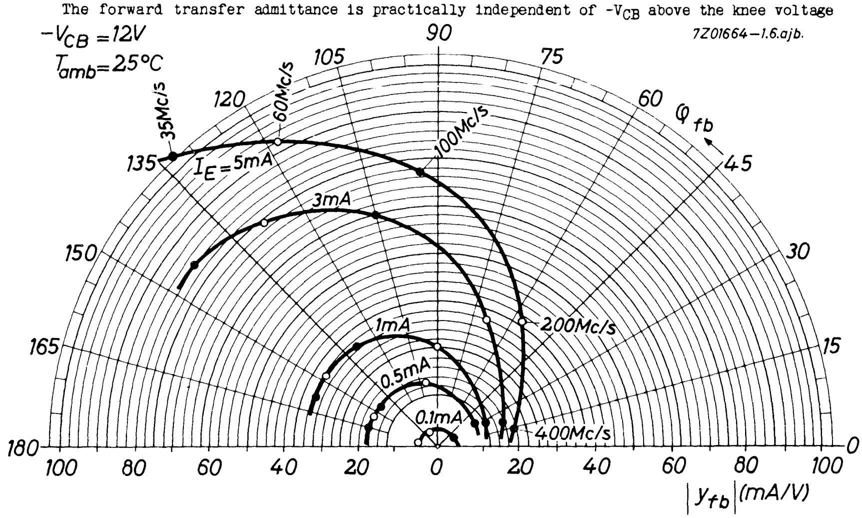
B



C

Measured with a length of leads between bottom of transistor and measuring jig of 3 mm

The forward transfer admittance is practically independent of $-V_{CB}$ above the knee voltage



D

GERMANIUM ALLOY-DIFFUSED TRANSISTORS

For data of these transistors please refer to the AF124 to 127.

7Z3 0334

R.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR of the p-n-p type for medium power, high voltage, high frequency applications, e.g. in the video output stage of television receivers

LIMITING VALUES (Absolute max. values)

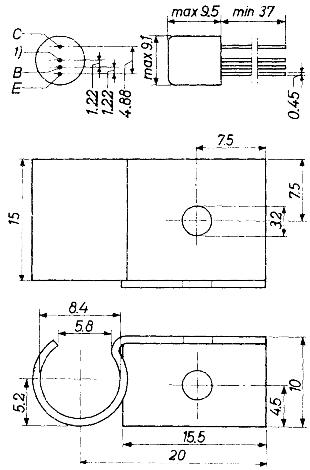
Collector		
Voltage (emitter reference) (See also page G)	$-V_{CE}$ = max.	70 V
Current	$-I_C$ = max.	30 mA
Dissipation	P_C = max.	375 mW
Emitter		
Current	I_E = max.	33 mA
Reverse current	$-I_E$ = max.	1 mA
Base		
Current	$-I_B$ = max.	3 mA
Reverse current	I_B = max.	1 mA
Temperatures		
Storage temperature	T_s =	-55 to +75 °C
Junction temperature		
continuous operation	T_j = max.	75 °C
intermittent operation (total duration max. 200 hours)	T_j = max. (t = max.	90 °C 200 hrs)

THERMAL DATA

Thermal resistance from junction		
to ambience in free air	K = max.	0.25 °C/mW
with cooling fin	K = max.	0.12 °C/mW

7Z2 1372 1.

Dimensions in mm



Cooling fin
No. 56207
Painted black

CHARACTERISTICS at T_{amb} = 25 °C

Collector voltage		
$-V_{CB}$ ($-I_C$ = 1 mA; I_E = 0 mA)	= 95 V	> 70 V
Emitter voltage		
$-V_{EB}$ ($-I_E$ = 50 µA; I_C = 0 mA)	= 1.5 V	> 0.5 V
Base current		
$-I_B$ (I_E = 10 mA; $-V_{CB}$ = 2 V)	= 55 µA	< 275 µA

REMARK

Driving the transistor into the bottoming knee region results in an excessively high turn-off delay

[1]) Interlead shield and metal case

7Z2 2319 2.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{amb} = 25 °C

Collector current See page B

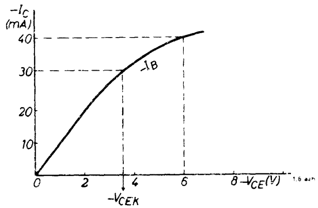
Base voltage

$-V_{BE}$ (I_E = 10 mA; $-V_{CB}$ = 2 V) = < 375 mV

Knee voltage

Measured at $-I_C$ = 30 mA

$-I_B$ = value at which $-I_C$ = 40 mA when $-V_{CE}$ = 6 V



$-V_{CEK}$ = 3.5 V < 5 V

Intrinsic base impedance

$|z_{rb}|$ (I_E = 10 mA; $-V_{CB}$ = 6 V; f = 2 Mc/s) = 30 Ω

Frequency at which $|h_{fe}|$ = 1

f_1 (I_E = 10 mA; $-V_{CB}$ = 6 V) = 175 Mc/s > 125 Mc/s

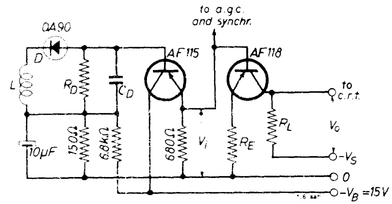
Forward transfer admittance

$|y_{fe}|$ (I_E = 10 mA; $-V_{CB}$ = 6 V; f = 10.7 Mc/s) = 130 mA/V > 100 mA/V

Feedback capacitance

$-c_{re}$ (I_E = 10 mA; $-V_{CB}$ = 6 V; f = 10.7 Mc/s) = 1.8 pF < 2.3 pF

OPERATING CHARACTERISTICS in a video output stage for a supply voltage up to 70 V



L = secondary winding of the coupling transformer between last I.F. stage and video detector

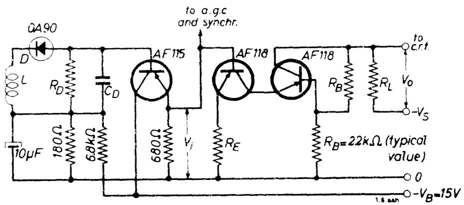
D, R_D, C_D = detection circuit

R_E should be chosen according to $A_V = \frac{V_o}{V_i} \approx \frac{R_L}{R_E}$, in which A_V is the voltage amplication of the output stage

Supply voltage	$-V_S$ =	50	60	70 V
Load resistance	R_L =	2.7	3.9	4.7 kΩ
Output voltage (black to white)	V_o =	32	39	45 V
Bandwidth at -3 dB	B =	6.0	4.1	3.4 Mc/s

If necessary enhancing of the bandwidth by a peaking coil in series with R_L (shunt compensation) or by a peaking coil in series with the lead to the cathode ray tube (series compensation) is possible

OPERATING CHARACTERISTICS in a video output stage for a supply voltage up to 110 V



L = secondary winding of the coupling transformer between last I.F. stage and video detector

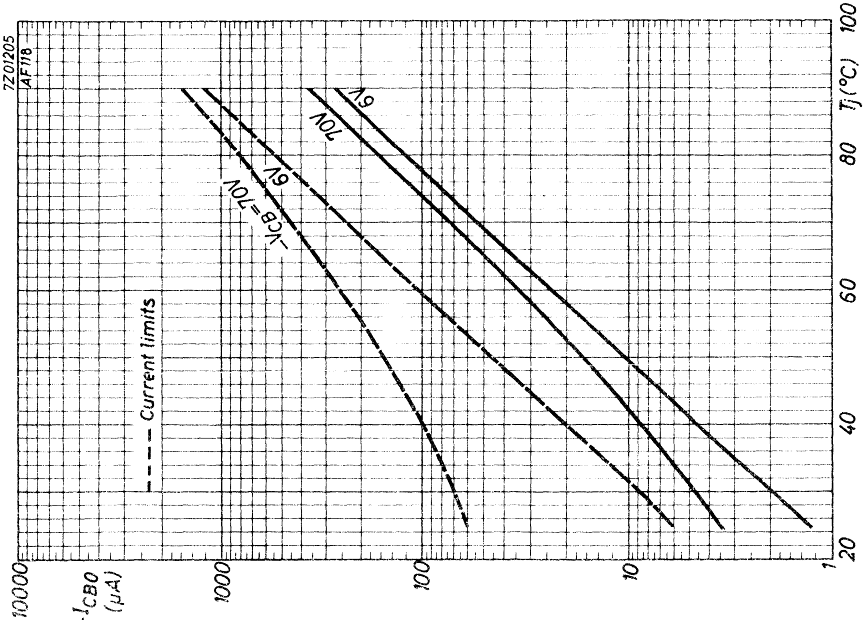
D, R_D, C_D = detection circuit

R_E should be chosen according to $A_V = \frac{V_O}{V_1} \approx \frac{1}{R_E} \cdot \frac{2R_B \cdot R_L}{2R_B + R_L}$, in which A_V is the voltage amplification of the output stage

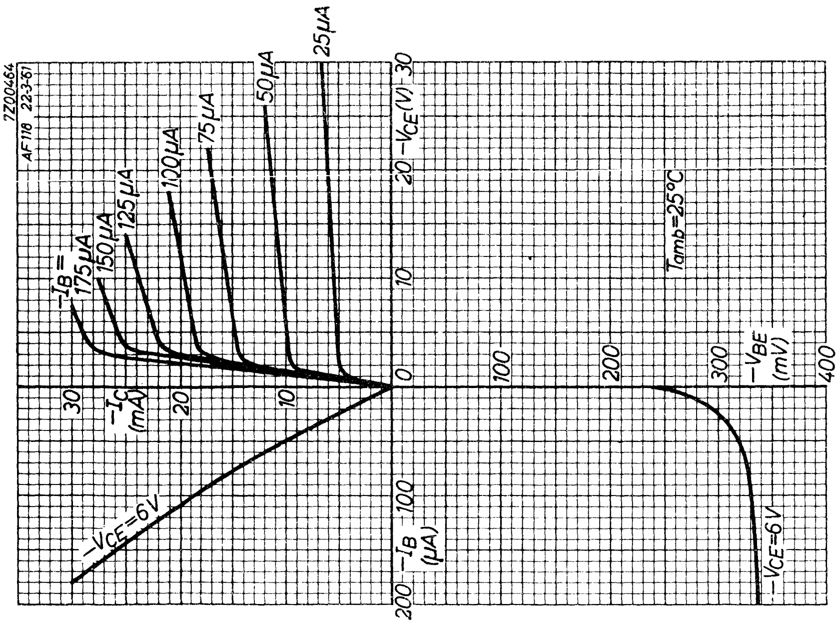
Supply voltage	$-V_S$ =	90	110 V
Load resistance	R_L =	4.7	6.8 kΩ
Output voltage (black to white)	V_O =	57	65 V
Bandwidth at -3 dB	B =	3.5	2.4 Mc/s

If necessary enhancing of the bandwidth by a peaking coil in series with R_L (shunt compensation) or by a peaking coil in series with the lead to the cathode ray tube (series compensation) is possible

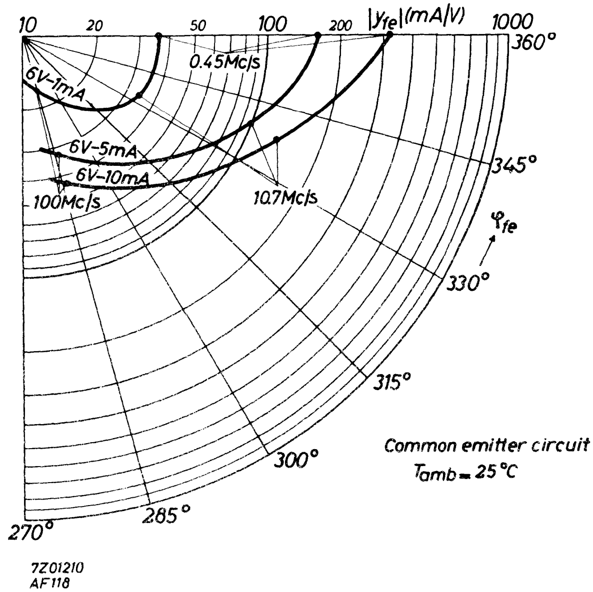
7Z2 1376

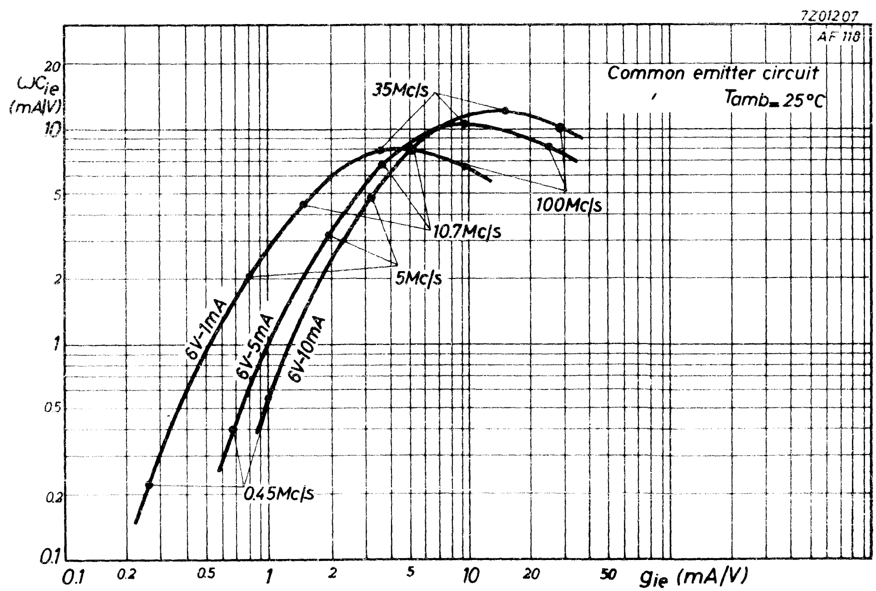

7Z01205
AF118
Current limits
$-V_{CB}$=70V
6V
70V
6V
$-I_{CBO}$ (μA)
10000
1000
100
10
1
20
40
60
80
100
T_j (°C)

B


7Z00464
AF118 22-3-61
$-I_B$=
175μA
150μA
125μA
100μA
75μA
50μA
25μA
0
10
20
30
$-V_{CE}$(V)
$-I_C$ (mA)
T_{amb}=25°C
100
200
300
400
$-V_{BE}$ (mV)
$-V_{CE}$=6V
$-I_B$ (μA)

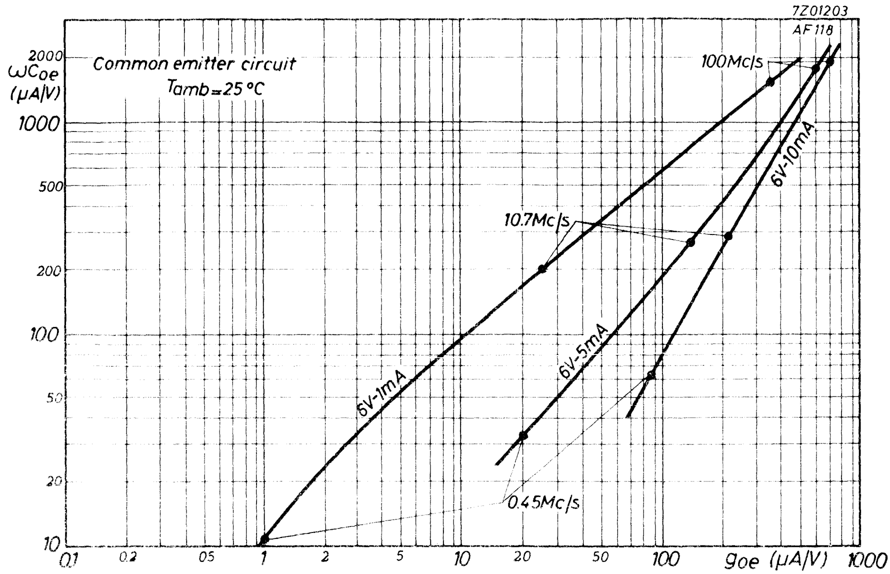
A


10
20
50
100
200
|y_fe| (mA/V)
1000
360°
0.45Mc/s
6V-1mA
6V-5mA
6V-10mA
100Mc/s
10.7Mc/s
345°
φ_fe
330°
315°
300°
285°
270°
Common emitter circuit
Tamb = 25 °C
7Z01210
AF118

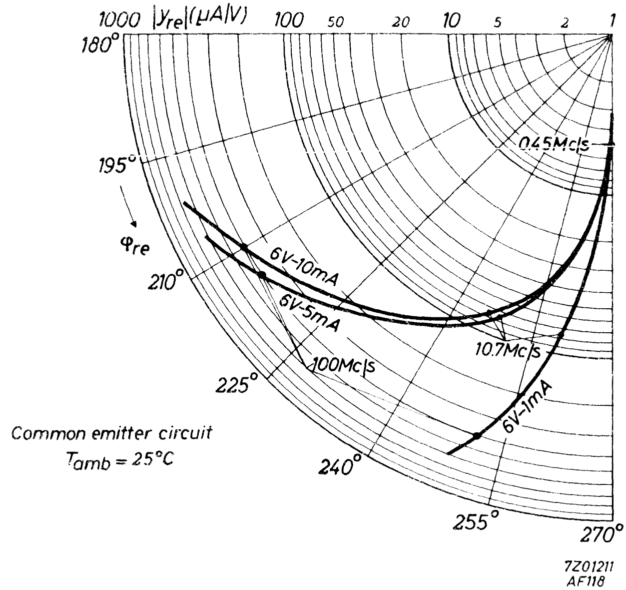

7Z01207
AF118
Common emitter circuit
Tamb = 25 °C
ωC_ie (mA/V)
35Mc/s
100Mc/s
10.7Mc/s
5Mc/s
6V-1mA
6V-5mA
6V-10mA
0.45Mc/s
g_ie (mA/V)

C

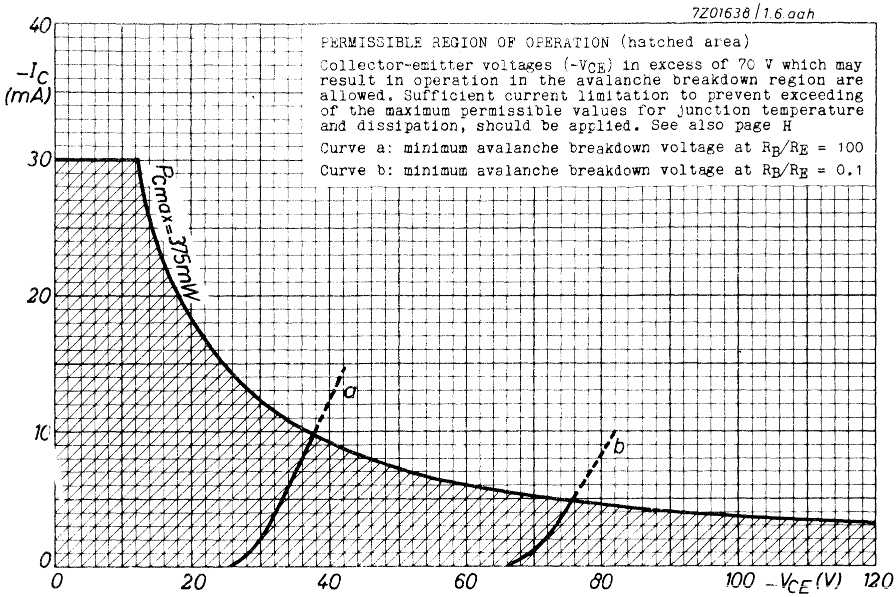
D


7Z01203
AF118
2000
ωC_{oe}
(μA/V)
1000
500
200
100
50
20
10
Common emitter circuit
T_{amb} = 25 °C
100Mc/s
10.7Mc/s
0.45Mc/s
6V-1mA
6V-5mA
6V-10mA
0.1
0.2
0.5
1
2
5
10
20
50
100
g_{oe} (μA/V)
1000

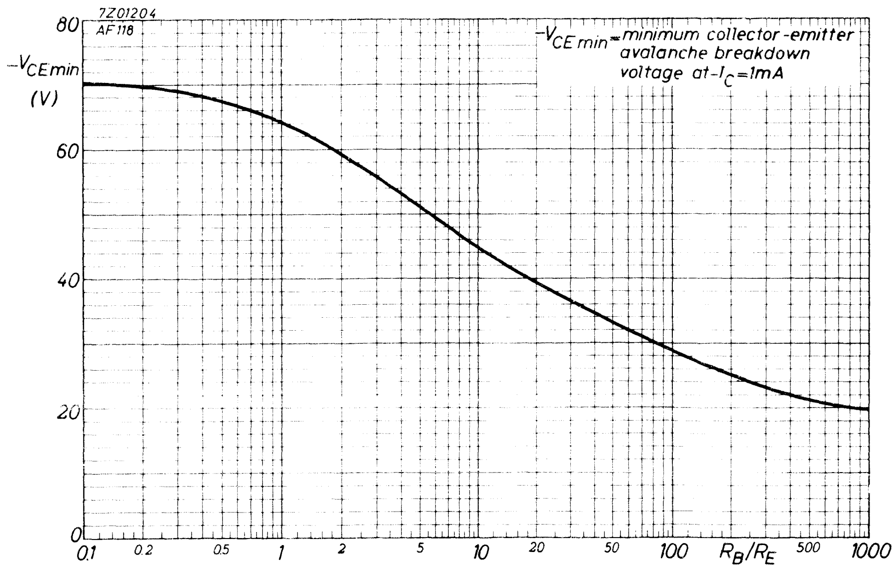
E


1000
$|y_{re}|$(μA/V)
100
50
20
10
5
2
1
180°
195°
φ_{re}
210°
225°
240°
255°
270°
0.45Mc/s
6V-10mA
6V-5mA
10.7Mc/s
100Mc/s
6V-1mA
Common emitter circuit
T_{amb} = 25°C
7Z01211
AF118

F


7Z01638 / 1.6.aah
PERMISSIBLE REGION OF OPERATION (hatched area)
Collector-emitter voltages (-VCE) in excess of 70 V which may result in operation in the avalanche breakdown region are allowed. Sufficient current limitation to prevent exceeding of the maximum permissible values for junction temperature and dissipation, should be applied. See also page H
Curve a: minimum avalanche breakdown voltage at RB/RE = 100
Curve b: minimum avalanche breakdown voltage at RB/RE = 0.1
PCmax=375mW
a
b
-IC (mA)
40
30
20
10
0
0
20
40
60
80
100
-VCE (V)
120

G


7Z01204
AF118
-VCEmin = minimum collector-emitter avalanche breakdown voltage at -IC=1mA
-VCEmin (V)
80
60
40
20
0
0.1
0.2
0.5
1
2
5
10
20
50
100
RB/RE
500
1000

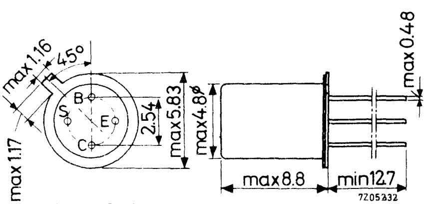
H

R.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR

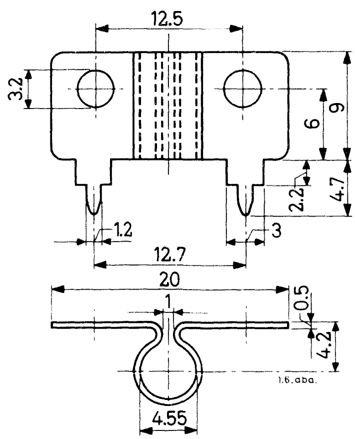
P-N-P transistor in a metal envelope with insulated leads and a shield lead connected to the case. It is intended for application at frequencies up to 100 MHz.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage $R_B/R_E < 100$; $R_E > 200\ \Omega$	$-V_{CER}$	max.	25	V
Collector current (peak value)	$-I_{CM}$	max.	15	mA
Total power dissipation up to $T_{amb} = 45\ ^{o}C$	P_{tot}	max.	140	mW
Junction temperature, incidentally	T_j	max.	90	^{o}C
Feedback capacitance at f = 0.45 MHz $-I_C = 1$ mA; $-V_{CE} = 10$ V	$-C_{re}$	typ.	450	fF
Transition frequency $-I_C = 3$ mA; $-V_{CE} = 10$ V	f_T	typ.	270	MHz
Transfer admittance at f = 35 MHz $-I_C = 3$ mA; $-V_{CE} = 10$ V	$\vert y_{fe}\vert$	typ.	80	$m\Omega^{-1}$

MECHANICAL DATA Dimensions in mm



S=Shield lead connected to case



Cooling fin: 56263

7Z3 0300

RATINGS (Limiting values) [1])

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage $R_B/R_E < 100$; $R_E > 200\ \Omega$	$-V_{CER}$	max.	25	V

Currents

Collector current (d.c.)	$-I_C$	max.	10	mA
Collector current (peak value)	$-I_{CM}$	max.	15	mA
Reverse emitter current	$-I_E$	max.	1	mA

Power dissipation

Total power dissipation up to $T_{amb} = 45\ ^oC$ with cooling clip 56263	P_{tot}	max.	140	mW

Temperatures

Storage temperature	T_{stg}		−55 to +75	^oC
Junction temperature: continuous	T_j	max.	75	^oC
incidentally	T_j	max.	90	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	= 0.45	$^oC/mW$
From junction to case	$R_{th\ j-c}$	= 0.22	$^oC/mW$
From junction to ambient with cooling clip 56263	$R_{th\ j-a}$	= 0.32	$^oC/mW$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0301

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

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	typ.	1.2	μA
		<	8	μA
$I_E = 0$; $-V_{CB} = 10$ V; $T_j = 75$ °C	$-I_{CBO}$	<	150	μA
Base current				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	$-I_B$	typ.	40	μA
		<	100	μA
Base-emitter voltage				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ.	320	mV
			280 to 380	mV
Feedback capacitance at f = 0.45 MHz				
$-I_C = 1$ mA; $-V_{CE} = 10$ V	$-C_{re}$	typ.	450	fF [1]
			250 to 650	fF [1]
Transition frequency				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	f_T	typ.	270	MHz
Noise figure at f = 100 MHz [2]				
$I_E = 2$ mA; $-V_{CB} = 5$ V	F	typ.	4.5	dB
		<	6	dB
y parameters at f = 0.45 MHz (common emitter) [3]				
$-I_C = 2$ mA; $-V_{CE} = 5$ V				
Input conductance	g_{ie}	typ.	0.8	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45	pF
Feedback admittance	$\|y_{re}\|$	typ.	1.7	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	270°	
Transfer admittance	$\|y_{fe}\|$	typ.	73	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	0	
Output conductance	g_{oe}	typ.	0.8	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	2.7	pF

1) 1 fF = 1 femtofarad = 10^{-15} F
2) To obtain minimum noise figure the terminating admittance at the input of the transistor shall be $|Y_S| = (11-6j)\ m\Omega^{-1}$
3) Length of leads between bottom of transistor and measuring jig is 5 mm

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

y parameters at f = 5.5 MHz (common emitter) [1])

$-I_C$ = 2 mA; $-V_{CE}$ = 5 V

Input conductance	g_{ie}	typ.	1.0	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45	pF
Feedback admittance	$\lvert y_{re}\rvert$	typ.	21	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	270°	
Transfer admittance	$\lvert y_{fe}\rvert$	typ.	71	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	350°	
Output conductance	g_{oe}	typ.	5	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	2.6	pF

y parameters at f = 10.7 MHz (common emitter) [1])

$-I_C$ = 2 mA; $-V_{CE}$ = 5 V

Input conductance	g_{ie}	typ.	1.3	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45	pF
Feedback admittance	$\lvert y_{re}\rvert$	typ.	40	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	270°	
Transfer admittance	$\lvert y_{fe}\rvert$	typ.	70	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	347°	
Output conductance	g_{oe}	typ.	13	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	2.5	pF

y parameters at f = 35 MHz (common emitter) [1])

$-I_C$ = 3 mA; $-V_{CE}$ = 10 V

Input conductance	g_{ie}	typ.	6.5	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	35	pF
Feedback admittance	$\lvert y_{re}\rvert$	typ.	100	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	260°	
Transfer admittance	$\lvert y_{fe}\rvert$	typ.	80	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	322°	
Output conductance	g_{oe}	typ.	100	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	1.8	pF

7Z3 0303

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

y parameters at f= 100 MHz (common base) [1]

I_E = 2 mA; $-V_{CB}$ = 5 V

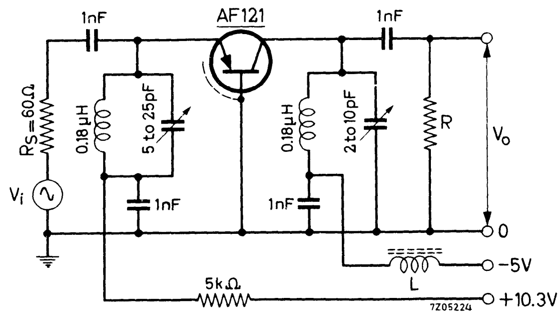
Input conductance	g_{ib}	typ.	32	$m\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	35	pF
Feedback admittance	$\lvert y_{rb}\rvert$	typ.	320	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	240°	
Transfer admittance	$\lvert y_{fb}\rvert$	typ.	34	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	110°	
Output conductance	g_{ob}	typ.	250	$\mu\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.6	pF

Transducer gain

$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$$

I_E = 2 mA; $-V_{CB}$ = 5 V; f = 100 MHz	G_{tr}	>	17	dB
		typ.	19	dB

Basic circuit for measuring the transducer gain

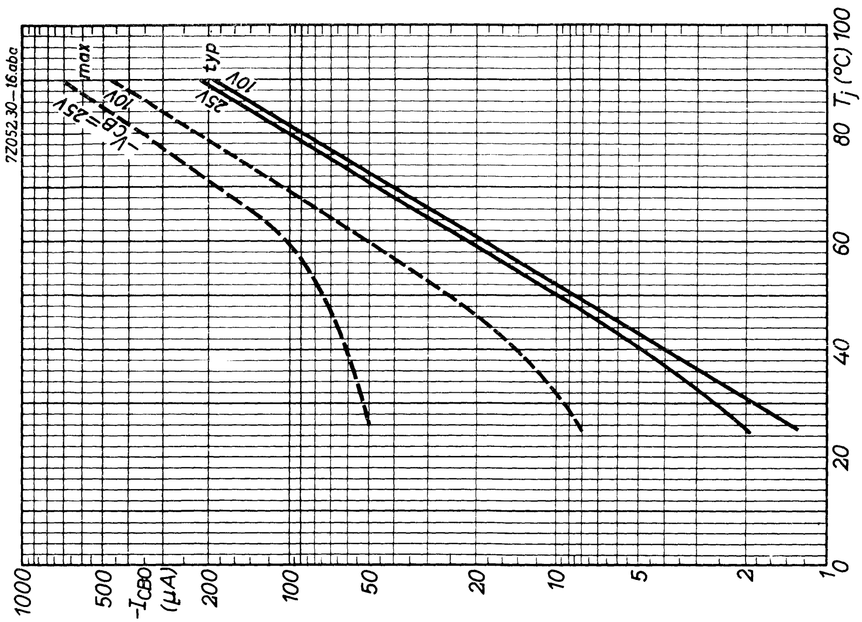


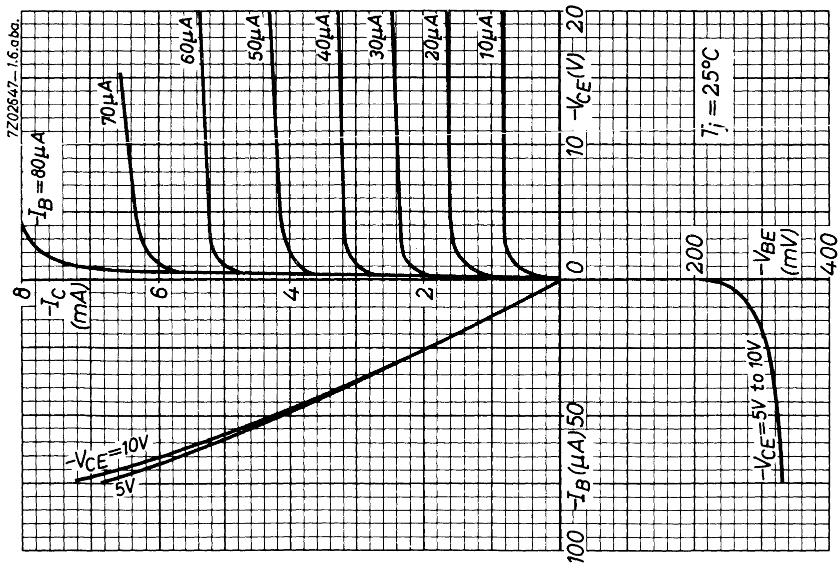
The resistor R is choosen such that the total load, consisting of R and the tuned circuit in parallel, R_L = 3.3 kΩ

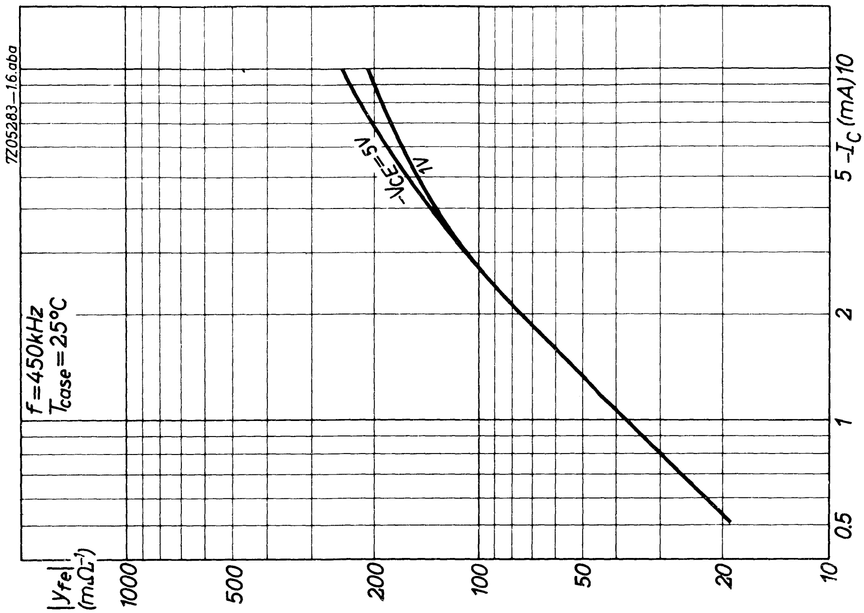
L is a ferrite wide-band choke

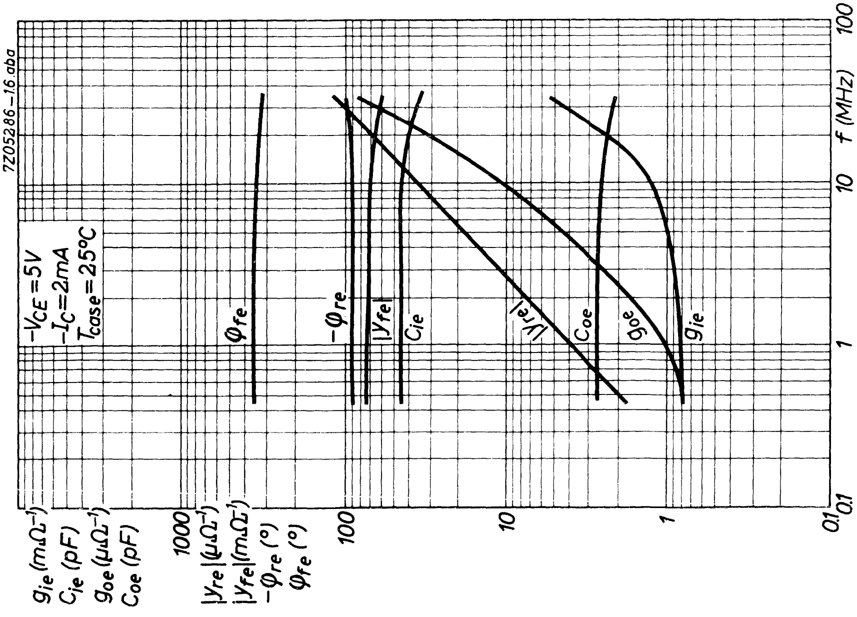
[1]) Length of leads between bottom of transistor and measuring jig is 5 mm.

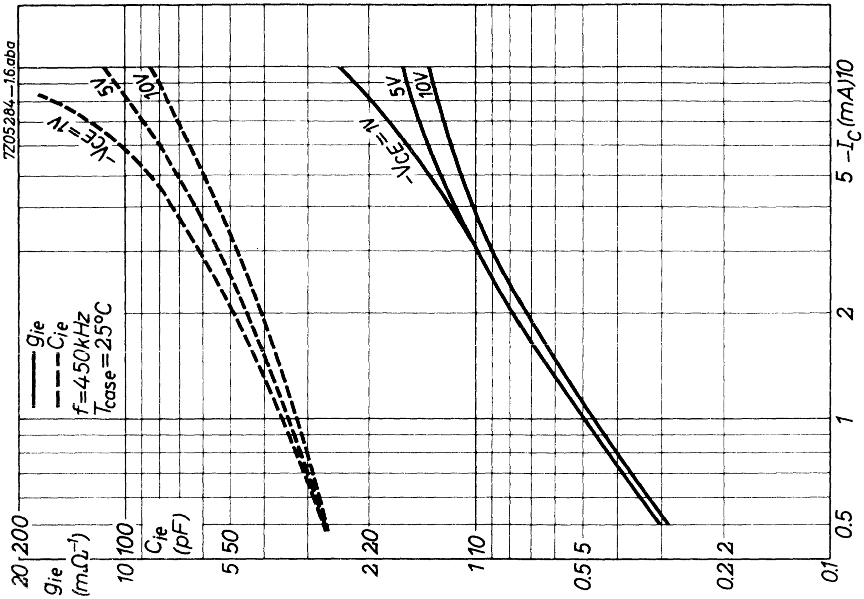
7Z3 0304

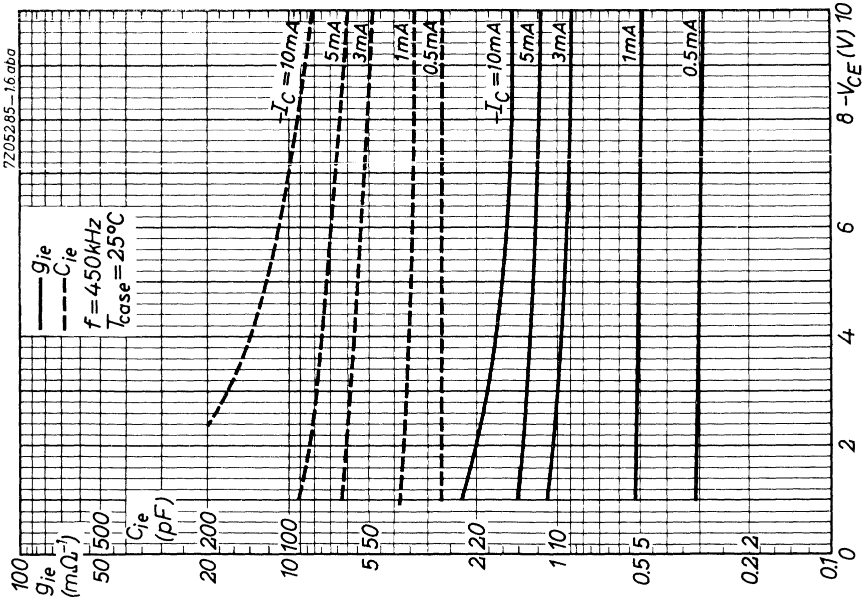

7Z05230–16.aba
max
typ
$-V_{CB}$ = 25V
10V
25V
10V
$-I_{CBO}$ (μA)
T_j (°C)
1000
500
200
100
50
20
10
5
2
1
0
20
40
60
80
100

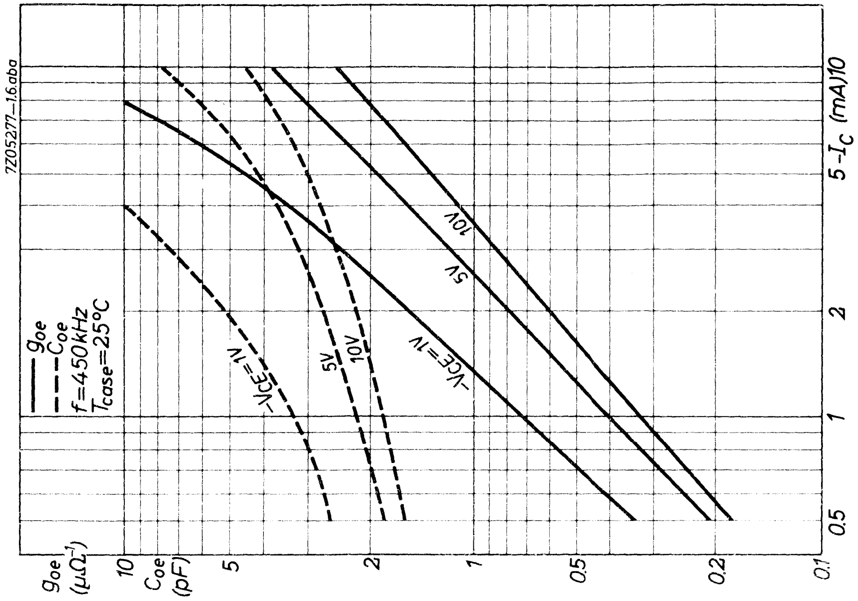

7Z02647–1.6.aba.
$-I_B$ = 80μA
70μA
60μA
50μA
40μA
30μA
20μA
10μA
$-I_C$ (mA)
$-V_{CE}$ (V)
T_j = 25°C
$-V_{CE}$ = 10V
5V
$-I_B$ (μA)
$-V_{BE}$ (mV)
$-V_{CE}$ = 5V to 10V
8
6
4
2
0
10
20
50
100
200
400

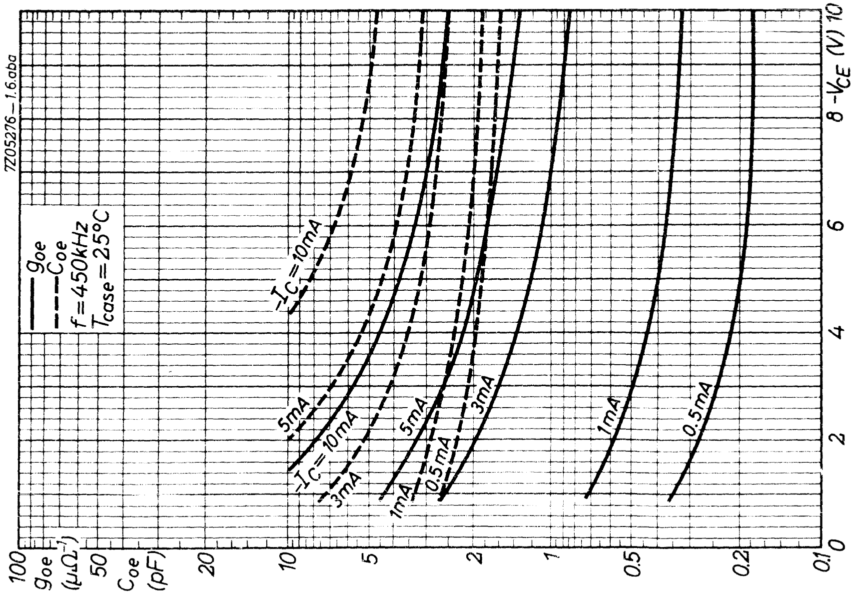

7Z05283—1.6.aba
f = 450 kHz
Tcase = 25°C
−VCE = 5V
1V
|yfe| (mΩ⁻¹)
1000
500
200
100
50
20
10
0.5
1
2
5
10
−IC (mA)

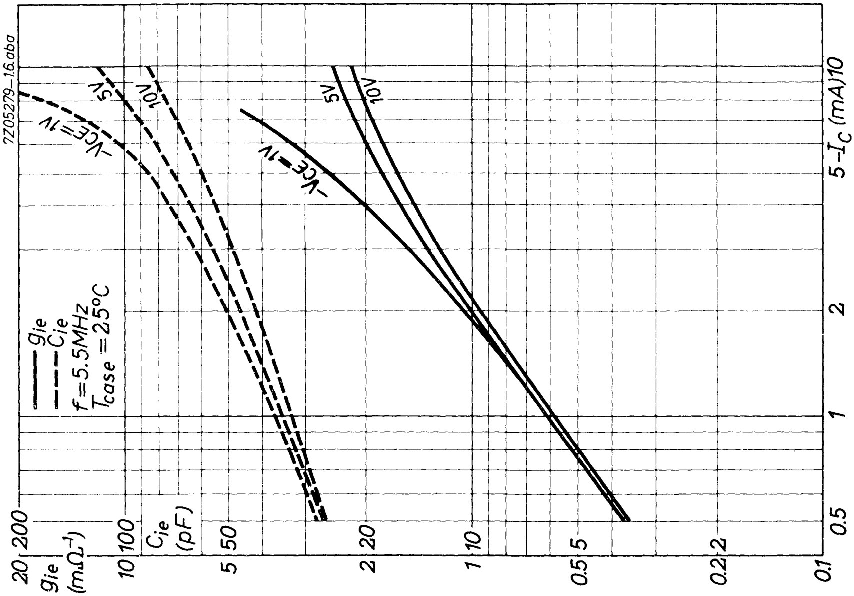

7Z05286—1.6.aba
−VCE = 5V
−IC = 2mA
Tcase = 25°C
φfe
−φre
|yfe|
Cie
|yre|
Coe
goe
gie
gie (mΩ⁻¹)
Cie (pF)
goe (µΩ⁻¹)
Coe (pF)
|yre| (µΩ⁻¹)
|yfe| (mΩ⁻¹)
−φre (°)
φfe (°)
1000
100
10
1
0.1
0.1
1
10
100
f (MHz)

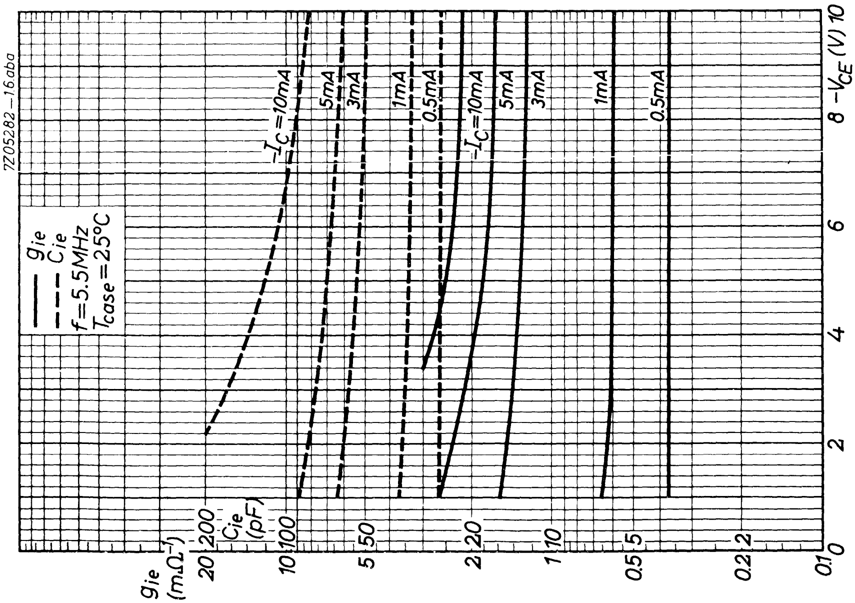

7Z05284–1.6.aba
g_{ie}
C_{ie}
f = 450 kHz
T_{case} = 25°C
$-V_{CE}$ = 1V
5V
10V
g_{ie} $(m\Omega^{-1})$
C_{ie} (pF)
$-I_C$ (mA)

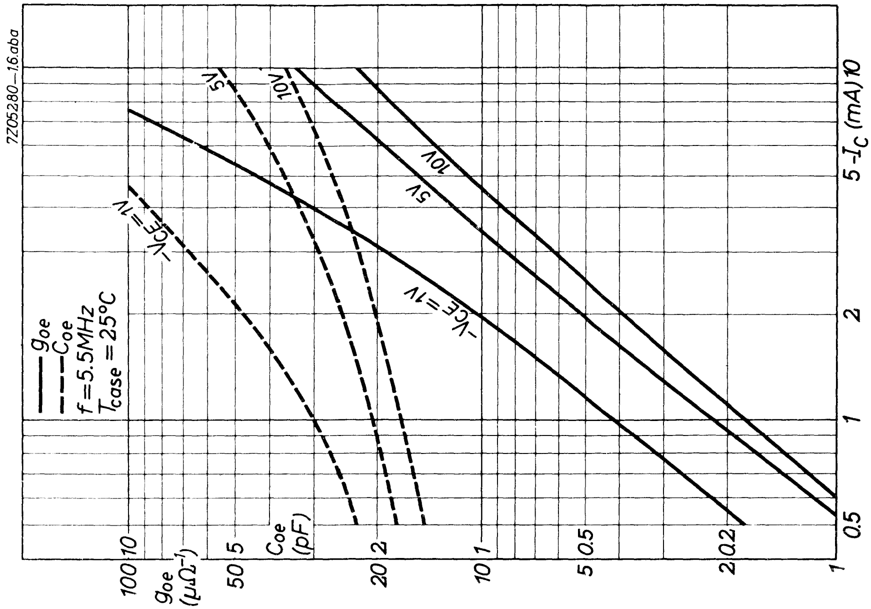

7Z05285–1.6.aba
g_{ie}
C_{ie}
f = 450 kHz
T_{case} = 25°C
$-I_C$ = 10mA
5mA
3mA
1mA
0.5mA
g_{ie} $(m\Omega^{-1})$
C_{ie} (pF)
$-V_{CE}$ (V)

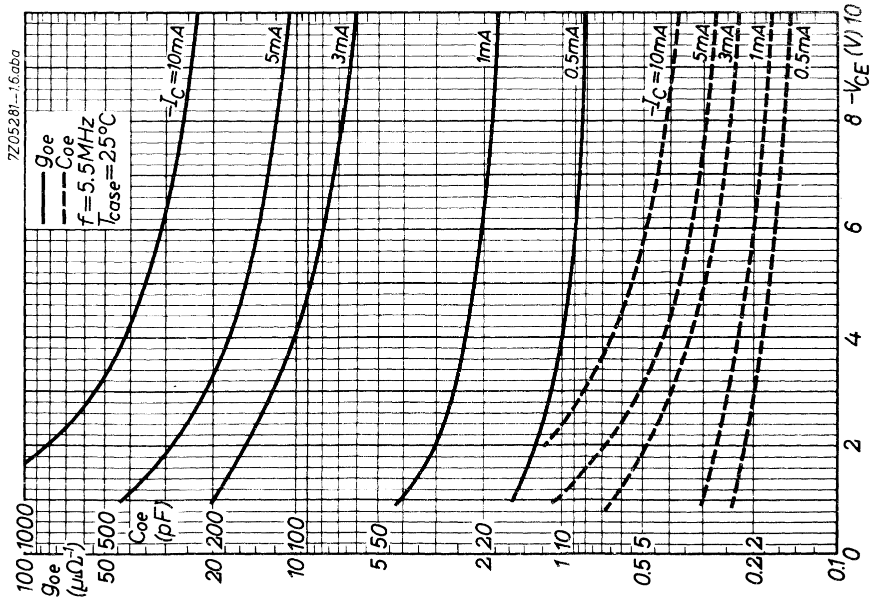

7Z05277—1.6.aba
g_{oe}
C_{oe}
f = 450 kHz
T_{case} = 25°C
$-V_{CE}$ = 1V
5V
10V
g_{oe} ($\mu\Omega^{-1}$)
C_{oe} (pF)
$-I_C$ (mA)

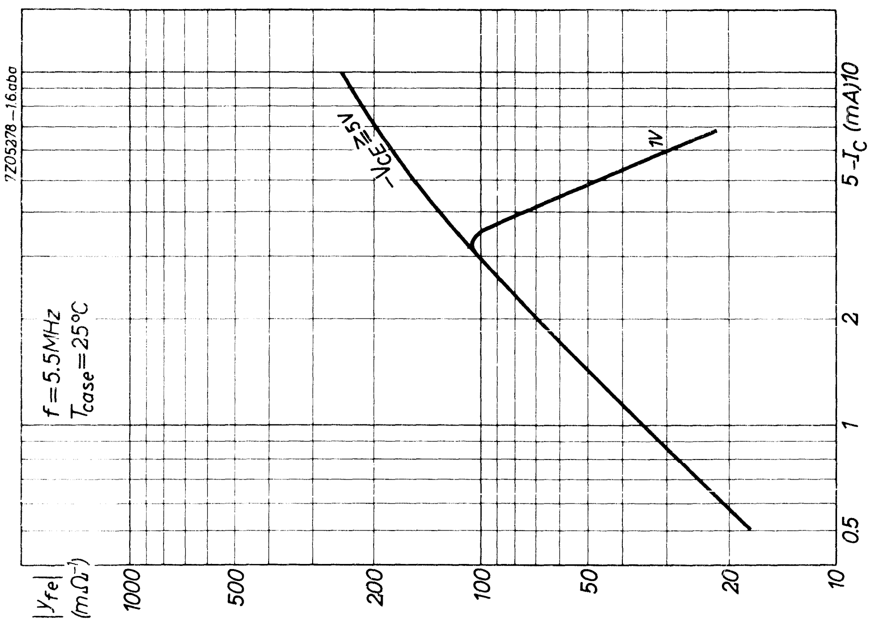

7Z05276—1.6.aba
g_{oe}
C_{oe}
f = 450 kHz
T_{case} = 25°C
$-I_C$ = 10mA
5mA
3mA
1mA
0.5mA
g_{oe} ($\mu\Omega^{-1}$)
C_{oe} (pF)
$-V_{CE}$ (V)

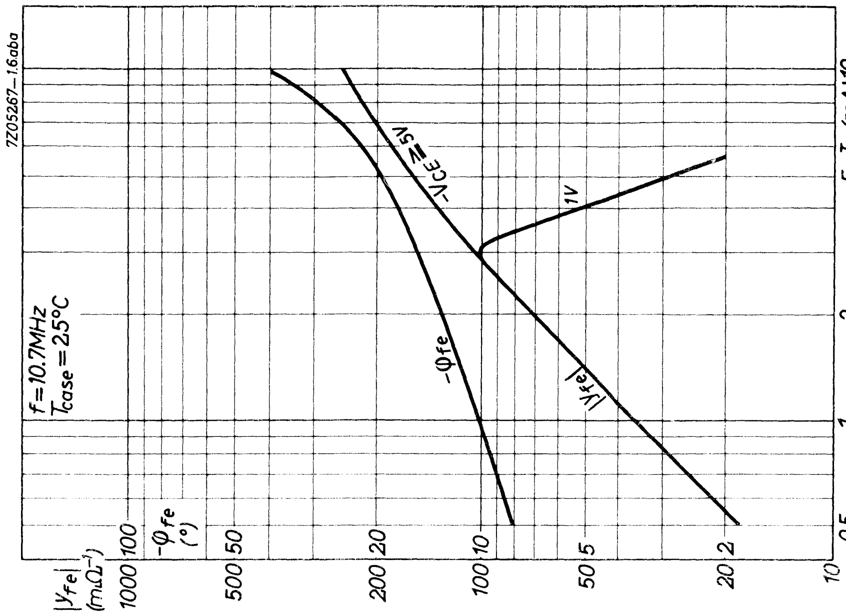

7Z05279-16.aba
g_{ie}
C_{ie}
f = 5.5MHz
T_{case} = 25°C
$-V_{CE}$ = 1V
5V
10V
g_{ie} ($m\Omega^{-1}$)
C_{ie} (pF)
$-I_C$ (mA)

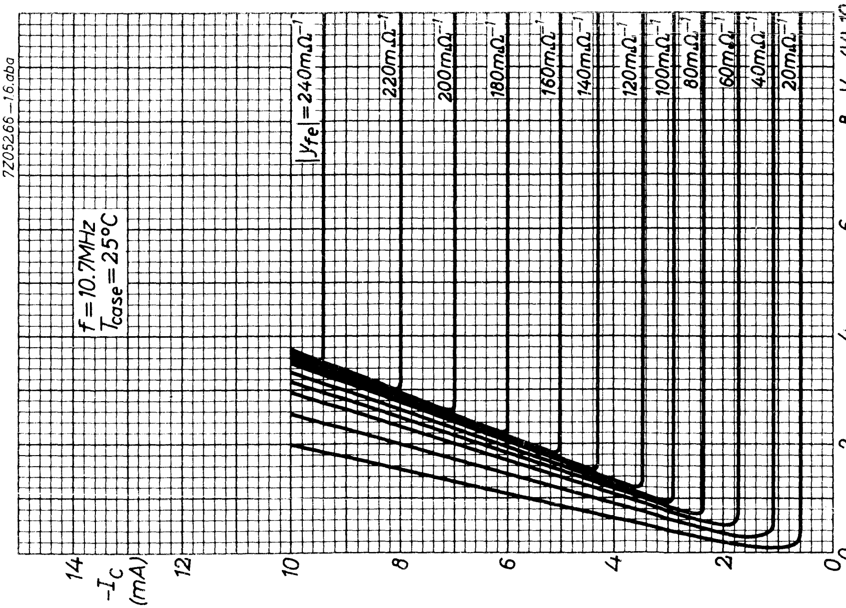

7Z05282-16.aba
g_{ie}
C_{ie}
f = 5.5MHz
T_{case} = 25°C
$-I_C$ = 10mA
5mA
3mA
1mA
0.5mA
g_{ie} ($m\Omega^{-1}$)
C_{ie} (pF)
$-V_{CE}$ (V)

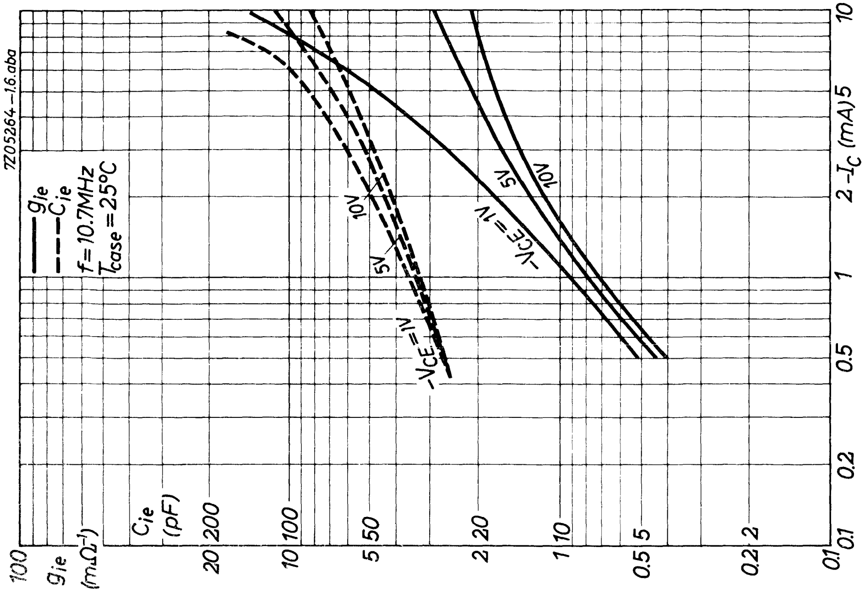

7Z05280—1.6.aba
goe
Coe
f=5.5MHz
Tcase = 25°C
-VCE=1V
5V
10V
-IC (mA)
goe (μΩ⁻¹)
Coe (pF)

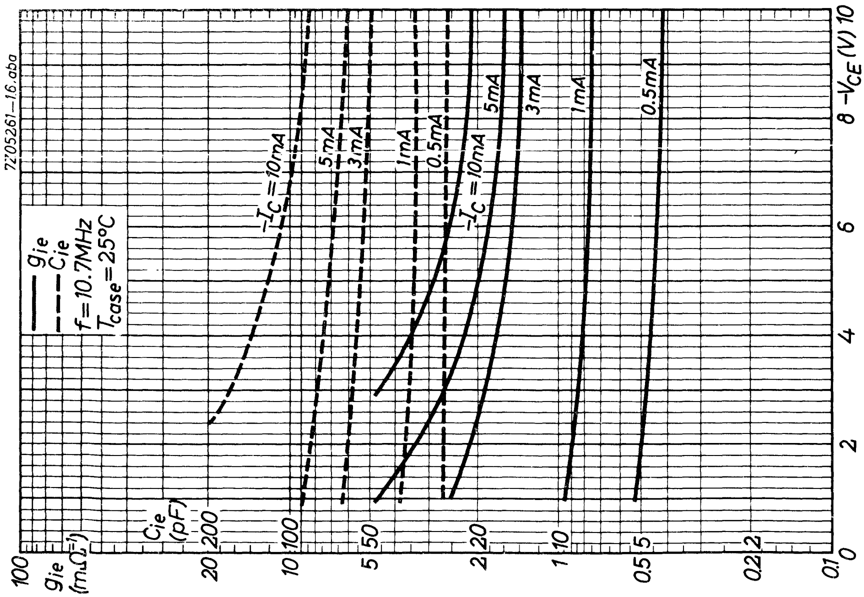

7Z05281—1.6.aba
goe
Coe
f=5.5MHz
Tcase=25°C
-IC=10mA
5mA
3mA
1mA
0.5mA
-VCE (V)
goe (μΩ⁻¹)
Coe (pF)

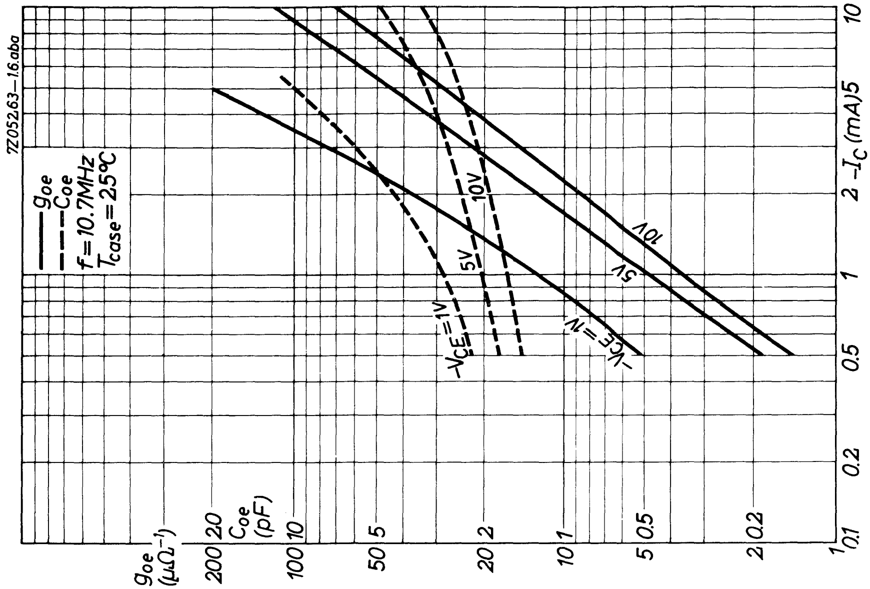

7Z05278 -1.6.aba
f = 5.5MHz
Tcase = 25°C
|yfe|
(mΩ-1)
1000
500
200
100
50
20
10
0.5
1
2
5
-IC (mA)10
-VCE = 5V
1V

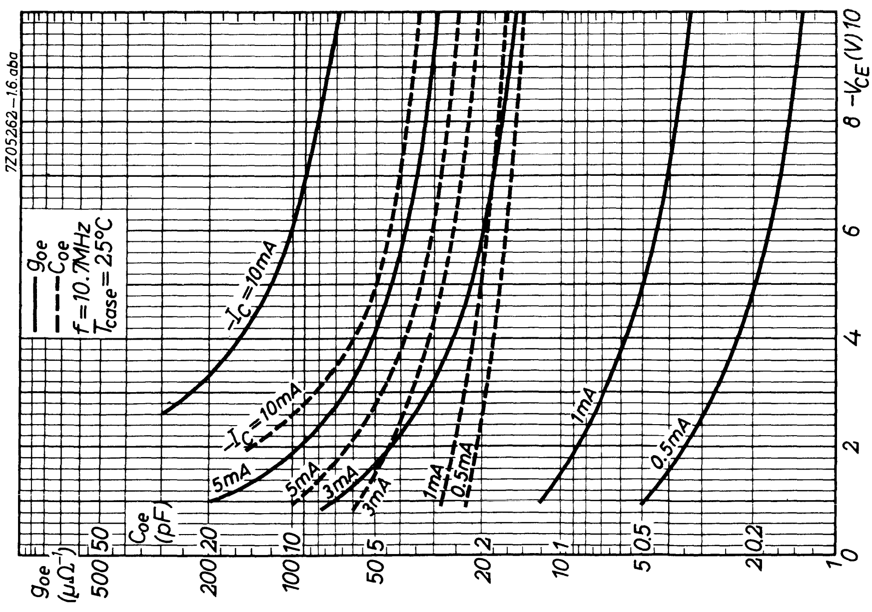

7Z05267–1.6.aba
f = 10.7MHz
Tcase = 25°C
−VCE = 5V
1V
−φfe
|yfe|
|yfe| (mΩ⁻¹)
−φfe (°)
1000 100
500 50
200 20
100 10
50 5
20 2
10
0.5
1
2
5 −IC (mA) 10

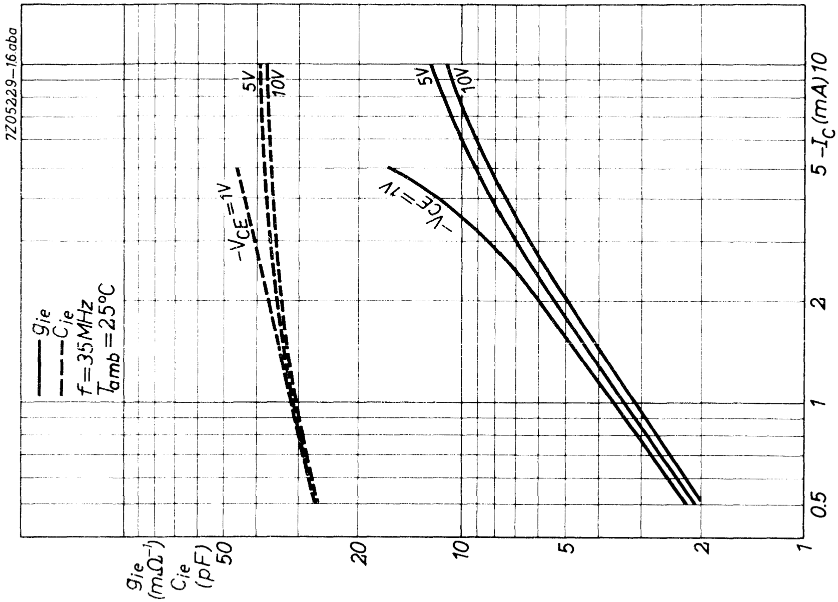

7Z05266–16.aba
f = 10.7MHz
Tcase = 25°C
|yfe| = 240mΩ⁻¹
220mΩ⁻¹
200mΩ⁻¹
180mΩ⁻¹
160mΩ⁻¹
140mΩ⁻¹
120mΩ⁻¹
100mΩ⁻¹
80mΩ⁻¹
60mΩ⁻¹
40mΩ⁻¹
20mΩ⁻¹
14
−IC (mA)
12
10
8
6
4
2
0
2
4
6
8 −VCE (V) 10

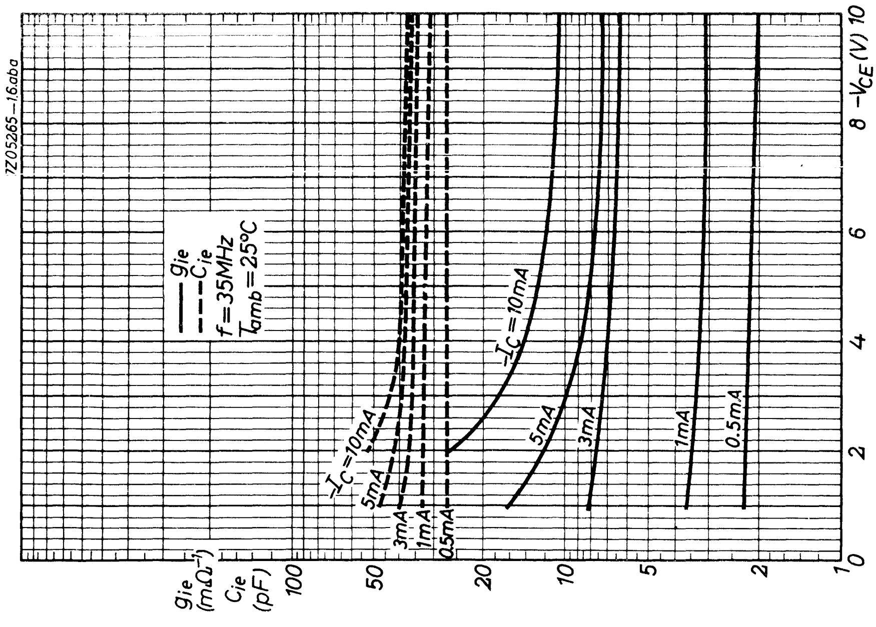

7Z05264-1.6.aba
gie
Cie
f = 10.7MHz
Tcase = 25°C
−VCE = 1V
5V
10V
−IC (mA)
Cie (pF)
gie (mΩ-1)

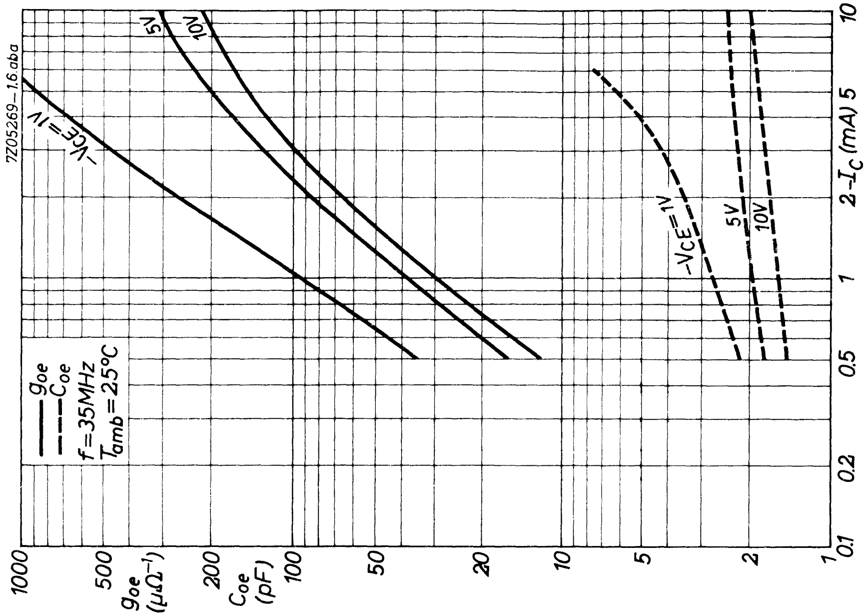

7Z05261-1.6.aba
gie
Cie
f = 10.7MHz
Tcase = 25°C
−IC = 10mA
5mA
3mA
1mA
0.5mA
−VCE (V)
Cie (pF)
gie (mΩ-1)

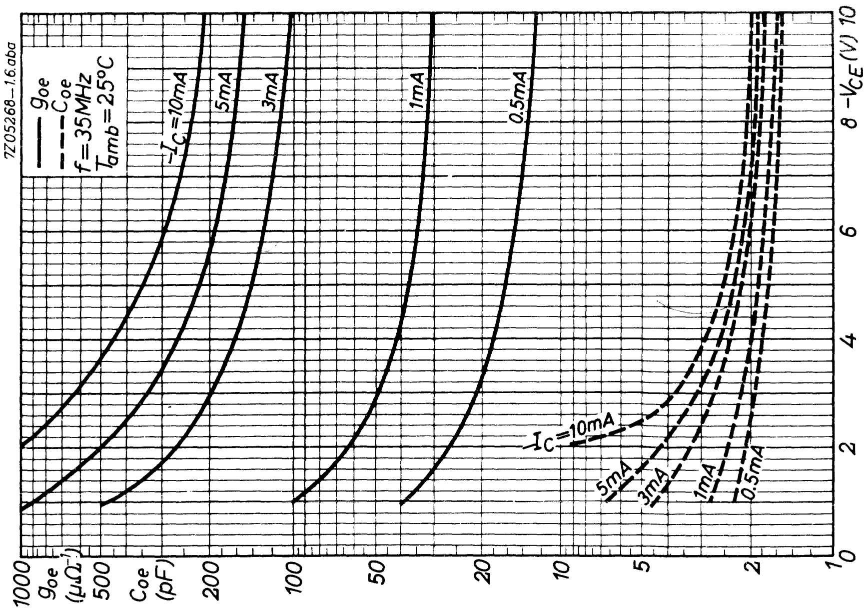

7Z05263–1.6.aba
goe
Coe
f=10.7MHz
Tcase=25°C
goe (μΩ⁻¹)
Coe (pF)
−IC (mA)
−VCE=1V
5V
10V

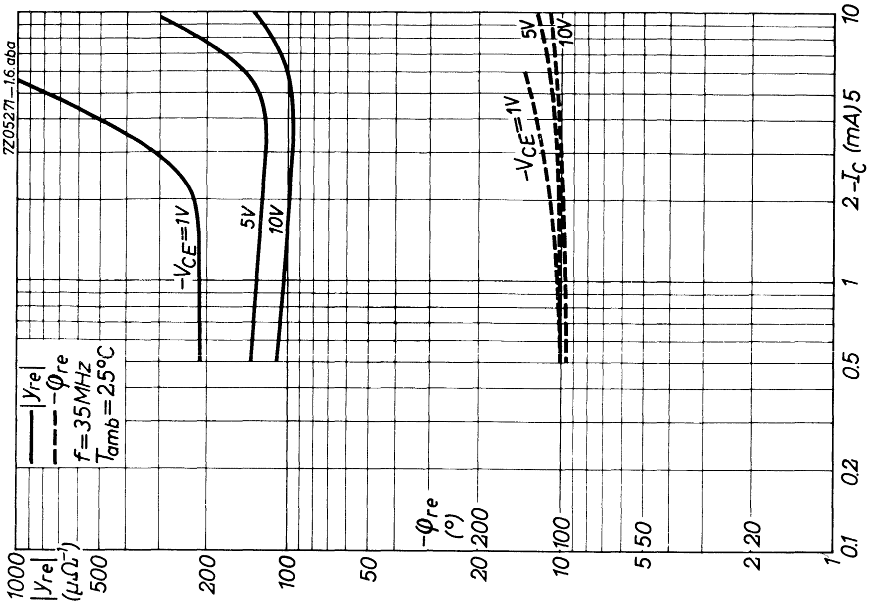

7Z05262–1.6.aba
goe
Coe
f=10.7MHz
Tcase=25°C
goe (μΩ⁻¹)
Coe (pF)
−VCE (V)
−IC=10mA
5mA
3mA
1mA
0.5mA

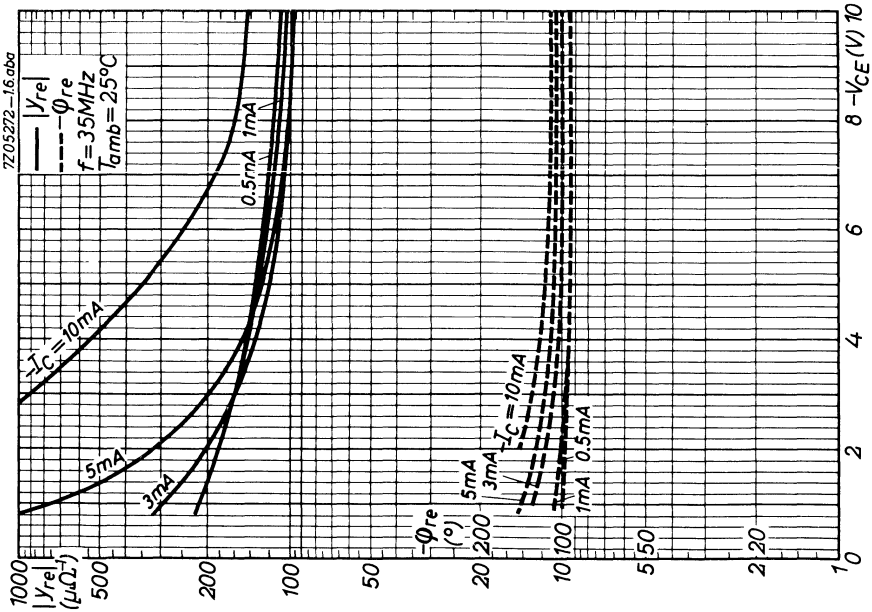

7Z05229-1.6.aba
g_{ie}
C_{ie}
f = 35MHz
T_{amb} = 25°C
$-V_{CE}$ = 1V
5V
10V
g_{ie} (mΩ^{-1})
C_{ie} (pF)
$-I_C$ (mA)
0.5
1
2
5
10
20
50

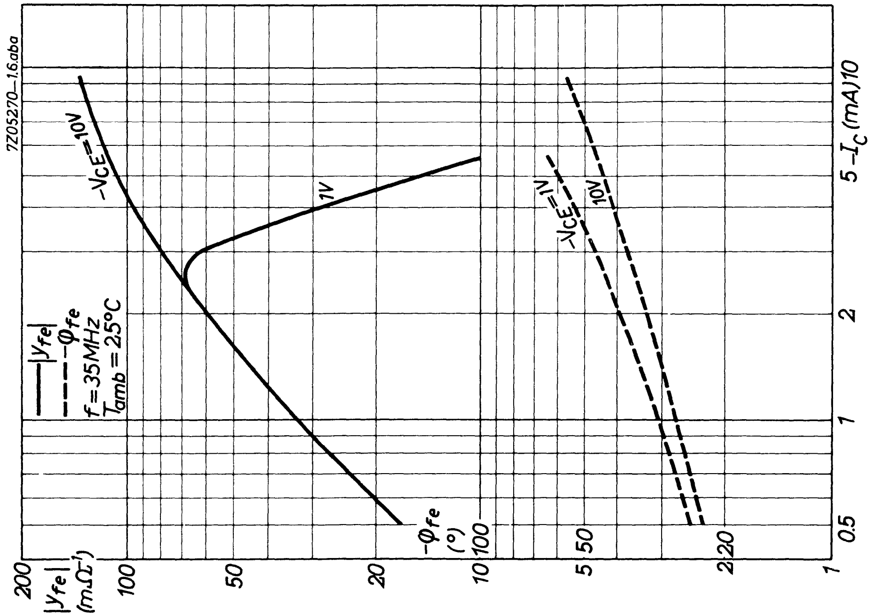

7Z05265-1.6.aba
g_{ie}
C_{ie}
f = 35MHz
T_{amb} = 25°C
$-I_C$ = 10mA
5mA
3mA
1mA
0.5mA
g_{ie} (mΩ^{-1})
C_{ie} (pF)
$-V_{CE}$ (V)
0
2
4
6
8
10
1
5
20
50
100

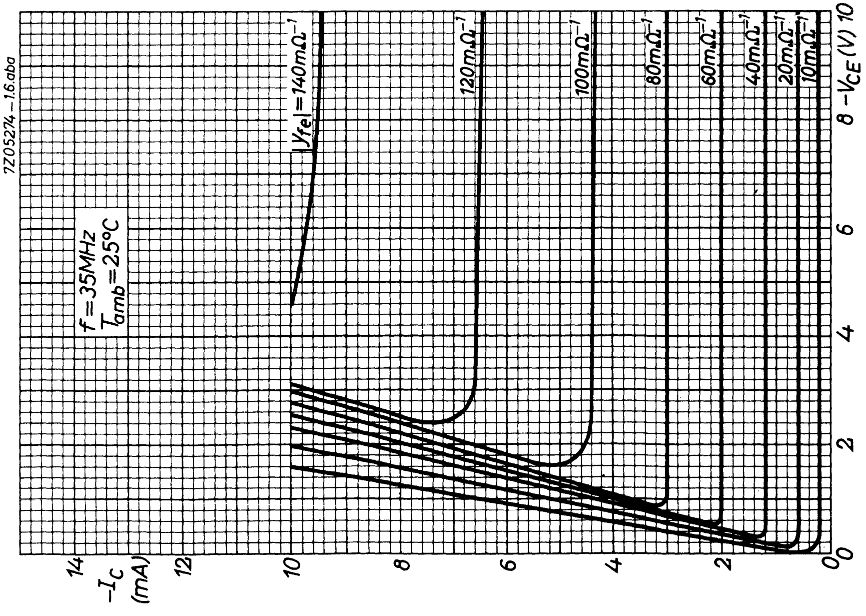

7Z05269-1.6.aba
g_{oe}
C_{oe}
f=35MHz
T_{amb}=25°C
$-V_{CE}$=1V
5V
10V
g_{oe} ($\mu\Omega^{-1}$)
C_{oe} (pF)
$-I_C$ (mA)
1000
500
200
100
50
20
10
5
2
1
0.1
0.2
0.5
1
2
5
10

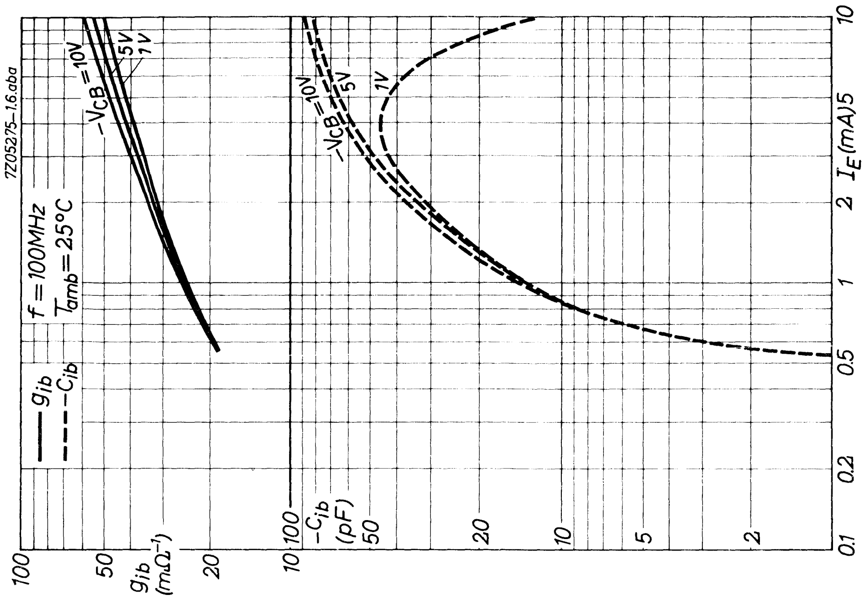

7Z05268-1.6.aba
g_{oe}
C_{oe}
f=35MHz
T_{amb}=25°C
$-I_C$=10mA
5mA
3mA
1mA
0.5mA
g_{oe} ($\mu\Omega^{-1}$)
C_{oe} (pF)
$-V_{CE}$ (V)
1000
500
200
100
50
20
10
5
2
1
0
2
4
6
8
10

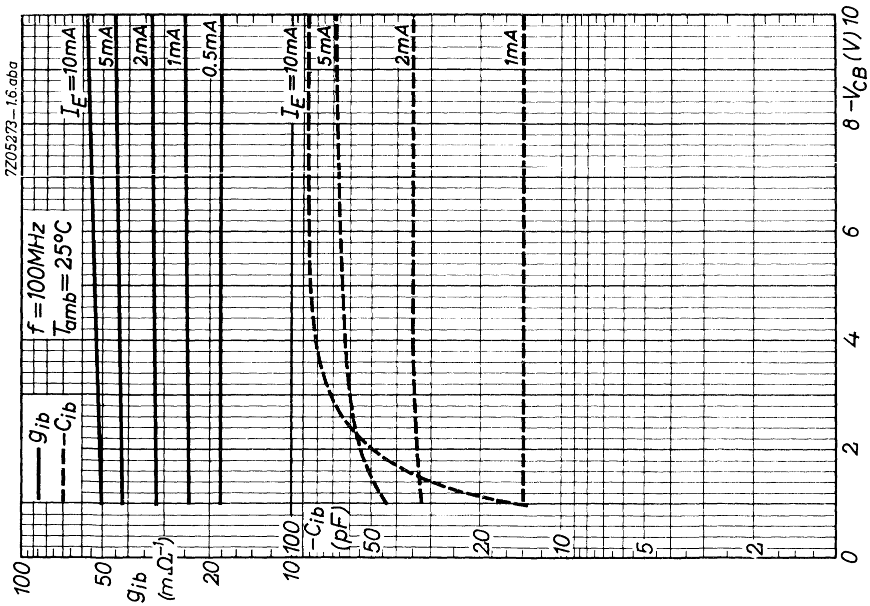

7Z05271–1.6.aba
|yre|
–φre
f = 35MHz
Tamb = 25°C
–VCE = 1V
5V
10V
–VCE = 1V
5V
10V
–φre
(°)
|yre|
(μΩ⁻¹)
–IC (mA)

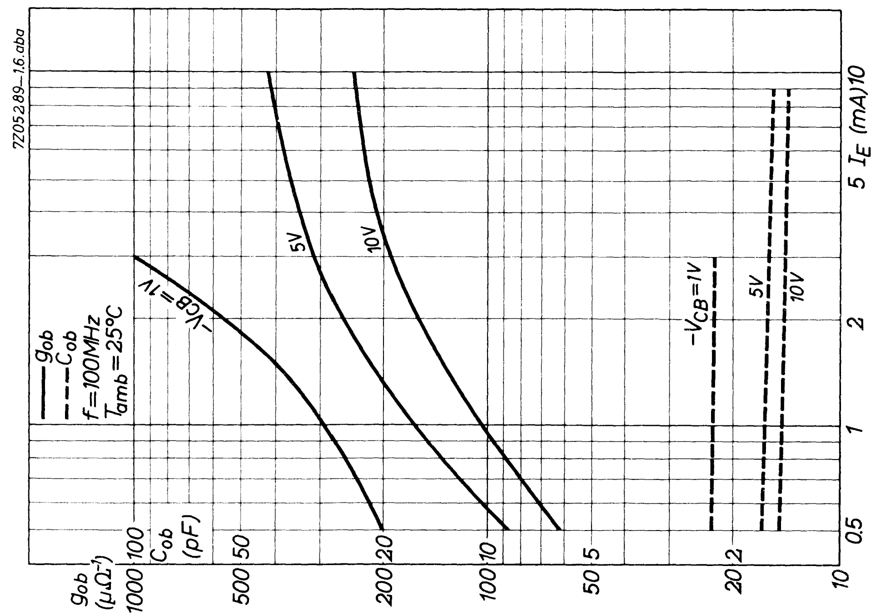

7Z05272–1.6.aba
|yre|
–φre
f = 35MHz
Tamb = 25°C
–IC = 10mA
5mA
3mA
0.5mA
1mA
–IC = 10mA
5mA
3mA
1mA
0.5mA
–φre
(°)
|yre|
(μΩ⁻¹)
–VCE (V)

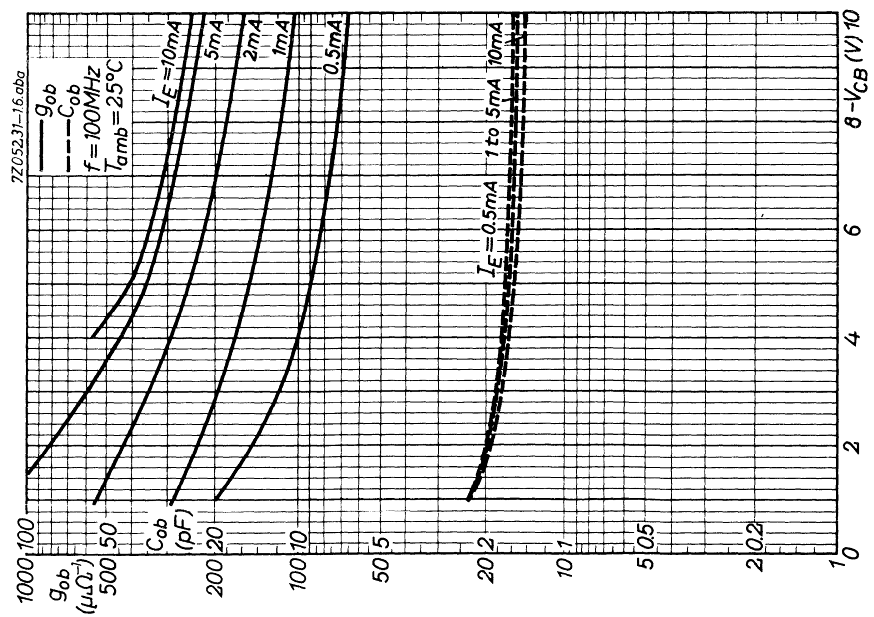

7Z05270—1.6.aba
|y_fe|
-φ_fe
f = 35MHz
T_amb = 25°C
-V_CE=10V
1V
-V_CE=1V
10V
-φ_fe (°)
|y_fe| (mΩ⁻¹)
-I_C (mA)

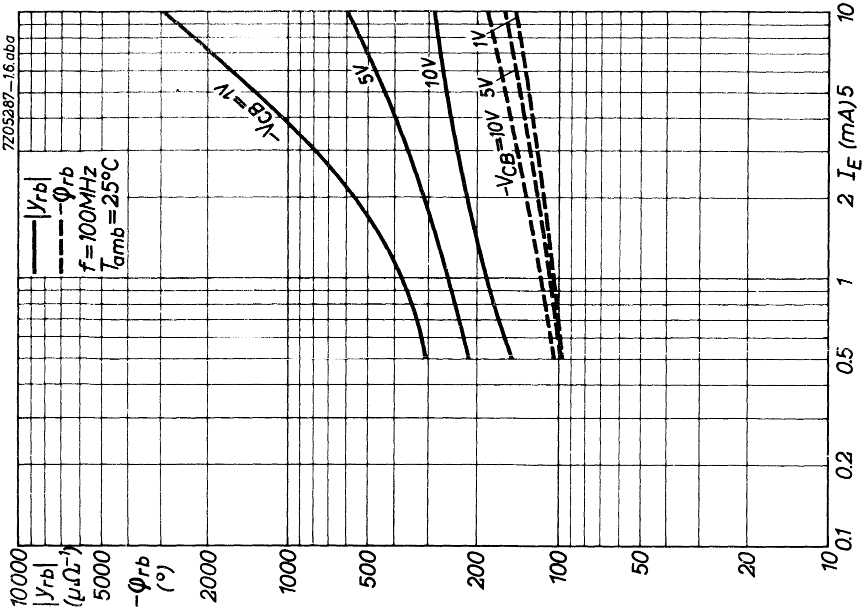

7Z05274—1.6.aba
f=35MHz
T_amb=25°C
|y_fe|=140mΩ⁻¹
120mΩ⁻¹
100mΩ⁻¹
80mΩ⁻¹
60mΩ⁻¹
40mΩ⁻¹
20mΩ⁻¹
10mΩ⁻¹
-V_CE (V)
-I_C (mA)

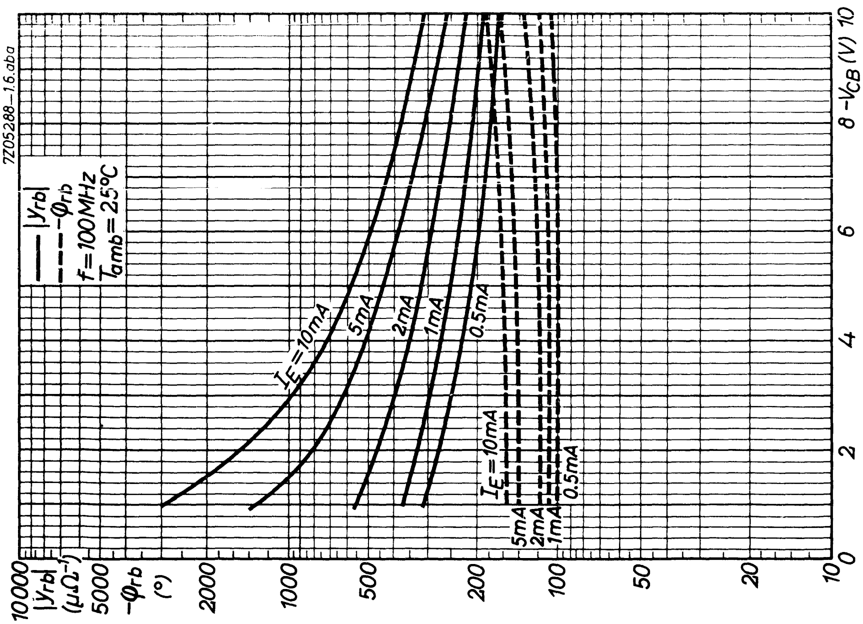

7Z05275-1.6.aba
g_{ib}
$-C_{ib}$
f = 100MHz
T_{amb} = 25°C
$-V_{CB}$ = 10V
5V
1V
g_{ib} ($m\Omega^{-1}$)
$-C_{ib}$ (pF)
I_E (mA)
100
50
20
10
5
2
0.1
0.2
0.5
1

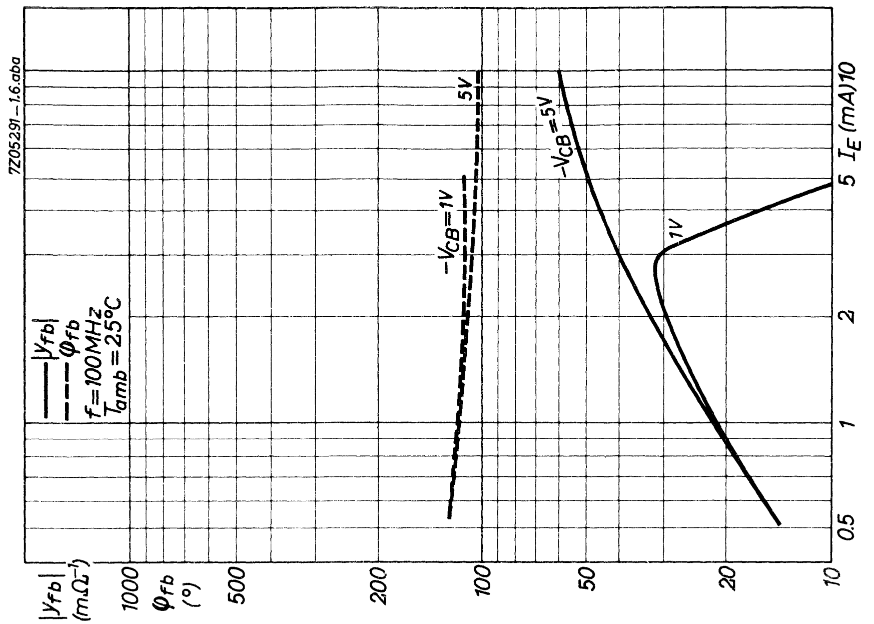

7Z05273-1.6.aba
g_{ib}
$-C_{ib}$
f = 100MHz
T_{amb} = 25°C
I_E = 10mA
5mA
2mA
1mA
0.5mA
g_{ib} ($m\Omega^{-1}$)
$-C_{ib}$ (pF)
$-V_{CB}$ (V)
100
50
20
10
5
2
0
4
6
8

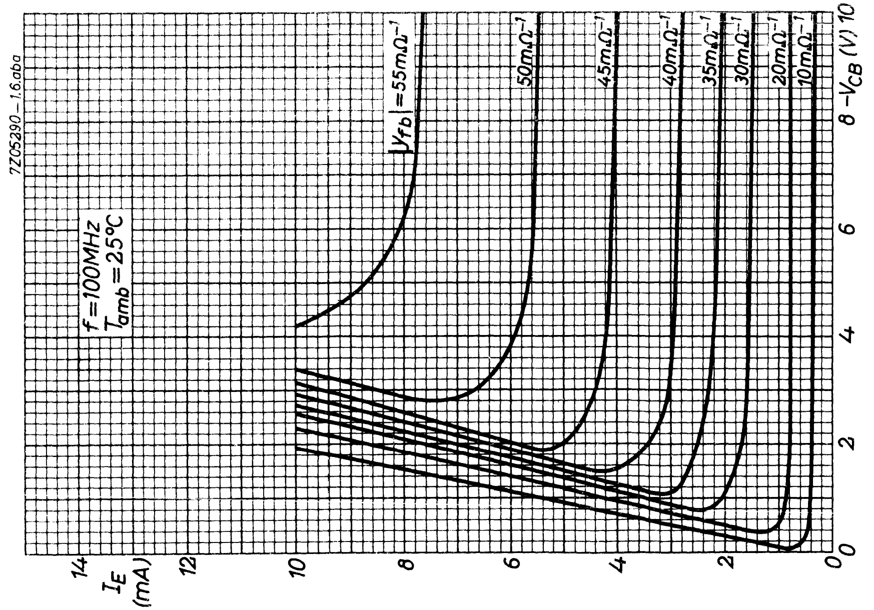

7Z05289-1.6.aba
g_ob
C_ob
f=100MHz
T_amb=25°C
-V_CB=1V
5V
10V
I_E (mA)
g_ob (μΩ^-1)
C_ob (pF)


7Z05231-1.6.aba
g_ob
C_ob
f=100MHz
T_amb=25°C
I_E=10mA
5mA
2mA
1mA
0.5mA
I_E=0.5mA 1 to 5mA 10mA
-V_CB (V)
g_ob (μΩ^-1)
C_ob (pF)


7Z05287–1.6.aba
|y_{rb}|
$-\varphi_{rb}$
f=100MHz
T_{amb}=25°C
$-V_{CB}$=1V
5V
10V
1V
5V
$-V_{CB}$=10V
10000
|y_{rb}| ($\mu\Omega^{-1}$)
5000
$-\varphi_{rb}$ (°)
2000
1000
500
200
100
50
20
10
0.1
0.2
0.5
1
2
5
10
I_E (mA)


7Z05288–1.6.aba
|y_{rb}|
$-\varphi_{rb}$
f=100MHz
T_{amb}=25°C
I_E=10mA
5mA
2mA
1mA
0.5mA
I_E=10mA
5mA
2mA
1mA
0.5mA
10000
|y_{rb}| ($\mu\Omega^{-1}$)
5000
$-\varphi_{rb}$ (°)
2000
1000
500
200
100
50
20
10
0
2
4
6
8
10
$-V_{CB}$ (V)

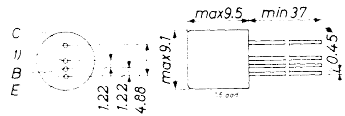

7Z05291 - 1.6.aba
|yfb|
φfb
f=100MHz
Tamb=25°C
-VCB=1V
5V
-VCB=5V
1V
IE (mA)
0.5
1
2
5
10
|yfb| (mΩ-1)
φfb (°)
1000
500
200
100
50
20
10


7Z05290 - 1.6.aba
f=100MHz
Tamb=25°C
|yfb|=55mΩ-1
50mΩ-1
45mΩ-1
40mΩ-1
35mΩ-1
30mΩ-1
20mΩ-1
10mΩ-1
-VCB (V)
0
2
4
6
8
10
IE (mA)
14
12
10
8
6
4
2
0

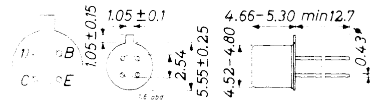
GERMANIUM ALLOY-DIFFUSED TRANSISTOR of the p-n-p type in metal envelope with low noise and high power gain at 100 Mc/s, for use as R.F. amplifier in F.M. receivers

Dimensions in mm

AF114



AF124



LIMITING VALUES (Absolute max. values)

Collector

Voltage (base reference)		$-V_{CB}$	= max.	32 V
Voltage (emitter reference)		$-V_{CE}$	= max.	32 V [2]
Current		$-I_C$	= max.	10 mA
Dissipation ($T_{amb} \leq 45\ ^oC$)	AF114	P_C	= max.	75 mW
Dissipation	AF124	P_C	= max.	60 mW

Emitter

Reverse current	$-I_E$	= max.	1 mA

Base

Current	$\lvert I_B \rvert$	= max.	1 mA

Temperatures

Storage temperature	T_s	=	$-55\ ^oC$ to $+75\ ^oC$
Junction temperature			
continuous operation	T_j	= max.	75 ^oC
intermittent operation (total duration max. 200 hrs)	T_j	= max.	90 ^oC
	(t	= max.	200 hrs)

THERMAL DATA

Thermal resistance from junction to ambience in free air	AF114	K	= max.	0.6 $^oC/mW$
	AF124	K	= max.	0.75 $^oC/mW$
Thermal resistance from junction to case	AF124	K	= max.	0.4 $^oC/mW$

1) Interlead shield and metal case

2) See also page F.

7Z2 3176

CHARACTERISTICS at $T_{amb} = 25\ ^oC$

Collector current at $I_E = 0$ mA

$-I_{CBO}$ ($-V_{CB}$ = 6 V; I_E = 0 mA)	= 1.2 µA	< 8 µA	

Collector voltage at $I_E = 0$ mA

$-V_{CB}$ ($-I_C$ = 50 µA; I_E = 0 mA)		> 32 V

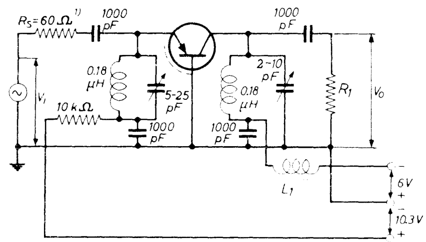
Base current

$-I_B$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 7 µA	< 25 µA

Base voltage

$-V_{BE}$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 270 mV	> 210 mV < 330 mV

Test circuit for power gain at 100 Mc/s



R_1 is chosen so that the total impedance R_L of the tuned circuit is 3.3 kΩ

L_1 = ferrite bead

Available power gain at 100 Mc/s in the circuit above

G (f = 100 Mc/s)	= 14 dB	> 12.5 dB

The available power gain is defined as

$$G = \frac{V_o^2}{V_1^2} \cdot \frac{4R_S}{R_L} = 0.073\ \frac{V_o^2}{V_1^2}\ .$$

1) Input source impedance

7Z2 1521

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

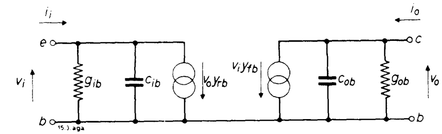
T_{amb} = 25 °C

Emitter voltage			
$-V_{EB}$ ($-I_E$ = 50 µA; I_C = 0 mA)	=	1.5 V	> 1.0 V
Frequency at which $\lvert h_{fe} \rvert$ = 1			
f_1 ($-V_{CB}$ = 6 V; I_E = 1 mA)	=	75 Mc/s	
Intrinsic base impedance			
$\lvert z_{rb} \rvert$ ($-V_{CB}$ = 6 V; I_E = 1 mA; f = 2 Mc/s)	=	20 Ω	
Feedback capacitance			
$-c_{re}$ ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 0.45 Mc/s)	=	1.5 pF	
Current amplification factor			
h_{fe} ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 kc/s)	=	150	
Noise figure			
F ($-V_{CB}$ = 6 V; I_E = 1 mA; f = 100 Mc/s; Input source resistance = 60 Ω)	=	8 dB	< 9.5 dB

7Z2 1131

3.

SMALL SIGNAL PARAMETERS measured with a length of lead between transistor bottom and measuring jig of 5 mm

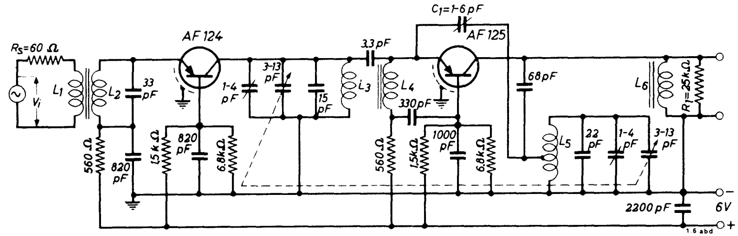


Measured at			
Collector voltage	$-V_{CB}$	=	6 V
Emitter current	I_E	=	1 mA
Frequency	f	=	100 Mc/s
Input conductance	g_{ib}	=	15 mA/V
Input capacitance	$-c_{ib}$	=	5 pF
Feedback admittance	$\lvert y_{rb} \rvert$	=	0.45 mA/V
Phase angle of feedback admittance	φ_{rb}	=	250 °
Transfer admittance	$\lvert y_{fb} \rvert$	=	16 mA/V
Phase angle of transfer admittance	φ_{fb}	=	95 °
Output conductance	g_{ob}	=	0.3 mA/V
Output capacitance	c_{ob}	=	2.5 pF

7Z2 1132

4.

FRONT-END UNIT OF F.M. TUNER



For data of the oscillator-mixer stage please refer to the data sheets of type AF125

Coil data. L_1: $4\frac{1}{2}$ turns of 0.3 mm enamelled copper wire, wound between L_2

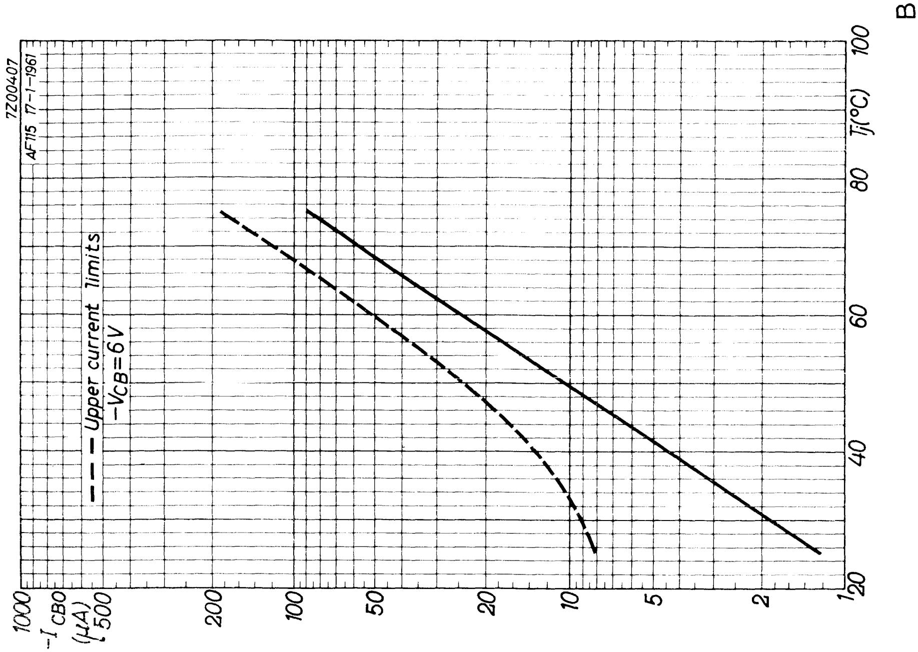
L_2: 4 turns of 1 mm enamelled copper wire, winding pitch 2 mm; inductance L = 0.18 µH; unloaded Q-factor Q_o = 60 to 80

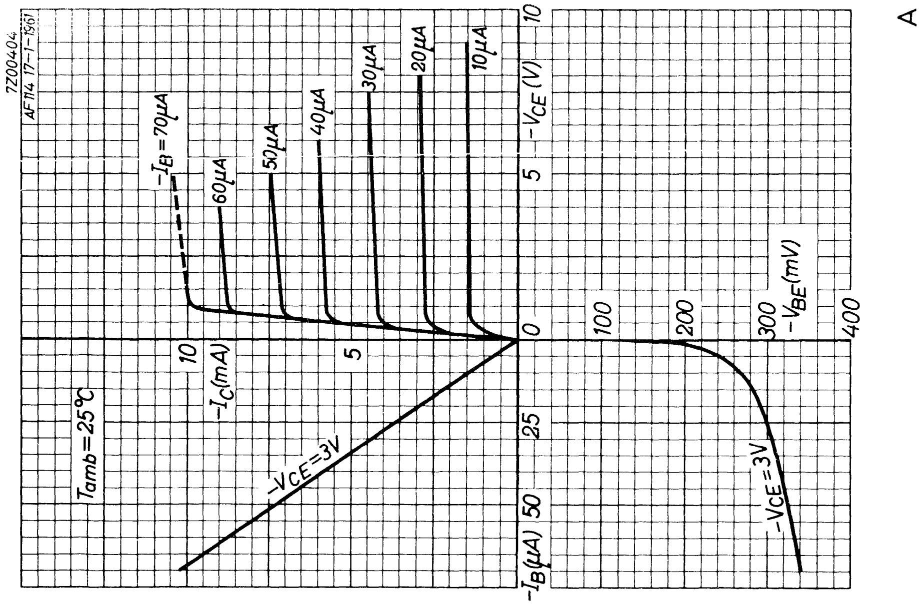
L_3: $3\frac{1}{4}$ turns of 1 mm silvered copper wire, winding pitch 2 mm; inductance L = 0.086 µH; unloaded Q-factor Q_o = 200

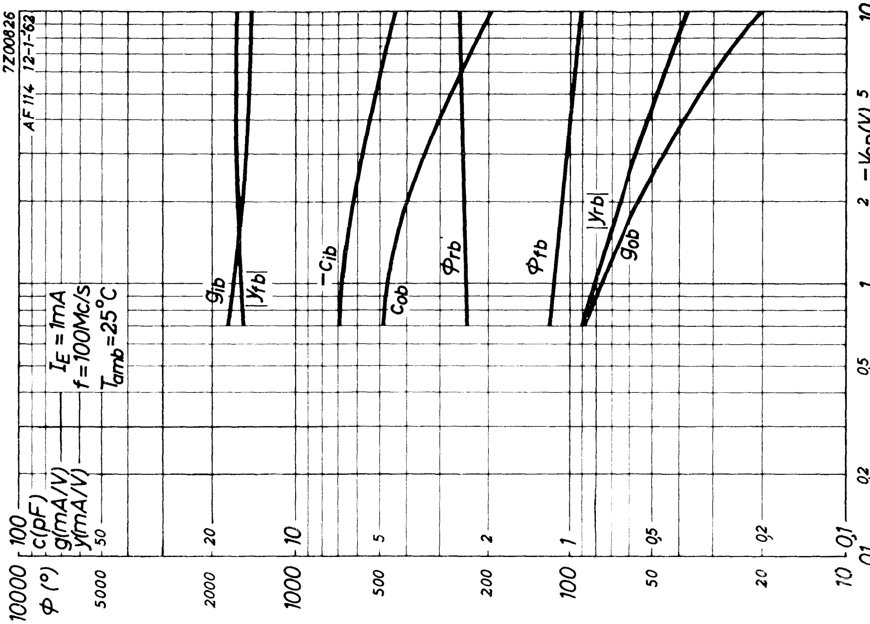
Operating characteristics

Frequency range	f	=	87 to 101 Mc/s	
Collector current AF124	$-I_C$	=	1.4 mA	
Total available power gain	G	=	28 dB	> 24 dB
Total noise factor	F	=	8 dB	< 9.5 dB
Oscillator voltage at aerial terminals		=	1.5 mV	
Image rejection		=	27 dB	

7Z2 1157

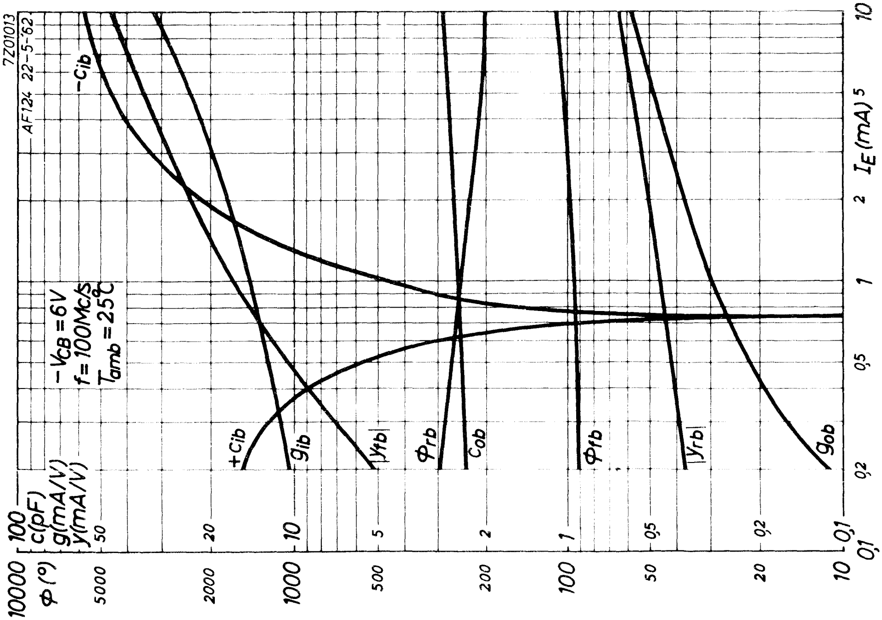

B
7Z00407
AF115 17-1-1961
Upper current limits
$-V_{CB}=6V$
$-I_{CBO}$ (μA)
1000
500
200
100
50
20
10
5
2
1
T_j(°C)
20
40
60
80
100


A
7Z00404
AF114 17-1-1961
$T_{amb}=25°C$
$-I_B=70μA$
60μA
50μA
40μA
30μA
20μA
10μA
$-V_{CE}$(V)
0
5
10
$-I_C$(mA)
10
5
$-V_{BE}$(mV)
100
200
300
400
$-I_B$(μA)
25
50
$-V_{CE}=3V$
$-V_{CE}=3V$



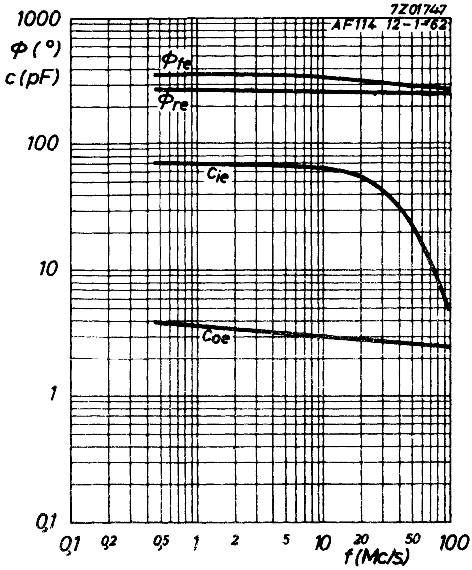
7Z00826
AF114 12-1-'62
I_E = 1mA
f = 100Mc/s
T_amb = 25°C
c(pF)
g(mA/V)
y(mA/V)
Φ (°)
g_ib
|y_fb|
−C_ib
C_ob
Φ_rb
Φ_fb
|y_rb|
g_ob
−V_CB(V)

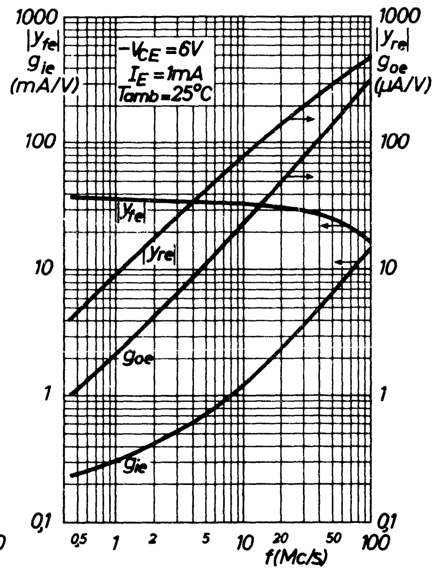
D



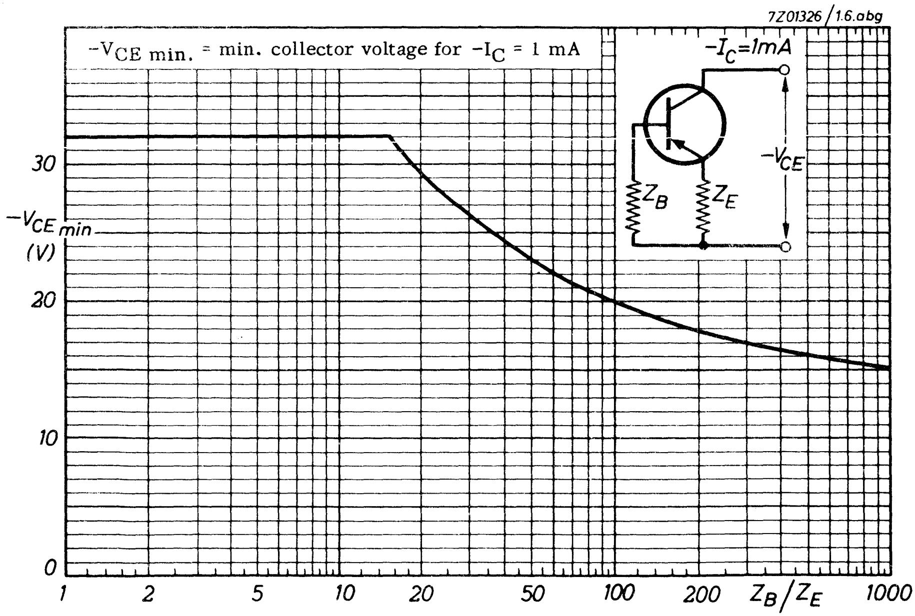
7Z01013
AF124 22-5-'62
−V_CB = 6V
f = 100Mc/s
T_amb = 25°C
c(pF)
g(mA/V)
y(mA/V)
Φ (°)
−C_ib
+C_ib
g_ib
|y_fb|
Φ_rb
C_ob
Φ_fb
|y_rb|
g_ob
I_E (mA)

C


7Z01747
AF114 12-1-'62
1000
φ (°)
c (pF)
φ_{fe}
φ_{re}
c_{ie}
c_{oe}
100
10
1
0,1
0,1 0,2 0,5 1 2 5 10 20 50 100
f (Mc/s)


1000
$|y_{fe}|$
g_{ie}
(mA/V)
$-V_{CE}$ = 6V
I_E = 1mA
Tamb = 25°C
1000
$|y_{re}|$
g_{oe}
(μA/V)
$|y_{fe}|$
$|y_{re}|$
g_{oe}
g_{ie}
100
10
1
0,1
0,5 1 2 5 10 20 50 100
f (Mc/s)

E

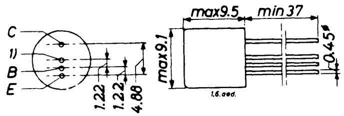

7Z01326 / 1.6.abg
$-V_{CE\ min.}$ = min. collector voltage for $-I_C$ = 1 mA
$-I_C$=1mA
$-V_{CE}$
Z_B
Z_E
$-V_{CE\ min}$
(V)
30
20
10
0
1 2 5 10 20 50 100 200 1000
Z_B/Z_E

F

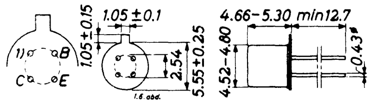
GERMANIUM ALLOY-DIFFUSED TRANSISTOR of the p-n-p type in metal envelope with high conversion gain up to 100 Mc/s, for use as mixer-oscillator in F.M. receivers and as R.F. amplifier and mixer-oscillator in short-wave receivers up to 27 Mc/s

Dimensions in mm

AF115



AF125



LIMITING VALUES (Absolute max. values)

Collector				
Voltage (base reference)		$-V_{CB}$	= max.	32 V
Voltage (emitter reference)		$-V_{CE}$	= max.	32 V [2])
Current		$-I_C$	= max.	10 mA
Dissipation ($T_{amb} \leq 45$ °C)	AF115	P_C	= max.	75 mW
Dissipation	AF125	P_C	= max.	60 mW
Emitter Reverse current		$-I_E$	= max.	1 mA
Base Current		$\lvert I_B \rvert$	= max.	1 mA
Temperatures				
Storage temperature		T_s	=	-55 °C to +75 °C
Junction temperature				
continuous operation		T_j	= max.	75 °C
intermittent operation (total duration max. 200 hrs)		T_j (t	= max. = max.	90 °C 200 hrs)

THERMAL DATA

Thermal resistance from junction to ambience in free air	AF115	K	= max.	0.6 °C/mW
	AF125	K	= max.	0.75 °C/mW
Thermal resistance from junction to case	AF125	K	= max.	0.4 °C/mW

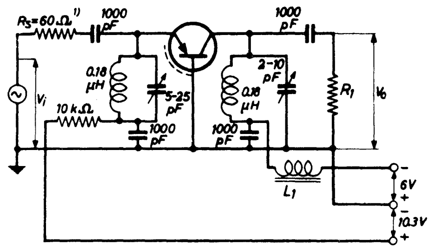
1) Interlead shield and metal case
2) See also page J

7Z2 3177 1.

CHARACTERISTICS at T_{amb} = 25 °C

Collector current at I_E = 0 mA		
$-I_{CBO}$ ($-V_{CB}$ = 6 V; I_E = 0 mA)	= 1.2 µA	< 8 µA
Collector voltage at I_E = 0 mA		
$-V_{CB}$ ($-I_C$ = 50 µA; I_E = 0 mA)		> 32 V
Base current		
$-I_B$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 7 µA	< 25 µA
Base voltage		
$-V_{BE}$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 270 mV	> 210 mV < 330 mV

Test circuit for power gain at 100 Mc/s



R_1 is chosen so that the total impedance R_L of the tuned circuit is 3.3 kΩ

L_1 = ferrite bead

Available power gain at 100 Mc/s in the circuit above

G (f = 100 Mc/s) = 13 dB > 10 dB

The available power gain is defined as

$$G = \frac{V_o^2}{V_i^2} \cdot \frac{4R_S}{R_L} = 0.073 \frac{V_o^2}{V_i^2} .$$

1) Input source impedance

7Z2 2320 2.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C

Emitter voltage

$-V_{EB}$ ($-I_E$ = 50 µA; I_C = 0 mA)	=	1.5 V	> 1.0 V

Frequency at which $\|h_{fe}\|$ = 1

f_1 ($-V_{CB}$ = 6 V; I_E = 1 mA)	=	75 Mc/s	

Intrinsic base impedance

$\|z_{rb}\|$ ($-V_{CB}$ = 6 V; I_E = 1 mA; f = 2 Mc/s)	=	25 Ω	

Feedback capacitance

$-c_{re}$ ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 0.45 Mc/s)	=	1.5 pF	

Current amplification factor

h_{fe} ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 kc/s)	=	150	

Noise figure

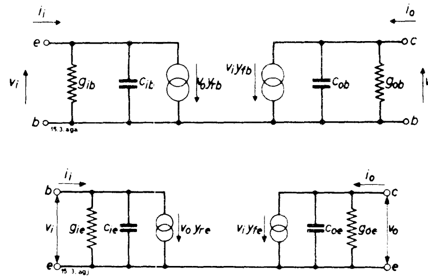
F ($-V_{CB}$ = 6 V; I_E = 1 mA; f = 100 Mc/s; Input source resistance = 60 Ω)	=	9.5 dB	
F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 10.7 Mc/s; Input source resistance = 200 Ω)	=	3.0 dB	
F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 Mc/s; Input source resistance = 500 Ω)	=	1.5 dB	< 3 dB

Conversion noise figure

F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 Mc/s; Input source resistance = 500 Ω)	=	3 dB	< 5 dB
F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 200 kc/s; Input source resistance = 2 kΩ)	=	4 dB	< 7 dB

7Z2 1135 3.

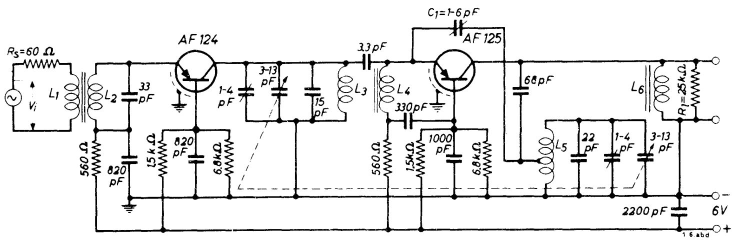
Small signal parameters measured with a length of lead between transistor bottom and measuring jig of 5 mm



Common base		Common emitter		Common emitter	
$-V_{CB}$ =	6 V	$-V_{CE}$ =	6 V	$-V_{CE}$ =	6 V
I_E =	1 mA	I_E =	1 mA	I_E =	1 mA
f =	100 Mc/s	f =	10.7 Mc/s	f =	0.45 Mc/s
g_{ib} =	15 mA/V	g_{ie} =	1.3 mA/V	g_{ie} =	0.25 mA/V
$-c_{ib}$ =	5 pF	c_{ie} =	65 pF	c_{ie} =	70 pF
$\|y_{rb}\|$ =	0.45 mA/V	$\|y_{re}\|$ =	80 µA/V	$\|y_{re}\|$ =	4 µA/V
φ_{rb} =	250 °	φ_{re} =	260 °	φ_{re} =	270 °
$\|y_{fb}\|$ =	15 mA/V	$\|y_{fe}\|$ =	34 mA/V	$\|y_{fe}\|$ =	37 mA/V
φ_{rb} =	95 °	φ_{fe} =	335 °	φ_{fe} =	0 °
g_{ob} =	0.35 mA/V	g_{oe} =	25 µA/V	g_{oe} =	1.0 µA/V
c_{ob} =	2.5 pF	c_{oe} =	3.0 pF	c_{oe} =	4 pF

7Z2 1801 4.

FRONT-END UNIT OF F.M. TUNER



For data of the R.F. stage please refer to the data sheets of type AF124

The oscillator voltage at the emitter of the AF125 should be adjusted to 80 mV by means of C_1 at a battery voltage V_S = 4 V

Coil data. L_4: 6 turns of 0.5 mm enamelled copper wire, closely wound; inductance L = 0.65 μH

L_5: $2\frac{1}{2}$ turns of 1 mm silvered copper wire, winding pitch 2 mm; inductance L = 0.062 μH unloaded Q-factor Q_o > 200. Tap at $1\frac{1}{8}$ turn from the earth side

L_6: 18 turns of 36 x 0.03 copper wire, enamelled, soldering graded, stranded, open covered, closely wound; inductance L = 2.9 μH; unloaded Q-factor Q_o = 120; Q-factor loaded with 25 kΩ = 60. Screening can A3 304 20

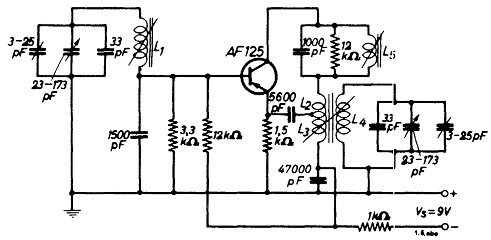
Operating characteristics

Collector current AF125	$-I_C$ =	1.5 mA
Oscillator voltage at the aerial terminals	=	1.5 mV

Shift of the oscillator frequency as a function of the battery voltage is about 50 kc/s from 6 to 5 V and about 100 kc/s from 5 to 4 V

7Z2 1137

SELF-OSCILLATING MIXER STAGE for the frequency range from 15.1 to 26.1 Mc/s



OPERATING CHARACTERISTICS measured at

Battery voltage	V_S	=	9 V
Collector voltage	$-V_{CE}$	=	6 V
Emitter current	I_E	=	1 mA

f	V_{osc} 1)	Δf_{osc} 2)	P_o/P_i 3)
(Mc/s)	(V)	(kc/s)	(dB)
15	0.11	3	26
20	0.14	2	23
26	0.15	10	20

For coil data see page 7

1) Oscillator voltage, measured between emitter and earth

2) Frequency shift by a battery voltage variation from 9 to 6 V

3) Conversion gain, defined as the ratio between the I.F. power in a 10 kΩ load (the total I.F. impedance in the collector lead) and the available R.F. power in the aerial circuit

7Z2 1138

SELF-OSCILLATING MIXER STAGE (continued)

Coil data.

L_1: $5\frac{1}{2}$ turns of 0.25 mm enamelled copper wire, closely wound on coil former with diameter of 7 mm; inductance L = 0.59 µH; unloaded Q-factor Q_o = 100 at f = 15 Mc/s, Q_o = 115 at f = 26 Mc/s

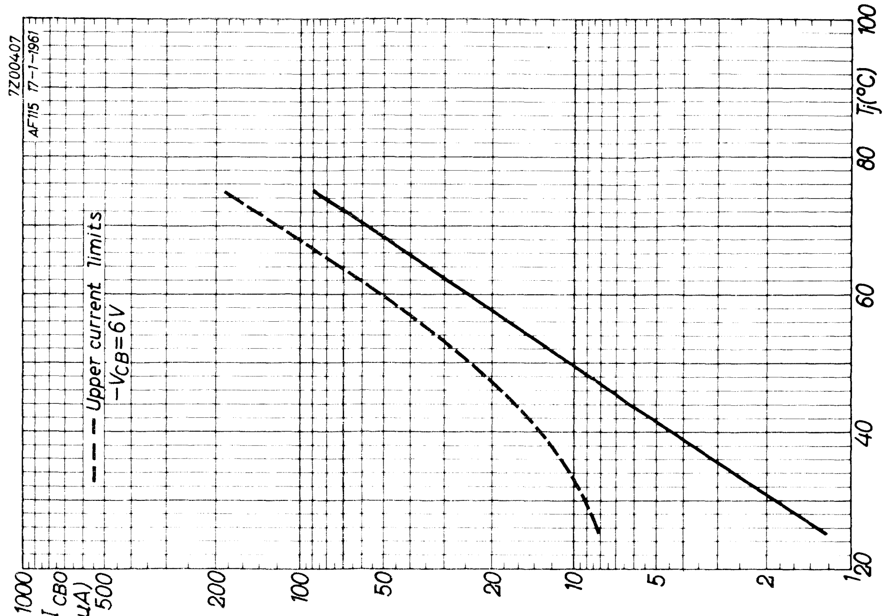
L_2: $1\frac{1}{4}$ turns of 0.25 mm enamelled copper wire, wound in L_4 at earth side

L_3: 1 turn of 0.25 mm enamelled copper wire, wound in L_4 at earth side

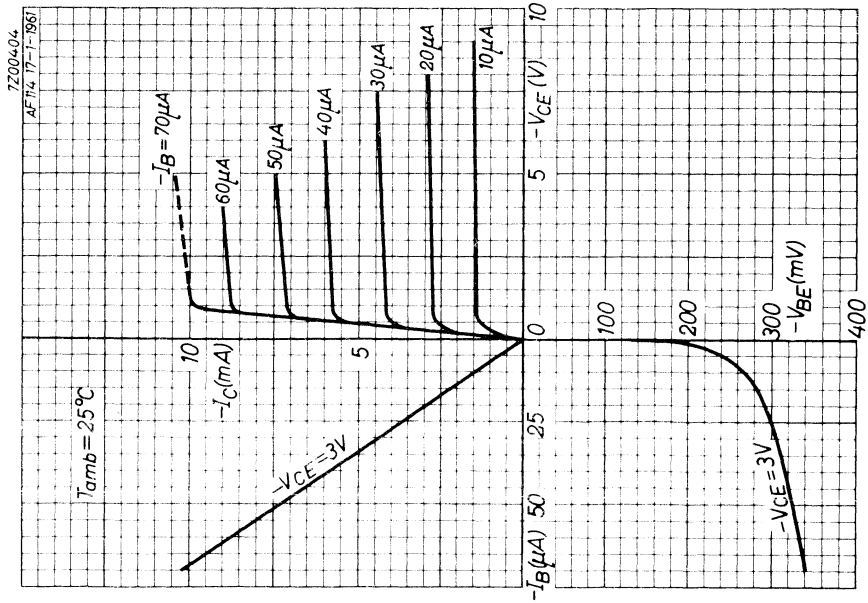
L_4: $6\frac{1}{2}$ turns of 0.9 mm enamelled copper wire, closely wound on coil former with diameter of 7 mm; inductance L = 0.46 µH; unloaded Q-factor Q_o = 110 at f = 15 Mc/s and at f = 26 Mc/s

L_5: Inductance L = 125 µH; unloaded Q-factor Q_o = 140

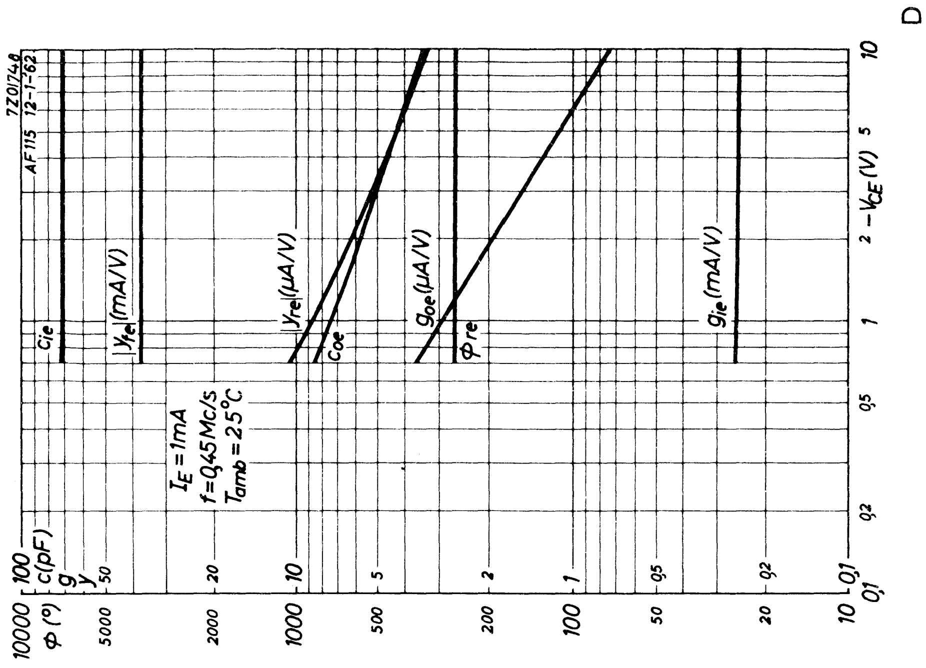
7Z2 1139

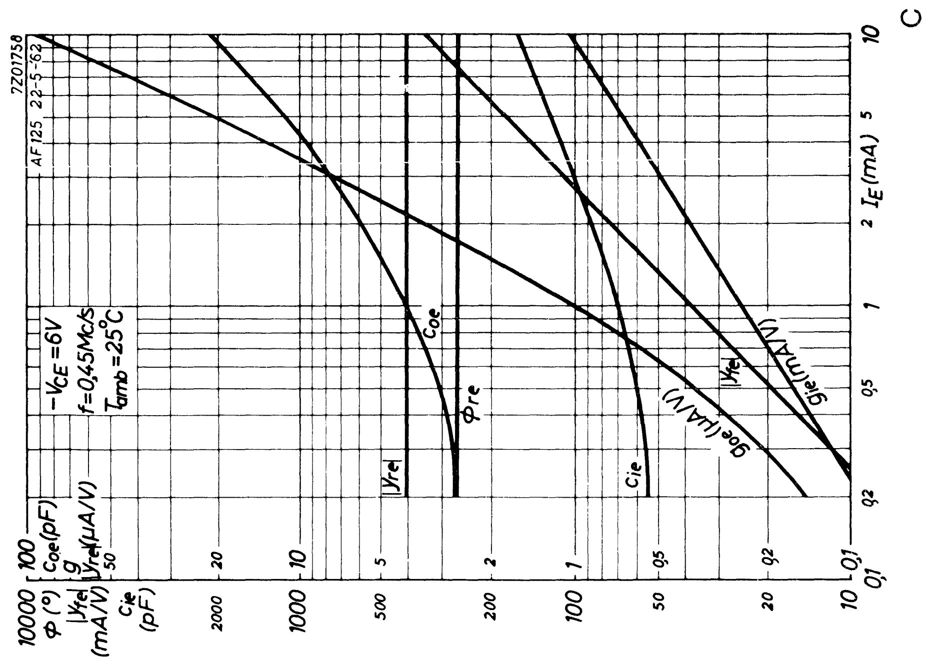

7Z00407
AF115 17-1-1961
Upper current limits
$-V_{CB}=6V$
$-I_{CBO}$ (μA)
1000
500
200
100
50
20
10
5
2
1
20
40
60
80
100
Tj(°C)

B

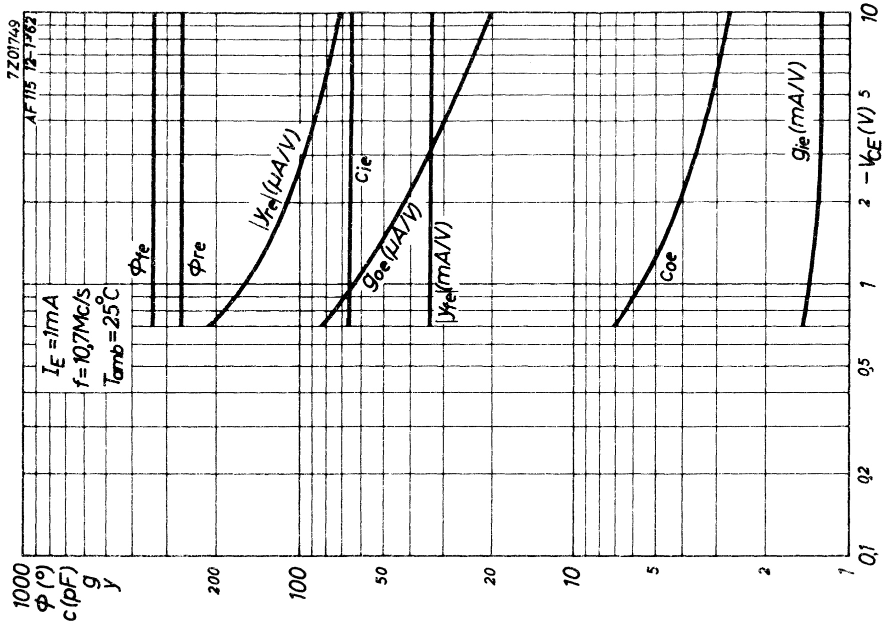

7Z00404
AF114 17-1-1961
$-I_B=70\mu A$
60µA
50µA
40µA
30µA
20µA
10µA
$-V_{CE}$ (V)
0
5
10
$-I_C$(mA)
$T_{amb}=25°C$
$-V_{CE}=3V$
25
50
$-I_B(\mu A)$
100
200
300
400
$-V_{BE}$(mV)
$-V_{CE}=3V$

A

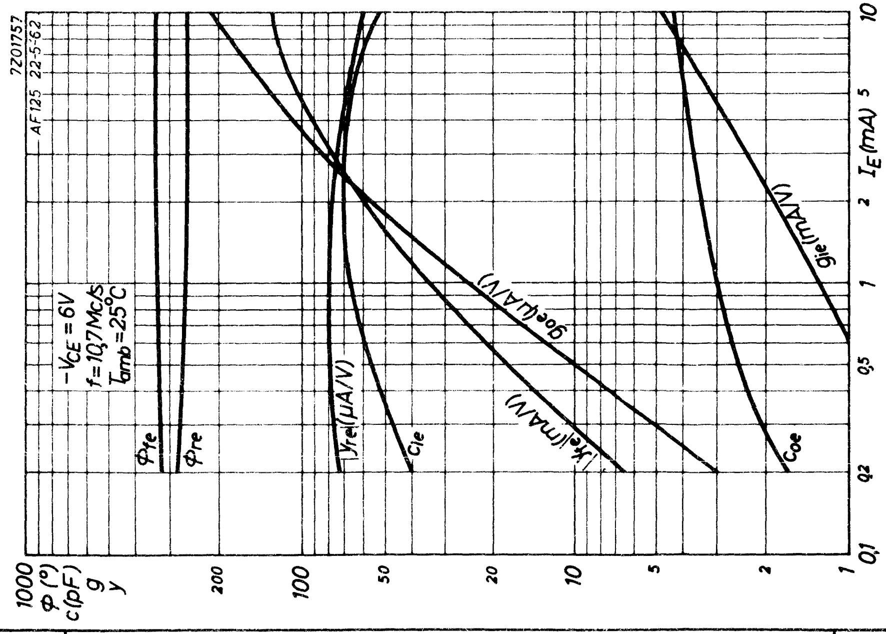

D
7Z01748
AF115 12-1-'62
$I_E = 1mA$
$f = 0{,}45 Mc/s$
$T_{amb} = 25°C$
c_{ie}
$|y_{fe}|(mA/V)$
$|y_{re}|(\mu A/V)$
c_{oe}
$g_{oe}(\mu A/V)$
φ_{re}
$g_{ie}(mA/V)$
$-V_{CE}(V)$
$\varphi(°)$
$c(pF)$
g
y

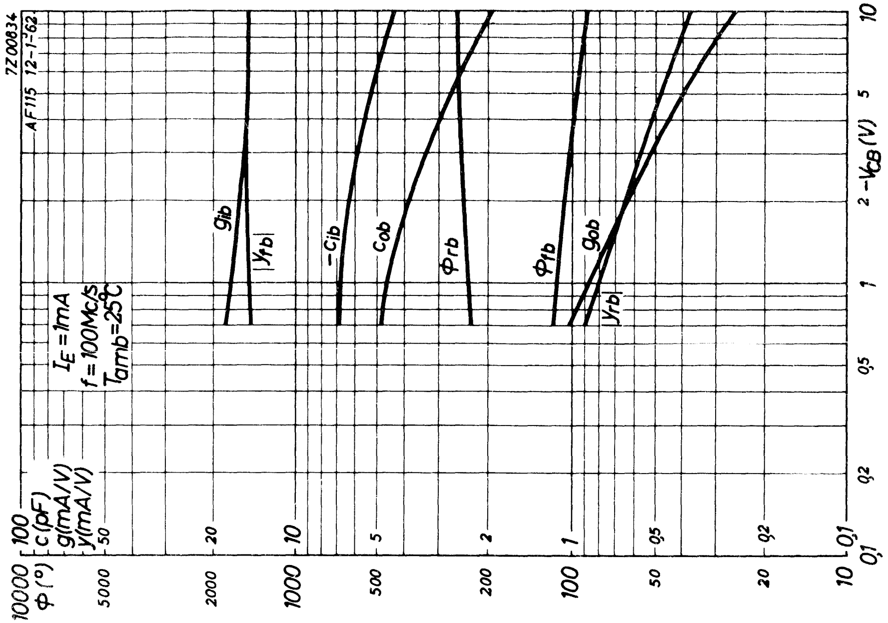

C
7Z01758
AF125 22-5-'62
$-V_{CE} = 6V$
$f = 0{,}45 Mc/s$
$T_{amb} = 25°C$
c_{oe}
φ_{re}
$|y_{re}|$
c_{ie}
$g_{oe}(\mu A/V)$
$|y_{fe}|$
$g_{ie}(mA/V)$
$I_E(mA)$
$\varphi(°)$
$|y_{fe}|(mA/V)$
$c_{ie}(pF)$
$c_{oe}(pF)$
g
$|y_{re}|(\mu A/V)$

F

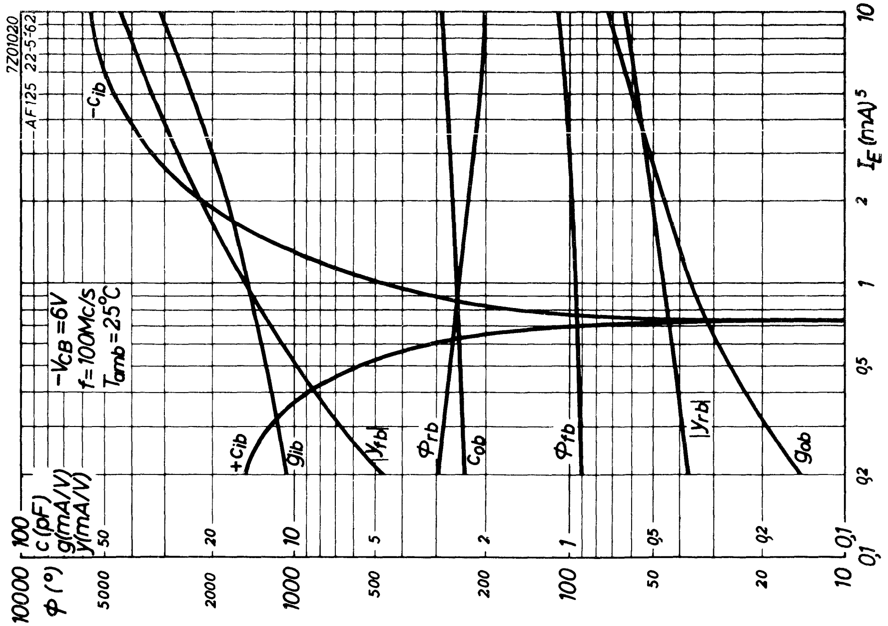

7Z01749
AF115 12-1-62
I_E = 1mA
f = 10,7Mc/s
T_{amb} = 25°C
φ_{fe}
φ_{re}
$|y_{re}|$(µA/V)
c_{ie}
g_{oe}(µA/V)
$|y_{fe}|$(mA/V)
c_{oe}
g_{ie}(mA/V)
1000
φ (°)
c (pF)
g
y
200
100
50
20
10
5
2
1
0,1
0,2
0,5
1
2
5
10
$-V_{CE}$(V)

E

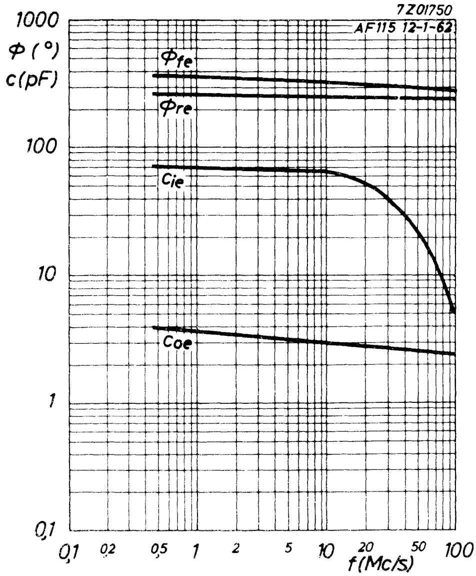

7Z01757
AF125 22-5-62
$-V_{CE}$ = 6V
f = 10,7Mc/s
T_{amb} = 25°C
φ_{fe}
φ_{re}
$|y_{re}|$(µA/V)
c_{ie}
$|y_{fe}|$(mA/V)
g_{oe}(µA/V)
c_{oe}
g_{ie}(mA/V)
1000
φ (°)
c (pF)
g
y
200
100
50
20
10
5
2
1
0,1
0,2
0,5
1
2
5
10
I_E(mA)

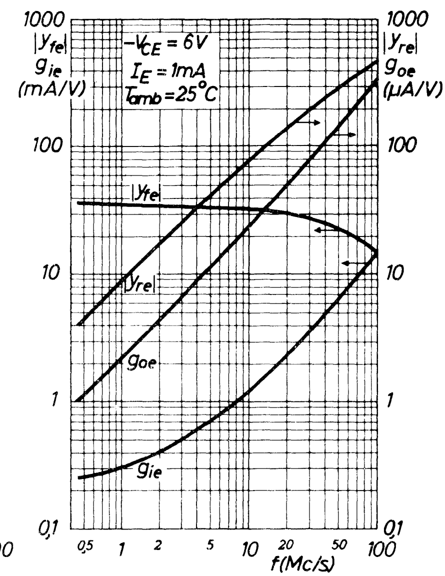

7Z00834
AF115 12-1-62
I_E = 1mA
f = 100Mc/s
T_{amb} = 25°C
g_{ib}
$|y_{fb}|$
$-C_{ib}$
C_{ob}
φ_{rb}
φ_{fb}
g_{ob}
$|y_{rb}|$
$-V_{CB}$ (V)
φ (°)
c (pF)
g (mA/V)
y (mA/V)

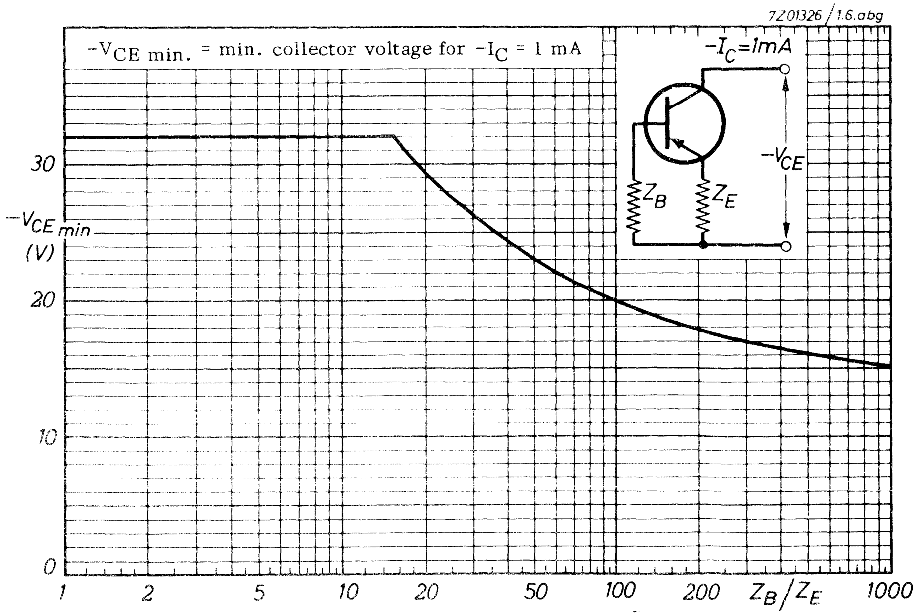
H


7Z01020
AF125 22-5-62
$-V_{CB}$ = 6V
f = 100Mc/s
T_{amb} = 25°C
$-C_{ib}$
$+C_{ib}$
g_{ib}
$|y_{fb}|$
φ_{rb}
C_{ob}
φ_{fb}
$|y_{rb}|$
g_{ob}
I_E (mA)
φ (°)
c (pF)
g (mA/V)
y (mA/V)

G


7Z01750
AF115 12-1-62
Φ (°)
c(pF)
Φfe
Φre
Cie
Coe
f(Mc/s)

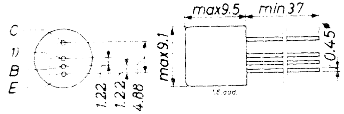

|yfe|
gie
(mA/V)
|yre|
goe
(μA/V)
−VCE = 6V
IE = 1mA
Tamb = 25°C
f(Mc/s)


7Z01326 / 1.6.abg
−VCE min. = min. collector voltage for −IC = 1 mA
−IC=1mA
−VCE
ZB
ZE
−VCE min
(V)
ZB/ZE

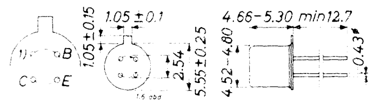
GERMANIUM ALLOY-DIFFUSED TRANSISTOR of the p-n-p type in metal envelope with low output conductance and low collector capacitance at 10.7 Mc/s and with low noise and good A.G.C. performance at high ambient temperatures, for use as I.F. amplifier in A.M. and F.M. receivers and as R.F. amplifier and mixer-oscillator in short-wave receivers up to 16 Mc/s

Dimensions in mm

AF116



AF126



LIMITING VALUES (absolute max. values)

Collector				
Voltage (base reference)		$-V_{CB}$	= max.	32 V
Voltage (emitter reference)		$-V_{CE}$	= max.	32 V [2]
Current		$-I_C$	= max.	10 mA
Dissipation ($T_{amb} \leq 45$ °C)	AF116	P_C	= max.	75 mW
Dissipation	AF126	P_C	= max.	60 mW
Emitter Reverse current		$-I_E$	= max.	1 mA
Base Current		$\|I_B\|$	= max.	1 mA
Temperatures				
Storage temperature		T_S	=	-55 °C to +75 °C
Junction temperature				
continuous operation		T_j	= max.	75 °C
intermittent operation (total duration max. 200 hrs)		T_j	= max.	90 °C
		(t	= max.	200 hrs)

THERMAL DATA

Thermal resistance from junction to ambience in free air	AF116	K	= max.	0.6 °C/mW
	AF126	K	= max.	0.75 °C/mW
Thermal resistance from junction to case	AF126	K	= max.	0.4 °C/mW

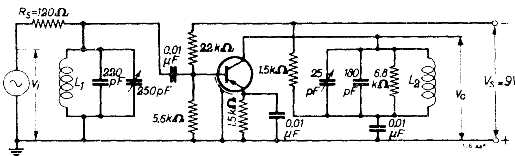
[1]) Interlead shield and metal case
[2]) See also page H

7Z2 3178

CHARACTERISTICS at T_{amb} = 25 °C

Collector current at I_E = 0 mA			
$-I_{CBO}$ ($-V_{CB}$ = 6 V; I_E = 0 mA)	= 1.2 µA	<	8 µA
Collector voltage at I_E = 0 mA			
$-V_{CB}$ ($-I_C$ = 50 µA; I_E = 0 mA)		>	32 V
Base current			
$-I_B$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 7 µA	<	25 µA
Base voltage			
$-V_{BE}$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 270 mV	> <	210 mV 330 mV

Test circuit for power gain at 10.7 Mc/s



L_1: inductance L = 0.5 µH; unloaded Q-factor Q_o = 100
L_2: inductance L = 2.47 µH; unloaded Q-factor Q_o = 100
R_S: input source resistance
R_L: total collector resistance = 4.8 kΩ

Available power gain at 10.7 Mc/s in the circuit above

G (f = 10.7 Mc/s) = 25 dB > 19 dB

The available power gain is defined as

$$G = \frac{4R_S}{R_L} \frac{V_o^2}{V_1^2} = 0.1 \frac{V_o^2}{V_1^2}$$

7Z2 1525

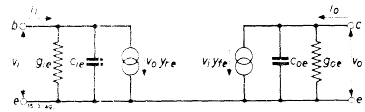
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C

Emitter voltage				
$-V_{EB}$	($-I_E$ = 50 µA; I_C = 0 mA)	= 1.5 V		> 1.0 V
Frequency at which $\lvert h_{fe} \rvert$ = 1				
f_1	($-V_{CB}$ = 6 V; I_E = 1 mA)	= 75 Mc/s		
Intrinsic base impedance				
$\lvert z_{rb'} \rvert$	$-V_{CB}$ = 6 V; I_E = 1 mA; f = 2 Mc/s	= 27 Ω		
Feedback capacitance				
$-c_{re}$	$-V_{CE}$ = 6 V; I_E = 1 mA; f = 0.45 Mc/s	= 1.5 pF		
Current amplification factor				
h_{fe}	$-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 kc/s	= 150		
Noise figure				
F	$-V_{CE}$ = 6 V; I_E = 1 mA; f = 10.7 Mc/s; Input source resistance = 200 Ω	= 3.0 dB	<	4.5 dB
F	$-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 Mc/s; Input source resistance = 500 Ω	= 1.5 dB	<	3 dB
Conversion noise figure				
F	$-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 Mc/s; Input source resistance = 500 Ω	= 3 dB	<	5 dB
F	$-V_{CE}$ = 6 V; I_E = 1 mA; f = 200 kc/s; Input source resistance = 2 kΩ	= 4 dB	<	7 dB

7Z2 1142

Small signal parameters measured with a length of lead between transistor bottom and measuring jig of 5 mm



Measured in common emitter circuit at

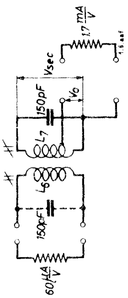
Collector voltage $-V_{CE}$ = 6 V

Emitter current I_E = 1 mA

Frequency	f = 10.7 Mc/s	f = 0.45 Mc/s
Input conductance	g_{ie} = 1.7 mA/V	g_{ie} = 0.25 mA/V
Input capacitance	c_{ie} = 60 pF	c_{ie} = 70 pF
Feedback admittance	$\lvert y_{re} \rvert$ = 0.1 mA/V	$\lvert y_{re} \rvert$ = 4.0 µA/V
Phase angle of feedback admittance	φ_{re} = 260 °	φ_{re} = 270°
Transfer admittance	$\lvert y_{fe} \rvert$ = 32 mA/V	$\lvert y_{fe} \rvert$ = 37 mA/V
Phase angle of transfer admittance	φ_{fe} = 335 °	φ_{fe} = 0 °
Output conductance	g_{oe} = 40 µA/V	g_{oe} = 1.0 µA/V
Output capacitance	c_{oe} = 3.5 pF	c_{oe} = 4.0 pF

7Z2 1143

COIL DATA (See page 5)



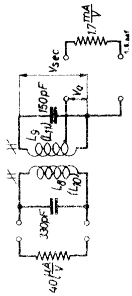
$L_6 = 1.4\ \mu H$ $L_7 = 1.4\ \mu H$

$Q_o \geq 120$ $Q_o \geq 110$

$Q_L = 70$ $Q_L = 92$

$KQ_L = 1.25$

$\frac{V_o}{V_{sec}} = 0.1$



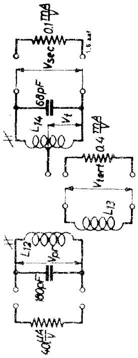
$L_8 = L_{10} = 0.67\ \mu H$ $L_9 = L_{11} = 1.4\ \mu H$

$Q_o \geq 110$ $Q_o \geq 110$

$Q_L = 92$ $Q_L = 92$

$KQ_L = 1.25$

$\frac{V_o}{V_{sec}} = 0.1$



$L_{12} = 1.2\ \mu H$ $L_{14} = 3.05\ \mu H$

$Q_o \geq 90$ $Q_o \geq 90$

$KQ_L = 0.7$

$\frac{V_{tert}}{V_{pr}} = 0.45$ $\frac{V_t}{V_{sec}} = 0.5$

L_{14} is bifilarly wound

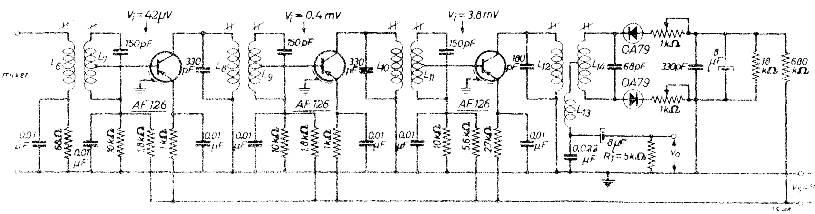
722 1145

5.

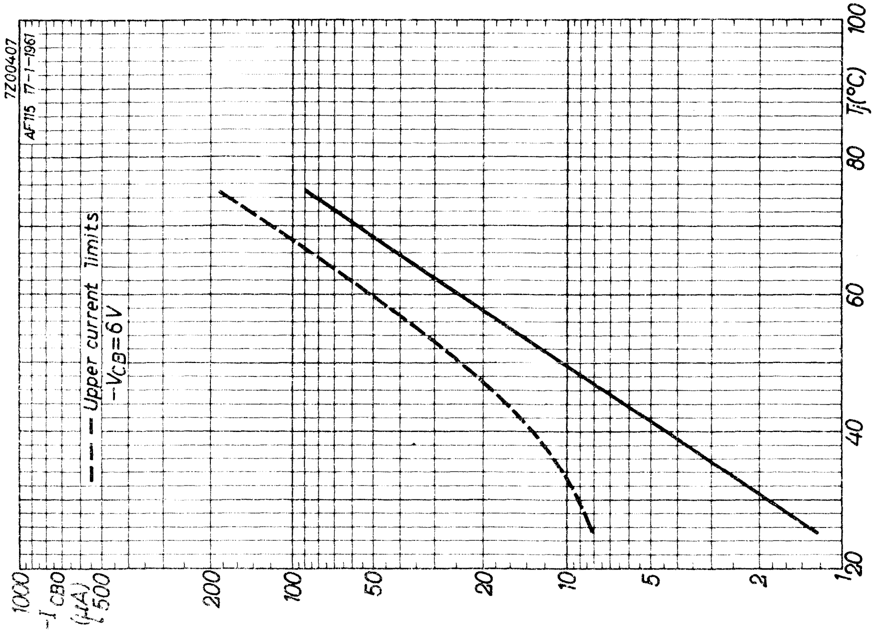
I.F. AMPLIFIER FOR 10.7 Mc/s

I_E of each transistor = 1.0 mA

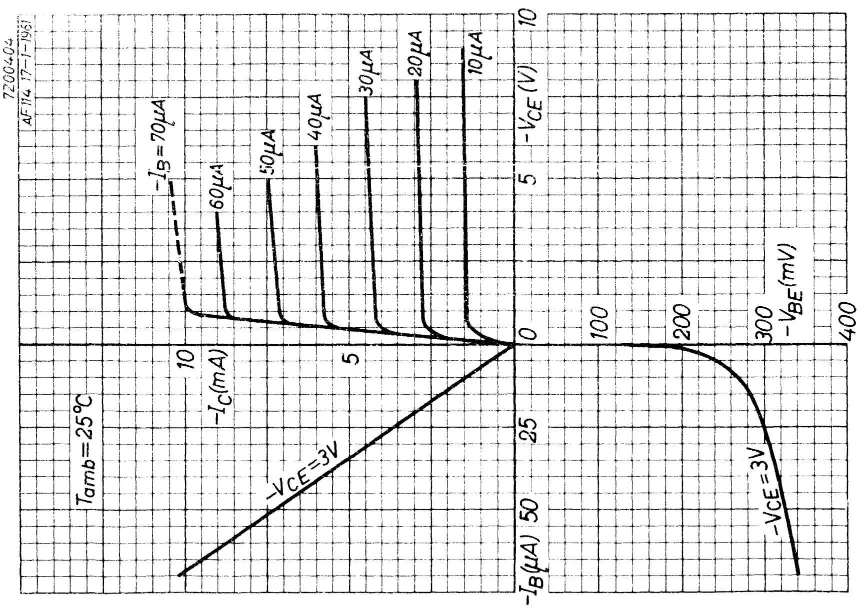
For coil data please refer to page 6



722 1144

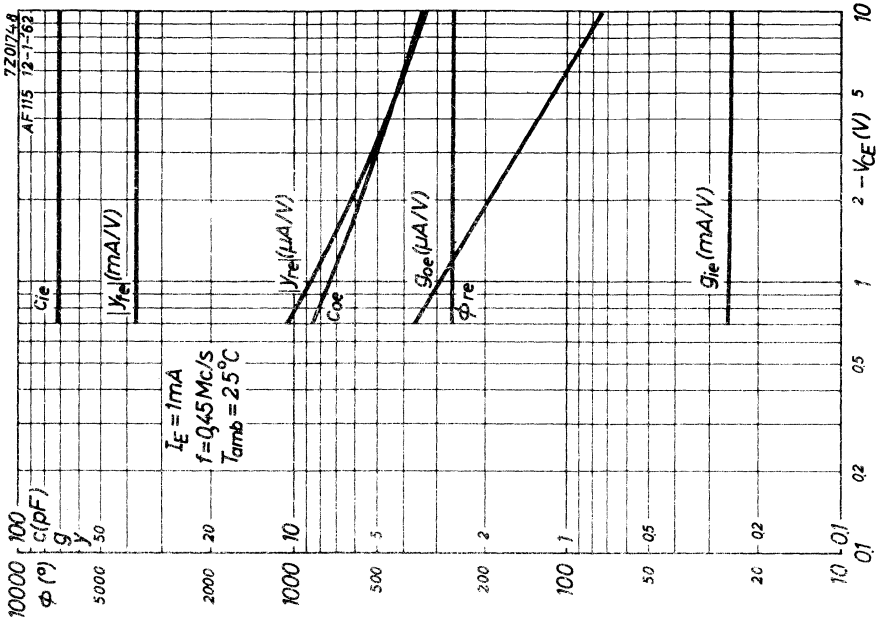

7Z00407
AF115 17-1-1961
Upper current limits
$-V_{CB}=6V$
$-I_{CBO}$ (μA)
1000
500
200
100
50
20
10
5
2
1
20
40
60
80
100
T_j(°C)

B


7Z00404
AF114 17-1-1961
$T_{amb}=25°C$
$-I_B=70μA$
60μA
50μA
40μA
30μA
20μA
10μA
$-V_{CE}$(V)
0
5
10
$-I_C$(mA)
10
5
$-V_{CE}=3V$
$-I_B$(μA)
25
50
100
200
300
400
$-V_{BE}$(mV)
$-V_{CE}=3V$

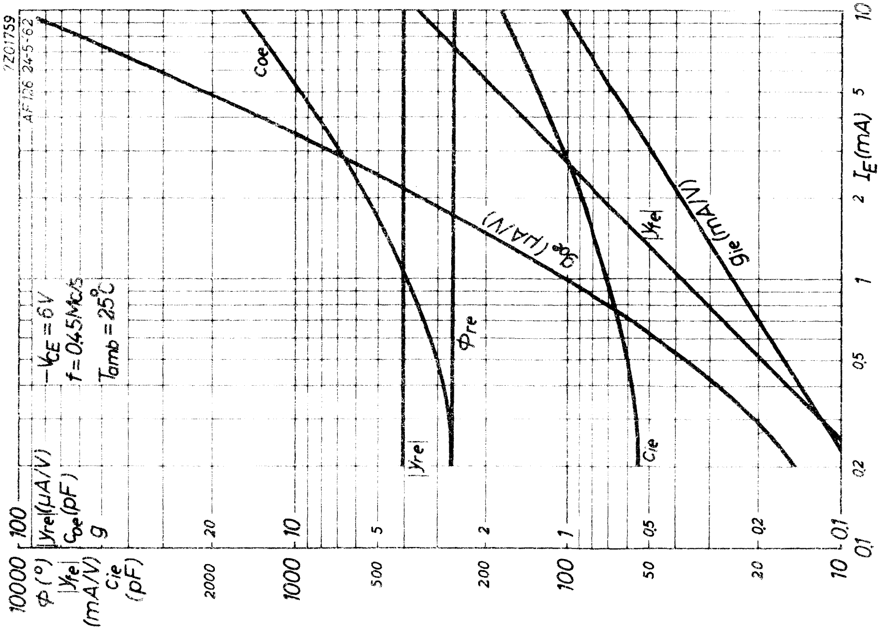
A

D



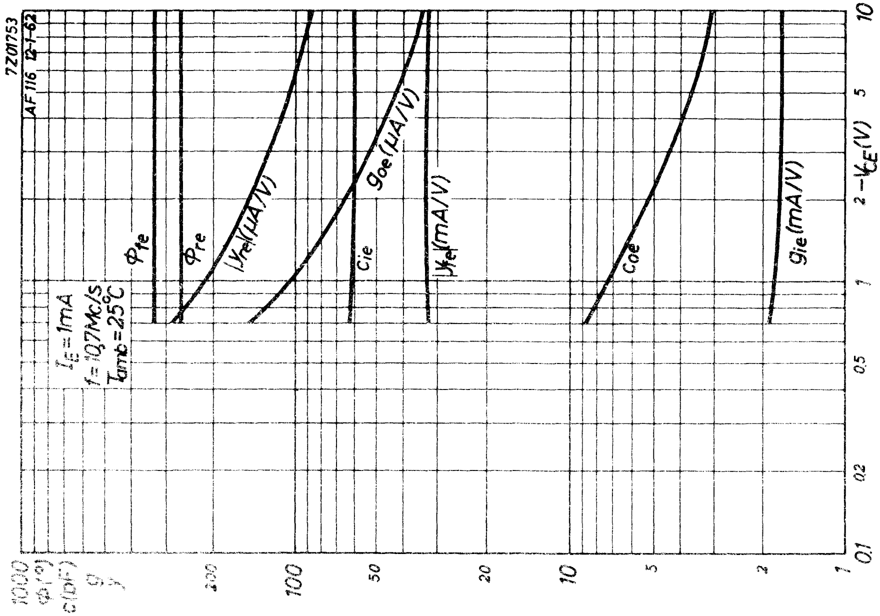
7Z01748
AF115 12-1-62
10000 Φ (°)
100 c(pF) g y
Cie
|yfe|(mA/V)
IE = 1mA
f = 0,45Mc/s
Tamb = 25°C
|yre|(µA/V)
Coe
goe(µA/V)
Φre
gie(mA/V)
-VCE(V)

C

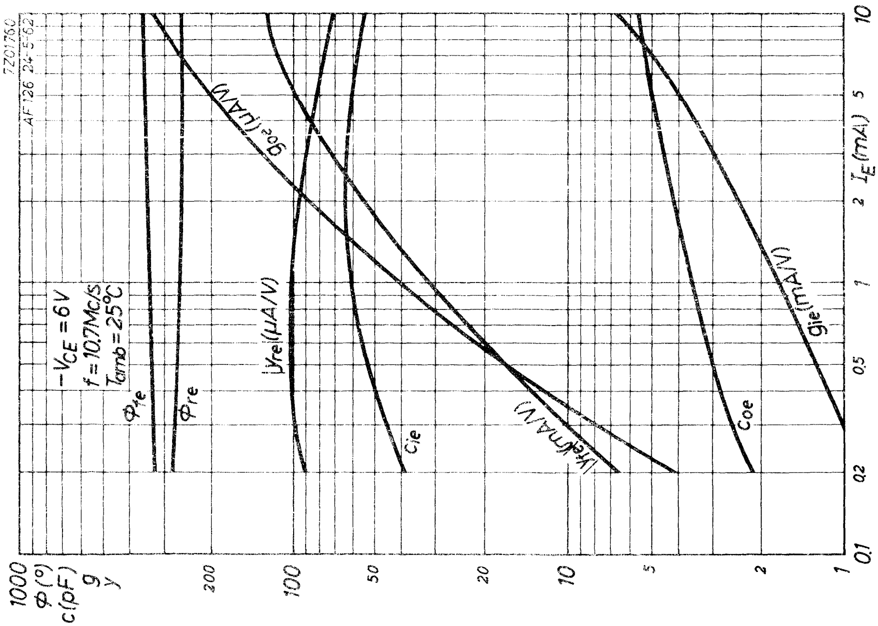


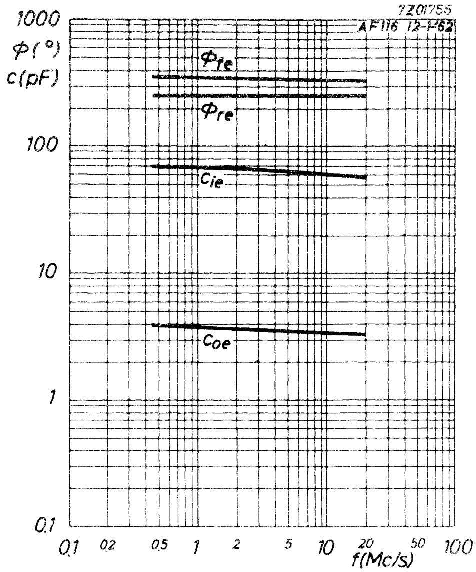
7Z01759
AF126 24-5-62
10000 Φ (°) |yfe| (mA/V) Cie (pF)
100 |yre|(µA/V) Coe(pF) g
-VCE = 6V
f = 0,45Mc/s
Tamb = 25°C
Coe
Φre
|yre|
Cie
goe(µA/V)
|yfe|
gie(mA/V)
IE(mA)

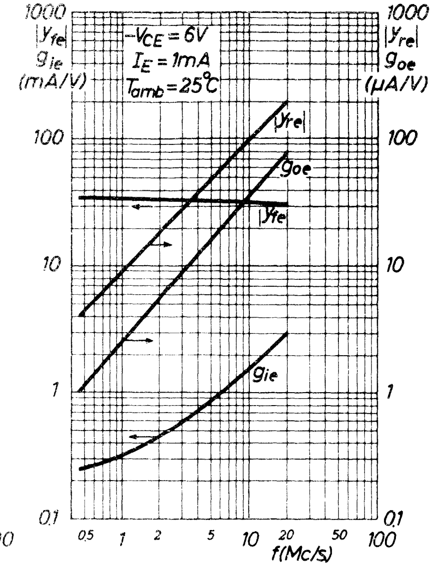
F.


7Z01753
AF 116 12-1-62
IE = 1mA
f = 10,7Mc/s
Tamb = 25°C
φfe
φre
|yre|(μA/V)
goe(μA/V)
Cie
|yfe|(mA/V)
Coe
gie(mA/V)
-VCE(V)
1000
φ(°)
c(pF)
g
y
200
100
50
20
10
5
2
1
0.1
0.2
0.5
1
2
5
10

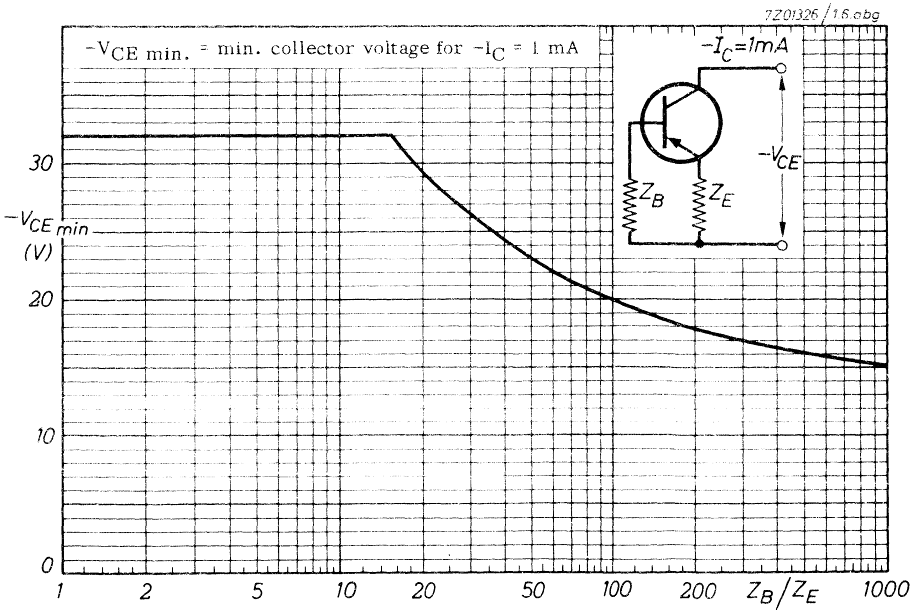
E


7Z01760
AF126 24-5-62
-VCE = 6V
f = 10.7Mc/s
Tamb = 25°C
φfe
φre
|yre|(μA/V)
goe(μA/V)
Cie
|yfe|(mA/V)
Coe
gie(mA/V)
IE(mA)
1000
φ(°)
c(pF)
g
y
200
100
50
20
10
5
2
1
0.1
0.2
0.5
1
2
5
10


7Z01755
AF116 12-1-'62
1000
φ(°)
c(pF)
Φ_{fe}
Φ_{re}
c_{ie}
c_{oe}
100
10
1
0.1
0.1 0.2 0.5 1 2 5 10 20 50 100
f(Mc/s)


1000
$|y_{fe}|$
g_{ie}
(mA/V)
$-V_{CE} = 6V$
$I_E = 1mA$
$T_{amb} = 25°C$
1000
$|y_{re}|$
g_{oe}
(μA/V)
$|y_{re}|$
g_{oe}
$|y_{fe}|$
g_{ie}
100
10
1
0.1
0.5 1 2 5 10 20 50 100
f(Mc/s)

G

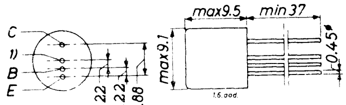

7Z01326 / 1.6.abg
$-V_{CE\ min.}$ = min. collector voltage for $-I_C$ = 1 mA
$-I_C=1mA$
$-V_{CE}$
Z_B
Z_E
$-V_{CE\ min}$
(V)
30
20
10
0
1 2 5 10 20 50 100 200 Z_B/Z_E 1000

H

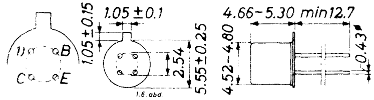
GERMANIUM ALLOY-DIFFUSED TRANSISTOR of the p-n-p type in metal envelope with low collector capacitance, low noise and good A.G.C. performance at high ambient temperatures, for use as I.F. amplifier, R.F. amplifier and oscillator-mixer in A.M. receivers up to 6 Mc/s

Dimensions in mm

AF117



AF127



LIMITING VALUES (absolute max. values)

Collector				
Voltage (base reference)		$-V_{CB}$	= max.	32 V
Voltage (emitter reference)		$-V_{CE}$	= max.	32 V [2]
Current		$-I_C$	= max.	10 mA
Dissipation ($T_{amb} \leq 45$ °C)	AF117	P_C	= max.	75 mW
Dissipation	AF127	P_C	= max.	60 mW
Emitter Reverse current		$-I_E$	= max.	1 mA
Base Current		$\|I_B\|$	= max.	1 mA
Temperatures				
Storage temperature		T_s	=	-55 °C to +75 °C
Junction temperature				
continuous operation		T_j	= max.	75 °C
intermittent operation (total duration max. 200 hrs)		T_j (t	= max. = max.	90 °C 200 hrs)

THERMAL DATA

Thermal resistance from junction to ambience in free air	AF117	K	= max.	0.6 °C/mW
	AF127	K	= max.	0.75 °C/mW
Thermal resistance from junction to case	AF127	K	= max.	0.4 °C/mW

[1]) Interlead shield and metal case

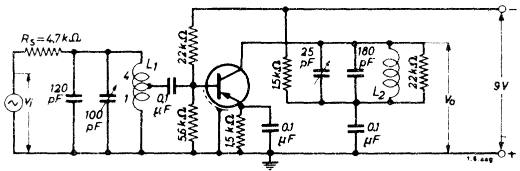
[2]) See also page E

7Z2 3179

CHARACTERISTICS at Tamb = 25 °C

Collector current at I_E = 0 mA		
$-I_{CBO}$ ($-V_{CB}$ = 6 V; I_E = 0 mA)	= 1.2 µA	< 8 µA
Collector voltage at I_E = 0 mA		
$-V_{CB}$ ($-I_C$ = 50 µA; I_E = 0 mA)		> 32 V
Base current		
$-I_B$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 7 µA	< 25 µA
Base voltage		
$-V_{BE}$ ($-V_{CB}$ = 6 V; I_E = 1 mA)	= 270 mV	> 210 mV < 330 mV

Test circuit for power gain at f = 0.45 Mc/s



L_1: inductance L = 625 µH; unloaded Q-factor Q_o = 140; tap at t = 0.2

L_2: inductance L = 625 µH; unloaded Q-factor Q_o = 140

R_S: input source resistance

R_L: total collector resistance = 20 kΩ

Available power gain at 0.45 Mc/s in the circuit above

G (f = 0.45 Mc/s)	= 42 dB	> 40 dB

The available power gain is defined by

$$G = \frac{4R_S}{R_L} \cdot \frac{V_o^2}{V_i^2} = 0.94 \frac{V_o^2}{V_i^2}$$

7Z2 1527

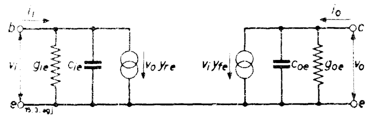
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

$T_{amb} = 25\ ^{\circ}C$

Emitter voltage				
$-V_{EB}$ ($-I_E$ = 50 µA; I_C = 0 mA)	=	1.5 V	>	1.0 V
Frequency at which $\lvert h_{fe}\rvert$ = 1				
f_1 ($-V_{CB}$ = 6 V; I_E = 1 mA)	=	75 Mc/s		
Intrinsic base impedance				
$\lvert z_{rb}\rvert$ ($-V_{CB}$ = 6 V; I_E = 1 mA; f = 2 Mc/s)	=	35 Ω		
Feedback capacitance				
$-c_{re}$ ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 0.45 Mc/s)	=	1.5 pF		
Current amplification factor				
h_{fe} ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 kc/s)	=	150		
Noise figure				
F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 Mc/s; Input source resistance = 500 Ω)	=	1.5 dB	<	3 dB
Conversion noise figure				
F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 1 Mc/s; Input source resistance = 500 Ω)	=	3 dB	<	5 dB
F ($-V_{CE}$ = 6 V; I_E = 1 mA; f = 200 kc/s; Input source resistance = 2 kΩ)	=	4 dB	<	7 dB

7Z2 1148

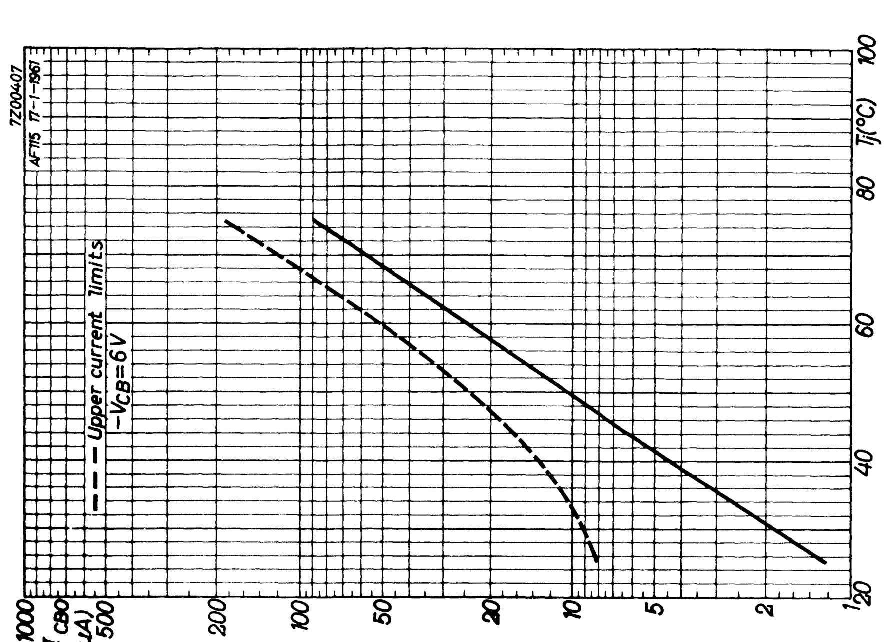
Small signal parameters



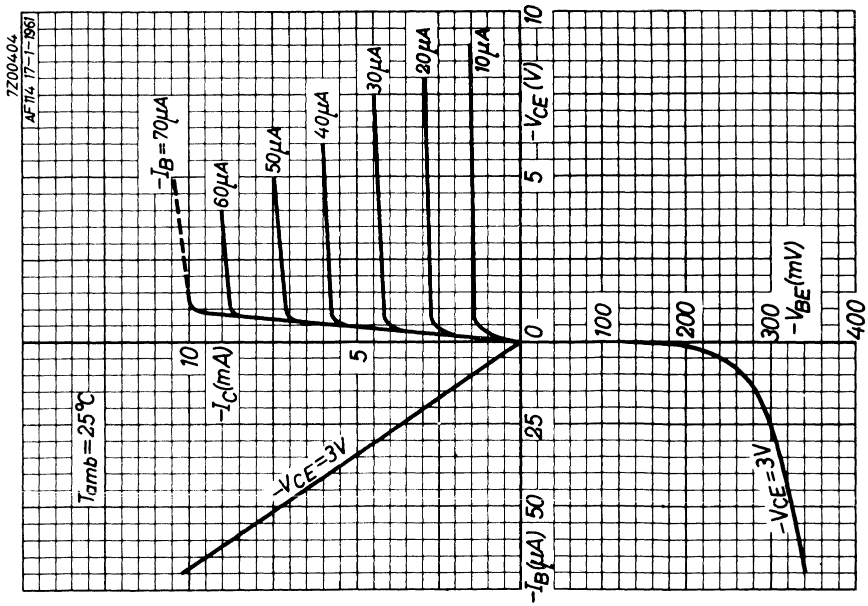
Measured in common emitter circuit at

Collector voltage	$-V_{CE}$	=	6 V
Emitter current	I_E	=	1 mA
Frequency	f	=	0.45 Mc/s
Input conductance	g_{ie}	=	0.25 mA/V
Input capacitance	c_{ie}	=	70 pF
Feedback admittance	$\lvert y_{re}\rvert$	=	4.0 µA/V
Phase angle of feedback admittance	φ_{re}	=	270 °
Transfer admittance	$\lvert y_{fe}\rvert$	=	37 mA/V
Phase angle of transfer admittance	φ_{fe}	=	0 °
Output conductance	g_{oe}	=	1.0 µA/V
Output capacitance	c_{oe}	=	4.0 pF

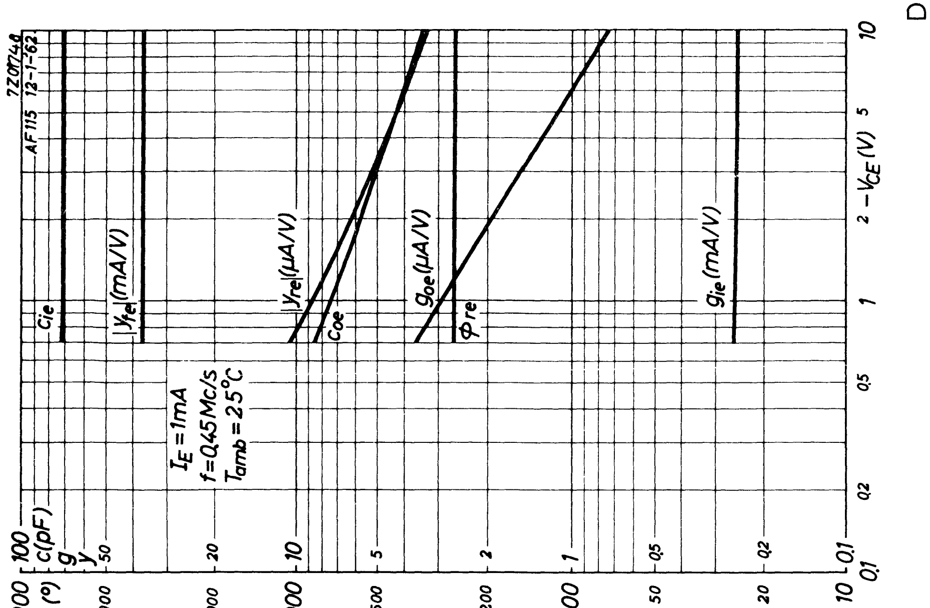
7Z2 1149

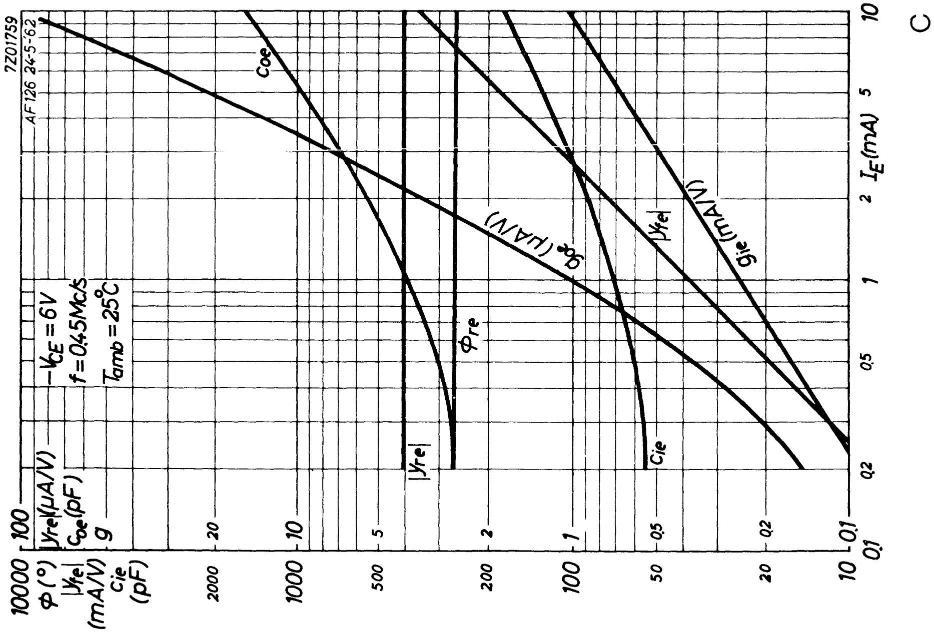

7Z00407
AF115 17-1-1961
Upper current limits
−V_CB=6V
−I_CBO (μA)
Tj(°C)
1000
500
200
100
50
20
10
5
2
1
20
40
60
80
100

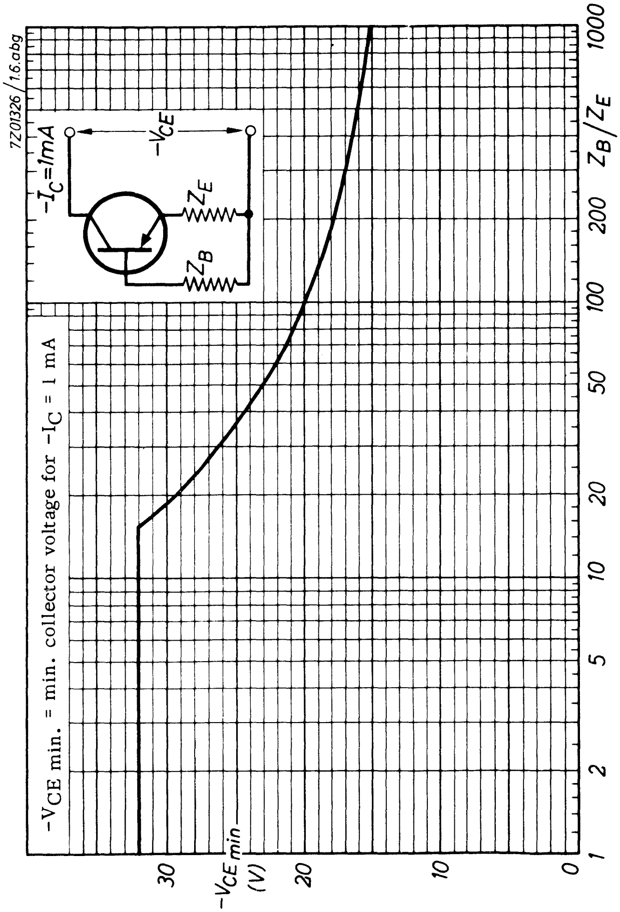
B


7Z00404
AF114 17-1-1961
T_amb=25°C
−I_B=70μA
60μA
50μA
40μA
30μA
20μA
10μA
−V_CE (V)
−I_C(mA)
−V_CE=3V
−I_B(μA)
−V_BE(mV)
−V_CE=3V
0
5
10
25
50
100
200
300
400

A


7Z01748 12-1-'62
AF115
I_E = 1mA
f = 0.45Mc/s
T_{amb} = 25°C
C_{ie}
$|y_{fe}|$(mA/V)
$|y_{re}|$(μA/V)
c_{oe}
g_{oe}(μA/V)
φ_{re}
g_{ie}(mA/V)
φ (°)
c(pF)
g
y
$-V_{CE}$(V)
D


7Z01759 24-5-'62
AF126
$-V_{CE}$ = 6V
f = 0.45Mc/s
T_{amb} = 25°C
c_{oe}
g_{oe}(μA/V)
$|y_{fe}|$
g_{ie}(mA/V)
φ_{re}
$|y_{re}|$
C_{ie}
φ (°)
$|y_{fe}|$ (mA/V)
C_{ie} (pF)
$|y_{re}|$(μA/V)
c_{oe}(pF)
g
I_E(mA)
C


7Z01326/1.6.abg
−V_CE min. = min. collector voltage for −I_C = 1 mA
−I_C=1mA
−V_CE
Z_E
Z_B
Z_B/Z_E
1
2
5
10
20
50
100
200
1000
−V_CE min
(V)
30
20
10
0

E

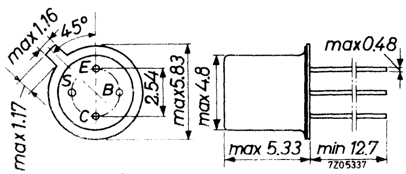
U.H.F. GERMANIUM MESA TRANSISTOR

P-N-P transistor in a TO-72 metal envelope, primarily intended for use in pre-amplifier, mixer or oscillator circuits up to frequencies of 860 MHz.

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.	10	mA
Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	60	mW
Junction temperature	T_j	max.	90	°C
Transition frequency				
$-I_C$ = 1.5 mA; $-V_{CE}$ = 12 V	f_T	typ.	550	MHz
Max. unilateralised power gain				
I_E = 1.5 mA; $-V_{CB}$ = 12 V; f = 800 MHz	G_{UM}	typ.	11.5	dB
Noise figure				
I_E = 1.5 mA; $-V_{CB}$ = 12 V;				
f = 800 MHz; R_S = 60 Ω	F	typ.	7	dB

MECHANICAL DATA Dimensions in mm

TO-72



S=Shield lead connected to case

7Z3 0413

RATINGS (Limiting values) [1]

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.	0.3	V

Currents

Collector current (d.c.)	$-I_C$	max.	10	mA
Collector current (peak value)	$-I_{CM}$	max.	10	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 ^oC	P_{tot}	max.	60	mW

Temperatures

Storage temperature	T_{stg}	-30 to +75		^oC
Junction temperature	T_j	max.	90	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.75	$^oC/mW$
From junction to case	$R_{th\ j-c}$	=	0.40	$^oC/mW$

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0048

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 20$ V	$-I_{CBO}$	typ.	0.5	μA
		<	8	μA
$I_B = 0$; $-V_{CE} = 15$ V	$-I_{CEO}$	<	500	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 0.3$ V	$-I_{EBO}$	typ.	2	μA
		<	100	μA
Base current				
$I_E = 1.5$ mA; $-V_{CB} = 12$ V	$-I_B$	typ.	30	μA
		<	150	μA
$I_E = 2$ mA; $-V_{CB} = 6$ V	$-I_B$	typ.	36	μA
$I_E = 5$ mA; $-V_{CB} = 6$ V	$-I_B$	typ.	66	μA
Emitter-base voltage				
$I_E = 1.5$ mA; $-V_{CB} = 12$ V	V_{EB}	typ.	380	mV
		320 to	430	mV
$I_E = 2$ mA; $-V_{CB} = 6$ V	V_{EB}	typ.	380	mV
		320 to	430	mV
$I_E = 5$ mA; $-V_{CB} = 6$ V	V_{EB}	typ.	405	mV
		360 to	450	mV
Transition frequency				
$-I_C = 1.5$ mA; $-V_{CE} = 12$ V	f_T	typ.	550	MHz
Reverse transfer time constant				
$I_E = 1.5$ mA; $-V_{CB} = 12$ V; f = 2.5 MHz	$r_{bb'} \cdot C_{b'c}$	typ.	3	ps
Feedback capacitance at f = 450 kHz				
$-I_C = 1.5$ mA; $-V_{CE} = 12$ V	$-C_{re}$	typ.	250	fF [1])
Noise figure at $R_S = 60\ \Omega$				
$I_E = 1.5$ mA; $-V_{CB} = 12$ V; f = 800 MHz	F	typ.	7	dB
		<	8.2	dB
f = 860 MHz	F	typ.	7.5	dB
		<	8.8	dB

[1]) 1 fF = 1 femtofarad = 10^{-15} F

7Z3 0049

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

y parameters at f = 800 MHz [1])

I_E = 1.5 mA; $-V_{CB}$ = 12 V

Input conductance	g_{ib}	typ.	7	$m\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	2.2	pF
Input susceptance	$-\omega C_{ib}$	typ.	11	$m\Omega^{-1}$
Feedback admittance	$\|y_{rb}\|$	typ.	0.4	$m\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	240°	
Transfer admittance	$\|y_{fb}\|$	typ.	14	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	35°	
Output conductance	g_{ob}	typ.	0.5	$m\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.5	pF

y parameters at f = 200 MHz [1])

I_E = 1.5 mA; $-V_{CB}$ = 12 V

Input conductance	g_{ib}	typ.	28	$m\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	19	pF
Input susceptance	$-\omega C_{ib}$	typ.	24	$m\Omega^{-1}$
Feedback admittance	$\|y_{rb}\|$	typ.	0.17	$m\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	250°	
Transfer admittance	$\|y_{fb}\|$	typ.	37	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	126°	
Output conductance	g_{ob}	typ.	90	$\mu\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.5	pF

Maximum unilateralised power gain

$$G_{UM} = \frac{|y_{fb}|^2}{4\, g_{ib} g_{ob}}$$

I_E = 1.5 mA; $-V_{CB}$ = 12 V; f = 800 MHz	G_{UM}	typ.	11.5	dB

---

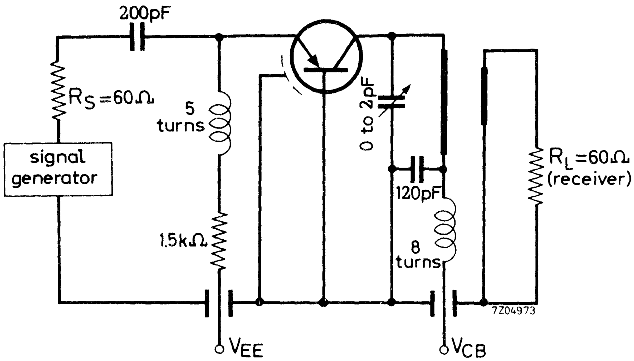
[1]) Measured with a lead length of 5 mm.

7Z3 0050

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

Transducer gain

Basic circuit for measuring the transducer gain G_{tr}.



Total effective collector resistance R_C = 1.4 kΩ

$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$$

I_E = 1.5 mA; $-V_{CB}$ = 12 V

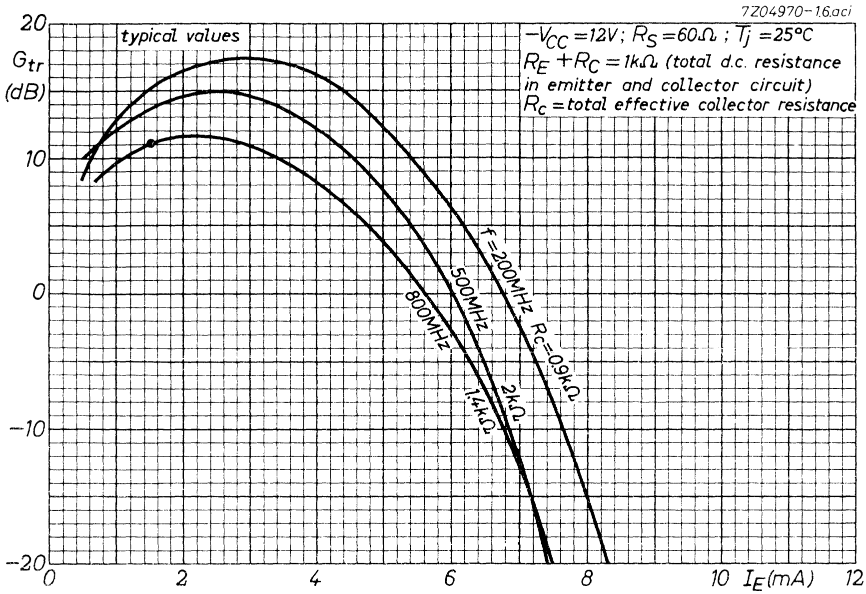
f = 800 MHz	G_{tr}	>	9	dB
		typ.	11	dB
f = 860 MHz	G_{tr}	>	7.5	dB
		typ.	10	dB

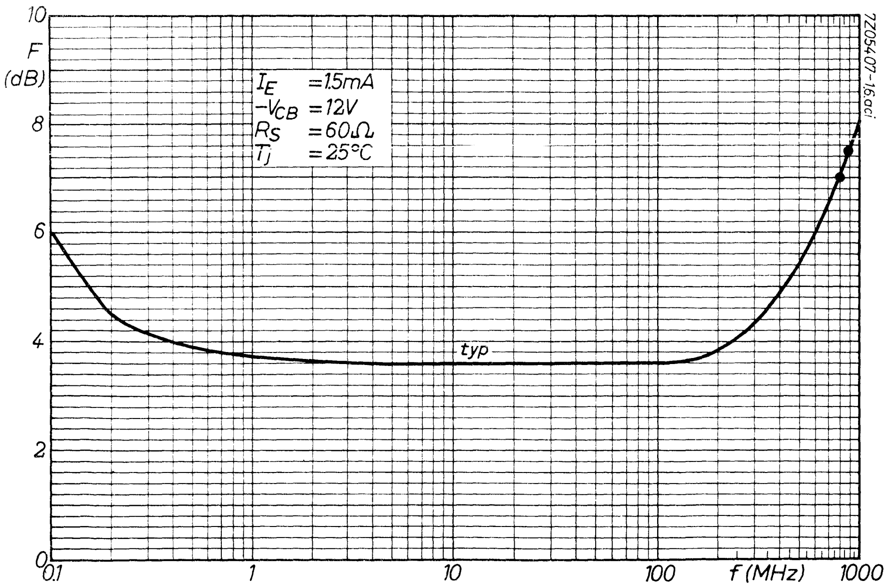
Reverse transducer gain

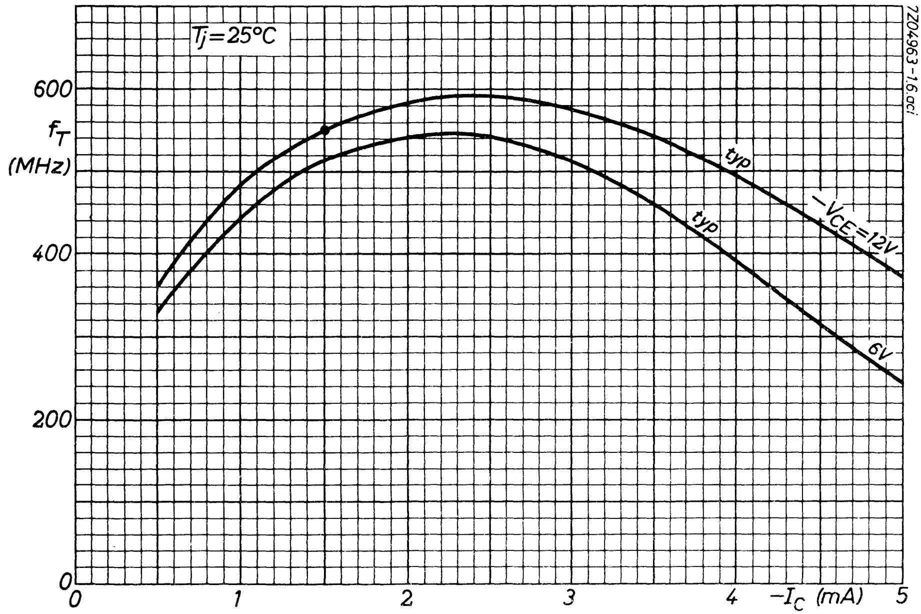
I_E = 1.5 mA; $-V_{CB}$ = 12 V; f = 800 MHz $G_{tr\ rev}$ typ. −23 dB

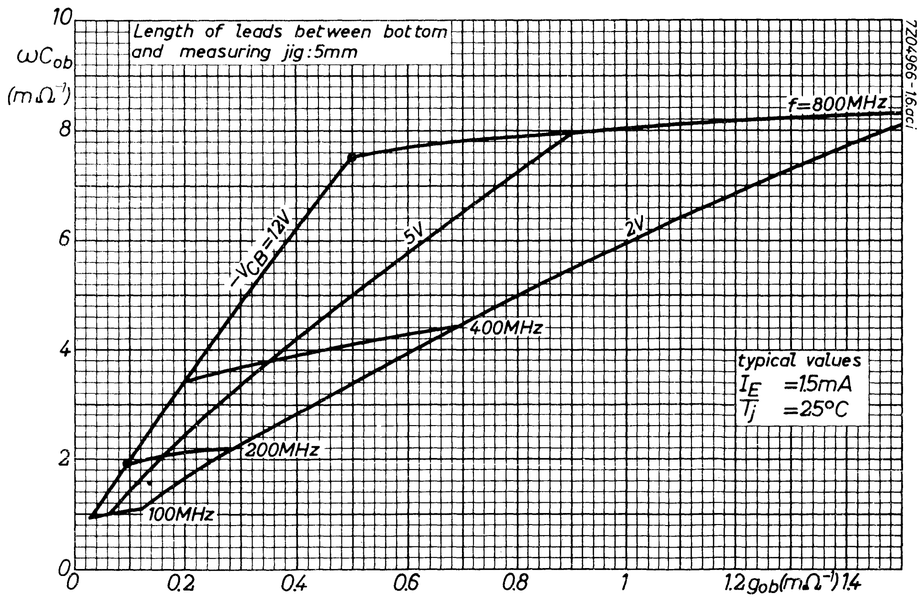
The reverse transducer gain is measured in the above circuit, with the source and the load resistance interchanged.

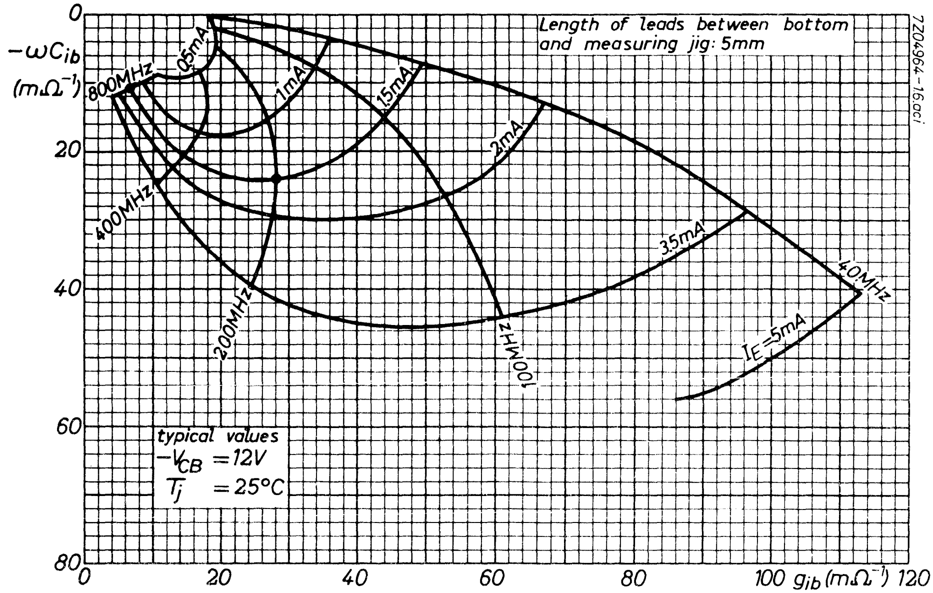
7Z3 0053

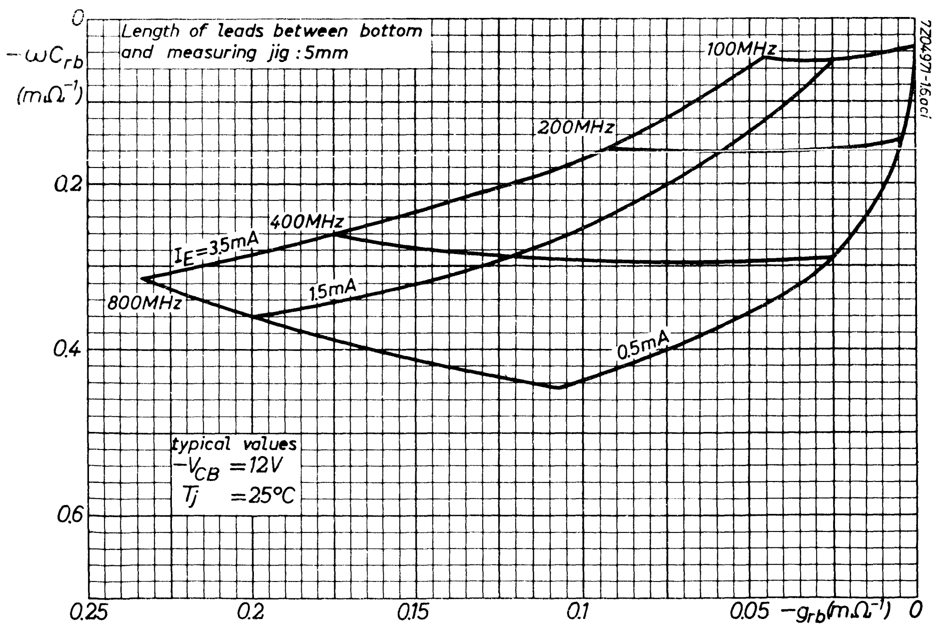

7Z04970-1.6.aci
typical values
$-V_{CC}$ = 12V; R_S = 60Ω; T_j = 25°C
$R_E + R_C$ = 1kΩ (total d.c. resistance in emitter and collector circuit)
R_c = total effective collector resistance
G_{tr} (dB)
f = 200MHz R_c = 0.9kΩ
500MHz
2kΩ
800MHz
1.4kΩ
I_E (mA)

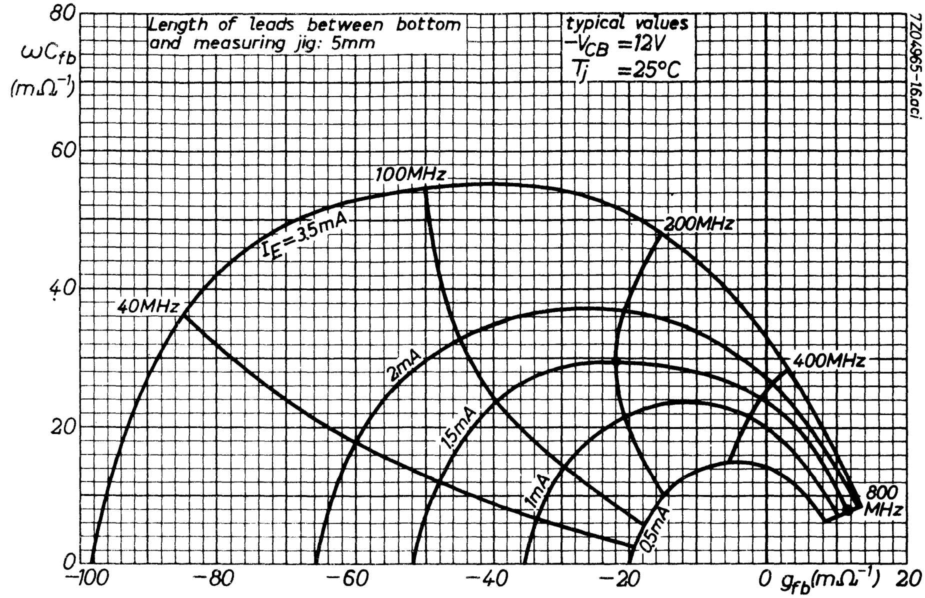

7Z05407-1.6.aci
F (dB)
I_E = 1.5mA
$-V_{CB}$ = 12V
R_S = 60Ω
T_j = 25°C
typ
f (MHz)

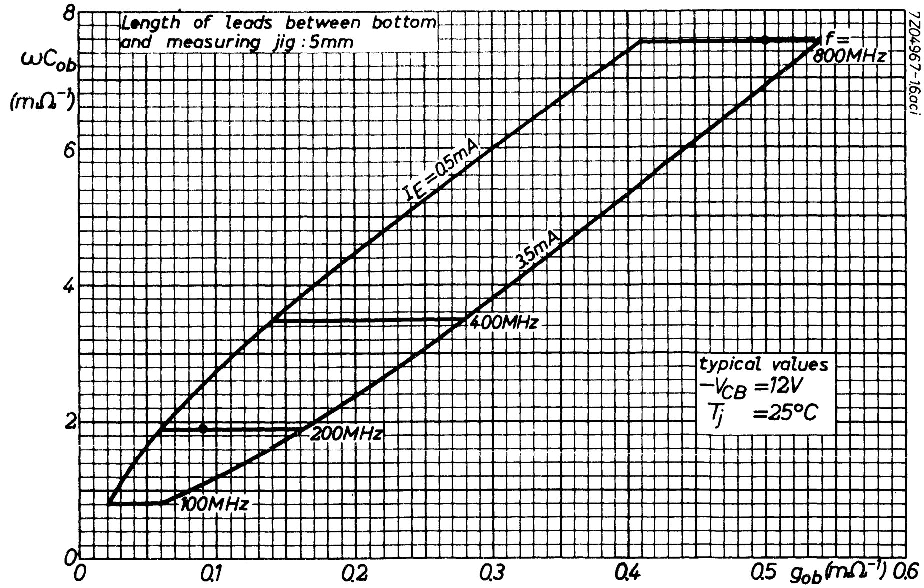

Tj=25°C
fT (MHz)
600
400
200
0
0
1
2
3
4
5
−IC (mA)
typ
typ
−VCE=12V
6V
7Z04963-1.6.aci

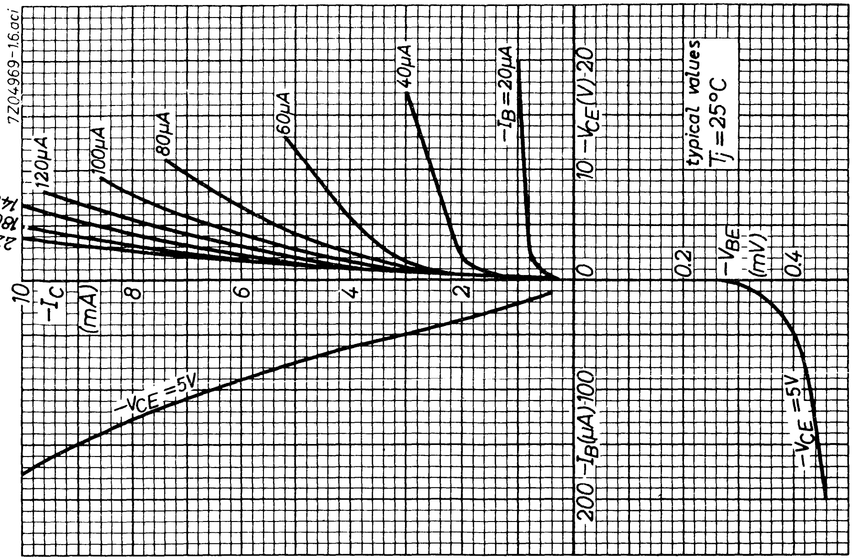

Length of leads between bottom and measuring jig:5mm
ωCob (mΩ⁻¹)
10
8
6
4
2
0
0
0.2
0.4
0.6
0.8
1
1.2 gob(mΩ⁻¹) 1.4
f=800MHz
400MHz
200MHz
100MHz
−VCB=12V
5V
2V
typical values
IE =1.5mA
Tj =25°C
7Z04966-1.6.aci

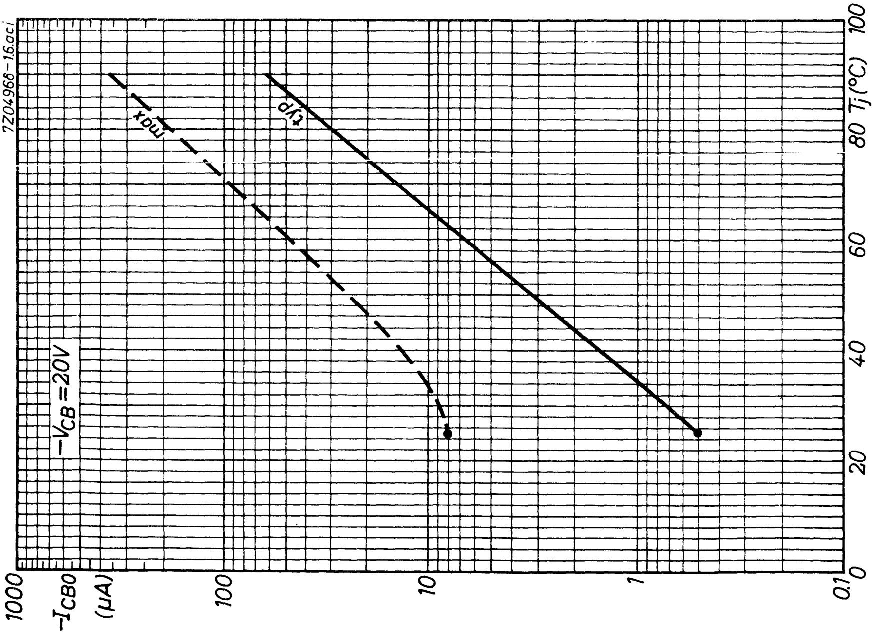

Length of leads between bottom and measuring jig: 5mm
7Z04964-1.6.oci
$-\omega C_{ib}$ ($m\Omega^{-1}$)
g_{ib} ($m\Omega^{-1}$)
0.5mA
1mA
1.5mA
2mA
3.5mA
I_E=5mA
800MHz
400MHz
200MHz
100MHz
40MHz
typical values
$-V_{CB}$ = 12V
T_j = 25°C
0
20
40
60
80
100
120


Length of leads between bottom and measuring jig: 5mm
7Z04971-1.6.oci
$-\omega C_{rb}$ ($m\Omega^{-1}$)
$-g_{rb}$ ($m\Omega^{-1}$)
100MHz
200MHz
400MHz
800MHz
I_E=3.5mA
1.5mA
0.5mA
typical values
$-V_{CB}$ = 12V
T_j = 25°C
0
0.2
0.4
0.6
0.25
0.15
0.1
0.05


Length of leads between bottom and measuring jig: 5mm
typical values
$-V_{CB}$ =12V
T_j =25°C
ωC_{fb} ($m\Omega^{-1}$)
g_{fb} ($m\Omega^{-1}$)
100MHz
200MHz
400MHz
40MHz
800 MHz
I_E=3.5mA
2mA
1.5mA
1mA
0.5mA
7Z04965-16aci


Length of leads between bottom and measuring jig: 5mm
typical values
$-V_{CB}$ =12V
T_j =25°C
ωC_{ob} ($m\Omega^{-1}$)
g_{ob} ($m\Omega^{-1}$)
f= 800MHz
400MHz
200MHz
100MHz
I_E=0.5mA
3.5mA
7Z04967-16aci


7Z04969-1.6.aci
typical values
Tj = 25 °C
−IB = 20 µA
40 µA
60 µA
80 µA
100 µA
120 µA
140 µA
180 µA
220 µA
−IC
(mA)
10
8
6
4
2
0
10 −VCE (V) 20
0.2
−VBE
(mV)
0.4
100
200 −IB (µA)
−VCE = 5V
−VCE = 5V


7Z04966-1.6.aci
−VCB = 20V
max
typ
1000
−ICBO
(µA)
100
10
1
0.1
0
20
40
60
80
100
Tj (°C)

R.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR

Germanium alloy-diffused transistor of the p-n-p type in a metal case with low noise and high gain up to 260 Mc/s, for use in V.H.F. applications as amplifier-, oscillator- and converter circuits.

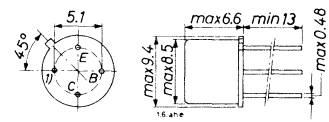
LIMITING VALUES (Absolute max. values)

Collector			
Voltage (base reference)	$-V_{CB}$	= max.	25 V
Current	$-I_C$	= max.	10 mA
Emitter			
Reverse current	$-I_E$	= max.	1 mA
Base			
Current	$-I_B$	= max.	1 mA
Dissipation			
Total dissipation at T_{amb} = 45 °C	P_{tot}	= max.	75 mW
Temperatures			
Storage temperature	T_s	=	−55 °C to +75 °C
Junction temperature continuous	T_j	= max.	75 °C
incidentally (total duration max. 200 hrs)	T_j	= max.	90 °C
	(t	= max.	200 hrs)

THERMAL DATA

Thermal resistance from junction to ambience in free air	K	= max.	0.6 °C/mW

Dimensions in mm
TO-12 case



7Z2 3044

1) Shield lead

CHARACTERISTICS at T_{amb} = 25 °C

Collector current at $I_E = 0$

$-V_{CB}$ = 12 V	$-I_{CBO}$	<	10 μA
$-V_{CB}$ = 25 V	$-I_{CBO}$	<	50 μA

Emitter voltage at $I_C = 0$

$-I_E$ = 50 μA	$-V_{EB}$	>	0.5 V

Base current

$-V_{CB}$ = 12 V; $-I_C$ = 1 mA	$-I_B$	<	50 μA

Base voltage

$-V_{CB}$ = 12 V; $-I_C$ = 1 mA	$-V_{BE}$	>	220 mV
	$-V_{BE}$	<	360 mV

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C

Frequency at which $|h_{fe}| = 1$

$-V_{CB}$ = 12 V; I_E = 1 mA — f_1 = 180 Mc/s

Base impedance

$-V_{CB}$ = 12 V; I_E = 1 mA; f = 2 Mc/s — $|z_{rb}|$ = 10 Ω

Feedback capacitance

$-V_{CE}$ = 12 V; $-I_C$ = 1 mA; f = 0.45 Mc/s — $-c_{re}$ = 0.8 pF

7Z2 2409

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN (continued)

T_{amb} = 25°C

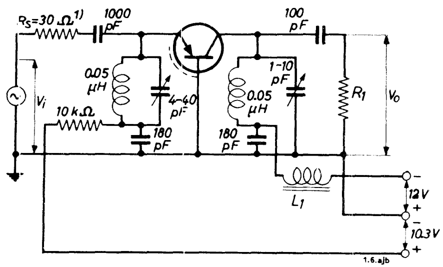
Current amplification factor

$-V_{CE}$ = 12 V; $-I_C$ = 1 mA
f = 1 kc/s — h_{fe} > 20

Noise figure

$-V_{CE}$ = 12 V; $-I_C$ = 1 mA
f = 200 Mc/s
Input source resistance = 30 Ω — F = 6 dB < 7.5 dB

Test circuit for power gain at 200 Mc/s



R_1 is chosen such that the total impedance R_L of the tuned circuit is 2.0 kΩ.

L_1 = ferrite bead

Available power gain at 200 Mc/s in the circuit above

G = 13 dB > 10 dB

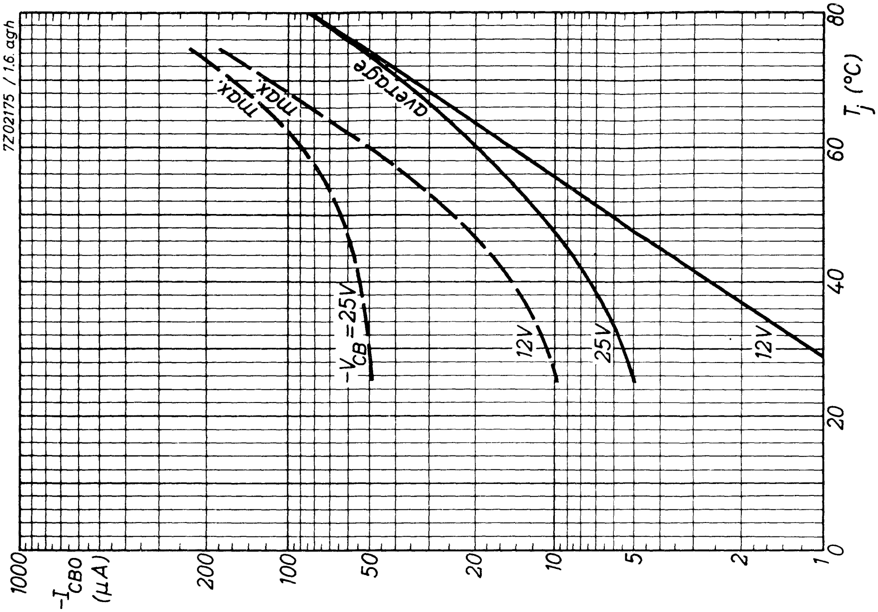
The available power gain is defined as

$$G = \frac{V_o^2}{V_i^2} \cdot \frac{4R_s}{R_L} = 0.06 \cdot \frac{V_o^2}{V_i^2}$$

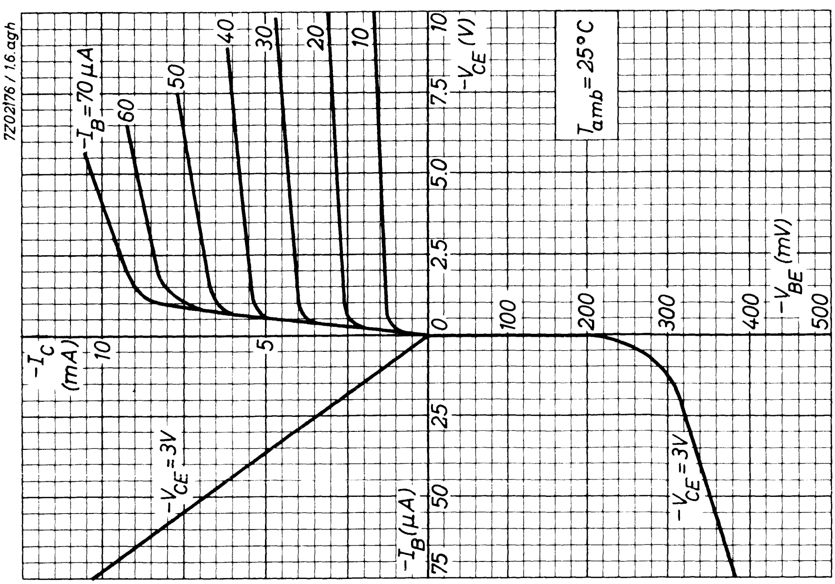
---

1) Input source resistance

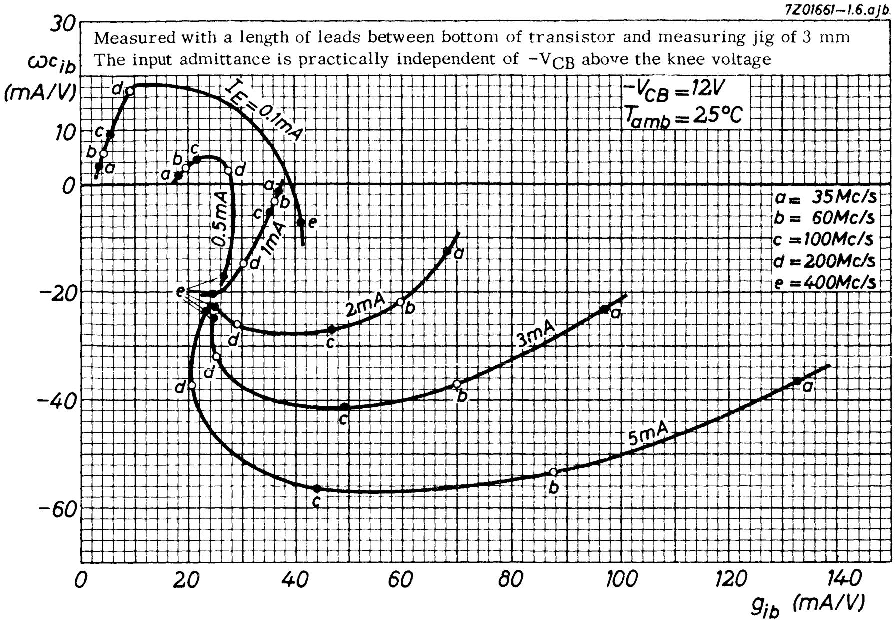
7Z2 2410


7Z02175 / 1.6.agh
$-I_{CBO}$ (µA)
T_j (°C)
average
max.
max.
$-V_{CB}$=25V
12V
25V
12V

B

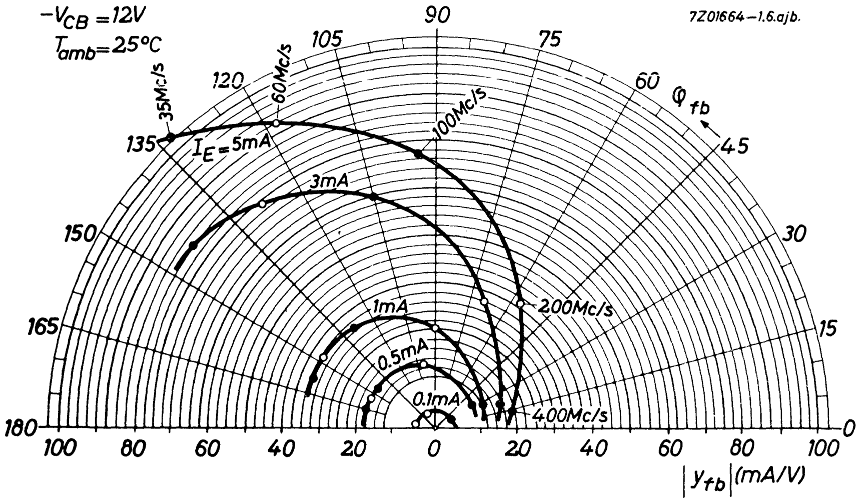

7Z02176 / 1.6.agh
$-I_B$=70µA
60
50
40
30
20
10
$-V_{CE}$ (V)
T_{amb}=25°C
$-I_C$ (mA)
$-V_{BE}$ (mV)
$-V_{CE}$=3V
$-I_B$(µA)
$-V_{CE}$=3V

A



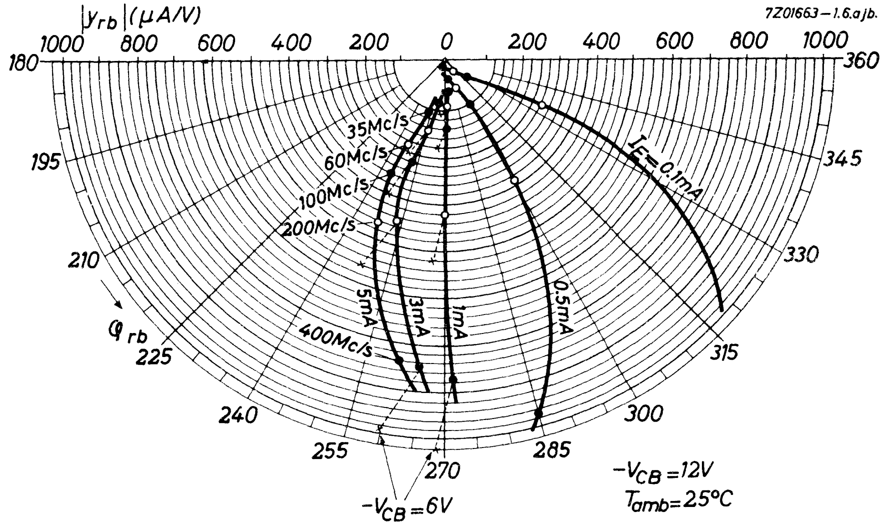
C

Measured with a length of leads between bottom of transistor and measuring jig of 3 mm
The forward transfer admittance is practically independent of $-V_{CB}$ above the knee voltage

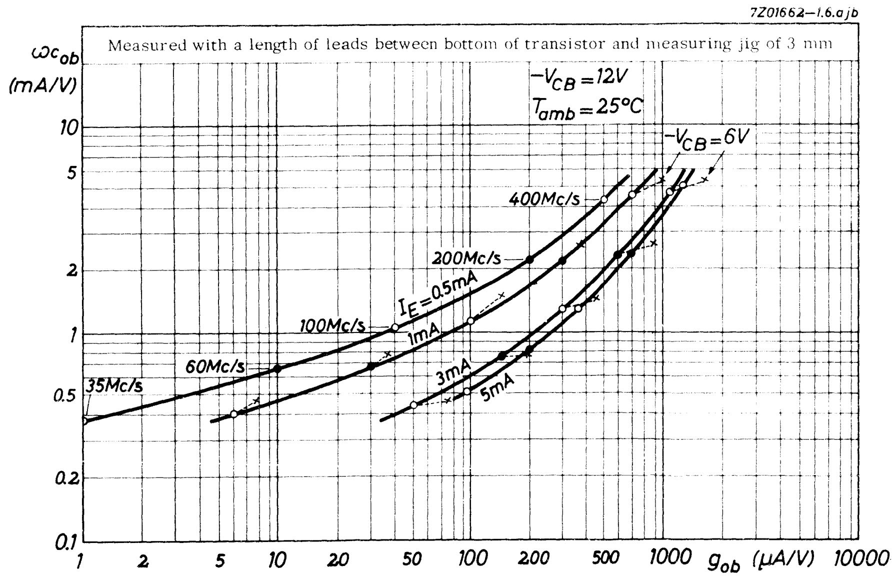


D

Measured with a length of leads between bottom of transistor and measuring jig of 3 mm



E



F

R.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR

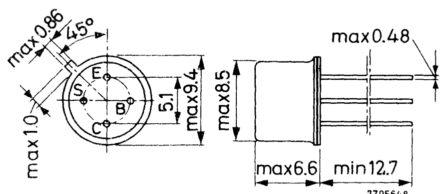
P-N-P transistor in a TO-12 metal envelope with a shield lead connected to the case. The AF179 is primarily intended for application in i.f. amplifiers of television receivers.

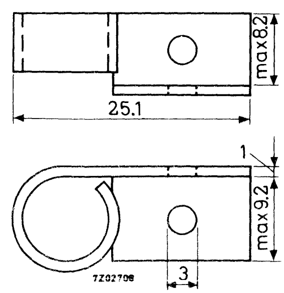
QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage $R_B/R_E \leq 100$; $R_E \geq 200\ \Omega$	$-V_{CER}$	max.	25	V
Collector current (peak value)	$-I_{CM}$	max.	15	mA
Total power dissipation up to $T_{amb} = 45\,^oC$	P_{tot}	max.	180	mW
Junction temperature; incidentally	T_j	max.	90	^oC
Feedback capacitance at f = 0.45 MHz $-I_C = 1$ mA; $-V_{CE} = 10$ V	$-C_{re}$	typ.	480	fF
Transition frequency $-I_C = 3$ mA; $-V_{CE} = 10$ V	f_T	typ.	270	MHz
Transfer admittance at f = 35 MHz $-I_C = 3$ mA; $-V_{CE} = 10$ V	$\|y_{fe}\|$	typ.	80	$m\Omega^{-1}$

MECHANICAL DATA

Dimensions in mm

TO-12





Type number of cooling fin and mounting clip 56265

7Z3 0575

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage $R_B/R_E \leq 100$; $R_E \geq 200\ \Omega$	$-V_{CER}$	max.	25	V

Currents

Collector current (d.c.)	$-I_C$	max.	10	mA
Collector current (peak value)	$-I_{CM}$	max.	15	mA
Reverse emitter current	$-I_E$	max.	1	mA

Power dissipation

Total power dissipation up to $T_{amb} = 45\,^{o}C$ with cooling clip 56265	P_{tot}	max.	180	mW

Temperatures

Storage temperature	T_{stg}		-65 to +80	^{o}C
Junction temperature: continuous	T_j	max.	80	^{o}C
incidentally	T_j	max.	90	^{o}C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	= 0.37	$^{o}C/mW$
From junction to case	$R_{th\ j\text{-}c}$	= 0.17	$^{o}C/mW$
From junction to ambient with cooling clip 56265	$R_{th\ j\text{-}a}$	= 0.25	$^{o}C/mW$

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0576

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	typ.	1.2	μA
		<	8	μA
$I_E = 0$; $-V_{CB} = 10$ V; $T_j = 75$ °C	$-I_{CBO}$	<	150	μA
Base current				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	$-I_B$	typ.	30	μA
		<	100	μA
Base-emitter voltage				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ.	330	mV
			280 to 380	mV
Feedback capacitance at f = 0.45 MHz				
$-I_C = 1$ mA; $-V_{CE} = 10$ V	$-C_{re}$	typ.	480	fF [1]
			330 to 680	fF [1]
Transition frequency				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	f_T	typ.	270	MHz
y parameters at f = 35 MHz (common emitter) [2]				
$-I_C = 3$ mA; $-V_{CE} = 10$ V				
Input conductance	g_{ie}	typ.	6.5	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	35	pF
Feedback admittance	$\|y_{re}\|$	typ.	100	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	260°	
Transfer admittance	$\|y_{fe}\|$	typ.	80	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	322°	
Output conductance	g_{oe}	typ.	100	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	1.8	pF

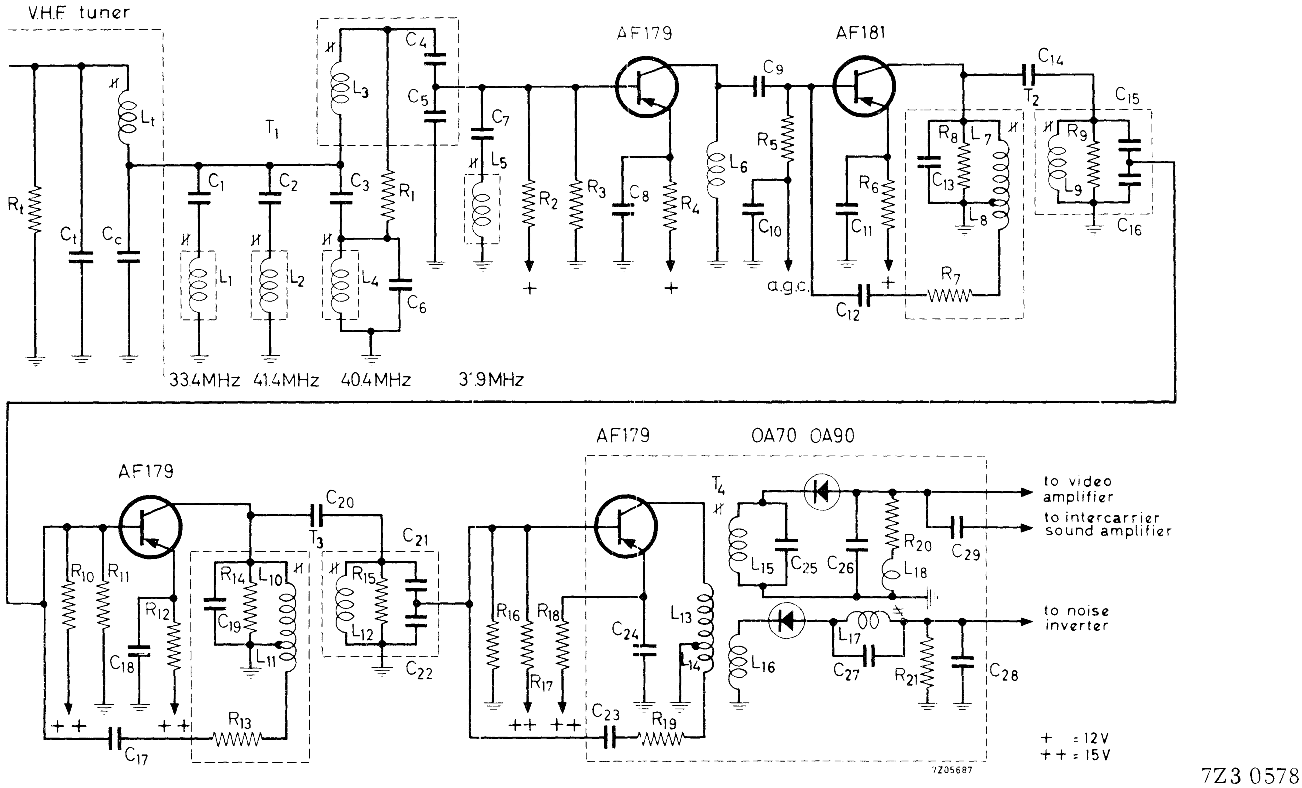
[1]) 1 fF = 1 femtofarad = 10^{-15} F

[2]) Length of leads between bottom of transistor and measuring jig is 3 mm

7Z3 0577

APPLICATION INFORMATION

Four-stage vision i.f. amplifier



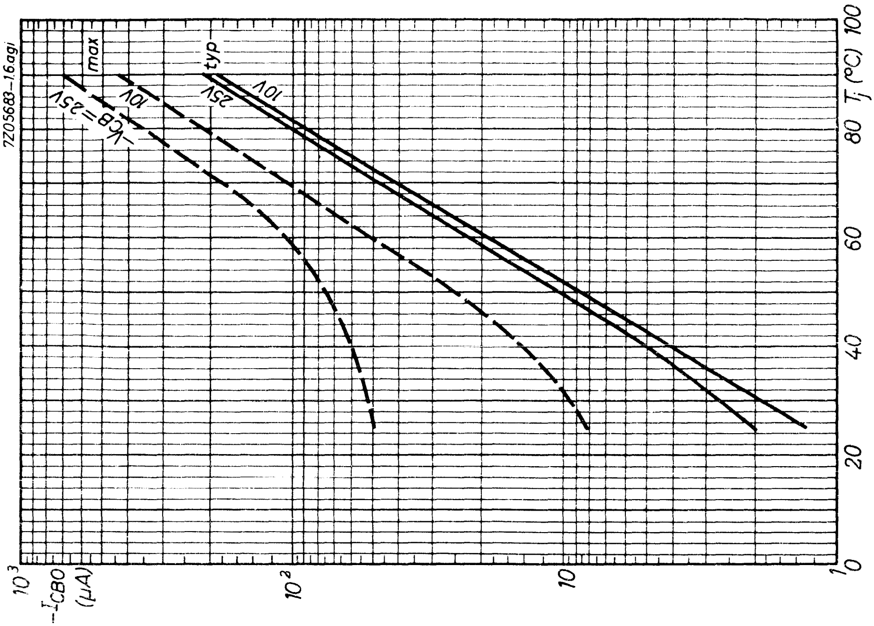
APPLICATION INFORMATION (continued)

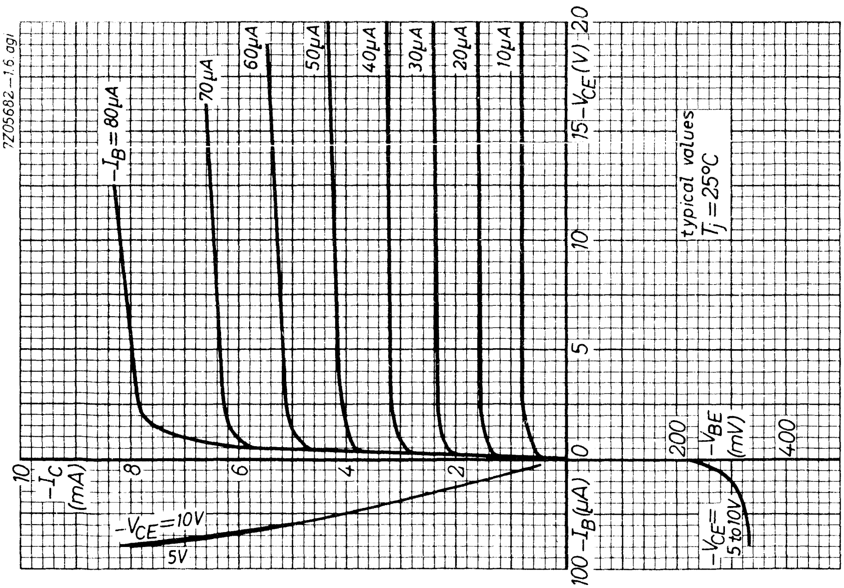
Components

R_1	2.2 kΩ	C_1	15 pF, ceramic plate, 30 V, ± 5%
R_2, R_{12}	1.5 kΩ	C_2, C_{26}, C_{28}	10 pF, ceramic plate, 30 V, ± 0.5 pF
R_3	1.8 kΩ	C_3, C_4, C_{27}	22 pF, ceramic plate, 30 V, ± 5%
R_4, R_9	680 Ω	C_5, C_{15}, C_{16}, C_{22}	100 pF, ceramic plate, 30 V, ± 5%
R_5, R_{18}	1 kΩ	C_6, C_7, C_{21}	39 pF, ceramic plate, 30 V, ± 5%
R_6	470 Ω	C_8, C_{10}, C_{11}, C_{18}, C_{24}	2.2 nF, pin-up ceramic, 500 V, −20 to +50%
R_7, R_{13}, R_{19}	150 Ω	C_9	1 nF, pin-up ceramic, 500 V, −20 to +50%
R_8, R_{14}	10 kΩ	C_{12}, C_{17}	3.3 pF, ceramic, 500 V, ± 0.5 pF
R_{10}, R_{15}	3.9 kΩ	C_{13}, C_{19}, C_{20}	3.9 pF, ceramic plate, 30 V, ± 0.5 pF
R_{11}	8.2 kΩ	C_{14}	6.8 pF, ceramic plate, 30 V, ± 0.5 pF
R_{16}	6.8 kΩ	C_{23}, C_{25}	5.6 pF, ceramic plate, 30 V, ± 0.5 pF
R_{17}, R_{20}	2.7 kΩ	C_{29}	4.7 pF, ceramic plate, 30 V, ± 0.5 pF
R_{21}	18 kΩ	C_c	68 pF + 30 pF (capacitance of screened connecting cable)
R_t	3.9 kΩ	C_t	6.8 pF + 2 pF (transistor output capacitance)
Carbon resistors,		L_6	100 μH
1/8 W, ± 10%		L_{18}	350 μH

For further information please refer to application information bulletin AI230

7Z3 0579


7Z05683-1.6.agi
max
typ
$-V_{CB}$ = 25V
10V
25V
10V
T_j (°C)
100
80
60
40
20
0
$-I_{CBO}$ (μA)
10^3
10^2
10
1


7Z05682-1.6.agi
$-I_B$ = 80μA
70μA
60μA
50μA
40μA
30μA
20μA
10μA
20
15 $-V_{CE}$ (V)
10
5
0
typical values
T_j = 25°C
10 $-I_C$ (mA)
8
6
4
2
$-V_{CE}$ = 10V
5V
100 $-I_B$ (μA)
200
$-V_{BE}$ (mV)
400
$-V_{CE}$ = 5 to 10V

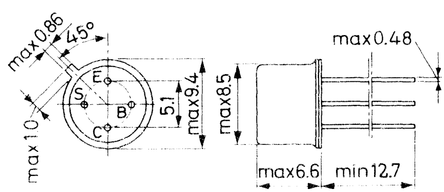
GERMANIUM ALLOY-DIFFUSED TRANSISTOR

P-N-P transistor in a TO-12 metal envelope with a shield lead connected to the case. It has a forward gain control characteristic and is primarily intended for use in the control stage of television intermediate frequency amplifiers.

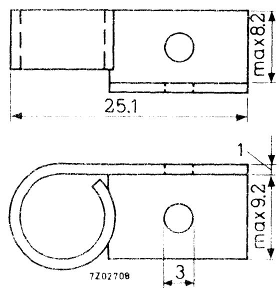
QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage $R_B/R_E \leq 100$	$-V_{CER}$	max.	30	V
Collector current (d.c.)	$-I_C$	max.	20	mA
Total power dissipation up to $T_{amb} = 25\,^{o}C$	P_{tot}	max.	156	mW
Junction temperature	T_j	max.	75	^{o}C
Transition frequency				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	f_T	typ.	170	MHz
Maximum unilaterised power gain				
$-I_C = 3$ mA; $-V_{CE} = 10$ V; f = 35 MHz	G_{UM}	typ.	35	dB
Gain control range	ΔG_{tr}	typ.	60	dB

MECHANICAL DATA Dimensions in mm

TO-12



S = Shield lead connected to case



Type number of cooling fin and mounting clip 56265

7Z3 0580

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	V
Collector-emitter voltage ($R_B/R_E \leq 100$)	$-V_{CER}$	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	0.6	V

Currents

Collector current (d.c.)	$-I_C$	max.	20	mA
Collector current (peak value)	$-I_{CM}$	max.	20	mA
Reverse emitter current (d.c.)	$-I_E$	max.	1	mA
Reverse emitter current (peak value)	$-I_{EM}$	max.	1	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	156	mW

Temperatures

Storage temperature	T_{stg}		-55 to +75	°C
Junction temperature: continuous	T_j	max.	75	°C
incidentally	T_j	max.	90	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.32	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0.14	°C/mW

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0581

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	<	7	μA
$I_E = 0$; $-V_{CB} = 10$ V; $T_j = 75$ °C	$-I_{CBO}$	typ. <	70 250	μA μA
Base current				
$I_E = 3$ mA; $-V_{CB} = 10$ V	$-I_B$	typ. <	50 150	μA μA
$I_E = 10$ mA; $-V_{CB} = 6$ V	$-I_B$	typ. 75 to	235 400	μA μA
Base-emitter voltage				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	$-V_{BE}$	typ. 320 to	360 400	mV mV
Feedback capacitance at f = 450 kHz				
$-I_C = 1$ mA; $-V_{CE} = 10$ V	$-C_{re}$	typ. 300 to	400 550	fF [1] fF [1]
Transition frequency				
$-I_C = 3$ mA; $-V_{CE} = 10$ V	f_T	typ.	170	MHz
y parameters at f = 35 MHz (common emitter)				
$-I_C = 3$ mA; $-V_{CE} = 10$ V				
Input conductance	g_{ie}	typ.	10	$m\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45	pF
Feedback admittance	$\|y_{re}\|$	typ.	75	$\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	270°	
Transfer admittance	$\|y_{fe}\|$	typ.	85	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	310°	
Output conductance	g_{oe}	typ.	60	$\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	3	pF
Maximum unilateralised power gain				
$G_{UM} = \frac{\|y_{fe}\|^2}{4 g_{ie} g_{oe}}$				
$-I_C = 3$ mA; $-V_{CE} = 10$ V; f = 35 MHz	G_{UM}	typ.	35	dB

[1]) 1 fF = 1 femtofarad = 10^{-15} F

7Z3 0582

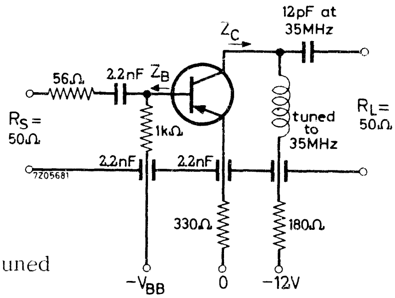
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Transducer gain

$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source with } R_S}$$

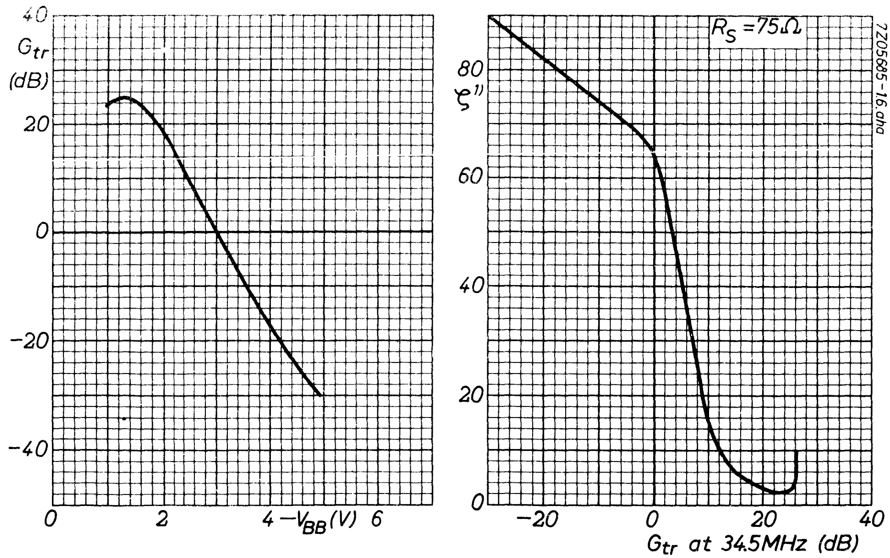
$-V_{BB}$ = 1.4 V; T_{amb} = 45 °C	G_{tr}	typ.	25	dB
$-V_{BB}$ = 3.6 V; T_{amb} = 45 °C	G_{tr}	typ.	−10	dB
		−16 to	−4	dB
Gain control range	ΔG_{tr}	>	56	dB
		typ.	60	dB

Test circuit:

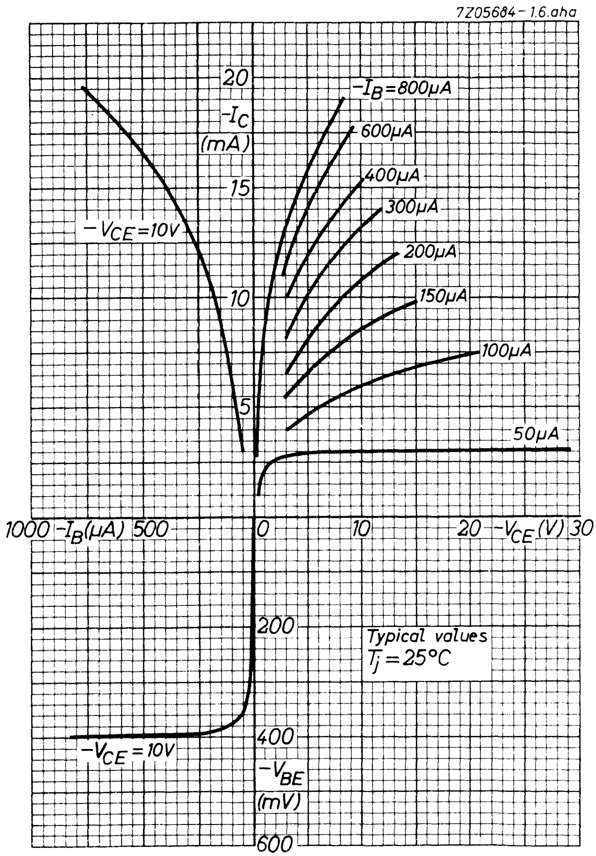


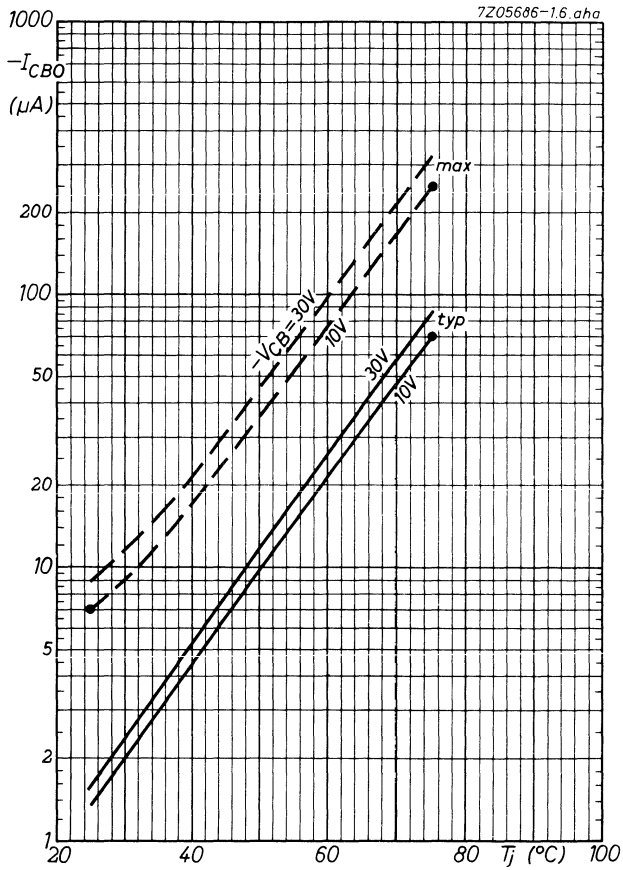
Z_B = 100 Ω resistive

Z_C = 2.5 kΩ single tuned



1) Interfering signal at 38 MHz causing a cross modulation factor of 1% versus transducer gain at 34.5 MHz. 7Z3 0583


7Z05684-1.6.aha
20
$-I_C$
(mA)
15
10
5
$-V_{CE}=10V$
$-I_B=800\mu A$
600μA
400μA
300μA
200μA
150μA
100μA
50μA
1000 $-I_B(\mu A)$ 500
0
10
20 $-V_{CE}(V)$ 30
200
400
$-V_{BE}$
(mV)
600
Typical values
$T_j=25°C$
$-V_{CE}=10V$

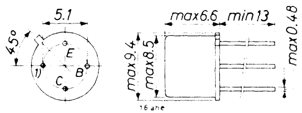

7Z05686-1.6.aha
1000
$-I_{CBO}$
(μA)
200
100
50
20
10
5
2
1
20
40
60
80
T_j (°C)
100
max
typ
$-V_{CB}$=30V
10V
30V
10V

R.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR

R.F. germanium alloy-diffused transistor of the p-n-p type in TO-12 metal case with low leakage current at high temperature and low noise.

Application: R.F. amplifier, mixer-oscillator and I.F. amplifier stages with frequencies up to 27 Mc/s in car radios.

Dimensions in mm



LIMITING VALUES (Absolute limits)

Voltages

Collector to base voltage	$-V_{CB}$	= max.	32 V
Collector to emitter voltage	$-V_{CE}$	= max.	32 V [2])

Currents

Collector current	$-I_C$	= max.	30 mA
Base current	$-I_B$	= max.	1 mA
Emitter reverse current			
continuous	$-I_E$	= max.	1 mA
peak	$-I_{EM}$	= max.	10 mA

Dissipation

Total dissipation	P_{tot}	= max.	120 mW

[1]) Shield lead
[2]) See also minimum $-V_{CE}$ for $-I_C$ = 1 mA at page G

7Z2 2420

LIMITING VALUES (continued)

Temperatures

Storage temperature	T_s	=	$-55\,^{\circ}C$ to $+100\,^{\circ}C$
Junction temperature			
continuous operation	T_j	= max.	90 °C
incidentally, up to a total of 200 hours	T_j	= max.	100 °C

THERMAL DATA

Thermal resistance from junction to ambience in free air	$K_{j\text{-}amb}$	= max.	0.45 °C/mW

CHARACTERISTICS at T_{amb} = 25 °C

Collector leakage current at				
$-V_{CB}$ = 10 V; I_E = 0 mA	$-I_{CBO}$	=	0.5 μA	< 3 μA
Base current at				
$-V_{CB}$ = 10 V; I_E = 1 mA	$-I_B$	>	5 μA	< 25 μA

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{amb} = 25 °C

Collector leakage current	$-I_{CBO}$		See page B	
Emitter reverse voltage at				
$-I_E$ = 50 μA; I_C = 0 mA	$-V_{EB}$	=	1.8 V	> 1.2 V
$-I_E$ = 1 mA; I_C = 0 mA	$-V_{EB}$	=	2.4 V	> 1.5 V
Base-emitter voltage at				
$-V_{CB}$ = 10 V; I_E = 1 mA	$-V_{BE}$	=	280 mV	> 220 mV < 340 mV
Feedback capacitance at				
$-V_{CE}$ = 10 V; $-I_C$ = 1 mA; f = 0.45 Mc/s	$-c_{re}$	=		1.5 pF

7Z2 2421

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

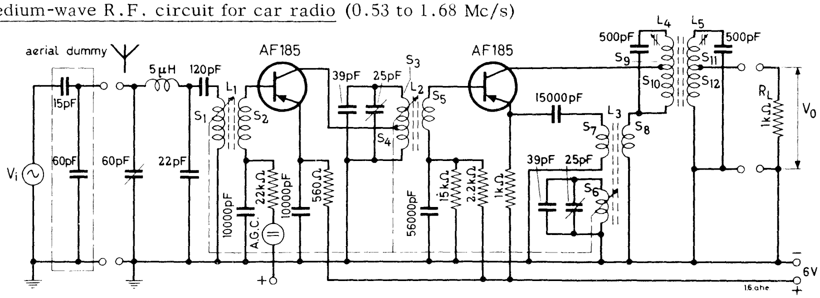
at T_{amb} = 25 °C (continued)

Base-emitter input resistance, at				
$-V_{CE}$ = 10 V; $-I_C$ = 1 mA; f = 35 Mc/s	$Re(h_{ie})$	=		30 Ω
Frequency at which $\lvert h_{fe}\rvert$ = 1 at				
$-V_{CE}$ = 10 V; $-I_C$ = 1 mA	f_1	=		80 Mc/s
Noise figure at				
$-V_{CE}$ = 10 V; $-I_C$ = 1 mA and:				
f = 0.2 Mc/s; R_S = 200 Ω	F	=	1.5 dB	
f = 1 Mc/s; R_S = 200 Ω	F	=	1.5 dB	
f = 1 Mc/s; R_S = 50 Ω	F	=	3 dB	< 4 dB
f = 10.7 Mc/s; R_S = 300 Ω	F	=	1.5 dB	
Conversion noise figure at				
$-V_{CE}$ = 10 V; $-I_C$ = 1 mA and:				
f = 0.2 Mc/s; R_S = 500 Ω	F_c	=	4.5 dB	< 8 dB
f = 1 Mc/s; R_S = 300 Ω	F_c	=	3 dB	< 5 dB
Small-signal parameters	See pages C, D, E and F			

Remark. The small-signal parameters have been measured with a length of leads of 5 mm between bottom of transistor and measuring jig.

7Z2 2422

Medium-wave R.F. circuit for car radio (0.53 to 1.68 Mc/s)



7Z2 2423

Stable continuous operation is insured up to an ambient temperature of 60 °C

D.C. adjustments

Emitter current of R.F. transistor I_E = 1.0 mA

Emitter current of mixer transistor I_E = 0.7 mA

Sensitivity at a frequency of 1 Mc/s, a modulation depth of 30% and a noise bandwidth of 4.5 kc/s

at a Signal to noise ratio	S/N	=	26 dB	20 dB
Aerial E.M.F.	V_i	=	26 μV	13 μV

Voltage gain V_o/V_i = 350

4

COIL DATA

Coil No.	L_1	L_2	L_3	L_4	L_5
Measuring frequency	1 Mc/s	1 Mc/s	1.45 Mc/s	0.45 Mc/s	0.45 Mc/s
Inductance	S_1 = 150-1500 μH	S_3+S_4 = 150-1500 μH	S_6 = 94-444 μH	S_9+S_{10} = 250 μH	$S_{11}+S_{12}$ = 250 μH
Total tuning capacitance	60 pF	60 pF	60 pF	500 pF	500 pF
Q_o	80	80	50	150	150
Tapping ratio	$\frac{V_{S_2}}{V_i} = 0.33$ [1]	$\frac{V_{S_4}}{V_{S_3}+V_{S_4}} = 0.14$ $\frac{V_{S_5}}{V_{S_4}} = 0.5$	$\frac{V_{S_8}}{V_{S_6}} = 0.14$ $\frac{V_{S_7}}{V_{S_8}} = 0.14$	$\frac{V_{S_{10}}}{V_{S_9}+V_{S_{10}}} = 0.3$	$\frac{V_{S_{12}}}{V_{S_{11}}+V_{S_{12}}} = 0.07$

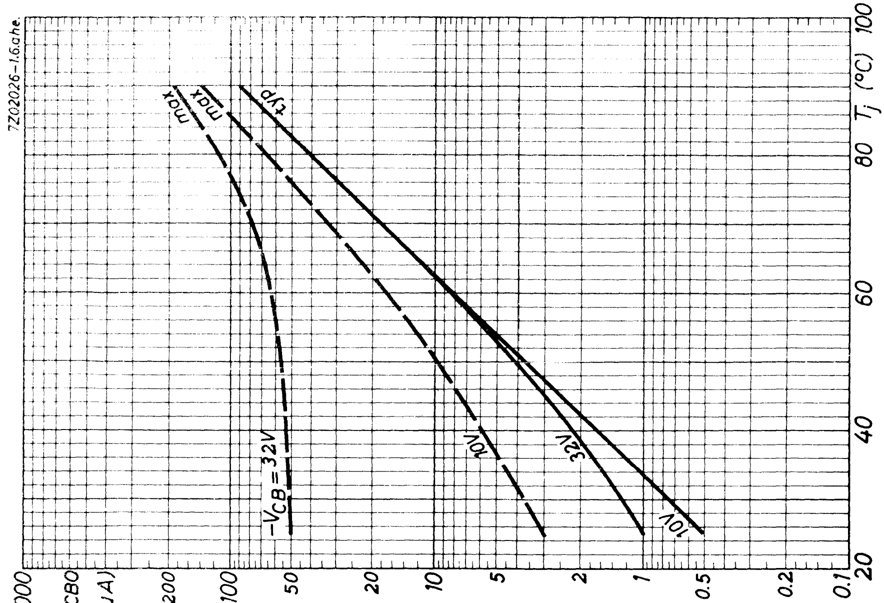
Source impedance across S_2 at 1 Mc/s = 200 Ω

Coupling between L_4 and L_5 : KQ_o = 1.2

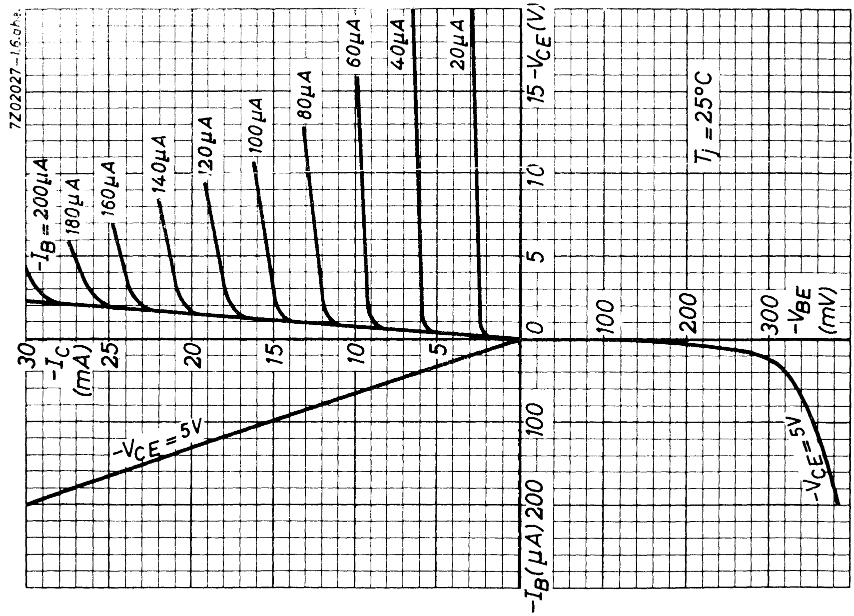
7Z2 2424

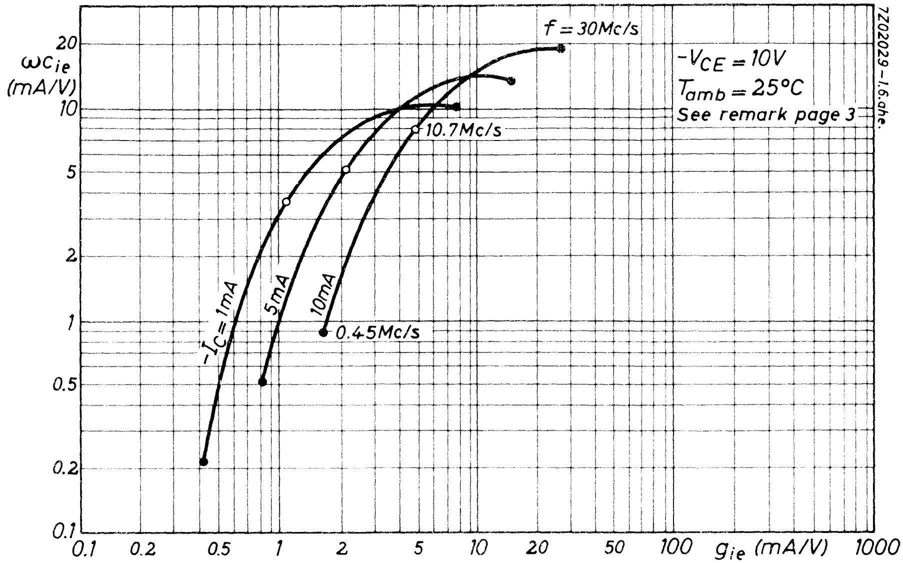
[1]) Measured without AF185

B

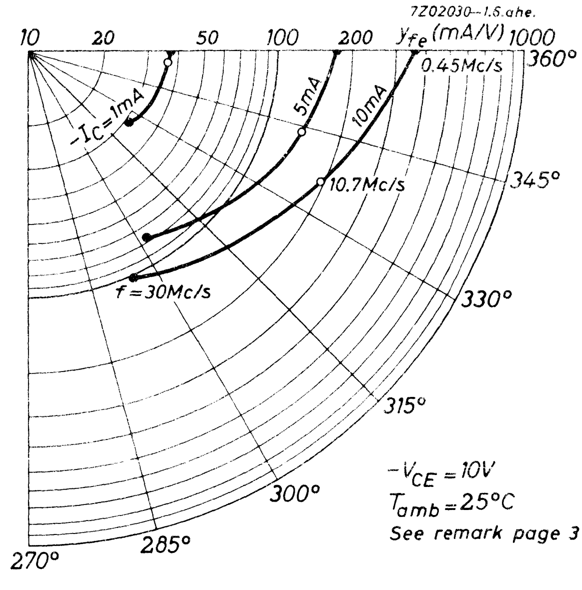

7Z02026-1.6.ahe.
$-I_{CBO}$ (μA)
T_j (°C)
max
max
typ
$-V_{CB}$ = 32V
10V
32V
10V
1000
200
100
50
20
10
5
2
1
0.5
0.2
0.1
20
40
60
80
100

A

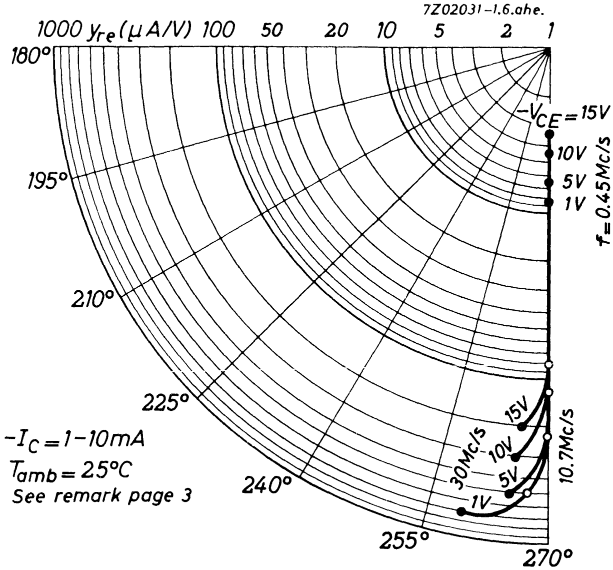

7Z02027-1.6.ahe.
$-I_C$ (mA)
$-V_{CE}$ (V)
$-I_B$ (μA)
$-V_{BE}$ (mV)
T_j = 25°C
$-I_B$ = 200μA
180μA
160μA
140μA
120μA
100μA
80μA
60μA
40μA
20μA
$-V_{CE}$ = 5V
$-V_{CE}$ = 5V
30
25
20
15
10
5
0
5
10
15
100
200
300
100
200


7Z02029–1.6.ahe.
ωc_{ie} (mA/V)
20
10
5
2
1
0.5
0.2
0.1
0.1
0.2
0.5
1
2
5
10
20
50
100
g_{ie} (mA/V)
1000
f = 30Mc/s
10.7Mc/s
0.45Mc/s
$-I_C$ = 1mA
5mA
10mA
$-V_{CE}$ = 10V
T_{amb} = 25°C
See remark page 3

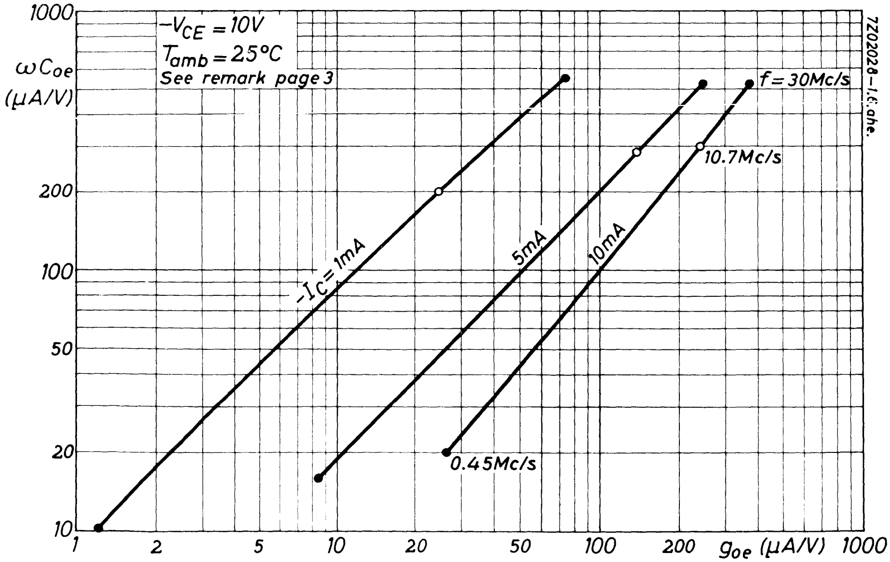
C


7Z02030–1.6.ahe.
10
20
50
100
200
y_{fe} (mA/V)
1000
360°
345°
330°
315°
300°
285°
270°
0.45Mc/s
10.7Mc/s
f = 30Mc/s
$-I_C$ = 1mA
5mA
10mA
$-V_{CE}$ = 10V
T_{amb} = 25°C
See remark page 3

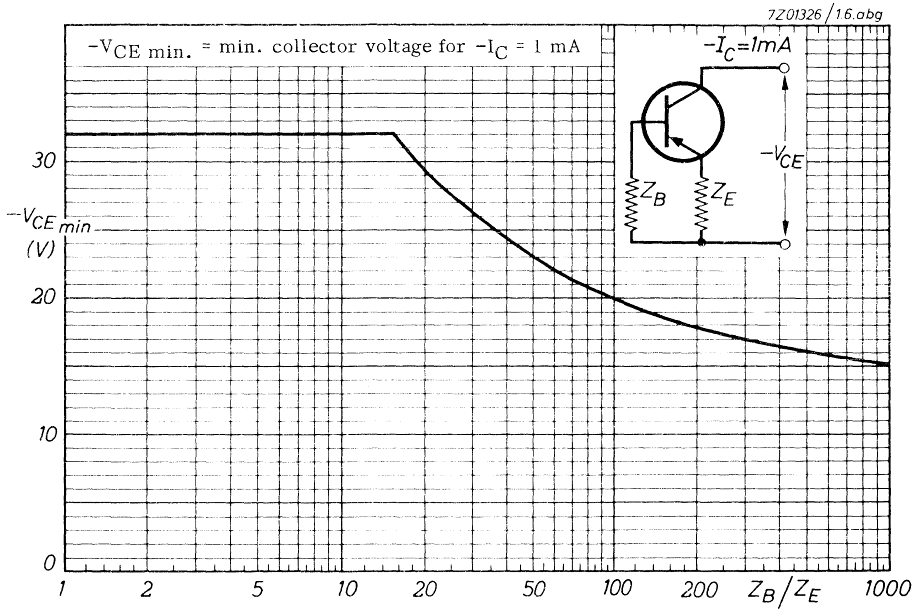
D


7Z02031-1.6.ahe.
1000 y_{re} (µA/V) 100 50 20 10 5 2 1
180°
195°
210°
225°
240°
255°
270°
$-V_{CE}$ = 15V
10V
5V
1V
f = 0.45Mc/s
15V
10V
5V
1V
30Mc/s
10.7Mc/s
$-I_C$ = 1-10mA
T_{amb} = 25°C
See remark page 3

E


7Z02028-1.6.ahe.
ωC_{oe} (µA/V)
1000
200
100
50
20
10
1 2 5 10 20 50 100 200 g_{oe} (µA/V) 1000
$-V_{CE}$ = 10V
T_{amb} = 25°C
See remark page 3
f = 30Mc/s
10.7Mc/s
0.45Mc/s
$-I_C$ = 1mA
5mA
10mA

F


7Z01326/1.6.abg
$-V_{CE\,min.}$ = min. collector voltage for $-I_C$ = 1 mA
$-I_C$=1mA
$-V_{CE}$
Z_B
Z_E
30
$-V_{CE\,min}$
(V)
20
10
0
1
2
5
10
20
50
100
200
Z_B/Z_E
1000

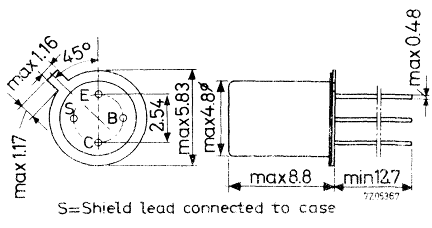
G

U.H.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR

P-N-P transistor in metal case, primarily intended for use in a forward-gain-controlled pre-amplifier and mixer oscillator unit at frequencies up to 900 MHz.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector current (peak value)	$-I_{CM}$	max.	15	mA
Total dissipation up to T_{amb} = 45 °C	P_{tot}	max.	70	mW
Junction temperature	T_j	max.	75	°C
Transition frequency $-I_C$ = 2 mA; $-V_{CE}$ = 10 V	f_T	typ.	820	MHz
Power gain of pre-amplifier I_E = 2 mA; $-V_{CB}$ = 10 V f = 860 MHz; T_j = 25 °C	G_p	typ.	9	dB
Noise figure at 800 MHz $-I_C$ = 2 mA; $-V_{CE}$ = 10 V Source conductance G_S = 20 mΩ^{-1}	F	typ.	8	dB
Thermal resistance	$R_{th\ j-a}$	=	0.65	°C/mW

MECHANICAL DATA Dimensions in mm



The AF186 is supplied in pairs
Marked with black dot: pre-amplifier
Marked with red dot : mixer-oscillator

7Z3 0394

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25	V
Collector-emitter voltage (resistance between base and emitter)	$-V_{CER}$	max.	25	V

Currents

Collector current (d.c.)	$-I_C$	max.	15	mA
Collector current (peak value)	$-I_{CM}$	max.	15	mA
Emitter current (d.c.)	I_E	max.	16	mA
Emitter current (peak value)	I_{EM}	max.	16	mA
Base current (d.c.)	$-I_B$	max.	1	mA
Base current (peak value)	$-I_{BM}$	max.	1	mA
Reverse emitter current	$-I_E$	max.	1	mA

Power dissipation

Total power dissipation up to T_{amb} = 45 °C	P_{tot}	max.	70	mW

Temperatures

Storage temperature	T_{stg}	-55 to +75		°C
Junction temperature: continuous	T_j	max.	75	°C
incidentally	T_j	max.	90	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.65	°C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0395

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	<	3.5	μA
$I_E = 0$; $-V_{CB} = 25$ V	$-I_{CBO}$	typ.	0.65	μA
		<	50	μA
Emitter cut-off current				
$I_C = 0$; $-V_{EB} = 0.3$ V	$-I_{EBO}$	typ.	0.5	μA
Base-emitter voltage				
$I_E = 2$ mA; $-V_{CB} = 10$ V	$-V_{BE}$		260 to 380	mV
Base current				
$I_E = 2$ mA; $-V_{CB} = 10$ V	$-I_B$	<	50	μA
$I_E = 10$ mA; $-V_{CB} = 5$ V	$-I_B$	<	800	μA
Power gain at f = 900 MHz				
$I_E = 2$ mA; $-V_{CB} = 10$ V Source conductance $G_S = 20$ mΩ^{-1} Load conductance $G_L = 2$ mΩ^{-1}				
Pre-amplifier	G_p	>	5.5	dB
		typ.	8.5	dB
Mixer-oscillator	G_p	>	7	dB
		typ.	8.5	dB
Transition frequency				
$-I_C = 2$ mA; $-V_{CE} = 10$ V	f_T	typ.	820	MHz
Feedback capacitance at f = 10.7 MHz				
$-I_C = 2$ mA; $-V_{CE} = 10$ V	$-C_{re}$	typ.	0.25	pF
		<	0.40	pF
Noise figure				
$-I_C = 2$ mA; $-V_{CE} = 10$ V Source conductance $G_S = 20$ mΩ^{-1}				
At f = 500 MHz	F	typ.	6.5	dB
At f = 800 MHz	F	typ.	8.0	dB
		<	10	dB

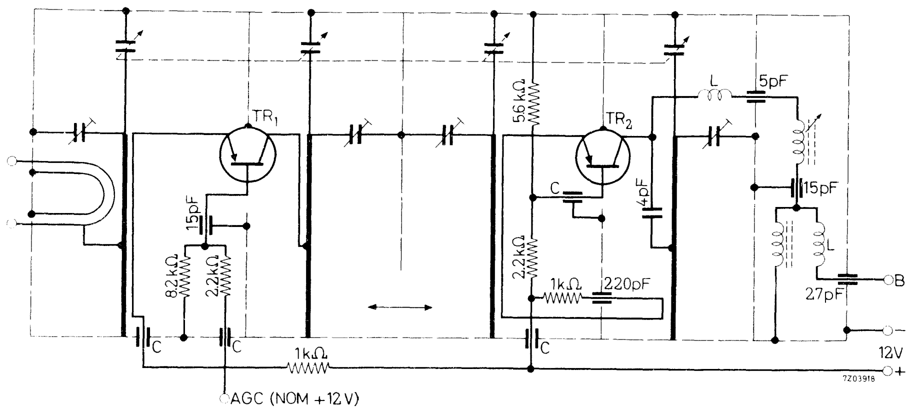
7Z3 0396

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

			Pre-amplifier (black dot)	Mixer-oscillator (red dot)	
y parameters at f = 35 MHz					
I_E = 2 mA; $-V_{CB}$ = 10 V					
Output conductance	g_{ob}	typ.		15	$\mu\Omega^{-1}$
Output capacitance	C_{ob}	typ.		1.5	pF
y parameters at f = 500 MHz					
I_E = 2 mA; $-V_{CB}$ = 10 V					
Input conductance	g_{ib}	typ.	17	17	$m\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	4	4	pF
Feedback admittance	$\|y_{rb}\|$	typ.	0.35	0.35	$m\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	245°	245°	
Transfer admittance	$\|y_{fb}\|$	typ.	25	25	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	90°	90°	
Output conductance	g_{ob}	typ.	0.35	0.35	$m\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.2	1.2	pF
y parameters at f = 900 MHz					
I_E = 2 mA; $-V_{CB}$ = 10 V					
Input conductance	g_{ib}	typ.	11	14	$m\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	1.8	1.8	pF
Feedback admittance	$\|y_{rb}\|$	typ.	0.6	0.7	$m\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	230°	230°	
Transfer admittance	$\|y_{fb}\|$	typ.	18	22	$m\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	55°	50°	
Output conductance	g_{ob}	typ.	0.7	0.9	$m\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.2	1.2	pF

7Z3 0397

APPLICATION INFORMATION



L	=	0.2 μH
C	=	Feed-through capacitance of 820 pF
TR_1	=	Pre-amplifier (black dot)
TR_2	=	Mixer-oscillator (red dot)

Tuner gain

at 860 MHz	typ.	22	dB
470 MHz	typ.	16	dB

Tuner noise

at 860 MHz	typ.	10.5	dB
	<	13	dB
470 MHz	typ.	7.5	dB

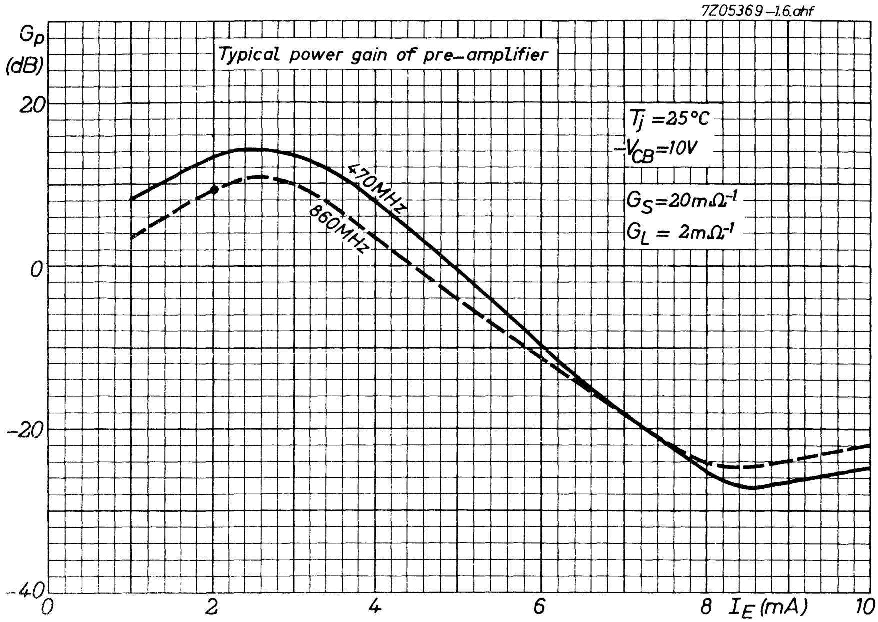
NOTES:

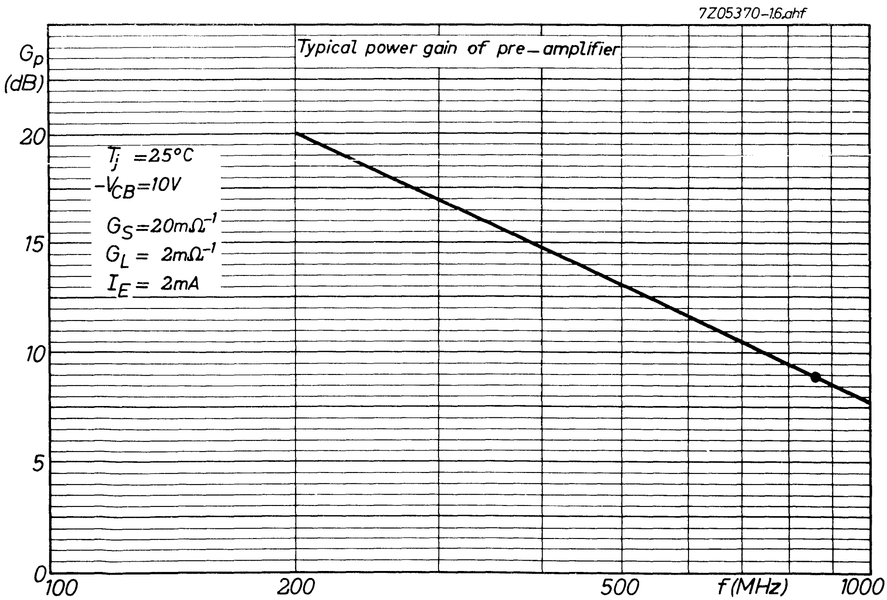
1. Tuner gain (in dB) =

$$10 \log \frac{\text{output power in a load of } 50\ \Omega \text{ connected to point B (see figure)}}{\text{available power of a source of } 300\ \Omega \text{ connected to the aerial terminals}}$$

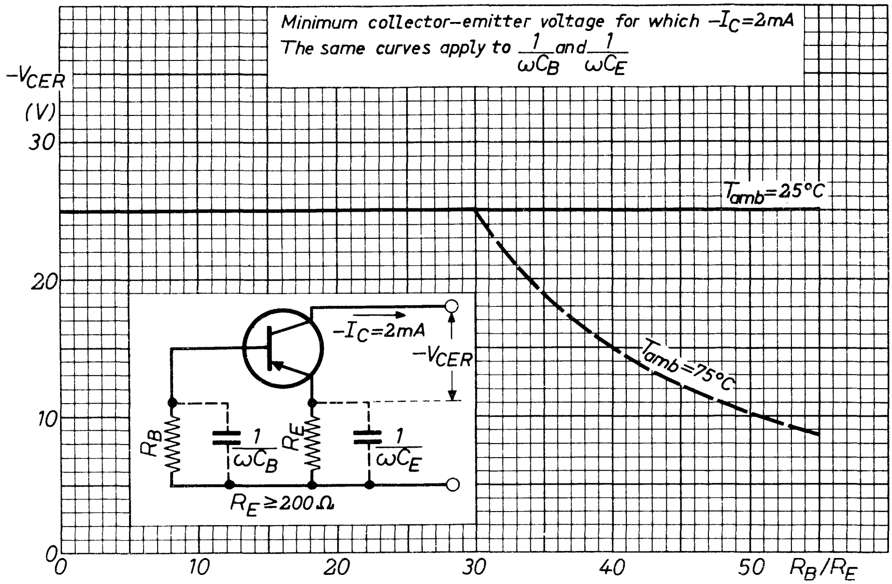
2. Typical gain control range of the tuner is 35 dB.

7Z3 0398

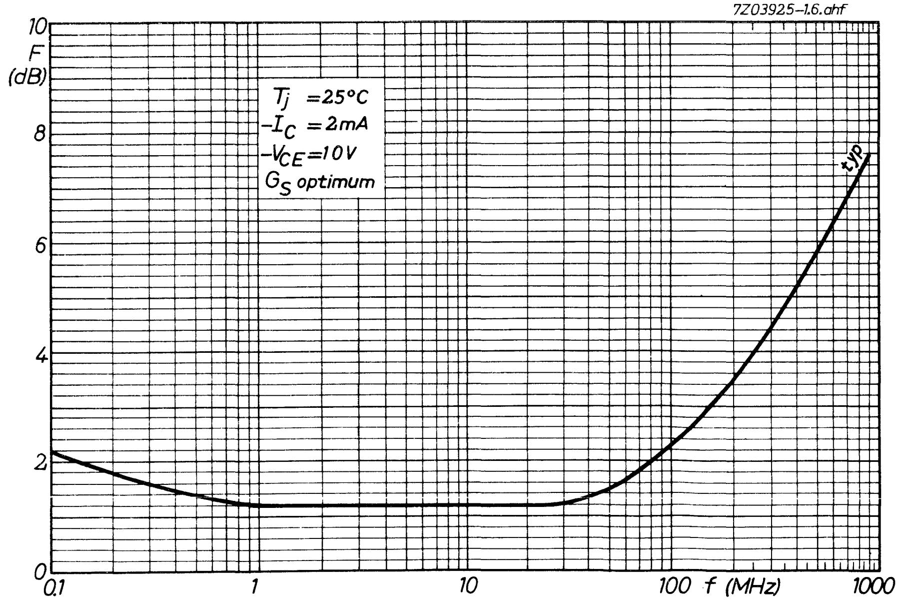

7Z05369-1.6.ahf
Typical power gain of pre-amplifier
Gp (dB)
20
0
-20
-40
0
2
4
6
8
10
IE (mA)
Tj = 25°C
-VCB = 10V
GS = 20mΩ-1
GL = 2mΩ-1
470MHz
860MHz

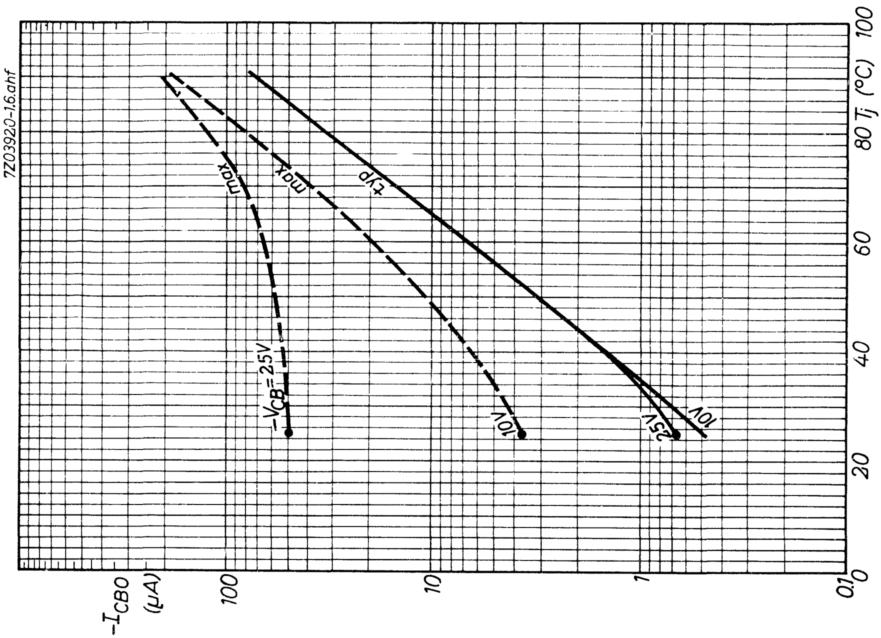

7Z05370-1.6.ahf
Typical power gain of pre-amplifier
Gp (dB)
20
15
10
5
0
100
200
500
1000
f (MHz)
Tj = 25°C
-VCB = 10V
GS = 20mΩ-1
GL = 2mΩ-1
IE = 2mA

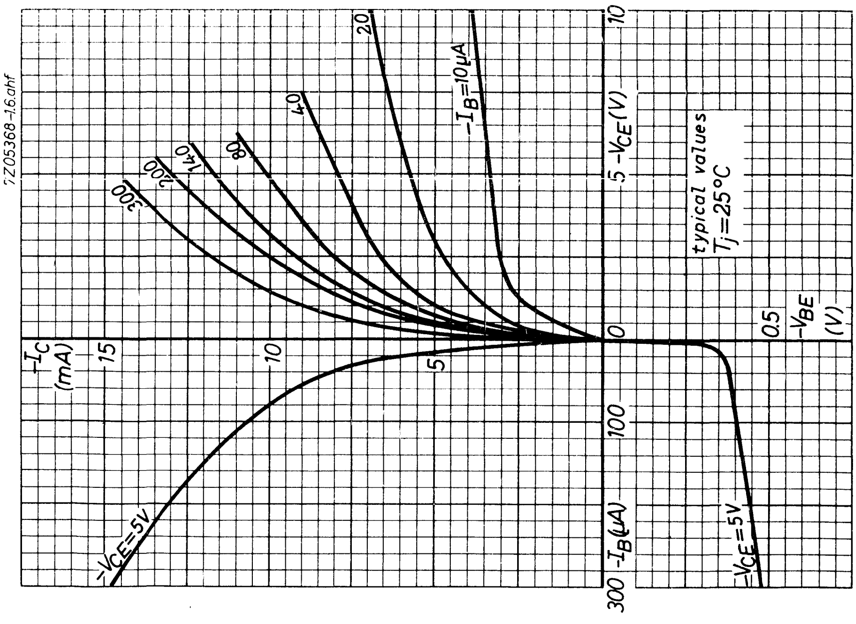
7Z05371-1.6.ahf



7Z03925-1.6.ahf




7Z03920-1.6.ahf
-I_CBO (μA)
100
10
1
0.1
0
20
40
60
80 T_j (°C)
100
max
max
typ
-V_CB=25V
10V
25V
10V


7Z05368-1.6.ahf
-I_B=10μA
20
40
80
140
200
300
10
5 -V_CE(V)
0
typical values
T_j=25°C
0.5 -V_BE (V)
-I_C (mA)
15
10
5
100
300 -I_B(μA)
-V_CE=5V
-V_CE=5V

V.H.F. alloy-diffused germanium transistor of the p-n-p type in TO-39 metal case for use as a power amplifier in transmitters with frequencies up to 180 Mc/s

LIMITING VALUES (Absolute max. limits)

Collector

Voltage (base reference)	$-V_{CB}$ = max.	32	V
Voltage (emitter reference)	$-V_{CE}$ = max.	32	V [1]
Peak current	$-I_{CM}$ = max.	300	mA
Continuous current	$-I_C$ = max.	150	mA

Emitter

Peak current	I_{EM} = max.	350	mA
Continuous current	I_E = max.	200	mA
Peak reverse current	$-I_{EM}$ = max.	30	mA
Continuous reverse current	$-I_E$ = max.	10	mA

Dissipation

Total dissipation	P_{tot} = max.	800	mW [2]

Temperatures

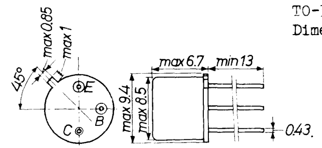
Storage temperature	T_s =	-55 °C to +75	°C
Junction temperature			
continuous operation	T_j = max.	90	°C
incidentally, up to a total of 200 hrs	T_j = max.	100	°C

THERMAL DATA

Thermal resistance from junction to ambience		
in free air	K <	0.25 °C/mW
mounted on heat sink of at least 12.5 cm^2	K <	0.08 °C/mW
Thermal resistance from junction to case	K <	0.035 °C/mW

1) At $-I_C$ = 1 mA and V_{BE} = 0 V
2) The max. incidental junction temperature of 100 °C may also be reached by a peak dissipation of 1000 mW.

7Z2 2426



TO-39 case
Dimensions in mm

The collector is electrically connected to the case.

Accessories for insulated mounting can be delivered separately (type number 56218).

CHARACTERISTICS at T_{amb} = 25 °C

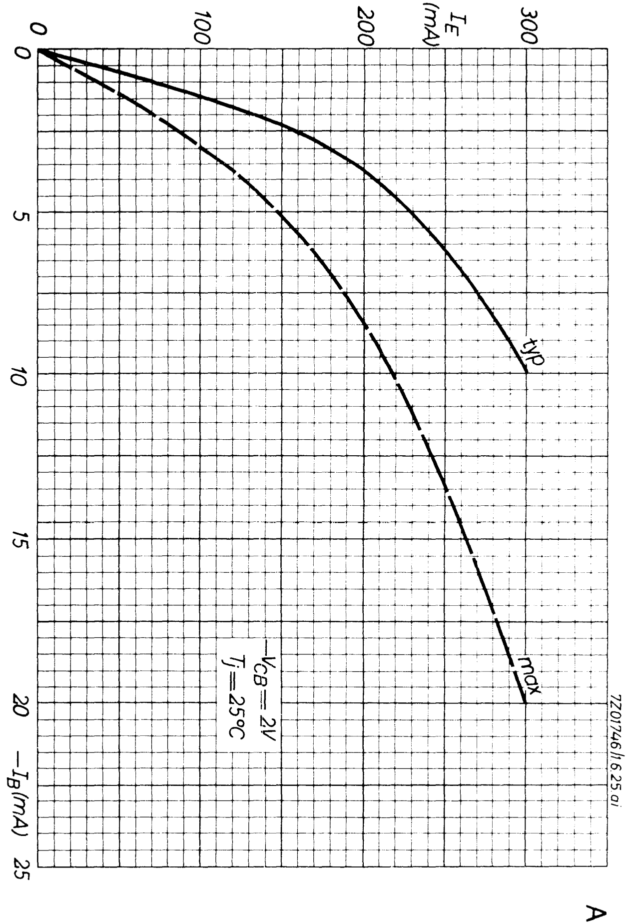
Collector leakage current at			
$-V_{CB}$ = 10 V; I_E = 0 mA	$-I_{CBO}$	<	10 µA
$-V_{CB}$ = 32 V; I_E = 0 mA	$-I_{CBO}$	<	1 mA
Emitter leakage current at			
$-V_{EB}$ = 0.5 V; I_C = 0 mA	$-I_{EBO}$	<	1 mA
Base current at			
I_E = 100 mA; V_{CB} = 2 V	$-I_B$	<	3 mA

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C

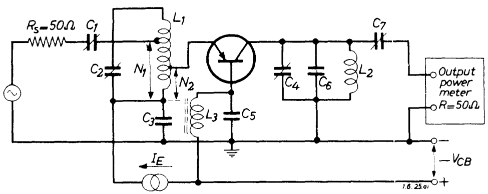
Collector leakage current	$-I_{CBO}$	See page E		
Base current at				
I_E = 80 mA; $-V_{CB}$ = 12 V	$-I_B$	= 1	<	2 mA
Collector saturation voltage at				
$-I_C$ = 300 mA; $-I_B$ = 20 mA	$-V_{CE}$		<	1 V
Frequency at which $\lvert h_{fe}\rvert$ = 1 at				
I_E = 100 mA; $-V_{CB}$ = 5 V	f_1	= 350	>	225 Mc/s
Base-emitter input resistance, output short-circuited for H.F. at				
(I_E = 100 mA; $-V_{CB}$ = 5 V) (f = 100 Mc/s)	r_{ie}	= 18		Ω
Collector capacitance at				
($-V_{CB}$ = 10 V; I_E = 0 mA) (f = 0.5 Mc/s)	c_c	= 12		pF

7Z2 2427



OPERATING CHARACTERISTICS as V.H.F. power amplifier at Tamb = 25°C

Circuit



f	=	80	180 Mc/s
C_1	=	50	15 pF
C_2	=	50	15 pF
C_3	=	10	1 nF
C_4	=	50	15 pF
C_5 1)	=	10	0.12 nF
C_6	=	82	0 pF
C_7	=	100	15 pF

f	=	80	180 Mc/s
L_1	=	0.1	0.08 μH
L_2	=	0.03	0.02 μH
L_3	=	H.F.choke	
N_1/N_{tot}	=	1	0.5
N_2/N_{tot}	=	0.5	0.22
Q_1	>	150	>200
Q_2	>	150	>200

Characteristics

Output power and available power gain at

I_E = 80 mA; $-V_{CB}$ = 12 V;

f = 80 Mc/s { P_o > 500 mW; G > 10 dB 2) }

f = 180 Mc/s { P_o > 400 mW; G > 9 dB 2) }

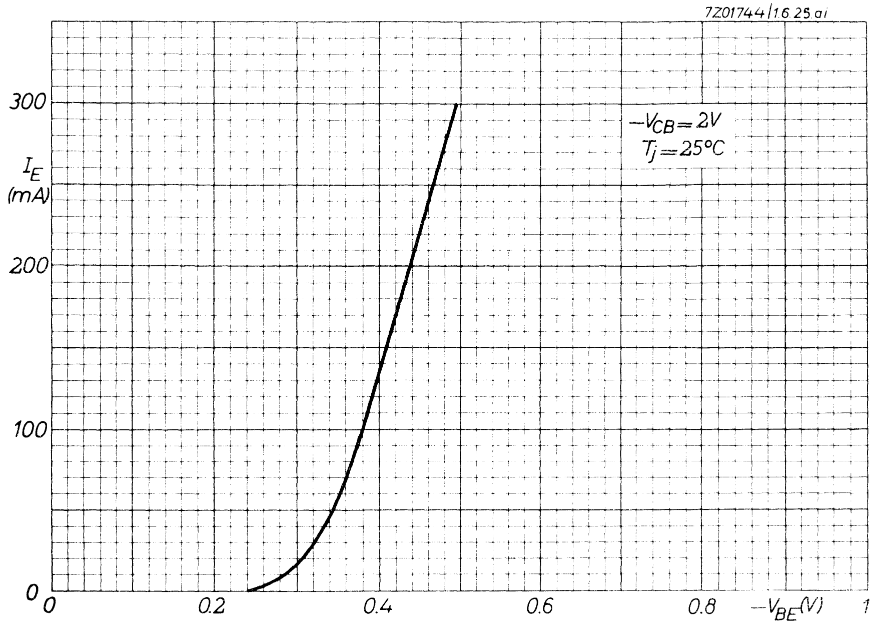
Design considerations

If the transistor is mounted on a heat sink with the aid of accessories for insulated mounting (e.g. accessories 56218), case and heat sink constitute a capacitor with the insulation as dielectricum. As the collector is connected to the case the total collector capacitance will be higher. Measures should be taken to prevent too high a capacitance, especially at 180 Mc/s.

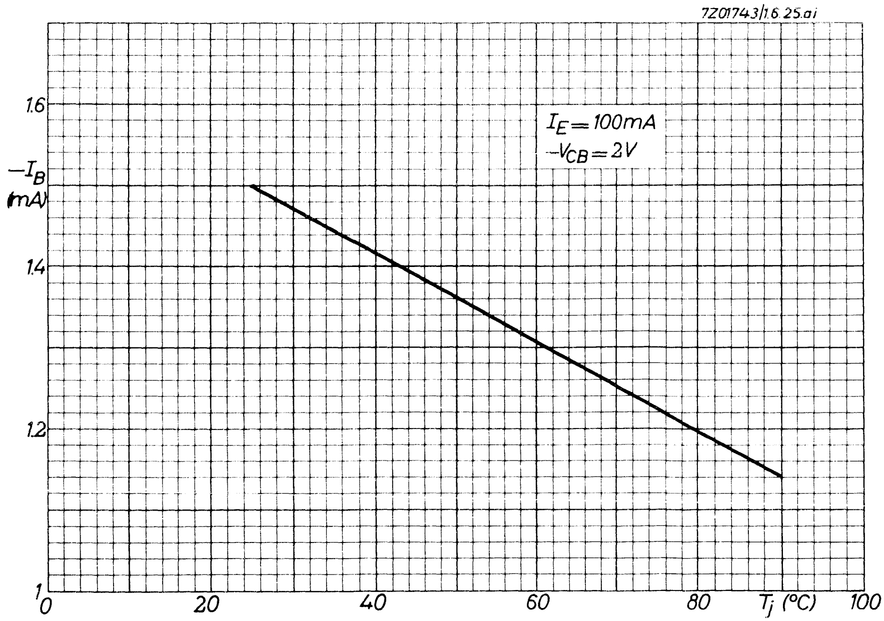
1) The capacitor C_5 should be chosen so that its series inductance can be neglected (e.g. a tubular ceramic capacitor mounted in a copper block).

2) Without insertion losses and at stated min. P_o

7Z2 1811 3.

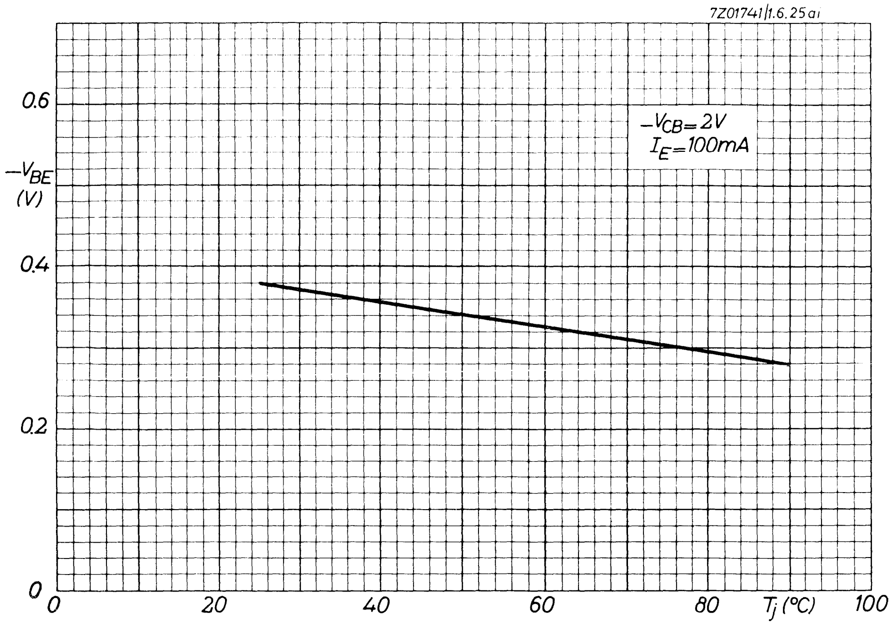

7Z01744/1.6.25.ai
$-V_{CB} = 2V$
$T_j = 25°C$
I_E (mA)
300
200
100
0
0
0.2
0.4
0.6
0.8
$-V_{BE}$ (V)
1

B

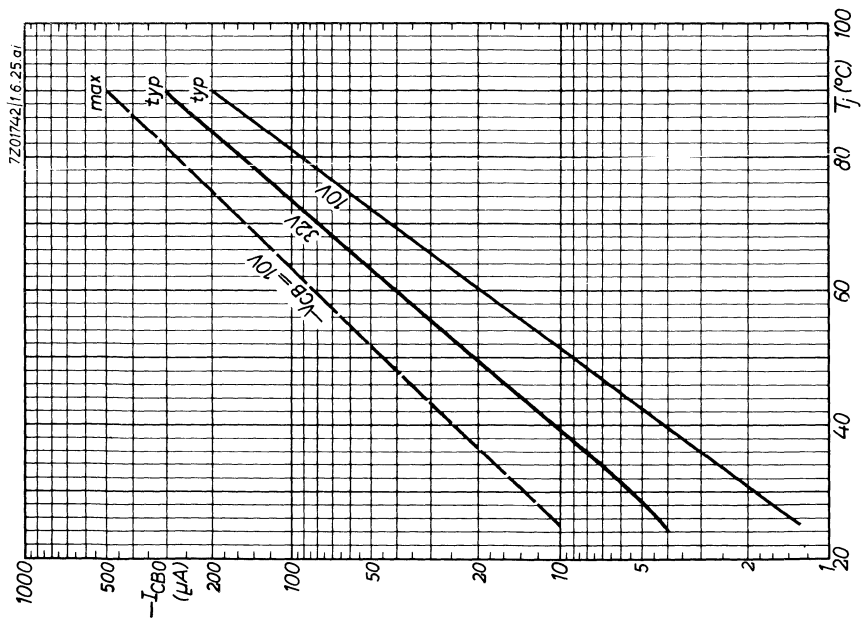

7Z01743/1.6.25.ai
$I_E = 100mA$
$-V_{CB} = 2V$
$-I_B$ (mA)
1.6
1.4
1.2
1
0
20
40
60
80
T_j (°C)
100

C

D

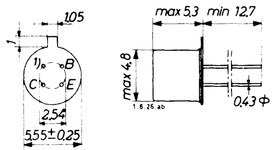

7Z01741/1.6.25ai
0.6
$-V_{BE}$ (V)
0.4
0.2
0
0
20
40
60
80
T_j (°C)
100
$-V_{CB}$ = 2V
I_E = 100mA

E


7Z01742/1.6.25ai
max
typ
typ
10V
32V
$-V_{CB}$ = 10V
1000
500
$-I_{CBO}$ (μA)
200
100
50
20
10
5
2
1
20
40
60
80
100
T_j (°C)

GERMANIUM JUNCTION TRANSISTOR of the p-n-p alloy diffused type in metal envelope for V.H.F. operation up to 200 Mc/s

Dimensions in mm



LIMITING VALUES (Absolute max. values)

Collector

Voltage (emitter reference)	$-V_{CE}$	= max.	20 V [2]
Voltage (base reference)	$-V_{CB}$	= max.	20 V
Current	$-I_C$	= max.	10 mA

Emitter

Reverse voltage (base reference)	$-V_{EB}$	= max.	500 mV
Current	I_E	= max.	10 mA
Reverse current	$-I_E$	= max.	1.0 mA

Base

Current	$-I_B$	= max.	1.0 mA

Dissipation

Total dissipation	P_{tot}	= max. $\frac{T_j max - T_{amb}}{K}$ [3]

Temperatures

Storage	T_S	=	-55 °C/+75 °C
Junction, continuous operation	T_j	= max.	75 °C
Junction, intermittent operation (total duration max. 200 hours)	T_j	= max.	90 °C
	(t	= max.	200 hrs)

THERMAL DATA

Thermal resistance from junction to ambience in free air	K	= max.	0.6 °C/mW

[1]) Interlead shield

[2]) At $V_{BE} \geq 500$ mV. At $-I_C$ = 10 mA, $-V_{CE}$ = max. 10 V

[3]) See also page H

7Z2 1108

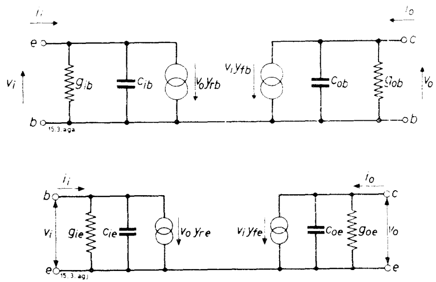
CHARACTERISTICS RANGE VALUES for equipment design

T_{amb} = 25 °C

Collector current at I_E = 0 mA		
$-I_{CBO}$ ($-V_{CB}$ = 6 V)	= 1.0 µA	< 6.0 µA
$-I_{CBO}$ ($-V_{CB}$ = 20 V)	= 2.6 µA	< 50 µA
Emitter current at I_C = 0 mA		
$-I_{EBO}$ ($-V_{EB}$ = 0.5 V)	= 2.0 µA	< 27 µA
Base voltage		
$-V_{BE}$ ($-V_{CE}$ = 6 V; $-I_C$ = 1 mA)	= 310 mV	> 220 mV < 380 mV
$-V_{BE}$ ($-V_{CE}$ = 2 V; $-I_C$ = 10 mA)	= 380 mV	
D.C. current amplification factor		
h_{FE} ($-V_{CE}$ = 6 V; $-I_C$ = 1 mA)	= 60	> 20
h_{FE} ($-V_{CE}$ = 2 V; $-I_C$ = 10 mA)	= 60	> 25
Frequency at which $\lvert h_{fe} \rvert$ = 1		
f_1 ($-V_{CE}$ = 6 V; $-I_C$ = 1 mA)	= 180 Mc/s	> 135 Mc/s
Current amplification factor		
h_{fe} ($-V_{CE}$ = 6 V; $-I_C$ = 1 mA; f = 1 kc/s)	= 70	> 20
Intrinsic base impedance		
z_{rb} ($-V_{CE}$ = 6 V; $-I_C$ = 1 mA; f = 2 Mc/s)	= 10 Ω	
Feedback capacitance		
c_{re} ($-V_{CE}$ = 6 V; $-I_C$ = 1 mA; f = 450 kc/s)	= 1.0 pF	< 1.5 pF
Noise		
F ($-V_{CE}$ = 12 V; $-I_C$ = 1 mA; f = 200 Mc/s; Input source resistance = 30Ω)	= 6.0 dB	< 7.5 dB
Available power gain in the circuit of page 4		
G_a	= 13 dB	> 10 dB

7Z2 1109

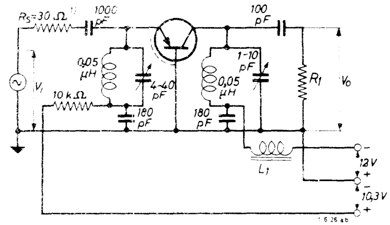
Small signal parameters. Measured with a length of lead between transistor bottom and measuring jig of 5 mm



Measured at:	Common base	Common emitter
Collector voltage	$-V_{CB}$ = 12 V	$-V_{CE}$ = 12 V
Collector current		$-I_C$ = 1 mA
Emitter current	I_E = 1 mA	
Frequency	f = 200 Mc/s	f = 200 Mc/s
Input conductance	g_{ib} = 32.5 mA/V	g_{ie} = 28 mA/V
Input capacitance	$-c_{ib}$ = 10 pF	c_{ie} = 13 pF
Feedback admittance	$\|y_{rb}\|$ = 0.41 mA/V	$\|y_{re}\|$ = 0.50 mA/V
Phase angle of feedback admittance	$-\varphi_{rb}$ = 80 °	$-\varphi_{re}$ = 110 °
Transfer admittance	$\|y_{fb}\|$ = 30 mA/V	$\|y_{fe}\|$ = 34 mA/V
Phase angle of transfer admittance	φ_{fb} = 115 °	$-\varphi_{fe}$ = 68 °
Output conductance	g_{ob} = 0.22 mA/V	g_{oe} = 0.22 mA/V
Output capacitance	c_{ob} = 2.0 pF	c_{oe} = 2.0 pF

7Z2 1110

Test circuit for power gain at 200 Mc/s

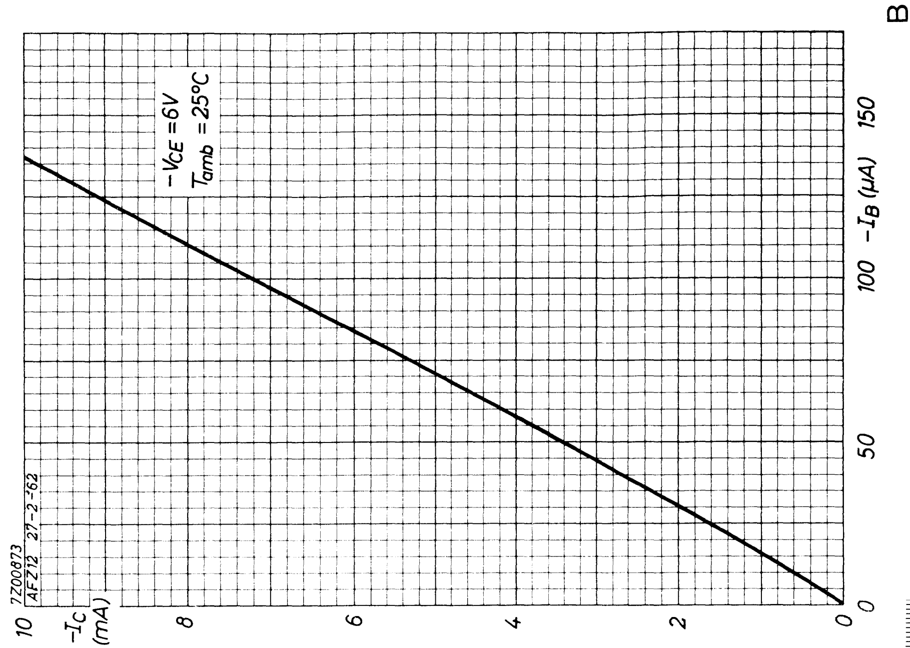


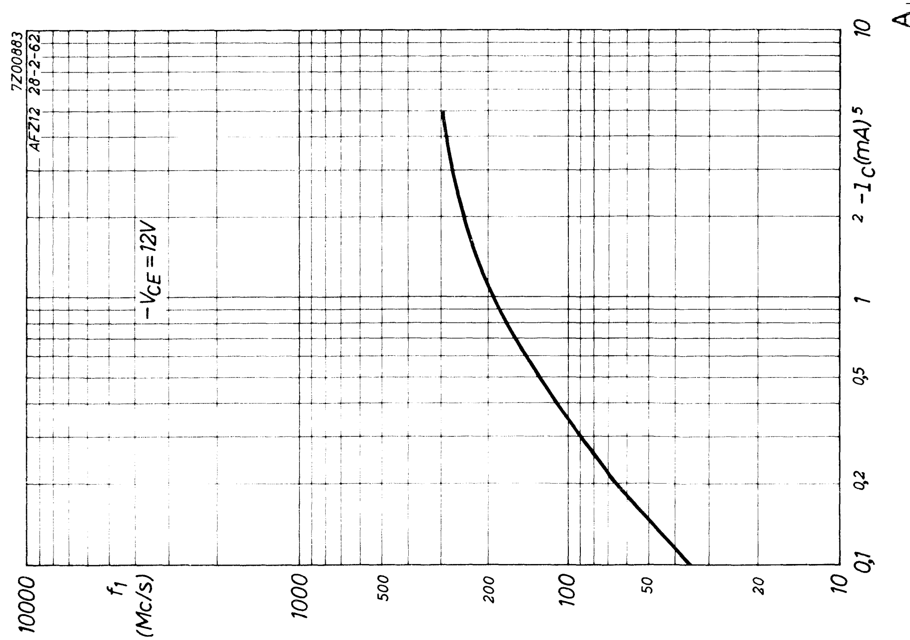
R_1 is chosen so that the total impedance R_L of the tuned circuit is 2 kΩ

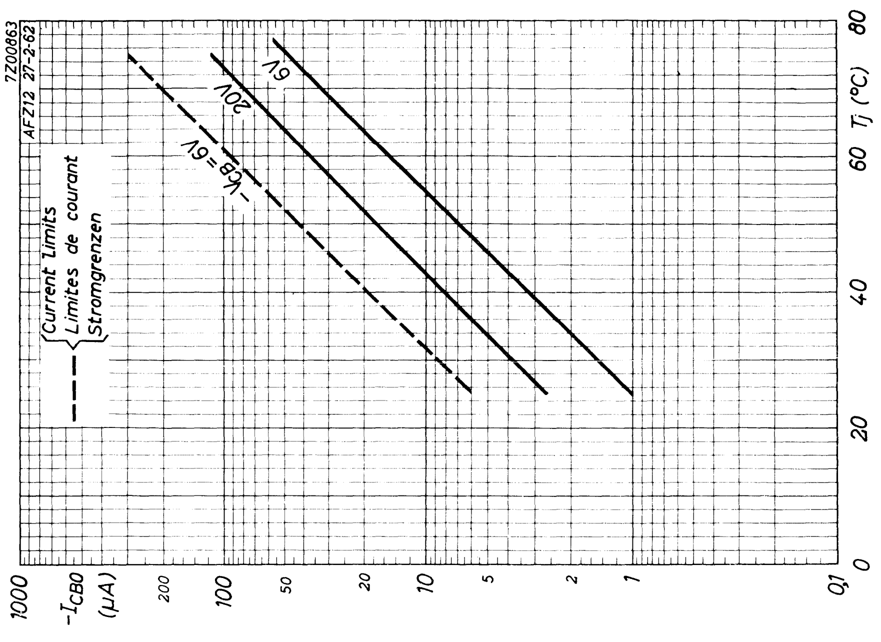
L_1 = ferrite bead

[1]) Input source impedance

7Z2 1111


B
7Z00873
AFZ12 27-2-62
$-V_{CE}$ = 6V
T_{amb} = 25°C
$-I_C$ (mA)
10
8
6
4
2
0
0
50
100
150
$-I_B$ (μA)


A
7Z00883
AFZ12 28-2-62
$-V_{CE}$ = 12V
f_1 (Mc/s)
10000
1000
500
200
100
50
20
10
0,1
0,2
0,5
1
2
5
10
$-I_C$ (mA)

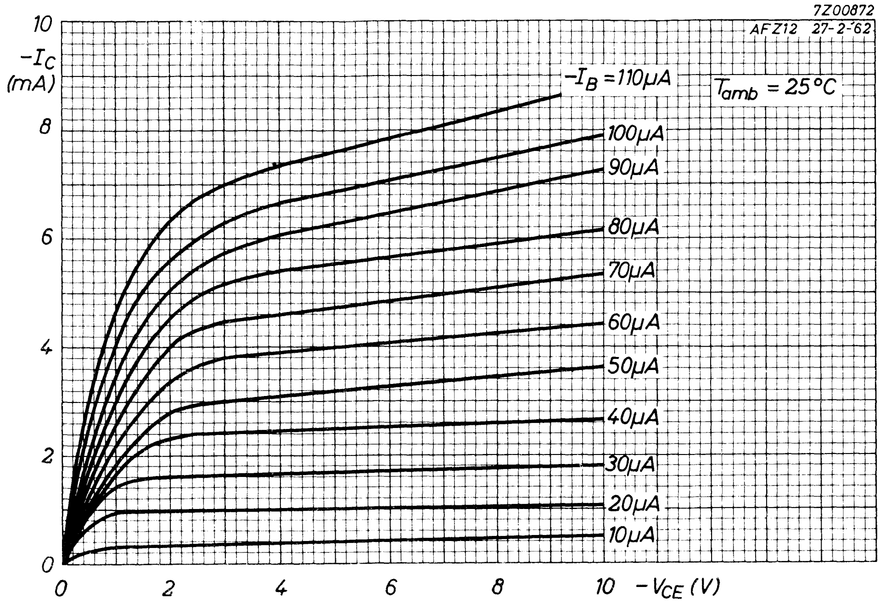


7Z00863
AFZ12 27-2-62
Current Limits
Limites de courant
Stromgrenzen
-VCB = 6V
20V
6V
-ICBO (µA)
1000
200
100
50
20
10
5
2
1
0,1
Tj (°C)
0
20
40
60
80

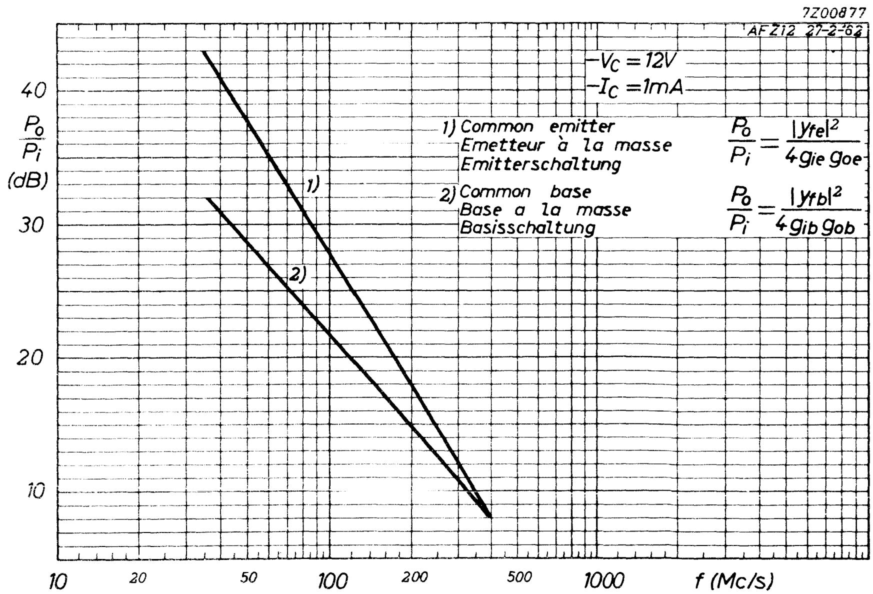
D

7Z00871
AFZ12 27-2-62
-VCE = 6V
Tamb = 25°C
-IC (mA)
10
8
6
4
2
0
-VBE (mV)
0
200
400
600

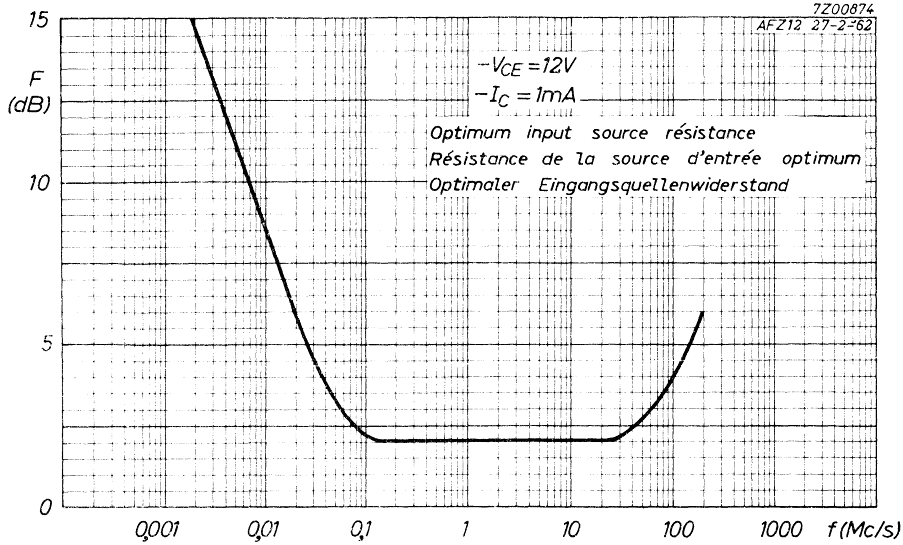
C


7Z00872
AFZ12 27-2-62
$-I_C$ (mA)
$-I_B$ = 110μA
100μA
90μA
80μA
70μA
60μA
50μA
40μA
30μA
20μA
10μA
T_{amb} = 25°C
$-V_{CE}$ (V)
0
2
4
6
8
10

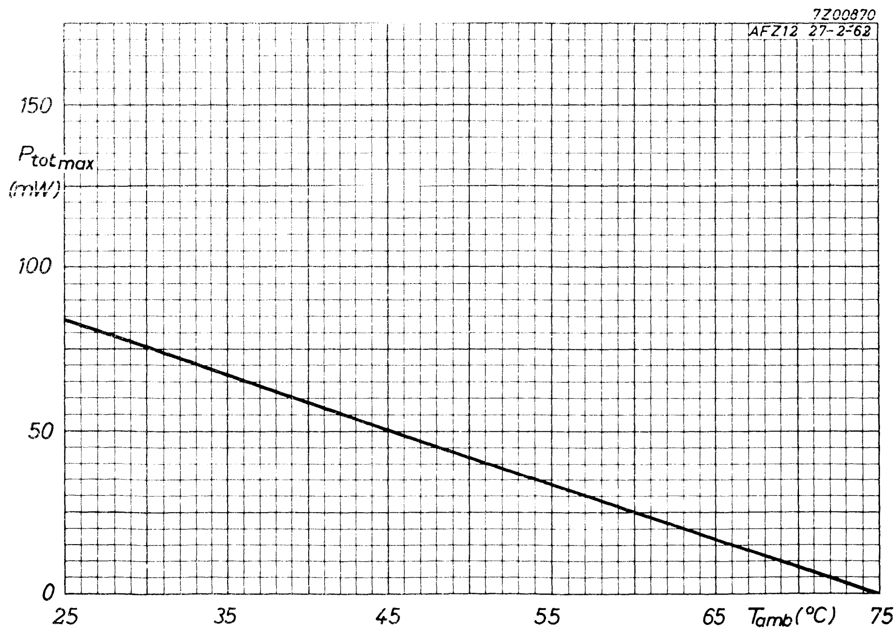
E


7Z00877
AFZ12 27-2-62
$-V_C = 12V$
$-I_C = 1mA$
1) Common emitter
Emetteur à la masse
Emitterschaltung
$\frac{P_o}{P_i} = \frac{|y_{fe}|^2}{4 g_{ie} g_{oe}}$
2) Common base
Base a la masse
Basisschaltung
$\frac{P_o}{P_i} = \frac{|y_{fb}|^2}{4 g_{ib} g_{ob}}$
$\frac{P_o}{P_i}$ (dB)
1)
2)
10
20
30
40
f (Mc/s)
10
20
50
100
200
500
1000

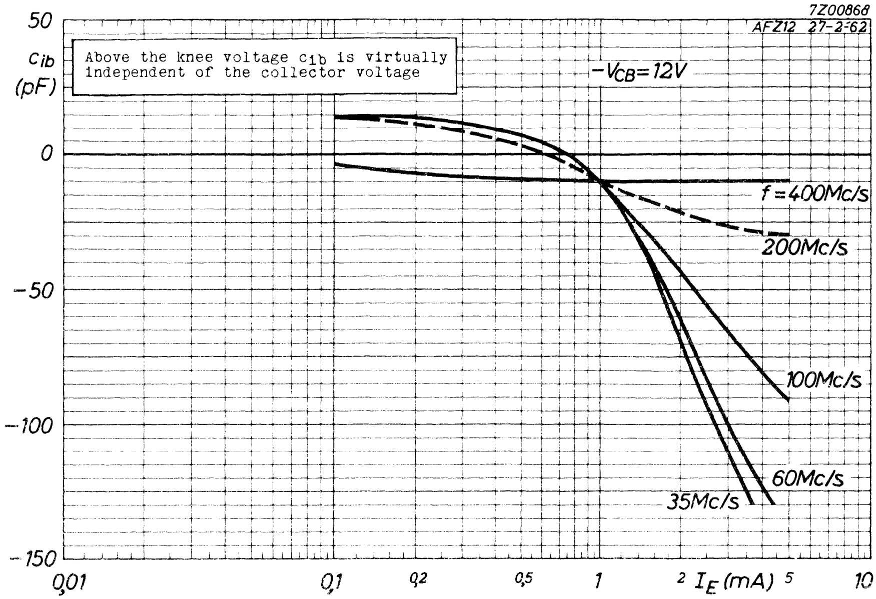
F

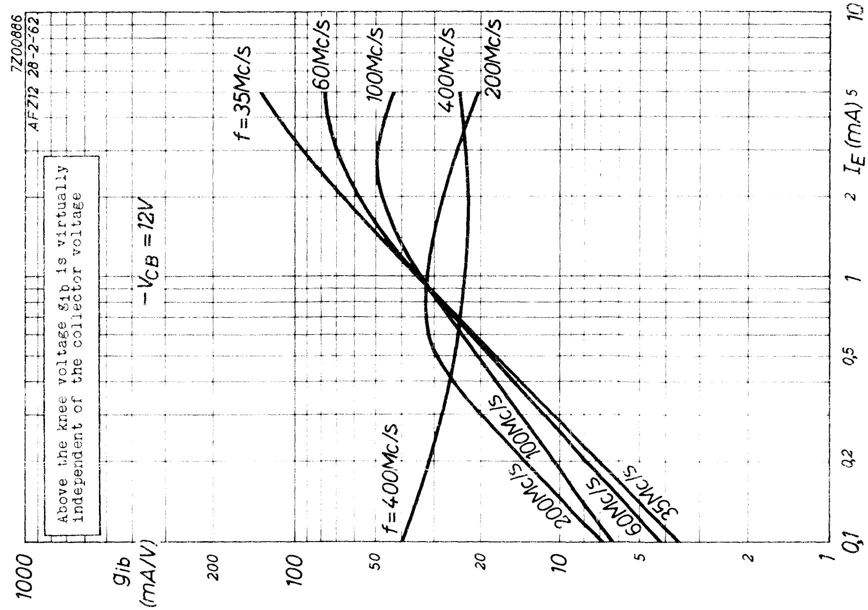

7Z00874
AFZ12 27-2-62
15
F
(dB)
10
5
0
$-V_{CE} = 12V$
$-I_C = 1mA$
Optimum input source résistance
Résistance de la source d'entrée optimum
Optimaler Eingangsquellenwiderstand
0,001
0,01
0,1
1
10
100
1000
f (Mc/s)

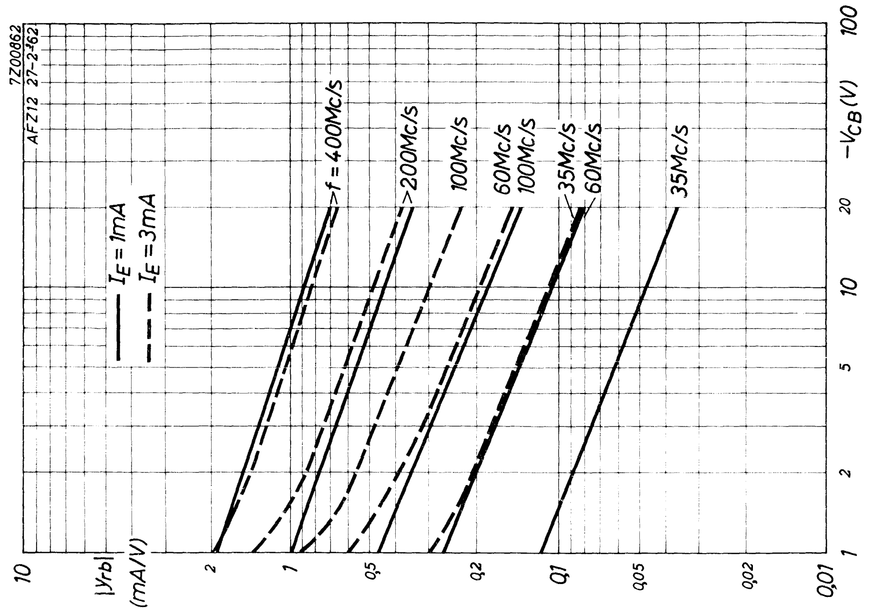
G


7Z00870
AFZ12 27-2-62
150
$P_{tot_{max}}$
(mW)
100
50
0
25
35
45
55
65
T_{amb} (°C)
75

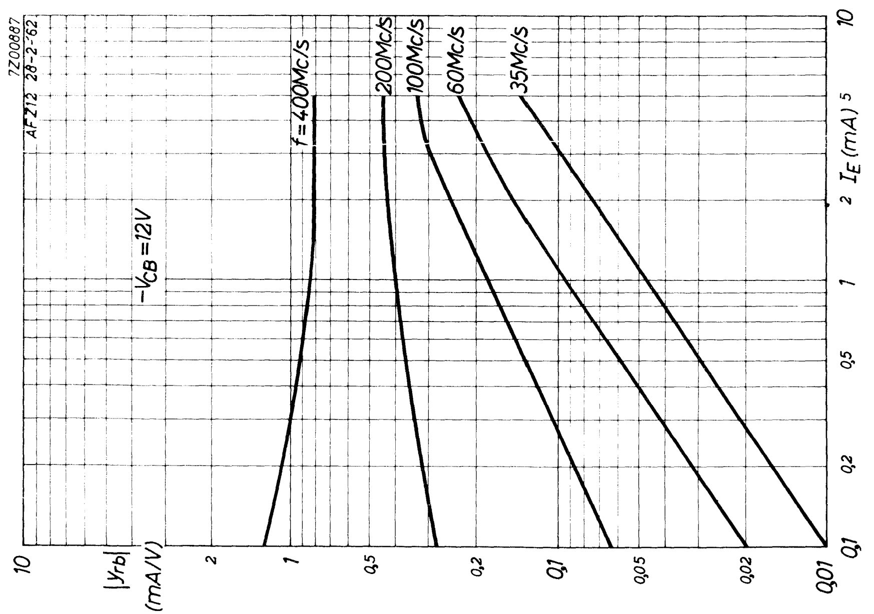
H


7Z00868
AFZ12 27-2-62
Above the knee voltage c_{ib} is virtually independent of the collector voltage
$-V_{CB}=12V$
c_{ib} (pF)
50
0
−50
−100
−150
f = 400Mc/s
200Mc/s
100Mc/s
60Mc/s
35Mc/s
0,01
0,1
0,2
0,5
1
2
5
10
I_E (mA)

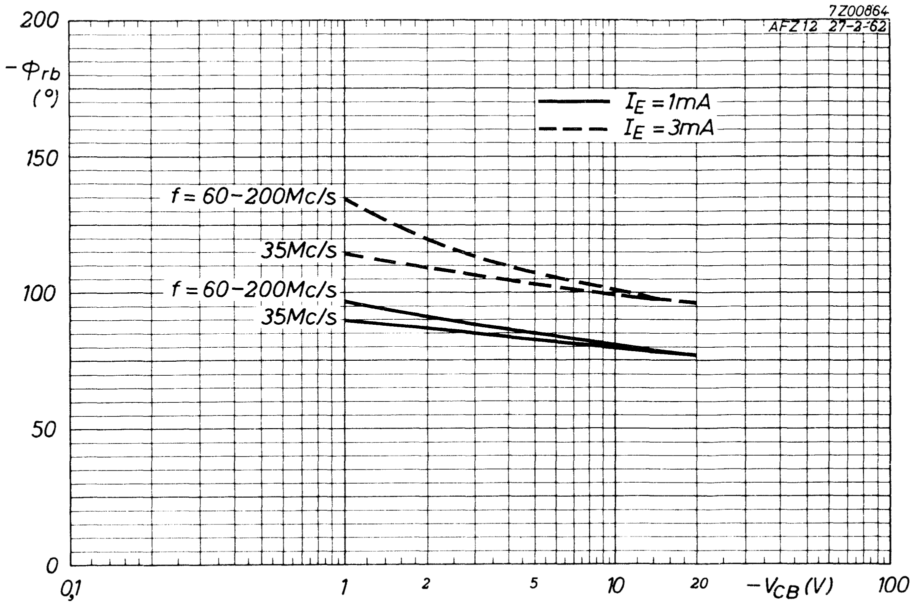

7Z00886
AFZ12 28-2-62
Above the knee voltage g_{ib} is virtually independent of the collector voltage
$-V_{CB}=12V$
f = 35Mc/s
60Mc/s
100Mc/s
400Mc/s
200Mc/s
f = 400Mc/s
100Mc/s
200Mc/s
60Mc/s
35Mc/s
g_{ib} (mA/V)
1000
200
100
50
20
10
5
2
1
I_E (mA)
10
5
2
1
0,5
0,2
0,1


7Z00862
AFZ12 27-2-'62
I_E = 1mA
I_E = 3mA
f = 400Mc/s
200Mc/s
100Mc/s
60Mc/s
100Mc/s
35Mc/s
60Mc/s
35Mc/s
-V_CB (V)
|y_rb|
(mA/V)

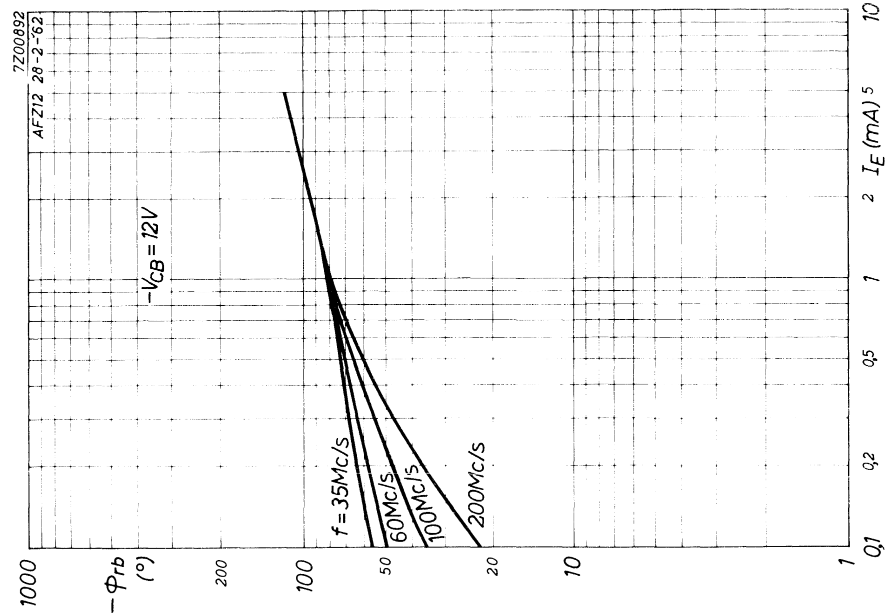
L


7Z00887
AFZ12 28-2-'62
-V_CB = 12V
f = 400Mc/s
200Mc/s
100Mc/s
60Mc/s
35Mc/s
I_E (mA)
|y_rb|
(mA/V)

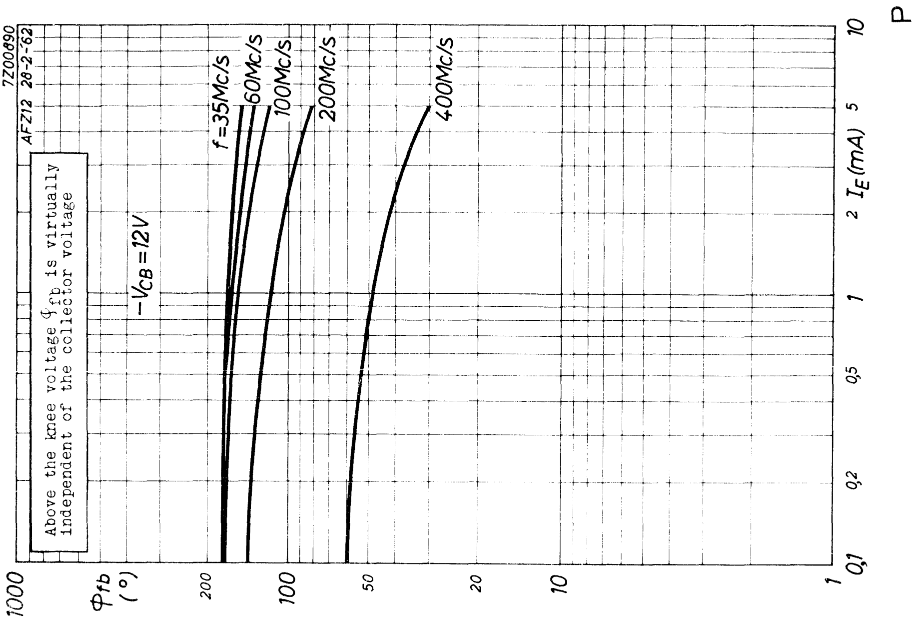
K


7Z00864
AFZ12 27-2-62
200
150
100
50
0
$-\varphi_{rb}$ (°)
$I_E = 1mA$
$I_E = 3mA$
f = 60−200Mc/s
35Mc/s
f = 60−200Mc/s
35Mc/s
0,1
1
2
5
10
20
$-V_{CB}$ (V)
100

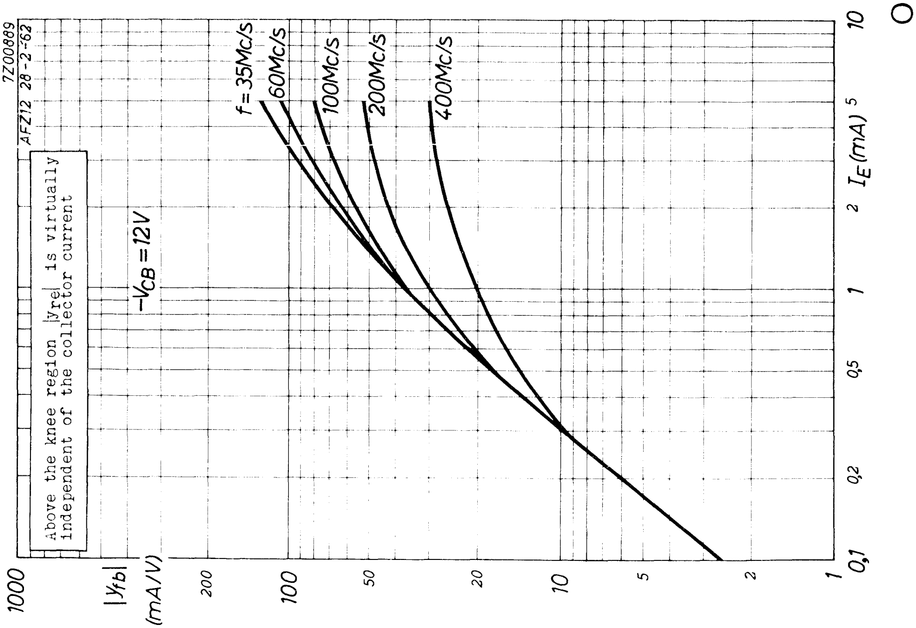
N


7Z00892
AFZ12 28-2-62
$-V_{CB}=12V$
f=35Mc/s
60Mc/s
100Mc/s
200Mc/s
1000
$-\varphi_{rb}$ (°)
200
100
50
20
10
1
I_E (mA)
10
5
2
1
0,5
0,2
0,1

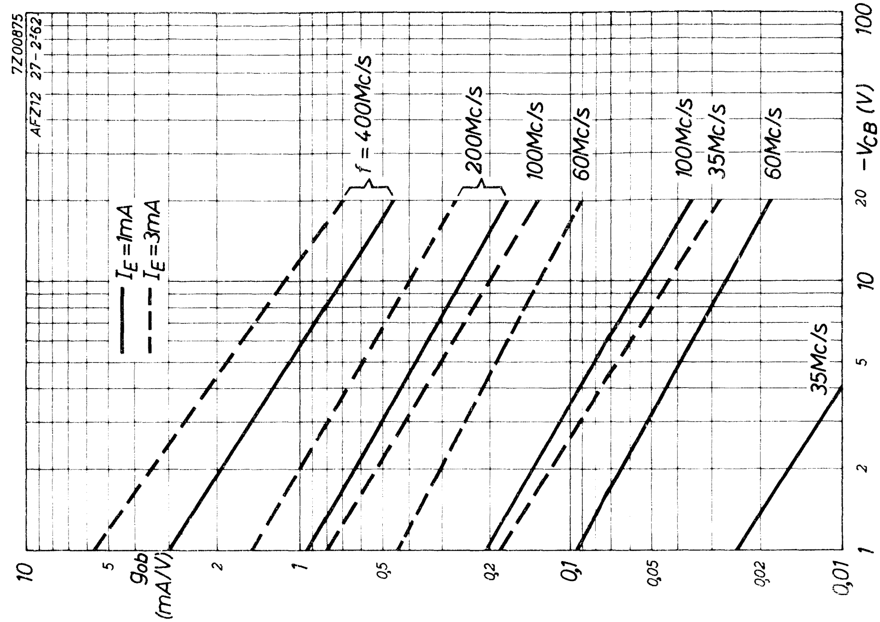
M

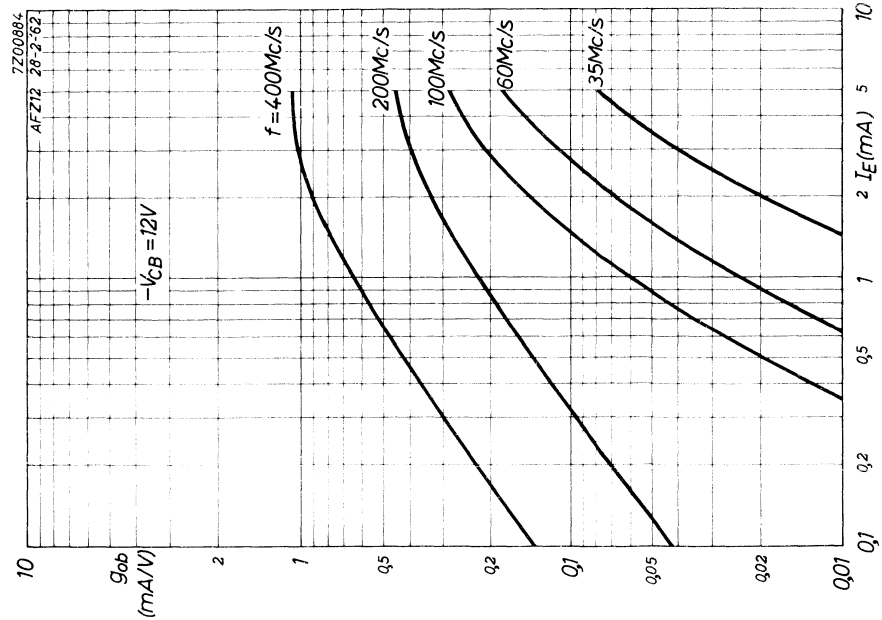

7Z00890
AFZ12 28-2-62
Above the knee voltage φfb is virtually independent of the collector voltage
−VCB = 12V
f = 35Mc/s
60Mc/s
100Mc/s
200Mc/s
400Mc/s
φfb (°)
1000
200
100
50
20
10
1
IE (mA)
0,1
0,2
0,5
1
2
5
10

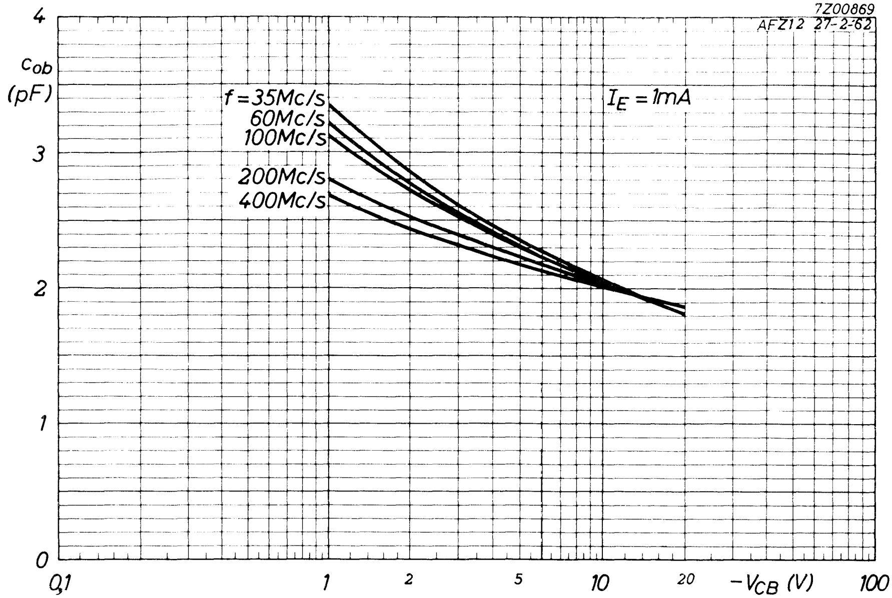
P


7Z00889
AFZ12 28-2-62
Above the knee region |yre| is virtually independent of the collector current
−VCB = 12V
f = 35Mc/s
60Mc/s
100Mc/s
200Mc/s
400Mc/s
|yfb| (mA/V)
1000
200
100
50
20
10
5
2
1
IE (mA)
0,1
0,2
0,5
1
2
5
10

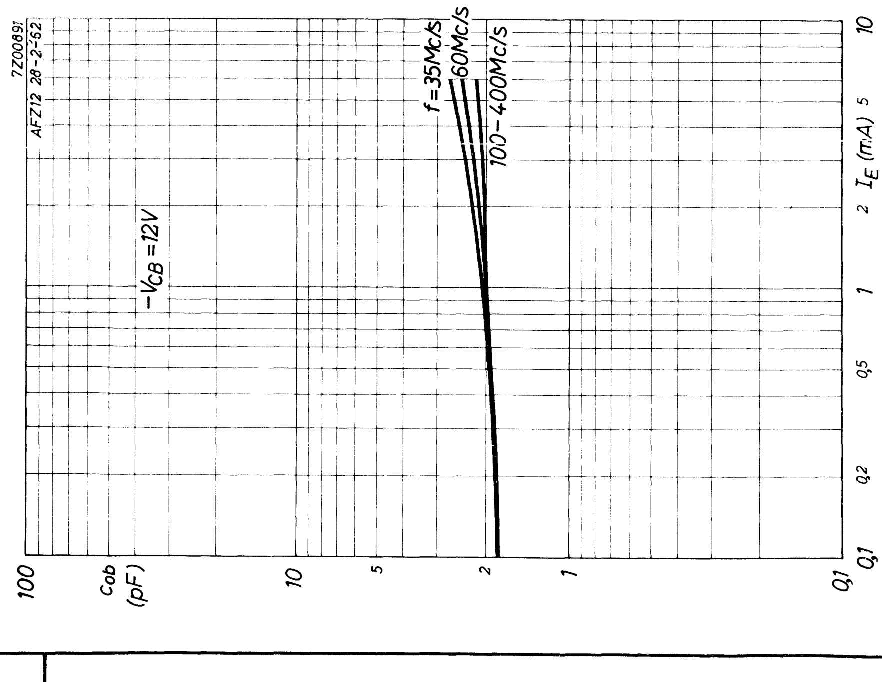
O


AFZ12 7Z00875 27-2-62
g_{ob} (mA/V)
$-V_{CB}$ (V)
I_E = 1mA
I_E = 3mA
f = 400Mc/s
200Mc/s
100Mc/s
60Mc/s
100Mc/s
35Mc/s
60Mc/s
35Mc/s
R

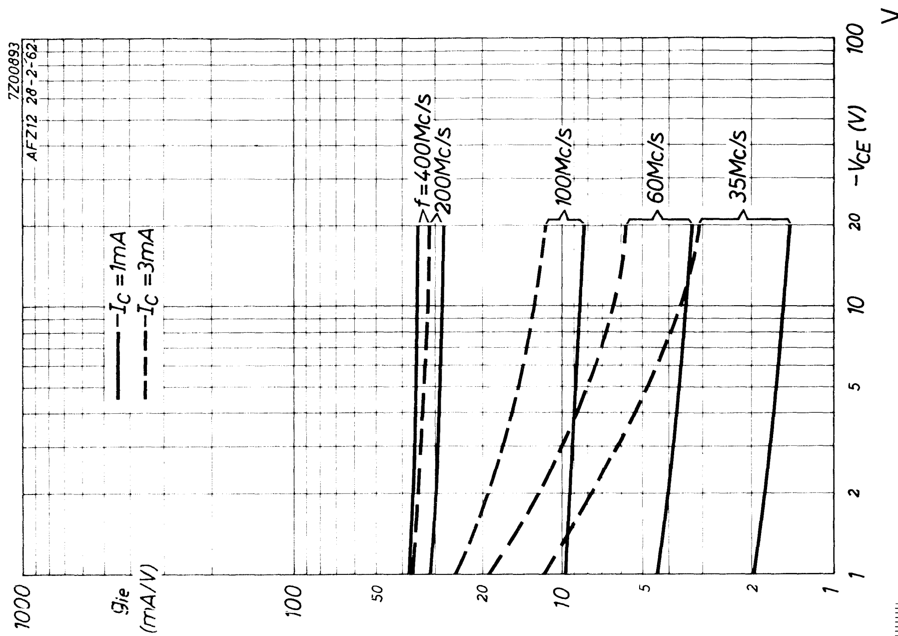

AFZ12 7Z00884 28-2-62
g_{ob} (mA/V)
I_E(mA)
$-V_{CB}$ = 12V
f = 400Mc/s
200Mc/s
100Mc/s
60Mc/s
35Mc/s
Q

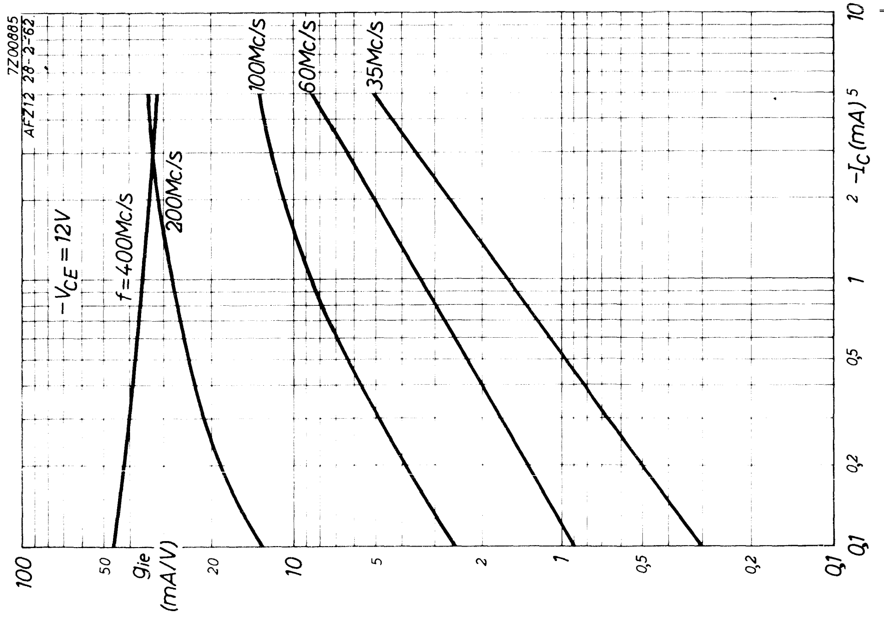

7Z00869
AFZ12 27-2-62
cob
(pF)
f = 35Mc/s
60Mc/s
100Mc/s
200Mc/s
400Mc/s
IE = 1mA
-VCB (V)
0,1
1
2
5
10
20
100
0
1
2
3
4

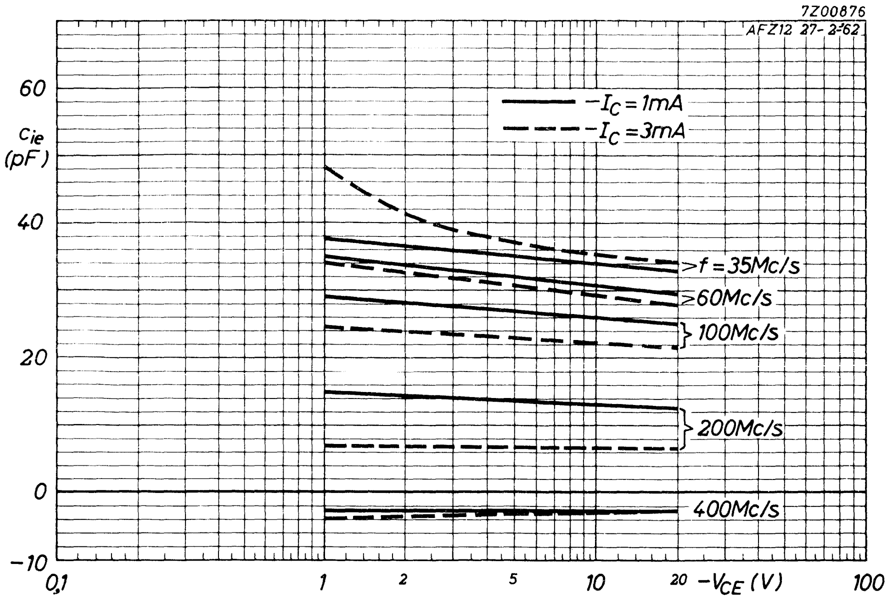
T


7Z00891
AFZ12 28-2-62
f = 35Mc/s
60Mc/s
100-400Mc/s
-VCB = 12V
IE (mA)
cob
(pF)
100
10
5
2
1
0,1
0,2
0,5
10

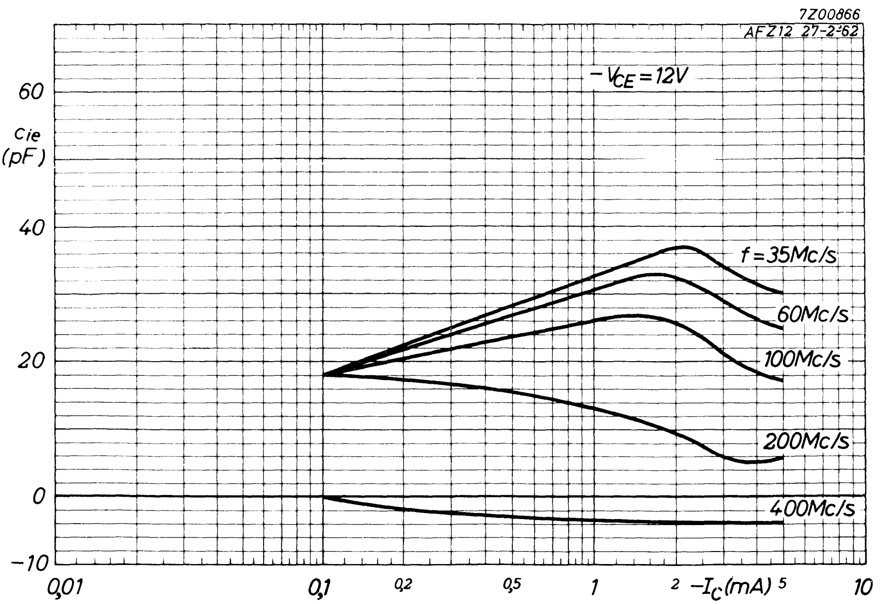
S


7Z00893
AFZ12 28-2-62
—— −I_C = 1mA
- - - −I_C = 3mA
≥f=400Mc/s
≥200Mc/s
100Mc/s
60Mc/s
35Mc/s
g_ie
(mA/V)
1000
100
50
20
10
5
2
1
1
2
5
10
20
−V_CE (V)
100
V

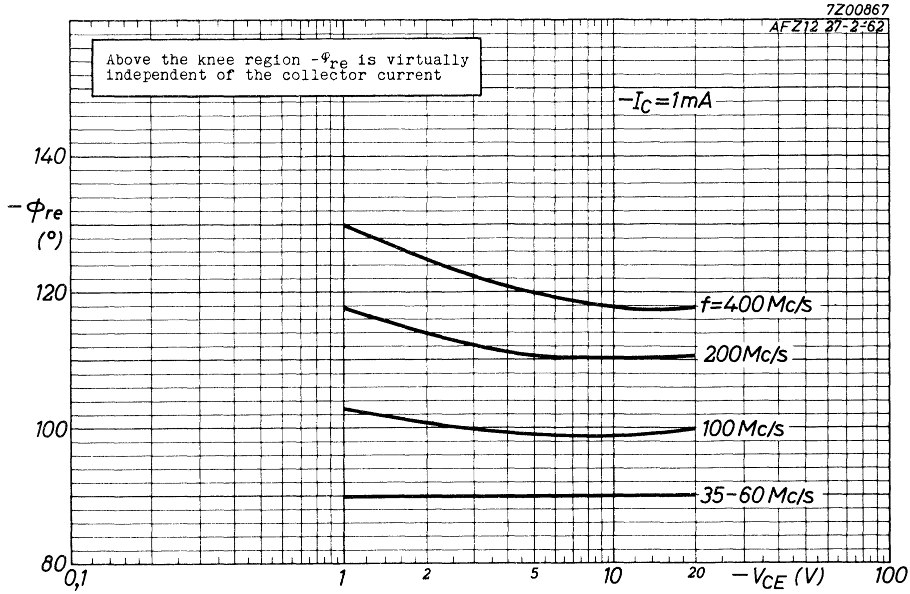

7Z00885
AFZ12 28-2-62
−V_CE = 12V
f=400Mc/s
200Mc/s
100Mc/s
60Mc/s
35Mc/s
g_ie
(mA/V)
100
50
20
10
5
2
1
0,5
0,2
0,1
0,1
0,2
0,5
1
2
5
−I_C (mA)
10


7Z00876
AFZ12 27-2-62
c_{ie} (pF)
$-I_C = 1mA$
$-I_C = 3mA$
f = 35Mc/s
60Mc/s
100Mc/s
200Mc/s
400Mc/s
$-V_{CE}$ (V)
60
40
20
0
−10
0,1
1
2
5
10
20
100

W

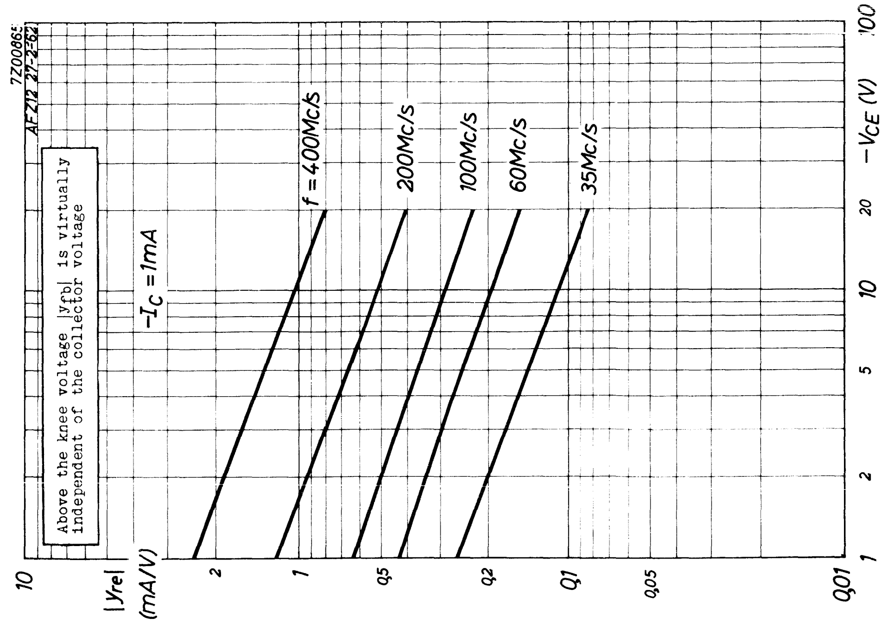

7Z00866
AFZ12 27-2-62
c_{ie} (pF)
$-V_{CE} = 12V$
f = 35Mc/s
60Mc/s
100Mc/s
200Mc/s
400Mc/s
$-I_C$(mA)
60
40
20
0
−10
0,01
0,1
0,2
0,5
1
2
5
10

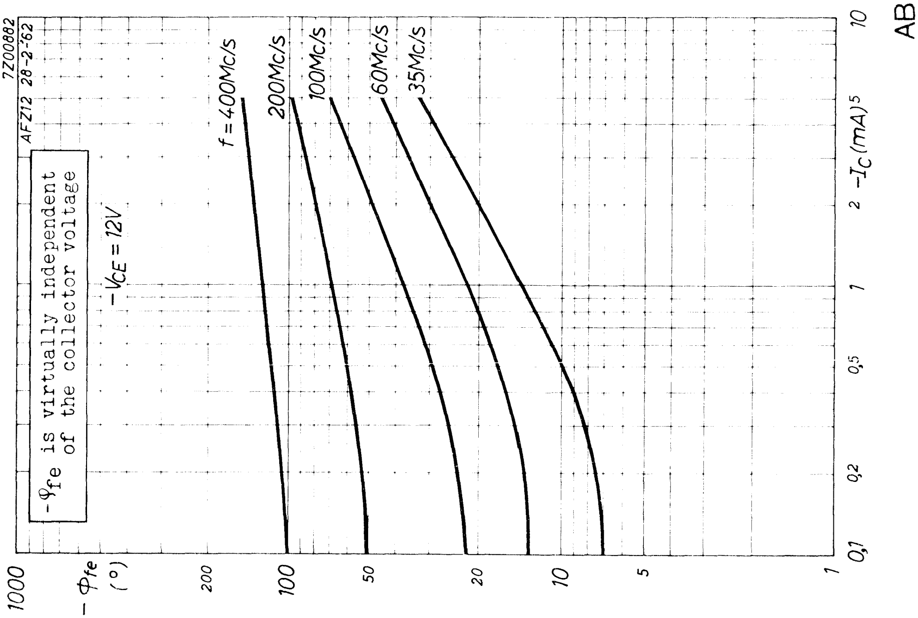
X

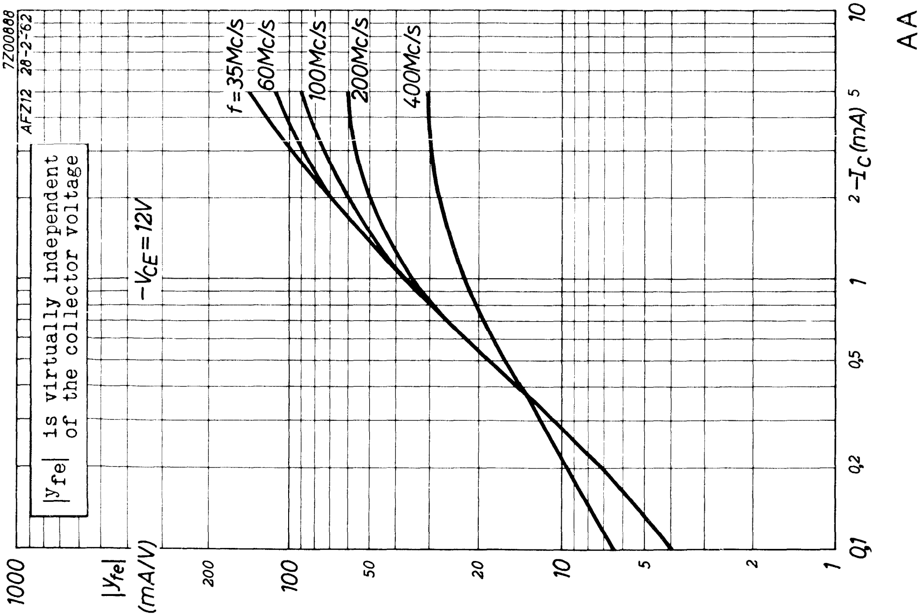

7Z00867
AFZ12 27-2-62
Above the knee region -φre is virtually independent of the collector current
−IC=1mA
−φre
(°)
140
120
100
80
f=400Mc/s
200Mc/s
100Mc/s
35-60Mc/s
0,1
1
2
5
10
20
−VCE (V)
100

Z

Y


7Z00865
AFZ12 27-2-62
Above the knee voltage |yfb| is virtually independent of the collector voltage
−IC=1mA
f=400Mc/s
200Mc/s
100Mc/s
60Mc/s
35Mc/s
10
|yre|
(mA/V)
2
1
0,5
0,2
0,1
0,05
0,01
1
2
5
10
20
−VCE (V)
100


7Z00882
AFZ12 28-2-'62
$-\varphi_{fe}$ is virtually independent of the collector voltage
$-V_{CE} = 12V$
f = 400Mc/s
200Mc/s
100Mc/s
60Mc/s
35Mc/s
$-\varphi_{fe}$ (°)
1000
200
100
50
20
10
5
1
0,1
0,2
0,5
1
2
5
10
$-I_C$ (mA)
AB


7Z00888
AFZ12 28-2-'62
$|y_{fe}|$ is virtually independent of the collector voltage
$-V_{CE} = 12V$
f = 35Mc/s
60Mc/s
100Mc/s
200Mc/s
400Mc/s
$|y_{fe}|$ (mA/V)
1000
200
100
50
20
10
5
2
1
0,1
0,2
0,5
1
2
5
10
$-I_C$ (mA)
AA

GERMANIUM ALLOYED TRANSISTORS

P-N-P transistors in a TO-5 metal envelope with the base connected to the case. These general purpose transistors are primarily intended for medium current medium speed computer logic applications.

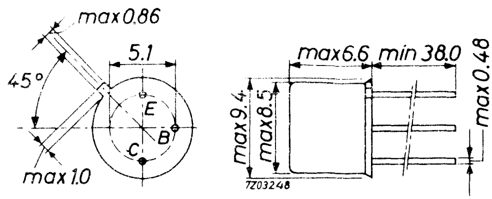
QUICK REFERENCE DATA

		ASY26		ASY27	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	15	V
Collector current (peak value)	$-I_{CM}$	max.	300	300	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	150	mW
Junction temperature	T_j	max.	85	85	°C
D.C. current gain at T_j = 25 °C					
$-I_C$ = 20 mA; $-V_{CE}$ = 1 V	h_{FE}	>	30	50	
$-I_C$ = 200 mA; $-V_{CE}$ = 1 V	h_{FE}	>	15	20	
Collector-emitter saturation voltage					
$-I_C$ = 10 mA; $-I_B$ = 0.33 mA	$-V_{CE\,sat}$	<	0.20		V
$-I_C$ = 10 mA; $-I_B$ = 0.2 mA	$-V_{CE\,sat}$	<		0.20	V
Transition frequency					
$-I_C$ = 3 mA; $-V_{CE}$ = 5 V	f_T	typ.	8	14	MHz
Turn on time ($t_d + t_r$)	t_{on}	typ.	340	250	ns
Turn off time ($t_s + t_f$)	t_{off}	typ.	975	1000	ns

MECHANICAL DATA

Dimensions in mm

TO-5
Base connected to case



7Z3 0019

RATINGS (Limiting values) [1]

Voltages

		ASY26	ASY27	
Collector-base voltage (open emitter)	$-V_{CBO}$	max. 30	25	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 15	15	V
Collector-emitter voltage at $+V_{BE}$ = 0.2 V	$-V_{CEX}$	max. 25	20	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max. 20	20	V

Currents

Collector current (d.c. or average over any 20 ms period)	$-I_C$	max.	200	mA
Collector current (peak value)	$-I_{CM}$	max.	300	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	mW

Temperatures

Storage temperature	T_{stg}		-65 to +100	°C
Junction temperature	T_j	max.	85	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	°C/mW
From junction to case	$R_{th\ j-c}$	=	0.2	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

			ASY26	ASY27	
I_E = 0; $-V_{CB}$ = 30 V	$-I_{CBO}$	<	7		µA
I_E = 0; $-V_{CB}$ = 25 V	$-I_{CBO}$	<		7	µA
I_E = 0; $-V_{CB}$ = 30 V; T_j = 60 °C	$-I_{CBO}$	<	35		µA
I_E = 0; $-V_{CB}$ = 25 V; T_j = 60 °C	$-I_{CBO}$	<		35	µA

Emitter cut-off current

			ASY26	ASY27	
I_C = 0; $-V_{EB}$ = 5 V	$-I_{EBO}$	<	3	3	µA

[1] Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0020

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

			ASY26	ASY27	
Currents at reverse biased emitter junction					
$-V_{CE} = 25$ V; $+V_{BE} = 0.2$ V; $T_j = 60\ ^oC$	$-I_{CEX}$	<	35		μA
$-V_{CE} = 20$ V; $+V_{BE} = 0.2$ V; $T_j = 60\ ^oC$	$-I_{CEX}$	<		35	μA
$-V_{CE} = 20$ V; $+V_{BE} = 5$ V; $T_j = 60\ ^oC$	$+I_{BEX}$	<	35	35	μA
Base-emitter voltage					
$-I_C = 100$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	0.65	0.55	V
$-I_C = 300$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	1.5	1.4	V
Collector-emitter saturation voltage					
$-I_C = 10$ mA; $-I_B = 0.33$ mA	$-V_{CE\,sat}$	<	0.20		V
$-I_C = 10$ mA; $-I_B = 0.2$ mA	$-V_{CE\,sat}$	<		0.20	V
$-I_C = 50$ mA; $-I_B = 2$ mA	$-V_{CE\,sat}$	<	0.25		V
$-I_C = 50$ mA; $-I_B = 1.25$ mA	$-V_{CE\,sat}$	<		0.25	V
Base-emitter saturation voltage					
$-I_C = 10$ mA; $-I_B = 0.4$ mA	$-V_{BE\,sat}$	> <	0.20 0.37		V V
$-I_C = 10$ mA; $-I_B = 0.25$ mA	$-V_{BE\,sat}$	> <		0.15 0.32	V V
$-I_C = 50$ mA; $-I_B = 2.4$ mA	$-V_{BE\,sat}$	<	0.55		V
$-I_C = 50$ mA; $-I_B = 1.55$ mA	$-V_{BE\,sat}$	<		0.45	V
Collector-emitter sustaining voltage					
$-I_C = 5$ mA; $I_B = 0$	$-V_{CEO\,sust}$	>	15	15	V
Punch through voltage	V_{pt}	>	25	20	V
Base-emitter floating voltage					
$I_B = 0$; $-V_{CE} = 25$ V; $T_j = 60\ ^oC$	$-V_{BE\,fl}$	<	0.20		V
$I_B = 0$; $-V_{CE} = 20$ V; $T_j = 60\ ^oC$	$-V_{BE\,fl}$	<		0.20	V

7Z3 0021

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

		ASY26		ASY27	
D.C. current gain					
$-I_C = 10$ mA; $-V_{CE} = 1$ V	h_{FE}	>	30	50	
		typ.	45	80	
$-I_C = 20$ mA; $-V_{CE} = 1$ V	h_{FE}	>	30	50	
		typ.	47	78	
		<	80	150	
$-I_C = 100$ mA; $-V_{CE} = 1$ V	h_{FE}	>	20	30	
		typ.	39	58	
$-I_C = 200$ mA; $-V_{CE} = 1$ V	h_{FE}	>	15	20	
		typ.	27	40	
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB} = 5$ V	C_c	typ.	11	11	pF
		<	16	16	pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$; $-V_{EB} = 5$ V	C_e	typ.	7	6	pF
		<	13	13	pF
Transition frequency					
$-I_C = 3$ mA; $-V_{CE} = 5$ V	f_T	>	4	6	MHz
		typ.	8	14	MHz
h parameters at f = 1 kHz					
$-I_C = 2$ mA; $-V_{CE} = 5$ V					
Input impedance	h_{ie}	typ.	0.75	1.4	kΩ
Reverse voltage transfer ratio	h_{re}	typ.	5.0	7.5	10^{-4}
Small signal current gain	h_{fe}	typ.	50	90	
Output admittance	h_{oe}	typ.	65	100	$\mu\Omega^{-1}$
Switching characteristics					
Desaturation time constant $I_C = 0$; $-I_B = 1$ mA	τ_s	<	1.25	1.25	μs
Current feed time constant $-I_{CM} = 50$ mA; $-V_{CE} = 0.75$ V	τ_c	<	2.2	2.2	μs
Voltage feed time constant $-I_{CM} = 1$ mA; $-V_{CE} = 0.75$ V	τ_v	<	0.2	0.2	μs

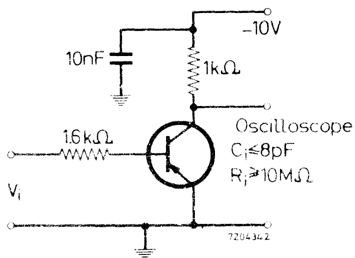
7Z3 0022

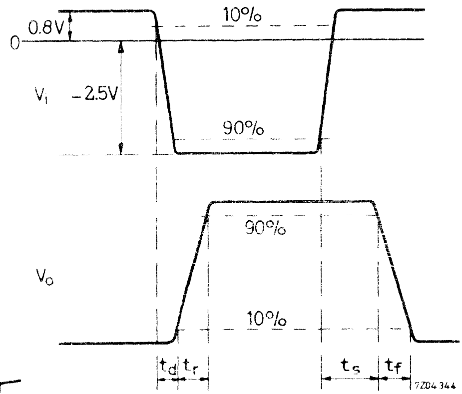
CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$

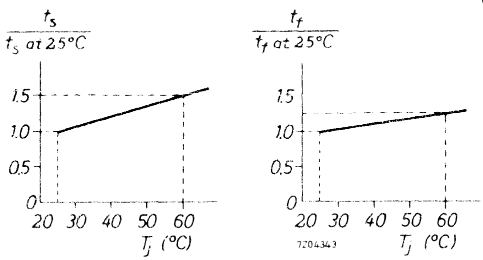
Switching times (See test circuit)

			ASY26	ASY27	
delay time	t_d	typ.	65	50	ns
		<	90	75	ns
rise time	t_r	typ.	275	200	ns
		<	490	350	ns
storage time	t_s	typ.	500	600	ns
		<	1350	1500	ns
fall time	t_f	typ.	475	400	ns
		<	730	620	ns

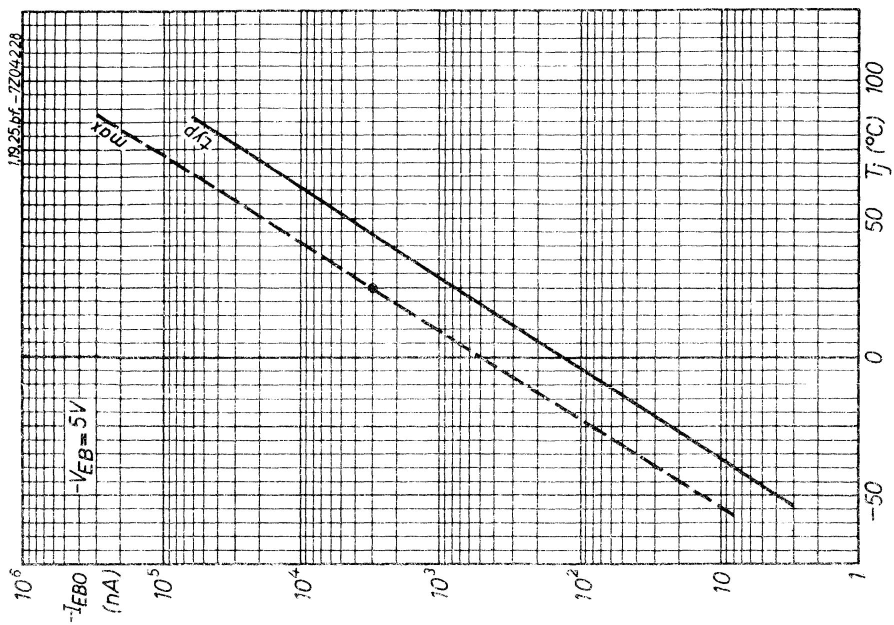
Test circuit:

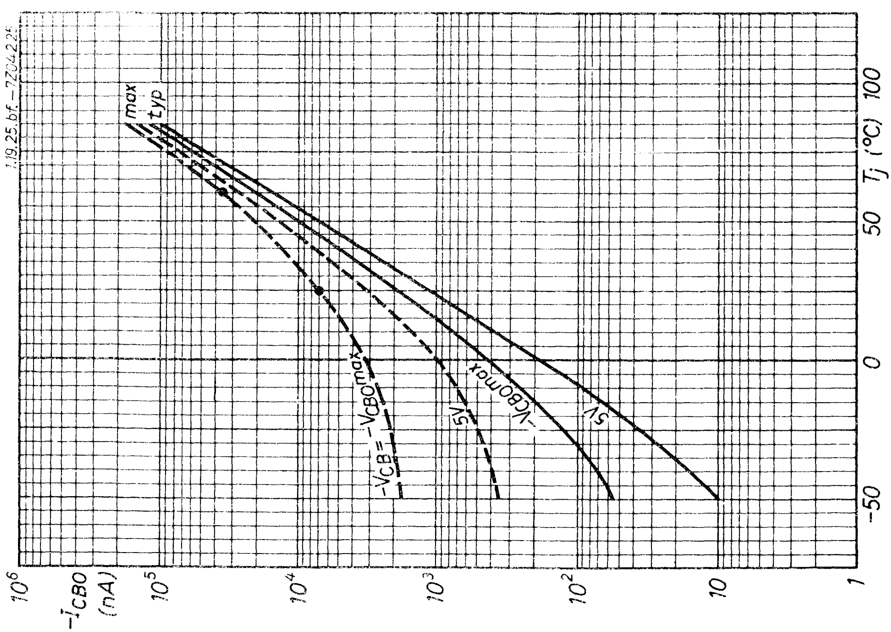


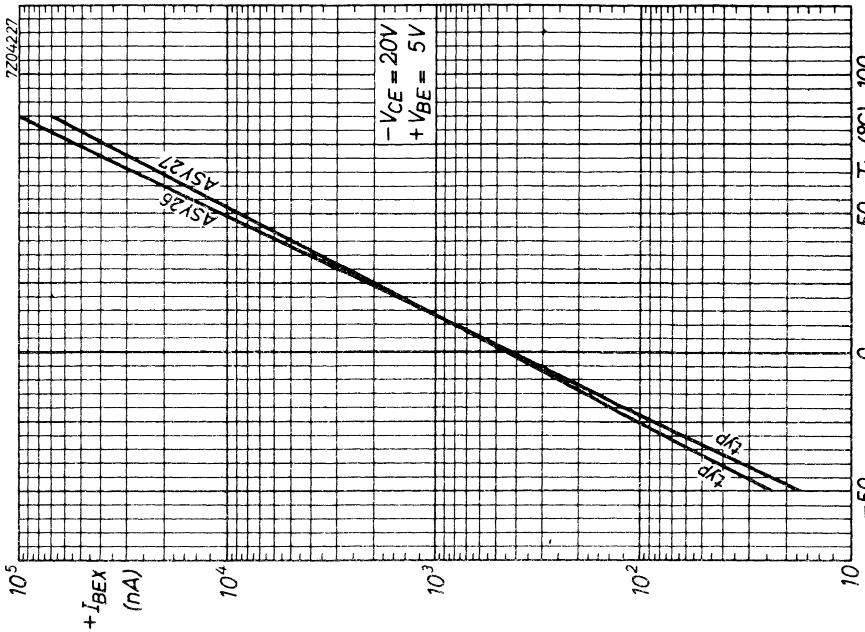


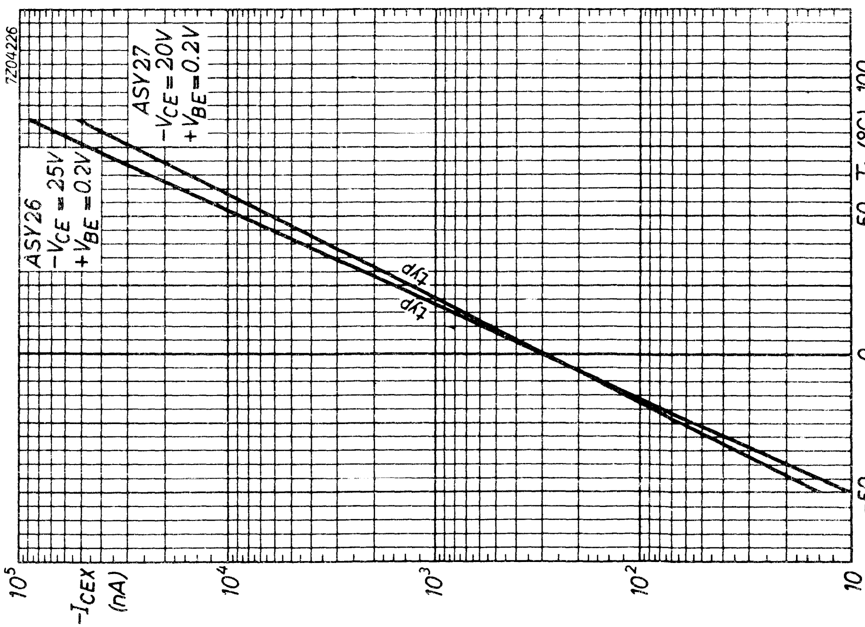


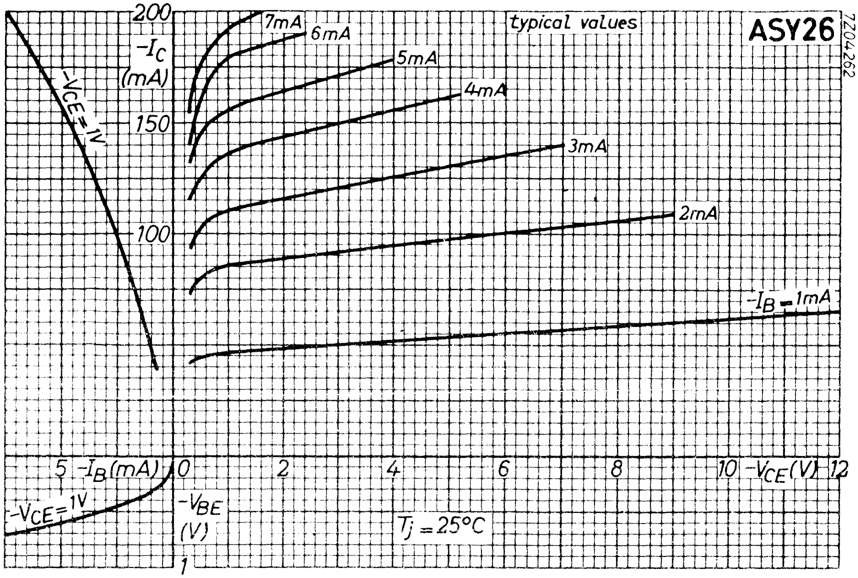
7Z3 0023

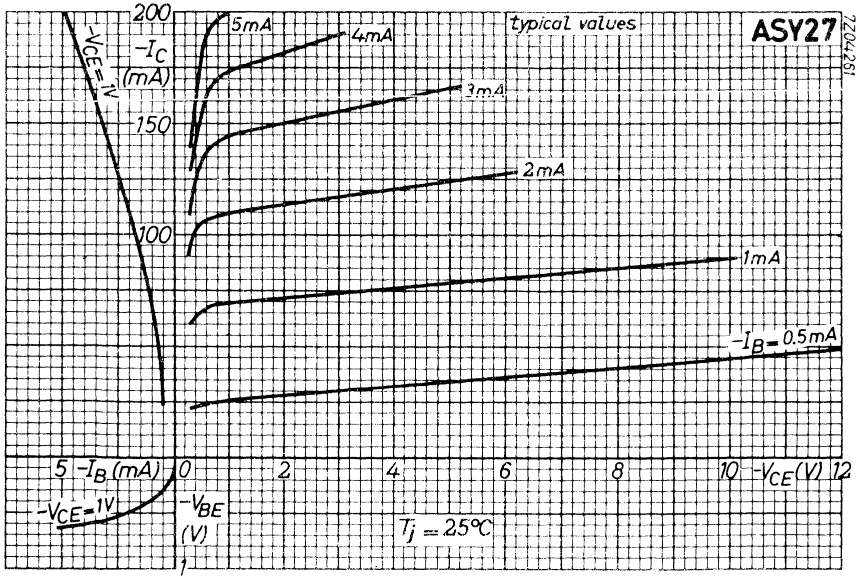

1.19.25.bf.-7Z04228
$-V_{EB} = 5V$
max
typ
$-I_{EBO}$ (nA)
10^6
10^5
10^4
10^3
10^2
10
1
T_j (°C)
100
50
0
−50

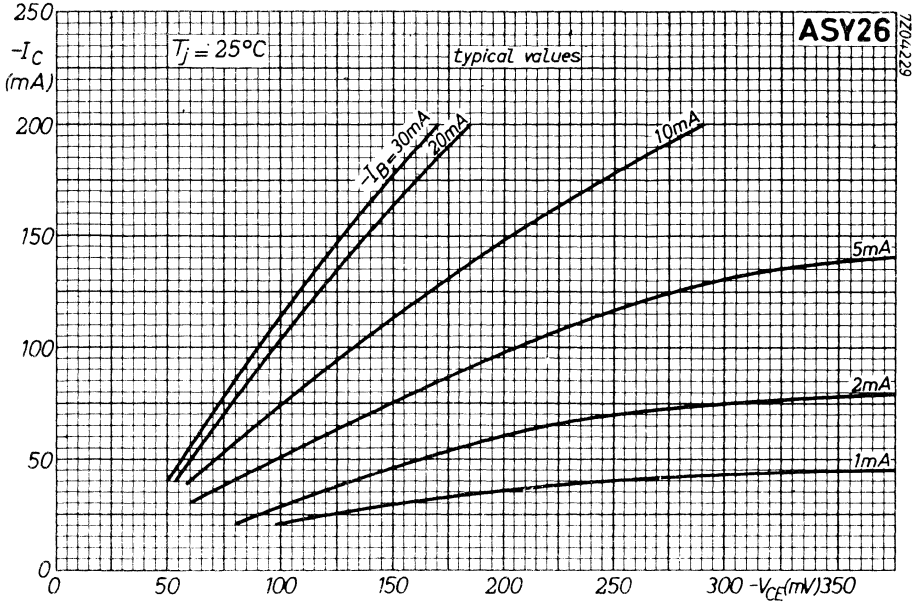

1.19.25.bf.-7Z04225
max
typ
$-V_{CB} = -V_{CBOmax}$
5V
$-V_{CBOmax}$
5V
$-I_{CBO}$ (nA)
10^6
10^5
10^4
10^3
10^2
10
1
T_j (°C)
100
50
0
−50

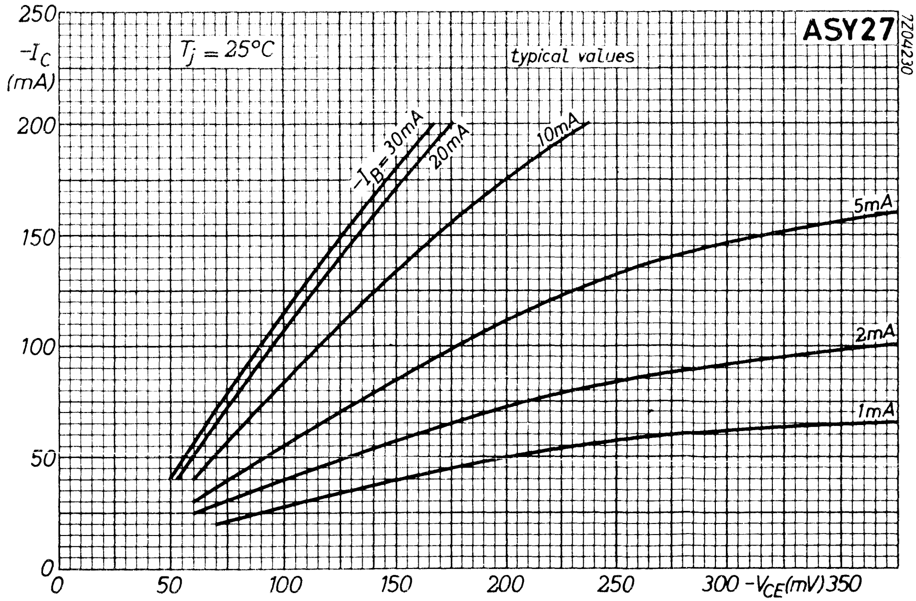

7Z04227
−VCE = 20V
+VBE = 5V
ASY27
ASY26
typ
typ
Tj (°C)
+IBEX (nA)
10^5
10^4
10^3
10^2
10
−50
0
50
100

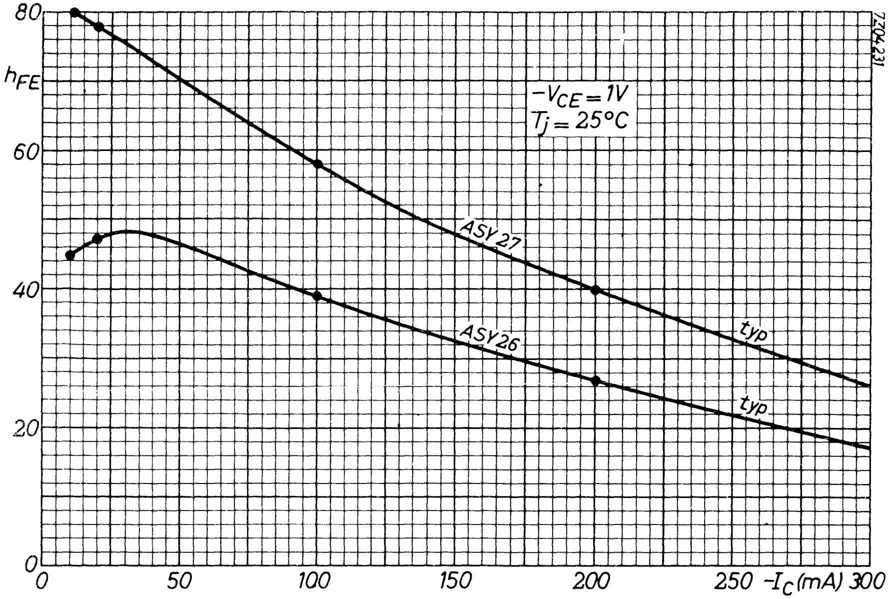

7Z04226
ASY26
−VCE = 25V
+VBE = 0.2V
ASY27
−VCE = 20V
+VBE = 0.2V
typ
typ
Tj (°C)
−ICEX (nA)
10^5
10^4
10^3
10^2
10
−50
0
50
100

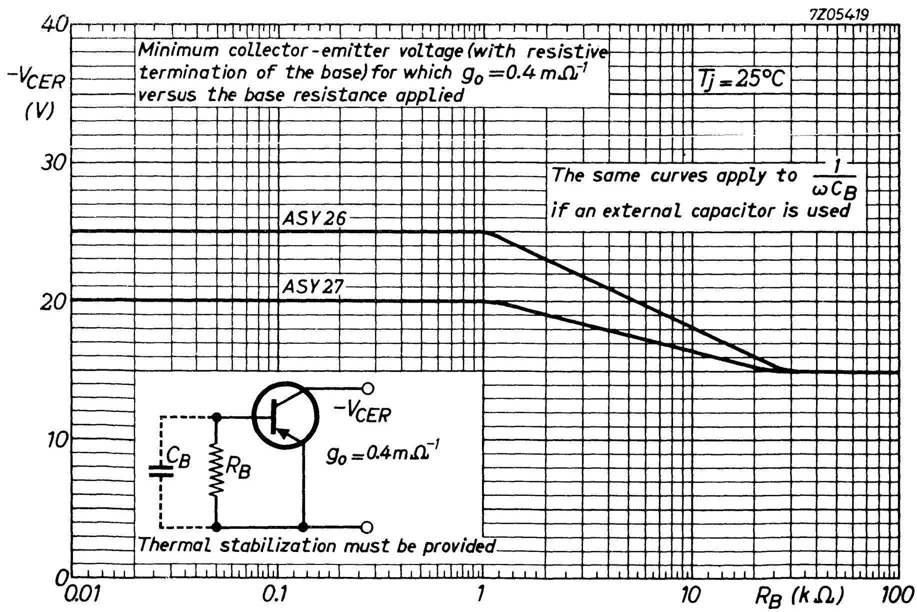

typical values
ASY26
7Z04262
200
$-I_C$
(mA)
150
100
7mA
6mA
5mA
4mA
3mA
2mA
$-I_B = 1mA$
$-V_{CE} = 1V$
5 $-I_B$ (mA) 0
2
4
6
8
10 $-V_{CE}$ (V) 12
$-V_{BE}$
(V)
1
$T_j = 25°C$

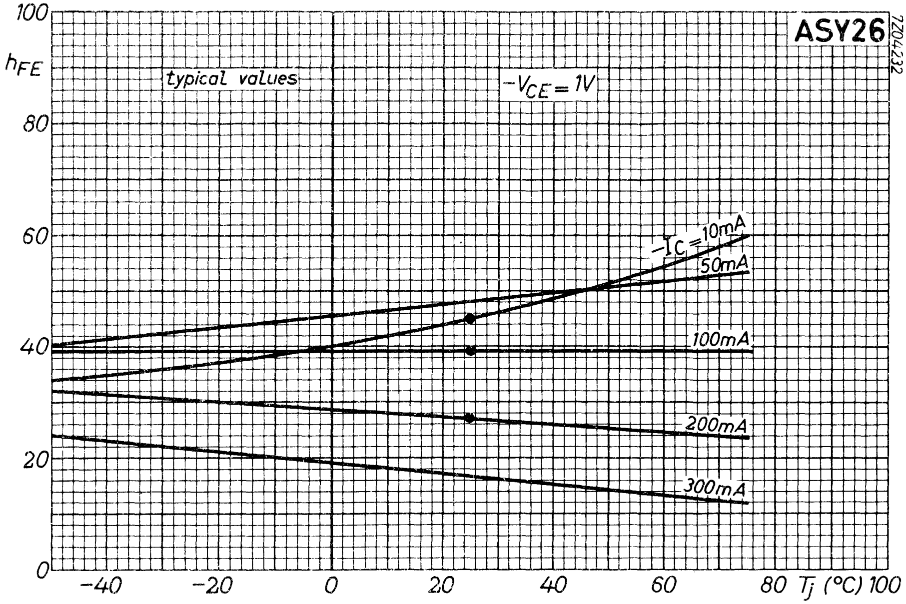

typical values
ASY27
7Z04261
200
$-I_C$
(mA)
150
100
5mA
4mA
3mA
2mA
1mA
$-I_B = 0.5mA$
$-V_{CE} = 1V$
5 $-I_B$ (mA) 0
2
4
6
8
10 $-V_{CE}$ (V) 12
$-V_{BE}$
(V)
1
$T_j = 25°C$

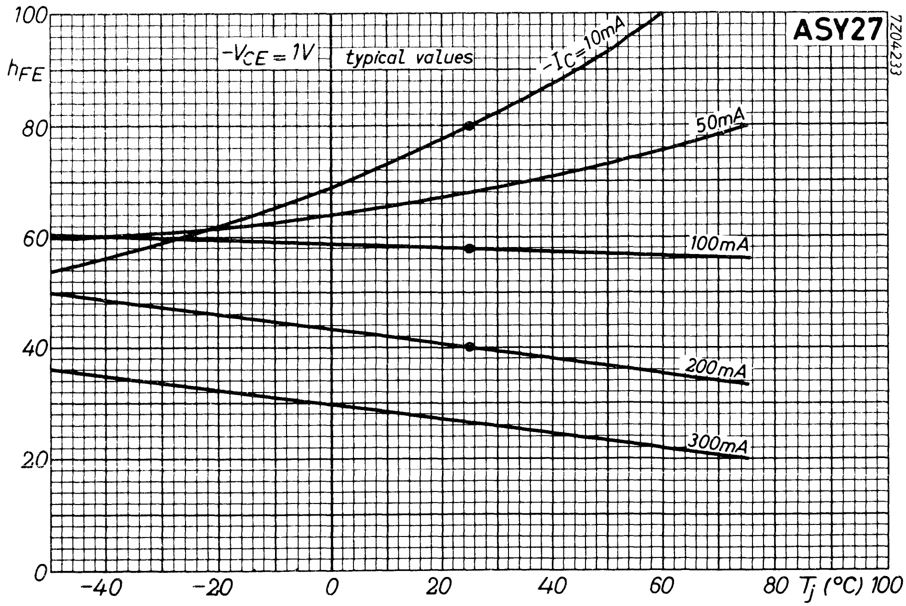

ASY26
7Z04229
$T_j = 25°C$
typical values
$-I_C$ (mA)
$-I_B$=30mA
20mA
10mA
5mA
2mA
1mA
250
200
150
100
50
0
0
50
100
150
200
250
300 $-V_{CE}$(mV) 350

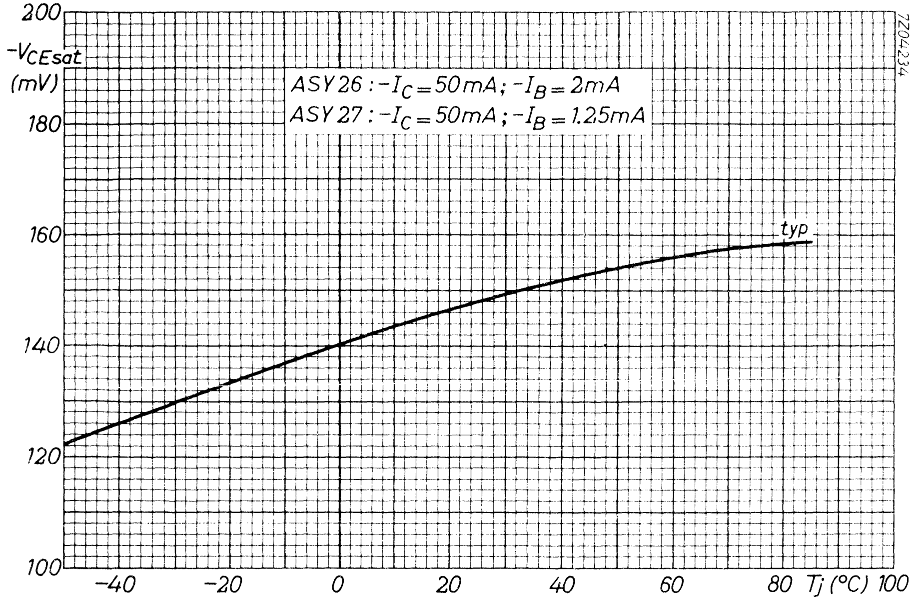

ASY27
7Z04230
$T_j = 25°C$
typical values
$-I_C$ (mA)
$-I_B$=30mA
20mA
10mA
5mA
2mA
1mA
250
200
150
100
50
0
0
50
100
150
200
250
300 $-V_{CE}$(mV) 350

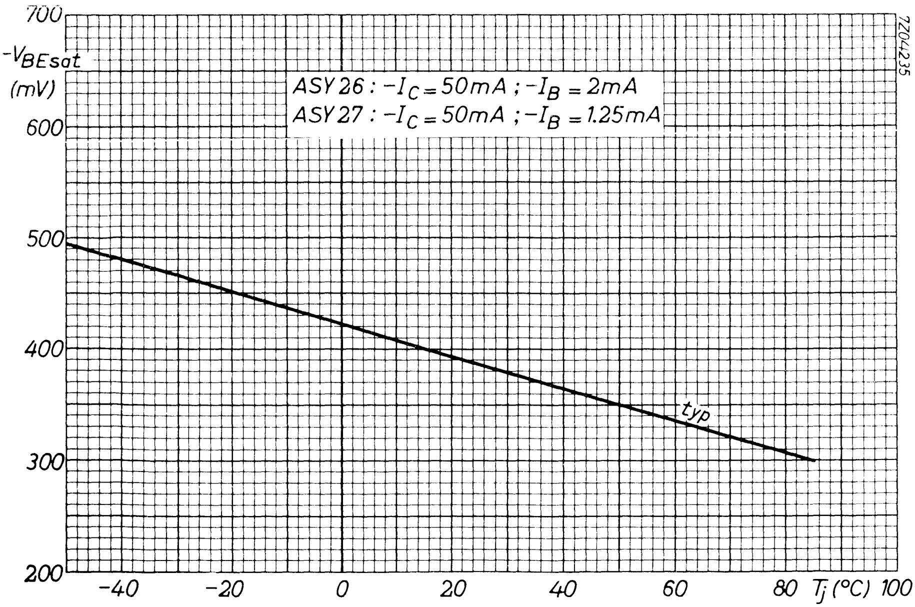

7Z04231
80
60
40
20
0
hFE
−VCE = 1V
Tj = 25°C
ASY27
ASY26
typ
typ
0
50
100
150
200
250
−IC (mA)
300

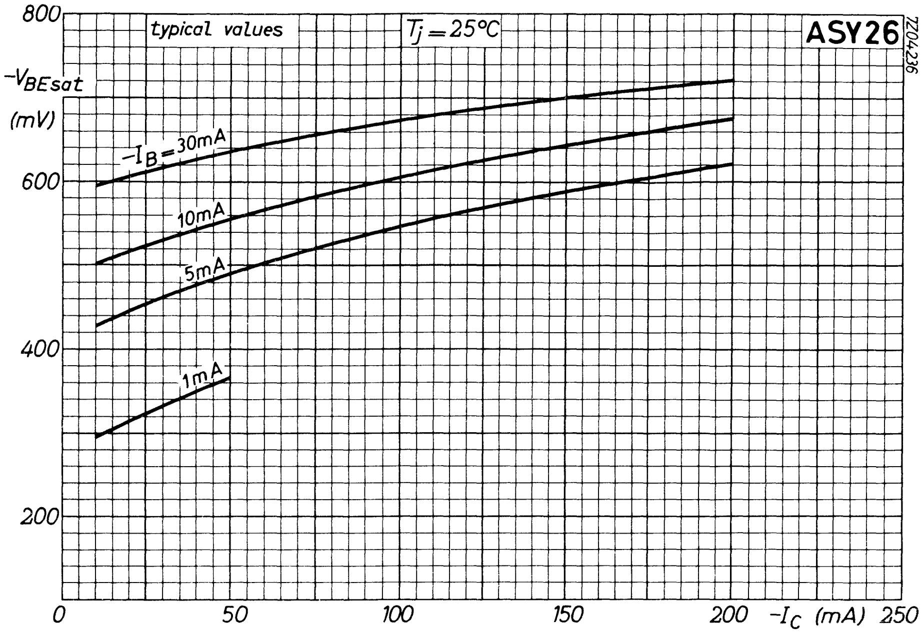

7Z05419
40
30
20
10
0
−VCER
(V)
Minimum collector-emitter voltage (with resistive termination of the base) for which g0 = 0.4 mΩ⁻¹ versus the base resistance applied
Tj = 25°C
The same curves apply to 1/ωCB if an external capacitor is used
ASY26
ASY27
CB
RB
−VCER
g0 = 0.4 mΩ⁻¹
Thermal stabilization must be provided
0.01
0.1
1
10
RB (kΩ)
100

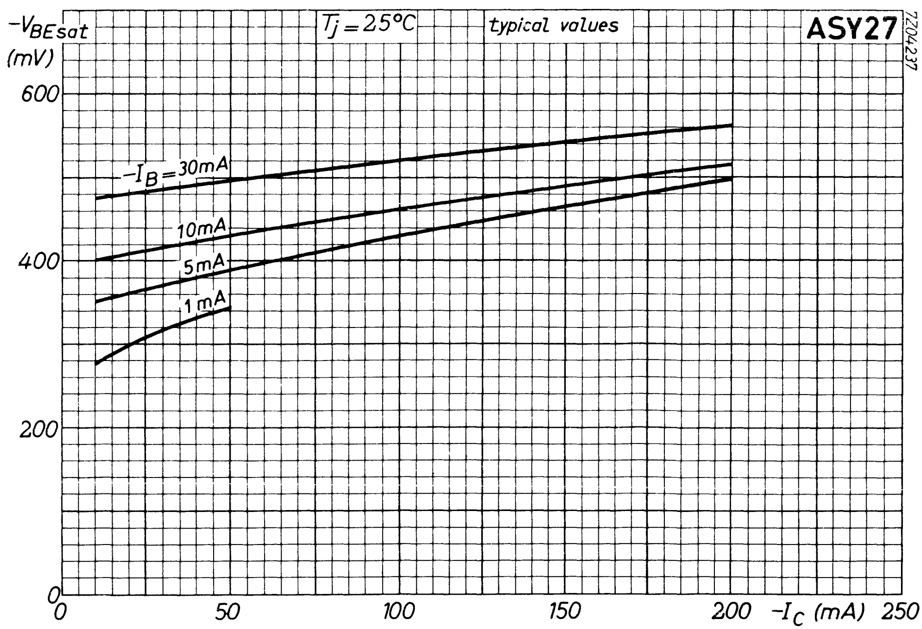

ASY26
7Z04232
hFE
typical values
-VCE = 1V
-IC = 10mA
50mA
100mA
200mA
300mA
100
80
60
40
20
0
-40
-20
0
20
40
60
80
Tj (°C)
100

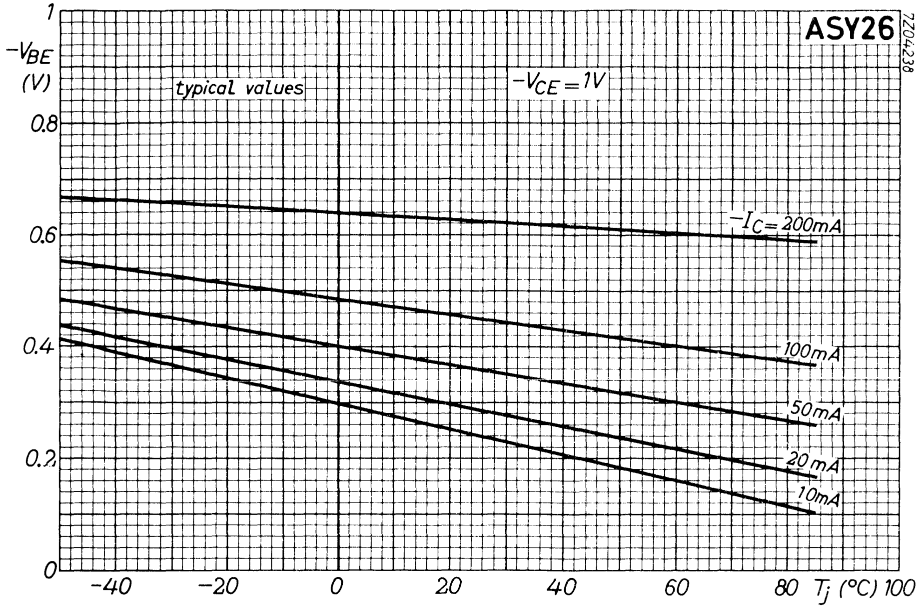

ASY27
7Z04233
hFE
-VCE = 1V
typical values
-IC = 10mA
50mA
100mA
200mA
300mA
100
80
60
40
20
0
-40
-20
0
20
40
60
80
Tj (°C)
100

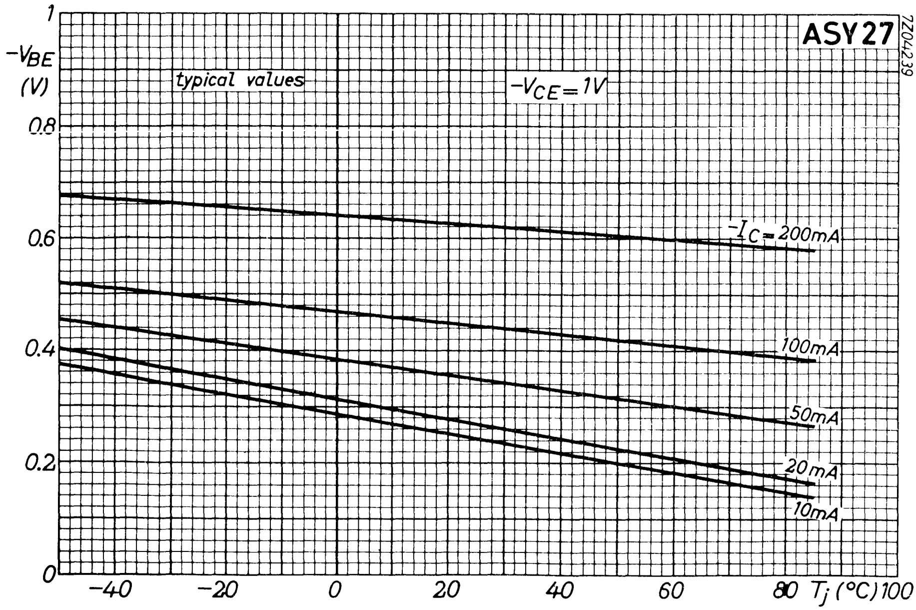

200
$-V_{CEsat}$
(mV)
180
160
140
120
100
ASY 26 : $-I_C = 50mA$; $-I_B = 2mA$
ASY 27 : $-I_C = 50mA$; $-I_B = 1.25mA$
typ
-40
-20
0
20
40
60
80
T_j (°C)
100
7Z04234

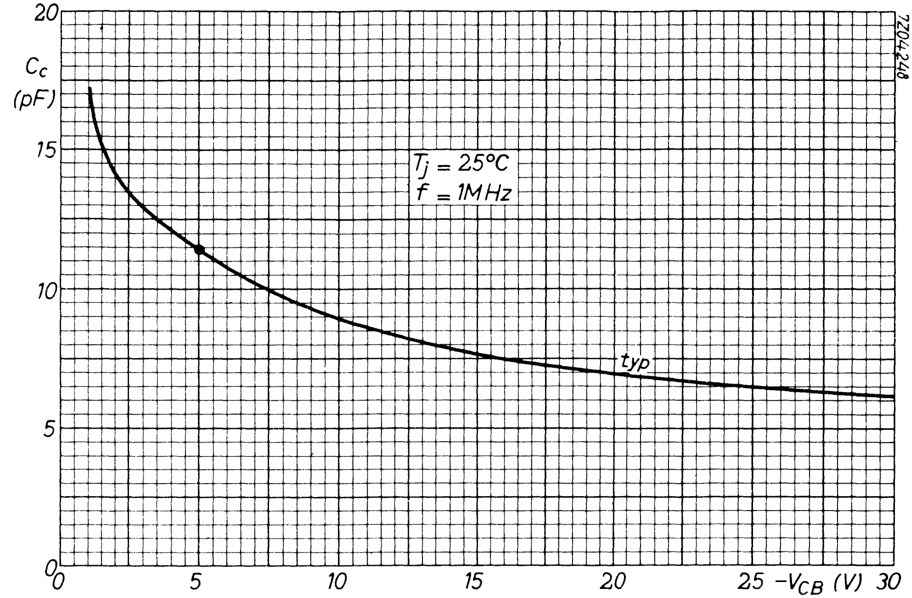

700
$-V_{BEsat}$
(mV)
600
500
400
300
200
ASY 26 : $-I_C = 50mA$; $-I_B = 2mA$
ASY 27 : $-I_C = 50mA$; $-I_B = 1.25mA$
typ
-40
-20
0
20
40
60
80
T_j (°C)
100
7Z04235

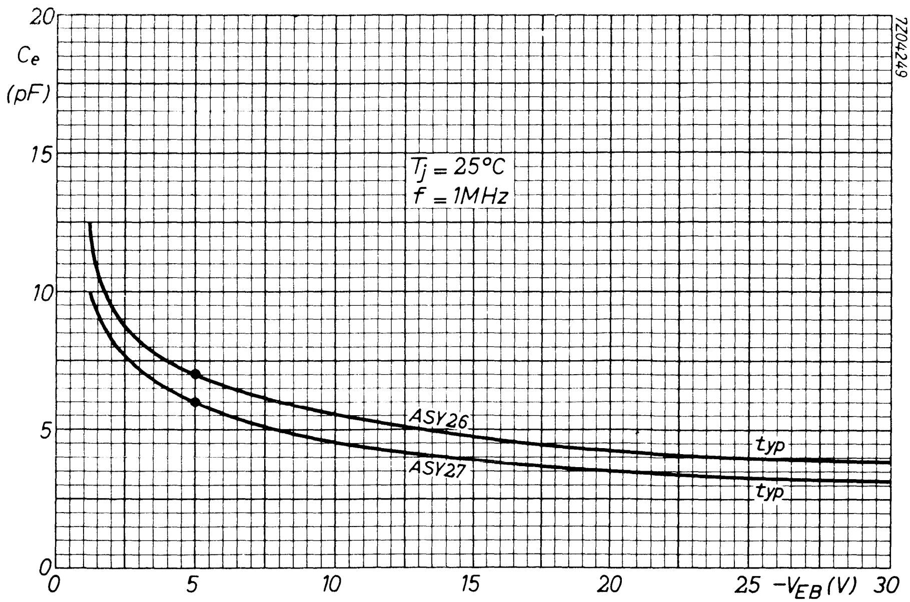

typical values
$T_j = 25°C$
ASY26
7Z04236
$-V_{BEsat}$ (mV)
800
600
400
200
$-I_B = 30mA$
10mA
5mA
1mA
0
50
100
150
200
$-I_C$ (mA)
250

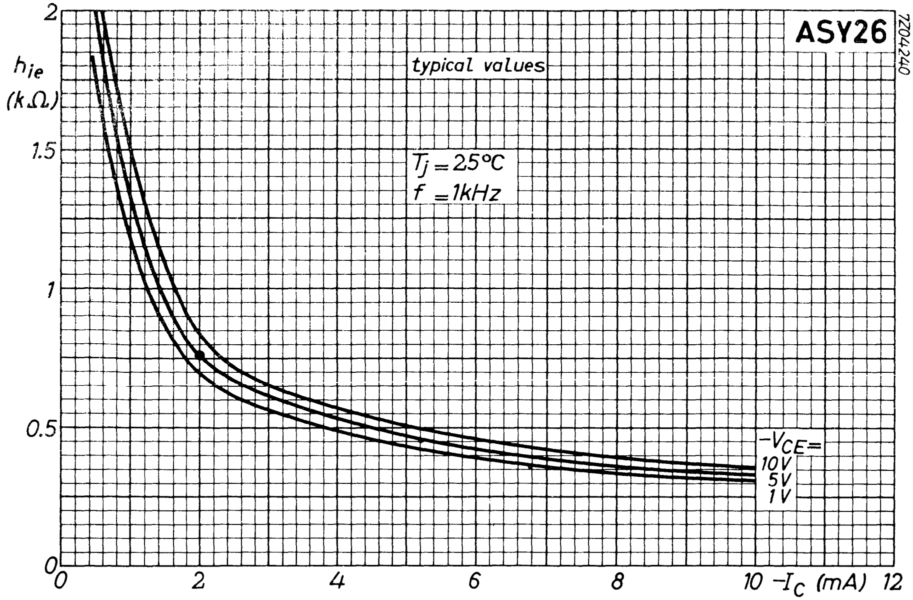

$T_j = 25°C$
typical values
ASY27
7Z04237
$-V_{BEsat}$ (mV)
600
400
200
0
$-I_B = 30mA$
10mA
5mA
1mA
0
50
100
150
200
$-I_C$ (mA)
250

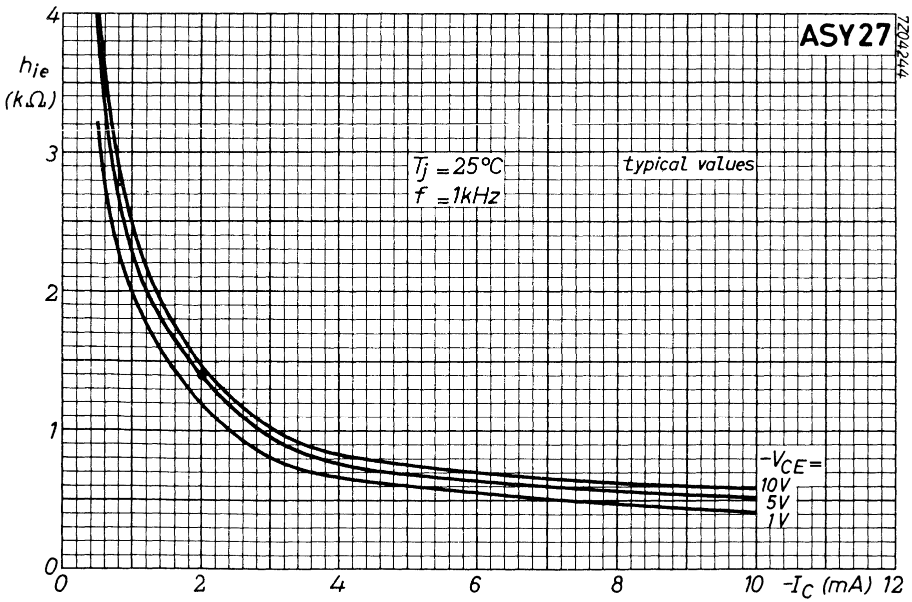

ASY26
7Z04238
$-V_{BE}$ (V)
typical values
$-V_{CE} = 1V$
$-I_C = 200mA$
100mA
50mA
20 mA
10mA
1
0.8
0.6
0.4
0.2
0
−40
−20
0
20
40
60
80
T_j (°C)
100

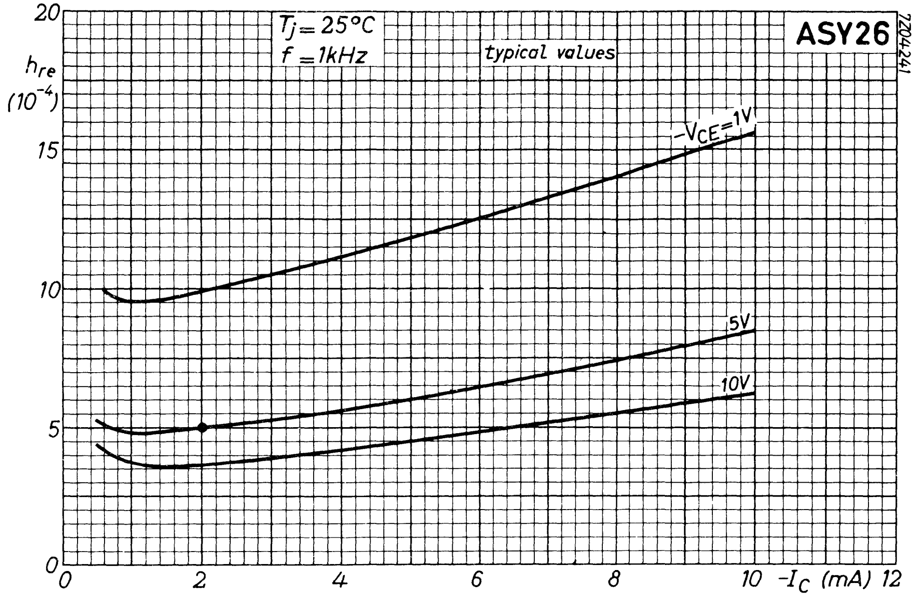

ASY27
7Z04239
$-V_{BE}$ (V)
typical values
$-V_{CE} = 1V$
$-I_C = 200mA$
100mA
50mA
20 mA
10mA
1
0.8
0.6
0.4
0.2
0
−40
−20
0
20
40
60
80
T_j (°C)
100

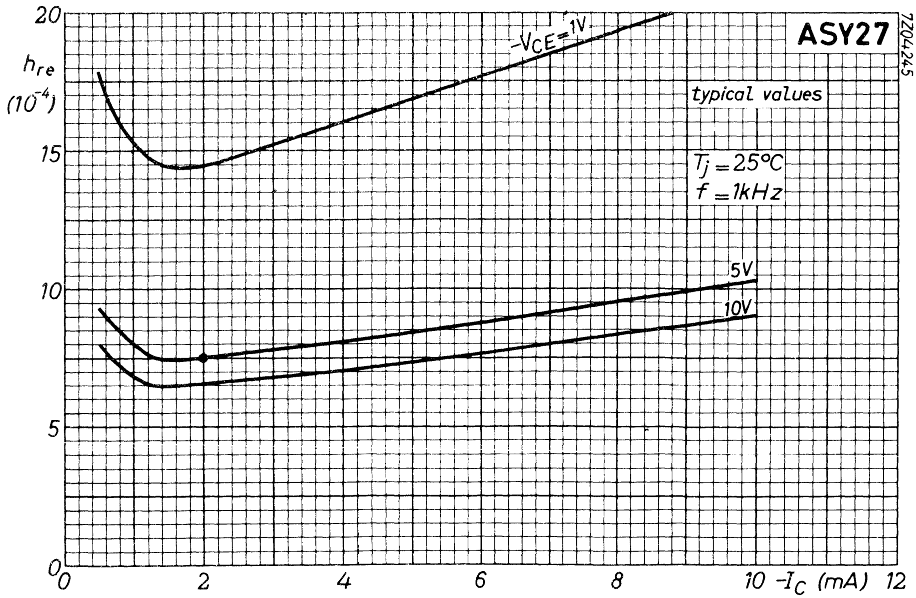

7Z04248
C_c
(pF)
20
15
10
5
0
$T_j = 25°C$
f = 1MHz
typ
0
5
10
15
20
25
$-V_{CB}$ (V)
30

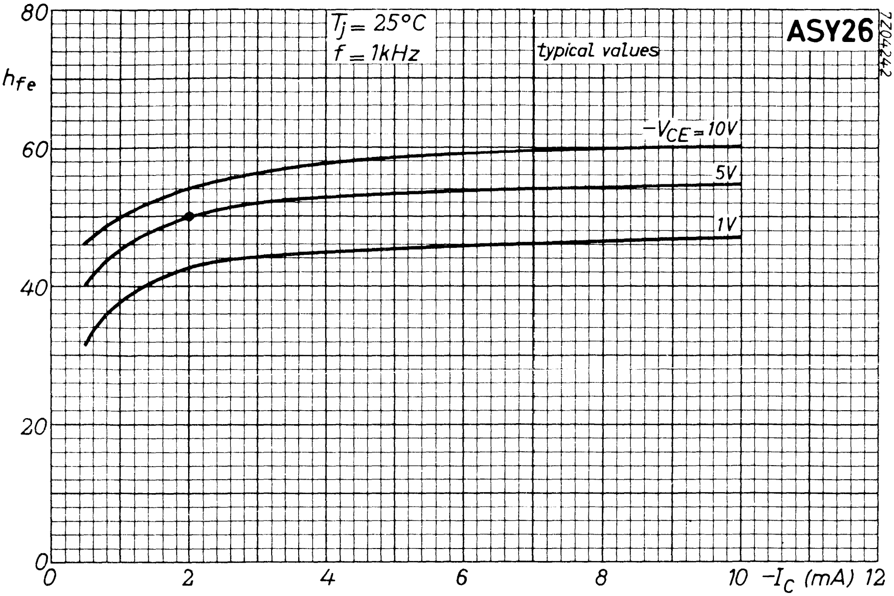

7Z04249
C_e
(pF)
20
15
10
5
0
$T_j = 25°C$
f = 1MHz
ASY26
ASY27
typ
typ
0
5
10
15
20
25
$-V_{EB}$ (V)
30

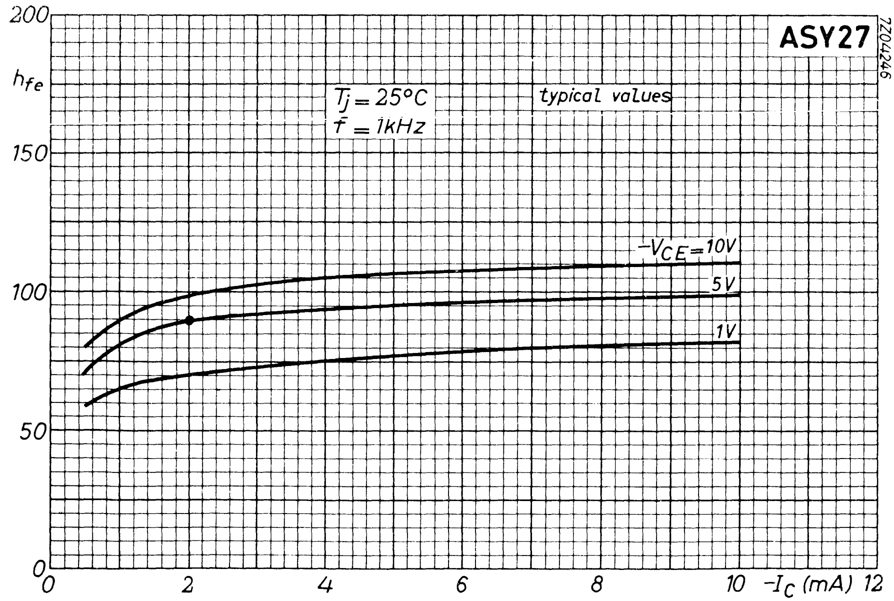

ASY26
7Z04240
typical values
h_{ie} (kΩ)
$T_j = 25°C$
$f = 1kHz$
$-V_{CE}=$
10 V
5 V
1 V
$-I_C$ (mA)
0
0.5
1
1.5
2
0
2
4
6
8
10
12

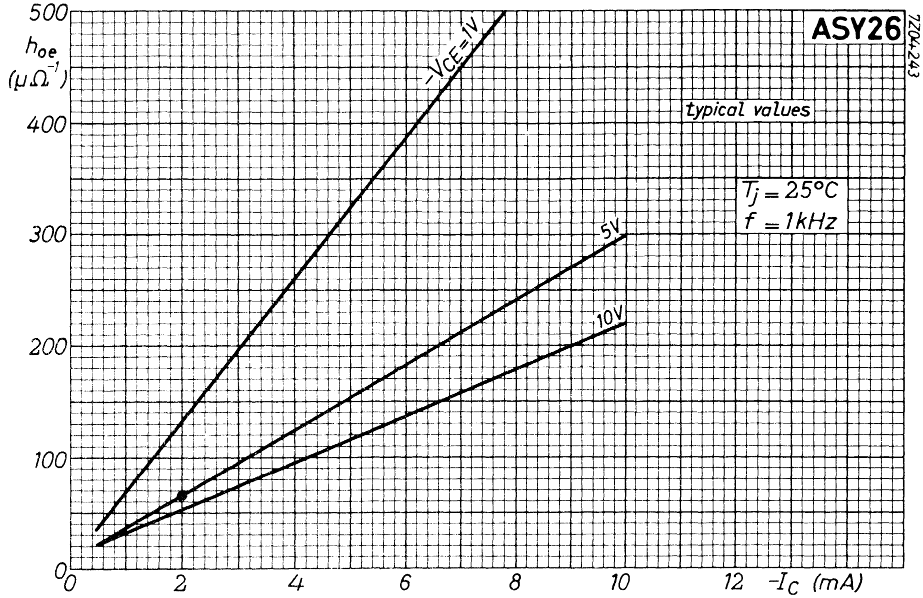

ASY27
7Z04244
h_{ie} (kΩ)
$T_j = 25°C$
$f = 1kHz$
typical values
$-V_{CE}=$
10 V
5 V
1 V
$-I_C$ (mA)
0
1
2
3
4
0
2
4
6
8
10
12

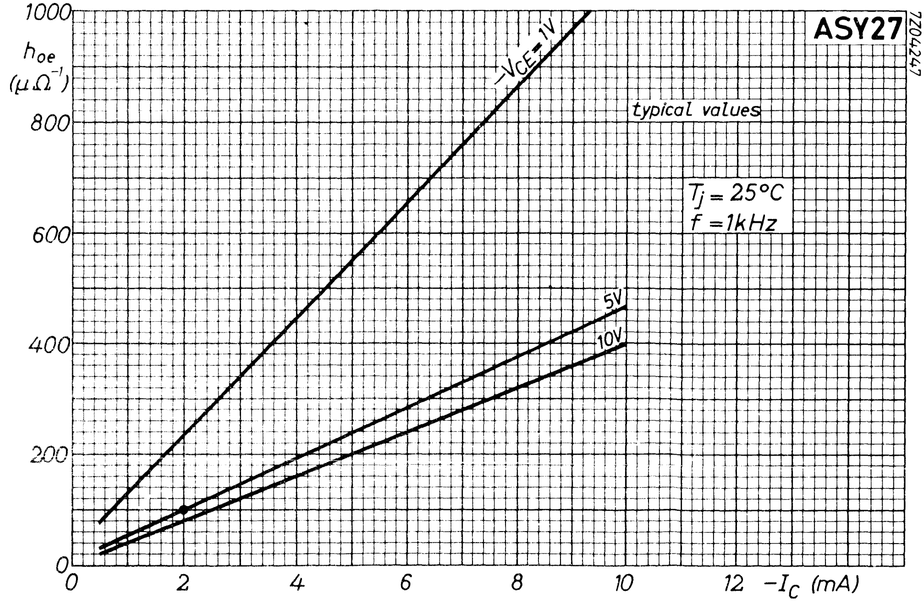

ASY26
$T_j = 25°C$
$f = 1kHz$
typical values
h_{re}
(10^{-4})
$-V_{CE} = 1V$
5V
10V
20
15
10
5
0
0
2
4
6
8
10
12
$-I_C$ (mA)
7Z04241

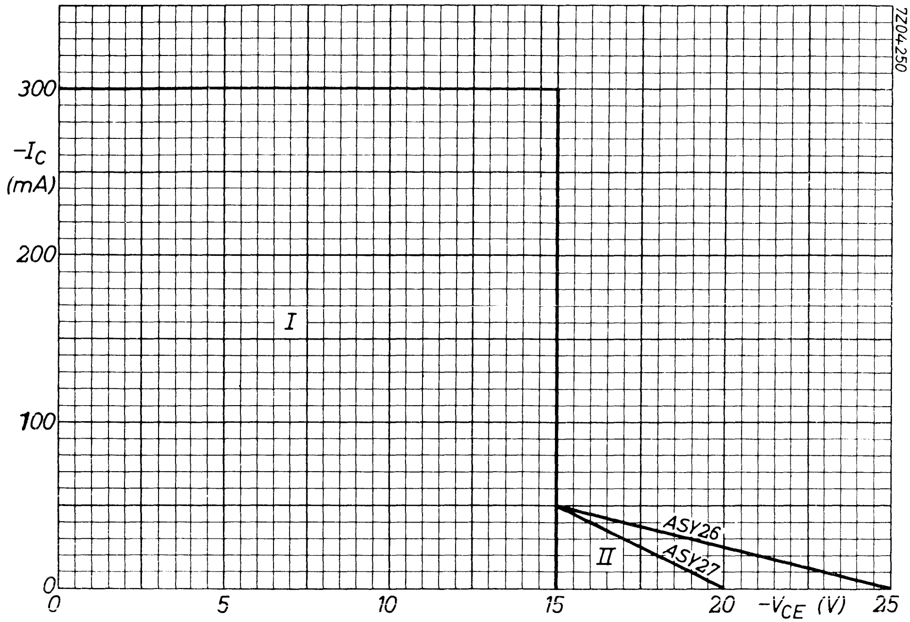

ASY27
typical values
$T_j = 25°C$
$f = 1kHz$
h_{re}
(10^{-4})
$-V_{CE} = 1V$
5V
10V
20
15
10
5
0
0
2
4
6
8
10
12
$-I_C$ (mA)
7Z04245


80
60
40
20
0
h_{fe}
$T_j = 25°C$
$f = 1kHz$
typical values
ASY26
7Z04242
$-V_{CE} = 10V$
5V
1V
0
2
4
6
8
10
$-I_C$ (mA)
12


200
150
100
50
0
h_{fe}
$T_j = 25°C$
$f = 1kHz$
typical values
ASY27
7Z04246
$-V_{CE} = 10V$
5V
1V
0
2
4
6
8
10
$-I_C$ (mA)
12


ASY26
7Z04243
h_{oe} ($\mu\Omega^{-1}$)
500
400
300
200
100
0
0
2
4
6
8
10
12
$-I_C$ (mA)
$-V_{CE}=1V$
5V
10V
typical values
$T_j = 25°C$
$f = 1kHz$


ASY27
7Z04247
h_{oe} ($\mu\Omega^{-1}$)
1000
800
600
400
200
0
0
2
4
6
8
10
12
$-I_C$ (mA)
$-V_{CE}=1V$
5V
10V
typical values
$T_j = 25°C$
$f = 1kHz$



I = permissible region of operation under all base-emitter conditions

II = additional region of operation when the transistor is cut-off with $+V_{BE} > 0.2$ V

Outside the permissible regions of operation the transistor can withstand transient energies of 200 μWs, provided:

$$0.2\ V < +V_{BE} < 2\ V$$

7Z3 0051

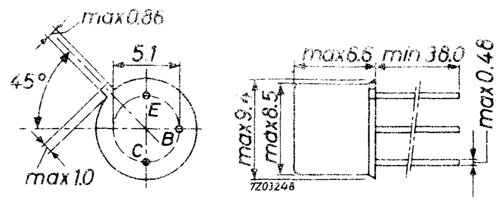
GERMANIUM ALLOYED TRANSISTORS

N-P-N transistors in a TO-5 metal envelope with the base connected to the case. These general purpose transistors are primarily intended for medium current medium speed computor logic applications.

QUICK REFERENCE DATA					
			ASY28	ASY29	
Collector-base voltage (open emitter)	V_{CBO}	max.	30	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	15	V
Collector current (peak value)	I_{CM}	max.	300	300	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	150	mW
Junction temperature	T_j	max.	85	85	°C
D.C. current gain at T_j = 25 °C					
I_C = 20 mA; V_{CE} = 1 V	h_{FE}	>	30	50	
I_C = 200 mA; V_{CE} = 1 V	h_{FE}	>	15	20	
Collector-emitter saturation voltage					
I_C = 10 mA; I_B = 0.33 mA	$V_{CE\,sat}$	<	0.20		V
I_C = 10 mA; I_B = 0.2 mA	$V_{CE\,sat}$	<		0.20	V
Transition frequency					
I_C = 3 mA; V_{CE} = 5 V	f_T	typ.	14	20	MHz
Turn on time ($t_d + t_r$)	t_{on}	typ.	225	185	ns
Turn off time ($t_s + t_f$)	t_{off}	typ.	775	800	ns

MECHANICAL DATA Dimensions in mm

TO-5
Base connected to case



7Z3 0024

RATINGS (Limiting values) [1])

Voltages

		ASY28	ASY29	
Collector-base voltage (open emitter)	V_{CBO}	max. 30	25	V
Collector-emitter voltage (open base)	V_{CEO}	max. 15	15	V
Collector-emitter voltage at $-V_{BE}$ = 0.2 V	V_{CEX}	max. 25	20	V
Emitter-base voltage (open collector)	V_{EBO}	max. 20	20	V

Currents

Collector current (d.c. or average over any 20 ms period)	I_C	max.	200	mA
Collector current (peak value)	I_{CM}	max.	300	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	150	mW

Temperatures

Storage temperature	T_{stg}		−65 to +100	°C
Junction temperature	T_j	max.	85	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.4	°C/mW
From junction to case	$R_{th\ j-c}$	=	0.2	°C/mW

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current

			ASY28	ASY29	
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	7		μA
I_E = 0; V_{CB} = 25 V	I_{CBO}	<		7	μA
I_E = 0; V_{CB} = 30 V; T_j = 60 °C	I_{CBO}	<	35		μA
I_E = 0; V_{CB} = 25 V; T_j = 60 °C	I_{CBO}	<		35	μA

Emitter cut-off current

I_C = 0; V_{EB} = 5 V	I_{EBO}	<	3	3	μA

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0025

CHARACTERISTICS (continued) $T_j = 25\ ^{o}C$ unless otherwise specified

			ASY28	ASY29	
Currents at reverse biased emitter junction					
$V_{CE} = 25$ V; $-V_{BE} = 0.2$ V; $T_j = 60\ ^{o}C$	I_{CEX}	<	35		μA
$V_{CE} = 20$ V; $-V_{BE} = 0.2$ V; $T_j = 60\ ^{o}C$	I_{CEX}	<		35	μA
$V_{CE} = 20$ V; $-V_{BE} = 5$ V; $T_j = 60\ ^{o}C$	$-I_{BEX}$	<	35	35	μA
Base-emitter voltage					
$I_C = 100$ mA; $V_{CE} = 1$ V	V_{BE}	<	0.65	0.55	V
$I_C = 300$ mA; $V_{CE} = 1$ V	V_{BE}	<	1.5	1.4	V
Collector-emitter saturation voltage					
$I_C = 10$ mA; $I_B = 0.33$ mA	$V_{CE\,sat}$	<	0.20		V
$I_C = 10$ mA; $I_B = 0.2$ mA	$V_{CE\,sat}$	<		0.20	V
$I_C = 50$ mA; $I_B = 2$ mA	$V_{CE\,sat}$	<	0.25		V
$I_C = 50$ mA; $I_B = 1.25$ mA	$V_{CE\,sat}$	<		0.25	V
Base-emitter saturation voltage					
$I_C = 10$ mA; $I_B = 0.4$ mA	$V_{BE\,sat}$	>	0.20		V
		<	0.37		V
$I_C = 10$ mA; $I_B = 0.25$ mA	$V_{BE\,sat}$	>		0.15	V
		<		0.32	V
$I_C = 50$ mA; $I_B = 2.4$ mA	$V_{BE\,sat}$	<	0.55		V
$I_C = 50$ mA; $I_B = 1.55$ mA	$V_{BE\,sat}$	<		0.45	V
Collector-emitter sustaining voltage					
$I_C = 5$ mA; $I_B = 0$	$V_{CEO\,sust}$	>	15	15	V
Punch through voltage	V_{pt}	>	25	20	V
Base-emitter floating voltage					
$I_B = 0$; $V_{CE} = 25$ V; $T_j = 60\ ^{o}C$	$V_{BE\,fl}$	<	0.20		V
$I_B = 0$; $V_{CE} = 20$ V; $T_j = 60\ ^{o}C$	$V_{BE\,fl}$	<		0.20	V

7Z3 0026

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

			ASY28	ASY29	
D.C. current gain					
$I_C = 10$ mA; $V_{CE} = 1$ V	h_{FE}	>	30	50	
		typ.	43	113	
$I_C = 20$ mA; $V_{CE} = 1$ V	h_{FE}	>	30	50	
		typ.	46	113	
		<	80	150	
$I_C = 100$ mA; $V_{CE} = 1$ V	h_{FE}	>	20	30	
		typ.	43	102	
$I_C = 200$ mA; $V_{CE} = 1$ V	h_{FE}	>	15	20	
		typ.	32	84	
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $V_{EB} = 5$ V	C_c	typ.	11	11	pF
		<	16	16	pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$; $V_{EB} = 5$ V	C_e	typ.	7	6	pF
		<	13	13	pF
Transition frequency					
$I_C = 3$ mA; $V_{CE} = 5$ V	f_T	>	4	10	MHz
		typ.	14	20	MHz
h parameters at f = 1 kHz					
$I_C = 2$ mA; $V_{CE} = 5$ V					
Input impedance	h_{ie}	typ.	0.75	1.4	kΩ
Reverse voltage transfer ratio	h_{re}	typ.	3.5	5.0	10^{-4}
Small signal current gain	h_{fe}	typ.	50	90	
Output admittance	h_{oe}	typ.	45	70	$\mu\Omega^{-1}$
Switching characteristics					
Desaturation time constant $I_C = 0$; $I_B = 1$ mA	τ_s	<	1.4	1.4	µs
Current feed time constant $I_{CM} = 50$ mA; $V_{CE} = 0.75$ V	τ_c	<	2.2	2.2	µs
Voltage feed time constant $I_{CM} = 1$ mA; $V_{CE} = 5$ V	τ_v	<	0.2	0.2	µs

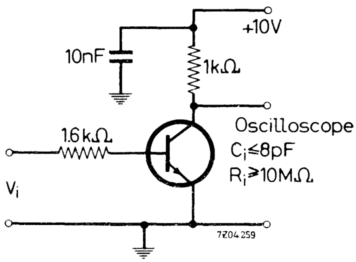
7Z3 0027

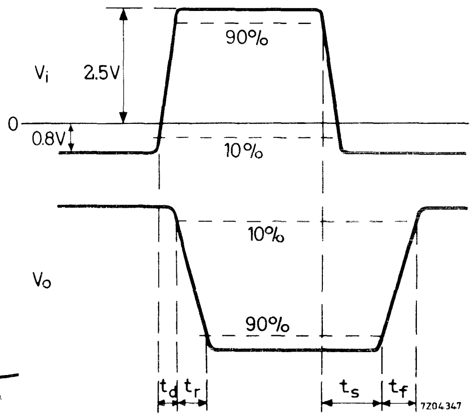
CHARACTERISTICS (continued) $T_j = 25\ ^oC$

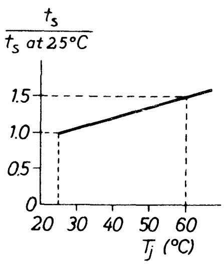
Switching times (See test circuit)

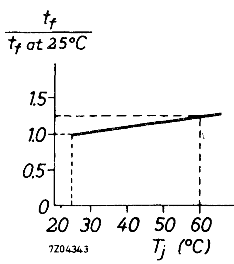
			ASY28	ASY29	
delay time	t_d	typ.	50	45	ns
		<	90	75	ns
rise time	t_r	typ.	175	140	ns
		<	400	300	ns
storage time	t_s	typ.	450	500	ns
		<	700	800	ns
fall time	t_f	typ.	325	300	ns
		<	620	520	ns

Test circuit:

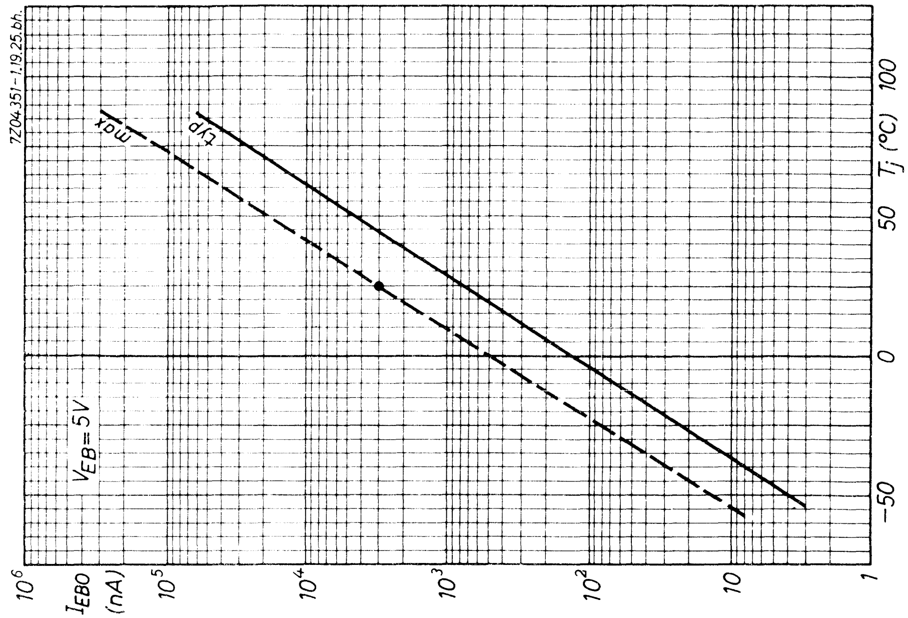


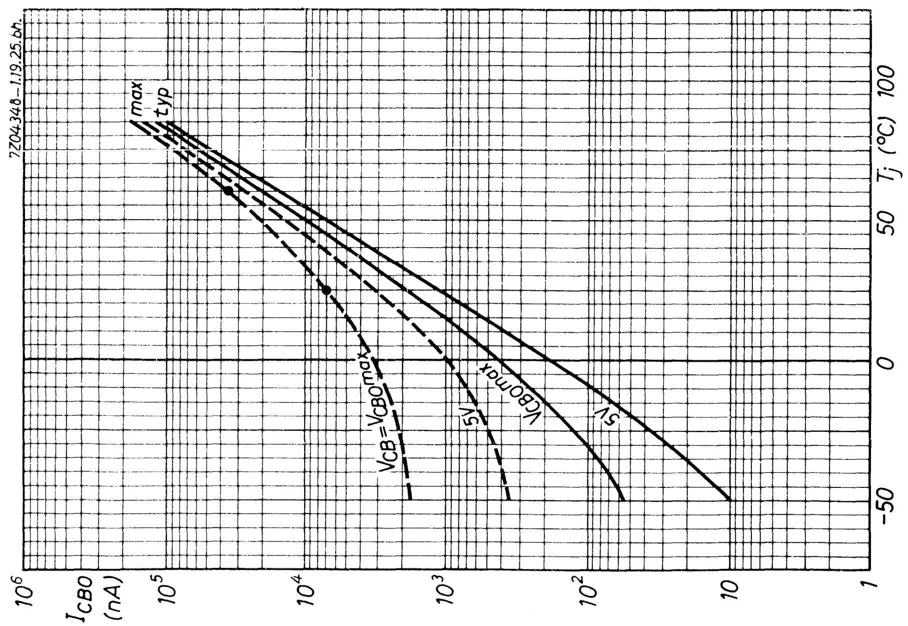


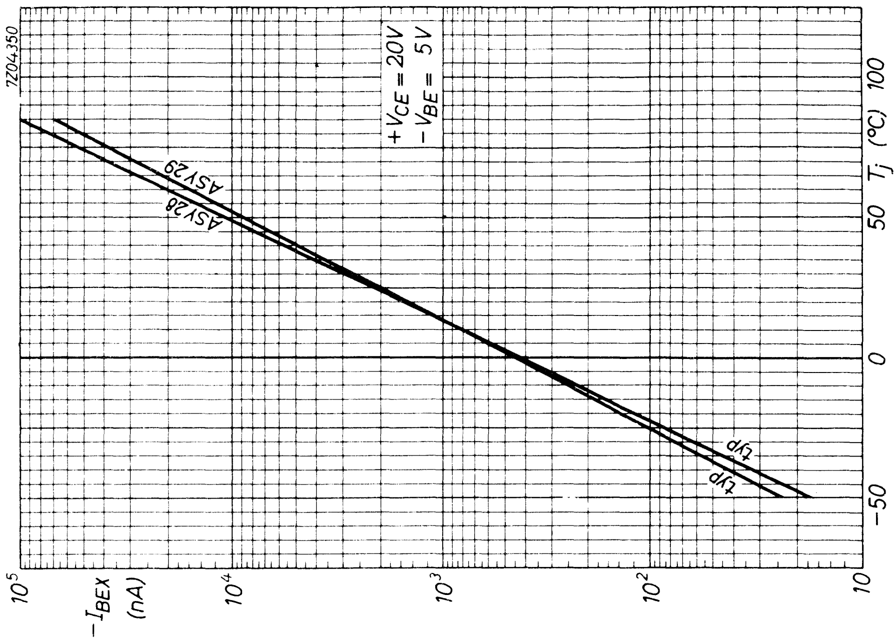


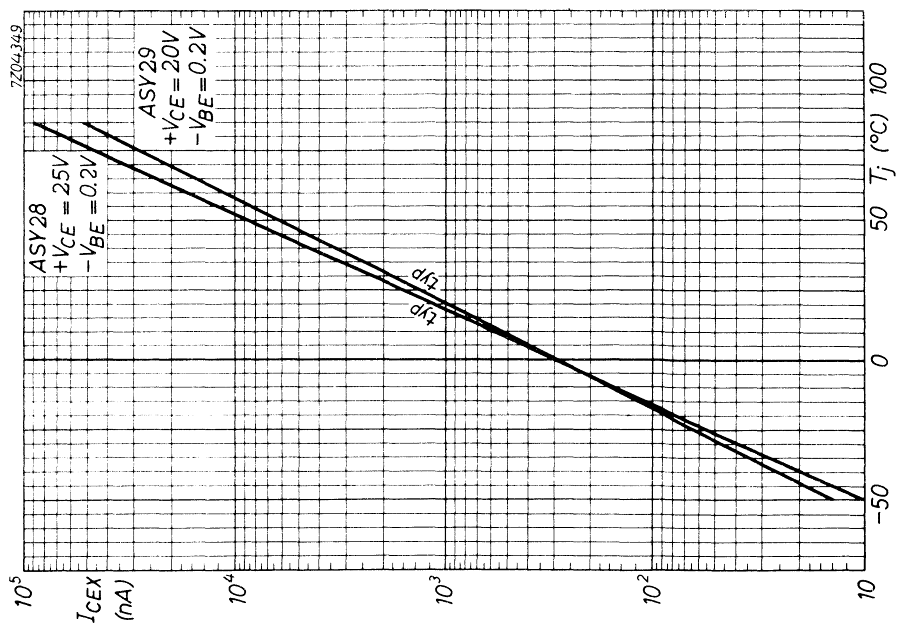


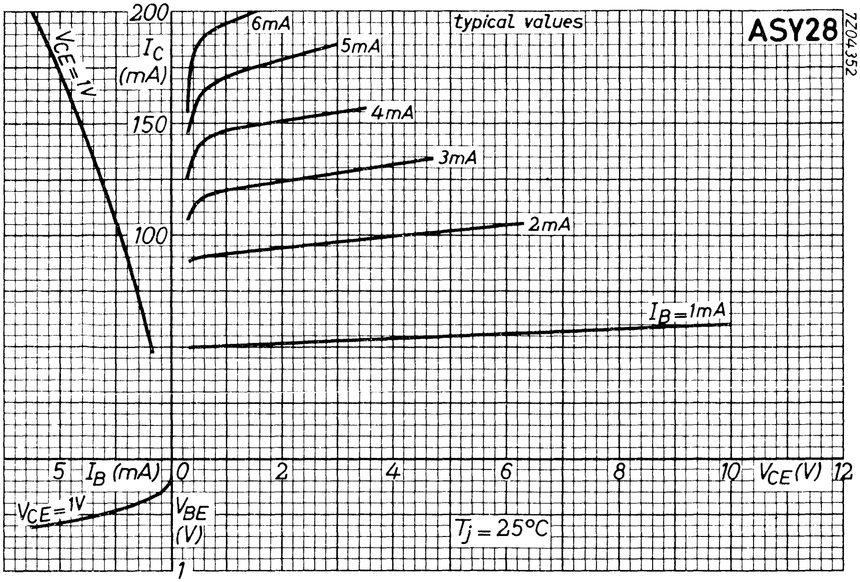
7Z3 0028

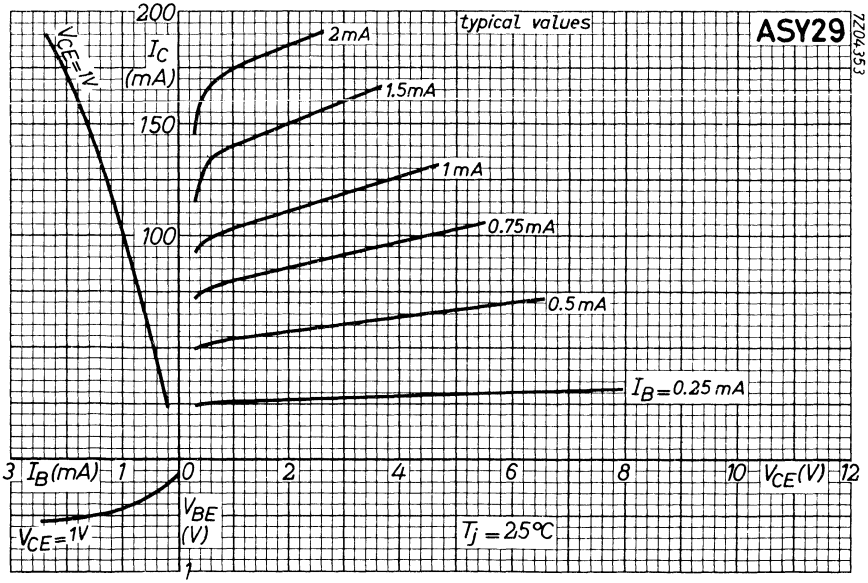

7Z04351–1.19.25.bh.
max
typ
V_{EB} = 5V
T_j (°C)
100
50
0
−50
I_{EBO} (nA)
10^6
10^5
10^4
10^3
10^2
10
1

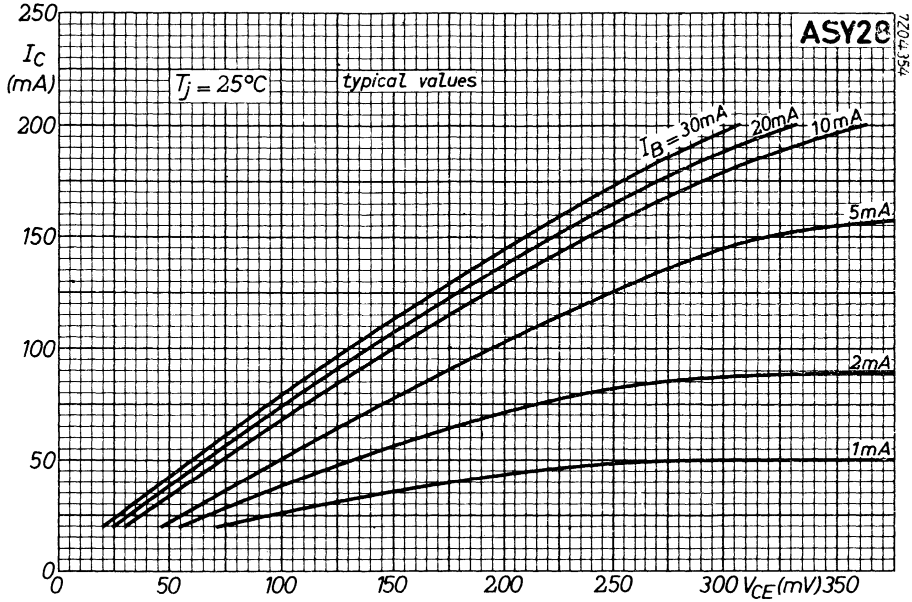

7Z04348–1.19.25.bh.
max
typ
V_{CB} = V_{CBO}max
5V
V_{CBO}max
5V
T_j (°C)
100
50
0
−50
I_{CBO} (nA)
10^6
10^5
10^4
10^3
10^2
10
1

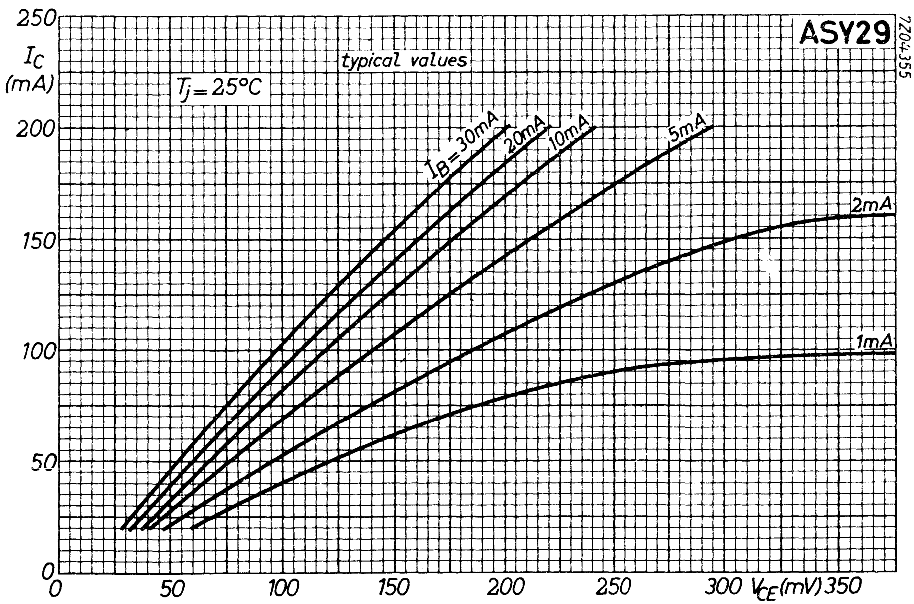

7Z04350
+VCE = 20V
−VBE = 5V
ASY29
ASY28
typ
typ
Tj (°C)
100
50
0
−50
−IBEX
(nA)
10^5
10^4
10^3
10^2
10

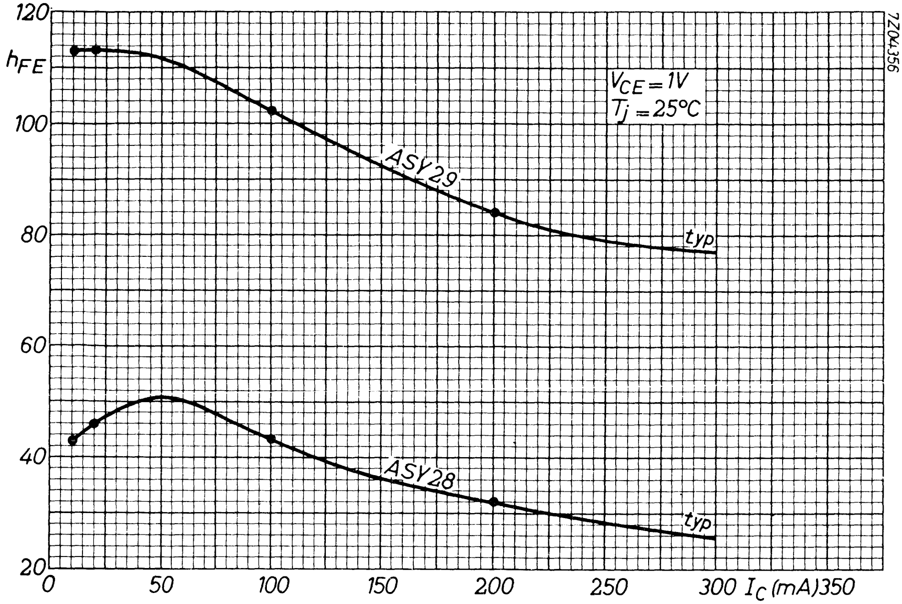

7Z04349
ASY29
+VCE = 20V
−VBE = 0.2V
ASY28
+VCE = 25V
−VBE = 0.2V
typ
typ
Tj (°C)
100
50
0
−50
ICEX
(nA)
10^5
10^4
10^3
10^2
10

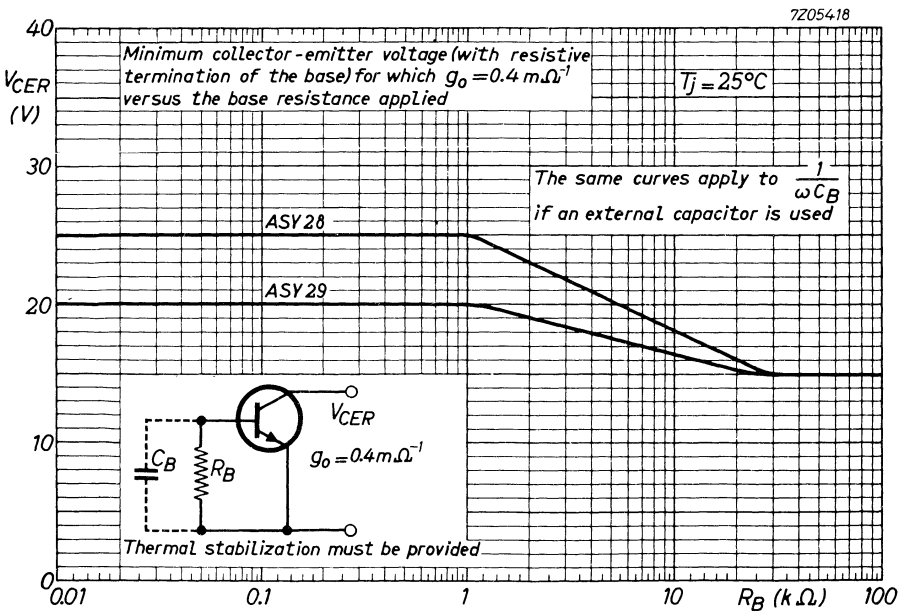

typical values
ASY28
7Z04352
200
I_C
(mA)
150
100
6mA
5mA
4mA
3mA
2mA
I_B=1mA
V_{CE}=1V
5
I_B (mA)
0
2
4
6
8
10
V_{CE}(V)
12
V_{BE}
(V)
1
T_j = 25°C

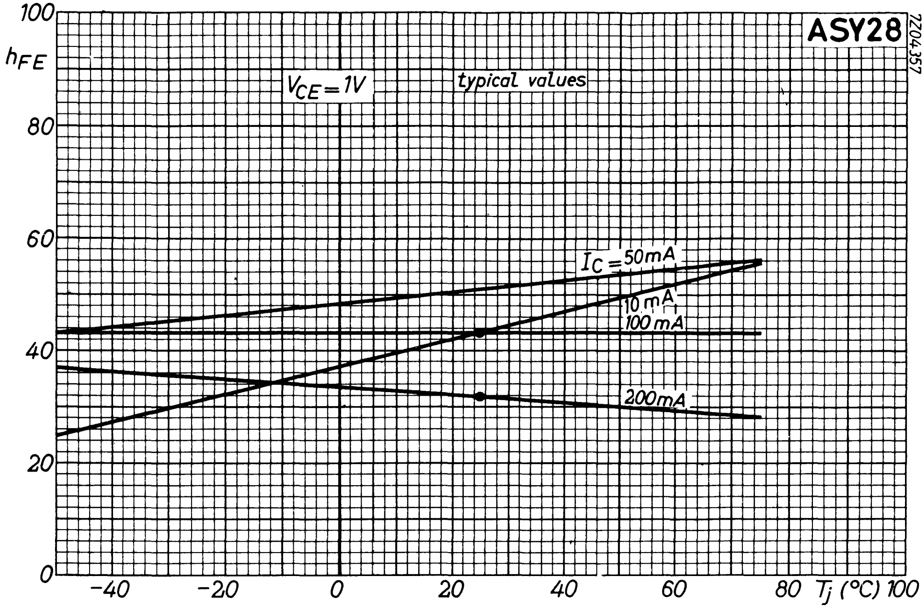

typical values
ASY29
7Z04353
200
I_C
(mA)
150
100
2mA
1.5mA
1mA
0.75mA
0.5mA
I_B=0.25 mA
V_{CE}=1V
3
I_B(mA)
1
0
2
4
6
8
10
V_{CE}(V)
12
V_{BE}
(V)
1
T_j = 25°C

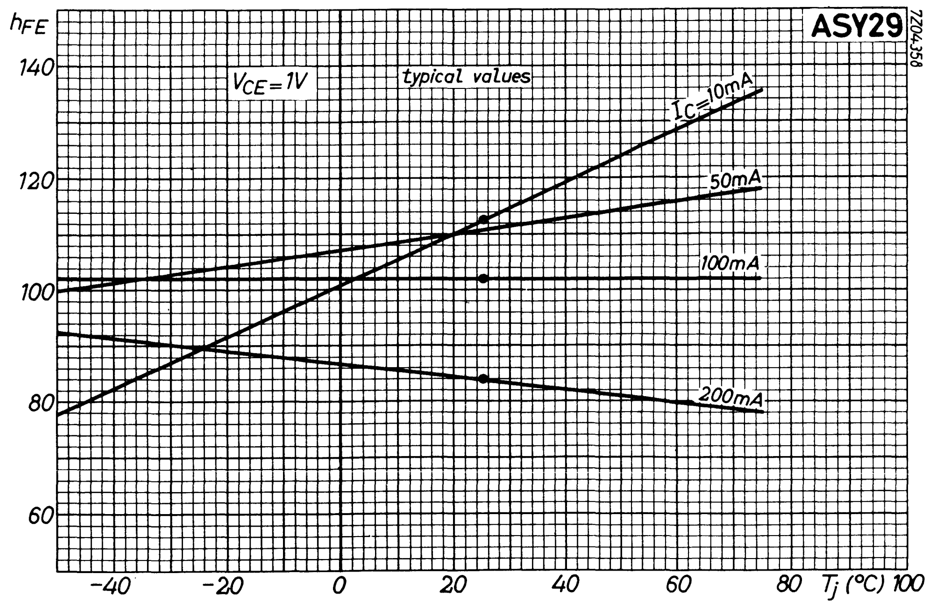

ASY28
7Z04354
I_C (mA)
$T_j = 25°C$
typical values
$I_B = 30mA$
20mA
10mA
5mA
2mA
1mA
250
200
150
100
50
0
0
50
100
150
200
250
300
350
V_{CE} (mV)

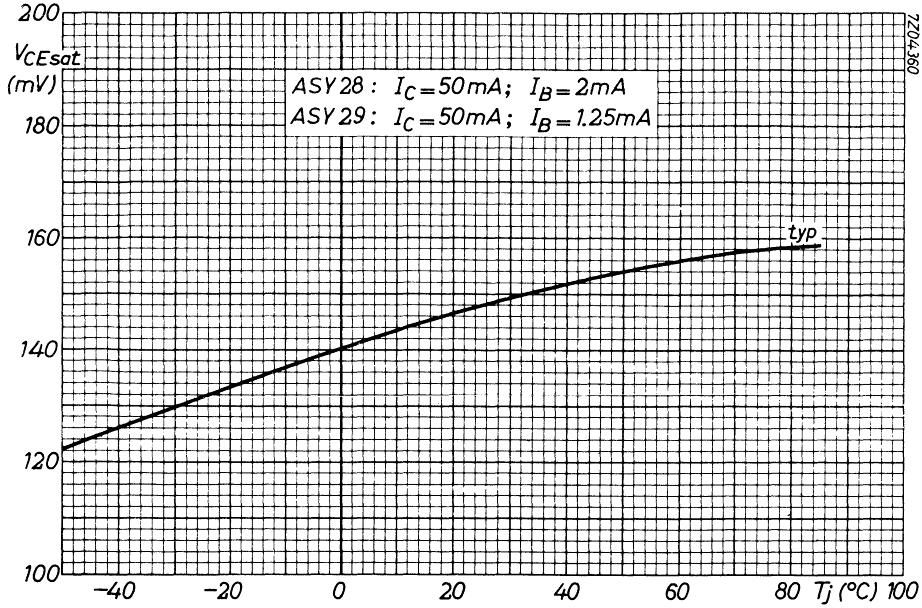

ASY29
7Z04355
I_C (mA)
typical values
$T_j = 25°C$
$I_B = 30mA$
20mA
10mA
5mA
2mA
1mA
250
200
150
100
50
0
0
50
100
150
200
250
300
350
V_{CE} (mV)

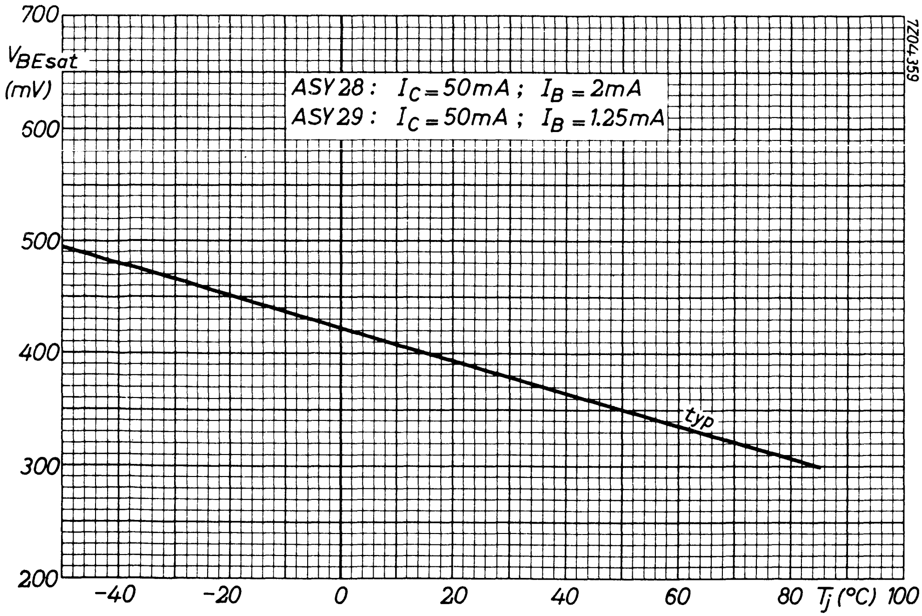

7Z04356
120
h_{FE}
100
80
60
40
20
0
50
100
150
200
250
300
I_C (mA)
350
$V_{CE} = 1V$
$T_j = 25°C$
ASY29
typ
ASY28
typ

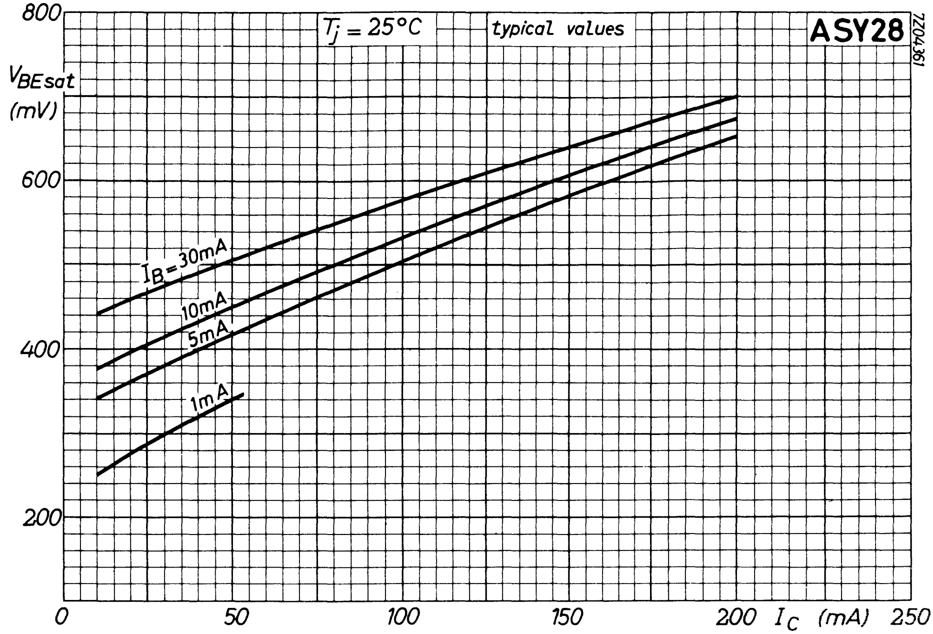

7Z05418
40
V_{CER}
(V)
30
20
10
0
0.01
0.1
1
10
R_B (k Ω)
100
Minimum collector-emitter voltage (with resistive termination of the base) for which $g_o = 0.4\ m\Omega^{-1}$ versus the base resistance applied
$T_j = 25°C$
The same curves apply to $\frac{1}{\omega C_B}$ if an external capacitor is used
ASY28
ASY29
C_B
R_B
V_{CER}
$g_o = 0.4 m\Omega^{-1}$
Thermal stabilization must be provided

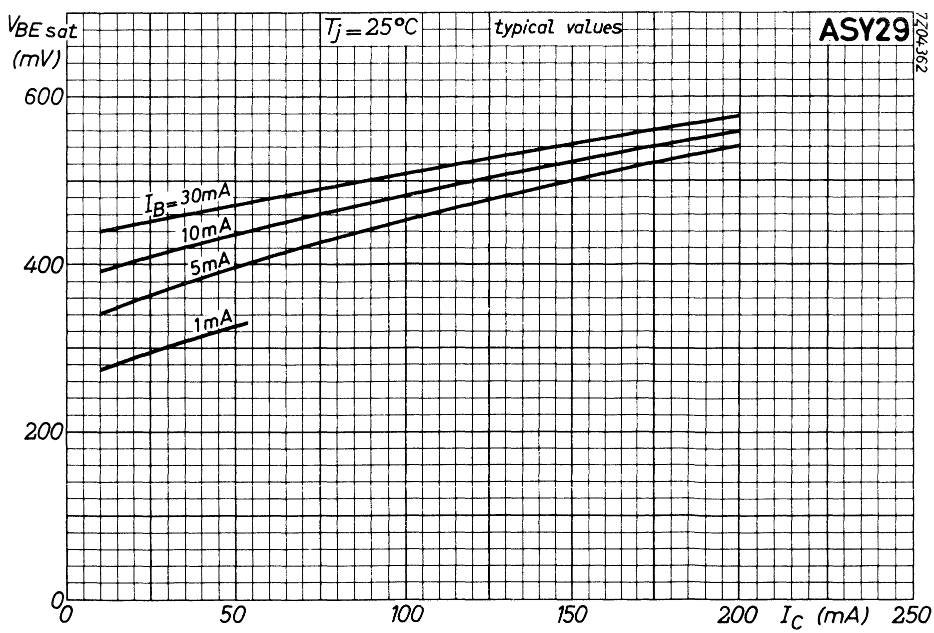

ASY28
7Z04357
h_{FE}
$V_{CE}=1V$
typical values
$I_C=50mA$
10 mA
100 mA
200mA
100
80
60
40
20
0
-40
-20
0
20
40
60
80
T_j (°C)
100

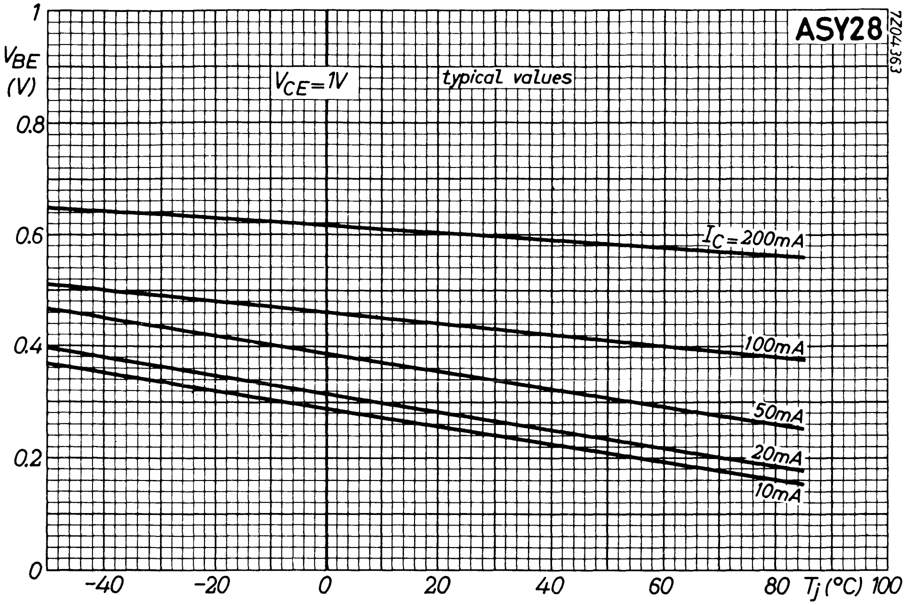

ASY29
7Z04358
h_{FE}
$V_{CE}=1V$
typical values
$I_C=10mA$
50mA
100mA
200mA
140
120
100
80
60
-40
-20
0
20
40
60
80
T_j (°C)
100

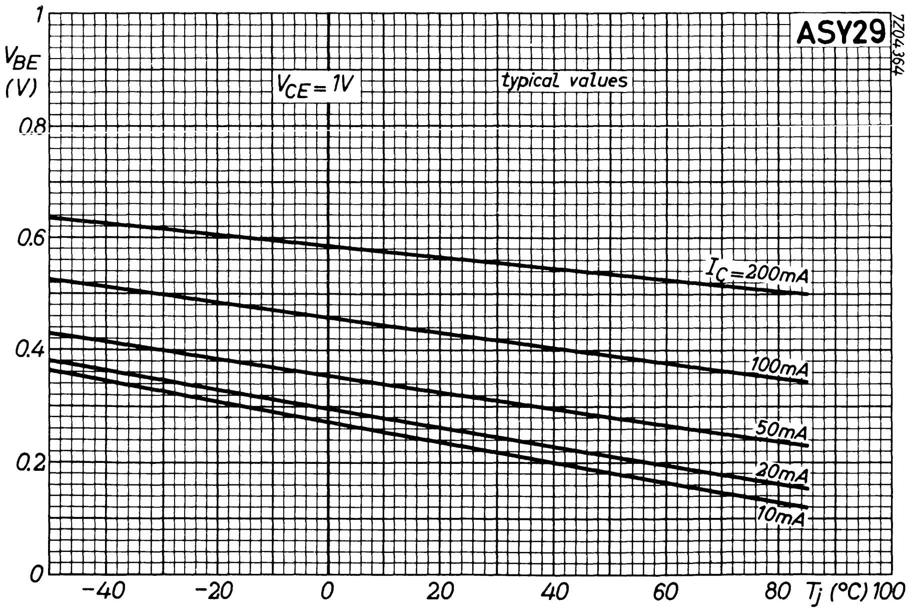

200
V_{CEsat}
(mV)
180
160
140
120
100
ASY 28 : $I_C = 50mA$; $I_B = 2mA$
ASY 29 : $I_C = 50mA$; $I_B = 1.25mA$
typ
−40
−20
0
20
40
60
80
T_j (°C)
100
7Z04360

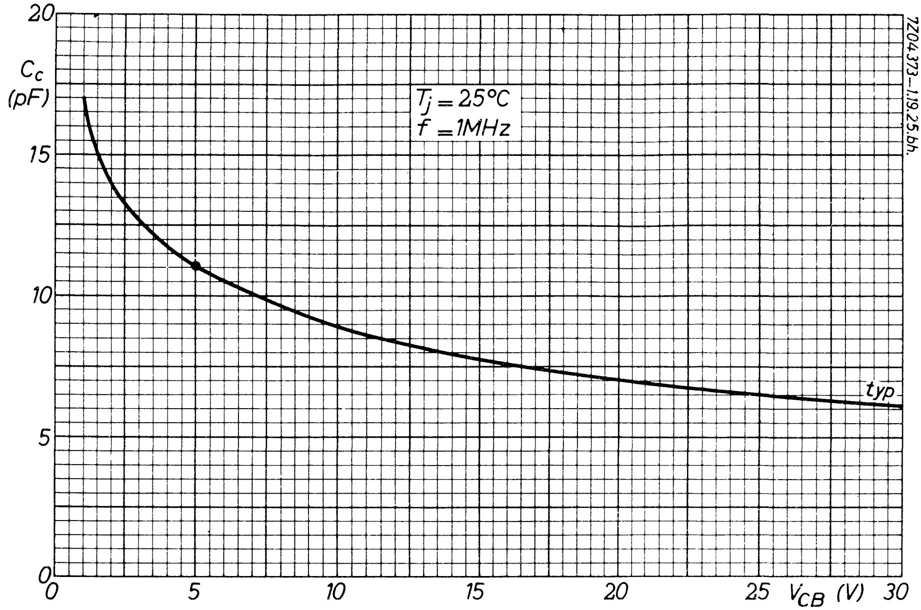

700
V_{BEsat}
(mV)
600
500
400
300
200
ASY 28 : $I_C = 50mA$; $I_B = 2mA$
ASY 29 : $I_C = 50mA$; $I_B = 1.25mA$
typ
−40
−20
0
20
40
60
80
T_j (°C)
100
7Z04359

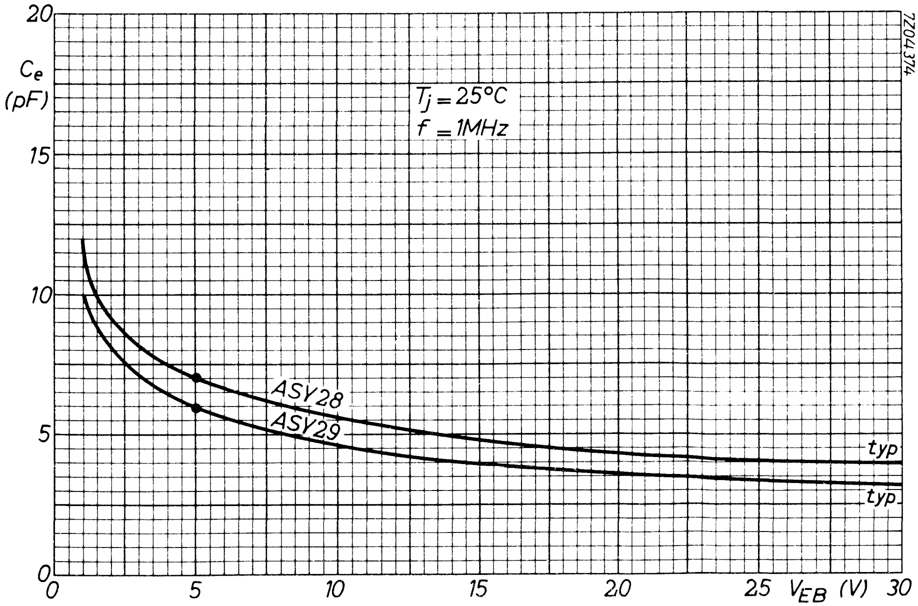

800
V_{BEsat}
(mV)
600
400
200
0
50
100
150
200
I_C (mA)
250
$T_j = 25°C$
typical values
ASY28
7Z04361
$I_B = 30mA$
10mA
5mA
1mA

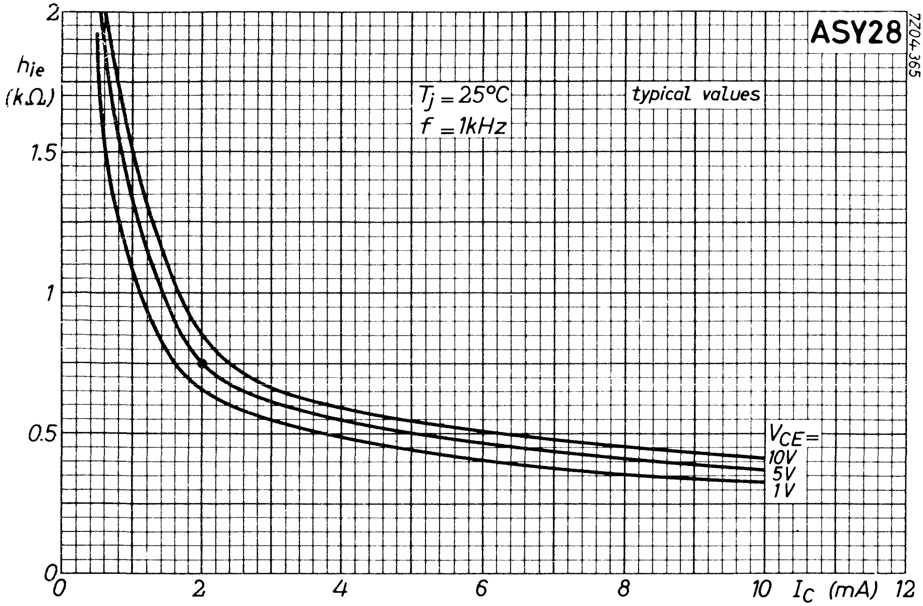

$V_{BE sat}$
(mV)
600
400
200
0
0
50
100
150
200
I_C (mA)
250
$T_j = 25°C$
typical values
ASY29
7Z04362
$I_B = 30mA$
10mA
5mA
1mA

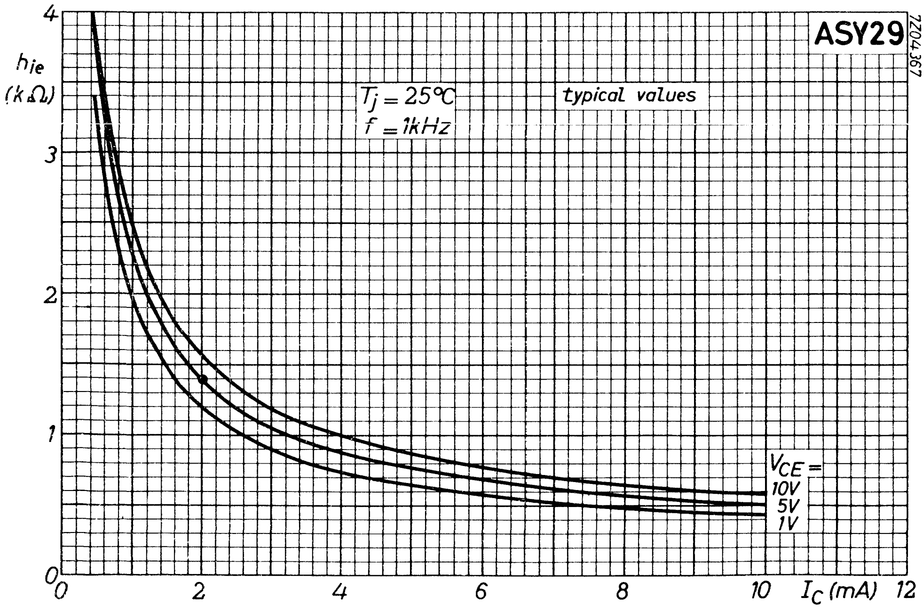

ASY28
7Z04363
V_{BE} (V)
V_{CE}=1V
typical values
I_C=200mA
100mA
50mA
20mA
10mA
1
0.8
0.6
0.4
0.2
0
-40
-20
0
20
40
60
80
T_j (°C)
100

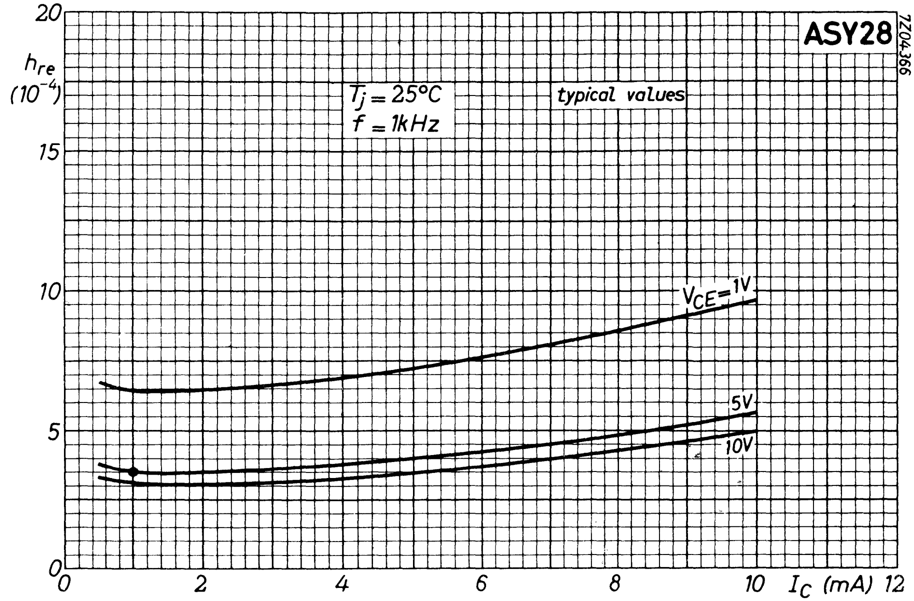

ASY29
7Z04364
V_{BE} (V)
V_{CE}=1V
typical values
I_C=200mA
100mA
50mA
20mA
10mA
1
0.8
0.6
0.4
0.2
0
-40
-20
0
20
40
60
80
T_j (°C)
100

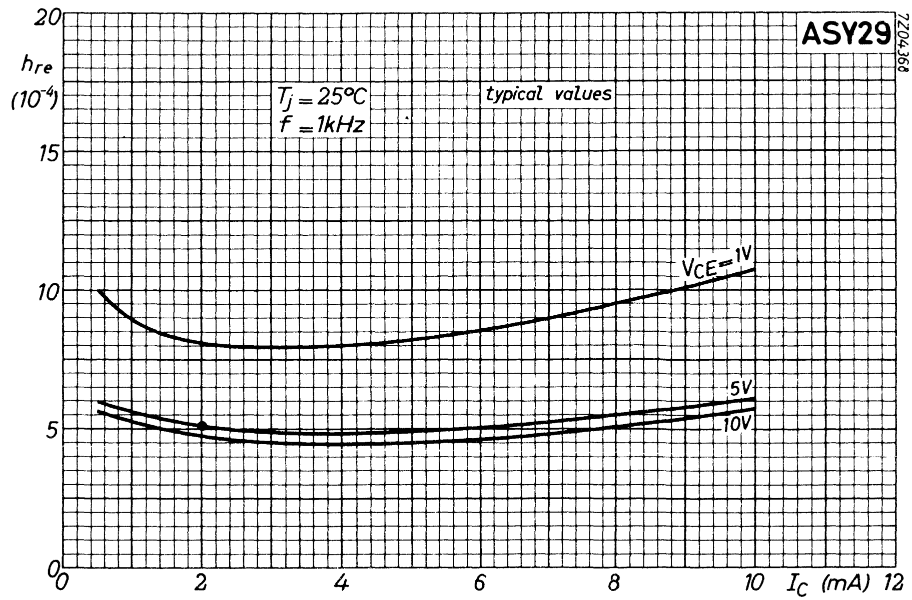

20
C_c
(pF)
15
10
5
0
$T_j = 25°C$
$f = 1MHz$
typ
0
5
10
15
20
25
V_{CB} (V)
30
7Z04373-1.19.25.bh.

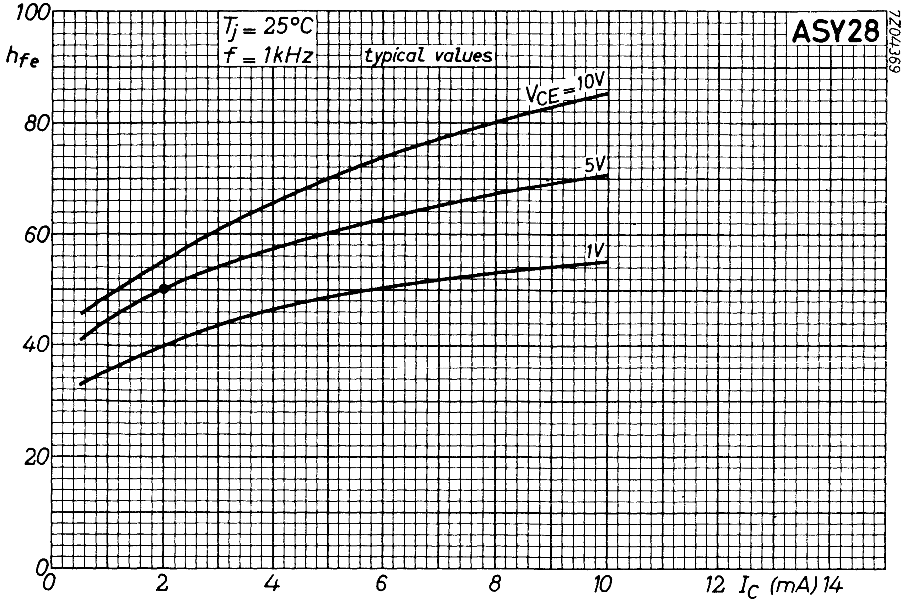

20
C_e
(pF)
15
10
5
0
$T_j = 25°C$
$f = 1MHz$
ASY28
ASY29
typ
typ
0
5
10
15
20
25
V_{EB} (V)
30
7Z04374

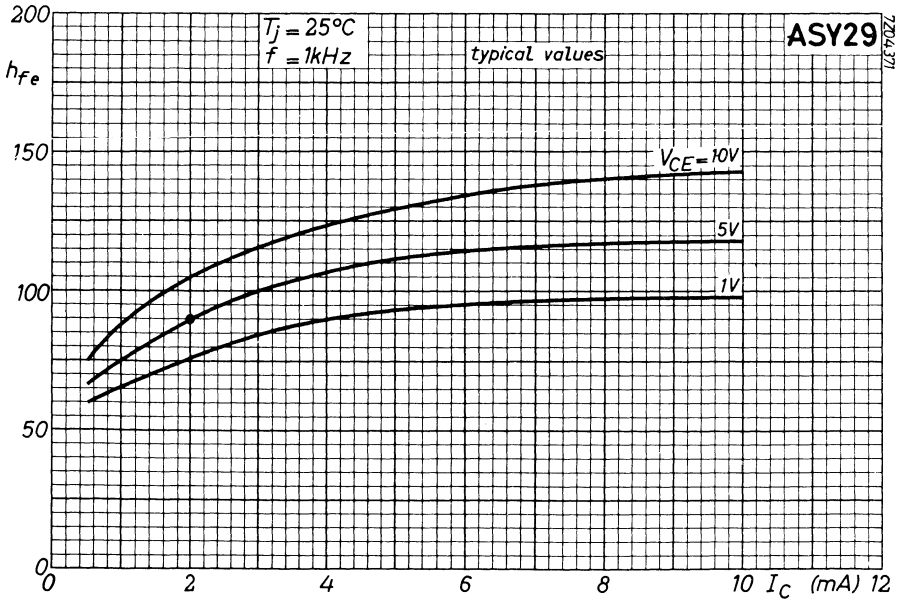

ASY28
7Z04 365
h_{ie} (kΩ)
$T_j = 25°C$
$f = 1kHz$
typical values
V_{CE}=
10V
5V
1V
I_C (mA)
2
1.5
1
0.5
0
0
2
4
6
8
10
12

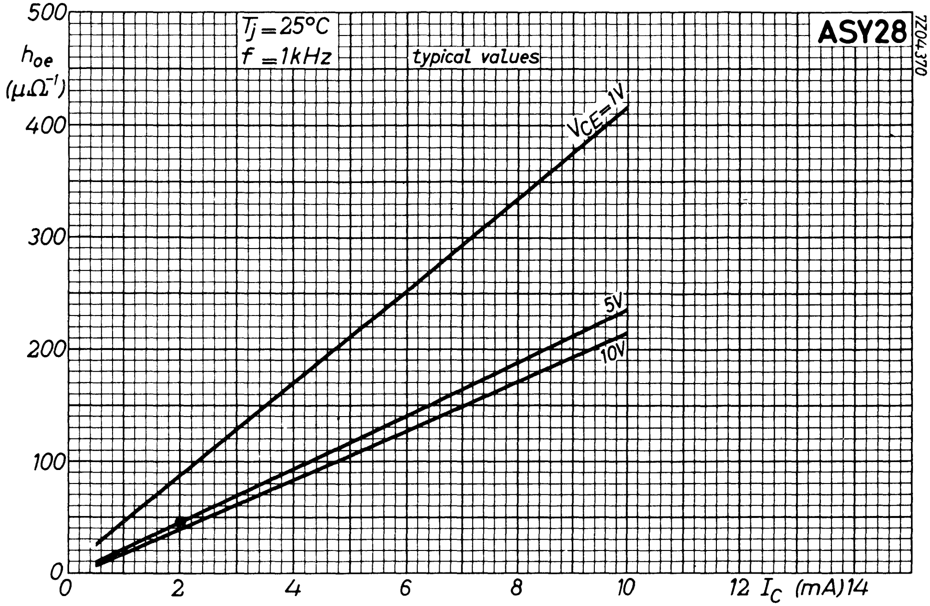

ASY29
7Z04 367
h_{ie} (kΩ)
$T_j = 25°C$
$f = 1kHz$
typical values
V_{CE}=
10V
5V
1V
I_C (mA)
4
3
2
1
0
0
2
4
6
8
10
12

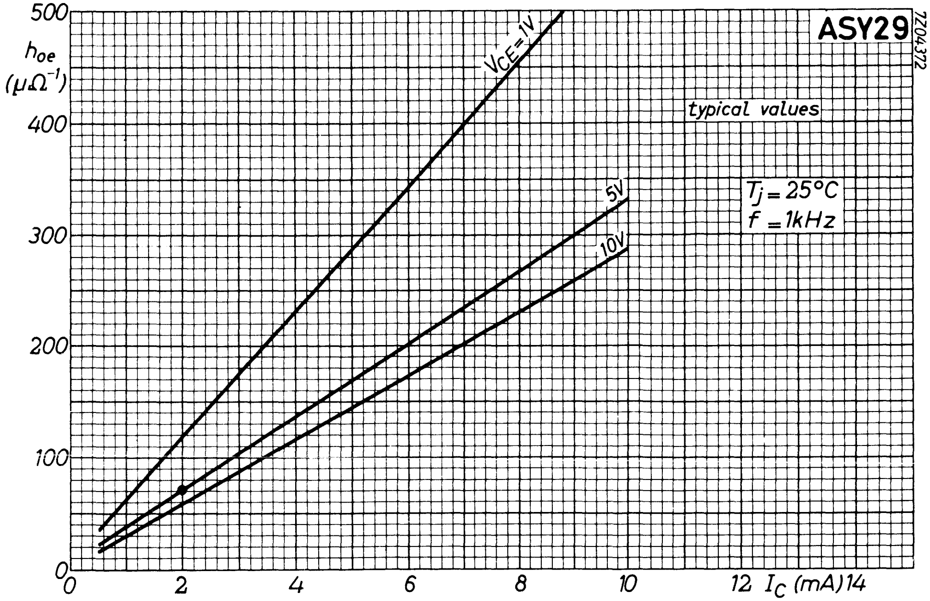

ASY28
7Z04366
h_{re}
(10^{-4})
$T_j = 25°C$
$f = 1kHz$
typical values
$V_{CE} = 1V$
5V
10V
I_C (mA)
0
2
4
6
8
10
12
5
15
20

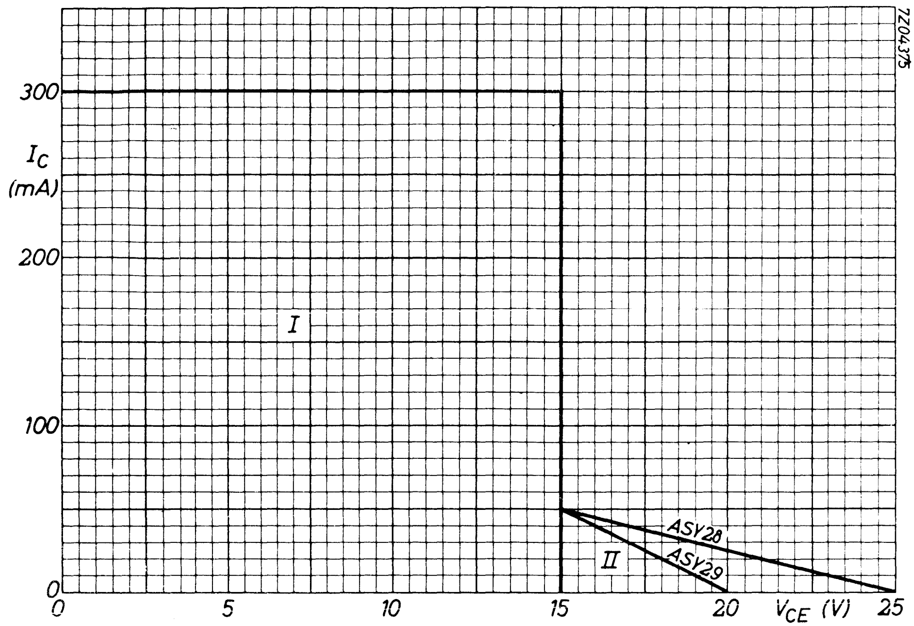

ASY29
7Z04368
h_{re}
(10^{-4})
$T_j = 25°C$
$f = 1kHz$
typical values
$V_{CE} = 1V$
5V
10V
I_C (mA)
0
2
4
6
8
10
12
5
15
20


100
h_{fe}
80
60
40
20
0
$T_j = 25°C$
$f = 1kHz$
typical values
ASY28
7Z04369
$V_{CE} = 10V$
5V
1V
0
2
4
6
8
10
12
I_C (mA)
14


200
h_{fe}
150
100
50
0
$T_j = 25°C$
$f = 1kHz$
typical values
ASY29
7Z04371
$V_{CE} = 10V$
5V
1V
0
2
4
6
8
10
I_C (mA)
12


500
h_{oe}
$(\mu\Omega^{-1})$
400
300
200
100
0
$T_j = 25°C$
$f = 1kHz$
typical values
ASY28
7Z04370
$V_{CE} = 1V$
5V
10V
0
2
4
6
8
10
12 I_C (mA) 14


500
h_{oe}
$(\mu\Omega^{-1})$
400
300
200
100
0
ASY29
7Z04372
$V_{CE} = 1V$
typical values
5V
10V
$T_j = 25°C$
$f = 1kHz$
0
2
4
6
8
10
12 I_C (mA) 14



I = permissible region of operation under all base-emitter conditions

II = additional region of operation when the transistor is cut-off with $-V_{BE} > 0.2$ V

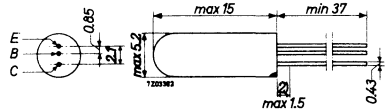
Outside the permissible regions of operation the transistor can withstand transient energies of 15 μWs, provided:

$$0.2 \text{ V} < -V_{BE} < 2 \text{ V and } I_C < 200 \text{ mA}$$

7Z3 0052

GERMANIUM ALLOY TRANSISTOR of the p-n-p type in all-glass construction for medium-current medium-speed computer logic applications

Dimensions in mm   The red dot indicates the collector



LIMITING VALUES (Absolute maximum values)

Collector

Voltage (base reference)	$-V_{CB}$ = max.	25 V
Voltage (emitter reference)	$-V_{CE}$ = max.	20 V
Current		
Peak	$-I_{CM}$ = max.	200 mA
D.C. and average (averaging time = max. 20 msec)	$-I_C$ = max.	100 mA
	(t_{av} = max.	20 msec)

Emitter

Voltage (base reference)	$-V_{EB}$ = max.	20 V
Current		
Peak	I_{EM} = max.	200 mA
D.C. and average (averaging time = max. 20 msec)	I_E = max.	125 mA
	(t_{av} = max.	20 msec)

Base

Current		
Peak	$-I_{BM}$ = max.	200 mA
D.C. and average (averaging time = max. 20 msec)	$-I_B$ = max.	25 mA
	(t_{av} = max.	20 msec)

Dissipation

Total dissipation	P_{tot} = max.	125 mW [1])

Temperatures

Storage	T_s =	-55 °C to +75 °C
Junction	T_j = max.	75 °C

[1]) The maximum admissible dissipation for a certain application can be calculated from the formula: $P_{tot} = \max. \frac{T_{j\,max} - T_{amb}}{K}$

[2]) Not tinned

7Z2 1118   1.

THERMAL DATA

Thermal resistance from junction to ambience in free air	K = max. 0.4 °C/mW
Thermal resistance from junction to case	K = max. 0.2 °C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector current at I_E = 0 mA	
$-I_{CBO}$ ($-V_{CB}$ = 5 V)	< 3 µA
Emitter current at I_C = 0 mA	
$-I_{EBO}$ ($-V_{EB}$ = 5 V)	< 3 µA
Base current at V_{CB} = 0 V	
$-I_B$ (I_E = 10 mA; V_{CB} = 0 V)	< 325 µA
$-I_B$ (I_E = 20 mA; V_{CB} = 0 V)	> 250 µA < 645 µA
$-I_B$ (I_E = 100 mA; V_{CB} = 0 V)	< 4.75 mA
Collector voltage	
$-V_{CB}$ ($-I_C$ = 40 µA; I_E = 0 mA; T_{amb} = 60 °C)	> 25 V
Emitter voltage	
$-V_{EB}$ ($-I_E$ = 100 µA; I_C = 0 mA; T_{amb} = 60 °C)	> 20 V
V_{EB} (I_E = 100 mA; V_{CB} = 0 V)	< 0.65 V
$-V_{BE}$ ($-I_C$ = 50 mA; $-I_B$ = 2.4 mA)	< 0.55 V
Punch through voltage	
V_{PT}	> 20 V

7Z2 2263   2.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

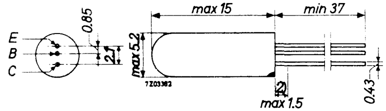
T_{amb} = 25 °C unless otherwise specified

Collector current		
$-I_C$ { $-V_{CE}$ = 20 V; V_{BE} = 0.2 V; T_{amb} = 60 °C }	<	35 µA
Base current		
I_B { $-V_{CE}$ = 20 V; V_{BE} = 5 V; T_{amb} = 60 °C }	<	35 µA
Collector voltage		
$-V_{CE}$ ($-I_C$ = 5 mA; I_B = 0 mA)	>	15 V
Floating potential		
$-V_{BE}$ ($-V_{CE}$ = 25 V; T_{amb} = 60 °C)	<	200 mV
Collector voltage in bottoming		
$-V_{CE}$ ($-I_C$ = 10 mA; $-I_B$ = 0.33 mA)	<	0.20 V
$-V_{CE}$ ($-I_C$ = 50 mA; $-I_B$ = 2.0 mA)	<	0.25 V
Base voltage		
$-V_{BE}$ ($-I_C$ = 10 mA; $-I_B$ = 0.4 mA)	>	0.20 V
	<	0.37 V
Frequency at which $\lvert h_{fe} \rvert$ = 1		
f_1 ($-V_{CE}$ = 5 V; $-I_C$ = 3 mA)	>	4 Mc/s
Collector capacitance		
c_c ($-V_{CB}$ = 5 V; I_E = 0 mA)	<	16 pF
Emitter capacitance		
c_e ($-V_{EB}$ = 5 V; I_C = 0 mA)	<	13 pF
Transient behaviour		
Time constant with current feed		
τ_c ($-V_{CE}$ = 0.75 V; $-I_{CM}$ = 50 mA)	<	2.2 µsec
Time constant with voltage feed		
τ_v ($-V_{CE}$ = 0.75 V; $-I_{CM}$ = 1 mA)	<	0.2 µsec
Desaturation time constant		
τ_s ($-I_C$ = 0 mA; $-I_B$ = 1 mA)	<	1.4 µsec

7Z2 2264

GERMANIUM ALLOY TRANSISTOR of the p-n-p type in all-glass construction for medium-current medium-speed computer logic applications

Dimensions in mm   The red dot indicates the collector



LIMITING VALUES (Absolute maximum values)

Collector

Voltage (base reference)	$-V_{CB}$ = max.	25 V
Voltage (emitter reference)	$-V_{CE}$ = max.	20 V
Current		
Peak	$-I_{CM}$ = max.	200 mA
D.C. and average (averaging time = max. 20 msec)	$-I_C$ = max.	100 mA
	(t_{av} = max.	20 msec)

Emitter

Voltage (base reference)	$-V_{EB}$ = max.	20 V
Current		
Peak	I_{EM} = max.	200 mA
D.C. and average (averaging time = max. 20 msec)	I_E = max.	125 mA
	(t_{av} = max.	20 msec)

Base

Current		
Peak	$-I_{BM}$ = max.	200 mA
D.C. and average (averaging time = max. 20 msec)	$-I_B$ = max.	25 mA
	(t_{av} = max.	20 msec)

Dissipation

Total dissipation	P_{tot} = max.	125 mW [1])

Temperatures

Storage	T_s =	-55 °C to +75 °C
Junction	T_j = max.	75 °C

[1]) The maximum admissible dissipation for a certain application can be calculated from the formula: $P_{tot} = \text{max.}\ \frac{T_j\ \text{max} - T_{amb}}{K}$

[2]) Not tinned

7Z2 1118   1.

THERMAL DATA

Thermal resistance from junction to ambience in free air	K = max. 0.4 °C/mW
Thermal resistance from junction to case	K = max. 0.2 °C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector current at I_E = 0 mA	
$-I_{CBO}$ ($-V_{CB}$ = 5 V)	< 3 µA
Emitter current at I_C = 0 mA	
$-I_{EBO}$ ($-V_{EB}$ = 5 V)	< .3 µA
Base current at V_{CB} = 0 V	
$-I_B$ (I_E = 10 mA; V_{CB} = 0 V)	< 195 µA
$-I_B$ (I_E = 20 mA; V_{CB} = 0 V)	> 130 µA < 390 µA
$-I_B$ (I_E = 100 mA; V_{CB} = 0 V)	< 3.25 mA
Collector voltage	
$-V_{CB}$ ($-I_C$ = 40 µA; I_E = 0 mA; T_{amb} = 60 °C)	> 25 V
Emitter voltage	
$-V_{EB}$ ($-I_E$ = 100 µA; I_C = 0 mA; T_{amb} = 60 °C)	> 20 V
V_{EB} (I_E = 100 mA; V_{CB} = 0 V)	< 0.55 V
$-V_{BE}$ ($-I_C$ = 50 mA; $-I_B$ = 1.55 mA)	< 0.45 V
Punch through voltage	
V_{PT}	> 20 V

7Z2 2265   2.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

T_{amb} = 25 °C unless otherwise specified

Collector current		
$-I_C$ { $-V_{CE}$ = 20 V; V_{BE} = 0.2 V; T_{amb} = 60 °C }	<	35 µA
Base current		
I_B { $-V_{CE}$ = 20 V; V_{BE} = 5 V; T_{amb} = 60 °C }	<	35 µA
Collector voltage		
$-V_{CE}$ ($-I_C$ = 5 mA; I_B = 0 mA)	>	15 V
Floating potential		
$-V_{BE}$ ($-V_{CE}$ = 20 V; T_{amb} = 60 °C)	<	200 mV
Collector voltage in bottoming		
$-V_{CE}$ ($-I_C$ = 10 mA; $-I_B$ = 0.2 mA)	<	0.20 V
$-V_{CE}$ ($-I_C$ = 50 mA; $-I_B$ = 1.25 mA)	<	0.25 V
Base voltage		
$-V_{BE}$ ($-I_C$ = 10 mA; $-I_B$ = 0.25 mA)	> <</br>	0.15 V 0.32 V
Frequency at which $\|h_{fe}\| = 1$		
f_1 ($-V_{CE}$ = 5 V; $-I_C$ = 3 mA)	>	6 Mc/s
Collector capacitance		
c_c ($-V_{CB}$ = 5 V; I_E = 0 mA)	<	16 pF
Emitter capacitance		
c_e ($-V_{EB}$ = 5 V; I_C = 0 mA)	<	13 pF
Transient behaviour		
Time constant with current feed		
τ_c ($-V_{CE}$ = 0.75 V; $-I_{CM}$ = 50 mA)	<	2.2 µsec
Time constant with voltage feed		
τ_v ($-V_{CE}$ = 0.75 V; $-I_{CM}$ = 1 mA)	<	0.2 µsec
Desaturation time constant		
τ_s ($-I_C$ = 0 mA; $-I_B$ = 1 mA)	<	1.4 µsec

7Z2 2266

SYMMETRICAL
N-P-N SWITCHING TRANSISTORS

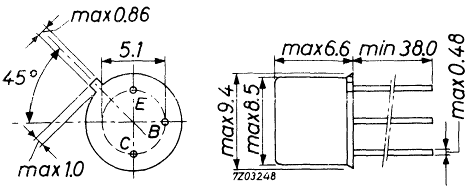
Symmetrical N-P-N germanium alloy transistors in a TO-5 metal envelope with the base connected to the case intended for high current medium speed switching applications.

QUICK REFERENCE DATA

			ASY73	ASY74	ASY75	
Collector-base voltage (open emitter)	V_{CBO}	max.	30	30	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	15	15	V
Collector-current (d.c. or average)	I_C	max.	400	400	400	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	140	140	140	mW
Junction temperature	T_j	max.	75	75	75	°C
D.C. current gain at T_j = 25 °C						
$-I_E$ = 200 mA; V_{CB} = 0	h_{FE}	>	20	35	50	
$-I_C$ = 200 mA; V_{EB} = 0	h_{FC}	>	12	20	20	
Transition frequency						
$-I_E$ = 3 mA; V_{CB} = 5 V	f_T	>	4	6	10	MHz
Desaturation time constant						
I_B = 1 mA; I_C = 0	τ_s		<1.75	1.75	1.75	μs

MECHANICAL DATA Dimensions in mm

TO-5
Base connected to case



7Z3 0688

RATINGS (Limiting values) [1])

Voltages

Collector-base voltage (open-emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	15	V [2])
Collector-emitter voltage with $-V_{BE}$ = 0.2 V	V_{CEX}	max.	20	V [2])
Emitter-base voltage (open collector)	V_{EBO}	max.	30	V

Currents

Collector current (d.c. or average over any 20 ms period)	I_C	max.	400	mA
Emitter current (d.c. or average over any 20 ms period)	$-I_E$	max.	400	mA
Base current (d.c. or average over any 20 ms period)	I_B	max.	40	mA
Base current (peak value)	I_{BM}	max.	400	mA

Power dissipation

Total steady state power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	140	mW

Temperatures

Storage temperature	T_{stg}		-55 to 85	°C
Operating junction temperature	T_j	max.	75	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.35	°C/mW
From junction to case	$R_{th\ j-c}$	=	0.2	°C/mW

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) For switch-off transients with inductive load see page I

7Z3 0689

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

<u>Collector cut-off current</u>

I_E = 0; V_{CB} = 5 V	I_{CBO}	<	3	μA
V_{CB} = 30 V; T_j = 55 °C	I_{CBO}	<	100	μA

<u>Emitter cut-off current</u>

I_C = 0; V_{EB} = 5 V	I_{EBO}	<	3	μA
V_{EB} = 30 V; T_j = 55 °C	I_{EBO}	<	100	μA

<u>Currents at reverse biased emitter junction</u>

V_{CE} = 20 V; $-V_{BE}$ = 0.2 V; T_j = 55 °C	I_{CEX}	<	50	μA
$-V_{BE}$ = 20 V; V_{CB} = 20 V; T_j = 55 °C	$-I_{BEX}$	<	50	μA

<u>Saturation voltages</u>

ASY73.	I_C = 50 mA; I_B = 2.5 mA	V_{CEsat}	<	0.22	V
	I_C = 200 mA; I_B = 10 mA	V_{CEsat}	<	0.30	V
	I_E = 200 mA; I_B = 16.5 mA	V_{ECsat}	<	0.30	V
	I_C = 50 mA; I_B = 3 mA	$V_{BE\,sat}$	<	0.50	V
	I_C = 200 mA; I_B = 12 mA	$V_{BE\,sat}$	<	0.90	V
ASY74.	I_C = 50 mA; I_B = 1.25 mA	V_{CEsat}	<	0.22	V
	I_C = 200 mA; I_B = 5.7 mA	V_{CEsat}	<	0.30	V
	I_C = 400 mA; I_B = 20 mA	V_{CEsat}	<	0.37	V
	I_E = 200 mA; I_B = 10 mA	V_{ECsat}	<	0.30	V
	I_C = 50 mA; I_B = 1.5 mA	$V_{BE\,sat}$	<	0.38	V
	I_C = 200 mA; I_B = 7 mA	$V_{BE\,sat}$	<	0.70	V
	I_C = 400 mA; V_{CB} = 0	$V_{BE\,sat}$	<	0.90	V
ASY75.	I_C = 50 mA; I_B = 0.75 mA	V_{CEsat}	<	0.22	V
	I_C = 200 mA; I_B = 4 mA	V_{CEsat}	<	0.30	V
	I_C = 400 mA; I_B = 13.5 mA	V_{CEsat}	<	0.37	V
	I_E = 200 mA; I_B = 10 mA	$V_{EC\,sat}$	<	0.30	V
	I_C = 50 mA; I_B = 0.95 mA	$V_{BE\,sat}$	<	0.34	V
	I_C = 200 mA; I_B = 5 mA	$V_{BE\,sat}$	<	0.60	V
	I_C = 400 mA; V_{CB} = 0	$V_{BE\,sat}$	<	0.70	V

<u>Sustaining voltage</u>

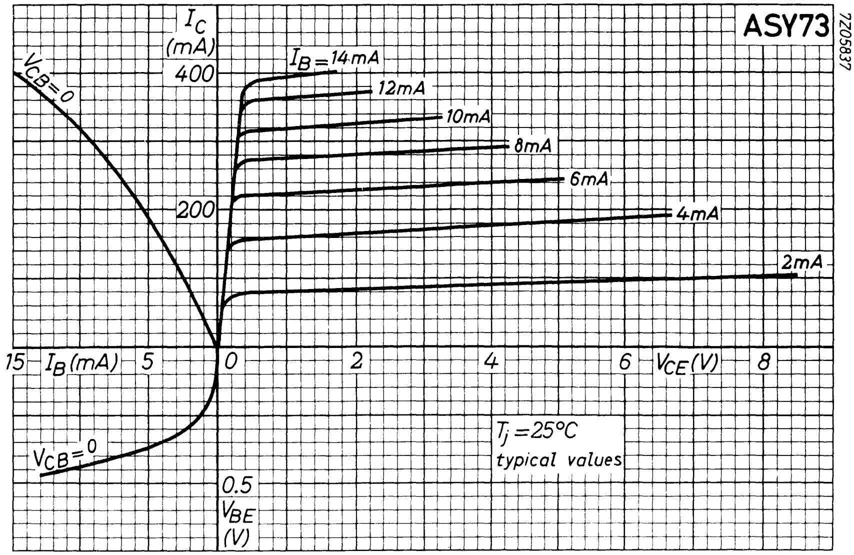
I_C = 10 mA; I_B = 0	$V_{CEOsust}$	>	15	V

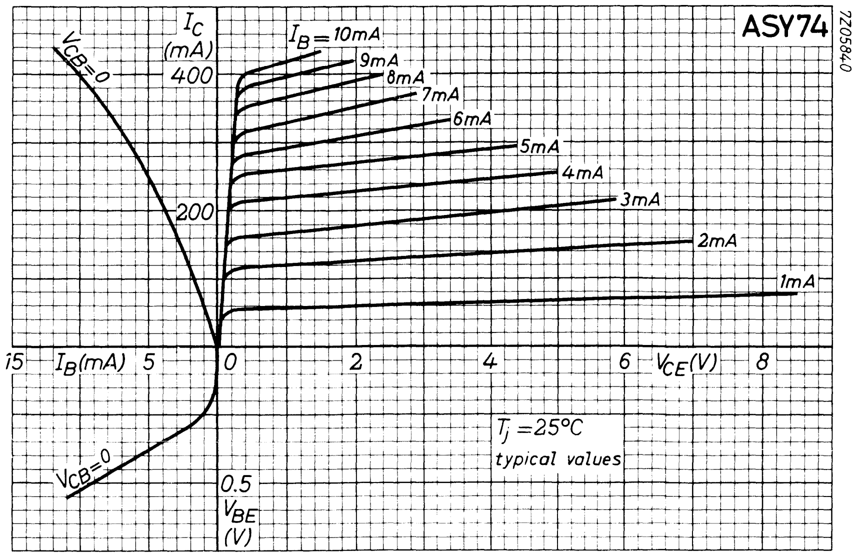
7Z3 0690

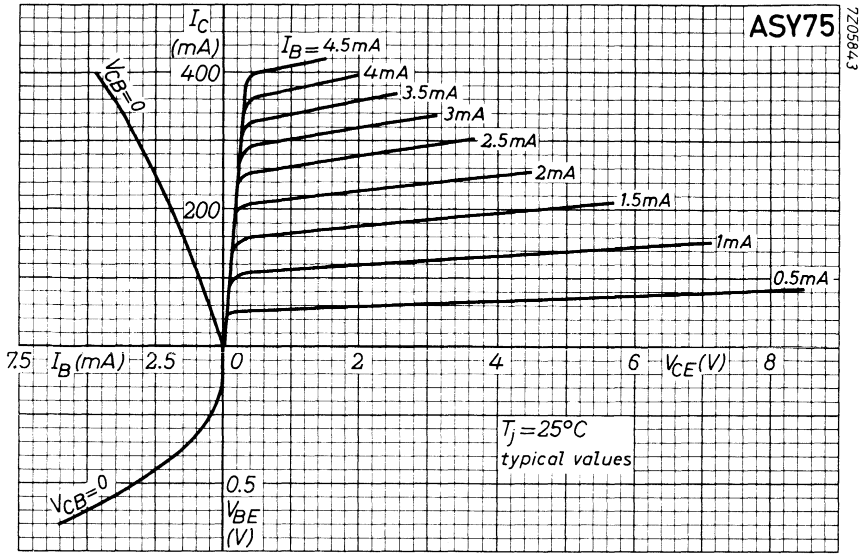
CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

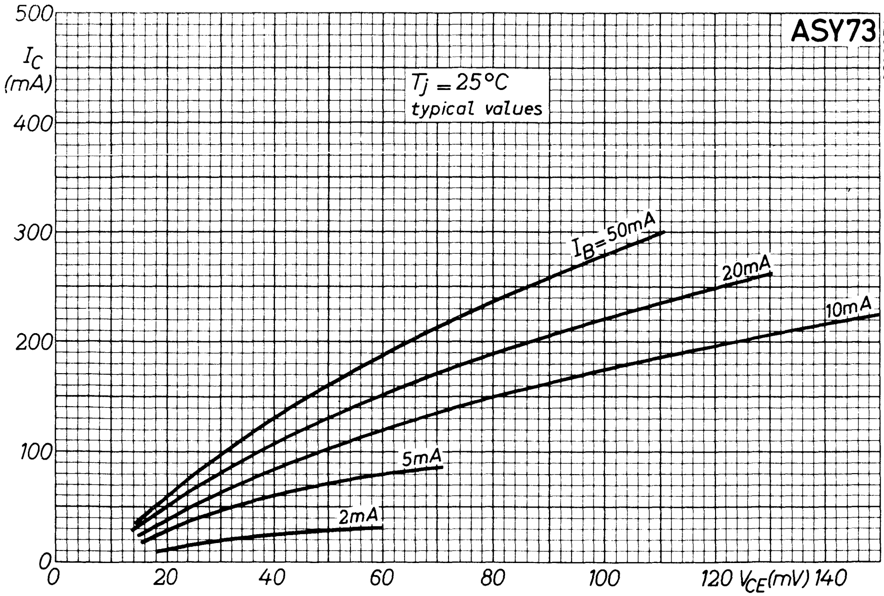
Punch-through voltage	V_{pt}	>	20	V
Floating potential				
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 55$ °C	V_{EBfl}	<	180	mV
$I_C = 0$; $V_{CB} = 20$ V; $T_j = 55$ °C	V_{CBfl}	<	180	mV
D.C. current gain				
ASY73 $V_{CB} = 0$; $-I_E = 50$ mA	h_{FE}	>	25	
$V_{CB} = 0$; $-I_E = 200$ mA	h_{FE}	>	20	
$V_{EB} = 0$; $-I_C = 200$ mA	h_{FC}	>	12	
ASY74 $V_{CB} = 0$; $-I_E = 50$ mA	h_{FE}	>	40	
$V_{CB} = 0$; $-I_E = 200$ mA	h_{FE}	>	35	
$V_{CB} = 0$; $-I_E = 400$ mA	h_{FE}	>	20	
$V_{EB} = 0$; $-I_C = 200$ mA	h_{FC}	>	20	
ASY75 $V_{CB} = 0$; $-I_E = 50$ mA	h_{FE}	>	65	
$V_{CB} = 0$; $-I_E = 200$ mA	h_{FE}	>	50	
$V_{CB} = 0$; $-I_E = 400$ mA	h_{FE}	>	30	
$V_{EB} = 0$; $-I_C = 200$ mA	h_{FC}	>	20	
Switching parameters				
Desaturation time constant $I_B = 1$ mA; $I_C = 0$	τ_s	<	1.75	µs
Current-feed time constant $I_{CM} = 200$ mA; $V_{CE} = 0.75$ V	τ_c	<	1.75	µs
Voltage-feed time constant $I_{CM} = 1$ mA; $V_{CE} = 5$ V	τ_v	<	0.20	µs
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$; $V_{CB} = 5$ V	C_c	<	30	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$; $V_{EB} = 5$ V	C_e	<	30	pF
Transition frequency				
$-I_E = 3$ mA; $V_{CB} = 5$ V ASY73	f_T	>	4	MHz
ASY74	f_T	>	6	MHz
ASY75	f_T	>	10	MHz

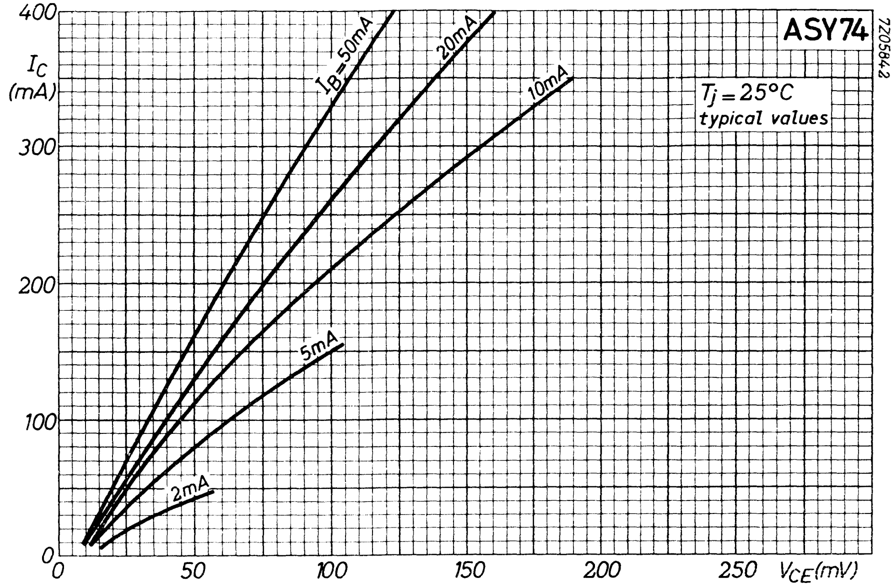
7Z3 0691

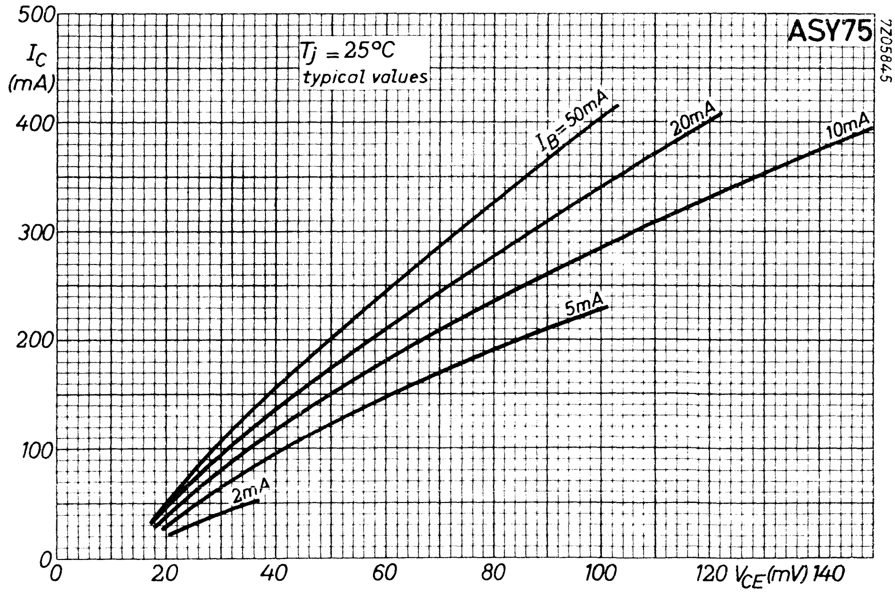

ASY73
7Z05837
I_C (mA)
400
200
I_B = 14mA
12mA
10mA
8mA
6mA
4mA
2mA
V_{CB}=0
15
I_B (mA)
5
0
2
4
6
V_{CE} (V)
8
T_j = 25°C
typical values
V_{CB}=0
0.5
V_{BE} (V)

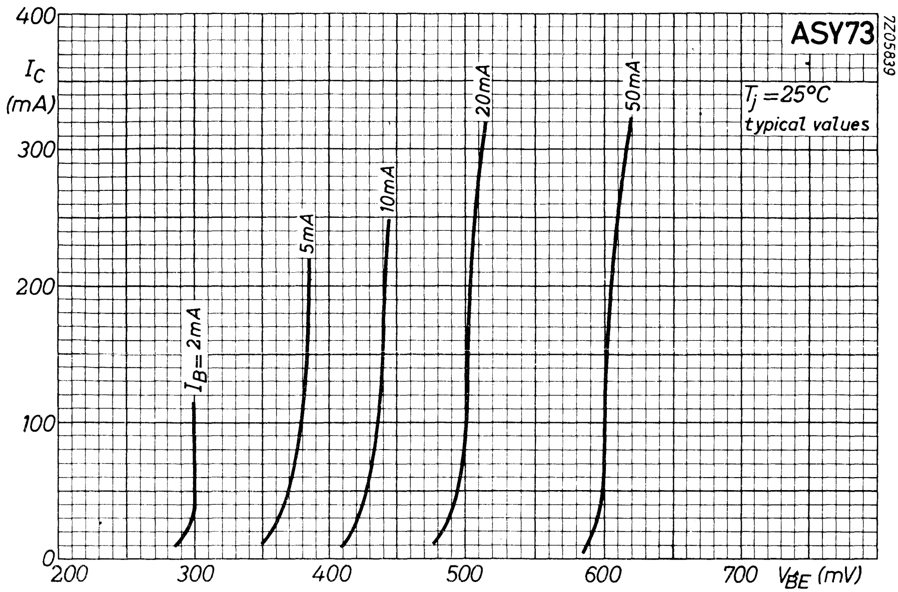

ASY74
7Z05840
I_C (mA)
400
200
I_B = 10mA
9mA
8mA
7mA
6mA
5mA
4mA
3mA
2mA
1mA
V_{CB}=0
15
I_B (mA)
5
0
2
4
6
V_{CE} (V)
8
T_j = 25°C
typical values
V_{CB}=0
0.5
V_{BE} (V)

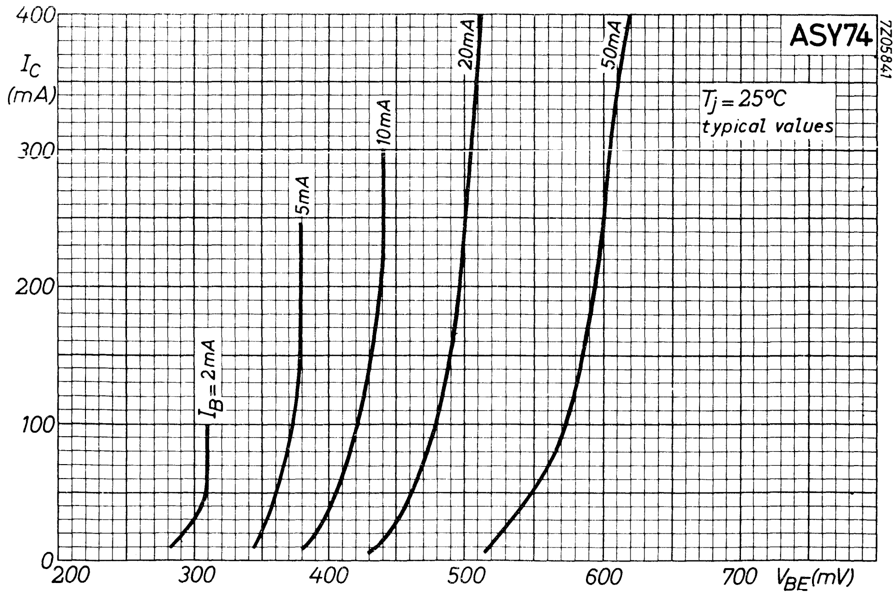

ASY75
7Z05843
I_C
(mA)
400
200
I_B=4.5mA
4mA
3.5mA
3mA
2.5mA
2mA
1.5mA
1mA
0.5mA
V_{CB}=0
7.5
I_B(mA)
2.5
0
2
4
6
V_{CE}(V)
8
T_j=25°C
typical values
V_{CB}=0
0.5
V_{BE}
(V)

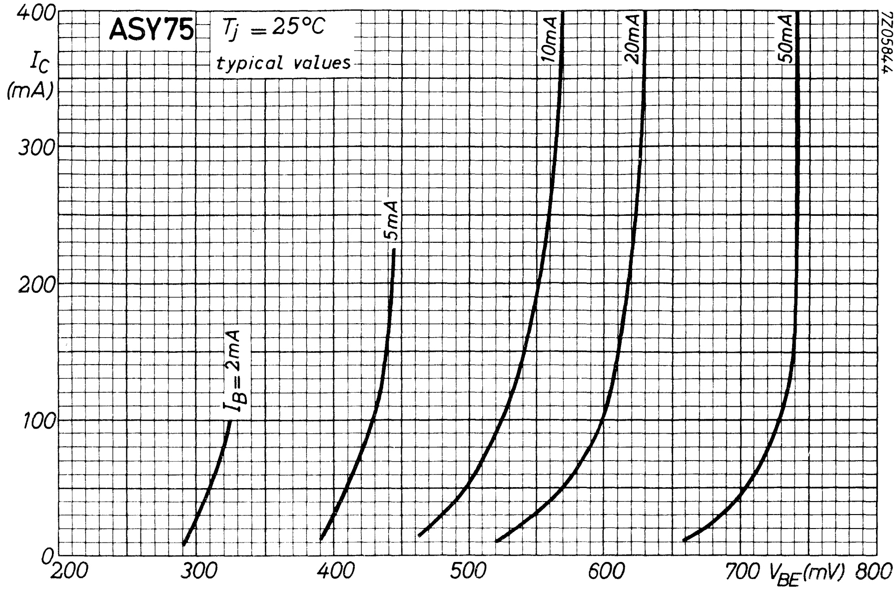

ASY73
7Z05838
500
I_C
(mA)
400
300
200
100
0
T_j = 25°C
typical values
I_B=50mA
20mA
10mA
5mA
2mA
0
20
40
60
80
100
120 V_{CE}(mV) 140


ASY74
7Z05842
I_C (mA)
$T_j = 25°C$
typical values
I_B=50mA
20mA
10mA
5mA
2mA
0
100
200
300
400
50
150
250
V_{CE}(mV)

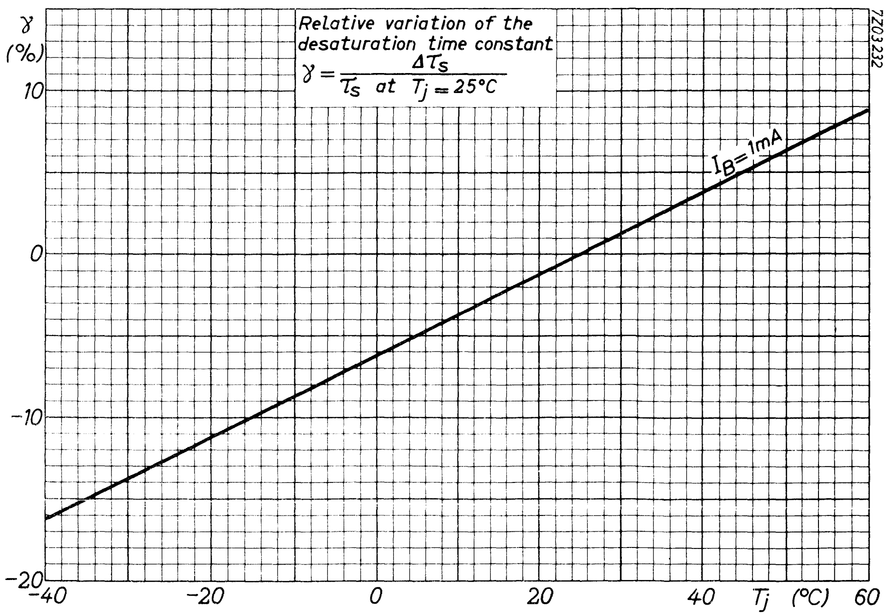

ASY75
7Z05845
I_C (mA)
$T_j = 25°C$
typical values
I_B=50mA
20mA
10mA
5mA
2mA
0
100
200
300
400
500
20
40
60
80
120
V_{CE}(mV)
140


ASY73
7Z05839
T_j = 25°C
typical values
I_C (mA)
V_{BE} (mV)
I_B = 2mA
5mA
10mA
20mA
50mA
0
100
200
300
400
200
300
400
500
600
700

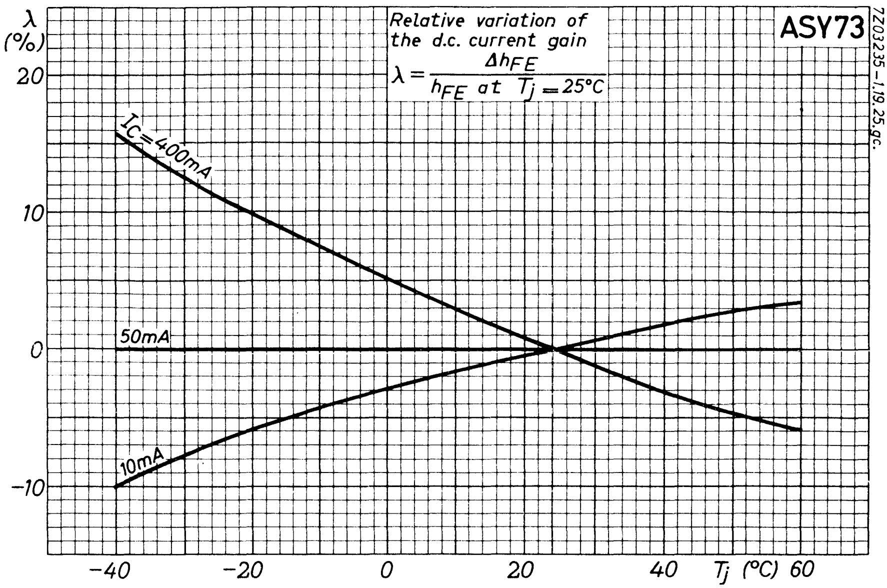

ASY74
7Z05841
T_j = 25°C
typical values
I_C (mA)
V_{BE} (mV)
I_B = 2mA
5mA
10mA
20mA
50mA
0
100
200
300
400
200
300
400
500
600
700

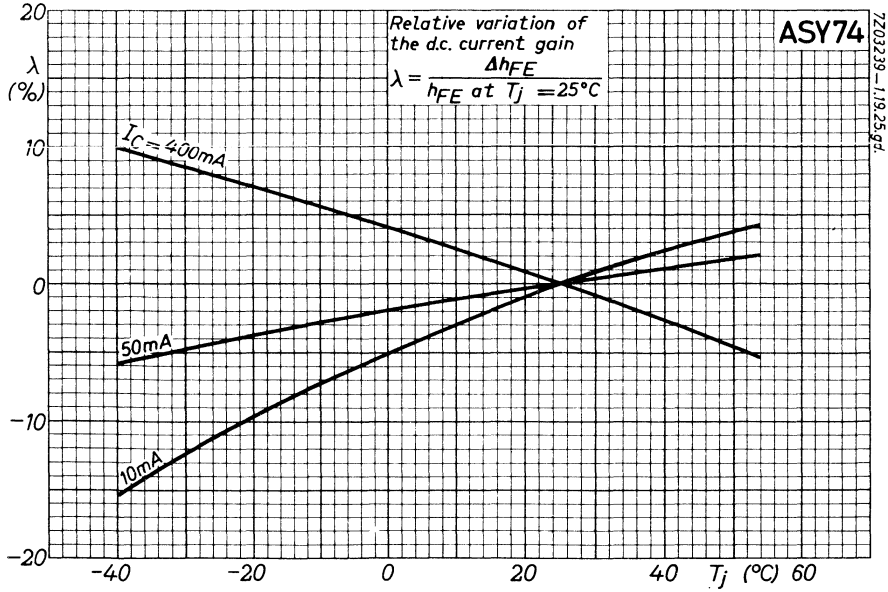


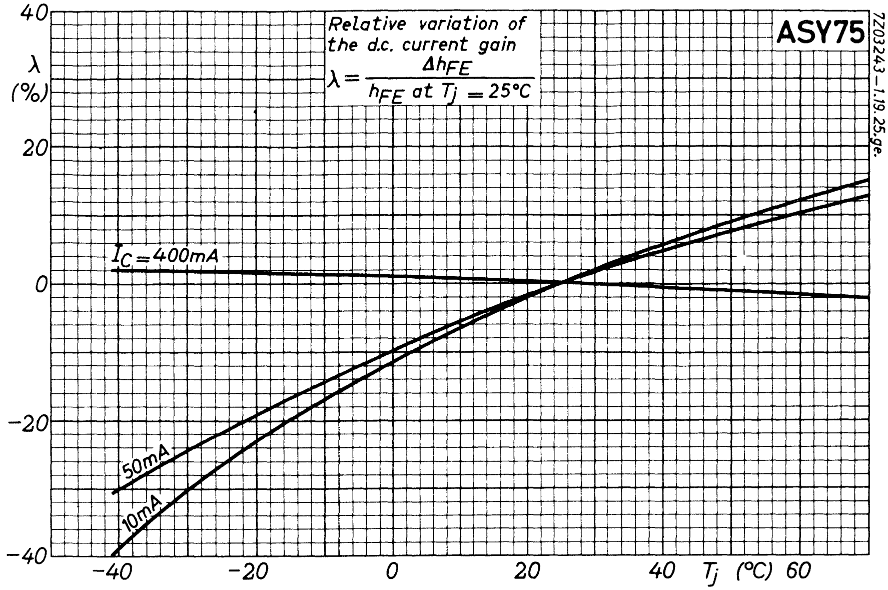
ASY75
$T_j = 25°C$
typical values
I_C (mA)
400
300
200
100
0
200
300
400
500
600
700
800
V_{BE} (mV)
$I_B = 2mA$
5mA
10mA
20mA
50mA
7Z05844

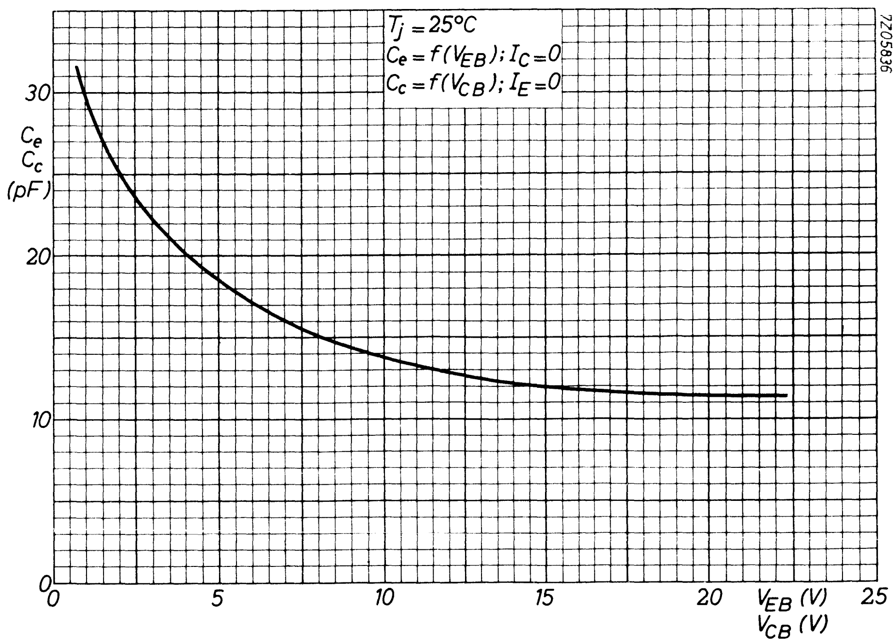


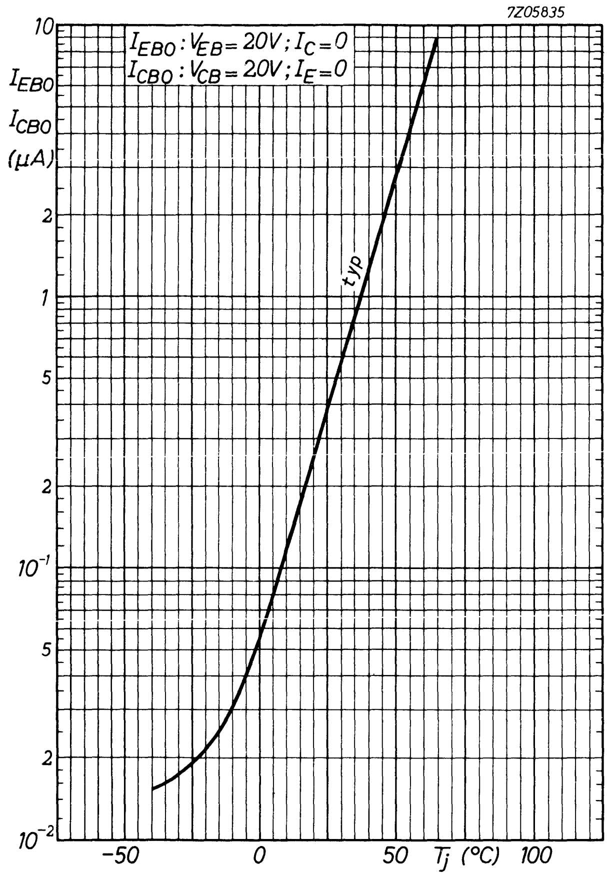
Relative variation of the desaturation time constant
$\gamma = \frac{\Delta\tau_s}{\tau_s \text{ at } T_j = 25°C}$
γ (%)
10
0
−10
−20
−40
−20
0
20
40
60
T_j (°C)
$I_B = 1mA$
7Z03232

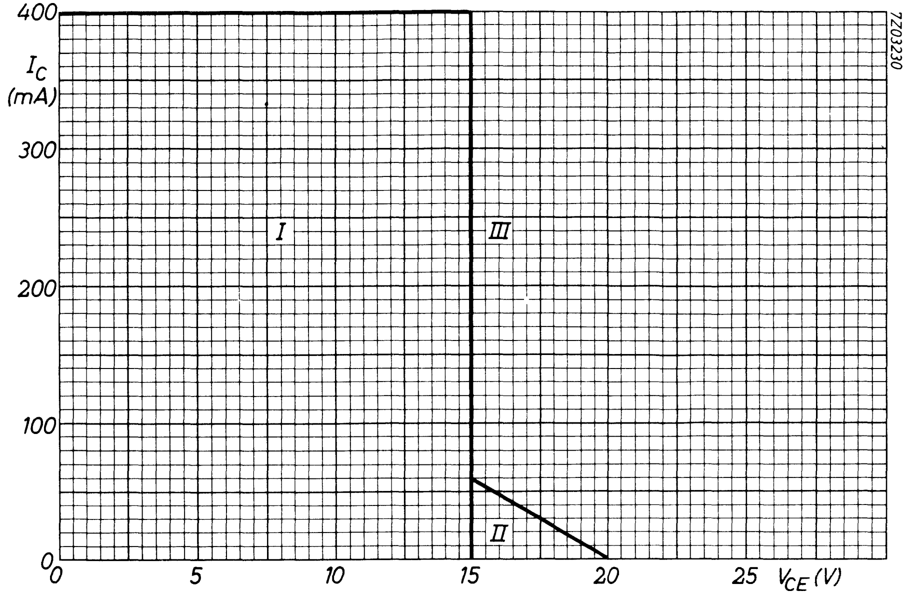

λ (%)
20
10
0
−10
Relative variation of the d.c. current gain
λ = ΔhFE / hFE at Tj = 25°C
ASY73
7Z03235−1.19.25.gc.
IC = 400mA
50mA
10mA
−40
−20
0
20
40
Tj (°C)
60


20
λ (%)
10
0
−10
−20
Relative variation of the d.c. current gain
λ = ΔhFE / hFE at Tj = 25°C
ASY74
7Z03239−1.19.25.gd.
IC = 400mA
50mA
10mA
−40
−20
0
20
40
Tj (°C)
60


Relative variation of the d.c. current gain
$\lambda = \frac{\Delta h_{FE}}{h_{FE} \text{ at } T_j = 25°C}$
ASY75
7Z03243-1.19.25.ge.
λ (%)
40
20
0
−20
−40
$I_C = 400mA$
50mA
10mA
−40
−20
0
20
40
T_j (°C)
60


$T_j = 25°C$
$C_e = f(V_{EB}); I_C = 0$
$C_c = f(V_{CB}); I_E = 0$
7Z05836
C_e
C_c
(pF)
30
20
10
0
0
5
10
15
20
V_{EB} (V)
V_{CB} (V)
25


7Z05835
I_{EBO} : V_{EB} = 20V ; I_C = 0
I_{CBO} : V_{CB} = 20V ; I_E = 0
I_{EBO}
I_{CBO}
(μA)
10
2
1
5
2
10^{-1}
5
2
10^{-2}
typ
−50
0
50
T_j (°C)
100



NOTES

I Region of permissible operation under all base-emitter conditions

II Additional region of operation when the transistor is cut-off

III During switching-off with inductive loads higher voltages than indicated by area I and area II are allowed, provided the inductive load is less than 250 μH and $0.2\ V < -V_{BE} < 2\ V$

7Z3 0692

P-N-P SWITCHING TRANSISTORS

Germanium p-n-p transistors in a TO-5 metal envelope with the base connected to the case. The ASY76, ASY77 and ASY80 are primarily intended for amplifying, switching and pulse oscillating applications.

QUICK REFERENCE DATA

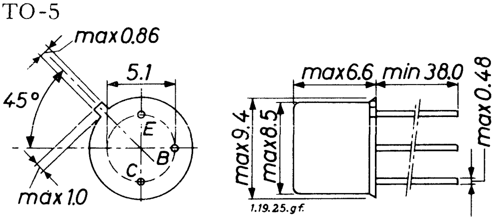
			ASY76	ASY77	ASY80	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	60	40	V
Collector-emitter voltage ($+V_{BE} = 0.6$ V)	$-V_{CEX}$	max.	32	60	40	V

Collector current (peak value)	$-I_{CM}$	max.	1000	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW
Junction temperature	T_j	max.	85	°C
Thermal resistance from junction to case	$R_{th\ j\text{-}c}$	=	75	°C/W
D.C. current gain at T_j = 25 °C				
$-I_C$ = 600 mA; $-V_{CE}$ = 1 V — ASY76, ASY77	h_{FE}	>	20	
$-I_C$ = 600 mA; $-V_{CE}$ = 1 V — ASY80	h_{FE}	>	40	
Transition frequency $-I_C$ = 1 mA; $-V_{CE}$ = 10 V	f_T	typ.	0.9	MHz

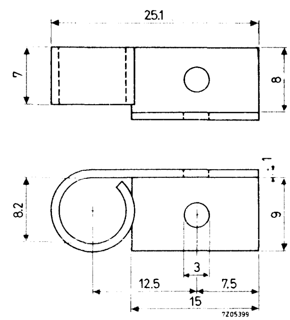
MECHANICAL DATA

Dimensions in mm

TO-5



Base connected to case



Type number of cooling and mounting clip 56265

7Z3 0570

RATINGS (Limiting values) [1])

Voltages

			ASY76	ASY77	ASY80	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	40	60	40	V
Collector-emitter voltage with $+V_{BE}$ = 0.6 V	$-V_{CEX}$	max.	32	60	40	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	10	20	V

Currents

Collector current (d.c. or average over any 20 ms period)	$-I_C$	max.	500	mA
Collector current (peak value)	$-I_{CM}$	max.	1000	mA
Base current (d.c. or average over any 20 ms period)	$-I_B$	max.	40	mA
Base current (peak value)	$-I_{BM}$	max.	200	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	mW

Temperatures

Storage temperature	T_{stg}		-65 to +85	°C
Junction temperature	T_j	max.	85	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	°C/W
From junction to case	$R_{th\ j\text{-}c}$	=	75	°C/W
From junction to ambient with cooling fin 56265 on a heatsink of 12.5 cm^2	$R_{th\ j\text{-}a}$	=	120	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0571

CHARACTERISTICS T_j = 25 °C unless otherwise specified

			ASY76	ASY77	ASY80	
Collector cut-off current						
$I_E = 0$; $-V_{CB} = 10$ V	$-I_{CBO}$	typ.	4.5	4.5	4.5	μA
		<	10	10	10	μA
$I_E = 0$; $-V_{CB} = 40$ V	$-I_{CBO}$	<	40	–	40	μA
$I_E = 0$; $-V_{CB} = 60$ V	$-I_{CBO}$	<	–	40	–	μA
Emitter cut-off current						
$I_C = 0$; $-V_{EB} = 10$ V	$-I_{EBO}$	<	20	20	20	μA
Currents at reverse biased emitter junction						
$-V_{CE} = 30$ V; $+V_{BE} = 0.5$ V	$-I_{CEX}$	<	30	–	30	μA
$-V_{CE} = 60$ V; $+V_{BE} = 0.5$ V	$-I_{CEX}$	<	–	30	–	μA
$-V_{CE} = 30$ V; $+V_{BE} = 0.5$ V; $T_j = 60$ °C	$-I_{CEX}$	<	200	–	200	μA
$-V_{CE} = 60$ V; $+V_{BE} = 0.5$ V; $T_j = 60$ °C	$-I_{CEX}$	<	–	200	–	μA
Sustaining voltage						
$-I_C = 600$ mA; $+V_{BE} = 0.6$ V	$-V_{CEXsust}$	>	–	–	32	V
Base-emitter voltage						
$I_E = 300$ mA; $V_{CB} = 0$	$-V_{BE}$	typ.	420	420	420	mV
		<	750	750	750	mV
Saturation voltages						
$-I_C = 300$ mA; $-I_B = 12$ mA	$-V_{CEsat}$	<	300	300	–	mV
$-I_C = 300$ mA; $-I_B = 6$ mA	$-V_{CEsat}$	<	–	–	400	mV
Emitter-base floating voltage						
$I_E = 0$; $-V_{CB} = 40$ V	$-V_{EBfl}$	<	300	–	300	mV
$I_E = 0$; $-V_{CB} = 60$ V	$-V_{EBfl}$	<	–	300	–	mV
D.C. current gain						
$-I_C = 10$ mA; $-V_{CE} = 6$ V	h_{FE}	>	45	45	–	
$-I_C = 50$ mA; $-V_{CB} = 0$	h_{FE}		–	–	60 to 165	
$-I_C = 300$ mA; $V_{CB} = 0$	h_{FE}		25 to 130	25 to 130	> 50	

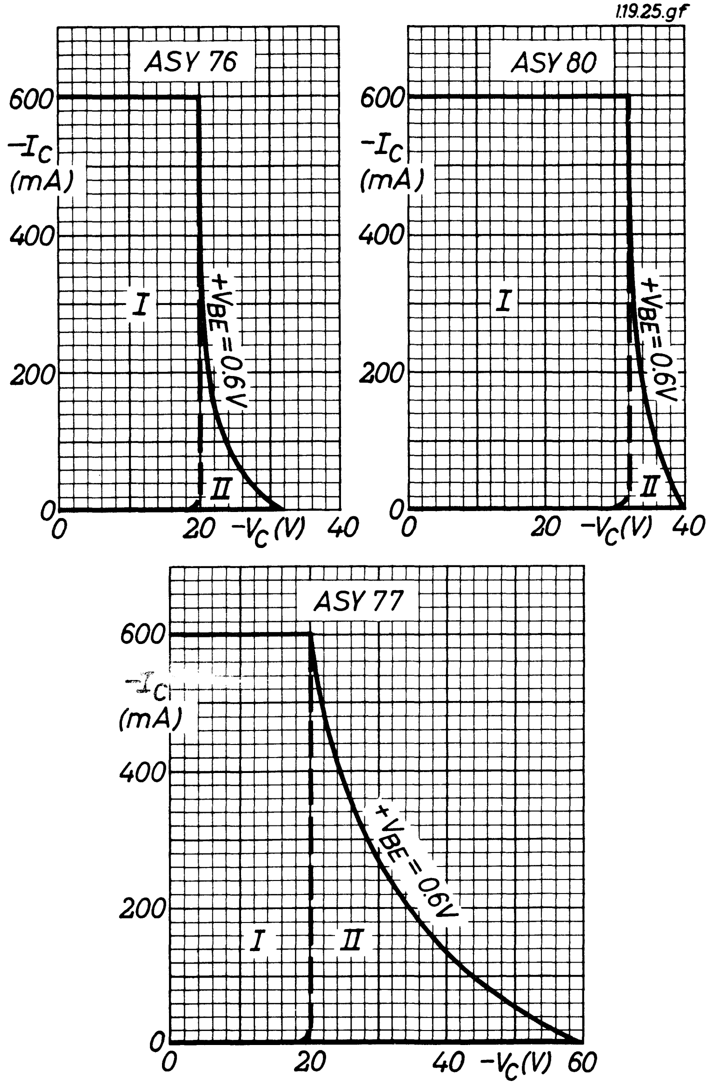
7Z3 0572

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

Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$; $-V_{CB} = 5$ V		C_c	typ.	40	pF
			<	60	pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$; $-V_{EB} = 5$ V		C_e	typ.	30	pF
			<	50	pF
Transition frequency					
$-I_C = 10$ mA; $-V_{CE} = 5$ V	ASY76, ASY77	f_T	>	500	kHz
	ASY80	f_T	>	700	kHz
Noise figure at f = 1 kHz					
$I_E = 0.5$ mA; $-V_{CB} = 2$ V					
Bandwidth 200 Hz; $R_S = 500\ \Omega$		F	<	15	dB
Feedback impedance at f = 0.5 MHz					
$I_E = 1$ mA; $-V_{CB} = 5$ V		$\|z_{rb}\|$	typ.	75	Ω

7Z3 0573

1.19.25.gf

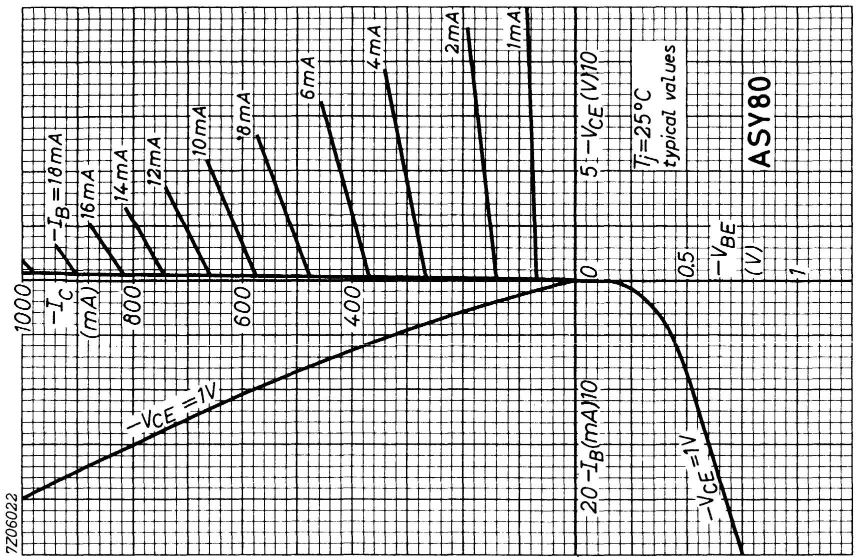


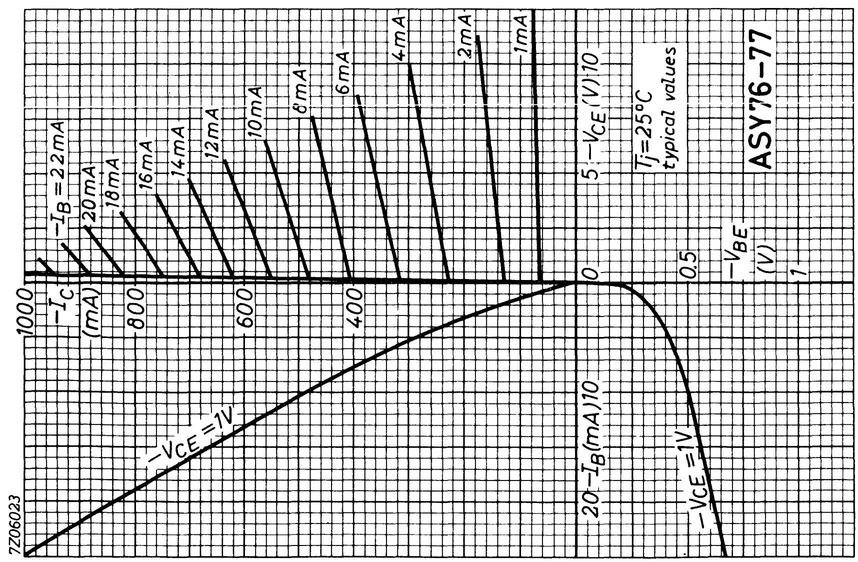
I = permissible region of operation under all base-emitter conditions

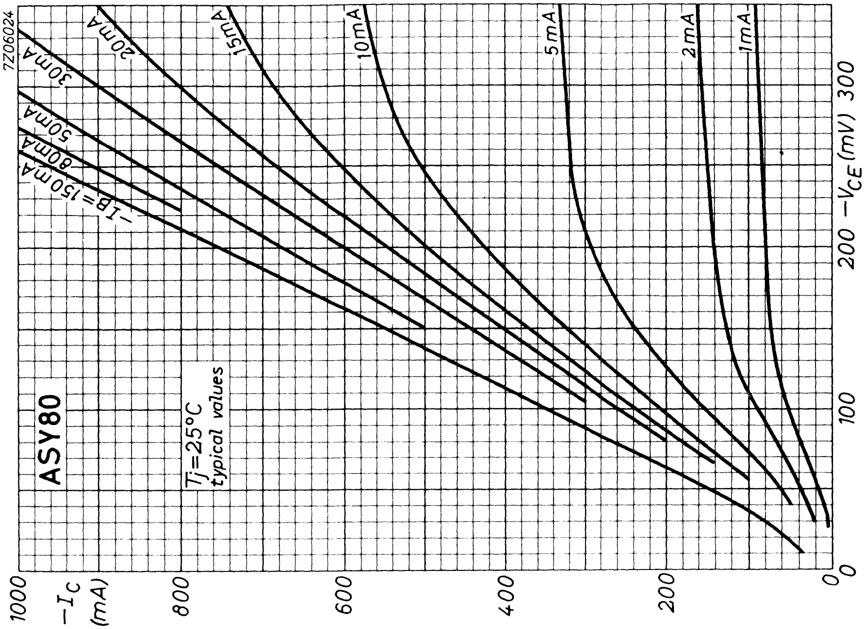
II = additional region of operation when the transistor is cut-off with $+V_{BE}$ = 0.6 V.

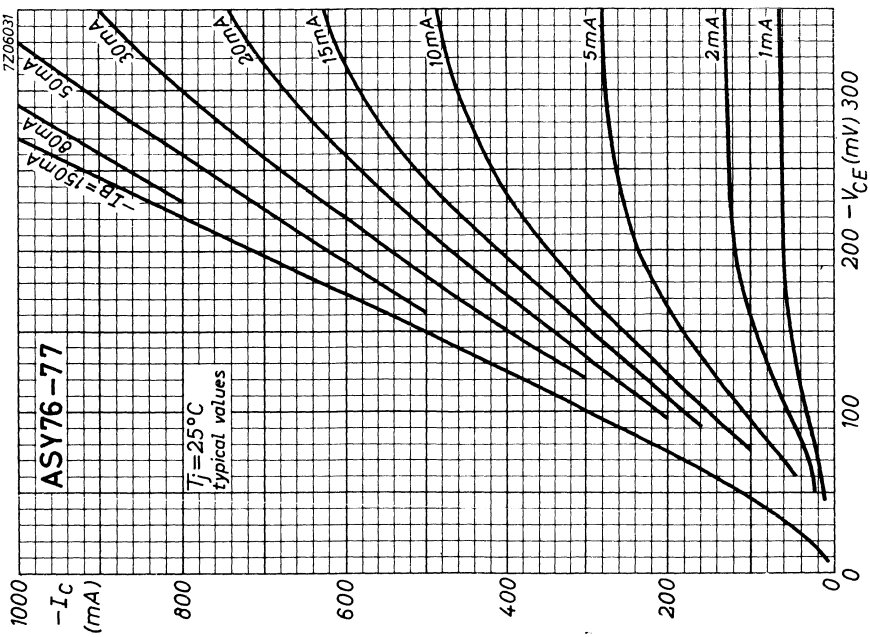
During switching off voltages higher than those indicated by the minimum avalanche curves at $+V_{BE}$ = 0.6 V are allowed if the transient energy is less than 12 mWs.

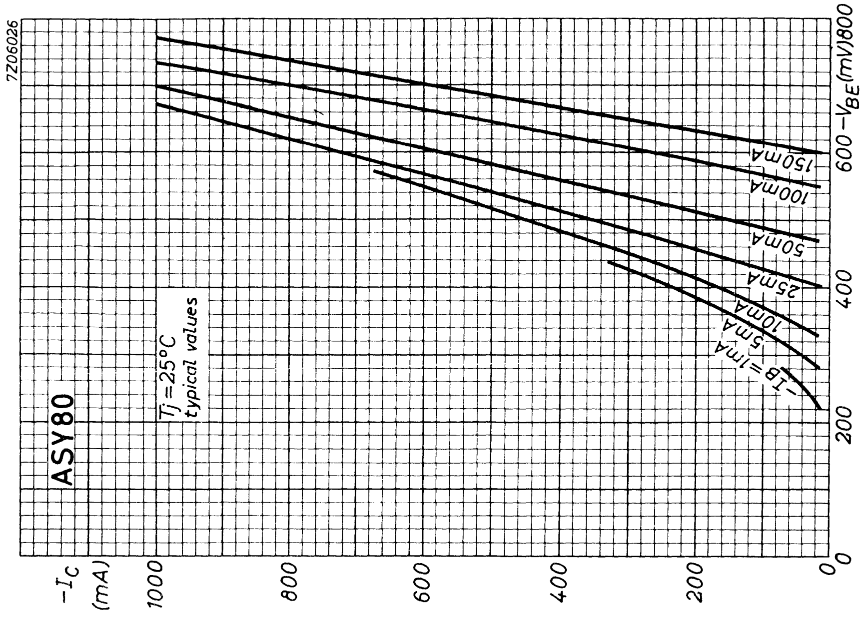
7Z3 0574

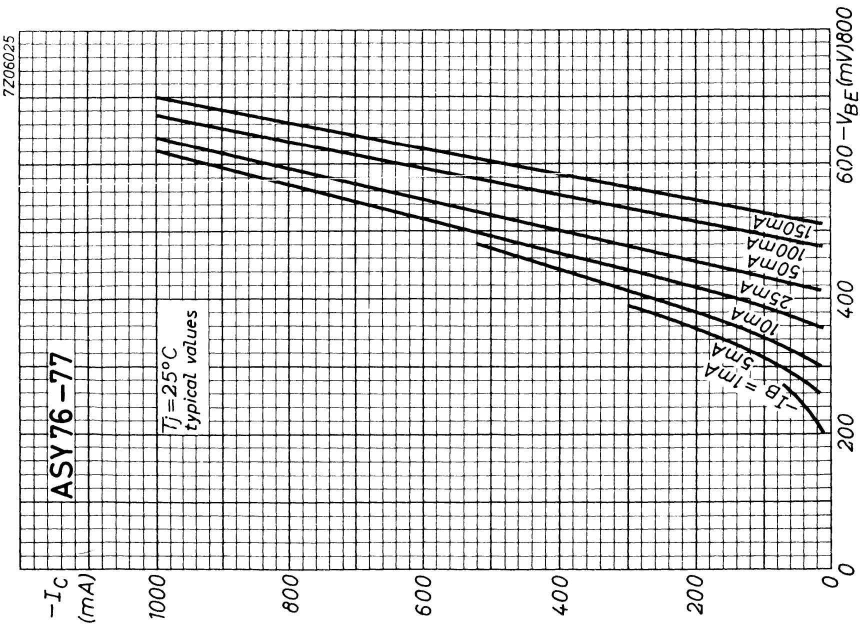

ASY80
$T_j = 25°C$
typical values
$-I_B = 18 mA$
16mA
14mA
12mA
10mA
8mA
6mA
4mA
2mA
1mA
$-I_C$
(mA)
1000
800
600
400
0
5
$-V_{CE}$ (V) 10
$-V_{CE} = 1V$
10
20 $-I_B$ (mA)
0.5
1
$-V_{BE}$
(V)
7Z06022

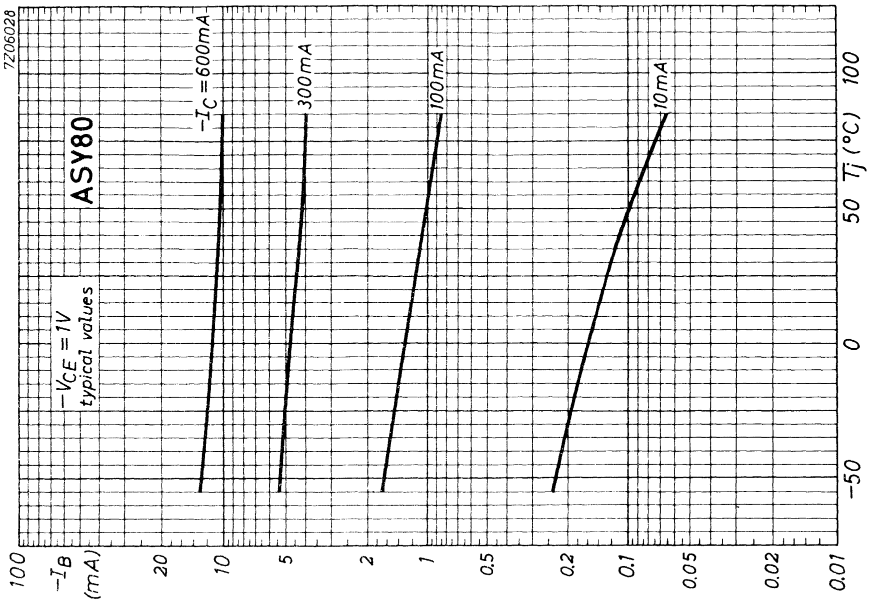

ASY76–77
$T_j = 25°C$
typical values
$-I_B = 22 mA$
20mA
18mA
16mA
14mA
12mA
10mA
8mA
6mA
4mA
2mA
1mA
$-I_C$
(mA)
1000
800
600
400
0
5
$-V_{CE}$ (V) 10
$-V_{CE} = 1V$
10
20 $-I_B$ (mA)
0.5
1
$-V_{BE}$
(V)
7Z06023

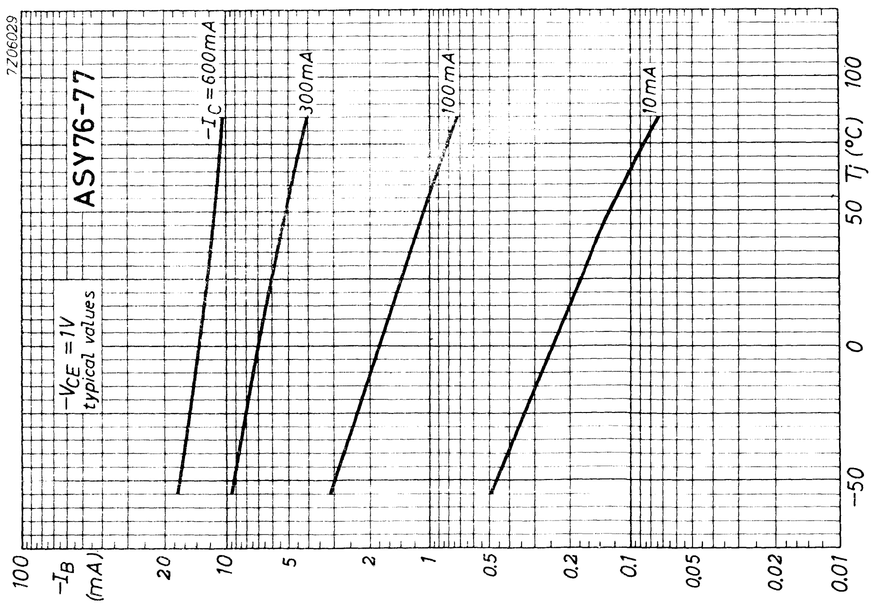

ASY80
Tj=25°C
typical values
7Z06024
−IB=150mA
80mA
50mA
30mA
20mA
15mA
10mA
5mA
2mA
1mA
−IC
(mA)
1000
800
600
400
200
0
0
100
200
300
−VCE (mV)

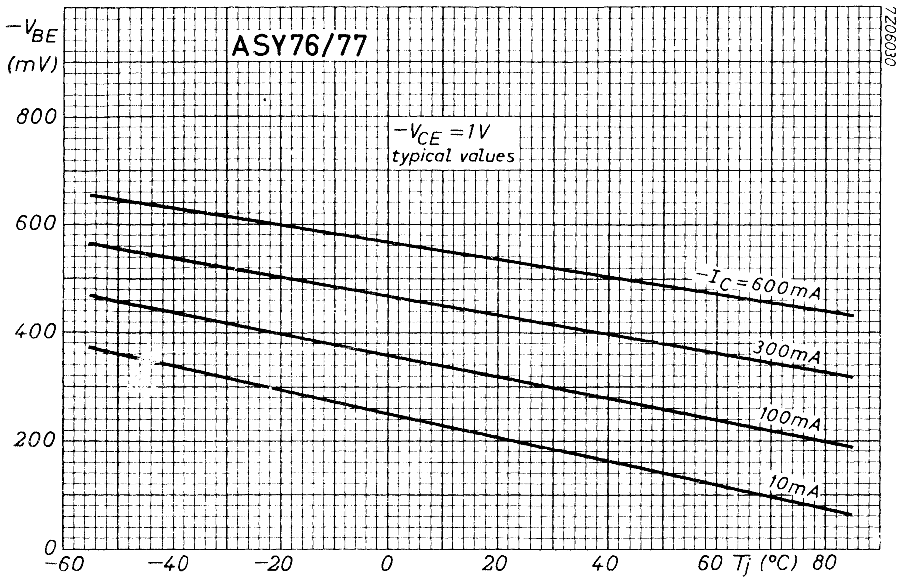

ASY76−77
Tj=25°C
typical values
7Z06031
−IB=150mA
80mA
50mA
30mA
20mA
15mA
10mA
5mA
2mA
1mA
−IC
(mA)
1000
800
600
400
200
0
0
100
200
300
−VCE (mV)

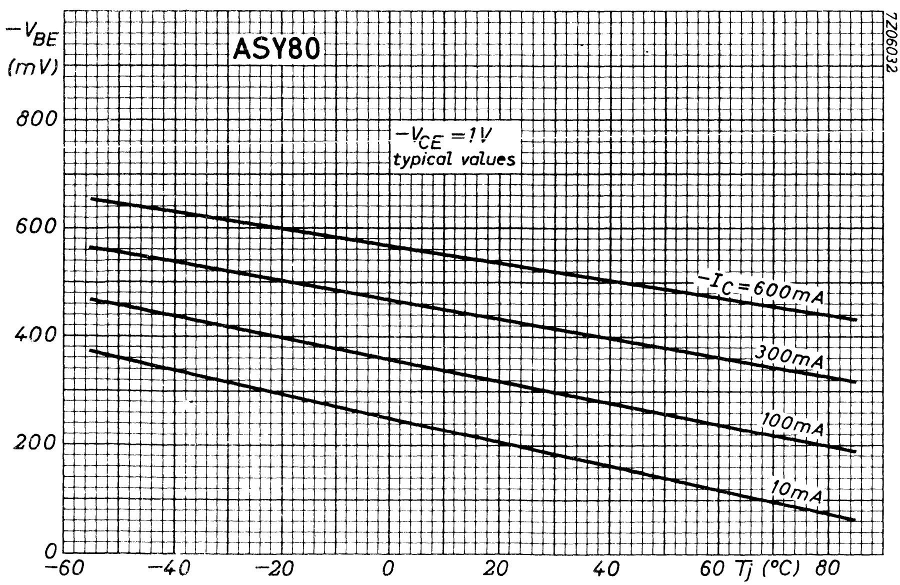

7Z06026
ASY80
Tj = 25°C
typical values
$-I_C$ (mA)
1000
800
600
400
200
0
0
200
400
600
$-V_{BE}$ (mV) 800
150mA
100mA
50mA
25mA
10mA
5mA
$-I_B$ = 1mA

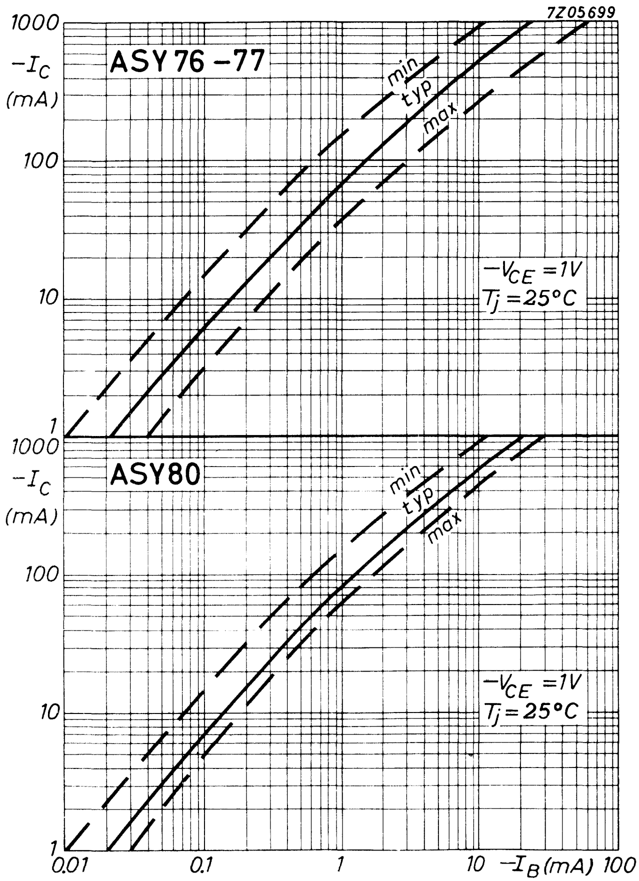

7Z06025
ASY76–77
Tj = 25°C
typical values
$-I_C$ (mA)
1000
800
600
400
200
0
0
200
400
600
$-V_{BE}$ (mV) 800
150mA
100mA
50mA
25mA
10mA
5mA
$-I_B$ = 1mA


7206028
ASY80
$-V_{CE} = 1V$
typical values
$-I_C = 600mA$
300mA
100mA
10mA
$-I_B$ (mA)
100
20
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
T_j (°C)
−50
0
50
100

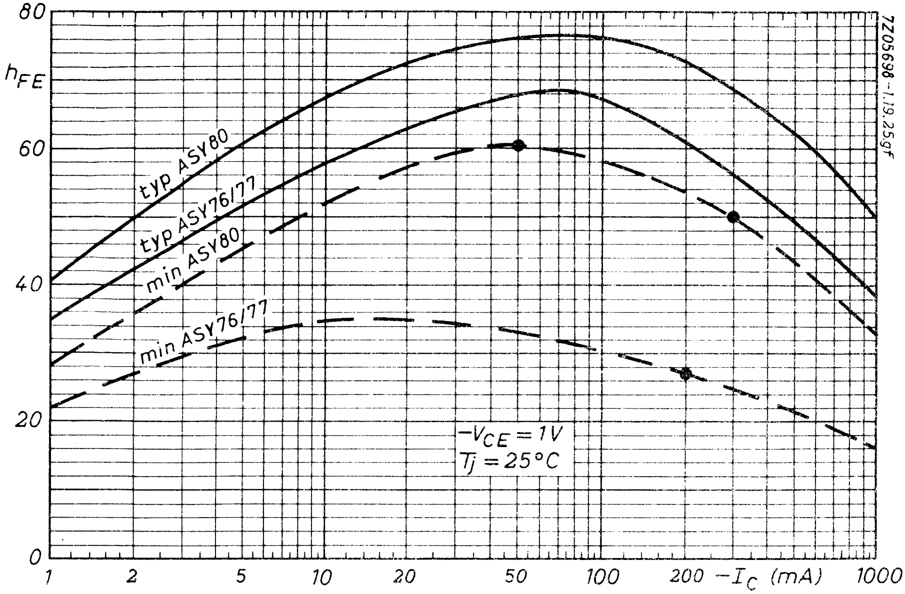

7206029
ASY76-77
$-V_{CE} = 1V$
typical values
$-I_C = 600mA$
300mA
100mA
10mA
$-I_B$ (mA)
100
20
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
T_j (°C)
−50
0
50
100

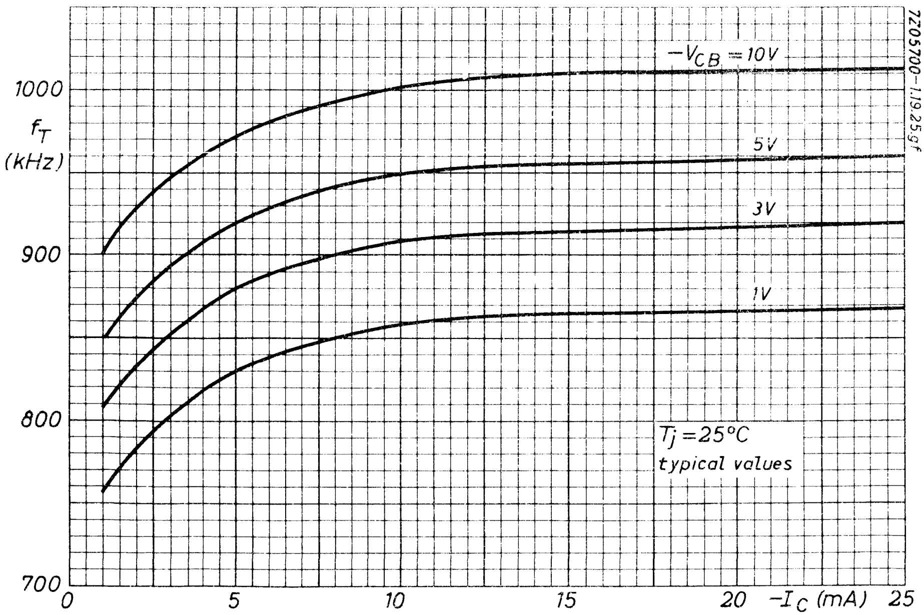

$-V_{BE}$ (mV)
800
600
400
200
0
ASY76/77
$-V_{CE}$ = 1V
typical values
$-I_C$ = 600mA
300mA
100mA
10mA
−60
−40
−20
0
20
40
60
T_j (°C)
80
7Z06030

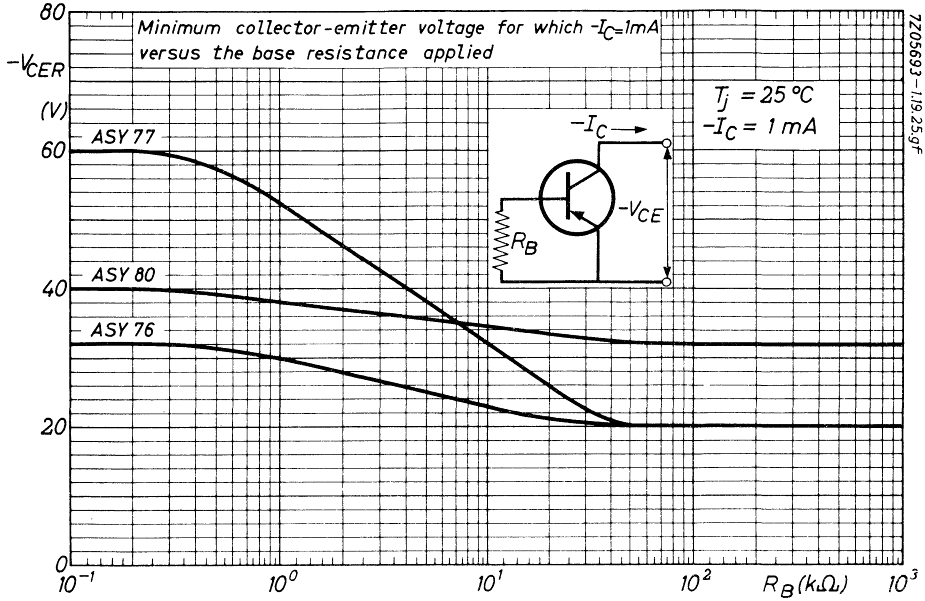

$-V_{BE}$ (mV)
800
600
400
200
0
ASY80
$-V_{CE}$ = 1V
typical values
$-I_C$ = 600mA
300mA
100mA
10mA
−60
−40
−20
0
20
40
60
T_j (°C)
80
7Z06032

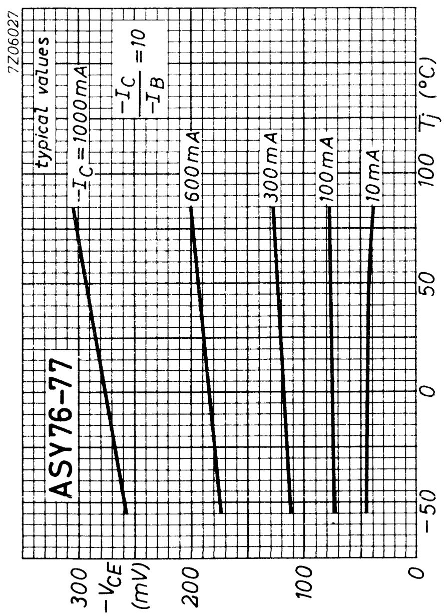


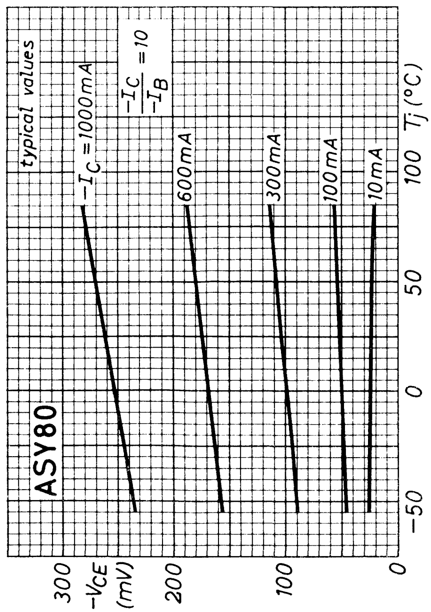
Base current as a function of collector current

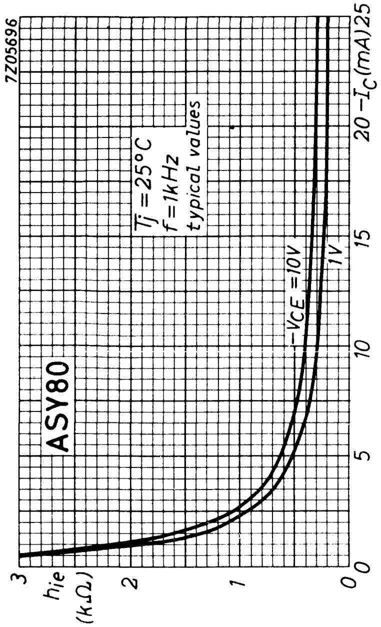

80
60
40
20
0
h_{FE}
typ ASY80
typ ASY76/77
min ASY80
min ASY76/77
$-V_{CE} = 1V$
$T_j = 25°C$
1
2
5
10
20
50
100
200
$-I_C$ (mA)
1000
7Z05698-1.19.25gf

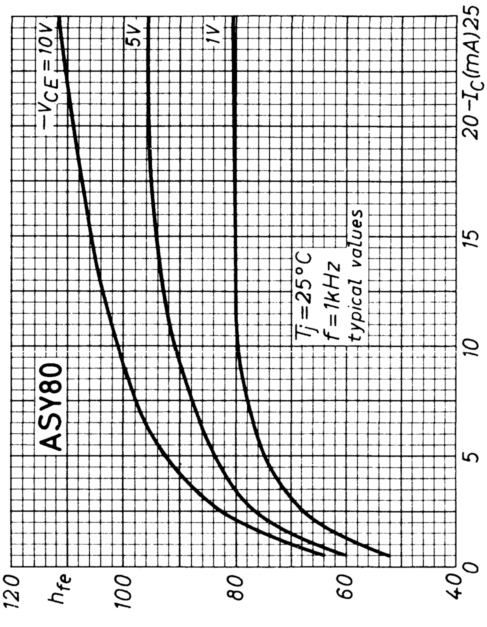

1000
900
800
700
f_T
(kHz)
$-V_{CB} = 10V$
5V
3V
1V
$T_j = 25°C$
typical values
0
5
10
15
20
$-I_C$ (mA)
25
7Z05700-1.19.25.gf

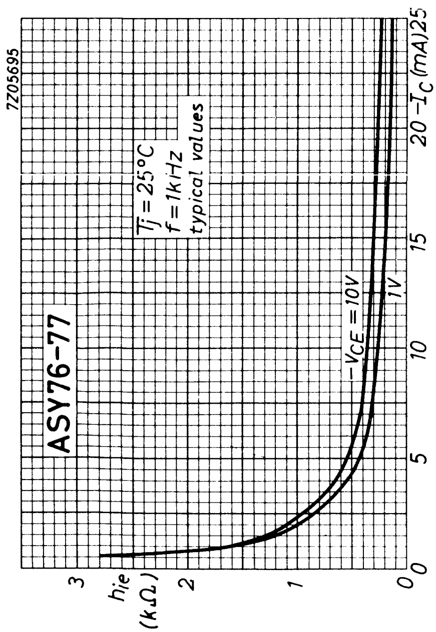

Minimum collector-emitter voltage for which $-I_C$=1mA versus the base resistance applied
$-V_{CER}$ (V)
80
60
40
20
0
ASY 77
ASY 80
ASY 76
T_j = 25 °C
$-I_C$ = 1 mA
$-I_C$
$-V_{CE}$
R_B
10^{-1}
10^0
10^1
10^2
10^3
R_B(kΩ)
7Z05693-1.19.25.gf

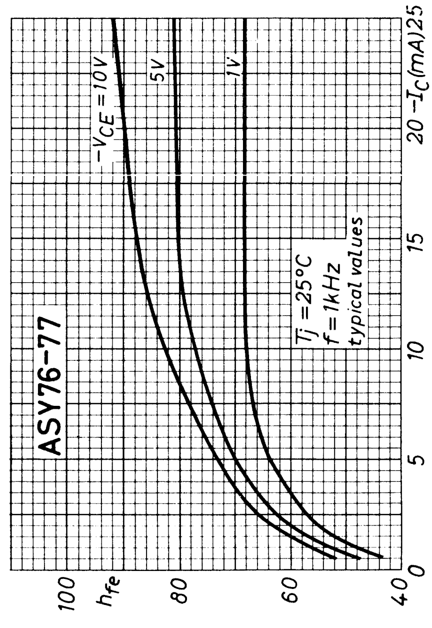

7Z06027
typical values
$-I_C$=1000mA
$\frac{-I_C}{-I_B}$ =10
600mA
300mA
100mA
10mA
ASY76-77
T_j (°C)
100
50
0
−50
300
$-V_{CE}$ (mV)
200
100
0

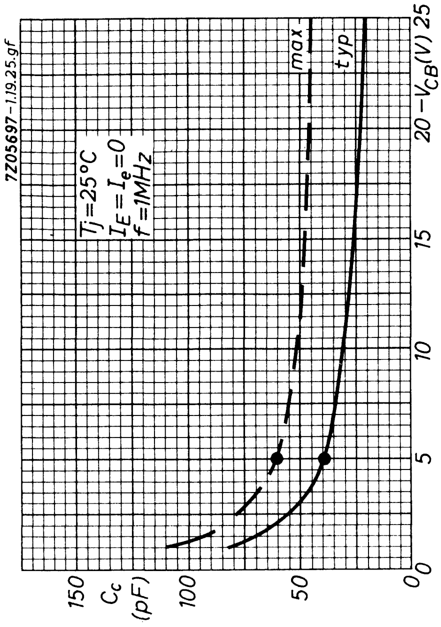

typical values
$-I_C$=1000mA
$\frac{-I_C}{-I_B}$ =10
600mA
300mA
100mA
10mA
ASY80
T_j (°C)
100
50
0
−50
300
$-V_{CE}$ (mV)
200
100
0

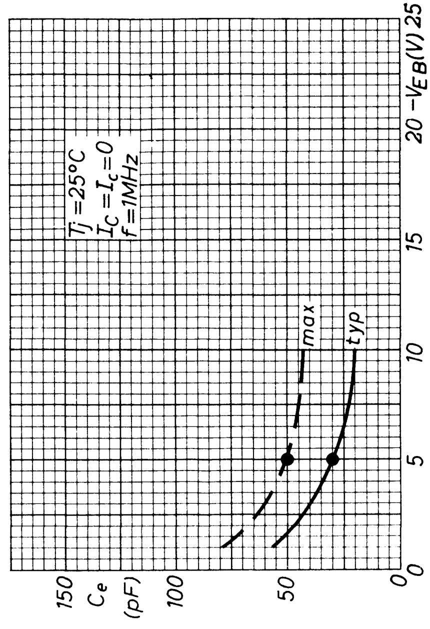

7Z05696
ASY80
$T_j = 25°C$
$f = 1kHz$
typical values
$-V_{CE} = 10V$
1V
h_{ie} (kΩ)
$-I_C$ (mA)

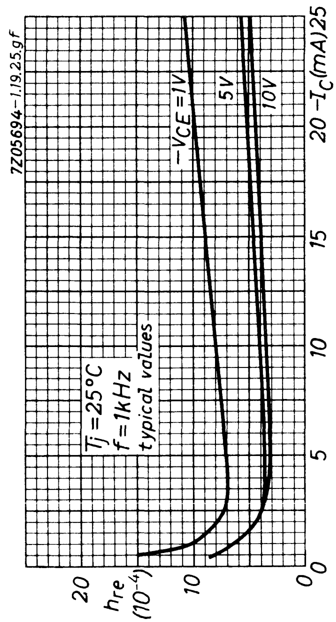

ASY80
$-V_{CE} = 10V$
5V
1V
$T_j = 25°C$
$f = 1kHz$
typical values
h_{fe}
$-I_C$ (mA)

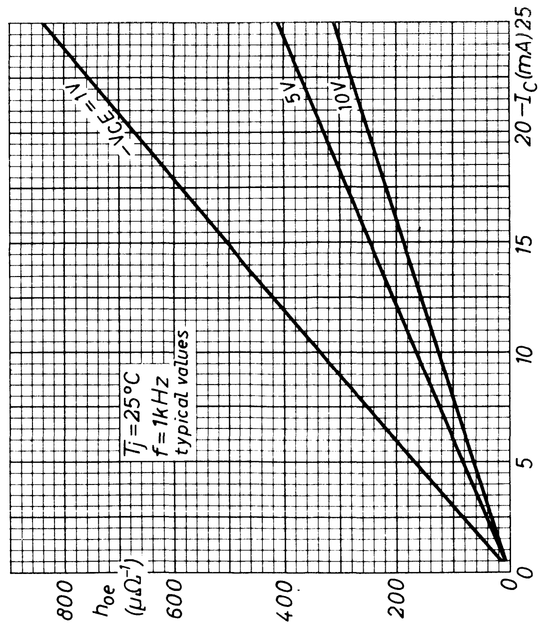

7Z05695
ASY76-77
$T_j = 25°C$
$f = 1kHz$
typical values
$-V_{CE} = 10V$
1V
h_{ie} (kΩ)
$-I_C$ (mA)

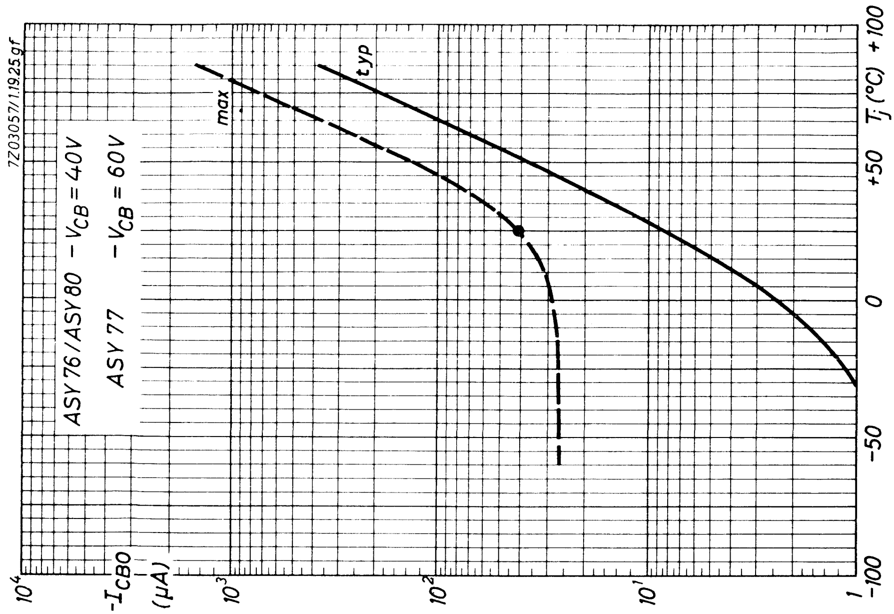

ASY76-77
$-V_{CE} = 10V$
5V
1V
$T_j = 25°C$
$f = 1kHz$
typical values
h_{fe}
$-I_C$ (mA)

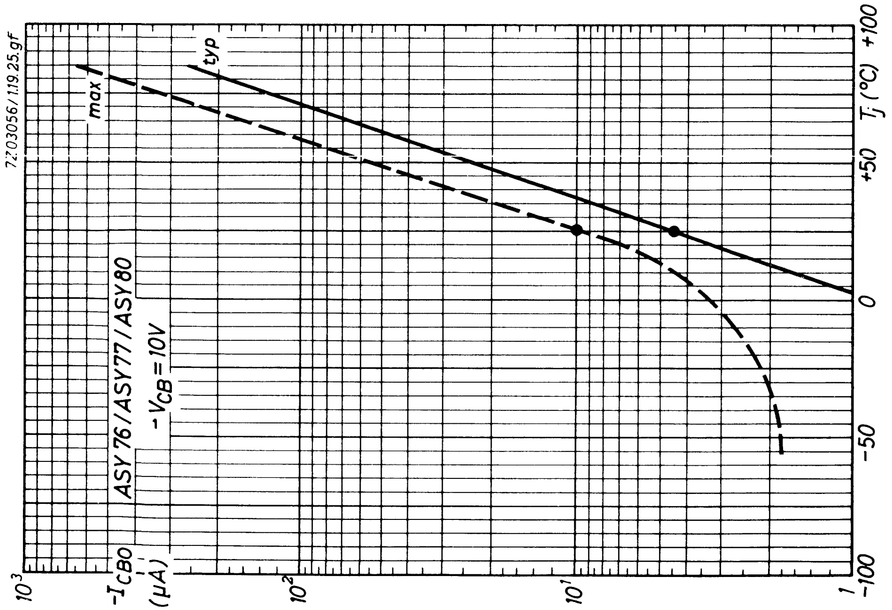

7Z05697-1.19.25.gf
$T_j = 25°C$
$I_E = I_e = 0$
f = 1MHz
max
typ
C_c
(pF)
150
100
50
0
5
10
15
20
$-V_{CB}$(V)
25


$T_j = 25°C$
$I_C = I_c = 0$
f = 1MHz
max
typ
C_e
(pF)
150
100
50
0
5
10
15
20
$-V_{EB}$(V)
25


7Z05694-1.19.25.gf
$T_j = 25°C$
f = 1kHz
typical values
$-V_{CE} = 1V$
5V
10V
h_{re}
(10^{-4})
20
10
0
5
10
15
20
$-I_C$(mA)
25


$T_j = 25°C$
f = 1kHz
typical values
$-V_{CE} = 1V$
5V
10V
h_{oe}
($\mu\Omega^{-1}$)
800
600
400
200
0
5
10
15
20
$-I_C$(mA)
25


7Z03057/1.19.25.gf
ASY76/ASY80 −V_CB = 40V
ASY77 −V_CB = 60V
max
typ
−I_CBO (µA)
T_j (°C)
10^4
10^3
10^2
10^1
1
−100
−50
0
+50
+100


7Z03056/1.19.25.gf
ASY76/ASY77/ASY80
−V_CB = 10V
max
typ
−I_CBO (µA)
T_j (°C)
10^3
10^2
10^1
1
−100
−50
0
+50
+100

POWER SWITCHING TRANSISTORS

P-N-P germanium low spread medium gain power transistors in a TO-3 metal case for power switching at high currents.

QUICK REFERENCE DATA

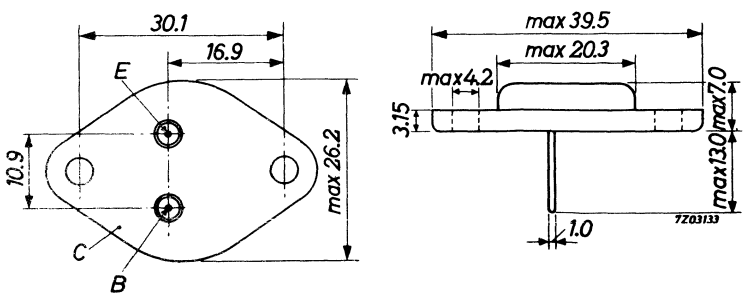
			ASZ 15	ASZ 16	ASZ 17	ASZ 18	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	100	60	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	60	32	32	32	V
Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	30	30	30	30	W
Junction temperature	T_j	max.	90	90	90	90	°C
D.C. current gain at T_j = 25 °C							
$-I_C$ = 1 A; $-V_{CE}$ = 1 V	h_{FE}	>	20	45	25	30	
		<	55	130	75	110	
$-I_C$ = 6 A; $-V_{CE}$ = 1 V	h_{FE}	>	15	35	20	20	
		<	30	80	45	65	
Transition frequency $-I_C$ = 1 A; $-V_{CE}$ = 5 V	f_T	typ.	200	250	220	220	kHz

MECHANICAL DATA

Dimensions in mm

TO-3

Collector connected to case



7Z3 0706

RATINGS (Limiting values) [1])

			ASZ 15	ASZ 16	ASZ 17	ASZ 18	
Voltages							
Collector-base voltage (open emitter) [2])	$-V_{CBO}$	max.	100	60	60	100	V
Collector-emitter voltage (open base) (see also pages G and H)	$-V_{CEO}$	max.	60	32	32	32	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	40	20	20	40	V

Currents				
Collector current (d.c.)	$-I_C$	max.	8	A
Collector current (peak value)	$-I_{CM}$	max.	10	A
Emitter current (d.c.)	I_E	max.	9	A
Emitter current (peak value	I_{EM}	max.	12	A
Base current (d.c.)	$-I_B$	max.	1	A
Base current (peak value)	$-I_{BM}$	max.	2	A
Power dissipation (see also page C)				
Total power dissipation up to T_{mb} = 45 °C	P_{tot}	max.	30	W
Temperatures				
Storage tmperature	T_{stg}		-65 to +90	°C
Junction temperature: continuous	T_j	max.	90	°C
incidentally	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.5	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
From mounting base to heatsink with lead washer and mica washer	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) When switched from a thermally stable on state with max. junction temperature to a not stabilized cut-off condition, $-V_{CBO\,max}$ is allowed, provided T_{amb} < 55 °C and $R_{th\ j\text{-}a}$ < 9 °C/W for ASZ16 and ASZ17
$R_{th\ j\text{-}a}$ < 5 °C/W for ASZ15 and ASZ18

7Z3 0707

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector current

$I_E = 0$; $-V_{CB} = 0.5$ V	$-I_{CBO}$	<	0.1	mA
$I_E = 0$; $-V_{CB} = -V_{CBOmax}$	$-I_{CBO}$	<	3.0	mA
$I_E = 0$; $-V_{CB} = -V_{CBOmax}$; $T_j = 100$ °C	$-I_{CBO}$	<	30	mA

Emitter current

$I_C = 0$; $-V_{EB} = -V_{EBOmax}$	$-I_{EBO}$	<	3.0	mA

			ASZ15	ASZ16	ASZ17	ASZ18	
Base current							
$I_E = 1$ A; $V_{CB} = 0$	$-I_B$	>	17.5	7.2	13	9	mA
		<	50	21.5	38	33	mA
$I_E = 6$ A; $V_{CB} = 0$	$-I_B$	>	190	73	130	90	mA
		<	375	165	285	285	mA
Emitter-base voltage							
$I_E = 6$ A; $V_{CB} = 0$	V_{EB}	>	0.6	–	0.4	–	V
		<	1.6	1.4	1.4	1.6	V
Saturation voltages							
$-I_C = 10$ A; $-I_B = 1$ A	$-V_{CEsat}$	<	0.4	0.4	0.4	0.4	V
	$-V_{BEsat}$	<	1.4	1.4	1.4	1.4	V
Emitter-base floating voltage							
$I_E = 0$; $-V_{CB} = 60$ V	$-V_{EBfl}$	<	0.5	–	–	0.5	V
$I_E = 0$; $-V_{CB} = 48$ V	$-V_{EBfl}$	<	–	0.5	0.5	–	V
D.C. current gain							
$-I_C = 1$ A; $-V_{CE} = 1$ V	h_{FE}	>	20	45	25	30	
		<	55	130	75	110	
$-I_C = 6$ A; $-V_{CE} = 1$ V	h_{FE}	>	15	35	20	20	
		<	30	80	45	65	
Transition frequency							
$-I_C = 1$ A; $-V_{CE} = 5$ V	f_T	typ.	200	250	220	220	kHz
Collector capacitance (f = 500 kHz)							
$I_E = I_e = 0$; $-V_{CB} = 5$ V	C_c	typ.	190	190	190	190	pF
Emitter capacitance (f = 500 kHz)							
$I_C = I_c = 0$; $-V_{EB} = 5$ V	C_e	typ.	150	150	150	150	pF

7Z3 0708

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

D.C. current gain ratio of matched pairs

$-I_C$ = 0.3 A	h_{FE1}/h_{FE2}	<	1.25
$-I_C$ = 6.0 A	h_{FE1}/h_{FE2}	<	1.25

Switching times

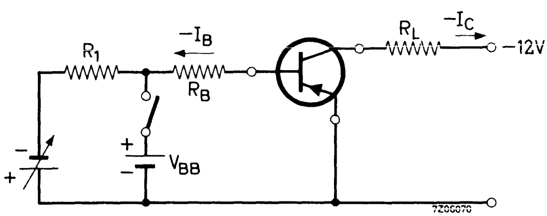
Circuit I: R_B = 10 Ω; R_1 = 220 Ω; R_L = 12 Ω

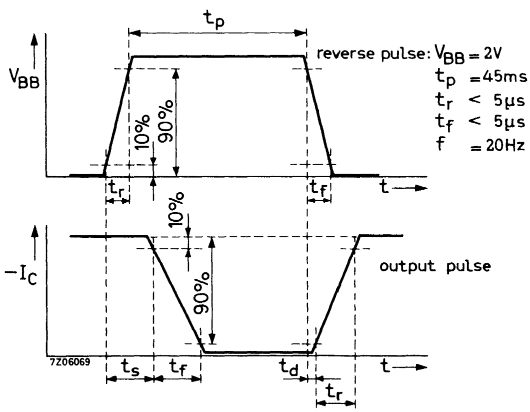
ASZ15: $-I_B$ = 75 mA	$-I_C$ = 1 A	delay time	t_d	<	2	µs
ASZ16: $-I_B$ = 35 mA		rise time	t_r	<	25	µs
ASZ17: $-I_B$ = 60 mA		storage time	t_s	<	10	µs
ASZ18: $-I_B$ = 50 mA		fall time	t_f	<	20	µs

Circuit II: R_B = 1 Ω; R_1 = 13 Ω; R_L = 1.2 Ω

ASZ15: $-I_B$ = 1.35 A	$-I_C$ = 10 A	delay time	t_d	<	1	µs
ASZ16: $-I_B$ = 0.6 A		rise time	t_r	<	20	µs
ASZ17: $-I_B$ = 1.0 A		storage time	t_s	<	15	µs
ASZ18: $-I_B$ = 1.0 A		fall time	t_f	<	35	µs

Test circuit:

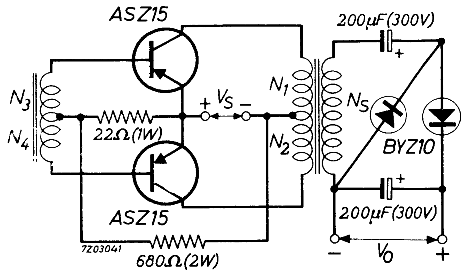




7Z3 0709

APPLICATION INFORMATION

Typical operation in a d.c. to d.c. converter



The data below have been designed for continuous operation up to T_{amb} = 55 ^{o}C. Incidentally, operation up to T_{amb} = 60 ^{o}C is permitted. (Based on $R_{th\ j-a}$ = 15 ^{o}C/W per transistor)

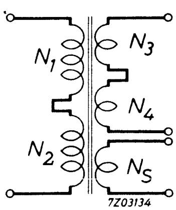
V_S	=	28	V
I_S	=	2.5	A
P_S	=	70	W
V_O	=	220	V
I_O	=	270	mA
P_O	=	60	W
η	=	86	%
f	=	450	Hz

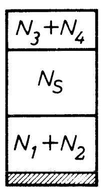
Losses

In transistors	:	2x2	W
In diodes	:	2x0.3	W
In biasing resistors	:	1.7	W
In transformer	:	3.7	W

Transformer data

The transformer core consists of square loop material (Telcon HCR alloy type 227)
Stacking height = 15 mm





$N_1 + N_2$, $N_3 + N_4$ are bifilarly wound

$N_1 = N_2$ = 46 turns of enamelled copper wire, 1 mm

$N_3 = N_4$ = 5 turns of enamelled copper wire, 0.5 mm

N_S = 190 turns of enamelled copper wire, 0.5 mm

7Z3 0710

OPERATING NOTES

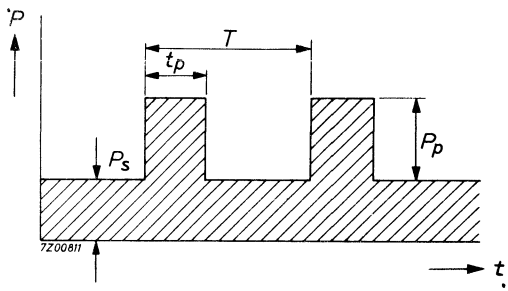
Determination of peak power ratings

For a pulse duration, shorter than the temperature stabilisation time

$$P_p = \frac{T_{j\,max} - T_{amb} - (R_{th\,j\text{-}mb} + R_{th\,mb\text{-}h} + R_{th\,h\text{-}a}) \cdot P_s}{R_{th\,t} + \delta \cdot R_{th\,h\text{-}a}}$$

For a pulse duration, longer than the temperature stabilisation time

$$P_p = \frac{T_{j\,max} - T_{amb}}{R_{th\,j\text{-}mb} + R_{th\,mb\text{-}h} + R_{th\,h\text{-}a}} - P_s$$



Where:

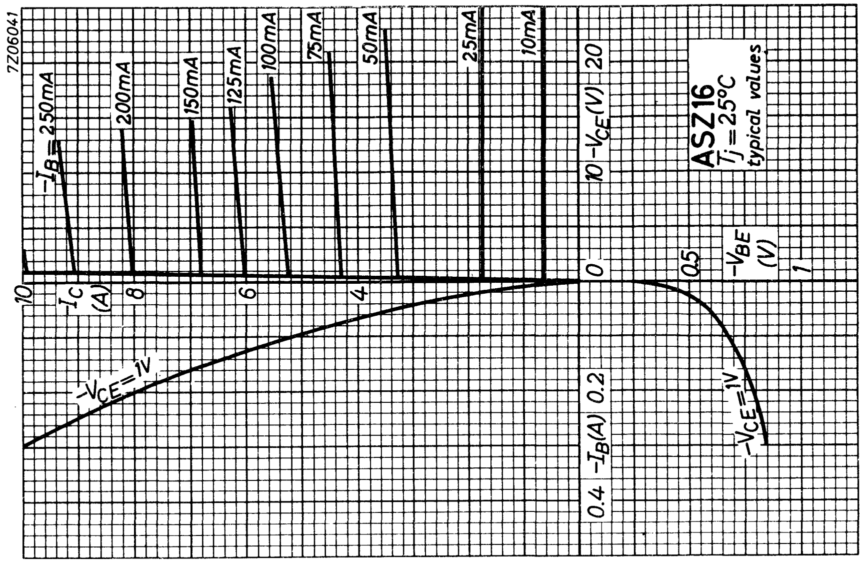
t_p = pulse duration
T = pulse period
δ = duty cycle = t_p/T
P_s = steady state power dissipation
P_p = permissible pulse power dissipation over P_s
$R_{th\,j\text{-}mb}$ = thermal resistance from junction to mounting base
$R_{th\,mb\text{-}h}$ = thermal resistance from mounting base to heatsink
$R_{th\,h\text{-}a}$ = thermal resistance from heatsink to ambient
$R_{th\,t}$ = transient thermal resistance = f(t, δ); see page F
(for durations longer than the temperature stabilisation time $R_{th\,t} = R_{th\,j\text{-}h} = R_{th\,j\text{-}mb} + R_{th\,mb\text{-}h}$)
$T_{j\,max}$ = maximum permissible junction temperature
T_{amb} = ambient temperature
Temperature stabilisation time = 1 s (see page F)

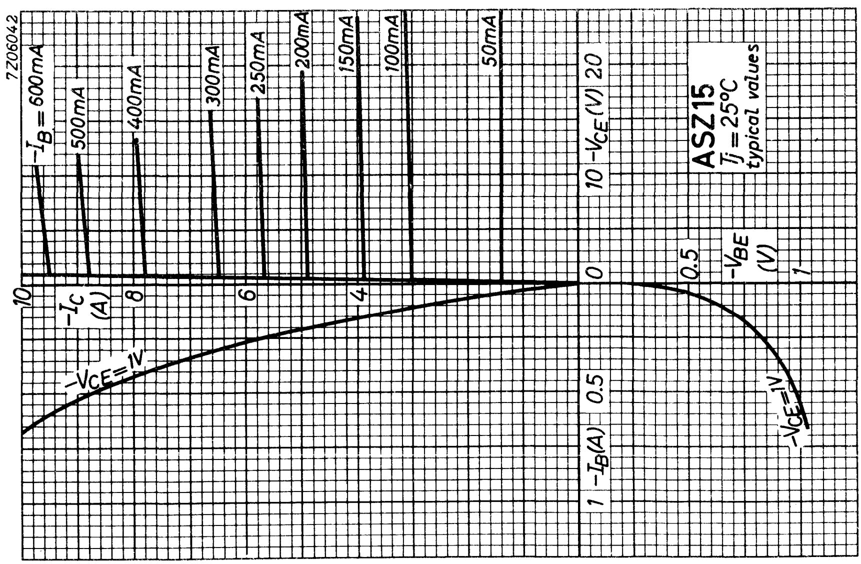
Example: P_s = 5 W, t = 1 ms, δ = 0.1, $R_{th\,mb\text{-}h}$ = 0.5 $^oC/W$,
$R_{th\,h\text{-}a}$ = 4.25 $^oC/W$ and T_{amb} = 25 ^oC

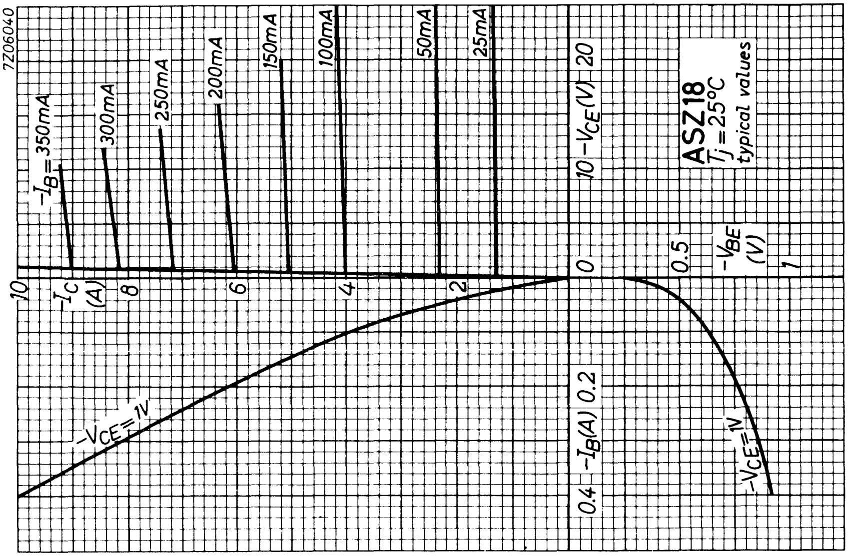
From t = 1 ms and δ = 0.1 it follows that $R_{th\,t}$ = 0.28 $^oC/W$ (page F)

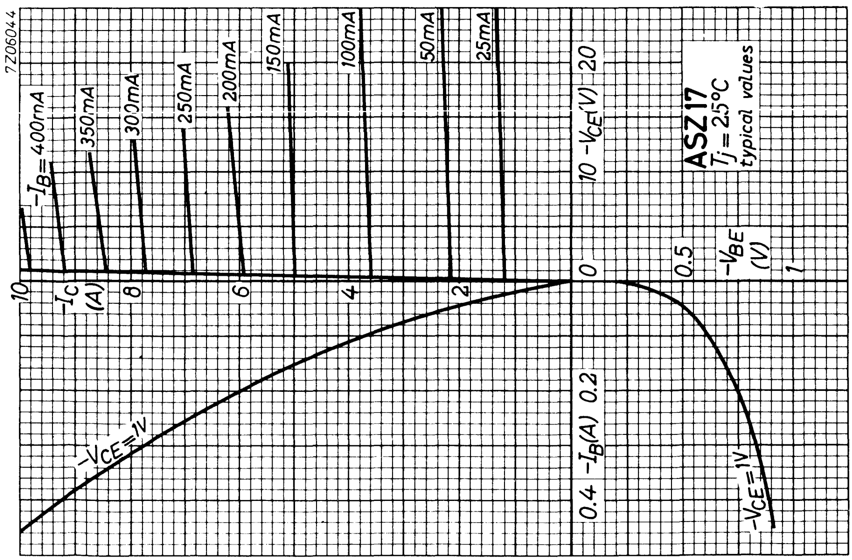
Then $P_p = \frac{90 - 25 - (1.5 + 0.5 + 4.25) \times 5}{0.28 + 0.1 \times 4.25} \approx 47.5$ W

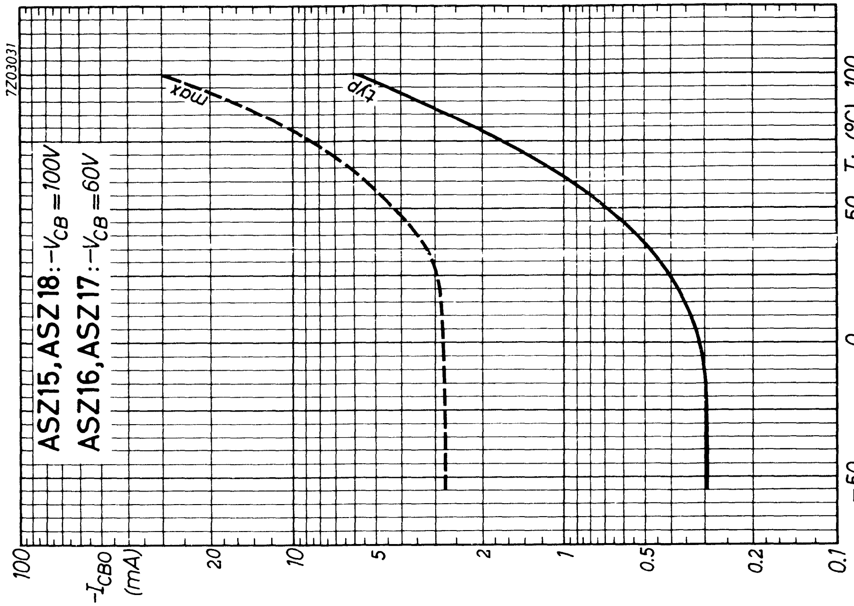
7Z3 0711

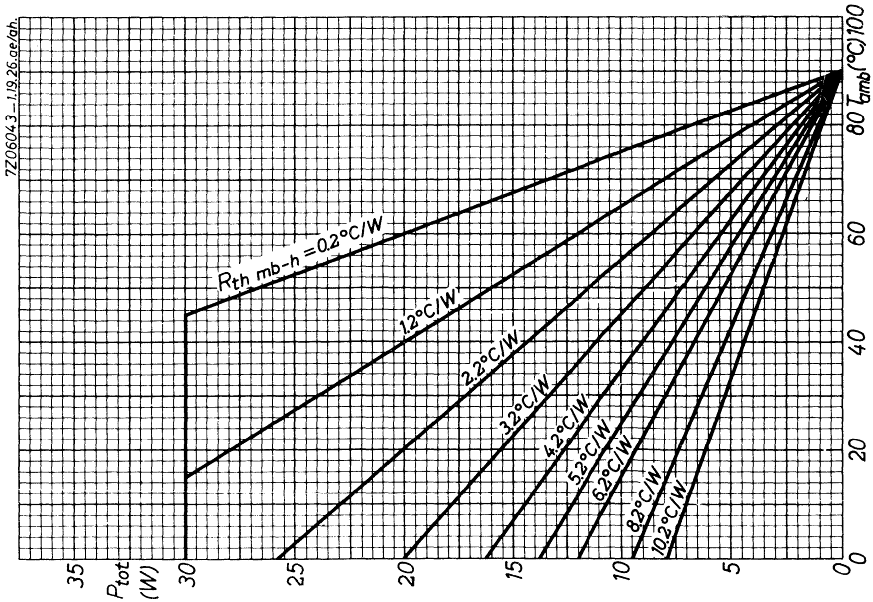

7Z06041
ASZ16
$T_j = 25°C$
typical values
$-I_B = 250mA$
200mA
150mA
125mA
100mA
75mA
50mA
25mA
10mA
$-I_C$ (A)
10
8
6
4
0
10 $-V_{CE}$(V) 20
0.5
$-V_{BE}$ (V)
1
$-V_{CE}=1V$
0.2
$-I_B$(A)
0.4
$-V_{CE}=1V$

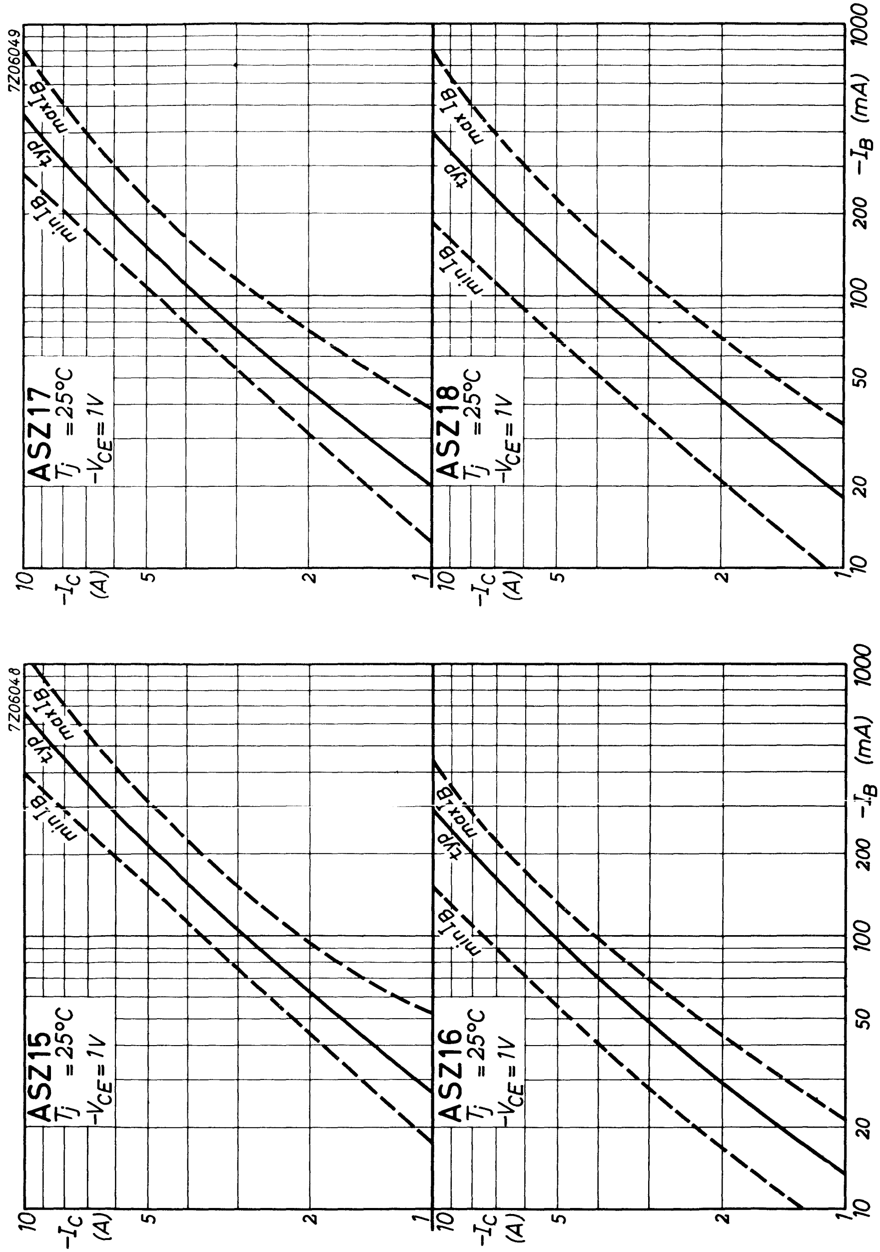

7Z06042
ASZ15
$T_j = 25°C$
typical values
$-I_B = 600mA$
500mA
400mA
300mA
250mA
200mA
150mA
100mA
50mA
$-I_C$ (A)
10
8
6
4
0
10 $-V_{CE}$(V) 20
0.5
$-V_{BE}$ (V)
1
$-V_{CE}=1V$
0.5
$-I_B$(A)
1
$-V_{CE}=1V$

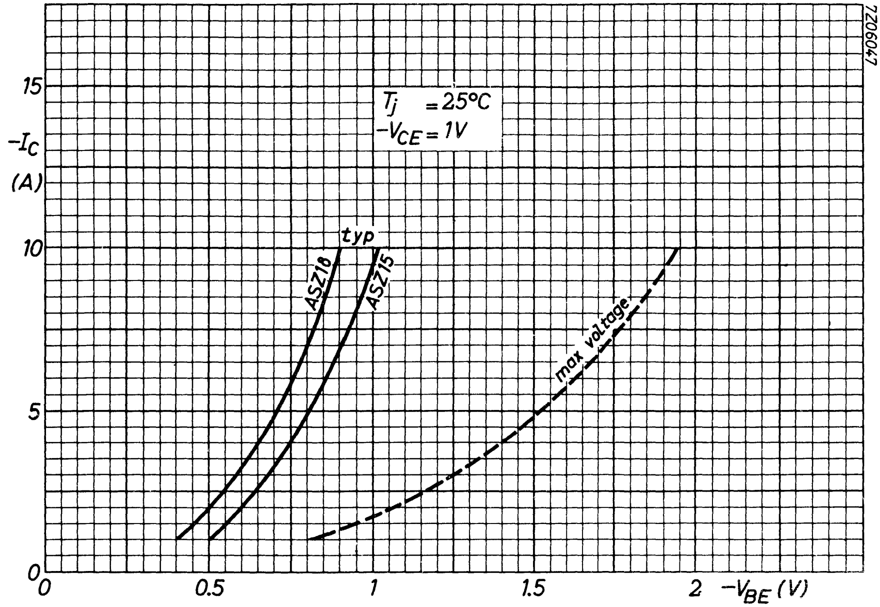

7Z06040
ASZ18
$T_j = 25°C$
typical values
$-I_B = 350mA$
300mA
250mA
200mA
150mA
100mA
50mA
25mA
$-I_C$ (A)
10
8
6
4
2
0
10 $-V_{CE}$(V) 20
0.5
$-V_{BE}$ (V)
1
0.4 $-I_B$(A) 0.2
$-V_{CE} = 1V$
$-V_{CE} = 1V$

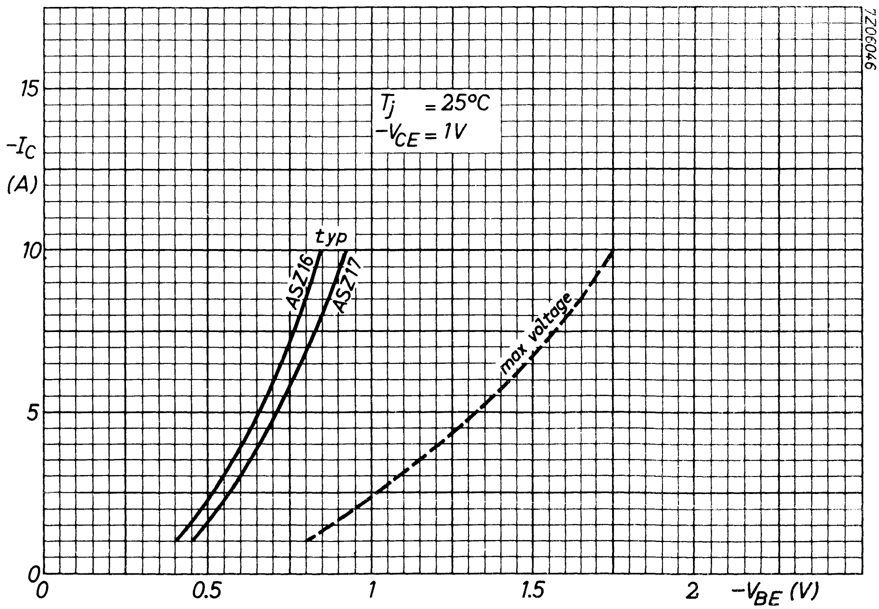

7Z06044
ASZ17
$T_j = 25°C$
typical values
$-I_B = 400mA$
350mA
300mA
250mA
200mA
150mA
100mA
50mA
25mA
$-I_C$ (A)
10
8
6
4
2
0
10 $-V_{CE}$(V) 20
0.5
$-V_{BE}$ (V)
1
0.4 $-I_B$(A) 0.2
$-V_{CE} = 1V$
$-V_{CE} = 1V$

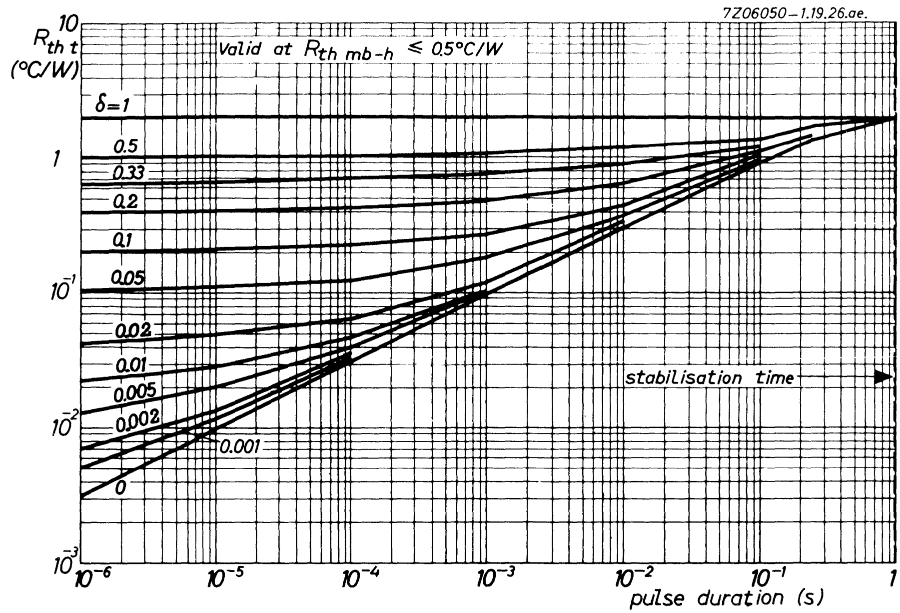

7Z03031
ASZ15, ASZ18: $-V_{CB}$ = 100V
ASZ16, ASZ17: $-V_{CB}$ = 60V
max
typ
$-I_{CBO}$ (mA)
100
20
10
5
2
1
0.5
0.2
0.1
T_j (°C)
−50
0
50
100

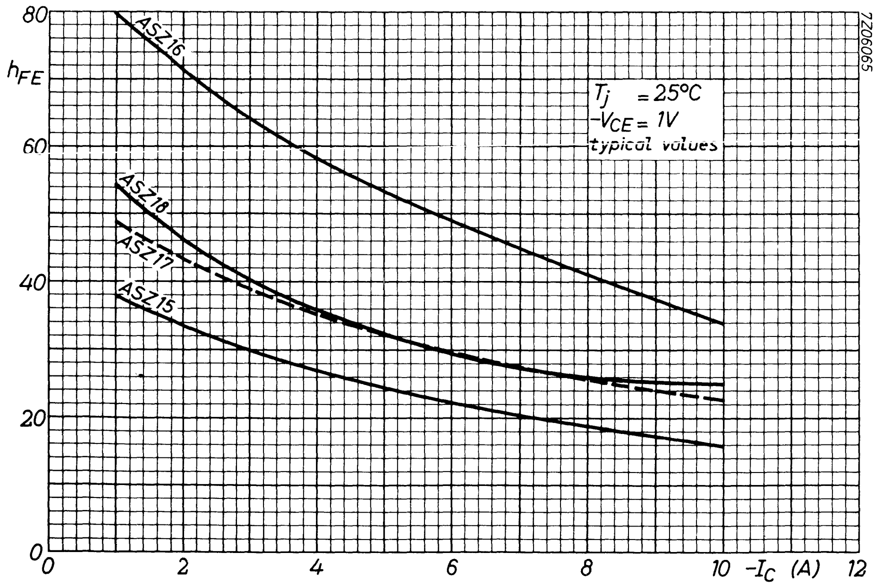

7Z06043-1.19.26.ae/ah.
$R_{th\ mb-h}$ = 0.2°C/W
1.2°C/W
2.2°C/W
3.2°C/W
4.2°C/W
5.2°C/W
6.2°C/W
8.2°C/W
10.2°C/W
P_{tot} (W)
35
30
25
20
15
10
5
0
T_{amb} (°C)
0
20
40
60
80
100

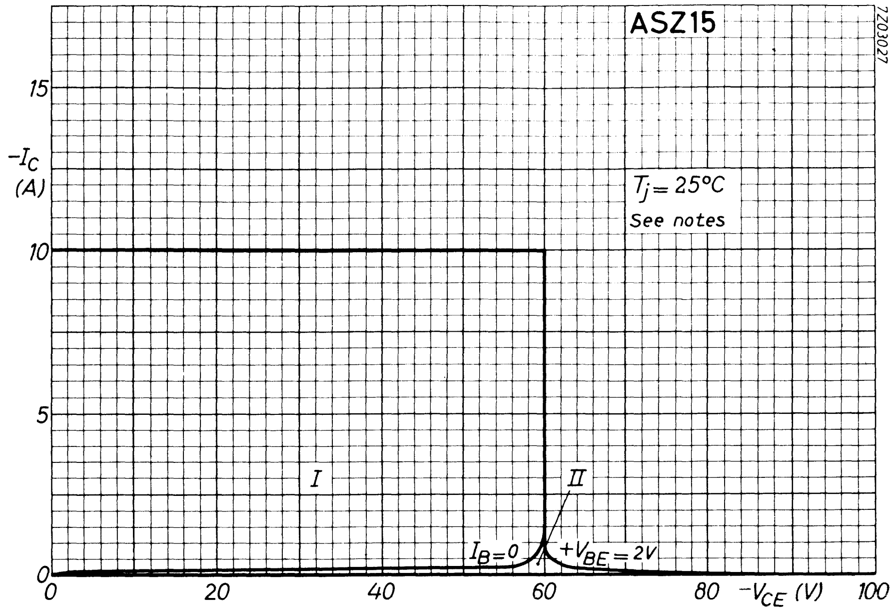

7Z06049
ASZ17
Tj = 25°C
−VCE = 1V
ASZ18
Tj = 25°C
−VCE = 1V
7Z06048
ASZ15
Tj = 25°C
−VCE = 1V
ASZ16
Tj = 25°C
−VCE = 1V
min IB
typ
max IB
−IC (A)
−IB (mA)
10
5
2
1
20
50
100
200
1000

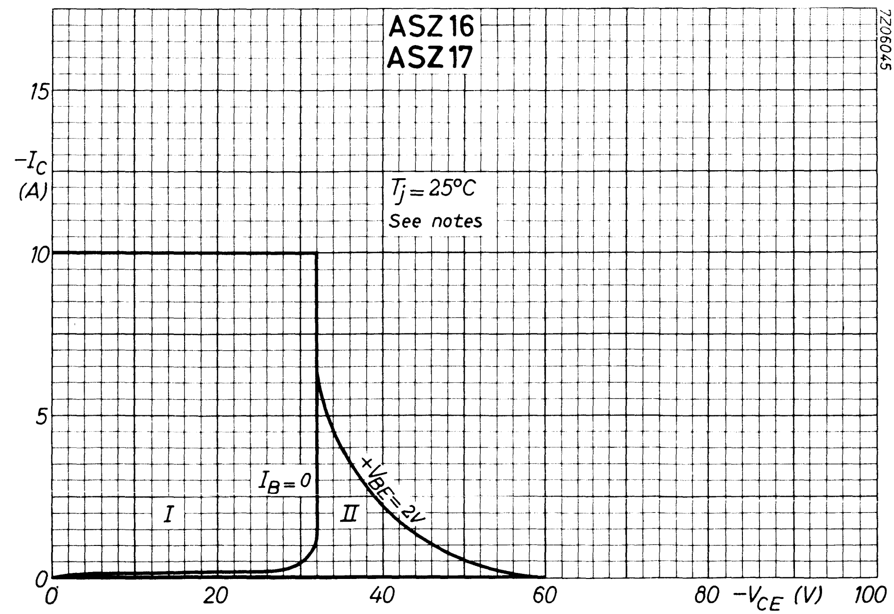

7Z06047
T_j = 25°C
$-V_{CE}$ = 1V
$-I_C$
(A)
15
10
5
0
typ
ASZ18
ASZ15
max voltage
0
0.5
1
1.5
2
$-V_{BE}$ (V)

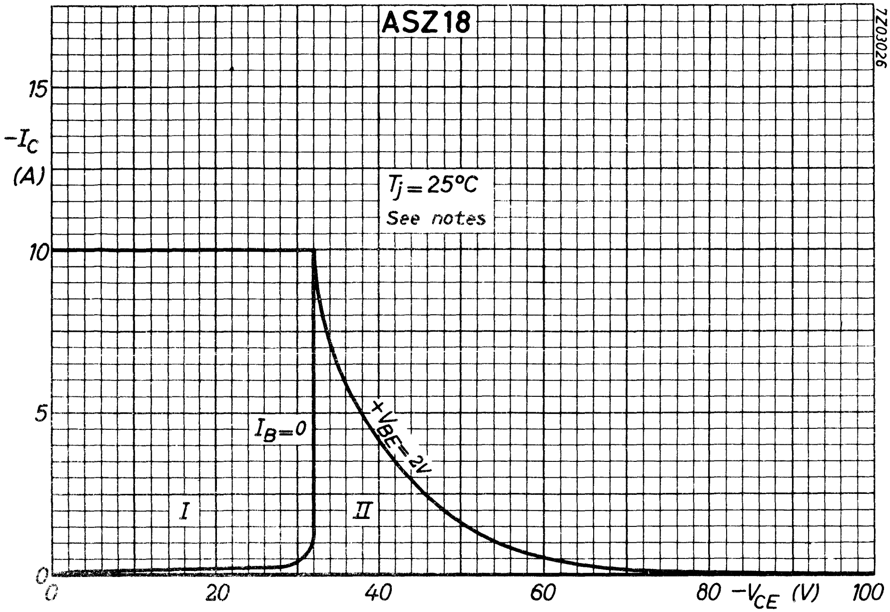

7Z06046
T_j = 25°C
$-V_{CE}$ = 1V
$-I_C$
(A)
15
10
5
0
typ
ASZ16
ASZ17
max voltage
0
0.5
1
1.5
2
$-V_{BE}$ (V)


7Z06050-1.19.26.ae.
$R_{th\,t}$ (°C/W)
Valid at $R_{th\,mb-h} \leq$ 0.5°C/W
δ=1
0.5
0.33
0.2
0.1
0.05
0.02
0.01
0.005
0.002
0.001
0
stabilisation time
pulse duration (s)


7Z06065
h_{FE}
ASZ16
ASZ18
ASZ17
ASZ15
T_j = 25°C
$-V_{CE}$ = 1V
typical values
$-I_C$ (A)


ASZ15
7Z03027
15
$-I_C$
(A)
$T_j = 25°C$
See notes
10
5
I
II
$I_B=0$
$+V_{BE}=2V$
0
0
20
40
60
80
$-V_{CE}$ (V)
100


ASZ16
ASZ17
7Z06045
15
$-I_C$
(A)
$T_j = 25°C$
See notes
10
5
$I_B=0$
$+V_{BE}=2V$
I
II
0
0
20
40
60
80
$-V_{CE}$ (V)
100



NOTES

I region of permissible operation under all base-emitter conditions

II additional region of operation when the transistor is cut-off with $+V_{BE}$ = 2 V

During switching-off, voltages higher than indicated by the minimum avalanche breakdown curves at $+V_{BE}$ = 2 V are allowed, provided the transient energy is less than 8 mWs.

7Z3 0712

P-N-P ALLOY DIFFUSED TRANSISTOR

Germanium alloy diffused transistor of the p-n-p type in metal case for use in wideband amplifier applications and current mode switching.

LIMITING VALUES (Absolute maximum values)

Collector			
Voltage (base reference)	$-V_{CB}$	= max.	40 V
Voltage (emitter reference) See also page G	$-V_{CE}$	= max.	40 V
Current	$-I_C$	= max.	25 mA
Base			
Current	$-I_B$	= max.	25 mA
Reverse current			
Continuous	I_B	= max.	1 mA
Peak	I_{BM}	= max.	10 mA
Dissipation			
Total dissipation	P_{tot}	= max.	110 mW
Temperatures			
Storage temperature	T_s	= max.	75 °C
Junction temperature			
Continuous operation	T_j	= −55 °C to +75 °C	
Incidentally (up to a total of 200 hours)	T_j	= max.	90 °C

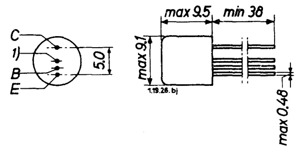
7Z2 2428

THERMAL DATA

Thermal resistance from junction to ambience in free air $K_{j\text{-}amb} < 0.6\ ^{\circ}C/mW$

MECHANICAL DATA

Dimensions in mm



CHARACTERISTICS at $T_{amb} = 25\ ^{\circ}C$

Collector current at $I_E = 0$			
$-V_{CB} = 6$ V	$-I_{CBO}$	<	4.5 μA
$-V_{CB} = 40$ V	$-I_{CBO}$	<	50 μA
Emitter current at $I_C = 0$			
$-V_{EB} = 1$ V	$-I_{EBO}$	<	50 μA
Base current			
$-V_{CB} = 6$ V; $I_E = 1$ mA	$-I_B$	<	25 μA
$-V_{CB} = 2$ V; $I_E = 10$ mA	$-I_B$	>	20 μA

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at $T_{amb} = 25\ ^{\circ}C$, unless otherwise specified

Base-emitter voltage			
$-V_{CB} = 6$ V; $I_E = 1$ mA	$-V_{BE}$	<	330 mV
		>	210 mV
$-V_{CB} = 2$ V; $I_E = 10$ mA	$-V_{BE}$	<	400 mV
		>	260 mV

[1]) Shield lead

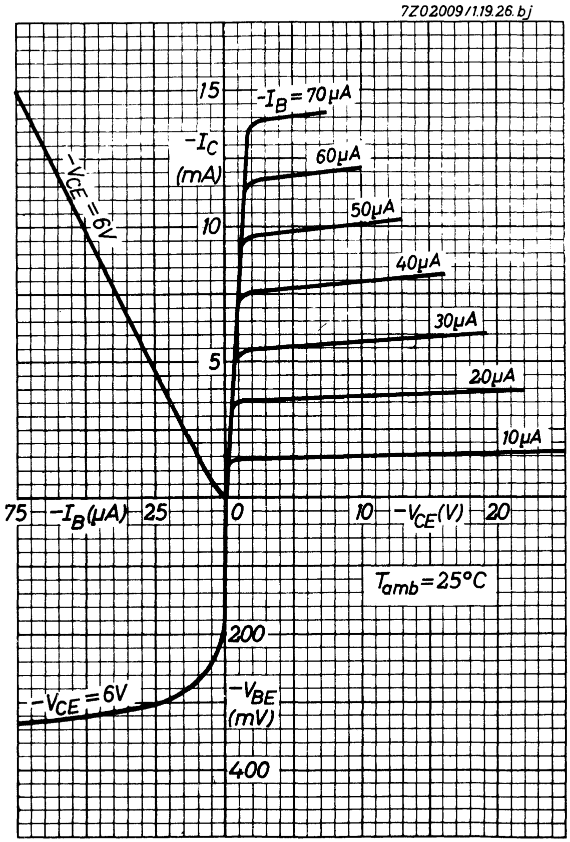
7Z2 2429

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN at T_{amb} = 25 °C (continued)

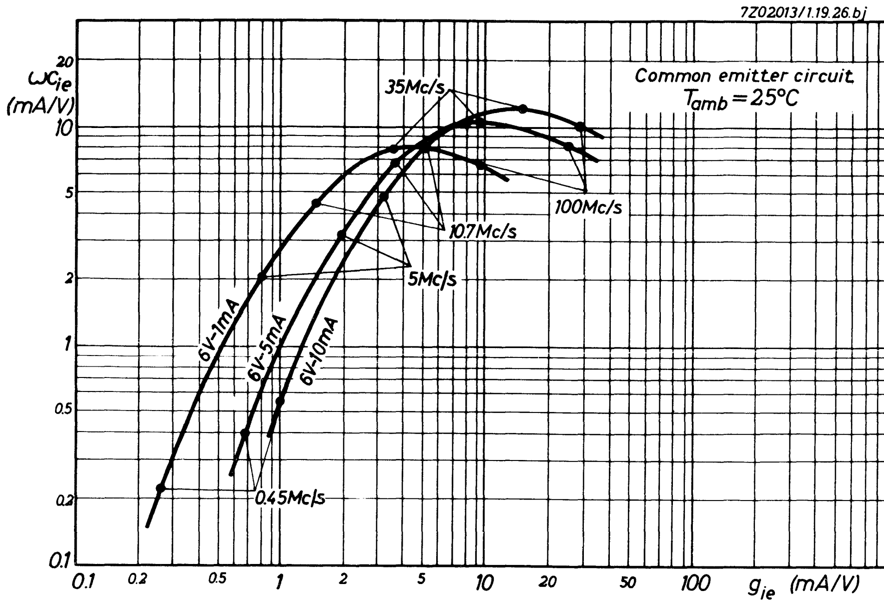
A.C. amplification factor			
$-V_{CB} \leqq 6$ V; $I_E \leqq 10$ mA, T_{amb} = 60 °C	h_{fb}	<	1.01
$-V_{CE}$ = 6 V; $-I_C$ = 1 mA; f = 1 kc/s	h_{fe}	>	45
Frequency at which $\lvert h_{fe} \rvert$ = 1			
$-V_{CB}$ = 6 V; I_E = 1 mA	f_1	= >	75 Mc/s 40 Mc/s
$-V_{CB}$ = 2 V; I_E = 10 mA	f_1	>	100 Mc/s
Intrinsic base impedance			
$-V_{CB}$ = 6 V; I_E = 1 mA; f = 2 Mc/s	$\lvert z_{rb} \rvert$	<	120 Ω
Collector capacitance			
$-V_{CB}$ = 6 V; I_E = 0 mA; f = 0.45 Mc/s	c_c	<	2.5 pF
Noise figure			
$-V_{CE}$ = 6 V; $-I_C$ = 1 mA; f = 1 kc/s; R_S = 500 Ω [1])	F	= <	15 dB 20 dB
$-V_{CE}$ = 6 V; $-I_C$ = 1 mA; f = 0.45 Mc/s; R_S = 500 Ω [1])	F	<	6 dB

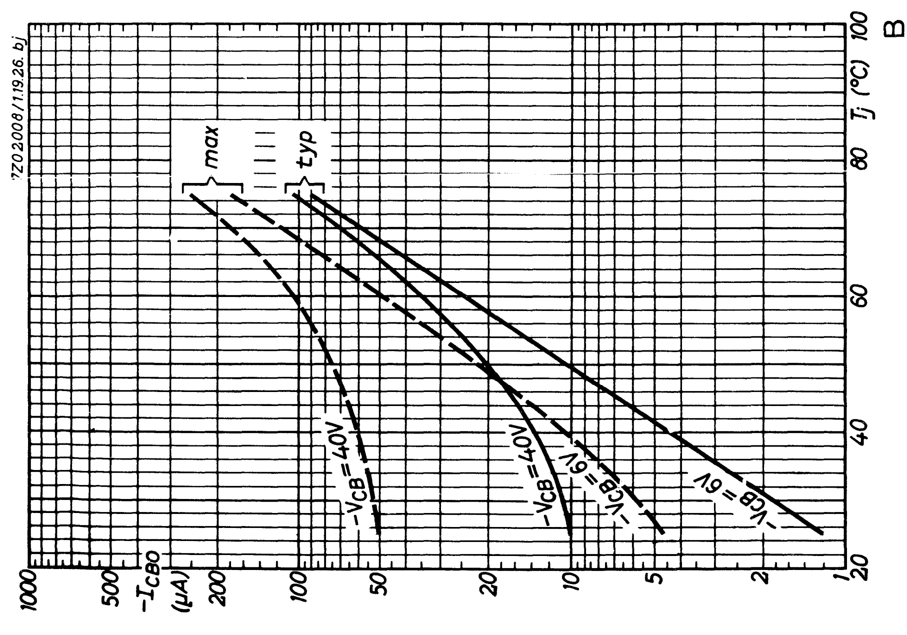
[1]) R_S = input source resistance

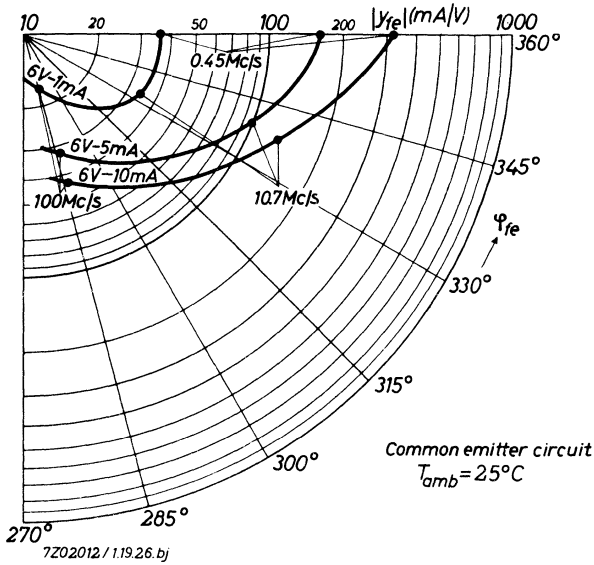
7Z2 2430


7Z02009/1.19.26.bj
15
$-I_B = 70\mu A$
$-I_C$
(mA)
60µA
50µA
10
40µA
30µA
5
20µA
10µA
$-V_{CE} = 6V$
75
$-I_B (\mu A)$
25
0
10
$-V_{CE} (V)$
20
$T_{amb} = 25°C$
200
$-V_{CE} = 6V$
$-V_{BE}$
(mV)
400

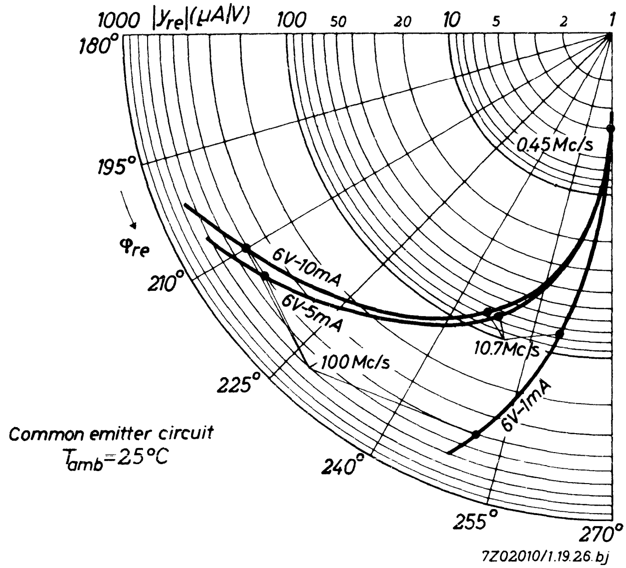
A


7Z02013/1.19.26.bj
C
Common emitter circuit
T_{amb} = 25°C
ωC_{ie} (mA/V)
35Mc/s
100Mc/s
10.7Mc/s
5Mc/s
0.45Mc/s
6V-1mA
6V-5mA
6V-10mA
g_{ie} (mA/V)

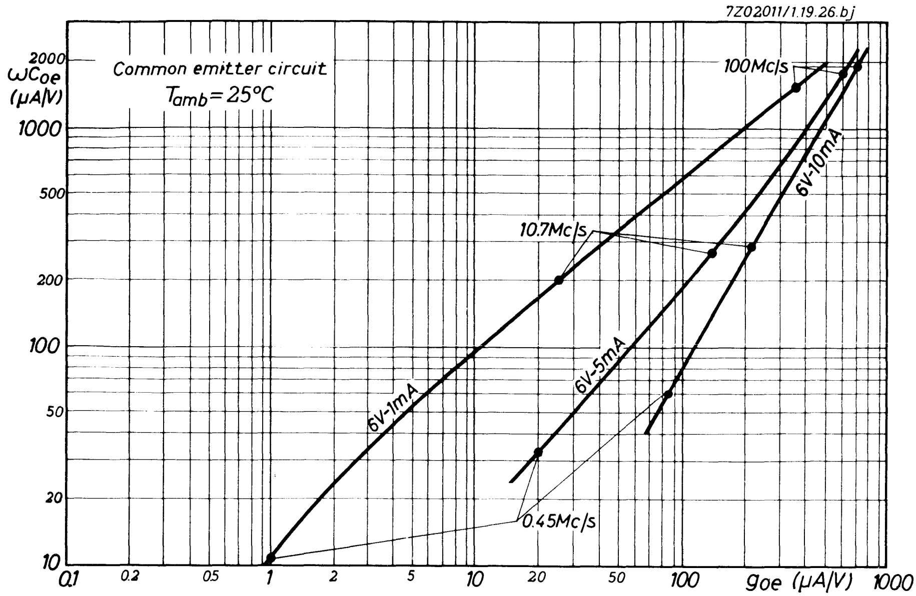

7Z02008/1.19.26.bj
B
T_j (°C)
max
typ
$-V_{CB}$ = 40V
$-V_{CB}$ = 6V
$-I_{CBO}$ (μA)


10
20
50
100
200
$|y_{fe}|$(mA/V)
1000
360°
345°
330°
315°
300°
285°
270°
φ_{fe}
0.45Mc/s
6V-1mA
6V-5mA
6V-10mA
100Mc/s
10.7Mc/s
Common emitter circuit
T_{amb}=25°C
7Z02012/1.19.26.bj

D

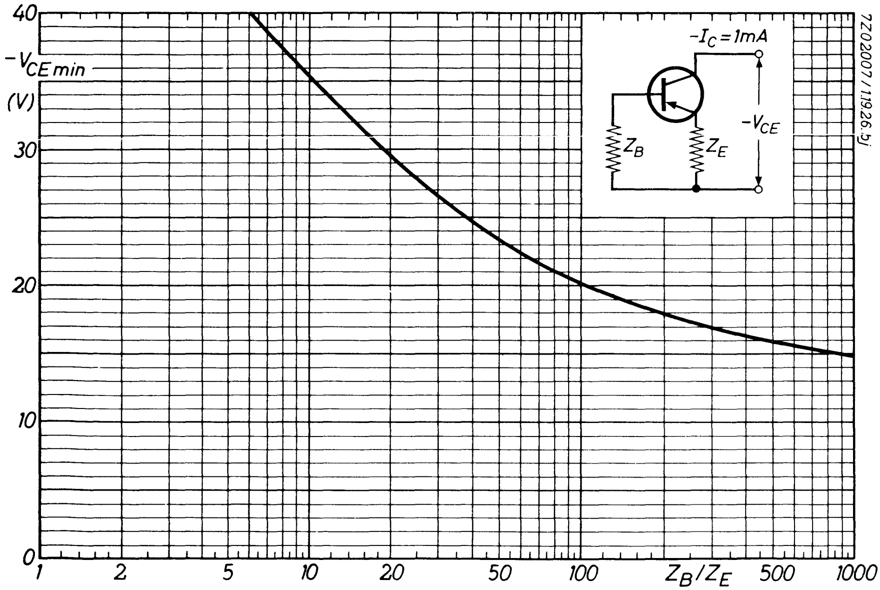

1000
$|y_{re}|$(μA/V)
100
50
20
10
5
2
1
180°
195°
210°
225°
240°
255°
270°
φ_{re}
0.45Mc/s
6V-10mA
6V-5mA
100 Mc/s
10.7Mc/s
6V-1mA
Common emitter circuit
T_{amb}=25°C
7Z02010/1.19.26.bj

E



7Z02011/1.19.26.bj
Common emitter circuit
T_{amb} = 25°C
ωC_{oe} (μA/V)
2000
1000
500
200
100
50
20
10
100Mc/s
10.7Mc/s
0.45Mc/s
6V-1mA
6V-5mA
6V-10mA
0.1
0.2
0.5
1
2
5
10
20
50
100
goe (μA/V)
1000

F

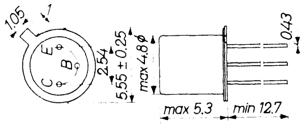


7Z02007/1.19.26.bj
$-V_{CE\,min}$ (V)
40
30
20
10
0
$-I_C$ = 1mA
Z_B
Z_E
$-V_{CE}$
1
2
5
10
20
50
100
Z_B/Z_E
500
1000

G

ALLOY-DIFFUSED TRANSISTOR of the p-n-p type in metal envelope for high-speed saturated logic applications

Dimensions in mm — Collector connected to case



LIMITING VALUES (Absolute max. values)

Collector

Voltage (base reference)	$-V_{CB}$	= max. 20 V
Voltage (emitter reference)	$-V_{CE}$	= max. 15 V
Current		
Peak	$-I_{CM}$	= max. 50 mA
D.C. and average (averaging time max. 20 msec)	$-I_C$	= max. 30 mA
	(t_{av}	= 20 msec)

Emitter

Reverse current [1]		
Peak	$-I_{EM}$	= max. 10 mA
D.C. and average (averaging time max. 20 msec)	$-I_E$	= max. 5 mA
	(t_{av}	= 20 msec)

Base

Current		
Peak	$-I_{BM}$	= max. 10 mA
D.C. and average (averaging time max. 20 msec)	$-I_B$	= max. 5 mA
	(t_{av}	= 20 msec)

Dissipation

Total dissipation	P_{tot}	= max. 120 mW

Temperatures

Storage temperature	T_s	= -55 °C to +75 °C
Junction temperature	T_j	= max. 85 °C

[1]) When the current is not limited the voltage must be less than 2.5 V

7Z2 2267 1.

THERMAL DATA

Thermal resistance from junction to ambience in free air	K = max. 0.50 °C/mW
Thermal resistance from junction to case	K = max. 0.18 °C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Collector current	
$-I_C$ ($-V_{CE}$ = 15 V; $-V_{EB}$ = 0.2 V; T_{amb} = 60 °C)	< 60 μA
Emitter current at I_C = 0 mA	
$-I_{EBO}$ ($-V_{EB}$ = 0.5 V; I_C = 0 mA)	< 2 μA
Base current	
$-I_B$ ($-V_{CE}$ = 15 V; $-V_{EB}$ = 0.2 V; T_{amb} = 60 °C)	< 60 μA
Collector voltage	
$-V_{CB}$ ($-I_C$ = 100 μA; I_E = 0 mA; T_{amb} = 60 °C)	> 20 V
$-V_{CE}$ ($-I_C$ = 100 μA; V_{BE} = 0 V)	> 15 V
$-V_{CE}$ ($-I_C$ = 5 mA; $-I_B$ = 0 mA)	> 9 V
$-V_{CE}$ ($-I_C$ = 10 mA; $-I_B$ = 1 mA)	< 0.35 V
$-V_{CE}$ ($-I_C$ = 50 mA; $-I_B$ = 3 mA)	< 1.10 V
Emitter voltage	
$-V_{EB}$ ($-I_E$ = 100 μA; I_C = 0 mA; T_{amb} = 60 °C)	> 2.5 V
Base voltage	
$-V_{BE}$ ($-I_C$ = 10 mA; $-I_B$ = 0.44 mA)	> 0.25 V < 0.5 V
D.C. current amplification factor	
h_{FE} ($-V_{CE}$ = 0.5 V; $-I_C$ = 10 mA)	> 30
h_{FE} ($-V_{CE}$ = 1.0 V; $-I_C$ = 30 mA)	> 50

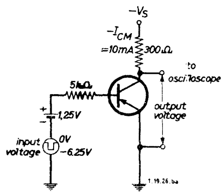
7Z2 1162 2.

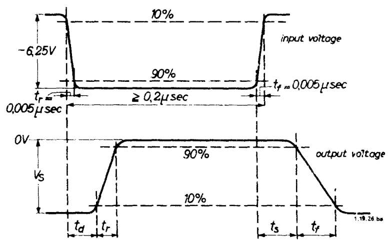
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Tamb = 25 °C

Base voltage		
$-V_{BE}$ ($-I_C$ = 30 mA; $-I_B$ = 0.9 mA)	> 0.35 V < 0.75 V	
Frequency at which $\|h_{fe}\|$ = 1		
f_1 (I_E = 10 mA; $-V_{CB}$ = 2 V)	> 300 Mc/s	
Collector capacitance		
c_c ($-V_{CB}$ = 6 V; I_E = 0 mA)	< 5 pF	
Emitter capacitance		
c_e ($-V_{EB}$ = 1 V; I_C = 0 mA)	< 2 pF	

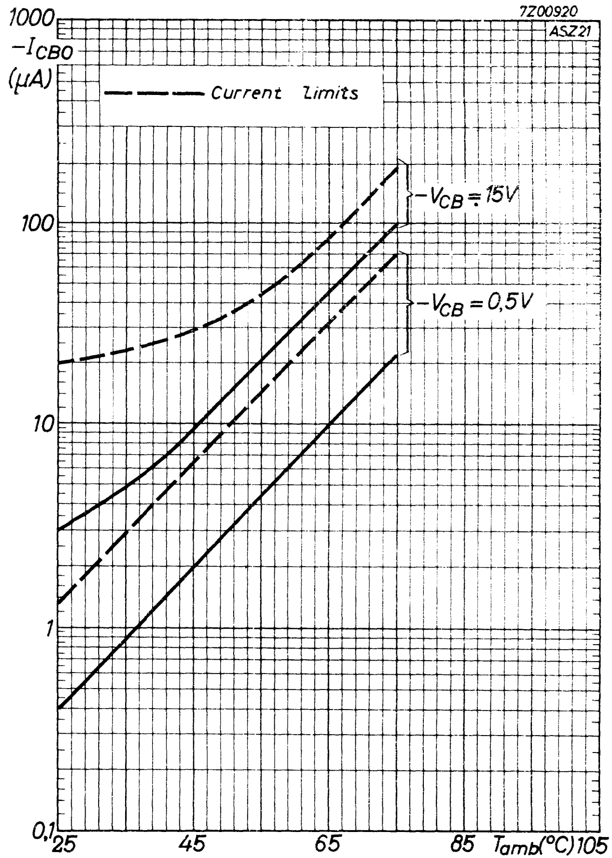
Transient behaviour





Delay time	t_d = 0.03 μsec	> 0.015 μsec	< 0.040 μsec
Rise time	t_r = 0.02 μsec	> 0.010 μsec	< 0.035 μsec
Storage time	t_s = 0.04 μsec	> 0.025 μsec	< 0.060 μsec
Fall time	t_f = 0.04 μsec	> 0.025 μsec	< 0.055 μsec

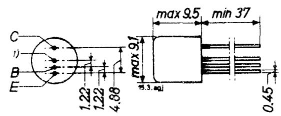
7Z2 1163



A

ALLOY-DIFFUSED JUNCTION TRANSISTOR of the p-n-p type in metal can for generating short duration pulses
TRANSISTOR À JONCTIONS du type p-n-p EN TECHNIQUE ALLIAGE-DIFFUSION dans un boîtier métallique pour la production d'impulsions à courte durée
p-n-p-FLÄCHENTRANSISTOR NACH DEM DIFFUSIONSLEGIERUNGS-VERFAHREN in Metallgehäuse zur Erzeugung von Impulsen kurzer Dauer

Dimensions in mm
Dimensions en mm
Abmessungen in mm



Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

$-I_{CM}$	= max.	100	mA
$-I_{CQ}$	= max.	2	mA [2]
$-V_{EB}$	= max.	2	V
P_{tot}	= max.	$\frac{T_{j\,max} - T_{amb}}{K}$ [3]	
T_j	= max.	75	°C

Storage temperature
Température d'emmagasinage = -55 °C/+75 °C
Lagerungstemperatur

[1]) Interlead shield and metal case
Blindage entre les connexions et boîtier métallique
Abschirmung zwischen den Anschlüssen und Metallgehäuse

[2]) Quiescent avalanche
Courant de collecteur de repos
Kollektorruhestrom

[3]) See also pages A and B
Voir aussi pages A et B
Siehe auch Seiten A und B

Thermal data. Thermal resistance

from junction to ambience in free air	K	≦ 0.6 °C/mW
from junction to case	K	≦ 0.5 °C/mW

Données thermiques. Résistance thermique

entre les jonctions et l'ambiance à l'air libre	K	≦ 0,6 °C/mW
entre les jonctions et le boîtier	K	≦ 0,5 °C/mW

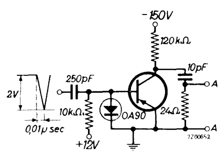
Thermische Daten. Wärmewiderstand

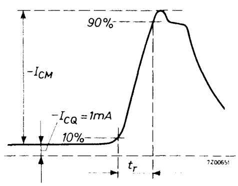
zwischen Kristall und Umgebung in freier Luft	K	≦ 0,6 °C/mW
zwischen Kristall und Gehäuse	K	≦ 0,5 °C/mW

Characteristics range values for equipment design
Gammes de valeurs des caractéristiques pour l'étude d'équipements
Kenndatenbereiche für Gerätentwurf

		T_{amb} = 25 °C	
$-V_{CB}$ = 6 V	$-I_{CBO}$ = 2,0 μA	< 8,0 μA	
$-V_{EB}$ = 0,5 V	$-I_{EBO}$ = 0,1 μA	< 0,5 μA	
$-I_C$ = 1 mA; I_E = 0 mA	$-V_{CB}$ = 24 V	> 15 V	< 30 V
$-V_{CB}$= 6 V; I_E = 0 mA	$c_{b'c}$	< 4,0 pF	

Collector current pulse
Impulsion du courant de collecteur
Kollektorstromimpuls





	$-I_{CM}$ = 40	< 60 mA [1])
	t_r	< 0,001 μsec

[1]) See page 3
Voir page 3
Siehe Seite 3

7Z2 3140 2.

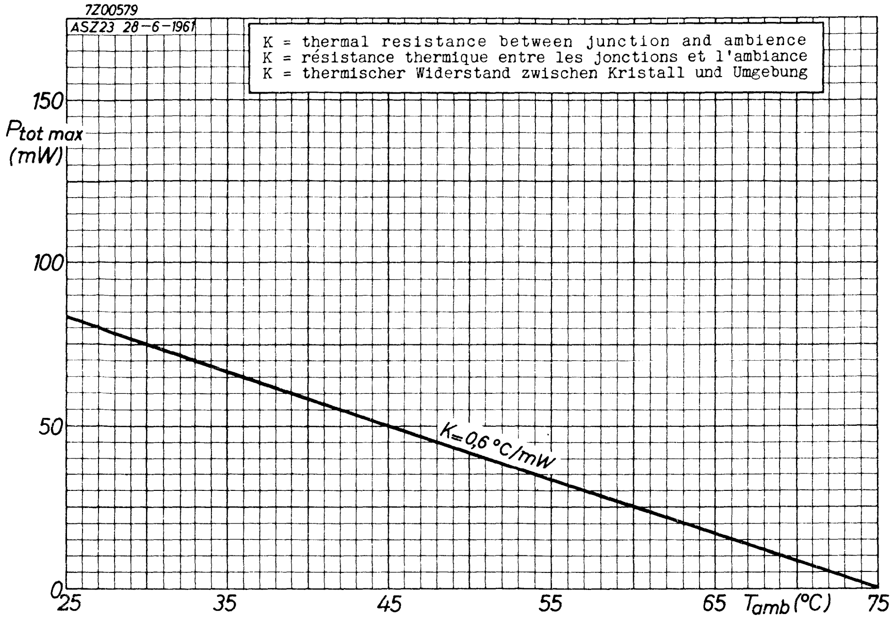
Collector current pulse (continued)
Impulsion du courant de collecteur (suite)
Kollektorstromimpuls (Fortsetzung)

Terminals A : to sampling oscilloscope
Bornes A : pour oscilloscope stroboscopique
Anschlussklemmen A: nach stroboskopischem Oszillographen

The resistance of 24 Ω should be a non inductive type and may be conveniently obtained by four lengths of coaxial cable in parallel with short circuit terminations (Each length = 1.5 m, Z_o = 95 Ω)
La résistance de 24 Ω doit être non-inductive et peut être obtenue par quatre pièces de câble coaxial en parallèle avec les extrémités en court-circuit (chaque pièce de 1,5 m, Z_o = 95 Ω)
Der Widerstand von 24 Ω soll induktionsfrei sein und kann mittels vier parallelgeschalteten Koaxialkabelstücke mit kurzgeschlossenen Enden erhalten werden (jedes Stück 1,5 m, Z_o = 95 Ω)

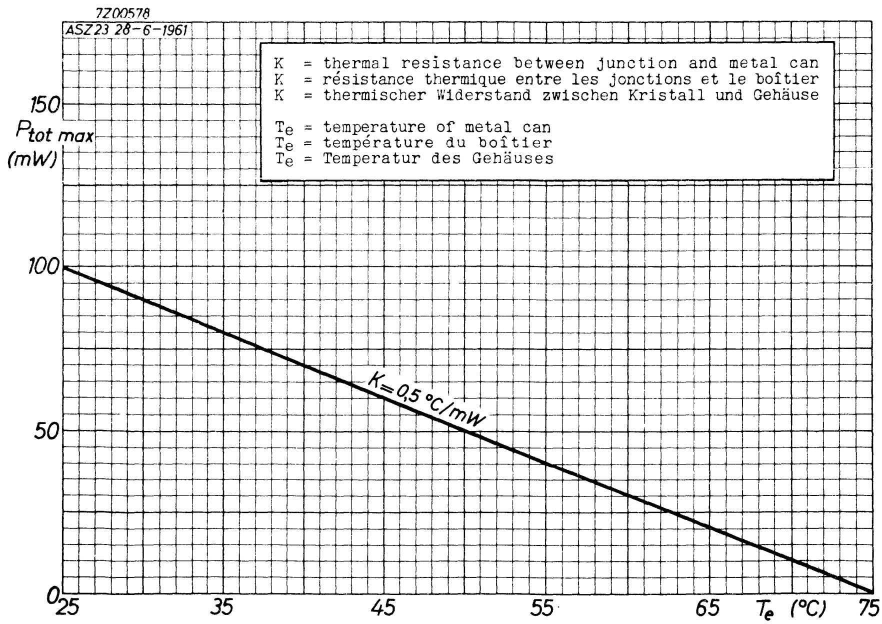
---

[1]) Higher values may be achieved in the circuit shown provided the collector circuit capacitance < 15 pF
Des valeurs plus élevées peuvent être obtenues dans le circuit page 2, si la capacité du circuit de collecteur est < 15 pF
Wenn die Kapazität der Kollektorschaltung < 15 pF ist, können in der angegebenen Schaltung höhere Werte erhalten werden



7Z00579
ASZ23 28-6-1961
K = thermal resistance between junction and ambience
K = résistance thermique entre les jonctions et l'ambiance
K = thermischer Widerstand zwischen Kristall und Umgebung
150
Ptot max (mW)
100
50
0
25
35
45
55
65
Tamb (°C)
75
K=0,6 °C/mW

A



7Z00578
ASZ23 28-6-1961
K = thermal resistance between junction and metal can
K = résistance thermique entre les jonctions et le boîtier
K = thermischer Widerstand zwischen Kristall und Gehäuse
Te = temperature of metal can
Te = température du boîtier
Te = Temperatur des Gehäuses
150
Ptot max (mW)
100
50
0
25
35
45
55
65
Te (°C)
75
K=0,5 °C/mW

B

GERMANIUM P-N-P POWER TRANSISTORS

Alloy diffused transistors in TO-3 metal case with the collector connected to the case.
The AU101 is meant for use in a line deflection output stage; the AU102 for the corresponding driver stage.

RATINGS (Limiting values) [1])

Collector-base voltage (open emitter)	AU101	$-V_{CBO}$	max.	120	V
	AU102	$-V_{CBO}$	max.	40	V
Collector current (d.c. and average)		$-I_C$	max.	10	A
Total power dissipation		P_{tot}	max.	10	W
Junction temperature (continuous)		T_j	max.	90	^oC

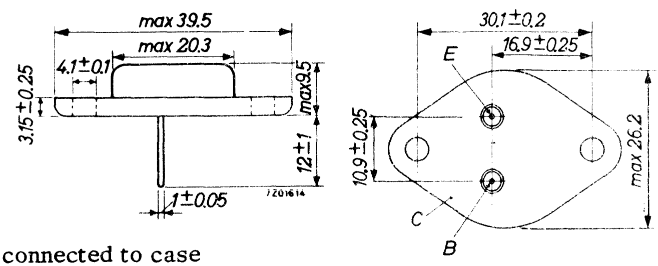
THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	$^oC/W$

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

D.C. current gain					
$I_E = 10$ A; $V_{CB} = 0$	AU101	h_{FE}		12 to 50	
	AU102	h_{FE}	>	7	
Transition frequency					
$-I_C = 0.5$ A; $-V_{CE} = 2$ V		f_T	>	400	kHz
Fall time from $-I_C = 8$A					
$T_j = 90\ ^oC$	AU101	t_f	<	2.6	µs
	AU102	t_f	<	3.9	µs

MECHANICAL DATA Dimensions in mm



TO-3
Collector connected to case

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0203

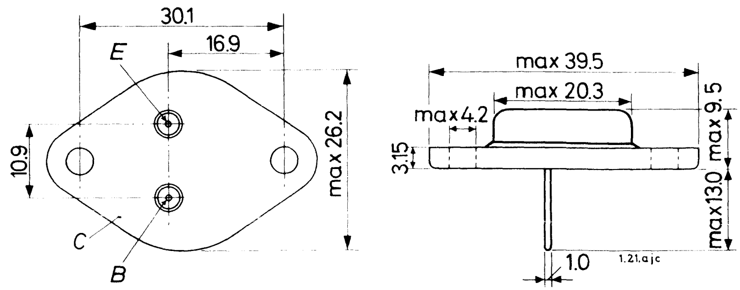
POWER TRANSISTOR

P-N-P germanium alloy-diffused transistor in a TO-3 metal case, primarily intended for use in line-detection output circuits of television receivers.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	155	V
Collector-emitter voltage ($+V_{BE}$ = 1 V)	$-V_{CEX}$	max.	155	V
Collector current (peak value)	$-I_{CM}$	max.	10	A
Total dissipation up to T_{mb} = 85 °C	P_{tot}	max.	10	W
Junction temperature	T_j	max.	90	°C
Thermal resistance	$R_{th\ j\text{-}mb}$	=	1.5	°C/W
Emitter-base breakdown voltage $-I_E$ = 100 mA (open collector)	$-V_{(BR)EBO}$	>	4	V
D.C. current gain at T_j = 25 °C $-I_C$ = 10 A; $-V_{CE}$ = 1 V	h_{FE}	>	15	
Transition frequency at T_j = 25 °C $-I_C$ = 0.5 A; $-V_{CE}$ = 2 V	f_T	typ.	15	MHz
Fall time	t_f	<	1.7	μs

MECHANICAL DATA Dimensions in mm

TO-3
Collector connected to case



Accessories see page 5 7Z3 0432

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	155	V
Collector-emitter voltage with $+V_{BE}$ = 1 V (See also page A)	$-V_{CEX}$	max.	155	V

Currents

Collector current (d.c.)	$-I_C$	max.	10	A
Collector current (peak value)	$-I_{CM}$	max.	10	A [2]
Emitter current (d.c.)	I_E	max.	12.5	A
Emitter current (peak value)	I_{EM}	max.	12.5	A
Base current (d.c.)	$-I_B$	max.	2.5	A
Base current (peak value)	$-I_{BM}$	max.	2.5	A
Reverse base current (d.c.)	$+I_B$	max.	0.1	A
Reverse base current (peak value) t = 5 µs	$+I_{BM}$	max.	2.5	A

Power dissipation (See also page B)

Total power dissipation up to T_{mb} = 85 °C	P_{tot}	max.	10	W

Temperatures

Storage temperature	T_{stg}		-55 to +90	°C
Junction temperature: continuous	T_j	max.	90	°C
incidentally	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.5	°C/W
From mounting base to heatsink without mica washer	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
with mica washer	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) Non repetitive peak collector current: 20 A

7Z3 0433

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $-V_{CB} = 155$ V	$-I_{CBO}$	<	10	mA
$I_E = 0$; $-V_{CB} = 155$ V; $T_j = 100$ °C	$-I_{CBO}$	<	60	mA
Base-emitter voltage				
$I_E = 10$ A; $-V_{CB} = 0.5$ V	$-V_{BE}$	<	0.75	V
Collector-emitter saturation voltage				
$-I_C = 10$ A; $-I_B = 0.8$ A (See also page D)	$-V_{CEsat}$	<	0.7	V
Emitter-base breakdown voltage				
$I_C = 0$; $-I_E = 100$ mA	$-V_{(BR)EBO}$	>	4	V
D.C. current gain				
$-I_C = 10$ A; $-V_{CE} = 1$ V	h_{FE}	>	15	
Transition frequency				
$-I_C = 0.5$ A; $-V_{CE} = 2$ V	f_T	typ.	15	MHz
Switching times when switched from $-I_B = 0.8$ A to $V_{BE} = 4$ V measured at $-I_C = 10$ A (See also page 4 and page E)				
storage time	t_s	<	3	μs
fall time	t_f	<	1.7	μs

7Z3 0434

MEASUREMENT OF SWITCHING TIMES

Fig.1: Circuit diagram

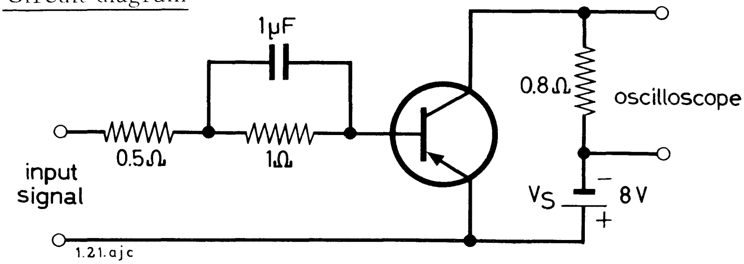


Fig.2: Input signal

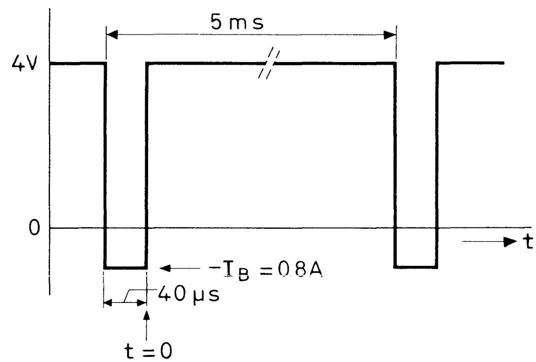
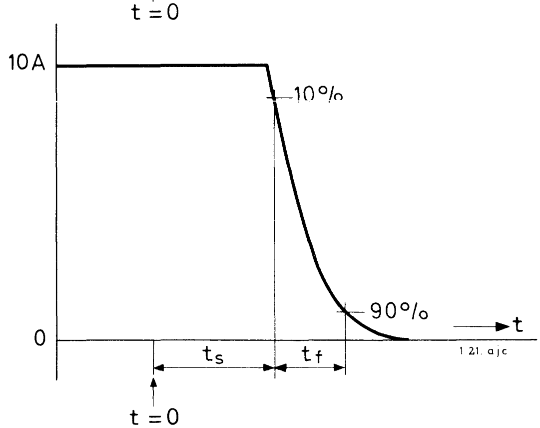
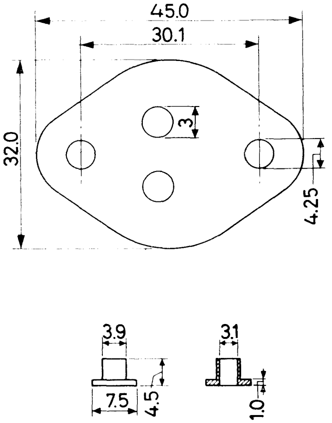


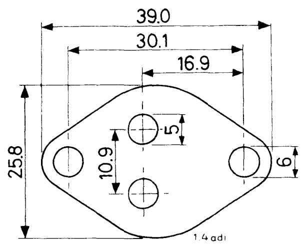
Fig.3: Output signal



7Z3 0435

ACCESSORIES

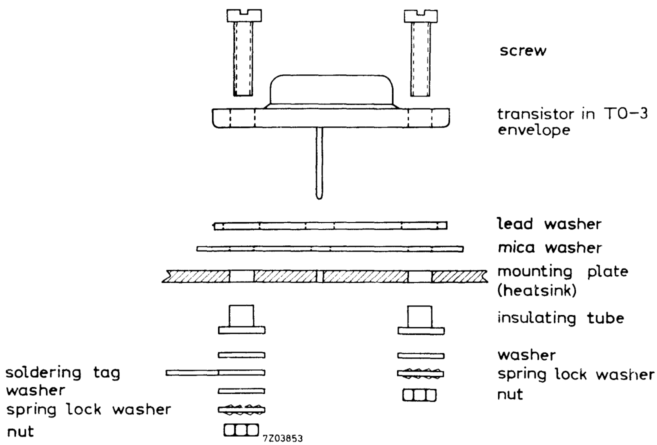




Type number 56201a
Mica insulation (50 μm)
and insulation tubes

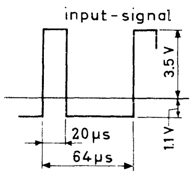
Type number 56201b
Lead washer (1 mm)

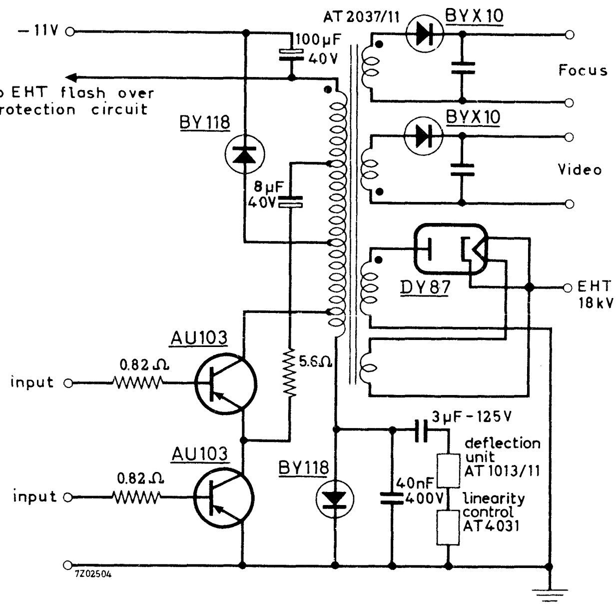
MOUNTING INSTRUCTIONS



1. For non-insulated mounting, remove mica washer
2. Torque on nut: max. 5 cm kg
3. For better heat transfer to the heatsink, use heatsink compound between the contact surfaces (e.g. Dow Corning 340).
4. For maximum cooling, the heatsink should be mounted vertically. 7Z3 0442

APPLICATION INFORMATION

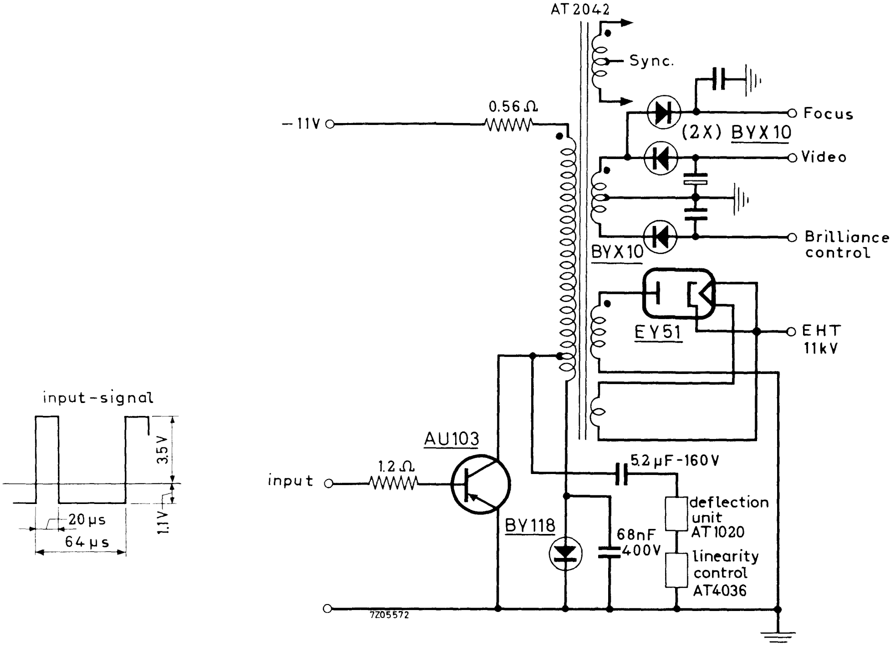




Circuit I : Typical parallel-series efficiency circuit for 110° deflection with an E.H.T. of 18 kV and a flyback ratio of 18%

7Z3 0436

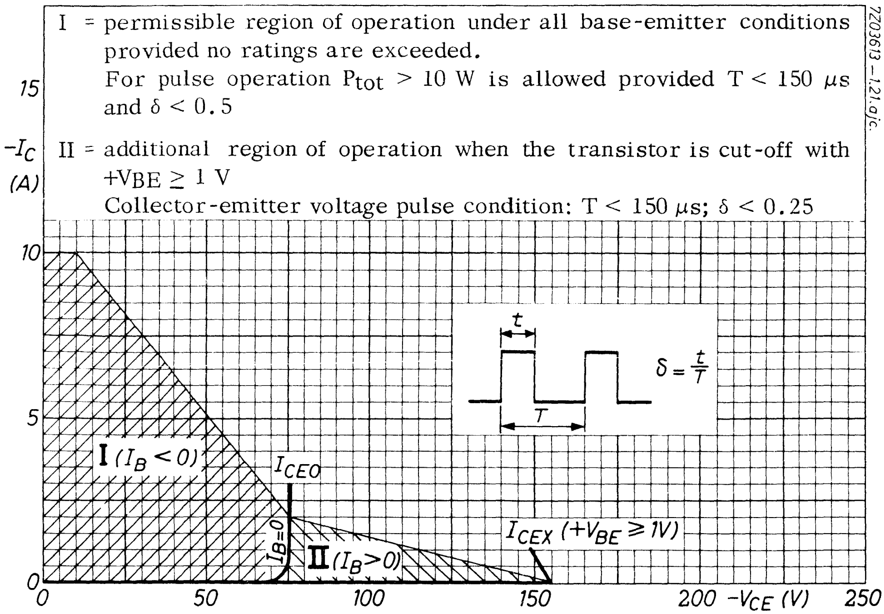
APPLICATION INFORMATION (continued)

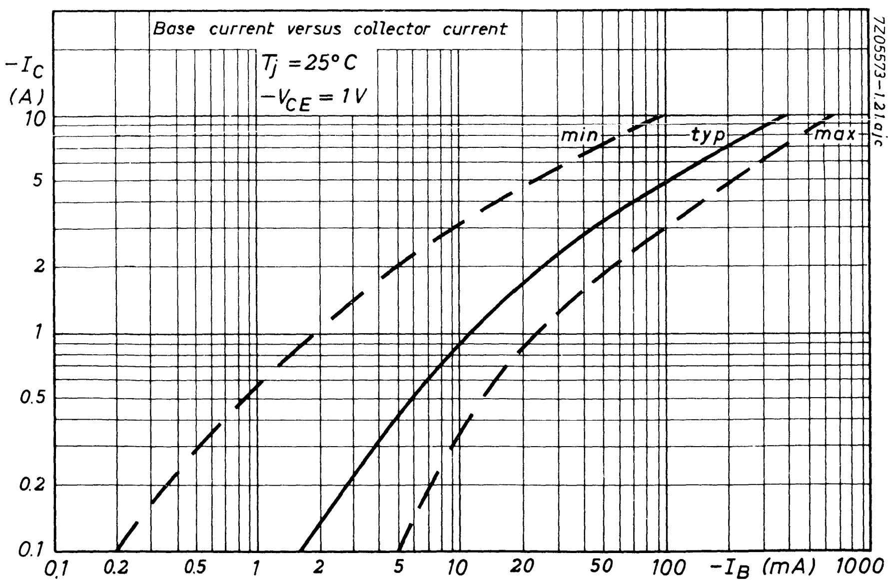


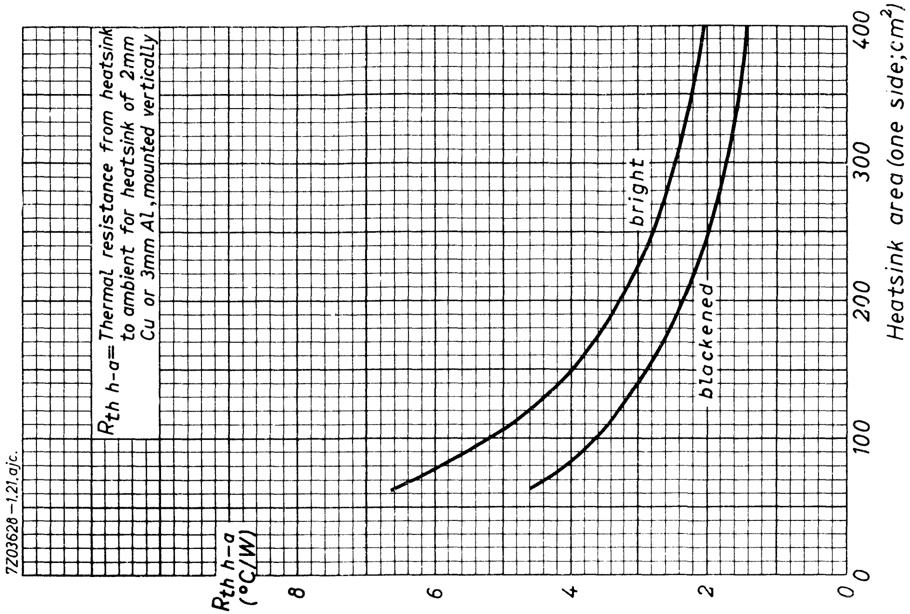
Circuit II: Typical parallel efficiency circuit for 90° deflection with an E.H.T. of 11 kV and a flyback ratio of 17.5%

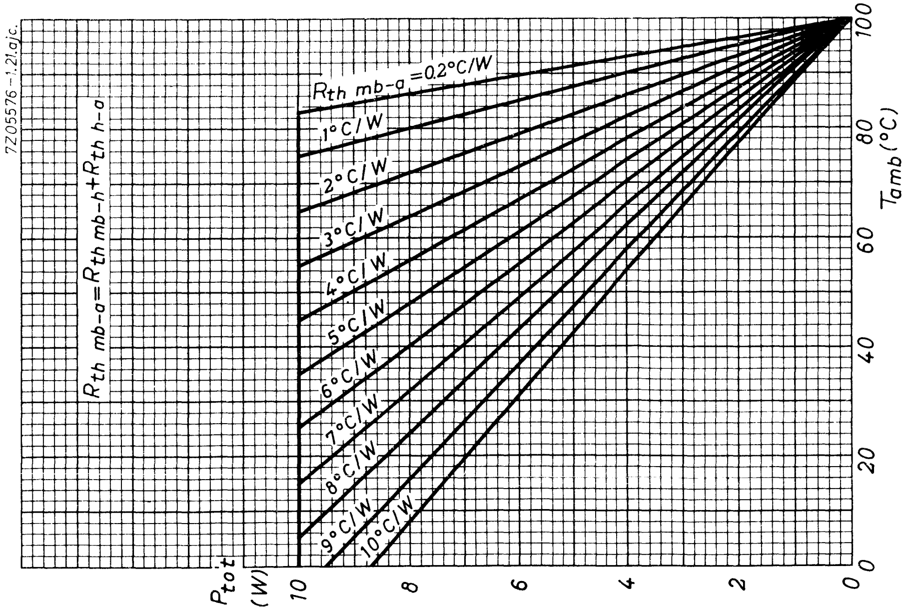
MORE INFORMATION IS AVAILABLE IN
APPLICATION INFORMATION
BULLETINS AI 242 AND AI 243

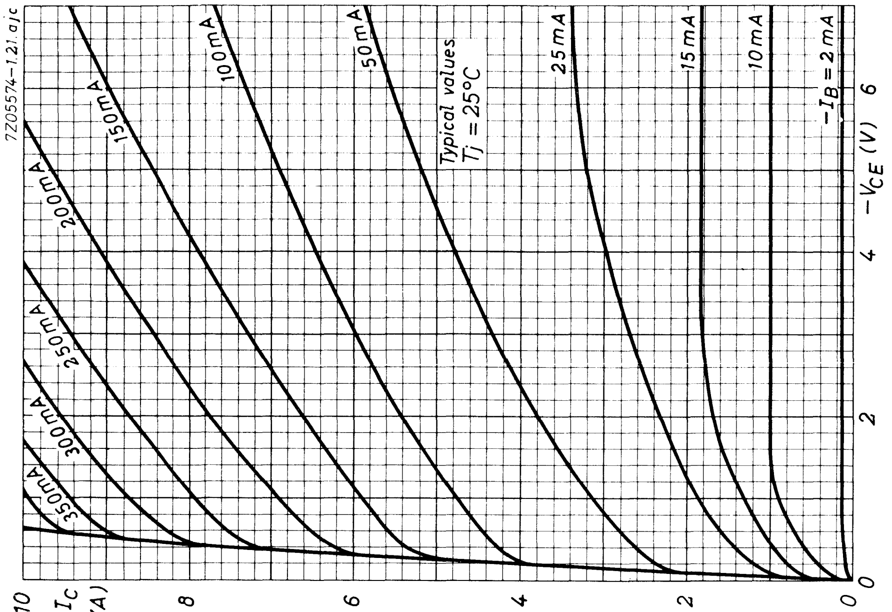
7Z3 0437

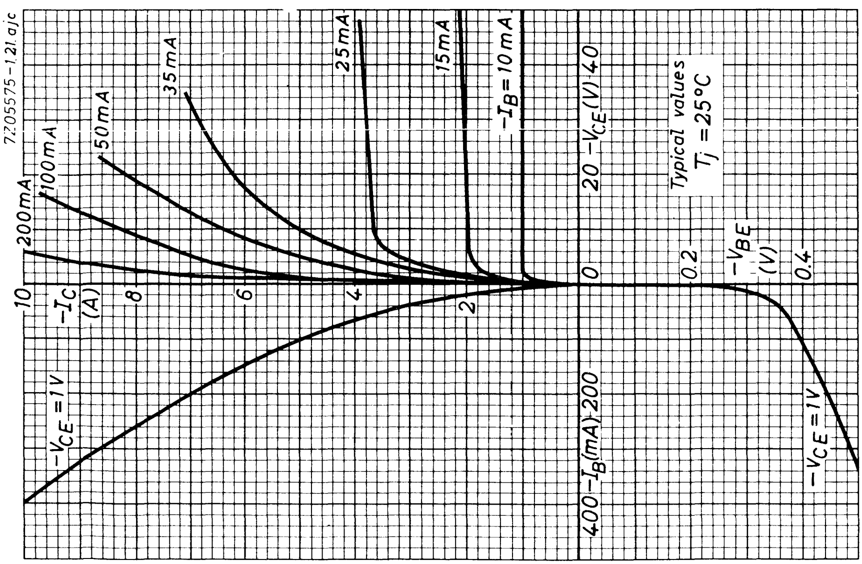

I = permissible region of operation under all base-emitter conditions provided no ratings are exceeded.
For pulse operation P_{tot} > 10 W is allowed provided T < 150 μs and δ < 0.5
II = additional region of operation when the transistor is cut-off with $+V_{BE} \geq 1$ V
Collector-emitter voltage pulse condition: T < 150 μs; δ < 0.25
$-I_C$ (A)
15
10
5
0
0
50
100
150
200 $-V_{CE}$ (V)
250
I (I_B < 0)
I_{CEO}
I_B=0
II (I_B>0)
I_{CEX} ($+V_{BE} \geq 1V$)
t
T
$\delta = \frac{t}{T}$
7Z03613-1.21.ajc

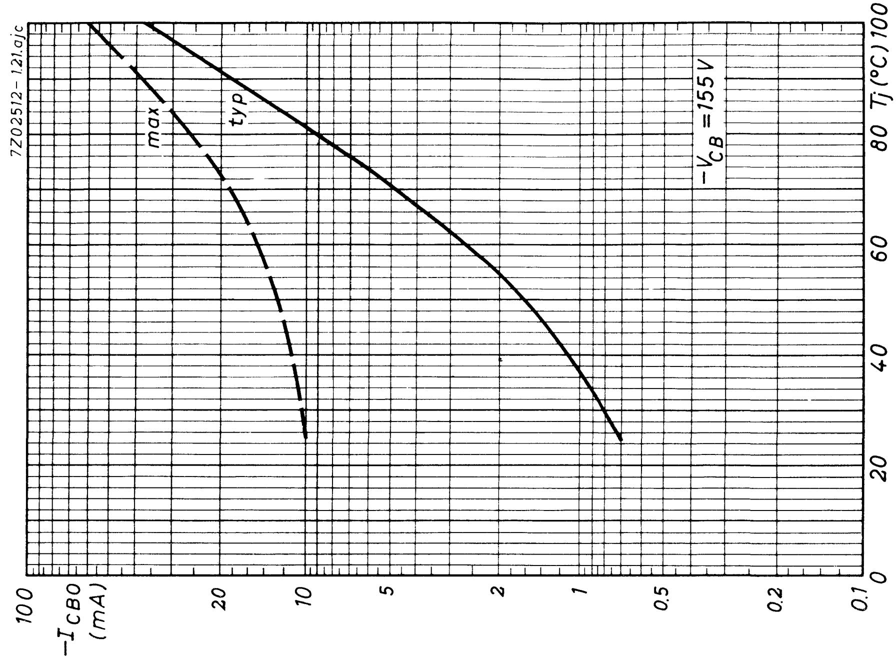

Base current versus collector current
T_j = 25° C
$-V_{CE}$ = 1 V
$-I_C$ (A)
10
5
2
1
0.5
0.2
0.1
0.1
0.2
0.5
1
2
5
10
20
50
100
$-I_B$ (mA)
1000
min
typ
max
7Z05573-1.21.ajc

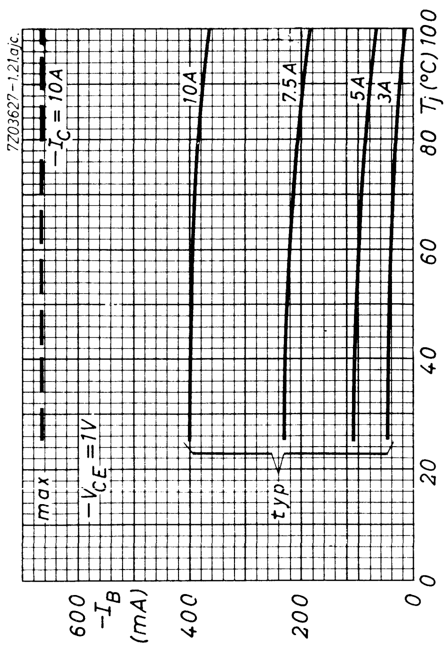

7Z03628-1.21.a/c.
Rth h-a = Thermal resistance from heatsink to ambient for heatsink of 2mm Cu or 3mm Al, mounted vertically
bright
blackened
Rth h-a (°C/W)
0
2
4
6
8
0
100
200
300
400
Heatsink area (one side; cm²)

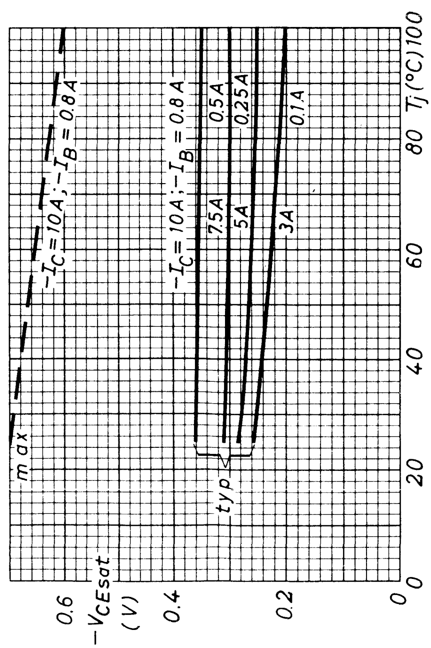

7Z05576-1.21.a/c.
Rth mb-a = Rth mb-h + Rth h-a
Rth mb-a = 0.2°C/W
1°C/W
2°C/W
3°C/W
4°C/W
5°C/W
6°C/W
7°C/W
8°C/W
9°C/W
10°C/W
Ptot (W)
0
2
4
6
8
10
0
20
40
60
80
100
Tamb (°C)

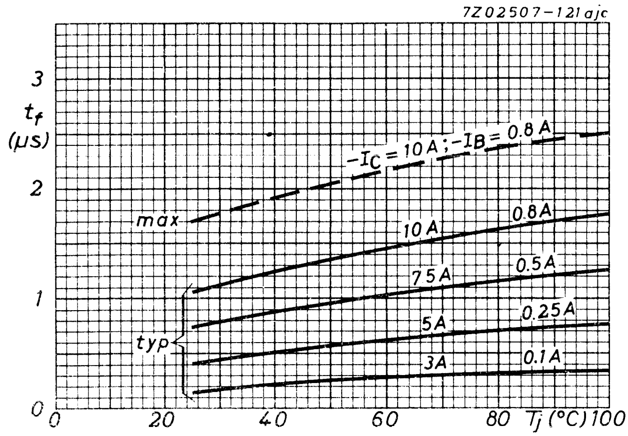

7Z05574-1.21.ajc
Typical values
$T_j = 25°C$
$-I_C$ (A)
$-V_{CE}$ (V)
$-I_B = 2$ mA
10 mA
15 mA
25 mA
50 mA
100 mA
150 mA
200 mA
250 mA
300 mA
350 mA
0
2
4
6
8
10

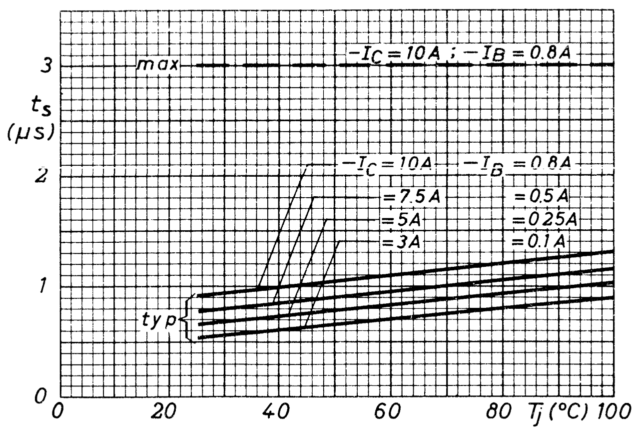

7Z05575-1.21.ajc
Typical values
$T_j = 25°C$
$-I_C$ (A)
$-V_{CE}$ (V)
$-I_B$ (mA)
$-V_{BE}$ (V)
$-I_B = 10$ mA
15 mA
25 mA
35 mA
50 mA
100 mA
200 mA
$-V_{CE} = 1$ V
$-V_{CE} = 1$ V
400
200
0
20
40
0.2
0.4
2
4
6
8
10


7Z02512-1.21.ajc
max
typ
$-V_{CB} = 155V$
$-I_{CBO}$ (mA)
100
20
10
5
2
1
0.5
0.2
0.1
Tj (°C)
0
20
40
60
80
100


7Z03627-1.21.ajc.
$-I_C = 10A$
max
$-V_{CE} = 1V$
10A
7.5A
5A
3A
typ
$-I_B$ (mA)
600
400
200
0
Tj (°C)
0
20
40
60
80
100


max
$-I_C = 10A; -I_B = 0.8A$
$-I_C = 10A; -I_B = 0.8A$
7.5A
5A
3A
0.5A
0.25A
0.1A
typ
$-V_{CEsat}$ (V)
0.6
0.4
0.2
0
Tj (°C)
0
20
40
60
80
100


7Z02507−121ajc
3
t_f
(μs)
2
1
0
max
typ
$-I_C = 10\,A$; $-I_B = 0.8\,A$
10 A
0.8 A
7.5 A
0.5 A
5 A
0.25 A
3 A
0.1 A
0
20
40
60
80
T_j (°C)
100


3
t_s
(μs)
2
1
0
max
typ
$-I_C = 10\,A$; $-I_B = 0.8\,A$
$-I_C = 10\,A$
$-I_B = 0.8\,A$
= 7.5 A
= 0.5 A
= 5 A
= 0.25 A
= 3 A
= 0.1 A
0
20
40
60
80
T_j (°C)
100

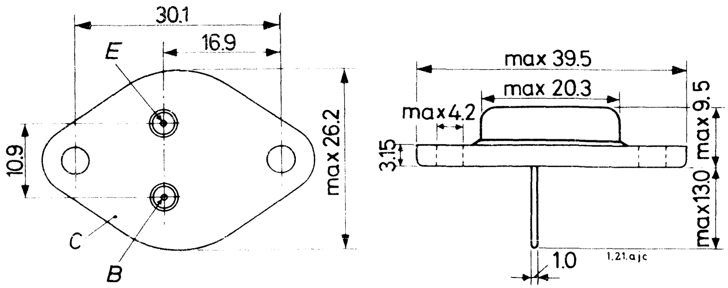
POWER TRANSISTOR

P-N-P germanium alloy-diffused transistor in a TO-3 metal case, primarily intended for use in line-deflection output circuits of television receivers.

QUICK REFERENCE DATA				
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	185	V
Collector-emitter voltage ($+V_{BE}$ = 1 V)	$-V_{CEX}$	max.	185	V
Collector current (peak value)	$-I_{CM}$	max.	12	A
Total dissipation up to T_{mb} = 77.5 °C	P_{tot}	max.	15	W
Junction temperature	T_j	max.	90	°C
Thermal resistance	$R_{th\ j-mb}$	=	1.5	°C/W
Emitter-base breakdown voltage $-I_E$ = 100 mA (open collector)	$-V_{(BR)EBO}$	>	4	V
D.C. current gain at T_j = 25 °C $-I_C$ = 12 A; $-V_{CE}$ = 1 V	h_{FE}	>	14	
Transition frequency at T_j = 25 °C $-I_C$ = 0.5 A; $-V_{CE}$ = 2 V	f_T	typ.	15	MHz
Fall time	t_f	<	1.8	μs

MECHANICAL DATA Dimensions in mm

TO-3
Collector connected to case



Accessories see page 5 7Z3 0438

RATINGS (Limiting values) [1]

Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	185	V
Collector-emitter voltage with $+V_{BE}$ = 1 V (See also page A)	$-V_{CEX}$	max.	185	V

Currents

Collector current (d.c.)	$-I_C$	max.	12	A
Collector current (peak value)	$-I_{CM}$	max.	12	A [2]
Emitter current (d.c.)	I_E	max.	14.5	A
Emitter current (peak value)	I_{EM}	max.	15.5	A
Base current (d.c.)	$-I_B$	max.	2.5	A
Base current (peak value)	$-I_{BM}$	max.	3.5	A
Reverse base current (d.c.)	$+I_B$	max.	0.1	A
Reverse base current (peak value) t = 5 μs	$+I_{BM}$	max.	3.0	A

Power dissipation (See also page A)

Total power dissipation up to T_{mb} = 77.5 °C	P_{tot}	max.	15	W

Temperatures

Storage temperature	T_{stg}		-55 to +90	°C
Junction temperature: continuous	T_j	max.	90	°C
incidentally	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.5	°C/W
From mounting base to heatsink with lead washer, without mica washer	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
with lead washer and mica washer	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

---

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

[2]) Non repetitive peak collector current: 25 A.

7Z3 0439

CHARACTERISTICS T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; $-V_{CB}$ = 185 V	$-I_{CBO}$	<	10	mA
I_E = 0; $-V_{CB}$ = 185 V; T_j = 100 °C	$-I_{CBO}$	<	60	mA
Base-emitter voltage				
I_E = 10 A; $-V_{CB}$ = 0.5 V	$-V_{BE}$	<	0.75	V
$-I_C$ = 12 A; $-V_{CE}$ = 1 V	$-V_{BE}$	<	0.95	V
Saturation voltages (See also page D)				
$-I_C$ = 12 A; $-I_B$ = 1.3 A	$-V_{CEsat}$	<	0.85	V
	$-V_{BEsat}$	<	0.85	V
Emitter-base breakdown voltage				
I_C = 0; $-I_E$ = 100 mA	$-V_{(BR)EBO}$	>	4	V
D.C. current gain				
$-I_C$ = 10 A; $-V_{CE}$ = 1 V	h_{FE}	>	15	
$-I_C$ = 12 A; $-V_{CE}$ = 1 V	h_{FE}	>	14	
Transition frequency				
$-I_C$ = 0.5 A; $-V_{CE}$ = 2 V	f_T	typ.	15	MHz
Switching times when switched from $-I_B$ = 1.3 A to $+V_{BE}$ = 4 V measured at $-I_C$ = 12 A (See also page 4 and page E)				
storage time	t_s	<	3	μs
fall time	t_f	<	1.8	μs

7Z3 0440

MEASUREMENT OF SWITCHING TIMES

Fig. 1: Circuit diagram

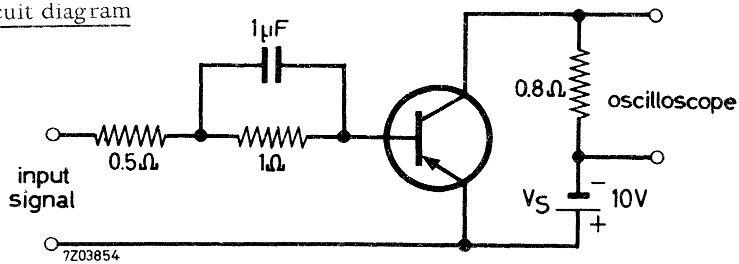


Fig. 2: Input signal

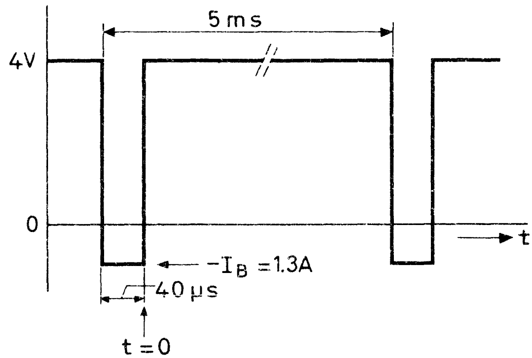
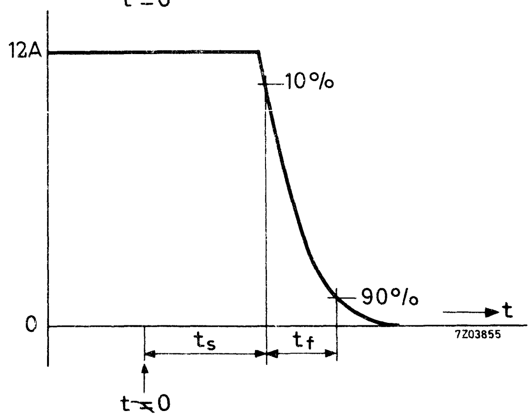
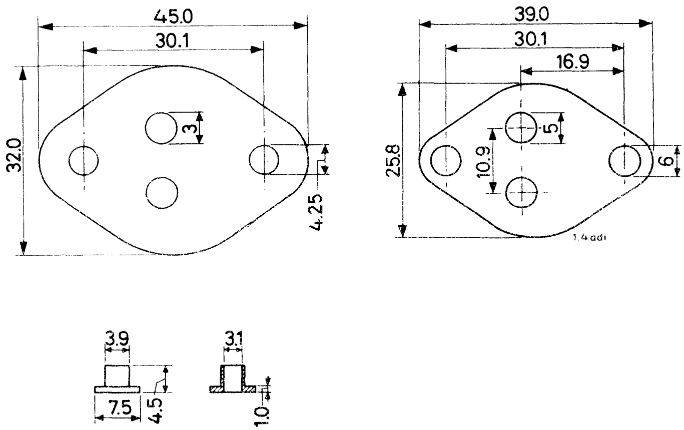


Fig. 3: Ouput signal



7Z3 0441

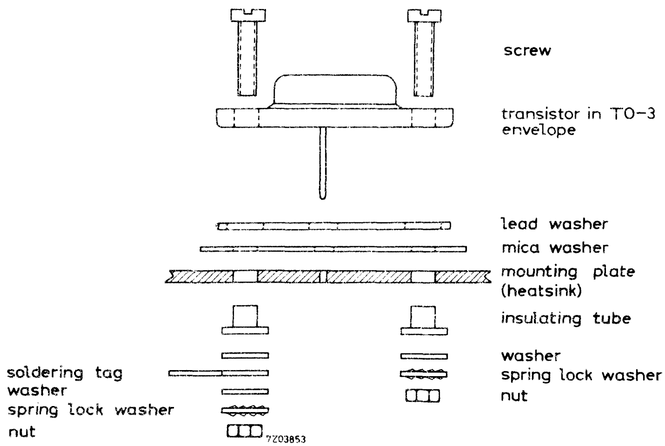
ACCESSORIES



Type number 56201a
Mica insulation (50 μm)
and insulation tubes

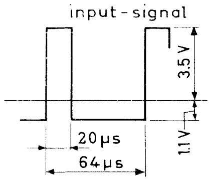
Type number 56201b
Lead washer (1 mm)

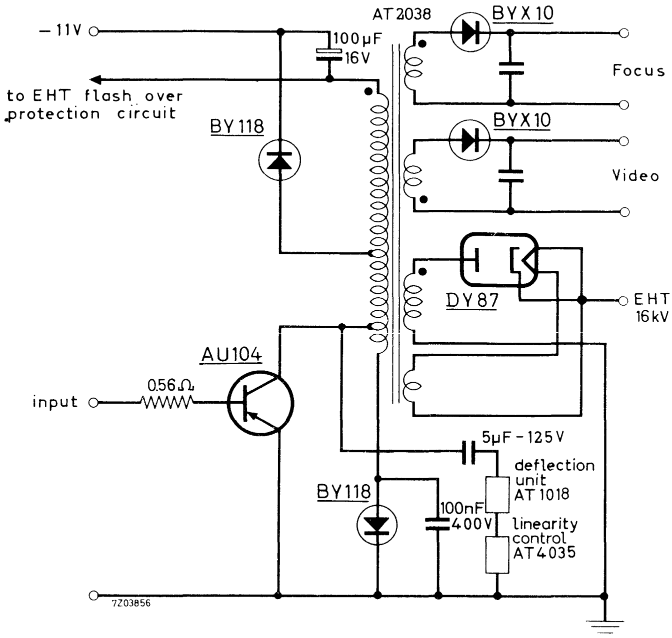
MOUNTING INSTRUCTIONS



1. For non-insulated mounting, remove mica washer
2. Torque on nut: max. 5 cm kg
3. For better heat transfer to the heatsink, use heatsink compound between the contact surfaces (e.g. Dow Corning 340).
4. For maximum cooling, the heatsink should be mounted vertically. 7Z3 0442

APPLICATION INFORMATION

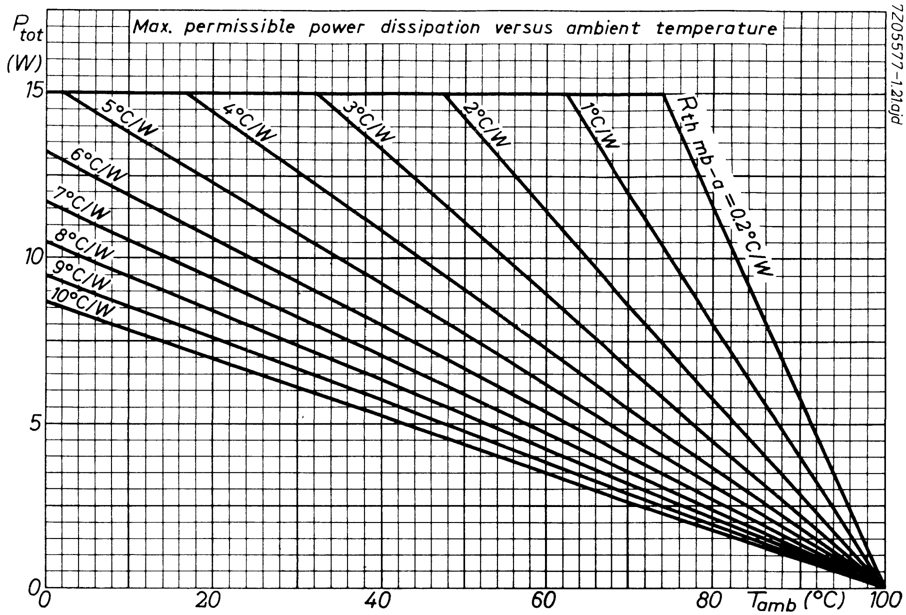




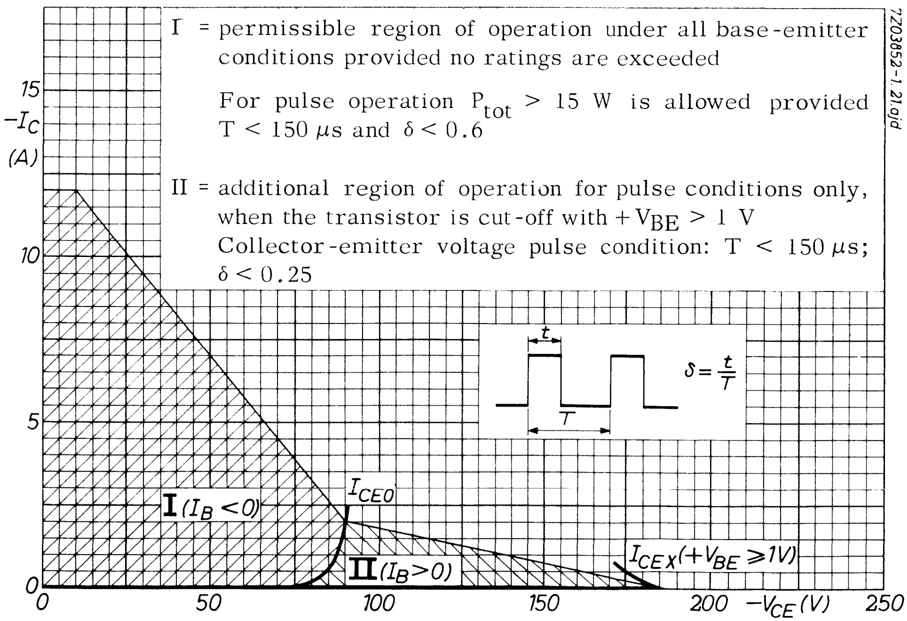
Typical parallel-series efficiency circuit for 110° deflection with an E.H.T. of 16 kV and a flyback ratio of 19.5 %

MORE INFORMATION IS AVAILABLE IN
APPLICATION INFORMATION
BULLETINS AI 241, AI 244 AND AI 245

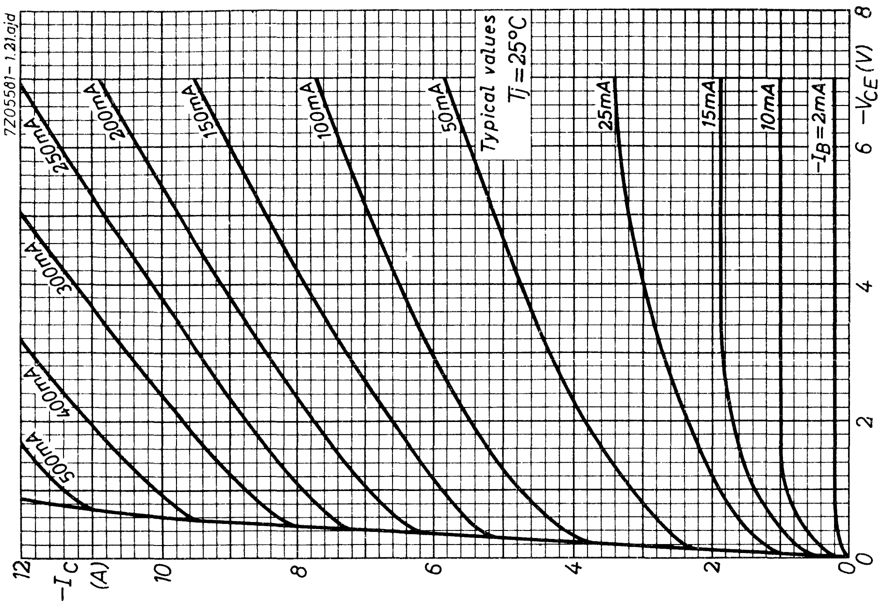
7Z3 0443

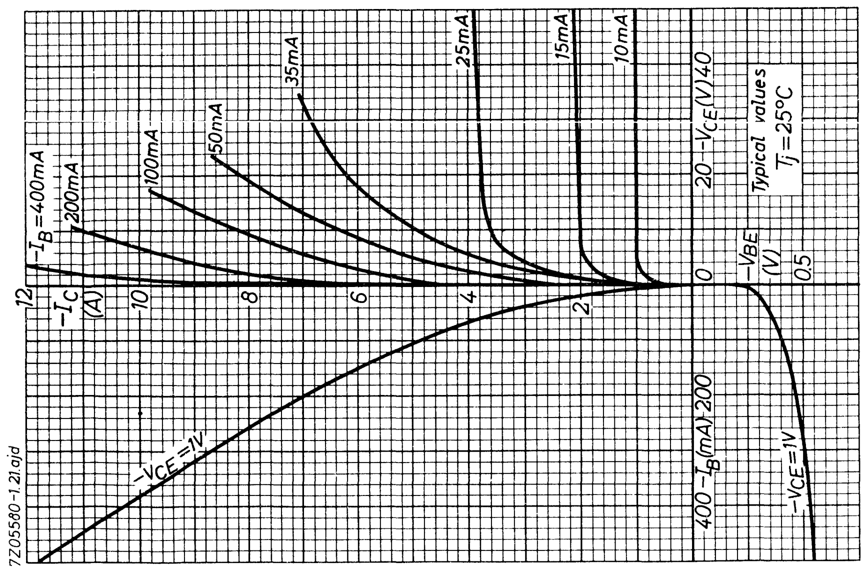


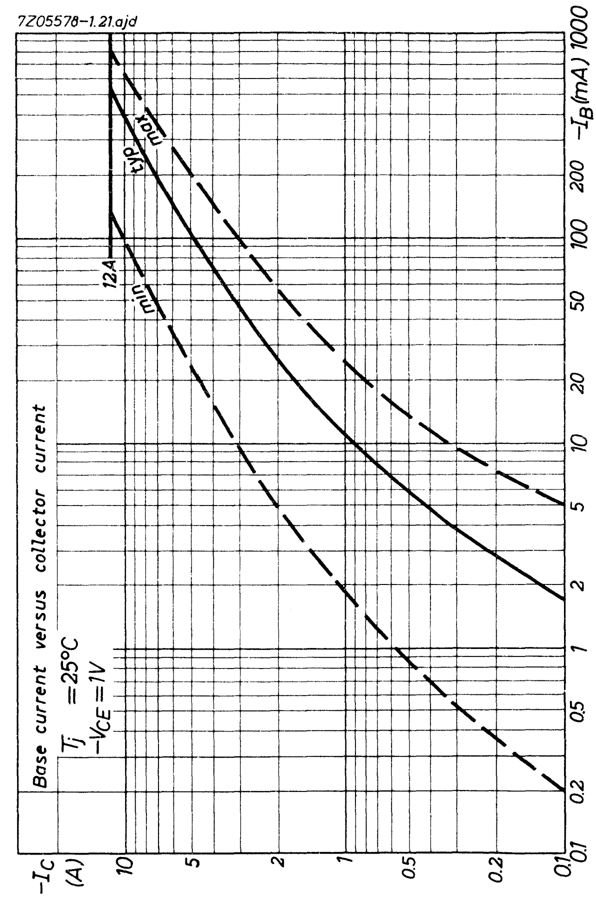
Max. permissible power dissipation versus ambient temperature
Ptot (W)
15
10
5
0
5°C/W
4°C/W
3°C/W
2°C/W
1°C/W
Rth mb-a = 0.2°C/W
6°C/W
7°C/W
8°C/W
9°C/W
10°C/W
0
20
40
60
80
Tamb (°C)
100
7Z05577-1.21.aid

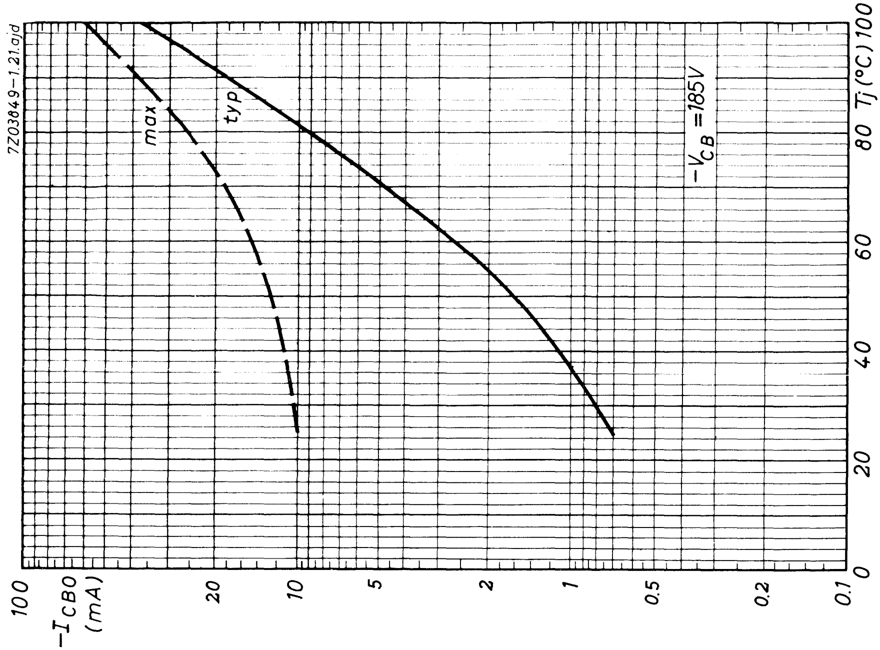


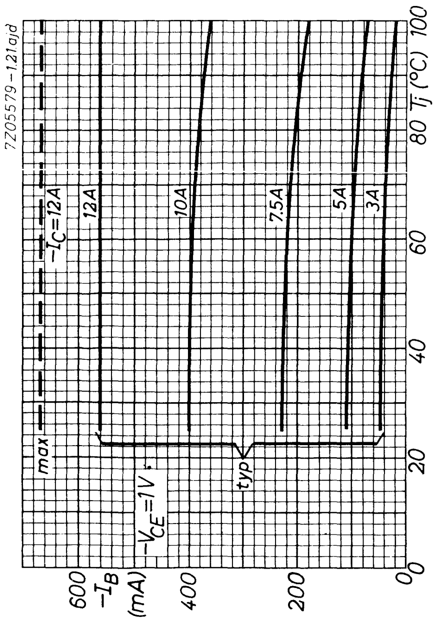
I = permissible region of operation under all base-emitter conditions provided no ratings are exceeded
For pulse operation Ptot > 15 W is allowed provided T < 150 μs and δ < 0.6
II = additional region of operation for pulse conditions only, when the transistor is cut-off with +VBE > 1 V
Collector-emitter voltage pulse condition: T < 150 μs; δ < 0.25
15
−IC (A)
10
5
0
t
δ = t/T
T
ICEO
I (IB < 0)
II (IB > 0)
ICEX (+VBE ≥ 1V)
0
50
100
150
200
−VCE (V)
250
7Z03852-1.21.aid

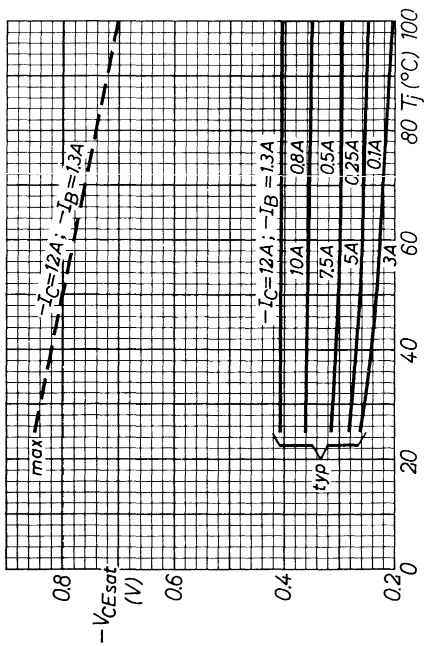

7Z05581-1.21.ajd
Typical values
Tj = 25°C
−I_B = 2mA
10mA
15mA
25mA
50mA
100mA
150mA
200mA
250mA
300mA
400mA
500mA
−I_C (A)
−V_CE (V)
0
2
4
6
8
10
12

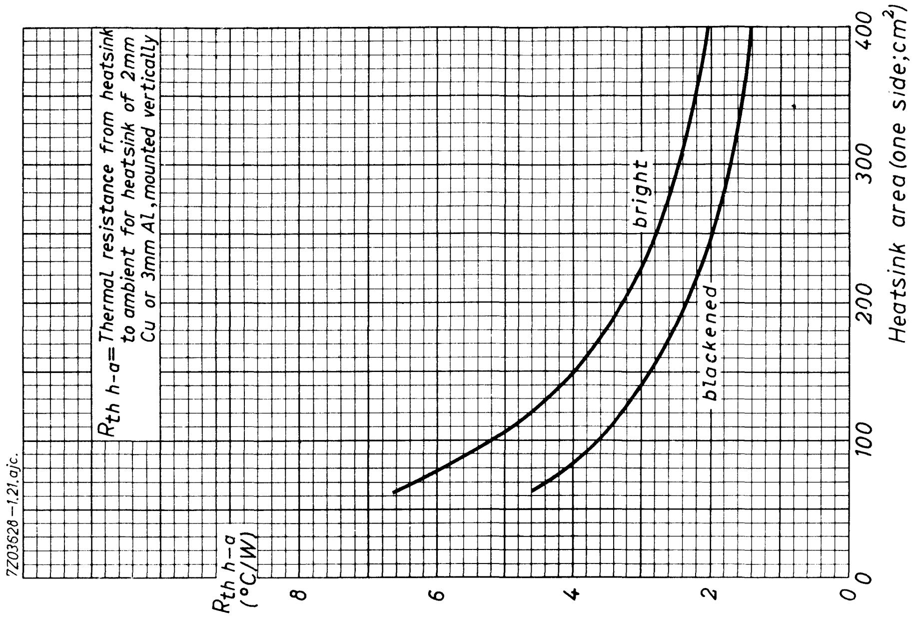

7Z05580-1.21.ajd
Typical values
Tj = 25°C
−I_B = 400mA
200mA
100mA
50mA
35mA
25mA
15mA
10mA
−I_C (A)
−V_CE (V)
−V_BE (V)
−I_B (mA)
−V_CE = 1V
−V_CE = 1V
0
0.5
20
40
200
400
2
4
6
8
10
12

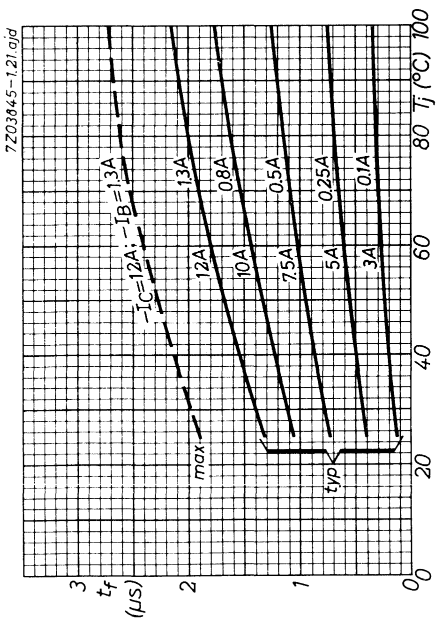

7Z05578-1.21.ajd
Base current versus collector current
T_j = 25°C
$-V_{CE}$ = 1V
$-I_B$ (mA)
$-I_C$ (A)
max
typ
min
12A
1000
200
100
50
20
10
5
2
1
0.5
0.2
0.1
10
5
2
1
0.5
0.2
0.1

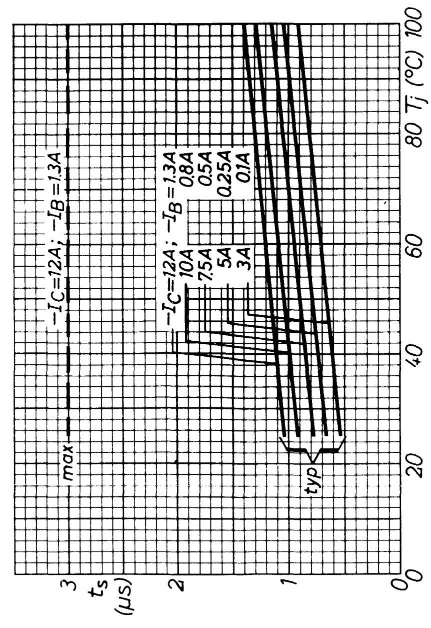

7Z03849-1.21.ajd
max
typ
$-V_{CB}$ =185V
T_j (°C)
$-I_{CBO}$ (mA)
100
20
10
5
2
1
0.5
0.2
0.1
0
20
40
60
80
100


7Z05579-1.21ajd
$-I_C$=12A
12A
10A
7.5A
5A
3A
max
typ
$-V_{CE}$=1V
$-I_B$ (mA)
600
400
200
0
T_j (°C)
0
20
40
60
80
100


$-I_C$=12A ; $-I_B$ =1.3A
max
$-I_C$=12A ; $-I_B$ =1.3A
10A
0.8A
7.5A
0.5A
5A
0.25A
3A
0.1A
typ
$-V_{CEsat}$ (V)
0.8
0.6
0.4
0.2
T_j (°C)
0
20
40
60
80
100


7Z03628-1.21.ajc.
$R_{th\ h-a}$ = Thermal resistance from heatsink to ambient for heatsink of 2mm Cu or 3mm Al, mounted vertically
$R_{th\ h-a}$ (°C/W)
bright
blackened
Heatsink area (one side; cm²)
0
100
200
300
400
0
2
4
6
8


7Z03845-1.21.ajd
t_f (μs)
$-I_C$=12A; $-I_B$=1.3A
12A
1.3A
10A
0.8A
7.5A
0.5A
5A
0.25A
3A
0.1A
max
typ
T_j (°C)
0
20
40
60
80
100
0
1
2
3


t_s (μs)
$-I_C$=12A; $-I_B$=1.3A
$-I_C$=12A; $-I_B$=1.3A
10A 0.8A
7.5A 0.5A
5A 0.25A
3A 0.1A
max
typ
T_j (°C)
0
20
40
60
80
100
0
1
2
3

ALLOY-DIFFUSED GERMANIUM POWER TRANSISTOR of the p-n-p type for non-saturated switching applications
TRANSISTOR DE PUISSANCE AU GERMANIUM DU TYPE p-n-p EN TECHNIQUE ALLIAGE-DIFFUSÉ pour applications de commutation sans saturation
DIFFUSIONSLEGIERTER p-n-p-GERMANIUM-LEISTUNGSTRANSISTOR für Schalteranwendungen ohne Sättigung

Limiting values (Absolute max. values)
Caractéristiques limites (Valeurs max. absolues)
Grenzdaten (Absolute Maximalwerte)

$-V_{CB}$	= max.	70 V [1]
$-V_{CE}$ (V_{BE} > 0,2 V)	= max.	60 V [2]
$-I_C$	= max.	700 mA [1]
I_E	= max.	750 mA
$-I_E$	= max.	50 mA
$-I_B$ (t_{av} = max. 20 msec)	= max.	50 mA
$-I_{BM}$	= max.	700 mA
P_{tot} (t_{av} = max. 20 msec)	= max.	6 W [3]
P_{tot} (t_{av} = max. 20 msec)	= max.	$\frac{T_{j\,max} - T_{amb}}{K}$ [4]
T_j	= max.	75 °C
Storage temperature Température d'emmagasinage Lagerungstemperatur	=	-55 °C/+75 °C

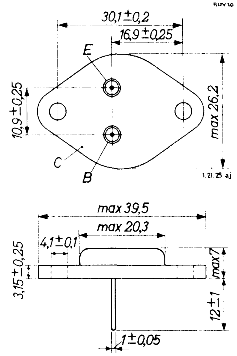
[1]) See also page C. During switching-off operation outside region II of page C is permissible provided the inductance of the circuit ≦ 250 μH and the switch-off time ≦ 15 μsec.
Voir aussi page C. Pendant la mise hors circuit le fonctionnement en dehors de la région II de page C est permis pourvu que l'inductance du circuit ≦ 250 μH et la durée de la mise hors circuit ≦ 15 μsec.
Siehe auch Seite C. Während des Ausschaltens ist Betrieb ausserhalb des Bereiches II auf Seite C erlaubt wenn die Selbstinduktion der Schaltung ≦ 250 μH und die Ausschaltdauer ≦ 15 μSek.

[2]) For common emitter operation due measures have to be taken to ensure electrical and thermal stability
Pour le fonctionnement à émetteur commun il faut prendre des mesures convenables pour assurer la stabilité électrique et thermique
Bei Betrieb in Emitterschaltung müssen geeignete Massnahmen getroffen werden zur Sicherung der elektrischen und thermischen Stabilität.

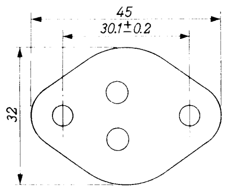
[3])[4]) See page 2; voir page 2; siehe Seite 2

7Z2 0975 1.

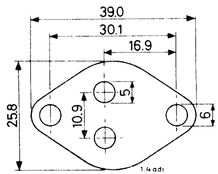
Dimensions in mm
Dimensions en mm
Abmessungen in mm



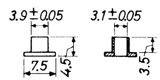
Mica insulation, 0.05 mm
Isolement de mica, 0,05 mm
Glimmerisolierung, 0,05 mm



Lead washer, 1 mm
Plaque de plomb, 1 mm
Bleischeibe, 1 mm



Insulation tubes
Isolateurs de traversée
Durchführungsisolatoren



[3]) Up to a transistor bottom temperature of 50 °C
Jusqu'à une température du fond du transistor de 50 °C
Bei einer Transistorbodentemperatur niedriger als 50 °C

[4]) At transistor bottom temperatures higher than 50 °C. K is the thermal resistance between junction and ambience
Aux températures du fond du transistor au-dessus de 50 °C. K est la résistance thermique entre les jonctions du transistor et l'ambiance
Bei Transistorbodentemperaturen höher als 50 °C. K ist der thermische Widerstand zwischen Transistorkristall und Umgebung.

7Z2 0976 2.

THERMAL DATA. Thermal resistance between junction and transistor bottom — K = max. 4.0 °C/W

Thermal resistance between transistor bottom and heat sink, when mounted with mica and lead washers (see page 2) — K = max. 0.5 °C/W

DONNÉES THERMIQUES. Résistance thermique entre les jonctions et le fond du transistor — K = max. 4,0 °C/W

Résistance thermique entre le fond du transistor et la plaque de refroidissement si le transistor est monté avec des plaques de mica et de plomb (voir page 2) — K = max. 0,5 °C/W

THERMISCHE DATEN. Wärmewiderstand zwischen Kristall und Transistorboden — K = max. 4,0 °C/W

Wärmewiderstand zwischen Transistorboden und Kühlplatte wenn der Transistor mit Glimmer- und Bleiplatten montiert ist (siehe Seite 2) — K = max. 0,5 °C/W

Characteristics
Caractéristiques
Kenndaten

T_m = temperature of transistor bottom
T_m = température du fond du transistor
T_m = Temperatur des Transistorbodens

$-V_{CE}$ = 60 V	$-I_E$ = 1 mA
V_{BE} = 1 V	I_C = 0 mA
T_m = 60 °C	T_m = 60 °C
$-I_C$ < 1 mA	$-V_{EB}$ > 1,5 V

$-V_{CE}$ = 60 V	I_E = 600 mA
R_{BE} = 56 Ω	$-V_{CB}$ = 0 V
T_m = 60 °C	T_m = 60 °C
$-I_C$ < 2 mA	V_{EB} > 0,1 V

I_E = 600 mA
$-V_{CB}$ = 10 V
T_m = 25 °C
V_{EB} < 0,45 V

7Z2 0977

Characteristics (continued)
Caractéristiques (suite)
Kenndaten (Fortsetzung)

$-I_C$ = 3 mA	I_E = 600 mA
I_E = 0 mA	$-V_{CB}$ = 30 V
T_m = 60 °C	T_j = 75 °C
$-V_{CB}$ > 70 V	$+I_B$ < 6 mA

$-V_{CE}$ = 60 V	I_E = 600 mA
V_{BE} = 1 V	$-V_{CB}$ = 10 V
T_m = 60 °C	T_m = 25 °C
$-I_B$ < 1 mA	$-I_B$ < 15 mA

Characteristics range values for equipment design
Gammes de valeurs des caractéristiques pour l'étude d'équipements
Kenndatenbereiche für Gerätentwurf

T_{amb} = 25 °C

$-I_{CBO}$ {see page B / voir page B / siehe Seite B}	$-V_{CB}$ = 10 V
	I_E = 0 mA
	c_c < 85 pF [2]

I_E = 300 mA	$-V_{CB}$ = 60 V
$-V_{CB}$ = 10 V	I_E = 0 mA
f_1 [1] = 120 Mc/s > 60 Mc/s	c_c < 45 pF [2]

[1]) Frequency at which $|h_{fe}| = 1$
Fréquence à laquelle $|h_{fe}| = 1$
Frequenz bei der $|h_{fe}| = 1$

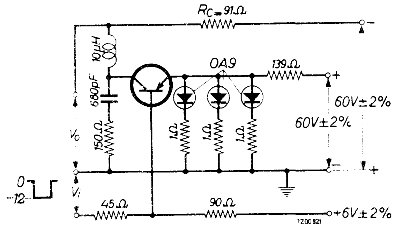
[2]) Collector capacitance
Capacité du collecteur
Kollektorkapazität

7Z2 0978

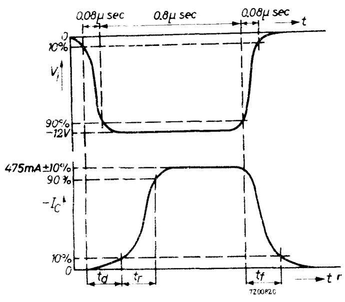
Characteristics range values for equipment design (continued)
Gammes de valeurs des caractéristiques pour l'étude d'équipements (suite)
Kenndatenbereiche für Gerätentwurf (Fortsetzung)

T_{amb} = 25 °C

Transient response
Phénomènes transitoires
Ausgleichsvorgänge

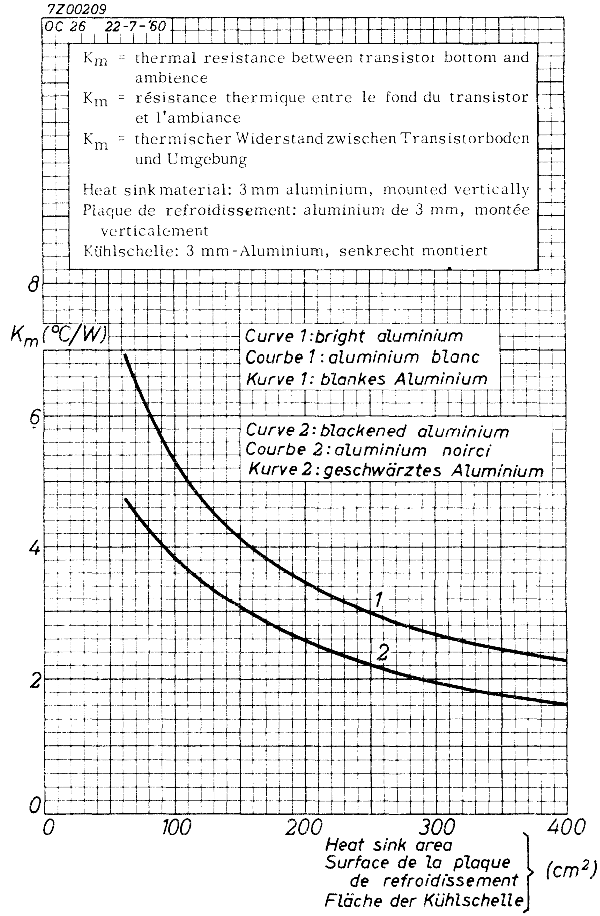


Tolerance of resistors ± 2 %
Tolérance des résistances ± 2 %
Streuung der Widerstände ± 2 %

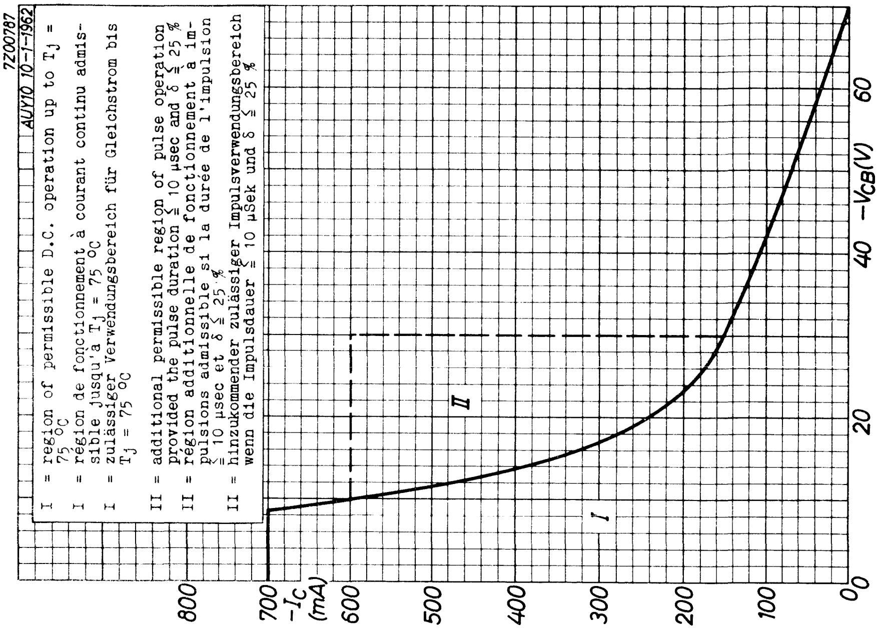


t_d < 0,2 μsec
t_r < 0,2 μsec
t_f < 0,2 μsec

7Z2 3139

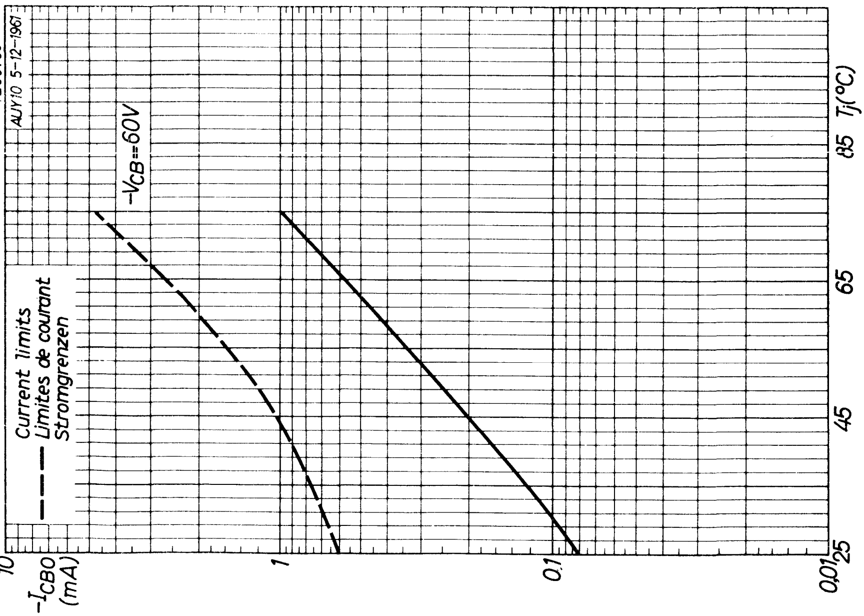


A



7Z00787
AUY10 10-1-1962
I = region of permissible D.C. operation up to Tj = 75 °C
I = région de fonctionnement à courant continu admissible jusqu'à Tj = 75 °C
I = zulässiger Verwendungsbereich für Gleichstrom bis Tj = 75 °C
II = additional permissible region of pulse operation provided the pulse duration ≦ 10 µsec and δ ≦ 25 %
II = région additionnelle de fonctionnement à impulsions admissible si la durée de l'impulsion ≦ 10 µsec et δ ≦ 25 %
II = hinzukommender zulässiger Impulsverwendungsbereich wenn die Impulsdauer ≦ 10 µSek und δ ≦ 25 %
II
I
-IC (mA)
800
700
600
500
400
300
200
100
0
0
20
40
60
-VCB(V)

C



7Z00788
AUY10 5-12-1961
Current limits
Limites de courant
Stromgrenzen
-VCB=60V
-ICBO (mA)
10
1
0.1
0.01
25
45
65
85
Tj(°C)

B

General section

Diodes

Thyristors
(Silicon controlled rectifiers)

Rectifier Stacks

Transistors

Photoelectric devices

Integrated circuits

Accessories

Supplement (latest data)

Printed in Holland
29/150/B/E